

General Information - About This Manual

Description and Operation

Introduction

This manual has been written in a format that is designed to meet the needs of technicians worldwide. The objective is to use common formats and include similar content in each manual.

This manual provides general descriptions for accomplishing diagnosis and testing, service and repair work with tested and effective techniques. Following them will help to ensure reliability.

Important Safety Instructions

Appropriate service methods and correct repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual carrying out the work.

Anyone who departs from the instructions provided in this manual must first establish that personal safety or vehicle integrity is not compromised by the choice of method, tools or components.

Warnings, Cautions and Notes in This Manual



WARNING: Warnings are used to indicate that failure to follow a procedure correctly may result in personal injury.



CAUTION: Cautions are used to indicate that failure to follow a procedure correctly may result in damage to the vehicle or equipment being used.

• **NOTE:** Notes are used to provide additional essential information required to carry out a complete and satisfactory repair.

Generic warnings or cautions are in their relevant description and operation procedure within section 100-00. If the generic warnings or cautions are required for a procedure, there will be a referral to the appropriate description and operation procedure.

If a warning, caution or note only applies to one step, it is placed at the beginning of the specific step.

Trustmark Authoring Standards (TAS) Removal and Installation Procedures

• **NOTE:** TAS style procedures can be identified by steps that have no accompanying step text and the magenta color of the electrical connectors and fasteners such as nuts, bolts, clamps or clips.

A TAS removal and installation procedure uses a sequence of color illustrations to indicate the order to be followed when removing/disassembling or installing/assembling a component.

Many of the TAS procedures will have the installation information within the removal steps. These procedures will have the following note at the beginning of the procedure:

• **NOTE:** Removal steps in this procedure may contain installation details.

Items such as O-ring seals, gaskets, seals, self-locking nuts and bolts are to be discarded and new components installed unless otherwise stated within the procedure. Coated nuts or bolts are to be reused, unless damaged or otherwise stated within the procedure.

Specification procedures will contain all technical data that are not part of a repair procedure.

TAS Graphics

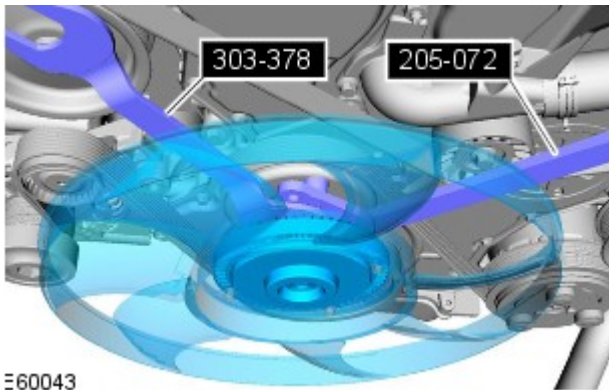
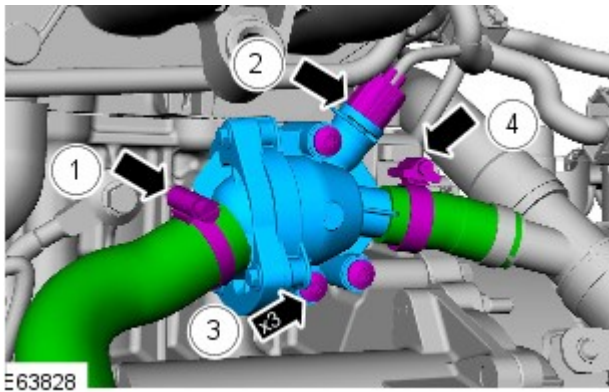
Colors used in the graphic are as follows:

- Blue - Indicates the target item, item to be removed/installed or disassembled/assembled
- Green and Brown - Indicates a secondary item that needs to be detached, removed/installed or disassembled/assembled prior to the target item
- Magenta - Indicates electrical connectors and fasteners such as nuts, bolts, clamps or clips
- Pale Blue - is for the special tool(s) and general equipment.

There may be multiple steps assigned to one illustration.

Numbered pointers are used to indicate the number of electrical connectors and fasteners such as nuts, bolts, clamps or clips.

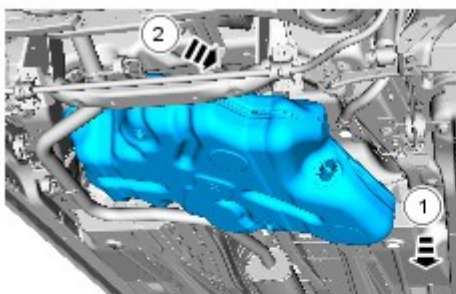
Items in the illustration can be transparent or use cutouts to show hidden detail(s).



TAS Symbols

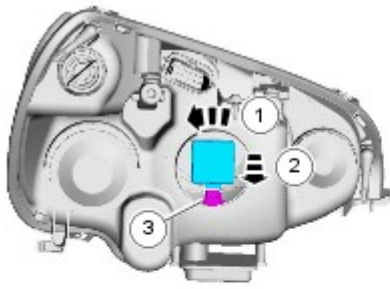
Symbols are used inside the graphics and in the text area to enhance the information display. The following paragraphs describe the various types and categories of symbols.

Prohibition symbols advise on prohibited actions to either avoid damage or health and safety related risks.



E85028

Health and Safety symbols recommend the use of particular protection equipment to avoid or at least reduce the risk or severity of possible injuries.

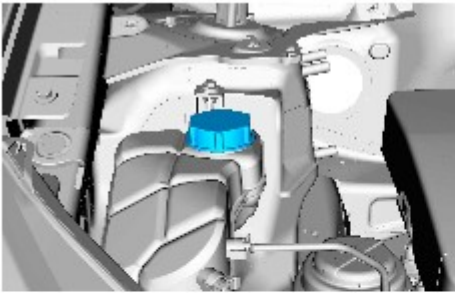


2.  



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Warning symbols are used to indicate potential risks resulting from a certain component or area.

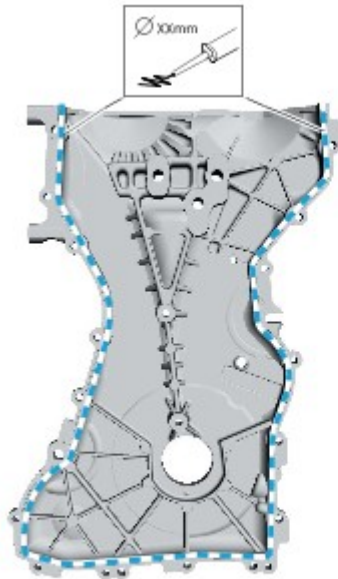


3. 



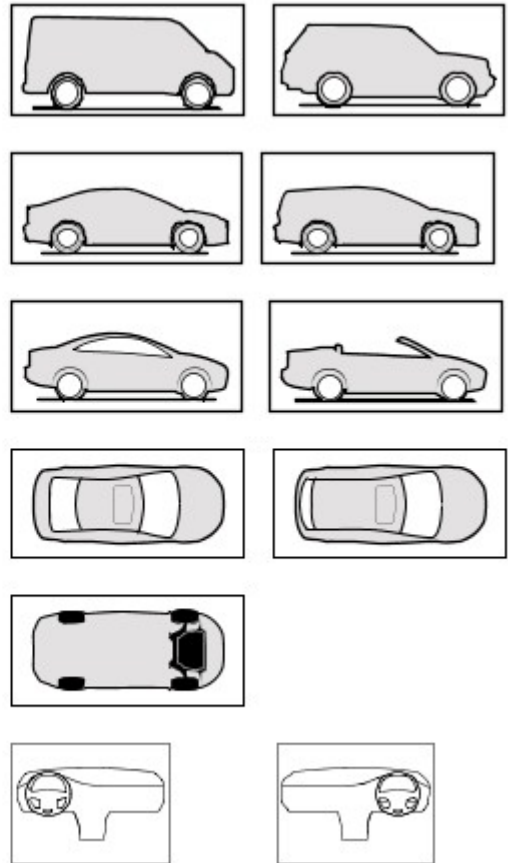
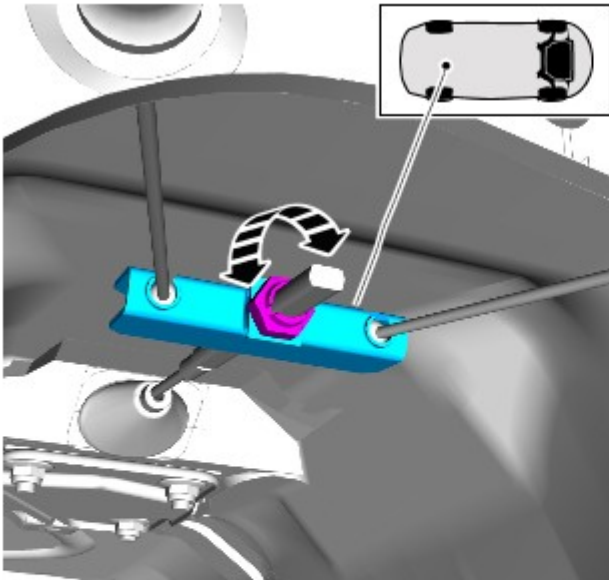
E85028

Instruction symbols are used to apply sealer, lubricant, weight, tape or cleaning detergent to a component.



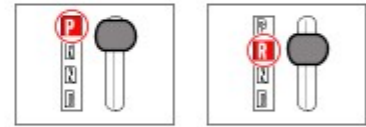
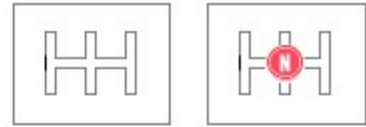
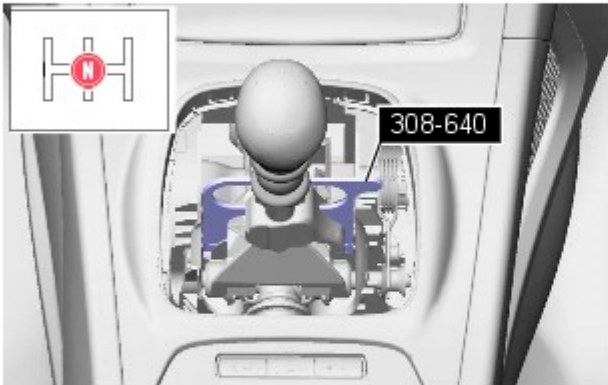
E84834

Location symbols are used to show the location of a component or system within the vehicle.



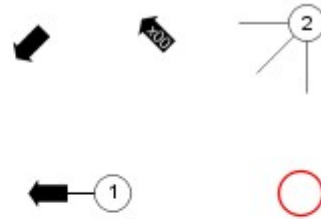
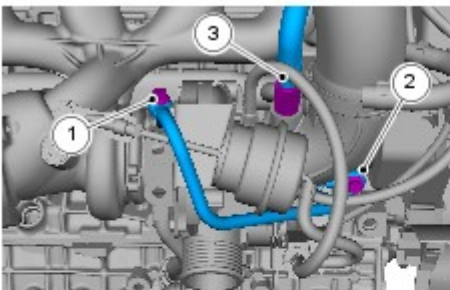
E84835

Gearshift lever or selector lever position symbols are used to show which gearshift lever or selector lever position is to be set.



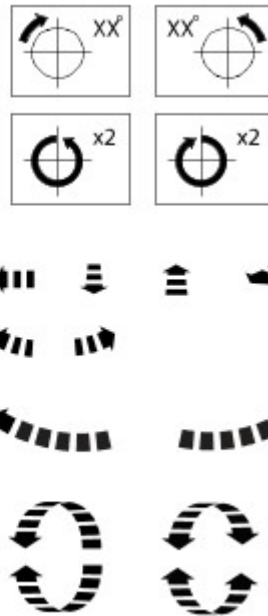
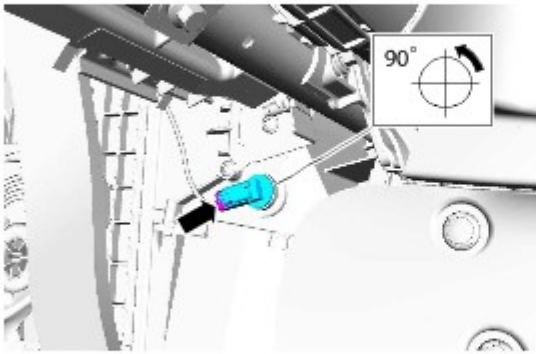
E84836

Pointer symbols are used to draw the attention to components and give special instructions such as a required sequence or number of components. The number of components is reflected by the value inside the luty arrow. A sequence number is located inside the circle. Numbers inside circles are also used to allocate special information such as tightening torques or chemicals to a particular component.



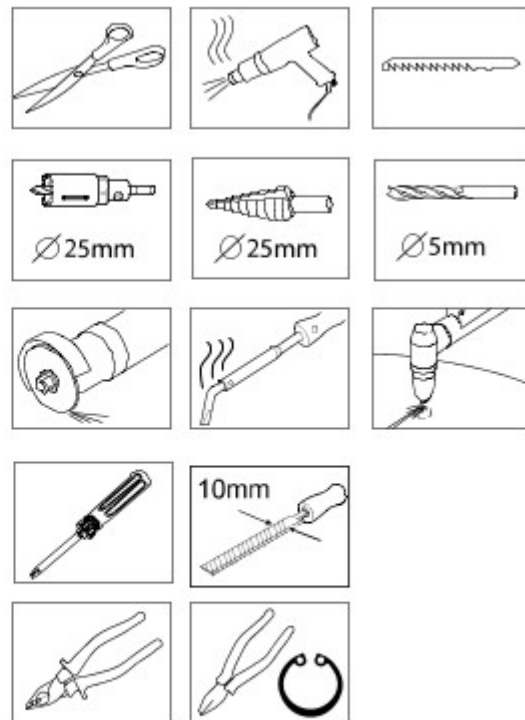
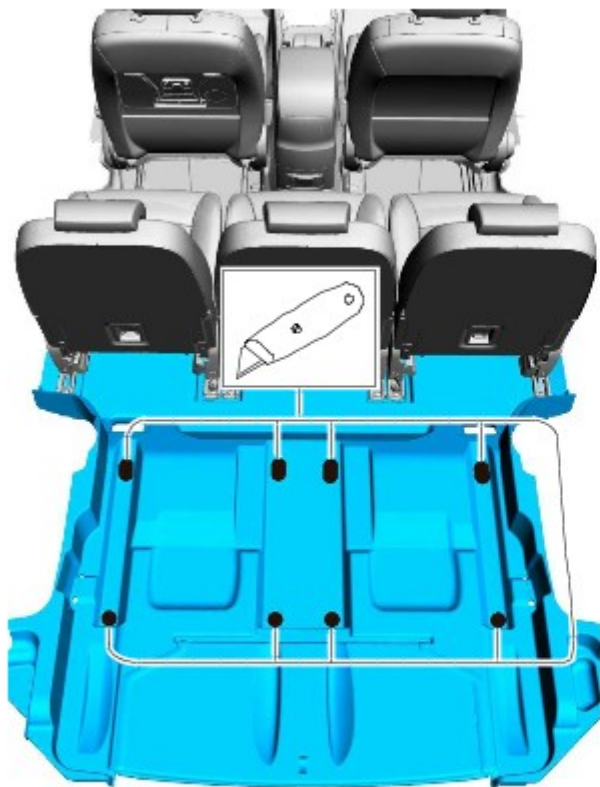
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Movement arrows are used to show three dimensional or rotational movements. These movements can include specific values inside the symbol if required.



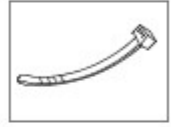
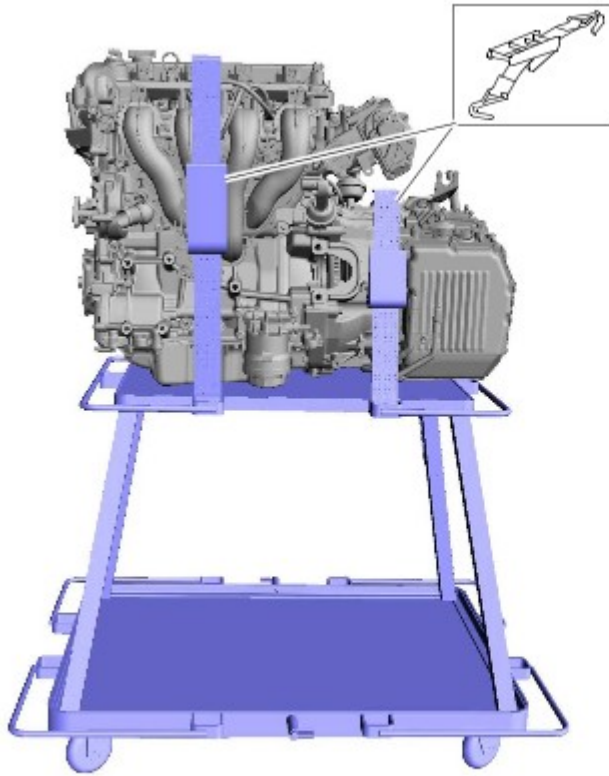
E84838

Standard tool symbols recommend the use of certain standard tools. These tools can include dimension values if required.



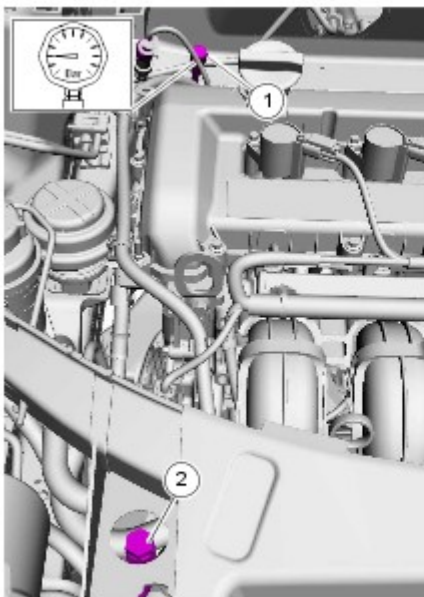
E84839

The following graphic illustrates a set of symbols that are used to provide detailed information on where to apply a material.



E84840

Measurement symbols provide detailed information on where to carry out a specific measurement. These symbols can include specific values if required.



E84841

Special Tools and Torque Figure(s)

Special tools will be shown with the tool number in the illustration. The special tool number(s), general equipment, material(s) and torque figure(s) used for the procedure step will be shown in the text column.

How to use This Manual

This manual covers all aspects necessary in order to service the vehicle effectively.

The manual is structured into five main sections, General Information, Chassis, Powertrain, Electrical and Body and Paint with each section dealing with a specific part of a vehicle system.

Each of the five main sections contain sub-sections dealing with items which form a part of that specific system.

Pages at the start of the manual list all sections available. Each section has a contents list detailing, where applicable, Specifications, Description and Operation, Diagnosis and Testing, General Procedures and Repair Procedures.

Where components need to be removed or disassembled in sequence, each operation in the sequence will be identified numerically and also graphically in an accompanying illustration.

- **NOTE:** Dimensions quoted are to design engineering specifications with service limits quoted, where applicable.

Workshop Manual Organization

The five main sections, together with the areas which they cover are given below:

- **Section 1** - General Information.
- **Section 2** - Chassis.
- **Section 3** - Powertrain.
- **Section 4** - Electrical.
- **Section 5** - Body and Paint.

Sub-section numbers appear after the initial section number, for example, **Section 412-03** covers air conditioning, which is part of the electrical section.

In the number given above, the first digit of the number '**4**' indicates the section **i.e. Electrical**.

The second and third digits '**12**' of the number indicate the vehicle system **i.e. Air Conditioning**.

The last two digits of the number '**03**' indicate the part of the system covered by the sub-section **i.e. Air Conditioning Compressor**.

General Information - Important Safety Instructions

Description and Operation

Safety Notice

Appropriate service methods and correct repair procedures are essential for the safe, reliable operation of all motor vehicles, as well as the safety of the person doing the work. This manual provides general directions for accomplishing service and repair work with tested effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the person doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in the manual must first establish that neither personal safety or vehicle integrity is compromised from choices of methods, tools or parts.

General Information - General Service Information

Description and Operation

Introduction

This manual has been written in a format that is designed to meet the needs of Land Rover technicians worldwide and to assist them in the efficient repair and maintenance of Land Rover vehicles.

This manual provides descriptions and methods for accomplishing adjustment, service and repair work using tested and effective procedures. Following these procedures will help ensure product reliability.

Special Tools

The Special Tool(s) Table provided at the beginning of each procedure lists the special tool(s) required to carry out repair operations within that specific procedure. Wherever possible, illustrations are provided which will assist technicians in identifying the special tool(s) required and also showing such tool(s) in use.

Special tools may be obtained from the manufacturer, SPX Tools, the addresses of their branches will be found in the Special Tools Glossary contained within this Section.

Important Safety Instructions

Appropriate service methods and correct repair procedures are essential for the safe and reliable operation of all motor vehicles as well as ensuring the personal safety of the individual carrying out the work.

This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Any person who departs from the instructions provided in this manual must first establish that they compromise neither their personal safety nor the vehicle integrity by their choice of methods, tools or parts.

Individuals who undertake their own repairs should have some skill or training and limit repairs to components which could not affect the safety of the vehicle or its passengers. Any repairs required to safety critical items such as steering, brakes, suspension or supplemental restraint system should be carried out by a Land Rover Dealer. Repairs to such items should NEVER be attempted by untrained individuals.

Warnings, Cautions and Notes which appear in this manual

As you read through this manual, you will come across Warnings, Cautions and Notes. A Warning, Caution or Note is placed at the beginning of a series of steps. If the warning, caution or note only applies to one step, it is placed at the beginning of the specific step after the step number.

Warnings, Cautions and Notes have the following meanings:

Warning: Procedures which must be followed to avoid the possibility of personal injury.

Caution: Calls attention to procedures which must be followed to avoid damage to components.

Note: Gives helpful information.

References

References to the Left Hand (LH) or Right Hand (RH) side given in this manual are made when viewing the vehicle or unit from the rear.

Fault Diagnostic Equipment

The vehicle is equipped with a number of electronic control systems to provide optimum performance of the vehicle's systems.

Diagnostic Equipment (T4) is available and must be used where specified. The use of this equipment will assist with the fault diagnostic abilities of the Dealer workshop. In particular, the equipment can be used to interrogate the electronic systems for diagnosis of faults which may become evident during the life of the vehicle.

This manual is produced as a reference source to supplement T4.

Features of the equipment include:

- a. Fully upgradeable support for the technician
- b. Structured diagnostics to accommodate all skill levels
- c. Direct print-out of screen information and test results

Testing the vehicle

Operations covered in this manual do not include reference to testing the vehicle after repair. It is essential that work is inspected and tested after completion and if necessary, a road test of the vehicle is carried out, particularly where safety related items are concerned.

Repairs and Replacement Parts

Land Rover parts are manufactured to the same exacting standards as the original factory fitted components. For this

reason, it is essential that only genuine Land Rover parts are used during maintenance or repair.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories.

Safety features and corrosion prevention treatments embodied in the vehicle may be impaired if other than Land Rover recommended parts are fitted. In certain territories, legislation prohibits the fitting of parts not to manufacturer's specification. Torque wrench setting figures, where given, must be adhered to and locking devices, where specified must be used. If the efficiency of a locking device is impaired during removal it must be replaced.

Owners purchasing accessories whilst travelling abroad must ensure that the accessory and its fitted location on the vehicle conform to legal requirements.

The terms of the vehicle warranty may be invalidated by the fitting of parts other than those recommended by Land Rover.

• **NOTE: The fitting of non-approved Land Rover parts and accessories or the carrying out of non-approved alterations or conversions may be dangerous. Any of the foregoing could affect the safety of the vehicle and occupants; also, the terms and conditions of the vehicle warranty may also be invalidated .**

All Land Rover recommended parts have the full backing of the vehicle warranty.

Land Rover Dealers are obliged to supply only Land Rover recommended parts.

Specifications

Land Rover are constantly seeking to improve the specification, design and production of their vehicles and alterations take place accordingly. Whilst every effort is made to ensure the accuracy of this Manual, it should not be regarded as an infallible guide to current specifications of any particular vehicle.

This Manual does not constitute an offer for sale of any particular vehicle. Land Rover dealers are not agents of Land Rover and have no authority to bind the manufacturer by any expressed or implied undertaking or representation.

General Information - Standard Workshop Practices

Description and Operation

Vehicle in Workshop

When working on a vehicle in the workshop always make sure that:

- Where practicable, the parking brake is applied and the wheels are securely chocked to prevent the vehicle moving forwards or backwards.
- Whenever possible, the ignition key is removed before any work is carried out on the vehicle.
- If the engine is to be run, there is adequate ventilation, or an extraction hose is used to remove exhaust fumes.
- There is adequate room to raise the vehicle and remove the wheels, if necessary.
- Fender covers are always installed if any work is to be carried out in the engine compartment.
- Where practicable, the battery is disconnected if working on the engine, underneath the vehicle, or if the vehicle is raised.
- **Caution: Prior to disconnecting the battery, refer to the Electrical Section of this manual - Battery disconnection/connection and the following paragraphs.** For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).



CAUTION: When electric arc welding on a vehicle, always disconnect the generator wiring to prevent the possibility of a surge of current causing damage to the internal components of the generator.

- If using welding equipment on the vehicle, a suitable fire extinguisher is readily available.

Battery - General



WARNING: It is essential that a period of 2 minutes elapses after the battery is disconnected before any work is undertaken on any part of the SRS system.



CAUTION: A discharged battery condition may have been caused by an electrical short circuit. If this condition exists there will be an apparently live circuit on the vehicle even when all normal circuits are switched off. This can cause arcing when the jumper cables are connected.

- **Caution: Prior to carrying out any procedures which involve disconnecting/ or connecting the battery, refer to the Electrical Section of this manual - Battery disconnection/connection.** For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Jump Starting a Vehicle

• CAUTIONS:



While it is not recommended that a vehicle is jump started, it is recognized that this may occasionally be the only practical way to mobilize a vehicle. Reference should be made to the following and also to the Electrical Section of this manual - Jump Starting.



It is advisable not to use starter/charger sets for jump starting but if this is unavoidable, make sure that the sets are not used in the 'START' mode.

- Always make sure that the jumper cables are adequate for the task.
- Always make sure that the slave battery is of the same voltage (12 volts) as the vehicle battery. The batteries must be connected in parallel.
- Make sure that the battery terminals of both batteries are fully tightened.
- Where another vehicle is used to jump start a disabled vehicle, make sure that the two vehicles are not touching.
- It is advisable that the engine of the donor vehicle is switched off during jump starting; take care to make sure that the battery of the donor vehicle does not also become discharged.
- Always make sure that switchable electric circuits are OFF before connecting jump cables. This reduces the risk of arcing occurring when the final connection is made.

Following jump starting of a disabled vehicle, the discharged battery must be checked for serviceability and recharged as soon as possible to avoid permanent damage.

Do not rely on the generator to restore a discharged battery. For a generator to recharge a battery, it would take in excess of eight hours continuous driving with no additional loads placed on the battery.

Trickle charging (defined as voltages <16 volts) may be carried out with the battery connected. Make sure that the battery terminals are fully tightened prior to trickle charging.



CAUTION: Boost charging may only be carried out with the battery disconnected from the vehicle.

Towing the Vehicle



WARNING: When towing is necessary, reference must be made to the Jacking, Lifting and Towing Section of this Manual.

When the vehicle is being towed the ignition switch must be in position II (steering lock released and warning lights illuminated). Only then will the steering, turn signal lamps, horn and stop lamps be operational. Failure to follow these instructions may result in personal injury. It must be noted that with the engine not running, the power steering and brake booster will be inoperative therefore, greater effort will be needed to steer the vehicle and apply the brakes.

General installation Instructions

Component removal

Whenever possible, clean components and the surrounding area before removal.

- Blank off openings exposed by component removal.
- Following disconnection, seal fuel, oil or hydraulic lines immediately using suitable blanking plugs or caps.
- Seal open ends of exposed oilways using suitable tapered hardwood plugs or conspicuous plastic plugs.
- Immediately a component is removed, place it in a suitable container; use a separate container for each component and its associated parts.
- Clean bench and provide marking materials, labels and containers before disassembling components.

Disassembling

Observe scrupulous cleanliness when disassembling components, particularly when brake, fuel, air suspension or hydraulic system parts are disassembled. A particle of dirt or cloth fragment could cause a serious malfunction if trapped in these systems.

- Blow out all tapped holes, crevices, oilways and fluid passages with dry, compressed air.



WARNING: Suitable eye protection must be worn.

- Use suitable marker ink to identify mating parts, do not use a scribe or centre punch as they could initiate cracks or distortion.
- Wire or tape mating parts together where necessary to prevent accidental interchange.
- Suitably identify parts which are to be renewed and to those parts requiring further inspection. Keep these parts separate.
- To make sure that the correct replacement part has been obtained, do not discard a part due for renewal until after comparing it with the new part.

Cleaning components

Always use cleaning agents which are suitable for the work being undertaken and the components being cleaned. NEVER use gasoline (petrol) as a cleaning agent (degreaser). Always make sure that the component being cleaned is compatible with the cleaning agent.

Always follow the manufacturer's instructions regarding the use of cleaning agents and make sure that the environment in which the work is being undertaken is suitable. See Health and Safety Precautions for further information regarding cleaning.

General inspection of components

All components should be inspected for wear or damage before reassembling.

- Always make sure that component to be inspected is clean and free from oil or grease.
- When a component is to be checked dimensionally against design specified values, use the appropriate measuring equipment i.e. micrometers, verniers, surface plates, dial test indicators (DTI).
- Always make sure that all measuring equipment is correctly calibrated before use.
- Reject a component which is not within specified values/limits or if it appears to be damaged.
- A component may be reinstalled if dimensions obtained during checking are at the maximum tolerance limit and it is in an undamaged condition.
- Bearing journal clearances should be checked where necessary using Plastigage.
- Gaskets, seals and O-ring seals are to be re-used unless damaged.

Joints and Joint Faces

All gaskets should be installed dry unless stated otherwise. Always apply the specified lubricant to O-rings and install O-rings using the fingers only.

Use gasket removal spray and/or plastic scrapers to remove traces of old gasket.



CAUTION: DO NOT use metal scrapers or emery cloth as these may damage the sealing surfaces.

Many joints use sealants instead of gaskets as the sealing medium. Where this is the case, the sealant together with its part number will be found listed in the relevant repair operation and also in the sealants table.



CAUTION: Always remove all traces of the old sealant prior to reassembly. Use plastic scrapers, specified solvents where available or dry, lint free cloth. DO NOT use metal scrapers or emery cloth as these may damage the sealing surfaces. Make sure that sealing surfaces are free from oil or grease as sealants will not adhere properly to contaminated surfaces.

Do not allow sealant to enter tapped holes or oilways.

Locking Devices

Always replace locking devices with one of the same design and of the correct size.

Tab washers

Always release locking tabs before loosening fixings, do not re-use tab washers.

Locknuts

Always use a backing spanner when loosening and tightening locknuts, brake and fuel pipe unions.

Roll pins

Always install new roll pins of the correct size.

Circlips

Always install new circlips ensuring that they are of the correct size for the groove.

Woodruff keys

Woodruff keys may be re-used provided there is no indication of wear or distortion.

Remove any burrs from edges of keyways using a fine file.

Split pins

Never attempt to straighten and re-use a split pin, always make sure that replacement pins are of the correct size for the hole in which they are to be installed.

Screw Threads

- Damaged nuts, bolts and screws must always be discarded. Attempting to recut or repair damaged threads with a tap or die impairs the strength and fit of the threads and is not recommended.
- **NOTE:** During certain repair operations, it may be necessary to remove traces of thread locking agents using a tap. Where this is necessary, the instruction to do so will appear in the relevant operation and it is essential that a tap of the correct size and thread is used.
- Some bolts are coated with a thread locking agent and unless stated otherwise, they must not be re-used. New bolts having the same part number as the original must always be installed. When nuts or bolts are to be discarded, the repair operation and relevant torque chart will include an instruction to that effect. Do not use proprietary thread locking agents as they may not meet the specification required. See also Encapsulated ('Patched') Bolts and Screws.
- Always make sure that replacement nuts and bolts are at least equal in strength to those that they are replacing. Castellated nuts must not be loosened to accept a split pin except in recommended cases when this forms part of an adjustment.
- Do not allow oil or grease to enter blind holes, the hydraulic action resulting from tightening the bolt or stud can split the housing and also give a false torque reading.
- Always tighten a nut, bolt or screw to the specified torque figure, damaged or corroded threads can give a false torque reading.
- Nut and bolt loosening and tightening sequences, where given, must ALWAYS be followed. Distortion of components or faulty sealing of joints will result if the sequences are not followed. Where an instruction is given to tighten in stages, these stages must be adhered to; do not attempt to combine stages particularly where certain stages involve tightening by degrees.
- To check or re-tighten a fixing to a specified torque, first loosen a quarter of a turn, then retighten to the specified torque figure.
- Unless instructed otherwise, do not lubricate bolt or nut threads prior to installing.

Where it is stated that bolts and screws may be re-used, the following procedures must be carried out:

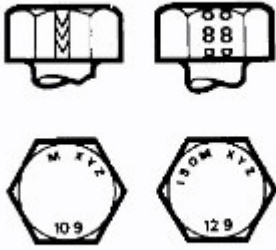
- Check that threads are undamaged.
- Remove all traces of locking agent from the threads.



CAUTION: DO NOT use a wire brush; take care that threads are not damaged.

- Make sure that threads are clean and free from oil or grease.
- Apply the specified locking agent to the bolt threads.

Bolt and Nut Identification



E48627

An ISO metric bolt or screw made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the bolt head.

In addition to marks identifying the manufacturer, the top of the bolt head is also marked with symbols indicating the strength grade e.g. 8.8, 10.9, 12.9, 14.9. Alternatively, some bolts and screws have the M and strength grade symbol stamped on the flats of the hexagon.

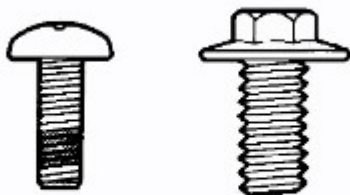
Encapsulated ('Patched') bolts and screws



E48628

Encapsulated ('patched') bolts and screws have a thread locking agent applied to the threads during manufacture. Most thread locking agents are colored, the band of color extending for 360° around the thread. Some locking agents however, are neutral in color and may not be so easily identified apart from a slightly darker area of thread where the locking agent has been applied. The locking agent is released and activated by the tightening process and is then chemically cured to provide the locking action.

Self-locking bolts and screws



E48629

Unless stated in a specific repair procedure, self-locking bolts and screws i.e. nylon patched or trilobular thread can be re-used provided that resistance is felt when the locking portion enters the female thread.

Nylon patched bolts and screws have a locking agent either applied to, or inserted in the threaded portion. They are identified by the presence of a colored section of thread extending approximately 180° around the thread or by a colored plug inserted into the bolt.

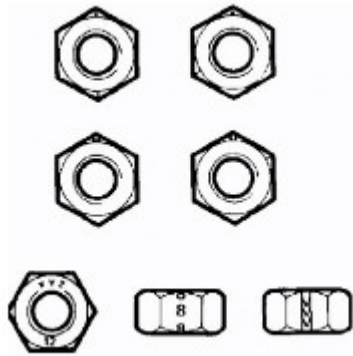
Trilobular bolts have a special thread form which creates a slight interference with the thread of the hole or nut into which it is screwed.



CAUTION: Do Not re-use self-locking fasteners in critical locations e.g. drive plates/flywheel or engine bearings. Do not install non self-locking fasteners where a self-locking fastener is specified.

Trilobular bolts should not be used as a substitute for patched bolts.

Nut identification



E48630

A nut with an ISO metric thread is marked on one face or one of the hexagonal flats with the strength grade symbol 8, 12, 14. Some nuts with the strength grade 4, 5 or 6 are also marked and some have the metric symbol M on the hexagonal flat opposite the strength grade marking.

A clock face system is sometimes used as an alternative method of indicating the strength grade. The external chamfers or a face of the nut is marked in a position relative to the appropriate hour mark on a clock face to indicate the strength grade.

A dot is used to locate the 12 o'clock position and a dash to indicate the strength grade. If the grade is above 12, two dots identify the 12 o'clock position.

When tightening a slotted or castellated nut, never loosen it to insert a split pin except where specified as part of an adjustment procedure. If difficulty is experienced in correctly positioning the slot, alternative washers or nuts should be selected.

Where a nut is tightened to adjust or maintain bearing pre-load, the tightening procedure must be adhered to.

Self-locking nuts

Unless stated otherwise, self-locking nuts once removed must be discarded and new nuts of the same type and strength grade installed.

Air Suspension

Always make sure that suitable eye protection is worn when working on the air suspension system.

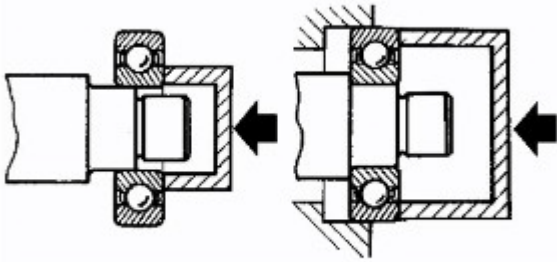
Ball and Roller Bearings

When removing and installing bearings, make sure that the following practices are observed to make sure component serviceability:



CAUTION: Service tools have been developed for removing the majority of bearings; these must always be used where specified.

- Remove all traces from bearing under inspection by cleaning with a suitable degreasant; maintain absolute cleanliness throughout operations.
- Conduct a visual inspection for markings on rolling elements, raceways, outer surfaces of outer or inner surfaces of inner rings. Reject any bearings found to be marked since marking in these areas indicates onset of wear.
- Hold inner race of bearing between finger and thumb of one hand and rotate outer race to check that it revolves absolutely smoothly. Repeat holding outer race and rotating inner race. DO NOT spin the bearing.
- Rotate outer ring gently using a reciprocating movement whilst holding inner ring; feel for any check or obstruction to rotation. Reject bearing if movement is not absolutely smooth.
- Check bearing for blueing or signs of overheating.
- Lubricate bearing with the specified lubricant.
- Inspect bearing surface of shaft and bearing housing for discoloration or other markings which indicate overheating of bearing or movement between bearing and seating.
- Before installing bearing, make sure that shaft and bearing housing are clean and free from burrs.
- If one bearing of a pair shows signs of wear, overheating etc., it is advisable to replace bearings as a pair unless it is suspected that one bearing may have been faulty when installed, was installed incorrectly or the fault arose due to oil seal failure.
- Never reinstall a bearing unless it is in a fully serviceable condition.



E48560

- When installing a bearing to a shaft, only apply force to the inner ring of the bearing. When installing a bearing into a housing, only apply force to the outer ring of the bearing.



CAUTION: Service tools have been developed for installing the majority of bearings; these must always be used where specified.

- In the case of grease lubricated bearings, fill the space between the bearing and outer seal with the recommended grade of grease before installing the seal.



CAUTION: When a waxed oil seal (installed dry) type of oil seal is to be installed, take great care that grease does not contaminate the running surface of the seal.

- Always make suitable reference marks between the components of separable bearings e.g. taper roller bearings when disassembling to make sure correct location of components when assembling. Never install new rollers in an outer ring, always install a new bearing assembly.

Brake Pads and Linings

Always install the correct grade and specification of brake pads and linings. When replacing these items, always replace as complete axle sets.

Brake Hydraulics

Always observe the following recommendations when working on the braking system:



WARNING: Do not intermix brake fluid of different specifications.

- Always use two spanners when loosening or tightening brake pipes or hose connections.
- Make sure that hoses run in a natural curve and are not kinked or twisted.
- Install brake pipes and hoses securely in their retaining clips and make sure that they cannot contact a potential chafing point.
- Containers used for brake fluid must be kept absolutely clean.
- Do not store brake fluid in unsealed containers, the fluid will absorb water which will lower the boiling point of the fluid.
- Do not allow brake fluid to be contaminated with other fluids such as mineral oil and do not put brake fluid in a container which has previously been used for storing other fluids.
- Do not re-use brake fluid which has been bled from the system.
- Always use brake fluid or a suitable brake cleaning fluid to clean hydraulic components.
- Unless stated otherwise, use only clean brake fluid to lubricate hydraulic seals and components.
- Always install blanking plugs to hoses, pipes or components immediately after disconnection.
- Check thread compatibility of original equipment with replacement components.
- Observe absolute cleanliness when working with hydraulic components.

Pipes and Hoses

When removing or installing flexible hydraulic pipes and hoses, make sure that the following procedures are observed to make sure component serviceability:

- Prior to removal, clean area around hose or pipe end which is to be disconnected.
- Obtain appropriate blanking plugs or caps before disconnecting hose or pipe end fittings in order that connections can be plugged immediately following disconnection.
- Always install blanking plugs or caps to pipes and unions immediately following disconnection.
- Clean hose or pipe and blow through with an air line.



WARNING: Suitable eye protection must be worn.

- Check hoses externally for cracks, separation of plies, security of end fittings and external damage; replace faulty hoses.
- Check pipes for signs of corrosion and chafing, replace as necessary.



CAUTION: If pipes are found to be chafed, rectify clips, mounting points etc., to prevent further problems in service.

- When installing hoses, make sure that no unnecessary bends are introduced and that hoses are not kinked, twisted or positioned close to potential chafing points.
- When installing pipes, make sure that pipes are positioned and clipped clear of potential chafing points.
- Always replace sealing washers installed to banjo bolts, sealing plugs etc.
- Always use a backing spanner when tightening unions and do not overtighten union nuts or banjo bolts.
- After engagement of 'quick-fit' connection hoses, perform a 'tug' test to make sure connection is securely installed.
- After any work on hydraulic systems, always check for fluid leaks whilst a second operator applies working pressure to the brake pedal or operates the system that has been worked on.

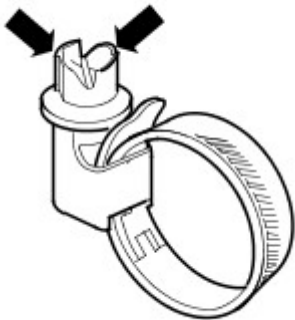
Fuel system hoses

Some fuel hoses are made up of two laminations, an armoured rubber outer sleeve and an inner viton core. Whenever a hose is removed, make sure that the inner bore is inspected to check that the viton lining has not become separated from the outer sleeve.



WARNING: Never attempt to repair fuel hoses or rectify leaking 'quick-fit' connectors. The fuel hose and connectors must be replaced as an assembly.

Fuel system hose clips



E48636

Certain fuel system hose clips are of the 'break-off head' type where a slot in the screw head shears off when the clip is tightened to a specific torque. These clips may be removed using a screwdriver and must be replaced with new clips on reassembly. Clips must be tightened until the portion of the slot shears off. Do not attempt to tighten clips by any other method, do not install any other type of clip.

'Quick-fit' connections are also installed to certain fuel hoses. After engagement of 'quick-fit' connections, perform a 'tug' test to make sure connection is securely installed.

Other fuel system hose clips are of the 'Jubilee' type and there may be a tamper proof cover installed over the screw head. These cover must be carefully removed before slackening the clip and should be replaced after final tightening, ensuring that the internal hexagon on the cover is correctly located on the clip screw.

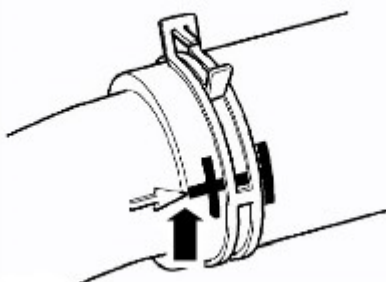
Cooling system hoses



CAUTION: The following precautions must be observed to make sure that the integrity of the cooling system hoses and their connection to the system is maintained.

Hose orientation and connection

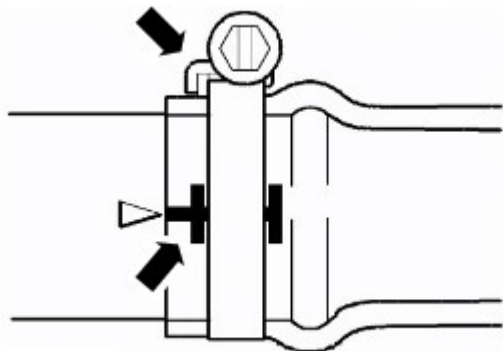
Correct orientation of cooling system hoses is important to make sure that hoses do not become fatigued or damaged through contact with adjacent components.



E48633

Where orientation marks are provided on the hose and corresponding component, the marks must be aligned when the hose is installed. Hoses must be installed fully on to their connection points, usually a moulded form on a pipe provides a positive indicator.

Hose clips



E48634

Markings are usually provided on the hose to indicate the correct clip position. If no markings are provided, position the clip directly behind the retaining lip at the end of the stub pipe. Worm drive clips should be orientated with the crimped side of the drive housing facing towards the end of the hose or the hose may become pinched between the clip and the stub pipe retaining lip. Unless otherwise stated, worm drive clips should be tightened to 3 Nm (2 lb-ft). Make sure that hose clips do not foul adjacent components.



E48635

Oetiker clips may be removed by bending the tag (arrowed) and releasing the free end of the clip. Clips must not be re-used. When installing new clips, make sure clip is positioned on hose before tightening and make sure that when clip is tightened, the tag is located in the longitudinal slot in the free end of the clip (arrowed in illustration).

'Quick-fit' connections are also installed to certain hoses/pipes. Inspect 'quick-fit' connections for damage, prior to connection. Replace if damaged. After engagement of 'quick-fit' connections, perform a 'tug' test to make sure connection is securely installed.

Heat protection

Always make sure that heat shields and protective sheathing are in good condition; replace if damage is evident. Particular care must be taken when routing hoses close to hot engine components such as the exhaust manifolds and exhaust gas recirculation (EGR) pipes. Hoses will relax and deflect slightly when hot, make sure this movement is taken into account when routing and securing hoses.

Electrical Precautions

General

The following guidelines are intended to make sure the safety of the operator whilst preventing damage to the electrical and electronic components of this vehicle.

Equipment

Prior to commencing any test procedure on the vehicle, make sure that the relevant test equipment is working correctly and that any harness or connectors are in good condition. It is particularly important to check the condition of all plugs and leads of mains operated equipment.

Polarity

Never reverse connect the vehicle battery and always make sure the correct polarity when connecting test equipment.

High voltage circuits

Whenever disconnecting live ht circuits, always use insulated pliers and never allow the open end of the ht lead to contact other components, particularly ECU's.

Vehicles installed with Bi-Xenon headlamp bulbs



WARNING: The following precautions must be observed as failure to comply may result in exposure to ultra-violet

rays, severe electric shock, burns or risk of an explosion.

- Safety goggles and gloves must be worn.
- Make sure that headlamps are switched off before removing bulbs.
- Do not touch the glass portion of the bulb.
- On no account should headlamps be switched on with the bulb removed from the headlamp.
- Bulb testing may only be carried out with the bulb installed in the headlamp.
- Bulbs must be disposed of in accordance with the local authority bye-laws.

Connectors and harnesses

The engine compartment of a vehicle is a particularly hostile environment for electrical components and connectors. Always observe the following:

- Make sure electrically related items are dry and oil free before disconnecting/connecting test equipment.
- Make sure that disconnected multiplugs and sensors are protected from any possible oil, coolant or other liquid contamination. Any such contamination could impair performance or lead to component failure.
- Never force connectors apart or pull on the wiring harness.
- Always make sure locking tabs are disengaged before disconnecting multiplugs etc. and make sure that correct orientation is achieved before connection.
- Make sure that any protection covers, insulation etc. are replaced if disturbed.

Having confirmed that a component is faulty, carry out the following:

- Switch off the ignition and disconnect the battery.
- Remove the component and support the disconnected harness.
- When replacing electrical components, keep oily hands away from electrical connections and make sure that locking tabs on connectors are fully engaged.

Battery Disconnection/Connection

Always refer to the Electrical Section of this manual - Battery Connection/Disconnection prior to attempting to connect or disconnect the battery.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Handling Precautions

The following information lists basic precautions which must be observed if fuel is to be handled safely. It also outlines other areas of risk which must not be ignored. As this information is issued for basic guidance only, consult your local Fire Department where any doubt as to personal and environmental safety exists - See also Health and Safety Precautions.

General precautions

Always have the correct type of fire extinguisher containing Foam, CO₂, Gas or powder accessible when handling or draining fuel or dismantling fuel systems. Fire extinguishers must also be located in areas where fuel is stored.

Make sure that suitable warning signs are exhibited.

Keep all sources of ignition well away from areas where fuel is being handled.

Make sure that any leadlamps are flameproof and kept clear of spillage.

• WARNINGS:



Do not disassemble or reassemble fuel system components whilst vehicle is over a pit.



No one should be permitted to repair components associated with fuel without first having specialist training.

Always disconnect the vehicle battery before carrying out disassembly, reassembly or draining work on a fuel system.

Fuel tank and system draining

Draining must be carried out in accordance with the procedures given in the relevant Fuel System section of this manual.

• WARNINGS:



Never drain fuel or work on a fuel system while the vehicle is over a pit. Extraction or draining of fuel must be carried out in a well ventilated area.



Never switch on or operate mobile (cellular) phones in the vicinity of vehicles when operations are being carried out on the fuel system.



Always attach fuel vapor warning labels to fuel tanks immediately after draining.



Containers used for storing fuel must be clearly marked with the contents and placed in a safe storage area which meets the requirements of the local authority.



CAUTION: Some fuel lines are now installed with 'quick release' connectors. If a connector is damaged, no attempt

must be made to repair the connector, a new fuel line and connector(s) assembly must be installed.

Always release pipe clips fully before attempting to disconnect fuel pipes.

Fuel tank repairs

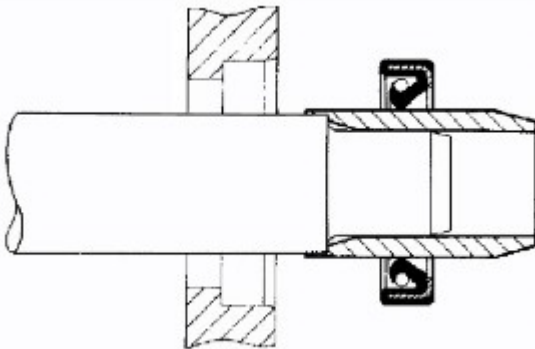


CAUTION: No attempt should be made to repair a plastic fuel tank. If the structure of the tank is damaged, a new tank must be installed.

Oil seals

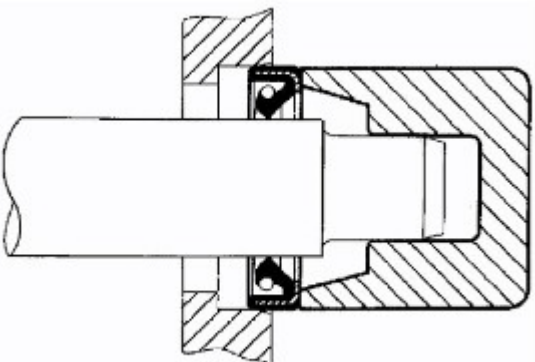
Never use a seal which has been improperly stored or handled.

- Take great care when removing old seals that the sealing surfaces and seal housing are not damaged.
- Carefully examine seal before installing to make sure that it is clean and undamaged.
- Make sure that the surface on which the seal is to run and also the seal housing is clean and free from burrs or scratches. Renew the component if the sealing surface cannot be restored.
- Special tools and protection sleeves are provided for installing the majority of seals and must be used when specified.
- Many seals are now coated with a protective wax and DO NOT need to be lubricated prior to installing. Always check the relevant repair procedure which will state if a seal must be installed dry. Never touch these seals with oily hands as the oil will contaminate the protective coating and affect the sealing properties of the seal; also, make sure that installing tools and protection sleeves are free from oil and grease. Seals which must be lubricated prior to installing should have the recommended lubricant applied to the areas specified in the repair procedure.
- Make sure that a seal is installed the correct way round. For example, the lip of the seal must face towards the lubricant which it is sealing.
- When installing an oil seal, make sure that it is positioned square to shaft and housing. Where the seal is to be installed to a housing prior to installing over a shaft, take care not to allow the weight of an unsupported shaft to rest on the seal.



E48561

- Always use the recommended special tool and protection sleeve to install an oil seal. If no tool is specified, use a suitable mandrel approximately 0.4 mm (0.015 in) smaller than the outside diameter of the seal. Use adhesive tape on the shaft to protect the sealing lip of the seal.



E48562

- Press or drift the seal in to the depth of its housing if the housing is shouldered or flush with the face of the housing where no shoulder is provided. Make sure that the seal is not tilted in the housing when it is installed.

Supplementary Restraint System (SRS) Precautions



WARNING: Do not install rear facing child seats in the front passenger seat.

The SRS contains components which are potentially hazardous to service personnel if not handled correctly. The following guidelines and precautions are intended to alert personnel to potential sources of danger and emphasise the importance of ensuring the integrity of the SRS components installed to the vehicle.



WARNING: The following precautions **MUST** be adhered to when working on the SRS system:

- The correct procedures must always be used when working on SRS components.
- Persons working on the SRS system must be fully trained and have been issued with the safety guidelines.
- The airbag modules contain extremely flammable and hazardous compounds. Contact with water, acids or heavy metals may produce harmful or explosive results. Do not dismantle, incinerate or bring into contact with electricity before the unit has been deployed.
- Always replace a seat belt assembly that has withstood the strain of a severe vehicle impact or if the webbing shows signs of fraying.
- Allow a period of 2 minutes to elapse after disconnecting the battery before undertaking any work on the SRS system.
- Always disconnect the vehicle battery before carrying out any electric welding on a vehicle installed with an SRS system.



CAUTION: Do not expose airbag modules or seat belt pre-tensioners to temperatures exceeding 85° C (185° F).

It should be noted that these precautions are not restricted to operations performed when servicing the SRS system. The same care should be exercised when working on ancillary systems and components located in the vicinity of SRS components; these include but are not limited to:

- Steering wheel airbag, clock spring.
- Passenger front airbag.
- Head airbag modules - front and rear.
- Seat belt pre-tensioners.
- SRS harnesses, link leads and connectors.
- Side curtain air bags.

Making the system safe

Before working on or in the vicinity of SRS components, make sure the system is rendered safe by performing the following operations:

- Remove the ignition key.
- Disconnect the battery, earth lead first.
- Wait 2 minutes for the SRS power circuit to discharge before commencing work.

• **NOTE:** The SRS uses energy reserve capacitors to keep the system active in the event of electrical supply failure under crash conditions. It is necessary to allow the capacitors sufficient time to discharge (2 minutes) in order to avoid the risk of accidental deployment.

Installation

In order to make sure system integrity, it is essential that the SRS system is regularly checked and maintained so that it is ready for effective operation in the event of a collision. Carefully inspect SRS components before installation. Do not install a part that shows signs of being dropped or improperly handled, such as dents, cracks or deformation.



WARNING: The integrity of the SRS systems is critical for safety reasons. Make sure the following precautions are always adhered to:

- Do not install accessories or other objects to trim panels which cover airbags.
- Never install used SRS components from another vehicle or attempt to repair an SRS component.
- When repairing an SRS system, only use genuine new parts.
- Never apply electrical power to an SRS component unless instructed to do so as part of an approved test procedure.
- Special fixings are necessary for installing an airbag module – do not use other fixings and make sure that all fixings are tightened to the correct torque.
- Always use new fixings when replacing an SRS component.

• **CAUTIONS:**



Take care not to trap airbag modules when installing interior trim components.



Make sure SRS components are not contaminated by oil or grease.

• **NOTE:** Following seat belt pre-tensioner deployment, the seat belts can still be used as conventional seat belts but will need to be replaced as soon as possible to make sure full SRS protection.

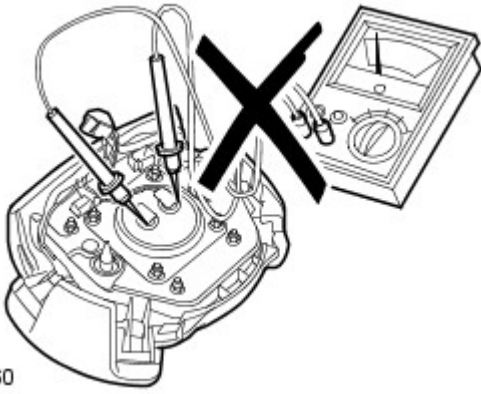
• **NOTE:** If the SRS components are to be replaced, the part number/bar code of the new unit must be recorded.

SRS component testing precautions

The SRS components are triggered using relatively low operating currents, always adhere to the following :



WARNING: Never use a multimeter or other general purpose equipment on SRS components. Use only T4 to diagnose system faults.



E48960

⚠ WARNING: Do not use electrical test equipment on the SRS harness while it is connected to any of the SRS components, it may cause accidental deployment and injury.

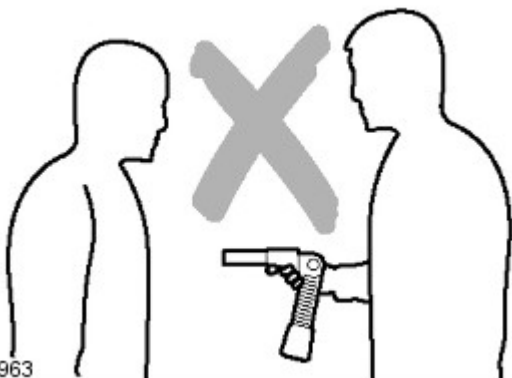
Handling and storage

Always observe the following precautions when handling SRS components:



E48961

- Never drop an SRS component. The airbag diagnostic control unit is a particularly shock sensitive device and must be handled with extreme care. Airbag modules and seat belt pre-tensioners could deploy if subjected to a strong shock.
- Never wrap your arms around an airbag module. If a module has to be carried, hold it by the cover with the cover uppermost and the base away from your body.
- Never transport airbag modules or seat belt pre-tensioners in the passenger compartment of a vehicle. Always use the luggage compartment of the vehicle for carrying airbag modules and seat belt pre-tensioner units.
- Never attach anything to an airbag cover or any trim component covering an airbag module. Do not allow anything to rest on top of an airbag module.
- Always keep components cool, dry and free from contamination.
- Never apply grease or cleaning solvents to seat belt pre-tensioner units, component failure could result.
- Always store an airbag module with the deployment side uppermost. If it is stored deployment side down, accidental deployment will propel the airbag module with sufficient force to cause serious injury.
- Keep new airbag modules in their original packaging until just prior to installing. Place the old module in the empty packaging for carriage.





E48963

• WARNINGS:

⚠ When handling any SRS component, hold by the gas generator housing, DO NOT hold by the airbag. Do not wrap the thumb around the gas generator while holding. Do not drape airbag over shoulder or around neck. For seat buckle type pre-tensioners, hold by the piston tube, with the open end of the piston tube pointing towards the ground and the buckle

facing away from your body. Do not cover the end of the piston tube. DO NOT hold buckle type pre-tensioners by the bracket assembly or cable. Never point the piston tube towards your body or other people.

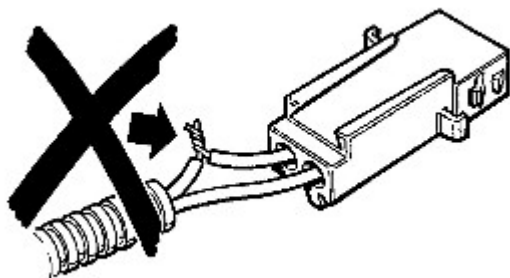
 Airbag modules and seat belt pre-tensioners are classed as explosive devices. For overnight and longer term storage, they must be stored in a secure steel cabinet which has been approved as suitable for the purpose and has been registered with the local authority.

 Store airbag modules or seat belt pre-tensioners in a designated storage area. If there is no designated storage area available, store in the locked luggage compartment of the vehicle and inform the workshop supervisor.

 CAUTION: Improper handling or storage can internally damage the airbag module making it inoperative. If you suspect the airbag module has been damaged, install a new module and refer to the deployment/disposal procedures for disposal of the damaged module.

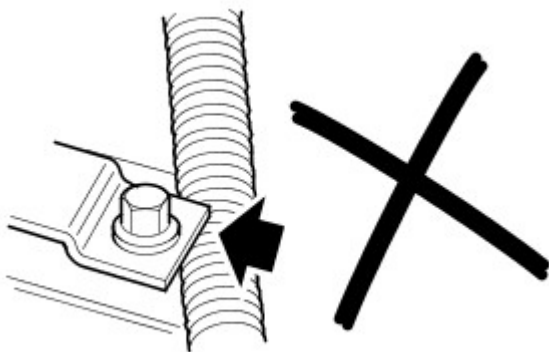
SRS harness and connectors

Always observe the following precautions with regards to SRS system electrical wiring:



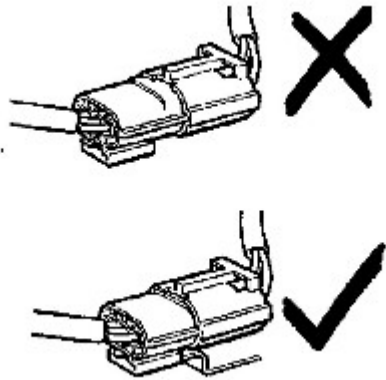
E48965

- Never attempt to modify, splice or repair SRS wiring.
 - Never install electrical equipment such as a mobile telephone, two-way radio or in-car entertainment system in such a way that it could generate electrical interference in the airbag harness. Seek specialist advice when installing such equipment.
- NOTE: SRS wiring can be identified by a special yellow outer sleeve protecting the wires (black with yellow stripe protective coverings are sometimes used).




E48964

 WARNING: Always make sure SRS wiring is routed correctly. Be careful to avoid trapping or pinching the SRS wiring.




E48966


 **WARNING:** Do not leave the connectors hanging loose or allow SRS components to hang from their harnesses. Look for possible chafing points.

Impact crash sensors - inspection

After any degree of side or frontal body damage, inspect the impact crash sensors. Replace a crash sensor if there is any sign of damage.

 **CAUTION:** Take extra care when painting or carrying out bodywork repairs in the vicinity of the crash sensors. Avoid direct exposure of the crash sensors or link harnesses to heat guns, welding or spraying equipment. Take care not to damage sensor or harness when reinstalling components.

Clock spring

 **CAUTION:** Always follow the procedure for installing and checking the clock spring as instructed in the SRS repairs section. Comply with all safety and installation procedures to make sure the system functions correctly. Observe the following precautions:

- Do not unlock and rotate the clock spring when it is removed from the vehicle.
- Do not turn the road wheels when the clock spring is removed from the vehicle.
- Always make sure the clock spring is removed and installed in its central position and with the front road wheels in the straight ahead position - refer to SRS repair section for the correct removal and installation procedure.
- If a new clock spring is being installed, make sure the locking tab holding the spring's rotational position is not broken; units with a broken locking tab must not be used.

Airbag and pre-tensioner deployment

 **WARNING:** During deployment parts of the airbag module become hot enough to burn you. Wait 30 minutes after deployment before touching the airbag module.

Deployment procedures and precautions as detailed in this manual should be strictly adhered to. Only personnel who have undergone the appropriate training should undertake deployment of airbag and pre-tensioner modules. The following precautions must be complied with:

- Only use deployment equipment approved for the intended purpose.
- Deployment of airbag / pre-tensioner modules must be performed in a well ventilated area which has been designated for the purpose.
- Make sure airbag / pre-tensioner modules are not damaged or ruptured before attempting to deploy.
- Where local legislation exists, notify the relevant authorities of intention to deploy airbag and pretensioner units.
- When deploying airbag pre-tensioner units, make sure that all personnel are at least 15 metres (45 feet) away from the deployment zone.
- Make sure deployment tool is connected correctly, in compliance with the instructions detailed in the SRS section of this manual. In particular, make sure deployment tool is NOT connected to battery supply before connecting to airbag module connector.
- When deploying seat belt pre-tensioners, make sure pre-tensioner unit is secured correctly to the seat.
- When removing deployed airbag modules and pre-tensioner units, wear protective clothing. Use gloves and seal deployed units in a plastic bag.
- Following deployment of any component of the SRS system within the vehicle, all SRS components must be replaced. DO NOT re-use or salvage any parts of the SRS system.
- Do not lean over an airbag module when connecting deployment equipment.

If a vehicle is to be scrapped, undeployed airbag modules and pre-tensioner units must be manually deployed. In this case airbags can be deployed in the vehicle. Before deployment, make sure the airbag module is secure within its correct mounting position. Deployment of the driver's airbag in the vehicle may damage the steering wheel; if the vehicle is not being scrapped, deploy the module outside of the vehicle.

SRS Component Replacement Policy

• **CAUTIONS:**

 The Restraints Control Module (RCM) will log a crash fault after every impact which is severe enough to cause airbag

deployment. **It is possible to have three crashes/impacts logged after one event where, for example, a front, side and rollover has occurred. After the third fault is logged, the SRS warning lamp will be illuminated and the restraints control module (RCM) must be replaced.**



The SRS side/front impact sensor(s) must be replaced if there are any signs of physical damage or if the restraints control module (RCM) is registering a fault.

The following information details the policy for replacement of SRS components as a result of a vehicle accident.

Impacts which do not deploy the airbags or pre-tensioners

Check for structural damage in the area of the impact paying particular attention to bumper armatures, longitudinals and bracketry.

Impacts which deploy the airbags or pre-tensioners

The replacement and inspection policy is dependent on the type and severity of the crash condition. The following guidelines are the minimum that should be exercised as a result of the deployment of specific SRS components.

Check for structural damage in the area of impact paying particular attention to bumper armatures, longitudinals and bracketry.

Front Airbag Deployment - Driver and Passenger



CAUTION: If the front airbags are deployed, the following components must be replaced:

- Driver airbag module
- Passenger airbag module
- Fly leads (where applicable) connecting front airbag modules to SRS harness
- Front seat belt buckle pre-tensioner
- Rear seat belt pre-tensioners - if installed
- Driver's seat belt retractor - if installed
- Clock spring
- Any front impact sensors that have been physically damaged or if a fault is being registered
- Restraints control module (RCM) if the three crashes/impacts have been stored

Additionally, the following items must be inspected for damage and replaced as necessary:

- Front passenger's seat belt retractor and webbing, tongue latching function, 'D' loop and body anchorage point
- Rear seat belt buckles, webbing, buckle covers, body anchorage points and tongue latching function
- Instrument panel moulding adjacent to passenger airbag module
- Steering wheel
- Front seat frames and head restraints
- Steering column - if adjustment is lost or if there are signs of collapse
- Seat belt height adjusters
- Rear seat belts

Side Air Bags



CAUTION: If the side curtain air bags are deployed, the following components must be replaced on the side of the vehicle on which the deployment occurred:

- Side curtain airbag
- Any side impact sensors that have been physically damaged or if a fault is being registered
- Restraints Control Module (RCM) if the three crashes/impacts have been stored

Additionally, the following items must be inspected for damage and replaced as necessary:

- Front seat belts, retractors and webbing, tongue latching function, 'D' loop and body anchorage points
- Rear seat belt buckles, webbing, buckle covers, tongue latching function, and body anchorage points
- Front seat frame and head restraints
- Door trim casing
- Seat belt height adjusters
- Rear seat belts

Head airbag modules



CAUTION: If the head airbag modules are deployed, the following components must be replaced on the side of the vehicle on which the deployment occurred:

- Head airbag modules
- Link lead between airbag gas generator and restraints control module (RCM) harness
- Airbag retaining clips
- Internal trim finisher
- Front seat belt buckle pre-tensioners
- Any side impact sensors that have been physically damaged or if a fault is being registered
- Restraints Control Module (RCM) if the three crashes/impacts have been stored

Additionally, the following items must be inspected for damage and replaced as necessary:

- Headlining
- Component mounting brackets

- Front seat belts, retractors and webbing, tongue latching function, 'D' loop and body anchorage points
- Rear seat belt buckles, webbing, buckle covers, tongue latching function, and body anchorage points
- Adjacent trim components
- Seat belt height adjusters

Rear impacts



CAUTION: If the seat belt pre-tensioners are deployed during a rear impact, the following components must be replaced:

- Seat belt pre-tensioners
- Front and rear seat belt retractors used during the impact
- Restraints Control Module (RCM) if the three crashes/impacts have been stored

Additionally, the following items must be inspected for damage and replaced as necessary:

- Seat belt height adjusters
- Front seat belts, retractors and webbing, tongue latching function, 'D' loop and body anchorage points
- Rear seat belt buckles, webbing, buckle covers, tongue latching function, and body anchorage points

(A/C) System Precautions

The A/C system contains fluids and components which could be potentially hazardous to the service engineer or the environment if not serviced and handled correctly. The following guidelines are intended to alert the service engineer to potential sources of danger and emphasise the importance of ensuring the integrity of the A/C operating conditions and components installed to the vehicle.

Where necessary, additional specific precautions are detailed in the relevant sections of this Manual and also in the Health and Safety Section. These precautions must be referred to prior to commencing repair operations.

The refrigerant used in the A/C system is HC-134a (Hydrofluorocarbon) R134a.

• WARNINGS:



Service must only be carried out by personnel familiar with both the vehicle system and the charging and testing equipment. All operations must be carried out in a well ventilated area away from open flame and heat sources.



R134a is a hazardous liquid and when handled incorrectly can cause serious injury. Suitable protective clothing, consisting of face protection, heat proof gloves, rubber boots and rubber apron or waterproof overalls, must be worn when carrying out operations on the A/C system.

Remedial actions



WARNING: Due to its low evaporating temperature, R134a must be handled with care. R134a splashed on any part of the body will cause immediate freezing of that area. Also, refrigerant cylinders and replenishment trolleys when discharging will freeze skin to them if contact is made.

If an accident involving R134a should occur, conduct the following remedial actions:

- If liquid R134a enters the eye, do not rub it. Gently run large quantities of eye wash over affected eye to raise the temperature. If an eye wash is not available, cool, clean water may be used to flush the eye. After rinsing, cover the eye with a clean pad and seek immediate medical attention.
- If liquid R134a is splashed onto the skin, run large quantities of water over the affected area to raise the temperature. Implement the same action if the skin comes in contact with discharging cylinders. Wrap the contaminated body parts in blankets (or similar materials) and seek immediate medical attention.
- If the debilitating effects of inhalation of R134a vapour are suspected, seek fresh air. If the affected person is unconscious, move them away from the contaminated area to fresh air and apply artificial respiration and/or oxygen and seek immediate medical attention.

Service precautions

Observe the following precautions when handling components used in the system:

- A/C units must not be lifted by their hoses, pipes or capillary lines.
- Hoses and lines must not be subjected to any twist or stress; the efficiency of the system will be impaired by kinks or restrictions. Make sure that hoses are correctly positioned before tightening couplings, and make sure that all clips and supports are utilised.
- Flexible hoses should not be positioned closer than 100 mm (4.0 in) to the exhaust manifold unless protected by heat shielding.
- Completed assemblies must be checked for refrigeration lines touching metal panels. Any direct contact of components and panels may transmit noise and so must be eliminated.
- The appropriate torque wrench must be used when tightening refrigerant connections to the stipulated value. An additional spanner must be used to hold the union to prevent twisting of the pipe when tightening connections.
- Before connecting any hose or pipe, make sure that refrigerant oil is applied to the seat of the new O-rings, **BUT NOT** to the threads of the connection.
- All protective plugs or caps must remain in place in the component until immediately prior to connection.
- Make sure components are at room temperature before uncapping/unplugging, to prevent condensation of moisture from the air that enters it.
- When disconnecting, immediately plug or cap all pipes to prevent ingress of dirt and moisture into the system.
- Components must not remain uncapped/unplugged, if a system has been left uncapped/unplugged for 24 hours or longer, a new receiver/drier must be installed.
- The receiver/drier contains desiccant which absorbs moisture. It must be positively sealed at all times. A

- receiver/drier that has been left uncapped for longer than 24 hours must not be used; install a new unit.
- The receiver/drier should be the last component connected to the system to make sure optimum dehydration and maximum moisture protection of the system.
- Whenever a component of the refrigeration system is replaced, it will also be necessary to install a new receiver/drier unit.
- Use alcohol and a clean lint-free cloth to clean dirty connections.
- Make sure that all new parts installed are marked for use with R134a.
- When a major repair has been completed, a leak test should be conducted; refer to the Repairs Section of this manual for the correct procedure.

Refrigerant oil



CAUTION: Refrigerant oil (ND-8 PAG) easily absorbs water and must not be stored for long periods. Do not pour unused refrigerant oil back into the container. Always use an approved refrigerant oil.

When replacing components in the system, drain the refrigerant oil from the component being replaced into a graduated container. On assembly, add the quantity of refrigerant oil drained to the new component - See Compressor Replacement in this Section.

A/C Compressor

A new compressor is sealed and pressurised with Nitrogen gas. When installing a new compressor, slowly release the sealing cap; gas pressure should be heard to vent as the seal is broken.



CAUTION: A new compressor should always be sealed and could be pressurised with nitrogen gas. To avoid possible oil loss, release the sealing cap(s) slowly. Do not remove the cap(s) until immediately prior to connecting the pipes to the compressor.

Rapid refrigerant discharge

If the A/C system is damaged as a result of an accident and the system is punctured, the refrigerant will discharge rapidly. The rapid discharge of refrigerant will also result in the loss of most of the oil from the system. The compressor must be removed and all the remaining oil in the compressor drained and refilled as instructed in the air conditioning section of this manual.

Precautions for refrigerant recovery, recycling and recharging

When the A/C system is recharged, any existing refrigerant is first recovered from the system and recycled. The system is then charged with the required weight of refrigerant and volume of refrigerant oil.



WARNING: Refrigerant must always be recycled before re-use to make sure that the purity of the refrigerant is high enough for safe use in the system. Recycling should always be carried out with equipment which is design certified by Underwriter Laboratory Inc. for compliance with SAE J1991. Other equipment may not recycle refrigerant to the required level of purity.

• CAUTIONS:



A R134a Refrigerant Recovery Recycling Recharging Station must not be used with any other type of refrigerant. Refrigerant R134a from domestic and commercial sources must not be used in motor vehicle systems.



The system must be evacuated immediately before recharging commences. Delay between evacuation and recharging is not permitted.

A/C Compressor Replacement

A new compressor is supplied filled with a full charge (X cm³) of refrigerant oil.

A calculated quantity of oil must be drained from the new compressor before installing. To calculate the quantity of oil to be drained:

- Remove the drain plug from the old compressor.
- Invert the compressor and gravity drain the oil into a calibrated measuring cylinder. Rotate the compressor clutch to make sure the compressor is completely drained.
- Note the quantity of oil drained (Y cm³).
- Calculate the quantity of oil to be drained from the new compressor using the following formula: $X \text{ cm}^3 - (Y \text{ cm}^3 + 20 \text{ cm}^3) = Q \text{ cm}^3$
- Remove the drain plug from the new compressor and drain Q cm³ of oil. install and tighten the compressor drain plug.

Vehicle Weights

Item	kg	lb
Maximum Gross Vehicle Weight (GVW) - All models*	3230	7106
Maximum weight of unbraked trailer:		
On-road	750	1650
Off-road	750	1650
Maximum towable weight (mass) - Trailers with overrun brakes		
On-road	3500	7700
Off-road	1000	2205
Maximum roof rack load (Including the mass of the roof rack):		

Item	kg	lb
On-road	75	110
Off-road	75	110

* Weight quoted is the maximum weight possible for vehicles in this model range; weights may be less for certain variants depending upon trim level, territorial requirements etc.

Vehicle Dimensions

Item	mm	in
Length - including number plate plinth - All models	4842	190.6
Width - All models:		
Mirrors extended	2189	86.2
Mirrors folded	2009	79.1
Coil Suspension - Maximum height - At EEC kerb weight - All models:		
With roof rack and rails	1891	74.4
With roof antenna module	1938	76.3
Air Suspension - Maximum height - At normal ride height - All models:		
With roof rack and rails	1891	74.4
With roof antenna module	1938	76.3
Wheelbase - All models	2885	113.5
Front overhang - All models	820	32.3
Rear overhang - All models	1130	44.5
Maximum roof load	75 kg	165 lb
Track - All models:		
Front	1601	63.0
Rear	1601	63.0
Coil Suspension:		
Underbody - Running clearance to exhaust - Minimum - Kerb weight	185	7.3
Front axle to axle undertray clearance	203	7.9
Rear axle to differential casing clearance	214	8.4
Air Suspension:		
Underbody - Running clearance to exhaust - Minimum - Kerb weight	185	7.3
Front axle to axle undertray clearance	203	7.9
Rear axle to differential casing clearance	214	8.4
Suspension articulation - All models:		
Front	255	10.03
Rear	330	12.9
Coil Suspension:		
Wading depth	600	23.6
Approach angle	32.2°	32.2°
Departure angle - Towbar NOT installed:		
With full size spare wheel	24.9°	24.9°
With space saver wheel	26.7°	26.7°
Departure angle - Towbar installed - NOT NAS vehicles	15.7°	15.7°
Departure angle - Towbar installed - NAS vehicles	18°	18°
Departure angle - Adjustable height towbar installed	14°	14°
Air Suspension:		
Wading depth - Off-road height	700	27.5
Approach angle:		
Standard ride height	32.2°	32.2°
Off-road ride height	37.2°	37.2°
Departure angle - Towbar NOT installed - Standard ride height:		
With full size spare wheel	24.9°	24.9°
With space saver wheel	26.7°	26.7°
Departure angle - Towbar NOT installed - Off-road ride height:		
With full size spare wheel	27.9°	27.9°
With space saver wheel	29.5°	29.5°
Departure angle - Towbar installed - NOT NAS vehicles:		
Standard ride height	15.7°	15.7°
Off-road ride height	18.5°	18.5°
Departure angle - Towbar installed - NAS vehicles:		
Standard ride height	18°	18°
Off-road ride height	21°	21°
Departure angle - Adjustable height towbar installed:		
Standard ride height	14°	14°
Off-road ride height	16.6°	16.6°
Ramp angle - Coil Suspension	22.8°	
Ramp angle - Air Suspension		
Standard ride height	22.8°	22.8°
Off-road ride height	27.9°	27.9°

General Information - Health and Safety Precautions

Description and Operation

Introduction

Modern vehicles contain many materials and liquids which if not handled with care can be hazardous to both personal health and the environment. Also, many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health.

This subsection lists some of these hazardous operations and the materials and equipment associated with them. Precautions necessary to avoid these hazards are identified.

The list is not exhaustive and all operations and procedures and the handling of materials, should be carried out with health and safety in mind.

Before using any product the Materials Safety Data Sheet supplied by the manufacturer or supplier should be consulted.



WARNING: Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should, as far as possible, be kept from contact with the skin. These liquids and substances include acid, anti-freeze, brake fluid, fuel, windscreen washer additives, lubricants, refrigerants and various adhesives.

Acids and Alkalis

For example - alkalis such as caustic soda used in cleaning materials; acids such as sulphuric acid used in batteries.

Both alkalis and acids are irritant and corrosive to the skin, eyes, nose and throat. They cause burns and can destroy ordinary protective clothing.

Avoid splashes to the skin, eyes and clothing. Wear suitable protective impervious apron, gloves and goggles. Do not breath mists.

Make sure access to eye wash bottles, shower and soap are readily available for splashing accidents.

Display Eye Hazard sign.

Air Bags

Highly flammable, explosive – observe No Smoking policy.

Used within the vehicle as safety restraints.

The inflator contains a high-energy propellant which, when ignited, produces a VERY HOT GAS (2500°C).

The gas inflator (generator) used in air bags is Sodium Azide. This material is hermetically sealed in each air bag module and is completely consumed during deployment. No attempt should be made to open an air bag inflator as this will lead to the risk of exposure to Sodium Azide. If a gas generator is ruptured, full protective clothing should be worn when dealing with the spillage.

After normal deployment, gloves and safety goggles should be worn during the handling process.

Deployed air bags should be disposed of in a plastic bag in accordance with local regulations at an approved chemical waste site.

Following any direct contact with Sodium Azide:

- Wash affected areas thoroughly with water.
- **SEEK IMMEDIATE MEDICAL ASSISTANCE.**

Air Bags - Do's

- Do store modules in an upright position.
- Do keep modules dry.
- Do carry modules with the cover side pointing away from the body.
- Do place modules with their cover side upwards.
- Do carefully inspect modules for damage.
- Do stand to one side when connecting modules.
- Do make sure all test equipment is properly calibrated and maintained.
- Do wash hands after handling deployed air bags.

Air Bags - Do Not

- Do Not store highly flammable material together with modules or gas generators.
- Do Not store gas generators at temperatures exceeding 80°C.
- Do Not store modules upside down.
- Do Not attempt to open a gas generator housing.
- Do Not expose gas generators to open flame or sources of heat.
- Do Not place anything on top of a module cover.
- Do Not use damaged modules.
- Do Not touch a fired module or gas generator for at least 10 minutes after firing.
- Do Not use any electrical probes on the wiring circuit.

Air Suspension

Whenever work is being undertaken on the air suspension system, suitable eye protection must be worn.

Air Conditioning Refrigerant

Highly flammable, combustible – observe No Smoking policy.

Skin contact may result in frostbite.

Instructions given by the manufacturer must be followed. Avoid naked lights, wear suitable protective gloves and goggles.

If refrigerant comes into contact with the skin or eyes, rinse the affected areas with water immediately. Eyes should also be rinsed with an appropriate irrigation solution such as a solution of 9% Sodium Chloride and Purified Water. **DO NOT RUB THE EYES AND SEEK IMMEDIATE MEDICAL ATTENTION.**

Air Conditioning Refrigerant

Do Not

- Do Not expose refrigerant bottles to sunlight or heat.
- Do Not expose refrigerant bottles to frost.
- Do Not drop refrigerant bottles.
- Do Not vent refrigerant to atmosphere under any circumstance.
- Do Not mix refrigerants.

Adhesives and Sealants

Many adhesives and sealants are highly flammable – OBSERVE NO SMOKING POLICY. These items, should be stored in flameproof cabinets in No Smoking areas. Cleanliness and tidiness in use should be observed, for example disposable paper covering benches. All adhesives and sealants should be dispensed from applicators where possible; containers, including secondary containers, should be labelled appropriately.

Anaerobic, Cyanoacrylate (super-glues) and other Acrylic Adhesives

Many are irritant, sensitizing or harmful to the skin and respiratory tract. Some are eye irritants.

Skin and eye contact should be avoided and the manufacturer's instructions followed.

Cyanoacrylate adhesives (super-glues) MUST NOT contact the skin or eyes. If skin or eye tissue is bonded, cover with a clean moist pad and **SEEK IMMEDIATE MEDICAL ATTENTION**. Do not attempt to pull skin tissue apart. Use in well ventilated areas as vapors can cause irritation to the nose and eyes.

For two-pack systems see Resin-based and Isocyanate Adhesives/Sealers.

Solvent-based Adhesives/Sealers - See Solvents

Follow manufacturers instructions.

Water-based Adhesives/Sealers

Those based on polymer emulsions and rubber/latex may contain small amounts of volatile, toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use.

Hot Melt Adhesives

In the solid state, they are safe. In the molten state they may cause burns and health hazards may arise from the inhalation of toxic fumes.

Use appropriate protective clothing and a thermostatically controlled heater with a thermal cut-out and adequate extraction.

Resin-based Adhesives/Sealers, for example Epoxide and Formaldehyde Resin-based

Mixing should be carried out in well ventilated areas as harmful or toxic volatile chemicals may be released.

Skin contact with uncured resins and hardeners can result in irritation, dermatitis, and absorption of toxic or harmful chemicals through the skin. Splashes can damage the eyes.

Provide adequate ventilation and avoid skin and eye contact.

Isocyanate (Polyurethane) Adhesives/Sealers

See also Resin-based Adhesives

Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.

Over exposure is irritating to the eyes and respiratory system. Excessive concentrations may produce effects on the nervous system including drowsiness. In extreme cases, loss of consciousness may result. Long term exposure to vapour concentrations may result in adverse health effects.

Prolonged contact with the skin may lead to skin irritation and in some cases, dermatitis.

Splashes entering the eye will cause discomfort and possible damage.

Any spraying should preferably be carried out in ventilated booths which incorporate facilities for removing vapors and spray droplets from the breathing zone.

Wear appropriate gloves, eye and respiratory protection.

Antifreeze

May be flammable when undiluted.

Vapors may be given off from coolant antifreeze when heated. Avoid breathing these vapors.

Antifreeze may be absorbed through the skin in toxic or harmful quantities. Antifreeze, if swallowed, can be fatal; **SEEK IMMEDIATE MEDICAL ATTENTION.**

Battery Acids

See also Alkalis and Acids.

Gases released during battery charging are explosive. Always remove the battery from the vehicle prior to charging. Never use naked flames or allow sparks near charging or recently charged batteries. NEVER add acid to a battery, the chemical reaction produced will be violent and explosive. In cases of eye contact, wash affected area with copious amounts of water and **SEEK IMMEDIATE MEDICAL ATTENTION.**

Make sure there is adequate ventilation during battery charging, observe NO SMOKING POLICY.

Brake Pads and Linings

Always fit the correct grade and specification of brake pads and linings. When renewing pads and linings, always replace as complete axle sets.

Brake and Clutch Fluid

Splashes to the skin and eyes are irritating and in the long term can be damaging, avoid prolonged skin contact. In cases of eye contact, wash affected area with copious amounts of water and SEEK IMMEDIATE MEDICAL ATTENTION.

Chemical Materials

All chemical materials should always be used with caution and stored and handled with care. They may be toxic, harmful, corrosive, irritant or highly flammable and give rise to hazardous fumes and dusts.

The effects of excessive exposure to chemicals may be immediate or delayed; briefly experienced or permanent; cumulative; superficial; life threatening; or may reduce life expectancy.

Chemical Materials - Do's

- Do carefully read and observe hazard and precaution warnings given on material containers (labels) and in any accompanying leaflets, posters or other instructions. Material health and safety data sheets can be obtained from manufacturers.
- Do remove chemical materials from the skin and clothing as soon as practicable after soiling. Change heavily soiled clothing and have it cleaned.
- Do organise work practices and protective clothing to avoid soiling of the skin and eyes.
- Do avoid breathing vapors, aerosols, dusts or fumes; inadequate container labelling; fire and explosion hazards.
- Do wash before job breaks, before eating, smoking, drinking or using toilet facilities when handling chemical materials.
- Do keep work areas clean, uncluttered and free of spills.
- Do store chemical materials according to national and local regulations.
- Do keep chemical materials out of the reach of children.

Chemical Materials - Do Not

- Do Not mix chemical materials except under the manufacturers instructions; some chemicals can form other toxic or harmful chemicals, give off toxic or harmful fumes or become explosive when mixed together.
- Do Not spray chemical materials, particularly those based on solvents, in confined spaces, for example when people are inside a vehicle.
- Do Not apply heat or flame to chemical materials except under the manufacturers instructions. Some are highly flammable and some may release toxic or harmful fumes.
- Do Not leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas such as pits.
- Do Not transfer chemical materials to unlabelled containers.
- Do Not clean hands or clothing with chemicals. Chemicals, particularly solvents and fuels, will dry skin and may cause irritation leading to dermatitis or be absorbed through the skin in toxic or harmful quantities.
- Do Not use emptied containers for other materials except when they have been cleaned under supervised conditions.
- Do Not sniff or smell chemical materials, even brief exposure to high concentrations of fumes can be toxic or harmful.

Corrosion Protection Materials

Some corrosion protection materials are highly flammable – observe NO SMOKING POLICY.

These materials are varied and the manufacturers instructions must always be followed. The materials may contain solvents, resins or petroleum products. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

Dust

Dust or powder produced during repair operations may be irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate.

Fine dusts of combustible material can present an explosion hazard. Avoid explosive limits and sources of ignition.

Electrical Equipment

Electric shock can result from the use of faulty electrical equipment or from the misuse of equipment in good condition.

Make sure that electrical equipment is maintained in good condition and frequently tested. Faulty equipment should be labelled and preferably removed from the work station.

Make sure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged. If using cable reel extension equipment, ALWAYS ensure that the cable is fully unwound from the reel.

Make sure that electrical equipment and flexes do not come into contact with water.

Make sure that electrical equipment is protected by the correct rated fuse.

Never misuse electrical equipment and never use equipment which is in any way faulty. The results could be fatal.

Make sure that the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist.

Make sure that the designated electrical workers are trained in basic First Aid.

In cases of electrocution:

- Switch off the power supply before approaching the victim.
- If this is not possible, **DO NOT TOUCH THE VICTIM** but push or drag the person from the source of electricity using dry, non-conductive material.
- Commence resuscitation if trained to do so.
- **SEEK IMMEDIATE MEDICAL ATTENTION.**

Exhaust Fumes

These contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should be run only under conditions of adequate exhaust extraction or general ventilation and not in confined spaces.

Gasoline (Petrol) engine

There may not be adequate warning of odour or of irritation before toxic or harmful effects arise. These may be immediate or delayed.

Gas Oil (Diesel engine)

Soot, discomfort and irritation usually give adequate warning of hazardous fume concentrations.

Fibre Insulation

The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect.

Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.

Fire

Many of the materials found on or associated with the repair of vehicles are highly flammable. Some give off toxic or harmful fumes if burnt; others such as fluoroelastomers when burnt or damaged by excessive heat can break down and produce highly corrosive hydrofluoric acid - See Fluoroelastomers.

Should any material be in a burnt or overheated condition, handle with extreme caution and wear protective clothing when handling such items. Dispose of such material in accordance with local regulations.

Decontaminate and dispose of protective clothing immediately after use.

Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.

Make sure, before using electrical or welding equipment, that there is no fire hazard present.

Have a suitable fire extinguisher available when using welding or heating equipment.

First Aid

Apart from meeting any legal requirements it is desirable for someone in the workshop to be trained in First Aid procedures.

Splashes in the eye should be flushed carefully with clean water for at least ten minutes.

Soiled skin should be washed with soap and water.

In case of cold burns, from alternative fuels, place affected area in cool to cold water.

Individuals affected by inhalation of gases and fumes should be removed to fresh air immediately. If effects persist, consult a doctor.

If liquids are swallowed inadvertently, consult a doctor giving him the information on the container or label. Do not induce vomiting unless this action is indicated on the label.

Fluoroelastomers (Synthetic Rubber)

Many 'O' rings, seals, hoses, flexible pipes and other similar which appear to be manufactured from natural rubber are, in fact, made of synthetic materials called Fluoroelastomers.

Under normal operating conditions, these materials are safe and do not constitute a health hazard. However, if the materials are damaged by burning or exposure to excessive heat, they can break down and produce highly corrosive hydrofluoric acid.



WARNING: Contact with hydrofluoric acid can cause serious burns on contact with the skin. If skin contact does occur, carry out the following steps immediately:

Remove any contaminated clothing.

SEEK IMMEDIATE MEDICAL ATTENTION

Irrigate affected area of skin with copious amounts of cold water or limewater for 15 to 60 minutes.

Foams - Polyurethane

Used in sound and noise insulation. Cured foams used in seat and trim cushioning.

Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.

Individuals with chronic respiratory diseases, asthma, bronchial medical problems, or histories of allergic diseases should not work in or near uncured materials.

The components, vapors or spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapors and spray mists must not be inhaled. These materials must be applied with adequate ventilation and respiratory protection. Do not remove the respirator immediately after spraying, wait until the vapour/mists have cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fumes. Smoking, naked flames or the use of electrical equipment during foaming operations and until vapors/mists have cleared should not be allowed. Any heat cutting of cured foams or partially cured foams should be carried out in areas having suitable fume extraction equipment.

Fuels

Avoid skin contact with fuel where possible. Should contact occur, wash the affected skin with soap and water.

Gasoline (Petrol)

Highly flammable - OBSERVE NO SMOKING POLICY.

Swallowing gasoline (petrol) can result in mouth and throat irritation and absorption from the stomach can result in drowsiness and unconsciousness. Small amounts can be fatal to children. Inhalation into the lungs, through vomiting, is a very serious hazard.

Gasoline (petrol) dries the skin and can cause irritation and prolonged or repeated contact may cause dermatitis; if it is allowed to enter the eyes, it will cause severe smarting. Wash affected area with copious amounts of water and **SEEK IMMEDIATE MEDICAL ATTENTION.**

Gasoline (petrol) may contain appreciable quantities of benzene, which is toxic upon inhalation and the concentration of vapors must be kept very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations will result in rapid loss of consciousness.

Make sure there is adequate ventilation when handling and using gasoline (petrol). Great care must be taken to avoid the serious consequences of inhalation in the event of vapour build up arising from spillages in confined spaces.

Special precautions apply to cleaning and maintenance operations on gasoline (petrol) storage tanks.

Gasoline (petrol) should not be used as a cleaning agent. It must not be siphoned by mouth.

Gas-oil (Diesel Fuel)

Combustible.

Prolonged skin contact with high boiling point gas oils (diesel fuel) may cause serious skin disorders including skin cancer.

Inhalation into the lungs will cause internal bleeding - **SEEK IMMEDIATE MEDICAL ATTENTION.**

If swallowed, DO NOT induce vomiting - SEEK IMMEDIATE MEDICAL ATTENTION.

Kerosene (Paraffin)

Used also as heating fuel, solvent and cleaning agent.

Flammable - OBSERVE NO SMOKING POLICY.

Irritation of the mouth and throat may result from swallowing. The main hazard from swallowing arises if liquid aspiration into the lungs occurs.

Liquid contact dries the skin and can cause irritation or dermatitis. Splashes in the eye may be slightly irritating.

In normal circumstances the low volatility does not give rise to harmful vapors. Exposure to mists and vapors from kerosene at elevated temperature should be avoided (mists may arise in dewaxing). Avoid skin and eye contact and make sure there is adequate ventilation.

If swallowed, DO NOT induce vomiting - SEEK IMMEDIATE MEDICAL ATTENTION.

Gas Cylinders

Gases such as oxygen, acetylene, argon and propane are normally stored in cylinders at pressures of up to 138 bar (13800 kPa) (2000 lbf/in²) and great care should be taken in handling these cylinders to avoid mechanical damage to them or to the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.

Cylinders should be stored in well ventilated enclosures, and protected from ice and snow or direct sunlight. Fuel gases, for example acetylene and propane should not be stored in close proximity to oxygen cylinders.

Care should be exercised to prevent leaks from gas cylinders and lines and also to avoid sources of ignition.

Only trained personnel should undertake work involving gas cylinders.

General Workshop Tools and Equipment

It is essential that all tools and equipment are maintained in good condition and the correct safety equipment is used where required.

Never use tools or equipment for any purpose other than that for which they were designed. Never overload equipment such as hoists, jacks, axle and chassis stands or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure the next time that the equipment is used.

Do not use damaged or defective tools or equipment, particularly high speed equipment such as grinding wheels. A damaged grinding wheel can disintegrate without warning and cause serious injury.

Wear suitable eye protection when using grinding, chiselling or sand blasting equipment.

Wear a suitable breathing mask when using abrasive blasting equipment or using spraying equipment.

Make sure there is adequate ventilation to control dusts, mists and fumes.

High Pressure Air, Lubrication and Oil Test Equipment

Always keep high pressure equipment in good condition, and regularly maintained, particularly at joints and unions.

Never direct a high pressure nozzle, for example diesel injector, at the skin as the fluid may penetrate to the underlying tissue and cause serious injury.

Jacking

Always refer to the Jacking and Lifting section of this manual prior to raising the vehicle off the ground.

When vehicle is to be raised by means of a jack, ensure that it is standing on level ground, that parking brake is applied and wheels are chocked. ALWAYS use the recommended jacking points and ensure that vehicle jack has sufficient load capacity for the weight of the vehicle.



WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Ensure that hoists have sufficient load capacity for the weight of the vehicle.

Legal Aspects

There are many laws and regulations relating to health and safety in the use and disposal of materials and equipment in a workshop.

For a safe working environment and to avoid environmental pollution, workshops should be familiar, in detail, with the many health and safety laws and regulations within their country, published by both national and local authorities.

Lubricants and Greases

Avoid all prolonged and repeated contact with mineral oils. All lubricants and greases may be irritating to the eyes and skin.

Used Engine Oil

Prolonged and repeated contact with engine oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities must be provided.

Do not employ used engine oils as lubricants or for any application where appreciable skin contact is likely to occur.

Health Protection Precautions

- Avoid prolonged and repeated contact with oils, particularly used engine oils.
- Wear protective clothing, including impervious gloves where practicable.
- Do not put oily rags into pockets.
- Avoid contaminating clothes, particularly underpants, with oil.
- Heavily soiled clothing and oil-impregnated footwear should not be worn. Overalls must be cleaned regularly.
- First Aid treatment should be obtained immediately for open cuts and wounds.
- Use barrier creams, applying them before each work period, to help the removal of oil from the skin.
- Wash with soap and water to make sure all oil is removed (skin cleansers and nail brushes will help). Preparations containing lanoline replace the natural skin oils which have been removed.
- Do not use gasoline (petrol), kerosene (paraffin), diesel fuel (gas oil), thinners or solvents for cleaning skin.
- If skin disorders develop, obtain medical advice without delay.
- Where practicable, degrease components prior to handling.
- Where there is a risk of eye contact, eye protection should be worn, for example chemical goggles or face shields; in addition an eye wash facility should be provided.

Environmental Precautions

This section provides general information which can help to reduce the environmental impacts from the activities carried out in workshops.

Emissions to air

Many of the activities that are carried out in workshops emit gases and fumes which can contribute to global warming, depletion of the ozone layer and/or the formation of photochemical smog at ground level. By considering how the workshop activities are carried out, these gases and fumes can be minimised, thus reducing the impact on the environment.

Exhaust fumes

Running car engines is an essential part of workshop activities and exhaust fumes need to be ventilated to atmosphere. However, the amount of time engines are running and the position of the vehicle should be carefully considered at all times, to reduce the release of poisonous gases and minimise the inconvenience to people living nearby.

Solvents

Some of the cleaning agents used are solvent based and will evaporate rapidly to atmosphere if used carelessly, or if containers are left unsealed. All containers must be firmly closed when not required and solvent should be used sparingly. Wherever possible, solvents having a low toxicity and flammability should be selected. Always follow the instructions supplied by the solvent manufacturer. Similarly, many paints are solvent based and the spray should be used in such a way as to reduce emissions to a minimum.

Refrigerant

It is illegal to release any refrigerant into the atmosphere. Discharge and replacement of these materials from air conditioning units should only be carried out using the appropriate equipment.

Discharges to water

Most workshops will have two systems for discharging waste water - storm drains and foul drains. Storm drains should only receive clean water i.e. rainwater. Foul drains will accept many of the normal waste water i.e. washing water, detergents and domestic type waste BUT NOT oil, petrol, solvent, acids, hydraulic fluid, antifreeze and similar fluids. If in doubt, always consult the local authority or water company.

Spillages

Every precaution must be taken to prevent spillage of oil, fuel, solvents etc., reaching the drains. All handling of such materials must take place well away from drains and preferably in an area with a suitable containing wall to prevent discharge into drains or watercourses. If a spillage occurs, it must be soaked up immediately using a spill kit where provided.

Checklist

Spillage prevention:

- Store liquids in a secure area.
- Make sure that taps on liquid containers are secure and cannot be accidentally turned on.
- Protect bulk storage tanks from vandalism by locking the valves.
- Transfer liquids from one container to another in an area away from open drains.
- Ensure lids are replaced securely on containers.
- Have spill kits available near to points of storage and liquid handling areas.

Spill Kits

Special materials are available to absorb a number of different substances. They can be in granular form, ready to use and are supplied in suitable containers. Disposal of used spill absorbing material is dealt with in Waste management.

Land contamination

Oils, fuels and solvents etc. can contaminate any soil with which they come into contact. Such materials MUST never be disposed of by pouring on to soil and every precaution must be taken to avoid spillage reaching soil. Waste materials

stored on open ground could either leak or have contaminating substances washed off them that would contaminate the land. Always store these materials in suitable skips or similarly robust containers.

Legal compliance

Some sites may have a discharge consent for effluent discharge to the foul drain for a car wash etc. It is essential to know the types of effluent which are allowed to be discharged into the drain and to check the results of any monitoring carried out by the Water Company.

Where paint spraying operations are carried out it may be necessary to apply to the Local Authority for an air emissions licence to operate the plant. If such a licence is necessary, additional precautions will be necessary to comply with the requirements and the results of any air quality monitoring must be checked regularly.

Checklist

Always adhere to the following:

- Know what legal consents and licences apply to the operations.
- Check that the emissions and discharges comply with legal requirements.

Waste Management

Pollution can be reduced by careful handling, storage and disposal of all waste materials that occur on sites. Legislation makes it illegal to dispose of waste materials other than to licensed waste carriers and disposal sites.

This means that it is necessary to not only know what the waste materials are but also to have the necessary documentation and licences.

Handling and storage of waste

Ensure that waste materials are not poured down the drain or on to soil and are stored in such a way that they do not escape on to land or soil.

All waste must be segregated into individual types e.g. oils, metals, batteries, scrap components etc. This will prevent any reaction between different materials and assist in disposal.

Disposal of waste

Dispose of waste in accordance with the following guidelines:

- **Fuel, hydraulic fluid, anti-freeze and oil:** Keep separate and dispose of to specialist contractors.
- **Refrigerant:** Collect in specialist equipment and reuse.
- **Detergents:** Safe to pour down the foul drain if diluted.
- **Paint, thinners:** Keep separate and dispose of to specialist contractor.
- **Components:** Return to supplier for refurbishment or disassemble and reuse any suitable parts. Dispose of remainder in ordinary waste.
- **Small parts:** Reuse any suitable parts, dispose of the remainder in ordinary waste.
- **Metals:** Can be sold if separate from general waste.
- **Tyres:** Keep separate and dispose of to specialist contractor. DO NOT attempt to dispose of tyres by burning.
- **Components/materials containing asbestos:** Keep separate and dispose of to specialist contractor.
- **Oil and fuel wastes (e.g. rags, used spill kit material):** Keep separate and dispose of to specialist contractors.
- **Air filters:** Keep separate and dispose of to specialist contractors.
- **Rubber/plastics:** Dispose of in ordinary waste.
- **Hoses:** Dispose of in ordinary waste.
- **Batteries:** Keep separate and dispose of to specialist contractors.
- **Air bags - DANGER EXPLOSIVES:** Keep separate and dispose of to specialist contractors.
- **Electrical components:** Return to supplier for refurbishment or disassemble and reuse any suitable components. Dispose of remainder in ordinary waste.
- **Catalytic converters:** May be sold if kept separate from general waste.
- **Packaging:** Compact/recycle as much as possible and dispose of in ordinary waste.
- **Office/paper waste:** Recycle paper and toner and ink cartridges, dispose of remainder in ordinary waste.

Noise

Car alarm testing, panel beating, running engines, using air tools etc. are operations which invariably produce a large amount of noise. The location of such activities and also the time of day must be carefully considered having regard to the proximity of houses schools etc.

Some operations may produce high noise levels which could, in time, damage hearing. In these cases, suitable ear protection must be worn.

Solder

Solders are mixtures of metals such that the melting point of the mixture is below that of the constituent metals (normally lead and tin). Solder application does not normally give rise to toxic lead fumes, provided a gas/air flame is used. Oxy-acetylene flames should not be used, as they are much hotter and will cause lead fumes to be produced.

Some fumes may be produced by the application of any flame to surfaces coated with grease, and inhalation of these should be avoided.

Removal of excess solder should be undertaken with care, to make sure that fine lead dust is not produced, which can give toxic effects if inhaled. Respiratory protection may be necessary.

Solder spillage and filings should be collected and removed promptly to prevent general air contamination by lead.

High standards of personal hygiene are necessary in order to avoid ingestion of lead or inhalation of solder dust from clothing.

Solvents

For example acetone, white spirit, toluene, xylene, trichloroethane.

Used in cleaning and dewaxing materials, paints, plastics, resins and thinners.

Some may be highly flammable or flammable.

Skin contact will degrease the skin and may result in irritation and dermatitis following repeated or prolonged contact. Some can be absorbed through the skin in toxic or harmful quantities.

Splashes in the eye may cause severe irritation and could lead to loss of vision.

Brief exposure of high concentrations of vapors or mists will cause eye and throat irritation, drowsiness, dizziness, headaches and, in the worst circumstances, unconsciousness.

Repeated or prolonged exposure to excessive but lower concentrations of vapors or mists, for which there might not be adequate warning indications, can cause more serious toxic or harmful effects.

Aspiration into the lungs, for example through vomiting, is the most serious consequence of swallowing.

Avoid splashes to the skin, eyes and clothing. Wear protective gloves, goggles and clothing if necessary.

Make sure there is good ventilation when in use, avoid breathing fumes, vapors and spray mists and keep containers tightly sealed. Do not use in confined spaces.

When spraying materials containing solvents, for example paints, adhesives, and metal coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.

Do not apply heat or flame except under specific and detailed manufacturers instructions.

Suspended Loads



CAUTION: Never improvise lifting tackle.

There is always a danger when loads are lifted or suspended. Never work under an unsupported, suspended or raised load, for example a suspended engine.

Always make sure that lifting equipment such as jacks, hoists, axle stands and slings are adequate and suitable for the job, in good condition and regularly maintained.

Viton

In common with many other manufacturers vehicles, some components installed to Land Rover vehicles have seals, 'O' rings or gaskets which contain a material known as 'Viton'.

Viton is a fluoroelastomer, that is a synthetic rubber type which contains Fluorine. Although Viton is the most well known fluoroelastomer, there are others, including Fluorel and Tecnoflon.

When used under design conditions fluoroelastomers are perfectly safe. If, however, they are exposed to temperatures in excess of 400°C, the material will not burn, but will decompose, and one of the products formed is hydrofluoric acid.

This acid is extremely corrosive and may be absorbed directly, through contact, into the general body system. **WHERE CASES OF SKIN CONTACT OCCUR, SEEK IMMEDIATE MEDICAL HELP.**

O-rings, seals or gaskets which have been exposed to very high temperatures will appear charred or as a black sticky substance.

DO NOT, under any circumstances touch them or the attached components.

Enquiries should be made to determine whether Viton or any other fluoroelastomer has been used in the affected O-ring, seal or gasket. If they are of natural rubber or nitrile there is no hazard. If in doubt, be cautious as the material may be Viton or any fluoroelastomer.

If Viton or any other fluoroelastomers have been used, the affected area should be decontaminated before the

commencement of work.

Disposable heavy duty plastic gloves should be worn at all times, and the affected area washed down using wire wool and a limewater (calcium hydroxide) solution to neutralise the acid before disposing of the decomposed Viton residue and final cleaning of the area. After use, the plastic gloves should be discarded carefully and safely.

Welding

Welding processes include Resistance Welding (Spot Welding), Arc Welding and Gas Welding.

Resistance Welding

This process may cause particles of molten metal to be emitted at a high velocity, and the eyes and skin must be protected.

Arc Welding

This process emits a high level of ultra-violet radiation which may cause arc-eye and skin burns to the operator and to other persons nearby. Gas-shielded welding processes are particularly hazardous in this respect. Personal protection must be worn, and screens used to shield other people.

CONTACT LENS WEARERS ARE ADVISED TO REVERT TO ORDINARY SPECTACLES WHEN ARC WELDING as the arc spectrum is believed to emit microwaves which dry out the fluid between the lens and the eye. This may result in blindness when the lens is removed from the eye.

Metal spatter will also occur, and appropriate eye and skin protection is necessary.

The heat of the welding arc will produce fumes and gases from the metals being welded, the rods and from any applied coatings or contamination on the surfaces being worked on. These gases and fumes may be toxic and inhalation of these should be avoided. The use of extraction ventilation to remove the fumes from the working area may be necessary particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases or confined spaces where adequate ventilation cannot be provided, air-fed respirators may be necessary.



CAUTION: Some of the components installed to the vehicle e.g. the interior cross beam and underbonnet cross member are manufactured from magnesium alloy. On no account should any welding operations be attempted on these components.

Gas Welding (and Cutting)

Oxy-acetylene torches may be used for welding and cutting, and special care must be taken to prevent leakage of these gases, with consequent risk of fire and explosion.

The process will produce metal spatter and eye and skin protection is necessary.

The flame is bright, and eye protection should be used, but the ultra-violet emission is much less than that from arc welding, and lighter filters may be used.

The process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged body parts, and inhalation of the fumes should be avoided.

In brazing, toxic fumes may be produced from the metals in the brazing rod, and a severe hazard may arise if brazing rods containing cadmium are used. In this event particular care must be taken to avoid inhalation of fumes and expert advice may be required.

SPECIAL PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING TAKES PLACE ON VESSELS WHICH HAVE CONTAINED COMBUSTIBLE MATERIALS, FOR EXAMPLE BOILING OR STEAMING OUT OF FUEL TANKS.

Warning Symbols on Vehicles

Decals showing warning symbols will be found on various vehicle components.

These decals must not be removed. The warnings are for the attention of owners/operators and persons carrying out service or repair operations on the vehicle.

General Information - Solvents, Sealants and Adhesives

Description and Operation

Solvents



WARNING: Always handle all solvents, sealers and adhesives with extreme care. Some contain chemicals or give off fumes which can be dangerous to health. Always follow the manufacturers instructions. If in doubt about any substance, particularly a solvent, DO NOT use it.



CAUTION: If in doubt about the suitability of any proprietary solvent or sealer for a particular application, contact the manufacturer of the product for information.

The Health and Safety Precautions subsection refers to some commonly used chemicals and materials, hazards associated with their use, and safety measures to be taken. Some of these chemicals may be included as an ingredient in a sealer or adhesive.

Sealers

Certain procedures in this manual involve the use of sealants during installation of components. Where a sealant is required, the application, together with the Land Rover part number is given in the General Specification at the start of each section and an instruction that a sealant must be used appears in the relevant repair procedure.

It is essential that the sealant(s) specified for a particular procedure are used, DO NOT use any other sealant.

Always remove traces of old sealant using a plastic scraper or suitable solvent, never use emery cloth or metal scrapers.

Adhesives

Whenever a procedure involves the use of an adhesive, the adhesive specified must be used and the manufacturer's instructions regarding application together with any health and safety precautions must be followed.

General Information - Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions

Description and Operation

• WARNINGS:



Fuel may not give adequate warning before toxic or harmful effects arise.



Exposure to fuel can be harmful and can cause severe health damage or death.



Extreme care must be exercised when handling hot fluids. Always wash off spilled fluids from affected areas of skin immediately.



Highly flammable mixtures are always present and may ignite when working on fuel systems. Do not allow naked flames, sparks or lighted substances to come near fuel related components.



Fuel must not be used as a cleaning agent.



Keep fuel containers tightly closed, out of direct sunlight and in a cool area. Keep away from heat sources, ignition sources and oxidizing agents.



SKIN CONTACT: Excessive or prolonged skin contact with diesel fuel may cause serious skin disorders including skin cancer.



SKIN CONTACT: Fuel is mildly irritating to the skin and may cause dermatitis due to defatting effect. Remove contaminated clothing. Wash affected areas of skin with soap and water. Seek medical attention for any persistent skin irritation or abnormality. Wash contaminated clothing before reuse.



EYE CONTACT: Fuel is mildly irritating to the eyes. Flush with plenty of running water, blinking as often as possible. Do not force the eyelid open. Seek medical attention for any persistent eye irritation or abnormality.



SWALLOWED: Fuel is moderately toxic and tends to foam on vomiting. If drawn into the lungs, inflammation may develop. Do not induce vomiting. If spontaneous vomiting occurs place the victim in a forward position to reduce the risk of fuel being drawn into the lungs. Give nothing by mouth. If breathing but unconscious, place in the recovery position. If breathing has stopped, apply artificial respiration. Seek immediate medical attention.



INHALED: Fuel is toxic to the respiratory and other body systems. Exposure may result in various symptoms including drowsiness, unconsciousness or severe health damage. Move a victim to fresh air. Keep a victim warm and at rest. If unconscious, place in the recovery position. If not breathing, apply artificial respiration. Give cardiac massage if necessary. Seek immediate medical attention.

• CAUTIONS:



Fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is essential that absolute cleanliness is observed when working with these components.



Make sure that the workshop area in which the vehicle is being worked on is as clean and as dust free as possible.

General Information - Road/Roller Testing

Description and Operation

Road or rolling road testing may be carried out for various reasons and a procedure detailing pre-test checks, through engine starting and stopping, pre-driving checks, on-test checks to final checks on completion of the test are given.

Unless complete vehicle performance is being checked, the full road test procedure need not be carried out. Instead, those items particularly relevant to the system(s) being checked can be extracted.

Pre-Test Checks



WARNING: If the brake system hydraulic fluid level is low, pedal travel is excessive or a hydraulic leak is found, do not attempt to road test the vehicle until the reason for the low fluid level, excessive pedal travel or hydraulic leak is found and rectified.

It is suggested that pre-test and functional tests of those systems/circuits which affect the safe and legal operations of the vehicle, such as brakes, lights and steering, should always be carried out before the road or rolling road test.

- Engine oil level
- Engine coolant level
- Tires, for correct pressure, compatible types and tread patterns, and wear within limits.
- There is sufficient fuel in the tank to complete the test.
- Check all around the engine, transmission and under the vehicle for oil, coolant, hydraulic and fuel leaks. Make a note of any apparent leaks and wipe off the surrounding areas to make it easier to identify the extent of the leak on completion of the test.

Starting the Engine

• **NOTE:** On initial drive away from cold and within the first 1.5 km (1 mile), do not depress accelerator pedal beyond half travel until the vehicle has attained a minimum speed of 25 km/h (15 miles/h). Never operate at high engine speed or with the accelerator pedal at full travel whilst the engine is cold.

With the ignition switched off, check:

- The parking brake is applied.
- **Manual gearbox:** The gear lever is in neutral.
- **Automatic gearbox:** The selector lever is in 'P' - Park
- **Transfer box:** 'H' - High is selected
- All instrument gauges read zero.

With the ignition switched on, check:

- Ignition controlled warning lights come on.
- Engine temperature gauge registers a reading compatible with the engine temperature.
- Fuel gauge registers a reading appropriate to the fuel level in the tank.
- The operation of the parking brake warning light and fluid level warning indicator light.

On Road Test Check:



CAUTION: At commencement of road testing, check the brake operation while still travelling at low speed before continuing with the test. If the brakes pull to one side, or appear to be otherwise faulty, do not continue with the road test until the fault has been found and rectified.

- **Manual gearbox:** Clutch pedal operation is not stiff or heavy.
- **Manual gearbox:** Initial gear engagement is smooth and there is no evidence of clutch drag.
- The parking brake releases completely.
- **Manual gearbox:** Clutch takes up the drive smoothly, without slip or judder.
- Gear changing is smooth, and there are no abnormal noises or vibrations from the gearbox.
- The engine power output is satisfactory, acceleration is smooth and accelerator pedal operation is not stiff or heavy, and engine speed returns to idle correctly.
- There is no excessive or abnormally colored smoke from the engine under normal driving, heavy load or overrun conditions.
- Steering operation is smooth, accurate, not excessively heavy or with excessive free play or vibration. Does not pull to one side and self centres smoothly after cornering.
- All instruments register the correct readings and operate correctly.
- Switches and controls operate smoothly and positively, warning or indicator lights operate correctly and the direction indicator control self cancels when the steering is returned to the straight ahead position.
- Heating and ventilation systems work correctly and effectively.
- Brakes operate efficiently.

Brake Testing

Avoid brake testing on busy roads where it can cause inconvenience or danger to other road users.



CAUTION: Brake testing which includes heavy brake applications should not be carried out with new brake pads/discs until the components have bedded-in. New brake friction components will not reach full efficiency until the bedding-in process is complete. Note that when new parking brake shoes or rear brake discs have been fitted, it is essential that the 'bedding-in' procedure given in Section 206-05 - Parking Brake Removal and Installation is carried out.

Test the brakes at several speeds within the normal operating range using both light and heavy pedal pressure. Note any tendency to snatch, pull or drag, and any undue delay in application or release.

Allow the vehicle to coast and note any tendency to pull to one side, or evidence that the brakes are binding.

After stopping the vehicle (not immediately after a period of heavy braking), carefully check the brake temperature. A disc which feels appreciably hotter than the others, could indicate that the pads on that disc are binding.

After completion of the test, check for:

- Oil, coolant, hydraulic, air and fuel leaks.
- Abnormal temperature of any moving components or assemblies, e.g. wheel hubs, transmission etc., which might indicate over tightness or lack of lubrication.

Rolling Road Testing

Four-Wheel Rolling Road



WARNING: Do not operate the footbrake or parking brake whilst the rollers are driving the road wheels. Ensure that once disconnected, propeller shafts are properly secured and clear of all moving components.

Provided that front and rear rollers are rotating at identical speeds and that normal workshop safety standards are applied, there is no speed restriction during testing except any that may apply to the tires.

Ensure that the parking brake is released prior to engaging roller driving mechanism.

Two-Wheel Rolling Road



CAUTION: On no account should an attempt be made to carry out any form of testing on a two-wheel rolling road.

Two-wheel rolling road testing must not be performed on this vehicle.

General Information - Special Tool Glossary

Description and Operation

Service Tools

Special service tools have been developed to facilitate removal, dismantling and assembly of mechanical components in a cost effective and time efficient manner. The use of such special tools also helps prevent the potential for damage to components.

Some operations described in this manual cannot be carried out properly without the aid of the relevant service tools.

All orders and enquiries from the United Kingdom and European countries except Germany, Austria, Switzerland and Spain and countries not in the following list should be sent direct to:

SPX UK Ltd.,

Genoa House,

Everdon Park,

Daventry,

Northants,

NN11 5YJ

England

Tel: 0044 (0) 1327 303467/303455

Fax: 0044 (0) 1327 706632

e-mail: spxsalesuk@servicesolutions.spx.com

Overseas orders for the following countries should be placed with the local distributor.

Germany, Austria and Switzerland

SPX Europe GMBH,

Porschestrasse 4,

63512 Hainburg,

Germany

Tel: 0049 61829590

Fax: 0049 6182959299

Spain

SPX Iberica SA,

C/Francisco Aritio,

158 nave 72 (Nudo Oeste),

19004 Guadalajara,

Spain

Tel: 0034 949208381

Fax: 0034 949208327

North America

SPX Corporation

665, Eisenhower Drive,

Owatonna,

MN 55060,

USA

Tel: 0018 772979110

Fax: 0018 005787375

Australia

SPX Australia,

28, Clayton Road,
Notting Hill,
Victoria 3168,
Australia

Tel: 0061 00395446222

Fax: 0061 00395445222

e-mail: sales@spx.com.au

Japan and East Asia

Jatek Ltd.,

5 - 53, Minawacho 2-chome,

Kohoku-ku,

Yokohama,

Kanagawa 223-0051,

Japan

Tel: 0081 455627700

Fax: 0081 455627800

General Information - Diagnostic Trouble Code (DTC) Index **DTC: Air Suspension Control Module (RLM)**

Description and Operation

Air Suspension Control Module (RLM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Air Suspension Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Vehicle Dynamic Suspension](#) (204-05 Vehicle Dynamic Suspension, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1A84-55	Car Configuration Data - not configured	<ul style="list-style-type: none"> System not configured - Data does not match that expected for specification Incorrect software version loaded 	<ul style="list-style-type: none"> Configure the Car Configuration File (CCF) using the approved diagnostic system. Ensure the Air Suspension Control Module software is the correct version (available from the Global Technical Reference web-site). Clear the DTC and test for normal operation
C112F-72	Air Spring Valve - actuator stuck open	<ul style="list-style-type: none"> Corner valve stuck open (fully or partially) Vehicle driven while system in "Tight Tolerance" mode 	<ul style="list-style-type: none"> Where possible, refer to the guided diagnostic routine for this DTC on the approved diagnostic system. Complete corner valve checks. If necessary, clear tight tolerance mode. Clear the DTC and retest
C1130-66	Air Spring Air Supply - signal has too many transitions / events	<ul style="list-style-type: none"> Air spring leak Leak in air harness to air spring Corner valve leak to gallery Compressor assembly fault Vehicle driven while system in "Tight Tolerance" mode 	<ul style="list-style-type: none"> Visually inspect the system for air leakage. Where possible, refer to the guided diagnostic routine for this DTC on the approved diagnostic system
C1130-7A	Air Spring Air Supply - fluid leak or seal failure	<ul style="list-style-type: none"> Detached or burst air pipe Leaking air spring or pipe to air spring (large leak) Loose pipe connection Insufficient pressure from compressor Height sensor fault 	<ul style="list-style-type: none"> Visually inspect the system for an excessive air leak. Check the height sensor linkage(s) for damage/restrictions. Visually inspect the air harness for evidence of melting, crushing, kinking or collapsing. Where possible, refer to the guided diagnostic routine for this DTC on the approved diagnostic system
C1131-92	Air Supply - performance or incorrect operation	<ul style="list-style-type: none"> Loose or burst air pipe Detached air pipe Leaking pipe from reservoir valve block to air supply unit or either axle valve block Insufficient pressure from compressor Reservoir valve block piped incorrectly 	<ul style="list-style-type: none"> Visually inspect the system for air leakage. Check the reservoir valve block pipes for correct routing and installation
C1A01-19	LED - circuit current above threshold	<ul style="list-style-type: none"> Switch pack LED circuit current above threshold LED cathode (negative) connection shorted to positive One or more LEDs short circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the LED_NEG circuit between the air suspension control module and switch pack for short circuit to battery. Repair as necessary. Clear the DTC and test for normal operation. If the DTC is still logged suspect the switch pack

General Information - Diagnostic Trouble Code (DTC) Index DTC: Anti-Lock Braking System (ABS)

Description and Operation

Anti-Lock Braking System (ABS)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the ABS Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
C0030-38	Left Front Tone Wheel - Signal frequency incorrect	<ul style="list-style-type: none"> Signal frequency incorrect Damaged ABS sensor ring 	Check front left wheel speed sensor ring for missing teeth or damage. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0031-14	Left Front Wheel Speed Sensor - Circuit short to ground or open	<ul style="list-style-type: none"> Sensor short circuit to ground or open circuit Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module
C0031-25	Left Front Wheel Speed Sensor - Signal shape/waveform failure	<ul style="list-style-type: none"> Sensor short circuit to ground Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0031-2F	Left Front Wheel Speed Sensor - Signal erratic	<ul style="list-style-type: none"> Sensor circuit fault Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0031-31	Left Front Wheel Speed Sensor - No signal	<ul style="list-style-type: none"> No sensor signal Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0031-62	Left Front Wheel Speed Sensor - Signal compare failure	<ul style="list-style-type: none"> Sensor signal compare failure Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on

DTC	Description	Possible Causes	Action
C0031-64	Left Front Wheel Speed Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module
C0033-38	Right Front Tone Wheel - Signal frequency incorrect	<ul style="list-style-type: none"> ● Signal frequency incorrect ● Damaged ABS sensor ring 	Check front right wheel speed sensor ring for missing teeth or damage. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0034-14	Right Front Wheel Speed Sensor - Circuit short to ground or open	<ul style="list-style-type: none"> ● Sensor short circuit to ground or open ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0034-25	Right Front Wheel Speed Sensor - Signal shape/waveform failure	<ul style="list-style-type: none"> ● Sensor signal shape / waveform failure ● Sensor short circuit to ground ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0034-2F	Right Front Wheel Speed Sensor - Signal erratic	<ul style="list-style-type: none"> ● Sensor signal erratic ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0034-31	Right Front Wheel Speed Sensor - No signal	<ul style="list-style-type: none"> ● No sensor signal ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0034-62	Right Front Wheel Speed Sensor - Signal compare failure	<ul style="list-style-type: none"> ● Sensor signal compare failure ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0034-64	Right Front Wheel Speed Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module
C0036-38	Left Rear Tone Wheel - Signal frequency incorrect	<ul style="list-style-type: none"> ● Signal frequency incorrect ● Damaged ABS sensor ring 	Check rear left wheel speed sensor ring for missing teeth or damage. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0037-14	Left Rear Wheel Speed Sensor - Circuit short to ground or open	<ul style="list-style-type: none"> ● Sensor short circuit to ground or open circuit ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module
C0037-25	Left Rear Wheel Speed Sensor - Signal shape/waveform failure	<ul style="list-style-type: none"> ● Sensor signal shape / waveform failure ● Sensor short circuit to ground ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on

DTC	Description	Possible Causes	Action
C0037-2F	Left Rear Wheel Speed Sensor - Signal erratic	<ul style="list-style-type: none"> ● Sensor signal erratic ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0037-31	Left Rear Wheel Speed Sensor - No signal	<ul style="list-style-type: none"> ● No sensor signal ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0037-62	Left Rear Wheel Speed Sensor - Signal compare failure	<ul style="list-style-type: none"> ● Sensor signal compare failure ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0037-64	Left Rear Wheel Speed Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module
C0039-38	Right Rear Tone Wheel - Signal frequency incorrect	<ul style="list-style-type: none"> ● Signal frequency incorrect ● Damaged ABS sensor ring 	Check rear right wheel speed sensor ring for missing teeth or damage. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C003A-14	Right Rear Wheel Speed Sensor - Circuit short to ground or open	<ul style="list-style-type: none"> ● Sensor short circuit to ground or open circuit ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module
C003A-25	Right Rear Wheel Speed Sensor - Signal shape/waveform failure	<ul style="list-style-type: none"> ● Sensor signal shape / waveform failure ● Sensor short circuit to ground ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C003A-2F	Right Rear Wheel Speed Sensor - Signal erratic	<ul style="list-style-type: none"> ● Sensor signal erratic ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C003A-31	Right Rear Wheel Speed Sensor - No signal	<ul style="list-style-type: none"> ● No sensor signal ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C003A-62	Right Rear Wheel Speed Sensor - Signal compare failure	<ul style="list-style-type: none"> ● Sensor signal compare failure ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C003A-64	Right Rear Wheel Speed Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure ● Sensor fault 	Check the sensor lead and connector for damage. If damaged, renew the sensor. Refer to the electrical circuit diagrams and check the circuit between the sensor and the ABS module

DTC	Description	Possible Causes	Action
C0051-28	Steering Wheel Position Sensor - Signal bias level out of range/zero adjustment failure	<ul style="list-style-type: none"> ● Signal bias level out of range/zero adjustment failure ● Incorrect angle sensor installed ● Wheel speed sensor wiring incorrectly wired across one axle ● Steering angle sensor fault 	Check for a correctly installed steering angle sensor. Refer to the electrical circuit diagrams and check the circuit between the wheel speed sensors and the ABS module to ensure the sensors on one axle are correctly wired to the correct control module left or right pin outs. Renew the steering angle sensor. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle (not always in a straight line) for at least 9 seconds to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0051-67	Steering Wheel Position Sensor - Signal incorrect after event	<ul style="list-style-type: none"> ● Sensor signal incorrect after event ● Steering angle sensor fault ● Control module software error 	Check for other DTCs that may aid diagnosis, especially in the steering angle sensor module. Renew the steering angle sensor. Clear the DTC and retest. If the problem persists, renew the ABS control module. Refer to the warranty policy and procedures manual if a module is suspect
C0062-28	Longitudinal Acceleration Sensor - Signal bias level out of range/zero adjustment failure	<ul style="list-style-type: none"> ● Sensor signal bias level out of range/zero adjustment failure ● Incorrectly installed sensor 	Check installation and mounting of sensor cluster. Clear the DTC and retest, if problem persists renew the sensor. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0062-54	Longitudinal Acceleration Sensor - Missing calibration	<ul style="list-style-type: none"> ● Sensor missing calibration ● Incorrect sensor installed ● Incorrectly configured sensor 	Ensure the correct sensor has been installed. Check mounting, connector and fuse of the sensor. Configure the sensor cluster using the manufacturers approved diagnostic system
C0062-64	Longitudinal Acceleration Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure ● Incorrectly installed sensor 	Clear the DTC and retest. Check mounting, connector and fuse of the sensor. Configure the sensor cluster using the manufacturers approved diagnostic system
C0063-14	Yaw Rate Sensor - Circuit short to ground or open	<ul style="list-style-type: none"> ● Sensor circuit short to ground or open ● Sensor fault 	The most likely cause of the fault is an open circuit on the harness. Refer to the electrical circuit diagrams and check the circuit between the sensor and the control module. Repair as necessary. Clear the DTC and retest. If the problem persists, renew the sensor
C0063-1C	Yaw Rate Sensor - Circuit voltage out of range	<ul style="list-style-type: none"> ● Sensor circuit voltage out of range 	Refer to the electrical circuit diagrams and check the sensor power supply circuit
C0063-27	Yaw Rate Sensor - Signal rate of change above threshold	<ul style="list-style-type: none"> ● Sensor circuit power supply fuse failure ● Sensor insecurely mounted ● Sensor fault ● Control module software error 	Refer to the electrical circuit diagrams and check the sensor power supply fuse. Check the yaw rate sensor connector condition. Ensure the sensor is correctly secured. If problem persists, renew the sensor. If the problem still persists, renew the ABS control module. Refer to the warranty policy and procedures manual if a module is suspect
C0063-28	Yaw Rate Sensor - Signal bias level out of range/zero adjustment failure	<ul style="list-style-type: none"> ● Sensor signal bias level out of range/zero adjustment failure ● Sensor insecurely mounted ● Sensor fault 	Ensure the sensor is correctly secured. If problem persists, renew the sensor
C0063-41	Yaw Rate Sensor - General checksum failure	<ul style="list-style-type: none"> ● Sensor general checksum failure ● Sensor fault ● Control module fault 	Renew the sensor. If the problem persists, renew the ABS control module. Refer to the warranty policy and procedures manual if a module is suspect
C0063-49	Yaw Rate Sensor - Internal electronic failure	<ul style="list-style-type: none"> ● Sensor internal electronic failure 	Clear the DTC and retest. If the problem persists, renew the sensor
C0063-4A	Yaw Rate Sensor - Incorrect component installed	<ul style="list-style-type: none"> ● Incorrect sensor installed 	Clear the DTC and retest. If the fault still exists renew the Yaw rate sensor with the suitable sensor cluster and repeat test cycle
C0063-64	Yaw Rate Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure - The sensor value is not within the expected range compared to the steering angle sensor. ● Sensor insecurely mounted 	<ul style="list-style-type: none"> • NOTE: This DTC can be set if the vehicle is being tested on chassis dyno rollers. <p>Ensure the sensor is correctly secured. Check that the steering angle sensor is correctly calibrated using the manufacturers recommended diagnostic system. If problem persists, renew the sensor. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 80kph (not always in a straight line) to ensure the lamps extinguish. When cycling the ignition,</p>

DTC	Description	Possible Causes	Action
			allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C0063-86	Yaw Rate Sensor - Signal invalid	<ul style="list-style-type: none"> ● Sensor signal invalid ● Incorrectly configured sensor 	Clear the DTC and retest. If the problem persists, renew the sensor
C0063-95	Yaw Rate Sensor - Incorrect assembly	<ul style="list-style-type: none"> ● Sensor incorrect assembly/internal sensor fault 	Ensure the correct sensor has been installed. Clear the DTC and retest. If the problem persists, renew the sensor. If the problem persists, renew the ABS control module. Refer to the warranty policy and procedures manual if a module is suspect
C0063-96	Yaw Rate Sensor - Component internal failure	<ul style="list-style-type: none"> ● Sensor power supply intermittent connection ● Sensor ground intermittent connection ● Sensor internal failure 	Refer to the electrical circuit diagrams and check the sensor power supply and ground connections to the sensor. Check the sensor connector and ABS module for security and integrity (water ingress of damaged pins). If the problem persists, renew the yaw rate sensor. Calibrate the new sensor using the manufacturers approved diagnostic system. If the fault returns after an ignition cycle, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
C0064-64	Roll Rate Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure ● Sensor insecurely mounted 	Ensure the sensor is correctly installed/secured. Clear DTC and Retest. If problem persists, renew the sensor
C006A-54	Multi-axis Acceleration Sensor - Missing calibration	<ul style="list-style-type: none"> ● Sensor missing calibration ● Serial number of yaw rate sensor saved in stored in control module memory does not match serial number of sensor ● Incorrect sensor installed ● Installed sensor not correctly calibrated 	Check that the correct sensor has been installed. Configure the sensor cluster using the manufacturers approved diagnostic system. If calibration fails several times, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
C0072-4B	Brake Temperature Too High - Over temperature	<ul style="list-style-type: none"> ● Excessive use of brakes ● Excessive use of traction control system 	This DTC is for information only. Clear the DTC
C101F-49	Generic Valve Failure - Internal electronic failure	<ul style="list-style-type: none"> ● ABS modulator internal fault 	Renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
C1109-24	Vehicle Dynamics Control Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high - DSC Switch operation fault - If the DSC switch is pressed for longer than 1 minute, the switch is deemed to be malfunctioning 	Check the switch operation. Refer to the electrical circuit diagrams and check the DSC switch and circuits. Check and install a new DSC switch as required
C1A77-16	Valve Relay Supply Circuit - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Circuit voltage below threshold ● Fuse ● Harness/connector damaged 	Refer to the electrical circuit diagrams and check the harness connection and fuse to the valve relay circuits
C1A90-12	Wheel Speed Sensor Supply - Circuit short to battery	<ul style="list-style-type: none"> ● Wheel speed sensor supply circuit short circuit to power 	Refer to the electrical circuit diagrams and check the wheel speed sensor power supply line circuits between the sensors and the control module
C1A95-4A	Wheel Speed Sensor - Incorrect component installed	<ul style="list-style-type: none"> ● The incorrect wheel speed sensor has been installed 	Check the correct wheel speed sensors are installed. Clear the DTC and retest
C1A95-64	Wheel Speed Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure ● Wheel speed sensor fault (any) ● Sensor ring damaged, incorrect or defective ● Harness fault ● Incorrect wheel/tire assembly size 	Check for correct wheel/tire sizes. Check the wheel speed sensors and circuits for damage. Remove the sensor and visually inspect the sensor ring on the constant velocity joint (CVJ) for missing or damaged teeth. If the sensor ring is damaged, renew the CVJ. Use an oscilloscope to examine the signals from all wheel speed sensors for abnormal high frequencies (modulation and peak signals). Renew sensors as necessary. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph for at least 30 seconds to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on

DTC	Description	Possible Causes	Action
C1A96-64	Brake Light Switch - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure ● Stop lamp switch fault ● Harness/connector issue 	Check the Stop lamp function. Ensure the brake lamp switch is correctly installed and configured. Refer to the electrical circuit diagrams and check the stop lamp switch circuit, rectify as necessary. Check the engine control module for DTCs. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph with at least one brake pedal press to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C1A97-24	Lateral Accelerometer - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Yaw rate/lateral acceleration sensor internal error 	Renew the combined lateral acceleration/yaw rate sensor
C1A98-2F	Yaw Rate Sensor - Signal erratic	<ul style="list-style-type: none"> ● Yaw rate sensor signal fault for 2 minutes 	Information only, regard as normal operation. Clear the DTC, cycle the ignition and retest. If the fault reoccurs, renew the combined lateral acceleration/yaw rate sensor. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C1A98-96	Yaw Rate Sensor - Component internal failure	<ul style="list-style-type: none"> ● Incorrect assembly ● Sensor installation incorrect ● Yaw rate/lateral acceleration sensor internal error 	Check the combined lateral acceleration/yaw rate sensor installation and orientation. Check mounting, connector and fuse of the sensor. Clear the DTC and retest. If the problem persists, renew the combined lateral acceleration/yaw rate sensor
C1B00-29	Steering Angle Sensor - Signal invalid	<ul style="list-style-type: none"> ● Sensor signal invalid ● Sensor installation incorrect ● steering angle sensor fault 	Check steering angle sensor module for DTCs. Check the steering angle sensor installation and orientation. Clear the DTC and retest. If the problem persists, renew the sensor
C1B00-49	Steering Angle Sensor - Internal electronic failure	<ul style="list-style-type: none"> ● Sensor internal electronic failure 	Check steering angle sensor module for DTCs. Renew the sensor
C1B00-64	Steering Angle Sensor - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor signal plausibility failure ● Sensor installation incorrect ● steering angle sensor fault ● Yaw rate sensor installation incorrect 	Check steering angle sensor module for DTCs. Check the steering angle sensor installation and orientation. Check the yaw rate sensor installation and orientation. Clear the DTC and retest. If the problem persists, renew the steering angle sensor
C1B00-92	Steering Angle Sensor - Performance or incorrect operation	<ul style="list-style-type: none"> ● Sensor performance or incorrect operation ● Sensor installation incorrect ● steering angle sensor fault 	Check steering angle sensor module for DTCs. Check the steering angle sensor installation and orientation. Check the yaw rate sensor installation and orientation. Clear the DTC and retest. If the problem persists, renew the steering angle sensor
C1B02-16	Return Pump - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Return pump circuit voltage below threshold ● Harness damaged ● Defective fuse 	Refer to the electrical circuit diagrams and check the circuit, fuses and the connection to the ABS module. Rectify as necessary. After rectification, either clear the DTCs and cycle the ignition or cycle the ignition and drive the vehicle above 15kph to ensure the lamps extinguish. When cycling the ignition, allow sufficient time for the 'P' symbol illumination to extinguish on the gear shifter (if installed) before returning the ignition state to on
C1B02-49	Return Pump - Internal electronic failure	<ul style="list-style-type: none"> ● ABS control module internal electronic failure 	Renew the ABS modulator. Refer to the warranty policy and procedures manual if a module is suspect
C1B22-24	Hill Descent Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high - If the HDC switch is pressed for longer than 1 minute, this DTC may be logged. ● Harness/connector issue 	Check the switch operation. Refer to the electrical circuit diagrams and check the switch and circuit for short to power
C2009-64	Front Axle Wheel Speed Sensors Swapped - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor location swapped 	Swap the front wheel speed sensor locations. Clear the DTC and retest. In order to clear the DTC/warning lamp after fault is rectified, the vehicle must be driven above 15km/h
C200A-64	Rear Axle Wheel Speed Sensors Swapped - Signal plausibility failure	<ul style="list-style-type: none"> ● Sensor location swapped 	Swap the rear wheel speed sensor locations. Clear the DTC and retest. In order to clear the DTC/warning lamp after fault is rectified, the vehicle must be driven above 15km/h

DTC	Description	Possible Causes	Action
U0001-88	High Speed CAN Communication Bus - Bus off	<ul style="list-style-type: none"> ● Bus off 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0074-88	Control Module Communication Bus "B" Off - Bus off	<ul style="list-style-type: none"> ● CAN Bus off 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0100-00	Lost Communication With ECM/PCM "A" - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the engine control module and traction control module
U0101-00	Lost Communication With TCM - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the transmission control module and traction control module
U0102-00	Lost Communication With Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the transfer case control module and traction control module
U0103-00	Lost Communication With Gear Shift Control Module A - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the gear shift control module and traction control module
U0104-00	Lost Communication With Cruise Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the cruise control module and traction control module
U0123-00	Lost Communication With Yaw Rate Sensor Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the yaw rate sensor control module and traction control module
U0126-00	Lost Communication With Steering Angle Sensor Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the steering angle sensor module and traction control module
U0128-00	Lost Communication With Park Brake Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the park brake control module and traction control module
U0132-00	Lost Communication With Suspension Control Module "A" - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the suspension control module and traction control module
U0133-00	Lost Communication With Active Roll Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the active roll control module and traction control module
U0136-00	Lost Communication With Differential Control Module - Rear - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the differential control module and traction control module
U0138-00	Lost Communication With All Terrain Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the all terrain control module and traction control module

DTC	Description	Possible Causes	Action
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and traction control module
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> Control module has been installed to the incorrect vehicle 	Ensure the correct module is installed
U0401-68	Invalid Data Received from ECM/PCM A - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the engine control module for related DTCs and refer to the relevant DTC index
U0402-68	Invalid Data Received from TCM - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the transmission control module for related DTCs and refer to the relevant DTC index
U0403-68	Invalid Data Received From Transfer Case Control Module - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the transfer case control module for related DTCs and refer to the relevant DTC index
U0404-68	Invalid Data Received From Gear Shift Control Module A - event information	<ul style="list-style-type: none"> Event information - transmission shift module related concern 	Check the transmission shift module for related DTCs and refer to the relevant DTC index
U0405-68	Invalid Data Received From Cruise Control Module - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the cruise control module for related DTCs and refer to the relevant DTC index
U0417-68	Invalid Data Received From Park Brake Control Module - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the park brake control module for related DTCs and refer to the relevant DTC index
U0421-68	Invalid Data Received from Suspension Control Module A - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the suspension control module for related DTCs and refer to the relevant DTC index
U0428-68	Invalid Data Received From Steering Angle Sensor Module - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the steering angle sensor control module for related DTCs and refer to the relevant DTC index
U0437-68	Invalid Data Received From Differential Control Module-Rear - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the differential control module for related DTCs and refer to the relevant DTC index
U0439-68	Invalid Data Received From All Terrain Control Module - Event information	<ul style="list-style-type: none"> Invalid data received 	Check the all terrain control module for related DTCs and refer to the relevant DTC index
U1A14-00	CAN Initialisation Failure - No sub type information	<ul style="list-style-type: none"> Incorrect control module installed to vehicle 	Check that the correct ABS module has been installed. Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> Car configuration file incorrectly configured Vehicle variant code value not supported in this project variant code value not released in this project variant code value out of range 	Configure the car configuration file using the manufacturers approved diagnostic system
U2101-68	Control Module Configuration Incompatible - Event information	<ul style="list-style-type: none"> Vehicle variant code distributed via CAN is not matching the code stored in the Central Junction Box memory ABS module has been installed from another vehicle (codes do not 	Check that the correct ABS module has been installed. Configure the car configuration file using the manufacturers approved diagnostic system

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> match expected) ● New ABS module has been installed and at first use code did not match (becomes historic after first use) 	
U3000-00	Control Module - No sub type information	<ul style="list-style-type: none"> ● Incorrect control module installed to vehicle 	Check that the correct ABS module has been installed. Refer to the electrical circuit diagrams and check the power and ground circuits to the component. Configure the module(s) using the manufacturers approved diagnostic system. Refer to the warranty policy and procedures manual if a module is suspect. Refer to the Network Communications section of the workshop manual
U3000-45	Control Module - Program memory failure	<ul style="list-style-type: none"> ● Program memory failure (software error) 	Clear the DTC and retest. Repeat for several times. If the problem persists, renew the ABS control module. Refer to the warranty policy and procedures manual if a module is suspect
U3000-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> ● Internal electronic failure 	Renew the ABS control module. Refer to the warranty policy and procedures manual if a module is suspect
U3000-4B	Control Module - Over temperature	<ul style="list-style-type: none"> ● Module over temperature has been detected ● Excessive ABS interaction has been invoked, possibly by diagnostic equipment 	Allow the unit to cool, clear the DTC and retest. If the problem persists, as a last resort renew the ABS control module. Consider environmental conditions before suspecting the module. Refer to the warranty policy and procedures manual if a module is suspect
U3000-53	Control Module - De-activated	<ul style="list-style-type: none"> ● Deactivated during software download to other modules on vehicle 	This is not a fault. ECU temporarily deactivated following programming session. Please cycle the ignition to clear
U3000-68	Control Module - Event information	<ul style="list-style-type: none"> ● Stability assist operation is in progress and this has been continuing for an unfeasible length of time 	Check for other related DTCs. Check the wheel speed sensors, combined yaw rate/lat Acc sensor and steering angle sensor
U3000-87	Control Module - Missing message	<ul style="list-style-type: none"> ● Car configuration file missing message 	Configure the car configuration file using the manufacturers approved diagnostic system
U3002-81	Vehicle Identification Number - Invalid serial data received	<ul style="list-style-type: none"> ● Invalid vehicle identification number 	Configure the car configuration file using the manufacturers approved diagnostic system
U3003-62	Battery Voltage - Signal compare failure	<ul style="list-style-type: none"> ● Signal compare failure 	Check the battery condition and state of charge. Check the vehicle charging system. Refer to the relevant workshop manual section
U3006-16	Control Module Input Power "A" - Circuit voltage below threshold	<ul style="list-style-type: none"> ● ABS control module circuit voltage below threshold ● Battery voltage low ● Battery ground cable: high resistance ● Battery connections loose/corroded ● Battery current drain 	Refer to the electrical circuit diagrams and check the module power and ground circuits. Check the battery condition and state of charge. Check the vehicle charging system. Refer to the relevant workshop manual section
U3006-17	Control Module Input Power "A" - Circuit voltage above threshold	<ul style="list-style-type: none"> ● ABS control module circuit voltage above threshold ● Charging system fault 	Check the battery condition and state of charge. Check the vehicle charging system. Refer to the relevant workshop manual section
U3006-1C	Control Module Input Power "A" - Circuit voltage out of range	<ul style="list-style-type: none"> ● ABS control module circuit voltage out of range, a momentary low voltage occurred 	Check the battery condition and state of charge. Check the vehicle charging system. Check the connector security to the module. Refer to the relevant workshop manual section

General Information - Diagnostic Trouble Code (DTC) Index **DTC: Audio Amplifier Module (AAM)**

Description and Operation

Audio Amplifier Module (AAM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Audio Amplifier Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1A00-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> Amplifier internal electrical failure (can be set in more than one module) Touch screen display (TSD) internal electrical failure (can be set in more than one module) 	Refer to the electrical guides and check the power and ground circuits to the module. Refer to the warranty policy and procedures manual if a module is suspect
B1A00-4B	Control Module - Over temperature	<ul style="list-style-type: none"> Amplifier shutdown requested (over-temperature) 	Clear the DTC and retest. Consider the atmospheric conditions before suspecting a module
B1A01-13	Speaker #1 - Circuit open	<ul style="list-style-type: none"> Left-hand rear door speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A01-1A	Speaker #1 - Circuit resistance below threshold	<ul style="list-style-type: none"> Left-hand rear door speaker circuit short circuit to ground Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A02-13	Speaker #2 - Circuit open	<ul style="list-style-type: none"> Right-hand rear door speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system.
B1A02-1A	Speaker #2 - Circuit resistance below threshold	<ul style="list-style-type: none"> Right-hand rear door speaker circuit short circuit to ground Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A03-13	Speaker #3 - Circuit open	<ul style="list-style-type: none"> Left-hand front mid/high range speaker circuit open circuit Left-hand door speaker circuit open circuit 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A03-1A	Speaker #3 - Circuit resistance below threshold	<ul style="list-style-type: none"> Left-hand door speaker circuit short circuit to ground Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A04-13	Speaker #4 - Circuit open	<ul style="list-style-type: none"> Right-hand front mid/high range speaker circuit open circuit Right-hand door speaker circuit open circuit 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A04-1A	Speaker #4 - Circuit resistance below threshold	<ul style="list-style-type: none"> Right-hand door speaker circuit short circuit to ground Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system

DTC	Description	Possible Causes	Action
B1A05-13	Speaker #5 - circuit open	<ul style="list-style-type: none"> ● Left-hand bass speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A05-1A	Speaker #5 - circuit resistance below threshold	<ul style="list-style-type: none"> ● Left-hand bass speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A05-13	Speaker #5 - Circuit open	<ul style="list-style-type: none"> ● Left-hand bass speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A05-1A	Speaker #5 - Circuit resistance below threshold	<ul style="list-style-type: none"> ● Left-hand bass speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A06-13	Speaker #6 - Circuit open	<ul style="list-style-type: none"> ● Right-hand bass speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A06-1A	Speaker #6 - Circuit resistance below threshold	<ul style="list-style-type: none"> ● Right-hand bass speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A07-13	Speaker #7 - Circuit open	<ul style="list-style-type: none"> ● Left-hand front bass speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A07-1A	Speaker #7 - Circuit resistance below threshold	<ul style="list-style-type: none"> ● Left-hand front bass speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A08-13	Speaker #8 - Circuit open	<ul style="list-style-type: none"> ● Right-hand front bass speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A08-1A	Speaker #8 - Circuit resistance below threshold	<ul style="list-style-type: none"> ● Right-hand front bass speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A09-13	Speaker #9 - Circuit open	<ul style="list-style-type: none"> ● Left-hand rear surround speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A09-1A	Speaker #9 - Circuit resistance below threshold	<ul style="list-style-type: none"> ● Left-hand rear surround speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A11-13	Speaker #11 - Circuit open	<ul style="list-style-type: none"> ● Front center fill speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A11-1A	Speaker #11 - Circuit resistance below threshold	<ul style="list-style-type: none"> ● Front center fill speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A12-13	Speaker #12 - Circuit open	<ul style="list-style-type: none"> ● Bass speaker circuit high resistance 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A12-1A	Speaker #12 - Circuit resistance below threshold	<ul style="list-style-type: none"> ● Bass speaker circuit short circuit to ground ● Speaker circuit short circuit to power 	Refer to the electrical guides and check the speaker circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system

DTC	Description	Possible Causes	Action
B1A96-68	Bus Still Active After Shut-Down Request - event information	<ul style="list-style-type: none"> ● Light still active 2 seconds after shut-down request 	Carry out the general media orientated system transport (MOST) test. Refer to the Network Communications section of the workshop manual
B1D84-13	Headphone Panel 1 - Circuit open	<ul style="list-style-type: none"> ● Headphone panel 1 circuit high resistance 	Refer to the electrical guides and check the headphone circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1D85-13	Headphone Panel 2 - Circuit open	<ul style="list-style-type: none"> ● Headphone panel 2 circuit high resistance 	Refer to the electrical guides and check the power and ground circuits to the component
B1D86-13	Headphone Panel 3 - Circuit open	<ul style="list-style-type: none"> ● Headphone panel 3 circuit high resistance 	Refer to the electrical guides and check the power and ground circuits to the component
B1D87-13	Headphone Panel 4 - Circuit open	<ul style="list-style-type: none"> ● Headphone panel 4 circuit high resistance 	Refer to the electrical guides and check the headphone circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
U3000-4A	Control Module - Incorrect component installed	<ul style="list-style-type: none"> ● Audio unit control module, incorrect component installed <ul style="list-style-type: none"> - The security of the media orientated system transport (MOST) network prevents the unauthorized addition of a module to the system. Car Configuration File does not have the 'SRM Installed' parameter set, but the module is installed to vehicle 	Configure the network to accept the module using the approved diagnostic system
U3000-55	Control Module - Not configured	<ul style="list-style-type: none"> ● Audio unit not configured ● Audio Amplifier Module circuit short to ground, short to power, open circuit, high resistance ● Equalizer setting not equal to car information of integrated head unit 	Where available, configure the module using the approved diagnostic system. check Audio Amplifier Module circuit for short to ground, short to power, open circuit, high resistance

General Information - Diagnostic Trouble Code (DTC) Index **DTC: Audio Front Control Module - High Line (ACM)**

Description and Operation

Audio Front Control Module - High Line (ACM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Audio Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1A56-01	Antenna - General Electrical Failure	<ul style="list-style-type: none"> Antenna connection is broken 	Check the antenna connection and circuit and for signs damage. Repair/renew as necessary
B1D21-15	Remote Control Switch - Circuit short to battery or open	<ul style="list-style-type: none"> Remote control switch circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check the steering wheel remote control switch circuit. Repair/renew as necessary
B1D79-01	Microphone Input - General Electrical Failure	<ul style="list-style-type: none"> Microphone circuit open circuit, short circuit to ground or short circuit to power Microphone configuration mismatched with Car Configuration File (CCF) 	Refer to the electrical circuit diagrams and check the microphone input circuit. Configure the system using the manufacturers approved diagnostic system
U0010-88	Medium Speed CAN Communication Bus - Bus off	<ul style="list-style-type: none"> BUS off 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> Central Junction Box network malfunction 	Refer to the Network Communications section of the workshop manual. Check for other CAN DTCs or apparently unrelated customer complaints. Carry out a complete vehicle DTC read. Refer to the electrical circuit diagrams and check the CAN and module power and ground circuits. Repair/renew as necessary. Clear the DTCs and test for normal operation
U0155-00	Lost Communication With Instrument Panel Cluster (IPC) Control Module - No sub type information	<ul style="list-style-type: none"> CAN bus circuit fault 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0156-00	Lost Communication With Information Center "A" - No sub type information	<ul style="list-style-type: none"> Lost communication with information center module Incorrect component installed 	Carry out the general media orientated system transport (MOST) test. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0159-00	Lost Communication With Parking Assist Control Module "A" - No sub type information	<ul style="list-style-type: none"> CAN communication error 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to

DTC	Description	Possible Causes	Action
			the Network Communications section of the workshop manual
U0164-00	Lost Communication With HVAC Control Module - No sub type information	<ul style="list-style-type: none"> ● CAN communication error 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0166-00	Lost Communication With Auxiliary Heater Control Module - No sub type information	<ul style="list-style-type: none"> ● CAN communication error 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0186-00	Lost Communication With Audio Amplifier "A" - No sub type information	<ul style="list-style-type: none"> ● CAN communication error 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0191-00	Lost Communication With Television - No sub type information	<ul style="list-style-type: none"> ● CAN communication error ● Incorrect component installed 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0193-00	Lost Communication With "Digital Audio Control Module A" - No sub type information	<ul style="list-style-type: none"> ● CAN communication error ● Incorrect component installed 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0194-00	Lost Communication With "Digital Audio Control Module B" - No sub type information	<ul style="list-style-type: none"> ● CAN communication error ● Incorrect component installed 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0196-00	Lost Communication With Entertainment Control Module-Rear "A" - No sub type information	<ul style="list-style-type: none"> ● CAN communication error ● Incorrect component installed 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0197-00	Lost Communication With Telephone Control Module - No sub type information	<ul style="list-style-type: none"> ● CAN communication error ● Incorrect component installed 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0237-00	Lost Communication With Digital Audio Control Module "C" - No sub type information	<ul style="list-style-type: none"> ● CAN communication error ● Incorrect component installed 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system

DTC	Description	Possible Causes	Action
U0253-00	Lost Communication With Portable Audio Interface Module - No sub type information	<ul style="list-style-type: none"> ● CAN communication error ● Incorrect component installed 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0256-00	Lost Communication With Front Controls Interface Module "A" - No sub type information	<ul style="list-style-type: none"> ● CAN communication error 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0264-00	Lost Communication With Camera Module-Rear - No sub type information	<ul style="list-style-type: none"> ● CAN communication error 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0300-00	Software Incompatibility - No sub type information	<ul style="list-style-type: none"> ● Invalid configuration message is received 	Configure the module using the approved diagnostic system
U0300-48	Software Incompatibility - supervision software failure	<ul style="list-style-type: none"> ● Supervision software failure 	Clear the DTC and retest. If the problem persists, configure the module using the approved diagnostic system
U0417-00	Invalid Data Received From Park Brake Control Module - No sub type information	<ul style="list-style-type: none"> ● Error signal over CAN 	Check for other DTCs. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0422-00	Invalid Data Received From Body Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check for other DTCs. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U0546-00	Invalid Data Received From Entertainment Control Module-Front - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check for other DTCs. Check that components installed are correctly specified and correctly configured in the Car Configuration File (CCF) using the manufacturers approved diagnostic system
U1A14-48	CAN Initialization Failure - supervision software failure	<ul style="list-style-type: none"> ● Audio control module supervision software failure 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U1A14-49	CAN Initialization Failure - Internal electronic failure	<ul style="list-style-type: none"> ● Internal electronic failure 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U2003-31	Fibre Optic Communication Bus - no signal	<ul style="list-style-type: none"> ● MOST ring break - no data received 	Carry out the general media orientated system transport (MOST) test. Refer to the Network Communications section of the workshop manual
U2003-86	Fibre Optic Communication Bus - Signal invalid	<ul style="list-style-type: none"> ● Signal invalid 	Carry out the general media orientated system transport (MOST) test. Refer to the Network Communications section of the workshop manual
U2003-88	Fibre Optic Communication Bus - Bus off	<ul style="list-style-type: none"> ● Bus off 	Carry out the general media orientated system transport (MOST) test. Refer to the Network Communications section of the workshop manual.
U2100-00	Initial Configuration Not Complete - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Re-configure the module using the manufacturer approved diagnostic system
U3000-04	Control Module - System Internal Failures	<ul style="list-style-type: none"> ● Audio unit internal failure - no communications with CD module 	Check the power and ground circuits to the component. Refer to the electrical circuit diagrams. Refer to the warranty policy and procedures manual if a module is suspect
U3000-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> ● Audio unit internal electronic failure (internal error) 	Check the power and ground circuits to the component. Refer to the electrical circuit diagrams. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
U3000-55	Control Module - not configured	<ul style="list-style-type: none"> ● Audio unit not configured ● Audio Amplifier Module circuit short to ground, short to power, open circuit, high resistance ● Equalizer setting not equal to car information of integrated head unit 	Where available, configure the module using the approved diagnostic system. check Audio Amplifier Module circuit for short to ground, short to power, open circuit, high resistance
U3000-68	Control Module - event information	<ul style="list-style-type: none"> ● Audio unit event information - MOST transceiver overheating 	Refer to the electrical circuit diagrams and check the power and ground circuits to the component. Check the MOST circuit. Carry out the general MOST test. Refer to the Network Communications section of the workshop manual and in the approved diagnostic system. Clear the DTC and retest. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Audio Front Control Module - Low Line (ACM)

Description and Operation

Audio Front Control Module - Low Line (ACM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Audio Amplifier Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1A01-11	Speaker #1 - Circuit short to ground	<ul style="list-style-type: none"> Speaker circuit short to ground, short to each other Audio Control Module failure Amplifier failure 	Refer to the electrical circuit diagrams and check Audio Control Module speaker to Amplifier circuit for short to ground, short to each other. Check and install a new Audio Control Module as required. Check and install a new Amplifier as required. Refer to the warranty policy and procedures manual if a module is suspect
U0074-88	Control Module Communication Bus "B" Off - Bus Off	<ul style="list-style-type: none"> Audio Control Module power circuit short to ground, open circuit Audio Control Module ground circuit high resistance, open circuit Medium speed CAN network circuit, short to ground, high resistance, open circuit 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0257-00	Lost Communication With Front Controls / Display Interface Module - No sub type information	<ul style="list-style-type: none"> Audio Control Module power circuit short to ground, open circuit Audio Control Module ground circuit high resistance, open circuit Medium speed CAN network circuit, short to ground, high resistance, open circuit 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Audio Control Module and Front Control Driver Information Control Module
U2100-00	Initial Configuration Not Complete - No sub type information	<ul style="list-style-type: none"> Audio Control Module not configured or incorrectly configured Central Junction Box not configured correctly 	Clear DTC and re-Test. Re-configure the Audio Control module using the manufacturer approved diagnostic system. Re-configure the Central Junction Box using the manufacturer approved diagnostic system

DTC	Description	Possible Causes	Action
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> ● Audio Control Module not configured or incorrectly configured ● Car Configuration File not configured correctly 	Clear DTC and re-test. Re-configure the Audio Control module using the manufacturer approved diagnostic system. Re-configure the Car Configuration File using the manufacturer approved diagnostic system
U3000-49	Control Module - internal electronic failure	<ul style="list-style-type: none"> ● Audio Control Module failure 	Check and install a new Audio Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
U3006-16	Control Module Input Power "A" - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Audio Control Module power feed circuit short to ground, high resistance, open circuit ● Charging system fault ● Discharged battery ● Audio Control Module failure 	Refer to the electrical circuit diagrams and check Audio Control Module circuit for short to ground, high resistance, open circuit. Refer to the electrical circuit diagrams and check charging circuit for open circuit, short to ground. Check and install a new alternator as required. Check and install a new battery as required. Check and install a new Audio Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Bluetooth Module - High Line (TEL)

Description and Operation

Bluetooth Module (TEL)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Telephone Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Cellular Phone](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1D79-84	Microphone Input - Signal below allowable range	<ul style="list-style-type: none"> The 'Receive Audio over MOST Test' failed and means that the audio received at the microphone detection point is too low Microphone fault Harness/connector fault Integrated head unit (IHU) fault 	Check the operation of the microphone. Refer to the electrical circuit diagrams and check the microphone (MIC) circuits. Renew/repair as necessary. Refer to the warranty policy and procedures manual if a module is suspect
U1A00-88	Private Communication Network - Bus off	<ul style="list-style-type: none"> Internal communications failure 	Clear the DTC and retest. If the problem persists, renew the Bluetooth Module. Refer to the warranty policy and procedures manual if a module is suspect
U2001-9A	Reduced System Function - Component or system operating conditions	<ul style="list-style-type: none"> Bluetooth error - system over-temperature 	Allow the system to cool, clear the DTC and check /monitor for re-occurrence. If DTC re-occurs suspect the module. Check and install a new module as required. Refer to the Warranty Policy and Procedures manual if a module is suspect
U201A-54	Control Module Main Calibration Data - Missing calibration	<ul style="list-style-type: none"> Local configuration file is missing (not loaded) in the control module 	Configure the module using the manufacturers approved diagnostic system (file download may take several minutes)
U3000-44	Control module - Data memory failure	<ul style="list-style-type: none"> Bluetooth Module RAM fault (data memory failure leading to possible corrupt local configuration file) 	Configure the module using the manufacturers approved diagnostic system and download the local configuration file. Clear the DTC and retest. If the problem persists, renew the Bluetooth Module. Refer to the warranty policy and procedures manual if a module is suspect
U3000-45	Control module - Program memory failure	<ul style="list-style-type: none"> Bluetooth Module ROM fault (data memory failure leading to possible corrupt local configuration file) 	Configure the module using the manufacturers approved diagnostic system and download the local configuration file. Clear the DTC and retest. If the problem persists, renew the Bluetooth Module. Refer to the warranty policy and procedures manual if a module is suspect
U3000-54	Control module - Missing calibration	<ul style="list-style-type: none"> MOST not configured correctly - incorrect voice language installed 	Check and amend the Car Configuration File in the Information and Entertainment Control Module using the manufacturer approved diagnostic system
U3000-56	Control module - Invalid/incomplete configuration	<ul style="list-style-type: none"> One or more of the received car configuration file (CCF) data parameters is deemed to be invalid 	Check and amend the Car Configuration File using the manufacturer approved diagnostic system
U3003-16	Battery Voltage - Circuit voltage below threshold	<ul style="list-style-type: none"> Battery voltage below threshold 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the

DTC	Description	Possible Causes	Action
U3003-17	Battery Voltage - Circuit voltage above threshold	<ul style="list-style-type: none"> ● Battery voltage above threshold 	module Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Central Junction Box (CJB)

Description and Operation

Central Junction Box (CJB)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules or components does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Central Junction Box, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Communications Network](#) (418-00 Module Communications Network, Diagnosis and Testing).

DTC	Description	Possible Cause	Action
B1009-51	Ignition Authorization - Not programmed	<ul style="list-style-type: none"> Not programmed 	Configure the module using the manufacturers approved diagnostic system
B1009-62	Ignition Authorization - Signal compare failure	<ul style="list-style-type: none"> Encrypted data exchange between Instrument Cluster and the Central Junction Box does not match 	Configure the module using the manufacturers approved diagnostic system. If problem persists carry out CAN Network Integrity Test and Module Self Test using manufacturer approved diagnostic system. Alternatively, refer to the electrical circuit diagrams and check CAN circuit
B1009-63	Ignition Authorization - Circuit/component protection time-out	<ul style="list-style-type: none"> Circuit/component protection time-out CAN circuit fault Instrument Cluster fault Central Junction Box fault Battery voltage too low 	<ul style="list-style-type: none"> Only diagnose this DTC if the Customer is reporting a start related issue <p>Clear the DTC and retest. Check for additional ignition related DTCs and rectify as necessary. If problem persists, carry out CAN Network Integrity Test and On Demand Self Test using manufacturer approved diagnostic system. Alternatively, refer to the electrical circuit diagrams and check CAN circuits</p>
B1009-81	Ignition Authorization - Invalid serial data received	<ul style="list-style-type: none"> Invalid serial data received CAN circuit fault Instrument Cluster fault 	Check for Instrument Cluster related DTCs. Configure the module using the manufacturer approved diagnostic system
B100D-51	Column Lock Authorization - Not programmed	<ul style="list-style-type: none"> Module not programmed 	Configure the Steering Column Lock Module using the manufacturers approved diagnostic system
B100D-64	Column Lock Authorization - Signal plausibility failure	<ul style="list-style-type: none"> Signal plausibility failure Steering column lock unable to perform lock action CAN Network fault Anti-lock Braking System, Engine Control Module, Central Junction Box fault 	<ul style="list-style-type: none"> Prior to clearing this DTC, carry out the Vehicle Functional Reset application using the manufacturer approved diagnostic system <p>Check the serviceability of the steering column and lock. Clear the DTC and retest. If the problem persists, carry out CAN Network Integrity Test and Module Self Test using the manufacturer approved diagnostic system. Alternatively, refer to the electrical circuit diagrams and check CAN Network</p>
B100D-67	Column Lock Authorization - Signal incorrect after event	<ul style="list-style-type: none"> Signal incorrect after event Instrument Cluster fault CAN Network fault 	Check for additional related DTCs. Clear the DTC and retest. If the problem persists, carry out CAN Network Integrity Test and Module Self Test using the manufacturer approved diagnostic system. Alternatively, refer to the electrical circuit diagrams and check CAN Network
B100D-81	Column Lock Authorization - Invalid serial data received	<ul style="list-style-type: none"> Invalid serial data received 	<ul style="list-style-type: none"> Prior to clearing this DTC, carry out the Vehicle Functional Reset application using the manufacturer approved diagnostic system <p>Configure the module using the manufacturer</p>

DTC	Description	Possible Cause	Action
		<ul style="list-style-type: none"> ● Encrypted data exchange between Steering Column Lock and the Central Junction Box does not match 	approved diagnostic system. Clear the DTC and retest. If the problem persists, carry out CAN Network Integrity Test and Module Self Test. Alternatively, refer to the electrical circuit diagrams and check CAN Network
B100D-87	Column Lock Authorization - Missing message	<ul style="list-style-type: none"> ● Missing message ● Battery voltage too low ● CAN Network fault ● No response from Steering Column Lock Module, Instrument Cluster, Central Junction Box ● Steering Column Lock Module, Instrument Cluster, Central Junction Box fault 	Check for additional related DTCs. Clear the DTC and retest. If the problem persists, carry out CAN Network Integrity Test and Module Self Test. Alternatively, refer to the electrical circuit diagrams and check CAN Network
B100D-96	Column Lock Authorization - Component internal failure	<ul style="list-style-type: none"> ● Component internal failure ● Battery voltage too low ● Torque load on Steering column 	<ul style="list-style-type: none"> • NOTE: Prior to clearing this DTC, carry out the Vehicle Functional Reset application using the manufacturer approved diagnostic system <p>Clear the DTC and retest. Check steering is not under high side load. Refer to the electrical circuit diagrams and check Steering Column Lock circuits. Carry out CAN Network Integrity Test and Module Self Test using the manufacturer approved diagnostic system. If the problem persists, renew the Steering Column Lock Module. Refer to the warranty policy and procedures manual if a module/component is suspect</p>
B1024-83	Start Control Unit - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● Value of signal protection calculation incorrect ● Start Control Unit fault ● LIN Network fault 	Clear the DTC and retest. Refer to the electrical circuit diagrams and check Start Control Unit circuits. If the problem persists, renew the Start Control Unit. Refer to the warranty policy and procedures manual if a module/component is suspect
B1024-87	Start Control Unit - Missing message	<ul style="list-style-type: none"> ● Missing message ● Start Control Unit fault ● LIN Network fault 	Clear the DTC and retest. Refer to the electrical circuit diagrams and check Start Control Unit circuits. If the problem persists, renew the Start Control Unit. Refer to the warranty policy and procedures manual if a module/component is suspect
B1026-11	Steering Column Lock - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Refer to the electrical circuit diagrams and check Steering Column Lock circuits
B102B-67	Passive Key - Signal incorrect after event	<ul style="list-style-type: none"> ● Passive key Authorization signal incorrect after event ● Encrypted data exchange between Steering Column Lock and Central Junction Box does not match ● Low speed CAN fault ● Remote Function Actuator module fault ● Central Junction Box fault 	Configure the module using the manufacturer approved diagnostic system. Check CAN communications between the modules
B102B-87	Passive Key - Missing message	<ul style="list-style-type: none"> ● Passive key Authorization missing message ● Confirm placement of key within vehicle ● Low speed CAN fault ● Key fob battery low/battery contact issue ● Interference from other RF signal ● Electromagnetic compatibility/noise ● Remote Function Actuator fault ● Receiver fault ● Receiver not programmed correctly ● Serial communication fault (between receiver and Remote Function Actuator module) ● Key fault ● Passive antenna fault ● Central Junction Box fault 	<ul style="list-style-type: none"> • NOTE: The action below is only required if this DTC and DTC B1B01-87 have been stored, or vehicle start issue has been reported <p>Check whereabouts of keys, including Spare and confirm correct functionality. Refer to the electrical circuit diagrams and check the power and ground circuits to the Remote Function Actuator module and receiver. Check CAN communications between Central Junction Box and Remote Function Actuator. Check key fob battery. Check vehicle surroundings for possible sources of interference, move vehicle and retest. Check CAN network for interference/electromagnetic compatibility related issues. Check serial circuit between receiver and Remote Function Actuator module. Refer to the electrical circuit diagrams and check circuits to all three antennas. Disconnect battery, then re-connect - confirm correct operation by re-programming keys using the manufacturer approved diagnostic system</p>
B1046-23	Front Fog Lamp Control Switch - Signal stuck low	<ul style="list-style-type: none"> ● Switch signal stuck low ● Switch circuit short to ground ● Switch activated for more 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the switch circuit. Clear the DTC and retest. If the DTC persists, renew the switch. Refer to the warranty policy and

DTC	Description	Possible Cause	Action
		<ul style="list-style-type: none"> than One minute ● Switch fault 	procedures manual if a module/component is suspect
B1047-23	Rear Fog Lamp Control Switch - Signal stuck low	<ul style="list-style-type: none"> ● Switch signal stuck low ● Switch circuit short to ground ● Switch activated for more than One minute ● Switch fault 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the switch circuit. Clear the DTC and retest. If the DTC persists, renew the switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B1051-23	Front Washer Switch - Signal stuck low	<ul style="list-style-type: none"> ● Switch signal stuck low ● Switch circuit short to ground ● Switch activated for more than One minute ● Switch fault 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the switch circuit. Clear the DTC and retest. If the DTC persists, renew the switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B1052-23	Rear Washer Switch - Signal stuck low	<ul style="list-style-type: none"> ● Switch signal stuck low ● Switch circuit short to ground ● Switch activated for more than One minute ● Switch fault 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the switch circuit. Clear the DTC and retest. If the DTC persists, renew the switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B1087-86	LIN Bus "A" - Signal invalid	<ul style="list-style-type: none"> ● The header of the LIN message received is incorrect 	Clear the stored DTC and retest, if the DTC returns localize the fault, refer to the electrical circuit diagrams and disconnect the Analogue Clock (by removing the supply fuse) and retest. Check the operation of the Steering Wheel Switches on the LIN Bus Circuit (i.e. Cruise, Gearshift paddles). If a fault is evident with either the Analogue Clock or the (LH) Steering Wheel Module, replace as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1087-88	LIN Bus "A" - Bus off	<ul style="list-style-type: none"> ● LIN Bus circuit short to power or ground 	Refer to the electrical circuit diagrams and check the LIN Circuit between the Central Junction Box and the (LH) Steering Wheel Module and Analogue Clock Module for Short Circuit to Power or Ground
B1088-86	LIN Bus "B" - Signal invalid	<ul style="list-style-type: none"> ● Signal invalid 	Refer to the electrical circuit diagrams and check the LIN B circuit between the Central Junction Box and the Rain/Light Sensor, Battery Backed Sounder and Interior Motion Sensor (where installed)
B1088-88	LIN Bus "B" - Bus off	<ul style="list-style-type: none"> ● Bus off 	Refer to the electrical circuit diagrams and check the LIN B circuit between the Central Junction Box and the Rain/Light Sensor, Battery Backed Sounder and Interior Motion Sensor (where installed)
B108B-11	Start Button Circuit "A" - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Refer to the electrical circuit diagrams and check the start button circuit
B108B-12	Start Button Circuit "A" - Circuit short to battery	<ul style="list-style-type: none"> ● Circuit short to power 	Refer to the electrical circuit diagrams and check the start button circuit
B108B-13	Start Button Circuit "A" - Circuit open	<ul style="list-style-type: none"> ● Circuit open circuit 	Refer to the electrical circuit diagrams and check the start button circuit
B108B-23	Start Button Circuit "A" - Signal stuck low	<ul style="list-style-type: none"> ● Start button signal stuck low ● Switch activated for more than One minute ● SW1 constantly active for a long period of time while button press detected at SW2 ● Switch failure 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the start button circuit. Renew the start switch as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B108C-11	Start Button Circuit "B" - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Refer to the electrical circuit diagrams and check the start button circuit
B108C-12	Start Button Circuit "B" - Circuit short to battery	<ul style="list-style-type: none"> ● Circuit short to power 	Refer to the electrical circuit diagrams and check the start button circuit
B108C-13	Start Button Circuit "B" - Circuit open	<ul style="list-style-type: none"> ● Circuit open circuit 	Refer to the electrical circuit diagrams and check the start button circuit
B108C-23	Start Button Circuit "B" - Signal stuck low	<ul style="list-style-type: none"> ● Start button signal stuck low ● Switch activated for more than One minute ● SW1 constantly active for a long period of time while button press detected at SW2 ● Switch failure 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the start button circuit. Renew the start switch as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1095-11	Wiper On/Off Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Wiper on/off relay circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit

DTC	Description	Possible Cause	Action
B1095-12	Wiper On/Off Relay - Circuit short to battery	<ul style="list-style-type: none"> Wiper on/off relay circuit short circuit to power 	Refer to the electrical circuit diagrams and check the circuit
B1095-13	Wiper On/Off Relay - Circuit open	<ul style="list-style-type: none"> Wiper on/off relay circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
B1096-11	Wiper High/Low Relay - Circuit short to ground	<ul style="list-style-type: none"> Wiper circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit
B1096-12	Wiper High/Low Relay - Circuit short to battery	<ul style="list-style-type: none"> Wiper circuit short circuit to power 	Refer to the electrical circuit diagrams and check the circuit
B1096-13	Wiper High/Low Relay - Circuit open	<ul style="list-style-type: none"> Wiper circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
B1097-11	Heated Windshield Relay - Circuit short to ground	<ul style="list-style-type: none"> Heated windshield relay circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit
B1097-12	Heated Windshield Relay - Circuit short to battery	<ul style="list-style-type: none"> Heated windshield relay circuit short circuit to power 	Refer to the electrical circuit diagrams and check the circuit
B1097-13	Heated Windshield Relay - Circuit open	<ul style="list-style-type: none"> Heated windshield relay circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
B109E-51	Remote Keyless Entry - not programmed	<ul style="list-style-type: none"> Not programmed 	Check for other related DTCs. Programme the system using the manufacturers approved diagnostic system
B10A2-31	Crash Input - No signal	<ul style="list-style-type: none"> No signal 	Check the Supplemental Restraints System and Engine Control Module for related DTCs. Refer to the electrical circuit diagrams and check the circuit between the Supplemental Restraints System the Central Junction Box and the Engine Control Module
B10A2-38	Crash Input - Signal frequency incorrect	<ul style="list-style-type: none"> Signal frequency incorrect 	Check the Restraints Control Module for DTCs and rectify first
B10AB-51	Remote Keyless Entry Synchronization - not programmed	<ul style="list-style-type: none"> Not programmed 	Check for other related DTCs. Programme the system using the manufacturers approved diagnostic system
B10AD-09	Rain Sensor - Component Failures	<ul style="list-style-type: none"> Rain Sensor / Ambient Light Sensor obscured Battery Supply Voltage below 9 Volts Sensor incorrectly installed Component failure 	Check the Rain/Light Sensor is not obscured. Check for related low voltage stored DTCs. Check the security and installation of the Rain/Light Sensor. Clear the DTC and retest. If the DTC returns suspect an internal fault. Refer to the warranty policy and procedures manual if a module/component is suspect
B10AD-83	Rain Sensor - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> value of signal protection calculation incorrect Sensor fault 	Clear the DTC and retest. If the problem persists, renew the Rain/Light Sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
B10AD-87	Rain Sensor - Missing message	<ul style="list-style-type: none"> Missing message, LIN slave node is not responding 	Check the operation of the Rain/Light Sensor. Refer to the electrical circuit diagrams and check the LIN circuit between the Rain/Light Sensor and the Central Junction Box. Check LIN control unit and Rain/Light Sensor power and ground circuits
B10AD-96	Rain Sensor - Component internal failure	<ul style="list-style-type: none"> Component internal failure 	Clear the DTC and retest. If the problem persists, renew the Rain/Light Sensor as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10E5-11	PCM Wake-Up Signal - Circuit short to ground	<ul style="list-style-type: none"> Engine Control Module wake-up signal short to ground 	Refer to the electrical circuit diagrams and test the early wake-up signal circuit
B10E5-15	PCM Wake-Up Signal - Circuit short to battery or open	<ul style="list-style-type: none"> Engine Control Module wake-up signal short power or open circuit 	Refer to the electrical circuit diagrams and test the early wake-up signal circuit
B10F2-4B	Sunroof Control - Over temperature	<ul style="list-style-type: none"> Sunroof control motor over temperature Temperature sensor defective or not calibrated Debris in the channels/guides Cable(s) sticking/damaged Roof opening panel not correctly aligned Motor fault 	Check the sunroof for smooth operation and obstructions that would cause the motor to overheat. If necessary, renew the motor. Refer to the warranty policy and procedures manual if a module/component is suspect
B10F2-74	Sunroof Control - Actuator slipping	<ul style="list-style-type: none"> Sunroof control motor slipping due to mechanical failure Debris in the channels/guides Cable(s) sticking/damaged Roof opening panel not 	Remove the motor and check the cables for free movement and damage. Check the sunroof for smooth operation and obstructions that would cause the motor to slip. If necessary, renew the motor. Refer to the warranty policy and procedures manual if a module/component is suspect

DTC	Description	Possible Cause	Action
		<ul style="list-style-type: none"> correctly aligned ● Motor fault 	
B10F2-93	Sunroof Control - No operation	<ul style="list-style-type: none"> ● No operation, roof position is not valid ● Motor position not calibrated 	Configure the module using the manufacturers approved diagnostic system
B10F2-9A	Sunroof Control - Component or system operating conditions	<ul style="list-style-type: none"> ● Component or system operating conditions <ul style="list-style-type: none"> - Excessive continuous motor operation 	This DTC is not necessarily a fault and may be logged when the sunroof has been operated continuously and the sunroof has temporarily been disabled to prevent motor over-heat. Clear the DTC and check the operation of the switch and sunroof operation
B10F8-11	Accessory Socket 'A' Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Accessory socket 'A' relay circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B10F8-12	Accessory Socket 'A' Relay - Circuit short to battery	<ul style="list-style-type: none"> ● Accessory socket 'A' relay circuit short to power 	Refer to the electrical circuit diagrams and check the circuit
B10F8-13	Accessory Socket 'A' Relay - Circuit open	<ul style="list-style-type: none"> ● Accessory socket 'A' relay circuit open ground 	Refer to the electrical circuit diagrams and check the circuit
B10F9-11	Accessory Socket 'B' Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Accessory socket 'B' relay circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B10F9-12	Accessory Socket 'B' Relay - Circuit short to battery	<ul style="list-style-type: none"> ● Accessory socket 'B' relay circuit short to power 	Refer to the electrical circuit diagrams and check the circuit
B10F9-13	Accessory Socket 'B' Relay - Circuit open	<ul style="list-style-type: none"> ● Accessory socket 'B' relay circuit open ground 	Refer to the electrical circuit diagrams and check the circuit
B1102-11	Trailer Stop Lamp - Circuit short to ground	<ul style="list-style-type: none"> ● Trailer stop lamp circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit. Repair as necessary
B1115-11	High Mounted Stop Lamp Control - Circuit short to ground	<ul style="list-style-type: none"> ● High mounted stop lamp control circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit. Repair as necessary
B112B-83	Steering Wheel Module - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● An internal memory checksum error in the steering wheel module has been detected by the central junction box 	Check the Steering Wheel Switch functions to localize the failure. Clear the stored DTC and retest. If the DTC returns suspect the (LH) Steering Wheel Module replace as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B112B-87	Steering Wheel Module - Missing message	<ul style="list-style-type: none"> ● The central junction box has reported the steering wheel module as not responding 	Check the operation of the Steering Wheel Switches on the LIN Bus Circuit (i.e. Cruise, Gearshift paddles where installed). Refer to the electrical circuit diagrams and check the LIN circuit between the Steering Wheel Module and the Central Junction Box. Check (LH) Steering Wheel Module power and ground circuits
B112B-96	Steering Wheel Module - Component internal failure	<ul style="list-style-type: none"> ● The central junction box has detected an internal error in the steering wheel module 	Clear the stored DTC and retest. If the DTC returns suspect the (LH) Steering Wheel Module replace as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B112C-83	Interior Motion Sensor - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● An internal memory checksum error in the interior motion sensor has been detected by the central junction box 	Clear the DTC and retest. If the DTC persists, renew the interior motion sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
B112C-87	Interior Motion Sensor - Missing message	<ul style="list-style-type: none"> ● The central junction box has reported the interior motion sensor as not responding 	Check the operation of the Interior Motion Sensor. Refer to the electrical circuit diagrams and check the LIN circuit between the Interior Motion Sensor and the Central Junction Box. Should also check LIN control unit power and ground circuits. Clear the DTC and retest. If the DTC persists, renew the interior motion sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
B112C-96	Interior Motion Sensor - Component internal failure	<ul style="list-style-type: none"> ● The central junction box has detected an internal error in the interior motion sensor 	Clear the DTC and retest. If the DTC persists, renew the interior motion sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
B113E-23	External Boot/Trunk Release Switch - Signal stuck low	<ul style="list-style-type: none"> ● External luggage compartment lid release switch digital input circuit - Signal stuck low ● Switch activated for more than One minute 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the external luggage compartment lid release switch digital input circuit for short to ground

DTC	Description	Possible Cause	Action
B1140-11	Engine Crank Authorization - Circuit short to ground	<ul style="list-style-type: none"> Engine crank Authorization signal circuit short circuit to ground 	Refer to the electrical circuit diagrams and check engine crank Authorization signal circuit
B1140-15	Engine Crank Authorization - Circuit short to battery or open	<ul style="list-style-type: none"> Engine crank Authorization signal circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check engine crank Authorization signal circuit
B1146-11	Passive Sounder Supply - Circuit short to ground	<ul style="list-style-type: none"> Security passive sounder control circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the security passive sounder control circuit
B1146-15	Passive Sounder Supply - Circuit short to battery or open	<ul style="list-style-type: none"> Security passive sounder control circuit short circuit to power, open circuit 	Refer to the electrical circuit diagrams and check the security passive sounder control circuit
B1182-51	Tire Pressure Monitoring System - not programmed	<ul style="list-style-type: none"> Diagnostic test to verify reception of all tire low pressure sensors has failed 	Using manufacturer approved diagnostic system, perform diagnostic routine to verify reception of all tire low pressure sensors by carrying out 'tire pressure monitoring system wheel unit and receiver reception test' test from 'set up and configuration' application and complete remedial actions
B11C2-11	Power Striker Close Relay - Circuit short to ground	<ul style="list-style-type: none"> Power striker close relay circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B11C2-12	Power Striker Close Relay - Circuit short to power	<ul style="list-style-type: none"> Power striker close relay circuit short to power 	Refer to the electrical circuit diagrams and check the circuit
B11C2-13	Power Striker Close Relay - Circuit open	<ul style="list-style-type: none"> Power striker close relay circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
B11C3-11	Power Striker Open Relay - Circuit short to ground	<ul style="list-style-type: none"> Power striker open relay circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B11C3-12	Power Striker Open Relay - Circuit short to power	<ul style="list-style-type: none"> Power striker open relay circuit short to power 	Refer to the electrical circuit diagrams and check the circuit
B11C3-13	Power Striker Open Relay - Circuit open	<ul style="list-style-type: none"> Power striker open relay circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
B11D1-86	LIN Bus "C" - Signal invalid	<ul style="list-style-type: none"> Signal invalid 	Refer to the electrical circuit diagrams and check the Roof Opening Panel LIN circuit between the Roof Opening Panel module, passenger fuse box and the Central Junction Box
B11D1-88	LIN Bus "C" - Bus off	<ul style="list-style-type: none"> Bus off Roof Opening Panel LIN network short to power, ground 	Refer to the electrical circuit diagrams and check the Roof Opening Panel LIN circuit between the Roof Opening Panel module, passenger fuse box and the Central Junction Box
B11D9-92	Vehicle Battery - performance or incorrect operation	<ul style="list-style-type: none"> Internal electronic failure 	Renew the battery monitoring module. Refer to the warranty policy and procedures manual if a module/component is suspect
B11DB-49	Battery Monitoring Module - Internal electronic failure	<ul style="list-style-type: none"> Internal electronic failure 	Renew the battery monitoring module. Refer to the warranty policy and procedures manual if a module/component is suspect
B11DB-83	Battery Monitoring Module - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> Value of signal protection calculation incorrect 	Clear the DTC and retest. If the problem persists, renew the Battery Monitoring System Module. Refer to the warranty policy and procedures manual if a module/component is suspect
B11DB-87	Battery Monitoring Module - Missing message	<ul style="list-style-type: none"> Missing message Battery monitoring module connector dis-connected/poor connection Battery monitoring module to passenger fuse box LIN circuit - open circuit Battery monitoring module to battery positive monitor circuit open circuit Battery monitoring module/passenger fuse box failure 	<ul style="list-style-type: none"> NOTE: Fault logging is inhibited by the CCF, but an incorrectly configured CCF could give erroneous DTC logging. <p>Check the operation of the Battery Monitoring System Module. Refer to the electrical circuit diagrams and check the LIN circuit between the Battery Monitoring System Module and the Central Junction Box. Check LIN control unit power and ground circuits</p>
B123A-11	Left Front Turn Indicator - Circuit short to ground	<ul style="list-style-type: none"> Left front turn signal lamp circuit short to ground 	Refer to the electrical circuit diagrams and check left front turn signal lamp circuit
B123A-15	Left Front Turn Indicator - Circuit short to battery or open	<ul style="list-style-type: none"> Left front turn signal lamp circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check left front turn signal lamp circuit

DTC	Description	Possible Cause	Action
B123B-11	Right Front Turn Indicator - Circuit short to ground	<ul style="list-style-type: none"> ● Right front turn signal lamp circuit short to ground 	Refer to the electrical circuit diagrams and check right front turn signal lamp circuit
B123B-15	Right Front Turn Indicator - Circuit short to battery or open	<ul style="list-style-type: none"> ● Right front turn signal lamp circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check right front turn signal lamp circuit
B1247-11	Left Rear Turn Indicator - Circuit short to ground	<ul style="list-style-type: none"> ● Left rear turn signal lamp circuit short to ground 	Refer to the electrical circuit diagrams and check left rear turn signal lamp circuit
B1247-15	Left Rear Turn Indicator - Circuit short to battery or open	<ul style="list-style-type: none"> ● Left rear turn signal lamp circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check left rear turn signal lamp circuit
B1248-11	Right Rear Turn Indicator - Circuit short to ground	<ul style="list-style-type: none"> ● Right rear turn signal lamp circuit short to ground 	Refer to the electrical circuit diagrams and check right rear turn signal lamp circuit
B1248-15	Right Rear Turn Indicator - Circuit short to battery or open	<ul style="list-style-type: none"> ● Right rear turn signal lamp circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check right rear turn signal lamp circuit
B124A-11	Right Daytime Running Light - Circuit short to ground	<ul style="list-style-type: none"> ● Right daytime running light circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B124A-15	Right Daytime Running Light - Circuit short to power or open circuit	<ul style="list-style-type: none"> ● Right daytime running light circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit
B124B-11	Left Daytime Running Light - Circuit short to ground	<ul style="list-style-type: none"> ● Left daytime running light circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B124B-15	Left Daytime Running Light - Circuit short to power or open circuit	<ul style="list-style-type: none"> ● Left daytime running light circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit
B1298-73	Steering Column Adjust Up Switch - Actuator stuck closed	<ul style="list-style-type: none"> ● Internal Switch fault 	Check the switch operation. Refer to the electrical circuit diagrams and check the column switch circuit
B1299-73	Steering Column Adjust Down Switch - Actuator stuck closed	<ul style="list-style-type: none"> ● Internal Switch fault 	Check the switch operation. Refer to the electrical circuit diagrams and check the column switch circuit
B129A-86	LIN Bus "D" - Signal invalid	<ul style="list-style-type: none"> ● Signal invalid 	Refer to the electrical circuit diagrams and check the Immobilizer Antenna LIN circuit between the Central Junction Box and the Immobilizer Antenna unit. Check for other Immobilizer DTCs
B129A-88	LIN Bus "D" - Bus off	<ul style="list-style-type: none"> ● Bus off ● Immobilizer Antenna LIN network short to power, ground - this is detected when nothing is read back after a header is transmitted 	Refer to the electrical circuit diagrams and check the Immobilizer Antenna LIN circuit between the Central Junction Box and the Immobilizer Antenna unit. Check for other Immobilizer DTCs
B12A1-73	Steering Column Adjust Out Switch - Actuator stuck closed	<ul style="list-style-type: none"> ● Internal Switch fault 	Check the switch operation. Refer to the electrical circuit diagrams and check the column switch circuit
B12A2-73	Steering Column Adjust In Switch - Actuator stuck closed	<ul style="list-style-type: none"> ● Internal Switch fault 	Check the switch operation. Refer to the electrical circuit diagrams and check the column switch circuit
B12A3-11	Steering Column Adjust Motor Drive A - Circuit short to ground	<ul style="list-style-type: none"> ● Motor circuit short to ground ● Motor fault 	Refer to the electrical circuit diagrams and check the circuit between the steering column adjust motor and the Central Junction Box. If no circuit faults are evident, suspect the steering column adjust motor. Refer to the warranty policy and procedures manual if a module/component is suspect
B12A3-15	Steering Column Adjust Motor Drive A - Circuit short to battery or open	<ul style="list-style-type: none"> ● Motor circuit short to power or open circuit ● Motor fault 	Refer to the electrical circuit diagrams and check the circuit between the steering column adjust motor and the Central Junction Box. If no circuit faults are evident, suspect the steering column adjust motor. Refer to the warranty policy and procedures manual if a module/component is suspect
B12A4-11	Steering Column Adjust Motor Drive B - Circuit short to ground	<ul style="list-style-type: none"> ● Motor circuit short to ground ● Motor fault 	Refer to the electrical circuit diagrams and check the circuit between the steering column adjust motor and the Central Junction Box. If no circuit faults are evident, suspect the steering column adjust motor. Refer to the warranty policy and procedures manual if a module/component is suspect
B12A4-15	Steering Column Adjust Motor Drive B - Circuit short to battery or open	<ul style="list-style-type: none"> ● Motor circuit short to power or open circuit ● Motor fault 	Refer to the electrical circuit diagrams and check the circuit between the steering column adjust motor and the Central Junction Box. If no circuit faults are evident, suspect the steering column adjust motor.

DTC	Description	Possible Cause	Action
			Refer to the warranty policy and procedures manual if a module/component is suspect
B12C9-86	LIN Bus "E" - Signal invalid	<ul style="list-style-type: none"> Battery monitoring system signal invalid 	Refer to the electrical circuit diagrams and check the Battery Monitoring System LIN circuit between the Central Junction Box and the Battery Monitoring System. Check for other Battery Monitoring System related DTCs
B12C9-88	LIN Bus "E" - Bus off	<ul style="list-style-type: none"> Bus off Battery Monitoring System LIN network short to power, ground - this is detected when nothing is read back after a header is transmitted 	Refer to the electrical circuit diagrams and check the Battery Monitoring System LIN circuit between the Central Junction Box and the Battery Monitoring System. Check for other Battery Monitoring System related DTCs
B12E8-23	Liftgate/Tailgate Control/Release Switch - Signal stuck low	<ul style="list-style-type: none"> Liftgate/tailgate control/release switch signal stuck low 	Refer to the electrical circuit diagrams and check the circuit
B12EE-11	Tailgate/Trunk Release - Circuit short to ground	<ul style="list-style-type: none"> Tailgate/Trunk release circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit
B12EE-15	Tailgate/Trunk Release - Circuit short to battery or open	<ul style="list-style-type: none"> Tailgate/Trunk release circuit short to power, open circuit 	Refer to the electrical circuit diagrams and check the circuit
B12EF-11	Trailer Fog Lamp - Circuit short to ground	<ul style="list-style-type: none"> Trailer fog lamp circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B12F3-11	Secondary Tailgate Release - Circuit short to ground	<ul style="list-style-type: none"> Secondary tailgate release circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit
B12F3-15	Secondary Tailgate Release - Circuit short to battery or open	<ul style="list-style-type: none"> Secondary tailgate release circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit
B12F4-12	Vehicle Speed Output - Circuit short to battery	<ul style="list-style-type: none"> Circuit short circuit to power 	Refer to the electrical circuit diagrams and check the circuit
B12F5-12	Fridge Relay Control - Circuit short to battery	<ul style="list-style-type: none"> Circuit short to power 	Refer to the electrical circuit diagrams and check the circuit
B130B-11	Right Rear Fog Lamp - Circuit short to ground	<ul style="list-style-type: none"> Circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit for short to ground
B130B-15	Right Rear Fog Lamp - Circuit short to battery or open	<ul style="list-style-type: none"> Circuit short to power or open 	Refer to the electrical circuit diagrams and check the circuit for short to power or open circuit
B130E-11	Left Rear Fog Lamp - Circuit short to ground	<ul style="list-style-type: none"> Circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit for short to ground
B130E-15	Left Rear Fog Lamp - Circuit short to battery or open	<ul style="list-style-type: none"> Circuit short to power or open 	Refer to the electrical circuit diagrams and check the circuit for short to power or open circuit
B1311-83	Clock Module - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> Value of signal protection calculation incorrect LIN 1 circuit fault 	Clear the DTC and retest. Refer to electrical circuit diagrams and check power and ground connections to clock module, check LIN circuit. Rectify any wiring faults. If the problem persists, renew the Clock Module. Refer to the warranty policy and procedures manual if a module/component is suspect
B1311-87	Clock Module - missing message	<ul style="list-style-type: none"> The central junction box has detected that the clock is not responding 	Refer to the electrical circuit diagrams to locate the fused supply circuit to the Analogue Clock. With the Ignition supply in the Off state, remove and reinstall the Fuse. Clear the DTC and retest. Refer to electrical circuit diagrams and check power and ground connections to clock module, check LIN circuit. Rectify any wiring faults. If the problem persists, renew the Clock Module. Refer to the warranty policy and procedures manual if a module/component is suspect
B1311-96	Clock Module - Component internal failure	<ul style="list-style-type: none"> Component internal failure 	Refer to the electrical circuit diagrams to locate the fused supply circuit to the Analogue Clock. With the Ignition supply in the Off state, remove and reinstall the Fuse. The clock hands will now set to the 12 position. Cycle the ignition state to On (the clock should now have self-adjusted to the time currently set within the Central Junction Box). Record then clear the stored DTC, cycle the ignition state to Off, return the state to ON, retest, if the DTC returns, renew the Analogue Clock Module. Refer to the warranty policy and procedures manual if a module/component is suspect

DTC	Description	Possible Cause	Action
B134E-11	Switch Illumination Adjustment Control - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B134E-12	Switch Illumination Adjustment Control - Circuit short to battery	<ul style="list-style-type: none"> ● Circuit short to power 	Refer to the electrical circuit diagrams and check the circuit
B134E-13	Switch Illumination Adjustment Control - Circuit open	<ul style="list-style-type: none"> ● Circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
B134F-23	Headlamp Flash Switch - Signal stuck low	<ul style="list-style-type: none"> ● Circuit signal stuck low ● Switch activated for more than one minute 	Check the operation of the switch. Refer to the electrical circuit diagrams and check the circuit
B136A-11	Heated Washer Jet/Nozzle Output Control - Circuit short to ground	<ul style="list-style-type: none"> ● Heated washer jet/nozzle output control circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B136A-12	Heated Washer Jet/Nozzle Output Control - Circuit short to battery	<ul style="list-style-type: none"> ● Heated washer jet/nozzle output control circuit short to power 	Refer to the electrical circuit diagrams and check the circuit
B136A-13	Heated Washer Jet/Nozzle Output Control - Circuit open	<ul style="list-style-type: none"> ● Heated washer jet/nozzle output control circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
B136B-11	Suspension Control Module Wake-up Signal - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B136B-15	Suspension Control Module Wake-up Signal - Circuit short to battery or open	<ul style="list-style-type: none"> ● Circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit
B1A84-51	Car Configuration Data - Not programmed	<ul style="list-style-type: none"> ● Not programmed 	Configure the module using the manufacturers approved diagnostic system
B1A85-96	Ambient Light Sensor - Component internal failure	<ul style="list-style-type: none"> ● Rain Sensor/Ambient Light Sensor obscured ● Sensor incorrectly installed ● Component failure 	Check the Rain/Light Sensor is not obscured. Check the security and installation of the Rain/Light Sensor. Clear the DTC and retest. If the DTC returns suspect an internal fault. Refer to the warranty policy and procedures manual if a module/component is suspect
B1A91-31	Speed/Position Sensor A - No signal	<ul style="list-style-type: none"> ● No signal from sensor (restricted sunroof functionality) ● Hall sensor A failure 	Clear the DTC and retest. If the problem persists, renew the Roof Opening Panel Module. Refer to the warranty policy and procedures manual if a module/component is suspect
B1A92-31	Speed/Position Sensor B - No signal	<ul style="list-style-type: none"> ● No signal from sensor (restricted sunroof functionality) ● Hall sensor B failure 	Clear the DTC and retest. If the problem persists, renew the Roof Opening Panel Module. Refer to the warranty policy and procedures manual if a module/component is suspect
B1B01-55	Key Transponder - Not configured	<ul style="list-style-type: none"> ● Not configured 	Configure the module using the manufacturers approved diagnostic system
B1B01-64	Key Transponder - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	Refer to the electrical circuit diagrams and check the power and ground circuits to the Central Junction Box and remote function actuator module. Check CAN communications between the modules. Re-synchronize ID by re-configuring the remote function actuator module as a new module
B1B01-81	Key Transponder - Invalid serial data received	<ul style="list-style-type: none"> ● Invalid serial data received 	Refer to the electrical circuit diagrams and check the power and ground circuits to the Central Junction Box and remote function actuator module. Check CAN communications between the modules. Re-synchronize ID by re-configuring the remote function actuator module as a new module
B1B01-87	Key Transponder - Missing message	<ul style="list-style-type: none"> ● This DTC could be logged if Smart Key Not Found warning message is displayed, and the start button is pressed without the key in the correct location as defined in the Driver Handbook ● No communication from key transponder during alternative (not passive) start event 	First confirm that the customer has not performed a start event with the key incorrectly located when the warning message Smart Key Not Found is displayed. Re-synchronize ID by re-configuring the Immobilizer Antenna Unit as a New module. Refer to the electrical circuit diagrams and check the power and ground circuits to the Immobilizer Antenna Unit
B1B33-51	Target ID Transfer - Not programmed	<ul style="list-style-type: none"> ● Not programmed ● A new engine management control module has been installed ● Failed communication with 	If necessary, program the relevant module using the manufacturers approved diagnostic system. Clear/ignore DTC

DTC	Description	Possible Cause	Action
		engine management system	
B1B33-64	Target ID Transfer - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure ● Failed communication with engine management system 	No action necessary, clear/ignore DTC
B1B33-81	Target ID Transfer - Invalid serial data received	<ul style="list-style-type: none"> ● Invalid serial data received ● Failed communication with engine management system 	No action necessary, clear/ignore DTC
B1B33-87	Target ID Transfer - Missing message	<ul style="list-style-type: none"> ● Missing message ● Failed communication with Engine Control Module 	<ul style="list-style-type: none"> ● NOTE: Only diagnose this DTC if the Customer is reporting a start related issue <p>Clear DTC and retest. If problem persists, carry out CAN Network Integrity Test and On Demand Self Test using the manufacturer approved diagnostic system. Alternatively, refer to the electrical circuit diagrams and check CAN circuits</p>
B1B56-46	Sunroof Module - Calibration/parameter memory failure	<ul style="list-style-type: none"> ● Roof opening panel control module - calibration/parameter memory failure 	Clear the DTC and retest. Re-calibrate the Roof Opening Panel using the manufacturers approved diagnostic system. If the problem persists, renew the Roof Opening Panel Module. Refer to the warranty policy and procedures manual if a module/component is suspect
B1B56-83	Sunroof Module - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● Value of signal protection calculation incorrect 	Clear the DTC and re-test. If the DTC resets, renew the roof opening panel control module. Refer to the warranty policy and procedures manual if a module/component is suspect
B1B56-87	Sunroof Module - Missing message	<ul style="list-style-type: none"> ● Missing message ● LIN 3 circuit fault 	<ul style="list-style-type: none"> ● NOTE: Fault logging is inhibited by the CCF, but an incorrectly configured CCF could give erroneous DTC logging. <p>Check the operation of the Roof Opening Panel Module. Refer to the electrical circuit diagrams and check the LIN circuit between the Roof Opening Panel Module and the Central Junction Box. Should also check LIN control unit power and ground circuits</p>
B1C32-11	Steering Column Tilt Solenoid - Circuit short to ground	<ul style="list-style-type: none"> ● Steering column motor tilt solenoid circuit short to ground 	<ul style="list-style-type: none"> ● NOTE: This component is a serviceable item <p>Refer to the electrical circuit diagrams and check the column tilt solenoid circuit for short to ground</p>
B1C32-15	Steering Column Tilt Solenoid - Circuit short to power or open circuit	<ul style="list-style-type: none"> ● Steering column tilt solenoid circuit short to power or open circuit 	<ul style="list-style-type: none"> ● NOTE: This component is a serviceable item <p>Refer to the electrical circuit diagrams and check the column tilt solenoid circuit for short to power or open circuit</p>
B1C33-12	Steering Column Tilt Feedback Signal - Circuit short to power	<ul style="list-style-type: none"> ● Steering column tilt feedback signal circuit short to power 	Refer to the electrical circuit diagrams and check the column tilt feedback signal circuit for short to power
B1C33-14	Steering Column Tilt Feedback Signal - Circuit short to ground or open circuit	<ul style="list-style-type: none"> ● Steering column tilt feedback signal circuit short to ground or open circuit 	Refer to the electrical circuit diagrams and check the column tilt feedback signal for circuit short to ground or open circuit
B1C34-11	Steering Column Telescopic Solenoid - Circuit short to ground	<ul style="list-style-type: none"> ● Steering column telescopic solenoid circuit short to ground 	<ul style="list-style-type: none"> ● NOTE: This component is a serviceable item <p>Refer to the electrical circuit diagrams and check the column telescopic solenoid circuit for short to ground</p>
B1C34-15	Steering Column Telescopic Solenoid - Circuit short to power or open circuit	<ul style="list-style-type: none"> ● Steering column telescopic solenoid circuit short to power or open circuit 	<ul style="list-style-type: none"> ● NOTE: This component is a serviceable item <p>Refer to the electrical circuit diagrams and check the column telescopic solenoid circuit for short to power or open circuit</p>
B1C35-12	Steering Column Telescopic Feedback Signal - Circuit short to power	<ul style="list-style-type: none"> ● Steering column telescopic feedback signal circuit short to power 	Refer to the electrical circuit diagrams and check the column telescopic feedback signal circuit for short to power
B1C35-14	Steering Column Telescopic Feedback Signal - Circuit short to ground or open circuit	<ul style="list-style-type: none"> ● Steering column telescopic feedback signal circuit short to ground or open circuit 	Refer to the electrical circuit diagrams and check the column telescopic feedback signal circuit for short to ground or open circuit
B1C36-11	Steering Column Adjust Switch - Circuit short to ground	<ul style="list-style-type: none"> ● Steering column adjust switch circuit short to ground 	Refer to the electrical circuit diagrams and check the column adjust switch circuit for short to ground

DTC	Description	Possible Cause	Action
B1C37-23	Master Lock Switch Stuck - Signal stuck low	<ul style="list-style-type: none"> ● Master central lock switch signal circuit short circuit to ground ● Switch activated for more than One minute ● Master central lock switch stuck/jammed ● Master central lock switch failure 	Refer to the electrical circuit diagrams and check the master switch lock circuit. Check the switch operation, renew as necessary. Refer to the warranty policy and procedures manual if a module/component is suspect
B1C38-23	Master Unlock Switch Stuck - Signal stuck low	<ul style="list-style-type: none"> ● Master central unlock switch signal circuit short circuit to ground ● Master central unlock switch stuck/jammed ● Master central unlock switch failure 	Refer to the electrical circuit diagrams and check the master switch unlock circuit. Check the switch operation, renew as necessary. Refer to the warranty policy and procedures manual if a module/component is suspect
B1C43-23	Master Interior Lamp Switch Stuck - Signal stuck low	<ul style="list-style-type: none"> ● Interior lamp circuit short to ground ● Switch activated for more than One minute ● Interior lamp switch fault 	Refer to the electrical circuit diagrams and check the interior lamp circuit. Check the switch operation, renew as necessary. Refer to the warranty policy and procedures manual if a module/component is suspect
B1C44-67	Rear Wiper Park Position Switch Stuck - Signal incorrect after event	<ul style="list-style-type: none"> ● Rear wiper park position circuit short to power, ground, open circuit ● Rear wiper motor park switch fault 	Ensure motor/mechanism is not jammed or seized. Clear the DTC and retest. If the DTC returns refer to the electrical circuit diagrams and check the rear wiper park position circuit. If no circuit fault found suspect an internal fault with the rear wiper motor, check and renew as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1C45-67	Front Wiper Park Position Switch Stuck - Signal incorrect after event	<ul style="list-style-type: none"> ● Front wiper park position circuit short to power, ground, open circuit ● Front wiper motor park switch fault 	Ensure motor/mechanism is not jammed or seized. Clear the DTC and retest. If the DTC returns refer to the electrical circuit diagrams and check the front wiper park position circuit. If no circuit fault found suspect an internal fault with the front wiper motor, check and renew as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1C53-29	Front Wiper Intermittent Data - Signal invalid	<ul style="list-style-type: none"> ● Front wiper intermittent circuit signal invalid ● Front wiper switch fault 	Refer to the electrical circuit diagrams and check the intermittent wiper switch circuit. Check the switch operation, renew as necessary. Refer to the warranty policy and procedures manual if a module/component is suspect
B1C55-12	Horn Relay - Circuit short to battery	<ul style="list-style-type: none"> ● Horn relay coil circuit short to power 	Refer to the electrical circuit diagrams and check the horn relay circuit, repair as necessary
B1C77-11	Rear Wiper Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Rear wiper fast relay coil circuit short to ground 	Refer to the electrical circuit diagrams and check the rear wiper fast relay circuit, repair/renew as necessary
B1C77-12	Rear Wiper Relay - Circuit short to battery	<ul style="list-style-type: none"> ● Rear wiper fast relay coil circuit short to power 	Refer to the electrical circuit diagrams and check the rear wiper fast relay circuit, repair/renew as necessary
B1C77-13	Rear Wiper Relay - Circuit open	<ul style="list-style-type: none"> ● Rear wiper fast relay coil open circuit 	Refer to the electrical circuit diagrams and check the rear wiper fast relay circuit, repair/renew as necessary
B1C82-11	Headlamp Washer Relay A - Circuit short to ground	<ul style="list-style-type: none"> ● Headlamp washer relay output circuit short to ground 	Refer to the electrical circuit diagrams and check the headlamp washer pump relay circuit, repair/renew as necessary
B1C82-12	Headlamp Washer Relay A - Circuit short to battery	<ul style="list-style-type: none"> ● Headlamp washer relay output circuit short to power 	Refer to the electrical circuit diagrams and check the headlamp washer pump relay circuit, repair/renew as necessary
B1C82-13	Headlamp Washer Relay A - Circuit open	<ul style="list-style-type: none"> ● Headlamp washer relay output circuit open circuit 	Refer to the electrical circuit diagrams and check the headlamp washer pump relay circuit, repair/renew as necessary
B1C90-11	Auxiliary Driving Lamps Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary
B1C90-12	Auxiliary Driving Lamps Relay - Circuit short to battery	<ul style="list-style-type: none"> ● Circuit short to power 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary
B1C90-13	Auxiliary Driving Lamps Relay - Circuit open	<ul style="list-style-type: none"> ● Circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary
B1C98-11	Left Corner Lamp Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Left-hand corner lamp short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary
B1C98-15	Left Corner Lamp Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Left-hand corner lamp short circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary

DTC	Description	Possible Cause	Action
B1C99-11	Right Corner Lamp Circuit - Circuit short to ground	<ul style="list-style-type: none"> Right-hand corner lamp short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary
B1C99-15	Right Corner Lamp Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> Right-hand corner lamp short circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary
B1D00-11	Left Low Beam - Circuit short to ground	<ul style="list-style-type: none"> Left low beam circuit short to ground 	Refer to the electrical circuit diagrams and check left low beam circuit for short to ground
B1D00-15	Left Low Beam - Circuit short to battery or open	<ul style="list-style-type: none"> Left low beam circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check left low beam circuit for short circuit to power or open circuit
B1D01-11	Right Low Beam - Circuit short to ground	<ul style="list-style-type: none"> Right low beam circuit short to ground 	Refer to the electrical circuit diagrams and check right low beam circuit for short to ground
B1D01-15	Right Low Beam - Circuit short to battery or open	<ul style="list-style-type: none"> Right low beam circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check right low beam circuit for short circuit to power or open circuit
B1D02-11	Left High Beam - Circuit short to ground	<ul style="list-style-type: none"> Left high beam circuit short to ground 	Refer to the electrical circuit diagrams and check left high beam circuit for short to ground
B1D02-15	Left High Beam - Circuit short to battery or open	<ul style="list-style-type: none"> Left high beam circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check left high beam circuit for short circuit to power or open circuit
B1D03-11	Right High Beam - Circuit short to ground	<ul style="list-style-type: none"> Right high beam circuit short to ground 	Refer to the electrical circuit diagrams and check right high beam circuit for short to ground
B1D03-15	Right High Beam - Circuit short to battery or open	<ul style="list-style-type: none"> Right high beam circuit short circuit to power or open circuit 	Refer to the electrical circuit diagrams and check right high beam circuit for short circuit to power or open circuit
B1D08-11	Left Trailer Direction Indicator Circuit - Circuit short to ground	<ul style="list-style-type: none"> Left trailer turn signal short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary. If no fault found with vehicle suspect issue lies with trailer socket connected equipment
B1D09-11	Right Trailer Direction Indicator Circuit - Circuit short to ground	<ul style="list-style-type: none"> Right trailer turn signal short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit, repair/renew as necessary. If no fault found with vehicle suspect issue lies with trailer socket connected equipment
B1D13-11	Interior Lights Circuit "A" - Circuit short to ground	<ul style="list-style-type: none"> Circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the circuit
B1D13-15	Interior Lights Circuit "A" - Circuit short to battery or open	<ul style="list-style-type: none"> Circuit short circuit to power or open circuit 	<p>• NOTE: This DTC may be logged under normal operating conditions. No action required if function is correct</p> <p>Refer to the electrical circuit diagrams and check the circuit.</p>
B1D17-83	Battery Backed Sounder - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> Value of signal protection calculation incorrect 	Clear the DTC and retest. If the problem persists, renew the Battery Backed Sounder. Refer to the warranty policy and procedures manual if a module/component is suspect
B1D17-87	Battery Backed Sounder - Missing message	<ul style="list-style-type: none"> Missing message 	<p>• NOTE: Fault logging is inhibited by the CCF, but an incorrectly configured CCF could give erroneous DTC logging</p> <p>Check the operation of the Battery Backed Sounder. Refer to the electrical circuit diagrams and check the LIN circuit between the Battery Backed Sounder and the Central Junction Box. Should also check LIN control unit power and ground circuits</p>
B1D17-96	Battery Backed Sounder - Component internal failure	<ul style="list-style-type: none"> Component internal failure 	Clear the DTC and retest, if the problem persists renew Battery Backed Sounder. Refer to the warranty policy and procedures manual if a module/component is suspect
B1D35-23	Hazard Switch Stuck - Signal stuck low	<ul style="list-style-type: none"> Hazard switch circuit short to ground Switch activated for more than One minute Hazard switch fault 	Check the hazard switch operation, refer to the electrical circuit diagrams and check the hazard switch circuit. Repair/renew as necessary. Refer to the warranty policy and procedures manual if a module/component is suspect
B1D97-96	Tilt Sensor - Component internal failure	<ul style="list-style-type: none"> Component internal failure 	Clear the DTC and retest, if the problem persists renew the Battery Backed Sounder. Refer to the warranty policy and procedures manual if a module/component is suspect
C111A-11	Right Stop Lamp - Circuit short to ground	<ul style="list-style-type: none"> Right stop lamp circuit short to ground 	Refer to the electrical circuit diagrams and check right stop lamp circuit

DTC	Description	Possible Cause	Action
C111A-15	Right Stop Lamp - Circuit short to battery or open	<ul style="list-style-type: none"> ● Right stop lamp circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check right stop lamp circuit
C111B-11	Left Stop Lamp - Circuit short to ground	<ul style="list-style-type: none"> ● Left stop lamp circuit short to ground 	Refer to the electrical circuit diagrams and check left stop lamp circuit
C111B-15	Left Stop Lamp - Circuit short to battery or open	<ul style="list-style-type: none"> ● Left stop lamp circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check left stop lamp circuit
C1A56-16	Left Front Tire Pressure Sensor and Transmitter Assembly - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Tire low pressure sensor low battery voltage 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
C1A56-86	Left Front Tire Pressure Sensor and Transmitter Assembly - Signal invalid	<ul style="list-style-type: none"> ● Tire low pressure sensor has reported out of range information for pressure, temperature or acceleration 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
C1A56-93	Left Front Tire Pressure Sensor and Transmitter Assembly - no operation	<ul style="list-style-type: none"> ● Tire low pressure sensor reception lost during driving caused by radio frequency interference, defective tire low pressure sensor or radio frequency receiver issues 	Refer to pinpoint test D in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
C1A57-12	Left Front Initiator - Circuit short to battery	<ul style="list-style-type: none"> ● Left front initiator or circuit short to power 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check front left initiator and circuit for short to power. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1A57-14	Left Front Initiator - Circuit short to ground or open	<ul style="list-style-type: none"> ● Left front initiator or circuit short to ground or open circuit 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check front left initiator and circuit for short to ground or open circuit. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1A58-16	Right Front Tire Pressure Sensor and Transmitter Assembly - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Tire low pressure sensor low battery voltage 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
C1A58-86	Right Front Tire Pressure Sensor and Transmitter Assembly - Signal invalid	<ul style="list-style-type: none"> ● Tire low pressure sensor has reported out of range information for pressure, temperature or acceleration 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
C1A58-93	Right Front Tire Pressure Sensor and Transmitter Assembly - no operation	<ul style="list-style-type: none"> ● Tire low pressure sensor reception lost during driving caused by radio frequency interference, defective tire low pressure sensor or radio frequency receiver issues 	Refer to pinpoint test D in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
C1A59-12	Right Front Initiator - Circuit short to battery	<ul style="list-style-type: none"> ● Right front initiator or circuit short to power 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check front right initiator and circuit for short to power. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1A59-14	Right Front Initiator - Circuit short to ground or open	<ul style="list-style-type: none"> ● Right front initiator or circuit short to ground or open circuit 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check front right initiator and circuit for short to ground or open circuit. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1A60-16	Left Rear Tire Pressure Sensor and Transmitter Assembly - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Tire low pressure sensor low battery voltage 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect

DTC	Description	Possible Cause	Action
C1A60-86	Left Rear Tire Pressure Sensor and Transmitter Assembly - Signal invalid	<ul style="list-style-type: none"> Tire low pressure sensor has reported out of range information for pressure, temperature or acceleration 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
C1A60-93	Left Rear Tire Pressure Sensor and Transmitter Assembly - no operation	<ul style="list-style-type: none"> Tire low pressure sensor reception lost during driving caused by radio frequency interference, defective tire low pressure sensor or radio frequency receiver issues 	Refer to pinpoint test D in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
C1A61-12	Left Rear Initiator - Circuit short to battery	<ul style="list-style-type: none"> Left rear initiator or circuit short to power 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check rear left initiator and circuit for short to power. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1A61-14	Left Rear Initiator - Circuit short to ground or open	<ul style="list-style-type: none"> Left rear initiator or circuit short to ground or open circuit 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check rear left initiator and circuit for short to ground or open circuit. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1A62-16	Right Rear Tire Pressure Sensor and Transmitter Assembly - Circuit voltage below threshold	<ul style="list-style-type: none"> Tire low pressure sensor low battery voltage 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
C1A62-86	Right Rear Tire Pressure Sensor and Transmitter Assembly - Signal invalid	<ul style="list-style-type: none"> Tire low pressure sensor has reported out of range information for pressure, temperature or acceleration 	Install a new Tire pressure monitoring system Tire low pressure sensor. Refer to the warranty policy and procedures manual if a module/component is suspect
C1A62-93	Right Rear Tire Pressure Sensor and Transmitter Assembly-no operation	<ul style="list-style-type: none"> Tire low pressure sensor reception lost during driving caused by radio frequency interference, defective tire low pressure sensor or radio frequency receiver issues 	Refer to pinpoint test D in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
C1A63-12	Right Rear Initiator - Circuit short to battery	<ul style="list-style-type: none"> Right rear initiator or circuit short to power 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check rear right initiator and circuit for short to power. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1A63-14	Right Rear Initiator - Circuit short to ground or open	<ul style="list-style-type: none"> Right rear initiator or circuit short to ground or open circuit 	Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm the fault is present. Refer to the electrical circuit diagrams and check rear right initiator and circuit for short to ground or open circuit. Carry out On Demand Self Test (ODST) using manufacturer approved diagnostic system to confirm rectification
C1D18-00	Wheel Localization Failed - No sub type information	<ul style="list-style-type: none"> Less than 3 Tire low pressure sensors can be localized at the running wheel positions due to an initiator or Tire low pressure sensor malfunction 	Refer to pinpoint test E in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
C1D21-05	Wheel Module - System Programming Failures	<ul style="list-style-type: none"> Tire low pressure sensor reception missing from the start of driving cycle (i.e. when ignition changed from off to on) caused by incompatible or defective Tire low pressure sensor(s) or radio frequency receiver 	Refer to pinpoint test F in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
C2004-11	Headlamp washer relay B - Circuit short to ground	<ul style="list-style-type: none"> Headlamp washer relay B circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
C2004-12	Headlamp washer relay B - Circuit short to power	<ul style="list-style-type: none"> Headlamp washer relay B circuit short to power 	Refer to the electrical circuit diagrams and check the circuit

DTC	Description	Possible Cause	Action
C2004-13	Headlamp washer relay B - Circuit open	<ul style="list-style-type: none"> Headlamp washer relay B circuit open circuit 	Refer to the electrical circuit diagrams and check the circuit
P0230-12	Fuel Pump Primary Circuit - Circuit short to battery	<ul style="list-style-type: none"> Circuit short circuit to power 	Refer to the electrical circuit diagrams and check the circuit
U0001-88	High Speed CAN Communication Bus - Bus off	<ul style="list-style-type: none"> Bus off 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0004-00	High Speed CAN Communication Bus (+) Low - No sub type information	<ul style="list-style-type: none"> High speed CAN communication Bus (+) short to ground 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0005-00	High Speed CAN Communication Bus (+) High - No sub type information	<ul style="list-style-type: none"> High speed CAN communication Bus (+) short to power 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0008-00	High Speed CAN Communication Bus (-) High - No sub type information	<ul style="list-style-type: none"> High speed CAN communication Bus (-) short to power 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0009-00	High Speed CAN Communication Bus (-) shorted to Bus (+) - No sub type information	<ul style="list-style-type: none"> High speed CAN communication Bus (-) shorted to (+) 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0010-88	Medium Speed CAN Communication Bus - Bus off	<ul style="list-style-type: none"> Bus off 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0013-00	Medium Speed CAN Communication Bus (+) Low - No sub type information	<ul style="list-style-type: none"> Medium speed CAN communication Bus (+) short to ground 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0014-00	Medium Speed CAN Communication Bus (+) High - No sub type information	<ul style="list-style-type: none"> Medium speed CAN communication Bus (+) short to power 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0017-00	Medium Speed CAN Communication Bus (-) High - No sub type information	<ul style="list-style-type: none"> Medium speed CAN communication Bus (-) short to power 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0018-00	Medium Speed CAN Communication Bus (-) shorted to Bus (+) - No sub type information	<ul style="list-style-type: none"> Medium speed CAN communication Bus (-) shorted to (+) 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0100-00	Lost Communication With ECM/PCM "A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Engine Control Module and Central Junction Box
U0101-00	Lost Communication With Transmission Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transmission Control Module and Central Junction Box
U0102-00	Lost Communication With Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transfer Case Control Module and Central Junction Box
U0121-00	Lost Communication With Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network

DTC	Description	Possible Cause	Action
			between the Anti-lock Braking System Module and Central Junction Box
U0126-00	Lost Communication With Steering Angle Sensor Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Steering Angle Sensor Module and Central Junction Box
U0128-00	Lost Communication With Park Brake Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Parking Brake Control Module and Central Junction Box
U0132-00	Lost Communication With Suspension Control Module "A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Suspension Control Module and Central Junction Box
U0138-00	Lost Communication with All Terrain Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Terrain Response Control Module and Central Junction Box
U0139-00	Lost Communication With Suspension Control Module "B" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Suspension Control Module and Central Junction Box
U0151-00	Lost Communication With Restraints Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Restraints Control Module and Central Junction Box
U0155-00	Lost Communication With Instrument Panel Cluster (IPC) Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Instrument Cluster and Central Junction Box
U0164-00	Lost Communication With HVAC Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Heating and Ventilation Control Module and Central Junction Box
U0184-00	Lost Communication With Radio - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the radio control module and Central Junction Box
U0199-00	Lost communication with Driver Door Module (DDM) - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Driver Door Module and Central Junction Box
U0200-00	Lost Communication With "Door Control Module "B" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Passenger Door Module and Central Junction Box

DTC	Description	Possible Cause	Action
U0208-00	Lost Communication With "Seat Control Module "A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Driver Seat Module and Central Junction Box
U0214-00	Lost Communication With Remote Function Actuation - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Remote Function Actuation module and Central Junction Box
U0241-00	Lost Communication With Headlamp Control Module "A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Headlamp Control Module A and Central Junction Box
U0242-00	Lost Communication With Headlamp Control Module "B" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Headlamp Control Module B and Central Junction Box
U1000-00	Solid State Driver Protection Active - Driver Disabled - No sub type information	<ul style="list-style-type: none"> No sub type information 	<ul style="list-style-type: none"> NOTE: when this DTC is present the relevant output is disabled <p>Check Central Junction Box for additional load related DTCs and refer to remedial actions for those DTCs. This DTC should only be cleared after all short circuit faults have been rectified</p>
U200D-11	Control Module Output Power A - Circuit short to ground	<ul style="list-style-type: none"> Circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit, repair as necessary
U200D-14	Control Module Output Power A - Circuit short to ground or open	<ul style="list-style-type: none"> Circuit short to ground or open circuit 	Refer to the electrical circuit diagrams and check the circuit, repair as necessary
U200D-15	Control Module Output Power A - Circuit short to battery or open	<ul style="list-style-type: none"> Circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit, repair as necessary
U200E-11	Control Module Output Power B - Circuit short to ground	<ul style="list-style-type: none"> Circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit, repair as necessary
U2010-11	Switch Illumination - Circuit short to ground	<ul style="list-style-type: none"> Switch illumination circuit short to ground 	Refer to electrical circuit diagrams and check the switch illumination circuit
U2017-51	Control Module Software #2 - Not programmed	<ul style="list-style-type: none"> Not programmed 	Configure the module using the manufacturers approved diagnostic system
U201B-54	Control Module Calibration Data #2 - Missing calibration	<ul style="list-style-type: none"> Missing calibration 	Configure the module using the manufacturers approved diagnostic system by running the relevant Configuration and Set up application for calibrating the Steering Column
U201F-04	External Receiver - system internal failures	<ul style="list-style-type: none"> Incompatible or defective external receiver 	Install the correct external receiver
U201F-11	External Receiver - Circuit short to ground	<ul style="list-style-type: none"> Tire pressure monitoring system radio frequency receiver or data line, short to ground 	Refer to pinpoint test A in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
U201F-12	External Receiver - Circuit short to battery	<ul style="list-style-type: none"> Tire pressure monitoring system radio frequency receiver or data line, short to power 	Refer to pinpoint test B in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
U201F-87	External Receiver - missing message	<ul style="list-style-type: none"> Tire pressure monitoring system radio frequency receiver or data line, open circuit Tire pressure monitoring system radio frequency receiver faulty 	Refer to pinpoint test C in the wheels and tires diagnosis and testing section of the workshop manual (see section 204-04) and proceed as directed
U2101-00	Control Module Configuration Incompatible	<ul style="list-style-type: none"> Car Configuration File incorrect 	Check and amend the Car Configuration File as required using the manufacturer approved diagnostic system

DTC	Description	Possible Cause	Action
U2104-23	Trip Meter Reset Button - Signal stuck low	<ul style="list-style-type: none"> ● Signal stuck low ● Switch activated for more than One minute ● Switch failure 	<ul style="list-style-type: none"> • NOTE: The Trip Switch connection at the Central Junction Box is C0581-25 <p>Check the operation of the switch. Refer to the electrical circuit diagrams and check the switch circuit. Clear the DTC and retest. If the DTC persists, renew the switch. Refer to the warranty policy and procedures manual if a module/component is suspect</p>
U2300-64	Central Configuration - Signal plausibility failure	<ul style="list-style-type: none"> ● Tire pressure monitoring system configuration data is invalid caused by incorrect car / local configuration file(s) 	Using the manufacturer approved diagnostic system check and amend the car / local configuration file (s)
U3000-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> ● Internal electronic failure 	Renew Central Junction Box. Refer to the warranty policy and procedures manual if a module/component is suspect
U3001-54	Control Module Improper Shutdown - Missing calibration	<ul style="list-style-type: none"> ● Missing calibration ● EEPROM hasn't stored the final axis position of the steering column telescope/tilt position 	Check for other steering column telescope/tilt DTCs. Clear the DTC and operate the steering column through the complete telescope and tilt functions ranges. If the DTC returns, configure the steering column module using the manufacturers approved diagnostic system by running the relevant Configuration and Set up application

General Information - Diagnostic Trouble Code (DTC) Index DTC: Climate Control Module (HVAC)

Description and Operation

Climate Control Module (HVAC)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Climate Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Climate Control System](#) (412-00 Climate Control System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
P0530-11	A/C Refrigerant Pressure Sensor A Circuit - circuit short to ground	<ul style="list-style-type: none"> ● A/C refrigerant pressure sensor circuit short to ground ● A/C refrigerant pressure sensor failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check A/C refrigerant pressure sensor circuit for short to ground. Check and install a new A/C refrigerant pressure sensor as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
P0530-15	A/C Refrigerant Pressure Sensor A Circuit - circuit short to battery or open	<ul style="list-style-type: none"> ● A/C refrigerant pressure sensor circuit short to power, open circuit ● A/C refrigerant pressure sensor failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check A/C refrigerant pressure sensor circuit for short to power, open circuit. Check and install a new A/C refrigerant pressure sensor as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
P0645-11	A/C Clutch Relay Control Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● A/C clutch relay control circuit short to ground 	Refer to the electrical circuit diagrams and check A/C clutch relay control circuit for short to ground
C1B14-13	Sensor Supply Voltage A - circuit open	<ul style="list-style-type: none"> ● Fresh - Recirculated air mode motor circuit short to ground, open circuit ● Fresh - Recirculated air mode motor failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check Fresh - Recirculated air mode motor circuit for short to ground, open circuit. Check and install a new Fresh - Recirculated air mode motor as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
C1B15-13	Sensor Supply Voltage B - circuit open	<ul style="list-style-type: none"> ● Fresh - Recirculated air mode motor circuit open circuit ● Evaporator sensor circuit open circuit ● Fresh - Recirculated air mode motor failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check Fresh - Recirculated air mode motor circuit for open circuit. Refer to the electrical circuit diagrams and check evaporator sensor circuit for open circuit. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
B1030-01	Left Front Seat Heater - General Electrical Failure	<ul style="list-style-type: none"> ● Left front seat heater circuit short to ground, short to power, open circuit ● Left front seat 	Refer to the electrical circuit diagrams and check left front seat heater circuit for short to ground, short to power, open circuit. Check and install a new left front seat heater element as required. Check and install a new left front heated seat module as required. Check and install a new Climate Control Module as

DTC	Description	Possible Causes	Action
		heater element(s) failure <ul style="list-style-type: none"> ● Left front seat heater thermistor failure ● Left front heated seat module failure ● Climate Control Module failure 	required. Refer to the warranty policy and procedures manual if a module is suspect
B1030-4B	Left Front Seat Heater - over temperature	<ul style="list-style-type: none"> ● Left front seat heater thermistor failure ● Left front heated seat module failure ● Climate Control Module failure 	Check and install a new left front heater element as required. Check and install a new left front heated seat module as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
B1030-87	Left Front Seat Heater - missing message	<ul style="list-style-type: none"> ● Left front seat heater LIN circuit short to ground, short to power, open circuit ● Left front heated seat module failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check left front seat heater LIN circuit for short to ground, short to power, open circuit. Check and install a new left front heated seat module as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
B1032-01	Right Front Seat Heater - General Electrical Failure	<ul style="list-style-type: none"> ● Right front seat heater circuit short to ground, short to power, open circuit ● Right front seat heater element(s) failure ● Right front seat heater thermistor failure ● Right front heated seat module failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check right front seat heater circuit for short to ground, short to power, open circuit. Check and install a new right front seat heater element as required. Check and install a new right front heated seat module as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
B1032-4B	Right Front Seat Heater - over temperature	<ul style="list-style-type: none"> ● Right front seat heater thermistor failure ● Right front heated seat module failure ● Climate Control Module failure 	Check and install a new right front heater element as required. Check and install a new right front heated seat module as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
B1032-87	Right Front Seat Heater - missing message	<ul style="list-style-type: none"> ● Right front seat heater LIN circuit short to ground, short to power, open circuit ● Right front heated seat module failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check right front seat heater LIN circuit for short to ground, short to power, open circuit. Check and install a new right front heated seat module as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
B1034-01	Left Front Seat Heater Element - General Electrical Failure	<ul style="list-style-type: none"> ● Left front seat heater circuit short to ground, short to power, open circuit ● Left front seat heater element failure ● Left front heated seat module failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check left front seat heater circuit for short to ground, short to power, open circuit. Check and install a new left front seat heater element as required. Check and install a new left front heated seat module as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect
B1036-01	Right Front Seat Heater Element - General Electrical Failure	<ul style="list-style-type: none"> ● Right front seat heater circuit short to ground, short to power, open circuit ● Right front seat heater element failure ● Right front heated seat module failure ● Climate Control Module failure 	Refer to the electrical circuit diagrams and check right front seat heater circuit for short to ground, short to power, open circuit. Check and install a new right front seat heater element as required. Check and install a new right front heated seat module as required. Check and install a new Climate Control Module as required. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Digital Audio Broadcast Module (DABM)

Description and Operation

Digital Audio Broadcast Module (DABM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Digital Audio Broadcast Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: Audio System (415-01, Description and Operation).

DTC	Description	Possible Causes	Action
B11A4-11	L-Band Antenna - Circuit short to ground	<ul style="list-style-type: none"> L-Band antenna circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit between the antenna and the tuner module
B11A4-15	L-Band Antenna - Circuit short to battery or open	<ul style="list-style-type: none"> L-Band antenna circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit between the antenna and the tuner module
B11A5-11	Band 3 Antenna - Circuit short to ground	<ul style="list-style-type: none"> Band 3 antenna circuit short to ground 	Refer to the electrical circuit diagrams and check the circuit
B11A5-15	Band 3 Antenna - Circuit short to battery or open	<ul style="list-style-type: none"> Band 3 antenna circuit short to power or open circuit 	Refer to the electrical circuit diagrams and check the circuit
U3000-04	Control Module - System Internal Failures	<ul style="list-style-type: none"> Digital audio broadcast module internal failure 	Renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
U3000-4A	Control Module - incorrect component installed	<ul style="list-style-type: none"> Digital audio broadcast module incorrect component installed The module has been installed to a vehicle not configured to accept it 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing modules menu and program the module
U3000-55	Control Module - not configured	<ul style="list-style-type: none"> Digital audio broadcast module not configured correctly 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing modules menu and program the module
U3000-87	Control Module - missing message	<ul style="list-style-type: none"> Missing message 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing modules menu and program the module
U3000-98	Control Module - component or system over temperature	<ul style="list-style-type: none"> Digital audio broadcast module component or system over temperature 	Cool the vehicle interior down by ensuring it is in the shade and have the A/C on cool. When cool, clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Digital Audio Control Module C (DACMC)

Description and Operation

Digital Audio Control Module C (DACMC)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Digital Audio Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: Audio System (415-01, Description and Operation).

DTC	Description	Possible Causes	Action
B1A56-02	Antenna - General signal failure	<ul style="list-style-type: none"> Antenna general signal failure 	Renew the diversity antenna amplifier
B1A56-11	Antenna - Circuit short to ground	<ul style="list-style-type: none"> Diversity antenna amplifier circuit short to ground 	Refer to the electrical guides and check the diversity antenna amplifier circuit and the antenna for short circuit to ground
B1A56-12	Antenna - Circuit short to battery	<ul style="list-style-type: none"> Diversity antenna amplifier circuit short to power 	Refer to the electrical guides and check the diversity antenna amplifier circuit and the antenna for short circuit to power
B1A56-13	Antenna - Circuit open	<ul style="list-style-type: none"> Diversity antenna amplifier circuit open circuit 	Refer to the electrical guides and check the diversity antenna amplifier circuit and the antenna for open circuit
U200D-14	Control Module Output Power A - Circuit short to ground or open	<ul style="list-style-type: none"> Diversity antenna amplifier power supply circuit short to ground or open circuit 	Refer to the electrical guides and check the diversity antenna amplifier power circuit
U3000-04	Control Module - System internal failures	<ul style="list-style-type: none"> Diversity antenna amplifier internal failure 	Renew the amplifier module
U3000-4A	Control Module - Incorrect component installed	<ul style="list-style-type: none"> Diversity antenna amplifier internal incorrect component installed The module has been installed to a vehicle not configured to accept it 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing modules menu and program the module
U3000-55	Control Module - Not configured	<ul style="list-style-type: none"> Diversity antenna amplifier not configured correctly 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing modules menu and program the module
U3000-87	Control Module - Missing message	<ul style="list-style-type: none"> Missing message 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing modules menu and program the module
U3000-98	Control Module - Component or system over temperature	<ul style="list-style-type: none"> Diversity antenna amplifier component or system over temperature 	Consider moving the amplifier mounting position to prevent unit overheating. Cool the vehicle interior down by ensuring it is in the shade and have the A/C on cool. When cool, clear the DTC and retest. If the problem persists, renew the amplifier module

General Information - Diagnostic Trouble Code (DTC) IndexDTC: Driver/Passenger Door Module (DDM/PDM)

Description and Operation

Driver/Passenger Door Module (DDM/PDM)

• CAUTIONS:



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.



When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• NOTE: When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the digital multimeter leads into account

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• NOTE: If diagnostic trouble codes are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals

• NOTE: Where an 'on demand self-test' is referred to, this can be accessed via the 'diagnostic trouble code monitor' tab on the manufacturers approved diagnostic system

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Driver/Passenger Door Control Modules, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Rear View Mirrors](#) (501-09 Rear View Mirrors, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B108F-23	Cabin Lock/Unlock Switch - Signal stuck low	<ul style="list-style-type: none"> ● Cabin lock/unlock switch signal stuck ● Switch pressed for longer than 20 seconds ● Switch circuit short circuit to power or ground ● Switch failure 	<ul style="list-style-type: none"> ● Check the switch operation and serviceability. Refer to the electrical circuit diagrams and check the switch circuit
B109C-11	Front Courtesy Light - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test front courtesy light circuit for short to ground
B109C-15	Front Courtesy Light - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test front courtesy light circuit for short to power or open circuit
B10EB-11	Driver door double locking motor - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test driver door double locking motor circuit for short to ground
B10EB-15	Driver door double locking motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test driver door double locking motor circuit for short to power or open circuit
B10EC-11	Passenger door double locking motor - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test passenger door double locking motor circuit for short to ground
B10EC-15	Passenger door double locking motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test passenger door double locking motor circuit for short to power or open circuit
B10ED-11	Rear Door Driver Side Double Locking Motor - Circuit short to ground	<ul style="list-style-type: none"> ● Rear driver door double locking motor circuit short circuit to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit

DTC	Description	Possible Causes	Action
B10ED-15	Rear Door Driver Side Double Locking Motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Rear driver door double locking motor circuit short circuit to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit
B10EE-11	Rear Door Passenger Side Double Locking Motor - Circuit short to ground	<ul style="list-style-type: none"> ● Rear passenger door double locking motor circuit short circuit to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit
B10EE-15	Rear Door Passenger Side Double Locking Motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Rear passenger door double locking motor circuit short circuit to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit
B1108-11	Driver door central locking motor - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test driver door central locking motor circuit for short to ground
B1108-15	Driver door central locking motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test driver door central locking motor circuit for short to power or open circuit
B1109-11	Passenger door central locking motor - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test passenger door central locking motor circuit for short to ground
B1109-15	Passenger door central locking motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test passenger door central locking motor circuit for short to power or open circuit
B110A-11	Rear Door Driver Side Central Locking Motor - Circuit short to ground	<ul style="list-style-type: none"> ● Rear driver door central locking motor circuit short circuit to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit
B110A-15	Rear Door Driver Side Central Locking Motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Rear driver door central locking motor circuit short circuit to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit
B110B-11	Rear Door Passenger Side Central Locking Motor - Circuit short to ground	<ul style="list-style-type: none"> ● Rear passenger door central locking motor circuit short circuit to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit
B110B-15	Rear Door Passenger Side Central Locking Motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Rear passenger door central locking motor circuit short circuit to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit
B1163-11	Left Mirror Heater Output short to ground - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test left mirror heater output circuit for short to ground
B1163-15	Left Mirror Heater Output short to power - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test left mirror heater output circuit for short to power or open circuit
B1164-11	Right Mirror Heater Output short to ground - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test right mirror heater output circuit for short to ground
B1164-15	Right Mirror Heater Output short to power - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test right mirror heater output circuit for short to power or open circuit
B1165-11	Left Front Puddle Lamp Output short to ground - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test left front puddle lamp output circuit for short to ground
B1165-15	Left Front Puddle Lamp Output open load or short to power - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test left front puddle lamp output circuit for short to power or open circuit
B1166-11	Right Front Puddle Lamp Output short to ground - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test right front puddle lamp output circuit for short to ground
B1166-15	Right Front Puddle Lamp Output open load or short to battery - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test right front puddle lamp output circuit for short to power or open circuit

DTC	Description	Possible Causes	Action
B117C-07	Rear Power Window Up - Mechanical Failures	<ul style="list-style-type: none"> ● Set when window is reversed during window up due to mechanical problems, window channel restriction preventing window closure or Window mechanism fault 	<ul style="list-style-type: none"> ● Check for mechanical problems with the window operation. Check for obstructions in the window channels and that the glass is not restricted in the full range of travel
B117C-72	Rear Power Window Up - Actuator stuck open	<ul style="list-style-type: none"> ● Door module internal relay sticking open 	<ul style="list-style-type: none"> ● Renew the relevant rear door module. Refer to the warranty policy and procedures manual if a module is suspect
B117C-73	Rear Power Window Up - Actuator stuck closed	<ul style="list-style-type: none"> ● Door module internal relay sticking closed 	<ul style="list-style-type: none"> ● Renew the relevant rear door module. Refer to the warranty policy and procedures manual if a module is suspect
B117C-92	Rear Power Window Up - performance or incorrect operation	<ul style="list-style-type: none"> ● Set when auto window up was interrupted (e.g. by pressing local switch) 	<ul style="list-style-type: none"> ● Check the window operation. Clear the DTC and retest
B117D-72	Rear Power Window Down - Actuator stuck open	<ul style="list-style-type: none"> ● Door module internal relay sticking open 	<ul style="list-style-type: none"> ● Renew the relevant rear door module. Refer to the warranty policy and procedures manual if a module is suspect
B117D-73	Rear Power Window Down - Actuator stuck closed	<ul style="list-style-type: none"> ● Door module internal relay sticking closed 	<ul style="list-style-type: none"> ● Renew the relevant rear door module. Refer to the warranty policy and procedures manual if a module is suspect
B117E-07	Front Power Window Up - Mechanical Failures	<ul style="list-style-type: none"> ● Set when window is reversed during window up due to mechanical problems, window channel restriction preventing window closure or Window mechanism fault 	<ul style="list-style-type: none"> ● Check for mechanical problems with the window operation. Check for obstructions in the window channels and that the glass is not restricted in the full range of travel
B117E-72	Front Power Window Up - Actuator stuck open	<ul style="list-style-type: none"> ● Door module internal relay sticking open 	<ul style="list-style-type: none"> ● Renew the relevant front door module. Refer to the warranty policy and procedures manual if a module is suspect
B117E-73	Front Power Window Up - Actuator stuck closed	<ul style="list-style-type: none"> ● Door module internal relay sticking closed 	<ul style="list-style-type: none"> ● Renew the relevant front door module. Refer to the warranty policy and procedures manual if a module is suspect
B117E-92	Front Power Window Up - performance or incorrect operation	<ul style="list-style-type: none"> ● Set when auto window up was interrupted (e.g. by pressing local switch) 	<ul style="list-style-type: none"> ● Check the window operation. Clear the DTC and retest
B117F-72	Front Power Window Down - Actuator stuck open	<ul style="list-style-type: none"> ● Door module internal relay sticking open 	<ul style="list-style-type: none"> ● Renew the relevant front door module. Refer to the warranty policy and procedures manual if a module is suspect
B117F-73	Front Power Window Down - Actuator stuck closed	<ul style="list-style-type: none"> ● Door module internal relay sticking closed 	<ul style="list-style-type: none"> ● Renew the relevant front door module. Refer to the warranty policy and procedures manual if a module is suspect
B1189-29	Front Window Position Sensor - Signal invalid	<ul style="list-style-type: none"> ● Missing signal from hall sensor 1 or 2 ● Sensor circuit fault ● Hall sensor fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the hall sensor circuit between the door module and window motor. Repair as necessary. If the problem persists, renew the window motor
B118A-29	Rear Window Position Sensor - Signal invalid	<ul style="list-style-type: none"> ● Missing signal from hall sensor 1 or 2 ● Sensor circuit fault ● Hall sensor fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the hall sensor circuit between the door module and window motor. Repair as necessary. If the problem persists, renew the window motor
B11D1-83	LIN Bus "C" - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● LIN Bus checksum error; driver switchpack internal fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the LIN Bus circuit between the driver door window switch and the door module. Check the connectors for integrity and security. Clear the DTC and retest. If the problem persists, renew the driver door window switch
B11D1-86	LIN Bus "C" - Signal invalid	<ul style="list-style-type: none"> ● LIN Bus header error; driver switchpack internal fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the LIN Bus circuit between the driver door window switch and the door module. Check the connectors for integrity and security. Clear the DTC and retest. If the problem persists, renew the driver door window switch

DTC	Description	Possible Causes	Action
B11D1-87	LIN Bus "C" - Missing message	<ul style="list-style-type: none"> ● Slave node communication missing; driver switchpack internal fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the LIN Bus circuit between the driver door window switch and the door module. Check the connectors for integrity and security. Clear the DTC and retest. If the problem persists, renew the driver door window switch
B11F6-11	Driver Folding Mirror Motor - Circuit short to ground	<ul style="list-style-type: none"> ● Driver folding mirror motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror fold circuit between the drivers door module and the mirror assembly. Repair as necessary
B11F6-15	Driver Folding Mirror Motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Driver mirror heater output circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror fold circuit between the drivers door module and the mirror assembly. Repair as necessary
B11F7-11	Passenger Folding Mirror Motor - Circuit short to ground	<ul style="list-style-type: none"> ● Passenger folding mirror motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror fold circuit between the passenger door module and the mirror assembly. Repair as necessary
B11F7-15	Passenger Folding Mirror Motor - Circuit short to battery or open	<ul style="list-style-type: none"> ● Passenger mirror heater output circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror fold circuit between the passenger door module and the mirror assembly. Repair as necessary
B1A98-83	LIN Bus Circuit #1 - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● Value of signal protection calculation incorrect 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the LIN Bus circuit between the rear door control unit and the Driver Door Module. Check the connectors for integrity and security. Clear the DTC and retest. If the problem persists, renew the rear door control module
B1A98-86	LIN Bus Circuit #1 - Signal invalid	<ul style="list-style-type: none"> ● Signal invalid 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the LIN Bus circuit between the rear door control unit and the Driver Door Module. Check the connectors for integrity and security. Clear the DTC and retest. If the problem persists, renew the rear door control module
B1A98-87	LIN Bus Circuit #1 - Missing message	<ul style="list-style-type: none"> ● Missing message 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the LIN Bus circuit between the rear door control unit and the Driver Door Module. Check the connectors for integrity and security. Clear the DTC and retest. If the problem persists, renew the rear door control module
B1C09-11	Driver Left/Right Mirror Motor Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to ground ● Mirror left/right motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the drivers door module and the mirror assembly. Repair as necessary
B1C09-15	Driver Left/Right Mirror Motor Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to power or open circuit ● Mirror left/right motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the drivers door module and the mirror assembly. Repair as necessary
B1C10-11	Driver Up/Down Mirror Motor Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the drivers door module and the mirror assembly. Repair as necessary
B1C10-15	Driver Up/Down Mirror Motor Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the drivers door module and the mirror assembly. Repair as necessary
B1C11-11	Passenger Left/Right Mirror Motor Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary
B1C11-15	Passenger Left/Right Mirror Motor Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary

DTC	Description	Possible Causes	Action
B1C12-11	Passenger Up/Down Mirror Motor Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary
B1C12-15	Passenger Up/Down Mirror Motor Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary
B1C13-11	Driver Up/Down Mirror Motor Feedback Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the driver door module and the mirror assembly. Repair as necessary
B1C13-15	Driver Up/Down Mirror Motor Feedback Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the driver door module and the mirror assembly. Repair as necessary
B1C14-11	Driver Left/Right Mirror Motor Feedback Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the driver door module and the mirror assembly. Repair as necessary
B1C14-15	Driver Left/Right Mirror Motor Feedback Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Driver mirror adjustment motor circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the driver door module and the mirror assembly. Repair as necessary
B1C15-11	Passenger Up/Down Mirror Motor Feedback Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary
B1C15-15	Passenger Up/Down Mirror Motor Feedback Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary
B1C16-11	Passenger Left/Right Mirror Motor Feedback Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to ground ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary
B1C16-15	Passenger Left/Right Mirror Motor Feedback Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Passenger mirror adjustment motor circuit short circuit to power or open circuit ● Mirror motor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the mirror motor circuit between the passenger door module and the mirror assembly. Repair as necessary
B1C39-29	Key Lock Switch - Signal invalid	<ul style="list-style-type: none"> ● Key lock switch signal invalid, stuck/jammed ● Switch held for longer than 20 seconds ● Key lock switch circuit short to ground (where connected) ● Key lock switch failure ● Central Junction Box fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and the key lock switch circuit. Clear the DTC and retest. If no other DTCs are present, ignore this fault. If the DTC returns, suspect an internal fault with the Central Junction Box. Refer to the warranty policy and procedures manual if a module is suspect
B1D06-11	Left Turn Indicator - Circuit short to ground	<ul style="list-style-type: none"> ● Left turn signal short circuit to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check left turn signal for short circuit to ground
B1D06-15	Left Turn Indicator - Circuit short to battery or open	<ul style="list-style-type: none"> ● Left turn signal short circuit to power ● Left turn signal high resistance, open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check left turn signal for short circuit high resistance, open circuit
B1D07-11	Right Turn Indicator - Circuit short to ground	<ul style="list-style-type: none"> ● Right turn signal short circuit to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check right turn signal for short circuit to ground
B1D07-15	Right Turn Indicator - Circuit short to battery or open	<ul style="list-style-type: none"> ● Right turn signal circuit short circuit to power ● Right turn signal circuit high resistance, open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check right turn signal for short circuit high resistance, open circuit
C1B14-11	Sensor Supply #1 - Circuit short to ground	<ul style="list-style-type: none"> ● Short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test window sensor supply circuit for short to ground

DTC	Description	Possible Causes	Action
C1B14-15	Sensor Supply #1 - Circuit short to battery or open	<ul style="list-style-type: none"> ● Short to power or open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test window sensor supply circuit for short to power or open circuit
C1B15-11	Sensor Supply Voltage A - Circuit short to ground	<ul style="list-style-type: none"> ● Hall sensor supply circuit short to ground ● Hall sensor fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the hall sensor supply circuit between the rear door module and the window motor. If the problem persists, renew the window motor
C1B15-15	Sensor Supply Voltage A - Circuit short to battery or open	<ul style="list-style-type: none"> ● Hall sensor supply circuit short to power or open circuit ● Hall sensor fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the hall sensor supply circuit between the rear door module and the window motor. If the problem persists, renew the window motor
U0010-00	Medium speed CAN communication Bus - No sub type information	<ul style="list-style-type: none"> ● Medium speed CAN communication Bus 	<ul style="list-style-type: none"> ● Carry out network integrity test using manufacturer approved diagnostic system. Refer to electrical circuit diagrams and test Medium speed CAN network for open, short circuit and high resistance
U0140-00	Lost communication with CJB - No sub type information	<ul style="list-style-type: none"> ● Logged when subscribed CAN message missing from CJB 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test power and ground supplies to Central Junction Box. Check CAN network between Driver Door Module and Central Junction Box. Carry out network integrity test using manufacturer approved diagnostic system
U0208-00	Lost communication With Driver Seat Module (DSM) - No sub type information	<ul style="list-style-type: none"> ● Missing message 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test power and ground supplies to Driver Seat Module. Check CAN network between Driver Door Module and Driver Seat Module. Carry out network integrity test using manufacturer approved diagnostic system
U0300-00	Internal control module software incompatibility - No sub type information	<ul style="list-style-type: none"> ● Invalid configuration message is received 	<ul style="list-style-type: none"> ● Re-configure the Rear Junction Box using the manufacturer approved diagnostic system. Clear the DTC and retest. If the DTC is still logged suspect the DDM/PDM. Refer to the warranty policy and procedures manual if a module is suspect
U2002-24	Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high 	<ul style="list-style-type: none"> ● Clear DTC and re-test. If DTC remains, install a new passenger side window switch
U2004-24	Auxiliary Switch Pack - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Left or right rear door local switch pressed for longer than 20 seconds ● Switch circuit short to ground or power 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the left and right door switch circuits
U2010-11	Switch Illumination - Circuit short to ground	<ul style="list-style-type: none"> ● Switch illumination circuit short to ground 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and check the switch illumination circuit
U2012-08	Car Configuration Parameter(s) - Bus Signal/Message Failures	<ul style="list-style-type: none"> ● Bus signal/message failures 	<ul style="list-style-type: none"> ● Cycle the ignition status and re-test. If DTC remains, re-configure the RJB using the manufacturer approved diagnostic system
U2013-24	Switch Pack - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high 	<ul style="list-style-type: none"> ● Clear DTC and re-test. If DTC remains, install a new driver side window switch pack
U2014-44	Control module hardware - Data memory failure	<ul style="list-style-type: none"> ● Data Memory Failure 	<ul style="list-style-type: none"> ● Install a new DDM/PDM, Refer to the warranty policy and procedures manual if a module is suspect
U2100-00	Initial configuration not complete - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	<ul style="list-style-type: none"> ● Re-configure the DDM/PDM using the manufacturer approved diagnostic system
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	<ul style="list-style-type: none"> ● Re-configure the module using the manufacturer approved diagnostic system. Check the configuration of the Car Configuration File (CCF)
U3003-62	Battery voltage - Signal compare failure	<ul style="list-style-type: none"> ● Mis-match of battery voltage, of 2 volts or lower, between DDM/PDM and RJB 	<ul style="list-style-type: none"> ● Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power and ground supply circuits to both modules

General Information - Diagnostic Trouble Code (DTC) Index DTC: Driver/Passenger Front Seat Module (DSM/PSM)

Description and Operation

Driver/Passenger Front Seat Module (DSM/PSM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Drivers/Passenger Seat Modules, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Seats](#) (501-10 Seating, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1060-11	Seat Headrest Motor Output - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat headrest motor circuit
B1060-15	Seat Headrest Motor Output - Circuit short to battery or open	<ul style="list-style-type: none"> ● Circuit short to battery or open 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat headrest motor circuit
B1064-31	Seat Headrest Motor Sensor - no signal	<ul style="list-style-type: none"> ● No signal from sensor ● Sensor/motor malfunction ● Harness/connector problem 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat headrest motor sensor circuit
B106D-24	Headrest Up Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B106E-24	Headrest Down Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1087-83	LIN Bus "A" - value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● LIN bus checksum error, value of signal protection calculation incorrect ● Generic LIN bus failure 	Check for other LIN Bus related DTCs. Refer to the electrical circuit diagrams and check the LIN Bus circuit
B1087-86	LIN Bus "A" - Signal invalid	<ul style="list-style-type: none"> ● Generic LIN bus failure ● Signal invalid - LIN bus Bit error / Parity Error /Synch Error 	Check for other LIN Bus related DTCs. Refer to the electrical circuit diagrams and check the LIN Bus circuit
B1087-87	LIN Bus "A" - missing message	<ul style="list-style-type: none"> ● Generic LIN bus failure ● Missing message ● Slave not responding or LIN bus short circuit to ground or power 	Check for other LIN Bus related DTCs. Refer to the electrical circuit diagrams and check the LIN Bus circuit
B1B86-11	Seat Height Motor Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat height motor circuit
B1B86-15	Seat Height Motor Relay - Circuit short to battery or open	<ul style="list-style-type: none"> ● Circuit short to power, open circuit 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat height motor circuit
B1B87-31	Seat Height Motor Speed/Position Sensor - no signal	<ul style="list-style-type: none"> ● No signal from sensor ● Sensor/motor malfunction ● Harness/connector problem 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat headrest motor sensor circuit

DTC	Description	Possible Causes	Action
B1B88-11	Seat Slide Motor Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat slide motor relay circuit
B1B88-15	Seat Slide Motor Relay - Circuit short to battery or open	<ul style="list-style-type: none"> ● Circuit short to power or open circuit 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat slide motor relay circuit
B1B89-31	Seat Slide Motor Speed/Position Sensor - no signal	<ul style="list-style-type: none"> ● No signal from sensor ● Sensor/motor malfunction ● Harness/connector problem 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat slide motor relay circuit
B1B90-11	Seat Tilt Motor Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat tilt motor relay circuit
B1B90-15	Seat Tilt Motor Relay - Circuit short to battery or open	<ul style="list-style-type: none"> ● Circuit short to power or open circuit 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat tilt motor relay circuit
B1B91-31	Seat Tilt Motor Speed/Position Sensor - no signal	<ul style="list-style-type: none"> ● No signal from sensor ● Sensor/motor malfunction ● Harness/connector problem 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat tilt motor speed sensor circuit
B1B92-11	Seat Recline Motor Relay - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to ground 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat recline motor relay circuit
B1B92-15	Seat Recline Motor Relay - Circuit short to battery or open	<ul style="list-style-type: none"> ● Circuit short to power or open circuit 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat recline motor relay circuit
B1B93-31	Seat Recline Motor Speed/Position Sensor - no signal	<ul style="list-style-type: none"> ● No signal from sensor ● Sensor/motor malfunction ● Harness/connector problem 	Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the seat recline motor speed sensor circuit
B1B94-24	Seat Height Up Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1B95-24	Seat Height Down Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1B96-24	Seat Slide Forward Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1B97-24	Seat Slide Backward Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1B98-24	Seat Tilt Up Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1B99-24	Seat Tilt Down Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1C00-24	Seat Recline Up Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1C01-24	Seat Recline Down Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1C02-24	Memory Store Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1C03-24	Memory #1 Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
B1C04-24	Memory #2 Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit

DTC	Description	Possible Causes	Action
B1C05-24	Memory #3 Switch - Signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high ● Switch malfunction 	Check the switch function. Check the seat wiring harness/connectors for security/integrity. Refer to the electrical circuit diagrams and check the switch circuit
U0010-88	Medium speed CAN Communication Bus - Bus off	<ul style="list-style-type: none"> ● CAN signal fault. ● Possible open circuit. ● Faulty Control module. 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and Seat Control Module
U0142-00	Lost Communication With Body Control Module "B" - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and Seat Control Module
U0155-00	Lost Communication With Instrument Panel Cluster (IPC) Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Instrument Panel Cluster and Seat Control Module
U0199-00	Lost Communication With "Door Control Module A" - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Door Control Module and Seat Control Module
U0300-00	Software Incompatibility - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check the module configuration using the approved diagnostic system. Check that the module software versions are the latest release and update as necessary
U1A14-49	CAN Initialization Failure - internal electronic failure	<ul style="list-style-type: none"> ● Module internal electronic failure 	Suspect Seat Control Module. Refer to the warranty policy and procedures manual if a module is suspect
U1A4C-00	Build / End of Line mode Active - No sub type information	<ul style="list-style-type: none"> ● Vehicle configuration incorrect 	Check the module configuration using the approved diagnostic system
U3000-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> ● Internal electronic failure - Internal RAM/ROM error 	Renew the Control module. Refer to the warranty policy and procedures manual if a module is suspect
U3001-46	Control Module Improper Shutdown - calibration / parameter memory failure	<ul style="list-style-type: none"> ● Calibration/parameter memory failure - Any motor activation (slide, height and recline axis) has been interrupted by an control module power disconnection while in manufacturing mode 	Clear the DTC and retest. If the problem persists, configure the module using the manufacturers approved diagnostic system
U3002-81	Vehicle Identification Number - invalid serial data received	<ul style="list-style-type: none"> ● Invalid serial data received 	Configure the module using the manufacturers approved diagnostic system
U3003-16	Battery Voltage - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Battery voltage below threshold (8 volts) 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module
U3003-17	Battery Voltage - Circuit voltage above threshold	<ul style="list-style-type: none"> ● Battery voltage above threshold 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Electric Steering Column Lock Module (VIM)

Description and Operation

Electric Steering Column Lock Module (VIM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Electric Steering Column Lock Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

DTC	Description	Possible Causes	Action
B100D-16	Column Lock Authorisation - circuit voltage below threshold	<ul style="list-style-type: none"> Electric Steering Column Lock circuit short to ground, high resistance, open circuit Electric Steering Column Lock failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check Electric Steering Column Lock circuit for short to ground, high resistance, open circuit. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
B100D-29	Column Lock Authorisation - signal invalid	<ul style="list-style-type: none"> Unlock or lock sensor invalid 	<ul style="list-style-type: none"> Clear the DTC, perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
B100D-42	Column Lock Authorisation - general memory failure	<ul style="list-style-type: none"> Electric Steering Column Lock internal memory failure 	<ul style="list-style-type: none"> Clear the DTC. Complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
B100D-51	Column Lock Authorisation - not programmed	<ul style="list-style-type: none"> Electric Steering Column Lock not programmed 	<ul style="list-style-type: none"> Configure the Electric Steering Column Lock using the manufacturers approved diagnostic system
B100D-62	Column Lock Authorisation - signal compare failure	<ul style="list-style-type: none"> Encrypted data exchange does not match between Electric Steering Column Lock and the Central Junction Box 	<ul style="list-style-type: none"> Configure the Electric Steering Column Lock using the manufacturers approved diagnostic system. Configure the Central Junction Box using the manufacturers approved diagnostic system. If the problem persists, complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest
B100D-64	Column Lock Authorisation - signal plausibility failure	<ul style="list-style-type: none"> Incorrect conditions to allow locking action to continue 	<ul style="list-style-type: none"> Clear the DTC and complete a CAN network integrity test using the manufacturers approved diagnostic system. , Perform an on demand self-test and retest. Check for other control module DTCs, in particular the ABS and powertrain modules. Rectify as necessary. Select the data logging function and confirm the 'Vehicle speed' and 'Engine speed' values are consistent with actual values
B100D-72	Column Lock Authorisation - actuator stuck open	<ul style="list-style-type: none"> Electric Steering Column Lock unable to reach locked state Electric Steering Column Lock internal failure 	<ul style="list-style-type: none"> Clear the DTC. Ensure the vehicle battery supply voltage is between 9-16Volts. Complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
B100D-73	Column Lock Authorisation - actuator stuck closed	<ul style="list-style-type: none"> ● Electric Steering Column Lock unable to reach unlocked state ● Electric Steering Column Lock internal failure 	<ul style="list-style-type: none"> ● Clear the DTC. Ensure the vehicle battery supply voltage is between 9-16Volts. Ensure the column lock bolt movement is not obstructed or restricted (the parked position of the road wheels may be exerting a turning force through the steering column, preventing the lock from releasing. The steering wheel may need to be held against the force to allow the column lock to release). Complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
B100D-77	Column Lock Authorisation - commanded position not reachable	<ul style="list-style-type: none"> ● Electric Steering Column Lock unable to reach unlocked or locked state ● Electric Steering Column Lock internal failure 	<ul style="list-style-type: none"> ● Clear the DTC. Ensure the vehicle battery supply voltage is between 9-16Volts. Ensure the column lock bolt movement is not obstructed or restricted (the parked position of the road wheels may be exerting a turning force through the steering column, preventing the lock from releasing. The steering wheel may need to be held against the force to allow the column lock to release). Complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
B100D-92	Column Lock Authorisation - performance or incorrect operation	<ul style="list-style-type: none"> ● Electric Steering Column Lock mechanism jammed, obstructed ● Electric Steering Column Lock internal failure 	<ul style="list-style-type: none"> ● Clear the DTC. Ensure the vehicle battery supply voltage is between 9-16Volts. Ensure the column lock bolt movement is not obstructed or restricted (the parked position of the road wheels may be exerting a turning force through the steering column, preventing the lock from releasing. The steering wheel may need to be held against the force to allow the column lock to release). Complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
B100D-94	Column Lock Authorisation - unexpected operation	<ul style="list-style-type: none"> ● Electric Steering Column Lock mechanism jammed, obstructed ● Electric Steering Column Lock internal failure 	<ul style="list-style-type: none"> ● Clear the DTC. Ensure the vehicle battery supply voltage is between 9-16Volts. Ensure the column lock bolt movement is not obstructed or restricted (the parked position of the road wheels may be exerting a turning force through the steering column, preventing the lock from releasing. The steering wheel may need to be held against the force to allow the column lock to release). Complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
B100D-96	Column Lock Authorisation - component internal failure	<ul style="list-style-type: none"> ● Electric Steering Column Lock mechanism jammed, obstructed ● Electric Steering Column Lock internal failure 	<ul style="list-style-type: none"> ● Clear the DTC. Ensure the vehicle battery supply voltage is between 9-16Volts. Ensure the column lock bolt movement is not obstructed or restricted (the parked position of the road wheels may be exerting a turning force through the steering column, preventing the lock from releasing. The steering wheel may need to be held against the force to allow the column lock to release). Complete a CAN network integrity test using the manufacturers approved diagnostic system. Perform an on demand self-test and retest. If the problem persists, check and install a new Electric Steering Column Lock. Refer to the warranty policy and procedures manual if a module is suspect
U0001-88	High Speed CAN Communication Bus - bus off	Bus off	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U3002-81	Vehicle Identification Number - invalid serial data received	<ul style="list-style-type: none"> ● Invalid vehicle identification number 	<ul style="list-style-type: none"> ● Confirm the correct VIN details are stored in Steering Column Lock using the approved diagnostic system

General Information - Diagnostic Trouble Code (DTC) Index TDV6 2.7L

Diesel, DTC: Engine Control Module (PCM)

Description and Operation

Engine Control Module (PCM) 2.7L TdV6



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Engine Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B10A2-31	Crash Input - no signal	<ul style="list-style-type: none"> No signal Inertia switch open circuit 	Check the crash inertia switch. Refer to the electrical circuit diagrams and check the inertia switch circuit
B10A2-36	Crash Input - signal frequency too low	<ul style="list-style-type: none"> Signal frequency too low Inertia switch low 	Check the crash inertia switch. Refer to the electrical circuit diagrams and check the inertia switch circuit
B10A2-37	Crash Input - signal frequency too high	<ul style="list-style-type: none"> Signal frequency too high Inertia switch high 	Check the crash inertia switch. Refer to the electrical circuit diagrams and check the inertia switch circuit
B10A2-39	Crash Input - incorrect has too few pulses	<ul style="list-style-type: none"> Incorrect signal; has too few pulses 	Check the crash inertia switch. Refer to the electrical circuit diagrams and check the inertia switch circuit
B10A2-3A	Crash Input - incorrect has too many pulses	<ul style="list-style-type: none"> Incorrect signal; has too many pulses 	Check the crash inertia switch. Refer to the electrical circuit diagrams and check the inertia switch circuit
P0001-13	Fuel Volume Regulator Control Circuit / Open - circuit open	<ul style="list-style-type: none"> Fuel volume control valve circuit open circuit Fuel volume control valve fault 	<ul style="list-style-type: none"> • NOTE: An open circuit will prevent the engine from running. <p>Refer to the electrical circuit diagrams and check the fuel volume control valve and circuits. Check the resistance of the valve and install a new high pressure fuel pump if the resistance is not between 1.5 and 15 ohms (the fuel volume control valve cannot be serviced separately). Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect</p>
P0003-11	Fuel Volume Regulator Control Circuit Low - circuit short to ground	<ul style="list-style-type: none"> Fuel volume control valve circuit short circuit to ground Fuel volume control valve fault 	<ul style="list-style-type: none"> • NOTE: An open circuit will prevent the engine from running. <p>Refer to the electrical circuit diagrams and check the fuel volume control valve and circuits. Check the resistance of the valve and install a new high pressure fuel pump if the resistance is not between 1.5 and 15 ohms (the fuel volume control valve cannot be serviced separately). Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect</p>
P0003-19	Fuel Volume Regulator Control Circuit Low - circuit current above threshold	<ul style="list-style-type: none"> Fuel volume control valve circuit current above threshold Fuel volume control valve fault 	<ul style="list-style-type: none"> • NOTE: An open circuit will prevent the engine from running. <p>Refer to the electrical circuit diagrams and check the fuel volume control valve and circuits. Check the resistance of the valve and install a new high pressure fuel pump if the resistance is not between 1.5 and 15 ohms</p>

DTC	Description	Possible Causes	Action
			(the fuel volume control valve cannot be serviced separately). Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0004-12	Fuel Volume Regulator Control Circuit High - circuit short to battery	<ul style="list-style-type: none"> Fuel volume control valve (VCV) circuit short circuit to power VCV failure 	Refer to the electrical circuit diagrams and check the fuel volume control valve and circuits. Check the resistance of the valve and install a new high pressure fuel pump if the resistance is not between 1.5 and 15 ohms (the fuel volume control valve cannot be serviced separately). Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P000E-21	Fuel Volume Regulator Control Exceeded Learning Limit - signal amplitude < minimum	<ul style="list-style-type: none"> Fuel volume control valve amplitude is less than the minimum specified 	Refer to the electrical circuit diagrams and check the fuel volume control valve and circuits. Check the resistance of the valve and install a new high pressure fuel pump if the resistance is not between 1.5 and 15 ohms (the fuel volume control valve cannot be serviced separately). Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P000E-22	Fuel Volume Regulator Control Exceeded Learning Limit - signal amplitude > maximum	<ul style="list-style-type: none"> Fuel volume control valve amplitude is greater than the maximum specified 	Refer to the electrical circuit diagrams and check the fuel volume control valve and circuits. Check the resistance of the valve and install a new high pressure fuel pump if the resistance is not between 1.5 and 15 ohms (the fuel volume control valve cannot be serviced separately). Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P006A-21	MAP - Mass or Volume Air Flow Correlation - signal amplitude < minimum	<ul style="list-style-type: none"> Air leakage in the intake path between the turbocharger and the engine 	Check the intake air system for leakage after the turbocharger. Check for DTCs indicating a Manifold Absolute Pressure sensor fault. Rectify as necessary. Clear the DTCs and test for normal operation
P006A-22	MAP - Mass or Volume Air Flow Correlation - signal amplitude > maximum	<ul style="list-style-type: none"> Mass or volume air flow correlation: right-hand bank - signal amplitude greater than maximum Oil ingress into the intake manifold Manifold absolute pressure and temperature (MAPT) sensor circuit fault MAPT sensor fault Mass Air Flow (MAF) sensor fault Turbocharger fault 	With the engine at idle, check the manifold air pressure and indicated torque set points using a data logger function. If the manifold air pressure is greater than 140 KPa (20.31 lbs/in ²) or the torque less than 70 Nm (51.63 lbf/ft), check for oil being drawn into the intake manifold. Repair/renew as necessary. Clear the DTCs and test for normal operation. Stop the engine and turn the ignition on. Using a data logger function, monitor the turbocharger actuator angles. Command the actuator to 5% pulse width modulated (PWM) then to 95% pulse width modulated (PWM) and check the angle values. The angle at 5% pulse width modulated (PWM) should be 0 - 20%, and at 95% 80 - 95%. If the values are inside this range, install a new MAF sensor. Refer to the relevant section of the workshop manual. If the values are outside this range, install a new turbocharger. Clear the DTCs and test for normal operation
P007C-16	Charge Air Cooler Temperature Sensor Circuit Low (Bank 1) - circuit voltage below threshold	<ul style="list-style-type: none"> Right-hand charge air temperature sensor circuit voltage below threshold (the charge air temperature sensor is part of the manifold absolute pressure and temperature (MAPT) sensor) Charge air temperature sensor circuit short circuit to ground Right-hand MAPT sensor fault 	Check the right-hand MAPT sensor and circuits. Refer to the electrical circuit diagrams. Check the resistance of the temperature sensor (pins 1 and 4 of the MAPT). Nominal resistance at 20°C (68°F) should be 2.5 Kohms. Install a new MAPT if necessary. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P007D-17	Charge Air Cooler Temperature Sensor Circuit High (Bank 1) - circuit voltage above threshold	<ul style="list-style-type: none"> Charge air temperature sensor circuit voltage above threshold (the charge air temperature sensor is part of the manifold absolute pressure and temperature (MAPT) sensor) Right-hand MAPT sensor 	Check the right-hand MAPT sensor and circuits. Refer to the electrical circuit diagrams. Check the resistance of the temperature sensor (pins 1 and 4 of the MAPT). Nominal resistance at 20°C (68°F) should be 2.5 Kohms. Install a new MAPT if necessary. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation

DTC	Description	Possible Causes	Action
		fault	
P007E-27	Charge Air Cooler Temperature Sensor Circuit Intermittent/Erratic (Bank 1) - signal rate of change above threshold	<ul style="list-style-type: none"> ● Right-hand charge air temperature sensor signal rate of change above threshold (the charge air temperature sensor is part of the manifold absolute pressure and temperature (MAPT) sensor) ● Right-hand MAPT sensor fault 	Check the right-hand MAPT sensor and circuits. Refer to the electrical circuit diagrams. With the engine running and at operating temperature, check the charge air temperature using a data logger function. Record the measurement at idle and increase the engine speed to 3,000 rpm. Record the reading and compare with the idle figure. If the value has increased by more than 20°C in 100 ms, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0087-00	Fuel Rail/System Pressure Too Low - no sub type information	<ul style="list-style-type: none"> ● Fuel rail pressure sensor disconnected ● Fuel rail pressure sensor to Engine Control Module sensing circuit short circuit to ground ● Fuel rail pressure sensor supply circuit high resistance ● Fuel rail pressure sensor failure ● Fuel line leak ● Restricted fuel line ● Fuel pump module circuit high resistance ● Fuel pump module circuit short circuit to ground ● Fuel pump module failure ● Volume control valve fault ● Pressure control valve fault 	Refer to the electrical guides and check the fuel rail pressure sensor circuits. For fuel rail pressure sensor tests, refer to the relevant workshop manual section. Check the low pressure fuel lines for damage or restrictions. Check the fuel pressure. Check the low pressure fuel pump module circuits and operation. Check for fuel rail and high pressure fuel line leaks. Check for volume control valve and pressure control valve DTCs and rectify as necessary
P0087-72	Fuel rail/system pressure too low - actuator stuck open	<ul style="list-style-type: none"> ● Fuel pressure control valve fault - Actuator stuck open 	Refer to the electrical circuit diagrams and check the pressure control valve actuator circuits and rectify as necessary. Check the resistance of the fuel pressure control valve. If the resistance is not between 0 and 5.4 ohms, install a new high pressure fuel pump (the fuel pressure control valve cannot be serviced separately). Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0088-00	Fuel Rail/System Pressure - Too High - no sub type information	<ul style="list-style-type: none"> ● Fuel rail pressure sensor to Engine Control Module wiring (supply/sense) short circuit to each other ● Fuel rail pressure sensor to Engine Control Module sense circuit short circuit to power ● Fuel rail pressure sensor failure ● Fuel pressure control valve (FPCV) fault ● Fuel pump module circuit short circuit to power ● Fuel pump module failure 	Check the fuel rail pressure sensor circuits. Refer to the electrical guides. For fuel rail pressure sensor tests, refer to the relevant workshop manual section. Check the fuel lines, check the fuel pressure and the fuel pump module circuits
P0088-73	Fuel rail/system pressure too high - actuator stuck closed	<ul style="list-style-type: none"> ● Fuel pressure control valve (PCV) stuck closed 	Refer to the electrical circuit diagrams and check the pressure control valve actuator circuits and rectify as necessary. Check the resistance of the fuel pressure control valve. If the resistance is not between 0 and 5.4 ohms, install a new high pressure fuel pump (the fuel pressure control valve cannot be serviced separately). Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0089-21	Fuel Pressure Regulator Performance - signal amplitude < minimum	<ul style="list-style-type: none"> ● Fuel pressure regulator performance - signal amplitude less than minimum ● Fuel pressure regulator signal circuit short to ground, open circuit or high resistance 	Refer to the electrical circuit diagrams and check fuel pressure regulator circuit for short to ground, open circuit, high resistance. Check for fuel pump related DTCs. Check and install new fuel pressure regulator as required

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> Fuel pressure regulator failure 	
P0089-22	Fuel Pressure Regulator Performance - signal amplitude > maximum	<ul style="list-style-type: none"> Fuel pressure regulator performance - signal amplitude greater than maximum Fuel pressure regulator signal circuit short to power Fuel pressure regulator fault 	Refer to the electrical circuit diagrams and check the pressure control valve actuator circuits and rectify as necessary. Check the resistance of the fuel pressure control valve. If the resistance is not between 0 and 5.4 ohms, install a new high pressure fuel pump (the fuel pressure control valve cannot be serviced separately). Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0090-13	Fuel Pressure Regulator 1 Control Circuit/Open - circuit open	<ul style="list-style-type: none"> Fuel pressure control valve circuit open circuit Fuel pressure control valve fault 	Refer to the electrical circuit diagrams and check the pressure control valve actuator circuits and rectify as necessary. Check the resistance of the fuel pressure control valve. If the resistance is not between 0 and 5.4 ohms, install a new high pressure fuel pump (the fuel pressure control valve cannot be serviced separately). Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0091-11	Fuel Pressure Regulator 1 Control Circuit Low - circuit short to ground	<ul style="list-style-type: none"> Fuel pressure control valve circuit short circuit to ground Fuel pressure control valve fault 	Refer to the electrical circuit diagrams and check the pressure control valve actuator circuits and rectify as necessary. Check the resistance of the fuel pressure control valve. If the resistance is not between 0 and 5.4 ohms, install a new high pressure fuel pump (the fuel pressure control valve cannot be serviced separately). Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0091-19	Fuel Pressure Regulator 1 Control Circuit Low - circuit current above threshold	<ul style="list-style-type: none"> Fuel pressure control valve circuit short circuit to power (circuit current above threshold) Fuel pressure control valve fault 	Refer to the electrical circuit diagrams and check the pressure control valve actuator circuits and rectify as necessary. Check the resistance of the fuel pressure control valve. If the resistance is not between 0 and 5.4 ohms, install a new high pressure fuel pump (the fuel pressure control valve cannot be serviced separately). Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0092-12	Fuel Pressure Regulator 1 Control Circuit High - circuit short to battery	<ul style="list-style-type: none"> Fuel pressure control valve circuit short circuit to power Fuel pressure control valve fault 	Refer to the electrical circuit diagrams and check the pressure control valve actuator circuits and rectify as necessary. Check the resistance of the fuel pressure control valve. If the resistance is not between 0 and 5.4 ohms, install a new high pressure fuel pump (the fuel pressure control valve cannot be serviced separately). Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation. Refer to the warranty policy and procedures manual if a high pressure fuel pump is suspect
P0100-36	Mass or Volume Air Flow A Circuit - signal frequency too low	<ul style="list-style-type: none"> Mass Air Flow (MAF) sensor signal frequency too low MAF sensor fault 	Refer to the electrical circuit diagrams and check the MAF sensor and circuits. Clear the DTCs and test for normal operation. If the problem persists, renew the MAF sensor
P0101-16	Mass or Volume Air Flow A Circuit Range/Performance - circuit voltage below threshold	<ul style="list-style-type: none"> Intake air path fault Mass Air Flow (MAF) sensor circuit voltage below threshold MAF sensor fault 	Check the intake air system for leaks, restrictions, etc. Check the MAF sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation. If the problem persists, renew the MAF sensor
P0101-17	Mass or Volume Air Flow A Circuit Range/Performance - circuit voltage above threshold	<ul style="list-style-type: none"> Intake air path fault Mass Air Flow (MAF) sensor circuit voltage above threshold MAF sensor fault 	Check the intake air system for leaks, restrictions, etc. Check the MAF sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation. If the problem persists, renew the MAF sensor

DTC	Description	Possible Causes	Action
P0102-21	Mass or Volume Air Flow A Circuit Low - signal amplitude < minimum	<ul style="list-style-type: none"> ● Intake air system fault ● Mass Air Flow (MAF) sensor circuit signal amplitude less than minimum ● Exhaust gas recirculation (EGR) valve fault 	Check the intake air system for leaks, etc. Repair/renew as necessary. Check the MAF sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary. Check that the EGR valves are not stuck. Using a data logger function, monitor the air flow and EGR valve position for both banks and road test the vehicle. Check that the EGR valves are in synch. Repair/renew as necessary. Clear the DTCs and test for normal operation
P0103-22	Mass or Volume Air Flow A Circuit High - signal amplitude > maximum	<ul style="list-style-type: none"> ● Check for water ingress into the Mass Air Flow (MAF) sensor <ul style="list-style-type: none"> - Water in the air intake can give the impression of high air flow ● Intake air system fault ● Mass Air Flow (MAF) sensor circuit signal amplitude greater than minimum ● Turbocharger fault 	Check the intake air system for leaks, etc. Repair/renew as necessary. Check the MAF sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary. With the ignition on, engine off, and using a data logger function, monitor the turbocharger actuator angles. Command the actuator to 5% pulse width modulated (PWM) then to 95% pulse width modulated (PWM) and check the angle values. The angle at 5% pulse width modulated (PWM) should be 0 - 20%, and at 95% pulse width modulated (PWM) 80 - 95%. If the values are inside this range, install a new MAF sensor. If the values are outside this range, install a new turbocharger. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0104-38	Mass or Volume Air Flow A Circuit Intermittent/Erratic - signal frequency incorrect	<ul style="list-style-type: none"> ● Mass Air Flow (MAF) sensor signal frequency incorrect ● MAF sensor circuit high resistance 	Check the MAF sensor and circuits. Refer to the electrical circuit diagrams. Measure the mass air flow at idle using a data logger function and record the value. Increase the engine speed to 2,000 rpm and record the value. If the value has changed by more than 30.55 g/s install a new MAF sensor and recheck. Clear the DTCs and test for normal operation
P0112-16	Intake Air Temperature Sensor 1 Circuit Low (Bank 1) - circuit voltage below threshold	<ul style="list-style-type: none"> ● Intake Air Temperature (IAT) sensor circuit voltage below threshold ● Intake air temperature sensor fault 	Check the intake air temperature sensor and circuits. Refer to the electrical circuit diagrams. Measure the resistance of the intake air temperature sensor (pins 2 and 3 of the MAF sensor). Nominal resistance at 20°C (68°F) should be 2.5 Kohms. If the values are outside this range, install a new MAF sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0113-17	Intake Air Temperature Sensor 1 Circuit High (Bank 1) - circuit voltage above threshold	<ul style="list-style-type: none"> ● Intake Air Temperature (IAT) sensor circuit voltage above threshold ● Intake air temperature sensor fault 	Check the intake air temperature sensor and circuits. Refer to the electrical circuit diagrams. Measure the resistance of the intake air temperature sensor (pins 2 and 3 of the MAF sensor). Nominal resistance at 20°C (68°F) should be 2.5 Kohms. If the resistance is outside this range, install a new MAF sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0114-27	Intake Air Temperature Sensor 1 Intermittent/Erratic (Bank 1) - signal rate of change above threshold	<ul style="list-style-type: none"> ● Intake Air Temperature (IAT) sensor circuit signal rate of change above threshold ● Intake air temperature sensor fault 	Check the intake air temperature sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to warm up. Read the intake air temperature using a data logger function and record the value. After ten minutes, read the value again and compare to the first reading. If the value has increased by more than 10° C per 100 ms, install a new MAF sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0116-26	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - signal rate of change below threshold	<ul style="list-style-type: none"> ● Engine Coolant Temperature (ECT) sensor circuit range/performance - signal rate of change below threshold ● ECT sensor fault 	Check the ECT sensor and circuits. Refer to the electrical circuit diagrams. With the engine cold, read the coolant temperature sensor using a data logger function and start the engine. Record the value and allow the engine to idle for 20 minutes. After 20 minutes, recheck the value. If the value has not increased by more than 10°C, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0117-16	Engine Coolant Temperature Sensor 1 Circuit Low - circuit voltage below threshold	<ul style="list-style-type: none"> ● Engine Coolant Temperature (ECT) sensor circuit low input - voltage below threshold ● ECT sensor fault 	Check the ECT sensor and circuits. Refer to the electrical circuit diagrams. Measure the resistance of the sensor. Nominal resistance at 20°C (68°F) should be between 35.47 and 39.21 Kohms. If the resistance is outside this range, install a new sensor. Refer to the relevant section of the workshop manual. Clear

DTC	Description	Possible Causes	Action
			the DTCs and test for normal operation
P0118-17	Engine Coolant Temperature Sensor 1 Circuit High - circuit voltage above threshold	<ul style="list-style-type: none"> ● Engine Coolant Temperature (ECT) sensor circuit high input - voltage above threshold ● ECT sensor fault 	Check the ECT sensor and circuits. Refer to the electrical circuit diagrams. Measure the resistance of the sensor. Nominal resistance at 20°C (68°F) should be between 35.47 and 39.21 Kohms. If the resistance is outside this range, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0119-27	Engine Coolant Temperature Sensor 1 Circuit Intermittent/Erratic - signal rate of change above threshold	<ul style="list-style-type: none"> ● Engine Coolant Temperature (ECT) sensor circuit intermittent/erratic - signal rate of change above threshold ● ECT sensor fault 	Check the ECT sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to warm up. Read the coolant temperature using a data logger function and record the value. Increase the engine speed to 2,000 rpm and recheck the value after two minutes at this engine speed. If the value has increased faster than 5°C per second, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0181-26	Fuel Temperature Sensor A Circuit Range/Performance - signal rate of change below threshold	<ul style="list-style-type: none"> ● Fuel temperature sensor circuit range/performance - signal rate of change below threshold ● Fuel temperature sensor fault 	Check the fuel temperature sensor and circuits. Refer to the electrical circuit diagrams. Check the fuel temperature using a data logger function. Make sure the fuel temperature is less than 30°C (86°F). Start the engine and allow to warm up for ten minutes. Recheck the fuel temperature. If the value has not increased by more than 8°C in this time, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0182-16	Fuel Temperature Sensor A Circuit Low - circuit voltage below threshold	<ul style="list-style-type: none"> ● Fuel temperature sensor circuit low input - voltage below threshold ● Fuel temperature sensor fault 	Check the fuel temperature sensor and circuits. Refer to the electrical circuit diagrams. Measure the sensor resistance. Nominal resistance at 20°C (68°F) should be between 5.86 and 6.62 Kohms. If the resistance is outside this range, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0183-17	Fuel Temperature Sensor A Circuit High - circuit voltage above threshold	<ul style="list-style-type: none"> ● Fuel temperature sensor circuit high input - voltage above threshold ● Fuel temperature sensor fault 	Check the fuel temperature sensor and circuits. Refer to the electrical circuit diagrams. Measure the sensor resistance. Nominal resistance at 20°C (68°F) should be between 5.86 and 6.62 Kohms. If the resistance is outside this range, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0184-27	Fuel Temperature Sensor A Circuit Intermittent - signal rate of change above threshold	<ul style="list-style-type: none"> ● Fuel temperature sensor circuit intermittent - signal rate of change above threshold ● Fuel temperature sensor circuit intermittent high resistance ● Fuel temperature sensor fault 	Check the fuel temperature sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to warm up. Check the fuel temperature using a data logger function. Increase the engine speed to 2,000 rpm and recheck the value. If the value has increased by more than 10°C per 100 ms, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0191-23	Fuel Rail Pressure Sensor A Circuit Range/Performance - signal stuck low	<ul style="list-style-type: none"> ● Fuel Rail Pressure (FRP) sensor circuit range/performance - signal stuck low ● Low fuel level ● Blocked/incorrectly connected low-pressure fuel lines ● FRP sensor fault ● Fuel pump module fault 	Check the fuel level and the condition and correct connection of the low-pressure fuel circuit lines (incorrect connection of the lines to and from the fuel filter can cause serious fuel pressure fluctuations). Check the FRP sensor and circuits. Check the fuel pump module and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P0191-24	Fuel Rail Pressure Sensor A Circuit Range/Performance - signal stuck high	<ul style="list-style-type: none"> ● Fuel Rail Pressure (FRP) sensor circuit range/performance - signal stuck high ● FRP sensor fault 	Check the FRP sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to idle. Check the fuel pressure value using a data logger function. Stop the engine, turn the ignition on, and recheck the fuel pressure. If the pressure is greater than 10 MPa (1,450 lbs/in ²) after 0.4 seconds, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation

DTC	Description	Possible Causes	Action
P0191-65	Fuel Rail Pressure Sensor A Circuit Range/Performance - signal has too few transitions / events	<ul style="list-style-type: none"> Fuel Rail Pressure (FRP) sensor circuit range/performance - signal has too few transitions/events FRP sensor fault 	Check the FRP sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to idle. Check the fuel pressure value using a data logger function. Increase the engine speed to 2,000 rpm and recheck the fuel pressure. If the value has changed by more than 40 MPa (5,801 lbs/in ²) per 10 ms, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0192-16	Fuel Rail Pressure Sensor A Circuit Low - circuit voltage below threshold	<ul style="list-style-type: none"> Fuel Rail Pressure (FRP) sensor circuit low input - voltage below threshold FRP sensor fault 	Check the FRP sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to idle. Check the fuel pressure value using a data logger function. If the value is 0 MPa (0 lbs/in ²), install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0193-17	Fuel Rail Pressure Sensor A Circuit High - circuit voltage above threshold	<ul style="list-style-type: none"> Fuel Rail Pressure (FRP) sensor circuit high input - voltage above threshold FRP sensor fault 	Check the FRP sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to idle. Check the fuel pressure value using a data logger function. If the value is greater than 180 MPa (26,106 lbs/in ²), install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0194-27	Fuel Rail Pressure Sensor A Circuit Intermittent/Erratic - signal rate of change above threshold	<ul style="list-style-type: none"> Fuel Rail Pressure (FRP) sensor circuit intermittent/erratic - signal rate of change above threshold FRP sensor fault 	Check the FRP sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to idle. Check the fuel pressure value using a data logger function. Increase the engine speed to 2,000 rpm and recheck the fuel pressure. If the value has changed by more than 40 MPa (5,801 lbs/in ²) per 10 ms, install a new sensor. Refer to the relevant section of the workshop manual. Clear the DTCs and test for normal operation
P0196-00	Engine Oil Temperature Sensor Range/Performance - no sub type information	<ul style="list-style-type: none"> Engine oil temperature (EOT) sensor circuit high resistance Engine oil temperature sensor circuit short circuit to ground Engine oil temperature sensor circuit short circuit to power Engine oil temperature sensor failure 	Check the engine oil temperature sensor and circuits. Refer to the electrical circuit diagrams. From cold, start the engine and check the oil temperature using a data logger function. Allow the engine to idle for ten minutes and recheck the oil temperature. If the value has not increased by more than 5°C in this time, install a new sensor. Clear the DTCs and test for normal operation
P0196-26	Engine Oil Temperature Sensor Range/Performance - signal rate of change below threshold	<ul style="list-style-type: none"> Engine oil temperature sensor circuit range/performance- signal rate of change below threshold Engine oil temperature sensor fault 	Check the Engine oil temperature sensor and circuits. Refer to the electrical circuit diagrams. From cold, start the engine and check the oil temperature using a data logger function. Allow the engine to idle for ten minutes and recheck the oil temperature. If the value has not increased by more than 5°C in this time, install a new sensor. Clear the DTCs and test for normal operation
P0197-00	Engine Oil Temperature Sensor Circuit Low - no sub type information	<ul style="list-style-type: none"> No sub type information 	Check the Engine oil temperature sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary
P0197-16	Engine Oil Temperature Sensor Circuit Low - circuit voltage below threshold	<ul style="list-style-type: none"> Engine oil temperature sensor circuit low input - voltage below threshold Engine oil temperature sensor fault 	Check the Engine oil temperature sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary
P0198-00	Engine Oil Temperature Sensor Circuit High - no sub type information	<ul style="list-style-type: none"> No sub type information 	Check the Engine oil temperature sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary
P0198-17	Engine Oil Temperature Sensor Circuit High - circuit voltage above threshold	<ul style="list-style-type: none"> Engine oil temperature sensor circuit high input - voltage above threshold Engine oil temperature sensor circuit short circuit to power Engine oil temperature sensor fault 	Check the Engine oil temperature sensor and circuits. Refer to the electrical circuit diagrams. Repair/renew as necessary
P0199-27	Engine Oil Temperature Sensor Circuit Intermittent/Erratic - signal rate of change above threshold	<ul style="list-style-type: none"> Engine oil temperature sensor circuit intermittent - signal rate of change above threshold Engine oil temperature sensor fault 	Check the Engine oil temperature sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and allow to idle. Check the oil temperature using a data logger function. Increase the engine speed to 2,000 rpm and recheck the value after two minutes at this

DTC	Description	Possible Causes	Action
			engine speed. If the value has increased by more than 40°C per second, install a new sensor. Clear the DTCs and test for normal operation
P0201-01	Cylinder 1 Injector Circuit / Open - General Electrical Failure	<ul style="list-style-type: none"> ● Fuel injector circuit open cylinder 1 - general electrical fault ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P0202-01	Cylinder 2 Injector Circuit / Open - General Electrical Failure	<ul style="list-style-type: none"> ● Fuel injector circuit open cylinder 2 - general electrical fault ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P0203-01	Cylinder 3 Injector Circuit / Open - General Electrical Failure	<ul style="list-style-type: none"> ● Fuel injector circuit open cylinder 3 - general electrical fault ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P0204-01	Cylinder 4 Injector Circuit / Open - General Electrical Failure	<ul style="list-style-type: none"> ● Fuel injector circuit open cylinder 4 - general electrical fault ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P0205-01	Cylinder 5 Injector Circuit / Open - General Electrical Failure	<ul style="list-style-type: none"> ● Fuel injector circuit open cylinder 5 - general electrical fault ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation

DTC	Description	Possible Causes	Action
P0206-01	Cylinder 6 Injector Circuit / Open - General Electrical Failure	<ul style="list-style-type: none"> Fuel injector circuit open cylinder 6 - general electrical fault Fuel injector circuit short circuit high resistance, short circuit to ground or power Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020A-33	Cylinder 1 Injection Timing - signal low time > maximum	<ul style="list-style-type: none"> Cylinder 1 injection timing - signal low time greater than maximum Fuel injector circuit short circuit high resistance, short circuit to ground or power Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020A-35	Cylinder 1 Injection Timing - signal high time > maximum	<ul style="list-style-type: none"> Cylinder 1 injection timing - signal high time greater than maximum Fuel injector circuit short circuit high resistance, short circuit to ground or power Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020B-33	Cylinder 2 Injection Timing - signal low time > maximum	<ul style="list-style-type: none"> Cylinder 2 injection timing - signal low time greater than maximum Fuel injector circuit short circuit high resistance, short circuit to ground or power Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020B-35	Cylinder 2 Injection Timing - signal high time > maximum	<ul style="list-style-type: none"> Cylinder 2 injection timing - signal high time greater than maximum Fuel injector circuit short circuit high resistance, short circuit to ground or power Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020C-33	Cylinder 3 Injection Timing - signal low time > maximum	<ul style="list-style-type: none"> Cylinder 3 injection timing - signal low time greater than maximum Fuel injector circuit short circuit high resistance, short circuit to ground or power Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3

DTC	Description	Possible Causes	Action
			microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020C-35	Cylinder 3 Injection Timing - signal high time > maximum	<ul style="list-style-type: none"> ● Cylinder 3 injection timing - signal high time greater than maximum ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020D-33	Cylinder 4 Injection Timing - signal low time > maximum	<ul style="list-style-type: none"> ● Cylinder 4 injection timing - signal low time greater than maximum ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020D-35	Cylinder 4 Injection Timing - signal high time > maximum	<ul style="list-style-type: none"> ● Cylinder 4 injection timing - signal high time greater than maximum ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020E-33	Cylinder 5 Injection Timing - signal low time > maximum	<ul style="list-style-type: none"> ● Cylinder 5 injection timing - signal low time greater than maximum ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Repair/renew as necessary. Clear the DTCs and test for normal operation
P020E-35	Cylinder 5 Injection Timing - signal high time > maximum	<ul style="list-style-type: none"> ● Cylinder 5 injection timing - signal high time greater than maximum ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Rectify as necessary. Clear the DTCs and test for normal operation

DTC	Description	Possible Causes	Action
P020F-33	Cylinder 6 Injection Timing - signal low time > maximum	<ul style="list-style-type: none"> ● Cylinder 6 injection timing - signal low time greater than maximum ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Rectify as necessary. Clear the DTCs and test for normal operation
P020F-35	Cylinder 6 Injection Timing - signal high time > maximum	<ul style="list-style-type: none"> ● Cylinder 6 injection timing - signal high time greater than maximum ● Fuel injector circuit short circuit high resistance, short circuit to ground or power ● Fuel injector fault 	During the following, clear DTCs and recheck after each step. Turn the ignition off and wait 20 seconds before turning the ignition back on to recheck DTCs. Check the connections for security. Disconnect the injector and measure the resistance and capacitance of the injector. If the resistance is not between 180 and 220 Kohms, or the capacitance not greater than 3 microfarad, install a new injector. If the injector is within specification, check the injector circuits for short circuit to ground, short circuit to power and for high resistance. Refer to the electrical circuit diagrams. Rectify as necessary. Clear the DTCs and test for normal operation
P0219-00	Engine Overspeed Condition - no sub type information	<ul style="list-style-type: none"> ● Crankshaft position (CKP) sensor circuit high resistance, short circuit to ground or power ● Camshaft position (CMP) sensor circuit high resistance, short circuit to ground or power ● Crankshaft position sensor failure ● Camshaft position sensor failure 	Check the crankshaft position and camshaft position sensor circuits. Refer to the electrical guides. Rectify as necessary. If no fault is found in the circuits, install new sensors as necessary. Clear the DTCs and test for normal operation. Check for oil ingestion into the intake air path. Rectify as necessary
P0236-27	Turbocharger/Supercharger Boost Sensor A Circuit Range/Performance - signal rate of change above threshold	<ul style="list-style-type: none"> ● Right-hand turbocharger boost sensor circuit high - signal rate of change above threshold ● Manifold absolute pressure and temperature (MAPT) sensor circuit intermittent high resistance ● Manifold absolute pressure and temperature (MAPT) sensor fault 	During the following, clear DTCs and recheck after each step. Check the MAPT sensor and circuits. Refer to the electrical circuit diagrams. Start the engine and check the manifold air pressure at idle using a data logger function. Increase the engine speed to 1,500 rpm and recheck the manifold air pressure. If the pressure has increased by more than 50 KPa per 10 ms, install a new sensor. Clear the DTCs and test for normal operation
P0237-16	Turbocharger/Supercharger Boost Sensor A Circuit Low - circuit voltage below threshold	<ul style="list-style-type: none"> ● Right-hand turbocharger boost sensor circuit low - voltage below threshold ● Manifold absolute pressure and temperature (MAPT) sensor circuit short circuit to ground ● Manifold absolute pressure and temperature (MAPT) sensor fault 	During the following, clear DTCs and recheck after each step. Check the MAPT sensor and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new sensor. Clear the DTCs and test for normal operation
P0238-17	Turbocharger/Supercharger Boost Sensor A Circuit High - circuit voltage above threshold	<ul style="list-style-type: none"> ● Right-hand turbocharger boost sensor circuit high - voltage above threshold ● Manifold absolute pressure and temperature (MAPT) sensor circuit short circuit to power ● Manifold absolute pressure and temperature (MAPT) sensor fault 	During the following, clear DTCs and recheck after each step. Check the MAPT sensor and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new sensor. Clear the DTCs and test for normal operation
P023D-21	Manifold Absolute Pressure - Turbocharger/Supercharger Boost Sensor A Correlation - signal amplitude < minimum	<ul style="list-style-type: none"> ● Manifold Absolute Pressure (MAP) sensor/right-hand turbocharger boost sensor correlation - signal amplitude less than minimum 	Check the intake air system. Check the turbocharger mechanical condition and operation. Check for oil being drawn into the intake manifold. Rectify as necessary. Using a data logger function, monitor the turbocharger actuator position and command the actuator to

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Intake air system fault ● Turbocharger mechanical fault ● Oil ingestion into manifold 	5% pulse width modulated (PWM), then 95% pulse width modulated (PWM) in 5% steps. Check the results. There should be a smooth curve between the minimum and maximum values. If not, install a new turbocharger. Clear the DTCs and test for normal operation
P023D-22	Manifold Absolute Pressure - Turbocharger/Supercharger Boost Sensor A Correlation - signal amplitude > maximum	<ul style="list-style-type: none"> ● Manifold Absolute Pressure (MAP) sensor/right-hand turbocharger boost sensor correlation - signal amplitude greater than maximum ● Intake air system fault ● Turbocharger mechanical fault ● Intake Air Temperature (IAT) sensor fault ● Mass Air Flow (MAF) sensor fault ● Manifold absolute pressure and temperature (MAPT) sensor fault ● Exhaust gas recirculation (EGR) sensor fault ● Turbocharger actuator position sensor fault 	Check the intake air system. Check the turbocharger mechanical condition and operation. Check for DTCs indicating a listed sensor fault. Rectify as necessary. Using a data logger function, monitor the turbocharger actuator position and command the actuator to 5% pulse width modulated (PWM), then 95% pulse width modulated (PWM) in 5% steps. Check the results. There should be a smooth curve between the minimum and maximum values. If not, install a new turbocharger. Clear the DTCs and test for normal operation
P025C-00	Fuel Pump Module Control Circuit Low - no sub type information	<ul style="list-style-type: none"> ● Oil Level sensor duty cycle below minimum threshold 	Refer to the electrical circuit diagrams and check the oil level sensor circuit
P025D-00	Fuel Pump Module Control Circuit High - no sub type information	<ul style="list-style-type: none"> ● Oil Level sensor duty cycle above maximum threshold 	Refer to the electrical circuit diagrams and check the oil level sensor circuit
P0263-00	Cylinder 1 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for blow-by etc and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P0266-00	Cylinder 2 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for blow-by etc and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P0269-00	Cylinder 3 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for blow-by etc and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P0272-00	Cylinder 4 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for blow-by etc and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the

DTC	Description	Possible Causes	Action
			above tests are all within range, install a new injector
P0275-00	Cylinder 5 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for blow-by etc and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P0278-00	Cylinder 6 Contribution/Balance - no sub type information	<ul style="list-style-type: none"> ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for blow-by etc and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P029A-00	Cylinder 1- Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P029B-00	Cylinder 1- Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P029C-00	Cylinder 1 - Injector Restricted - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P029D-00	Cylinder 1- Injector Leaking - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P029E-00	Cylinder 2- Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P029F-00	Cylinder 2- Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A0-00	Cylinder 2 - Injector Restricted - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A1-00	Cylinder 2 - Injector Leaking - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A2-00	Cylinder 3- Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A3-00	Cylinder 3- Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A4-00	Cylinder 3 - Injector Restricted - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A5-00	Cylinder 3 - Injector Leaking - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A6-00	Cylinder 4- Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A7-00	Cylinder 4- Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02A8-00	Cylinder 4 - Injector Restricted - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> valve, piston/ring, etc ● Injector fault 	are all within range, install a new injector
P02A9-00	Cylinder 4 - Injector Leaking - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02AA-00	Cylinder 5 - Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02AB-00	Cylinder 5 - Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02AC-00	Cylinder 5 - Injector Restricted - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02AD-00	Cylinder 5 - Injector Leaking - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02AE-00	Cylinder 6 - Fuel Trim at Max Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02AF-00	Cylinder 6 - Fuel Trim at Min Limit - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit short circuit to ground, power or high resistance ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical guides and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02B0-00	Cylinder 6 - Injector Restricted - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02B1-00	Cylinder 6 - Injector Leaking - no sub type information	<ul style="list-style-type: none"> ● Fuel injector circuit high resistance ● Fuel injector circuit short circuit to ground ● Fuel injector circuit short circuit to power ● Injector leak ● Cylinder compression low <ul style="list-style-type: none"> - Cylinder leakage past the injector - Cylinder leakage past the glow plug - Mechanical fault, valve, piston/ring, etc ● Injector fault 	Refer to the electrical circuit diagrams and check the fuel injector circuit. Check the injector and surrounding area for evidence of fuel leakage. Disconnect the injector and check for evidence of fuel leakage in the connector. Rectify as necessary. Clear the DTCs. Reconnect the injector and start the engine. Allow to warm up to above 60°C (140°F) and allow to idle (cylinder balance diagnosis is now active). If the DTC resets, check for Cylinder leakage and rectify as necessary. Clear the DTCs and recheck. Carry out a compression test only if the DTC resets. If the above tests are all within range, install a new injector
P02CD-00	Cylinder 1 Fuel Injector Offset Learning at Max Limit - no sub type information	Fuel injector failure	Renew fuel injector for related cylinder
P02CF-00	Cylinder 2 Fuel Injector Offset Learning at Max Limit - no sub type information	Fuel injector failure	Renew fuel injector for related cylinder
P02D1-00	Cylinder 3 Fuel Injector Offset Learning at Max Limit - no sub type information	Fuel injector failure	Renew fuel injector for related cylinder
P02D3-00	Cylinder 4 Fuel Injector Offset Learning at Max Limit - no sub type information	Fuel injector failure	Renew fuel injector for related cylinder
P02D5-00	Cylinder 5 Fuel Injector Offset Learning at Max Limit - no sub type information	Fuel injector failure	Renew fuel injector for related cylinder
P02D7-00	Cylinder 6 Fuel Injector Offset Learning at Max Limit - no sub type information	Fuel injector failure	Renew fuel injector for related cylinder
P0326-21	Knock Sensor 1 Circuit Range/Performance (Bank 1) - signal amplitude < minimum	<ul style="list-style-type: none"> ● Knock sensor 1 circuit range/performance, right-hand bank (rear) - signal amplitude less than minimum ● Knock sensor incorrectly installed ● Knock sensor connections reversed 	Check that the knock sensors are correctly installed and tightened to the correct torque. Check that the knock sensor connections are connected to the correct sensor. Check the knock sensor circuit, Refer to the electrical circuit diagrams. Rectify as necessary

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Knock sensor circuit short circuit to ground 	
P0326-22	Knock Sensor 1 Circuit Range/Performance (Bank 1) - signal amplitude > maximum	<ul style="list-style-type: none"> ● Knock sensor 1 circuit range/performance, right-hand bank (rear) - signal amplitude greater than maximum ● Knock sensor incorrectly installed ● Knock sensor connections reversed ● Knock sensor circuit short circuit to ground 	Check that the knock sensors are correctly installed and tightened to the correct torque. Check that the knock sensor connections are connected to the correct sensor. Check the knock sensor circuit, Refer to the electrical circuit diagrams. Rectify as necessary
P0331-21	Knock Sensor 1 Circuit Range/Performance (Bank 2) - signal amplitude < minimum	<ul style="list-style-type: none"> ● Knock sensor 2 circuit range/performance, left-hand bank (rear) - signal amplitude less than minimum ● Knock sensor incorrectly installed ● Knock sensor connections reversed ● Knock sensor circuit short circuit to ground 	Check that the knock sensors are correctly installed and tightened to the correct torque. Check that the knock sensor connections are connected to the correct sensor. Check the knock sensor circuit, Refer to the electrical circuit diagrams. Rectify as necessary
P0331-22	Knock Sensor 1 Circuit Range/Performance (Bank 2) - signal amplitude > maximum	<ul style="list-style-type: none"> ● Knock sensor 2 circuit range/performance, left-hand bank (rear) - signal amplitude greater than maximum ● Knock sensor incorrectly installed ● Knock sensor connections reversed ● Knock sensor circuit short circuit to ground 	Check that the knock sensors are correctly installed and tightened to the correct torque. Check that the knock sensor connections are connected to the correct sensor. Check the knock sensor circuit, Refer to the electrical circuit diagrams. Rectify as necessary
P0335-78	Crankshaft Position Sensor A Circuit - alignment or adjustment incorrect	<ul style="list-style-type: none"> ● Crankshaft position (CKP) sensor - alignment or adjustment incorrect ● Crankshaft position sensor circuit short circuit to ground ● Crankshaft position sensor circuit short circuit to power ● Crankshaft position sensor circuit high resistance ● Crankshaft position sensor fault ● Crankshaft position sensor wheel fault 	Check the crankshaft position sensor and circuits. Refer to the electrical circuit diagrams. Check the sensor and wheel for correct installation and condition. Rectify as necessary. Clear the DTCs and test for normal operation
P0336-31	Crankshaft Position (CKP) Sensor Circuit Range/Performance - no signal	<ul style="list-style-type: none"> ● Crankshaft position (CKP) sensor range/performance - signal missing ● Crankshaft position sensor circuit short circuit to ground ● Crankshaft position sensor circuit short circuit to power ● Crankshaft position sensor circuit high resistance ● Crankshaft position sensor fault ● Crankshaft position sensor wheel fault 	Check the crankshaft position sensor and circuits. Refer to the electrical circuit diagrams. Check the sensor and wheel for correct installation and condition. Rectify as necessary. Clear the DTCs and test for normal operation
P0336-38	Crankshaft Position (CKP) Sensor Circuit Range/Performance - signal frequency incorrect	<ul style="list-style-type: none"> ● Crankshaft position (CKP) sensor range/performance - signal frequency ● Crankshaft position sensor circuit short circuit to ground ● Crankshaft position sensor circuit short circuit to power ● Crankshaft position sensor circuit high resistance ● Crankshaft position sensor fault ● Crankshaft position sensor wheel fault 	Check the crankshaft position sensor and circuits. Refer to the electrical circuit diagrams. Check the sensor and wheel for correct installation and condition. Rectify as necessary. Clear the DTCs and test for normal operation

DTC	Description	Possible Causes	Action
P0336-64	Crankshaft position (CKP) sensor circuit range/performance - signal plausibility failure	<ul style="list-style-type: none"> ● Crankshaft position (CKP) sensor range/performance - signal plausibility fault ● Crankshaft position sensor circuit short circuit to ground ● Crankshaft position sensor circuit short circuit to power ● Crankshaft position sensor circuit high resistance ● Crankshaft position sensor fault ● Crankshaft position sensor wheel fault 	Check the crankshaft position sensor and circuits. Refer to the electrical circuit diagrams. Check the sensor and wheel for correct installation and condition. Rectify as necessary. Clear the DTCs and test for normal operation
P0336-66	Crankshaft position (CKP) sensor circuit range/performance - signal has too many transitions / events	<ul style="list-style-type: none"> ● Crankshaft position (CKP) sensor range/performance - signal has too many transitions/events ● Crankshaft position sensor circuit short circuit to ground ● Crankshaft position sensor circuit short circuit to power ● Crankshaft position sensor circuit high resistance ● Crankshaft position sensor fault ● Crankshaft position sensor wheel fault 	Check the crankshaft position sensor and circuits. Refer to the electrical circuit diagrams. Check the sensor and wheel for correct installation and condition. Rectify as necessary. Clear the DTCs and test for normal operation
P0341-29	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or single sensor) - signal invalid	<ul style="list-style-type: none"> ● Camshaft position (CMP) sensor range/performance - signal invalid ● Camshaft position sensor circuit short circuit to ground ● Camshaft position sensor circuit short circuit to power ● Camshaft position sensor circuit high resistance ● Camshaft position sensor fault 	Check the camshaft position sensor and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new sensor. Clear the DTCs and test for normal operation
P0341-3A	Camshaft Position Sensor A Circuit Range/Performance (Bank 1 or single sensor) - incorrect has too many pulses	<ul style="list-style-type: none"> ● Camshaft position (CMP) sensor range/performance - too many pulses ● Camshaft segment period too short 	Check the camshaft position sensor and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new sensor. Clear the DTCs and test for normal operation
P0342-31	Camshaft Position Sensor A Circuit Low (Bank 1 or single sensor) - no signal	<ul style="list-style-type: none"> ● Camshaft position (CMP) sensor circuit low input - no signal ● Camshaft position sensor circuit short circuit to ground ● Camshaft position sensor circuit short circuit to power ● Camshaft position sensor circuit high resistance ● Camshaft position sensor fault 	Check the camshaft position sensor and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new sensor. Clear the DTCs and test for normal operation
P0380-72	Glow Plug/Heater Circuit A - actuator stuck open	<ul style="list-style-type: none"> ● Right-hand bank glow plug circuit - actuator stuck open ● Low battery voltage ● Relay circuit from relay 	Check the battery condition and state of charge. Check the relay and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new relay. Clear the DTCs and test for normal operation
P0380-73	Glow Plug/Heater Circuit A - actuator stuck closed	<ul style="list-style-type: none"> ● Right-hand bank glow plug circuit - actuator stuck closed ● Low battery voltage ● Relay circuit to relay 	Check the battery condition and state of charge. Check the relay and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new relay. Clear the DTCs and test for normal operation
P0383-11	Glow Plug Control Module Control Circuit Low - circuit short to ground	<ul style="list-style-type: none"> ● Glow plug relay, control circuit short circuit to ground ● Glow plug relay failure 	Refer to the electrical guides and check the relay and circuits. If no fault is found in the circuits, install a new relay. Clear the DTCs and test for normal operation
P0384-12	Glow Plug Control Module Control Circuit High - circuit short to battery	<ul style="list-style-type: none"> ● Glow plug relay, control circuit short circuit to power ● Glow plug relay failure 	Refer to the electrical guides and check the relay and circuits. If no fault is found in the circuits, install a new relay. Clear the DTCs and test for normal operation

DTC	Description	Possible Causes	Action
P0401-21	Exhaust Gas Recirculation A Flow Insufficient Detected - signal amplitude < minimum	<ul style="list-style-type: none"> Exhaust gas recirculation (EGR) insufficient flow detected - signal amplitude less than minimum EGR control deviation lower limit right-hand bank (intake manifold tuning (IMT) valve closed) bank specific control of EGR 	Allow the engine to warm up, switch off and turn the ignition on. Using a data logger function, check the EGR valve angles for both banks. Command the valve actuators to 100% then 0% pulse width modulated (PWM), and recheck the valve angles. The angles should range between 95% and 5%. If this is not the case, install new valves as necessary. Clear the DTCs and test for normal operation
P0402-22	Exhaust Gas Recirculation A Flow Excessive Detected - signal amplitude > maximum	<ul style="list-style-type: none"> Right-hand Exhaust Gas Recirculation (EGR) excessive flow detected - signal amplitude greater than maximum EGR control deviation upper limit right-hand bank (intake manifold tuning (IMT) valve closed) bank specific control of EGR 	Allow the engine to warm up, switch off and turn the ignition on. Using a data logger function, check the EGR valve angle. Command the valve actuator to 0% then 100% pulse width modulated (PWM), and recheck the valve angles. The angles should range between 5% and 95%. If this is not the case, install a new valve as necessary. Clear the DTCs and test for normal operation
P0403-00	Exhaust Gas Recirculation A Control Circuit - no sub type information	<ul style="list-style-type: none"> Exhaust gas recirculation (EGR) valve circuit high resistance EGR valve circuit short circuit to ground EGR valve circuit short circuit to power EGR valve failure 	Refer to the relevant workshop manual section. Check the EGR valve, coolers and pipework. Refer to the electrical circuit diagrams and check the MAF sensor and circuits. Allow the engine to warm up, switch off and turn the ignition on. Using a data logger function, check the EGR valve angle. Command the valve actuator to 0% then 100% pulse width modulated (PWM) and recheck the values. The angle should range between 5% and 95%. If this is not the case, install a new valve as necessary. Clear the DTCs and test for normal operation
P0403-19	Exhaust Gas Recirculation A Control Circuit - circuit current above threshold	<ul style="list-style-type: none"> Right-hand Exhaust Gas Recirculation (EGR) control circuit - current over threshold EGR valve control circuit short circuit to ground EGR valve control circuit short circuit to power 	Check the EGR valve and circuits. Refer to the electrical circuit diagrams. Using a data logger function, turn the ignition on and check the EGR valve values for both banks. Turn the ignition off and make sure the cleaning cycle is performed (the valves should cycle from 0% to 100% approximately 6 times). Turn the ignition on, command the actuators to 0% pulse width modulated (PWM) and check the sensor reading. The value should be 0 - 20%. Command the actuators to 100% pulse width modulated (PWM) and check the sensor reading. The value should be 80 - 95%. If the values are outside this range, install a new valve as necessary. Clear the DTCs and test for normal operation. If there is still an issue, suspect the Engine Control Module. Refer to the warranty policy and procedures manual if an Engine Control Module is suspect
P0405-21	Exhaust Gas Recirculation Sensor A Circuit Low - signal amplitude < minimum	<ul style="list-style-type: none"> Right-hand Exhaust Gas Recirculation (EGR) sensor circuit low - signal amplitude less than minimum EGR valve position sensor circuit short circuit to ground EGR valve position sensor fault 	Check the right-hand Exhaust Gas Recirculation (EGR) sensor and circuits. Refer to the electrical circuit diagrams. Using a data logger function, check the EGR valve angle. With the ignition on, engine off, command the valve actuator to 0% pulse width modulated (PWM), and then to 100% pulse width modulated (PWM) and recheck the EGR valve angle. The value should range from 0 - 20% to 80 - 95%. If this is not the case, install a new sensor. Clear the DTCs and test for normal operation
P0406-22	Exhaust Gas Recirculation Sensor A Circuit High - signal amplitude > maximum	<ul style="list-style-type: none"> Right-hand Exhaust Gas Recirculation (EGR) sensor circuit high - signal amplitude greater than maximum EGR valve position sensor circuit short circuit to power EGR valve position sensor fault 	Check the right-hand Exhaust Gas Recirculation (EGR) sensor and circuits. Refer to the electrical circuit diagrams. Using a data logger function, check the EGR valve angle. With the ignition on, engine off, command the valve actuator to 0% pulse width modulated (PWM), and then to 100% pulse width modulated (PWM) and recheck the EGR valve angle. The value should range from 0 - 20% to 80 - 95%. If this is not the case, install a new sensor. Clear the DTCs and test for normal operation
P0407-21	Exhaust Gas Recirculation Sensor B Circuit Low - signal amplitude < minimum	<ul style="list-style-type: none"> Right-hand Exhaust Gas Recirculation (EGR) throttle position sensor circuit low - signal amplitude less than minimum EGR throttle position sensor circuit short circuit to ground 	Check the EGR throttle position sensor and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new EGR valve. Clear the DTCs and test for normal operation

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● EGR throttle position sensor circuit high resistance ● Exhaust Gas Recirculation (EGR) sensor fault 	
P0408-22	Exhaust Gas Recirculation Sensor B Circuit High - signal amplitude > maximum	<ul style="list-style-type: none"> ● Right-hand Exhaust Gas Recirculation (EGR) throttle position sensor circuit low - signal amplitude greater than maximum ● EGR throttle position sensor circuit short circuit to power ● EGR throttle position sensor fault 	Check the EGR throttle position sensor and circuits. Refer to the electrical circuit diagrams. If no fault is found in the circuits, install a new EGR valve. Clear the DTCs and test for normal operation
P0425-62	Catalyst Temperature Sensor Circuit (Bank 1, Sensor Circuit 1) - signal compare failure	<ul style="list-style-type: none"> ● Pre-catalytic converter temperature sensor signal compare failure(right-hand bank sensor 1) ● Pre-catalytic converter temperature sensor correlation compare with at least two other sensors ● Pre-catalytic converter temperature sensor failure ● Pre-catalytic converter temperature sensor circuit - short to ground, power or open circuit 	Refer to the electrical circuit diagrams and check pre-catalytic converter temperature sensor circuit for open circuit, short to ground, short to power. Check pre-catalytic converter temperature sensor for dirt contamination, corrosion, water ingress damage. Renew the sensor
P0426-00	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - no sub type information	<ul style="list-style-type: none"> ● Pre-catalytic converter temperature sensor gradient check (right hand bank sensor 1) ● Pre-catalytic converter temperature sensor failure ● Pre-catalytic converter temperature sensor circuit - short to ground, power or open circuit ● Pre-catalytic converter temperature sensor circuit high resistance 	Refer to the electrical circuit diagrams and check pre-catalytic converter temperature sensor circuit for open circuit, short to ground, short to power and intermittent poor or dirty connections. Renew the sensor
P0426-1A	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - circuit resistance below threshold	<ul style="list-style-type: none"> ● Pre-catalytic converter temperature sensor circuit resistance below threshold (right-hand bank sensor 1) ● Pre-catalytic converter temperature sensor plausibility at cold start, temperature difference too high ● Pre-catalytic converter temperature sensor stuck at high temperature value 	Refer to the electrical circuit diagrams and check pre-catalytic converter temperature sensor circuit for low resistance, short to ground. Renew the sensor
P0426-1B	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - circuit resistance above threshold	<ul style="list-style-type: none"> ● Pre-catalytic converter temperature sensor circuit resistance above threshold (right-hand bank sensor 1) ● Pre-catalytic converter temperature sensor plausibility at cold start, temperature difference too low ● Pre-catalytic converter temperature sensor stuck at high temperature value 	Refer to the electrical circuit diagrams and check pre-catalytic converter temperature sensor circuit for high resistance, open circuit. Renew the sensor
P0426-1E	Catalyst Temperature Sensor Circuit Range/Performance (Bank 1, Sensor Circuit 1) - circuit resistance out of range	<ul style="list-style-type: none"> ● Pre-catalytic converter temperature sensor circuit resistance out of range (right-hand bank sensor 1) ● Pre-catalytic converter temperature sensor plausibility at engine running, temperature too low ● Pre-catalytic converter temperature sensor stuck at low temperature value 	Refer to the electrical circuit diagrams and check pre-catalytic converter temperature sensor circuit for open circuit, short to ground, short to power. Check pre-catalytic converter temperature sensor for dirt contamination, corrosion, water ingress damage. Renew the sensor

General Information - Diagnostic Trouble Code (DTC) Index TDV6 3.0L

Diesel, DTC: Engine Control Module (PCM)

Description and Operation

Engine Control Module (PCM) 3.0L TdV6



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Engine Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Diagnosis and Testing).

DTC	Description	Possible Cause	Action
B1087-93	LIN Bus "A" - No operation	<ul style="list-style-type: none"> Generator LIN bus communication circuit failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the generator LIN bus circuit, for short circuit to power, short circuit to ground, open circuit. Repair wiring harness as required. Clear DTC and retest
B10A2-32	Crash Input - Signal low time < minimum	<ul style="list-style-type: none"> NOTE: - Circuit SRS_INPUT - Restraints control module fault Auxiliary junction box fault Harness fault 	<ul style="list-style-type: none"> This DTC is set when the 'airbag deployed' signal supplied by the restraints control module is outside the specification expected by the engine control module Check the restraints control module for DTCs and refer to the relevant DTC index Check auxiliary junction box for DTCs and refer to the relevant DTC index Refer to electrical circuit diagrams and check the supplementary restraints system input circuit for faults. This circuit is a single wire which connects the restraints control module to the auxiliary junction box and the engine control module. Check this circuit for short circuit to power or ground, open circuit including intermittent faults. Repair wiring as required. Clear DTC and retest
B10A2-35	Crash Input - Signal high time > maximum	<ul style="list-style-type: none"> NOTE: - Circuit SRS_INPUT - Restraints control module fault Auxiliary junction box fault Harness fault 	<ul style="list-style-type: none"> This DTC is set when the 'airbag deployed' signal supplied by the restraints control module is outside the specification expected by the engine control module Check the restraints control module for DTCs and refer to the relevant DTC index Check auxiliary junction box for DTCs and refer to the relevant DTC index Refer to electrical circuit diagrams and check the supplementary restraints system input circuit for faults. This circuit is a single wire which connects the restraints control module to the auxiliary junction box and the engine control module. Check this circuit for short circuit to power or ground, open circuit including intermittent faults. Repair wiring as required. Clear DTC and retest
B10A2-36	Crash Input - Signal frequency too low	<ul style="list-style-type: none"> NOTE: - Circuit SRS_INPUT - The engine control module detected excessive duration for one cycle of the output across a 	<ul style="list-style-type: none"> This DTC is set when the 'airbag deployed' signal supplied by the restraints control module is outside the specification expected by the engine control module Check the restraints control module for DTCs and refer to the relevant DTC index

DTC	Description	Possible Cause	Action
		specified sample size <ul style="list-style-type: none"> ● Restraints control module fault ● Auxiliary junction box fault ● Harness fault 	<ul style="list-style-type: none"> ● Check auxiliary junction box for DTCs and refer to the relevant DTC index ● Refer to electrical circuit diagrams and check the supplementary restraints system input circuit for faults. This circuit is a single wire which connects the restraints control module to the auxiliary junction box and the engine control module. Check this circuit for short circuit to power or ground, open circuit including intermittent faults. Repair wiring as required. Clear DTC and retest
B10A2-37	Crash Input - Signal frequency too high	<ul style="list-style-type: none"> ● NOTE: - Circuit SRS_INPUT - ● The engine control module detected insufficient duration for one cycle of the output across a specified sample size ● Restraints control module fault ● Auxiliary junction box fault ● Harness fault 	<ul style="list-style-type: none"> ● This DTC is set when the 'airbag deployed' signal supplied by the restraints control module is outside the specification expected by the engine control module ● Check the restraints control module for DTCs and refer to the relevant DTC index ● Check auxiliary junction box for DTCs and refer to the relevant DTC index ● Refer to electrical circuit diagrams and check the supplementary restraints system input circuit for faults. This circuit is a single wire which connects the restraints control module to the auxiliary junction box and the engine control module. Check this circuit for short circuit to power or ground, open circuit including intermittent faults. Repair wiring as required. Clear DTC and retest
B11D9-00	Vehicle Battery - No sub type information	<ul style="list-style-type: none"> ● Harness fault ● Battery fault ● Battery monitoring system module fault 	<ul style="list-style-type: none"> ● This DTC is set when the battery monitoring system fails a diagnostic check ● Refer to the battery care manual and verify that the vehicle battery is fully charged and serviceable before continuing with further diagnostic tests. If a battery fault is indicated Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component ● Refer to the electrical circuit diagrams and check the connections between the battery and the battery monitoring module are clean and secure ● Ensure that full battery voltage is present on the monitor line pin at the battery monitoring system module connector. Ensure the battery ground connection is clean and secure ● Check the LIN bus connections to the battery monitoring system module. Check LIN bus integrity. If no fault found in wiring harness suspect battery monitoring system module failure. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B11DB-87	Battery Monitoring Module - Missing message	<ul style="list-style-type: none"> ● Harness fault ● Battery monitoring system module fault 	<ul style="list-style-type: none"> ● This DTC is set when the engine control module has lost communication with the battery monitoring system module ● Refer to the battery care manual and verify that the vehicle battery is fully charged and serviceable before continuing with further diagnostic tests. If a battery fault is indicated Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component ● Refer to the electrical circuit diagrams and check the connections between the battery and the battery monitoring module are clean and secure ● Ensure that full battery voltage is present on the monitor line pin at the battery monitoring system module connector. Ensure the battery ground connection is clean and secure ● Check the LIN bus connections to the

DTC	Description	Possible Cause	Action
			battery monitoring system module. Check LIN bus integrity. If no fault found in wiring harness suspect battery monitoring system module failure. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1206-68	Crash Occurred - Event information	<ul style="list-style-type: none"> ● Event information - the engine control module has received a crash signal from the restraints control module 	<ul style="list-style-type: none"> ● This DTC is set if the restraints control module has deployed the restraints systems following activation of the crash sensors. Check the restraints control module for DTCs and refer to the relevant DTC index
P0030-11	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit short to ground	<ul style="list-style-type: none"> ● NOTE: - Circuit LPPH_A - ● The engine control module has detected a ground measurement for a period longer than expected or has detected a ground measurement when another value was expected ● Harness fault - Pre catalyst oxygen sensor heater control circuit short circuit to ground ● Pre catalyst oxygen sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signals, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1). Refer to the electrical circuit diagrams and check the pre catalyst oxygen sensor heater control (heater ground) circuit for short circuit to ground. This circuit runs from the engine control module through the transmission harness to the exhaust system. Check for external harness damage due to chafing or heat. Repair harness as required. Clear DTC and retest ● Suspect sensor failure if DTC resets. Heater circuit resistance measured at the component connector at approximately 20°C ambient temperature should be 2.4 - 4.0 Ohms. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0030-12	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit short to battery	<ul style="list-style-type: none"> ● NOTE: - Circuit LPPH_A - ● The engine control module has detected a vehicle power measurement for a period longer than expected or has detected a vehicle power measurement when another value was expected ● Harness fault - Pre catalyst oxygen sensor heater control circuit short circuit to power ● Pre catalyst oxygen sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signals, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1). Refer to the electrical circuit diagrams and check the pre catalyst oxygen sensor heater control (heater ground) circuit for short circuit to power. This circuit runs from the engine control module through the transmission harness to the exhaust system. Check for external harness damage due to chafing or heat. Repair harness as required. Clear DTC and retest ● Suspect sensor failure if DTC resets. Heater circuit resistance measured at the component connector at approximately 20°C ambient temperature should be 2.4 - 4.0 Ohms. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0030-13	HO2S Heater Control Circuit (Bank 1, Sensor 1) - Circuit open	<ul style="list-style-type: none"> ● NOTE: - Circuit LPPH_A - ● The engine control module has determined an open circuit via lack of bias voltage, low current flow, no change in the state of an input in response to an output ● Harness fault - Pre catalyst oxygen sensor heater control circuit open circuit ● Pre catalyst oxygen sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signals, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1). Refer to the electrical circuit diagrams and check the pre catalyst oxygen sensor heater control (heater ground) circuit for open circuit. This circuit runs from the engine control module through the transmission harness to the exhaust system. Check for external harness damage due to chafing or heat. Repair harness as required. Clear DTC and retest ● Suspect sensor failure if DTC resets. Heater circuit resistance measured at the component connector at approximately 20°C ambient temperature should be 2.4 - 4.0 Ohms. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

General Information - Diagnostic Trouble Code (DTC) Index DTC: Engine Control Module (PCM) 4.0L V6

Description and Operation

Engine Control Module (PCM) 4.0L V6



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Engine Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
C0031-00	Left Front Wheel Speed Sensor - no sub type information	<ul style="list-style-type: none"> Invalid data received from ABS wheel speed signal 	Check for ABS DTCs. Refer to the relevant DTC index
C0034-00	Right Front Wheel Speed Sensor - no sub type information	<ul style="list-style-type: none"> Invalid data received from ABS wheel speed signal 	Check for ABS DTCs. Refer to the relevant DTC index
C0037-00	Left Rear Wheel Speed Sensor - no sub type information	<ul style="list-style-type: none"> Invalid data received from ABS wheel speed signal 	Check for ABS DTCs. Refer to the relevant DTC index
C003A-00	Right Rear Wheel Speed Sensor - no sub type information	<ul style="list-style-type: none"> Invalid data received from ABS wheel speed signal 	Check for ABS DTCs. Refer to the relevant DTC index
P0031-00	HO2S Heater Control Circuit Low (Bank 1, Sensor 1) - no sub type information	<ul style="list-style-type: none"> Heated O₂ sensor heater power supply circuit high resistance Heated O₂ sensor heater control circuit high resistance Heated O₂ sensor heater failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0032-00	HO2S Heater Control Circuit High (Bank 1, Sensor 1) - no sub type information	<ul style="list-style-type: none"> Heated O₂ sensor heater power supply circuit high resistance Heated O₂ sensor heater control circuit high resistance Heated O₂ sensor heater failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0036-00	HO2S Heater Control Circuit (Bank 1, Sensor 2) - no sub type information	<ul style="list-style-type: none"> Catalyst monitor sensor heater control circuit short circuit to ground Catalyst monitor sensor heater control circuit high resistance Catalyst monitor sensor heater failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0051-00	HO2S Heater Control Circuit Low (Bank 2, Sensor 1) - no sub type information	<ul style="list-style-type: none"> Heated O₂ sensor heater power supply circuit high resistance Heated O₂ sensor heater control circuit high resistance Heated O₂ sensor heater failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0052-00	HO2S Heater Control Circuit High (Bank 2, Sensor 1) - no sub type information	<ul style="list-style-type: none"> Heated O₂ sensor heater power supply circuit high resistance Heated O₂ sensor heater 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> control circuit high resistance ● Heated O₂ sensor heater failure 	
P0056-00	HO ₂ S Heater Control Circuit (Bank 2, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (left-hand bank) heater control circuit short circuit to ground ● Catalyst monitor sensor heater control circuit high resistance ● Catalyst monitor sensor heater failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0069-00	(Manifold Absolute Pressure) - Barometric Pressure Correlation - no sub type information	<ul style="list-style-type: none"> ● Manifold Absolute Pressure (Manifold Absolute Pressure) sensor failure ● BARO sensor failure(internal Engine Control Module fault) 	Check the Manifold Absolute Pressure sensor and circuits. Refer to the electrical circuit diagrams. Refer to the warranty policy and procedures manual if a module is suspect
P0071-00	Ambient Air Temperature Sensor Range/Performance - no sub type information	<ul style="list-style-type: none"> ● Ambient temperature sensor range performance (stuck) 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0072-00	Ambient Air Temperature Sensor Circuit Low - no sub type information	<ul style="list-style-type: none"> ● Ambient temperature sensor circuit low input 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0073-00	Ambient Air Temperature Sensor Circuit High - no sub type information	<ul style="list-style-type: none"> ● Ambient temperature sensor circuit high input 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0101-00	Mass or Volume Air Flow A Circuit - no sub type information	<ul style="list-style-type: none"> ● Blocked air cleaner ● Air intake leak ● Engine breather leak ● Mass Air Flow (MAF) sensor sensing circuit high resistance, intermittent short circuit to ground ● Mass Air Flow (MAF) sensor supply circuit high resistance 	Check the air cleaner for blockage, etc. Check the air intake system for leaks. Check the engine breather system. Refer to the electrical circuit diagrams and check the Mass Air Flow circuit
P0102-00	Mass or Volume Air Flow A Circuit Low - no sub type information	<ul style="list-style-type: none"> ● Mass Air Flow (MAF) sensor supply circuit high resistance, short circuit to ground ● Mass Air Flow (MAF) sensor ground circuit high resistance ● Mass Air Flow (MAF) sensor failure 	Refer to the electrical circuit diagrams and check the Mass Air Flow circuit. If no circuit fault exists, renew the Mass Air Flow sensor. Clear the DTC and retest
P0103-00	Mass or Volume Air Flow A Circuit High - no sub type information	<ul style="list-style-type: none"> ● Mass Air Flow (MAF) sensor sensing circuit short circuit to power ● Mass Air Flow (MAF) sensor return circuit high resistance ● Mass Air Flow (MAF) sensor failure 	Refer to the electrical circuit diagrams and check the Mass Air Flow circuit. If no circuit fault exists, renew the Mass Air Flow sensor. Clear the DTC and retest
P0106-00	Manifold Absolute Pressure/BARO Sensor Range/Performance - no sub type information	<ul style="list-style-type: none"> ● Intake manifold air leak (loose or missing component) ● Manifold Absolute Pressure sensor circuit(s) fault ● Manifold Absolute Pressure sensor failure 	Check the intake manifold for security, etc. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0107-00	Manifold Absolute Pressure/BARO Sensor Low - no sub type information	<ul style="list-style-type: none"> ● Manifold Absolute Pressure sensor circuit high resistance, short circuit to ground ● Manifold Absolute Pressure sensor supply circuit high resistance ● Manifold Absolute Pressure sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0108-00	Manifold Absolute Pressure/BARO Sensor High - no sub type information	<ul style="list-style-type: none"> ● Manifold Absolute Pressure sensor return circuit high resistance ● Manifold Absolute Pressure sensor sense circuit short circuit to power ● Manifold Absolute Pressure sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest

DTC	Description	Possible Causes	Action
P0111-23	Intake Air Temperature Sensor 1 Circuit Range/Performance (Bank 1) - signal stuck low	<ul style="list-style-type: none"> ● Signal stuck low at engine start ● Intake Air Temperature sensor circuit(s) high resistance ● Intake Air Temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0111-24	Intake Air Temperature Sensor 1 Circuit Range/Performance (Bank 1) - signal stuck high	<ul style="list-style-type: none"> ● Signal stuck high at engine start ● Intake Air Temperature sensor circuit(s) high resistance ● Intake Air Temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0111-29	Intake Air Temperature Sensor 1 Circuit Range/Performance (Bank 1) - signal invalid	<ul style="list-style-type: none"> ● Signal invalid ● Intake Air Temperature sensor circuit(s) high resistance ● Intake Air Temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0113-00	Intake Air Temperature Sensor 1 Circuit High (Bank 1) - no sub type information	<ul style="list-style-type: none"> ● Intake Air Temperature sensor circuit(s) short circuit to ground ● Intake Air Temperature sensor sensing circuit short circuit to power ● Intake Air Temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0116-23	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - signal stuck low	<ul style="list-style-type: none"> ● Low coolant level ● Engine thermostat failure ● Engine Coolant Temperature sensor sensing circuit intermittent high resistance ● Engine Coolant Temperature sensor failure 	Check the coolant level and the thermostat operation (stuck open). Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0116-24	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - signal stuck high	<ul style="list-style-type: none"> ● Low coolant level ● Engine coolant thermostat failure ● Engine Coolant Temperature sensor sensing circuit intermittent high resistance ● Engine Coolant Temperature sensor failure 	Check the coolant level and the thermostat operation (stuck closed). Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0116-29	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - signal invalid	<ul style="list-style-type: none"> ● Low coolant level ● Engine coolant thermostat failure ● Engine Coolant Temperature sensor sensing circuit intermittent high resistance ● Engine Coolant Temperature sensor failure 	Check the coolant level and the thermostat operation. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0117-00	Engine Coolant Temperature Sensor 1 Circuit Low - no sub type information	<ul style="list-style-type: none"> ● Engine Coolant Temperature sensor disconnected ● Engine coolant temperature (Engine Coolant Temperature) sensor sensing circuit high resistance, short circuit to power ● Engine Coolant Temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0118-00	Engine Coolant Temperature Sensor 1 Circuit High - no sub type information	<ul style="list-style-type: none"> ● Engine overheat condition/cooling fan failure ● Engine Coolant Temperature sensor wiring short circuit to ground ● Engine Coolant Temperature sensor failure 	Check the coolant level and the thermostat operation (stuck closed). Check for cooling fan DTCs. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0121-00	Throttle/Pedal Position Sensor A Circuit Range/Performance - no sub type information	<ul style="list-style-type: none"> ● Throttle position sensor wiring high resistance ● Throttle position sensor sensing circuits (Throttle position 1 or Throttle position 2) short circuit to power ● Throttle position sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest

DTC	Description	Possible Causes	Action
P0122-00	Throttle/Pedal Position Sensor A Circuit Low - no sub type information	<ul style="list-style-type: none"> ● Throttle position sensor sensing circuit 1 short circuit to ground, high resistance ● Throttle position sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0123-00	Throttle/Pedal Position Sensor A Circuit High - no sub type information	<ul style="list-style-type: none"> ● Throttle position sensor sensing circuit (Throttle position1) short circuit to power ● Throttle position sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0125-00	Insufficient Coolant Temp For Closed Loop Fuel Control - no sub type information	<ul style="list-style-type: none"> ● Low coolant level ● Engine thermostat failure ● Engine Coolant Temperature sensor sensing circuit intermittent high resistance ● Engine Coolant Temperature sensor failure 	Check the coolant level and thermostat operation. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0128-00	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature) - no sub type information	<ul style="list-style-type: none"> ● Contaminated coolant ● Engine coolant thermostat failure ● Engine Coolant Temperature sensor failure - Engine Coolant Temperature sensor DTC may also be flagged 	Check the coolant level/condition and thermostat operation. Check for Engine Coolant Temperature sensor DTCs
P0130-1A	O2 Circuit (Bank 1, Sensor 1) - circuit resistance below threshold	<ul style="list-style-type: none"> ● Heated O₂ sensor (right-hand bank) element impedance low ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0130-1B	O2 Circuit (Bank 1, Sensor 1) - circuit resistance above threshold	<ul style="list-style-type: none"> ● Heated O₂ sensor (right-hand bank) element impedance high ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0131-00	O2 Circuit Low Voltage (Bank 1, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor signal circuit high resistance ● Heated O₂ sensor signal circuit short circuit to ground ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0132-00	O2 Circuit High Voltage (Bank 1, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor (right-hand bank) signal circuit short circuit to power ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0133-00	O2 Circuit Slow Response (Bank 1, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor (right-hand bank) to Engine Control Module wiring high resistance ● Exhaust leak ● HO₂ sensor failure 	Check the exhaust system for leaks. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0134-00	O2 Circuit No Activity Detected (Bank 1, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor (right-hand bank) slow activation 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0137-00	O2 Circuit Low Voltage (Bank 1, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (right-hand bank) to Engine Control Module wiring high resistance ● Catalyst monitor sensor short circuit to ground ● Catalyst monitor sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0138-00	O2 Circuit High Voltage (Bank 1, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (right-hand bank) sensing circuit short circuit to power ● Catalyst monitor sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0139-00	O2 Circuit Slow Response (Bank 1, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (right-hand bank) slow response 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0140-00	O2 Circuit Slow Response (Bank 1, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor (right-hand bank) to Engine Control Module wiring high resistance ● Catalyst monitor sensing 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> circuit short circuit to power ● Catalyst monitor short circuit to ground 	
P0141-00	O2 Heater Circuit (Bank 1, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (right-hand bank) heater control circuit high resistance ● Catalyst monitor sensor heater failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0150-1A	O2 Circuit (Bank 2, Sensor 1) - circuit resistance below threshold	<ul style="list-style-type: none"> ● Circuit (left-hand bank) resistance below threshold ● Element impedance low ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0150-1B	O2 Circuit (Bank 2, Sensor 1) - circuit resistance above threshold	<ul style="list-style-type: none"> ● Circuit (left-hand bank) resistance above threshold ● Element impedance high ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0151-00	O2 Circuit Low Voltage (Bank 2, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor (left-hand bank) signal circuit high resistance ● Heated O₂ sensor signal circuit short circuit to ground ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0152-00	O2 Circuit High Voltage (Bank 2, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor (left-hand bank) signal circuit short circuit to power ● Heated O₂ sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0153-00	O2 Circuit Slow Response (Bank 2, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor (left-hand bank) to Engine Control Module wiring high resistance ● Exhaust leak ● Heated O₂ sensor failure 	Check the exhaust system for leaks. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0154-00	O2 Circuit No Activity Detected (Bank 2, Sensor 1) - no sub type information	<ul style="list-style-type: none"> ● Heated O₂ sensor (left-hand bank) slow activation 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0157-00	O2 Circuit Low Voltage (Bank 2, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (left-hand bank) to Engine Control Module wiring high resistance ● Catalyst monitor sensor short circuit to ground ● Catalyst monitor sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0158-00	O2 Circuit High Voltage (Bank 2, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (left-hand bank) sensing circuit short circuit to power ● Catalyst monitor sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0159-00	O2 Circuit Slow Response (Bank 2, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (left-hand bank) slow response 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0160-00	O2 Circuit No Activity Detected (Bank 2, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor (left-hand bank) to Engine Control Module wiring high resistance ● Catalyst monitor sensing (left-hand bank) circuit short circuit to power ● Catalyst monitor short circuit to ground 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0161-00	O2 Heater Circuit (Bank 2, Sensor 2) - no sub type information	<ul style="list-style-type: none"> ● Catalyst monitor sensor (left-hand bank) heater control circuit malfunction 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0171-00	System Too Lean (Bank 1) - no sub type information	<ul style="list-style-type: none"> ● Air intake leak between Mass Air Flow (MAF) sensor and cylinder head ● Mass Air Flow (MAF) sensor fault (low intake air flow) ● Fuel filter/system restriction ● Low fuel pressure ● Fuel injector restriction ● Exhaust leak (before catalyst) 	Check the intake air system for leaks, etc. Check the fuel system for restrictions, DTCs, etc. Check the exhaust system for leaks, etc. Check for evaporative emission DTCs

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Evaporative emission system fault 	
P0172-00	System Too Rich (Bank 1) - no sub type information	<ul style="list-style-type: none"> ● Restricted air filter ● High fuel pressure ● Leaking fuel injector(s) ● Oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) ● Mass Air Flow (MAF) sensor fault ● Evaporative emission system fault 	Check the intake air system for restrictions, etc. Check the fuel system for leaks, DTCs, etc. Check the oil condition. Check for Mass Air Flow (MAF) sensor and evaporative emission DTCs
P0174-00	System Too Lean (Bank 2) - no sub type information	<ul style="list-style-type: none"> ● Air intake leak between Mass Air Flow (MAF) sensor and cylinder head ● Mass Air Flow (MAF) sensor fault (low intake air flow) ● Fuel filter/system restriction ● Low fuel pressure ● Fuel injector restriction ● Exhaust leak (before catalyst) ● Evaporative emission system fault 	Check the intake air system for leaks, etc. Check the fuel system for restrictions, DTCs, etc. Check the exhaust system for leaks, etc. Check for evaporative emission DTCs
P0175-00	System too Rich (Bank 2) - no sub type information	<ul style="list-style-type: none"> ● Restricted air filter ● High fuel pressure ● Leaking fuel injector(s) ● Oil contaminated with fuel (too many cold starts with vehicle subsequently not getting hot enough for long enough) ● Mass Air Flow (MAF) sensor fault ● Evaporative emission system fault 	Check the intake air system for restrictions, etc. Check the fuel system for leaks, DTCs, etc. Check the oil condition. Check for Mass Air Flow (MAF) sensor and evaporative emission DTCs
P0196-23	Engine Oil Temperature Sensor Range/Performance - signal stuck low	<ul style="list-style-type: none"> ● Oil temperature sensor sensing circuit intermittent high resistance ● Oil temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0196-24	Engine Oil Temperature Sensor Range/Performance - signal stuck high	<ul style="list-style-type: none"> ● Oil temperature sensor sensing circuit intermittent high resistance ● Oil temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0196-29	Oil Temperature Sensor Circuit Range/Performance - signal invalid	<ul style="list-style-type: none"> ● Oil temperature sensor sensing circuit intermittent high resistance ● Oil temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0197-00	Engine Oil Temperature Sensor Circuit Low - no sub type information	<ul style="list-style-type: none"> ● Oil temperature sensor sensing circuit short circuit to ground ● Oil temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0198-00	Engine Oil Temperature Sensor Circuit High - no sub type information	<ul style="list-style-type: none"> ● Oil temperature sensor sensing circuit high resistance, short circuit to power ● Oil temperature sensor failure 	Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the sensor. Clear the DTC and retest
P0201-00	Cylinder 1 Injector Circuit / Open - no sub type information	<ul style="list-style-type: none"> ● Injector disconnected ● Injector harness wiring high resistance, short circuit to ground ● Injector failure 	For fuel system tests, refer to the relevant workshop manual section. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the injector. Clear the DTC and retest
P0202-00	Cylinder 2 Injector Circuit / Open - no sub type information	<ul style="list-style-type: none"> ● Injector disconnected ● Injector harness wiring high resistance, short circuit to ground ● Injector failure 	For fuel system tests, refer to the relevant workshop manual section. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the injector. Clear the DTC and retest
P0203-00	Cylinder 3 Injector Circuit / Open - no sub type information	<ul style="list-style-type: none"> ● Injector disconnected ● Injector harness wiring high resistance, short circuit to ground ● Injector failure 	For fuel system tests, refer to the relevant workshop manual section. Refer to the electrical circuit diagrams and check the sensor circuit. If no circuit fault exists, renew the injector. Clear the DTC and retest

General Information - Diagnostic Trouble Code (DTC) Index V8 5.0L Petrol, DTC: Engine Control Module (PCM)

Description and Operation

Engine Control Module (PCM) 5.0L V8



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Engine Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Electronic Engine Controls](#) (303-14D Electronic Engine Controls - V8 5.0L Petrol, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B10A2-31	Crash Input - No signal	<ul style="list-style-type: none"> • NOTE: - Circuit SRS_SIGNAL - • Loss of communication between restraints control module and engine control module 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check restraints control module pulse width modulated SRS signal line circuit, hard wired connection between engine control module and restraints control module for short circuit to ground, short circuit to power, open circuit. Repair circuit as required, clear the DTC and retest
B10AC-81	Cruise Control Switch - Invalid serial data received	<ul style="list-style-type: none"> • The engine control module has received an invalid command from the steering wheel switch pack 	<ul style="list-style-type: none"> • Clear the DTC and press all the steering wheel switches, re-check for DTCs. Refer to the electrical circuit diagrams and check the speed control switch circuit for open circuit, short circuit to power, short circuit to ground, disconnected • Check and install a new steering wheel module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B10AC-82	Cruise Control Switch - Alive / sequence counter incorrect / not updated	<ul style="list-style-type: none"> • Cruise buttons alive counter is not incrementing. Which suggests that the LIN bus is faulty • Steering wheel module is not connected • Steering wheel module failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check the speed control switch circuit for open circuit, short circuit to power, short circuit to ground, disconnected • Refer to the electrical circuit diagrams and check the LIN bus between steering wheel module and the CAN gateway • Check and install a new steering wheel module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B10AC-83	Cruise Control Switch - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> • Cruise buttons checksum incorrect, incorrect cruise switches fitted to vehicle 	<ul style="list-style-type: none"> • Check and install new cruise switches as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

DTC	Description	Possible Causes	Action
B10AC-96	Cruise Control Switch - Component internal failure	<ul style="list-style-type: none"> ● Speed control switch circuit, open circuit, short circuit to power, short circuit to ground, disconnected ● Speed control switch failure ● Steering wheel module failure 	<ul style="list-style-type: none"> ● Check for related DTCs in other central junction boxes ● Refer to the electrical circuit diagrams and check the speed control switch circuit for open circuit, short circuit to power, short circuit to ground, disconnected ● Check and install a new speed control switch as required. Check and install a new steering wheel module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B10FF-68	Ignition Control - Event information	<ul style="list-style-type: none"> ● Spark plug(s) fault ● Wiring harness fault ● Ignition coil(s) fault 	<ul style="list-style-type: none"> ● Refer to repair manual and check spark plug(s) for condition and security. Replace any defective components as required ● Refer to electrical wiring diagrams and check ignition coil circuit for intermittent open circuit, short circuit to power, short circuit to ground ● Check and install a new coil(s) as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B11DB-01	Battery Monitoring Module - General electrical failure	<ul style="list-style-type: none"> ● NOTE: - Circuit BATTERY - ● Charging system fault ● Battery monitoring signal line circuit fault ● Vehicle battery fault 	<ul style="list-style-type: none"> ● Refer to electrical wiring diagrams and check charging system for faults. Perform any repairs required ● Refer to the electrical wiring diagrams and check the battery monitoring system module circuit for open circuit, short circuit to ground, short circuit to power ● Refer to the workshop manual and the battery care manual, inspect the vehicle battery and ensure it is fully charged and serviceable before performing further tests
B11DB-87	Battery Monitoring Module - Missing message	<ul style="list-style-type: none"> ● NOTE: - Circuit BATTERY - ● Battery signal line circuit fault 	<ul style="list-style-type: none"> ● Refer to the electrical wiring diagrams and check the battery monitoring system module circuit for open circuit, short circuit to ground, short circuit to power ● Refer to the electrical circuit diagrams and check the LIN circuit for short circuit to ground, short circuit to power, open circuit
B1206-68	Crash Occurred - Event information	<ul style="list-style-type: none"> ● NOTE: - Circuit SRS_SIGNAL - ● Engine control module has detected the vehicle has crashed - event information DTC only 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the engine control module to restraints control module circuit for short circuit to ground, short circuit to power, open circuit. Repair circuit as required, clear the DTC and retest
C0031-00	Left Front Wheel Speed Sensor - No sub type information	<ul style="list-style-type: none"> ● Invalid data received from anti-lock braking system module - left front wheel speed signal fault 	<ul style="list-style-type: none"> ● Check anti-lock braking system module for related DTCs and refer to relevant DTC index
C0034-00	Right Front Wheel Speed Sensor - No sub type information	<ul style="list-style-type: none"> ● Invalid data received from anti-lock braking system module - right front wheel speed signal fault 	<ul style="list-style-type: none"> ● Check anti-lock braking system module for related DTCs and refer to relevant DTC index
C0037-00	Left Rear Wheel Speed Sensor - No sub type information	<ul style="list-style-type: none"> ● Invalid data received from anti-lock braking system module - left rear wheel speed signal fault 	<ul style="list-style-type: none"> ● Check anti-lock braking system module for related DTCs and refer to relevant DTC index
C003A-00	Right Rear Wheel Speed Sensor - No sub type information	<ul style="list-style-type: none"> ● Invalid data received from anti-lock braking system module - right rear wheel speed signal fault 	<ul style="list-style-type: none"> ● Check anti-lock braking system module for related DTCs and refer to relevant DTC index
P0010-13	Intake (A) Camshaft Position Actuator (Bank 1) - Circuit open	<ul style="list-style-type: none"> ● NOTE: - Circuit VFS_IN_A - ● Intake (A) camshaft position actuator (Bank 1) open circuit ● Engine control module interface harness open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check intake (A) camshaft position actuator (Bank 1) circuit for open circuit ● Refer to the electrical circuit diagrams and check engine control module

DTC	Description	Possible Causes	Action
			interface harness for open circuit
P0011-00	Intake (A) Camshaft Position Timing - Over-Advanced (Bank 1) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit VFS_IN_A - Intake (A) camshaft position actuator (Bank 1) open circuit Engine control module interface harness open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check intake (A) camshaft position actuator (Bank 1) circuit for open circuit Refer to the electrical circuit diagrams and check engine control module interface harness for open circuit
P0013-13	Exhaust (B) Camshaft Position Actuator (Bank 1) - Circuit open	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_A - Exhaust (B) camshaft position actuator (Bank 1) open circuit Engine control module interface harness open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check exhaust (B) camshaft position actuator (Bank 1) circuit for open circuit Refer to the electrical circuit diagrams and check engine control module interface harness for open circuit
P0015-00	Exhaust (B) Camshaft Position Timing - Over-Retarded (Bank 1) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_A - Exhaust (B) camshaft position actuator (Bank 1) open circuit, short circuit to ground, short circuit to power 	<ul style="list-style-type: none"> Check for related DTC P0365-00. Refer to the electrical circuit diagrams and check exhaust (B) camshaft position actuator (Bank 1) for open circuit, short circuit to ground, short circuit to power
P0016-00	Crankshaft Position - Camshaft Position Correlation - Bank 1 Sensor A - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_A - The relative positions of the crankshaft position sensor and cam timing plate teeth are not correct Engine timing incorrect Timing chain installed incorrectly Variable valve timing forced fully advanced 	<ul style="list-style-type: none"> Check engine timing. Check camshaft sensor timing plate is installed correctly. Check timing chain is installed correctly
P0017-00	Crankshaft Position - Camshaft Position Correlation - Bank 1 Sensor B - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_A - The relative positions of the crankshaft position sensor and camshaft timing plate teeth are not correct Engine timing incorrect Timing chain installed incorrectly Variable valve timing forced fully advanced 	<ul style="list-style-type: none"> Check for related DTC P0365-00. Check engine timing. Check camshaft sensor timing plate is installed correctly. Check timing chain is installed correctly Refer to the electrical circuit diagrams and check exhaust (B) camshaft position actuator (Bank 1) for open circuit, short circuit to ground, short circuit to power
P0018-00	Crankshaft Position - Camshaft Position Correlation - Bank 2 Sensor A - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit VFS_IN_B - The relative positions of the crankshaft position sensor and camshaft timing plate teeth are not correct Engine timing incorrect Timing chain installed incorrectly Variable valve timing forced fully advanced 	<ul style="list-style-type: none"> Check engine timing. Check camshaft sensor timing plate is installed correctly. Check timing chain is installed correctly
P0019-00	Crankshaft Position - Camshaft Position Correlation - Bank 2 Sensor B - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_B - The relative positions of the crankshaft position sensor and camshaft timing plate teeth are not correct Engine timing incorrect Timing chain installed incorrectly Variable valve timing forced fully advanced 	<ul style="list-style-type: none"> Check engine timing. Check camshaft sensor timing plate is installed correctly. Check timing chain is installed correctly
P001A-13	Intake (A) Cam Profile Control Circuit (Bank 1) - Circuit open	<ul style="list-style-type: none"> NOTE: - Circuit CPS_A - Camshaft profile switching solenoid bank 1 open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 1 for open circuit
P001B-11	Intake (A) Cam Profile Control Circuit Low (Bank 1) - Circuit short to ground	<ul style="list-style-type: none"> NOTE: - Circuit CPS_A - Camshaft profile switching solenoid bank 1 circuit short circuit to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 1 circuit for short circuit to ground
P001C-12	Intake (A) Cam Profile Control Circuit High (Bank 1) - Circuit short to battery	<ul style="list-style-type: none"> NOTE: - Circuit CPS_A - Camshaft profile switching solenoid bank 1 circuit short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 1 circuit for short circuit to power

DTC	Description	Possible Causes	Action
P001D-13	Intake (A) Cam Profile Control Circuit (Bank 2) - Circuit open	<ul style="list-style-type: none"> NOTE: - Circuit CPS_B - Camshaft profile switching solenoid bank 2 open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 2 for open circuit
P001E-11	Intake (A) Cam Profile Control Circuit Low (Bank 2) - Circuit short to ground	<ul style="list-style-type: none"> NOTE: - Circuit CPS_B - Camshaft profile switching solenoid bank 2 circuit short circuit to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 2 circuit for short circuit to ground
P001F-12	Intake (A) Cam Profile Control Circuit High (Bank 2) - Circuit short to battery	<ul style="list-style-type: none"> NOTE: - Circuit CPS_B - Camshaft profile switching solenoid bank 2 circuit short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 2 circuit for short circuit to power
P0020-13	Intake (A) Camshaft Position Actuator (Bank 2) - Circuit open	<ul style="list-style-type: none"> NOTE: - Circuit VFS_IN_B - Intake valve solenoid 2 open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check intake valve solenoid 2 for open circuit
P0023-13	Exhaust (B) Camshaft Position Actuator (Bank 2) - Circuit open	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_B - Exhaust (B) Camshaft Position actuator (Bank 2) circuit, open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check exhaust (B) camshaft position actuator (Bank 2) circuit for open circuit
P0026-72	Intake Valve Control Solenoid Circuit Range/Performance (Bank 1) - Actuator stuck open	<ul style="list-style-type: none"> NOTE: - Circuit VFS_IN_A - Intake valve solenoid 1 angle less than target Intake valve solenoid 1 slow or not operating 	<ul style="list-style-type: none"> Check operation of intake valve solenoid 1. Check and install a new intake valve solenoid 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0026-77	Intake Valve Control Solenoid Circuit Range/Performance (Bank 1) - Commanded position not reachable	<ul style="list-style-type: none"> NOTE: - Circuit VFS_IN_A - Intake valve solenoid 1 angle greater than target Intake valve solenoid 1 not returning to target in time Intake valve solenoid 1 stuck advanced 	<ul style="list-style-type: none"> Check operation of intake valve solenoid 1. Check and install a new intake valve solenoid 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0027-72	Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 1) - Actuator stuck open	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_A - Exhaust valve solenoid 1 angle less than target Exhaust valve solenoid 1 slow or not operating 	<ul style="list-style-type: none"> Check operation of exhaust valve solenoid 1. Check and install a new exhaust valve solenoid 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0027-77	Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 1) - Commanded position not reachable	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_A - Exhaust valve solenoid 1 angle greater than target Exhaust valve solenoid 1 not returning to target in time Exhaust valve solenoid 1 stuck advanced 	<ul style="list-style-type: none"> Check operation of exhaust valve solenoid 1. Check and install a new exhaust valve solenoid 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0028-72	Intake Valve Control Solenoid Circuit Range/Performance (Bank 2) - Actuator stuck open	<ul style="list-style-type: none"> NOTE: - Circuit VFS_IN_B - Intake valve solenoid 2 angle less than target Intake valve solenoid 2 slow or not operating 	<ul style="list-style-type: none"> Check operation of intake valve solenoid 2. Check and install a new intake valve solenoid 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0028-77	Intake Valve Control Solenoid Circuit Range/Performance (Bank 2) - Commanded position not reachable	<ul style="list-style-type: none"> NOTE: - Circuit VFS_IN_B - Intake valve solenoid 2 angle greater than target Intake valve solenoid 2 not returning to target in time Intake valve solenoid 2 stuck advanced 	<ul style="list-style-type: none"> Check operation of intake valve solenoid 2. Check and install a new intake valve solenoid 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0029-72	Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 2) - Actuator stuck open	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_B - Exhaust valve solenoid 2 angle less than target Exhaust valve solenoid 2 slow or 	<ul style="list-style-type: none"> Check operation of exhaust valve solenoid 2. Check and install a new exhaust valve solenoid 2 as required. Refer to the warranty policy and procedures manual, or determine if

DTC	Description	Possible Causes	Action
		not operating	any prior approval programme is in operation, prior to the installation of a new module/component
P0029-77	Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 2) - Commanded position not reachable	<ul style="list-style-type: none"> NOTE: - Circuit VFS_EX_B - Exhaust valve solenoid 2 angle greater than target Exhaust valve solenoid 2 not returning to target in time Exhaust valve solenoid 2 stuck advanced 	<ul style="list-style-type: none"> Check operation of exhaust valve solenoid 2. Check and install a new exhaust valve solenoid 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0031-11	HO2S Heater Control Circuit Low (Bank 1, Sensor 1) - Circuit short to ground	<ul style="list-style-type: none"> NOTE: - Circuit HTR_CTRL_A_UPSTREAM - NOTE: LR - Circuit UHEGO HEATER A - Pre catalyst oxygen sensor-odd heater control circuit (Bank 1, Sensor 1) circuit short circuit to ground 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1) Refer to the electrical circuit diagrams and check pre catalyst oxygen sensor-odd heater control circuit (Bank 1, Sensor 1) circuit for short circuit to ground
P0031-13	HO2S Heater Control Circuit Low (Bank 1, Sensor 1) - Circuit open	<ul style="list-style-type: none"> NOTE: - Circuit HTR_CTRL_A_UPSTREAM - NOTE: LR - Circuit UHEGO HEATER A - Pre catalyst oxygen sensor-odd heater control circuit (Bank 1, Sensor 1) circuit, open circuit 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1) Refer to the electrical circuit diagrams and check pre catalyst oxygen sensor-odd heater control circuit (Bank 1, Sensor 1) circuit for open circuit
P0032-12	HO2S Heater Control Circuit High (Bank 1, Sensor 1) - Circuit short to battery	<ul style="list-style-type: none"> NOTE: - Circuit HTR_CTRL_A_UPSTREAM - NOTE: LR - Circuit UHEGO HEATER A - Pre catalyst oxygen sensor-odd heater control circuit (Bank 1, Sensor 1) circuit short circuit to power 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1) Refer to the electrical circuit diagrams and check pre catalyst oxygen sensor-odd heater control circuit (Bank 1, Sensor 1) circuit for short circuit to power
P0036-00	HO2S Heater Control Circuit (Bank 1, Sensor 2) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit HTR_HEGO_A - Catalyst oxygen sensor heater circuit control fuse failure Post catalyst oxygen sensor-odd heater control circuit short circuit to ground, short circuit to power, open circuit Catalyst oxygen sensor heater circuit control relay circuit short circuit to ground, short circuit to power, open circuit Catalyst oxygen sensor heater circuit control relay failure Post catalyst oxygen sensor-odd failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 2 (0x03A2) Refer to the electrical circuit diagrams and check post catalyst oxygen sensor-odd sensor fuse for open circuit Refer to the electrical circuit diagrams and check post catalyst oxygen sensor-odd sensor circuit for short circuit to ground, short circuit to power, open circuit Refer to the electrical circuit diagrams and check catalyst oxygen sensor heater circuit control relay circuit for short circuit to ground, short circuit to power, open circuit Check and install a new catalyst oxygen sensor heater control relay, as required. Check and install a new post catalyst oxygen sensor-odd as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P003C-00	A Camshaft Profile Control Performance /Stuck Off (Bank 1) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit CPS_A - Oil supply blockage to camshaft profile switching solenoid Catalyst oxygen sensor failure, giving false flag Camshaft profile switching solenoid bank 1 circuit fault Camshaft profile switching solenoid bank 1 fault 	<ul style="list-style-type: none"> Check for the presence of oil at the camshaft profile switching solenoid Check for catalyst oxygen sensor related DTCs Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 1 circuit for short circuit to power, short circuit to ground, open circuit Check and install a new camshaft profile switching solenoid bank 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in

DTC	Description	Possible Causes	Action
			<p>operation, prior to the installation of a new module/component</p> <ul style="list-style-type: none"> ● Clear DTC and road test the vehicle. If fault remains contact dealer technical support before carrying out any further work
P003E-00	A Camshaft Profile Control Performance/ Stuck Off (Bank 2) - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit CPS_B - <ul style="list-style-type: none"> ● Oil supply blockage to camshaft profile switching solenoid ● Catalyst oxygen sensor failure, giving false flag ● Camshaft profile switching solenoid bank 2 circuit fault ● Camshaft profile switching solenoid bank 2 fault 	<ul style="list-style-type: none"> ● Check for the presence of oil at the camshaft profile switching solenoid ● Check for catalyst oxygen sensor related DTCs ● Refer to the electrical circuit diagrams and check camshaft profile switching solenoid bank 2 circuit for short circuit to power, short circuit to ground, open circuit ● Check and install a new camshaft profile switching solenoid bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component ● Clear DTC and road test the vehicle. If fault remains contact dealer technical support before carrying out any further work
P0051-11	HO2S Heater Control Circuit Low (Bank 2, Sensor 1) - Circuit short to ground	<ul style="list-style-type: none"> • NOTE: - Circuit HTR_CTRL_B_UPSTREAM - • NOTE: LR - Circuit UHEGO HEATER B - <ul style="list-style-type: none"> ● Pre catalyst oxygen sensor-even heater control circuit (Bank 2, Sensor 1) circuit short circuit to ground 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 2 Sensor 1 (0x03A4) ● Refer to the electrical circuit diagrams and check pre catalyst oxygen sensor-even heater control circuit (Bank 2, Sensor 1) circuit for short circuit to ground
P0051-13	HO2S Heater Control Circuit Low (Bank 2, Sensor 1) - Circuit open	<ul style="list-style-type: none"> • NOTE: - Circuit HTR_CTRL_B_UPSTREAM - • NOTE: LR - Circuit UHEGO HEATER B - <ul style="list-style-type: none"> ● Pre catalyst oxygen sensor-even heater control circuit (Bank 2, Sensor 1) circuit, open circuit 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 2 Sensor 1 (0x03A4) ● Refer to the electrical circuit diagrams and check pre catalyst oxygen sensor-even heater control circuit (Bank 2, Sensor 1) circuit for open circuit
P0052-12	HO2S Heater Control Circuit High (Bank 2, Sensor 1) - Circuit short to battery	<ul style="list-style-type: none"> • NOTE: - Circuit HTR_CTRL_B_UPSTREAM - • NOTE: LR - Circuit UHEGO HEATER B - <ul style="list-style-type: none"> ● Pre catalyst oxygen sensor-even heater control circuit (Bank 2, Sensor 1) circuit short circuit to power 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 2 Sensor 1 (0x03A4) ● Refer to the electrical circuit diagrams and check pre catalyst oxygen sensor-even heater control circuit (Bank 2, Sensor 1) circuit for short circuit to power
P0054-00	HO2S Heater Resistance (Bank 1, Sensor 2) - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit HTR_CTRL_A_UPSTREAM - • NOTE: LR - Circuit UHEGO HEATER A - <ul style="list-style-type: none"> ● Catalyst oxygen sensor heater circuit control fuse failure ● Post catalyst oxygen sensor-odd heater control circuit short circuit to ground, short circuit to power, open circuit, high resistance ● Catalyst oxygen sensor heater circuit control relay circuit short circuit to ground, short circuit to power, open circuit ● Catalyst oxygen sensor heater circuit control relay failure ● Post catalyst oxygen sensor-odd failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1 (0x03A1) ● Refer to the electrical circuit diagrams and check post catalyst oxygen sensor-odd sensor fuse for open circuit ● Refer to the electrical circuit diagrams and check post catalyst oxygen sensor-odd sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance ● Refer to the electrical circuit diagrams and check catalyst oxygen sensor heater circuit control relay circuit for short circuit to ground, short circuit to power, open circuit ● Check and install a new catalyst oxygen sensor heater control relay, as required. Check and install a new post catalyst oxygen sensor-odd as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a

DTC	Description	Possible Causes	Action
			new module/component
P0056-00	HO2S Heater Control Circuit (Bank 2, Sensor 2) - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit HTR_HEGO_B - ● Post catalyst oxygen sensor-even heater control circuit short circuit to ground, short circuit to power, open circuit ● Catalyst oxygen sensor heater circuit control relay circuit short circuit to ground, short circuit to power, open circuit ● Catalyst oxygen sensor heater circuit control relay failure ● Post catalyst oxygen sensor-even failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 2 Sensor 2 (0x03A5) ● Refer to the electrical circuit diagrams and check post catalyst oxygen sensor-even sensor circuit for short circuit to ground, short circuit to power, open circuit ● Refer to the electrical circuit diagrams and check catalyst oxygen sensor heater circuit control relay circuit for short circuit to ground, short circuit to power, open circuit ● Check and install a new catalyst oxygen sensor heater control relay, as required. Check and install a new post catalyst oxygen sensor-even, as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0060-00	HO2S Heater Resistance (Bank 2, Sensor 2) - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit HTR_CTRL_B_UPSTREAM - • NOTE: LR - Circuit UHEGO HEATER B - ● Catalyst oxygen sensor heater circuit control fuse failure ● Post catalyst oxygen sensor-even heater control circuit short circuit to ground, short circuit to power, open circuit, high resistance ● Catalyst oxygen sensor heater circuit control relay circuit short circuit to ground, short circuit to power, open circuit ● Catalyst oxygen sensor heater circuit control relay failure ● Post catalyst oxygen sensor-even failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Oxygen Sensor (O2S) Heater Duty Cycle Bank 2 Sensor 2 (0x03A5) ● Refer to the electrical circuit diagrams and check post catalyst oxygen sensor-even sensor fuse for open circuit ● Refer to the electrical circuit diagrams and check post catalyst oxygen sensor-even sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance ● Refer to the electrical circuit diagrams and check catalyst oxygen sensor heater circuit control relay circuit for short circuit to ground, short circuit to power, open circuit ● Check and install a new catalyst oxygen sensor heater control relay, as required. Check and install a new post catalyst oxygen sensor-even as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0069-29	MAP - Barometric Pressure Correlation - Signal invalid	<ul style="list-style-type: none"> ● Manifold absolute pressure sensor failure ● Engine control module failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Barometric Pressure Sensor Voltage (0x035A). Check for related manifold absolute pressure sensor DTCs ● Refer to the electrical circuit diagrams and check manifold absolute pressure sensor circuit for short circuit to ground, short circuit to power, open circuit ● Check and install new manifold absolute pressure sensor as required. Check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0071-21	Ambient Air Temperature Sensor Range/Performance - Signal amplitude < minimum	<ul style="list-style-type: none"> • NOTE: Jaguar - Circuit AMBIENT_TEMP_SENSOR - • NOTE: LR - Circuit TAMB TEMP - ● Ambient air temperature sensor circuit short circuit to ground, short circuit to power, open circuit ● Temperature and manifold absolute 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Ambient Air Temperature Sensor Voltage (0x03BA) ● Refer to the electrical circuit diagrams and check ambient air temperature sensor circuit for short circuit to ground, short circuit to power, open circuit

DTC	Description	Possible Causes	Action
		pressure sensor circuit short circuit to ground, short circuit to power, open circuit <ul style="list-style-type: none"> ● Ambient air temperature sensor failure ● Temperature and manifold absolute pressure sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check temperature and manifold absolute pressure sensor circuit for short circuit to ground, short circuit to power, open circuit ● Check and install a new ambient air temperature sensor as required. Check and install a new temperature and manifold absolute pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0071-22	Ambient Air Temperature Sensor Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> ● NOTE: - Circuit AMBIENT_TEMP_SENSOR - ● NOTE: LR - Circuit TAMB TEMP - ● Ambient air temperature sensor circuit short circuit to ground, short circuit to power, open circuit ● Temperature and manifold absolute pressure sensor circuit short circuit to ground, short circuit to power, open circuit ● Ambient air temperature sensor failure ● Temperature and manifold absolute pressure sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Ambient Air Temperature Sensor Voltage (0x03BA) ● Refer to the electrical circuit diagrams and check ambient air temperature sensor circuit for short circuit to ground, short circuit to power, open circuit ● Refer to the electrical circuit diagrams and check temperature and manifold absolute pressure sensor circuit for short circuit to ground, short circuit to power, open circuit ● Check and install a new ambient air temperature sensor as required. Check and install a new temperature and manifold absolute pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0072-00	Ambient Air Temperature Sensor Circuit Low - No sub type information	<ul style="list-style-type: none"> ● NOTE: - Circuit AMBIENT_TEMP_SENSOR - ● NOTE: LR - Circuit TAMB TEMP - ● Ambient air temperature sensor circuit short circuit to ground, open circuit, high resistance ● Ambient air temperature sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Ambient Air Temperature Sensor Voltage (0x03BA) ● Refer to the electrical circuit diagrams and check ambient air temperature sensor circuit for short circuit to ground, open circuit, high resistance ● Check and install a new ambient air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0073-00	Ambient Air Temperature Sensor Circuit High - No sub type information	<ul style="list-style-type: none"> ● NOTE: - Circuit AMBIENT_TEMP_SENSOR - ● NOTE: LR - Circuit TAMB TEMP - ● Ambient air temperature sensor ground circuit high resistance, open circuit ● Ambient air temperature sensor signal circuit short circuit to power ● Ambient air temperature sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signals Ambient Air Temperature Sensor Voltage (0x03BA) ● Refer to the electrical circuit diagrams and check ambient air temperature sensor circuit for short circuit to ground, high resistance, short circuit to power. Check connector terminals for corrosion or damage ● Check and install a new ambient air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P007B-23	Charge Air Cooler Temperature Sensor Circuit Range/Performance (Bank 1) - Signal stuck low	<ul style="list-style-type: none"> ● NOTE: - Circuit TMAP_TEMP_SENSOR - ● Charge air cooler temperature sensor circuit poor / intermittent connection ● Charge air cooler temperature sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Charge Air Temperature Voltage (0x03EE) ● Refer to the electrical circuit diagrams and check charge air cooler temperature sensor circuit for poor, intermittent connection ● Check and install a new charge air cooler temperature sensor as required. Refer to the warranty policy and

DTC	Description	Possible Causes	Action
			procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P007B-24	Charge Air Cooler Temperature Sensor Circuit Range/Performance (Bank 1) - Signal stuck high	<ul style="list-style-type: none"> • NOTE: - Circuit TMAP_TEMP_SENSOR - ● Charge air cooler temperature sensor circuit short circuit to ground, open circuit ● Charge air cooler temperature sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Charge Air Temperature Voltage (0x03EE) ● Refer to the electrical circuit diagrams and check charge air cooler temperature sensor circuit for short circuit to ground, open circuit ● Check and install a new charge air cooler temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P007B-29	Charge Air Cooler Temperature Sensor Circuit Range/Performance (Bank 1) - Signal invalid	<ul style="list-style-type: none"> • NOTE: - Circuit TMAP_TEMP_SENSOR - ● Charge air cooler temperature sensor circuit short circuit to ground, open circuit, short circuit to power ● Charge air cooler temperature sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Charge Air Temperature Voltage (0x03EE) ● Refer to the electrical circuit diagrams and check charge air cooler temperature sensor circuit for short circuit to ground, open circuit, short circuit to power ● Check and install a new charge air cooler temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0087-00	Fuel Rail/System Pressure - Too Low - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit FUEL_HIGH_PRESS_SENSOR - ● Fuel rail pressure sensor circuit short circuit to ground, open circuit, high resistance ● Fuel rail pressure sensor failure ● Fuel lines leaking or restricted ● Fuel pump failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Fuel Rail Pressure Sensor - High Range Sensor Voltage (0x0377) ● Refer to the electrical circuit diagrams and check fuel rail pressure sensor circuit for short circuit to ground, open circuit, high resistance ● Check for fuel pump related DTCs. Check fuel lines for leakage or restriction ● Check and install new fuel rail pressure sensor as required. Check and install a new fuel pump as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0088-00	Fuel Rail/System Pressure - Too High - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit FUEL_HIGH_PRESS_SENSOR - ● Fuel rail pressure sensor circuit short to each other, high resistance, short circuit to power ● Fuel rail pressure sensor failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Fuel Rail Pressure Sensor - High Range Sensor Voltage (0x0377) ● Refer to the electrical circuit diagrams and check fuel rail pressure sensor circuit for short to each other, high resistance, short circuit to power ● Check and install new fuel rail pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P008A-00	Low Pressure Fuel System Pressure - Too Low - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit LOW_PRESS_FUEL_PRESS_SENSOR - ● Low pressure fuel sensor circuit failure, short circuit to ground, short circuit to power, open circuit ● Fuel pump driver module circuit short circuit to ground, short circuit to power, open circuit ● Low pressure fuel 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Fuel Rail Pressure - Low Range Sensor Voltage (0x0376) ● Check fuel system for leakage ● Refer to the electrical circuit diagrams and check low pressure fuel sensor circuit for short circuit to ground, short circuit to power, open circuit ● Refer to the electrical circuit diagrams

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Fuel pump driver module failure 	<p>and check fuel pump driver module circuit short circuit to ground, short circuit to power, open circuit</p> <ul style="list-style-type: none"> ● Check and install a new low pressure fuel sensor as required. Check and install a new fuel pump driver module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P008B-00	Low Pressure Fuel System Pressure - Too High - No sub type information	<ul style="list-style-type: none"> ● NOTE: - Circuit LOW_PRESS_FUEL_PRESS_SENSOR - ● Low pressure fuel sensor circuit short circuit to ground, short circuit to power, open circuit ● Fuel pump driver module circuit short circuit to ground, short circuit to power, open circuit ● Blockage or restriction in low pressure fuel line ● Low pressure fuel sensor failure ● Fuel pump driver module failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Fuel Rail Pressure - Low Range Sensor Voltage (0x0376) ● Refer to the electrical circuit diagrams and check low pressure fuel sensor circuit for short circuit to ground, short circuit to power, open circuit. Check for blockage or restriction in low pressure fuel line ● Refer to the electrical circuit diagrams and check fuel pump driver module circuit short circuit to ground, short circuit to power, open circuit ● Check and install a new low pressure fuel sensor as required. Check and install a new fuel pump driver module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P00AB-23	Intake Air Temperature Sensor 1 Circuit Range/Performance (Bank 2) - Signal stuck low	<ul style="list-style-type: none"> ● NOTE: - Circuit INLET_AIR_TEMP_SENSOR_B - ● Intake air temperature sensor bank 2 circuit short circuit to ground, open circuit ● Intake air temperature sensor bank 2 failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Intake Air Temperature Sensor Bank 2 (0x0312) ● Refer to the electrical circuit diagrams and check intake air temperature sensor bank 2 circuit for short circuit to ground, open circuit ● Check and install a new intake air temperature sensor bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P00AB-24	Intake Air Temperature Sensor 1 Circuit Range/Performance (Bank 2) - Signal stuck high	<ul style="list-style-type: none"> ● NOTE: - Circuit INLET_AIR_TEMP_SENSOR_B - ● Intake air temperature sensor bank 2 circuit short circuit to power ● Intake air temperature sensor bank 2 failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Intake Air Temperature Sensor Bank 2 (0x0312) ● Refer to the electrical circuit diagrams and check intake air temperature sensor bank 2 circuit for short circuit to power ● Check and install a new intake air temperature sensor bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P00AB-29	Intake Air Temperature Sensor 1 Circuit Range/Performance (Bank 2) - Signal invalid	<ul style="list-style-type: none"> ● NOTE: - Circuit INLET_AIR_TEMP_SENSOR_B - ● Intake air temperature sensor bank 2 circuit short circuit to ground, open circuit, short circuit to power ● Intake air temperature sensor bank 2 failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Intake Air Temperature Sensor Bank 2 (0x0312) ● Refer to the electrical circuit diagrams and check intake air temperature sensor bank 2 circuit for open circuit, short circuit to ground, short circuit to power ● Check and install a new intake air temperature sensor bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a

DTC	Description	Possible Causes	Action
			new module/component
P00AC-00	Intake Air Temperature Sensor 1 Circuit Low (Bank 2) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit INLET_AIR_TEMP_SENSOR_B - Intake air temperature sensor bank 2 sensing circuit short circuit to ground, high resistance, disconnected Intake air temperature sensor bank 2 failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signal, Intake Air Temperature Sensor Bank 2 (0x0312) Refer to the electrical circuit diagrams and check intake air temperature sensor bank 2 circuit for short circuit to ground, open circuit, high resistance, disconnected connector Check and install a new intake air temperature sensor bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P00AD-00	Intake Air Temperature Sensor 1 Circuit High (Bank 2) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit INLET_AIR_TEMP_SENSOR_B - Intake air temperature sensor bank 2 sensing circuit short ground, short circuit to power, open circuit, high resistance Intake air temperature sensor bank 2 failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signal, Intake Air Temperature Sensor Bank 2 (0x0312) Refer to the electrical circuit diagrams and check intake air temperature sensor bank 2 circuit for short ground, short circuit to power, open circuit, high resistance. Check for backed out or damaged connector pins Check and install a new intake air temperature sensor bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P00C6-00	Fuel Rail Pressure Too Low - Engine Cranking - No sub type information	<ul style="list-style-type: none"> No fuel at pump Injector stuck open Fuel pressure sensor signal stuck Fuel pump failure 	<ul style="list-style-type: none"> Check fuel supply to both pumps (if engine runs then supply is not suspect). If engine does not run perform fuel prime routine. Use fuel pump diagnostic routine to determine if one pump has failed, if so replace pump. If a fuel injector is stuck open the exhaust will smell of fuel and fuelling adaptations may indicate rich shift. Perform checks for as DTC P0191-00 Check and install a new fuel pump as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0101-00	Mass or Volume Air Flow A Circuit Range/Performance - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit MAF_SENSOR_A - NOTE: Customer likely to report hesitation Blocked air cleaner element(s) Leakage from air intake system Blocked engine breather Blockage in air intake system Carbon build-up on throttle blade Blocked catalyts Blocked injectors MAF/IAT sensor bank 1 circuit - high resistance, intermittent short circuit to ground, high resistance MAF/IAT sensor bank 1 failure 	<ul style="list-style-type: none"> Check air cleaner element is free from restriction Check for leak from air intake system, rectify as required Ensure the engine breather system is correctly installed and in serviceable condition Make sure throttle blade is clean of carbon Check for blocked catalyts Refer to the electrical circuit diagrams and check MAF/IAT sensor bank 1 sensor circuit for intermittent short circuit to ground, high resistance Check for blocked injectors Check and install a new MAF/IAT sensor bank 1 sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0102-00	Mass or Volume Air Flow A Circuit Low - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit MAF_SENSOR_A - NOTE: Customer likely to report hesitation Mass air flow sensor bank 1 circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check mass air flow sensor bank 1 circuit for high resistance, open circuit Check and install a new mass air flow sensor bank 1 as required. Refer to the warranty policy and procedures

DTC	Description	Possible Causes	Action
		high resistance, open circuit <ul style="list-style-type: none"> ● Mass air flow sensor bank 1 failure 	manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0103-00	Mass or Volume Air Flow A Circuit High - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit MAF_SENSOR_A - • NOTE: Customer likely to report hesitation ● Mass air flow sensor bank 1 circuit high resistance, open circuit, short circuit to ground, short circuit to power ● Blocked air cleaner element(s) ● Blockage in air intake system ● Mass air flow sensor bank 1 failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Mass Air Flow Sensor, Bank 1 (0x0314) ● Check mass air flow sensor circuit fuse. If fuse fails, may see DTCs P0103, P010C and P250C ● Refer to the electrical circuit diagrams and check mass air flow sensor bank 1 circuit for short circuit to power, high resistance ● Check air cleaner element is free from restriction ● Check air intake system for blockage ● Check and install a new mass air flow sensor bank 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0106-00	Manifold Absolute Pressure/BARO Sensor Range/Performance - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit MAP_SENSOR - ● Blocked air cleaner element(s) ● Intake manifold air leak ● Manifold absolute pressure sensor circuit short circuit to ground, short circuit to power, open circuit, high resistance ● Engine breather leak ● Carbon build up on throttle plate ● Exhaust system blocked ● Manifold absolute pressure sensor failure ● BARO sensor failure 	<ul style="list-style-type: none"> ● Check air cleaner element is free from restriction ● Check for leak from air intake system, rectify as required ● Refer to the electrical circuit diagrams and check manifold absolute pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance ● Ensure the engine breather system is correctly installed and in serviceable condition ● Make sure throttle blade is clean of carbon ● Check for blocked exhaust ● Check and install a new manifold absolute pressure sensor as required. Check for related BARO sensor DTC P0069-29. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0107-00	Manifold Absolute Pressure/BARO Sensor Low - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit MAP_SENSOR - ● Manifold absolute pressure sensor circuit short circuit to ground, open circuit, high resistance ● Manifold absolute pressure sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check manifold absolute pressure sensor circuit for short circuit to ground, open circuit, high resistance ● Check and install a new manifold absolute pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0108-00	Manifold Absolute Pressure/BARO Sensor High - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit MAP_SENSOR - ● Manifold absolute pressure sensor circuit short circuit to power, open circuit, high resistance ● Manifold absolute pressure sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check manifold absolute pressure sensor circuit for short circuit to power, open circuit, high resistance ● Check and install a new manifold absolute pressure sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P010B-00	Mass or Volume Air Flow B Circuit Range/Performance - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit MAF_SENSOR_B - • NOTE: Customer likely to report hesitation ● Blocked air cleaner element(s) ● Leakage from air intake system ● Blocked engine breather ● Blockage in air intake system 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Mass Air Flow Sensor 2 Voltage (0x0503). Check for related DTCs P0102 or P0103 ● Check air cleaner element is free from restriction ● Check for leak from air intake system, rectify as required

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Carbon build-up on throttle blade ● Blocked catalyts ● Blocked injectors ● MAF/IAT sensor bank 2 circuit - high resistance, intermittent short circuit to ground, high resistance ● MAF/IAT sensor bank 2 failure 	<ul style="list-style-type: none"> ● Ensure the engine breather system is correctly installed and in serviceable condition ● Make sure throttle blade is clean of carbon ● Check for blocked catalyts ● Check for blocked injectors ● Refer to the electrical circuit diagrams and check MAF/IAT sensor bank 2 sensor circuit for intermittent short circuit to ground, high resistance ● Check and install a new MAF/IAT sensor bank 2 sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P010C-00	Mass or Volume Air Flow B Circuit Low - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit MAF_SENSOR_B - • NOTE: Customer likely to report hesitation ● Mass air flow sensor bank 2 circuit high resistance, open circuit, short circuit to ground, short circuit to power ● Mass air flow sensor bank 2 failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Mass Air Flow Sensor 2 Voltage (0x0503) ● Check mass air flow sensor circuit fuse. If fuse fails, may see DTCs P0103, P010C and P250C ● Refer to the electrical circuit diagrams and check mass air flow sensor bank 2 circuit for high resistance, open circuit, short circuit to ground, short circuit to power ● Check and install a new mass air flow sensor bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P010D-00	Mass or Volume Air Flow B Circuit High - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit MAF_SENSOR_B - • NOTE: Customer likely to report hesitation ● Mass air flow sensor bank 2 circuit high resistance, open circuit, short circuit to ground, short circuit to power ● Blocked air cleaner element(s) ● Blockage in air intake system ● Mass air flow sensor bank 2 failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system check datalogger signal, Mass Air Flow Sensor 2 Voltage (0x0503) ● Check mass air flow sensor circuit fuse. If fuse fails, may see DTCs P0103, P010C and P250C ● Check air cleaner element is free from restriction ● Check for blockage in air intake system ● Refer to the electrical circuit diagrams and check mass air flow sensor bank 2 circuit for high resistance, open circuit, short circuit to ground, short circuit to power ● Check and install a new mass air flow sensor bank 2 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P010F-00	Mass or Volume Air Flow Sensor A/B Correlation - No sub type information	<ul style="list-style-type: none"> • NOTE: Customer likely to report hesitation ● Blocked air cleaner element(s) ● Leakage from air intake system ● Blocked engine breather ● Blockage in air intake system ● Carbon build-up on throttle blade ● Blocked catalyts ● MAF/IAT sensor bank 1 circuit - high resistance, intermittent short circuit to ground, high resistance ● MAF/IAT sensor bank 1 failure 	<ul style="list-style-type: none"> ● Check air cleaner element is free from restriction ● Check for leak from air intake system, rectify as required ● Ensure the engine breather system is correctly installed and in serviceable condition ● Make sure throttle blade is clean of carbon. Check for blocked catalyts ● Refer to the electrical circuit diagrams and check MAF/IAT sensor bank 1 sensor circuit for intermittent short circuit to ground, high resistance ● Check and install a new MAF/IAT sensor bank 1 sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

DTC	Description	Possible Causes	Action
P0111-23	Intake Air Temperature Sensor 1 Circuit Range/Performance - Signal stuck low	<ul style="list-style-type: none"> NOTE: - Circuit INLET_AIR_TEMP_SENSOR_A - Intake air temperature sensor short circuit to ground, open circuit, high resistance Intake air temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check intake air temperature sensor circuit for short circuit to ground, open circuit, high resistance Check and install a new intake air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0111-24	Intake Air Temperature Sensor 1 Circuit Range/Performance - Signal stuck high	<ul style="list-style-type: none"> NOTE: - Circuit INLET_AIR_TEMP_SENSOR_A - Intake air temperature sensor circuit short circuit to power, open circuit Intake air temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check intake air temperature sensor circuit for short circuit to power, open circuit Check and install a new intake air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0111-29	Intake Air Temperature Sensor 1 Circuit Range/Performance - Signal invalid	<ul style="list-style-type: none"> NOTE: - Circuit INLET_AIR_TEMP_SENSOR_A - Intake air temperature sensor circuit short circuit to ground, short circuit to power, open circuit Intake air temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check intake air temperature sensor circuit for short circuit to ground, short circuit to power, open circuit Check and install a new intake air temperature sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0112-00	Intake Air Temperature Sensor 1 Circuit Low (Bank 1) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit INLET_AIR_TEMP_SENSOR_A - Intake air temperature sensor circuit short circuit to ground, short circuit to power, open circuit, high resistance Intake air temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check intake air temperature sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance Check and install a new intake air temperature sensor bank 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0113-00	Intake Air Temperature Sensor 1 Circuit High (Bank 1) - No sub type information	<ul style="list-style-type: none"> NOTE: - Circuit INLET_AIR_TEMP_SENSOR_A - Intake air temperature sensor circuit short circuit to power, open circuit, high resistance Intake air temperature sensor failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check intake air temperature sensor circuit for short circuit to power, open circuit, high resistance Check and install a new intake air temperature sensor bank 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0116-23	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - Signal stuck low	<ul style="list-style-type: none"> NOTE: - Circuit COOLANT_TEMP_SENSOR - Battery reset carried out when the engine was warm/hot Engine coolant temperature sensor 1 sensing circuit intermittent high resistance Engine coolant temperature sensor 1 failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check datalogger signal, Engine Coolant Temperature Sensor Voltage (0x0357) Check for related DTC P2610- 87. Start the engine and switch off. Clear DTC and re-test Refer to the electrical circuit diagrams and check engine coolant temperature sensor 1 circuit for intermittent high resistance Check and install a new engine coolant temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

DTC	Description	Possible Causes	Action
P0116-24	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - Signal stuck high	<ul style="list-style-type: none"> • NOTE: - Circuit COOLANT_TEMP_SENSOR • Engine coolant temperature sensor 1 sensing circuit intermittent high resistance • Engine coolant temperature sensor 1 failure • Battery reset carried out when the engine was warm/hot 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check datalogger signal, Engine Coolant Temperature Sensor Voltage (0x0357) • Check for related DTC P2610- 87. Start the engine and switch off. Clear DTC and re-test • Refer to the electrical circuit diagrams and check engine coolant temperature sensor 1 circuit for intermittent high resistance • Check and install a new engine coolant temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0116-29	Engine Coolant Temperature Sensor 1 Circuit Range/Performance - Signal invalid	<ul style="list-style-type: none"> • NOTE: - Circuit COOLANT_TEMP_SENSOR • Low coolant level • Engine coolant temperature sensor 1 sensing circuit - intermittent high resistance • Engine coolant temperature sensor 1 failure • Possible airlock in cooling system 	<ul style="list-style-type: none"> • Fill cooling system to correct level and specification • Using the manufacturer approved diagnostic system check datalogger signal, Engine Coolant Temperature Sensor Voltage (0x0357) • Refer to the electrical circuit diagrams and check engine coolant temperature sensor 1 circuit for intermittent high resistance • Check and install new engine coolant temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component • Bleed cooling system
P0117-16	Engine Coolant Temperature Sensor 1 Circuit Low - Circuit voltage below threshold	<ul style="list-style-type: none"> • NOTE: - Circuit COOLANT_TEMP_SENSOR • Engine coolant temperature sensor 1 circuit short circuit to ground • Engine coolant temperature sensor 1 failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check datalogger signal, Engine Coolant Temperature Sensor Voltage (0x0357) • Refer to the electrical circuit diagrams and check engine coolant temperature sensor 1 circuit for short circuit to ground • Check and install a new Engine coolant temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0118-17	Engine Coolant Temperature Sensor 1 Circuit High - Circuit voltage above threshold	<ul style="list-style-type: none"> • NOTE: - Circuit COOLANT_TEMP_SENSOR • Engine coolant temperature sensor 1 circuit short circuit to power, open circuit, sensor disconnected • Engine coolant temperature sensor 1 failure 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check datalogger signal, Engine Coolant Temperature Sensor Voltage (0x0357) • Refer to the electrical circuit diagrams and check engine coolant temperature sensor 1 circuit for short circuit to power, open circuit, sensor disconnected • Check and install new engine coolant temperature sensor 1 as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0121-00	Throttle/Pedal Position Sensor A Circuit Range/Performance - No sub type information	<ul style="list-style-type: none"> • Corrupt engine control module software flash • Engine control module power supply circuit open circuit, high resistance • Engine control module damage through water ingress, internal fault 	<ul style="list-style-type: none"> • Using the manufacturer approved diagnostic system check and install latest relevant level of software to the engine control module • Refer to the electrical circuit diagrams and check engine control module power supply circuit for open circuit, high resistance • Check and install a new engine control module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation,

DTC	Description	Possible Causes	Action
P0122-00	Throttle/Pedal Position Sensor A Circuit Low - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit THROTTLE_POSITION_SENSOR_1 - <ul style="list-style-type: none"> ● Throttle position sensor 1 circuit short circuit to ground, open circuit ● Throttle position sensor 1 failure 	<p>prior to the installation of a new module/component</p> <ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check throttle position sensor 1 circuit for short circuit to ground, open circuit ● Clear DTC and repeat automated diagnostic procedure using the manufacturer approved diagnostic system. If DTC remains suspect the electronic throttle unit ● Check and install a new electronic throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0123-00	Throttle/Pedal Position Sensor A Circuit High - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit THROTTLE_POSITION_SENSOR_1 - <ul style="list-style-type: none"> ● Throttle position sensor 1 circuit short circuit to ground, short circuit to power, open circuit ● Throttle position sensor 1 failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check throttle position sensor 1 circuit for short circuit to ground, short circuit to power, open circuit ● Clear DTC and repeat automated diagnostic procedure using the manufacturer approved diagnostic system. If DTC remains suspect the electronic throttle unit ● Check and install a new electronic throttle unit as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0125-00	Insufficient Coolant Temp For Closed Loop Fuel Control - No sub type information	<ul style="list-style-type: none"> ● Coolant temperature sensor 1 circuit, open circuit, high resistance ● Engine coolant temperature sensor 1 failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check engine coolant temperature sensor 1 circuit for open circuit, high resistance ● Check and install a new engine coolant temperature sensor 1. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0126-26	Insufficient Coolant Temp For Stable Operation - Signal rate of change below threshold	<ul style="list-style-type: none"> ● Thermostat stuck open ● Coolant temperature coolant sensor circuit, short circuit to ground, short circuit to power, open circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check engine coolant temperature sensor 1 circuit for short circuit to ground, short circuit to power, open circuit ● Check for related coolant temperature coolant sensor faults. Check and install a new thermostat as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0128-00	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature) - No sub type information	<ul style="list-style-type: none"> ● Thermostat stuck open ● Cooling fans running continuously or at a high duty 	<ul style="list-style-type: none"> ● Check for related coolant temperature coolant sensor faults ● Check cooling fans for correct operation. Repair as required ● Check and install a new thermostat as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0131-00	O2 Circuit Low Voltage (Bank 1, Sensor 1) - No sub type information	<ul style="list-style-type: none"> ● Pre-catalyst oxygen sensor odd disconnected ● Pre-catalyst oxygen sensor odd variable circuit, short circuit to ground ● Pre-catalyst oxygen sensor odd variable circuit, open circuit ● Pre-catalyst oxygen sensor odd heater fault ● Pre-catalyst oxygen sensor odd 	<ul style="list-style-type: none"> ● Check pre-catalyst oxygen sensor odd connector is connected ● Refer to the electrical circuit diagrams and check pre-catalyst oxygen sensor odd variable circuit for short circuit to ground, open circuit ● Check pre-catalyst oxygen sensor odd heater circuit ● Check and install a new pre-catalyst oxygen sensor odd as required. Refer

DTC	Description	Possible Causes	Action
		failure	to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0131-1A	O2 Sensor Circuit Low Voltage (Bank 1 Sensor 1) - Circuit resistance below threshold	<ul style="list-style-type: none"> • NOTE: - Circuit UHEGO_A_VARIABLE - • Pre-catalyst oxygen sensor odd disconnected • Pre-catalyst oxygen sensor odd variable circuit, short circuit to ground • Pre-catalyst oxygen sensor odd variable circuit, open circuit • Pre-catalyst oxygen sensor odd heater fault • Pre-catalyst oxygen sensor odd failure 	<ul style="list-style-type: none"> • Check pre-catalyst oxygen sensor odd connector is connected • Refer to the electrical circuit diagrams and check pre-catalyst oxygen sensor odd variable circuit for short circuit to ground, open circuit • Check pre-catalyst oxygen sensor odd heater circuit • Check and install a new pre-catalyst oxygen sensor odd as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0132-1B	O2 Sensor Circuit High Voltage (Bank 1 Sensor 1) - Circuit resistance above threshold	<ul style="list-style-type: none"> • NOTE: - Circuit UHEGO_A_VARIABLE - • Pre-catalyst oxygen sensor odd disconnected • Pre-catalyst oxygen sensor odd variable circuit, short circuit to power • Pre-catalyst oxygen sensor odd variable circuit, open circuit • Pre-catalyst oxygen sensor odd heater fault • Pre-catalyst oxygen sensor odd failure 	<ul style="list-style-type: none"> • Check pre-catalyst oxygen sensor odd connector is connected • Refer to the electrical circuit diagrams and check pre-catalyst oxygen sensor odd variable circuit for short circuit to power, open circuit • Check pre-catalyst oxygen sensor odd heater circuit • Check and install a new pre-catalyst oxygen sensor odd as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0132-00	O2 Circuit High Voltage (Bank 1, Sensor 1) - No sub type information	<ul style="list-style-type: none"> • Pre-catalyst oxygen sensor odd disconnected • Pre-catalyst oxygen sensor odd variable circuit, short circuit to power • Pre-catalyst oxygen sensor odd variable circuit, open circuit • Pre-catalyst oxygen sensor odd heater fault • Pre-catalyst oxygen sensor odd failure 	<ul style="list-style-type: none"> • Check pre-catalyst oxygen sensor odd connector is connected • Refer to the electrical circuit diagrams and check pre-catalyst oxygen sensor odd variable circuit for short circuit to power, open circuit • Check pre-catalyst oxygen sensor odd heater circuit • Check and install a new pre-catalyst oxygen sensor odd as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0133-00	O2 Circuit Slow Response (Bank 1, Sensor 1) - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit UHEGO_A_VARIABLE - • Exhaust leak • Pre-catalyst oxygen sensor odd to engine control module wiring shield high resistance • Fuel control system fault • Pre-catalyst oxygen sensor odd failure 	<ul style="list-style-type: none"> • Check pre-catalyst oxygen sensor odd is correctly installed in exhaust manifold • Check for and rectify any exhaust leak between cylinder head and catalytic converter • Refer to the electrical circuit diagrams and check pre-catalyst oxygen sensor odd to engine control module wiring shield for high resistance • Check fuel control system for failure • Check and install a new pre-catalyst oxygen sensor odd as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
P0134-00	O2 Circuit No Activity Detected (Bank 1, Sensor 1) - No sub type information	<ul style="list-style-type: none"> • NOTE: - Circuit UHEGO_A_VARIABLE - • Pre-catalyst oxygen sensor odd circuit short circuit to ground, short circuit to power, open circuit • Pre-catalyst oxygen sensor odd failure 	<ul style="list-style-type: none"> • Refer to the electrical circuit diagrams and check pre-catalyst oxygen sensor odd circuit for short circuit to ground, short circuit to power, open circuit • Check and install a new pre-catalyst oxygen sensor odd as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

General Information - Diagnostic Trouble Code (DTC) Index DTC: Front Controls Interface Module (FCIM) - Front Integrated Control Panel

Description and Operation

Front Controls Interface Module (FCIM) - Front Integrated Control Panel



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Front Controls Interface Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
U0010-88	Medium Speed CAN Communication Bus - bus off	<ul style="list-style-type: none"> CAN network circuit short to ground, short to power, open circuit 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0140-00	Lost Communication With Body Control Module - no sub type information	<ul style="list-style-type: none"> CAN network failure between Front Integrated Control Panel and Central Junction Box 	Refer to the electrical circuit diagrams and check the power and ground connections to the Central Junction Box. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Front Integrated Control Panel and the Central Junction Box
U0155-00	Lost Communication With Instrument Panel Cluster (IPC) Control Module - no sub type information	<ul style="list-style-type: none"> CAN network failure between Front Integrated Control Panel and Instrument Panel Cluster 	Refer to the electrical circuit diagrams and check the power and ground connections to the Instrument Panel Cluster. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Front Integrated Control Panel and the Instrument Panel Cluster
U0164-00	Lost Communication With HVAC Control Module - no sub type information	<ul style="list-style-type: none"> CAN network failure between HVAC Control Module and Front Integrated Control Panel 	Refer to the electrical circuit diagrams and check the power and ground connections to the HVAC Control Module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Front Integrated Control Panel and HVAC Control Module
U0166-00	Lost Communication With Auxiliary Heater Control Module - no sub type information	<ul style="list-style-type: none"> Car Configuration File incorrect - Fuel Fired Booster Heater Module incorrectly listed as installed/not installed CAN network failure between Front Integrated Control Panel and Fuel Fired Booster Heater Module 	Check Car Configuration File is correct. Clear DTC and retest. Refer to the electrical circuit diagrams and check the power and ground connections to the Fuel Fired Booster Heater Module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Front Integrated Control Panel and the Fuel Fired Booster Heater Module
U0300-00	Internal Control Module Software Incompatibility - no sub type information	<ul style="list-style-type: none"> Car Configuration File incorrect Front Integrated Control Panel installed to wrong vehicle 	Check Car Configuration File is correct. Clear DTC and retest. Check and install a new Front Integrated Control Panel as required. Refer to the warranty policy and procedures manual if a module is suspect
U0424-68	Invalid Data Received From HVAC Control Module - event information	<ul style="list-style-type: none"> HVAC control module error 	Check HVAC module for related DTCs and refer to relevant DTC Index

DTC	Description	Possible Causes	Action
U2002-24	Switch - signal stuck high	<ul style="list-style-type: none"> ● Switch(s) stuck or continually pressed by customer ● Front Integrated Control Panel failure 	Ensure no buttons are inadvertently being pressed. Clear DTC and re-check, if DTC is still present suspect Front Integrated Control Panel. Check and install a new Front Integrated Control Panel as required, Refer to the warranty policy and procedures manual if a module is suspect
U2100-00	Initial Configuration Not Complete - no sub type information	<ul style="list-style-type: none"> ● Front Integrated Control Panel not programmed 	Re-configure the Front Integrated Control Panel using the manufacturer approved diagnostic system
U2101-00	Control Module Configuration Incompatible - no sub type information	<ul style="list-style-type: none"> ● Car Configuration File mis-match 	Check Car Configuration File is correct. Clear DTC and retest. Check and install a new Front Integrated Control Panel as required. Refer to the warranty policy and procedures manual if a module is suspect
U3000-41	Control Module - general checksum failure	<ul style="list-style-type: none"> ● Front Integrated Control Panel not programmed ● Front Integrated Control Panel failure 	Clear DTC and re-test, If DTC remains suspect the Front Integrated Control Panel. Check and install a new Front Integrated Control Panel as required, Refer to the warranty policy and procedures manual if a module is suspect
U3003-62	Battery Voltage - signal compare failure	<ul style="list-style-type: none"> ● Charging system fault ● Vehicle battery fault ● Front Integrated Control Panel failure 	Refer to repair manual and battery care manual, check vehicle battery and charging system. Perform any repairs required. Check and install a new Front Integrated Control Panel as required. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Front Controls Interface Module B (FCIMB)

Description and Operation

Front Controls Interface Module B (FCIMB)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Front Controls Interface Module B (multifunction display), for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
U0010-88	Medium Speed CAN Communication Bus - bus off	<ul style="list-style-type: none"> CAN network circuit short to ground, short to power, open circuit 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0140-00	Lost Communication With Central Junction Box - no sub type information	<ul style="list-style-type: none"> CAN network failure between Front Controls Interface Module B and Central Junction Box 	Refer to the electrical circuit diagrams and check the power and ground connections to the Central Junction Box. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Front Control Interface Module and the Central Junction Box
U0256-00	Lost Communication With Front Controls Interface Module "A" - No sub type information	<ul style="list-style-type: none"> CAN network failure between Front Controls Interface Module and Front Controls Interface Module B 	Refer to the electrical circuit diagrams and check the power and ground connections to the Front Controls Interface Module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Front Controls Interface Module and the Front Controls Interface Module B
U0300-00	Internal Control Module Software Incompatibility - no sub type information	<ul style="list-style-type: none"> Signal Configuration File incorrect or corrupt Front Controls Interface Module B installed to wrong vehicle 	Clear DTC and retest. If DTC remains, install a new Front Controls Interface Module B as required. Refer to the warranty policy and procedures manual if a module is suspect
U2002-24	Switch - signal stuck high	<ul style="list-style-type: none"> Switch(s) stuck or continually pressed by customer Front Controls Interface Module B failure 	Ensure no buttons are inadvertently being pressed. Clear DTC and re-check, if DTC is still present suspect Front Controls Interface Module B. Check and install a new Front Controls Interface Module B as required. Refer to the warranty policy and procedures manual if a module is suspect
U3000-41	Control Module - general checksum failure	<ul style="list-style-type: none"> Front Control Interface Module not programmed Front Controls Interface Module B failure 	Clear DTC and re-test, If DTC remains suspect the Front Controls Interface Module B. Check and install a new Front Controls Interface Module B as required. Refer to the warranty policy and procedures manual if a module is suspect
U3003-62	Battery Voltage - signal compare failure	<ul style="list-style-type: none"> Charging system fault Vehicle battery fault Front Controls Interface Module B failure 	Refer to repair manual and battery care manual, check vehicle battery and charging system. Perform any repairs required. Check and install a new Front Controls Interface Module B as required. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
B1A85-11	Ambient Light Sensor - circuit short to ground	<ul style="list-style-type: none"> ● Ambient light sensor circuit short to ground ● Ambient light sensor failure 	<p>• NOTE: The ambient light sensor and circuits are integral to the Front Controls Interface Module B</p> <p>Clear DTC and re-test. If DTC remains, check Ambient Light Sensor Voltage (0x721C) Datalogger signal using manufacturer approved diagnostic system. Check the voltage decreases when the sensor is covered and increases when a light source is directed into the sensor. If the sensor voltage does not change with varying light intensity suspect the Front Controls Interface Module B. Refer to the warranty policy and procedures manual prior to installing a new module</p>
B1A85-12	Ambient Light Sensor - circuit short to battery	<ul style="list-style-type: none"> ● Ambient light sensor circuit short to power ● Ambient light sensor failure 	<p>• NOTE: The ambient light sensor and circuits are integral to the Front Controls Interface Module B</p> <p>Clear DTC and re-test. If DTC remains, check Ambient Light Sensor Voltage (0x721C) Datalogger signal using manufacturer approved diagnostic system. Check the voltage decreases when the sensor is covered and increases when a light source is directed into the sensor. If the sensor voltage does not change with varying light intensity suspect the Front Controls Interface Module B. Refer to the warranty policy and procedures manual prior to installing a new module</p>

General Information - Diagnostic Trouble Code (DTC) Index DTC: Front Entertainment Module (FEM)

Description and Operation

Front Entertainment Module (FEM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Front Entertainment Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B100F-25	Video Input "B" - signal shape / waveform failure	<ul style="list-style-type: none"> Rear camera disconnected Camera malfunction 	Check the video signal connection and whether it is being broadcasted. Where available, configure the rear camera using the manufacturers approved diagnostic system. Check whether the rear camera is broadcasting an image by entering diagnostics selecting 'Video Input Test' then press 'Rear View Camera'. Check whether a clear image is displayed. Refer to the electrical circuit diagrams and check the video signal circuit between the rear camera and the Camera Control Module. If the problem persists, renew the camera. Clear the DTC and retest
B1010-25	Video Input "C" - signal shape / waveform failure	<ul style="list-style-type: none"> Television/Rear seat entertainment video input disconnected TV/DVD malfunction 	Check the video signal connection and whether it is being broadcasted. Where available, configure the TV or Rear Seat Entertainment module (RSE) using the manufacturers approved diagnostic system. Check whether the TV or RSE is broadcasting an image by entering diagnostics selecting 'Video Input Test' then press 'TV/RSE'. Check whether a clear image is displayed. Refer to the electrical circuit diagrams and check the video signal circuit from the RSE. If the problem persists, renew the RSE. Refer to the warranty policy and procedures manual if a module is suspect Clear the DTC and retest
B108E-14	Display - Circuit short to ground or open circuit	<ul style="list-style-type: none"> Display circuit short circuit to ground or open circuit Module internal fault 	Renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
B108E-17	Display - circuit voltage above threshold	<ul style="list-style-type: none"> Display circuit voltage above threshold Module internal fault 	Renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
B108E-1C	Display - circuit voltage out of range	<ul style="list-style-type: none"> Display circuit voltage out of range Module internal fault 	Renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
B108E-87	Display - missing message	<ul style="list-style-type: none"> Display internal video signal fault Module internal fault 	Clear the DTC and switch of the ignition. Allow sufficient time for the infotainment relay to power down and retest. If DTC persists reprogram the display via a software update using the manufacturers approved diagnostic system. Clear the DTC and switch of the ignition. Allow sufficient time for the infotainment relay to power down and retest. If DTC persists renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
B119F-11	GPS Antenna - circuit short to ground	<ul style="list-style-type: none"> Antenna circuit short circuit to ground 	Check the global positioning system (GPS) connector to the front entertainment module for security and integrity. Check the GPS antenna is not damaged. Refer to the electrical circuit diagrams and check the circuit between the GPS antenna and the front entertainment module. Repair as necessary. Where an approved diagnostic

DTC	Description	Possible Causes	Action
			system is available, enter the diagnostics and select 'GPS Information'. Check that latitude and longitude data is shown and GPS satellites are being seen
B119F-13	GPS Antenna - circuit open	<ul style="list-style-type: none"> ● Antenna circuit open circuit ● Antenna not connected 	Check the global positioning system (GPS) connector to the front entertainment module for security and integrity. Check the GPS antenna is not damaged. Refer to the electrical circuit diagrams and check the circuit between the GPS antenna and the front entertainment module. Repair as necessary. Where an approved diagnostic system is available, enter the diagnostics and select 'GPS Information'. Check that latitude and longitude data is shown and GPS satellites are being seen
B11A3-49	Gyroscope - Internal electronic failure	<ul style="list-style-type: none"> ● Control module internal electronic failure 	Renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
B121C-13	Hard Drive - circuit open	<ul style="list-style-type: none"> ● Module internal hard drive open circuit/not connected ● Control module internal electronic failure 	Renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
B121C-44	Hard Drive - data memory failure	<ul style="list-style-type: none"> ● Control module internal electronic failure 	Renew the front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
B1D55-14	Antenna #2 - Circuit short to ground or open circuit	<ul style="list-style-type: none"> ● NOTE: This DTC is always set after the On Demand Self Test (ODST) has been run. Ignore this DTC, if this is the only DTC set ● Antenna disconnected ● Antenna circuit short circuit to ground ● Antenna circuit open circuit 	Check that the traffic message (TMC) connector is connected to the front entertainment module and the TMC antenna or circuit is not damaged. Where an approved diagnostic system is available, enter diagnostics and select 'RDS-TMC Information'. Check the date/time and frequency is shown
B1D56-14	Antenna #3 - Circuit short to ground or open circuit	<ul style="list-style-type: none"> ● Antenna disconnected ● Antenna circuit short circuit to ground ● Antenna circuit open circuit 	Check that the vehicle information and communication systems (VICS) connector is connected to the front entertainment module and the VICS antenna or circuit is not damaged. Where an approved diagnostic system is available, enter diagnostics and select 'RDS-TMC Information'. Check that latitude and longitude data is shown and GPS satellites are being seen
U1A01-56	Communication Link - Invalid / incomplete configuration	<ul style="list-style-type: none"> ● Invalid/incomplete configuration 	Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. Configure the module using the manufacturers approved diagnostic system. If DTC persists renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
U1A4B-82	Control Module Processor B - alive / sequence counter incorrect / not updated	<ul style="list-style-type: none"> ● Module internal sequence counter incorrect/not updated 	Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. Configure the module using the manufacturers approved diagnostic system. If DTC persists renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
U1A4B-87	Control Module Processor B - missing message	<ul style="list-style-type: none"> ● Module missing message 	Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. Configure the module using the manufacturers approved diagnostic system. If DTC persists renew the Front Entertainment Module. Refer to the warranty policy and procedures manual if a module is suspect
U2005-62	Vehicle Speed - signal compare failure	<ul style="list-style-type: none"> ● Vehicle speed and calculated GPS system vehicle speed mismatch ● Vehicle speed signal circuit between ABS and navigation system module - short or open circuit 	Check the ABS connector and wiring harness. Where an approved diagnostic system is available, enter diagnostics and select 'Vehicle Signals'. Check that the vehicle speeds both increase when the car is moving. Refer to the electrical circuit diagrams and check vehicle speed signal circuit between the ABS module and navigation system module
U2101-00	Control Module Configuration Incompatible - no sub type information	<ul style="list-style-type: none"> ● Car Configuration File parameter mismatch ● Invalid/incomplete configuration 	Using the manufacturers approved diagnostic system, check the Car Configuration File parameters match the vehicle setup
U2101-4A	Control Module Configuration Incompatible - incorrect component installed	<ul style="list-style-type: none"> ● Navigation map license mismatch ● Invalid/incomplete configuration 	Enter the navigation menu and select 'Map changer'. Check that the map regions match the Front Entertainment Module market

DTC	Description	Possible Causes	Action
U210A-85	Temperature Sensor - signal above allowable range	<ul style="list-style-type: none"> ● Media Orientated System Transport (MOST) Fibre Optic Transceiver (FOT) overheating 	Cool the vehicle interior down by ensuring it is in the shade and the A/C on cool. Where an approved diagnostic system is available, enter diagnostics and select 'Vehicle Signals'. Check the Media Orientated System Transport (MOST), Fibre Optic Transceiver (FOT) and Printed Circuit Board (PCB) temperatures. When cool, clear the DTC and retest. Refer to the warranty policy and procedures manual if a module is suspect
U3003-17	Battery Voltage - circuit voltage above threshold	<ul style="list-style-type: none"> ● Battery voltage above threshold 	Where an approved diagnostic system is available, enter diagnostics and select 'Vehicle Signals'. Compare the Battery voltage with the control module vehicle voltage. Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Fuel Fired Booster Heater Module (AHCM)

Description and Operation

Fuel Fired Booster Heater Module (AHCM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all diagnostic trouble codes that could be logged in the fuel fired booster heater module, for additional diagnosis and testing information refer to the relevant diagnosis and testing section.
For additional information, refer to: [Fuel Fired Booster Heater](#) (412-02B Auxiliary Heating, Diagnosis and Testing).

• **NOTE:** Where an 'on demand self-test' is referred to, this can be accessed via the 'DTC Monitor' tab on the manufacturers approved diagnostic system.

DTC	Description	Possible Causes	Action
B1206-53	Crash Occurred - deactivated	<ul style="list-style-type: none"> Crash signal received over CAN network 	<ul style="list-style-type: none"> NOTE: Event information - the restraints control module has recorded a crash event Using the manufacturer approved diagnostic system, check other modules for related diagnostic trouble codes
B1D22-11	Coolant Temperature Sensor - circuit short to ground	<ul style="list-style-type: none"> Fuel fired booster heater coolant temperature sensor internal fault 	<ul style="list-style-type: none"> Check and install a new fuel fired booster heater coolant temperature sensor Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for stored diagnostic trouble codes Check for correct operation
B1D22-15	Coolant Temperature Sensor - circuit short to battery or open	<ul style="list-style-type: none"> Fuel fired booster heater coolant temperature sensor internal fault 	<ul style="list-style-type: none"> Check and install a new fuel fired booster heater coolant temperature sensor Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for stored diagnostic trouble codes Check for correct operation
B1D23-13	Overheat Sensor - circuit open	<ul style="list-style-type: none"> Fuel fired booster heater coolant temperature sensor internal fault 	<ul style="list-style-type: none"> Check and install a new fuel fired booster heater coolant temperature sensor Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for stored diagnostic trouble codes Check for correct operation
B1D24-11	Glow Plug - circuit short to ground	<ul style="list-style-type: none"> Fuel fired booster heater glow plug internal fault 	<ul style="list-style-type: none"> Carry out circuit checks, inspect the glow plug cables and connector. Repair the circuit or check and install a new fuel fired booster heater glow plug as required For additional information, refer to: (412-02B Auxiliary Heating) Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 2.7L

DTC	Description	Possible Causes	Action
			<p>Diesel (Removal and Installation), Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 3.0L Diesel (Removal and Installation).</p> <ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for stored diagnostic trouble codes Check for correct operation
B1D24-15	Glow Plug - circuit short to battery or open	<ul style="list-style-type: none"> Fuel fired booster heater glow plug internal fault 	<ul style="list-style-type: none"> Carry out circuit checks, inspect the glow plug cables and connector. Repair the circuit or check and install a new fuel fired booster heater glow plug as required For additional information, refer to: (412-02B Auxiliary Heating) Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 2.7L Diesel (Removal and Installation), Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 3.0L Diesel (Removal and Installation). Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for stored diagnostic trouble codes Check for correct operation
B1D25-11	Heater Fuel Pump - circuit short to ground	<ul style="list-style-type: none"> Heater fuel pump circuit short to ground Heater fuel pump failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel fired booster heater fuel pump and circuit for short to ground Repair the circuit or check and install a new fuel fired booster heater fuel pump as required Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for stored diagnostic trouble codes Check for correct operation
B1D25-15	Heater Fuel Pump - circuit short to battery or open	<ul style="list-style-type: none"> Heater fuel pump circuit short to power, open circuit Heater fuel pump failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the fuel fired booster heater fuel pump and circuit for short to power, open circuit Repair the circuit or check and install a new fuel fired booster heater fuel pump as required Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for stored diagnostic trouble codes Check for correct operation
B1D26-11	Combustion Air Blower - circuit short to ground	<ul style="list-style-type: none"> Fuel fired booster heater module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) If the diagnostic trouble code reoccurs check and install a new fuel fired booster heater module Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1D26-15	Combustion Air Blower - circuit short to battery or open	<ul style="list-style-type: none"> Fuel fired booster heater module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary

DTC	Description	Possible Causes	Action
			heater/operation check) <ul style="list-style-type: none"> ● If the diagnostic trouble code reoccurs check and install a new fuel fired booster heater module ● Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1D26-92	Combustion Air Blower - performance or incorrect operation	<ul style="list-style-type: none"> ● Fuel fired booster heater module failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for reoccurrence of the diagnostic trouble code ● If the diagnostic trouble code reoccurs check and install a new fuel fired booster heater module ● Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1D26-93	Combustion Air Blower - no operation	<ul style="list-style-type: none"> ● Fuel fired booster heater module failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for reoccurrence of the diagnostic trouble code ● If the diagnostic trouble code reoccurs check and install a new fuel fired booster heater module ● Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1D27-11	Heater Coolant Pump - circuit short to ground	<ul style="list-style-type: none"> ● Heater coolant pump circuit short to ground ● Heater coolant pump failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the fuel fired booster heater water pump and circuit for short to ground ● Repair the circuit or check and install a new fuel fired booster heater water pump as required ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D27-15	Heater Coolant Pump - circuit short to battery or open	<ul style="list-style-type: none"> ● Heater coolant pump circuit short to power, open circuit ● Heater coolant pump failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the fuel fired booster heater water pump and circuit for short to power, open circuit ● Repair the circuit or check and install a new fuel fired booster heater water pump as required ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D28-11	Fuel Pre-heater - circuit short to ground	<ul style="list-style-type: none"> ● NOTE: The pre heat is performed by the ignition glow plug ● Fuel fired booster heater glow plug internal fault 	<ul style="list-style-type: none"> ● Carry out circuit checks, inspect the glow plug cables and connector ● Check and install a new fuel fired booster heater glow plug as required For additional information, refer to: (412-02B Auxiliary Heating) <ul style="list-style-type: none"> ● Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 2.7L Diesel (Removal and Installation), ● Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 3.0L Diesel (Removal and Installation).

DTC	Description	Possible Causes	Action
			<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D28-15	Fuel Pre-heater - circuit short to battery or open	<ul style="list-style-type: none"> • NOTE: The pre heat is performed by the ignition glow plug ● Fuel fired booster heater glow plug internal fault 	<ul style="list-style-type: none"> ● Carry out circuit checks, inspect the glow plug cables and connector ● Check and install a new fuel fired booster heater glow plug as required For additional information, refer to: (412-02B Auxiliary Heating) Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 2.7L Diesel (Removal and Installation), Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 3.0L Diesel (Removal and Installation). ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D29-93	No Start, Even After Restart Attempt - no operation	<ul style="list-style-type: none"> ● No fuel present at fuel fired booster heater module ● Exhaust system blocked ● Air intake blocked 	<ul style="list-style-type: none"> ● Check vehicle fuel level ● Check fuel lines to fuel fired booster heater module for blockage, kinking or damage ● Check exhaust system and air intake for blockage, kinking or damage ● Check fuel for aeration and correct fuel delivery ● Check vehicle is not parked on an incline when parking heater is operated ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D30-93	No Start In Test Mode - no operation	<ul style="list-style-type: none"> ● No fuel present at fuel fired booster heater module ● Exhaust system blocked ● Air intake blocked 	<ul style="list-style-type: none"> ● Check vehicle fuel level ● Check fuel lines to Fuel fired booster heater module for blockage, kinking or damage ● Check exhaust system and air intake for blockage, kinking or damage ● Check fuel for aeration and correct fuel delivery ● Check vehicle is not parked on an incline when parking heater is operated ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D31-94	Flame Detected Prior to Normal Operation - unexpected operation	<ul style="list-style-type: none"> • NOTE: The glow plug and flame sensor are a combined unit ● Glow plug circuit fault 	<ul style="list-style-type: none"> ● Check exhaust system and air intake for blockage, kinking or damage ● Carry out circuit checks, inspect the glow plug cables and connector. Repair the circuit or check and install a new fuel fired booster heater glow plug as required For additional information, refer to: (412-02B Auxiliary Heating) Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 2.7L Diesel (Removal and Installation), Fuel Fired Booster Heater Glow Plug And Burner Assembly - TDV6 3.0L Diesel (Removal and Installation). ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check

DTC	Description	Possible Causes	Action
			(Setup and configuration/auxiliary heater/operation check) <ul style="list-style-type: none"> ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D32-92	Multiple Flame Interruption During Heating Cycle - performance or incorrect operation	<ul style="list-style-type: none"> ● No fuel present at fuel fired booster heater module ● Exhaust system blocked ● Air intake blocked 	<ul style="list-style-type: none"> ● Check vehicle fuel level ● Check fuel lines to Fuel fired booster heater module for blockage, kinking or damage ● Check exhaust system and air intake for blockage, kinking or damage ● Check fuel for aeration and correct fuel delivery ● Check vehicle is not parked on an incline when parking heater is operated ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D33-92	Flame Interruption During Normal Operation - performance or incorrect operation	<ul style="list-style-type: none"> ● No fuel present at fuel fired booster heater module ● Exhaust system blocked ● Air intake blocked 	<ul style="list-style-type: none"> ● Check vehicle fuel level ● Check fuel lines to Fuel fired booster heater module for blockage, kinking or damage ● Check exhaust system and air intake for blockage, kinking or damage ● Check fuel for aeration and correct fuel delivery ● Check vehicle is not parked on an incline when parking heater is operated ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D34-68	Heater In Lock Out Mode - event information	<ul style="list-style-type: none"> ● Fuel fired booster heater system fault 	<ul style="list-style-type: none"> ● NOTE: For information only, rectify other stored fuel fired booster heater diagnostic trouble codes prior to this diagnostic trouble code ● Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) ● Check for stored diagnostic trouble codes ● Check for correct operation
B1D63-11	External Control Relay - circuit short to ground	<ul style="list-style-type: none"> ● Fuel fired booster heater module failure 	<ul style="list-style-type: none"> ● Check and install a new fuel fired booster heater module as required ● Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1D63-15	External Control Relay - circuit short to battery or open	<ul style="list-style-type: none"> ● Fuel fired booster heater module failure 	<ul style="list-style-type: none"> ● Check and install a new fuel fired booster heater module as required ● Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U0010-00	Medium Speed CAN Communication Bus - no sub type information	<ul style="list-style-type: none"> ● Medium speed CAN communication bus off 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0028-08	Vehicle Communication Bus A - Bus Signal / Message Failures	<ul style="list-style-type: none"> ● Medium speed CAN communication bus off ● Fuel fired booster heater module failure 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0300-00	Internal Control Module Software Incompatibility - no sub type information	<ul style="list-style-type: none"> ● Fuel fired booster heater module not configured or incorrectly configured 	<ul style="list-style-type: none"> ● Re-configure the fuel fired booster heater module using the manufacturer approved diagnostic system (Module programming/Configure existing module/Auxiliary heater control module)

DTC	Description	Possible Causes	Action
U2101-00	Control Module Configuration Incompatible - no sub type information	<ul style="list-style-type: none"> Fuel fired booster heater module not configured or incorrectly configured Central junction box not configured correctly 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for reoccurrence of the diagnostic trouble code If the diagnostic trouble code returns Using the manufacturer approved diagnostic system check and up-date the car configuration file as required Re-configure the Fuel fired booster heater module using the manufacturer approved diagnostic system Check for stored diagnostic trouble codes Check for correct operation
U3000-16	Control Module - circuit voltage below threshold	<ul style="list-style-type: none"> Fuel fired booster heater module power circuit fault Battery/charging system fault 	<ul style="list-style-type: none"> Check other modules for related diagnostic trouble codes If other modules contain low voltage related diagnostic trouble codes, suspect a common cause (battery/charging system fault) If not, refer to the electrical circuit diagrams and check the power and ground circuits to the fuel fired booster heater module Check for stored diagnostic trouble codes Check for correct operation
U3000-17	Control Module - circuit voltage above threshold	<ul style="list-style-type: none"> Charging system fault Fuel fired booster heater module failure 	<ul style="list-style-type: none"> Check other modules for related diagnostic trouble codes If other modules contain high voltage related diagnostic trouble codes, suspect a common cause (battery/charging system fault) If not, refer to the electrical circuit diagrams and check the power and ground circuits to the fuel fired booster heater module Check for stored diagnostic trouble codes Check for correct operation
U3000-43	Control Module - special memory failure	<ul style="list-style-type: none"> Fuel fired booster heater module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for reoccurrence of the diagnostic trouble code If the diagnostic trouble code returns Install a new fuel fired booster heater module as required Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U3000-49	Control Module - internal electronic failure	<ul style="list-style-type: none"> Fuel fired booster heater module failure 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, record then clear any stored diagnostic trouble codes then conduct the fuel fired booster heater operation check (Setup and configuration/auxiliary heater/operation check) Check for reoccurrence of the diagnostic trouble code If the diagnostic trouble code returns Install a new fuel fired booster heater module as required Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U3003-62	Battery Voltage - signal compare failure	<ul style="list-style-type: none"> There is a difference of more than 2 volts between the power supply to the fuel fired booster heater and the battery voltage value broadcast via the CAN bus 	<ul style="list-style-type: none"> Check other modules for related diagnostic trouble codes If other modules contain voltage related diagnostic trouble codes, suspect a common cause (battery/charging system fault) If not, refer to the electrical circuit diagrams and check the power and ground circuits to the fuel fired booster heater

DTC	Description	Possible Causes	Action
			module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Headlamp Control Module A (HCM)

Description and Operation

Headlamp Control Module A (HCM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Headlamp Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Headlamps](#) (417-01 Exterior Lighting, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1041-04	Levelling Control - System internal failures	<ul style="list-style-type: none"> No headlamp levelling functionality - Module internal failure 	Install a new headlamp Control module as required. Refer to the warranty policy and procedures manual
B1041-54	Levelling Control - Missing calibration	<ul style="list-style-type: none"> Levelling sensor calibration routine not carried out 	<ul style="list-style-type: none"> NOTE: Sensor calibration routine must be carried out with the vehicle unladen and with correct tire pressures. Carry out the levelling sensor calibration routine using the manufacturer approved diagnostic system
B1087-83	LIN Bus "A" - Value of signal protection calculation incorrect	<ul style="list-style-type: none"> Checksum error 	Clear the DTC and re-test. If the DTC remains install a new headlamp Control module. Refer to the warranty policy and procedures manual
B1087-86	LIN Bus "A" - Signal invalid	<ul style="list-style-type: none"> Signal invalid 	Clear the DTC and re-test. If the DTC remains install a new headlamp Control module. Refer to the warranty policy and procedures manual
B1087-88	LIN Bus "A" - Bus off	<ul style="list-style-type: none"> Bus Off LIN Bus circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the LIN bus circuit. Check for other related DTCs
B10AE-11	Headlamp Leveling Motor - Circuit short to ground	<ul style="list-style-type: none"> Headlamp Levelling motor Control circuit - short to ground 	Refer to the electrical circuit diagrams and check headlamp levelling motor Control circuit for short to ground and the motor signal voltage
B10AE-12	Headlamp Leveling Motor - Circuit short to battery	<ul style="list-style-type: none"> Headlamp levelling motor Control circuit - short to power 	Refer to the electrical circuit diagrams and check headlamp levelling motor Control circuit for short to power
B10AE-64	Headlamp Leveling Motor - Signal plausibility failure	<ul style="list-style-type: none"> signal plausibility failure 	Refer to the electrical circuit diagrams and check the LIN bus circuit. Check for other related DTCs
B1A59-11	Sensor 5 Volt Supply - Circuit short to ground	<ul style="list-style-type: none"> Headlamp levelling sensor 5 volt supply circuit - short to ground 	Refer to the electrical circuit diagrams and check headlamp levelling sensor 5 volt supply circuit for short to ground
B1A59-12	Sensor 5 Volt Supply - Circuit short to battery	<ul style="list-style-type: none"> Headlamp levelling sensor 5 volt supply circuit - short to power 	Refer to the electrical circuit diagrams and check headlamp levelling sensor 5 volt supply circuit for short to power
B1D64-01	Left Headlamp Swivelling Motor - General electrical failure	<ul style="list-style-type: none"> General electrical failure- Left headlamp swivelling motor error 	Check the headlamp connections, clear the DTC and re-test. If the DTC remains install a new headlamp
B1D64-04	Left Headlamp Swivelling Motor - System internal failures	<ul style="list-style-type: none"> System internal failures - Left headlamp swivelling motor error 	Check the headlamp connections, clear the DTC, switch off the ignition and allow sufficient time for the module to power down and re-test. If the DTC persists, install a new headlamp
B1D64-87	Left Headlamp Swivelling Motor - Missing message	<ul style="list-style-type: none"> Missing message 	Check the headlamp connections, clear DTC and re-test. If DTC remains install a new headlamp

DTC	Description	Possible Causes	Action
B1D65-01	Right Headlamp Swivelling Motor - General electrical failure	<ul style="list-style-type: none"> General electrical failure- right headlamp swivelling motor error 	Clear the DTC and re-test. If the DTC remains install a new headlamp
B1D65-04	Right Headlamp Swivelling Motor - System internal failures	<ul style="list-style-type: none"> System internal failures - Right headlamp swivelling motor error 	Check the headlamp connections, clear the DTC, switch off the ignition and allow sufficient time for the module to power down and re-test. If the DTC persists, install a new headlamp
B1D65-87	Right Headlamp Swivelling Motor - Missing message	<ul style="list-style-type: none"> Missing message 	Check the headlamp connections, clear DTC and re-test, if DTC remains install a new headlamp
B1D68-00	Left Headlamp Swivelling Feedback Sensor - No sub type information	<ul style="list-style-type: none"> sensor not detected 	Check the headlamp connector for integrity. Refer to the circuit diagrams and check headlamp circuit. Clear DTC and re-test, if DTC remains install a new headlamp
B1D69-00	Right Headlamp Swivelling Feedback Sensor - No sub type information	<ul style="list-style-type: none"> sensor not detected 	Check the headlamp connector for integrity. Refer to the circuit diagrams and check headlamp circuit. Clear DTC and re-test, if DTC remains install a new headlamp
C1A04-11	Right Front Height Sensor - Circuit short to ground	<ul style="list-style-type: none"> Height sensor harness wiring short circuit to ground 	Check the Ride Level Module for DTCs. Check the sensor connector for damage. Refer to the electrical circuit diagrams and check the sensor circuit for continuity or short circuit. Check sensor signal changes when sensor is rotated. If any height sensor fixings are slackened or found to be loose, or a height sensor has been changed, the vehicle ride height must be re-calibrated. Calibrate the system using the approved diagnostic system
C1A04-15	Right Front Height Sensor - Circuit short to battery or open	<ul style="list-style-type: none"> Height sensor harness wiring short circuit to power 	Check the Ride Level Module for DTCs. Check the sensor connector for damage. Refer to the electrical circuit diagrams and check the sensor circuit for continuity or short circuit. Check sensor signal changes when sensor is rotated. If any height sensor fixings are slackened or found to be loose, or a height sensor has been changed, the vehicle ride height must be re-calibrated. Calibrate the system using the approved diagnostic system
C1A04-64	Right Front Height Sensor - Signal plausibility failure	<ul style="list-style-type: none"> Height sensor signal plausibility failure 	Check the Ride Level Module for DTCs. Check the sensor connector for damage. Refer to the electrical circuit diagrams and check the sensor circuit for continuity or short circuit. Check sensor signal changes when sensor is rotated. If any height sensor fixings are slackened or found to be loose, or a height sensor has been changed, the vehicle ride height must be re-calibrated. Calibrate the system using the approved diagnostic system
C1A06-11	Right Rear Height Sensor - Circuit short to ground	<ul style="list-style-type: none"> Height sensor harness wiring short circuit to ground 	Check the Ride Level Module for DTCs. Check the sensor connector for damage. Refer to the electrical circuit diagrams and check the sensor circuit for continuity or short circuit. Check sensor signal changes when sensor is rotated. If any height sensor fixings are slackened or found to be loose, or a height sensor has been changed, the vehicle ride height must be re-calibrated. Calibrate the system using the approved diagnostic system
C1A06-15	Right Rear Height Sensor - Circuit short to battery or open	<ul style="list-style-type: none"> Height sensor harness wiring short circuit to power 	Check the Ride Level Module for DTCs. Check the sensor connector for damage. Refer to the electrical circuit diagrams and check the sensor circuit for continuity or short circuit. Check sensor signal changes when sensor is rotated. If any height sensor fixings are slackened or found to be loose, or a height sensor has been changed, the vehicle ride height must be re-calibrated. Calibrate the system using the approved diagnostic system
C1A06-64	Right Rear Height Sensor - Signal plausibility failure	<ul style="list-style-type: none"> Height sensor signal plausibility failure 	Check the Ride Level Module for DTCs. Check the sensor connector for damage. Refer to the electrical circuit diagrams and check the sensor circuit for continuity or short circuit. Check sensor signal changes when sensor is rotated. If any height sensor fixings are slackened or found to be loose, or a height sensor has been changed, the vehicle ride height must be re-calibrated. Calibrate the system using the approved diagnostic system
U0001-88	High Speed CAN Communication Bus - Bus off	Bus off	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0101-00	Lost Communication with TCM - No sub type information	<ul style="list-style-type: none"> CAN Bus communication error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transmission Control Module and Headlamp Control Module

DTC	Description	Possible Causes	Action
U0102-00	Lost Communication with Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> ● CAN Bus communication error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transfer Case Control Module and Headlamp Control Module
U0121-00	Lost Communication With Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> ● CAN Bus communication error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the ABS Module and Headlamp Control Module
U0126-00	Lost Communication With Steering Angle Sensor Module - No sub type information	<ul style="list-style-type: none"> ● CAN Bus communication error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Steering Angle Sensor Control Module and Headlamp Control Module
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> ● CAN Bus communication error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and Headlamp Control Module
U0142-00	Lost Communication With Body Control Module "B" - No sub type information	<ul style="list-style-type: none"> ● CAN Bus communication error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and Headlamp Control Module
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> ● Car Configuration File information incompatible to ECU 	Check/amend Car Configuration File using the manufacturer approved diagnostic system
U0402-00	Invalid Data Received From Transmission Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check the Transmission Control Module for related DTCs and refer to the relevant DTC index
U0403-00	Invalid Data Received From Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check the Transfer Case Control Module for related DTCs and refer to the relevant DTC index
U0415-00	Invalid Data Received From Anti-Lock Brake System Control Module - No sub type information	<ul style="list-style-type: none"> ● Invalid data received from ABS module 	Check the ABS Module for related DTCs and refer to the relevant DTC index
U0428-00	Invalid Data Received From Steering Angle Sensor Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check the steering angle sensor module for related DTCs and refer to the relevant DTC index
U2100-00	Initial Configuration Not Complete - No sub type information	<ul style="list-style-type: none"> ● Car Configuration File information not received completely 	Check/amend Car Configuration File using manufacturer approved diagnostic system
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> ● Car Configuration File information incompatible to ECU 	Check/amend Car Configuration File using manufacturer approved diagnostic system
U3002-81	Vehicle Identification Number - Invalid serial data received	<ul style="list-style-type: none"> ● Stored VIN does not match most recent VIN 	Check/amend Car Configuration File using manufacturer approved diagnostic system
U3003-16	Battery Voltage - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Circuit voltage below threshold 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical guides and check the power and ground supply circuits to the module.
U3003-17	Battery Voltage - Circuit voltage above threshold	<ul style="list-style-type: none"> ● Circuit voltage above threshold 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical guides and check the power and ground supply circuits to the module
U3003-62	Battery Voltage - Signal compare failure	<ul style="list-style-type: none"> ● Mis-match in battery voltage, between Central Junction Box and headlamp Control module, of 2 volts or more 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power and ground supply circuits to both modules

General Information - Diagnostic Trouble Code (DTC) Index DTC: Headlamp Control Module B (HCM2)

Description and Operation

Headlamp Control Module B (HCM2)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Headlamp Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Autolamps](#) (417-01 Exterior Lighting, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1286-16	Interior Mirror - Circuit voltage below threshold	<ul style="list-style-type: none"> Mirror circuit voltage below threshold <ul style="list-style-type: none"> The electrochromic function does not work 	<ul style="list-style-type: none"> This DTC is for information only. Clear the DTC and retest. If the problem persists, renew the mirror module. Refer to the warranty policy and procedures manual if a module is suspect
B1286-17	Interior Mirror - Circuit voltage above threshold	<ul style="list-style-type: none"> Mirror circuit voltage above threshold <ul style="list-style-type: none"> The electrochromic function does not work 	<ul style="list-style-type: none"> This DTC is for information only. Clear the DTC and retest. If the problem persists, renew the mirror module. Refer to the warranty policy and procedures manual if a module is suspect
B1286-44	Interior Mirror - Data memory failure	<ul style="list-style-type: none"> Mirror control module data memory failure <ul style="list-style-type: none"> (the electrochromic function does not work) 	<ul style="list-style-type: none"> Renew the interior mirror module. Refer to the warranty policy and procedures manual if a module is suspect
B1286-47	Interior Mirror - Watchdog/safety micro controller failure	<ul style="list-style-type: none"> Control module watchdog/safety Micro controller failure <ul style="list-style-type: none"> The electrochromic function does not work 	<ul style="list-style-type: none"> This DTC is for information only. Clear the DTC and retest. If the problem persists, renew the mirror module. Refer to the warranty policy and procedures manual if a module is suspect
B1286-49	Interior Mirror - Internal electronic failure	<ul style="list-style-type: none"> Mirror internal failures (Active Light Sensor) <ul style="list-style-type: none"> The electrochromic function does not work 	<ul style="list-style-type: none"> Renew the interior mirror module. Refer to the warranty policy and procedures manual if a module is suspect
B1286-60	Interior Mirror	<ul style="list-style-type: none"> Operation Temperature below limit <ul style="list-style-type: none"> (the electrochromic function does not work) 	<ul style="list-style-type: none"> Allow the vehicle interior temperature to increase, clear the DTC and retest. Consider the environmental conditions before condemning the module
B1286-78	Interior Mirror - Alignment or adjustment incorrect	<ul style="list-style-type: none"> DTC for information only and is logged whenever the increased sensitivity mode has been activated to provide a log of the number of times the feature has been used (increased sensitivity mode is cancelled when the ignition is cycled) 	<ul style="list-style-type: none"> Ignore/clear this DTC
B1286-96	Interior Mirror - Component internal failure	<ul style="list-style-type: none"> Mirror internal failures 	<ul style="list-style-type: none"> Renew the interior mirror module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
B1286-97	Interior Mirror - Component or system operation obstructed or blocked	<ul style="list-style-type: none"> Mirror internal camera component or system operation obstructed or blocked 	<ul style="list-style-type: none"> Remove obstructions from the mirror camera (remove stickers etc., clean windscreen inside and out). Clear the DTC and retest for normal operation
B1286-98	Interior Mirror - Component or system over temperature	<ul style="list-style-type: none"> Component or system over temperature 	<ul style="list-style-type: none"> Consider the environmental conditions before condemning the module. Allow the component/system to cool, clear the DTC and retest for normal operation
B12AC-11	Electrochromic Door Mirror - Circuit short to ground	<ul style="list-style-type: none"> Electrochromic door mirror output circuit short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the mirror circuit. Repair as necessary
B12AC-12	Electrochromic Door Mirror -Circuit short to battery	<ul style="list-style-type: none"> Electrochromic door mirror output circuit short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the mirror circuit. Repair as necessary
B12EB-78	Camera Horizontal Alignment - Alignment or adjustment incorrect	<ul style="list-style-type: none"> Mirror internal camera alignment or adjustment incorrect Mirror module fault Windscreen alignment incorrect 	<ul style="list-style-type: none"> Check the mirror for security and correct positioning. Clear the DTC and retest for normal operation. If the problem persists, renew the mirror module. Refer to the warranty policy and procedures manual if a module is suspect
B12EC-78	Camera Vertical Alignment - Alignment or adjustment incorrect	<ul style="list-style-type: none"> Mirror internal camera alignment or adjustment incorrect Mirror module fault Windscreen alignment incorrect 	<ul style="list-style-type: none"> Check the mirror for security and correct positioning. Clear the DTC and retest for normal operation. If the problem persists, renew the mirror module. Refer to the warranty policy and procedures manual if a module is suspect
B134A-78	Target Aim Verification - Camera Horizontal Alignment - Alignment or adjustment incorrect	<ul style="list-style-type: none"> Mirror internal camera alignment or adjustment incorrect Mirror module fault Windscreen alignment incorrect 	<ul style="list-style-type: none"> DTC for information only. Clear/ignore DTC
B134B-78	Target Aim Vertical - Camera Horizontal Alignment - Alignment or adjustment incorrect	<ul style="list-style-type: none"> Mirror internal camera alignment or adjustment incorrect Mirror module fault Windscreen alignment incorrect 	<ul style="list-style-type: none"> DTC for information only. Clear/ignore DTC
U0010-88	Medium Speed CAN Communication Bus - Bus off	<ul style="list-style-type: none"> Bus off 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and Rain/Light Sensor
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> No sub type information 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system, ensure that the module contains the latest software version and is correctly configured, update if necessary. Clear the DTC and retest
U201A-57	Control Module Main Calibration Data - Invalid/incomplete software component	<ul style="list-style-type: none"> Invalid/incomplete software component Main calibration is invalid to car configuration file or not complete stored to the mirror 	<ul style="list-style-type: none"> Using the manufacturers approved diagnostic system, check the configuration of the car configuration file and software version of the module is correct
U2100-00	Initial Configuration Not Complete - No sub type information	<ul style="list-style-type: none"> No sub type information 	<ul style="list-style-type: none"> Wait 30 seconds, clear DTC and retest
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> No sub type information 	<ul style="list-style-type: none"> Using the manufacturers approved diagnostic system, check the configuration of the car configuration file

General Information - Diagnostic Trouble Code (DTC) Index DTC: Image Processing Module B (IPMB)

Description and Operation

Image Processing Module B (IPMB)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Image Processing Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Video System](#) (415-07 Video System, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B100E-29	Video Input "A" signal - Signal invalid	<ul style="list-style-type: none"> Video output connection error Video output line short or open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the circuit between the cameras and the touch screen display control module
B1087-00	LIN Bus "A" - No sub type information	<ul style="list-style-type: none"> LIN Bus error 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the LIN circuit between the cameras and the camera control module
B12BD-19	Rear Camera - Circuit current above threshold	<ul style="list-style-type: none"> Rear camera circuit current above threshold Camera is drawing little or no current, indicating an open circuit fault or disconnected camera 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the rear camera circuit for short to power, open circuit, high resistance
B12BD-31	Rear Camera - no signal	<ul style="list-style-type: none"> Rear camera circuit fault Rear camera faulty 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the rear camera circuit for open circuit Check and install new rear camera as required Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12BD-49	Rear Camera - internal electronic failure	<ul style="list-style-type: none"> Rear camera internal electronic failure 	<ul style="list-style-type: none"> Check and install new rear camera as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12BD-54	Rear Camera - missing calibration	<ul style="list-style-type: none"> Rear camera not calibrated Camera not installed correctly 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system calibrate the rear camera Check the camera is fitted and aligned correctly
B12BE-19	Left Front Camera - Circuit current above threshold	<ul style="list-style-type: none"> Left front camera circuit current above threshold Left front camera is drawing little or no current, indicating an open circuit fault or disconnected camera 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left front camera circuit for short to power, open circuit, high resistance
B12BE-31	Left Front Camera - no signal	<ul style="list-style-type: none"> Left front camera circuit fault Left front camera faulty 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the left front camera circuit for open circuit Check and install new left front camera as required Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

DTC	Description	Possible Causes	Action
B12BE-49	Left Front Camera - Internal electronic failure	<ul style="list-style-type: none"> ● Left front camera internal electronic failure 	<ul style="list-style-type: none"> ● Check and install new left front camera as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12BE-54	Left Front Camera - missing calibration	<ul style="list-style-type: none"> ● Left front camera not calibrated 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system calibrate the left front camera
B12BF-19	Right Front Camera - Circuit current above threshold	<ul style="list-style-type: none"> ● Right front camera circuit current above threshold ● Right front camera is drawing little or no current, indicating an open circuit fault or disconnected camera 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the right front camera circuit for short to power, open circuit, high resistance
B12BF-31	Right Front Camera - no signal	<ul style="list-style-type: none"> ● Right front camera circuit fault ● Right front camera faulty 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the right front camera circuit for open circuit ● Check and install new right front camera as required Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12BF-49	Right Front Camera - internal electronic failure	<ul style="list-style-type: none"> ● Right front camera internal electronic failure 	<ul style="list-style-type: none"> ● Check and install new right front camera as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12BF-54	Right Front Camera - missing calibration	<ul style="list-style-type: none"> ● Right front camera not calibrated 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system calibrate the right front camera
B12C0-19	Left Mirror Camera - Circuit current above threshold	<ul style="list-style-type: none"> ● Left mirror camera circuit current above threshold ● Left mirror camera is drawing little or no current, indicating an open circuit fault or disconnected camera 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the left mirror camera circuit for short to power, open circuit, high resistance
B12C0-31	Left Mirror Camera - no signal	<ul style="list-style-type: none"> ● Left mirror camera circuit fault ● Left mirror camera faulty 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the left mirror camera circuit for open circuit ● Check and install new left mirror camera as required Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12C0-49	Left Mirror Camera - internal electronic failure	<ul style="list-style-type: none"> ● Left mirror camera internal electronic failure 	<ul style="list-style-type: none"> ● Check and install new left mirror camera as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12C0-54	Left Mirror Camera - missing calibration	<ul style="list-style-type: none"> ● Left mirror camera not calibrated 	<ul style="list-style-type: none"> ● Using the manufacturer approved diagnostic system calibrate the left mirror camera
B12C1-19	Right Mirror Camera - Circuit current above threshold	<ul style="list-style-type: none"> ● Right mirror camera circuit current above threshold ● Right mirror camera is drawing little or no current, indicating an open circuit fault or disconnected camera 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the right mirror camera circuit for short to power, open circuit, high resistance
B12C1-31	Right Mirror Camera - no signal	<ul style="list-style-type: none"> ● Right mirror camera circuit fault ● Right mirror camera faulty 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the right mirror camera circuit for open circuit ● Check and install new right mirror camera as required Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B12C1-49	Right Mirror Camera - internal electronic failure	<ul style="list-style-type: none"> ● Right mirror camera internal electronic failure 	<ul style="list-style-type: none"> ● Check and install new right mirror camera as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

DTC	Description	Possible Causes	Action
B12C1-54	Right Mirror Camera - missing calibration	<ul style="list-style-type: none"> Right mirror camera not calibrated 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system calibrate the right mirror camera
P1603-00	EEPROM Malfunction - No sub type information	<ul style="list-style-type: none"> Control module internal memory error 	Clear the DTC and retest. If the DTC resets, renew the module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U0010-88	Medium Speed CAN Communication Bus - bus off	<ul style="list-style-type: none"> Bus off 	Refer to the electrical circuit diagrams and check CAN private network for short, open circuit. Carry out CAN network integrity tests using the manufacturer approved diagnostic system. Refer to the Network Communications section of the workshop manual
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> Incorrect software loaded Lost CAN signal 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the parking aid module. Update as necessary
U1A4B-49	Control Module Processor B - internal electronic failure	<ul style="list-style-type: none"> Internal electronic failure 	Clear the DTC and retest. If the DTC resets, renew the module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U201A-51	Control Module Main Calibration Data - not programmed	<ul style="list-style-type: none"> Local config/calibration file missing/invalid (LCF) 	Configure the module using the approved diagnostic system
U3000-46	Control Module - calibration / parameter memory failure	<ul style="list-style-type: none"> Internal memory error 	Clear the DTC and retest. If the DTC resets, renew the module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U3000-47	Control Module - watchdog / safety MicroController failure	<ul style="list-style-type: none"> Watchdog/safety MicroController failure 	Clear the DTC and retest. If the DTC resets, renew the module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U3000-49	Control Module - internal electronic failure	<ul style="list-style-type: none"> Internal memory error 	Clear the DTC and retest. If the DTC resets, renew the module. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U3000-98	Control Module - component or system over temperature	<ul style="list-style-type: none"> Component or system over temperature 	Consider the environmental conditions before suspecting a module. Allow the module to cool, clear the DTC and retest. Refer to the warranty policy and procedures manual if a module is suspect
U3003-62	Battery Voltage - Signal compare failure	<ul style="list-style-type: none"> Signal compare failure 	Check vehicle battery connections and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Instrument Cluster (IPC)

Description and Operation

Instrument Cluster (IPC)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Instrument Panel Cluster, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.
For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1009-51	Ignition Authorisation - not programmed	<ul style="list-style-type: none"> Ignition authorisation not programmed 	Configure the instrument cluster using the manufacturers approved diagnostic system
B1009-87	Ignition Authorisation - missing message	<ul style="list-style-type: none"> Ignition authorisation message missing 	Configure the instrument cluster using the manufacturers approved diagnostic system
B100D-64	Column Lock Authorisation - signal plausibility failure	<ul style="list-style-type: none"> Request to lock or unlock steering column lock has failed due to engine RPM or vehicle speed 	Check the engine control module for related stored DTCs
B1026-12	Steering Column Lock - Circuit short to battery	<ul style="list-style-type: none"> Steering column lock circuit short to power 	Refer to the wiring diagrams and check the electric steering column ground circuit
B104A-00	Button 1 - No sub type information	<ul style="list-style-type: none"> No sub type information Joy pad switch is faulty 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the instrument cluster. Refer to the warranty policies and procedures before renewing the module
B104B-00	Button 2 - No sub type information	<ul style="list-style-type: none"> No sub type information Joy pad switch is faulty 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the instrument cluster. Refer to the warranty policies and procedures before renewing the module
B104C-00	Button 3 - No sub type information	<ul style="list-style-type: none"> No sub type information Joy pad switch is faulty 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the instrument cluster. Refer to the warranty policies and procedures before renewing the module
B104D-00	Button 4 - No sub type information	<ul style="list-style-type: none"> No sub type information Joy pad switch is faulty 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the instrument cluster. Refer to the warranty policies and procedures before renewing the module
B104E-00	Button 5 - No sub type information	<ul style="list-style-type: none"> No sub type information Joy pad switch is faulty 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the instrument cluster. Refer to the warranty policies and procedures before renewing the module
B108E-13	Display - Circuit open	<ul style="list-style-type: none"> Cluster display connector fails continuity check, continuity circuit in display flex cable open circuit 	Renew the instrument cluster. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
B10B7-86	Rear Air Discharge Temperature - Signal invalid	<ul style="list-style-type: none"> ● Display illumination area temperature sensor signal is out of range 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the instrument cluster. Refer to the warranty policy and procedures manual if a module is suspect
B115C-7A	Transfer Fuel Pump - fluid leak or seal failure	<ul style="list-style-type: none"> ● Transfer fuel pump fault, fluid leak or seal failure 	Check for other fuel pump related DTCs. Renew the transfer fuel (jet) pump
B1A14-96	RCM Warning Lamp - Component internal failure	<ul style="list-style-type: none"> ● SRS LED failure ● Warning lamp circuit fault 	Check the harness connector to the Instrument Cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the Instrument Cluster. Refer to the warranty policies and procedures before renewing the module
B1A68-86	Ambient Temperature Sensor - Signal invalid	<ul style="list-style-type: none"> ● Internal board temperature sensor signal is out of range/invalid 	Check the harness connector to the Instrument Cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the Instrument Cluster. Refer to the warranty policies and procedures before renewing the module
B1A85-96	Ambient Light Sensor - Component internal failure	<ul style="list-style-type: none"> ● Internal light sensor failure 	Check the harness connector to the Instrument Cluster for security and integrity. Clear the DTC and retest the switch function. If the problem persists, renew the Instrument Cluster. Refer to the warranty policies and procedures before renewing the module
P0485-12	Fan Power/Ground Circuit - Circuit short to battery	<ul style="list-style-type: none"> ● Fan power/ground circuit short to power 	Refer to the electrical wiring diagrams and check the cluster cooling fan circuit and rectify as necessary. Clear the DTC and retest
P060A-08	Internal Control Module Monitoring Processor Performance - Bus Signal/Message Failures	<ul style="list-style-type: none"> ● Internal communication errors are causing lock-ups and resets 	Suspect the Instrument Cluster. Refer to the warranty policies and procedures before renewing the module
P0607-4B	Control Module Performance - Over temperature	<ul style="list-style-type: none"> ● Cluster over temperature 	Check the cluster cooling fan/circuit and rectify as necessary. Clear the DTC and retest
P0610-55	Control Module Vehicle Options Error - Not configured	<ul style="list-style-type: none"> ● Control module incorrectly configured 	Configure the module using the manufacturers approved diagnostic system
U0001-88	High Speed CAN Communication Bus - bus off	<ul style="list-style-type: none"> ● High speed CAN Bus circuit fault ● Module internal failure 	Refer to the electrical circuit diagrams and check the high speed CAN Bus circuit for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0010-88	Medium Speed CAN Communication Bus - bus off	<ul style="list-style-type: none"> ● Medium speed CAN Bus circuit fault ● Module internal failure 	Refer to the electrical circuit diagrams and check the medium speed CAN Bus circuit for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0100-00	Lost Communication With ECM/PCM "A" - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Engine Control Module and Instrument Cluster
U0101-00	Lost Communication with TCM - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transmission Control Module and Instrument Cluster
U0102-00	Lost Communication with Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transfer Case Control Module and Instrument Cluster
U0103-00	Lost Communication With Gear Shift Control Module A - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Gear Shift Control Module and Instrument Panel Cluster
U0104-00	Lost Communication With Cruise Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Speed Control Module and Instrument Cluster

DTC	Description	Possible Causes	Action
U0121-00	Lost Communication With Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Anti-lock Braking System Module and Instrument Cluster
U0126-00	Lost Communication With Steering Angle Sensor Module - no sub type information	<ul style="list-style-type: none"> Power or ground circuit fault CAN Bus circuit fault Module internal failure 	Refer to the electrical circuit diagrams and check the power, ground and CAN Bus circuit to the steering angle sensor for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0127-00	Lost Communication With Tire Pressure Monitor Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Tire Pressure Monitoring System Module and Instrument Cluster
U0128-00	Lost Communication With Park Brake Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Parking Brake Module and Instrument Cluster
U0132-00	Lost Communication With Suspension Control Module "A" - no sub type information	<ul style="list-style-type: none"> Power or ground circuit fault CAN Bus circuit fault Module internal failure 	Refer to the electrical circuit diagrams and check the power, ground and CAN Bus circuits to the air suspension module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0133-00	Lost Communication With Active Roll Control Module - no sub type information	<ul style="list-style-type: none"> Power or ground circuit fault CAN Bus circuit fault Module internal failure 	Refer to the electrical circuit diagrams and check the power, ground and CAN Bus circuit to the dynamic response module (ARCM) for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0136-00	Lost Communication With Differential Control Module - Rear - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Rear Differential Control Module and Instrument Cluster
U0138-00	Lost Communication with All Terrain Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Terrain Response Control Module and Instrument Cluster
U0139-00	Lost Communication With Suspension Control Module "B" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Suspension Control Module and Instrument Cluster
U0139-08	Lost Communication With Suspension Control Module "B" - Bus Signal/Message Failures	<ul style="list-style-type: none"> Bus signal/message failures 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Suspension Control Module and Instrument Cluster
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and Instrument Cluster
U0141-00	Lost Communication With Body Control Module "A" - no sub type information	<ul style="list-style-type: none"> Power or ground circuit fault CAN Bus circuit fault Module internal failure 	Refer to the electrical circuit diagrams and check the power, ground and CAN Bus circuit to the body control module for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0151-00	Lost Communication With Restraints Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Restraints Control Module and Instrument

DTC	Description	Possible Causes	Action
			Cluster
U0154-00	Lost Communication With Restraints Occupant Classification System Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Restraints Control Module and Instrument Cluster
U0159-00	Lost Communication With Parking Assist Control Module "A" - No sub type information	<ul style="list-style-type: none"> CAN Link Instrument Cluster /parking aid module missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Parking Aid Module and Instrument Cluster
U0164-00	Lost Communication With HVAC Control Module - No sub type information	<ul style="list-style-type: none"> CAN Link instrument cluster/HVAC module missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Heating and Ventilation Control Module and Instrument Panel Cluster
U0184-00	Lost Communication With Radio - no sub type information	<ul style="list-style-type: none"> Power or ground circuit fault CAN Bus circuit fault Module internal failure 	Refer to the electrical circuit diagrams and check the power, ground and CAN Bus circuit to the audio head unit for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0199-00	Lost Communication With "Door Control Module A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Door Control Module and Instrument Panel Cluster
U0208-00	Lost Communication With "Seat Control Module A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Seat Control Module and Instrument Panel Cluster
U0214-00	Lost Communication With Remote Function Actuation - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Remote Function Actuation Control Module and Instrument Panel Cluster
U0232-00	Lost Communication With Side Obstacle Detection Control Module - Left - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Side Obstacle Detection Control Module and Instrument Panel Cluster
U0241-00	Lost Communication With Headlamp Control Module "A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Headlamp Control Module and Instrument Panel Cluster
U0242-00	Lost Communication With Headlamp Control Module "B" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Headlamp Control Module and Instrument Panel Cluster
U0250-00	Lost Communication With Impact Classification System Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Impact Classification System Module and Instrument Panel Cluster
U025D-00	Lost Communication With Front Controls Interface Module "B" - no sub type information	<ul style="list-style-type: none"> Power or ground circuit fault CAN Bus circuit fault Module internal failure 	Refer to the electrical circuit diagrams and check the power, ground and CAN Bus circuit to the front controls interface module B (FCIMB) for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test

DTC	Description	Possible Causes	Action
U0264-00	Lost Communication With Camera Module-Rear - no sub type information	<ul style="list-style-type: none"> ● Power or ground circuit fault ● CAN Bus circuit fault ● Module internal failure 	Refer to the electrical circuit diagrams and check the power, ground and CAN Bus circuit to the rear view camera for fault. Using the manufacturer approved diagnostic system, complete a CAN network integrity test
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box (CJB) using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the instrument pack cluster. Update/configure as necessary
U0402-68	Invalid Data Received from TCM - event information	<ul style="list-style-type: none"> ● Event information 	Check for transmission Control module DTCs. Refer to relevant DTC index
U1A00-00	Private Communication Network - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the LIN Bus circuit
U2013-02	Switch Pack - General signal failure	<ul style="list-style-type: none"> ● General signal failure 	Refer to the electrical circuit diagrams and check the LIN Bus circuit
U2013-08	Switch Pack - Bus signal / message failures	<ul style="list-style-type: none"> ● General signal failure 	Refer to the electrical circuit diagrams and check the LIN Bus circuit
U210A-86	Temperature Sensor - Signal invalid	<ul style="list-style-type: none"> ● Temperature sensor signal invalid 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest. If the problem persists, renew the instrument cluster. Refer to the warranty policy and procedures manual if a module is suspect
U3000-46	Control Module - calibration / parameter memory failure-calibration / parameter memory failure	<ul style="list-style-type: none"> ● Odometer reading on cluster is missing or incorrect - calibration / parameter memory failure 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest. If the problem persists, renew the instrument cluster. Refer to the warranty policy and procedures manual if a module is suspect
U3000-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> ● Internal electronic failure 	Check the harness connector to the instrument cluster for security and integrity. Clear the DTC and retest. If the problem persists, renew the instrument cluster. Refer to the warranty policy and procedures manual if a module is suspect
U3000-55	Control Module - not configured	<ul style="list-style-type: none"> ● Speedometer is inaccurate ● Tire size compensation is incorrectly configured 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing modules menu and program the module
U3000-87	Control Module - missing message	<ul style="list-style-type: none"> ● Car Configuration File missing message 	Configure the Car Configuration File using the approved diagnostic system
U3002-81	Vehicle Identification Number - invalid serial data received	<ul style="list-style-type: none"> ● Invalid vehicle identification number 	Configure the Car Configuration File using the approved diagnostic system
U3003-16	Control Module - Circuit voltage below threshold	<ul style="list-style-type: none"> ● Circuit voltage below threshold (9V) 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module
U3003-17	Control Module - Circuit voltage above threshold	<ul style="list-style-type: none"> ● Circuit voltage above threshold (16V) 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module
U3003-62	Control Module - Signal compare failure	<ul style="list-style-type: none"> ● Signal compare failure 	Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Navigation Control Module (NAV)

Description and Operation

DTC Index

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Touch Screen Display (TSD) for additional Diagnosis and Testing information refer to the Navigation System, Section 415-00.

• CAUTIONS:



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.



When probing connectors to take measurements in the course of the pinpoint tests, use the adaptor kit, part number 3548-1358-00.

• NOTE: If the control module is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module.

• NOTE: Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer approved diagnostic system).

• NOTE: When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• NOTE: If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

DTC	Description	Possible Causes	Action
B100F-25	Video Input "B" - Signal shape/waveform failure	<ul style="list-style-type: none"> Rear proximity camera video input disconnected Camera malfunction 	<ul style="list-style-type: none"> Check the video signal connection and whether it is being broadcasted. Where available, configure the rear / proximity cameras using the approved diagnostic system. Check whether the rear / proximity cameras are broadcasting an image by entering touch screen diagnostics selecting 'Video Input Test' then press 'Rear View / Proximity Camera'. Check whether a clear image is displayed. Refer to the electrical circuit diagrams and check the video signal circuit between the rear / proximity cameras and the Camera Control Module If the problem persists, renew the camera or cameras. Clear the DTC and perform an on demand self test
B1010-25	Video Input "C" - Signal shape/waveform failure	<ul style="list-style-type: none"> Television/Rear seat entertainment video input disconnected TV/DVD malfunction 	<ul style="list-style-type: none"> Check the video signal connection and whether it is being broadcasted. Where available, configure the TV or DVD using the manufacturers approved diagnostic system. Check whether the TV or Rear Seat Entertainment Module (RSE) is broadcasting an image by entering diagnostics selecting 'Video Input Test' then press 'TV/DVD'. Check whether a clear image is displayed. Refer to the electrical circuit diagrams and check the video signal circuit from the TV or Rear Seat Entertainment (RSE) module If the problem persists, renew the Television or Rear Seat Entertainment Module (RSE) or DVD module. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B108E-14	Display - Circuit short to ground or open	<ul style="list-style-type: none"> Internal display circuit short circuit to ground, open circuit 	<ul style="list-style-type: none"> Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. If the DTC persists contact Dealer Technical Support (DTS)

DTC	Description	Possible Causes	Action
B108E-17	Display - Circuit voltage above threshold	<ul style="list-style-type: none"> ● Internal display circuit short circuit to ground, open circuit 	<ul style="list-style-type: none"> ● Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. If the DTC persists contact Dealer Technical Support (DTS)
B108E-1C	Display - Circuit voltage out of range	<ul style="list-style-type: none"> ● Internal display circuit short circuit to ground, open circuit 	<ul style="list-style-type: none"> ● Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. If the DTC persists contact Dealer Technical Support (DTS)
B108E-87	Display- missing message	<ul style="list-style-type: none"> ● Display communication failure 	<ul style="list-style-type: none"> ● Clear the DTC and switch off the ignition. Allow sufficient time for the infotainment relay to power down and retest. If DTC persists reprogram the Front Entertainment Module (FEM)
B108E-88	Display - Bus off	<ul style="list-style-type: none"> ● Bus off ● Front Entertainment Module (FEM) internal failure 	<ul style="list-style-type: none"> ● Clear the DTC and switch off the ignition. Allow sufficient time for the infotainment relay to power down and retest. If DTC persists renew the Front Entertainment Module (FEM). Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B119F-11	GPS Antenna - Circuit short to ground	<ul style="list-style-type: none"> ● Global Positioning System (GPS) antenna circuit short circuit to ground 	<ul style="list-style-type: none"> ● Check the global positioning system (GPS) [blue] connector to the Front Entertainment Module (FEM) for security and integrity. Check that the GPS antenna is not damaged. Refer to the electrical circuit diagrams and check the circuit between the GPS antenna and the Front Entertainment Module (FEM). Test the GPS outside in open space for more than 2 minutes after power on. Enter touch screen diagnostics and select 'Next', 'Vehicle Information' then 'GPS Information'. Check that HDOP is less than 5 and GPS satellites show more than 4 'P's
B119F-13	GPS Antenna - Circuit open	<ul style="list-style-type: none"> ● Antenna circuit open circuit ● Antenna not connected 	<ul style="list-style-type: none"> ● Check the global positioning system (GPS) [blue] connector to the Front Entertainment Module (FEM) for security and integrity. Check that the GPS antenna is not damaged. Refer to the electrical circuit diagrams and check the circuit between the GPS antenna and the Front Entertainment Module (FEM). Test the GPS outside in open space for more than 2 minutes after power on. Enter touch screen diagnostics and select 'Next', 'Vehicle Information' then 'GPS Information'. Check that HDOP is less than 5 and GPS satellites show more than 4 'P's
B11A3-49	Gyroscope - Internal electronic failure	<ul style="list-style-type: none"> ● Internal gyroscope failure 	<ul style="list-style-type: none"> ● Enter touch screen diagnostics and select 'Next', 'Vehicle information' then 'Vehicle sensor'. Check that the Gyro sensor voltage is around 2500mV when stationary, but changes along the bearing when the car is moving while turning the steering wheel. If the Gyro sensor voltage or bearing does not change when the car is moving while turning the steering wheel renew the Front Entertainment Module (FEM). Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B121B-13	Keypad Input Switch - Circuit open	<ul style="list-style-type: none"> ● Touch screen display input key circuit open circuit ● Touch screen display input key fault 	<ul style="list-style-type: none"> ● Check whether the input keys are working by entering the touch screen diagnostics and selecting 'Hard Key Test'. If one or more of the input keys do not respond (except audio off) renew the Front Entertainment Module. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B121C-13	Hard Drive - Circuit open	<ul style="list-style-type: none"> ● Module internal hard drive open circuit/not connected 	<ul style="list-style-type: none"> ● Check whether the Hard Drive is connected by entering the touch screen diagnostics selecting 'Next' then 'HDD Information'. Check that the hard drive serial number, operating time and model name appear. If the SMART test fails 'NG' renew the Front Entertainment Module (FEM). Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

DTC	Description	Possible Causes	Action
B121C-44	Hard Drive - Data memory failure	<ul style="list-style-type: none"> ● internal hard drive data memory failure 	<ul style="list-style-type: none"> ● Check whether the Hard Drive is connected by entering the touch screen diagnostics selecting 'Next' then 'HDD Information'. Check that the hard drive serial number, operating time and model name appear. If the SMART test fails 'NG' renew the Front Entertainment Module (FEM). Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1D56-14	Antenna #3 - Circuit short to ground or open	<ul style="list-style-type: none"> ● Vehicle Information and Communication Antenna (VICS) disconnected ● Vehicle Information and Communication Antenna (VICS) circuit short circuit to ground, open circuit 	<ul style="list-style-type: none"> ● Enter touch screen diagnostics and select 'Next', 'Vehicle information', 'VICS' then 'Radio Wave Beacon' and 'Infrared beacon'. Check that Time and Beacon number data are shown. Check that the Vehicle Information and Communication System (VICS) antenna or circuit is not damaged ● Refer to the electrical circuit diagrams and check the circuit between the Vehicle Information and Communication System (VICS) antenna and the Front Entertainment Module (FEM) for short to ground, open circuit
U1A01-56	Communication Link -Invalid/incomplete configuration	<ul style="list-style-type: none"> ● Internal communication failure 	<ul style="list-style-type: none"> ● Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. If the DTC persists reprogram the Front Entertainment Module (FEM) ● If DTC still persists renew the Front Entertainment Module. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U1A4B-82	Control Module Processor B - Alive/sequence counter incorrect/not updated	<ul style="list-style-type: none"> ● Internal communication failure 	<ul style="list-style-type: none"> ● Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. Enter touch screen diagnostics and select 'Configurations'. Check that the vehicle type is displayed and the sub CPU SW version are shown. If the DTC persists reprogram the Front Entertainment Module (FEM). Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U1A4B-87	Control Module Processor B - Missing message	<ul style="list-style-type: none"> ● Internal communication failure 	<ul style="list-style-type: none"> ● Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. Re-configure the Front Entertainment Module (FEM) using the manufacturers approved diagnostic system ● If DTC persists renew the Front Entertainment Module (FEM). Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U2005-62	Vehicle Speed - Signal compare failure	<ul style="list-style-type: none"> ● Vehicle speed and calculated GPS system vehicle speed mismatch ● Vehicle speed signal circuit between Anti-Lock Braking (ABS) Module and Navigation System Module (NAV) short to ground, short to power 	<ul style="list-style-type: none"> ● Check the Anti-Lock Braking (ABS) Module connector and wiring harness. using the manufacturer approved diagnostic system, enter diagnostics and select 'Vehicle Signals'. Check that the vehicle speeds both increase when the car is moving ● Refer to the electrical circuit diagrams and check vehicle speed signal circuit between the Anti-Lock Braking (ABS) Module and Navigation System Module (NAV) for short to ground, short to power, open circuit
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> ● Car Configuration File (CCF) parameter mismatch ● Invalid/incomplete configuration 	<ul style="list-style-type: none"> ● Enter touch screen diagnostics and select 'Self Test' and wait for the test results to complete. The Car Configuration File (CCF) mismatch parameter(s) will be listed in the description with DTC 'U210100'. The Car Configuration File (CCF) parameters values for Brand, HLDF, MMMType, Navigation, MMMJapan, MMMFitted, MMMVariant, NavRegion, MMM3, VICS, GPSReceiver, Intercom, ParkingAidDisplay, HandOfDrive or AmbientLight can be found by entering the touch screen diagnostics 'Vehicle Configurations' and pressing 'Next' until the parameter is shown. Contact Dealer Technical Support (DTS) reporting the Car Configuration (CCF) parameter name and value ● Contact dealer technical support to assist in re-configuring the Car Configuration File (CCF) using the manufacturers approved diagnostic

DTC	Description	Possible Causes	Action
			<p>system. Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down</p>
U2101-4A	Control Module Configuration Incompatible - Incorrect component installed	<ul style="list-style-type: none"> ● Navigation map license mismatch ● Invalid/incomplete configuration 	<ul style="list-style-type: none"> ● If the map screen is not shown after entering diagnostics and pressing 'I Agree' then start routine 0x6024 'Update Map Configuration' with option 0x03. Allow 30 seconds for the routine to complete before entering the map screen. If a map screen is still not shown Contact Dealer Technical Support (DTS) ● Enter the navigation menu and select 'Map changer'. Check that the map regions match the Front Entertainment Module market. The Car Configuration File parameters values for MapConfiguration can be found by entering the touch screen diagnostics 'Vehicle Configurations' and pressing 'Next' until the parameter is shown. Contact Dealer Technical Support (DTS) to assist in re-configuring the Car Configuration File (CCF) for the map market using the manufacturers approved diagnostic system. Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down
U210A-85	Temperature Sensor - signal above allowable range	<ul style="list-style-type: none"> ● Front Entertainment Module (FEM) over temperature ● Interior cabin over heating 	<ul style="list-style-type: none"> ● Cool the vehicle interior down by ensuring it is in the shade and have the A/C on cool. Enter touch screen diagnostics and select 'Vehicle Signals'. Check the Media Orientated System Transport (MOST) FOT temperature ● When cool, clear the DTC and retest
U3003-17	Battery Voltage - Circuit voltage above threshold	<ul style="list-style-type: none"> ● Battery voltage above 16 volts 	<ul style="list-style-type: none"> ● Check vehicle battery and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Occupant Classification System (OCS)

Description and Operation

Occupant Classification System (OCS)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Occupant Classification System, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Air Bag Supplemental Restraint System \(SRS\)](#) (501-20B Supplemental Restraint System, Diagnosis and Testing).

DTC	Description	Possible Cause	Action
B1193-53	Crash Event Storage Full and Locked - deactivated	<ul style="list-style-type: none"> Crash event occurred 	<ul style="list-style-type: none"> Clear diagnostic trouble code and re-test
B1A54-01	Occupant Belt Tension Sensor - General Electrical Failure	<ul style="list-style-type: none"> General electrical failure 	<ul style="list-style-type: none"> Clear diagnostic trouble code and re-test. If the problem persists, check and install a new safety belt tension sensor as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
B1A54-02	Occupant Belt Tension Sensor - General signal failure	<ul style="list-style-type: none"> General signal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check safety belt tension and mat pressure sensor circuits for short to each other
B1A54-11	Occupant Belt Tension Sensor - circuit short to ground	<ul style="list-style-type: none"> Safety belt tension sensor voltage reference or signal circuit - short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check safety belt tension sensor voltage reference and signal circuits for short to ground
B1A54-12	Occupant Belt Tension Sensor - circuit short to battery	<ul style="list-style-type: none"> Safety belt tension sensor voltage reference or signal circuit - short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check safety belt tension sensor voltage reference and signal circuits for short to power
B1A54-13	Occupant Belt Tension Sensor - circuit open	<ul style="list-style-type: none"> Safety belt tension sensor voltage reference or signal circuit - open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check safety belt tension sensor voltage reference and signal circuits for open circuit
B1A62-02	Pressure Sensor - General signal failure	<ul style="list-style-type: none"> General signal failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check safety belt tension and mat pressure sensor circuits for short to each other
B1A62-11	Pressure Sensor - circuit short to ground	<ul style="list-style-type: none"> Mat pressure sensor voltage reference or signal circuits - short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check mat pressure sensor voltage reference and signal circuits for short to ground
B1A62-12	Pressure Sensor - circuit short to battery	<ul style="list-style-type: none"> Mat pressure sensor voltage reference, ground or signal circuits - short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check mat pressure sensor voltage reference, ground and signal circuits for short to power
B1A62-13	Pressure Sensor - circuit open	<ul style="list-style-type: none"> Mat pressure sensor voltage reference or signal circuit - open circuit 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check mat pressure sensor voltage reference and signal circuits for open circuit

DTC	Description	Possible Cause	Action
B1A62-7B	Pressure Sensor - low fluid level	<ul style="list-style-type: none"> ● Low fluid level - bladder damaged 	<ul style="list-style-type: none"> ● Check and install new bladder as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U0001-88	High Speed CAN Communication Bus - Bus off	<ul style="list-style-type: none"> ● Bus off 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check CAN network for short, open circuit. Carry out the CAN network integrity test using the manufacturer approved diagnostic system
U0151-00	Lost Communication With Restraints Control Module - no sub type information	<ul style="list-style-type: none"> ● Restraints control module missing message 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check power and ground supplies to restraints control module. Carry out CAN network integrity test using the manufacturer approved diagnostic system
U0300-00	Internal Control Module Software Incompatibility - no sub type information	<ul style="list-style-type: none"> ● Master car configuration file ID does not correspond 	<ul style="list-style-type: none"> ● Check correct occupancy seat module is installed for vehicle specification. Check auxiliary junction box for related diagnostic trouble codes and refer to relevant diagnostic trouble code index
U2016-51	Control Module Main Software - not programmed	<ul style="list-style-type: none"> ● Main software not programmed 	<ul style="list-style-type: none"> ● Check and install a new occupancy seat module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U201A-51	Control Module Main Calibration Data - not programmed	<ul style="list-style-type: none"> ● Main calibration data not programmed 	<ul style="list-style-type: none"> ● Check and install a new occupancy seat module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U3000-04	Control Module - System Internal Failures	<ul style="list-style-type: none"> ● Occupancy seat module internal electronic failure 	<ul style="list-style-type: none"> ● Check and install a new occupancy seat module as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
U3000-54	Control Module - missing calibration	<ul style="list-style-type: none"> ● This diagnostic trouble code is set if a 'calibrate occupancy seat module empty seat offset' routine is requested and fails due to one of the pre-conditions to execute the routine 	<ul style="list-style-type: none"> ● Check the following criteria have all been achieved: Ignition status set to RUN/START. Verify seat is always empty after power-up before re-zero is requested. The occupancy seat module has gone through the seat assembly plant calibration. No collision event received from the restraints control module during the current ignition cycle. No faults present in the current ignition cycle. The trigger message for calibrate empty seat offset has been received from the diagnostic tool. Occupancy seat module has enough time to begin classification. Temperature is between 6C (42F) and 36C (97F)
U3003-16	Battery Voltage - circuit voltage below threshold	<ul style="list-style-type: none"> ● Circuit voltage below threshold 	<ul style="list-style-type: none"> ● Check battery is in fully charged and serviceable condition. Check integrity of charging system
U3003-17	Battery Voltage - circuit voltage above threshold	<ul style="list-style-type: none"> ● Circuit voltage above threshold 	<ul style="list-style-type: none"> ● Check battery is in fully charged and serviceable condition. Check integrity of charging system

General Information - Diagnostic Trouble Code (DTC) Index DTC: Parking

Aid Module (PAM)

Description and Operation

Parking Aid Module (PAM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Parking Aid Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Parking Aid](#) (413-13 Parking Aid, Diagnosis and Testing).

• **NOTE:** Physical damage to the sensor (impact damage or scratched sensor surface) must **NOT** be changed under warranty.

DTC	Description	Possible Causes	Action
B1B36-01	Front Right Outer Sensor - General Electrical Failure	<ul style="list-style-type: none"> General electric failure Signal circuit short circuit to ground Signal circuit high resistance Connector/harness problem Sensor missing 	If DTCs B1B36-01, B1B38-01, B1B4001 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action
B1B36-12	Front Right Outer Sensor - Circuit short to battery	<ul style="list-style-type: none"> Signal circuit short circuit to power 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front right outer sensor only
B1B36-96	Front Right Outer Sensor - component internal failure	<ul style="list-style-type: none"> Component internal failure 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front right outer sensor only
B1B38-01	Front Right Inner Sensor - General Electrical Failure	<ul style="list-style-type: none"> General electric failure Signal circuit short circuit to ground Signal circuit high resistance Connector/harness problem 	If DTCs B1B36-01, B1B38-01, B1B40-01 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the

DTC	Description	Possible Causes	Action
			correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action
B1B38-12	Front Right Inner Sensor - Circuit short to battery	<ul style="list-style-type: none"> ● Signal circuit short circuit to power 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front right inner sensor only
B1B38-96	Front Right Inner Sensor - component internal failure	<ul style="list-style-type: none"> ● Component internal failure 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front right inner sensor only
B1B40-01	Front Left Outer Sensor - General Electrical Failure	<ul style="list-style-type: none"> ● General electric failure ● Signal circuit short circuit to ground ● Signal circuit high resistance ● Connector/harness problem 	If DTCs B1B36-01, B1B38-01, B1B40-01 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action
B1B40-12	Front Left Outer Sensor - Circuit short to battery	<ul style="list-style-type: none"> ● Signal circuit short circuit to power 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front left outer sensor only
B1B40-96	Front Left Outer Sensor - component internal failure	<ul style="list-style-type: none"> ● Component internal failure 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front left outer sensor only
B1B42-01	Front Left Inner Sensor - General Electrical Failure	<ul style="list-style-type: none"> ● General electric failure ● Signal circuit short circuit to ground ● Signal circuit high resistance ● Connector/harness problem 	If DTCs B1B36-01, B1B38-01, B1B40-01 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action

DTC	Description	Possible Causes	Action
B1B42-12	Front Left Inner Sensor - Circuit short to battery	<ul style="list-style-type: none"> ● Signal circuit short circuit to power 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front left inner sensor only
B1B42-96	Front Left Inner Sensor - component internal failure	<ul style="list-style-type: none"> ● Component internal failure 	Check front bumper harness for signs of damage. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the front left inner sensor only
B1B44-01	Rear Right Outer Sensor - General Electrical Failure	<ul style="list-style-type: none"> ● General electric failure ● Signal circuit short circuit to ground ● Signal circuit high resistance ● Connector/harness problem 	If DTCs B1B36-01, B1B38-01, B1B40-01 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action
B1B44-12	Rear Right Outer Sensor - Circuit short to battery	<ul style="list-style-type: none"> ● Signal circuit short circuit to power 	Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear right outer sensor only
B1B44-96	Rear Right Outer Sensor - component internal failure	<ul style="list-style-type: none"> ● Component internal failure 	Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear right outer sensor only
B1B46-01	Rear Right Inner Sensor - General Electrical Failure	<ul style="list-style-type: none"> ● General electric failure ● Signal circuit short circuit to ground ● Signal circuit high resistance ● Connector/harness problem 	If DTCs B1B36-01, B1B38-01, B1B40-01 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action
B1B46-12	Rear Right Inner Sensor - Circuit short to battery	<ul style="list-style-type: none"> ● Signal circuit short circuit to power 	Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear right inner sensor only
B1B46-96	Rear Right Inner Sensor - component internal failure	<ul style="list-style-type: none"> ● Component internal failure 	Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear right inner sensor only

DTC	Description	Possible Causes	Action
B1B48-01	Rear Left Outer Sensor - General Electrical Failure	<ul style="list-style-type: none"> ● General electric failure ● Signal circuit short circuit to ground ● Signal circuit high resistance ● Connector/harness problem 	<p>If DTCs B1B36-01, B1B38-01, B1B40-01 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action</p>
B1B48-12	Rear Left Outer Sensor - Circuit short to battery	<ul style="list-style-type: none"> ● Signal circuit short circuit to power 	<p>Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear left outer sensor only</p>
B1B48-96	Rear Left Outer Sensor - component internal failure	<ul style="list-style-type: none"> ● Component internal failure 	<p>Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear left outer sensor only</p>
B1B50-01	Rear Left Inner Sensor - General Electrical Failure	<ul style="list-style-type: none"> ● General electric failure ● Signal circuit short circuit to ground ● Signal circuit high resistance ● Connector/harness problem 	<p>If DTCs B1B36-01, B1B38-01, B1B40-01 and B1B42-01 are all present, check the Car Configuration File and vehicle specification to ensure front sensors have been specified. If correctly specified, check that front bumper has sensors and wiring loom installed. Check the front bumper wiring harness connector to main wiring loom for security and integrity. Check the connectors to the parking aid module for security and integrity. Clear DTCs and power up parking aid system and confirm problem resolution. If problem persists, check the Car Configuration File to ensure correct configuration for front and rear sensors relative to installed vehicle specification. Check whether the correct parking aid module has been installed to the vehicle. Check the correct/latest software has been installed. Correct the Car Configuration File or update to the correct software, clear DTCs, power up parking aid system and confirm problem resolution. Refer to the electrical circuit diagrams and check the front bumper harness for short circuit between signal and ground wires within harness. Check the front bumper harness for short circuit to bodywork or other grounded components (chafing). Check the wiring and sensor connectors for integrity and damage, then re-connect sensor and confirm connection (connector latched). Clear DTC, power up parking aid system and check corrective action. If the problem persists then renew the sensor. Clear DTC, power up parking aid system and check corrective action</p>
B1B50-12	Rear Left Inner Sensor - Circuit short to battery	<ul style="list-style-type: none"> ● Signal circuit short circuit to power 	<p>Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear left inner sensor only</p>
B1B50-96	Rear Left Inner Sensor - component internal failure	<ul style="list-style-type: none"> ● Component internal failure 	<p>Check rear bumper harness. Check the connector for integrity and damage, then re-connect sensor to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sensor circuit. If the problem persists, renew the rear left inner sensor only</p>
B1B52-01	Rear Sounder - Park Aid - General Electrical Failure	<ul style="list-style-type: none"> ● General electric failure ● Signal circuit short circuit to ground ● Signal circuit high resistance ● Connector/harness problem 	<p>Check the connector for integrity and damage, then re-connect sounder to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sounder circuit. If the problem persists, renew the sounder only</p>

DTC	Description	Possible Causes	Action
B1B52-12	Rear Sounder - Park Aid - circuit short to battery	<ul style="list-style-type: none"> Signal circuit short circuit to ground 	Check the connector for integrity and damage, then re-connect sounder to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sounder circuit. If the problem persists, renew the sounder only
B1B52-12	Rear Sounder - Park Aid - Circuit short to battery	<ul style="list-style-type: none"> Signal circuit short circuit to ground 	Check the connector for integrity and damage, then re-connect sounder to confirm connection. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the sounder circuit. If the problem persists, renew the sounder only
B1B54-11	Function LED - Park Aid - Circuit short to ground	<ul style="list-style-type: none"> Signal circuit short circuit to ground 	Check the parking aid switch and LED functionality. Refer to the electrical circuit diagrams and check the circuit. Repair/renew as necessary
B1B57-11	Front Sensors Power Circuit - circuit short to ground	<ul style="list-style-type: none"> Front sensor power circuit short circuit to ground Connector/harness problem 	Check the connector for integrity and damage, then re-connect sensor to confirm connection. Check the connector. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the front bumper circuit. If the problem persists, renew the sounder only
B1B58-11	Rear Sensors Power Circuit - Circuit short to ground	<ul style="list-style-type: none"> Rear sensor power circuit short circuit to ground Connector/harness problem 	Check the connector for integrity and damage, then re-connect sensor to confirm connection. Check the connector. Cycle ignition to power up parking aid system and check corrective action. Refer to the electrical circuit diagrams and check the rear bumper circuit. If the problem persists, renew the sounder only
B1C30-73	Disable Switch - Actuator stuck closed	<ul style="list-style-type: none"> Actuator stuck closed 	Check the switch function. Refer to the electrical circuit diagrams and check the circuit
U0010-00	Medium Speed CAN Communication Bus - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Where available, using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0140-87	Lost Communication With Body Control Module - missing message	<ul style="list-style-type: none"> No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Where available, using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0155-00	Lost Communication With Instrument Panel Cluster (IPC) Control Module - No sub type information	<ul style="list-style-type: none"> CAN Link ECM/IPC network malfunction 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Where available, using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the parking aid module. Check the configuration of the Car Configuration File using the manufacturers recommended diagnostic system. Update as necessary
U0422-00	Invalid Data Received From Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the parking aid module. Update as necessary.
U0423-00	Invalid Data Received From Instrument Panel Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U0443-00	Invalid Data Received From Body Control Module "B" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. Check CAN wiring. Using the manufacturer approved diagnostic system, complete a CAN integrity test. Refer to the electrical circuit diagrams and check the module CAN, power and ground circuits. Refer to the Network Communications section of the workshop manual
U2100-00	Initial Configuration Not Complete - No sub type information	<ul style="list-style-type: none"> No sub type information 	Configure the module using the manufacturers approved diagnostic system
U2101-00	Control Module Configuration Incompatible - No sub type	<ul style="list-style-type: none"> No sub type information 	Configure the module using the manufacturers approved diagnostic system

DTC	Description	Possible Causes	Action
	information		
U3000-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> ● Audio unit internal electronic failure(internal error) 	Refer to the electrical circuit diagrams and check the power and ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policy and procedures manual if a module is suspect
U3002-81	Vehicle Identification Number - invalid serial data received	<ul style="list-style-type: none"> ● Invalid serial data received 	Configure the module using the manufacturers approved diagnostic system
U3003-62	Battery Voltage - Signal compare failure	<ul style="list-style-type: none"> ● Signal compare failure 	Check vehicle battery connections and charging system. Refer to the relevant section in the workshop manual. Refer to the electrical circuit diagrams and check the power supply circuits to the module

General Information - Diagnostic Trouble Code (DTC) Index **DTC: Parking Brake Module (PBM)**

Description and Operation

Parking Brake Module (PBM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Parking Brake Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Parking Brake](#) (206-05 Parking Brake and Actuation, Diagnosis and Testing).

Bedding mode is a special mode available in the parking brake module (PBM) that disables the stability assist system (ABS) and allows the parking brake to provide the braking force rather than the conventional braking system whilst the vehicle is moving at a velocity of >3kph. This mode is entered via a series of brake pedal presses and switch applications, full details on this procedure is available in the relevant section of the workshop manual. If brake bedding mode is entered accidentally by the driver the RED warning lamp will flash in the Instrument Cluster, the module will return to normal operational mode when the ignition has been cycled. This DTC (C1104-68) is intended to highlight the fact that although the RED lamp was illuminated there was no fault present in the control module.

• **NOTE:** Where reference is made to a drive cycle test, refer to the relevant Diagnosis and Testing Section.

DTC	Description	Possible Causes	Action
C0062-01	Longitudinal Acceleration Sensor - General electrical failure	<ul style="list-style-type: none"> General electrical failure 	Check the electrical connections to the sensor. Clear the DTC and retest. If the problem persists, renew the sensor
C0062-02	Longitudinal Acceleration Sensor - General signal failure	<ul style="list-style-type: none"> General signal failure 	Check the electrical connections to the sensor. Clear the DTC and retest. If the problem persists, renew the sensor
C0062-54	Longitudinal Acceleration Sensor - Missing calibration	<ul style="list-style-type: none"> Missing calibration 	Check the electrical connections to the sensor. Calibrate the sensor using the manufacturers approved diagnostic system
C1104-68	Brake Bedding Mode - Event information	<ul style="list-style-type: none"> Event information Brake bedding mode has been entered 	This is not a fault. This is where the parking brake bedding-in mode has been activated. For information on how the bedding-in mode is activated and deactivated
C1A41-01	Clutch Pedal Sensor - General Electrical Failure	<ul style="list-style-type: none"> General electrical failure 	Check the electrical connections to the sensor. Clear the DTC and retest. If the problem persists, renew the sensor
C1A41-02	Clutch Pedal Sensor - General signal failure	<ul style="list-style-type: none"> General signal failure 	Check the electrical connections to the sensor. Clear the DTC and retest. If the problem persists, renew the sensor
C1A43-01	Motor Supply - General electrical failure	<ul style="list-style-type: none"> • NOTE: The electric motor is part of the parking brake actuator module Internal motor circuit fault 	Clear DTCs, complete drive cycle 3 to test for normal operation, refer to the relevant drive cycle shown below this table. Refer to the warranty policy and procedures manual if a module is suspect
C1A43-19	Motor Supply - Circuit current above threshold	<ul style="list-style-type: none"> Circuit current above threshold 	Refer to the electrical circuit diagrams and check the circuit. Check the power and ground connections to the modules
C1A43-67	Motor Supply - Signal incorrect after event	<ul style="list-style-type: none"> Signal incorrect after event 	Check the functionality of the park brake. Check for other related DTCs. Clear the DTC and retest. If the problem persists, renew the park brake actuator
C1A46-01	Mismatch Between Motor Drive Current and Resultant Force - General Electrical Failure	<ul style="list-style-type: none"> General electrical failure 	Check the functionality of the park brake. Check for other related DTCs. Clear the DTC and retest. If the problem persists, renew the park brake actuator.

DTC	Description	Possible Causes	Action
C1A46-64	Mismatch Between Motor Drive Current and Resultant Force - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	Check the functionality of the park brake. Check for other related DTCs. Clear the DTC and retest. If the problem persists, renew the park brake actuator
C1A47-01	Force Sensor - General electrical failure	<ul style="list-style-type: none"> ● NOTE: The force sensor is part of the parking brake actuator module ● Internal force sensor electrical fault 	Clear DTCs, complete drive cycle 1 to test for normal operation, refer to the relevant drive cycle shown below this table. Refer to the warranty policy and procedures manual if a module is suspect.
C1A47-02	Force Sensor - General signal failure	<ul style="list-style-type: none"> ● NOTE: The force sensor is part of the parking brake actuator module ● Internal force sensor plausibility failure 	Clear DTCs, complete drive cycle 3 to test for normal operation, refer to the relevant drive cycle shown below this table. Refer to the warranty policy and procedures manual if a module is suspect.
C1A47-54	Force Sensor - Missing calibration	<ul style="list-style-type: none"> ● NOTE: The force sensor is part of the parking brake actuator module ● Internal force sensor not calibrated 	Clear DTCs, complete drive cycle 1 to test for normal operation, refer to the relevant drive cycle shown below this table. Refer to the warranty policy and procedures manual if a module is suspect.
C1A48-01	Warning Lamp - General electrical failure	<ul style="list-style-type: none"> ● Parking brake actuator module to instrument cluster warning lamp circuit open circuit ● Parking brake actuator module to instrument cluster warning lamp circuit short circuit to ground ● Parking brake actuator module to instrument cluster warning lamp circuit short circuit to power ● Parking brake actuator module fault ● Instrument cluster fault 	Check the parking brake actuator module to instrument cluster warning lamp circuit. Refer to the electrical circuit diagrams. Rectify as necessary. Refer to the warranty policy and procedures manual if a module is suspect. Clear DTCs, complete drive cycle 1 to test for normal operation
C1A53-68	Manual Emergency Release Activated - Event information	<ul style="list-style-type: none"> ● Emergency release cable activated and stuck/damaged ● Parking brake cables seized/damaged ● Actuator jammed 	Check that the emergency release cable is not permanently pulled (or stuck). Check the parking brake cables for broken or loose connections. Attempt to re-engage the parking brake by pulling the apply switch TWICE. Clear DTCs, complete the following drive cycle. Pull the parking brake emergency release cable. Pull the parking brake switch to the apply position, hold until the parking brake motor has stopped (this may take up to 20 seconds). Release the switch to idle position. For parking brake actuator module manual emergency release
U0073-88	Control Module Communication Bus "A" Off - Bus off	<ul style="list-style-type: none"> ● Bus off 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0100-00	Lost Communication With ECM/PCM "A" - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the engine control module and parking brake module
U0101-00	Lost Communication with TCM - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the transmission control module and parking brake module
U0102-00	Lost Communication With Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the ABS module and parking brake module
U0121-00	Lost Communication With Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the ABS

DTC	Description	Possible Causes	Action
			module and parking brake module
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the generic electronics module and parking brake module
U0300-55	Internal Control Module Software Incompatibility - not configured	<ul style="list-style-type: none"> Parking brake module configuration does not match vehicle configuration Parking brake actuator module fault 	Check that the correct module is installed to the vehicle. Check that the Car Configuration File (CCF) is being correct. Configure the module(s) using the approved diagnostic system
U0401-00	Invalid Data Received From ECM/PCM A - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check the engine control module for related DTCs and refer to the relevant DTC index
U0402-00	Invalid data received from the TCM - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check the transmission control module for related DTCs and refer to the relevant DTC index
U0403-00	Invalid Data Received From The Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check the transfer case control module for related DTCs and refer to the relevant DTC index
U0415-00	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check the ABS module for related DTCs and refer to the relevant DTC index.
U0422-00	Invalid Data Received From Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check the Central Junction Box for related DTCs and refer to the relevant DTC index
U1A14-49	CAN Initialization failure- Internal electronic failure	<ul style="list-style-type: none"> CAN error Parking brake actuator module fault 	Clear DTCs, complete drive cycle 1 to test for normal operation, refer to the relevant drive cycle shown below this table. Refer to the warranty policy and procedures manual if a module is suspect.
U2002-01	Switch - General electrical failure	<ul style="list-style-type: none"> Parking brake switch circuit open circuit Parking brake switch circuit short circuit to ground Parking brake switch circuit short circuit to power Parking brake switch circuit short circuit to each other Parking brake switch fault 	Note that this DTC can be set by very slow operation of the parking brake switch. Check the parking brake switch and circuits. Refer to the electrical circuit diagrams. Install a new parking brake switch as necessary. Clear DTCs, complete drive cycle 1
U2002-12	Switch - Circuit short to battery	<ul style="list-style-type: none"> Parking brake switch circuit short circuit to power Parking brake switch fault 	Check the parking brake switch and circuits. Refer to the electrical circuit diagrams. Install a new parking brake switch as necessary. Clear DTCs, complete drive cycle 1
U2002-2F	Switch - Signal erratic	<ul style="list-style-type: none"> Parking brake switch signal erratic Parking brake switch fault 	Note that this DTC can be set by very slow operation of the parking brake switch. Check the parking brake switch and circuits. Refer to the electrical circuit diagrams. Install a new parking brake switch as necessary. Clear DTCs, complete drive cycle 1
U2002-92	Switch - Performance or incorrect operation	<ul style="list-style-type: none"> Parking brake switch performance or incorrect operation Parking brake switch fault 	Note that this DTC can be set by very slow operation of the parking brake switch. Check the parking brake switch and circuits. Refer to the electrical circuit diagrams. Install a new parking brake switch as necessary. Clear DTCs, complete drive cycle 1
U2012-00	Car Configuration Parameter(s) - No sub type information	<ul style="list-style-type: none"> Module incorrectly programmed 	Check/amend the Car Configuration File using the manufacturer approved diagnostic system
U3000-00	Control Module - No sub type information	<ul style="list-style-type: none"> General electric failure 	Check the control module connections for security and serviceability. Clear the DTC and retest
U3000-16	Control Module - Circuit voltage below threshold	<ul style="list-style-type: none"> Control module circuit voltage below threshold: <ul style="list-style-type: none"> Voltage less than (master control module voltage - 2V) for > 10 seconds 	Check the battery condition and state of charge. Refer to the relevant section of the workshop manual. Check the module power and ground connections. Refer to the electrical circuit diagrams

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● Battery voltage low ● Control module circuit High resistance 	
U3000-17	Control Module - Circuit voltage above threshold	<ul style="list-style-type: none"> ● Control module circuit voltage above threshold ● Battery voltage high (overcharging) ● Control module circuit short circuit to power 	Check the battery condition and state of charge. Refer to the relevant section of the workshop manual. Check the module power and ground circuits. Refer to the electrical circuit diagrams
U3000-4B	Control Module - Over temperature	<ul style="list-style-type: none"> ● Control module over temperature 	Allow the unit to cool, clear the DTC and retest. Do not renew the modulator as this is a protection function to ensure no internal damage occurs
U300A-64	Ignition Switch - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	Check the ignition switch connections. Check the circuit between the ignition switch and the parking brake module. Refer to the electrical circuit diagrams. Clear the DTC and retest
U0422-68	Invalid Data Received From Body Control Module - event information	<ul style="list-style-type: none"> ● Event information 	Check the Central Junction Box for related DTCs and refer to the relevant DTC index
U0452-68	Invalid Data Received From Restraints Control Module - event information	<ul style="list-style-type: none"> ● Event information 	Check the Restraints Control Module for related DTCs and refer to the relevant DTC index
U0401-68	Invalid Data Received from ECM/PCM A - event information	<ul style="list-style-type: none"> ● Event information 	Check the Engine Control Module for related DTCs and refer to the relevant DTC index

General Information - Diagnostic Trouble Code (DTC) Index DTC: Portable Audio Interface Module (APIM)

Description and Operation

Portable Audio Interface Module (APIM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Accessory Protocol Interface Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

DTC	Description	Possible Causes	Action
U3000-13	Control Module - Circuit open	<ul style="list-style-type: none"> Universal serial bus (USB) harness between portable audio interface panel and user interface panel is not properly connected Connection - detect circuit between portable audio interface panel and user interface panel is not grounded Universal serial bus (USB) harness between portable audio interface panel and user interface panel is open circuit 	Check for correct connection of universal serial bus (USB) harness between portable audio interface panel and user interface panel. Refer to the electrical circuit diagrams and check portable audio interface module connection detect circuit between portable audio interface panel and user interface panel is grounded. Install universal serial bus (USB) harness between portable audio interface panel and user interface panel as required, refer to the new module/component installation note at the top of the DTC Index
U3000-44	Control Module - Data memory failure	<ul style="list-style-type: none"> Portable audio interface module internal RAM memory failure 	Suspect the portable audio interface module. Check and install a new module as required. Refer to the warranty policy and procedures manual if a module is suspect
U3000-45	Control Module - Program memory failure	<ul style="list-style-type: none"> Portable audio interface module internal flash memory failure 	Suspect the portable audio interface module. Check and install a new module as required. Refer to the warranty policy and procedures manual if a module is suspect
U3000-55	Control Module - Not configured	<ul style="list-style-type: none"> Portable audio interface module not configured correctly 	Re-program the portable audio interface module, clear DTC and re-test. If DTC remains carry out MOST tests and test USB cable for open, short circuit, clear DTC and re-test. If DTC remains suspect the portable audio interface module, check and install a new module as required. Refer to the warranty policy and procedures manual if a module is suspect
U3003-62	Battery Voltage - Signal compare failure	<ul style="list-style-type: none"> Portable audio interface module voltage differs more than $\pm 2V$ compared to central electronics module voltage 	Refer to the electrical circuit diagrams and check the fuses, power and ground connections to both modules

General Information - Diagnostic Trouble Code (DTC) Index DTC: Rear Differential Control Module (RDCM)

Description and Operation

Rear Differential Control Module (RDCM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Rear Differential Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Rear Drive Axle and Differential](#) (205-02 Rear Drive Axle/Differential, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
P0562-00	System Voltage Low - No sub type information	<ul style="list-style-type: none"> Rear Differential Control Module voltage supply below 9V 	Check the battery charge condition, refer to the electrical circuit diagrams and check the wiring to the Rear Differential Control Module, repair as necessary
P0563-00	System Voltage High - No sub type information	<ul style="list-style-type: none"> System voltage high (supply voltage supply greater than 16 volts) 	Check Engine control module for stored DTCs , Suspect charging system fault. Refer to the electrical circuit diagrams and check, power and ground circuit for fault
P0604-00	Internal Control Module Random Access Memory (RAM) Error - No sub type information	<ul style="list-style-type: none"> Rear Differential Control Module internal error 	Clear the DTC and retest. If the problem persists, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
P0605-00	Internal Control Module Read Only Memory (ROM) Error - No sub type information	<ul style="list-style-type: none"> Rear Differential Control Module internal error 	Clear the DTC and retest. If the problem persists, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
P0606-00	Control Module Processor - No sub type information	<ul style="list-style-type: none"> Watch dog reset - Internal control module failure 	This is a control module internal check DTC and is not necessarily a fault. If no other DTCs are logged and no customer complaint exists, clear/ignore this DTC. If the problem persists, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
P0607-00	Control Module Performance - No sub type information	<ul style="list-style-type: none"> Rear Differential Control Module internal error - charge pump voltage below threshold 	Clear the DTC and retest. If the problem persists, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
P0652-00	Sensor Reference Voltage 'B' Circuit Low - No sub type information	<ul style="list-style-type: none"> Position sensor supply below 5.7V Sensor failure(within actuator) 	Refer to the electrical circuit diagrams and check the differential actuator sensor position circuit, repair as necessary. If no circuit problems exist, renew the differential actuator
P0653-00	Sensor Reference Voltage 'B' Circuit High - No sub type information	<ul style="list-style-type: none"> Position sensor supply above 8.3V Internal control module failure 	Refer to the electrical circuit diagrams and check the differential actuator hall sensor ref voltage at the control module or the actuator. If voltage is too high, then suspect control module fault. Refer to the warranty policy and procedures manual if a module is suspect
P0666-00	PCM/ECM/TCM Internal Temperature Sensor 'A' Circuit - No sub type information	<ul style="list-style-type: none"> Rear Differential Control Module internal temperature sensor value above 105°C 	This is a control module internal check DTC and is not necessarily a fault. If no other DTCs are logged and no customer complaint exists, clear this DTC and retest. Check the security of control module fixings. Check the module ground connection. Consider environmental conditions before suspecting the control module. If the problem persists, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
P0702-64	Transmission Control System Electrical - Signal plausibility failure	<ul style="list-style-type: none"> ● Implausibility of differential motor temperature sensor and oil temperature sensor readout detected ● Motor or oil temperature sensor circuit short circuit to ground or power 	Check the rear differential oil quantity and specification. Refer to the relevant section of the workshop manual. Check both temperature sensor circuits and connectors for damage/water ingress, repair as necessary. Where available, after vehicle has been switched off for at least an hour, use the manufacturer approved diagnostic system to read motor temperature and oil temperature sensor values. Temperature difference should be less than 25°C. Clear the DTC and retest
P0712-00	Transmission Fluid Temperature Sensor 'A' Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Differential actuator internal temperature sensor open circuit or short circuit to ground 	Refer to the electrical circuit diagrams and check the differential actuator sensor circuit, repair as necessary. If no circuit problems exist, renew the differential actuator
P0713-00	Transmission Fluid Temperature Sensor 'A' Circuit High - No sub type information	<ul style="list-style-type: none"> ● Differential actuator internal temperature sensor open circuit or short circuit to power 	Refer to the electrical circuit diagrams and check the circuit between oil temp sensor and control module connector, repair as necessary. Measure oil temp sensor resistance at control module connector. Resistance should be less than 10K if oil temp >0°C. If not suspect, oil temp sensor open-circuit. If no circuit problems exist, renew the sensor
P0806-00	Clutch Position Sensor Circuit Range/Performance - No sub type information	<ul style="list-style-type: none"> ● Mismatch of actual and expected/calculated actuator position - Internal differential actuator error 	Calibrate the clutch and range change mechanism using the manufacturer approved diagnostic system. Clear the DTC and retest. If the problem persists, renew the differential actuator
P0807-00	Clutch Position Sensor Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Differential actuator internal position sensor supply, ground, signal A or B open circuit or sensor supply, signal A or B short circuit to ground 	Refer to the electrical circuit diagrams and check the differential actuator motor position hall sensor signal circuit (A or B), repair as necessary. If no circuit problems exist, renew the differential actuator
P0808-00	Clutch Position Sensor Circuit High - No sub type information	<ul style="list-style-type: none"> ● Differential actuator internal position sensor signal 1 or 2 short circuit to power 	Refer to the electrical circuit diagrams and check the differential actuator motor position hall sensor signal circuit (A or B), repair as necessary. If no circuit problems exist, renew the differential actuator
P080A-00	Clutch Position Not Learned - No sub type information	<ul style="list-style-type: none"> ● Rear Differential Control Module (RDCM) not calibrated ● Differential clutch stuck or out of tolerance 	Using the manufacturer approved diagnostic system, calibrate the Rear Differential Control Module. Clear the DTC and retest. If the problem persists, renew the rear differential assembly. Refer to the warranty policy and procedures manual if a differential is suspect.
P0894-00	Transmission Component Slipping - No sub type information	<ul style="list-style-type: none"> ● Differential actuator internal magnetic brake is slipping 	Renew the differential actuator
P0900-00	Clutch Actuator Circuit/Open - No sub type information	<ul style="list-style-type: none"> ● Differential actuator supply open circuit 	Refer to the electrical circuit diagrams and check the differential actuator circuit, repair as necessary
P0901-00	Clutch Actuator Circuit Range/Performance - No sub type information	<ul style="list-style-type: none"> ● Differential actuator supply short circuit ● Both DC motor supply leads are short circuited together ● H Bridge overload detected 	Refer to the electrical circuit diagrams and check the differential actuator circuit. Check the actuator circuit resistance carefully (a good motor also has a low resistance). Repair as necessary
P0902-00	Clutch Actuator Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Differential actuator supply circuit short to ground. 	Refer to the electrical circuit diagrams and check the differential actuator circuit, repair as necessary
P0903-00	Clutch Actuator Circuit High - No sub type information	<ul style="list-style-type: none"> ● Differential actuator supply circuit short to power 	Refer to the electrical circuit diagrams and check the differential actuator circuit, repair as necessary
P1603-00	EEPROM Malfunction - No sub type information	<ul style="list-style-type: none"> ● Rear Differential Control Module internal error 	Clear the DTC and retest. If the problem persists, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect
P1783-00	Transmission Over-Temperature Condition - No sub type information	<ul style="list-style-type: none"> ● Rear Differential oil sump temperature sensor value above 160°C 	Confirm the customer complaint and vehicle usage at the time of DTC event. Check the operation of the rear differential. Check the rear differential oil quantity and specification. Refer to the relevant section of the workshop manual. Clear the DTC and retest. If the problem persists, suspect an electrical fault. Check for water ingress into wiring harness/connectors. Renew the actuator
P186A-00	Differential Lock-Up Actuator Brake Control Circuit/Open - No sub type information	<ul style="list-style-type: none"> ● Open circuit of actuator internal magnetic brake supply leads 	Refer to the electrical circuit diagrams and check the differential actuator circuit, repair as necessary. If no circuit problems exist, renew the differential actuator

DTC	Description	Possible Causes	Action
P186B-00	Differential Lock-Up Actuator Brake Control Circuit Low - No sub type information	<ul style="list-style-type: none"> Short circuit to ground of both differential actuator internal magnetic brake pins 	Refer to the electrical circuit diagrams and check the differential actuator circuit, repair as necessary. If no circuit problems exist, renew the differential actuator
P186C-00	Differential Lock-Up Actuator Brake Control Circuit High - No sub type information	<ul style="list-style-type: none"> Short circuit to power of both differential actuator internal magnetic brake pins 	Refer to the electrical circuit diagrams and check the differential actuator circuit, repair as necessary. If no circuit problems exist, renew the differential actuator
P186D-00	Clutch Actuator Stuck - No sub type information	<ul style="list-style-type: none"> Actuator fault 	Using the manufacturers approved diagnostic system, calibrate the Rear Differential Control Module/clutch actuator. If the problem persists, renew the actuator
P2742-00	Transmission Fluid Temperature Sensor 'B' Circuit Low - No sub type information	<ul style="list-style-type: none"> Rear differential oil sump temperature sensor short circuit to ground 	Refer to the electrical circuit diagrams and check the differential oil temperature sensor circuit, repair as necessary
P2743-00	Transmission Fluid Temperature Sensor 'B' Circuit High - No sub type information	<ul style="list-style-type: none"> Rear differential oil sump temperature sensor open circuit or short circuit to power 	Refer to the electrical circuit diagrams and check the differential oil temperature sensor circuit, repair as necessary
P2785-00	Clutch Actuator Temperature Too High - No sub type information	<ul style="list-style-type: none"> Extensive prolonged off-road use Insufficient oil quantity Incorrect oil specification Internal actuator problem 	Check for other DTCs (e.g. P186B). If multiple DTCs exist, suspect a control module internal fault. Confirm the customer complaint and vehicle usage at the time of DTC event. Check the operation of the rear differential. Check the rear differential oil quantity and specification. Refer to the relevant section of the workshop manual. Clear the DTC and retest. If the problem persists, renew the actuator
P2787-00	Clutch Temperature Too High - No sub type information	<ul style="list-style-type: none"> Rear differential clutch pack temperature (calculated) above 200°C 	Confirm the customer complaint and vehicle usage at the time of DTC event. Check the operation of the rear differential. Check the rear differential oil quantity and specification. Refer to the relevant section of the workshop manual. Clear the DTC and retest. If the problem persists, renew the actuator
U0001-88	High Speed CAN Communication Bus - Bus off	Bus off	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0100-00	Lost Communication With ECM/PCM "A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Engine Control Module and Rear Differential Control Module
U0102-00	Lost Communication With Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transfer Case Control Module and Rear Differential Control Module
U0121-00	Lost Communication With Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Anti-lock Braking System module and Rear Differential Control Module
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Central Junction Box and Rear Differential Control Module
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> Rear Differential Control Module not configured Incorrect software installed 	Check & confirm differential control module installed is correct. If correct, clear DTC, ignition off for 5 seconds, ignition on and then check if DTC reoccurs. If the problem persists, configure the module using the manufacturers approved diagnostic system
U0403-68	Invalid Data Received From Transfer Case Control Module - Event information	<ul style="list-style-type: none"> Event information 	Check the transfer case control module for related DTCs and refer to the relevant DTC index

DTC	Description	Possible Causes	Action
U0415-68	Lost Communication With Anti-Lock Brake System (ABS) Control Module - Event information	<ul style="list-style-type: none"> ● Event information 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Anti-lock Braking System module and Rear Differential Control Module
U0422-68	Invalid Data Received from Body Control Module - Event information	<ul style="list-style-type: none"> ● Event information- invalid vehicle configuration message 	Check the generic electronics module for related DTCs and refer to the relevant DTC index
U0443-68	Invalid Data Received From Body Control Module "B" - Event information	<ul style="list-style-type: none"> ● Event information 	Check the generic electronics module for related DTCs and refer to the relevant DTC index
U1A14-49	CAN Initialization failure- Internal electronic failure	<ul style="list-style-type: none"> ● Rear Differential Control Module has failed the CAN serial data communication software initialization or the CAN controller initialization ● Internal control module failure 	Clear the DTC and retest. If the problem persists, configure the module using the manufacturers approved diagnostic system. Clear the DTC and retest. If the problem persists, renew the control module. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Rear Entertainment Module (REM)

Description and Operation

Rear Entertainment Module (REM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Rear Entertainment Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1A00-44	Control Module - data memory failure	<ul style="list-style-type: none"> Rear entertainment control module - data memory failure 	Refer to the warranty policy and procedures manual if a module is suspect
B1A00-98	Control Module - component or system over temperature	<ul style="list-style-type: none"> Rear entertainment control module, component or system over-temperature 	Check the module and circuits. Refer to the electrical circuit diagrams. Clear the DTC and retest. Consider the atmospheric conditions before suspecting a module.
B1D50-79	Digital Disk Player - Mechanical linkage failure	<ul style="list-style-type: none"> Digital versatile disc (DVD) changer mechanical fault - Error report from AiNet 	Check for a mechanical fault (jammed magazine, etc). Rectify as necessary
B1D50-93	Digital Disk Player - No operation	<ul style="list-style-type: none"> Digital versatile disc (DVD) changer is not responding Communication error between the main and DVD microprocessors - No response from AiNet 	Refer to the electrical circuit diagrams and check the AiNet circuits. Rectify as necessary
B1D50-98	Digital Disk Player - Component or system over temperature	<ul style="list-style-type: none"> A high temperature condition has been detected 	Check the installation of the DVD module. Make sure there is sufficient airflow. Clear the DTC and retest. Consider the atmospheric conditions before suspecting a module
B1D81-93	Rear Left Display Module - No operation	<ul style="list-style-type: none"> Left-hand rear display is not responding Communication error between the main and left-hand display microprocessors No response from the IS bus 	Check the IS bus circuits. Refer to the electrical circuit diagrams
B1D81-98	Rear Left Display Module - Component or system over temperature	<ul style="list-style-type: none"> A high temperature condition has been detected 	Clear the DTC and retest. Consider the atmospheric conditions before suspecting a module
B1D82-93	Rear Right Display Module - No operation	<ul style="list-style-type: none"> Right-hand rear display is not responding Communication error between the main and right-hand display microprocessors No response from the IS bus 	Check the IS bus circuits. Refer to the electrical circuit diagrams
B1D82-98	Rear Right Display Module - Component or system over temperature	<ul style="list-style-type: none"> A high temperature condition has been detected 	Clear the DTC and retest. Consider the atmospheric conditions before suspecting a module
B1D83-93	Center Display Module - no operation	<ul style="list-style-type: none"> Center display is not responding Communication error between the main and center display microprocessors No response from the IS bus 	Check the center display and IS bus circuits. Refer to the electrical circuit diagrams

General Information - Diagnostic Trouble Code (DTC) Index DTC: Remote Function Actuator (RFA)

Description and Operation

Remote Function Actuator (RFA)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Remote Function Actuation Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B102B-00	Passive Key - no sub type information	<ul style="list-style-type: none"> Passive key response error Incorrect key Key incorrectly programmed 	<ul style="list-style-type: none"> Re-Program the key using the manufacturers approved diagnostic system
B10A9-00	Remote Keyless Entry Less Than 2 Keys Programmed - no sub type information	<ul style="list-style-type: none"> Secret key has been programmed to the vehicle but less than 2 key fobs have been programmed 	<ul style="list-style-type: none"> Re-Program the key fobs using the manufacturers approved diagnostic system
B10C1-00	Left Front Unlock Pull Switch - signal stuck open	<ul style="list-style-type: none"> No power supply to door handle Switch circuit open, or short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power supply to the door handle. Check the switch circuit is not open circuit or short to power. Repair wiring as required
B10C1-24	Left Front Unlock Pull Switch - signal stuck ON	<ul style="list-style-type: none"> Switch circuit short circuit to ground Switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the switch circuit is not short to ground. Repair wiring as required. If no wiring harness faults suspect switch, refer to the warranty policy and procedures manual if a module/component is suspect
B10C2-00	Left Rear Unlock Pull Switch - signal stuck open	<ul style="list-style-type: none"> No power supply to door handle Switch circuit open, or short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power supply to the door handle. Check the switch circuit is not open circuit or short to power. Repair wiring as required
B10C2-24	Left Rear Unlock Pull Switch - signal stuck ON	<ul style="list-style-type: none"> Switch circuit short circuit to ground Switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the switch circuit is not short to ground. Repair wiring as required. If no wiring harness faults suspect switch, refer to the warranty policy and procedures manual if a module/component is suspect
B10C3-00	Right Front Unlock Pull Switch - signal stuck open	<ul style="list-style-type: none"> No power supply to door handle Switch circuit open, or short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power supply to the door handle. Check the switch circuit is not open circuit or short to power. Repair wiring as required
B10C3-24	Right Front Unlock Pull Switch - signal stuck ON	<ul style="list-style-type: none"> Switch circuit short circuit to ground Switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the switch circuit is not short to ground. Repair wiring as required. If no wiring harness faults suspect switch, refer to the warranty policy and procedures manual if a module/component is suspect

DTC	Description	Possible Causes	Action
B10C4-00	Right Rear Unlock Pull Switch - signal stuck open	<ul style="list-style-type: none"> No power supply to door handle Switch circuit open, or short circuit to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power supply to the door handle. Check the switch circuit is not open circuit or short to power. Repair wiring as required
B10C4-24	Right Rear Unlock Pull Switch - signal stuck ON	<ul style="list-style-type: none"> Switch circuit short circuit to ground Switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the switch circuit is not short to ground. Repair wiring as required. If no wiring harness faults suspect switch, refer to the warranty policy and procedures manual if a module/component is suspect
B10C5-24	Trunk Unlock Pull Switch - signal stuck ON	<ul style="list-style-type: none"> Switch circuit short circuit to ground Switch fault 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the switch circuit is not short to ground. Repair wiring as required. If no wiring harness faults suspect switch, refer to the warranty policy and procedures manual if a module/component is suspect
B10C6-00	Exterior Trunk Antenna - no sub type information	<ul style="list-style-type: none"> Passive Trunk open does not function, antenna failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check loadspace RHS antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new loadspace RHS antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10C6-11	Exterior Trunk Antenna - circuit short to ground	<ul style="list-style-type: none"> One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check loadspace RHS antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B10C6-12	Exterior Trunk Antenna - circuit short to battery	<ul style="list-style-type: none"> One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check loadspace RHS antenna circuit for short to power. Clear the diagnostic trouble code and retest
B10C6-13	Exterior Trunk Antenna - circuit open	<ul style="list-style-type: none"> One or both antenna wires open 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check loadspace RHS antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B10C6-1C	Exterior Trunk Antenna - circuit voltage out of range	<ul style="list-style-type: none"> Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10C7-00	Interior Trunk Antenna - no sub type information	<ul style="list-style-type: none"> Antenna failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner LHS antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new headliner LHS antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10C7-11	Interior Trunk Antenna - circuit short to ground	<ul style="list-style-type: none"> One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner LHS antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B10C7-12	Interior Trunk Antenna - circuit short to battery	<ul style="list-style-type: none"> One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner LHS antenna circuit for short to power. Clear the diagnostic trouble code and retest
B10C7-13	Interior Trunk Antenna - circuit open	<ul style="list-style-type: none"> One or both antenna wires open 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner LHS antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B10C7-1C	Interior Trunk Antenna - circuit voltage out of range	<ul style="list-style-type: none"> Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10C8-00	Interior Center Antenna - no sub type information	<ul style="list-style-type: none"> Antenna failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner RHS antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new headliner RHS antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10C8-11	Interior Center Antenna - circuit short to ground	<ul style="list-style-type: none"> One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner RHS antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest

DTC	Description	Possible Causes	Action
B10C8-12	Interior Center Antenna - circuit short to battery	<ul style="list-style-type: none"> One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner RHS antenna circuit for short to power. Clear the diagnostic trouble code and retest
B10C8-13	Interior Center Antenna - circuit open	<ul style="list-style-type: none"> One or both antenna wires open 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check headliner RHS antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B10C8-1C	Interior Center Antenna - circuit voltage out of range	<ul style="list-style-type: none"> Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10C9-00	Interior Front Antenna - no sub type information	<ul style="list-style-type: none"> Antenna failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check interior front cabin antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new interior front cabin antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10C9-11	Interior Front Antenna - circuit short to ground	<ul style="list-style-type: none"> One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check interior front cabin antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B10C9-12	Interior Front Antenna - circuit short to battery	<ul style="list-style-type: none"> One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check interior front cabin antenna circuit for short to power. Clear the diagnostic trouble code and retest
B10C9-13	Interior Front Antenna - circuit open	<ul style="list-style-type: none"> One or both antenna wires open 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check interior front cabin antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B10C9-1C	Interior Front Antenna - circuit voltage out of range	<ul style="list-style-type: none"> Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CA-00	Left rear door handle Antenna - no sub type information	<ul style="list-style-type: none"> Antenna failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check left rear door handle antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new left rear door handle antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CA-11	Left rear door handle Antenna - circuit short to ground	<ul style="list-style-type: none"> One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check left rear door handle antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B10CA-12	Left rear door handle Antenna - circuit short to battery	<ul style="list-style-type: none"> One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check left rear door handle antenna circuit for short to power. Clear the diagnostic trouble code and retest
B10CA-13	Left rear door handle Antenna - circuit open	<ul style="list-style-type: none"> One or both antenna wires open 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check left rear door handle antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B10CA-1C	Left rear door handle Antenna - circuit voltage out of range	<ul style="list-style-type: none"> Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CB-00	Right rear door handle Antenna - no sub type information	<ul style="list-style-type: none"> Antenna failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check right rear door handle antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new right rear door handle antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CB-11	Right rear door handle Antenna - circuit short to ground	<ul style="list-style-type: none"> One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check right rear door handle antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B10CB-12	Right rear door handle Antenna - circuit short to battery	<ul style="list-style-type: none"> One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check right rear door handle antenna circuit for short to power. Clear the diagnostic trouble code and retest
B10CB-13	Right rear door handle Antenna - circuit open	<ul style="list-style-type: none"> One or both antenna wires open 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check right rear door handle antenna circuit for open circuit. Clear the diagnostic trouble code and retest

DTC	Description	Possible Causes	Action
B10CB-1C	Right rear door handle Antenna - circuit voltage out of range	<ul style="list-style-type: none"> ● Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> ● Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CC-24	Left Front Latch Clutch Switch - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CD-24	Left Rear Latch Clutch Switch - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CE-24	Right Front Latch Clutch Switch - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B10CF-24	Right Rear Latch Clutch Switch - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B10D1-24	Left Front Lock Button - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B10D2-24	Left Rear Lock Button - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B10D3-24	Right Front Lock Button - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B10D4-24	Right Rear Lock Button - signal stuck ON	<ul style="list-style-type: none"> ● Short to ground on switch circuit ● Switch fault 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground, if no wiring harness fault suspect switch. Refer to the warranty policy and procedures manual if a module/component is suspect
B12D5-00	Door Handle Proximity Sensor - no sub type information	<ul style="list-style-type: none"> ● Short to ground at door handle switch supply circuit 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the circuit for short to ground. Repair wiring as required, if no wiring harness fault suspect keyless vehicle module. Refer to the warranty policy and procedures manual if a module/component is suspect
B12D6-00	Fast Door Unlock/Open Actuator - no sub type information	<ul style="list-style-type: none"> ● E latch circuit failure 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and check E latch relay output circuits for short to power or ground, if no wiring harness fault suspect keyless vehicle module. Refer to the warranty policy and procedures manual if a module/component is suspect
B12EA-96	Radio Frequency (RF) Receiver - component internal failure	<ul style="list-style-type: none"> ● RF receiver has an internal HW failure 	<ul style="list-style-type: none"> ● Renew the receiver
B1335-00	Front Triangulation / Loadspace Antenna - No sub type information	<ul style="list-style-type: none"> ● Antenna failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check center console front antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new center console front antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1335-11	Front Triangulation / Loadspace Antenna - circuit short to ground	<ul style="list-style-type: none"> ● One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check center console front antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B1335-12	Front Triangulation / Loadspace Antenna - circuit short to battery	<ul style="list-style-type: none"> ● One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check center console front antenna circuit for short to power. Clear the diagnostic trouble code and retest
B1335-13	Front Triangulation / Loadspace Antenna - circuit open	<ul style="list-style-type: none"> ● One or both antenna wires open 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check center console front antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B1335-1C	Front Triangulation / Loadspace Antenna - circuit voltage out of range	<ul style="list-style-type: none"> ● Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> ● Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect

DTC	Description	Possible Causes	Action
B1336-00	Left Front Door External Antenna - No sub type information	<ul style="list-style-type: none"> ● Antenna failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check left front door handle antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new left front door handle antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1336-11	Left Front Door External Antenna - circuit short to ground	<ul style="list-style-type: none"> ● One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check left front door handle antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B1336-12	Left Front Door External Antenna - circuit short to battery	<ul style="list-style-type: none"> ● One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check left front door handle antenna circuit for short to power. Clear the diagnostic trouble code and retest
B1336-13	Left Front Door External Antenna - circuit open	<ul style="list-style-type: none"> ● One or both antenna wires open 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check left front door handle antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B1336-1C	Left Front Door External Antenna - circuit voltage out of range	<ul style="list-style-type: none"> ● Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> ● Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1337-00	Right Front Door External Antenna - No sub type information	<ul style="list-style-type: none"> ● Antenna failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check right front door handle antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new right front door handle antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B1337-11	Right Front Door External Antenna - circuit short to ground	<ul style="list-style-type: none"> ● One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check right front door handle antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B1337-12	Right Front Door External Antenna - circuit short to battery	<ul style="list-style-type: none"> ● One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check right front door handle antenna circuit for short to power. Clear the diagnostic trouble code and retest
B1337-13	Right Front Door External Antenna - circuit open	<ul style="list-style-type: none"> ● One or both antenna wires open 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check right front door handle antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B1337-1C	Right Front Door External Antenna - circuit voltage out of range	<ul style="list-style-type: none"> ● Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> ● Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B133D-00	Loadspace/Interior Boot Antenna - No sub type information	<ul style="list-style-type: none"> ● Antenna failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check loadspace LHS antenna circuit for short to ground, short to power. Clear the diagnostic trouble code and retest. If the problem persists, check and install new right front door handle antenna as required. Refer to the warranty policy and procedures manual if a module/component is suspect
B133D-11	Loadspace/Interior Boot Antenna - circuit short to ground	<ul style="list-style-type: none"> ● One or both antenna wires shorted to ground or shorted to each other 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check loadspace LHS antenna circuit for short to ground, short to each other. Clear the diagnostic trouble code and retest
B133D-12	Loadspace/Interior Boot Antenna - circuit short to battery	<ul style="list-style-type: none"> ● One or both antenna wires shorted to battery 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check loadspace LHS antenna circuit for short to power. Clear the diagnostic trouble code and retest
B133D-13	Loadspace/Interior Boot Antenna - circuit open	<ul style="list-style-type: none"> ● One or both antenna wires open 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check loadspace LHS antenna circuit for open circuit. Clear the diagnostic trouble code and retest
B133D-1C	Loadspace/Interior Boot Antenna - circuit voltage out of range	<ul style="list-style-type: none"> ● Fault with voltage supply to all antenna drivers 	<ul style="list-style-type: none"> ● Check and install new keyless vehicle module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
U0010-00	Medium Speed CAN Communication Bus - no sub type information	<ul style="list-style-type: none"> ● CAN communication failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network. Clear the diagnostic trouble code and retest. If the problem persists, check and install new keyless vehicle module as required. Refer to the warranty

DTC	Description	Possible Causes	Action
			policy and procedures manual if a module/component is suspect
U0140-00	Lost Communication With Body Control Module - no sub type information	<ul style="list-style-type: none"> CAN connection open or fault in body control module 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the central junction box and keyless vehicle module. Clear the diagnostic trouble code and retest. If the problem persists, check and install new body control module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
U0300-00	Internal Control Module Software Incompatibility - no sub type information	<ul style="list-style-type: none"> Signal configuration file not loaded 	<ul style="list-style-type: none"> Using the manufacturer approved diagnostic system check and up-date the car configuration file as required. Clear the diagnostic trouble code and re-test
U201F-00	External Receiver - no sub type information	<ul style="list-style-type: none"> Communication to the RF receiver module has been lost, short either to ground, or battery 	<ul style="list-style-type: none"> Check K-Line wiring. Refer to the electrical circuit diagrams and check the module K-Line, power and ground circuits. Clear the diagnostic trouble code and retest. If the problem persists, check and install new keyless vehicle module or RF receive module as required. Refer to the warranty policy and procedures manual if a module/component is suspect
U201F-31	External Receiver - No signal	<ul style="list-style-type: none"> Communication to the RF receiver module has been lost 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check remote keyless entry module circuit for short to power, open circuit, high resistance Check and install a new RF receiver module or keyless vehicle module as required
U201F-95	External Receiver - incorrect assembly	<ul style="list-style-type: none"> The RF receiver frequency does not match the car config file parameter 	<ul style="list-style-type: none"> Verify car config value for RF frequency is correct. If not, re-configure body control module with proper car configuration file. If correct, replace RF receiver with proper frequency unit.
U2100-00	Initial Configuration Not Complete - no sub type information	<ul style="list-style-type: none"> Calibration file has not been received or is incomplete 	<ul style="list-style-type: none"> Reload the correct calibration file for the vehicle type into the module using the manufacturer approved diagnostic system
U2101-00	Control Module Configuration Incompatible - no sub type information	<ul style="list-style-type: none"> Car configuration parameter is outside expected value 	<ul style="list-style-type: none"> Verify car config value sent by body control module is correct for the vehicle. If not, re-configure body control module with proper car configuration file. If correct, reload the correct calibration file for the vehicle type into the module using the manufacturer approved diagnostic system
U3000-49	Control Module - internal electronic failure	<ul style="list-style-type: none"> Internal electronic failure 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power and ground circuits to the module. Refer to the warranty policy and procedures manual if a module is suspect
U3002-81	Vehicle Identification Number - invalid serial data received	<ul style="list-style-type: none"> Invalid vehicle identification number 	<ul style="list-style-type: none"> Configure the car configuration file using the manufacturer approved diagnostic system

General Information - Diagnostic Trouble Code (DTC) Index DTC: Restraints Control Module (RCM)

Description and Operation

Restraints control module (RCM)



WARNING: TO AVOID ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY, THE BACKUP POWER SUPPLY MUST BE DEPLETED BEFORE REPAIRING OR REPLACING ANY AIR BAG SUPPLEMENTAL RESTRAINT SYSTEM (SRS) COMPONENTS. TO DEplete THE BACKUP POWER SUPPLY ENERGY, DISCONNECT THE BATTERY GROUND CABLE AND WAIT ONE MINUTE. FAILURE TO FOLLOW THIS INSTRUCTION MAY RESULT IN PERSONAL INJURY.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- NOTE: Given the legal implications of a restraints system failure, harness repairs to Air Bag module circuits are not acceptable. Where the text refers to "REPAIR the circuit", this will normally mean the replacement of a harness.
- NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.
- NOTE: When performing electrical voltage or resistance checks, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When checking resistance, always take the resistance of the DMM leads into account.
- NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint checks.
- NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.
- NOTE: If DTCs are recorded and, after performing the pinpoint checks, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Restraints control module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Air Bag Supplemental Restraint System \(SRS\)](#) (501-20B Supplemental Restraint System, Diagnosis and Testing).

DTC	Description	Possible Cause	Action
B0001-11	Driver Frontal Stage 1 Deployment Control - circuit short to ground	<ul style="list-style-type: none"> • Driver Airbag Ignitor (Stage 1) circuit short to ground 	<ul style="list-style-type: none"> • Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 1) circuit for short to ground • Check for intermittent shorts to ground within the clockspring by rotating the steering column during the checks
B0001-12	Driver Frontal Stage 1 Deployment Control - circuit short to battery	<ul style="list-style-type: none"> • Driver Airbag Ignitor (Stage 1) circuit short to power 	<ul style="list-style-type: none"> • Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 1) circuit for short to power • Check for intermittent shorts to power within the clockspring by rotating the steering column during the checks
B0001-1A	Driver Frontal Stage 1 Deployment Control - circuit resistance below threshold	<ul style="list-style-type: none"> • Driver Airbag Ignitor (Stage 1) circuit resistance below threshold 	<ul style="list-style-type: none"> • Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 1) circuit for short circuit (Check connector security at clockspring and airbag) • Check for intermittent short circuits within the clockspring by rotating the steering column during the checks
B0001-1B	Driver Frontal Stage 1 Deployment Control - circuit resistance above threshold	<ul style="list-style-type: none"> • Driver Airbag Ignitor (Stage 1) high circuit resistance 	<ul style="list-style-type: none"> • Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 1) circuit for high resistance or open circuit • Check for intermittent open circuit, high resistance faults within the clockspring by rotating the steering column during the checks
B0001-64	Driver Frontal Stage 1 Deployment Control - signal plausibility failure	<ul style="list-style-type: none"> • Driver Airbag Ignitor (Stage 1) signal plausibility failure 	<ul style="list-style-type: none"> • Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0001-95	Driver Frontal Stage 1 Deployment Control - incorrect assembly	<ul style="list-style-type: none"> • Driver Airbag Ignitor (Stage 1) Incorrect assembly. Short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> • Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 1) circuit for faults • Check for intermittent short circuits within the clockspring by rotating the steering column during the checks

DTC	Description	Possible Cause	Action
B0002-11	Driver Frontal Stage 2 Deployment Control - circuit short to ground	<ul style="list-style-type: none"> Driver Airbag Ignitor (Stage 2) circuit short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Driver Airbag Ignitor (Stage 2) circuit for short to ground Check for intermittent shorts to ground within the clockspring by rotating the steering column during the checks
B0002-12	Driver Frontal Stage 2 Deployment Control - circuit short to battery	<ul style="list-style-type: none"> Driver Airbag Ignitor (Stage 2) circuit short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Driver Airbag Ignitor (Stage 2) circuit for short to power Check for intermittent shorts to power within the clockspring by rotating the steering column during the checks
B0002-1A	Driver Frontal Stage 2 Deployment Control - circuit resistance below threshold	<ul style="list-style-type: none"> Driver Airbag Ignitor (Stage 2) circuit resistance below threshold 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 2) circuit for short circuit (Check connector security at clockspring and airbag) Check for intermittent short circuits within the clockspring by rotating the steering column during the checks
B0002-1B	Driver Frontal Stage 2 Deployment Control - circuit resistance above threshold	<ul style="list-style-type: none"> Driver Airbag Ignitor (Stage 2) high circuit resistance 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 2) circuit for high resistance or open circuit Check for intermittent open circuit, high resistance faults within the clockspring by rotating the steering column during the checks
B0002-64	Driver Frontal Stage 2 Deployment Control - signal plausibility failure	<ul style="list-style-type: none"> Driver Airbag Ignitor (Stage 2) signal plausibility failure 	<ul style="list-style-type: none"> Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0002-95	Driver Frontal Stage 2 Deployment Control - incorrect assembly	<ul style="list-style-type: none"> Driver Airbag Ignitor (Stage 2) Incorrect assembly. Short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Driver Airbag Ignitor (Stage 2) circuit for faults Check for intermittent short circuits within the clockspring by rotating the steering column during the checks
B0010-11	Passenger Frontal Stage 1 Deployment Control - circuit short to ground	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 1) circuit short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 1) circuit for short to ground
B0010-12	Passenger Frontal Stage 1 Deployment Control - circuit short to battery	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 1) circuit short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 1) circuit for short to power
B0010-1A	Passenger Frontal Stage 1 Deployment Control - circuit resistance below threshold	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 1) circuit resistance below threshold 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 1) circuit for short circuit (Check connectors for security)
B0010-1B	Passenger Frontal Stage 1 Deployment Control - circuit resistance above threshold	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 1) high circuit resistance 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 1) circuit for high resistance or open circuit
B0010-64	Passenger Frontal Stage 1 Deployment Control - signal plausibility failure	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 1) signal plausibility failure 	<ul style="list-style-type: none"> Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0010-95	Passenger Frontal Stage 1 Deployment Control - incorrect assembly	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 1) Incorrect assembly. Short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 1) circuit for faults
B0011-11	Passenger Frontal Stage 2 Deployment Control - circuit short to ground	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 2) circuit short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 2) circuit for short to ground
B0011-12	Passenger Frontal Stage 2 Deployment Control - circuit short to battery	<ul style="list-style-type: none"> Front Passenger Airbag Ignitor (Stage 2) circuit short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 2) circuit for short to power

DTC	Description	Possible Cause	Action
B0011-1A	Passenger Frontal Stage 2 Deployment Control - circuit resistance below threshold	<ul style="list-style-type: none"> ● Front Passenger Airbag Ignitor (Stage 2) circuit resistance below threshold 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 2) circuit for short circuit (Check connectors for security)
B0011-1B	Passenger Frontal Stage 2 Deployment Control - circuit resistance above threshold	<ul style="list-style-type: none"> ● Front Passenger Airbag Ignitor (Stage 2) high circuit resistance 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 2) circuit for high resistance or open circuit
B0011-64	Passenger Frontal Stage 2 Deployment Control - signal plausibility failure	<ul style="list-style-type: none"> ● Front Passenger Airbag Ignitor (Stage 2) signal plausibility failure 	<ul style="list-style-type: none"> ● Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0011-95	Passenger Frontal Stage 2 Deployment Control - incorrect assembly	<ul style="list-style-type: none"> ● Front Passenger Airbag Ignitor (Stage 2) Incorrect assembly short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Front Passenger Airbag Ignitor (Stage 2) circuit for faults
B0020-11	Left Side Air Bag Deployment Control - circuit short to ground	<ul style="list-style-type: none"> ● Left Side Airbag Ignitor circuit short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test Driver (LHD) / Passenger (RHD) Side Airbag Ignitor circuit for short to ground
B0020-12	Left Side Air Bag Deployment Control - circuit short to battery	<ul style="list-style-type: none"> ● Left Side Airbag Ignitor circuit short to power 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test Driver (LHD) / Passenger (RHD) Side Airbag Ignitor circuit for short to power
B0020-1A	Left Side Air Bag Deployment Control - circuit resistance below threshold	<ul style="list-style-type: none"> ● Left Side Airbag Ignitor circuit resistance below threshold 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Driver (LHD) / Passenger (RHD) Side Airbag Ignitor circuit for short circuit (Check connectors for security)
B0020-1B	Left Side Air Bag Deployment Control - circuit resistance above threshold	<ul style="list-style-type: none"> ● Left Side Airbag Ignitor high circuit resistance 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Driver (LHD) / Passenger (RHD) Side Airbag Ignitor circuit for high resistance or open circuit
B0020-64	Left Side Air Bag Deployment Control - signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	<ul style="list-style-type: none"> ● Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0020-95	Left Side Airbag Deployment Control - incorrect assembly	<ul style="list-style-type: none"> ● Incorrect assembly - short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Driver (LHD) / Passenger (RHD) Side Airbag Ignitor circuit for faults
B0021-11	Left Curtain Deployment Control 1 - circuit short to ground	<ul style="list-style-type: none"> ● Left hand Curtain Ignitor circuit short to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test Left Side Curtain Ignitor circuit for short to ground
B0021-12	Left Curtain Deployment Control 1 - circuit short to battery	<ul style="list-style-type: none"> ● Left hand Curtain Ignitor circuit short to power 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and test Left Side Curtain Ignitor circuit for short to power
B0021-1A	Left Curtain Deployment Control 1 - circuit resistance below threshold	<ul style="list-style-type: none"> ● Left hand Curtain Ignitor circuit resistance below threshold 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Left Side Curtain Ignitor circuit for short circuit (Check connectors for security)
B0021-1B	Left Curtain Deployment Control 1 - circuit resistance above threshold	<ul style="list-style-type: none"> ● Left hand Curtain Ignitor high circuit resistance, open circuit 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Left Side Curtain Ignitor circuit for high resistance or open circuit
B0021-64	Left Curtain Deployment Control 1 - signal plausibility failure	<ul style="list-style-type: none"> ● Left hand Curtain Ignitor configuration error 	<ul style="list-style-type: none"> ● Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0021-95	Left Curtain Deployment Control 1 - incorrect assembly	<ul style="list-style-type: none"> ● Incorrect assembly - short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> ● Refer to electrical circuit diagrams and test Left Side Curtain Ignitor circuit for faults

DTC	Description	Possible Cause	Action
B0022-11	Left Curtain Deployment Control 2 - circuit short to ground	<ul style="list-style-type: none"> Left hand Curtain Ignitor circuit short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Left Side Curtain (Row 3) Ignitor circuit for short to ground
B0022-12	Left Curtain Deployment Control 2 - circuit short to battery	<ul style="list-style-type: none"> Left hand Curtain Ignitor circuit short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Left Side Curtain (Row 3) Ignitor circuit for short to power
B0022-1A	Left Curtain Deployment Control 2 - circuit resistance below threshold	<ul style="list-style-type: none"> Left hand Curtain Ignitor circuit resistance below threshold 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Left Side Curtain (Row 3) Ignitor circuit for short circuit (Check connectors for security)
B0022-1B	Left Curtain Deployment Control 2 - circuit resistance above threshold	<ul style="list-style-type: none"> Left hand Curtain Ignitor high circuit resistance, open circuit 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Left Side Curtain (Row 3) Ignitor circuit for high resistance or open circuit
B0022-64	Left Curtain Deployment Control 2 - signal plausibility failure	<ul style="list-style-type: none"> Left hand Curtain Ignitor configuration error 	<ul style="list-style-type: none"> Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0022-95	Left Curtain Deployment Control 2 - incorrect assembly	<ul style="list-style-type: none"> Incorrect assembly - short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Left Side Curtain (Row 3) Ignitor circuit for faults
B0028-11	Right Side Air Bag Deployment Control - circuit short to ground	<ul style="list-style-type: none"> Right side air bag circuit - short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Right Side Airbag Ignitor circuit for short to ground
B0028-12	Right Side Air Bag Deployment Control - circuit short to battery	<ul style="list-style-type: none"> Right side air bag circuit - short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and test Right Side Airbag Ignitor circuit for short to power
B0028-1A	Right Side Air Bag Deployment Control - circuit resistance below threshold	<ul style="list-style-type: none"> Circuit resistance below threshold 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Right Side Airbag Ignitor circuit for short circuit (Check connectors for security)
B0028-1B	Right Side Air Bag Deployment Control - circuit resistance above threshold	<ul style="list-style-type: none"> High Circuit Resistance 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Right Side Airbag Ignitor circuit for high resistance or open circuit
B0028-64	Right Side Air Bag Deployment Control - signal plausibility failure	<ul style="list-style-type: none"> Signal plausibility failure 	<ul style="list-style-type: none"> Configuration error- This output has been switched off but the Airbag is actually installed. Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0028-95	Right Side Airbag Deployment Control - incorrect assembly	<ul style="list-style-type: none"> Incorrect assembly - short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and test Right Side Airbag Ignitor circuit for faults
B0029-11	Right Curtain Deployment Control 1 - circuit short to ground	<ul style="list-style-type: none"> Right Curtain Ignitor circuit short to ground 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check Right Curtain Ignitor circuit for short to ground
B0029-12	Right Curtain Deployment Control 1 - circuit short to battery	<ul style="list-style-type: none"> Right Curtain Ignitor circuit short to power 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check Right Curtain Ignitor circuit for short to power
B0029-1A	Right Curtain Deployment Control 1 - circuit resistance below threshold	<ul style="list-style-type: none"> Right Curtain Ignitor circuit resistance below threshold 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and check Right Curtain Ignitor circuit for short circuit (Check connectors for security)
B0029-1B	Right Curtain Deployment Control 1 - circuit resistance above threshold	<ul style="list-style-type: none"> Right Curtain Ignitor high circuit resistance 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and check Right Curtain Ignitor circuit for high resistance or open circuit
B0029-64	Right Curtain Deployment Control 1 - signal plausibility failure	<ul style="list-style-type: none"> Right Curtain Ignitor configuration error 	<ul style="list-style-type: none"> Re-configure the Restraints control module using the manufacturer approved diagnostic system
B0029-95	Right Curtain Deployment Control 1 - incorrect assembly	<ul style="list-style-type: none"> Incorrect assembly - short circuit between two different circuits (at least two faults) 	<ul style="list-style-type: none"> Refer to electrical circuit diagrams and check Right Curtain Ignitor circuit for faults

General Information - Diagnostic Trouble Code (DTC) Index DTC: Satellite Digital Audio Radio System Module (SARM)

Description and Operation

Satellite Digital Audio Radio System Module (SARM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Satellite Radio Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Audio System](#) (415-01A Audio Unit, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1A89-11	Satellite Antenna - Circuit short to ground	<ul style="list-style-type: none"> ● Circuit short to power. The Satellite Digital Audio Radio Module has detected a vehicle power measurement for a period longer than expected, or has detected a vehicle power measurement when another value was expected ● Satellite Digital Audio Radio antenna cable short to ground ● Internal failure Satellite Digital Audio Radio Module ● Internal failure Satellite Digital Audio Radio antenna 	Refer to the electrical circuit diagrams and check Satellite Digital Audio Radio antenna cable for short to ground. Install Satellite Digital Audio Radio antenna harness as required. Suspect the Satellite Digital Audio Radio Module, check and install a new Satellite Digital Audio Radio Module as required. Suspect the Satellite Digital Audio Radio antenna, check and install a new Satellite Digital Audio Radio antenna as required. Refer to the warranty policy and procedures manual if a Module is suspect
B1A89-12	Satellite Antenna - Circuit short to battery	<ul style="list-style-type: none"> ● Circuit short to power. The Satellite Digital Audio Radio Module has detected a vehicle power measurement for a period longer than expected, or has detected a vehicle power measurement when another value was expected ● Satellite Digital Audio Radio antenna cable short to power ● Internal failure Satellite Digital Audio Radio Module ● Internal failure Satellite Digital Audio Radio antenna 	Refer to the electrical circuit diagrams and check Satellite Digital Audio Radio antenna cable for short to power. Install Satellite Digital Audio Radio antenna harness as required. Suspect the Satellite Digital Audio Radio Module, check and install a new Satellite Digital Audio Radio Module as required. Suspect the Satellite Digital Audio Radio antenna, check and install a new Satellite Digital Audio Radio antenna as required. Refer to the warranty policy and procedures manual if a module is suspect
B1A89-13	Satellite Antenna - Circuit open	<ul style="list-style-type: none"> ● Circuit open. The Satellite Digital Audio Radio Module has determined an open circuit via lack of bias voltage, low current flow, no change in the state of an input in response to an output ● Satellite Digital Audio Radio antenna cable open circuit ● Internal failure Satellite Digital Audio Radio Module ● Internal failure Satellite Digital Audio Radio antenna 	Refer to the electrical circuit diagrams and check Satellite Digital Audio Radio antenna cable for open circuit. Install Satellite Digital Audio Radio antenna harness as required. Suspect the Satellite Digital Audio Radio Module, check and install a new Satellite Digital Audio Radio Module as required. Suspect the Satellite Digital Audio Radio antenna, check and install a new Satellite Digital Audio Radio antenna as required. Refer to the warranty policy and procedures manual if a module is suspect
U3000-04	Control Module - System internal failures	<ul style="list-style-type: none"> ● Satellite Digital Audio Radio Module internal failure 	Suspect the Satellite Digital Audio Radio Module, check and install a new Satellite Digital Audio Radio Module as required, Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
U3000-4A	Control Module - Incorrect component installed	<ul style="list-style-type: none"> ● Satellite Digital Audio Radio Module. Incorrect component installed ● Car configuration mismatch 	Using the manufacturer approved diagnostic system select the vehicle configuration Main Menu, vehicle configuration, display and or modify the vehicle configuration file data. Check update as required
U3000-55	Control Module - Not configured	<ul style="list-style-type: none"> ● Satellite Digital Audio Radio Module, not configured ● Incorrect car configuration file data received 	Using the manufacturer approved diagnostic system select the vehicle configuration main menu, select configure existing Modules menu and program the Satellite Digital Audio Radio Module

General Information - Diagnostic Trouble Code (DTC) Index DTC: Steering Angle Sensor Module (SASM)

Description and Operation

Steering Angle Sensor Module (SASM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Steering Angle Sensor Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Steering System](#) (211-00 Steering System - General Information, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
C0051-04	Steering Wheel Position Sensor - System Internal Failures	<ul style="list-style-type: none"> System internal failure Harness/connector issue 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the steering angle sensor connector and circuits. Check the sensor calibration using the approved diagnostic/calibration system before renewing the sensor
C0051-62	Steering Wheel Position Sensor - Signal compare failure	<ul style="list-style-type: none"> Signal compare failure Harness/connector issue 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the steering angle sensor connector and circuits. Check the sensor calibration using the approved diagnostic/calibration system
C0051-64	Steering Wheel Position Sensor - Signal plausibility failure	<ul style="list-style-type: none"> Signal plausibility failure Harness/connector issue 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the steering angle sensor, connector and circuits. Check the sensor calibration using the approved diagnostic/calibration system
U0001-88	High Speed CAN Communication Bus - Bus Off	<ul style="list-style-type: none"> Bus off 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0122-00	Lost Communication With Vehicle Dynamics Control Module - No sub type information	<ul style="list-style-type: none"> Lost Communication 	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check power and ground supplies to Anti-lock Braking System Module. Check CAN Network between Steering Angle Sensor Module and Anti-lock Braking System Module. Alternatively, using the manufacturer approved diagnostic system, carry out CAN Network Integrity Test
U0140-55	Lost Communication With Body Control Module - not configured	<ul style="list-style-type: none"> Lost Communication 	<ul style="list-style-type: none"> Configure the modules using the approved diagnostic/calibration system. Refer to the Network Communications section of the workshop manual
U0300-55	Internal Control Module Software Incompatibility - not configured	<ul style="list-style-type: none"> Connector or connection failure CAN hardware failure CAN configuration failure- The module has failed to recognize the correct Master Configuration ID <ul style="list-style-type: none"> - Indicates that an internal software mismatch has occurred which could be due to problems with software download 	<ul style="list-style-type: none"> Configure the modules using the approved diagnostic/calibration system. Refer to the Network Communications section of the workshop manual

DTC	Description	Possible Causes	Action
		between the Master and the rest of network nodes	
U1A14-49	CAN Initialization failure- internal electronic failure	<ul style="list-style-type: none"> ● Steering angle sensor module internal CAN controller failure 	<ul style="list-style-type: none"> ● Renew the steering angle sensor module. Refer to the warranty policy and procedures manual if a module is suspect
U3002-62	Vehicle Identification Number - Signal compare failure	<ul style="list-style-type: none"> ● Mismatch between received VIN and stored VIN in steering angle sensor 	<ul style="list-style-type: none"> • NOTE: This DTC will occur if a Steering Angle Sensor Module has been substituted from another vehicle to fix an issue with the original Steering Angle Sensor Module/vehicle ● Clear the diagnostic trouble code and retest. If the problem persists, check and install new Steering Angle Sensor Module as required. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Television Control Module (TVM)

Description and Operation

Television Control Module (TVM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Television Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Video System](#) (415-07 Video System, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B1A00-16	Control Module - Circuit voltage below threshold	<ul style="list-style-type: none"> Control module circuit voltage below threshold: <ul style="list-style-type: none"> - Voltage less than (master control module voltage - 2V) for >10 seconds Battery voltage low Control module circuit High resistance 	Check the battery condition and state of charge. Refer to the relevant section of the workshop manual. Check the module power and ground circuits. Refer to the electrical circuit diagrams
B1A00-17	Control Module - Circuit voltage above threshold	<ul style="list-style-type: none"> Control module circuit voltage above threshold Battery voltage high (overcharging) Control module circuit short circuit to power 	Check the battery condition and state of charge. Refer to the relevant section of the workshop manual. Check the module power and ground circuits. Refer to the electrical circuit diagrams
B1A00-48	Control Module - Supervision software failure	<ul style="list-style-type: none"> Control module supervision software fault 	Where available, configure the module using the approved diagnostic system. Refer to the warranty policy and procedures manual if a module is suspect
B1A00-49	Control Module - Internal electronic failure	<ul style="list-style-type: none"> Control module hardware fault 	Renew the module. Refer to the warranty policy and procedures manual and renew the module
B1A56-11	Antenna - Circuit short to ground	<ul style="list-style-type: none"> Antenna circuit short circuit to ground 	Refer to the electrical circuit diagrams and check the antenna circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A56-12	Antenna - Circuit short to battery	<ul style="list-style-type: none"> Antenna circuit short circuit to power 	Refer to the electrical circuit diagrams and check the antenna circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1A56-13	Antenna - Circuit open	<ul style="list-style-type: none"> Antenna circuit high resistance 	Refer to the electrical circuit diagrams and check the antenna circuit. Where possible, refer to the guided diagnostic routine for this code on the approved diagnostic system
B1D55-11	Antenna #2 - Circuit short to ground	<ul style="list-style-type: none"> Antenna 2 circuit short circuit to ground 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D55-12	Antenna #2 - Circuit short to battery	<ul style="list-style-type: none"> Antenna 2 circuit short circuit to power 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D55-13	Antenna #2 - Circuit open	<ul style="list-style-type: none"> Antenna 2 circuit High resistance 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D56-11	Antenna #3 Circuit - Circuit short to ground	<ul style="list-style-type: none"> Antenna 3 circuit short circuit to ground 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D56-12	Antenna #3 Circuit - Circuit short to battery	<ul style="list-style-type: none"> Antenna 3 circuit short circuit to power 	Check the antenna and circuits. Refer to the electrical circuit diagrams

DTC	Description	Possible Causes	Action
B1D56-13	Antenna #3 Circuit - Circuit open	<ul style="list-style-type: none"> ● Antenna 3 circuit High resistance 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D57-11	Antenna #4 Circuit - Circuit short to ground	<ul style="list-style-type: none"> ● Antenna 4 circuit short circuit to ground 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D57-12	Antenna #4 Circuit - Circuit short to battery	<ul style="list-style-type: none"> ● Antenna 4 circuit short circuit to power 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D57-13	Antenna #4 Circuit - Circuit open	<ul style="list-style-type: none"> ● Antenna 4 circuit High resistance 	Check the antenna and circuits. Refer to the electrical circuit diagrams
B1D58-11	Television Output - Circuit short to ground	<ul style="list-style-type: none"> ● Television output circuit short circuit to ground 	Check the television output circuits. Refer to the electrical circuit diagrams
B1D58-12	Television Output - Circuit short to battery	<ul style="list-style-type: none"> ● Television output circuit short circuit to power 	Check the television output circuits. Refer to the electrical circuit diagrams
B1D58-13	Television Output - Circuit open	<ul style="list-style-type: none"> ● Television output circuit High resistance 	Check the television output circuits. Refer to the electrical circuit diagrams
U1A20-87	Incomplete MOST Ring Reported By TVM - Missing message	<ul style="list-style-type: none"> ● No signal from the TV module (TVM) ● Fibre optic ring break condition reported 	Carry out the general media orientated system transport (MOST) test. Refer to the Network Communications section of the workshop manual and in the approved diagnostic system, where available

General Information - Diagnostic Trouble Code (DTC) Index DTC: Terrain Response Control Module (ATCM)

Description and Operation

Terrain Response Control Module (ATCM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the All Terrain Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section.

For additional information, refer to: [Ride and Handling Optimization](#) (204-06 Ride and Handling Optimization, Diagnosis and Testing).

• **NOTE:** There are references to "power latch" within the DTC index. This is where the module must be reset by means of a complete power down and power up.

DTC	Description	Possible Causes	Action
C1A00-46	Control Module - Calibration/parameter memory failure	<ul style="list-style-type: none"> The Terrain response control module has indicated a calibration/parameter memory failure for embedded systems using FLASH memory. This is equivalent to EEPROM in RAM/ROM/EEPROM embedded systems Corruption in the non-volatile memory storage system (EEPROM) in the Terrain response control module 	Rectify this DTC before attempting to rectify others. Record all DTCs logged and clear them. With ignition on select a terrain response special program, turn off the ignition, then turn back on the ignition and verify the selected special program is still active. If the selected terrain response special program is still not active and has returned to the general program, confirm if DTC has returned. Repeat procedure again once more. If DTC is still present install a new terrain response rotary control switch and control module. Refer to the warranty policy and procedures manual if a module is suspect
C1A01-96	LED - Component internal failure	<ul style="list-style-type: none"> LED circuit short circuit to ground or open circuit 	<p>• NOTE: If the system is in 'failsafe default mode due to another issue no LEDs will illuminate. This fault does not cause the system to go to 'failsafe default'.</p> <p>Refer to the Description and Operation section of workshop manual. Check terrain response system, special program LEDs. One or more of the LEDs is suspected of not illuminating as appropriate. With the engine running move the terrain response rotary control switch through all five programmes and confirm the appropriate special program LED does not illuminate when the terrain response rotary control switch is in that position. Suspect the terrain response rotary control switch and control module, check and install a new terrain response rotary control switch and control module as required. Refer to the warranty policy and procedures manual if a module is suspect</p>
C1A02-94	Rotary Encoder Stuck In Intermediate Position - Unexpected operation	<ul style="list-style-type: none"> The terrain response rotary control switch is held in an intermediate position (between the special programmes) for more than 60 seconds Foreign object preventing correct operation of terrain response rotary control switch Mechanical damage to the terrain response rotary control switch 	<p>• NOTE: Suspect driver error do not replace the terrain response rotary control at this time</p> <p>Check for foreign object preventing correct operation of terrain response rotary control. Start the vehicle engine, rotate the terrain response rotary control until it has located a genuine detent, wait 60 seconds. Stop the vehicle engine, clear the DTC and retest</p>

DTC	Description	Possible Causes	Action
U0001-88	High Speed CAN Communication Bus Off - Bus off	<ul style="list-style-type: none"> ● Bus off. The Terrain response control module has detected the data bus is not available ● CAN bus short circuit to ground, power or open circuit ● Failure of another control module on the CAN bus 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0100-00	Lost Communication With The ECM/PCM 'A' - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has not received one or more expected messages from the Engine Control Module ● Engine Control Module power circuit open circuit ● Engine Control Module ground circuit open circuit ● High speed CAN circuit communications failure ● Engine Control Module disconnected from the high speed CAN communication bus ● Engine Control Module disconnected from the high speed CAN communication bus ● Engine Control Module high speed CAN Low circuit open circuit ● Engine Control Module not configured ● Engine Control Module failure 	Using the manufacturer approved diagnostic system, check the Engine Control Module for DTCs and refer to the relevant DTC index. Using the manufacturer approved diagnostic system, carry out network integrity test. Using the manufacturer approved diagnostic system, re-configure the Engine Control Module. Refer to electrical circuit diagrams check the power and ground connections to Engine Control Module. Check the high speed CAN low and CAN high circuits, repair as necessary. Clear the DTC and retest. If the problem persists, suspect the Engine Control Module. Refer to the warranty policy and procedures manual if a module is suspect. Check the system is operating correctly and the DTC does not return
U0101-00	Lost Communication With The TCM - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has not received one or more expected messages from the Transmission Control Module ● High speed CAN circuit communications failure ● Transmission Control Module power circuit open circuit ● Transmission Control Module ground circuit open circuit ● Transmission Control Module disconnected from the high speed CAN communication bus ● Transmission Control Module disconnected from the high speed CAN communication bus ● Transmission Control Module high speed CAN Low circuit open circuit ● Transmission Control Module not configured ● Transmission Control Module failure 	Using the manufacturer approved diagnostic system, check the Transmission Control Module for DTCs and refer to the relevant DTC index. Using the manufacturer approved diagnostic system, carry out network integrity test. Using the manufacturer approved diagnostic system, re-configure the Transmission Control Module. Refer to electrical circuit diagrams check the power and ground connections to Transmission Control Module. Check the high speed CAN low and CAN high circuits, repair as necessary. Clear the DTC and retest. If the problem persists, suspect the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect. Check the system is operating correctly and the DTC does not return
U0102-00	Lost Communication With The Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has not received one or more expected messages from the Transfer Case Control Module ● High speed CAN circuit communications failure ● Transfer Case Control Module power circuit open circuit ● Transfer Case Control Module ground circuit open circuit ● Transfer Case Control Module disconnected from the high speed CAN communication bus ● Transfer Case Control Module high speed CAN Low circuit open circuit ● Transfer Case Control Module high speed CAN High circuit open circuit ● Transfer Case Control Module not configured 	Using the manufacturer approved diagnostic system, check the Transfer Case Control Module for DTCs and refer to the relevant DTC index. Using the manufacturer approved diagnostic system, carry out network integrity test. Using the manufacturer approved diagnostic system, re-configure the Transfer Case Control Module. Refer to electrical circuit diagrams check the power and ground connections to Transfer Case Control Module. Check the high speed CAN low and CAN high circuits, repair as necessary. Clear the DTC and retest. If the problem persists, suspect the Transfer Case Control Module. Refer to the warranty policy and procedures manual if a module is suspect. Check the system is operating correctly and the DTC does not return

DTC	Description	Possible Causes	Action
U0121-00	Lost Communication With Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> ● Transfer Case Control Module failure 	<p>Using the manufacturer approved diagnostic system, check the ABS Control Module for DTCs and refer to the relevant DTC index. Using the manufacturer approved diagnostic system, carry out network integrity test. Using the manufacturer approved diagnostic system, re-configure the ABS Control Module. Refer to electrical circuit diagrams check the power and ground connections to ABS Control Module. Check the high speed CAN low and CAN high circuits, repair as necessary. Clear the DTC and retest. If the problem persists, suspect the ABS Control Module. Refer to the warranty policy and procedures manual if a module is suspect. Check the system is operating correctly and the DTC does not return</p>
U0132-00	Lost Communication With Suspension Control Module 'A' - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has not received one or more expected messages from the Suspension Control Module (Ride Level Module) ● High speed CAN circuit communications failure ● Suspension Control Module power circuit open circuit ● Suspension Control Module ground circuit open circuit ● Suspension Control Module disconnected from the high speed CAN communication bus ● Suspension Control Module high speed CAN Low circuit open circuit ● Suspension Control Module high speed CAN High circuit open circuit ● Suspension Control Module not configured ● Suspension Control Module failure 	<p>Using the manufacturer approved diagnostic system, check the Suspension Control Module for DTCs and refer to the relevant DTC index. Using the manufacturer approved diagnostic system, carry out network integrity test. Using the manufacturer approved diagnostic system, re-configure the Suspension Control Module. Refer to electrical circuit diagrams check the power and ground connections to Suspension Control Module. Check the high speed CAN low and CAN high circuits, repair as necessary. Clear the DTC and retest. If the problem persists, suspect the Suspension Control Module. Refer to the warranty policy and procedures manual if a module is suspect. Check the system is operating correctly and the DTC does not return</p>
U0139-00	Lost Communication With Suspension Control Module 'B' - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has not received one or more expected messages from the Suspension Control Module (Continuously Variable Dampening) ● High speed CAN circuit communications failure ● Suspension Control Module power circuit open circuit ● Suspension Control Module ground circuit open circuit ● Suspension Control Module disconnected from the high speed CAN communication bus ● Suspension Control Module high speed CAN Low circuit open circuit ● Suspension Control Module high speed CAN High circuit open circuit ● Suspension Control Module not configured ● Suspension Control Module failure 	<p>Using the manufacturer approved diagnostic system, check the Suspension Control Module for DTCs and refer to the relevant DTC index. Using the manufacturer approved diagnostic system, carry out network integrity test. Using the manufacturer approved diagnostic system, re-configure the Suspension Control Module. Refer to electrical circuit diagrams check the power and ground connections to Suspension Control Module. Check the high speed CAN low and CAN high circuits, repair as necessary. Clear the DTC and retest. If the problem persists, suspect the Suspension Control Module. Refer to the warranty policy and procedures manual if a module is suspect. Check the system is operating correctly and the DTC does not return</p>

DTC	Description	Possible Causes	Action
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has not received one or more expected messages from the Central Junction Box ● High speed CAN circuit communications failure ● Central Junction Box power circuit open circuit ● Central Junction Box ground circuit open circuit ● Central Junction Box disconnected from the high speed CAN communication bus ● Central Junction Box high speed CAN Low circuit open circuit ● Central Junction Box high speed CAN High circuit open circuit ● Central Junction Box not configured ● Central Junction Box failure 	Using the manufacturer approved diagnostic system, check the Central Junction Box for DTCs and refer to the relevant DTC index. Using the manufacturer approved diagnostic system, carry out network integrity test. Using the manufacturer approved diagnostic system, re-configure the Central Junction Box. Refer to electrical circuit diagrams check the power and ground connections to Central Junction Box. Check the high speed CAN low and CAN high circuits, repair as necessary. Clear the DTC and retest. If the problem persists, suspect the Central Junction Box. Refer to the warranty policy and procedures manual if a module is suspect. Check the system is operating correctly and the DTC does not return
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has failed to recognize a matching master configuration ID from the CAN data bus master ● The Terrain response control module has incorrect CAN configuration ● CAN Bus master not correctly configured ● Message containing configuration ID not received due to CAN Bus issue ● Message containing configuration ID not transmitted by CAN Bus master 	Using the manufacturer approved diagnostic system, check the CAN configuration in the Terrain response control module, check correct software versions installed and update as necessary. If similar DTCs from other modules exist suspect CAN Bus or CAN Bus master Control module. Check CAN Bus operation, check the CAN configuration in the CAN Bus master module, check correct software versions installed and update as necessary. Check the system is operating correctly and the DTC does not return
U0401-68	Invalid Data Received From The ECM/PCM 'A' - Event information	<ul style="list-style-type: none"> ● * The Terrain response control module has detected that the Engine Control Module had operated in a way or at a time that it had not been commanded to operate ● The engine management system, Engine Control Module is unable to support normal terrain response functionality, the terrain response system will go into default condition ● Engine management fault ● Engine Control Module failure 	Using the manufacturer approved diagnostic system, check the Engine Control Module for DTCs and refer to the relevant DTC index, rectify as required. Check the system is operating correctly and the DTC does not return. If the problem persists, suspect the Engine Control Module. Refer to the warranty policy and procedures manual if a module is suspect
U0403-68	Invalid Data Received From The Transfer Case Control Module - Event information	<ul style="list-style-type: none"> ● The Terrain response control module has detected that the Transfer Case Control Module had operated in a way or at a time that it had not been commanded to operate ● The Transfer Case Control Module is unable to support normal terrain response functionality, the terrain response system will go into default condition ● Transfer Case system fault ● Transfer Case Control Module failure 	Using the manufacturer approved diagnostic system, check the Transfer Case Control Module for DTCs and refer to the relevant DTC index, rectify as required. Check the system is operating correctly and the DTC does not return. If the problem persists, suspect the Transfer Case Control Module. Refer to the warranty policy and procedures manual if a module is suspect
U0415-68	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module - Event information	<ul style="list-style-type: none"> ● The Terrain response control module has detected that the ABS Module had operated in a way or at a time that it had not been commanded to operate ● The ABS Module is unable to support normal terrain response functionality, the terrain response system will 	Using the manufacturer approved diagnostic system, check the ABS Module for DTCs and refer to the relevant DTC index, rectify as required. Check the system is operating correctly and the DTC does not return. If the problem persists, suspect the ABS Module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
		<ul style="list-style-type: none"> ● go into default condition ● ABS system fault ● ABS Module failure 	
U0421-68	Invalid Data Received From Suspension Control Module 'A' - Event information	<ul style="list-style-type: none"> ● The Terrain response control module has detected that the Suspension Control Module (Ride Level Module) had operated in a way or at a time that it had not been commanded to operate ● The Suspension Control Module is unable to support normal terrain response functionality, the terrain response system will go into default condition ● Suspension system fault ● Suspension Control Module failure 	Using the manufacturer approved diagnostic system, check the Suspension Control Module for DTCs and refer to the relevant DTC index, rectify as required. Check the system is operating correctly and the DTC does not return. If the problem persists, suspect the Suspension Control Module. Refer to the warranty policy and procedures manual if a module is suspect
U0422-68	Invalid Data Received From Body Control Module - Event information	<ul style="list-style-type: none"> ● The Terrain response control module has detected that the Central Junction Box had operated in a way or at a time that it had not been commanded to operate ● The Central Junction Box is unable to support normal terrain response functionality, the terrain response system will go into default condition ● Central Junction Box system fault ● Central Junction Box failure 	Using the manufacturer approved diagnostic system, check the Central Junction Box for DTCs and refer to the relevant DTC index, rectify as required. Check the system is operating correctly and the DTC does not return. If the problem persists, suspect the Central Junction Box. Refer to the warranty policy and procedures manual if a module is suspect
U043A-68	Invalid Data Received From Suspension Control Module "B" - Event information	<ul style="list-style-type: none"> ● The Terrain response control module has detected that the Suspension Control Module (Continuously Variable Damping) had operated in a way or at a time that it had not been commanded to operate ● The Suspension Control Module is unable to support normal terrain response functionality, the terrain response system will go into default condition ● Suspension system fault ● Suspension Control Module failure 	Using the manufacturer approved diagnostic system, check the Suspension Control Module for DTCs and refer to the relevant DTC index, rectify as required. Check the system is operating correctly and the DTC does not return. If the problem persists, suspect the Suspension Control Module. Refer to the warranty policy and procedures manual if a module is suspect
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> ● The Terrain response control module has detected a mismatch between the hardware connected and the hardware expected ● Vehicle not correctly configured ● Incorrect components installed for vehicle configuration 	Using the manufacturer approved diagnostic system, check the Car Configuration File, rectify as necessary. Check correct components for vehicle configuration are installed, rectify as necessary. Check the system is operating correctly and the DTC does not return

General Information - Diagnostic Trouble Code (DTC) Index DTC: Transfer Case Control Module (TCCM)

Description and Operation

Transfer box Control Module (TCCM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the transfer box control module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Transfer Case](#) (308-07B Transfer Case, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
P0560-00	System Voltage - No sub type information	<ul style="list-style-type: none"> Power or ground supply circuit fault Battery or charging system fault 	<ul style="list-style-type: none"> NOTE: This DTC may be logged due to battery voltage, suspect battery or charging system fault Check the battery condition and state of charge. Check the battery connections, power and ground cables. Refer to the relevant workshop manual section Using the manufacturer approved diagnostic system, check other modules, for related diagnostic trouble codes and refer to the relevant diagnostic trouble code index Clear the DTC and retest Using the manufacturer approved diagnostic system monitor supply voltage - Datalogger / section 308 manual transmission / transaxle and clutch /control module supply voltage = Pid D111 Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0561-00	System Voltage Unstable - No sub type information	<ul style="list-style-type: none"> Battery disconnected and reconnected Battery connections loose/corroded Battery ground cable intermittent high resistance Battery positive cable intermittent: high resistance 	<ul style="list-style-type: none"> Check the battery condition and state of charge. Check the battery connections, power and ground cables. Refer to the relevant section of the workshop manual Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0562-00	System Voltage Low - No sub type information	<ul style="list-style-type: none"> Battery voltage low Battery ground cable high resistance Battery connections loose/corroded Battery current drain 	<ul style="list-style-type: none"> Check the battery condition and state of charge. Check the battery connections, power and ground cables. Check the ignition power supply circuit connections and circuit. Refer to the relevant workshop manual section Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0563-00	System Voltage High - No sub type information	<ul style="list-style-type: none"> Vehicle battery boosted from high voltage starting aid Battery voltage high Generator over charge condition 	<ul style="list-style-type: none"> Check if the vehicle has been jump-started. Check the battery condition and state of charge. Check the battery connections, power and ground cables. Refer to the relevant workshop manual section
P0607-00	Control Module Performance - No sub type information	<ul style="list-style-type: none"> Transfer box control module - event information - CPU watch dog 	<ul style="list-style-type: none"> Check the transfer box control module circuits and connectors. Refer to the electrical circuit diagrams. Clear the DTC. Cycle the ignition, allow power latch and retest. If the DTC resets, suspect the transfer box control module. Refer to the warranty policy and procedures manual if a

DTC	Description	Possible Causes	Action
			module is suspect
P0634-00	PCM / ECM / TCM Internal Temperature A Too High - No sub type information	<ul style="list-style-type: none"> ● Transfer box motor, driver stage over-temperature deactivation ● Transfer box internal sensor error 	<ul style="list-style-type: none"> ● Consider atmospheric and customer driving conditions before carrying out any other action. Refer to the electrical circuit diagrams and check the transfer box control module circuits, especially the transfer box actuator hall effect sensor circuit. Refer to the warranty policy and procedures manual if a module is suspect
P0641-00	Sensor Reference Voltage A Circuit - No sub type information	<ul style="list-style-type: none"> ● Transfer box motor hall effect sensor supply circuit high resistance ● Transfer box motor hall effect sensor ground circuit high resistance ● Transfer box motor hall effect sensor failure ● Transfer box control module failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box control module circuits, especially the transfer box actuator hall effect sensor circuit. Refer to the warranty policy and procedures manual if a module is suspect ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0642-00	Sensor Reference Voltage A Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Transfer box motor hall effect sensor supply circuit short circuit to ground ● Transfer box motor hall effect sensor supply circuit high resistance ● Transfer box motor hall effect sensor failure ● Transfer box control module failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box control module circuits, especially the transfer box actuator hall effect sensor circuit. Refer to the warranty policy and procedures manual if a module is suspect ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0643-00	Sensor Reference Voltage A Circuit High - No sub type information	<ul style="list-style-type: none"> ● Transfer box motor hall effect sensor supply circuit short circuit to power ● Transfer box motor hall effect sensor failure ● Transfer box control module failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box control module circuits, especially the transfer box actuator hall effect sensor circuit. Refer to the warranty policy and procedures manual if a module is suspect ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0652-00	Sensor Reference Voltage B Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Gear shift position sensor supply circuit short circuit to ground ● Gear shift position sensor supply circuit high resistance ● Gear shift position sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box control module circuits, especially the transfer box position sensor circuit (manual transmission x-sensor and manual transmission y-sensor). Renew the sensor ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0653-00	Sensor Reference Voltage B Circuit High - No sub type information	<ul style="list-style-type: none"> ● Gear shift position sensor supply circuit short circuit to power ● Gear shift position sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box control module circuits, especially the transfer box position sensor circuit (manual transmission x-sensor and manual transmission y-sensor). Renew the sensor ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0666-00	PCM/ECM/TCM Internal Temperature Sensor 'A' Circuit - No sub type information	<ul style="list-style-type: none"> ● Changeover solenoid, driver stage over-temperature deactivation 	<ul style="list-style-type: none"> ● Consider atmospheric and customer driving conditions before carrying out any other action. Refer to the electrical circuit diagrams and check the transfer box mode change solenoid circuit. Check for over-temperature DTCs in other modules
P0698-00	Sensor Reference Voltage C Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Manual transmission output shaft speed sensor circuit short circuit to ground ● Manual transmission output shaft speed sensor circuit high resistance ● Manual transmission output shaft speed sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transmission circuits, especially the transmission output speed sensor circuit. Renew the sensor
P0699-00	Sensor Reference Voltage C Circuit High - No sub type information	<ul style="list-style-type: none"> ● Manual transmission output shaft speed sensor circuit short circuit to power ● Manual transmission output shaft speed 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transmission circuits, especially the transmission output speed sensor circuit. Renew the sensor

DTC	Description	Possible Causes	Action
		sensor failure	
P0702-00	Transmission Control System Electrical - No sub type information	<ul style="list-style-type: none"> ● Unexpected reset ● Battery short circuit to ground ● Generator circuit short circuit to ground ● Transfer box control module supply short circuit to ground 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check for intermittent loss of power or ground of the main power supply circuits to the module. Check the battery connections, power and ground cables. Check the ignition power supply circuit connections and circuit
P0712-00	Transmission Fluid Temperature Sensor 'A' Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Transfer box motor temperature sensor circuit short circuit to ground ● Transfer box motor temperature sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box motor temperature sensor and circuits ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0713-00	Transfer box Motor Temperature Sensor A Circuit - No sub type information	<ul style="list-style-type: none"> ● Transfer box motor temperature sensor circuit short circuit to power ● Transfer box motor temperature sensor circuit high resistance ● Transfer box motor temperature sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box motor temperature sensor and circuits ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0715-00	Turbine/Input Shaft Speed Sensor A Circuit - no sub type information	<ul style="list-style-type: none"> ● Clutch slip - transmission input and output speeds incorrect for selected gear ratio 	<ul style="list-style-type: none"> • NOTE: This DTC may be induced by the driver ● Confirm that the DTC has not been induced by the driving style of the driver (riding the clutch). Refer to the electrical circuit diagrams and check the circuit between gearbox secondary speed sensor and the transfer box control module. Check the gear selector mechanism for correct operation
P0716-00	Turbine/Input Shaft Speed Sensor A Circuit Range/Performance - no sub type information	<ul style="list-style-type: none"> ● Clutch slip - transmission input and output speeds incorrect for selected gear ratio 	<ul style="list-style-type: none"> • NOTE: This DTC may be induced by the driver ● Confirm that the DTC has not been induced by the driving style of the driver (riding the clutch). Refer to the electrical circuit diagrams and check the circuit between gearbox secondary speed sensor and the transfer box control module. Check the gear selector mechanism for correct operation
P0717-00	Turbine/Input Shaft Speed Sensor A Circuit No Signal - no sub type information	<ul style="list-style-type: none"> ● Clutch slip - transmission input and output speeds incorrect for selected gear ratio 	<ul style="list-style-type: none"> • NOTE: This DTC may be induced by the driver ● Confirm that the DTC has not been induced by the driving style of the driver (riding the clutch). Refer to the electrical circuit diagrams and check the circuit between gearbox secondary speed sensor and the transfer box control module. Check the gear selector mechanism for correct operation
P0780-00	Shift Malfunction - No sub type information	<ul style="list-style-type: none"> ● Gear shifting blocked (the transfer box motor movement and position does not correspond to the expected values) 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check transfer box motor circuit and transfer box motor hall effect sensor circuit. Check transfer box motor
P0806-00	Clutch Position Sensor Circuit Range/Performance - No sub type information	<ul style="list-style-type: none"> ● Clutch and range change mechanism calibration failure 	<ul style="list-style-type: none"> ● Calibrate the clutch and range change mechanism using the manufacturer approved diagnostic system. If fault is still present check the transfer box circuit, especially the transfer box motor circuit, transfer box motor hall effect sensor circuit and transfer box range position sensor circuit. In box of manual transmission variant also check x-sensor, y-sensor and manual transmission output speed sensor circuit ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine
P0807-00	Clutch Position Sensor Circuit Low - No sub type information	<ul style="list-style-type: none"> ● Transfer box motor hall effect sensor signal circuit short circuit to ground ● Transfer box motor hall effect sensor failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check the transfer box circuits, especially the transmission output speed sensor circuit. Repair/renew as necessary ● Using the manufacturer approved diagnostic system carry out the guided diagnostic routine

General Information - Diagnostic Trouble Code (DTC) IndexDTC: Transmission Control Module (TCM) - Bosch

Description and Operation

Transmission Control Module (TCM) - Bosch



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Transmission Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to:

[Automatic Transmission](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Diagnosis and Testing),
[Diagnostics](#) (307-01C Automatic Transmission/Transaxle - V6 4.0L Petrol/TDV6 2.7L Diesel, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
P0121-86	Throttle/Pedal Position Sensor A Circuit Range/Performance - Signal invalid	<ul style="list-style-type: none"> Throttle position sensor wiring high resistance Throttle position sensor sensing circuits (Throttle position 1 or Throttle position 2) short circuit to power Throttle position sensor failure 	Refer to the electrical circuit diagrams and check the throttle position sensor circuit. Check for engine management DTCs. Renew the sensor
P0219-86	Engine Overspeed Condition - Signal invalid	<ul style="list-style-type: none"> Engine speed implausible (too high or too low) 	Check for related Engine Control Module DTCs
P0500-81	Vehicle Speed Sensor A - invalid serial data received	<ul style="list-style-type: none"> Vehicle speed signal not detected 	Check for related Anti-lock Braking System DTCs
P0501-81	Vehicle Speed Sensor A Range/Performance - invalid serial data received	<ul style="list-style-type: none"> Range/Performance 	Check for related Anti-lock Braking System DTCs
P0561-00	System Voltage Unstable - No sub type information	<ul style="list-style-type: none"> Power supply voltage is out of range when the engine is running 	Check the battery and charging system. Refer to the relevant workshop manual section
P0562-21	System Voltage Low - Signal amplitude < minimum	<ul style="list-style-type: none"> Supply voltage to TCM very low 	Check the battery condition and state of charge. Check the Transmission Control Module connector and supply circuits. Refer to the electrical circuit diagrams
P0563-22	System Voltage High - Signal amplitude > maximum	<ul style="list-style-type: none"> Power supply voltage is too high if the engine is running and there has been no jump-start or transmission limp-home event 	Check the battery and charging system. Refer to the relevant workshop manual section. Check if the vehicle has been jump-started
P0601-41	Internal Control Module Memory Check Sum Error - general checksum failure	<ul style="list-style-type: none"> Checksum error 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0603-00	Internal Control Module Keep Alive Memory (KAM) Error - No sub type information	<ul style="list-style-type: none"> Keep-alive memory (KAM) error 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module

DTC	Description	Possible Causes	Action
P0605-41	Internal Control Module Read Only Memory (ROM) Error - General checksum failure	<ul style="list-style-type: none"> Read only memory (ROM) error 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policy and procedures manual if a module is suspect
P0613-00	TCM Processor - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-04	TCM Processor - system internal failures	<ul style="list-style-type: none"> Internal failure 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-06	TCM Processor - algorithm based failures	<ul style="list-style-type: none"> Software algorithm based failures 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-11	TCM Processor - Circuit short to ground	<ul style="list-style-type: none"> Internal circuit short to ground 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-12	TCM Processor - Circuit short to battery	<ul style="list-style-type: none"> Internal circuit short to power 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-13	TCM Processor - Circuit open	<ul style="list-style-type: none"> Internal circuit open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-14	TCM Processor - Circuit short to ground or open	<ul style="list-style-type: none"> Internal circuit short to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-21	TCM Processor - Signal amplitude < minimum	<ul style="list-style-type: none"> Signal amplitude < minimum 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module.
P0613-22	TCM Processor - Signal amplitude > maximum	<ul style="list-style-type: none"> Signal amplitude > minimum 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-26	TCM Processor - Signal rate of change below threshold	<ul style="list-style-type: none"> Signal rate of change below threshold 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-47	TCM Processor - watchdog/safety micro controller failure	<ul style="list-style-type: none"> Watchdog/safety Micro controller failure 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-49	TCM Processor - internal electronic failure	<ul style="list-style-type: none"> Internal electronic failure 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0613-68	TCM Processor - event information	<ul style="list-style-type: none"> Event information 	Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a

DTC	Description	Possible Causes	Action
			Transmission Control Module
P061B-61	Internal Control Module Torque Calculation Performance - Signal calculation failure	<ul style="list-style-type: none"> Transmission Control Module positive torque signal not valid 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policy and procedures manual if a module is suspect
P061B-65	Internal Control Module Torque Calculation Performance - Signal has too few transitions / events	<ul style="list-style-type: none"> Transmission Control Module positive torque signal not valid 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policy and procedures manual if a module is suspect
P062F-04	Internal Control Module EEPROM Error - system internal failures	<ul style="list-style-type: none"> EEPROM error 	Check that the transit relay is not still installed. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0642-21	Sensor Reference Voltage A Circuit Low - Signal amplitude < minimum	<ul style="list-style-type: none"> Reference voltage circuit short circuit to ground Reference voltage circuit high resistance 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0643-22	Sensor Reference Voltage A Circuit High - Signal amplitude > maximum	<ul style="list-style-type: none"> Reference voltage circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0657-13	Actuator Supply Voltage A Circuit / Open - Circuit open	<ul style="list-style-type: none"> Supply voltage circuit open circuit 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0657-1C	Actuator Supply Voltage A Circuit / Open - Circuit voltage out of range	<ul style="list-style-type: none"> Supply circuit voltage out of range 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0658-11	Actuator Supply Voltage A Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Supply voltage circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0659-12	Actuator Supply Voltage A Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Supply voltage circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0668-21	PCM / ECM / TCM Internal Temperature Sensor A Circuit Low - Signal amplitude < minimum	<ul style="list-style-type: none"> Module internal temperature too low Temperature sensor circuit high resistance Temperature sensor circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0669-22	ECM / ECM / TCM Internal Temperature Sensor A Circuit High - Signal amplitude > maximum	<ul style="list-style-type: none"> Module internal temperature too high Temperature sensor circuit short circuit to power 	Check for engine overheating and cooling system faults. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0700-02	Transmission Control System (MIL Request) - General signal failure	<ul style="list-style-type: none"> General signal failure 	This indicates more than one fault is present. Check all DTC's reported on the vehicle and resolve. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control

DTC	Description	Possible Causes	Action
			Module
P0700-22	Transmission Control System (MIL Request) - Signal amplitude > maximum	<ul style="list-style-type: none"> Emergency position not reachable 	This indicates more than one fault is present. Check all DTC's reported on the vehicle and resolve. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0700-75	Transmission Control System (MIL Request) - Emergency position not reachable	<ul style="list-style-type: none"> Signal implausible 	This indicates more than one fault is present. Check all DTC's reported on the vehicle and resolve. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0705-00	Transmission Range Sensor A Circuit (PRNDL Input) - No sub type information	<ul style="list-style-type: none"> Signal implausible 	Check the gear selector mechanism connector and wiring. Check the gear selector cable setting. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0710-13	Transmission Fluid Temperature Sensor A Circuit - Circuit open	<ul style="list-style-type: none"> Transmission fluid temperature sensor circuit open circuit Temperature sensor fault 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0711-01	Transmission Fluid Temperature Sensor A Circuit Range/Performance - general electrical failure	<ul style="list-style-type: none"> Transmission fluid temperature sensor general electrical failure Temperature sensor fault 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0712-00	Transmission Fluid Temperature Sensor A Circuit Low - No sub type information	<ul style="list-style-type: none"> Sensor circuit: high resistance Sensor circuit: short circuit to ground 	Refer to the guided diagnostic routine for this code on the approved diagnostic system
P0711-22	Transmission Fluid Temperature Sensor A Circuit Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> Transmission fluid temperature sensor signal amplitude greater than maximum Temperature sensor fault 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0712-11	Transmission Fluid Temperature Sensor A Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Sensor circuit high resistance Sensor circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0713-12	Transmission Fluid Temperature Sensor A Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Sensor circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0716-14	Turbine/Input Shaft Speed Sensor A Circuit Range/Performance - Circuit short to ground or open	<ul style="list-style-type: none"> Sensor circuit high resistance Sensor circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0716-21	Turbine/Input Shaft Speed Sensor A Circuit Range/Performance - Signal amplitude < minimum	<ul style="list-style-type: none"> Turbine/input shaft speed sensor signal too small 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0716-22	Turbine/Input Shaft Speed Sensor A Circuit Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> Turbine/input shaft speed sensor signal too large 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control

DTC	Description	Possible Causes	Action
			Module
P0717-12	Turbine/Input Shaft Speed Sensor A Circuit No Signal - Circuit short to battery	<ul style="list-style-type: none"> ● Sensor circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0720-12	Output Shaft Speed Sensor Circuit - Circuit short to battery	<ul style="list-style-type: none"> ● Sensor circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0720-14	Output Shaft Speed Sensor Circuit - Circuit short to ground or open	<ul style="list-style-type: none"> ● Sensor circuit high resistance ● Sensor circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0721-22	Output Shaft Speed Sensor Circuit Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Signal amplitude above maximum ● Range/performance 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0721-27	Output Shaft Speed Sensor Circuit Range/Performance - Signal rate of change above threshold	<ul style="list-style-type: none"> ● Signal rate of change above threshold 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0721-64	Output Shaft Speed Sensor Circuit Range/Performance - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0729-00	Gear 6 Incorrect Ratio - No sub type information - No sub type information - No sub type information	<ul style="list-style-type: none"> ● Incorrect ratio ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission
P0730-00	Incorrect Gear Ratio - No sub type information	<ul style="list-style-type: none"> ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission
P0731-00	Gear 1 Incorrect Ratio - No sub type information	<ul style="list-style-type: none"> ● Incorrect ratio ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission
P0732-00	Gear 2 Incorrect Ratio - No sub type information	<ul style="list-style-type: none"> ● Incorrect ratio ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission
P0733-00	Gear 3 Incorrect Ratio - No sub type information	<ul style="list-style-type: none"> ● Incorrect ratio ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission.
P0734-00	Gear 4 Incorrect Ratio - No sub type information	<ul style="list-style-type: none"> ● Incorrect ratio ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission
P0735-00	Gear 5 Incorrect Ratio - No sub type information	<ul style="list-style-type: none"> ● Incorrect ratio ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission
P0736-62	Reverse Incorrect Ratio - Signal compare failure	<ul style="list-style-type: none"> ● Slip too high between input and output shaft speeds - signal compare failure 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and procedures before renewing the transmission
P0736-64	Reverse Incorrect Ratio - Signal plausibility failure	<ul style="list-style-type: none"> ● Slip too high between input and output shaft speeds 	Check the transmission oil level and quality. Adjust as necessary. Clear the DTC and retest. If the problem persists, renew the transmission (sensor is internal). Refer to the warranty policies and

DTC	Description	Possible Causes	Action
			procedures before renewing the transmission
P0740-13	Torque Converter Clutch Solenoid Circuit / Open - Circuit open	<ul style="list-style-type: none"> ● Solenoid circuit high resistance 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0741-07	Torque Converter Clutch Solenoid Circuit Performance/Stuck Off - mechanical failures	<ul style="list-style-type: none"> ● Solenoid circuit stuck off ● Slip too high at torque converter clutch 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0748-21	Pressure Control Solenoid A Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> ● Solenoid signal amplitude < minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0748-22	Pressure Control Solenoid A Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Solenoid signal amplitude > minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0751-13	Shift Solenoid A Performance/Stuck Off - Circuit open	<ul style="list-style-type: none"> ● Performance ● Stuck off ● Solenoid circuit high resistance 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0751-14	Shift Solenoid A Performance/Stuck Off - Circuit short to ground or open	<ul style="list-style-type: none"> ● Performance ● Stuck off ● Solenoid circuit high resistance ● Solenoid circuit short circuit to ground 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0752-11	Shift Solenoid A Stuck On - Circuit short to ground	<ul style="list-style-type: none"> ● Stuck on ● Solenoid valve short circuit to ground 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0753-12	Shift Solenoid A Electrical - Circuit short to battery	<ul style="list-style-type: none"> ● Solenoid valve short circuit to power 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0778-21	Pressure Control Solenoid B Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> ● Pressure control solenoid signal amplitude < minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0778-22	Pressure Control Solenoid B Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Pressure control solenoid signal amplitude > minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0780-00	Shift malfunction - No sub type information	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0781-00	1 - 2 Shift - No sub type information	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission

DTC	Description	Possible Causes	Action
P0781-62	1 - 2 Shift - Signal compare failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0781-64	1 - 2 Shift - Signal plausibility failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0782-22	2 - 3 Shift - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Input/Output shaft ratio signal amplitude > minimum 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0782-26	2 - 3 Shift - Signal rate of change below threshold	<ul style="list-style-type: none"> ● Input/Output shaft ratio signal rate of change below threshold 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0782-62	2 - 3 Shift - Signal compare failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0782-64	2 - 3 Shift - Signal plausibility failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0783-00	3 - 4 Shift - No sub type information	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0783-00	3 - 4 Shift - no sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0783-23	3 - 4 Shift - Signal stuck low	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0783-62	3 - 4 Shift - Signal compare failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0783-64	3 - 4 Shift - Signal plausibility failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0784-00	4 - 5 Shift - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission

DTC	Description	Possible Causes	Action
P0784-23	4 - 5 Shift - Signal stuck low	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0784-62	4 - 5 Shift - Signal compare failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0784-64	4 - 5 Shift - Signal plausibility failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0798-21	Pressure Control Solenoid C Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> ● Pressure control solenoid signal amplitude < minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0798-22	Pressure Control Solenoid C Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Pressure control solenoid signal amplitude > maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P081C-62	Park Input Circuit - Signal compare failure	<ul style="list-style-type: none"> ● Park lock signal compare failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P081C-64	Park Input Circuit - Signal plausibility failure	<ul style="list-style-type: none"> ● Park lock signal plausibility failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0826-26	Up and Down Switch Circuit - Signal rate of change below threshold	<ul style="list-style-type: none"> ● Implausible signal 	Refer to the electrical guides and check the circuit between the gear selector mechanism and the Transmission Control Module. Check the switch operation of the transmission shift selector
P0829-23	5-6 Shift - Signal stuck low	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0829-62	5-6 Shift - Signal compare failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0829-64	5-6 Shift - Signal plausibility failure	<ul style="list-style-type: none"> ● Input/Output shaft ratio too high during a shift ● Clutch does not open or close 	Check the fluid level and condition. Adjust as necessary. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission. Refer to the warranty policies and procedures before renewing a Transmission
P0850-29	Park / Neutral Switch Input Circuit - Signal invalid	<ul style="list-style-type: none"> ● Starter inhibit signal fault 	Refer to the electrical circuit diagrams and check the park/neutral switch circuit between the central electronics module, the Engine Control Module and Transmission Control Module
P0897-00	Transmission Fluid Deteriorated - No subtype information	<ul style="list-style-type: none"> ● Temperature too high over too long a time ● Transmission temperature sensor fault 	Check for transmission temperature sensor related DTCs. Check transmission oil cooler and repair/replace as necessary. Renew the transmission fluid

DTC	Description	Possible Causes	Action
P0928-13	Gear Shift Lock Solenoid Control Circuit/Open - Circuit open	<ul style="list-style-type: none"> Shift interlock solenoid open circuit 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0929-14	Gear Shift Lock Solenoid Control Circuit Range/Performance - Circuit short to ground or open	<ul style="list-style-type: none"> Shift interlock solenoid short circuit to ground or open circuit 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0930-11	Gear Shift Lock Solenoid/Actuator Circuit A Low - Circuit short to ground	<ul style="list-style-type: none"> Shift interlock solenoid short circuit to ground 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0931-12	Gear Shift Lock Solenoid/Actuator Circuit A High - Circuit short to battery	<ul style="list-style-type: none"> Shift interlock solenoid short circuit to power 	Refer to the electrical guides and check the circuit between the Transmission Control Module and the shift lock solenoid. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0938-29	Hydraulic Oil Temperature Sensor Range/Performance - Signal invalid	<ul style="list-style-type: none"> Temperature sensor signal not plausible Transmission fluid temperature compared with module temperature fault 	Check for engine overheating and cooling system faults. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0960-13	Pressure Control Solenoid A Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit high resistance 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0960-14	Pressure Control Solenoid A Control Circuit / Open - Circuit short to ground or open	<ul style="list-style-type: none"> Control circuit high resistance Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0962-11	Pressure Control Solenoid A Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0963-12	Pressure Control Solenoid A Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0964-13	Pressure Control Solenoid B Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit high resistance 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0964-14	Pressure Control Solenoid B Control Circuit / Open - Circuit short to ground or open	<ul style="list-style-type: none"> Control circuit high resistance Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module

DTC	Description	Possible Causes	Action
P0966-11	Pressure Control Solenoid B Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0967-12	Pressure Control Solenoid B Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0968-13	Pressure Control Solenoid C Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit open circuit 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0968-14	Pressure Control Solenoid C Control Circuit / Open - Circuit short to ground or open	<ul style="list-style-type: none"> Control circuit short circuit to ground or open circuit 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0970-11	Pressure Control Solenoid C Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P0971-12	Pressure Control Solenoid C Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P1783-00	Transmission Over temperature Condition - No sub type information	<ul style="list-style-type: none"> Valve body module shut-down detected on last drive cycle 	Check for engine overheating and cooling system faults. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the module. Consider environmental conditions before condemning the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2716-21	Pressure Control Solenoid D Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> Pressure control solenoid signal amplitude < minimum 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2716-22	Pressure Control Solenoid D Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> Pressure control solenoid signal amplitude > maximum 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2718-13	Pressure Control Solenoid D Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit open circuit 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2718-14	Pressure Control Solenoid D Control Circuit / Open - Circuit short to ground or open	<ul style="list-style-type: none"> Control circuit high resistance Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2720-11	Pressure Control Solenoid D Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the

DTC	Description	Possible Causes	Action
			problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission control
P2721-12	Pressure Control Solenoid D Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2725-21	Pressure Control Solenoid E Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> Solenoid signal amplitude < minimum 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2725-22	Pressure Control Solenoid E Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> Solenoid signal amplitude > maximum 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2727-13	Pressure Control Solenoid E Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit open circuit 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2727-14	Pressure Control Solenoid E Control Circuit / Open - Circuit short to ground or open	<ul style="list-style-type: none"> Control circuit high resistance Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission control
P2729-11	Pressure Control Solenoid E Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Control circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2730-12	Pressure Control Solenoid E Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2759-22	Torque Converter Clutch Pressure Control Solenoid Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> Pressure control solenoid fault 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2761-14	Torque Converter Clutch Pressure Control Solenoid Control Circuit / Open - Circuit short to ground or open	<ul style="list-style-type: none"> Pressure control solenoid circuit high resistance 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2762-21	Torque Converter Clutch Pressure Control Solenoid Control Circuit Range / Perf - Signal amplitude < minimum	<ul style="list-style-type: none"> Pressure control solenoid circuit current too low 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
P2763-12	Torque Converter Clutch Pressure Control Solenoid Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Pressure control solenoid circuit short circuit to power 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module

DTC	Description	Possible Causes	Action
P2764-11	Torque Converter Clutch Pressure Control Solenoid Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> ● Pressure control solenoid circuit short circuit to ground 	Check for other DTCs and rectify as necessary. Check the Transmission Control Module connector and the power/ground circuits to the Transmission Control Module. Clear the DTC and retest. If the problem persists, renew the module. Refer to the warranty policies and procedures before renewing a Transmission Control Module
U0001-88	High Speed CAN Communication CAN Bus - bus off	Bus off	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0100-82	Lost Communication With ECM/PCM "A" - alive/sequence counter incorrect/not updated	<ul style="list-style-type: none"> ● Alive counter error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Engine Control Module and Transmission Control Module
U0100-83	Lost Communication With ECM/PCM "A" - value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● Checksum error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Engine Control Module and Transmission Control Module
U0100-87	Lost Communication With ECM/PCM "A" - missing message	<ul style="list-style-type: none"> ● Missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Engine Control Module and Transmission Control Module
U0102-87	Lost Communication with Transfer Case Control Module - missing message	<ul style="list-style-type: none"> ● Missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Transfer Case Control Module and Transmission Control Module
U0103-87	Lost Communications with Gear Shift Module A - missing message	<ul style="list-style-type: none"> ● Missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Gear Shift Module and Transmission Control Module
U0122-82	Lost Communication With Vehicle Dynamics Control Module - alive/sequence counter incorrect/not updated	<ul style="list-style-type: none"> ● Alive counter error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Anti-lock Braking System Module and Transmission Control Module
U0122-83	Lost Communication With Vehicle Dynamics Control Module - value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● Checksum error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Anti-lock Braking System Module and Transmission Control Module
U0122-87	Lost Communication With Vehicle Dynamics Control Module - missing message	<ul style="list-style-type: none"> ● Missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Anti-lock Braking System Module and Transmission Control Module
U0126-87	Lost Communication With Steering Angle Sensor Module - missing message	<ul style="list-style-type: none"> ● Missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Steering Angle Sensor and Transmission Control Module
U0128-87	Lost Communication With Park Brake Control Module - missing message	<ul style="list-style-type: none"> ● Missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Parking Brake Module and

DTC	Description	Possible Causes	Action
			Transmission Control Module
U0155-82	Lost Communication With Instrument Panel Cluster (IPC) Control Module - alive/sequence counter incorrect/not updated	<ul style="list-style-type: none"> ● Alive counter error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Instrument Cluster and Transmission Control Module
U0155-83	Lost Communication With Instrument Panel Cluster (IPC) Control Module - value of signal protection calculation incorrect	<ul style="list-style-type: none"> ● Checksum error 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Instrument Cluster and Transmission Control Module
U0155-87	Lost Communication With Instrument Panel Cluster (IPC) Control Module - missing message	<ul style="list-style-type: none"> ● Missing message 	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Instrument Cluster and Transmission Control Module
U0300-55	Internal Control Module Software Incompatibility - not configured	<ul style="list-style-type: none"> ● Module is not configured 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the Transmission Control Module. Update as necessary
U0401-86	Invalid Data Received from ECM/PCM A - Signal invalid	<ul style="list-style-type: none"> ● Signal invalid 	Check for engine management system (EMS/PCM) DTCs. Refer to the relevant section in the workshop manual. Check the correct software version in the Engine Control Module using the manufacturers approved diagnostic system. Update as necessary
U0416-86	Invalid Data Received From Vehicle Dynamics Control Module - Signal invalid	<ul style="list-style-type: none"> ● Signal invalid 	Check for other Anti-lock Braking System related DTCs. Check for other EMS related DTC faults (brake signal related). Check the Anti-lock Braking System control module installation/configuration and for correct software version using the manufacturers approved diagnostic system. Refer to the lost communication statement at the start of the Network Communications section in the workshop manual
U2023-86	Control Module Network Signal Calibration Data - Signal invalid	<ul style="list-style-type: none"> ● Engine torque information - Fault received from external node 	Check for engine management system (EMS/PCM) DTCs. Refer to the relevant section in the workshop manual. Check the control module for correct software version using the manufacturers approved diagnostic system
U3000-4A	Control Module - incorrect component installed	<ul style="list-style-type: none"> ● Incorrect component installed ● Mismatch between configuration data and read configuration 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the Transmission Control Module. Update as necessary
U3000-81	Control Module - invalid serial data received	<ul style="list-style-type: none"> ● Invalid serial data received 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the Transmission Control Module. Update as necessary

General Information - Diagnostic Trouble Code (DTC) IndexDTC: Transmission Control Module (TCM) - Siemens

Description and Operation

Transmission Control Module (TCM) - Siemens



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Transmission Control Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to:

[Automatic Transmission](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Diagnosis and Testing),
[Automatic Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Diagnosis and Testing),
[Diagnostics](#) (307-01C Automatic Transmission/Transaxle - V6 4.0L Petrol/TDV6 2.7L Diesel, Diagnosis and Testing),
[Diagnostics](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
P0121-86	Throttle/Pedal Position Sensor A Circuit Range/Performance - Signal invalid	<ul style="list-style-type: none"> Throttle position sensor sensing circuit signal invalid Throttle position sensor failure 	Check for Engine Control Module DTCs
P0219-86	Engine Overspeed Condition - Signal invalid	<ul style="list-style-type: none"> Engine speed implausible (signal invalid) 	Check for Engine Control Module DTCs
P0500-81	Vehicle Speed Sensor A - Invalid serial data received	<ul style="list-style-type: none"> Vehicle speed signal invalid serial data received 	Check for ABS related DTCs
P0501-81	Vehicle Speed Sensor A Range/Performance - Invalid serial data received	<ul style="list-style-type: none"> Vehicle speed signal invalid serial data received 	Check for ABS related DTCs
P0561-1C	System Voltage Unstable - Circuit voltage out of range	<ul style="list-style-type: none"> Power supply voltage is out of range when the engine is running 	Check the battery and charging system. Refer to the relevant workshop manual section
P0562-21	System Voltage Low - Signal amplitude < minimum	<ul style="list-style-type: none"> Supply voltage to TCM very low 	Check the battery condition and state of charge. Check the Transmission Control Module connector and power supply circuits. Refer to the electrical circuit diagrams
P0563-22	System Voltage High - Signal amplitude > maximum	<ul style="list-style-type: none"> Power supply voltage is too high if the engine is running and there has been no jump-start or transmission limp-home event 	Check the battery condition and state of charge. Check the Transmission Control Module connector and power supply circuits. Refer to the electrical circuit diagrams
P0601-41	Internal Control Module Memory Check Sum Error-General checksum failure	<ul style="list-style-type: none"> Checksum error 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0604-92	Internal Control Module Random Access Memory (RAM) Error - Performance or incorrect operation	<ul style="list-style-type: none"> Control module internal memory error 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
P0613-06	TCM Processor - Algorithm Based Failures	<ul style="list-style-type: none"> Internal processor watchdog error 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0613-47	TCM Processor - Watchdog/safety microcontroller failure	<ul style="list-style-type: none"> Internal processor watchdog error 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0613-68	TCM Processor - Event information	<ul style="list-style-type: none"> Event information 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P061B-00	Internal Control Module Torque Calculation Performance - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P061B-64	Internal Control Module Torque Calculation Performance# - Signal plausibility failure	<ul style="list-style-type: none"> Signal plausibility failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P062F-04	Internal Control Module EEPROM Error - System internal failures	<ul style="list-style-type: none"> EEPROM error 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0642-21	Sensor Reference Voltage A Circuit Low - Signal amplitude < minimum	<ul style="list-style-type: none"> Reference voltage circuit signal amplitude below minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0643-22	Sensor Reference Voltage A Circuit High - Signal amplitude > maximum	<ul style="list-style-type: none"> Reference voltage circuit signal amplitude above maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0657-13	Actuator Supply Voltage A Circuit / Open - Circuit open	<ul style="list-style-type: none"> Supply voltage circuit open circuit 	Check for other related DTCs. Check the park lock actuator, the actuator connector and wiring. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and test the shift lever in all positions. If the problem persists, renew the Transmission Control Module Refer to the warranty policies and procedures before renewing the transmission
P0658-11	Actuator Supply Voltage A Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Supply voltage circuit short circuit to ground 	Check for other related DTCs. Check the park lock actuator, the actuator connector and wiring. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and test the shift lever in all positions. If the problem persists, renew the Transmission Control Module Refer to the warranty policies and procedures before renewing the transmission
P0659-12	Actuator Supply Voltage A Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Supply voltage circuit short circuit to power 	Check for other related DTCs. Check the park lock actuator, the actuator connector and wiring. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and test the shift lever in all positions. If the problem persists, renew the Transmission Control Module Refer to the warranty policies and procedures before renewing the transmission
P0667-01	PCM / ECM / TCM Internal Temperature Sensor Range/Performance - General electrical failure	<ul style="list-style-type: none"> Module internal temperature sensor general failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module Consider environmental conditions before condemning the module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
P0667-04	PCM / ECM / TCM Internal Temperature Sensor Range/Performance - System internal failures	<ul style="list-style-type: none"> ● Module internal temperature sensor general failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Consider environmental conditions before condemning the module. Refer to the warranty policy and procedures manual if a module is suspect
P0667-49	PCM / ECM / TCM Internal Temperature Sensor A Circuit Low - Internal electronic failure	<ul style="list-style-type: none"> ● Module internal temperature sensor general failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Consider environmental conditions before condemning the module. Refer to the warranty policy and procedures manual if a module is suspect
P0700-02	Transmission Control System (MIL Request) - General signal failure	<ul style="list-style-type: none"> ● General signal failure 	Check for other DTCs and rectify those first. Clear the DTCs and road test the vehicle. If further DTCs are logged, investigate according to the individual faults logged
P0700-22	Transmission Control System (MIL Request) - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Signal amplitude above maximum 	Check for other DTCs and rectify those first. Clear the DTCs and road test the vehicle. If further DTCs are logged, investigate according to the individual faults logged
P0700-75	Transmission Control System (MIL Request) - Emergency position not reachable	<ul style="list-style-type: none"> ● Emergency position not reachable 	Check for other DTCs and rectify those first. Clear the DTCs and road test the vehicle. If further DTCs are logged, investigate according to the individual faults logged
P0710-15	Transmission Fluid Temperature Sensor A Circuit - Circuit short to battery or open	<ul style="list-style-type: none"> ● Circuit short to power or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0711-22	Transmission Fluid Temperature Sensor A Circuit Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Signal amplitude above maximum 	Allow the transmission to cool, clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0712-11	Transmission Fluid Temperature Sensor A Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> ● Sensor circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0716-14	Turbine/Input Shaft Speed Sensor A Circuit Range/Performance - Circuit short to ground or open	<ul style="list-style-type: none"> ● Sensor circuit short circuit to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0716-21	Turbine/Input Shaft Speed Sensor A Circuit Range/Performance - Signal amplitude < minimum	<ul style="list-style-type: none"> ● Signal amplitude below minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0716-22	Turbine/Input Shaft Speed Sensor A Circuit Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Signal amplitude above maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0717-12	Turbine/Input Shaft Speed Sensor A Circuit No Signal - Circuit short to battery	<ul style="list-style-type: none"> ● Sensor circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0720-12	Output Shaft Speed Sensor Circuit - Circuit short to battery	<ul style="list-style-type: none"> ● Sensor circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0720-14	Output Shaft Speed Sensor Circuit - Circuit short to ground or open	<ul style="list-style-type: none"> ● Sensor circuit short circuit to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
P0721-22	Output Shaft Speed Sensor Circuit Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Signal amplitude above maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0721-27	Output Shaft Speed Sensor Circuit Range/Performance - Signal rate of change above threshold	<ul style="list-style-type: none"> ● Signal rate of change above threshold 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0721-64	Output Shaft Speed Sensor Circuit Range/Performance - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0729-07	Gear 6 Incorrect Ratio - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical Failures 	Renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0731-07	Gear 1 Incorrect Ratio - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0732-07	Gear 2 Incorrect Ratio - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0733-07	Gear 3 Incorrect Ratio - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0734-07	Gear 4 Incorrect Ratio - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0735-07	Gear 5 Incorrect Ratio - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0736-07	Reverse Incorrect Ratio - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0740-13	Torque Converter Clutch Solenoid Circuit / Open - Circuit open	<ul style="list-style-type: none"> ● Solenoid circuit open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0741-07	Torque Converter Clutch Solenoid Circuit Performance/Stuck Off - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Renew the torque converter. If the transmission oil condition is very poor/dirty, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0781-07	1 - 2 Shift - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0781-77	1 - 2 Shift - Commanded position not reachable	<ul style="list-style-type: none"> ● Commanded position not reachable 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0782-07	2 - 3 Shift - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0782-77	2 - 3 Shift - Commanded position not reachable	<ul style="list-style-type: none"> ● Commanded position not reachable 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0783-07	3 - 4 Shift - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty

DTC	Description	Possible Causes	Action
			policies and procedures before renewing the transmission
P0783-77	3 - 4 Shift - Commanded position not reachable	<ul style="list-style-type: none"> Commanded position not reachable 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0784-07	4 - 5 Shift - Mechanical Failures	<ul style="list-style-type: none"> Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0784-77	4 - 5 Shift - Commanded position not reachable	<ul style="list-style-type: none"> Commanded position not reachable 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0798-1E	Pressure Control Solenoid C Electrical - Circuit resistance out of range	<ul style="list-style-type: none"> Circuit resistance out of range 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0798-21	Pressure Control Solenoid C Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> Signal amplitude below minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0798-22	Pressure Control Solenoid C Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> Signal amplitude above maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0815-33	Upshift Switch Circuit - Signal low time > maximum	<ul style="list-style-type: none"> Circuit signal low time greater than maximum 	Refer to the electrical circuit diagrams and check the circuit between the command upshift switch and the Transmission Control Module Check the switch operation of the Transmission Shift Selector
P0816-33	Downshift Switch Circuit - Signal low time > maximum	<ul style="list-style-type: none"> Downshift switch signal low time less than maximum 	Check the steering wheel gear change switches and the manual/sport gate switch operation at the gear shift lever. Refer to the electrical circuit diagrams and check the switch circuit
P081C-62	Park Input Circuit - Signal compare failure	<ul style="list-style-type: none"> Park lock signal compare failure 	Check locking mechanism operation in Park and the Park confirmation switch operation. Refer to the electrical circuit diagrams and check the switch circuit
P081C-64	Park Input Circuit - Signal plausibility failure	<ul style="list-style-type: none"> Park lock signal plausibility failure 	Check locking mechanism operation in Park and the Park confirmation switch operation. Refer to the electrical circuit diagrams and check the switch circuit
P0826-62	Up and Down Switch Circuit - Signal compare failure	<ul style="list-style-type: none"> Circuit signal compare failure 	Refer to the electrical circuit diagrams and check the circuit between the command shift switch and the Transmission Control Module Check the switch operation of the Transmission Shift Selector
P0829-07	5-6 Shift - Mechanical Failures	<ul style="list-style-type: none"> Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0829-77	5-6 Shift - Commanded position not reachable	<ul style="list-style-type: none"> Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and road test the vehicle. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P0850-29	Park / Neutral Switch Input Circuit - Signal invalid	<ul style="list-style-type: none"> Starter inhibit signal invalid 	Refer to the electrical circuit diagrams and check the park/neutral switch circuit between the central electronics module, the Engine Control Module and Transmission Control Module Clear the DTC and check that the engine starts in park and neutral and not in any other selected position. If the fault persists, renew the renew the Transmission Control

DTC	Description	Possible Causes	Action
			Module
P0915-01	Gear Shift Position Circuit Range/Performance - General electrical failure	<ul style="list-style-type: none"> General electrical failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0915-64	Gear Shift Position Circuit Range/Performance - Signal plausibility failure	<ul style="list-style-type: none"> Signal plausibility failure 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0930-00	Gear Shift Lock Solenoid/Actuator Circuit A Low - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other related DTCs. Check the shift lock actuator, the connectors and wiring. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and test the shift lever in all positions. If the problem persists, renew the Transmission Control Module Refer to the warranty policies and procedures before renewing the transmission
P0931-00	Gear Shift Lock Solenoid/Actuator Circuit A High - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other related DTCs. Check the shift lock actuator, the connectors and wiring. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and test the shift lever in all positions. If the problem persists, renew the Transmission Control Module Refer to the warranty policies and procedures before renewing the transmission
P0938-29	Hydraulic Oil Temperature Sensor Range/Performance - Signal invalid	<ul style="list-style-type: none"> Temperature sensor signal invalid 	Allow the transmission to cool, clear the DTC and road test the vehicle. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0963-12	Pressure Control Solenoid A Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0963-13	Pressure Control Solenoid A Control Circuit High - Circuit open	<ul style="list-style-type: none"> Control circuit open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0964-13	Pressure Control Solenoid B Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit high resistance 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0966-11	Pressure Control Solenoid B Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Control circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0966-14	Pressure Control Solenoid B Control Circuit Low - Circuit short to ground or open	<ul style="list-style-type: none"> Control circuit short circuit to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0966-1E	Pressure Control Solenoid B Control Circuit Low - Circuit resistance out of range	<ul style="list-style-type: none"> Circuit resistance out of range 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0966-21	Pressure Control Solenoid B Control Circuit Low - Signal amplitude < minimum	<ul style="list-style-type: none"> Circuit signal amplitude below minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0967-12	Pressure Control Solenoid B Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
P0967-22	Pressure Control Solenoid B Control Circuit High - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Circuit signal amplitude above maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0968-13	Pressure Control Solenoid C Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> ● Control circuit open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0970-11	Pressure Control Solenoid C Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> ● Control circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0970-14	Pressure Control Solenoid C Control Circuit Low - Circuit short to ground or open	<ul style="list-style-type: none"> ● Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0971-12	Pressure Control Solenoid C Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> ● Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0972-21	Shift Solenoid A Control Circuit Range/Performance - Signal amplitude < minimum	<ul style="list-style-type: none"> ● Circuit signal amplitude below minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0972-22	Shift Solenoid A Control Circuit Range/Performance - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Circuit signal amplitude above maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0973-11	Shift Solenoid A Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> ● Shift solenoid circuit short to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0973-14	Shift Solenoid A Control Circuit Low - Circuit short to ground or open	<ul style="list-style-type: none"> ● Shift solenoid circuit short to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P0973-1E	Shift Solenoid A Control Circuit Low - Circuit resistance out of range	<ul style="list-style-type: none"> ● Shift solenoid circuit resistance out of range 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P1706-9A	High Vehicle Speed Observed in Park - component or system operating conditions	<ul style="list-style-type: none"> ● Component or system operating conditions - Misuse indication 	<ul style="list-style-type: none"> • NOTE: Park mechanism damage associated with this DTC may not be covered under the manufacturers warranty. <p>Check parking pawl/park mechanism for correct operation. Clear DTC and retest</p>
P2700-07	Transmission Friction Element A Apply Time Range/Performance - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P2701-07	Transmission Friction Element B Apply Time Range/Performance - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P2702-07	Transmission Friction Element C Apply Time Range/Performance - Mechanical Failures	<ul style="list-style-type: none"> ● Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the

DTC	Description	Possible Causes	Action
			transmission. Refer to the warranty policies and procedures before renewing the transmission
P2703-07	Transmission Friction Element D Apply Time Range/Performance - Mechanical Failures	<ul style="list-style-type: none"> Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P2704-07	Transmission Friction Element E Apply Time Range/Performance - Mechanical Failures	<ul style="list-style-type: none"> Mechanical failures 	Check the fluid level and condition. Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the transmission. Refer to the warranty policies and procedures before renewing the transmission
P2716-1E	Pressure Control Solenoid D Electrical - Circuit resistance out of range	<ul style="list-style-type: none"> Pressure control solenoid circuit resistance out of range 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2716-21	Pressure Control Solenoid D Electrical - Signal Amplitude < Minimum	<ul style="list-style-type: none"> Pressure control solenoid signal amplitude less than minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2716-22	Pressure Control Solenoid D Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> Pressure control solenoid signal amplitude greater than maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2718-13	Pressure Control Solenoid D Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2720-11	Pressure Control Solenoid D Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> Control circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2720-14	Pressure Control Solenoid D Control Circuit Low - Circuit short to ground or open circuit	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2721-12	Pressure Control Solenoid D Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2725-1E	Pressure Control Solenoid E Electrical - Circuit resistance out of range	<ul style="list-style-type: none"> Solenoid circuit resistance out of range 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2725-21	Pressure Control Solenoid E Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> Solenoid signal amplitude less than minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2725-22	Pressure Control Solenoid E Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> Solenoid signal amplitude greater than maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2727-13	Pressure Control Solenoid E Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> Control circuit open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect

DTC	Description	Possible Causes	Action
P2729-11	Pressure Control Solenoid E Control Circuit Low - Circuit short to ground	<ul style="list-style-type: none"> ● Control circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2729-14	Pressure Control Solenoid E Control Circuit Low - Circuit short to ground or open circuit	<ul style="list-style-type: none"> ● Control circuit short circuit to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2730-12	Pressure Control Solenoid E Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> ● Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2734-1E	Pressure Control Solenoid F Electrical - Circuit resistance out of range	<ul style="list-style-type: none"> ● Control circuit resistance out of range 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2734-21	Pressure Control Solenoid F Electrical - Signal amplitude < minimum	<ul style="list-style-type: none"> ● Control circuit signal amplitude less than minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2734-22	Pressure Control Solenoid F Electrical - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Control circuit signal amplitude greater than maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2736-13	Pressure Control Solenoid F Control Circuit / Open - Circuit open	<ul style="list-style-type: none"> ● Control circuit open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2738-11	Pressure Control Solenoid F Control Low - Circuit short to ground	<ul style="list-style-type: none"> ● Control circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2738-14	Pressure Control Solenoid F Control Low - Circuit short to ground or open circuit	<ul style="list-style-type: none"> ● Control circuit short circuit to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2739-12	Pressure Control Solenoid F Control High - Circuit short to battery	<ul style="list-style-type: none"> ● Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2763-12	Torque Converter Clutch Pressure Control Solenoid Control Circuit High - Circuit short to battery	<ul style="list-style-type: none"> ● Control circuit short circuit to power 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2763-22	Torque Converter Clutch Pressure Control Solenoid Control Circuit High - Signal amplitude > maximum	<ul style="list-style-type: none"> ● Control circuit signal amplitude greater than maximum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2764-11	Torque Converter Clutch Pressure Control Solenoid Control Circuit High - Circuit short to ground	<ul style="list-style-type: none"> ● Control circuit short circuit to ground 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2764-14	Torque Converter Clutch Pressure Control Solenoid Control Circuit High - Circuit short to ground or open	<ul style="list-style-type: none"> ● Control circuit short circuit to ground or open circuit 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the

DTC	Description	Possible Causes	Action
	circuit		warranty policy and procedures manual if a module is suspect
P2764-1E	Torque Converter Clutch Pressure Control Solenoid Control Circuit High - Circuit resistance out of range	<ul style="list-style-type: none"> Control circuit resistance out of range 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
P2764-21	Torque Converter Clutch Pressure Control Solenoid Control Circuit High - Signal amplitude < minimum	<ul style="list-style-type: none"> Control circuit signal amplitude less than minimum 	Check the Transmission Control Module connector and the power/ground circuits to the module. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect
U0001-88	High Speed CAN Communication CAN Bus - Bus off	Bus off	Refer to the electrical circuit diagrams and check the power and ground connections to the module. Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network
U0100-00	Lost Communication With ECM/PCM "A" - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other CAN Bus off codes. Examine E-box for water ingress, moisture or loose plugs. Refer to the electrical circuit diagrams and check the module connector and power/ground circuits. Refer to network communication section of the workshop manual. Using the manufacturers approved diagnostic system, complete a CAN integrity test
U0102-00	Lost Communication with Transfer Case Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other CAN Bus off codes. Examine E-box for water ingress, moisture or loose plugs. Refer to the electrical circuit diagrams and check the module connector and power/ground circuits. Refer to network communication section of the workshop manual. Using the manufacturers approved diagnostic system, complete a CAN integrity test
U0121-00	Lost Communication With Anti-Lock Brake System (ABS) Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other CAN Bus off codes. Examine E-box for water ingress, moisture or loose plugs. Refer to the electrical circuit diagrams and check the module connector and power/ground circuits. Refer to network communication section of the workshop manual. Using the manufacturers approved diagnostic system, complete a CAN integrity test
U0126-00	Lost Communication With Steering Angle Sensor Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other CAN Bus off codes. Examine E-box for water ingress, moisture or loose plugs. Refer to the electrical circuit diagrams and check the module connector and power/ground circuits. Refer to network communication section of the workshop manual. Using the manufacturers approved diagnostic system, complete a CAN integrity test
U0128-00	Lost Communication With Park Brake Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other CAN Bus off codes. Examine E-box for water ingress, moisture or loose plugs. Refer to the electrical circuit diagrams and check the module connector and power/ground circuits. Refer to network communication section of the workshop manual. Using the manufacturers approved diagnostic system, complete a CAN integrity test
U0138-00	Lost Communication with All Terrain Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other CAN Bus off codes. Examine E-box for water ingress, moisture or loose plugs. Refer to the electrical circuit diagrams and check the module connector and power/ground circuits. Refer to network communication section of the workshop manual. Using the manufacturers approved diagnostic system, complete a CAN integrity test
U0140-00	Lost Communication With Body Control Module - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other CAN Bus off codes. Examine E-box for water ingress, moisture or loose plugs. Refer to the electrical circuit diagrams and check the module connector and power/ground circuits. Refer to network communication section of the workshop manual. Using the manufacturers approved diagnostic system, complete a CAN integrity test
U0300-00	Internal Control Module Software Incompatibility - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other modules reporting CAN Bus off or lost communication faults. If other modules report problems, check the software version in the Central Junction Box (GEM) using the manufacturers approved diagnostic system. If no other modules report problems, check the software version in the Transmission Control Module Update as necessary
U0401-00	Invalid Data Received from ECM/PCM A - No sub type information	<ul style="list-style-type: none"> No sub type information 	Check for other module related DTCs. Refer to the relevant section in the workshop manual. Check the control module for correct software version using the manufacturers approved diagnostic system

DTC	Description	Possible Causes	Action
U0401-64	Invalid Data Received from ECM/PCM A - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	Check for other module related DTCs. Refer to the relevant section in the workshop manual. Check the control module for correct software version using the manufacturers approved diagnostic system
U0401-68	Invalid Data Received from ECM/PCM A - Event information	<ul style="list-style-type: none"> ● Event information 	Check for other module related DTCs. Refer to the relevant section in the workshop manual. Check the control module for correct software version using the manufacturers approved diagnostic system
U0415-64	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module - Signal plausibility failure	<ul style="list-style-type: none"> ● Signal plausibility failure 	Check for other module related DTCs. Refer to the relevant section in the workshop manual. Check the control module for correct software version using the manufacturers approved diagnostic system
U0415-68	Invalid Data Received From Anti-Lock Brake System (ABS) Control Module - Event information	<ul style="list-style-type: none"> ● Event information 	Check for other module related DTCs. Refer to the relevant section in the workshop manual. Check the control module for correct software version using the manufacturers approved diagnostic system
U0422-68	Invalid Data Received From Central Electronics Module - Event information	<ul style="list-style-type: none"> ● Event information 	Check the operation of the command shift switch. Check the electrical connections to the switch. Refer to the electrical circuit diagrams and check the circuit between the command shift switch and the Transmission Control Module. Check the power/ground circuits and the Central Junction Box connector. Refer to the lost communication statement in the network communication section of the workshop manual
U2101-00	Control Module Configuration Incompatible - No sub type information	<ul style="list-style-type: none"> ● No sub type information 	Check that the vehicle configuration is correctly set in the car configuration file using the manufacturer's approved diagnostic software. Check and update the Transmission Control Module software version if necessary
U3000-4B	Control Module - Over temperature	<ul style="list-style-type: none"> ● Module over temperature 	Check the Transmission Control Module connector and the power/ground circuits to the module. Refer to the electrical circuit diagrams and check the transmission cooling circuit. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module Consider environmental conditions before condemning the module. Refer to the warranty policy and procedures manual if a module is suspect
U3001-94	Control Module Improper Shutdown - Unexpected operation	<ul style="list-style-type: none"> ● Event information 	DTC for information only. Clear the DTC and retest. If the problem persists, renew the Transmission Control Module. Refer to the warranty policy and procedures manual if a module is suspect

General Information - Diagnostic Trouble Code (DTC) Index DTC: Multifunction Display Module (FCDIM)

Description and Operation

Multifunction Display Module (FCDIM)



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Multifunction Display Module, for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Diagnosis and Testing).

DTC	Description	Possible Causes	Action
B10BD-11	Multifunctional Switch - circuit short to ground	<ul style="list-style-type: none"> Steering Wheel Module (LH) circuit short to ground Steering Wheel Module (LH) internal failure 	Refer to the electrical circuit diagrams and check the Steering Wheel Module (LH) circuit for short to ground. Check and install a new Steering Wheel Module (LH) as required. Refer to the warranty policy and procedures manual if a module is suspect
B10BD-13	Multifunctional Switch - circuit open	<ul style="list-style-type: none"> Steering Wheel Module (LH) circuit open. Steering Wheel Module (LH) internal failure 	Refer to the electrical circuit diagrams and check Steering Wheel Module (LH) circuit for open circuit. Check and install a new Steering Wheel Module (LH) as required. Refer to the warranty policy and procedures manual if a module is suspect
B10BD-23	Multifunctional Switch - Activation too long - signal stuck low	<ul style="list-style-type: none"> A constant Steering Wheel Module (LH) switch input has been received for more than two minutes Steering Wheel Module (LH) failure 	Clear DTC, cycle ignition if DTC returns suspect Steering Wheel Module (LH) internal fault. Check and install a new Steering Wheel Module (LH) as required. Refer to the warranty policy and procedures manual if a module is suspect
U0010-88	Medium Speed CAN Communication Bus - BMS Bus Off - bus off	<ul style="list-style-type: none"> CAN BUS off condition detected when the ECU required the BUS Medium Speed CAN BUS Circuit Fault CAN BUS circuit short to power, ground or open circuit 	Using the manufacturer approved diagnostic system, complete a Medium Speed CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network.
U0074-88	Control Module Communication Bus Off - IMS CAN - bus off	<ul style="list-style-type: none"> CAN BUS off condition detected when the ECU required the BUS Medium Speed CAN BUS Circuit Fault CAN BUS circuit, short to power, ground or open circuit 	Using the manufacturer approved diagnostic system, complete a Medium Speed CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network.
U0140-00	Lost communication with the BCM - no sub type information	<ul style="list-style-type: none"> Missing message from the Central Junction Box CAN network fault CAN BUS circuit, short to power, ground or open circuit 	Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Multifunction Display Module and the Central Junction Box
U0155-00	Lost communication with the ICP - no sub type information	<ul style="list-style-type: none"> Missing message from the Integrated Control Panel (Lower) CAN network fault CAN BUS circuit, short to power, ground or open circuit 	Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Multifunction Display Module and the Integrated Control Panel (Lower)

DTC	Description	Possible Causes	Action
U0184-00	Lost communication with Radio (IAM) - no sub type information	<ul style="list-style-type: none"> ● Lost Communications with the Audio Front Control Module ● CAN network fault ● CAN BUS circuit, short to power, ground or open circuit 	Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Multifunction Display Module and the Audio Front Control Module
U0195-00	Lost communication with Telephone Control Module (BVC) - no sub type information	<ul style="list-style-type: none"> ● Missing message from the Telephone Module 	Using the manufacturer approved diagnostic system, complete a CAN network integrity test. Refer to the electrical circuit diagrams and check the CAN network between the Multifunction Display Module and Telephone Module
U0422-68	Invalid Data Received From Body Control Module (BCM) - event information	<ul style="list-style-type: none"> ● Invalid data received from Central Junction Box ● Multifunction Display Module internal failure 	Check for related DTCs within the Central Junction Box. Clear DTC and re-check, if DTC remains suspect a Multifunction Display Module internal fault. Check and install a new Multifunction Display Module as required. Refer to the warranty policy and procedures manual if a module is suspect
U2100-00	Initial Configuration Not Complete - no sub type information	<ul style="list-style-type: none"> ● Multifunction Display Module configuration not complete ● Multifunction Display Module internal failure 	Confirm the latest Strategy and Calibration software is installed, using the manufacturer approved diagnostic system carry out the new Multifunction Display Module application and update the Multifunction Display Module software if required
U2101-00	Control Module Configuration Incompatible - no sub type information	<ul style="list-style-type: none"> ● Invalid Car Configuration received from Central Junction Box ● Car Configuration parameter incorrect ● Multifunction Display Module internal failure 	Using the manufacturer approved diagnostic system check and amend the Car Configuration as required
U300-00	Control Module - no sub type information	<ul style="list-style-type: none"> ● Multifunction Display Module software corrupted ● Multifunction Display Module internal failure 	Suspect Multifunction Display Module internal fault. Clear the DTC, cycle ignition state to off then on. If the DTC returns replace the Multifunction Display Module. Refer to the warranty policy and procedures manual if a module is suspect
U3006-16	Control Module Input Power "A" - circuit voltage below threshold	<ul style="list-style-type: none"> ● The power supply to the Multifunction Display Module has been below 9 Volts for more than 1000 milliseconds 	Suspect Battery fault. Check the battery condition and state of charge. Check the vehicle charging system. Refer to the relevant workshop manual section. Clear the DTC, cycle ignition state to off then on if DTC returns refer to the electrical circuit diagrams and check power and ground circuit to the Multifunction Display Module
U3006-17	Control Module Input Power "A" - circuit voltage above threshold	<ul style="list-style-type: none"> ● The power supply to the Multifunction Display Module has been above 16 Volts for more than 1000 milliseconds 	Suspect Charging fault. Check the battery condition and state of charge. Check the vehicle charging system. Refer to the relevant workshop manual section

General Information - Diagnostic Trouble Code (DTC) Index DTC: Bluetooth Module - Mid Line (SPRM)

Description and Operation



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).

• **NOTE:** If a module/component is suspected to have failed and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• **NOTE:** Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• **NOTE:** If DTCs are recorded and, after performing the pinpoint checks, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

The table below lists all Diagnostic Trouble Codes (DTCs) that could be logged in the Bluetooth® Telephone Control Module (TEL), for additional Diagnosis and Testing information refer to the relevant Diagnosis and Testing Section. For additional information, refer to: [Cellular Phone](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

Bluetooth® Telephone Control Module (TEL)

DTC	Description	Possible Causes	Action
B1D79-11	Microphone Input - circuit short to ground	<ul style="list-style-type: none"> Microphone circuit short to ground Microphone failure 	Refer to the electrical circuit diagrams and check the microphone circuit for short to ground. Check and install a new microphone as required.
B1D79-12	Microphone Input - circuit short to battery	<ul style="list-style-type: none"> Microphone circuit short to power Microphone failure 	Refer to the electrical circuit diagrams and check the microphone circuit for short to power. Check and install a new microphone as required.
B1D79-13	Microphone Input - circuit open	<ul style="list-style-type: none"> Microphone circuit open circuit, high resistance Microphone disconnected Microphone failure 	Refer to the electrical circuit diagrams and check the microphone circuit for open circuit, high resistance. Check the microphone electrical connector. Check and install a new microphone as required.
B1D79-1E	Microphone Input - circuit resistance out of range	<ul style="list-style-type: none"> Microphone circuit open circuit, high resistance Microphone disconnected Microphone failure 	Refer to the electrical circuit diagrams and check the microphone circuit for open circuit, high resistance. Check the microphone electrical connector. Check and install a new microphone as required.
U0010-88	Medium Speed CAN Communication Bus - bus off	<ul style="list-style-type: none"> Control Area Network (CAN) circuit short to ground, short to power, open circuit 	Refer to the electrical circuit diagrams and check the power and ground connections to the Bluetooth® Telephone Control Module (TEL). Using the manufacturer approved diagnostic system, complete a Control Area Network (CAN) integrity test. Refer to the electrical circuit diagrams and check the Control Area Network (CAN).
U2100-00	Initial Configuration Not Complete - no sub type information	<ul style="list-style-type: none"> Car Configuration File (CCF) mis-match Bluetooth® Telephone Control Module (TEL) failure 	Using the manufacturer approved diagnostic system; check the Car Configuration File (CCF) is correct. Clear the DTC and retest. Re-configure the Bluetooth® Telephone Control Module (TEL) as required. Check and install a new Bluetooth® Telephone Control Module (TEL) as required. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component.
U2101-00	Control Module Configuration Incompatible - no sub type information	<ul style="list-style-type: none"> Car Configuration File (CCF) mis-match Bluetooth® Telephone Control Module (TEL) failure 	Using the manufacturer approved diagnostic system; check the Car Configuration File (CCF) is correct. Clear the DTC and retest. Re-configure the Bluetooth® Telephone Control Module (TEL) as required. Check and install a new Bluetooth® Telephone Control Module (TEL) as required. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component.
U3000-41	Control Module - general checksum failure	<ul style="list-style-type: none"> Bluetooth® Telephone Control Module (TEL) failure 	Using the manufacturer approved diagnostic system, clear the DTC and retest. Re-configure the Bluetooth® Telephone Control Module (TEL) as required. Check and install a new Bluetooth® Telephone Control Module (TEL) as required. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

DTC	Description	Possible Causes	Action
U3000-44	Control Module - data memory failure	<ul style="list-style-type: none"> ● Bluetooth® Telephone Control Module (TEL) failure 	Using the manufacturer approved diagnostic system, clear the DTC and retest. Re-configure the Bluetooth® Telephone Control Module (TEL) as required. Check and install a new Bluetooth® Telephone Control Module (TEL) as required. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component.
U3000-45	Control Module - program memory failure	<ul style="list-style-type: none"> ● Bluetooth® Telephone Control Module (TEL) failure 	Using the manufacturer approved diagnostic system, clear the DTC and retest. Re-configure the Bluetooth® Telephone Control Module (TEL) as required. Check and install a new Bluetooth® Telephone Control Module (TEL) as required. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component.
U3000-46	Control Module - calibration parameter memory failure	<ul style="list-style-type: none"> ● Bluetooth® Telephone Control Module (TEL) failure 	Using the manufacturer approved diagnostic system, clear the DTC and retest. Re-configure the Bluetooth® Telephone Control Module (TEL) as required. Check and install a new Bluetooth® Telephone Control Module (TEL) as required. Refer to the Warranty Policy and Procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component.
U3000-51	Control Module - not programmed	<ul style="list-style-type: none"> ● Bluetooth® Telephone Control Module (TEL) not programmed 	Using the manufacturer approved diagnostic system, clear the DTC and retest. Re-configure the Bluetooth® Telephone Control Module (TEL) as required.

Identification Codes - Identification Codes

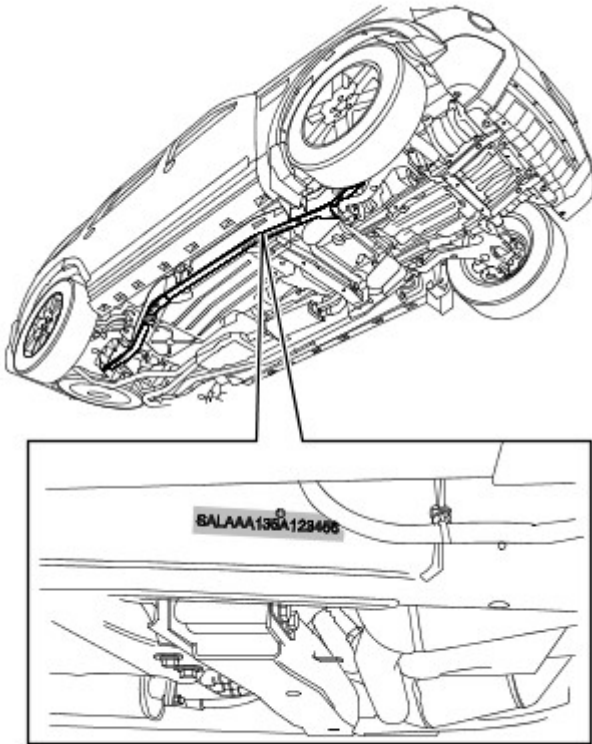
Description and Operation

VIN Number

The VIN number will be found in three locations:

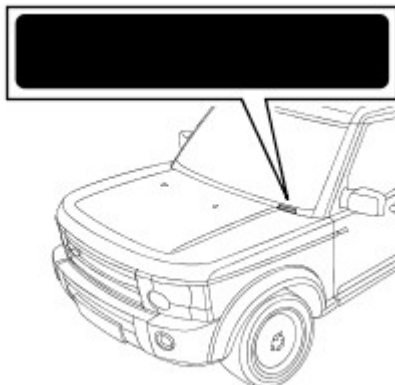
- 1. Stamped on the side of the RH longitudinal member, rearward of the body front mounting.
- 2. At the bottom of the windshield glass on the LH side of the vehicle and visible from the outside.
- 3. **UK, Europe and ROW - Not NAS/Canada** - On the VIN plate attached to the bonnet locking platform.
- 4. **NAS/Canada** - On the Tire Data/Specification label attached to the front of the LH B-pillar.

Longitudinal Member VIN



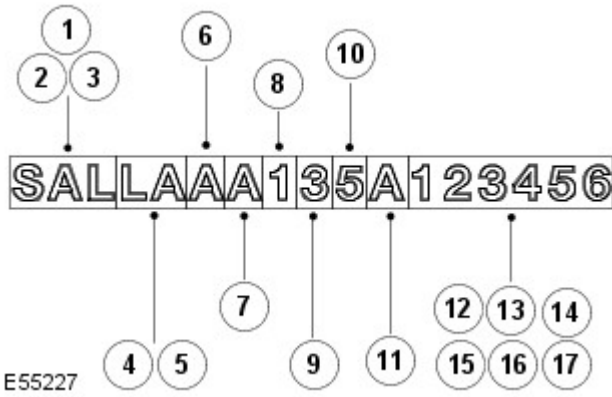
E54942

Windscreen VIN



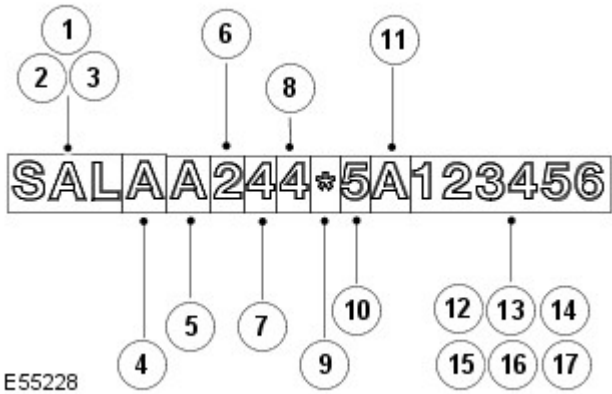
E54943

VIN number - UK, EU and ROW



VIN Position	Character	Identifies
1 - 3 - World identifier	SAL	Land Rover (UK)
4,5 - Vehicle type	LA	Land Rover - Discovery 4
6 - Class	A	Standard
6 - Class	J	Japan
7 - Body style	A	4 Door
7 - Body style	D	Commercial
7 - Body style	K	Armoured
8 - Engine	1	276DT - V6 2.7 Diesel
8 - Engine	4	406PN - V6 4.0 Petrol
8 - Engine	6	276DT - V6 2.7 Diesel with cDPF
8 - Engine	D	508PN - V8 5.0 NA Petrol
8 - Engine	F	306DT - V6 3.0 Diesel
8 - Engine	G	306DT - V6 3.0 Diesel with cDPF
9 - Transmission and steering	3	RHD Automatic
9 - Transmission and steering	4	LHD Automatic
9 - Transmission and steering	7	RHD Manual
9 - Transmission and steering	8	LHD Manual
10 - Model year	A	2010
11 - Plant	A	Solihull
11 - Plant	G	CKD Russia
12 - 17 - Serial number	1 2 3 4 5 6	Unique six digit serial number

VIN number - NAS and Canada

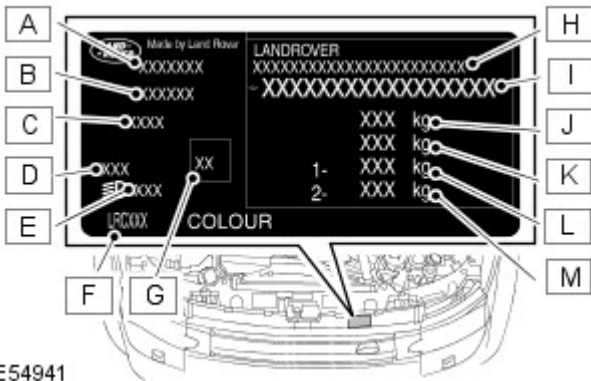


• NOTE: # Manual belts with driver and passenger frontal air bags and side inflatable restraint (1st,2nd (& 3rd) row when fitted).

VIN Position	Character	Identifies
1 - 3 - World identifier	SAL	Land Rover (UK)
4 - Make / Model	A	Land Rover - LR4
5 - Class / Nas restraint type	B	TL "S" / LR3 Base 5 Seats #
5 - Class / Nas restraint type	C	TL "S" / LR3 Base 7 Seats #
5 - Class / Nas restraint type	D	TL "SE" 5 Seats #
5 - Class / Nas restraint type	E	TL "SE" 7 Seats #
5 - Class / Nas restraint type	F	TL "HSE" 5 Seats #
5 - Class / Nas restraint type	G	TL "HSE" 7 Seats #
5 - Class / Nas restraint type	H	TL "HSE" Lux 5 Seats #
5 - Class / Nas restraint type	K	TL "HSE" Lux 7 Seats #
5 - Class / Nas restraint type	L	TL "HSE" Plus 5 Seats #
5 - Class / Nas restraint type	M	TL "HSE" Plus 7 Seats #
5 - Class / Nas restraint type	N	China
6 - Body style	2	4 Door Station Wagon
7 - Engine	1	276DT - V6 2.7 Diesel
7 - Engine	4	406PN - V6 4.0 Petrol

VIN Position	Character	Identifies
7 - Engine	D	508PN - V8 5.0 NA
7 - Engine	F	306DT - V6 3.0 Diesel
8- Transmission and steering	4	LHD Automatic
9 - Check digit	*	Derived by calculation
10- Model year	A	2010
11 - Plant	A	Solihull
12 -17 - Serial number	1 2 3 4 5 6	Unique six digit serial number

Bonnet locking platform VIN plate - Not NAS/Canada

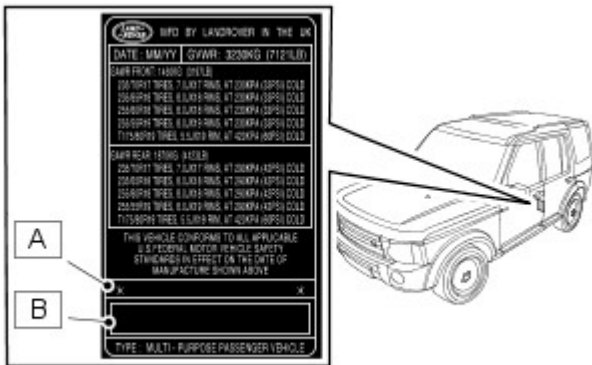


E54941

The VIN plate contains the following information:

- **A** - Reserved
- **B** - Engine Description
- **C** - Country
- **D** - Diesel Indicator
- **E** - Reserved
- **F** - Headlamp Code/initial aim value - If shown
- **G** - Colour code/group
- **H** - Type/Approval Number - If shown
- **I** - VIN Number
- **J** - Gross Vehicle Weight
- **K** - Gross Train Weight
- **L** - Front Axle Weight
- **M** - Rear Axle Weight

VIN/Certification/Tire Data Label - NAS only

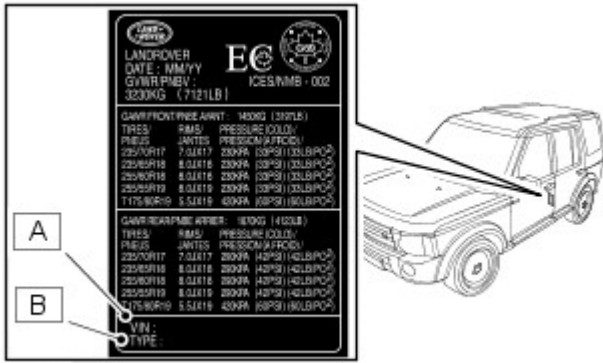


E54951

The Certification Label contains the following VIN information:

- **A** - * Vehicle VIN Number
- **B** - Bar code identification

VIN/Tire Pressure Specification Label - Canada only



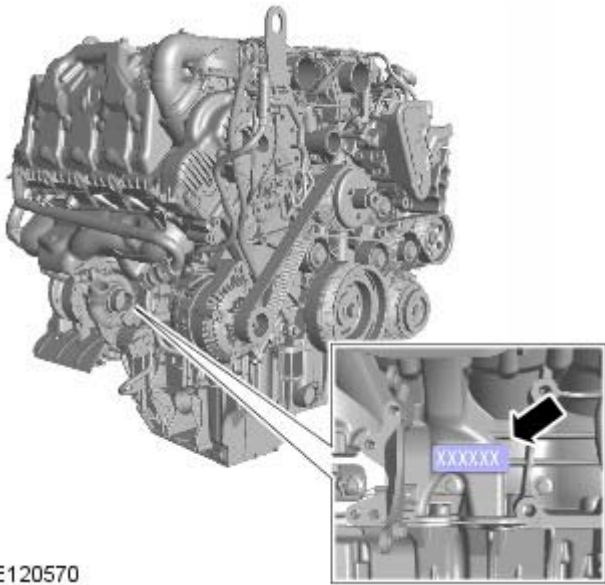
E54950

The Tire Pressure Certification Label contains the following VIN information:

- **A** - Vehicle VIN Number
- **B** - Vehicle Type

Unit/Assembly Serial Number Locations

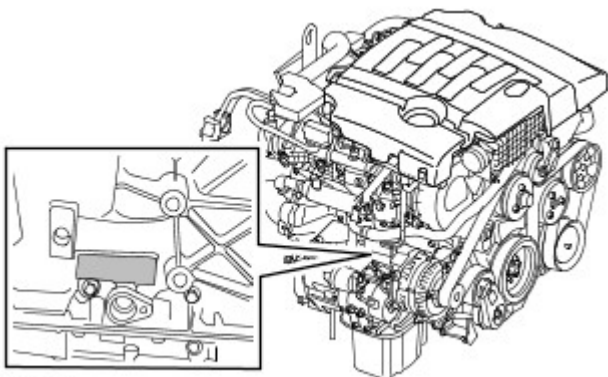
3.0 litre V6 Diesel Engine Serial Number



E120570

3.0 Litre V6 Diesel Engine Serial Number is stamped on the RH side of the cylinder block.

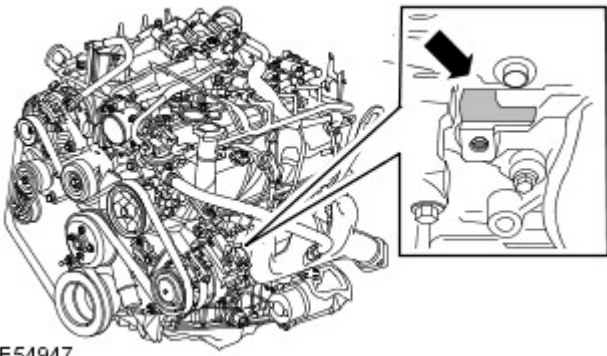
2.7 Litre V6 Diesel Engine Serial Number



E54949

The 2.7 Litre V6 Diesel Engine Serial Number is stamped on the RH side of the cylinder block.

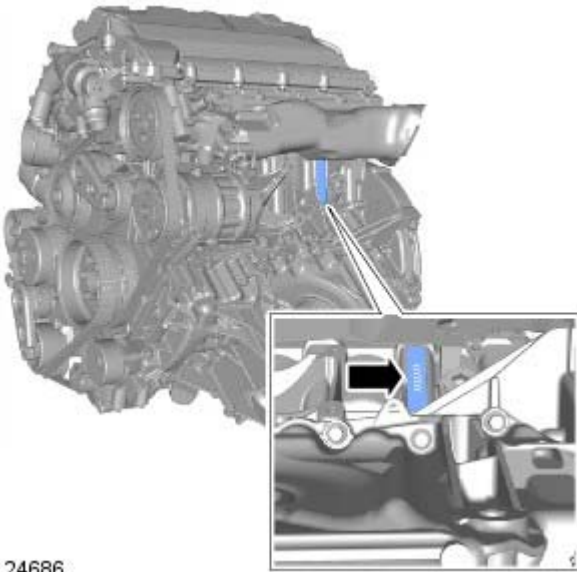
4.0 Litre V6 Petrol Engine Serial Number



E54947

The 4.0 Litre V6 Petrol Engine Serial Number is stamped on the LH side of the cylinder block.

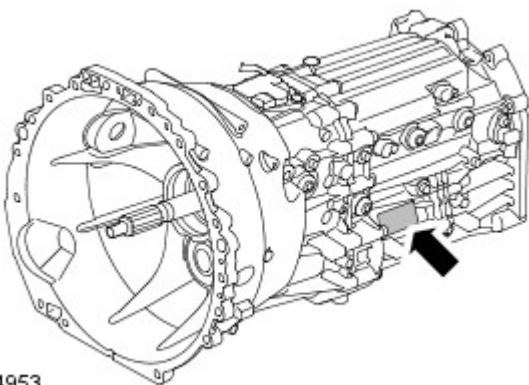
5.0 Litre NA V8 Petrol Engine Serial Number



E124686

The 5.0 Litre NA V8 Petrol Engine Serial Number is stamped on the LH side of the cylinder block.

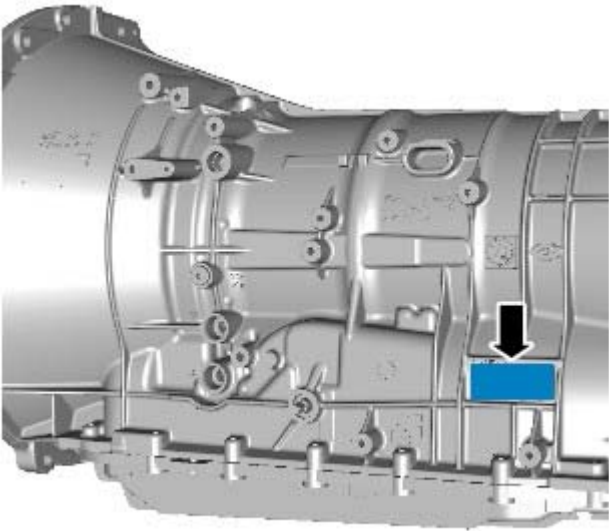
Manual Gearbox Serial Number



E54953

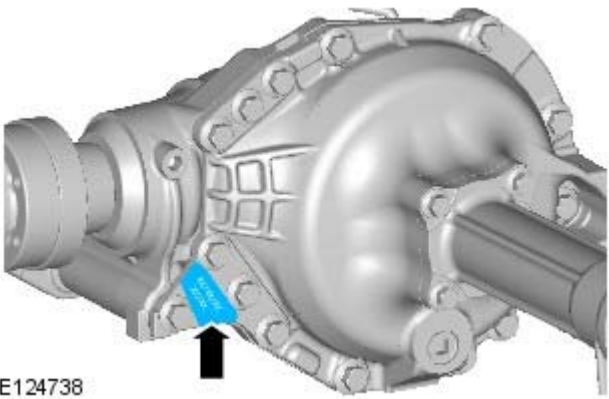
The Manual Gearbox Serial Number is stamped on the rear LH side of the gearbox casing.

Automatic Gearbox Serial Number



E120916

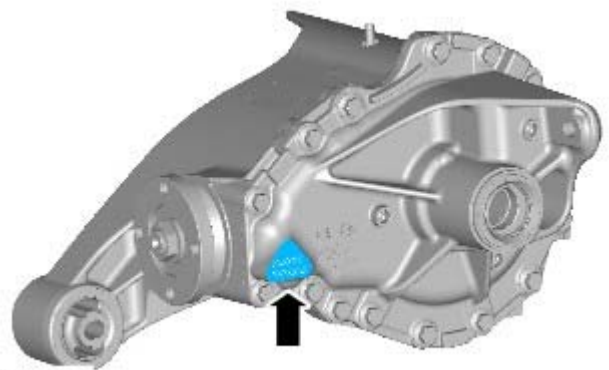
The Automatic Gearbox Serial Number is stamped on the rear LH side of the gearbox casing.
Front Differential Serial Number



E124738

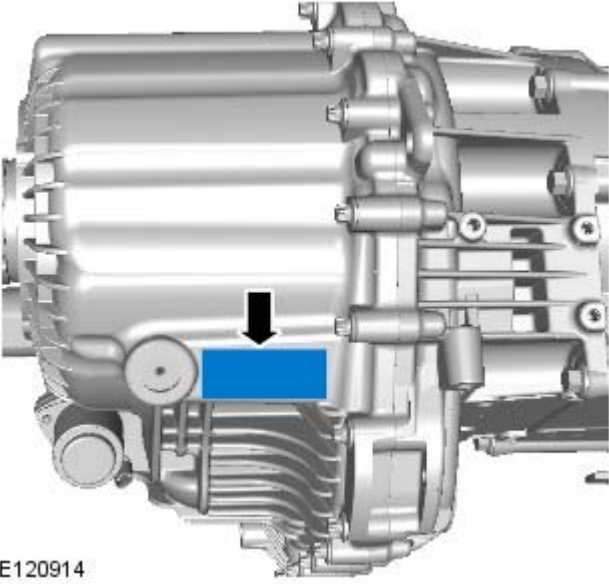
The Front Differential Serial Number is stamped on the underside of the differential casing and is located above the removable cross member.

Rear Differential Serial Number



E124739

The Rear Differential Serial Number is stamped on the underside of the differential casing adjacent to the front mounting.
Transfer Case Serial Number



E120914

The Transfer Case serial number is stamped on the RH side of the transfer case and may also be on a bar coded self-adhesive label attached to the case.

Jacking and Lifting - Jacking

Description and Operation

General



WARNING: The following instructions must be adhered to before raising the vehicle off the ground:

- Position vehicle on a solid, level surface.
- Apply the parking brake.
- Select 'P' - PARK on automatic transmission selector or 1st gear on manual transmission and 'H' High on transfer case.



WARNING: If the drive shaft(s) are to be disconnected, it will be necessary to raise all four wheels off the ground in order that the shaft(s) can be rotated. DO NOT use the customer jack and ensure that the vehicle is adequately supported on axle stands. With the vehicle raised, it will be necessary to release the park brake and select Neutral - 'N' in the main transmission to enable the drive shaft(s) to be rotated

• CAUTIONS:



To avoid damage to the underbody components of the vehicle, the following instructions must be adhered to:



Do not position jacks or axle stands under the following components:

- Body structure other than any approved jacking or lifting points
- Bumpers
- Fuel lines
- Fuel tank
- Brake lines
- Front or rear suspension arms
- Steering linkage
- Transfer case
- Front or rear differential units
- Transmission
- Engine oil pan - See note below

• NOTE: For certain repair operations, it may be necessary to support the engine under the oil pan. In this case, a block of hardwood or a rubber pad must be positioned on the jack lifting pad to protect the oil pan.

Vehicle jack

The jack provided with the vehicle is only intended for use in an emergency such as changing a tire. DO NOT use the jack for any other purpose. Refer to the Owner's Handbook for the vehicle jack location points and jacking procedures.



WARNING: Never work under a vehicle supported solely by the vehicle jack.

Hydraulic jack

A hydraulic jack with a minimum lifting capacity of 1500 kg, (3,300 lbs) must be used.

• WARNINGS:



Do not commence work on the underside of the vehicle until suitable axle stands have been placed in the correct position.



Always chock the wheels when jacking. The parking brake may be ineffective when the wheel(s) are off the ground.

Raising and Supporting the Vehicle

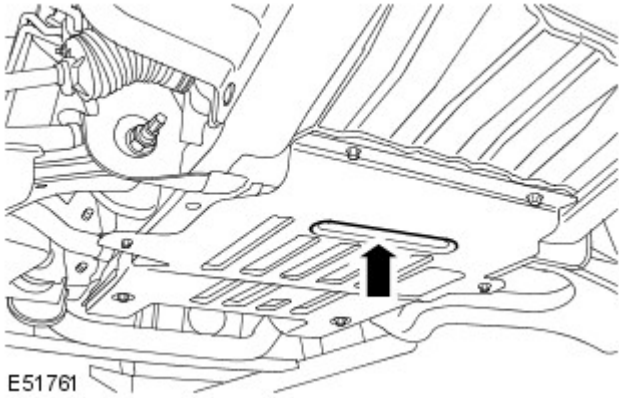
To assist in raising the vehicle, jacking points are provided as shown in the following illustrations.

Raising the Front of the Vehicle

Apply the parking brake.

Select 'P' - PARK on automatic transmission selector.

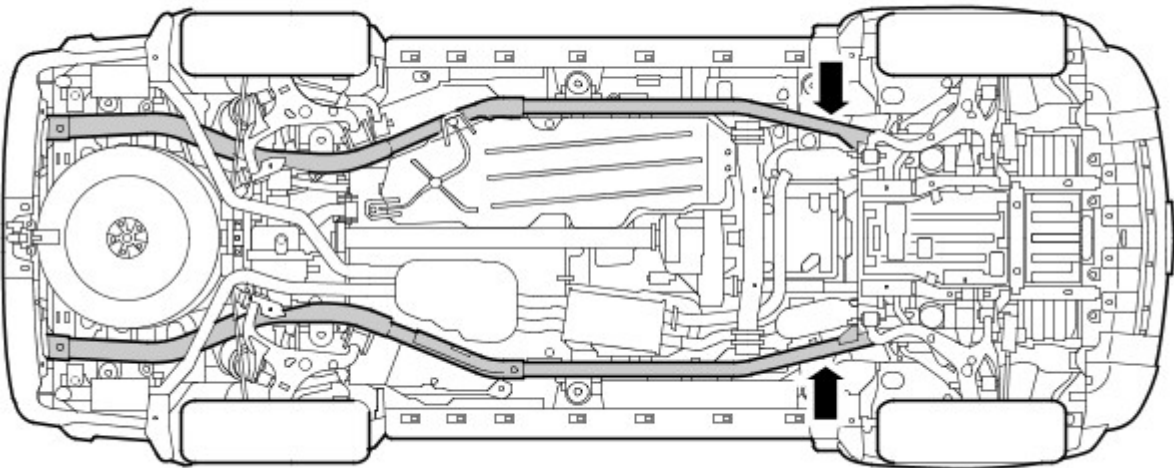
 **WARNING:** Always chock the rear wheels when jacking the front of the vehicle.



Position the lifting pad of the hydraulic jack in the centre of the recess in the engine undershield.

• **NOTE:** If the engine undershield has been removed, position the jack lifting pad in the centre of the front cross beam.

With the vehicle raised to the desired height, position axle stands at positions shown.



 **CAUTION:** Position suitable material between axle stands and longitudinal members to prevent damage to the longitudinal members.

Carefully lower jack until vehicle rests on axle stands.

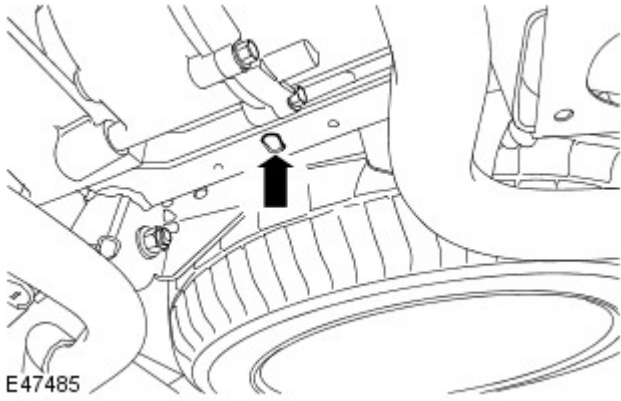
 **WARNING:** Before commencing work on the underside of the vehicle, ensure that axle stands are correctly positioned and vehicle is securely supported.

Reverse procedure when removing vehicle from stands.

Raising the Rear of the Vehicle

Select 'P' - PARK on automatic transmission selector.

 **WARNING:** Always chock the front wheels when jacking the rear of the vehicle.

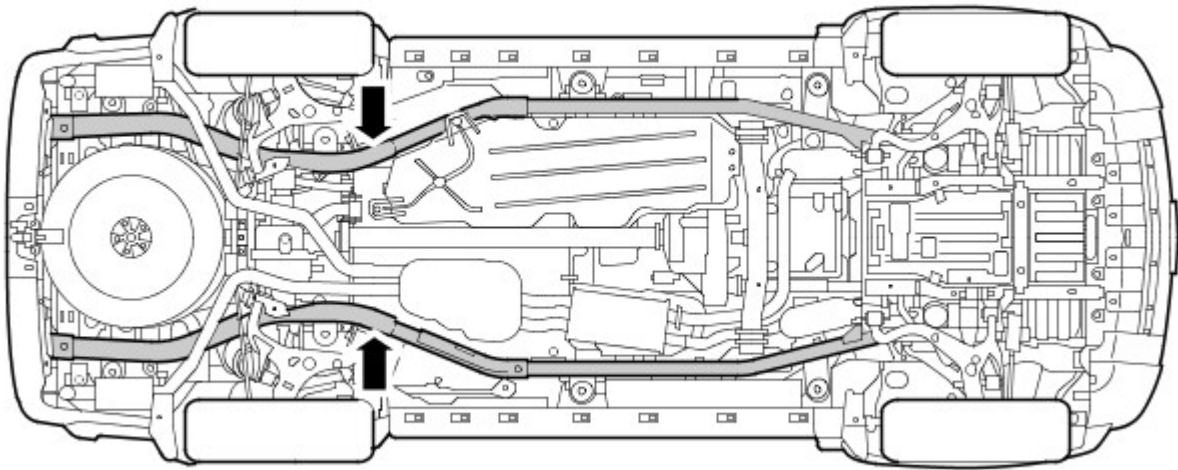


E47485

Position the lifting pad of the hydraulic jack under the centre of the rear cross member as shown.



CAUTION: Take care that the lifting pad of the jack is of a suitable size to avoid damaging the heat shield. It is not advisable to use a spacer block between the lifting pad and the rear cross member as this may result in some vehicle instability.



E47486

With vehicle raised to desired height, position axle stands at positions shown.



CAUTION: Position suitable material between axle stands and longitudinal members to prevent damage to the longitudinal members.

Carefully lower jack until vehicle rests on axle stands.



WARNING: Before commencing work on underside of vehicle, ensure that axle stands are correctly positioned and vehicle is securely supported.

Reverse procedure when removing vehicle from stands.

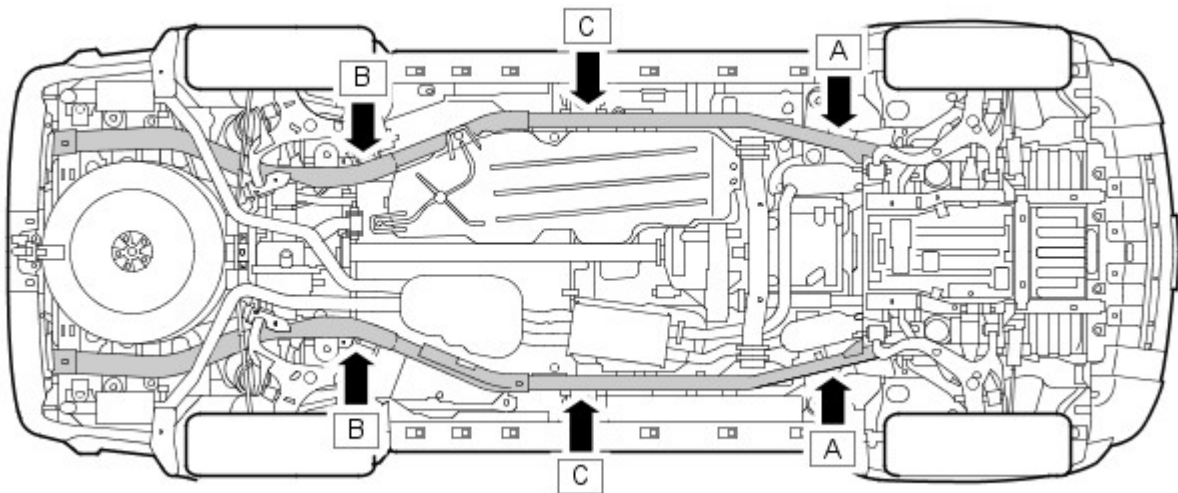
Raising Vehicle - One Wheel/side

Apply the parking brake.

Select 'P' - PARK on automatic transmission selector.

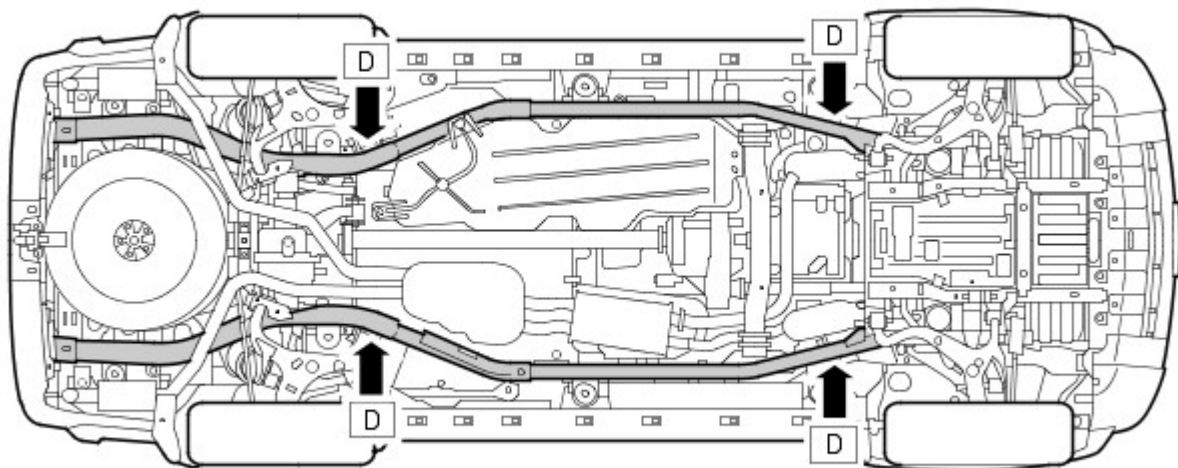


WARNING: Always chock the wheels which are not to be raised.



E47487

- **One front wheel** - position lifting pad of hydraulic jack beneath longitudinal member on the side to be raised at Point 'A'
 - **One rear wheel** - position lifting pad of jack beneath longitudinal member on the side to be raised at Point 'B'
 - **Front and rear wheels - ONE SIDE** - position lifting pad of jack beneath longitudinal member on the side to be raised at Point 'C'
- NOTE: Point 'C' is in line with number 3 body mounting.



E47488

With vehicle at desired height, position axle stand(s) beneath longitudinal members and adjacent to the lifting pad of the jack at appropriate point(s) D.

⚠ CAUTION: Position suitable material between axle stands and longitudinal members to prevent damage to the longitudinal members.

Carefully lower jack until vehicle rests on axle stands.


⚠ WARNING: Before commencing work on underside of vehicle, ensure that axle stands are correctly positioned and vehicle is securely supported.

Reverse procedure when removing vehicle from stands.

Jacking and Lifting - Lifting

Description and Operation

Vehicle on Wheels - Four Post Ramp

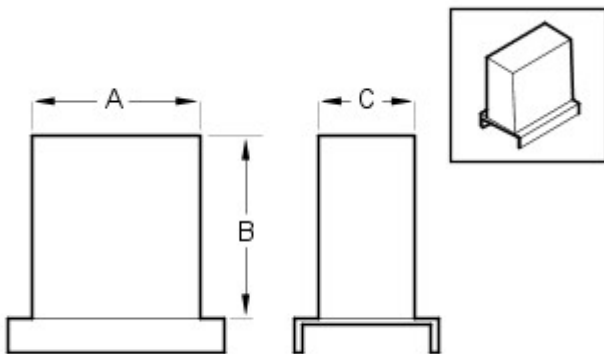
 **WARNING:** If the drive shaft(s) are to be disconnected, it will be necessary to raise all four wheels off the ramp in order that the shaft(s) can be rotated. If the wheel free facility is not to be used, raise the vehicle off the ramp using suitable equipment. With the vehicle raised, position axle stands in the positions shown for the front and rear support blocks - see illustration in Jacking. With the axle stands positioned, release the parking brake and select NEUTRAL 'N' in the transmission.

 **WARNING:** Do not push the vehicle backwards and forwards along the ramp in order to gain access to the drive shaft fixings.

Position the vehicle on the ramp with the front and rear of the vehicle equidistant from the ends of the ramp. Chock the wheels, select NEUTRAL in the transmission and where practicable, apply the parking brake.

Wheel Free Lift - Four Post Ramp

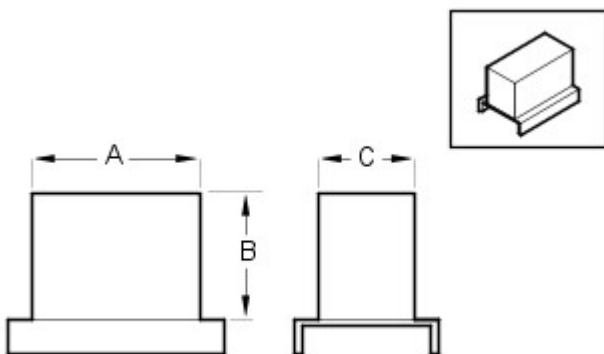
• **NOTE:** To enable the vehicle to be supported correctly on the wheel free longitudinal, it will be necessary to produce 2 off each of the support blocks to the dimensions given in the accompanying illustrations. The supporting part of each block must be manufactured from suitable hardwood or metal and the 'U' shaped base of each block must be manufactured from metal. Note that it is essential to ensure that the 'U' shaped base of each block is wide enough to fit over the wheel free longitudinal.



E48763

Front Support Block Dimensions

- 'A' = 127.0 mm (5.0 in)
- 'B' = 146.0 mm (5.75 in)
- 'C' = 89.0 mm (3.5 in)



E48764

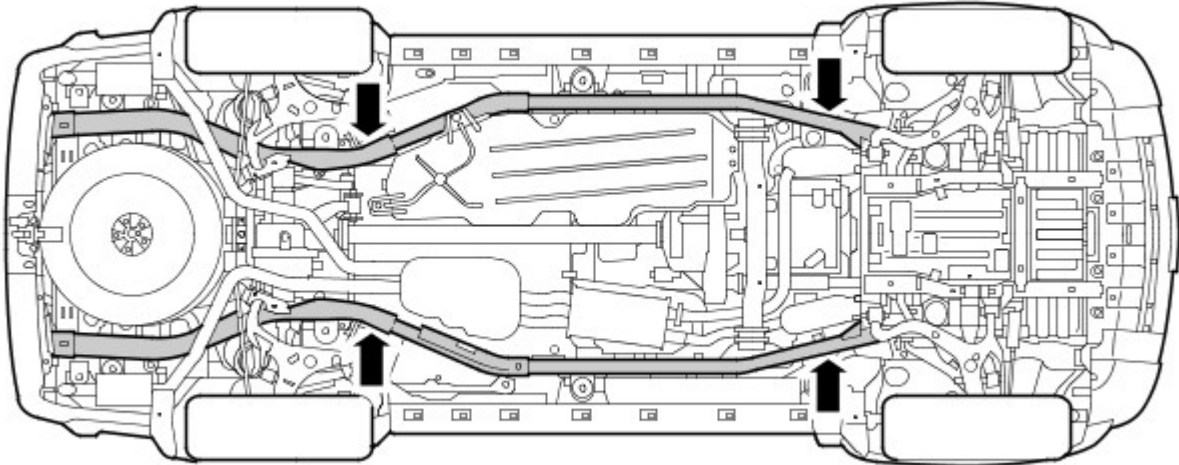
Rear support block dimensions

- 'A' = 152.0 mm (6.0 in)
- 'B' = 101.0 mm (4.0 in)
- 'C' = 76.0 mm (3.0 in)

Raising and Supporting the Vehicle

1. Position vehicle on ramp.
2. Position suspension in 'off-road' height.
3. Apply parking brake.

4. Raise ramp to desired height.



E47489

5. Align the wheel free longitudinals beneath the body frame longitudinals and position the support blocks beneath the longitudinals in the positions shown.



CAUTION: Ensure that the front and rear support blocks are correctly oriented to front and rear of vehicle.

6. Engage wheel free and lower ramp slowly until weight of vehicle rests on support blocks and road wheels are just clear of ramp.

7. Ensure that the vehicle is correctly supported on all four support blocks, that blocks are still correctly positioned and are in full contact with the body frame longitudinals.

8. Lower the ramp.



WARNING: Make sure that the vehicle is stable before commencing work.

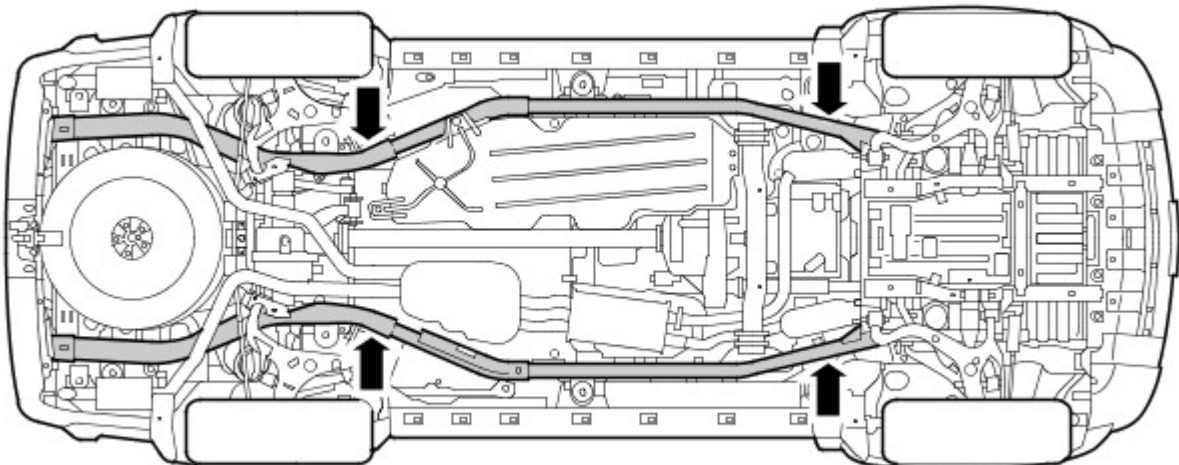
• **NOTE:** Return the suspension to 'normal ride height' when the vehicle is removed from the ramp.

Two Post Lift



CAUTION: If the drive shaft(s) are to be removed, release the parking brake and select NEUTRAL 'N' in the transmission in order that the shaft(s) can be rotated when the vehicle is raised to the desired height.

1. Position the vehicle with the centre of the lift pillars aligned approximately with the front of the driver/passenger seat cushions.



E47489

2. Extend the lifting arms and position the pad of each lifting arm beneath the body frame longitudinal lifting points.

3. Raise the vehicle until the wheels are just clear of the ground and check that the pads of each lifting arm are still

correctly positioned.

4. Raise the vehicle to the desired height.

5. Ensure that vehicle is correctly supported on all four lifting pads, that pads are still correctly positioned and are in full contact with the body frame longitudinals.



WARNING: Make sure that the vehicle is stable before commencing work.

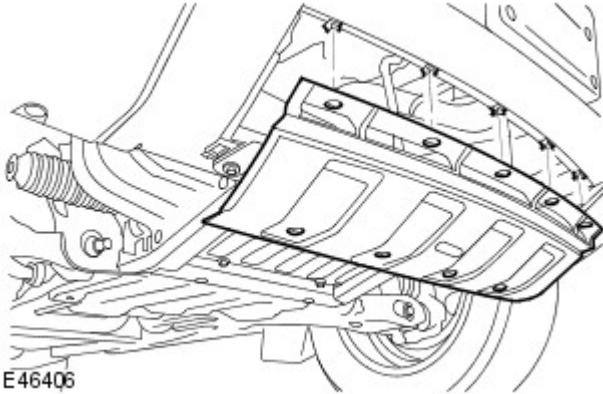
Jacking and Lifting - Vehicle Recovery

Description and Operation

Towing/Lashing eyes



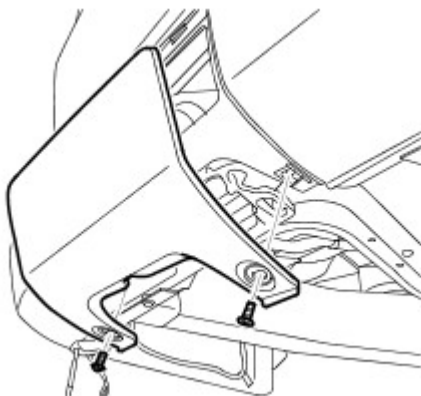
CAUTION: The single towing/lashing eyes at the front and rear of the vehicle are designed for vehicle recovery purposes only and **MUST** not be used to tow a trailer or caravan.



The front towing/lashing eye is accessible after releasing the 9 toggle fasteners securing the towing eye access panel and removing the panel.



CAUTION: Ensure that during towing, the towing attachment does not contact the bumper.



The rear towing/lashing eye 'A' is accessible after releasing the 2 fasteners securing the access panel to the bumper and removing the panel.



CAUTION: This towing/lashing eye should only be used for towing another vehicle or for recovery purposes to enable this vehicle to be positioned in order that the front towing eye may be used for recovery/towing.

4 Wheel Towing

• CAUTIONS:



Suspended towing of this vehicle **MUST NOT** be attempted, if 4 wheel towing is not possible, vehicle must be recovered on a suitable trailer.



The vehicle may be towed for a maximum of 3 hours or 90 miles (150 km) at a maximum speed of 30 mph (50 km/h), these limits **MUST NOT** be exceeded.



The following procedures must be followed to ensure that the vehicle is towed in a safe condition and damage to the vehicle transmission system is prevented.

1. Remove the front towing/lashing eye access panel.
2. Secure the towing attachment from the recovery vehicle to the towing/lashing eye.



CAUTION: Ensure that the towing attachment will not contact the front bumper during towing.

3. Apply the parking brake.
4. Insert ignition key and turn the ignition switch to position 'II'.
5. **Manual gearbox:** Apply the footbrake and position the gear lever in 'N' - Neutral.



CAUTION: If 'N' - Neutral cannot be selected, front and rear propeller shafts must be removed before vehicle is towed.

6. **Automatic gearbox:** Apply the footbrake and move the selector lever to the 'N' Neutral position.

- **NOTE:** If electrical power is not available, use the manual interlock release tab on the selector lever to move the selector lever to the Neutral position.

All vehicles

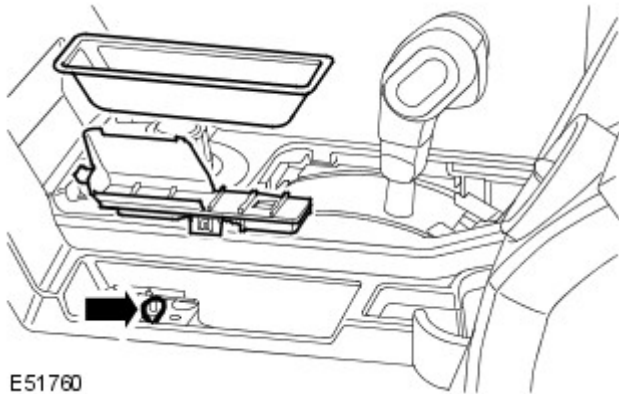
7. Select 'H' - HIGH on the transfer box.



CAUTION: If electrical power is not available, and 'H' - HIGH cannot be selected, the vehicle may not be towed but must be recovered on a suitable trailer. If, however, transfer box was in 'H' - HIGH when electrical power was lost, vehicle may still be towed.

8. Release the parking brake.

- **NOTE:** If electrical power is not available, it will be necessary to release the parking brake manually using the following procedures:



- **NOTE:** Left hand drive illustrated, right hand drive on opposite side of centre console.

9. Lift out the coin tray from the centre console
10. Remove the access panel from the centre console.
11. Locate the electric parking brake release cable, insert a suitable tool through the cable eye and pull the cable upwards to release the parking brake.



CAUTION: The electric parking brake will not function until electrical power is restored it will, therefore, be necessary to chock the wheels when vehicle is at a standstill.



WARNING: Do not release the parking brake until towing is about to commence. Whilst towing, do not attempt to remove the ignition key and do not turn the key to any position other than 'II'. With the engine switched off, the power assisted steering system and brake booster will be inoperative thereby resulting in an increase in the effort required to turn the steering wheel and apply the brakes.



CAUTION: The vehicle tow connections should only be used in normal road conditions, 'snatch' recovery must be avoided.

On completion of 4 wheel towing

1. Apply the parking brake or if electrical power is not available, securely chock the wheels.
2. Detach towing equipment from towing/lashing eyes.
3. Fit the towing eye access panel and secure the toggle fasteners.

Transporting by trailer



CAUTION: Use the towing/lashing eyes at the front and rear of the vehicle, DO NOT secure lashing hooks or restraints to any other part of the vehicle.

Position the vehicle, apply the parking brake and select 'N' - Neutral on the manual or automatic gearbox selector lever



CAUTION: If electrical power is not available and the parking brake is released, it will not be possible to re-apply the parking brake. It will, therefore be necessary to select 1st gear - manual gearbox or 'P' Park - automatic gearbox and ensure that the vehicle wheels are adequately chocked to prevent vehicle movement.

Jacking and Lifting - Jacking

Description and Operation

General



WARNING: The following instructions must be adhered to before raising the vehicle off the ground:

- Position vehicle on a solid, level surface.
- Apply the parking brake.
- Select 'P' - PARK on automatic transmission selector or 1st gear on manual transmission and 'H' High on transfer case.



WARNING: If the drive shaft(s) are to be disconnected, it will be necessary to raise all four wheels off the ground in order that the shaft(s) can be rotated. DO NOT use the customer jack and ensure that the vehicle is adequately supported on axle stands. With the vehicle raised, it will be necessary to release the park brake and select Neutral - 'N' in the main transmission to enable the drive shaft(s) to be rotated

• CAUTIONS:



To avoid damage to the underbody components of the vehicle, the following instructions must be adhered to:



Do not position jacks or axle stands under the following components:

- Body structure other than any approved jacking or lifting points
- Bumpers
- Fuel lines
- Fuel tank
- Brake lines
- Front or rear suspension arms
- Steering linkage
- Transfer case
- Front or rear differential units
- Transmission
- Engine oil pan - See note below

• NOTE: For certain repair operations, it may be necessary to support the engine under the oil pan. In this case, a block of hardwood or a rubber pad must be positioned on the jack lifting pad to protect the oil pan.

Vehicle jack

The jack provided with the vehicle is only intended for use in an emergency such as changing a tire. DO NOT use the jack for any other purpose. Refer to the Owner's Handbook for the vehicle jack location points and jacking procedures.



WARNING: Never work under a vehicle supported solely by the vehicle jack.

Hydraulic jack

A hydraulic jack with a minimum lifting capacity of 1500 kg, (3,300 lbs) must be used.

• WARNINGS:



Do not commence work on the underside of the vehicle until suitable axle stands have been placed in the correct position.



Always chock the wheels when jacking. The parking brake may be ineffective when the wheel(s) are off the ground.

Raising and Supporting the Vehicle

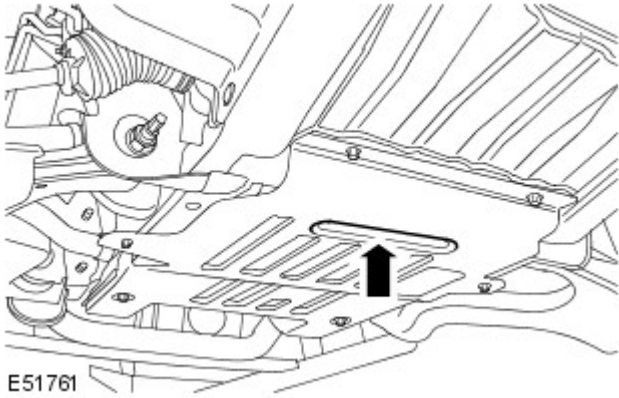
To assist in raising the vehicle, jacking points are provided as shown in the following illustrations.

Raising the Front of the Vehicle

Apply the parking brake.

Select 'P' - PARK on automatic transmission selector.

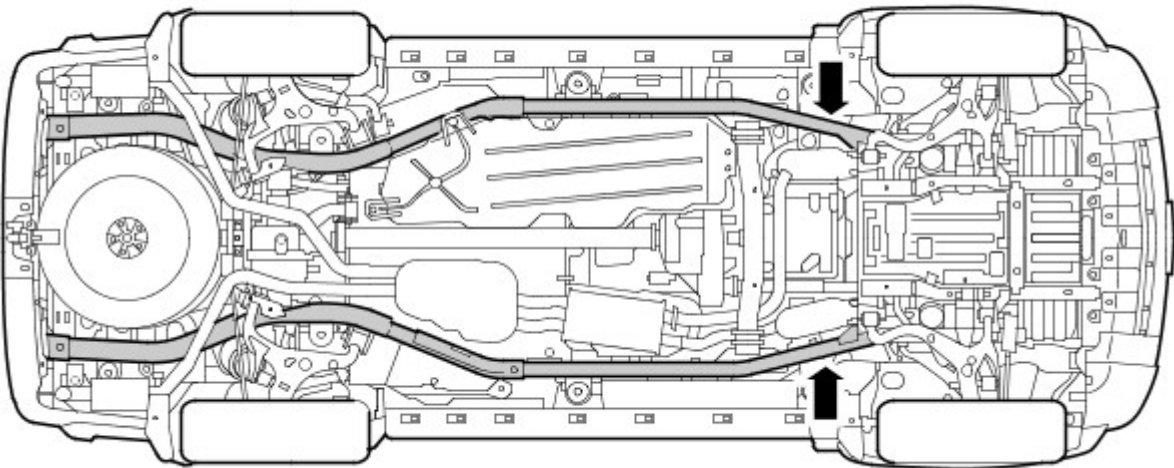
 **WARNING:** Always chock the rear wheels when jacking the front of the vehicle.



Position the lifting pad of the hydraulic jack in the centre of the recess in the engine undershield.

• **NOTE:** If the engine undershield has been removed, position the jack lifting pad in the centre of the front cross beam.

With the vehicle raised to the desired height, position axle stands at positions shown.



 **CAUTION:** Position suitable material between axle stands and longitudinal members to prevent damage to the longitudinal members.

Carefully lower jack until vehicle rests on axle stands.

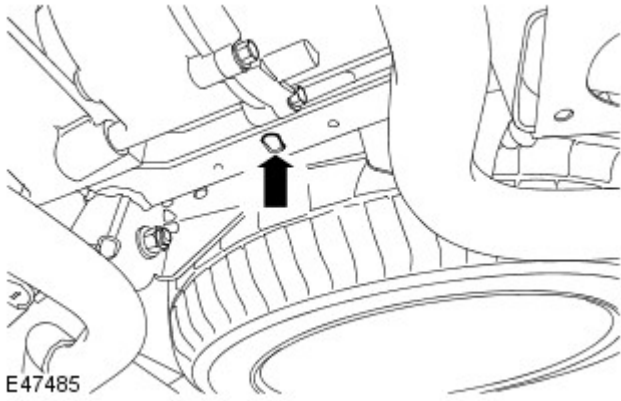
 **WARNING:** Before commencing work on the underside of the vehicle, ensure that axle stands are correctly positioned and vehicle is securely supported.

Reverse procedure when removing vehicle from stands.

Raising the Rear of the Vehicle

Select 'P' - PARK on automatic transmission selector.

 **WARNING:** Always chock the front wheels when jacking the rear of the vehicle.

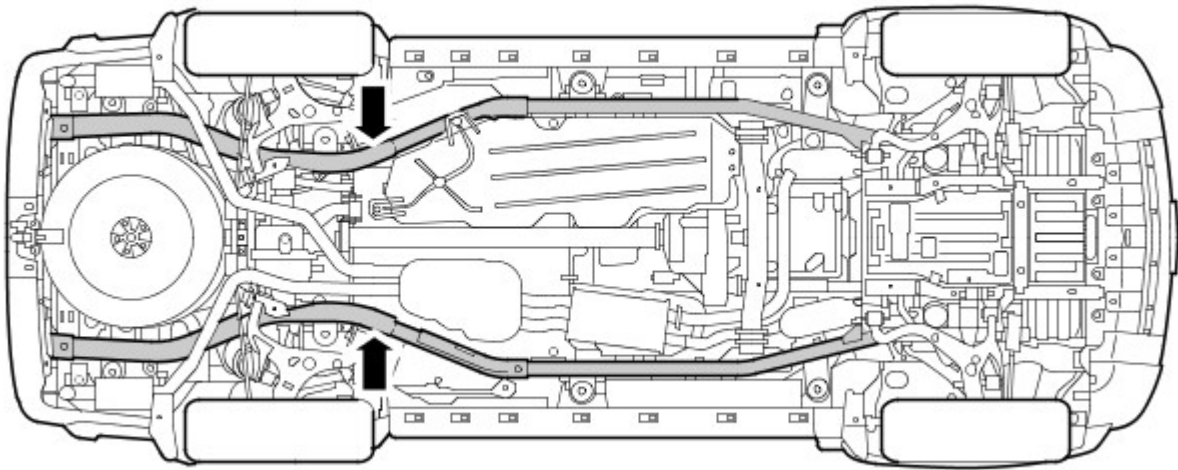


E47485

Position the lifting pad of the hydraulic jack under the centre of the rear cross member as shown.



CAUTION: Take care that the lifting pad of the jack is of a suitable size to avoid damaging the heat shield. It is not advisable to use a spacer block between the lifting pad and the rear cross member as this may result in some vehicle instability.



E47486

With vehicle raised to desired height, position axle stands at positions shown.



CAUTION: Position suitable material between axle stands and longitudinal members to prevent damage to the longitudinal members.

Carefully lower jack until vehicle rests on axle stands.



WARNING: Before commencing work on underside of vehicle, ensure that axle stands are correctly positioned and vehicle is securely supported.

Reverse procedure when removing vehicle from stands.

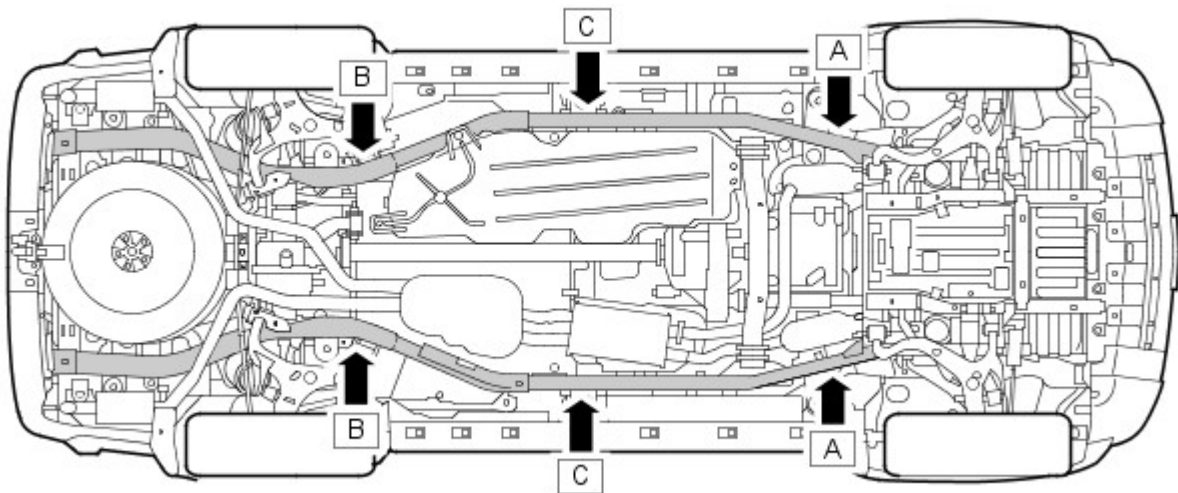
Raising Vehicle - One Wheel/side

Apply the parking brake.

Select 'P' - PARK on automatic transmission selector.

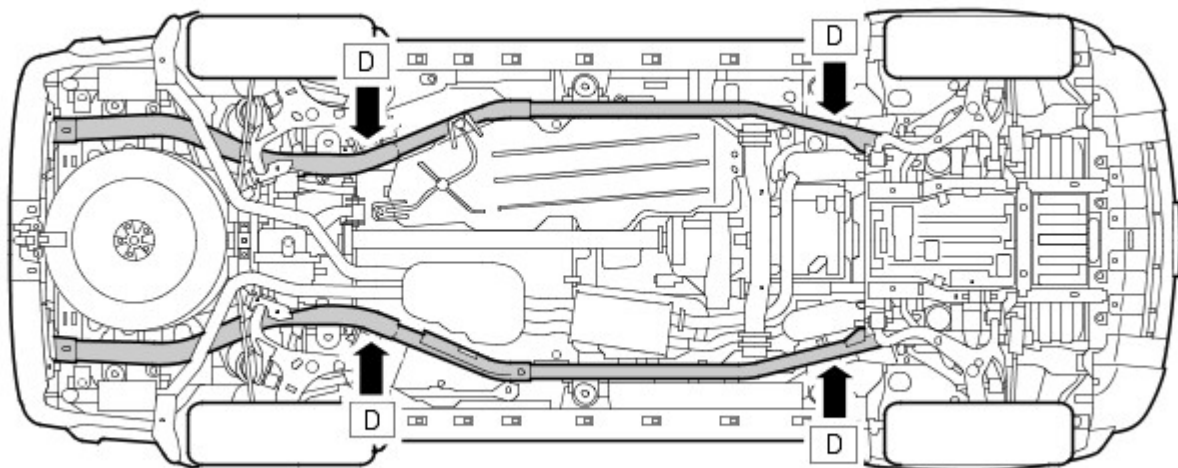


WARNING: Always chock the wheels which are not to be raised.



E47487

- **One front wheel** - position lifting pad of hydraulic jack beneath longitudinal member on the side to be raised at Point 'A'
 - **One rear wheel** - position lifting pad of jack beneath longitudinal member on the side to be raised at Point 'B'
 - **Front and rear wheels - ONE SIDE** - position lifting pad of jack beneath longitudinal member on the side to be raised at Point 'C'
- NOTE: Point 'C' is in line with number 3 body mounting.



E47488

With vehicle at desired height, position axle stand(s) beneath longitudinal members and adjacent to the lifting pad of the jack at appropriate point(s) D.

⚠ CAUTION: Position suitable material between axle stands and longitudinal members to prevent damage to the longitudinal members.

Carefully lower jack until vehicle rests on axle stands.

⚠ WARNING: Before commencing work on underside of vehicle, ensure that axle stands are correctly positioned and vehicle is securely supported.

Reverse procedure when removing vehicle from stands.

Jacking and Lifting - Lifting

Description and Operation

Vehicle on Wheels - Four Post Ramp

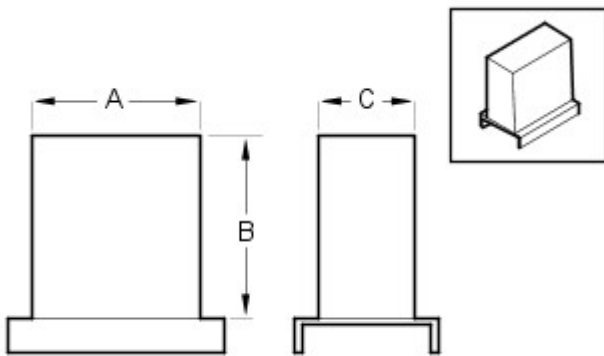
WARNING: If the drive shaft(s) are to be disconnected, it will be necessary to raise all four wheels off the ramp in order that the shaft(s) can be rotated. If the wheel free facility is not to be used, raise the vehicle off the ramp using suitable equipment. With the vehicle raised, position axle stands in the positions shown for the front and rear support blocks - see illustration in Jacking. With the axle stands positioned, release the parking brake and select NEUTRAL 'N' in the transmission.

WARNING: Do not push the vehicle backwards and forwards along the ramp in order to gain access to the drive shaft fixings.

Position the vehicle on the ramp with the front and rear of the vehicle equidistant from the ends of the ramp. Chock the wheels, select NEUTRAL in the transmission and where practicable, apply the parking brake.

Wheel Free Lift - Four Post Ramp

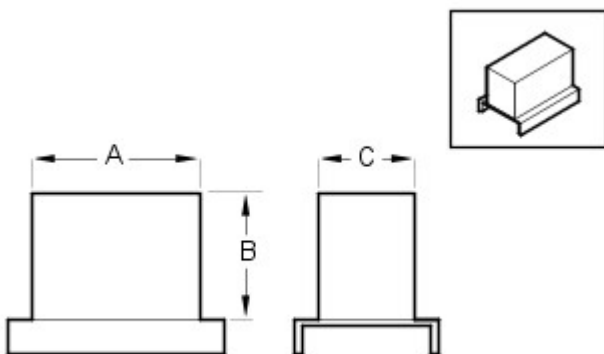
• **NOTE:** To enable the vehicle to be supported correctly on the wheel free longitudinals, it will be necessary to produce 2 off each of the support blocks to the dimensions given in the accompanying illustrations. The supporting part of each block must be manufactured from suitable hardwood or metal and the 'U' shaped base of each block must be manufactured from metal. Note that it is essential to ensure that the 'U' shaped base of each block is wide enough to fit over the wheel free longitudinals.



E48763

Front Support Block Dimensions

- 'A' = 127.0 mm (5.0 in)
- 'B' = 146.0 mm (5.75 in)
- 'C' = 89.0 mm (3.5 in)



E48764

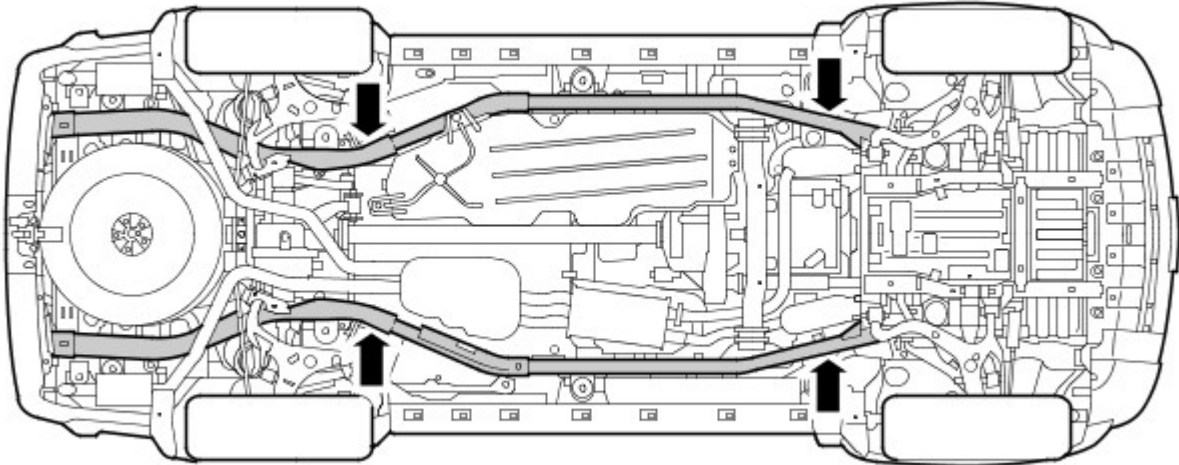
Rear support block dimensions

- 'A' = 152.0 mm (6.0 in)
- 'B' = 101.0 mm (4.0 in)
- 'C' = 76.0 mm (3.0 in)

Raising and Supporting the Vehicle

1. Position vehicle on ramp.
2. Position suspension in 'off-road' height.
3. Apply parking brake.

4. Raise ramp to desired height.



E47489

5. Align the wheel free longitudinals beneath the body frame longitudinals and position the support blocks beneath the longitudinals in the positions shown.



CAUTION: Ensure that the front and rear support blocks are correctly oriented to front and rear of vehicle.

6. Engage wheel free and lower ramp slowly until weight of vehicle rests on support blocks and road wheels are just clear of ramp.

7. Ensure that the vehicle is correctly supported on all four support blocks, that blocks are still correctly positioned and are in full contact with the body frame longitudinals.

8. Lower the ramp.



WARNING: Make sure that the vehicle is stable before commencing work.

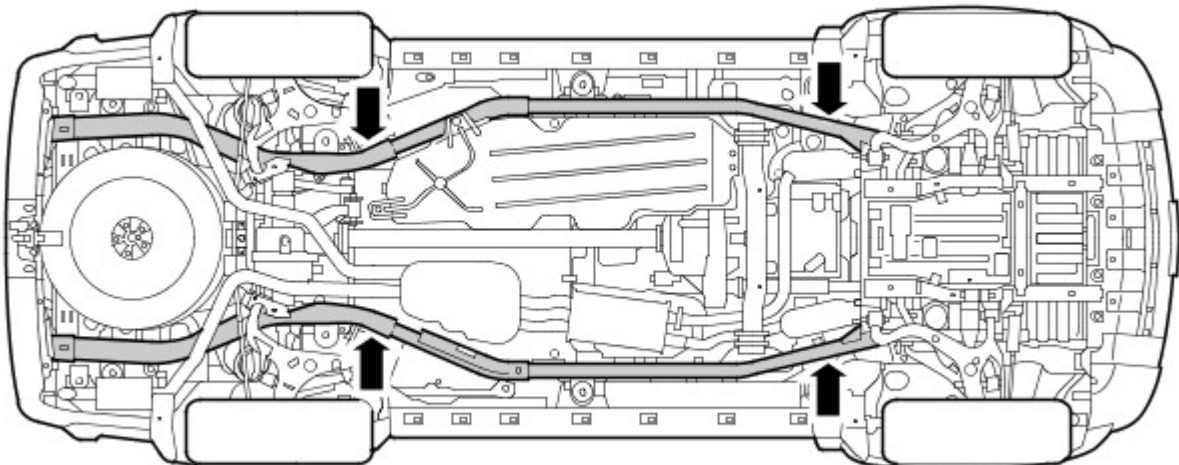
• **NOTE:** Return the suspension to 'normal ride height' when the vehicle is removed from the ramp.

Two Post Lift



CAUTION: If the drive shaft(s) are to be removed, release the parking brake and select NEUTRAL 'N' in the transmission in order that the shaft(s) can be rotated when the vehicle is raised to the desired height.

1. Position the vehicle with the centre of the lift pillars aligned approximately with the front of the driver/passenger seat cushions.



E47489

2. Extend the lifting arms and position the pad of each lifting arm beneath the body frame longitudinal lifting points.

3. Raise the vehicle until the wheels are just clear of the ground and check that the pads of each lifting arm are still

correctly positioned.

4. Raise the vehicle to the desired height.

5. Ensure that vehicle is correctly supported on all four lifting pads, that pads are still correctly positioned and are in full contact with the body frame longitudinals.



WARNING: Make sure that the vehicle is stable before commencing work.

Jacking and Lifting - Jacking

Description and Operation



WARNING: Make sure that any jacks or stands that are used to raise the vehicle have sufficient capacity to support the additional weight of the armoured vehicle.



CAUTION: Do not position jacks or axle stands under the following components:

- Body structure other than any approved jacking or lifting points
- Bumpers
- Fuel lines
- Fuel tank
- Brake lines
- Front or rear suspension arms
- Steering linkage
- Transfer case
- Front or rear differential units
- Transmission

For certain repair operations it may be necessary to support the engine under the oil pan. In this event, a block of hardwood or a rubber pad must be positioned on the jack lifting pad to protect the oil pan.

Vehicle Jack

• **WARNINGS:**



The trolley jack supplied with the vehicle is heavy and if handled incorrectly may cause injury. Use extreme caution when lifting or manoeuvring the jack.



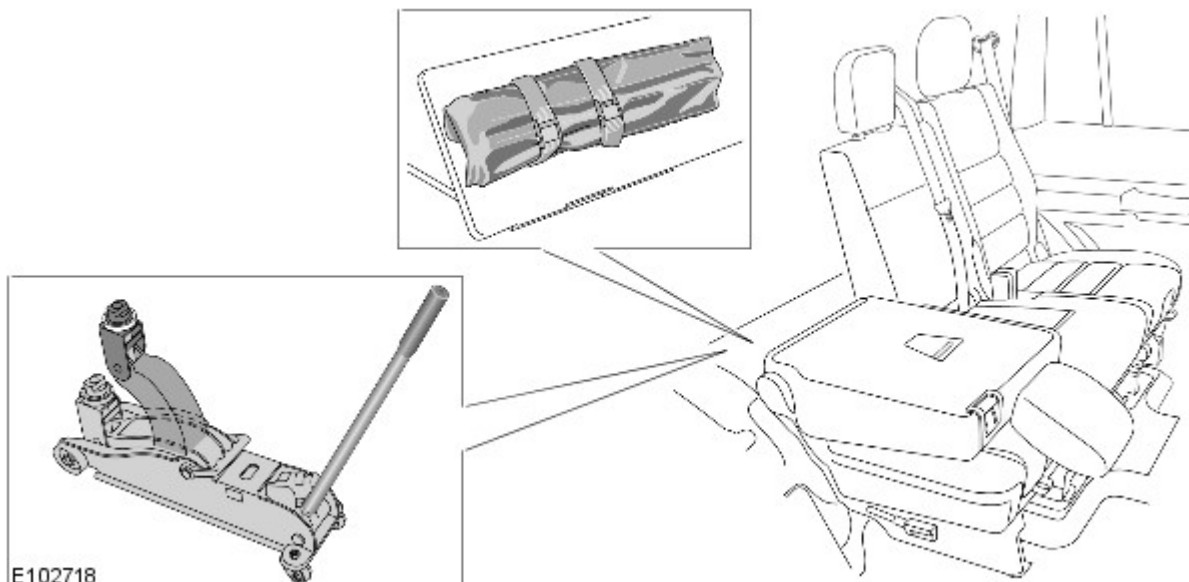
Never work under a vehicle supported solely by the vehicle jack.



The vehicle jack is intended to be used in an emergency for changing a deflated tire. Never use the jack to raise the vehicle for any other purpose. Refer to the Driver Handbook when using the jack supplied with the vehicle. Failure to follow these instructions may result in personal injury.

The trolley jack and lever are stowed behind the rear seats under the hinged forward section of floor. The wheel changing tool kit is in a small bag, stowed in the same area.

Vehicle jack and tool kit stowage area



Safety Precautions

The following safety precautions must be observed when raising the vehicle with the vehicle jack:

- Never rely on a jack alone to support a vehicle. Always use suitable stands to provide rigid support.
- When working beneath a vehicle use a vehicle lift if possible, instead of a jack and stands.
- Make sure that the vehicle is standing on firm and level ground before using a jack.
- Do not rely on the parking brake alone; chock the wheels, and if possible put the automatic transmission into 'Park'.
- Check that any lifting equipment used has adequate capacity for the load being lifted and is in correct working order.

Spare Wheel

- WARNINGS:



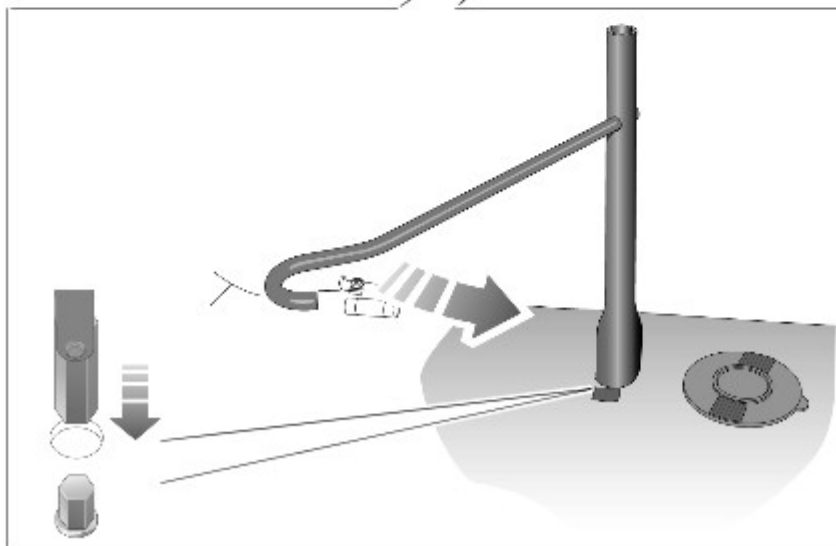
The spare wheel is heavy and if handled incorrectly may cause injury. Use extreme caution when lifting or manoeuvring the wheels.



Remove the spare wheel before using the jack to avoid destabilising the vehicle when raised.

The spare wheel is stowed underneath the vehicle in the same position as on a standard vehicle. The winch used for lowering the spare wheel is accessed through the access port in the rear loadspace area.

Spare-wheel access port

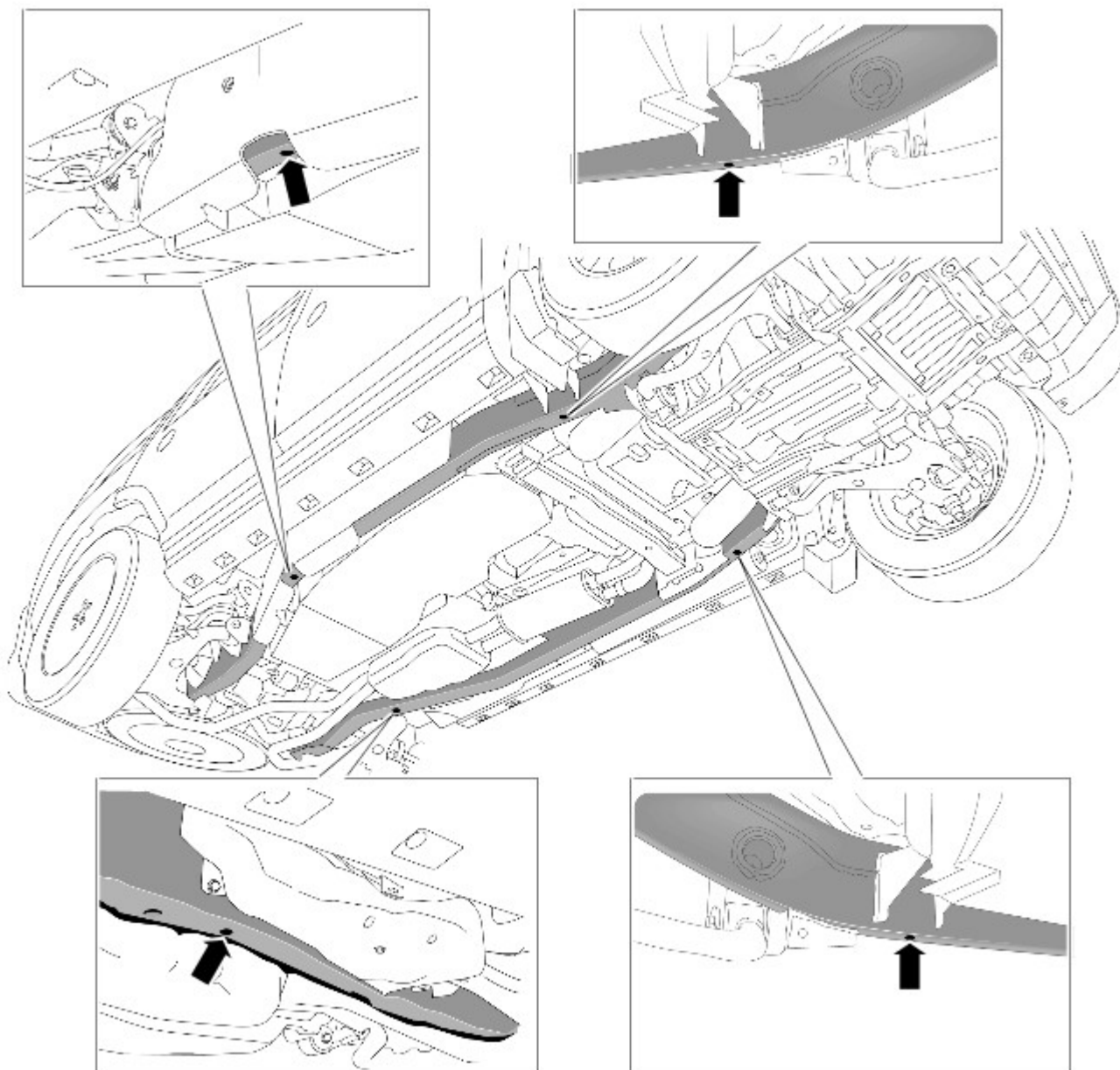


E102720

Jacking Points

The jacking and lifting points for the armoured vehicle are the same as the standard vehicle.

Vehicle jacking points



E104286

Vehicle Weight

The weight of the vehicle is greater than the standard vehicle. Always make sure that any jacks or lifts are capable of supporting the additional loads.

Description	Front	Rear	Total
Unladen	-	-	3550 kg (minimum)
Gross Vehicle Weight	1850 kg	2350 kg	4050 kg

Jacking and Lifting - Lifting

Description and Operation



WARNING: Make sure that any lifts that are used to raise the vehicle have sufficient capacity to support the additional weight of the armoured vehicle.

The jacking and lifting points for the armoured vehicle are the same as the standard vehicle.

Four Post Lift

Four Post Lift – Vehicle on Wheels

Position the vehicle on the lift with the front and rear of the vehicle equidistant away from the ends of the lift. Chock the wheels; select Park 'P' in the transmission and where practicable, apply the parking brake.



WARNING: Do not push the vehicle backwards and forwards along the lift.

Four Post Lift – Wheel Free



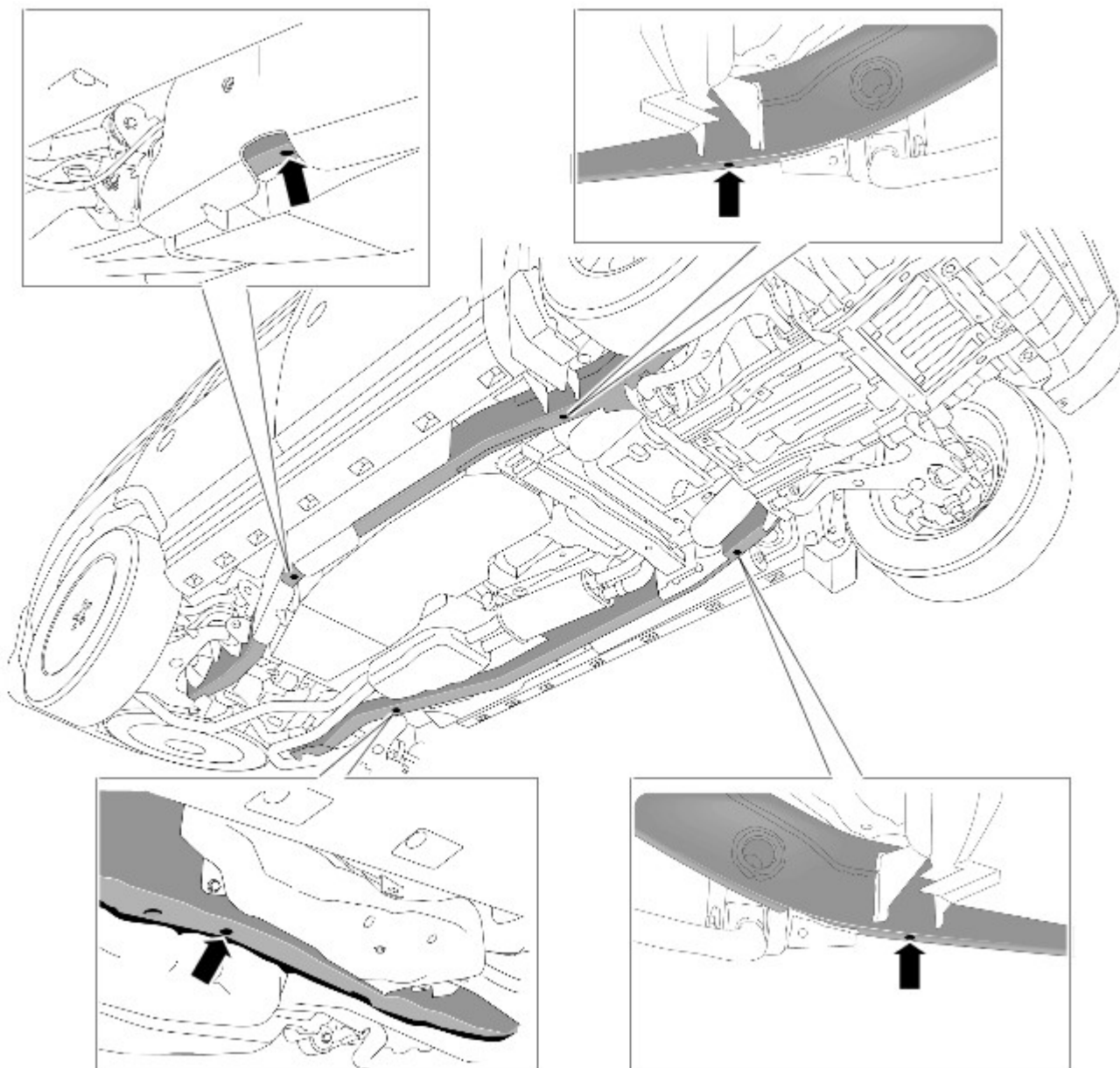
WARNING: The armoured vehicle cannot be supported safely using the wheel-free facility of a four-post lift. Therefore, under no circumstances must this method be used.

Two Post Lift



CAUTION: If the drive shaft(s) are to be removed, release the parking brake and select Neutral 'N' in the transmission in order that the shaft(s) can be rotated when the vehicle is raised to the desired height.

Vehicle lifting points



E104286

- Position the vehicle with the centre of the lift pillars aligned approximately with the front of the driver and front passenger seat cushions.
- Extend the lifting arms and position the pad of each lifting arm beneath the body-frame longitudinal lifting points (arrowed above).
- Raise the vehicle until the wheels are just clear of the ground and check that the pads of each lifting arm are still correctly positioned.
- Raise the vehicle to the desired height.
- Ensure that the vehicle is correctly supported on all four lifting pads; that the pads are still correctly positioned and are in full contact with the body-frame longitudinal lifting points.

 **WARNING:** Ensure that the vehicle is stable before commencing work.

Vehicle Weight

The weight of the vehicle is greater than the standard vehicle. Always make sure that any jacks or lifts are capable of supporting the additional loads.

Description	Front	Rear	Total
Unladen	-	-	3550 kg (minimum)
Gross Vehicle Weight	1850 kg	2350 kg	4050 kg

Jacking and Lifting - Vehicle Recovery

Description and Operation

Refer to the Driver Handbook for vehicle recovery information.



CAUTION: Ensure that the transport company recovering the vehicle is aware that this is an armoured vehicle, as it may have a bearing on the type of recovery vehicle used.

Maintenance Schedules - Maintenance Schedules - Gasoline Engines

Description and Operation

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

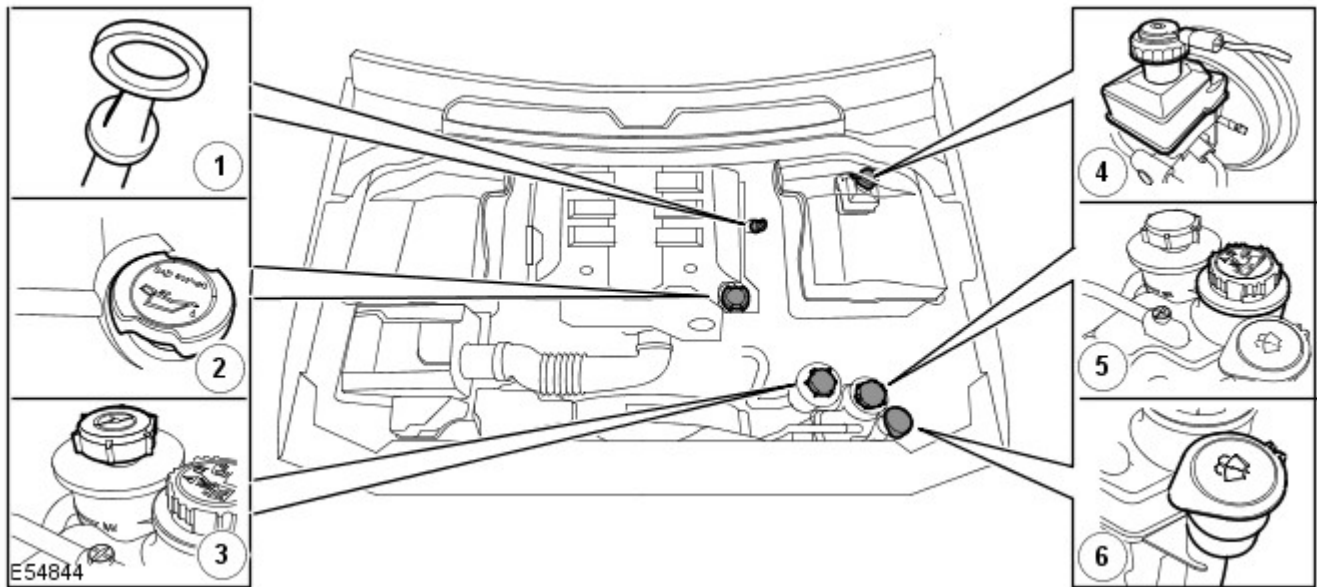
Torque Specifications

Description	Nm	lb-ft
Seat frame fixing Torx screws	40	30
Seat belt fixing Torx screws	40	30
Road wheel nuts	140	103



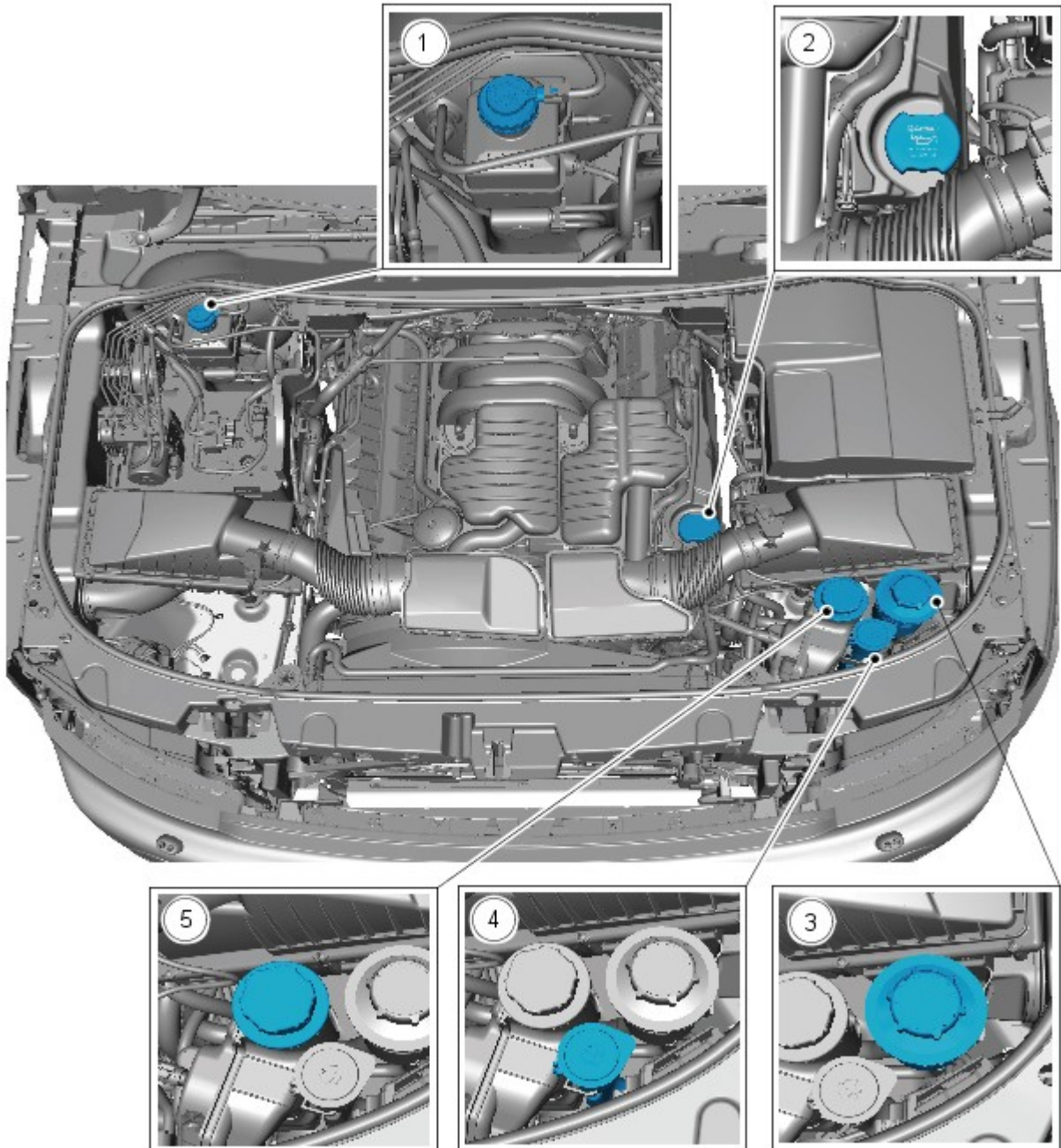
CAUTION: Unless stated otherwise, the following operations must be carried out at every service interval. Note that the 'A' and 'B' Service Intervals listed on the 'Maintenance Check Sheet' for vehicles operating under arduous conditions, vary from those specified for vehicles operating under normal conditions. Reference must therefore, always be made to the 'Arduous Conditions Maintenance Check Sheet' for vehicles operating under these conditions.

Underbonnet View - 4.0 Litre



- 1. Engine oil level indicator
- 2. Engine oil filler cap
- 3. Power steering fluid reservoir
- 4. Brake fluid reservoir (LH drive illustrated - RH drive on opposite side)
- 5. Coolant expansion tank
- 6. Windscreen washer reservoir

Underbonnet View - 5.0 Litre



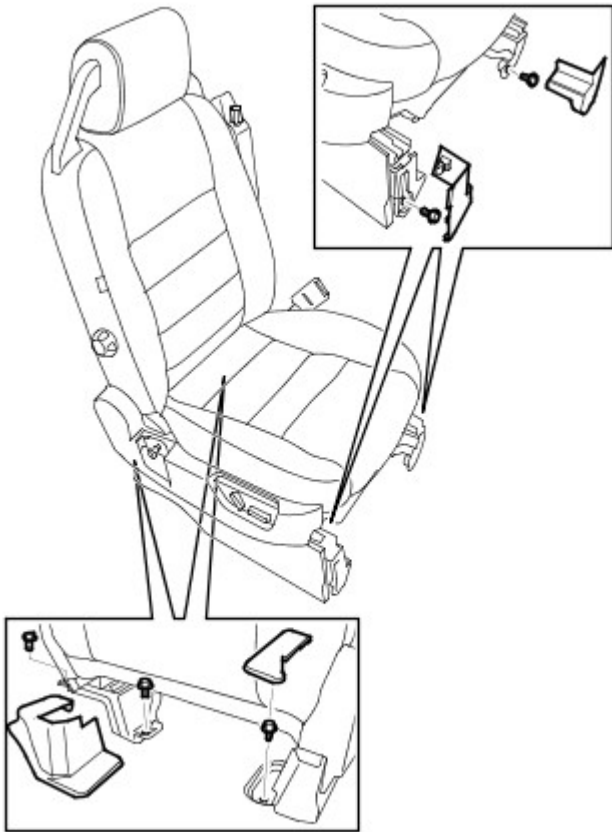
E123152

- 1. Brake fluid reservoir (LH drive illustrated - RH drive on opposite side)
- 2. Engine oil filler cap
- 3. Power steering fluid reservoir
- 4. Windshield washer reservoir
- 5. Coolant expansion tank

Maintenance Operations

Seats and Safety Belts

Front seat frame fixings - Every 2 years or 30,000 miles (48,000 km)

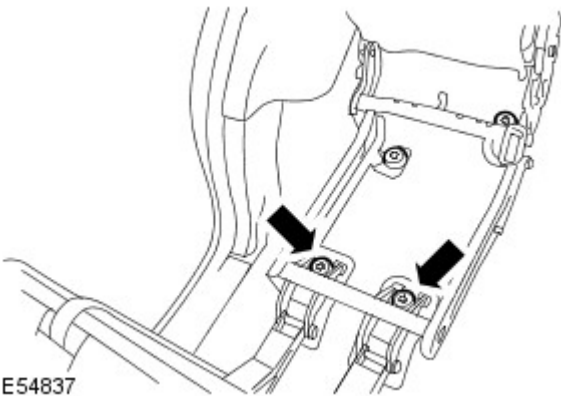


E45101

1. Carefully remove the trim panels covering the seat frame fixing Torx screws.
2. Check that the front seat frame fixing Torx screws are secure and that the seat frames show no signs of movement.
3. Install the trim panels on completion.

Front seat frame fixings - Every 2 years or 30,000 miles (48,000 km)

⚠ CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 1 year or 15,000 miles (24,000 km)

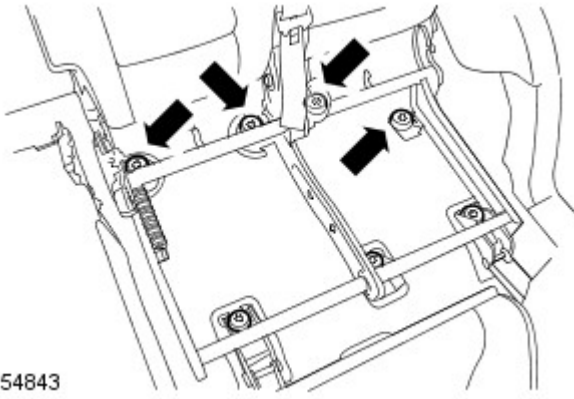


E54837

4. Check that the rear seat frame front fixings are secure and that the seat frames show no signs of movement.

Front seat frame fixings - Every 2 years or 30,000 miles (48,000 km)

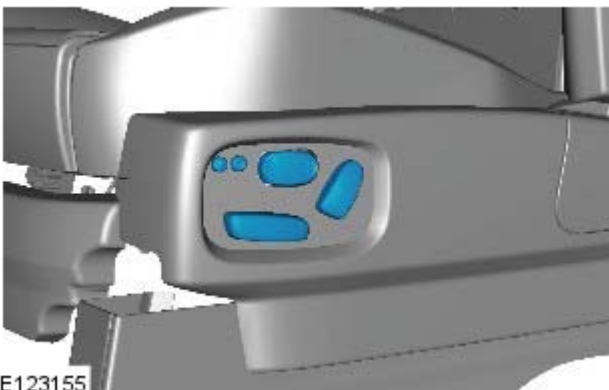
⚠ CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 1 year or 15,000 miles (24,000 km)



E54843

5. Fold the seat cushions forwards and check that the rear seat frame rear fixings are secure and that the seat frames show no signs of movement.
6. Fold the seat cushions back on completion.

Front seat controls



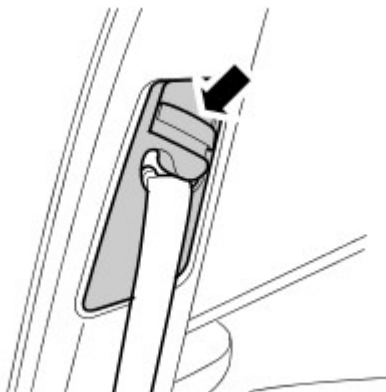
E123155

7. Check operation of all seat controls.

Front seat frame fixings - Every 2 years or 30,000 miles (48,000 km)

⚠ CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 1 year or 15,000 miles (24,000 km)

8. Fully extend each Safety belt and check that it returns unassisted; repeat for all belts.
9. Check entire length of safety belt webbing for signs of fraying or damage; repeat for all belts.
10. Connect each safety belt to the correct buckle, check safety belt buckle and tongue are secure; check that buckle releases tongue correctly.
11. Check all safety belt and buckle mountings and fixings for security.



E54871

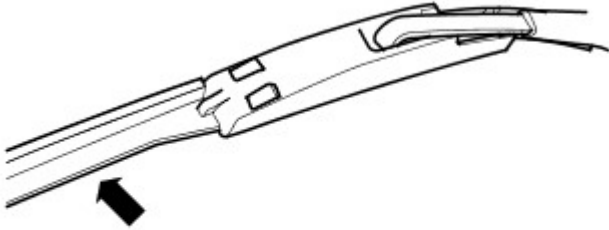
12. Check front safety belt height adjusters for correct operation.

Lamps, Horns and Warning Indicators

1. Check side, head, fog, reversing and tail lamps for correct operation.
2. Check operation of headlamp automatic levelling system - if installed.

3. Check turn signals and hazard warning lamps for correct operation.
4. Check brake (stop) lamps for correct operation.
5. Check all exterior lamp lenses for clarity and condition; pay particular attention to headlamp and fog lamp lenses for stone chips or damage.
6. Check horn for loud, clear sound.
7. Switch on headlamps and check that side/headlamp reminder warning sounds when door is opened.
8. Check operation of interior courtesy lamps.
9. Check operation of all instrument pack warning and indicator lamps.

Washers and Wipers



E54838

1. Check all wiper blades for condition and signs of splits or damage.
2. Check security of wiper arms.
3. Operate front and rear windshield washers, check that jets are clear and correctly aimed.
4. Operate front and rear wipers at all speeds and check for smooth, smear free operation.

Check High/Low Gear Engagement

1. Select LOW range gear, drive vehicle forwards 3 to 4 vehicle lengths, stop vehicle and select HIGH range gear - gears must engage smoothly.

Pollen Filter

1. Replace pollen filter.
For additional information, refer to: [Pollen Filter](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Corrosion/Cosmetic Inspection

1. Carry out the annual corrosion/cosmetic inspection using the Annual Corrosion Inspection Sheet.

Wheels and Tires

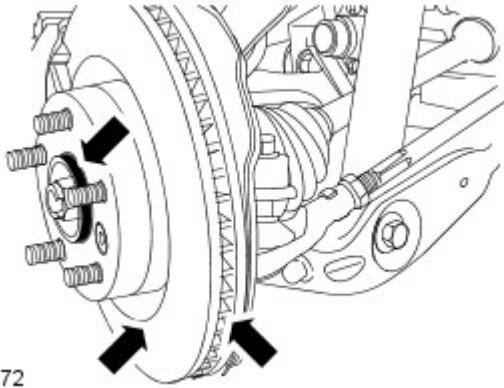
1. Check that tires comply with manufacturer's specification.
For additional information, refer to: [Wheels and Tires](#) (204-04 Wheels and Tires, Description and Operation).
 2. Check/adjust tire pressures including spare.
For additional information, refer to: [Wheels and Tires](#) (204-04 Wheels and Tires, Description and Operation).
 3. **Vehicle with Uni-directional tires installed:** Mark the wheel to stud relationship of each road wheel and note location of each road wheel to its respective hub.
 4. Loosen road wheel nuts. Raise vehicle to a wheel free condition.
For additional information, refer to: [Lifting](#) (100-02 Jacking and Lifting, Description and Operation).
 5. Remove the road wheels.
 6. Visually check tires for condition, lumps or bulges. Check tread depth across the width of the tire and around the circumference; make sure that remaining tread depth does not contravene local legislative requirements.
- NOTE: Do not install wheels at this stage.

Braking System



CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 3 months or 3,750 miles (6,000 km)

1. Inspect front brake pads for wear.
For additional information, refer to: [Specifications](#) (206-03 Front Disc Brake, Specifications).
2. Inspect rear brake pads for wear.
For additional information, refer to: [Specifications](#) (206-04 Rear Disc Brake, Specifications).
3. Check brake calipers for signs of fluid leaks.



4. Check brake discs for condition.
5. Check all brake booster and brake system pipes and hoses for condition, chafing and leaks.
6. Clean road wheel hub spigots and apply grease, Land Rover Part Number RYL 105020 to the wheel mating surface of each spigot.
7. **Vehicles with Uni-directional tires installed:** Install road wheels on their respective hubs ensuring that stud to wheel relationship is maintained.
8. **Vehicles with NON uni-directional tires installed:** Install wheels on the opposite side of the vehicle but make sure that they are the same axle as they were originally installed.
9. Install road wheel nuts and tighten to 140 Nm (103 lb-ft).



CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 2 years or 30,000 miles (48,000 km)

10. **Every 3 years or 45,000 miles (72,000 km):** Replace brake fluid.
For additional information, refer to: [Brake System Bleeding](#) (206-00 Brake System - General Information, General Procedures).
11. **Every 6 years or 90,000 miles (144,000 km):** Replace all flexible brake hoses.

Electric Parking Brake



CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 3 months or 3,750 miles (6,000 km)

1. Check the adjustment of the electric parking brake.
For additional information, refer to: [Parking Brake Shoe and Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).
2. **Vehicles operating under arduous conditions:** Check the condition of the electric parking brake system.

Road Wheel Speed Sensors



CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 3 months or 3,750 miles (6,000 km)

1. Inspect the road wheel speed sensor harnesses for damage.

Radiator and Cooling Fan

1. **Vehicles operating under arduous conditions:** Visually check radiator for external obstructions, check cooling fan blades for damage.

Air Suspension

1. **Every 5 years or 75,000 miles (120,000 km) - Vehicles operating under arduous conditions:** Replace air suspension compressor filter.
For additional information, refer to: [Air Suspension Air Filter](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

Door Locks and Hinges

1. Check operation of all door locks, bonnet lock and fuel filler flap.
2. Lubricate all door check straps, bonnet catch and fuel filler flap catch.

Cooling System

1. Check specific gravity of coolant using a hydrometer.

• **NOTE:** A suitable hydrometer is available from the Equipment Programme under Part Number 511 3302 001 00.

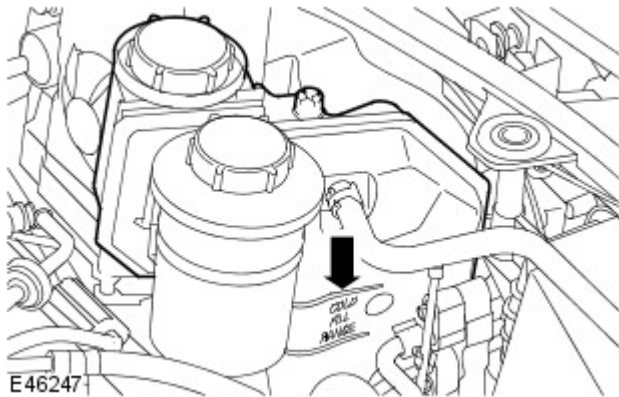
2. Top-up cooling system if necessary.

For additional information, refer to: [Specifications](#) (303-03C Engine Cooling - V6 4.0L Petrol, Specifications) / [Specifications](#) (303-03D Engine Cooling - V8 5.0L Petrol, Specifications).



CAUTION: Anti-freeze concentration must be maintained at 50%.

Cooling system - Check/Top-up



WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank whilst the system is hot.



CAUTION: Engine coolant will damage the paint finished surfaces. If coolant is spilled, immediately remove the coolant and wash the area with water.

1. Check the level of coolant in the expansion tank. With the engine cold, the coolant level must be to the '**UPPER LEVEL**' indicator mark above the '**COLD FILL RANGE**' text on the side of the expansion tank. Ignore any coolant which may be visible in the top section of the tank.

2. If topping-up is required, remove expansion tank filler cap and top-up coolant level to the '**UPPER LEVEL**' indicator mark.

For additional information, refer to: [Specifications](#) (303-03C Engine Cooling - V6 4.0L Petrol, Specifications) / [Specifications](#) (303-03D Engine Cooling - V8 5.0L Petrol, Specifications).



CAUTION: Always top-up with a 50% mixture of anti-freeze and water.

3. Install expansion tank filler cap, tighten cap until ratchet is heard to 'click'.

Coolant - Replace

1. **Every 10 years or 150,000 miles (240,000 km):** Replace the coolant.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

Ignition System

2. **Every 3 years or 45,000 miles (72,000 km) - Vehicles operating under arduous conditions:** Replace spark plugs.

For additional information, refer to: [Spark Plugs](#) (303-07A Engine Ignition - V6 4.0L Petrol, Removal and Installation) / [Spark Plugs](#) (303-07B Engine Ignition - V8 5.0L Petrol, Removal and Installation).

5. **Every 7 years or 105,000 miles (168,000 km):** Replace spark plugs.

For additional information, refer to: [Spark Plugs](#) (303-07A Engine Ignition - V6 4.0L Petrol, Removal and Installation) / [Spark Plugs](#) (303-07B Engine Ignition - V8 5.0L Petrol, Removal and Installation).

• **NOTE:** * 4.0 litre V6 engines may have either copper or platinum spark plugs installed.

Air Filtering

1. **Every 5 years or 75,000 miles (120,000 km):** Replace the air filter element.

For additional information, refer to: [Air Cleaner Element](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation) / [Air Cleaner Element](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

Ancillary Drive Belt

1. Check the condition of the ancillary drive belt.
2. Remove all traces of mud and dirt from the drive belt and pulleys.
3. Check the drive belt for signs of splitting and wear.



CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out every 5 years or 75,000 miles (120,000 km).

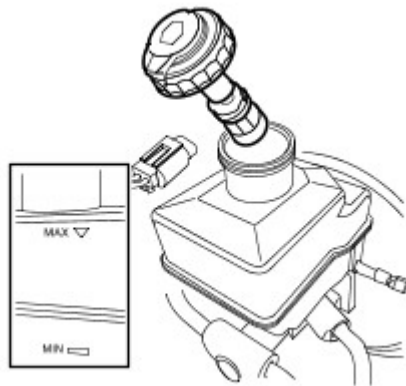
4. **Every 7 years or 105,000 miles (168,000 km):** Replace the ancillary drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation) /

[Accessory Drive Belt](#) (303-05D Accessory Drive - V8 5.0L Petrol, Removal and Installation).

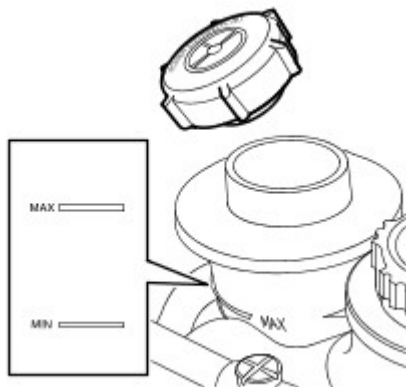
Fluid Levels

Brake fluid reservoir



1. Remove the auxiliary battery box cover.
2. Check the fluid level in the brake fluid reservoir, the level must be to the '**MAX**' mark on the reservoir; top-up if necessary.
3. Clean the area around the reservoir filler cap, remove cap.
4. If necessary, top-up using the recommended fluid to the '**MAX**' mark on the reservoir.
For additional information, refer to: [Specifications](#) (206-00 Brake System - General Information, Specifications).
5. Install the reservoir filler cap.
6. Install the auxiliary battery box cover.

Power steering fluid reservoir



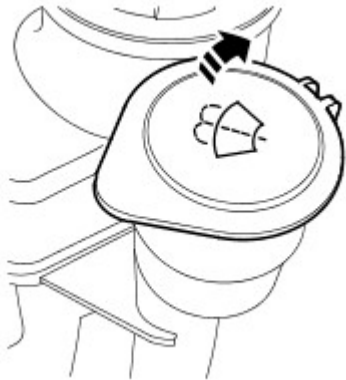
CAUTION: To prevent over filling, check/top-up the system with the engine switched off and the system cold. Make sure that the steering wheel is in the straight ahead position, do not turn the steering wheel prior to checking the fluid level.

1. Check that the fluid level is to the mid-way mark between the '**MAX**' and '**MIN**' marks on the fluid reservoir, top-up if necessary.
2. Clean the area around the reservoir filler cap, remove cap.
3. If necessary, top-up using the recommended fluid to the mid-way mark on the reservoir.
For additional information, refer to: [Specifications](#) (211-02 Power Steering, Specifications).

 **CAUTION: Do not fill reservoir above the 'MAX' mark.**

4. Install the reservoir filler cap.

Windshield washer reservoir



E54847

1. Remove the windshield washer reservoir filler cap.

2. Top-up the reservoir using a mixture of an approved windshield washer fluid and water until the level is to the bottom of the gauze filter in the reservoir filler neck.

3. Install the reservoir filler cap.

Engine Oil and Filter

• CAUTIONS:



Rest of World Vehicles - Not UK and Europe: The following service items must be carried out every 6 months or 7,500 miles (12,000 km).



When vehicles are operating under arduous conditions, the following service items must be carried out every 3 months or 3,750 miles (6,000 km).

1. Renew engine oil and filter - 4.0 litre engine.

For additional information, refer to: [Specifications](#) (303-01C Engine - V6 4.0L Petrol, Specifications) / [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).

2. Renew engine oil and filter - 5.0 litre engine.

For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).

Automatic Transmission

2. **Every 10 years or 150,000 miles (240,000 km):** Renew automatic transmission fluid.

For additional information, refer to: [Specifications](#) (307-01D, Specifications) / [Transmission Fluid Drain and Refill](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).

Transfer Case

1. **Every 5 years or 75,000 miles (120,000 km):** Renew transfer case oil.

For additional information, refer to: [Specifications](#) (308-07B Transfer Case, Specifications) / [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).

Differential Assemblies

1. **Every 10 years or 150,000 miles (240,000 km):** Renew front differential oil.

For additional information, refer to: [Specifications](#) (205-03 Front Drive Axle/Differential, Specifications) / [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).

2. **Every 5 years or 75,000 miles (120,000 km):** Renew rear 'Electronic Torque Managed (ETM)' differential oil.

For additional information, refer to: [Specifications](#) (205-02 Rear Drive Axle/Differential, Specifications) / [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).

3. **Every 10 years or 150,000 miles (240,000 km):** Renew rear 'OPEN' differential oil.

For additional information, refer to: [Specifications](#) (205-02 Rear Drive Axle/Differential, Specifications) / [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

Suspension and Body Mountings

1. Check for free play in all suspension and body mounting rubbers.

2. Check condition of suspension rubber boots and gaiters.

3. Lift the vehicle so that front wheels are clear of ground/ramp to enable insertion of a suitable lever (e.g. a 1200mm long steel tube). Check the lower ball joints for free play by placing the lever between the ground/ramp and the tire, and lifting the wheel assembly with the lever. A second person will be required to check simultaneously for any ball joint lift. If free play (knock) is noted in the ball joint, replacement is required.

Fuel System

1. Check fuel system pipes, hoses and unions for chafing, leaks and corrosion.

Electrical Harnesses

1. Check all electrical harnesses for chafing.

Oil/Fluid Leaks

1. Check for oil/fluid leaks.

Exhaust System

1. Check exhaust system for leaks, security and damage.

Power Steering

1. Check power steering rod ball joint fixings, gaiters and condition of ball joints and dust covers.

2. Check power steering pipes, hoses and unions for chafing, leaks and corrosion.

Fault Lamp(s)

1. If fault lamp(s) are illuminated, test the associated system using approved Land Rover diagnostic equipment and report findings.

Road Test

1. Carry out road test of vehicle.

For additional information, refer to: [Road/Roller Testing](#) (100-00 General Information, Description and Operation).

General

1. Endorse Service Record.

2. Report any unusual features of vehicle condition and any additional work required.

Additional Items That May Require Attention

It is recommended that:

1. **Every 6 years:** All brake fluid hydraulic seals are replaced.

• **NOTE:** This is in addition to the maintenance requirement that flexible brake hoses **MUST** be replaced at this service interval.

2. **After 50 miles (80 km) continuous use in severe off-road conditions i.e. wading, deep mud and abrasive grit/slurry:** The electric parking brake should be cleaned and inspected.

3. **After 50 miles (80 km) continuous use in severe off-road conditions i.e. wading, deep mud and abrasive grit/slurry:** The ancillary drive belt should be cleaned and inspected.

4. **Vehicles with air suspension installed:** Vehicles used extensively in arduous or off road conditions will require the compressor air inlet filter to be renewed more frequently.

5. **Vehicles used in dusty or field conditions or deep wading:** More frequent attention to the air cleaner will be required.

Maintenance Schedules - Maintenance Schedules - Diesel Engines

Description and Operation

• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

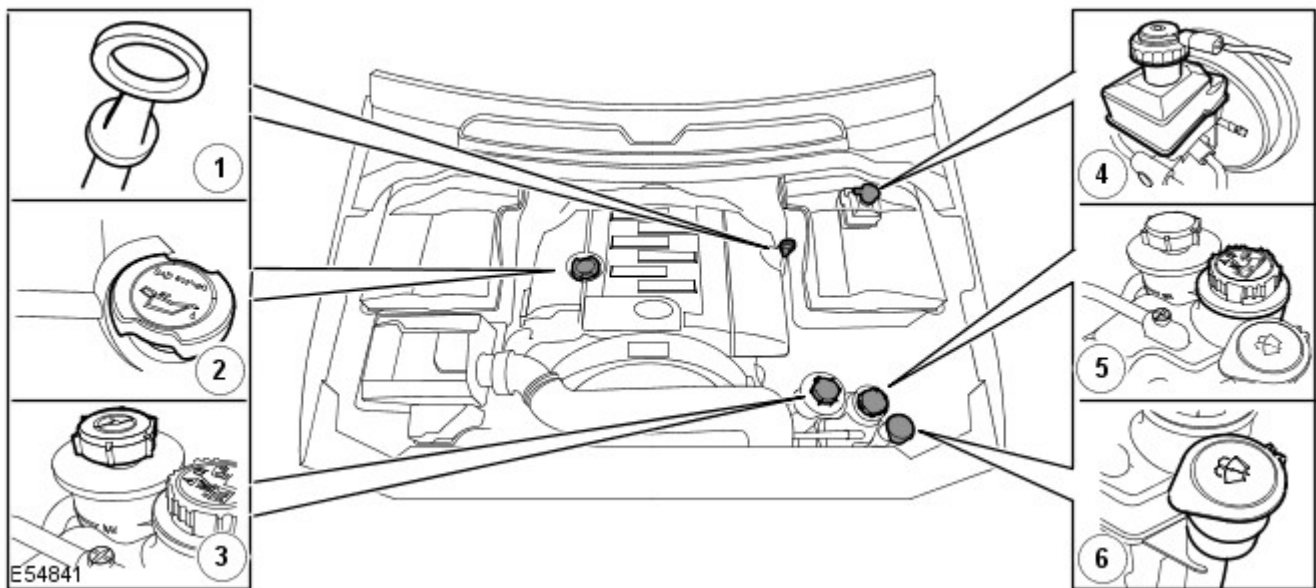
Torque Specifications

Description	Nm	lb-ft
Seat frame fixing Torx screws	40	30
Seat belt fixing Torx screws	40	30
Road wheel nuts	140	103



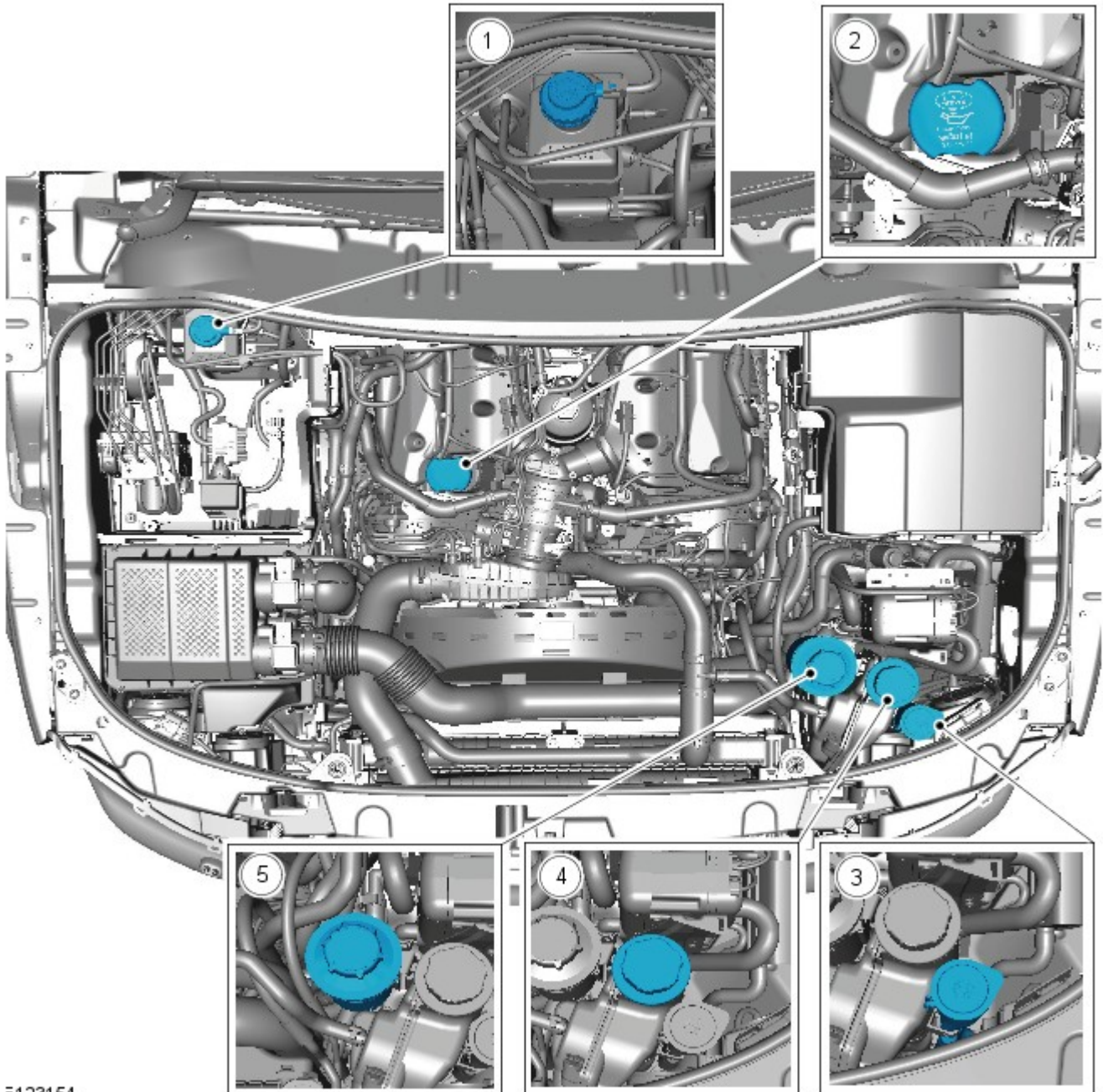
CAUTION: Unless stated otherwise, the following operations must be carried out at every service interval. Note that the A and B Services listed on the Maintenance Check Sheet, applicable to vehicles operating under arduous conditions, vary both in period and mileage (kilometres) to the intervals specified for those vehicles operating under normal conditions. Reference must therefore, always be made to the 'Arduous Conditions Maintenance Check Sheet' for vehicles operating under these conditions.

Underbonnet View - 2.7 Litre



- 1. Engine oil level indicator
- 2. Engine oil filler cap
- 3. Power steering fluid reservoir
- 4. Brake/clutch fluid reservoir (LH drive illustrated - RH drive on opposite side)
- 5. Coolant expansion tank
- 6. Windshield washer reservoir

Underbonnet View - 3.0 Litre

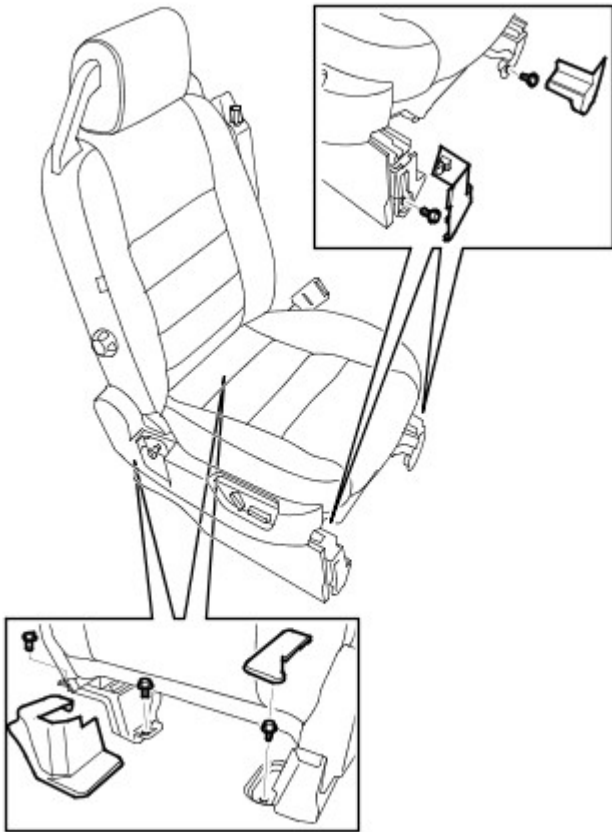


E123154

- 1. Brake/clutch fluid reservoir (LH drive illustrated - RH drive on opposite side)
- 2. Engine oil filler cap
- 3. Windshield washer reservoir
- 4. Coolant expansion tank
- 5. Power steering fluid reservoir

Maintenance Operations

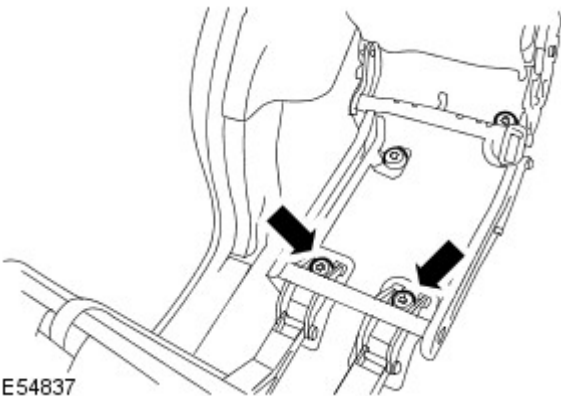
Seats and Safety Belts



E45101

Front seat frame fixings - Every 2 years or 30,000 miles (48,000 km) - vehicles with 2.7L diesel. Or 32,000 miles (52,000 km) - vehicles with 3.0L diesel

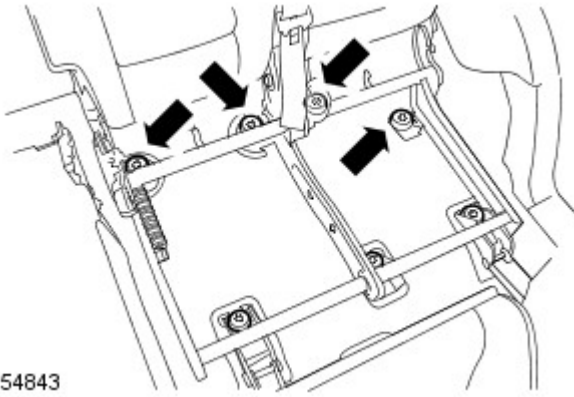
1. Carefully remove the trim panels covering the seat frame fixing Torx screws.
2. Check that the front seat frame fixing Torx screws are secure and that the seat frames show no signs of movement.
3. Reinstall the trim panels on completion.



E54837

Front seat frame fixings - Every 2 years or 30,000 miles (48,000 km) - vehicles with 2.7L diesel. Or 32,000 miles (52,000 km) - vehicles with 3.0L diesel

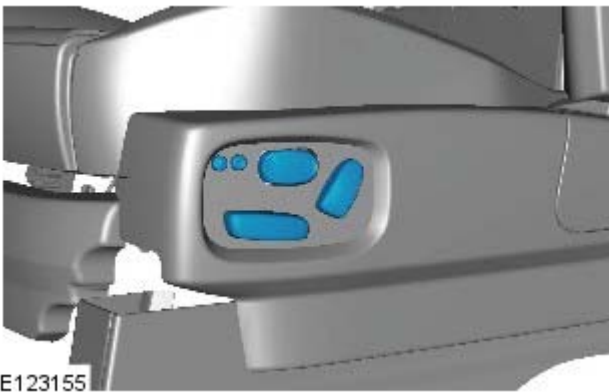
4. Check that the rear seat frame front fixings are secure and that the seat frames show no signs of movement.



E54843

Front seat frame fixings - Every 2 years or 30,000 miles (48,000 km) - vehicles with 2.7L diesel. Or 32,000 miles (52,000 km) - vehicles with 3.0L diesel

5. Fold the seat cushions forwards and check that the rear seat frame rear fixings are secure and that the seat frames show no signs of movement.
6. Fold the seat cushions back on completion.



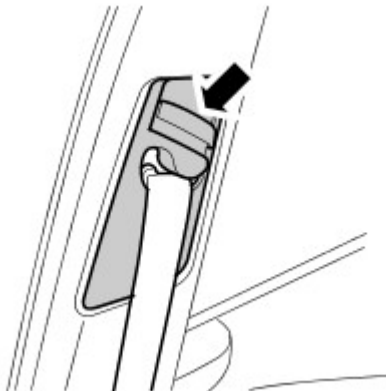
E123155

Front seat controls

7. Check operation of all seat controls.

Safety belts - Every 2 years or 30,000 miles (48,000 km) - vehicles with 2.7L diesel. Or 32,000 miles (52,000 km) - vehicles with 3.0L diesel

8. Fully extend each safety belt and check that it returns unassisted; repeat for all belts.
9. Check entire length of safety belt webbing for signs of fraying or damage; repeat for all belts.
10. Connect each safety belt to the correct buckle, check safety belt buckle and tongue are secure; check that buckle releases tongue correctly.
11. Check all safety belt and buckle mountings and fixings for security.



E54871

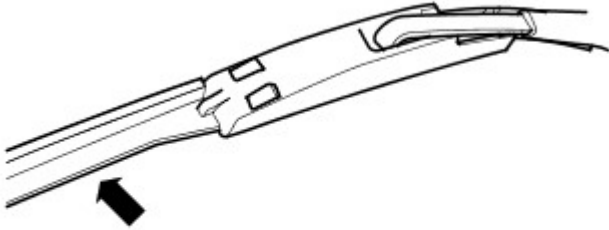
12. Check front safety belt height adjusters for correct operation.

Lamps, Horns and Warning Indicators

1. Check side, head, fog, reversing and tail lamps for correct operation.
2. Check operation of headlamp automatic levelling system - if installed.

3. Check turn signals and hazard warning lamps for correct operation.
4. Check brake (stop) lamps for correct operation.
5. Check all exterior lamp lenses for clarity and condition; pay particular attention to headlamp and fog lamp lenses for stone chips or damage.
6. Check horn for loud, clear sound.
7. Switch on headlamps and check that side/headlamp reminder warning sounds when door is opened.
8. Check operation of interior courtesy lamps.
9. Check operation of all instrument pack warning and indicator lamps.

Washers and Wipers



E54838

1. Check all wiper blades for condition and signs of splits or damage.
2. Check security of wiper arms.
3. Operate front and rear windshield washers, check that jets are clear and correctly aimed.
4. Operate front and rear wipers at all speeds and check for smooth, smear free operation.

Check High/Low Gear Engagement

1. Select LOW range gear, drive vehicle forwards 3 to 4 vehicle lengths, stop vehicle and select HIGH range gear - gears must engage smoothly.

Pollen Filter

1. Replace pollen filter.
For additional information, refer to: [Pollen Filter](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Corrosion/Cosmetic Inspection

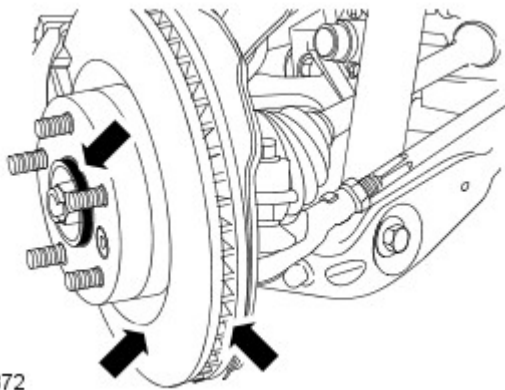
1. Carry out the annual corrosion/cosmetic inspection using the Annual Corrosion Inspection Sheet.

Wheels and Tires

1. Check that tires comply with manufacturer's specification.
For additional information, refer to: [Wheels and Tires](#) (204-04 Wheels and Tires, Description and Operation).
2. Check/adjust tire pressures including spare.
For additional information, refer to: [Wheels and Tires](#) (204-04 Wheels and Tires, Description and Operation).
3. **Vehicles with Uni-directional tires installed:** Mark the wheel to stud relationship of each road wheel and note location of each road wheel to its respective hub.
4. Loosen road wheel nuts. Raise vehicle to a wheel free condition.
For additional information, refer to: [Lifting](#) (100-02 Jacking and Lifting, Description and Operation).
5. Remove the road wheels.
6. Visually check tires for condition, lumps or bulges. Check tread depth across the width of the tire and around the circumference; make sure that remaining tread depth does not contravene local legislative requirements.

• **NOTE:** Do not install wheels at this stage.

Braking System



E54872

⚠ CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out:

- Every 3 months or 3,750 miles (6,000 km) - vehicles with 2.7L diesel
- Every 3 months or 4,000 miles (6,500 km) - vehicles with 3.0L diesel

1. Inspect front brake pads for wear.
For additional information, refer to: [Specifications](#) (206-03 Front Disc Brake, Specifications).
2. Inspect rear brake pads for wear.
For additional information, refer to: [Specifications](#) (206-04 Rear Disc Brake, Specifications).
3. Check brake calipers for signs of fluid leaks.
4. Check brake discs for condition.
5. Check all brake booster and brake system pipes and hoses for condition, chafing and leaks.
6. Clean road wheel hub spigots and apply grease, Land Rover Part Number RYL 105020 to the wheel mating surface of each spigot.
7. **Vehicles with Uni-directional tires installed:** Install road wheels to their respective hubs ensuring that stud to wheel relationship is maintained.
8. **Vehicles with NON uni-directional tires installed:** Install wheels on the opposite side of the vehicle but make sure that they on the same axle as they were originally installed.
9. Install road wheel nuts and tighten to 140 Nm (103 lb-ft).

⚠ CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out:

- Every 2 years or 30,000 miles (48,000 km) - vehicles with 2.7L diesel
- Every 2 years or 32,000 miles (52,000 km) - vehicles with 3.0L diesel

10. **Every 2 years or 30,000 miles (48,000 km) - vehicles with 2.7L diesel. Or 32,000 miles (52,000 km) - vehicles with 3.0L diesel:** Replace brake fluid.
For additional information, refer to: [Brake System Bleeding](#) (206-00 Brake System - General Information, General Procedures).
11. **Every 6 years or 90,000 miles (144,000 km) - vehicles with 2.7L diesel. Or 96,000 miles (156,000 km) - vehicles with 3.0L diesel:** Replace all flexible brake hoses.

Electric Parking Brake

⚠ CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out:

- Every 3 months or 3,750 miles (6,000 km) - vehicles with 2.7L diesel
- Every 3 months or 4,000 miles (6,500 km) - vehicles with 3.0L diesel

1. Check the adjustment of the electric parking brake.
For additional information, refer to: [Parking Brake Shoe and Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).
2. **Vehicles operating under arduous conditions:** Check the condition of the electric parking brake system.

Road Wheel Speed Sensors

⚠ CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out:

- Every 3 months or 3,750 miles (6,000 km) - vehicles with 2.7L diesel
- Every 3 months or 4,000 miles (6,500 km) - vehicles with 3.0L diesel

1. Inspect the road wheel speed sensor harnesses for damage.

Fuel Filter Element

• CAUTIONS:



When vehicles are operating under arduous conditions, the following service item must be carried out:

- Every 12 months or 15,000 miles (24,000 km) - vehicles with 2.7L diesel
- Every 12 months or 16,000 miles (26,000 km) - vehicles with 3.0L diesel



China and India markets only: The following service item must be carried out:

- Every 6 months or 7,500 miles (12,000 km) - vehicles with 2.7L diesel
- Every 6 months or 8,000 miles (13,000 km) - vehicles with 3.0L diesel

1. Every 2 years or 30,000 miles (48,000 km) - vehicles with 2.7L diesel. Or 32,000 miles (52,000 km) - vehicles with 3.0L diesel: Replace fuel filter element. For additional information, refer to:

[Fuel Filter Element - VIN Range: SALLA000304->END_OF_06MY](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation),

[Fuel Filter Element](#) (310-01B Fuel Tank and Lines - TDV6 3.0L Diesel, Removal and Installation).

Fuel Sedimentor



CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out:

- Every 3 months or 3,750 miles (6,000 km) - vehicles with 2.7L diesel
- Every 3 months or 4,000 miles (6,500 km) - vehicles with 3.0L diesel

1. Drain the fuel sedimentor.

For additional information, refer to: [Diesel Filter Water Drain-Off](#) (310-00 Fuel System - General Information, General Procedures).

Radiator/intercooler and Cooling Fan



CAUTION: Vehicles operating under arduous conditions:

1. Visually check the radiator/intercooler for external obstructions, check cooling fan blades for damage.
2. Remove any debris from the intercooler using a low pressure hose.

Air Suspension

1. Every 5 years or 75,000 miles (120,000 km) - vehicles with 2.7L diesel. Or 80,000 miles (129,000 km) - vehicles with 3.0L diesel - **On vehicles operating under arduous conditions:** Replace the air suspension compressor filter. For additional information, refer to: [Air Suspension Air Filter](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

Door Locks and Hinges

1. Check operation of all door locks, bonnet lock and fuel filler flap.
2. Lubricate all door check straps, bonnet catch and fuel filler flap catch.

Cooling System

1. Check specific gravity of coolant using a hydrometer.

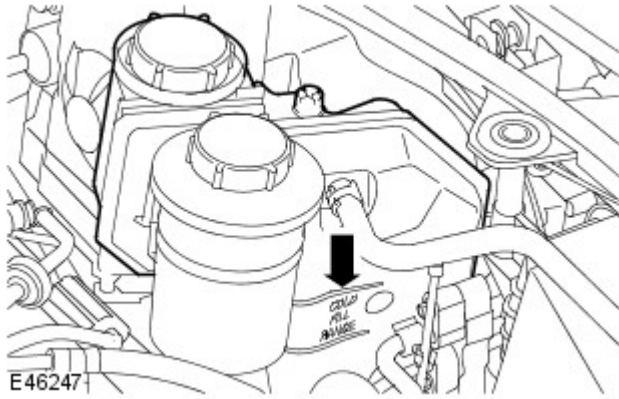
• **NOTE:** A suitable hydrometer is available from the Equipment Programme under Part Number 511 3302 001 00.

2. Top-up cooling system if necessary.

For additional information, refer to: [Specifications](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Specifications) / [Specifications](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Specifications).



CAUTION: Anti-freeze concentration must be maintained at 50%.



Cooling system - Check/Top-up



WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank whilst the system is hot.



CAUTION: Engine coolant will damage the paint finished surfaces. If coolant is spilled, immediately remove the coolant and wash the area with water.

1. Check the level of coolant in the expansion tank. With the engine cold, the coolant level must be to the '**UPPER LEVEL**' indicator mark above the '**COLD FILL RANGE**' text on the side of the expansion tank. Ignore any coolant which may be visible in the top section of the tank.

2. If topping-up is required, remove expansion tank filler cap and top-up coolant level to the '**UPPER LEVEL**' indicator mark.

For additional information, refer to: [Specifications](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Specifications) / [Specifications](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Specifications).



CAUTION: Always top-up with a 50% mixture of anti-freeze and water.

3. Fit expansion tank filler cap, tighten cap until ratchet is heard to 'click'.

Coolant - Replace

1. **Every 10 years or 150,000 miles (240,000 km) - vehicles with 2.7L diesel. Or 160,000 miles (258,000 km) - vehicles with 3.0L diesel:** Replace the coolant.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

Air Filtering



CAUTION: When vehicles are operating under arduous conditions, the following service item must be carried out:

- Every 12 months or 15,000 miles (24,000 km) - vehicles with 2.7L diesel
- Every 12 months or 16,000 miles (26,000 km) - vehicles with 3.0L diesel

1. **Every 3 years or 45,000 miles (72,000 km) - vehicles with 2.7L diesel. Or 48,000 miles (77,000 km) - vehicles with 3.0L diesel:** Replace the air filter element.

For additional information, refer to: [Air Cleaner Element](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation) / [Air Cleaner Element](#) (303-12B Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Removal and Installation).

Ancillary Drive Belt

1. Check the condition of the ancillary drive belt.

2. Remove all traces of mud and dirt from the drive belt and pulleys.

3. Check the drive belt for signs of splitting and wear.



CAUTION: When vehicles are operating under arduous conditions, the following service items must be carried out:

- Every 5 years or 75,000 miles (120,000 km) - vehicles with 2.7L diesel
- Every 5 years or 80,000 miles (129,000 km) - vehicles with 3.0L diesel

2. **Every 10 years or 150,000 miles (241,000 km) - vehicles with 2.7L diesel. Or 160,000 miles (258,000 km) - vehicles with 3.0L diesel:** Replace the ancillary drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation) / [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

Camshaft Timing Belt and High Pressure Fuel Pump Drive Belt/Rear End Accessory Drive (READ) Belt



CAUTION: When vehicles are operating under arduous conditions, the following service item must be carried out:

- Every 4 years or 60,000 miles (96,000 km) - vehicles with 2.7L diesel
- Every 4 years or 56,000 miles (90,000 km) - vehicles with 3.0L diesel

3. Every 7 years or 105,000 miles (168,000 km) - vehicles with 2.7L diesel. Or 112,000 miles (180,000 km) - vehicles with 3.0L diesel: Replace camshaft timing belt.

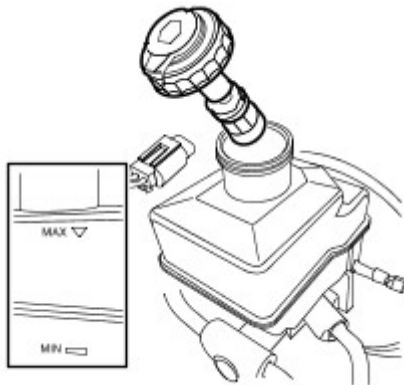
For additional information, refer to: [Timing Belt](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair) / [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

Replace the High pressure fuel pump drive belt.

For additional information, refer to: [Fuel Injection Pump Belt - VIN Range: SALLA000304->END OF 06 MY](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation) / [Rear End Accessory Drive \(READ\)](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

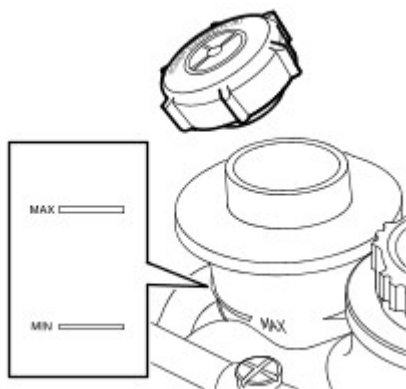
Fluid Levels

Brake/clutch fluid reservoir



1. Remove the auxiliary battery box cover.
2. Check the fluid level in the brake/clutch fluid reservoir, the level must be to the '**MAX**' mark on the reservoir; top-up if necessary.
3. Clean the area around the reservoir filler cap, remove the cap.
4. If necessary, top-up using the recommended fluid to the '**MAX**' mark on the reservoir.
For additional information, refer to: [Specifications](#) (206-00 Brake System - General Information, Specifications).
5. Reinstall the reservoir filler cap.
6. Install the auxiliary battery box cover.

Power steering fluid reservoir



CAUTION: To prevent over filling, check/top-up the system with the engine switched off and the system cold. Make sure that the steering wheel is in the straight ahead position, do not turn the steering wheel prior to checking the fluid level.

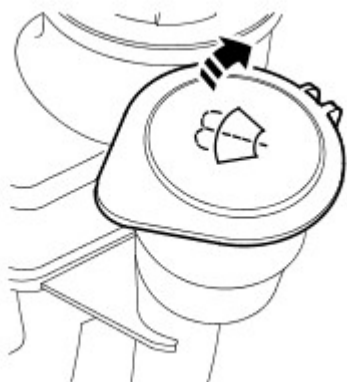
1. Check that the fluid level is to the mid-way mark between the '**MAX**' and '**MIN**' marks on the fluid reservoir, top-up if necessary.
2. Clean the area around the reservoir filler cap, remove the cap.

3. If necessary, top-up using the recommended fluid to the mid-way mark on the reservoir. For additional information, refer to: [Specifications](#) (211-02 Power Steering, Specifications).

 **CAUTION: Do not fill reservoir above the 'MAX' mark.**

4. Reinstall the reservoir filler cap.

Windshield washer reservoir



E54847

1. Remove the windshield washer reservoir filler cap.

2. Top-up the reservoir using a mixture of an approved windshield washer fluid and water until the level is to the bottom of the gauze filter in the reservoir filler neck.

3. Reinstall the reservoir filler cap.

Engine Oil and Filter

• CAUTIONS:

 **When vehicles are operating under arduous conditions, the following service items must be carried out:**

- Every 3 months or 3,750 miles (6,000 km) - vehicles with 2.7L diesel
- Every 3 months or 4,000 miles (6,500 km) - vehicles with 3.0L diesel

 **Rest of World Vehicles - Not UK and Europe: The following service items must be carried out:**

- Every 6 months or 7,500 miles (12,000 km) - vehicles with 2.7L diesel
- Every 6 months or 8,000 miles (13,000 km) - vehicles with 3.0L diesel

1. Renew engine oil and filter.

For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures) /

[Engine Oil Draining and Filling](#) (303-01B Engine - TDV6 3.0L Diesel, General Procedures).

Automatic Transmission

1. **Every 10 years or 150,000 miles (241,000 km) - vehicles with 2.7L diesel:** Renew automatic transmission fluid.

For additional information, refer to: [Specifications](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Specifications) /

[Transmission Fluid Drain and Refill](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

1. **Every 9 years or 144,000 miles (232,000 km) - vehicles with 3.0L diesel:** Renew automatic transmission fluid.

For additional information, refer to: [Specifications](#) (307-01D, Specifications) /

[Transmission Fluid Drain and Refill](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).

Transfer Case

1. **Every 5 years or 75,000 miles (120,000 km) - vehicles with 2.7L diesel. Or 80,000 miles (129,000 km) - vehicles with 3.0L diesel:** Renew transfer case fluid.

For additional information, refer to: [Specifications](#) (308-07B Transfer Case, Specifications) /

[Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).

Differential Assemblies

1. **Every 10 years or 150,000 miles (241,000 km) - vehicles with 2.7L diesel. Or 160,000 miles (258,000 km) - vehicles with 3.0L diesel:** Renew front differential oil.

For additional information, refer to: [Specifications](#) (205-03 Front Drive Axle/Differential, Specifications) /

[Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).

2. **Every 5 years or 75,000 miles (120,000 km) - vehicles with 2.7L diesel. Or 80,000 miles (129,000 km) - vehicles**

with 3.0L diesel: Renew rear 'Electronic Torque Managed (ETM)' differential oil.
For additional information, refer to: [Specifications](#) (205-02 Rear Drive Axle/Differential, Specifications) / [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

3. Every 10 years or 150,000 miles (241,000 km) - vehicles with 2.7L diesel. Or 160,000 miles (258,000 km) - vehicles with 3.0L diesel: Renew rear 'OPEN' differential oil.
For additional information, refer to: [Specifications](#) (205-02 Rear Drive Axle/Differential, Specifications) / [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

Suspension and Body Mountings

1. Check for free play in all suspension and body mounting rubbers.
2. Check condition of suspension rubber boots and gaiters.
3. Lift the vehicle so that front wheels are clear of ground/ramp to enable insertion of a suitable lever (e.g. a 1200mm long steel tube). Check the lower ball joints for free play by placing the lever between the ground/ramp and the tire, and lifting the wheel assembly with the lever. A second person will be required to check simultaneously for any ball joint lift. If free play (knock) is noted in the ball joint, replacement is required.

Fuel System

1. Check fuel system pipes, hoses and unions for chafing, leaks and corrosion.

Electrical Harnesses

1. Check all electrical harnesses for chafing.

Oil/Fluid Leaks

1. Check for oil/fluid leaks.

Exhaust System

1. Check exhaust system for leaks, security and damage.

Power Steering

1. Check power steering rod ball joint fixings, gaiters and condition of ball joints and dust covers.
2. Check power steering pipes, hoses and unions for chafing, leaks and corrosion.

Clutch

1. Check clutch pipes and unions for chafing, leaks and corrosion.

Fault Lamp(s)

1. If fault lamp(s) are illuminated, test the associated system using approved Land Rover diagnostic equipment and report findings.

Road Test

1. Carry out road test of vehicle.
For additional information, refer to: [Road/Roller Testing](#) (100-00 General Information, Description and Operation).

General

1. Endorse Service Record.
2. Report any unusual features of vehicle condition and any additional work required.

Additional Items That May Require Attention

It is recommended that:

1. **Every 6 years:** All brake fluid hydraulic seals are replaced.
 - **NOTE:** This is in addition to the maintenance requirement that flexible brake hoses **MUST** be replaced at this service interval.
2. **After 50 miles (80 km) continuous use in severe off-road conditions i.e. wading, deep mud and abrasive grit/slurry:** The electric parking brake should be cleaned and inspected.
3. **After 50 miles (80 km) continuous use in severe off-road conditions i.e. wading, deep mud and abrasive grit/slurry:** The ancillary drive belt should be cleaned and inspected.
4. **Vehicles with air suspension installed:** Vehicles used extensively in arduous or off road conditions will require the compressor air inlet filter to be renewed more frequently.
5. **Vehicles used in dusty or field conditions or deep wading:** More frequent attention to the air cleaner will be required.

6. Vehicles used in areas where fuel quality is poor: Where vehicles are used in these areas, the fuel sedimentor may require draining at more frequent intervals.

Suspension System - General Information -

Coil Spring Suspension

Item	Specification
Type:	
Front	Independent with single rate coil spring, twin tube damper and high stress anti-roll bar
Rear	Independent with dual rated coil spring, twin tube damper and anti-roll bar

Air Spring Suspension

Item	Specification
Type	Independent with twin tube damper, anti-roll bars and air springs with multiple, driver selectable ride heights - Standard, off-road and access.

Steering Geometry - Front



CAUTION: When checking or adjusting front or rear steering geometry, the vehicle must either have a full fuel tank or have sufficient weight placed in the vehicle's load space to give the equivalent weight of a full fuel tank. The weight must be evenly distributed at the front and the right hand side of the load space. The fuel tank capacity is 86.3 litres (18.9 Imperial gallons) (22.7 US gallons). Depending on the amount of fuel in the tank, calculate the amount of weight which must be added:

- 1 litre of fuel weighs 0.8 kg (1.7 pounds)
- 1 Imperial gallon of fuel weighs 3.6 kg (8.0 pounds)
- 1 US gallon of fuel weighs 3.0 kg (6.7 pounds)

Suspension at Standard Ride Height	Coil Spring Suspension	Dynamic (Air) Suspension
LHD		
LH Camber	-9' ± 45' (-0.15° ± 0.75°)	-9' ± 45' (-0.15° ± 0.75°)
RH Camber	-30' ± 45' (-0.5° ± 0.75°)	-30' ± 45' (-0.5° ± 0.75°)
Cross Camber	21' ± 45' (-0.35° ± 0.75°)	21' ± 45' (-0.35° ± 0.75°)
LH Castor	3°52' ± 45' (3.86° ± 0.75°)	3°52' ± 45' (3.86° ± 0.75°)
RH Castor	4°10' ± 45' (4.17° ± 0.75°)	4°10' ± 45' (4.17° ± 0.75°)
Castor Balance	-19' ± 45' (0.31° ± 0.75°)	-19' ± 45' (0.31° ± 0.75°)
Total Toe	10' ± 12' (0.16° ± 0.20°)	10' ± 12' (0.16° ± 0.20°)
RHD		
LH Camber	-30' ± 45' (-0.5° ± 0.75°)	-30' ± 45' (-0.5° ± 0.75°)
RH Camber	-30' ± 45' (-0.5° ± 0.75°)	-30' ± 45' (-0.5° ± 0.75°)
Cross Camber	0' ± 45' (0.0° ± 0.75°)	0' ± 45' (0.0° ± 0.75°)
LH Castor	4°1' ± 45' (4.02° ± 0.75°)	4°1' ± 45' (4.02° ± 0.75°)
RH Castor	4°1' ± 45' (4.02° ± 0.75°)	4°1' ± 45' (4.02° ± 0.75°)
Castor Balance	0' ± 45' (0.0° ± 0.75°)	0' ± 45' (0.0° ± 0.75°)
Total Toe	10' ± 12' (0.16° ± 0.20°)	10' ± 12' (0.16° ± 0.20°)

Steering Geometry - Rear

Suspension at Standard Ride Height	Coil Spring Suspension	Dynamic (Air) Suspension
LH Camber	-30' ± 45' (-0.5° ± 0.75°)	-45' ± 45' (-0.75° ± 0.75°)
RH Camber	-30' ± 45' (-0.5° ± 0.75°)	-45' ± 45' (-0.75° ± 0.75°)
LH Toe	7' ± 6' (0.12° ± 0.10°)	7' ± 6' (0.12° ± 0.10°)
RH Toe	7' ± 6' (0.12° ± 0.10°)	7' ± 6' (0.12° ± 0.10°)
Thrust Angle	0' ± 8' (0° ± 0.14°)	0' ± 8' (0° ± 0.14°)
Total Toe	14' ± 8' (0.24° ± 0.14°)	14' ± 8' (0.24° ± 0.14°)

Suspension System - General Information - Suspension System

Diagnosis and Testing

Principle of Operation

For a detailed description of the Suspension System and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

[Front Suspension](#) (204-01 Front Suspension, Description and Operation),
[Rear Suspension](#) (204-02 Rear Suspension, Description and Operation).

Inspection and Verification



WARNING: Before carrying out a road test, make sure the vehicle is safe to do so. Failure to follow this instruction may result in personal injury.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. Gather as much information from the driver as possible and verify the customer concern by carrying out a road test, as closely as possible reproducing the conditions under which the fault occurs.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Tire pressures ● Damaged wheels or tires ● Wheel bearing(s) ● Loose or damaged front or rear suspension components ● Loose, damaged or missing suspension fastener(s) ● Damaged or leaking air suspension components ● Worn or damaged suspension bushing(s) ● Loose, worn or damaged steering system components ● Damaged axle components ● Damaged Chassis

3. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the symptom chart.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Crabbing	<ul style="list-style-type: none"> ● Incorrect rear thrust angle ● Front or rear suspension components 	Check the rear alignment. REFER to: Four-Wheel Alignment (204-00 Suspension System - General Information, General Procedures). Check the front and rear suspension for signs of damage or wear.
Drift/Pull/Wander	<ul style="list-style-type: none"> ● Tire pressures ● Uneven tire wear ● Damaged steering components ● Wheel alignment ● Brake drag ● Unevenly loaded or overloaded vehicle 	Check and adjust the tire pressures (see visual inspection). Check for uneven tire wear, investigate the cause and rectify as necessary. Check the steering for wear/damage. Check and adjust the wheel alignment as necessary. Check for binding brakes, rectify as necessary. Advise the driver of the load issues.
Front bottoming or riding low	<ul style="list-style-type: none"> ● Damaged suspension components ● Air spring fault 	Check the suspension components for damage. Check the dynamic suspension. REFER to: Vehicle Dynamic Suspension (204-05 Vehicle Dynamic Suspension, Diagnosis and Testing).
Uneven tire wear	<ul style="list-style-type: none"> ● Incorrect tire pressure (rapid center rib or inner and outer edge wear) ● Incorrect front or rear toe (rapid inner or outer edge wear) ● Incorrect camber (rapid inner or outer edge wear) ● Tires out of balance 	Check and adjust the tire pressures (see visual inspection). Check and adjust the wheel alignment as necessary. REFER to: Four-Wheel Alignment (204-00 Suspension System - General Information, General Procedures). Balance the wheels and tires as necessary.

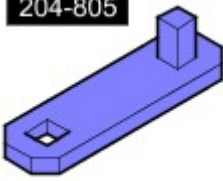
Symptom	Possible Causes	Action
	(tires cupped or dished)	
Harsh ride	<ul style="list-style-type: none"> ● Damaged suspension components ● Air spring fault 	Check the suspension components for damage. Check the dynamic suspension. REFER to: Vehicle Dynamic Suspension (204-05 Vehicle Dynamic Suspension, Diagnosis and Testing).
Shimmy or wheel tramp	<ul style="list-style-type: none"> ● Wheels/tires ● Loose wheel nut(s) ● Loose front suspension fasteners ● Front wheel bearing(s) fault ● Worn or damaged suspension component bushing ● Loose, worn or damaged ball joint(s) ● Loose, worn or damaged steering components ● Front wheel alignment 	Check the wheels and tires for condition and balance. Check and tighten the wheel nuts and suspension fasteners to specification. Check the front wheel bearings, suspension bushings, ball joints and steering components for wear or damage. Check and adjust the wheel alignment as necessary. REFER to: Four-Wheel Alignment (204-00 Suspension System - General Information, General Procedures).
Poor return ability of the steering (self-centering)	<ul style="list-style-type: none"> ● Steering column ● Ball joints ● Steering components 	Check the steering column universal joints, etc. Check the ball joints and other steering components
Sway or roll	<ul style="list-style-type: none"> ● Loose front or rear stabilizer bar ● Worn lower suspension arm stabilizer bar insulators ● Air spring fault 	Check the stabilizer bar security and condition. Rectify as necessary. Check the function of the active stabilization system (where installed). REFER to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Diagnosis and Testing). Check the air springs. REFER to: Vehicle Dynamic Suspension (204-05 Vehicle Dynamic Suspension, Diagnosis and Testing).
Vehicle leans to one side	<ul style="list-style-type: none"> ● Front or rear suspension components ● Air spring fault 	Check the front and rear suspension. Check the air springs. REFER to: Vehicle Dynamic Suspension (204-05 Vehicle Dynamic Suspension, Diagnosis and Testing).

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Suspension System - General Information - Four-Wheel Alignment

General Procedures

Special Tool(s)	
 <p>204-805</p> <p>E137184</p>	204-805

• CAUTIONS:



Make sure the vehicle is on a flat level surface.



Make sure the tire pressures are within specification.



Make sure that only the manufacturers' recommended four wheel alignment equipment is used.



Make sure the vehicles fuel tank is full, if not distribute extra weight evenly over the fuel tank area to represent a full tank of fuel.



Make sure there are no heavy objects in the vehicle.



Make sure the air suspension is set to NORMAL ride height.



Make sure the steering is in the straight ahead position.



Make sure the slip plates (turntables) are free to move before adjusting the geometry.

• NOTE: This procedure can be used for vehicles with either air or coil spring suspension.

1. Check the tie rod ends, suspension joints, wheel bearings and wheels and tires for damage, wear and free play.

- Adjust or repair any worn, damaged or incorrectly adjusted components.

2. Check and adjust tire pressures.

3. Position the vehicle on a calibrated, level, vehicle lift.

4. Release the vehicle parking brake.

5. Vehicles with dynamic suspension: Using the approved diagnostic tool, check the air suspension control module for fault codes and clear as required.

6. Vehicles with dynamic suspension: Using the diagnostic tool, set vehicle to 'Geometry Set Mode', using the instructions below. Putting the vehicle into this mode will make sure that the ride heights are controlled more accurately.

1. Select the 'Configuration' tab

2. Select 'Set up and Configure'.

3. Select 'Air Suspension'.

4. Select 'Suspension Geometry Set Up'.

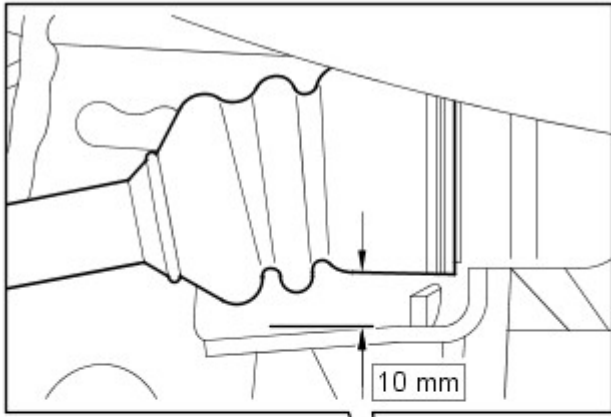
5. Select 'Tight Tolerance Mode'.


6. Follow the on-screen instructions until the set up process has finished.

7. NOTE: If rear camber adjustment is required, loosen the rear camber adjustment bolts enough to allow adjustment before starting any other wheel alignment adjustments. Do not fully loosen the rear camber adjustment bolts.

Using only four wheel alignment equipment approved by Land

Over, check and adjust the wheel alignment.

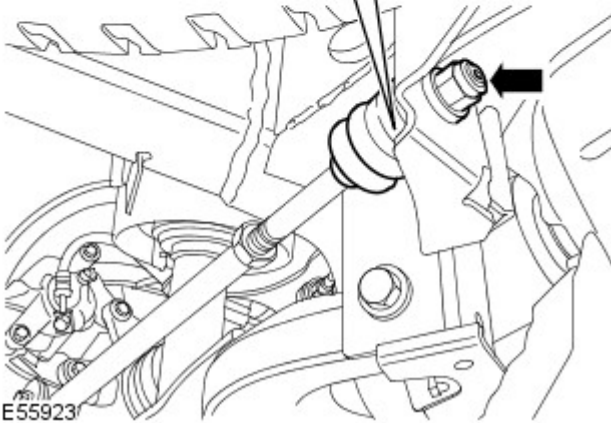


8.  **CAUTION:** Make sure the toe link anti-rotation tang is fully seated in the integrated body frame before tightening the toe link retaining nut. Failure to follow this instruction will result in damage to the toe link or integrated body frame.

• **NOTE:** This step is only required if the toe links have been removed or replaced.

Adjust the rear bump steer.

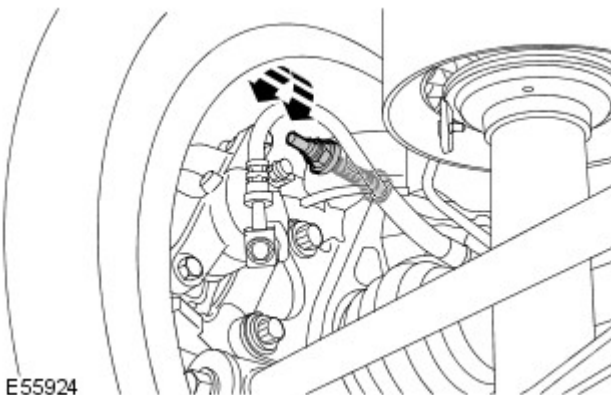
- Loosen the toe link inner ball joint retaining nut.
- Set the gap, between the underside of the toe link rubber boot and the integrated body frame bracket, to 10 mm (0.473 in).
- Tighten the toe link inner ball joint retaining nut to 133 Nm (98 lb.ft)
- Repeat the above procedure for the other side.



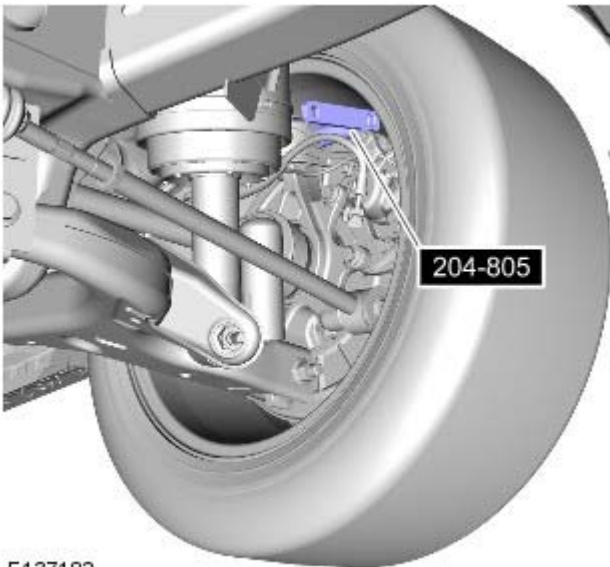
E55923

9. Adjust the rear camber.

- Loosen the rear camber adjusting bolts.
- Rotate the rear camber adjusting bolt until the correct value is obtained.
- Repeat the above procedure for the other side.
- Tighten the rear camber adjusting bolts.

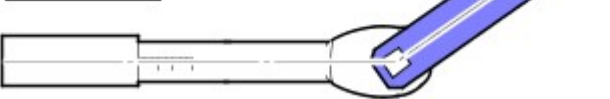
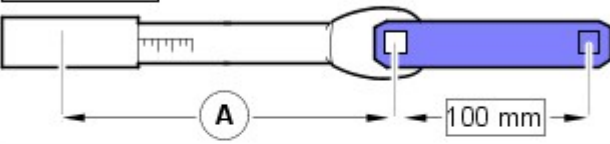


E55924



E137182

10. Install the special tool and a suitable socket to the rear camber adjusting bolt retaining nut.



E137185

11. NOTE: The torque wrench must be installed in a direct line with the special tool, as shown.

• NOTE: Calculate the torque wrench setting using the formula below.

• NOTE: Key to letters:

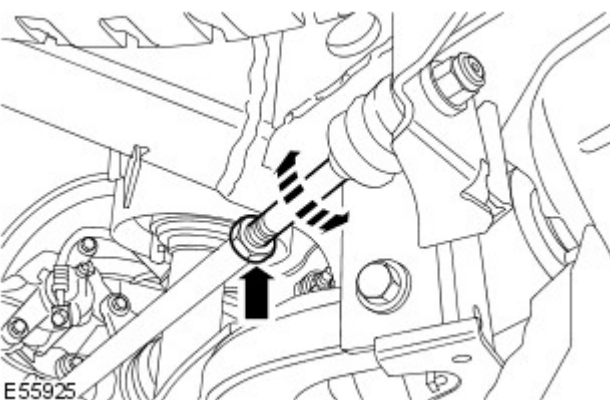
- **A** = Effective length of the torque wrench, measured in mm.

Formula:

- **Torque wrench setting (Nm) = $(133 \times A) / (A + 100)$**

Using the special tool, a suitable extension bar and a torque wrench, fully tighten the camber adjusting bolt retaining nut.

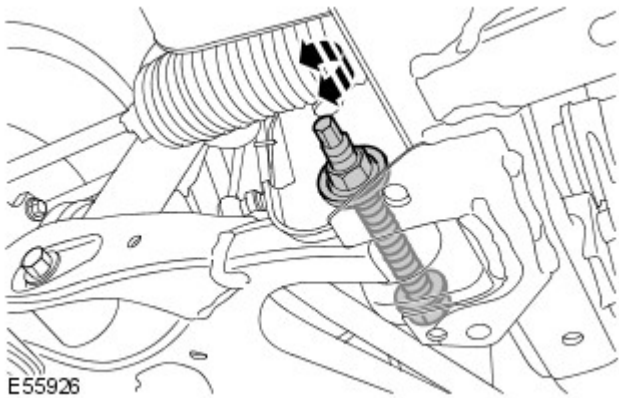
- Use the torque wrench setting calculated above.
- Repeat the above procedure for the other side.




E55925

12. Adjust the rear toe.

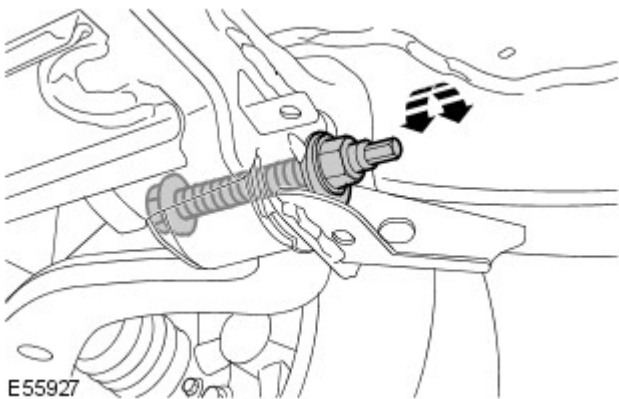
- Loosen the toe link adjustment locking nut.
- Rotate the toe link inner ball joint until the correct rear toe value is obtained.
- Tighten the toe link adjustment locking nut to 130 Nm (96 lb.ft).
- Repeat the above procedure for the other side.
- Repeat the rear toe measurement.



13.  **CAUTION:** Make sure the slip plates (turntables) are free to move before adjusting the geometry.

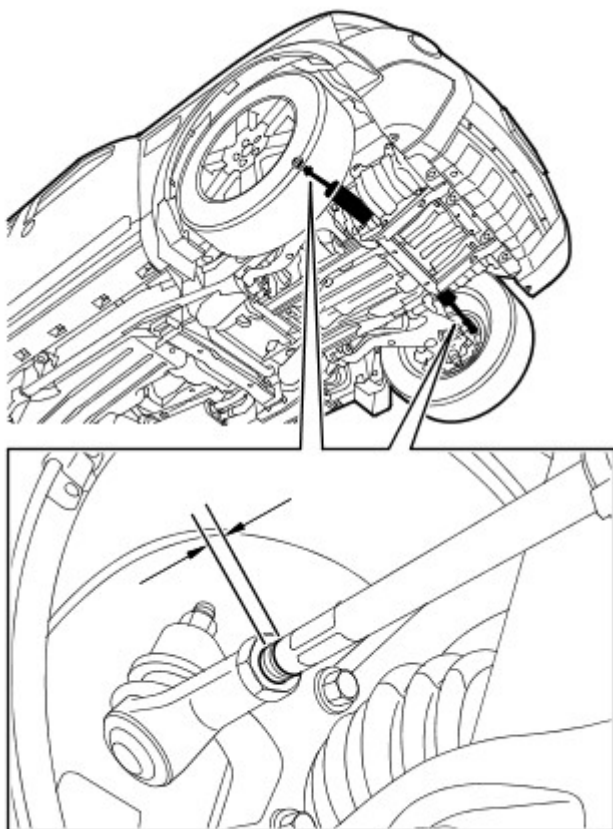
Adjust the front camber.

- Loosen the lower arm front camber adjusting bolt.
- Rotate the front camber adjusting bolt until the correct value is obtained.
- Tighten the lower arm front camber adjusting bolt to 275 Nm (203 lb.ft).
- Repeat the above procedure for the other side.



14. Adjust the front castor.

- Loosen the lower arm rear castor adjusting bolt.
- Rotate the castor adjusting bolt until the correct value is obtained.
- Tighten the lower arm rear castor adjusting bolt.
- Repeat the above procedure for the other side.
- Repeat the castor measurement.
- Repeat the above procedure until both castors achieve the correct value.
- Tighten the lower arm rear castor adjusting bolts to 275 Nm (203 lb.ft).



15. Align the steering to straight ahead.

- Measure the length of the exposed thread on each track rod.
- If the exposed thread lengths differ by more than two millimetres:
- Stage one: Loosen one track rod end locking nut.
- Stage two: Rotate the track rod until the lengths of the exposed threads on both track rods are equal.
- Stage three: Tighten the track rod end locking nut.
- Stage four: Rotate the steering wheel until both front toe measurements are equal.



16. Adjust the front toe.

- Loosen the track rod end locking nuts.
- Rotate the track rods to adjust each individual front toe to the correct value.
- Tighten the track rod end locking nuts to 53 Nm (39 lb.ft).

17. Vehicles with dynamic suspension: Using the diagnostic tool, return the vehicle to 'Normal Mode'.

1. Select the 'Configuration' tab
2. Select 'Set up and Configure'.
3. Select 'Air Suspension'.
4. Select 'Suspension Geometry Set Up'.
5. Select 'Normal Mode'.
6. Follow the on-screen instructions until the normal mode process has finished.

18. Calibrate the steering angle sensor using the diagnostic tool.

Suspension System - General Information - Front Wheel Bearing and Wheel Hub Runout Check

General Procedures

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: LH illustration shown, RH is similar.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the road wheel.

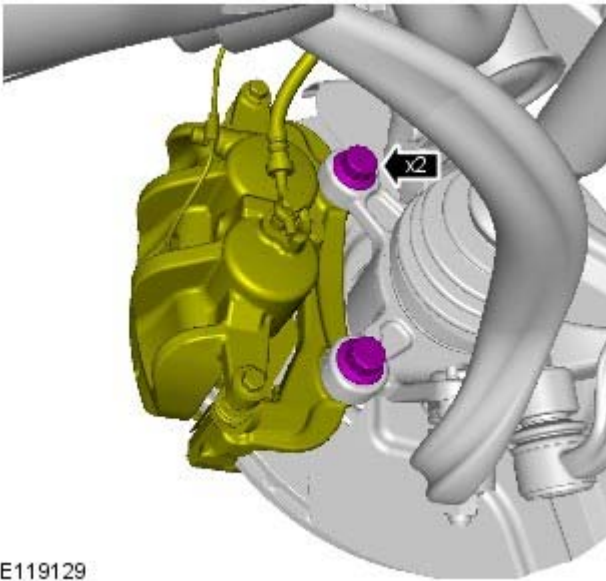
3. CAUTIONS:

 Do not allow the brake caliper to hang on the brake hose.

 LH side: Do not allow the brake caliper to hang on the brake pad wear warning sensor lead.

- NOTE: Models with standard brakes shown, models with high performance brakes similar.

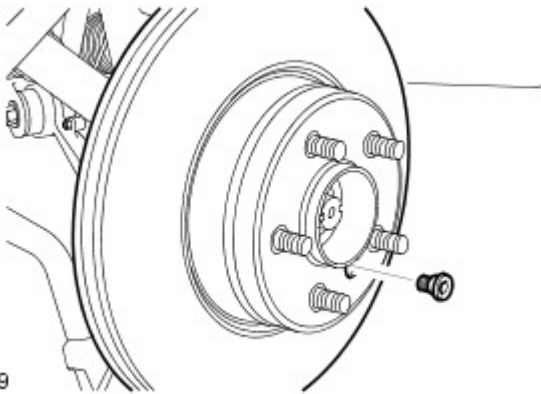
Release the brake caliper and tie aside.



E119129

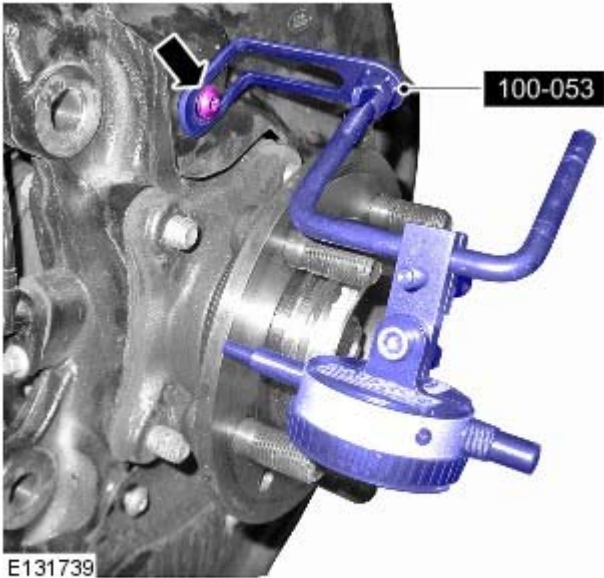
4. Remove the front brake disc.

- Remove the Allen screw.



E61629

5. Thoroughly clean the hub mounting face.



6. Using special tool (100-053) mount a Dial Test Indicator (DTI) to and secure to the backplate using the upper backplate fixing.

7.  **CAUTION:** Make sure the DTI is positioned clear of the wheel studs.

Position the DTI probe on the outer edge of the hub face.

8. Zero the DTI and rotate the hub one complete revolution to measure hub runout.
9. Remove the DTI.
10. Install the brake disc.
 - Tighten the Torx screw to 35 Nm (26 lb.ft).
11. Install the brake caliper and tighten the bolts. TORQUE: 275 Nm
12. Install the road wheel and tighten nuts to 140Nm (103 lb-ft).
13. Repeat the above procedure on the opposite side.
14. Depress the brake pedal several times to set brake pads.
15. Lower the vehicle.

Front Suspension -

Coil Spring Suspension

Item	Specification
Road spring color coding:	
	YELLOW/BLUE
	YELLOW/GREY
	YELLOW

Note: The first color indicates the fitted position of the spring on the vehicle i.e. front. The secondary color identifies the thickness of the isolator which is fitted to a particular spring to ensure that the vehicle ride height is maintained within specified limits. Replacement springs will be supplied with the appropriate isolator fitted.

Torque Specifications

Description	Nm	lb-ft
* Stabilizer bar link nuts	115	85
Stabilizer bar clamp nuts	115	85
Front axle crossmember bolts	115	85
Shock absorber and spring assembly to lower arm bolt	300	221
Shock absorber top mounting nuts	70	52
* Shock absorber upper bush rebound plate nut	98	72
Heat shield bolts	10	7
* Upper arm and wheel knuckle nut	70	52
* Tie-rod end ball joint nut	76	56
Brake hose retaining bracket to wheel knuckle bolt	22	16
* + Halfshaft retaining nut	230	169
Brake hose to upper arm bolt	22	16
Upper arm nuts and bolts	175	129
Radiator access panel bolts	10	7
Wheel hub bolts	115	85
Brake disc dust shield bolts	10	7
Lower arm bolts	275	203
Lower arm ball joint retaining nut	115	85
Lower arm front camber adjusting bolt	275	203
Lower arm rear castor adjusting bolts	275	203
Toe link inner ball joint retaining nut	133	98
Rear camber adjusting bolts	133	98
Track rod end locking nuts	53	39
Wheel speed sensor bolt	10	7
Axle carrier bushing bolt - M14	105	77
Axle carrier bracket bolts	80	59
Road wheel nuts	140	103

* **New nut/bolts must be fitted**

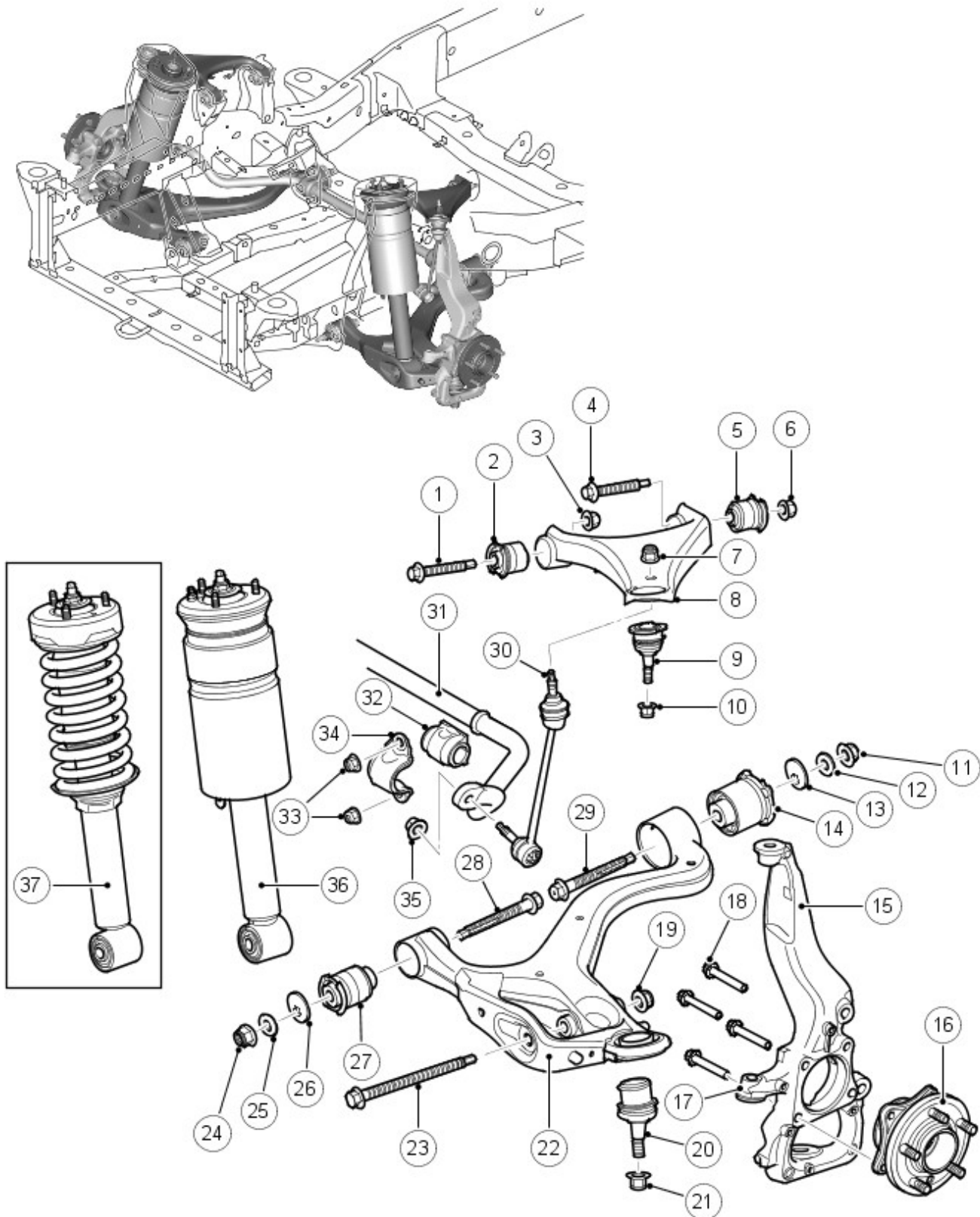
+ **Stake nut on completion**

Front Suspension - Front Suspension

Description and Operation

Front Suspension Component Layout

• NOTE: Air suspension version shown



E45850

Item	Part Number	Description
1	-	Flanged bolt (Upper control arm forward bush)
2	-	Bush - forward (Upper control arm)
3	-	Nut (Upper control arm forward bush)
4	-	Flanged bolt (Upper control arm forward bush)

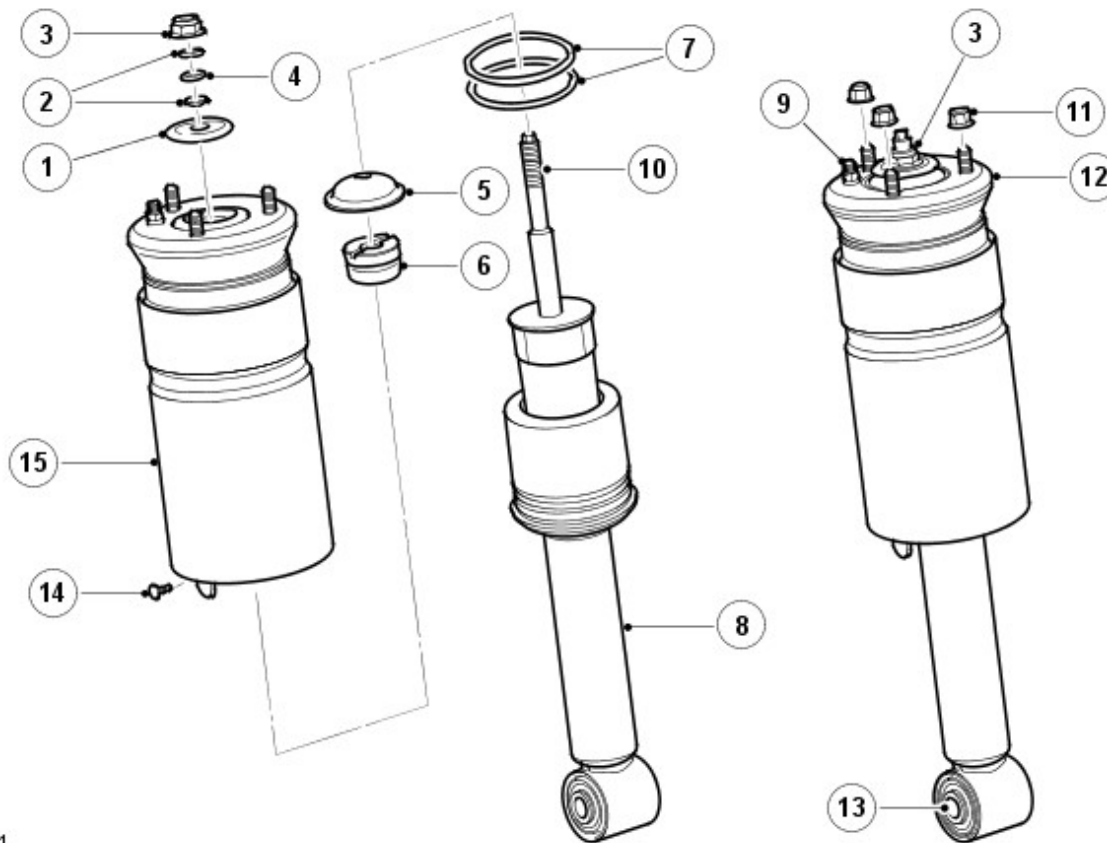
5	-	Bush - rearward (Upper control arm)
6	-	Nut (Upper control arm rearward bush)
7	-	Nut (Anti-roll bar link to upper control arm)
8	-	Upper control arm
9	-	Ball joint (Upper control arm to swivel hub)
10	-	Nut (Ball joint to swivel hub attachment)
11	-	Nut (Lower control arm rearward bush)
12	-	Flat washer
13	-	Cam washer (Lower control arm rearward bush)
14	-	Bush - rearward (lower control arm)
15	-	Wheel knuckle
16	-	Wheel hub and bearing assembly
17	-	Steering rack attachment
18	-	Wheel hub bolt (4 off)
19	-	Nut (Damper assembly lower attachment)
20	-	Ball joint (Lower control arm to swivel hub)
21	-	Nut (Ball joint to swivel hub attachment)
22	-	Lower control arm (air suspension version shown)
23	-	Bolt (Damper assembly lower attachment)
24	-	Nut (Lower control arm forward bush)
25	-	Flat washer
26	-	Cam washer (Lower control arm forward bush)
27	-	Lower control arm forward bush
28	-	Bolt (Lower control arm forward bush)
29	-	Bolt (Lower control arm rearward bush)
30	-	Anti-roll bar link
31	-	Anti-roll bar
32	-	Anti-roll bar bush
33	-	Nut (anti-roll bar bracket)
34	-	Anti-roll bar bracket
35	-	Nut (anti-roll bar link to anti-roll bar)
36	-	Damper assembly (air)
37	-	Damper assembly (coil spring)

GENERAL

The front suspension is a fully independent design which offers a reduction in unsprung weight over the beam axle design fitted to previous Land Rover models. The front suspension comprises an upper control arm, a lower control arm, a wheel knuckle and hub, an anti-roll bar and links assembly and a damper assembly. The damper can have a coil spring or air spring, both damper types use a similar design. The suspension components are common to both coil and air spring versions.

The suspension control arms have been designed for maximum ground clearance and also allow for adjustment of the camber and castor using cam adjusters.

DAMPER MODULE - AIR SUSPENSION



E45851

Item	Part Number	Description
1	-	Rebound washer*
2	-	O-ring - damper rod (2 off)*
3	-	Self-locking nut*
4	-	Spacer - damper rod*
5	-	Bump washer
6	-	Spring aid*
7	-	O-ring - air spring sleeve support (2 off)*
8	-	Damper assembly*
9	-	Voss air fitting
10	-	Damper rod
11	-	Self-locking nut (3 off)
12	-	Top mount
13	-	Bush
14	-	Retaining pin - air spring assembly*
15	-	Air spring assembly*

• NOTE: * shows service items

The damper module comprises an air spring assembly, top mount and a damper assembly. The damper and air spring are only serviceable as complete assemblies.

Damper

The damper assembly is a twin tube design with the conventional coil spring replaced by the air spring. The lower end of the damper is fitted with a bush and is attached to the lower control arm with a bolt and nut.

The damper functions by restricting the flow of hydraulic fluid through internal galleries within the damper. The damper rod moves axially within the damper, its movement limited by the flow of fluid through the galleries, providing damping of undulations in the terrain. The damper rod is sealed at its exit point from the damper body to maintain the fluid within the unit and to prevent the ingress of dirt and moisture. The seal also incorporates a wiper to keep the rod clean.

Air Spring

The air spring comprises an aluminium restraining cylinder, top mount, spring aid, air sleeve and an inner support sleeve.

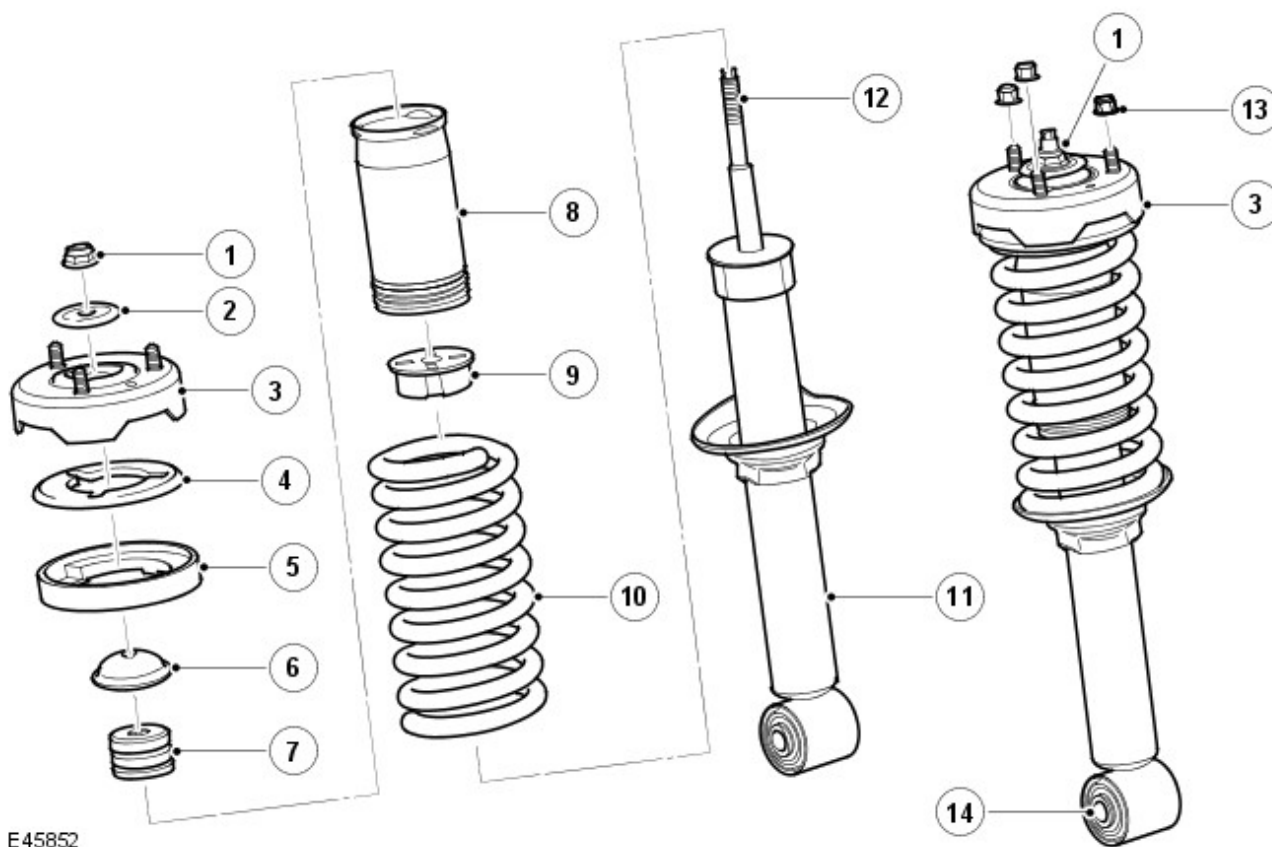
The air sleeve is made from a flexible rubber material which allows the sleeve to roll up and down the air spring piston as the vehicle changes height. The air sleeve is attached to the restraining cylinder and support sleeve by crimp rings which provide an air tight seal. The support sleeve contains a seal carrier which has two O-rings sealing the support sleeve and two O-rings sealing to the damper body. The top of the air sleeve is crimped to the top mount which attaches to the chassis frame with 3 integral studs and self-locking nuts.

A spring aid is fitted to the damper rod and prevents the top mount contacting the top of the damper during full suspension compression and assists the suspension tune. The lower end of the air spring is located over the damper body and seats on a fabricated seat on the damper body. The air sleeve is positively attached to the seat with a retaining pin. The damper rod is located through a central hole in the top mount. The rod is threaded at its outer end. A self-locking nut secures the air spring to the damper rod.

The top mount is an integral part of the air spring and is fitted with a bush and rebound washer. A bump washer is located between the top mount plate and the damper rod. The top mount is secured to the damper rod with a self-locking nut. The top mount attaches to a housing on the chassis with 3 integral studs and self-locking nuts. The top mount also incorporates a 6 mm Voss air fitting which allows for the attachment of the air harness.

A gaitor is available as a dealer fit component. The gaitor is similar to the one fitted to the rear air damper module and is available if a customer experiences dirt and debris becoming trapped between the air sleeve and the restraining cylinder under certain terrain conditions.

DAMPER MODULE - COIL SPRING SUSPENSION



E45852

Item	Part Number	Description
1	-	Self locking nut
2	-	Rebound washer
3	-	Top mount assembly
4	-	Spring spacer (selective)
5	-	Spring isolator
6	-	Bump washer
7	-	Spring aid
8	-	Dust tube
9	-	Bump cup
10	-	Coil spring
11	-	Damper
12	-	Damper rod
13	-	Self locking nut (3 off)
14	-	Bush

The coil spring damper module comprises a damper, coil spring and top mount.

Damper

The damper assembly is a twin tube design with the conventional coil spring located on a welded spring seat on the damper tube. The lower end of the damper is fitted with a bush and is attached to the lower control arm with a bolt and nut.

The damper functions by restricting the flow of hydraulic fluid through internal galleries within the damper. The damper rod moves axially within the damper, its movement limited by the flow of fluid through the galleries, providing damping of undulations in the terrain. The damper rod is sealed at its exit point from the damper body to maintain the fluid within the unit and to prevent the ingress of dirt and moisture. The seal also incorporates a wiper to keep the rod clean.

The damper rod is located through a central hole in the top mount. The rod is threaded at its outer end. A self-locking nut secures the top mount to the damper rod.

A spring aid is fitted to the damper rod and prevents the top mount contacting the top of the damper during full suspension compression and also assists the suspension tune.

Spring and Top Mount

The coil spring fitted differs with vehicle specification. Each spring is colour coded to identify its rating and fitment

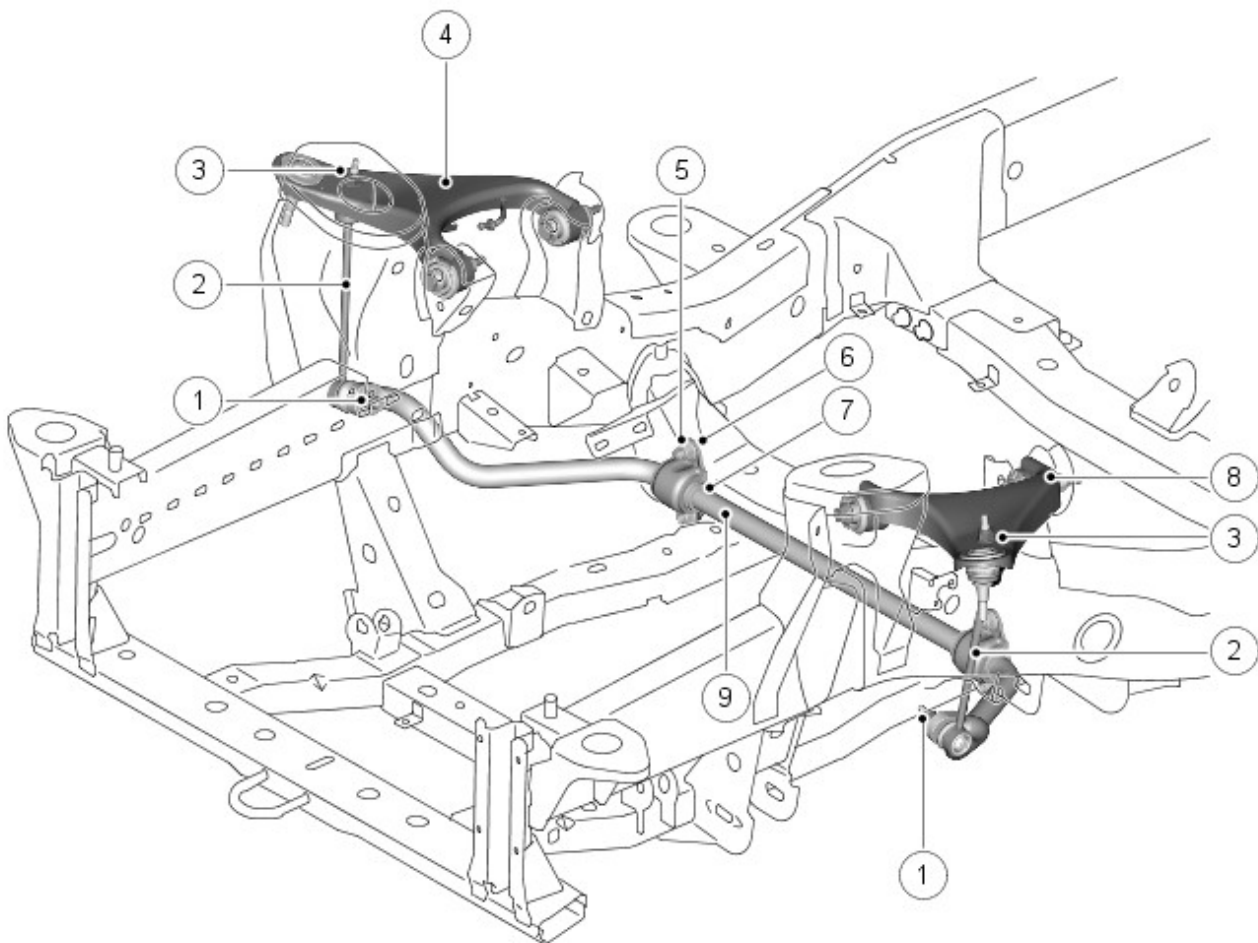
requirements.

The coil spring is located in a spring seat which is an integral part of the damper body. The design of the spring seat prevents the spring rotating. The opposite end of the coil spring is located in a spring isolator which is fitted in the top mount. The spring isolator is made from rubber and prevents any noise produced during damper and spring compression/extension from being transmitted to the vehicle body.

The top mount is fitted with a bush and rebound washer which are located between the top mount plate and the damper rod, a self locking nut secures the damper rod to the top mount. The top mount attaches to a housing on the chassis with 3 integral studs and self-locking nuts.

The spring is fitted with spring spacers which are located between the spring isolator and the top mount. The spring spacers control the length of the spring to maintain the correct trim height. The spring spacers are colour coded and are supplied with a replacement spring.

ANTI-ROLL BAR



E45853

Item	Part Number	Description
1	-	Nut - link to anti-roll bar (2 off)
2	-	Link (2 off)
3	-	Nut - link to upper control arm (2 off)
4	-	RH upper control arm
5	-	Nut (4 off)
6	-	Bracket (2 off)
7	-	Bush (2 off)
8	-	LH upper control arm
9	-	Anti-roll bar

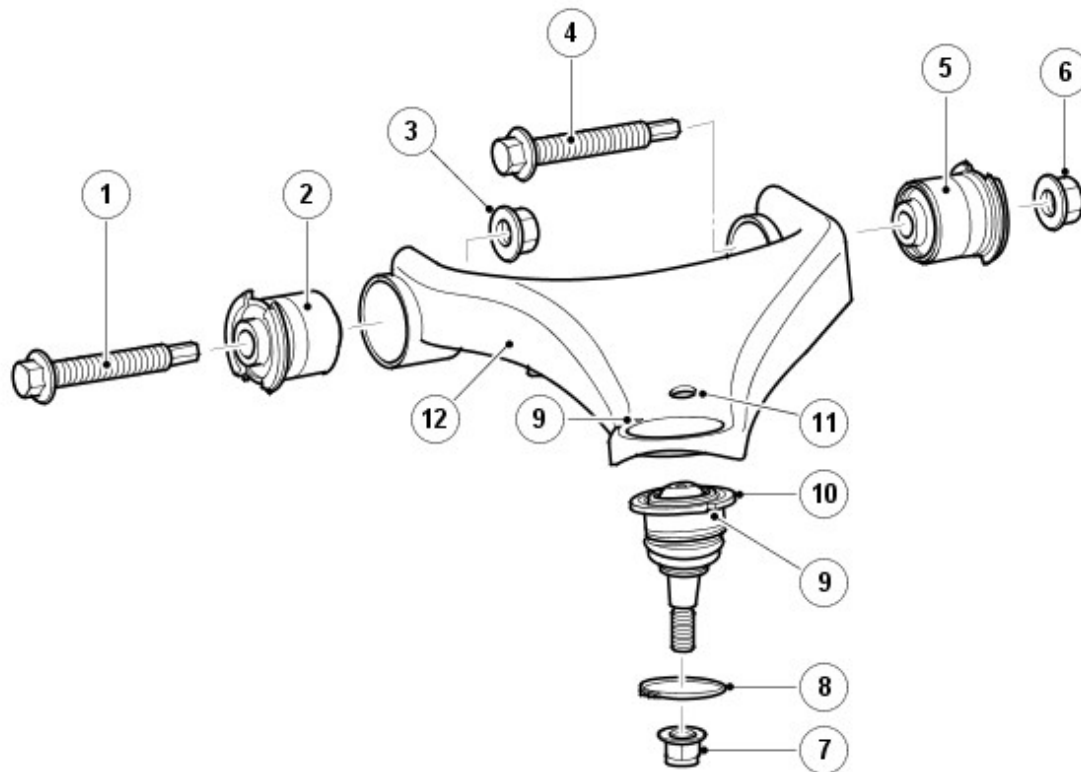
The anti-roll bar is fabricated from induction hardened, solid spring steel bar. The anti-roll bar operates, via a pair of links,

from their attachment to the upper control arm.

The anti-roll bar is attached to the forward face of the chassis front cross member. The anti-roll bar is attached to the cross member with two, Teflon lined bushes. Brackets, which are pressed onto the bushes, are attached to the cross member with nuts, screwed onto studs in the cross member. The anti-roll bar has crimped, 'anti-shuffle' collars pressed in position on the inside edges of the bushes. The collars prevent sideways movement of the anti-roll bar.

The ends of the anti-roll bar are attached to the upper control arms via links. This allows the anti-roll bar to move with the wheel travel providing maximum effectiveness. Each link has a ball joint at each end. The top ball joint is attached to the link, parallel with the link axis. The ball joint is located in a hole in the upper control arm and secured with a self-locking nut. The bottom ball joint is attached to the link at 90 degrees to the link axis. The ball joint is located in a hole in the end of the anti-roll bar and secured with a self-locking nut. The links are not handed and therefore can be fitted to either side of the anti-roll bar.

UPPER CONTROL ARM



E45854

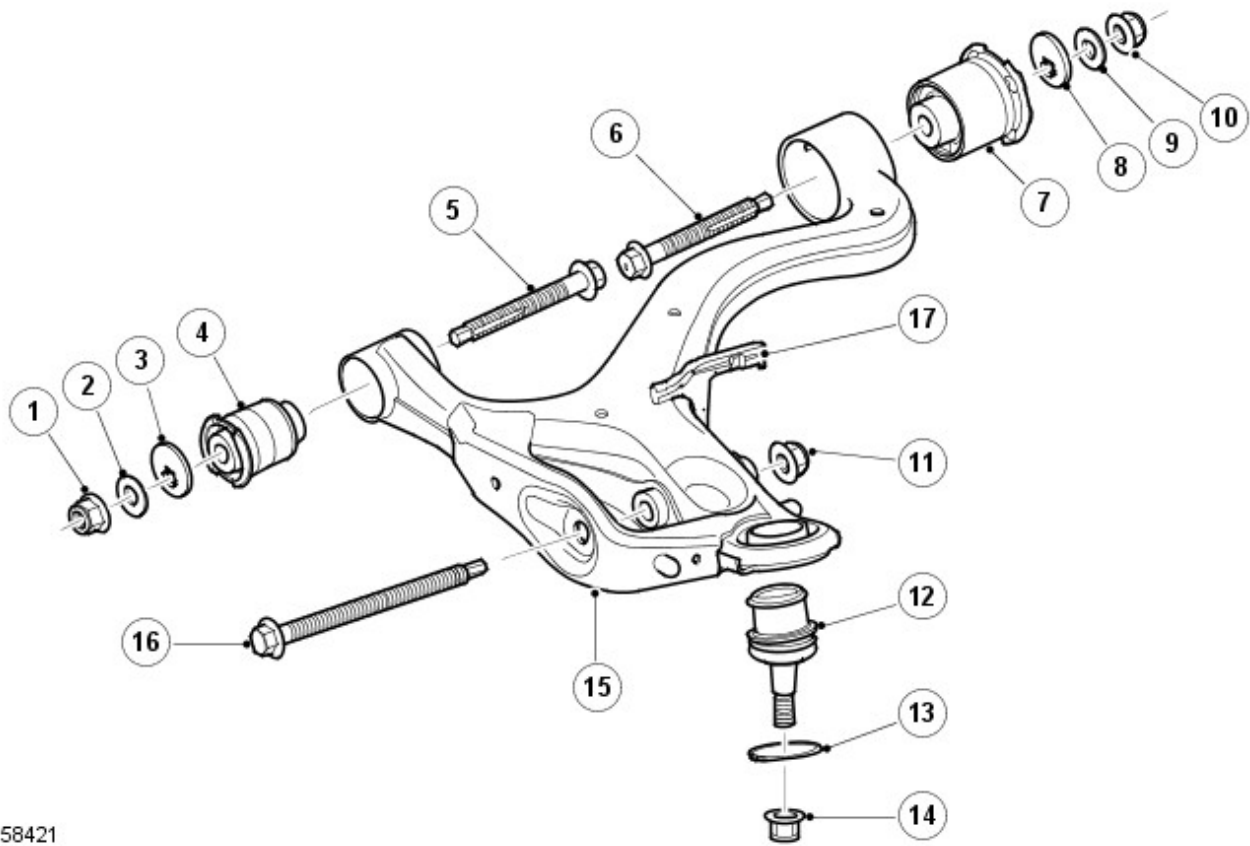
Item	Part Number	Description
1	-	Flanged bolt
2	-	Bush
3	-	Self locking nut
4	-	Flanged bolt
5	-	Bush
6	-	Self locking nut
7	-	Self locking nut
8	-	Circlip
9	-	Timing marks
10	-	Ball joint
11	-	Anti-roll bar link attachment hole
12	-	Upper control arm

The upper control arm assembly comprises, the control arm, two bushes and a ball joint. The upper control arm is a pressed steel fabrication. Its outer end has a hole to accept the ball joint. A small indentation is located adjacent to the ball joint hole and is used to obtain the correct orientation of the ball joint. A smaller hole near the ball joint provides for the attachment of the anti-roll bar link. The underside of the upper control arm has a bracket for attachment of the height sensor link arm and two further brackets which secure the brake hose, pad wear sensor and wheel speed sensor cables.

The inner end of the arm has two fabricated bush housings which are welded to the arm pressing. A bush is pressed into each housing. The bushes are located between lugs on the chassis and are secured with bolts and self-locking nuts through metal inserts in the centre of the bushes.

The ball joint is pressed into the upper control arm. The ball joint is an interference fit in the hole which prevents the ball joint from moving. A circlip is fitted to the ball joint to retain it in the hole. The top face of the ball joint has two semi-circular cut-outs. One of these cut-outs must be aligned with the small indentation in the upper control arm to ensure the correct operation of the ball joint.

LOWER CONTROL ARM



E58421

Item	Part Number	Description
1	-	Self locking nut
2	-	Flat washer
3	-	Cam washer
4	-	Bush
5	-	Special bolt
6	-	Bolt
7	-	Hydrobush
8	-	Cam washer
9	-	Flat washer
10	-	Self locking nut
11	-	Self locking nut - damper lower attachment
12	-	Ball joint
13	-	Circlip
14	-	Self locking nut
15	-	Lower control arm
16	-	Bolt - damper lower attachment
17	-	Jacking bracket (Vehicles with coil springs only)

The lower control arm assembly comprises, the control arm, two bushes and a ball joint. The lower control arm is a pressed steel fabrication with a hole at its outer end to accept the ball joint.

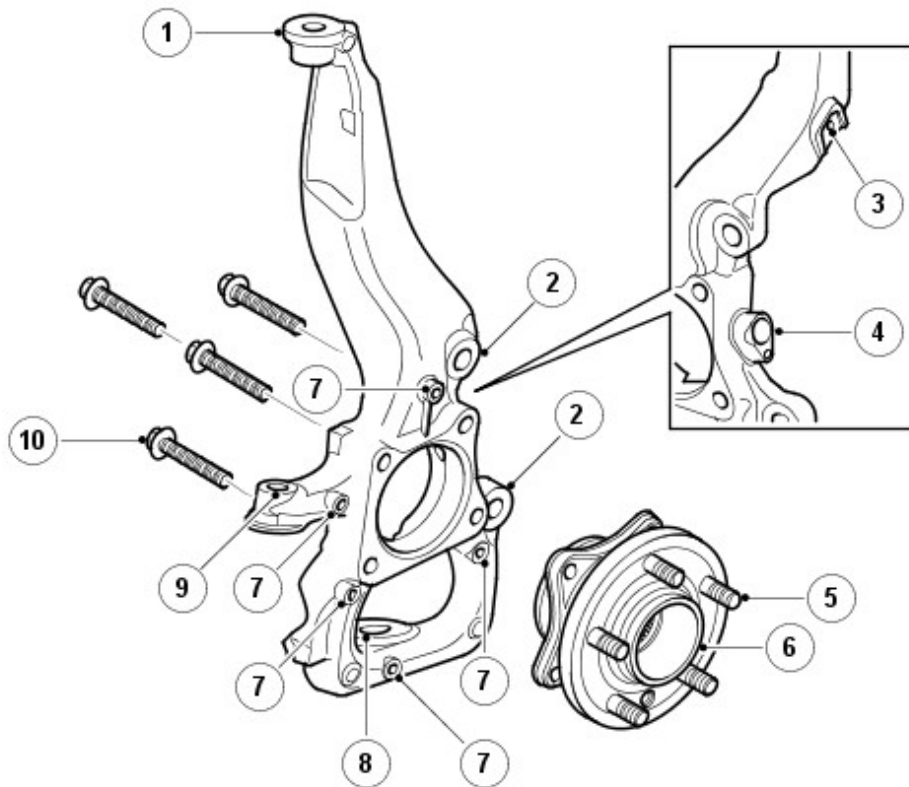
The inner end of the arm has two fabricated bush housings which are welded to the arm pressing. A bush is pressed into each housing. The rear bush is a hydrobush which provides a progressive increase in the hardness of the bush as the deflection of the wheel increases. The bushes are located between lugs on the chassis and are secured with bolts and self-locking nuts through metal inserts in the centre of the bushes. The forward bush, self-locking nut, has a cam washer located beneath it. The cam washer is located between lugs on the chassis bracket and its orientation can be adjusted to set the front camber. The rear bush, self-locking nut, also has a cam washer located beneath it. The cam washer is located between lugs on the chassis bracket and its orientation can be adjusted to set the front castor.

On vehicles fitted with coil springs only, a jacking bracket is located on the lower control arm.

A central aperture in the arm provides for the attachment of the damper module lower bush. The damper is secured with a long bolt which is positioned through holes in the arm and secured with a self-locking nut.

The ball joint is pressed into the lower control arm. The ball joint is an interference fit in the hole which prevents the ball joint from moving. A circlip is fitted to the ball joint to retain it in the hole.

WHEEL KNUCKLE, HUB AND BEARING ASSEMBLY



E45856

Item	Part Number	Description
1	-	Upper control arm attachment
2	-	Brake caliper attachment holes
3	-	Brake hose bracket attachment point
4	-	Wheel speed sensor location
5	-	Wheels studs
6	-	Wheel hub
7	-	Brake disc dust shield attachment holes
8	-	Lower control arm ball joint attachment
9	-	Steering rack ball joint attachment
10	-	Wheel hub bolts (4 off)

The wheel knuckle is a machined casting which is located between the ball joints of the upper and lower control arms. The knuckle has four clearance holes which allow for the fitment of four bolts which secure the wheel hub housing. A cast boss on the forward edge of the knuckle provides for attachment of the steering gear, tie rod ball joint.

The wheel hub and bearing assembly comprises the wheel hub housing, wheel hub and taper roller bearing. The wheel hub and bearing assembly is a non-serviceable component. Five M14 studs are pressed into the wheel hub and provide for the attachment of the road wheel with wheel nuts.


The wheel hub housing is a machined forging which houses a taper roller bearing. The housing has four threaded holes which provide for the attachment to the wheel knuckle with four bolts.

The wheel hub has a splined centre bore which mates with corresponding splines on the half shaft. Rotation of the half shaft is passed, via the splines, to the wheel hub which rotates on the taper roller bearing.

Front Suspension - Front Stabilizer Bar

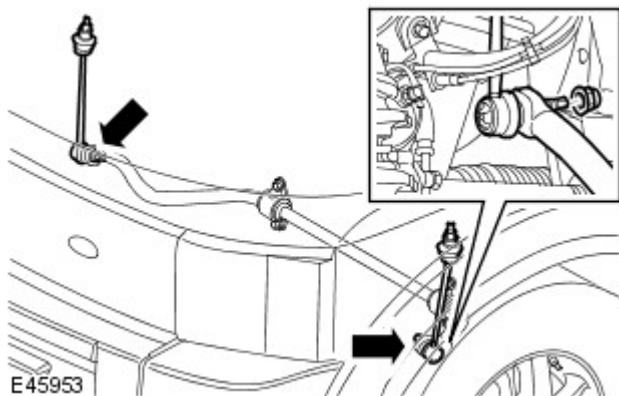
Removal and Installation

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

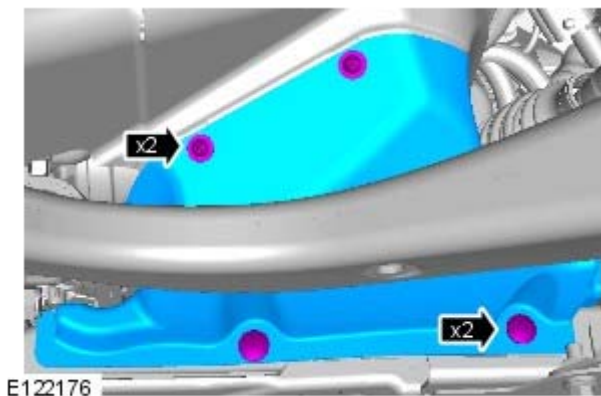
- Remove the wheels and tires.
- Disconnect both the stabilizer bar links from the stabilizer bar.
 - Remove and discard the 2 nuts.



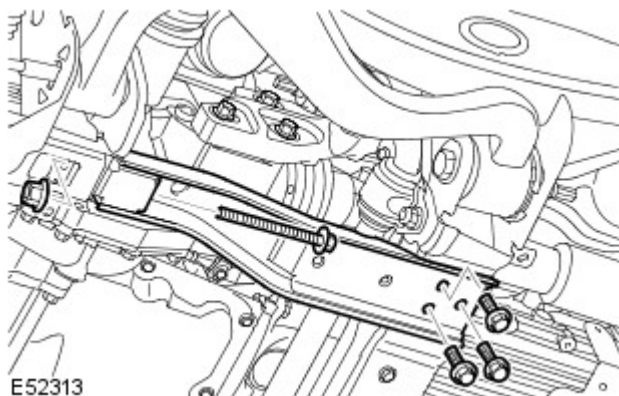
- NOTE:** RH side only.

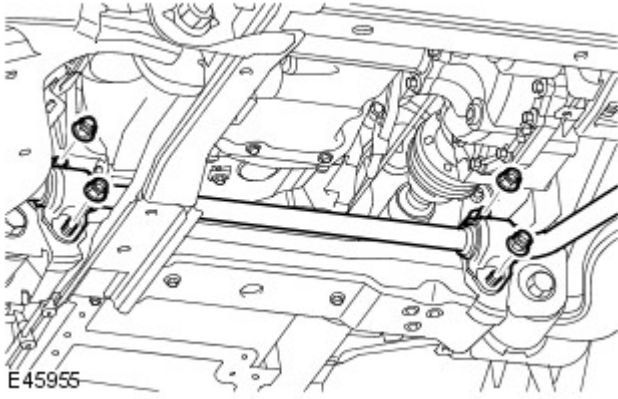
Remove the fender splash shield lower extension panel.

- Remove the 2 screws.
- Remove the 2 clips.



- Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
- Remove the front axle crossmember.
 - Remove the 4 bolts.





7. Remove the stabilizer bar bushing.

- Remove the 4 nuts.
- Remove the stabilizer bar clamps.

8. Remove the stabilizer bar.

- Remove the stabilizer bar out through the LH side wheel arch.

Installation

1. Install the stabilizer bar.

- Install the stabilizer bar through the LH side wheel arch.

2. Install the stabilizer bar bushing.

- Install the stabilizer bar clamps.
- Tighten the nuts to 115 Nm (85 lb.ft).

3. Install the front axle crossmember.

- Tighten the 4 bolts to 115 Nm (85 lb.ft).

4. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

5. NOTE: RH side only.

Install the fender splash shield lower extension panel.

- Install the 2 screws.
- Install the 2 clips.

6. Connect both stabilizer bar links to the stabilizer bar.

- Install new nuts and tighten to 115 Nm (85 lb.ft).


7. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Front Stabilizer Bar Link


Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

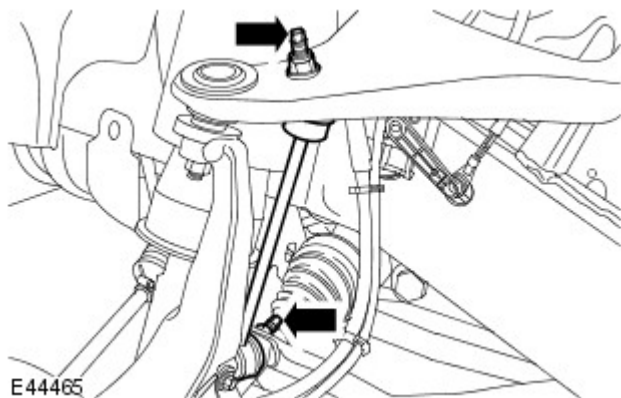
Raise and support the vehicle.

2. Remove the wheel and tire.

3.  **CAUTION:** Use a wrench on the hexagon provided to prevent the ball joint rotating.

Remove the stabilizer bar link.

- Remove and discard the 2 nuts.

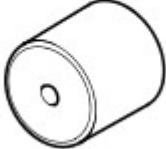





Installation

1. Install the stabilizer bar link.
 - Tighten the nuts to 115 Nm (85 lb.ft).
2. Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Upper Arm Ball Joint

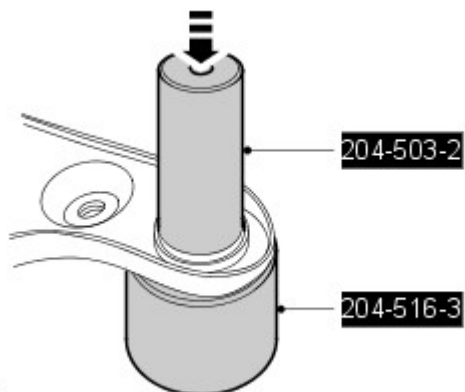
Removal and Installation

Special Tool(s)	
 <p>204-516/3 E50961</p>	Ball joint remover 204-516/3 (LRT 64-026/3)
 <p>204-530-2 E50156</p>	Ball joint remover 204-530-2
 <p>204-530-3 E50157</p>	Ball joint installer 204-530-3
 <p>204-530-1 E50155</p>	Ball joint installer 204-530-1

Removal


- NOTE: This procedure shows removal and installation of the upper arm ball joint.

1. Remove the upper arm.
For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).
2. Remove the dust seal.
 - Remove the seal retainer.
 - Remove the circlip.
3. Using the special tools, remove the ball joint.

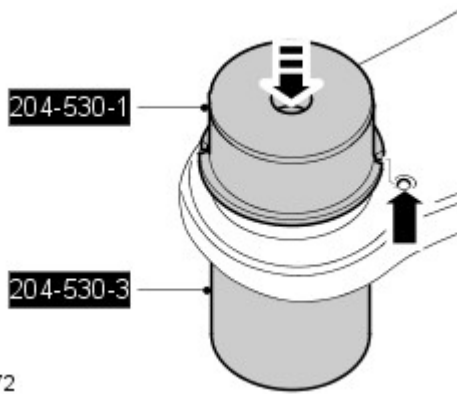


E50160

Installation

1.  CAUTION: Make sure the timing marks are aligned.

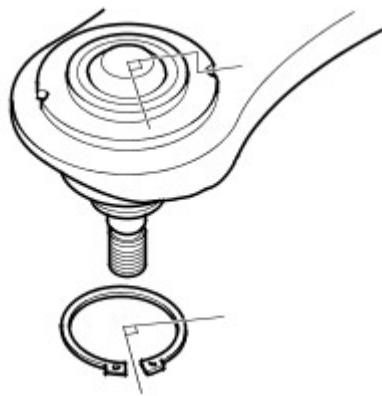
Using the special tools, install the ball joint.



E50172

2.  CAUTION: Circlip holes to be 90 degrees rotated from timing marks.

Install the circlip.



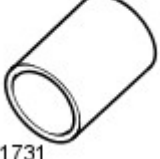




E50173

3. Install the upper arm.
For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).


Front Suspension - Lower Arm Ball Joint

Removal and Installation

Special Tool(s)	
 <p>204-531/3 E51733</p>	Remover/installer front lower arm ball joint 204-531/3
 <p>204-531/2 E51732</p>	Remover/installer front lower arm ball joint 204-531/2
 <p>204-531/1 E51731</p>	Remover/installer front lower arm ball joint 204-531/1
 <p>204-753 E104988</p>	Remover/installer front lower arm ball joint 204-753
 <p>204-754 E104989</p>	Remover/installer front lower arm ball joint 204-754

Removal

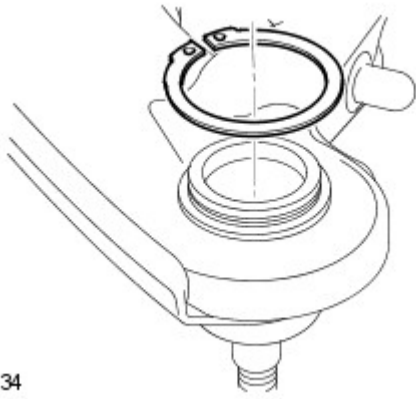
All vehicles

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

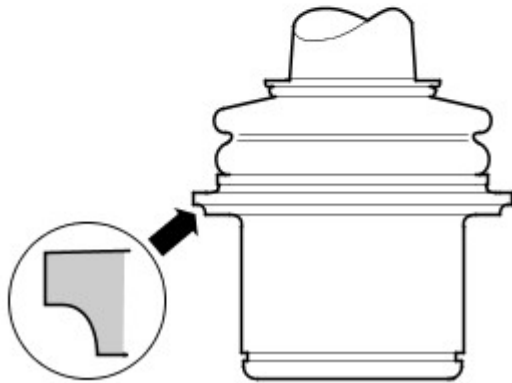
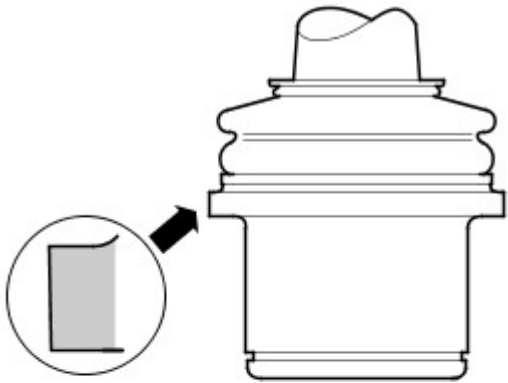
- Remove the wheel and tire.
- Remove the lower arm.
For additional information, refer to: [Lower Arm](#) (204-01 Front Suspension, Removal and Installation).

4. Remove the circlip.



E51734

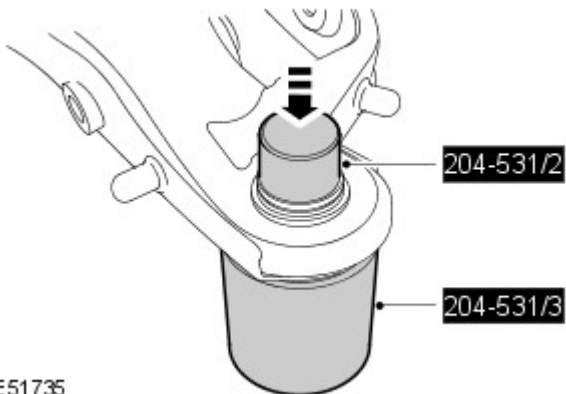
5. Inspect the installed ball joint to determine if a radius is present.



E104990

Ball joint without radius

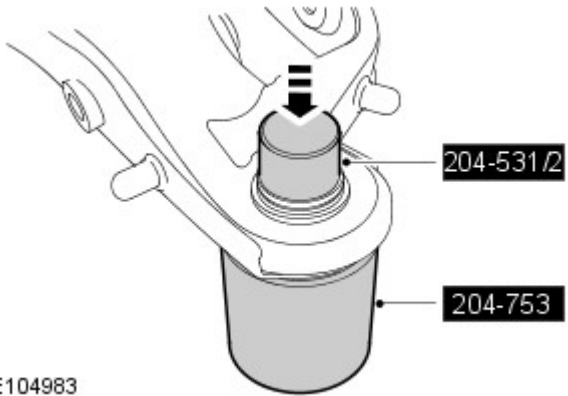
6. Using the special tools, remove the ball joint.



E51735

Ball joint with radius

7. Using the special tools, remove the ball joint.

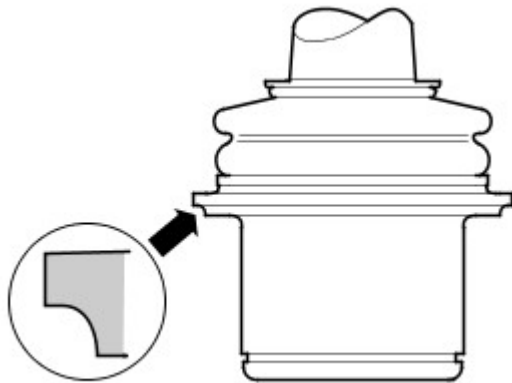
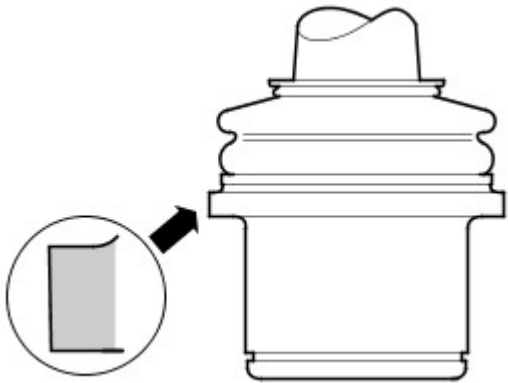


E104983

Installation

All vehicles

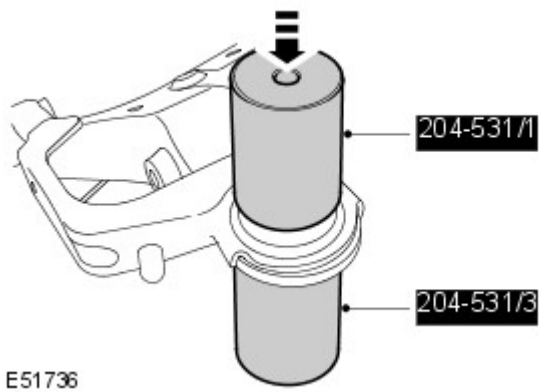
1. Clean the components.
2. Inspect the new ball joint to determine if a radius is present.



E104990

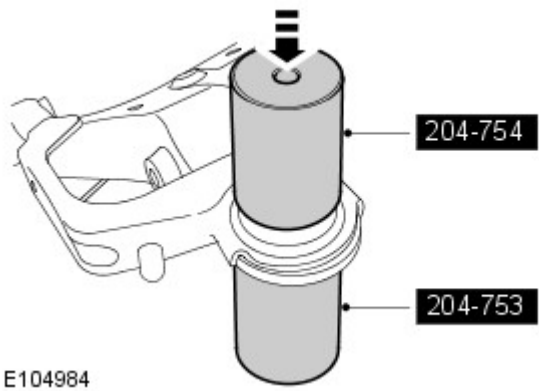
Ball joint without radius

3. Using the special tools, install the ball joint.



Ball joint with radius

4. Using the special tools, install the ball joint.



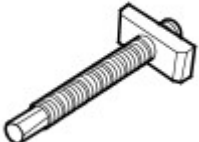
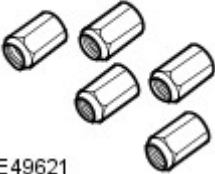

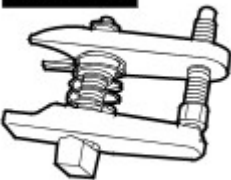


All vehicles

5. Install the circlip.
6. Install the lower arm.
For additional information, refer to: [Lower Arm](#) (204-01 Front Suspension, Removal and Installation).
7. Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).


Front Suspension - Wheel Knuckle

Removal and Installation

Special Tool(s)	
 <p>204-506/1 E49618</p>	Halfshaft remover/replacer 204-506/1(LRT-60-030/1)
 <p>204-506/2 E49619</p>	Halfshaft remover/replacer 204-506/2(LRT-60-030/2)
 <p>204-506/3 E49620</p>	Halfshaft remover/replacer 204-506/3(LRT-60-030/3)
 <p>204-506/5 E49621</p>	Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)
 <p>204-506-01 E49622</p>	Halfshaft installer adapter 204-506-01(LRT-60-030/4)
 <p>205-754A E45276</p>	Ball joint separator 205-754(LRT-54-027)

Removal

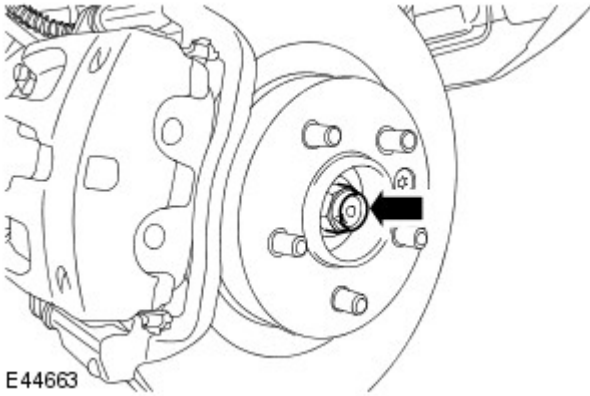
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

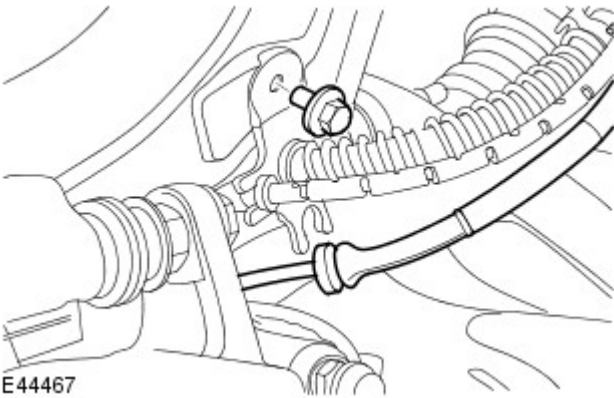
2. Remove the wheel and tire.

3. Loosen the halfshaft retaining nut.



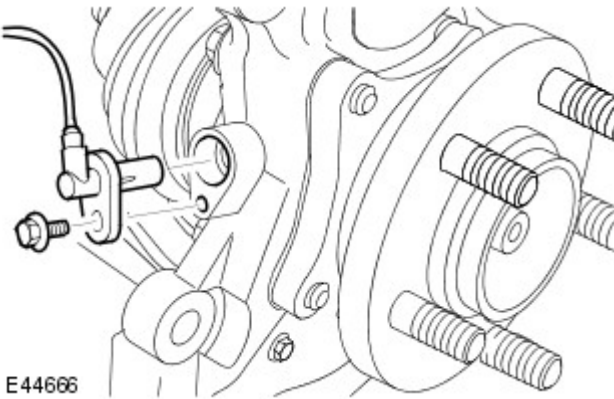
4. Release the brake hose bracket from the wheel knuckle.

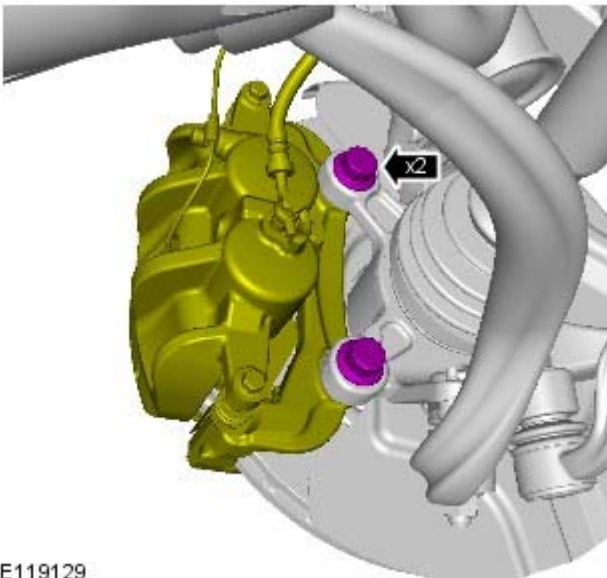
- Remove the bolt.



5. Release the wheel speed sensor from the wheel knuckle.

- Remove the bolt.





E119129

6. CAUTIONS:



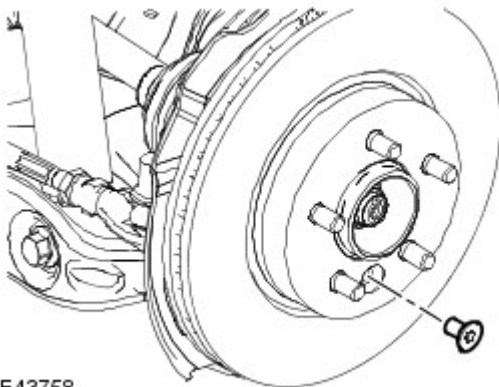
Do not allow the brake caliper to hang on the brake hose.



LH side: Do not allow the brake caliper to hang on the brake pad wear warning sensor lead.

Remove the brake caliper and anchor plate.

- Remove the 2 bolts.
- Tie the brake caliper and brake caliper anchor plate assembly aside.



E43758

7. Remove the brake disc.

- Remove the Torx screw.

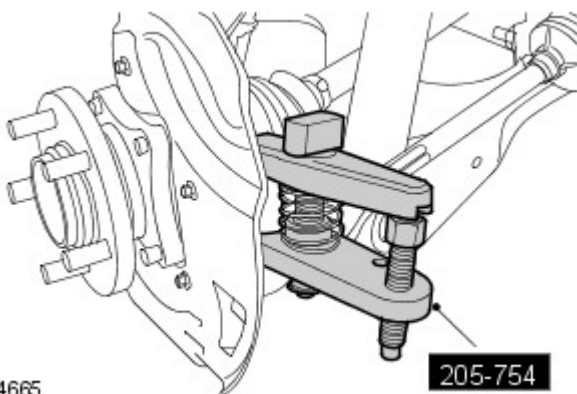
8. Remove the halfshaft retaining nut.

- Discard the nut.

9. Loosen the tie-rod end ball joint retaining nut.

10. Using the special tool, release the tie-rod end ball joint from the wheel knuckle.

- Discard the nut.



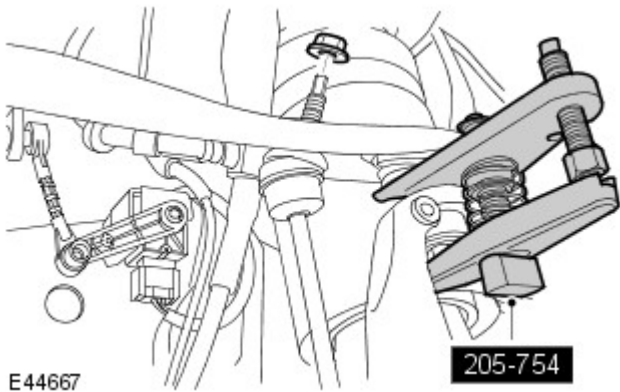
E44665


11. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

Remove and discard the stabilizer bar link nut.

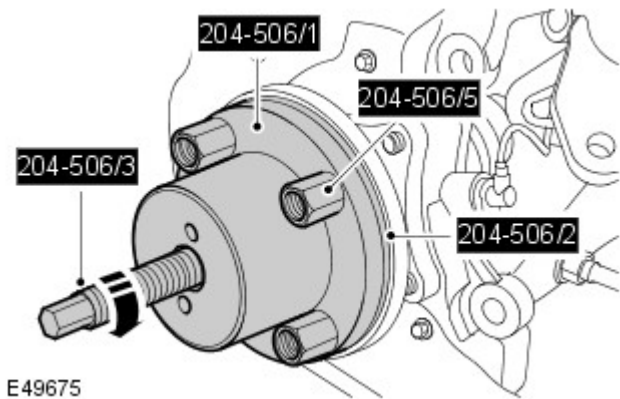
12. Loosen the upper arm retaining nut.

13. Using the special tool, release the upper arm ball joint.



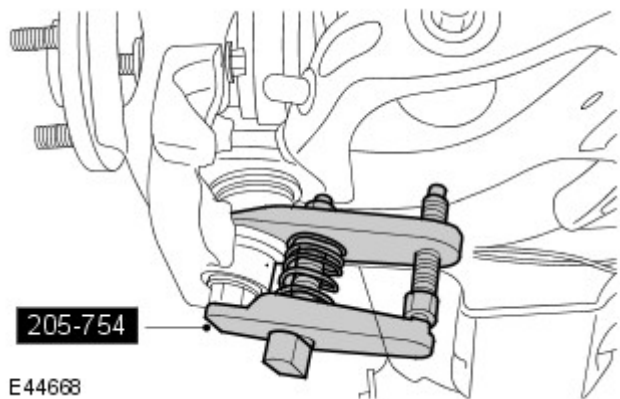
14.  CAUTION: Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.


Using the special tools, release the halfshaft from the drive flange.



15. Remove the lower ball joint retaining nut.

16. Using the special tool, release the lower ball joint from the steering knuckle.



17.  CAUTION: The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

Remove the upper arm retaining nut.

- Discard the nut.

18. NOTE: Do not disassemble further if the component is removed for access only.

Remove the wheel knuckle.




19. Remove the brake disc dust shield.
- Remove the four retaining bolts.



20. Remove the wheel hub.
- Remove the 4 bolts.

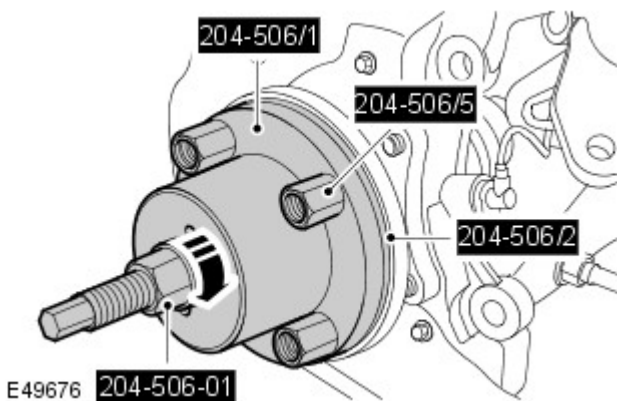
Installation

1. Clean the components.
2. Install the wheel hub.
 - Tighten the 4 bolts to 115 Nm (85 lb.ft).
3. Install the brake disc dust shield.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).

4.  **CAUTION:** The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

With assistance, install the wheel knuckle.

5. Using the special tools, install the halfshaft in the wheel hub.



6. Connect the upper arm and wheel knuckle.
 - Install a new nut and tighten to 70 Nm (52 lb.ft).


7. Secure the stabilizer bar link.

- Install a new nut and tighten to 115 Nm (85 lb.ft).

8. Tighten the lower arm ball joint retaining nut to 115 Nm (85 lb.ft).

9. Connect the tie-rod end ball joint.

- Install a new nut and tighten to 76 Nm (56 lb.ft).

10.  **CAUTION:** Install the halfshaft nut finger tight.

Install a new halfshaft retaining nut and lightly tighten.


11. Make sure the brake disc and hub mating surfaces are clean.

12. Install the brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

13. Install the brake caliper and anchor plate.

- Clean the brake caliper anchor plate using brake cleaning fluid.
- Tighten the bolts to 275 Nm (203 lb.ft).

14.  **CAUTION:** Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

Tighten the new halfshaft retaining nut to 230 Nm (170 lb.ft).

- Stake the nut to the halfshaft.

15. Install the wheel speed sensor.

- Tighten the bolt to 10 Nm (7 lb.ft).

16. Secure the brake hose retaining bracket to the wheel knuckle.

- Tighten the bolt to 22 Nm (16 lb.ft).



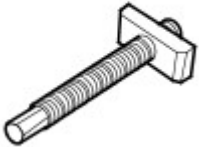
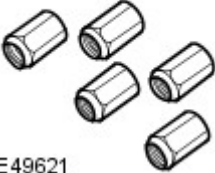

17. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

18. Install the wheel and tire.


- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Front Wheel Bearing and Wheel Hub

Removal and Installation

Special Tool(s)	
 <p>204-506/1 E49618</p>	<p>Halfshaft remover/replacer 204-506/1(LRT-60-030/1)</p>
 <p>204-506/2 E49619</p>	<p>Halfshaft remover/replacer 204-506/2(LRT-60-030/2)</p>
 <p>204-506/3 E49620</p>	<p>Halfshaft remover/replacer 204-506/3(LRT-60-030/3)</p>
 <p>204-506/5 E49621</p>	<p>Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)</p>
 <p>204-506-01 E49622</p>	<p>Halfshaft installer adapter 204-506-01(LRT-60-030/4)</p>

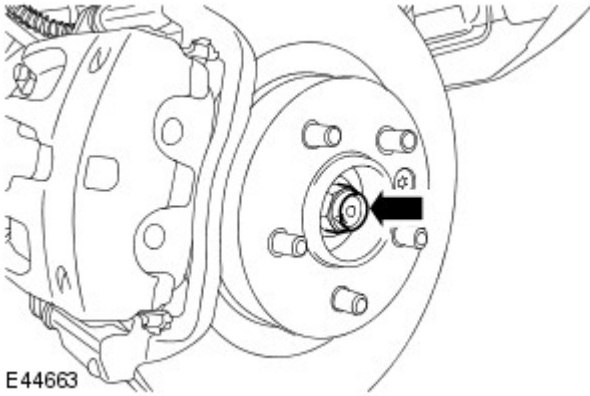
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.

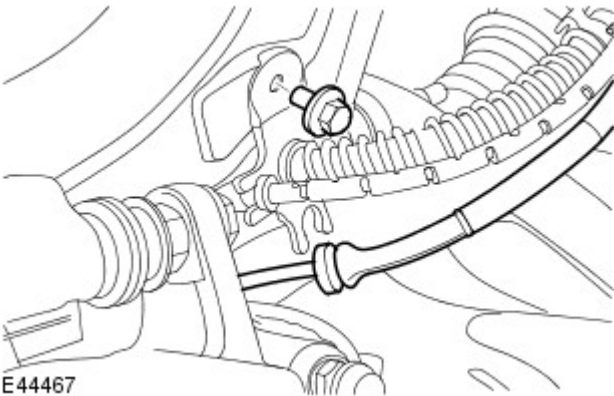
3. Loosen the halfshaft retaining nut.



E44663

4. Release the brake hose bracket from the wheel knuckle.

- Remove the bolt.



E44667

5. Remove the wheel speed sensor retaining bolt.

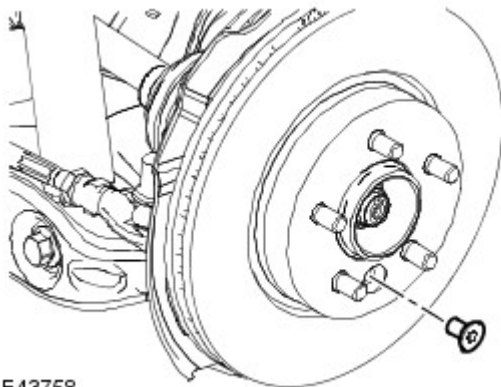
6.  **CAUTION:** Do not allow the brake caliper to hang on the brake hose.

Release the brake caliper anchor plate from the wheel knuckle and tie the caliper aside.

- Tie aside complete with the wheel speed sensor.

7. Remove the brake disc.

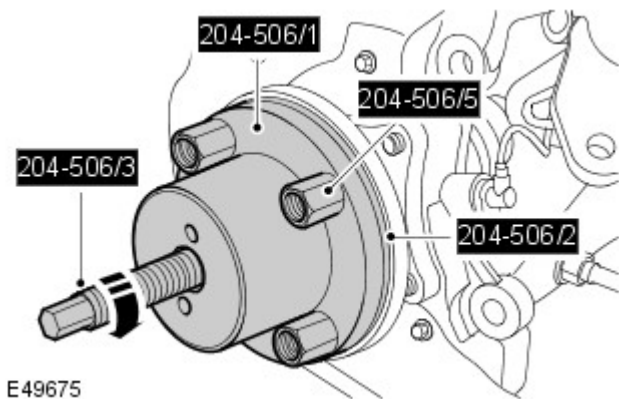
- Remove the Torx screw.




E43758

8. Remove the halfshaft retaining nut.

- Discard the nut.

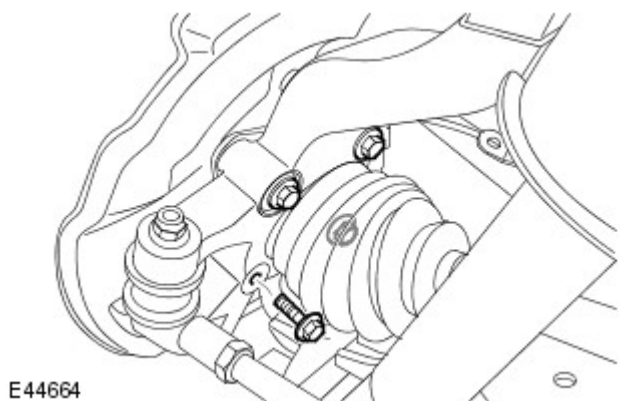


9.  **CAUTION:** Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

Using the special tools, release the halfshaft from the wheel hub.

10. Remove the wheel hub.

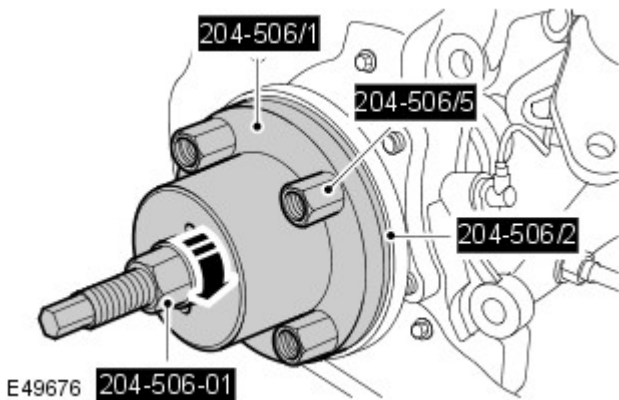
- Remove the 4 bolts.



Installation

1. Clean the components.
2. Install the wheel hub.

- Using the special tools, install the halfshaft in the wheel hub.
- Tighten the 4 bolts to 115 Nm (85 lb.ft).



3. Install a new halfshaft retaining nut and lightly tighten.
4. Make sure the brake disc and hub mating surfaces are clean.
5. Install the brake disc.
 - Tighten the Torx screw to 35 Nm (26 lb.ft).
6. Install the brake caliper and anchor plate.
 - Install the wheel speed sensor.
 - Tighten the bolts to 275 Nm (203 lb.ft).
7. Install the wheel speed sensor retaining bolt.
8. Secure the brake hose retaining bracket to the wheel knuckle.
 - Tighten the bolt to 22 Nm (16 lb.ft).

9.  **CAUTION:** Do not use air tools to install the nut. Failure

to follow this instruction may result in damage to the component.

Tighten the new halfshaft retaining nut to 230 Nm (170 lb.ft).

- Stake the nut to the halfshaft.

10. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.


11. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Shock Absorber and Spring Assembly

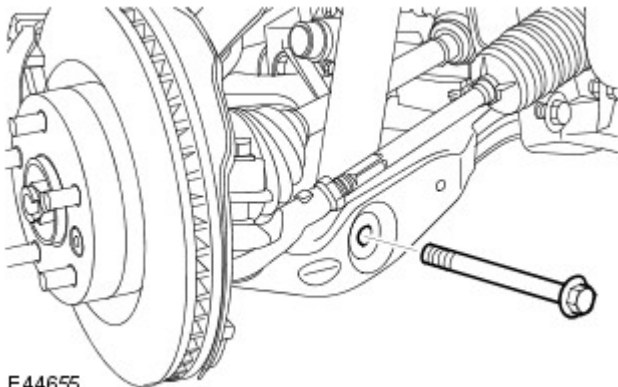
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

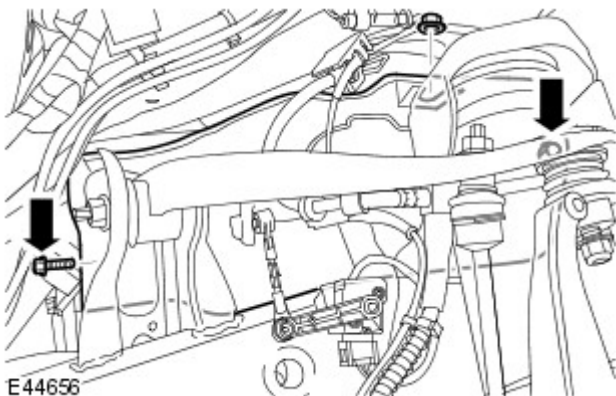
2. Remove the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Disconnect the shock absorber and spring assembly from the lower arm.
 - Remove the nut and bolt.



E44655

4. Release the heat shield for access to the shock absorber and spring assembly upper mounting inner nut.

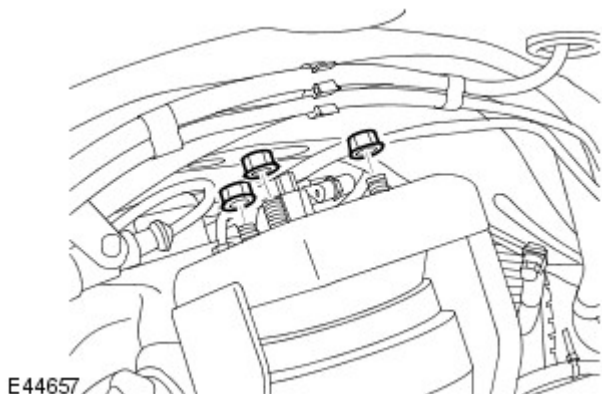
- Remove the three retaining bolts.



E44656

5. Remove the shock absorber and spring assembly.

- Remove the three retaining bolts.



E44657

Installation

1. Install the shock absorber and spring assembly.
 - Make sure the spring and shock absorber assembly top mounting to body mating faces are clean.
 - Fit the nuts and tighten to 70 Nm (52 lb.ft).

2. Secure the heat shield.

- Install the three retaining bolts and tighten to 10 Nm (7 lb.ft).

3. Connect the shock absorber and spring assembly to the lower arm.

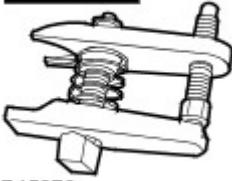
- Tighten the nut and bolt to 300 Nm (221 lb.ft).

4. Install the fender splash shield.


For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

Front Suspension - Upper Arm

Removal and Installation


Special Tool(s)	
 <p>205-754A</p> <p>E45276</p>	Ball joint separator
	205-754(LRT-54-027)

Removal

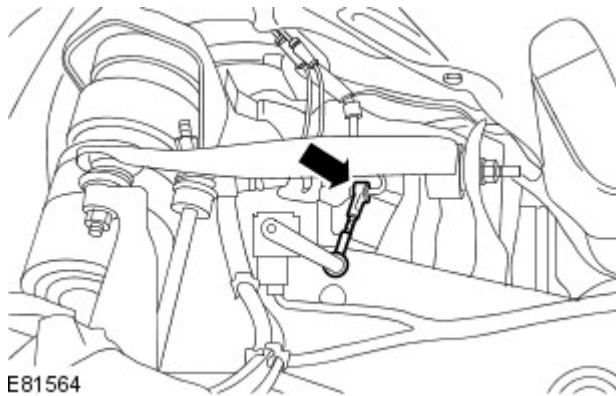
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the wheel and tire.

-  **CAUTION:** Do not use excessive force to disconnect the height sensor link.

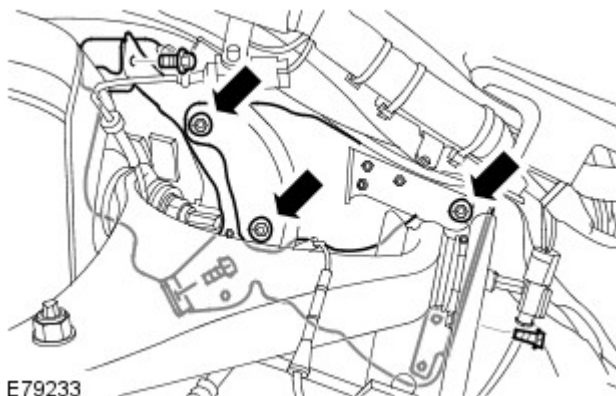
Disconnect the height sensor link arm.




E81564

- Remove the upper arm and brake line heat shields for access.

- Remove the 3 nuts.
- Remove the 3 bolts.

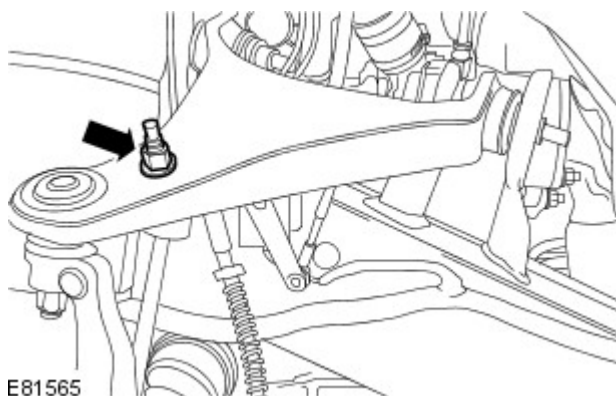


E79233

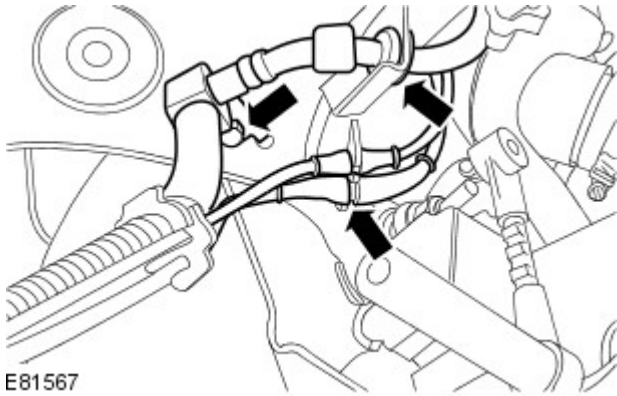
-  **CAUTION:** Use a wrench on the hexagon provided to prevent the ball joint rotating.

Remove the stabilizer bar link nut.

- Discard the nut.

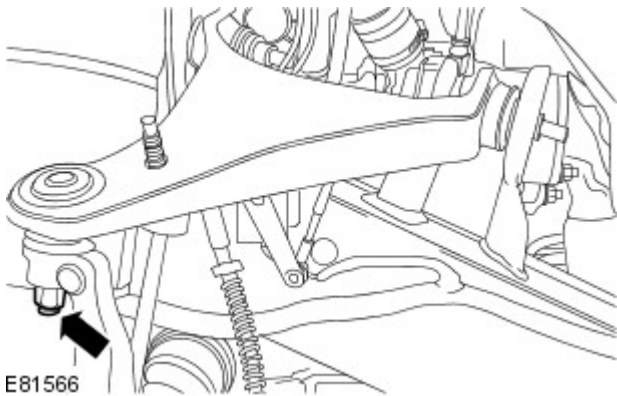



E81565



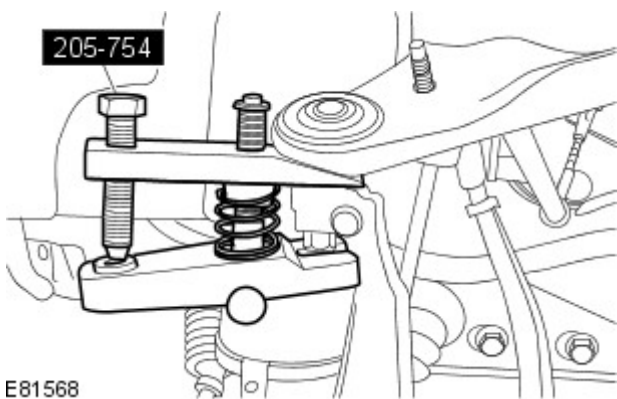
6. Release the brake hose and wheel speed sensor leads from the upper arm.

- Remove the bolt.



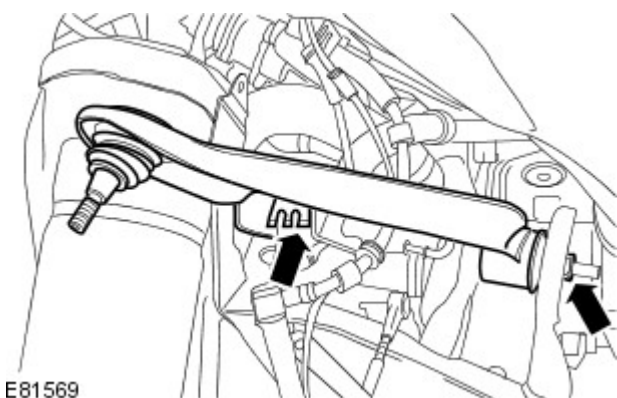
7.  CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

Loosen the upper arm retaining nut.



8. Using the special tool, release the upper arm ball joint.

- Remove and discard the nut.



9. Remove the upper arm.

- Remove and discard the 2 nuts.

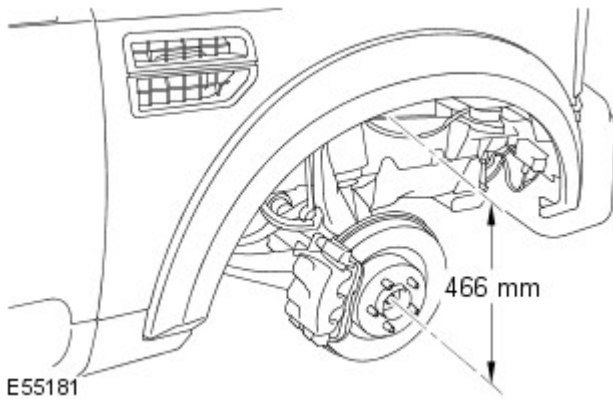
Installation

1. Install the upper arm.

- Fit the bolts but do not fully tighten at this stage.
- Install new nuts.

2. Connect the upper arm and wheel knuckle.

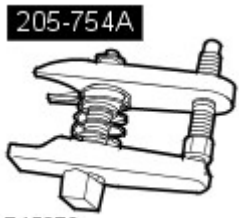
- Install a new nut and tighten to 70 Nm (52 lb.ft).
3. Secure the brake hose and wheel speed sensor leads to the upper arm.
 - Tighten the bolt to 23 Nm (17 lb.ft).
 4. Secure the stabilizer bar link.
 - Install a new nut and tighten to 115 Nm (85 lb.ft).
 5. Install the upper arm and brake line heat shields.
 - Install the 3 bolts.
 - Install the 3 nuts.
 6. Connect the height sensor link.
 7. Set the height distance between the centre of the halfshaft end and the edge of the fender trim to 466 mm (18.34").



8. Tighten the 2 upper arm nuts and bolts to 175 Nm (129 lb.ft).
9. Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
10. Using the Land Rover approved diagnostic system, calibrate the suspension ride height.
For additional information, refer to: [Ride Height Adjustments](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

Front Suspension - Lower Arm

Removal and Installation


Special Tool(s)	
 <p>205-754A E45276</p>	<p>Ball joint separator 205-754(LRT-54-027)</p>

Removal

1. Place vehicle into access mode.

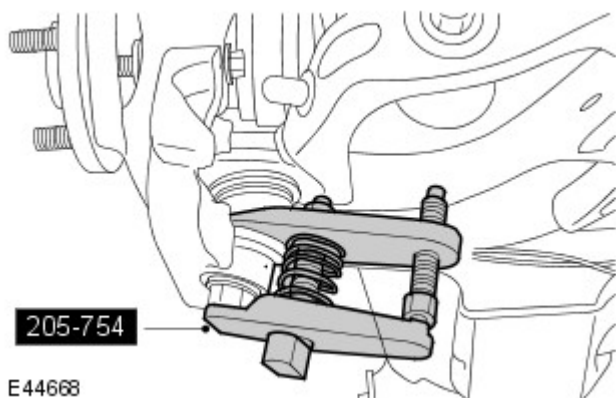


E99855

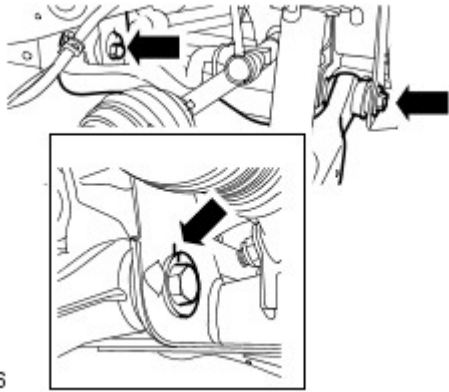
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the wheel and tire.
4. Remove the lower ball joint retaining nut.
5. Using the special tool, release the lower ball joint from the steering knuckle.



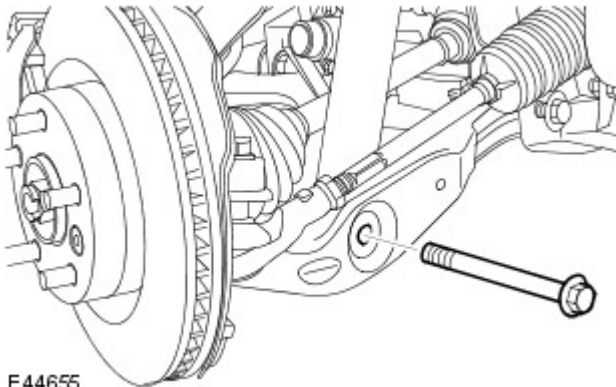
E44668



E99856

6. Mark the position of the bolts in relation to the chassis brackets.


- Remove the 2 bolts.



E44655

7. Disconnect the shock absorber and spring assembly from the lower arm.

- Remove the nut and bolt.

8.  **CAUTION:** Only displace the wheel knuckle sufficiently outboard to release the lower arm past the undertray. This will prevent the inboard driveshaft joint from separating. Failure to follow this instruction may result in damage to the vehicle.

- **NOTE:** Make sure the steering is in the straight ahead position.


Remove the lower arm.

- Release the lower arm from the subframe and reposition downwards.
- Rotate the lower arm and position forward to release from the wheel knuckle.

Installation

1. Install the lower arm.

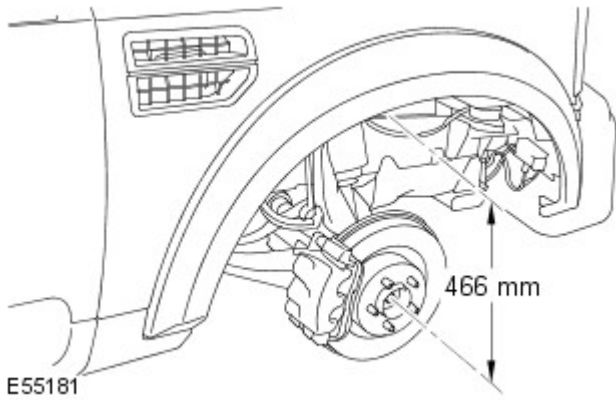
- Fit the bolts but do not fully tighten at this stage.

2.  **CAUTION:** The lower arm ball joint can be damaged by excessive articulation. Do not over articulate the ball joint. Failure to follow this instruction will result in damage to vehicle.

Connect the lower arm to the wheel knuckle.

- Tighten the lower arm ball joint retaining nut to 115 Nm (85 lb.ft).

3. Set the height distance between the centre of the halfshaft end and the edge of the fender trim to 466 mm (18.34").

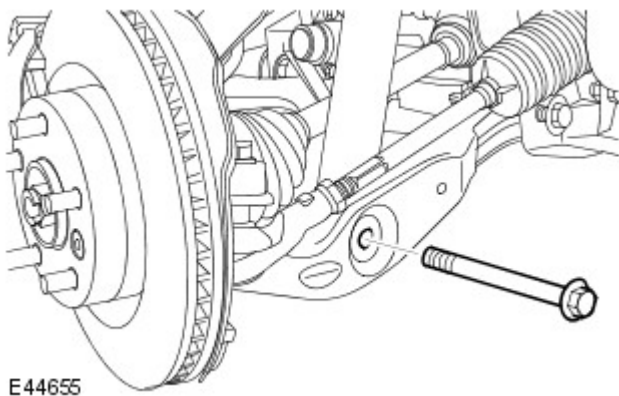


4. Tighten the lower arm bolts to 275 Nm (203 lb.ft).

- Align the bolts to the marks made previously.

5. Connect the shock absorber and spring assembly to the lower arm.

- Tighten the nut and bolt to 300 Nm (221 lb.ft).







6. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

7. Carry out the wheel alignment procedure.


Front Suspension - Upper Arm Bushing

Removal and Installation

Special Tool(s)	
 204-532/1 E55136	Receiver cup upper arm bushes 204-532/1
 204-532/2 E55137	Remover upper arm bushes 204-532/2
 204-532/3 E55138	Installer upper arm front bush 204-532/3
 204-532/4 E55139	Installer upper arm rear bush 204-532/4

Removal

- NOTE: The bushings must be replaced in pairs, LH and RH sides.

1.  WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

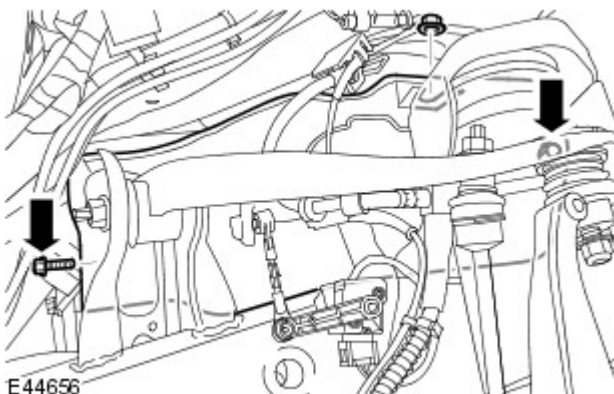
2. Remove the front wheels and tires.

3. Remove the LH upper arm.

For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).

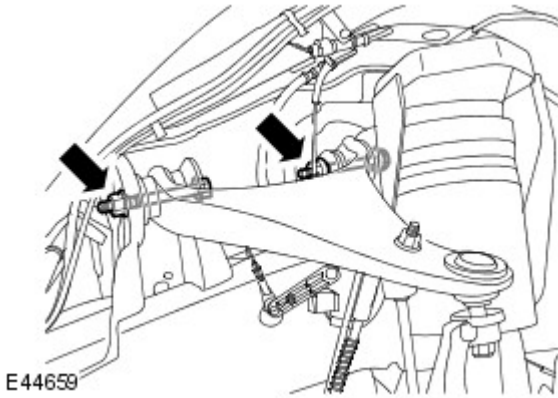
4. Release the heat shield for access to the upper arm bolts.

- Remove the nut.
- Remove the forward bolt and loosen the rearward bolt.




E44656

5. Loosen the upper arm bolts.




6. Disconnect the height sensor link arm.

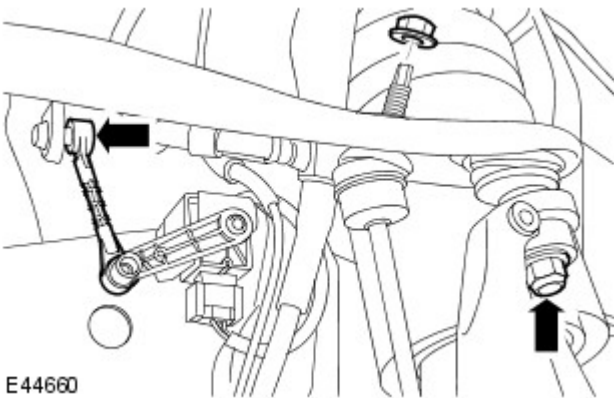
7.  CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

Remove the stabilizer bar link nut.

- Discard the nut.

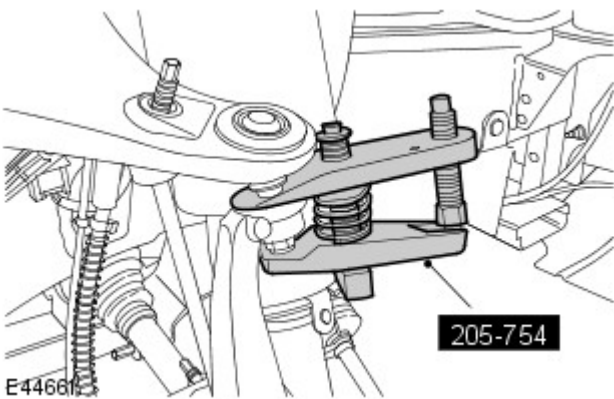
8.  CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

Loosen the upper arm retaining nut.



9. Using the special tool, release the upper arm ball joint.

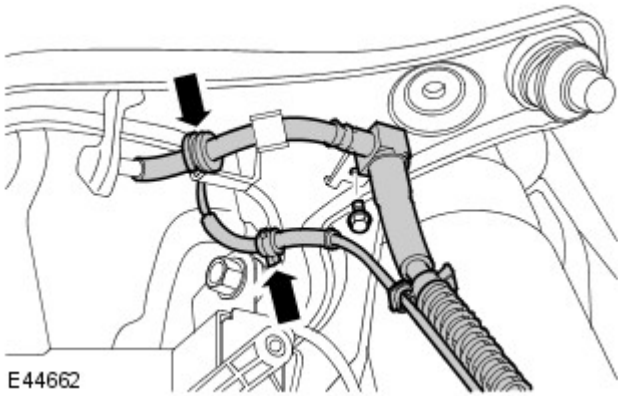
- Remove and discard the retaining nut.



10. Release the brake hose from the upper arm.

11. Release the wheel speed sensor lead from the upper arm.

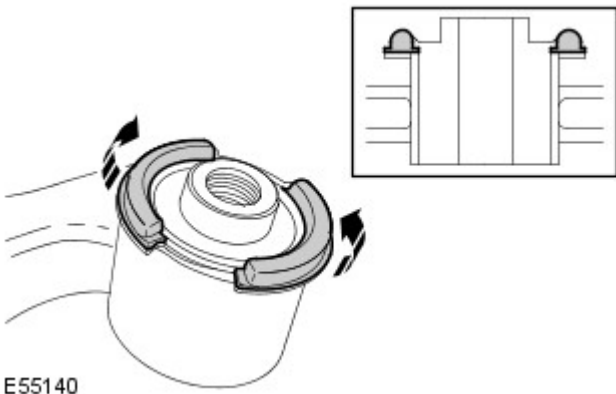
12. Remove the RH upper arm.



13. Note the position of the bushing in relation to the upper arm.

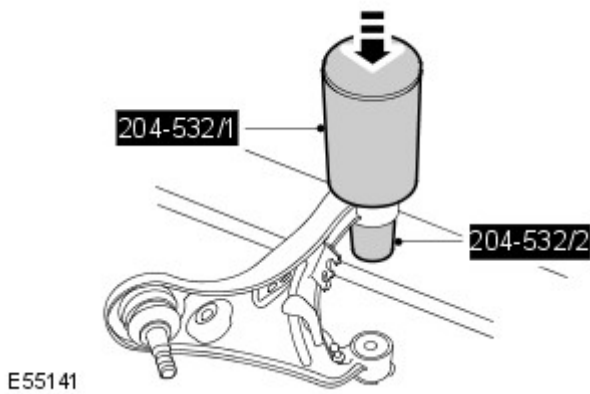
14.  **CAUTION:** The bush flanges need to be removed to allow bush removal.

Using a suitable tool, bend over the bush flanges.




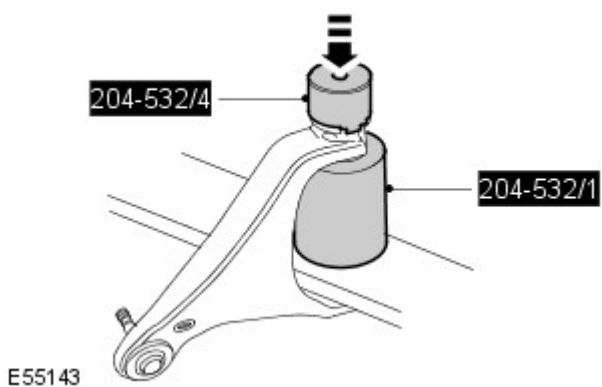
15. Using a hacksaw, remove the flange from the bushing, making sure the upper arm is not damaged.

16. Using the special tools, remove and discard the upper arm bushings.



Installation

3. Using the special tools, install the upper arm front bushings.
 1.  **CAUTION:** Make sure the correct special tool is used to install the bushings to the correct depth.
 - Fit the bolts but do not fully tighten at this stage.
 - Align the arrow on the bush with the mark, previously made on the upper arm.
 2. Using the special tools, install the upper arm rear bushings.
4. Secure the brake hose to the upper arm.
 - Align the arrow on the bush with the mark, previously made on the upper arm.
 - Tighten the bolt to 23 Nm (17 lb.ft).



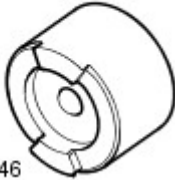
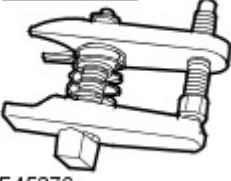
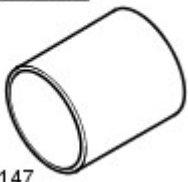
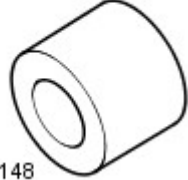
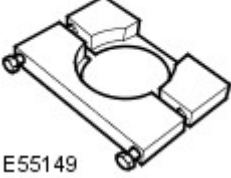




5. Secure the wheel speed sensor lead to the upper arm.
6. Connect the upper arm and wheel knuckle.
 - Install a new nut and tighten to 70 Nm (52 lb.ft).
7. Secure the stabilizer bar link.
 - Install a new nut and tighten to 115 Nm (85 lb.ft).

- 8.** Connect the height sensor link arm.
- 9.** Set the height distance between the centre of the halfshaft end and the edge of the fender trim to 466 mm (18.34").
- 10.** Tighten the 2 upper arm nuts and bolts to 175 Nm (129 lb.ft).
- 11.** Secure the heat shield.
- 12.** Install the LH upper arm.
For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).
- 13.** Install the front wheels and tires.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Lower Arm Bushing

Removal and Installation

Special Tool(s)	
<p>204-536/1</p>  <p>E55144</p>	<p>Receiver front lower arm front bush 204-536/1</p>
<p>204-536/2</p>  <p>E55145</p>	<p>Remover front lower arm front bush 204-536/2</p>
<p>204-536/3</p>  <p>E55146</p>	<p>Installer front lower arm front bush 204-536/3</p>
<p>205-754A</p>  <p>E45276</p>	<p>Ball joint separator 205-754(LRT-54-027)</p>
<p>204-535/1</p>  <p>E55147</p>	<p>Receiver lower arm rear bush 204-535/1</p>
<p>204-535/2</p>  <p>E55148</p>	<p>Remover lower arm rear bush 204-535/2</p>
<p>204-535/4</p>  <p>E55149</p>	<p>Remover plate lower arm rear bush 204-535/4</p>

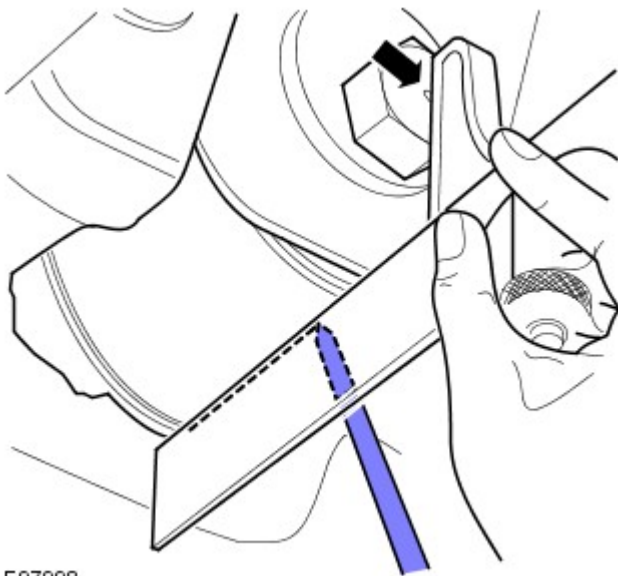
<p>204-535/3</p>  <p>E55150</p>	<p>Installer lower arm rear bush</p> <p>204-535/3</p>
<p>204-535/5</p>  <p>E55151</p>	<p>Installer/depth setter lower arm rear bush</p> <p>204-535/5</p>

Removal

- NOTE: If installing the front bushes, both front bushes must be replaced.
- NOTE: If installing the rear bushes, both rear bushes must be replaced.
- NOTE: Take note of the fitted position of the bush.

1. Make sure that the tire pressures are correct and that the vehicle is at the correct ride height.
For additional information, refer to: [Ride Height Adjustments](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

2. Mark the position of the bushing in relation to the lower arm.



E97998

1. Using a spirit level type engineers square, align through the center of the bolt head retaining the lower arm rear bush with a perpendicular drop.
2. Align the rule of the engineers square along the lowest point on the circumference of the lower arm rear bush boss.
3. Apply a piece of tape to the arm and mark a horizontal line along the underside of the lower arm rear bush boss (parallel with the bush axis).
4. Make sure that the process is carried out on both right-hand side and left-hand side.

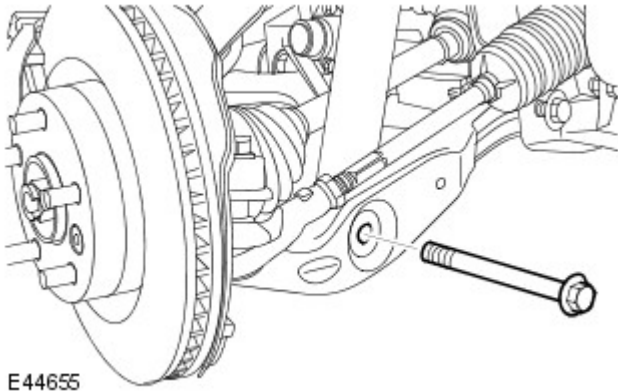
3. ⚠️ WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Remove the wheels and tires.

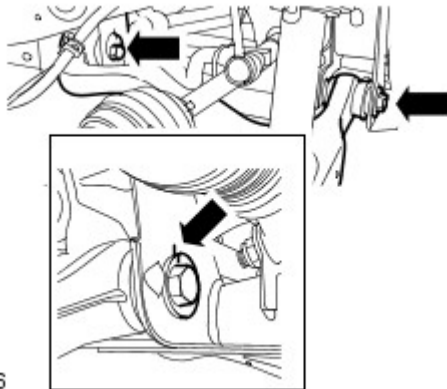
5. Remove the RH lower arm.

For additional information, refer to: [Lower Arm](#) (204-01 Front Suspension, Removal and Installation).



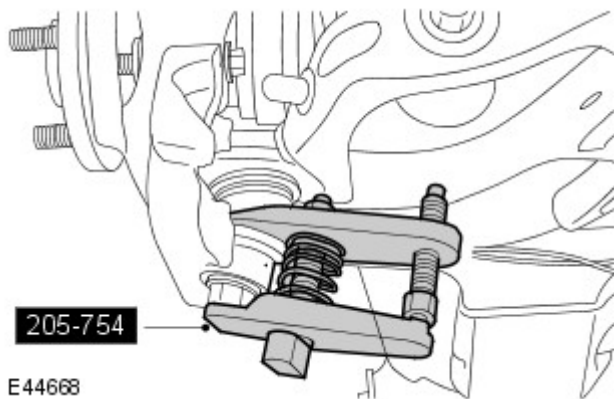
6. Disconnect the shock absorber and spring assembly from the LH lower arm.

- Remove the nut and bolt.



7. Mark the position of the bolts in relation to the chassis brackets.

- Remove the 2 bolts.



8. Remove the LH lower ball joint retaining nut.

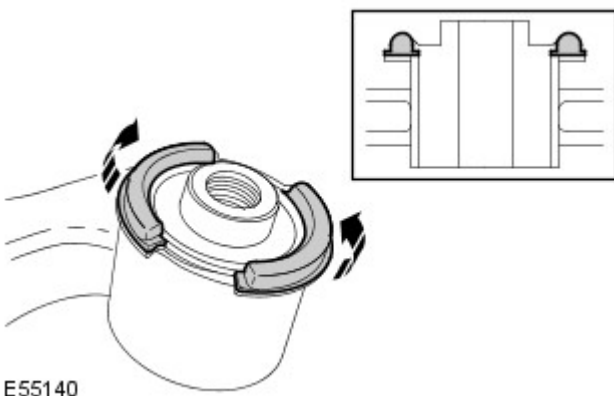
9. Using the special tool, release the LH lower ball joint from the steering knuckle.

10. Remove the LH lower arm.

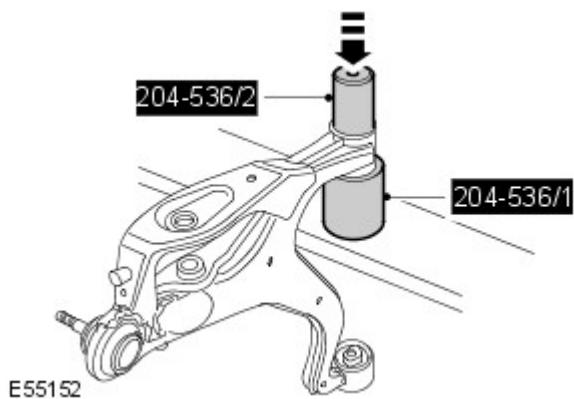
11. Note the position of the bushing in relation to the lower arm.

12.  **CAUTION:** The bush flanges need to be removed to allow bush removal.

Remove the lower arm front bushing flanges.

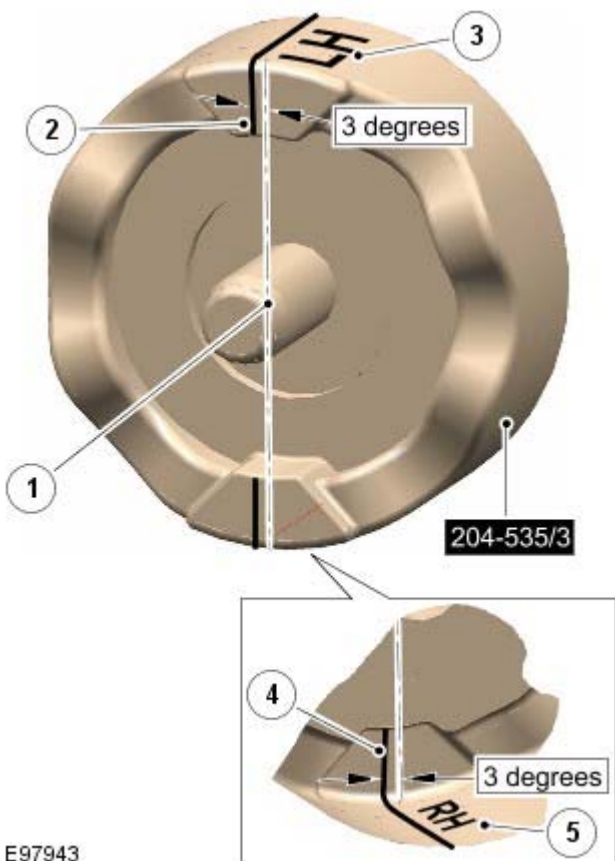


13. Using the special tools, remove and discard the lower arm front bushings.



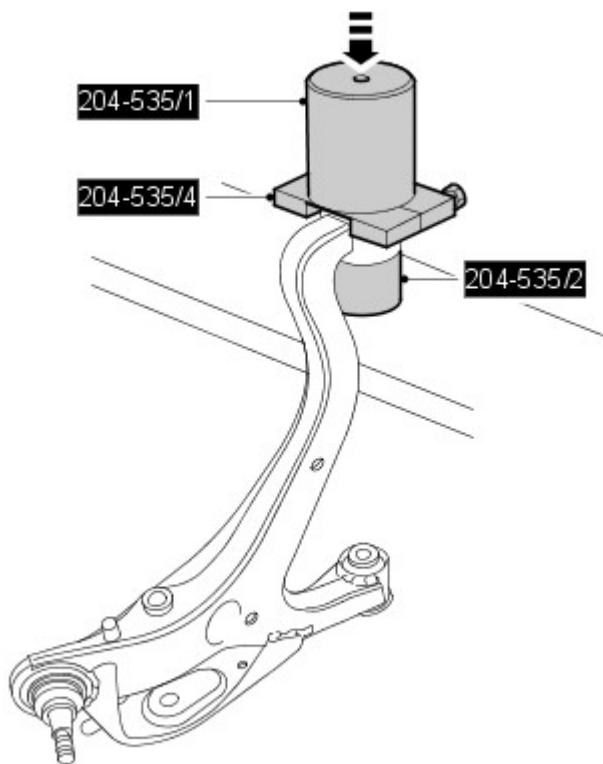
14. Apply alignment guide lines to installer tool (204-535/3).

1. Mark center line on installer tool.
2. Mark line across top surface 3 degrees to the left of center line.
3. Mark 'LH' on top surface.
4. Mark line across bottom surface 3 degrees to the left of the center line.
5. Mark 'RH' on bottom surface.




E97943

15. Using the special tools, remove and discard the lower arm rear bushings.



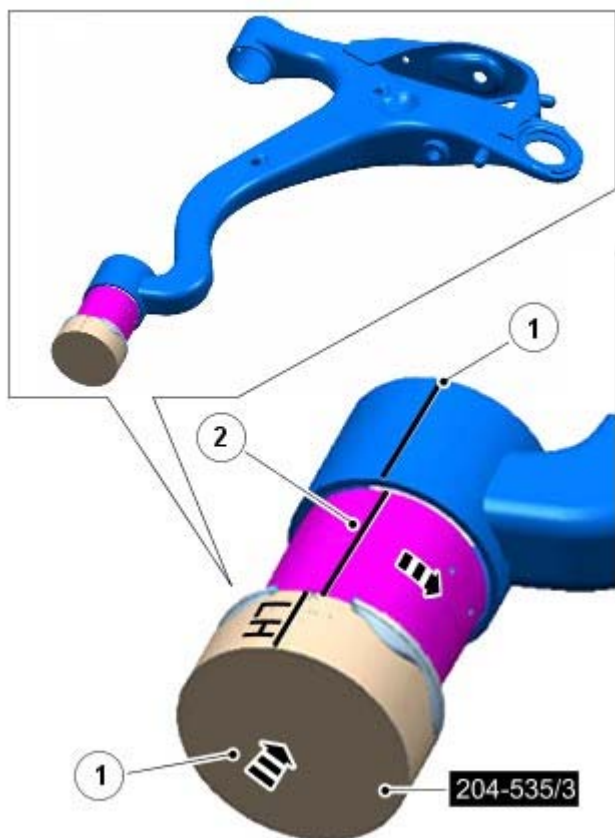
E55153

Installation


1.  CAUTION: Make sure the bush is correctly aligned.

Mark the position of the bushing in relation to the lower arm.

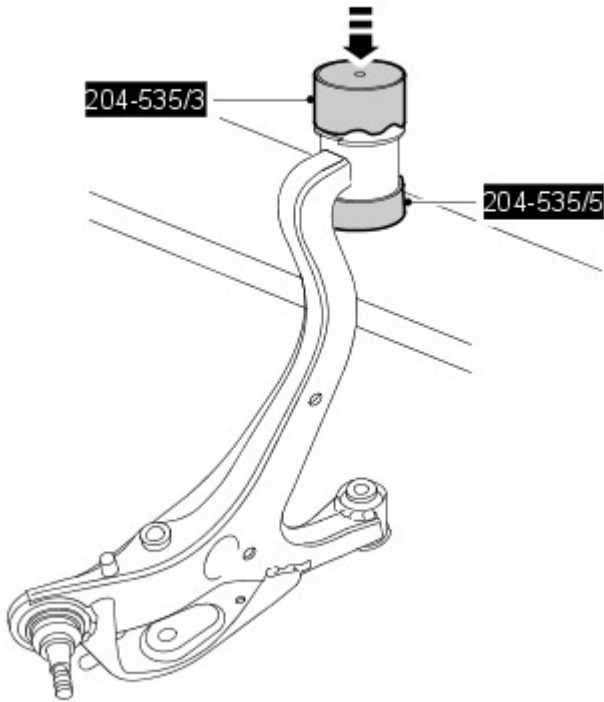
1. Make sure the correct marked side line 'RH' or 'LH' on the special tool (204-535/3) is aligned with the scribed line on the RH or LH bush to be installed.
2. Extend the line from the installer tool onto the bush using a marker pen. Using the marked line, align the bush to the lower arm before installing the bush.




E97944

2.  CAUTION: Make sure the correct special tool is used to install the bushings to the correct depth.

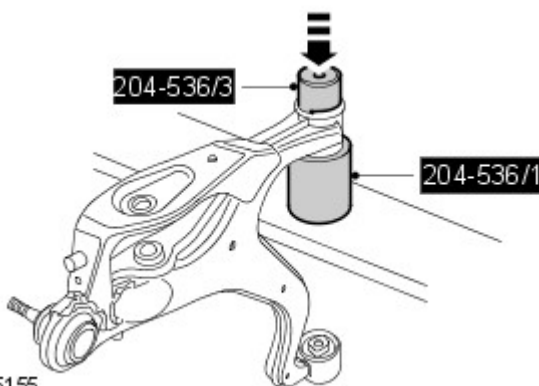
Using the special tools, install the lower arm rear bushings.



E55154

3.  CAUTION: Make sure the bush is correctly aligned.

Using the special tools, install the lower arm front bushings



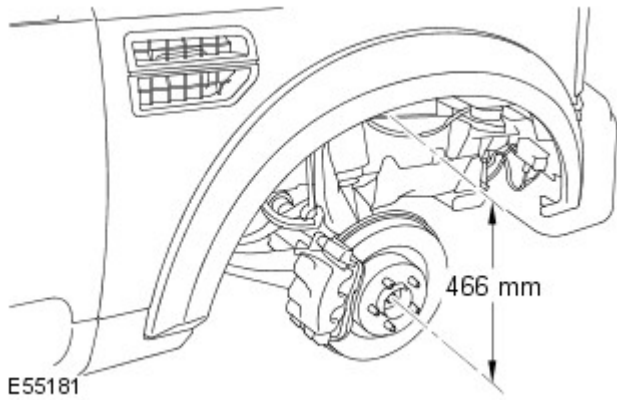
E55156

4. Install the LH lower arm.

- Fit the bolts but do not fully tighten at this stage.

5. Connect the shock absorber and spring assembly to the lower arm.

- Tighten the nut and bolt to 300 Nm (221 lb.ft).



6. Set the height distance between the centre of the halfshaft end and the edge of the fender trim to 466 mm (18.34").

7. Tighten the lower arm bolts to 275 Nm (203 lb.ft).
 - Align the bolts to the marks made previously.
8. Connect the shock absorber and spring assembly to the lower arm.
 - Tighten the nut and bolt to 300 Nm (221 lb.ft).
9. Install the RH lower arm.
For additional information, refer to: [Lower Arm](#) (204-01 Front Suspension, Removal and Installation).
10. Install the wheels and tires.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
11. Carry out the wheel alignment procedure.

Front Suspension - Shock Absorber and Spring AssemblyTDV6 2.7L Diesel

Disassembly and Assembly

Disassembly

• WARNINGS:



Ensure the spring compressor Safe Working Load (SWL) meets or exceeds the spring rating quoted in the Specifications section.
For additional information, refer to: [Specifications](#) (204-00 Suspension System - General Information, Specifications).

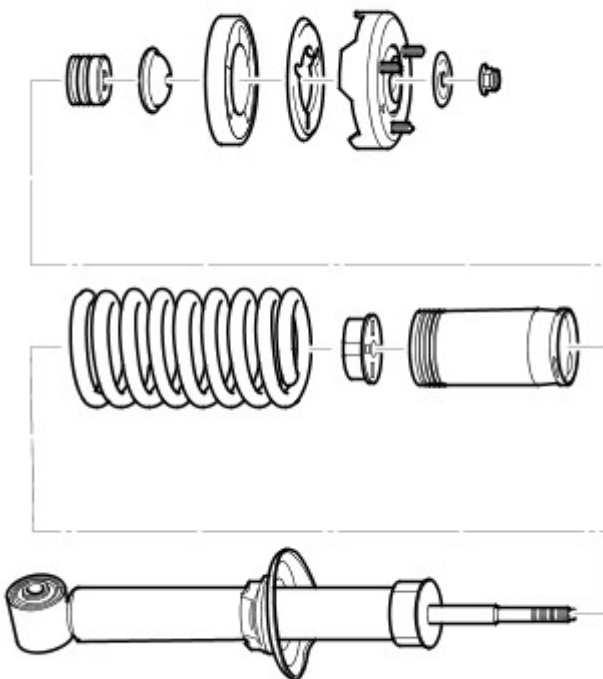


Always follow the spring compressor manufacturer's instructions.

- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

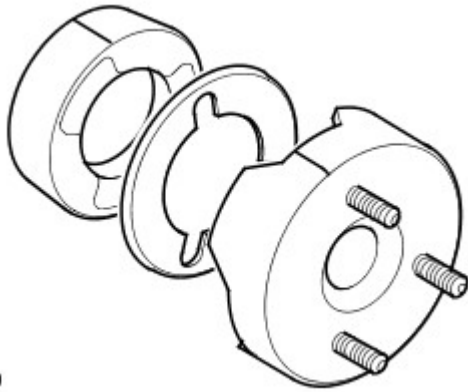
Raise and support the vehicle.

- Remove the shock absorber and spring assembly.
For additional information, refer to: [Shock Absorber and Spring Assembly](#) (204-01 Front Suspension, Removal and Installation).
- Install a suitable spring compressor in a vise.
- Install the shock absorber and spring assembly in the spring compressor.
 - Compress the spring just sufficiently to relieve the spring tension.
- Remove the shock absorber.
 - Restrain the shock absorber spindle, remove and discard the nut.
 - Remove the upper bush rebound plate and upper bush.
 - Remove the upper mounting assembly.
 - Remove the dust tube and rebound plate assembly.
 - Remove the spring aid.



E51728

- Remove the spring from the spring compressor.

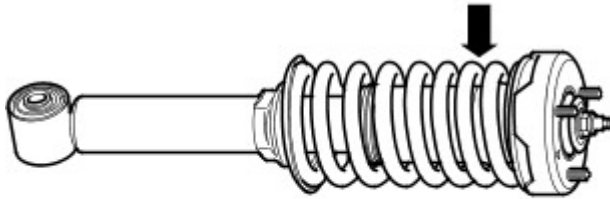


E51729

7. Clean and inspect the components for deterioration.

- To aid reassembly, mark the position of the rubber insulator in relation to the upper mounting plate.
- Remove the rubber insulator.
- Remove the spacer.
- Remove the rebound plate from the dust tube.

Assembly



E51726

1. Install the spring in the spring compressor.

- Make sure the spring is installed with the close coils positioned towards the top of the shock absorber.

2. Install the spring aid.

3. Install the dust tube.

- Install the rebound plate into the dust tube.

4. Install the shock absorber.

- Make sure the spring is correctly located in the spring seat.

5. Install the upper mounting.

- Install the spacer and rubber insulator, making sure the spacer drops over the stud heads and the insulator is aligned with the mark made previously.
- Install the upper bush and upper bush rebound plate.
- Install a new nut and tighten to 98 Nm (72 lb.ft).

6. Install the shock absorber and spring assembly.

For additional information, refer to: [Shock Absorber and Spring Assembly](#) (204-01 Front Suspension, Removal and Installation).

Rear Suspension -

Coil Spring Suspension

Item	Specification
Road spring color coding - 5 Seat Model:	BROWN/WHITE
	BROWN/GREEN
	BROWN/ORANGE
	BROWN
Road spring color coding - 7 Seat Model:	RED/WHITE
	RED/GREEN
	RED/ORANGE
	RED

Note: The first color indicates the fitted position of the spring on the vehicle i.e. rear. The secondary color identifies the thickness of the isolator which is fitted to a particular spring to ensure that the vehicle ride height is maintained within specified limits. Replacement springs will be supplied with the appropriate isolator fitted.

General Specifications

Item	Specification
Gap between underside of the toe link rubber boot and the integrated body frame bracket	10.0 mm (0.394 in)
Height between the center of the halfshaft end and the edge of the fender trim	485 mm (19.10 in)

Torque Specifications

Description	Nm	lb-ft
Toe link bolt	175	129
* Toe link inner ball joint retaining nut	133	98
* Stabilizer bar link nuts	115	85
Stabilizer bar clamp bolts	62	46
Body mount retaining bolts	133	83
Shock absorber to the lower suspension arm nut and bolt	300	221
Shock absorber to suspension turret nuts	70	52
Lower arm to wheel knuckle bolt	175	129
Lower arm bolts	275	203
*+ Halfshaft retaining nut	350	258
Upper arm to wheel knuckle nut	133	98
Upper arm front bolt	175	129
Upper arm rear bolt	275	203
Brake tube unions	18	13
Rear camber adjusting bolts	133	98
Wheel speed sensor	9	7
Brake disc dust shield bolts	9	7
Parking brake cable coupling	8	6
Road wheel nuts	140	103

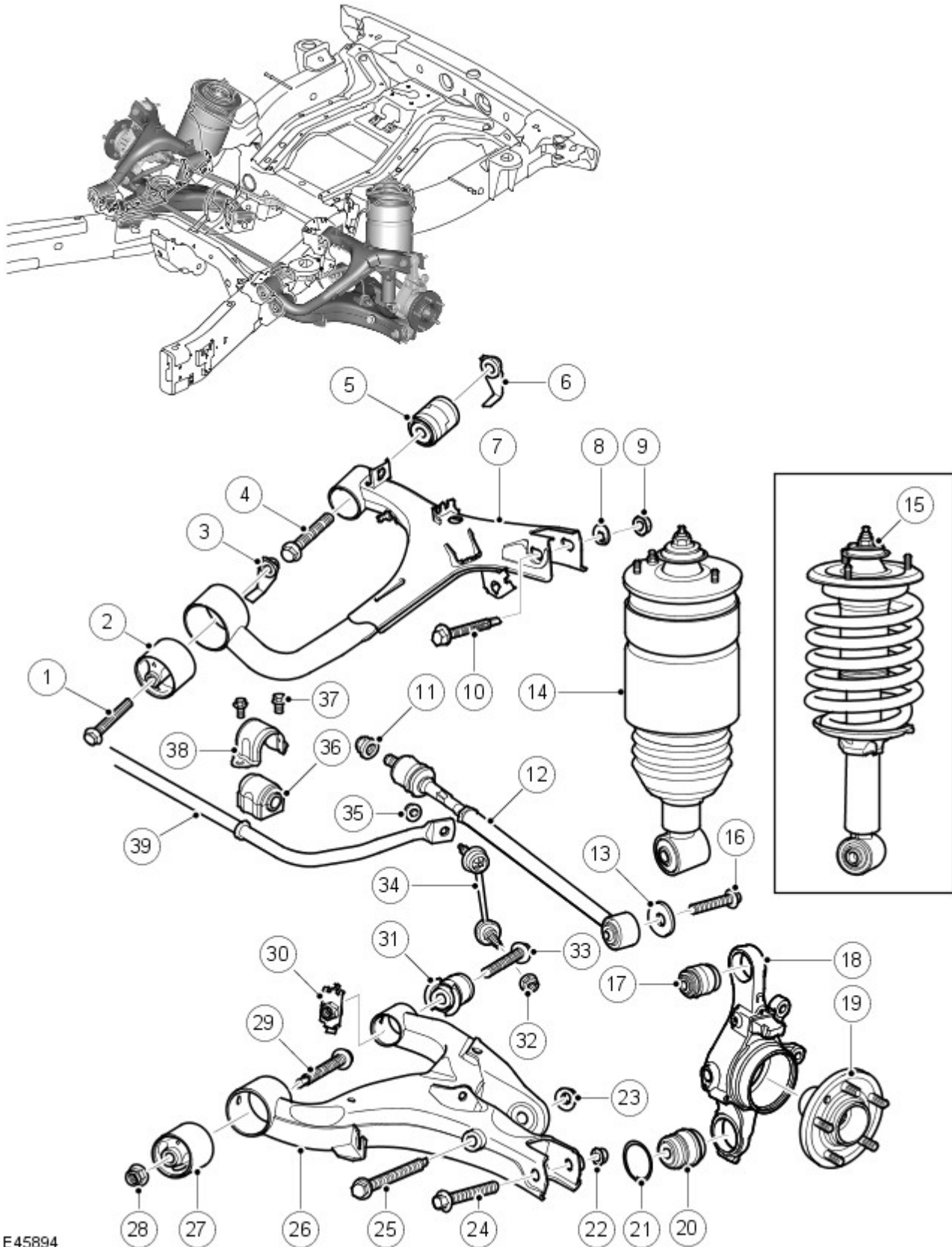
* New nut must be installed

+ Nut must be staked after tightening

Rear Suspension - Rear Suspension

Description and Operation

Rear Suspension Component Location



E45894

Item	Part Number	Description
1	-	Bolt (Upper control arm forward bush)
2	-	Bush - Forward (Upper control arm)
3	-	Caged nut (Upper control arm forward bush)
4	-	Bolt (Upper control arm rearward bush)

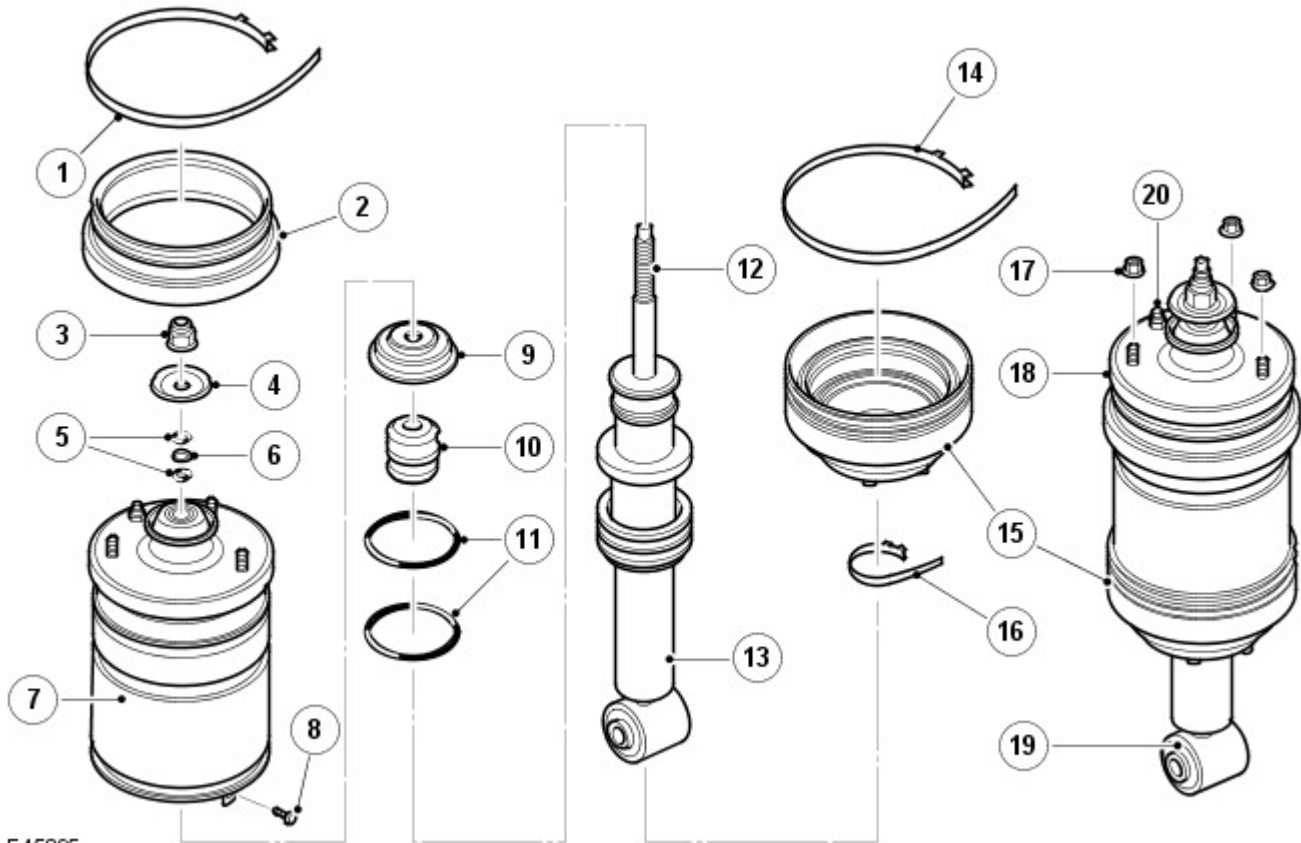
5	-	Bush - Rearward (Upper control arm)
6	-	Caged nut (Upper control arm rearward bush)
7	-	Upper control arm
8	-	Eccentric washer (Wheel knuckle upper ball joint)
9	-	Nut (Wheel knuckle upper ball joint)
10	-	Bolt (Wheel knuckle upper ball joint)
11	-	Special nut (Adjustable transverse toe link)
12	-	Adjustable transverse toe link
13	-	Washer (Adjustable transverse toe link)
14	-	Damper module assembly (Air)
15	-	Damper module assembly (Coil)
16	-	Bolt (Adjustable transverse toe link)
17	-	Ball joint (Wheel knuckle upper)
18	-	Wheel knuckle and bearing assembly
19	-	Wheel hub
20	-	Stake nut
21	-	Circlip
22	-	Wheel bearing
23	-	Ball joint (Wheel knuckle lower)
24	-	Circlip (Wheel knuckle lower ball joint)
25	-	Self-locking nut (Wheel knuckle lower ball joint)
26	-	Self-locking nut (Damper assembly lower attachment)
27	-	Bolt (Wheel knuckle lower ball joint)
28	-	Bolt (Damper assembly lower attachment)
29	-	Lower control arm
30	-	Bumpstop clip
31	-	Self-locking nut (Lower control arm forward bush)
32	-	Bush - Forward (Lower control arm)
33	-	Bolt (Lower control arm forward bush)
34	-	Nut and retainer (Lower control arm rearward bush)
35	-	Self-locking nut (Anti-roll bar link to lower control arm)
36	-	Bolt (Lower control arm rearward bush)
37	-	Bush - Rearward (Lower control arm)
38	-	Anti-roll bar link
39	-	Self-locking nut (Anti-roll bar link to anti-roll bar)
40	-	Anti-roll bar bush
41	-	Bolt (Anti-roll bar bracket)
42	-	Anti-roll bar
43	-	Anti-roll bar bracket
44	-	Bumpstop clip

GENERAL

The independent rear suspension offers a reduction in unsprung weight over the beam axle design fitted to previous Land Rover models. The rear suspension comprises an upper control arm, a lower control arm, a wheel knuckle and wheel hub, two spring damper modules and an anti-roll bar and links assembly. The damper modules use a similar design of damper which can be fitted with either a coil spring or an air spring.

The rear suspension control arms have been designed to give maximum ground clearance and also allow for the adjustment of the camber using a cam bolt and adjustment of toe and bump steer via an adjustable transverse link.

DAMPER MODULE - AIR SUSPENSION



E45895

Item	Part Number	Description
1	-	Strap*
2	-	Upper gaitor*
3	-	Self-locking nut *
4	-	Rebound washer*
5	-	O-ring - Damper rod*
6	-	Spacer - Damper rod*
7	-	Air spring*
8	-	Retaining pin - Air spring sleeve support*
9	-	Bump washer*
10	-	Spring aid*
11	-	O-ring - Air sleeve support (2 off)*
12	-	Damper rod
13	-	Damper assembly
14	-	Strap*
15	-	Lower gaitor*
16	-	Strap*
17	-	Self-locking nut (3 off)
18	-	Top mount assembly
19	-	Bush
20	-	Voss connector

• NOTE: * Shows service items

The damper module comprises an air spring assembly, top mount and a damper assembly. The damper and air spring are only serviceable as complete assemblies.

Damper

The damper assembly is a twin tube design with the conventional coil spring replaced by the air spring. The lower end of the damper is fitted with a bush and is attached to the lower control arm with a bolt and nut.

The damper functions by restricting the flow of hydraulic fluid through internal galleries within the damper. The damper rod moves axially within the damper, its movement limited by the flow of fluid through the galleries, providing damping of undulations in the terrain. The damper rod is sealed at its exit point from the damper body to maintain the fluid within the unit and to prevent the ingress of dirt and moisture. The seal also incorporates a wiper to keep the rod clean.

Air Spring

The air spring is similar in design to the air spring used on the front suspension.

The air spring comprises an aluminium restraining cylinder, top mount, spring aid, air sleeve and an inner support sleeve.

The air sleeve is made from a flexible rubber material which allows the sleeve to roll up and down the air spring piston as the vehicle changes height. The air sleeve is attached to the restraining cylinder and the support sleeve with crimp rings which provide an air tight seal. The support sleeve contains a seal carrier which has two O-rings sealing the support sleeve

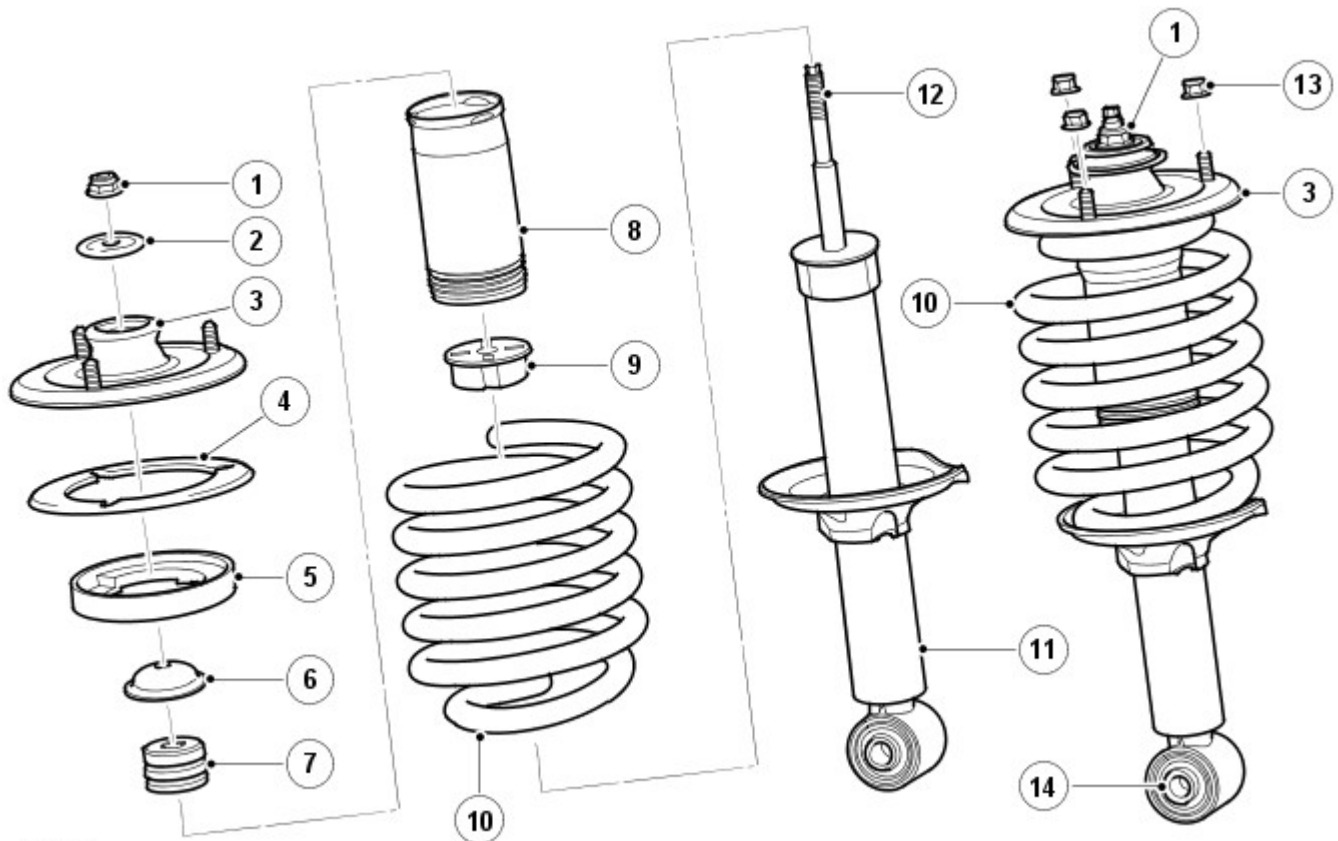
and two O-rings sealing to the damper body. The top of the air sleeve is crimped to the top mount which attaches to a mounting on the chassis with 3 integral studs and self-locking nuts.

A spring aid is fitted to the damper rod and prevents the top mount contacting the top of the damper during full suspension compression and assists the suspension tune. The lower end of the air spring is located over the damper body and seats on a fabricated seat on the damper body. The air sleeve is positively attached to the seat with a retaining pin. The damper rod is located through a central hole in the top mount. The rod is threaded at its outer end and accepts a self-locking nut which secures the air spring to the damper rod.

The top mount is an integral part of the air spring and is fitted with a bush and rebound washer which are located between the top mount plate and the damper rod. A self locking nut secures the damper rod to the top mount. The top mount attaches to a housing on the chassis with 3 integral studs and self-locking nuts. The top mount also incorporates a 6 mm Voss air fitting which allows for the attachment of the air harness.

The air spring is fitted with two gaitors. The upper gaitor is fitted between the top mount and the air spring restraining cylinder. The lower gaitor is secured to the lower end of the restraining cylinder and the damper body with metal straps. The gaitors prevent dirt and debris becoming trapped between the air sleeve and the restraining cylinder.

DAMPER MODULE - COIL SPRING SUSPENSION



Item	Part Number	Description
1	-	Self locking nut
2	-	Rebound washer
3	-	Top mount assembly
4	-	Spring spacer (selective)
5	-	Spring isolator
6	-	Bump washer
7	-	Spring aid
8	-	Dust tube
9	-	Bump cup
10	-	Coil spring
11	-	Damper
12	-	Damper rod
13	-	Self locking nut (3 off)
14	-	Bush

The coil spring damper module comprises a damper, a coil spring and a top mount.

Damper

The damper assembly is a similar design to the front suspension damper, with a twin tube design with an spring seat attached to the damper body. The lower end of the damper is fitted with a bush and is attached to the lower control arm with a bolt and self-locking nut. The damper functions by restricting the flow of hydraulic fluid through internal galleries within the damper.

The damper rod moves axially within the damper, its movement limited by the flow of fluid through the galleries, providing

damping of undulations in the terrain. The damper rod is sealed at its exit point from the damper body to maintain the fluid within the unit and to prevent the ingress of dirt and moisture. The seal also incorporates a wiper to keep the rod clean.

The damper rod is located through a central hole in the top mount. The rod is threaded at its outer end and a self-locking nut secures the top mount to the damper rod.

A spring aid is fitted to the damper rod and prevents the top mount contacting the top of the damper during full suspension compression and assists the suspension tune.

Spring and Top Mount

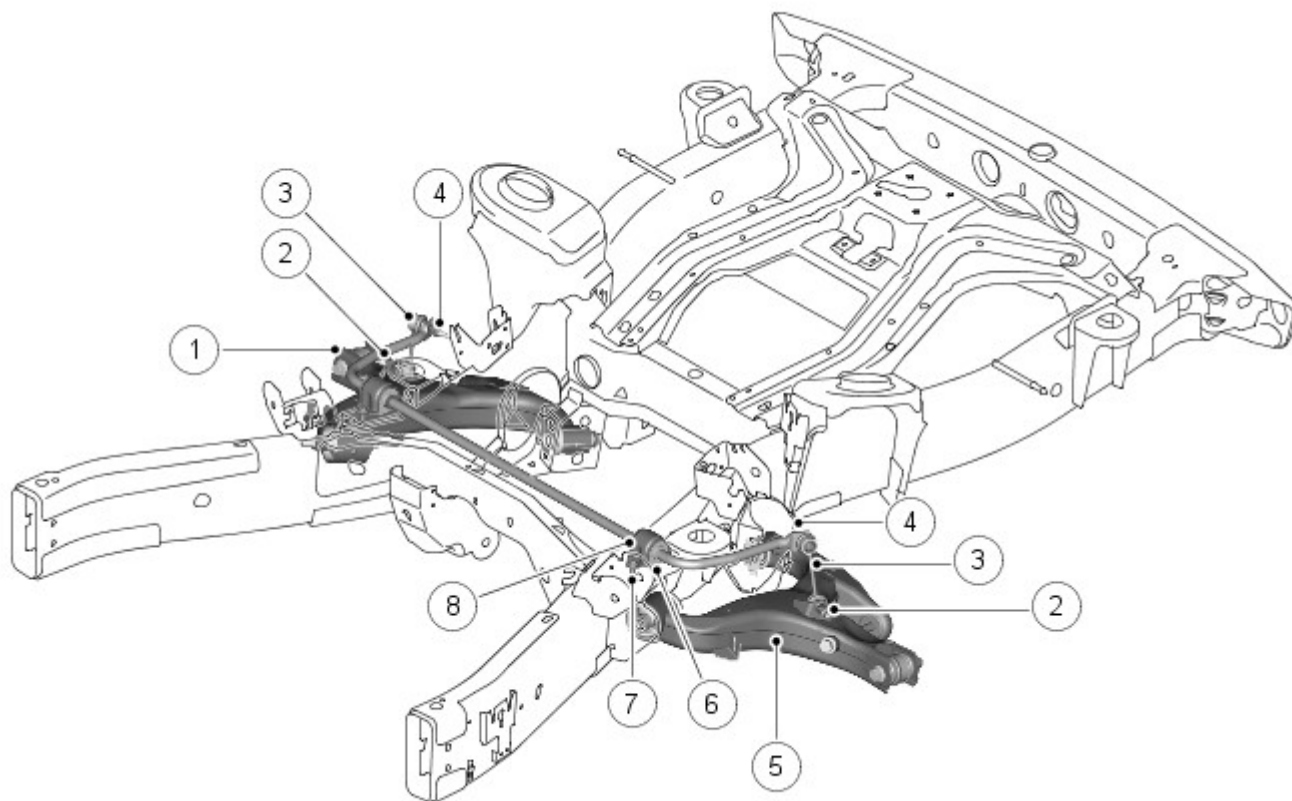
The coil spring fitted differs with vehicle specification. Each spring is color coded to identify its rating and fitment requirements.

The coil spring is located in a spring seat which is an integral part of the damper body. The design of the spring seat prevents the spring rotating. The opposite end of the coil spring is located in a spring isolator which is fitted in the top mount. The spring isolator is made from rubber and prevents any noise produced during spring and damper compression/extension from being transmitted to the vehicle body. Three types of spring isolator are available which allow for differences in vehicle specification.

The top mount is fitted with a bush and a rebound washer which are located between the top mount plate and the damper rod. The top mount is secured to the damper rod with a self-locking nut. The top mount attaches to a housing on the vehicle chassis with three integral studs and self-locking nuts.

The spring is fitted with spring spacers which are located between the spring isolator and the top mount. The spring spacers control the length of the spring to maintain the correct trim height. The spring spacers are colour coded and are supplied with a replacement spring.

ANTI-ROLL BAR



E45897

Item	Part Number	Description
1	-	RH lower control arm
2	-	Nut - link to lower control arm (2 off)
3	-	Link (2 off)
4	-	Nut - link to anti-roll bar (2 off)
5	-	LH lower control arm
6	-	Bush (2 off)
7	-	Bolt (4 off)
8	-	Bracket (2 off)

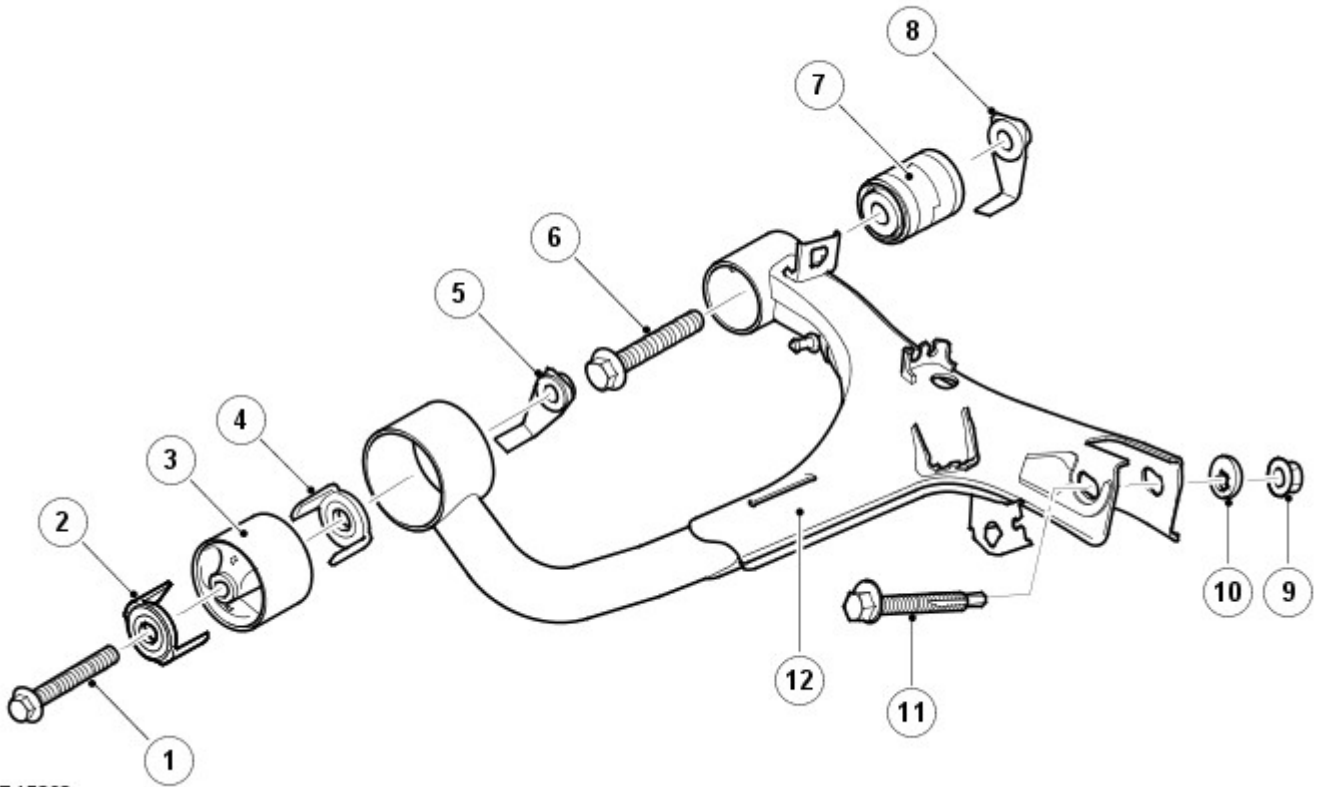
The anti-roll bar is fabricated from heat treated, solid, spring steel bar. The anti-roll bar operates, via a pair of links, from its attachment to the lower control arms.

The anti-roll bar is located on the upper face of a combined body mount and anti-roll bar bracket which is welded to each chassis side member. The anti-roll bar is attached to the brackets with two, Teflon lined bushes. The bushes are fitted with brackets, which are pressed onto the bushes and secured to the chassis brackets with bolts.

The anti-roll bar has crimped, 'anti-shuffle' collars pressed into position on the inside edges of the bushes. The collars prevent sideways movement of the anti-roll bar.

The ends of the anti-roll bar are attached to the lower control arms via links. This allows the anti-roll bar to move with the wheel travel providing maximum effectiveness. Each link has a ball joint at each end. The top ball joint is attached to the link at 90 degrees to the link axis and is located in a hole in the end of the anti-roll bar and secured with a self locking nut. The bottom ball joint is also attached to the link at 90 degrees to the axis of the link and is located in a hole in a bracket on the lower control and arm and secured with a self-locking nut. The links are not handed and therefore can be fitted to either side of the anti-roll bar.

UPPER CONTROL ARM



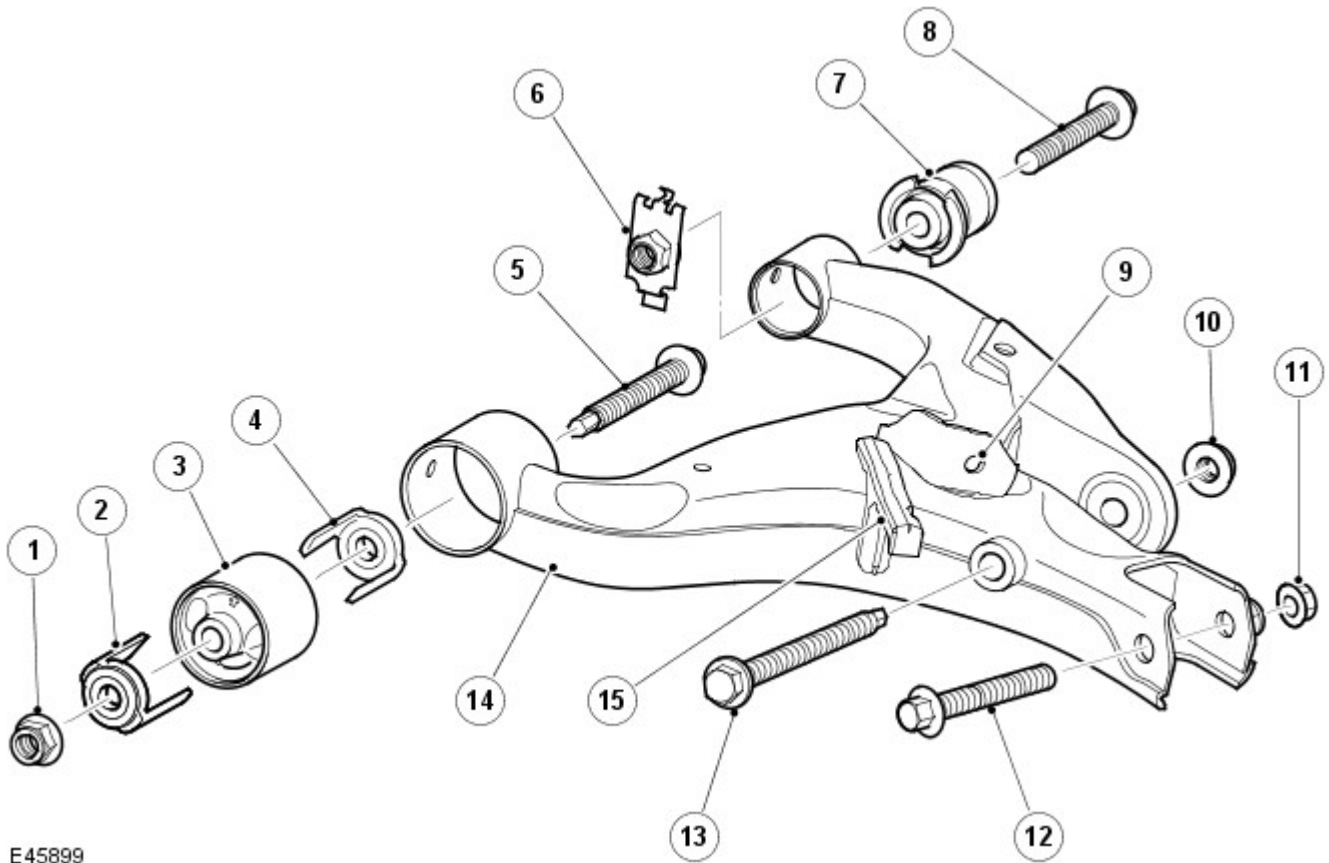
E45898

Item	Part Number	Description
1	-	Bolt
2	-	Bumpstop clip
3	-	Forward bush
4	-	Bumpstop clip
5	-	Caged nut
6	-	Bolt
7	-	Rearward bush
8	-	Caged nut
9	-	Self-locking nut - upper knuckle ball joint
10	-	Eccentric washer - upper knuckle ball joint
11	-	Cam bolt - upper knuckle ball joint
12	-	Upper control arm

The upper control arm locates in brackets on the upper surface of each chassis side member. The upper control arm assembly comprises the control arm and two bushes. The upper control arm is a pressed steel fabrication. Its outer end has two brackets with slotted holes which locate the upper ball joint of the knuckle. The ball joint is secured in the upper control arm with a cam bolt, eccentric washer and a self-locking nut. The cam bolt and the eccentric washer allow for the adjustment of the wheel camber.

Two fabricated tubular housings provide the location for the forward and rearward bushes. The bushes, which are pressed into the housings, locate between brackets on the chassis side members and are secured with bolts and caged nuts through metal inserts in the centre of the bushes.

LOWER CONTROL ARM



E45899

Item	Part Number	Description
1	-	Self-locking nut
2	-	Clip
3	-	Forward bush
4	-	Clip
5	-	Bolt
6	-	Nut and retainer
7	-	Rearward bush
8	-	Bolt
9	-	Anti-roll bar link bracket
10	-	Self-locking nut - damper lower attachment
11	-	Self-locking nut - knuckle upper ball joint attachment
12	-	Bolt - knuckle upper ball joint attachment
13	-	Bolt - damper lower attachment
14	-	Lower control arm
15	-	Jacking bracket (Vehicles with coil springs only)

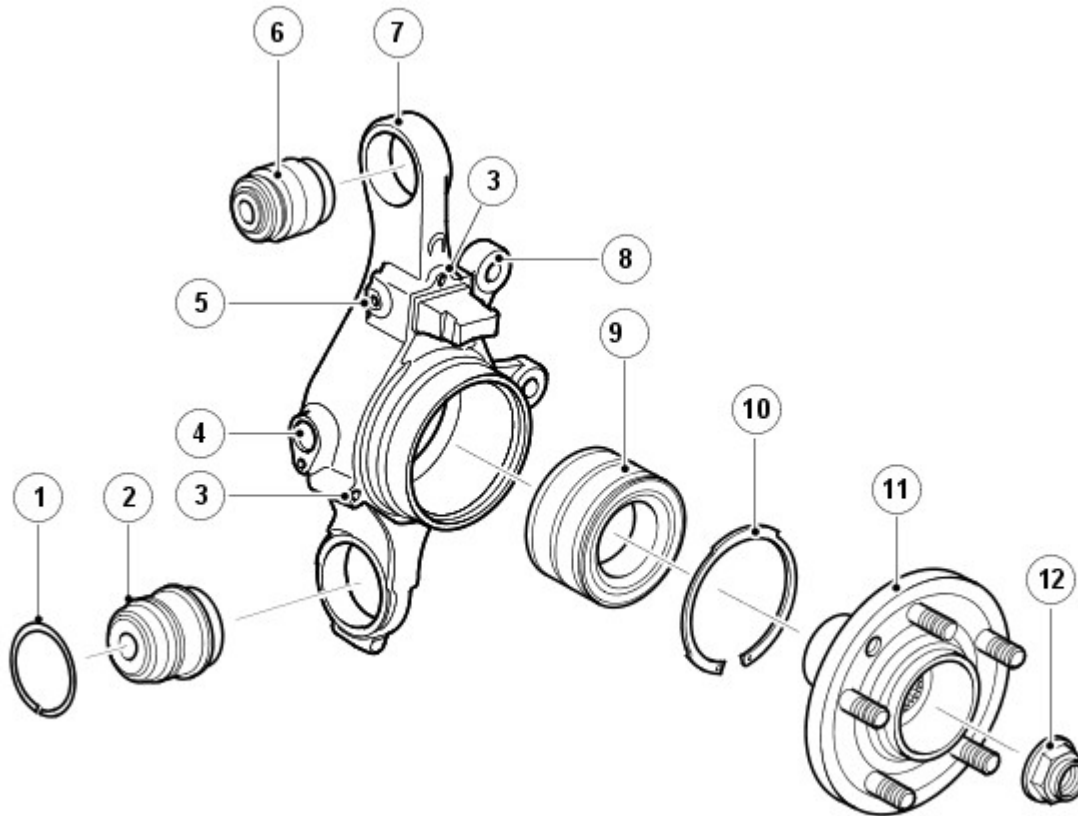
The lower control arm locates in brackets on the lower surface of each chassis side member. The lower control arm assembly comprises the control arm and two bushes. The lower control arm is a pressed steel fabrication. Its outer end has two brackets which locate the lower ball joint of the knuckle. The ball joint is secured with a bolt and self-locking nut. The lower control arm also provides for the attachment of the damper bush which is secured with a bolt and a self-locking nut.

A bracket, welded to the upper surface of the lower control arm, allows for the attachment of the anti-roll bar link, bottom ball joint which is secured with a self-locking nut.

Two fabricated tubular housings provide the location for the forward and rearward bushes. The bushes, which are pressed into the housings, locate between brackets on the chassis side members. The forward bush is secured to the chassis bracket with a bolt and self-locking nut. The rearward bush is secured to the chassis bracket with a bolt and a nut and retainer. The nut and retainer allows for easy installation or removal of the bolt by removing the requirement to hold the self-locking nut when installing or removing the bolt.

On vehicles fitted with coil springs only, a jacking bracket is located on the lower control arm.

WHEEL KNUCKLE, WHEEL HUB AND BEARING ASSEMBLY



E45900

Item	Part Number	Description
1	-	Circlip - lower ball joint
2	-	Ball joint - lower
3	-	Park brake assembly attachment holes
4	-	Wheel speed sensor location
5	-	Wheel speed sensor cable bracket attachment
6	-	Ball joint - upper
7	-	Knuckle
8	-	Brake caliper attachment holes
9	-	Wheel bearing
10	-	Circlip - wheel bearing retention
11	-	Nut - halfshaft
12	-	Wheel hub
13	-	Wheel studs




The wheel knuckle is a machined forging which is located between the upper and lower control arms. The knuckle is fitted with two ball joints which are pressed into the knuckle, with the lower ball joint being secured with a circlip. The ball joints are positioned between brackets on the upper and lower control arms and secured to the arms with a bolt and self-locking nut.

The wheel knuckle provides the location for the rear wheel taper roller bearing, which is pressed into a machined bore and retained with a circlip. The wheel bearing is a serviceable item. The knuckle has a machined bore which provides the location for the wheel speed sensor. Four threaded holes allow for the attachment of the park brake assembly. A cast boss on the knuckle provides positive location for the park brake assembly. Two bosses on the knuckle casting provide the attachment points for the rear brake caliper.

The wheel hub is a machined casting which is pressed into the wheel bearing in the knuckle. The hub has a splined centre bore which mates with corresponding splines on the halfshaft. Five M14 studs are pressed into the wheel hub and provide for the attachment of the road wheel with wheel nuts. Rotation of the halfshaft is passed, via the splines, to the wheel hub which rotates on the taper roller bearing.

Rear Suspension - Upper Arm Ball Joint

Removal and Installation

Special Tool(s)	
 <p>204-525-1 E49576</p>	Remover/installer rear upper arm ball joint 204-525/1
 <p>204-525-2 E49575</p>	Remover/installer rear upper arm ball joint 204-525/2
 <p>204-525-1 E49574</p>	Remover/installer rear upper arm ball joint 204-525/3

Removal

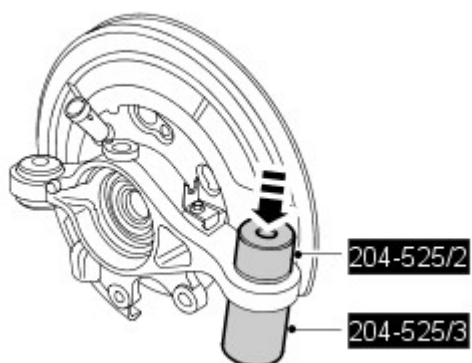
-  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

- Remove the wheel knuckle.
For additional information, refer to: [Wheel Knuckle](#) (204-02 Rear Suspension, Removal and Installation).

- Using the special tools, remove the ball joint.

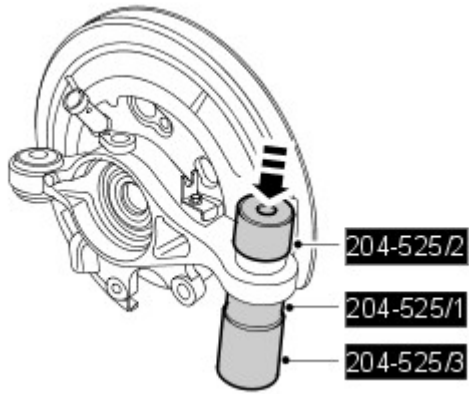
- Position machined face against the special tool.



E49577


Installation

- Clean the components.



E49578

2. CAUTIONS:

 Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

 If the push in force is less than 10 kN the wheel knuckle must be replaced.

Using the special tools, install the ball joint.

- Position machined face against the special tool.



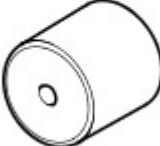


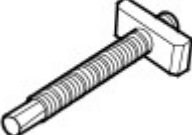

3. Install the wheel knuckle.

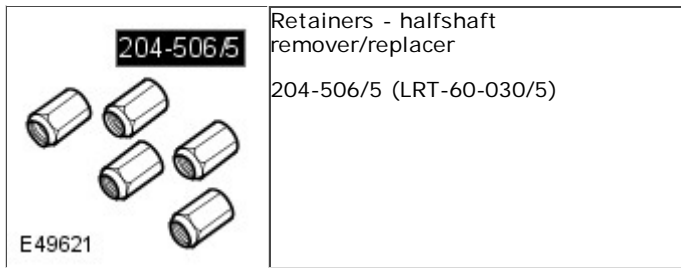
For additional information, refer to: [Wheel Knuckle](#) (204-02 Rear Suspension, Removal and Installation).

4. Install the wheel and tire.

Rear Suspension - Lower Arm Ball Joint


Removal and Installation

Special Tool(s)	
<p>204-516/1</p>  <p>E46795</p>	<p>Ball joint remover/installer 204-516/1 (LRT-64-026/1)</p>
<p>204-516/2</p>  <p>E50960</p>	<p>Ball joint remover/installer 204-516/2 (LRT-64-026/2)</p>
<p>204-516/3</p>  <p>E50961</p>	<p>Ball joint remover/installer 204-516/3 (LRT-64-026/3)</p>
<p>204-516/4</p>  <p>E50962</p>	<p>Ball joint remover/installer 204-516/4 (LRT-64-026/4)</p>
<p>204-506/1</p>  <p>E49618</p>	<p>Halfshaft remover/replacer 204-506/1 (LRT-60-030/1)</p>
<p>204-506/3</p>  <p>E49620</p>	<p>Halfshaft remover/replacer 204-506/3 (LRT-60-030/3)</p>
<p>204-506-01</p>  <p>E49622</p>	<p>Halfshaft installer adapter 204-506-01</p>



Removal

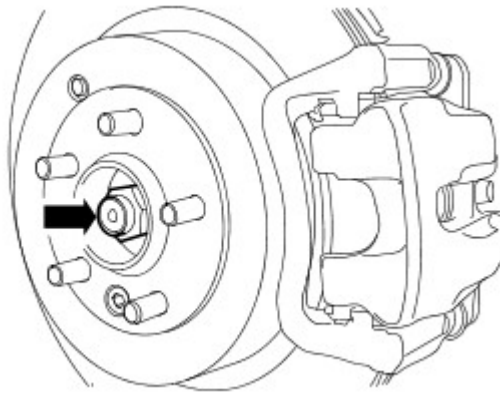
 **CAUTION:** The bolt securing the toe link to the wheel knuckle must not be used more than 5 times. Mark the bolt head with a suitable centre punch.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.

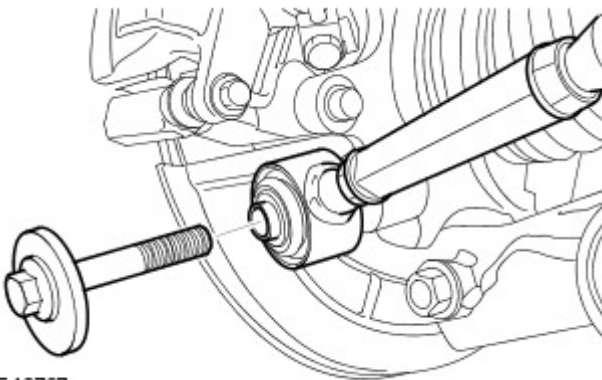
3. Loosen the halfshaft retaining nut.



E46796

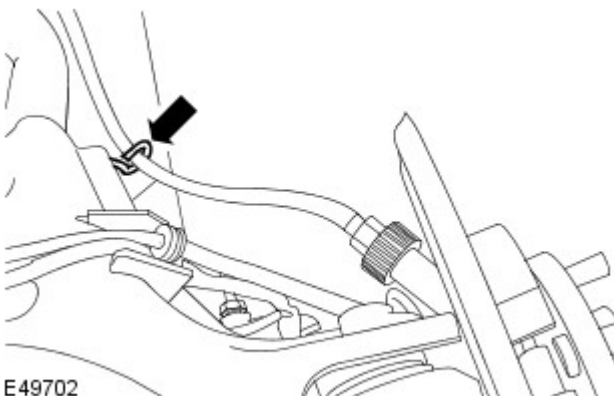
4. Disconnect the toe link.

- Remove the bolt.



E46797

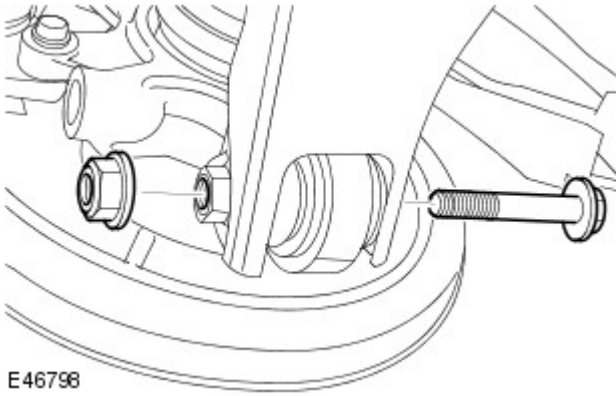
5. Release the parking brake cable from the lower arm.



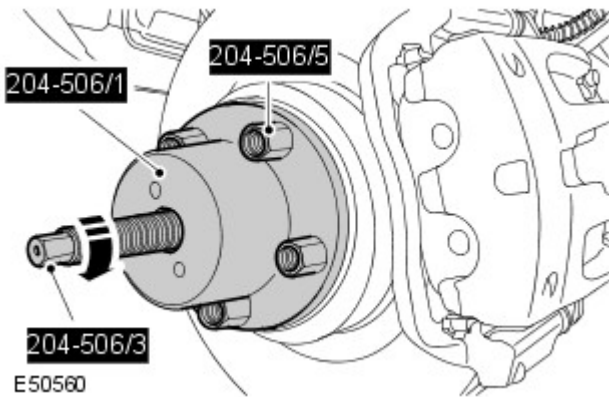
E49702

6. Remove the halfshaft retaining nut.
7. Release the knuckle from the lower arm.

- Remove the bolt.

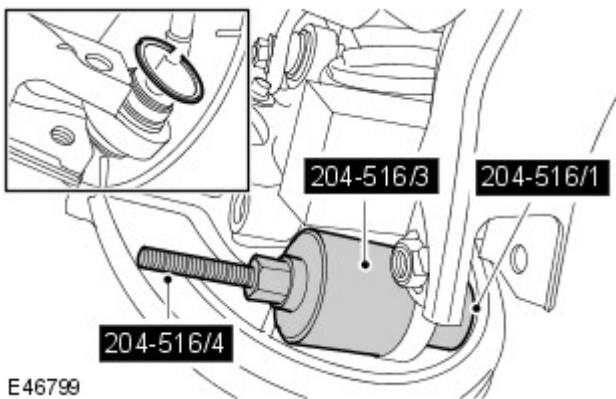


8. Using the special tools, release the halfshaft from the wheel hub.




9. Using the special tool, remove the lower arm ball joint.

- Support the wheel knuckle to give access to the lower ball joint.
- Remove and discard the snap ring.



Installation

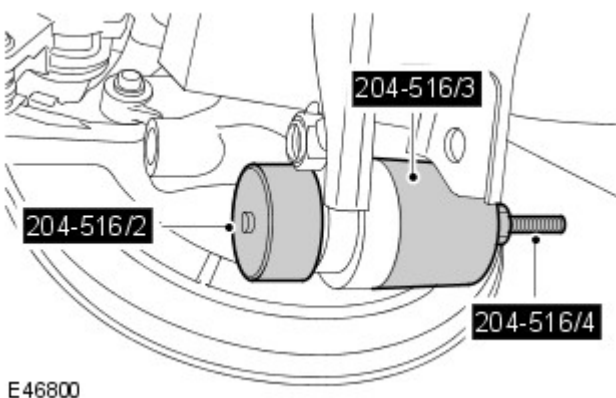
1. CAUTIONS:

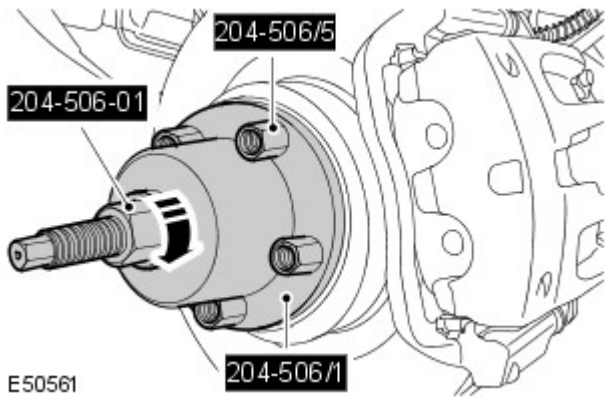
 If the push in force is less than 17 kN the wheel knuckle must be replaced.

 Make sure the ball joint is installed from the chamfered side of the wheel knuckle.


Using the special tool, install the lower arm ball joint.

- Install the snap ring.





2. Using the special tools, install the halfshaft in the wheel hub.


3.  CAUTION: Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Connect the lower arm to the wheel knuckle.

- Tighten the bolt to 175 Nm (129 lb.ft).

4. Install a new halfshaft retaining nut and lightly tighten.

5. Secure the parking brake cable.

6.  CAUTION: Do not use a bolt that has been installed more than 5 times. Check the bolt head for centre punch marks. A bolt head with 4 centre punch marks indicates the bolt has been installed 5 times and must be replaced.

Connect the toe link.

- Tighten the bolt to 175 Nm (129 lb.ft).
- Mark the bolt head with a centre punch, to indicate the number of times it has been used.

7. Tighten the halfshaft retaining nut to 350 Nm (258 lb.ft).




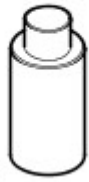


- Stake the nut to the halfshaft.

8. Install the wheel and tire.


9. Carry out the wheel alignment procedure.

Rear Suspension - Wheel Bearing and Wheel Hub

Removal and Installation

Special Tool(s)	
 <p>204-509/10 E49584</p>	<p>Rear wheel bearing remover/installer 204-509/10(LRT-60-033/10)</p>
 <p>205-802/1 E49579</p>	<p>Rear wheel bearing remover/installer 205-802/1</p>
 <p>205-802/2 E49580</p>	<p>Rear wheel bearing remover/installer 205-802/2</p>
 <p>205-802/3 E49581</p>	<p>Rear wheel bearing remover/installer 205-802/3</p>
 <p>205-802/4 E49582</p>	<p>Rear wheel bearing remover/installer 205-802/4</p>
 <p>205-802/5 E49583</p>	<p>Rear wheel bearing remover/installer 205-802/5</p>

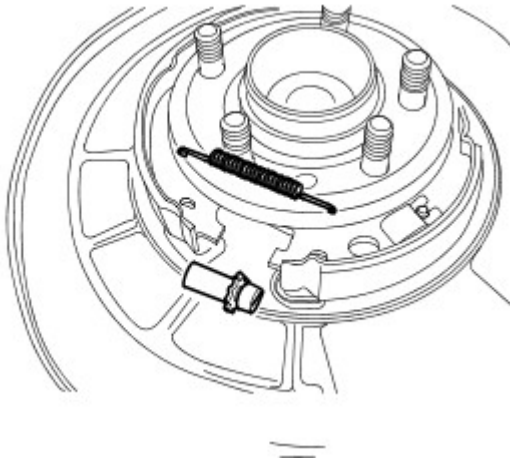
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the wheel knuckle.
For additional information, refer to: [Wheel Knuckle](#) (204-02 Rear Suspension, Removal and Installation).

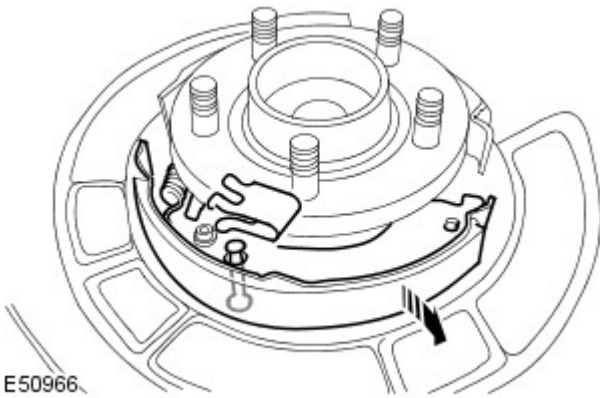
3. Remove the adjuster and return spring.



E50965

4. Remove the primary brake shoe.

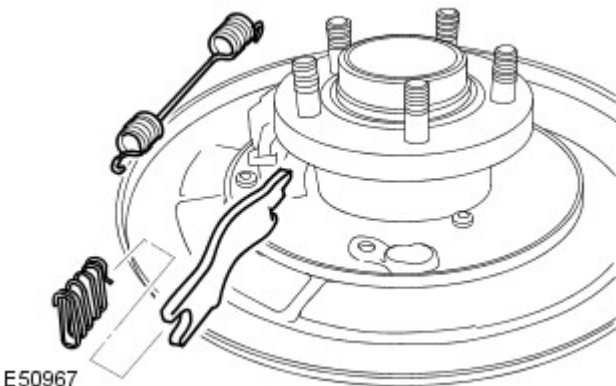
- Remove the hold-down spring and retaining pin.
- Pivot the shoe to release it from the spreader plate and return spring.



E50966

5. Remove the spreader plate and spring.

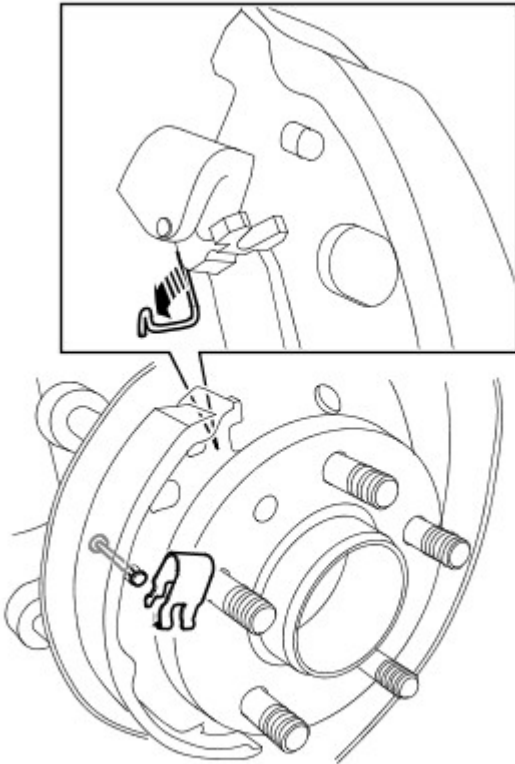
6. Remove the return spring.



E50967

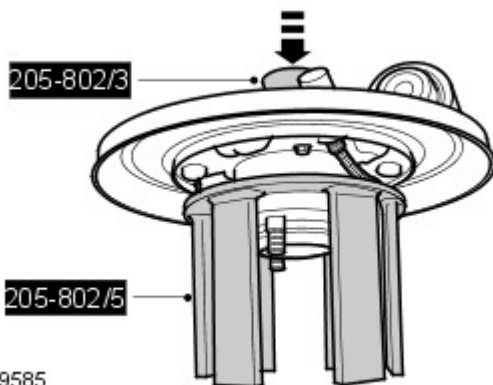
7. Remove the secondary brake shoe.

- Remove the hold-down spring and retaining pin.
- Disconnect the parking brake cable retaining spring from the brake shoe lever.



E50181

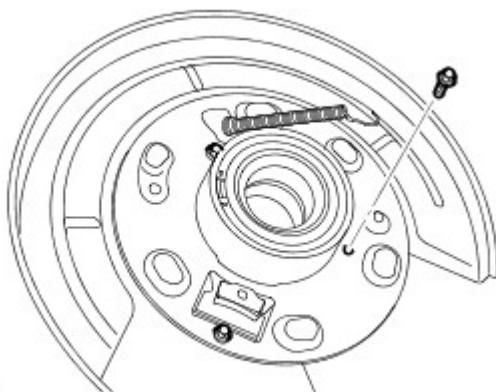
8. Using the special tools, remove the drive flange.



E49585

9. Remove the brake disc dust shield.

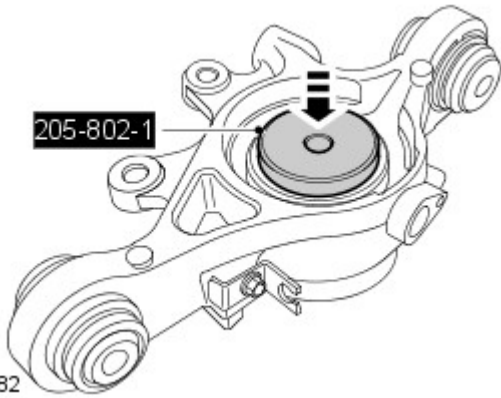
- Remove the 3 screws.



E49586

10. Using the special tools, remove the wheel bearing.

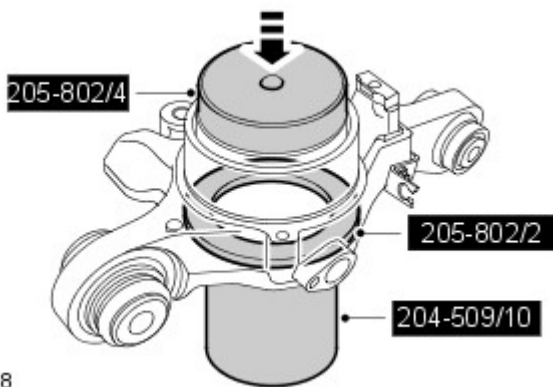
- Remove the circlip.




E50182

Installation

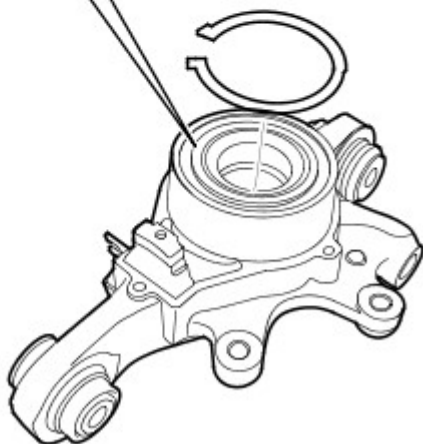
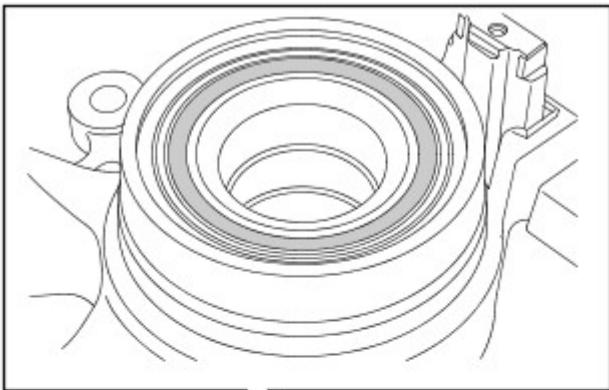
1. Clean the components.
2. Using the special tools, install the wheel bearing.



E49588

3.  CAUTION: Make sure that the bearing seal is not damaged when installing the circlip.


Install the circlip.



E49587

4. Install the brake disc dust shield.

- Tighten the bolts to 9 Nm (7 lb.ft).

5.  **WARNING:** Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

Clean the backing plate and apply grease to the brake shoe contacts.

6. Clean the adjuster and set it to its minimum extension.

7. Install the secondary brake shoe.

- Connect the parking brake cable retaining spring to the brake shoe lever, making sure the spring is not twisted.
- Install the hold-down spring and retaining pin.

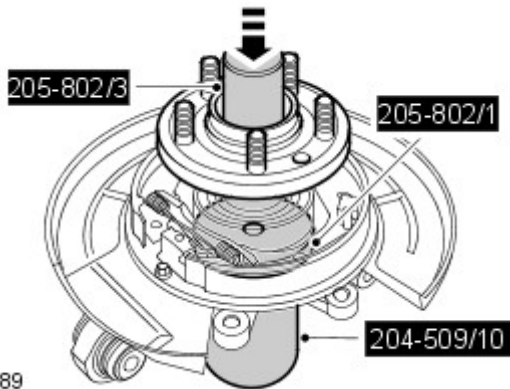
8. Install the primary brake shoe.

- Install the spreader plate and the spring.
- Install the return spring.
- Install the hold-down spring and retaining pin.

9. Install the return spring.

10. Install the brake shoe adjuster.

11. Using the special tools, install the drive flange.



12. Install the wheel knuckle.

For additional information, refer to: [Wheel Knuckle](#) (204-02 Rear Suspension, Removal and Installation).

Rear Suspension - Rear Stabilizer Bar

Removal and Installation

Removal



CAUTION: It is possible to install the stabilizer bar incorrectly. Note the position of the stabilizer bar before removal.



1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

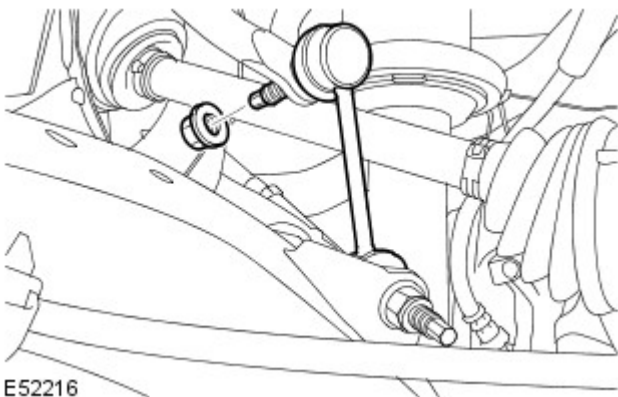
2. Remove the wheel and tire.
3. Remove the rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
4. Remove the spare wheel and tire.
5. Raise the vehicle.
6. Remove the rear wheels and tires.



7. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

Release both stabilizer bar links.

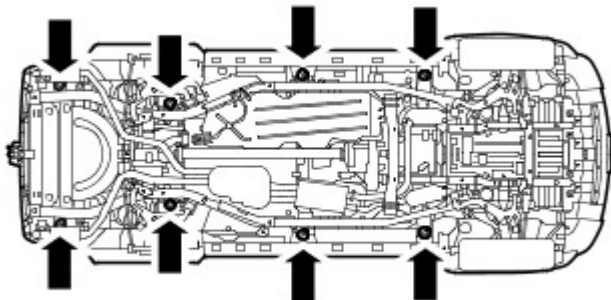
- Remove and discard the 2 nuts.



E52216

8. Remove the body mount retaining bolts.

- Remove the 8 bolts.



E52217

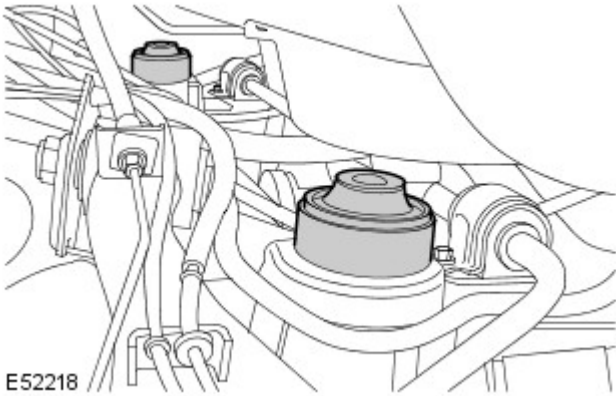


9. CAUTION: Only raise the body sufficiently to remove the body mount.

Carefully raise the body.

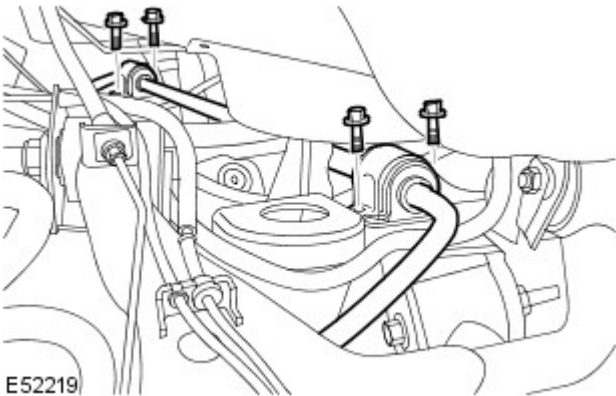
- Using suitable stands, raise the body to release the body mounts.

10. Remove the 2 rear body mounts.



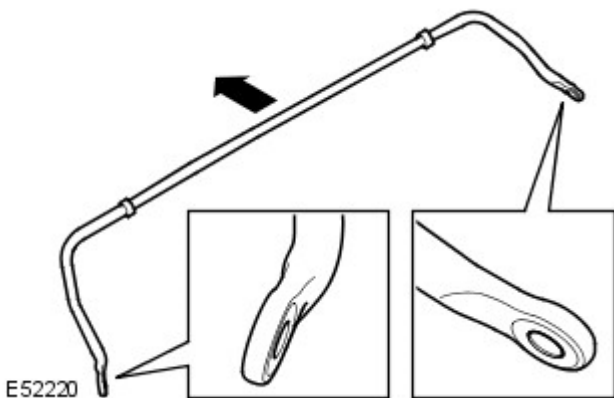
11. Remove the stabilizer bar bushing.

- Remove the stabilizer bar clamps.
- Remove the 4 bolts.




12.  CAUTION: Mark the position of the stabilizer bar.

Remove the stabilizer bar.



Installation

1.  CAUTION: Make sure the stabilizer bar is correctly installed.

Install the stabilizer bar.

2. Install the stabilizer bar bushing.

3. Install the stabilizer bar clamps.

- Tighten the 4 retaining bolts to 62 Nm (46 lb.ft).

4. Install the body mounts.

5. Lower the body.

- Remove the stands.

6. Install the body mount retaining bolts.

- Tighten the 8 retaining bolts to 133 Nm (98 lb.ft).

7. Attach both stabilizer bar links.

- Tighten the nuts to 115 Nm (85 lb.ft).

8. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

9. Lower the vehicle.




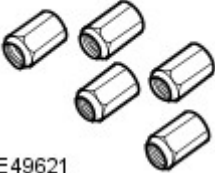

10. Install the spare wheel and tire.

11. Install the rear bumper cover.


For additional information, refer to: [Rear Bumper Cover](#)
(501-19 Bumpers, Removal and Installation).

Rear Suspension - Wheel Knuckle

Removal and Installation

Special Tool(s)	
 <p>204-506/1 E49618</p>	<p>Halfshaft remover/replacer 204-506/1(LRT-60-030/1)</p>
 <p>204-506/2 E49619</p>	<p>Halfshaft remover/replacer 204-506/2(LRT-60-030/2)</p>
 <p>204-506/3 E49620</p>	<p>Halfshaft remover/replacer 204-506/3(LRT-60-030/3)</p>
 <p>204-506/5 E49621</p>	<p>Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)</p>
 <p>204-506-01 E49622</p>	<p>Halfshaft installer adapter 204-506-01(LRT-60-030/4)</p>

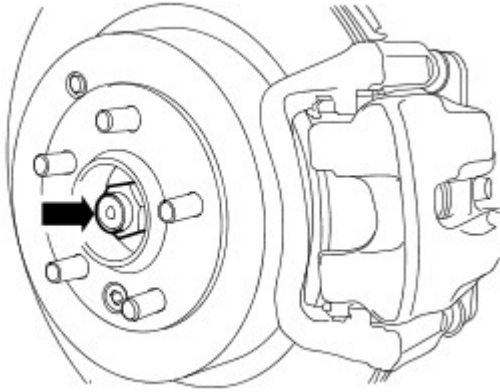
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheels and tires.

3. Loosen the halfshaft retaining nut.



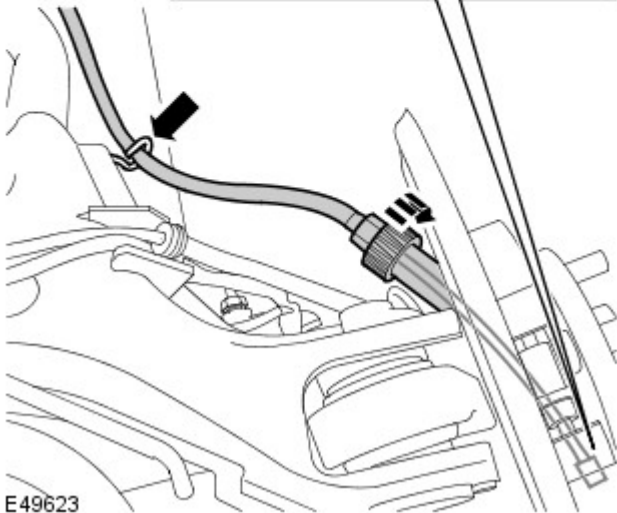
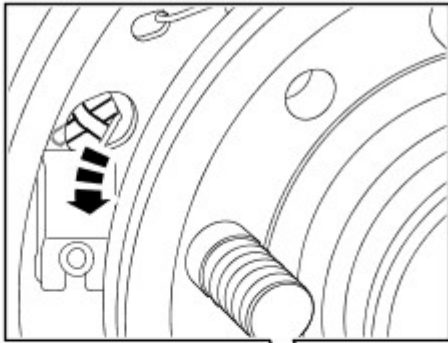
E46796

4. Remove the brake disc.

For additional information, refer to: [Brake Disc](#) (206-04 Rear Disc Brake, Removal and Installation).

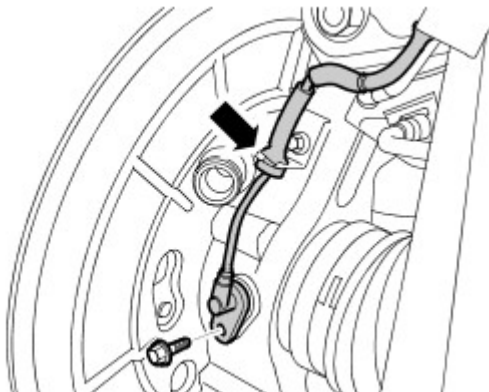
5. Release the parking brake cable.

- Disconnect the parking brake cable from the brake shoe lever.
- Disconnect the parking brake cable from the backplate.
- Release the cable from the lower arm.



E49623

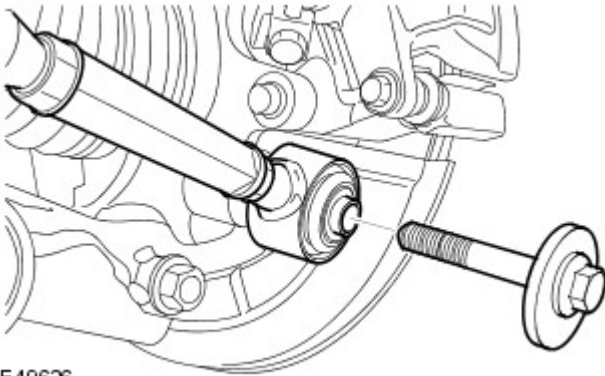
6. Release the wheel speed sensor from the wheel knuckle.



E49624


7. Disconnect the toe link.

- Remove and discard the bolt.



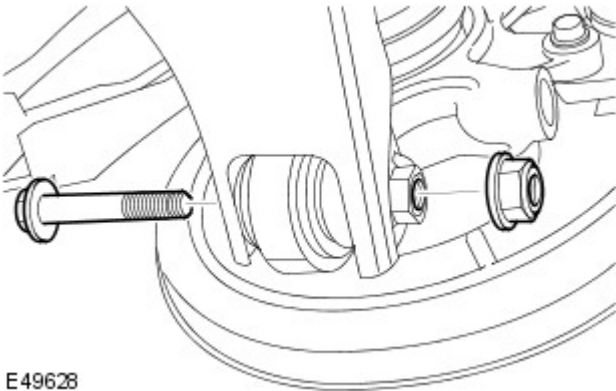
E49626

8. Remove the halfshaft retaining nut.


9.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Release the knuckle from the lower arm.

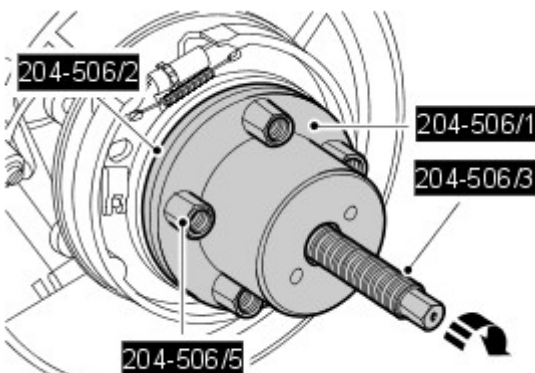
- Remove the bolt.




E49628

10.  CAUTION: Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

Using the special tools, release the halfshaft from the wheel hub.

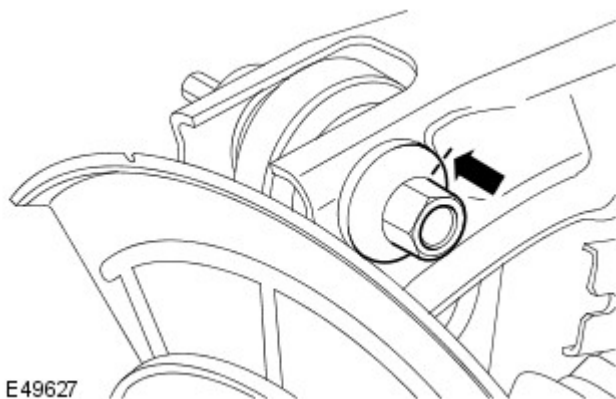


E49625


11.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Disconnect the upper arm from the wheel knuckle.

- Mark the position of the bolt in relation to the upper arm.
- Remove the nut and bolt.
- Discard the nut.




E49627

12.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Remove the wheel knuckle.

Installation

1. Clean the components.

2.  **CAUTION:** Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

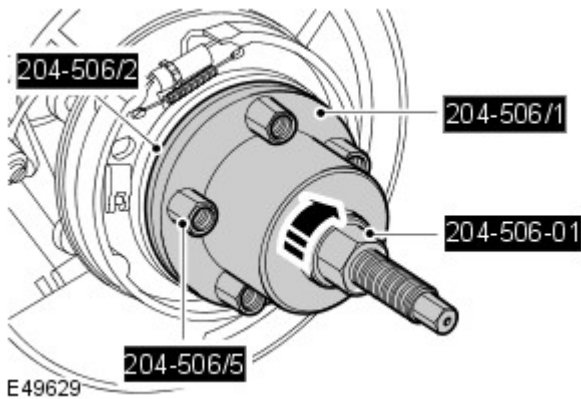
Install the wheel knuckle.

- Locate the halfshaft.

3. Connect the upper arm and wheel knuckle.


- Align the bolt to the marks made previously.
- Install a new nut and tighten to 133 Nm (98 lb.ft).

4. Using the special tools, install the halfshaft in the wheel hub.



5.  **CAUTION:** Install the halfshaft nut finger tight.

Install a new halfshaft retaining nut and lightly tighten.

6.  **CAUTION:** Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Connect the lower arm to the wheel knuckle.

- Tighten the nut and bolt to 175 Nm (129 lb.ft).

7. Connect the toe link.

- Tighten the new bolt to 175 Nm (129 lb.ft).

8. Install the wheel speed sensor.


- Tighten the bolt to 9 Nm (7 lb.ft).

9. Locate the parking brake cable to the backplate.

- Connect the cable to the brake shoe lever.
- Tighten the coupling to 8 Nm (6 lb.ft).
- Secure the parking brake cable to the lower arm.

10. Install the brake disc.

For additional information, refer to: [Brake Disc](#) (206-04 Rear Disc Brake, Removal and Installation).

11.  **CAUTION:** Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

Tighten the halfshaft retaining nut to 350 Nm (258 lb.ft).

- Stake the nut to the halfshaft.







12. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

13. Carry out the wheel alignment procedure.


Rear Suspension - Upper Arm Bushing

Removal and Installation

Special Tool(s)	
 <p>204-528-1</p> <p>E50585</p>	Remover/installer - rear suspension upper arm front bushing 204-528/1
 <p>204-528-2</p> <p>E50586</p>	Remover/installer - rear suspension upper arm front bushing 204-528/2
 <p>204-528-3</p> <p>E50587</p>	Remover/installer - rear suspension upper arm front bushing 204-528/3
 <p>204-527-1</p> <p>E50580</p>	Remover/installer rear suspension upper arm rear bushing 204-527/1
 <p>204-527-2</p> <p>E50581</p>	Remover/installer rear suspension upper arm rear bushing 204-527/2
 <p>204-527-3</p> <p>E50582</p>	Remover/installer rear suspension upper arm rear bushing 204-527/3

Removal

- NOTE: The bushings must be replaced in pairs, LH and RH sides.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheels and tires.

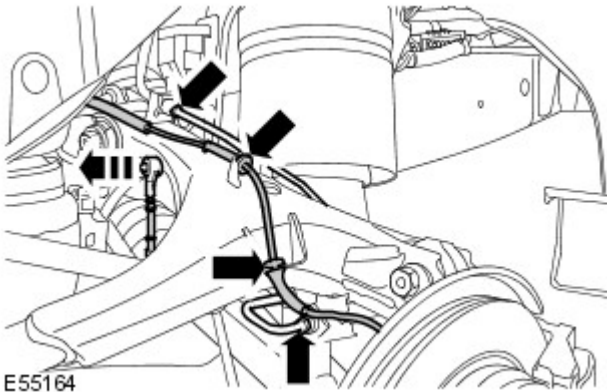
3.  **CAUTION:** Always plug any open connections to prevent contamination.

Remove the brake tube.

- Disconnect the 2 brake tube unions.
- Remove the brake hose clips and release the hoses.
- Release the brake tube from the clip.

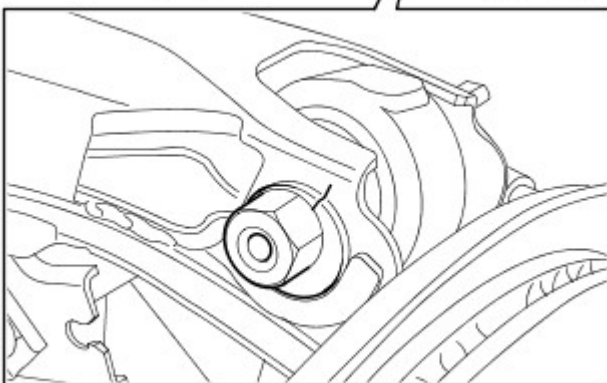
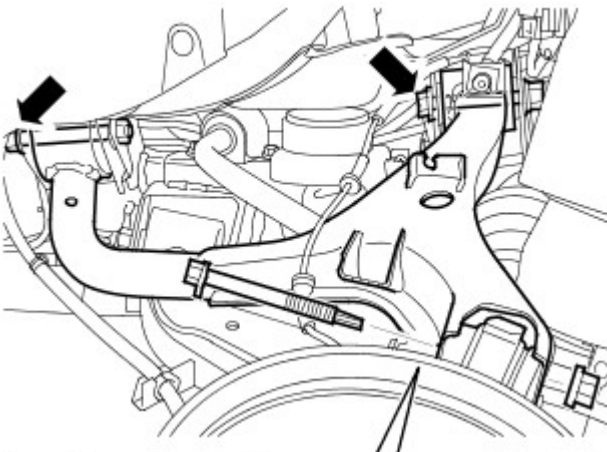
4. Disconnect the height sensor link.

5. Release the wheel speed sensor lead.



6. Remove the LH upper arm.

- Loosen the upper arm bolts.
- Mark the position of the bolt in relation to the upper arm.
- Disconnect the upper arm from the wheel knuckle.
- Remove the upper arm bolts.



E55166

7. Remove the RH upper arm.

For additional information, refer to: [Upper Arm](#) (204-02 Rear Suspension, Removal and Installation).

8. Mark the position of the bushing in relation to the upper arm.

9. Using the special tools, remove and discard the rear upper arm front bushing.

10. Using the special tools, remove and discard the rear upper arm rear bushing.

Installation

1. CAUTIONS:



Make sure the bush is correctly aligned.



Make sure the correct special tool is used to install the bushings to the correct depth.

Using the special tools, install the rear upper arm front bushing.



CAUTION: Make sure the bush is correctly aligned.

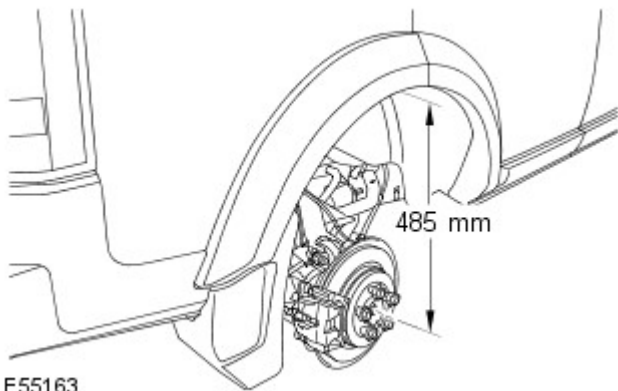
Using the special tools, install the rear upper arm rear bushing.

3. Install the LH upper arm.

- Fit the bolts but do not fully tighten at this stage.

4. Set the height between the center of the halfshaft end and the edge of the fender trim to 485 mm (19.10").

- Support with an axle stand.



CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Connect the upper arm and wheel knuckle.

- Align the bolt to the marks made previously.
- Tighten the bolt to 133 Nm (98 lb.ft).

6. Tighten the upper arm front bolt to 175 Nm (129 lb.ft).

7. Tighten the upper arm rear bolt to 275 Nm (203 lb.ft).

8. Secure the wheel speed sensor lead.

9. Secure the brake pad wear indicator sensor lead.

10. Connect the height sensor link.

11. Install the brake tube.

- Tighten the brake tube unions to 18 Nm (13 lb.ft).

12. Install the RH upper arm.

For additional information, refer to: [Upper Arm](#) (204-02 Rear Suspension, Removal and Installation).


13. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Suspension - Rear Stabilizer Bar Link


Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

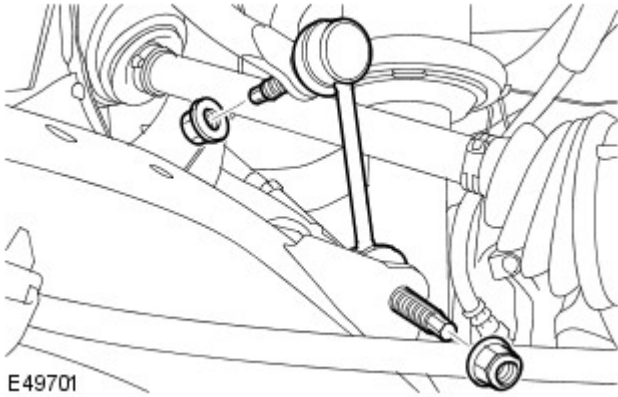
Raise and support the vehicle.

2. Remove the wheel and tire.

3.  **CAUTION:** Use a wrench on the hexagon provided to prevent the ball joint rotating.

Remove the stabilizer bar link.

- Remove and discard the 2 nuts.




Installation

1. Install the stabilizer bar link.
 - Tighten the nuts to 115 Nm (85 lb.ft).
2. Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Suspension - Lower Arm

Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

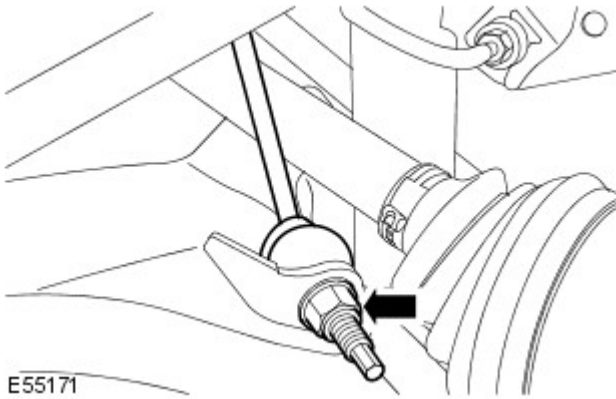
Raise and support the vehicle.

2. Remove the wheel and tire.

3.  **CAUTION:** Use a wrench on the hexagon provided to prevent the ball joint rotating.

Release the stabilizer bar link.

- Remove and discard the retaining nut.




E55171

4. Loosen the 2 lower arm bolts.
5. Disconnect the shock absorber and spring assembly from the lower arm.

- Remove the nut and bolt.

6. Release the parking brake cable.

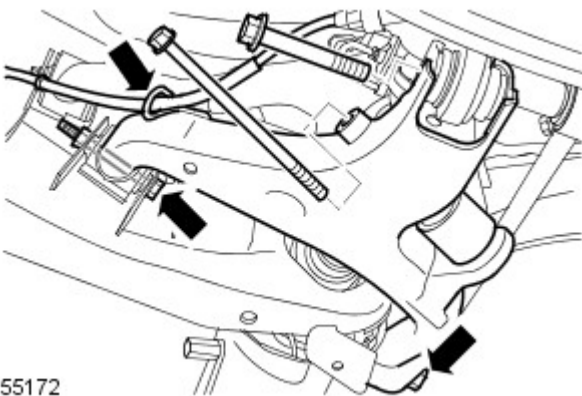
7. Remove the 2 lower arm bolts.

8.  **CAUTION:** Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Release the knuckle from the lower arm.

- Remove the bolt.

9. Remove the lower arm.




E55172

Installation

1. Install the lower arm.

- Fit the bolts but do not fully tighten at this stage.

2.  **CAUTION:** Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

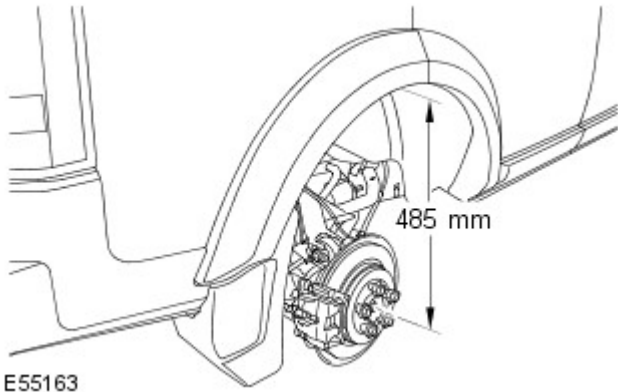
Connect the lower arm to the wheel knuckle.

- Tighten the bolt to 175 Nm (129 lb.ft).

3. Connect the shock absorber and spring assembly to the lower arm.

- Tighten the nut and bolt to 300 Nm (221 lb.ft).

4. Set the height between the center of the halfshaft end and the edge of the fender trim to 485 mm (19.10").



5. Tighten the lower arm bolts to 275 Nm (203 lb.ft).

6. Secure the parking brake cable.

7. Connect the stabilizer link.

- Install a new nut and tighten to 115 Nm (85 lb.ft).

8. Install the wheel and tire.


- Tighten the wheel nuts to 140 Nm (103 lb.ft).

9. Carry out the wheel alignment procedure.

Rear Suspension - Upper Arm


Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.

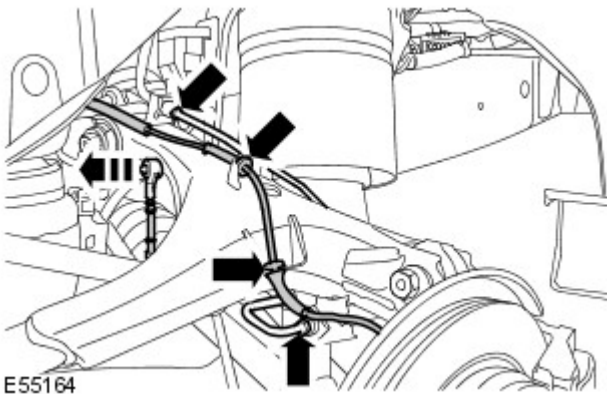
3.  **CAUTION:** Always plug any open connections to prevent contamination.

Remove the brake tube.

- Disconnect the 2 brake tube unions.
- Remove the brake hose clips and release the hoses.
- Release the brake tube from the clip.

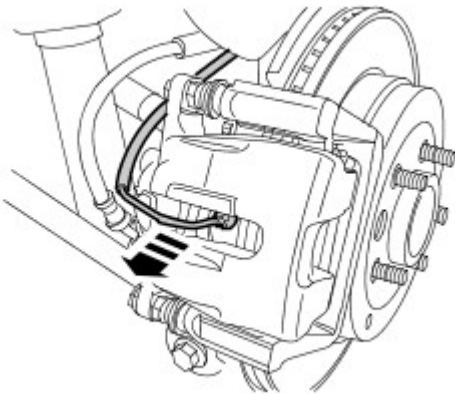
4. Disconnect the height sensor link.

5. Release the wheel speed sensor lead.

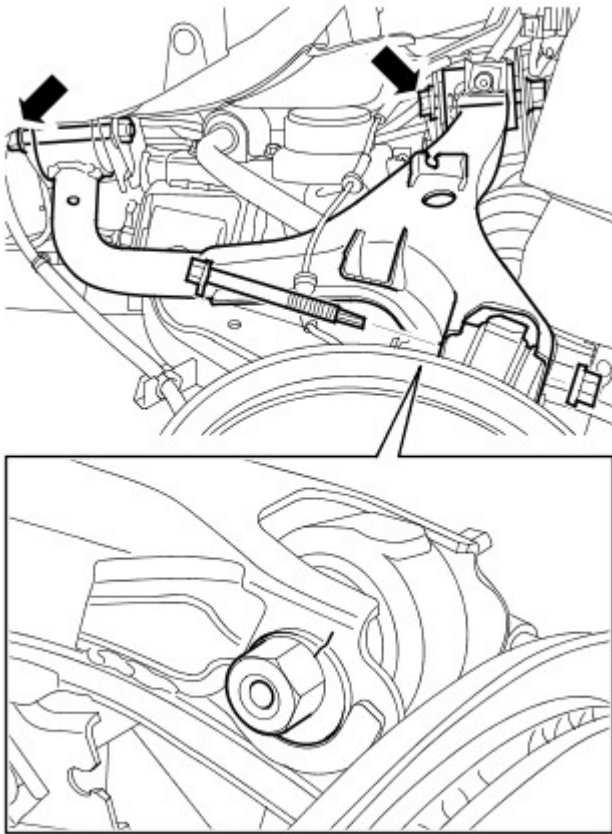


E55164

6. RH side only: Release the brake pad wear indicator sensor lead.



E55165



E55166

7. Remove the upper arm.

- Loosen the upper arm bolts.
- Mark the position of the bolt in relation to the upper arm.
- Remove the nut and bolt, then release the upper arm from the wheel knuckle.
- Remove the upper arm bolts.

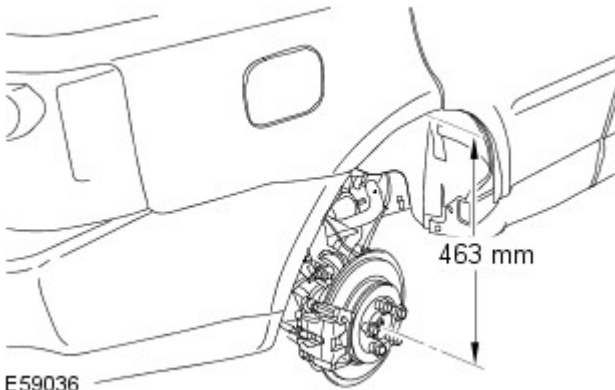
Installation

1. Install the upper arm.


- Fit the bolts but do not fully tighten at this stage.

2. Set the height, between the center of the halfshaft end and the edge of the fender trim, to 463 mm (18.23").

- Support with an axle stand.



E59036

3.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Connect the upper arm and wheel knuckle.

- Align the bolt to the marks made previously.
- Tighten the bolt to 133 Nm (98 lb.ft).

4. Tighten the upper arm front bolt to 175 Nm (129 lb.ft).

5. Tighten the upper arm rear bolt to 275 Nm (203 lb.ft).

6. Secure the wheel speed sensor lead.

7. Secure the brake pad wear indicator sensor lead.

8. Connect the height sensor link.

9. Install the brake tube.

- Tighten the brake tube unions to 18 Nm (13 lb.ft).

10. Bleed the brake system.

For additional information, refer to: [Component Bleeding](#) (206-00 Brake System - General Information, General Procedures).

11. Install the wheel and tire.


- Tighten the wheel nuts to 140 Nm (103 lb.ft).

12. Carry out the wheel alignment procedure.

Rear Suspension - Toe Link

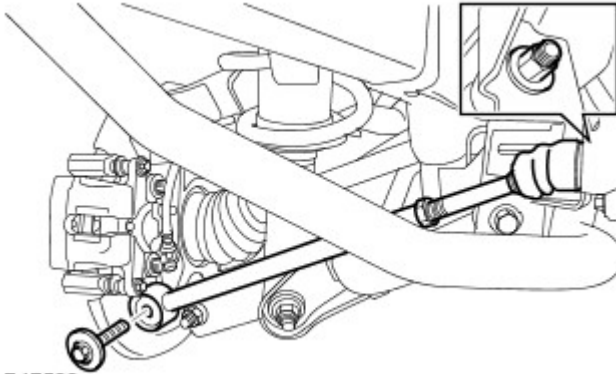
Removal and Installation

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Raise and support the vehicle.

- Remove the wheel and tire.
- Disconnect the toe link.
 - Remove and discard the bolt.
- Remove the toe link.
 - Remove and discard the nut.



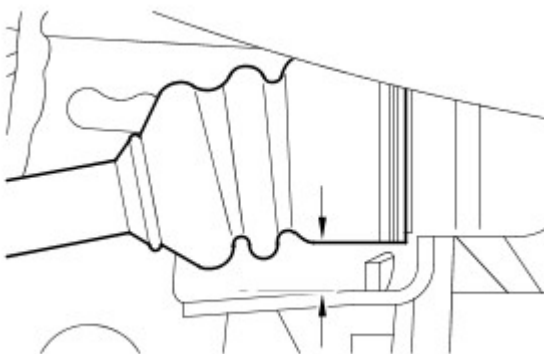
E47523

Installation

-  **CAUTION:** Make sure the toe link anti-rotation tang is fully seated in the integrated body frame before tightening the toe link retaining nut. Failure to follow this instruction will result in damage to the toe link or integrated body frame.

Install the toe link.

- Install a new nut and lightly tighten.
- Connect the toe link.
 - Using a M14 X 2 tap, clean the threads of the knuckle fixing hole. Blow out debris with an air-line.
 - Tighten the new bolt to 175 Nm (129 lb.ft).
 - Set the gap, between the underside of the toe link rubber boot and the integrated body frame bracket, to 10 mm (0.473 in).
 - Tighten the toe link inner ball joint retaining nut to 133 Nm (98 lb.ft)









E47524

- Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
- Carry out the wheel alignment procedure.


Rear Suspension - Lower Arm Bushing

Removal and Installation

Special Tool(s)	
 204-526/1 E55175	Receiver rear lower arm front bush 204-526/1
 204-526/2 E55176	Remover rear lower arm front bush 204-526/2
 204-526/3 E55177	Installer rear lower arm front bush 204-526/3
 204-532/1 E55178	Receiver rear lower arm rear bush 204-540/1
 204-540/2 E55179	Remover rear lower arm rear bush 204-540/2
 204-540/3 E55180	Installer rear lower arm rear bush 204-540/3

Removal

- NOTE: The bushings must be replaced in pairs, LH and RH sides.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheels and tires.

3. Remove the LH lower arm.

For additional information, refer to: [Lower Arm](#) (204-02 Rear Suspension, Removal and Installation).

4. Remove the RH lower arm.

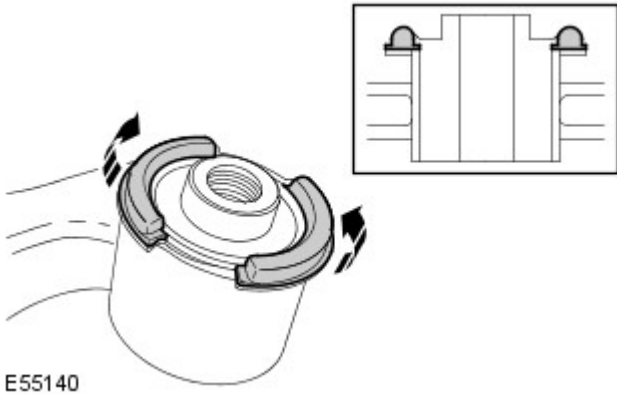
5. Note the position of the bushing in relation to the lower arm.

6.  **CAUTION:** The bush flanges need to be removed to allow bush removal.

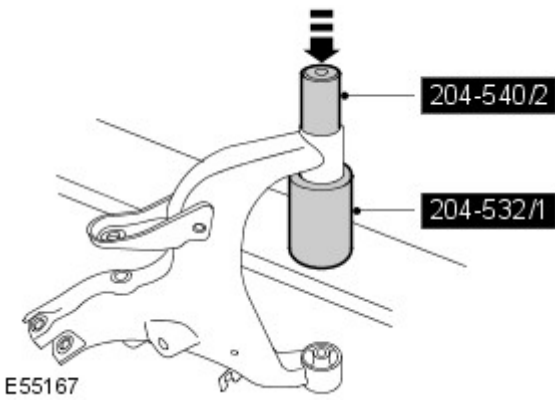
• **NOTE:** Take note of the fitted position of the bush.

Using a suitable tool, bend over the bush flanges.

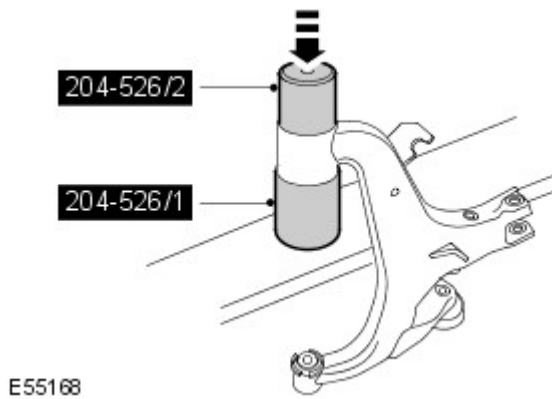
7. Using a hacksaw, remove the flange from the bushing, making sure the upper arm is not damaged.



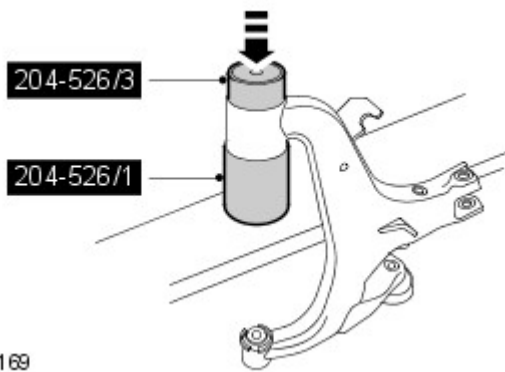
8. Using the special tools, remove and discard the lower arm rear bushings.



9. Using the special tools, remove and discard the lower arm front bushings.




Installation

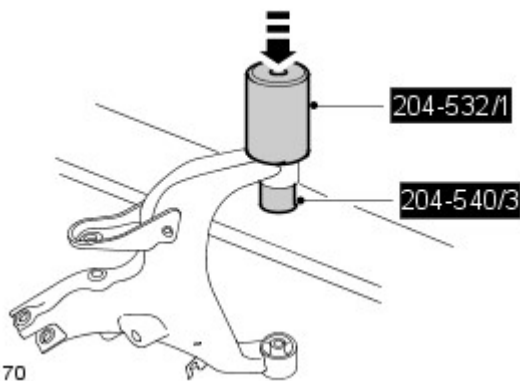



1. CAUTIONS:

 Make sure the bush is correctly aligned.

 Make sure the correct special tool is used to install the bushings to the correct depth.

Using the special tools, install the lower arm front bushings



2.  CAUTION: Make sure the bush is correctly aligned.


Using the special tools, install the lower arm rear bushings.

3. Install the LH lower arm.
For additional information, refer to: [Lower Arm](#) (204-02 Rear Suspension, Removal and Installation).
4. Install the RH lower arm.
5. Install the wheels and tires.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
6. Carry out the wheel alignment procedure.

Rear Suspension - Shock Absorber and Spring AssemblyTDV6 2.7L Diesel

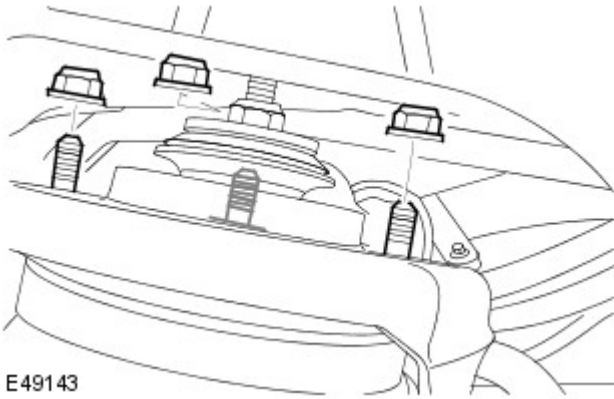
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

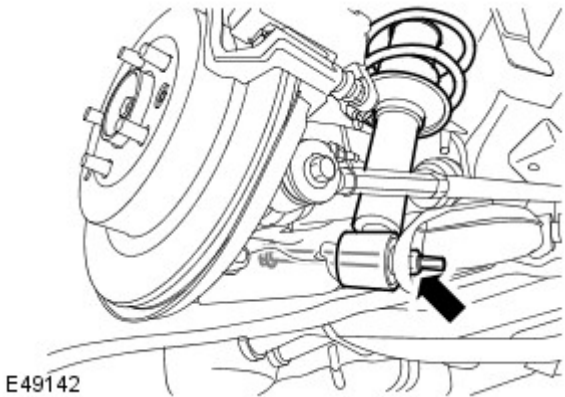
2. Remove the wheel and tire.
3. Loosen the 3 spring and shock absorber retaining nuts.



E49143

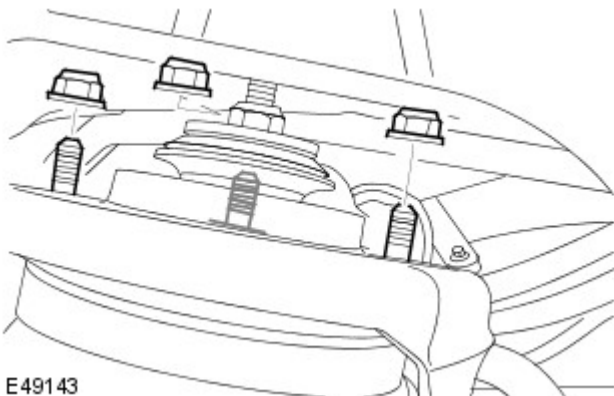
4. Disconnect the shock absorber and spring assembly from the lower arm.

- Using a jack and a suitable block of wood, support the base of the shock absorber.
- Remove the nut and bolt.



E49142

5. Remove the shock absorber and spring assembly retaining nuts.



E49143

6. Remove the shock absorber and spring assembly.

Installation

1. Install the shock absorber and spring assembly.
 - Make sure the spring and shock absorber assembly top mounting to body mating faces are clean.
 - Install the nuts but do not fully tighten at this stage.

2. Connect the shock absorber and spring assembly to the lower arm.

- Tighten the nut and bolt to 300 Nm (221 lb.ft).
- Tighten the three retaining nuts to 70 Nm (52 lb.ft).

3. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Suspension - Shock Absorber and Spring Assembly TDV6 2.7L Diesel

Disassembly and Assembly

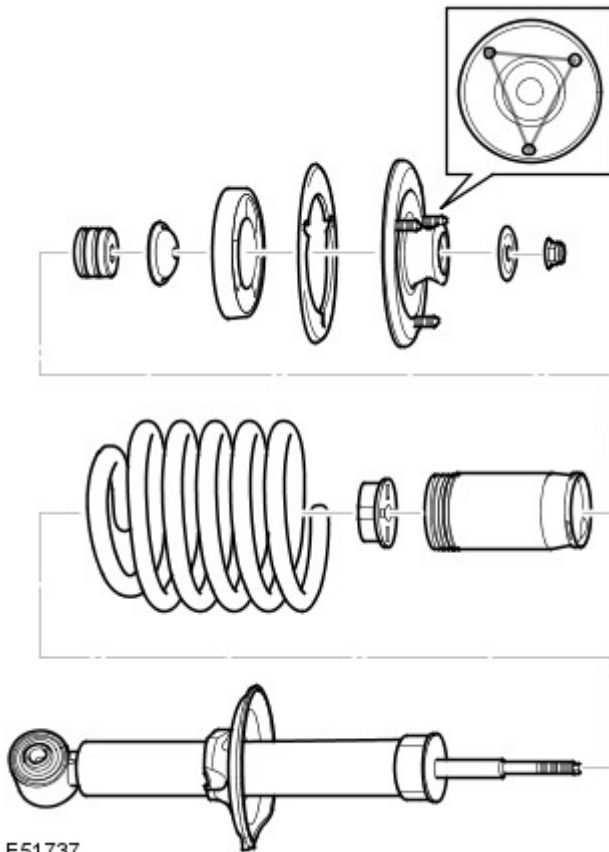
Disassembly



WARNING: Ensure the spring compressor Safe Working Load (SWL) meets or exceeds the spring rating quoted in the Specifications section.

1. Raise and support the vehicle.
2. Remove the wheel and tire.
3. Remove the shock absorber and spring assembly.
For additional information, refer to: [Shock Absorber and Spring Assembly - TDV6 2.7L Diesel](#) (204-02 Rear Suspension, Removal and Installation).
4. Install a suitable spring compressor in a vise.
5. Install the shock absorber and spring assembly in the spring compressor.
 - Compress the spring just sufficiently to relieve the spring tension.

6. Remove the shock absorber.
 - Restrain the shock absorber spindle, remove and discard the nut.
 - Remove the upper bush rebound plate and upper bush.
 - Remove the upper mounting assembly.
 - Remove the dust tube and rebound plate assembly.
 - Remove the spring aid.



E51737

7. Remove the spring from the spring compressor.

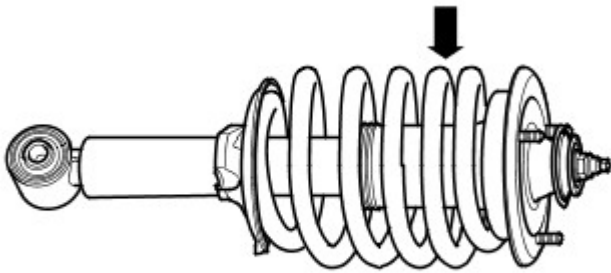
Assembly



E51738

1. Clean and inspect the components for deterioration.

- Remove the rubber insulator.
- Remove the spacer.
- Remove the rebound plate from the dust tube.



E51740

2. Install the spring in the spring compressor.

- Make sure the spring is installed with the close coils positioned towards the top of the shock absorber.

3. Install the spring aid.

4. Install the dust tube.

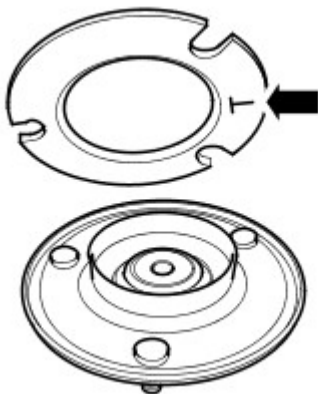
- Install the rebound plate into the dust tube.

5. Install the shock absorber.

- Make sure the spring is correctly located in the spring seat.

6. Install the upper mounting.

- Install the spacer and rubber insulator, making sure the spacer drops over the stud heads.
- Install the upper bush and upper bush rebound plate.
- Install a new nut and tighten to 98 Nm (72 lb.ft).



E51739

7. Install the shock absorber and spring assembly.

For additional information, refer to: [Shock Absorber and Spring Assembly - TDV6 2.7L Diesel](#) (204-02 Rear Suspension, Removal and Installation).

8. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Wheels and Tires -

Wheels

Wheel type	Wheel size
Alloy wheel	7J x 17
Alloy wheel	8J x 18
Alloy wheel	8J x 19
Alloy wheel	8.5J x 20
Reduced size spare wheel - Steel	5.5J x 19

• CAUTIONS:



With reduced size spare wheel fitted, do not exceed 50 mph (80 kph) and replace with standard size wheel at earliest opportunity.



Do not use power tools when operating the spare wheel winch, raise and lower winch manually using hand tools only.

Tire Sizes - Standard Fit

Wheel size	Tire size	Tire load index
7J x 17 - Alloy	235/70 R17H - All terrain	111
8J x 18 - Alloy	255/60 R18V - All terrain	112
8J x 19 - Alloy	255/55 R19V - All terrain	111
8.5J x 20 - Alloy	255/50 R20Y - All terrain	109



CAUTION: Inner tubes must not be fitted with any of these tires.

Tire Sizes - Accessory Fit

Wheel size	Tire size	Tire load index
8J x 19 - Alloy	255/55 R19 - Mud terrain	111
8J x 19 - Alloy	255/55 R19 - Sand	111



CAUTION: Inner tubes must not be fitted with any of these tires.

Tire Pressures - Not NAS/Gulf/Brazil Vehicles

Loading condition	bars	lbf/in ²	kPa
Normal operating conditions - Up to 4 people:			
Front	2.3	33	230
Rear	2.5	36	250
Vehicle loaded to maximum gross vehicle weight:			
Front	2.5	36	250
Rear	2.9	42	290
Reduced size spare wheel	4.2	60	420
* Standard size spare wheel	2.9	42	290



CAUTION: * The standard size spare wheel tire should be inflated to the maximum gross vehicle weight pressure and the pressure for the front or rear wheel locations must be adjusted accordingly if the wheel is to be used under conditions other than with the vehicle loaded to maximum gross vehicle weight.

Tire Pressures - NAS/Gulf/Brazil Vehicles

Loading condition	bars	lbf/in ²	kPa
All conditions			
Front	2.5	36	250
Rear	2.9	42	290
Reduced size spare wheel	4.2	60	420
* Standard size spare wheel	2.9	42	290



CAUTION: The standard size spare tyre should be inflated to the highest recommended pressure when stored on the vehicle. The inflation pressure must be adjusted to suit the axle location when the spare is used to replace a punctured road tyre."

General Specification

Item	Make	Location
Tire low pressure sensor	Continental/Siemens	On inside of wheel rim
Tire pressure sensor initiator:		
Front	Continental/Siemens	Attached to the fender splash shield adjacent to the front bumper
Rear	Continental/Siemens	Attached to the fender splash shield adjacent to the rear bumper

Recommended Lubricant

Application	Land Rover Part No.
Wheel hub spigot	RYL 105020

Torque Specifications

Description	Nm	lb-ft
* Road wheel nuts	140	103
Tire low pressure sensor	8	6

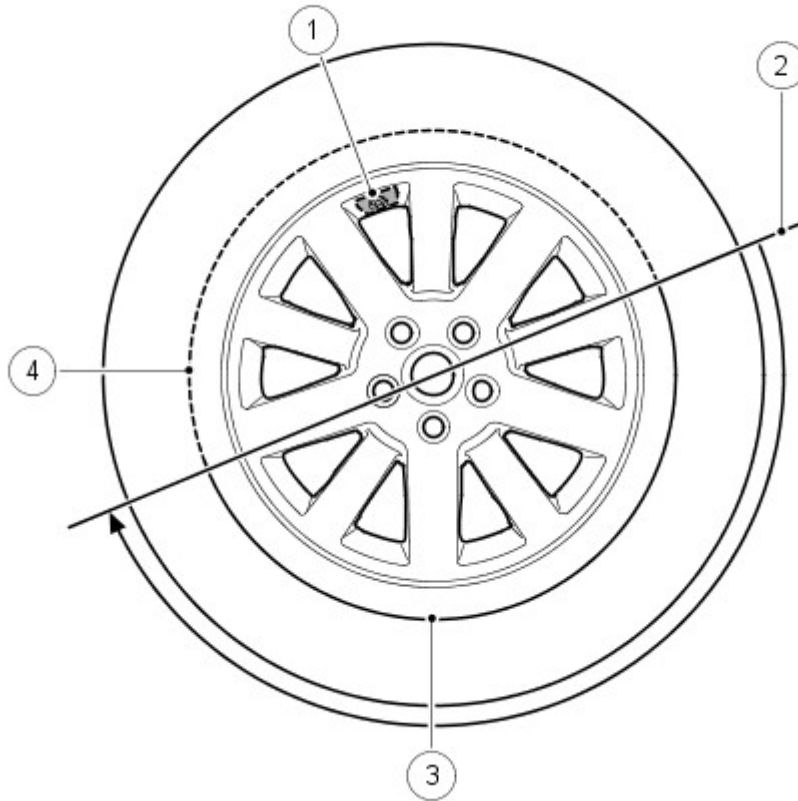
* Wheel nuts must be tightened by diagonal selection

Wheels and Tires - Wheels and Tires

Description and Operation

TIRES

Care must be taken when removing and refitting tires to ensure that the tire pressure sensor is not damaged.



E45549

Item	Part Number	Description
1	-	Tire valve and pressure sensor
2	-	Tire fitting/removal tool initial start position
3	-	High tire and bead tension area
4	-	Low tire and bead tension area

When removing the tire, the bead breaker must not be used within 90 degrees of the tire valve in each direction.

When using the tire removal machine, the fitting arm start position must be positioned as shown in the tire changing illustration. The wheel can then be rotated through 180 degrees in a counterclockwise direction. This will relieve the high tension from the tire bead allowing the remaining 180 degrees of the tire to be manually pulled from the rim.

When refitting the tire, position the fitting arm as shown. Rotate the tire and take care that the bead on the low tension side of the tire does not damage the sensor.

Tread Act - NAS Only

Vehicles supplied to the North American markets must comply with the legislation of the Transport Recall Enhancement, Accountability and Documentation (TREAD) act. Part of the requirement of the TREAD act is for the vehicle to display a label, positioned on the driver's side B-pillar, which defines the recommended tire inflation pressure, load limits and maximum load of passengers and luggage weight the vehicle can safely carry. This label will be specific to each individual vehicle and will be installed on the production line.

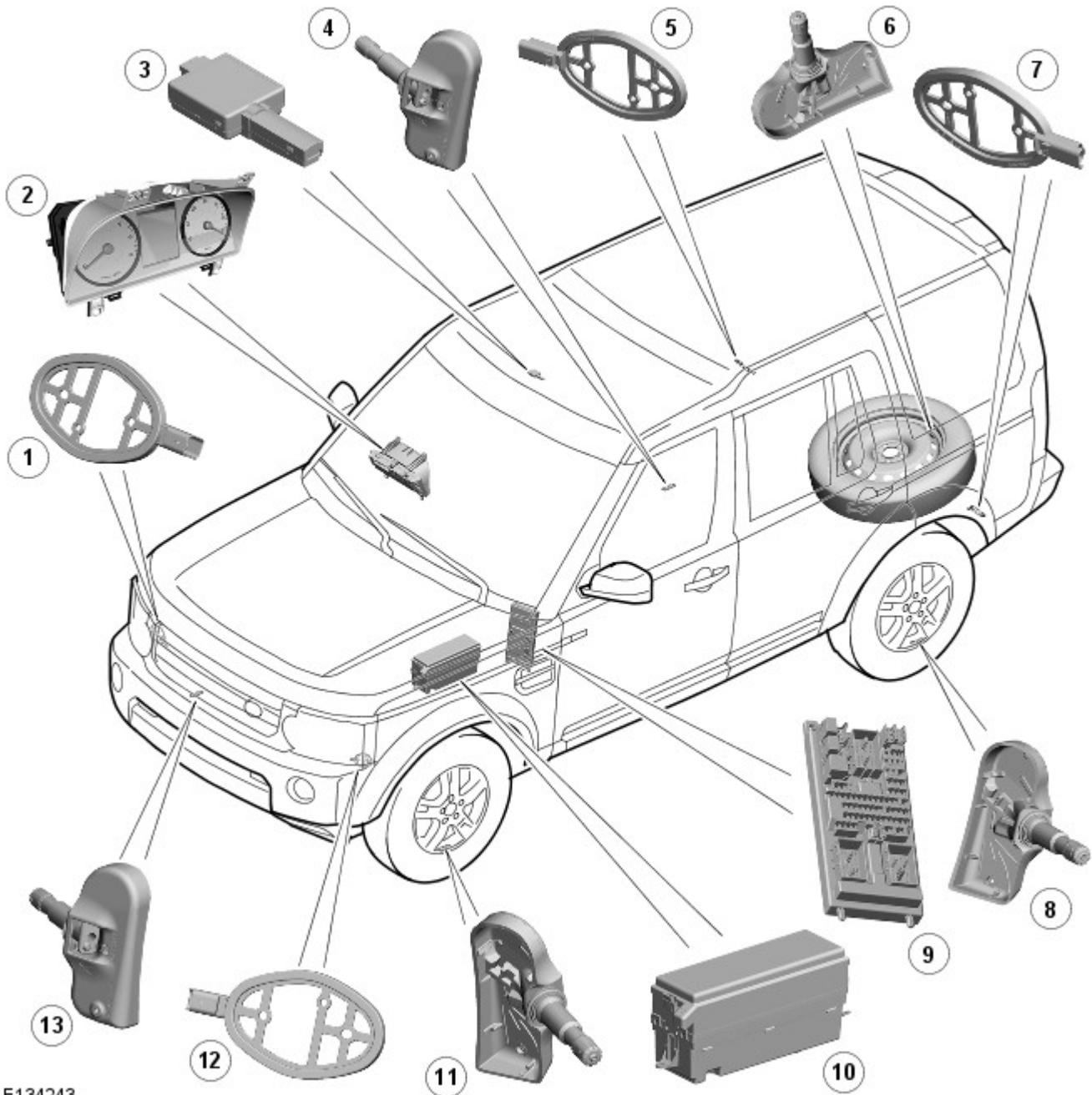
This label must not be removed from the vehicle. The label information will only define the specification of the vehicle as it came off the production line. It will not include dealer or owner fitted accessory wheels and tires of differing size from the original fitment.

• **NOTE:** If tires and wheels of a non-standard size are fitted to the vehicle, the car configuration file must be updated using a Land Rover approved diagnostic system.

If the label is damaged or removed for body repair, it must be replaced with a new label specific to that vehicle. A new label is requested from Land Rover parts and will be printed specifically for the supplied VIN of the vehicle.

TIRE PRESSURE MONITORING SYSTEM (TPMS)

Tire Pressure Monitoring System - Component Location



E134243

Item	Part Number	Description
1	-	RH (right-hand) front initiator
2	-	Instrument cluster
3	-	TPMS RF receiver
4	-	RH rear tire pressure sensor
5	-	RH rear initiator
6	-	Spare tire pressure sensor
7	-	LH (left-hand) rear initiator
8	-	LH rear tire pressure sensor
9	-	CJB (central junction box)
10	-	EJB (engine junction box)
11	-	LH front tire pressure sensor
12	-	LH front initiator
13	-	RH front tire pressure sensor

The purpose of the Tire Pressure Monitoring System (TPMS) is to assist the driver in maintaining the vehicle's tire pressures at the optimum level in order to:

- improve fuel consumption
- maintain ride and handling characteristics
- reduce the risk of rapid tire deflation – which may be caused by under inflated tires
- comply with legislation in relevant markets.

The TPMS measures the pressure in each of the tires on the vehicle (including the spare, if required) and issues warnings to the driver if any of the pressures deviate from defined tolerances.

• **NOTE:** During a 'blow out' a very rapid reduction in pressure is experienced. The system is not intended to warn the driver of a 'blow out', since it is not possible to give the driver sufficient warning that such an event is occurring, due to its

short duration. The design of the TPMS is to assist the driver in keeping the tires at the correct pressure, which will tend to reduce the likelihood of a tire 'blow out' occurring.

• **NOTE:** TPMS is inhibited when the vehicle is in Delivery mode. For more details on Delivery mode refer to the PDI manual.

A single TPMS hardware configuration is used. TPMS status information is relayed to the driver with a message displayed in the instrument cluster message center and a amber warning indicator.

Tire Location

Because of the requirement for different pressure targets and thresholds for the front and rear tires, the [CJB](#) can identify the location of the tires on the vehicle, and assign a received tire pressure sensor identification to a specific position on the vehicle (i.e. FL (front left), FR (front right), RL (rear left) or RR (rear right)).

Tire location is performed automatically by the [CJB](#) using an auto-location function. This function requires no manual intervention by the driver. The [CJB](#) can automatically learn the position of tires on the vehicle if the tire pressure sensors or their positions are changed on the vehicle.

The tire learn and location process is ready to commence when the vehicle has been stationary or is traveling at less than 12 mph (20 km/h) for 15 minutes. This is known as 'parking mode'. The learn/locate process requires the vehicle to be driven at speeds of more than 12 mph (20 km/h) for 15 minutes. If the vehicle speed reduces to below 12 mph (20 km/h), the learn process timer is suspended until the vehicle speed increases to more than 12 mph (20 km/h), after which time the timer is resumed. If the vehicle speed remains below 12 mph (20 km/h) for more than 15 minutes, the timer is set to zero and process starts again.

The [CJB](#) can automatically detect, under all operating conditions, the following:

- one or more tire pressure sensors have been replaced
- one or more tire pressure sensor identifications are missing
- one or more 'alien' identifications are being received, i.e. the [CJB](#) can reject identifications from tire pressure sensors that do not belong to the vehicle
- the spare tire and one of the tires in use on the vehicle have exchanged position on the vehicle.

If the tire pressure sensors fitted to the running wheels (not the spare) are changed, the [CJB](#) can learn the new sensor identifications automatically. The learn function requires no manual intervention by the driver.

If a new sensor is fitted to the spare tire it must have its identification code programmed into the [CJB](#) using a Land Rover approved diagnostic system, or used on the vehicle as a 'running' wheel and the vehicle driven for 15 minutes at more than 12.5 mph (20 km/h).

Spare Tire Identification

Depending on the vehicle specification, the spare tire may or may not be fitted with a tire pressure sensor.

• **NOTE:** Tire pressure sensors cannot be fitted to steel space saver spare wheels.

If the spare tire is fitted with a tire pressure sensor, the [CJB](#) can detect it, determine that it is the spare tire and monitor its pressure and issue warnings to the driver accordingly. If the [CJB](#) expects the spare tire to be fitted with a tire pressure sensor and it does not, the [CJB](#) will not show a fault to the driver, however a fault code will be stored in the [CJB](#).

If the spare tire is being monitored and the driver replaces a flat 'running' tire with the spare tire, the [CJB](#) will not continually warn the driver that the original flat tire (now in the spare position) is flat. This prevents distraction of the driver by constant pressure warnings being issued. The driver is reminded by a message displayed for 20 seconds at each ignition on cycle that the spare tire is flat.

System Operation

Each time the vehicle is driven, the [CJB](#) transmits a Low Frequency (LF) (125 KHz) signal to each initiator in turn. This is received by the tire pressure sensor which transmits a Radio Frequency (RF) (315 or 433 MHz depending on market) signal to the RF receiver. This signal contains coded data which corresponds to sensor identification, air pressure, air temperature and acceleration data. This signal is communicated to the [CJB](#) via a K-bus line.

The system enters 'parking mode' after the vehicle speed has been less than 12.5 mph (20 km/h) for 12 minutes. In parking mode the tire pressure sensors transmit a coded signal to the [CJB](#) once every 13 hours. If the tire pressure decreases by more than 1 lbf/in² (0.6 bar) the sensor will transmit more often if pressure is being lost.

The spare tire sensor transmits a signal every 13 hours in the same manner as the road wheels when in parking mode. If the tire pressure decreases by more than 1 lbf/in² (0.6 bar) the sensor will transmit more often if pressure is being lost.

As each wheel responds to the LF signal from the [CJB](#), it is assigned a position on the vehicle and is monitored for the remainder of that drive cycle in that position.

When the vehicle has been parked for more than 15 minutes and then driven at a speed of more than 12.5 mph (20 km/h), the initiators fire in turn for 18 seconds in the following order:

- Front left
- 6 second pause (for the to detect a response from the tire pressure sensor)
- Front right
- 6 second pause
- Rear right
- 6 second pause
- Rear left
- 6 second pause.

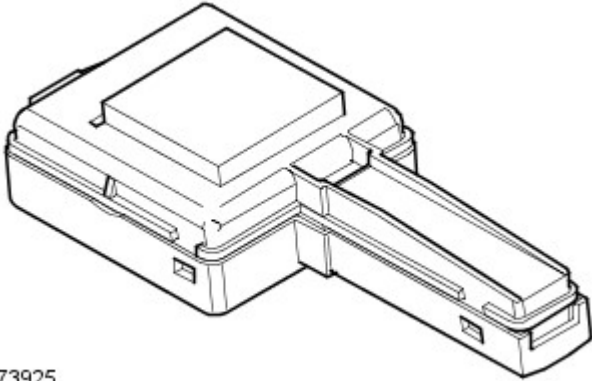
Each tire pressure sensor responds in turn so the [CJB](#) can establish the sensor positions at the start of the drive cycle.

This process is repeated up to three times but less if the sensor positions are already known in the [CJB](#). The process is known as 'Auto Location' and takes 7 to 8 minutes to complete. During this period the tire sensors transmit at regular intervals, once every 15 seconds. For the remainder of the drive cycle the tire sensors transmit once every 60 seconds or if a change in tire pressure is sensed until the vehicle stops and the system returns to parking mode.

Once the wheel position is established, the initiators stop firing a signal and do not fire again until the vehicle has been parked for more than 15 minutes. The signal transmissions from each wheel sensor continue at 1 minute intervals whilst the vehicle is being driven. This transmission is to monitor the tire pressure.

At 25% deflation the amber warning indicator in the instrument cluster is illuminated and an appropriate message displayed in the message center.

RF Receiver

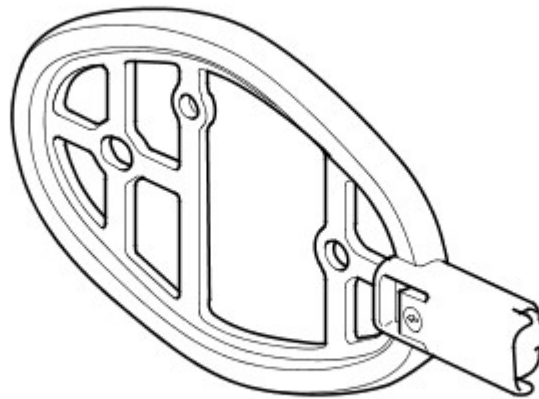


E73925

The RF receiver is mounted behind the overhead console and connects to the vehicle harness via a fly lead.

The RF receiver receives transmissions from each of the tire pressure sensors via an internal antenna. This information is then communicated to the [CJB](#) via a dedicated Local Interconnect Network (K-bus).

Initiator



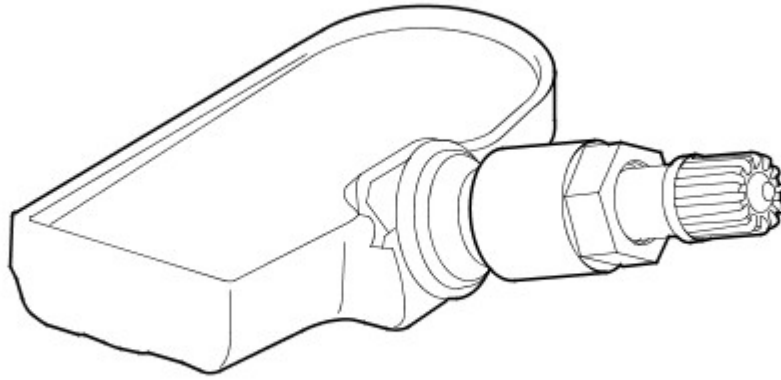
E45552

The initiators are located at the front of the front wheel arches and at the rear of the rear wheel arches and are secured with two scrivenets. The TPMS has four initiators and each has a connector which connects with the body harness.

The initiator is a passive, Low Frequency (LF) transmitter. Each initiator provides an auto-location feature to identify tire positions on the vehicle and transmit that data to the [CJB](#).

The [CJB](#) energizes each initiator in turn using LF drivers. The corresponding tire pressure sensor detects the resulting LF transmission and responds by initiating an RF transmission of its data. This data is received by the RF receiver and communicated to the [CJB](#) via a K-bus. The [CJB](#) can then determine which sensor is transmitting and its location on the vehicle.

Tire Pressure Sensor



E45553

The TPMS system uses 'active' tire pressure sensors which are mounted on each wheel, inside the tire cavity. The sensor is retained in position by the valve attachment to the wheel structure. The sensors transmit their RF signals at either 315 MHz or 433 MHz dependent on market requirements.

The sensors periodically measure the pressure and temperature of the air inside the tire plus the centripetal acceleration acting on the sensor. These measurements are transmitted periodically to the RF receiver located behind the overhead console.

The tire pressure sensors are self-contained units which have no electrical connections into or out of the sensor.

The care points detailed in the 'Tires' section of this chapter must be followed to avoid damage to the sensor. If the sensor is replaced, the nut, seal and washer must also be replaced and the sensor tightened to the correct torque value as given in the Service Repair manual.

The RF transmission from the sensor contains a unique identification code in its transmission data, so that the [CJB](#) can identify the tire on the vehicle. If the sensor is replaced on a 'running' wheel, the new sensor identification will be learnt when the vehicle is first driven at a speed of more than 12.5 mph (20 km/h) for 15 minutes. If a new sensor is fitted to the spare wheel, the identification for that sensor must be programmed into the [CJB](#) using a Land Rover approved diagnostic system or that wheel will not be monitored. The code is provided on a label with the complete wheel and tire assembly when new and is also printed on the casing of each sensor.

The replacement spare wheel may also be programmed to the vehicle by using it as a 'running' wheel for 15 minutes at more than 12.5 mph (20 km/h), then replacing it to the spare wheel position.

In order to conserve battery power, the tire sensor module uses different transmission rates when the wheel is stationary or moving. The wheel speed required to change between the stationary and moving transmission rates is very low to allow for the requirement for slow off-road driving.

Instrument Cluster Indications



E134246

Item	Part Number	Description
1	-	Message center
2	-	Amber warning indicator

The warning indications to the driver are common on all vehicles fitted with TPMS. Warnings are conveyed by an amber light emitting diode (LED) warning indicator and a text message displayed in the message center.

The warning indicator and message center are driven by CAN messages from the [CJB](#). The warning indicator is illuminated by the cluster software for 3 seconds when the vehicle is in power mode 6 for a bulb check.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Controller Area Network (CAN)

The [CJB](#) sends and receives a number of digital messages via the medium speed controller area network (CAN). The received messages are used for the operation of the TPMS. The transmitted messages comprise of TPMS status and requests to the instrument cluster to illuminate warnings indicators and/or display messages in the message center.

Transmitted Messages

The [CJB](#) transmits the messages shown in the following table.

Message	Received By
TPMS diagnostic response	A Land Rover approved diagnostic system.
TPMS amber warning indicator request at 25% tire deflation	Instrument cluster
TPMS message display request	Instrument cluster

Diagnostics

The [CJB](#) has a diagnostic connection via the medium speed CAN to enable system status and faults to be retrieved using a Land Rover approved diagnostic system.

Additionally, an on-board diagnostic routine within the [CJB](#) constantly monitors the system and alerts the driver to system faults by illuminating the amber warning indicator and/or displaying a message in the instrument cluster message center.

Fault Detection

If a sensor fails, the amber warning indicator in the instrument cluster will be illuminated. A message 'XX Tyre Not Monitored' will be displayed in the message center in addition to the amber warning indicator.

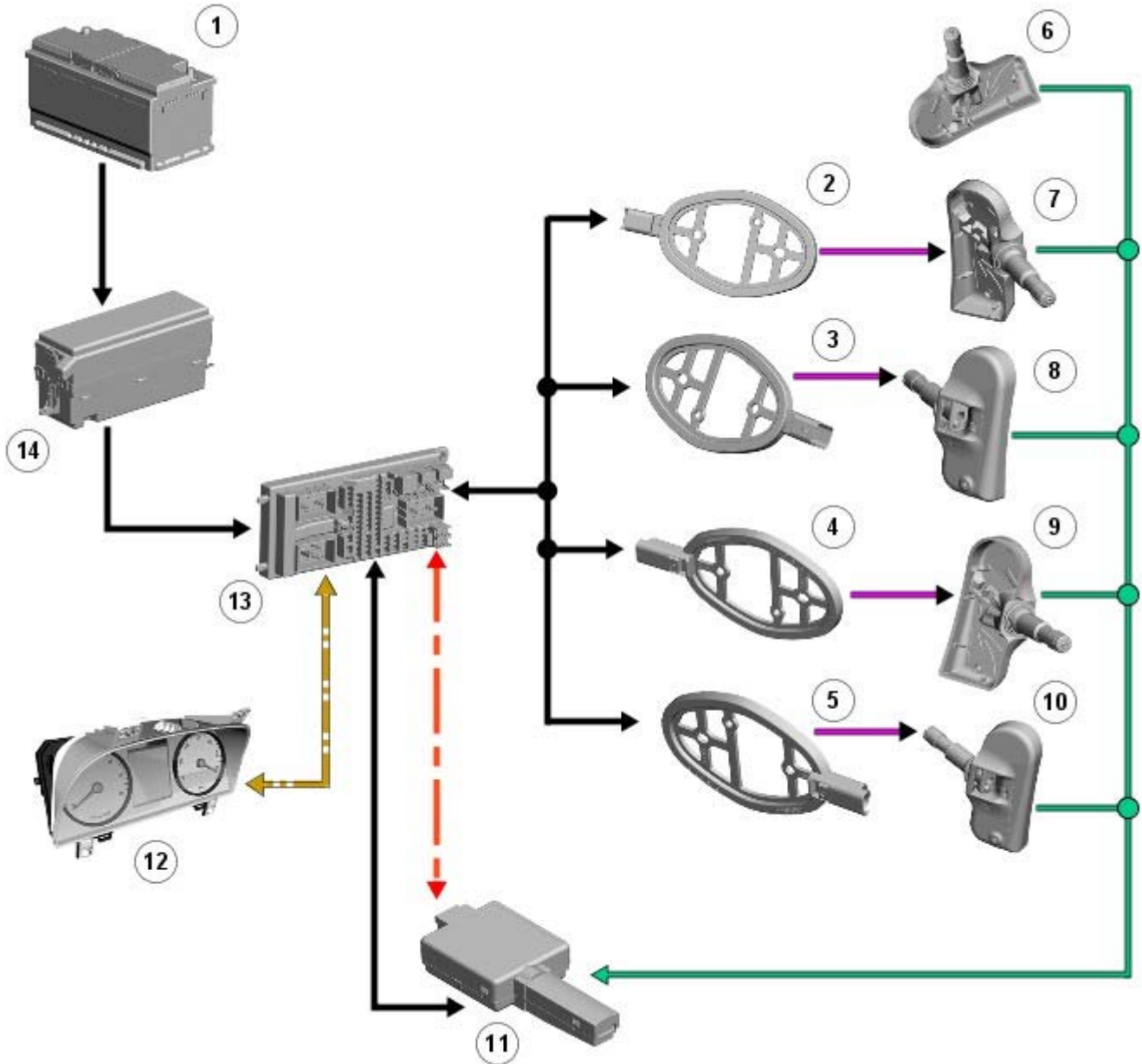
- **NOTE:** 'XX' is the tire position on the vehicle, e.g. FL (front left), FR (front right), RL (rear left) or RR (rear right).

If more than one sensor fails or the [CJB](#) develops a fault, the amber warning indicator will be illuminated. A message 'Tyre Monitoring System Fault' will be displayed in the message center in addition to the amber warning indicator. This fault could also be caused if RF interference near the vehicle affects the system signal reception. When the interference has ceased, the fault will be automatically cancelled and the TPMS will operate normally.

If a tire pressure sensor battery voltage becomes low, the sensor transmits a message to the [CJB](#). The [CJB](#) stores the low battery condition as a fault flag in its memory with no other visual warnings displayed. If the battery fails, the sensor will stop transmitting and the [CJB](#) will transmit a message to display 'FL Tyre Not Monitored' for example in the message center. The dealer should interrogate the [CJB](#) for the fault flag using a Land Rover approved diagnostic system to determine the cause of the message. If the battery has failed, the sensor must be replaced and the stored fault flags removed using a Land Rover approved diagnostic system. The [CJB](#) will learn the identification of the new sensor when the vehicle is driven. If the replaced sensor is fitted to the spare wheel (if fitted), its identification must be manually programmed into the [CJB](#) using a Land Rover approved diagnostic system or by using it as a 'running' wheel for 15 minutes at more than 12.5 mph (20 km/h), then replacing it to the spare wheel position.

CONTROL DIAGRAM

• NOTE: **A** = Hardwired; **B** = K-Bus; **F** = RF Transmission; **N** = Medium Speed CAN Bus; **W** = LF Transmission



E134245



Item	Part Number	Description
1	-	Battery
2	-	RH rear initiator
3	-	LH rear initiator
4	-	RH front initiator
5	-	LH front initiator
6	-	Spare tire pressure sensor
7	-	RH rear tire pressure sensor
8	-	LH rear tire pressure sensor
9	-	RH front tire pressure sensor
10	-	LH front tire pressure sensor
11	-	TPMS RF receiver

12	-	Instrument Cluster
13	-	CJB
14	-	EJB

Wheels and Tires - Wheels and Tires

Diagnosis and Testing

Principles of Operation

For a detailed description of the wheels and tires, refer to the relevant Description and Operation section in the workshop manual.

REFER to: [Wheels and Tires](#) (204-04 Wheels and Tires, Description and Operation) / [Wheels and Tires](#) (204-04, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

1. **1.** Verify the customer complaint. As much information as possible should be gathered from the driver to assist in diagnosing the cause(s). Confirm which of the following two warning types (A or B) exist for the Tire Pressure Monitoring System when the ignition status is switched from 'OFF' to 'ON'
 - **(A) Check Tire Pressure Warnings.** A low tire pressure warning will **continuously** illuminate the low tire pressure warning lamp. This warning may be accompanied by a text message such as CHECK TIRE PRESSURE (refer to owner literature). The manufacturer approved diagnostic system does NOT need to be used. Diagnostic Trouble Codes (DTCs) are not generated with this type of warning. To extinguish this warning it is essential that, with the ignition 'ON', all vehicle tires (including the spare) are to be set to the correct pressure as stated in the vehicle handbook or as indicated on the placard label in the passenger/driver door aperture. **It is not necessary to drive the vehicle to clear 'check tire pressure' warnings - just changing the tire pressure causes the tire low pressure sensor to transmit new data.**
 - **NOTE:** The tire pressures should be set by:
 - Using a calibrated tire pressure gauge
 - With 'cold' tires (vehicle parked in the ambient temperature for at least one hour, not in a garage with an artificial ambient temperature)
 - **NOTE:** If the tire pressure warning does not clear within two minutes, it is likely that the gauge is not correctly calibrated or the tires are 'warm'. Carry out the following steps until the warning has cleared:
 - Rotate wheels approximately 180 degrees
 - Increase the tire pressures by 3psi
 - Wait a further two minutes
 - When the tires are at ambient temperature and a **calibrated** gauge is available, reset the tire pressures to the correct pressure.
 - **NOTE:** Tire pressure adjustments are part of routine owner maintenance. Tire pressure adjustments that are required due to a lack of owner maintenance are not to be claimed under vehicle warranty.
 - **(B) System Fault Warnings.** When a system fault is detected, the low tire pressure warning lamp will flash for approximately 75 seconds prior to being continuously illuminated. Visually inspect wheel arch Tire Pressure Monitoring System Antennas and check for system DTCs. External visual damage to the tire low pressure sensors and air leaks will not cause system fault warnings (note: nut and seal system should be replaced at each tyre change using the available service kit). Check for the presence of tire low pressure sensors on all four wheels (note: a tire low pressure sensor has a metal valve stem rather than a rubber one).
2. **2.** Check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Pinpoint Tests

PINPOINT TEST A : U201F11 TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO GROUND							
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS						
A1: U201F11 VERIFY EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO GROUND							
	<ol style="list-style-type: none"> 1 Ignition OFF. 2 Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875. 3 Measure the resistance between <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>C2875, harness side</th> <th>Battery</th> </tr> </thead> <tbody> <tr> <td>Pin 1</td> <td></td> <td>Negative terminal</td> </tr> </tbody> </table> 		C2875, harness side	Battery	Pin 1		Negative terminal
	C2875, harness side	Battery					
Pin 1		Negative terminal					
	Is the resistance less than 5 Ohms? Yes GO to A2. No GO to A3.						
A2: U201F11 CHECK THE EXTERNAL RECEIVER DATA LINE CIRCUIT FOR SHORT CIRCUIT TO GROUND							
	<ol style="list-style-type: none"> 1 Disconnect the Body Control Module electrical connector, C0580. 						

	<table border="1"> <tr> <td>2</td> <td>Measure the resistance between</td> <td></td> </tr> <tr> <td></td> <td>C2875, harness side</td> <td>Battery</td> </tr> <tr> <td>Pin 1</td> <td></td> <td>Negative terminal</td> </tr> </table>	2	Measure the resistance between			C2875, harness side	Battery	Pin 1		Negative terminal
2	Measure the resistance between									
	C2875, harness side	Battery								
Pin 1		Negative terminal								
	<p>Is the resistance less than 5 Ohms? Yes REPAIR the short circuit in wiring harness. No GO to A4.</p>									
A3: U201F11 CHECK THE TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER FOR SHORT CIRCUIT TO GROUND										
	<table border="1"> <tr> <td>1</td> <td>Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.</td> </tr> <tr> <td>2</td> <td>Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).</td> </tr> </table>	1	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	2	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .					
1	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.									
2	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .									
	<p>Is the DTC U201F11 set? Yes Replace Tire Pressure Monitoring Receiver. No Investigate possible cause of intermittent failure.</p>									
A4: U201F11 CHECK THE BODY CONTROL MODULE FOR SHORT CIRCUIT TO GROUND										
	<table border="1"> <tr> <td>1</td> <td>Reconnect the Body Control Module electrical connector, C0580.</td> </tr> <tr> <td>2</td> <td>Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.</td> </tr> <tr> <td>3</td> <td>Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).</td> </tr> </table>	1	Reconnect the Body Control Module electrical connector, C0580.	2	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	3	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .			
1	Reconnect the Body Control Module electrical connector, C0580.									
2	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.									
3	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .									
	<p>Is the DTC U201F11 set? Yes Replace Body Control Module. No Investigate possible cause of intermittent failure.</p>									

PINPOINT TEST B : U201F12 TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO POWER

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS												
B1: U201F12 VERIFY EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO POWER													
	<table border="1"> <tr> <td>1</td> <td>Ignition OFF.</td> </tr> <tr> <td>2</td> <td>Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.</td> </tr> <tr> <td>3</td> <td>Measure the resistance between</td> </tr> <tr> <td></td> <td>C2875, harness side</td> <td>Battery</td> </tr> <tr> <td>Pin 1</td> <td></td> <td>Positive terminal</td> </tr> </table>	1	Ignition OFF.	2	Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	3	Measure the resistance between		C2875, harness side	Battery	Pin 1		Positive terminal
1	Ignition OFF.												
2	Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.												
3	Measure the resistance between												
	C2875, harness side	Battery											
Pin 1		Positive terminal											
	<p>Is the resistance less than 5 Ohms? Yes GO to B2. No GO to B3.</p>												
B2: U201F12 CHECK THE EXTERNAL RECEIVER DATA LINE CIRCUIT FOR SHORT CIRCUIT TO POWER													
	<table border="1"> <tr> <td>1</td> <td>Disconnect the Body Control Module electrical connector, C0580.</td> </tr> <tr> <td>2</td> <td>Measure the resistance between</td> </tr> <tr> <td></td> <td>C2875, harness side</td> <td>Battery</td> </tr> <tr> <td>Pin 1</td> <td></td> <td>Positive terminal</td> </tr> </table>	1	Disconnect the Body Control Module electrical connector, C0580.	2	Measure the resistance between		C2875, harness side	Battery	Pin 1		Positive terminal		
1	Disconnect the Body Control Module electrical connector, C0580.												
2	Measure the resistance between												
	C2875, harness side	Battery											
Pin 1		Positive terminal											
	<p>Is the resistance less than 5 Ohms? Yes REPAIR the short circuit in wiring harness. No GO to B4.</p>												
B3: U201F12 CHECK THE TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER FOR SHORT CIRCUIT TO POWER													
	<table border="1"> <tr> <td>1</td> <td>Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.</td> </tr> <tr> <td>2</td> <td>Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).</td> </tr> </table>	1	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	2	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .								
1	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.												
2	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .												
	<p>Is the DTC U201F12 set? Yes Replace Tire Pressure Monitoring Receiver. No Investigate possible cause of intermittent failure.</p>												
B4: U201F12 CHECK THE BODY CONTROL MODULE FOR SHORT CIRCUIT TO POWER													
	<table border="1"> <tr> <td>1</td> <td>Reconnect the Body Control Module electrical connector, C0580.</td> </tr> <tr> <td>2</td> <td>Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.</td> </tr> <tr> <td>3</td> <td>Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).</td> </tr> </table>	1	Reconnect the Body Control Module electrical connector, C0580.	2	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	3	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .						
1	Reconnect the Body Control Module electrical connector, C0580.												
2	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.												
3	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .												
	<p>Is the DTC U201F12 set? Yes Replace Body Control Module. No Investigate possible cause of intermittent failure.</p>												

PINPOINT TEST C : U201F87 TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER DATA LINE MISSING MESSAGE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS		
C1: U201F87 VERIFY EXTERNAL RECEIVER DATA LINE MISSING MESSAGE			
	<table border="1"> <tr> <td>1</td> <td>Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).</td> </tr> </table>	1	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).
1	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).		

	Is the DTC U201F87 set? Yes GO to C2. No Investigate possible cause of intermittent failure.																
C2: U201F87 CHECK EXTERNAL RECEIVER DATA LINE CIRCUIT																	
	<table border="1"> <tr> <td>1</td> <td>Ignition OFF.</td> </tr> <tr> <td>2</td> <td>Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.</td> </tr> <tr> <td>3</td> <td>Disconnect the Body Control Module electrical connector, C0580.</td> </tr> <tr> <td>4</td> <td>Measure the resistance between</td> </tr> <tr> <td></td> <td> <table border="1"> <tr> <td></td> <td>C2875, harness side</td> <td>C0580, harness side</td> </tr> <tr> <td>Pin 1</td> <td></td> <td>Pin 25</td> </tr> </table> </td> </tr> </table>	1	Ignition OFF.	2	Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	3	Disconnect the Body Control Module electrical connector, C0580.	4	Measure the resistance between		<table border="1"> <tr> <td></td> <td>C2875, harness side</td> <td>C0580, harness side</td> </tr> <tr> <td>Pin 1</td> <td></td> <td>Pin 25</td> </tr> </table>		C2875, harness side	C0580, harness side	Pin 1		Pin 25
1	Ignition OFF.																
2	Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.																
3	Disconnect the Body Control Module electrical connector, C0580.																
4	Measure the resistance between																
	<table border="1"> <tr> <td></td> <td>C2875, harness side</td> <td>C0580, harness side</td> </tr> <tr> <td>Pin 1</td> <td></td> <td>Pin 25</td> </tr> </table>		C2875, harness side	C0580, harness side	Pin 1		Pin 25										
	C2875, harness side	C0580, harness side															
Pin 1		Pin 25															
	Is the resistance less than 5 ohms? Yes GO to C3. No REPAIR the high resistance/open circuit in wiring harness.																
C3: U201F87 CHECK EXTERNAL RECEIVER																	
	<table border="1"> <tr> <td>1</td> <td>Reconnect the Body Control Module electrical connector, C0580.</td> </tr> <tr> <td>2</td> <td>Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.</td> </tr> <tr> <td>3</td> <td>Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).</td> </tr> </table>	1	Reconnect the Body Control Module electrical connector, C0580.	2	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	3	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .										
1	Reconnect the Body Control Module electrical connector, C0580.																
2	Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.																
3	Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .																
	Is the DTC U201F87 set? Yes Replace Tire Pressure Monitoring Receiver. GO to C4. No Investigate possible cause of intermittent failure.																
C4: U201F87 CHECK BODY CONTROL MODULE.																	
	1 Using manufacturer approved diagnostic system run On Demand Self Test (0x0202) .																
	Is the DTC U201F87 set? Yes Replace Body Control Module. No Test is complete. No further action is required.																

PINPOINT TEST D : C1A5693, C1A5893, C1A6093, C1A6293 DEFECTIVE RUNNING TIRE LOW PRESSURE SENSOR OR RECEIVER

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: C1A5693, C1A5893, C1A6093, C1A6293 CHECK FOR ADDITIONAL DTCS	
	1 Using manufacturer approved diagnostic system check for additional DTCs C1A5693, C1A5893, C1A6093, C1A6293, with identical time stamps.
	Have all four DTCs logged with identical time stamps in the Body Control module? Yes Diagnose and fix DTCs related to the tire pressure monitoring receiver. No Using manufacturer approved diagnostic system, perform diagnostic routine to verify reception of all tire low pressure sensors, by carrying out 'TPMS wheel unit & receiver reception test' from set up and configuration application and complete remedial actions.

PINPOINT TEST E : C1D1800 LOCALIZATION FAILURE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: C1D1800 ESTABLISH THE LOCATIONS OF THE TIRE LOW PRESSURE SENSOR LOCALIZATION FAILURES	
	<ul style="list-style-type: none"> NOTE: To clear or reset information read in datalogger signal 'Unsuccessful wheel position triggering statistic' (0x4149) Use manufacturer approved diagnostic system and carry out 'Reset/ Clear Specified Function' (0x040E) from Special Applications. 1 Using manufacturer approved diagnostic system read datalogger signal 'Unsuccessful wheel position triggering statistic' (0x4149) to establish the locations of the tire low pressure sensor localization failures.
	Have the locations of the tire low pressure sensor localization failures been identified? Yes GO to E2. No Investigate possible cause of intermittent failure.
E2: C1D1800 CHECK FOR ADDITIONAL LF INITIATOR CIRCUIT DTCS	
	1 Using manufacturer approved diagnostic system check for additional DTCs C1A5712, C1A5714, C1A5912, C1A5914, C1A6112, C1A6114, C1A6312, C1A6314.
	Are any of the following DTCs logged C1A5712, C1A5714, C1A5912, C1A5914, C1A6112, C1A6114, C1A6312, C1A6314? Yes Refer to the DTC Index. Check for possible causes for each of the logged DTCs and carry out the repair operations specified. No GO to E3.
E3: C1D1800 CHECK FOR ADDITIONAL TIRE LOW PRESSURE SENSOR DTCS	
	1 Using manufacturer approved diagnostic system check for additional DTCs C1A5693, C1A5893, C1A6093, C1A6293, C1D2105.

	<p>Are any of the following DTCs logged C1A5693, C1A5893, C1A6093, C1A6293, C1D2105?</p> <p>Yes Refer to the DTC Index. Check for possible causes for each of the logged DTCs and carry out the repair operations specified.</p> <p>No GO to E4.</p>
E4: C1D1800 CHECK INITIATORS ARE CORRECTLY INSTALLED	
	<p>1 Check for correct installation of Initiators for the locations identified. REFER to: (204-04 Wheels and Tires) Tire Pressure Monitoring System (TPMS) Front Antenna (Removal and Installation), Tire Pressure Monitoring System (TPMS) Rear Antenna (Removal and Installation).</p>
	<p>Are the Initiators correctly installed?</p> <p>Yes GO to E5.</p> <p>No Install Initiators to the correct locations.</p>
E5: C1D1800 CHECK FOR SHORT CIRCUIT IN INITIATOR HARNESS	
	1 Ignition OFF.
	2 Disconnect the Body Control Module electrical connector, C0584 (Front LF Initiators).
	3 Disconnect the Body Control Module electrical connector, C0586 (Rear LF Initiators).
	4 Measure the resistance of Front Right Hand Initiator.
	C0584, harness side
	C0584, harness side
	Pin 1
	Pin 2
	5 Measure the resistance of Front Left Hand Initiator.
	C0584, harness side
	C0584, harness side
	Pin 14
	Pin 15
	6 Measure the resistance of Rear Right Hand Initiator.
	C0586, harness side
	C0586, harness side
	Pin 30
	Pin 31
	7 Measure the resistance of Rear Left Hand Initiator.
	C0586, harness side
	C0586, harness side
	Pin 18
	Pin 19
	<p>Are any of the Initiator resistance measurements less than 1 Ohm?</p> <p>Yes REPAIR the short circuit as required.</p> <p>No Install the correct tire low pressure sensor, of correct frequency, in accordance with that defined in the manufacturer approved diagnostic system new tire low pressure sensor application, to the position(s) identified. REFER to: Tire Low Pressure Sensor (204-04 Wheels and Tires, Removal and Installation).</p>

PINPOINT TEST F : C1D2105 MISSING, INCOMPATIBLE OR DEFECTIVE RUNNING TIRE LOW PRESSURE SENSOR(S) OR RECEIVER

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
F1: C1D2105 CHECK FOR CORRECT WHEEL AND TIRE ASSEMBLY AND TIRE LOW PRESSURE SENSORS	
	<ul style="list-style-type: none"> NOTE: As a visual check, a tire low pressure sensor has a metal valve stem rather than a rubber one and cannot be installed to a mini or space saver spare wheel.
	1 Check that all full size running wheel and tire assemblies have tire low pressure sensors installed.
	<p>Is a full size wheel and tire assembly with tire low pressure sensor installed to all running wheel positions?</p> <p>Yes Using manufacturer approved diagnostic system, perform diagnostic routine to verify reception of all tire low pressure sensors, by carrying out 'TPMS wheel unit & receiver reception test' from set up and configuration application and complete remedial actions.</p> <p>No If agreed with the customer, install the correct wheel and tire assembly or tire low pressure sensor(s), of correct frequency, in accordance with that defined in the manufacturer approved diagnostic system new tire low pressure sensor application. (Note: If the datalogger signal 'Number Of Missing Tire Pressure Wheel Units' is 4 and the Instrument Panel Cluster displays text message 'Tire Pressure Monitoring Unavailable', the system has detected winter tire installation, as detailed in the owner's manual. Confirm why the vehicle has non-TPMS wheel & tire assemblies installed before installing tire low pressure sensors, which are not to be claimed under vehicle warranty.)</p>

Component Tests

Wheels and Tires

For wheel and tire specification information (pressures, torques, etc).
REFER to: [Specifications](#) (204-04 Wheels and Tires, Specifications).

When replacing wheels or tires, local legislation regarding health and safety must be complied with.

If the vehicle has a Tire Pressure Monitoring System installed, only manufacturer approved wheels and tires should be used. If the wheel and tire size is changed (for example from R18 to R20) the Tire Pressure Monitoring System module should be updated with the correct pressure information appropriate to the new wheel and tire set. Update the Tire Pressure Monitoring System module using the manufacturer approved diagnostic system.

As a general guideline, only replace tires in pairs or as a set, and only with tires of equivalent size and specification.

Confirm the symptoms of the customer complaint.

As much information as possible should be gathered from the driver to assist in diagnosing the cause(s).

1. Before a road test, carry out a basic inspection to make sure the vehicle is safe and legal to drive.

Basic inspection

- Correct tire inflation.
REFER to: [Specifications](#) (204-04 Wheels and Tires, Specifications).
- Legal tire tread depth
- Cuts/Bulges in tire sidewall(s)
- Tire ply separation
- Embedded objects
- Wheel rim damage
- Correct tire installation (specification, direction of rotation, etc)
- Any obvious distortion of the tire (flat/high spots)
- Worn/Damaged steering or suspension components

Road test

If the results of the basic inspection are acceptable, carry out a road test to confirm the symptoms.

To reproduce the symptoms, test the vehicle on similar roads to those on which the fault occurs and at similar speeds (provided it is legal to do so).

If the vibration or noise can be reproduced, note the speed at which it occurs and see if it is possible to drive through the symptom, meaning, is it possible to alter the fault by driving faster or slower than the speed at which it occurs?

If it **is** possible, it is likely that the fault is caused by an imbalance in the wheel or tire.

If the vibration or noise gets worse as the vehicle speed increases, it is likely that the fault is caused by distortion in the wheel or tire, or worn or damaged components.

Distortion checks

Check for distortion by raising the vehicle so that the wheels are free and placing an axle stand or similar fixed object next to each wheel in turn.

If the stand is placed at the tread of the tire, the tire can be checked for ovality by turning the wheel by hand and checking for high or low spots where the gap between the tread and the stand increases or reduces.


If the stand is placed next to the wheel rim or tire sidewall, the wheel and tire can be checked for run-out in a similar way.

Wheels and Tires - Tire Low Pressure Sensor

Removal and Installation


Removal

• NOTE: It is strongly recommended that the valve seal and steel washer is replaced each time a tire is changed to avoid a seal failure. The seal and washer must be replaced if the sensor is removed. Removal of the sensor retaining nut must be regarded as sensor removal. The valve cap must always be in place except when inflating, releasing pressure or checking pressure.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


2. Remove the wheel and tire.

3.  **CAUTION:** To avoid damage to the tire low pressure sensor, release the tire bead from the rim, 180 degrees from the valve.

Remove the tire from the wheel.

4. CAUTIONS:

-  Do not push on the valve.

-  If the tire low pressure sensor is to be re-installed, a new washer, seal and nut must be installed.

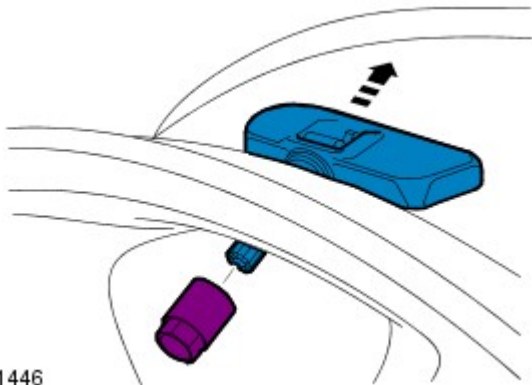
-  If the tire low pressure sensor is to be re-installed, a new washer, seal, nut and silver coloured nickel valve core must be installed.

Remove the tire low pressure sensor.

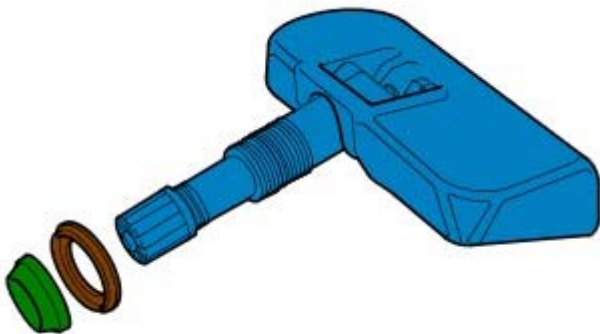
- Remove the nut.
- Release and withdraw the sensor along the valve axis.

5. If necessary, install a new seal and washer.

- Remove and discard the seal and washer.
- Install a new washer and seal, making sure the valve remains pressed fully onto its seat.




E51446

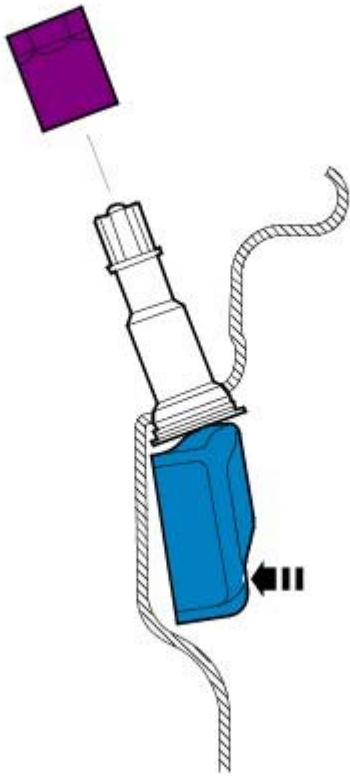


E51447


Installation

1.  **CAUTION:** Do not use compressed air to clean the sensor. Do not clean the sensor with solvents or cleaning agents of any type, use a clean dry cloth.

Clean the component mating faces.



E51449

2.  CAUTION: Do not apply any lubricant to the new valve.

• NOTE: If the sensor is replaced on a 'running' wheel, the new sensor identification will be learnt when the vehicle is first driven. If a new sensor is fitted to the spare wheel the identification for that sensor must be programmed into the Tire Pressure Monitoring System (TPMS) module using T4. The identification code is provided on a label with the complete assembly and is also printed on the casing of each sensor.

Install the tire low pressure sensor.

- Install and hand tighten the nut whilst keeping the sensor in place.
- Tighten the nut to 6.5 Nm (4.8 lb.ft).

3. Install the tire and balance the wheel.


4. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Wheels and Tires - Tire Pressure Monitoring System (TPMS) Front Antenna

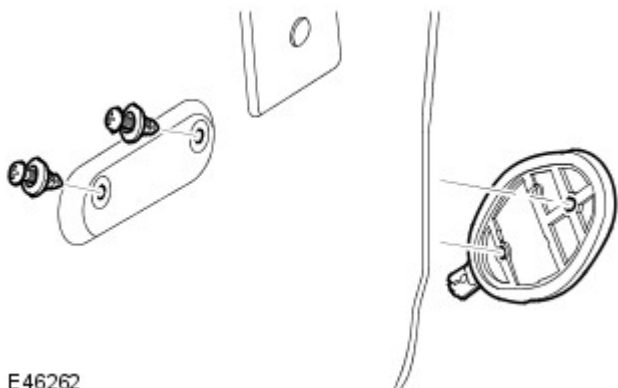
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the tire pressure antenna.
 - Remove the 2 retainers.



E46262

Installation

1. To install, reverse the removal procedure.
2. Initiate a new tire pressure antenna using T4.

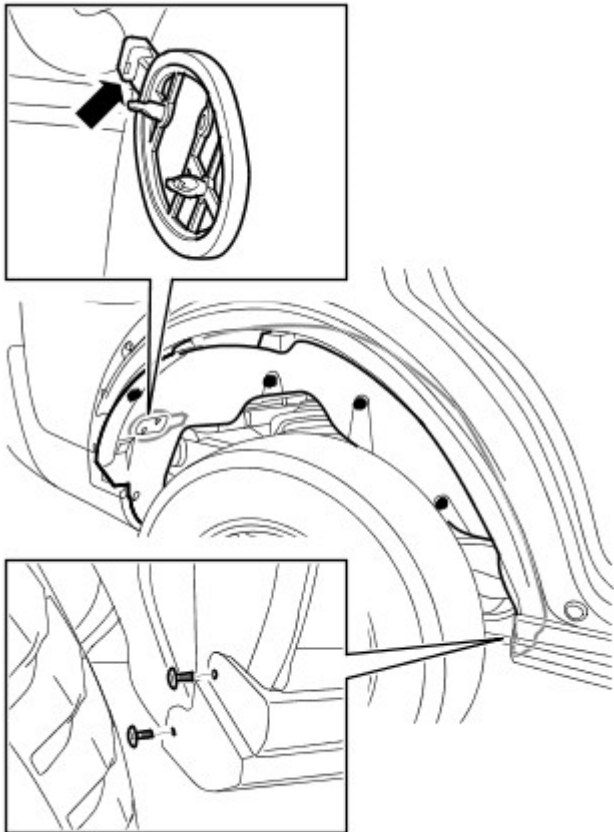
Wheels and Tires - Tire Pressure Monitoring System (TPMS) Rear Antenna

Removal and Installation

Removal

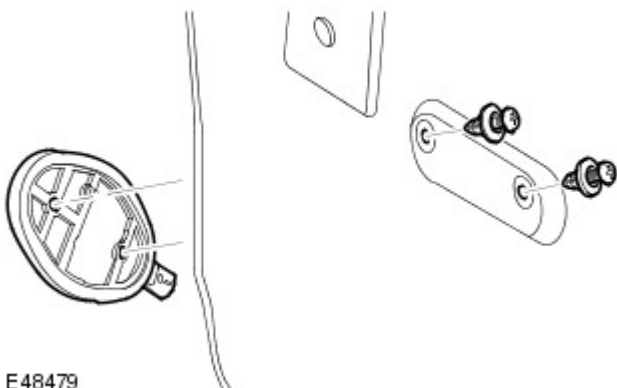
1. Remove the fender moulding.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

2. Remove the fender splash shield.
 - Remove the 2 screws.
 - Remove the 6 retainers.
 - Disconnect the electrical connector.



E48478

3. Remove the tire pressure antenna.
 - Remove the 2 retainers.



E48479

Installation

1. To install, reverse the removal procedure.
2. Initiate a new tire pressure antenna using T4.

Vehicle Dynamic Suspension -

Air Suspension - General Specification

Item	Specification
Ride height:	
Off road	55 mm (2.1 in) above standard
Access - reselectable whilst vehicle is moving	50 mm (1.9 in) below standard
Trim height	Configured using T4 plus special tools
Height sensors:	
Location	4 per vehicle - one sensor for each wheel
Height sensor arm colour coding:	
Left hand side, front and rear	WHITE
Right hand side, front and rear	BLACK
Height sensor operating voltages:	
Supply voltage	5 volts - supplied by air suspension ECU
Output voltage	Left hand front and right hand rear - Decreases to 0.5 volts with bump travel. Right hand front and left hand rear - Decreases to 4.5 volts with bump travel
Spring/damper modules:	
Type	Guided air spring surrounding twin tube damper
Pressures:	
Normal - Front	800 to 1000 kPa (8.0 to 10.0 bar) (116.0 to 145.0 lbf/in ²)
Normal - Rear	500 to 800 kPa (5.0 to 8.0 bar) (72.5 to 116.0 lbf/in ²)
Burst pressure	3500 kPa (35 bar) (507.5 lbf/in ²)
Maximum spring pressure - Full bump at gross vehicle weight	Approximately 2700 kPa (27 bar) (391.5 lbf/in ²)
Air compressor:	Supplied with air drier, electrically switched, pilot operated exhaust valve and double temperature sensors
Controlled by	ECU
Maximum pressure	1680 kPa (16.8 bar) (243.6 lbf/in ²)
Air reservoir:	
Volume	9 litres (0.31 cu.ft)
Working pressure	1750 kPa (17.5 bar) (253.75 lbf/in ²)
Maximum operating pressure	2300 kPa (23 bar) (333.5 lbf/in ²)
Reservoir valve block	Incorporates pressure sensor to monitor spring and air reservoir pressures
Valve blocks:	
Front	2 corner valves, 1 cross link valve - all mounted on front bumper armature
Rear	2 corner valves, 1 cross link valve - all mounted on left hand rear spring tower

General Specifications

Item	Specification
Gap between underside of the toe link rubber boot and the chassis bracket	10.0 mm (0.393 in)

Torque Specifications

Description	Nm	lb-ft
Air suspension compressor bolts	10	7
Air suspension compressor lower cover bolts	10	7
Voss connector to the front solenoid valve block	2.5	1.7
Voss connector to the front and rear air springs	3.5	2.6
Voss connector to the rear solenoid valve block	2.5	1.7
Voss connector to the air suspension reservoir	5	4
Voss connector to the air suspension reservoir solenoid valve block	2.5	1.7
Air suspension control module bolt	10	7
Air suspension reservoir bolts	23	17
* Stabilizer bar link nuts	115	85
Toe link bolt	175	129
Toe link inner ball joint retaining nut	133	98
Toe link nut	103	76
Toe link adjustment locking nut	130	96
Lower front arm camber adjusting bolt	275	203
Lower arm rear castor adjusting bolts	275	203
Track rod end locking nuts	53	39
Rear camber adjusting bolts	133	98
Front and rear air spring/shock absorber to the suspension turret nuts	63	46
Front and rear air spring/shock absorber to the lower suspension arm nut and bolt	300	221
* Front and rear air spring/shock absorber top nut	98	72
Heat shield bolts	10	7
* + Halfshaft nut	350	258
Wheel speed sensor bolt	10	7
Brake disc dust shield bolts	10	7
Wheel hub bolts	115	85
* Lower arm ball joint retaining nut	115	85
* Tie-rod end ball joint	76	56
Suspension height sensor Torx bolts	2.2	1.5
Road wheel nuts	140	103

* New nut must be fitted

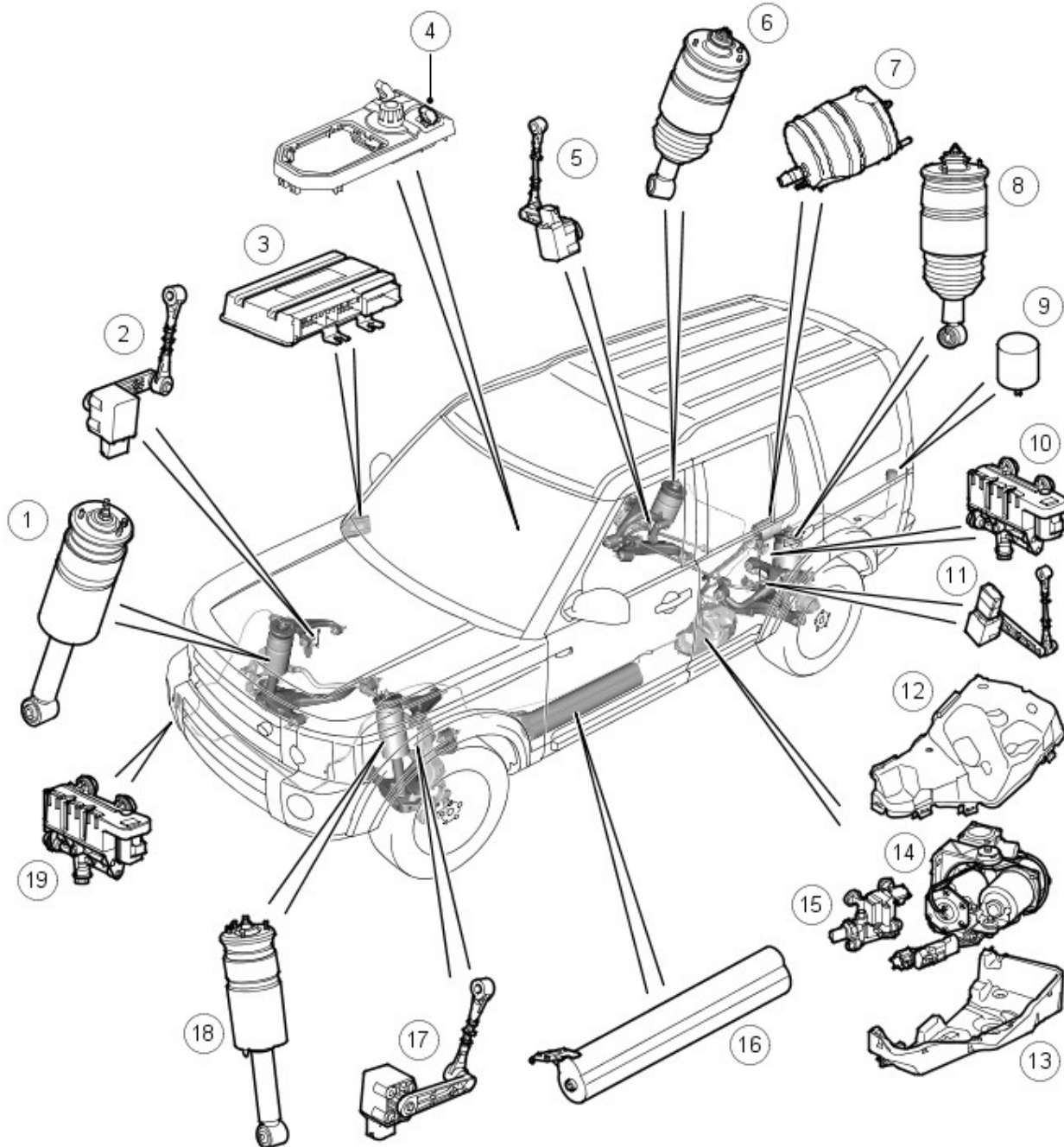
+ Stake nut on completion of tightening

Vehicle Dynamic Suspension - Vehicle Dynamic Suspension

Description and Operation

Dynamic Suspension - Component Location

• NOTE: Right hand drive vehicle shown



E45174

Item	Part Number	Description
1	-	Front RH air spring damper module
2	-	Front RH height sensor
3	-	Air suspension control module
4	-	Air suspension control switch
5	-	Rear RH height sensor
6	-	Rear RH air spring damper module
7	-	Air supply unit silencer

8	-	Rear LH air spring damper module
9	-	Air filter
10	-	Rear valve block
11	-	Rear LH height sensor
12	-	Upper acoustic cover
13	-	Lower acoustic cover
14	-	Air supply unit
15	-	Reservoir valve block
16	-	Air reservoir
17	-	Front LH height sensor
18	-	Front LH air spring damper module
19	-	Front valve block

GENERAL

- NOTE: This section covers the air suspension control system.

Front suspension is detailed in a separate section.

For additional information, refer to: [Front Suspension \(204-01 Front Suspension, Description and Operation\)](#).

Rear suspension is detailed in a separate section.

For additional information, refer to: [Rear Suspension \(204-02 Rear Suspension, Description and Operation\)](#).

Terrain Response™ is detailed in a separate section.

For additional information, refer to: [Ride and Handling Optimization \(204-06 Ride and Handling Optimization, Diagnosis and Testing\)](#).

The dynamic suspension system is a four corner air suspension system which is fitted to higher specification vehicles in place of the conventional damper and coil spring suspension used on non-air suspension models.

The dynamic suspension system is electronically controlled by an air suspension control module which controls the air supply unit, reacts to inputs from four height sensors and distributes air around the system via valve blocks.

The main air suspension system components are:

- Air suspension control module
- Air supply unit
- Four height sensors
- Three valve block assemblies
- Reservoir
- Air harness
- Four suspension air spring damper modules.

The four corner air suspension system maintains the vehicle height under all operating conditions by controlling the mass of air in the air springs. The air suspension control module uses signals from the four height sensors to maintain the correct suspension height. This is achieved by operating pneumatic control valves to increase or decrease the mass of air in the air spring damper modules.

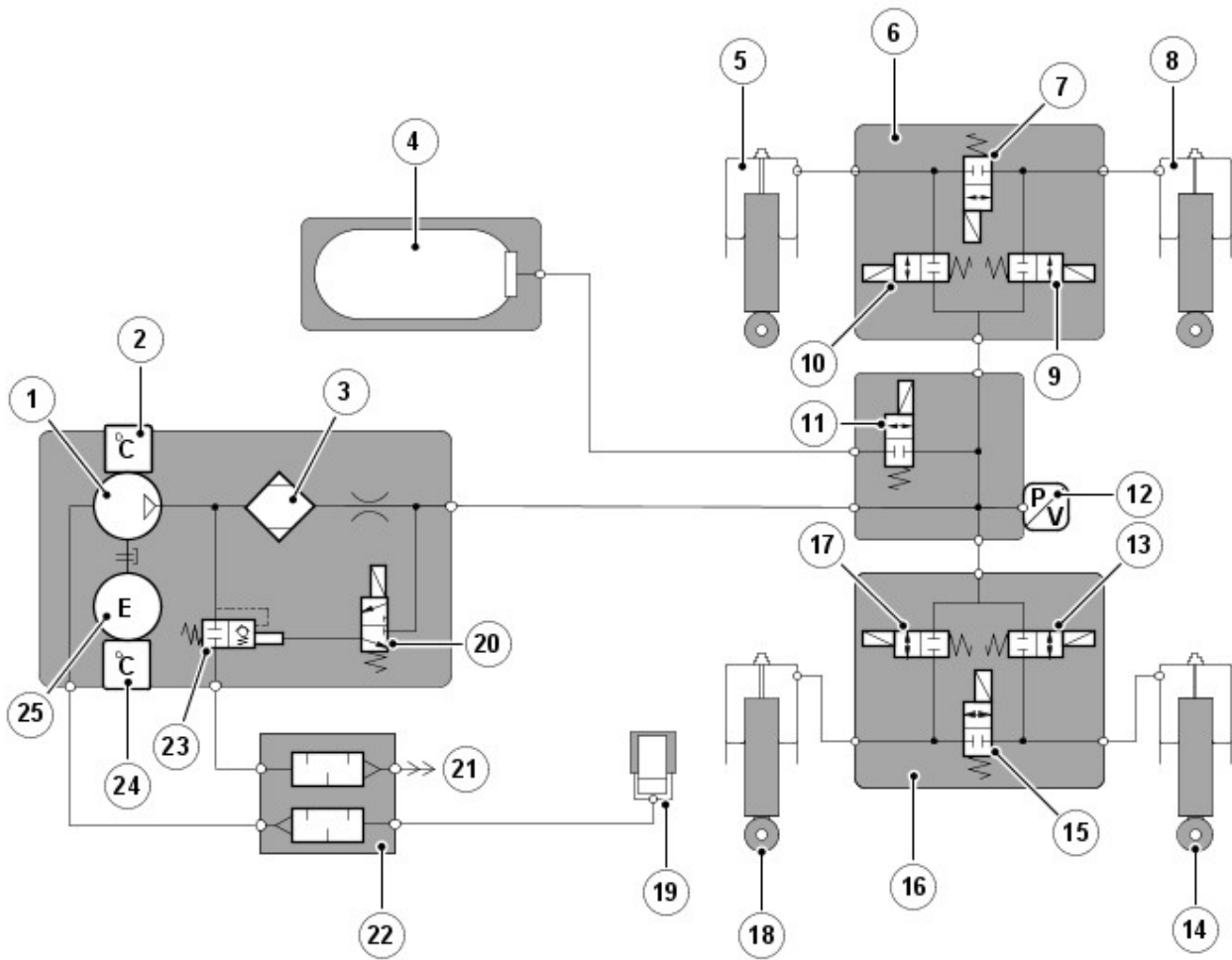
The air suspension system has three driver selectable, pre-determined ride heights. A driver interface indicates the selected ride height and direction of movement. Additional information is also relayed to the driver via the instrument cluster message center (where fitted) and by audible warnings also transmitted by the instrument cluster.

Height changes can only be made when the engine is running and the driver's and passenger doors are closed.

Access height can be selected with the engine not running, within 40 seconds of moving the ignition switch to the off position provided the driver's door has not been opened in this time.

The air suspension can be controlled manually by the driver using a switch on the center console to select the required height change.

Schematic Pneumatic Circuit



E45175

Item	Part Number	Description
1	-	Compressor
2	-	Compressor temperature sensor
3	-	Air dryer
4	-	Reservoir
5	-	Front LH air spring damper module
6	-	Front valve block
7	-	Cross link valve
8	-	Front RH air spring damper module
9	-	Front RH corner valve
10	-	Front LH corner valve
11	-	Reservoir control valve
12	-	Pressure sensor
13	-	Rear RH corner valve
14	-	Rear RH air spring damper module
15	-	Cross link valve
16	-	Rear valve block
17	-	Rear LH corner valve
18	-	Rear LH air spring damper module
19	-	Inlet air filter
20	-	Pilot exhaust valve
21	-	Exhaust
22	-	Air silencer
23	-	Pressure relief and exhaust valve
24	-	Motor temperature sensor
25	-	Electric motor

OPERATING MODES

Using the air suspension switch, the driver is able to manually select one of four ride states:

- ON-ROAD - this height is the normal operating height of the vehicle
- OFF-ROAD - this height is higher than the on-road height and provides improved ground clearance, approach, departure and breakover angles
- ACCESS - this height is lower than the on-road height and makes entering and exiting the vehicle easier for the occupants
- CRAWL (Locked at access) - this height allows the vehicle to be driven at the access height at low speeds to provide increased roof clearance in low car parks etc.

• NOTE: Vehicle height changes are prevented if the air suspension control module receives a 'Door Open' signal from the Central Junction Box (CJB).

An additional 'TRANSPORTATION' mode is also available but is only selectable using the Land Rover approved diagnostic equipment.

An additional function allows the vehicle to be raised or lowered from outside of the vehicle when the vehicle is stationary. For example, this may assist with the attachment of a trailer and is achieved using the buttons on the remote handset and the ignition switch in the off position. The remote handset can be programmed to perform a number of additional functions. For additional information, refer to: [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

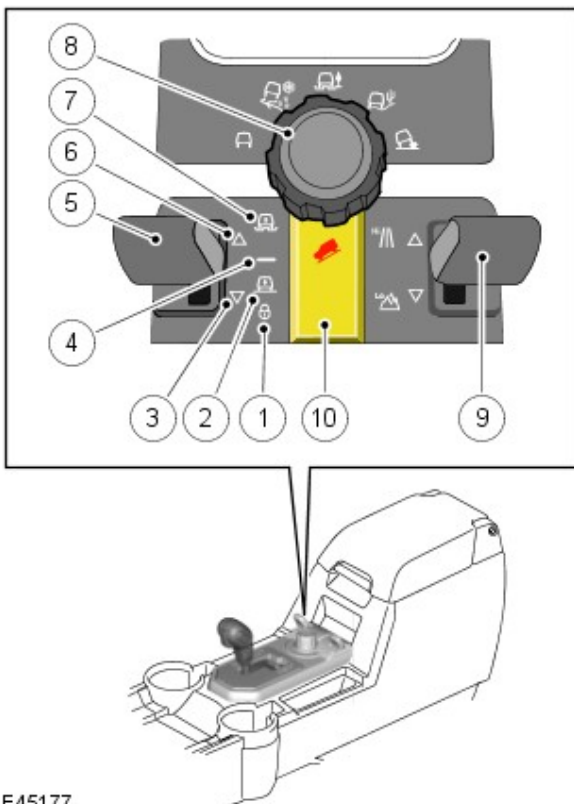
If the air suspension control module senses that the vehicle has grounded and lost traction, the control module can temporarily increase and/or redistribute the volume of air supplied to the affected air spring(s) to maximize the available traction. This is known as extended mode and will be indicated to the driver by the lamps on the air suspension switch flashing, and messages displayed in the instrument cluster message center.

If the air suspension control module senses that the vehicle is prevented from moving upwards or downwards during a height change or leveling correction, the control module will adopt a safe state and further height changes will be suspended.

If a fault is detected by the air suspension control module, the control module will reduce the system functionality dependent on the type and severity of the fault. The control module will also store a fault code which can be retrieved using the Land Rover approved diagnostic equipment. If a severe fault occurs, the control module will attempt to put the vehicle in a safe condition. A fault is relayed to the driver by the illumination of the air suspension warning indicator, the instrument cluster message center and an audible warning emitted from the instrument cluster.

If the detected fault is minor and does not affect vehicle safety, the air suspension warning indicator in the instrument cluster will illuminate in an amber color and the fault should be rectified at the earliest opportunity. If a more severe fault is detected, the warning indicator will illuminate in a red color above 31 mph (50 km/h) vehicle speed, and the vehicle should be driven with care until the fault is rectified. An audible warning is emitted by the instrument cluster sounder when the warning indicator is illuminated. The indicator will change to an amber color and the audible warning will stop when the vehicle speed is reduced.

Air Suspension Switch Mode Lamps



E45177

Item	Part Number	Description
1	-	Crawl mode lamp
2	-	Access mode lamp
3	-	Lowering lamp
4	-	On-road mode lamp
5	-	Air suspension switch
6	-	Raising lamp
7	-	Off-road mode lamp
8	-	Terrain Response™ rotary control
9	-	Transfer box range switch
10	-	Hill Descent Control (HDC) switch

On-Road Mode

This is the normal ride height for the vehicle.

Off-Road Mode

Off-road mode will only be activated if the vehicle speed is less than 25 mph (40 km/h). The vehicle will be raised 55 mm (2.2 in) higher than the on-road mode to provide additional body clearance and improved approach, departure and breakover angles. If the vehicle speed exceeds 31 mph (50 km/h), the air suspension control module will automatically lower the vehicle to the on-road mode height. At 25 to 28 mph (40 to 45 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will lower.

• **NOTE:** The suspension can be automatically set to off-road mode when some Terrain Response programs and low range are selected.

Access Mode

Access mode lowers the vehicle body height by 50 mm (2 in) and provides easier entry, exit and loading of the vehicle. Access mode can be pre-selected when the vehicle is moving. The vehicle will partly lower as the vehicle speed decreases, lowering to the full access mode height when the vehicle reaches 5 mph (8 km/h). If the required road speed is not reached within a predetermined time, the air suspension will return the vehicle to the previously selected height.

Access mode can be selected at any vehicle speed. When access mode is selected, the response of the air suspension system will depend on the vehicle speed:

- If the vehicle speed is more than 12.5 mph (20 km/h), the air suspension control module will wait for up to one minute for the vehicle speed to be reduced. The access mode lamp and the lowering lamp will flash while the air suspension control module waits for the vehicle speed to be reduced, the on-road mode lamp will remain illuminated. If the vehicle speed is not reduced sufficiently, the access mode request will be cancelled after 1 minute.
- If the vehicle speed is less than 12.5 mph (20 km/h), the air suspension control module will lower the suspension to a part lowered height and will remain at this height for up to one minute. The on-road mode lamp will extinguish as the air suspension control module lowers the suspension to the part lowered height. The access mode lamp and the lowering lamp will illuminate. When part lowered is reached, the 'lower' lower lamp will flash. If the vehicle speed is not reduced to less than 5 mph (8 km/h) in the one minute period, the access mode request will be cancelled.
- If the vehicle speed is less than 5 mph (8 km/h), the suspension will be lowered to access mode immediately. The access mode lamp and the lowering lamp will illuminate. When the access mode height is reached, the lowering lamp will be extinguished.

Access height may be selected up to 40 seconds after the ignition is turned off, provided that the driver's door has not been opened within this time.

The suspension will automatically rise from access mode when the vehicle speed exceeds 6.2 mph (10 km/h). If access mode was selected directly from off-road mode then the system will return to off-road mode when the vehicle speed exceeds 6.2 mph (10 km/h). Otherwise the system will lift the suspension to On-road height.

Selecting Access Mode Directly from Off-Road Mode

When the suspension is in off-road mode height, pressing the air suspension switch once and then a second time before the lowering lamp is extinguished, the control module will lower the suspension to access mode height. The control module will remember to return the suspension to off-road height automatically if the vehicle speed increases above 6.2 mph (10 km/h).

Crawl (Locked at Access) Mode

Crawl mode allows the vehicle to be driven at access height. The vehicle is locked in access height and can be selected at a speed of less than 21.7 mph (35 km/h) and can be driven at low speeds to improve clearance in areas with restricted headroom, i.e. car parks. If the vehicle exceeds 24.8 mph (40 km/h), crawl mode will be cancelled and the vehicle will return to on-road height.

Crawl mode allows the vehicle to be driven at low speeds with the suspension locked at the access mode height. This allows the vehicle to be driven in low car parks etc. with increased roof clearance.

Crawl mode can be selected from Normal or Access ride heights up to 21.7 mph (35 km/h), with a long press of the switch in the down direction. The access mode lamp and the crawl mode lamp will be illuminated. When the control module is in crawl mode, on-road mode height will be selected automatically if the vehicle speed exceeds 25 mph (40 km/h). At 18.6 to 21.7 mph (30 to 35 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will raise. Crawl mode can also be manually cancelled by moving the switch in the up direction for 1 second. The crawl mode lamp will be extinguished.

Automatic Height Change Warnings

When the suspension is in off-road mode, access mode or crawl mode height, the air suspension control module will change the suspension height automatically when the vehicle speed exceeds predetermined thresholds.

When the suspension is at off-road mode or crawl mode height, the control module issues a warning to advise the driver that the vehicle is approaching the speed threshold. The instrument cluster sounder will emit a chime, a message will be displayed in the message center and the on-road mode lamp and either the raising or lowering lamp will flash.

The off-road mode or crawl mode height speed warning is removed when the vehicle speed is reduced.

SPECIAL MODES

Door Open Functionality

If one or more of the vehicle doors are opened during a height change when the vehicle is stationary, the air suspension control module will restrict further height change. The door open signal is transmitted by the CJB on the high speed CAN bus and received by the air suspension control module. This keeps the vehicle level to the set height when a door opens to allow for changes in loading conditions.

A hardwired door status signal is also transmitted from the CJB to the air suspension control module. This signal provides door status information when the high speed CAN bus is off, i.e.; during periodic re-leveling.

The lamp on the air suspension switch for the target mode height will remain illuminated and the raising or lowering lamp will

flash.

If all of the doors are closed within 90 seconds, the height change will resume. If the 90 second period is exceeded and all of the doors are not closed, the height change will be cancelled. The mode lamps showing the previously selected height and the target height will be illuminated. The mode height change can be reselected by operating the switch, however, if the vehicle is driven at speed of more than 5 mph (8 km/h) the control module will continue to raise or lower the vehicle to the target mode height.

Extended Mode

If the vehicle becomes grounded and the traction control becomes operational, the air suspension control module automatically increases the mass of air in the air springs to raise the vehicle clear of the obstruction. Extended mode is activated automatically and cannot be selected manually.

When the air suspension control module has activated the extended mode, the off-road mode lamp will flash if the suspension is above off-road mode height. The off-road mode and on-road mode lamps will flash if the suspension is between off-road mode and on-road mode heights. The on-road mode and access mode lamps will flash if the suspension is between on-road mode and access mode. A message will also be displayed in the message center.

To exit the extended mode, press the air suspension switch briefly in the up or down position or drive the vehicle at a speed of more than 2 mph (3 km/h) for 45 seconds.

Additional Lift in Extended Mode

In later software a feature is available to provide additional body clearance when in extended mode. When extended mode has been invoked and the automatic lifting of the vehicle is complete, the driver can request an additional lift of the vehicle. This can be particularly useful when extended mode has to be activated on soft surfaces.

The additional lift can be requested once the raising lamp has extinguished. Press and hold the switch in the up direction for 3 seconds whilst simultaneously depressing the brake pedal. A chime from the instrument cluster will sound to confirm that the request has been accepted. The raising symbol will be illuminated while the vehicle is being lifted.

Suspension Prevented From Moving

If the air suspension control module is attempting to change the suspension height and it detects that the suspension is prevented from moving, the control module will stop all suspension movement. This can be caused by jacking the vehicle, attempting to lower the vehicle onto an object or raising the vehicle against an obstruction.

The air suspension switch lamps operate as described for extended mode and the same message is displayed in the message center. To start the air suspension system operating, press the air suspension switch briefly in the up or down position, or drive the vehicle at a speed of more than 2 mph (3 km/h) for 45 seconds.

High Speed Mode

In later software a high speed mode is introduced. High speed mode is a non-selectable, automatic mode which lowers the vehicle height by 20 mm to improve vehicle handling. This feature is fully automated and is 'invisible' to the driver.

If the vehicle speed exceeds 100 mph (160 km/h) for more than 5 seconds, the air suspension control module initiates the high speed mode. When the vehicle speed reduces to less than 80 mph (130 km/h) for more than 30 seconds, the vehicle returns to 'on-road' height. This function is cancelled if a trailer is connected to the trailer socket.

Periodic Re-leveling

When the vehicle is parked, the air suspension control module 'wakes up' two hours after the ignition was last switched off and then once every six hours. The vehicle height is checked and if the vehicle is not level within a pre-set tolerance, small downwards height adjustments may be made automatically.

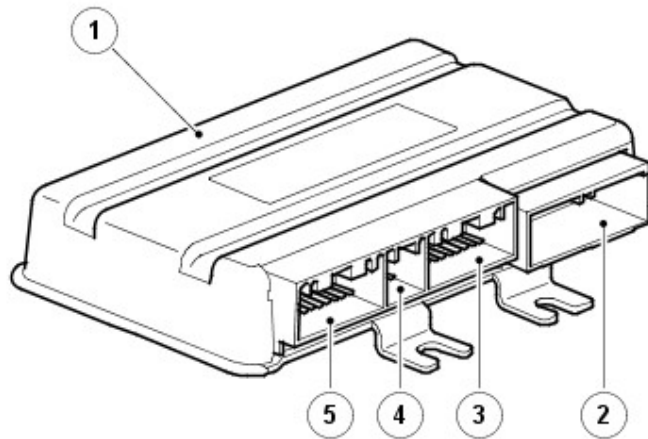
Transportation Mode

Transportation mode is a factory set mode which locks the suspension to enable the vehicle to be safely lashed to a transporter. Transportation mode can only be selected or deselected using the Land Rover approved diagnostic equipment.

When the ignition switch is switched off, the vehicle will be lowered onto the bump stops. This ensures that the securing straps do not become loose should air leak from the air springs.

When the engine is running, the air supply unit will operate to raise the vehicle height, allowing the vehicle to be loaded. When the ignition switch is subsequently switched off, the vehicle will again lower onto the bump stops. An audible warning will be emitted from the instrument cluster sounder until the vehicle has reached the higher transportation height.

AIR SUSPENSION CONTROL MODULE



E45176

Item	Part Number	Description
1	-	Air suspension control module
2	-	Connector C2321
3	-	Connector C2320
4	-	Connector C2030
5	-	Connector C0867

The air suspension control module is located behind the instrument panel, on the driver's side 'A' pillar. The control module is attached to the 'A' pillar with a single screw and two plastic clips.

Calibration

A calibration routine is performed using the Land Rover approved diagnostic equipment to access the position of each corner of the vehicle, and record the settings in the ECU memory. Once set, the calibration is not required to be performed unless the air suspension control module is removed or replaced, a height sensor is removed or replaced or a suspension arm to which the sensor is connected is removed or replaced. If the removed height sensor is subsequently refitted, the calibration procedure will have to be performed to ensure the integrity of the system.

If the air supply unit, the reservoir, a valve block, a damper module or the air harness is removed or replaced, the system will not require recalibration.

Inputs and Outputs

The air suspension control module uses four harness connectors for all inputs and outputs.

The air suspension control module uses inputs received on the CAN bus from other vehicle systems. The system uses longitudinal acceleration, lateral acceleration, steering angle and wheel speed data to control the suspension operation in differing driving conditions.

The system will react differently if one or more of these data inputs is missing or incorrect, for example, if the steering angle sensor is missing or incorrect, the air suspension control module assumes a default value of zero which may result in some unnecessary leveling activity.

Air Supply Unit Relay

The air supply unit relay is located in the battery junction box in the engine compartment. The relay is connected directly to the battery via fusible link 10E (60A). The relay coil is connected to and controlled by the air suspension control module. The relay is used by the air suspension control module to control the operation of the compressor.

When air supply unit operation is required, the air suspension control module supplies power and ground for the relay coil which energizes, closing the relay contacts. This allows battery voltage via the fusible link to pass through the relay and operate the air supply unit electric motor and the compressor.

The battery voltage is also passed from the relay, via a splice joint in the harness, to the air suspension control module and is used as a signal that the relay is operating.

System Inhibits

A number of conditions exist where a change of ride height is undesirable. To counter this, the air suspension control module is programmed with a number of system inhibits. If any of the conditions detailed below exist, the air suspension control module will suspend height changes and height corrections.

Compressor

The temperature sensors located within the compressor protect the compressor from overheating. If the compressor temperature rises above set limits, the air suspension control module will inhibit the compressor operation. These limits are shown in the following table:

Compressor Head Temperature Sensor

	Lifting	Filling Reservoir
Stop	140°C (284°F)	130°C (266°F)
Start	120°C (248°F)	110°C (230°F)

Compressor Brush Temperature Sensor

	Lifting	Filling Reservoir
Stop	140°C (284°F)	130°C (266°F)
Start	120°C (248°F)	110°C (230°F)

Cornering

If the air suspension control module registers a cornering force greater than 0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the cornering force falls to less than 0.15g. The air suspension control module receives a message from the lateral acceleration sensor (which is an integral part of the ABS yaw rate sensor) on the high speed CAN bus for the cornering force.

Rapid Acceleration

If the air suspension control module registers a rapid acceleration greater than 0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the rapid acceleration falls to less than 0.15g. Acceleration is calculated by the air suspension control module from a vehicle speed signal received via the high speed CAN bus.

Rapid Deceleration

If the air suspension control module registers a rapid deceleration smaller than -0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the rapid deceleration rises above -0.15g. Deceleration is calculated by the air suspension control module from a vehicle speed signal received via the high speed CAN bus.

Vehicle Jack

The air suspension control module will inhibit all height changes and corrections if it detects a corner lowering too slowly for more than 1.2 seconds. This is interpreted as the corner identified as moving too slowly being supported on a jack. In this situation, the corner height will not change when air is released from the air spring because the jack acts as a mechanical prop. The system will remain inhibited until any of the following conditions exist:

- The air suspension switch is moved to the up or down position
- Vehicle speed rises to more than 2 mph (3 km/h) for more than 45 seconds.

Door Open

The air suspension control module will stop all height change requests while any of the doors are open. Vehicle leveling continues with a door open by keeping the vehicle at the height when the door was opened if the vehicle load changes.

Diagnostics

The air suspension control module can store fault codes which can be retrieved using the Land Rover approved diagnostic equipment. The diagnostic information is obtained via the diagnostic socket which is located in the lower instrument panel closing panel, on the driver's side, below the steering column.

The diagnostic socket allows the exchange of information between the various control modules on the bus systems, and the Land Rover approved diagnostic equipment. This allows the fast retrieval of diagnostic information and programming of certain functions using the Land Rover approved diagnostic equipment.

Fault Detection

The air suspension control module performs fault detection and plausibility checks. Fault detection is limited to faults that the control module can directly measure as follows:

- Sensor electrical hardware faults
- Valve electrical hardware faults
- Sensor and actuator supply faults
- Bus failures
- Control module hardware errors.

Plausibility checks are checks on signal behavior, as follows:

- Average height does not change correctly
 - Height changes too slowly
- Gallery pressure
 - Does not increase fast enough when reservoir filling requested
 - Increases when system is inactive
 - Too low when lifting is requested
 - Increases too rapidly when filling reservoir
 - Does not decrease when gallery is vented
 - Pressure varies too much when inactive.
- Compressor temperature
 - Sensor voltage too large - head and brush sensors (short circuit to battery)
 - Takes too long to be readable after suitable compressor run time - head and brush sensors
 - Does not increase when compressor active - head sensor only
- Sensor activity
 - Signal floating
 - Constant articulation when moving

When a fault is detected, the air suspension control module will attempt to maintain a comfortable ride quality and where possible will retain as much functionality as possible.

The system functionality depends on the severity of the fault.

Faults

Faults are categorized into order of severity and effect on the system as follows (with 1. being a minor fault and 5. being a major fault):

- Height sensor faults (hardware faults) and reservoir valve block failure
 - Retain full functionality with no 'refinements', e.g. cross-link valves inoperative, no compensation for uneven surfaces.
- Pressure sensor faults, compressor faults, corner valves stuck shut
 - Road speed signal not available
 - Vehicle returns to on-road mode height when next requested

- Levels at 'current' height.
- Reservoir valve stuck open, exhaust valve stuck shut if below on-road mode height, corner valves stuck open if above on-road mode height
 - Vehicle returns to on-road mode height when next requested
 - Does not level at 'current' height.
- Failure of multiple height sensors, cross-articulation when driving, calibration corrupted
 - Vehicle lowers to bump stops.
- ABS module failure, CAN bus failure
 - If the air suspension control module loses communications with the ABS module or the ABS module reports a fault, the air suspension control module immediately returns to the 'default' height, which is below the on-road ride height. Once at the default height, the control module will continue to level the vehicle at this height. It is unlikely that the fault will be in the air suspension control module. When the fault is repaired, the air suspension control module will resume full functionality but the error will remain in the control module memory.

For major faults the control module will not level the vehicle at the 'current' ride height. The control module freezes height changes until it receives a manual or automatic request for height change. The control module will return to standard height if possible and freezes once standard height is achieved.

If the suspension is above the on-road height and the air suspension control module cannot lower the suspension, all height changes will be frozen. The control module will issue a message on the high speed CAN bus which is received by the instrument cluster which displays a maximum advisable speed in the message center. An immediate 'freeze' of the vehicle height is caused by the following:

- Failure of more than one height sensor - vehicle on bump stops
- Implausible articulation symptoms detected - vehicle on bump stops
- Valve or solenoid failure - corner valve stuck open below on-road mode height or exhaust valve stuck shut above on-road mode height
- Stuck corner or whole vehicle (diagnosed using plausibility of the sensor inputs).

If height change is not possible, e.g. exhaust valve failed closed at off-road height or compressor failed at access height, the control module will not level or change height.

If the air suspension control module has a hardware fault, the control module will disable all air suspension functions. Detectable hardware errors include memory error, control module failure, calibrations errors.

Fault Messages

The air suspension has two methods which it can use to inform the driver of a fault in the air suspension system; the air suspension switch LED's and the instrument cluster message center.

When minor faults occur and the air suspension control module is able to level the vehicle to the 'current' ride height, the air suspension switch LED's will display the current ride height.

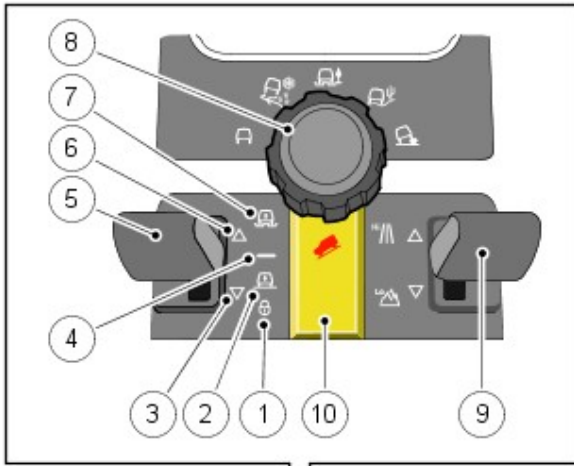
If the air suspension control module suffers a major failure and there is no air suspension control, all the control switch LED's will remain off.

If a fault occurs and the air suspension control module can determine the ride height and the vehicle is not above on-road mode height, the driver will be notified via an 'air suspension fault max speed 30 mph (50 km/h)' message, displayed in the message center.

If the control module cannot determine the height of the vehicle, or the vehicle is above on-road mode height, cannot be lowered and the vehicle speed is too high, an air suspension fault message is displayed.

If the vehicle is restricted to on-road mode height an air suspension fault normal height only message is displayed.

AIR SUSPENSION SWITCH



E45177

Item	Part Number	Description
1	-	Crawl mode lamp
2	-	Access mode lamp
3	-	Lowering lamp
4	-	On-road mode lamp
5	-	Air suspension switch
6	-	Raising lamp
7	-	Off-road mode lamp
8	-	Terrain Response™ rotary control
9	-	Transfer box range switch
10	-	Hill Descent Control (HDC) switch

The air suspension control switch is located in the center console, behind the manual or automatic transmission selector lever. The switch is a three position, non-latching switch which allows selection of the following driver selectable modes:

- Off-road mode
- On-road mode
- Access mode
- Crawl (locked at access) mode.

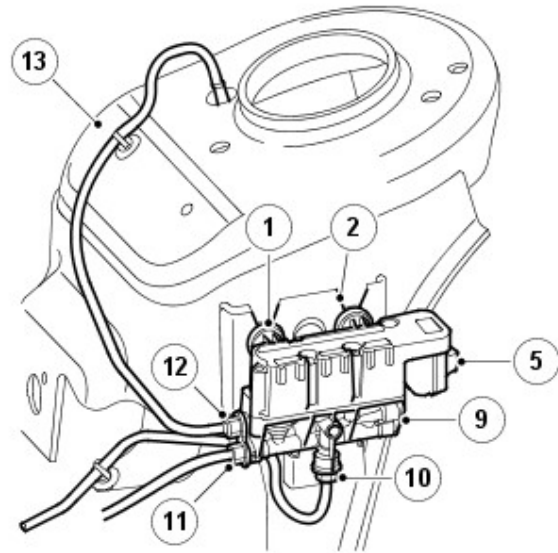
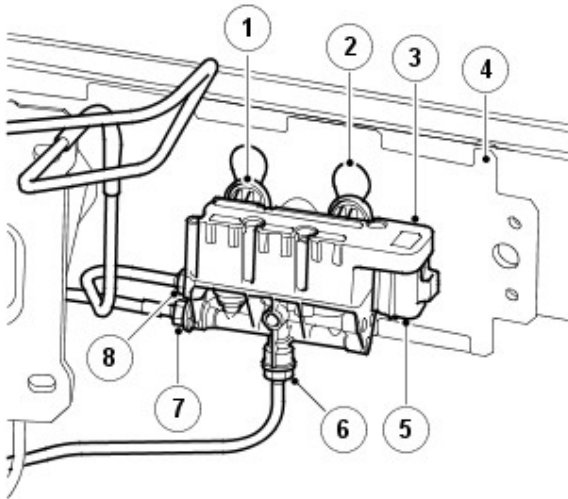
The air suspension switch can be moved forwards or backwards from its central position. The switch is non-latching and returns to the central position when released. The switch completes an earth path to the air suspension control module when operated. This earth path is completed on separate wires for the raise and lower switch positions, allowing the control module to determine which selection the driver has made.

The switch has six symbols which illuminate to show the current selected height and the direction of movement. The raise and lower symbols will flash and a warning tone will be emitted from the instrument cluster sounder when a requested height change is not allowed, i.e. vehicle speed too fast.

A flashing symbol indicates that the air suspension system is in a waiting state or that the system will override the driver's selection because the speed threshold is too high.

The driver can also ignore the system's warnings signals and allow the height to change automatically. For example, increasing the vehicle speed to more than 25 mph (40 km/h) will cause the control module to automatically change the ride height from off-road mode to on-road mode.

FRONT AND REAR AXLE VALVE BLOCKS



E45178

Item	Part Number	Description
1	-	Isolation rubber mounts (3 off)
2	-	Location slots
3	-	Front valve block, valves and solenoid assembly
4	-	Front bumper armature
5	-	Electrical connector
6	-	LH air spring damper module air harness connection
7	-	Air inlet/outlet connection
8	-	RH air spring damper module air harness connection
9	-	Rear valve block, valves and solenoid assembly
10	-	RH air spring damper module air harness connection
11	-	Air inlet/outlet connection
12	-	LH air spring damper module air harness connection
13	-	Rear suspension turret

The front and rear axle valve blocks are similar in their design and construction and control the air supply and distribution to the front or rear pairs of air spring damper modules respectively. The difference between the two valves is the connections from the valve block to the left and right hand air spring damper modules and the valve size. It is important that the correct valve block is fitted to the correct axle. Fitting the incorrect valve block will not stop the air suspension system from functioning but will result in slow raise and lower times and uneven raising and lowering between the front and rear axles.

The front valve block is attached to the right hand end of the front bumper armature assembly. The valve block has three attachment lugs which are fitted with isolation rubber mounts. The rubber mounts locate in slots in the armature. The valve lugs locate in the holes above the slots and are pushed downwards into positive location in the slots.

The rear valve block is located on the forward face of the left hand rear suspension turret. The valve block has three attachment lugs which are fitted with isolation rubber mounts which locate in a bracket with three slotted holes. The bracket is attached to the left hand side of the chassis. The isolation rubber mounts locate in the 'V' shaped slots and are pushed downwards into positive location in the slots.

The front and rear valve blocks each have three air pipe connections which use 'Voss' type air fittings. One connection is an air pressure inlet/outlet from the reservoir valve block. The remaining two connections provide the pressure connections to the left and right hand air springs.

Each valve block contains three solenoid operated valves; two corner valves and one cross-link valve. Each of the valve solenoids is individually controlled by the air suspension control module. The solenoids have a resistance value of 2 Ohms at a temperature of 20°C (68°F).

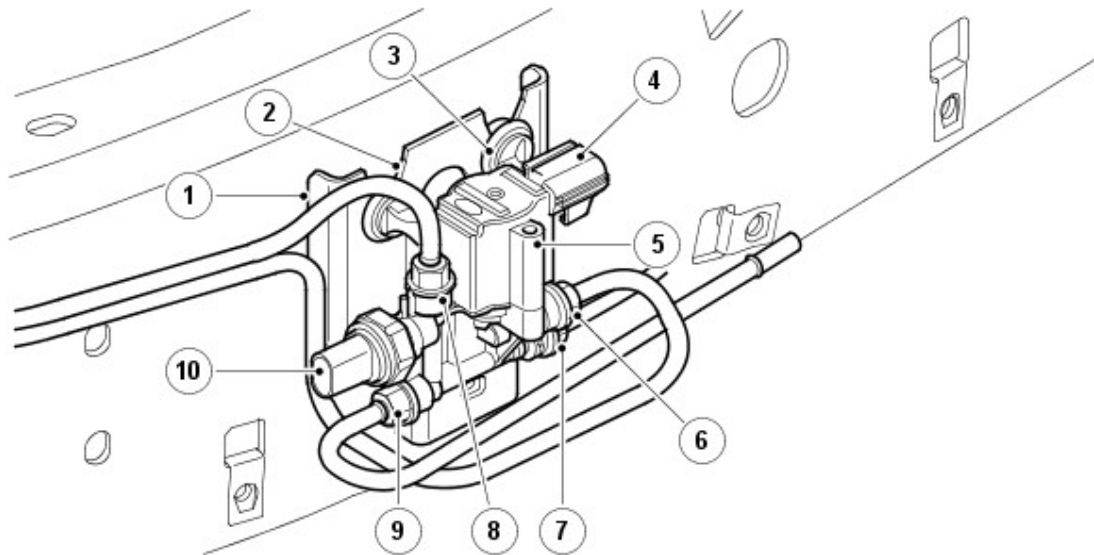
Corner Valves

The corner valves control the flow of air into and out of the individual air springs. When the solenoid is de-energized, the corner valves are held in a closed position by internal springs. When the solenoid is energized, the valve armature moves and allows air to flow into or out of the air spring.

Cross Link Valves

The cross-link valve provides a connection between the two air springs on the same axle. When de-energized, the cross-link valve prevents air passing from one air spring to another. When the solenoid is energized, the valve spool moves and allows air to pass from one air spring to the other. This increases wheel articulation and improves ride comfort at low vehicle speeds.

RESERVOIR VALVE BLOCK



E45179

Item	Part Number	Description
1	-	Chassis mounting bracket
2	-	Location slot
3	-	Isolation rubber mounts (3 off)
4	-	Electrical connector
5	-	Reservoir valve block, valves and solenoid assembly
6	-	Reservoir connection
7	-	Rear valve block connection
8	-	Front valve block connection
9	-	Air supply unit connection
10	-	Pressure sensor

The reservoir valve block controls the storage and distribution of air from the reservoir. The reservoir valve block also contains the system pressure sensor.

The reservoir valve block is attached to a bracket on the outside of the left hand chassis rail, between the reservoir and the air supply unit. The valve block is located within the air supply unit acoustic box to protect it from dirt ingress and damage from stones. The valve block has three attachment lugs which are fitted with isolation rubber mounts which locate in the chassis bracket which has three slotted holes. The isolation rubber mounts locate in the 'V' shaped slots and are pushed downwards into positive location in the slots.

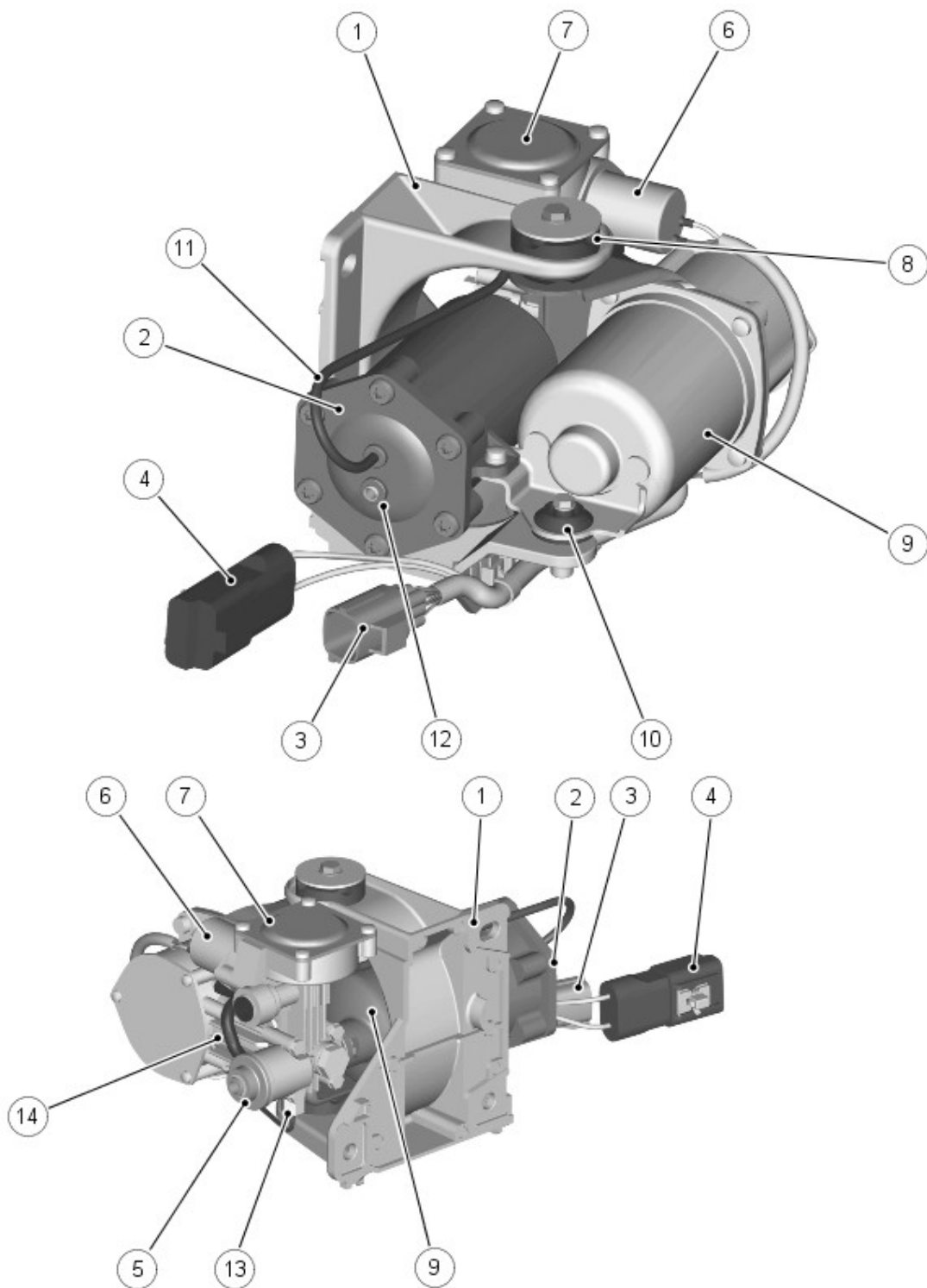
The valve block has four air pipe connections which use 'Voss' type air fittings. The connections provide for air supply from the air supply unit, air supply to and from the reservoir and air supply to and from the front and rear valve blocks. The connections from the air supply unit and the front and rear control valves are all connected via a common gallery within the valve and therefore are all subject to the same air pressures.

The valve block contains a solenoid operated valve which is controlled by the air suspension control module. The solenoid valve controls the pressure supply to and from the reservoir. The solenoid has a resistance value of 2 Ohms at a temperature of 20°C (68°F). When energized, the valve spool moves allowing air to pass to or from the reservoir.

The valve block also contains a pressure sensor which can be used to measure the system air pressure in the air springs and the reservoir. The pressure sensor is connected via a harness connector to the air suspension control module. The control module provides a 5V reference voltage to the pressure sensor and monitors the return signal voltage from the sensor.

Using this sensor, the control module controls the air supply unit operation and therefore limits the nominal system operating pressure to 244 lbf/in² (16.8 bar gage).

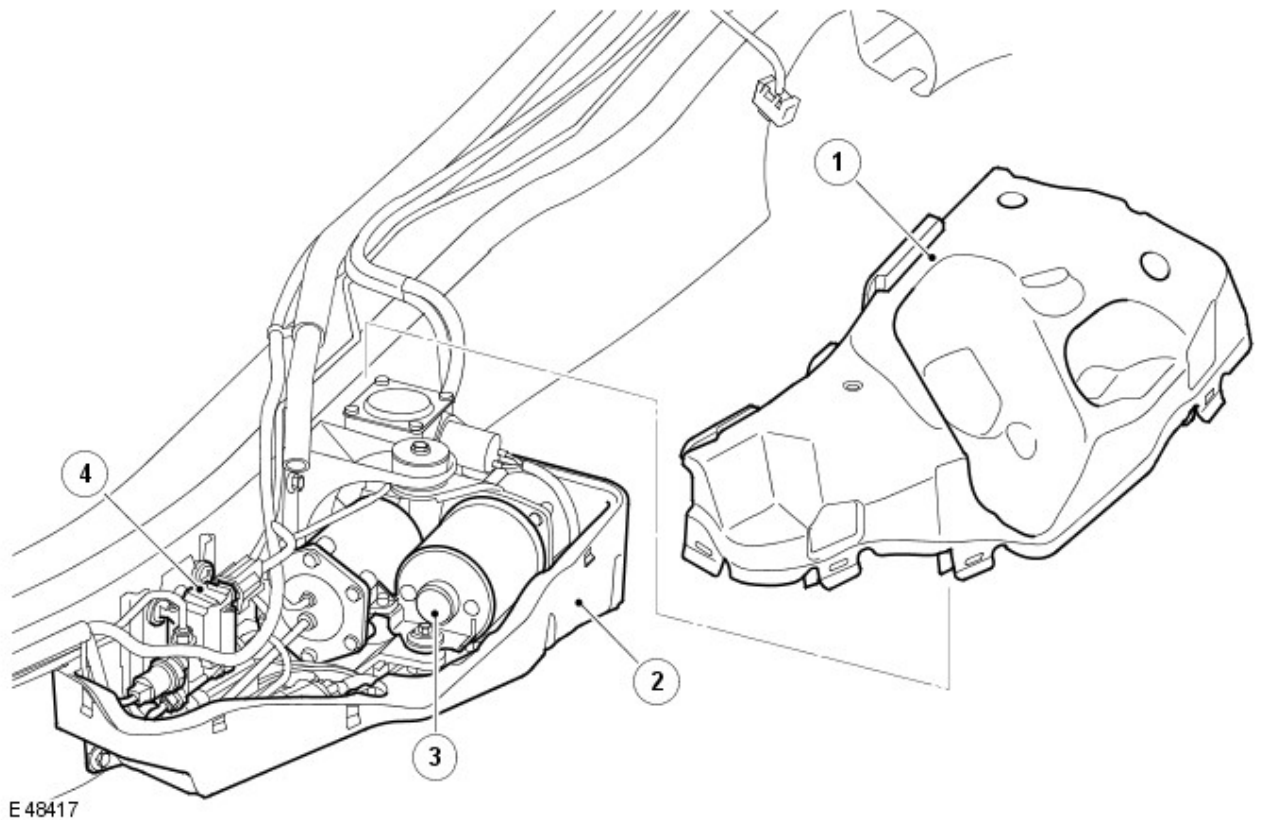
AIR SUPPLY UNIT



E45180

Item	Part Number	Description
1	-	Mounting bracket
2	-	Air dryer
3	-	Pilot exhaust valve solenoid and temperature sensors harness connector
4	-	Motor harness connector
5	-	Intake port
6	-	Pilot exhaust valve
7	-	Exhaust valve
8	-	Isolation mounting rubber (2 off)
9	-	Electric motor
10	-	Isolation mounting rubber (1 off)
11	-	Pilot air pipe
12	-	High pressure supply to air suspension system
13	-	Compressor cylinder head temperature sensor
14	-	Compressor

The air supply unit is located on the outside of the left hand chassis rail, forward of the upper control arm. The unit is attached to the chassis rail with three bolts and is protected by an acoustic box.



Item	Part Number	Description
1	-	Upper cover
2	-	Lower cover
3	-	Air supply unit
4	-	Reservoir valve block

The acoustic box, which comprises of two parts: upper and lower, surrounds the air supply unit. The acoustic box is a plastic molding which is lined with an insulating foam which controls the operating noise of the air supply unit. The reservoir valve block is also located in the acoustic box, forward of the air supply unit.

The air supply unit comprises the following major components:

- A piston compressor
- A 12V electric motor
- A solenoid operated pilot valve
- An exhaust valve
- An air dryer unit

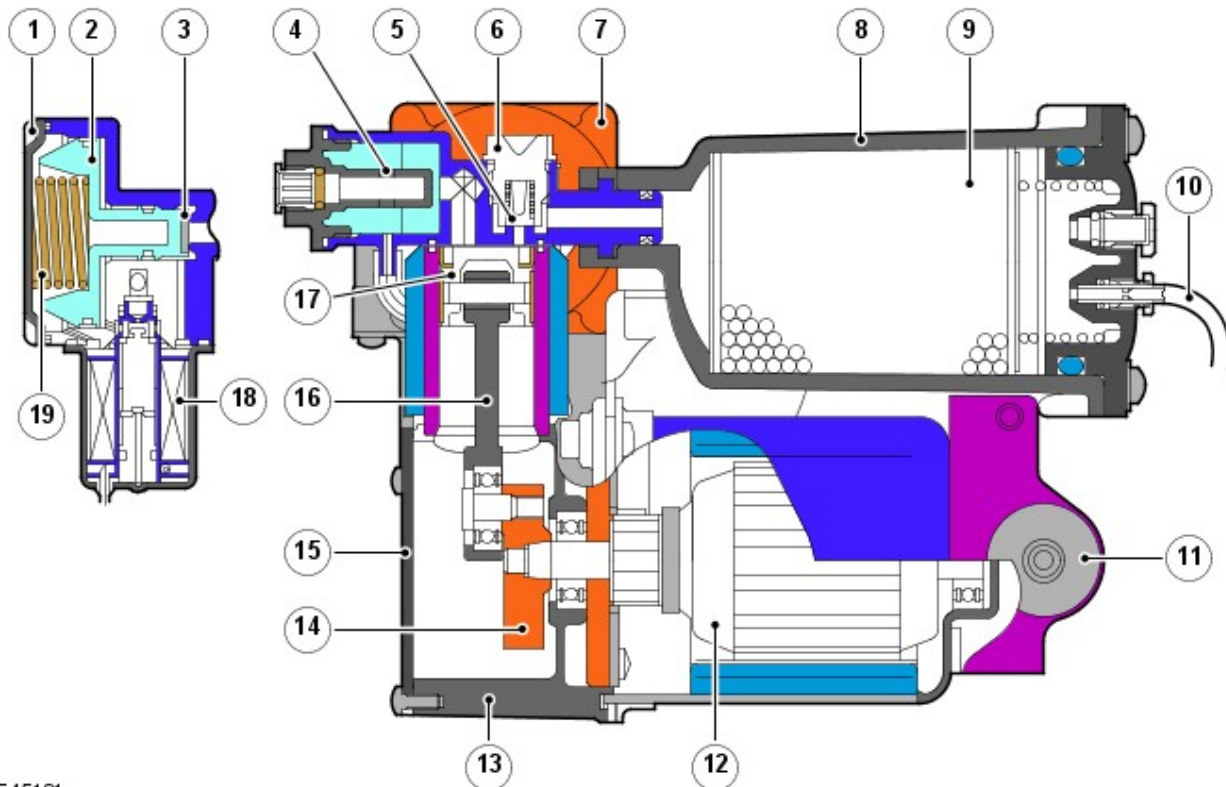
The air supply unit can be serviced in the event of component failure, but is limited to the following components; air dryer, pilot exhaust pipe and the rubber mounts.

The air supply unit is attached to a bracket which is bolted to the chassis. The unit is mounted to the bracket with flexible isolation mounting rubbers which assist with preventing operating noise being transmitted to the chassis.

Removal of the air supply unit does not require the whole air suspension system to be depressurized. The front and rear valve blocks and the reservoir valve block are normally closed when de-energized, preventing air pressure in the air springs and the reservoir escaping when the unit is disconnected.

There are a number of conditions that will inhibit operation of the air supply unit. It is vitally important that these system inhibits are not confused with a system malfunction. A full list of air supply unit inhibits are given in the air suspension control module section in this chapter.

Air Supply Unit - Sectional View



E45181

Item	Part Number	Description
1	-	Exhaust valve cap
2	-	Plunger
3	-	Valve seat
4	-	Intake silencer port
5	-	Delivery valve
6	-	Valve guide
7	-	Cylinder head
8	-	Dryer case
9	-	Desiccant
10	-	Pilot exhaust line
11	-	Isolation rubber mount
12	-	Motor assembly
13	-	Crankcase
14	-	Crank
15	-	Crankcase cover
16	-	Connecting rod
17	-	Piston
18	-	Pilot exhaust valve
19	-	Spring - pressure relief

Pilot Exhaust Valve

A solenoid operated pilot exhaust valve is connected to the air delivery gallery, downstream of the air dryer. The pilot valve, when opened, operates the main compressor exhaust valve. This allows the air springs to be deflated when required.

When the solenoid is energized, pilot air moves the exhaust valve plunger, allowing pressurized air from the air springs and/or reservoir to pass via the reservoir control valve to the air supply unit.

The solenoid has a resistance value of 4 Ohms at a temperature of 20°C (68°F).

Exhaust Valve

The exhaust valve has three functions. It operates in conjunction with the pilot exhaust valve to allow air to be exhausted from the air springs and/or the reservoir as described previously.

The valve also protects the system from over-pressure. The valve is connected into the main pressure gallery which is always subject to the system pressure available in either the air springs or the reservoir. The valve is controlled by a spring which restricts the maximum operating pressure to between 333.5 to 370 lbf/in² (23.0 to 25.5 bar).

The minimum pressure in the system is also controlled by the exhaust valve to ensure that, even when deflated, the air springs contain a positive pressure of approximately 14.5 lbf/in² (1 bar gage) with respect to atmosphere. This protects the air spring by ensuring it can still 'roll' over the piston without creasing.

Electric Motor

The electric motor is a 12V dc motor with a nominal operating voltage of 13.5V. The motor drives a crank which has an eccentric pin to which the compressor connecting rod is attached.

The motor is fitted with a temperature sensor on the brush PCB assembly. The sensor is connected to the air suspension control module which monitors the temperature and can suspend motor operation if an overheat condition occurs.

Compressor

The compressor comprises a motor driven connecting rod and piston which operate in a cylinder with a cylinder head. The motor rotates the crank moving the piston up and down in the cylinder bore. The air in the cylinder is compressed with the up stroke and is passed via delivery valve, through the air dryer into the system.

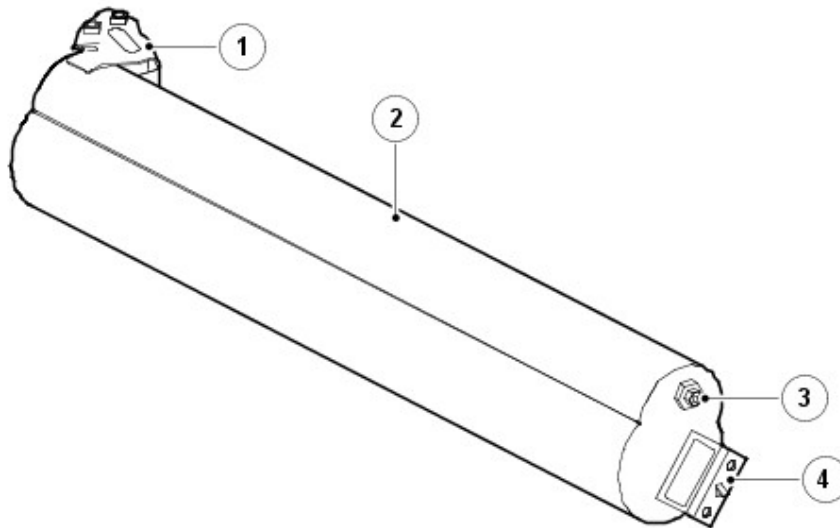
Air Dryer

The air dryer is an integral part of the air supply unit. The air dryer contains a desiccant which absorbs moisture. Pressurized air is passed through the air dryer which removes any moisture in the compressed air before it is passed to the reservoir and/or the system

When the air is exhausted from the system, the returning air is passed through the air dryer, regenerating the air dryer by removing moisture from the desiccant and expelling it to atmosphere via the exhaust.

The air dryer is an essential component in the system ensuring that only dry air is present in the system. If moist air is present in the system, freezing can occur, resulting in poor system operation or component malfunction/failure.

AIR RESERVOIR



E45182

Item	Part Number	Description
1	-	Front bracket
2	-	Reservoir
3	-	Air hose connection to reservoir valve block
4	-	Rear bracket

The reservoir is an air storage vessel which provides fast air suspension lift times by the immediate availability of pressurized air into the system.

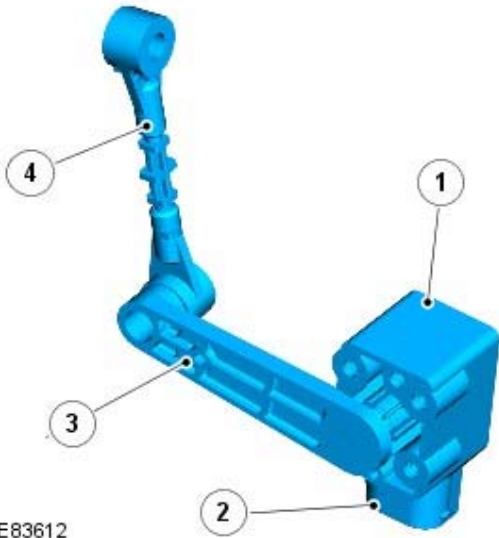
The reservoir is a steel fabrication and is located on the outside of the left hand chassis rail, in front of the air supply unit. The reservoir has a bracket at each end which attach to the body mounting brackets on the chassis.

The rearward end of the reservoir has a 'Voss' air fitting which provides for the connection of the air hose between the reservoir and the reservoir valve block.

The reservoir has a capacity of 550 in³ (9 liters). The nominal working pressure of the reservoir is 243.6 lbf/in² (16.8 bar gage), with a maximum pressure of 333.5 lbf/in² (23 bar gage).

HEIGHT SENSORS

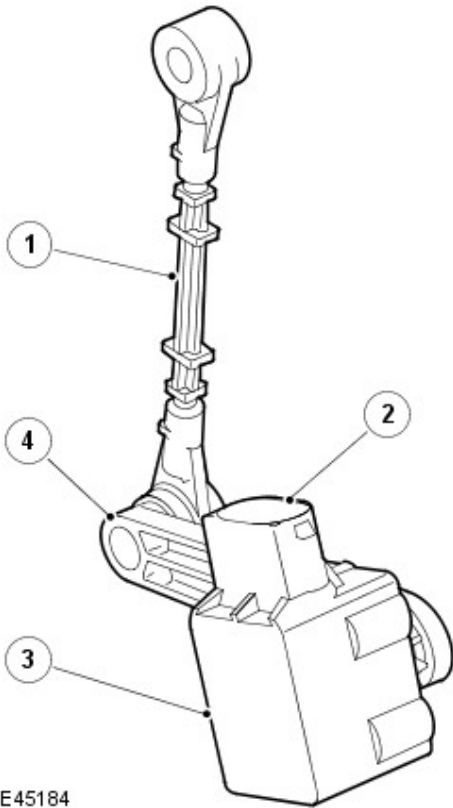
Front Height Sensor



E83612

Item	Part Number	Description
1	-	Sensor body
2	-	Electrical connector
3	-	Lever arm
4	-	Drop link

Rear Height Sensor



E45184

Item	Part Number	Description
1	-	Drop link
2	-	Electrical connector
3	-	Sensor body
4	-	Lever arm

A height sensor is fitted in each corner of the vehicle to monitor the ride height of the vehicle. The sensor bodies are attached with screws to brackets on the chassis rails.

Each sensor comprises a sensor body which contains a single track rotary potentiometer, a lever arm and a drop link.

The sensor lever arm has a drop link which provides the connection between the sensor and the suspension control arm. The drop link is a serviceable component and is a push fit to the lever arm and the suspension control arm.

The sensors are connected via their harness connector to the air suspension control module which receives the signal output from each sensor and, using preprogrammed information, converts the signal to a height for each sensor position.

The front and rear sensors are handed and are colored coded for identification as follows:

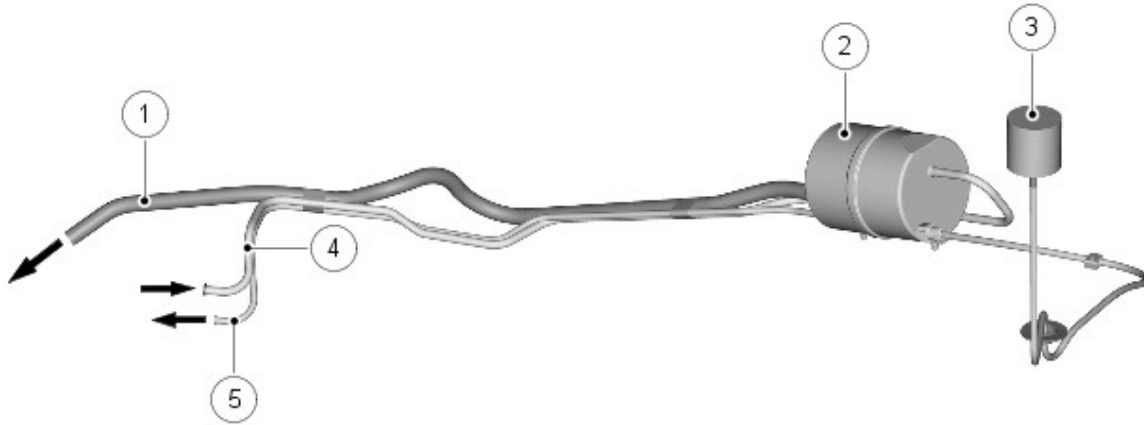
- Right hand front and rear - black colored lever
- Left hand front and rear - white colored lever.

Calibration

A calibration routine is performed using the Land Rover approved diagnostic equipment to read the position of each corner of the vehicle, and record the settings in the ECU memory. Once set, the calibration is not required to be performed unless the air suspension control module is removed or replaced, a height sensor is removed or replaced or a suspension arm to which the sensor is connected is removed or replaced. If the removed height sensor is subsequently refitted, the calibration procedure will have to be performed to ensure the integrity of the system.

If a replacement drop link is fitted, recalibration is not required providing the sensor body is not removed from its mounting bracket.

AIR SILENCER AND INLET AIR FILTER



E45185

Item	Part Number	Description
1	-	Exhaust (to atmosphere)
2	-	Inlet and exhaust silencer
3	-	Air inlet filter
4	-	Exhaust air from air supply unit
5	-	Air inlet supply to air supply unit

The air silencer is required to limit any noise produced from the air supply unit during inflation or deflation of the air springs.

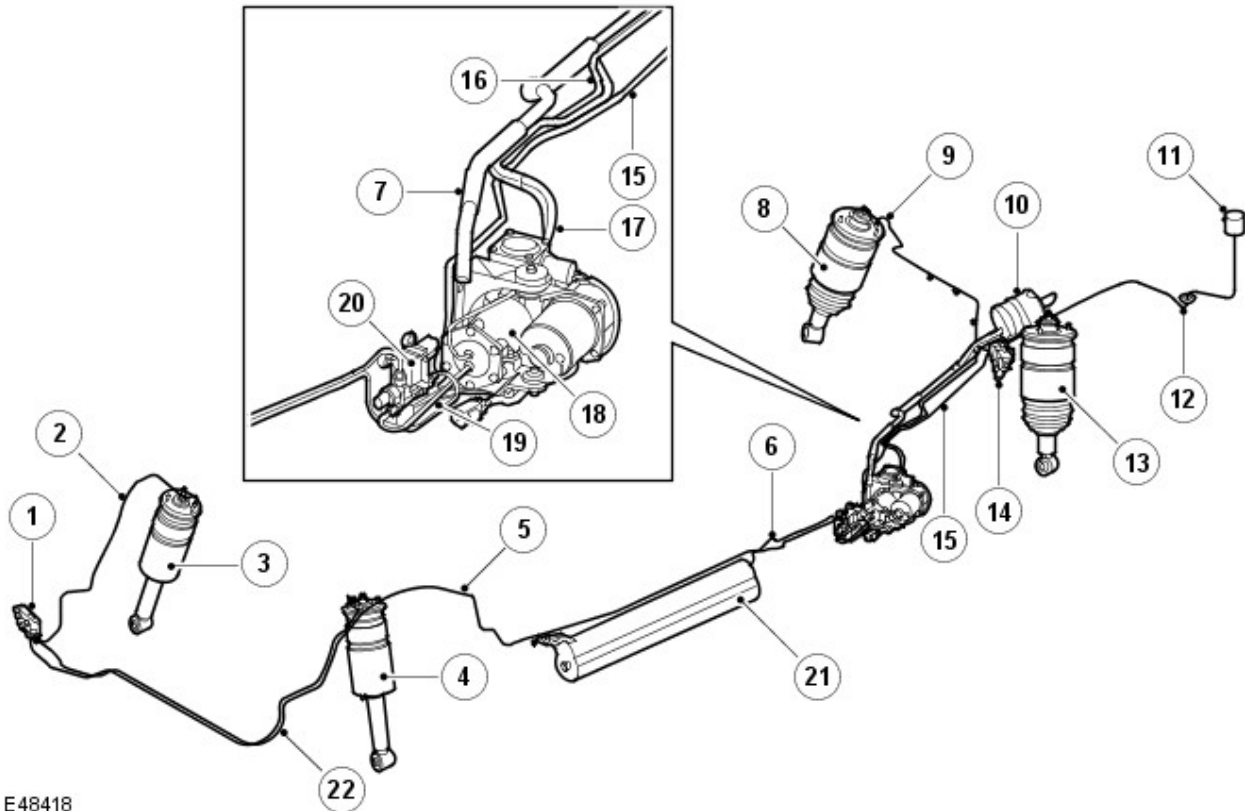
The silencer comprises two plastic molded cans bonded together and contains two blocks of silencing foam. A pipe connection is molded onto each end of the silencer and provide for the attachment of the exhaust air to atmosphere pipe and the exhaust air pipe from the air supply unit.

A secondary chamber, located around the outside of the exhaust chamber forms the silencer for the inlet air. Pipe connections are molded onto each end of the intake silencer and provide for the attachment of the air inlet pipe from the inlet air filter and the air inlet pipe to the air supply unit. The intake air silencer is a hollow chamber with no noise reduction foam filling.

The air intake filter is connected via a pipe to the intake silencer chamber of the air silencer unit. The filter is located in the rear left hand corner of the body, away from possible sources of dirt and moisture.

The filter contains a foam element which removes particulate matter from the inlet air before it reaches the silencer or the air supply unit.

AIR HARNESS



E48418

Item	Part Number	Description
1	-	Front axle valve block
2	-	Pipe - Front axle valve block to front RH air spring damper module
3	-	Front RH air spring damper module
4	-	Front LH air spring damper module
5	-	Pipe - Reservoir valve block to front axle valve block
6	-	Pipe - Reservoir valve block to reservoir
7	-	Pipe - Exhaust
8	-	Rear RH air spring damper module
9	-	Pipe - Rear axle valve block to rear RH air spring damper module
10	-	Air silencer assembly
11	-	Air inlet filter
12	-	Pipe - Main inlet
13	-	Rear LH air spring damper module
14	-	Rear axle valve block
15	-	Pipe - Reservoir valve block to rear axle valve block
16	-	Pipe - Compressor inlet
17	-	Pipe - Compressor exhaust
18	-	Air supply unit
19	-	Pipe - Air supply unit to reservoir valve block
20	-	Reservoir valve block
21	-	Reservoir
22	-	Pipe - Front axle valve block to front LH air spring damper module

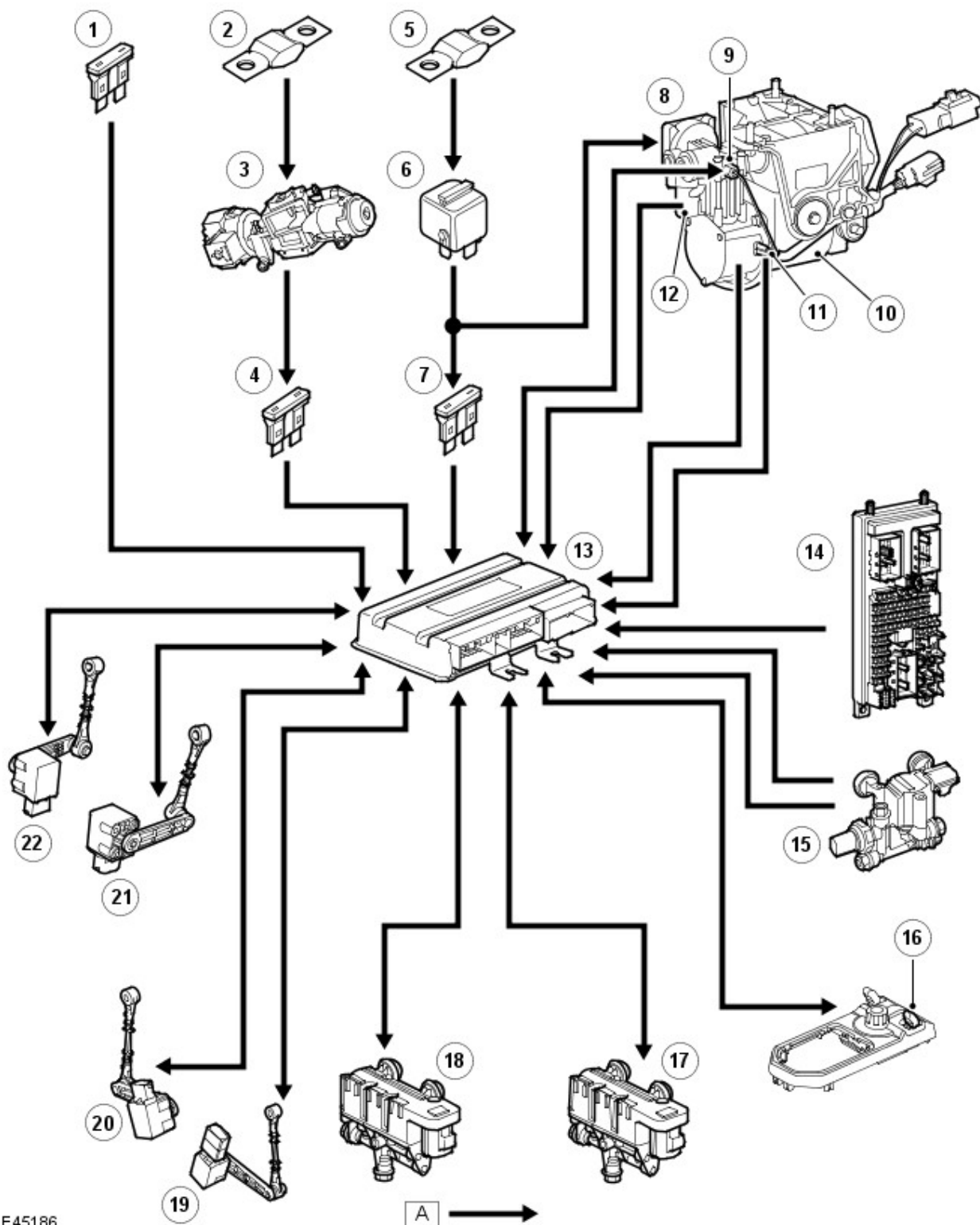
The air harness comprises ten separate nylon pipes which are connected between the system components with Voss connectors. The pipes have the following diameters:

Pipe	Diameter
High pressure pipes	6 mm
Compressor inlet pipe	8 mm
Inlet filter to silencer	8 mm
Compressor exhaust pipe	10 mm
Silencer exhaust pipe	19 mm

If a pipe becomes damaged, an in-line connector is available for repair purposes. The pipes are secured to the body and the chassis with a number of plastic clips.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired



E45186

Item	Part Number	Description
1	-	Fuse 26E (20A)
2	-	Fusible link 11E (30A)
3	-	Ignition switch
4	-	Fuse 35P (5A)
5	-	Fusible link 10E (60A)
6	-	Air supply unit relay
7	-	Fuse 3E (5A)
8	-	Air supply unit
9	-	Compressor temperature sensor
10	-	Motor
11	-	Motor temperature sensor
12	-	Exhaust valve solenoid
13	-	Air suspension control module
14	-	Central junction box
15	-	Reservoir control valve
16	-	Air suspension switch

17	-	Front control valve
18	-	Rear control valve
19	-	RH rear height sensor
20	-	LH rear height sensor
21	-	RH front height sensor
22	-	LH front height sensor

Vehicle Dynamic Suspension - Vehicle Dynamic Suspension

Diagnosis and Testing

Principle of Operation

For a detailed description of the Vehicle Dynamic Suspension System and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Vehicle Dynamic Suspension](#) (204-05 Vehicle Dynamic Suspension, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Air leakage ● Air springs ● Reservoir ● Compressor ● Compressor air filter ● Pipework and unions ● Sensor installation ● Valve block(s) ● Suspension components 	<ul style="list-style-type: none"> ● Battery ● Fuse(s) ● Wiring harness physical damage or water ingress ● Loose or corroded electrical connectors ● Air suspension control switch ● Controller Area Network (CAN) circuits ● Sensors ● Actuators ● Valve block(s) ● Air suspension control module

3. 3. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the symptom chart.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Message	Possible Other Warnings	Possible Causes	Action
Vehicle on bump stops	<ul style="list-style-type: none"> ● Suspension fault 	<ul style="list-style-type: none"> ● Two chimes repeated regularly Red indicator permanently illuminated 	<ul style="list-style-type: none"> ● Water ingress to wiring harness or connectors ● Air leak(s) ● Vehicle in transportation mode ● System not calibrated or calibration corrupt ● Implausible articulation symptoms detected ● Failure of multiple height sensors ● Air suspension control module failure 	Visually inspect the wiring harness and connectors for water ingress. Visually inspect the system for air leakage. Check the system mode and calibration using the approved diagnostic system. Check for implausible articulation symptoms, i.e. height sensor or linkage fault, deflated air spring, under inflated tire etc. Note implausible articulation symptoms may be caused by an un-calibrated height sensor. Check for height sensor DTCs and refer to the DTC index. Refer to the warranty policy and procedures manual if a module is suspect.
Vehicle does not sit level	<ul style="list-style-type: none"> ● Suspension fault 	<ul style="list-style-type: none"> ● Two chimes repeated regularly Red indicator permanently illuminated 	<ul style="list-style-type: none"> ● Water ingress to wiring harness or connectors ● Air leak(s) ● Calibration corrupt ● cross-link valve fault ● Height sensor fault ● Reservoir valve stuck open ● Exhaust valve stuck closed ● Corner valves stuck open ● Air suspension control module failure 	Visually inspect the wiring harness and connectors for water ingress. Visually inspect the system for air leakage and refer to the guided diagnostic routine on the approved diagnostic system. Check the system calibration using the approved diagnostic system. For front and rear cross link valve tests refer to the guided diagnostic routine on the approved diagnostic system. Check for height sensor DTCs and refer to the DTC index. For reservoir and exhaust valve tests refer to the guided diagnostic routine on the approved diagnostic system. Check for corner valve

Symptom	Possible Message	Possible Other Warnings	Possible Causes	Action
				DTCs and refer to the DTC index. Refer to the warranty policy and procedures manual if a module is suspect.
Vehicle sits too low	<ul style="list-style-type: none"> ● Suspension fault ● Hill descent control (HDC) fault, system not available ● Dynamic stability control (DSC) 	<ul style="list-style-type: none"> ● Two chimes, amber indicator permanently illuminated ● One chime ● DSC amber indicator permanently illuminated ● ABS indicator permanently illuminated 	<ul style="list-style-type: none"> ● Water ingress to wiring harness or connectors ● Air leak(s) ● Air suspension compressor temperature sensor fault ● Inlet air filter blockage/restriction ● Air suspension compressor fault ● Exhaust valve stuck/sticking ● Air suspension control module lost communication with ABS module ● ABS fault. ● Air suspension control module failure 	Visually inspect the wiring harness and connectors for water ingress. Visually inspect the system for air leakage. For air compressor temperature sensor, inlet air filter, exhaust valve and air compressor tests refer to the guided diagnostic routine on the approved diagnostic system. For Air suspension control module lost communication with ABS module, refer to the lost communication codes statement at the end of this table. Check for ABS DTCs, Refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if a module is suspect.
Vehicle sits too high	<ul style="list-style-type: none"> ● Suspension fault 	<ul style="list-style-type: none"> ● Two chimes, amber indicator permanently illuminated 	<ul style="list-style-type: none"> ● Reservoir valve stuck open ● Exhaust valve stuck closed ● Corner valves stuck open ● Air suspension control module failure 	For reservoir valve and exhaust valve tests refer to the guided diagnostic routine on the approved diagnostic system. Check for corner valve DTCs and refer to the DTC index. Refer to the warranty policy and procedures manual if a module is suspect.
System detects extended mode unnecessarily when lowering	<ul style="list-style-type: none"> ● - 	<ul style="list-style-type: none"> ● - 	<ul style="list-style-type: none"> ● Crossed gallery and air spring pipes ● Incorrect valve block installed to front or rear ● Damage or blockage in air harness 	Refer to the guided diagnostic routine on the approved diagnostic system.
Vehicle leans/tilts after being left over-night or for some days	<ul style="list-style-type: none"> ● - 	<ul style="list-style-type: none"> ● - 	<ul style="list-style-type: none"> ● Leaking air spring(s) ● Leak from corner valve to gallery ● Exhaust valve stuck open 	Refer to the guided diagnostic routine on the approved diagnostic system.
After vehicle left over-night or for some days system regularly indicates "Suspension vehicle raising slowly" when first driving off	<ul style="list-style-type: none"> ● Suspension vehicle raising slowly 	<ul style="list-style-type: none"> ● - 	<ul style="list-style-type: none"> ● Leaking air spring(s) ● Leaking reservoir 	Refer to the guided diagnostic routine on the approved diagnostic system.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Air Suspension Control Module \(RLM\)](#) (100-00 General Information, Description and Operation).

Air Suspension Deflation Exit Routine

1. Key on, engine off.
2. Key off.
3. Press and release raise switch.
4. Press and release lower switch.
5. Key on, engine off.
6. Key on, engine running.
7. Press and release raise switch twice.

8. **8.** Press and release lower switch twice.

9. **9.** Press and release raise switch.

Vehicle Dynamic Suspension - Air Suspension System Depressurize and Pressurize

General Procedures

• WARNINGS:



A small amount of air pressure will be left in the air suspension system.



Eye protection must be worn.



Wear protective gloves.


• CAUTIONS:



Make sure tailgate, hood and all doors are closed.



Make sure the vehicle is in a clear working area.

1.  **WARNING:** The air suspension system is pressurised up to 16.8 bar (244 lbf/in²). Make sure no dirt or grease enters the system. Always wear hand, eye and ear safety standard protection when working on the system.


Using T4, depressurize the air suspension.

2. Using T4, pressurize the air suspension.

- Start and run the engine.

Vehicle Dynamic Suspension - Ride Height Adjustments

General Procedures


Special Tool(s)	
 <p>204-557B</p> <p>E95131</p>	<p>Gauge, Ride height</p> <p>204-557B</p>

• CAUTIONS:

 Make sure the wheels and tires, tie rod ends, suspension joints and wheel bearings are free from damage, wear and free play.

 Make sure there are no heavy objects in the vehicle.


 The ride height must be measured with the vehicle weight supported by the suspension.

 With the engine running and all vehicle doors closed, make sure the air suspension is functioning and the vehicle height can be raised and lowered using the air suspension switch.

 Drive the vehicle on to a flat, level surface.

 Make sure the steering wheel is in the straight ahead position.


• NOTE: This procedure must be carried out after replacement of the air suspension control module, removal or replacement of a height sensor, removal or replacement of the front or rear suspension arms, replacement of body panels incorporating suspension fixing points.

1.  CAUTION: Make sure the vehicle is not moved once it has been positioned to take measurements.

Position the vehicle on a flat level surface.

2. Connect the diagnostic tool to the vehicle data link connector (DLC).

- Connect the vehicle data link cable into the vehicle communications module.
- Connect the diagnostic tool USB Lead into the vehicle communications module.
- Connect the data link cable to the data link connector.
- Connect the diagnostic tool USB lead to the diagnostic tool USB port.

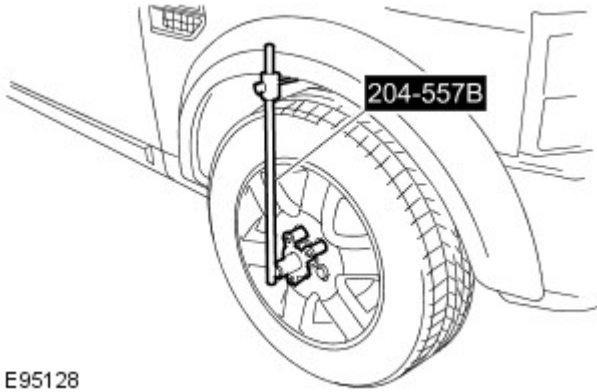
3.  CAUTION: Make sure the ignition switch is turned off, the park brake is on and the selector lever is in park.

• NOTE: IDS already loaded with the latest issue of software.


Switch IDS on and navigate to the vehicle identification number (VIN) input screen.

4. Enter the vehicle identification number (VIN) and navigate to the vehicle configuration menu.

- Select setup and configuration.
- Select air suspension height calibration and read all warnings and cautions.
- Follow the on-screen prompts.



E95128

5.  CAUTION: The diagnostic tool will cause the vehicle height to change during some parts of the calibration process.

- NOTE: Do not install the special tool over a locking wheel nut.
- NOTE: Make sure the special tool is square to the wheel face with the measuring rod in a vertical position.
- NOTE: Take the measurement from the top edge of the slider on the special tool.
- NOTE: Make sure the fender splash shields are correctly fitted.


Once in the suspension height measurement screen, use the special tool to measure and record the height setting from each wheel center to the wheel arch.


- Follow the on-screen prompts.

6. After successful calibration of the air suspension switch off the diagnostic tool and return to its original position.

Vehicle Dynamic Suspension - Air Leaks

General Procedures

Special Tool(s)	
	Hose Cutter 204-494 (LRT 60-002)


1.  **CAUTION:** Any leak detection spray used must have a corrosion inhibitor, and must not cause damage to paintwork, plastics, metals or plastic lines.


• **NOTE:** The recommended leak detection spray is GOTEC LDS, Landrover part number STC 1090.


The recommended leak detection spray should be used to identify any suspected leaks. This procedure should also be used where any of the air suspension components have been disturbed.


2. Clean around the area of the suspected air leak.
3. Using the recommended leak detection spray, spray around all of the air suspension components, working systematically until the source of the air leak has been found.
4. If any of the air suspension components are found to be leaking e.g. air spring, compressor, reservoir or a solenoid valve block, repair is effected by replacement only.
5. Using T4, depressurize the air suspension system. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).


6. CAUTIONS:

 Different air lines in the air suspension system have different material properties and wall thicknesses. It is important, in order to prevent subsequent air line failure, that the new air line material and wall thicknesses are identical to those of the air line being removed.

 Replacement air line must be cut from a new air line with the equivalent Land Rover part number as the one being replaced. Do not use air line cut from a roll or coil.

 Any existing heatsleeves and abrasion sleeves must be replaced as part of the repair.

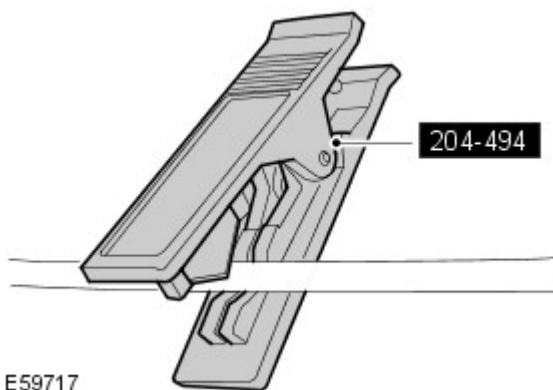
 Air line connectors should be positioned in areas away from heat sources such as the exhaust system, and away from any section of air line with a heat shield installed.

 Do not trim air line ends. If the end of the air line is damaged, the air line must be cut and a new section added using a Land Rover approved air line connector, or the air line must be renewed completely.

• **NOTE:** Air lines must only be cut using either Hose cutter 204-494 (LRT 60-002), available from SPX LTD or Hose cutter YA1000A, available from Snap-On Tools. Make sure the cut air line end is free from damage or burrs.

• **NOTE:** Only Land Rover approved air lines have been tested to the correct pressure and temperature specifications.

• **NOTE:** Only the Land Rover approved air line connector, RYC500210, has been tested to the correct pressure and temperature specifications.



- NOTE: If the markings or tape adjacent to the air line connections are removed when cutting air lines, the cut end of the air line must be clearly marked with a suitable colored tape or paint mark.

If the source of the air leak is found to be an air line connection, renew the Voss connector and, if required, the end of the air line. Using the special tool, cut off the damaged end of the air line and replace with new Land Rover approved air line and air line connectors as required.

7. If the source of the air leak is found to be in a section of air line, either; renew the air line, or, using the special tool, cut out the damaged section of air line and replace with new Land Rover approved air line, and air line connectors, as required.

8. NOTE: If the repair has been unsuccessful repeat the above steps until the air leak is rectified.


Using T4, pressurize the air suspension system.
For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

Vehicle Dynamic Suspension - Suspension Height Sensor

Removal and Installation

Removal

- NOTE: This procedure covers removal and installation of both the front and rear suspension height sensors.
- NOTE: The right hand sensor has a black colored lever and the left hand sensor has a white colored lever.

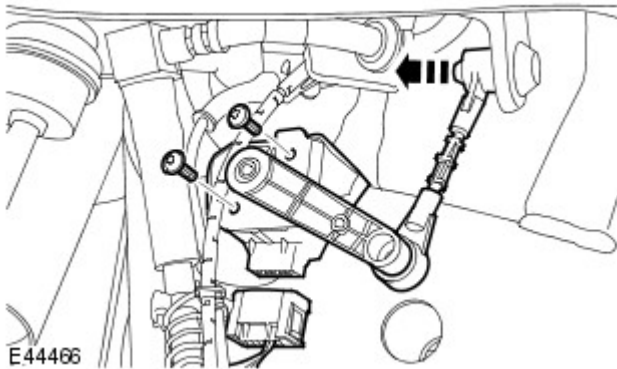
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


2.  **CAUTION:** Do not use excessive force to disconnect the height sensor link.

Remove the suspension height sensor.

- Disconnect the height sensor link.
- Disconnect the electrical connector.
- Remove the 2 Torx screws.



Installation

1.  **CAUTION:** Make sure the Torx screw is not over tightened. Failure to follow this instruction will result in damage to the vehicle.

To install, reverse the removal procedure.

- Tighten the screws to 3 Nm (2 lb.ft).
2. Using Land Rover approved diagnostic equipment, calibrate the ride height.

Vehicle Dynamic Suspension - Air Suspension Reservoir

Removal and Installation

Removal

- 1. ⚠ WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Using T4, depressurize the air suspension. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

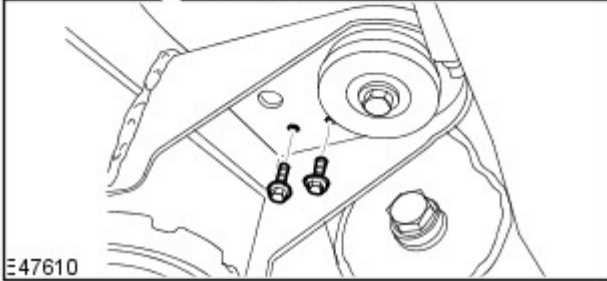
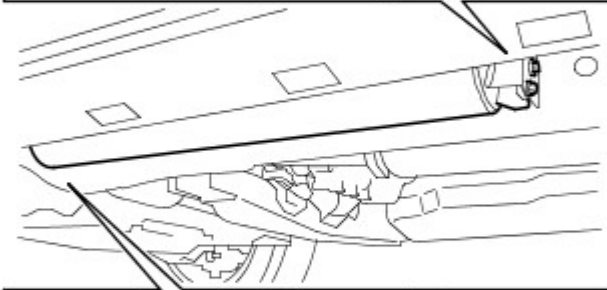
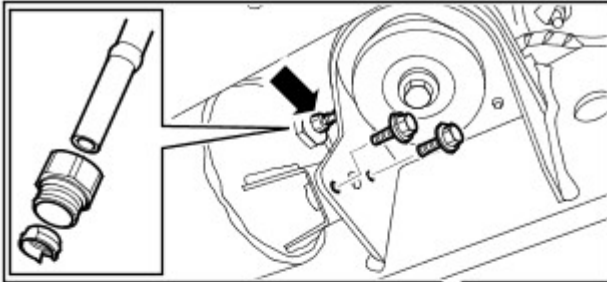
3. CAUTIONS:

⚠ Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

⚠ The air line must only be disconnected by removal of the Voss connector. Do not remove the air line retaining boss from the air suspension reservoir. Failure to follow this instruction may result in damage to the vehicle.

⚠ Visually inspect the air line ends for damage or wear. Repair or replace the air line as necessary.

Disconnect the air line from the air suspension reservoir.



- Remove the air suspension reservoir.
 - Remove the 4 bolts.
- Remove the Voss connector from the air line.
 - Remove and discard the collet and the union.

Installation

- ⚠ CAUTION:** Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

Install a new Voss connector to the air reservoir.

- Tighten the new Voss connector to 5 Nm (4 lb.ft).

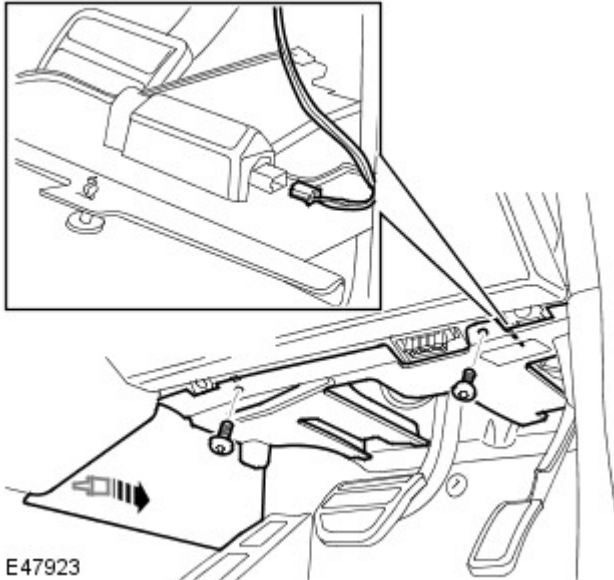
- Install the air suspension reservoir.
 - Using T4, pressurize the air suspension. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).
 - Locate the air reservoir to the chassis brackets. Fit the bolts and tighten to 23 Nm (17 lb.ft).
 - Fully seat the air line into the Voss connector.
 - Pull on the air line to make sure it is fully installed into the Voss connector.

Vehicle Dynamic Suspension - Air Suspension Control Module

Removal and Installation

Removal

1. Driver side: Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the closing trim panel.

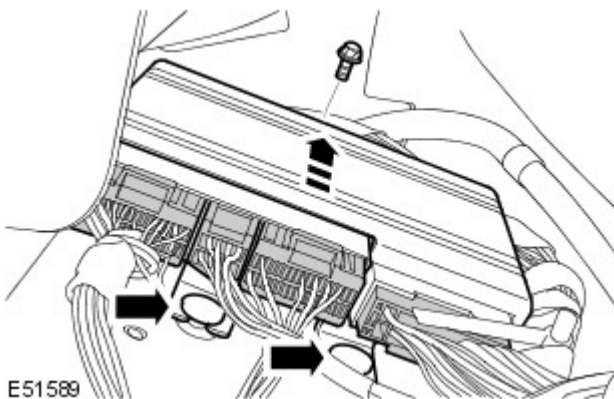


E47923

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.

3. Remove the air suspension control module.

- Disconnect the 4 electrical connectors.
- Remove the bolt.
- Release from the 2 clips.



E51589


Installation

1. Install the air suspension control module.
 - Secure with the clips.
 - Connect the electrical connectors.
 - Tighten the bolt to 9 Nm (7 lb.ft).
2. Install the closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.
3. Install the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Initiate a new control module using T4.

Vehicle Dynamic Suspension - Air Suspension Reservoir Solenoid Valve Block

Removal and Installation

Removal

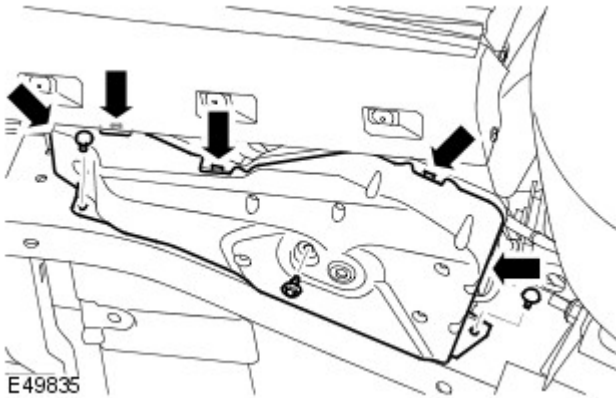
- 1.  WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- 2.** Using T4, depressurize the air suspension. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

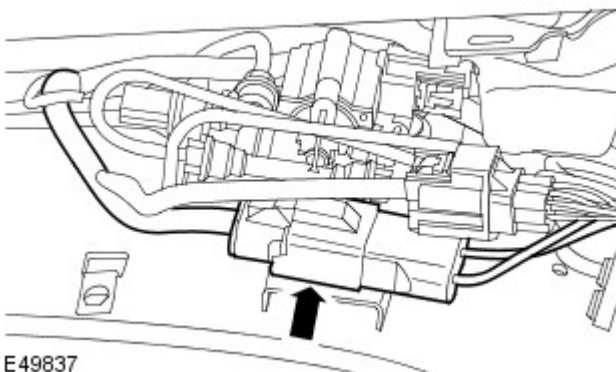
- 3.** Remove the air suspension compressor lower cover.

- Remove the 3 bolts.
- Release the 5 clips.





- 4.** Move the air compressor electrical connector aside.

- Release the 2 clips.



- 5. CAUTIONS:**

 Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

 Visually inspect the air line ends for damage or wear. Repair or replace the air line as necessary.

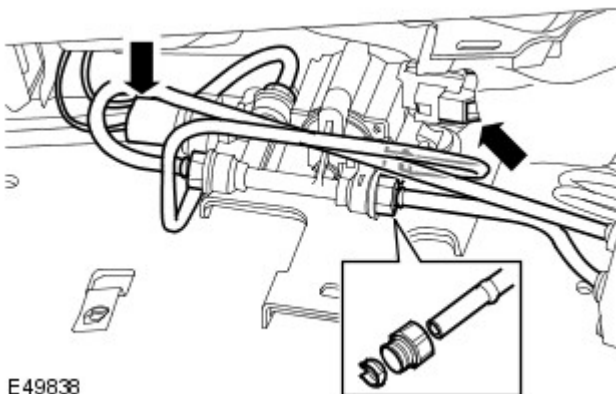
- **NOTE:** Note the air line fitted positions.

Remove the air suspension reservoir solenoid valve block.

- Disconnect the 4 air lines.
- Disconnect the 2 electrical connectors.
- Release the valve block 3 rubber insulators.

- 6.** Remove the Voss connectors.

- Remove and discard the collets and the unions.



Installation

1.  CAUTION: Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

• NOTE: New air suspension components are supplied with new Voss connectors tightened to the correct torque. Do not install new voss connectors if a new component is being installed.

Install new Voss connectors to the air suspension reservoir solenoid valve block.

- Tighten to 2.5 Nm (1.7 lb.ft).

2. NOTE: Make sure the valve block does not become detached during connection of the air lines.

Install the air suspension reservoir solenoid valve block.

- Secure the 3 valve block rubber insulators.
- Connect the electrical connectors.
- Connect the air lines into the Voss connector.
- Pull on each air line to make sure it is fully installed into the Voss connector.

3. Secure the air compressor electrical connector.

4. Install the air suspension compressor lower cover.

- Install the bolts and tighten to 10 Nm (7 lb.ft).

5. Using T4, pressurize the air suspension.

For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

Vehicle Dynamic Suspension - Air Suspension Compressor Drier

Removal and Installation

Removal



CAUTION: If a new air suspension compressor, air compressor drier or air compressor delivery valve kit is installed due to failure, an air compressor relay must be installed. Failure to follow this instruction may result in damage to the air suspension system components.

- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the air suspension compressor.
For additional information, refer to: [Air Suspension Compressor](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

- CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

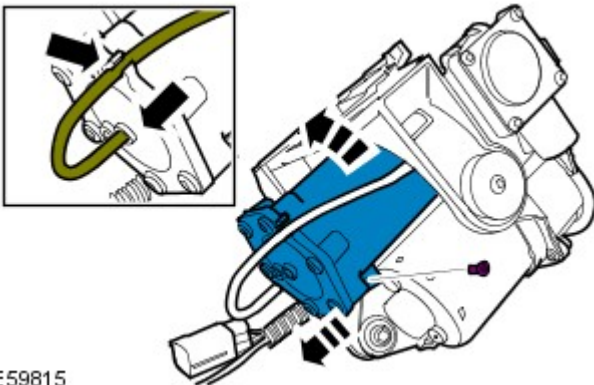
Disconnect the air line from the air suspension compressor drier.

- Release the air line from the retaining clip.

- NOTE:** If equipped, note the position of the air suspension compressor retaining cable.

Remove the air suspension compressor drier.

- Remove the retaining screw.
- Remove and discard the O-ring seal.



E59815

Installation

- Install a new O-ring seal.
 - Lubricate the O-ring with a lithium based grease.
- NOTE:** If equipped, make sure the air suspension compressor retaining cable is correctly routed around the compressor cylinder head.

Install the air suspension compressor drier.

- Install the retaining screw and tighten to 3 Nm (2.2 lb.ft).

3. CAUTIONS:

Visually inspect the air line ends for damage or wear. Replace the air line as necessary.

Pull on the air line to make sure it is securely intalled in the connector.

Connect the air line to the air suspension compressor drier.

- Attach the air line to the retaining clip.

- Install the air suspension compressor.
For additional information, refer to: [Air Suspension Compressor](#)

(204-05 Vehicle Dynamic Suspension, Removal and Installation).

Vehicle Dynamic Suspension - Air Suspension Compressor

Removal and Installation

Removal

⚠ WARNING: Steps 1 and 2 must be carried out within 10 minutes of each other, failure to follow this instruction may result in personnel injury.

⚠ CAUTION: If a new air suspension compressor, air compressor drier or air compressor delivery valve kit is installed due to failure, an air compressor relay must be installed. Failure to follow this instruction may result in damage to the air suspension system components.

⚠ CAUTION: Make sure the ignition switch is turned off, the park brake is on and the selector lever is in park position.

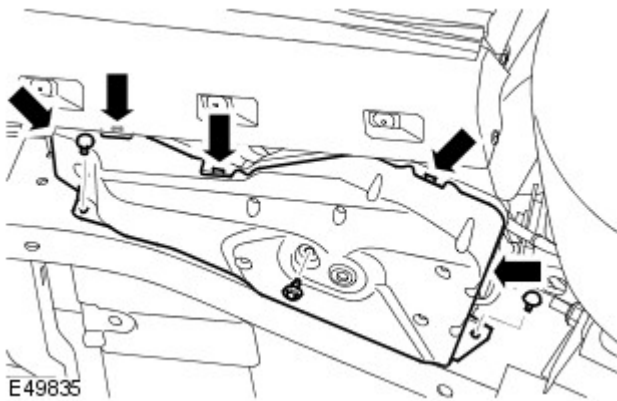
Open the front door.

⚠ WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle, make sure at least one of the wheels is off the ground.

3. Remove the air suspension compressor lower cover.

- Remove the bolt.
- Release the 5 clips.

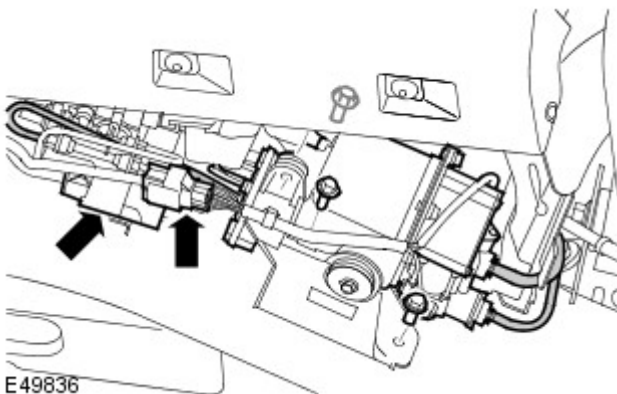


⚠ CAUTION: Always plug any open connections to prevent contamination.

• **NOTE:** Access to the top compressor fixing bolt is very restricted. It is advisable to use a 3/8 inch drive socket with a flexible coupling.

Remove the air suspension compressor.

- Disconnect the 3 air lines.
- Disconnect the 2 electrical connectors.
- Remove the 3 bolts.



Installation

1. CAUTIONS:

⚠ Make sure that the wiring harness and the air suspension pipes are not trapped behind the air suspension compressor bracket.

⚠ Make sure the air suspension compressor upper cover is correctly positioned.

• **NOTE:** Install the upper retaining bolt, but do not fully tighten, before installing the 2 lower retaining bolts.

Install the air suspension compressor.

- Tighten the bolts to 23 Nm (17 lb.ft).
- Connect the air lines.
- Connect the electrical connectors.

2. CAUTIONS:



Make sure the air suspension exhaust pipe is correctly located in to the air suspension upper cover.



Make sure the air suspension compressor upper cover is correctly positioned.


Install the air suspension compressor lower cover.

- Install the bolt and tighten to 9 Nm (7 lb.ft).

Vehicle Dynamic Suspension - Air Suspension Front Solenoid Valve Block

Removal and Installation


Removal


-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the RH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
- Using T4, depressurize the air suspension.
For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

4. CAUTIONS:

 Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

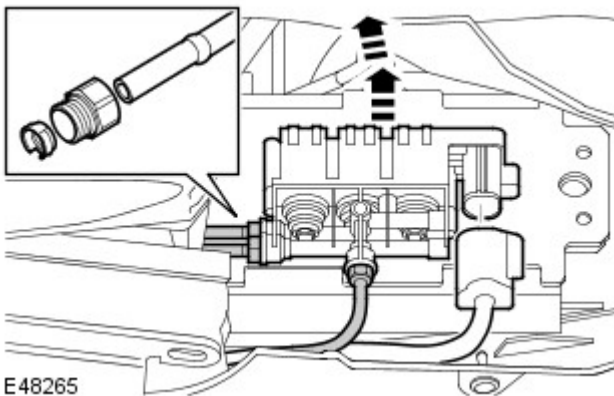
 Visually inspect the air line ends for damage or wear. Repair or replace the air line as necessary.

- **NOTE:** Note the air line fitted positions.

Disconnect the 3 air lines from the air suspension front solenoid valve block.

- Remove the air suspension front solenoid valve block.

- Disconnect the electrical connector.
- Release the valve block 3 rubber insulators.



E48265

- Remove the Voss connectors from the air lines.

- Remove and discard the collet and the union.

Installation

-  **CAUTION:** Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

- **NOTE:** New air suspension components are supplied with new Voss connectors tightened to the correct torque. Do not install new voss connectors if a new component is being installed.

Install new Voss connectors to the air suspension front solenoid valve block.

- Tighten to 2.5 Nm (1.7 lb.ft).

- NOTE:** Make sure the valve block does not become detached during connection of the air lines.

Install the air suspension front solenoid valve block.

- Secure the 3 valve block rubber insulators.
- Connect the air lines into the Voss connector.


- Pull on each air line to make sure it is fully installed into the Voss connector.
 - Connect the electrical connector.
3. Using T4, pressurize the air suspension.
For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).
 4. Install the RH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

Vehicle Dynamic Suspension - Rear Air Spring

Removal and Installation

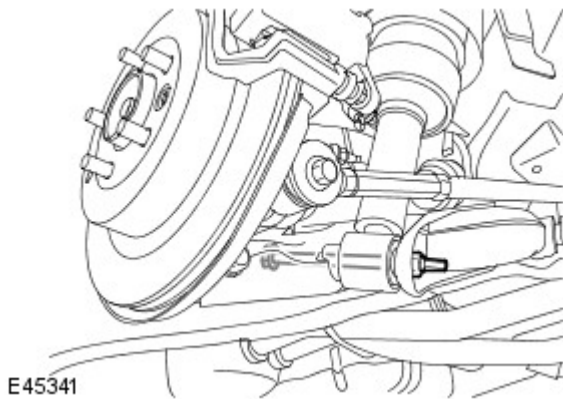
Removal

- NOTE: Only the air spring being removed needs to be depressurised.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

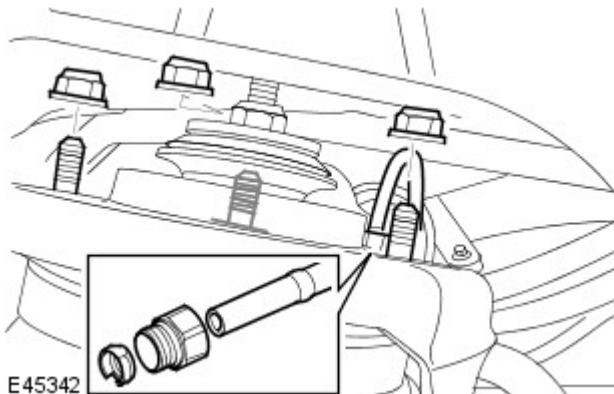
2. Remove the wheel and tire.
3. Using T4, depressurise the air suspension.
For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).
4. Disconnect the rear air spring from the lower arm.
 - Remove the nut and bolt.



5.  **CAUTION:** Always plug any open connections to prevent contamination.

Disconnect the air line.

6. Using a trolley jack, support the rear air spring assembly.
7. Remove 3 rear air spring retaining nuts.
8. Remove the rear air spring.
9. Remove the Voss connector from the air line.
 - Remove the collet and the union.



Installation

1. Install a new Voss connector to the air spring.
 - Tighten to 3.5 Nm (2.6 lb.ft)
2. Install the rear air spring.
 3. Connect the shock absorber and spring assembly to the lower arm.
 - Make sure the spring and shock absorber assembly top mounting to body mating faces are clean.
 - Tighten the nut and bolt to 300 Nm (221 lb.ft).
 - Connect the air line into the Voss connector.
4. Using T4, pressurise the air suspension.
For additional information refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

[Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).


5. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Vehicle Dynamic Suspension - Air Suspension Muffler

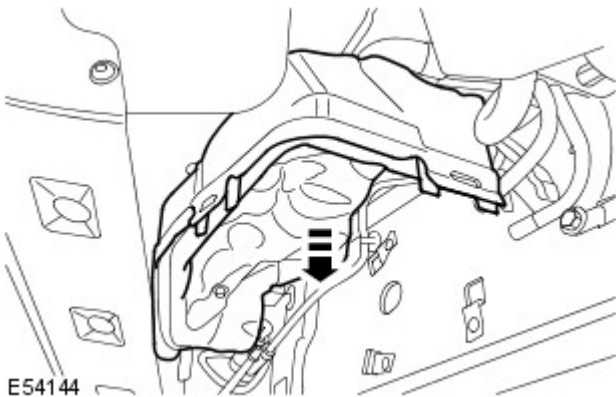
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

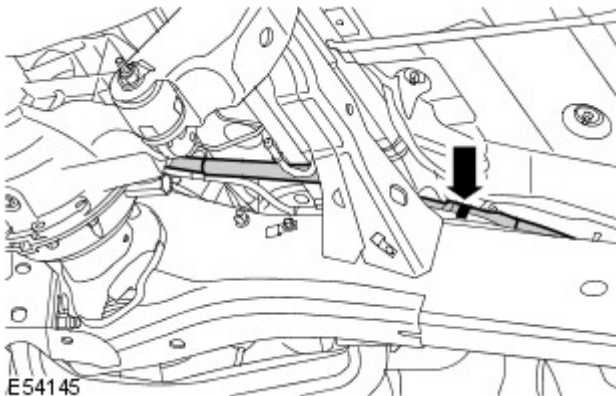
2. Remove the muffler assembly.
For additional information, refer to: Muffler (309-00B Exhaust System - 4.4L, Removal and Installation).
3. Remove the evaporative emissions canister.
For additional information, refer to: [Evaporative Emission Canister](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Removal and Installation).
4. Remove the air suspension compressor.
For additional information, refer to: [Air Suspension Compressor](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).
5. Remove the air suspension compressor upper cover.



6. Disconnect the air suspension intake filter pipe.

7. Remove the air suspension muffler.

- Release clip from the air suspension muffler pipe.
- Release the air suspension compressor to air suspension silencer pipes.




Installation

1. Install the air suspension muffler.

- Locate the air suspension muffler pipes.
- Secure the clip.

2. Connect the air suspension intake filter.

3.  **CAUTION:** Make sure the air suspension compressor upper cover is correctly positioned.

Install the air suspension compressor upper cover.

4. Install the air suspension compressor.
For additional information, refer to: [Air Suspension Compressor](#)


(204-05 Vehicle Dynamic Suspension, Removal and Installation).

5. Install the evaporative emissions canister.
For additional information, refer to: [Evaporative Emission Canister](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Removal and Installation).
6. Install the muffler assembly.
For additional information, refer to: Muffler (309-00B Exhaust System - 4.4L, Removal and Installation).

Vehicle Dynamic Suspension - Air Suspension Rear Solenoid Valve Block

Removal and Installation


Removal


1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the LH rear wheel and tire.
3. Using T4, depressurize the air suspension.
For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

4. CAUTIONS:

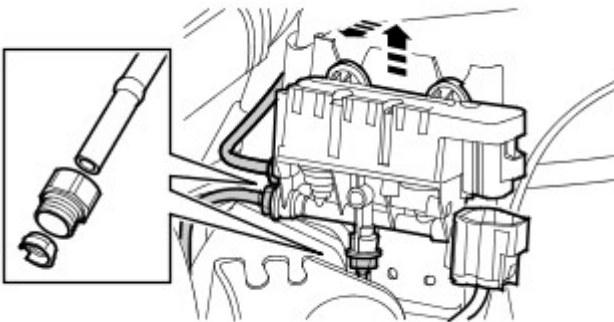
 Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

 Visually inspect the air line ends for damage or wear. Repair or replace the air line as necessary.

- **NOTE:** Note the air line fitted positions.

Disconnect 3 air lines from the rear valve block.

5. Disconnect the electrical connector.
6. Remove the rear valve block.
 - Release the valve block 3 rubber insulators.
7. Remove the Voss connectors from the air lines.
 - Remove and discard the collets and the unions.



E48266

Installation

1. **NOTE:** New air suspension components are supplied with new Voss connectors tightened to the correct torque. Do not install new voss connectors if a new component is being installed.

Install new Voss connectors to the rear valve block.

- Tighten to 2.5 Nm (1.7 lb.ft).
2. Install the rear valve block.
 - Secure the 3 valve block rubber insulators.
 - Connect the electrical connector.
 - Connect the air lines into the Voss connector.
 - Pull on each air line to make sure it is fully installed into the Voss connector.
 3. Using T4, pressurize the air suspension.
For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

4. Install the wheel and tire.

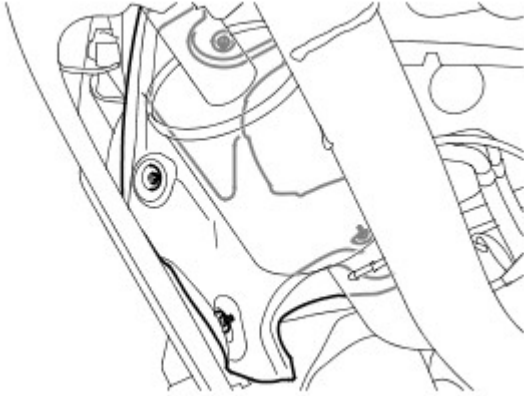
- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Vehicle Dynamic Suspension - Air Suspension Air Filter

Removal and Installation

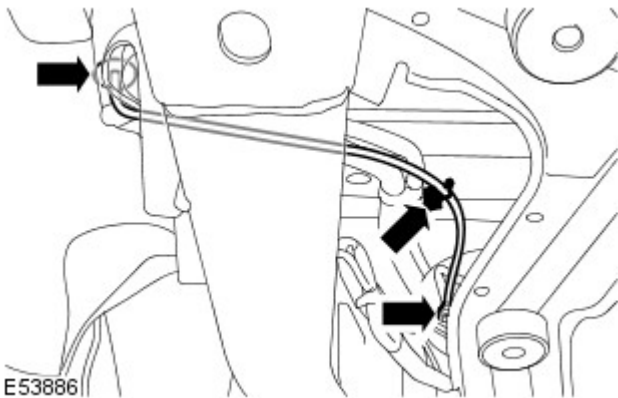
Removal

1. Open the liftgate and tailgate.
2. Remove the spare wheel and tire.
3. Remove the 4 nuts securing the LH rear tail pipe heat shield.



E53885

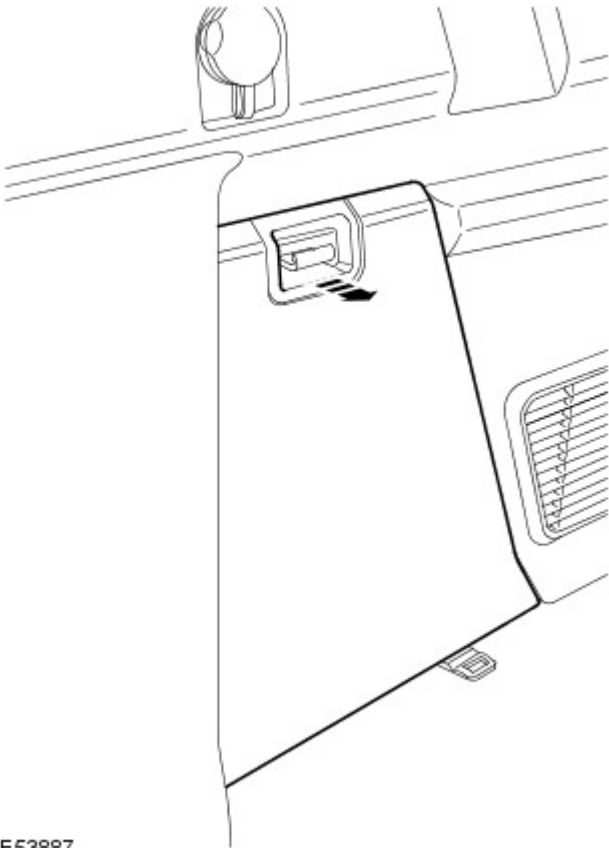
4. Reposition the LH rear tail pipe heat shield.
5. Disconnect the air suspension intake filter pipe.
6. Detach the air suspension intake filter.



E53886

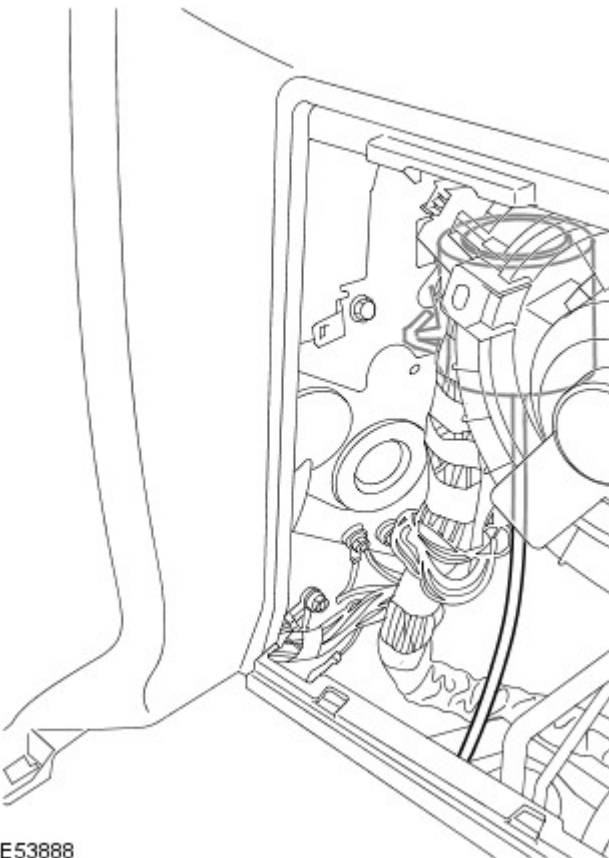
- Release the grommet.
- Release from the clip.

7. Remove the LH lower rear quarter trim access panel.



E53887

8. Remove the air suspension intake filter.



E53888



Installation

1. Install the air suspension intake filter.
 - Install the grommet.

2. Install the LH lower rear quarter trim access panel.
3. Attach the air suspension intake filter.
4. Connect the air suspension intake filter.
5. Reposition the LH rear tail pipe heat shield.
 - Install the nuts.
6. Install the spare wheel and tire.
7. Close the liftgate and tailgate.

Vehicle Dynamic Suspension - Front Air Shock Absorber

Removal and Installation

Special Tool(s)	
 <p>204-538 E51385</p>	<p>Air spring tester 204-538</p>
 <p>204-700 E99789</p>	<p>Remover front air shocker absorber spindle nut 204-700</p>

Removal

- NOTE: This procedure should also be used to remove the front air spring.

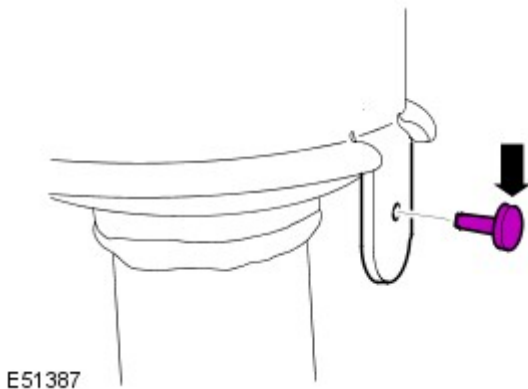
1. Remove the front shock absorber and air spring assembly. For additional information, refer to: [Front Shock Absorber and Air Spring Assembly](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

2. NOTE: If no leak is detected, investigate other areas of the air suspension for faults.

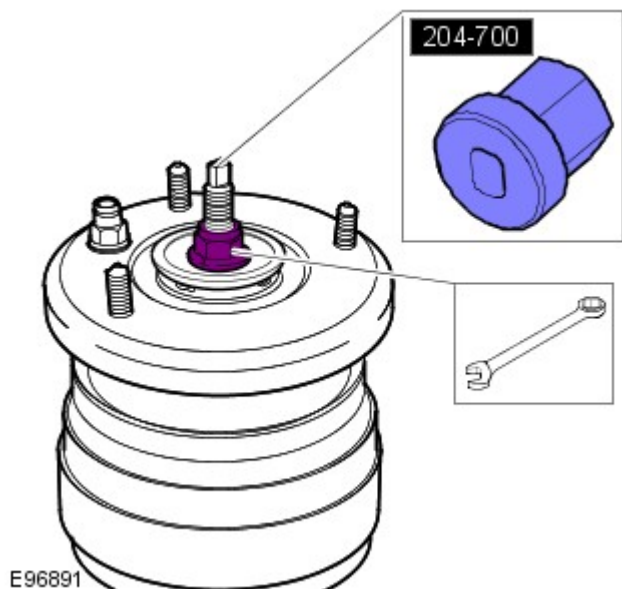
Check the assembly for leaks.

- Inflate the module to 4 bar and check for pressure loss using leak detector spray.
- If a leak is suspected, immerse the shock absorber and air spring assembly in a tank of water to locate the source of the leak and mark the area.

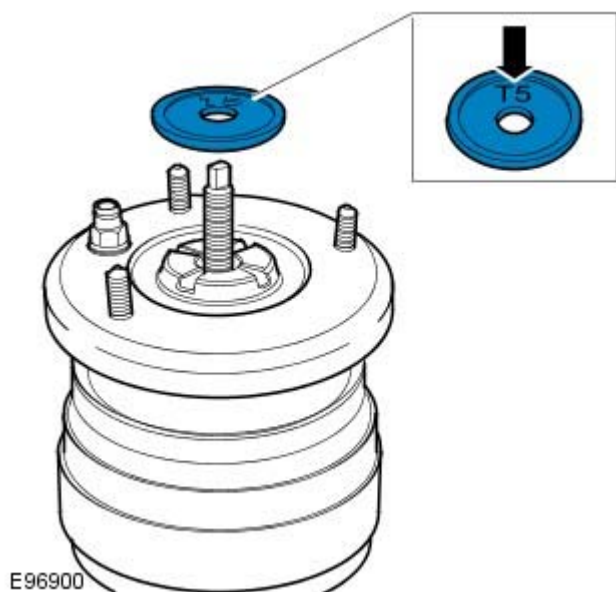
3. Remove the nylon retaining pin.




4. Using the special tool, remove the nut.



5. Remove the rebound washer.

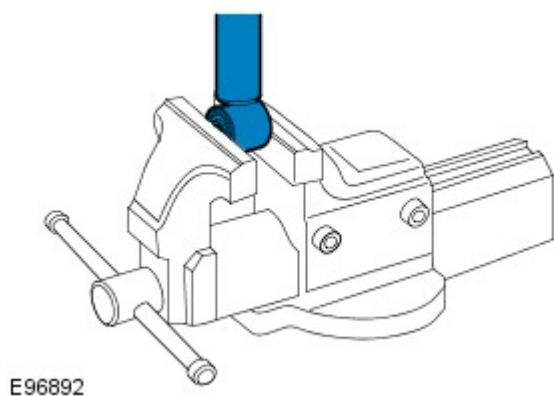


6. CAUTIONS:

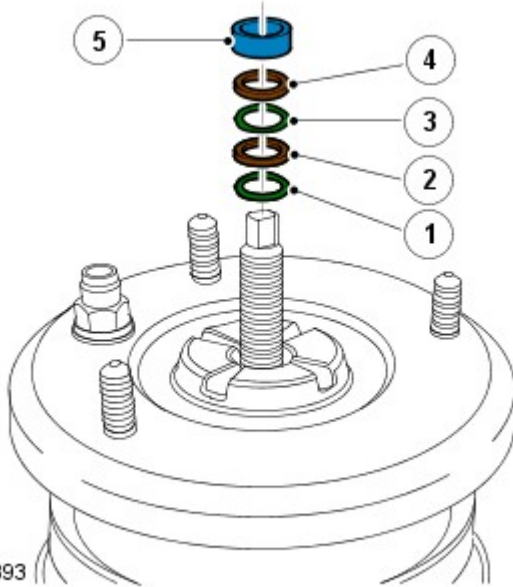
 Make sure protective jaws are installed to the vice. Failure to follow this instruction may result in damage to the component.

 Do not clamp the shock absorber tube. Failure to follow this instruction may result in damage to the component.

Position the front shock absorber and air spring assembly in a vice.

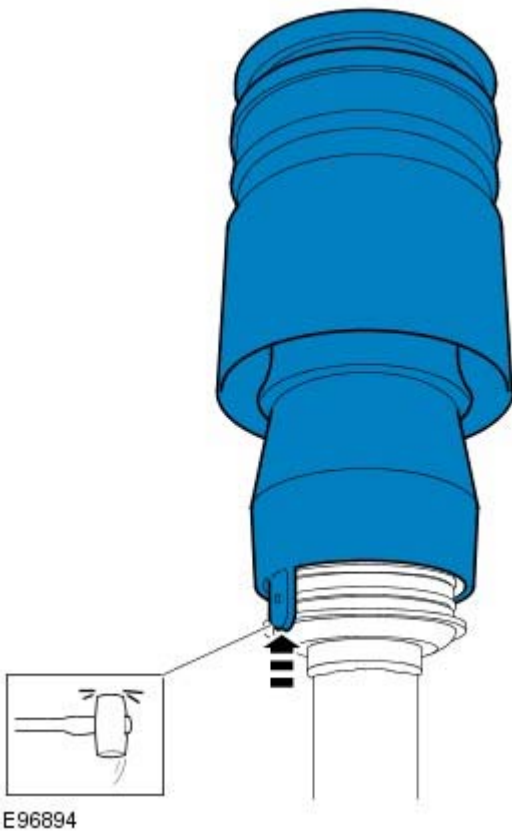


7. Remove and discard the 3 spacers and 2 O-ring seals.



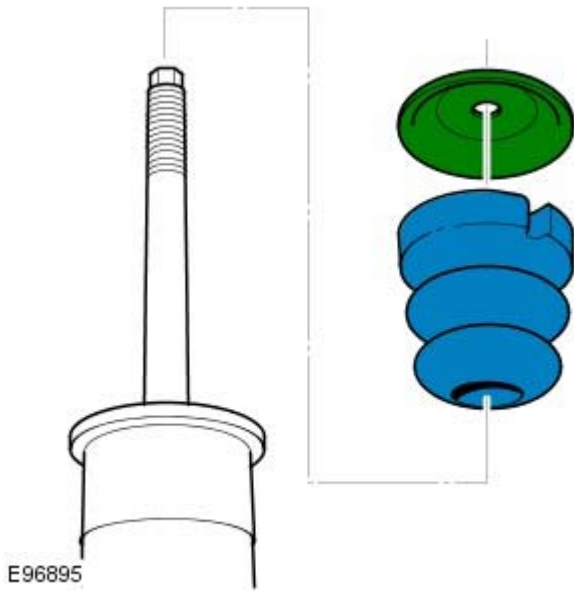
8. Remove the air spring.

- Using a soft faced mallet, gently tap the sleeve support upwards to release it from the O-ring seals.

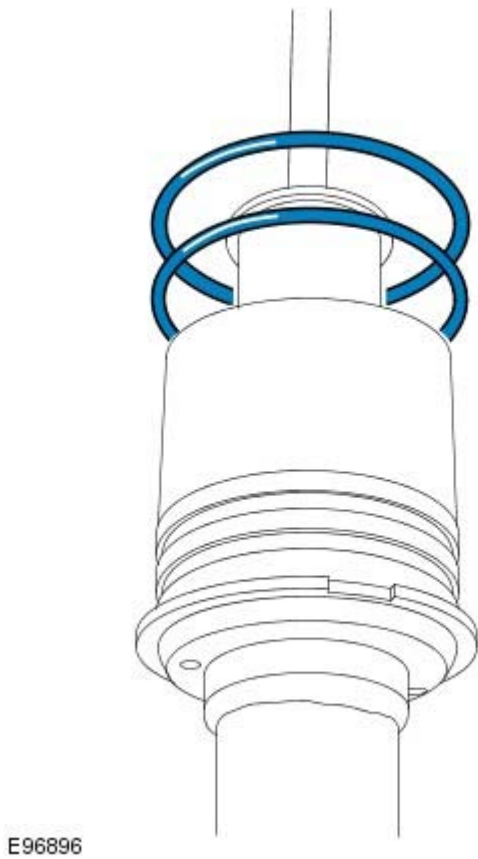


9. NOTE: Note the fitted position.

Remove the bump plate and spring aid.

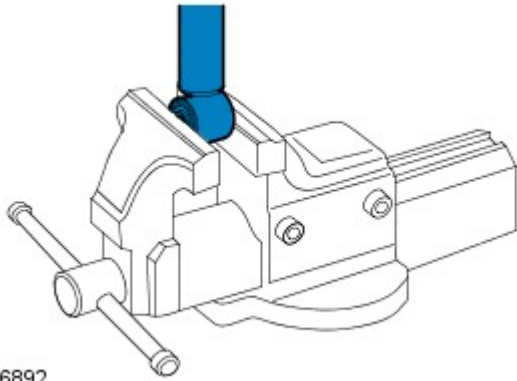


10. Remove and discard the 2 large black O-ring seals from the lower seal carrier.




11. Remove the front shock absorber and air spring assembly from the vice.


Installation



E96892

1. CAUTIONS:

 Make sure protective jaws are installed to the vice. Failure to follow this instruction may result in damage to the component.

 Do not clamp the shock absorber tube. Failure to follow this instruction may result in damage to the component.

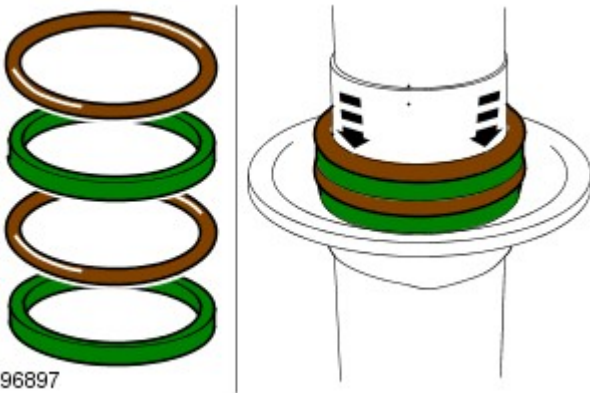
Position the front shock absorber and air spring assembly in a vice.

2.  CAUTION: Use compressed air and lint free non-flocking material.

Clean the components.

3. Lift the seal carrier to expose the O-ring seal stack.

- Make sure that the damper body O-ring seals and spacers are fully seated to the spring seat.

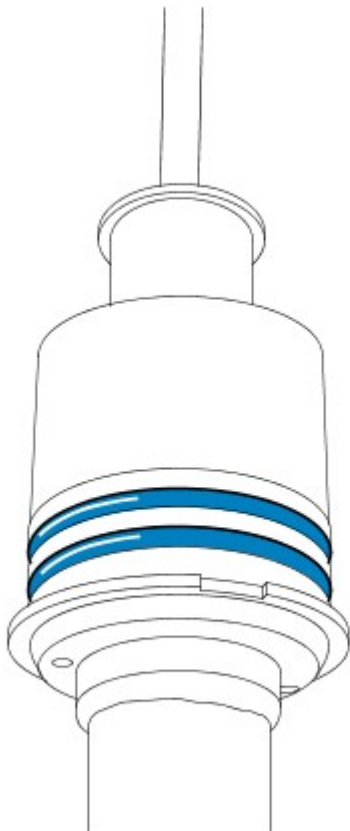


E96897

4.  CAUTION: Take care not to damage the O-ring seals during installation.

Install new O-ring seals to the seal carrier.

- Apply loctite 8021 (silicon-based oil) to the O-ring seals.



E96898

5. NOTE: Make sure that these components are installed to the noted removal position.

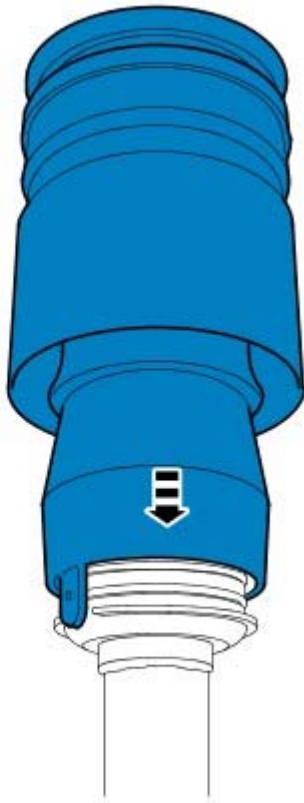
Install the bump plate and spring aid.



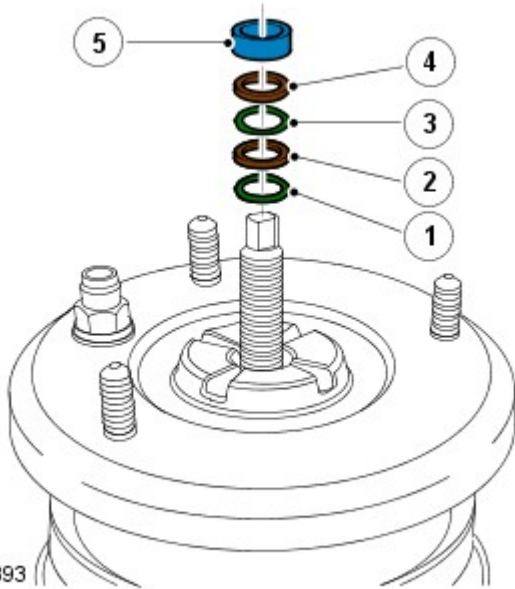
E96899

6. Install the air spring.

- Align the sleeve support with the first O-ring seal making sure that the location tag is correctly aligned with the spring seat cut-out.




E99908



E96893

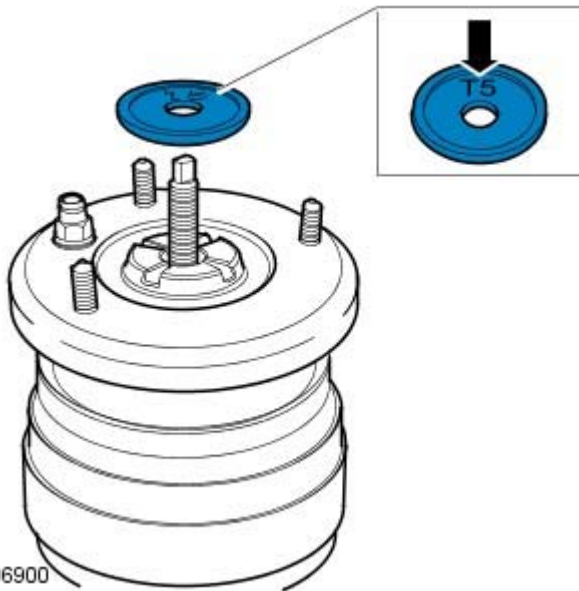
7. CAUTIONS:

 Make sure that the threads of the front air shock absorber are covered with protective tape.

 Take care not to damage the O-ring seals during installation.

Install the components in the following order:

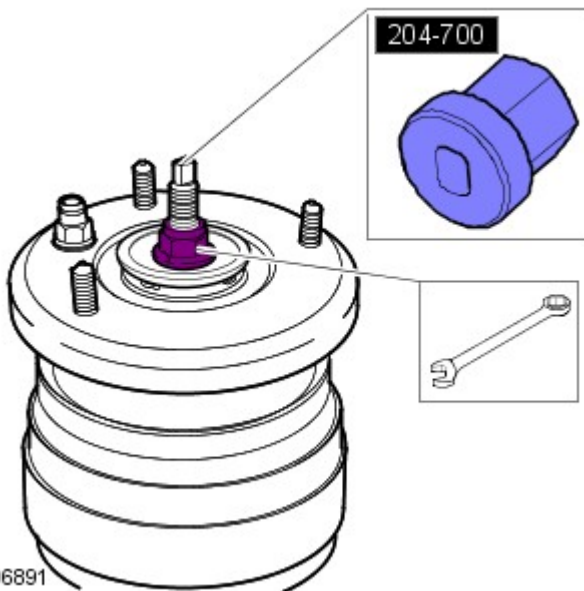
1. O-ring seal
2. Spacer
3. O-ring seal
4. Spacer
5. Spacer



E96900

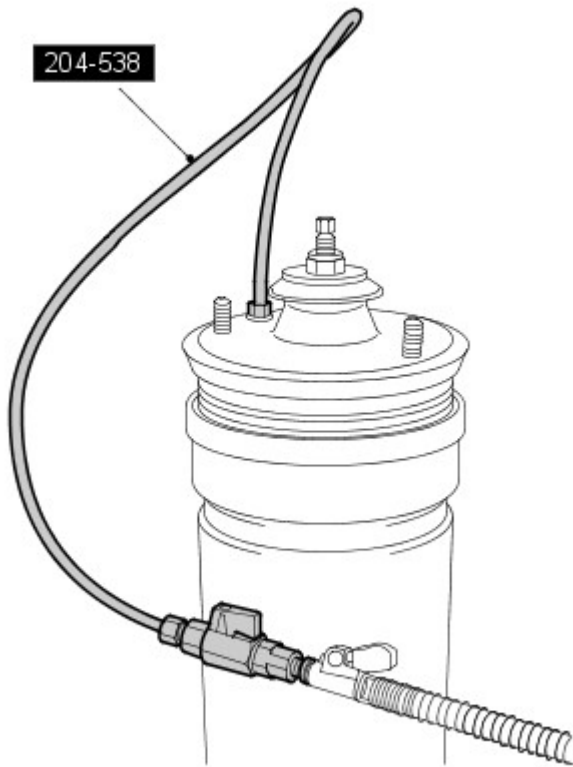
8. NOTE: The "T5" stamp on the upper face of the rebound washer must be visible after assembly.

Install the rebound washer.



E96891

9. Install a new nut and using the special tool, and tighten to 98 Nm (72 lb.ft).



E51445

10. CAUTIONS:



The air supply must be free of any moisture.



If during disassembly the air sleeve is unrolled, the air sleeve may inflate incorrectly (to one side). If this occurs, release the air pressure, and insert a suitable tool that will not damage the air sleeve or piston (a screw driver handle), into the side opposite the bulge. Inflate and deflate until the air sleeve inflates correctly (the air sleeve will be uniform inside the shroud).

• **NOTE:** To prevent damage when seating the sleeve support over the large black O-rings, compressed air should be used to inflate the air spring.

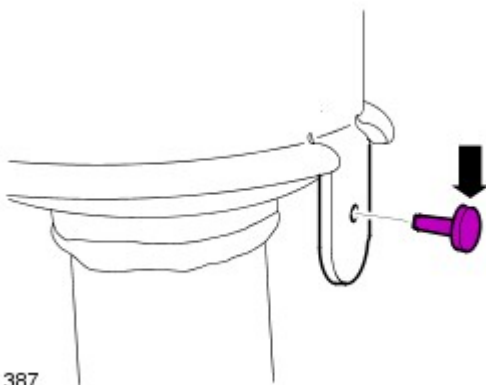
Using the special tool coupled to a tire inflator with a gauge, apply approximately 2 bar of air pressure to the air spring to fully seat the sleeve support over the O-ring seals.

11. Check the assembly for leaks.

- Inflate the module to 4 bar and check for pressure loss using leak detector spray.
- If a leak is suspected, immerse the shock absorber and air spring assembly in a tank of water to locate the source of the leak.

12. Depressurize and remove the special tool from the shock absorber and air spring assembly.

13. Install the nylon retaining pin.





E51387

14. NOTE: Install a new air spring pipe connector.

Install the front shock absorber and air spring assembly. For additional information, refer to: [Front Shock Absorber and Air Spring Assembly](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).


Vehicle Dynamic Suspension - Rear Air Shock Absorber

Removal and Installation

Special Tool(s)	
 <p>204-538 E51385</p>	<p>Air spring tester 204-538</p>
 <p>100-050 E57611</p>	<p>Band-it Thrift tool 100-050 (LRT-99-019)</p>

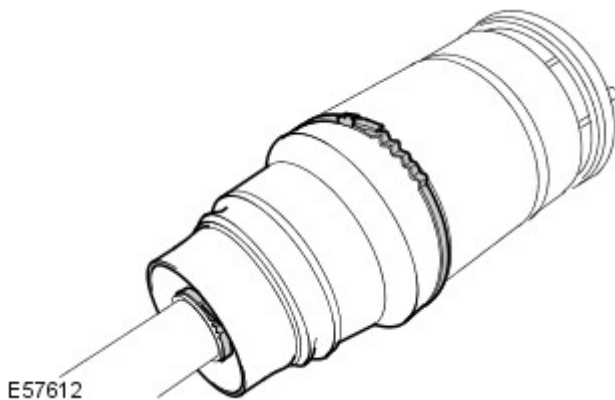
Removal

- NOTE: This procedure should also be used to remove the rear air spring.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

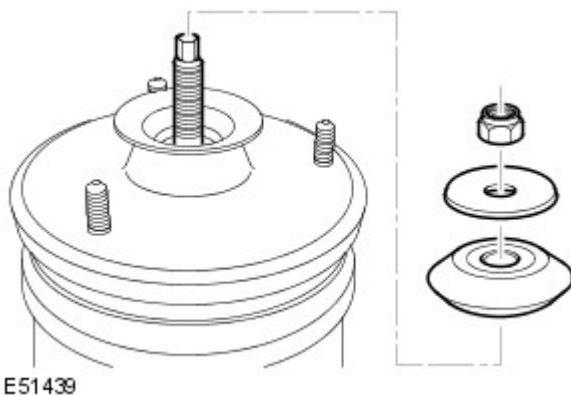
Raise and support the vehicle.

2. Remove the wheel and tire.
3. Remove the shock absorber and spring assembly.
For additional information, refer to: [Rear Shock Absorber and Air Spring Assembly](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).
4. Remove the gaiter.
 - Remove and discard the 2 straps.



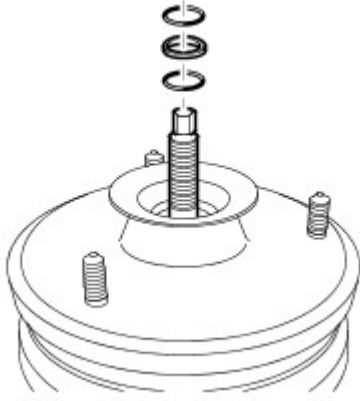
5. Remove the nut, rebound washer and rubber bushing.

- Discard the nut.



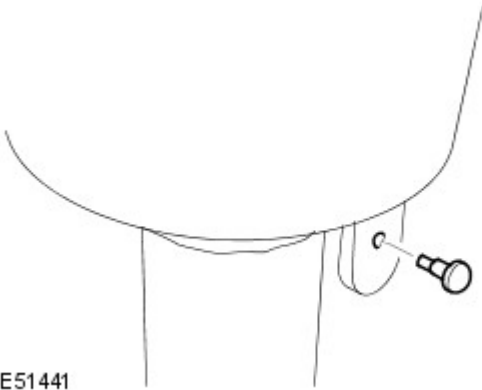
6. Remove and discard the O-ring seals and spacer.

E51440



7. Remove the nylon retaining pin.

E51441

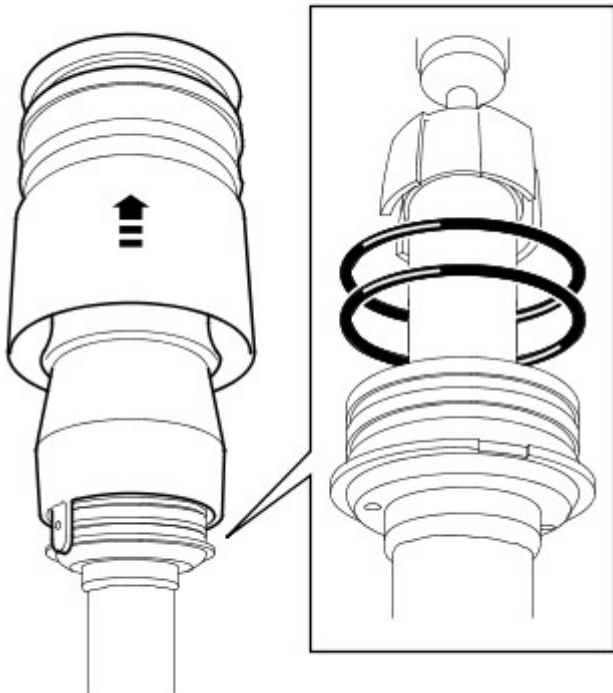


8. Remove the rebound plate and spring aid.

9. Remove the air spring.

- Using a soft faced mallet, gently tap the sleeve support upwards to release it from the O-ring seals.
- Remove and discard the 2 O-ring seals.

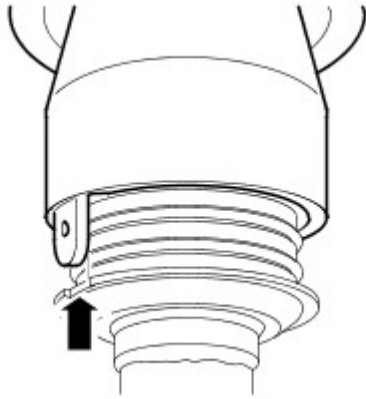
E51442



10. Remove the shock absorber from the vise.

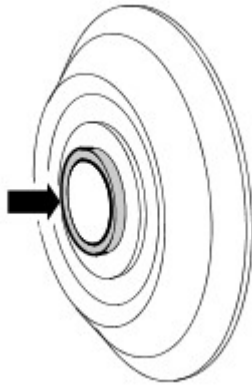
Installation

1. Install the shock absorber in the vise.
2. Clean the components.
3. Lubricate and install new O-rings to the seal carrier.
4. Install the spring aid and rebound plate.
5. Install the air spring.
 - Align the piston with the first O-ring seal, making sure the location tag is correctly aligned.



E51443

6. Install the new O-ring seals and spacer, taking care not to damage the seals.
7. Install the rubber bushing and rebound washer.
 - Make sure the formed insert on the bushing is located against the O-ring seal.



E51444

8. Install and lightly tighten the nut.

9. CAUTIONS:



The air supply must be free of any moisture.



If during disassembly the air sleeve is unrolled, the air sleeve may inflate incorrectly (to one side). If this occurs, release the air pressure, and insert a suitable tool that will not damage the air sleeve or piston (a screw driver handle), into the side opposite the bulge. Inflate and deflate until the air sleeve inflates correctly (the air sleeve will be uniform inside the shroud).

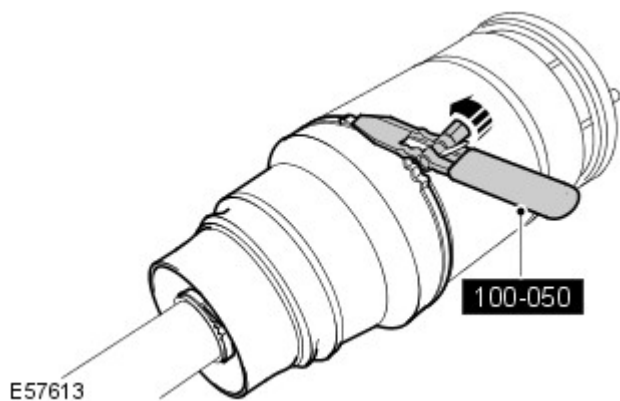
Install the air spring piston over the O-ring seals.

- Using the special tool coupled to a tire inflator with a gauge, apply approximately 2 bar of air pressure to the air spring to fully seat the piston over the O-ring seals.

10. Tighten the top nut to 98 Nm (72 lb.ft).

11. Check the assembly for leaks.

- Inflate the module to 4 bar and check for pressure loss.
- If a leak is suspected, immerse the spring and shock absorber assembly in a tank of water to locate the source of the leak.



12. Install the gaiter.

- Using the special tool, install new straps.

13. Install the shock absorber and spring assembly.
For additional information, refer to: [Rear Shock Absorber and Air Spring Assembly](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).


Vehicle Dynamic Suspension - Front Shock Absorber and Air Spring Assembly

Assembly

Removal and Installation

Removal

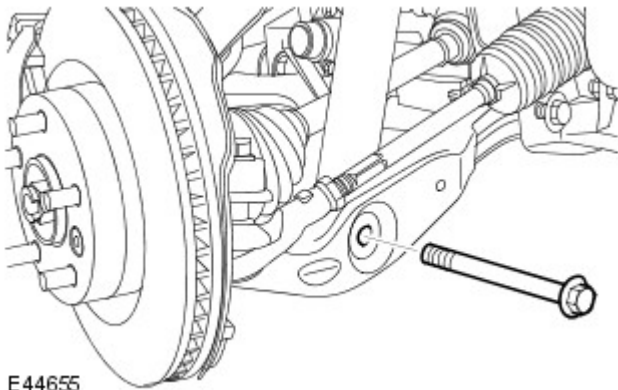
- NOTE: Only the air spring being removed needs to be depressurized.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

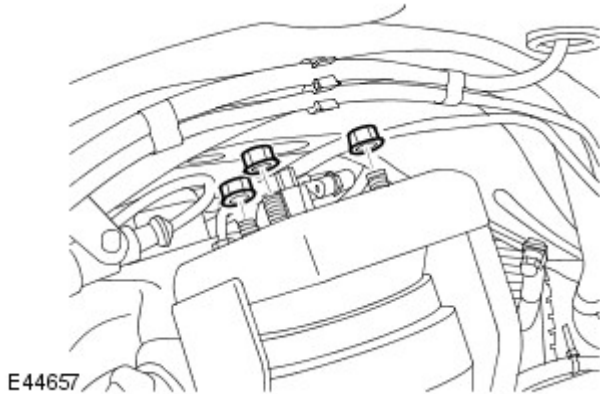
2. Remove the wheel and tire.
3. Using the Land Rover approved diagnostic system, depressurize the air suspension. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).
4. Disconnect the shock absorber and air spring assembly from the lower arm.

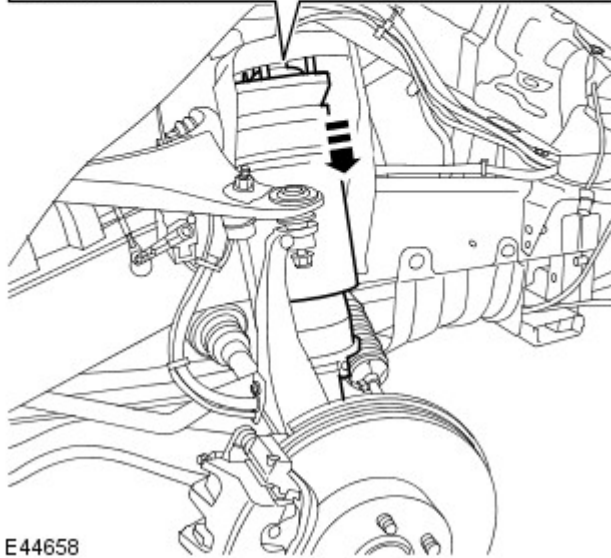
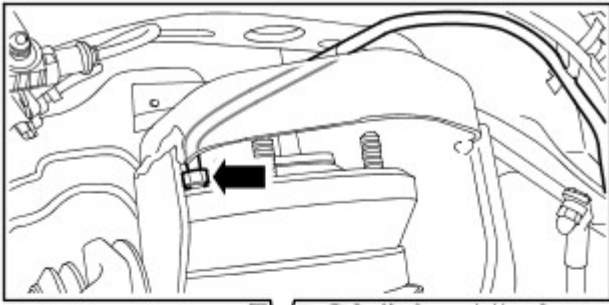
- Remove the nut and bolt.



5. Release the shock absorber and air spring assembly.

- Remove the 3 nuts.





E44658

6.  **CAUTION:** Always plug any open connections to prevent contamination.

Reposition the shock absorber and air spring assembly.

- Disconnect the air line.

7. Remove the shock absorber and air spring assembly.

8. Remove the Voss connector from the air line.

- Remove and discard the collet and the union.

Installation

1.  **CAUTION:** Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

Install a new Voss connector to the air spring.

- Tighten to 3.5 Nm (2.6 lb.ft)

2. **NOTE:** Remove and discard the blanking caps.

- **NOTE:** Clean the component mating faces.

Install the shock absorber and air spring assembly.

- Connect the air line into the Voss connector.
- Pull on the air line to make sure it is fully installed into the Voss connector.
- Install the nuts and tighten to 63 Nm (46 lb.ft).

3. Connect the shock absorber and air spring assembly to the lower arm.

- Tighten the nut and bolt to 300 Nm (221 lb.ft).

4. Using the Land Rover approved diagnostic system, pressurize the air suspension.

For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

5. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Vehicle Dynamic Suspension - Rear Shock Absorber and Air Spring

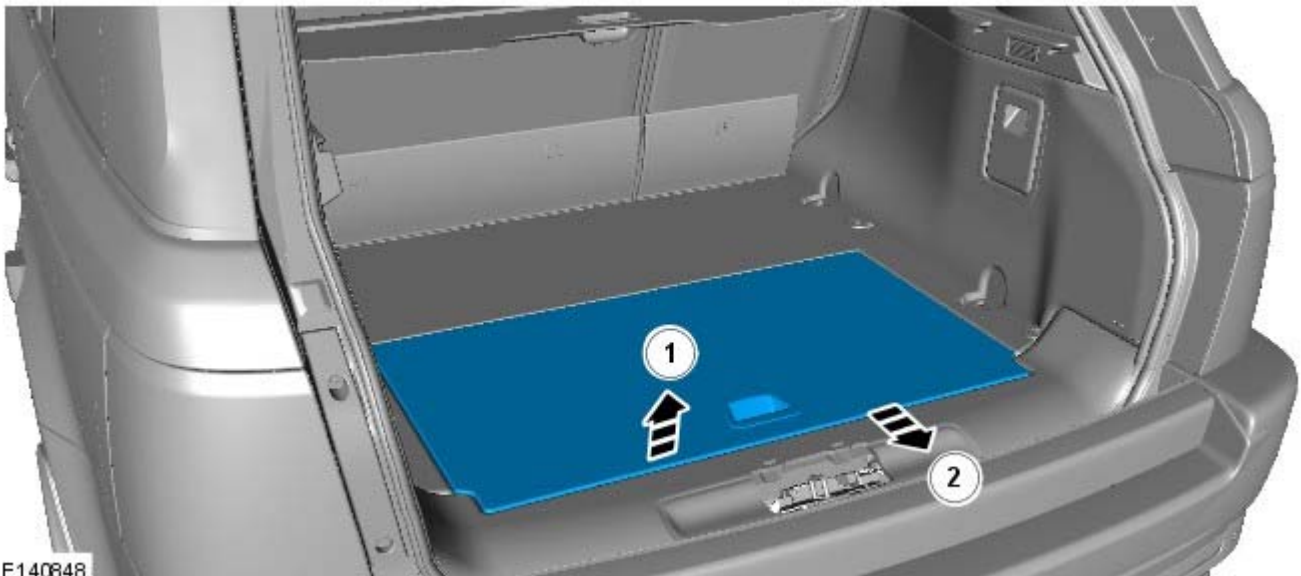
Assembly

Removal and Installation

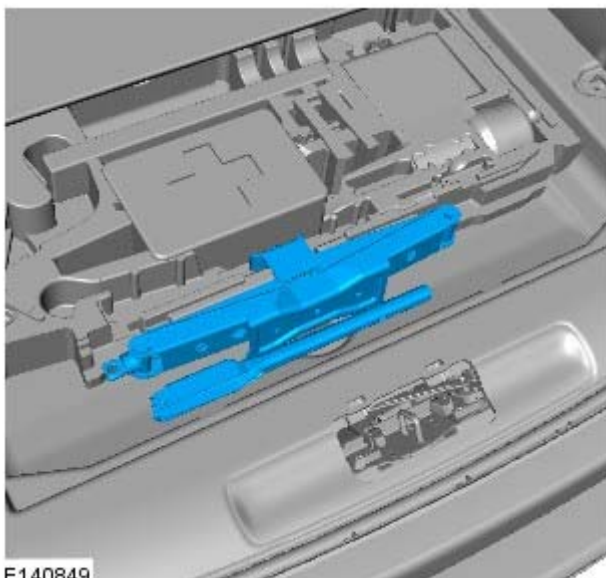
Removal

- NOTE: Only the air spring being removed needs to be depressurised.
- NOTE: RH illustration shown, LH is similar.

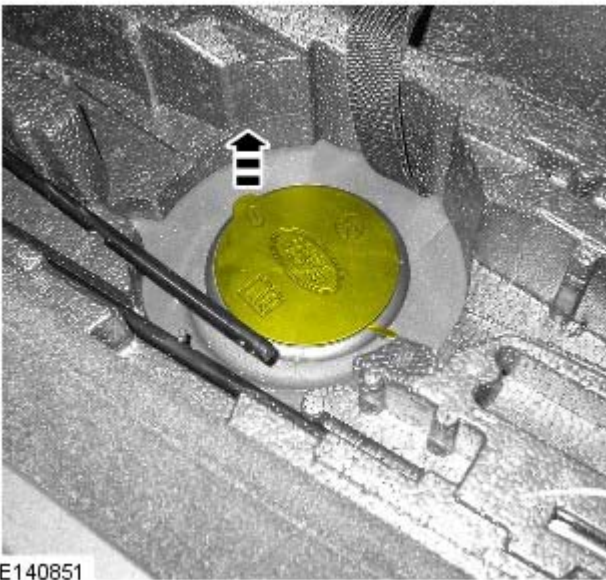
1. Using the Land Rover approved diagnostic system, depressurize the air suspension. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).
2. Remove the loadspace floor panel.



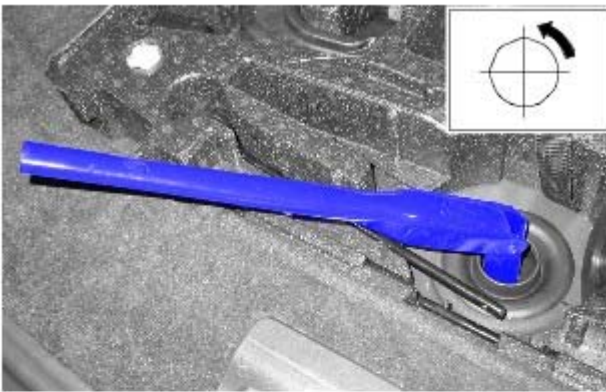
3. Remove the jack and wheel brace.



4. Remove the spare wheel/tool compartment cover.

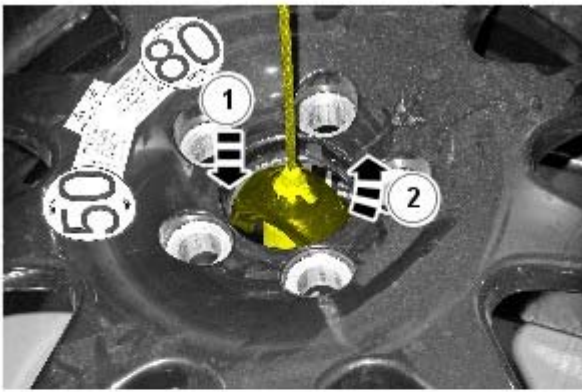


5. Lower the spare wheel and tire.




6. Remove the spare wheel.


- Disconnect the spare wheel release strap and position aside.



E140853

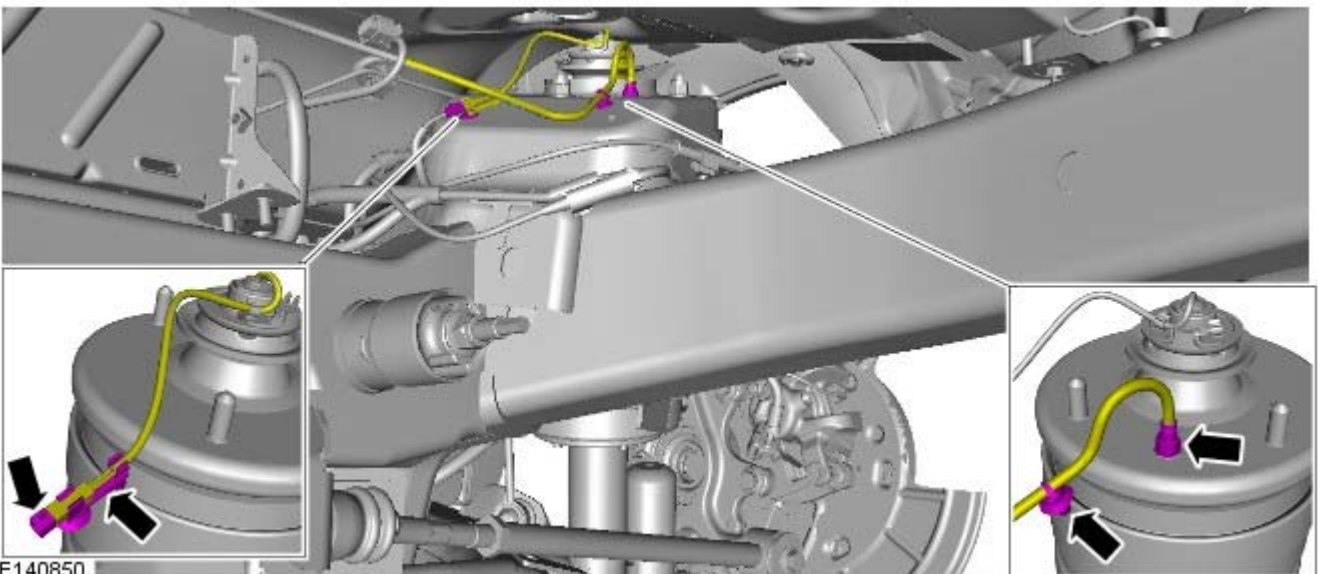
7.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

8.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

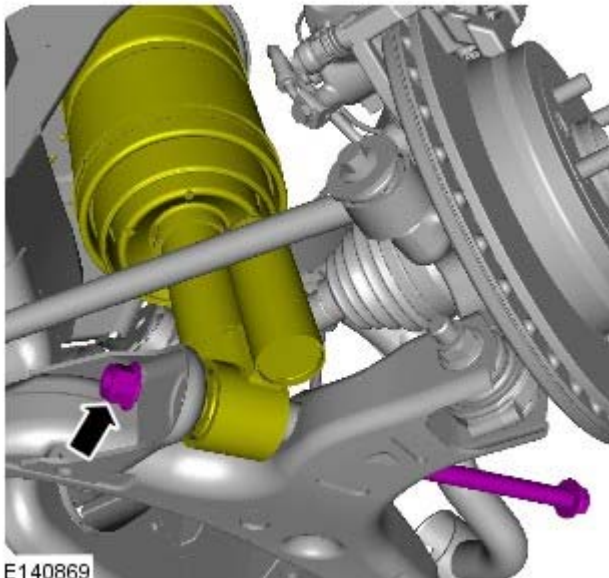
Remove the Voss connector from the air line.

- Remove and discard the collet and the union.
- Disconnect the active damping wiring.



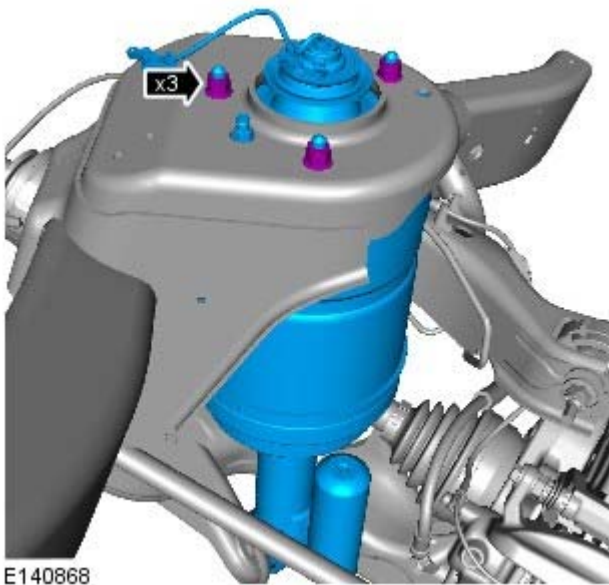
E140850

9. Remove the wheel and tire.



10. Disconnect the shock absorber and air spring assembly from the lower arm.

- Remove the nut and bolt.



11. Remove the three shock absorber and air spring retaining nuts.

- Remove the shock absorber and air spring assembly.

Installation

1. Install the shock absorber and air spring assembly.

- Make sure the shock absorber and air spring assembly top mounting to body mating faces are clean.
- Fit the nuts and tighten to 63 Nm (46 lb.ft).
- Connect the air line into the Voss connector.
- Tug on the air line to make sure it is fully installed into the Voss connector.

2. Connect the shock absorber and air spring assembly to the lower arm.

- Tighten the nut and bolt to 300 Nm (221 lb.ft).

3. Install the wheel and tire.

CAUTION: Make sure the new Voss connector is installed and tightened to the correct torque (40 Nm (30 lb.ft)).

4. Install a new Voss connector to the air spring.

5. Lower the vehicle on the lift.

6. Connect the spare wheel release strap to the spare wheel and tire.

- Attach the active damping wiring.


7. Install the spare wheel and tire.

- Raise the spare wheel and tire.
8. Install the spare wheel/tool compartment cover.
 9. Install the jack and wheel brace.
 10. Install the loadspace floor panel.
 11. Using the Land Rover approved diagnostic system, pressurize the air suspension.
For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

Vehicle Dynamic Suspension - Air Suspension Pressure Sensor

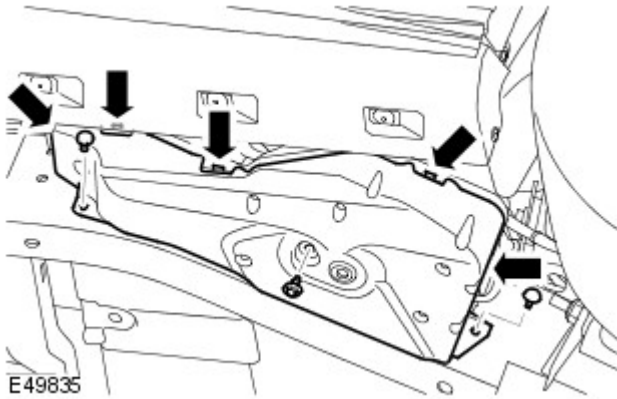
Removal and Installation

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Raise and support the vehicle.

- Remove the air compressor housing cover.
 - Remove the 3 bolts.
 - Release the 5 clips.



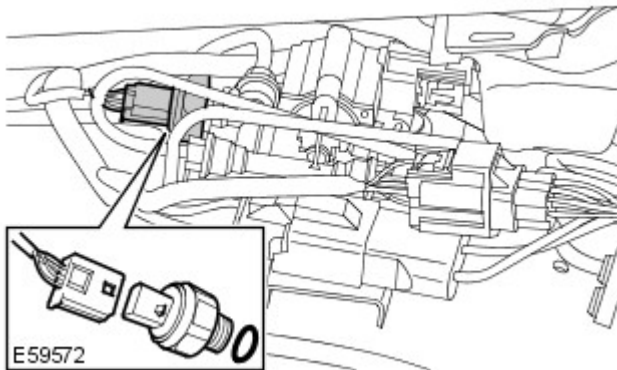
- Using T4, depressurize the air suspension. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).
- NOTE:** Make sure the valve block does not become detached during removal of the air pressure sensor.

Disconnect the electrical connector.

-  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the air pressure sensor.

- Remove and discard the O-ring seal.



Installation

- NOTE:** Make sure the valve block does not become detached during installation of the air pressure sensor.

Install the air pressure sensor.

- Install a new O-ring seal.
- Tighten to 5 Nm (4 lb.ft).

- Connect the electrical connector.

- Using T4, pressurize the air suspension. For additional information, refer to: [Air Suspension System Depressurize and Pressurize](#) (204-05 Vehicle Dynamic Suspension, General Procedures).

- CAUTIONS:**

-  Make sure the air suspension compressor upper cover is correctly positioned.



Make sure the air suspension exhaust pipe is correctly located in to the air suspension upper cover.

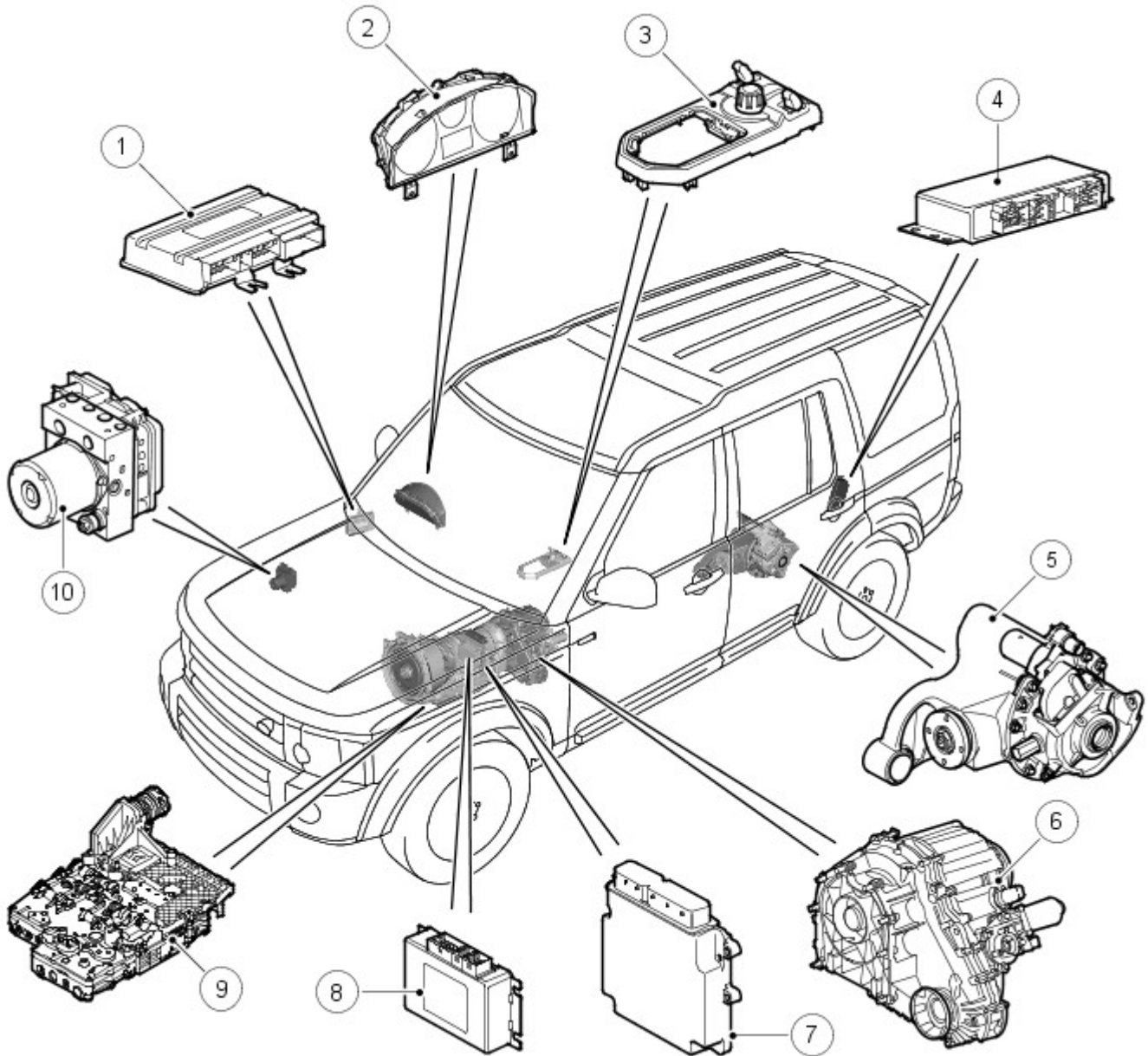
Install the air compressor housing cover.

- Install the bolts and tighten to 9 Nm (7 lb.ft).

Ride and Handling Optimization - Ride and Handling Optimization

Description and Operation

Terrain Response - Component Location



E47120

Item	Part Number	Description
1	-	Air suspension control module
2	-	Instrument cluster
3	-	Terrain Response rotary control and control module
4	-	Rear differential control module (if fitted)
5	-	Rear differential
6	-	Transfer box (center differential and high/low range)
7	-	Engine control module
8	-	Transfer box control module
9	-	Transmission control module (automatic transmission only)
10	-	ABS module

GENERAL

The Terrain Response™ system allows the driver to select a program which aims to provide the optimum settings for traction and performance for the prevailing terrain conditions. The system cannot be switched off. The 'special programs off' is the default program and covers all general driving conditions. Four specific terrain programs are selectable to cover all terrain surfaces.

The system is controlled by a rotary control located on the center console, rearward of the selector lever (automatic transmission) or gearshift lever (manual transmission). The rotary control allows the selection of one of the following five programs:

- Special programs off
- Grass/Gravel/Snow
- Mud/Ruts
- Sand
- Rock crawl.

The rotary control can be rotated through 360 degrees or more in either direction and selects each program in turn. When Terrain Response is fitted to a vehicle, a hi-line instrument cluster will also be fitted which will display the selected program in the message center.

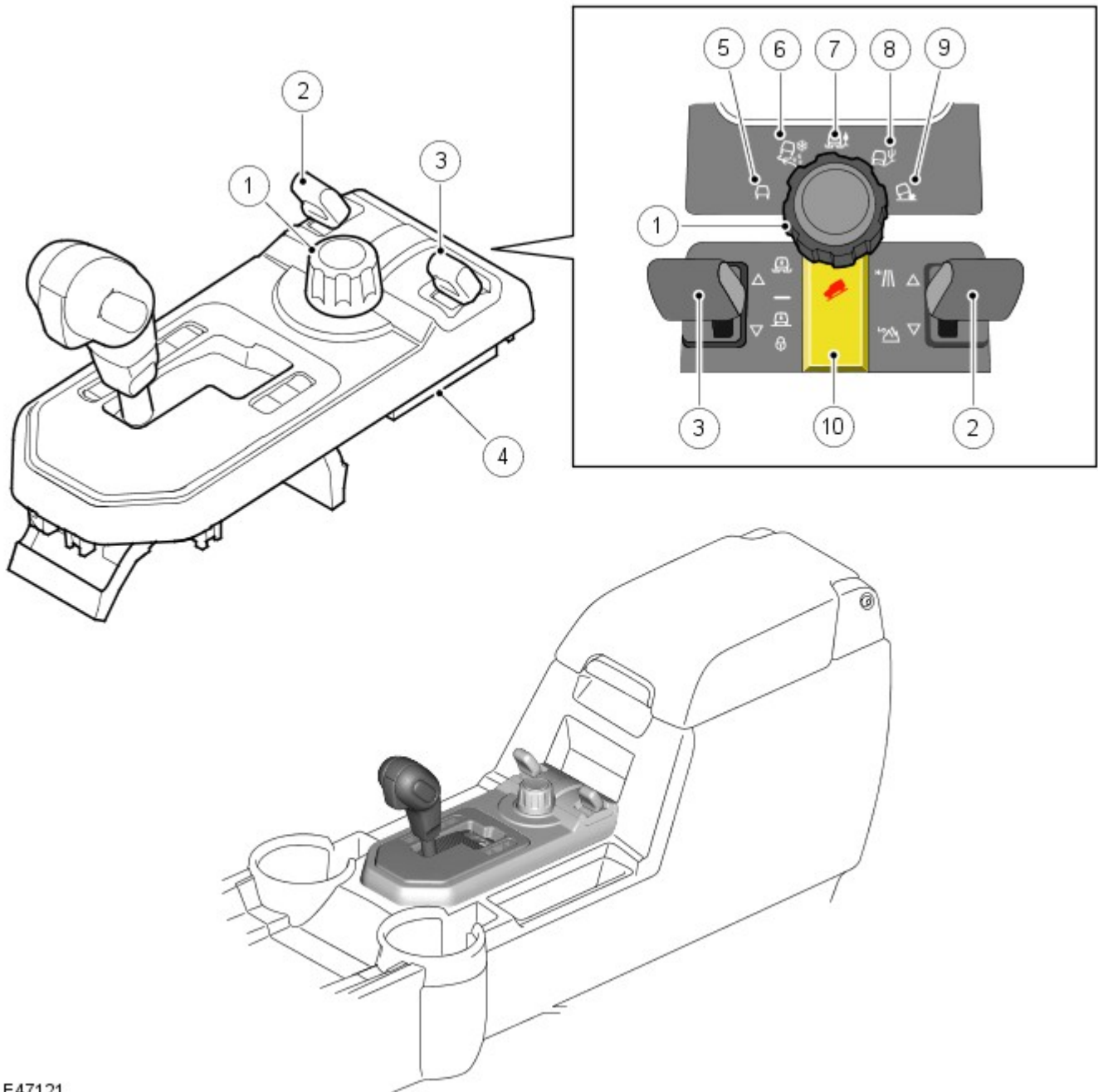
The Terrain Response system uses a combination of a number of vehicle subsystems to achieve the required vehicle characteristics for the terrain selected. The following subsystems make up the Terrain Response system:

- Engine management system
- Automatic transmission (if fitted)
- Transfer box (center differential)
- Rear differential (electronically controlled)
- Brake system (ABS/DSC/ETC/HDC functions)
- Air suspension.

A Terrain Response control module is located below the rotary control. The control module detects the selection made on the rotary control and transmits a signal on the high speed CAN which is received by each of the subsystem control modules. Each of the affected control modules contain software which applies the correct operating parameters to their controlled system for the Terrain Response program selection made. Each control module also provides a feedback for the selected program so that the Terrain Response control module can check that all systems have changed to the correct operating parameters.

Information is displayed in the instrument cluster message center which informs the driver of improvements which can be made to the vehicle operating parameters to optimise the vehicle for the prevailing conditions. Inexperienced off-road drivers may benefit from the automatic assistance of the Terrain Response system and the driver information. Experienced off-road drivers can select the specific programs for extreme conditions to access control over the vehicle systems (e.g., throttle shift maps or traction settings) which are not accessible on vehicles without Terrain Response.

TERRAIN RESPONSE ROTARY CONTROL AND MODULE



E47121

Item	Part Number	Description
1	-	Terrain Response rotary control
2	-	Transfer box high/low range switch
3	-	Air suspension switch
4	-	Terrain Response control module
5	-	Special programs off
6	-	Grass/gravel/snow program
7	-	Mud/ruts program
8	-	Sand program
9	-	Rock/crawl program
10	-	HDC switch

The Terrain Response rotary control is located in the center console and allows the selection of five operating programs. Each program is denoted by a symbol which represents the terrain encountered. The rotary control can be rotated to select the required program. The control will only select the last program in its direction of rotation. Further rotation of the control once the last program in either direction has been selected, will have no effect, e.g. once rock crawl has been selected, further rotation in a clockwise direction will have no effect.

The Terrain Response control module is located below the rotary control. The module is connected via a harness connector which also contains the wiring for the HDC switch, the transfer box high/low range switch, the air suspension switch and the switch illumination circuits. The control module and switch uses four of these wires for a 12V battery supply when the ignition switch is in ignition position II, a ground and high speed CAN positive and negative.

TERRAIN RESPONSE OPERATION

The following vehicle subsystem control modules are used for the Terrain Response system:

- Engine management (engine control module)
- Transmission control (transmission control module - automatic transmission only)
- Transfer box control (transfer box control module)
- Rear differential control (rear differential control module - if fitted)
- Air suspension control (air suspension control module)
- Brake system (ABS/DSC/ETC/HDC functions) (ABS module)

Each subsystem operates in different ways in relation to the selected Terrain Response program to achieve the optimum traction, stability and ease of control for the terrain encountered. The system has a safety factor built in which ensures that any program can be safely used on any surface, even when an inappropriate program selection has been made.

Engine Management System (EMS)

The EMS varies the throttle pedal response to control the engine torque output. The EMS can change the throttle maps to change the amount of torque per percentage of pedal travel. The EMS can also change the throttle response to control the allowed torque change relative to the percentage pedal travel.

Each terrain program uses a combination of operating parameters for each subsystem. Changing between terrain programs initiates a different set of operating characteristics which will be noticeable to the driver. The driver will notice differences in engine and throttle response when, for example, the throttle pedal is held in a constant position and the terrain program is changed from grass/gravel/snow to sand, the driver will notice the torque and engine speed increase. If the terrain program is changed from sand to grass/gravel/snow the driver will notice a reduction in torque and engine speed.

• **NOTE:** The change in torque and engine speed can take approximately 30 seconds and care must be taken not to confuse the Terrain Response system operation with an EMS fault.

Transmission Control

The transmission control module changes the shift maps for the Terrain Response program selected. This changes the shift points providing early or late upshifts and downshifts.

On slippery surfaces the transmission will select 2nd gear in high range or 3rd gear in low range for starting from a standstill to minimise wheel slip. In muddy conditions the transmission will provide maximum torque output from the transmission. In sand the transmission will provide an output which passes maximum engine power from the transmission.

In rock crawl special program (low range) the transmission will select 1st gear for driving off.

Sport mode is only available when the general program is selected and the transfer box is in high range. Sport mode is disabled in low range and all Terrain Response special programs. CommandShift™ is available in any program and also in high or low range.

If the transmission is in 'Sport' mode and a special program is subsequently selected, the transmission will automatically change to manual 'CommandShift™' mode. If a special program is already selected and the transmission selector lever is moved from drive 'D' to the 'Sport' mode position, the transmission will automatically change to 'CommandShift™' mode.

Transfer Box and Rear Differential Control

The transfer box electronically controlled differential and the rear electronically controlled differential (if fitted) are treated as one system. The electronic rear differential is an optional fitment on vehicles fitted with the Terrain Response system. The differential control has two operating strategies; pre-emptive and reactive.

The pre-emptive strategy anticipates and predicts the locking torque value required for each differential to minimise slip and maximise stability. Each Terrain Response program has a different threshold and input criteria for the pre-emptive strategy. The pre-emptive strategy improves vehicle traction and composure by avoiding wheel spin. This is achieved by anticipating the amount of differential lock required for the program selected. For example, a high locking torque would be applied for rock crawl or slippery surfaces.

The reactive strategy varies the amount of locking torque in response to the actual slip level and the dynamic behaviour of the vehicle. Each Terrain Response program has a different threshold and input for the reactive strategy. The reactive strategy improves vehicle traction and composure by eliminating any wheel spin which has occurred after the pre-emptive strategy was applied. The locking response applied is applicable to the terrain program selected, for example, very sensitive on slippery surfaces to provide maximum traction and minimise surface damage.

The locking torque calculations use various signals from other subsystems, for example, engine torque, throttle position, selected gear, steering angle, vehicle speed, lateral acceleration, yaw behaviour.

The Dynamic Stability Control function of the ABS system can override the Terrain Response differential control and reduce any applied locking torque during DSC action. For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

Air Suspension Control

The air suspension control module contains a strategy which provides automatic switching between normal and off-road heights. Changes in vehicle height settings will be relayed to the driver via the instrument cluster message center and LED illuminated icons on the switch. The automatic selection and deselection of the vehicle height provides automatic increase and decrease in ground clearance and aims to provide maximum benefit to the selected terrain program.

On a vehicle fitted with a correctly installed, Land Rover approved trailer socket, if an electrical load is sensed on the trailer socket, height changes are prohibited and the message center displays a message advising that a trailer is connected and off-road height is not automatically selected. The driver can raise the suspension manually using the air suspension switch.

• **NOTE:** The prohibiting of the automatic ride height selection is only operational if a Land Rover approved trailer socket is fitted and an electrical load is sensed on the socket.

ABS Control

The ABS module controls several vehicle functions and adjusts the operating parameters of these functions to optimise the selected Terrain Response program.

Traction control uses different slip/acceleration thresholds to improve traction and vehicle composure. For example, the system sensitivity is increased on slippery surfaces to reduce wheel spin.

If DSC is switched off (with the DSC switch on the instrument panel) when using a Terrain Response special program, if the special program is subsequently changed for a different program DSC is automatically switched back on.

The stability control uses different threshold values for the selected program to automatically reduce DSC intervention, removing the requirement for the driver to disable the DSC system in order to reduce engine intervention which is sometimes induced in extreme off-road conditions. In extreme sand conditions, there may be an additional benefit of disabling the DSC function using the DSC switch on the instrument panel in addition to selecting the sand program.

HDC is automatically switched on or off and target speeds are adjusted in response to the Terrain Response program selected. The responsiveness of the HDC function is also increased where required.

Automatic operation of HDC aims to assist the driver by switching the system on or off when it is of most benefit. Target speeds for HDC operation are also adjusted according to the vehicle operating conditions.

Incorrect Program Usage

Selection of an inappropriate program is discouraged in the following ways:

- The active program icon is continually displayed in the instrument cluster message center
- The Terrain Response control module 'locks' out certain functions in some programs, e.g.,
 - cruise control is only available with the special programs off or grass/gravel/snow program
 - transmission 'Sport' mode is deactivated in all special programs.
- In any special program, except the grass/gravel/snow program, when the ignition has been in the off position continually for more than 6 hours, the Terrain Response system defaults to the Special Programs Off
- When in the grass/gravel/snow program, the Terrain Response system will never default to the Special Programs Off. This is to allow for drivers in cold climates where continuous use of the grass/gravel/snow program would be beneficial
- The rock crawl program is only available with the transfer box in low range.

Selection of an inappropriate program for the terrain conditions will not endanger the driver or cause damage to the vehicle. Continued use of an inappropriate program may reduce the life of some components. The driver may notice reduced vehicle response, with the engine and transmission being less responsive than in the special programs off. Also, in some programs, HDC will remain on, signified by illumination of the HDC indicator in the instrument cluster. The driver may also notice torque 'wind-up' in the center and rear differentials causing a 'braking' effect when the vehicle is manoeuvred in some special programs.

The use of the special programs in the Terrain Response system is monitored by the Terrain Response control module which records the mileage and time the vehicle has operated in a specific program in high and low range. This information can be retrieved using T4 and used by the dealer technician to check customer concerns, e.g. high fuel consumption which may be due to continued use of a certain program.

Driver Information

The high specification instrument cluster fitted to all vehicles with Terrain Response, contains a message center which displays vehicle information to the driver. The message center contains the Terrain Response program icons which display the currently selected program. If no symbol is displayed, no special program is selected and the system is in special programs off.

Any required changes to the subsystems are also passed to the driver in the form of indicator illumination in the instrument cluster or appropriate messages in the message center, HDC off or air suspension height change for example.

In certain operating conditions, the Terrain Response system also displays advice or warning messages to ensure the driver is using the vehicle to its full potential, e.g.,

- Steering angle is displayed in the message center to avoid driving in deep ruts with steering lock applied
- gear information is displayed to recommend a gear for slippery conditions
- if the system automatically provided off road ride height, but the driver subsequently lowers the vehicle to normal height, then the system may advise that this will cause a risk of grounding.

The messages which can be displayed in the instrument cluster message center are detailed in the Information and Message Center section.

For additional information, refer to: Information and Message Center (413-08, Description and Operation).

DIAGNOSTICS

The Terrain Response control module stores information on detected Terrain Response faults and CAN errors which can be interrogated using T4. The Terrain Response sub-systems and the instrument cluster also store fault information relating to CAN errors from the Terrain Response control module.

The control module also stores the miles travelled and time elapsed in high range for the individual programs and in low range for use of all programs which can also be retrieved using T4. This information aids diagnosis of the Terrain Response system and also provides an indication of Terrain Response system abuse by the driver which can lead to premature component failure.

Terrain Response System Fault Diagnosis

Terrain Response relies on the correct functionality of the five sub-systems. If one of the sub-systems develops a fault, the Terrain Response system will not function, even though the fault is not in the Terrain Response system. The Terrain

Response control module and rotary control should only be investigated if there are no apparent faults in any of the sub-systems. If a fault in a sub-system is subsequently corrected, the Terrain Response system will function normally after an ignition on and off cycle.

Terrain Response Sub-System Faults

If a fault occurs in a sub-system, the driver is alerted by the illumination of a warning indicator and/or an appropriate message for that sub-system in the instrument cluster message center. There will be no warning of a Terrain Response system fault.

When a sub-system fault is present and the driver attempts to select a different Terrain Response program using the rotary control or at the next ignition on cycle, a message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' will appear in the message center. This implies that the Terrain Response system has a fault, but only because a sub-system fault is preventing its operation. This message will be displayed for 5 seconds per ignition cycle, but is repeated if a further selection is made by the driver using the Terrain Response rotary control or at the next ignition on cycle.

• **NOTE:** The message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' can also be generated by a fault in the Terrain Response rotary control or control module. See following section for details of rotary control or control module faults.

It is not possible for the Terrain Response control module to cause any fault behaviour (warning indicator illumination or message generation) in any of the five sub-systems. Illumination of a sub-system warning indicator and/or a sub-system related message will never be associated with a Terrain Response control module or Terrain Response system fault.

The sub-system control modules can detect a fault with the CAN signal from the Terrain Response control module. If a fault in the Terrain Response system is detected, the sub-system control modules will operate in the 'special programs off' setting. The sub-system control modules will record a fault code for a failure of the Terrain Response CAN signal. These faults can be retrieved using T4 and will provide useful information to indicate investigation of the Terrain Response control module or the CAN network.

Terrain Response Rotary Control or Control Module Fault

If a fault occurs in the Terrain Response rotary control, all rotary control icon amber LEDs will be turned off (background illumination will remain on) and rotation of the rotary control is ignored. The instrument cluster message center will display a message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' when the fault occurs, if the fault is present and the driver attempts to select a special program (if the control module is able to do this) or at the next ignition on cycle.

If a failure of a rotary control icon amber LED occurs, the Terrain Response system will still function. Any selected special program will default to 'special programs off' at every ignition on cycle, with the exception of the grass/gravel/snow program.

The Terrain Response rotary control and the control module are an integral unit. If a fault occurs in either component, the whole unit will require replacement.

CAN Faults

If a CAN fault exists and prevents Terrain Response system operation, all of the Terrain Response rotary control icon LEDs will be illuminated and rotation of the rotary control is ignored.

If the instrument cluster does not receive a Terrain Response system CAN message from the Terrain Response Control module, the message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' will be displayed when the fault occurs and will be repeated at every ignition on cycle.

User Error

The following incorrect usage of the system may be misinterpreted as a system fault:

- Engine not running - Program changes and driver advisory messages are only available with the engine running
- Rock crawl program selected but transfer box in high range
- Special program change attempted with DSC or ABS active (this includes ABS cycling which is operational when HDC is being used on slippery or loose surfaces).
- Special program change attempted with overheat condition present on center or rear differential.

Ride and Handling Optimization - Ride and Handling Optimization

Diagnosis and Testing

Principles of Operation

Ride and handling optimization incorporates the terrain response system which links a number of modules around the vehicle to give the best combination of settings in the different systems.

For a detailed description of the Ride and Handling System and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Ride and Handling Optimization](#) (204-06 Ride and Handling Optimization, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Tire condition, pressures, etc ● Driveline components (correct installation, damage, etc) ● Engine components (correct installation, damage, etc) ● Transmission components (correct installation, damage, etc) ● Suspension components (correct installation, damage, etc) 	<ul style="list-style-type: none"> ● Fuses ● Harnesses/Connectors ● Terrain response module ● Engine Control Module (ECM) ● Transmission Control Module (TCM) ● Transfer case control module ● Anti-lock Braking (ABS) control module ● Rear differential control module ● Dynamic suspension control module ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Because the overall function of the system is dependent on sub-systems, it is possible to misinterpret displays in the message center as being terrain response faults when they are actually a result of a fault in one of the sub-systems.

Refer to the table below for help in deciding when to investigate terrain response faults and when the fault is likely to be in a sub-system.

Symptom	Description	Possible Causes	Action
Message center display indicating a sub-system fault	The message center indicates to the driver that a fault has occurred and in which sub-system	<ul style="list-style-type: none"> ● Any sub-system fault supported by the message center 	For details of the available messages, refer to the relevant section of the workshop manual. Carry out a complete vehicle DTC read and follow the diagnostic routine(s) indicated.
Message center display: System fault special programs not available , terrain response switch operation normal	This message will display when a sub-system fault has occurred if the driver attempts to change the special program, and at each ignition on cycle for 5 seconds until the fault is rectified	<ul style="list-style-type: none"> ● Any sub-system fault supported by the message center 	For details of the available messages, refer to the relevant section of the workshop manual. Carry out a complete vehicle DTC read and follow the diagnostic routine(s) indicated.
Message center display: System fault special programs not available , ALL terrain response switch LEDs illuminated	CAN circuit errors	<ul style="list-style-type: none"> ● CAN circuit: short circuit to ground ● CAN circuit: short circuit to power ● CAN circuit: high resistance 	Carry out a complete vehicle DTC read and follow the diagnostic routine(s) indicated.
Special program changes not available	User error	<ul style="list-style-type: none"> ● Engine not running ● Rock crawl selected with transfer box in high range ● Special program change attempted with ABS or DSC active - This includes ABS 	Refer to the relevant section of the workshop manual. Make sure that the driver is familiar with the correct operation of the system.

Symptom	Description	Possible Causes	Action
		cycling as part of HDC <ul style="list-style-type: none"> <li>● Special program change attempted with an overheat condition present in the center or rear differential 	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Terrain Response Control Module \(ATCM\)](#) (100-00 General Information, Description and Operation).

Ride and Handling Optimization - Ride and Handling Optimization Switch

Removal and Installation

Removal

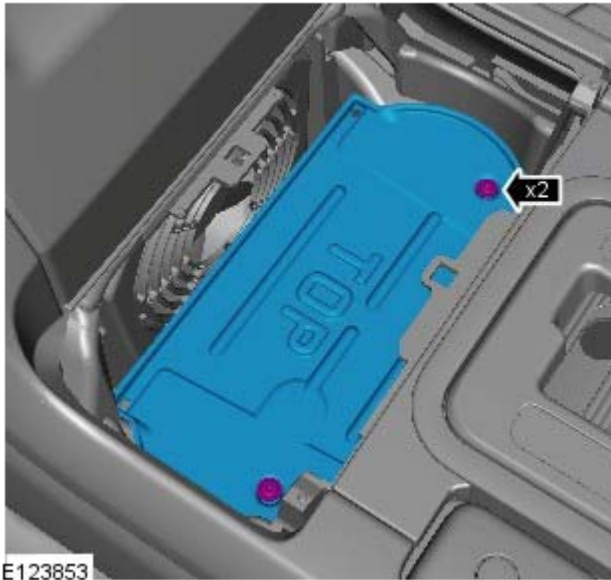
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**
- NOTE: Make sure that the gear selector lever is in position N before removing any components.



1.

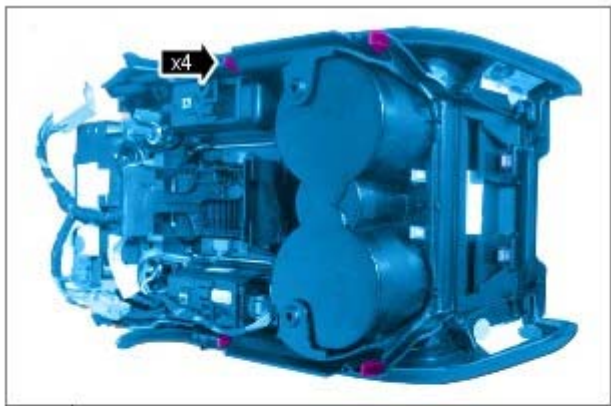


2.



E123853

3.



4.

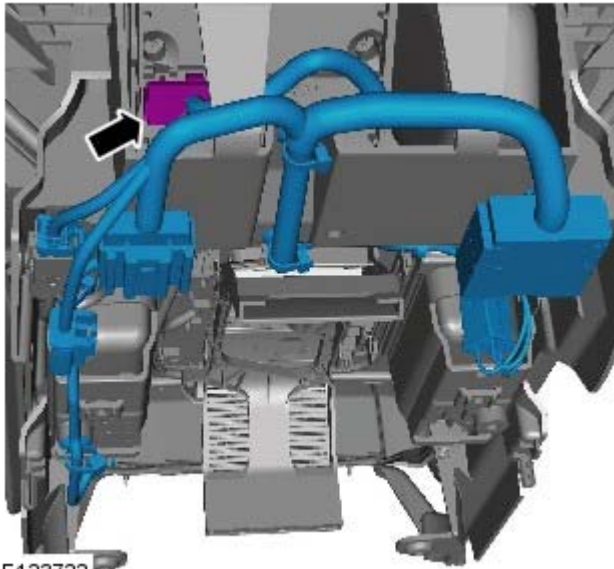


E123213

5.

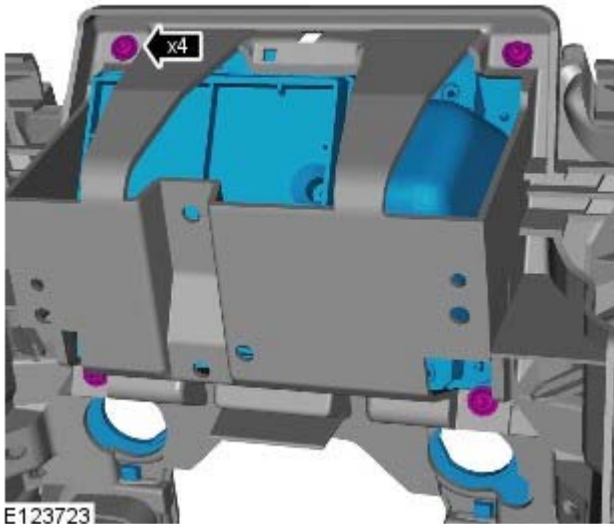


E123214



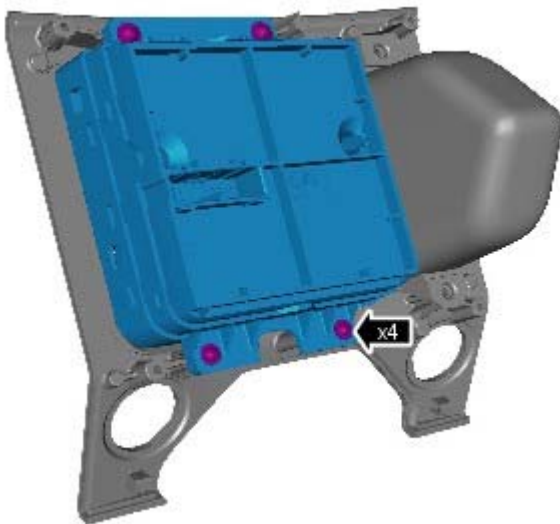
E123722

6.



E123723

7.



E124214

8.

Installation

1. To install, reverse the removal procedure.

Driveshaft -**Front Drive (Propeller) Shaft**

Item	Specification
Type	One piece, variable length steel tube.
Constant velocity joints	Plunging type, fitted at front and rear.

Rear Drive (Propeller) Shaft

Item	Specification
Type	Two piece, variable length steel tube with isolated centre bearing and swaged front section to provide controlled collapse of the shaft during a crash.
Constant velocity joints	Plunging constant velocity joints are positioned at the front and centre of the shaft with a fixed, Hookes type universal joint at the rear.

Torque Specifications

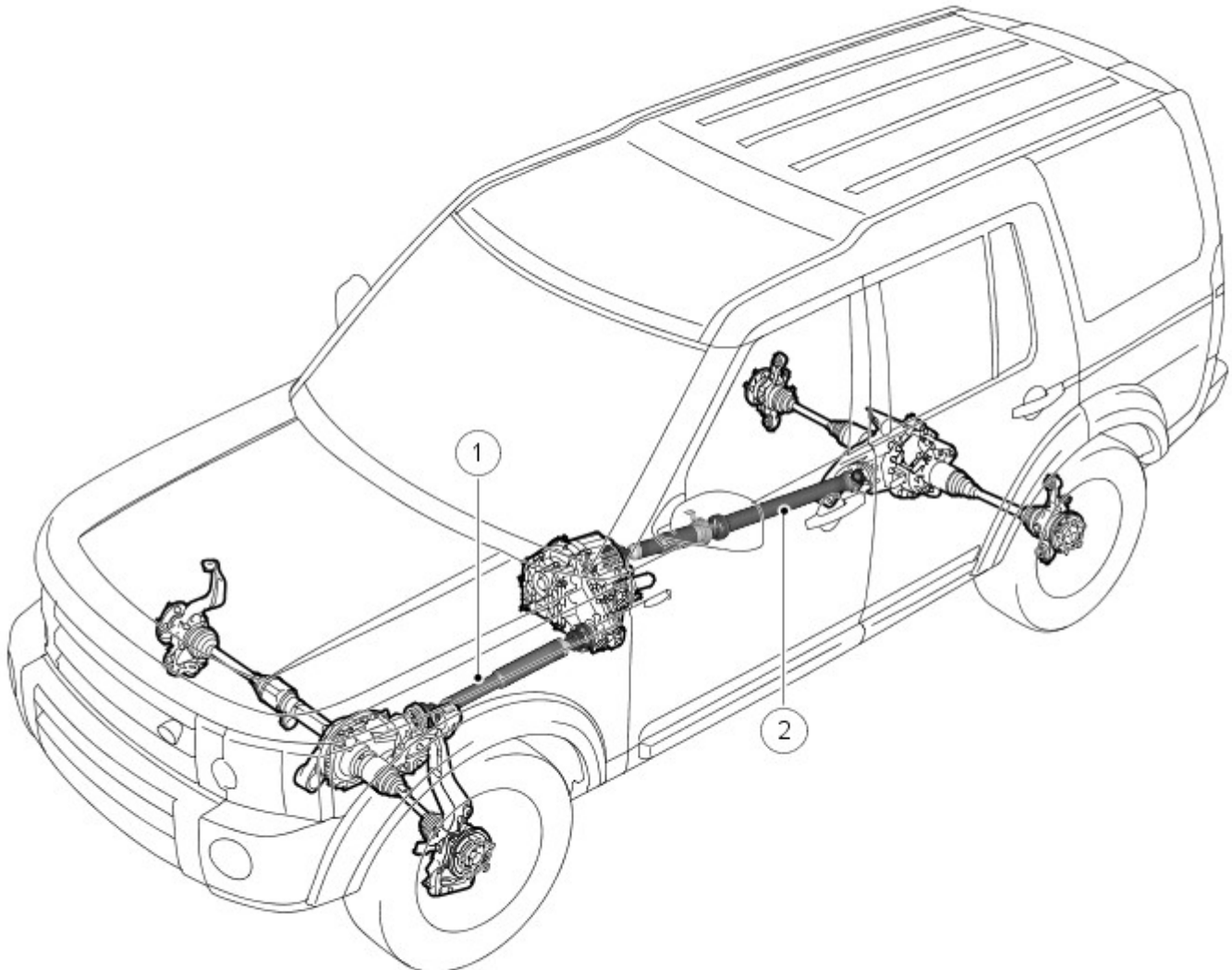
Description	Nm	lb-ft
* Front driveshaft to front axle drive flange Torx bolts:		
Stage 1	45	33
Stage 2	Further 90°	Further 90°
* Front driveshaft to transfer case drive flange Torx bolts:		
Stage 1	45	33
Stage 2	Further 90°	Further 90°
* Rear driveshaft to rear axle drive flange Torx bolts	150	110
Rear driveshaft to transfer case drive flange Torx bolts	73	54
Rear driveshaft center bearing bolts	30	22
Fuel tank heat shield bolts	5	4
Fuel tank heat shield nuts	3	2

*** New 'Patched' Torx bolts must be installed**

Driveshaft - Driveshaft

Description and Operation

Drive shaft Component Location



E46304

Item	Part Number	Description
1	-	Front drive shaft
2	-	Rear drive shaft

GENERAL

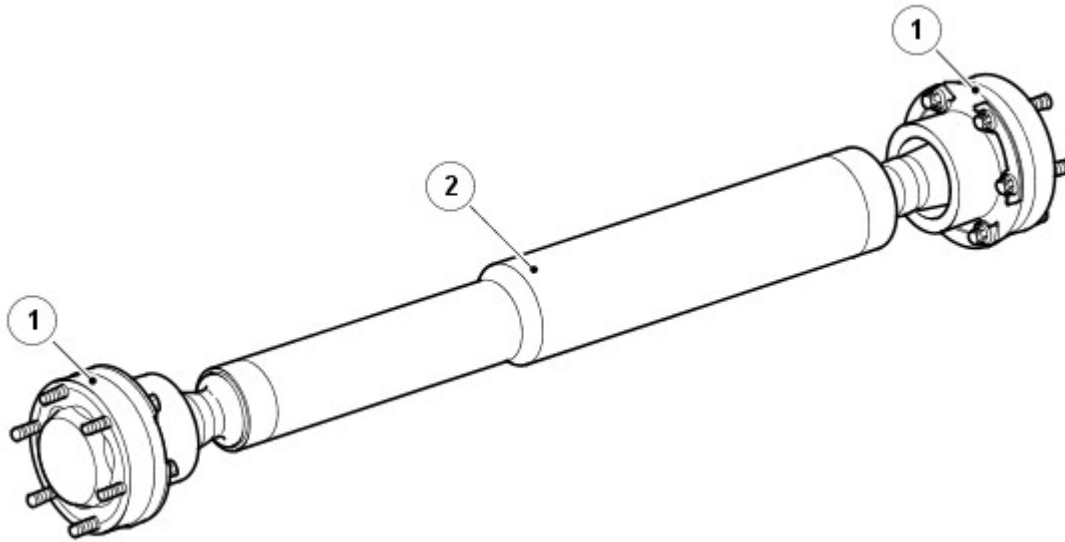
Drive shafts are used to transmit drive from the transfer box to the front and rear differentials.

The front drive shaft is a one-piece unit, connected to the transfer box and front differential unit via Constant Velocity (CV) joints.

The rear drive shaft is a two-piece unit, supported on a central bearing due to its increased length. The rear drive shaft is connected to the transfer box via a CV joint and the rear differential with a universal joint. These joints allow for angular deviations of the drive shaft due to acceleration and braking.

The front and rear drive shafts are not serviceable items and a failure will require the replacement of the complete drive shaft assembly.

FRONT DRIVE SHAFT



E46305

Item	Part Number	Description
1	-	CV joint
2	-	Front drive shaft

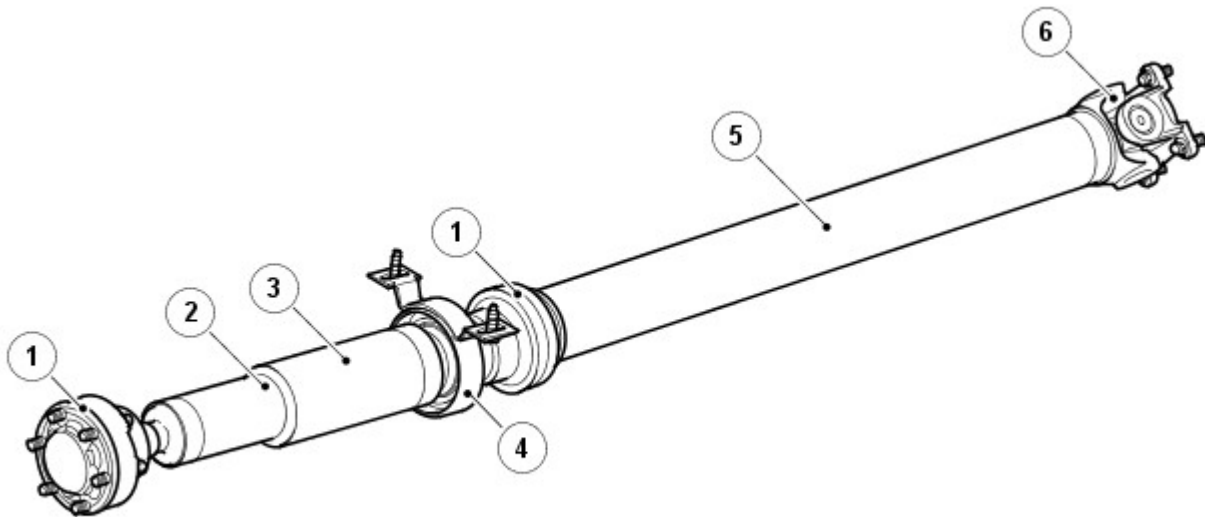
The front drive shaft is constructed from 1.7 mm wall tubular steel. A CV joint is attached to each end of the drive shaft (see 'Halfshaft Joint' section for more information on CV joints). The shaft has an overall nominal length of 713 mm.

Each CV joint has six holes, which allow for attachment to the input flange of the front differential and the front output flange of the transfer box. The CV joints are secured to the front differential and transfer box with six Torx head adhesive retained bolts.

Three compression link washers are fitted under each pair of bolts. The washers are required to prevent compression of the CV joints attachment flange.

A shroud is pressed over the CV joint. The shroud seals to the joint body using an internal gasket and to the front output flange of the transfer box using an end cap and internal gasket. This prevents the ingress of dirt and moisture. The CV joints allow for movement of the drive shaft caused by small movements in the transmission and transfer box mountings.

REAR DRIVE SHAFT ASSEMBLY



E46306

Item	Part Number	Description
1	-	CV joints
2	-	Collapsible crash section
3	-	Front shaft assembly
4	-	Support bearing
5	-	Rear shaft assembly
6	-	Universal joint

The rear drive shaft assembly comprises front and rear shaft assemblies and a centrally mounted shaft bearing. The rear drive shaft assembly has an overall nominal length of 1309 mm.

Front Shaft Assembly

The front shaft assembly incorporates a crash feature within the tube, which controls the collapse of the drive shaft during a crash.

The front shaft assembly comprises a CV joint at each end (see 'Halfshaft Joint' section for more information on CV joints).

The front CV joint (transfer box end) has six radial holes, which provide for the attachment to the transfer box rear output flange. The joint is secured to the output flange with six torx bolts, which screw into threaded holes in the flange. Three compression link washers are fitted under each pair of bolts. The rear splined shaft mates with splines in the rear shaft CV joint hub and is pressed in and fixed with Locktite. A machined surface on the shaft accepts the shaft bearing, which is a press fit.

Rear Shaft Assembly

The rear shaft assembly comprises a Hookes type universal joint at the rear (rear differential end).

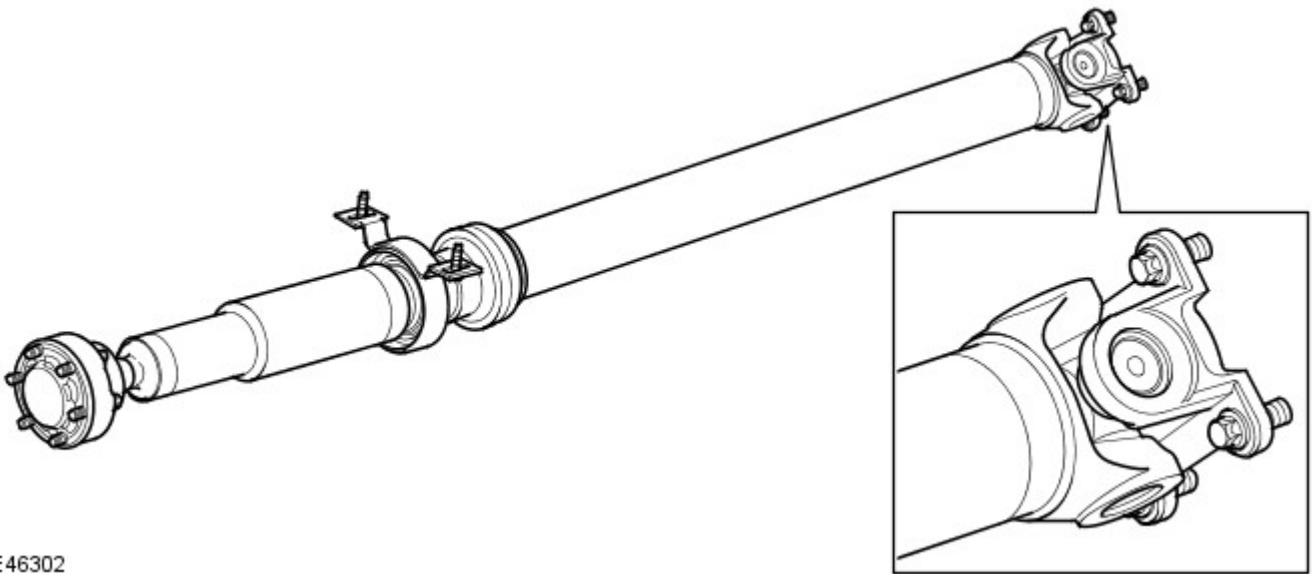
The universal joint is welded to the rear shaft tube and is secured to the input shaft of the rear differential with four flanged nuts. The opposite end of the rear shaft tube is welded directly to the CV joint body.

Shaft Bearing Assembly

The shaft bearing assembly comprises a pressed steel housing, a rubber diaphragm and a ball bearing. The diaphragm is bonded into the housing. An internal metal ring, bonded to the bush, allows for the bearing to be press fitted into it. The rubber bush allows for small deviations in alignment and also absorbs vibrational forces. The shaft bearing assembly is located by screws, which pass through plain holes in the bearing assembly and locate into nuts welded on the inside face of the chassis cross-member.

Driveshaft - Universal Joints

Description and Operation



E46302

A Hookes type universal joint is used to connect the rear drive shaft assembly to the rear differential, allowing for angular deviations of the drive shafts due to acceleration and braking.

The joint is bolted to the input shaft of the rear differential with four flanged adhesive screws and is lubricated during manufacture and sealed for life.

Driveshaft - Front Driveshaft V8 5.0L Petrol


Removal and Installation

Removal



CAUTION: It is possible to fit the driveshaft incorrectly. Note the orientation before removal.

• **NOTE:** A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

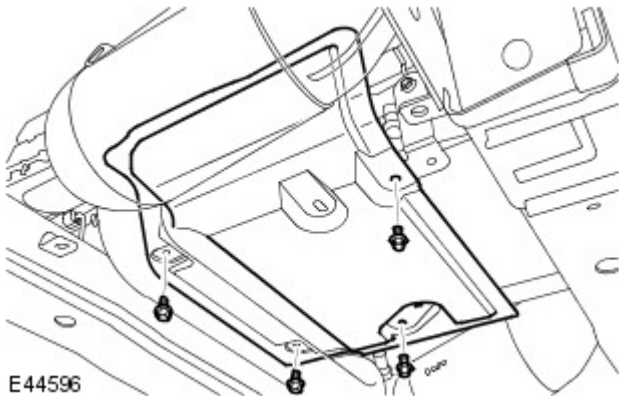
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

3. Remove the transmission heat shield.

- Remove the 4 bolts.



4. **CAUTIONS:**



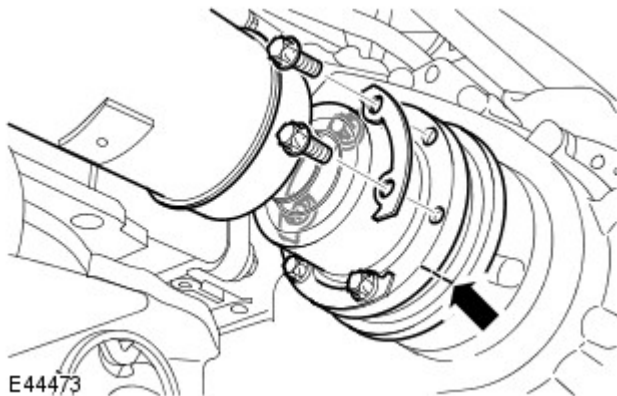
Mark the position of the driveshaft flange in relation to the drive pinion flange.



To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.



5. **CAUTIONS:**



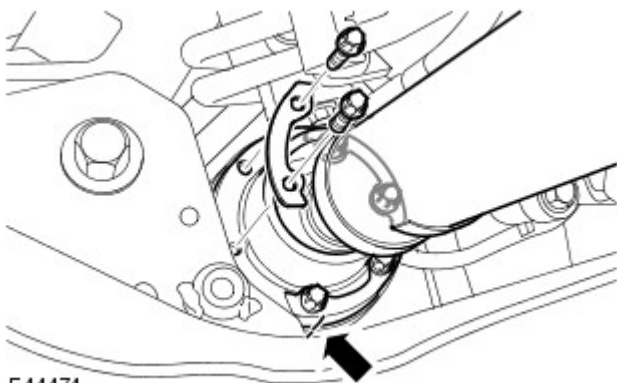
Mark the position of the driveshaft flange in relation to the drive pinion flange.



To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

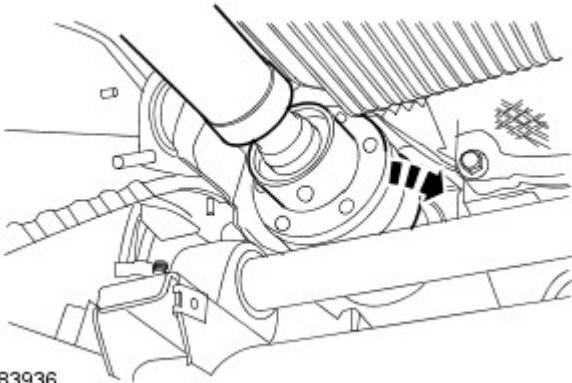
Release the driveshaft from the front axle drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.



6. Remove the front driveshaft.

- Compress the joints to disengage the drive flanges.




E83936

Installation

1. **NOTE:** A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.


Install the driveshaft.

- Clean the components.
- Compress the joints to engage the drive flanges.

2.  **CAUTION:** Make sure that new bolts are installed.

Secure the driveshaft to the front axle drive flange.

- Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
- Stage 2: Tighten the bolts a further 90 degrees.

3.  **CAUTION:** Make sure that new bolts are installed.

Secure the driveshaft to the transfer case drive flange.

- Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
- Stage 2: Tighten the bolts a further 90 degrees.

4. Install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

5. Install the transmission crossmember.

For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Driveshaft - Front DriveshaftV6 4.0L Petrol

Removal and Installation


Removal



CAUTION: It is possible to fit the driveshaft incorrectly. Note the orientation before removal.

• **NOTE:** A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

4. CAUTIONS:



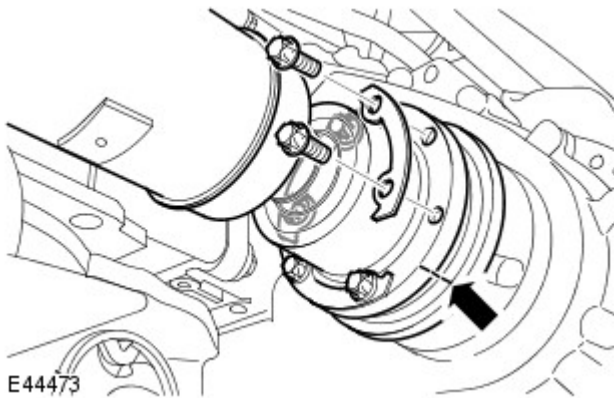
Mark the position of the driveshaft flange in relation to the drive pinion flange.



To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.



5. CAUTIONS:



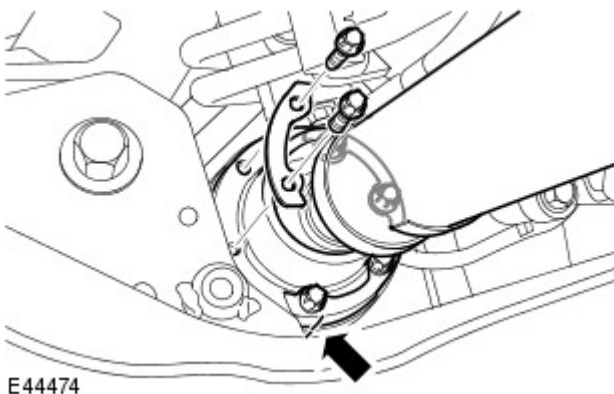
Mark the position of the driveshaft flange in relation to the drive pinion flange.



To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the front axle drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.



6. Remove the front driveshaft.

Installation

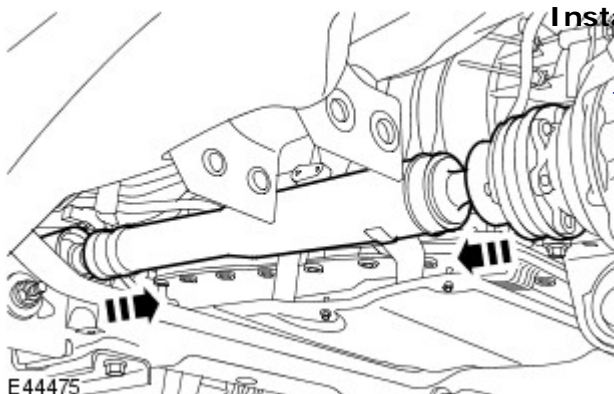
Compress the joints to disengage the drive flanges.
1. **NOTE:** A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

Install the driveshaft.

- Clean the components.
- Compress the joints to engage the drive flanges.

2. Attach the driveshaft to the front axle drive flange.

- Tighten the new Torx bolts to 45 Nm (33 lb.ft), then a further 90 degrees.



3. Attach the driveshaft to the transfer case drive flange.

- Tighten the new Torx bolts to 45 Nm (33 lb.ft), then a further 90 degrees.

4. Install the exhaust system.

For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Driveshaft - Front DriveshaftTDV6 2.7L Diesel

Removal and Installation


Removal



CAUTION: It is possible to fit the driveshaft incorrectly. Note the orientation before removal.

• **NOTE:** A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

4. Remove the crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

5. CAUTIONS:



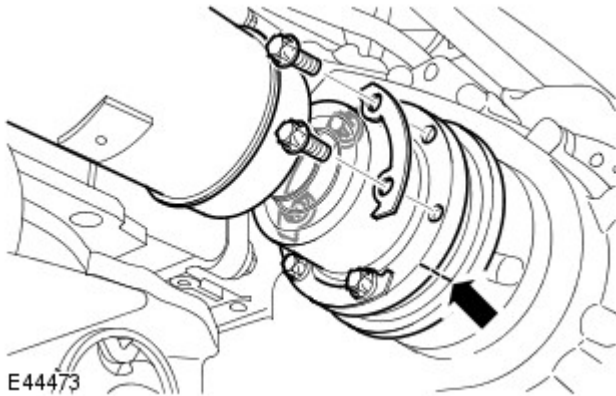
Mark the position of the driveshaft flange in relation to the drive pinion flange.



To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.



6. CAUTIONS:



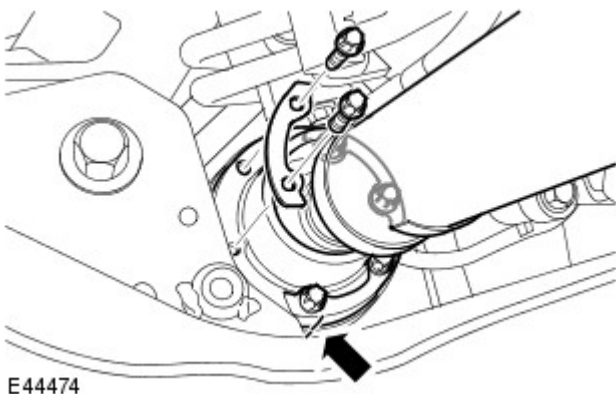
Mark the position of the driveshaft flange in relation to the drive pinion flange.

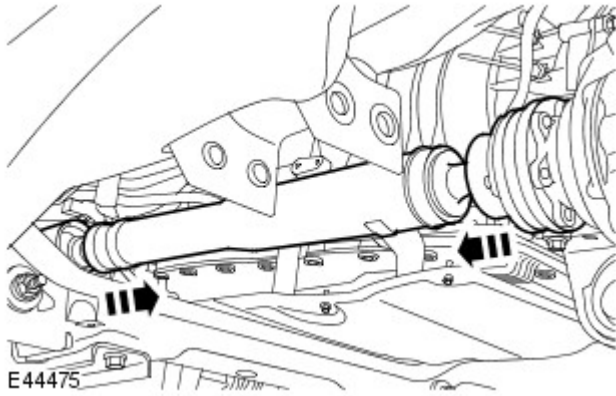


To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the front axle drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.





7. Remove the front driveshaft.

- Compress the joints to disengage the drive flanges.
- Remove the washer from the transfer case drive flange.

Installation

1. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

Install the driveshaft.

- Clean the components.
 - Install the washer.
 - Compress the joints to engage the drive flanges.
- 2. Attach the driveshaft to the front axle drive flange.**
- Tighten the new Torx bolts to 45 Nm (33 lb.ft), then a further 90 degrees.
- 3. Attach the driveshaft to the transfer case drive flange.**
- Tighten the new Torx bolts to 45 Nm (33 lb.ft), then a further 90 degrees.
- 4. Install the transmission crossmember.**
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
- 5. Install the engine undershield.**
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
- 6. Connect the battery ground cable.**
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Driveshaft - Front Driveshaft TDV6 3.0L Diesel

Removal and Installation

Removal



CAUTION: It is possible to fit the driveshaft incorrectly. Note the orientation before removal.

• **NOTE:** A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

1. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

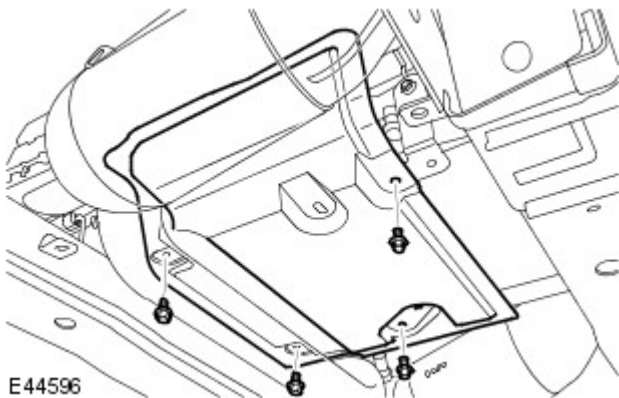
Raise and support the vehicle.

2. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

3. **NOTE:** If equipped.

Remove the transmission heat shield.

- Remove the 4 bolts.



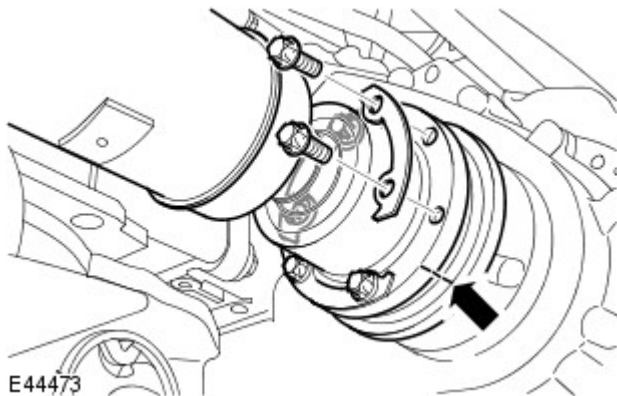
4. **CAUTIONS:**

Mark the position of the driveshaft flange in relation to the drive pinion flange.

To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.



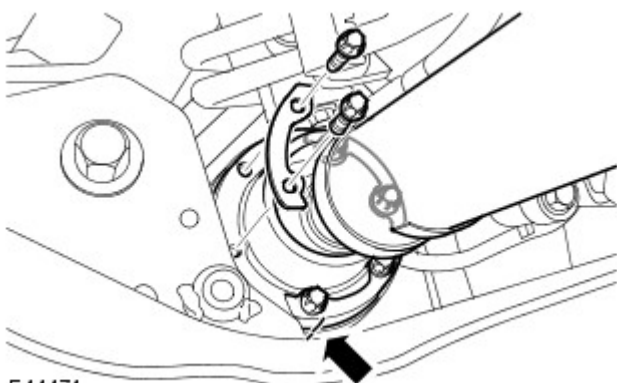
5. **CAUTIONS:**

Mark the position of the driveshaft flange in relation to the drive pinion flange.

To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

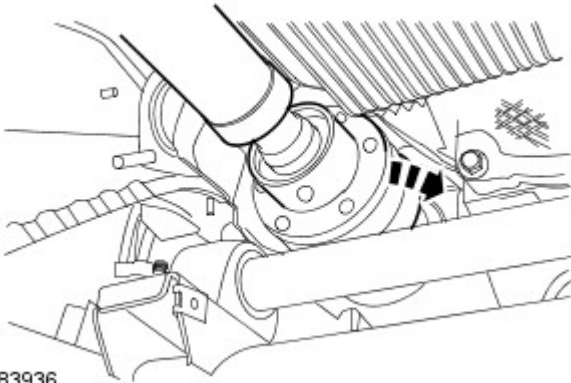
Release the driveshaft from the front axle drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.



6. Remove the front driveshaft.

- Compress the joints to disengage the drive flanges.




E83936

Installation

1. **NOTE:** A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.


Install the driveshaft.

- Clean the components.
- Compress the joints to engage the drive flanges.

2.  **CAUTION:** Make sure that new bolts are installed.

Secure the driveshaft to the front axle drive flange.

- Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
- Stage 2: Tighten the bolts a further 90 degrees.

3.  **CAUTION:** Make sure that new bolts are installed.

Secure the driveshaft to the transfer case drive flange.

- Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
- Stage 2: Tighten the bolts a further 90 degrees.

4. Install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

5. Install the transmission crossmember.


For additional information, refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Driveshaft - Rear Driveshaft

Removal and Installation

Removal

• NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the fuel tank heat shield.
 - Remove the 3 bolts and 2 nuts.



E44306

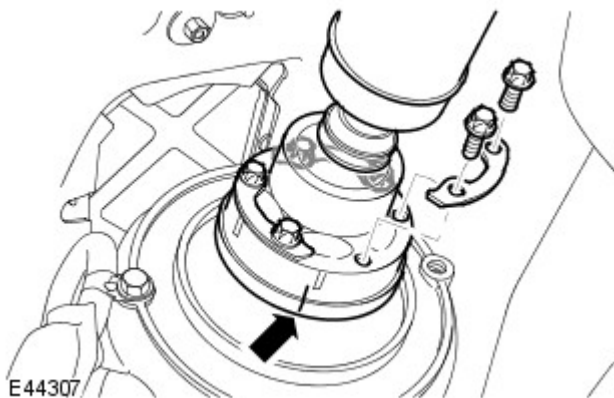
3. CAUTIONS:

 Mark the position of the driveshaft flange in relation to the drive pinion flange.

 To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers.



E44307

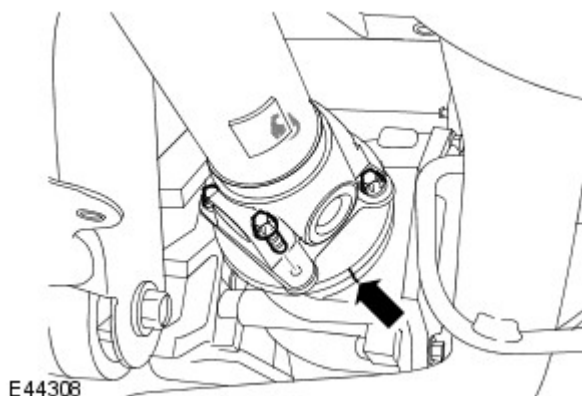
4. CAUTIONS:

 Mark the position of the driveshaft flange in relation to the drive pinion flange.

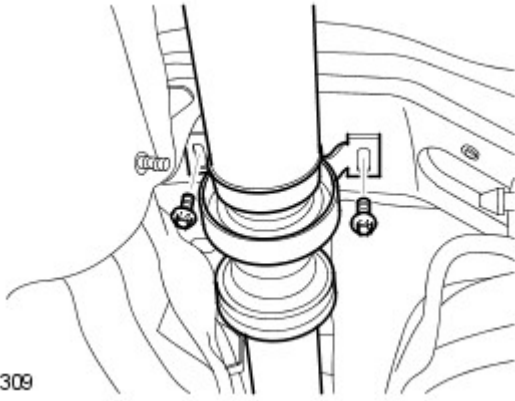
 To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the rear axle drive flange.

- Remove and discard the 4 Torx bolts.



E44308



E44309

5. With assistance, remove the driveshaft.

- Remove the 2 driveshaft center bearing mount bolts.

Installation

1. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

Attach the driveshaft to the rear axle drive flange.


- Clean the component mating faces.
- Attach the driveshaft to the rear axle drive flange.
- Tighten the new Torx bolts to 150 Nm (110 lb.ft).

2. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

Attach the driveshaft to the transfer case drive flange.

- Clean the component mating faces.
- Tighten the Torx bolts to 73 Nm (54 lb.ft).

3. CAUTIONS:

 Align the driveshaft center bearing mount by moving the floating front section of the shaft backward or forwards until the bolt holes in the mount align with the holes in the chassis.

 Make sure the center bearing mount is not under tension.

Install the driveshaft center bearing mount bolts.

- Align the center bearing mount.
- Tighten the driveshaft center bearing retaining bolts to 30 Nm (22 lb.ft).

4. Install the fuel tank heat shield.

- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the nuts to 3 Nm (2 lb.ft).

Rear Drive Axle/Differential -

Sealers

Item	Land Rover Part No.
Input shaft flange nut	STC 50553
Input shaft splines	STC 50554
Differential (ETM) unit locking motor	STC 50550

Lubricants

Item	Specification
* Recommended lubricant:	
'Open' unit	Castrol SAF-XO - 75W/90
Electronic torque managed (ETM) unit	Castrol SAF Carbon Mod Plus

*** Do not use any lubricant other than that specified**

Capacities

Unit	Capacity
'Open' differential	1.1 litres (2.3 US pints) (1.16 US quarts)
Electronic torque managed (ETM) differential	1.5 litres (3.17 US pints) (1.6 US quarts)

Rear 'Open' Differential

Item	Specification
Reduction ratio:	
V6 Diesel engine - Manual transmission	3.07:1
V6 Diesel engine - Automatic transmission	3.54:1
V6 Petrol engine - Automatic transmission	3.73:1
V8 Petrol engine - Automatic transmission	3.54:1

Rear Electronic Torque Managed (ETM) Differential

Item	Specification
Electronic torque managed (ETM) range	Up to 2500 Nm (98.5 lbf/ft)
Electronic torque managed (ETM) motor	Operates the ball/ramp mechanism and wet clutch. Motor incorporates a temperature sensor and is controlled by an ECU
Differential type	4 pin
Reduction ratio:	
V6 Diesel engine - Manual transmission	3.07:1
V6 Diesel engine - Automatic transmission	3.54:1
V6 Petrol engine - Automatic transmission	3.73:1
V8 Petrol engine - Automatic transmission	3.54:1

Torque Specifications

Description	Nm	lb-ft
Oil drain plug, with Hexagonal drive plug	54	40
Oil drain plug, with 3/8" square drive plug	28	21
Oil filler plug	34	25
Oil temperature sensor	22	16
++ Differential locking motor	10	7
Differential front mounting bolt	275	203
Differential rear mounting bolts	175	129
* Driveshaft to rear axle drive flange Torx bolts	150	110
Lower arm to wheel knuckle	275	203
Toe link bolt	175	129
Stabilizer bar link nuts	115	85
**+ Halfshaft retaining nut	350	258
Fuel tank heat shield nuts and bolts	10	7
Road wheel nuts	140	103

*** New 'Patchlok' Torx bolts must be installed**

**** New nut must be installed**

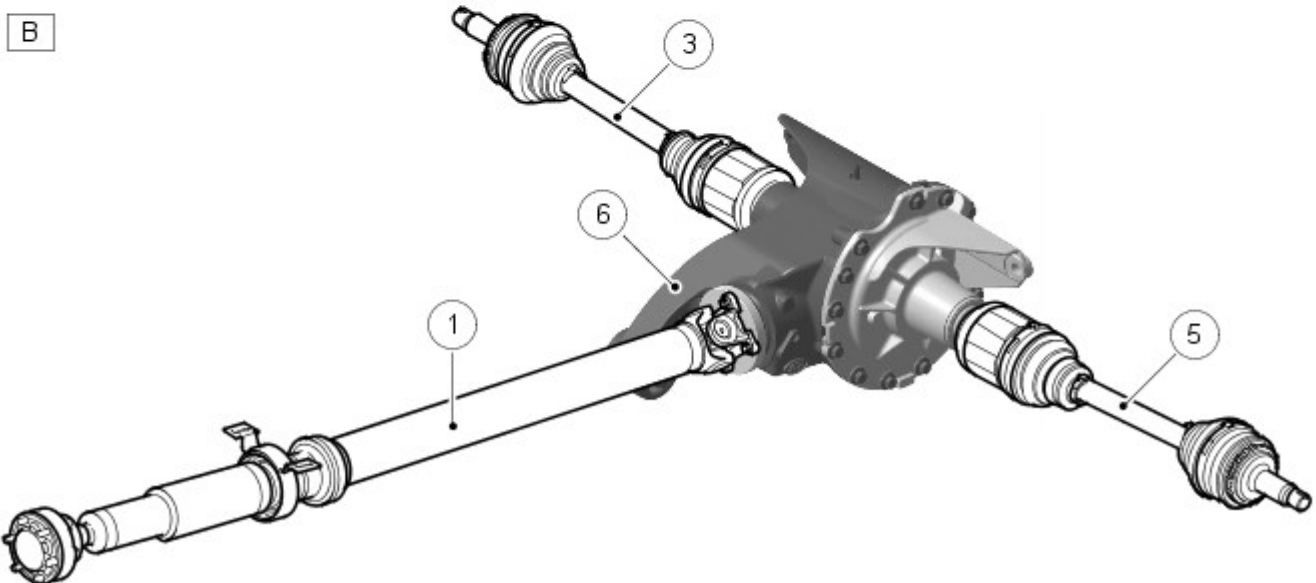
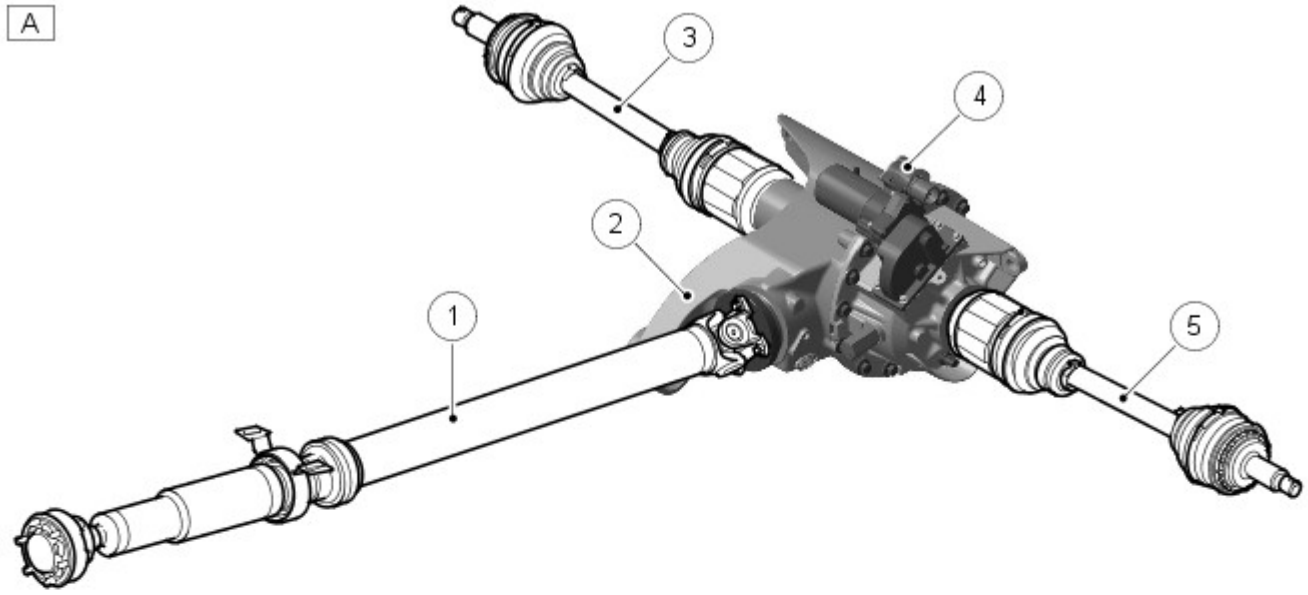
+ Stake nut on completion of tightening operation

++ Apply sealant, Part No. STC 50550 to flange of locking motor

Rear Drive Axle/Differential - Rear Drive Axle and Differential

Description and Operation

GENERAL



E51166

Item	Part Number	Description
A	-	Electronic rear differential
B	-	Open rear differential
1	-	Rear driveshaft
2	-	Electronic rear differential
3	-	RH rear drive halfshaft
4	-	Actuator (locking) motor assembly
5	-	LH rear drive halfshaft
6	-	Rear differential

The open rear differential converts the 'angle of drive' through 90° and distributes drive, via the rear drive halfshafts, to the rear wheels.

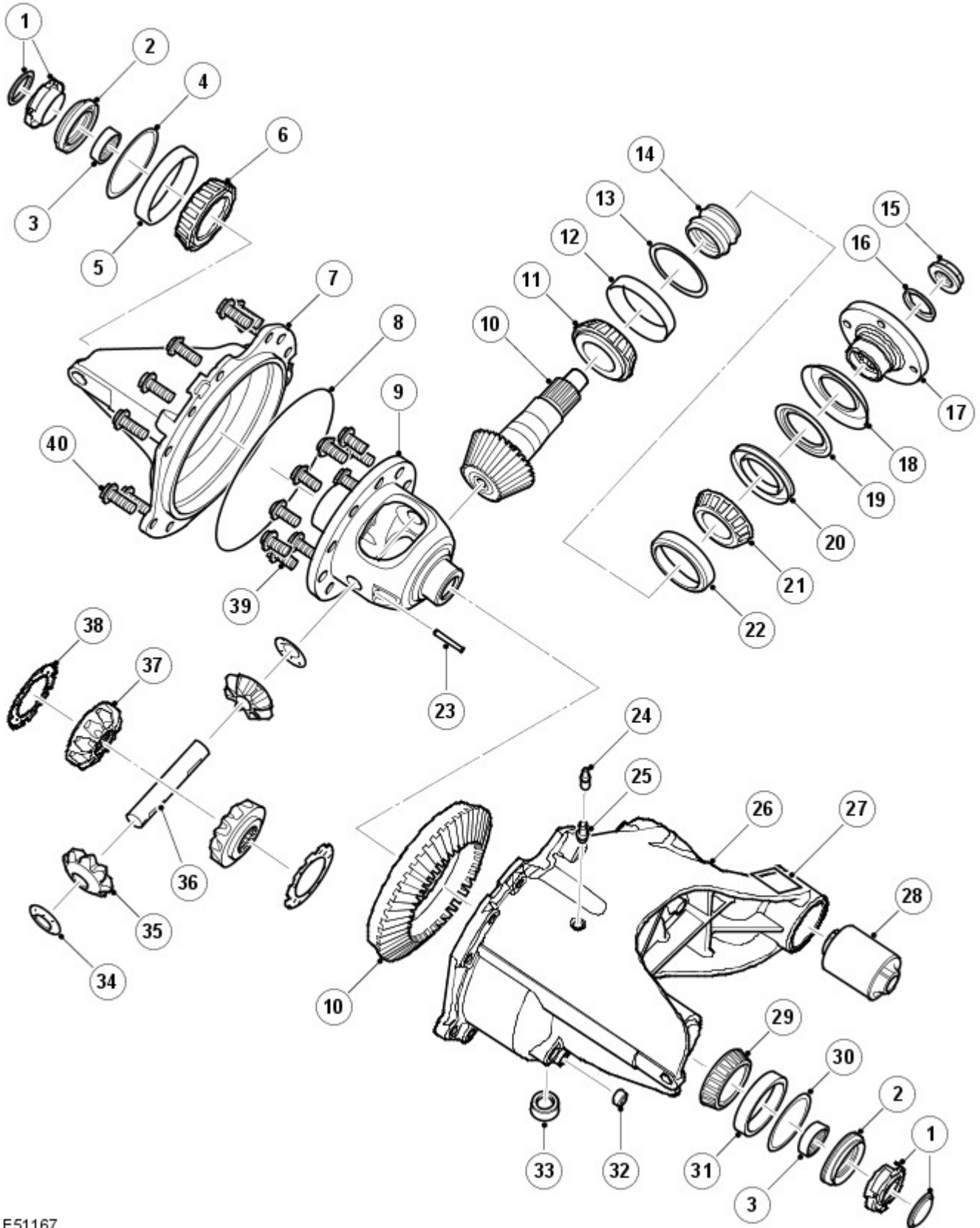
The open rear differential for the V6 and V8 petrol variants has the same output ratio, but the output ratios for the TdV6 diesel are different, depending on whether automatic or manual transmission is fitted.

The open rear differential is located centrally in the rear of the chassis.

The units are mounted to the chassis via rubber bushes and bolts; two mounting points at the rear of the unit and one at the front.

OPEN REAR DIFFERENTIAL ASSEMBLY

Open Rear Differential - Exploded View



E51167

Item	Part Number	Description
1	-	Cap
2	-	Seal
3	-	Bearing assembly, without race
4	-	Bearing pre-load spacer
5	-	Bearing
6	-	Roller bearing cup
7	-	Cover

8	-	Seal
9	-	Differential carrier
10	-	Gear and pinion assembly
11	-	Bearing
12	-	Roller bearing cup
13	-	Shim
14	-	Collapsible spacer
15	-	Pinion nut
16	-	Retainer
17	-	Flange
18	-	Outer deflector
19	-	Inner deflector
20	-	Oil seal
21	-	Bearing
22	-	Roller bearing cup
23	-	Roll pin
24	-	Breather cap
25	-	Breather
26	-	Case
27	-	Data location
28	-	Mounting bush
29	-	Bearing
30	-	Bearing pre-load spacer
31	-	Roller bearing cup
32	-	Plug
33	-	Drain plug
34	-	Thrust washer
35	-	Planet gears
36	-	Crosspin shaft
37	-	Sunwheel
38	-	Thrust washer
39	-	Bolt, 10 of
40	-	Bolt, 12 of

The cast iron casing comprises two parts; a cover and a carrier. The carrier provides locations for all the internal components. The carrier is sealed to the cover via an O-ring seal and secured with twelve bolts. The cover and carrier have cast fins, which assist mobility. A breather tube is fitted to the top of the carrier. This allows a plastic tube to be fitted and routed to a high point under the vehicle body, preventing the ingress of water when the vehicle is wading.

The carrier contains an oil drain plug. The differential unit contains approximately 1.16 litres of oil from a dry fill. If oil is being replaced, a smaller quantity of oil will be required due to residual oil retained in the pinion housing.

The differential is a conventional design using a hypoid gear layout, similar to the front differential. The open rear differential is available in three ratios. V8 petrol engine vehicles use a differential with a final drive ratio of 3.73:1, V6 petrol engine vehicles use a differential with a final drive ratio of 3.73:1 and TdV6 engine vehicles use a final drive ratio of 3.54, for vehicles with automatic transmission and 3.07 for vehicles with manual transmission. Changing the number of teeth between the crown wheel drive gear and pinion gear changes the ratio.

The differential comprises a pinion shaft and hypoid pinion gear and a crown wheel drive gear with an integral cage, which houses two planet gears. Two sun wheels are also located in the cage and pass the rotational drive to the drive shafts.

The pinion shaft is mounted on two opposed taper roller bearings, with a collapsible spacer located between them. The spacer is used to hold the bearings in alignment and also collapses under the pressure applied to the pinion flanged nut. This allows the flanged nut to be tightened to a predetermined torque, which collapses the spacer, setting the correct bearing preload.

The pinion shaft has an externally splined outer end, which accepts and locates the input flange, which is retained by the pinion nut and retainer. The input flange has four threaded holes and mates with the rear drive shaft. Four bolts secure the rear drive shaft to the input flange. An oil seal is pressed into the pinion housing and seals the input flange to the pinion housing. The pinion shaft has a hypoid gear at its inner end, which mates with the crown wheel drive gear.

The crown wheel drive gear is located on the differential case and secured with ten screws. The differential case is mounted on taper roller bearings located in machined bores on each side of the pinion housing. Shims are retained in the casing behind the bearing cups, the shim thickness is selected to apply the correct bearing preload and hypoid backlash.

The differential carrier has a through hole, which provides location for the shaft. The shaft is supported by a sun gear and a needle roller bearing. The shaft is fitted with a snap ring at one end, which locates in a machined groove in the sun gear, locking the shaft in position.

The sun gears are located in pockets in the carrier cage and mesh with the planet gears. Spacers are fitted between the sun wheels and the carrier and set the correct mesh contact between the planet gears and the sun wheels. Each sun wheel has a machined bore with internal splines and machined groove near the splined end. The groove provides positive location for a snap ring fitted to the end of each output flange.

Each output shaft has a spline, which locates in each sun wheel. A snap ring fitted to the splined shaft locates in the groove the sun wheel bore and positively locates the output shaft. Oil seals are pressed into each side of the pinion housing and seal the seal the output shaft.

Differential Operation

The operating principles of the front and rear differentials are the same. Rotational input from the drive shaft is passed via the input flange to the pinion shaft and pinion gear. The angles of the pinion gear to the crown wheel drive gear moves the rotational direction through 90°.

The transferred rotational motion is now passed to the crown wheel drive gear, which in turn rotates the differential casing. The shaft, which is secured to the casing, also rotates at the same speed as the casing. The planet gears, which are mounted on the shaft, also rotate with the casing. In turn, the planet gears transfer their rotational motion to the left and right hand sun wheels, rotating the drive halfshafts.

When the vehicle is moving in a forward direction, the torque applied through the differential to each sun wheel is equal. In this condition both drive halfshafts rotate at the same speed. The planet gears do not rotate and effectively lock the sun wheels to the differential casing.

If the vehicle is turning, the outer wheel will be forced to rotate faster than the inner wheel by having a greater distance to travel. The differential senses the torque difference between the sun wheels. The planet gears rotate on their axes to allow the outer wheel to rotate faster than the inner one.

SERVICE

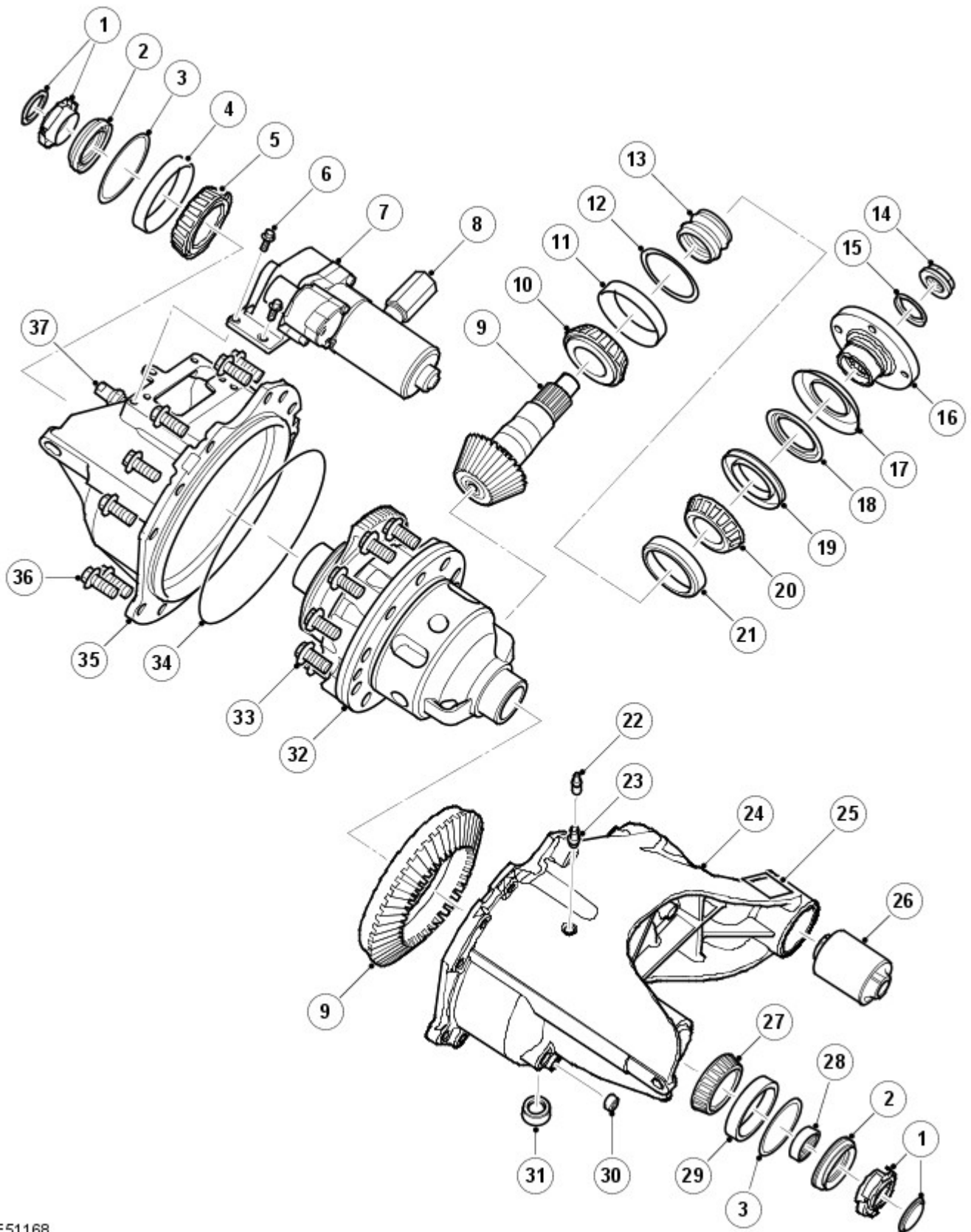
The oil used in the open rear differential is Castrol SAF-XO. The oil contains unique additives, which enhance the differentials operation. No other oil must be used in the open rear differential.

Open Rear Differential Serviceable Components

- Needle roller bearing assemblies
- Halfshaft seals
- Chassis bush/fixings
- Lubricant.

ELECTRONIC REAR DIFFERENTIAL ASSEMBLY

Electronic Rear Differential - Exploded View



E51168

Item	Part Number	Description
1	-	Cap
2	-	O ring
3	-	Bearing pre-load spacer
4	-	Bearing
5	-	Bearing cup
6	-	Bolt, 4 of
7	-	Housing and motor assembly
8	-	Damper
9	-	Gear and pinion assembly
10	-	Bearing
11	-	Bearing cup

12	-	Shim
13	-	Collapsible spacer
14	-	Pinion nut
15	-	Retainer
16	-	Flange
17	-	Deflector, outer
18	-	Deflector, inner
19	-	Seal
20	-	Bearing
21	-	Bearing cup
22	-	Breather cap
23	-	Breather
24	-	Case
25	-	Data location
26	-	Mounting bush
27	-	Bearing
28	-	Bearing assembly without race
29	-	Bearing cup
30	-	Filler plug
31	-	Drain plug
32	-	Electronic differential assembly
33	-	Bolt, 10 of
34	-	O ring
35	-	Cover
36	-	Bolt, 12 of
37	-	Temperature sensor

The electronic rear differential has the same functionality as the open rear differential but incorporates a locking feature.

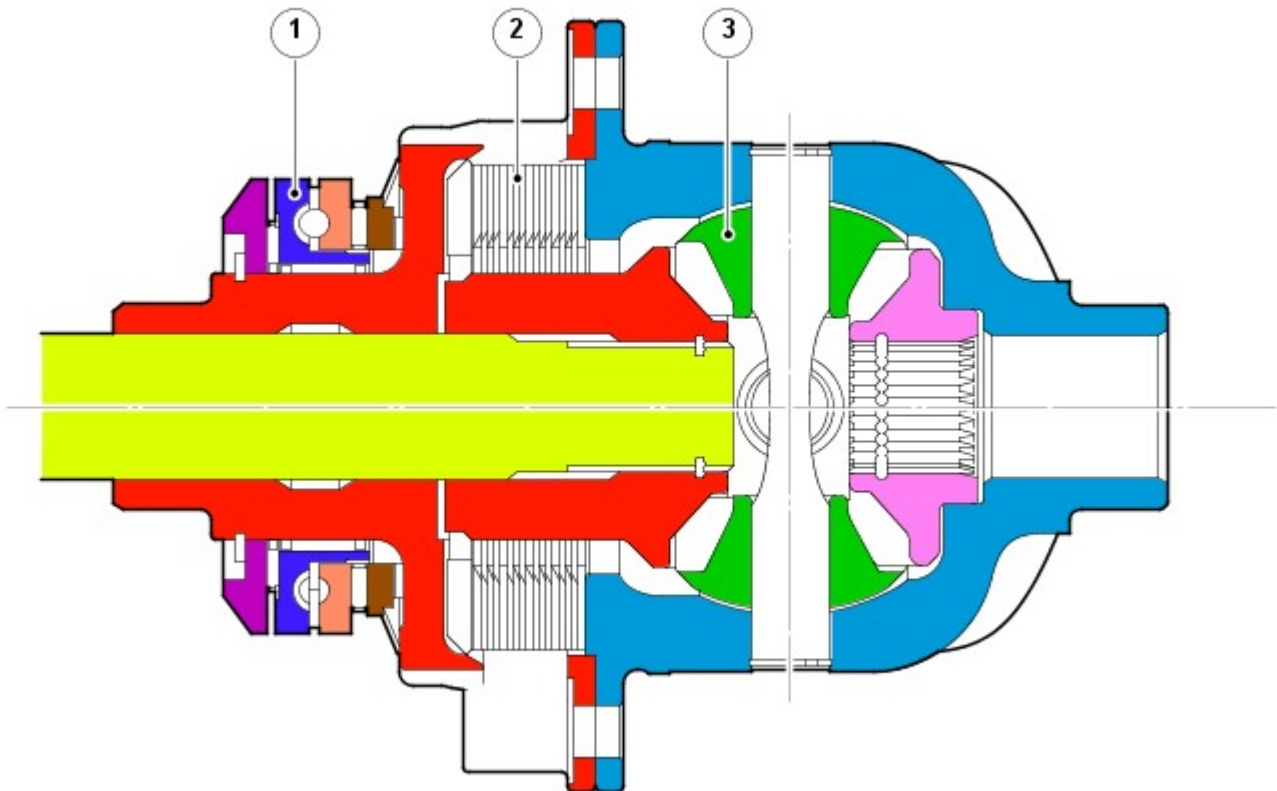
An electronically controlled multi-plate clutch provides a rear differential lock and torque biasing function to give improved traction performance and vehicle dynamic stability.

A strategy, to electronically control the rear differential multi-plate clutch assembly, has been developed to provide:

- a pre-loading function, increasing locking torque with increased driving torque
- a slip controller to increase locking torque under off-road conditions and decrease locking torque for optimum comfort, e.g. parking.

The unit receives a torque input from the transfer box output shaft, which is passed through the unit to two outputs for the rear drive halfshafts.

The unit detects wheel slip via various vehicle system inputs to the electronic rear differential control module and locks the differential accordingly.



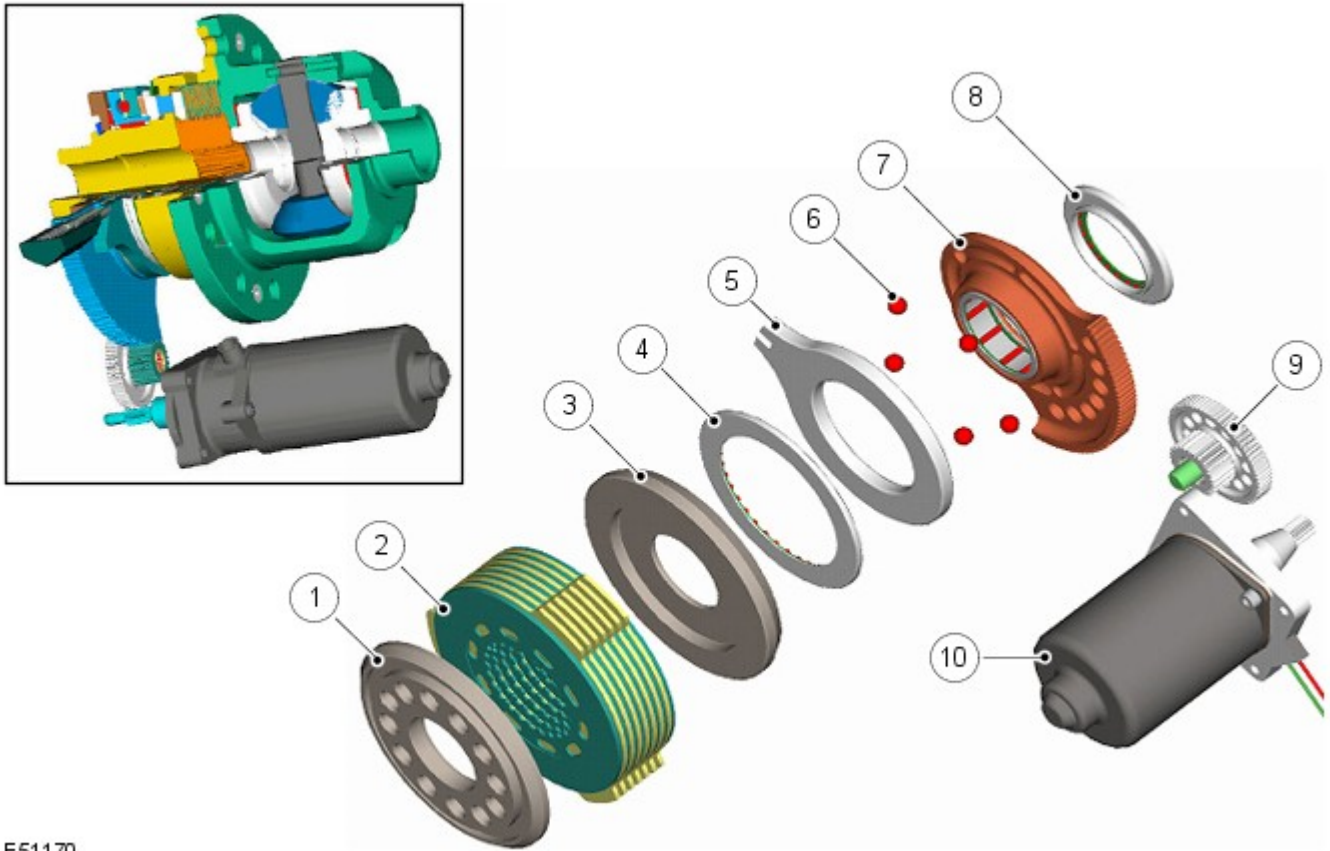
E51169

Item	Part Number	Description
1	-	Actuator

2	-	Clutch pack
3	-	Differential

The electronic rear differential locking and biasing feature is actuated via a DC motor, which is controlled by the electronic rear differential control module, via a Pulse Width Modulation (PWM) signal.

Multi-plate Clutch Assembly



E51170

Item	Part Number	Description
1	-	Pressure disc
2	-	Clutch plate assembly
3	-	Pressure disc
4	-	Thrust race
5	-	Output actuator
6	-	Actuator balls
7	-	Input actuator
8	-	Bearing pre-load spacer
9	-	Reduction gearset
10	-	Actuator motor

The multi-plate clutch assembly for both centre (transfer box) and electronic rear differentials act in a similar way. The aim of the multi-plate clutch assembly is to prevent excessive differential slip and therefore maximise the traction performance of the vehicle. This is fundamentally different from the 'braked' traction control, which can only counter act differential slip when it occurs.

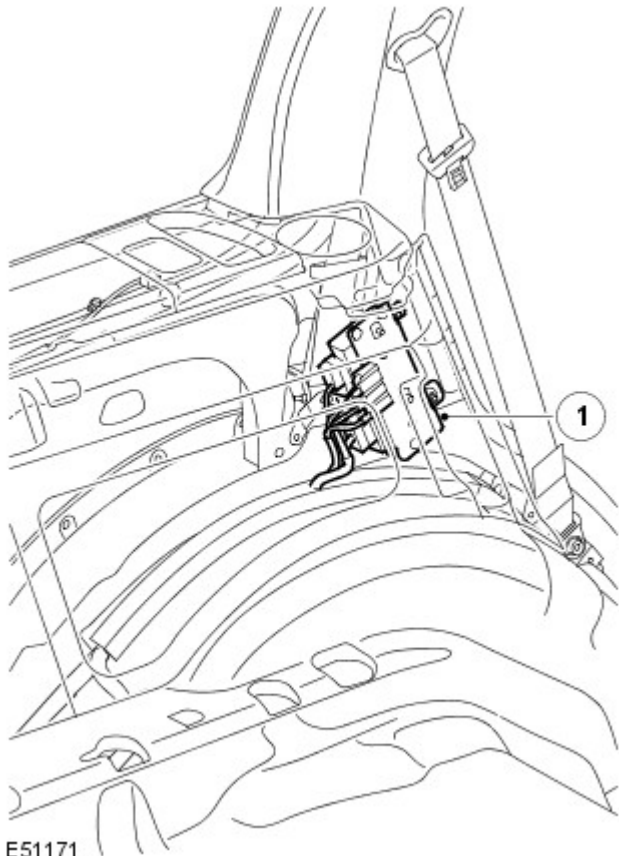
A certain amount of differential slip is required to allow the vehicle to turn corners and to remain stable under control of the Anti-lock Braking System (ABS). The transfer box control module monitors the driver's demands through primary vehicle controls and automatically sets the slip torque at the rear differential via the electronic rear differential control module. The system is completely automatic and does not require any special driver input.

The multi-plate clutch assembly actively controls the torque flow through the rear differential and optimises the torque distribution in the driveline. The clutch assembly biases the torque from the differential to the wheels with the higher grip and prevents the wheels with the lower grip from spinning.

By turning the input actuator disc, via the motor shaft, the output actuator is rotated. This movement acts on 5 balls in a ramp mechanism between the input and output actuators and gives a defined axial movement. The movement forces the pressure disc to induce friction between the sun gear and differential case via the clutch plates supported by the sun gear and the plates supported by the clutch basket on the differential case. This frictional force inhibits the differential rotation; the differential case and left hand differential side gear are locked together.

Electronic Rear Differential Control Module

The electronic rear differential control module controls the multi-plate clutch actuation. The control module is mounted on a bracket located on the LH C-pillar, behind the trim.



E51171

Item	Part Number	Description
1	-	Electronic rear differential control module

The control module is connected on the Controller Area Network (CAN) bus and controls the differential operation using CAN messages from other control modules on the network.

The control module uses three connectors for all inputs and outputs. It receives a permanent power supply via a 40A fusible link located in the Battery Junction Box (BJB), and an ignition supply via fuse 24 located in the Central Junction Box (CJB).

The control module memorises the position of the electronic rear differential motor when the ignition is switched off.

The control module controls the closed loop position sensing system within the motor and regulates the power supply to the motor.

If the control module is replaced, T4 must be connected to the vehicle and the electronic rear differential control module self-calibration procedure must be performed. This procedure must also be performed if the motor or differential assembly is replaced.

If a fault occurs with the electronic rear differential, the control module records an error code and a warning lamp, in the instrument cluster, illuminates permanently.

Electronic Rear Differential Control Module Pin Out Details

Connector C2162

Pin No.	Description	Input/output
1	Not used	-
2	CAN bus low	Input/output
3	CAN bus high	Input/output
4	Not used	-
5	CAN bus high	Input/output
6	CAN bus low	Input/output

Connector C2163

Pin No.	Description	Input/output
1	Not used	-
2	Not used	-
3	Ground	-
4	Ignition feed	Input
5	Not used	-
6	Ground	-
7	Battery feed	Input
8	Battery feed	Input

Connector C2164

Pin No.	Description	Input/output
---------	-------------	--------------

Pin No.	Description	Input/output
1	+ve for actuator Hall sensor	Input
2	Not used	-
3	Actuator motor	Output
4	Hall sensor - Signal A	Input
5	Not used	-
6	Not used	-
7	Hall sensor - Signal B	Input
8	Differential oil temperature sensor	Input
9	Not used	-
10	Ground - Hall sensor	-
11	Differential oil temperature sensor	Output
12	Actuator motor	Input
13	Motor temperature sensor	Output
14	Not used	-
15	Not used	-
16	Motor temperature sensor	Input
17	Motor brake solenoid	Output
18	Motor brake solenoid	Input

CAN Bus Messages

The CAN bus is a high speed broadcast network connected between various vehicle control modules. It allows the fast exchange of data between control modules every few microseconds. The bus comprises two wires, which are twisted together to minimise electromagnetic interference (noise) produced by the CAN messages.

For additional information, refer to: Communications Network (418-00 Module Communications Network, Description and Operation).

The electronic rear differential control module is connected on the CAN bus, via the transfer box control module, and controls differential operation using CAN messages from other control units on the network. Wheel speed, steering angle, automatic transmission speed, temperature information, car configuration, axle ratios and mode inputs, are some of the main signals received by the control module.

The control module also sends messages via the CAN bus to tell other control modules on the network, the status of the electronic rear differential. The clutch torque and default mode status are some of the main signals sent out by the control module.

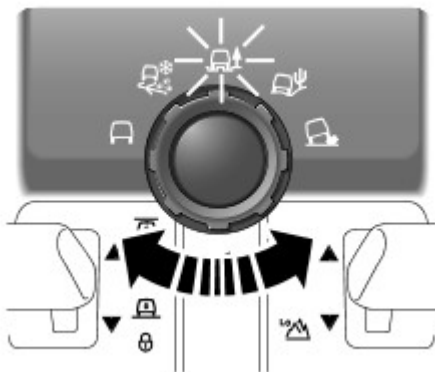
The following table shows the messages that can be displayed in the message centre of a high-line instrument cluster relating to the electronic rear differential:

Message	Description	Chime
'TRANSMISSION OVERHEAT' 'SLOW DOWN'	Rear differential temperature has reached or is approaching the overheat threshold.	None
'TRANSMISSION FAULT' 'TRACTION REDUCED'	Transfer box control module has stopped transmitting CAN bus messages. Defaults to open centre differential. Message also displayed when fault occurs with electronic rear differential.	None
'TRANSMISSION FAULT' 'STOP SAFELY'	Fault has occurred with electronic rear differential. Stop vehicle at earliest opportunity.	Single

On vehicles fitted with the low line instrument cluster, in place of the message centre there will be a status lamp, which has the following logic:

- Amber - Over temperature
- Red - Failure, stop vehicle

TERRAIN RESPONSE™



The Terrain Response™ system allows the driver to select a program, which will provide the optimum settings for traction and performance for the prevailing terrain conditions.

The system is controlled by a rotary control located on the centre console.

The system uses a combination of vehicle subsystems to achieve the required vehicle characteristics for the terrain selected. The following subsystems form the Terrain Response™ system:

- Engine management system
- Automatic transmission (if fitted)
- Transfer box
- Brake system
- Air suspension.

Each subsystem control module provides a feedback for the selected program so that the Terrain Response™ control module can check that all systems are controlling the system correctly. The exception to this is the electronic rear differential control module which does not provide feedback to the Terrain Response™ system as it is a slave to the transfer box control module.

For additional information, refer to: [Ride and Handling Optimization](#) (204-06 Ride and Handling Optimization, Description and Operation).

SERVICE

The oil used in the electronic rear differential is Castrol SAF-Carbon Mod Plus. The oil contains unique additives and friction modifiers, which enhance the differentials operation. No other oil must be used in the electronic rear differential.

Electronic Rear Differential Serviceable Components

- Halfshaft seals
- Needle roller bearing assembly
- Chassis bush/fixings
- Actuator motor
- Temperature sensor
- Control module and bracket
- Lubricant.

DIAGNOSTICS

The electronic rear differential control module can store fault codes, which can be retrieved using T4 or a diagnostic tool using ISO-14229 protocol.

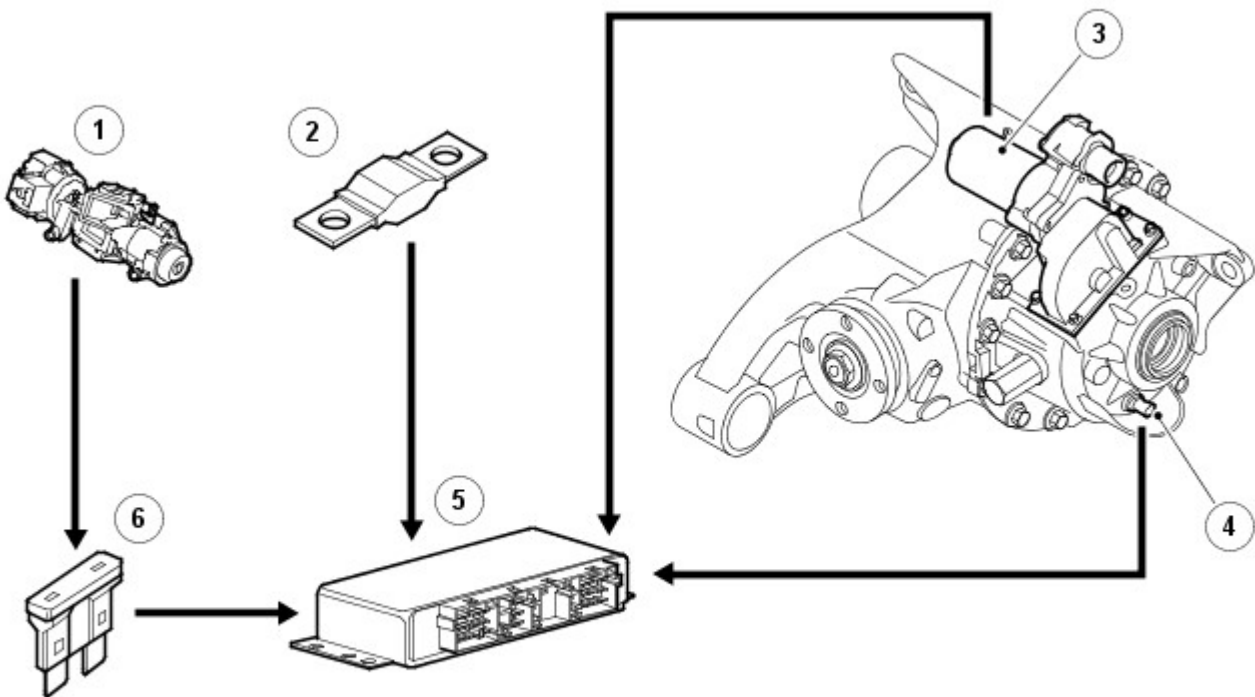
The information is communicated via a diagnostic socket.

The diagnostic socket allows the exchange of information between the various control modules on the bus systems and T4 or another suitable diagnostic tool. The information is communicated to the socket via the CAN bus. This allows the retrieval of diagnostic information and programming of certain functions using T4 or another suitable diagnostic tool.

The electronic rear differential control module uses Diagnostic Trouble Codes (DTC), which relate to electronic rear differential electrical faults.

ELECTRONIC REAR DIFFERENTIAL CONTROL DIAGRAM

- NOTE: A = Hardwired



Item	Part Number	Description
1	-	Ignition switch
2	-	Fusible link (battery)
3	-	Actuator motor
4	-	Oil temperature sensor
5	-	Electronic rear differential control module
6	-	Fuse (ignition)

Rear Drive Axle/Differential - Rear Drive Axle and Differential

Diagnosis and Testing

Principles of Operation

For a detailed description of the Rear Drive Axle and Differential and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Rear Drive Axle and Differential](#) (205-02 Rear Drive Axle/Differential, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Differential oil leakage ● Sensor installation 	<ul style="list-style-type: none"> ● power ● Fuse(s) ● Wiring harness physical damage or water ingress ● Loose or corroded electrical connectors ● Controller Area Network (CAN) circuits ● Sensors ● Rear differential control module

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Message	Possible Other Warnings	Possible Causes	Action
Running at reduced capability with fault present	<ul style="list-style-type: none"> ● Rear differential fault 	<ul style="list-style-type: none"> ● Driveline overheat warning lamp illuminated ● Rear differential/driveline fault warning lamp illuminated 	<ul style="list-style-type: none"> ● Water ingress to wiring harness or connectors ● Reduced differential capability ● Differential increased tolerances ● Internal fault ● Rear differential control module fault (Rear differential control module) 	Visually inspect the wiring harness and connectors for water ingress. Refer to the warranty policy and procedures manual if a module is suspect.
Rear differential overheat	<ul style="list-style-type: none"> ● Rear Differential Overheat Slow Down 	<ul style="list-style-type: none"> ● Driveline overheat warning lamp illuminated 	<ul style="list-style-type: none"> ● Oil level incorrect ● Oil level incorrect specification ● Sensor fault ● Internal fault 	Check for correct oil quantity and specifications. Refer to the relevant section of the workshop manual.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Rear Differential Control Module \(RDCM\)](#) (100-00 General Information, Description and Operation).

Rear Drive Axle/Differential - Differential Draining and Filling

General Procedures



CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

• **NOTE:** The only way to check the fluid level in the differential is to drain all the fluid out and refill with the correct quantity, shown in the specification section.

For additional information, refer to: [Specifications](#) (205-02 Rear Drive Axle/Differential, Specifications).

- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- CAUTION:** Do not undo or remove the large protruding hexagon on the differential casing.

Remove the differential case lubricant filler plug.

- Clean the area around the lubricant filler plug.
- Position container to collect fluid loss.



- Drain the differential lubricant.

- Clean the area around the drain plug.
- Remove the fluid drain plug.



- CAUTION:** There has been 2 different types of fixings used for the drain plug. Note the type and make sure the correct torque is applied, see below.

Install the lubricant drain plug.

- Clean the drain plug.
- Up to differential serial number 254325: Tighten the hexagonal drive drain plug to 54 Nm (40 lb.ft).
- From differential serial number 254326: Tighten the 3/8" square drive drain plug to 28 Nm (21 lb.ft).

5. CAUTIONS:



There have been 2 different types of fixings used for the drain plug. Note the type and differential serial number, and make sure the correct torque is applied, see below.



Make sure the correct specification and quantity of oil is used.

Fill the differential with the correct amount of lubricant.
For additional information, refer to: [Specifications](#) (205-02 Rear Drive Axle/Differential, Specifications).


6. Install the differential filler plug.

- Clean the filler plug.
- Tighten the filler plug to 34 Nm (25 lb.ft).

Rear Drive Axle/Differential - Differential Locking Motor

In-vehicle Repair

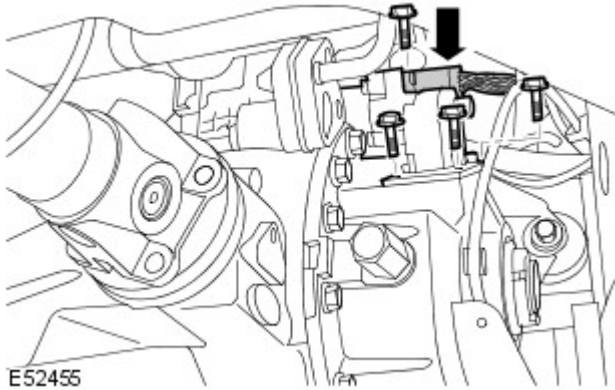
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

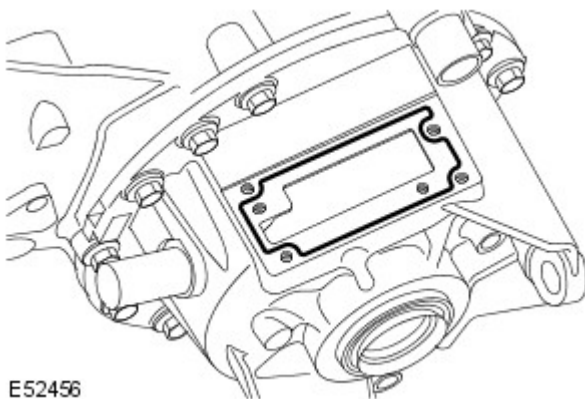
2. Remove the differential locking motor.

- Disconnect the electrical connector.
- Remove the 4 bolts.



Installation

1. Clean the component mating faces.
2. Apply continuous bead of sealant to the motor mating face on the differential.




3. Install the differential locking motor.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
4. Lower the vehicle.
5. Calibrate the differential locking motor using the diagnostic tool.

Rear Drive Axle/Differential - Rear Axle Oil Temperature Sensor

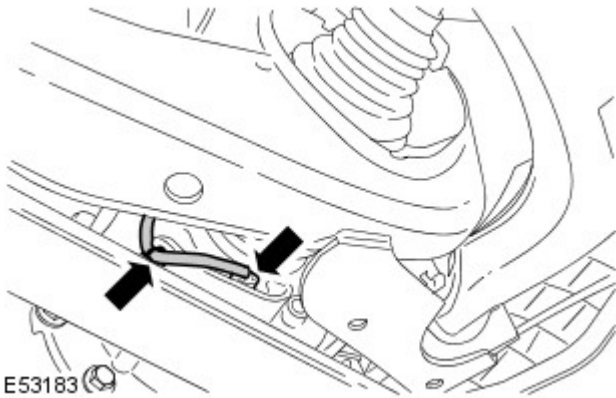
In-vehicle Repair

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

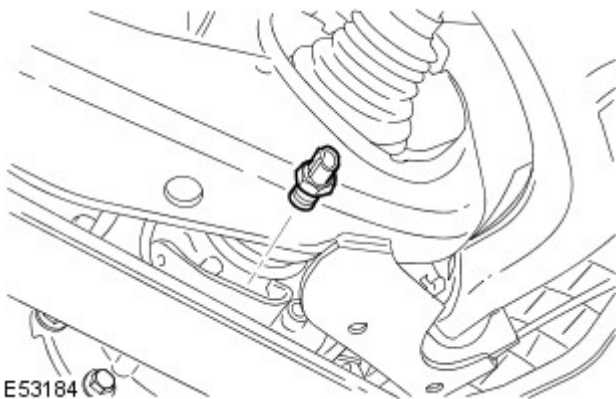
Raise and support the vehicle.

- Drain the differential lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).
- Disconnect the electrical connector.
 - Release the wiring harness retaining clip.



- Remove the oil temperature sensor.

- Remove and discard the O-ring seal.

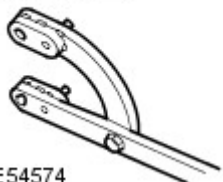








Installation

- Clean the component mating faces.
- Install the oil temperature sensor.
 - Tighten to 22 Nm (16 lb.ft).
- Connect the electrical connector.
 - Secure the wiring harness clip.
- Fill the differential with the correct amount of lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

Rear Drive Axle/Differential - Drive Pinion Seal

In-vehicle Repair

Special Tool(s)	
<p>205-053</p>  <p>E54574</p>	<p>Flange holding tool</p> <p>205-053</p>
<p>205-053</p>  <p>E54585</p>	<p>Adapter for</p> <p>205-053</p>
<p>100-012</p>  <p>E54135</p>	<p>Impulse extractor</p> <p>100-012(LRT-99-004)</p>
<p>205-821</p>  <p>E54586</p>	<p>Installer drive pinion oil seal</p> <p>205-821</p>
<p>205-824</p>  <p>E54587</p>	<p>Remover drive flange</p> <p>205-824</p>
<p>205-823</p>  <p>E54700</p>	<p>Remover drive pinion seal</p> <p>205-823</p>
<p>205-821-01</p>  <p>E 112195</p>	<p>Seal installer, adaptor</p> <p>205-821-01</p>

Removal


• CAUTIONS:



The input flange must not be change for one from another unit.



The drive pinion seal must only be renewed for 1 repair.

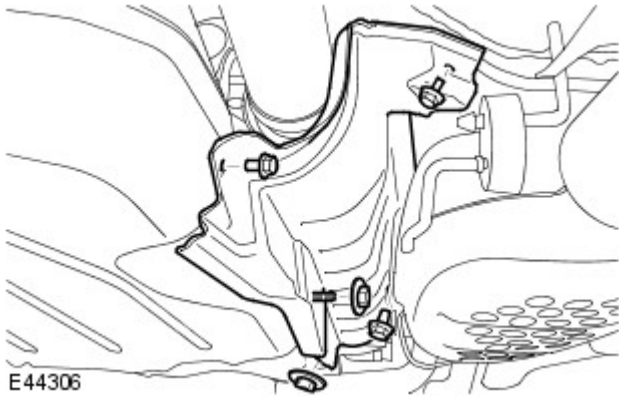
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Drain the differential lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

3. Remove the fuel tank heat shield.

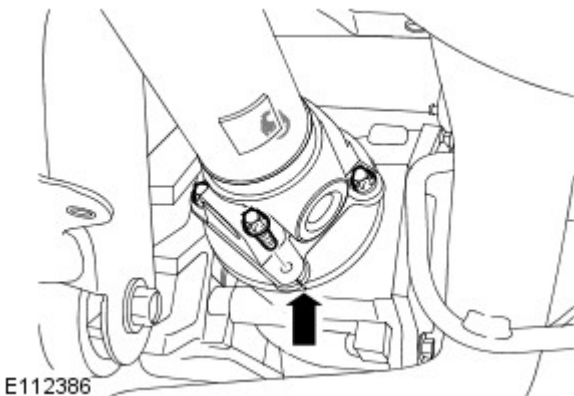
- Remove the 3 bolts and 2 nuts.



4.  **CAUTION:** Mark the position of the driveshaft flange in relation to the drive pinion flange.

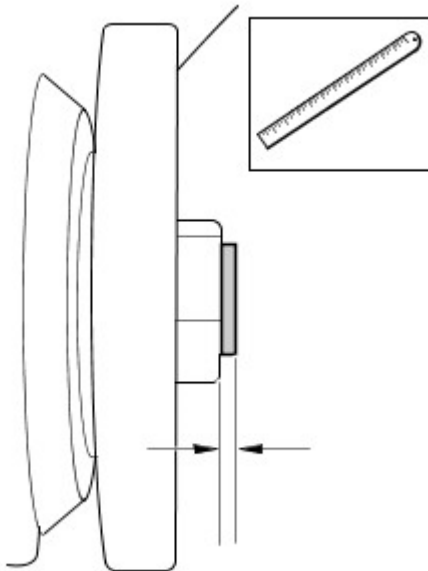
Release the driveshaft from the rear axle drive pinion flange.

- Remove and discard the 4 Torx bolts.




5. Measure the depth of the pinion nut on the pinion shaft.

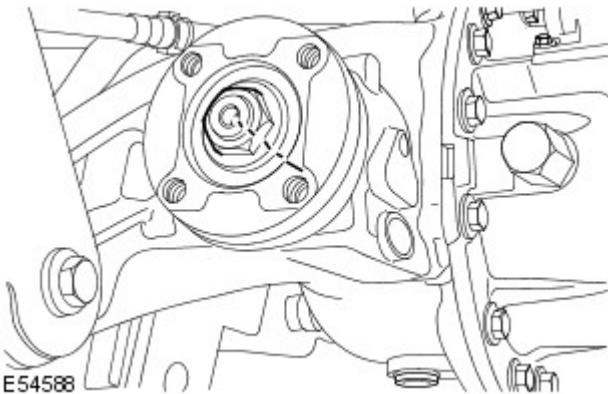
- Note measurement for installation.



E112387

6.  CAUTION: This step must be carried out to make sure that the drive pinion nut is correctly tightened on assembly.

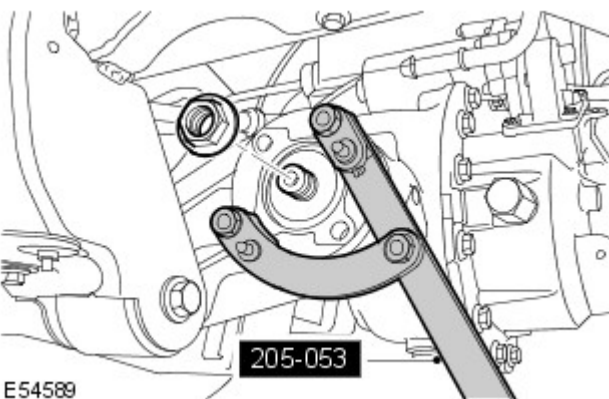
Accurately scribe a line to mark the drive pinion shaft to the drive pinion nut and pinion flange.



E54588

7. Remove the drive pinion flange retaining nut.

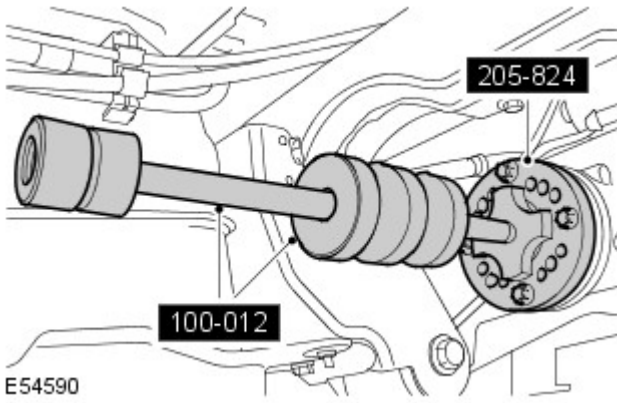
- Using the special tool, counter hold the drive pinion flange.
- Note number of turns for installation.



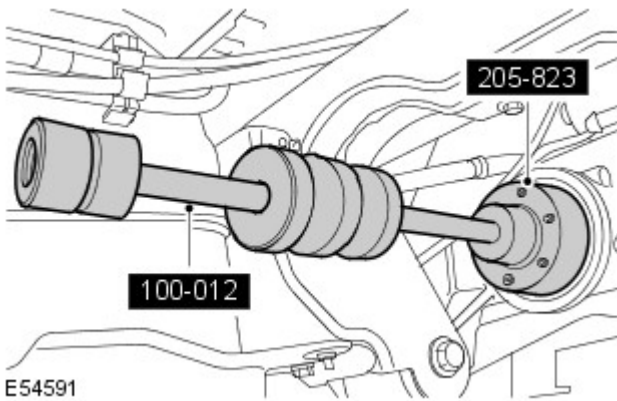
E54589

8. Using the special tool, remove the drive pinion flange.

- Check flange seal journal for any damage.

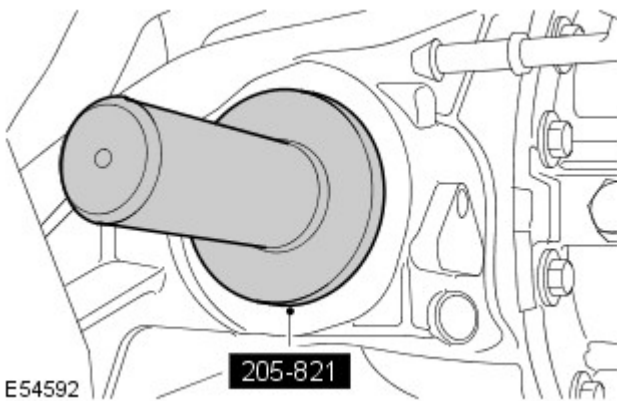


9. Using the special tool, remove the drive pinion seal.



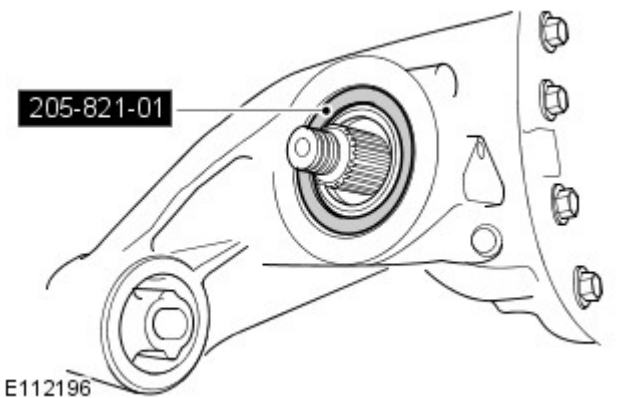
Installation

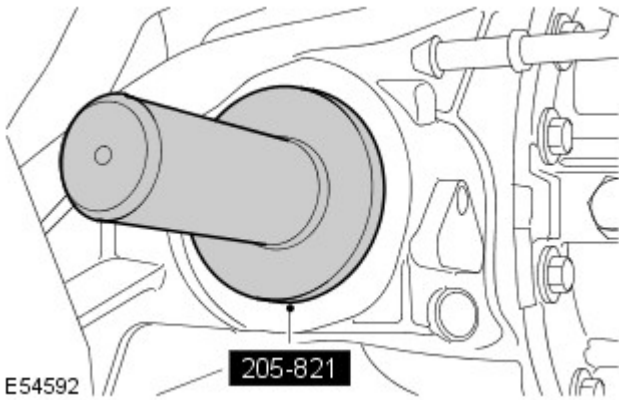
1. Clean the drive pinion flange.
2. Clean the drive pinion seal mating faces.
3. Using the special tool, install the new drive pinion seal.



4. Remove the special tool.

- Install special tool 205-821-01 to the seal face.





5.  CAUTION: Make sure adaptor is removed or damage to the vehicle may occur.


Using the special tool, install the new drive pinion seal.

- Remove the special tools.

6.  CAUTION: Make sure the drive pinion flange scribed marks are aligned.

Install the drive pinion flange.

7. CAUTIONS:

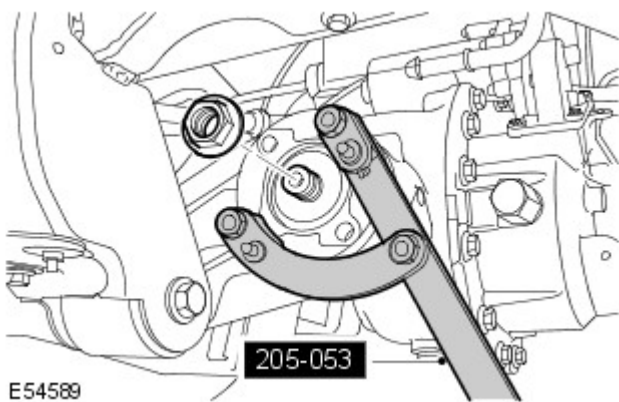
 Make sure the mark on the drive pinion nut is never tightened short of the scribed mark on the drive pinion shaft.

 Make sure the drive pinion flange has no end float and is free to rotate.

 Make sure the scribed mark on the drive pinion nut is no more than a maximum of 5 degrees past the scribed mark on the drive pinion shaft.

Install the drive pinion flange retaining nut.

- Using the special tool, counter hold the drive pinion flange.
- Install nut to previously noted number of turns.
- Measure the depth of the pinion nut on the pinion shaft.




8. Attach the driveshaft to the rear axle drive flange.

- Clean the component mating faces.
- Attach the driveshaft to the rear axle drive flange.
- Tighten the new Torx bolts to 150 Nm (110 lb.ft).

9. Install the fuel tank heat shield.

- Tighten the bolts and nuts to 10 Nm (7 lb.ft).

10.  CAUTION: Make sure the correct specification and quantity of oil is used.

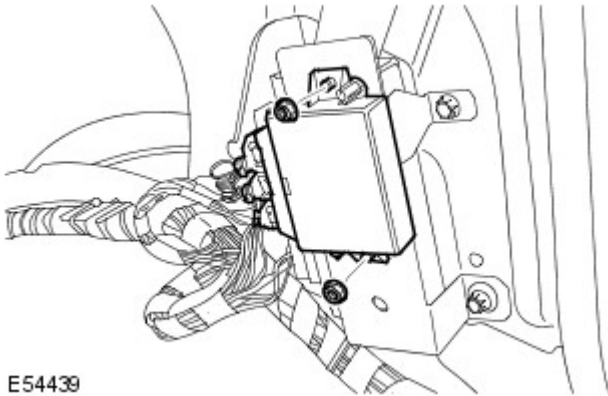
Fill the differential with the correct amount of lubricant. For additional information, refer to: [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

Rear Drive Axle/Differential - Differential Locking Module

In-vehicle Repair

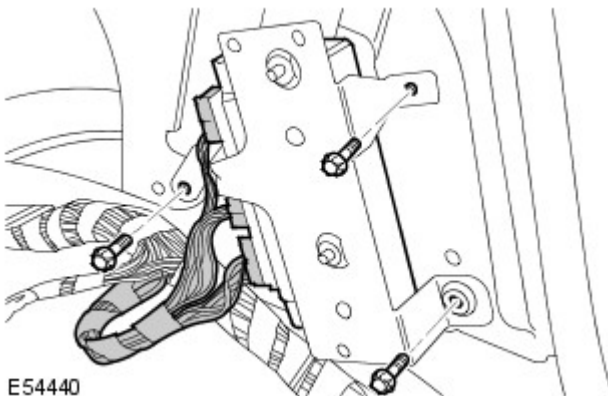
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the rear quarter trim panel.
For additional information, refer to: [Rear Quarter Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the parking aid module.
 - Remove the 2 nuts.



E54439

4. Remove the differential locking module.
 - Disconnect the 3 electrical connectors.
 - Remove the 3 bolts.



E54440

Installation

1. Install the differential locking module.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
 - Connect and secure the electrical connectors.
2. Install the parking aid module.
 - Tighten the nuts to 10 Nm (7 lb.ft).
3. Install the rear quarter trim panel.
For additional information, refer to: [Rear Quarter Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
5. Use T4 to calibrate a new differential locking module.

Rear Drive Axle/Differential - Axle Assembly

Removal and Installation

Removal



CAUTION: Do not loosen or remove the large protruding hexagon on the differential casing.

- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

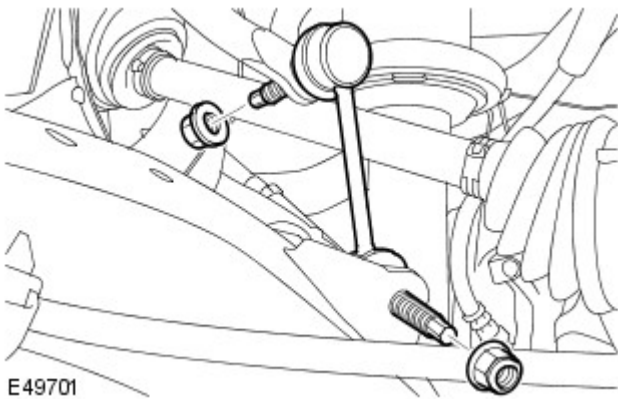
Raise and support the vehicle.

- Remove the rear wheels and tires.
- Remove the muffler assembly.
For additional information, refer to: [Muffler](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation) / [Muffler](#) (309-00 Exhaust System - 4.4L, Removal and Installation) / [Muffler - Vehicles Without Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).
- Drain the differential fluid.
For additional information, refer to: [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).
- Remove the RH rear halfshaft.
For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).

- CAUTION:** Use a wrench on the hexagon provided to prevent the ball joint rotating.

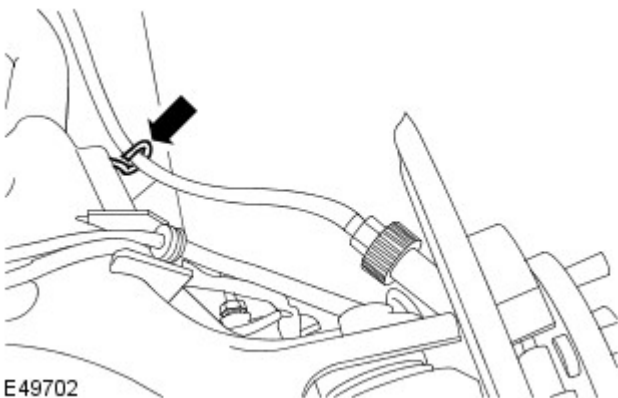
Remove the LH rear stabilizer bar link.

- Remove and discard the 2 nuts.



E49701

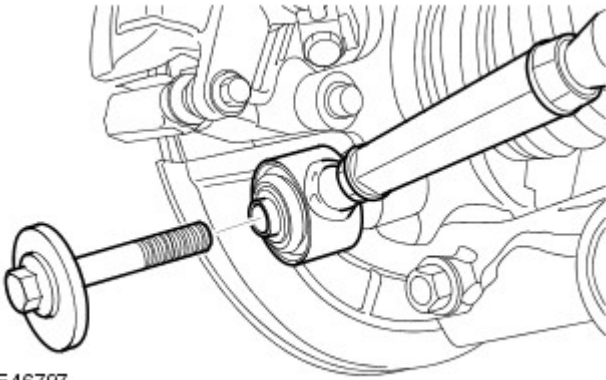
- Release the parking brake cable from the LH lower arm.




E49702

8. Release the LH rear toe link.

- Remove the bolt.

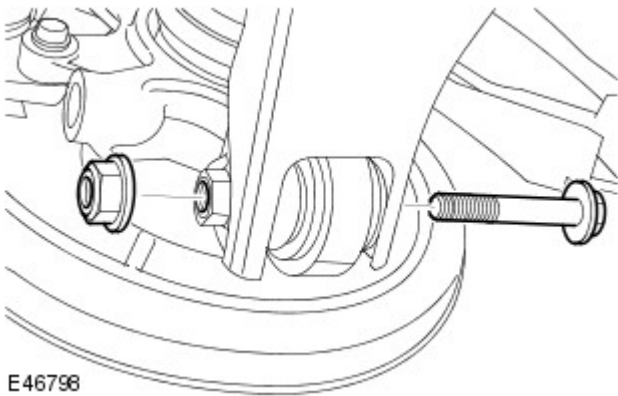


E46797

9.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Release the LH rear wheel knuckle from the lower arm.

- Remove the bolt.
- Using a suitable stand, support the LH rear wheel knuckle.

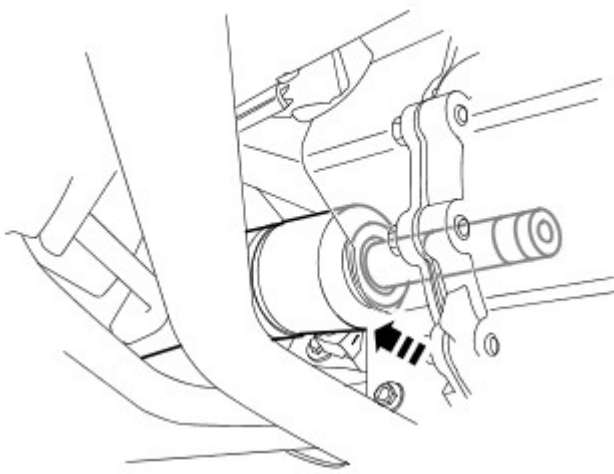


E46798

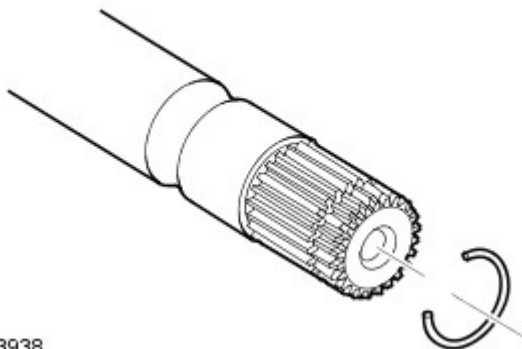
10. NOTE: RH illustration shown, LH is similar

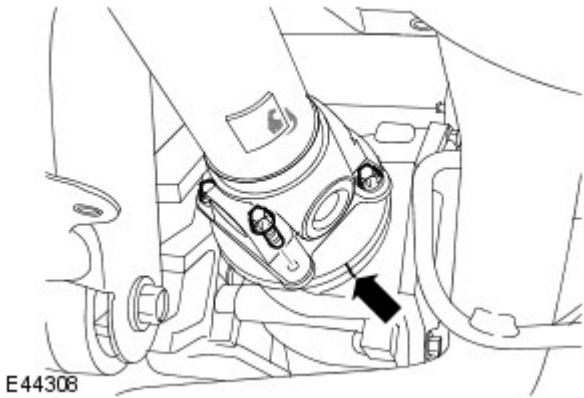
Release the LH rear halfshaft from the axle assembly.

- Remove and discard the snap ring.



E63938

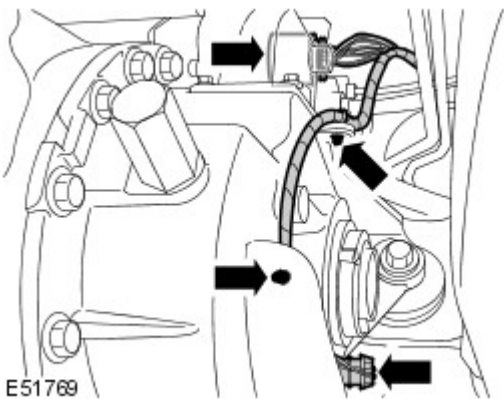




11.  **CAUTION:** Mark the position of the driveshaft flange in relation to the drive pinion flange.

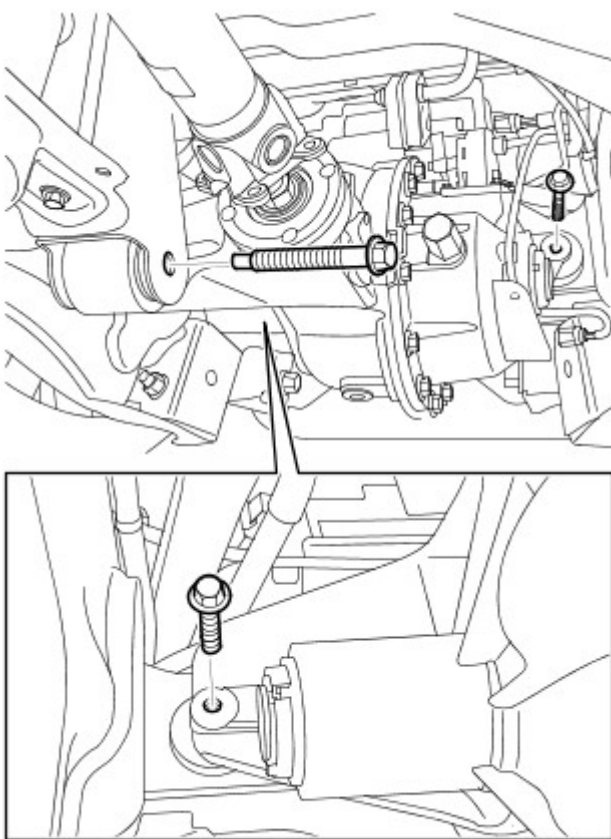
Release the driveshaft from the rear axle drive flange.

- Remove and discard the 4 bolts.
- Support the driveshaft using a suitable tie strap.




12. Vehicles with differential locking motor: Disconnect the 2 electrical connectors.

- Release the 2 wiring harness clips.



13. Using a transmission jack, support the rear axle assembly.

14.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

With assistance, remove the rear axle assembly.

- Remove the 3 bolts.
- Disconnect the breather line.

Installation

1. With assistance, install the rear axle assembly.

- Tighten the front mounting bolt to 275 Nm (203 lb.ft).
- Tighten the rear mounting bolts to 175 Nm (129 lb.ft).
- Connect the breather line.

2. Vehicles with differential locking motor: Connect the electrical connectors.

- Secure the wiring harness clips.

3. **NOTE:** Install new bolts.

Secure the driveshaft to the rear axle drive flange.

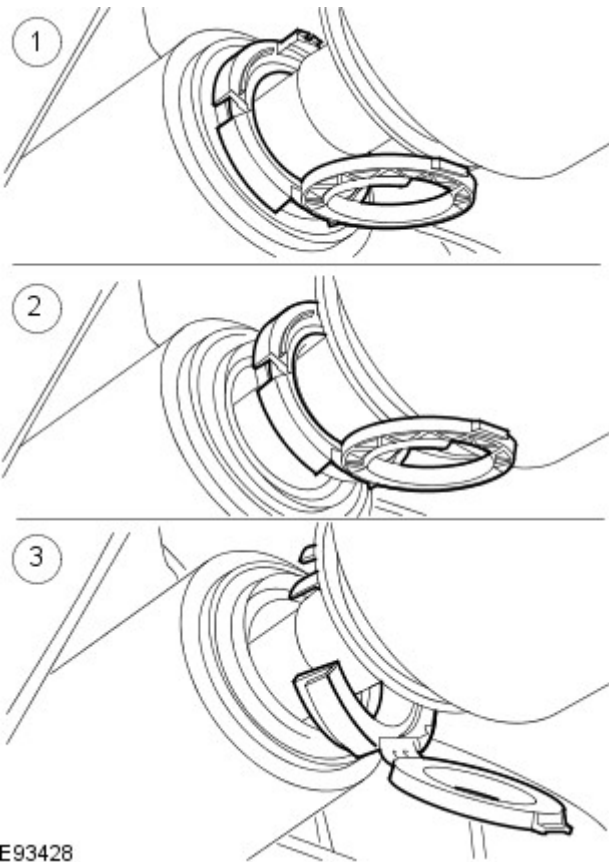
- Clean the component mating faces.
- Tighten the bolts to 150 Nm (110 lb.ft).

4. Install a new snap ring to the LH halfshaft.


5. **NOTE:** Do not fully engage the halfshaft until the oil seal protector has been removed.

Secure the LH halfshaft in the axle assembly.

1. Open the halfshaft seal protector and install the halfshaft.
2. Release the halfshaft seal protector from the halfshaft seal.
3. Remove the halfshaft seal protector.
4. Fully install the halfshaft.
5. Make sure the snap ring is fully engaged and retains the halfshaft.



E93428

6.  **CAUTION:** Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Secure the LH rear wheel knuckle to the lower arm.

- Tighten the nut and bolt to 275 Nm (203 lb.ft).

7. Secure the LH rear toe link.

- Tighten the bolt to 175 Nm (129 lb.ft).

8. Secure the parking brake cable to the LH lower arm.

9. **NOTE:** Install new nuts.

Install the LH rear stabilizer bar link.

- Tighten the nuts to 115 Nm (85 lb.ft).

10. Install the RH rear halfshaft.

For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).

11. Fill the differential with fluid.

For additional information, refer to: [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

12. Install the muffler assembly.








For additional information, refer to: [Muffler](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation) / [Muffler](#) (309-00 Exhaust System - 4.4L, Removal and Installation) / [Muffler - Vehicles Without Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).



13. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Drive Axle/Differential - Axle Housing Bushing


Removal and Installation

Special Tool(s)	
<p>502-009/2</p>  <p>E54205</p>	<p>Remover rear differential rear bush 502-009/2</p>
<p>211-294</p>  <p>E54206</p>	<p>Hydraulic two legged puller 211-294</p>
<p>205-825/4</p>  <p>E54207</p>	<p>Adaptor/button 205-825/4</p>
<p>205-825/3</p>  <p>E54208</p>	<p>Installer rear differential front bush 205-825/3</p>
<p>205-825/5</p>  <p>E54209</p>	<p>Receiver cup rear differential front bush 205-825/5</p>
<p>205-825/6</p>  <p>E54210</p>	<p>Bearing Housing 205-825/6</p>
<p>51203</p>  <p>E54149</p>	<p>Bearing Set for 16mm Bolt 51203</p>

 <p>205-825/7</p> <p>E54211</p>	<p>Remover/Installer long 16mm bolt</p> <p>205-825/7</p>
 <p>205-825/8</p> <p>E55277</p>	<p>Nut for long 16mm bolt</p> <p>205-825/8</p>

Removal

- NOTE: Take note of the fitted position of the bush.

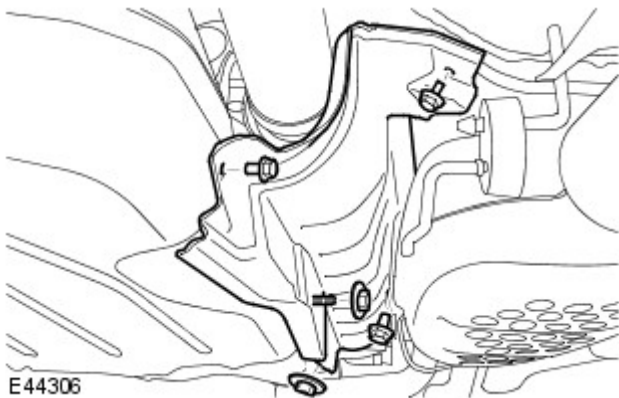
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the muffler assembly.
For additional information, refer to: Muffler (309-00, Removal and Installation).

3. Remove the fuel tank heat shield.

- Remove the 3 bolts and 2 nuts.



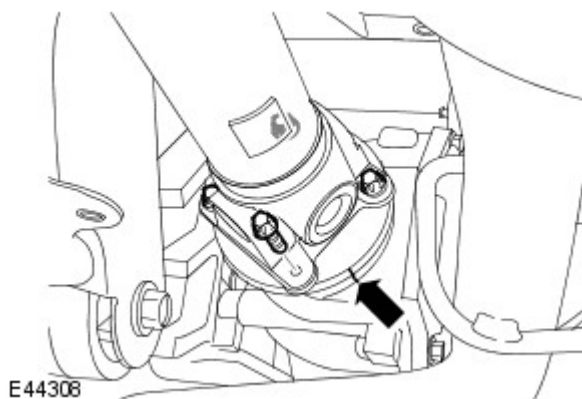
4. CAUTIONS:

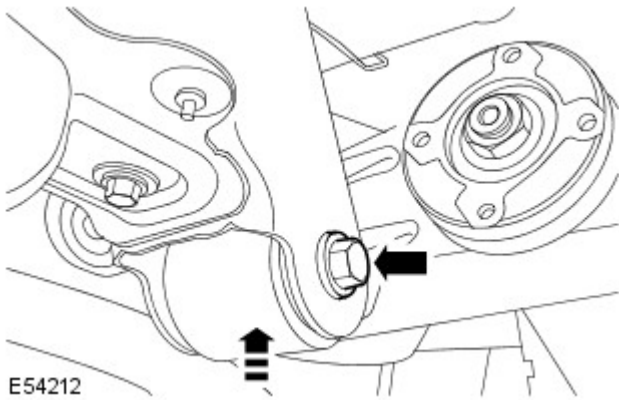
 Mark the position of the driveshaft flange in relation to the drive pinion flange.

 To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the rear axle drive flange.

- Remove and discard the 4 Torx bolts.

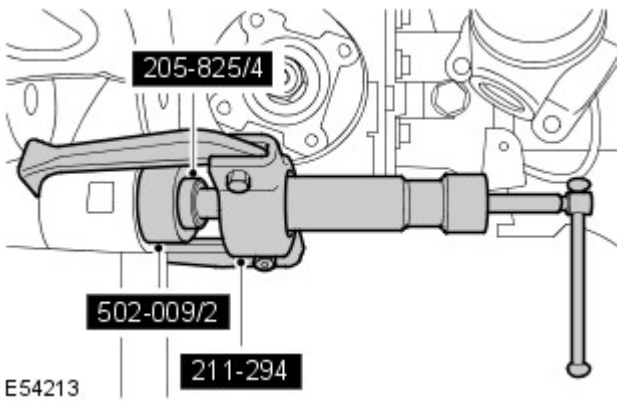




5.  CAUTION: Make sure the weight of the axle is always supported.

Using a suitable jack, lower the front of the axle.

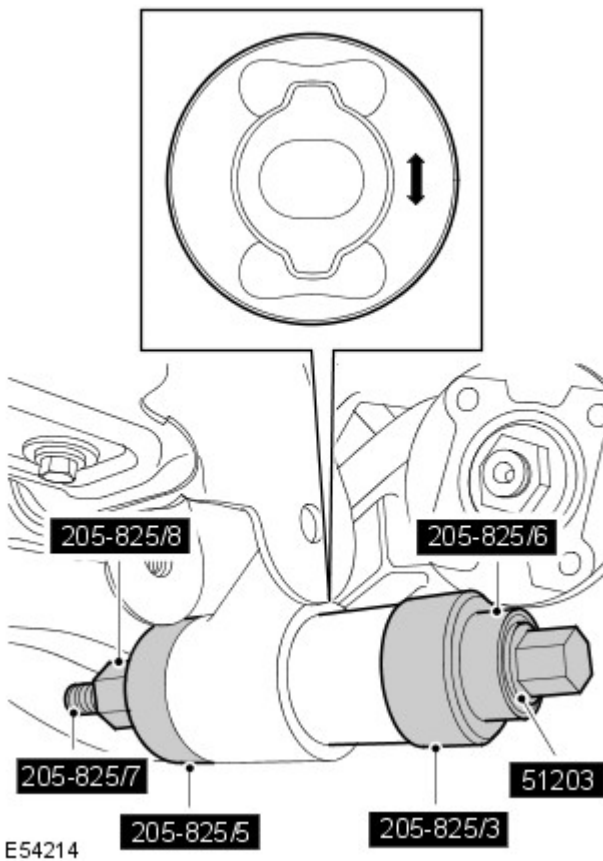
- Remove the axle front retaining bolt.




6. Using the special tools, remove the axle housing bushing.

Installation

1. Using the special tools, install the axle housing bushing.



2.  CAUTION: Make sure the weight of the axle is always supported.

Using a suitable jack, raise the front of the differential.

- Install the axle front retaining bolt.
- Tighten to 275 Nm (203 lb.ft).

3. Attach the driveshaft to the rear axle drive flange.

- Clean the component mating faces.
- Attach the driveshaft to the rear axle drive flange.
- Tighten the new Torx bolts to 150 Nm (110 lb.ft).

4. Install the fuel tank heat shield.



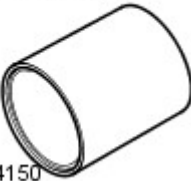


- Tighten the bolts and nuts to 10 Nm (7 lb.ft).

5. Install the muffler assembly.

For additional information, refer to: Muffler (309-00, Removal and Installation).


Rear Drive Axle/Differential - Rear Axle Housing Support Insulator

Removal and Installation

Special Tool(s)	
 <p>502-009/5 E54148</p>	<p>Remover/Installer long 14mm bolt 502-009/5</p>
 <p>51203 E54149</p>	<p>Bearing set for 14mm and 16mm bolt, 51203</p>
 <p>502-009/1 E54150</p>	<p>Receiver cup rear differential rear bush 502-009/1</p>
 <p>502-009/2 E54151</p>	<p>Remover rear differential rear bush 502-009/2</p>
 <p>502-009/3 E54152</p>	<p>Installer rear differential rear bush 502-009/3</p>

Removal

- NOTE: Take note of the fitted position of the bush.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

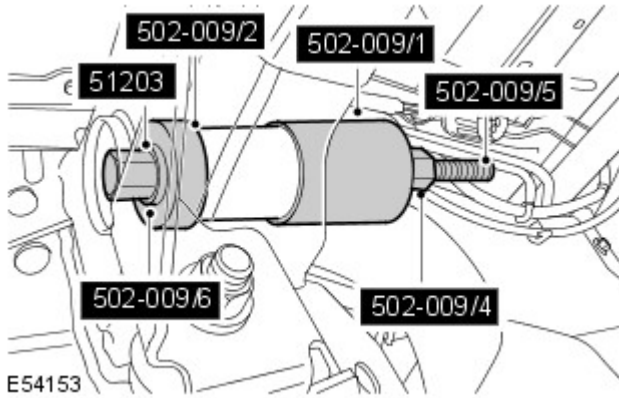
2. Remove the wheels and tires.

3. Remove the rear differential.

For additional information, refer to: [Axle Assembly](#) (205-02 Rear Drive Axle/Differential, Removal and Installation).

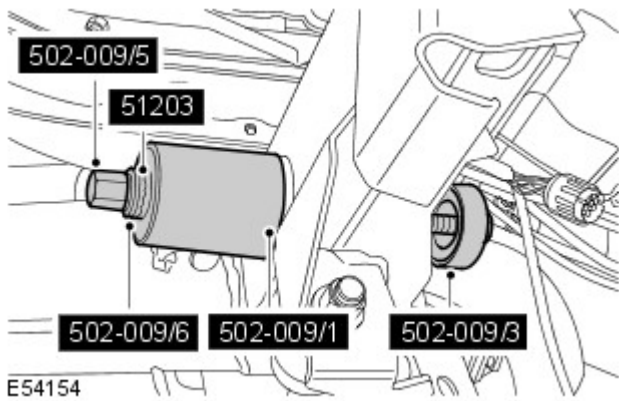
4. NOTE: Take note of the fitted position of the bush.

Using the special tools, remove the rear axle housing support insulator.



Installation

1. Using the special tools, install the rear axle housing support insulator.



2. Install the rear differential.
For additional information, refer to: [Axle Assembly](#) (205-02 Rear Drive Axle/Differential, Removal and Installation).
3. Install the wheels and tires.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Axle/Differential -

Sealers

Item	Land Rover Part No.
Input shaft flange nut	STC 50553
Input shaft splines	STC 50554

Lubricants

Item	Specification
* Recommended lubricant	Castrol SAF-XO - 75W/90

* **Do not use any lubricant other than that specified**

Capacities

Item	Capacity
Front differential	0.61 litres (1.07 pints) (0.64 US quarts)

Axle Tube

Item	Specification
Axle tube seal (Used on later models. Earlier models used an o-ring)	Land Rover Part No: STC 50550

Front Differential

Item	Specification
Reduction ratio:	
V6 Diesel engine - Manual transmission	3.07:1
V6 Diesel engine - Automatic transmission	3.54:1
V6 Petrol engine - Automatic transmission	3.73:1
V8 Petrol engine - Automatic transmission	3.54:1

Torque Specifications

Description	Nm	lb-ft
Oil drain plug	54	40
Oil filler plug	34	25
Differential locking module bolts	10	7
Parking aid module nuts	10	7
Differential case bolts:		
M14 Front bolt	105	77
*Axle carrier to differential bolts - Stage 1	80	59
*Axle carrier to differential bolts - Stage 2	Further 60°	Further 60°
Front axle crossmember bolts	115	85
** Driveshaft to front axle drive flange Torx bolts		
Stage 1	45	33
Stage 2	Further 90°	Further 90°
Road wheel nuts	140	103

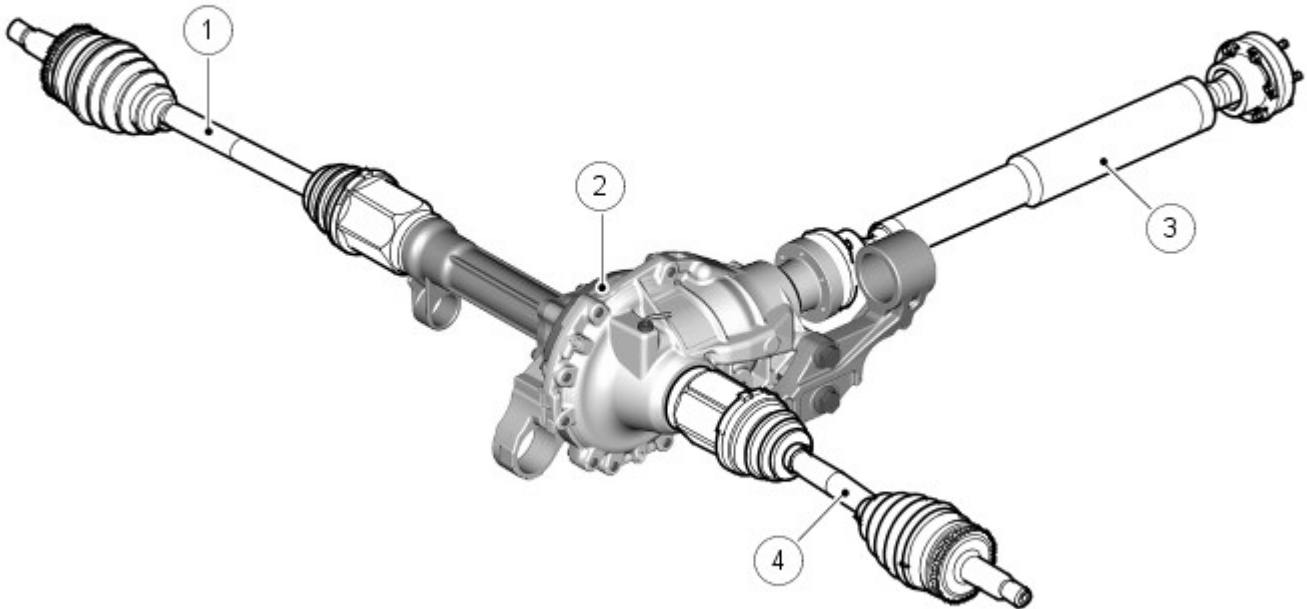
* **New bolts must be fitted**

** **New 'Patchlok' Torx bolts must be fitted**

Front Drive Axle/Differential - Front Drive Axle and Differential

Description and Operation

GENERAL



E50981

Item	Part Number	Description
1	-	RH front drive halfshaft
2	-	Front differential assembly
3	-	Front driveshaft
4	-	LH front drive halfshaft

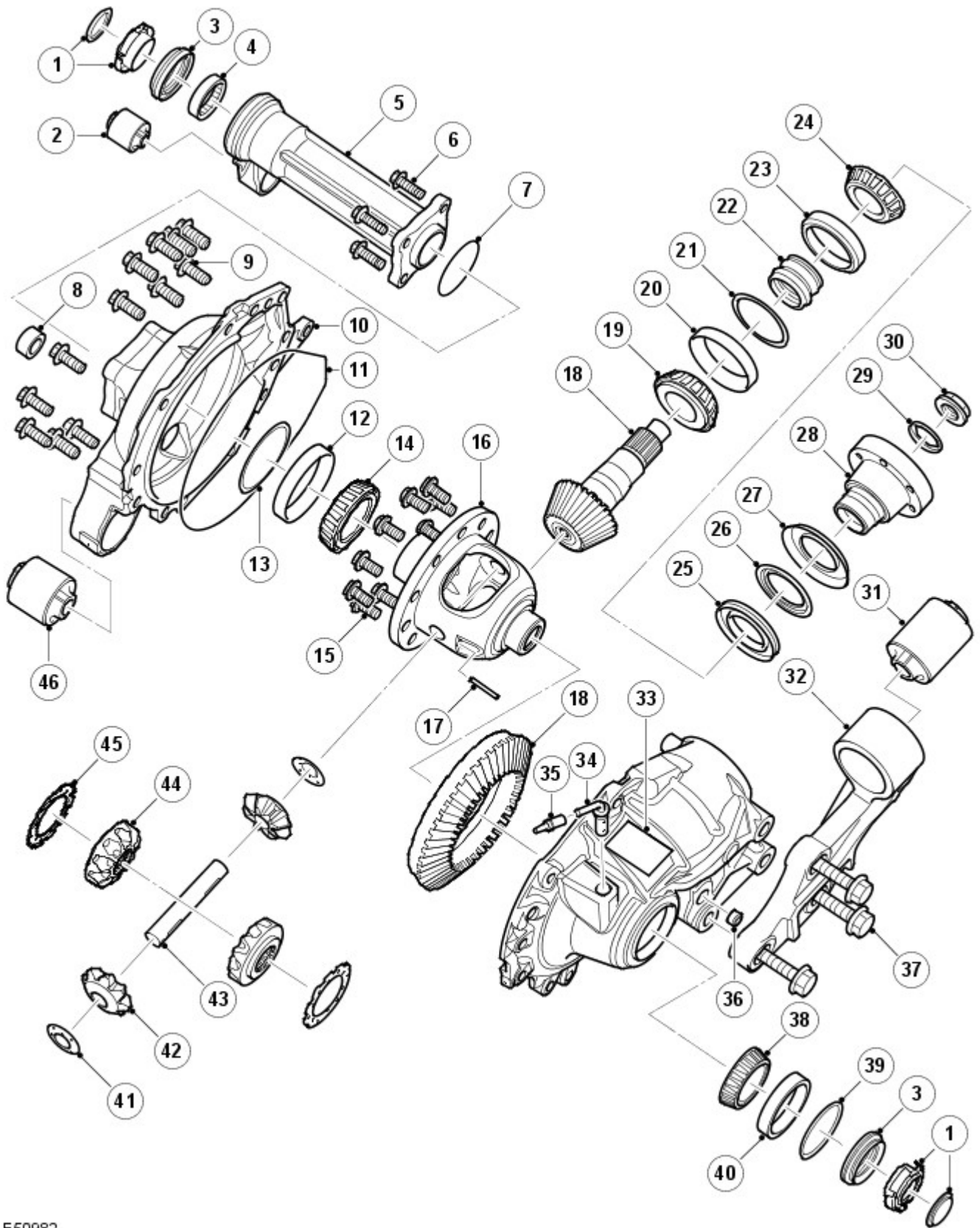
The front differential converts the 'angle of drive' through 90° and distributes drive, via the front drive halfshafts, to the front wheels.

The front differential for the V6 and V8 petrol variants have the same output ratio, but the output ratios for the TdV6 are different, depending on whether automatic or manual transmission is fitted.

The front differential is mounted on the LH side of the chassis.

FRONT DIFFERENTIAL ASSEMBLY

Front Differential - Exploded View



E50982

Item	Part Number	Description
1	-	Protection cap
2	-	Mounting bush assembly
3	-	Seal
4	-	Bearing assembly
5	-	Front tube
6	-	Bolt, 4 of
7	-	O-ring
8	-	Drain plug
9	-	Bolt, 14 of
10	-	Cover assembly
11	-	Cover seal

12	-	Roller bearing cup
13	-	Bearing preload spacer
14	-	Taper roller bearing
15	-	Bolt, 10 of
16	-	Differential case
17	-	Roll pin
18	-	Gear and pinion assembly
19	-	Taper roller bearing
20	-	Roller bearing cup
21	-	Shim
22	-	Collapsible spacer
23	-	Roller bearing cup
24	-	Taper roller bearing
25	-	Oil seal
26	-	Inner deflector
27	-	Outer deflector
28	-	Flange
29	-	Pinion nut retainer
30	-	Pinion nut
31	-	Mounting bush assembly
32	-	Axle mounting bracket
33	-	Data label
34	-	Breather tube
35	-	Cap
36	-	Fill plug
37	-	Bolt, 3 of
38	-	Taper roller bearing
39	-	Bearing preload spacer
40	-	Roller bearing cup
41	-	Thrust washer
42	-	Planet gear
43	-	Shaft
44	-	Sunwheel
45	-	Thrust washer
46	-	Mounting bush assembly

The casing comprises two halves with machined mating faces. When assembled, the cast iron casing halves are sealed with a thin film of Loctite 5999 sealant and secured together with fourteen bolts. A breather tube is fitted to the casings. This allows a plastic tube to be fitted and routed to a high point in the engine compartment, preventing the ingress of water when the vehicle is wading.

The RH casing is fitted with a drain plug. The front differential unit contains approximately 0.7 litre of oil for a dry fill.

The differential is a conventional design using a hypoid gear layout. This employs a hypoid bevel pinion gear and crown wheel, with the pinion offset above the centre line of the crown wheel. This design allows for a larger pinion gear to be used, which has the advantages of increased gear strength and reduced operating noise.

The front differential is available in three ratios. V8 and V6 petrol engine vehicles use a front differential with a final drive ratio of 3.73:1 and TdV6 diesel engine vehicles use a final drive ratio of 3.07:1, for vehicles with manual transmission, and 3.54:1 for vehicles with automatic transmission. Changing the number of teeth between the crown-wheel drive gear and pinion gear changes the ratio.

The differential comprises a pinion shaft and hypoid bevel gear, a crown wheel drive gear with an integral cage, which houses two planet gears. Two sun wheels are also located in the cage and pass the rotational drive to the drive shaft shafts.

The pinion shaft is mounted on two opposed taper roller bearings with a collapsible spacer located between them. The spacer is used to hold the bearings in alignment and also collapses under the pressure applied to the pinion nut. This allows the nut to be tightened to a predetermined torque, which collapses the spacer, setting the correct bearing preload.

The pinion shaft has an externally splined outer end which accepts and locates the input flange, which is retained by the pinion nut. The opposite end of the output flange has an internal spline which provides positive location for the front propeller shaft. The flange has an external O-ring seal which seals against the front propeller shaft shroud preventing the ingress of dirt and moisture into the splines. An oil seal is pressed into the LH casing and seals the input flange to the differential unit. The pinion shaft has a hypoid bevel gear at its inner end which mates with the crown wheel drive gear.

The crown wheel drive gear is located on the carrier and secured with ten screws. The carrier is mounted on taper roller bearings located in each casing half. The bearings are press fitted into the casing and a spacer is located on the outside face to set backlash and apply preload to the bearing.

The carrier is fitted with a shaft onto which the two planet gears are mounted. The shaft is secured in the carrier with a roll pin. The sun wheels are located in pockets within the carrier and mesh with the planet gears. Thrust washers are located between the carrier and the sun wheels and hold the sun wheels in mesh with the planet gears. Each sun wheel has a machined, splined, bore to accept the drive shaft. A groove is machined in the bore to locate the snap ring fitted to the drive shaft, providing positive drive shaft location.

Differential Operation

The operating principles of the front and rear differentials are the same. Rotational input from the propeller shaft is passed via the input flange to the pinion shaft and pinion gear. The angles of the pinion gear to the crown wheel drive gear moves the rotational direction through 90°.

The transferred rotational motion is now passed to the crown wheel drive gear, which in turn rotates the carrier. The shaft,

which is secured to the carrier, also rotates at the same speed as the carrier. The planet gears, which are mounted on the shaft, also rotate with the carrier. In turn, the planet gears transfer their rotational motion to the left and right hand sun wheels, rotating the drive shafts.

When the vehicle is moving in a forward direction, the torque applied through the differential to each sun wheel is equal. In this condition both drive shafts rotate at the same speed. The planet gears do not rotate and effectively lock the sun wheels to the carrier.

If the vehicle is turning, the outer wheel will be forced to rotate faster than the inner wheel by having a greater distance to travel. The differential senses the torque difference between the sun wheels. The planet gears rotate on their axes to allow the outer wheel to rotate faster than the inner one.

SERVICE

The oil used in the front differential is Castrol SAF-XO. The oil contains unique additives, which enhance the differentials operation. No other oil must be used in the front differential.

Front Differential Serviceable Components

- Halfshaft seals
- Needle roller bearing assemblies
- Chassis bush/fixings
- Lubricant.

Front Drive Axle/Differential - Differential Draining and Filling

General Procedures



CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, not to act as a level indicator.

• **NOTE:** The only way to check the fluid level in the differential is to drain all the fluid out and refill with the correct quantity, shown in the specification section.

For additional information, refer to: [Specifications](#) (205-03 Front Drive Axle/Differential, Specifications).

- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

- Remove the differential case lubricant filler plug.

- Clean the area around the lubricant filler plug.
- Position container to collect fluid loss.



- Drain the differential lubricant.

- Clean the area around the drain plug.
- Remove the fluid drain plug.



- CAUTION:** There have been 2 different types of fixings used for the drain plug. Note the type and differential serial number, and make sure the correct torque is applied, see below.

Install the lubricant drain plug.

- Clean the drain plug.
- Up to differential serial number 254845: Tighten the hexagonal drive drain plug to 54 Nm (40 lb.ft).
- From differential serial number 254846: Tighten the 3/8" square drive drain plug to 28 Nm (21 lb.ft).

- CAUTION:** Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, not to act as a level indicator.

Fill the differential with the correct amount of lubricant.
For additional information, refer to: [Specifications](#) (205-03 Front Drive Axle/Differential, Specifications).

7. Install the differential filler plug.




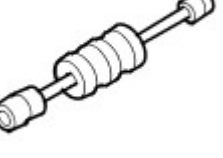
- Tighten the filler plug to 34 Nm (25 lb.ft).

8. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#)
(501-02 Front End Body Panels, Removal and Installation).


Front Drive Axle/Differential - Drive Pinion Seal

In-vehicle Repair

Special Tool(s)	
 <p>205-053</p> <p>E54574</p>	<p>Flange holding tool</p> <p>205-053</p>
 <p>205-824</p> <p>E54587</p>	<p>Remover drive flange</p> <p>205-824</p>
 <p>205-820</p> <p>E54703</p>	<p>Installer - drive pinion oil seal</p> <p>205-820</p>
 <p>100-012</p> <p>E54135</p>	<p>Impulse extractor</p> <p>100-012(LRT-99-004)</p>

Removal

 **CAUTION:** The drive pinion seal must only be renewed once.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Drain the differential lubricant.

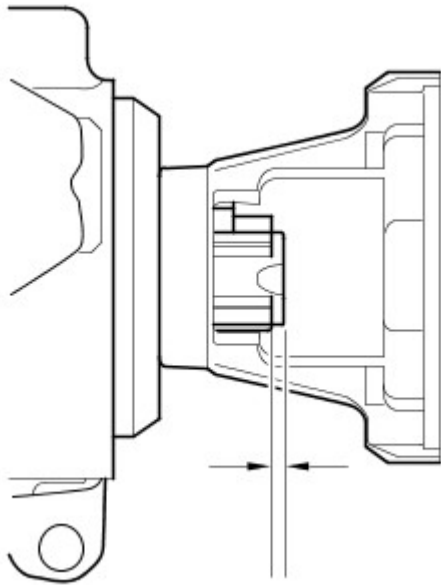
For additional information, refer to: [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).

3. Remove the front driveshaft.


For additional information, refer to: [Front Driveshaft - V8 5.0L Petrol](#) (205-01 Driveshaft, Removal and Installation) / [Front Driveshaft - V6 4.0L Petrol](#) (205-01 Driveshaft, Removal and Installation) / [Front Driveshaft - TDV6 3.0L Diesel](#) (205-01 Driveshaft, Removal and Installation) / [Front Driveshaft - TDV6 2.7L Diesel](#) (205-01 Driveshaft, Removal and Installation).

4. Measure the depth of the pinion nut on the pinion shaft.

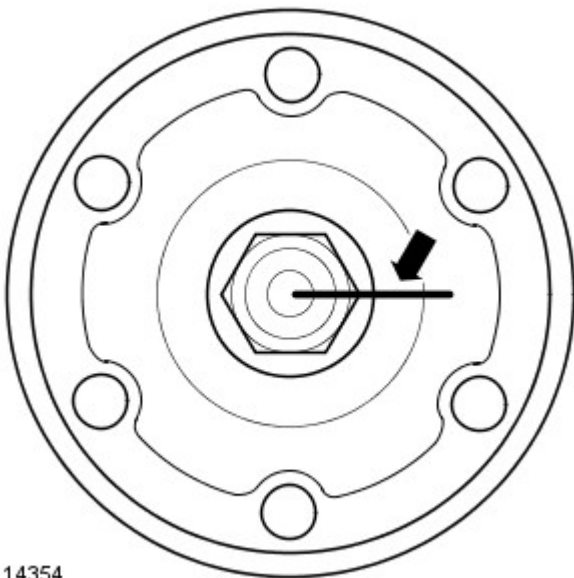
- Note measurement for installation.



E114355

5.  CAUTION: This step must be carried out to make sure that the drive pinion nut is correctly tightened on assembly.

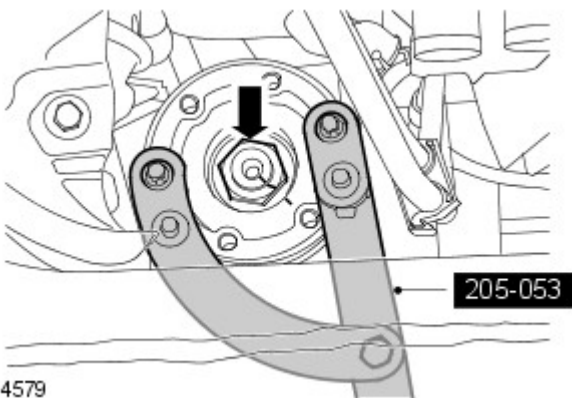
Accurately scribe a line to mark the drive pinion shaft to the drive pinion nut and pinion flange.



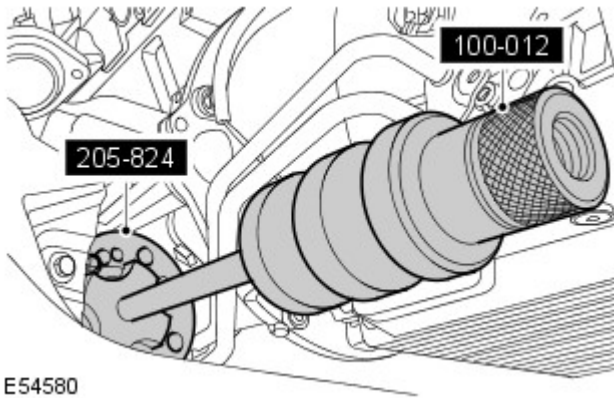
E114354


6. Remove the drive pinion flange retaining nut.

- Using the special tool, counter hold the drive pinion flange.
- Discard the drive pinion nut retainer.

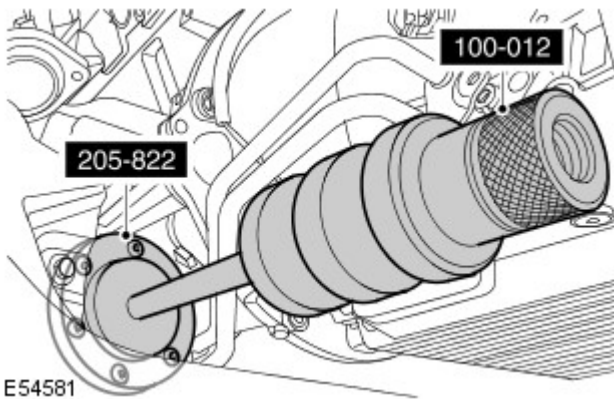


E54579



7.  CAUTION: Make sure only a bolt is used with the special tool, to draw the drive pinion flange off the drive pinion shaft.

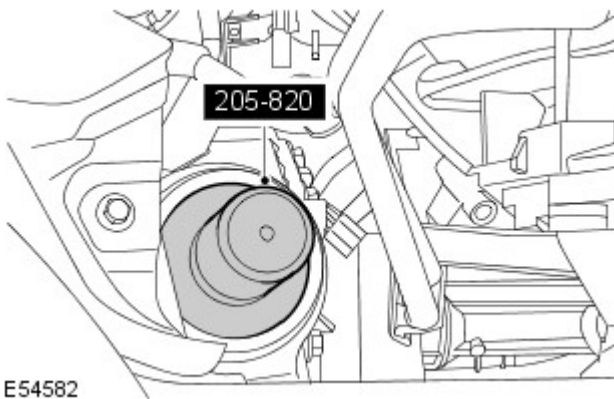
Using the special tool, remove the drive pinion flange.



8. Using the special tool, remove the drive pinion seal.

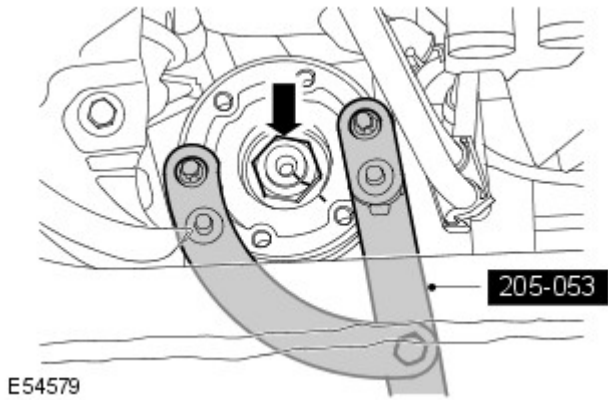
Installation

1. Clean the drive pinion flange.
2. Clean the drive pinion seal mating faces.
3. Using the special tool, install the new drive pinion seal.






4.  CAUTION: Make sure the drive pinion flange scribed marks are aligned.

Install the drive pinion flange.



5. CAUTIONS:

-  Make sure the mark on the drive pinion nut is never tightened short of the scribed mark on the drive pinion shaft.
-  Make sure the drive pinion flange has no end float and is free to rotate.
-  Make sure the scribed mark on the drive pinion nut is no more than a maximum of 5 degrees past the scribed mark on the drive pinion shaft.

Install the drive pinion flange retaining nut.

- Using the special tool, counter hold the drive pinion flange.
- Install nut to previously noted number of turns.
- Measure the depth of the pinion nut on the pinion shaft.

6. Install the front driveshaft.

For additional information, refer to: [Front Driveshaft - V8 5.0L Petrol](#) (205-01 Driveshaft, Removal and Installation) / [Front Driveshaft - V6 4.0L Petrol](#) (205-01 Driveshaft, Removal and Installation) / [Front Driveshaft - TDV6 3.0L Diesel](#) (205-01 Driveshaft, Removal and Installation) / [Front Driveshaft - TDV6 2.7L Diesel](#) (205-01 Driveshaft, Removal and Installation).

7. CAUTION: Make sure the correct specification and quantity of oil is used.

Fill the differential with the correct amount of lubricant. For additional information, refer to: [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).

Front Drive Axle/Differential - Axle Tube

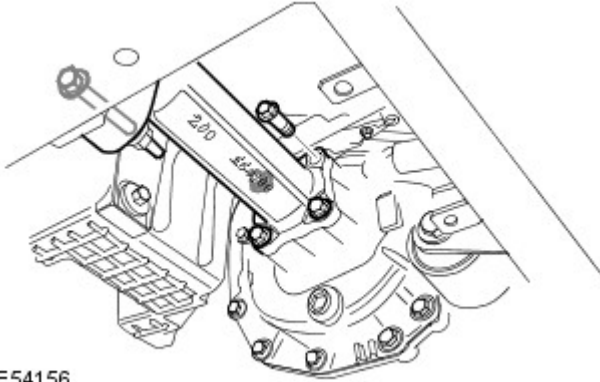
In-vehicle Repair

Removal

1. Remove the RH halfshaft.
For additional information, refer to: [Front Halfshaft RH](#) (205-04 Front Drive Halfshafts, Removal and Installation).

2. Remove the axle tube.

- Remove the bolt from the bushing.
- Remove the 4 bolts.
- Rotate and remove the axle tube.
- Early models: Remove and discard the O-ring seal.
- Later models: Remove the sealant.



E54156

Installation

1. Install the axle tube.

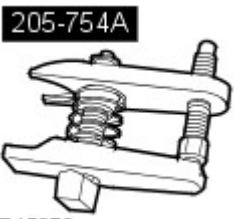


- Clean the component mating faces.
- Early models: Install a new O-ring seal.
- Later models: Apply sealant to the mating face.
For additional information, refer to: [Specifications](#) (205-03 Front Drive Axle/Differential, Specifications).
- Tighten the 4 axle tube bolts to 50 Nm (37 lb.ft).
- Tighten the axle tube bushing bolt to 63 Nm (46 lb.ft).

2. Install the RH halfshaft.

For additional information, refer to: [Front Halfshaft RH](#) (205-04 Front Drive Halfshafts, Removal and Installation).

Front Drive Axle/Differential - Axle Assembly

Removal and Installation

Special Tool(s)	
 <p>205-754A E45276</p>	Ball joint separator 205-754(LRT-54-027)
 <p>204-703 E99557</p>	Front Stabilizer Bar Bushing Tightening Tool 204-703
 <p>204-705 E99558</p>	Front Stabilizer Bar Bushing Tightening Tool 204-705

Removal

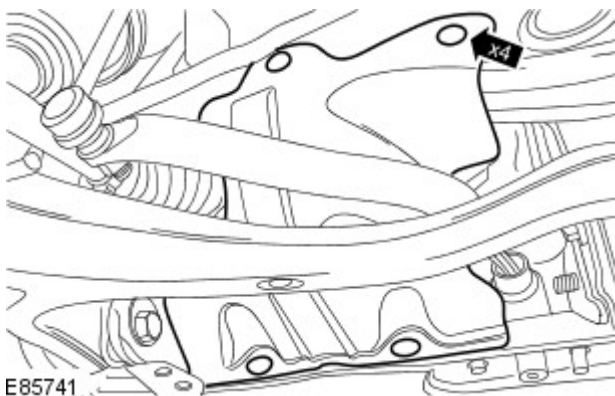
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

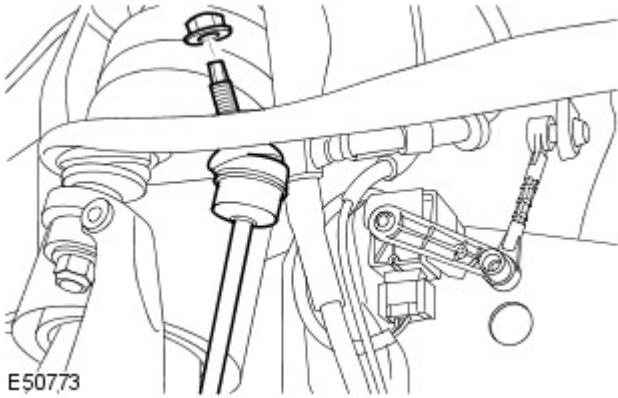
All vehicles

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

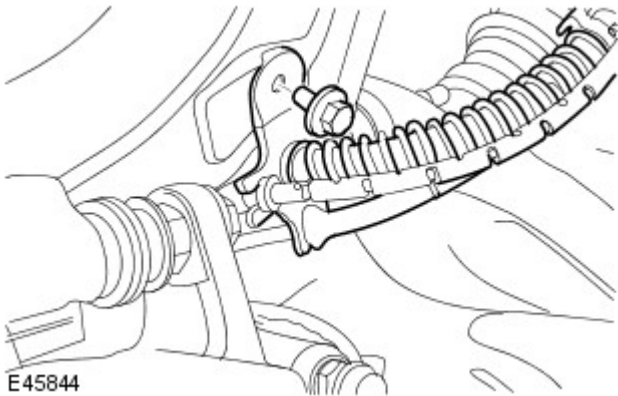
2. Remove the front wheels and tires.
3. Remove the axle tube.
For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).
4. Remove the LH splash shield.
 - Remove the 4 clips.





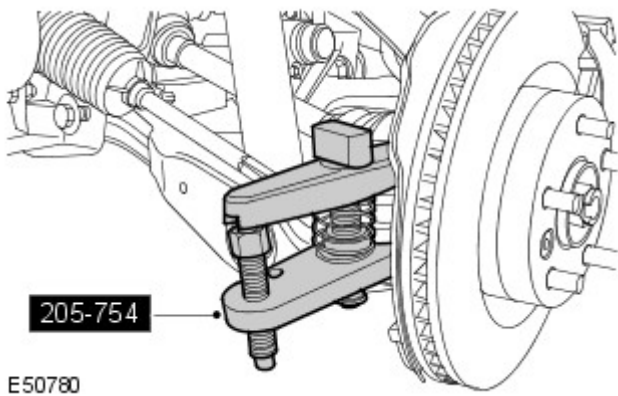
5. Release the LH stabilizer bar link.


- Remove and discard the nut.



6. Release the LH brake hose bracket from the wheel knuckle.

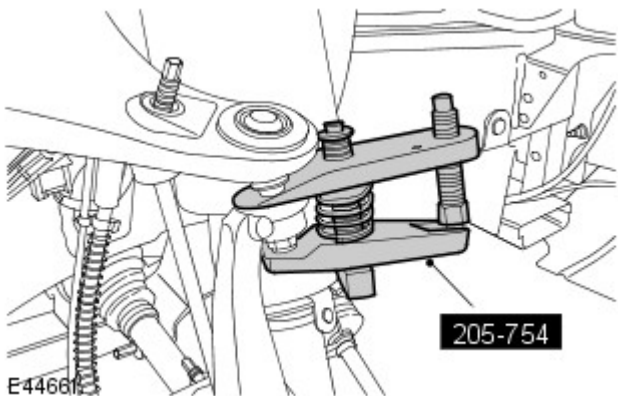
- Remove the bolt.




7.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.


Using the special tool, release the LH tie-rod end ball joint from the wheel knuckle.

- Remove and discard the nut.



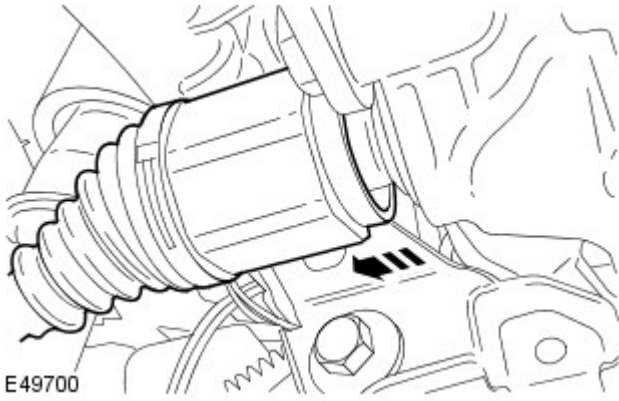
8. CAUTIONS:

 Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

 The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

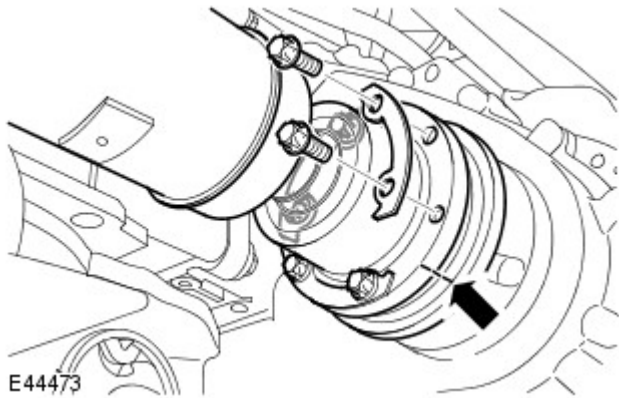
Using the special tool, release the LH upper arm ball joint.

- Remove and discard the nut.



9. Release the LH halfshaft from the axle assembly.

- Remove and discard the snap ring.
- Using a suitable tie strap, support the LH halfshaft.



10. CAUTIONS:

 Mark the position of the driveshaft flange in relation to the drive pinion flange.

 To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

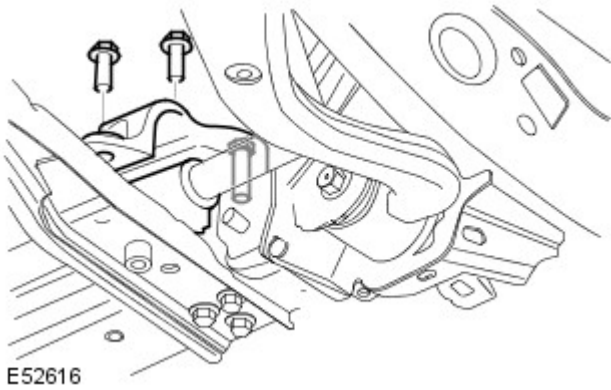
Release the driveshaft from the front axle drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.
- Using a suitable tie strap, secure the driveshaft end plate.

Vehicles with Active Stabilization

11. Remove the stabilizer bar bushing.

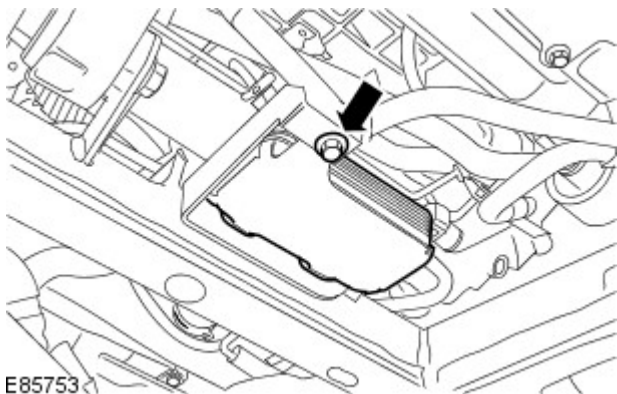
- Remove the 3 bolts.
- Remove the clamp.
- Remove the stabilizer bar bushing.



Vehicles with diesel engine

12. Release the fuel cooler.

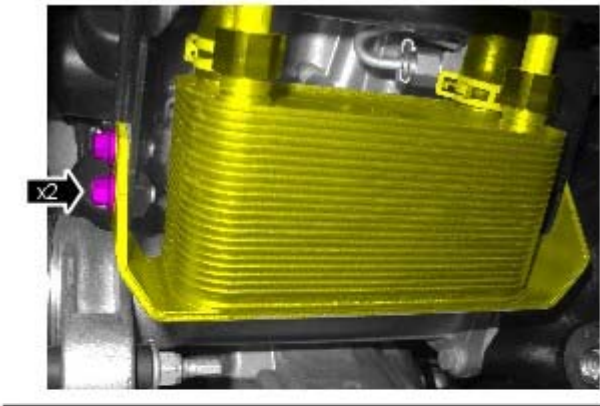
- Remove the bolt.



Vehicles with 5.0L engine

13. Release the automatic transmission fluid cooler.

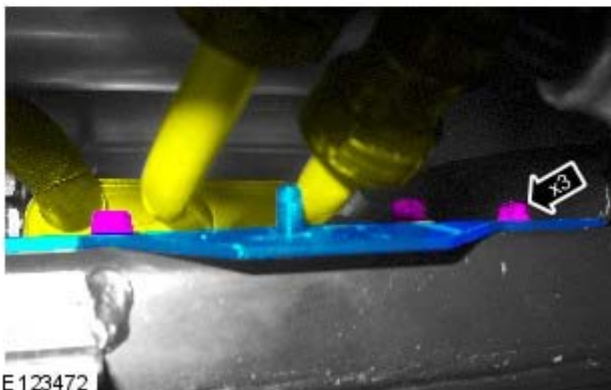
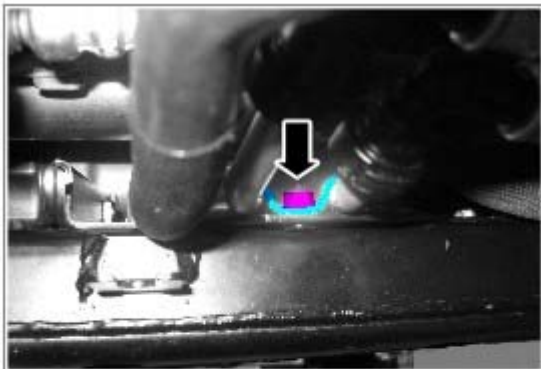
- Remove the 4 bolts.



E123471

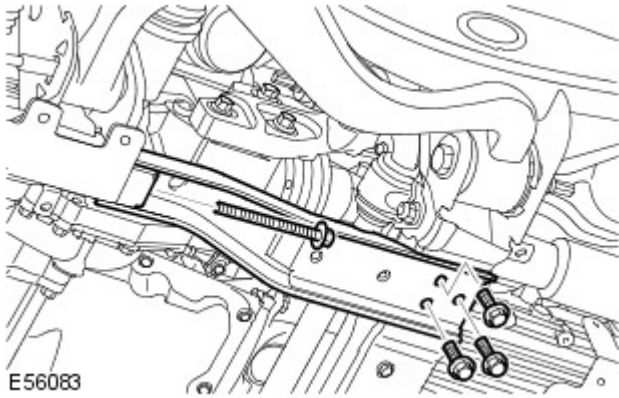
14. Remove the transmission fluid cooler mounting bracket.

- Release the transmission fluid cooler pipe bracket.
- Remove the nut.
- Remove the 3 bolts.



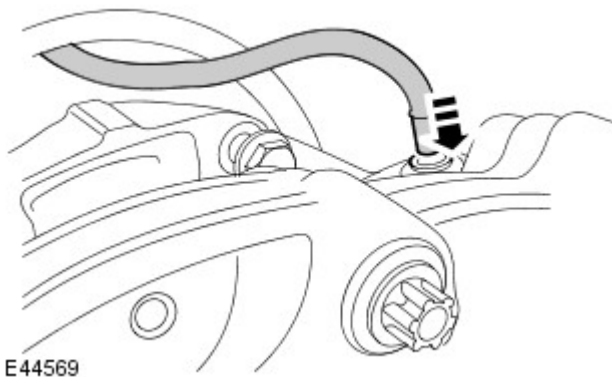
E123472


All vehicles



15. Remove the front axle crossmember.

- Remove the 4 bolts.



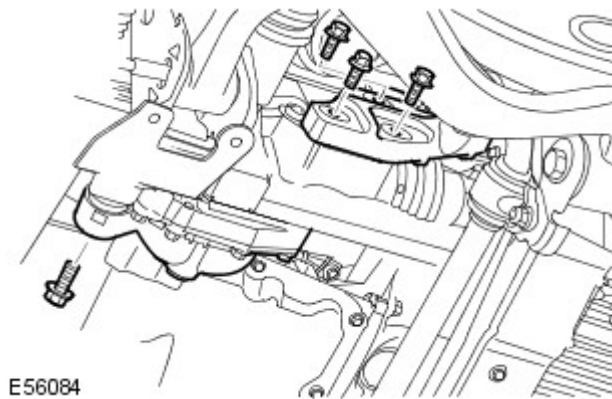
16.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the breather line.

- Release the clip.

17. Using a transmission jack, support the front axle assembly.

18. With assistance, remove the front axle assembly.



- Remove and discard the 3 axle assembly rear mounting bolts.
- Remove the front axle assembly front mounting bolt.

Installation

All vehicles

1. With assistance, install the front axle assembly.

- With assistance, raise and manoeuvre the front final drive unit.
- Tighten the 3 new bolts in the front axle assembly to 80 Nm (59 lb.ft), then a further 60 degrees.
- Tighten the front axle assembly front mounting bolt to 105 Nm (77 lb.ft).

2. Connect the breather line.

3. Install the front axle crossmember.

- Tighten the 4 bolts to 115 Nm (85 lb.ft).

Vehicles with 5.0L engine

4. Install the transmission fluid cooler mounting bracket.

- Tighten the 3 bolts to 25 Nm (18 lb.ft.).
- Secure the transmission fluid cooler coolant pipe to the coolant hose bracket.
- Tighten the nut to 15 Nm (11 lb.ft.).

5. Install the automatic transmission fluid cooler.

- Tighten the 4 bolts to 25 Nm (18 lb.ft.).

Vehicles with diesel engine

6. Secure the fuel cooler.

- Tighten the bolt to 23 Nm (17 lb.ft.).

Vehicles with Active Stabilization

7. Install the stabilizer bar bushing.

- Install the clamp.
- Install the bolts.
- Tighten the bolts to 115 Nm (85 lb.ft.).

All vehicles

8. **NOTE:** Make sure that new bolts are installed.

Secure the driveshaft to the front axle drive flange.

- Stage 1: Tighten the bolts to 45 Nm (33 lb.ft.).
- Stage 2: Tighten the bolts a further 90 degrees.
- Remove and discard the tie strap.

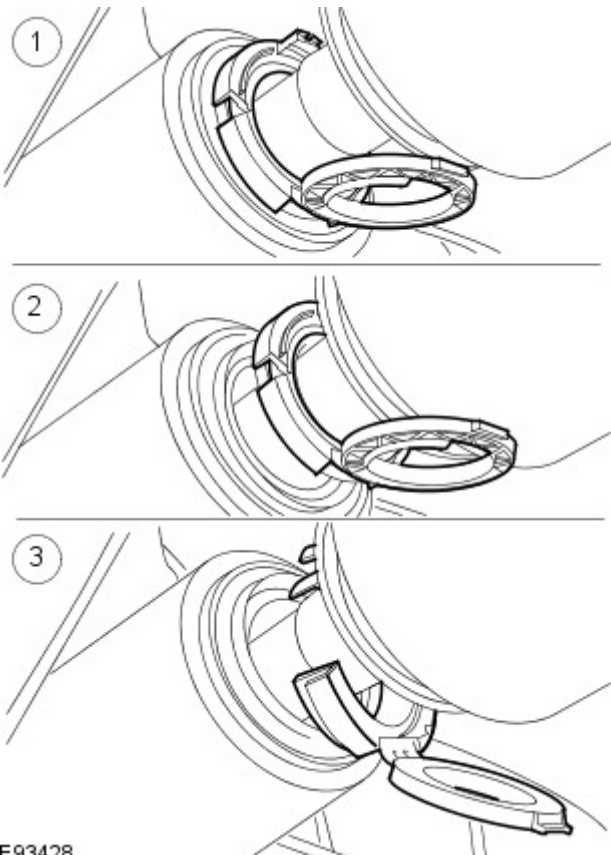
9. Install a new snap ring to the LH halfshaft.

- Remove and discard the tie strap.

10. **NOTE:** Do not fully engage the halfshaft until the oil seal protector has been removed.

Secure the LH halfshaft in the axle assembly.

1. Open the halfshaft seal protector and install the halfshaft.
2. Release the halfshaft seal protector from the halfshaft seal.
3. Remove the halfshaft seal protector.
4. Fully install the halfshaft.



11.  **WARNING:** Make sure that a new nut is installed.

Secure the LH upper arm to the wheel knuckle.

- Install a new nut and tighten to 70 Nm (52 lb.ft).

12.  **WARNING:** Make sure that a new nut is installed.

Secure the LH tie-rod end ball joint to the wheel knuckle.

- Install a new nut and tighten to 70 Nm (52 lb.ft).

13. Secure the LH brake hose bracket to the wheel knuckle.

- Tighten the bolt to 22 Nm (16 lb.ft).

14. Secure the LH stabilizer bar link.

- Install a new nut and tighten to 115 Nm (85 lb.ft).

15. Install the LH splash shield.

- Install the clips.

16. Install the axle tube.

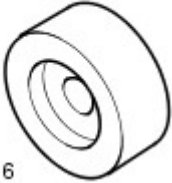


For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).

17. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Axle/Differential - Axle Carrier Bushing

Removal and Installation

Special Tool(s)	
 <p>205-825/3 E54216</p>	<p>Installer rear axle front bush 205-825/3</p>
 <p>205-825/5 E54209</p>	<p>Receiver cup rear differential front bush 205-825/5</p>
 <p>502-009/2 E54205</p>	<p>Remover rear differential rear bush 502-009/2</p>

Removal



CAUTION: Make sure the bush is correctly aligned.

- **NOTE:** Take note of the fitted position of the bush.



1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

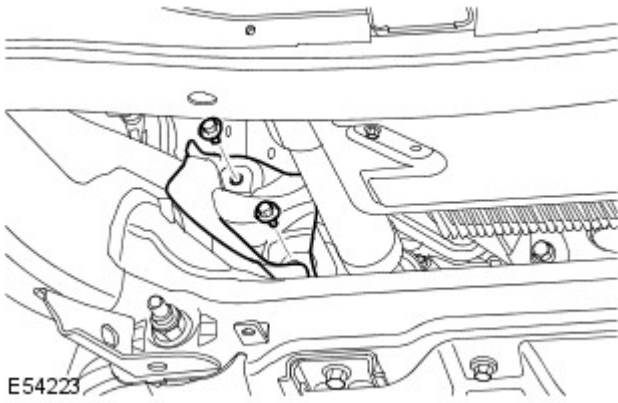
- 2.** Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).
For additional information, refer to:

[Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation),
[Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation),
[Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation),
[Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).

- 3.** Using a jack, support the axle assembly.

4. Remove the axle carrier bushing heat shield.

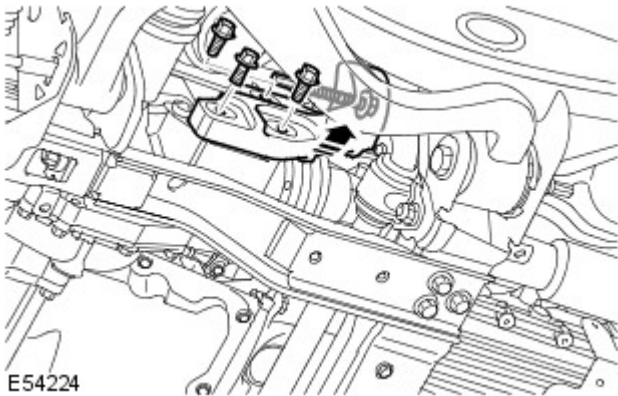
- Remove the two retaining bolts.



5.  CAUTION: The bolts must only be used once.

Remove the axle carrier.

- Remove and discard the three bolts retaining the axle carrier to the axle.
- Remove the axle carrier bushing bolt.



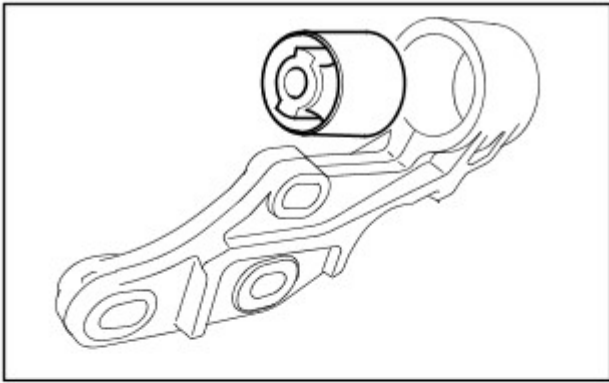
6. NOTE: Take note of the fitted position of the bush.


Using the special tools, remove the axle carrier bushing.



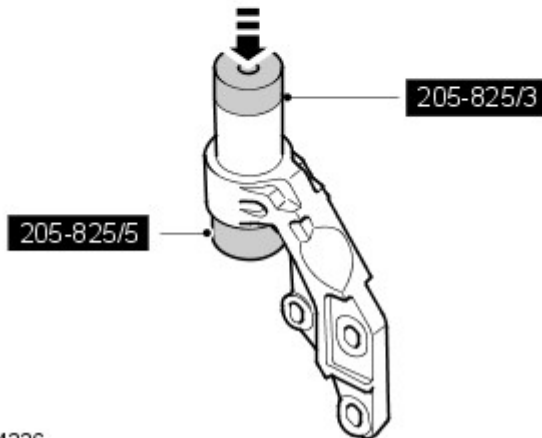
E54225

Installation



1.  **CAUTION:** Make sure the bush is correctly aligned.

Using the special tools, install the axle carrier bushing.



E54226




2. Install the axle carrier.
 - Tighten the M14 bolt to 105 Nm (77 lb.ft).
 - Tighten the new axle carrier bracket bolts to 80 Nm (59 lb.ft), then a further 60 degrees.
3. Install the axle carrier bushing heat shield.
4. Remove the axle support.
5. Install the exhaust system.

For additional information, refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).
For additional information, refer to:

 - [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation),
 - [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation),
 - [Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation),
 - [Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).

Front Drive Axle/Differential - Axle Tube Bushing

Removal and Installation

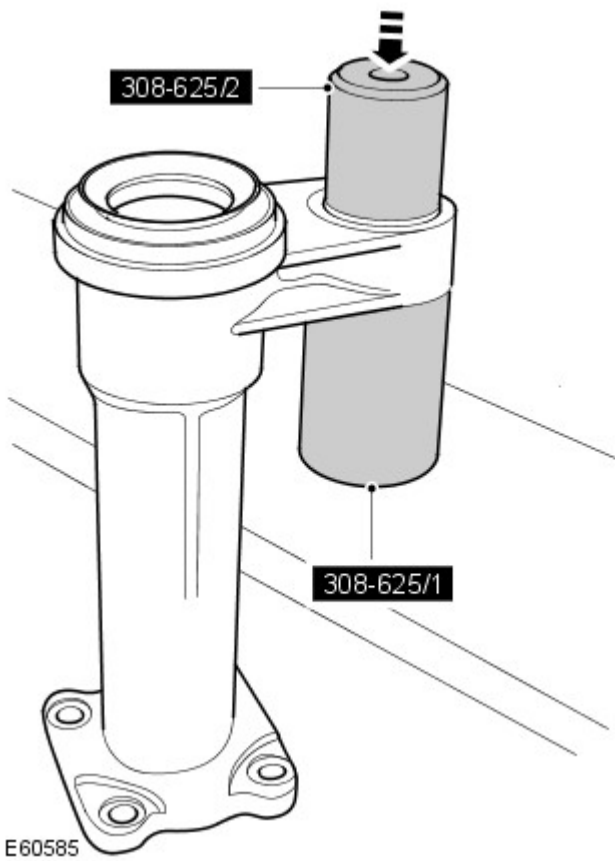
Special Tool(s)	
 <p>308-625/1</p> <p>E60582</p>	<p>Remover/installer - Front axle extension support bush</p> <p>308-625/1</p>
 <p>308-625/2</p> <p>E60583</p>	<p>Remover/installer - Front axle extension support bush</p> <p>308-625/2</p>
 <p>308-625/3</p> <p>E60584</p>	<p>Remover/installer - Front axle extension support bush</p> <p>308-625/3</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Raise and support the vehicle.
3. Remove the axle tube.
For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).

4. NOTE: Note the fitted position.

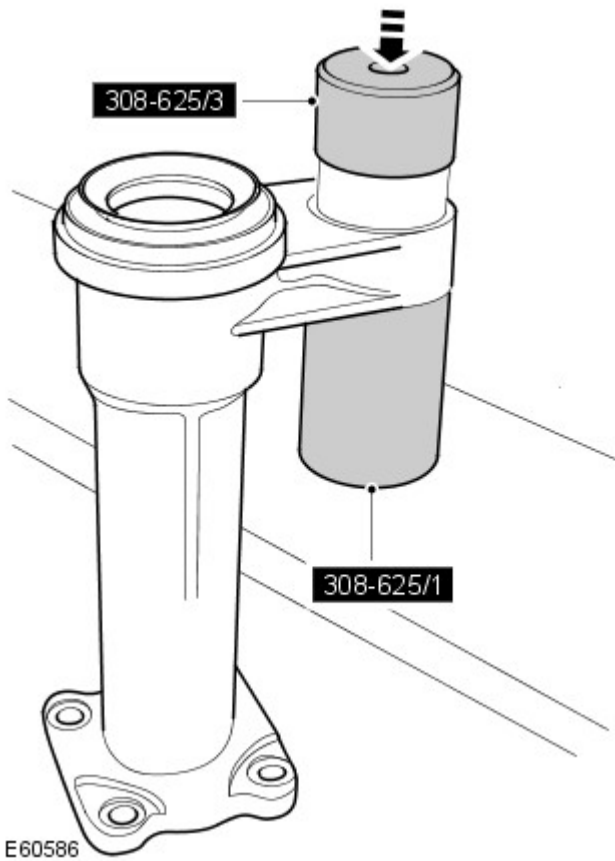
Using the special tools, remove the bushing.



Installation

1. NOTE: Note the fitted position.

Using the special tools, install the bushing.










2. Install the axle tube.
For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).

3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Front Drive Axle/Differential - Axle Cover Bushing


Removal and Installation

Special Tool(s)	
<p>502-009/6</p>  <p>E55285</p>	<p>Bearing Housing</p> <p>502-009/6</p>
<p>51204</p>  <p>E55278</p>	<p>Bearing set for 14mm bolt</p> <p>51204</p>
<p>205-825/3</p>  <p>E54216</p>	<p>Installer rear axle front bush</p> <p>205-825/3</p>
<p>502-009/2</p>  <p>E54205</p>	<p>Remover rear differential rear bush</p> <p>502-009/2</p>
<p>502-009/5</p>  <p>E54148</p>	<p>Remover/Installer long 14mm bolt</p> <p>502-009/5</p>
<p>502-009/4</p>  <p>E55284</p>	<p>Nut for long 14mm bolt</p> <p>502-009/4</p>
<p>205-825/1</p>  <p>E54219</p>	<p>Receiver cup front axle front bush</p> <p>205-825/1</p>

Removal

 CAUTION: Make sure the bush is correctly aligned.

- NOTE: Take note of the fitted position of the bush.

1.  WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

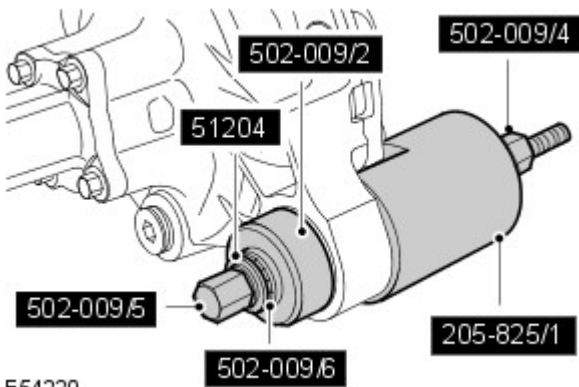
2. Remove the front wheels and tires.

3. Remove the front differential.


For additional information, refer to: [Axle Assembly](#) (205-03 Front Drive Axle/Differential, Removal and Installation).

4. NOTE: Take note of the fitted position of the bush.

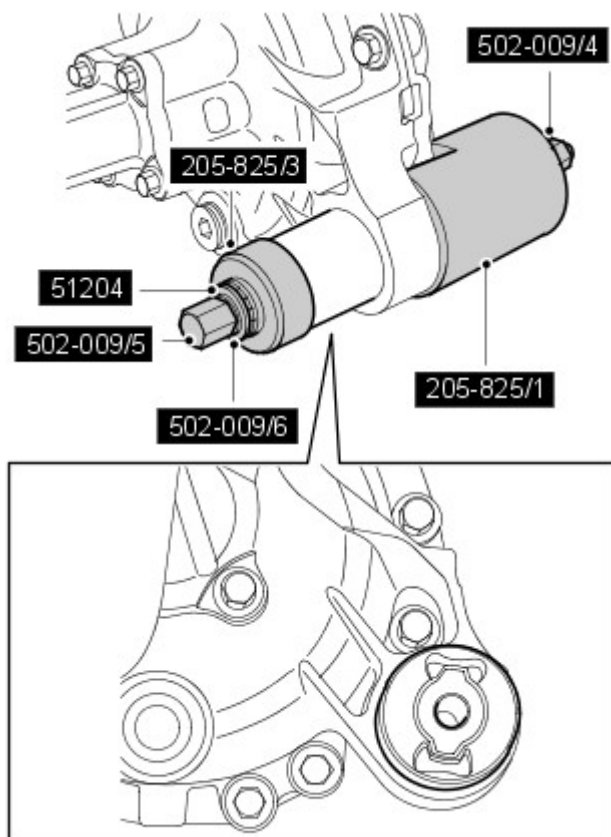
Using the special tools, remove the front axle housing support insulator.



Installation

1.  CAUTION: Make sure the bush is correctly aligned.

Using the special tools, install the front axle housing support insulator.



2. Install the front differential.

For additional information, refer to: [Axle Assembly](#) (205-03 Front Drive Axle/Differential, Removal and Installation).

3. Install the front wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts -

General Specification

Item	Specification
Type	Fully floating, fixed length, solid shafts incorporating constant velocity joints at each end of shaft

Lubricant

Item	Specification
Outboard joint	Use grease supplied with replacement boot kit (Optimol MS139G)
Inboard joint	Use grease supplied with replacement boot kit (1 Luber C MS132G)

General Specification

Item	Specification
Type	Fully floating, solid shafts incorporating 'plug-in' constant velocity joint at inboard end and fixed constant velocity joint at outboard end of shaft

Torque Specifications

Description	Nm	lb-ft
* Stabilizer bar link nut	115	85
* Stabilizer link nut	115	85
* Tie rod end ball joint nut	76	56
Brake hose retaining bracket to wheel knuckle bolt	25	18
*+ Halfshaft retaining nut	230	169
Road wheel nuts	140	103

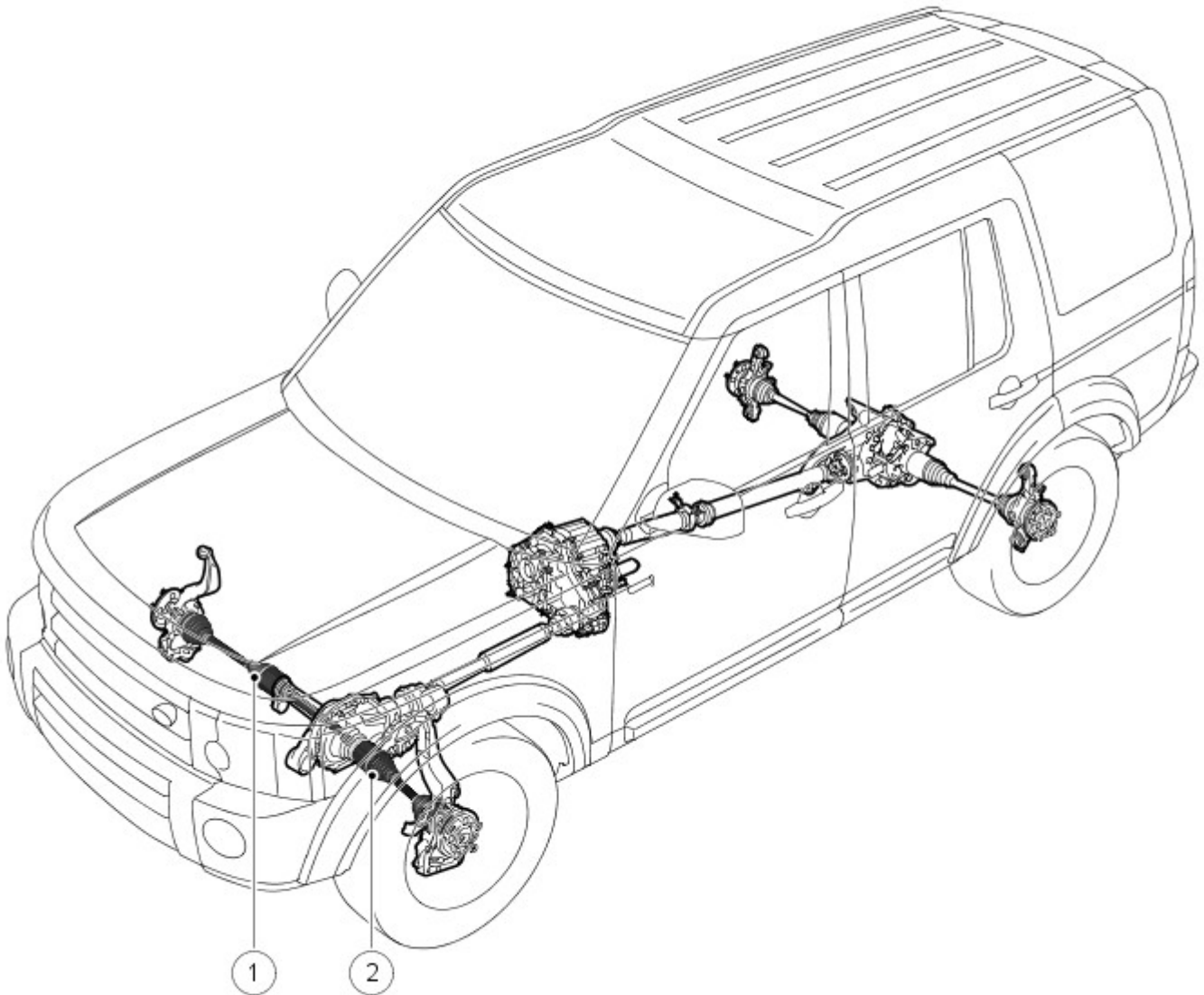
* **New nut must be fitted**

+ **Stake nut on completion**

Front Drive Halfshafts - Front Drive Halfshafts

Description and Operation

Front Drive Halfshaft Component Location



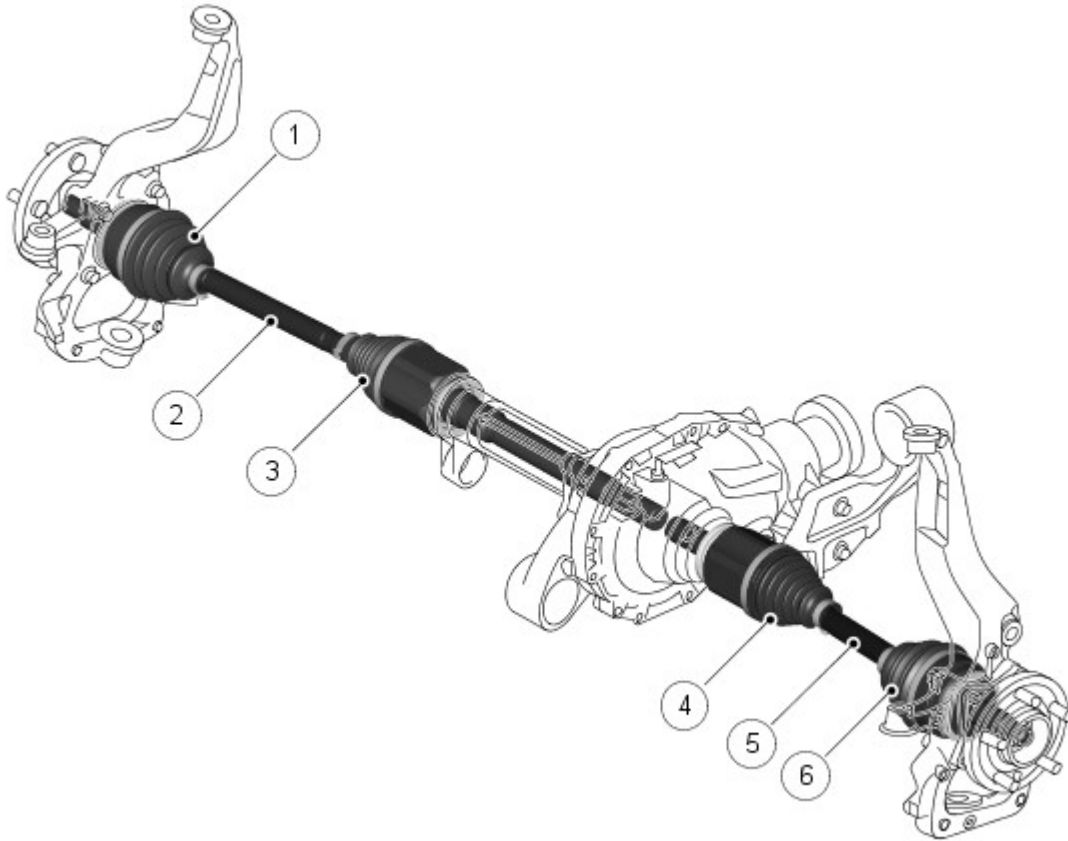
E46376

Item	Part Number	Description
1	-	RH front drive halfshaft
2	-	LH front drive halfshaft

GENERAL

The front drive shafts are handed components with the RH drive shaft being longer than the LH drive shaft. Both shafts are of similar construction with Constant Velocity (CV) joints at each end to allow for steering and suspension movement.

FRONT DRIVE HALFSHAFT ASSEMBLY



E46377

Item	Part Number	Description
1	-	RH outer CV joint
2	-	RH front drive halfshaft
3	-	RH inner CV joint
4	-	LH inner CV joint
5	-	LH front drive halfshaft
6	-	LH outer CV joint

The front drive shafts are similar in their construction. The only difference is the lengths of each shaft, the LH drive shaft is a longer shaft with an extended stem.

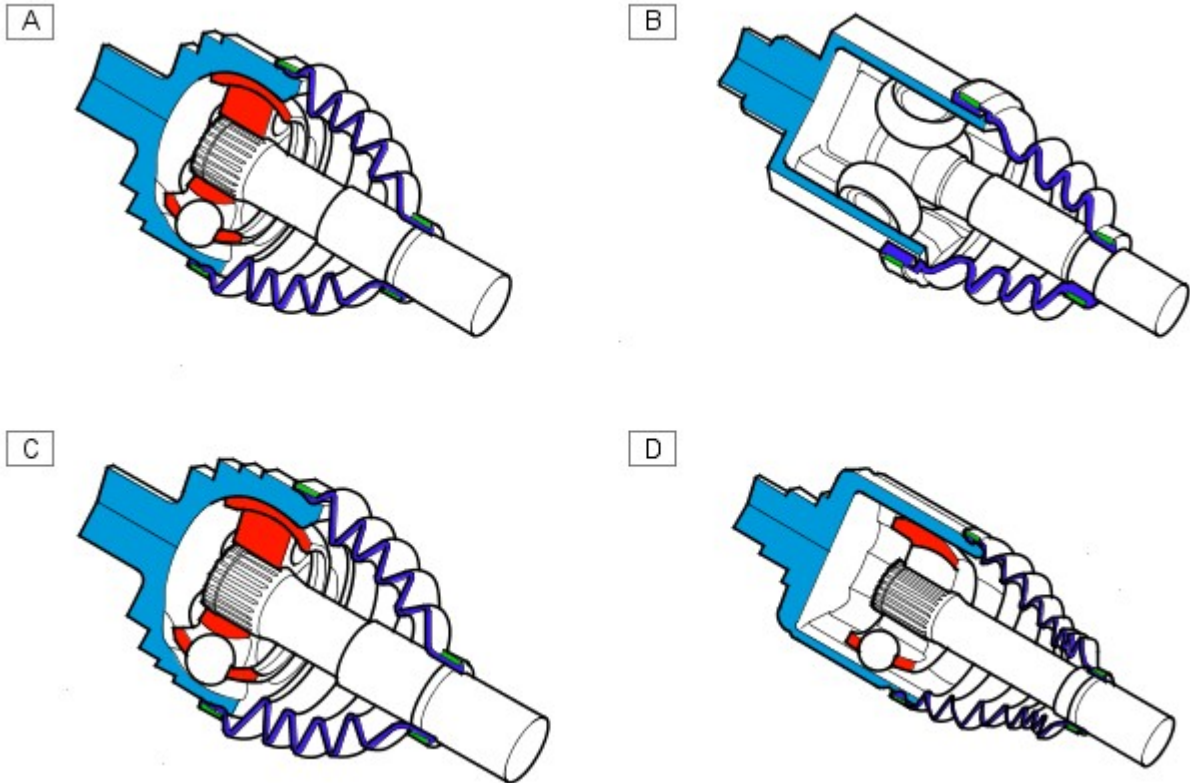
The outer CV joints have a target wheel on the outer diameter. This is used by the ABS wheel speed sensor for vehicle and wheel speed calculations.

Each drive shaft comprises two CV joints (inner and outer), boots, an outer tube and a solid barshaft, which is retained in the front differential by a circlip (see 'Halfshaft Joint' section for more information on CV joints).

Front Drive Halfshafts - Halfshaft Joint

Description and Operation

Front Drive HalfShaft – Sectional Views



E50637

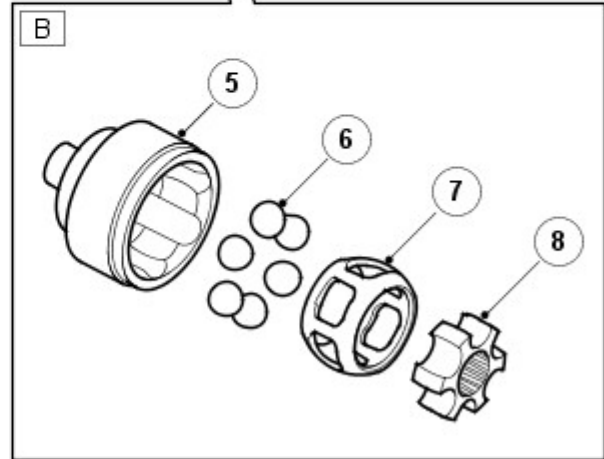
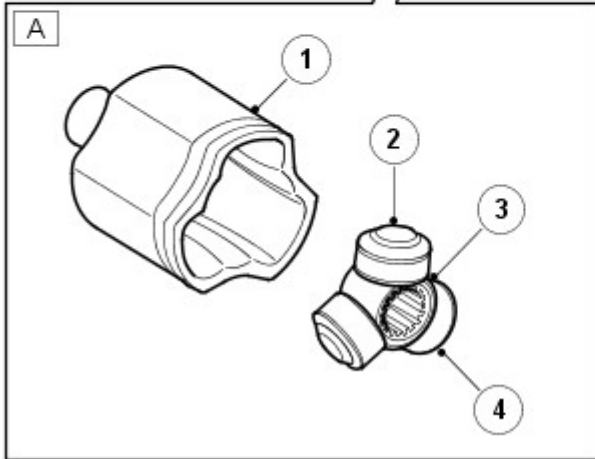
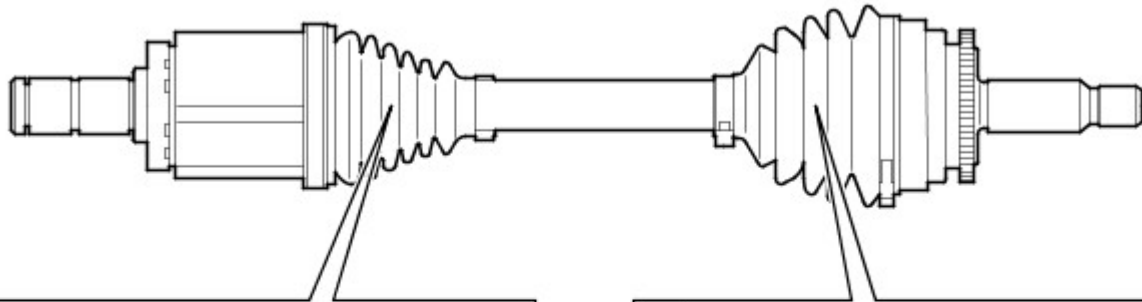
Item	Part Number	Description
A	-	Front outboard halfshaft joint
B	-	Rear outboard halfshaft joint
C	-	Rear inboard halfshaft joint
D	-	Front inboard halfshaft joint

The outboard and rear inboard CV joints are of the Birfield design. This design uses longitudinal, elliptical grooves, which retain six steel balls. The balls are further retained by a cage. The constant velocity is achieved by the position of the steel balls. If a centre line is drawn through the balls and the driven hub or differential shaft, the two centre lines always bisect each other at the angle of drive. This condition allows the rotational speed of the driven shaft to be passed to the driven hub or differential shaft with no loss of rotational speed regardless of the shaft angle. The CV joints are packed with grease, which is retained in the joint by a synthetic rubber gaiter. The gaiter is retained at each end by a metal clamp, which provides a water tight seal to prevent the ingress of dirt and moisture. The CV joints are retained on their respective shaft or tube by an internal snap ring. The snap rings are located in a groove on each shaft or tube end and locate in a mating groove in the CV joint.

⚠ CAUTION: The inner hub is not retained in the joint body on this type of joint. The joint is held together in it's unfitted state only by the boot. Pulling on the barshaft can therefore pull the hub out of the joint body. For this reason care must be taken when handling and fitting the front driveshafts.

The shaft is a sliding fit inside the outer tube, which allows for the small length changes, which occur with articulation of the suspension. The shaft is located in a ball cage, which is retained inside the outer tube. The ball cage ensures that the shaft is held rigidly in the outer tube whilst allowing it to freely move in and out of the tube as necessary. A sealing plug is pressed into the outer tube and retains grease around the balls in the cage.

The inner CV joints are similar in design and operation to the outer joints except that the inner joints use rollers rather than balls to transmit the drive.



E46396

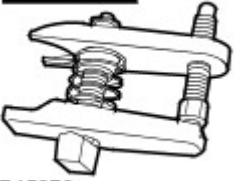

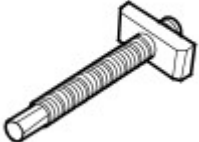

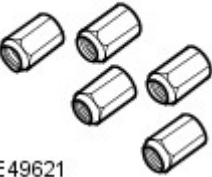


Item	Part Number	Description
A	-	Inner CV joint
B	-	Outer CV joint
1	-	Tulip outer race
2	-	Trunions (3 of)
3	-	Spider
4	-	Rollers (3 of)
5	-	Outer race
6	-	Steel balls (6 of)
7	-	Cage
8	-	Inner race



The front inboard joint is a 'tripode joint', having three 'feet' or 'podes'. The torque is transmitted from the outer race to the connecting shaft by means of rollers running on needle rollers around the trunions of the tripod spider. The roller tracks of the outer race enable the tripod assembly to move angularly and axially within the joint.

The inner CV joint shaft is splined and mates with splines in the front differential. There is no internal retaining mechanism for this type of joint so care must be taken during service as the shaft and CV joint can separate.

Front Drive Halfshafts - Front Halfshaft LH

Removal and Installation

Special Tool(s)	
 <p>205-754A</p> <p>E45276</p>	<p>Ball joint separator 205-754(LRT-54-027)</p>
 <p>204-506/1</p> <p>E49618</p>	<p>Halfshaft remover/replacer 204-506/1(LRT-60-030/1)</p>
 <p>204-506/3</p> <p>E49620</p>	<p>Halfshaft remover/replacer 204-506/3(LRT-60-030/3)</p>
 <p>204-506-01</p> <p>E49622</p>	<p>Halfshaft installer adapter 204-506-01(LRT-60-030/4)</p>
 <p>204-506/5</p> <p>E49621</p>	<p>Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)</p>
 <p>308-005</p> <p>E54134</p>	<p>Axle oil seal remover 308-005(LRT-37-004/2)</p>
 <p>100-012</p> <p>E54135</p>	<p>Impulse extractor 100-012(LRT-99-004)</p>

<p>308-626/2</p>  <p>E54137</p>	<p>Installer/Guide halfshaft oil seal 308-626/2</p>
<p>308-626/1</p>  <p>E54136</p>	<p>Installer halfshaft oil seal 308-626/1</p>

Removal

• CAUTIONS:




Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint.



Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

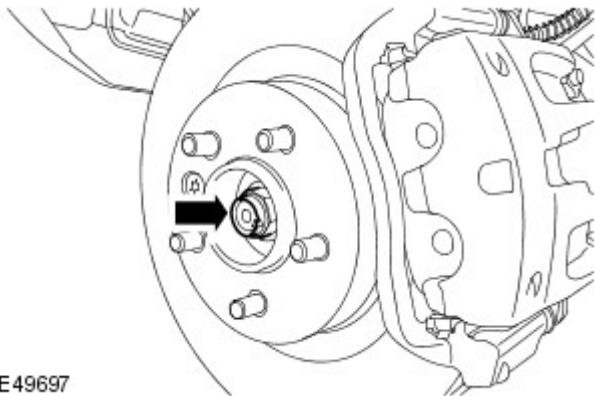


Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

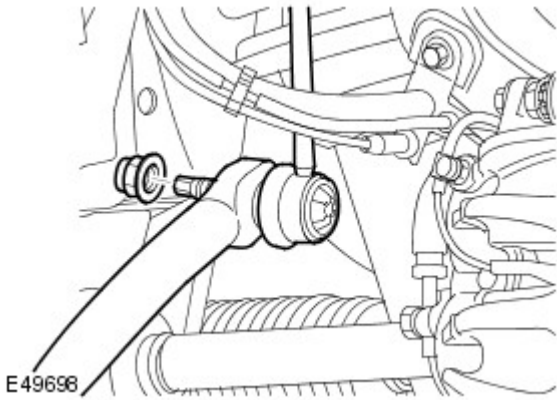
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Drain the differential lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).
- Remove the wheel and tire.
- Remove the halfshaft retaining nut.
 - Discard the nut.



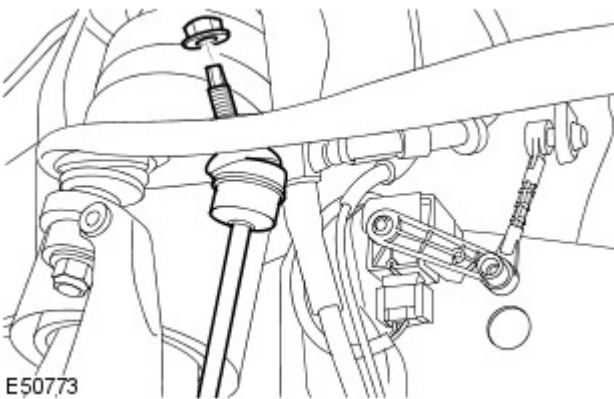
E49697




5.  CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

Disconnect the RH stabilizer bar link.

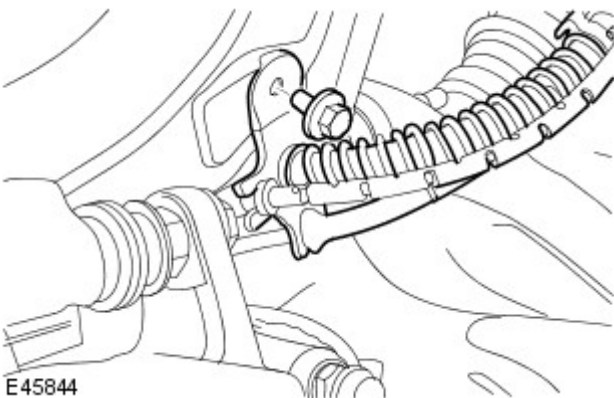
- Remove and discard the nut.



6.  CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

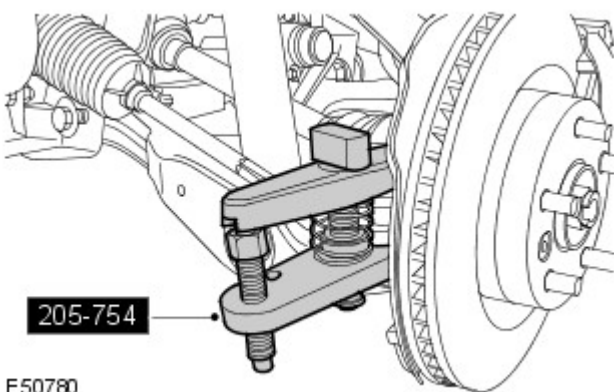
Remove the stabilizer bar link nut.

- Remove and discard the nut.




7. Release the brake hose bracket from the wheel knuckle.

- Remove the bolt.




8. Loosen the tie-rod end ball joint retaining nut.

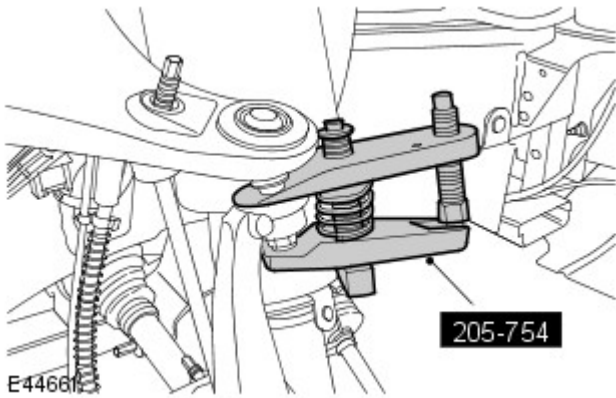
9.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.


Using the special tool, release the tie-rod end ball joint from the wheel knuckle.

- Discard the nut.

10.  CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

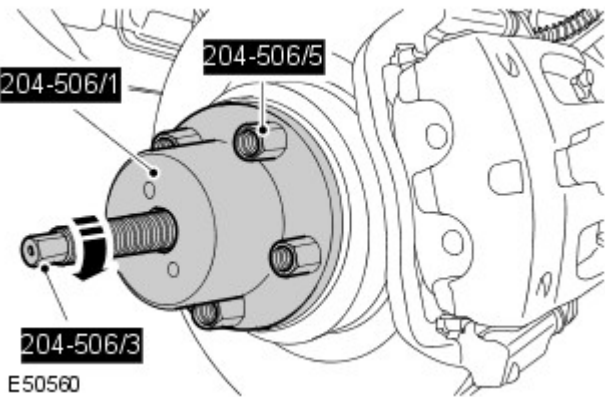
Loosen the upper arm retaining nut.




11.  **CAUTION:** Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.


Using the special tool, release the upper arm ball joint.

- Remove and discard the retaining nut.



12. CAUTIONS:

 The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

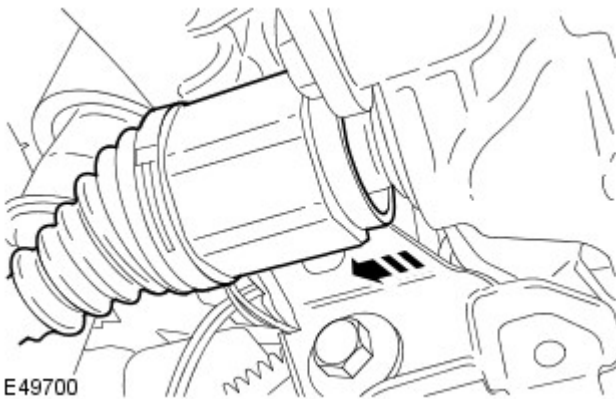
 Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

 Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

Using the special tools, release the halfshaft from the wheel hub.

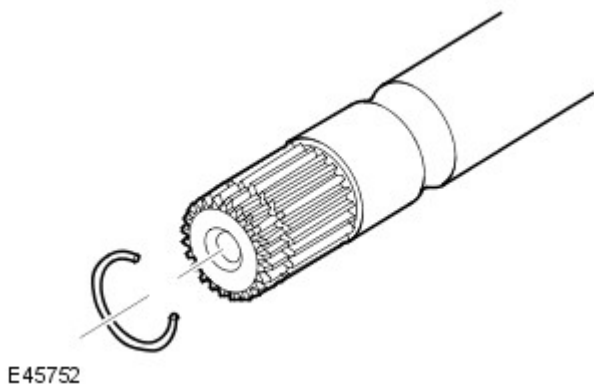
13. Release the halfshaft from the wheel knuckle.

14. Release the halfshaft from the differential housing.

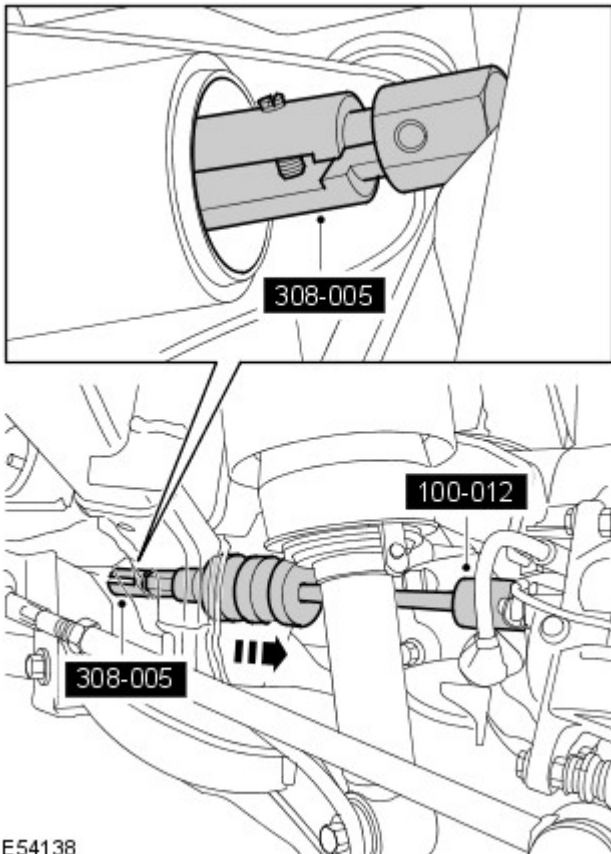


15. Remove the halfshaft.

- Raise the stabilizer bar to allow removal of the halfshaft.
- Remove and discard the snap ring.



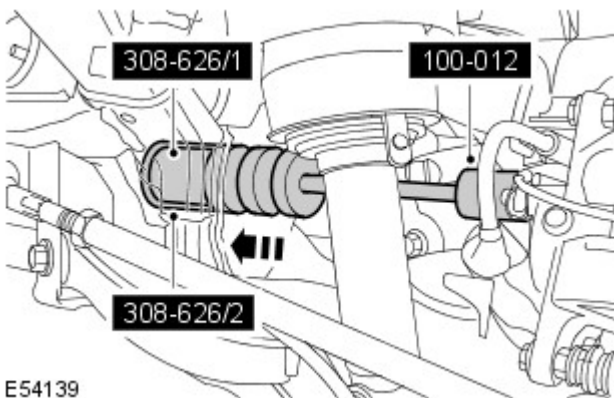
16. Using the special tools, remove and discard the halfshaft oil seal.



Installation

1. Clean the components.
2. Using the special tools, install a new halfshaft oil seal.

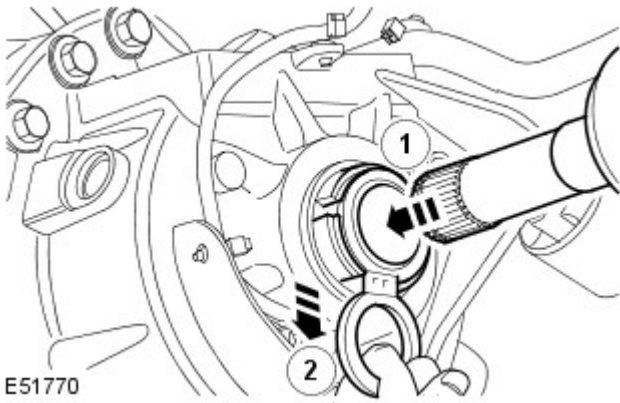
- The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.



3. **NOTE:** Do not fully engage the halfshaft until the oil seal protector has been removed.

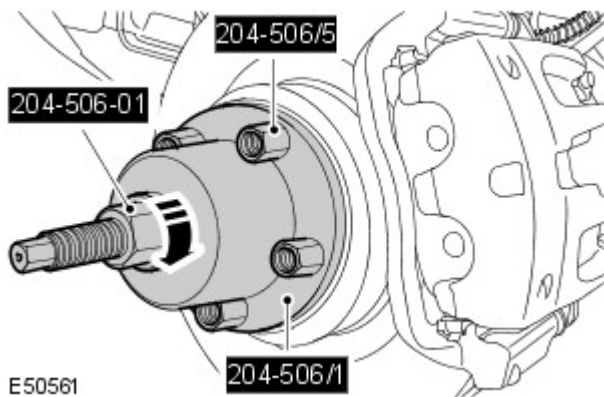
Install the halfshaft.

- Install the snap ring.
- Lubricate the seal and the bearing running surfaces with clean axle oil.
- Make sure the snap ring is fully engaged and retains the halfshaft.
- Open the halfshaft oil seal protector.



4. NOTE: The oil seal protector is designed to break into two pieces.

Remove and discard the halfshaft oil seal protector.



5. CAUTION: The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

Using the special tools, install the halfshaft in the wheel hub.

6. Connect the upper arm and wheel knuckle.

- Install a new nut and tighten to 70 Nm (52 lb.ft).

7. Secure the stabilizer bar link.

- Install a new nut and tighten to 115 Nm (85 lb.ft).

8. Connect the tie-rod end ball joint.

- Install a new nut and tighten to 76 Nm (56 lb.ft).

9. CAUTION: Install the halfshaft nut finger tight.

Install a new halfshaft retaining nut and lightly tighten.

10. Secure the brake hose retaining bracket to the wheel knuckle.

- Tighten the bolt to 22 Nm (16 lb.ft).

11. Secure the RH stabilizer link.

- Install a new nut and tighten to 115 Nm (85 lb.ft).

12. CAUTION: Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

Tighten the new halfshaft retaining nut to 230 Nm (170 lb.ft).

- Stake the nut to the halfshaft.

13. Install the wheels and tires.

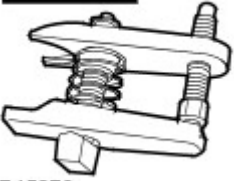

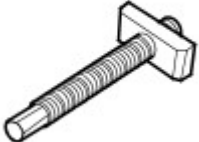

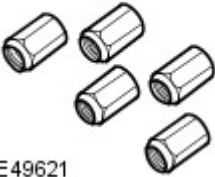


- Tighten the wheel nuts to 140 Nm (103 lb.ft).




14. CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

Fill the differential with the correct amount of lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).

Front Drive Halfshafts - Front Halfshaft RH

Removal and Installation

Special Tool(s)	
 <p>205-754A</p> <p>E45276</p>	<p>Ball joint separator 205-754(LRT-54-027)</p>
 <p>204-506/1</p> <p>E49618</p>	<p>Halfshaft remover/replacer 204-506/1(LRT-60-030/1)</p>
 <p>204-506/3</p> <p>E49620</p>	<p>Halfshaft remover/replacer 204-506/3(LRT-60-030/3)</p>
 <p>204-506-01</p> <p>E49622</p>	<p>Halfshaft installer adapter 204-506-01(LRT-60-030/4)</p>
 <p>204-506/5</p> <p>E49621</p>	<p>Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)</p>
 <p>308-005</p> <p>E54134</p>	<p>Axle oil seal remover 308-005(LRT-37-004/2)</p>
 <p>100-012</p> <p>E54135</p>	<p>Impulse extractor 100-012(LRT-99-004)</p>

 <p>308-626/2</p> <p>E54137</p>	<p>Installer/Guide halfshaft oil seal 308-626/2</p>
 <p>308-626/1</p> <p>E54136</p>	<p>Installer halfshaft oil seal 308-626/1</p>
 <p>205-819</p> <p>E54141</p>	<p>Halfshaft bearing installer 205-819</p>

Removal

• CAUTIONS:




Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.



Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

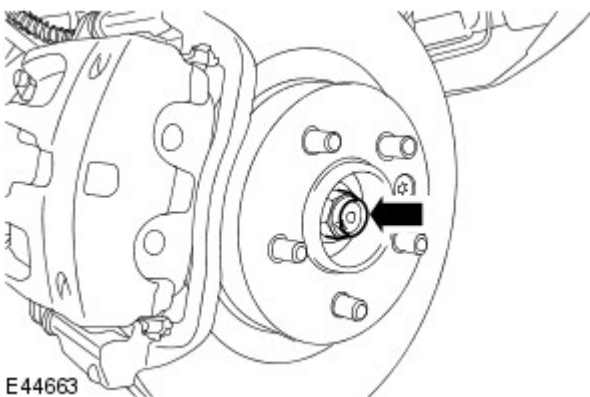


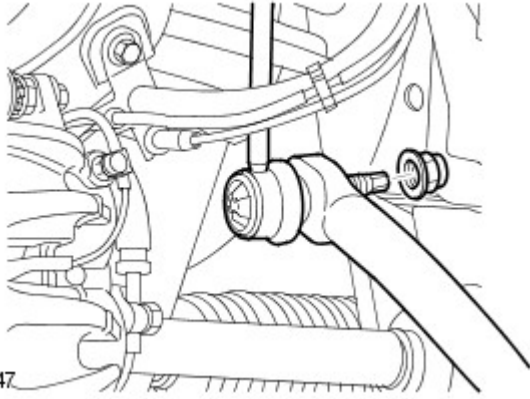
Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint.


-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Drain the differential lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).
- Remove the wheels and tires.
- Remove the halfshaft retaining nut.
 - Discard the nut.

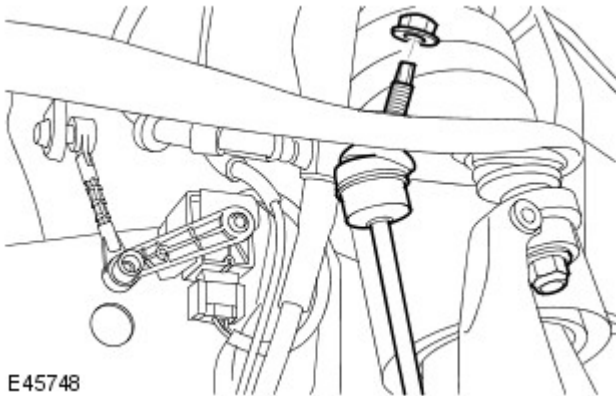





5.  CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

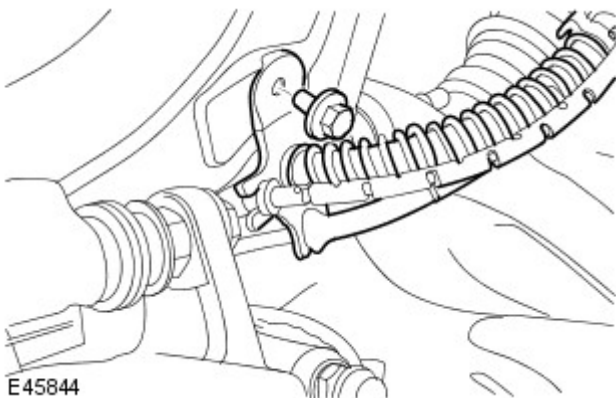
Disconnect the LH stabilizer bar link.

- Remove and discard the nut.



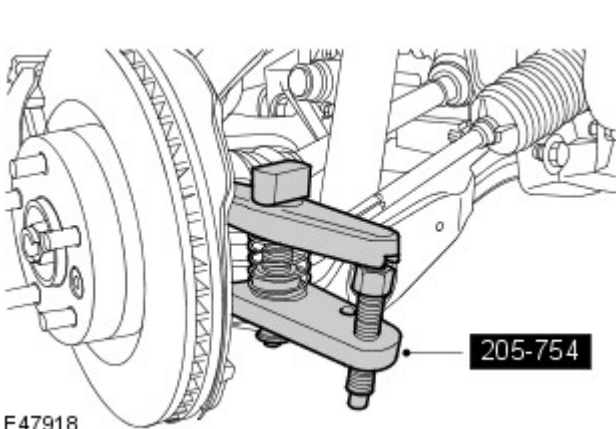
6.  CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

Remove the stabilizer bar link nut.




7. Release the brake hose bracket from the wheel knuckle.

- Remove the bolt.




8. Loosen the tie-rod end ball joint retaining nut.

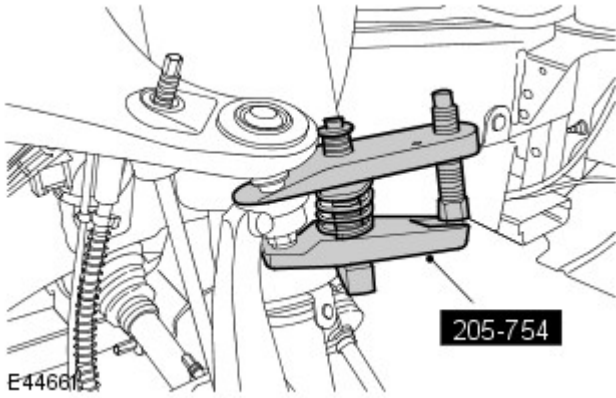
9.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.


Using the special tool, release the tie-rod end ball joint from the wheel knuckle.

- Discard the nut.

10.  CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

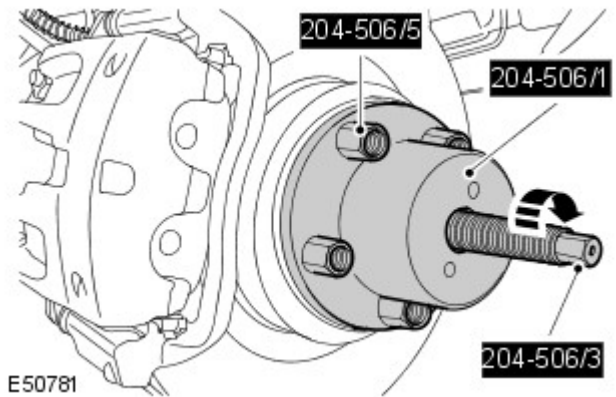
Loosen the upper arm retaining nut.




11.  **CAUTION:** Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.


Using the special tool, release the upper arm ball joint.

- Remove and discard the retaining nut.



12. CAUTIONS:

 The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

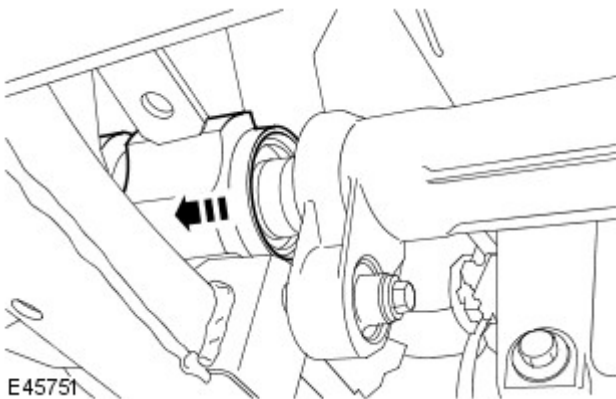
 Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

Using the special tools, release the halfshaft from the wheel hub.

13. Release the halfshaft from the wheel knuckle.

14. Position a container to collect the oil spillage.

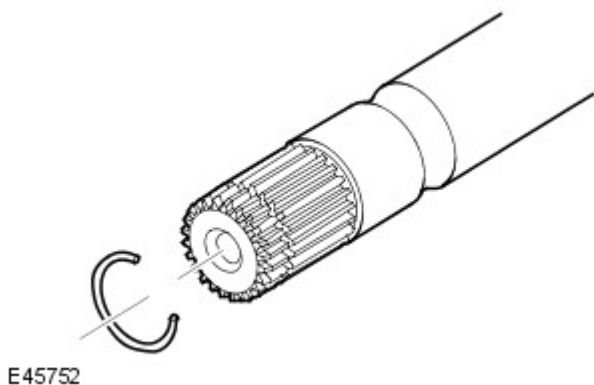
15. Release the halfshaft from the differential housing.



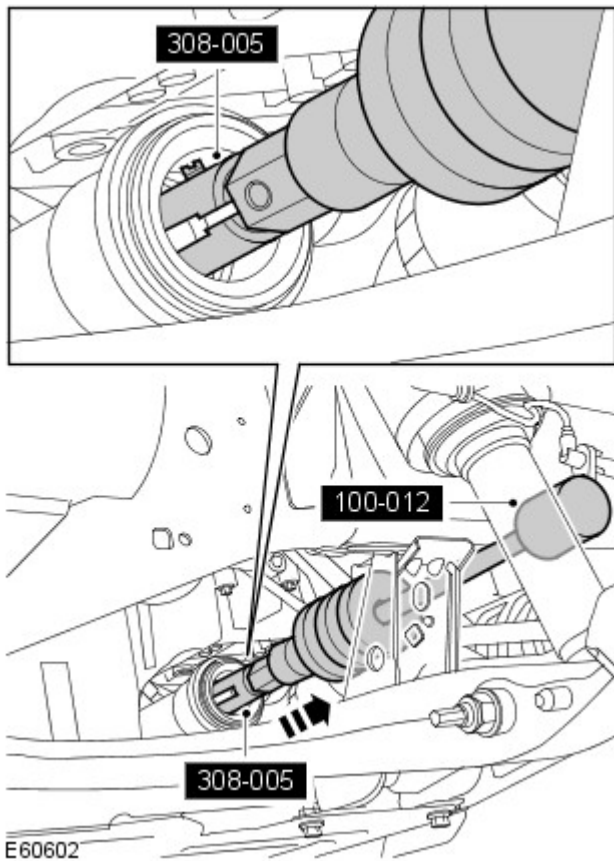
16.  **CAUTION:** Keep the halfshaft horizontal to avoid damaging the oil seal.

Remove the halfshaft.

- Raise the stabilizer bar to allow removal of the halfshaft.
- Remove and discard the snap ring.



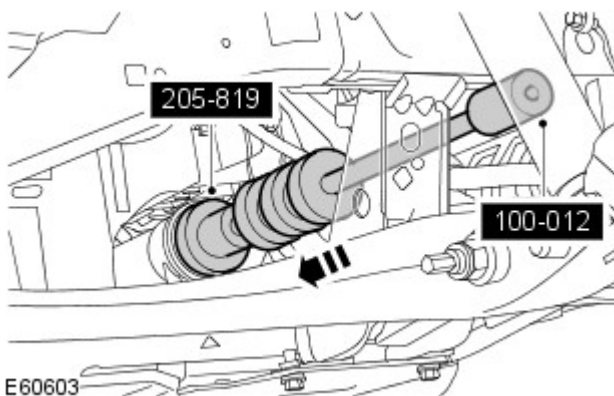
17. Using the special tools, remove and discard the halfshaft oil seal.



Installation

1. Clean the components.
2. Using the special tools, install a new halfshaft oil seal.

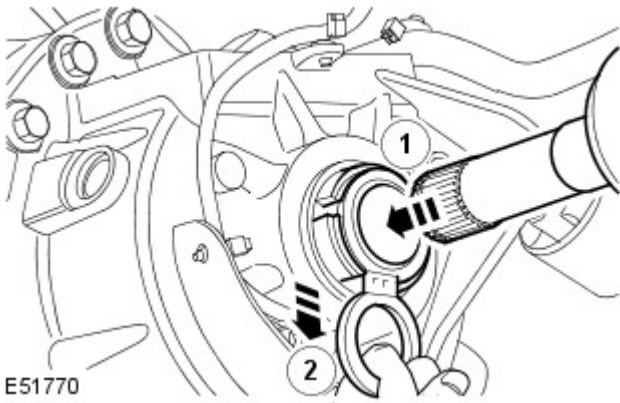
- The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.



3. **NOTE:** Do not fully engage the halfshaft until the oil seal protector has been removed.

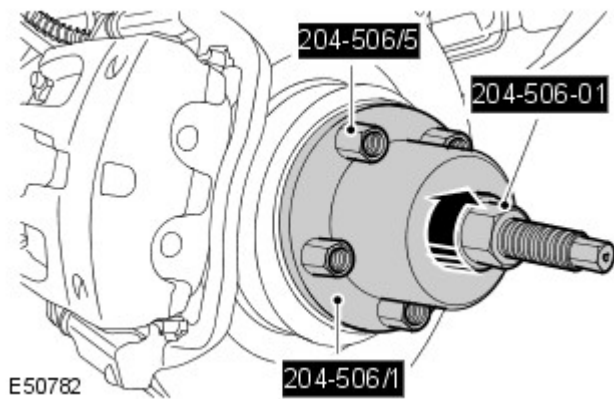
Install the halfshaft.

- Install the snap ring.
- Lubricate the seal and the bearing running surfaces with clean axle oil.
- Make sure the snap ring is fully engaged and retains the halfshaft.
- Open the halfshaft oil seal protector.



4. NOTE: The oil seal protector is designed to break into two pieces.

Remove and discard the halfshaft oil seal protector.



5. **CAUTION:** The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

Using the special tools, install the halfshaft in the wheel hub.

6. Connect the upper arm and wheel knuckle.

- Install a new nut and tighten to 70 Nm (52 lb.ft).

7. Secure the stabilizer bar link.

- Install a new nut and tighten to 115 Nm (85 lb.ft).

8. Connect the tie-rod end ball joint.

- Install a new nut and tighten to 76 Nm (56 lb.ft).

9. **CAUTION:** Install the halfshaft nut finger tight.

Install a new halfshaft retaining nut and lightly tighten.

10. Secure the brake hose retaining bracket to the wheel knuckle.

- Tighten the bolt to 22 Nm (16 lb.ft).

11. Secure the LH stabilizer link.

- Install a new nut and tighten to 115 Nm (85 lb.ft).

12. **CAUTION:** Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

Tighten the new halfshaft retaining nut to 230 Nm (170 lb.ft).

- Stake the nut to the halfshaft.

13. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).


14. **CAUTION:** Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

Fill the differential with the correct amount of lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-03 Front Drive Axle/Differential, General Procedures).

Front Drive Halfshafts - Outer Constant Velocity (CV) Joint Boot

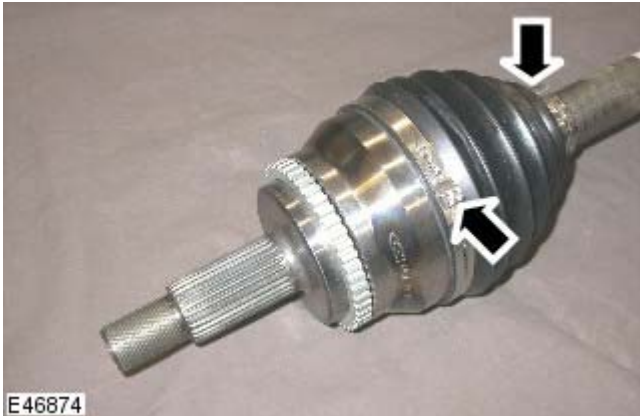
Removal and Installation

Removal

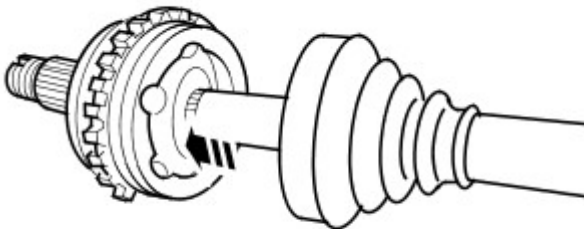
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.
3. Remove the halfshaft.
For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).
4. Clamp the halfshaft in a vise.
5. Remove and discard the CV joint boot retaining clamps.



6. Slide the CV joint boot along the halfshaft to gain access to the joint.
7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
 - Remove and discard the snap ring.



8. Remove the outer CV joint boot.


Installation


1. Clean the components.
2. Install the CV joint boot.
3. Install the outer CV joint.
 - Install the snap ring.
 - Position the CV joint on the halfshaft, press the snap ring into its groove and push the CV joint fully on to the halfshaft.
 - Pull on the CV joint to ensure the snap ring has fully engaged.
4. Pack the CV joint with the grease supplied.



E137494

5. CAUTIONS:

 Make sure the CV boot is not pushed too far onto the drive shaft and the recess is exposed, failure to follow this instruction may result in damage to the component.

 After the clamps have been secured do not adjust them, failure to follow this instruction may result in damage to the component.

Install the CV joint boot to the CV joint.

- Using a suitable tool, secure the CV joint boot with the new clamps.

6. Install the halfshaft.

For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).


7. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts - Outer Constant Velocity (CV) Joint

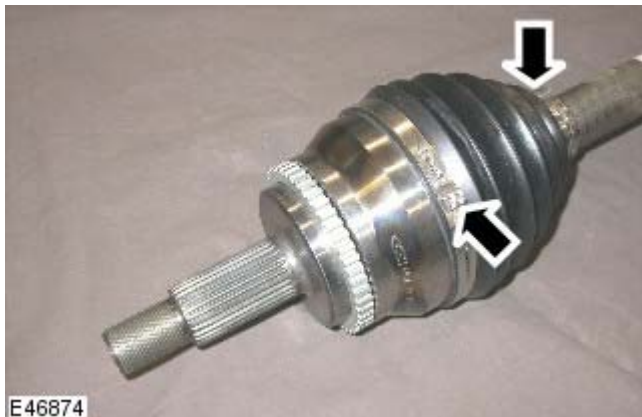
Removal and Installation

Removal

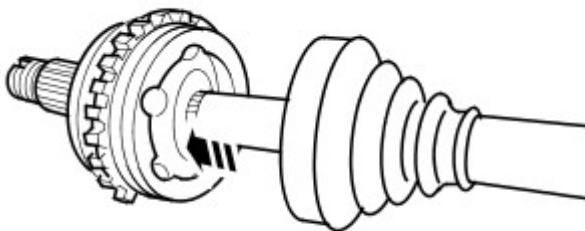
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.
3. Remove the halfshaft.
For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).
4. Clamp the halfshaft in a vise.
5. Remove and discard the CV joint boot retaining clamps.



6. Slide the CV joint boot along the halfshaft to gain access to the joint.
7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
 - Remove and discard the snap ring.



E46875

8. Remove the outer CV joint boot.


Installation


1. Clean the components.
2. Install the CV joint boot.
3. Install the outer CV joint.
 - Install the snap ring.
 - Position the CV joint on the halfshaft, press the snap ring into its groove and push the CV joint fully on to the halfshaft.
 - Pull on the CV joint to ensure the snap ring has fully engaged.
4. Pack the CV joint with the grease supplied.



E137494

5. CAUTIONS:

 Make sure the CV boot is not pushed too far onto the drive shaft and the recess is exposed, failure to follow this instruction may result in damage to the component.

 After the clamps have been secured do not adjust them, failure to follow this instruction may result in damage to the component.

Install the CV joint boot to the CV joint.

- Using a suitable tool, secure the CV joint boot with the new clamps.

6. Install the halfshaft.

For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).


7. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts - Inner Constant Velocity (CV) Joint Boot

Removal and Installation

Removal

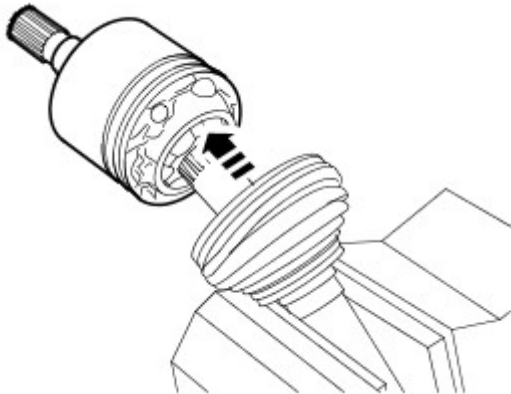
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.
3. Remove the halfshaft.
For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).
4. Clamp the halfshaft in a vise.
5. Remove and discard the CV joint boot retaining clamps.

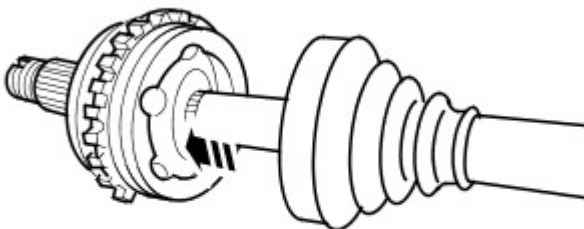


6. Slide the CV joint boot along the halfshaft to gain access to the joint.



7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.

- Remove and discard the snap ring.



8. Remove the inner joint boot.

Installation








1. Clean the components.
2. Install the inner joint boot.



3. Install the inner joint.
 - Install a new snap ring.
 - Position the CV joint on the halfshaft, press the snap ring into its groove and push the CV joint fully on to the halfshaft.
 - Pull on the CV joint to ensure the snap ring has fully engaged.
4. Pack the joint with the grease supplied.
5. Install the CV joint boot to the CV joint.
 - Secure with the new clamps.
6. Install the halfshaft.

For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).
7. Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts - Halfshaft Seal LH

Removal and Installation

Special Tool(s)	
 <p>205-754A</p> <p>E45276</p>	Ball joint separator (LRT-54-027) 205-754
 <p>204-506/1</p> <p>E49618</p>	Halfshaft remover/replacer (LRT-60-030/1) 204-506/1
 <p>204-506/3</p> <p>E49620</p>	Halfshaft remover/replacer (LRT-60-030/3) 204-506/3
 <p>204-506-01</p> <p>E49622</p>	Halfshaft installer adapter 204-506-01
 <p>204-506/5</p> <p>E49621</p>	Retainers - halfshaft remover/replacer (LRT-60-030/5) 204-506/5
 <p>308-005</p> <p>E54134</p>	Axle oil seal remover (LRT-37-004/2) 308-005
 <p>100-012</p> <p>E54135</p>	Impulse extractor (LRT-99-004) 100-012

 <p>308-626/2</p> <p>E54137</p>	<p>Installer/Guide halfshaft oil seal 308-626/2</p>
 <p>308-626/1</p> <p>E54136</p>	<p>Installer halfshaft oil seal 308-626/1</p>


Removal

• CAUTIONS:

 Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint

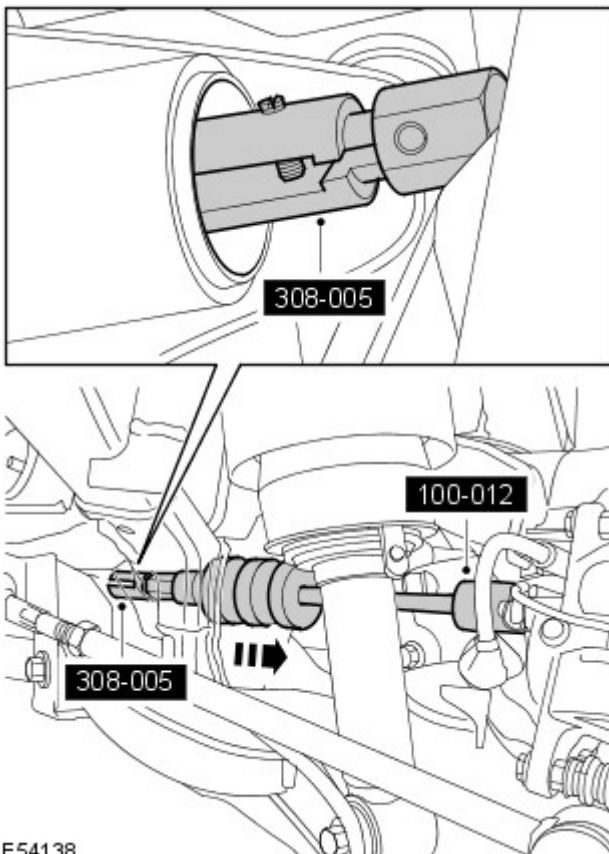
 Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

 Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

 **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

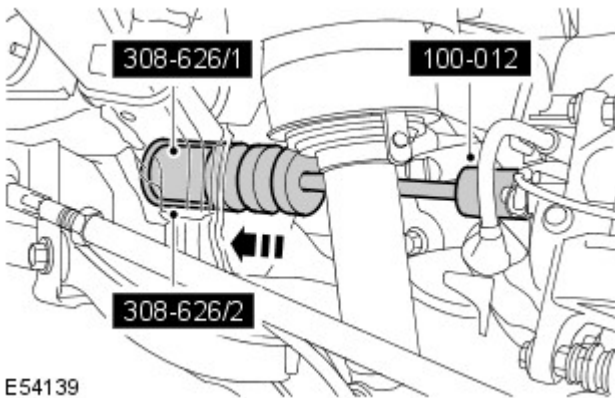
- Remove the LH halfshaft.
For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).
- Using the special tools, remove and discard the halfshaft oil seal.



Installation

1. Using the special tools, install a new halfshaft oil seal.

- The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.










E54139



2. Install the LH halfshaft.

For additional information, refer to: [Front Halfshaft LH](#) (205-04 Front Drive Halfshafts, Removal and Installation).

Front Drive Halfshafts - Halfshaft Seal RH

Removal and Installation

Special Tool(s)	
 <p>205-754A</p> <p>E45276</p>	Ball joint separator (LRT-54-027) 205-754
 <p>204-506/1</p> <p>E49618</p>	Halfshaft remover/replacer (LRT-60-030/1) 204-506/1
 <p>204-506/3</p> <p>E49620</p>	Halfshaft remover/replacer (LRT-60-030/3) 204-506/3
 <p>204-506-01</p> <p>E49622</p>	Halfshaft installer adapter 204-506-01
 <p>204-506/5</p> <p>E49621</p>	Retainers - halfshaft remover/replacer (LRT-60-030/5) 204-506/5
 <p>308-005</p> <p>E54134</p>	Axle oil seal remover (LRT-37-004/2) 308-005
 <p>100-012</p> <p>E54135</p>	Impulse extractor (LRT-99-004) 100-012


<p>308-626/2</p>  <p>E54137</p>	<p>Installer/Guide halfshaft oil seal 308-626/2</p>
<p>308-626/1</p>  <p>E54136</p>	<p>Installer halfshaft oil seal 308-626/1</p>

Removal

• CAUTIONS:

 Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

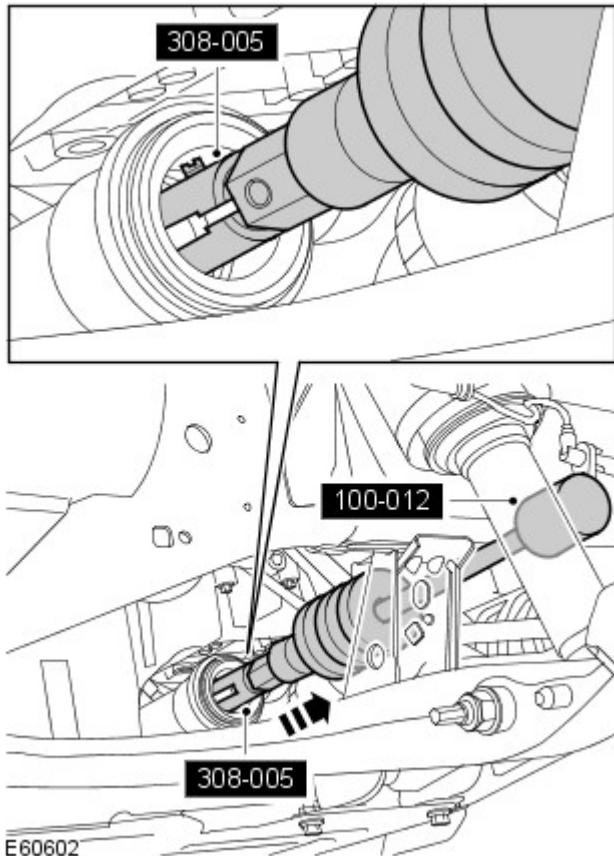
 Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

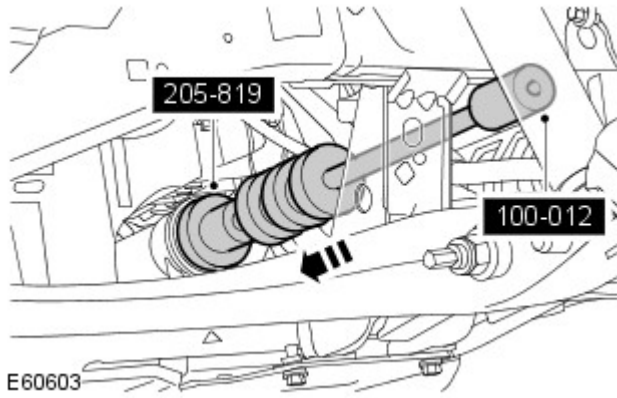
2. Remove the RH halfshaft.
For additional information, refer to: [Front Halfshaft RH](#) (205-04 Front Drive Halfshafts, Removal and Installation).

3. Using the special tools, remove and discard the halfshaft oil seal.



Installation

1. Using the special tools, install a new halfshaft oil seal.



2. Install the RH halfshaft.
For additional information, refer to: [Front Halfshaft RH](#) (205-04 Front Drive Halfshafts, Removal and Installation).

Rear Drive Halfshafts -

Recommended Lubricant

Item	Specification
Outboard joint	Use grease supplied with replacement boot kit (Optimol MS139G)
Inboard joint	Use grease supplied with replacement boot kit (Thermax MS141G)

General Specification

Item	Specification
Type	Fully floating, solid shafts incorporating plunging constant velocity joint at inboard end and fixed constant velocity joint at outboard end of shaft

Torque Specifications

Description	Nm	lb-ft
* Lower arm to wheel knuckle nut	275	203
Toe link bolt	175	129
*+ Halfshaft nut	350	258
Road wheel nuts	140	103

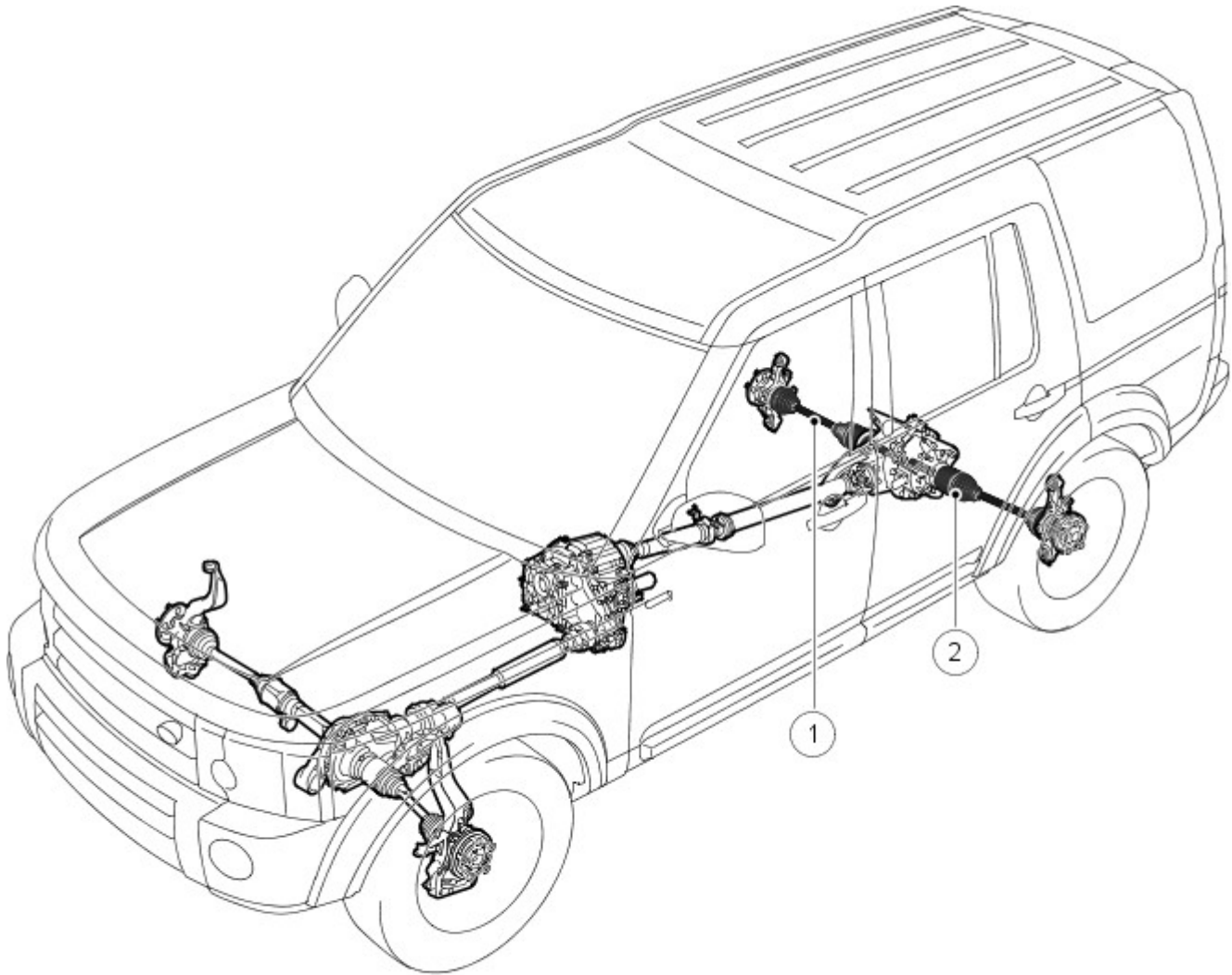
* **New nut must be fitted**

+ **Stake nut on completion**

Rear Drive Halfshafts - Rear Drive Halfshafts

Description and Operation

Rear Drive Halfshaft Component Locations



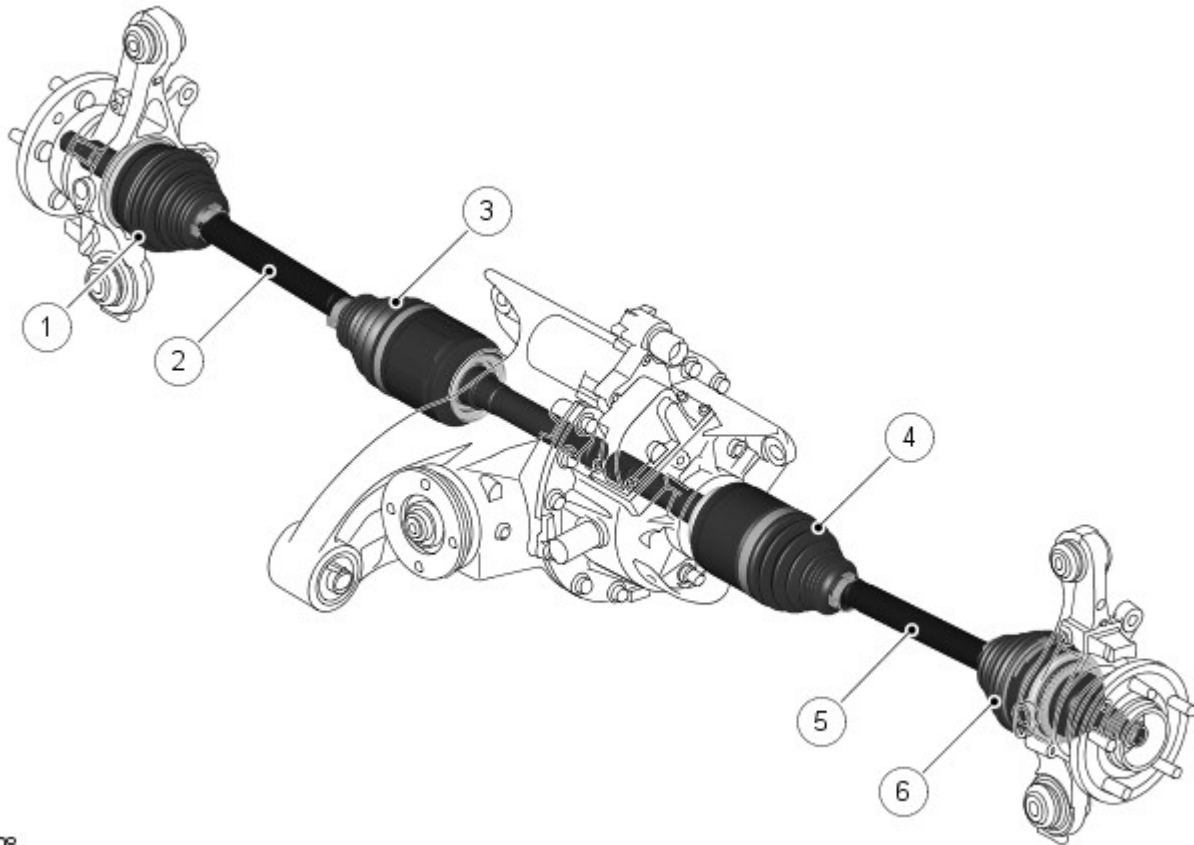
E46407

Item	Part Number	Description
1	-	RH rear drive halfshaft
2	-	LH rear drive halfshaft

GENERAL

The rear drive halfshafts are identical in their construction with a Constant Velocity (CV) joint at each end to allow for suspension movement.

REAR DRIVE SHAFT ASSEMBLY



E46408

Item	Part Number	Description
1	-	RH outer CV joint
2	-	RH rear drive halfshaft
3	-	RH inner CV joint
4	-	LH inner CV joint
5	-	LH rear drive halfshaft
6	-	LH outer CV joint


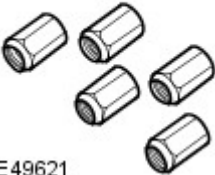
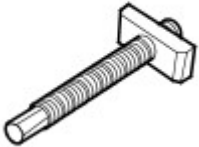




Each outer CV joint has a target wheel on the outer diameter. This target is used by the ABS wheel speed sensor for vehicle and wheel speed calculations.

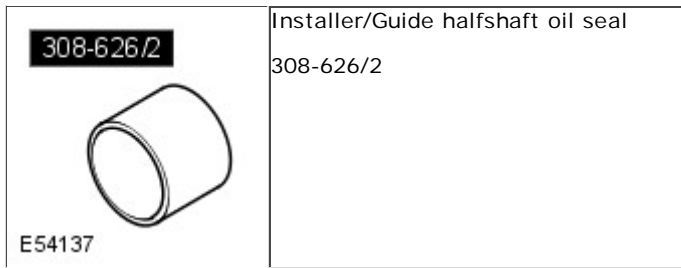
Each rear drive halfshaft comprises two CV joints (inner and outer), boots and a solid barshaft, which is retained in the rear differential by a circlip.

The CV joints used on the rear drive halfshafts share the same design and operating principles as the front drive halfshafts CV joints (see 'Halfshaft Joint' section for more information on CV joints). The rear drive halfshaft inner joint hubs are retained by peening over the lip of the joint body.

Rear Drive Halfshafts - Rear Halfshaft

Removal and Installation

Special Tool(s)	
 <p>204-506/1 E49618</p>	Halfshaft remover/replacer 204-506/1(LRT-60-030/1)
 <p>204-506/5 E49621</p>	Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)
 <p>204-506/3 E49620</p>	Halfshaft remover/replacer 204-506/3(LRT-60-030/3)
 <p>204-506-01 E49622</p>	Halfshaft installer adapter 204-506-01(LRT-60-030/4)
 <p>308-005 E54134</p>	Axle oil seal remover 308-005(LRT-37-004/2)
 <p>100-012 E54135</p>	Impulse extractor 100-012(LRT-99-004)
 <p>308-626/1 E54136</p>	Installer halfshaft oil seal 308-626/1



Removal

• CAUTIONS:



Do not allow halfshafts to hang unsupported at one end or joint damage will occur.




Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint.



Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

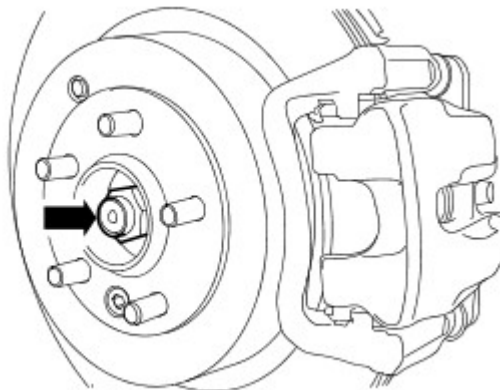


Do not undo or remove the large protruding hexagon on the differential casing.

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

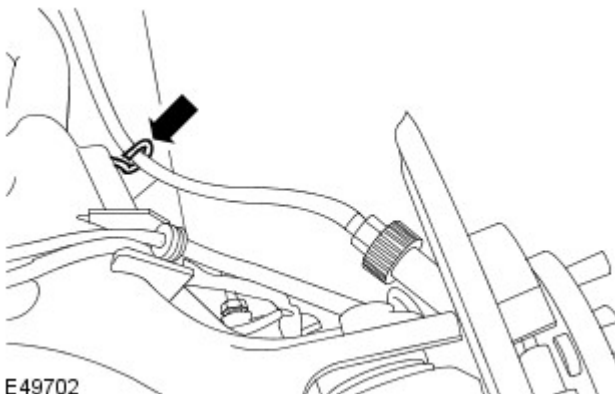
Raise and support the vehicle.

- Drain the differential lubricant.
For additional information, refer to: [Differential Draining and Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).
- Remove the wheel and tire.
- Loosen the halfshaft retaining nut.
 - Discard the nut.



E46796

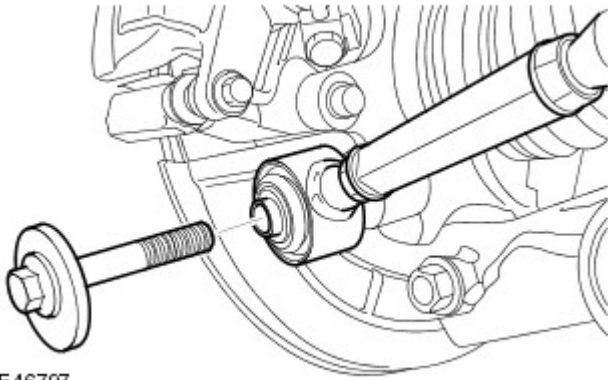
- Remove the stabilizer bar link.
For additional information, refer to: [Rear Stabilizer Bar Link](#) (204-02 Rear Suspension, Removal and Installation).
- Release the parking brake cable from the lower arm.



E49702


7. Disconnect the toe link.

- Remove the bolt.



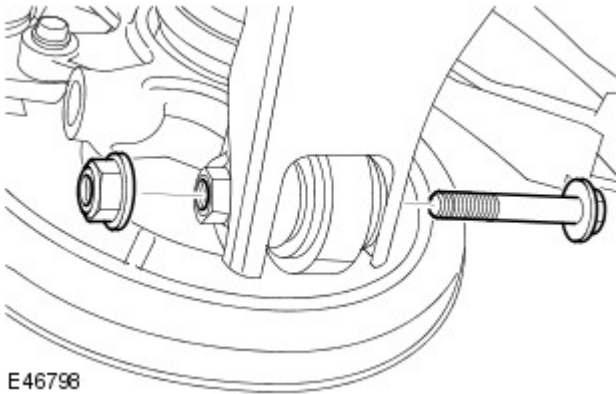
E46797

8. Remove and discard the halfshaft retaining nut.


9.  CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Release the knuckle from the lower arm.

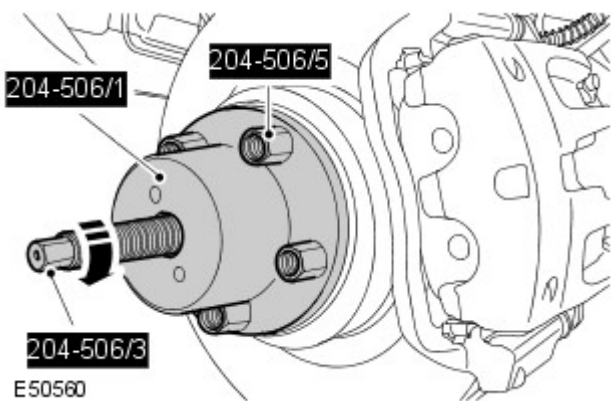
- Remove the bolt.



E46798

10.  CAUTION: Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

Using the special tools, release the halfshaft from the wheel hub.



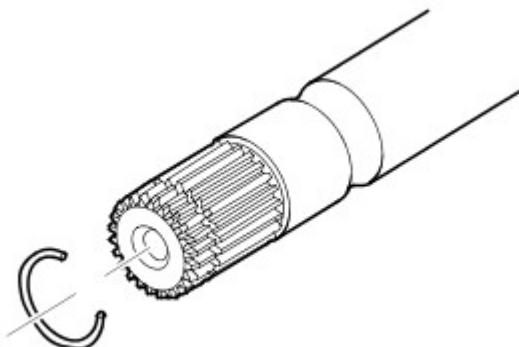
E50560

11. Position a container to collect the oil spillage.

12. Release the halfshaft from the differential housing.

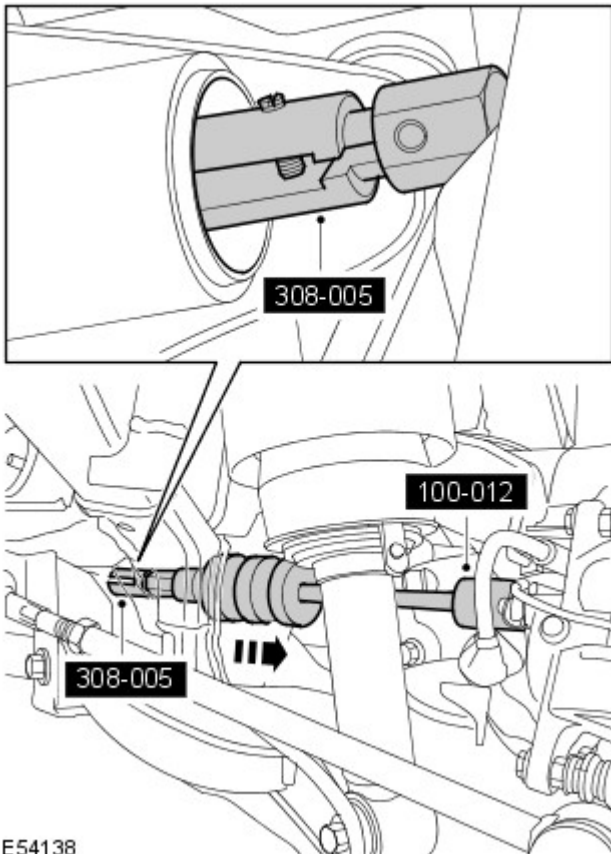
13. With assistance, remove the halfshaft.

- Remove and discard the snap ring.



E45752

14. Using the special tools, remove and discard the halfshaft oil seal.

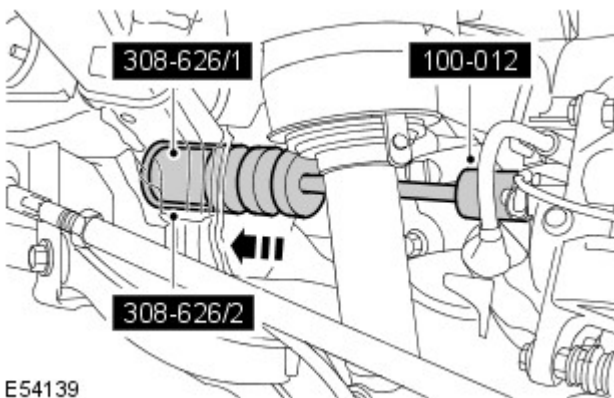


E54138

Installation

1. Clean the components.
2. Using the special tools, install a new halfshaft oil seal.

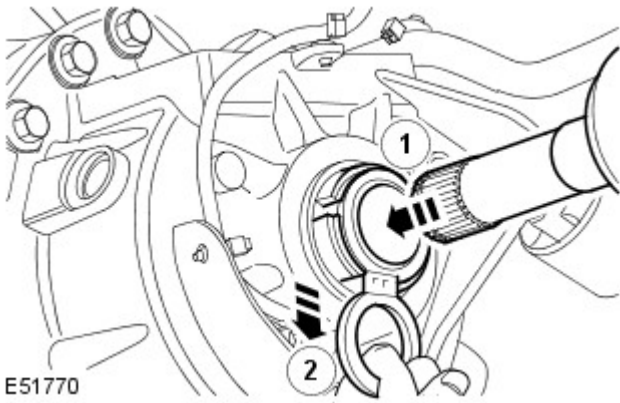
- The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.



E54139

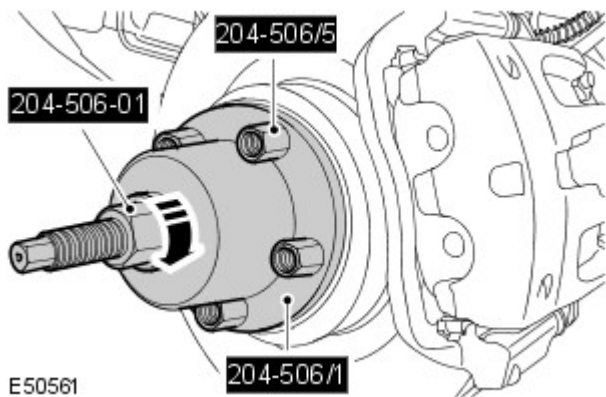
3. With assistance, install the halfshaft.

- Install the snap ring.
- Open the halfshaft oil seal protector.
- Make sure the snap ring is fully engaged and retains the halfshaft.



4. NOTE: The oil seal protector is designed to break into two pieces.

Remove and discard the halfshaft oil seal protector.



5. Using the special tools, install the halfshaft in the wheel hub.

6. **CAUTION:** Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

Connect the lower arm to the wheel knuckle.

- Tighten to 275 Nm (203 lb.ft).
- Tighten the new nut to 275 Nm (203 lb.ft).

7. **CAUTION:** Install the halfshaft nut finger tight.

Install a new halfshaft retaining nut and lightly tighten.

8. Connect the toe link.

- Tighten the bolt to 175 Nm (129 lb.ft).

9. Secure the parking brake cable to the lower arm.

10. Install the stabilizer bar link.

For additional information, refer to: [Rear Stabilizer Bar Link](#) (204-02 Rear Suspension, Removal and Installation).

11. **CAUTION:** Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

Tighten the new halfshaft retaining nut to 350 Nm (258 lb.ft).

- Stake the nut to the halfshaft.

12. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

13. **CAUTION:** Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

Fill the differential with the correct amount of lubricant.


For additional information, refer to: [Differential Draining and](#)

[Filling](#) (205-02 Rear Drive Axle/Differential, General Procedures).

Rear Drive Halfshafts - Outer Constant Velocity (CV) Joint Boot

Removal and Installation

Removal

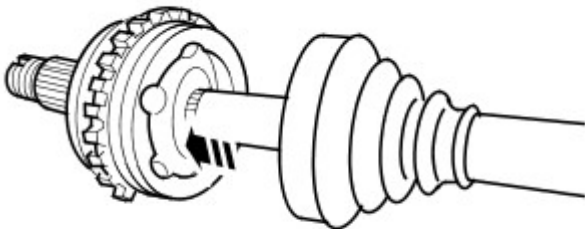
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.
3. Remove the halfshaft.
For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).
4. Clamp the halfshaft in a vise.
5. Remove and discard the CV joint boot retaining clamps.



6. Slide the CV joint boot along the halfshaft to gain access to the joint.
7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
 - Remove and discard the snap ring.



8. Remove the outer CV joint boot.

Installation

1. Clean the components.
2. Install the CV joint boot.
3. Install the outer CV joint.
 - Install the snap ring.
 - Position the CV joint on the halfshaft, press the snap ring into its groove and push the CV joint fully on to the halfshaft.
 - Pull on the CV joint to ensure the snap ring has fully engaged.
4. Pack the CV joint with the grease supplied.
5. Install the CV joint boot to the CV joint.
 - Secure with the new clamps.

6. Install the halfshaft.

For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).


7. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Drive Halfshafts - Inner Constant Velocity (CV) Joint Boot

Removal and Installation

Removal

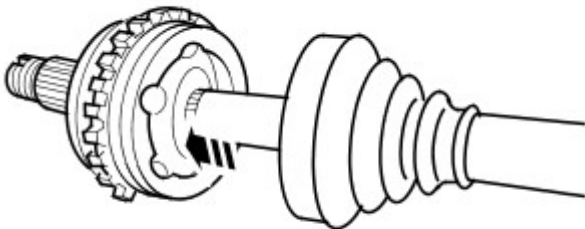
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the wheel and tire.
3. Remove the halfshaft.
For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).
4. Clamp the halfshaft in a vise.
5. Remove and discard the CV joint boot retaining clamps.



6. Slide the CV joint boot along the halfshaft to gain access to the joint.
7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
 - Remove and discard the snap ring.



E46875

8. Remove the inner CV joint boot.

Installation

1. Clean the components.
2. Install the inner CV joint boot.
3. Install the inner joint.
 - Install a new snap ring.
 - Position the CV joint on the halfshaft, press the snap ring into its groove and push the CV joint fully on to the halfshaft.
 - Pull on the CV joint to ensure the snap ring has fully engaged.
4. Pack the joint with the grease supplied.
5. Install the boot to the joint.
 - Secure with the new clamps.

6. Install the halfshaft.




For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).

7. Install the wheel and tire.


- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Drive Halfshafts - Halfshaft Bearing

Removal and Installation

Special Tool(s)	
 <p>308-005</p> <p>E54134</p>	<p>Axle oil seal remover</p> <p>308-005 (LRT-37-004/2)</p>
 <p>100-012</p> <p>E54135</p>	<p>Impulse extractor</p> <p>100-012 (LRT-99-004)</p>
 <p>205-819</p> <p>E54141</p>	<p>Halfshaft bearing installer</p> <p>205-819</p>

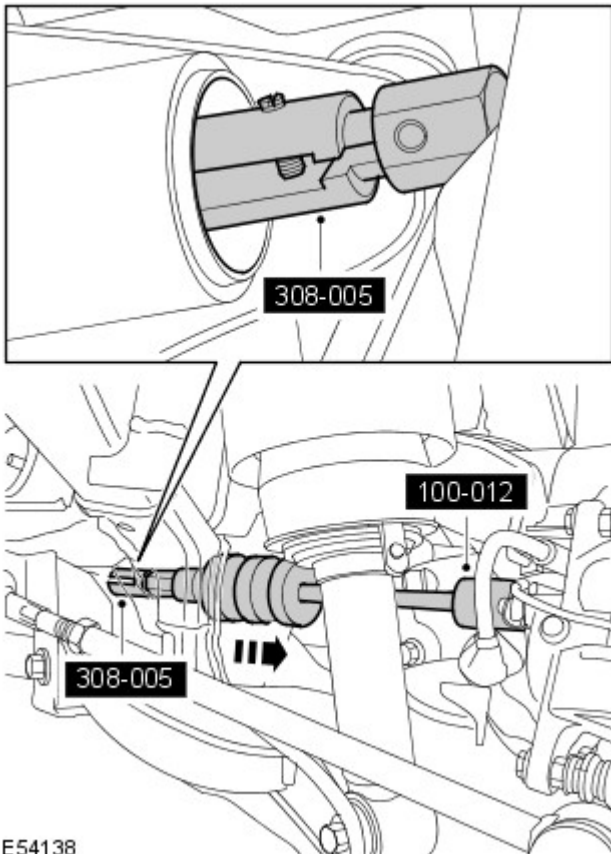
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

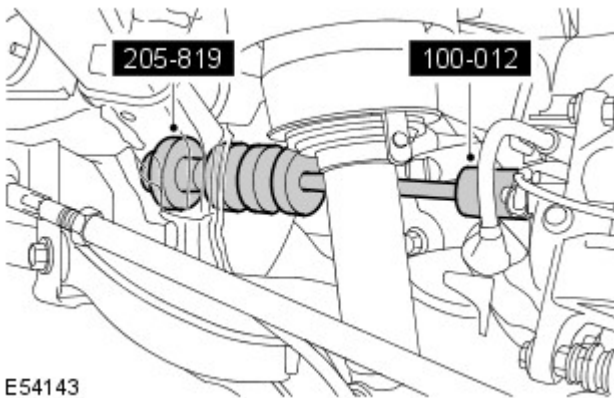
- Remove the wheel and tire.
- Remove and discard the halfshaft oil seal.
For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).

- Using the special tool, remove and discard the halfshaft bearing.



Installation

- Using the special tools, install a new halfshaft bearing.



- Install a new halfshaft oil seal.
For additional information, refer to: [Rear Halfshaft](#) (205-05 Rear Drive Halfshafts, Removal and Installation).
- Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Brake System - General Information -

Brake Hydraulic Fluid

Item	Specification
* Recommended hydraulic fluid	SHELL DONAX YB DOT4 ESL FLUID



CAUTION: * If the above fluid is not available, use a low viscosity DOT 4 brake fluid meeting ISO 4925 Class 6 and Land Rover LRES22BF03 requirements.

General Specification

Item	Specification
Footbrake type:	
Vehicles without Brembo brakes	Hydraulic, servo assisted, self-adjusting with front/rear split hydraulic system, twin piston sliding calipers to the front and single piston sliding calipers to the rear
Vehicles with Brembo brakes	Hydraulic, servo assisted, self-adjusting with front/rear split hydraulic system, opposed six piston calipers to the front and single piston sliding calipers to the rear
Parking brake type	Twin shoe (leading/trailing) operating on rear wheels and controlled from park brake lever in floor console via twin cables

Brake System - General Information - Brake System

Diagnosis and Testing

Principles of Operation

For a detailed description of the Brake System and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

- [Front Disc Brake](#) (206-03 Front Disc Brake, Description and Operation),
- [Rear Disc Brake](#) (206-04 Rear Disc Brake, Description and Operation),
- [Parking Brake](#) (206-05 Parking Brake and Actuation, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
 - If a road test is necessary make sure the vehicle is safe to do so.
2. **2.** Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Brake pad(s) condition and installation ● Brake caliper(s) condition and installation ● Brake disc(s) condition and installation ● Parking brake disc(s)/parking brake drum(s) condition and installation ● Parking brake shoes condition and installation ● Parking brake cable(s) condition and installation ● Brake booster condition and installation ● Brake booster vacuum hose condition and installation ● Brake master cylinder condition and installation ● Hydraulic Control Unit (HCU) ● Brake fluid leaks ● Brake warning indicator

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Brake noise	<ul style="list-style-type: none"> ● Debris ● Brake pads ● Brake disc(s) 	Refer to the relevant section of the workshop manual.
Brake vibration	<ul style="list-style-type: none"> ● Suspension components ● Brake disc(s) 	Refer to the relevant section of the workshop manual.
Excessive brake pedal travel/brake pedal spongy	<ul style="list-style-type: none"> ● Brake pads ● Air in the brake system ● Brake master cylinder ● Brake fluid leak (see visual inspection) 	Worn pads may make the pedal travel excessive, new pads may make the pedal spongy. Check after bedding in the pads. Check the pedal travel. If the pedal "pumps-up", suspect air in the system. Check for a cause for air ingress, rectify as necessary. If the pedal sinks to the floor when held under pressure when there are no external leaks, suspect a master cylinder fault. Refer to the relevant section of the workshop manual.
Excessive brake pedal effort/brake pedal hard	<ul style="list-style-type: none"> ● Brake pipe(s) ● Brake caliper slide(s) ● Brake caliper piston(s) ● Brake vacuum pipe ● Brake vacuum pump ● Brake booster 	Check for damaged brake pipes. Check the brake calipers. Check the brake vacuum pipe for air leaks, rectify as necessary. Check the brake vacuum pump operation. Refer to the relevant section of the workshop manual. Check the brake booster.

Symptom	Possible Causes	Action
Low foot brake efficiency/brakes pulling/sticking/binding	<ul style="list-style-type: none"> ● Brake pipe(s) ● Pads ● Brake caliper piston(s) ● Brake caliper slide(s) ● Brake disc(s) 	Check the vehicle for damaged brake pipes. Inspect the brake pads. Check the brake calipers. Check the brake discs. Refer to the relevant section of the workshop manual.
Parking brake will not engage or release	<ul style="list-style-type: none"> ● Parking brake cables ● Parking brake shoes ● Parking brake adjusters ● Rear brake disc(s)/parking brake drum(s) ● Parking brake actuator malfunction 	Check the parking brake cable(s) for operation/condition. Check that the cable end connector(s) are correctly installed to the operating lever(s). Inspect the parking brake shoes for wear. Check the parking brake shoes for correct adjustment. Check the rear brake disc(s)/parking brake drum(s). Check the parking brake actuator for damage and/or excessive noise in normal operation. Refer to the relevant section of the workshop manual.
Low parking brake efficiency/parking brake sticking/binding		
Brake warning indicator staying illuminated	<ul style="list-style-type: none"> ● Brake reservoir fluid level ● Brake pads ● Brake pad wear sensor leads ● Brake fluid level sensor 	Check the brake fluid level, top up if required. Inspect the brake pads. Check the brake pad sensor circuit. Refer to the electrical guides. Check the function of the brake fluid level sensor. Refer to the relevant section of the workshop manual.


DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Brake System - General Information - Rear Brake Disc Runout Check

General Procedures

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: RH illustration shown, LH is similar.
- NOTE: It is not necessary to carry out the parking brake shoe 'bedding-in procedure' if the rear brake discs or parking brake shoes have been removed for access to other components.

1.  CAUTION: Do not turn the ignition on when the parking brake service mode has been set, this will result in the parking brake being released from the service mode.

Enter the parking brake into the service mode.

- Turn the ignition on.
- Apply, and hold, the footbrake.
- Apply, and hold, the parking brake switch to the RELEASE position.
- Turn the ignition off.
- Release the footbrake.
- Release the parking brake switch.

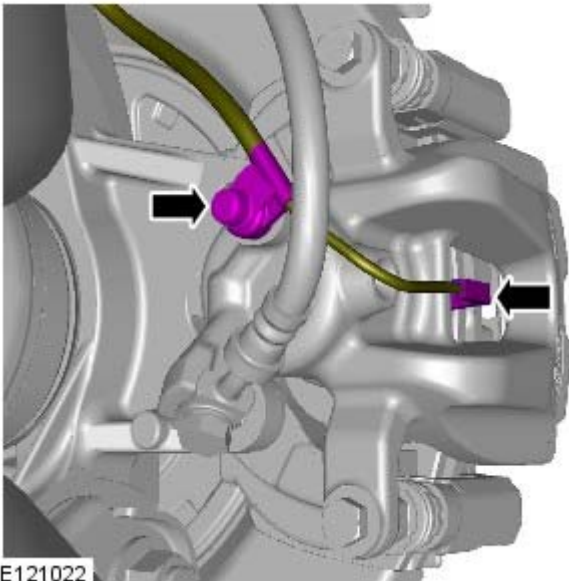
2.  WARNING: Make sure to support the vehicle with axle stands.

Raise rear of vehicle.

3. Remove road wheel.

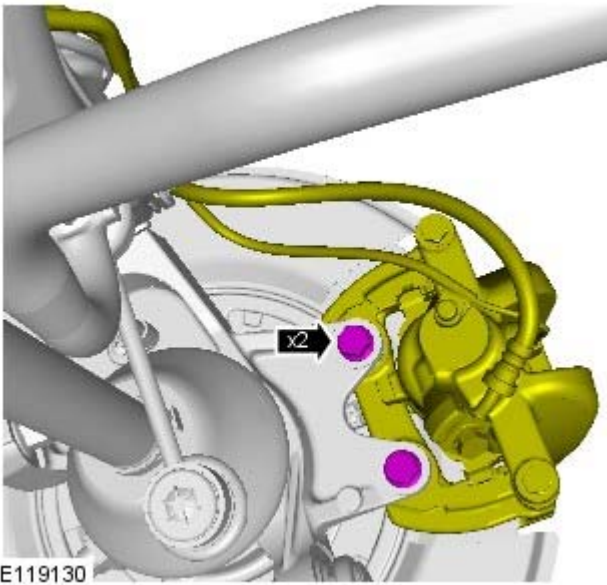
4.  CAUTION: The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

RH side rear only: Disconnect the brake pad wear indicator sensor lead.



E121022

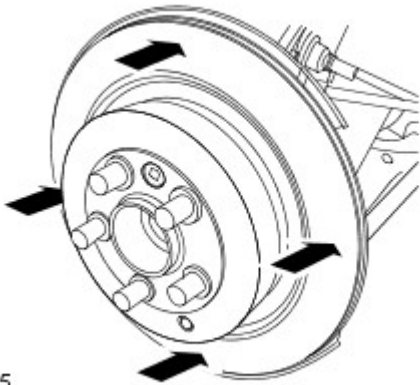
5. Remove 2 bolts securing brake caliper to hub. Release caliper from hub and tie aside.



E119130

6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

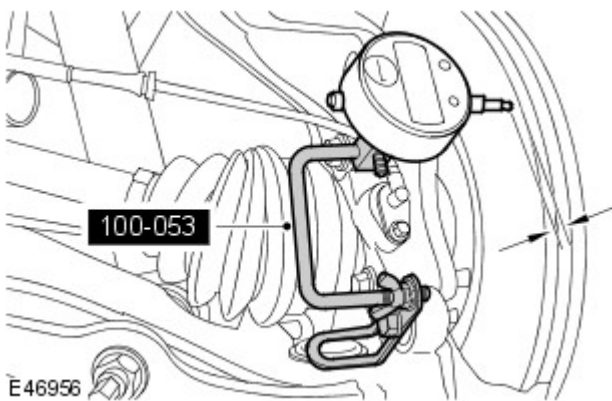
At 4 points around the disc, measure disc thickness using a micrometer; renew disc if less than service limit or if variation is exceeded: Disc thickness, NEW = 20 mm Service limit = 18 mm. Thickness variation maximum = 0.01 mm.



E46955

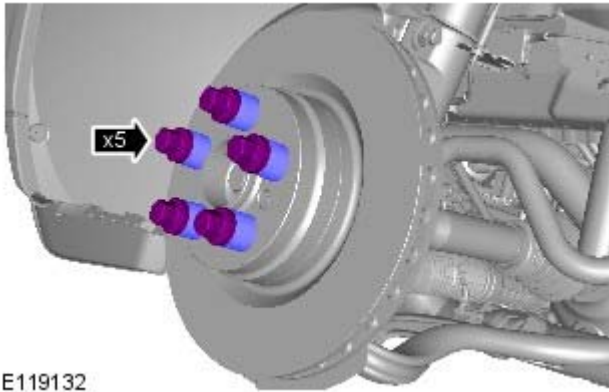
7. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Mount a Dial Test Indicator (DTI) to and secure to inboard side of hub using caliper assembly upper bolt hole.



E46956

8. Position DTI probe 5 mm in from outer edge of disc.



E119132

9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Tighten the wheel nuts to 140 Nm (103 lb.ft).

- Install spacer washers under the wheel nuts.

10. Zero DTI and rotate wheel one complete revolution to measure disc runout. Disc runout must not exceed 0.09 mm (0.003 in).

11. If disc runout is outside limits:

12. Remove the wheel hub nuts.

- Remove the spacer washers.

13. Remove Allen screw securing brake disc to drive flange.

14. Remove brake disc.

15. Ensure mating surfaces of disc and drive flange are clean.

16. Install the brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

17. Tighten the wheel nuts to 140 Nm (103 lb.ft).

- Install spacer washers under the wheel nuts.

18. Check disc runout as detailed above.

19. If runout is still outside limits, renew disc and/or hub.

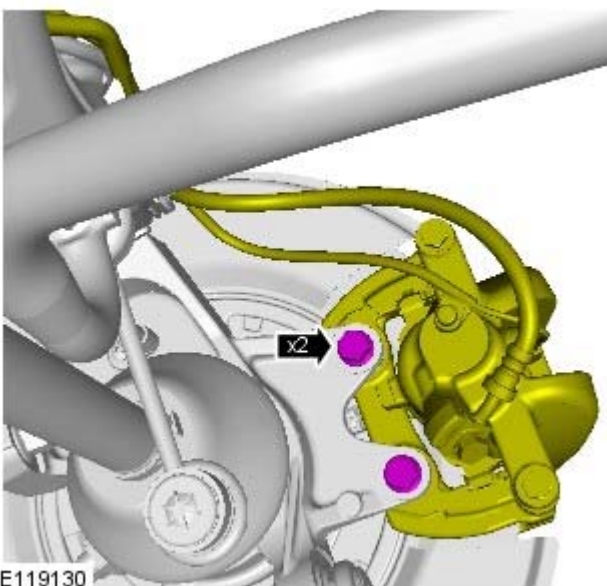
20. Remove the wheel hub nuts.

- Remove the spacer washers.

21. Remove the DTI.

22. Install the brake caliper anchor bolts

- Tighten the bolts to 115 Nm (85 lb.ft).



E119130

23. Tighten the wheel nuts to 140 Nm (103 lb.ft).

24. Depress brake pedal several times to set brake pads.

25. Remove stands and lower vehicle.

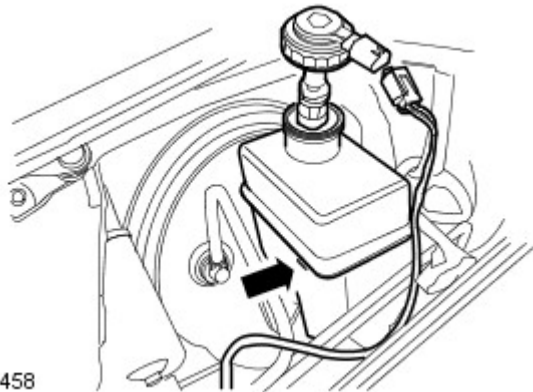
Brake System - General Information - Brake System Bleeding

General Procedures



WARNING: If any components upstream of the Hydraulic Control Unit (HCU), including the HCU itself are replaced, the brake system must be bled using Land Rover approved diagnostic equipment. This will ensure that all air is expelled from the new component(s).

- **NOTE:** Bleeding of the complete brake system must be carried out using Land Rover approved diagnostic equipment. Where only the primary or secondary brake circuits have been disturbed in isolation, it should only be necessary to bleed that circuit. Partial bleeding of the hydraulic system is only permissible if a brake tube or hose has been disconnected with only minimal loss of fluid.
- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



E62458

1. **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.



WARNING: Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

- **CAUTIONS:**



CAUTION: Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

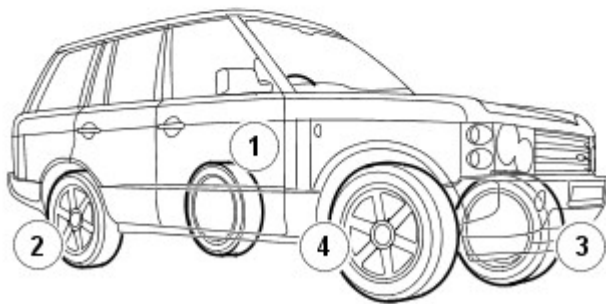
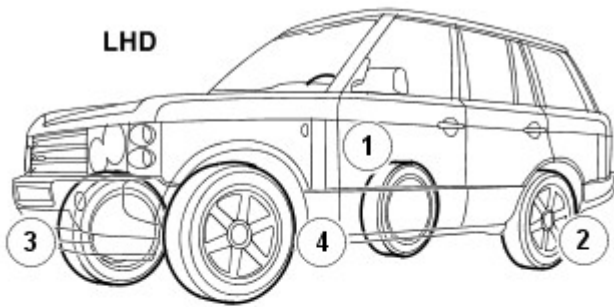


CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

Fill the brake fluid reservoir to the MAX mark.

- Disconnect the brake fluid reservoir electrical connector.
 - Remove the brake fluid reservoir cap.
4. Conduct the bleed procedure with the engine running.
 5. Connect the diagnostic tool to the vehicle, select diagnostic and proceed as directed for bleeding the brake system.

- Starting at the brake caliper furthest away from the brake master cylinder, loosen the bleed screw by one-half to three-quarters of a turn.




E62462

RHD

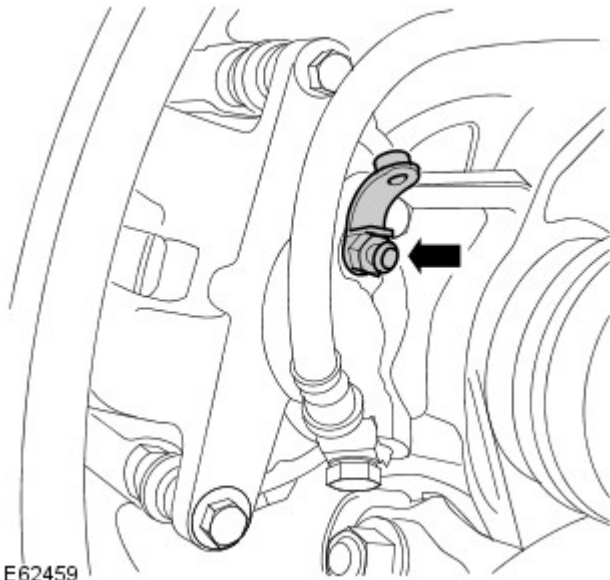
- Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.


- Hold the bleed container at least 300 mm above the Caliper that is being bled.

-  **CAUTION:** The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

With assistance, depress the brake pedal steadily through to 2/3 of its full stroke.


- With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.
- Repeat steps 8 and 9, 28 times for the rear brake and 10 times for the front brake.
- At the end of the bleed process, depress and hold the brake pedal down.



12.  **CAUTION:** Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

With the brake pedal fully depressed, tighten the bleed screw to 10 Nm (7 lb.ft).

13. Fill the brake fluid reservoir to the MAX mark.

14.  **WARNING:** Braking efficiency may be seriously impaired if an incorrect bleed sequence is used.

Repeat the brake bleeding procedure for each brake caliper, following the above sequence.

15. Fill the brake fluid reservoir to the MAX mark.

16. Apply the brakes and check for leaks.

17. Install the brake fluid reservoir cap.

- Connect the brake fluid reservoir electrical connector.

18. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Brake System - General Information - Brake System Pressure Bleeding


General Procedures

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.


1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.

3.  **WARNING:** Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

- CAUTIONS:

 Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

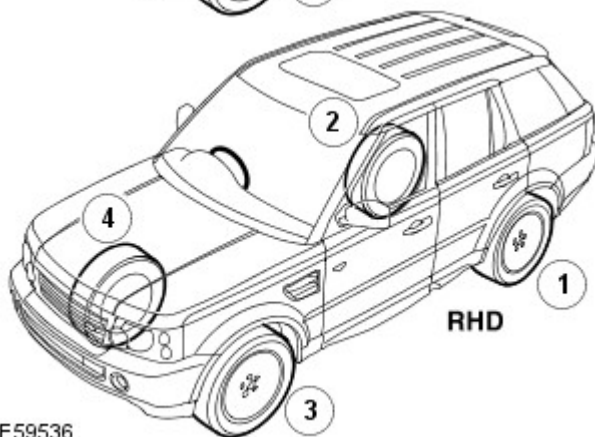
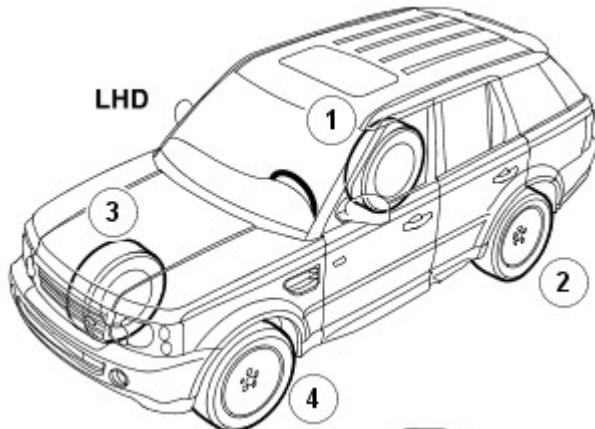
 The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

Fill the brake fluid reservoir to the MAX mark.

- Disconnect the brake fluid reservoir electrical connector.
- Remove the brake fluid reservoir cap.

4. Conduct the bleed procedure with the engine running.

5. Starting at the brake caliper furthest away from the brake master cylinder, loosen the bleed screw by one-half to three-quarters of a turn.




E59536

- 6.

- Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar


containing a small quantity of approved brake fluid.

- Hold the bleed container at least 300 mm above the Caliper that is being bled.

7.  **CAUTION:** The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

With assistance, depress the brake pedal steadily through to 2/3 of its full stroke.


- 8.** With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.
- 9.** Repeat steps 7 and 8, 28 times for the rear brake and 10 times for the front brake.
- 10.** At the end of the bleed process, depress and hold the brake pedal down.

11.  **CAUTION:** Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

With the brake pedal fully depressed, tighten the bleed screw.

- On vehicles with high performance brakes, tighten the front caliper bleed screw to 19 Nm (14 lb.ft).
- On vehicles with standard brakes, tighten the front caliper bleed screw to 10 Nm (7 lb.ft).
- Tighten the rear caliper bleed screws to 10 Nm (7 lb.ft).

12. Fill the brake fluid reservoir to the MAX mark.

13.  **WARNING:** Braking efficiency may be seriously impaired if an incorrect bleed sequence is used.

Repeat the brake bleeding procedure for each brake caliper, following the above sequence.

- 14.** Fill the brake fluid reservoir to the MAX mark.
- 15.** Apply the brakes and check for leaks.
- 16.** Install the brake fluid reservoir cap.

- Connect the brake fluid reservoir electrical connector.

17. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Brake System - General Information - Component Bleeding

General Procedures



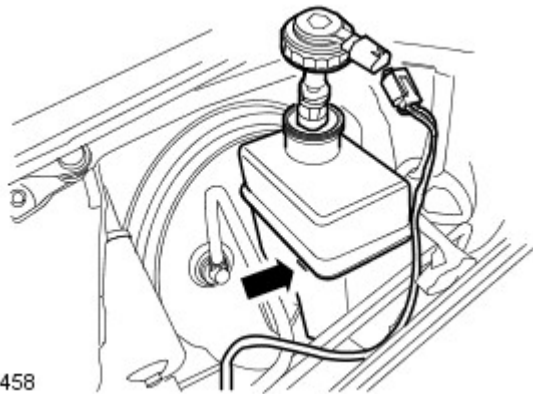
WARNING: If any components upstream of the Hydraulic Control Unit (HCU), including the HCU itself are replaced, the brake system must be bled using Land Rover approved diagnostic equipment. This will ensure that all air is expelled from the new component(s).



CAUTION: LH illustration shown, RH is similar.

• **NOTE:** Bleeding of the complete brake system must be carried out using Land Rover approved diagnostic equipment. The following manual procedure covers bleeding the brake system for components down stream of the HCU, where only the primary or secondary brake circuits have been disturbed in isolation. Partial bleeding of the hydraulic system is only permissible if a brake tube or hose has been disconnected with only minimal loss of fluid.

• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



E62458



1. WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.

3. Pump the brake pedal until the brake vacuum assistance is exhausted.



4. WARNING: Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

• **CAUTIONS:**



! Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.



! The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

Remove the brake fluid reservoir cap.

- Disconnect the brake fluid reservoir electrical connector.
- Fill the brake fluid reservoir to the MAX mark.

5. Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.

- Hold the bleed container at least 300 mm above the Caliper that is being bled.

6. Loosen the bleed screw by one-half turn to three-quarters of a turn.



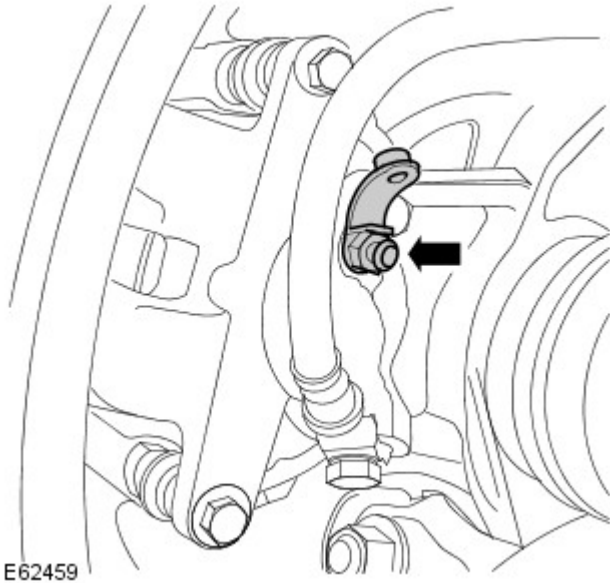
7. CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.


With assistance, depress the brake pedal steadily through to 2/3 of its full stroke.

8. With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.

9. Repeat steps 7 and 8, 28 times for the rear brake and 10 times for the front brake.

10. At the end of the bleed process, depress and hold the brake pedal down.



11.  **CAUTION:** Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

With the brake pedal fully depressed, tighten the bleed screw.

- On vehicles with high performance brakes, tighten the front caliper bleed screw to 19 Nm (14 lb.ft).
- On vehicles with standard brakes, tighten the front caliper bleed screw to 10 Nm (7 lb.ft).
- Tighten the rear caliper bleed screws to 10 Nm (7 lb.ft).

12. Fill the brake fluid reservoir to the MAX mark.

13. Apply the brakes and check for leaks.

14. Install the brake fluid reservoir cap.

- Connect the brake fluid reservoir electrical connector.

15. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Front Disc Brake -

Item	Specification
Disc type	Ventilated
Disc diameter:	
Vehicles with 4.0L or 2.7L diesel engine	317 mm (12.6 in)
Vehicles with 5.0L or 3.0L diesel engine	360 mm (14.2 in)
Disc thickness:	
New	30.0 mm (1.18 in)
Service limit	27.0 mm (1.063 in)
Maximum disc run-out - disc installed	0.05 mm (0.002 in)
Caliper type	Sliding pin, twin piston
Piston diameter	48.0 mm (1.8 in)
Pad minimum thickness	3.0 mm (0.12 in)
Brake pad wear warning lead:	
Location	Front left hand brake pad
Activates at	75% of pad life utilised

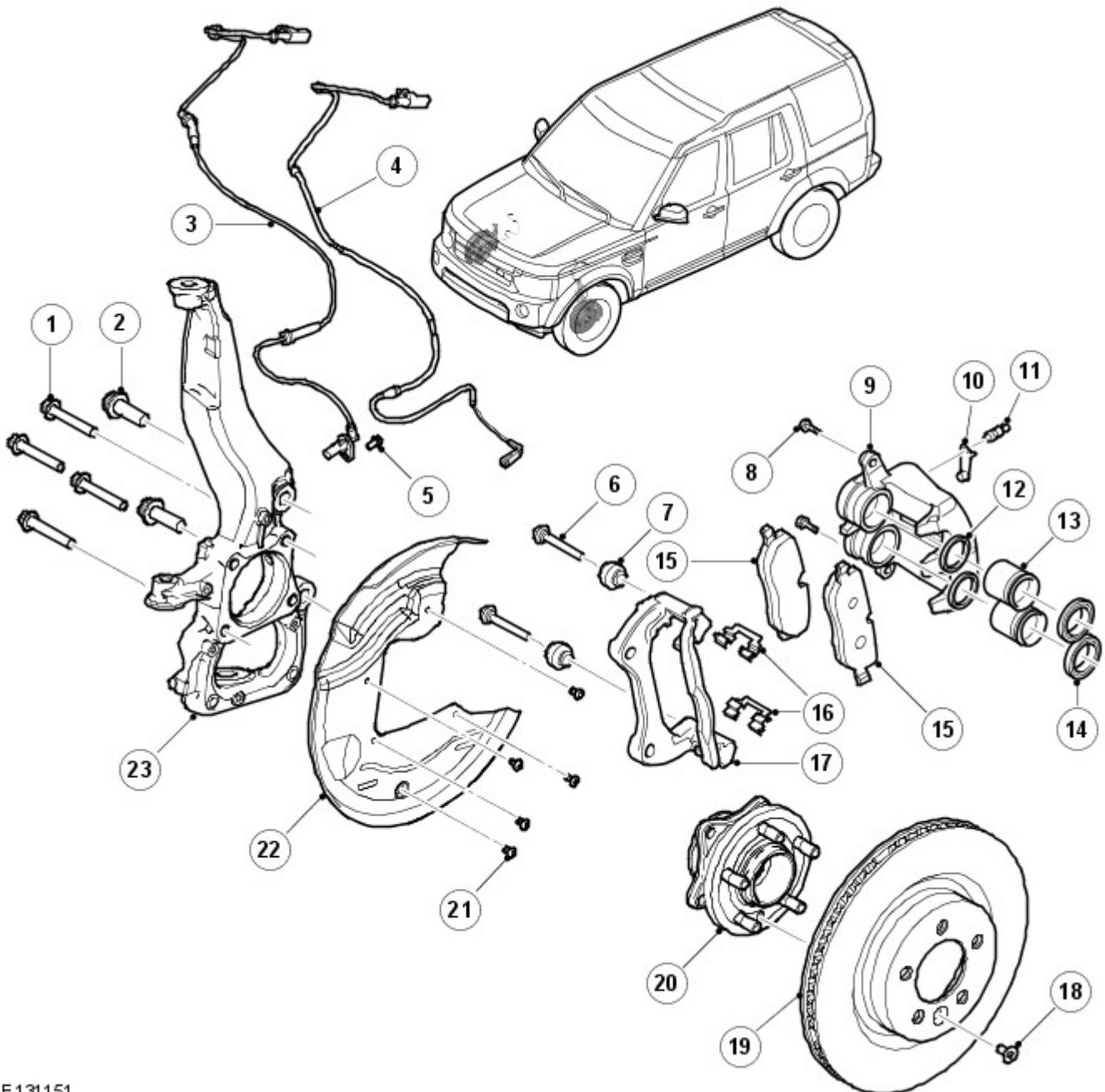
Torque Specifications

Description	Nm	lb-ft
Brake caliper bleed screw	10	7
Brake disc Torx screw	16	12
Brake caliper anchor plate bolts	275	202
Brake caliper housing bolts	35	26
Brake hose union	32	24
Brake hose retaining bracket to wheel knuckle bolt	22	16
Road wheel nuts	140	103

Front Disc Brake - Front Disc Brake

Description and Operation

COMPONENT LOCATIONS



E131151

Item	Part Number	Description
1	-	Hub bearing assembly bolt (x 4)
2	-	Caliper bolt (x 2)
3	-	Wheel speed sensor
4	-	Brake pad wear sensor lead
5	-	Wheel speed sensor bolt
6	-	Guide pin (x 2)
7	-	Guide pin dust cover (x 2)
8	-	Guide pin bolt (x 2)
9	-	Caliper body
10	-	Bleed screw dust cap
11	-	Bleed screw
12	-	Piston seal (x 2)
13	-	Piston (x 2)
14	-	Piston dust cover (x 2)
15	-	Brake pad
16	-	Brake pad retainers
17	-	Caliper carrier

18	-	Brake disc retaining bolt
19	-	Brake disc
20	-	Hub bearing assembly
21	-	Dust shield screw (x 5)
22	-	Dust shield
23	-	Front knuckle

GENERAL

The front brakes each consist of a twin piston brake caliper, a ventilated brake disc and a dust shield. All models except 2.7L feature the same caliper, disc and dust shield.

The brake caliper is attached to the rear of the front knuckle. The brake pads are made from an asbestos free material. The inboard brake pad of the left front brake incorporates a wear sensor.

When hydraulic pressure is supplied to the caliper, the pistons extend and force the inner pad against the disc. The caliper body reacts and slides on the guide pins to bring the outer pad into contact with the disc.

The front brake pad wear sensor is connected in series with the rear brake pad wear sensor, between the instrument cluster and ground. When a brake pad incorporating a brake pad wear sensor is approximately 75% worn, the brake pad wear sensor goes open circuit. When the instrument cluster detects the open circuit, it illuminates the amber Light Emitting Diode (LED) in the brake warning indicator. Vehicles with the high line instrument cluster also display an appropriate warning in the message center and sound a warning chime.

For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

At the beginning of each ignition cycle, the instrument cluster performs a bulb check on the brake warning indicator: the indicator is illuminated amber for 1.5 seconds, red for 1.5 seconds, then goes off.

Front Disc Brake - Brake Disc Vehicles With: Standard Brakes

Removal and Installation

Removal

 **WARNING:** If installing a new brake disc, install new brake pads.

 **CAUTION:** Brake discs must be renewed in pairs.


- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.
- **NOTE:** The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the front wheel and tire.

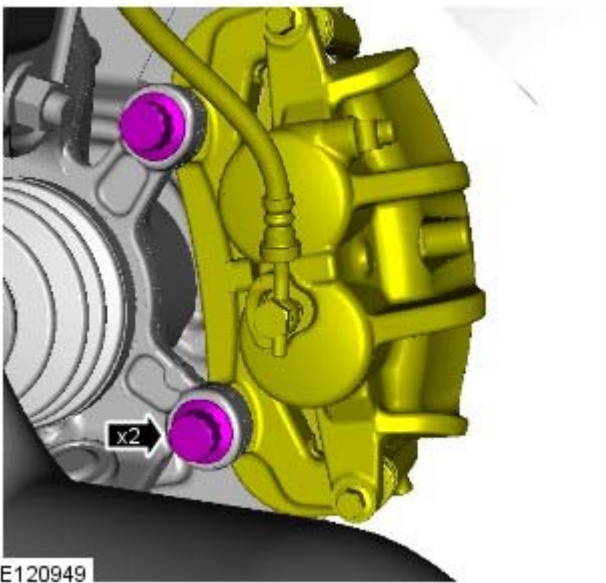
3. **CAUTIONS:**

 Do not allow the brake caliper to hang on the brake hose.

 **LH side:** Do not allow the brake caliper to hang on the brake pad wear warning sensor lead.

Remove the brake caliper and anchor plate.

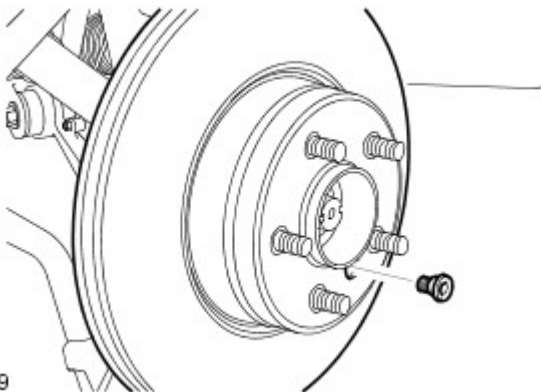
- Remove the brake caliper anchor bolts.
- Tie the brake caliper aside.



E120949

4. Remove the front brake disc.

- Remove the Allen screw.



E61629

Installation

1. Make sure the brake disc and hub mating surfaces are clean.
2. Install the brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

3. Install the brake caliper and anchor plate.

- Clean the component mating faces.
- Tighten the wheel nuts to 140 Nm (103 lb.ft).
- Tighten the bolts to 275 Nm (203 lb.ft).

5. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

Front Disc Brake - Brake Pads Vehicles With: Standard Brakes

Removal and Installation

Removal

• WARNINGS:



Brake pads must be renewed in axle sets only, otherwise braking efficiency may be impaired.



If the brake pad wear warning light has been activated, the pad wear sensor must be replaced.

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. **WARNING:** Make sure to support the vehicle with axle stands.

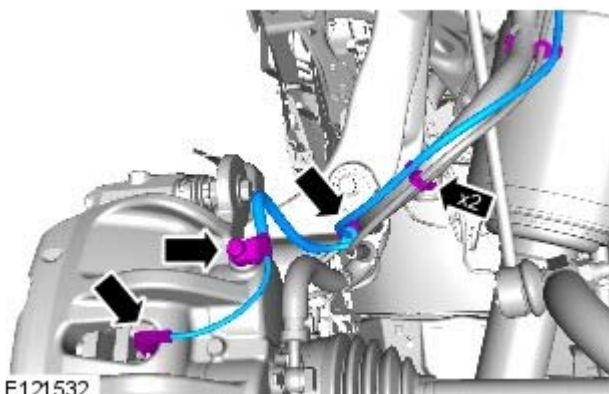
Raise and support the vehicle.

2. Remove the wheels and tires.



3. **CAUTION:** The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

LH side front: Disconnect the brake pad wear indicator sensor wiring harness.



E121532

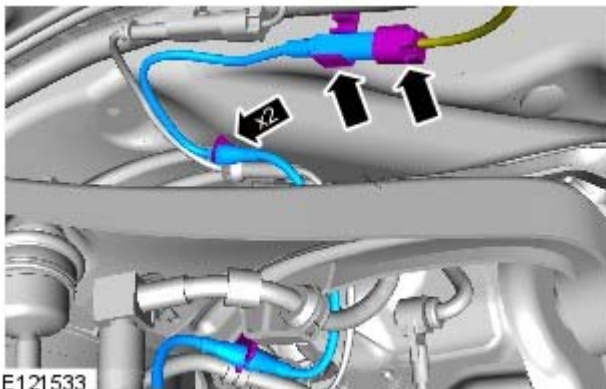
4. **NOTE:** This step is only required if a new wear indicator harness is installed.

Remove the front LH fender splash shield.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

5. **NOTE:** This step is only required if a new wear indicator harness is installed.

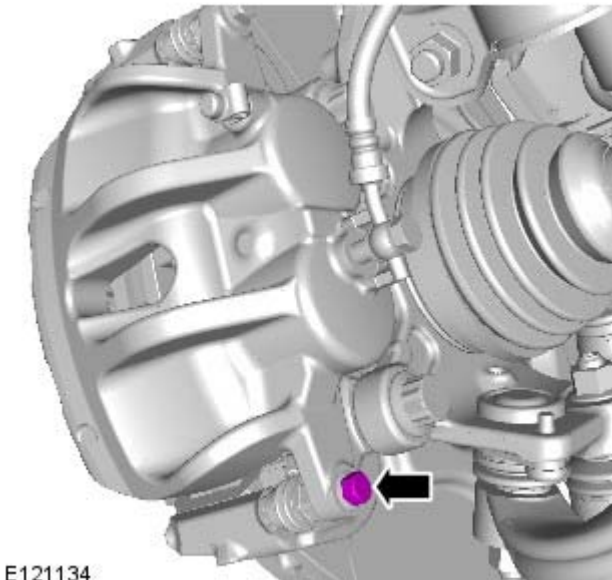
LH side front: Release and disconnect the brake pad wear indicator wiring harness.



E121533

6. NOTE: Use an additional wrench to prevent the component from rotating.

Remove the brake caliper lower bolt.

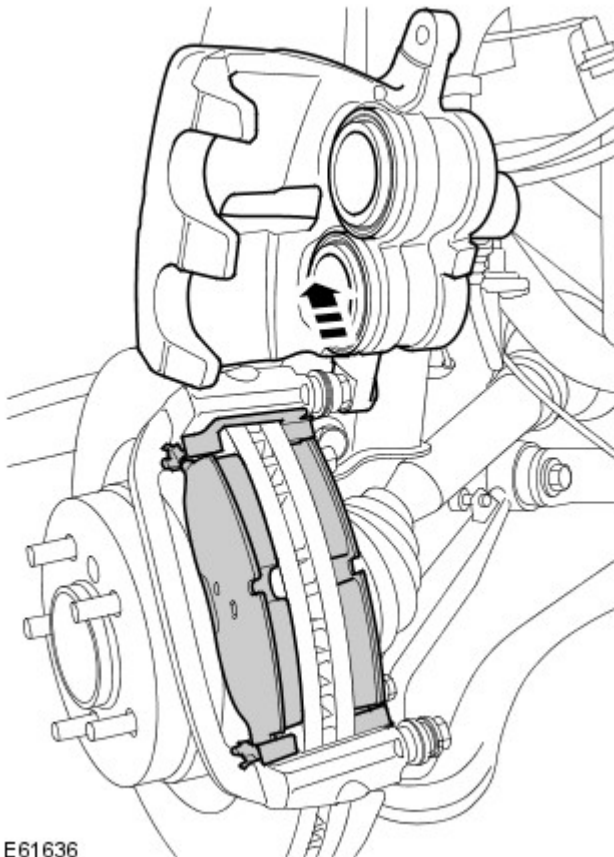


E121134

7. NOTE: Note the orientation of the brake pads.

Remove the brake pads.


- Rotate the brake caliper upwards.
- Remove the 2 clips.



E61636

8. Repeat the above 2 steps for the other side.

Installation

1.  **WARNING:** Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

Clean the brake caliper housing and anchor plate using brake cleaning fluid.

2. Inspect the caliper piston and slide pin seals for damage.

3. **CAUTIONS:**



The brake caliper should move freely on both slide pins.



If necessary, renew the components.

Check the slide pins for correct operation.



4. CAUTION: Check the brake fluid reservoir level before pushing the piston back, failure to follow this instruction may result in damage to the vehicle.

• NOTE: As the piston is pushed back into the caliper housing, the brake fluid level in the reservoir will rise. Do not allow the reservoir to overflow.

Press the pistons into the caliper housing.

5. NOTE: Make sure the brake pads are installed in the correct orientation.

Install the brake pads.

- Install the 2 clips.
- Apply a suitable amount of the supplied grease to the mating faces of the brake pads and brake calipers.

6. Rotate the brake caliper downwards.

- Tighten the bolt to 35 Nm (26 lb.ft).

7. Repeat the above procedure for the other side.

8. NOTE: This step is only required if a new wear indicator harness is installed.

LH side front: Connect the brake pad wear indicator wiring harness electrical connection.

9. NOTE: This step is only required if a new wear indicator harness is installed.

Install the front LH fender splash shield.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

10. LH side front: Connect the brake pad wear indicator wiring harness.

11. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

12. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

Front Disc Brake - Brake Caliper Vehicles With: Standard Brakes

Removal and Installation

Removal


 CAUTION: LH illustration shown, RH is similar.

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

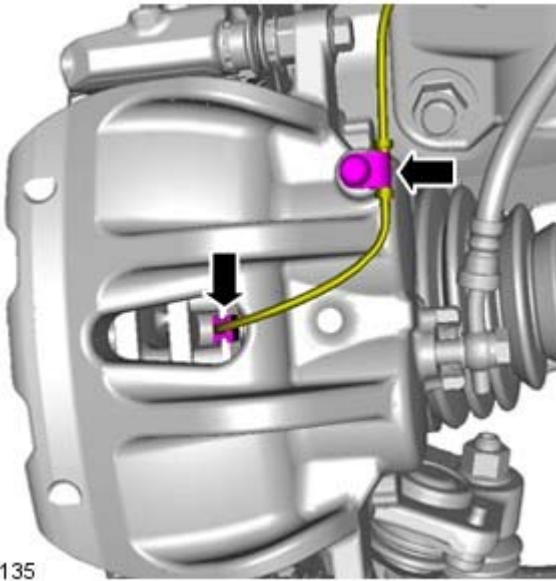
1.  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the wheel and tire.


3.  CAUTION: The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

LH side only: Disconnect the brake pad wear indicator sensor.



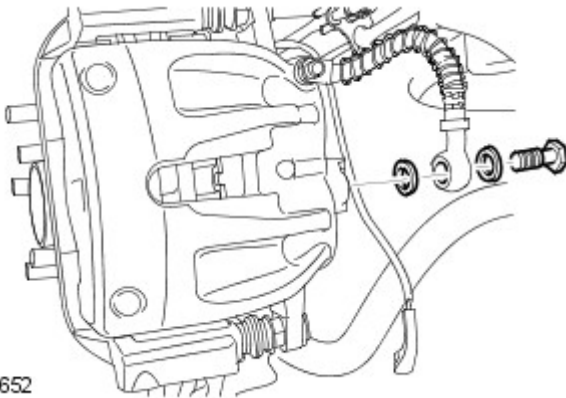
E121135

4.  WARNING: Be prepared to collect escaping fluid.

 CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the brake hose from the brake caliper.

- Remove the union.
- Remove and discard the two sealing washers.
- Install blanking caps to the exposed ports.



E61652

5. NOTE: Note the orientation of the brake pads.

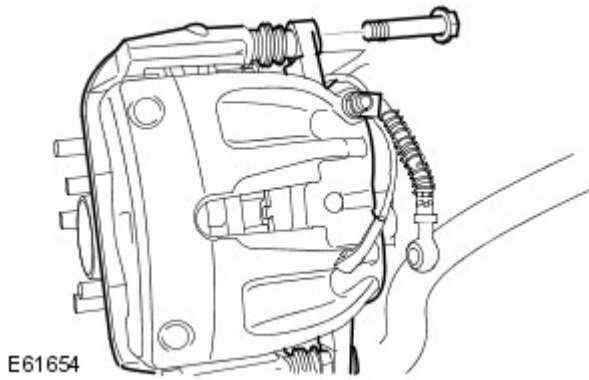
Remove the brake pads.

For additional information, refer to: [Brake Pads - Vehicles With: Standard Brakes](#) (206-03 Front Disc Brake, Removal and Installation).

6. NOTE: Use an additional wrench to prevent the component from rotating.

Remove the brake caliper housing.

- Remove the brake caliper upper bolt.



Installation

1. NOTE: Use an additional wrench to prevent the component from rotating.

• NOTE: Make sure the brake caliper guide pins are installed in the correct orientation.

Install the brake caliper.

- Tighten the brake caliper upper bolt to 35 Nm (26 lb.ft).

2. NOTE: Make sure the brake pads are installed in the correct orientation.

Install the brake pads.

For additional information, refer to: [Brake Pads - Vehicles With: Standard Brakes](#) (206-03 Front Disc Brake, Removal and Installation).

- Apply a suitable amount of the supplied grease to the mating faces of the brake pads and brake calipers.

3. Connect the brake hose to the brake caliper.

- Clean the component mating faces.
- Remove the blanking caps from the ports.
- Install new sealing washers.
- Tighten the brake hose union to 32 Nm (24 lb.ft).

4. LH side only: Connect the brake pad wear indicator sensor.

5. Bleed the brake caliper.

For additional information, refer to: [Component Bleeding](#) (206-00 Brake System - General Information, General Procedures).

6. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Disc Brake -

Item	Specification
Disc type	Ventilated
Disc diameter:	
Vehicles with 4.0L or 2.7L diesel engine	325 mm (12.7 in)
Vehicles with 5.0L or 3.0L diesel engine	354 mm (13.9 in)
Disc thickness - All engines:	
New	20.0 mm (0.78 in)
Service limit	18.0 mm (0.71 in)
Maximum disc run-out - disc installed	0.09 mm (0.003 in)
Caliper type	Sliding pin, single piston
Piston diameter	45.0 mm (1.7 in)
Pad minimum thickness	3.0 mm (0.12 in)
Brake pad wear warning lead:	
Location	Rear right hand brake pad
Activates at	75% of pad life utilised

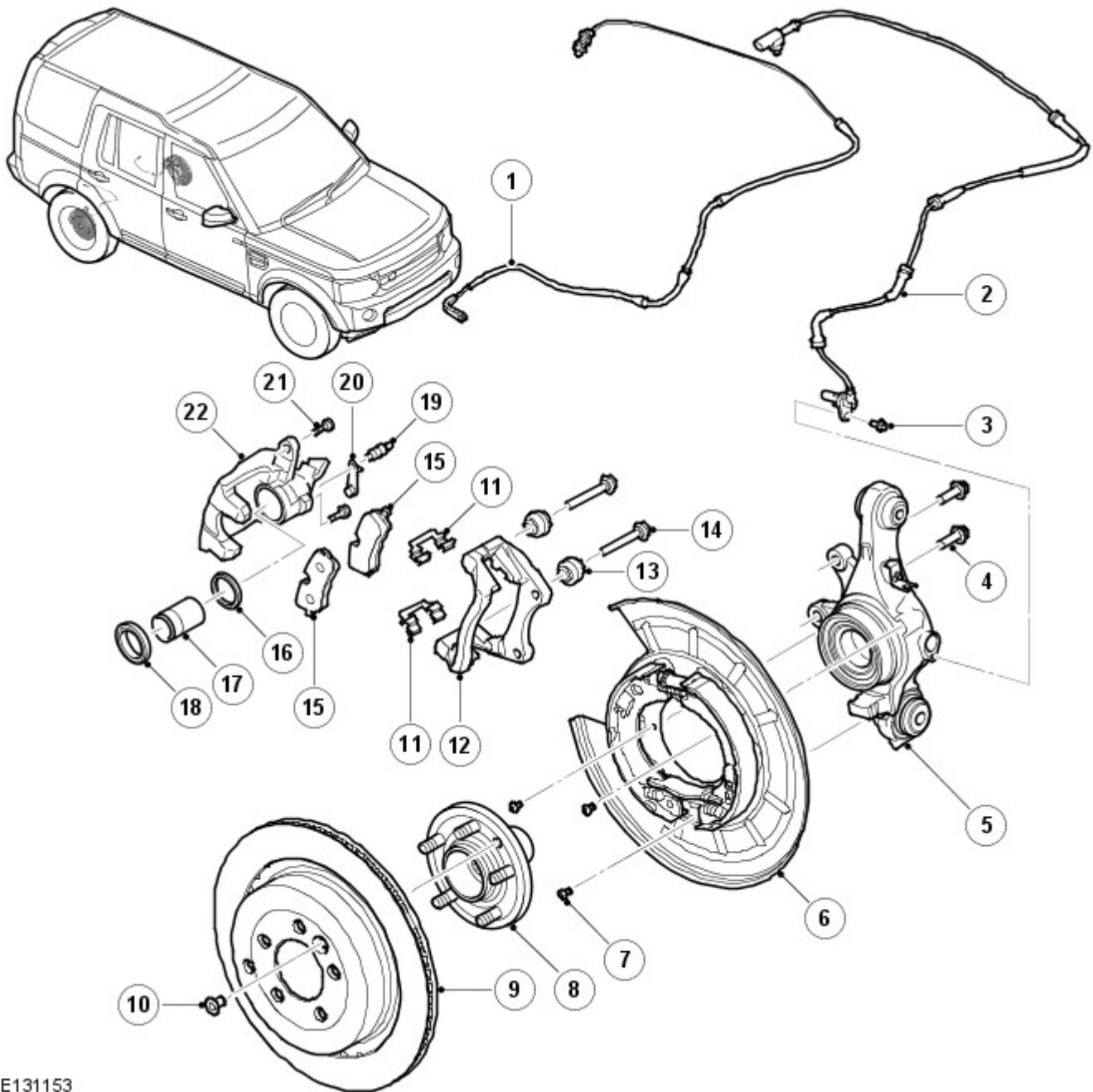
Torque Specifications

Description	Nm	lb-ft
Brake caliper bleed screw	10	7
Brake caliper housing to anchor plate bolts	35	26
Brake hose union	32	24
Brake disc Torx screw	16	12
Brake caliper anchor plate to wheel knuckle bolts	115	85
Road wheel nuts	140	103

Rear Disc Brake - Rear Disc Brake

Description and Operation

COMPONENT LOCATIONS



E131153

Item	Part Number	Description
1	-	Brake pad wear sensor lead
2	-	Wheel speed sensor
3	-	Wheel speed sensor bolt
4	-	Caliper bolt (x 2)
5	-	Rear knuckle
6	-	Backplate assembly and dust shield
7	-	Dust shield screw (x 3)
8	-	Drive flange assembly
9	-	Brake disc
10	-	Brake disc retaining bolt
11	-	Brake pad retainers
12	-	Caliper carrier
13	-	Guide pin dust cover (x 2)
14	-	Guide pin (x 2)
15	-	Brake pad
16	-	Piston seal
17	-	Piston

18	-	Piston dust cover
19	-	Bleed screw
20	-	Bleed screw dust cap
21	-	Guide pin bolt (x 2)
22	-	Caliper body

GENERAL

The rear brakes each consist of a single piston brake caliper, a ventilated brake disc and a dust shield (integrated as part of the parking brake). 2.7L and 4.0L models feature a different caliper and disc than the 3.0L and 5.0L models. The dust shield and parking brake are common on all derivatives.

The brake caliper is attached to the rear knuckle. The brake pads are made from an asbestos free material. The inboard brake pad of the right rear brake incorporates a wear sensor.

When hydraulic pressure is supplied to the caliper, the piston extends and forces the inner pad against the disc. The caliper body reacts and slides on the guide pins to bring the outer pad into contact with the disc.

The rear brake pad wear sensor is connected in series with the front brake pad wear sensor, between the instrument cluster and ground. When a brake pad incorporating a brake pad wear sensor is approximately 75% worn, the brake pad wear sensor goes open circuit. When the instrument cluster detects the open circuit, it illuminates the amber Light Emitting Diode (LED) in the brake warning indicator. Vehicles with the high line instrument cluster also display an appropriate warning in the message center and sound a warning chime.

For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

At the beginning of each ignition cycle, the instrument cluster performs a bulb check on the brake warning indicator: the indicator is illuminated amber for 1.5 seconds, then red for 1.5 seconds.

Rear Disc Brake - Brake Disc

Removal and Installation

Removal

 **WARNING:** If installing a new brake disc, install new brake pads.

 **CAUTION:** Brake discs must be renewed in pairs.

• **NOTE:** If the parking brake shoes or the brake discs have been removed for access to other components then **DO NOT** carry out the bedding in procedure.

• **NOTE:** LH illustration shown, RH is similar.

• **NOTE:** The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

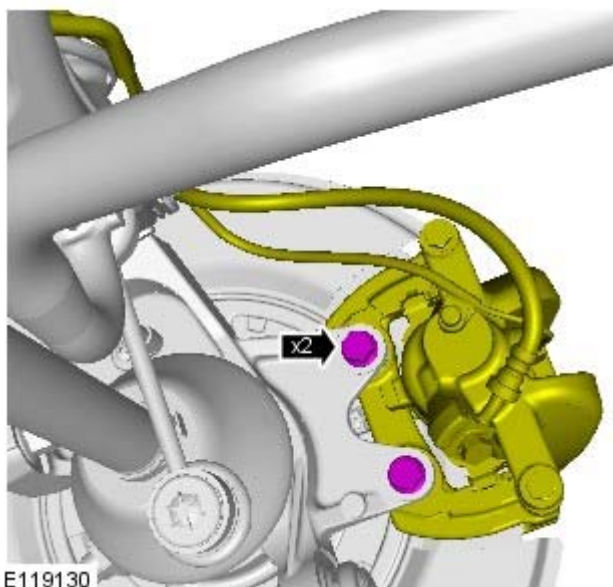
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Remove the rear wheel and tire.

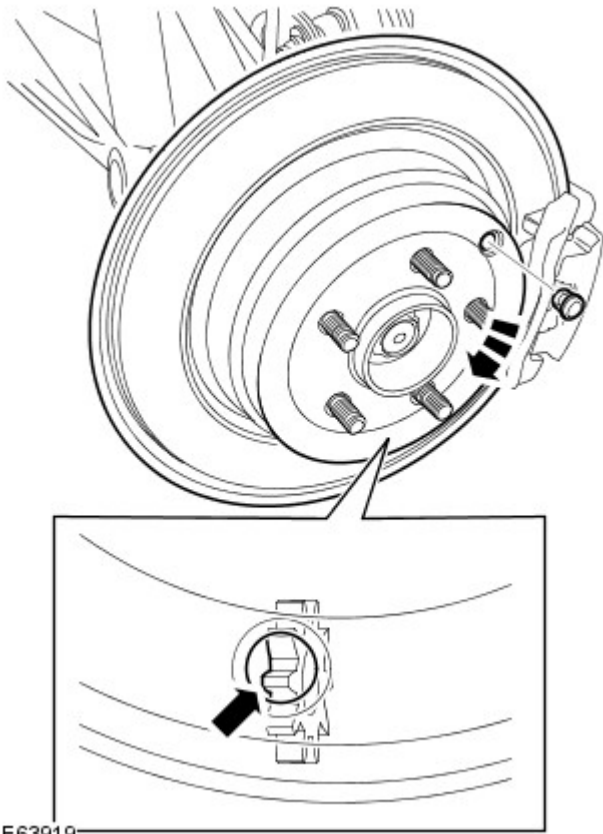
4. Remove the brake caliper and anchor plate.



5. NOTE: Rotate the rear brake disc to locate the parking brake shoe adjuster.

Release the parking brake shoe adjustment.

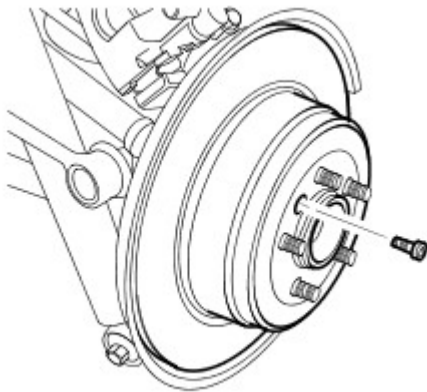
- Remove the parking brake shoe adjuster access plugs.
- Rotate the parking brake shoe adjuster.



E63919

6. Remove the rear brake disc.

- Remove the Allen screw.



E63921

Installation

1. Make sure that the rear brake disc and hub mating surfaces are clean.
2. Install the rear brake disc.
 - Tighten the bolt to 35 Nm (26 lb.ft).
3. Install the brake caliper and anchor plate.
 - Tighten the bolts to 115 Nm (85 lb.ft).
4. Adjust the parking brake.
For additional information, refer to: [Parking Brake Shoe and Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).
5. Install the rear wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Disc Brake - Brake Pads

Removal and Installation

Removal



WARNING: Brake pads must be renewed in axle sets only, otherwise braking efficiency may be impaired.

- NOTE: RH illustration shown, LH is similar.
- NOTE: The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

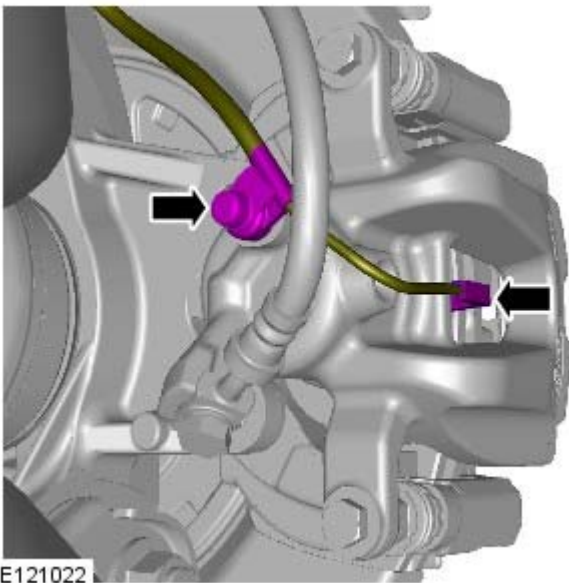


1. WARNING: Make sure to support the vehicle with axle stands.

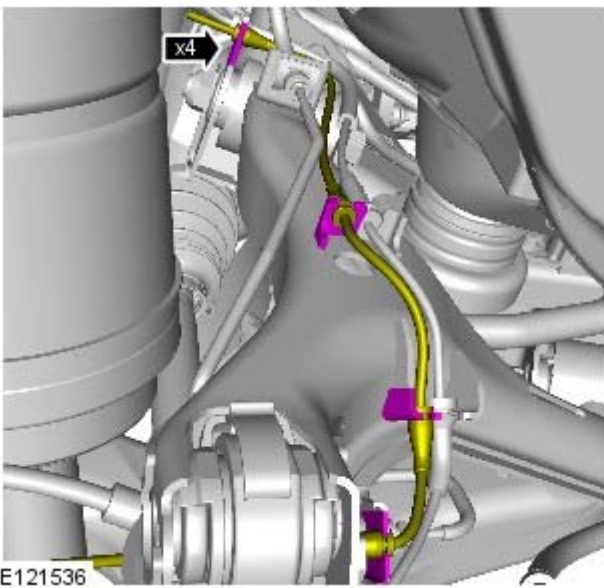
Raise and support the vehicle.

2. Remove the wheels and tires.

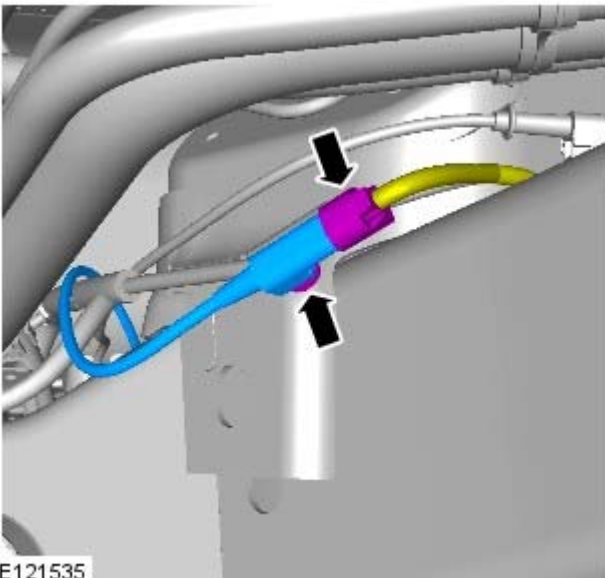
3. RH side rear: Disconnect the brake pad wear indicator sensor wiring harness.



4. RH side rear: Disconnect the brake pad wear indicator sensor wiring harness.



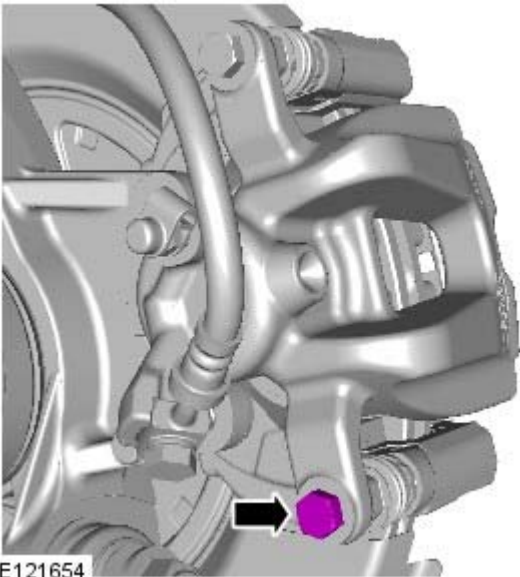
5. RH side rear: Release and disconnect the brake pad wear indicator wiring harness electrical connector.



E121535

6. NOTE: Use an additional wrench to prevent the component from rotating.

Remove the brake caliper lower bolt.



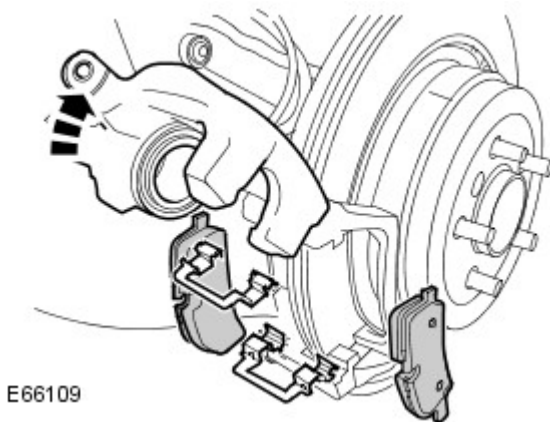
E121654

7. NOTE: Note the orientation of the brake pads.

- NOTE: Note the orientation of the clips.

Remove the brake pads.


- Rotate the brake caliper upwards.
- Remove the 2 clips.



E66109

8. Repeat the above 2 steps for the other side.

Installation

1.  **WARNING:** Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

Clean the brake caliper housing and anchor plate using brake cleaning fluid.

2. Inspect the caliper piston and slide pin seals for damage.

3. CAUTIONS:



The brake caliper should move freely on both slide pins.



If necessary, renew the components.


Check the slide pins for correct operation.

4. Position a bleed jar containing a small quantity of approved brake fluid. Connect the bleed tube to the bleed screw and loosen the screw.

5. Press the piston into the caliper housing.

- Tighten the rear caliper bleed screws to 10 Nm (7 lb.ft).

6. Disconnect the bleed tube and remove the jar.

7.  CAUTION: If installed, the adhesive strips covering the outer brake pads must be removed before installation. Failure to follow this instruction may result in damage to the vehicle.

If installed, remove the adhesive strips from the 2 outer brake pads.

8. NOTE: Make sure the brake pads are installed in the correct orientation.

• NOTE: Make sure that the clips are installed in the correct orientation.

Install the brake pads.

- Install the 2 clips.

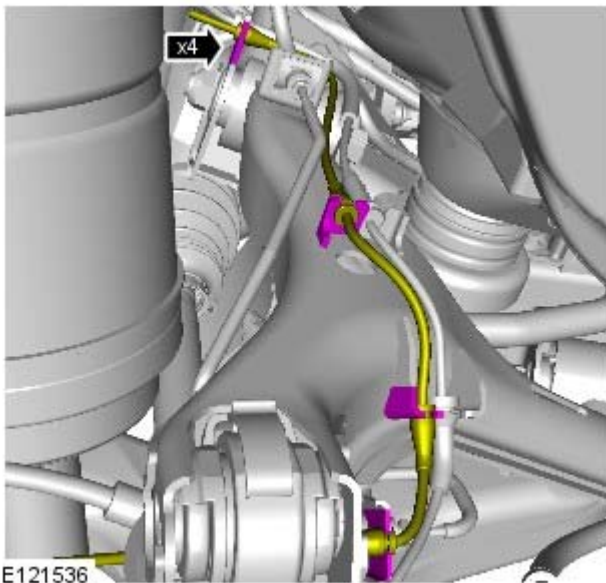
9. Rotate the brake caliper downwards.

- Tighten the brake caliper lower bolt to 35 Nm (26 lb.ft).

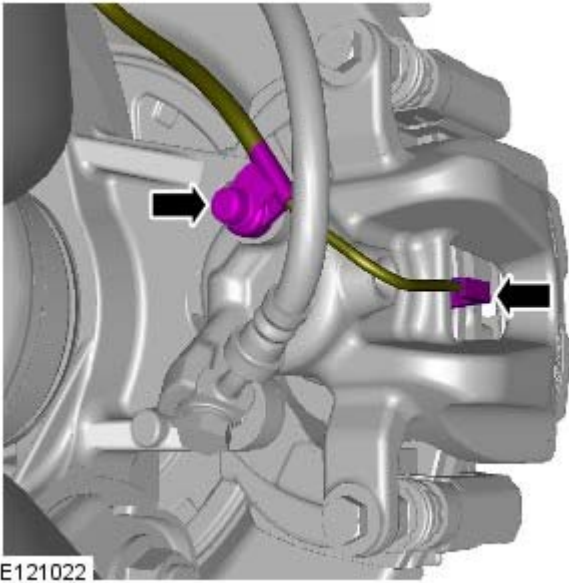
10. Repeat the above procedure for the other side.

11. RH side rear: Connect the brake pad wear indicator wiring harness electrical connection.

12. RH side rear: Connect the brake pad wear indicator sensor wiring harness.



13. RH side rear: Connect the brake pad wear indicator sensor wiring harness.



14. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

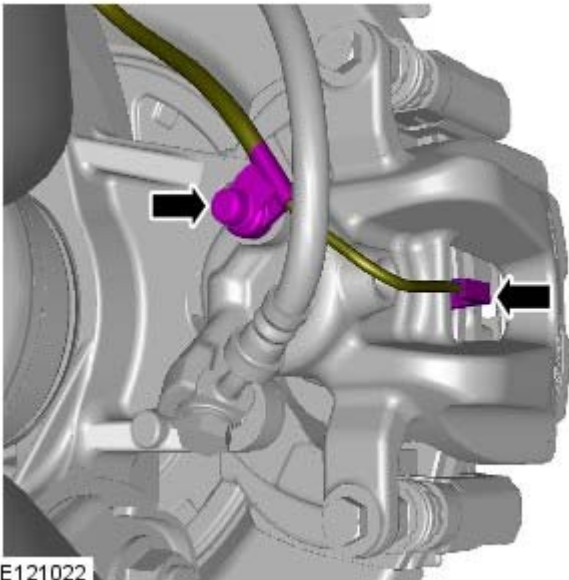
15. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

Rear Disc Brake - Brake Caliper

Removal and Installation

Removal

- NOTE: RH illustration shown, LH is similar.




E121022

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the wheel and tire.

3.  **CAUTION:** The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.


RH side only: Disconnect the brake pad wear indicator sensor.

- Release from the clip.

4. NOTE: Note the orientation of the brake pads.

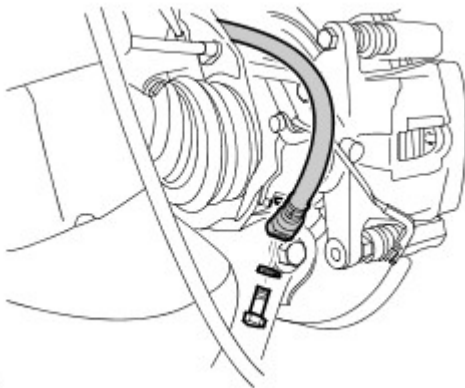
Remove the brake pads.

For additional information, refer to: [Brake Pads](#) (206-04 Rear Disc Brake, Removal and Installation).

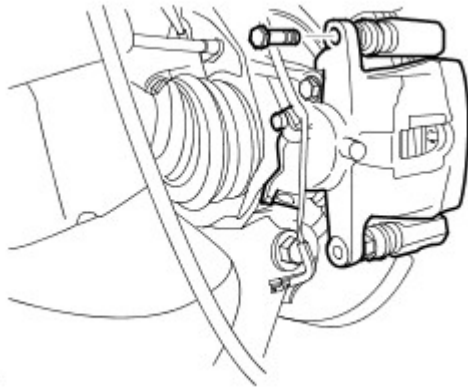
5.  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the brake hose from the brake caliper.

- Remove the union.
- Remove and discard the two sealing washers.
- Install blanking caps to the exposed ports.



E66183



E66184

6. NOTE: Use an additional wrench to prevent the component from rotating.

Remove the brake caliper housing.

- Remove the brake caliper upper bolt.

Installation

1. NOTE: Use an additional wrench to prevent the component from rotating.

Install the brake caliper.

- Tighten the brake caliper upper bolt to 35 Nm (26 lb.ft).

2. NOTE: Make sure the brake pads are installed in the correct orientation.

Install the brake pads.

For additional information, refer to: [Brake Pads](#) (206-04 Rear Disc Brake, Removal and Installation).

3. Connect the brake hose to the brake caliper.

- Clean the component mating faces.
- Remove the blanking caps from the ports.
- Install new sealing washers.
- Tighten the brake hose union to 32 Nm (24 lb.ft).

4. Connect the brake pad wear indicator sensor.

5. Bleed the brake caliper.

For additional information, refer to: [Component Bleeding](#) (206-00 Brake System - General Information, General Procedures).

6. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Disc Brake - Brake Caliper Anchor Plate

Removal and Installation


Removal

- NOTE: RH illustration shown, LH is similar.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

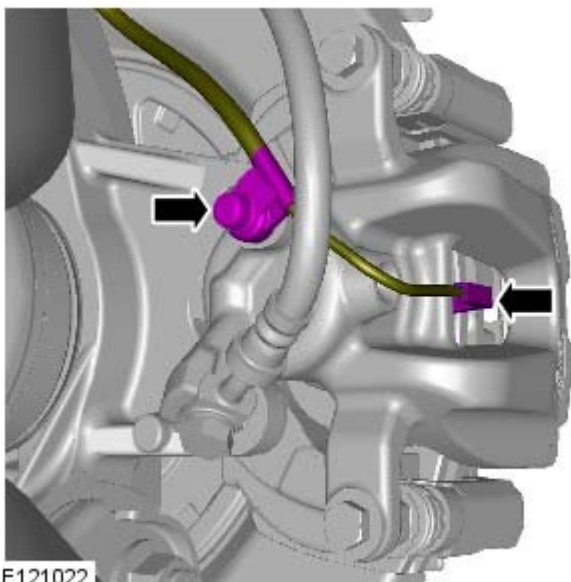
Raise and support the vehicle.

2. Remove the wheel and tire.

3.  **CAUTION:** The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

RH side only: Disconnect the brake pad wear indicator sensor.

- Release from the clip.

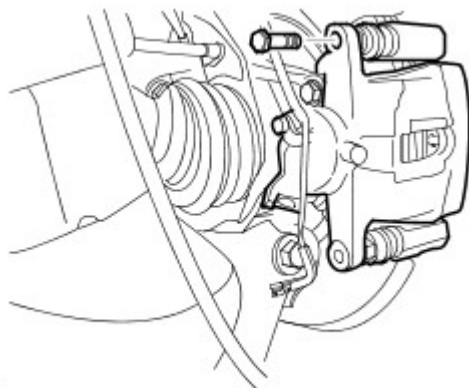


E121022

4. Remove the rear brake pads.
For additional information, refer to: [Brake Pads](#) (206-04 Rear Disc Brake, Removal and Installation).
5. NOTE: Use an additional wrench to prevent the component from rotating.

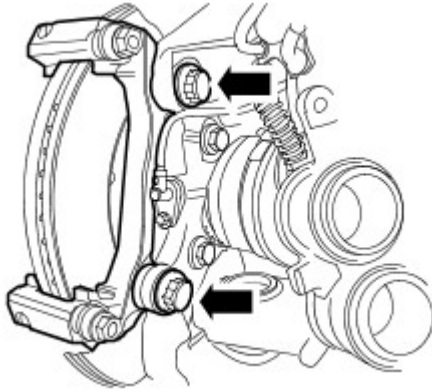
Remove the brake caliper housing.

- Remove the brake caliper upper bolt.



E66184

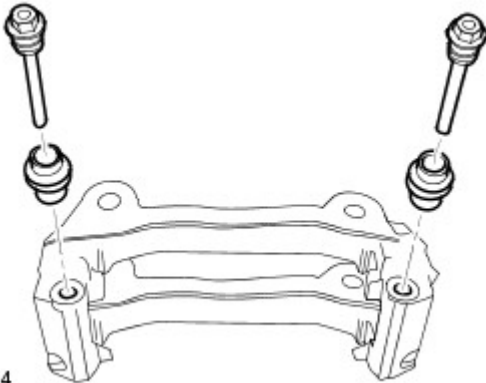
6. Remove the brake caliper anchor plate.



E52889

7. NOTE: Note the orientation of the brake caliper guide pins.

Remove the guide pins and seals.



E53724

Installation

1. CAUTIONS:



The brake caliper should move freely on both slide pins.



If necessary, renew the components.

• NOTE: Make sure the brake caliper guide pins are installed in the correct orientation.

Install the brake caliper guide pins.

- Check the condition of the caliper guide pin seals.
- Check for correct operation.

2. Install the brake caliper anchor plate.

- Tighten the bolts to 115 Nm (85 lb.ft).

3. NOTE: Use an additional wrench to prevent the component from rotating.

Install the brake caliper.

- Tighten the brake caliper upper bolt to 35 Nm (26 lb.ft).

4. Install the rear brake pads.

For additional information, refer to: [Brake Pads](#) (206-04 Rear Disc Brake, Removal and Installation).

5. Connect the brake pad wear indicator sensor.

6. Install the wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

Parking Brake and Actuation -

General Specification

Item	Specification
Make	Continental Teves
Model/type	N5528001
Operation	Twin cable operation to park brake with emergency cable release located in passenger compartment
Minimum brake lining material thickness	2.0 mm (0.078 in)

Torque Specifications

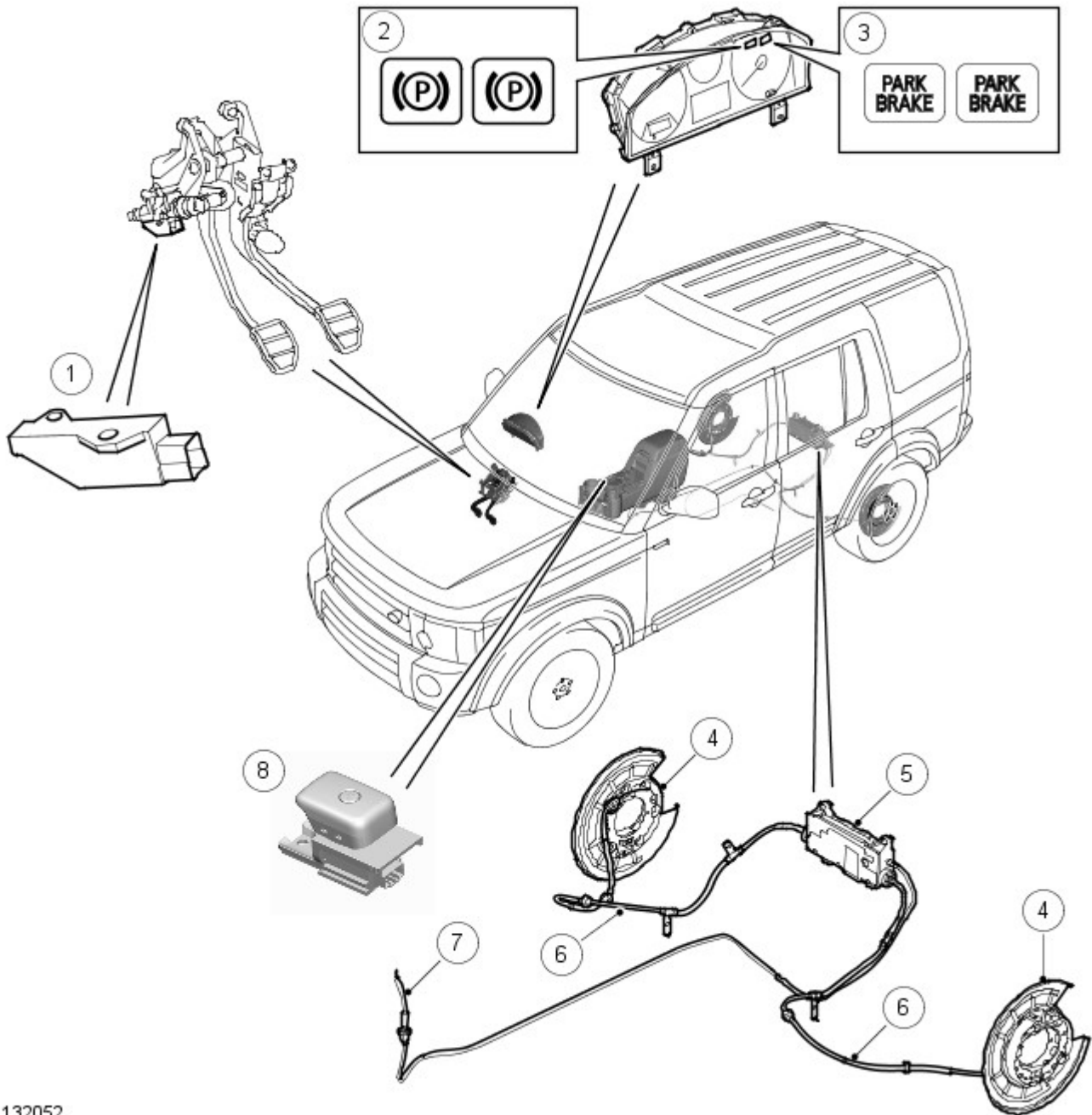
Description	Nm	lb-ft
Wedge adjuster Allen screw	7	5
Rear brake disc Torx screw	35	26
Brake caliper anchor plate to wheel knuckle bolts	115	85
Brake caliper to anchor plate bolts	35	26
Parking brake actuator and cable assembly nuts	5	4
Parking brake actuator mounting bracket bolts	22	16
Fuel tank heat shield nuts	3	2
Fuel tank heat shield bolts	6	4
* LH/RH parking brake cable bolts	22	16
Parking brake cable coupling	8	6
Road wheel nuts	140	103

* New nuts/bolts must be installed

Parking Brake and Actuation - Parking Brake

Description and Operation

COMPONENT LOCATIONS



E132052

Item	Part Number	Description
1	-	Clutch pedal position sensor (manual transmission models only)
2	-	Parking brake indicators (all except NAS (north American specification))
3	-	Parking brake indicators (NAS only)
4	-	Drum brake
5	-	Parking brake module
6	-	Parking brake cable
7	-	Emergency release cable
8	-	Parking brake switch

GENERAL

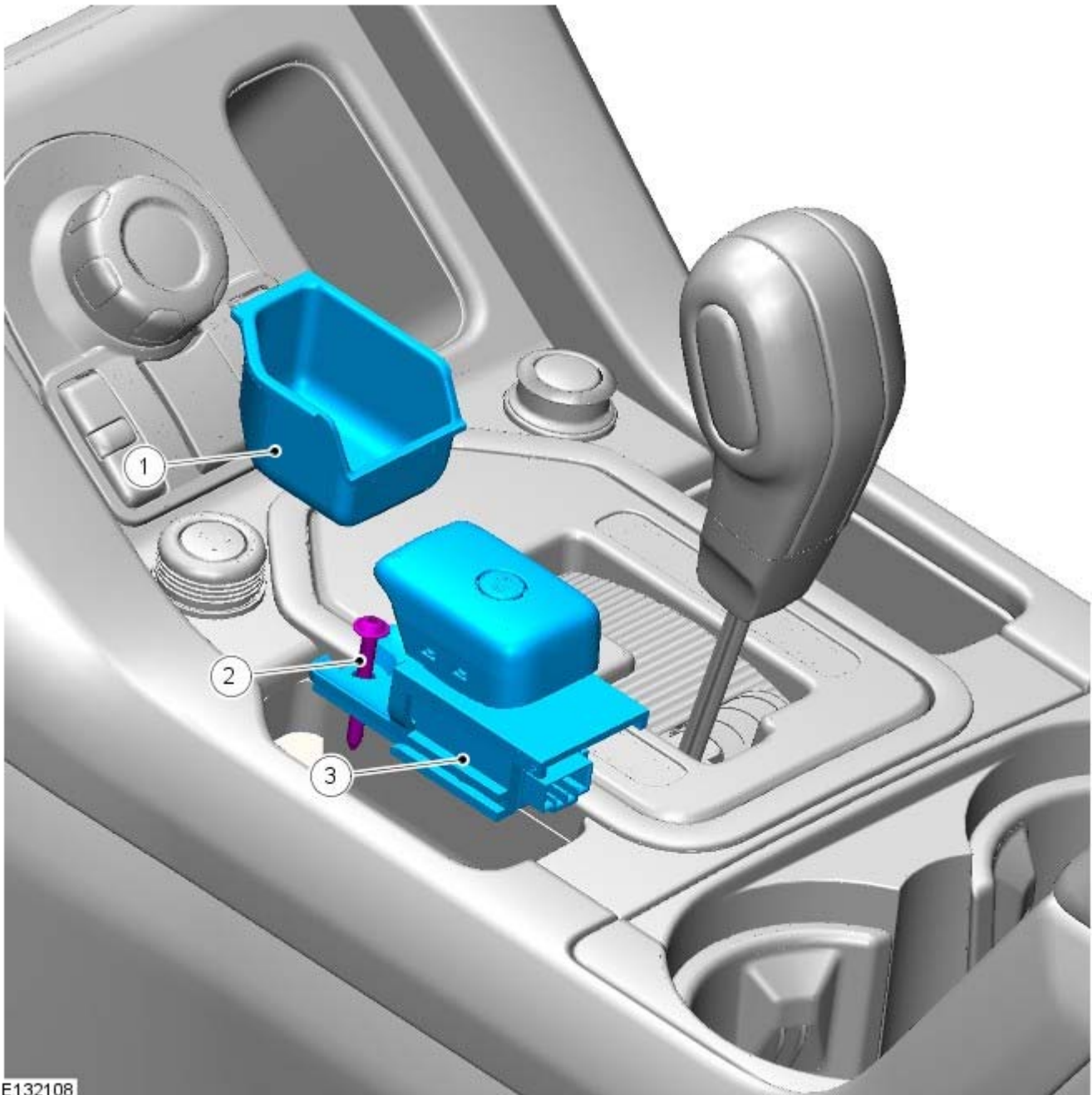
The parking brake is an electrically actuated system that operates drum brakes integrated into the rear brake discs. The parking brake system consists of:

- A parking brake switch.
- Left and right drum brakes.
- Left and right brake cables.
- An emergency release cable.
- A clutch pedal position sensor (manual transmission models only).

- Two parking brake indicators.
- A parking brake module.

The parking brake is operated by the parking brake module, which adjusts the tension of the brake cables to apply and release the drum brakes. Operation of the parking brake module is initiated by the parking brake switch.

PARKING BRAKE SWITCH



Item	Part Number	Description
1	-	Side stowage tray
2	-	Securing screw
3	-	Parking brake switch

The parking brake switch is used by the driver to apply and release the parking brake, and is installed in the center console adjacent to the gear lever.

Slots on the sides of the parking brake switch engage with the top panel of the center console, and a screw secures the parking brake switch in position. An electrical connector on the back of the switch provides the interface with the vehicle wiring. A brake symbol on the switch illuminates when the exterior lamps are selected on.

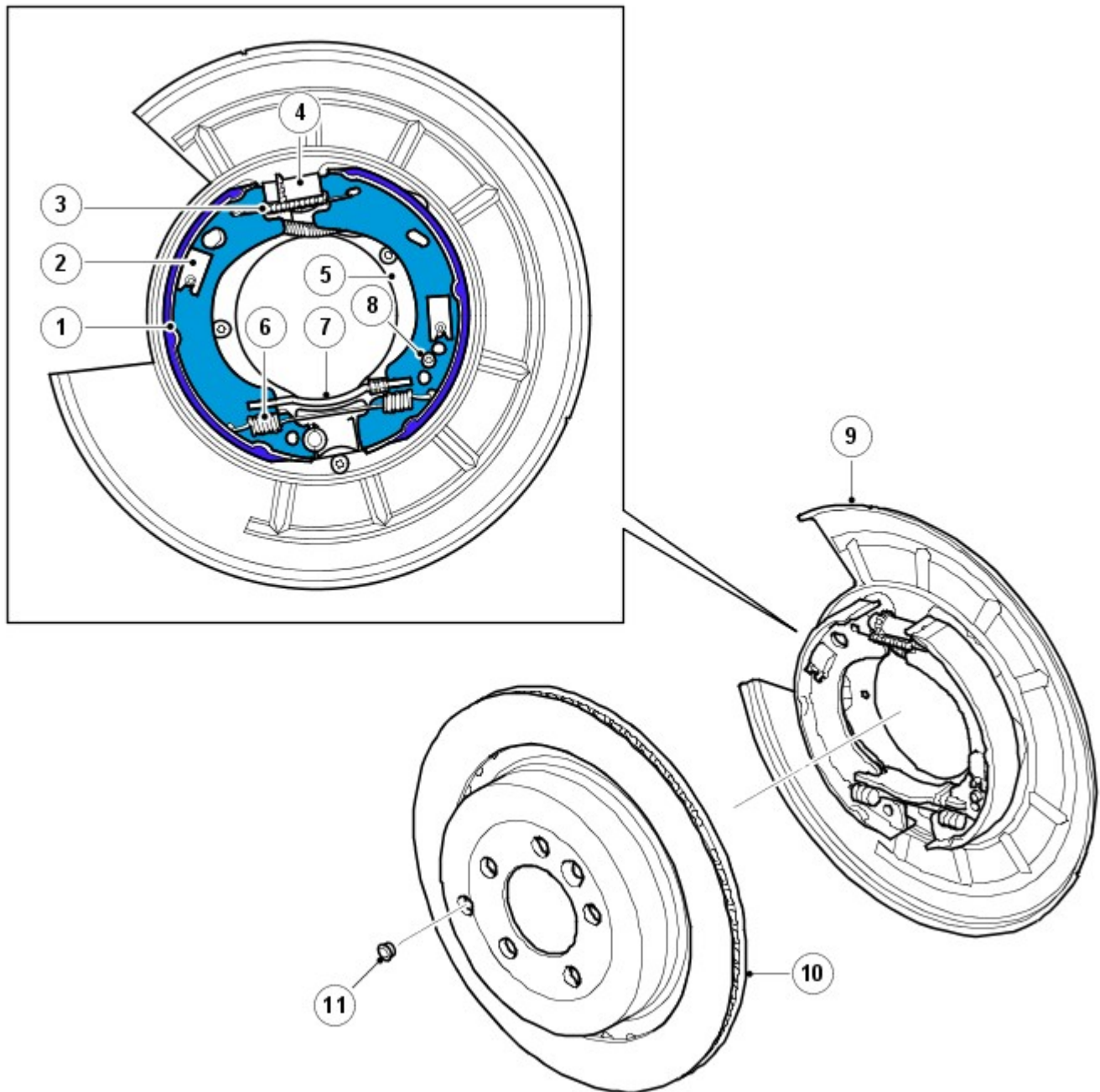
There are three states for the parking brake switch:

- Apply request, when the handle of the parking brake switch is pulled up.
- Release request, when the handle of the parking brake switch is pushed down.
- Idle, when the handle of the parking brake switch is in the central or rest position.

Microswitches, incorporated into the parking brake switch, are activated by the handle of the parking brake switch. To determine the operating state of the parking brake switch, the parking brake module scans the circuits containing the microswitches.

DRUM BRAKES

• NOTE: RH brake shown, LH brake similar



E49844

Item	Part Number	Description
1	-	Brake shoe
2	-	Shoe locating pin and clip
3	-	Adjuster spring
4	-	Toothed wheel adjuster
5	-	Backplate
6	-	Return spring
7	-	Cross strut
8	-	Wedge adjuster screw
9	-	Dust shield
10	-	Rear brake disc
11	-	Adjuster access plug

Each drum brake consists of a pair of brake shoes installed on a backplate attached to the rear hub carrier. The brake shoes operate on the drum integrated into the rear brake disc. The orientation of the brake shoes differ by 180° between the left-hand (LH) and right-hand (RH) brakes.

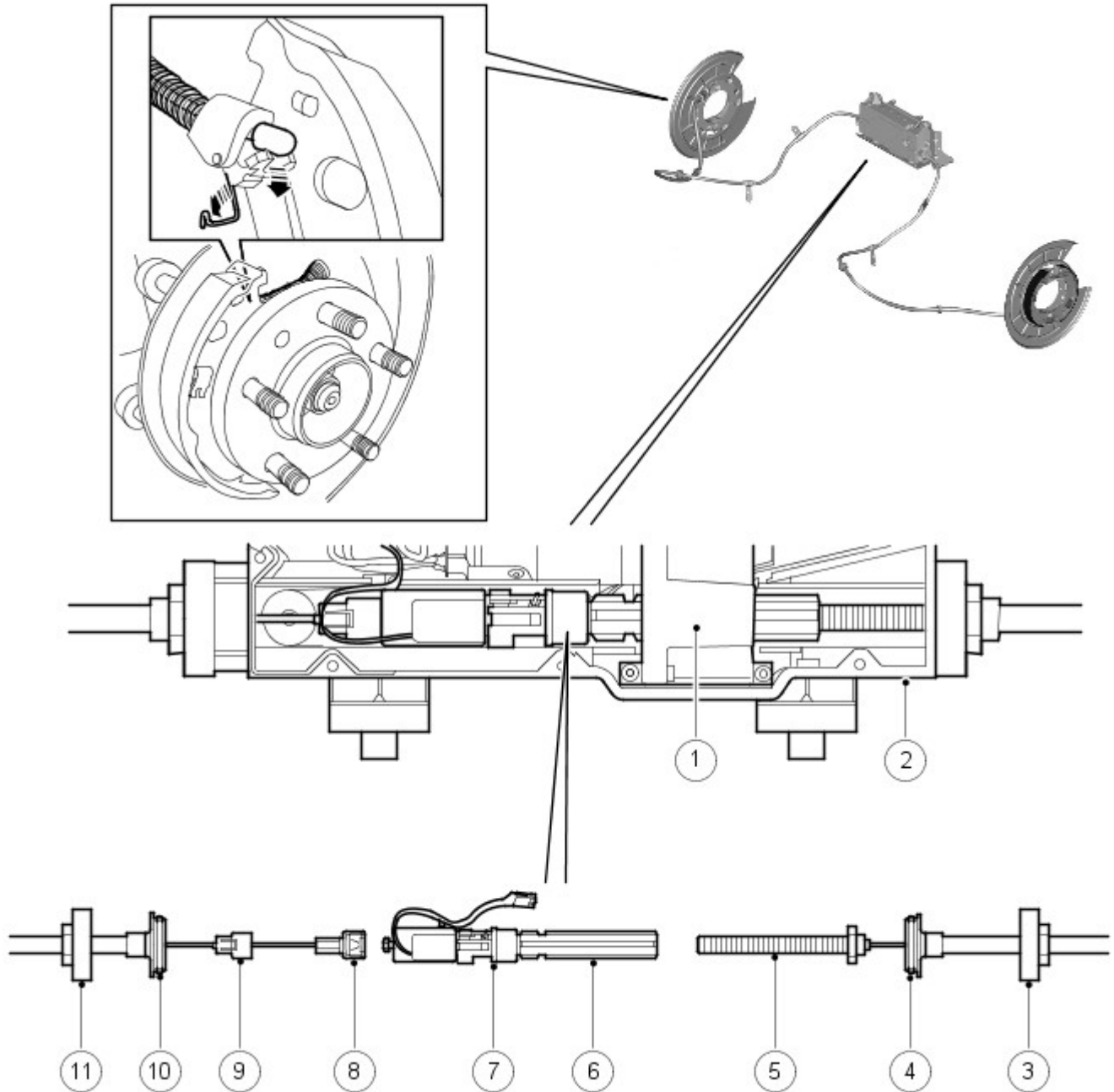
When the parking brake module tensions the brake cables, the movement is transmitted to an operating lever on one of the brake shoes. The operating lever pivots against a cross strut, which forces the brake shoes apart and into contact with the drum in the rear brake disc. Brake shoe to drum clearance is set with two manual adjusters, which are accessed through a hole in the brake disc. One of the adjusters is a conventional toothed wheel adjuster. The second adjuster is a wedge adjuster operated by an Allen screw.

After replacement of the brake shoes or brake discs, a bedding in procedure must be performed to ensure the drum brakes operate satisfactorily.

For additional information, refer to: [Parking Brake Shoe and Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).

Prior to removing a brake disc from a vehicle, power should be disconnected from the parking brake module. Operation of the parking brake switch while a brake disc is removed can cause the actuating mechanism in the parking brake module to seize.

BRAKE CABLES



E49845

Item	Part Number	Description
1	-	Gearbox
2	-	Parking brake module housing
3	-	Cable nut
4	-	Sealing collar
5	-	Threaded connector
6	-	Spline shaft
7	-	Force sensor
8	-	Shoe
9	-	Locking cover
10	-	Sealing collar
11	-	Cable nut

The brake cables consist of Bowden cables installed between the parking brake module and the drum brakes. Nuts, on the ends of the outer cables, secure the brake cables to the parking brake module and the backplate of the related drum brake. In each drum brake, the inner cable is located in the guide spring and connected to the brake shoe operating lever

by a nipple on the end of the cable. In the parking brake module, the two inner cables are joined together via the force sensor and the spline shaft.

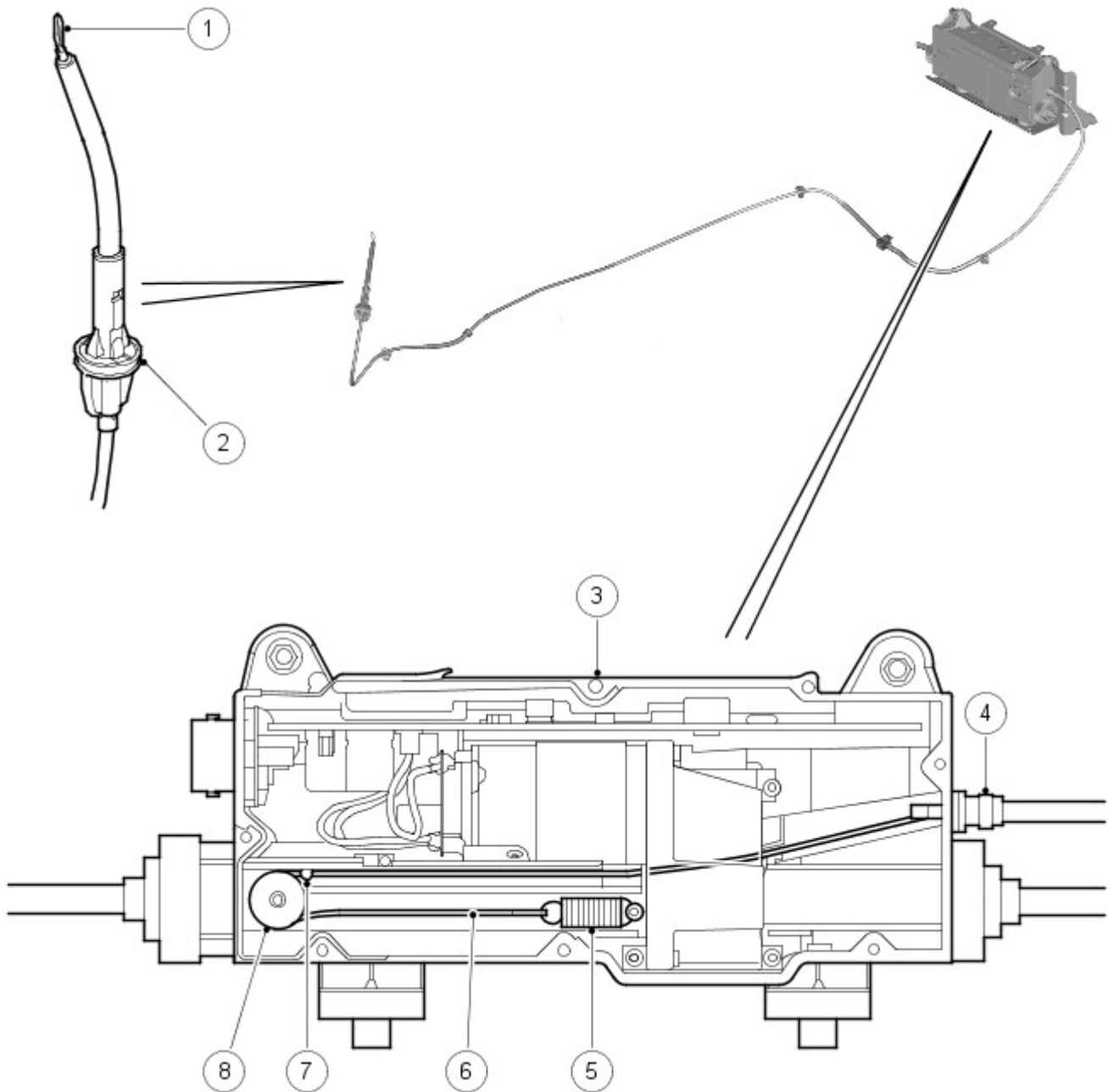
The inner cable of the RH brake cable is connected to a nipple on the force sensor by a 'shoe' on the end of the cable; a locking cover keeps the shoe engaged with the nipple.

The inner cable of the LH brake cable is connected to the spline shaft by a threaded connector (LH thread); a squared flange at the end of the threaded connector locates in the housing of the parking brake module, to prevent the threaded connector from turning with the spline shaft.

When the spline shaft turns, the threaded connector of the LH brake cable is screwed into or out of the spline shaft, which changes the effective length of the inner cables and operates the drum brakes. The ability of the spline shaft to move axially in the gearbox equalizes the load applied by the inner cables to the two drum brakes.

Prior to disconnecting a brake cable, power should be disconnected from the parking brake module. Operation of the parking brake switch while a brake cable is disconnected can cause the actuating mechanism in the parking brake module to seize. In addition, the parking brake may not switch off until 20 minutes after Power mode 0 selected. Automatic re-apply cannot be eliminated until this period has expired.

EMERGENCY RELEASE CABLE



E49846

Item	Part Number	Description
1	-	Pull ring
2	-	Quick release fitting
3	-	Parking brake module
4	-	Sealing collar
5	-	Spring

6	-	Inner cable
7	-	Nipple
8	-	Pulley wheel

The emergency release cable allows the parking brake to be mechanically released if:

- The parking brake cannot be electrically released because of a system fault.
- The battery is disconnected or battery voltage decreases below 7.5 volts while the parking brake is applied, so that the parking brake cannot be electrically released.

The parking brake is mechanically released by disconnecting the force sensor from the spline shaft in the parking brake module. During normal operation, the force sensor and the spline shaft are locked together by a lever operated pawl on the end of the spline shaft, which engages with a spigot on the force sensor.

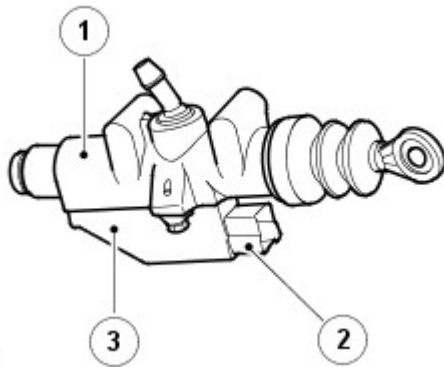
The emergency release cable is a Bowden cable installed between the parking brake module and the center console. The emergency release cable is held in clips along the underside of the vehicle and enters the passenger compartment below the center console through an aperture in the transmission tunnel. A quick release fitting seals the emergency release cable in the aperture. At the parking brake module, a sealing collar on the outer cable is a push fit in the housing of the parking brake module.

In the center console, a pull ring is installed on the end of the inner cable. The pull ring is designed to fit the hook on the end of the jack handle which, in combination with a screwdriver shaft, can be used to pull on the cable.

The pull required to release the latch is approximately 200 N (45 lbf). When the pull ring of the emergency release cable is released, the spring in the parking brake module retracts the inner cable and the nipple moves away from the pawl operating lever.

After the emergency release cable has been used to release the parking brake, the next time an apply selection is made with the parking brake switch, the parking brake module automatically runs through a latching procedure to reconnect the spline shaft with the force sensor. The parking brake module turns the spline shaft so that it moves towards the force sensor. The pawl of the spline shaft then re-engages with the spigot of the force sensor. A second apply selection with the parking brake switch is required to apply the parking brake.

CLUTCH PEDAL POSITION SENSOR (MANUAL TRANSMISSION MODELS ONLY)



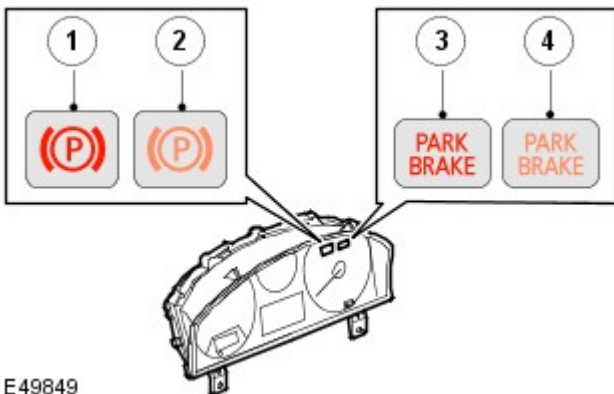
E49848

Item	Part Number	Description
1	-	Clutch master cylinder
2	-	Electrical connector
3	-	Clutch pedal position sensor

The clutch pedal position sensor supplies a signal of clutch pedal position to the parking brake module.

The clutch pedal position sensor is a Hall effect sensor which is attached to the side of the clutch master cylinder. The position of the piston in the clutch master cylinder effects a magnetic field in the sensor, and is translated by the sensor into an analogue voltage signal for the parking brake module. The parking brake module relates the signal to the position of the clutch pedal.

PARKING BRAKE INDICATORS



E49849

Item	Part Number	Description
1	-	Red warning indicator (all except NAS)
2	-	Amber warning indicator (all except NAS)
3	-	Red warning indicator (NAS only)
4	-	Amber warning indicator (NAS only)

The parking brake has two warning indicators, one amber and one red, located in the speedometer of the instrument cluster.

Amber Parking Brake Warning Indicator

The amber parking brake warning indicator is continuously illuminated if there is a parking brake system fault. Operation of the indicator is controlled by a high speed controller area network (CAN) bus signal from the parking brake module to the instrument cluster.

Red Parking Brake Warning Indicator

When the parking brake is applied, the red parking brake warning indicator is continuously illuminated while the ignition is on and for 3 minutes after the ignition is switched off. If the system is unable to comply with an apply or release request, due to a system fault, the indicator flashes.

When the ignition is on and the indicator is not flashing, operation is controlled by a high speed CAN bus signal. When the ignition is off or when the indicator is flashing, operation is controlled by a hardwired signal from the parking brake module to the instrument cluster.

Text Messages

On vehicles with the high line instrument cluster, when there is a fault condition, illumination of the warning indicators is accompanied by a text message displayed in the message center. For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

PARKING BRAKE MODULE

The parking brake module monitors external and internal inputs and adjusts the tension of the brake cables to operate the drum brakes and provide the required parking brake function.

The parking brake module is installed on a support bracket attached to the front of the spare wheel carrier. Two rubber mounts, installed on lugs on the underside of the parking brake module, locate in holes in the support bracket. The top corners of the parking brake module are secured to the support bracket with rubber mounts and flanged nuts.

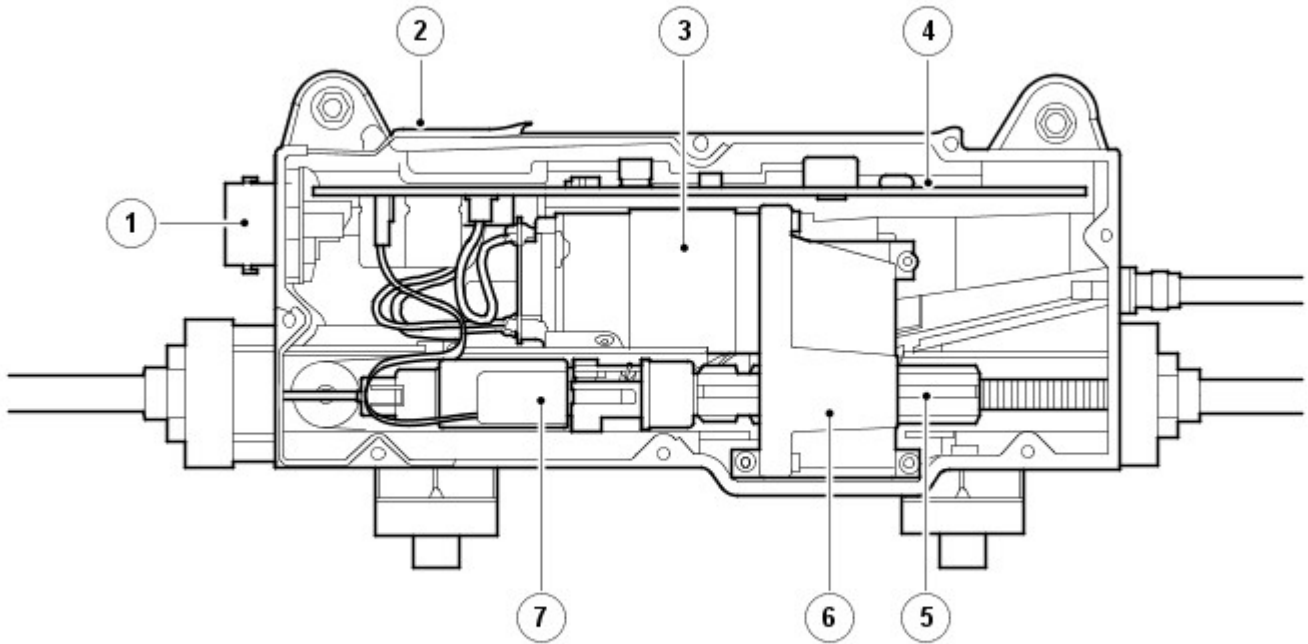
The main components of the parking brake module are:

- A PCB (printed circuit board) incorporating the ASIC (application specific integrated circuit) for control of the parking brake.
- An electric motor.
- A gearbox.
- A spline shaft.
- A force sensor.

The spline shaft and the force sensor are connected together by a latch on the end of the spline shaft. The spline shaft rotates on the latch and moves axially in the gearbox. The latch and the force sensor slide in a channel in the body of the parking brake module.

To apply or release the drum brakes, the parking brake module runs the electric motor, which drives the gearbox. The gearbox turns the spline shaft to increase or decrease the tension in the brake cables. The parking brake module monitors the load exerted by the brake cables using the input from the force sensor.

Interior of Parking Brake Module



E49850

Item	Part Number	Description
1	-	Electrical connector
2	-	Housing
3	-	Electric motor
4	-	PCB
5	-	Spline shaft
6	-	Gearbox
7	-	Force sensor

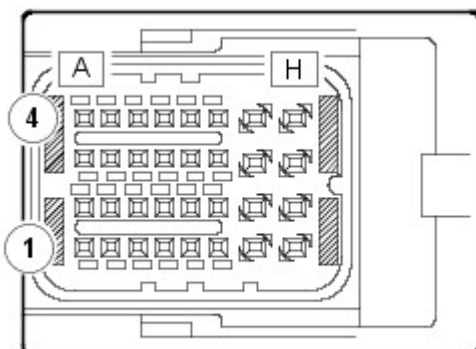
Inputs and Outputs

A 32 pin electrical connector on the RH side of the parking brake module provides the interface between the PCB and the vehicle wiring.

The parking brake module is powered by two permanent battery power feeds from the battery junction box (BJB). Two connections with the central junction box (CJB) provide battery voltage signals in Power mode 0 and Power mode 6. Other hardwired inputs consist of those from the parking brake switch and, on manual transmission models, the clutch pedal position sensor.

In addition to the hardwired connections, the parking brake module is connected to the high speed CAN bus to enable communication with other vehicle systems.

Parking Brake Module Harness Connector C2178



E49851

Parking Brake Module Harness Connector C2178 Pin Details

Pin No.	Description	Input/Output
A1	Not used	-
A2	High speed CAN bus low out	Input/Output
A3	High speed CAN bus high in	Input/Output

Pin No.	Description	Input/Output
A4	High speed CAN bus low in	Input/Output
B1	Not used	-
B2	High speed CAN bus high out	Input/Output
B3	Parking brake switch SW1	Input
B4	Parking brake switch SW4	Input
C1 and C2	Not used	-
C3	Parking brake switch SW2	Input
C4	Parking brake switch SW5	Output
D1 to E1	Not used	-
E2	Clutch pedal position sensor ground	Input
E3	Clutch pedal position sensor signal	Input
E4	Clutch pedal position sensor power supply	Output
F1	Not used	-
F2	Not used	-
F3	Ignition power supply	Input
F4	Red parking brake indicator	Output
G1	Not used	-
G2	Ground	Output
G3	Not used	-
G4	Battery power supply	Input
H1	Not used	-
H2	Ground	Output
H3	Not used	-
H4	Battery power supply	Input

PARKING BRAKE OPERATION

The parking brake can be applied at any time provided sufficient battery power is available. For the parking brake to be released, various pre-conditions are required. The parking brake has manual and automatic operating modes, to cater for different operating circumstances, as detailed in the following table:

Operating Modes

Mode	Pre-Conditions	Driver Action
Static apply	Vehicle speed less than 2.5 km/h (1.6 mph).	Pull up parking brake switch.
Static release	1. Vehicle speed less than 2.5 km/h (1.6 mph). 2. Engine running. OR Ignition is ON and brake pedal or clutch pedal pressed (manual transmission). OR Ignition is ON and brake pedal or accelerator pedal pressed (automatic transmission).	Press down parking brake switch.
Ignition OFF apply	1. Vehicle speed less than 10 km/h (6.25 mph). 2. Ignition is OFF. 3. Selector lever is not in position 'P'. (automatic transmission).	Switch the ignition OFF.
Igniton OFF apply inhibit	1. Vehicle speed less than 2.5 km/h (1.6 mph). 2. Ignition is OFF. 3. Selector lever is not in position 'P'. (automatic transmission).	Switch the ignition OFF while pressing down parking brake switch.
Dynamic apply	Vehicle speed more than 2.5 km/h (1.6 mph).	Pull up parking brake switch as required.
Dynamic release	Vehicle speed more than 2.5 km/h (1.6 mph).	Release (to neutral position) or press down parking brake switch.
DAR (drive away release) (automatic transmission only)	1. Ignition is ON. 2. Transmission in gear 1, 2 or R (with high range selected) or 1, 2, 3 or R (with low range selected). 3. Accelerator pedal pressed more than 2%. 4. Seatbelt is fastened. 5. Drivers door is closed.	None. Parking brake released automatically on drive away.

Operating Voltages

Actuation of the parking brake (apply or release) is only started if the power supply to the parking brake module is within 9 to 18 volts. At any voltage in this range, the parking brake module is able to tighten the brake cables to the maximum, to fully apply the parking brake, although at voltages between 9 and 10.5 volts the actuation time may exceed 1.0 second.

During a parking brake actuation:

- If the power supply to the parking brake module decreases to less than 8.3 volts, the parking brake module continues the actuation, but stores a related fault code. If the ignition is on, the parking brake module also signals the instrument cluster to illuminate the amber parking brake warning indicator and flash the red parking brake warning indicator. On vehicles with the high line instrument cluster, a message advising there is a parking brake fault is shown in the message center. The warning indications are discontinued if the power supply voltage increases to 8.3 volts or more.
- If the power supply voltage decreases to less than 7.5 volts, the parking brake module discontinues the actuation. Actuation is automatically resumed if the power supply voltage subsequently increases to 7.5 volts or more and the parking brake switch request is still valid.
- If the power supply voltage decreases below 6.5 volts, the parking brake function is disabled for the remainder of the ignition cycle.
- If the power supply voltage increases to more than 18.0 volts, the parking brake module immediately disables the

parking brake function and stores a related fault code. If the ignition is on, the parking brake module also signals the instrument cluster to illuminate the amber parking brake warning indicator and flash the red parking brake warning indicator. On vehicles with the high line instrument cluster, a message advising that the parking brake has a fault and is not functioning is shown in the message center. The parking brake function remains disabled until the power supply voltage is within 9 to 18 volts again. When the power supply voltage is within 9 to 18 volts again, the warning indications are cancelled and actuation is automatically resumed if the parking brake module is in a dynamic mode of operation with a valid parking brake switch request.

- **NOTE:** The instrument cluster shuts down below 8 volts, so warning indications and messages are not displayed below 8 volts. CAN transmission stops if battery voltage drops below 7.0 volts and re-starts when voltage goes above 7.5 volts.

Sleep Mode

To reduce quiescent drain on the vehicle battery, the parking brake module incorporates a sleep mode. The parking brake module enters the sleep mode, provided the ignition is off and there are no signals from the wheel speed sensors, when one of the following occurs:

- 20 minutes elapse after the last actuation of the parking brake.
- If no actuation occurred, 20 minutes elapse after the ignition is switched off.

The parking brake module wakes up from the sleep mode when one of the following occurs:

- An apply or release request is made with the parking brake switch.
- The ignition is switched on.
- A key out apply is activated.

The parking brake module wakes up within 500 ms. The high speed CAN bus is activated within 200 ms maximum.

When the parking brake module is woken with a release request from the parking brake switch, the parking brake module ignores the request but illuminates the red brake warning indicator. The parking brake module extinguishes the red brake warning indicator and goes back to sleep immediately the switch is released to the neutral position.

When the parking brake module is woken with an apply request from the parking brake switch, if the parking brake is already applied the parking brake module ignores the request but illuminates the red brake warning indicator. The parking brake module extinguishes the red brake warning indicator and goes back to sleep immediately the switch is released to the neutral position. If the parking brake is in the released condition when the apply request is made, the parking brake module illuminates the red brake warning indicator and applies the parking brake. The parking brake module extinguishes the red brake warning indicator and goes back to sleep 3 minutes after the apply activation, or immediately after the switch is released to the neutral position, whichever occurs last.

Dynamic Apply

In the dynamic apply mode, if the vehicle speed is more than 10 km/h (6.25 mph) when the parking brake switch is selected to apply, the parking brake module requests the ABS module to activate the disc brakes on all four wheels. When the vehicle comes to a standstill, the parking brake module statically applies the parking brake. Once the static load is achieved, the hydraulic pressure is removed. If the parking brake switch is released to the neutral position, or pressed down to the release position, during dynamic apply, braking is cancelled.

The anti-lock brake system (ABS) module monitors the deceleration rate using the wheel speed sensor signals, and adjusts the hydraulic pressure to the disc brakes as required to achieve the required rate. All of the anti-lock control - traction control system brake functions remain enabled in the dynamic apply mode.

The parking brake module incorporates two fallback functions for the dynamic apply mode.

- Fallback 1 is invoked if vehicle speed is between 2.5 km/h (1.25 mph) and V_{max} when the parking brake switch is selected to apply and the ABS module is unable to fulfil a hydraulic request. When fallback 1 is invoked, the parking brake module decelerates the vehicle, using only the parking brake. The parking brake module monitors the deceleration rate using the wheel speed information from the ABS module, and adjusts the tension of the brake cables to achieve the required rate. During deceleration the parking brake module also uses the wheel speed inputs from the ABS module to operate an anti-lock function for the rear wheels. When vehicle speed decreases to 2.5 km/h (1.25 mph) the parking brake module switches to the static apply mode.
- Fallback 2 is invoked if there is a loss of communication between the parking brake module and the ABS module or the CAN bus has failed. When fallback 2 is invoked, the parking brake module decelerates the vehicle using only the parking brake. The parking brake module tightens the brake cables under the control of the driver, no anti-lock function is available.

While dynamic apply is active, including fallback 1 and fallback 2, the parking brake module also outputs high speed CAN bus signals to:

- The ABS module, to apply the stoplamps.
- The instrument cluster, to sound an intermittent warning buzzer, at 0.5 second on, 1.0 second off.
- The instrument cluster, to illuminate the red parking brake warning indicator. The indicator is permanently illuminated except in fallback 2, when it flashes.

DAR Pre-arming

The DAR pre-arming function operates when the transfer box is in high range to reduce the parking brake release time during DAR and to provide a smooth take-off. DAR pre-arming is invoked when:

- The ignition is ON.
- The transmission is in gear 1, 2 or R.
- The vehicle is stationary.
- No failsafe tighten actuation has occurred.

Automatic Load Adjustment

While the ignition is on, the parking brake module constantly monitors the input from the force sensor. If the tension of the brake cables goes outside the limits for a given operating mode, the parking brake module automatically restores the tension within limits.

Failsafe Tighten. If, during pre-arming, the vehicle moves, then the maximum cable force is reinstated for the remainder of that ignition cycle.

Automatic Apply. While the parking brake is applied, if the tension of the brake cables decreases by a prescribed amount from the initial setting, the parking brake module automatically restores the tension to the initial setting.

Automatic Release. While the parking brake is released, if the tension of the brake cables increase to a prescribed amount, the parking brake module automatically reduces the tension to zero.

Parking Brake Switch Monitoring

The parking brake module monitors for the following types of fault in the parking brake switch system. If a fault is detected, the parking brake module stores a related fault code:

- Short circuits between a pull-down transistor in the parking brake module and battery voltage.
- Broken wires and microswitches.
- Plausibility.

The parking brake switch has a degree of in-built redundancy. If a single microswitch fault is detected the parking brake module can still determine the operating state of the parking brake switch. Short circuits or multiple failures cause the parking brake module to disable the parking brake switch for the remainder of the ignition cycle. The parking brake module also disables the parking brake switch if a plausibility fault occurs. However, since plausibility faults are usually caused by incomplete operation of the parking brake switch, the parking brake switch is re-enabled if the parking brake module subsequently establishes a plausible operating state.

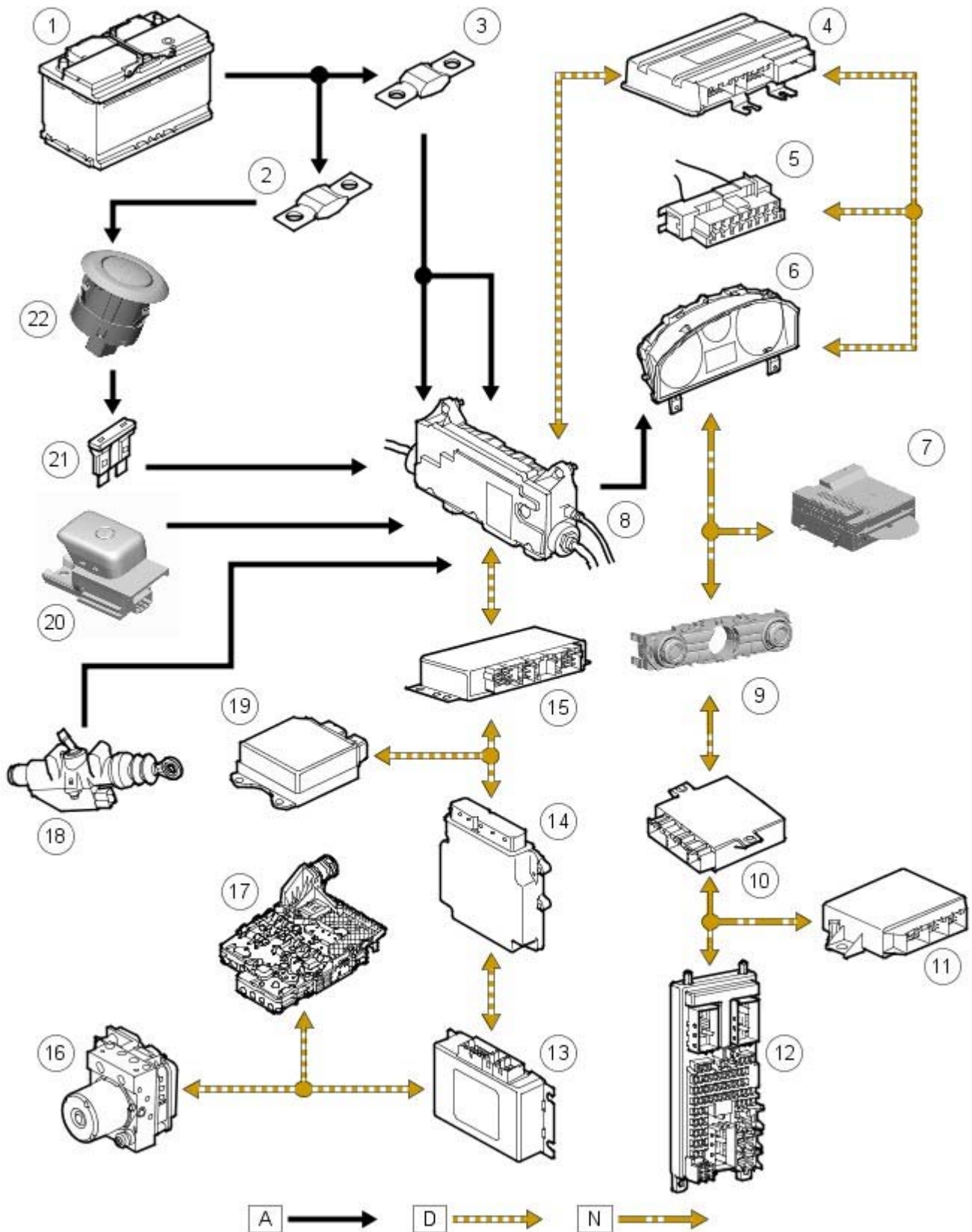
If a single microswitch fault is detected, the parking brake module signals the instrument cluster to illuminate the amber parking brake warning indicator. On vehicles with the high line instrument cluster, the parking brake module also signals the instrument cluster to display a message advising there is a parking brake fault. During an apply actuation, the parking brake module also signals the instrument cluster to flash the red parking brake warning indicator.

For all other fault types, the parking brake module signals the instrument cluster to illuminate the amber parking brake warning indicator, and, on vehicles with the high line instrument cluster, to display a message advising the parking brake has a fault and is not functioning. If it makes an apply actuation, the parking brake module signals the instrument cluster to flash the red parking brake warning indicator for the remainder of the ignition cycle.

On the next ignition cycle, the warning indicators and the messages are only activated if the fault is still present, although the fault code is retained by the parking brake module until cleared by T4.

CONTROL DIAGRAM

- NOTE: A = Hardwired connection; D = High speed CAN bus; N = Medium speed CAN bus



E 132053

Item	Part Number	Description
1	-	Battery
2	-	Fusible link 17E, BJB
3	-	Fusible link 8E, BJB
4	-	Air suspension control module
5	-	Diagnostic socket
6	-	Instrument cluster
7	-	Integrated head unit
8	-	Parking brake module

9	-	automatic temperature control (ATC) module
10	-	Tire Pressure Monitoring Module (TPMM)
11	-	Parking Aid module
12	-	CJB module
13	-	Transfer box control module
14	-	engine control module (ECM)
15	-	Rear differential control module
16	-	ABS module
17	-	transmission control module (TCM)
18	-	Clutch pedal position sensor
19	-	restraints control module (RCM)
20	-	Parking brake switch
21	-	Fuse 9P, CJB (ignition)
22	-	Ignition push button

Parking Brake and Actuation - Parking Brake

Diagnosis and Testing

Principles of Operation

For a detailed description of the Parking Brake System and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Parking Brake](#) (206-05 Parking Brake and Actuation, Description and Operation).

Inspection and Verification

• CAUTIONS:



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.



Please note this is a sealed unit and no attempt must be made to open the actuator as it will invalidate any warranty claim.

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Parking brake cable(s) condition and installation ● Parking brake shoes condition and fitment ● Parking brake drums (integrated into rear brake discs) ● Parking brake actuator module condition and installation 	<ul style="list-style-type: none"> ● Parking brake indicators ● Fuses ● Wiring harness/electrical connectors <ul style="list-style-type: none"> - Check for bent/corroded pins ● Controller Area Network (CAN) circuits ● Parking brake switch ● Parking brake actuator module

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Parking brake will not engage or release	<ul style="list-style-type: none"> ● Parking brake cables fouled, trapped or damaged ● Parking brake cables incorrectly routed or fixed ● Parking brake shoes, linings worn/contaminated ● Parking brake drums (integrated into rear brake discs) ● Parking brake shoes incorrectly adjusted following replacement ● Parking brake actuator module malfunction 	<p>Check the parking brake cables for fouling, trapping or damage. Check the cables for correct routing. Check that the cable end fitting connector(s) are correctly fitted to the operating lever(s). Inspect the parking brake shoes and drums for condition/wear/contamination, REFER to: Rear Disc Brake (206-04 Rear Disc Brake, Description and Operation) / Parking Brake Shoes (206-05, Removal and Installation). Check the parking brake shoes for correct adjustment. REFER to: Parking Brake Shoe and Lining Adjustment (206-05 Parking Brake and Actuation, General Procedures). Check the operation of the parking brake actuator module, check for damage and/or excessive noise during operation. Check for parking brake actuator module DTCs.</p>
Low parking brake efficiency/parking brake sticking/binding		

DTC Index

For a complete list of all Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

REFER to: Diagnostic Trouble Code (DTC) Index (100-00, Description and Operation).

Brake Bedding Mode

Bedding mode is a special mode available in the parking brake module (PBM) that disables the stability assist system (ABS) and allows the parking brake to provide the braking force rather than the conventional braking system whilst the vehicle is moving at a velocity of >3kph. This mode is entered via a series of brake pedal presses and switch applications, full details on this procedure is available in the relevant section of the workshop manual. If brake bedding mode is entered accidentally by the driver the RED warning lamp will flash in the Instrument Pack, the module will return to normal operational mode when the ignition has been cycled. This DTC (C1104-68) is intended to highlight the fact that although the RED lamp was illuminated there was no fault present in the control module.

Drive Cycles

Drive Cycle 1 Description

- Ignition On
- Make sure that no parking brake activation (diagnostic command or switch input) is attempted for a minimum of 3 seconds
- Retest for functionality

Drive Cycle 2 Description

- Ignition On
- Drive vehicle at a constant speed of 20KPH (13MPH) or slightly above in 2nd gear
- At a constant speed of 20KPH (13MPH) or slightly above apply the parking brake via the parking brake switch
- Press the brake pedal

Drive Cycle 3 Description

- Ignition On
- Make sure that the vehicle is stationary and that the parking brake is released
- Pull the parking brake switch to the apply position and hold in this position until the parking brake motor has stopped (this may take up to 5 seconds)
- Release the parking brake switch to the idle position, leave in the idle position for 2 seconds
- Push the parking brake switch to the release position (while pressing the brake pedal) and keep in this position until the parking brake motor has stopped (this may take up to 5 seconds)
- Release the parking brake switch to the idle position


Parking Brake and Actuation - Parking Brake Shoe and Lining Adjustment


General Procedures

• NOTE: This procedure must be carried out if, new parking brake shoes are fitted, new rear brake discs are fitted or if the vehicle has been mud wading (not water) for more than 50 miles.


1. Check the parking brake for correct operation.

2. CAUTIONS:

 When the vehicle is in the mounting position a red flashing light may appear on the instrument cluster. This indicates that the parking brake actuator is in the mounting position. It does not indicate a vehicle fault.

 The warning lamp on the instrument cluster will flash whilst the parking brake is being driven into the mounting position.

Using the Land Rover approved diagnostic system, drive the parking brake to the mounting position.

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

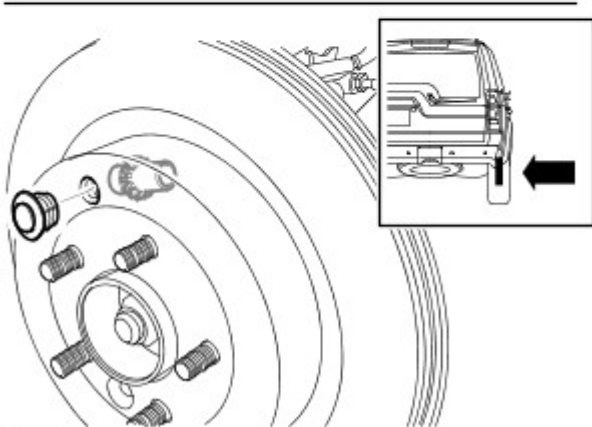
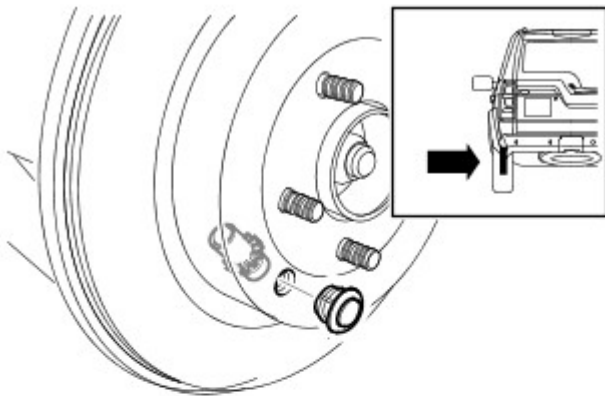
Raise and support the vehicle.

4. Remove the wheels and tires.


5. NOTE: Align the access hole with the indicators located on the back plate.

Locate the parking brake shoe adjuster.

- Remove the access plug.
- Rotate the brake disc.



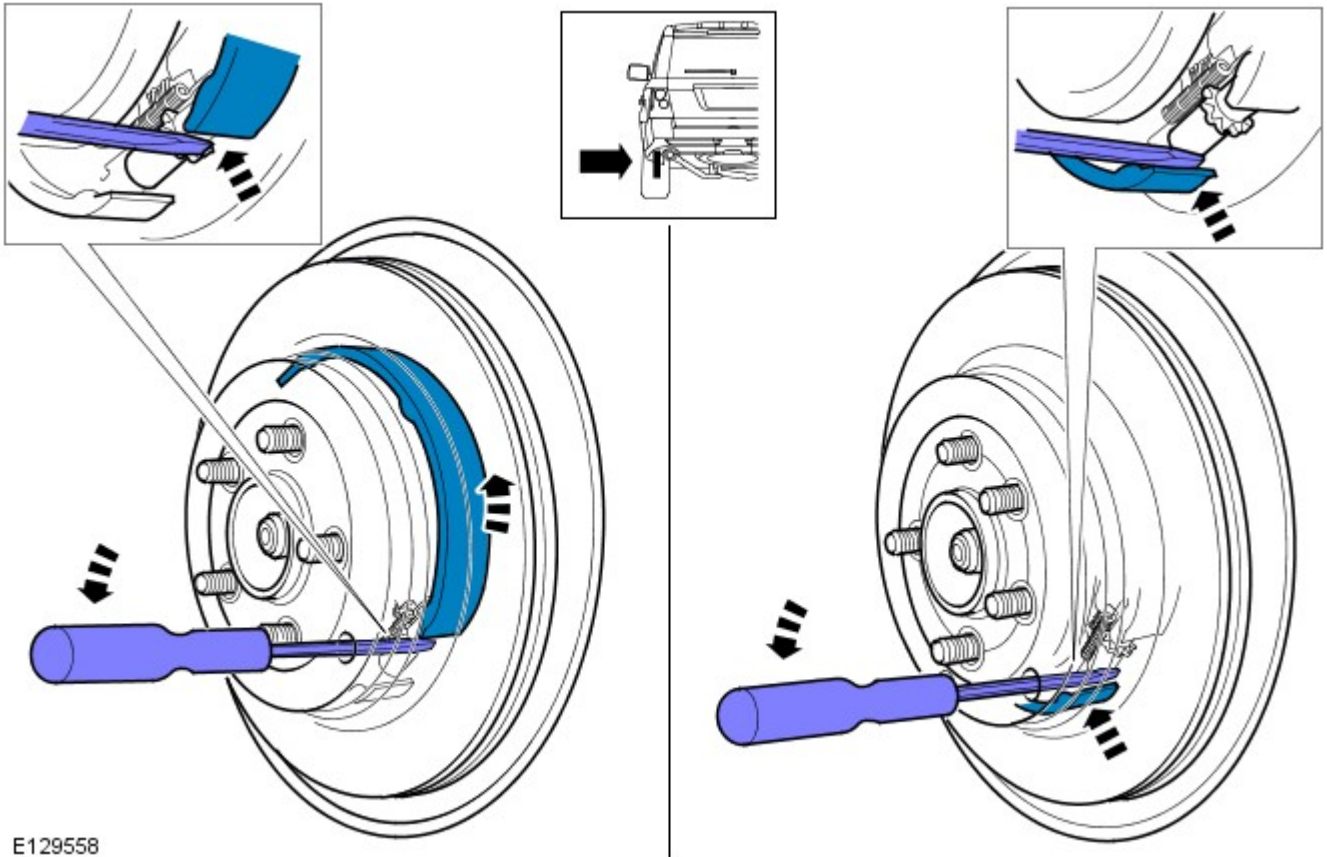
E48748

6.  **CAUTION:** Failure to follow this step may cause damage to the parking brake system. Failure to displace the parking brake shoes, as shown, will result in incorrect clearance when carrying out the adjustment step.


• NOTE: The movement of the parking brake shoe will be small and may not be felt when levering.

• NOTE: LH shown.

Using a flat blade screwdriver, lever the brake shoes as indicated.

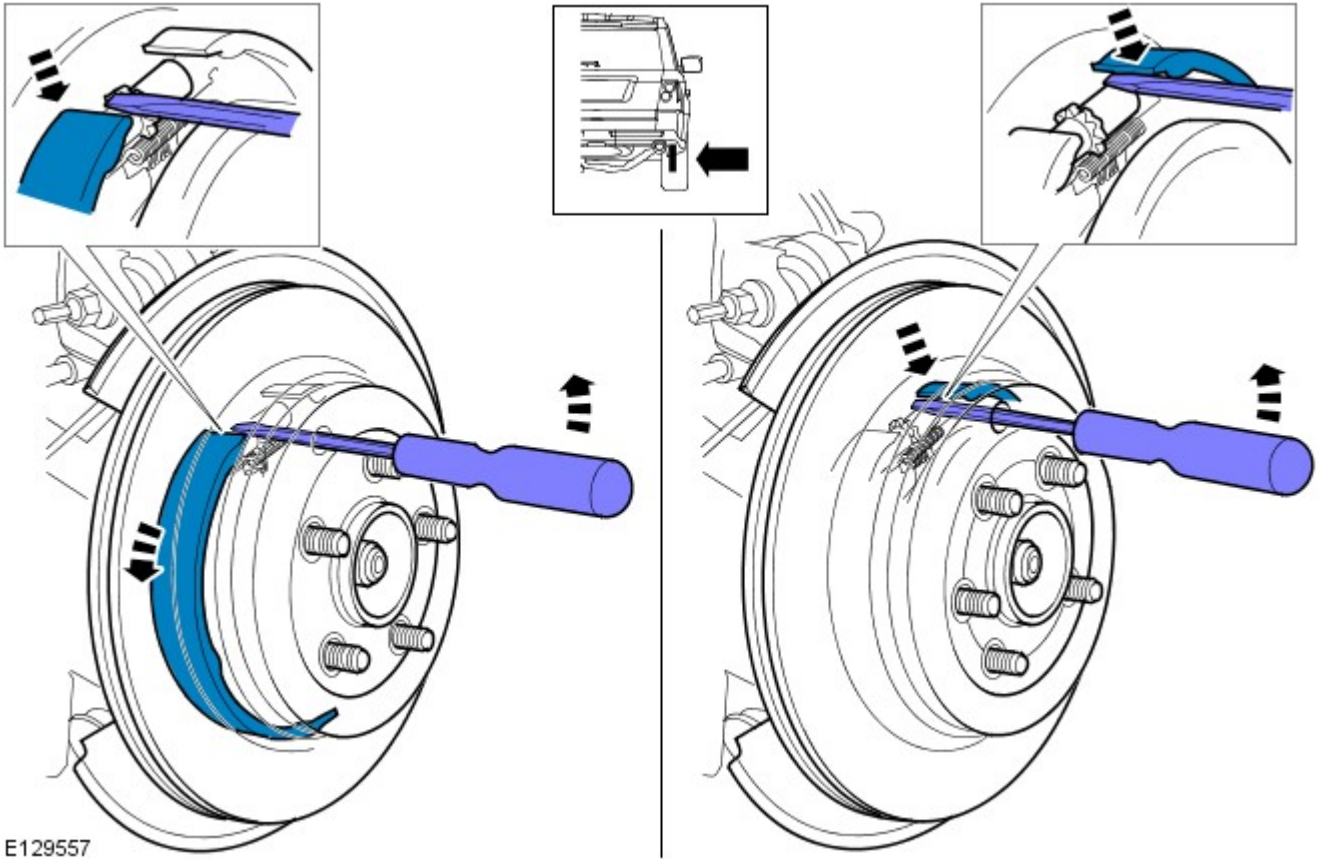


E129558


7.  CAUTION: Failure to follow this step may cause damage to the parking brake system. Failure to displace the parking brake shoes, as shown, will result in incorrect clearance when carrying out the adjustment step.

- NOTE: The movement of the parking brake shoe will be small and may not be felt when levering.
- NOTE: RH Shown.

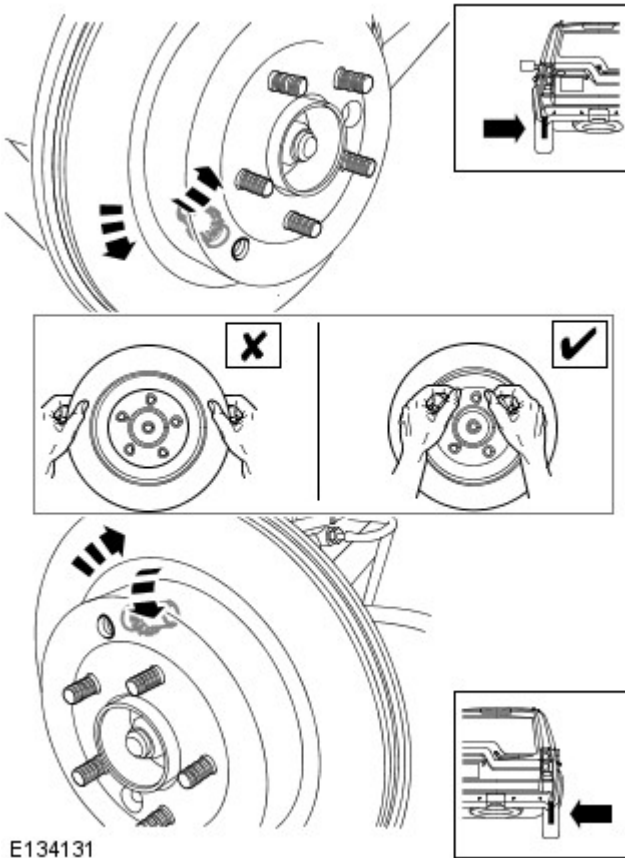
Using a flat blade screwdriver, lever the brake shoes as indicated.



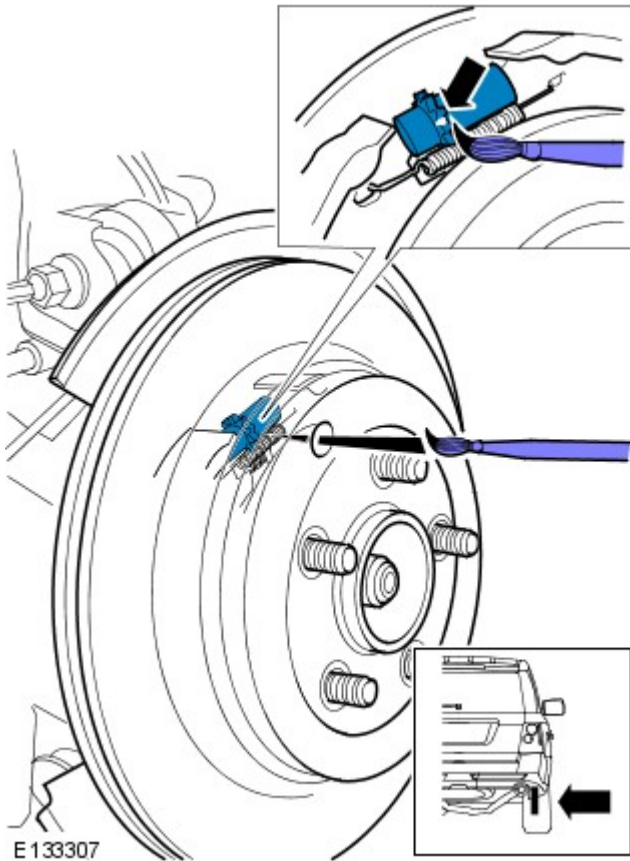
E129557

8.  **CAUTION:** Do not apply excessive force on the brake shoe adjuster. Failure to follow this instruction may result in damage to the parking brake system

Using a flat bladed screwdriver rotate the brake shoe adjuster to extend it until the brake disc is locked hand tight.



E134131



E133307

9. **⚠ CAUTION:** The following steps sets the running clearance for the parking brake shoes, failure to adhere to the paint marking process may cause damage to the park brake system when the adjustment steps are carried out.

Using suitable marker, mark the position of the brake shoe adjuster.

10. **⚠ CAUTION:** The parking brake adjuster must be rotated back EXACTLY one full revolution. Failure to follow this instruction may result in damage to the parking brake system.

Rotate the adjuster back one revolution until paint mark is visible.

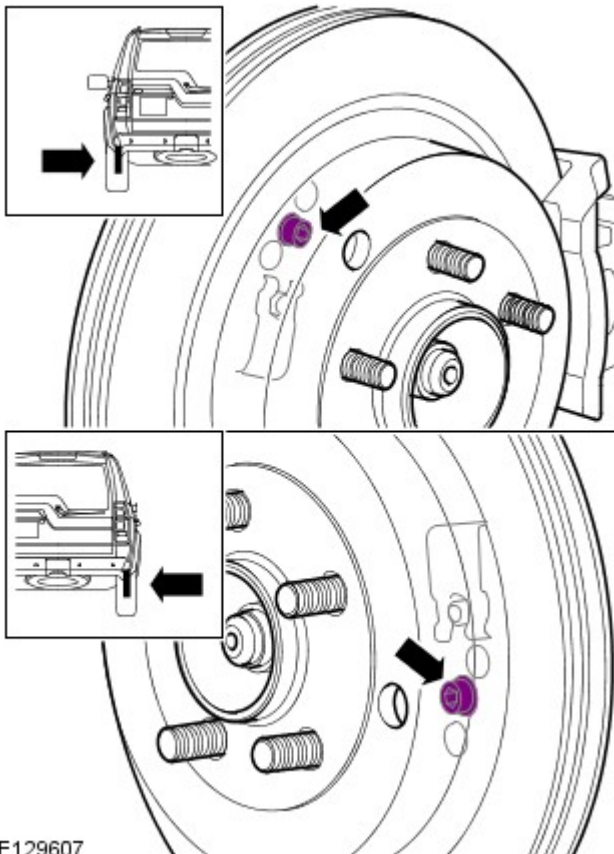
11. **⚠ CAUTION:** The wedge adjuster must be correctly seated to make sure the parking brake cable is correctly adjusted. Failure to follow this instruction may result in damage to the parking brake system.

12. Repeat the above procedure for the other side.
13. **⚠ CAUTION:** If the parking brake shoes or the brake discs have been removed for access to other components then DO NOT carry out this procedure.

14. **⚠ CAUTION:** Loosen the wedge adjuster Allen screw half a turn.

Tap the brake disc lightly with a soft faced mallet, around the parking brake shoe location within the brake disc. Carry out the parking brake shoe bedding-in procedure. For additional information, refer to: [Parking Brake Shoes Bedding-In](#) (206-05 Parking Brake and Actuation General Procedures).

- Tighten the wedge adjuster Allen screw to 8 Nm (5 lb.ft).
- Install the access plug.



E129607

Parking Brake and Actuation - Parking Brake Shoes Bedding-In

General Procedures

• NOTE: This procedure must be carried out if, new parking brake shoes are fitted, new rear brake discs are fitted or if the vehicle has been mud wading (not water) for more than 50 miles.

1. Carry out the parking brake shoe bedding-in procedure.

2. NOTE: The electronic parking brake 'Service Bedding-in Procedure mode' will be active for the remainder of the ignition cycle, or until the vehicle speed exceeds 31 mph (50 kph). If the procedure needs to be re-entered, the entry actions must be repeated.

To enter 'Service Bedding-in Procedure' mode.

- Start and run the engine.
- Apply the footbrake 3 times within 10 seconds and hold applied after the 3rd application.
- Apply the electronic parking brake switch 4 times, followed by 3 release applications within 10 seconds.

3. Once the Service Bedding-in procedure mode has been entered, the electronic parking brake linings can be bedded-in by conducting 10 repeated stops from 30 - 35 kph (19 - 22 mph), followed by a 500 metre (547 yard) interval between each stop to allow the brakes to cool, using the electronic parking brake control switch.

- The electronic parking brake brake force will be increased up to the dynamic maximum so long as the switch is held in the applied position.
- If the switch is released to either the NEUTRAL or OFF positions, the electronic parking brake will be released.
- The electronic parking brake MUST be allowed to cool between applications, either by driving at 19 mph (30 kph) for 500 metres (547 yards) or remaining stationary for 1 minute between each application.

Parking Brake and Actuation - Parking Brake Cable LH

Removal and Installation

Removal



CAUTION: To avoid accidental operation of the parking brake, and possible damage to the parking brake actuator, remove Fusible link 8, located in the engine compartment fuse box before commencing work.

• **NOTE:** If the parking brake system has completed less than 50,000 cycles it is permissible to replace the parking brake cables. If over 50,000 cycles have been completed, then the cables can only be replaced as part of the parking brake actuator and cable assembly. The parking brake cycle count can be checked using the Land Rover approved diagnostic system, (ON/OFF = 1 cycle). If a cable breaks or becomes detached whilst the vehicle is being driven, a 'parking brake actuator unjamming procedure' may be required using the Land Rover approved diagnostic system.

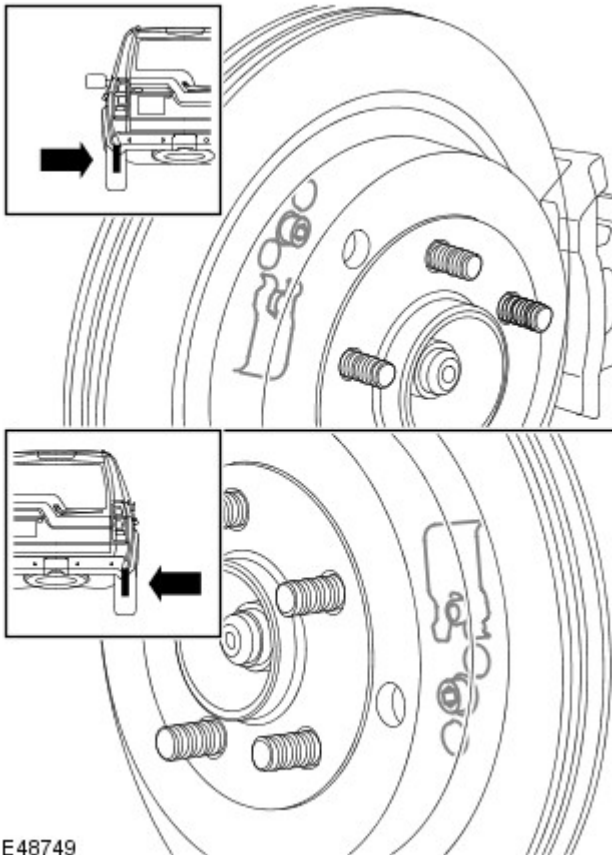
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.
2. Isolate the parking brake electrical circuit.
 - Remove fuse number 8 from the BJB.



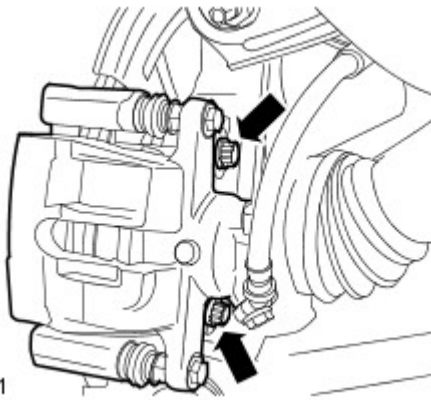
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Remove both rear wheels and tires.
5. Release the parking brake shoe adjustment.
 - Loosen the screw.



E48749

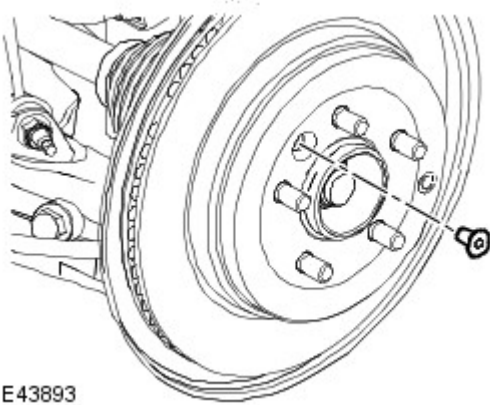


E93861

6.  **CAUTION:** Do not allow the brake caliper to hang on the brake hose.

Reposition the LH rear brake caliper.

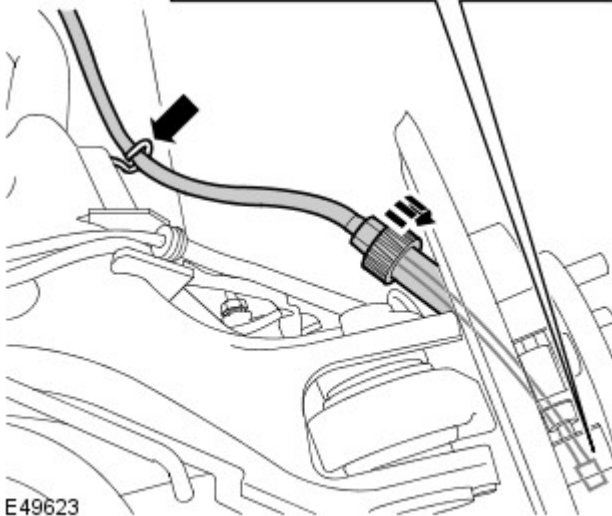
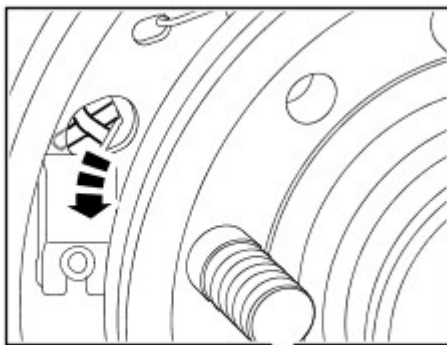
- Remove the 2 bolts.
- Using a suitable tie strap, support the brake caliper.



E43893

7. Remove the LH rear brake disc.

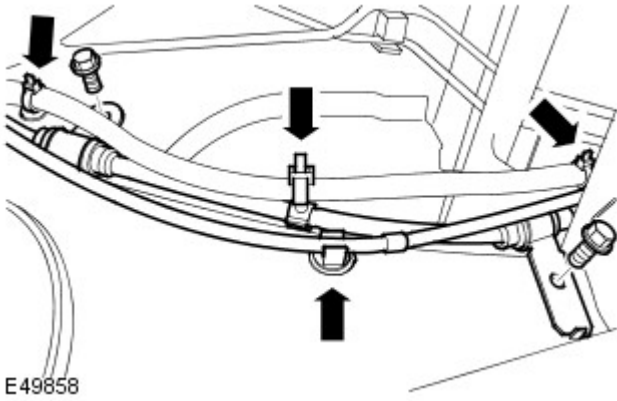
- Remove the screw.



E49623

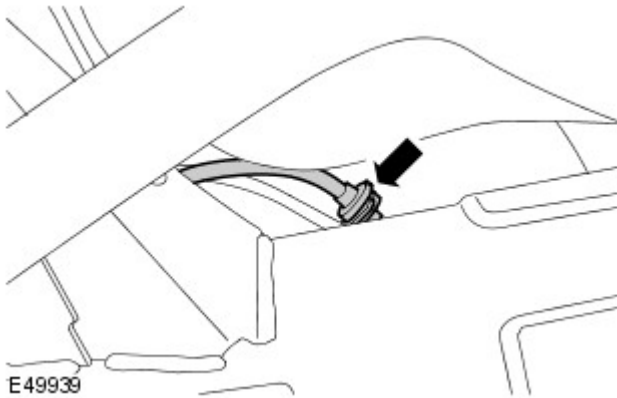
8. Disconnect parking brake cable from the wheel hub.

- Fully loosen the nut.
- Release the cable from the lower arm.
- Disconnect the inner cable from the brake shoe.

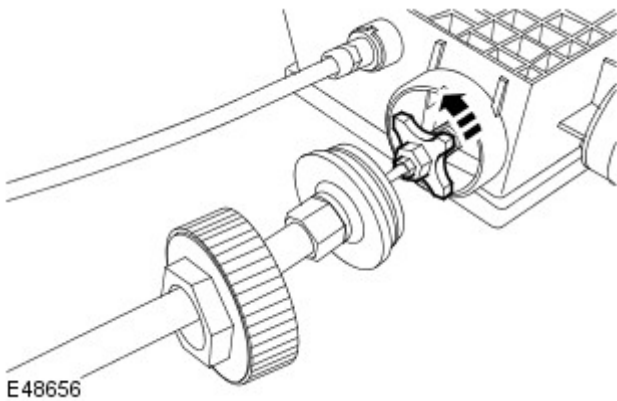


9. Release the LH parking brake cable.

- Remove the 2 bolts.
- Release the 3 wiring harness clips.
- Release the cable from the clip on the chassis.



10. Release the LH parking brake cable.



11. Remove the LH parking brake cable.

- Release the retaining nut.
- Release and remove the cable.

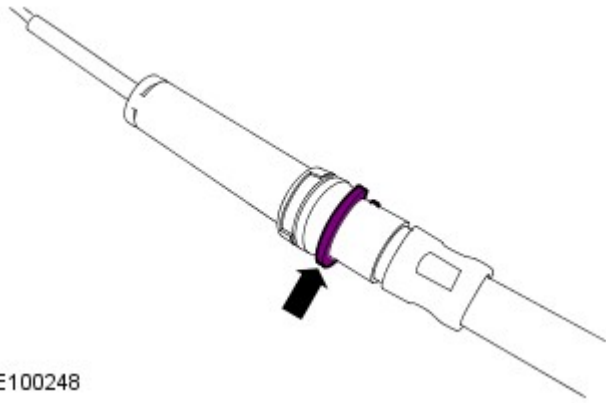
Installation

1. Install the LH parking brake cable.

- LH cable: Screw the cable in 5 complete turns.
- Tighten the retaining nut.

2. Locate and secure the LH parking brake cable.

- Tighten the bolts to 22 Nm (16 lb.ft).
- Secure the wiring harness.
- Secure the cable grommet to the integrated body frame bracket.




E100248

3. NOTE: Make sure that the brake cable circlip is positioned as shown.

Connect the parking brake cable to the wheel hub.

- Connect the cable to the brake shoe lever.
- Locate the cable to the backplate.
- Tighten the nut to 8 Nm (6 lb.ft).

4.  CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

Install the LH rear brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

5. Secure the LH rear brake caliper.

- Remove and discard the tie strap.
- Tighten the bolts to 115 Nm (85 lb.ft).

6. NOTE: The adjustment procedure must be carried out in full.

Adjust the parking brake shoes.

For additional information, refer to: [Parking Brake Shoe and Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).

7. Install the rear wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

8. Install fuse number 8 into the BJB.

Parking Brake and Actuation - Parking Brake Cable RH

Removal and Installation

Removal



CAUTION: To avoid accidental operation of the parking brake, and possible damage to the parking brake actuator, remove Fusible link 8, located in the engine compartment fuse box before commencing work.

• **NOTE:** If the parking brake system has completed less than 50,000 cycles it is permissible to replace the parking brake cables. If over 50,000 cycles have been completed, then the cables can only be replaced as part of the parking brake actuator and cable assembly. The parking brake cycle count can be checked using the Land Rover approved diagnostic system, (ON/OFF = 1 cycle). If a cable breaks or becomes detached whilst the vehicle is being driven, a 'parking brake actuator unjamming procedure' may be required using the Land Rover approved diagnostic system.

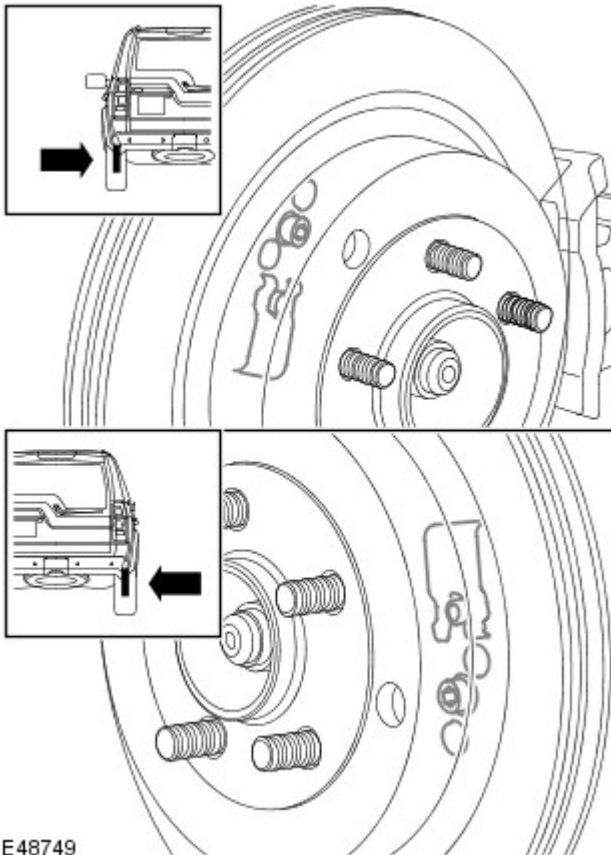
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.
2. Isolate the parking brake electrical circuit.
 - Remove fuse number 8 from the BJB.



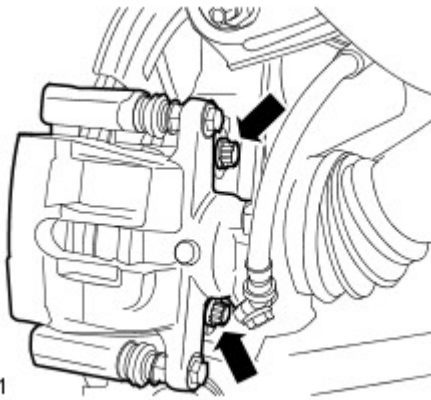
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Remove the wheels and tires.
5. Release the parking brake shoe adjustment.
 - Loosen the screw.



E48749

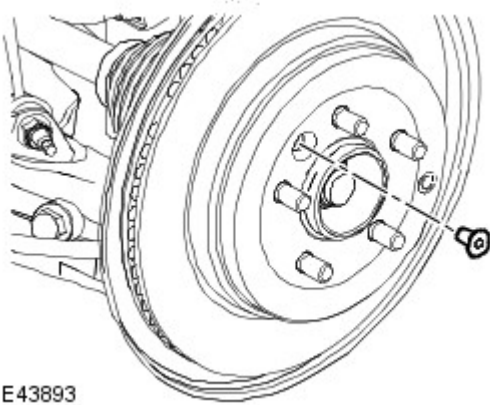


E93861

6.  CAUTION: Do not allow the brake caliper to hang on the brake hose.

Reposition the RH rear brake caliper.

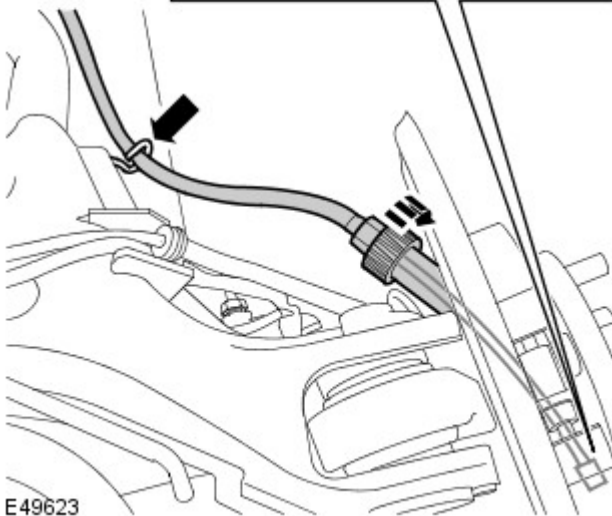
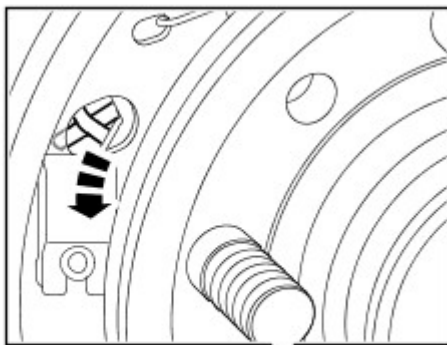
- Remove the 2 bolts.
- Using a suitable tie strap, support the brake caliper.



E43893

7. Remove the RH rear brake disc.

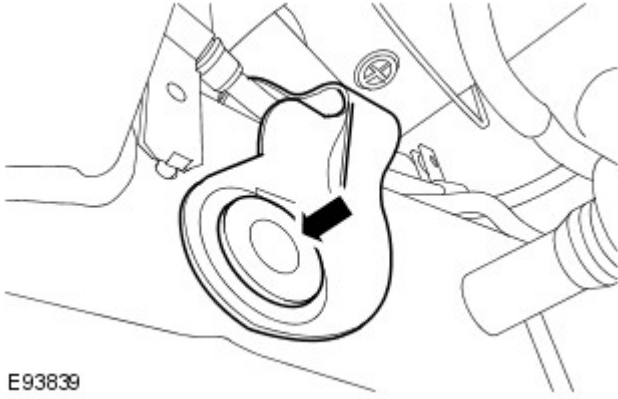
- Remove the screw.




E49623

8. Disconnect parking brake cable from the wheel hub.

- Fully loosen the nut.
- Release the cable from the lower arm.
- Disconnect the inner cable from the brake shoe.

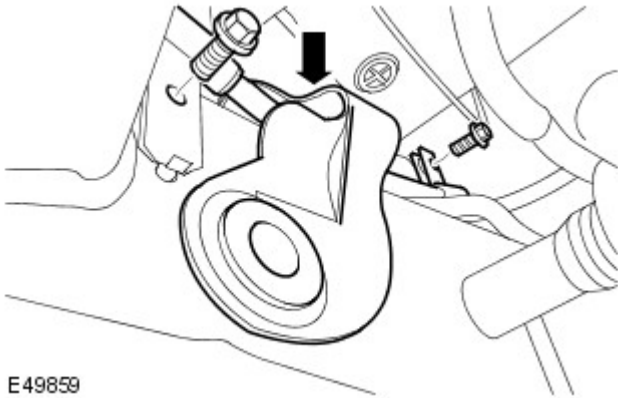


E93839

9.  CAUTION: The fuel tank breather line bracket can be easily damaged when releasing it from the chassis.

Release the fuel tank breather line bracket.

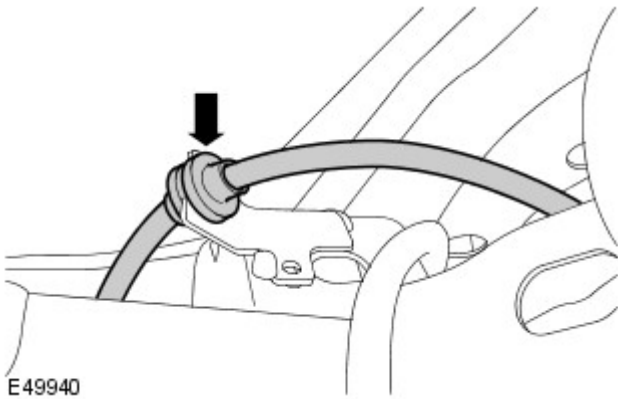
- Remove the plastic insert.



E49859

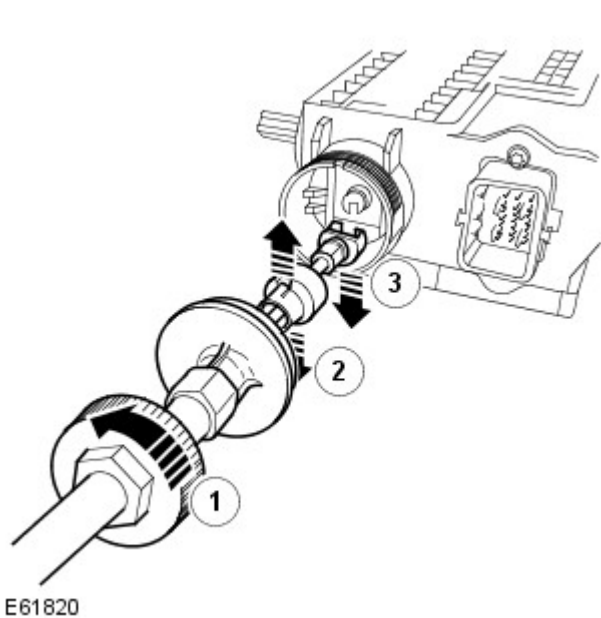
10. Release the RH parking brake cable.


- Remove the 2 bolts.
- Release the parking brake cable from the 2 pipe clips.
- Release the cable from the clip on the chassis.



E49940

11. Release the RH parking brake cable.



12.  **CAUTION:** Make sure that no dirt or moisture enters the actuator during cable replacement.

Remove the RH parking brake cable.

- Release the retaining nut.
- Release the cable retaining clip.
- Release and remove the cable.

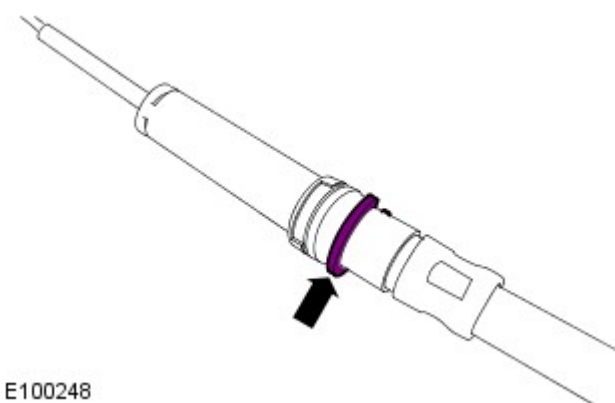
Installation


1. Install the RH parking brake cable.
 - Install the cable.
 - Install the cable retaining clip.
 - Tighten the retaining nut.
2. Secure the fuel tank breather line bracket.
 - Install the plastic insert.
3. Locate and secure the RH parking brake cable.
 - Tighten the bolts to 22 Nm (16 lb.ft).
 - Secure the parking brake cable to the 2 pipe clips.
 - Secure the cable grommet to the integrated body frame bracket.

4. **NOTE:** Make sure that the brake cable circlip is positioned as shown.

Connect the parking brake cable to the wheel hub.

- Connect the cable to the brake shoe lever.
- Locate the cable to the backplate.
- Tighten the nut to 8 Nm (6 lb.ft).



5.  **CAUTION:** Make sure that the component is clean, free of foreign material and lubricant.

Install the RH rear brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

6. Secure the RH rear brake caliper.

NOTE: The adjustment procedure must be carried out in full.

- Remove and discard the tie strap.
- Adjust the parking brake shoes.
- Tighten the bolts to 115 Nm (85 lb.ft).

For additional information, refer to: [Parking Brake Shoe and](#)

[Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).

8. Install the rear wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

9. Install fuse number 8 into the BJB.

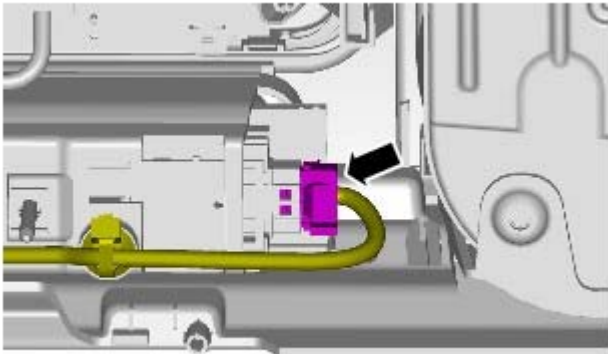
Parking Brake and Actuation - Parking Brake Switch

Removal and Installation

Removal

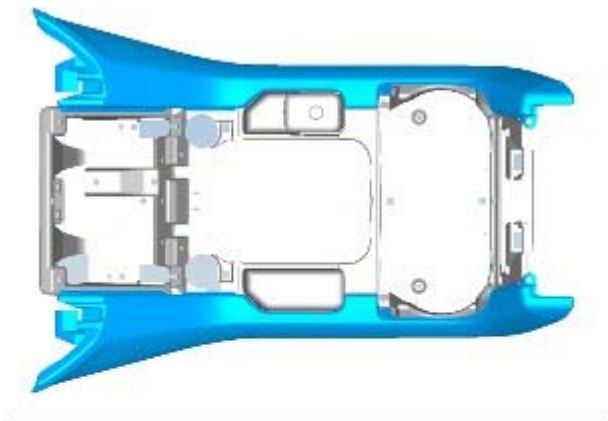
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

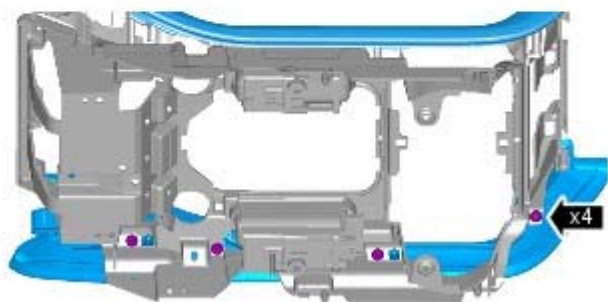


E129852

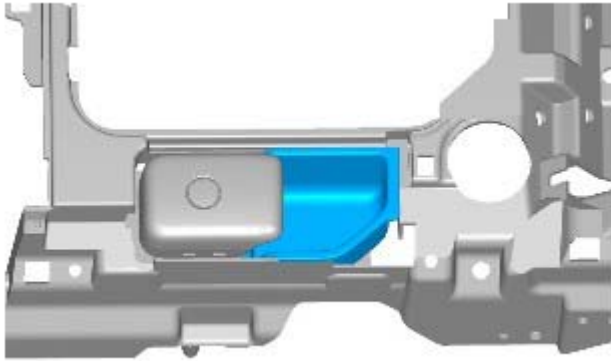
2.



3.

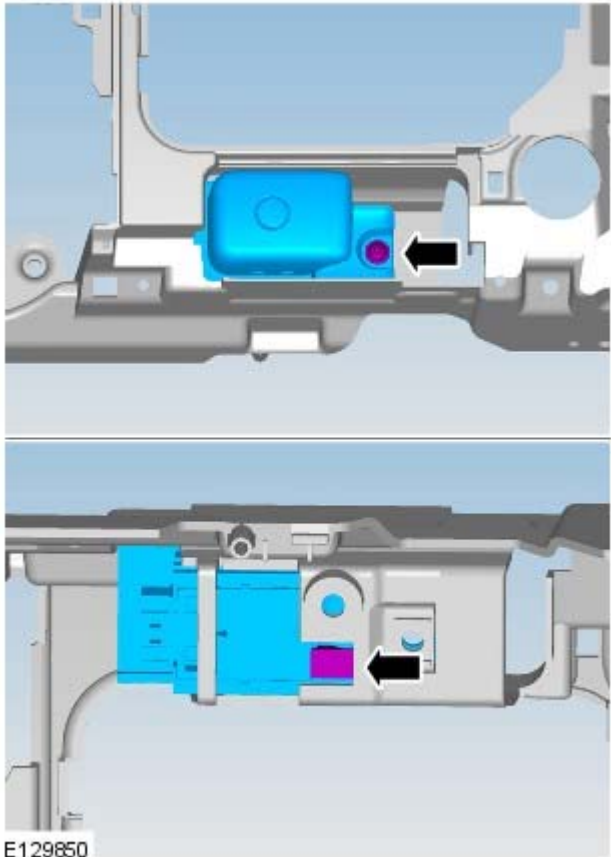


E129849



E129851

4.



E129850

5.

Installation


1. To install, reverse the removal procedure.

Parking Brake and Actuation - Parking Brake Actuator

Removal and Installation

Removal

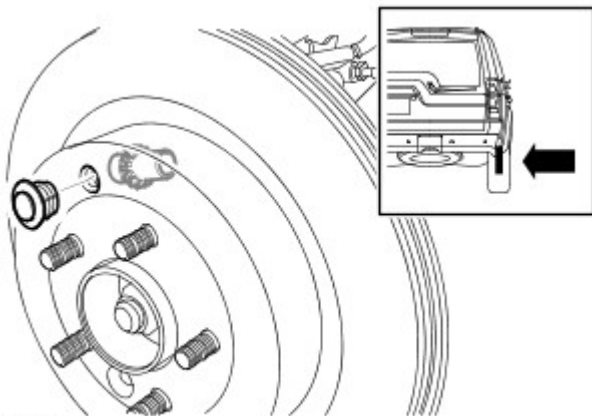
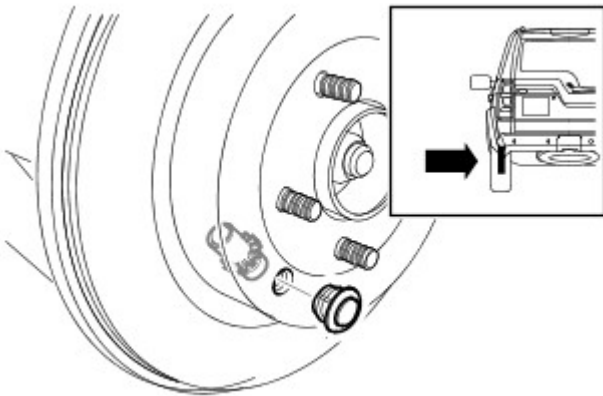
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.
2. Isolate the parking brake electrical circuit.
 - Remove fuse number 8 from the BJB.

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Remove the rear wheels and tires.
5. Release the parking brake shoe adjustment.

- Remove the plug from the access hole in the brake disc.
- Using a suitable tool, rotate the brake shoe adjuster to release the adjustment.

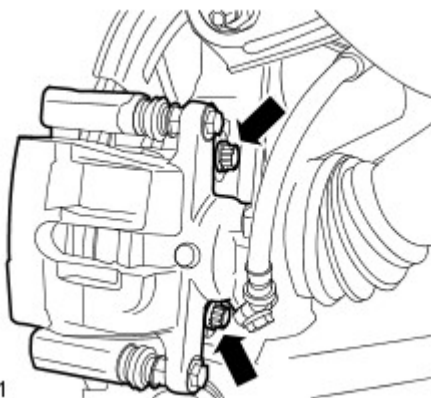


E48748

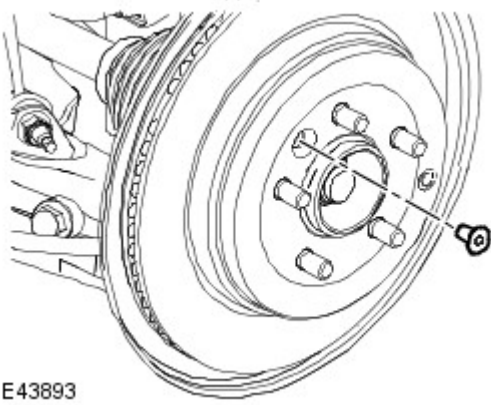
6.  **CAUTION:** Do not allow the brake caliper to hang on the brake hose.

Reposition the RH rear brake caliper.

- Remove the 2 bolts.
- Using a suitable tie strap, support the brake caliper.



E93861



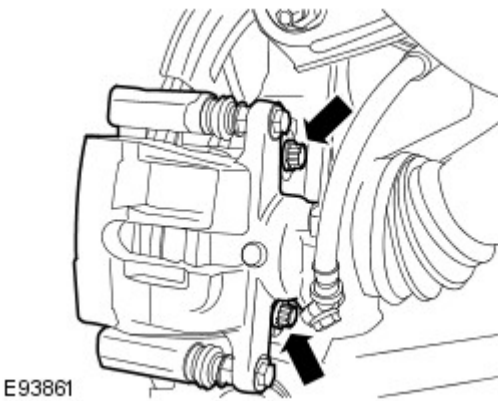
7. Remove the RH rear brake disc.

- Remove the screw.

8.  **CAUTION:** Do not allow the brake caliper to hang on the brake hose.

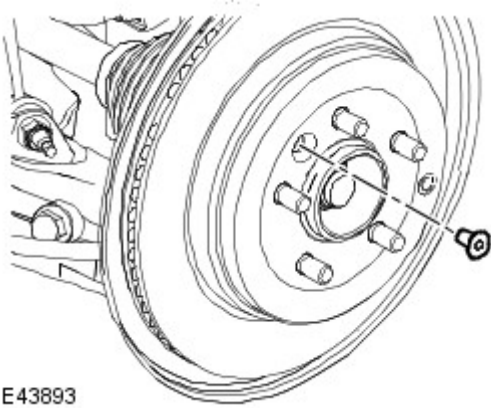
Reposition the LH rear brake caliper.

- Remove the 2 bolts.
- Using a suitable tie strap, support the brake caliper.



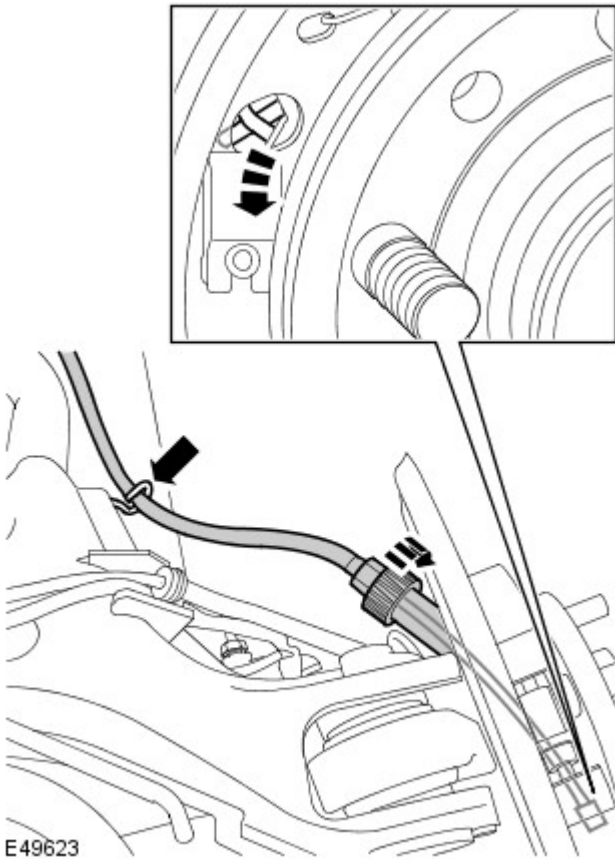
9. Remove the LH rear brake disc.

- Remove the screw.



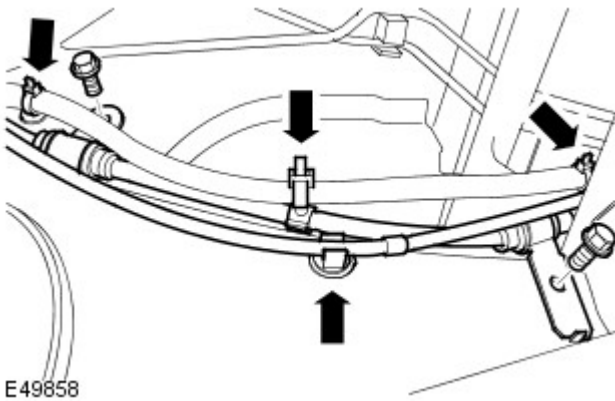
10. Disconnect both parking brake cables from the wheel hubs.

- Fully loosen the nut.
- Release the cable from the lower arm.
- Disconnect the inner cable from the brake shoe.

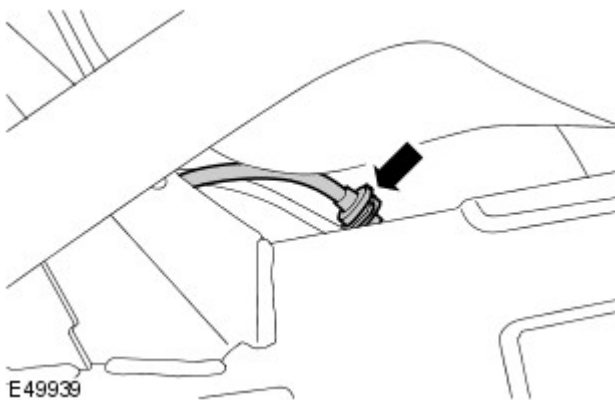


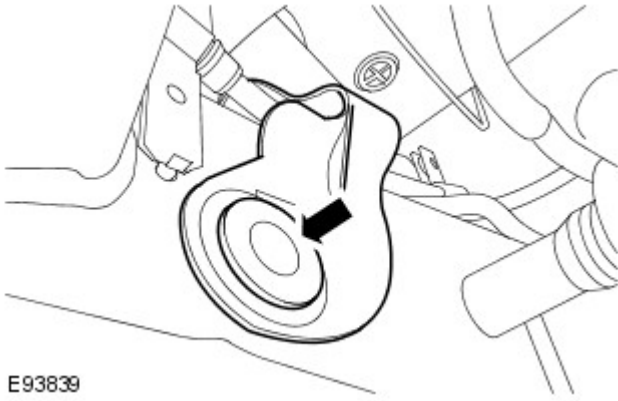
11. Release the LH parking brake cable.

- Remove the 2 bolts.
- Release the 3 wiring harness clips.
- Release the cable from the clip on the chassis.




12. Release the LH parking brake cable.



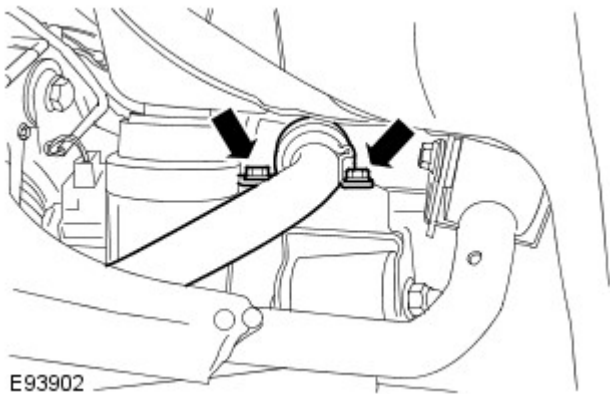


E93839

13.  **CAUTION:** The fuel tank breather line bracket can be easily damaged when releasing it from the chassis.

Release the fuel tank breather line bracket.

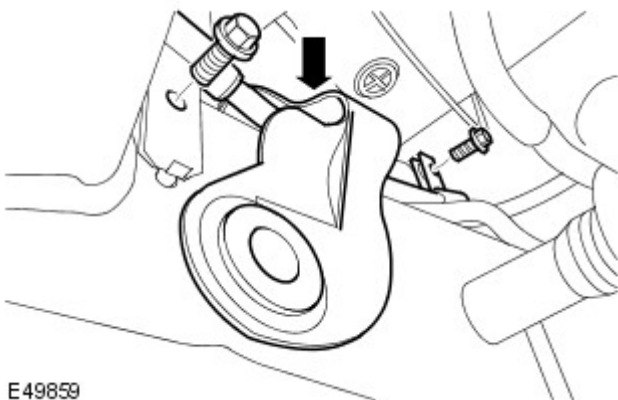
- Remove the plastic insert.



E93902

14. Raise the RH side of the rear stabilizer bar.

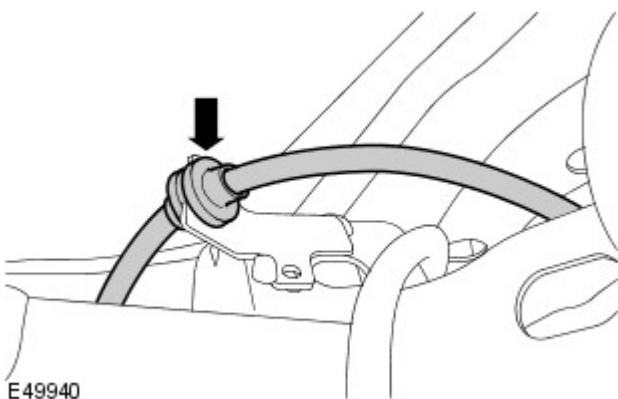
- Loosen the 2 bolts.



E49859

15. Release the RH parking brake cable.

- Remove the 2 bolts.
- Release the parking brake cable from the 2 pipe clips.
- Release the cable from the clip on the chassis.

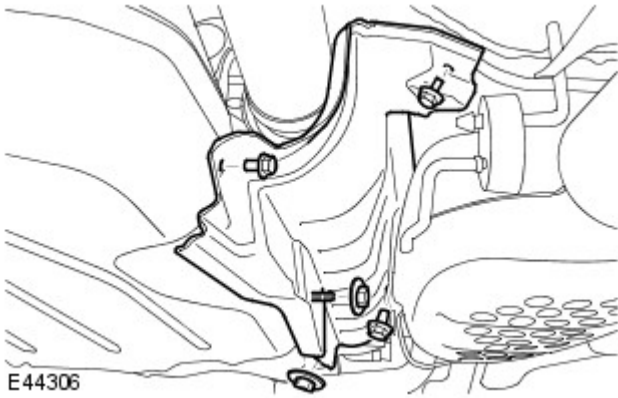


E49940


16. Release the RH parking brake cable.

17. Remove the fuel tank heat shield.

- Remove the 3 bolts and 2 nuts.

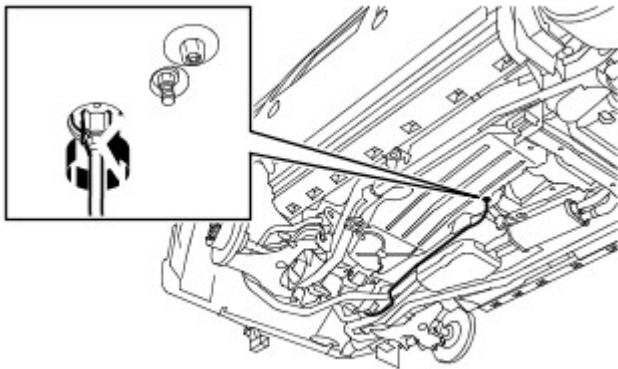


E44306


18.  CAUTION: Inspect the parking brake emergency release cable to body seal and replace if damaged.

- NOTE: Note the fitted position of the parking brake emergency release cable to body seal.

Release the parking brake emergency release cable.

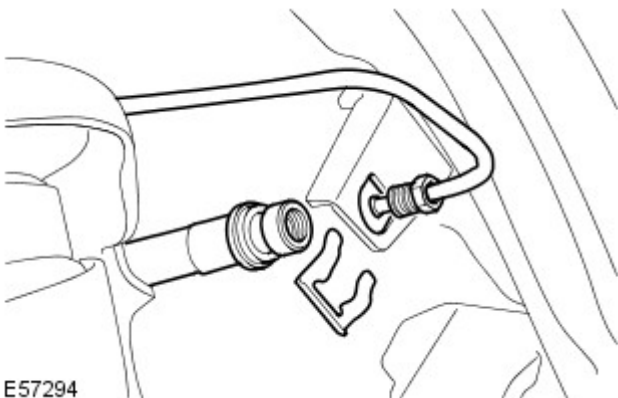


E49860

19.  CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

RH side rear: Disconnect the brake line.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

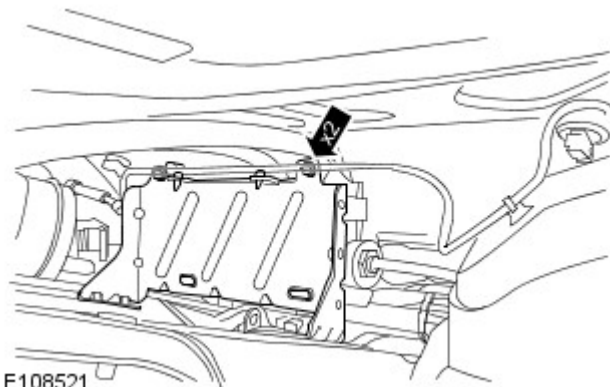


E57294

20. NOTE: Note the routing of the parking brake emergency release cable.

Displace the parking brake actuator and cable assembly.

- Disconnect the electrical connector.
- Remove the 2 nuts.

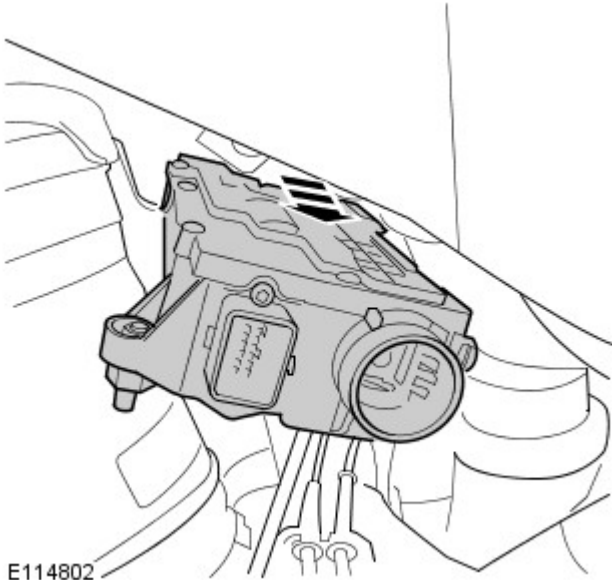


E108521

21. NOTE: Brake cable shown removed for clarity.

Remove the parking brake actuator and cable assembly.

- Withdraw from the RH rear wheel arch aperture.



E114802

Installation

1. NOTE: Note the routing of the parking brake emergency release cable.

Install the parking brake actuator and cable assembly.

- Install the 2 nuts.
- Connect the electrical connector.

2. NOTE: Remove and discard the blanking caps.

RH side rear: Connect the brake line.

- Clean the component mating faces.
- Secure the clip.
- Tighten the brake line union to 16 Nm (12 lb.ft).

3. ⚠ CAUTION: Make sure the parking brake emergency release cable to body seal is installed correctly.

Locate and secure the parking brake emergency release cable.

4. Install the fuel tank heat shield.

- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the nuts to 3 Nm (2 lb.ft).

5. Secure the fuel tank breather line bracket.

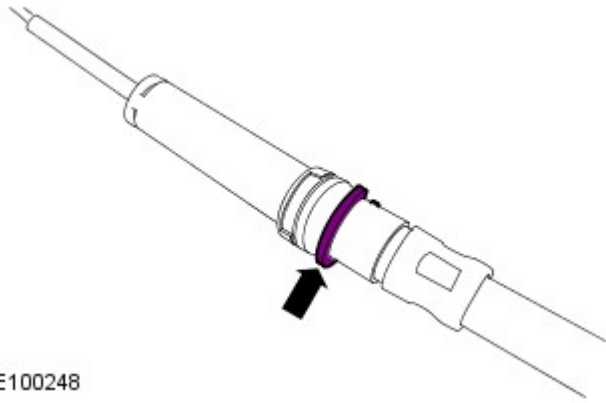
- Install the plastic insert.

6. Locate and secure the RH parking brake cable.

- Tighten the bolts to 22 Nm (16 lb.ft).
- Secure the parking brake cable to the 2 pipe clips.
- Secure the cable grommet to the integrated body frame bracket.

7. Locate and secure the LH parking brake cable.

- Tighten the bolts to 22 Nm (16 lb.ft).
- Secure the wiring harness.
- Secure the cable grommet to the integrated body frame bracket.



E100248

8. NOTE: Make sure that the brake cable circlip is positioned as shown.

Connect the parking brake cables to the wheel hubs.

- Connect the cable to the brake shoe lever.
- Locate the cable to the backplate.
- Tighten the nut to 8 Nm (6 lb.ft).

9. ⚠ CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

Install the LH rear brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

10. Secure the LH rear brake caliper.

- Remove and discard the tie strap.
- Tighten the bolts to 115 Nm (85 lb.ft).

11. ⚠ CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

Install the RH rear brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

12. Secure the RH rear brake caliper.

- Remove and discard the tie strap.
- Tighten the bolts to 115 Nm (85 lb.ft).

13. Adjust the parking brake shoes.

For additional information, refer to: [Parking Brake Shoe and Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).

14. Bleed the brake system.

For additional information, refer to: [Component Bleeding](#) (206-00 Brake System - General Information, General Procedures).

15. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

16. Install fuse number 8 into the BJB.

17. Using the Land Rover approved diagnostic system, calibrate the parking brake actuator on an even surface.

18. Apply and release hand brake to confirm operation.

Parking Brake and Actuation - Parking Brake Shoes

Removal and Installation


Removal

• NOTE: If the parking brake shoes or the brake discs have been removed for access to other components then DO NOT carry out the bedding in procedure.

1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.

2. Isolate the parking brake electrical circuit.

- Remove fuse number 8 from the BJB.

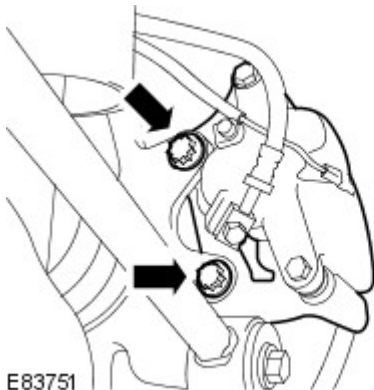
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


4. Remove the wheels and tires.

5. Release the brake caliper.

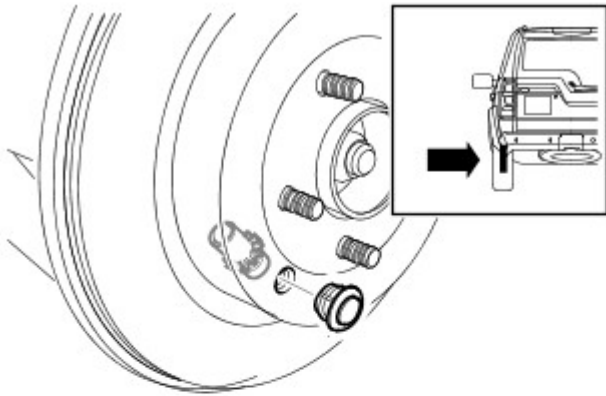
- Remove the brake caliper anchor bolts.



E83751

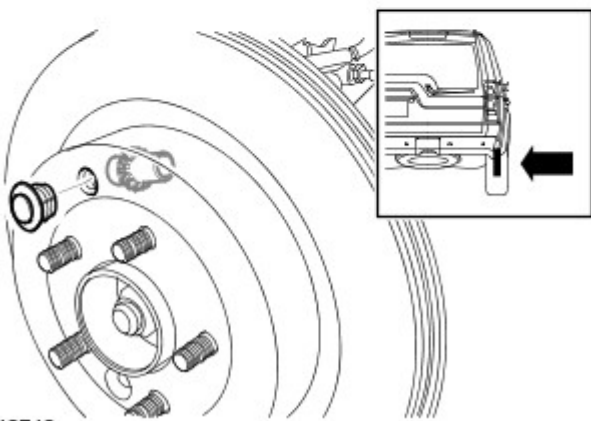
6.  **CAUTION:** Do not allow the brake caliper to hang on the brake hose.

Tie the brake caliper aside.

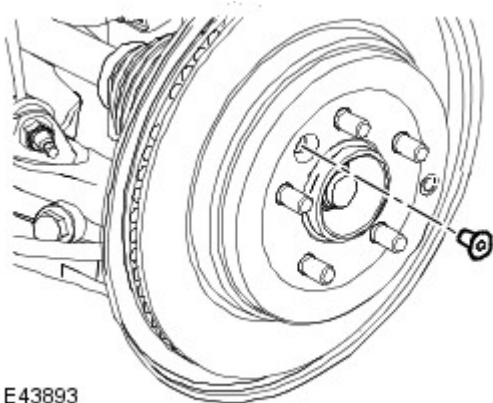


7. Release the park brake shoe adjustment.

- Remove the plug from the access hole in the brake disc.
- Using a suitable tool, rotate the brake shoe adjuster to release the adjustment.



E48748




8. Remove the brake disc.

- Remove the Torx screw.

E43893

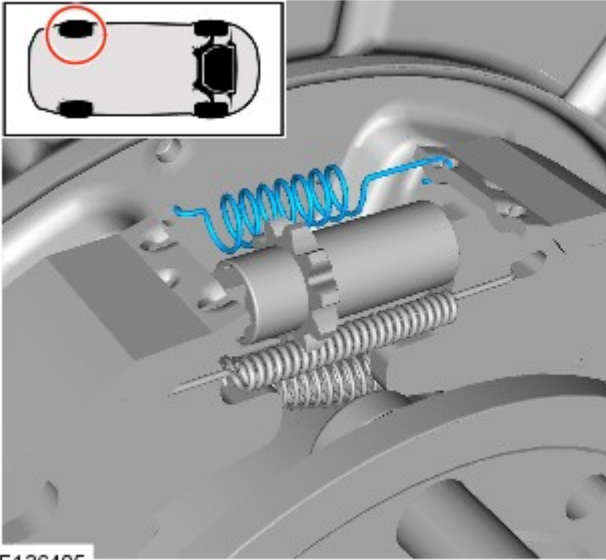
9. CAUTIONS:

 Make sure that the green bias spring is installed to the right hand parking brake shoes and the red bias spring is installed to the left hand parking brake shoes.

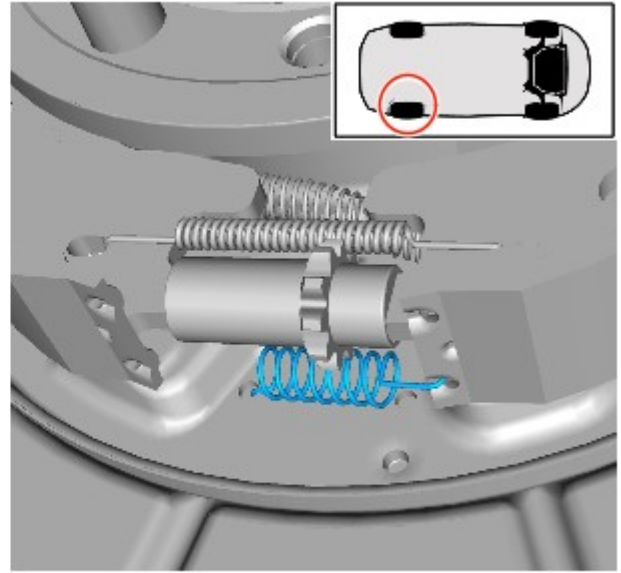
 Make sure the brake shoe spring is not over stretched.

• NOTE: **If equipped.**

Remove the bias spring(s).



E136405



10. Remove the adjuster and return spring.

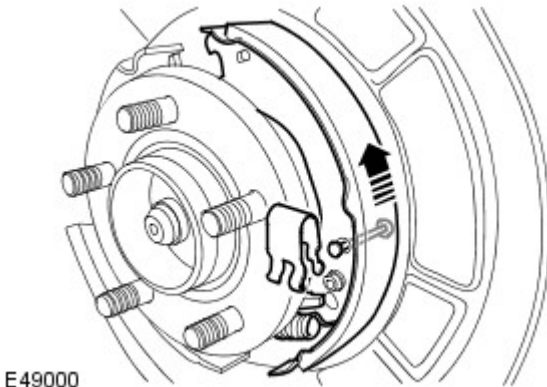
- Release the parking brake shoe adjuster to the minimum adjustment.



E48999

11. Remove the primary brake shoe.

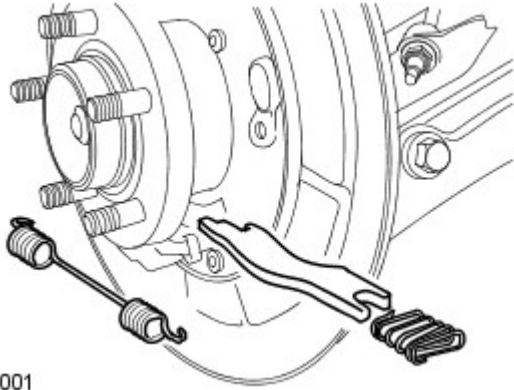
- Remove the hold-down spring and retaining pin.
- Pivot the shoe to release it from the spreader plate and return spring.



E49000

12. Remove the spreader plate and spring.

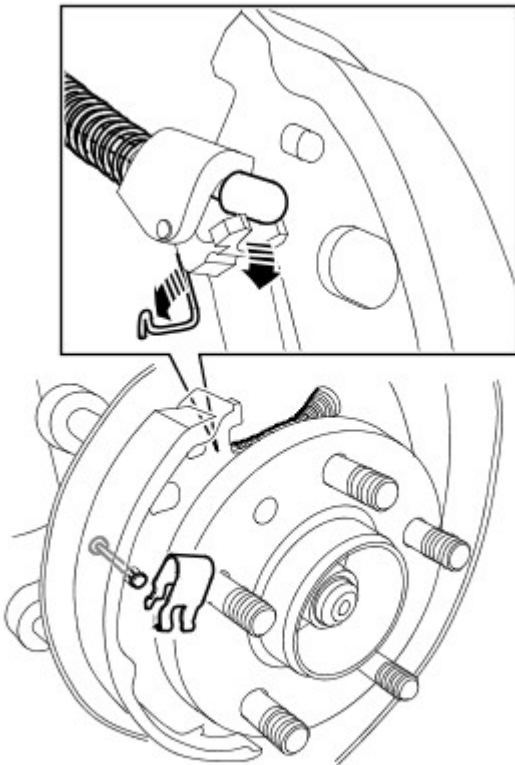
13. Remove the return spring.



E49001

14. Remove the secondary brake shoe.


- Remove the hold-down spring and retaining pin.
- Disconnect the parking brake cable retaining spring from the brake shoe lever.
- Release the parking brake cable.



E49002

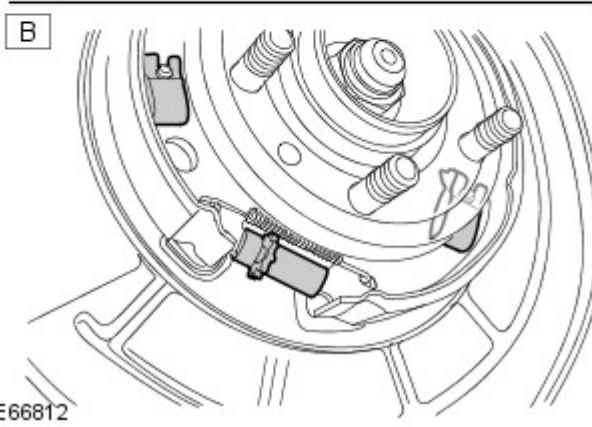
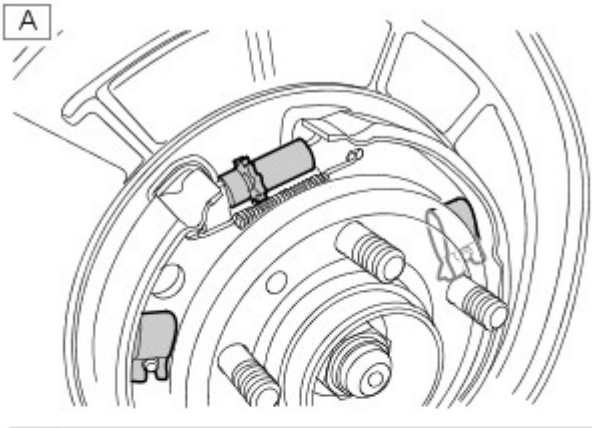
15. Repeat the above procedure for the other side.

Installation

1.  **WARNING:** Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

Clean the backing plate and apply grease to the brake shoe contacts.

2. Clean the adjuster and set it to its minimum extension.



E66812

3. CAUTIONS:

- ⚠ Make sure the brake shoe spring is not over stretched.
- ⚠ Make sure the closed end of the retaining clip is installed facing the brake shoe adjuster. Failure to follow this instruction may result in damage to the vehicle.
- ⚠ Illustration 'A' is the LH side and 'B' is the RH side.

Install the secondary brake shoe.

- Connect the parking brake cable.
- Connect the parking brake cable retaining spring to the brake shoe lever, making sure the spring is not twisted.
- Install the hold-down spring and retaining pin.

4. Install the spreader plate and the spring.

- Using a tie strap, tie back the spreader plate spring.

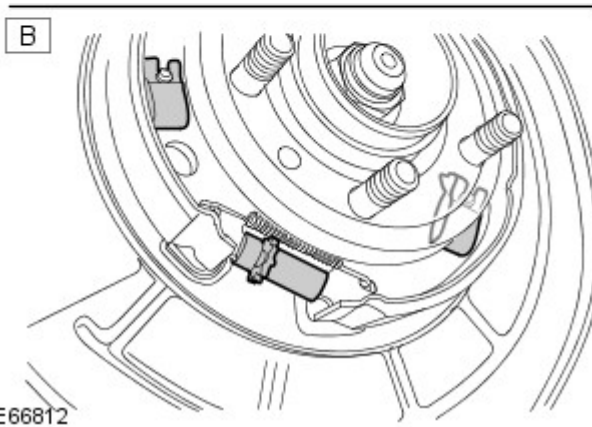
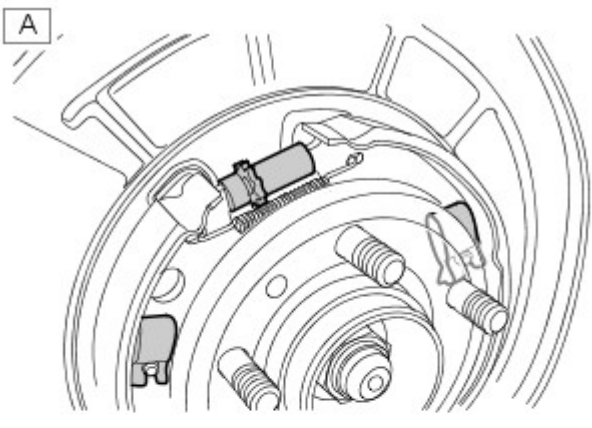
5. ⚠ WARNING: Make sure the return spring and the adjuster spring are correctly installed to the primary shoe.

• CAUTIONS:

- ⚠ Make sure the brake shoe spring is not over stretched.
- ⚠ Make sure the closed end of the retaining clip is installed facing the brake shoe adjuster. Failure to follow this instruction may result in damage to the vehicle.
- ⚠ Illustration 'A' is the LH side and 'B' is the RH side.

Install the primary brake shoe.

- Install the return spring.
- Connect the primary brake shoe to the return spring.
- Locate the primary brake shoe to the spreader plate.
- Install the hold-down spring and retaining pin.



E66812


6. ⚠ CAUTION: Make sure the brake shoe spring is not over

stretched.

Install the brake shoe adjuster and the retaining spring.

7. Remove and discard the spreader plate spring tie strap.

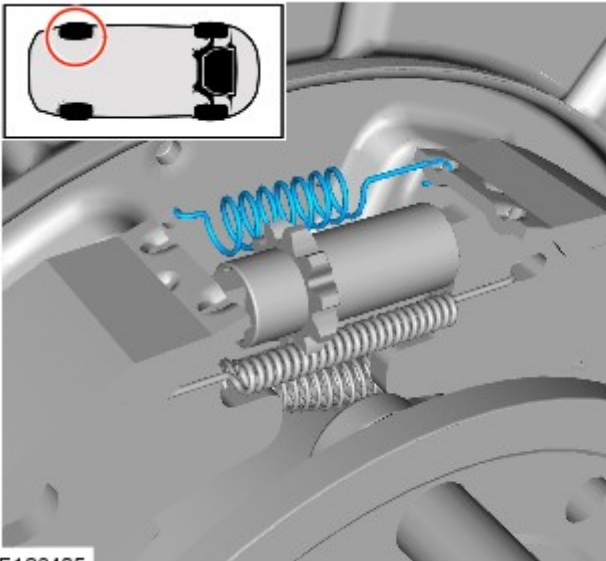
8. CAUTIONS:

 Make sure that the green bias spring is installed to the right hand parking brake shoes and the red bias spring is installed to the left hand parking brake shoes.

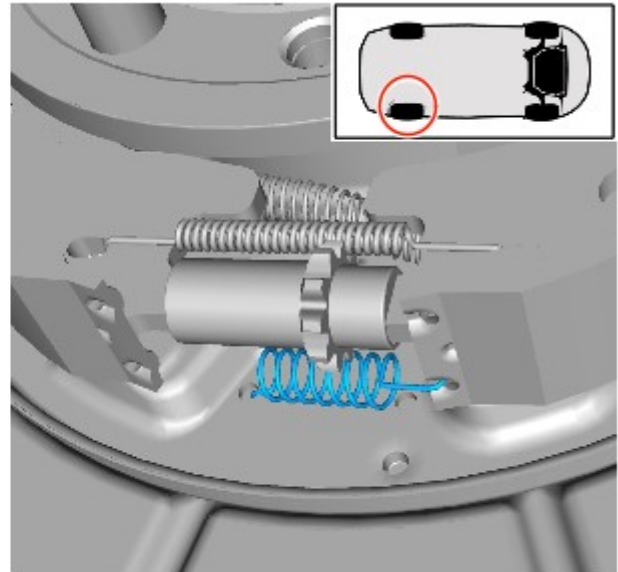
 Make sure the brake shoe spring is not over stretched.

• **NOTE: If equipped.**

Install the bias spring(s).



E136405



9. Make sure the brake disc and hub mating surfaces are clean.

10. Install the brake disc.

- Tighten the Torx screw to 35 Nm (26 lb.ft).

11. Install the brake caliper.

- Tighten the bolts to 115 Nm (85 lb.ft).

12. Repeat the above procedure for the other side.

13. Adjust the parking brake.

For additional information, refer to: [Parking Brake Shoe and Lining Adjustment](#) (206-05 Parking Brake and Actuation, General Procedures).

14. Install the wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

15. Install fuse number 8 into the BJB.

Hydraulic Brake Actuation -

General Specifications

Item	Specification
Master cylinder bore diameter:	
Primary	27 mm (1.1 in)
Secondary	20.6 mm (0.8 in)
Stroke	36 mm (1.4 in)

Torque Specifications

Description	Nm	lb-ft
Brake pedal nut and bolt - Automatic gearbox	45	33
Brake pedal bracket Torx bolts - Automatic gearbox	10	7
Brake booster to brake pedal bracket nuts - Automatic gearbox	25	18
Brake master cylinder nuts	26	19
Brake pipe unions	18	13

Hydraulic Brake Actuation - Hydraulic Brake Actuation

Description and Operation

COMPONENT LOCATIONS

- NOTE: RHD shown, LHD similar



E48285

Item	Part Number	Description
1	-	Brake pedal (automatic shown)
2	-	Brake warning indicator (NAS)
3	-	Brake warning indicator (all except NAS)

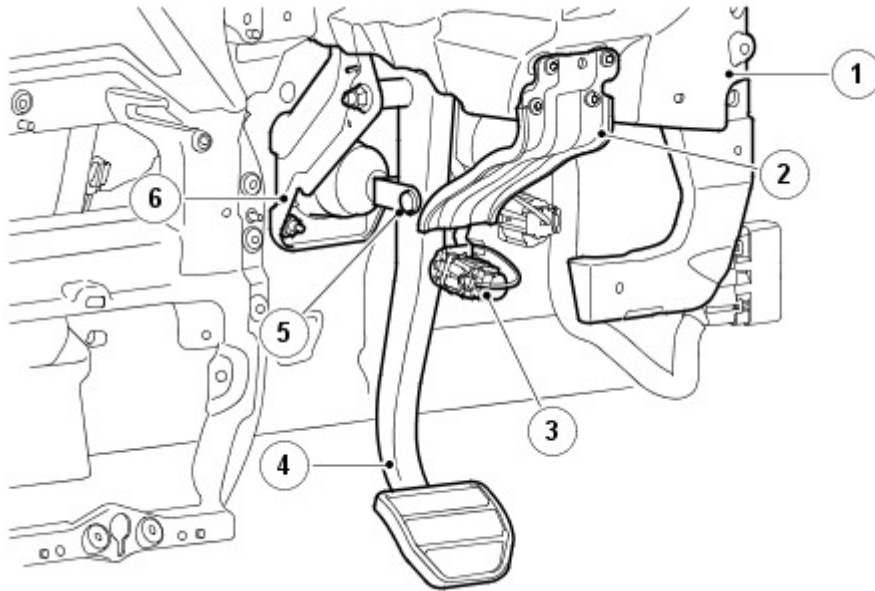
4	-	Brake pipes and hoses
5	-	Brake master cylinder and reservoir

GENERAL

Hydraulic brake actuation consists of the brake pedal, the brake master cylinder and the hydraulic pipes and hoses.

BRAKE PEDAL

- NOTE: Automatic gearbox model shown, manual gearbox model similar



E48286

Item	Part Number	Description
1	-	In-vehicle cross beam
2	-	Brake pedal buffer
3	-	Stoplamp switch
4	-	Brake pedal
5	-	Clevis pin and clip
6	-	Brake pedal bracket

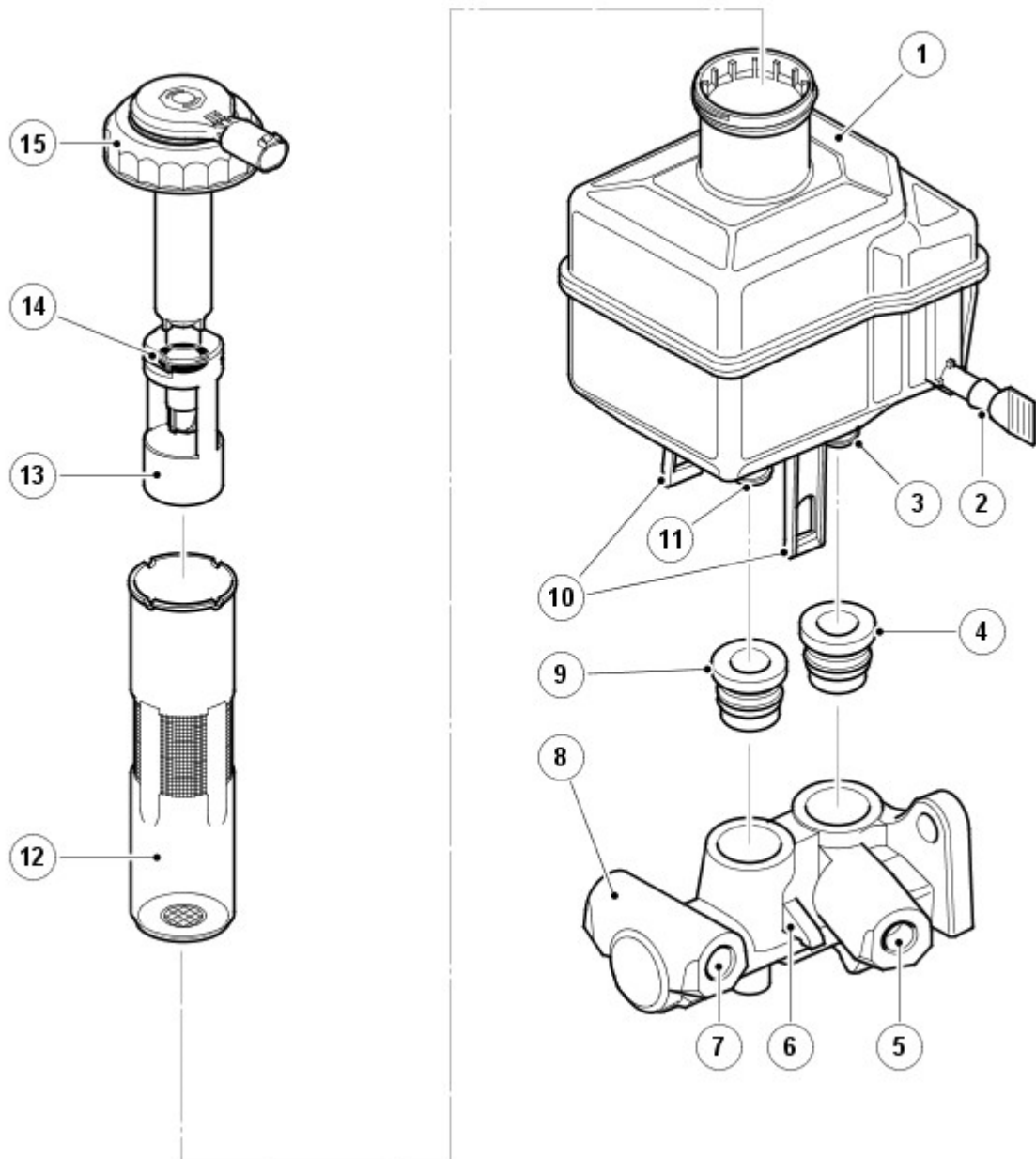
The brake pedal is mounted in a bracket attached to the rear side of the engine bulkhead. On Left Hand Drive (LHD) manual gearbox models, the brake pedal shares a bracket and pivot bolt with the clutch pedal. On Right Hand Drive (RHD) manual gearbox models, the brake pedal has a separate bracket. A clevis pin and clip connect the brake pedal to the push rod of the brake booster. A brake pedal buffer is installed on the in-vehicle cross beam to restrain rearward movement of the brake pedal in an accident.

The stoplamp switch is mounted in the brake pedal bracket and operated by the brake pedal.

For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).

BRAKE MASTER CYLINDER AND RESERVOIR

- NOTE: RHD version shown, LHD version similar



E48287

Item	Part Number	Description
1	-	Reservoir
2	-	Clutch outlet spigot and sealing cap
3	-	Primary outlet spigot
4	-	Reservoir to master cylinder seal, primary inlet
5	-	Primary outlet port
6	-	Reservoir securing lug
7	-	Secondary outlet port
8	-	Cylinder housing
9	-	Reservoir to master cylinder seal, secondary inlet
10	-	Reservoir securing straps
11	-	Secondary outlet spigot
12	-	Filter
13	-	Float
14	-	Magnet
15	-	Reservoir cap and level switch

The brake master cylinder and reservoir is attached to the front of the brake booster, on the driver side of the engine compartment.

Master Cylinder

The brake master cylinder consists of a cylinder housing containing two pistons in tandem. The rear piston produces pressure for the primary circuit and the front piston produces pressure for the secondary circuit. The pistons incorporate center valves with a high flow rate to ensure there is always sufficient fluid available at the hydraulic control unit for stability control operations.

When the brake pedal is pressed, the front push rod in the brake booster pushes the primary piston along the bore of the cylinder housing. This produces pressure in the primary pressure chamber which, in conjunction with the primary spring, overcomes the secondary spring and simultaneously moves the secondary piston along the bore. The initial movement of the pistons, away from the piston stops, closes the primary and secondary center valves. Further movement of the pistons then pressurizes the fluid in the primary and secondary pressure chambers, and thus the brake circuits. The fluid in the chambers behind the pistons is unaffected by the movement of the pistons and can flow unrestricted through the feed holes between the chambers and the reservoir.

When the brake pedal is released, the primary and secondary springs push the pistons back down the bore of the cylinder housing. As the pistons contact the piston stops, the primary and secondary center valves open, which allows fluid to circulate unrestricted between the two hydraulic circuits and the reservoir, through the center valves, the chambers behind the pistons and the cylinder housing inlets.

Should a failure occur in one of the brake circuits, the remaining brake circuit will still operate effectively, although brake pedal travel and vehicle braking distances will increase.

Reservoir

The reservoir is installed on top of the master cylinder to provide a supply of brake fluid for the primary and secondary circuits of the brake system. On manual gearbox models, the reservoir also provides a supply of brake fluid for the clutch. For additional information, refer to: [Clutch Controls](#) (308-02 Clutch Controls - TDV6 2.7L Diesel, Description and Operation).

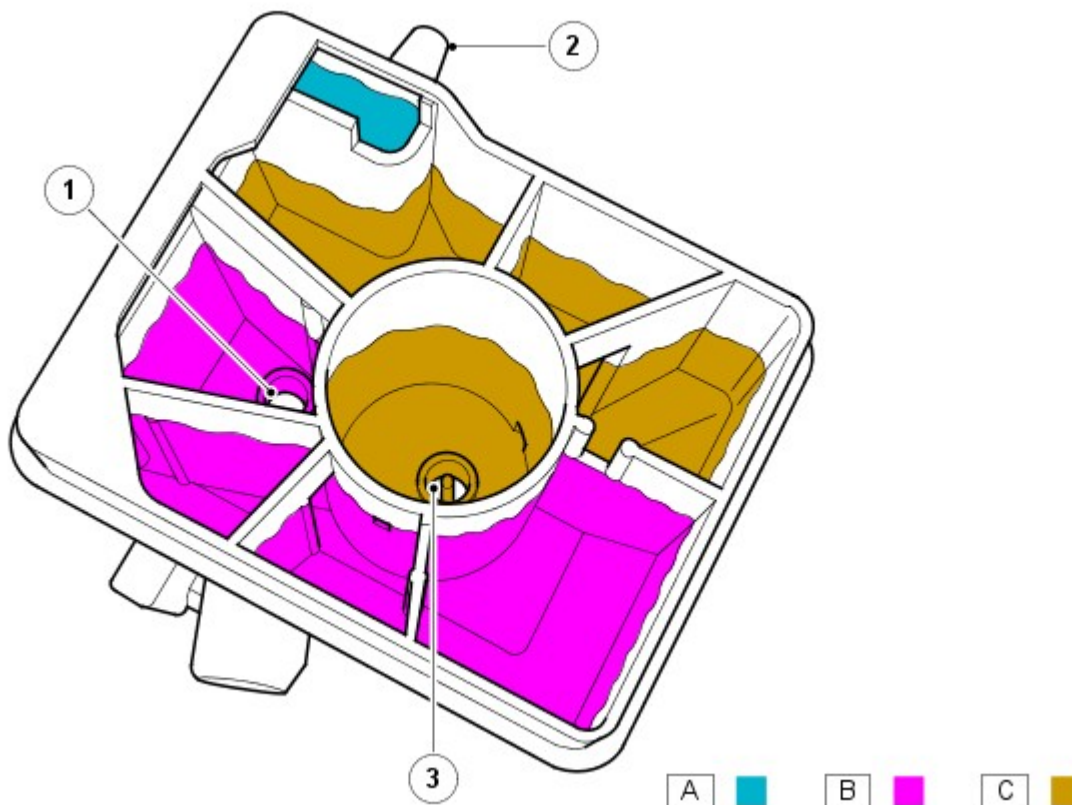
Two straps, integrated onto the sides of the reservoir, engage with lugs on the master cylinder to secure the reservoir in position. Two outlet spigots on the underside of the reservoir locate in seals installed in the inlet ports of the master cylinder. An outlet spigot is installed on the left side of the reservoir for the clutch hydraulic circuit, if required. On automatic gearbox models, the clutch outlet spigot is sealed with a cap, formed during manufacture of the reservoir, which is only removed if the reservoir is installed on a manual gearbox model.

The reservoir is internally divided to isolate the circuits from each other at low fluid levels, and so prevent a leak in one circuit from disabling the other circuit(s). The dividing walls support a central well and divide the area around the well into a further eight separate compartments. The well forms an extension of the filler neck and contains the filter and the fluid level switch.

The well and the surrounding compartments are interconnected by slots in the dividing walls. The slots are positioned such that when the reservoir is full, fluid can move between the well and all of the surrounding compartments, but at low fluid levels the interior forms separate reservoirs for each circuit and the amount retained in each reservoir if there is a leak from one of the other circuits.

Reservoir Interior

- NOTE: A = Clutch reservoir; B = Primary circuit reservoir; C = Secondary circuit reservoir



E48288

Item	Part Number	Description
1	-	Primary outlet
2	-	Clutch outlet
3	-	Secondary outlet

The filler neck of the reservoir is sealed with a cap incorporating the level switch. The level switch is operated by a magnet, which is installed in the float on the bottom of the switch. The switch reacts to the influence of the magnetic field surrounding the magnet.

When the reservoir is full, the float rests against the bottom of the switch and holds the level switch open. When the fluid level decreases, the float moves down and the switch closes to connect a ground to the instrument cluster. When the ground is made, the instrument cluster illuminates the red Light Emitting Diode (LED) in the brake warning indicator. Vehicles with the high line instrument cluster also display an appropriate warning in the message center. For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

At the beginning of each ignition cycle, the instrument cluster performs a bulb check on the brake warning indicator; the indicator is illuminated amber for 1.5 seconds, then red for 1.5 seconds.

The instrument cluster broadcasts the status of the brake fluid level, on the high speed Controller Area Network (CAN) bus, to the Anti-lock Brake System (ABS) module.

For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).

BRAKE PIPES AND HOSES

The brake pipes and hoses connect the master cylinder to the wheel brakes via the hydraulic control unit. The pipes are arranged to provide a front and rear split braking system. The brakes on the front axle are operated by the primary system; the brakes on the rear axle are operated by the secondary system.

Hydraulic Brake Actuation - Brake Fluid Reservoir

Removal and Installation

Removal



CAUTION: Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

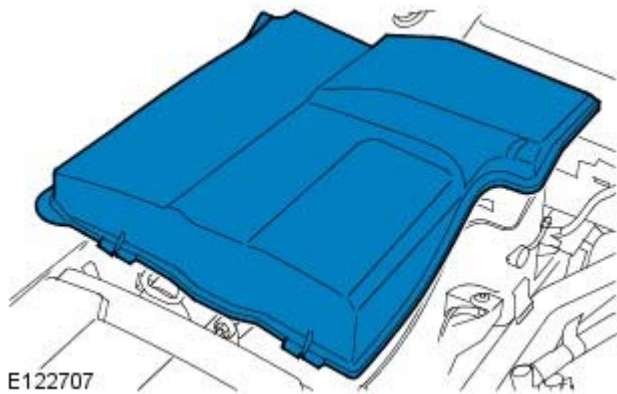
All vehicles



1. WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the cover.



3. Position an absorbent cloth to collect fluid spillage.

4. Disconnect the low brake fluid warning indicator switch electrical connector.

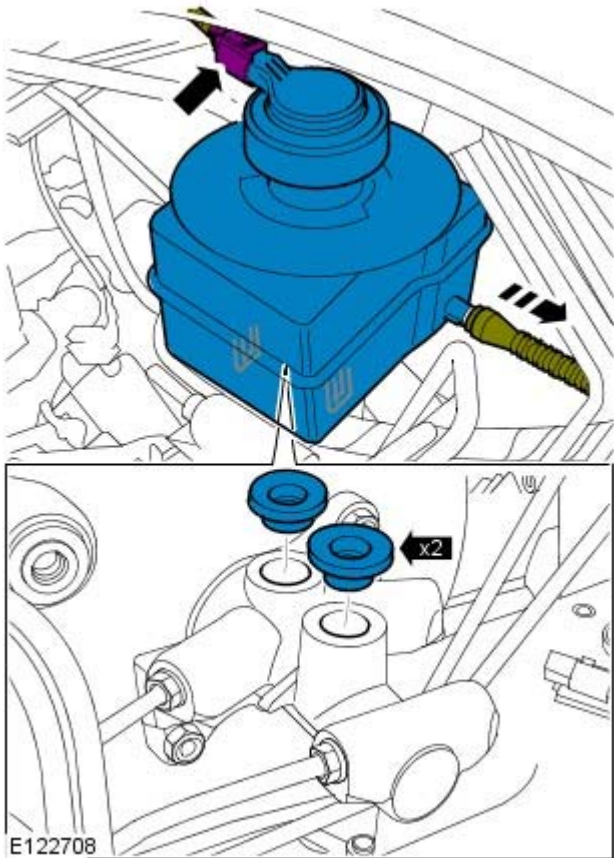
Vehicles with manual transmission



5. CAUTION: Always plug any open connections to prevent contamination.

Disconnect the clutch master cylinder supply line.

All vehicles



6.  CAUTION: Always plug any open connections to prevent contamination.

Remove the brake fluid reservoir.

- Release the 2 clips.
- Remove and discard 2 brake fluid reservoir seals.

Installation

All vehicles

1. Clean the components.
2. Install the brake fluid reservoir.
 - Install new brake fluid reservoir seals.

Vehicles with manual transmission

3. Connect the clutch master cylinder supply line.

All vehicles

4. Connect the low brake fluid warning indicator switch electrical connector.
5. Bleed the brake system using T4.
For additional information, refer to: [Brake System Bleeding](#) (206-00 Brake System - General Information, General Procedures).

Vehicles with manual transmission

6. Bleed the clutch system.
For additional information, refer to: [Clutch System Bleeding](#) (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

Hydraulic Brake Actuation - Brake Master Cylinder


Removal and Installation

Removal

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

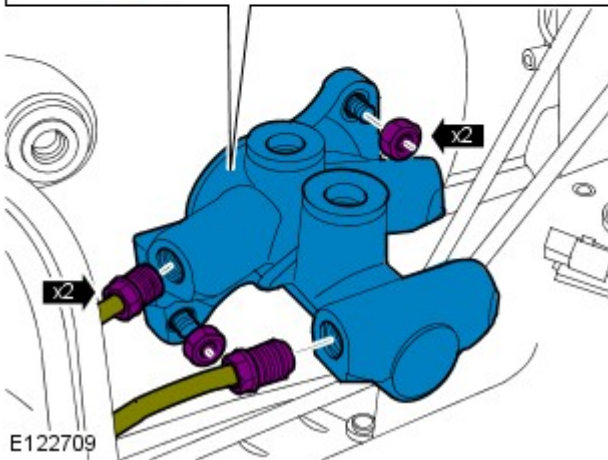
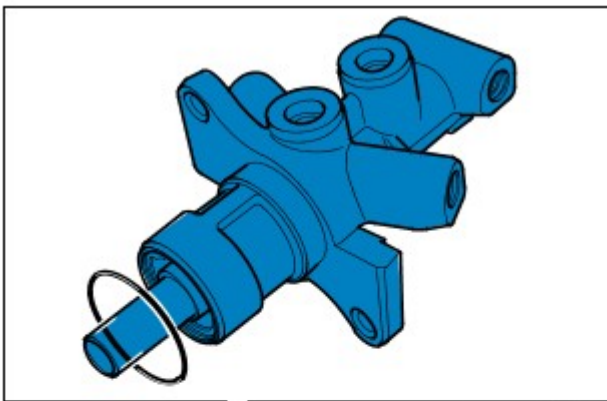
2. Remove the brake fluid reservoir.
For additional information, refer to: [Brake Fluid Reservoir](#) (206-06 Hydraulic Brake Actuation, Removal and Installation).

3.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the brake master cylinder brake tubes.

4. Remove the brake master cylinder.

- Remove the 2 nuts.
- Remove and discard the O-ring seal.



Installation

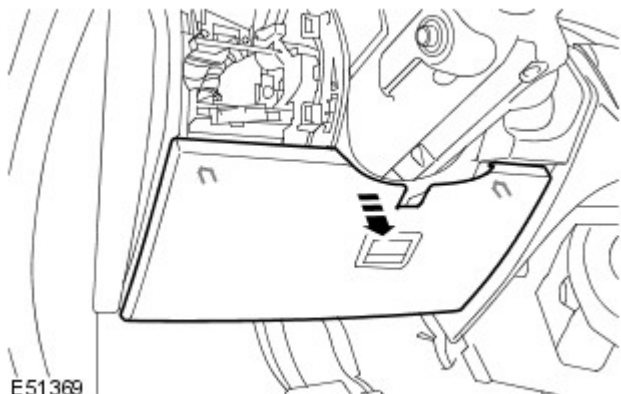
1. Install the brake master cylinder.
 - Install a new O-ring seal.
 - Tighten the nuts to 23 Nm (17 lb.ft).
2. Connect the brake tubes.
 - Tighten the brake tube unions to 18 Nm (13 lb.ft).
3. Install the brake fluid reservoir.
For additional information, refer to: [Brake Fluid Reservoir](#) (206-06 Hydraulic Brake Actuation, Removal and Installation).

Hydraulic Brake Actuation - Brake Pedal Vehicles With: 6HP28 6-Speed Automatic Transmission/6HP26 6-Speed Automatic Transmission

Removal and Installation

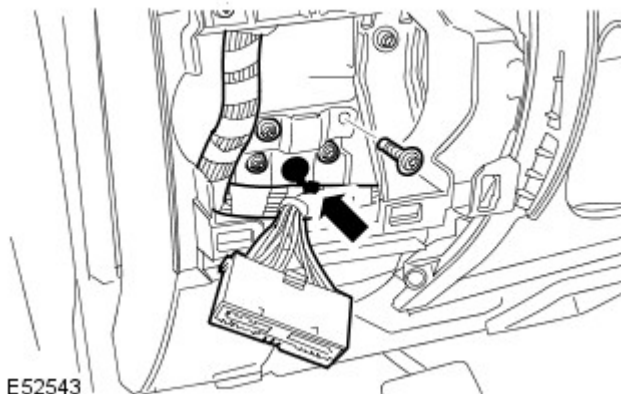
Removal

1. Remove the headlamp switch.
For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).
2. Remove the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).
3. Remove the instrument panel access panel.
 - Release the 2 clips.



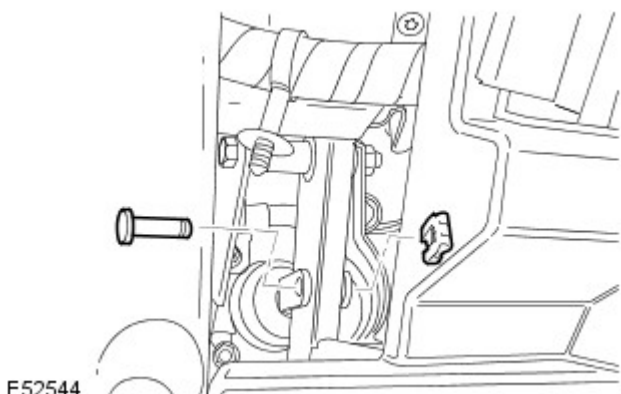
E51369

4. Remove the brake pedal bracket.
 - Release the wiring harness clip.
 - Remove the 4 Torx bolts.



E52543

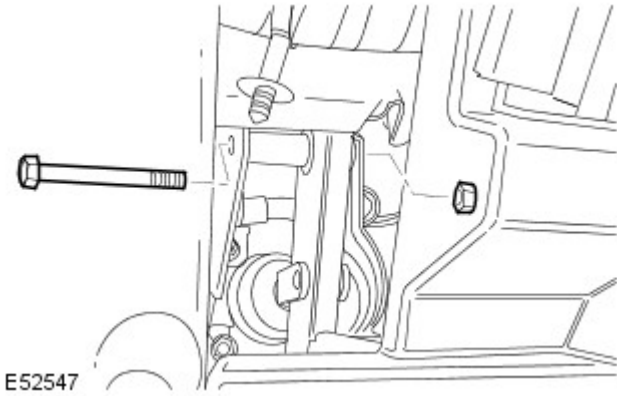
5. Remove the brake pedal clevis pin.
 - Remove the clip.



E52544

6. Remove the brake pedal.

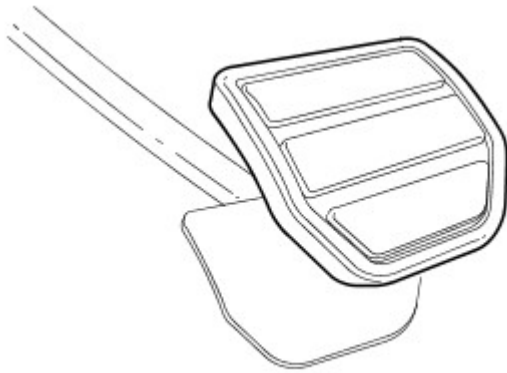
- Remove the nut and bolt.



E52547

7. NOTE: Do not disassemble further if the component is removed for access only.

Remove the brake pedal pad.



E52548

Installation

1. Install the brake pedal pad.
2. Install the brake pedal.
 - Clean the component mating faces.
 - Tighten the nut and bolt to 45 Nm (33 lb.ft).
3. Install the brake pedal clevis pin.
 - Install the clip.
4. Install the brake pedal bracket.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
 - Secure the wiring harness.
5. Install the instrument panel access panel.
 - Secure with the clips.
6. Install the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).
7. Install the headlamp switch.
For additional information, refer to: [Headlamp Switch](#) (417-01, Removal and Installation).

Hydraulic Brake Actuation - Brake Pedal and Bracket Vehicles With: S6-53 6-Speed Manual Transmission

Removal and Installation

Removal

• NOTE: The brake pedal, clutch pedal and bracket is serviced as a complete assembly. The procedure to remove and install the assembly is shown in the clutch pedal procedure.

1. Remove the clutch and brake pedal assembly.
For additional information, refer to: [Clutch Pedal](#) (308-02 Clutch Controls - TDV6 2.7L Diesel, Removal and Installation).

Installation

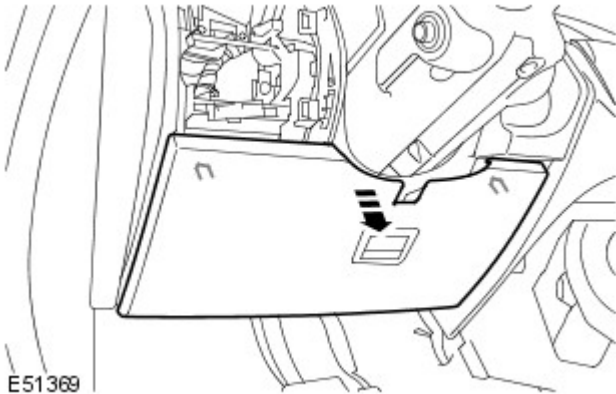
1. Install the clutch and brake pedal assembly.
For additional information, refer to: [Clutch Pedal](#) (308-02 Clutch Controls - TDV6 2.7L Diesel, Removal and Installation).

Hydraulic Brake Actuation - Brake Pedal and Bracket Vehicles With: 6HP28 6-Speed Automatic Transmission/6HP26 6-Speed Automatic Transmission

Removal and Installation

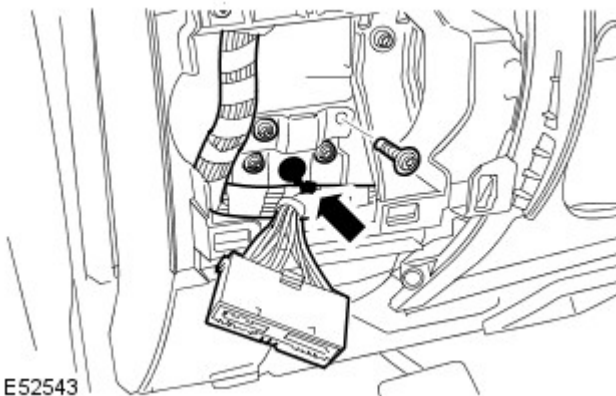
Removal

1. Remove the headlamp switch.
For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).
2. Remove the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).
3. Remove the instrument panel access panel.
 - Release the 2 clips.



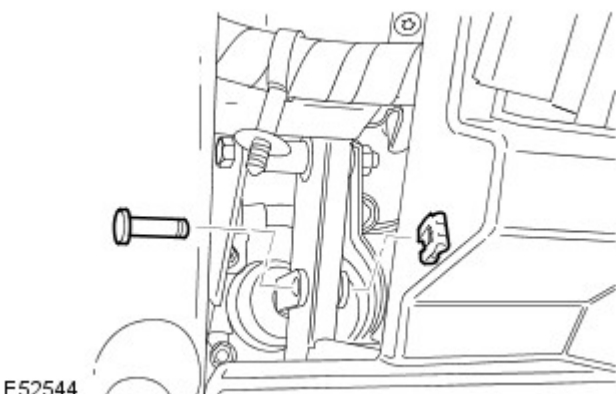
E51369

4. Remove the brake pedal bracket.
 - Release the wiring harness clip.
 - Remove the 4 Torx bolts.

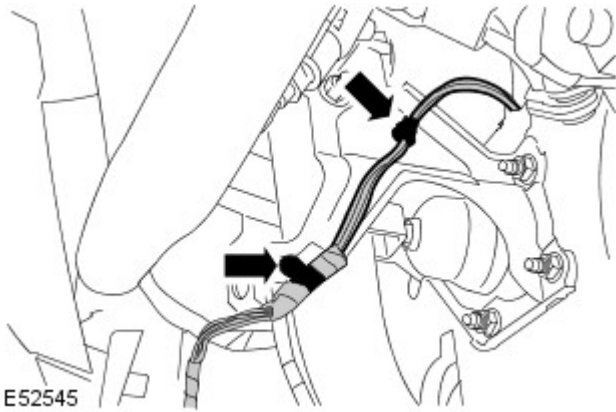


E52543

5. Remove the brake pedal clevis pin.
 - Remove the clip.

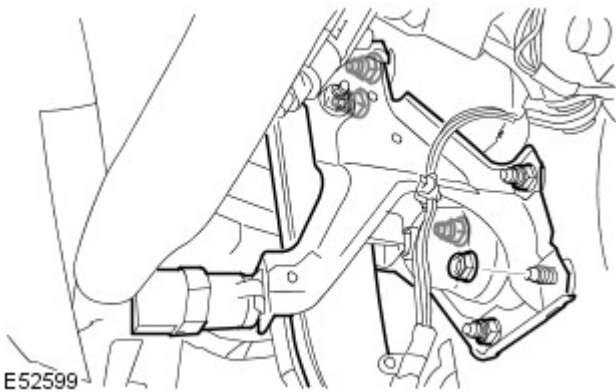


E52544



6. Release the stoplamp wiring harness.

- Release the 2 clips.



7. Remove the brake pedal assembly.

- Remove the 6 nuts.
- Position the brake booster forward to aid the removal of the brake pedal assembly.

Installation

1. Install the brake pedal assembly.

- Position the brake booster to the brake pedal bracket.
- Tighten the nuts to 25 Nm (18 lb.ft).

2. Secure the wiring harness.

- Secure the clips.

3. Install the brake pedal clevis pin.

- Install the clip.

4. Install the brake pedal bracket.

- Tighten the Torx bolt to 10 Nm (7 lb.ft).
- Secure the wiring harness.

5. Install the instrument panel access panel.

- Secure with the clips.

6. Install the stoplamp switch.

For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

7. Install the headlamp switch.

For additional information, refer to: [Headlamp Switch](#) (417-01, Removal and Installation).

Power Brake Actuation -**Sealant**

Application	Land Rover Part No.
Brake vacuum pump - 2.7 Litre engine	8510302

General Specifications

Item	Specification
Brake booster type	Twin chamber 228 and 254 mm (9.0 and 10.0 in)
Boost ratio	7:1
Brake vacuum pump make and type:	
V6 - 2.7 litre diesel engine	Bosch 240cc SWP
V6 - 4.0 litre and V8 - 4.4 litre petrol engine	Hella UP28

Torque Specifications

Description	Nm	lb-ft
Brake booster nut	23	17
Brake master cylinder nuts	26	19
M12 brake pipe unions	16	12
M14 brake pipe unions	18	13
Brake pedal buffer bolts	10	7
Brake vacuum pump nuts - 4.0 and 4.4 litre engines	5	4
Brake vacuum pump bolts - 2.7 litre engine	23	17
Brake vacuum pump retaining stud - 2.7 litre engine	13	10
Brake vacuum pump retaining nut - 2.7 litre engine	13	10
High pressure fuel supply line retaining bolt - 2.7 litre engine	10	7
* Exhaust cross-over pipe nuts 2.7 litre engine	22	16
Exhaust cross-over pipe support bracket bolts - 2.7 litre	25	18
Exhaust manifold heatshield bolt - 2.7 litre	10	7

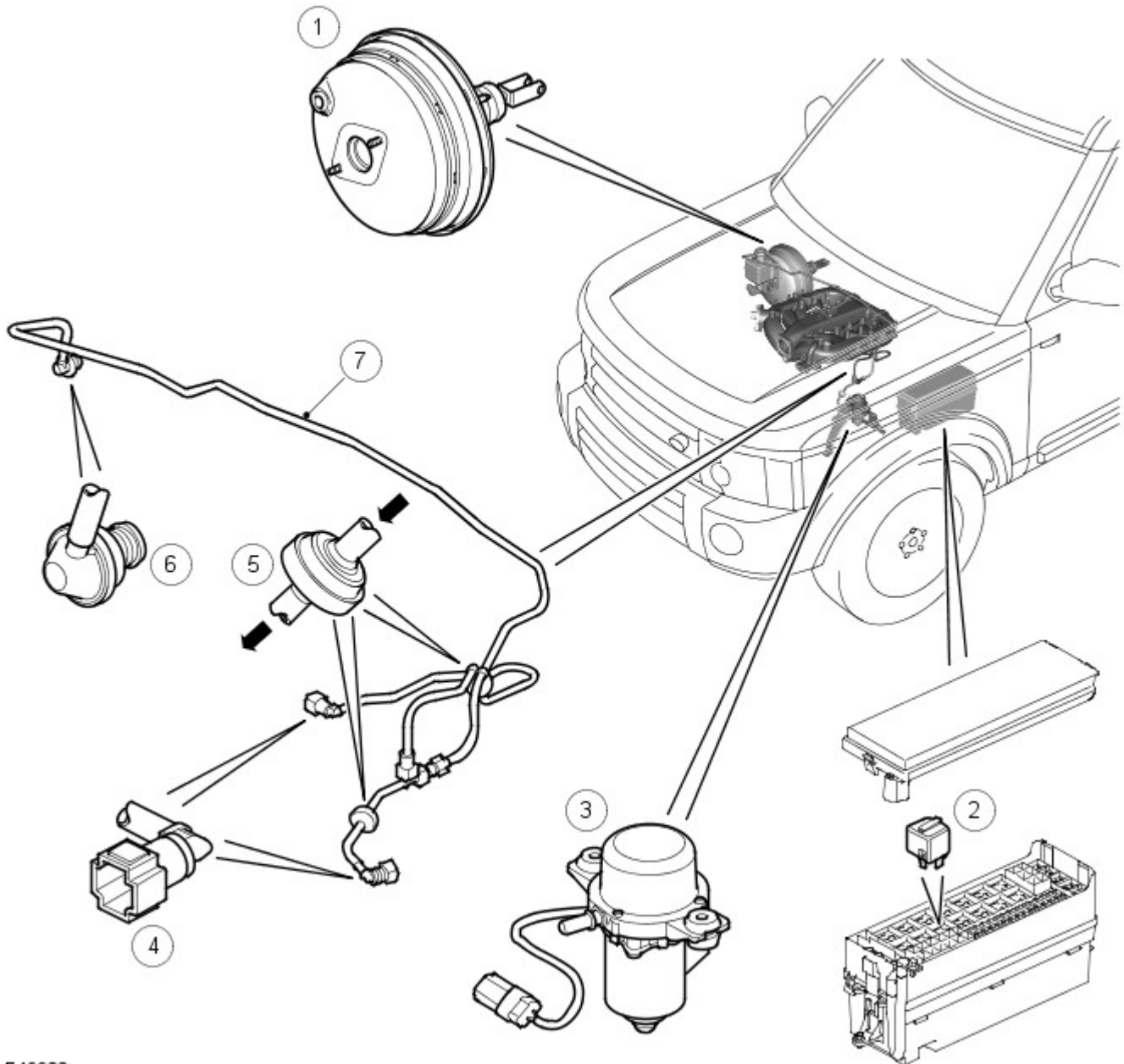
* **New nuts must be fitted**

Power Brake Actuation - Brake Booster

Description and Operation

COMPONENT LOCATIONS - 4.0L

• NOTE: RHD shown, LHD similar

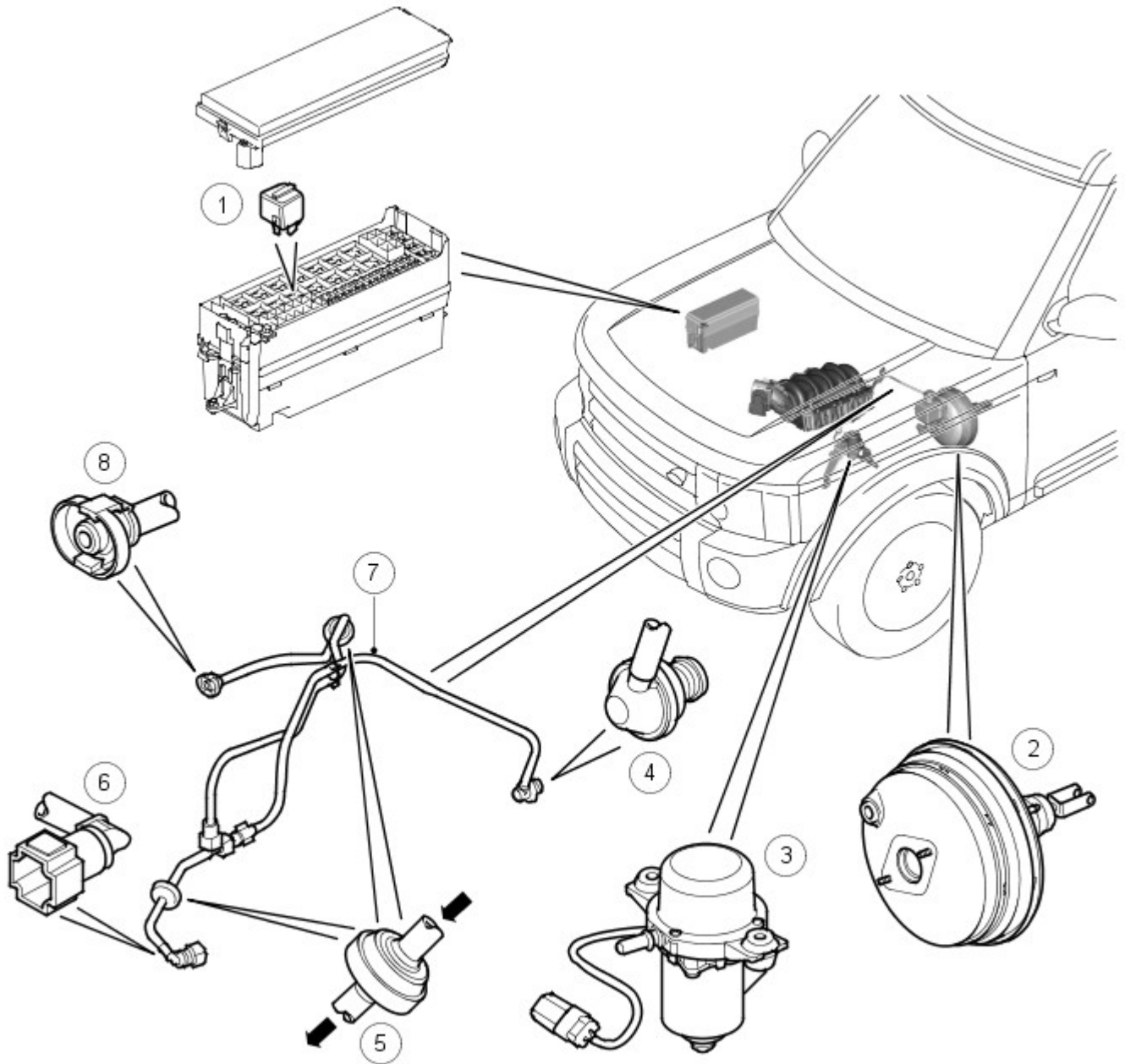


E49902

Item	Part Number	Description
1	-	Brake booster
2	-	Vacuum pump relay
3	-	Vacuum pump
4	-	Vacuum pipe connections to vacuum pump and inlet manifold
5	-	Check valve
6	-	Vacuum pipe connection to brake booster
7	-	Vacuum pipes

COMPONENT LOCATIONS - 4.4L

• NOTE: LHD shown, RHD similar

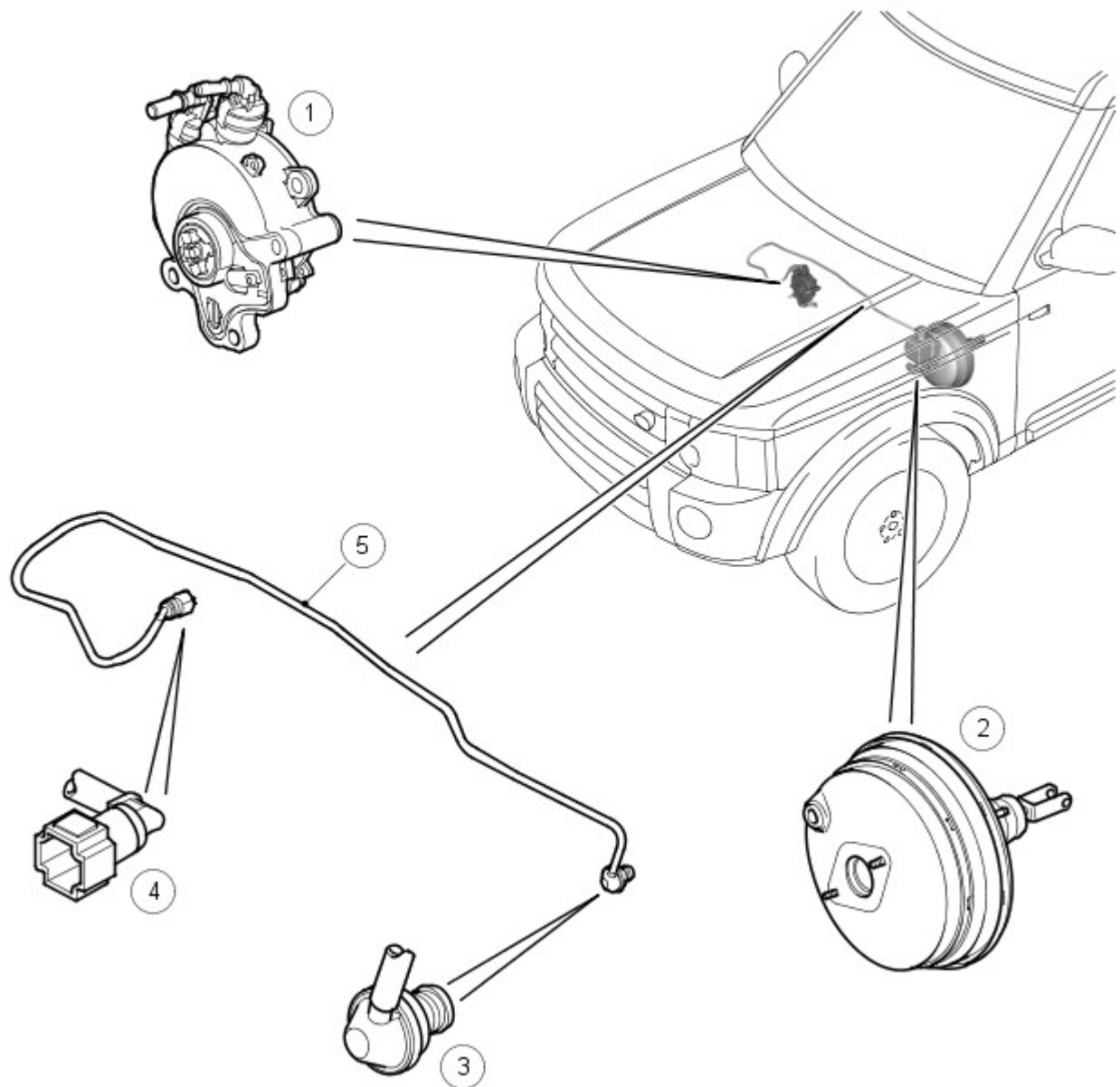


E49903

Item	Part Number	Description
1	-	Vacuum pump relay
2	-	Brake booster
3	-	Vacuum pump
4	-	Vacuum pipe connection to brake booster
5	-	Check valve
6	-	Vacuum pipe connection to vacuum pump
7	-	Vacuum pipes
8	-	Vacuum pipe connection to inlet manifold

COMPONENT LOCATIONS - 2.7L DIESEL

• NOTE: LHD shown



E49904

Item	Part Number	Description
1	-	Vacuum pump
2	-	Brake booster
3	-	Vacuum pipe connection to brake booster (includes check valve)
4	-	Vacuum pipe connection to vacuum pump
5	-	Vacuum pipes

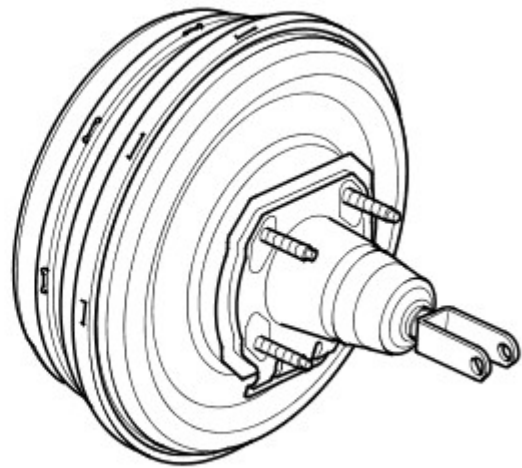
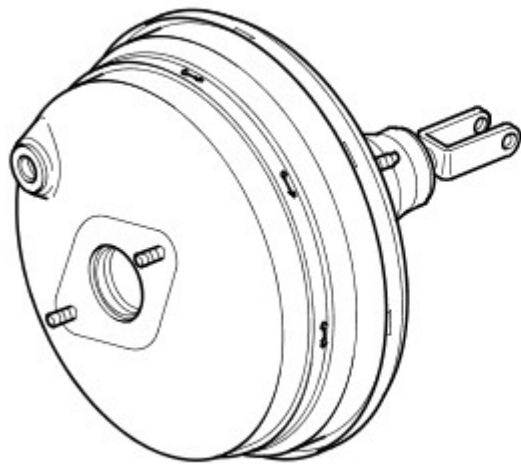
GENERAL

Power assistance for the brakes is provided by a vacuum operated brake booster. On petrol models, the vacuum is produced by the intake manifold and an electric vacuum pump. On diesel models, the vacuum is produced by an engine driven vacuum pump.

VACUUM PIPES

Plastic vacuum pipes connect the brake booster to the vacuum source. Check valves are incorporated into the vacuum pipes. On petrol models there are two in-line check valves, to maintain the vacuum in the brake booster when the throttle is open and the vacuum pump is not running, and prevent fuel vapor entering the brake booster. On diesel models there is a single check valve integrated into the vacuum pipe connection with the brake booster, to maintain the vacuum in the brake booster when the vacuum pump is operating at less than the optimum.

BRAKE BOOSTER

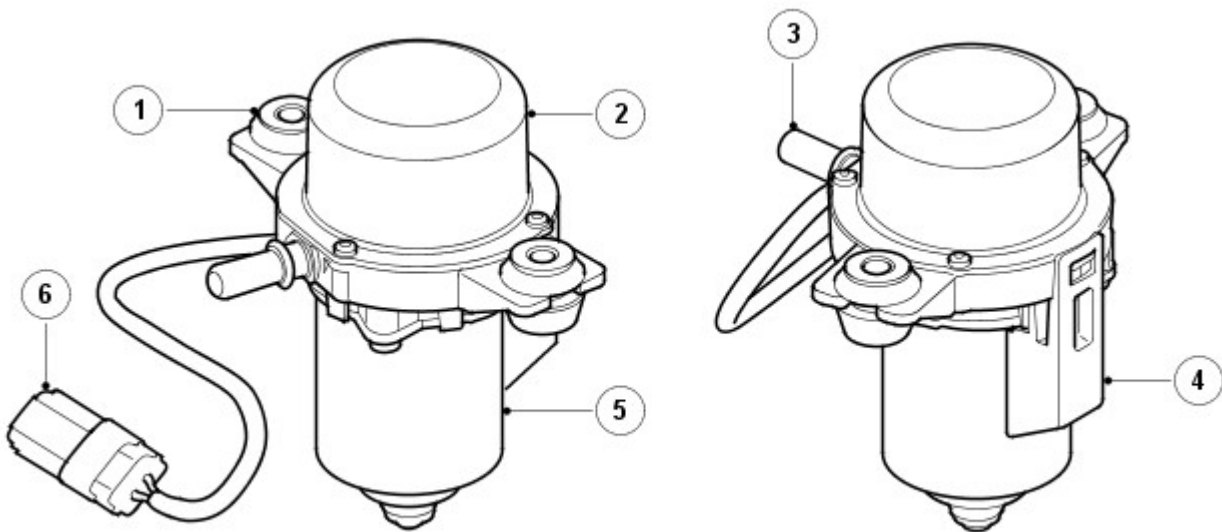


E49905

The brake booster is installed in the driver side of the engine compartment, on the engine bulkhead.

The brake booster is a dual diaphragm unit with a boost ratio of 8.0 : 1 and 28 bar loop-in in all engine variants. The input push rod is connected to the brake pedal. The output push rod locates in the primary piston of the brake master cylinder. A vacuum pipe, installed in a grommet in the front face of the housing, connects the brake booster to the intake manifold and electric vacuum pump (petrol models) or the engine driven vacuum pump (diesel models).

VACUUM PUMP (4.0L AND 4.4L)



E49906

Item	Part Number	Description
1	-	Anti-vibration mount
2	-	Pump cover
3	-	Vacuum pump inlet
4	-	Rubber shroud for exhaust port
5	-	Motor cover
6	-	Electrical connector

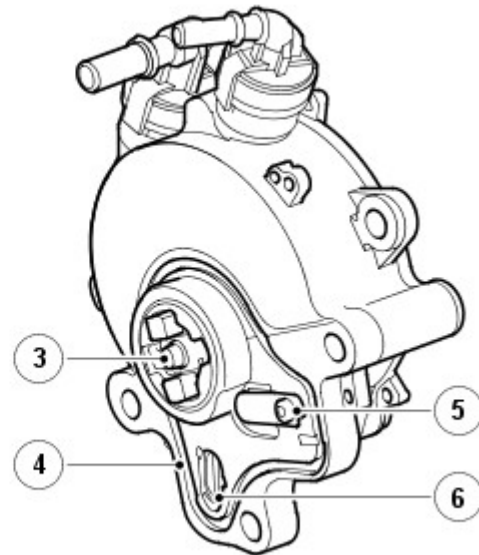
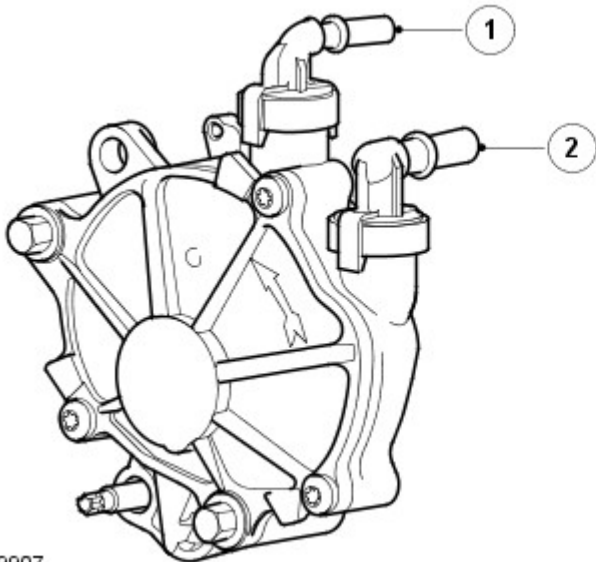
On petrol models the electric vacuum pump supplements the main vacuum supply from the engine manifold.

The vacuum pump is installed on a mounting bracket in the front left corner of the engine compartment. Two anti-vibration mounts on the vacuum pump are located on studs on the mounting bracket and secured with nuts.

The vacuum pump consists of a radial vane pump driven by an electric motor. The rotor and vanes of the pump are made from a self-lubricating carbon based material. A stub pipe is installed in the inlet of the pump to provide a connection point for the vacuum pipe from the brake booster. A second stub pipe, which is covered by a rubber shroud, is installed in the outlet from the pump.

Operation of the vacuum pump is controlled by the Engine Control Module (ECM), which uses the brake vacuum pump relay in the Battery Junction Box (BJB) to switch power to the vacuum pump. The ECM controls the time for which the vacuum pump is switched on and has in-built safeguards to protect the pump from overuse, e.g. continuous running is not allowed so a minimum delay time is specified between applications.

VACUUM PUMP (2.7L DIESEL)



E49907

Item	Part Number	Description
1	-	Vacuum connection (not used)
2	-	Vacuum connection for brake booster
3	-	Drive dog
4	-	Seal
5	-	Oil inlet port
6	-	Oil return/air vent

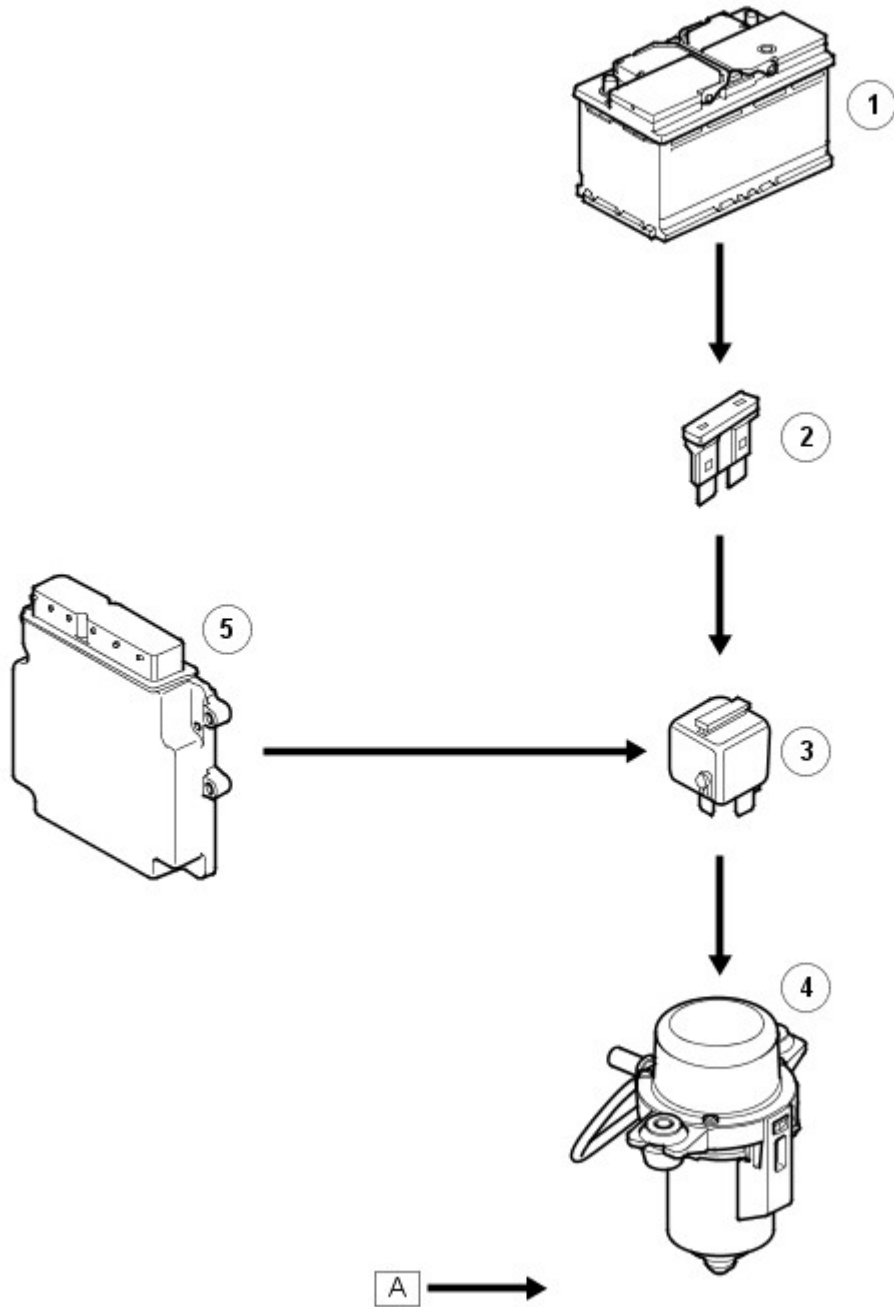
A vacuum pump is installed on diesel models as the air inlet system does not produce sufficient vacuum for satisfactory operation of the brake booster.

The vacuum pump is a radial vane pump which is attached to the rear of the RH cylinder head and driven at half engine speed by the exhaust camshaft. The vacuum pipe from the brake booster connects to an elbow on the rim of the vacuum pump.

The vacuum pump is lubricated and cooled by engine oil supplied to a port in the front face of the vacuum pump from a gallery in the cylinder head. The oil return is through a vent in the front face of the pump into a drain cavity in the cylinder head. Air extracted from the brake booster is vented into the drain cavity with the returning engine oil.

VACUUM PUMP CONTROL DIAGRAM (4.0L AND 4.4L)

- NOTE: A = Hardwired connection



E49908

A →

Item	Part Number	Description
1	-	Battery
2	-	Fuse 24E, battery junction box
3	-	Vacuum pump relay
4	-	Vacuum pump
5	-	Engine control module

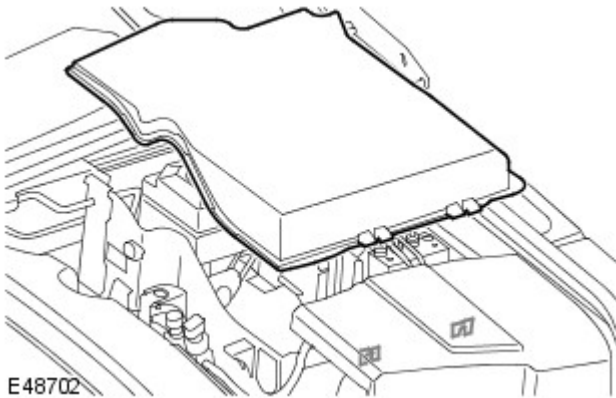
Power Brake Actuation - Brake Booster

Removal and Installation

Removal

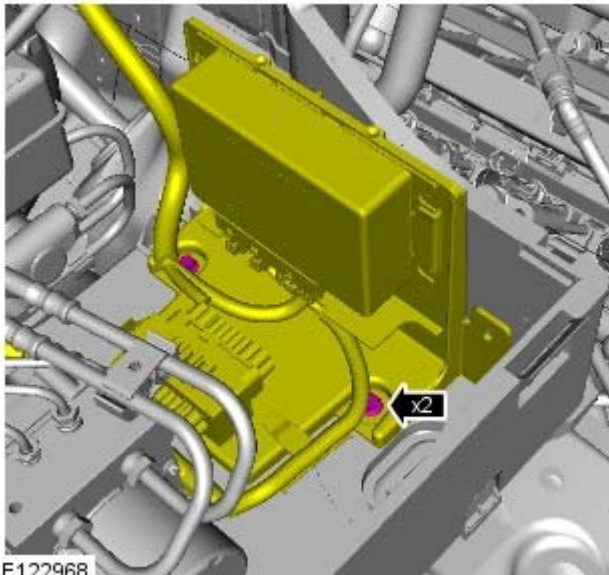
1. Pump the brake pedal until the brake vacuum assistance is exhausted.
2. Remove the auxiliary battery cover.

- Release the 2 clips.



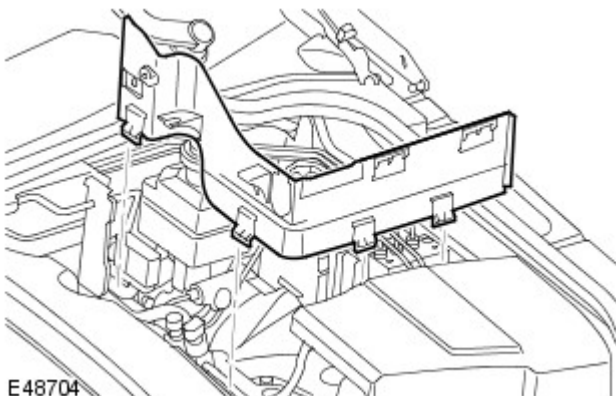
3. If installed, remove the auxiliary battery.
4. Detach the automatic transmission module bracket and position it to one side.

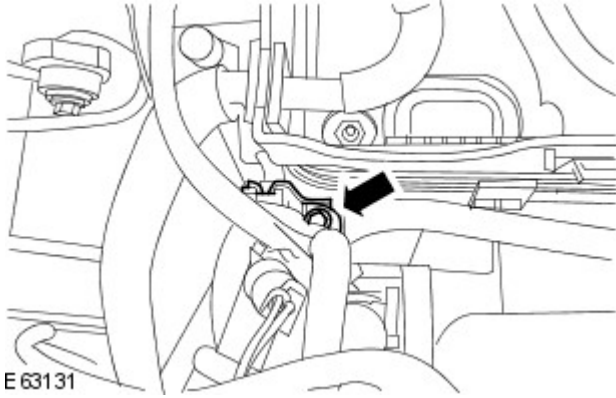
- Remove the 2 bolts.



5. Remove the auxiliary battery compartment side wall.

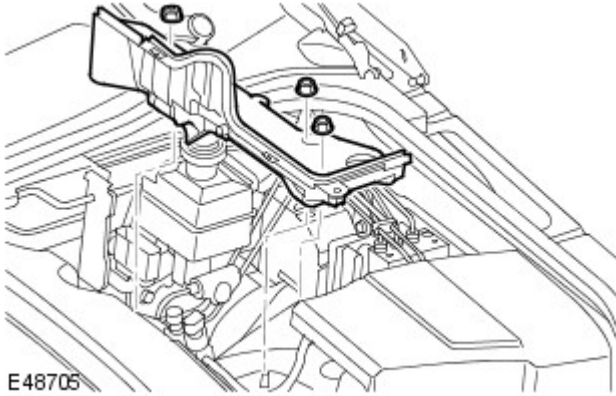
- Release the four clips.





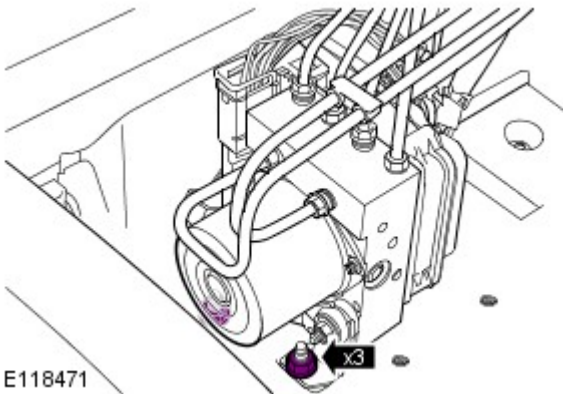
6. Release the Air Conditioning (A/C) pipes.

- Remove the retaining screw.



7. Remove the auxiliary battery tray.


- Remove the 3 bolts.



8. Release the Anti-lock Brake System (ABS) module.

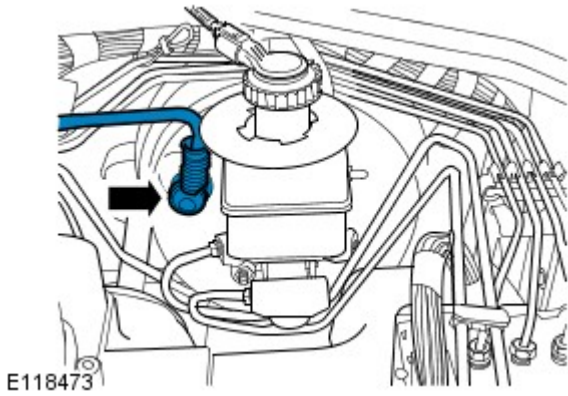
- Remove the 3 nuts.
- Release the brake tubes from the clip.

9. Disconnect the low brake fluid warning indicator switch electrical connector.

10.  **CAUTION:** Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

Position an absorbent cloth to collect fluid spillage.


11. Disconnect the brake booster vacuum hose from the brake booster.



12. CAUTIONS:

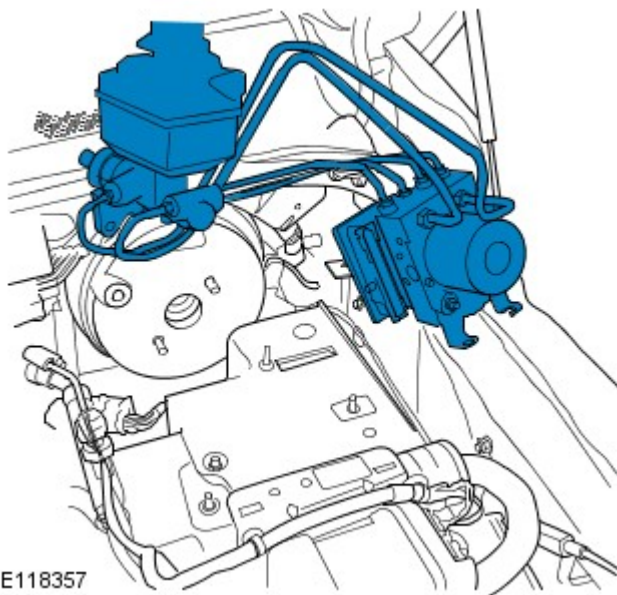
 Make sure that excessive force is not used. Failure to follow this instruction may result in damage to the vehicle.

 Make sure the wings and trim panels are covered and protected, failure to follow this instruction may result in damage to the vehicle.

 Make sure the brake pipes are not damaged when displacing the brake master cylinder and ABS module. Failure to follow this instruction may result in damage to the vehicle.

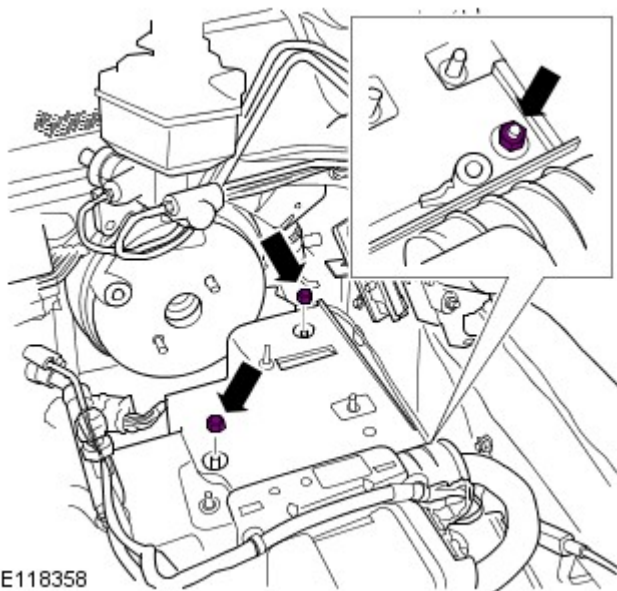
Displace the brake master cylinder and ABS module as a complete assembly.

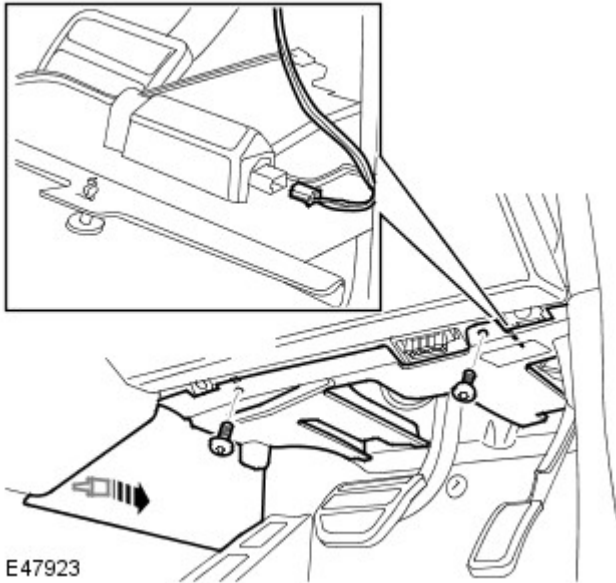
- Remove the 2 nuts.
- Discard the master cylinder seals.



13. Remove the outer plenum base.

- Remove the 3 nuts.

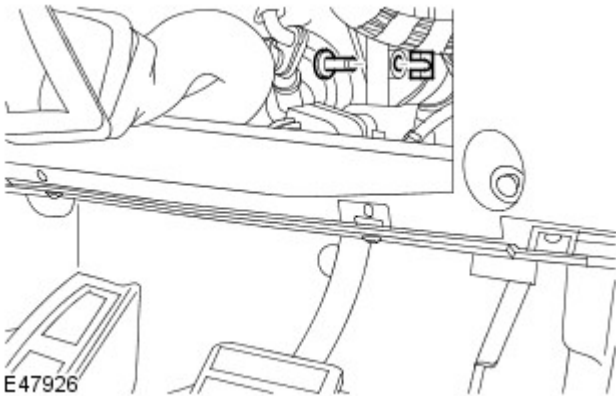




E47923

14. Remove the driver side closing trim panel.

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.

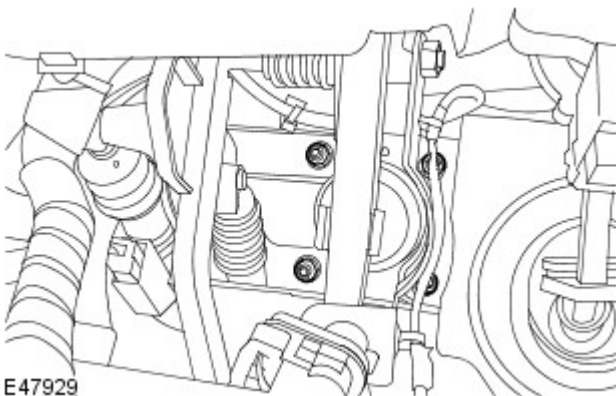


E47926

15. NOTE: The cover is shown removed for clarity.

Remove the brake booster push rod clevis pin.

- Remove the retaining clip.



E47929

16. Remove the brake booster.

- Remove the 4 nuts.

Installation

1. Install the brake booster.

- Tighten the nuts to 23 Nm (17 lb.ft).

2. Install the brake booster push rod clevis pin.


- Install the retaining clip.

3. Connect the brake booster vacuum hose.

4. Install the outer plenum base.

- Carefully lift the anti-lock brake system modulator for access.

- Install the 3 nuts.

5.  CAUTION: Make sure the master cylinder is correctly aligned.

- NOTE: Install new seals and nuts.

Install the the brake master cylinder and ABS module.

- Tighten the nuts to 23 Nm (17 lb.ft).

6. Secure the anti-lock brake system modulator.

- Install the 3 nuts.
- Secure the brake tubes to the clip.

7. Connect the low brake fluid warning indicator switch electrical connector.

8. Install the auxiliary battery tray.

- Install the 3 bolts.

9. Install the auxiliary battery compartment side wall.

- Secure with the four retaining clips.

10. Secure the A/C pipes.

- Install the retaining screw.

11. Secure the automatic transmission module bracket

- Install the 2 bolts.

12. If installed, install the auxiliary battery.

13. NOTE: This step is to check the tightness of the retaining nuts after the initial tighten to make sure that torque has not relaxed.

Check the brake booster retaining nuts.

- Tighten the nuts to 23 Nm (17 lb.ft).

14. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

15. Start engine and check the brake booster operation.

Power Brake Actuation - Brake Vacuum Pump TDV6 2.7L Diesel

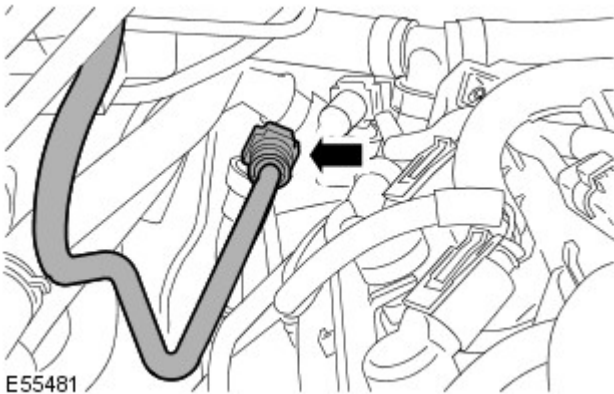
Removal and Installation

Removal


1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

3.  **CAUTION:** Always plug any open connections to prevent contamination.

Disconnect the brake booster vacuum line from the brake vacuum pump.



E55481

4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

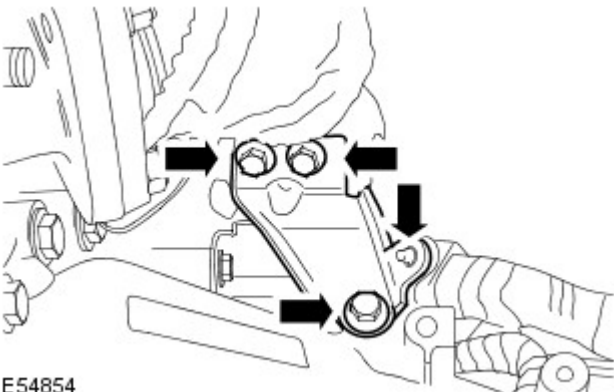
Raise and support the vehicle.

5. Remove the exhaust system. For additional information, refer to: (309-00A Exhaust System - TDV6 2.7L Diesel)

[Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (Removal and Installation),
[Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (Removal and Installation).

6. Lower the rear of the transmission for access.
7. Remove the exhaust cross-over pipe LH support bracket.

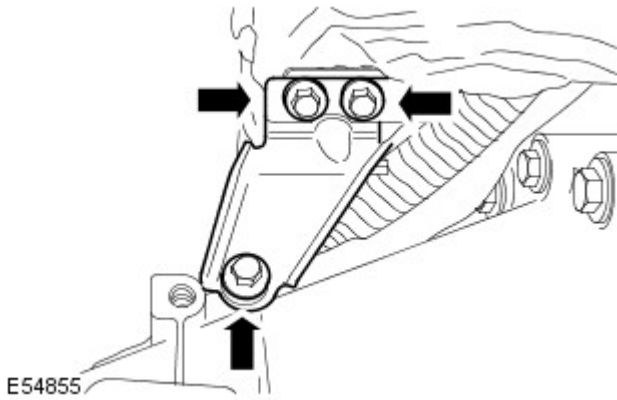
- Release the wiring harness.
- Remove the 3 bolts.



E54854

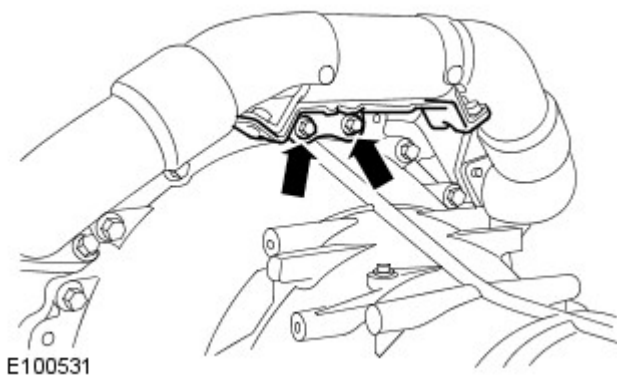
8. Remove the exhaust cross-over pipe RH support bracket.


- Remove the 3 bolts.



9. Remove the exhaust cross-over pipe center support bracket.

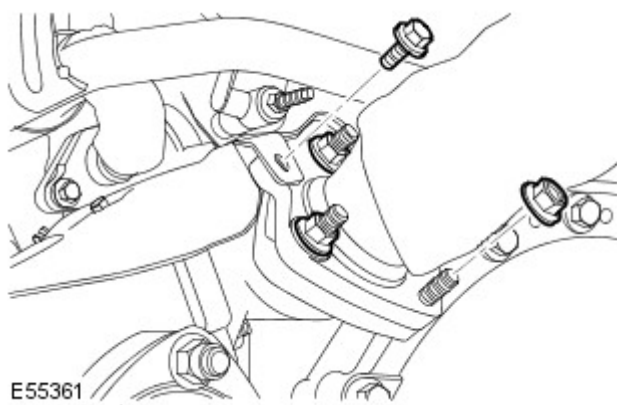
- Remove the 2 bolts.



10.  CAUTION: Take care when handling the cross-over pipe as damage to the insulating material may occur.

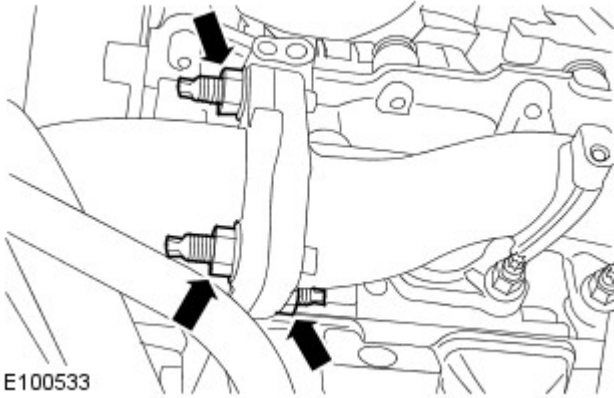
Release the exhaust cross-over pipe from the turbocharger.

- Remove the turbocharger heat shield bolt.
- Remove and discard the 3 nuts.

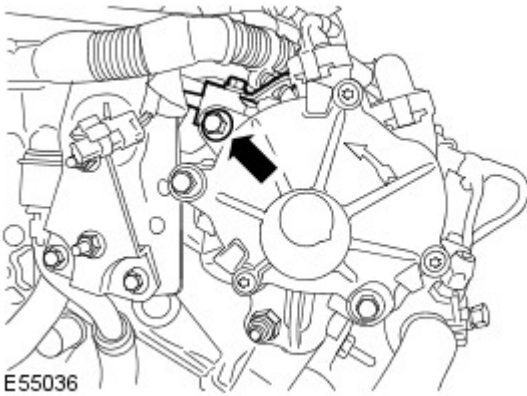


11. Remove the RH exhaust manifold heat shield.

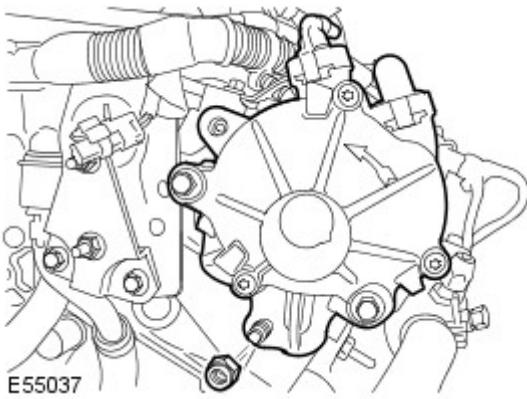




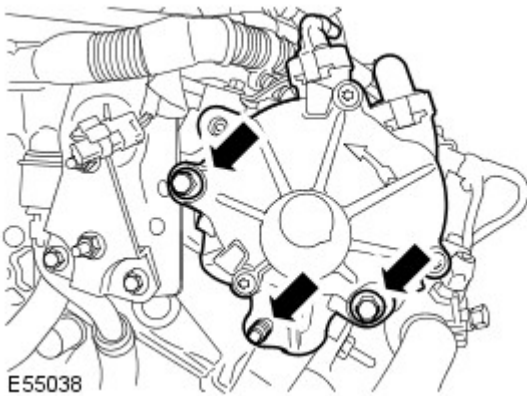
12. Remove the exhaust cross-over pipe.
- Remove and discard the 3 nuts.
 - Remove and discard the 2 gaskets.



13. Release the high-pressure fuel supply line.
- Remove the bolt.

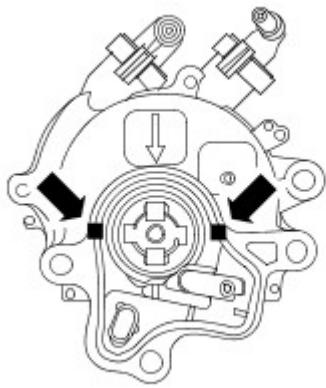


14. Remove the brake vacuum pump nut.




15. Remove the brake vacuum pump.
- Remove the stud.
 - Remove the 2 bolts.

Installation



E56076

1.  **CAUTION:** Extreme care is required during assembly so that the sealant is not smeared. If the sealant is smeared, the mating faces must be cleaned and new sealant must be applied.

Apply sealant to the two places shown.

- Make sure the vacuum pump seal is clean and dry.
- Make sure that the dogs on the vacuum pump are aligned with the camshaft.
- Apply a 2mm square of Loctite 518 sealant in the 2 places shown.
- Install the brake vacuum pump immediately after applying the sealant.
- The brake vacuum pump should be fitted directly to the engine without smearing the sealant.

2. Install the brake vacuum pump.

- Install the 2 bolts.
- Tighten the bolts to 23 Nm (17 lb.ft).

3. Install the brake vacuum pump stud.

- Tighten to 13 Nm (10 lb.ft).

4. Install the brake vacuum pump nut.

- Tighten to 13 Nm (10 lb.ft).

5. Secure the high-pressure fuel supply line.

- Tighten the bolt to 10 Nm (7 lb.ft).

6. Install 3 new exhaust manifold studs.

- Tighten the 3 studs to 13 Nm (10 lb. ft).

7. Install 3 new turbocharger studs.

- Tighten the 3 studs to 13 Nm (10 lb. ft).

8.  **CAUTION:** Take care when handling the cross-over pipe as damage to the insulating material may occur.

Install the exhaust cross-over pipe.

- Clean the component mating faces.
- Install 2 new gaskets.
- Install 6 new nuts
- Tighten the 6 nuts to 24 Nm (18 lb. ft).

9. Install the exhaust cross-over pipe center support bracket.

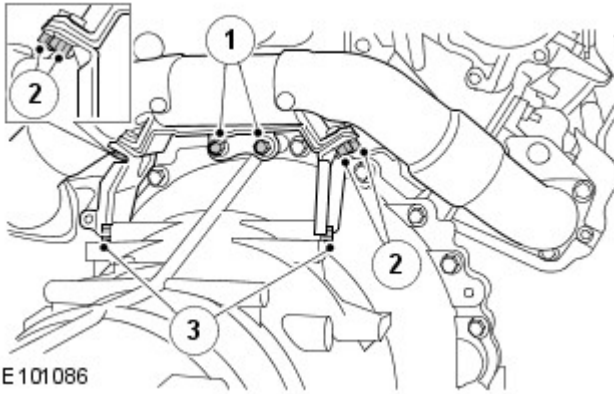
- Loosely install the 2 bolts.

10. Install the exhaust cross-over pipe RH support bracket.

- Loosely install the 3 bolts.

11. Install the exhaust cross-over pipe LH support bracket.

- Loosely install the 3 bolts.



12. Tighten the exhaust cross-over pipe mounting bracket bolts in the following sequence.

- Tighten the 2 bolts marked 1 to 10 Nm (7 lb.ft).
- Undo the 2 bolts by 90 degrees.
- Tighten the 2 bolts marked 3 to 10 Nm (7 lb.ft).
- Undo the 2 bolts by 90 degrees.
- Tighten the 4 bolts marked 2 to 25 Nm (18 lb.ft).
- Tighten the 2 bolts marked 1 to 25 Nm (18 lb.ft).
- Tighten the 2 bolts marked 3 to 25 Nm (18 lb.ft).
- Attach the wiring harness.

13. Install the RH exhaust manifold heat shield.

- Tighten the 3 bolts to 10 Nm (7 lb.ft).

14. Install the turbocharger heat shield.

- Tighten the bolt to 10 Nm (7 lb.ft).

15. Install the exhaust system. For additional information, refer to: (309-00A Exhaust System - TDV6 2.7L Diesel)

[Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\) \(Removal and Installation\)](#),
[Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\) \(Removal and Installation\)](#).

16.  **CAUTION:** Always plug any open connections to prevent contamination.

Connect the brake booster vacuum line to the brake vacuum pump.

17. Install the engine cover.

For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

18. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

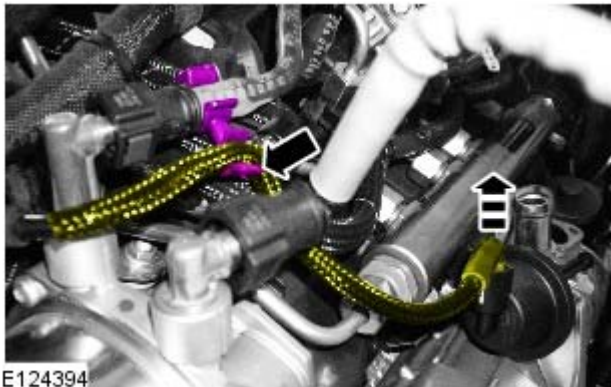
Power Brake Actuation - Brake Vacuum Pump TDV6 3.0L Diesel

Removal and Installation

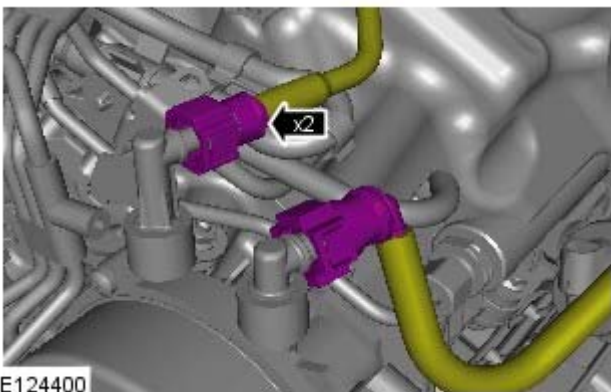
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

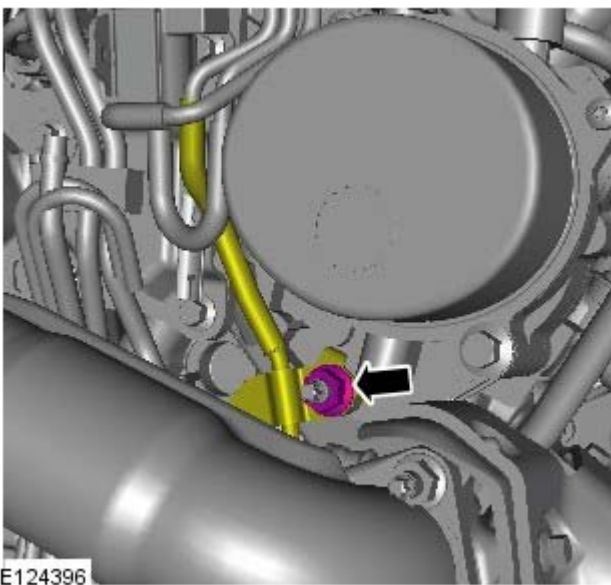
1. Refer to: [Body - TDV6 3.0L Diesel/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).



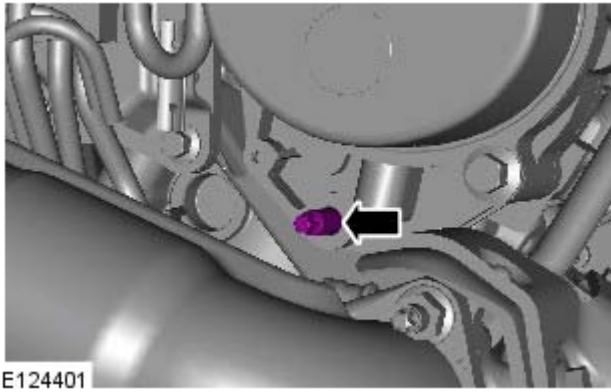
2.



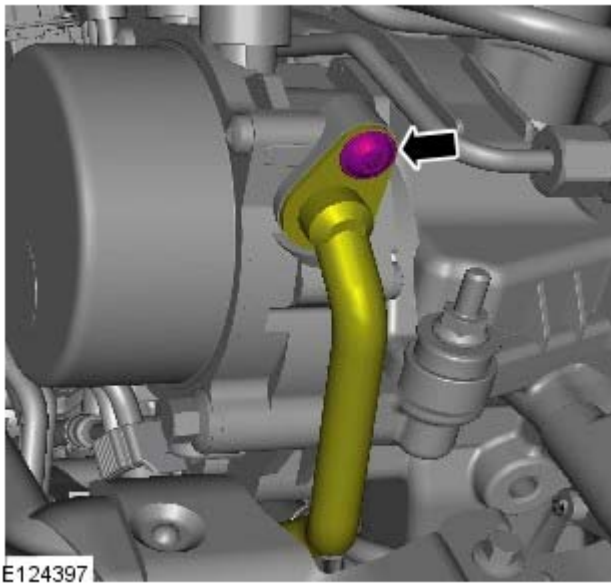
3.



4. Torque: 23 Nm

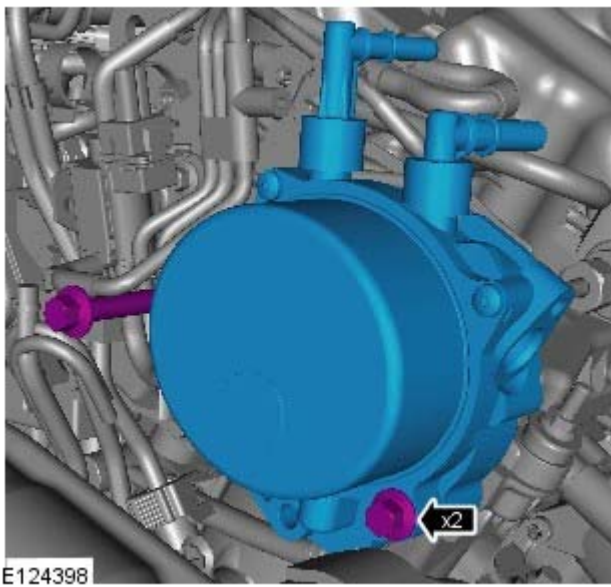


5. Torque: 13 Nm



6. **6.** NOTE: Discard the O-ring seal.

Torque: 10 Nm

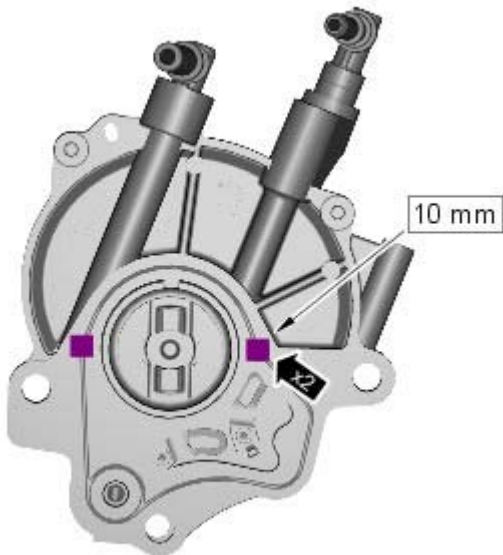


7. Torque: 23 Nm



E124399

Installation



E116820

8.

1. **1.** NOTE: Install a new gasket.

- NOTE: Install a new O-ring seal.

- NOTE: Apply silicone gasket sealant or equivalent meeting Land Rover specification.

- NOTE: The application of sealant must be 10 mm square in two places. Install the brake vacuum pump immediately after applying the sealant.

- NOTE: The brake vacuum pump should be fitted directly to the engine without smearing the sealant.

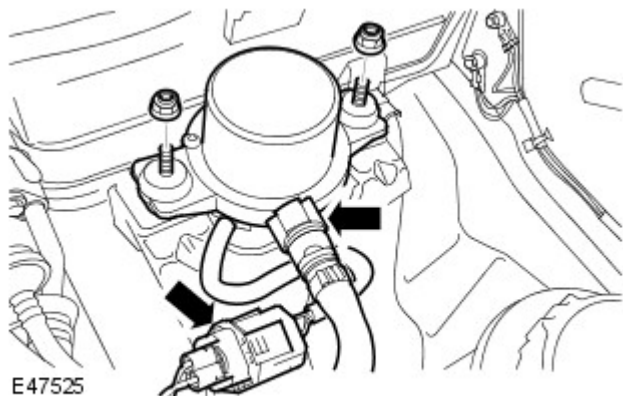
- NOTE: Make sure that the drive coupling is aligned with camshaft coupling.

To install, reverse the removal procedure.

Power Brake Actuation - Brake Vacuum Pump V6 4.0L Petrol

Removal and Installation

Removal



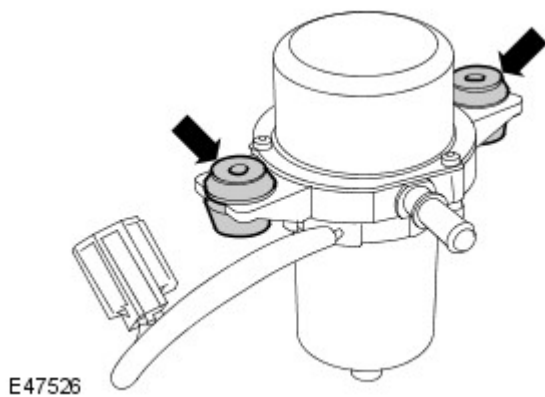
1.  **CAUTION:** Always plug any open connections to prevent contamination.

Remove the brake vacuum pump.

- Release and disconnect the electrical connector.
- Disconnect the vacuum line.
- Remove the 2 nuts.

2. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the 2 rubber insulators.



Installation

1. To install, reverse the removal procedure.


- Tighten the nuts to 5 Nm (4 lb.ft).

Power Brake Actuation - Brake Vacuum Pump V8 5.0L Petrol

Removal and Installation

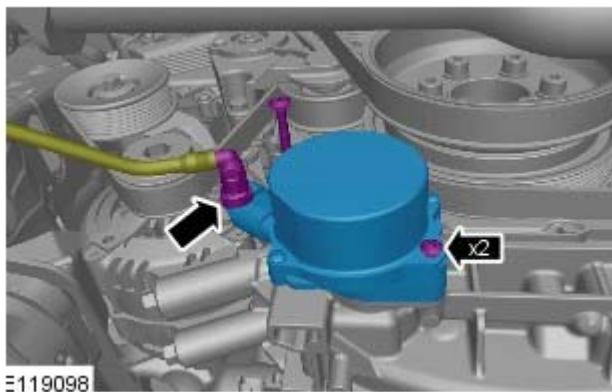
Removal

• NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).



4.



5. **NOTE:** Discard the seal.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 12 Nm

Installation

1. **NOTE:** Install a new seal.
To install, reverse the removal procedure.

Anti-Lock Control - Traction Control -

General Specification

Item	Specification
System make/type	Bosch 8.0 Anti-lock braking system with Electronic Brake Distribution (EBD), Corner Brake Control (CBC), Electronic Traction Control (ETC), Hill Descent Control (HDC), Anti-roll Mitigation (ARM), Emergency Brake Assist (EBA), and Dynamic Stability Control (DSC)
Wheel speed sensors:	
Make/type	Bosch DF11i
Location	Front and rear knuckles with the active directional sensor acting on the driveshaft pole wheel
Yaw rate sensor make/type	Bosch DRS MM1.OR

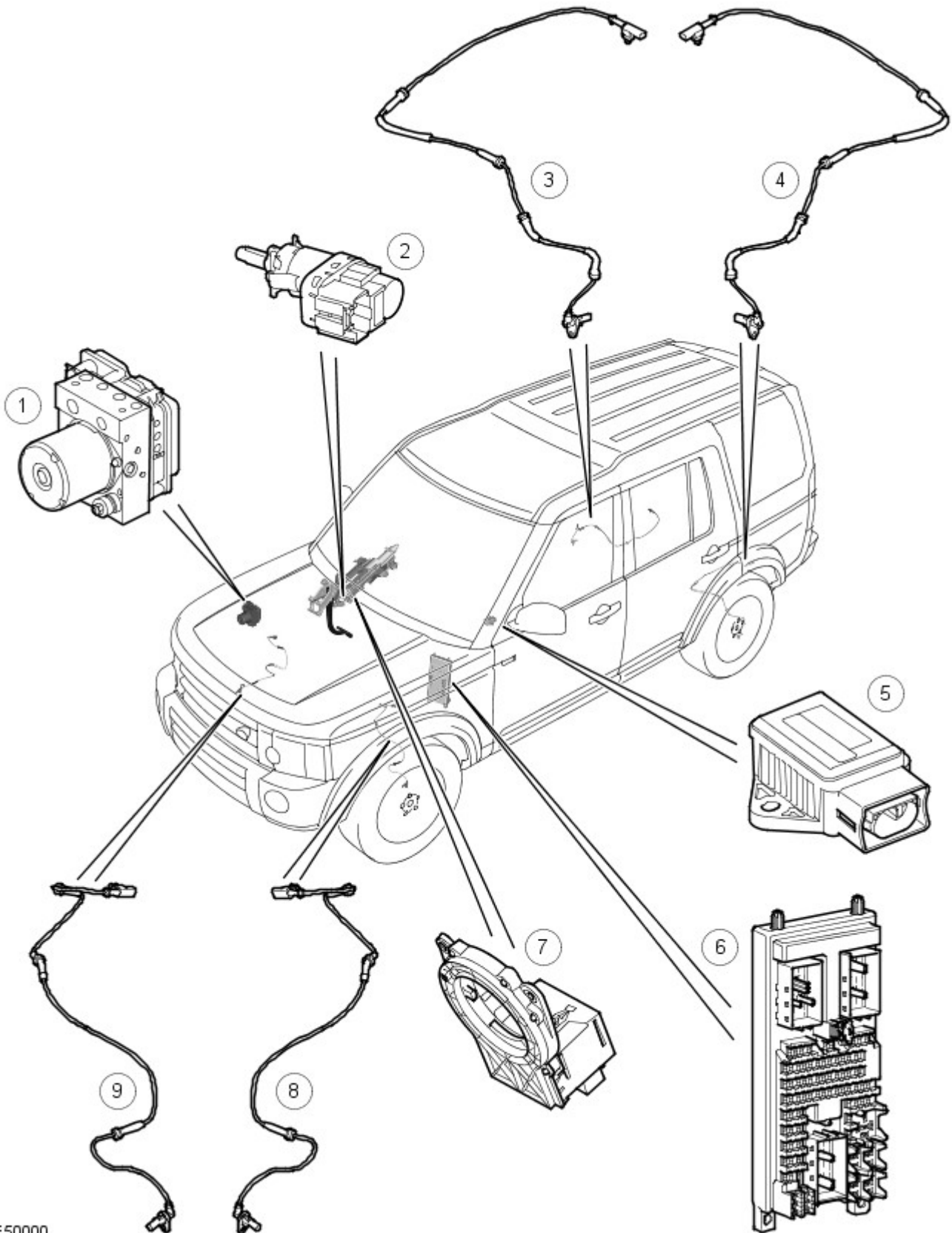
Torque Specifications

Description	Nm	lb-ft
Front road wheel speed sensor bolt	9	7
Front brake caliper anchor plate bolts	275	203
Front brake caliper housing bolts	32	24
Front brake hose retaining bracket to wheel knuckle bolt	25	18
Rear road wheel speed sensor to wheel knuckle bolt	9	7
ABS module mounting bracket nuts	8	6
ABS module to mounting bracket nuts	23	17
M10 Brake tube union nuts	15	11
M12 Brake tube union nuts	15	11
M14 Brake tube union nut	17	13
Yaw rate sensor bolts	7	5
Road wheel nuts	140	103

Anti-Lock Control - Traction Control - Anti-Lock Control - Traction Control

Description and Operation

COMPONENT LOCATIONS - SHEET 1 OF 2

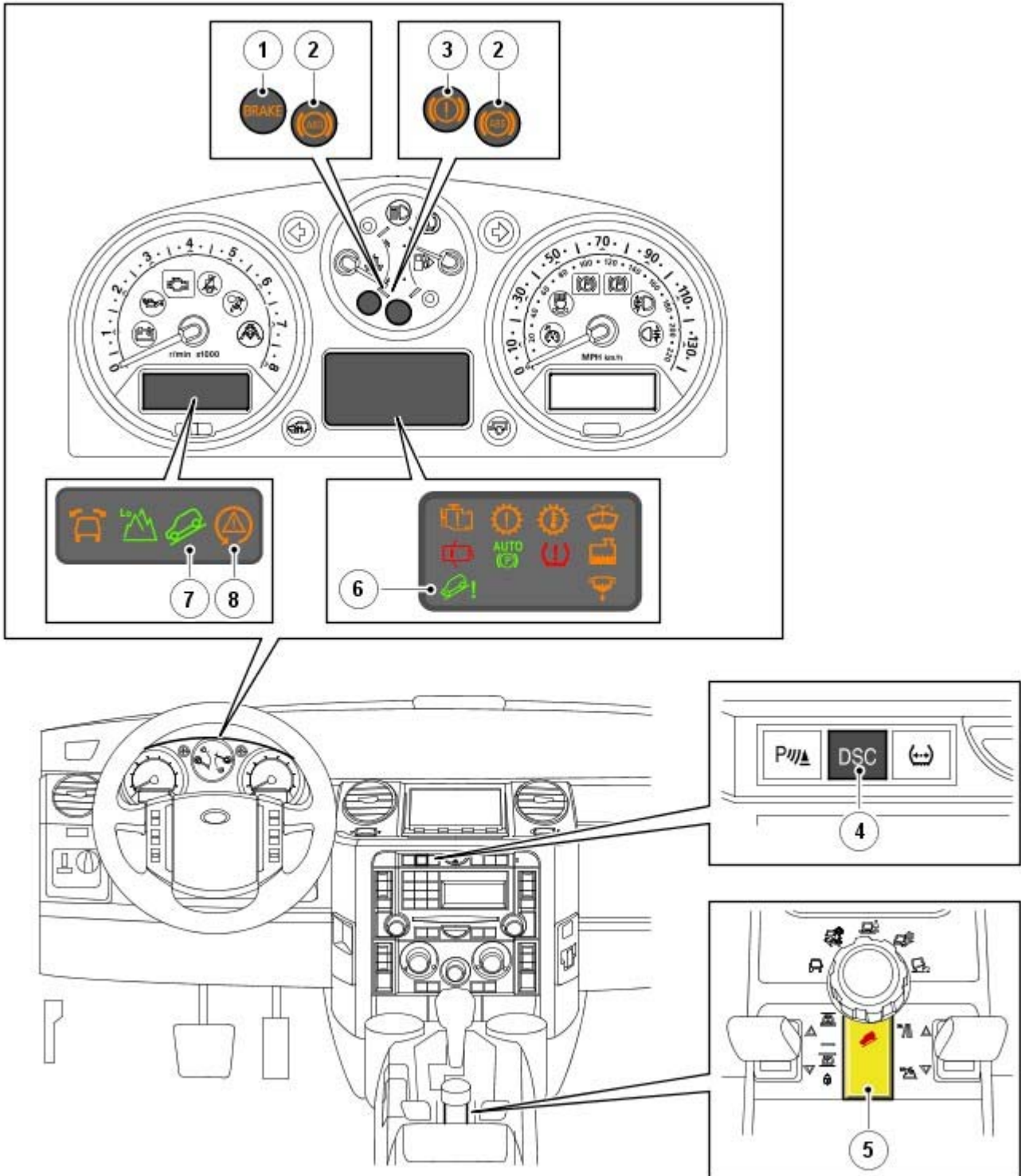


E50000

Item	Part Number	Description
1	-	Hydraulic control unit with attached anti-lock brake system (ABS) module
2	-	Stoplamp switch
3	-	Right rear wheel speed sensor
4	-	Left rear wheel speed sensor

5	-	Yaw rate and lateral acceleration sensor
6	-	HDC (hill descent control) relay (non-serviceable, integrated into central junction box (CJB))
7	-	Steering angle sensor
8	-	Left front wheel speed sensor
9	-	Right front wheel speed sensor

COMPONENT LOCATIONS - SHEET 2 OF 2



E50001

Item	Part Number	Description
1	-	Brake warning indicator (NAS (north American specification) only)
2	-	ABS warning indicator
3	-	Brake warning indicator (all except NAS)
4	-	DSC (dynamic stability control) switch

5	-	HDC (hill descent control) switch
6	-	HDC warning indicator (low line instrument cluster only)
7	-	HDC information indicator
8	-	DSC warning indicator

GENERAL

The anti-lock control - traction control system is based on the 4 channel Bosch 8.0 system and provides the following brake functions:

- ABS.
- ARM (active roll mitigation).
- CBC (corner brake control).
- DSC.
- electronic brake force distribution (EBD).
- ETC (electronic traction control).
- emergency brake assist (EBA).
- EDC (engine drag-torque control).
- HDC.

The system consists of the following components:

- A DSC switch.
- An HDC switch.
- An HDC relay.
- A stoplamp switch.
- Four wheel speed sensors.
- A yaw rate and lateral acceleration sensor.
- A steering angle sensor.
- Warning indicators; four on vehicles with a high line instrument cluster and five on vehicles with a low line instrument cluster.
- A hydraulic control unit (HCU) with attached ABS module.

DSC SWITCH

The DSC switch allows the DSC function to be selected off. Although Land Rover recommend that DSC is selected on for all normal driving conditions, it may be beneficial to de-select DSC, to maximize traction, under the following conditions:

- If the vehicle needs to be rocked out of a hollow or a soft surface.
- Driving on loose surfaces or with snow chains.
- Driving in deep sand, snow or mud.
- On tracks with deep longitudinal ruts.

The DSC switch is a non-latching switch installed in the center switch pack on the instrument panel. Pressing the DSC switch connects an ignition power feed to the ABS module. With the first press of the DSC switch, the ABS module disables the DSC functions. When the DSC switch is pressed again, the ABS module re-enables the DSC functions. The DSC switch must be pressed for a minimum of 0.3 s for the ABS module to react. The DSC function is re-enabled at the beginning of each ignition cycle.

The status of the DSC switch selection is shown by the DSC warning indicator. The DSC warning indicator is off while DSC is selected on, and continuously illuminated while DSC is selected off.

A DSC switch request to disable DSC is ignored if the air suspension system has failed, or is in off-road height at speeds above 60 km/h (37.5 mph).

To guard against incorrect operation or a broken switch, if the input from the DSC switch is held high for more than one minute, a failure is stored in the ABS module.

Even if DSC is deselected, driving maneuvers with extreme yaw or lateral acceleration may trigger DSC activity to assist vehicle stability.

HDC SWITCH

The HDC switch controls the selection of the HDC function.

The HDC switch is a non-latching switch installed on the center console, to the rear of the gear shift lever. Pressing and releasing the HDC switch momentarily connects an ignition power feed to the ABS module. With the first press and release of the HDC switch, the ABS module enables operation of the HDC function. When the HDC switch is pressed and released again, the ABS module disables operation of the HDC function.

To guard against incorrect operation or a broken switch, if the switch is pressed for more than 10 seconds no change of state occurs. If the input from the HDC switch is held high for more than one minute, a failure is stored in the ABS module.

HDC RELAY

The HDC relay is used to illuminate the stoplamps when the brakes are activated during HDC operation and during dynamic application of the parking brake.

The HDC relay is a non-serviceable, solid state relay on the circuit board of the CJB. Operation of the HDC relay is controlled by the ABS module switching the coil to ground. The ABS module monitors brake system hydraulic pressure and energizes the HDC relay during active braking. A pressure threshold and time filter prevent the stoplamps from flickering when HDC is braking.

STOPLAMP SWITCH

The stoplamp switch is mounted in the brake pedal bracket and operated by the brake pedal. The stoplamp switch is a two pole switch: The Brake Switch (BS) pole supplies a brake pedal status signal to the ABS module; the Brake Lamp Switch (BLS) pole operates the stoplamps and also supplies a brake pedal status signal to the ABS module and to the engine control module (ECM).

While the brake pedal is released:

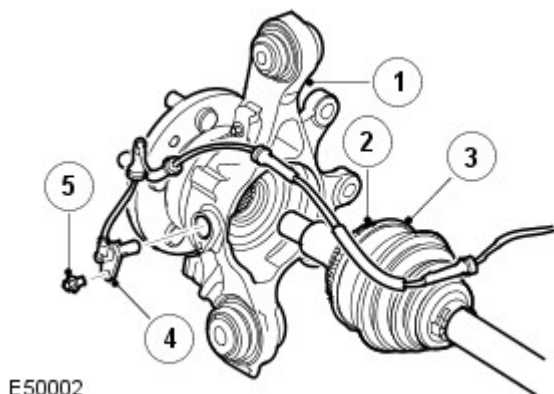
- The BS contacts are closed, and connect an ignition power feed from the CJB to the ABS module.
- The BLS contacts are open.

When the brake pedal is pressed:

- The BS contacts open.
- The BLS contacts close, and connect an ignition power feed from the CJB to the three stoplamps, the ABS module and the ECM.

The ABS module monitors the status inputs from the stoplamp switch and broadcasts the brake pedal status and an associated quality factor on the high speed controller area network (CAN) bus.

WHEEL SPEED SENSORS



E50002

Item	Part Number	Description
1	-	Knuckle assembly
2	-	Sensor ring
3	-	Halfshaft
4	-	Wheel speed sensor
5	-	Screw

An active wheel speed sensor is installed in each wheel hub to provide the ABS module with a rotational speed signal from each road wheel. The head of each wheel speed sensor is positioned close to a 48 tooth sensor ring on the outer diameter of the constant velocity joint of the halfshaft. A flying lead connects each sensor to the vehicle wiring.

The wheel speed sensors each have a power supply connection and a signal connection with the ABS module. When the ignition switch is in position II, the ABS module supplies power to the wheel speed sensors and monitors the return signals. Any rotation of the halfshafts induces current fluctuations in the return signals which are converted into individual wheel speeds and the overall vehicle speed by the ABS module.

The ABS module outputs the individual wheel speeds and the vehicle speed on the high speed CAN bus for use by other systems. The quality of the vehicle speed signal is also broadcast on the high speed CAN bus. If all wheel speed signals are available to calculate vehicle speed from, the quality of the vehicle speed signal is set to 'data calculated within specified accuracy'. If one or more wheel speed sensors is faulty, the quality of the vehicle speed signal is set to 'accuracy outside specification'.

The ABS module monitors the wheel speed sensor circuits for faults. If a fault is detected the ABS module stores a related fault code and illuminates the appropriate warning indicators, depending on the system functions affected (DSC/ETC, ABS, EBA/EBD, HDC). A warning chime sounds and, on vehicles with the high line instrument cluster, a related message is shown in the message center.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Since the wheel speed sensors are active devices, a return signal is available when the road wheels are not turning, which enables the ABS module to check the sensors while the vehicle is stationary. In addition, the direction of travel of each wheel can be sensed. This information is broadcast on the high speed CAN bus for use by other systems.

YAW RATE AND LATERAL ACCELERATION SENSOR

The yaw rate and lateral acceleration sensor provides the ABS module with inputs of yaw rate and lateral acceleration.

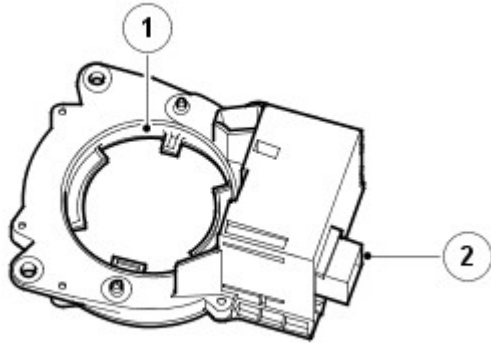
The yaw rate and lateral acceleration sensor is installed under the center console and secured to the transmission tunnel with two bolts.

When the ignition switch is in position II, the yaw rate and lateral acceleration sensor receives an ignition power feed from the CJB. The sensor is self diagnosed by the ABS module and can be interrogated using T4. The ABS module broadcasts the yaw rate and lateral acceleration values, on the high speed CAN bus, for use by other systems.

The ABS module monitors the yaw rate and lateral acceleration sensor for faults. If a fault is detected the ABS module stores a related fault code and illuminates the DSC warning indicator and, on vehicles with the low line instrument cluster,

the HDC warning indicator. A warning chime sounds and, on vehicles with the high line instrument cluster, a message advising of an HDC fault is shown in the message center. For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

STEERING ANGLE SENSOR



E50003

Item	Part Number	Description
1	-	Gear wheel
2	-	Electrical connector

The steering angle sensor measures the steering wheel angle and the rate of change of the steering wheel angle (known as the steering wheel angle speed). These measurements are output on the high speed CAN bus, together with a quality factor signal, and used by the ABS module for CBC and DSC operation.

The steering angle sensor is fixed to the pivot bracket of the steering column by three screws. A gear wheel in the steering angle sensor engages with a plastic drive collar fixed onto the lower shaft of the column. Inside the steering angle sensor, the gear wheel meshes with a gear train containing magnets. An eight pin electrical connector provides the interface between the vehicle wiring and integrated circuits in the steering angle sensor.

The steering angle sensor uses the MR (magneto resistive) effect, which evaluates the direction of magnetic fields, to measure the angular position of the lower shaft, and thus the steering wheel angle. When the steering wheel turns, the steering column lower shaft rotates the gear wheel in the steering angle sensor, which drives the gear train and rotates the magnets on the gears. The direction of the magnetic fields is constantly monitored by the steering angle sensor and converted into a steering wheel angle and steering wheel angle speed.

The steering angle sensor performs a plausibility check of the steering wheel angle each time the following conditions co-exist:

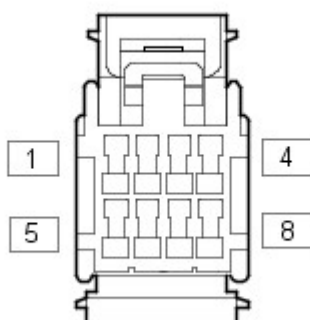
- The vehicle is traveling in a straight line.
- The vehicle speed is between 20 and 25 km/h (12.5 and 15.6 mph).
- The transfer box is in high range.
- The brake pedal is not pressed.
- There is no ABS, DSC or ETC activity.

The steering angle sensor uses inputs of wheel speed, yaw rate and lateral acceleration to determine when the vehicle is traveling in a straight line. When all of the conditions co-exist, the steering angle sensor checks the steering angle, which should be $0 \pm 15^\circ$. If the steering angle is outside the limits on two successive checks, the steering angle sensor changes the quality factor signal to 'outside specification' for the remainder of the ignition cycle and stores a fault code. At the beginning of each ignition cycle the quality factor signal is reset to 'within specified accuracy'.

The status of the steering angle sensor can be determined using T4.

If the steering angle sensor is replaced, the new sensor must be calibrated using T4. The steering angle sensor must also be re-calibrated any time it is disturbed from the steering column, or if the upper and lower steering columns are separated.

Steering Angle Sensor Harness Connector C0862



E50004

Steering Angle Sensor Harness Connector C0862 Pin Details

Pin No.	Description	Input/Output
1 to 4	Not used	-
5	Ignition power supply	Input
6	High speed CAN bus high	Input/Output
7	High speed CAN bus low	Input/Output
8	Ground	-

WARNING INDICATORS

The following anti-lock control - traction control indicators are installed in the instrument cluster:

ABS Warning Indicator

The ABS warning indicator is an amber colored indicator located between the coolant temperature gage and the fuel level gage.

The ABS warning indicator is continuously illuminated if there is a fault that affects ABS performance or causes the ABS function to be disabled.

Operation of the ABS warning indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

When the ignition switch is first turned to position II, the ABS warning indicator illuminates for approximately 3 seconds as a bulb check. During the bulb check, if a fault is stored in the memory of the ABS module, the ABS warning indicator goes off for 0.5 second, 0.5 second after the start of the bulb check. If a fault during the previous ignition cycle caused the ABS warning indicator to be illuminated, the ABS warning indicator may remain illuminated after the next bulb check, even if the fault has been rectified and cleared from the ABS module; the ABS warning indicator remains illuminated until vehicle speed reaches 15-20 km/h (9.5-12.5 mph) while additional checks of the related inputs are performed.

Brake Warning Indicator

The brake warning indicator is a dual colored indicator, located in the coolant temperature gage, that illuminates amber for EBA faults and red for EBD faults. The brake warning indicator is also used to give warnings of:

- Low brake fluid level (illuminates red).
For additional information, refer to: [Hydraulic Brake Actuation](#) (206-06 Hydraulic Brake Actuation, Description and Operation).
- Brake pad wear (illuminates amber).
For additional information, refer to: [Rear Disc Brake](#) (206-04 Rear Disc Brake, Description and Operation).

Operation of the brake warning indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

When the ignition switch is first turned to position II, the brake warning indicator illuminates amber for approximately 1.5 seconds then red for approximately 1.5 seconds, as a bulb check.

DSC Warning Indicator

The DSC warning indicator is an amber colored warning indicator located in the tachometer.

Each time the DSC or the ETC function is active, the DSC warning indicator flashes at 2 Hz. If DSC has been selected off, or there is a fault that disables the DSC or the ETC function, the DSC warning indicator is continuously illuminated. If DSC has been selected off, vehicles with the high line instrument cluster also display a message, advising that DSC is switched off.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Operation of the DSC warning indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

When the ignition switch is first turned to position II, the DSC warning indicator illuminates for approximately 3 seconds as a bulb check. If a fault during the previous ignition cycle caused the DSC warning indicator to be illuminated, the DSC warning indicator may remain illuminated after the next bulb check, even if the fault has been rectified and cleared from the ABS module; the DSC warning indicator may remain illuminated during vehicle operation while additional checks of the related inputs are performed.

HDC Information Indicator

The HDC information indicator is a green colored indicator located in the tachometer.

The HDC information indicator is continuously illuminated while the HDC function is selected on and the vehicle is within the parameters for HDC operation; when the vehicle is outside the parameters for HDC operation, the HDC information indicator is flashed at 2 Hz.

Operation of the HDC information indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

HDC Warning Indicator

On the low line instrument cluster, the HDC warning indicator is an amber colored indicator located between the tachometer and the speedometer. On vehicles with the high line instrument cluster, the HDC warning indicator consists of a message in the message center.

On the low line instrument cluster the HDC warning indicator is continuously illuminated if there is a fault that affects the

HDC function, and flashed at 2 Hz if the HDC function is temporarily unavailable because of brake overheat.

On the high line instrument cluster, appropriate messages are displayed in the message center if there is a fault that affects the HDC function, or if the HDC function is temporarily unavailable because of brake overheat.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Operation of the HDC warning indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

On the low line instrument cluster, when the ignition switch is first turned to position II, the HDC warning indicator illuminates for approximately 3 seconds as a bulb check.

HCU

The HCU is a 4 channel unit that modulates the supply of hydraulic pressure to the brakes under the control of the ABS module.

The HCU is attached by three mounting bushes to a bracket in the plenum box on the driver side of the engine compartment. Hydraulic pipes connect the HCU to the master cylinder and the brakes.

For additional information, refer to: [Hydraulic Brake Actuation](#) (206-06 Hydraulic Brake Actuation, Description and Operation).

The primary and secondary outlets of the master cylinder are connected to primary and secondary circuits within the HCU. The primary circuit in the HCU has separate outlet ports to the front brakes. The secondary circuit in the HCU has separate outlet ports to the rear brakes. Each of the circuits in the HCU contain the following components to control the supply of hydraulic pressure to the brakes:

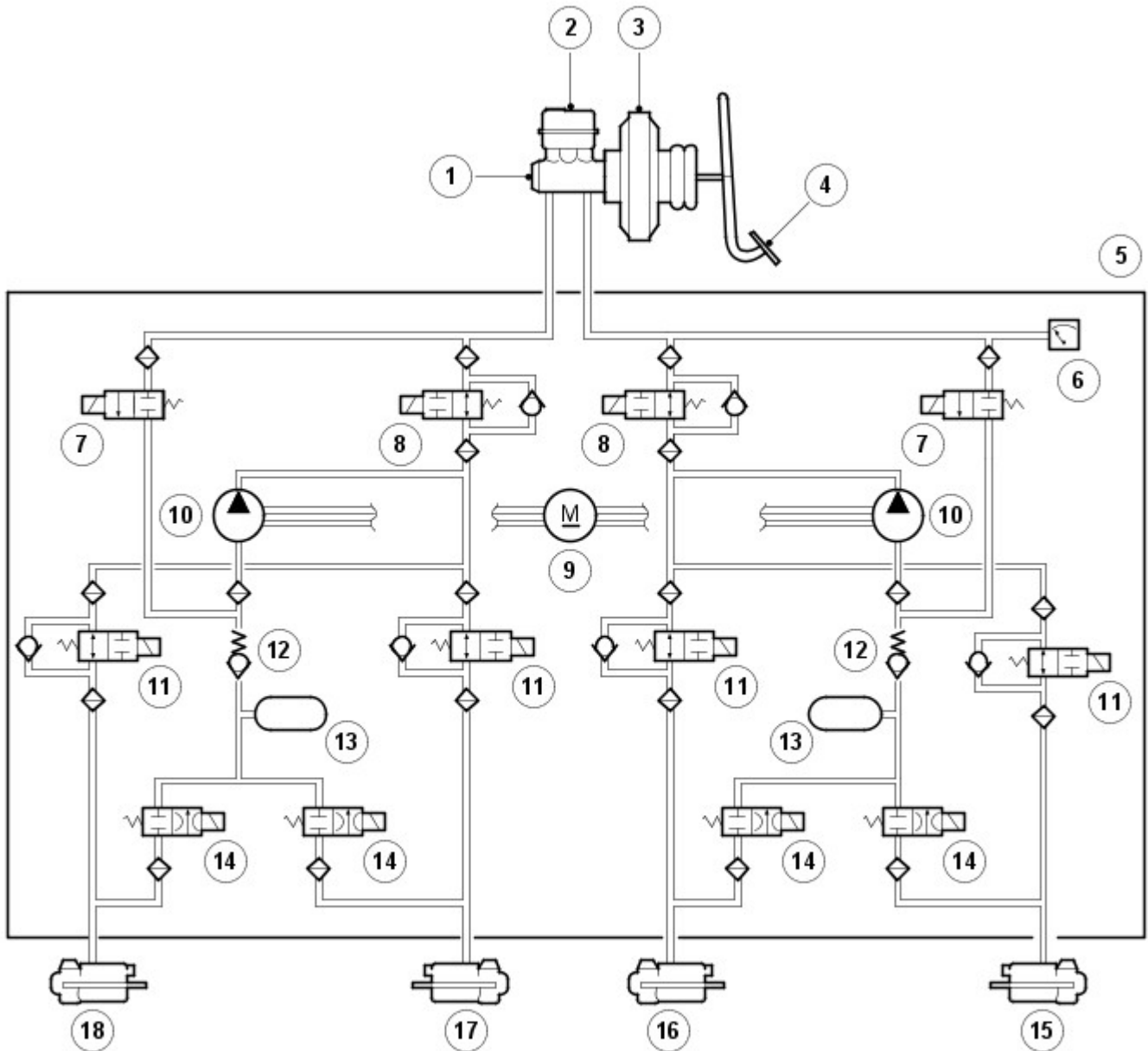
- A normally open, solenoid operated, pilot valve, to enable active braking.
- A normally closed, solenoid operated, priming valve, to connect the brake fluid reservoir to the return pump during active braking.
- A return pump, to generate hydraulic pressure for active braking and return brake fluid to the reservoir.
- Normally open, solenoid operated, inlet valves and normally closed, solenoid operated, outlet valves, to modulate the hydraulic pressure in the individual brakes.
- An accumulator and a relief valve, to allow the fast release of pressure from the brakes.
- Filters, to protect the components from contamination.

The primary circuit also incorporates a pressure sensor to provide the ABS module with a hydraulic pressure signal.

Contact pins on the HCU mate with contacts on the ABS module to provide the electrical connections from the ABS module to the return pump motor and the pressure sensor. The solenoids that operate the valves are installed in the ABS module.

Replacement HCU are supplied pre-filled. After installation on the vehicle, T4 must be used to operate the solenoid valves and the return pump to ensure correct bleeding of the HCU and brake circuits.

Schematic of HCU



E50005

Item	Part Number	Description
1	-	Master cylinder
2	-	Reservoir
3	-	Brake booster
4	-	Brake pedal
5	-	HCU
6	-	Pressure sensor
7	-	Priming valve
8	-	Pilot valve
9	-	Return pump motor
10	-	Return pump
11	-	Inlet valve
12	-	Relief valve
13	-	Accumulator
14	-	Outlet valve
15	-	Left front brake
16	-	Right front brake
17	-	Right rear brake
18	-	Left rear brake

The HCU has three operating modes: Normal braking/EBD, ABS braking and active braking.

Normal Braking/EBD Mode

Initially, all of the solenoid operated valves are de-energized. Operating the brake pedal produces a corresponding increase or decrease of pressure in the brakes, through the open pilot valves and inlet valves. If the ABS module determines that EBD is necessary, it energizes the inlet valves for the brakes of the trailing axle, to isolate the brakes

from any further increase in hydraulic pressure.

ABS Braking Mode

If the ABS module determines that ABS braking is necessary, it energizes the inlet and outlet valves of the related brake and starts the return pump. The inlet valve closes to isolate the brake from pressurized fluid; the outlet valve opens to release pressure from the brake into the accumulator and the return pump circuit; the reduced pressure allows the wheel to accelerate. The ABS module then operates the inlet and outlet valves to modulate the pressure in the brake to apply the maximum braking effort without locking the wheel. Control of the valves for each wheel takes place individually.

Active Braking Mode

The active braking mode is used to generate and control hydraulic pressure to the brakes for functions other than ABS braking, e.g. DSC, EBA, ETC, HDC and dynamic application of the parking brake.

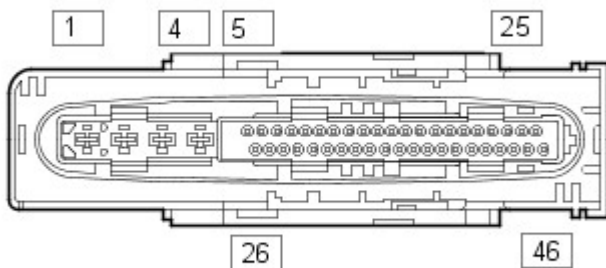
For active braking, the ABS module energizes the pilot valves and priming valves, starts the return pump and energizes all of the inlet valves. Brake fluid, drawn from the reservoir through the master cylinder and priming valve, is pressurized by the return pump and supplied to the inlet valves. The ABS module then operates the inlet valves and outlet valves, as required, to modulate the pressure in the individual brakes. Some noise may be generated during active braking.

ABS MODULE

The ABS module controls the brake functions using the HCU to modulate hydraulic pressure to the individual wheel brakes.

The ABS module is attached to the HCU, in the plenum box on the driver side of the engine compartment. A 46 pin connector provides the electrical interface between the ABS module and the vehicle wiring.

ABS Module Harness Connector C0506



E50006

ABS Module Harness Connector C0506 Pin Details

Pin No.	Description	Input/Output
1	Ground	Output
2	Battery power supply	Input
3	Battery power supply	Input
4	Ground	Output
5	Front left wheel speed sensor signal	Input
6	Rear left wheel speed sensor power supply	Output
7	Rear right wheel speed sensor power supply	Output
8	Rear right wheel speed sensor signal	Input
9	Front right wheel speed sensor power supply	Output
10	Front right wheel speed sensor signal	Input
11 to 13	Not used	-
14	High speed CAN bus low	Input/Output
15	Yaw rate and lateral acceleration sensor ground	Input
16	Yaw rate signal	Input
17	Not used	-
18	Yaw rate and lateral acceleration sensor reference	Input
19	Not used	-
20	Lateral acceleration signal	Input
21	Not used	-
22	HDC relay	Output
23 to 25	Not used	-
26	Front left wheel speed sensor power supply	Output
27	Rear left wheel speed sensor signal	Input
28	Ignition power supply	Input
29	Not used	-
30	Stoplamp switch BLS contacts	Input
31	DSC switch	Input
32	Not used	-
33	Road speed signal	Output
34	Not used	-
35	High speed CAN bus high	Input/Output
36	HDC switch	Input

Pin No.	Description	Input/Output
37	Yaw rate and lateral acceleration sensor test	Output
38 to 40	Not used	-
41	Stoplamp switch BS contacts	Input
42 to 46	Not used	-

SYSTEM OPERATION

ABS

ABS controls the speed of all road wheels to ensure optimum wheel slip when braking at the adhesion limit. This prevents the wheels from locking, which helps to retain effective steering control of the vehicle.

On the front axle, the brake pressure is modulated separately for each wheel. On the rear axle, brake pressure is modulated by select low. Select low applies the same pressure to both rear brakes, with the pressure level being determined by the wheel on the lower friction surface. This maintains rear stability on split friction surfaces.

ARM

The ARM function uses the brakes and the engine to attempt to restore stability if the vehicle is forced into such a harsh manoeuvre that it risks tipping over.

The ABS module monitors driver inputs and vehicle behavior using various powertrain signals and the inputs from the wheel speed sensors, the steering angle sensor and the yaw rate and lateral acceleration sensor. These are compared with modeled behavior and, if vehicle behavior reaches a given risk level, the ABS module cuts the engine power, or brakes one or more wheels, just enough to help the vehicle regain its poise and help the driver remain in control.

While the ignition is on, ARM is permanently enabled, even when DSC has been selected off.

CBC

CBC influences the brake pressures, below the DSC and ABS thresholds, to counteract the yawing moment produced when braking in a corner. CBC produces a correction torque by limiting the brake pressure on one side of the vehicle.

DSC

DSC uses the brakes and powertrain torque control to help maintain the lateral stability of the vehicle. While the ignition is on the DSC function is permanently enabled unless selected off by the DSC switch. Even if DSC is deselected, driving maneuvers with extreme yaw or lateral acceleration may trigger DSC activity to assist vehicle stability.

DSC enhances driving safety in abrupt maneuvers and in understeer or oversteer situations which may occur in a bend. The ABS module monitors the yaw rate and lateral acceleration of the vehicle, and the steering input, then selectively applies individual brakes and signals for powertrain torque adjustments to reduce understeer or oversteer.

In general: in an understeering situation, the inner wheels are braked to counteract the yaw movement towards the outer edge of the bend; in an oversteering situation, the outer wheels are braked to prevent the rear end of the vehicle from pushing towards the outer edge of the bend.

The ABS module monitors the tracking stability of the vehicle using inputs from the wheel speed sensors, the steering angle sensor and the yaw rate and lateral acceleration sensor. The tracking stability is compared with stored target data and, whenever the tracking stability deviates from the target data, the ABS module intervenes by applying the appropriate brakes. On vehicles with an automatic transmission, when the DSC function is active, the ABS module also signals the transmission control module (TCM) to prevent gear shifts. If necessary, the ABS module also signals:

- The ECM, to reduce engine torque.
- The transfer box control module, to adjust the locking torque of the center differential.
- The rear differential control module, to adjust the locking torque of the rear differential.

The DSC function overrides the differential locking torque requests from the terrain response system.

EBD

EBD limits the brake pressure applied to the rear wheels. When the brakes are applied, the weight of the vehicle transfers forwards, which reduces the ability of the rear wheels to transfer braking effort to the road surface. This can cause the rear wheels to slip and make the vehicle unstable.

EBD uses the anti-lock braking hardware to automatically optimize the pressure of the rear brakes, below the point where anti-lock braking would be invoked. Only the rear axle is under EBD control.

ETC

ETC attempts to optimize forward traction by reducing engine torque or braking a spinning wheel until it regains grip.

ETC is activated if an individual wheel speed is above that of the vehicle reference speed (positive slip) and the brake pedal is not pressed. The spinning wheel is braked, allowing the excess torque to be transmitted to the non spinning wheels through the drive line. If necessary, the ABS module also sends a high speed CAN bus message to the ECM to request a reduction in engine torque. Torque reduction requests are for either a slow or fast response: a slow response requests a reduction of throttle angle (4.0L and 4.4L only); a fast response requests an ignition cut-off (4.0L and 4.4L) or a fuel cut-off (2.7L Diesel).

When the DSC function is selected off with the DSC switch, the engine torque reduction feature is disabled.

On vehicles with an automatic transmission, when the ETC function is active the ABS module also signals the TCM to prevent gear shifts.

EBA

EBA assists the driver, in emergency braking situations, by automatically maximizing the braking effort. There are two situations when the ABS module will invoke EBA: when the brake pedal is pressed very suddenly and when the brake pedal is pressed hard enough to bring the front brakes into ABS operation.

When the brake pedal is pressed very suddenly, the ABS module increases the hydraulic pressure to all of the brakes until they reach the threshold for ABS operation, thus applying the maximum braking effort for the available traction. The ABS module monitors for the sudden application of the brakes using the inputs from the stoplamp switch and from the pressure sensor in the HCU. With the brake pedal pressed, if the rate of increase of hydraulic pressure exceeds the predetermined limit, the ABS module invokes emergency braking.

When the brake pedal is pressed hard enough to bring the front brakes into ABS operation, the ABS module increases the hydraulic pressure to the rear brakes up to the ABS threshold.

EBA operation continues until the driver releases the brake pedal enough for the hydraulic pressure in the HCU to drop below a threshold value stored in the ABS module.

EDC

EDC prevents wheel slip caused by any of the following:

- A sudden decrease in engine torque when the accelerator is suddenly released.
- The sudden engagement of the clutch after a downshift on manual transmission vehicles.
- A downshift using the CommandShift™ on automatic transmission vehicles.

When the ABS module detects the onset of wheel slip without the brakes being applied it signals the ECM, on the high speed CAN bus, to request a momentary increase in engine torque.

HDC

HDC uses brake intervention to control vehicle speed and acceleration during low speed descents in off-road and low grip on-road conditions. Generally, equal pressure is applied to all four brakes, but pressure to individual brakes can be modified by the ABS and DSC functions to retain stability. Selection of the HDC function is controlled by the HDC switch on the center console. HDC operates in both high and low ranges, at vehicle speeds up to 50 km/h (31.3 mph).

On manual transmission vehicles, HDC may be used in first and reverse gears in high range and all gears in low range. Once the vehicle is moving, the clutch pedal should be fully released. The vehicle should not be driven with HDC active and the transmission in neutral.

On automatic transmission vehicles, HDC may be used in D, R and CommandShift 1 in high range, and in D, R and all CommandShift gears in low range. When in D, the transmission control module will automatically select the most appropriate gear. The vehicle should not be driven with HDC active and the transmission in N.

HDC can be selected at speeds up to 80 km/h (50 mph), but will only be enabled at speeds below 50 km/h (31.3 mph). When HDC is selected:

- At speeds up to 50 km/h (31.3 mph), the HDC information indicator is permanently illuminated if a valid gear is selected and, on manual transmission vehicles, the clutch pedal is not depressed.
- At speeds from >50 to 80 km/h (>31.3 to 50 mph) the HDC information indicator flashes and, on vehicles with the high line instrument cluster, a message advising that the speed is too high is displayed in the message center. For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).
If the HDC switch is pressed while vehicle speed is more than 80 km/h (50 mph), the HDC information indicator will not illuminate and HDC will not be selected.
- If the speed reaches 80 km/h (50 mph) or more, a warning chime sounds, the HDC function is switched off, the information indicator goes off and, on vehicles with the high line instrument cluster, a message advising that HDC has been switched off is displayed in the message center.

When HDC is enabled, the ABS module calculates a target speed and compares this with the actual vehicle speed. The ABS module then operates the HCU, in the active braking mode, as required to achieve and maintain the target speed. During active braking for HDC, the ABS module also energizes the HDC relay to operate the stop lamps. Applying the foot brakes during active braking may result in a pulse through the brake pedal, which is normal.

The target speed varies, between minimum and maximum values for each gear and transmission range, depending on driver inputs through the foot pedals. If the foot pedals are not operated, the ABS module adopts a default target speed.

Low Range Target Speeds

Limit	Speed, km/h (mph)			
	Gear			
	1, R	Automatic Transmission		Manual Transmission 2 to 6
D, 2 to 6		1, R		
Default	3.5 (2.19)	6 (3.75)	3.5 (2.19)	6 (3.75)
Minimum	3.5 (2.19)	3.5 (2.19)	3.5 (2.19)	3.5 (2.19)
Maximum	20 (12.5)	20 (12.5)	20 (12.5)	20 (12.5)

High Range Target Speeds

Limit	Speed, km/h (mph)		
	Gear		
	1, R	Automatic Transmission	
D		1, R	
Default	6 (3.75)	10 (6.25)	6 (3.75)
Minimum	6 (3.75)	6 (3.75)	6 (3.75)
Maximum	20 (12.5)	20 (12.5)	20 (12.5)

The target speed is varied between the minimum and maximum values using the accelerator pedal.

The target speed can also be varied by pressing the speed control '+' and '-' buttons (where fitted). For additional information, refer to:

[Speed Control](#) (310-03C Speed Control - V6 4.0L Petrol, Description and Operation),
[Speed Control](#) (310-03A Speed Control - TDV6 2.7L Diesel, Description and Operation).

During changes of target speed, the ABS module limits deceleration and acceleration to -0.5 m/s^2 (-1.65 ft/s^2) and $+0.5 \text{ m/s}^2$ ($+1.65 \text{ ft/s}^2$) respectively.

On manual transmission models target speed changes are suspended during gear changes, to prevent unwanted braking when the accelerator pedal is released to change gear. The ABS module determines a gear change is occurring from:

- Gear position information on the high speed CAN bus.
- The rate of release of the accelerator pedal.
- The status of the clutch pedal.

To provide a safe transition from active braking to brakes off, the ABS module invokes a fade out strategy, which gradually discontinues the braking effort, if it detects any of the following during active braking:

- HDC selected off with the HDC switch.
- Failure of a component used by HDC, but not critical to fade out function.
- Accelerator pedal pressed when transmission is in neutral.
- Brake overheat.

If fade out is invoked because of deselection or component failure, the HDC function is cancelled by the ABS module. If fade out is invoked because the accelerator pedal is pressed with the transmission in neutral, or because of brake overheat, the HDC function remains in standby and resumes operation when the accelerator pedal is released or the brakes have cooled.

The fade out strategy increases the target speed, at a constant acceleration rate of 0.5 m/s^2 (1.65 ft/s^2), until the maximum target speed is reached or until no active braking is required for 0.5 s. If the accelerator pedal is positioned within the range that influences target speed, the acceleration rate is increased to 1.0 m/s^2 (3.3 ft/s^2).

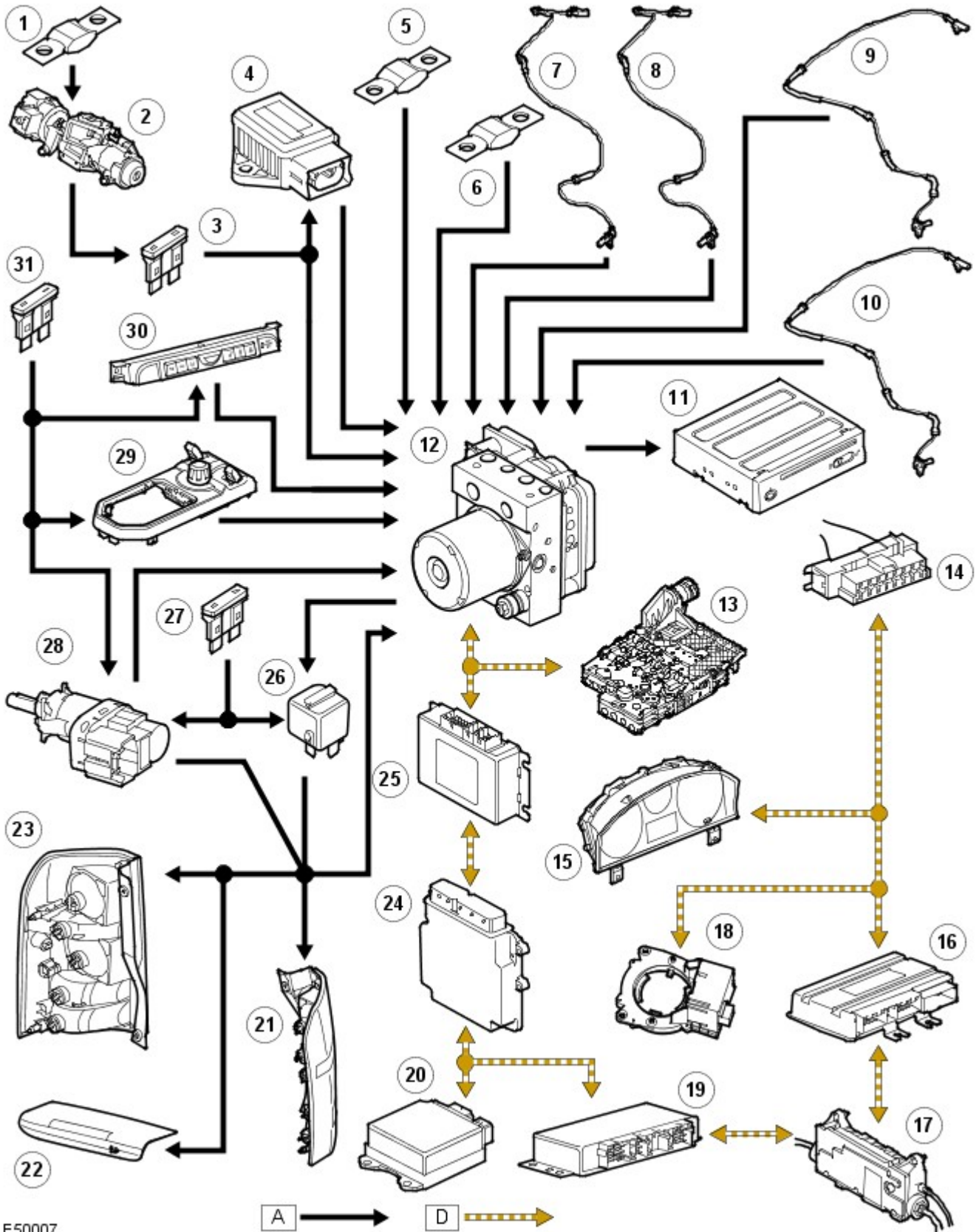
When fade out is invoked because of component failure, a warning chime sounds and the HDC information indicator is extinguished. The HDC warning indicator is illuminated (low line instrument cluster) or a message advising there is a fault is displayed in the message center (high line instrument cluster).

When fade out is invoked because of brake overheat on vehicles with the high line instrument cluster, a message advising that HDC is temporarily unavailable is displayed. On vehicles with the low line instrument cluster, the HDC warning indicator flashes. At the end of fade out, the HDC information indicator flashes. The flashing indicators and/or message continue while HDC remains selected until the brakes have cooled.

To monitor for brake overheat, the ABS module monitors the amount of braking activity and, from this, estimates the temperature of each brake. If the estimated temperature of any brake exceeds a preset limit, the ABS module invokes the fade out strategy. After the fade out cycle, the HDC function is re-enabled when the ABS module estimates that all of the brake temperatures are at less than 64% of the temperature limit.

ANTI-LOCK CONTROL DIAGRAM

- NOTE: A = Hardwired connections; D = High speed CAN bus



E50007

Item	Part Number	Description
1	-	Fusible link 11E, battery junction box (BJB)
2	-	Ignition switch
3	-	Fuse 37P, CJB
4	-	Yaw rate and lateral acceleration sensor
5	-	Fusible link 9E, BJB
6	-	Fusible link 23E, BJB
7	-	Front wheel speed sensor
8	-	Front wheel speed sensor
9	-	Rear wheel speed sensor
10	-	Rear wheel speed sensor
11	-	Navigation computer

12	-	ABS module
13	-	Transmission control module
14	-	Diagnostic socket
15	-	Instrument cluster
16	-	Air suspension control module
17	-	Parking brake module
18	-	Steering angle sensor
19	-	Rear differential control module
20	-	Restraints control module
21	-	Left stoplamp
22	-	Center stoplamp
23	-	Right stoplamp
24	-	ECM
25	-	Transfer box control module
26	-	HDC relay (non-serviceable, integrated into CJB)
27	-	Fuse 15P, CJB
28	-	Stoplamp switch
29	-	HDC switch
30	-	DSC switch
31	-	Fuse 66P, CJB

Anti-Lock Control - Traction Control - Anti-Lock Control - Traction Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the Anti-Lock Control- Traction Control System and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Tire size, condition and installation ● Wheel speed sensor condition and installation ● Steering Angle Sensor (SAS) condition and installation ● Yaw rate sensor and accelerometer condition and installation ● Hydraulic control unit (with attached ABS module) condition and installation 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Warning lamp operation ● Wheel speed sensors ● Central junction box ● HDC switch ● DSC switch ● Stop lamp switch ● Yaw rate sensor and accelerometer ● Steering Angle Sensor (SAS) ● Anti-lock Braking (ABS) module ● Controller Area Network (CAN) circuits

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Anti-Lock Braking System \(ABS\)](#) (100-00 General Information, Description and Operation).

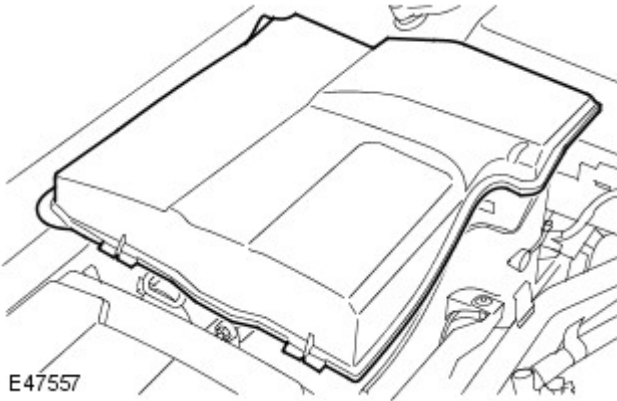
Anti-Lock Control - Traction Control - Anti-Lock Brake System (ABS) Module

Removal and Installation

Removal


 **CAUTION:** Make sure the ignition switch is in position 0.


1. Remove the cover.



2. Disconnect the electrical connector.

3. CAUTIONS:

 Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

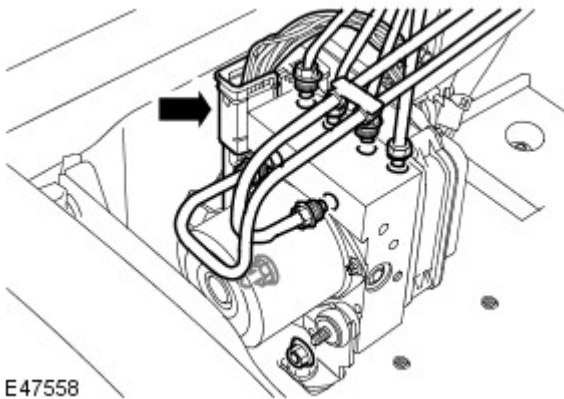
 Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the 6 brake tubes.

- Position an absorbent cloth to collect fluid spillage.

4. Remove the ABS module from the mounting bracket.

- Loosen, but do not remove, the 2 nuts securing the ABS module to the bracket.



Installation

1. **NOTE:** Make sure the ABS module locating grommet is correctly seated in the bracket before installing the ABS module.

• **NOTE:** Make sure the ABS module locating pin is correctly located in the grommet, and the 2 front isolators are fully seated in the bracket slots.

Install the ABS module.

- Tighten the 2 ABS module retaining nuts to 8 Nm (6 lb.ft).
- Remove the blanking caps from the ports.
- Tighten the two M10 and three M12 brake tube unions to 15 Nm (11 lb.ft).

- Tighten the M14 brake tube union to 17 Nm (13 lb.ft).
- Connect the electrical connector.
- Remove the ABS module from the mounting bracket.

2. Using T4, bleed the braking system.

For additional information, refer to: Brake System Pressure Bleeding (206-00, General Procedures).


3. Install the cover.

4. If a new ABS module has been installed, interrogate the ABS system using T4.

Anti-Lock Control - Traction Control - Front Wheel Speed Sensor

Removal and Installation

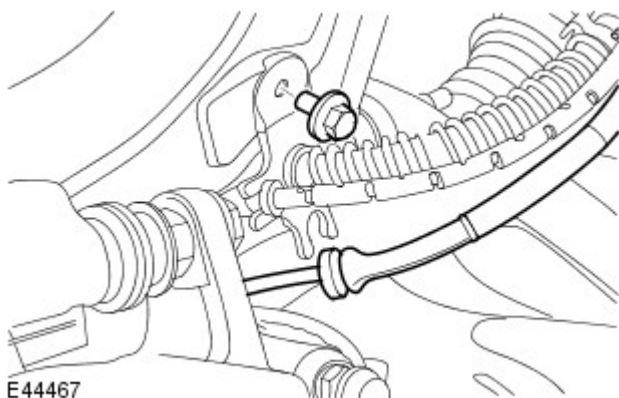
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Release the brake hose bracket from the wheel knuckle.

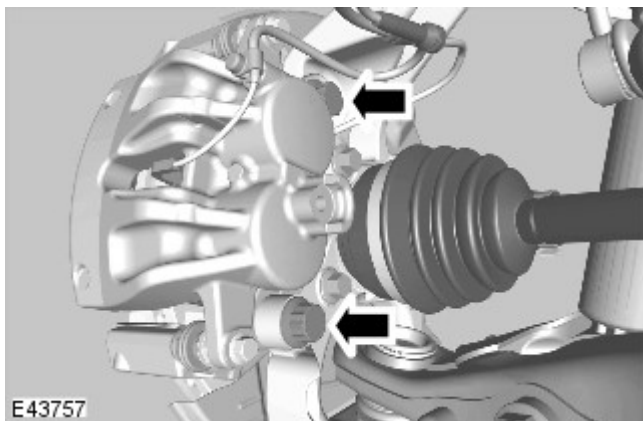
- Remove the retaining bolt.



4.  **CAUTION:** Do not allow the brake caliper to hang on the brake hose.

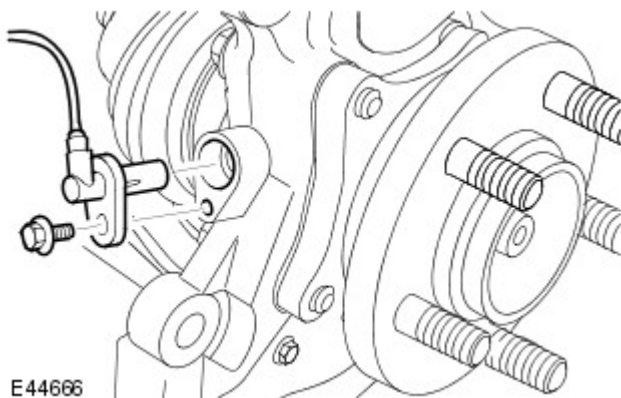
Release the brake caliper anchor plate from the wheel knuckle and tie the caliper aside.

- Remove the two retaining bolts.



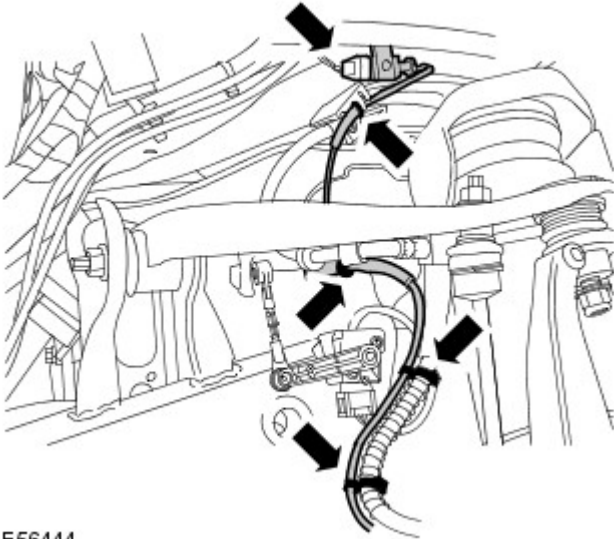
5. Release the wheel speed sensor from the wheel knuckle.

- Remove the bolt.



6. Remove the wheel speed sensor.

- Disconnect the electrical connector.
- Release the wiring harness from the 5 clips.



E56444

Installation

1. Make sure the wheel speed sensor location in the wheel knuckle is free of dirt.
2. **NOTE:** Make sure the electrical connector retaining clip is attached to the body wiring harness.


Install the wheel speed sensor.

- Connect the electrical connector.
 - Attach the wiring harness to the 5 clips.
 - Tighten the bolt to 9 Nm (7 lb.ft).
3. Secure the brake caliper and anchor plate to the wheel knuckle.
 - Tighten the bolts to 275 Nm (203 lb.ft).
 4. Secure the brake hose retaining bracket to the wheel knuckle.
 - Tighten the bolt to 25 Nm (18 lb.ft).
 5. Install the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
 6. Install the wheel and tire.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
 7. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.
 8. If a new wheel speed sensor has been installed, interrogate the ABS system using T4.

Anti-Lock Control - Traction Control - Rear Wheel Speed Sensor

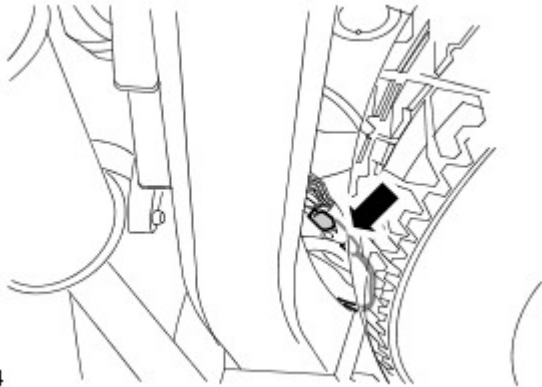
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

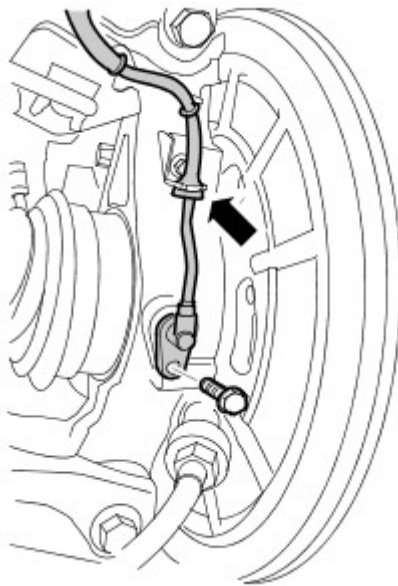
Raise and support the vehicle.

2. Remove the wheel and tire.
3. Disconnect the anti-lock brake system (ABS) sensor electrical connector.
 - Release the wiring harness retaining clip.



E52454

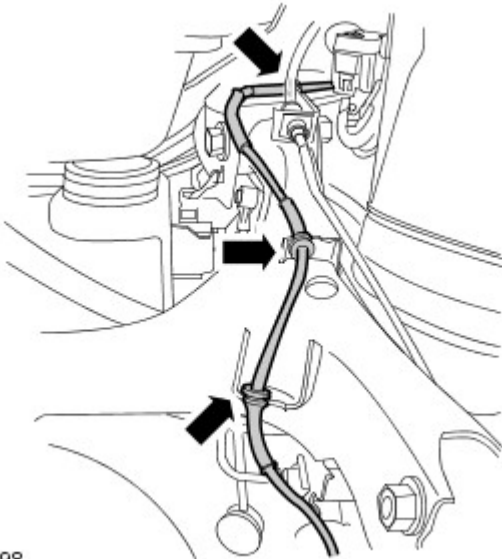
4. Release the wheel speed sensor from the wheel knuckle.
 - Release the wiring harness.
 - Remove the retaining bolt.



E56445

5. Remove the wheel speed sensor.

- Release the wiring harness from the 4 clips.



E56698

Installation

1. Make sure the wheel speed sensor location in the wheel knuckle is free of dirt.

2. Install the wheel speed sensor.

- Attach the wiring harness to the 4 clips.

3. Secure the wheel speed sensor to the wheel knuckle.

- Tighten the bolt to 9 Nm (7 lb.ft).
- Attach the wiring harness to the clip.

4. **NOTE:** Make sure the electrical connector retaining clip is attached to the body wiring harness.

Connect the ABS sensor electrical connector.

- Attach the wiring harness.

5. If a new wheel speed sensor has been installed, interrogate the ABS system using T4.

Anti-Lock Control - Stability Assist - Yaw Rate Sensor

Removal and Installation

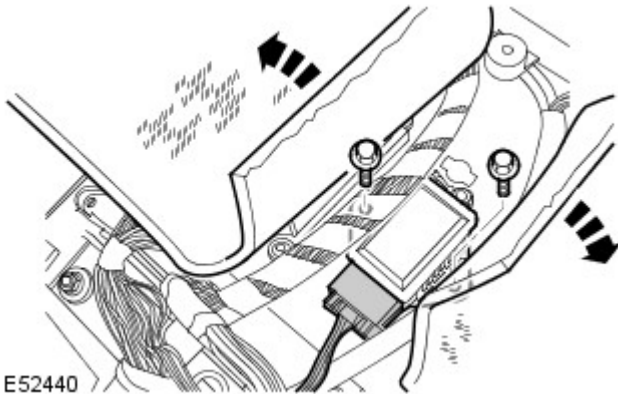
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the floor console.
For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).

3.  **CAUTION:** Make sure the wiring harness is protected when cutting the carpet.

Remove the yaw rate sensor.

- Cut the carpet for access.
- Position the wiring harness aside.
- Disconnect the electrical connector.
- Remove the two retaining bolts.



Installation


1. Install the yaw rate sensor.
 - Tighten the bolts to 7 Nm (5 lb.ft).
 - Connect the electrical connector.
 - Attach the wiring harness.
 - Attach the carpet.
2. Install the floor console.
For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. If a new yaw rate sensor has been installed, interrogate the ABS system using T4.

Anti-Lock Control - Stability Assist - Yaw Rate Sensor

Removal and Installation

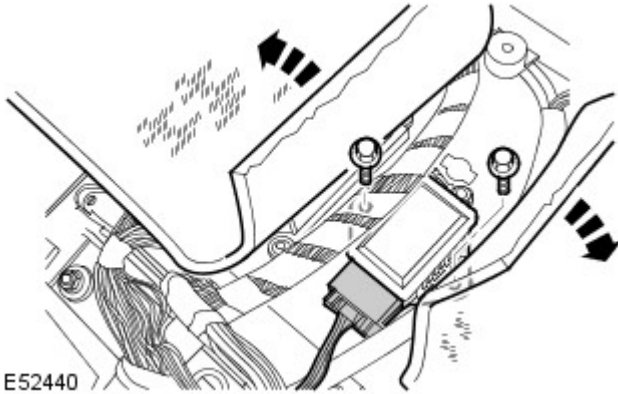
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the floor console.
For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).

3.  **CAUTION:** Make sure the wiring harness is protected when cutting the carpet.

Remove the yaw rate sensor.

- Cut the carpet for access.
- Position the wiring harness aside.
- Disconnect the electrical connector.
- Remove the two retaining bolts.



Installation

1. Install the yaw rate sensor.
 - Tighten the bolts to 7 Nm (5 lb.ft).
 - Connect the electrical connector.
 - Attach the wiring harness.
 - Attach the carpet.
2. Install the floor console.
For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. If a new yaw rate sensor has been installed, interrogate the ABS system using T4.

Steering System - General Information - Steering System

Diagnosis and Testing

Principles of Operation

For a detailed description of the Steering System and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Power Steering](#) (211-02 Power Steering, Description and Operation) / [Steering Linkage](#) (211-03 Steering Linkage, Description and Operation) / [Steering Column](#) (211-04 Steering Column, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
 - If a road test is necessary make sure the vehicle is safe to do so.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check the tires for correct pressure, size and tread pattern ● Check for wheel rim and tire damage ● Check road wheel security ● Check the power steering fluid level and the hydraulic circuit for oil leaks ● Check the power steering pump drive belt condition and tension ● Check the power steering pump for security, wear, damage and excessive noise ● Check the steering gear assembly for damage, wear and security ● Check the hydraulic pipes and cooler lines for damage and correct routing ● Check the steering joints for damage, excessive play, wear and security ● Check the steering column and joints for damage, excessive play, wear and security 	<ul style="list-style-type: none"> ● Steering Angle Sensor Module (SASM) and circuits ● Controller Area Networks (CAN) circuits

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Steering wanders	<ul style="list-style-type: none"> ● Excessive free play in the steering system ● Steering geometry incorrectly aligned 	Check for excessive movement or play in the steering system with the engine running. Check for play at several different steering positions. Carry out steering geometry and alignment checks. Refer to the relevant section of the workshop manual
Steering pulls to the left or right	<ul style="list-style-type: none"> ● Steering geometry incorrectly aligned 	Carry out steering geometry and alignment checks using a four wheel alignment system. REFER to: Four-Wheel Alignment (204-00 Suspension System - General Information, General Procedures). Ensure that the tire direction of rotation is correct for the position on the vehicle (where directional tires are installed)
Steering feels notchy when turning from lock to lock	<ul style="list-style-type: none"> ● Steering or suspension swivel joints seized ● Steering tie rod end joints or track rod inner joints seized ● Steering column or universal joints seized ● Steering gear internal components misaligned, worn or damaged 	Disconnect the steering gear from the suspension. Check for freedom of movement in the suspension. Disconnect the steering column from the steering gear. Check the steering column and universal joints for freedom of movement. Check the steering gear for freedom of movement. Rectify as necessary
Steering feels tight and does not self-center	<ul style="list-style-type: none"> ● Steering gear internal components misaligned, worn or damaged 	

Symptom	Possible Causes	Action
Power steering hydraulics noisy operation	<ul style="list-style-type: none"> ● Power steering fluid level low or contaminated ● Incorrect specification of power steering fluid ● Filter in the power steering reservoir blocked ● Power steering fluid aerated ● power steering hoses twisted or restricted 	<p>Check and top-up the power steering fluid level if required, using the correct specification of fluid. REFER to: Specifications (211-00 Steering System - General Information, Specifications).</p> <p>Check for contaminated fluid. Drain the fluid from the reservoir and visually inspect the filter for obstructions/blockage. Repair/renew as necessary. Check for air ingress into the system. Check the power steering hoses for twisting or restrictions. Rectify as necessary</p>
Power steering pump noisy	<ul style="list-style-type: none"> ● Power steering fluid level low or contaminated ● Filter in the power steering reservoir blocked ● Pump internal components worn or damaged 	<p>Check and top-up the power steering fluid level if required. REFER to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).</p> <p>Check for contaminated fluid. Drain the fluid from the reservoir and visually inspect the filter for obstructions/blockage. Repair/renew as necessary. Check for excessive pump noise. Rectify as necessary</p>
Power steering gear noisy	<ul style="list-style-type: none"> ● Power steering fluid level low or contaminated ● Steering gear internal components worn or damaged 	<p>Check and top-up the power steering fluid level if required. Refer to the relevant section of the workshop manual. Check for contaminated fluid. Check for excessive steering gear noise. Rectify as necessary</p>
Steering column noisy	<ul style="list-style-type: none"> ● Steering column fouling or universal joints dry 	<p>Check the steering column and universal joints. Rectify as necessary</p>
Power steering feels heavier than normal through its operating range	<ul style="list-style-type: none"> ● Lack of power assistance 	<p>Check the power steering pump pressure. Check the steering column has no damage and rotates freely</p>
Power steering feels too light at speed		
Power steering feels too heavy at standstill and low speed		


DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Steering System - General Information - Power Steering System Filling and Bleeding

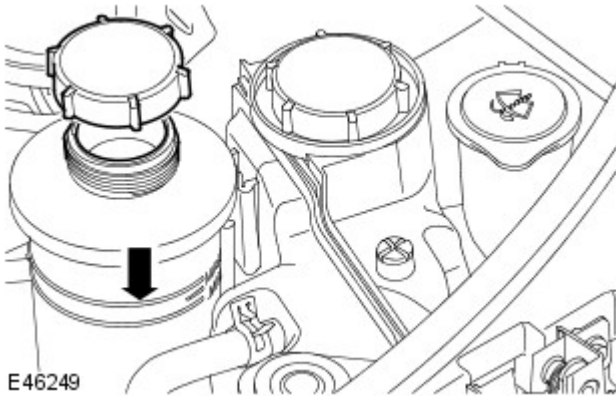
General Procedures

1. Check the power steering fluid level.

2.  **CAUTION:** Fluid must always be present in the reservoir during bleeding.

Remove the filler cap and fill to the MAX level mark.

- Install the reservoir filler cap.



3. Start the engine and allow to run for 10 seconds, stop the engine.

- Check the power steering fluid, if aerated, wait until fluid is free from bubbles then top-up reservoir to UPPER level mark with recommended fluid.

4.  **CAUTION:** Do not hold steering on full lock for longer than 10 seconds.

Start the engine and turn steering fully lock to lock, stop the engine.

- Check and top-up power steering fluid level.

5. Start and run the engine for 2 minutes, turn the steering fully lock to lock.

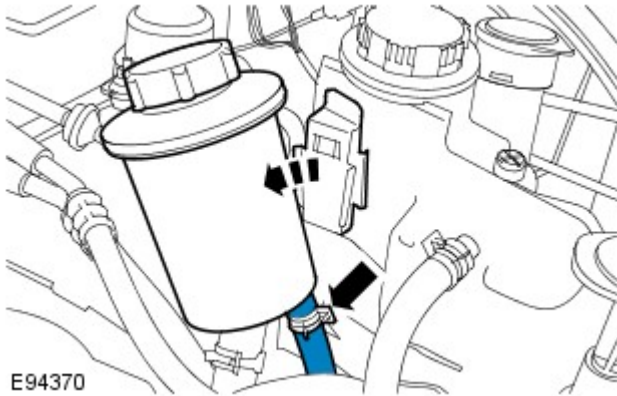
- Check and top-up power steering fluid level.

Steering System - General Information - Power Steering System Flushing

General Procedures

- NOTE: If heavy steering or contamination within the power steering system is found, it is necessary to carry out the system flush procedure as detailed below. If any components have been replaced in the power steering system the procedure below must be carried out in full.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the power steering fluid reservoir cap.
2. Using a suitable syringe, remove the power steering fluid from the power steering fluid reservoir.



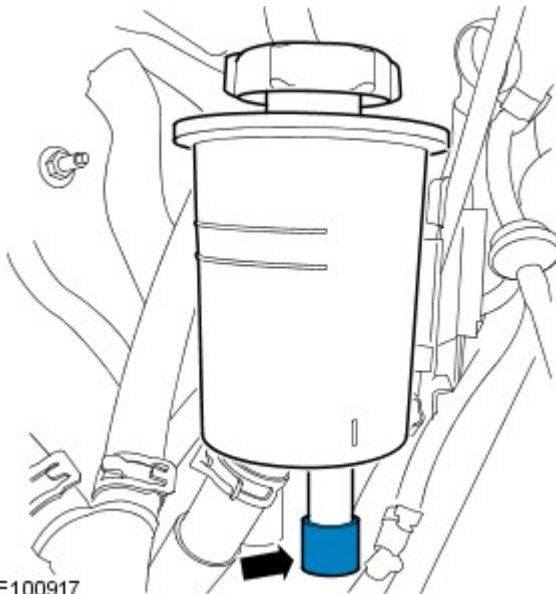
E94370

3.  CAUTION: Be prepared to collect escaping fluids.

- NOTE: Note the orientation of the clip.

Detach the power steering fluid reservoir.

- Detach but do not remove the power steering fluid reservoir.
- Release the power steering fluid return hose from the power steering fluid reservoir.
- If a quick release coupling is fitted to the power steering return hose, release the power steering fluid return hose from the coupling by removing the clip.



E100917

4.  CAUTION: Be prepared to collect escaping fluids.

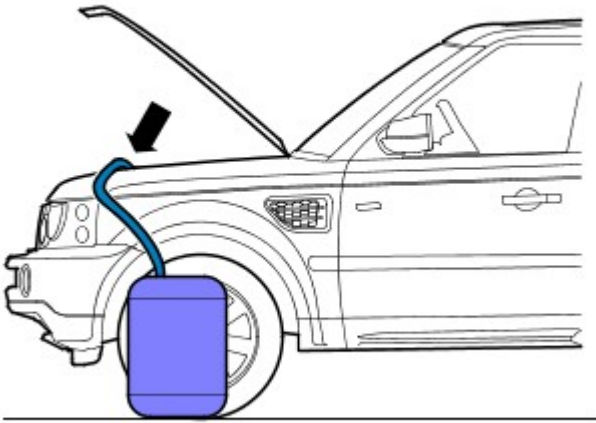
- NOTE: Make sure that all openings are sealed. Use new blanking caps.

Using a suitable blanking cap, cap the power steering reservoir return pipe.

5.  CAUTION: Be prepared to collect escaping fluids.

• NOTE: Make sure the extended pipe is not kinked or twisted and is correctly secured with hose clips.

Attach a suitable pipe to the power steering return hose to allow the fluid to drain.

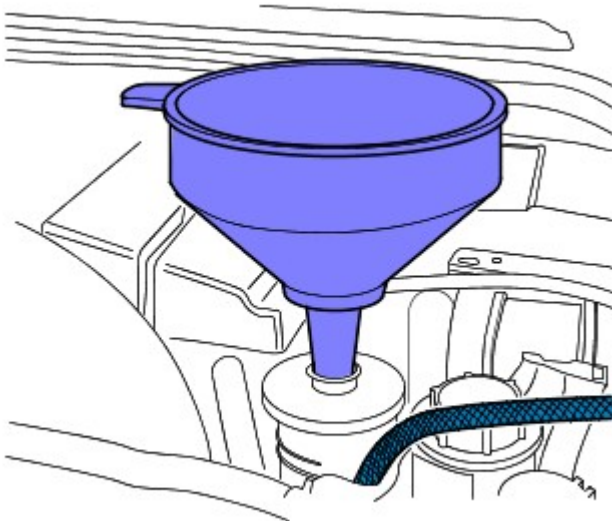


E 100918


6. NOTE: The suitable funnel should have the a capacity of 4 litres and O-ring seal

• NOTE: The suitable funnel must be tightly sealed to the power steering fluid reservoir to avoid fluid leakage.

Install a suitable funnel onto the power steering fluid reservoir.




E94372

7.  WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle with the wheels just clear of the ground.

8. CAUTIONS:

 Steps 8 and 9 must be carried out within 2 - 3 seconds of each other. Failure to follow this instruction may result in damage to the power steering system.

 Be prepared to collect escaping fluids.

Using the suitable funnel, top up the power steering system with the specified fluid. Make sure the fluid level is maintained at two thirds full in the funnel.

9. CAUTIONS:



Be prepared to collect escaping fluids.



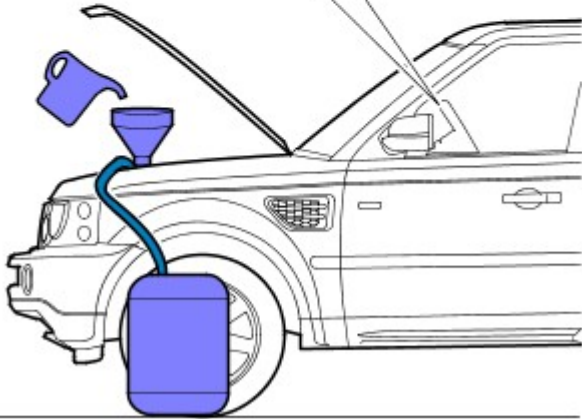
Do not allow the power steering fluid level in the power steering fluid reservoir to fall below the minimum power steering fluid level. Failure to follow this instruction may result in damage to the power steering system.



Make sure the engine is switched off as soon as the full 4 litres of power steering fluid has entered the power steering fluid reservoir.

Flush the power steering system.

- Start the engine
- With assistance turn the steering slowly lock to lock 3 times at approximately 1 revolution every 5 seconds.
- Continue to flush the power steering system until 4 litres of power steering fluid has been added to the power steering reservoir. This should take approximately 30 seconds.

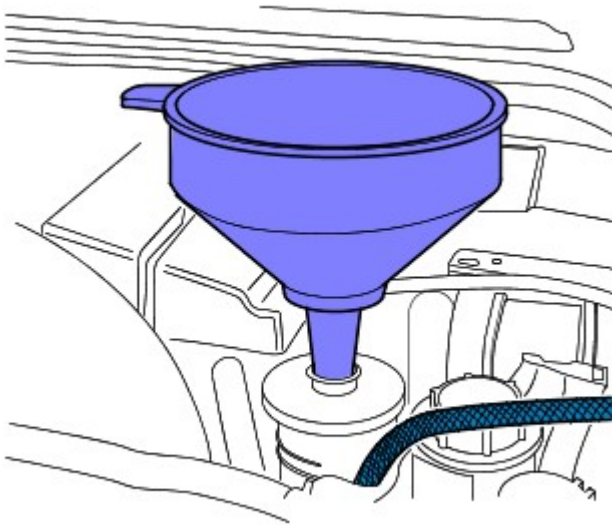


E94373



10. CAUTION: Be prepared to collect escaping fluids.

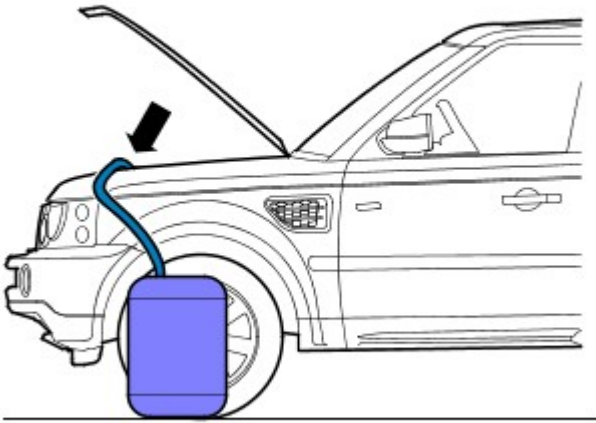
Remove the suitable funnel.



E94372

11.  CAUTION: Be prepared to collect escaping fluids.

Remove the suitable pipe to the power steering return hose.



E 100918

12.  CAUTION: Be prepared to collect escaping fluids.

- NOTE: Note the orientation of the clip.

If a quick release coupling is fitted to the power steering return hose, connect the power steering fluid return hose to the coupling by installing the clip.

13. Install a new power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - V6 4.0L Petrol/V8 5.0L Petrol/TDV6 3.0L Diesel](#) (211-02 Power Steering, Removal and Installation).

Power Steering -

Power Steering Fluid

Item	Specification
Recommended power steering fluid	Texaco Cold Climate Fluid 14315

Capacity

Item	Capacity
System capacity - Maximum - Fill to mark on reservoir	0.89 litre (1.5 pints) (0.9 US quarts)

General Specification

Item	Specification
Type	Power assisted rack and pinion, speed proportional with belt driven pump, remote hydraulic fluid reservoir and fluid cooler
Steering wheel diameter	395 mm (15.5 in)
Number of turns - lock to lock	3.32
Turning circle	11.45 m (37.5 ft)
System ratio	17.8:1
System operating pressure	110 bars (11000 kPa)(1595 lbf/in ²)
Pump relief valve operating pressure	114 ± 4 bar (11400 ± 400 kPa) (1653 ± 58 lbf/in ²)
Fluid flow rate - constant	8.8 ± 0.5 litre/min (15.4 ± 0.8 pints/min) (9.2 ± 0.5 US quarts/min)
Steering rack travel	166 mm (6.22 in)
Piston diameter	52 mm (1.9 in)
Rack bar diameter	30 mm (1.12 in)
Steering angle sensor make/part number	Panasonic ECS64SUKX

Torque Specifications

Description	Nm	lb-ft
Power steering pump bolts - All engines	25	18
High pressure line to power steering pump - All engines	25	18
Power steering pump bolts - All engines	25	18
High pressure line to power steering pump - All engines	25	18
Low pressure line to power steering pump - All engines	25	18
Steering angle sensor Torx screws	3	2
* Steering column intermediate shaft nut	22	16
++ Steering column intermediate shaft to the lower shaft bolt	25	18
Horn nut	10	7
Coolant expansion tank bolts	10	7
A/C condenser refrigerant line bolts	25	18
++ Power steering fluid lines bolt - 2.7 litre	25	18
+ Power steering gear to cross member bolts	175	129
High pressure line to steering gear bolt	25	18
Power steering line support bracket bolt	10	7
High pressure line union nut	30	22
* Tie rod end ball joint nuts	76	56
** Universal joint to steering gear bolt	25	18
Radiator access panel bolts	10	7
Oil filter	18	13

* New nut(s) must be fitted

+ New cage nuts must be fitted

** New 'Patchlok' bolt must be fitted

++ New bolt must be fitted

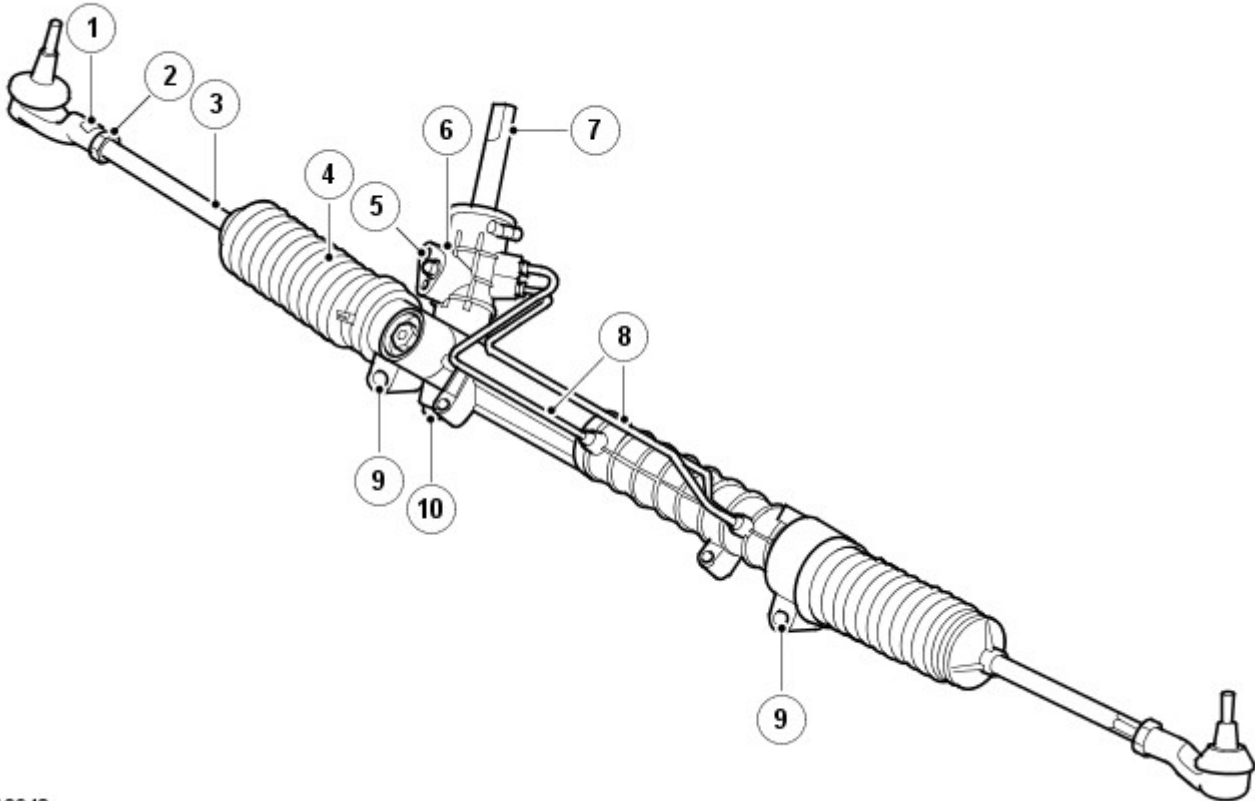
17	-	Screw
18	-	Cooler

GENERAL

The steering system comprises a TRW manufactured rack and pinion steering gear, a power steering pump, a reservoir, a fluid cooler and fluid hoses. The steering gear is a conventional end take-off rack and pinion power assisted unit.

The steering gear rack has a travel of 166 mm (6.53 in). Lock to lock requires 3.33 revolutions of the steering wheel, which gives a ratio of 45 mm (1.77 in)/revolution at the center position and 52.6 mm (2.07 in)/revolution at end of lock.

STEERING GEAR



E46942

Item	Part Number	Description
1	-	Tie-rod end
2	-	Locknut
3	-	Tie-rod
4	-	Gaitor
5	-	Pressure/return connection from/to pump
6	-	Valve unit housing
7	-	Input shaft
8	-	Pressure/return pipes
9	-	Steering gear casing attachment lugs
10	-	Pinion housing

The steering gear is located at the front of the engine, below the accessory belt drive. The gear is attached to two brackets on the chassis and is secured to the brackets with flanged bolts and caged nuts. The cage prevents the nuts from turning when the bolts are loosened or tightened. The cage nuts can only be used once and must be replaced when the gear is removed. For service, M12 Nylock nuts are available as a replacement for the cage nut.

The steering gear comprises an aluminium, cast, one piece housing which contains a mechanical steering rack, a valve unit and an integrated hydraulic power unit.

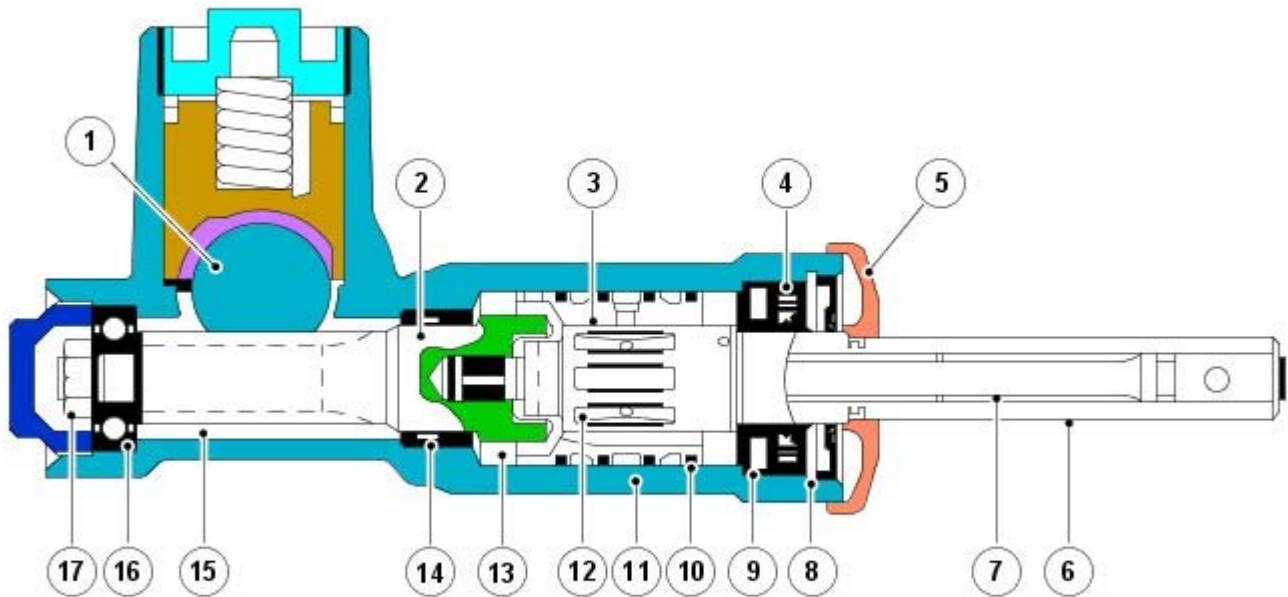
The steering gear uses a rack with an integrated piston which is guided on plain bearings within the rack housing. The pinion, which is attached to the valve unit, runs in bearings and meshes with the rack teeth. The rack is pressed against the pinion by a spring loaded yoke which ensures that the teeth mesh with the minimum of play. The pinion is connected to the valve unit via a torsion bar. The rotary motion of the steering wheel is converted into linear movement of the rack by the pinion and is initiated by the valve unit. This movement is transferred into movement of the road wheels by adjustable tie-rods.

The 49 mm (1.92 in) diameter piston of the hydraulic power unit is located at one end of the gear housing. Each side of the piston is connected to fluid pressure or fluid return via external metal pipes which are connected to the valve unit.

Each end of the gear has a threaded hole which provides for the fitment of the tie-rod. The external ends of the gear are sealed with gaitors which prevent the ingress of dirt and moisture. The tie-rod has a long threaded area which allows for the fitment of the tie-rod end. The thread allows for the adjustment of the steering toe. When the correct toe is achieved, a locknut is tightened against the tie-rod end preventing inadvertent movement.

The gear has a central hole machined along its length. The hole allows the air in the gaitors to be balanced when the steering is turned. The gaitors are serviceable items and are retained on the gear housing and the tie-rod with zip ties.

Valve Unit



E46943

Item	Part Number	Description
1	-	Rack
2	-	Pinion shaft
3	-	Outer sleeve
4	-	Oil sleeve
5	-	Dirt seal
6	-	Input shaft
7	-	Torsion bar
8	-	Circlip
9	-	Oil seal
10	-	PTFE ring
11	-	Steering gear casting
12	-	Slots
13	-	Pin - Pinion shaft to outer sleeve
14	-	Oil seal
15	-	Pinion shaft
16	-	Bearing
17	-	Pinion shaft nut

The valve unit is an integral part of the steering gear. The principle function of the valve unit is to provide maximum power assistance (i.e. when parking) with minimum effort required to turn the steering wheel.

The pinion housing of the valve is an integral part of the main steering gear casting. The pinion housing has four machined ports which provide connections for pressure feed from the power steering pump, return fluid to the reservoir and pressure feeds to each side of the cylinder piston.

The valve unit comprises an outer sleeve, an input shaft, a torsion bar and a pinion shaft. The valve unit is co-axial with the pinion shaft which is connected to the steering column via the input shaft. The valve unit components are located in the steering gear pinion housing which is sealed with a cap.

The outer sleeve is located in the main bore of the pinion housing. Three annular grooves are machined on its outer diameter. PTFE rings are located between the grooves and seal against the bore of the pinion housing. Holes are drilled radially in each annular groove through the wall of the sleeve. The bore of the outer sleeve is machined to accept the input shaft. Six equally spaced slots are machined in the bore of the sleeve. The ends of the slots are closed and do not continue to the end of the outer sleeve. The radial holes in the outer sleeve are drilled into each slot.

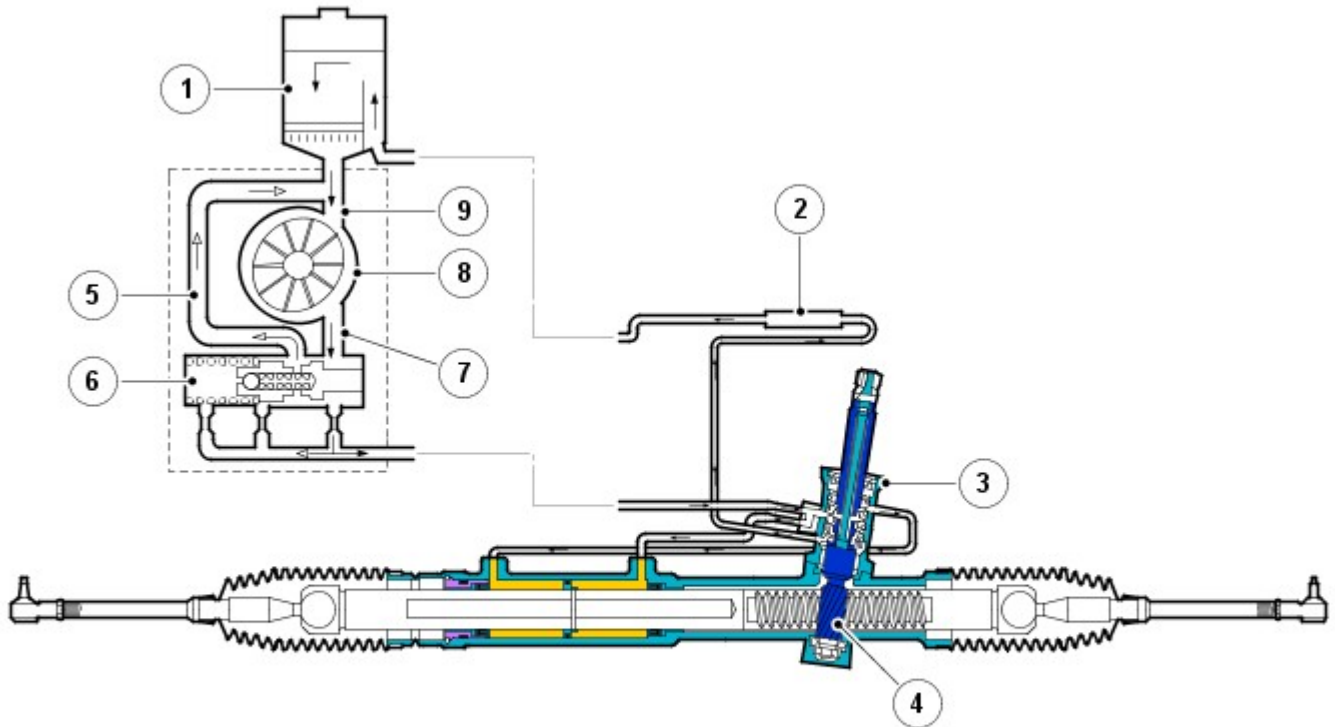
The input shaft has two machined flats at its outer end which allow for the attachment of the steering column intermediate shaft yoke. The flats ensure that the intermediate shaft is fitted in the correct position to maintain the optimum phase angle. The inner end of the input shaft forms a dog-tooth which mates with a slot in the pinion shaft. The fit of the dog-tooth in the slot allows a small amount of relative rotation between the input shaft and the pinion shaft before the dog-tooth contacts the wall of the slot. This ensures that, if the power assistance fails, the steering can be

operated manually without over stressing the torsion bar. The central portion of the input shaft has equally spaced longitudinal slots machined in its circumference. The slots are arranged alternately around the input shaft.

The torsion bar is fitted inside the input shaft and is an interference fit in the pinion shaft. The torsion bar is connected to the input shaft by a drive pin. The central diameter of the torsion bar is machined to a smaller diameter in its central section. The smaller diameter allows the torsion bar to twist in response to torque applied from the steering wheel in relation to the grip of the tyres on the road surface.

The pinion shaft has machined upper teeth on its central diameter which mate with teeth on the steering gear rack. A slot, machined in the upper end of the pinion shaft mates with the dog-tooth on the input shaft. The pinion shaft locates in the pinion housing and rotates on ball and roller bearings.

Power Steering Hydraulic Operation



E46944

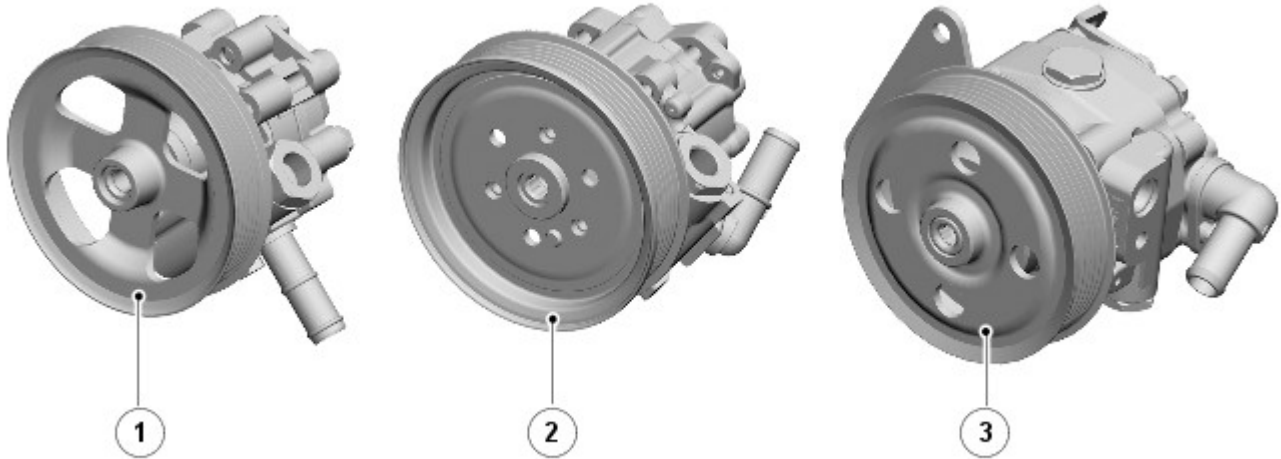
Item	Part Number	Description
1	-	Reservoir
2	-	Cooler
3	-	Valve unit
4	-	Steering rack and pinion
5	-	Flow control/pressure relief return
6	-	Flow control/Pressure relief valve
7	-	Output port
8	-	Power steering pump
9	-	Low pressure suction line

When the engine is started the power steering pump draws fluid from the reservoir into the low pressure suction line. The fluid passes through the pump and emerges as pressurised fluid at the outlet port. The attenuated high pressure hose passes the pressurised fluid to the steering gear valve unit.

If no steering effort is applied, there is minimal restriction within the system and the supply pressure from the pump is low. Minimal pressure is applied, via the valve unit, to each side of the piston in the hydraulic cylinder and the full flow from the power steering pump returns to the reservoir via the fluid cooler.

When steering effort is applied in either direction, the return flow of fluid to the reservoir is restricted, causing the supply pressure from the pump to increase. The pressurised fluid is directed to the applicable side of the piston in the hydraulic cylinder, via the valve unit, providing the power assistance required to reduce the steering effort. Fluid displaced from the low pressure side of the cylinder is returned via the valve unit and fluid cooler to the reservoir. The fluid cooler reduces the fluid temperature which prolongs the life of hoses and seals in the system.

POWER STEERING PUMP



E131159

Item	Part Number	Description
1	-	4.0L V6
2	-	5.0L V8
3	-	2.7L, 3.0L TdV6

The power steering pumps used on the four engine variants are basically the same pump with different connection fittings. The pump is a positive displacement, vane type pump which supplies hydraulic pressure to the steering gear valve unit. The pump is driven by a Poly Vee belt from the crankshaft pulley and output from the pump increases proportionally with engine speed. A self-adjusting tensioner is fitted to maintain the correct tension on the belt.

The pump has an internal flow control valve which also incorporates a pressure relief valve. The pressure relief valve limits the maximum pressure supplied to the steering gear to 114 bar (1653 lbf in²) ± 4 bar (58 lbf in²) on V6 petrol engines, and 115 bar (1667 lbf in²) ± 4 bar (58 lbf in²) for V8 petrol, and V6 diesel models. The flow control valve regulates the flow to a constant value of 8.8 l/min (1.93 gal/min) ± 0.5 l/min (0.1 gal/min) regardless of engine speed. The pump has a displacement of 9.6 cc/rev (0.58 in³/rev) on V6 petrol, and V6 diesel, but 11 cc/rev (0.67 in³/rev) for V8 petrol.

A shaft runs longitudinally through the pump. One end of the shaft is fitted with a pressed-on drive pulley, the opposite end of the shaft is closed by a cover. The shaft runs in bearings located in the body and oil seals at each end of the shaft prevent leakage of hydraulic fluid.

The pump contains ten vanes on petrol models, and eleven vanes on diesel models which rotate within a cam ring and are driven by the shaft. As the vanes rotate, the cam ring causes the space between the vanes to increase. This causes a depression between the vanes and fluid is drawn from the reservoir via the suction hose into the space between the vanes.

As the shaft rotates, the inlet port is closed to the vanes which have drawn in fluid, trapping the fluid between the vanes. The cam ring causes the space between the vanes to reduce and consequentially compresses and pressurises the hydraulic fluid trapped between them.

Further rotation of the shaft moves the vanes to the outlet port. As the vanes pass the port plate the pressurised fluid passes from the pump outlet port into the pressure hose to the steering gear.

The pressurised fluid is subject to control by the flow control and pressure relief valve. The flow control valve maintains a constant flow of fluid supplied to the steering gear irrespective of engine speed variations. The pressure relief valve limits the pressure on the output side of the pump. A metering orifice is included in the discharge port of the pump. If the pressure in the orifice reaches a predetermined level, a spring loaded ball in the center of the flow control valve is lifted from its seat and allows pressurised fluid to recirculate within the pump.

The pressure relief valve will operate if the discharge from the pump is restricted, i.e.; steering held on full lock. If the output from the pump is blocked, all output is recirculated through the pump. In this condition, as no fresh fluid is drawn into the pump from the reservoir, the fluid temperature inside the pump will increase rapidly. Consequentially, periods of operation of the steering gear on full lock should be kept to a minimum to prevent overheating of the pump and the fluid within it.

RESERVOIR



E46941

The fluid reservoir is located on a bracket in the left hand side of the engine compartment, behind the radiator. The reservoir comprises a body, cap and filter. The purpose of the reservoir is to contain a surplus of the hydraulic fluid in the system to allow for expansion and contraction of the fluid due to temperature variations. The fluid level ensures that the supply connection on the bottom of the reservoir is covered with fluid at all operating vehicle attitudes. Any air which is present in the system is exhausted from the system in the reservoir.

The body is a plastic moulding with two ports at the bottom which provide for the connection of the suction supply and return hoses. Moulded markings on the side of the reservoir denote the upper and lower fluid levels. A non-serviceable, 100 micron nylon mesh filter is fitted in the body. The filter removes particulate matter from the fluid before it is drawn into the pump supply connection.

The cap is rotated counterclockwise for one quarter turn to release from the body. The cap is fitted with an O-ring to prevent fluid leakage. The cap incorporates a breather hole to allow for changes in fluid level during operation and prevent vacuum or pressurisation of the reservoir.

HIGH PRESSURE HOSE

The high pressure hose connecting the pump to the steering gear valve unit contains two attenuators. Each attenuator comprises a bullet shaped restrictor which is secured inside the hose. The restrictors damp pressure pulses from the pump, consequently reducing noise and strain on downstream components. The attenuators are an integral part of the hose and cannot be serviced separately.

FLUID COOLER

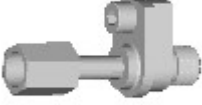

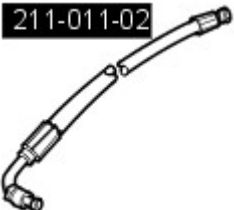


- **NOTE:** Diesel engine vehicles are not fitted with a fluid cooler.

The fluid cooler is located in the return line from the steering gear to the reservoir. The cooler comprises a flexible hose and a solid pipe which connect between the reservoir and the return pipe from the steering gear. The cooler is an integral part of the pipe and cannot be replaced as a separate component.

The cooler is a fabricated aluminium tube, through which the power steering fluid passes. The outer diameter of the cooler tube has aluminium loops attached to it which dissipate heat. Cool air entering the front of the vehicle passes over the cooler and flows through the loops. The loops act as heat exchangers, conducting heat from the fluid as it passes through the tube.

Power Steering - Power Steering Pressure Test TDV6 2.7L Diesel

General Procedures

Special Tool(s)	
 <p>E87857</p>	<p>Adaptor, power steering pressure test</p> <p>211-011-12</p>
 <p>E58730</p>	<p>Hose - power steering pressure test</p> <p>211-011-02(LRT-57-002)</p>
 <p>E58730</p>	<p>Hose - power steering pressure test</p> <p>211-011-02(LRT-57-002)</p>
 <p>E58732</p>	<p>Valve block power steering test</p> <p>211-011-01(LRT-57-001)</p>
 <p>E58733</p>	<p>Hose and gauge - power steering pressure test</p> <p>211-287(LRT-57-005)</p>



CAUTION: If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.

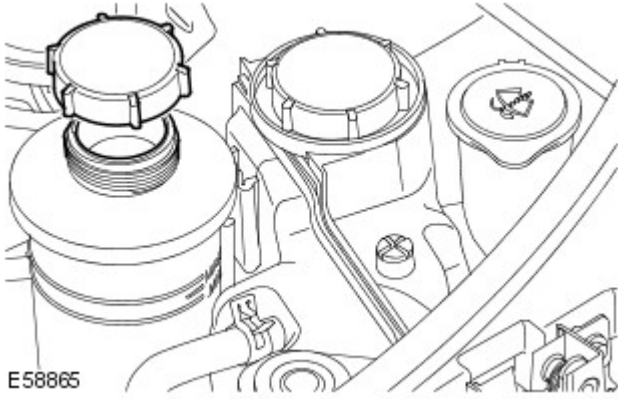
• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

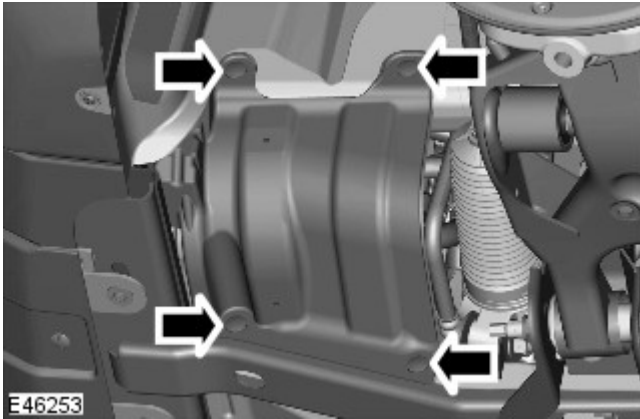
Raise and support the vehicle.

2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).



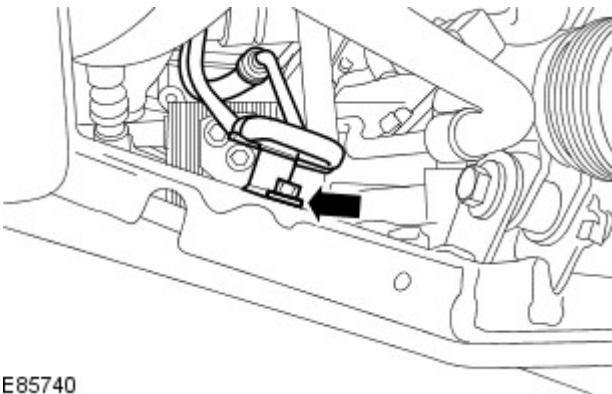
3. Siphon the fluid from the power steering reservoir.

- Remove the filler cap.



4. Remove the front LH splash shield.

- Remove the 4 clips.




5. Release the steering gear high-pressure line.

- Remove the bolt.

6. Remove the front LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

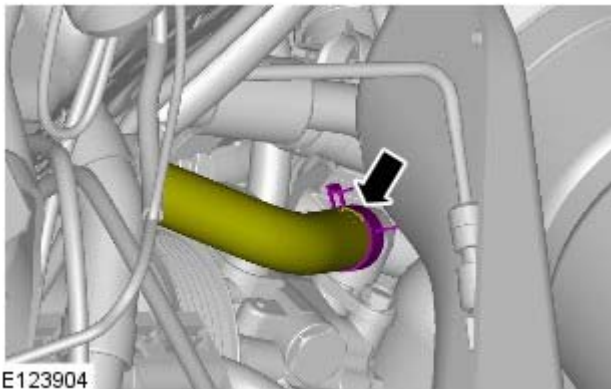
7. CAUTIONS:

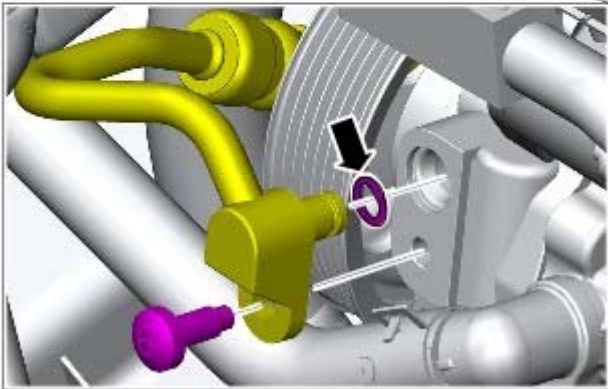
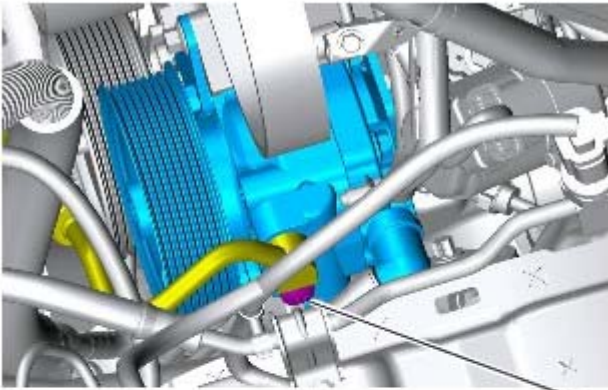
 Make sure that all openings are sealed. Use new blanking caps.

 Make sure that the area around the component is clean and free of foreign material.


Disconnect the power steering pump supply hose.

- Release the clip.
- Position a container to collect the fluid.





E94170

8.  **CAUTION:** Make sure that the area around the component is clean and free of foreign material.

Disconnect the power steering pump high-pressure line.

- Remove the bolt.

9. Install the special tools.

- Tie the pressure gauge aside.

10. **NOTE:** Remove and discard the blanking caps.

Connect the power steering pump supply hose.

- Secure with the clip.

11. Fill the power steering reservoir.

12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

13. **NOTE:** Make sure the steering components and test equipment are free from leaks.

- **NOTE:** Maintain the maximum fluid level during the test.
- **NOTE:** Make sure the steering is in the straight ahead position.
- **NOTE:** Under no circumstances must the low pressure spigot be removed from the steering pump.

With the test valve open start the engine.

- Start the engine and turn steering fully lock to lock, stop the engine.
- Top-up the power steering fluid reservoir.
- Install the reservoir filler cap.

14. For correct power steering pressures, refer to the steering specification section.

For additional information, refer to: [Specifications](#) (211-02 Power Steering, Specifications).

15.  **CAUTION:** Do not hold steering at full lock for longer than 10 seconds.

With the engine at idle, slowly turn the steering wheel and hold on full lock.

- Record the pressure reading.

16. Repeat the above procedure for the other side.

- Record the pressure reading.

17. With the engine at idle, release the steering wheel. The pressure should be, at or below, the pressure specified.

18. Pressure outside this tolerance, indicates a fault.

19.  **CAUTION:** Pump damage will occur if test valve is closed for longer periods.

To determine if the fault is in the steering pump or the steering rack, close the test valve for a maximum of 5 seconds.

20. If the pressures recorded fall outside the given values, replace the power steering pump.

21. If the maximum pump pressure is correct, check the hoses for correct routing and condition, if correct suspect the steering gear.

22. On completion of the test stop the engine, disconnect the battery ground cable and siphon the steering fluid from the reservoir.

23. **CAUTIONS:**



Make sure that all openings are sealed. Use new blanking caps.



Make sure that the area around the component is clean and free of foreign material.

Disconnect the power steering pump supply hose.

- Release the clip.

24. Disassemble the test equipment.

25. Connect the power steering pump high-pressure line.

- Tighten the bolt to 25 Nm (18 lb.ft).
- Install a new O-ring seal.

26. **NOTE:** Remove and discard the blanking caps.

Connect the power steering pump supply hose.

- Secure with the clip.
- Remove the container.

27. Secure the steering gear high-pressure line.

- Tighten the bolt to 10 Nm (7 lb.ft).

28. Install the front LH splash shield.

- Install the clips.

29. Install the front LH fender splash shield.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

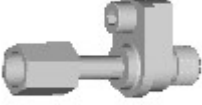




30. Connect the battery ground cable.

31. Fill and bleed the power steering system.

For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Pressure Test TDV6 3.0L Diesel

General Procedures

Special Tool(s)	
 E87857	Adaptor, power steering pressure test 211-011-12
 E58730	Hose - power steering pressure test 211-011-02(LRT-57-002)
 E58730	Hose - power steering pressure test 211-011-02(LRT-57-002)
 E58732	Valve block power steering test 211-011-01(LRT-57-001)
 E58733	Hose and gauge - power steering pressure test 211-287(LRT-57-005)



CAUTION: If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.



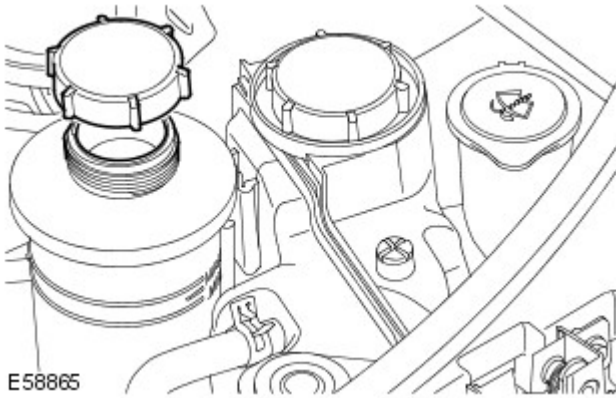
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Disconnect the battery ground cable.
 For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

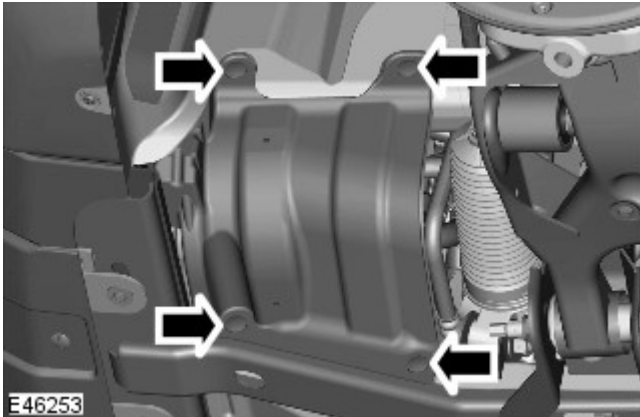
3. Siphon the fluid from the power steering reservoir.

- Remove the filler cap.



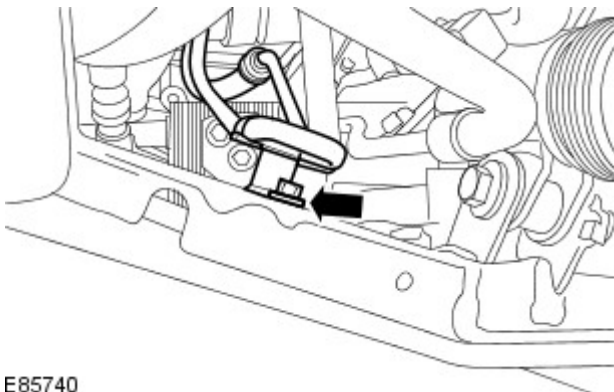
4. Remove the front LH splash shield.

- Remove the 4 clips.



5. Release the steering gear high-pressure line.

- Remove the bolt.




6. Remove the front LH fender splash shield.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

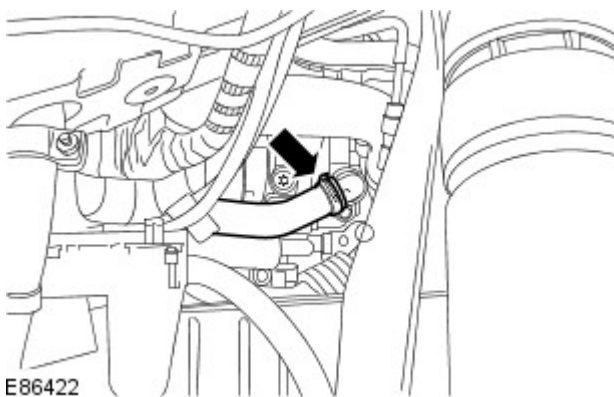
7. CAUTIONS:

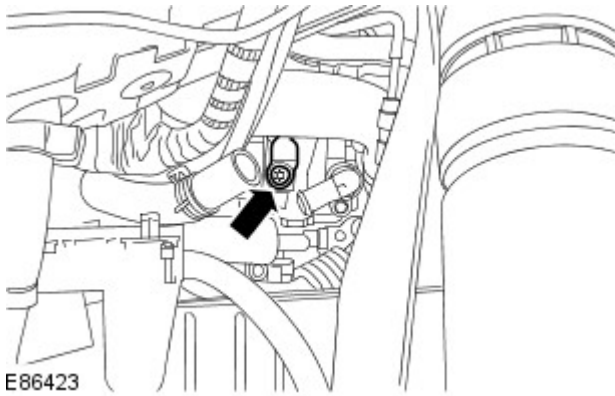
 Make sure that all openings are sealed. Use new blanking caps.


 Make sure that the area around the component is clean and free of foreign material.

Disconnect the power steering pump supply hose.

- Release the clip.
- Position a container to collect the fluid.





8.  CAUTION: Make sure that the area around the component is clean and free of foreign material.

Disconnect the power steering pump high-pressure line.

- Remove the bolt.

9. Install the special tools.

- Tie the pressure gauge aside.

10. NOTE: Remove and discard the blanking caps.

Connect the power steering pump supply hose.

- Secure with the clip.

11. Fill the power steering reservoir.

12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

13. NOTE: Make sure the steering components and test equipment are free from leaks.

- NOTE: Maintain the maximum fluid level during the test.
- NOTE: Make sure the steering is in the straight ahead position.
- NOTE: Under no circumstances must the low pressure spigot be removed from the steering pump.

With the test valve open start the engine.

- Start the engine and turn steering fully lock to lock, stop the engine.
- Top-up the power steering fluid reservoir.
- Install the reservoir filler cap.

14. For correct power steering pressures, refer to the steering specification section.

For additional information, refer to: [Specifications](#) (211-02 Power Steering, Specifications).

15.  CAUTION: Do not hold steering at full lock for longer than 10 seconds.

With the engine at idle, slowly turn the steering wheel and hold on full lock.

- Record the pressure reading.

16. Repeat the above procedure for the other side.

- Record the pressure reading.

17. With the engine at idle, release the steering wheel. The pressure should be, at or below, the pressure specified.

18. Pressure outside this tolerance, indicates a fault.

19.  CAUTION: Pump damage will occur if test valve is closed for longer periods.

To determine if the fault is in the steering pump or the steering rack, close the test valve for a maximum of 5 seconds.

20. If the pressures recorded fall outside the given values, replace the power steering pump.

21. If the maximum pump pressure is correct, check the hoses for correct routing and condition, if correct suspect the steering gear.
22. On completion of the test stop the engine, disconnect the battery ground cable and siphon the steering fluid from the reservoir.

23. CAUTIONS:



Make sure that all openings are sealed. Use new blanking caps.



Make sure that the area around the component is clean and free of foreign material.

Disconnect the power steering pump supply hose.

- Release the clip.

24. Disassemble the test equipment.

25. Connect the power steering pump high-pressure line.

- Tighten the bolt to 25 Nm (18 lb.ft).
- Install a new O-ring seal.

26. NOTE: Remove and discard the blanking caps.

Connect the power steering pump supply hose.

- Secure with the clip.
- Remove the container.

27. Secure the steering gear high-pressure line.

- Tighten the bolt to 10 Nm (7 lb.ft).

28. Install the front LH splash shield.

- Install the clips.

29. Install the front LH fender splash shield.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

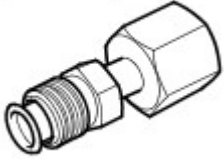


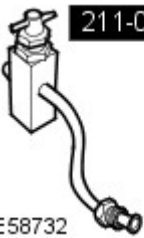


30. Connect the battery ground cable.

31. Fill and bleed the power steering system.

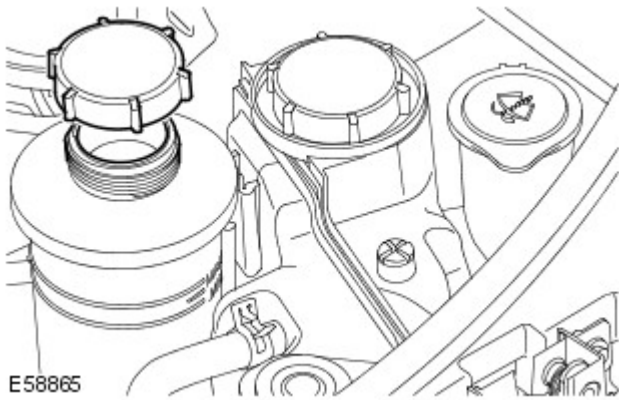
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Pressure Test V6 4.0L Petrol

General Procedures

Special Tool(s)	
 <p>211-313 E58729</p>	<p>Adapter, power steering pressure test 211-313 (LRT-57-035A)</p>
 <p>211-011-02 E58730</p>	<p>Hose, power steering pressure test 211-011-02 (LRT-57-002)</p>
 <p>211-011-11 E58731</p>	<p>Hose, power steering pressure test 211-011-11</p>
 <p>211-011-01 E58732</p>	<p>Valve block, power steering pressure test 211-011-01 (LRT-57-001)</p>
 <p>211-287 E58733</p>	<p>Hose and gauge, power steering pressure test 211-287 (LRT-57-005)</p>
 <p>211-325 E58734</p>	<p>Adapter, power steering pressure test 211-325 (LRT-57-042)</p>


1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



3. Siphon the fluid from the power steering reservoir.

- Remove the filler cap.
- Install the filler cap.

4. Position an absorbent cloth to collect fluid spillage.

5.  CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

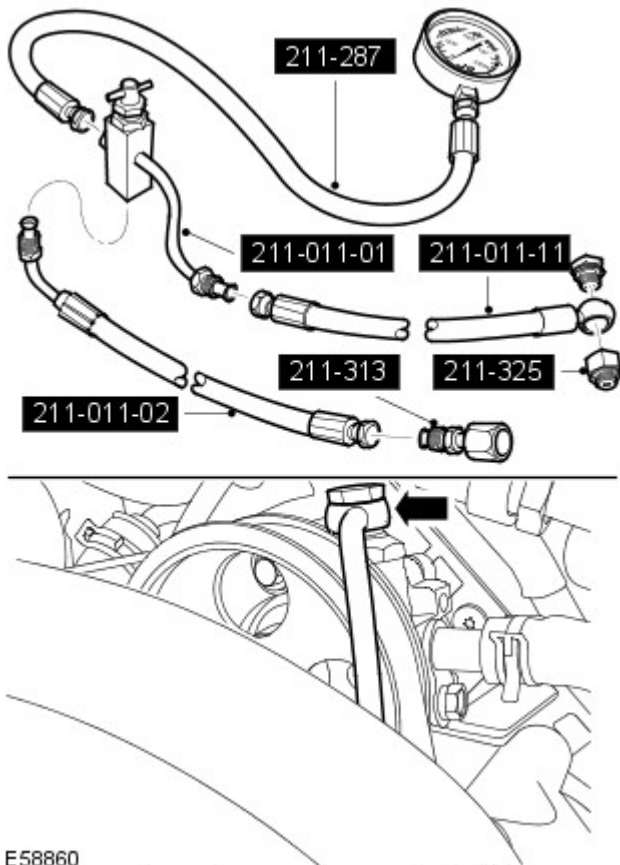
- NOTE: Some fluid spillage is inevitable during this operation.
- NOTE: Care must be taken to avoid contamination of the drive belt.

Disconnect the power steering high-pressure pipe union.

- Remove the bolt.
- Remove and discard the 2 sealing washers.
- Position a container to collect the fluid.

6. Install the special tools to the power steering high-pressure port.

- Install the O-ring seal.
- Tie the pressure gauge aside under the hood.



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7. Install the special tool to the high-pressure union.

- Install the O-ring seals.
- Connect the special tool line, to the special tool valve block assembly.

8. Refill the power steering reservoir.

- Remove the filler cap.

9. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

10. NOTE: Ensure the steering components and test equipment are free from leaks.

- NOTE: Maintain the maximum fluid level during the test.
- NOTE: Make sure the steering is in the straight ahead position.
- NOTE: Under no circumstances must the low pressure spigot be removed from the steering pump.

With the test valve open start the engine.

- Start the engine and turn steering fully lock to lock, stop the engine.
- Top-up the power steering fluid reservoir.
- Install the reservoir filler cap.

11. For correct power steering pressures, refer to the steering specification section.

For additional information, refer to: [Specifications](#) (211-02 Power Steering, Specifications).

12. With the engine at idle, slowly turn the steering wheel and hold on full lock.

- Record the pressure reading.

13. Repeat the above procedure for the other side.

- Record the pressure reading.

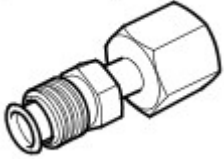

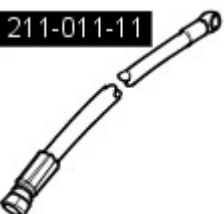
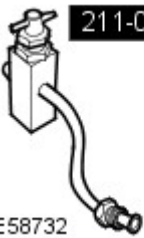


14. With the engine at idle, release the steering wheel. The pressure should be at or below the pressure specified. To determine if the fault is in the steering pump or the steering rack, close the test valve for a maximum of 5 seconds.


1. Pressure outside this tolerance, indicates a fault.

16. If the pressures recorded fall outside the given values, replace the power steering pump.
17. If the maximum pump pressure is correct, then suspect the power steering rack.
18. On completion of the test stop the engine, disconnect the battery ground cable and siphon the steering fluid from the reservoir.
 - Remove the filler cap.
 - Install the filler cap.
19. Disassemble the test equipment.
20. Connect the high-pressure line to the power steering pump.
 - Clean the component mating faces.
 - Install the new O-ring seals.
 - Tighten the bolt to 25 Nm (18 lb.ft).
21. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
22. Connect the battery ground cable.
23. Refill and bleed the power steering.
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Pressure Test V8 5.0L Petrol

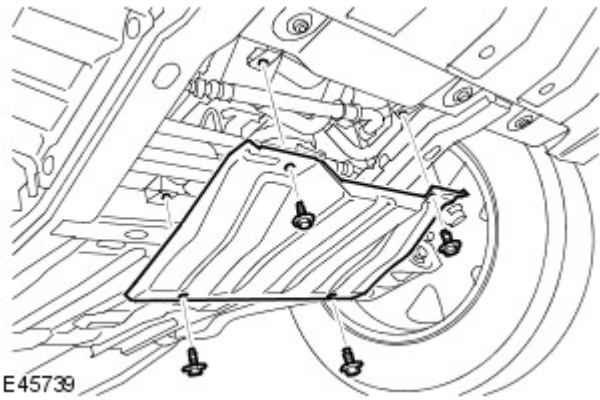
General Procedures

Special Tool(s)	
<p>211-313</p>  <p>E58729</p>	<p>Adapter, power steering test 211-313 (LRT-57-035A)</p>
<p>211-011-02</p>  <p>E58730</p>	<p>Hose, power steering test 211-011-02 (LRT-57-002)</p>
<p>211-011-11</p>  <p>E58731</p>	<p>Hose, power steering test 211-011-11</p>
<p>211-011-01</p>  <p>E58732</p>	<p>Valve block, power steering test 211-011-01 (LRT-57-001)</p>
<p>211-287</p>  <p>E58733</p>	<p>Hose and gauge, power steering test 211-287 (LRT-57-005)</p>
<p>211-325</p>  <p>E58734</p>	<p>Adapter, power steering test 211-325 (LRT-57-042)</p>

1.  WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

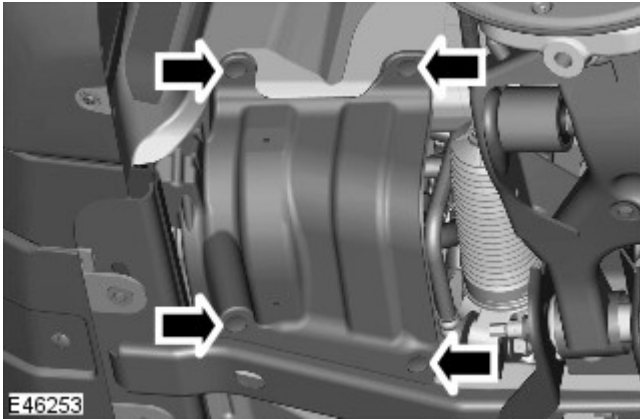
Raise and support the vehicle.

2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).



3. Remove the radiator access panel.

- Remove the 4 bolts.



4. Remove the front LH splash shield.

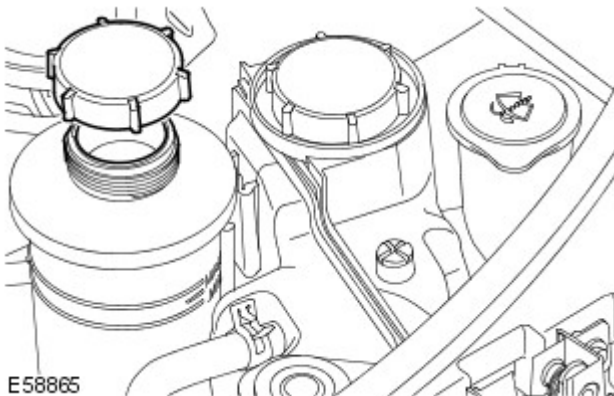
- Remove the 4 clips.

5. Remove the front LH fender splash shield.


For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

6. Siphon the fluid from the power steering reservoir.

- Remove the filler cap.
- Install the filler cap.



7. Position an absorbent cloth to collect fluid spillage.

8.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- NOTE: Some fluid spillage is inevitable during this operation.
- NOTE: Care must be taken to avoid contamination of the drive belt.

Disconnect the power steering high-pressure pipe union.

- Remove the bolt.
- Remove and discard the 2 sealing washers.
- Position a container to collect the fluid.

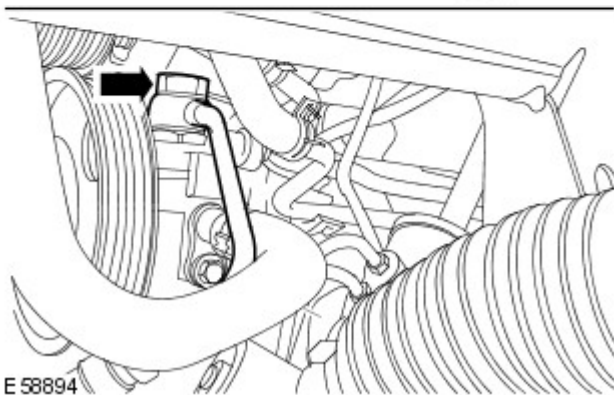
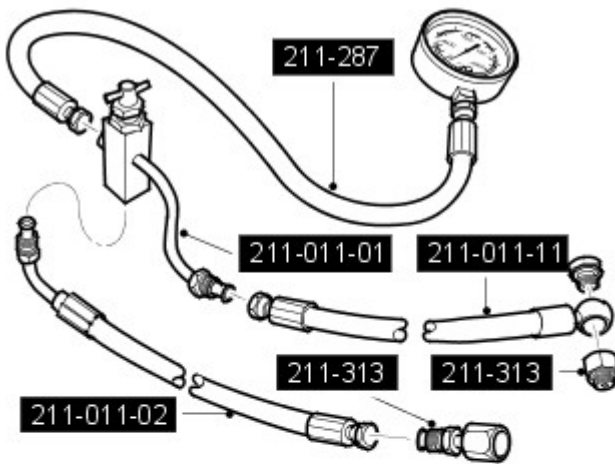
9. Install the special tools to the power steering high-pressure

port.

- Install the O-ring seal.
- Tie the pressure gauge aside under the hood.

10. Install the special tool to the high-pressure union.

- Install the O-ring seals.
- Connect the special tool line, to the special tool valve block assembly.



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11. Refill the power steering reservoir.

- Remove the filler cap.

12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

13. NOTE: Ensure the steering components and test equipment are free from leaks.

- NOTE: Maintain the maximum fluid level during the test.
- NOTE: Make sure the steering is in the straight ahead position.
- NOTE: Under no circumstances must the low pressure spigot be removed from the steering pump.

With the test valve open start the engine.

- Start the engine and turn steering fully lock to lock, stop the engine.
- Top-up the power steering fluid reservoir.
- Install the reservoir filler cap.

14. For correct power steering pressures, refer to the steering specification section. For additional information, refer to: [Specifications](#) (211-02 Power Steering, Specifications).

15. With the engine at idle, slowly turn the steering wheel and hold on full lock.

- Record the pressure reading.

16. Repeat the above procedure for the other side. With the engine at idle, release the steering wheel. The pressure should be, at or below, the pressure specified.


- Record the pressure reading.

18. Pressure outside this tolerance, indicates a fault.
19. To determine if the fault is in the steering pump or the steering rack, close the test valve for a maximum of 5 seconds.
20. If the pressures recorded fall outside the given values, replace the power steering pump.
21. If the maximum pump pressure is correct, then suspect the power steering rack.
22. On completion of the test stop the engine, disconnect the battery ground cable and siphon the steering fluid from the reservoir.
 - Remove the filler cap.
 - Install the filler cap.
23. Disassemble the test equipment.
24. Connect the high-pressure line to the power steering pump.
 - Clean the component mating faces.
 - Install the new O-ring seals.
 - Tighten the bolt to 25 Nm (18 lb.ft).
25. Install the front LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
26. Install the front LH splash shield.
 - Secure with the clips.
27. Install the radiator access panel.
 - Tighten the M6 bolts to 10 Nm (7 lb.ft).
 - Tighten the M10 bolts to 45 Nm (33 lb.ft).
28. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
29. Refill and bleed the power steering.
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Steering Gear V6 4.0L Petrol

Removal and Installation

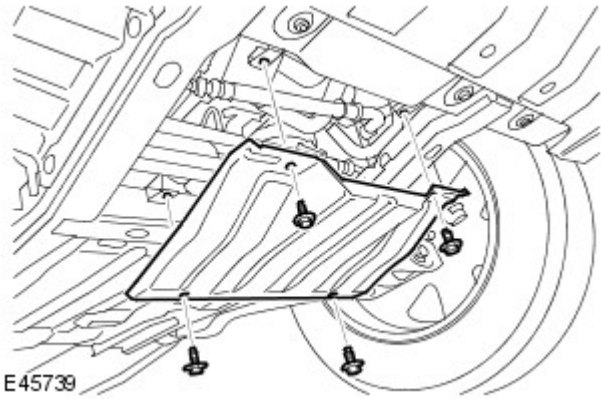
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

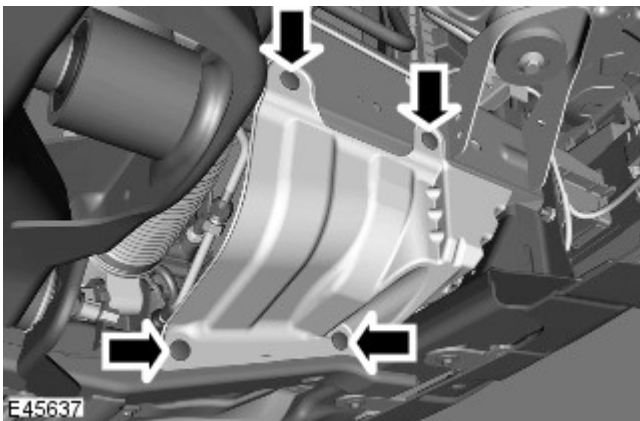
2. Remove the radiator access panel.

- Remove the 4 bolts.



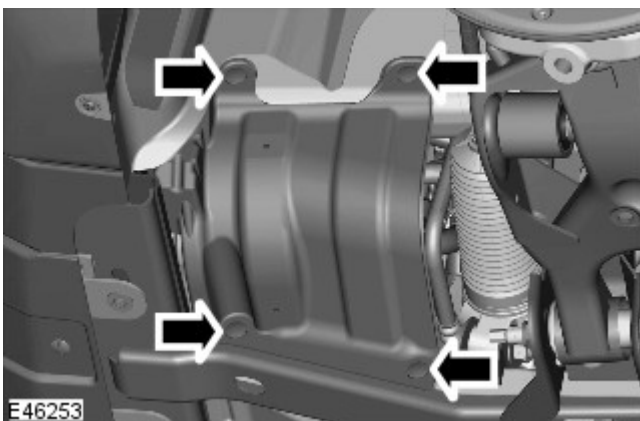
3. Remove the front RH splash shield.

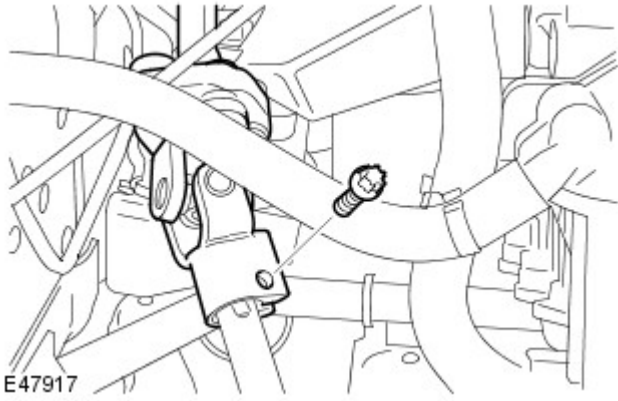
- Remove the 4 clips.



4. Remove the front LH splash shield.

- Remove the 4 clips.

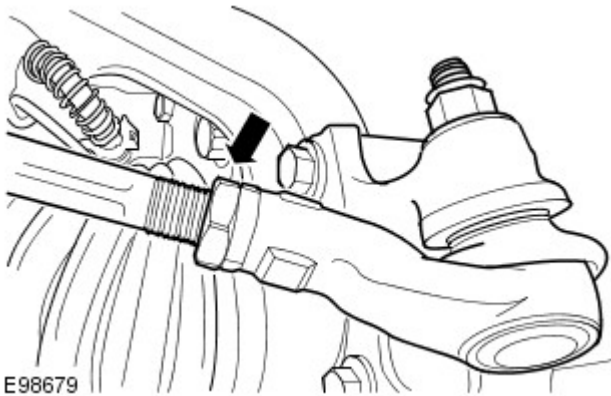




5. NOTE: Make sure the steering is in the straight ahead position.

Release the universal joint from the steering gear.

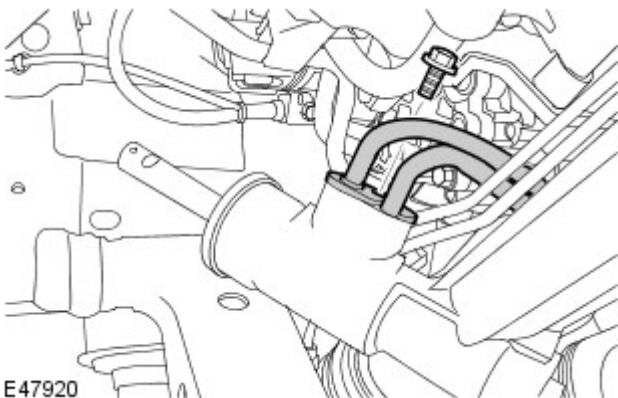
- Remove and discard the bolt.



6. NOTE: LH illustration shown, RH is similar.

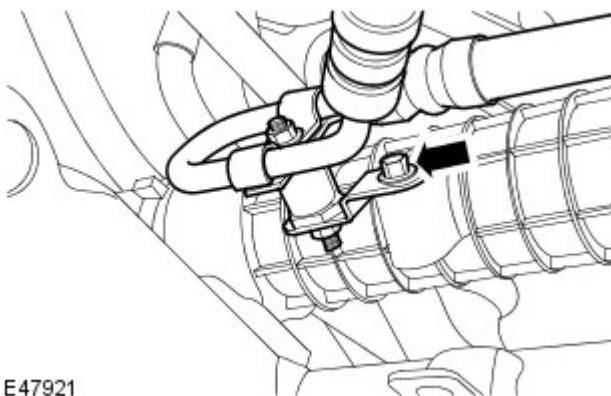
Release both tie-rod end ball joints.

- Loosen the locknut.
- Release both track rods from tie rod ends, note the number of turns for installation.



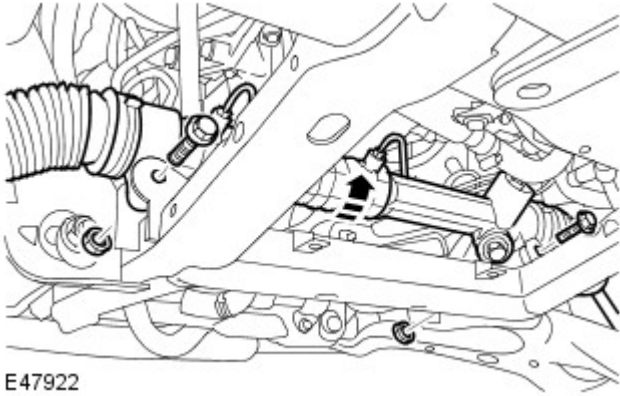
7. Disconnect the pressure lines from the power steering gear.

- Remove the bolt.
- Position an absorbent cloth to collect fluid spillage.
- Remove and discard the O-ring seals.



8. Remove the steering gear high-pressure line.

- Remove the bolt.



E47922

9. Remove the steering gear.

- Remove the 2 bolts and discard the cage nuts.
- With assistance, carefully rotate and release the steering gear.

Installation

1. With assistance, install the steering gear.

- Clean the component mating faces.
- Tighten the bolts to 175 Nm (129 lb.ft).

2. NOTE: Do not install the support bracket bolt until the steering gear connections are tightened.

Install the steering gear high pressure line.

3. NOTE: Lubricate the seals with clean power steering fluid.

Connect the steering gear pressure lines.

- Clean the component mating faces.
- Install new O-ring seals.

4. Install the power steering line support bracket.

- Tighten the bolt to 10 Nm (7 lb.ft).

5. Connect the tie-rod end ball joints.

- Attach both tie rods to previously noted positions.
- Tighten the tie-rod locking nut.

6. Connect the universal joint to the steering gear.

- Install a new patchlock bolt and tighten to 25 Nm (18 lb.ft).

7. Install the radiator access panel.

- Install the 4 bolts and tighten to 10 Nm (7 lb.ft).

8. Install the front LH splash shield.

9. Install the front RH splash shield.

10. Fill and bleed the power steering system.

For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).


11. Adjust the front wheel alignment.

Power Steering - Steering Gear TDV6 3.0L Diesel


Removal and Installation

Removal

- NOTE: LHD illustration shown, RHD is similar.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

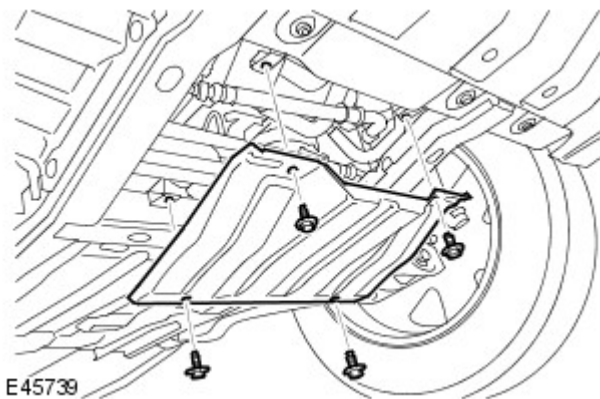
Raise and support the vehicle.

2.  **CAUTION:** Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

Center the steering wheel.

3. Remove the radiator splash shield.

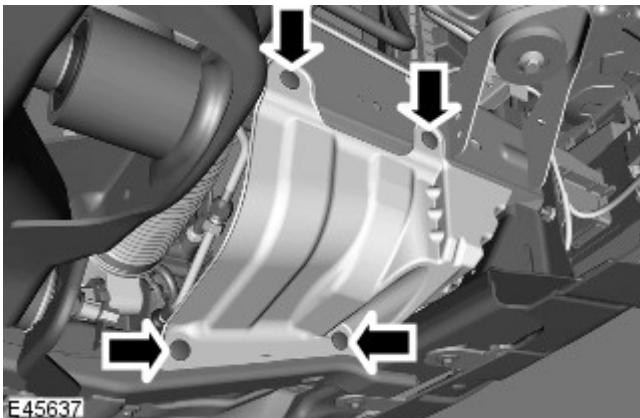
- Remove the 4 bolts.



4. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

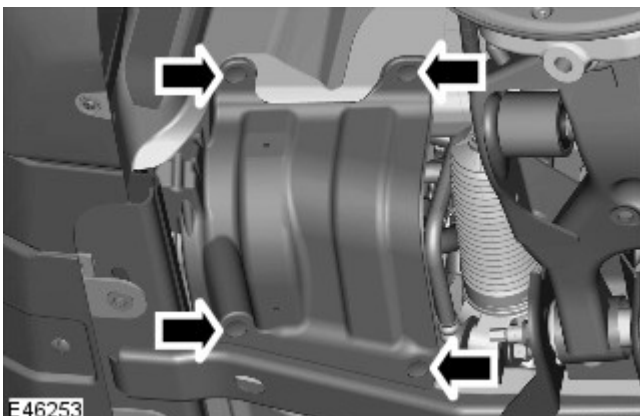
5. Remove the front RH splash shield.

- Remove the 4 clips.



6. Remove the front LH splash shield.

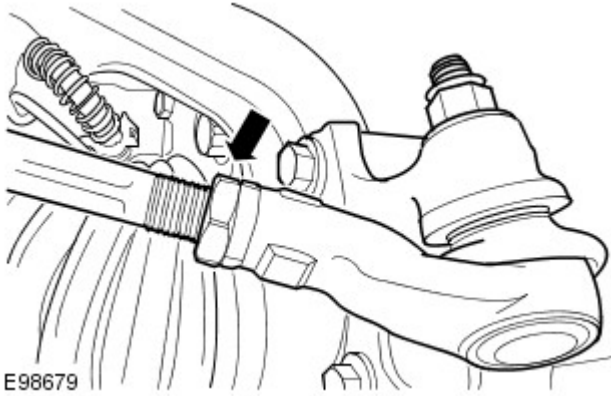
- Remove the 4 clips.



7. NOTE: LH illustration shown, RH is similar.

Release both tie-rod end ball joints.

- Loosen the locknut.
- Release both track rods from tie rod ends, note the number of turns for installation.

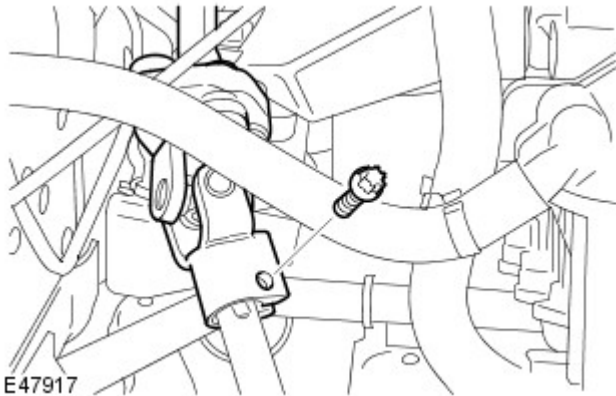


E98679

8. NOTE: Note the fitted position.

Disconnect the lower steering column from the steering gear.

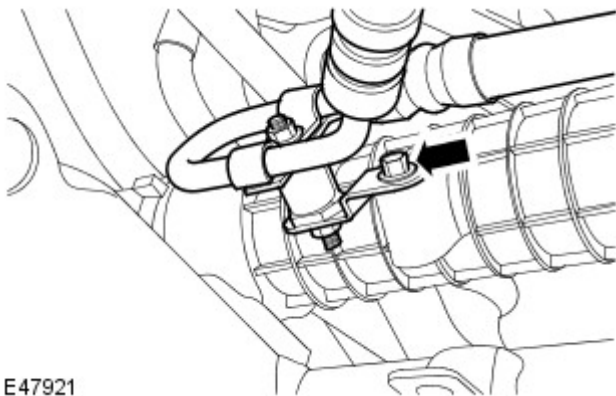
- Remove and discard the bolt.



E47917

9. Remove the steering gear high-pressure line.

- Remove the bolts.



E47921

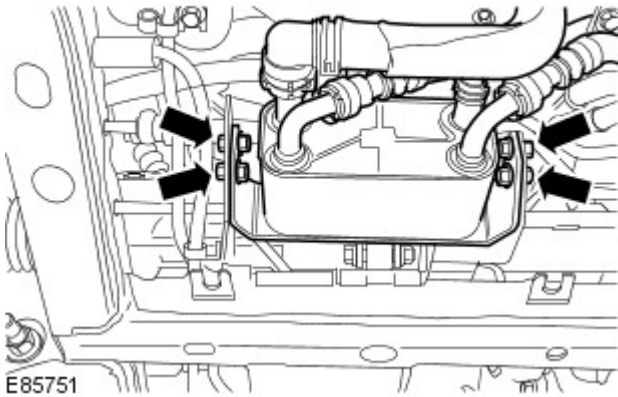
10. Disconnect the steering gear control valve actuator electrical connector.



E60776

11. Release the transmission fluid cooler.

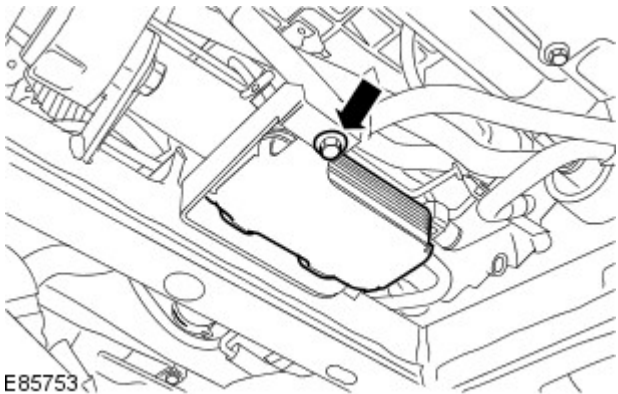
- Remove the 4 bolts.



E85751

12. Release the fuel cooler.

- Remove the bolt.



E85753

13. CAUTIONS:



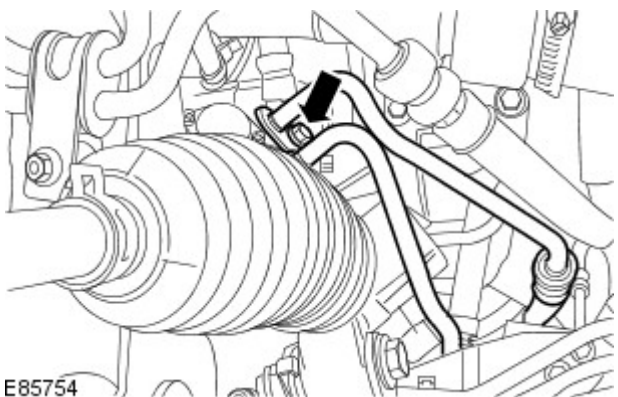
Make sure that the area around the component is clean and free of foreign material.



Make sure that all openings are sealed. Use new blanking caps.

Disconnect the power steering high pressure line and return line from the steering gear.

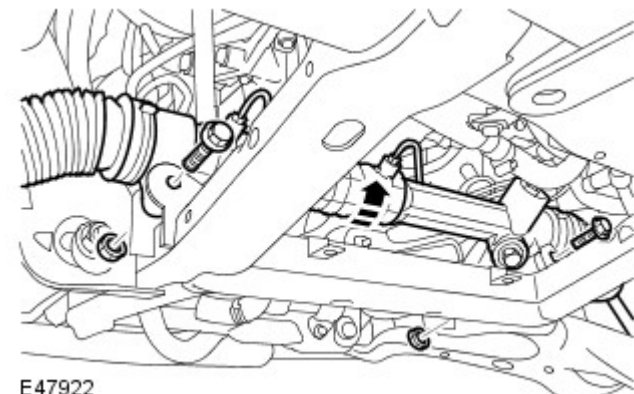
- Remove and discard the bolt.
- Remove and discard the 2 O-ring seals.



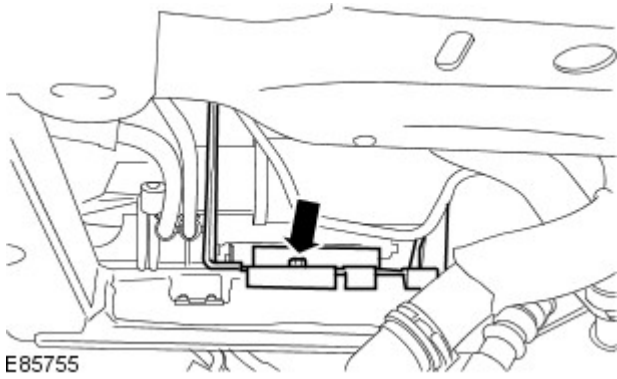
E85754

14. Release the steering gear.

- Remove the 2 bolts.



E47922



15. Remove the transmission fluid cooler and fuel cooler support bracket.

- Remove the bolt.
- Release the coolant line.

16. Remove the steering gear.

Installation

1. Install the steering gear.

2. Install the transmission fluid cooler and fuel cooler support bracket.

- Secure the coolant line.
- Tighten the bolt to 23 Nm (17 lb.ft).

3. Secure the steering gear.

- Tighten the bolts to 175 Nm (129 lb.ft).

4. **NOTE:** Remove and discard the blanking caps.

• **NOTE:** Lubricate the seals with clean power steering fluid.

Connect the power steering high pressure line and return line to the steering gear.

- Install new O-ring seals.
- Tighten the new bolt to 22 Nm (16 lb.ft).

5. Secure the fuel cooler.

- Tighten the bolt to 23 Nm (17 lb.ft).

6. Secure the transmission fluid cooler.

- Tighten the nuts and bolts to 25 Nm (18 lb.ft).

7. Connect the steering gear control valve actuator electrical connector.

8. Install the power steering line support bracket.

- Tighten the bolt to 10 Nm (7 lb.ft).

9. Connect the lower steering column shaft to the steering gear.

- Tighten the new bolt to 24 Nm (18 lb.ft).

10. Connect the tie-rod end ball joints.

- Attach both tie rods to previously noted positions.
- Tighten the tie-rod locking nut.

11. Install the front LH splash shield.

- Install the clips.

12. Install the front RH splash shield.

- Install the clips.

13. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

14. Install the radiator splash shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

15. Fill and bleed the power steering system.

For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).


16. Adjust the front wheel alignment.

Power Steering - Steering Gear V8 5.0L Petrol

Removal and Installation

Removal

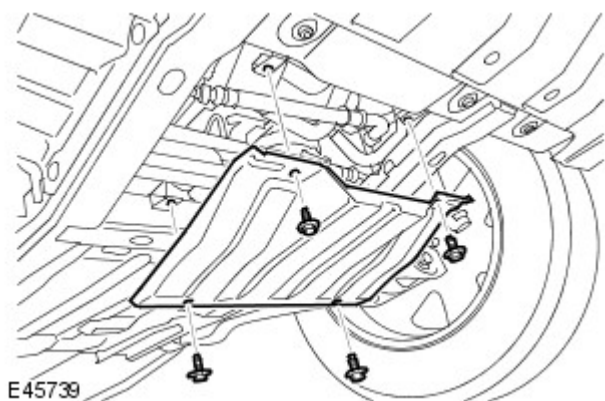
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: LHD illustration shown, RHD is similar.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

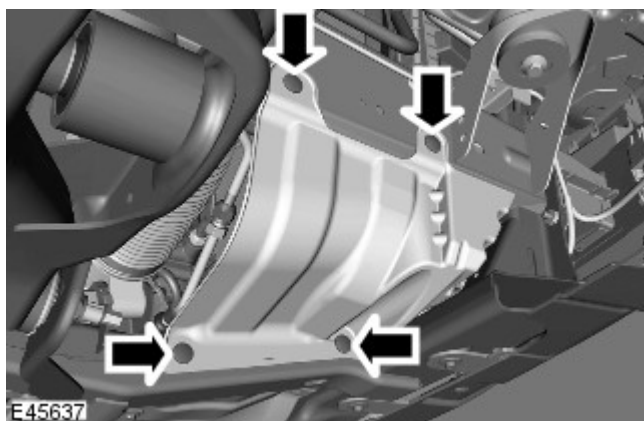
2. Remove the radiator access panel.

- Remove the 4 bolts.



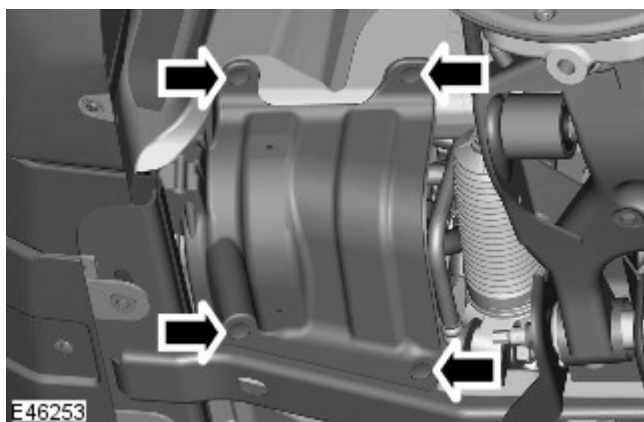
3. Remove the front RH splash shield.

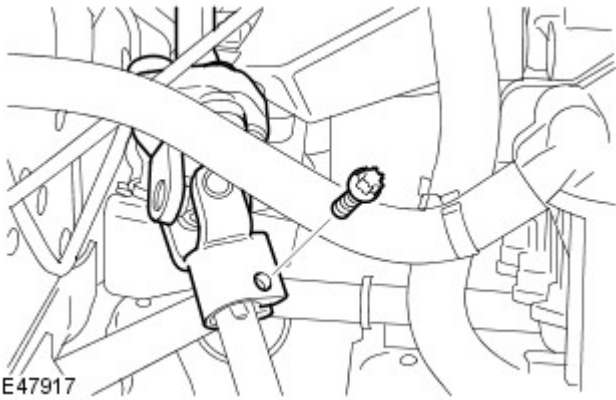
- Remove the 4 clips.




4. Remove the front LH splash shield.

- Remove the 4 clips.



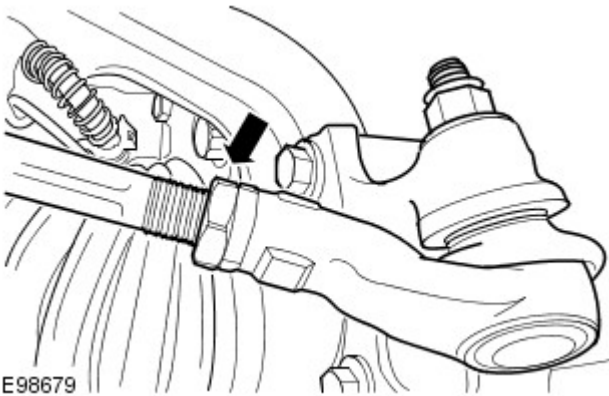


5.  **CAUTION:** Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

• **NOTE:** Make sure the steering is in the straight ahead position.

Release the universal joint from the steering gear.

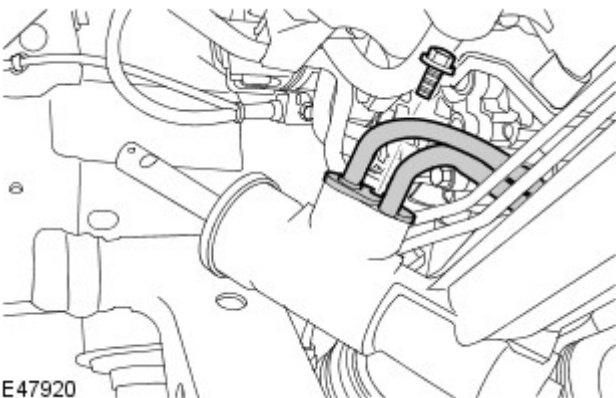
- Remove and discard the bolt.



6. **NOTE:** LH illustration shown, RH is similar.

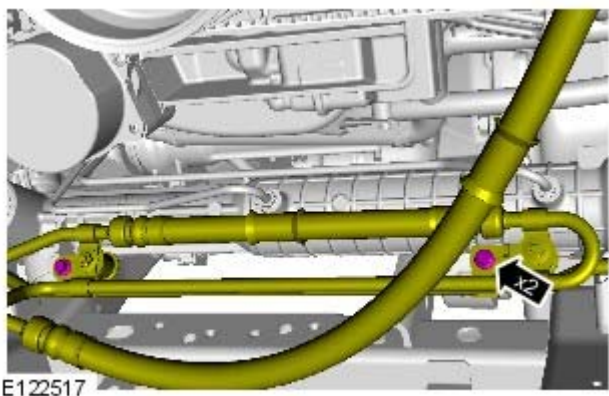
Release both tie-rod end ball joints.

- Loosen the locknut.
- Release both track rods from tie rod ends, note the number of turns for installation.



7. Disconnect the pressure lines from the power steering gear.

- Remove the bolt.
- Position an absorbent cloth to collect fluid spillage.
- Remove and discard the O-ring seals.

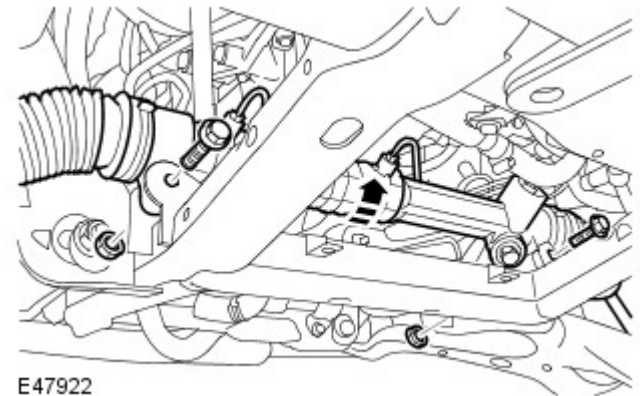


8. Remove the steering gear high-pressure line.

- Remove the bolts.



9. Disconnect the steering gear electrical connector.



10. Remove the steering gear.

- Remove the 2 bolts and discard the cage nuts.
- Release the steering gear.

Installation

1. Clean the component mating faces.
2. Install the steering gear.
 - Tighten the bolts to 175 Nm (129 lb.ft).
3. Connect the electrical connector.
4. **NOTE: Do not install the support bracket bolt until the steering gear connections are tightened.**

Install the steering gear high pressure line.
5. **NOTE: Lubricate the seals with clean power steering fluid.**

Connect the steering gear pressure lines.


 - Clean the component mating faces.
 - Install new O-ring seals.
 - Tighten the bolt to 22 Nm (16 lb.ft).
6. Install the power steering line support bracket.
 - Tighten the bolt to 10 Nm (7 lb.ft).
7. Connect the tie-rod end ball joints.
 - Attach both tie rods to previously noted positions.
 - Tighten the tie-rod locking nut.
8. Connect the universal joint to the steering gear.
 - Install a new patchlock bolt and tighten to 25 Nm (18 lb.ft).
9. Install the radiator access panel.
 - Install the 4 bolts and tighten to 10 Nm (7 lb.ft).
10. Install the front LH splash shield.

- 11.** Install the front RH splash shield.
- 12.** Fill and bleed the power steering system.
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).
- 13.** Adjust the front wheel alignment.

Power Steering - Steering Gear TDV6 2.7L Diesel

Removal and Installation

Removal

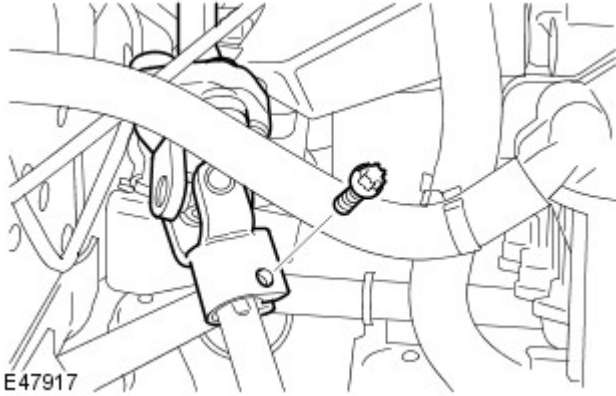
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. **NOTE:** Make sure the steering is in the straight ahead position.

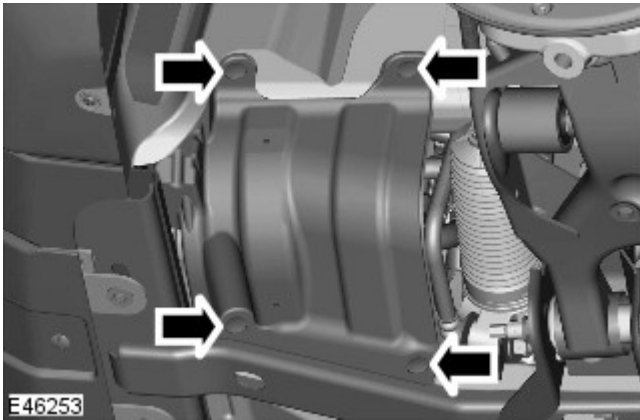
Release the universal joint from the steering gear.

- Remove and discard the bolt.



3. Remove the front RH and LH splash shields.

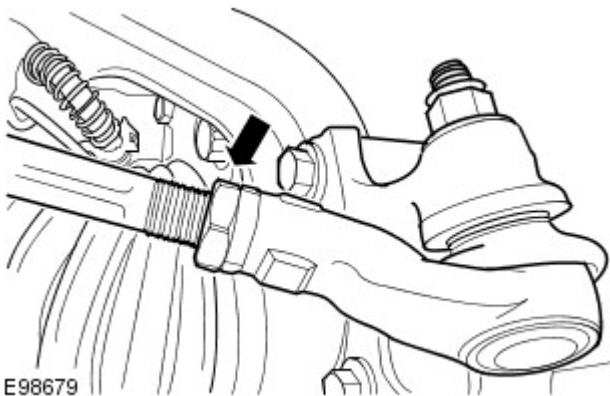
- Remove the 8 clips.

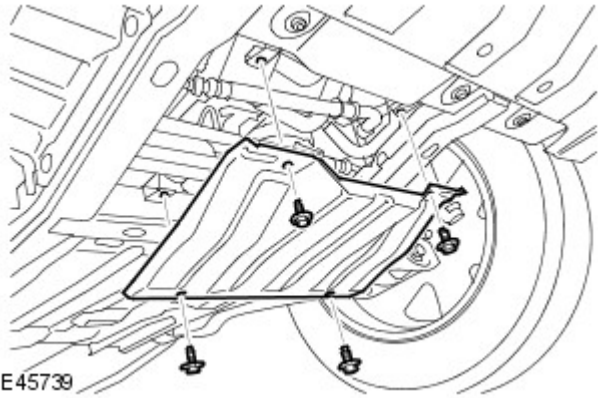


4. **NOTE:** LH illustration shown, RH is similar.

Release both tie-rod end ball joints.

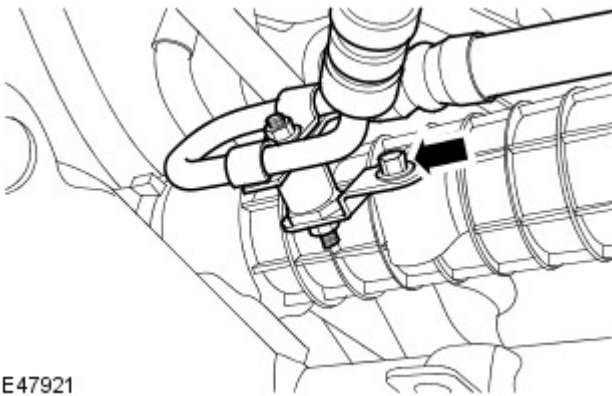
- Loosen the locknut.
- Release both track rods from tie rod ends, note the number of turns for installation.





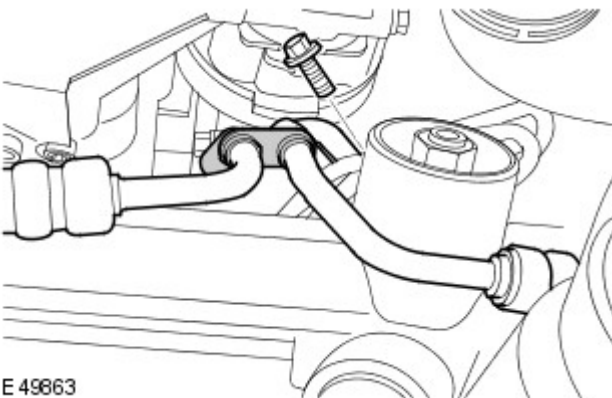
5. Remove the radiator access panel.


- Remove the 4 bolts.



6. Release the power steering line support mount.

- Remove the bolt.

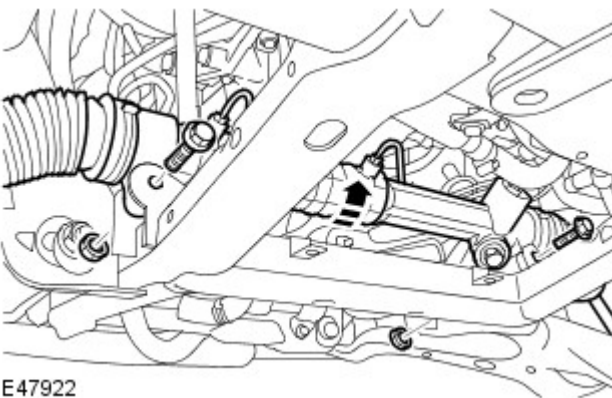


7.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** Some fluid spillage is inevitable during this operation.

Disconnect the power steering fluid lines.

- Position a container to collect spillage.
- Remove the clip.
- Remove and discard the bolt.
- Discard the O-ring seals.



8. Remove the steering gear.

- Remove the 2 bolts and discard the nuts.

Installation

1. Install the steering gear.

- Clean the component mating faces.

- Use new nuts and tighten the nuts and bolts to 175 Nm (129 lb.ft).
2. Install the power steering fluid lines.
 - Clean the component mating faces.
 - Install new O-ring seals.
 - Install the clip.
 - Tighten the new bolt to 25 Nm (18 lb.ft).
 3. Secure the power steering line support mount.
 - Install the bolt.
 4. Connect the universal joint to the steering gear.
 - Install a new patchlock bolt and tighten to 25 Nm (18 lb.ft).
 5. Install the radiator access panel.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 6. Install the splash shields.
 - Install the clips.
 7. Connect the tie-rod end ball joints.
 - Attach both tie rods to previously noted positions.
 - Tighten the tie-rod locking nut.
 8. Fill and bleed the power steering system.
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).
 9. Adjust the front wheel alignment.

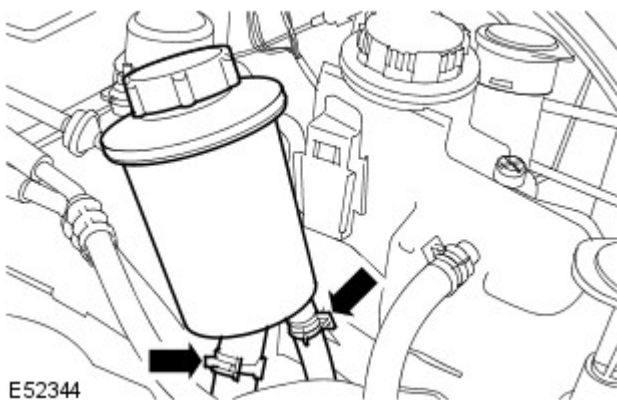
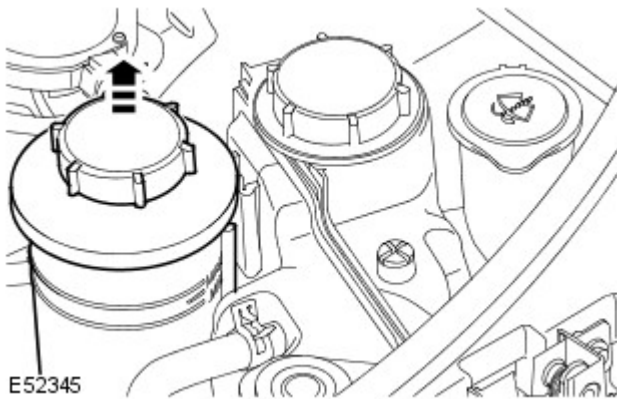
Power Steering - Power Steering Fluid Reservoir V6 4.0L Petrol/V8 5.0L Petrol/TDV6 3.0L Diesel


Removal and Installation

Removal

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Siphon the fluid from the power steering reservoir.
3. Release the power steering fluid reservoir from the bracket.



4.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• NOTE: Some fluid spillage is inevitable during this operation.

Remove the power steering fluid reservoir.

- Position an absorbent cloth to collect fluid spillage.
- Release the hose clips and disconnect the hoses.

Installation

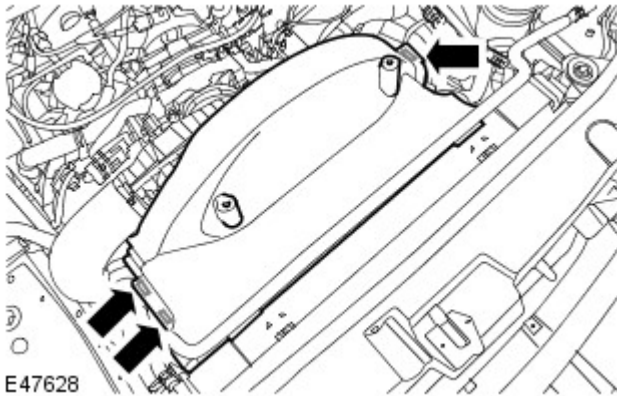
1. To install, reverse the removal procedure.
2. Fill and bleed the power steering system.
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Fluid Reservoir TDV6 2.7L Diesel

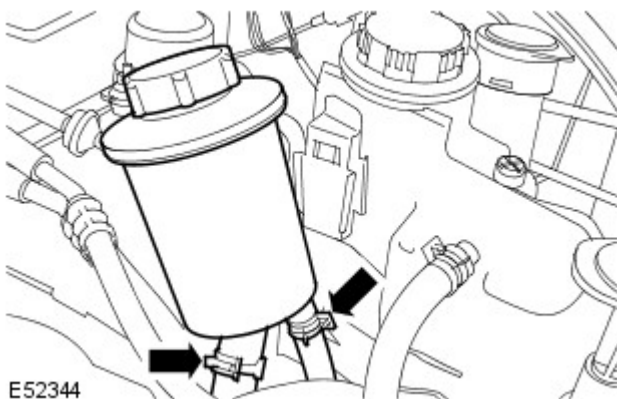
Removal and Installation


Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air cleaner assembly.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
3. Remove the cooling fan shroud.



- Release the coolant hose.
- Release the 3 clips.



4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** Some fluid spillage is inevitable during this operation.

Remove the power steering reservoir.


- Position a container to collect spillage.
- Release the 2 clips.
- Disconnect the 2 hoses.

Installation

1. Install the power steering fluid reservoir.
 - Clean the component mating faces.
 - Connect the hoses.
 - Secure with the 2 clips.
2. Install the cooling fan shroud.
 - Secure the coolant hose.
3. Install the air cleaner assembly.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
4. Fill and bleed the power steering system.
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Fluid Cooler V6 4.0L Petrol/V8 5.0L Petrol

Removal and Installation

Special Tool(s)	
 <p>310-044</p> <p>E50921</p>	Spring lock decoupler
	310-044

Removal

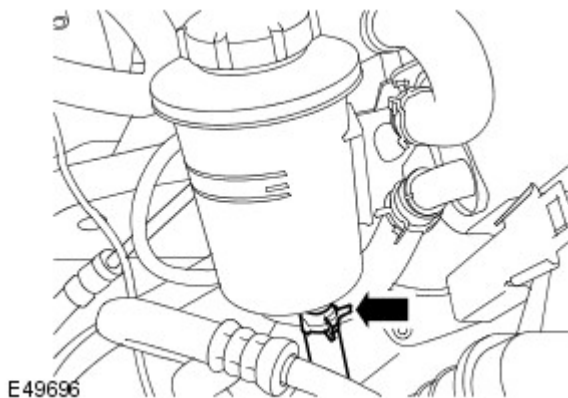
All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
3. Remove the coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation) / [Coolant Expansion Tank](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
4. Siphon the fluid from the power steering reservoir.

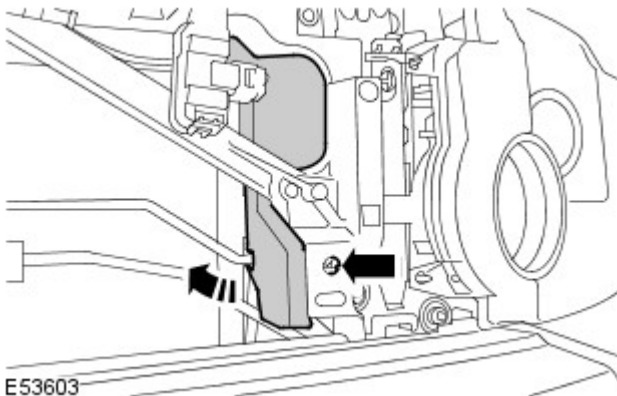
5. ⚠ CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the steering reservoir return hose.

- Position an absorbent cloth to collect fluid spillage.
- Release the clip.



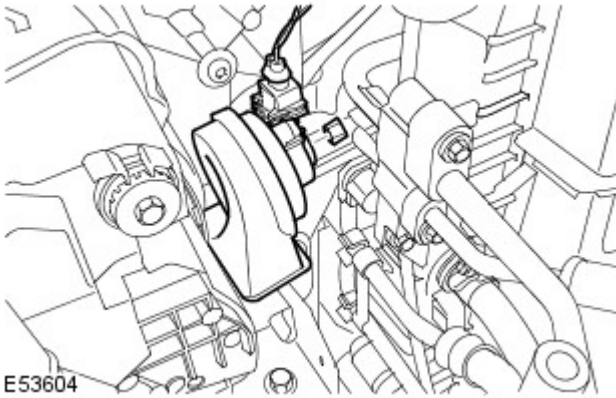
6. Release the LH radiator air deflector lower clip, position the deflector aside.



Vehicles with 4.0L engine

7. Position the LH horn aside for access.

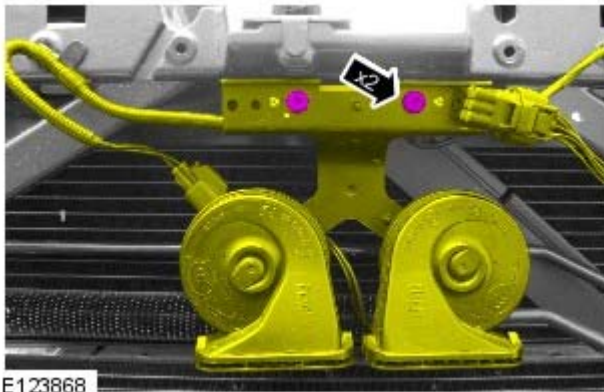
- Remove the nut.




Vehicles with 5.0L engine

8. Position the horns to one side for access.

- Remove the 2 bolts.



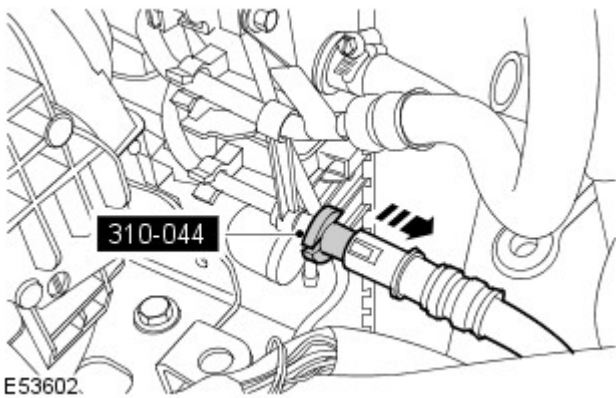
All vehicles

9.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** Some fluid spillage is inevitable during this operation.

Using the special tool, disconnect the cooler line.

- Position an absorbent cloth to collect fluid spillage.

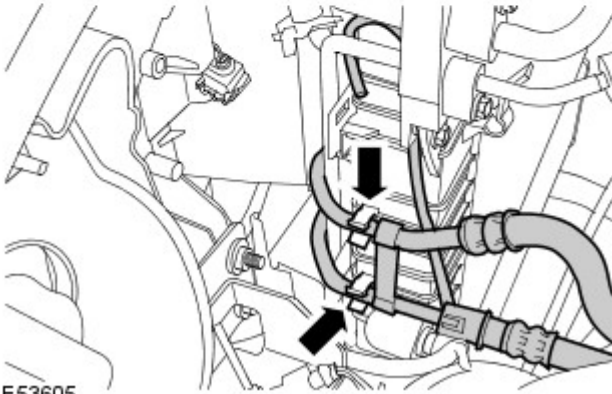
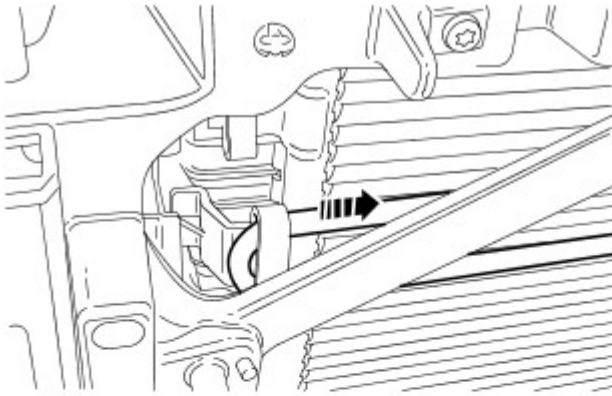


10. Remove the cooler line separating clip.

11. NOTE: Care must be taken to prevent damage to the cooler elements during removal and installation.

Remove the power steering fluid cooler.

- Release the 3 clips.



E53605

Installation

All vehicles

1. Install the power steering fluid cooler.
 - Position and secure in the clips.
2. Install the power steering fluid line and hose.
 - Clean the component mating faces.
 - Secure the hose with the clip.
3. Install the cooler line separating clip.

Vehicles with 4.0L engine

4. Install the horn assembly.
 - Tighten the nut to 10 Nm (7 lb.ft).

Vehicles with 5.0L engine

5. Install the horn assemblies.
 - Tighten the 2 bolts to 10 Nm (7 lb.ft).

All vehicles

6. Install the radiator deflector.
 - Secure with the clip.
7. Install the coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank \(303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation\)](#) / [Coolant Expansion Tank \(303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation\)](#).
8. Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08

Exterior Trim and Ornamentation, Removal and Installation).

9. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

10. Fill and bleed the power steering system.


For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Fluid Cooler TDV6 2.7L Diesel

Removal and Installation

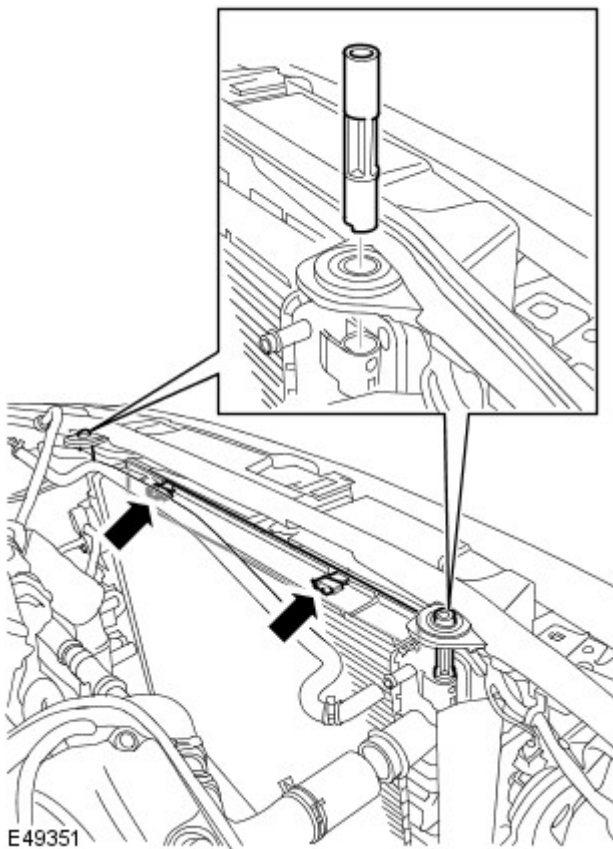
Special Tool(s)	
 E50921	Spring lock decoupler
	310-044

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

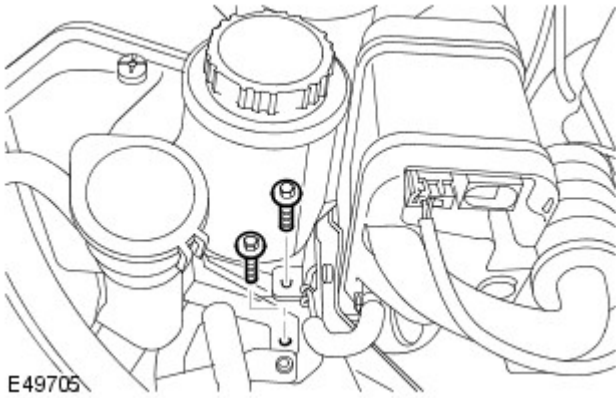
Raise and support the vehicle.

- Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- Remove the cooling fan lower shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
- Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- Remove the radiator securing pegs.
- Remove the radiator upper deflector.
 - Release the 2 clips.



7. Release the coolant expansion tank.

- Remove the 2 bolts.



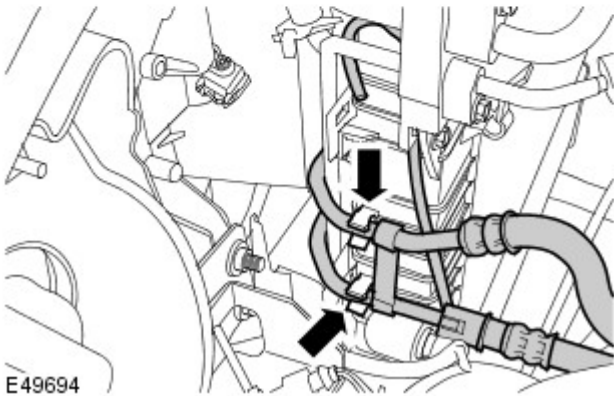
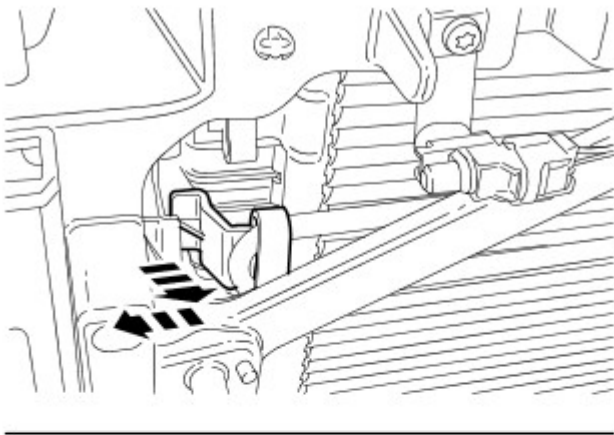
8. Tie the engine air intake duct towards the engine.

9. Tie the fuel fired booster heater coolant lines towards the engine.

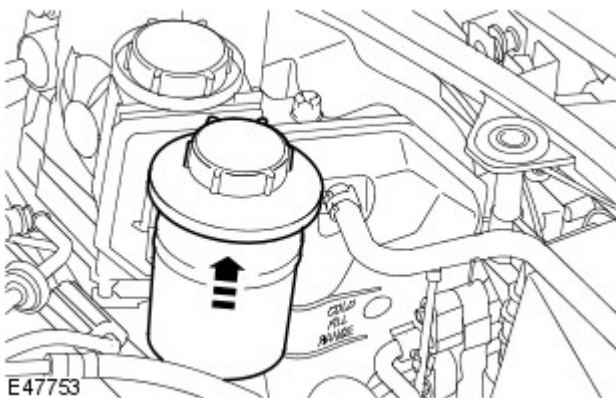
10. NOTE: Note the position of the differential breather line.

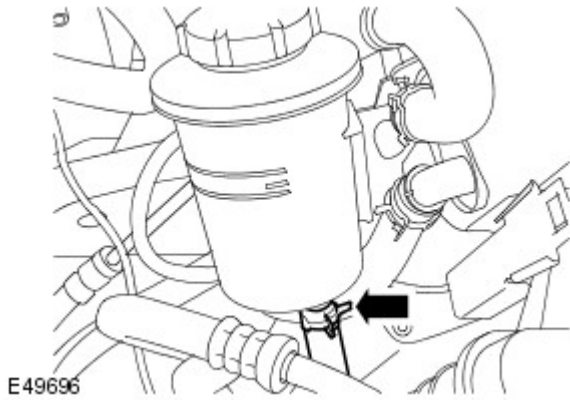
Release the power steering fluid cooler.


- Release it from 3 clips.



11. Release the power steering fluid reservoir.



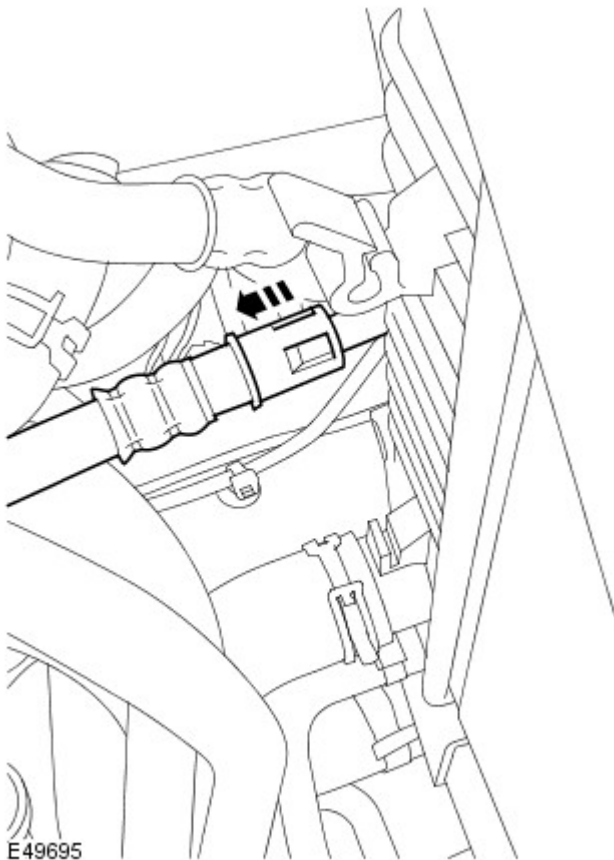



12.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

• **NOTE:** Some fluid spillage is inevitable during this operation.

Disconnect the power steering cooler line from the fluid reservoir.

- Release the clip.
- Allow the fluid to drain into a container.



13.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

• **NOTE:** Some fluid spillage is inevitable during this operation.

Remove the power steering fluid cooler.

- Using the special tool, release the clip.

Installation

1. Install the power steering fluid cooler.
 - Clean the component mating faces.
 - Secure the clip.
2. Connect the power steering cooler line to the fluid reservoir.
 - Clean the component mating faces.
 - Secure with the clip.
3. Install the power steering fluid reservoir.
4. Position the front differential breather line.
5. Secure the power steering fluid cooler line.
 - Secure in the 3 clips.
6. Secure the coolant expansion tank.
 - Tighten the 2 bolts to 10 Nm (7 lb.ft).

7. Install the radiator upper deflector.
8. Install the radiator securing pegs.
9. Connect the A/C condenser refrigerant lines.
 - Clean the component mating faces.
 - Install new O-ring seals.
 - Tighten the bolts to 25 Nm (18 lb.ft).
10. Install the radiator grille.

For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
11. Install the cooling fan lower shroud.

For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
13. Fill and bleed the power steering system.


For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Pump VIN Range: 07 MODEL

YEAR->CURRENT

Removal and Installation

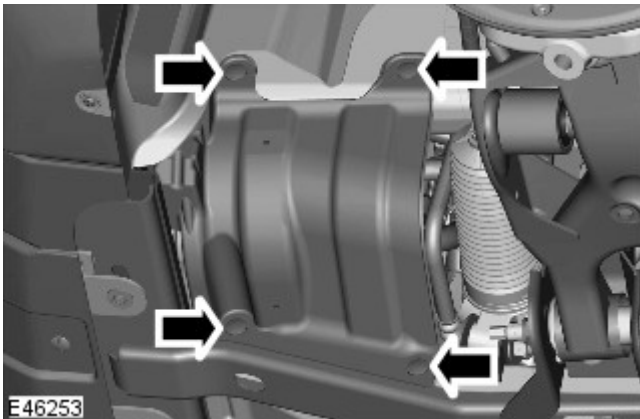
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
4. Recover the air conditioning (A/C) refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
5. Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
6. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
7.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

8. Remove the LH front wheel and tire.
9. Remove the fender splash shield lower trim panel.

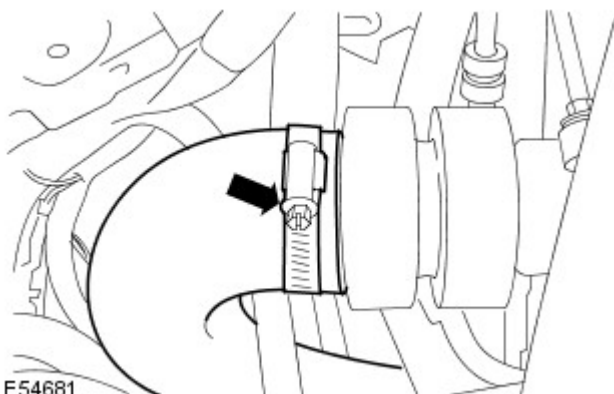
- Remove the 4 clips.



10. Remove the front LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

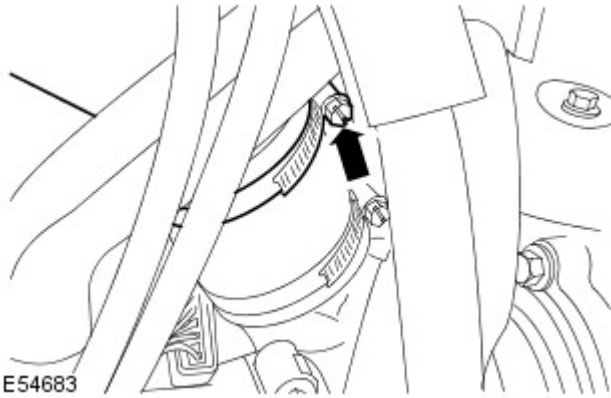
11. Remove the upper arm and brake line heat shields for access.
12. Disconnect the charge air cooler inlet hose.

- Remove the two retaining bolts.
Remove the 3 nuts.
- Remove the retaining nut.
- Remove the 3 bolts.



14. Disconnect the charge air cooler inlet hose.

- Loosen the clip.



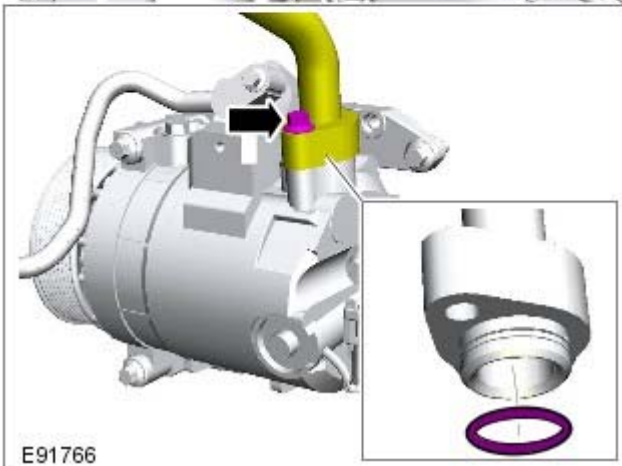
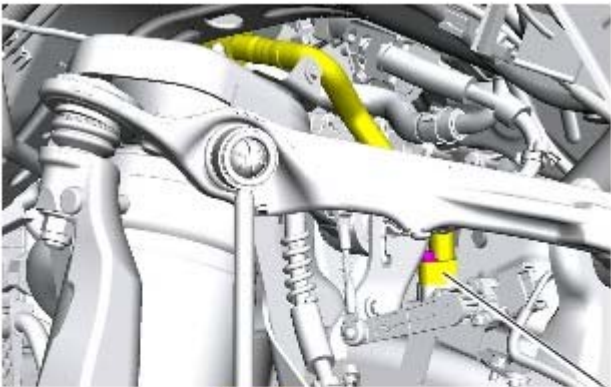
15. CAUTIONS:

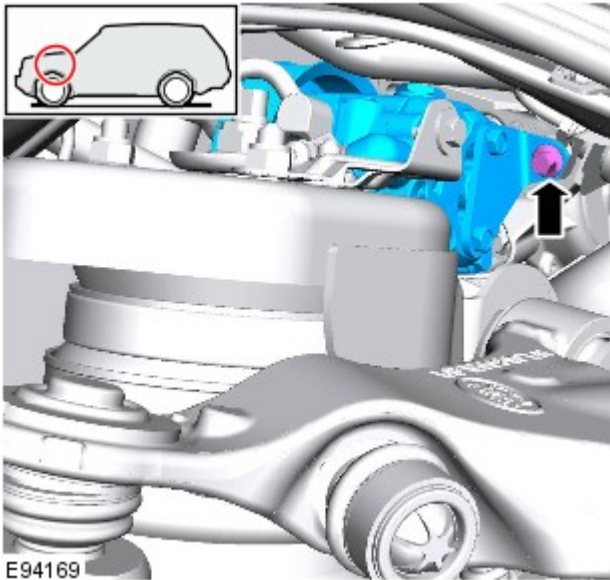
 Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

 Care must be taken to avoid damage to the mating surfaces.

Release the A/C low pressure pipe from the compressor.

- Remove and discard the O-ring seal.
- Using a suitable tie strap, secure the A/C low-pressure pipe aside.







E94169

16. Remove the power steering pump rear fixing bracket retaining bolt.

- Reposition the charge air cooler inlet pipe to gain access to the power steering pump retaining bolt.

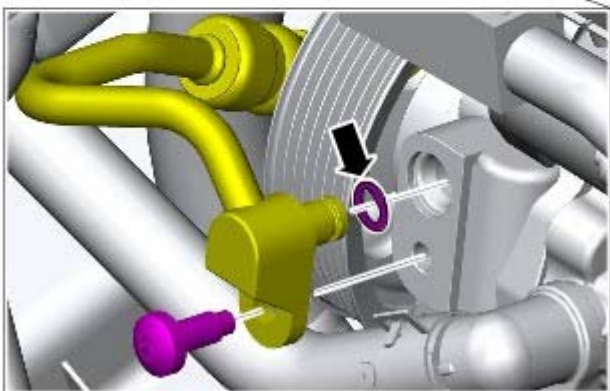
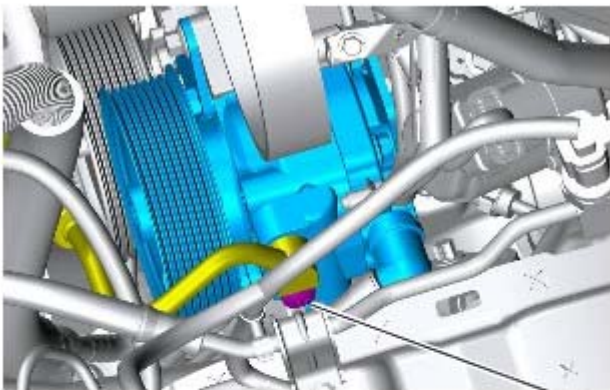
17.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Lower the vehicle.

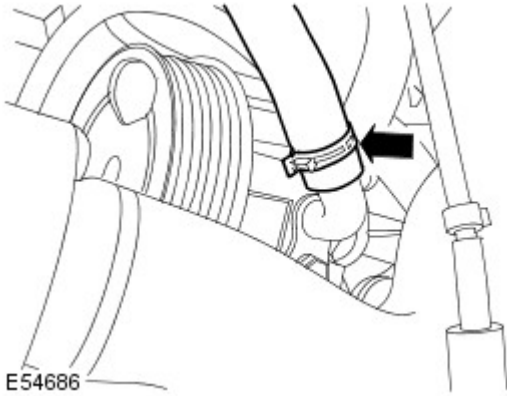
18.  **CAUTION:** If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.


Disconnect the high pressure line from the power steering gear.

- Remove and discard the O-ring seal.
- Install blanking caps to the exposed ports.
- Allow the fluid to drain into a container.



E94170



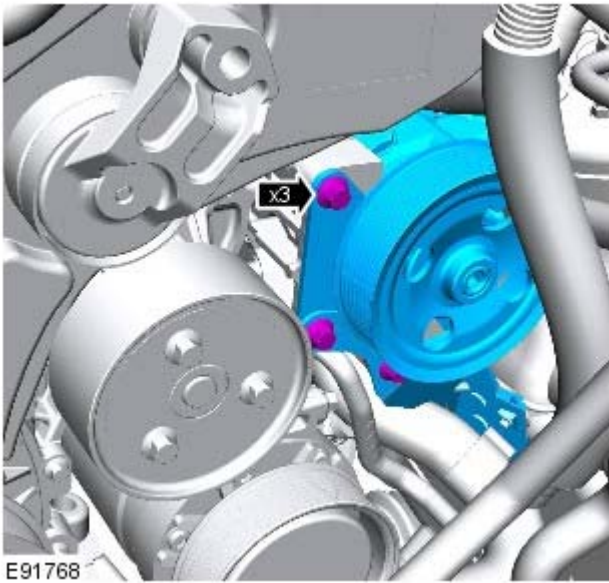
19.  **CAUTION:** If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.

Disconnect the power steering pump supply hose.

- Clamp the power steering pump supply hose to minimise fluid loss.
- Install blanking caps to the exposed ports.

20. Remove the power steering pump.


- Remove the 3 power steering pump front retaining bolts.



Installation

1. Install the power steering pump and bracket.


- Install the 3 power steering pump front bolts and lightly tighten, then back off each bolt a 1/4 turn.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise the vehicle.

3. Install the power steering pump rear fixing bracket retaining bolt.

- Reposition the charge air cooler inlet pipe to gain access to the power steering pump retaining bolt.
- Tighten the bolt to 25 Nm (18 lb.ft).

4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Lower the vehicle.

5. Tighten power steering pump front retaining bolts to 24 Nm (18 lb.ft).

6. Connect the power steering supply hose.

- Remove the blanking caps from the ports.
- Remove the hose clamp.

7. **NOTE:** Lubricate the seals with clean power steering fluid.


Connect the power steering high-pressure pipe union.

- Remove the blanking caps from the ports.
- Install a new O-ring seal.
- Tighten the Torx bolt to 25 Nm (18 lb.ft).
- Remove the container.

8.  **CAUTION:** Lubricate the new seals with clean refrigerant oil.

Install the A/C low pressure pipe to the compressor.

- Remove the blanking caps from the ports.
- Install a new O-ring seal.
- Tighten the bolt to 9 Nm (7 lb.ft).

9.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise the vehicle.

10. Connect the charge air cooler inlet hose.

- Tighten the clips.

11. Secure the charge air cooler inlet pipe.

- Install the two retaining bolts.
- Install the retaining nut.
- Tighten to 10 Nm (7 lb.ft).

12. Install the upper arm and brake line heat shields.

- Install the 3 bolts.
- Install the 3 nuts.


13. Install the fender splash shield lower trim panel.

- Install the 4 clips.

14. Install the front LH fender splash shield.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

15. Install the wheel and tire.

16.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Lower the vehicle.

17. Install the accessory drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

18. Install the auxiliary battery tray.

For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

19. Recharge the A/C system

For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

20. Install the cooling fan shroud.

For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

21. Check and top-up power steering fluid level.

For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

22. Install the engine cover.

For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

23. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Power Steering - Power Steering Pump TDV6 3.0L Diesel

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

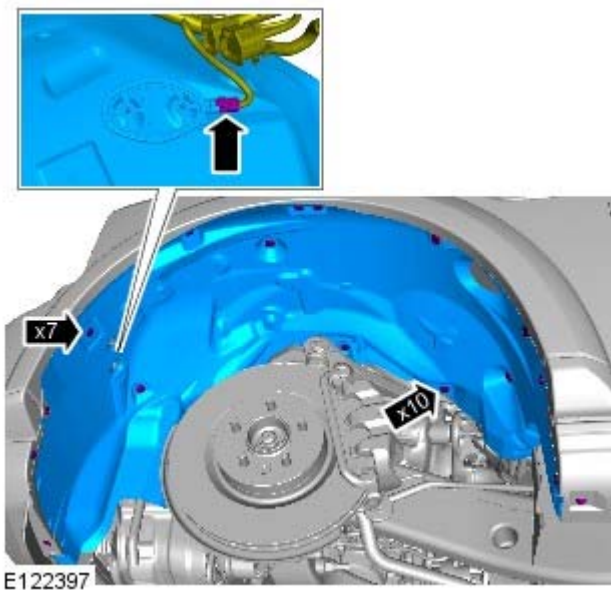
3. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

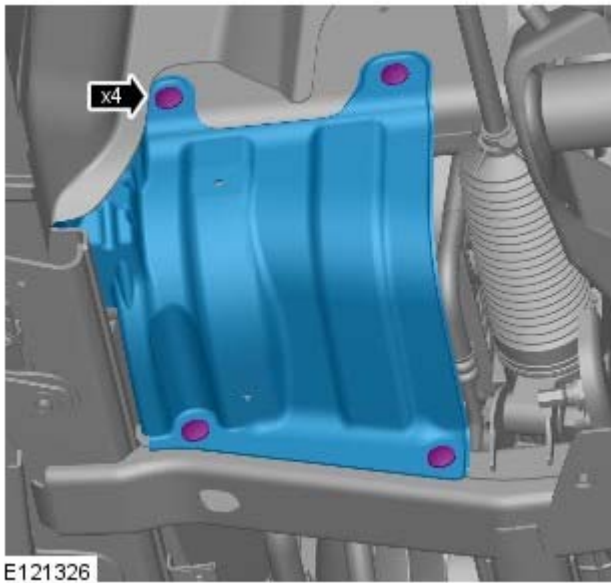
4. Refer to: [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

5. Remove the LH front wheel and tire.

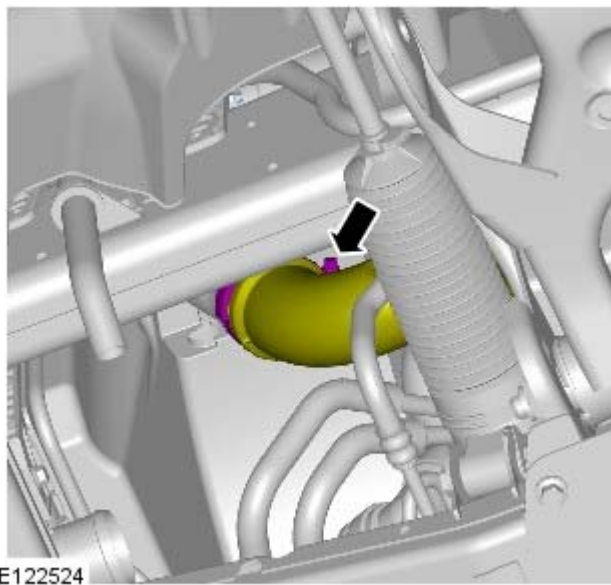
Torque: 140 Nm

- 6.

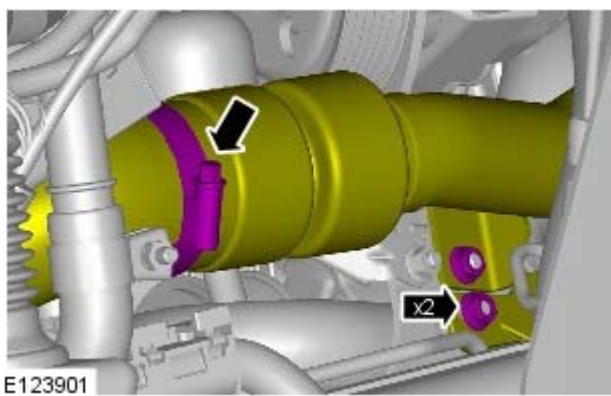




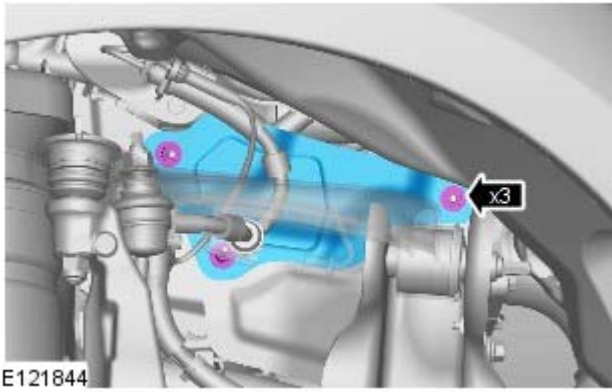
7.



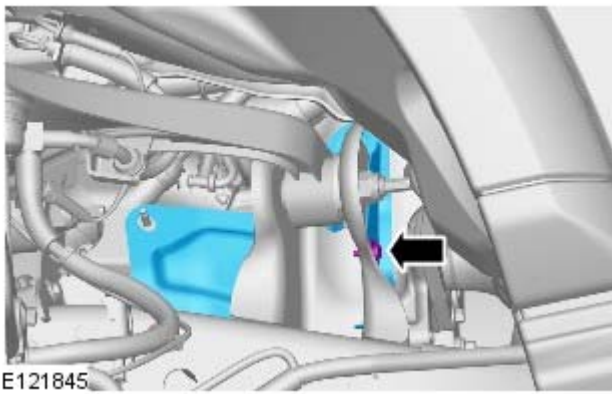
8.



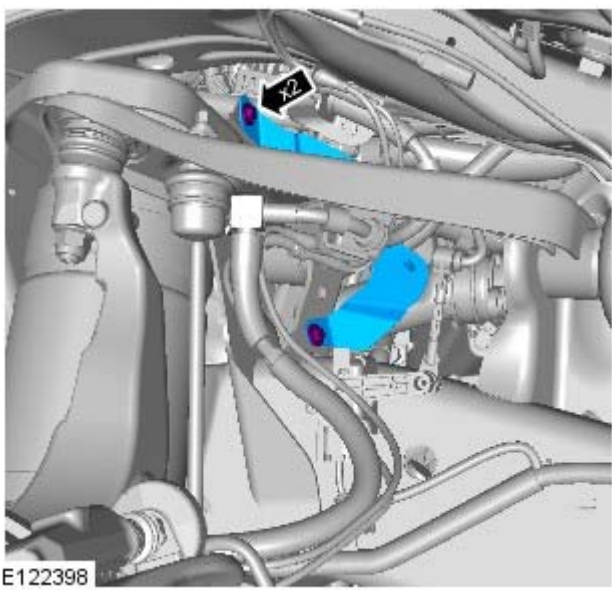
9. Torque:
Nuts 6 Nm



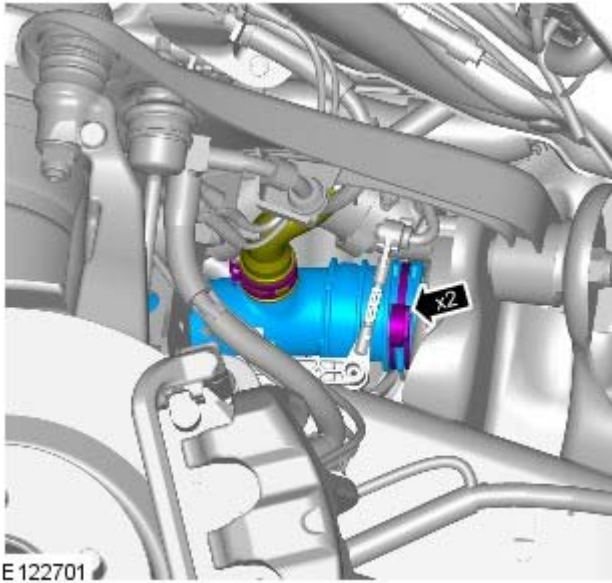
10. Torque: 9 Nm



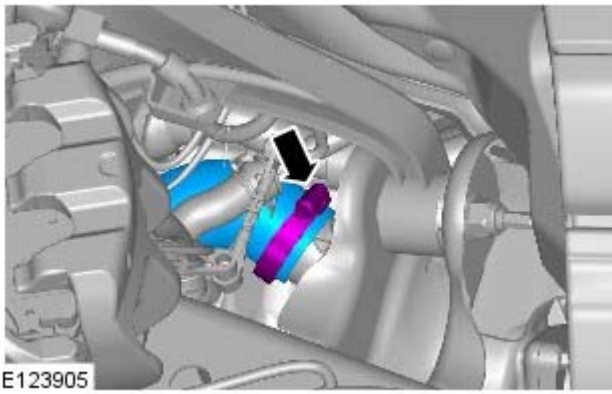
11. Torque: 9 Nm



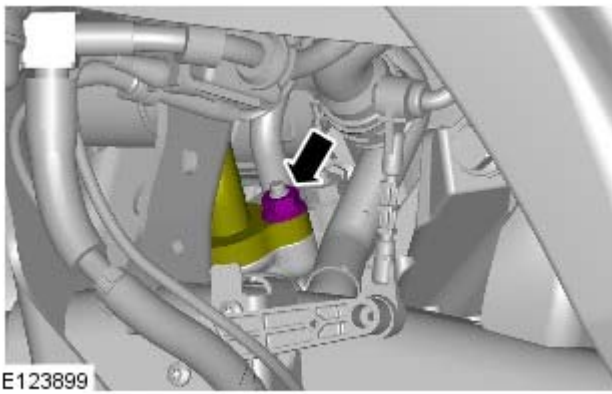
12. Torque: 9 Nm



13.

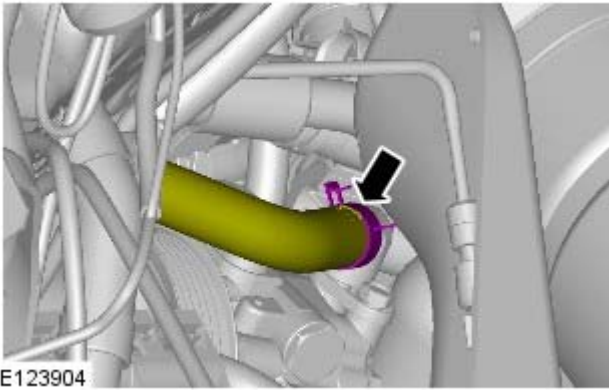



14.




15. **15.** NOTE: Make sure that all openings are sealed. Use new blanking caps.

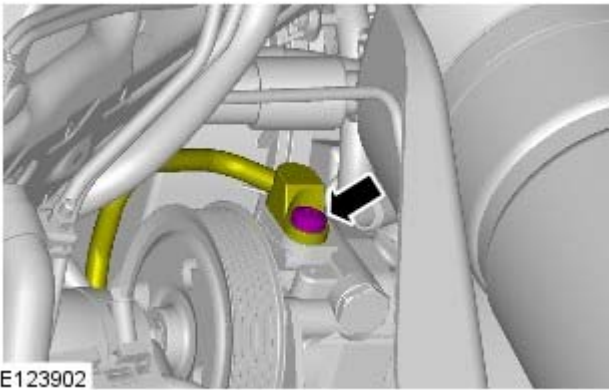
Torque: 18 Nm




16. **16.**  **WARNING:** Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

 **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

- **NOTE:** Make sure that all openings are sealed. Use new blanking caps.

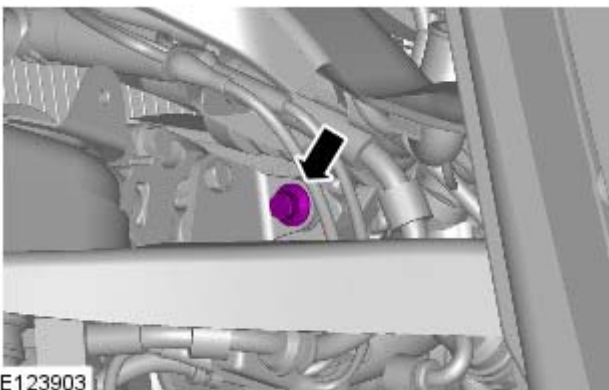


17. **17.**  **WARNING:** Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

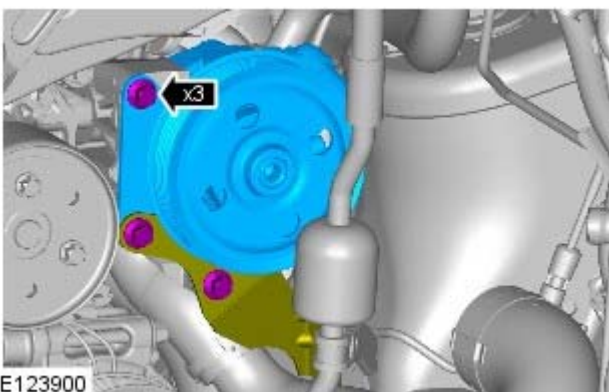
 **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

- **NOTE:** Make sure that all openings are sealed. Use new blanking caps.

Torque: 24 Nm



18. *Torque:* 25 Nm



19. *Torque:* 25 Nm

Installation


1. To install, reverse the removal procedure.

2. Refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

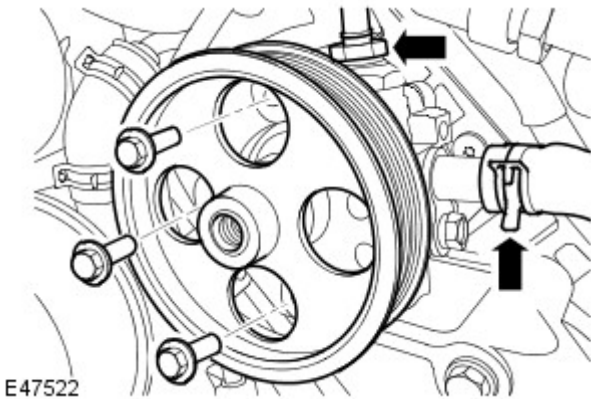
Power Steering - Power Steering Pump V6 4.0L Petrol

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.
 - **NOTE:** Some oil spillage is inevitable during this operation.

Clamp the power steering pump supply hose to minimise fluid loss.
4. Disconnect the high pressure line at the steering pump union.
 - Position an absorbent cloth to collect fluid spillage.
5. Disconnect the power steering pump supply hose.
 - Release the clip.
6. Remove the power steering pump.
 - Remove the 3 bolts.



Installation

1. Install the power steering pump.
 - Clean the component mating faces.
 - Install and tighten the bolts to 25 Nm (18 lb.ft).
2. Connect the power steering supply hose to the steering pump.
 - Clean the component mating faces.
 - Secure with the clip.
3. Connect the high pressure line to the steering pump.
 - Clean the component mating faces.
 - Install new seals.
 - Tighten the union to 25 Nm (18 lb.ft).
4. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Specifications).

6. Fill and bleed the power steering system.

For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Pump V8 5.0L Petrol

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

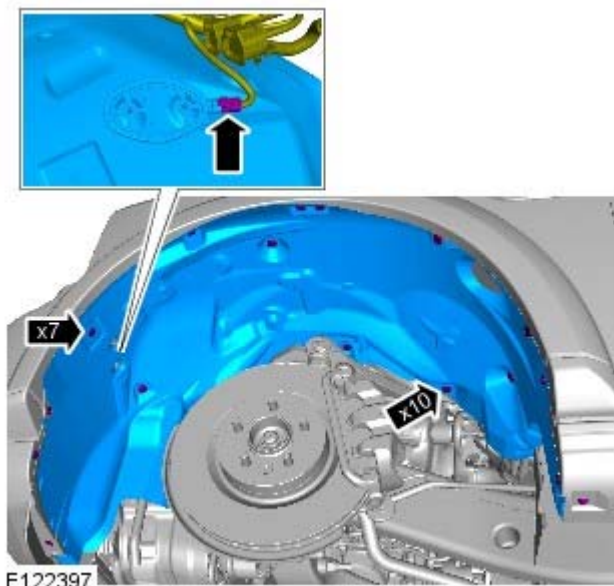
3. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

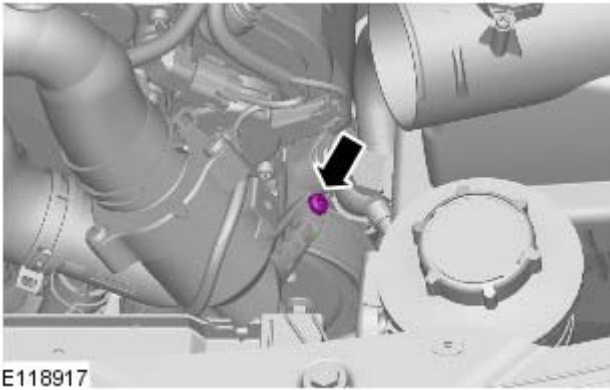
4. Refer to: [Accessory Drive Belt](#) (303-05D Accessory Drive - V8 5.0L Petrol, Removal and Installation).

5. Remove the LH front road wheel.

Torque: 140 Nm


- 6.



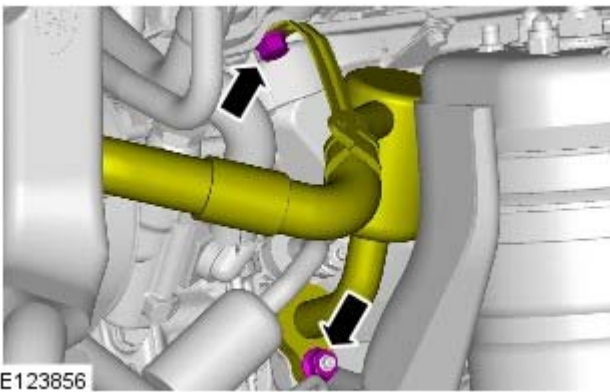


7. *Torque:* 10 Nm



8.  **CAUTION:** Note the fitted position of the component prior to removal.

Torque: 25 Nm

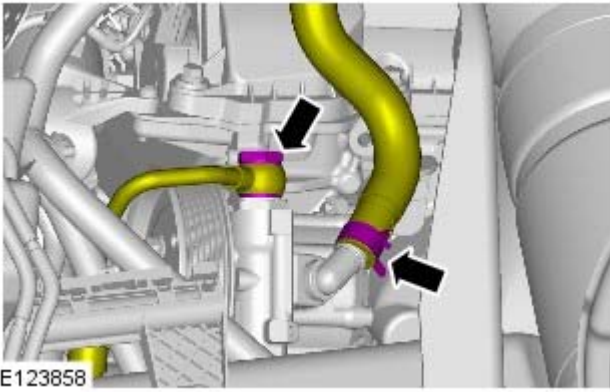


9. **9. CAUTIONS:**


 Make sure that all openings are sealed. Use new blanking caps.

 A new O-ring seal is to be installed.

Torque: 18 Nm

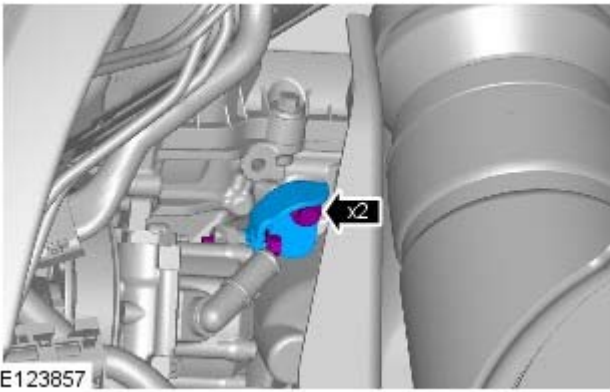


10. **10. CAUTIONS:**

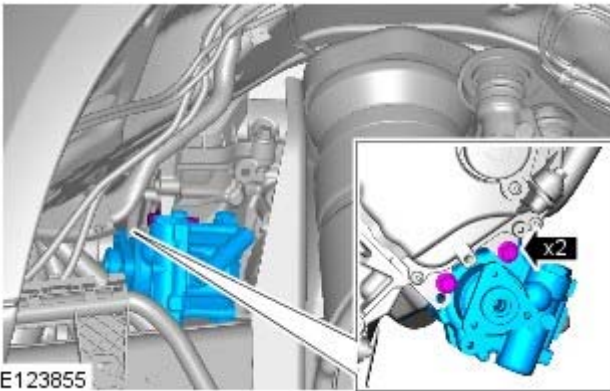
 Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.


 Make sure that all openings are sealed. Use new blanking caps.

Torque: 25 Nm



11. *Torque:* 25 Nm



12.  **CAUTION:** Note the fitted position of the component prior to removal.

Torque: 25 Nm

Installation

1. To install, reverse the removal procedure.
2. Refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Power Steering - Steering Angle Sensor

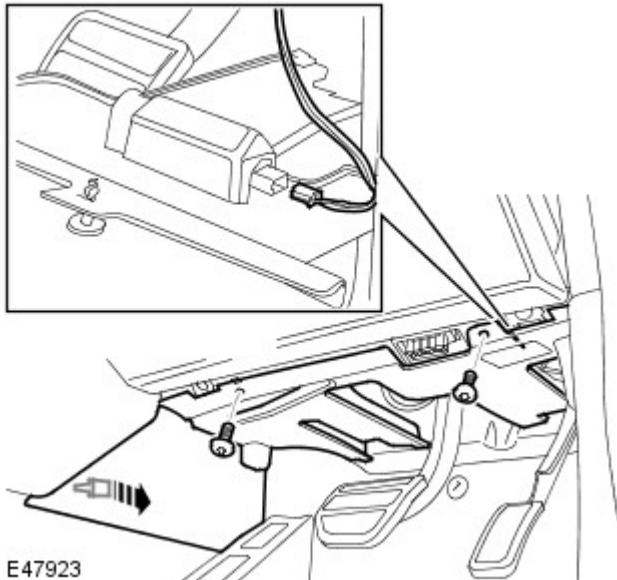
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the driver side closing trim panel.

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47923

3. Disconnect the steering angle sensor electrical connector.



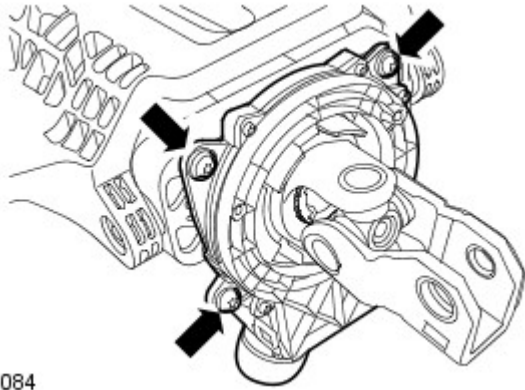
E47076

4. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.



E49465



E47084

5. Remove the steering angle sensor.

- Remove the 3 Torx screws.

Installation

1. Install the steering angle sensor.

- Tighten the Torx screws to 3 Nm (2 lb.ft).

2. Connect the steering column intermediate shaft.

- Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).

3. Connect the steering angle sensor electrical connector.

4. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

6. Initiate a new steering angle sensor using T4.

Power Steering - Power Steering Pump to Steering Gear Pressure Line

Removal and Installation

Removal

- NOTE: RHD shown, LHD is similar.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

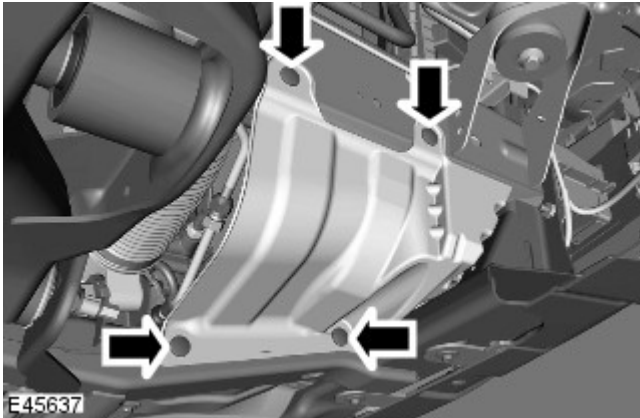
All vehicles

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the front RH splash shield.

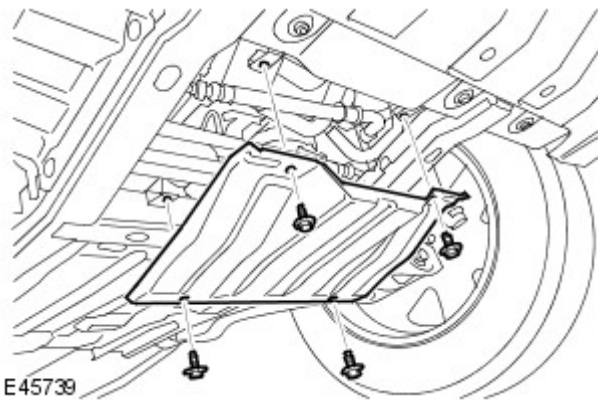
- Remove the 4 clips.

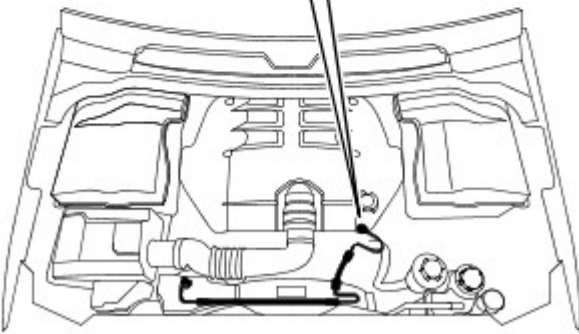
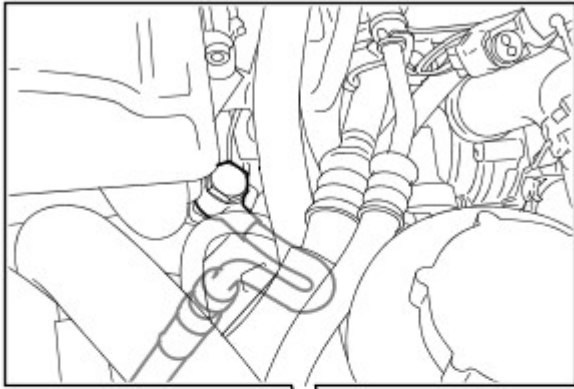


3. Remove the front LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).


4. Remove the radiator access panel.

- Remove the 4 bolts.





E72350

5.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

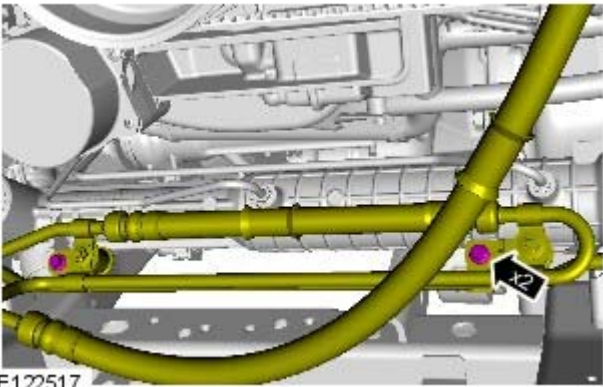
Disconnect the high pressure line from the power steering pump.

- Loosen and release the power steering pump line.
- Allow the fluid to drain into a container.
- Remove and discard the 2 sealing washers.

Vehicles with 5.0L engine

6. Release the power steering line support brackets.

- Remove the 2 nuts.
- Release the hose.

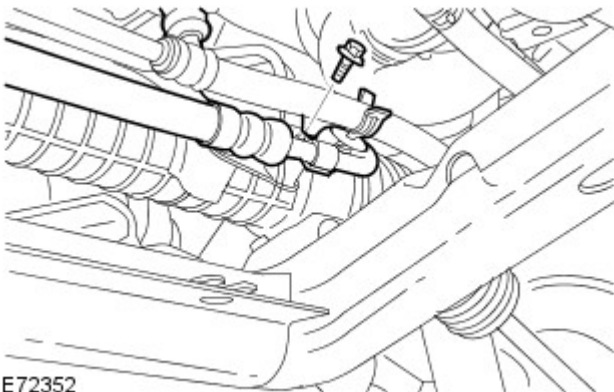


E122517

All other engine types

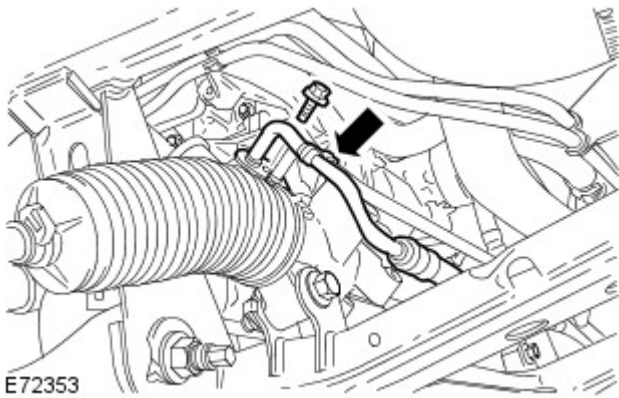
7. Release the power steering line support bracket.


- Remove the nut.
- Release the hose.



E72352

All vehicles



8.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the high pressure line from the power steering gear.

- Remove the bolt.
- Release the power steering gear line.
- Remove and discard the O-ring seal.

9. Remove the steering gear high-pressure line.

Installation

All vehicles

1. Install the steering gear high-pressure line.
2. Connect the high-pressure line to the power steering gear.
 - Install the O-ring seal.
 - Attach the power steering gear high-pressure line.
 - Tighten the bolt to 25 Nm (18 lb.ft).

Vehicles with 5.0L engine

3. Install the power steering line support brackets.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 - Secure the hose with the clip.

All other engine types

4. Install the power steering line support bracket.
 - Tighten the nut to 10 Nm (7 lb.ft).
 - Secure the hose with the clip.

All vehicles

5. Connect the high-pressure line to the power steering pump.
 - Install new sealing washers.
 - Connect the power steering pump high-pressure line.
6. Install the radiator access panel.
 - Tighten the bolts to 10 Nm (7 lb.ft).
7. Install the front LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
8. Install the front RH splash shield.
 - Secure with the clips.
9. Fill and bleed the power steering system.
For additional information, refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Steering Linkage -

Torque Specifications

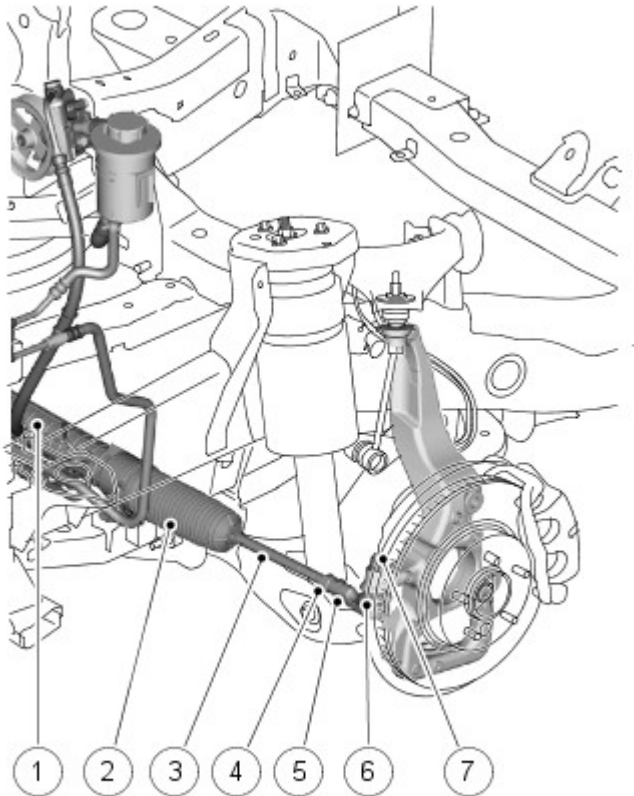
Description	Nm	lb-ft
* Tie-rod end nut - Vehicles fitted with an M12 nut	76	56
* Tie-rod end nut - Vehicles fitted with an M14 nut	150	111
Tie-rod locking nut	55	40
Road wheel nuts	140	103

* **New nut must be installed**

Steering Linkage - Steering Linkage

Description and Operation

Steering Linkage Component Location



E46659

Item	Part Number	Description
1	-	Steering gear
2	-	Steering gear boot
3	-	Tie rod
4	-	Locknut
5	-	Tie rod end
6	-	Ball joint
7	-	Self-locking nut

GENERAL

The steering linkage comprises the tie rod which provides the connection between the steering gear and the front wheel knuckle.

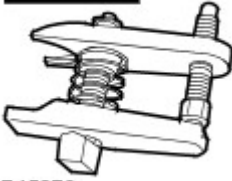
Each end of the steering gear has a threaded hole which provides for the fitment of the tie rods. The external ends of the tie rods are sealed with steering gear boots to prevent the ingress of dirt and moisture into the steering gear.

The outer ends of the tie rods are threaded to allow the fitment of the tie rod ends. The tie rod ends are screwed onto the tie rods and locked with locknuts to prevent inadvertent movement. The thread on the tie rod allows the position of the tie rod end to be adjusted in order to set the correct toe angle for each front wheel.


The tie rod end comprises a forged housing with a threaded bore for attachment to the tie rod. The tie rod end incorporates a non-serviceable tapered ball joint which locates in a tapered hole in the front wheel knuckle and is secured with a self-locking nut. The ball joint has an internal hexagonal drive which enables the joint to be held stationary when the self-locking nut is tightened.

Steering Linkage - Tie Rod End

Removal and Installation

Special Tool(s)	
 <p>205-754A E45276</p>	<p>Ball joint separator 205-754 (LRT-54-027)</p>

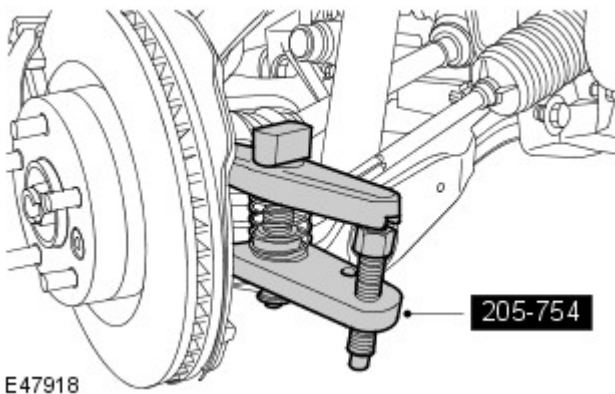
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

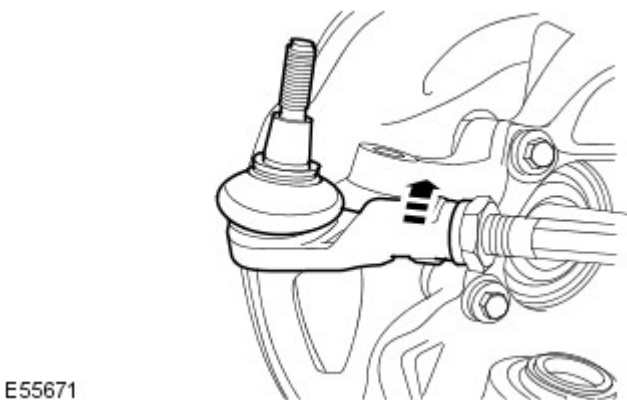
Raise and support the vehicle.

- Remove the front wheel.
- Loosen the tie rod end ball joint retaining nut.
- Loosen the tie rod end lock nut.
- Using the special tool, release the tie-rod end ball joint from the wheel knuckle.


- Remove and discard the tie rod end retaining nut.



- Remove the tie-rod end, note the number of turns for installation.



Installation

- Install the tie rod end, note the number of turns until adjacent to the locknut.
-  **CAUTION:** To prevent damage to the tie rods, use an additional wrench when loosening or tightening the components.

Connect the tie rod end ball joint.

- Clean the component mating faces.
- For vehicles fitted with an M12 nut, install a new nut and tighten to 76 Nm (56 lb.ft).

- For vehicles fitted with an M14 nut, install a new nut and tighten to 150 Nm (111 lb.ft).
3. Tighten the tie rod locking nut.
 - Clean the component mating faces.
 - Tighten the nut to 55 Nm (40 lb.ft).
 4. Install the front wheel.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
 5. Lower the vehicle.
 6. Using only four wheel alignment equipment approved by Land Rover, check and adjust the wheel alignment.

Steering Linkage - Steering Gear Boot

Removal and Installation

Removal

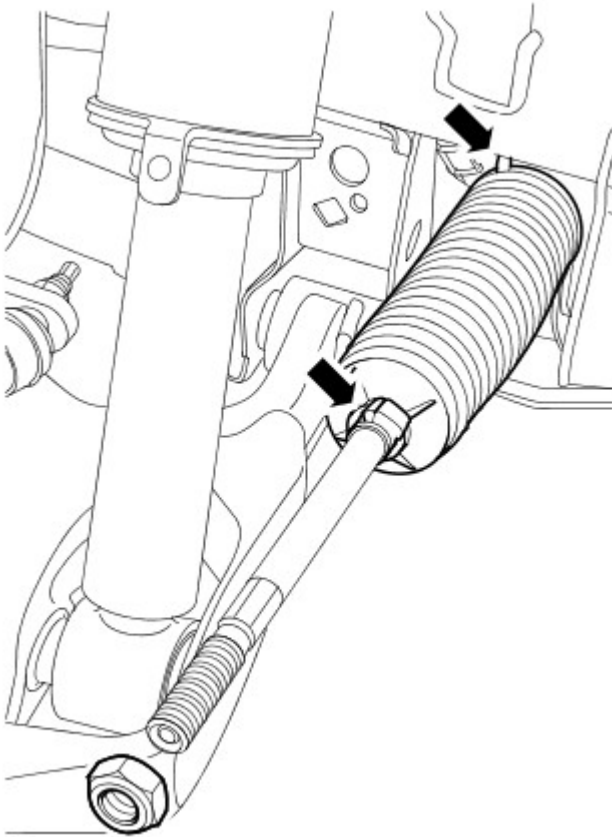
1. Remove the tie-rod end.
For additional information, refer to: [Tie Rod End](#) (211-03 Steering Linkage, Removal and Installation).

2. **NOTE:** Note the fitted position.

Remove the locknut.

3. Remove the steering gear boot.

- Release the 2 clips.



E55694

Installation

1. Install the steering gear boot.

- Clean the component mating faces.
- Secure with the clips.

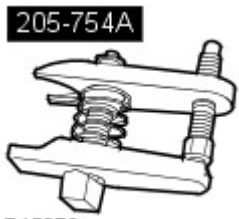
2. Install the locknut.

3. Install the tie-rod end.


For additional information, refer to: [Tie Rod End](#) (211-03 Steering Linkage, Removal and Installation).

Steering Linkage - Tie Rod

Removal and Installation

Special Tool(s)	
 <p>205-754A</p> <p>E45276</p>	<p>Ball joint separator</p> <p>205-754(LRT-54-027)</p>

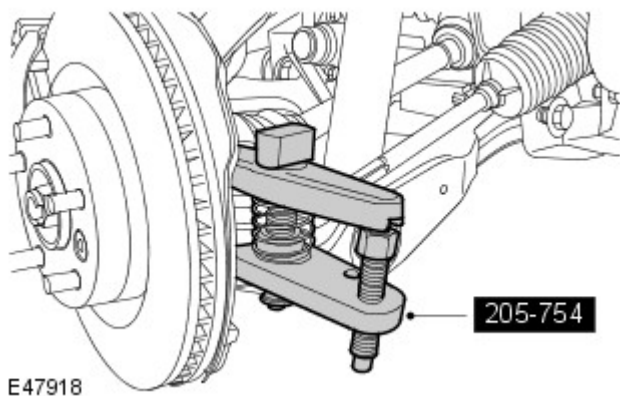
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

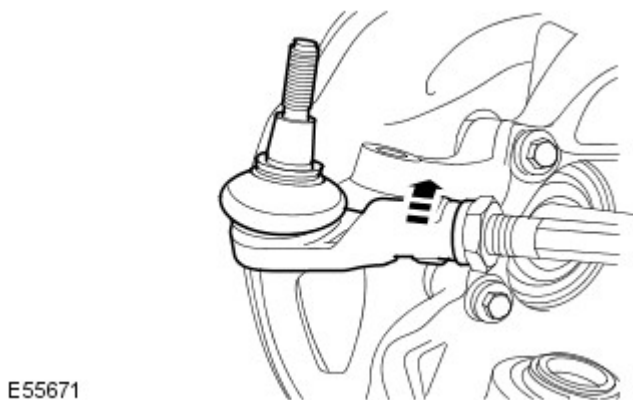
Raise and support the vehicle.

- Remove the front wheel.
- Loosen the outer tie-rod end ball joint retaining nut.
- Loosen the outer tie-rod end lock nut.
- Using the special tool, release the tie-rod end ball joint from the wheel knuckle.

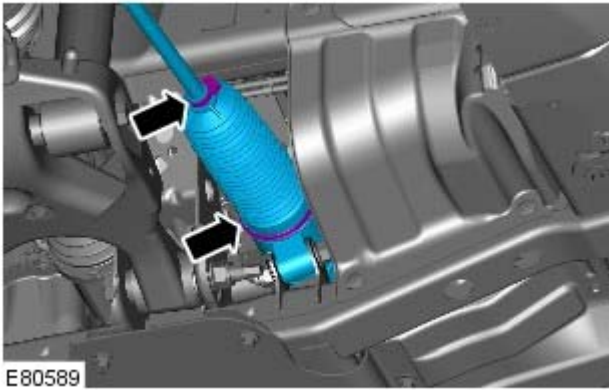
- Remove and discard the tie rod end retaining nut.



- Remove the outer tie-rod end, note the number of turns for installation.

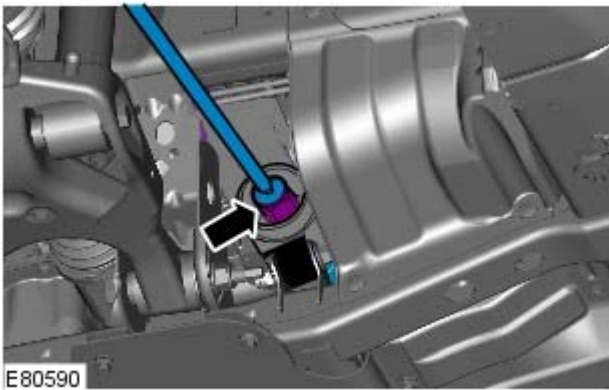


- Remove the outer tie-rod end lock nut.



8. Remove the steering gear boot.

- Release the 2 clips.



9. Remove the inner tie-rod end.

- Loosen the nut.

Installation

1. Install the inner tie-rod end.
 - Tighten the nut to 100 Nm (74 lb.ft).
2. Install the steering gear boot.
 - Secure with the clips.
3. Install the outer tie-rod end lock nut.
4. Install the tie rod end, note the number of turns until adjacent to the locknut.

5.  **CAUTION:** To prevent damage to the tie rods, use an additional wrench when loosening or tightening the components.

Connect the tie-rod end ball joint.

- Clean the component mating faces.
 - For vehicles fitted with an M12 nut, install a new nut and tighten to 76 Nm (56 lb.ft).
 - For vehicles fitted with an M14 nut, install a new nut and tighten to 150 Nm (111 lb.ft).
6. Tighten the tie-rod locking nut.
 - Clean the component mating faces.
 - Tighten the nut to 55 Nm (40 lb.ft).
 7. Install the front wheel.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).

8. Lower the vehicle.

9. Using only four wheel alignment equipment approved by Land Rover, check and adjust the wheel alignment.

Steering Column -

General Specification

Item	Specification
Type	Two piece, articulated with flexible coupling to steering rack; fitted with energy absorption system and having a 120 mm (4.7 in) ride down capability with a 4.5 kN (0.45 ton force) maximum decoupling load on the intermediate shaft and a 77 mm (3.0 in) collapse stroke on the lower shaft.
Upper column adjustment:	
Reach	40 mm (1.57 in)
Rake	6°

Torque Specifications

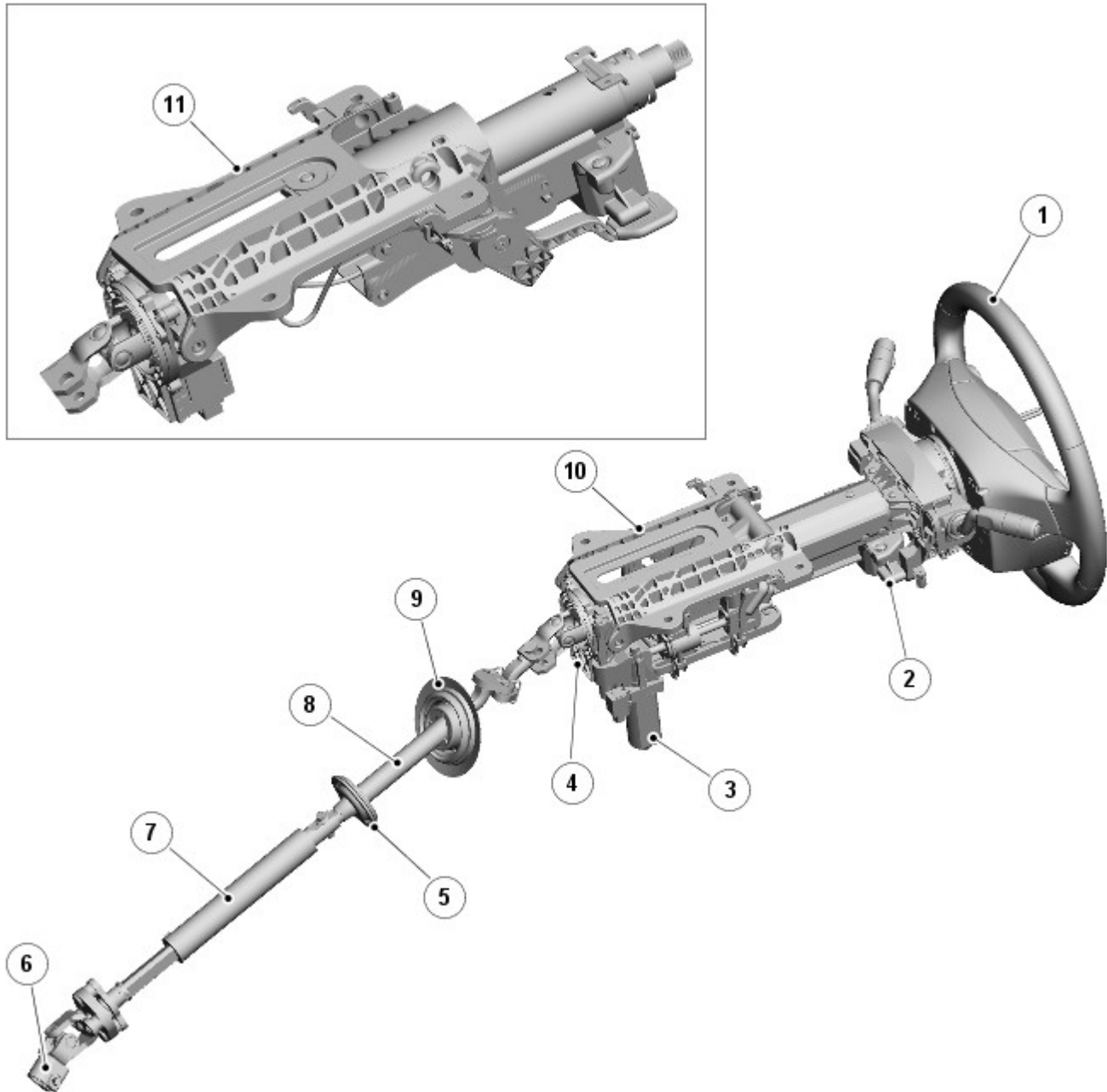
Description	Nm	lb-ft
Steering angle sensor Torx screws	3	2
* Steering column intermediate shaft to lower shaft bolts	30	22
* Steering column intermediate shaft to steering column nut	22	16
Steering column switch assembly Torx bolts	3	2
Steering wheel bolt	63	46

* **New bolts/nut must be installed**

Steering Column - Steering Column

Description and Operation

Component Location



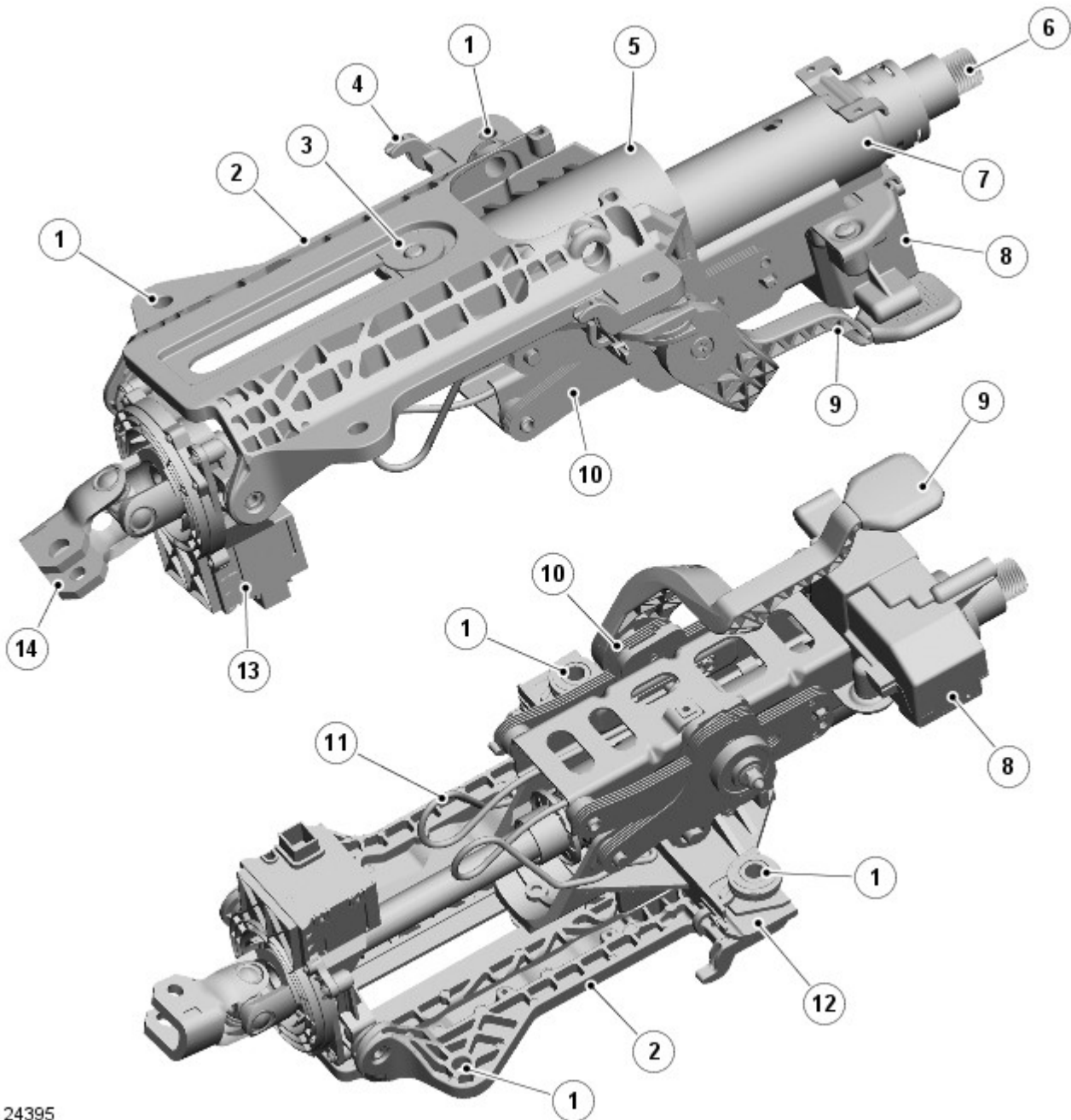
E124335

Item	Part Number	Description
1	-	Steering wheel
2	-	Electronic steering lock
3	-	Electric motor
4	-	Steering angle sensor
5	-	Bulkhead mounting
6	-	Lower collapsible shaft yoke
7	-	Lower collapsible shaft
8	-	Intermediate shaft
9	-	Gaitor
10	-	Upper steering column assembly - Electric
11	-	Upper steering column assembly - Manual

Overview

The steering column comprises the upper column assembly, the intermediate shaft and the lower collapsible shaft. The three components are positively connected together to pass driver rotary input from the steering wheel to a linear output of the steering rack.

Upper Column Assembly - Manual



E124395

Item	Part Number	Description
1	-	Attachment holes
2	-	Roof bracket
3	-	Screw
4	-	Locating hook
5	-	'U' bracket
6	-	Steering wheel splines
7	-	Main body
8	-	Electronic steering lock
9	-	Adjustment lever
10	-	Clamp plate assembly
11	-	Adjustment balance spring (2 off)
12	-	Shearing capsule (2 off)
13	-	Steering angle sensor
14	-	Swing yoke

The steering column is attached to the in-vehicle crossbeam and secured with four, 8 mm thread forming, pan head Torx drive screws. The two forward attachment screws are fixed through the column mounting bracket, the two rearward mounting screws also pass through the shearing capsules. In the event of a high energy frontal impact, the shearing capsules remain fixed to the crossbeam, but the 'U' bracket (with the main body) disengages from the capsules, allowing the column to shorten axially (collapse), with the coiled straps absorbing energy to reduce occupant loading.



WARNING: Take care when handling the column not to trap fingers if releasing the adjustment lever at any point during the removal procedure when the column is not in the vehicle. The balance springs will cause the column to rapidly

move to its upper-most position.

The column comprises a cast magnesium roof bracket which is attached to the in-vehicle crossbeam. Attached to the roof bracket is a pivot housing, a 'U' bracket, upper and lower shafts and a main body. The roof bracket has two hooks which locate in slots in the in-vehicle crossbeam. The hooks assist in supporting the weight of the column during removal or installation.

The pivot housing is attached to the forward end of the roof bracket with two pivot pins. The pivot housing allows for adjustment of the column rake and contains a bearing which supports the column lower shaft.

The 'U' bracket is attached to the roof bracket by a screw, bush and plastic washer assembly (third fixing) located in a slot in the top of the roof bracket. When the column is assembled into the vehicle, the shearing capsules, which are attached to the 'U' bracket, are clamped up against the roof bracket by the fixing screws, preventing movement of the 'U' bracket. The bolts also pass through rectangular section steel straps, which at one end, have coils that locate around a plastic bush (positioned on the shearing capsule). The straps are used to control the rate of column collapse, in the event of a high energy frontal impact.

The main body is positioned in the 'U' bracket via the lever bolt. The bolt is captive within the vertical slots in the 'U' bracket and the horizontal slots in the main body. The bolt also passes through the clamp plate assemblies (one on either side of the 'U' bracket). The body houses the middle and upper bearings through which the upper shaft is located. Two offset holes in the main body provide for the attachment of the electronic steering lock assembly.

The upper and lower shafts are located through the length of the column assembly. The upper shaft is supported in two bearings in the main body and the lower shaft is located in the upper shaft and supported in a bearing in the pivot housing. The lower shaft has a tubular section with external splines. These mate with the internal splines in the upper shaft. The purpose of the splines is to transmit rotational movement of the upper shaft to the lower shaft, but allowing the two components to telescope into each other in the event of a collision. The length of the splined sections allow for 120 mm (4.72 in) of linear movement. The lower shaft is fitted with a universal joint spider to which a swivel yoke is attached. The swivel yoke attaches to the intermediate shaft of the steering column on the interior side of the bulkhead using a special cam bolt and self-locking nut.

A steering angle sensor is attached to the pivot housing of the column and its centre gear is rotated by a drive collar which is attached to the lower shaft and rotates with movement of the steering wheel. The sensor transmits steering angle data on the high speed **CAN** bus which is used by various systems on the vehicle. The steering angle sensor is designed to become detached from the column in the event of a frontal impact. Care must be taken when handling the column assembly to prevent accidental damage to the sensor.

The upper steering column assembly houses the electronic column lock mechanism and control module.

The steering column is adjustable for reach and rake. The column can be adjusted for 40 mm (1.57 in) of reach adjustment and 6° of rake adjustment. The adjustment mechanism comprises an adjustment lever, a cam plate, a lever bolt and nut, two brake pads and two clamp plate assemblies.

A plastic adjustment lever is located on the underside of the column assembly and is attached to a cam plate. When the lever is pulled downwards, the cam plate rotates and releases tension in the lever bolt. The lever bolt also passes through two sets of clamp plate assemblies. When the lever is moved upwards, the cam plate rotates applying tension to the lever bolt, which applies pressure to the brake pads which in turn apply pressure to the clamp plate assemblies (which lock the column in the desired position). The lever bolt is retained by a self-locking lever nut, which abuts a thrust bearing.



WARNING: Under no circumstances should the lever nut torque be reduced, as this will reduce the clamping efficiency of the adjustment mechanism possibly affecting the stability of the column during a frontal impact.

The pivot housing is attached to the roof bracket with two pivot pins. When the rake adjustment is operated, the pivot housing rotates around the pivot pins to allow for the up and down adjustment, but maintains a positive location to the roof bracket. An adjustment spring is fitted between the 'U' bracket and the main body, to counteract the weight of the main body, upper shaft, steering wheel and airbag, preventing the steering wheel from dropping rapidly when the adjustment lever is released.

In the event of a high energy frontal impact, the upper column assembly is designed to axially collapse reducing impact injury to the driver. A number of components interact together to ensure that the collapse of the column is in a controlled manner. The following components control the column collapse:

- Pressure washer and bush (third fixing)
- Shearing capsules
- Straps
- Upper and lower shaft (splined) connection

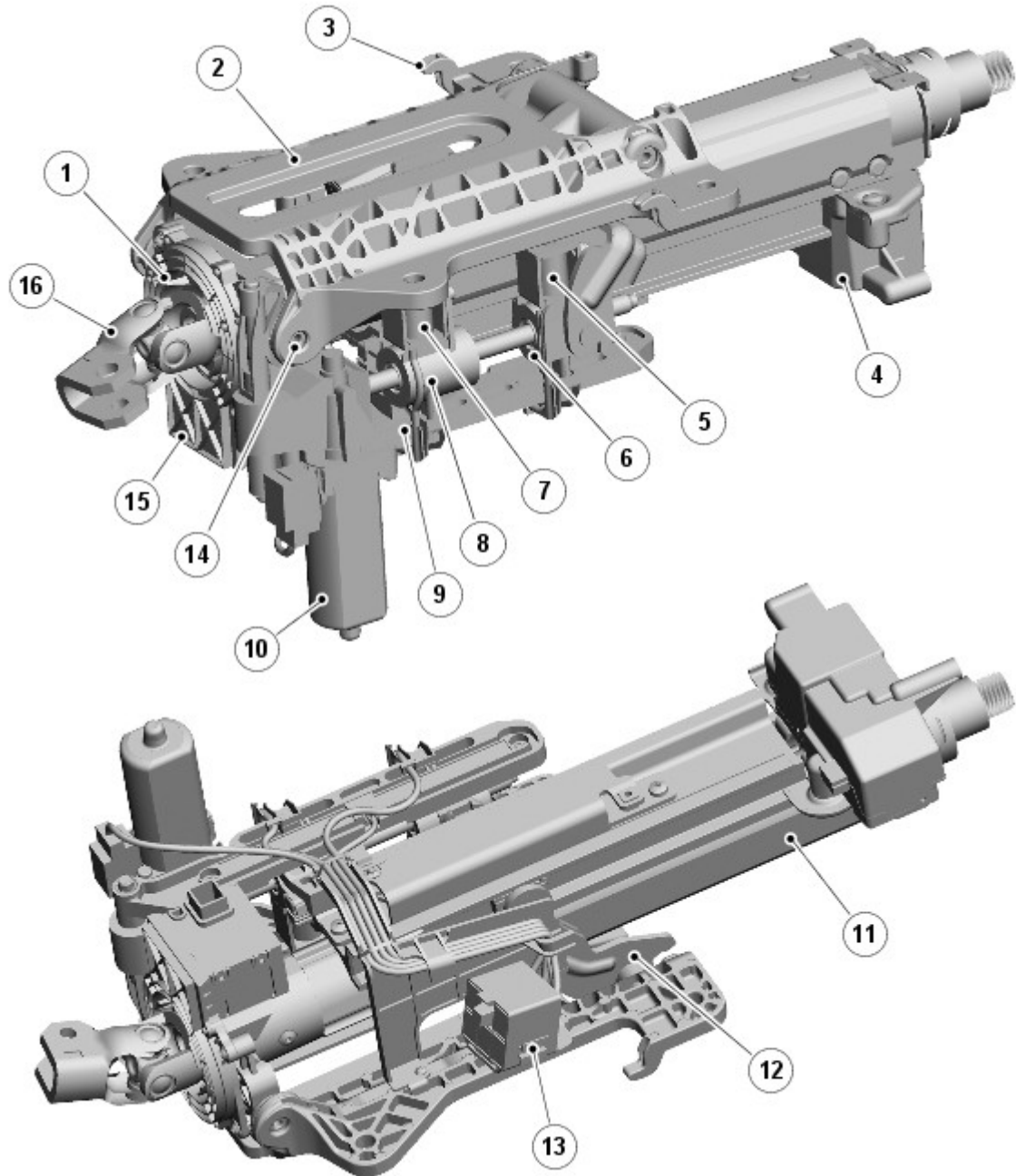
The shearing capsules have a central hole through which the rearward attachment bolts pass through into the roof bracket. The capsules are located in the 'U' bracket by tapered slots, which have small cut-outs in the inside faces. The shearing capsules have a number of small holes which align with the cut-outs in the 'U' bracket. When the capsules are installed, plastic is injected into the holes and cut-outs. This plastic retention of the capsules provides the initial controlled break-out force for the column in the event of a collision. After 10 mm of displacement, the 'U' bracket is no longer located by the shearing capsules. When handling the column, care should be taken that the shearing capsules are not impacted or dislodged.

The tension in the 'Third Fixing' screw, applies a clamp load to the roof bracket (via the bush and compression washers). In the event of a collision, this clamp load (supplementary to the shearing capsules) must be overcome before the column can collapse. When this load has been exceeded (and the fixing has been displaced 20 mm (0.79 in)) it slides easily within the roof bracket slot, providing directional control to the column, as it collapses. Under no circumstances should the screw torque be adjusted.

The straps are rectangular section steel, which at one end, have coils that locate around a plastic bush (positioned on the shearing capsule). The other end is formed into a hook which locates within a slot in the 'U' bracket. When a collision has occurred, and the 'U' bracket has been displaced from the shearing capsules by 8 mm (0.3 in), the straps begin to un-roll due to the displacement of the 'U' bracket. The straps provide the main element for energy absorption as the column collapses. The cross section of the straps change after approximately 40 mm (1.6 in) of extension, changing the amount of

energy that they absorb.

Upper Column Assembly - Electric



E124336

Item	Part Number	Description
1	-	Pivot housing
2	-	Roof bracket
3	-	Locating hook
4	-	Electronic steering lock
5	-	Rake solenoid
6	-	Rake clutch
7	-	Reach solenoid
8	-	Reach clutch
9	-	Potentiometer
10	-	Electric motor
11	-	Outer profile
12	-	Rake lever
13	-	Electrical connector
14	-	Pivot pin
15	-	Steering angle sensor
16	-	Swing yoke

The steering column is attached to the in-vehicle crossbeam and secured with four, 8mm, thread forming, pan head Torx drive screws. In the event of a high energy frontal impact, a strap and shear pin on the underside of the column provides a controlled collapse of the outer housing on the inner housing, allowing the column to shorten axially (collapse), absorbing energy to reduce occupant loading.

The column comprises a cast magnesium roof bracket which is attached to the in-vehicle crossbeam. Attached to the roof bracket is a pivot housing, a outer housing and upper and lower shafts. The roof bracket has two hooks which locate in slots in the in-vehicle crossbeam. The hooks assist in supporting the weight of the column during removal or installation.

The rake lever locates the aluminum outer profile, into which is fixed the electronic steering lock adaptor. The inner profile is located within the outer profile, by 2 linear bearing assemblies, which allow a telescopic action for the reach adjustment.

The assembly of the upper and lower shafts is located within the column by the bearings in the electronic steering lock adaptor and the pivot housing. Both shafts are tubular. The lower shaft has external splines (which are over molded with nylon), and these mate with the internal splines in the upper shaft. The purpose of the splines is to transmit rotational movement of the upper shaft to the lower shaft, yet allow telescopic movement during column axial collapse. The lower shaft is fitted with a universal joint spider to which a swivel yoke is attached. The swivel yoke attaches to the intermediate shaft of the steering column on the interior side of the bulkhead using a special cam bolt and self-locking nut.

A steering angle sensor is attached to the pivot housing of the column and its centre gear is rotated by a drive collar which is attached to the lower shaft and rotates with movement of the steering wheel. The sensor transmits steering angle data on the high speed [CAN](#) bus which is used by various systems on the vehicle. The steering angle sensor is designed to become detached from the column in the event of a frontal impact. Care must be taken when handling the column assembly to prevent accidental damage to the sensor.

The upper steering column assembly houses the electronic column lock mechanism and control module.

The steering column is adjustable electrically for reach and rake. The adjustment mechanism comprises an electric adjustment motor, a lead screw, a rake solenoid, a reach solenoid, a rake clutch and a reach clutch.

The column adjustment is controlled by the driver using a joystick switch located on the left hand side of the column cowl. The joystick can be moved forward and backward to adjust the column reach in and out and moved up and down to adjust the rake. The single electric motor is used for both adjustment ranges. The switch selection uses the applicable solenoid, engaging the applicable clutch on the lead screw.

When the auto function is activated, the steering column will adjust to the uppermost tilt position with ignition off, and re-adjust to the previous set position, with ignition on.

For the reach adjustment, the lead screw drives the outer housing in or out as required. For the rake adjustment, the lead screw drives a rake lever which moves the column up or down as applicable.

The pivot housing is attached to the roof bracket with two pivot pins. When the rake adjustment is operated, the pivot housing rotates around the pivot pins to allow for the up and down adjustment, but maintains a positive location to the roof bracket.

The electric steering column is linked to and controlled by the memory control module. The memory control module provides storage of three separate memory positions which are stored against three individual vehicle keys. For additional information, refer to: Seats (501-10, Description and Operation).

. The electric column also has an easy egress feature which lifts the column to its maximum rake to allow easier access to the vehicle.

In the event of a high energy frontal impact, the upper column assembly is designed to collapse reducing impact injury to the driver. A number of components interact together to ensure that the collapse of the column is in a controlled manner. The following components control the column collapse:

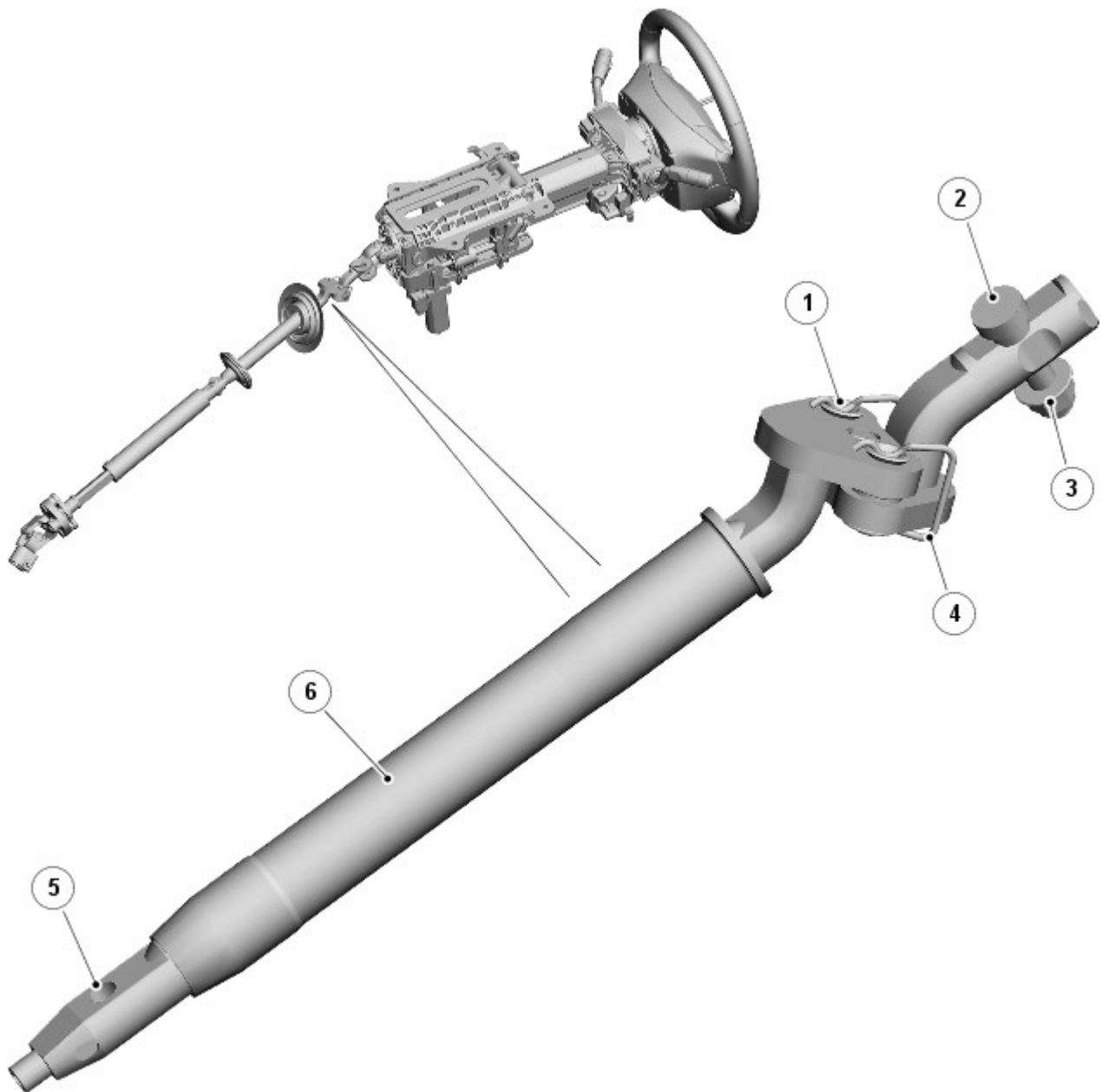
- Shear pin
- Strap
- Upper and lower shaft (splined) connection

The strap is rectangular section steel, which is secured by two Allen screws to the outer housing and by a shear pin to the strap guide. The strap provides the main element for energy absorption as the column collapses. To initiate axial movement of the column, the shear pin has to be severed, friction between several column interfaces has to be overcome, and an axial load applied sufficient to initiate strap guide deformation. Once the column is telescoping, deformation of the strap guide, and sliding friction between column interfaces, absorbs the energy of the occupant in a controlled manner, as the column collapses.



WARNING: Do not attempt to dismantle the steering column. The crash safety of the unit will be compromised.

Intermediate Shaft



E124337

Item	Part Number	Description
1	-	Load limiter pins
2	-	Cam bolt
3	-	Self-locking nut
4	-	Retention spring
5	-	Attachment hole
6	-	Seal sleeve

⚠ CAUTION: Care should be taken when handling the intermediate shaft, to ensure that it is not subject to impacts or that the retention spring is not displaced.

The non-handed, intermediate shaft is attached at its upper end to the swivel yoke on the lower shaft of the steering column assembly. The intermediate shaft comprises two main parts; the upper and lower axis which are joined together with a shear joint.

The upper axis has a cut-out in the shaft which allows for the fitment of the cam bolt. Only when the shaft is located correctly in the swivel yoke, can the cam bolt be inserted. A self-locking nut is fitted to the cam bolt. The torque applied as the nut is tightened, rotates the bolt, forcing the cam against the shaft, positioning it correctly in the swivel yoke prior to the joint being clamped.

• **NOTE:** If the self-locking nut is removed for any reason, it is recommended that a new, correct nut is fitted to maintain the optimum torque on the cam bolt.

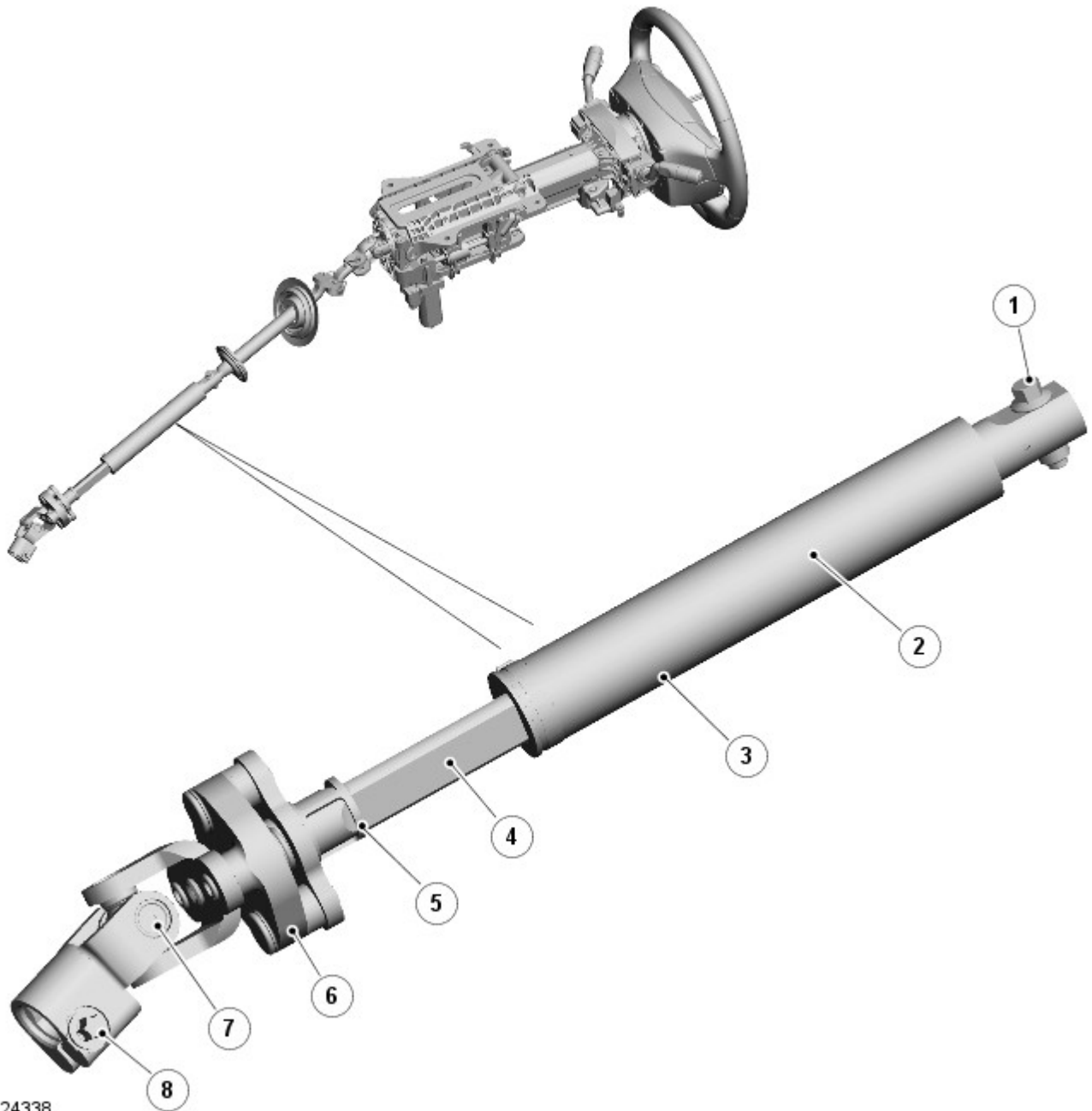
The lower axis is fitted with a plastic molded seal sleeve which provides a suitable surface for the location of the plastic bearings within the two bulkhead seals. The bottom of the lower axis is machined to a double 'D' shape which tapers at the end. One side of the taper has a slot which is used to align the intermediate shaft and the lower collapsible shaft to ensure that the correct orientation of the steering wheel to steering gear is maintained. A hole is drilled through the

double 'D' shape and provides for attachment of the intermediate shaft to the lower collapsible shaft.

The upper and lower axis, are joined together via a load limiter. The load limiter is designed to disconnect the upper and lower axis in the event of a high energy frontal impact preventing an excessive load being applied to the steering column (causing intrusion into the passenger compartment or an unstable airbag deployment).

The load limiter comprises two plates which are part of the upper and lower axis. The plates have a central 'guide' pin, and two retention pins, which pass through bushes in the plates, onto which a rubber and steel washer are staked in position. The size of the staking controls the load at which the lower axis separates from the upper axis. A wire 'retention' spring is also fitted to the load limiter.

Lower Collapsible Shaft



E124338

Item	Part Number	Description
1	-	Bolt
2	-	Heat shield
3	-	Female shaft
4	-	Male shaft
5	-	Plastic spacer
6	-	Flexible coupling
7	-	Universal joint
8	-	Torx bolt

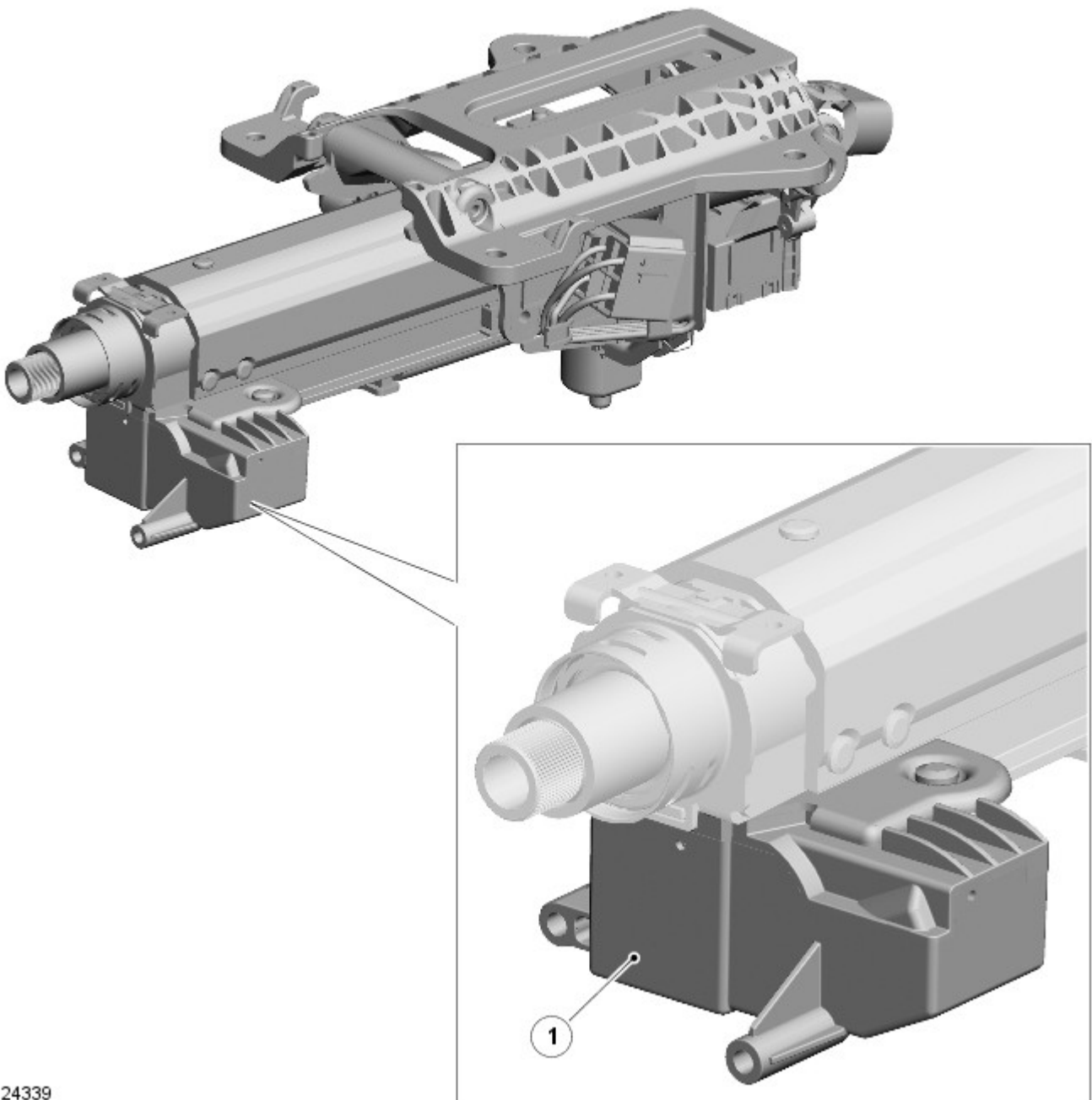
The lower collapsible shaft is a handed component and the correct component must be fitted to ensure that the steering phase angle is maintained. The shaft is attached at its upper end to the intermediate shaft and at its lower end to the valve unit pinion on the steering gear. These attachment joints can only be fitted in one orientation to ensure the correct alignment of the steering wheel to the steering gear. The shaft comprises two female and male shafts which are a telescopic fit on each other. The male shaft can slide up to 77 mm (3.03 in) within the female shaft in the event of a

frontal impact, to minimize the effect of frontal intrusion. The sliding fit also allows for dynamic displacement between the chassis and the body during severe off-road driving. A plastic spacer is fitted to the male shaft which is only used as an assembly aid during vehicle production and serves no function once the shaft is assembled to the vehicle.

The female shaft is a triangular section tube which is formed to a double 'D' hole at its upper end which mates with the intermediate shaft. An indentation pressed in the wall of the tube ensures the correct alignment between the intermediate shaft and the lower collapsible shaft. A captive nut, clinched to one side of a hole in the double 'D' section, allows for the fitment of a patchlock bolt to secure the intermediate shaft. Clamped around the end of the female shaft is a dust seal which prevents the ingress of dirt and moisture into the sliding joint, and a heat sleeve is also fitted to reflect radiant heat from the exhaust.

The male shaft is a triangular section tube which is staked at its lower end into a flange. A cage and curved 'spring plates' are fitted to its upper end, which slide in the female shaft. A pin is fitted into the side of the female tube, to secure the male tube in the bore. The lower end of the male shaft is fitted with a flexible coupling to absorb vibration and steering 'kick back', transmitted from the steering gear. A 'stabilizing pin' is fitted through the coupling to prevent coupling articulation (acting as a universal joint), while still allowing rotational flexing and plunge movement. The coupling is a rubber molding within which are nylon fibres wound around the attachment holes to transmit torque applied to the steering. The coupling is attached to a drive flange (which is part of the male shaft), and to the 'U' yoke which in turn is connected to the pinion yoke, by the universal joint assembly.

Electronic Steering Column Lock



E124339

Item	Part Number	Description
1	-	Electronic steering column lock

With the passive start system, a conventional steering lock mechanism cannot be used. An electronic system was developed which comprises a steering column assembly locking unit with an integrated control module. The steering lock is operated with the door locks when the vehicle is locked or unlocked. A control module, located inside the steering column, controls a motor, releasing the steering lock when appropriate.

The upper steering column assembly houses the column lock mechanism and control module. The components are assembled with non-removable pins for security reasons and are therefore non-serviceable. Failure of any steering lock components will require replacement of the upper steering column assembly.

The steering column lock comprises a locking motor and locking bolt. The locking motor drives a cam, which moves the locking bolt into and out of engagement with the locking sleeve on the steering column. The locking motor is fitted with a Hall effect sensor, which informs the control module of the position (locked/unlocked) of the steering lock mechanism.

Steering Column - Steering Column

Removal and Installation

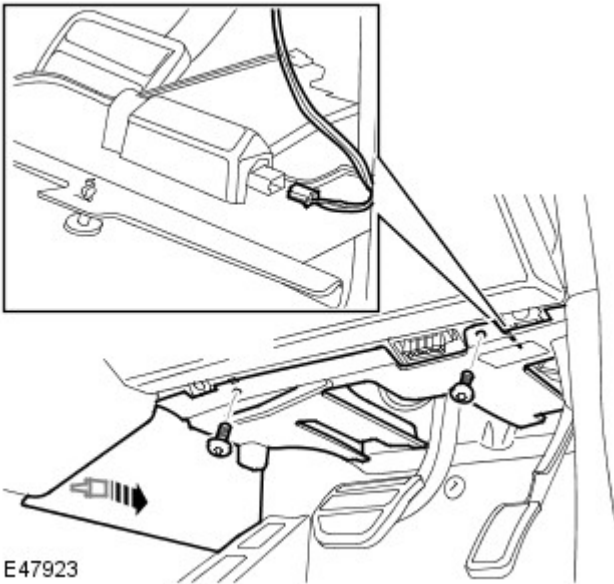
Removal

WARNING: Take care if releasing the adjustment lever when the column has been removed from the vehicle. The spring is under a high tension, and if released, could cause personal injury. Make sure fingers are clear from any areas, likely to be trapped.

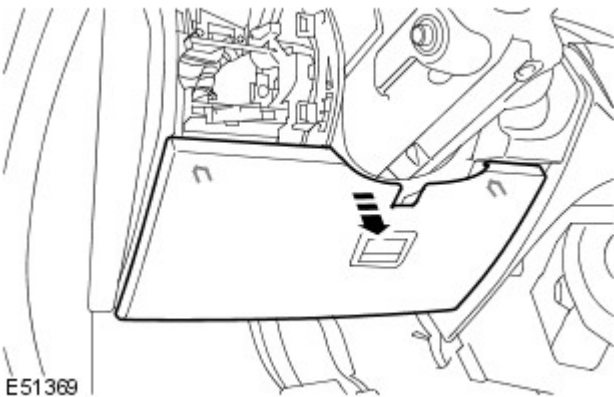
CAUTION: Air tools **MUST NOT** be used on steering column bolts.

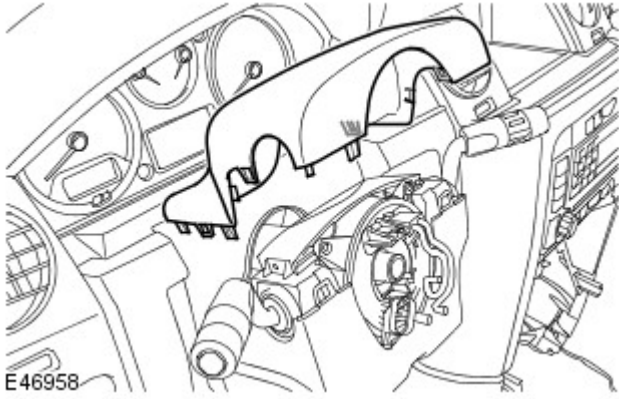
All vehicles

1. Fully extend the steering column for access.
2. Remove the steering wheel.
For additional information, refer to: [Steering Wheel](#) (211-04 Steering Column, Removal and Installation).
3. Remove the drivers side register trim panel.
For additional information, refer to: [Driver Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).
4. Remove the driver side closing trim panel.
 - Release the clip.
 - Remove the 2 screws.
 - Disconnect the electrical connector.



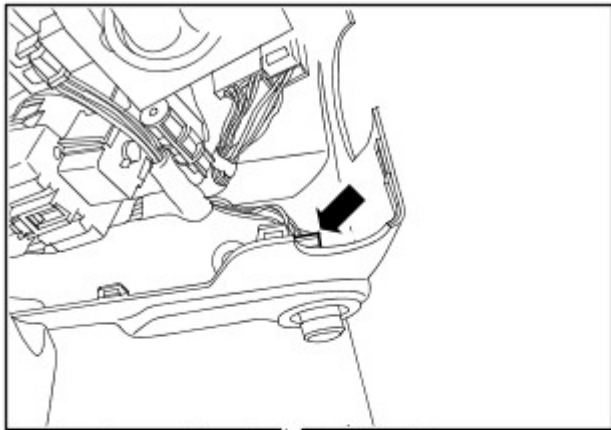
5. Remove the instrument panel access panel.
 - Release the 2 clips.





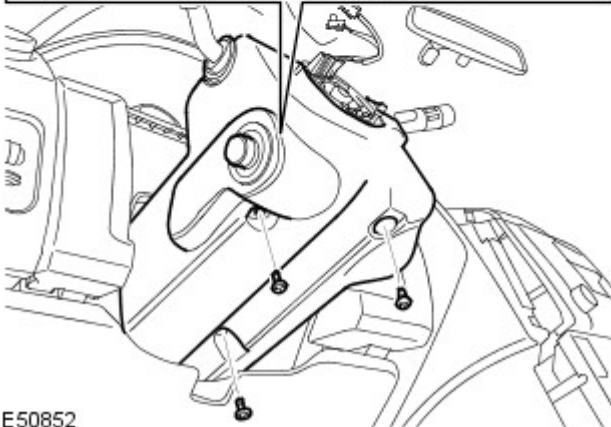
6. Remove the steering column upper shroud.

- Release the 6 clips.



7. Remove the steering column lower shroud.

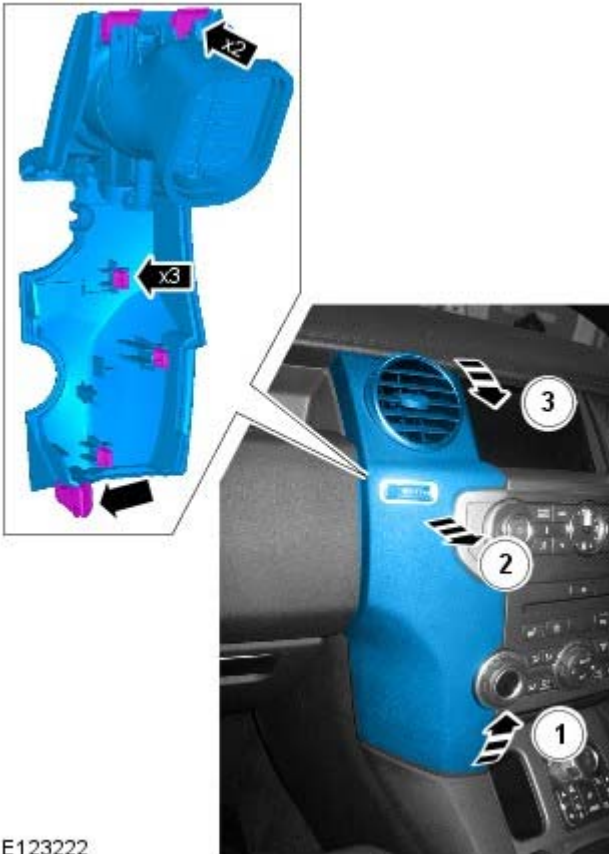
- Remove the 3 Torx screws.
- Disconnect the electrical connector.



E50852

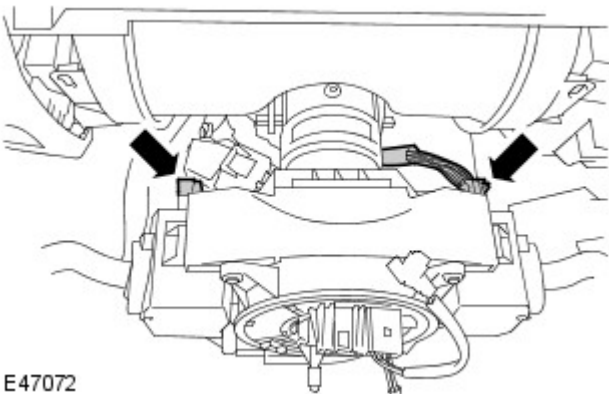
8. Remove the steering column side trim panel.

- Release the 4 clips.
- Disconnect 2 tabs.



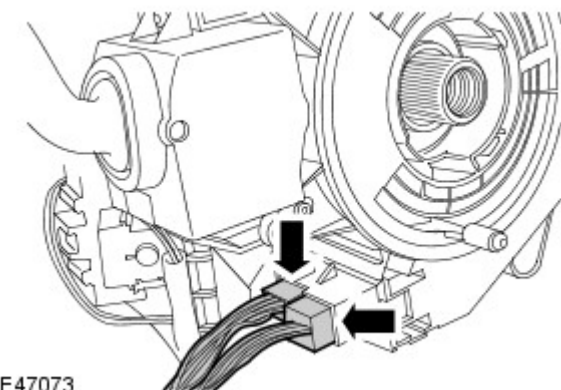
E123222

9. Disconnect the 2 electrical connectors from the steering column multifunction switches.



E47072

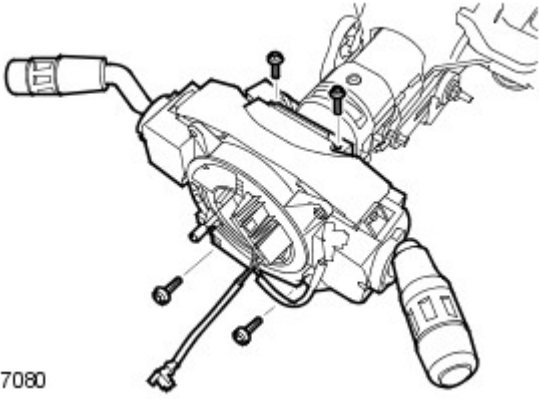
10. Disconnect the 2 electrical connectors from the clockspring.



E47073

11. Remove the steering column switch assembly.

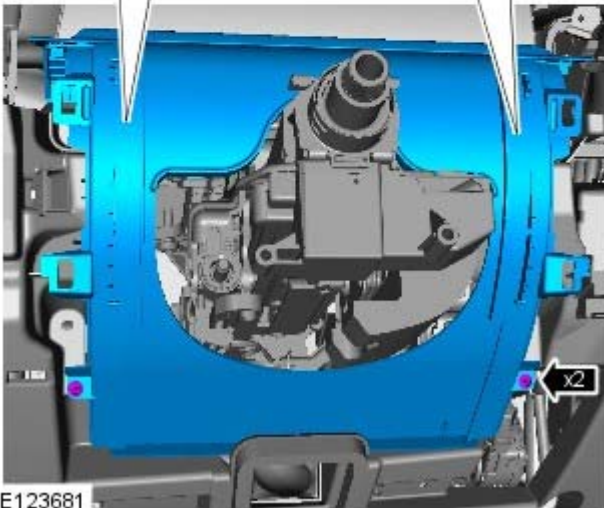
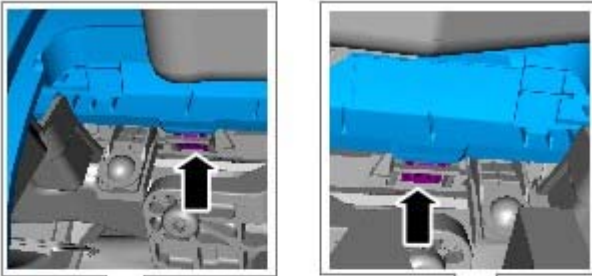
- Remove the 4 Torx bolts.



E47080

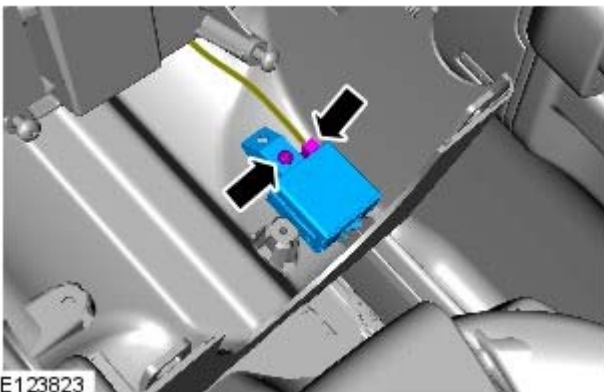
12. Remove the steering column gaiter panel.

- Remove the 2 Torx screws.
- Release the 2 clips.



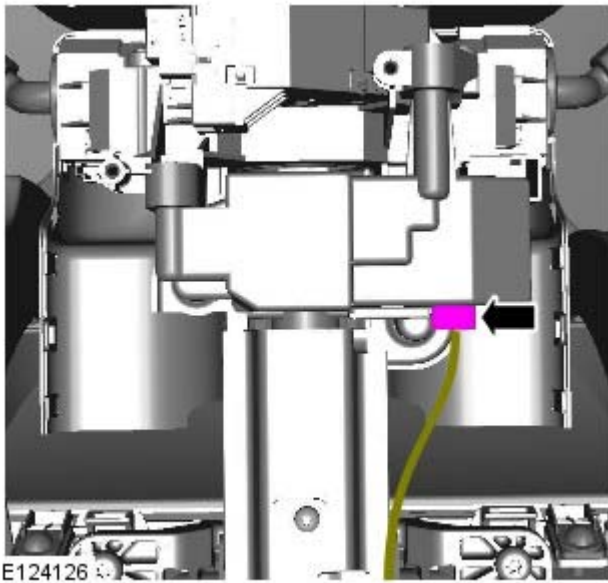
E123681

13. Disconnect the smart key antenna.



E123823

14. Disconnect the steering column lock electrical connector.



15. Disconnect the steering angle sensor electrical connector.



Vehicles with electric steering column

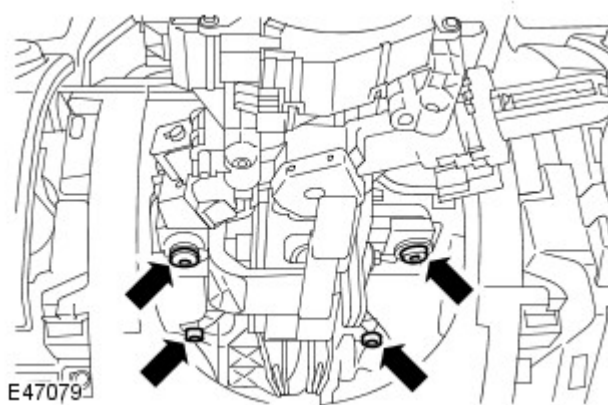
16. Disconnect the steering column adjustment motor electrical connector.







17. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.

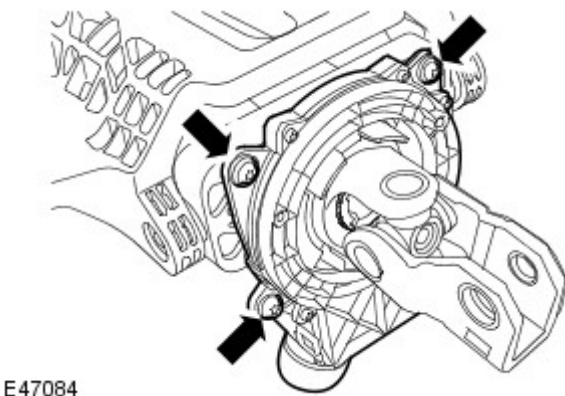


18.  **WARNING:** Take care if releasing the adjustment lever when the column has been removed from the vehicle. The spring is under a high tension, and if released, could cause personal injury. Make sure fingers are clear from any areas, likely to be trapped.

 **CAUTION:** If the steering angle sensor is damaged upon removal of the steering column, the sensor **MUST** be replaced.

With assistance, remove the steering column.

- Remove the 4 Torx bolts.




19. Remove the steering angle sensor.

- Remove the 3 Torx screws.

Installation

Vehicles with electric steering column

1.  **CAUTION:** The potentiometer adjustment values are unique for each steering column. Failure to enter the correct code during calibration may result in damage to the vehicle.

Note the potentiometer hexadecimal code on the new steering column label for future reference.



All vehicles

2. Install the steering angle sensor.

- Tighten the Torx screws to 3 Nm (2.2 lb.ft).

3. CAUTIONS:



Make sure the bolt holes are clean and free of swarf.



The steering column bolts must be tightened by hand a minimum of 3 revolutions.



Air tools MUST NOT be used on steering column bolts.

With assistance, install the steering column.

- Tighten the bolts in sequence to 25 Nm (18 lb.ft).

4. Connect the steering column intermediate shaft.

- Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).

5. Secure the wiring harness to the steering column.

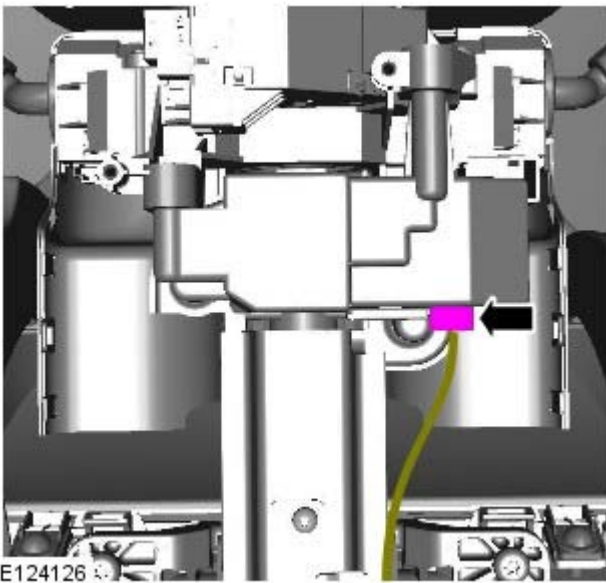
Vehicles with electric steering column

6. Connect the steering column adjustment motor electrical connector.

All vehicles

7. Connect the steering angle sensor electrical connector.

8. Connect the steering column lock electrical connector.



9. Connect the smart key antenna.

10. Install the steering column gaiter panel.

- Secure with the clips.
- Tighten the Torx screws.

11. Install the steering column switch assembly.

- Tighten the Torx bolts to 3 Nm (2 lb.ft).

12. Connect the clockspring and multifunction switch electrical connectors.

13. Install the steering column side trim panel.

- Secure with the clips.

14. Install the steering column shrouds.
15. Install the instrument panel access panel.
 - Secure with the clips.
16. Install the closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.
17. Install the steering wheel.

For additional information, refer to: [Steering Wheel](#) (211-04 Steering Column, Removal and Installation).
18. Install the drivers side register trim panel.

For additional information, refer to: [Driver Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).
19. Calibrate the steering angle sensor using the Land Rover approved diagnostic tool.

Vehicles with electric steering column

20. If a new electric steering column is fitted re-calibrate the steering column potentiometer using the Land Rover approved diagnostic system.

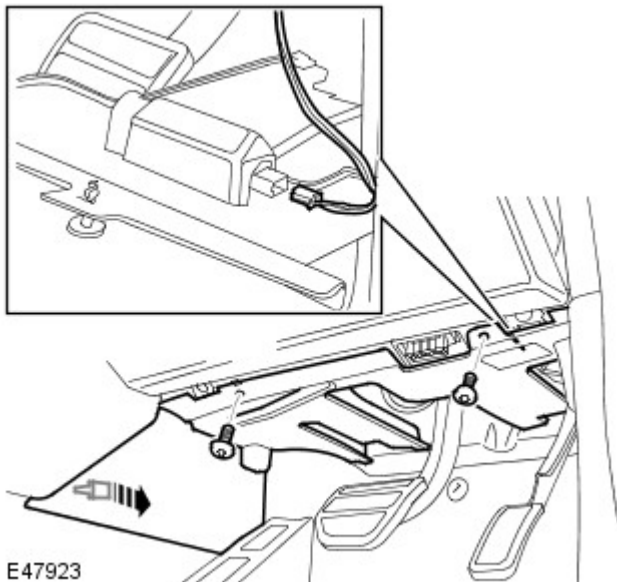
Steering Column - Steering Column Shaft

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the driver side closing trim panel.
 - Release the clip.
 - Remove the 2 screws.
 - Disconnect the electrical connector.



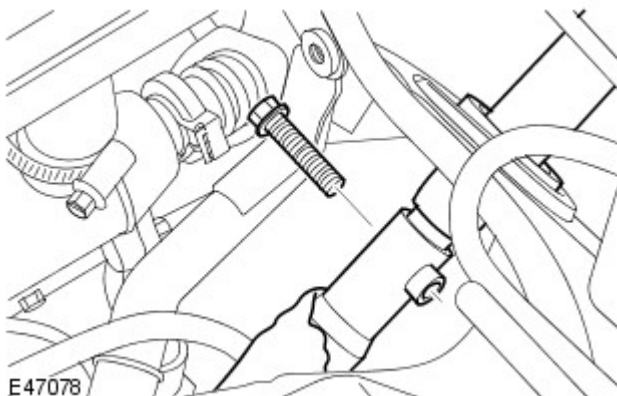
E47923

3. Disconnect the steering column intermediate shaft from the steering column.
 - Note the fitted position.
 - Remove the special bolt and discard the nut.



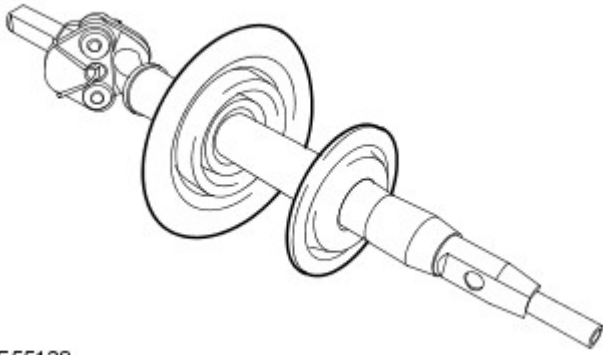
E49465

4. Disconnect the steering column intermediate shaft from the lower shaft.
 - Note the fitted position.
 - Remove and discard the bolt.



E47078

5. Remove the steering column intermediate shaft.
 - Release the 2 grommets.



E55128

6. NOTE: Do not disassemble further if the component is removed for access only.

• NOTE: Note the fitted position.

Remove the 2 intermediate shaft grommets.

Installation

1. Install the steering column intermediate shaft.
 - Install the grommets.
2. Connect the steering column intermediate shaft to the lower shaft.
 - Tighten the new bolt to 25 Nm (18 lb.ft).
3. Connect the steering column intermediate shaft to the steering column.
 - Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).
4. Install the driver side closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Steering Column - Steering Column Lower Shaft

Removal and Installation

Removal



CAUTION: Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Turn the steering wheel to the straight ahead position.

3. CAUTIONS:



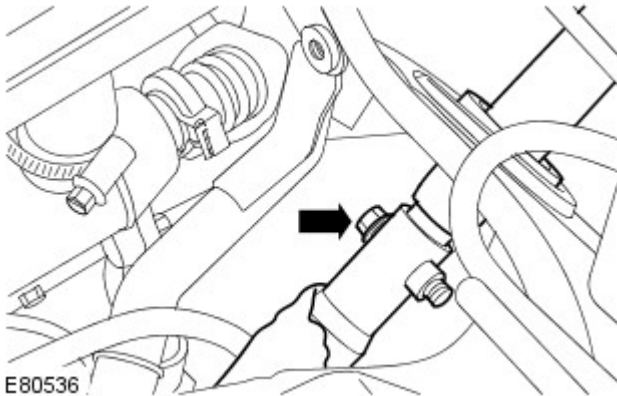
Make sure the steering wheel is in the straight ahead position.



Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

- **NOTE:** Note the fitted position.

Remove and discard the steering column lower shaft upper bolt.



4. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

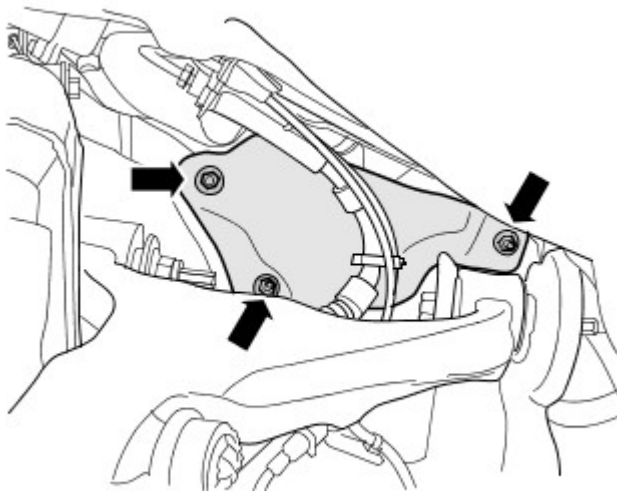
Raise and support the vehicle.



CAUTION: Make sure that the brake hose and the wiring harnesses are not damaged during the removal and installation of the heat shields.

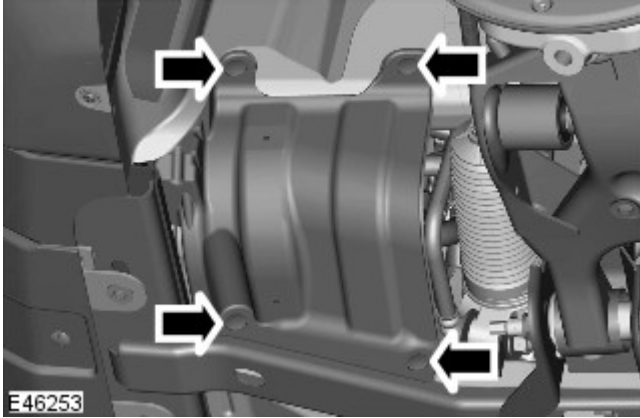
Remove the upper suspension arm heat shield for access.

- Remove the 3 nuts.




6. **CAUTION:** Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

Disconnect the steering column lower shaft from the intermediate shaft.

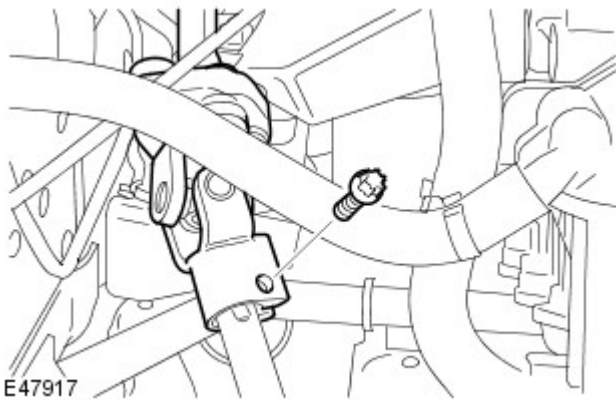



7. Remove the fender splash shield lower trim.

- Remove the 4 clips.

8.  CAUTION: Make sure that the steering is correctly positioned using the road wheels. Do not turn the steering wheel. Failure to follow this instruction may result in damage to the vehicle.

Turn the steering until access can be gained to the steering column lower shaft bolt.



9.  CAUTION: Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.


Remove and discard the steering column lower shaft bolt.

10. Remove the steering column lower shaft.

- Disconnect the steering column lower shaft from the steering gear.

Installation

1. Clean the component mating faces.

2.  CAUTION: Make sure that the road wheels are in the straight ahead position.

Install the steering column lower shaft.

- Connect the steering column lower shaft to the steering gear.
- Connect the steering column intermediate shaft to the lower shaft.

3. Lower the vehicle on the lift.

4.  CAUTION: Make sure that a new bolt is installed.

Install the steering column lower shaft upper bolt.

- Install a new bolt and tighten to 30 Nm (22 lb.ft).

5. Raise the vehicle on the lift.

6. CAUTIONS:

 Do not turn the steering wheel with the steering column

lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.



Make sure that the steering is correctly positioned using the road wheels. Do not turn the steering wheel. Failure to follow this instruction may result in damage to the vehicle.

Turn the steering until access can be gained to the steering column lower shaft bolt.

7. Install the steering column lower shaft to steering gear bolt.

- Install a new bolt and tighten to 30 Nm (22 lb.ft).

8. Install the fender splash shield lower trim.

- Install the 4 clips.

9. Install the upper suspension arm heat shield.

- Install the 3 nuts.

10. Lower the vehicle on the lift.


Steering Column - Steering Wheel

Removal and Installation

Removal

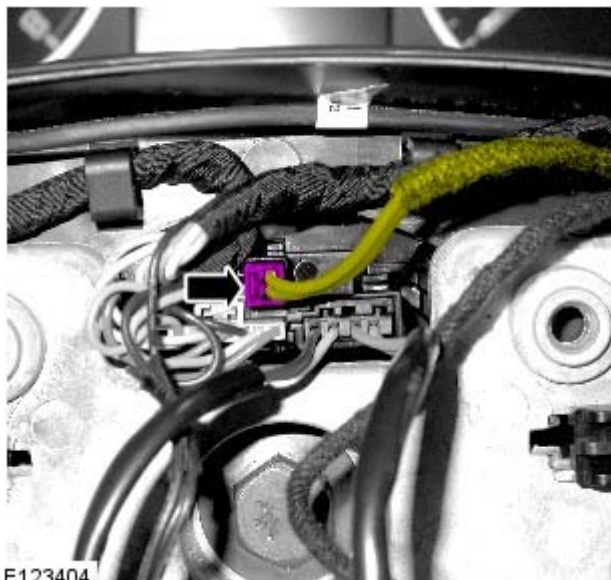
1. Refer to: [Important Safety Instructions](#) (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

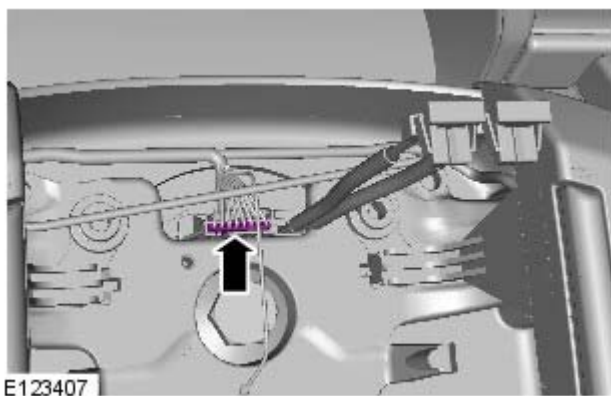
3.  **WARNING:** To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any air bag supplementary restraints system (SRS) components. To deplete the backup power supply energy, disconnect the battery ground cable and wait for one minute. Failure to follow this instruction may result in personal injury.

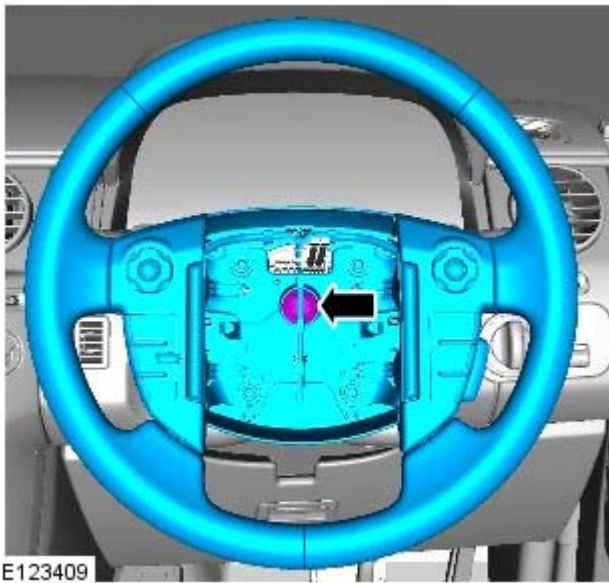
Refer to: [Driver Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).

4.



5.





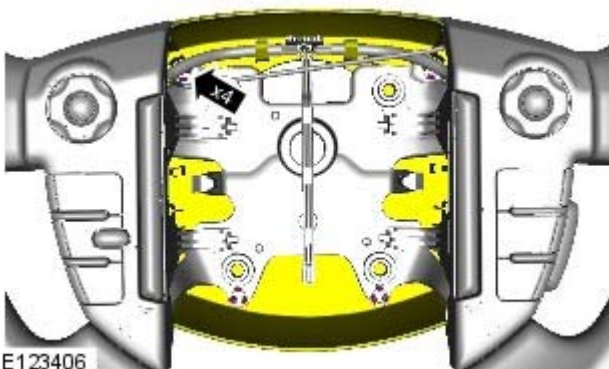
E123409

6. **NOTE:** Note the steering wheel to column alignment marks.



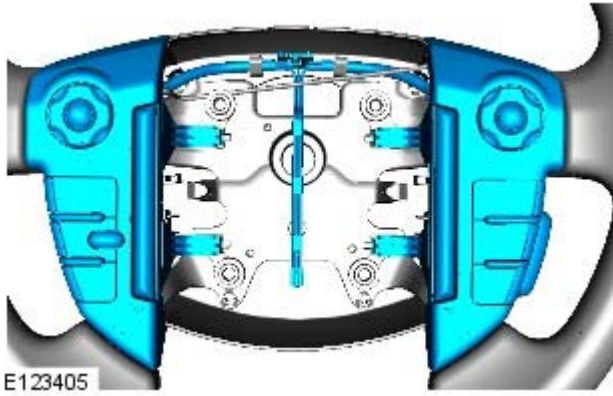
E123408

- 7.

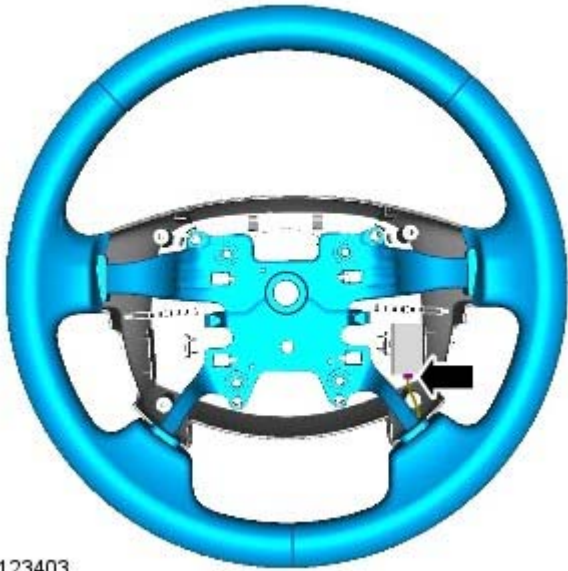


E123406

- 8.

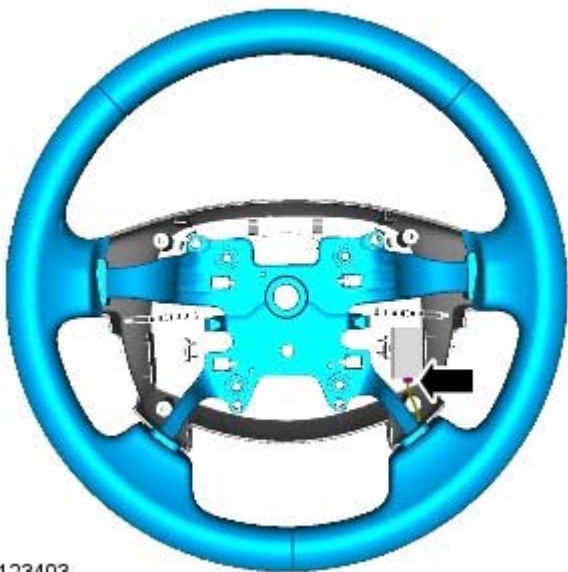


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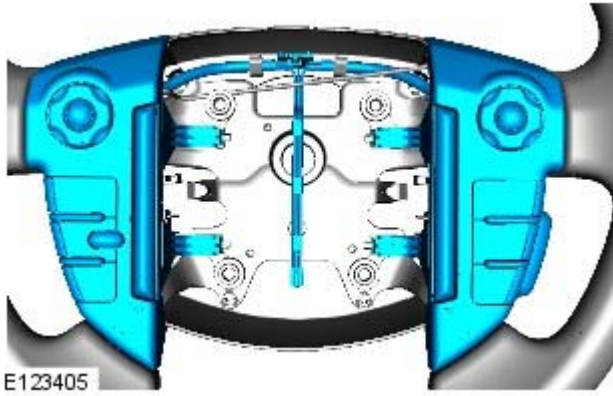


10.

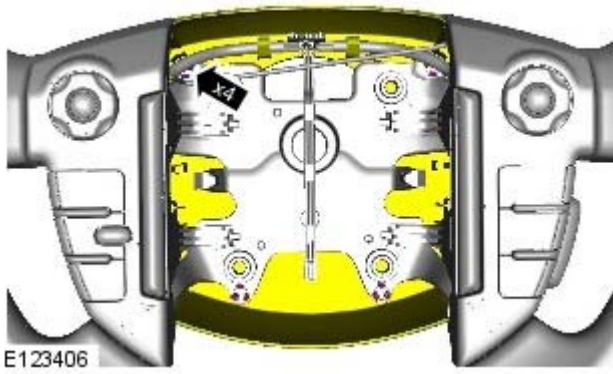
Installation



1.



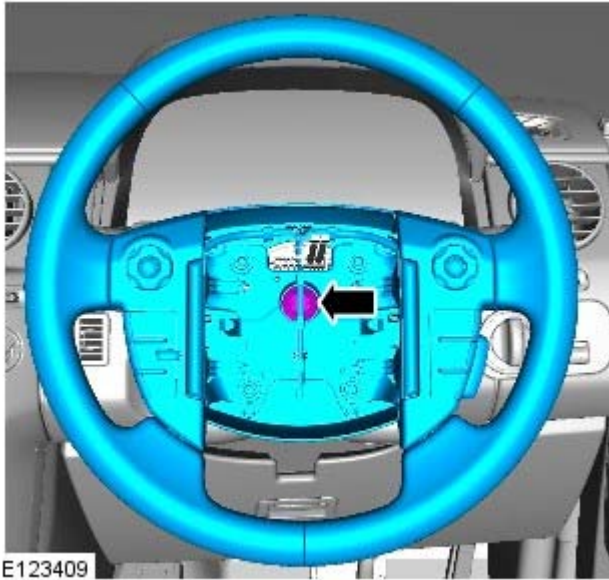
2.



3.

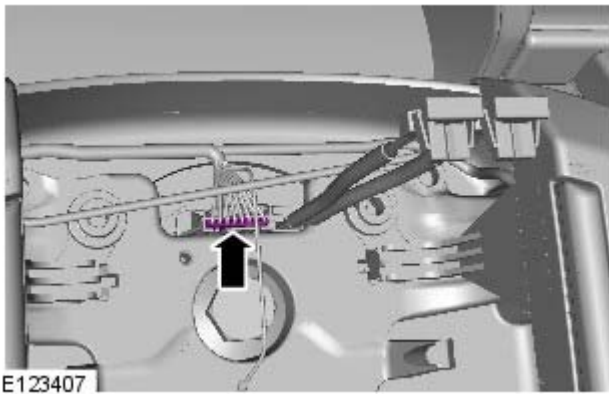


4. Torque: 6 Nm

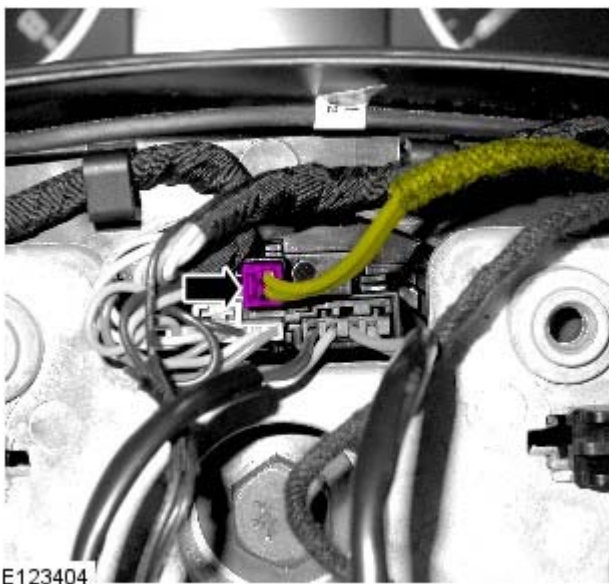


5. **NOTE:** Note the steering wheel to column alignment marks.

Torque: 63 Nm



- 6.



- 7.

8. Refer to: [Driver Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).

9. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System -

General Information, Specifications).

Steering Column Switches -

Torque Specifications

Description	Nm	lb-ft
Steering column switch Torx screws	3	2

Steering Column Switches - Steering Column Lock and Ignition Switch Housing

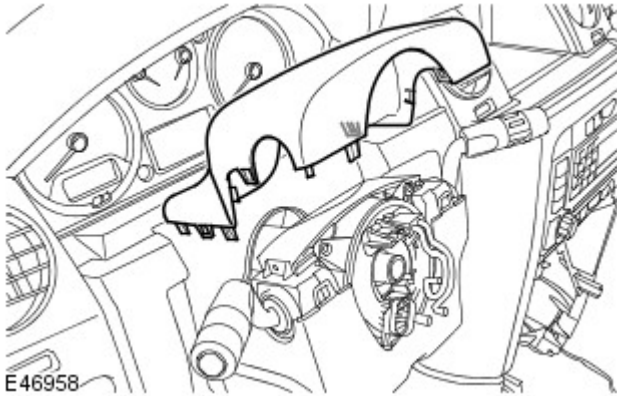
Removal and Installation

Removal

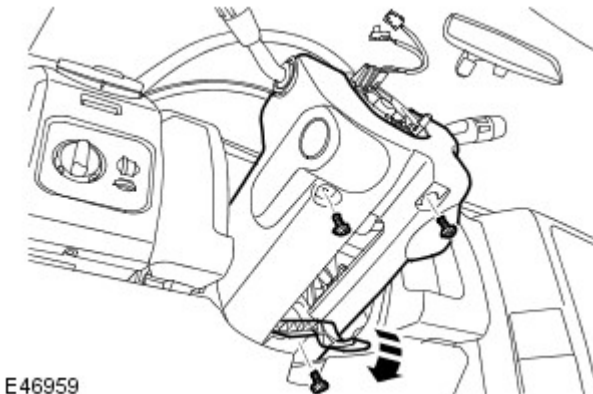


CAUTION: If the ignition lock cylinder and switch are both removed from the ignition switch assembly, the assembly shaft **MUST NOT** be rotated. Failure to comply will cause the incorrect operation of the lock, and the assembly must be replaced.

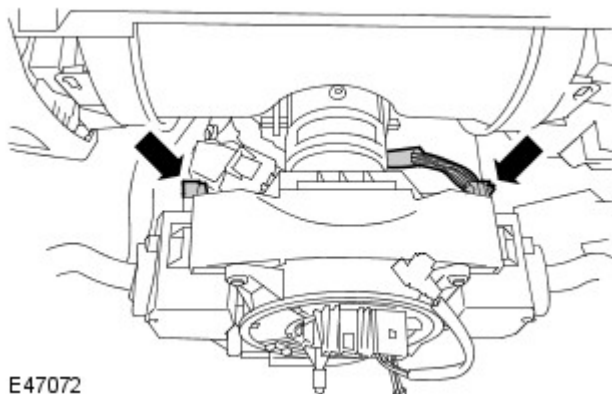
1. Fully extend the steering column for access.
2. Remove the steering wheel.
For additional information, refer to: Steering Wheel (211-04, Removal and Installation).
3. Remove the steering column upper shroud.
 - Release the 6 clips.



- Release the 6 clips.

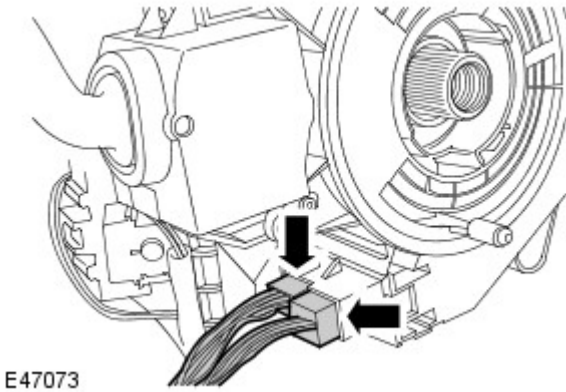


4. Remove the steering column lower shroud.
 - Remove the 3 Torx screws.
 - Release the steering column adjustment lever.



5. Disconnect the 2 electrical connectors from the steering column multifunction switches.

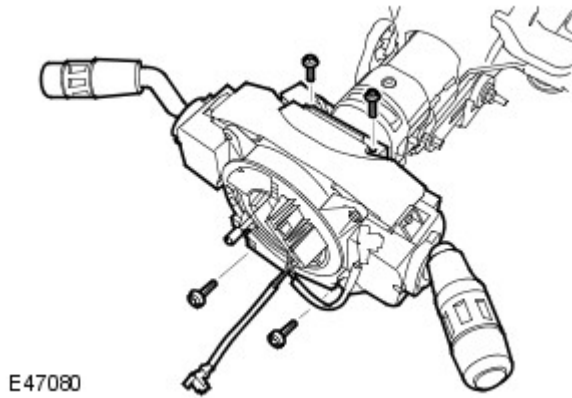
6. Disconnect the 2 electrical connectors from the clockspring.



E47073

7. Remove the steering column switch assembly.

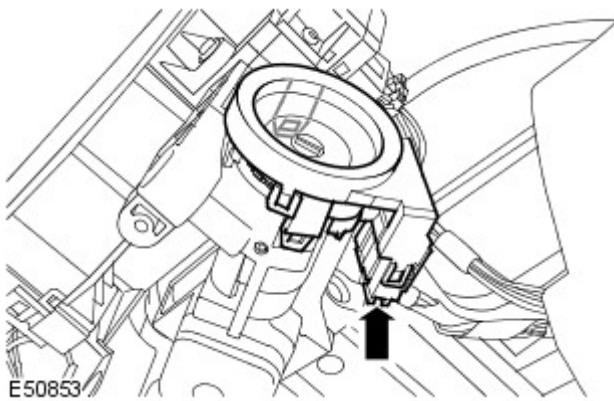
- Remove the 4 Torx bolts.



E47080

8. Remove the passive coil.

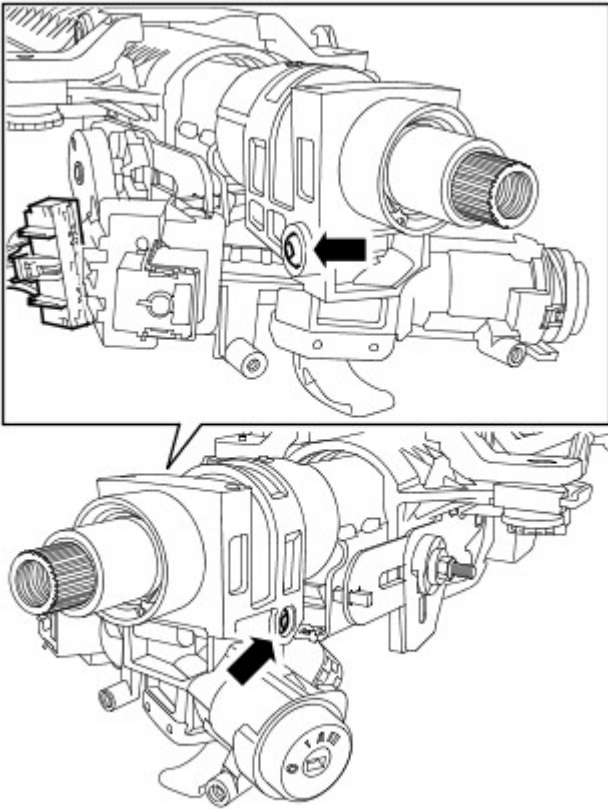
- Disconnect the electrical connector.
- Release the 2 clips.



E50853

9. Remove the ignition switch assembly.

- Remove and discard the 2 shear bolts.
- Disconnect the electrical connector.

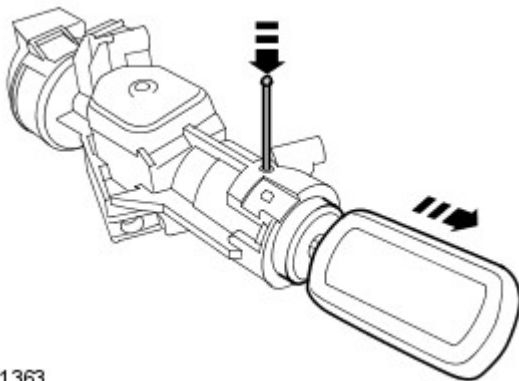


E50482

10. NOTE: Do not disassemble further if the component is removed for access only.

Remove the ignition lock cylinder.

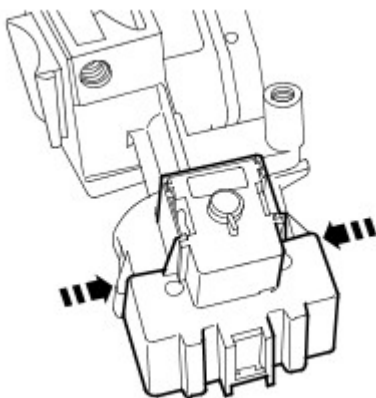
- Turn the ignition key to position 1.
- Insert a pin, not exceeding 2 mm diameter, through the access hole in the ignition lock cylinder housing to depress the plunger, and release the ignition lock cylinder.



E51363

11. Remove the ignition switch.

- Depress the 2 clips.



E51364

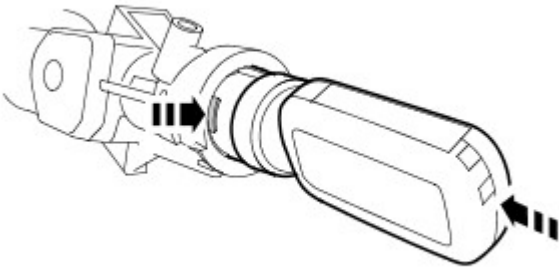
Installation

1. Install the ignition switch.

- Secure with the clips.

2. Install the ignition lock cylinder.

- Turn the ignition key to position 1.
- Locate into guides and depress the plunger.



E51372

3. Install the passive coil.

- Secure the clips.
- Connect the electrical connector.

4. Install the ignition switch assembly.

- Tighten the shear bolts until the heads shear off.
- Connect the electrical connector.

5. Install the steering column switch assembly.

- Tighten the Torx bolts to 3 Nm (2 lb.ft).

6. Connect the clockspring and multifunction switch electrical connectors.

7. Install the steering column shrouds.

8. Install the steering wheel.

For additional information, refer to: Steering Wheel (211-04, Removal and Installation).

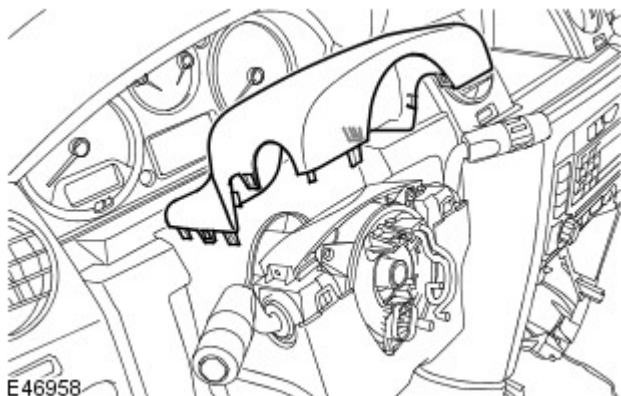
Steering Column Switches - Ignition Switch

Removal and Installation

Removal

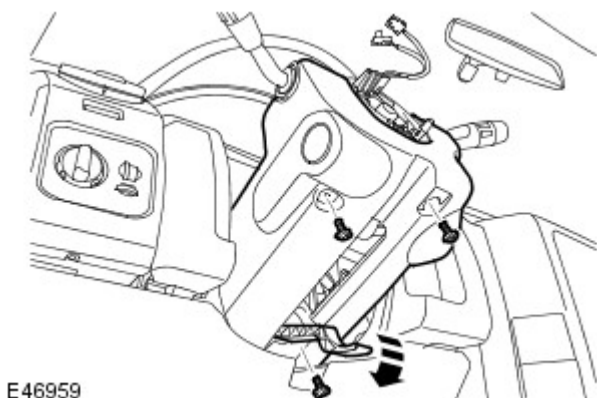
1. Fully extend the steering column for access.
2. Remove the steering column upper shroud.

- Release the 4 clips.



3. Remove the steering column lower shroud.

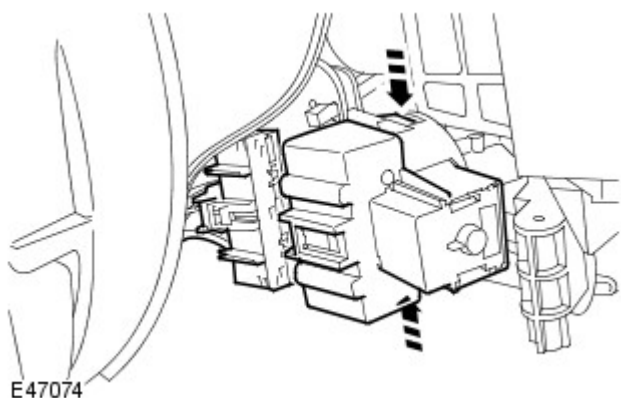
- Remove the 3 Torx screws.
- Release the steering column adjustment lever.



4.  **CAUTION:** The ignition key must be removed prior to the removal of the ignition switch.

Remove the ignition switch.

- Disconnect the electrical connector.
- Depress the 2 clips.



Installation

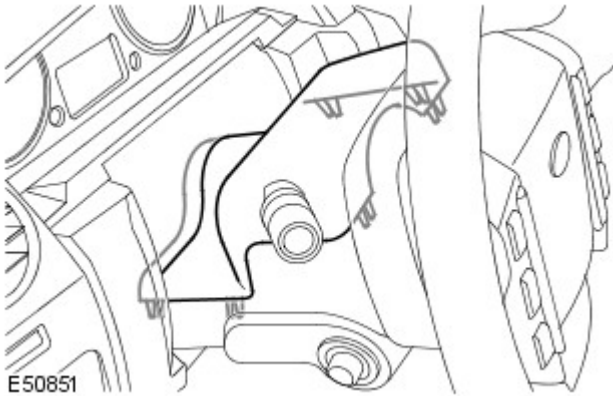
1. Install the ignition switch.
 - Secure with the clips.
 - Connect the electrical connector.
2. Install the steering column shrouds.
 - Tighten the Torx screws.
 - Secure the clips.
 - Secure the adjustment lever.

Steering Column Switches - Steering Column Multifunction Switch RH

Removal and Installation

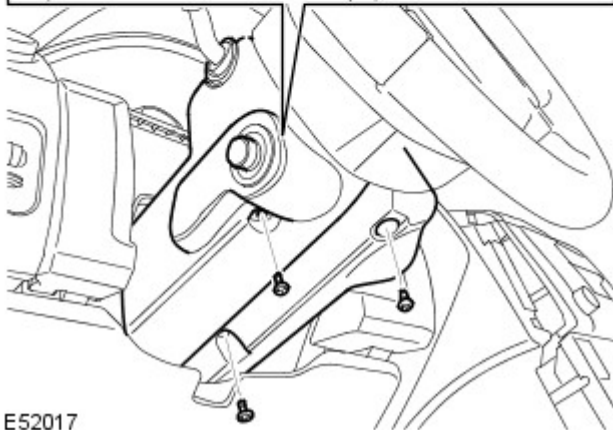
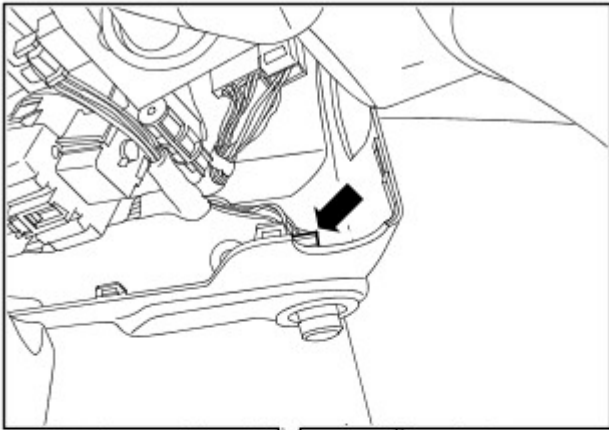
Removal

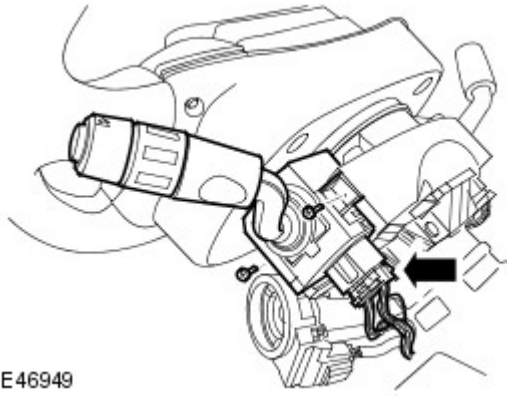
1. Fully extend the steering column for access.
2. Remove the steering column upper shroud.
 - Release the 6 clips.



3. Remove the steering column lower shroud.

- Remove the 3 Torx screws.
- Disconnect the electrical connector.





E46949

4. Remove the steering column multifunction switch.

- Disconnect the electrical connector.
- Remove the 2 screws.

Installation

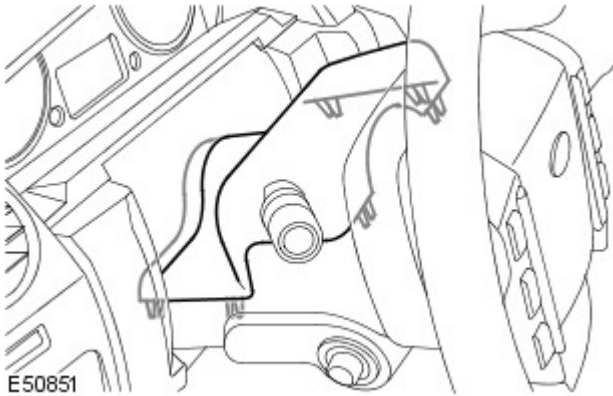
1. To install, reverse the removal procedure.

Steering Column Switches - Steering Column Multifunction Switch LH

Removal and Installation

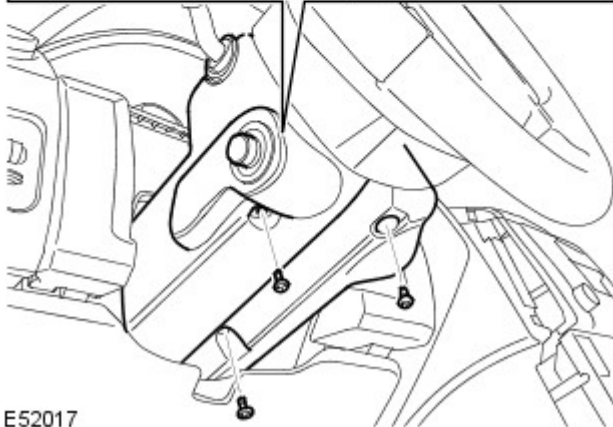
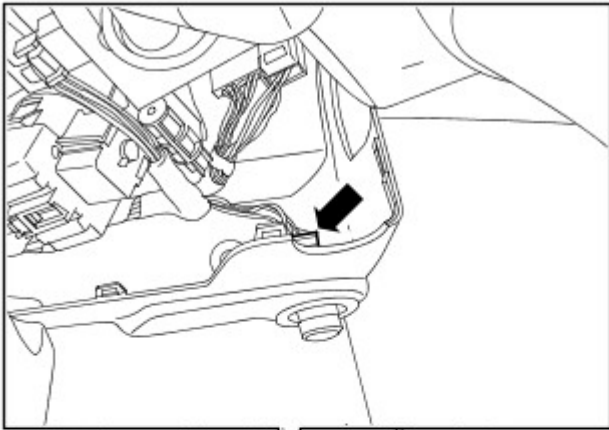
Removal

1. Fully extend the steering column for access.
2. Remove the steering column upper shroud.
 - Release the 6 clips.



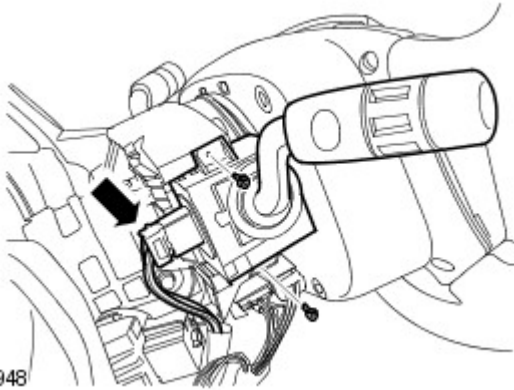
3. Remove the steering column lower shroud.

- Remove the 3 Torx screws.
- Disconnect the electrical connector.



4. Remove the steering column multifunction switch.

- Disconnect the electrical connector.
- Remove the 2 screws.



E46948

Installation

1. To install, reverse the removal procedure.

Engine System - General Information - Engine V6 4.0L Petrol

Diagnosis and Testing

Overview

Diagnosis of the different areas of the engine is covered in other specific sections of this workshop manual. This section is limited to an oil pressure test.

For a detailed description of the engine system and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.
3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

Engine Oil Pressure Test - 4.0L

• **NOTE:** Prior to checking the engine oil pressure, a road test of 6 miles (10 kilometres), must be carried out. Do not attempt to attain engine normal operating temperature by allowing the engine to idle.

1. **1.** Disconnect the battery ground cable.
2. • **WARNINGS:**

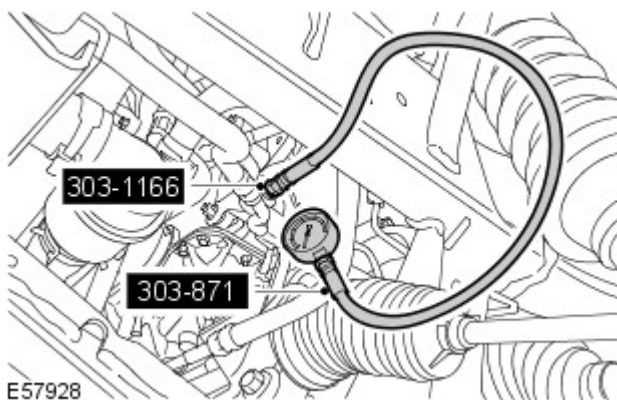


The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.



Wear protective gloves.

2. **2.** Remove the engine oil pressure sensor.
REFER to: [Engine Oil Pressure \(EOP\) Sensor](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Removal and Installation).
3. **3.** Install the special tool.
4. **4.** Install the special tool gauge and tighten the union.



5. **5.** Check and top-up the engine oil if required.
6. **6.** Connect the battery ground cable.
7. **7.** Start and run the engine.
8. **8.** Note the oil pressure readings with the engine running at idle and 3500 RPM.
REFER to: [Specifications](#) (303-01C Engine - V6 4.0L Petrol, Specifications).
9. **9.** Turn off the engine.
10. **10.** Disconnect the battery ground cable.
11. **11.** Remove the special tools.
 1. Clean the components.
12. **12.** Install the oil pressure sensor.
REFER to: [Engine Oil Pressure \(EOP\) Sensor](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Removal and Installation).
13. **13.** Check and top-up the engine oil if required.

14. **14.** Connect the battery ground cable.

Engine System - General Information - EngineTDV6 2.7L Diesel

Diagnosis and Testing

Overview

Diagnosis of the different areas of the engine is covered in other specific sections of this workshop manual. This section is limited to an oil pressure test.

For a detailed description of the engine system and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Engine oil level ● Coolant level ● Transmission fluid level ● Fuel level ● Coolant leaks ● Oil leaks ● Fuel leaks ● Visibly damaged or worn parts ● Loose or missing nuts or bolts ● Fuel contamination/grade/quality ● Sensor fitment/condition ● Viscous fan and solenoid

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. Use the approved diagnostic system or a scan tool to retrieve any diagnostic trouble codes (DTCs) before carrying out the following procedure.
 - Make sure that all DTCs are cleared following rectification.

Oil Pressure check

• **NOTE:** Prior to checking the engine oil pressure, a road test of 6 miles (10 kilometers), must be carried out. Do not attempt to attain engine normal operating temperature by allowing the engine to idle.

1. • **WARNINGS:**

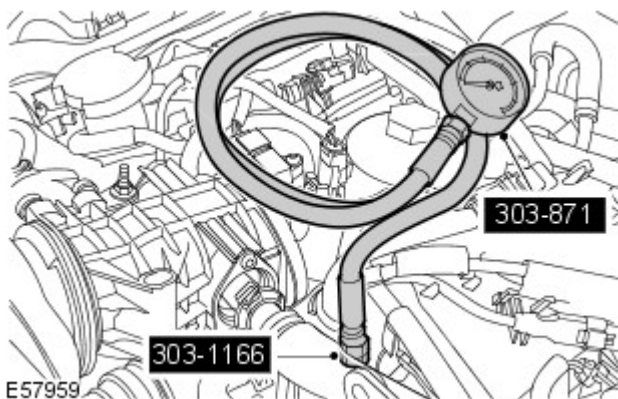


The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.



Wear protective gloves.

1. 1. Remove the oil pressure sensor.
REFER to: [Engine Oil Pressure \(EOP\) Sensor](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Removal and Installation).
2. 2. Install the special tool to the oil filter housing.
3. 3. Install the special tool gauge and tighten the union.



4. 4. Check and top-up the engine oil, if required.

5. **5.** Start and run the engine.
6. **6.** Note the oil pressure readings with the engine running at idle and 3500 RPM.
REFER to: [Specifications](#) (303-01A Engine - TDV6 2.7L Diesel, Specifications).
7. **7.** Turn off the engine.
8. **8.** Remove the special tools.
9. **9.** Install the oil pressure sensor.
REFER to: [Engine Oil Pressure \(EOP\) Sensor](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Removal and Installation).
10. **10.** Check and top-up the engine oil, if required.

Engine System - General Information - EngineTDV6 3.0L Diesel

Diagnosis and Testing

Principle of Operation

For a detailed description of the 3.0L Diesel engine, refer to the relevant Description and Operation section in the workshop manual. REFER to: (303-01B Engine - TDV6 3.0L Diesel)

[Engine](#) (Description and Operation),
[Engine](#) (Description and Operation),
[Engine](#) (Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ○ Coolant level ○ Coolant leaks ○ Oil level ○ Oil leaks ○ Visibly damaged or worn parts ○ Loose or missing nuts or bolts 	<ul style="list-style-type: none"> ○ Wiring harness ○ Electrical connector(s) ○ Injectors ○ Glow plugs ○ 5 volt sensor supply ○ Sensor(s) ○ Cooling fan control module and motor ○ Engine Control Module (ECM)

2. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
3. If the concern is not visually evident, verify the symptom and refer to the relevant Symptom Chart. Symptom Charts have been separated into **Leaks** and **Noise Vibration and Harshness (NVH)** for ease of use. Alternatively, check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Charts

Symptom Chart, Leaks

Symptom	Possible Cause	Action
External coolant leaks	<ul style="list-style-type: none"> ● Damaged hose(s) ● Damaged expansion tank ● Damaged radiator ● Leaking seals/gaskets ● Cracked/damaged casings 	Check cooling system.
Internal coolant leaks Note: This may be indicated by the production of white smoke from the exhaust	<ul style="list-style-type: none"> ● Leaking seals/gaskets ● Cracked/damaged casings 	Check cooling system.
Engine overheats	<ul style="list-style-type: none"> ● Insufficient coolant ● Insufficient oil ● Pressure cap fault ● Thermostat not opening ● Coolant pump failure ● Cooling fan failure 	Check cooling system.
Engine takes too long to reach operating temperature	<ul style="list-style-type: none"> ● Thermostat stuck open 	Check cooling system.
External oil leaks	<ul style="list-style-type: none"> ● Gaskets ● Seals ● Oil pipes ● Oil filter ● Oil cooler ● Damaged/cracked casings ● Crankcase ventilation system ● Piston ring blow-by 	Clean and confirm the area of the leak. Check the visual condition of oil carrying components. Check the crankcase ventilation system. Carry out a compression test, GO to Pinpoint Test A .
Internal oil leaks (leaks into coolant or combustion chamber) Note: This may be indicated by the production of blue smoke from the exhaust	<ul style="list-style-type: none"> ● Gaskets ● Seals ● Damaged/cracked casings ● Worn valve guides 	Check for traces of oil in the coolant. Check for evidence of oil in the combustion chambers (deposits on the glow plugs, etc). Confirm oil consumption and vehicle usage with the owner/driver. Carry out an oil consumption test, GO to Pinpoint Test B .

Symptom	Possible Cause	Action
	<ul style="list-style-type: none"> Worn cylinder bores/pistons Broken piston rings 	

Symptom Chart, NVH

• NOTE: As the checks suggested here are open to interpretation, they should be used as a guide only. Descriptions of noises, etc, are in general terms, so depend on a degree of experience on the part of the technician.


Symptom	Possible Cause	Action
Rattle/ticking from top of engine	<ul style="list-style-type: none"> Valve gear noise Camshaft bearing noise Camshaft chain noise Tensioner noise Vacuum pump noise High pressure fuel pump noise 	Check the engine oil pressure, GO to Pinpoint Test C... . Check the function of the hydraulic tappets and the camshaft condition. Check the camshaft bearings, chains and tensioners. Check the vacuum pump, and high pressure fuel pump
Growl from top of engine	<ul style="list-style-type: none"> High pressure fuel pump belt noise High pressure fuel pump belt tensioner noise 	Check the high pressure fuel pump belt and tensioner
Squeaking/Creaking/Squeal from front of engine	<ul style="list-style-type: none"> Front End Accessory Drive (FEAD) belt FEAD belt tensioner Driven components on FEAD belt 	Check the FEAD belt and driven components.
Whine/Slap/Growl from front of engine	<ul style="list-style-type: none"> Front End Accessory Drive (FEAD) belt FEAD belt tensioner Driven components on FEAD belt Timing belt noise Timing belt tensioner noise 	Check the FEAD belt and driven components. Check the timing belt and tensioners
Knock from lower half of engine (often worse with a cold engine)	<ul style="list-style-type: none"> Piston slap Piston pin noise Connecting rod bearing noise 	Check the engine oil pressure, GO to Pinpoint Test C... . Check piston, cylinder bore, piston pin and connecting rod bearing for excess wear
Knock/Rumble from lower half of engine (often worse on overrun)	<ul style="list-style-type: none"> Main bearing noise 	Check the engine oil pressure, GO to Pinpoint Test C... . Check connecting rod bearing for excess wear
Misfire/Rough running	<ul style="list-style-type: none"> Engine management system Fuel charging and controls Exhaust gas recirculation (EGR) system Burnt/sticking valves Worn valve guides Worn cylinder bores/pistons Broken piston rings Damaged/cracked casings 	Check engine management and fuel charging and controls systems for failure. Check EGR system for failures. Carry out a compression test, GO to Pinpoint Test A... Check for excess wear in engine components

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Pinpoint Tests

• NOTE: Where reference is made to 'suitable equipment', this refers to standard workshop equipment. Refer to the operating instructions for your own equipment when performing any tests.

PINPOINT TEST A : CHECK THE CYLINDER COMPRESSIONS	
 WARNING: Only compression testers able to read the higher compression pressures found in diesel engines should be used. Failure to follow this instruction may result in personal injury.	
• NOTE: Where possible, compression testing should be carried out on an engine at operating temperature.	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: CARRY OUT A DRY CYLINDER COMPRESSION TEST	
1	Make sure the parking brake is applied and that the selector lever is in park.
2	Set the ignition status to OFF .

3	Remove the starter relay.
4	Disconnect the starter motor solenoid connector.
5	Connect a suitable remote starter device to the starter motor solenoid.
6	Remove the glow plugs.
7	Install adaptor 303-1131 in place of the glow plug in the first cylinder to be tested.
8	Connect a suitable compression tester to the adaptor. See warning above.
9	Using the remote starter device, crank the engine a minimum of five revolutions.
10	Record the compression figure and the number of revolutions taken to reach it.
11	Repeat steps 7 - 10 above for the remaining cylinders, cranking the engine for a similar number of revolutions each time.
12	Compare the compression figures across all the cylinders.
	Are the compression figures within 10% of each other? Yes Unless the compression figures are universally very low (experience will indicate this), check for other causes for the customer complaint. No GO to A2.

A2: CARRY OUT A WET CYLINDER COMPRESSION TEST

 **CAUTION:** If engine oil is introduced into the cylinders, run the engine at 2,000 rpm for a minimum of ten minutes after completing testing to prevent damage to the catalytic converters. Failure to follow this instruction may result in damage to the vehicle.

• **NOTE:** There is a combustion chamber in the top of each piston. Make sure that the oil is not allowed to run into this chamber.

1	Using a suitable oil can with a flexible spout, introduce a small amount of clean engine oil into the cylinder just before testing, such that the oil is able to run between the piston and the cylinder bore.
2	Repeat steps 7 - 10 from the test above, introducing oil into each cylinder just before testing.
3	Compare the compression figures across all the cylinders.
	Is the compression figure higher than the dry test? Yes A higher figure following the introduction of oil may indicate a worn or damaged cylinder bore, piston and/or piston rings. Disassembly would be required to confirm this. No If the compression figure is unaffected by the introduction of oil, but the figure is still less than 90% of the other cylinders, this may indicate a burnt and/or sticking valve, leaking head gasket, etc. Disassembly would be required to confirm this. Clear any DTCs which may have been induced by the test.

PINPOINT TEST B : OIL CONSUMPTION TEST

• **NOTE:** Oil consumption will vary, depending on a number of factors. New engines will normally use more oil than 'run-in' engines, although a guideline would be to expect 16,000 Km (10,000 miles) per liter.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: CHECK FOR EXCESSIVE OIL CONSUMPTION	
1	Start the engine and allow it to run until it reaches normal operating temperature.
2	Make sure the vehicle is parked on a level surface and set ignition status to OFF .
3	Allow to settle for at least five minutes.
4	Check the oil level.
5	Correct the level, if necessary, and record the reading and mileage in the vehicle history.
6	Make sure that the owner/driver is aware that a test is being carried out, and that they should not top-up their oil level for the duration of the test, but should check the level every 160-240 Km (100-150 miles).
7	When the oil level reaches the ADD mark, the customer should bring the vehicle in to be checked.
8	Top-up the oil to the level at the beginning of the test and record the amount of oil needed to do so, and the mileage covered in the course of the test.
9	From this, the consumption can be calculated, and a decision made as to whether or not the consumption is considered excessive.
	Is the consumption excessive for the mileage and/or use? Yes Disassembly will be required to check the components indicated in the symptom chart. No No further action is required.

PINPOINT TEST C : CHECK THE ENGINE OIL PRESSURE

• **NOTE:** Check and, if necessary, top-up the engine oil level before beginning this test.



• **NOTE:** Where reference is made to 'suitable equipment', this refers to standard workshop equipment. Refer to the operating instructions for your own equipment when performing any tests.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: CHECK FOR LOW ENGINE OIL PRESSURE	
1	Remove the oil pressure sensor.
2	Connect a suitable oil pressure gauge in place of the oil pressure sensor.
3	Start the engine and check for leaks at the gauge connection.
4	Allow the engine to idle and monitor the oil pressure.
5	Raise the engine speed to 2,500 rpm and monitor the oil pressure.

	<p>Is the oil pressure less than 0.50 bar (7.25 psi) between idle and 2,500 rpm?</p> <p>Yes GO to C2.</p> <p>No GO to C3.</p>
C2: CHECK FOR LOW ENGINE OIL PRESSURE AT ENGINE SPEEDS GREATER THAN 2,500 RPM	
	<p>1 Raise the engine speed to above 2,500 rpm and monitor the oil pressure.</p>
	<p>Is the oil pressure less than 1.0 bar (14.5 psi) at engine speeds greater than 2,500 rpm?</p> <p>Yes Pressure this low may indicate a problem with: oil pump, filtering, clearances within the engine. Check if there are any other indications of engine faults (noise, etc), refer to the symptom chart above.</p> <p>No GO to C3.</p>
C3: CHECK FOR HIGH ENGINE OIL PRESSURE	
	<p>1 Monitor the engine oil pressure at varying engine speeds.</p>
	<p>Does the oil pressure reach 4.0 bar (58 psi)?</p> <p>Yes Pressure this high may indicate a blockage in the lubrication system. If this is not resolved, high oil pressure will lead to engine oil leaks and other failures.</p> <p>No If the oil pressure stays in the band between 0.50 bar (7.25 psi) and 1.0 bar (14.5 psi) this would be considered normal.</p>

Engine System - General Information - Engine V8 5.0L Petrol

Diagnosis and Testing

Special Tool(s)	
 <p>303-1451</p> <p>E136285</p>	Oil pressure testing adaptor, 303-1451
 <p>303-871</p> <p>E57919</p>	Oil pressure testing gauge, 303-871

Principle of Operation

For a detailed description of the 5.0L engine, refer to the relevant Description and Operation sections in the workshop manual. REFER to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Description and Operation).

Inspection and Verification

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> <input type="checkbox"/> Coolant leaks <input type="checkbox"/> Oil leaks <input type="checkbox"/> Leaks in the fuel system <input type="checkbox"/> Visibly damaged or worn parts <input type="checkbox"/> Loose or missing fixings 	<ul style="list-style-type: none"> <input type="checkbox"/> Fuses <input type="checkbox"/> Loose or corroded electrical connectors <input type="checkbox"/> Harnesses <input type="checkbox"/> Sensors

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

• NOTE: If an engine is suspect, and the vehicle remains under the Manufacturers warranty refer to the Warranty Policy and Procedure manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new engine.

• NOTE: Due to the possibility of loose carbon, that has become trapped between the valve face and seat, effecting the pressure readings, when carrying out a compression test and some cylinders are found to have low pressures, install the spark plugs, road test the vehicle and re-test the suspect cylinders. If the correct pressures are restored, no further action is required.

Symptom	Action
All engine related issues	<ul style="list-style-type: none"> ● Check ECM for Diagnostic Trouble Codes (DTCs) and refer to DTC Index.
Difficult to start hot and cold	<ul style="list-style-type: none"> ● Carry out general engine checks: <ul style="list-style-type: none"> - Compression test. Refer to component tests in this section. - Valve clearances - Spark plug condition and color
Poor idle	<ul style="list-style-type: none"> ● Ensure the air intake system is free from leaks ● Carry out general engine checks: <ul style="list-style-type: none"> - Compression test. Refer to component tests in this section. - Valve clearances - Spark plug condition and color ● Check for collapsed catalytic converter/blocked exhaust system ● Check long and short term fuel trim datalogger signals <ul style="list-style-type: none"> - Readings up to 10%: may be considered as acceptable if the readings are equal bank to bank - Positive readings of between 10-20%: check for air leaks in air intake system - Negative readings of between 10-20%: check for over fuelling e.g. leaking

Symptom	Action
	injectors, high fuel pressure - Readings above 20%: check for DTCs and refer to DTC Index. ● Carry out a vacuum gauge check. Refer to component tests in this section
Insufficient power/Insufficient compression	● Ensure the air intake system is free from leaks ● Carry out general engine checks: - Compression test. Refer to component tests in this section. - Valve clearances - Spark plug condition and color ● Check for collapsed catalytic converter/blocked exhaust system ● Check long and short term fuel trim datalogger signals - Readings up to 10%: may be considered as acceptable if the readings are equal bank to bank - Positive readings of between 10-20%: check for air leaks in air intake system - Negative readings of between 10-20%: check for over fuelling e.g. leaking injectors, high fuel pressure - Readings above 20%: check for DTCs and refer to DTC Index. ● Carry out a vacuum gauge check. Refer to component tests in this section
Oil consumption	● Carry out oil leak check followed by an oil consumption test. Refer to the component tests in this section ● If oil consumption is excessive: ● Check the integrity of the engine breather system ● Carry out general engine checks: - Compression test. Refer to component tests in this section. - Valve clearances - Spark plug condition and color
Noise	● Refer to the Special Service Messages on the Electronic Product Quality Report (EPQR) system for sound files. If the symptom does NOT compare to any of the sound files, contact Dealer Technical Support (DTS)

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - V8 5.0L Petrol, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Component Tests

Engine Oil Leaks

- NOTE: Before installing new gaskets or oil seals, make sure that the fault is clearly established.

If the oil leak cannot be identified clearly by a visual inspection, carry out an Ultraviolet test:

Fluorescent Oil Additive Method

1. Clean the engine with a suitable cleaning fluid (brake cleaner).
2. Drain the engine oil and refill with recommended oil, premixed with Diesel Engine Oil Dye or equivalent. Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines. If oil is not premixed, fluorescent additive must first be added to the crankcase.
3. Run engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using a 12 Volt Master UV Diagnostic Inspection Kit or equivalent. A clear bright yellow or orange area will identify leak. For extremely small leaks, several hours may be required for the leak to appear.
4. As necessary, pressurize the main oil gallery system to locate leaks due to incorrectly sealed, loose or cocked plugs. If the flywheel bolts leak oil, look for sealer on the threads.
5. Repair all leaks as necessary.

Compression Test

General Remarks

• NOTE: Removing fuses and disconnecting electrical components may cause the Engine Control Module (ECM) to log Diagnostic Trouble Codes (DTCs). After the measurements have been carried out, DTCs should be cleared from memory by connecting to the Manufacturer Approved Diagnostic System.

- NOTE: Only check the compression pressure with the valves set to the prescribed clearance (if this can be adjusted).

The compression pressure should be checked with the engine at normal operating temperature.

Check the Compression Pressure



WARNING: Move gear selector lever to 'P' position. Failure to follow this instruction may result in personal injury.

1. Remove the fuel pump relay.

2. **2.** Start the engine - the engine will start, run for a few seconds then stall.
3. **3.** Remove the spark plugs.
4. **4.** Install the compression tester.
5. **5.** Install an auxiliary starter switch in the starting circuit. With the ignition switch OFF, using the auxiliary starter switch, crank the engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes required to obtain the highest reading.
6. **6.** Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.
7. **7.** Install the removed components in reverse order, observing the specified tightening torques.
8. **8.** Clear all DTCs from the ECM.

Interpretation of the Results

• **NOTE:** Due to the possibility of loose carbon that has become trapped between the valve face and seat effecting the pressure readings, when carrying out a compression test and cylinders are found to have low pressures, install the spark plugs, road test the vehicle and re-test the suspect cylinders. If the correct pressures are restored, no further action is required.

The indicated compression pressures are considered within specification if the lowest reading cylinder is within 75% of the highest reading.

If the cylinder pressures are found to be low, carry out a leakdown test to determine the location of the fault (if any leakback can be heard through the engine breather system suspect the piston rings, if any leakback can be heard through the inlet system suspect the inlet valve or seat, if any leakback can be heard through the exhaust manifold suspect the exhaust valve or seat. If the measurements for two cylinders next to each other are both too low then it is very likely that the cylinder head gasket between them is burnt through. This can also be recognized by traces of engine oil in the coolant and/or coolant in the engine oil).

Oil Consumption Test

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 16,100 km (10,000 miles) when a new engine is being broken in or until certain internal components become conditioned. Vehicles used in heavy-duty operation may use more oil. The following are examples of heavy-duty operation:

- Trailer towing applications
- Severe loading applications
- Sustained high speed operation

Engines need oil to lubricate the following internal components:

- Cylinder block cylinder walls
- Pistons and piston rings
- Intake and exhaust valve stems
- Intake and exhaust valve guides
- All internal engine components

When the pistons move downward, a thin film of oil is left on the cylinder walls. As the vehicle is operated, some oil is also drawn into the combustion chambers past the intake and exhaust valve stem seals and burned.

The following are examples of conditions that can affect oil consumption rates:

- Engine size
- Operator driving habits
- Ambient temperatures
- Quality and viscosity of oil
- Engine is being run in an overfilled condition (check the oil level at least five minutes after a hot shutdown with the vehicle parked on a level surface. The oil level should not be above the top of the cross-hatched area and the letter "F" in FULL).

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles on short trips or in below-freezing ambient temperatures may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the full mark on the oil level indicator due to dilution (condensation and fuel) in the engine crankcase. The vehicle then might be driven at high speeds on the highway where the condensation and fuel boil off. The next time the engine oil is checked it may appear that a liter of oil was used in about 160 km (100 miles). Oil consumption rate is about one liter per 2,400 km (1,500 miles).

Make sure the selected engine oil meets Jaguar specification and the recommended API performance category "SG" and SAE viscosity grade as shown in the vehicle Owner's Guide. It is also important that the engine oil is changed at the intervals specified for the typical operating conditions.

The following diagnostic procedure is used to determine the source of excessive oil consumption.

• **NOTE:** Oil use is normally greater during the first 16,100 km (10,000 miles) of service. As mileage increases, oil use decreases. High speed driving, towing, high ambient temperature and other factors may result in greater oil use.

1. **1.** Define excessive consumption, such as the number of miles driven per liter of oil used. Also determine customers driving habits, such as sustained high speed operation, towing, extended idle and other considerations.
2. **2.** Verify that the engine has no external oil leaks as described under Engine Oil Leaks in this section.
3. **3.** Carry out an oil consumption test:

- Run the engine to normal operating temperature. Switch engine OFF and allow oil to drain back for at least five minutes .
- With vehicle parked on level surface, check the engine oil level.
- If required, add engine oil to set level exactly to the FULL mark.
- Record the vehicle mileage.
- Instruct the customer to return for a level check after driving the vehicle as usual for 1,610 km (1000 miles).
- Check the oil level under the same conditions and at the same location as the initial check.

• **NOTE:** If the oil consumption rate is unacceptable go to Step 4.

4. **4.** Check the Positive Crankcase Ventilation (PCV) system. Make sure the system is not plugged.
5. **5.** Check for plugged oil drain-back holes in the cylinder head and cylinder block.
6. **6.** If the condition still exists after carrying out the above tests go to step 9.
7. **7.** Carry out a cylinder compression test. Refer to the Compression Test procedure in this section. This can help determine the source of oil consumption such as valves, piston rings or other areas.
8. **8.** Check valve guides for excessive guide clearance. Install new valve stem seals after verifying valve guide clearance.
9. **9.** Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on the tips of the spark plugs can be a clue to internal oil consumption.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect a vacuum gauge or equivalent to the intake manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is performed. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 feet) of elevation above sea level.

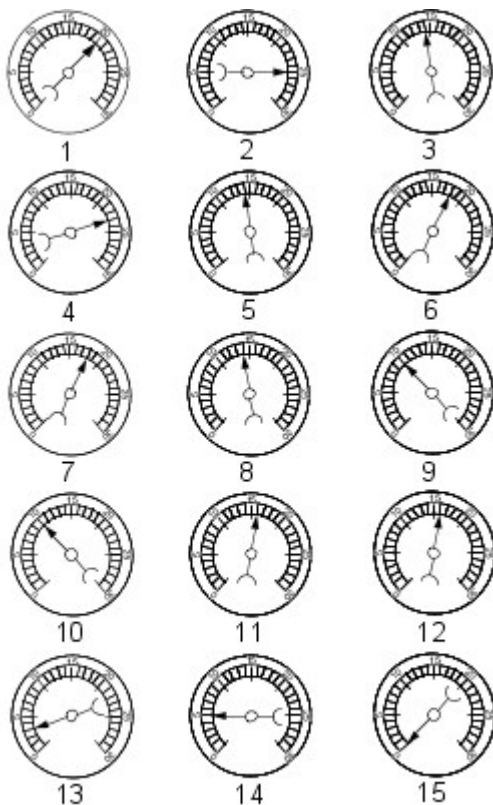
The reading should be steady. As necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust damper until needle moves easily without excessive flutter.

Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



VJJ0001694

1. **1.** NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.
2. **2.** NORMAL READING DURING RAPID ACCELERATION: When the engine is rapidly accelerated, the needle will drop

to a low (not to zero) reading. When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3. **3. NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP:** The needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.
4. **4. WORN RINGS OR DILUTED OIL:** When the engine is accelerated, the needle drops to 0 kPa (0 in-Hg). Upon deceleration, the needle runs slightly above 74 kPa (22 in-Hg).
5. **5. STICKING VALVES:** When the needle remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.
6. **6. BURNED OR BENT VALVES:** A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or damaged valves. Insufficient hydraulic valve tappet or hydraulic lash adjuster clearance will also cause this reaction.
7. **7. POOR VALVE SEATING:** A small but regular downscale flicking can mean one or more valves are not seating correctly.
8. **8. WORN VALVE GUIDES:** When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.
9. **9. WEAK VALVE SPRINGS:** When the needle oscillation becomes more violent as engine RPM is increased, weak valve springs are indicated. The reading at idle could be relatively steady.
10. **10. LATE VALVE TIMING:** A steady but low reading could be caused by late valve timing.
11. **11. IGNITION TIMING RETARDED:** Retarded ignition timing will produce a steady but somewhat low reading.
12. **12. INSUFFICIENT SPARK PLUG GAP:** When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.
13. **13. INTAKE LEAK:** A low, steady reading can be caused by an intake manifold or throttle body gasket leak.
14. **14. BLOWN HEAD GASKET:** A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head to cylinder block surface.
15. **15. RESTRICTED EXHAUST SYSTEM:** When the engine is first started and is idled, the reading may be normal, but as the engine RPM is increased, the back pressure caused by a clogged muffler, kinked tail pipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory such as the power brake booster, the unit will not function correctly. Always repair vacuum leaks.

Engine Oil Pressure Check

• **NOTE:** Prior to checking the engine oil pressure, a road test of 6 miles (10 kilometres), must be carried out. Do not attempt to attain engine normal operating temperature by allowing the engine to idle.

1. **1.** Disconnect the battery ground cable. Refer to section 414-00 - Charging System - General Information of the workshop manual
2. • **WARNINGS:**



The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.



Wear protective gloves.

2. Remove the engine oil filter element
REFER to: [Oil Filter Element](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

• **NOTE:** Ensure the oil filter element is not contaminated during this procedure

3. **3.** Install the oil filter element into special tool (Oil filter adapter number 303-1451)
4. **4.** Install the special tool (Oil filter adapter number 303-1451) to the engine. Torque: 25 Nm
5. **5.** Install the special tool (Oil pressure testing gauge, 303-871) and tighten the union
6. **6.** Connect the battery ground cable
7. **7.** Refer to owner hand book, check and top-up the engine oil if required
8. **8.** Start and run the engine
9. **9.** Note the oil pressure readings with the engine running at idle and 3500 RPM
10. **10.** Turn off the engine
11. **11.** Disconnect the battery ground cable
12. **12.** Remove the special tools
 1. Clean the components

13. **13.** Install the engine oil filter element
REFER to: [Oil Filter Element](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

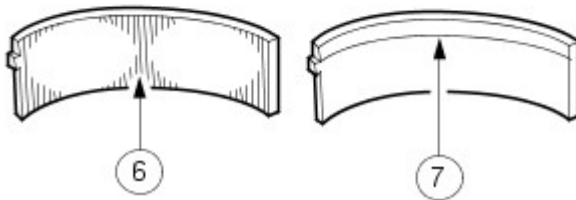
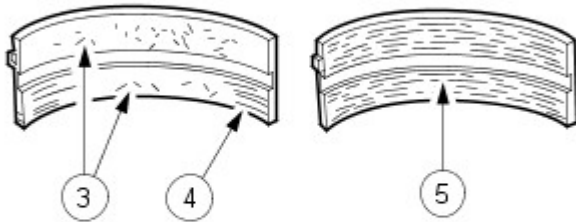
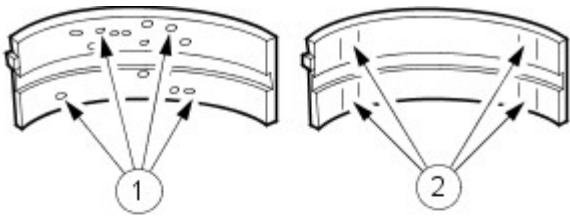
• NOTE: Ensure the oil filter element is not contaminated during this procedure

14. **14.** Connect the battery ground cable

15. **15.** Refer to owner hand book, check and top-up the engine oil if required

Engine System - General Information - Bearing Inspection

General Procedures



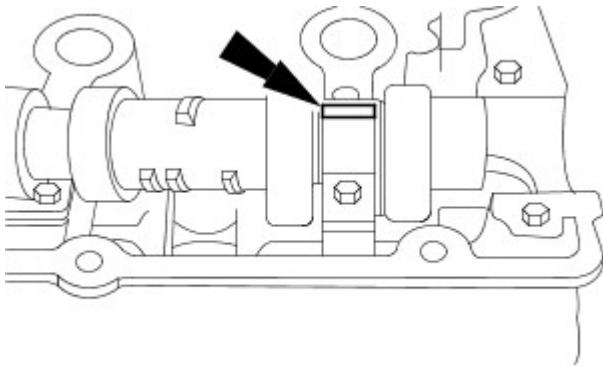
1. Inspect bearings for the following defects.

1. Cratering - fatigue failure
2. Spot polishing - incorrect seating.
3. Imbedded dirt engine oil.
4. Scratching - dirty engine oil.
5. Base exposed - poor lubrication.
6. Both edges worn - journal damaged.
7. One edge worn - journal tapered or bearing not seated.

VUJ0002219

Engine System - General Information - Camshaft Bearing Journal Clearance

General Procedures



VUJ0001696

1. NOTE: Make sure that the following stages are followed exactly. The tappets or followers must be removed to carry out this measurement.

- **NOTE:** Make sure that the camshaft is to specification.
- **NOTE:** The bearing caps and journals should be free from engine oil and dirt.

Position on a length of plastigage on the bearing cap.

- Insert the camshaft, without lubrication, into the cylinder head.
- Position a plastigage strip, which should be equal to the width of the bearing cap, on the bearing journal.

2. Install the camshaft bearing caps.

- Follow the relevant tightening sequence.

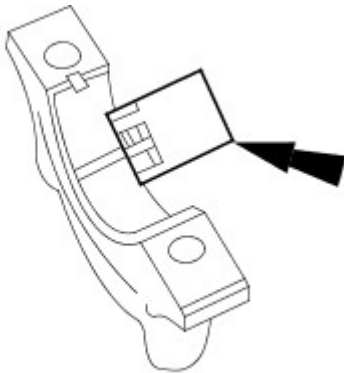
3. NOTE: Do not strike the bearing caps.

Remove the camshaft bearing caps.

- Follow the relevant loosening sequence.

4. Using the special tool, read off the measurement.

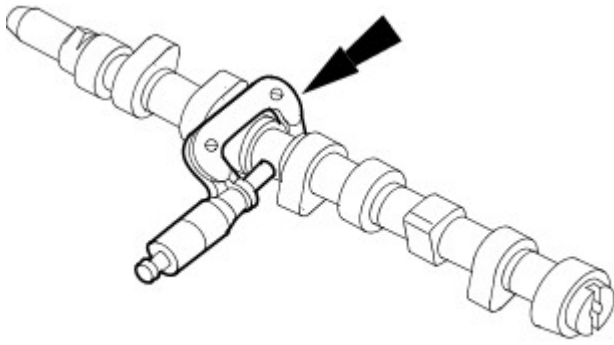
- Compare the width of plastigage with the plastigage scale.
- The value that is read off is the bearing clearance.
- If the values are not to specification install a new camshaft.



VUJ0001697

Engine System - General Information - Camshaft Bearing Journal Diameter

General Procedures



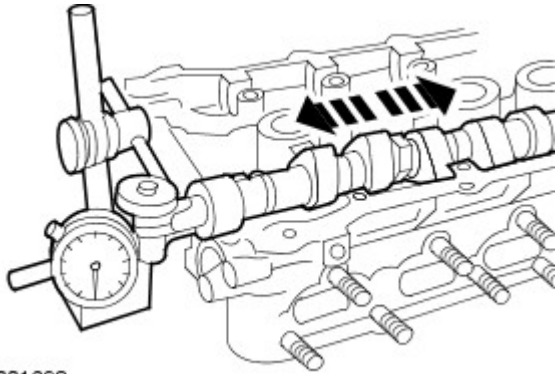
1. Determine the diameter of the camshaft journals.

- Using a micrometer measure the diameter at 90 degree intervals to determine if the journals are out-of-round.
- Measure at two different points on the journal to determine if there is any tapering.
- If the measurements are out of the specified range, install a new camshaft.

VUJ0001695

Engine System - General Information - Camshaft End Play

General Procedures



VUJ0001698

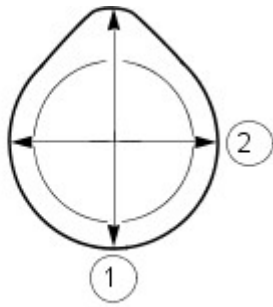
1. NOTE: Make sure that the camshaft is to specification.

Using the special tool, measure the end play.

- Slide the camshaft in both directions. Read and note the maximum and minimum values on the dial indicator gauge.
 1. End play = maximum value minus minimum value.
- If the measurement is out of specification, install new components.

Engine System - General Information - Camshaft Lobe Lift

General Procedures

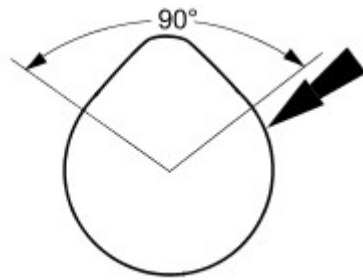


1. Measure the diameter (1) and diameter (2) with a vernier caliper. The difference in measurements is the lobe lift.

VUJ0001699

Engine System - General Information - Camshaft Surface Inspection

General Procedures

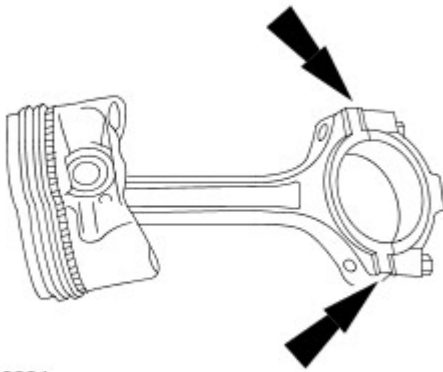


1. Inspect camshaft lobes for pitting or damage in the active area. Minor pitting is acceptable outside the active area.


VUJ0001700

Engine System - General Information - Connecting Rod Cleaning

General Procedures



VUJ0002224

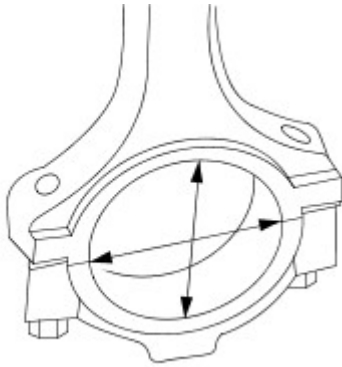
1.  CAUTION: Do not use a caustic cleaning solution or damage to connecting rods may occur.

Mark and separate the parts and clean with solvent. Clean the oil passages.

Engine System - General Information - Connecting Rod Large End Bore

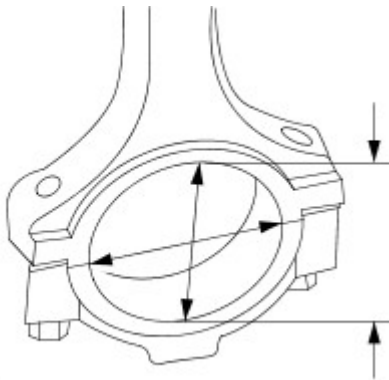
General Procedures

1. Measure the bearing bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.



VUJ0002223

2. Measure the bearing bore diameter in two directions. Verify the bearing bore is within specification.



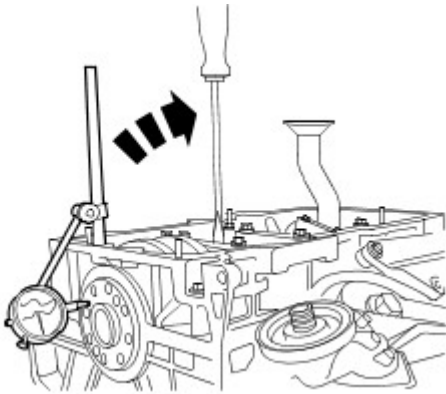
VUJ0002222

Engine System - General Information - Crankshaft End Play

General Procedures

1. Using the Dial Indicator Gauge with Brackets, measure the end play.

- Measure the end play by lifting the crankshaft using a lever.
- If the value is out of the specification, install new thrust half rings to take up the end float and repeat the measurement.



VUJ0002235

Engine System - General Information - Crankshaft Main Bearing Journal Clearance

General Procedures

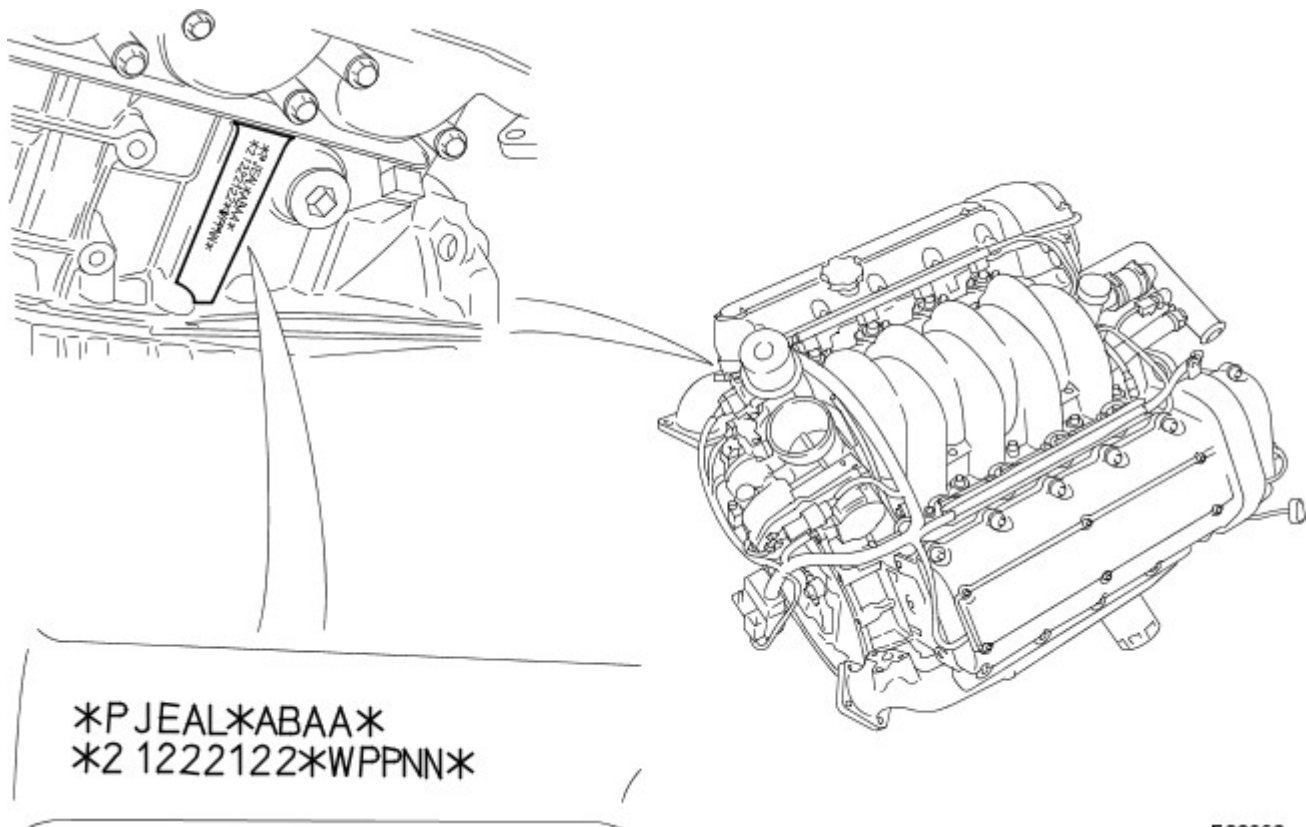


CAUTION: THESE PROCEDURES SHOULD NOT BE CARRIED OUT DURING THE MANUFACTURERS WARRANTY PERIOD.

1. NOTE: Example - *PJEAL* - Crankshaft Main Journal Diameter.

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this example engine, the crank journal at the front of the engine is grade P, and at the rear is grade L.

- The selection of main bearing shells is described in the following chart.



E33992

2. NOTE: Example - *ABAA* - Crankshaft (Big End Bearing) Crankpin Diameter

- NOTE: For vehicles built up to 2002 MY.
- NOTE: If the crankshaft main bearing carrier retaining bolts have been marked with a center punch dot, they must be discarded and new bolts installed.

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this example engine, the crankpin at the front of the engine is grade A and at the rear is also grade A.

- Grade A = 56,000 to 55,994 mm (Bearing Shell Color Code - Blue).
- Grade B = 55,994 to 55,988 mm (Bearing Shell Color Code - Green).
- Grade C = 55,988 to 55,982 mm (Bearing Shell Color Code - Yellow).

3. NOTE: Example - *ABAA* - Crankshaft (Big End Bearing) Crankpin Diameter

- NOTE: For vehicles built from 2002 MY.

- **NOTE: If the crankshaft main bearing carrier retaining bolts have been marked with a center punch dot, they must be discarded and new bolts installed.**

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this example engine, the crankpin at the front of the engine is grade A and at the rear is also grade A.

- Grade A = 53,000 to 52,994 mm (Bearing Shell Color Code - Blue).
- Grade B = 52,994 to 52,988 mm (Bearing Shell Color Code - Green).
- Grade C = 52,988 to 52,982 mm (Bearing Shell Color Code - Yellow).

4. NOTE: Example - *21222122* - Cylinder Bore and Piston

The cylinder bore grades read from LEFT to RIGHT as follows:

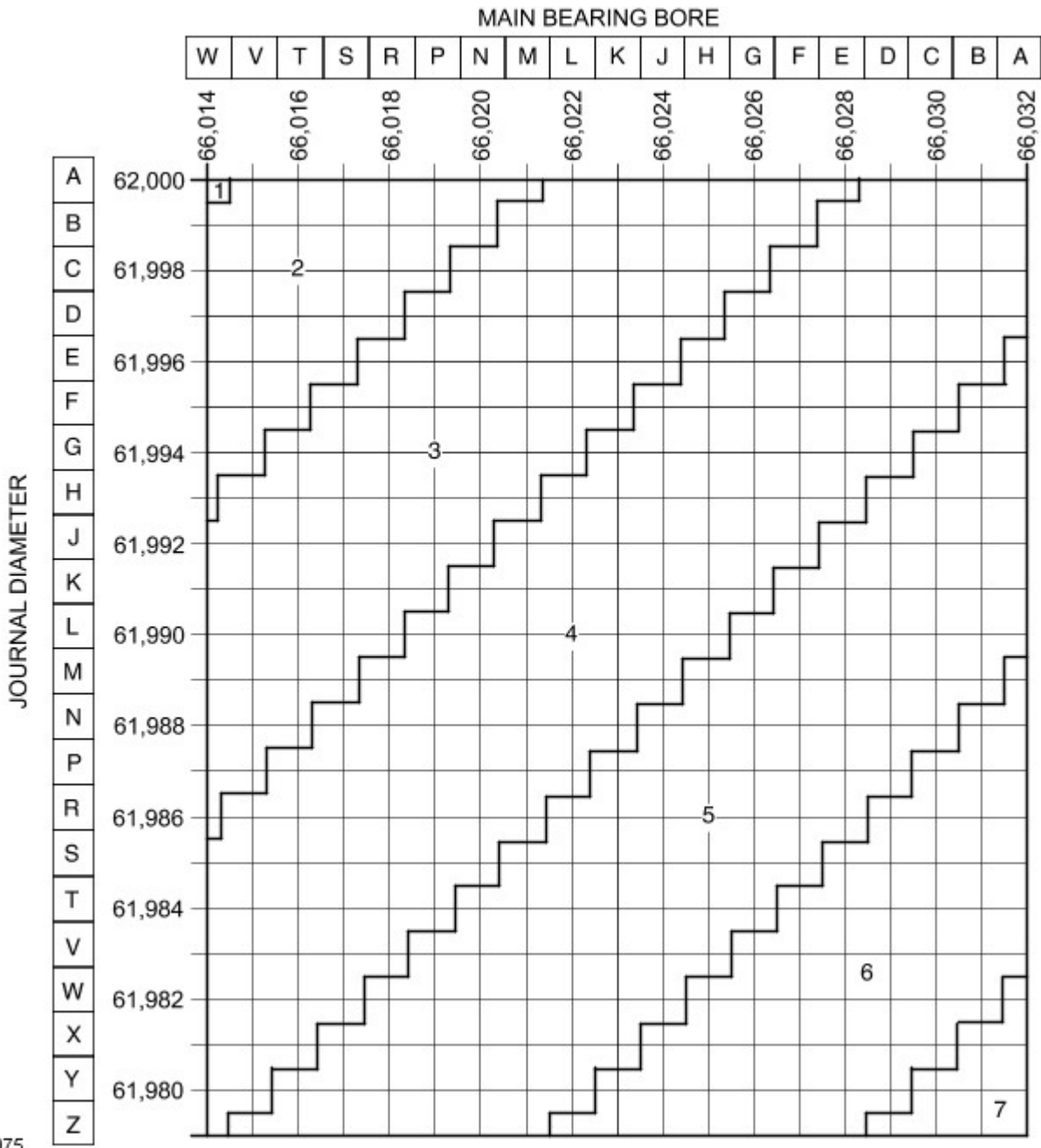
- Bank 2 - Cylinder 1, Bank 2 - Cylinder 2, Bank 2 - Cylinder 3, Bank 2 - Cylinder 4, Bank 1 - Cylinder 4,
- Bank 1 - Cylinder 3, Bank 1 - Cylinder 2, Bank 1 - Cylinder 1.
- **(Note, in earlier publications Bank 1 was described as A-Bank and Bank 2 as B-Bank)**
- Grade 1 Bore = 85,990 to 86,000 mm.
- Grade 2 Bore = 86,000 to 86,010 mm.
- Grade 3 Bore = 86,010 to 86,020 mm.

5. NOTE: Example - *WPPNN* - Crankshaft Main Bearing Bore in Cylinder Block

Read the grade letters from LEFT to RIGHT = FRONT to REAR of engine eg. for this example engine, the crank journal bore at the front of the engine is grade W, and at the rear is grade N.

- The selection of main bearing shells is described in the following **JOURNAL DIAMETER AND MAIN BEARING BORE CHART**.

6. JOURNAL DIAMETER AND MAIN BEARING BORE CHART



E94075

7. NOTE: THIS PROCEDURE SHOULD ONLY BE CARRIED OUT WHEN REPLACING MAIN BEARING SHELLS.

• NOTE: Refer to the **JOURNAL DIAMETER AND MAIN BEARING BORE CHART** in step 6 for tolerance and bearing information.

The number in each diagonal band represents a PAIR of color coded main bearing shells which must be used with a specific journal, depending on the combination of journal diameter and crankshaft bore diameter. The color codes for each band are as follows:

1. **Blue / Green and Blue / Green**
2. **Blue / Green and Blue**
3. **Blue and Blue**
4. **Blue and Green**
5. **Green and Green**
6. **Green and Yellow**
7. **Yellow and Yellow**

- Consider crankshaft journal 5 (from the example grade markings on the cylinder block) - the cylinder block bore is Grade N and the crankshaft journal diameter is Grade L.

From the chart, it will be seen that the point of intersection is in Band 4 which equates to one Blue shell and one Green shell.

- When the appropriate pair of color codes have been selected for a journal, either color may be installed to the cylinder block or to the bedplate, but, the shell which is to be installed to the cylinder block must have an oil groove and the shell which is to be installed to the bedplate must be plain.

8. NOTE: THIS PROCEDURE SHOULD ONLY BE CARRIED OUT WHEN A REPLACEMENT CRANKSHAFT OR CYLINDER BLOCK HAS BEEN FITTED.

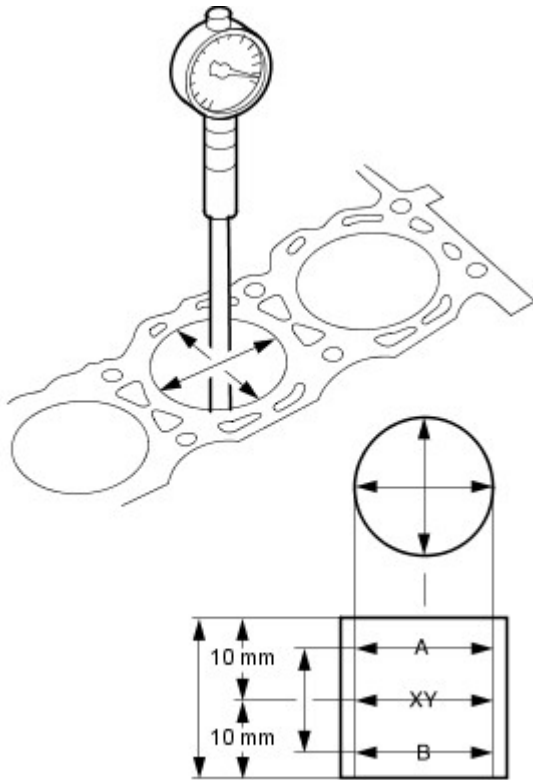
- NOTE: Refer to the **JOURNAL DIAMETER AND MAIN BEARING BORE CHART** in step 6 for tolerance and bearing information.

The thickness grade of all main bearing shells are to be selected to give a total running clearance of not less than 0.022 mm or greater than 0.040 mm.

- Each bearing bore in the block/bedplate assembly should be measured at two mutually perpendicular diameters 45° to the vertical in the middle of the bearing.
- The minimum diameter of the two is to be used.
- Each crankshaft main bearing journal should be measured dynamically at a point in line with the middle of each bearing.
- When the appropriate pair of color codes have been selected for a journal, either color may be installed to the cylinder block or to the bedplate, but, the shell which is to be installed to the cylinder block must have an oil groove and the shell which is to be installed to the bedplate must be plain.

Engine System - General Information - Cylinder Bore Out-of-Round

General Procedures



1. NOTE: The main bearing caps or lower crankcase must be in place and tightened to the specified torque; however, the bearing shells should not be installed.

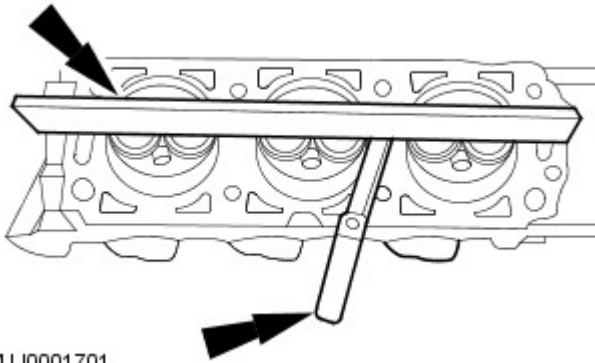
Measure the cylinder bore with an internal micrometer.

- Carry out the measurements in different directions and at different heights to determine if there is any out-of-roundness or tapering.
- If the measurement is out of the specified range, hone out the cylinder bore or install a new block.

VUJ0002234

Engine System - General Information - Cylinder Head Distortion

General Procedures



VUJ0001701

1. Measure the cylinder block/cylinder head distortion.

- Using the special tool, measure the mating face distortion.
- If the value is not to specification rework the mating face.

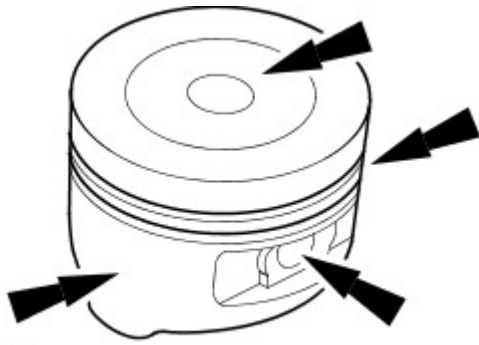
Engine System - General Information - Exhaust Manifold Cleaning and Inspection

General Procedures


1. Inspect the cylinder head joining flanges of the exhaust manifold for evidence of exhaust gas leaks.
2. Inspect the exhaust manifold for cracks, damaged gasket surfaces, or other damage that would make it unfit for further use.

Engine System - General Information - Piston Inspection

General Procedures



VUJ0002233

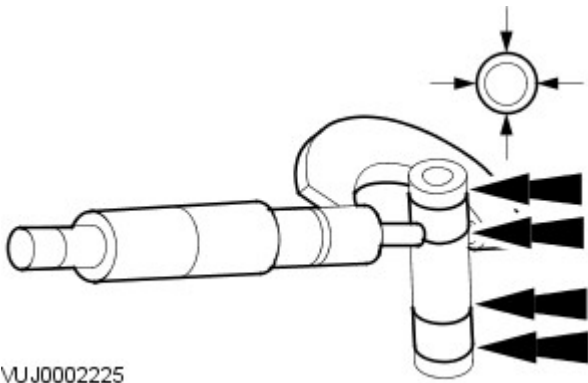
1.  CAUTION: Do not use any aggressive cleaning fluid or a wire brush to clean the piston.

Carry out a visual inspection.

- Clean the piston skirt, pin bush, ring grooves and crown and check for wear or cracks.
- If there are signs of wear on the piston skirt, check whether the connecting rod is twisted or bent.

Engine System - General Information - Piston Pin Diameter

General Procedures



VUJ0002225

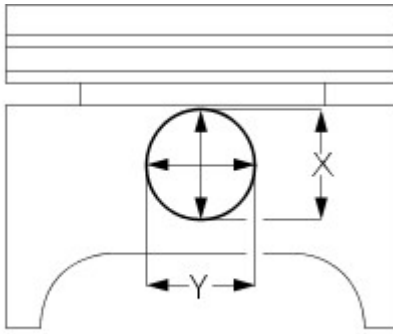
1. NOTE: The piston and piston pin are a matched pair. Do not mix up the components.

Measure the piston pin diameter.

- Measure the diameter in two directions.
- If the values are not to specification, install a new piston and a new piston pin.

Engine System - General Information - Piston Pin to Bore Diameter

General Procedures



VUJ0002232

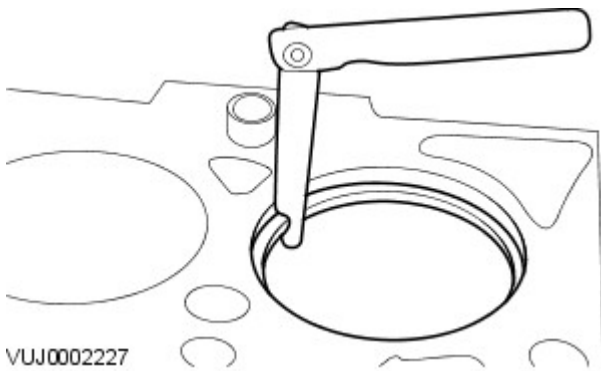
1. NOTE: The piston and piston pin form a matched pair. Do not mix up the components.

Measure the diameter of the piston pin bore.

- Measure the diameter in two directions.
- If the values are not to specification, install both a new piston and a new piston pin.

Engine System - General Information - Piston Ring End Gap

General Procedures



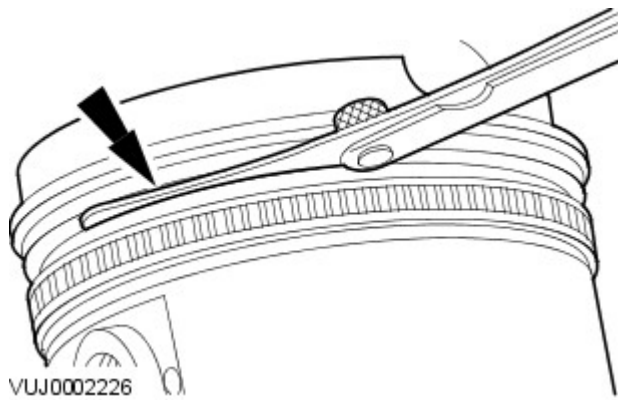
1.  CAUTION: Do not mix up the piston rings. Install the piston rings in the same position and location.

Using the Feeler Gauge, measure the piston ring gap.

- The values given in the specification refer to a gauge ring used during production.

Engine System - General Information - Piston Ring-to-Groove Clearance

General Procedures



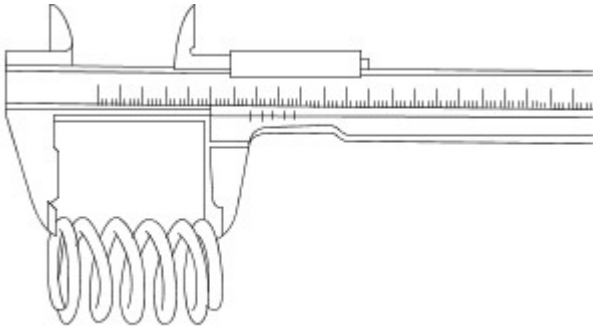
1. NOTE: The piston ring must protrude from the piston groove. To determine the piston ring clearance, insert the Feeler Gauge right to the back of the groove, behind the wear ridge.

Using the Feeler Gauge, measure the piston ring clearance.

Engine System - General Information - Valve Spring Free Length

General Procedures

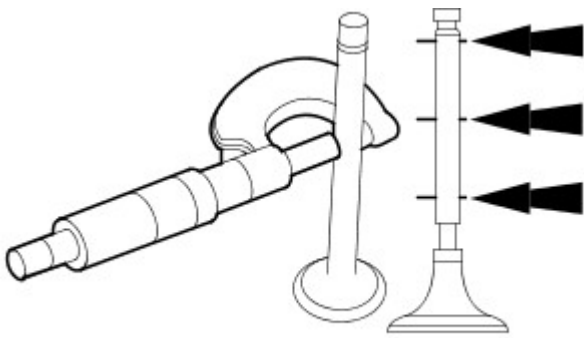
1. Using a vernier gauge, measure the free length of each valve spring. Verify the length is within specification.



VUJ0002221

Engine System - General Information - Valve Stem Diameter

General Procedures



1. Using a micrometer measure the diameter of the valve stems.

- If the measurements are not to specification, install a new valve.

VUJ0002220

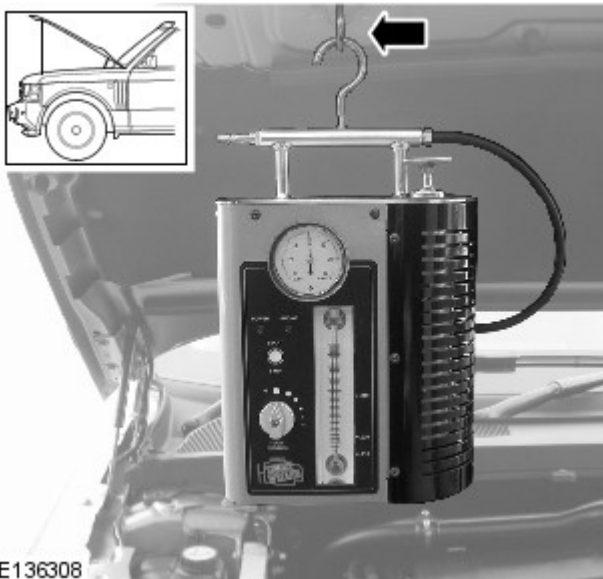
Engine System - General Information - Leakage Test Using Smoke Test Equipment

General Procedures



CAUTION: The compressed air line supply pressure must be between 3.5 and 12 bar (50 and 175 psi) for the smoke test equipment to function correctly. Do not exceed this pressure. Failure to follow this instruction may result in damage to the smoke test equipment.

- **NOTE:** The vehicle battery must be in good condition and fully charged before carrying out this procedure.
- **NOTE:** On vehicles with 3.0L TDV6, it will be necessary to insert smoke at both air cleaner outlet pipes independently if the right hand turbocharger and associated hoses are to be tested.
- **NOTE:** In some cases it may be necessary to remove undertrays, trim or engine covers to obtain access to all potential leak locations.
- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.
- **NOTE:** For further information regarding operation of the test equipment refer to the manufacturers operators manual supplied with the kit.



E136308



1. WARNING: Use an additional support to prevent the hood from falling if the smoke test equipment is secured to the hood. Failure to follow this instruction may result in personal injury.

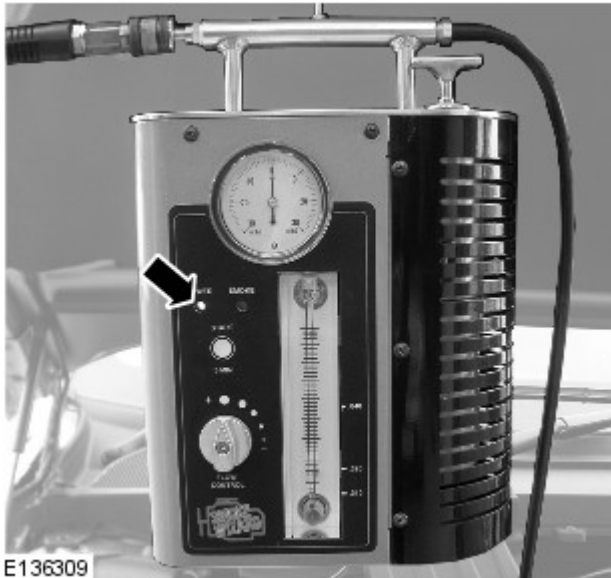
Install the smoke test equipment to a suitable location under the hood.

2. Connect a suitable compressed air line to the smoke test equipment.
3. Connect the smoke test equipment positive power cable to the battery positive terminal.



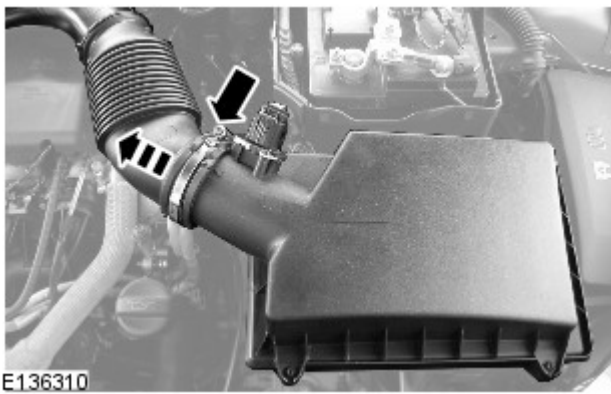
4. WARNING: Do not connect the smoke test equipment negative cable to the battery negative terminal.

Connect the smoke test equipment negative cable to a suitable body ground point.



5. NOTE: A flashing green light indicates low battery voltage. In this case, place the battery on charge and make sure that the battery is fully charged before using the smoke test equipment.

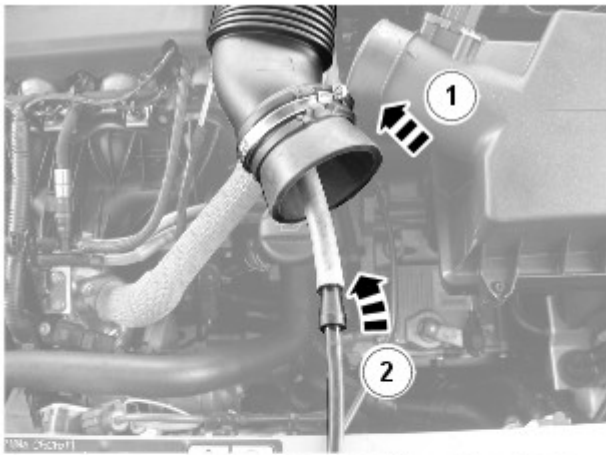
Observe the power indicator lamp on the smoke test equipment. Make sure that a continuous green light is displayed.



6. NOTE: In some cases it may be necessary to remove the air cleaner(s) to allow access to the air cleaner outlet pipes.

- NOTE: In some cases it will be necessary to cap one of the air cleaner outlet pipes. Use the blanking caps supplied in the kit to cap the open orifice.

Disconnect the air cleaner outlet pipe(s).



7. NOTE: Make sure the smoke test equipment adapter is a good fit to the air cleaner outlet pipe. This must be an air tight seal.

Connect the smoke test equipment supply hose to the air cleaner outlet pipe.

1. Install the appropriate adapter to the air cleaner outlet pipe.
2. Connect the smoke test equipment supply hose to the adapter link hose.



E136311

8. NOTE: The flow control valve must be in the fully open position.

• NOTE: Smoke is produced for 5 minutes. The smoke test equipment will automatically switch off after this period of time.

Switch the smoke test equipment on.



E136312

9. Remove the oil filler cap, and observe until a constant flow of smoke is visible leaving the oil filler orifice. Install the oil filler cap.

10. NOTE: The longer smoke is allowed to exit from a leak, the more fluorescent dye will be deposited at a leak location.

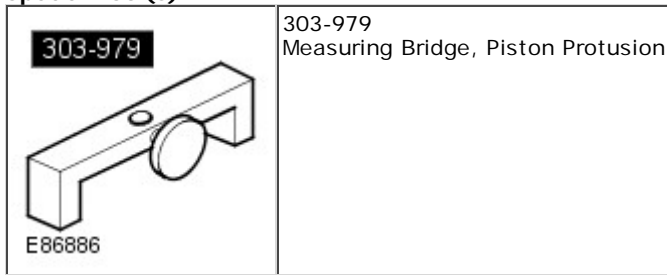
Using the torch supplied in the kit set to white light, look for escaping smoke. Alternatively, use the ultraviolet light to look for fluorescent dye deposits at the source of a leak.

Engine System - General Information - Cylinder Head Gasket Selection TDV6

3.0L Diesel

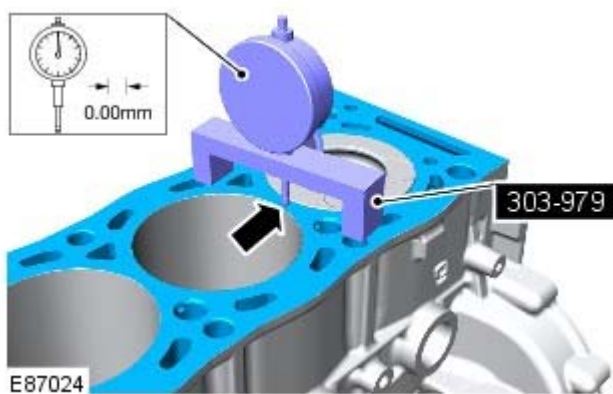
General Procedures


Special Tool(s)



Check

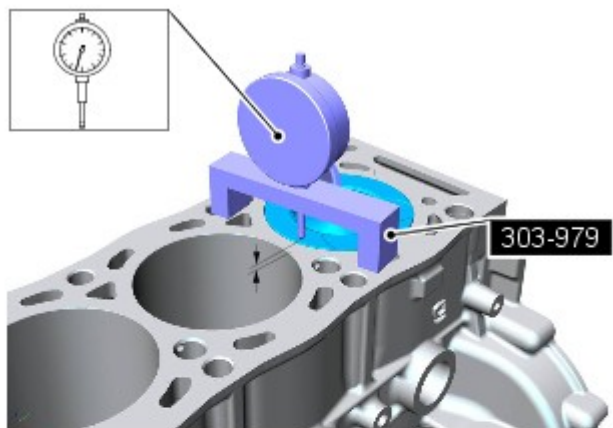
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.




1.  CAUTION: Make sure that the surface is clean and free of foreign material.

Zero the gauge on the cylinder block machined face.

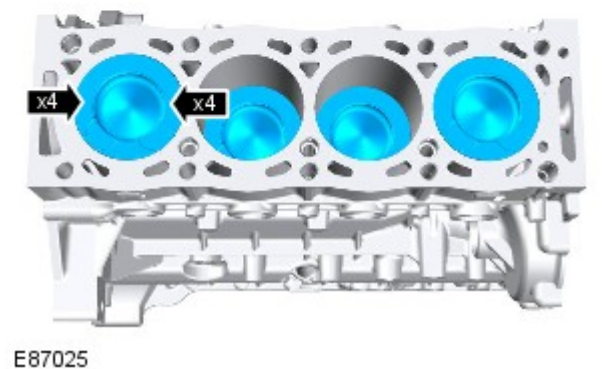
Special Tool(s): [303-979](#)



2.  CAUTION: Make sure that the surface is clean and free of foreign material.

- NOTE: Note the dial gauge readings.

Take 2 measurements on each piston crown.



3. Use the average piston protrusion measurement (taken from all

piston measurements), to select the correct thickness cylinder head gasket.

Refer to: [Specifications](#) (303-01B Engine - TDV6 3.0L Diesel, Specifications).

Engine - TDV6 2.7L Diesel -

Sealers

Description	Land Rover Part No.
Camshaft caps	8510302
'T' joints - ladder frame to engine block	STC 50550
Coolant plug - threaded	STC 50552
Oil pump upper middle retaining bolt	STC 50552

Lubricants

Description	Specification
Engine oil, SAE 5W-30	Use 5W/30 oil to specification WSS-M2C-913B meeting ACEA B1/B3

Note: WSS is a Ford prefix to the oil specification

Capacities

Engine Oil Capacity	Specification
Dry fill including filter for factory fitted engine	6.55 litres (11.5 pints) (6.9 US quarts)
Dry fill including filter for all new engines fitted in service	7.05 litres (12.4 pints) (7.4 US quarts)
Oil and filter change	5.54 litres (9.6 pints) (5.8 US quarts)
Amount of oil required to bring level from 'MIN' to 'MAX' mark on oil level indicator	1.5 litres (2.6 pints) (1.6 US quarts)

Dimensions

Item	Specification
Length	523 mm (20.59 in)
Width	717 mm (28.25 in)
Height	771 mm (30.35 in)

General Specifications

Item	Specification
Type	2.7 litre, 60 degree 'V', common rail direct injection, turbocharged and intercooled diesel, twin overhead camshafts, 4 valves per cylinder
Cylinder arrangement	V6, numbers 1 and 4 cylinders at front of engine when engine is viewed from rear
Cylinder numbering	Number 1 cylinder - right hand bank; Number 4 cylinder - left hand bank
Bore - nominal	81.0 mm (3.188 in)
Stroke	88.0 mm (3.464 in)
Capacity	2720 cm ³ (165.9 in ³)
Firing order	1 - 4 - 2 - 5 - 3 - 6
Compression ratio	17.3:1
Direction of rotation	Anti-clockwise viewed from rear of engine
Maximum power	147 kW (200 PS) (197 bhp) @ 4000 rev/min
Maximum torque	440 Nm (324 lb-ft) @ 1900 rev/min
Engine oil pressure:	
At idle	0.7 bar (70 kPa) (10 lb/in ²)
At 3500 rev/min	1.9 bar (190kPa) (27.5 lb/ft ²)
Maximum permissible cylinder head warp	
Total flame face	0.1 mm
150 mm x 150 mm square on flame face	0.05 mm
25 mm x 25 mm square on flame face	0.025 mm

Torque Specifications

Description	Nm	lb-ft
Accessory drive belt idler retaining bolt	47	35
Accessory drive belt tensioner M8 retaining bolts	47	35
Accessory drive belt tensioner M10 retaining bolts	25	18
Air conditioning (A/C) compressor retaining bolts	23	17
A/C compressor mounting bracket retaining bolts	23	17
A/C compressor low pressure pipe fixing	9	7
A/C manifold retaining bolt	20	15
Battery positive cable mounting bolts	10	7
* Camshaft inner bearing cap retaining bolts		
Stage 1: tighten bolts 1 to 14	1	1
Stage 2: tighten bolts 1 to 14	5	4
Stage 3: tighten bolts 1 to 14	10	7
* Camshaft outer bearing cap retaining bolts		
Stage 1: tighten bolts 1 to 4	1	1
Stage 2: tighten bolts 1 to 4	5	4
Stage 3: tighten bolts 1 to 4	10	7
Camshaft position sensor retaining bolt	10	7
+1 Camshaft hub retaining bolts		
Stage 1	80	59
Stage 2	Further 90°	Further 90°
Camshaft pulley retaining bolts	23	17
Camshaft timing belt cover securing bolts	10	7
+2 Crankshaft pulley retaining bolt		
Stage 1	100	74

Description	Nm	lb-ft
Stage 2	Further 90°	Further 90°
Crankshaft damper bolts	14	10
Crankshaft position sensor retaining bolt	5	4
Crankshaft rear seal retainer plate	10	7
Coolant outlet elbow	10	7
* +² Cylinder head retaining bolts		
Stage 1	20	15
Stage 2	40	30
Stage 3	80	59
Stage 4	Further 180°	Further 180°
Differential front mounting bracket heat shield	10	7
EGR valve inlet tube	10	7
EGR valve mounting bolts	10	7
EGR valve support bracket fixing	10	7
Engine breather tube securing bolt	10	7
Engine mount retaining nuts to cross member	62	46
Engine mount bracket to engine mount retaining bolts	62	46
Engine mount bracket to engine block retaining bolts	115	85
Exhaust cross over pipe retaining nuts	24	18
Exhaust manifold heat shield retaining bolts	10	7
Exhaust manifold retaining nuts	23	17
Exhaust manifold retaining studs	13	10
* + Flexplate retaining bolts		
Stage 1	50	37
Stage 2	Further 45°	Further 45°
Stage 3	Further 45°	Further 45°
Fuel injection pump	23	17
Fuel injection pump pulley retaining nut	50	37
Fuel injection supply manifold	23	17
Fuel injection supply manifold securing bracket	23	17
Fuel injection supply line unions		
Stage 1 - High pressure fuel supply line union at the fuel injection diverter rail	15	11
Stage 2 - High pressure fuel supply line union at the fuel injection supply manifold	15	11
Stage 3 - High pressure fuel supply line union at the fuel injection diverter rail	30	22
Stage 4 - High pressure fuel supply line union at the fuel injection supply manifold	30	22
Fuel injection high pressure supply line mounting bolt	10	7
Fuel injector retaining bolts	10	7
Fuel filter mounting bolts	10	7
Generator retaining bolts	23	17
Generator mount bracket retaining bolts	23	17
Glow plugs	11	8
Intake air shut off throttle elbow support bracket bolts	10	7
Knock sensor retaining bolts	20	15
Oil cooler to cylinder block retaining bolts	10	7
Oil level indicator tube upper retaining bolt	10	7
Oil pan retaining bolts	10	7
Oil pump screen and pick-up tube	10	7
Oil pump to engine block retaining bolts	10	7
Oil pan drain plug	23	17
Oil separator retaining bolts	10	7
Oil temperature sensor	10	7
Oil filter	25	18
Piston cooling jet retaining bolt	10	7
Power steering bracket retaining bolts	23	17
Power steering pump retaining bolts	23	17
Power steering high pressure pipe fixing	25	18
Primary timing chain tensioner retaining bolts	10	7
Secondary timing chain tensioner bolts	10	7
Starter motor retaining bolts	45	33
Timing belt tensioner retaining bolt	24	18
Timing belt idler pulley retaining bolt	45	33
Transmission fluid cooler pipe securing bracket	10	7
Transmission retaining bolts	45	33
Turbo heat shield	10	7
Turbo support bracket	22	16
Coolant pump retaining bolts	10	7
Coolant pump pulley retaining bolts	23	17
Coolant pump outlet pipe retaining bolts	10	7
Valve cover retaining bolts	10	7
Vacuum pump retaining bolts	23	17
Vacuum pump retaining nuts	13	10

*** Bolts must be tightened in sequence**

+ New bolts must be installed

¹ Lightly oil bolt threads

² Do not apply lubricant to bolt threads

Engine - TDV6 2.7L Diesel - Engine

Description and Operation

External View



E44216

GENERAL

The TdV6 engine is a 2.7 litre, direct injection, six-cylinder diesel engine having two banks of three cylinders, arranged at 60 degrees to each other. There are 4 valves per cylinder, which are operated by two overhead camshafts per cylinder bank. The engine emission comply with ECD3 (European Commission Directive) legislative requirements and employs two catalytic converters, electronic engine management control, positive crankcase ventilation and exhaust gas recirculation to limit the emission of pollutants. The unit is water cooled and turbo-charged. The fuel injection system features common rail technology.

The cylinder block is manufactured in Compacted Graphite Iron (CGI) and is coupled with a separate aluminium ladder frame to provide a lightweight, compact and very stiff bottom end of the engine. The cylinder heads are cast aluminium with a moulded plastic camshaft cover. The single-piece oil sump is formed from stamped steel. The cast iron exhaust manifolds are unique for each cylinder bank and a moulded plastic acoustic cover is fitted over the upper engine to reduce engine-generated noise.

TECHNICAL FEATURES

The technical features include:

- 60 degree 'vee' 6 cylinder engine with a CGI cylinder block

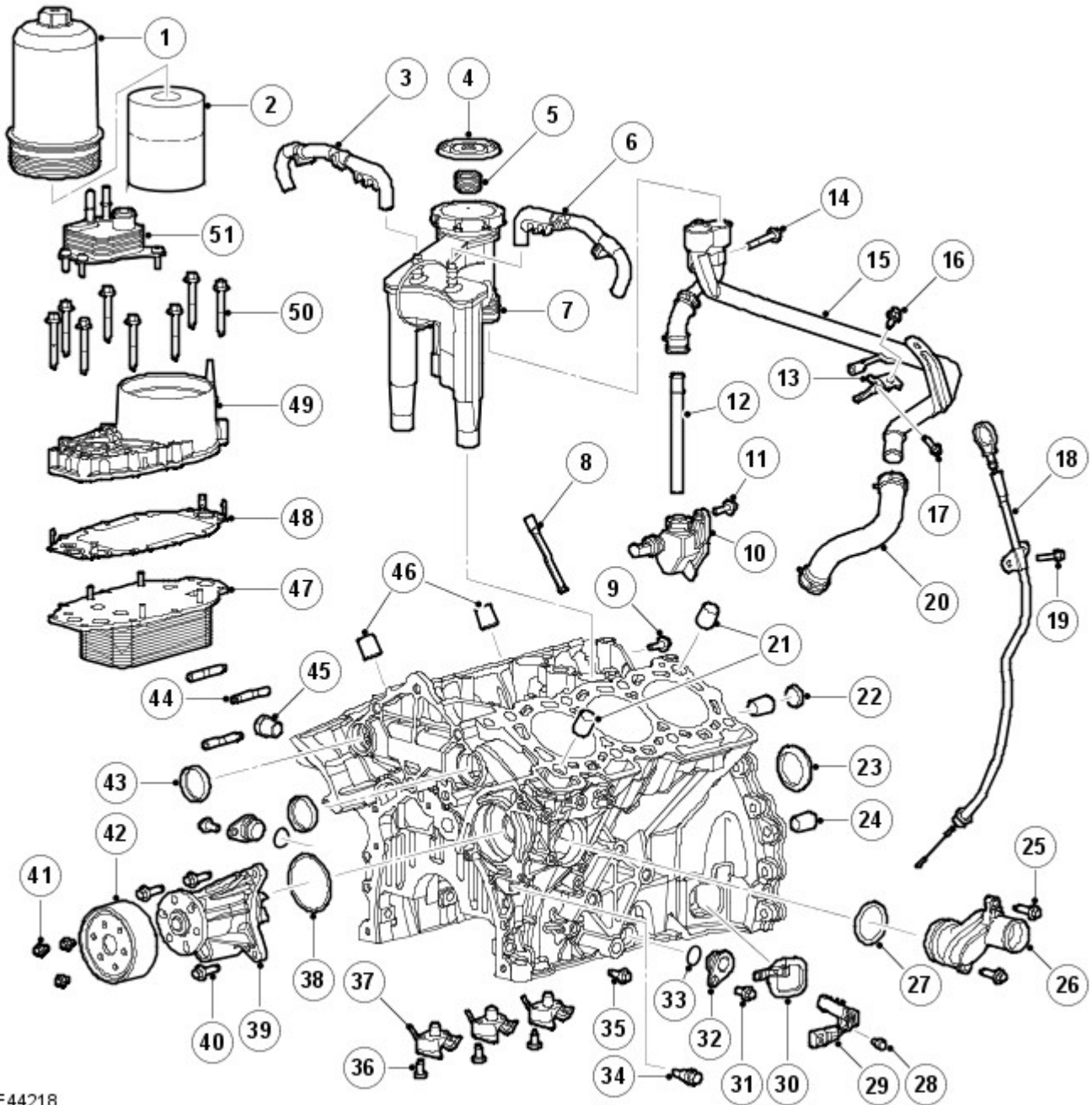
- Plastic cylinder head cover
- Two light, high strength, aluminium cylinder heads
- 4-valve technology with centrally arranged fuel injectors
- Steel roller rockers with hydraulic lash adjusters
- Twin plenum intake system integrated with the camshaft cover
- Variable Geometry Turbocharger
- Common rail direct fuel injection system
- High pressure fuel pump
- Gallery cooled pistons with a central crown bowl
- Two electronically controlled Exhaust Gas Recirculation (EGR) valves
- Two EGR coolers
- Exhaust re-treatment by means of a diesel specific oxidation catalytic converter and primary catalytic converter
- Cooling fan with electro-viscous clutch drive.

ENGINE DATA

The technical data is detailed below:

DESCRIPTION	TYPE
Configuration	60 degree V6
Maximum power	147 kW at 4000 rpm
Maximum torque	440 Nm at 1900 rpm
Displacement	2720cc
Stroke/bore	81mm/88mm
Compression ratio	17.3:1
Firing order	1 4 2 5 3 6
Oil capacity	6.55 litres (initial fill) 5.45 litres (service fill, includes oil filter)
Engine weight (with oil)	235kg (Automatic) 260kg (Manual, inc. clutch plate and cover)

CYLINDER BLOCK COMPONENTS



E44218

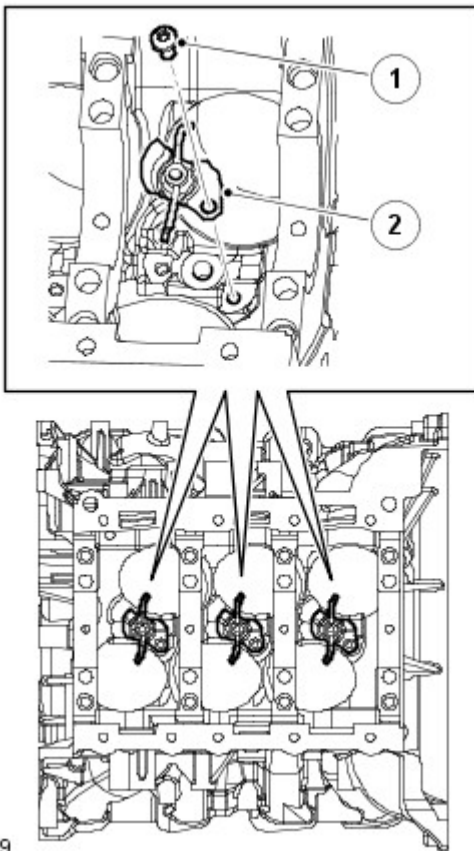
Item	Part Number	Description
1	-	Oil filter cap
2	-	Oil filter element
3	-	Scavenge pipe
4	-	Diaphragm
5	-	Spring
6	-	Scavenge pipe
7	-	Crankcase ventilation oil separator assembly
8	-	Turbocharger feed filter
9	-	Bolt
10	-	Crankcase ventilation drain reservoir assembly
11	-	Bolt
12	-	Crankcase ventilation oil return tube
13	-	Bracket
14	-	Bolt
15	-	Crankcase ventilation oil return assembly
16	-	Bolt
17	-	Bolt
18	-	Oil level gauge
19	-	Bolt
20	-	Crankcase ventilation return hose
21	-	Cylinder head locating dowels
22	-	Core plug
23	-	Seal
24	-	Transmission locating dowel

25	-	Bolt, 2 of
26	-	Water inlet connector assembly
27	-	O ring
28	-	Bolt
29	-	Crankshaft position (CKP) sensor
30	-	Cylinder block aperture cover
31	-	Bolt
32	-	Blanking plug
33	-	O ring
34	-	Crankshaft timing plug
35	-	Bolt
36	-	Bolt, 3 of
37	-	Piston cooling jets
38	-	O ring
39	-	Water pump
40	-	Bolt, 3 of
41	-	Bolt, 3 of
42	-	Water pump pulley
43	-	Core plug
44	-	Stud bolts, 3 of
45	-	Coolant drain plug
46	-	Cylinder head locating dowels
47	-	Lower oil filter and cooler assembly
48	-	Seal
49	-	Upper oil filter and cooler assembly
50	-	Bolt, 8 of
51	-	Fuel cooler

Cylinder Block

The cylinders and crankcase are contained in the cylinder block, which is of single cast CGI construction with a hollow beam structure. With this type of construction less material is required than for a conventional cast iron block, therefore, reducing engine weight and length.

Piston Cooling Jets



E44219

Item	Part Number	Description
1	-	Bolt
2	-	Piston cooling jet

Jets located in the cylinder block provide piston and gudgeon pin lubrication and cooling. These jets spray oil on to the inside of the piston, the oil then flows through two internal wave shaped channels to help cool each piston crown.

Lubrication oil is distributed through the cylinder block, via the main oil gallery and channels bored in the block, to all critical moving parts. These channels divert oil to the main and big-end bearings via holes machined into the crankshaft.

A tapping at the rear RH side of the cylinder block, below the RH cylinder head, connects a pipe to the turbocharger by means of a banjo connection. Oil is supplied, under pressure, via this tapping, from the oil pump to provide lubrication for the turbocharger bearings.

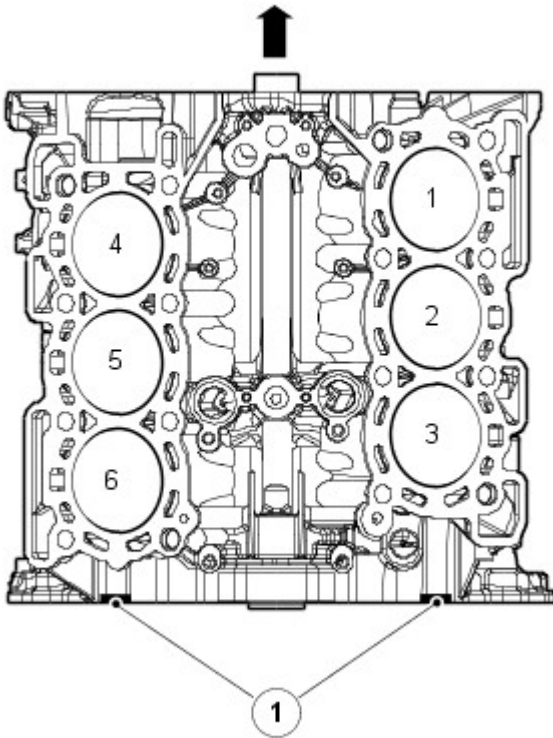
Cylinder cooling is achieved by coolant circulating through chambers in the cylinder block casting.

Two hollow metal dowels are used to locate the cylinder heads to the cylinder block, one on each side at the rear of the unit.

A port is included at the rear LH side of the ladder frame, below the turbocharger, to connect the turbocharger oil return pipe to the sump.

A plug sealing the lubrication cross-drilling gallery is located at the front RH side of the cylinder block. Plugs for the main lubrication gallery are included at the front and rear of the cylinder block.

Engine Data Locations

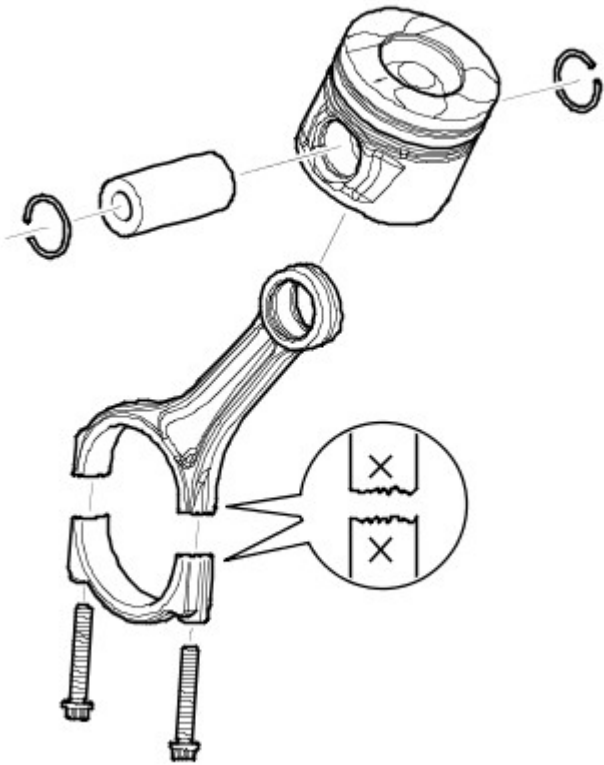


E44217

Item	Part Number	Description
1	-	Engine data locations

Engine data is marked at two locations at the back of the cylinder block. Component diameters are represented by alphabetical and numerical codes; keys to the codes are in the Service Repair Procedures (SRP) Manual.

Connecting Rods and Pistons

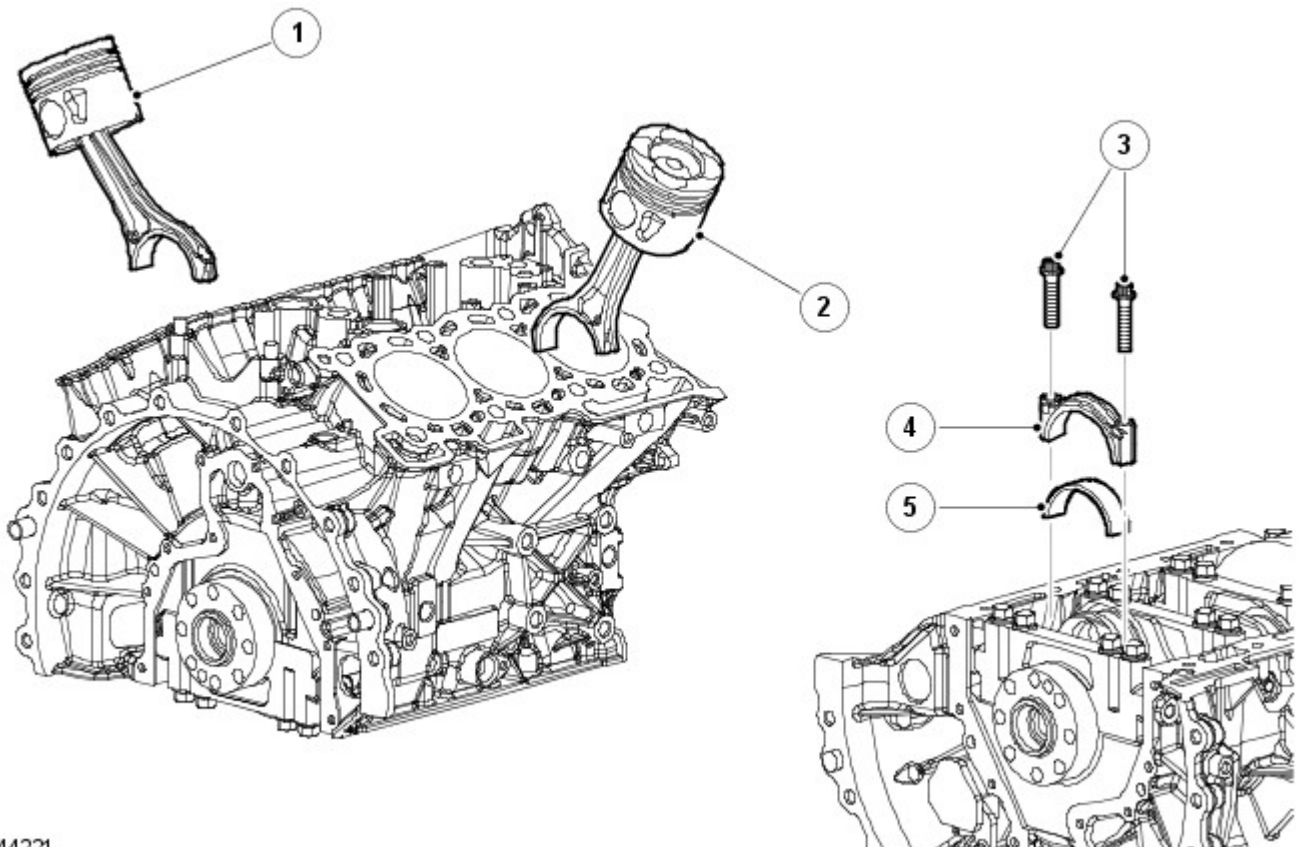


E44220

The connecting rods are manufactured from sinter-forged steel and have fracture-split bearing caps. The bearing caps are produced by fracturing the opposing sides of the connecting rod at the bearing horizontal centre-line. As well as being easier to manufacture, when reassembled the fractured surfaces interlock to form a strong seamless joint. The cylinder position is etched on adjoining sides of the joint to identify matching connecting rods and bearing caps. The selective connecting rod bearings are aluminium/tin split plain bearings. The connecting rod bearing is 'sputter coated', which is a manufacturing process that layers the bearing material to produce a higher load capacity for improved durability.

- NOTE: The connecting rods are not selective.

Connecting Rod Installation



E44221

Item	Part Number	Description
1	-	Piston and connecting rod assembly, cylinders 4-6
2	-	Piston and connecting rod assembly, cylinders 1-3
3	-	Bolts
4	-	Connecting rod bearing cap
5	-	Connecting rod lower bearing

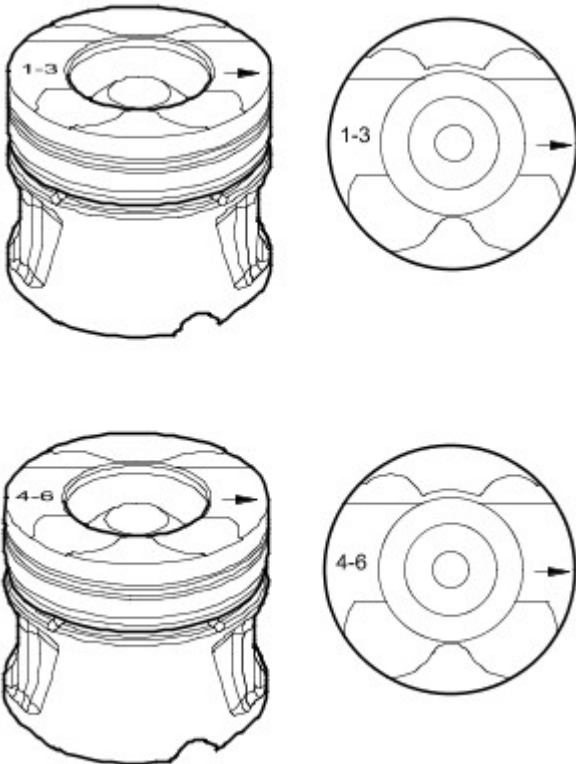
When installing a connecting rod, ensure the back of the connecting rod faces the centre of the 'vee'.

The pistons are made from aluminium alloy and are fitted with three rings. The piston crown incorporates a pronounced bowl; this forms the combustion chamber, which promotes swirl and turbulence necessary for good combustion and improved emissions. In addition, the piston skirt has a molybdenum-coated surface, which counteracts scoring of the cylinder bore and piston.

The piston also incorporates a double wave gallery within the piston crown to enhance piston cooling. The pistons are supplied oil by means of spray jets located in the cylinder block oil gallery. These jets ensure optimum piston cooling to counteract the high temperatures generated by the combustion process.

Each piston is installed on a wrist pin located in a aluminium/tin bushing in the connecting rod.

Piston Installation



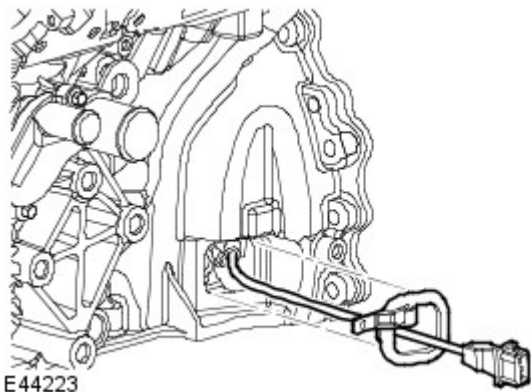
E44222

When installing pistons ensure the arrows on the piston crowns all point to the front of the engine and the pistons are located in the correct cylinder banks, i.e. cylinders 1, 2, 3 or cylinders 4, 5, 6.

- **NOTE:** All pistons are common single grade/single part number for all engines.

The piston top ring is a taper type and is fitted with the taper to the top of the piston. All rings marked 'top' are assembled with 'top' uppermost. All rings must be spaced evenly around the piston before installing. The circumference gap of the double bevelled oil control ring must be opposite the spiral control joint.

Crankshaft Position Sensor



The Crankshaft Position (CKP) sensor is located at the rear of the crankshaft, behind the flywheel in the LH side of the rear oil seal retainer. The sensor provides an input of engine crankshaft speed and position. The sensor works on the principle of the Hall effect and scans a trigger wheel (magnetic disc) on the crankshaft. An air gap of 0.4 to 1.5mm, between the trigger wheel and the CKP sensor, is achieved by the positional mounting of the sensor. For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

Starter Motor

The engine starter motor is installed at the rear RH side of the ladder frame, at the cylinder block to ladder frame split line. For additional information, refer to: [Starting System](#) (303-06A Starting System - TDV6 2.7L Diesel, Description and Operation).

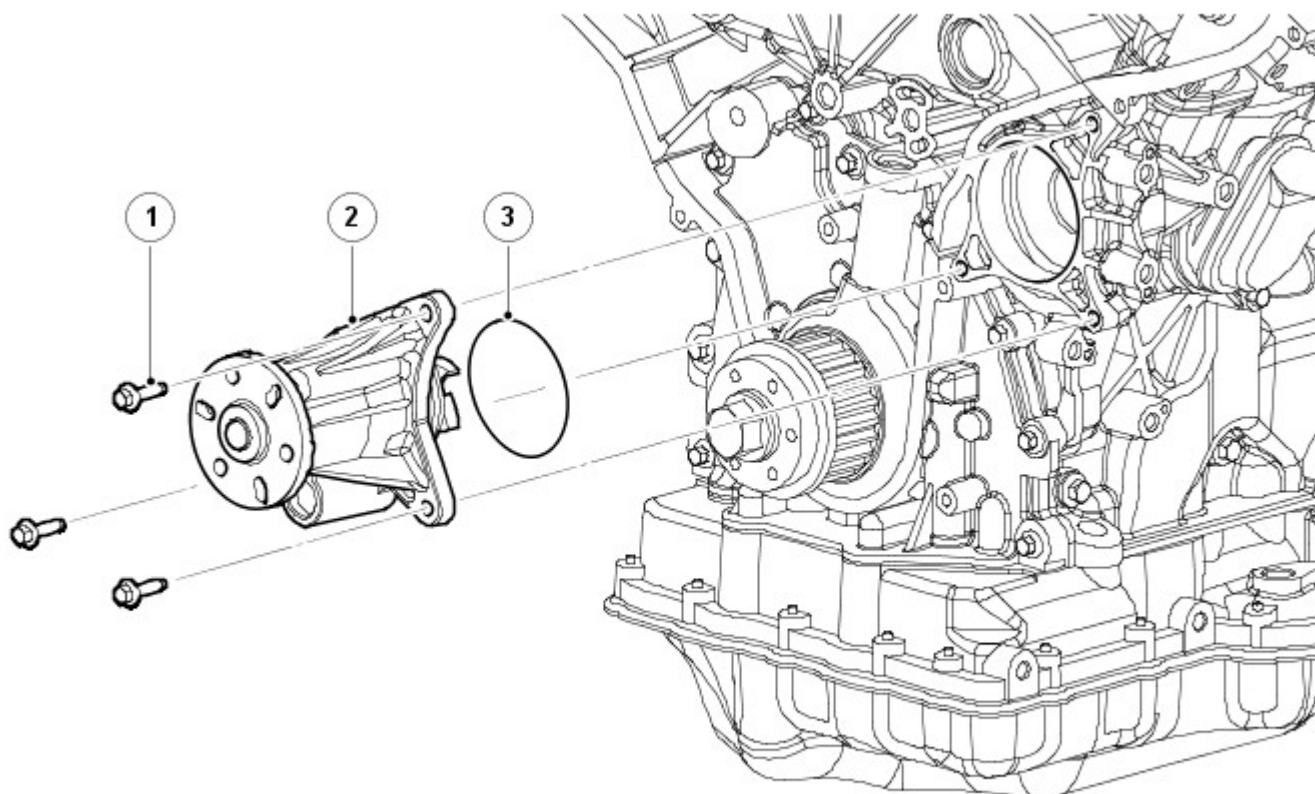
Coolant Drain Plug

Two coolant drain plugs are installed in the cylinder block, one is fitted in the rear RH side, and the other is fitted in the middle of the cylinder block on the LH side.

Cylinder Block Heater

On vehicles destined for cold climates, a cylinder block heater replaces a core plug in the middle of the cylinder block on the LH side.

Coolant Pump



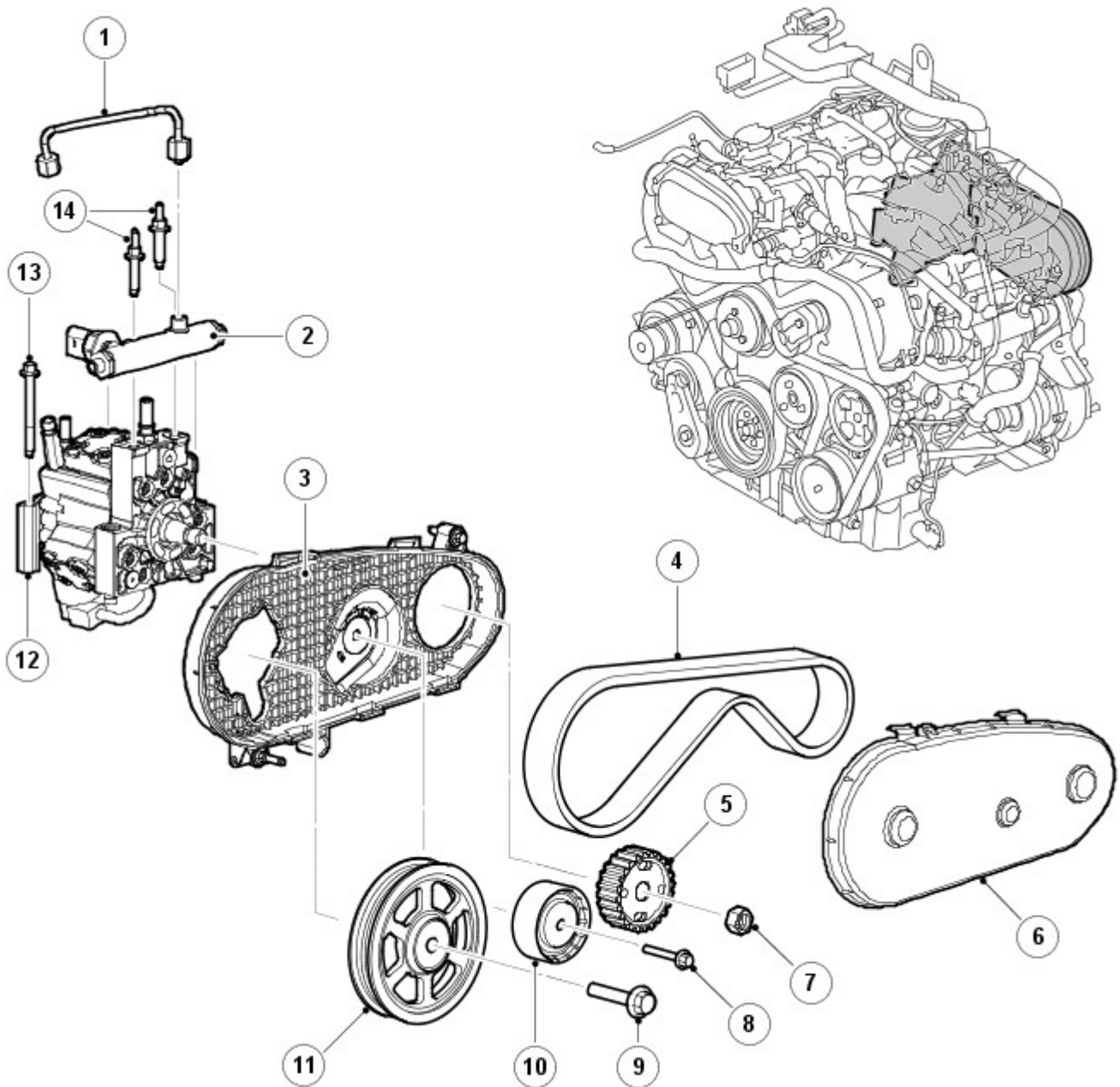
E44224

Item	Part Number	Description
1	-	Bolts

2	-	Water pump
3	-	'O' ring seal

The coolant pump is installed on the LH side of the cylinder block front face and is secured and sealed via three bolts and an 'O' ring seal. The coolant pump is driven by a poly-vee belt via the crankshaft.

High-Pressure Fuel Pump



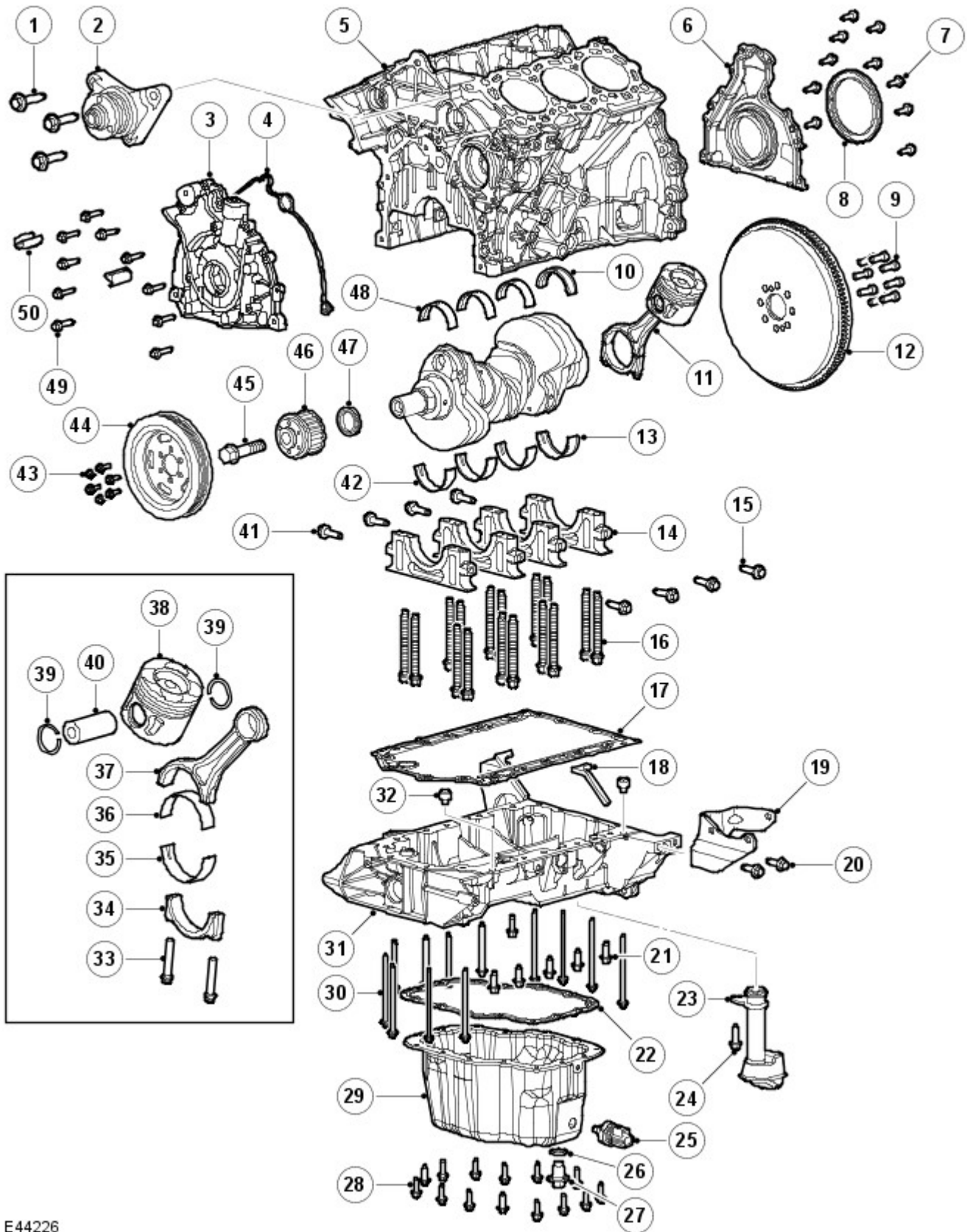
E44225

Item	Part Number	Description
1	-	Fuel pipe
2	-	Diverter rail assembly
3	-	Rear cover
4	-	Belt
5	-	Fuel pump pulley
6	-	Front cover
7	-	Nut
8	-	Bolt
9	-	Bolt
10	-	Tensioner
11	-	LH exhaust camshaft pulley
12	-	High pressure fuel pump
13	-	Bolt
14	-	Stud bolts

The high-pressure fuel pump supplies the common rail with fuel and is fixed to the rear of the cylinder block in the centre of the 'vee'. The pump is a 3 radial piston type controlled by the EMS and belt driven from the exhaust camshaft of the LH cylinder head.

For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel,

CRANKSHAFT AND SUMP COMPONENTS



E44226

Item	Part Number	Description
1	-	Bolts, 3 of
2	-	Fan driver bracket
3	-	Oil pump
4	-	Seal
5	-	Cylinder block
6	-	Rear oil seal retainer

7	-	Bolts, 10 of
8	-	Crankshaft position sensor trigger wheel
9	-	Bolts, 8 of
10	-	Main thrust bearing, upper
11	-	Piston and connecting rod assembly
12	-	Flywheel
13	-	Lower main thrust bearing
14	-	Main bearing caps, 4 of
15	-	Cross bolts, 4 of
16	-	Main bearing cap bolts, 16 of
17	-	Gasket
18	-	Seal
19	-	Bracket
20	-	Bolts, 2 of
21	-	Bolts, 6 of
22	-	Gasket
23	-	Oil pick-up
24	-	Bolt
25	-	Oil temperature sensor
26	-	Seal
27	-	Drain plug
28	-	Bolts, 14 of
29	-	Oil pan assembly
30	-	Bolts, 12 of
31	-	Ladder frame
32	-	Dowel
33	-	Bolts, 2 of
34	-	Connecting rod cap
35	-	Connecting rod cap bearing
36	-	Connecting rod bearing
37	-	Connecting rod
38	-	Piston
39	-	Piston pin retainer
40	-	Piston pin
41	-	Cross bolts, 4 of
42	-	Lower main bearings
43	-	Bolts, 5 of
44	-	Crankshaft damper pulley
45	-	Bolt
46	-	Crankshaft drive pulley
47	-	Crankshaft front oil seal
48	-	Upper main bearings
49	-	Bolts, 10 of
50	-	Seal

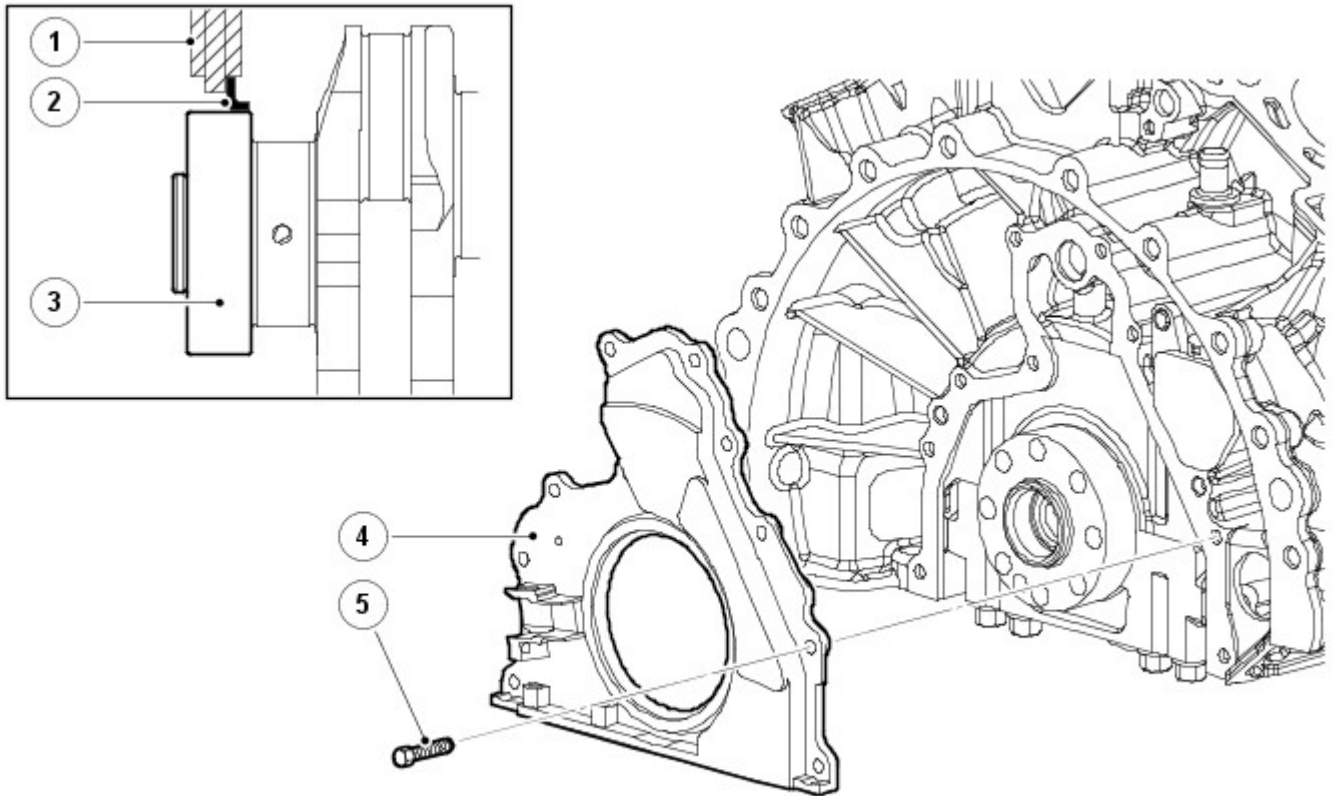
Crankshaft

The crankshaft is forged steel and fillet rolled with induction hardened journals, which run in four bearings with clamped two layer bearing shells.

The main bearing caps are double and cross-bolted, this adds to the strength and rigidity of the engine block.

The crankshaft drive pulley is not keyed onto the crankshaft; it is secured to the crankshaft by a single bolt.

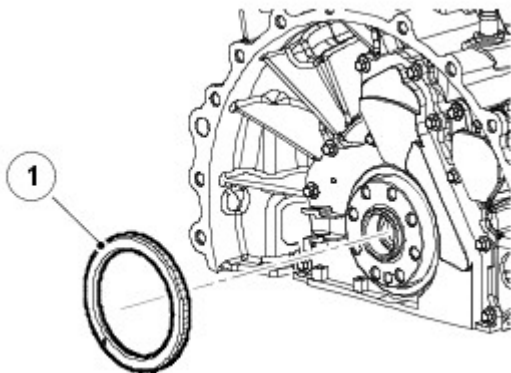
- NOTE: Under no circumstances must the crankshaft pulley be tightened or loosened with the timing belt fitted.
- NOTE: Do not attempt to remove the crankshaft drive pulley unless you have the correct special crankshaft-locking tool.



E44227

Item	Part Number	Description
1	-	Housing
2	-	Seal
3	-	Crankshaft
4	-	Rear oil seal retainer
5	-	Bolt

The crankshaft rear oil seal is a press fit in the rear oil seal retainer. The rear oil seal retainer also houses the CKP sensor.



E44228

Item	Part Number	Description
1	-	CKP sensor trigger wheel

The trigger wheel is located on the rear of the crankshaft. It is pressed onto the crankshaft using a special tool, which also precisely aligns the trigger wheel for crankshaft position and timing. The trigger wheel consists of 60 magnets, minus 2 for ECM crankshaft position reference and synchronisation. The magnets cannot be seen on the trigger-wheel; therefore, it can only be positioned using the special tool.

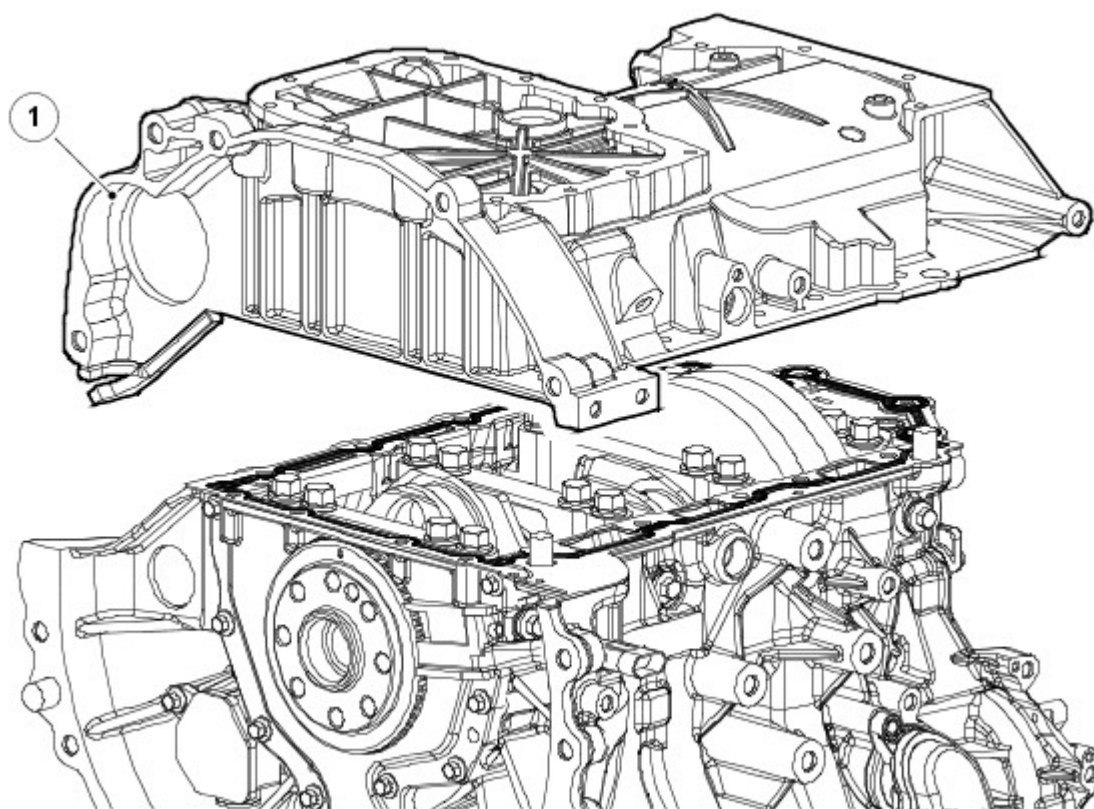
The CKP sensor air gap is 0.4mm to 0.5mm there is no adjustment. The sensor bolts into the rear oil seal retainer and the tolerance on the retainer and sensor gives an air gap within the specified range.

• **NOTE:** If the trigger wheel is removed for any reason, a new trigger wheel must be fitted. Do not reuse the old trigger wheel.

Main Bearings

The main bearings are aluminium/tin split plain selective bearings. An oil groove in the top half of each bearing transfers oil into the crankshaft for lubrication of the connecting rod bearings. The upper and lower shells of bearing number four contain integral thrust washers, which limits the end float of the crankshaft.

Ladder Frame



E44229

Item	Part Number	Description
1	-	Ladder frame

The ladder frame is fitted to the lower cylinder block to stiffen the base structure thus helping to reduce Noise, Vibration and Harshness (NVH). The frame is made of high-pressure die cast aluminium and also incorporates an oil baffle plate to reduce oil foaming and slosh.

The ladder frame is secured to the cylinder block with 2 dowels, 2 locator pins for the gasket and 18 retaining bolts; three different lengths of bolts are used:

- M6 x 20, 6 of
- M8 x 75, 4 of
- M6 x 105, 8 of

Iron inserts, cast into the main bearing supports of the ladder frame, minimise main bearing clearance changes due to heat expansion.

A gasket seals the joint between the ladder frame and the cylinder block.

A port for the oil level gauge tube is included in the casting on the LH side of the ladder frame.

An oil pick-up pipe with integral strainer locates in the front of the ladder frame to provide oil to the crankshaft driven oil pump.

Sump

The sump consists of a pressed steel oil pan bolted to the aluminium alloy ladder frame with 14 M6 x 16 bolts. The engine oil drain plug and the oil temperature sensor are located at the rear left corner of the sump.

A reusable gasket seals the joint between the oil pan and the ladder frame; a bead of sealant seals the joint between the sump and the ladder frame.

Oil Temperature Sensor

The engine oil temperature sensor is located at the rear left corner of the sump. The sensor provides the ECM and the instrument pack with the engine oil temperature status.

The sensor circuit consists of an internal voltage divider circuit which, incorporates an Negative Temperature Coefficient (NTC) thermistor. As the engine oil temperature rises the resistance through the sensor decreases and visa versa. The output from the sensor is the change in voltage, as the thermistor allows more current to pass to earth relative to the temperature of the oil.

For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

Rear Oil Seal Retainer

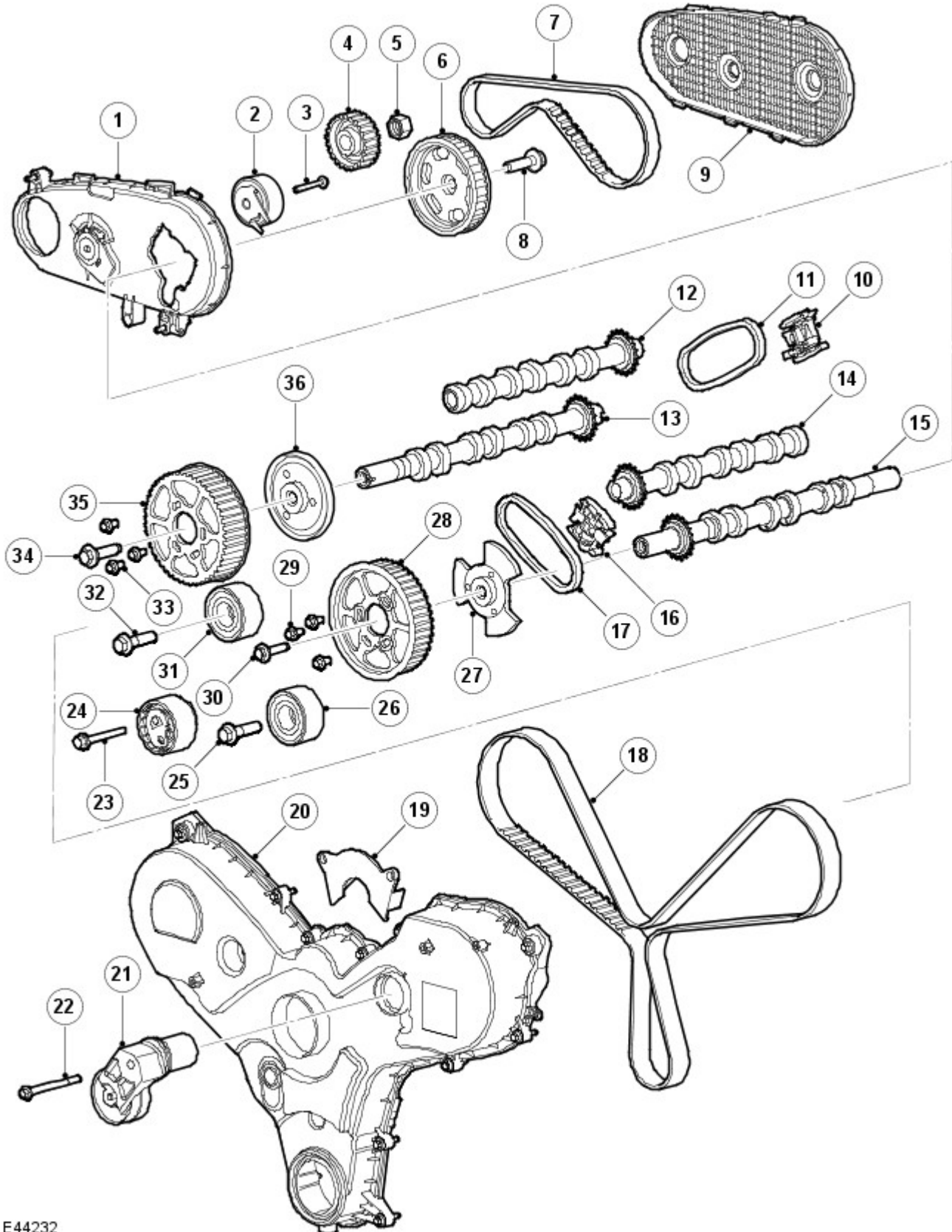
The crankshaft rear oil seal retainer is attached to the rear of the cylinder block by ten bolts and is sealed with a rubber seal. The retainer also houses the crankshaft position sensor.

Dual Mass Flywheel

On vehicles with manual transmission, the dual mass flywheel is bolted on the rear of the crankshaft with eight bolts. A dowel on the crankshaft flange ensures that the flywheel is correctly located. A ring gear is fitted on the outer diameter of the flywheel. The ring gear is not serviceable.

The dual mass flywheel is used to insulate the gearbox from torsional and transient vibrations produced by the engine. For additional information, refer to: [Clutch](#) (308-01 Clutch - TDV6 2.7L Diesel, Description and Operation).

CAMSHAFT TIMING COMPONENTS



E44232

Item	Part Number	Description
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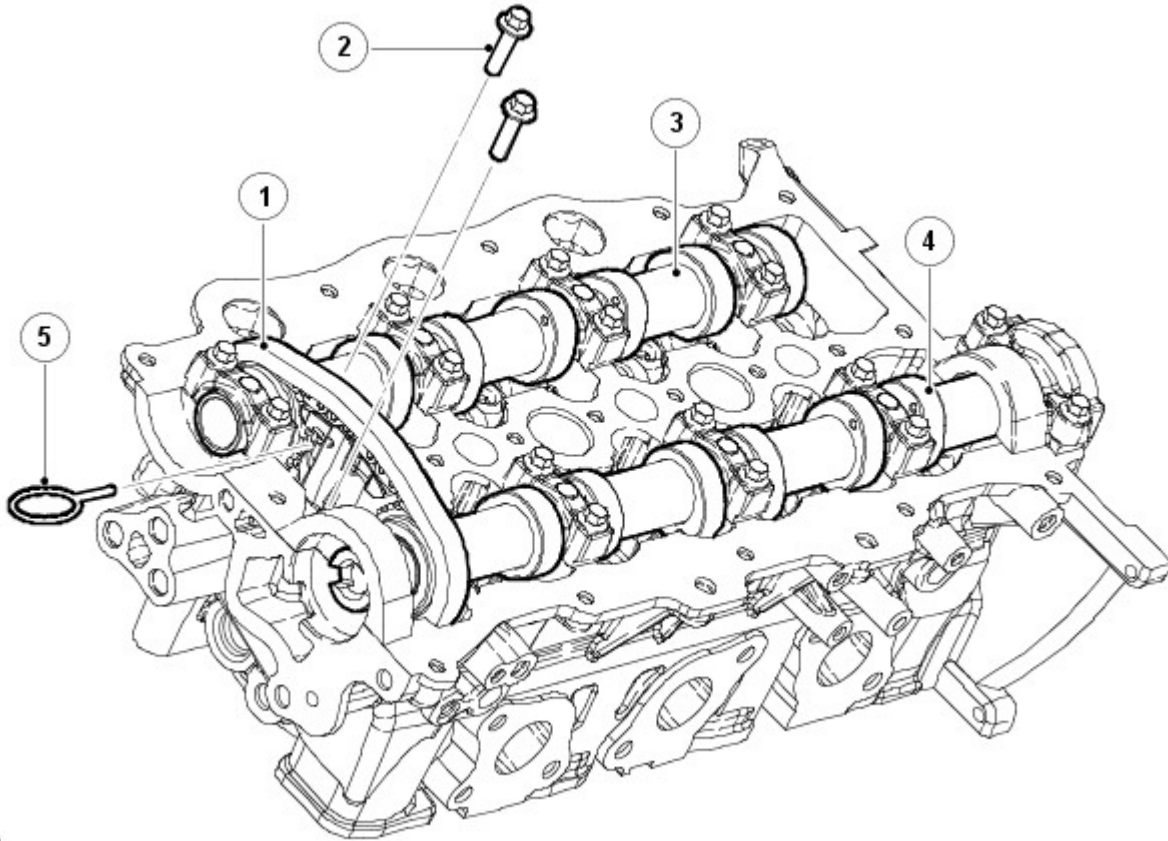
1	-	Rear Engine Accessory Drive (READ) rear cover
2	-	READ tensioner
3	-	Bolt
4	-	Fuel pump pulley
5	-	Nut
6	-	READ camshaft pulley
7	-	READ belt
8	-	Bolt
9	-	READ front cover
10	-	RH chain tensioner
11	-	RH timing chain
12	-	RH inlet camshaft
13	-	RH exhaust camshaft
14	-	LH inlet camshaft
15	-	LH exhaust camshaft
16	-	LH chain tensioner
17	-	LH timing chain
18	-	Timing belt
19	-	Front cover bridge
20	-	Primary drive cover
21	-	Idler
22	-	Bolt
23	-	Bolt
24	-	Tensioner
25	-	Bolt
26	-	Idler
27	-	Camshaft hub
28	-	LH camshaft timing pulley
29	-	Bolt, 3 of
30	-	Bolt, 1 of
31	-	Idler
32	-	Bolt, 1 of
33	-	Bolt, 3 of
34	-	Bolt, 1 of
35	-	RH camshaft timing pulley
36	-	Camshaft hub

Primary Drive

Primary drive is provided by a single toothed belt from the crankshaft to the exhaust camshaft gears of each cylinder bank via two idler pulleys and a tensioner.

Timing belt adjustment is carried out by an eccentric type tensioner mounted on the RH front face of the cylinder block.

Secondary Drive



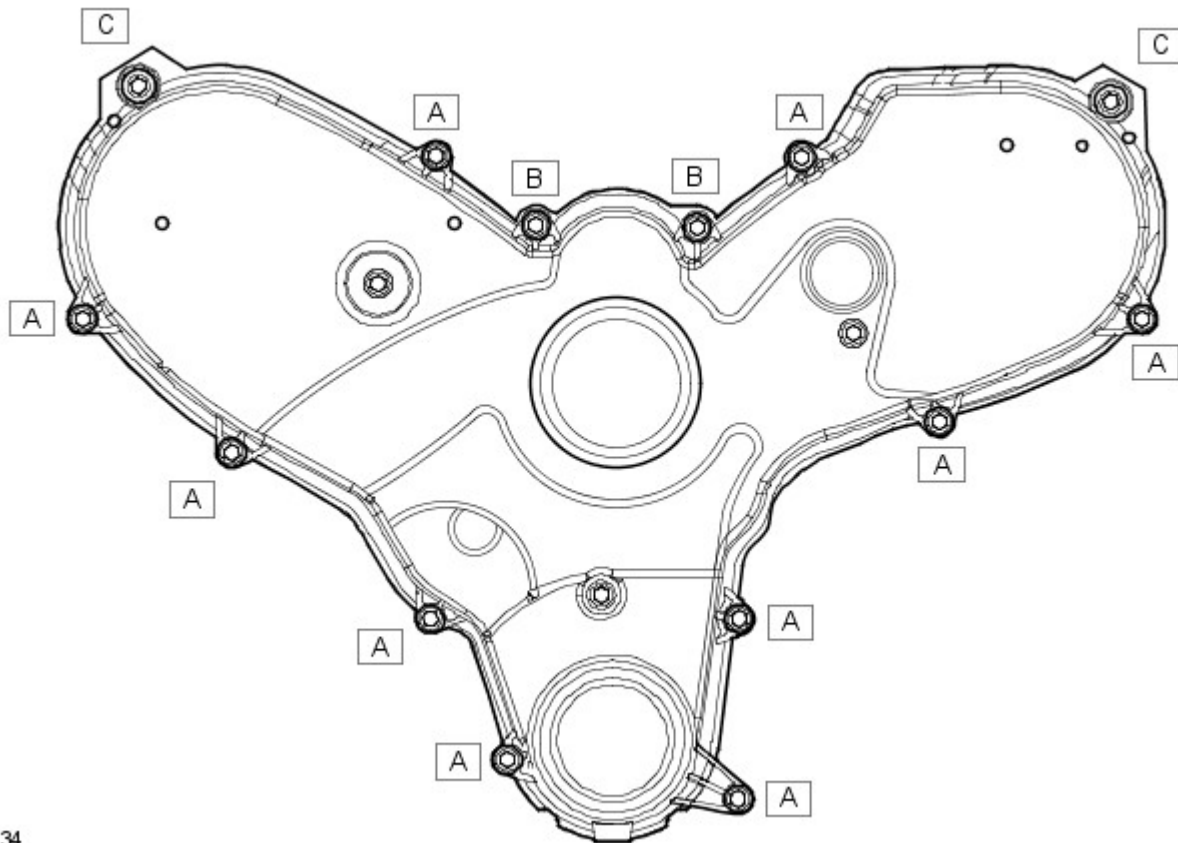
E44233

Item	Part Number	Description
1	-	Timing chain
2	-	Bolts
3	-	Inlet camshaft
4	-	Exhaust camshaft
5	-	Tensioner firing pin

Secondary drive is provided by two short crossover chains, which transfer drive from the exhaust camshaft gears to the inlet camshaft gears. The crossover drives are located at the rear of the RH cylinder bank and the front of the LH cylinder bank. This allows for a much shorter and simpler run for the main camshaft drive belt at the front of the engine.

Each crossover chain is tensioned via an automatic chain tensioner, which acts directly on the chains via a guide rail. The tensioners are located between the exhaust and inlet camshafts at the front or rear of the cylinder head, depending on the cylinder bank.

Timing Cover

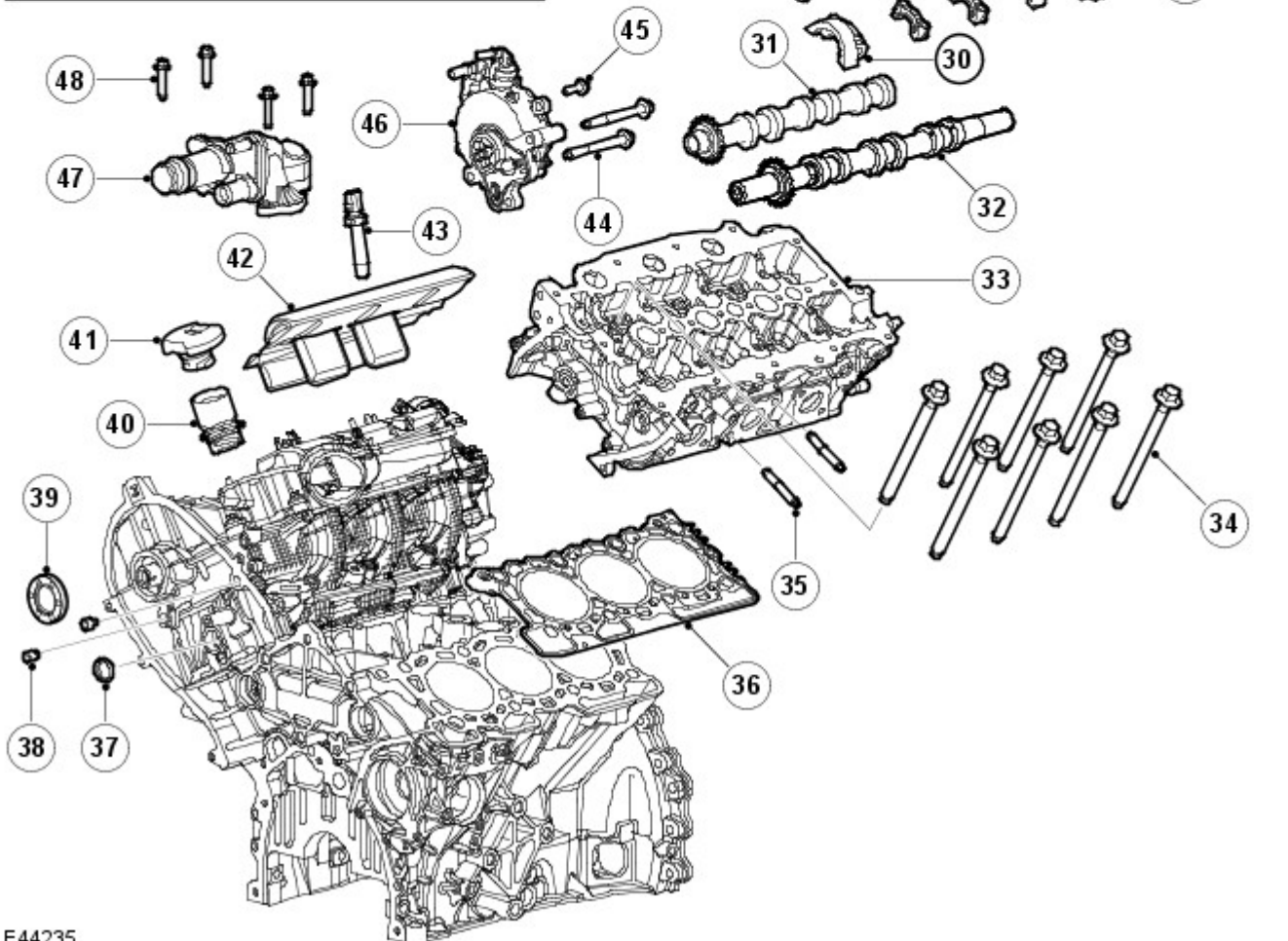
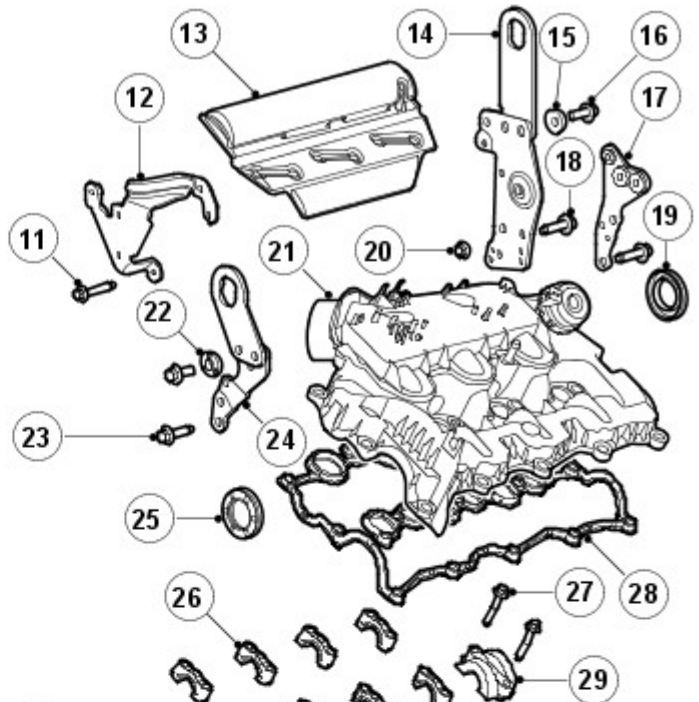
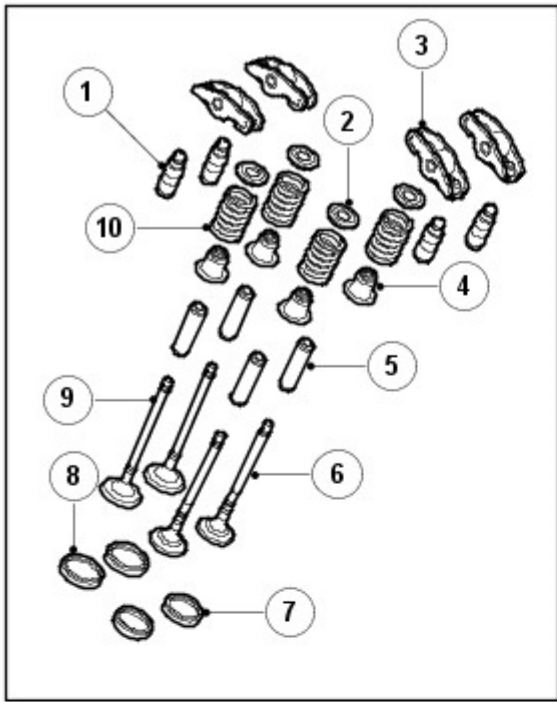


E44234

Item	Part Number	Description
A	-	Bolt (M6 x 32), 13 of
B	-	Bolt (M6 x 36), 2 of
C	-	Bolt (M6 x 30), 2 of

The plastic timing cover is bolted to the front of the cylinder block and cylinder heads with sixteen bolts and sealed with a rubber seal.

CYLINDER HEAD COMPONENTS

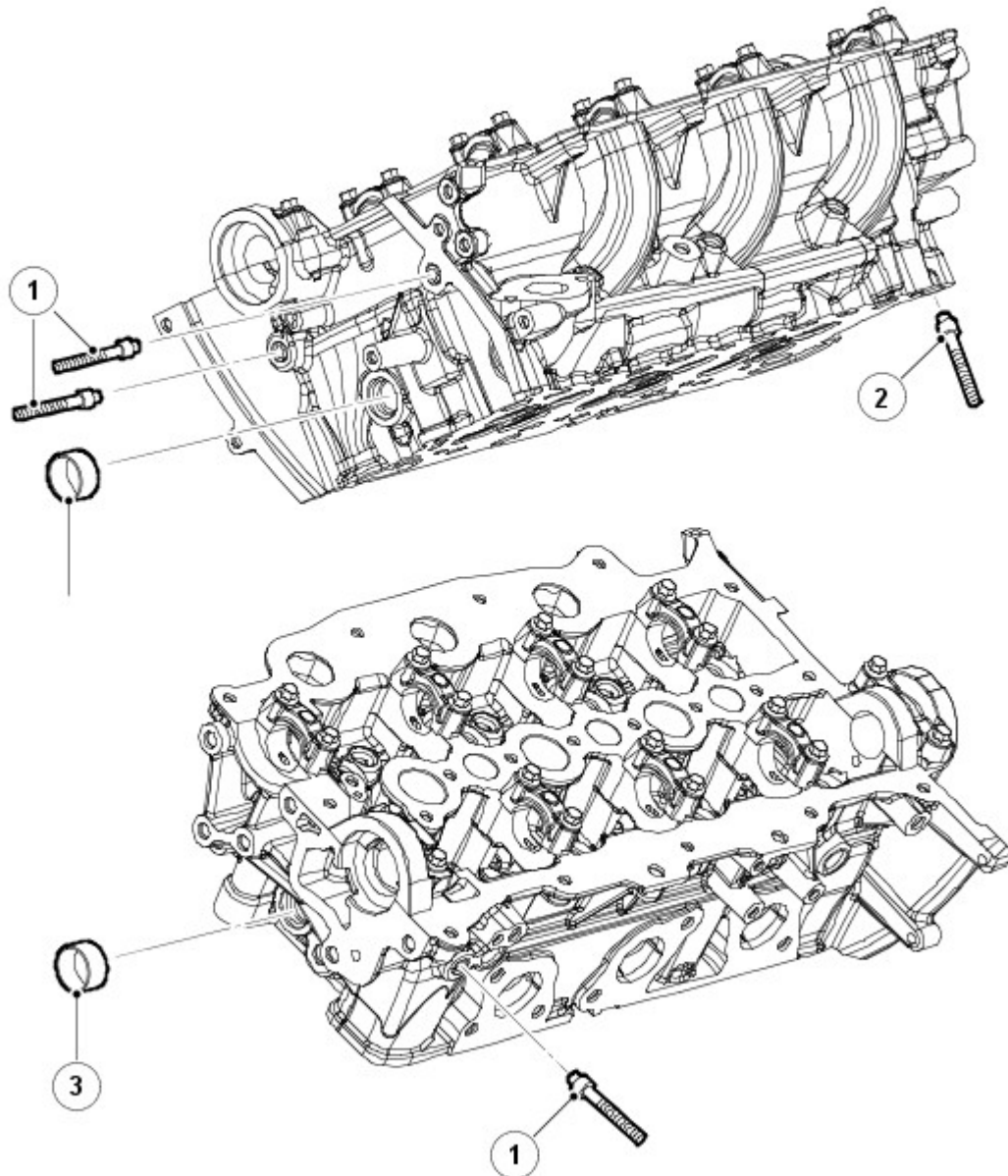


E44235

Item	Part Number	Description
1	-	Hydraulic lash adjusters
2	-	Valve spring retainers
3	-	Roller rockers
4	-	Valve stem seals
5	-	Valve guides
6	-	Exhaust valves
7	-	Intake valves
8	-	Exhaust valve seats
9	-	Intake valve seats
10	-	Valve springs
11	-	Bolt

12	-	Bracket
13	-	Cover
14	-	Lifting eye
15	-	Washer
16	-	Bolt
17	-	Bracket
18	-	Bolt
19	-	Seal
20	-	Cap
21	-	Inlet manifold cover assembly
22	-	Washer
23	-	Bolt
24	-	Lifting eye
25	-	Seal
26	-	Camshaft bearing caps
27	-	Bolts
28	-	Gasket
29	-	Camshaft bearing cap and seal housing
30	-	Camshaft bearing cap and seal housing
31	-	Inlet camshaft
32	-	Exhaust camshaft
33	-	LH cylinder head
34	-	Cylinder head bolts
35	-	Exhaust manifold studs
36	-	LH cylinder head gasket
37	-	Core plug
38	-	Plug
39	-	Seal
40	-	Oil filler tube
41	-	Oil filler cap
42	-	Cover
43	-	Injectors
44	-	Bolts
45	-	Bolt
46	-	Vacuum pump
47	-	Water outlet assembly
48	-	Bolts

Cylinder Heads



E44236

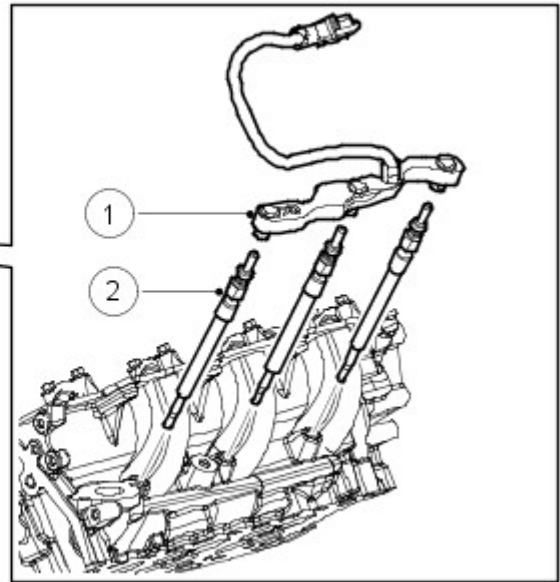
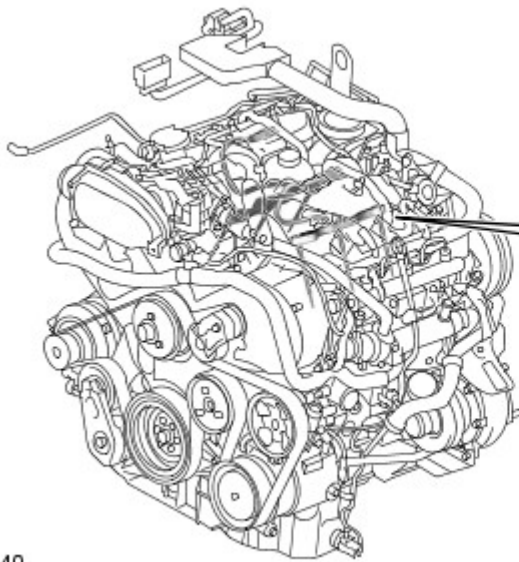
The aluminium gravity die cast cylinder heads are unique to each cylinder bank. Eight deep-seated bolts, to reduce distortion, secure each cylinder head to the cylinder block. The cylinder head bolts are located beneath the camshafts, four under the inlet camshaft and four under the exhaust camshaft. Two hollow dowels align each cylinder head with the cylinder block.

- NOTE: The cylinder head bolts are not accessible with the camshafts fitted.
- NOTE: The cylinder head cannot be reworked.

The cylinder head has four ports machined at each cylinder location, two exhaust ports and two inlet ports. One of the inlet ports is helical and functions as a swirl port, the other is arranged laterally as a tangential port and functions as a charge port.

The six fuel injection nozzles are centrally mounted; one above each cylinder and each is fixed to the cylinder head by means of a clamp and two M6 x 35 bolts.

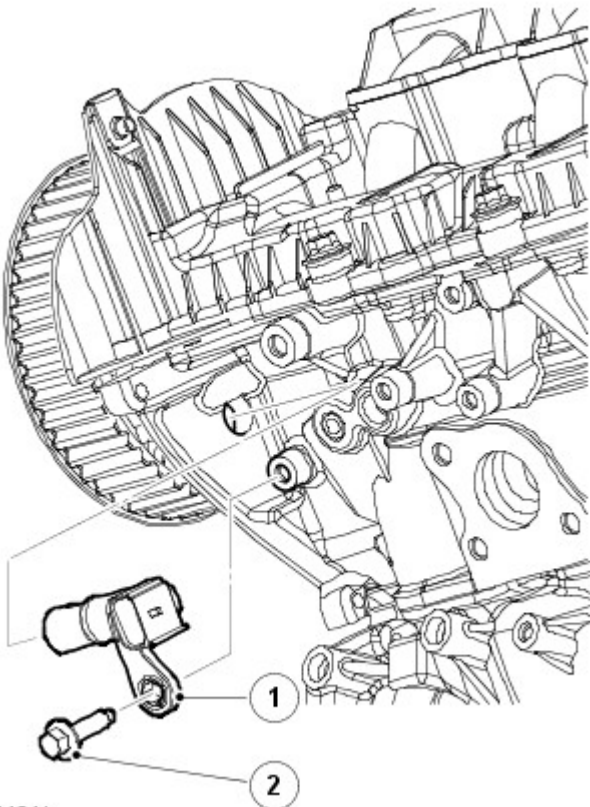
For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation) / [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Description and Operation).



E44240

Item	Part Number	Description
1	-	Harness connector
2	-	Glow plugs

The glow plugs are arranged centrally on the inlet side of the cylinder head, between the two inlet ports of each cylinder. For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).



E44241

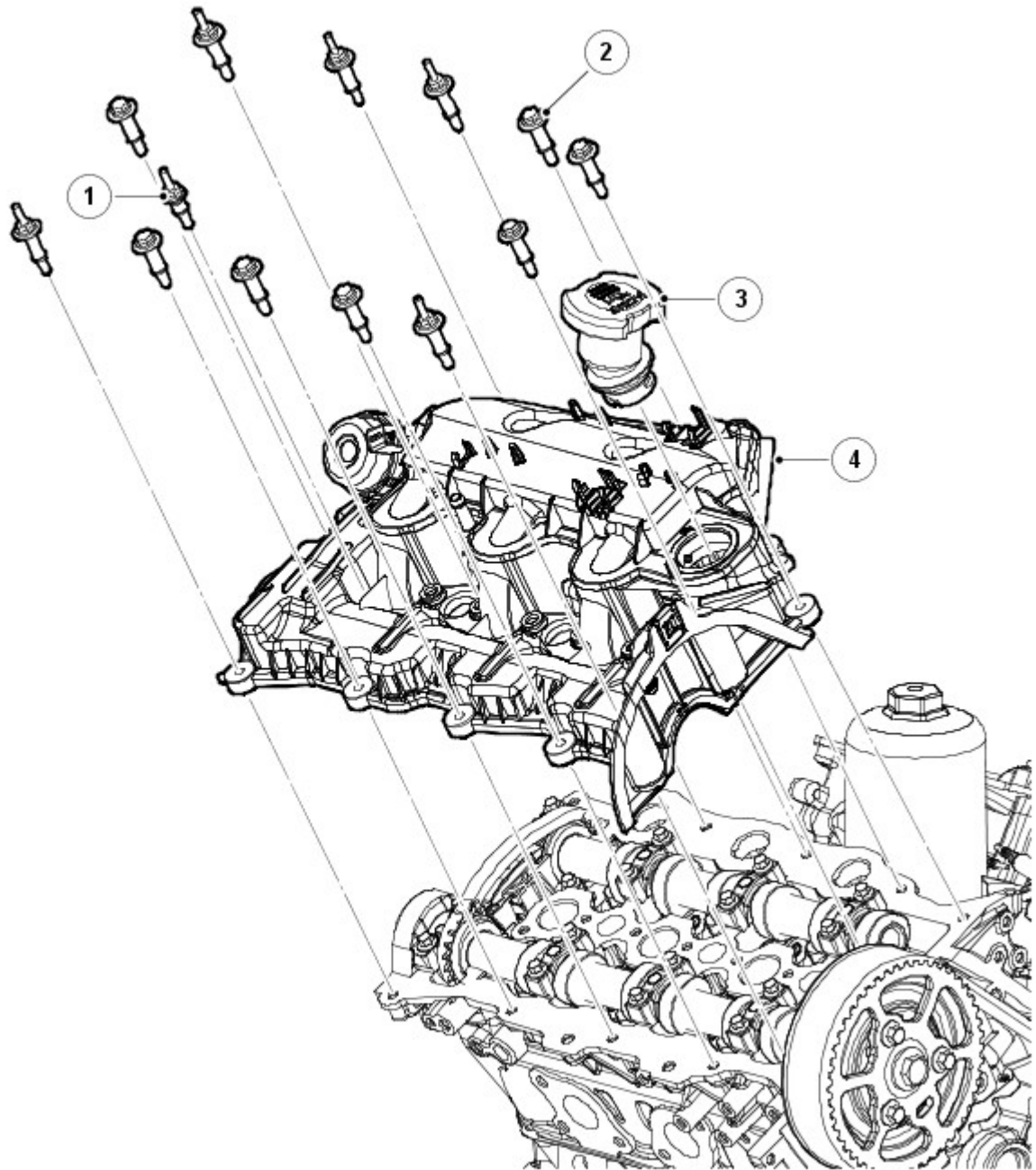
Item	Part Number	Description
1	-	Camshaft Position (CMP) sensor

The CMP sensor locates through a hole in a flange on the front LH side of the LH cylinder head. The exhaust camshaft gear of the LH cylinder head incorporates a trigger wheel, which is used in conjunction with the sensor to measure engine position.

For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

The engine lifting eyes are bolted to the cylinder head, one at the front and two at the rear, one per cylinder head.

Camshaft Covers



E44237

Item	Part Number	Description
1	-	Stud bolt M6 x 40, 6 of
2	-	Bolt M6 x 40, 7 of
3	-	Oil filler aperture
4	-	RH camshaft cover assembly

The camshaft covers are manufactured from vinyl ester composite. The RH bank camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. The LH bank camshaft cover incorporates an outlet for the part load engine breather.

For additional information, refer to: [Engine Emission Control](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Description and Operation).

Silicon rubber in-groove gaskets seal the joints between the camshaft covers and the cylinder heads. Together with spacers and seals on the camshaft cover fasteners, they also isolate the covers from direct contact with the cylinder heads, to reduce noise.

Cylinder Head Gasket

The cylinder head gasket is a three-layer, laminated steel type and is available in five different thickness. The choice of gasket thickness is dependent on the maximum piston protrusion. Gasket thickness is identified by serrations cut into the front end of the gasket.

Gasket Selection Table

Piston Protrusion (mm)	Gasket Thickness (mm)	Identification
0.541 - 0.590	1.12	1
0.591 - 0.640	1.17	2
0.641 - 0.690	1.22	3
0.691 - 0.740	1.27	4

Piston Protrusion (mm)	Gasket Thickness (mm)	Identification
0.741 - 0.790	1.32	5

To calculate the correct cylinder head gasket thickness, each piston must be measured at two points, with an average of the two measurements taken to determine the piston protrusion. The highest of the three measurements will determine the gasket required for that particular cylinder head.

- NOTE: The difference between the maximum and minimum protrusion measurement in any one bank should not be greater than 0.1mm. It is permissible to have a different grade of gaskets between the LH and RH banks.

Camshafts

The camshafts are of a hollow steel tube construction, with pressed on sintered lobes. Each camshaft is retained by aluminium alloy caps, five for the exhaust camshafts and four for the inlet camshafts. Location letters, A to I for the intake camshaft and R to Z for the exhaust camshaft, are marked on the outer faces of the caps for each cylinder head.

The LH cylinder bank exhaust camshaft is machined to accept a rear camshaft gear. The rear camshaft gear provides drive for High Pressure (HP) fuel pump, located centrally at the rear of the 'vee', via a short-toothed belt and tensioner pulley.

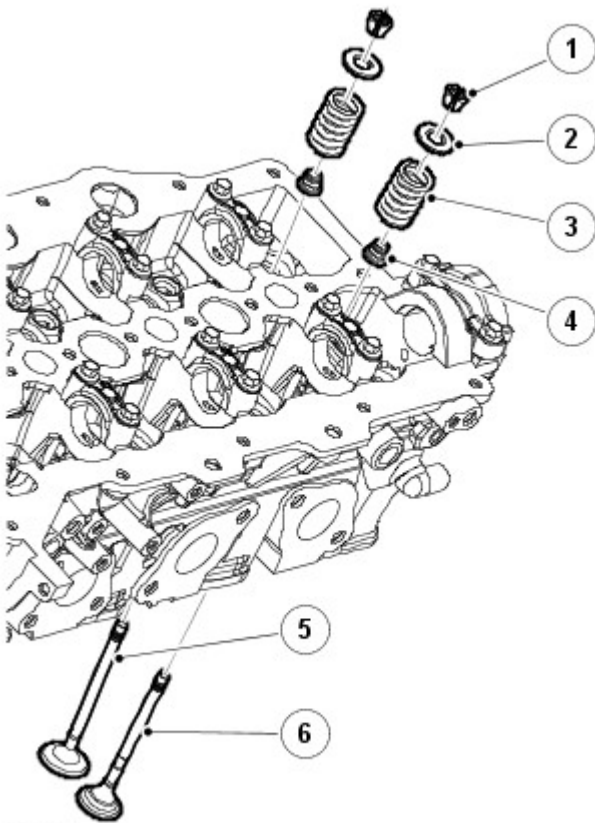
The RH cylinder head exhaust camshaft is machined at the rear end to provide a drive connection for the vacuum pump.

- NOTE: The camshaft drive sprockets also form the thrust faces for the camshaft endfloat. In production the endfloat is 0.065mm to 0.185mm. In service, if the endfloat is out of specification, the camshaft(s) or cylinder head(s) may have to be replaced.

Camshaft Timing

Valve	Position
Inlet valve opens	8.5° BTDC
Inlet valve closes	35.5° ABDC
Exhaust valve opens	64° BBDC
Exhaust valve closes	12° ATDC

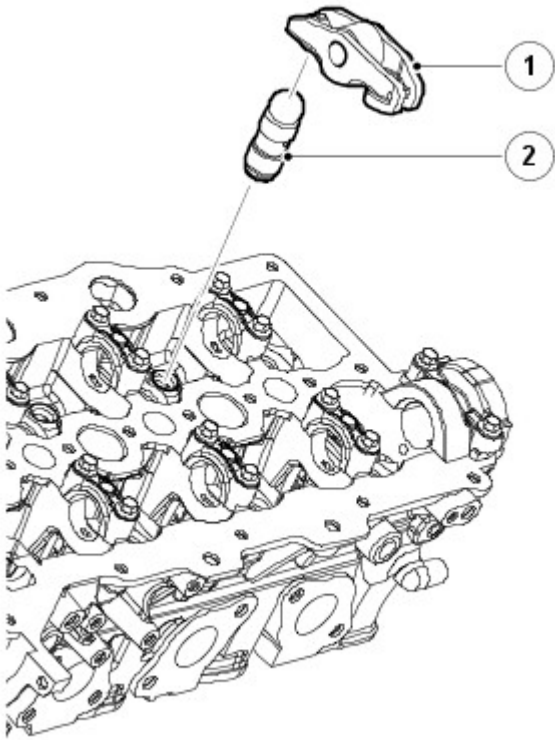
Inlet and Exhaust Valves



E44239

Item	Part Number	Description
1	-	Valve spring collets
2	-	Valve spring retainer
3	-	Valve spring
4	-	Valve stem seal
5	-	Inlet valve
6	-	Exhaust valve

Each cylinder head incorporates two overhead camshafts operating four valves per cylinder via steel roller rockers with hydraulic lash adjusters.

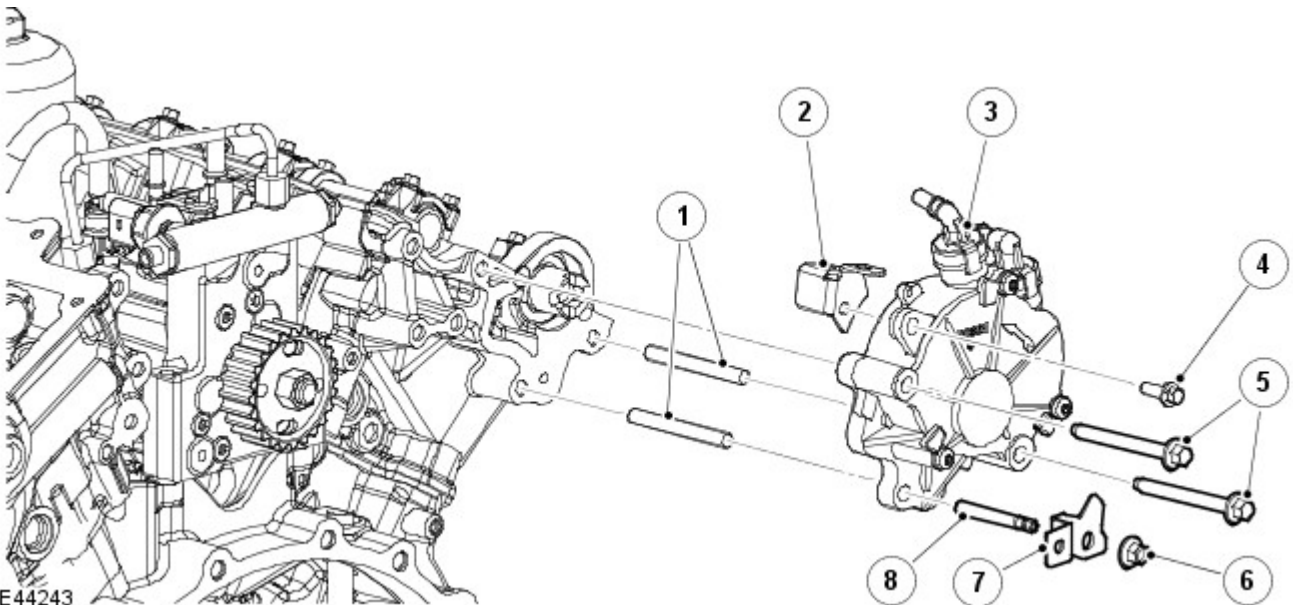


E44238

Item	Part Number	Description
1	-	Roller rocker
2	-	Hydraulic lash adjuster

The lightweight valve gear provides good economy and noise levels. Valve head diameters are 31mm (1.220 in) for the exhaust and 35mm (1.378 in) for the intake. All valves have 5mm (0.197 in) diameter stems supported in sintered metal seats and guide inserts. Collets, valve collars and spring seats locate single valve springs on both intake and exhaust valves. Valve stem seals are integrated into the spring seats.

Vacuum Pump

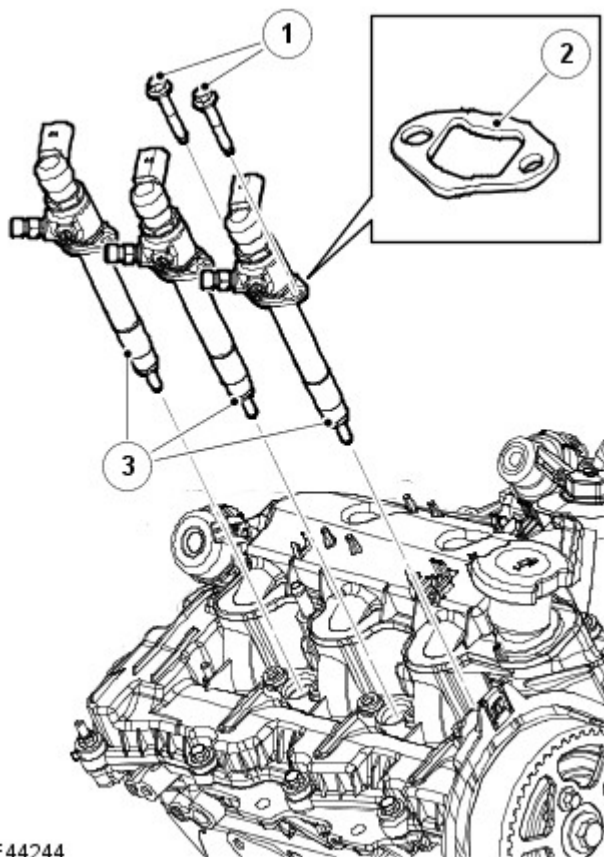


E44243

Item	Part Number	Description
1	-	Location dowels
2	-	Bracket
3	-	Vacuum pump
4	-	Bolt
5	-	Bolts
6	-	Nut
7	-	Bracket (transmission breather hose)
8	-	Stud

The vacuum pump is located at the rear of the RH side cylinder head and is driven from the exhaust camshaft.

Fuel Injectors



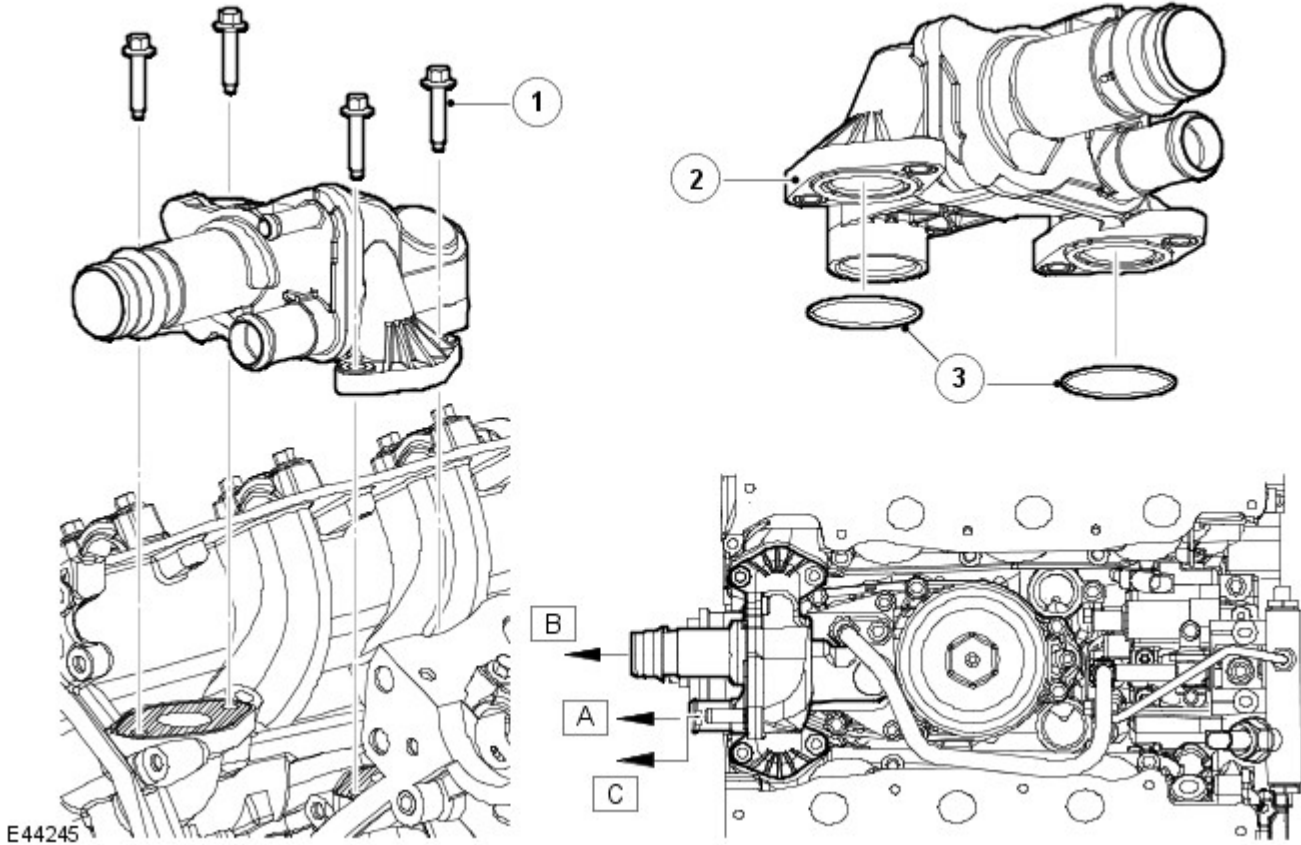
E44244

Item	Part Number	Description
1	-	Bolt, 2 per injector
2	-	Clamp
3	-	Injectors

The fuel injectors inject the quantity of fuel required for all the engine operating conditions into the combustion chambers. The quantity of fuel injected during each working cycle is composed of a noise-reducing pilot injection phase and a main injection phase.

The six, side fed, piezo electrically controlled fuel injectors are installed in the fuel rails. The start of fuel injection and the quantity of fuel injected is controlled directly by the ECM. Two O-rings seal each injector to the manifold interface. For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation) / [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Description and Operation).

Water Outlet Assembly



Item	Part Number	Description
1	-	Bolt, 4 of
2	-	Water outlet assembly
3	-	Seals
A	-	Water outlet housing assembly, EGR outlet
B	-	Water outlet housing assembly, radiator outlet
C	-	Water outlet housing assembly, bleed valve

The water outlet assembly connects the cooling channels of the cylinder block to the cooling channels of the LH and RH cylinder heads and provides the coolant outlet for the EGR and coolant return.

LUBRICATION SYSTEM

General

Oil is drawn from the reservoir in the oil pan and pressurised by the oil pump. The output from the oil pump is then filtered and distributed through internal oil passageways.

All moving parts are lubricated by pressure or splash oil. Pressurised oil is also provided for operation of the hydraulic adjusters and the timing gear chain tensioners.

The engine is lubricated by a force-feed oil circulation system with a full flow oil filter. The oil cooler forms a unit with the oil filter and fuel cooler, which is mounted centrally in the middle of the cylinder block between the two banks of cylinders. The engine oil is cooled using the engine cooling system. This eliminates the need for an additional engine oil cooler remotely mounted.

The fuel cooler, which forms part of the oil filter body, is also cooled by engine coolant. In addition there is a further fuel cooler in the return line to the fuel tank.

The oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the quick return of the oil, reducing the volume of oil required and enabling an accurate check of the contents soon after the engine stops.

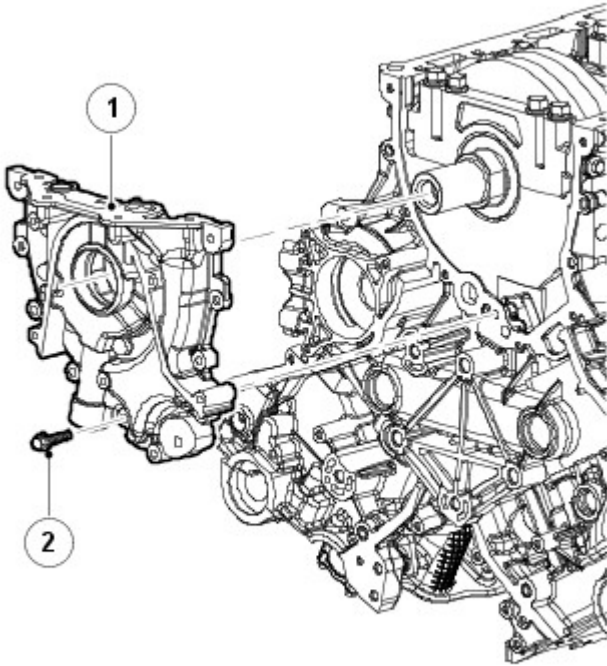
System replenishment is through the oil filler cap on the RH camshaft cover.

With the exception of the pump and level gauge, all oil system components are installed on the sump.

Oil Pick-up

The moulded composite oil pick-up is immersed in the oil reservoir to provide a supply to the oil pump during all normal vehicle attitudes. The castellated inlet allows the supply to be maintained even if the sump pan is deformed (e.g. by 'grounding'). A mesh screen in the inlet prevents debris from entering the oil system.

Oil Pump



E44230

Item	Part Number	Description
1	-	Oil pump
2	-	Bolt

The oil pump is a gear type pump and is bolted and dowelled to the front of the engine block. It is sealed by means of a rubber gasket, which is recessed into the oil pump housing. The pump inlet and outlet ports align with oil passages in the ladder frame.

The pumping element is an eccentric rotor, which is directly driven by flats on the crankshaft. An integral pressure relief valve regulates pump outlet pressure at 4.5 Bar (65.25 Psi).

The front crankshaft oil seal is housed in the oil pump casing and is fitted such that its front face is 1mm underflush with the machined front face of the oil pump.

- NOTE: The seal is not to be pushed all the way into the bore as this will block the seal drains.

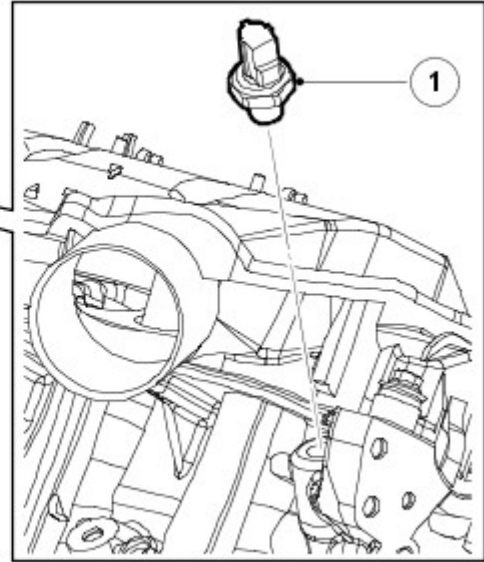
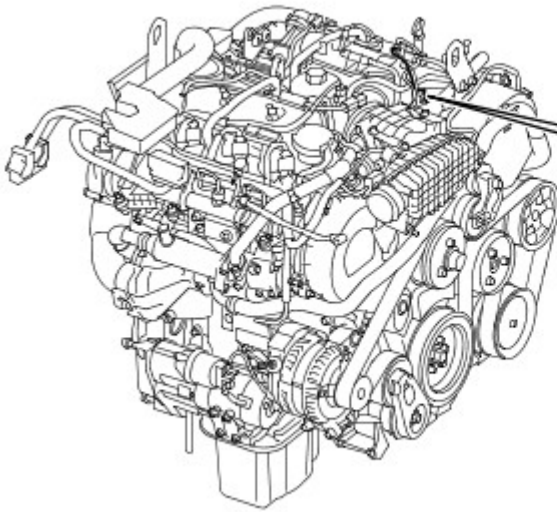
Oil Filter

The oil filter is a replaceable cartridge installed on an adapter in the centre of the 'vee'. An internal bypass facility permits full flow bypass if the filter is blocked.

- NOTE: In service care must be taken when removing the oil filter to minimise oil drips and spillage into the engine 'vee' and cam covers:

- Do not use air/power tools
- Unscrew oil filter cap 4-5 turns
- Leave for a minimum of 1 minute to allow to drain
- Remove cap, ensuring minimal oil spillage
- Replace oil filter element into the cap (can only be fitted in one direction)
- Replace cap and torque to specification.

Oil Pressure Switch



E44247

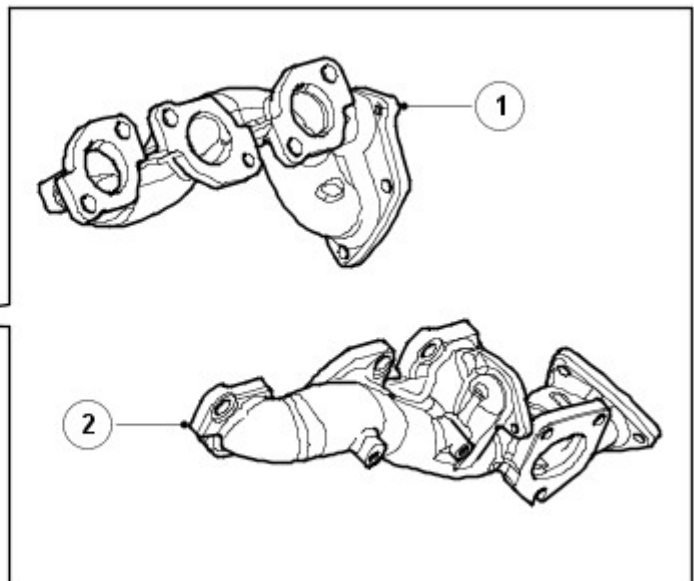
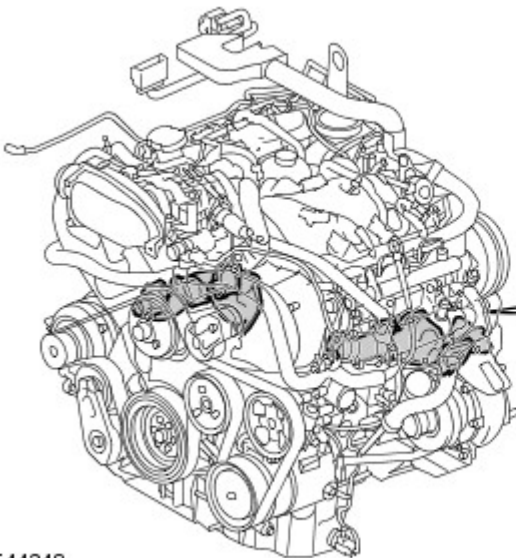
Item	Part Number	Description
1	-	Oil pressure switch

The oil pressure switch, located in the 'vee' at the front of the LH cylinder head, connects a ground input to the instrument cluster when oil pressure is present. The switch operates at a pressure of 0.15 to 0.41 Bar (2.2 to 5.9 Psi).

Oil Level Gauge

The oil level gauge locates midway along the LH side of the oil pan, supported in a tube installed in the ladder frame. Two holes in the end of the gauge indicate the minimum and maximum oil levels. There is a difference of approximately 1 litre (1 US quart) between the two levels.

EXHAUST MANIFOLD



E44248

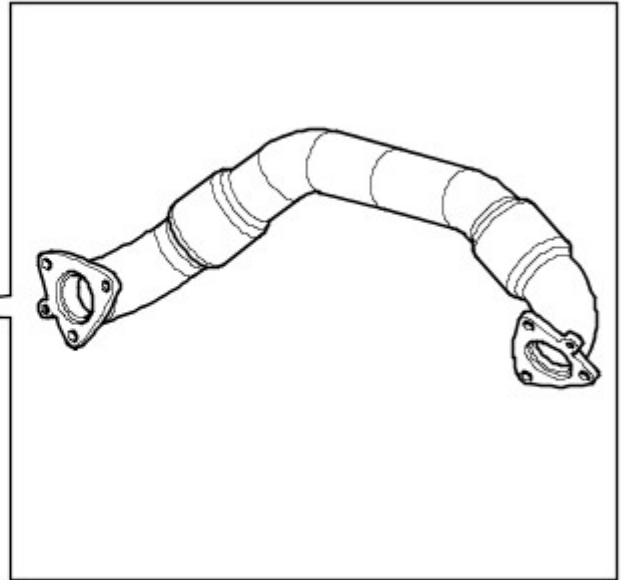
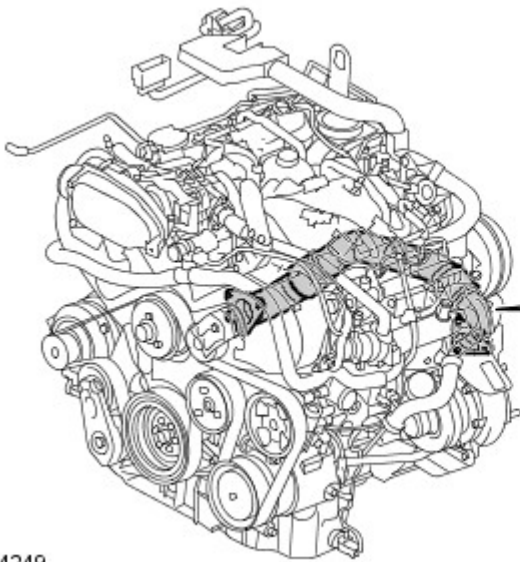
Item	Part Number	Description
1	-	LH exhaust manifold
2	-	RH exhaust manifold

The exhaust manifolds are cast from steel alloy and are unique for each cylinder bank. They are sealed to the cylinder head by means of a steel gasket. Sacrificial plastic sleeves are used to align the manifolds. These sleeves must be changed when refitting the manifolds. Spacers on the securing bolts allow the manifolds to expand and retract with changes of temperature while maintaining the clamping loads.

Each manifold has a connection for the EGR transfer pipe.

The engine is fitted with a Variable Geometry Turbocharger (VGT), which is fixed to the exhaust manifold by a three hole flange with a steel gasket.

Crossover Pipe



E44249

A crossover pipe carries the exhaust gasses from the RH exhaust manifold to the turbocharger on the LH exhaust manifold. The crossover pipe is located at the rear of the engine and is routed across the top of the transmissions bell housing.

Engine - TDV6 2.7L Diesel - Engine


Diagnosis and Testing

For additional information.


REFER to: [Engine - TDV6 2.7L Diesel](#) (303-00 Engine System - General Information, Diagnosis and Testing).

Engine - TDV6 2.7L Diesel - Engine Oil Draining and Filling

General Procedures

Special Tool(s)	
 <p>303-1128</p> <p>E54553</p>	<p>Oil filter element remover</p> <p>303-1128</p>

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

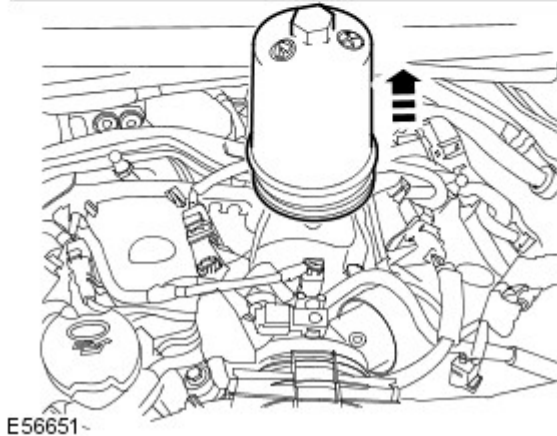
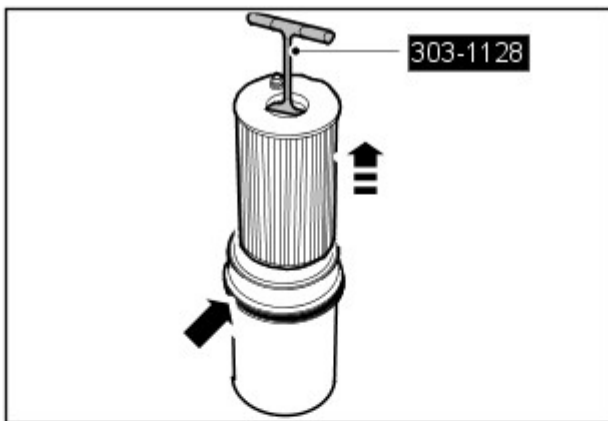
Raise and support the vehicle.

3. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

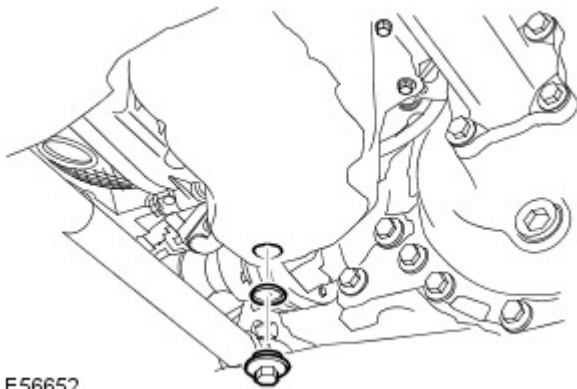
4.  **CAUTION:** When removing the oil filter assembly, make sure the fuel temperature sensor is not damaged.

Using the special tool, remove the oil filter element.

- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.
- Remove element cover.
- Remove and discard the O-ring seal.



5. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



6. Remove the lubricant drain plug.

- Position a container to collect the fluid.
- Discard the oil pan drain plug seal.

7. Install the lubricant drain plug.

- Clean the component mating faces.
- Install a new sealing washer.
- Tighten the drain plug to 25 Nm (18 lb.ft).

8. Install the oil filter element.

- Clean the components.
- Make sure the oil filter element spigot aligns with the hole in the filter housing.
- Install a new O-ring seal.
- Tighten the element cover to 25 Nm (18 lb.ft).

9. Fill the engine with oil.

10. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

11. Install the engine cover.

For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

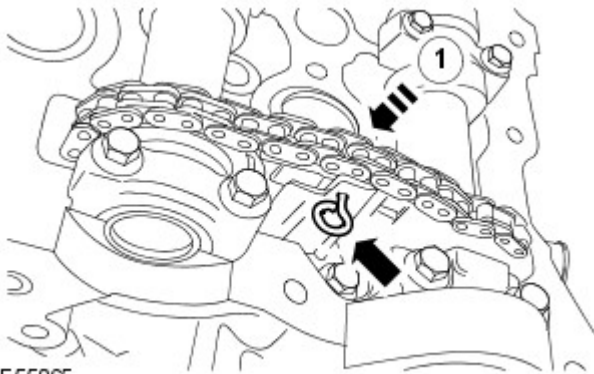
13. Check and top-up the engine oil.

Engine - TDV6 2.7L Diesel - Camshaft RH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the camshaft front seal.
For additional information, refer to: [Camshaft Front Seal](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
3. Remove the brake vacuum pump.
For additional information, refer to: [Brake Vacuum Pump - TDV6 2.7L Diesel](#) (206-07 Power Brake Actuation, Removal and Installation).
4. Remove the RH valve cover.
For additional information, refer to: [Valve Cover RH](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
5. Retain the secondary timing chain tensioner piston.
 - Reposition the secondary timing chain tensioner.
 - Install a 1.5 mm (0.060 in.) diameter pin into the secondary timing chain tensioner piston.

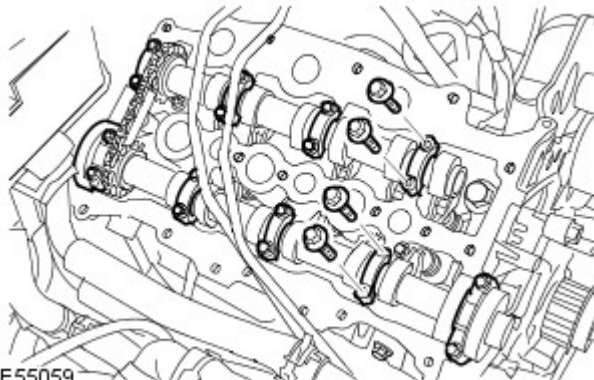


E55065

6.  **CAUTION:** Evenly and progressively, release the camshaft bearing caps.

Remove the camshaft bearing caps.

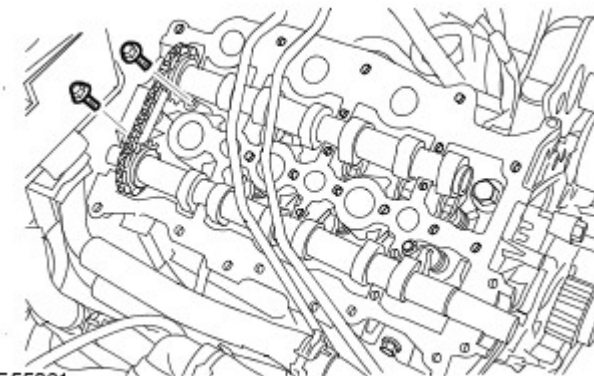
- Remove the 18 retaining bolts.



E55059

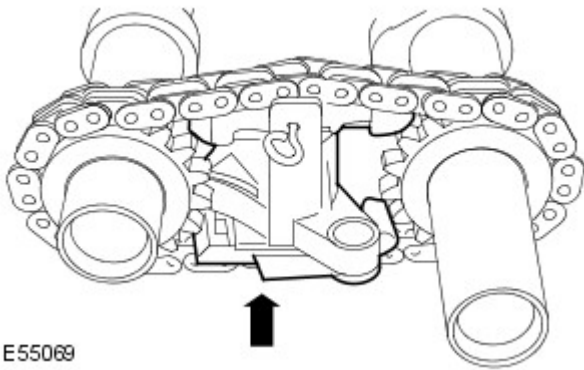
7. Remove the camshafts and secondary timing chain tensioner assembly.

- Remove the two retaining bolts.
- Release the RH secondary timing chain tensioner.



E55061

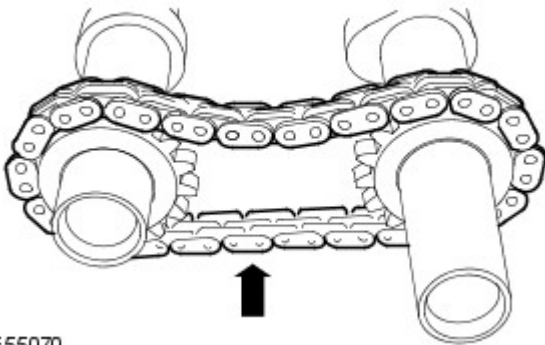
8. Remove the secondary timing chain tensioner.



E55069

9. Remove the RH camshafts.


- Release the secondary timing chain from the RH camshafts.



E55070

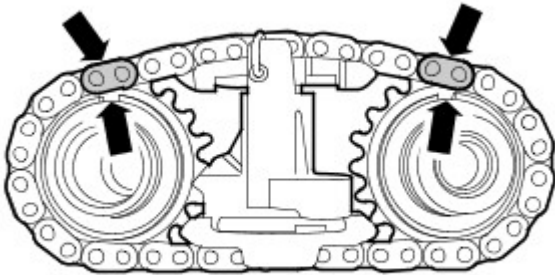
Installation

1. Install the secondary timing chain onto the camshafts.

2.  **CAUTION:** Do not release the secondary timing chain tensioner locking pin until all of the camshaft bearing caps have been installed.

Install the secondary timing chain tensioner.

- Align the marks on the camshafts with the marks on the secondary timing chain.



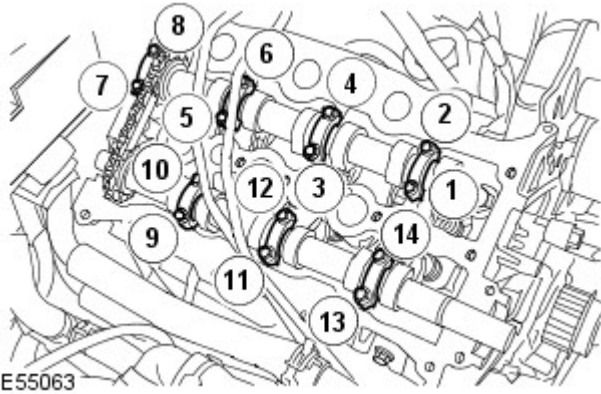
E55062

3. Install the camshafts and secondary timing chain tensioner assembly.

- Lubricate the journals and camshaft lobes.

4. Attach the RH secondary timing chain tensioner.

- Tighten the two retaining bolts to 10 Nm (7 lb.ft).



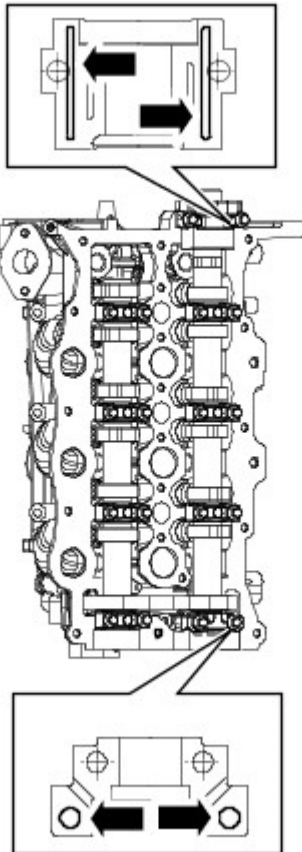
E55063

5. Install the camshaft bearing caps.

- Do not install the two exhaust camshaft end bearing caps at this stage.
- Tighten the bolts evenly in three stages in the sequence shown.
- Stage one: Tighten to 1 Nm (1 lb.ft).
- Stage two: Tighten to 5 Nm (4 lb.ft).
- Stage three: Tighten to 10 Nm (7 lb.ft).

6. Apply sealant to the two exhaust camshaft end bearing caps at the positions shown.

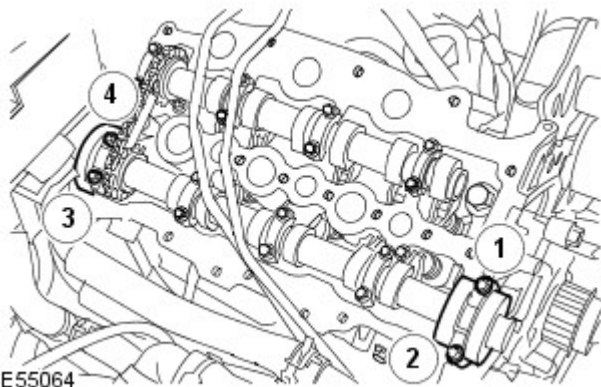
For additional information, refer to: [Specifications](#) (303-01A Engine - TDV6 2.7L Diesel, Specifications).



E56492

7. Install the camshaft bearing caps.

- Tighten the bolts evenly in three stages in the sequence shown.
- Stage one: Tighten to 1 Nm (1 lb.ft).
- Stage two: Tighten to 5 Nm (4 lb.ft).
- Stage three: Tighten to 10 Nm (7 lb.ft).



E55064

8. Release the secondary timing chain tensioner piston.

- Remove the locking pin.

9. Install the RH valve cover.

For additional information, refer to: [Valve Cover RH](#) (303-01A

Engine - TDV6 2.7L Diesel, In-vehicle Repair).

10. Install the brake vacuum pump.

For additional information, refer to: [Brake Vacuum Pump - TDV6 2.7L Diesel](#) (206-07 Power Brake Actuation, Removal and Installation).

11. Install the camshaft front seal.

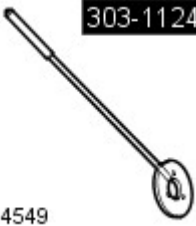

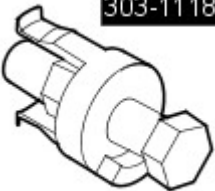

For additional information, refer to: [Camshaft Front Seal](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

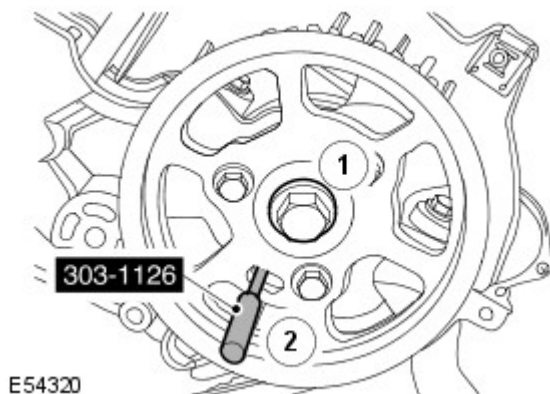
Engine - TDV6 2.7L Diesel - Camshaft Front Seal

In-vehicle Repair

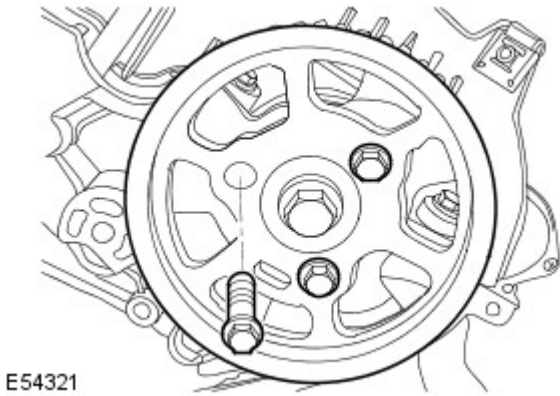
Special Tool(s)	
 <p>303-1124</p> <p>E54549</p>	Holder - Camshaft Pulleys Front 303-1124
 <p>303-1119</p> <p>E54542</p>	Installer - Camshaft Oil Seal 303-1119
 <p>303-1118</p> <p>E54541</p>	Remover - Camshaft Oil Seal 303-1118
 <p>303-1126</p> <p>E54551</p>	Timing Pin - Camshaft Pulleys 303-1126

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Raise and support the vehicle.
3. Remove and discard the timing belt.
For additional information, refer to: [Timing Belt](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
4. Remove the special tool.
 - Stage one: Retain the camshaft pulley.
 - Stage two: Remove the special tool.

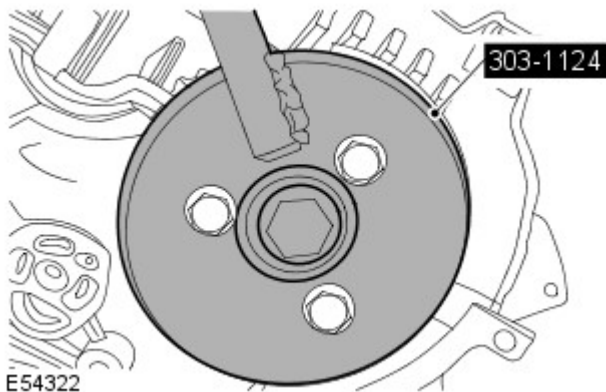


5. Remove the camshaft pulley.
- Remove the three retaining bolts.



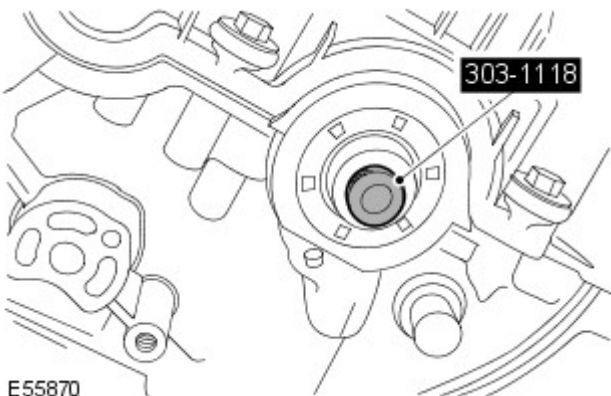
E54321

6. Using the special tool, remove the camshaft pulley hub.
- Remove and discard the retaining bolt.




E54322

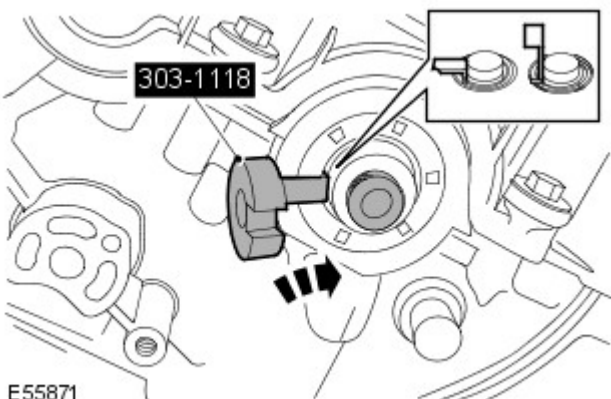
7. Install the special tool to the camshaft.



E55870

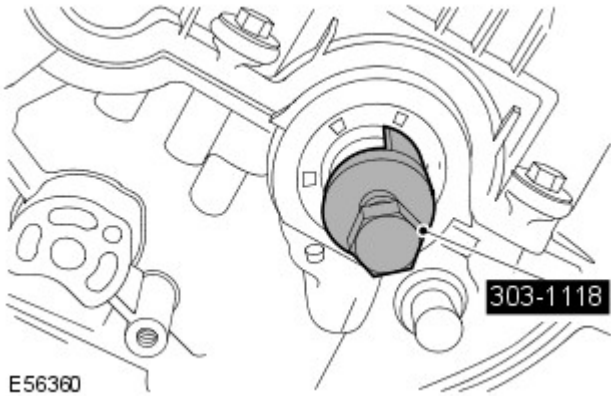
8.  CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

Install the special tool into the camshaft front seal.

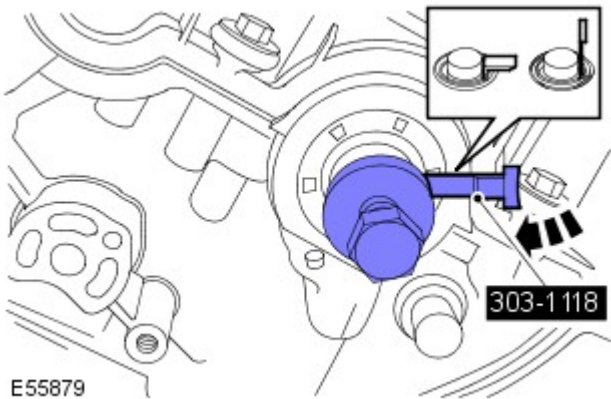


E55871

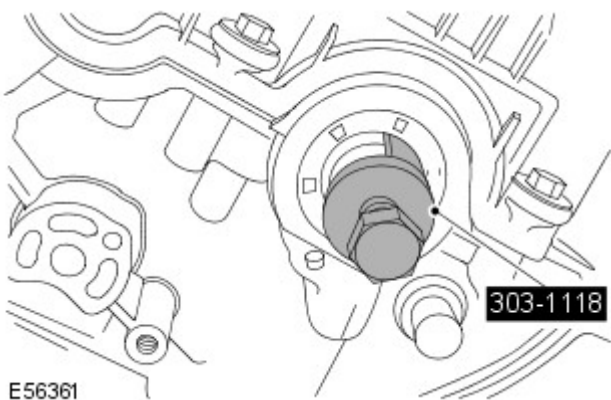
9. Install the special tool extracting bolt.



10. Install the special tool into the camshaft front seal.



11. Using the special tool, remove the camshaft front seal.



Installation

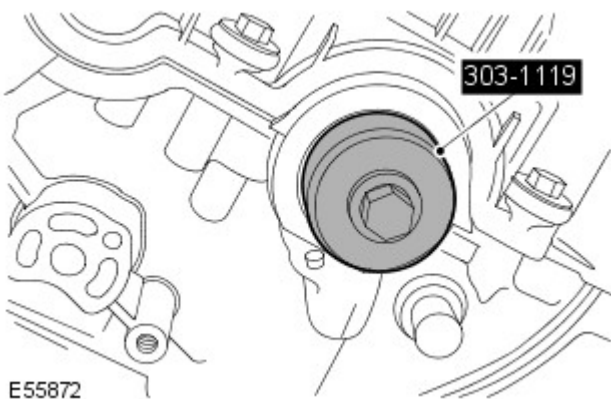
1. CAUTIONS:

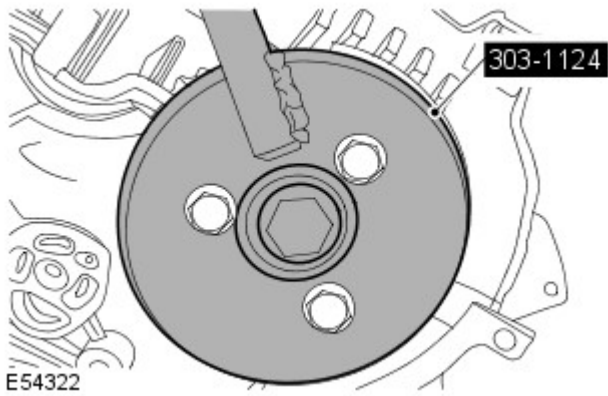
 Make sure the seal is installed correctly.

 Do not use any lubricant on the camshaft front seal or the camshaft. Failure to follow this instruction may result in damage to the vehicle.

Using the special tool, install the camshaft front seal.

- Clean the component mating faces.
- Use the discarded camshaft pulley hub retaining bolt with the special tool.





2. Using the special tool, install the camshaft pulley hub.

- Install a new retaining bolt.
- Tighten the retaining bolt in two stages:
- Stage one: Tighten to 80 Nm (59 lb.ft).
- Stage two: Tighten a further 80 degrees.

3. Install the camshaft pulley.

- Install the bolts, but do not tighten fully at this stage.

4. Install the special tool.

- Stage one: Retain the camshaft pulley.
- Stage two: Install the special tool.



5. Install the new timing belt.






For additional information, refer to: [Timing Belt](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

6. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

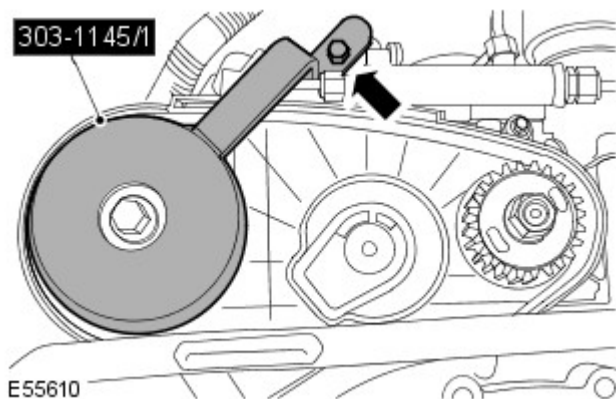
Engine - TDV6 2.7L Diesel - Camshaft Rear Seal

In-vehicle Repair

Special Tool(s)	
 <p>303-1118 E54541</p>	Camshaft Seal Remover 303-1118
 <p>303-1119 E54542</p>	Camshaft Seal Installer 303-1119
 <p>303-1145/1 E60399</p>	Camshaft pulley holding tool 303-1145/1
 <p>303-1145/2 E60429</p>	Camshaft pulley bolt remover 303-1145/2
 <p>303-1145/3 E60430</p>	Camshaft pulley bolt socket 303-1145/3

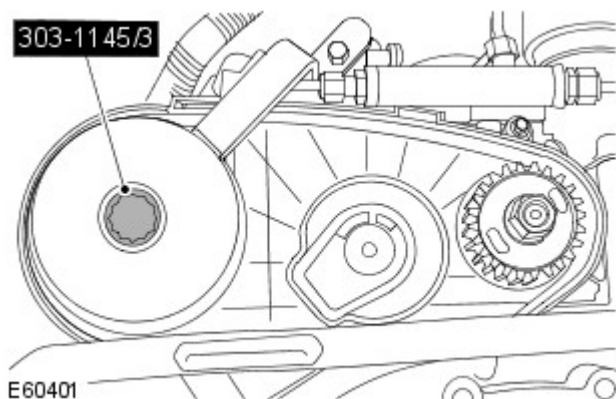
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the fuel injection pump belt.
For additional information, refer to: [Fuel Injection Pump Belt - VIN Range: SALLA000304->END OF 06 MY](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

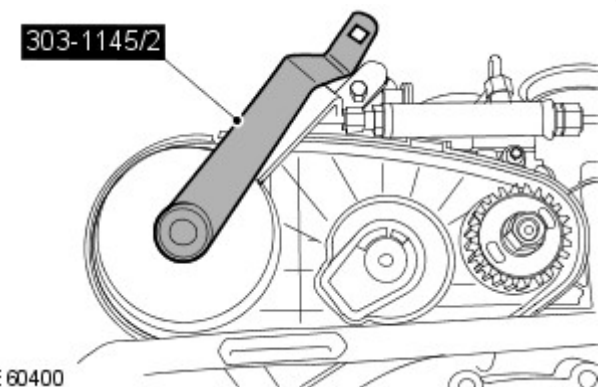


3. Install the special tool to the camshaft rear pulley.

- Rotate the crankshaft to align the special tool to the engine lifting bracket.
- Install the special tool retaining bolt.



4. Install the special tool to the camshaft rear pulley retaining bolt.

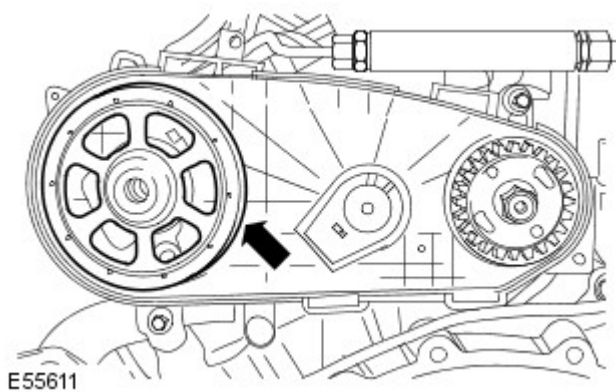


5. Using the special tools, remove and discard the camshaft rear pulley retaining bolt.

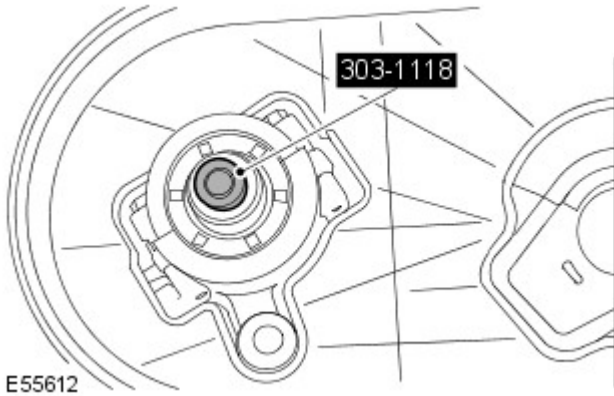
- Rotate the crankshaft clockwise to retain the camshaft rear pulley.

6. Remove the special tools.


7. Remove the camshaft rear pulley.

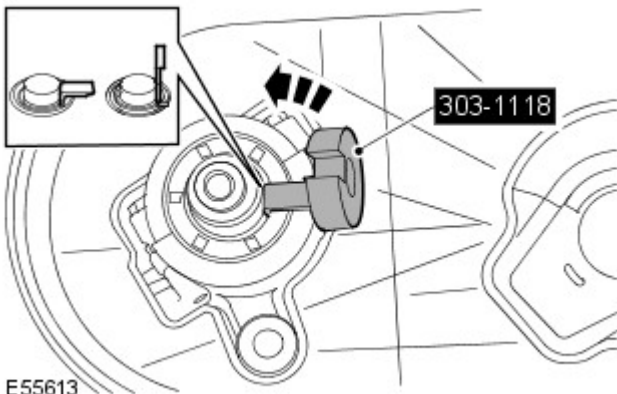


8. Install the special tool to the camshaft.




E55612

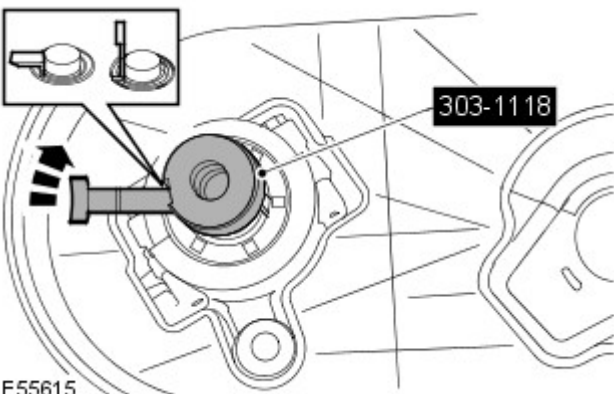
9.  CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.



E55613

Install the special tool into the camshaft rear seal.

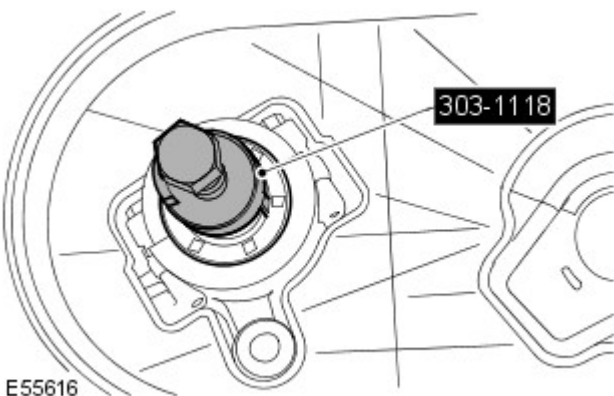
10.  CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.



E55615

Install the special tool into the camshaft rear seal.

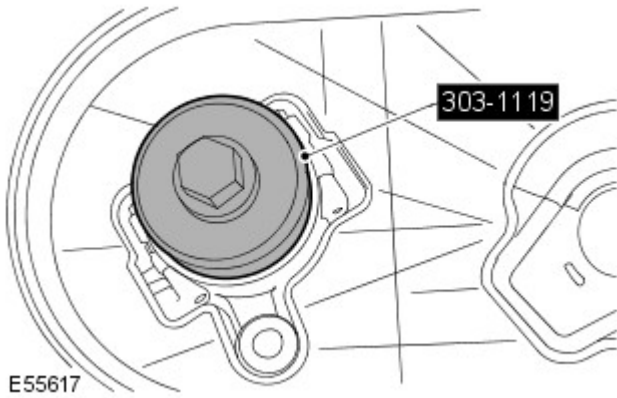
11. Using the special tool, remove and discard the camshaft rear seal.



E55616

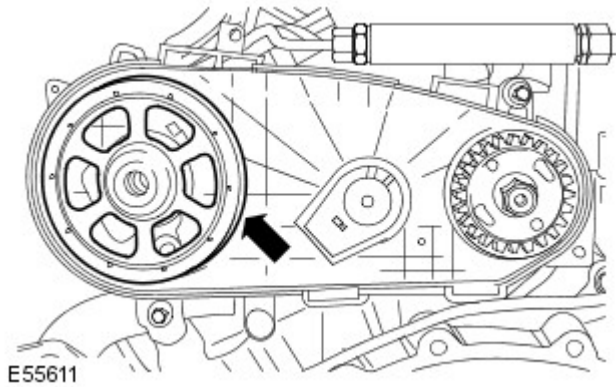
Installation

1. Using the special tool, install the new camshaft rear seal.



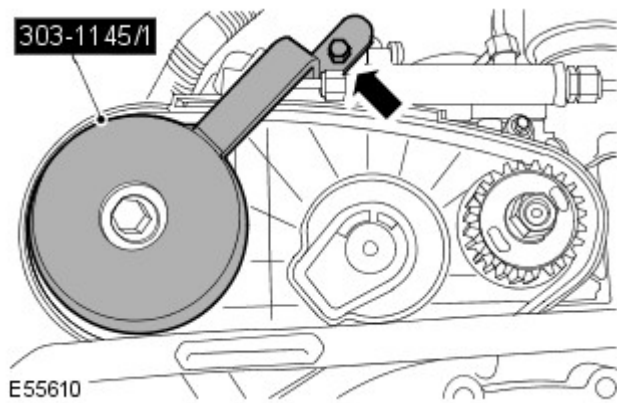
2. Install the camshaft rear pulley.

- Install a new camshaft pulley retaining bolt.

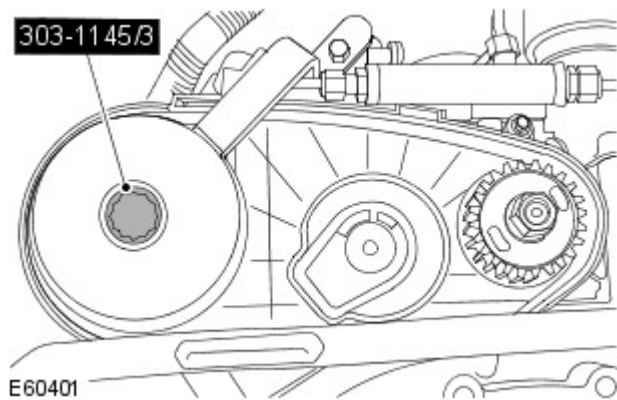


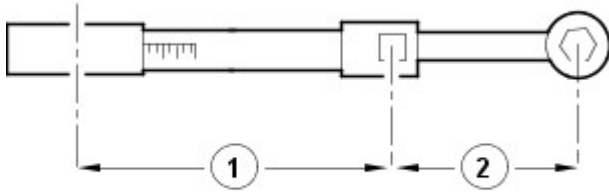
3. Install the special tool to the camshaft rear pulley.

- Install the special tool retaining bolt.

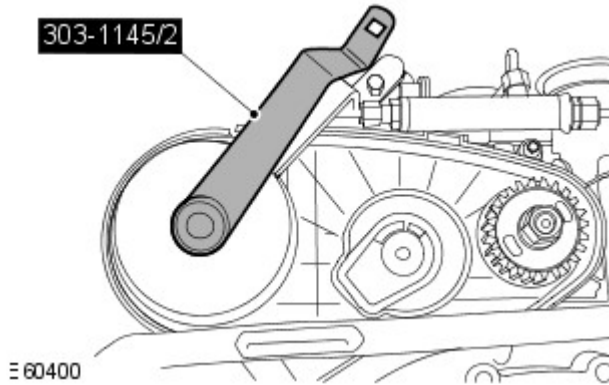


4. Install the special tool to the camshaft rear pulley retaining bolt.






E37107



5.  **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Calculate the setting for the torque wrench.

- Stage 1: Multiply the required torque by the effective length of the torque wrench (1).
- Stage 2: Add the effective length of the special tool (2) to the effective length of the torque wrench.
- Stage 3: Divide the total of stage 1 by the total of stage 2.
- Stage 4: Set the torque wrench to the figure arrived at in stage 3.

6.  **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Using the special tools, tighten the camshaft rear pulley retaining bolt to 40 Nm (30 lb.ft).

7.  **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

- Rotate the crankshaft counter-clockwise to retain the camshaft rear pulley.
- Stage one: Tighten to 80 Nm (59 lb.ft).
- Stage two: Tighten a further 80 degrees.

8. Remove the special tools.

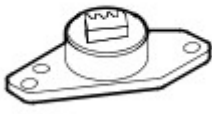

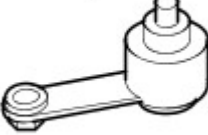



9.  **CAUTION:** Install a new fuel injection pump belt. Failure to follow this instruction may result in damage to the vehicle.

Install the fuel injection pump belt.
For additional information, refer to: [Fuel Injection Pump Belt - VIN Range: SALLA000304->END OF 06 MY](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

10. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).

Engine - TDV6 2.7L Diesel - Crankshaft Front Seal


In-vehicle Repair

Special Tool(s)	
 <p>303-1123 E 54546</p>	Locking Tool - Flywheel 303-1123
 <p>303-1116 E 54539</p>	Timing Pin - Manual Transmission 303-1116
 <p>303-1117 E 54540</p>	Timing Pin - Automatic Transmission 303-1117
 <p>303-1120 E 54543</p>	Crankshaft Front Seal Remover 303-1120
 <p>303-1122 E 54545</p>	Crankshaft Front Seal Sleeve 303-1122
 <p>303-1121 E 54544</p>	Crankshaft Front Seal Installer 303-1121

Removal

All vehicles

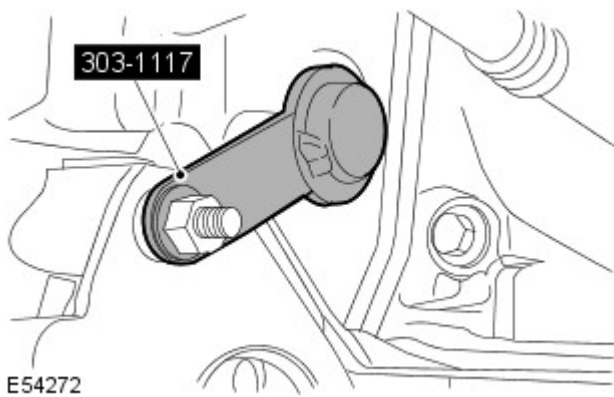
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove and discard the timing belt.
For additional information, refer to: [Timing Belt](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

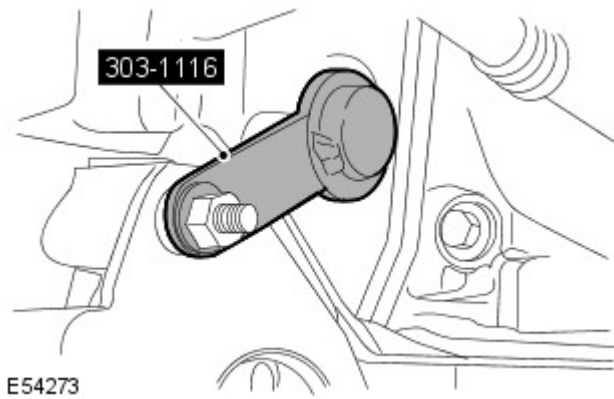
Vehicles with automatic transmission

4. Remove the special tool.



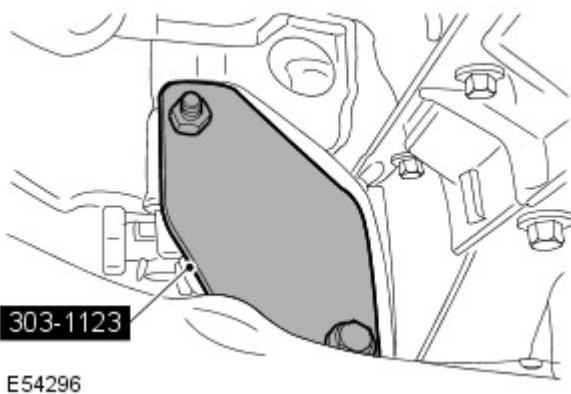
Vehicles with manual transmission

5. Remove the special tool.



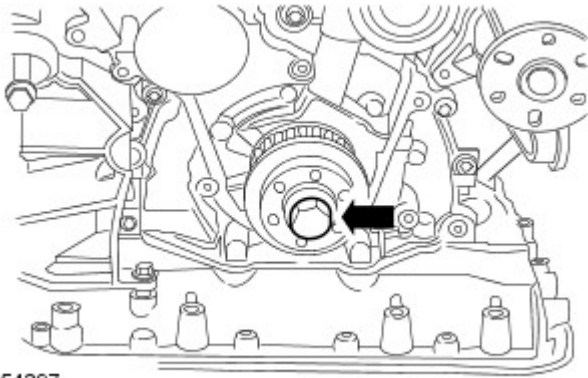
All vehicles

6. Install the special tool.



7. Loosen the crankshaft pulley retaining bolt.

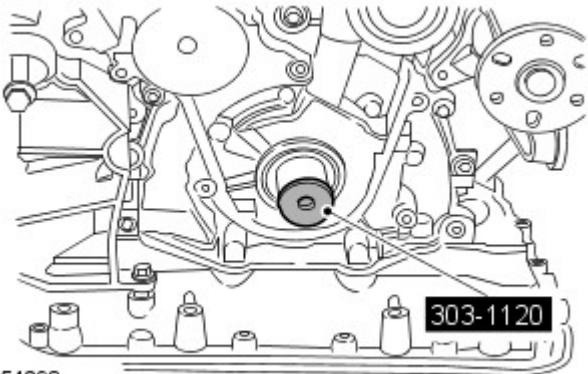
8. Using a suitable tool, release the crankshaft pulley.



E54297

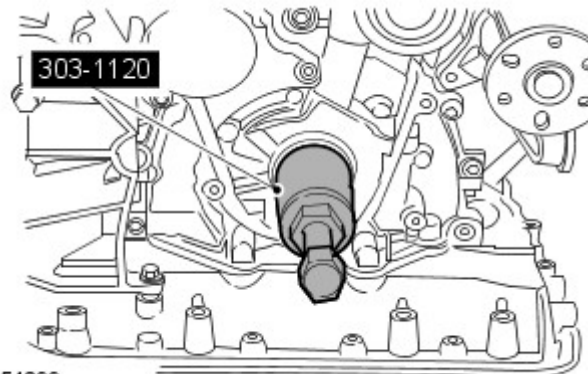
9. Remove the crankshaft pulley.

- Remove the crankshaft pulley retaining bolt.
- Discard the bolt.



E54298

10. Install the special tool to the crankshaft.



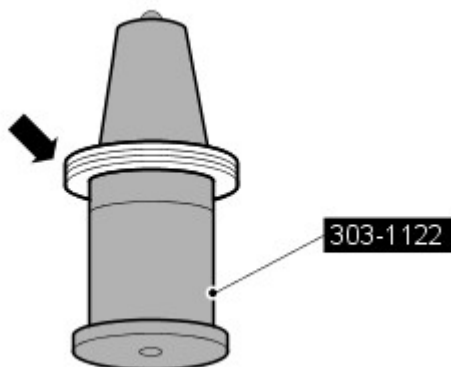
E54299

11. Using the special tool, remove the crankshaft front seal.


- Remove the special tool.
- Remove and discard the seal from the special tool.

Installation

All vehicles



E54300

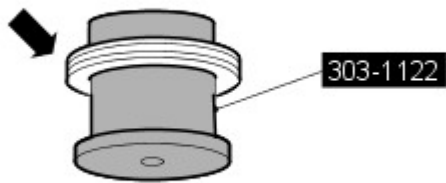
1.  **CAUTION:** Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.

• **NOTE:** Make sure all component mating faces are clean.

Install a new crankshaft front seal to the special tool.

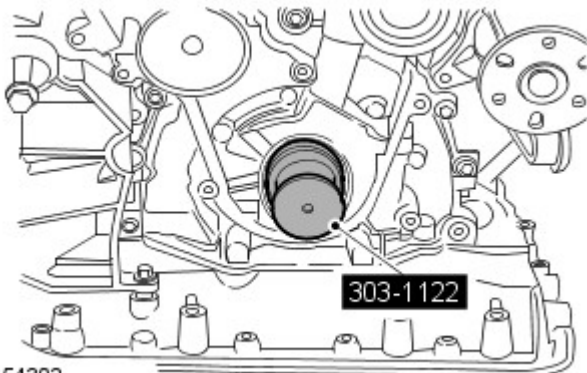
2. Reposition the crankshaft front seal along the special tool.

- Remove the sleeve from the special tool.



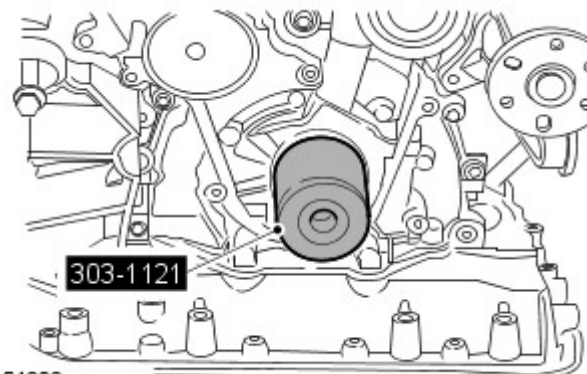
E54301

3. Install the special tool to the crankshaft.




E54302

4. Install the special tool to the crankshaft.

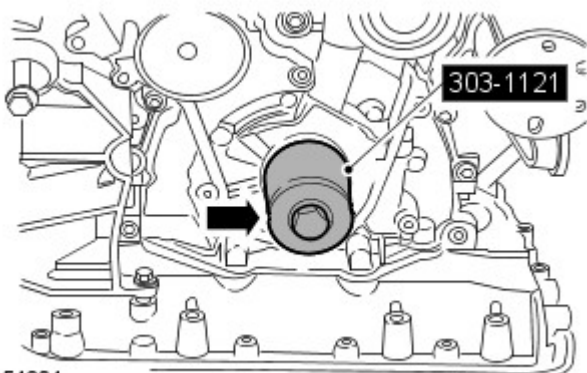


E54303

5.  CAUTION: Make sure the seal is installed correctly.

Using the special tool, install the crankshaft front seal.

- Use the discarded crankshaft bolt with the service tool.



E54304

6.  CAUTION: Make sure the seal is installed correctly.

Remove the special tool.

- Remove and discard the crankshaft pulley retaining bolt.

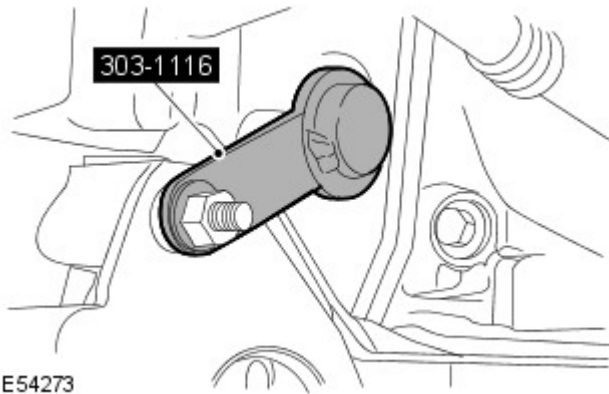
7. Install the crankshaft pulley.

- Install a new crankshaft pulley retaining bolt.
- Tighten the retaining bolt in two stages:
- Stage one: Tighten to 100 Nm (74 lb.ft).
- Stage two: Tighten a further 90 degrees.

8. Remove the special tool.

Vehicles with manual transmission

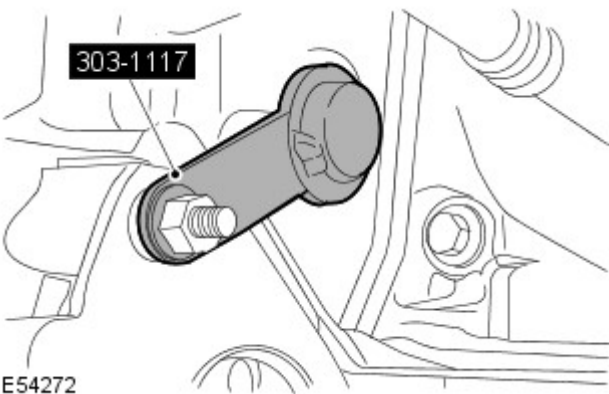
9. Install the special tool.



E54273

Vehicles with automatic transmission

10. Install the special tool.



E54272

All vehicles

11. Install the new timing belt.

For additional information, refer to: [Timing Belt](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Engine - TDV6 2.7L Diesel - Crankshaft Rear Seal with Retainer Plate

In-vehicle Repair

Removal

- NOTE: The crankshaft rear seal and retainer plate are supplied as an assembly and cannot be serviced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

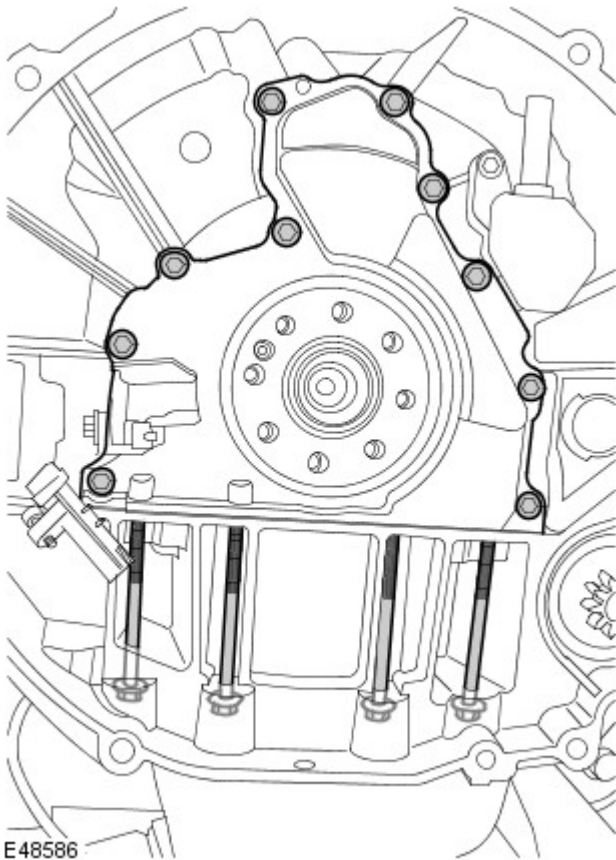
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

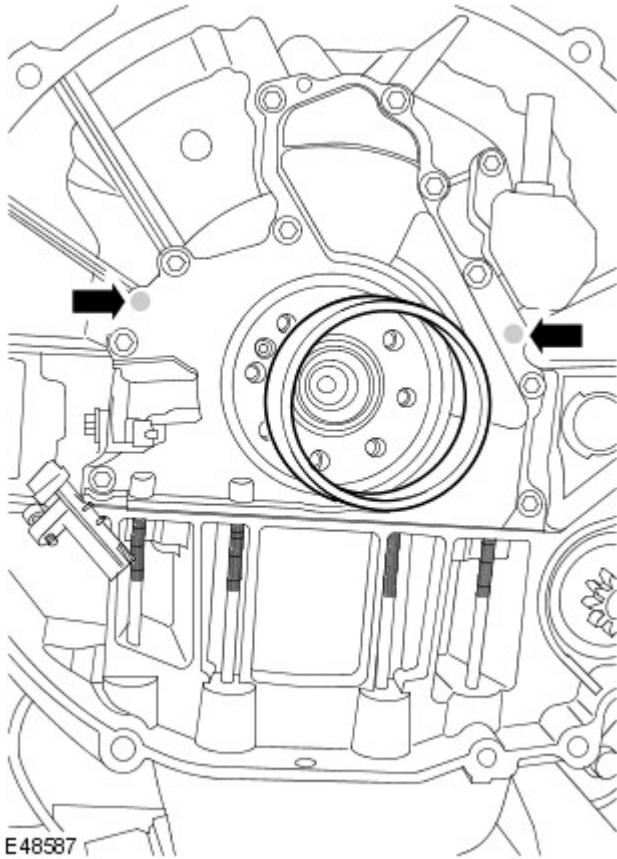
3. Remove the CKP sensor ring.
For additional information, refer to: [Crankshaft Position \(CKP\) Sensor Ring](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Removal and Installation).

4. Remove the crankshaft retainer plate.

- Remove the 14 bolts.



Installation



1. CAUTIONS:



Oil seals must be fitted dry.



Tighten the bolts securing the seal retainer to the cylinder block first.

Install the crankshaft retainer plate.

- Clean the component mating faces.
- Install the seal retainer with its protection sleeve onto the crankshaft.
- Locate the seal retainer onto the sump flange.
- Engage the seal retainer dowels with the cylinder block and lightly tighten 2 bolts on opposite sides of the retainer.
- Remove the seal protection sleeve.
- Install remaining bolts and tighten all bolts evenly to 10 Nm (7 lb.ft).

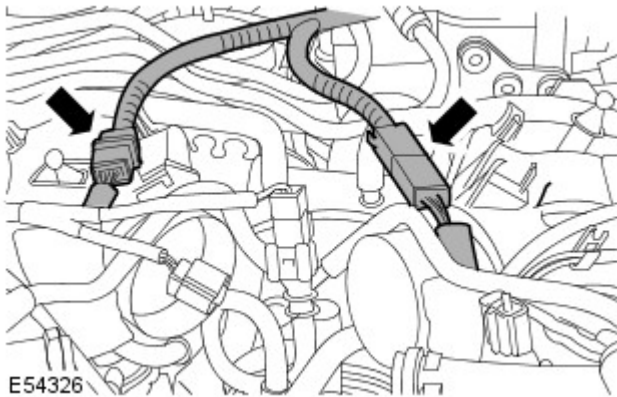
2. Install the CKP sensor ring to the crankshaft.
For additional information, refer to: [Crankshaft Position \(CKP\) Sensor Ring](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Cylinder Head LH

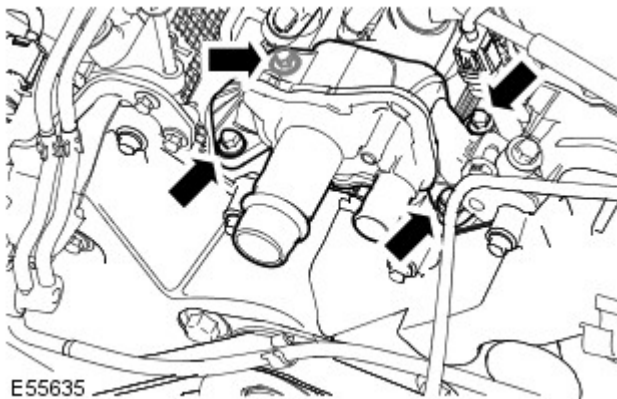
In-vehicle Repair

Removal

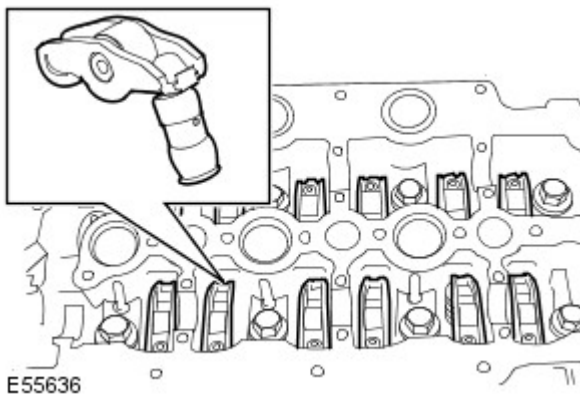
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH bank camshafts.
3. Remove the LH exhaust manifold.
For additional information, refer to: [Exhaust Manifold LH](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
4. Disconnect the LH glow plug wiring harness electrical connector.

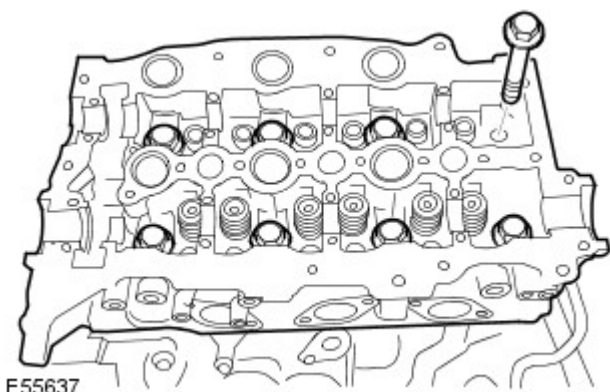


5. Remove the cylinder head coolant outlet connector.





6. Remove the hydraulic adjuster and rocker assemblies.





7. CAUTIONS:

-  Only use a plastic scraper to clean off the old gasket.
-  The cylinder head must not be placed mating face down. Failure to follow this instruction may result in damage to the vehicle.


Remove the LH cylinder head assembly.

- Remove and discard the eight cylinder head bolts.
- Remove and discard the cylinder head gasket.

Installation

1. Clean the component mating faces.
2. Check cylinder head face for distortion, across the center and from corner to corner.
3. **NOTE:** The cylinder head gasket must be installed over the cylinder head to cylinder block dowels.

Install a new cylinder head gasket.

4.  **CAUTION:** Use care when installing the cylinder head. Damage to the cylinder block, cylinder head or cylinder head gasket may result.

- **NOTE:** Install a new cylinder head gasket.
- **NOTE:** The cylinder head gasket must be installed over the cylinder head to cylinder block dowels.
- **NOTE:** Make sure the cylinder head is installed in its original position.
- **NOTE:** Tighten the retaining bolts in the indicated sequence in four stages.

Install the LH cylinder head assembly and install new cylinder head retaining bolts.

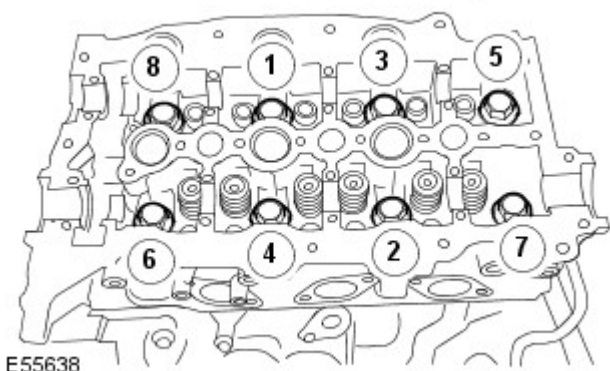
- Stage one: Tighten to 20 Nm (15 lb.ft).
- Stage two: Tighten to 40 Nm (30 lb.ft).
- Stage three: Tighten to 80 Nm (59 lb.ft).
- Stage four: Tighten a further 180 degrees.

5. Install the hydraulic adjuster and rocker assemblies.
6. Connect the LH glow plug wiring harness electrical connector.
7. **NOTE:** Install new O-ring seals.

Install the cylinder head coolant outlet connector.

- Install the four retaining bolts and tighten to 10 Nm (7 lb.ft).


8. Install the LH exhaust manifold.
For additional information, refer to: [Exhaust Manifold LH](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
9. Install the LH bank camshafts.
10. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).



Engine - TDV6 2.7L Diesel - Cylinder Head RH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the RH exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
3. Remove the RH camshafts.
4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

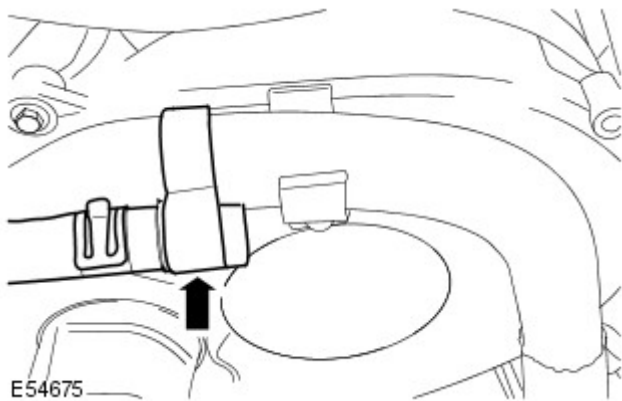
Raise and support the vehicle.

5. Release the engine breather tube.
 - Remove the retaining bolt.



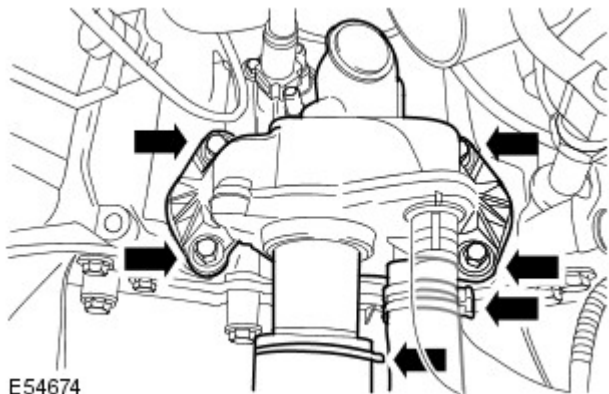
E55043

6. Release the coolant bleed hose.
 - Release the retaining clip.

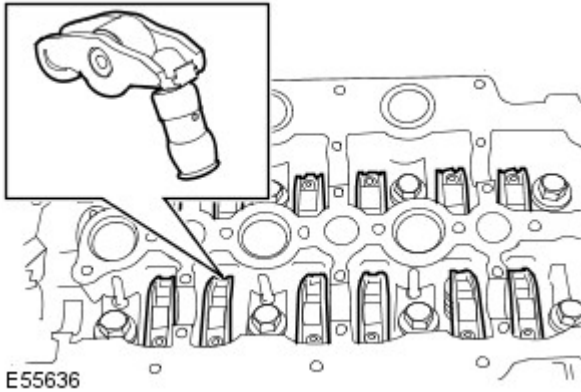


E54675

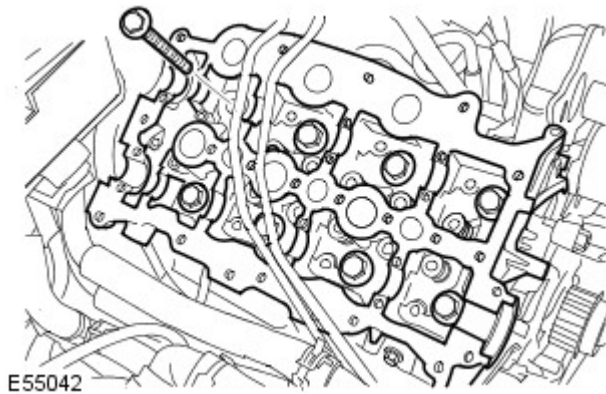
7. Remove the cylinder head coolant elbow.
 - Release the two retaining clips and disconnect the hoses.
 - Remove the four retaining bolts.
 - Remove and discard the O-ring seals.



E54674



8. Remove the hydraulic adjuster and rocker assemblies.



9. CAUTIONS:



The cylinder head must not be placed mating face down. Failure to follow this instruction may result in damage to the vehicle.



Only use a plastic scraper to clean off the old gasket.

Remove the RH cylinder head assembly.

- Remove and discard the eight cylinder head bolts.
- Remove and discard the cylinder head gasket.

Installation

1. Clean the component mating faces.
2. Check cylinder head face for distortion, across the center and from corner to corner.
For additional information, refer to: [Specifications](#) (303-01A Engine - TDV6 2.7L Diesel, Specifications).



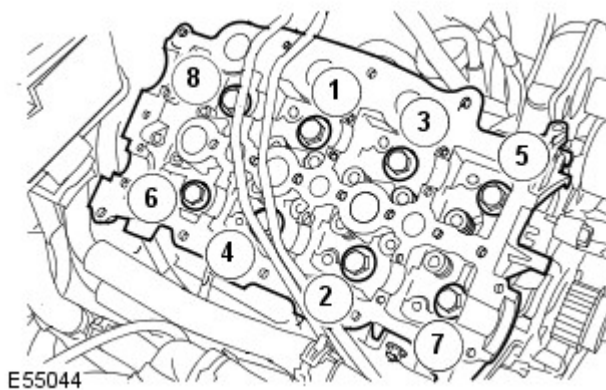
CAUTION: The head gasket must be installed over the cylinder block dowels.

Install a new cylinder head gasket.

4. **NOTE:** Tighten the retaining bolts in the indicated sequence in four stages.

Install the RH cylinder head assembly

- Install new cylinder head retaining bolts.
- Tighten the bolts evenly in four stages to the sequence shown.
- Stage one: Tighten to 20 Nm (15 lb.ft).
- Stage two: Tighten to 40 Nm (30 lb.ft).
- Stage three: Tighten to 80 Nm (59 lb.ft).
- Stage four: Tighten a further 180 degrees.



5. Install the hydraulic adjuster and rocker assemblies.

6. Install the cylinder head coolant outlet elbow.

- Install new O-ring seals.
- Install the four retaining bolts and tighten to 10 Nm (7 lb.ft).
- Connect the hoses and secure with the clips.

7. Secure the coolant bleed hose.
8. Secure the engine breather tube.
 - Tighten the bolt to 10 Nm (7 lb.ft).
9. Install the RH camshafts.
10. Install the RH exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
11. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Valve Cover LH

In-vehicle Repair

Removal

• WARNINGS:



Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.

• CAUTIONS:



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

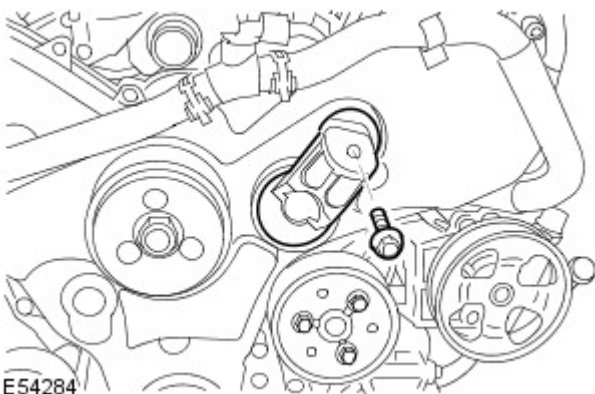


Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

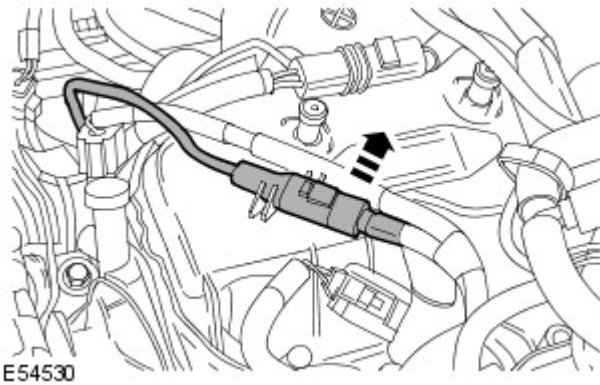
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake air shutoff throttle.
For additional information, refer to: [Intake Air Shutoff Throttle](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).
3. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. Remove the accessory drive belt idler pulley.
 - Remove the retaining bolt.



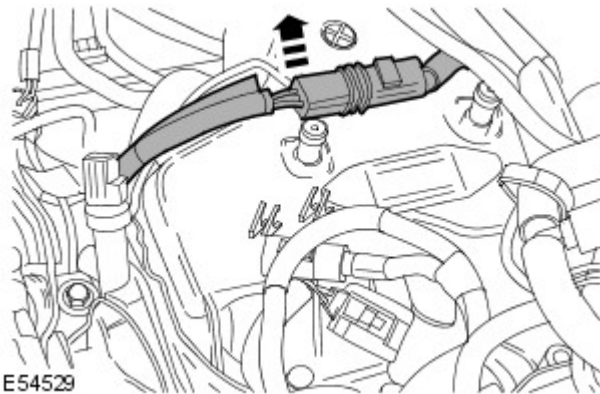
E54284

5. Release the knock sensor (KS) harness from the valve cover.

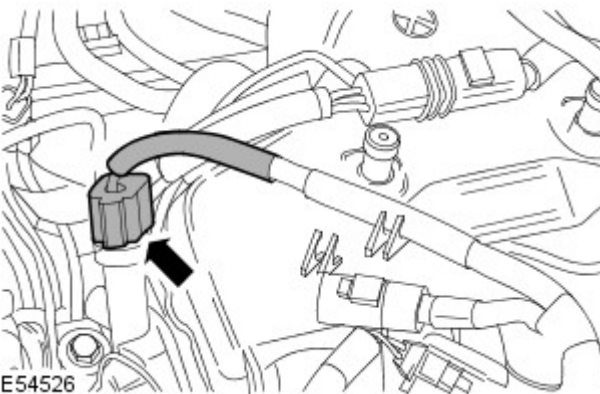
6. Disconnect the KS electrical connector.



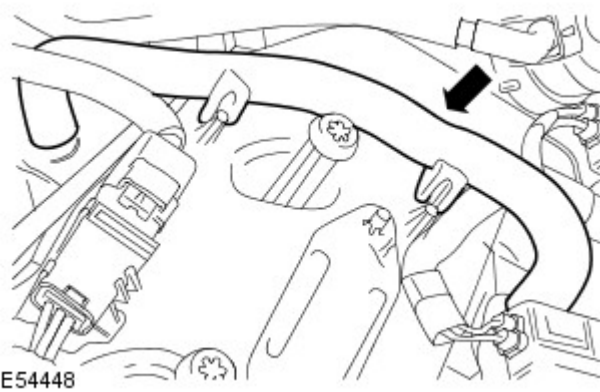
7. Release the glow plug harness from the valve cover.



8. Disconnect the engine oil pressure (EOP) sensor electrical connector.



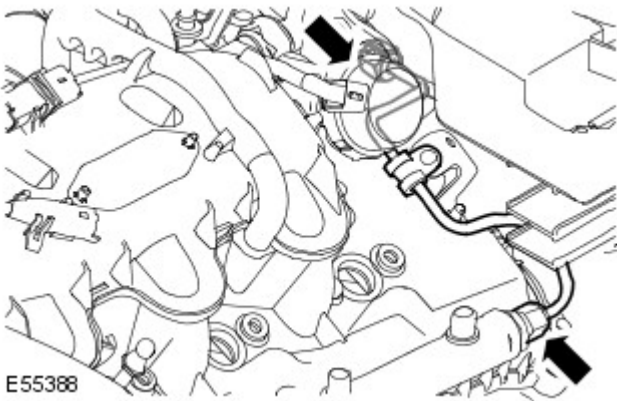
9. Disconnect the valve cover breather hose.




10. Remove the fuel injector.
For additional information, refer to: [Fuel Injector](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).
11. Remove the 2 remaining fuel injectors.

12. Release the high-pressure fuel supply line.

- Remove the retaining bolt.



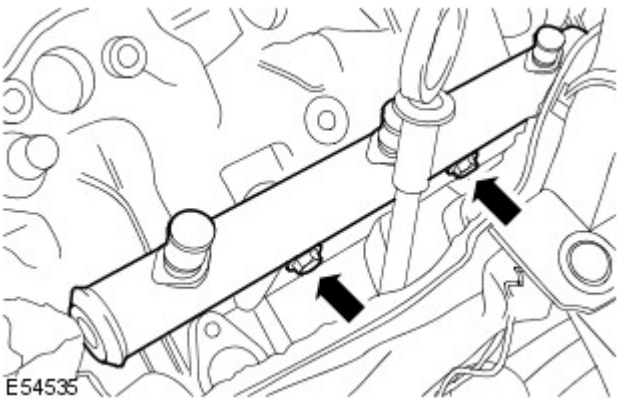
13.  CAUTION: Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

Remove and discard the high-pressure fuel supply line.

- Install blanking caps to the exposed ports.

14. Remove the fuel injection supply manifold.

- Remove the two retaining bolts.

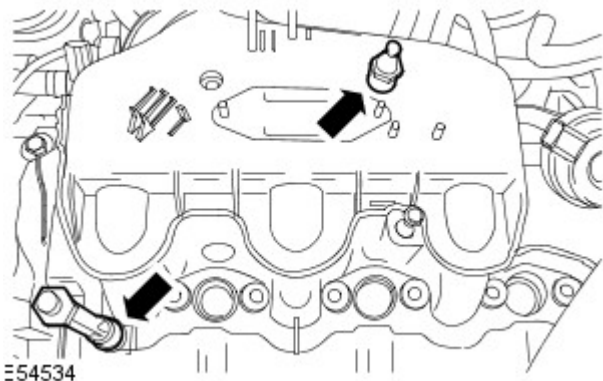


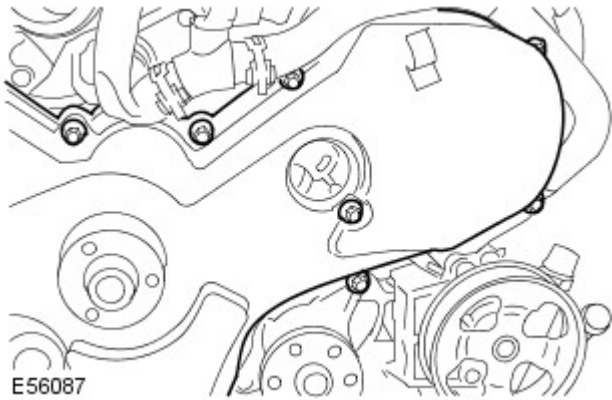
15. Remove the fuel injection supply manifold securing bracket.

- Release the dipstick tube.
- Remove the three retaining bolts.



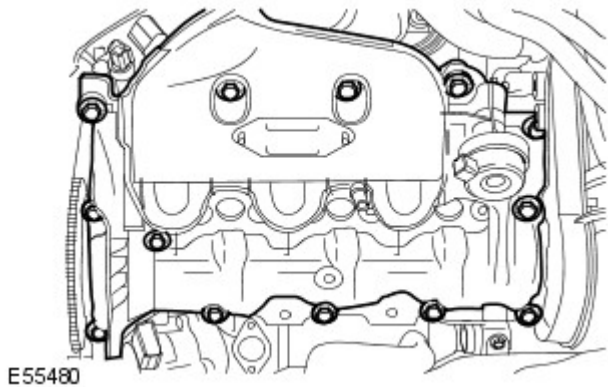
16. Remove the engine cover locating studs.





17. Release the timing belt cover.

- Reposition the timing cover to access the two front valve cover retaining bolts.
- Fully loosen the seven timing belt cover retaining bolts shown.



18. Remove the LH valve cover.

- Loosen the 13 valve cover retaining bolts.

Installation

1. Install the LH valve cover.

- Tighten the 13 retaining bolts to 10 Nm (7 lb.ft).

2. Attach the timing belt cover.

- Tighten the seven retaining bolts to 10 Nm (7 lb.ft).

3. Install the engine cover locating studs.

4. Install the fuel injection supply manifold securing bracket.

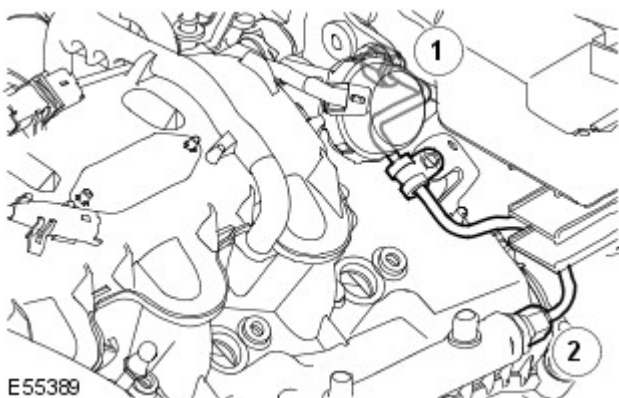
- Install the two retaining bolts.
- Tighten the bolts to 23 Nm (17 lb.ft).
- Secure the dipstick tube.

5. Install the fuel injection supply manifold.

- Install the two bolts, but do not fully tighten at this stage.

6. Install a new high-pressure fuel supply line.

- Remove the blanking caps from the ports.
- Install the new high-pressure fuel supply line, but do not tighten unions at this stage.
- Tighten the fuel injection supply manifold retaining bolts to 23 Nm (17 lb.ft).
- Tighten the fuel injection supply line unions in the sequence shown in four stages:
 - Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
 - Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).



- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 30 Nm (22 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 30 Nm (22 lb.ft).

7. Secure the high-pressure fuel supply line.

- Tighten the retaining bolt to 10 Nm (7 lb.ft).

8. Install the fuel injector.

For additional information, refer to: [Fuel Injector](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

9. Install the 2 remaining fuel injectors.

10. Connect the valve cover breather hose.

11. Connect the EOP sensor electrical connector.

12. Connect the KS electrical connector.

13. Attach the glow plug harness and KS harness to the valve cover.

14. Install the accessory drive belt idler pulley.

- Install the retaining bolt and tighten to 47 Nm (35 lb.ft).

15. Install the accessory drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

16. Install the intake air shutoff throttle.

For additional information, refer to: [Intake Air Shutoff Throttle](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

17. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Valve Cover RH

In-vehicle Repair

Removal

• WARNINGS:



Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.



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Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.

• CAUTIONS:



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

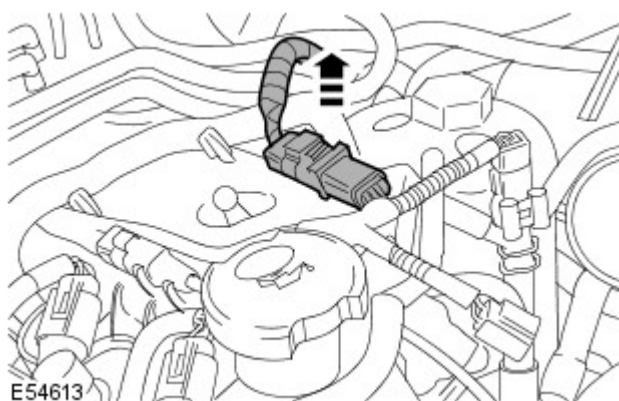


Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

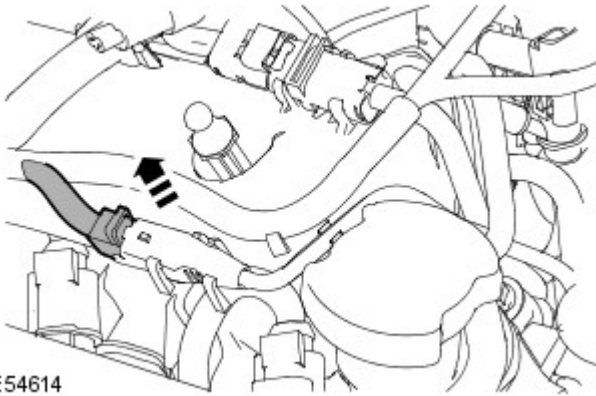


Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake air shutoff throttle.
For additional information, refer to: [Intake Air Shutoff Throttle](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).
3. Release the glow plug harness from the valve cover.



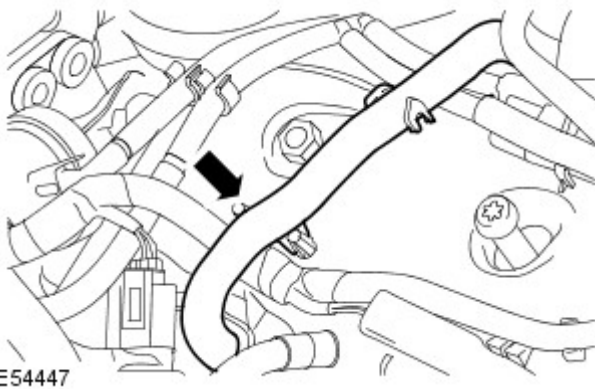
4. Release the knock sensor (KS) harness from the valve cover.



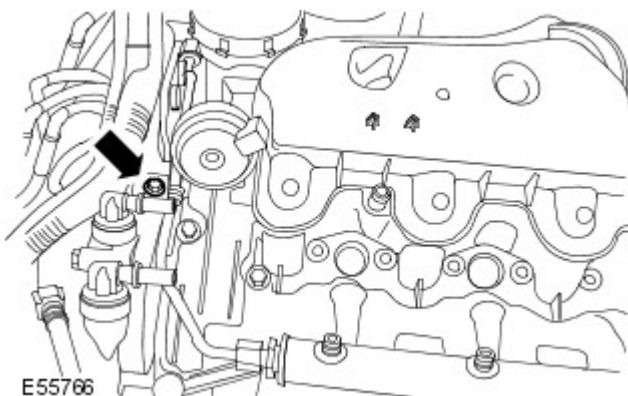
5. Disconnect the KS electrical connector.

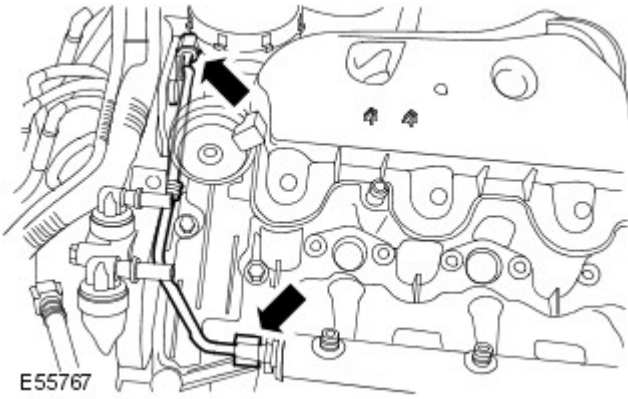



6. Disconnect the valve cover breather hose.



7. Remove the fuel injector.
For additional information, refer to: [Fuel Injector](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).
8. Remove the remaining fuel injectors.
9. Release the high-pressure fuel supply line.
 - Remove the retaining bolt.

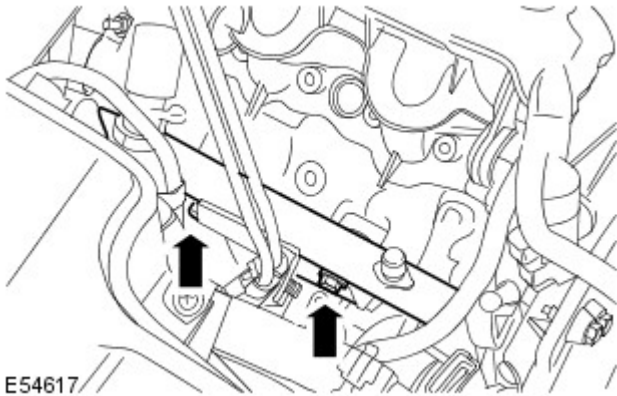




10.  **CAUTION:** Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

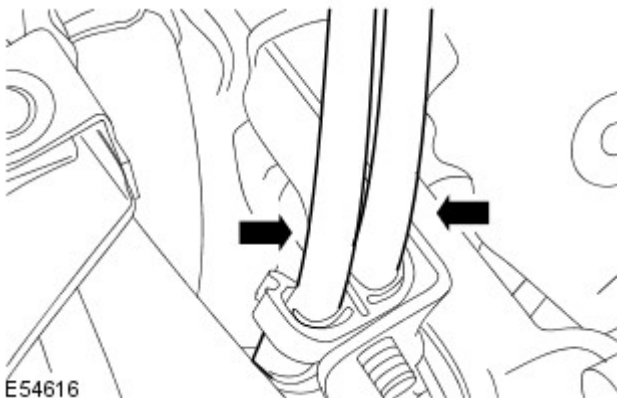
Remove and discard the high-pressure fuel supply line.

- Install blanking caps to the exposed ports.

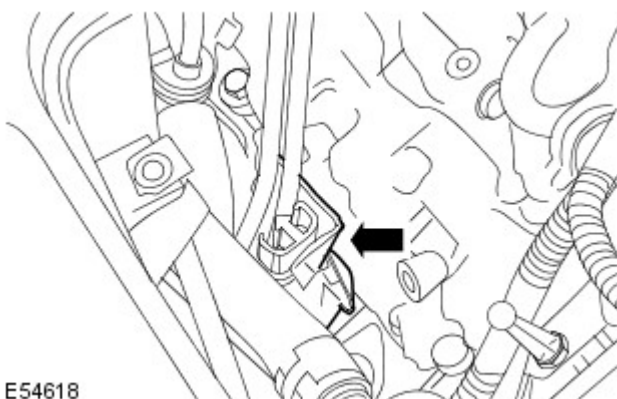


11. Remove the fuel injection supply manifold.

- Remove the two retaining bolts.

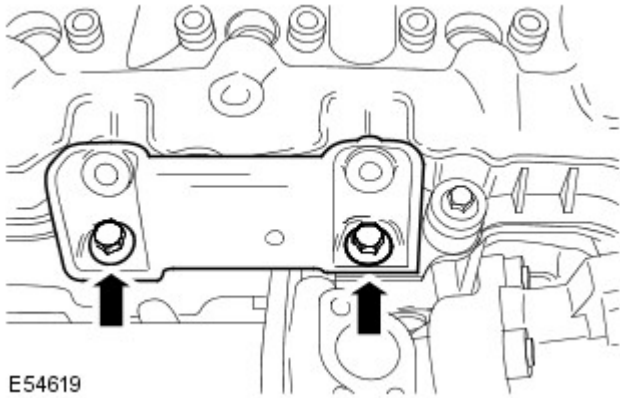


12. Detach the fuel lines.



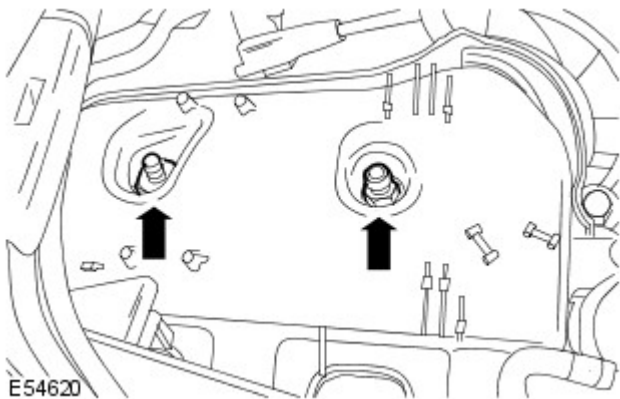
13. Remove the fuel line securing bracket.

- Remove the retaining bolt.

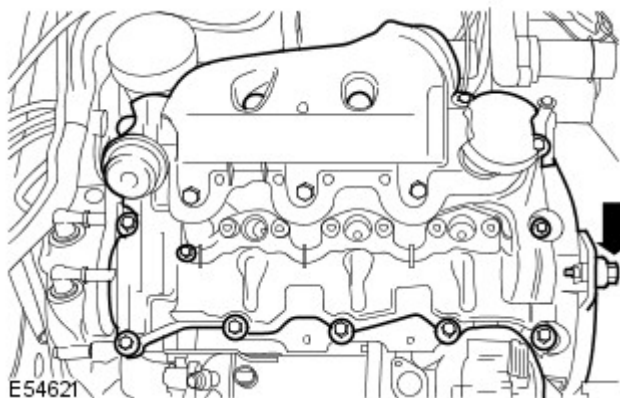


14. Remove the fuel injection supply manifold securing bracket.

- Remove the two retaining bolts.



15. Remove the engine cover locating studs.

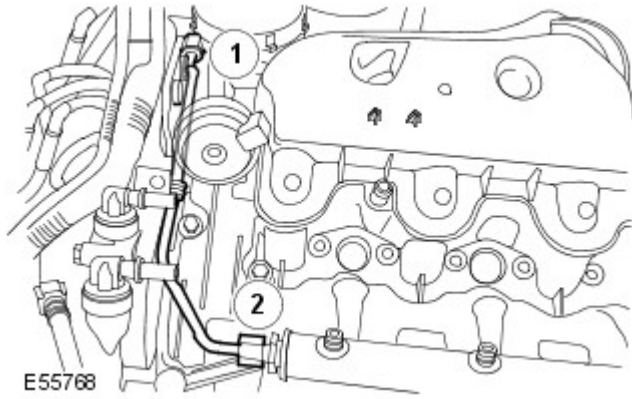


16. Remove the RH valve cover.

- Fully loosen the 14 valve cover retaining bolts.

Installation

1. Install the RH valve cover.
 - Tighten the 14 retaining bolts to 10 Nm (7 lb.ft).
2. Install the engine cover locating studs.
3. Install the fuel injection supply manifold securing bracket.
 - Install the two retaining bolts.
 - Tighten the bolts to 23 Nm (17 lb.ft).
4. Install the fuel line retaining bracket.
 - Tighten to 10 Nm (7 lb.ft).
5. Attach the fuel lines to the retaining bracket.
6. Install the fuel injection supply manifold.
 - Install the two bolts, but do not fully tighten at this stage.



7. Install a new high-pressure fuel supply line.

- Remove the blanking caps from the ports.
- Loosely install the new high-pressure fuel supply line.
- Tighten the fuel injection supply manifold retaining bolts to 23 Nm (17 lb.ft).
- Tighten the fuel injection supply line unions in the sequence shown in four stages:
 - Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
 - Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).
 - Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 30 Nm (22 lb.ft).
 - Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 30 Nm (22 lb.ft).

8. Secure the high-pressure fuel supply line.

- Tighten the bolt to 10 Nm (7 lb.ft).

9. Install the fuel injector.

For additional information, refer to: [Fuel Injector](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

10. Install the remaining fuel injectors.

11. Connect the valve cover breather hose.

12. Connect the KS electrical connector.

13. Attach the glow plug harness and KS harness to the valve cover.

14. Install the intake air shutoff throttle.

For additional information, refer to: [Intake Air Shutoff Throttle](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

15. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Engine Mount LH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the turbocharger.
For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).

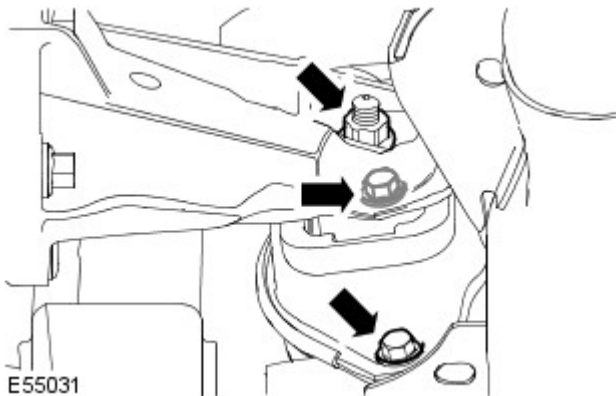
3.  **CAUTION:** Protect the engine during this operation.

Support the engine.


- Raise the engine clear of its LH mount.

4. Remove the engine mount.

- Remove the retaining nut.
- Raise the engine clear of its LH mount.
- Remove and discard the two retaining bolts.







Installation

1. Install the engine mount.
 - Clean the component mating faces.
 - Install new retaining bolts.
 - Tighten the bolts to 45 Nm (33 lb.ft), then a further 60 degrees.
2.  **CAUTION:** Protect the engine during this operation.
Lower the engine onto its mount.
3. Install the engine mount retaining nut.
 - Tighten the nut to 90 Nm (66 lb.ft).
4. Install the turbocharger.
For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Camshafts LH

In-vehicle Repair

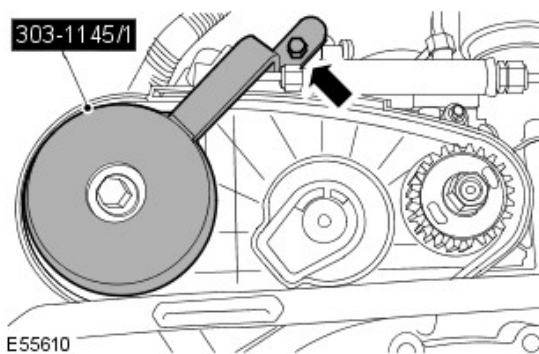
Special Tool(s)	
 <p>303-1145/1 E60399</p>	Camshaft pulley holding tool 303-1145/1
 <p>303-1145/2 E60429</p>	Camshaft pulley bolt remover 303-1145/2
 <p>303-1145/3 E60430</p>	Camshaft pulley bolt socket 303-1145/3
 <p>303-1119 E54542</p>	Installer - Camshaft Oil Seal 303-1119

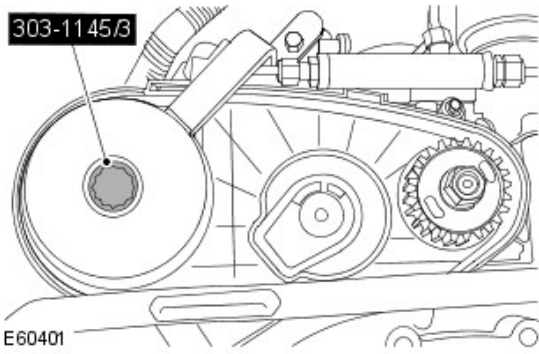
Materials

Name	Specification
Loctite 242	ESK-M4G247-A1

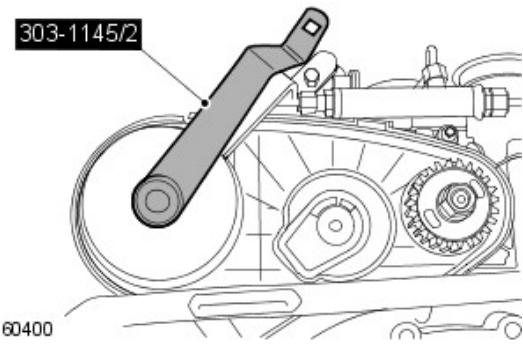
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the camshaft front seal.
For additional information, refer to: [Camshaft Front Seal](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
3. Remove the LH valve cover.
For additional information, refer to: [Valve Cover LH](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
4. Remove the fuel injection pump belt.
For additional information, refer to: [Fuel Injection Pump Belt - VIN Range: SALLA000304->END OF 06 MY](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
5. Install the special tool to the camshaft rear pulley.
 - Rotate the crankshaft to align the special tool to the engine lifting bracket.
 - Install the special tool retaining bolt.



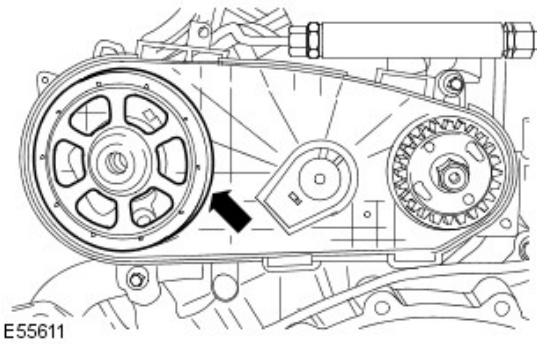


6. Install the special tool to the camshaft rear pulley retaining bolt.



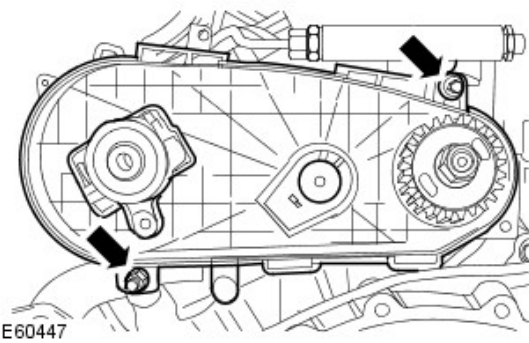
7. Using the special tools, remove and discard the camshaft rear pulley retaining bolt.

- Rotate the crankshaft clockwise to retain the camshaft rear pulley.



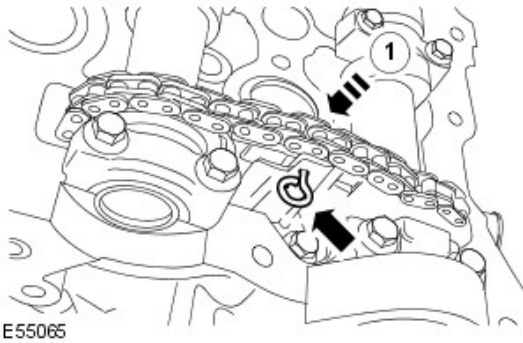
8. Remove the special tools.

9. Remove the camshaft rear pulley.



10. Remove the fuel injection pump belt rear cover.

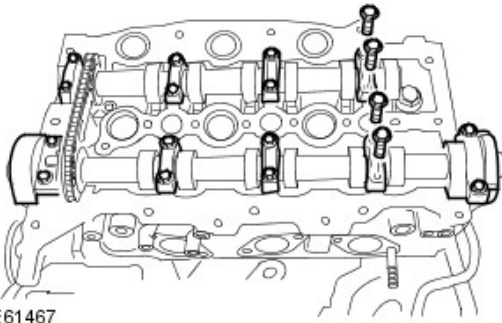
- Remove the fuel injection pump belt rear cover retaining bolt.



11. Retain the secondary timing chain tensioner piston.

- Reposition the secondary timing chain tensioner.
- Install a 1.5 mm (0.060 in.) diameter pin into the secondary timing chain tensioner piston.

E55065

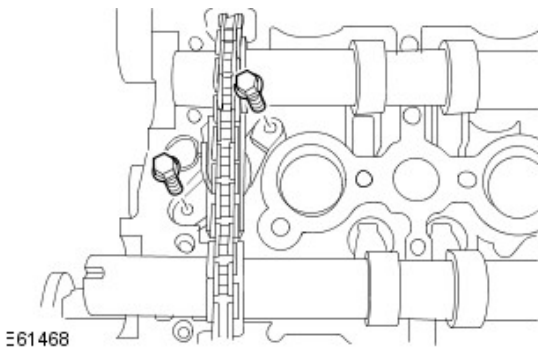


12.  **CAUTION:** Evenly and progressively, release the camshaft bearing caps.

Remove the camshaft bearing caps.

- Remove the 18 retaining bolts.

E61467

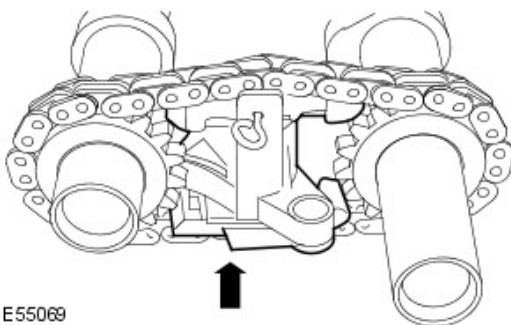


13. Remove the camshafts and secondary timing chain tensioner assembly.

- Remove the two retaining bolts.
- Release the LH secondary timing chain tensioner.

E61468

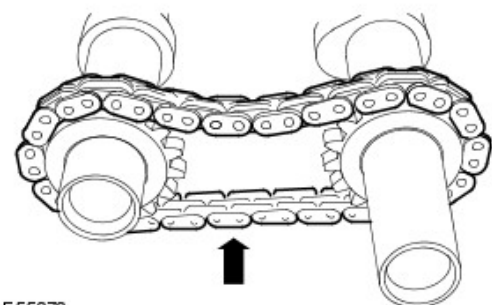
14. Remove the secondary timing chain tensioner.



E55069

15. Remove the LH camshafts.


- Release the secondary timing chain from the LH camshafts.
- Remove and discard the LH camshaft rear seal.



E55070

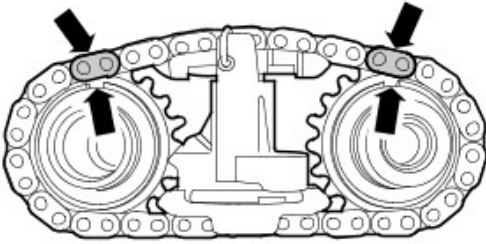
Installation

1. Install the secondary timing chain onto the camshafts.

2.  **CAUTION:** Do not release the secondary timing chain tensioner locking pin until all of the camshaft bearing caps have been installed.

Install the secondary timing chain tensioner.

- Align the marks on the camshafts with the marks on the secondary timing chain.



E55062

3. Install the camshafts and secondary timing chain tensioner assembly.

- Lubricate the journals and camshaft lobes.

4. Attach the LH secondary timing chain tensioner.

- Tighten the two retaining bolts to 10 Nm (7 lb.ft).

5. Install the camshaft bearing caps.

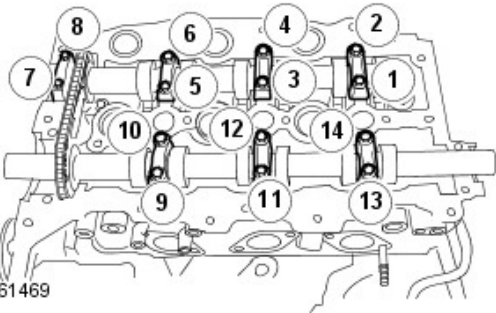
- Do not install the two exhaust camshaft end bearing caps at this stage.

- Tighten the bolts evenly in three stages in the sequence shown.

- Stage one: Tighten to 1 Nm (1 lb.ft).

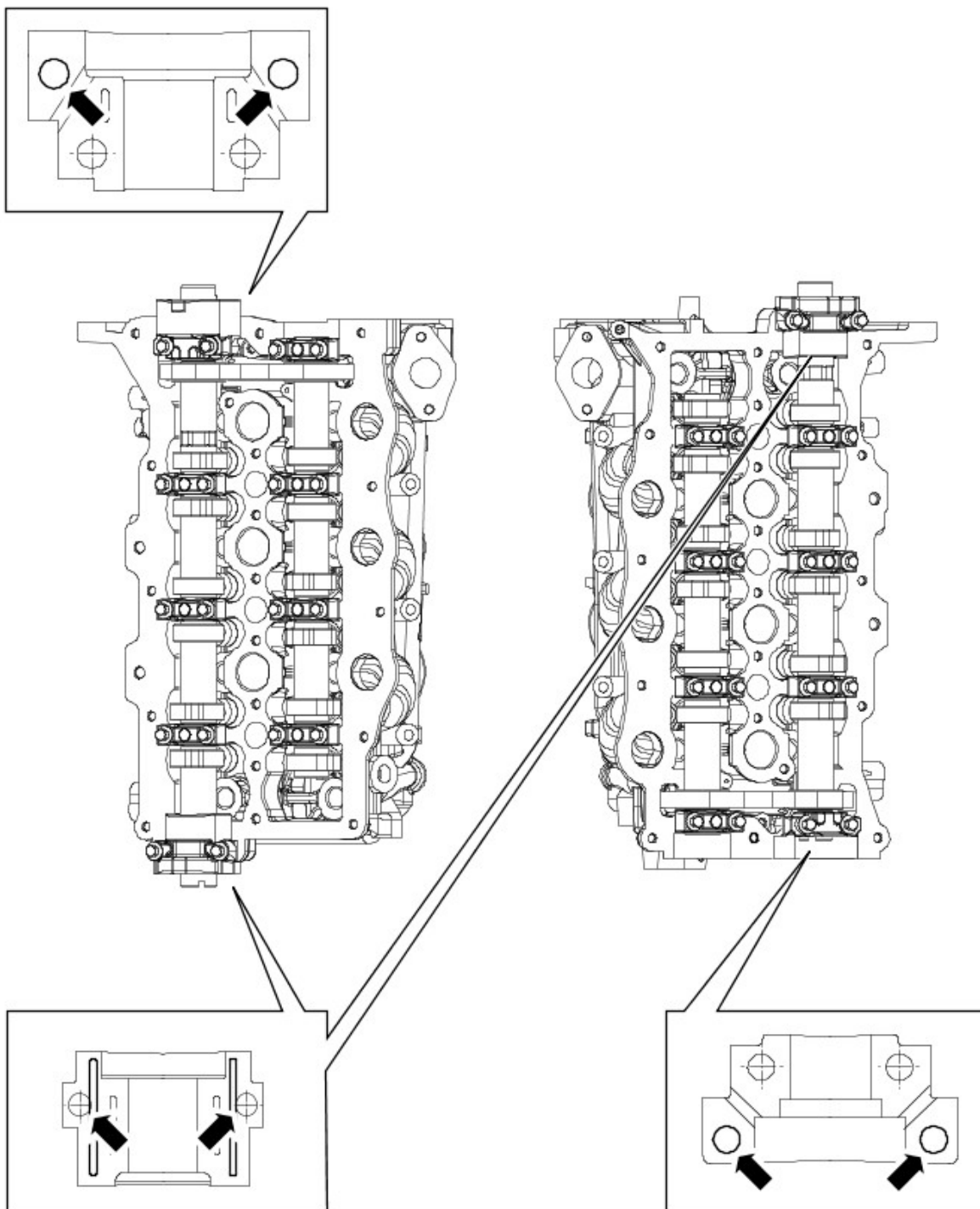
- Stage two: Tighten to 5 Nm (4 lb.ft).

- Stage three: Tighten to 10 Nm (7 lb.ft).



E61469

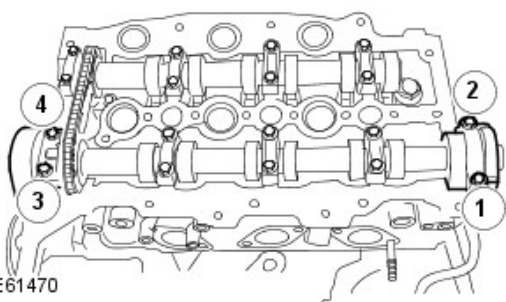
6. Apply sealant to the two exhaust camshaft end bearing caps at the positions shown. For additional information, refer to: [Specifications](#) (303-01A Engine - TDV6 2.7L Diesel, Specifications).



E55072

7. Install the exhaust camshaft end bearing caps.

- Tighten the bolts evenly in three stages in the sequence shown.
- Stage one: Tighten to 1 Nm (1 lb.ft).
- Stage two: Tighten to 5 Nm (4 lb.ft).
- Stage three: Tighten to 10 Nm (7 lb.ft).



E61470

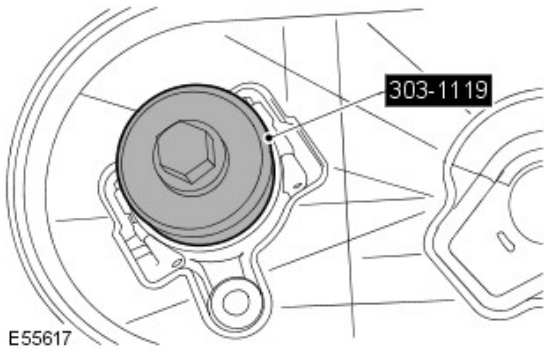
8. Release the secondary timing chain tensioner piston.

- Remove the locking pin.

9. Install the fuel injection pump belt rear cover.

- Install the fuel injection pump belt rear cover retaining bolt.

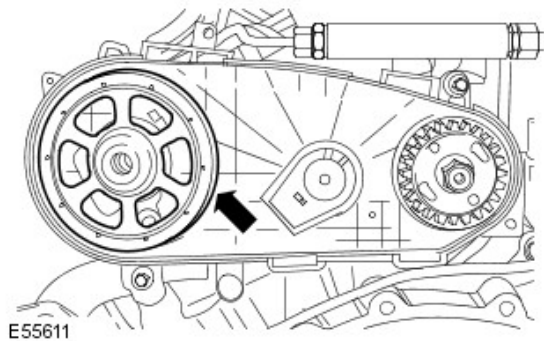
10. Using the special tool, install the new camshaft rear seal.



E55617

11. Install the camshaft rear pulley.

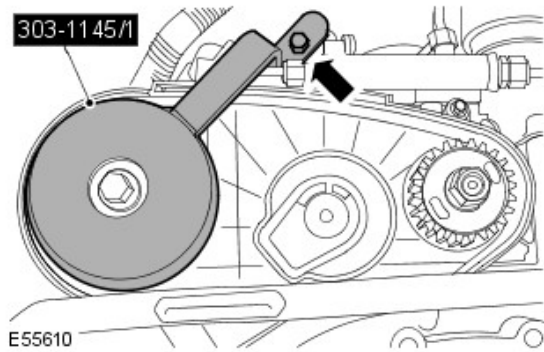
- Apply loctite 242 to the new camshaft pulley bolt.
- Install a new camshaft pulley retaining bolt.



E55611

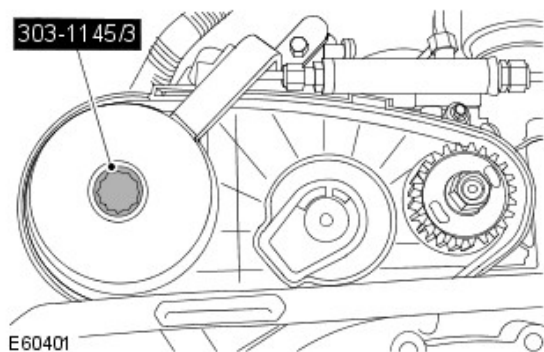
12. Install the special tool to the camshaft rear pulley.

- Install the special tool retaining bolt.

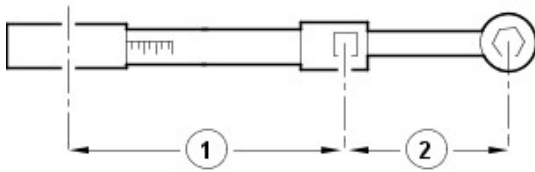


E55610

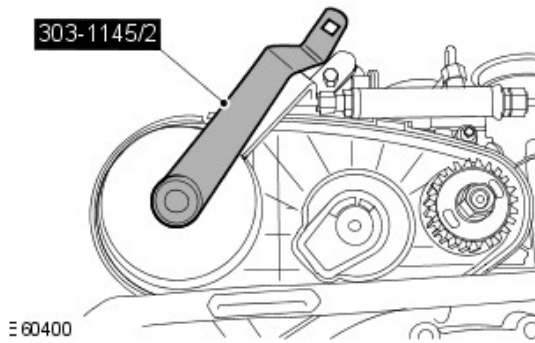
13. Install the special tool to the camshaft rear pulley retaining bolt.




E60401




E37107




14.  **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Calculate the setting for the torque wrench.

- Stage 1: Multiply the required torque by the effective length of the torque wrench (1).
- Stage 2: Add the effective length of the special tool (2) to the effective length of the torque wrench.
- Stage 3: Divide the total of stage 1 by the total of stage 2.
- Stage 4: Set the torque wrench to the figure arrived at in stage 3.

15.  **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Using the special tools, tighten the camshaft rear pulley retaining bolt to 40 Nm (30 lb.ft).

16.  **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Using the special tools, tighten the camshaft rear pulley bolt a further 75 Nm (56 lb.ft).

- Rotate the crankshaft counter-clockwise to retain the camshaft rear pulley.

17. Remove the special tools.

18. Install the fuel injection pump belt.

For additional information, refer to: [Fuel Injection Pump Belt - VIN Range: SALLA000304->END OF 06 MY](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

19. Install the LH valve cover.

For additional information, refer to: [Valve Cover LH](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

20. Install the camshaft front seal.

For additional information, refer to: [Camshaft Front Seal](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).


21. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Engine Mount RH

In-vehicle Repair

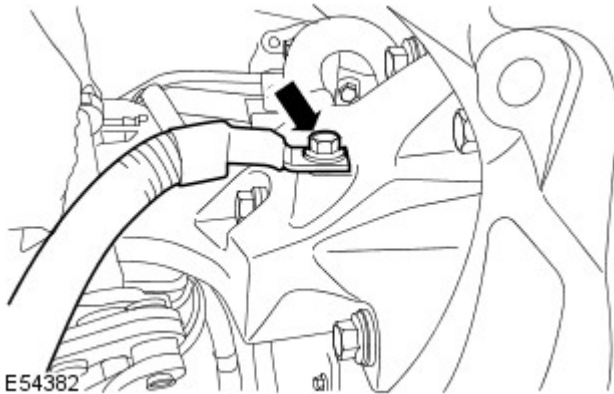
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

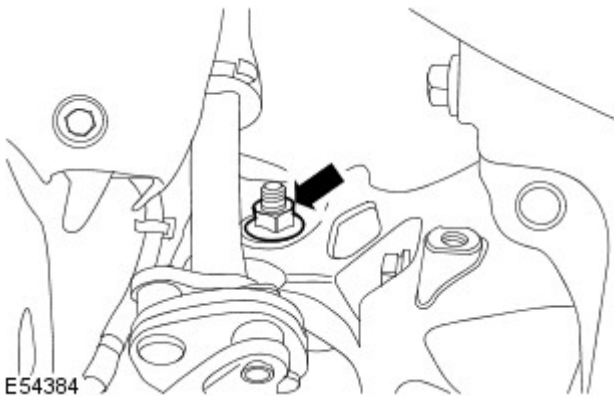
Raise and support the vehicle.


3. Remove the generator.
For additional information, refer to: [Generator](#) (414-02A Generator and Regulator - TDV6 2.7L Diesel, Removal and Installation).

4. Disconnect the ground cable.
 - Remove the ground cable retaining bolt.



5. Remove the engine mount bracket.
 - Remove the nut.

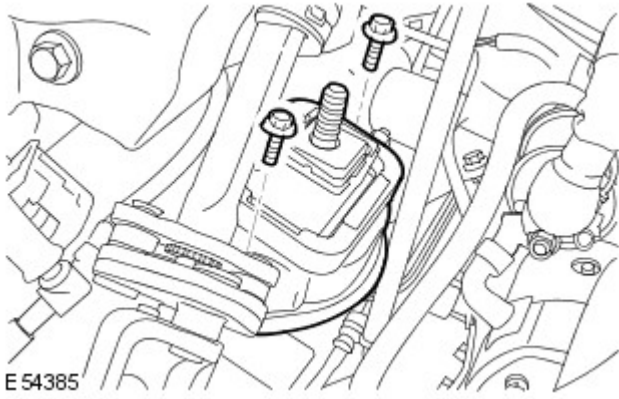


6.  **CAUTION:** Protect the engine during this operation.

Detach the engine mounting bracket.

- Support the engine.
- Remove the four retaining bolts.





7. Remove the engine mount.

- Remove and discard the two retaining bolts.

Installation

1. Install the engine mount.

- Clean the component mating faces.
- Install new retaining bolts.
- Tighten the two new bolts to 45 Nm (33 lb.ft), then a further 60 degrees.

2. Install the engine mount bracket.

- Clean the component mating faces.
- Tighten the four retaining bolts to 80 Nm (59 lb.ft).

3. Attach the engine mounting bracket.

- Lower the engine onto its mount.
- Tighten the nut to 90 Nm (66 lb.ft).

4. Connect the ground cable.

- Install the retaining bolt.

5. Install the generator.

For additional information, refer to: [Generator](#) (414-02A Generator and Regulator - TDV6 2.7L Diesel, Removal and Installation).


6. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Flywheel

In-vehicle Repair

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

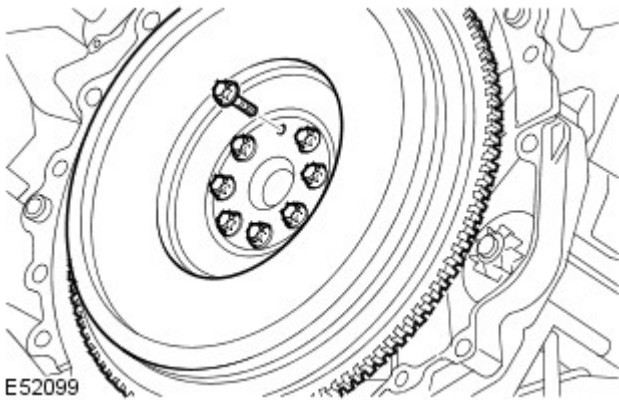
Raise and support the vehicle.

2. Remove the pressure plate and clutch disc.
For additional information, refer to: [Clutch Disc and Pressure Plate](#) (308-01 Clutch - TDV6 2.7L Diesel, Removal and Installation).


3. **NOTE:** Prevent the flywheel from rotating.

Remove the flywheel.

- Remove the 8 Torx bolts.



Installation

1.  **CAUTION:** Tighten the bolts in a diagonal sequence.
- **NOTE:** Prevent the flywheel from rotating.

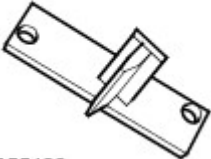
Install the flywheel.

- Clean the component mating faces.
- Tighten the retaining bolts in three stages.
- Tighten the Torx bolts to 45 Nm (33 lb.ft).
- Tighten the Torx bolts by 45 degrees.
- Tighten the Torx bolts by a further 45 degrees.


2. Install the clutch disc and pressure plate.
For additional information, refer to: [Clutch Disc and Pressure Plate](#) (308-01 Clutch - TDV6 2.7L Diesel, Removal and Installation).

Engine - TDV6 2.7L Diesel - Flexplate

In-vehicle Repair

Special Tool(s)	
 <p>303-947</p> <p>E55482</p>	<p>Flex plate locking tool (LRT-12-145)</p> <p>303-947</p>

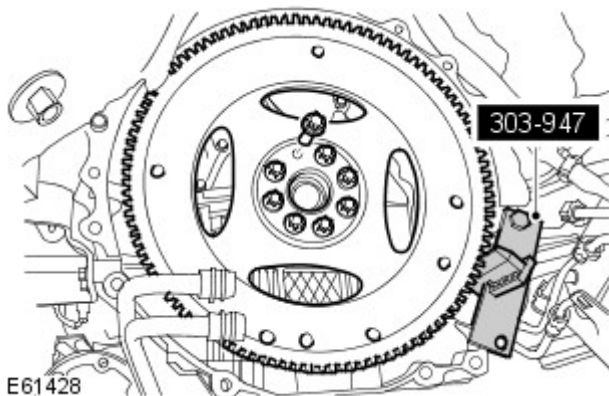
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Raise and support the vehicle.

3. Remove the transmission.
For additional information, refer to: [Transmission](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Removal and Installation).
4. Remove the torque converter flexplate.

- Using the special tool, lock the flexplate.
- Remove the 8 Torx bolts.

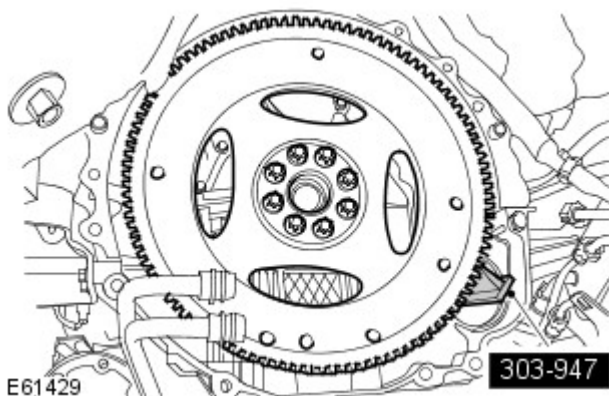


Installation

1.  **CAUTION:** Tighten the bolts in a diagonal sequence.

Install the torque converter flexplate.

- Clean the component mating faces.
- Using the special tool, lock the flexplate.
- Tighten the Torx bolts progressively in 3 stages.
- Tighten the Torx bolts to 50 Nm (37 lb.ft).
- Tighten the Torx bolts by 45 degrees.
- Tighten the Torx bolts by a further 45 degrees.



2. Install the transmission.
For additional information, refer to: [Transmission](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information,

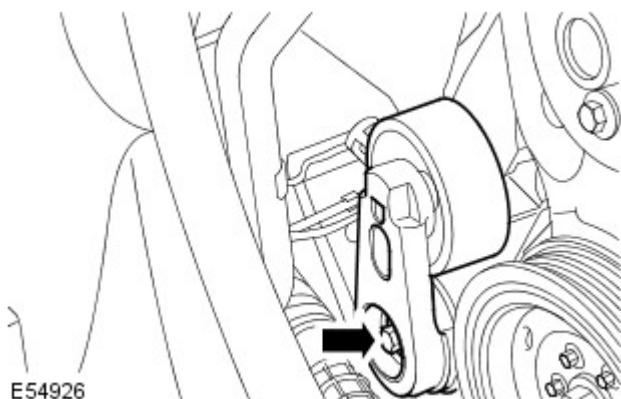
Specifications).

Engine - TDV6 2.7L Diesel - Oil Pump

In-vehicle Repair

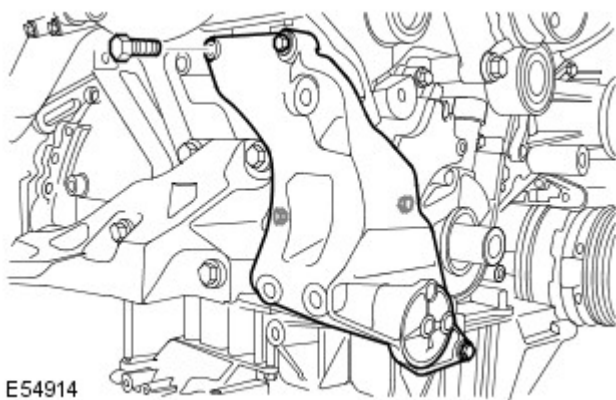
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the generator.
For additional information, refer to: [Generator](#) (414-02A Generator and Regulator - TDV6 2.7L Diesel, Removal and Installation).
3. Remove the accessory drive belt tensioner.
 - Remove the LH retaining bolt.



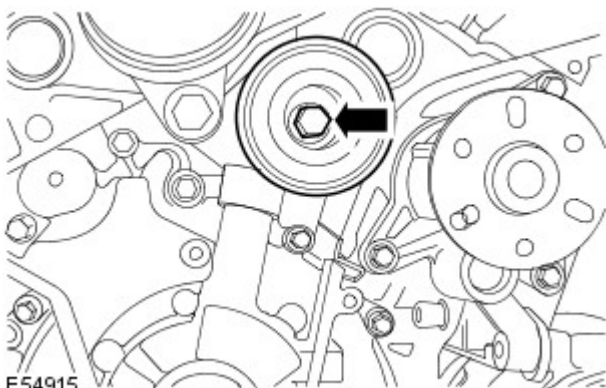
E54926

4. Remove the oil pan extension.
5. Remove the crankshaft front oil seal.
For additional information, refer to: [Crankshaft Front Seal](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
6. Remove the generator mounting bracket.
 - Remove the five retaining bolts.




E54914

7. Remove the timing belt idler pulley.
 - Remove the LH retaining bolt.



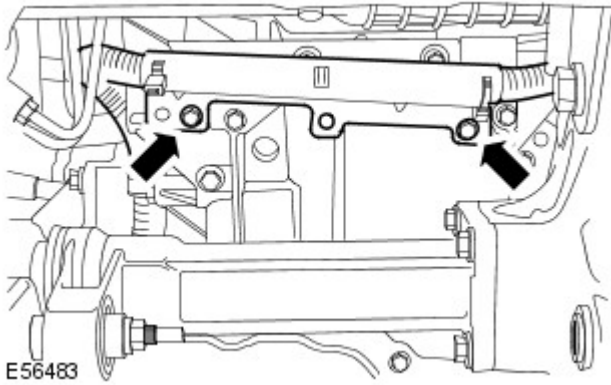
E54915

8.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

9. Release the battery positive cable.

- Remove the two retaining bolts.



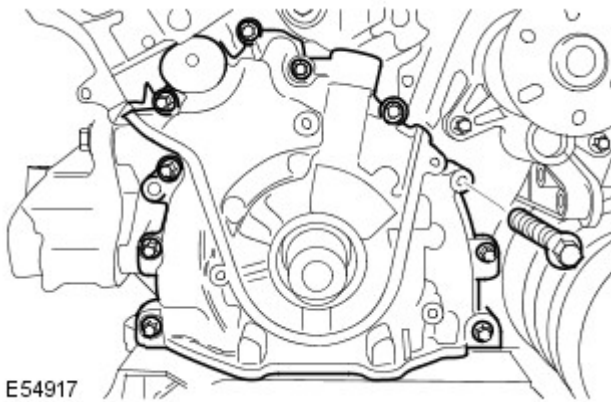
10. Remove the oil pump lower retaining bolts.

- Remove the four retaining bolts.



11. Remove the oil pump.

- Remove the ten retaining bolts.
- Remove the timing belt cover sealing strips.
- Remove and discard the gasket.



Installation

1. Prime the oil pump.

- Fill the orifice shown with 20 ml of engine oil.
- Rotate the oil pump drive 2 complete turns.



E123911

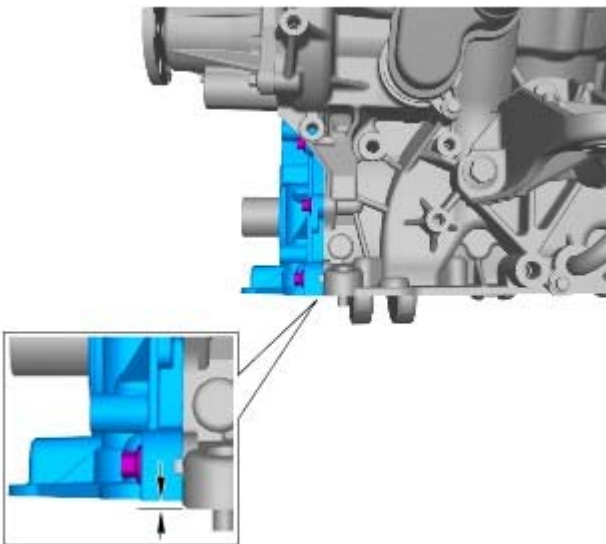
2. CAUTIONS:

 Make sure that the mating faces are clean and free of foreign material.


 Make sure the gasket is installed correctly.

Install the oil pump.

- Clean the component mating faces.
- Install a new gasket.
- Lightly tighten the bolts in the position shown.

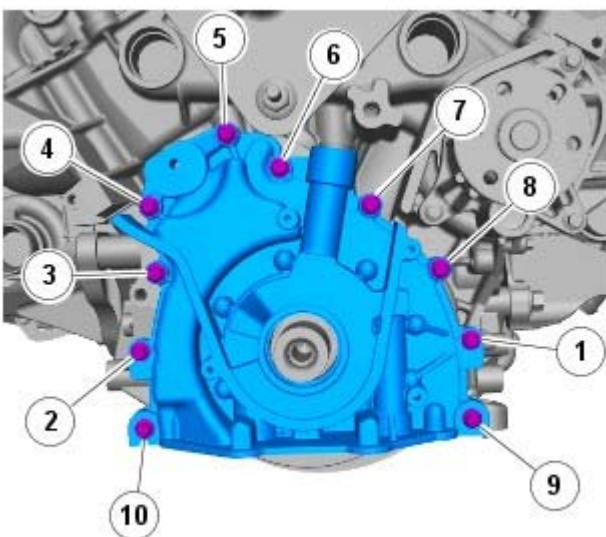


E123913

3.  CAUTION: Make sure the base of the oil pump is aligned within 0.2 mm of the base of the engine block. Failure to follow this instruction may result in damage to the vehicle.

• NOTE: Vehicles fitted with oil pumps without dowels.

Check the oil pump to engine block alignment.



E123912

4. Secure the oil pump.

- Tighten the bolts in the sequence shown to 10 Nm .

5. Install the oil pump lower retaining bolts.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).
6. Install the battery positive cable.
 - Tighten the two retaining bolts to 10 Nm (7 lb.ft).
 7. Install the timing belt idler pulley.
 - Tighten the bolt to 45 Nm (33 lb.ft).
 8. Install the crankshaft front oil seal.
For additional information, refer to: [Crankshaft Front Seal](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
 9. Install the oil pan extension.
 10. Install the generator mounting bracket.
 - Tighten the bolts to 22 Nm (16 lb.ft).
 11. Install the accessory drive belt tensioner.
 - Tighten the bolt to 45 Nm (33 lb.ft).
 12. Install the generator.
For additional information, refer to: [Generator](#) (414-02A Generator and Regulator - TDV6 2.7L Diesel, Removal and Installation).
 13. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Oil Pressure Switch

In-vehicle Repair






1. Refer to Engine Oil Pressure (EOP) Sensor.
For additional information, refer to: [Engine Oil Pressure \(EOP\) Sensor](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Removal and Installation).

Engine - TDV6 2.7L Diesel - Oil Cooler




In-vehicle Repair

Removal

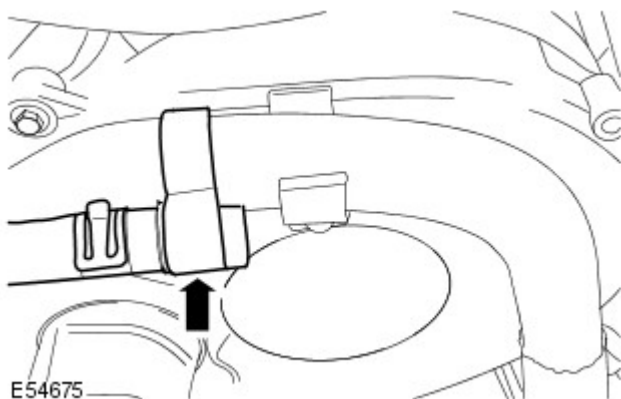
• WARNINGS:

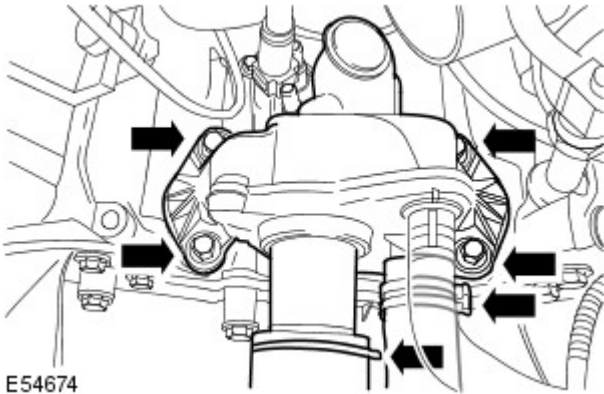
-  Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.
-  Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.
-  Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.

• CAUTIONS:

-  Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.
-  Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

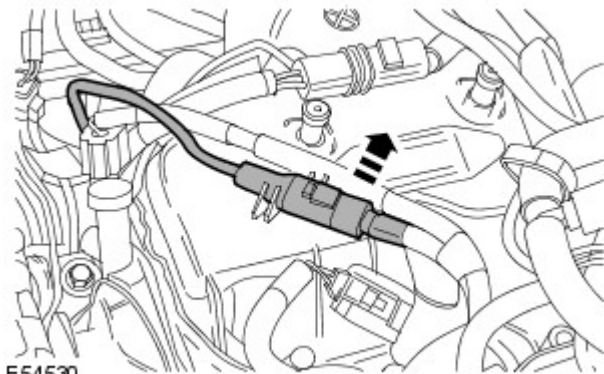
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
3. Remove the crankcase vent oil separator.
For additional information, refer to: Crankcase Vent Oil Separator (303-08, Removal and Installation).
4. Release the coolant bleed hose from the LH exhaust gas recirculation (EGR) coolant inlet hose.
 - Release the retaining clip.





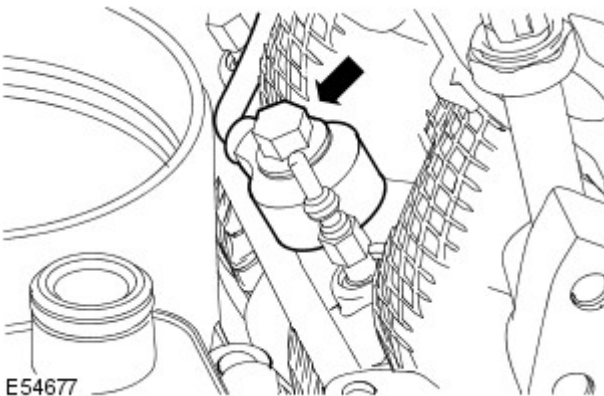
E54674

5. Remove the cylinder head coolant elbow.
 - Release the two retaining clips and disconnect the hoses.
 - Remove the four retaining bolts.
 - Remove and discard the O-ring seals.



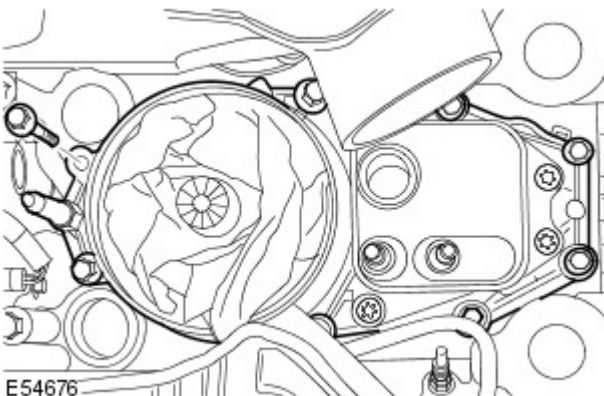
E54530

6. Disconnect the knock sensors (KS) electrical connector.
 - Release the KS harness from the valve cover.



E54677

7. Remove the LH KS.
 - Remove the retaining bolt.



E54676

8. **NOTE:** Some fluid spillage is inevitable during this operation.

Remove the oil cooler.

- Remove the eight retaining bolts.
- Remove and discard the gasket.
- Remove and discard the O-ring seal.

Installation

1.  **CAUTION:** Make sure the gasket is installed correctly.

- **NOTE:** Make sure all component mating faces are clean.

Install the oil cooler.

- Install a new gasket.
- Install a new O-ring seal.
- Install the eight retaining bolts and tighten to 10 Nm (7 lb.ft).

2. Install the LH KS.

- Install the retaining bolt and tighten to 20 Nm (15 lb.ft).
- Connect the knock sensor electrical connector.
- Attach the KS harness to the valve cover.

3. Install the cylinder head coolant outlet elbow.

- Install new O-ring seals.
- Install the four retaining bolts and tighten to 10 Nm (7 lb.ft).
- Connect the hoses and secure with the clips.

4. Secure the coolant bleed hose to the EGR coolant inlet hose.

5. Install the crankcase vent oil separator.

For additional information, refer to: Crankcase Vent Oil Separator (303-08, Removal and Installation).

6. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

7. Refill and bleed the cooling system.


For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

8. Check and top-up the engine oil.

Engine - TDV6 2.7L Diesel - Oil Pump Screen and Pickup Tube

In-vehicle Repair

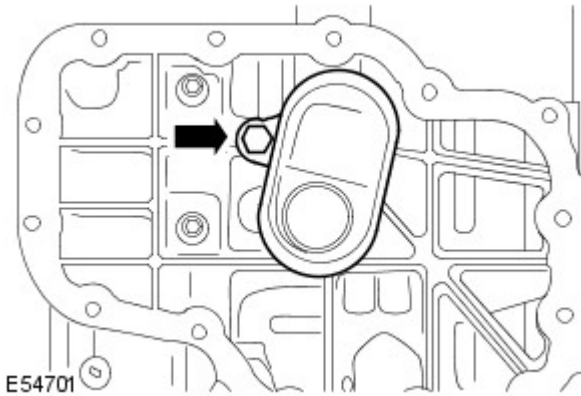
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the oil pan.
For additional information, refer to: [Oil Pan](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
4. Remove the oil pump screen and pickup tube.

- Remove the bolt.
- Remove and discard both O-ring seals.
- Clean the seal contact area.



Installation

1. **NOTE:** Lubricate new seals with clean engine oil.

Install the oil pump screen and pickup tube.

- Clean the components.
- Install new O-ring seals.
- Tighten the bolt to 10 Nm (7 lb.ft).


2. Install the oil pan.
For additional information, refer to: [Oil Pan](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Oil Pan

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

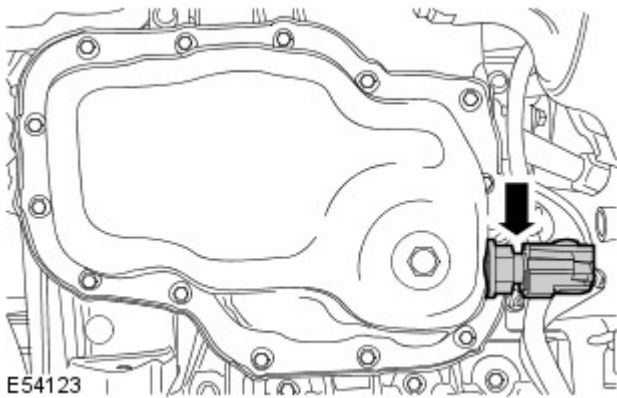
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Drain the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures).

5. Remove the oil temperature sensor.

- Disconnect the engine oil temperature sensor electrical connector.
- Remove and discard the O-ring seal.

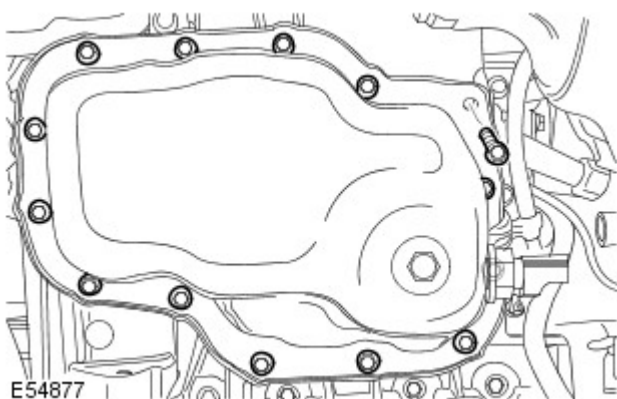


6. Disconnect the engine wiring harness.

- Release the engine wiring harness from the retaining bracket.

7. Remove the oil pan.

- Remove the 14 oil pan bolts.
- Remove and discard the gasket.



Installation

1. Install the oil pan.

- Clean the component mating faces.
- Install a new gasket.
- Evenly and progressively tighten the bolts to 10 Nm (7 lb.ft).

2. Connect the engine wiring harness.

- Attach the engine wiring harness to the retaining bracket.
3. Install the oil temperature sensor.
 - Install a new O-ring seal.
 - Tighten the sensor to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
 4. Fill the engine with oil.

For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures).
 5. Install the engine cover.

For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
 6. Connect the battery ground cable.

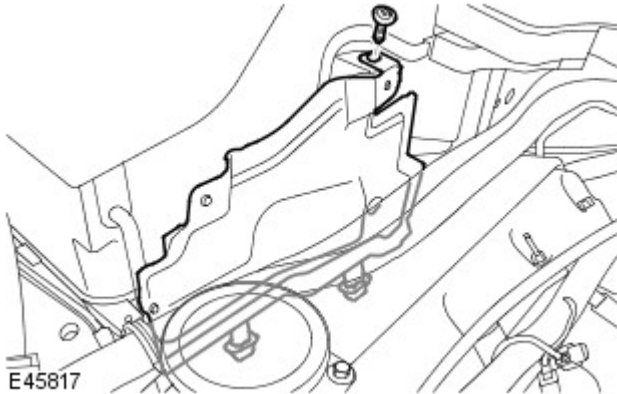
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Oil Pan Extension

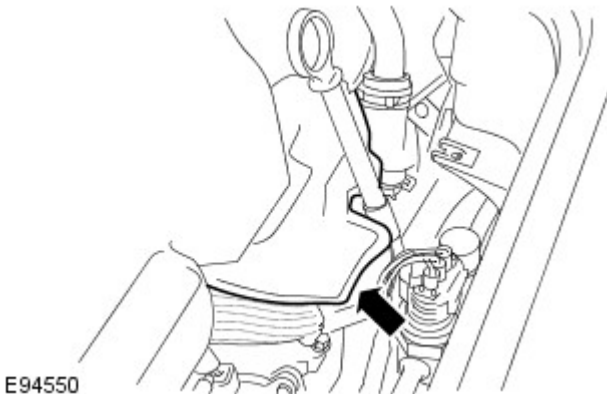
In-vehicle Repair

Removal

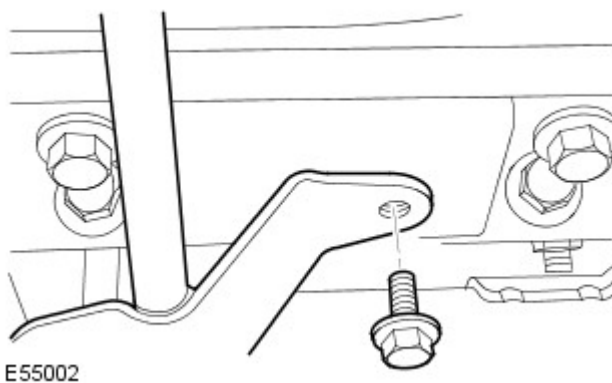
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine compartment upper heat shield.
 - Remove the screw.




3. Reposition the injector sound proofing.



4. Release the oil level indicator and tube from the oil pan extension.
 - Remove the bolt.
 - Remove and discard the O-ring seal.



5.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

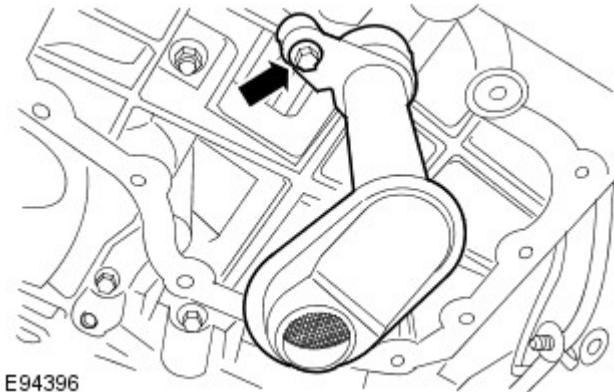
Raise and support the vehicle.

6. Remove the front wheels and tires.
7. Remove the front axle tube.
For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).
8. Remove the oil pan.
For additional information, refer to: [Oil Pan](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

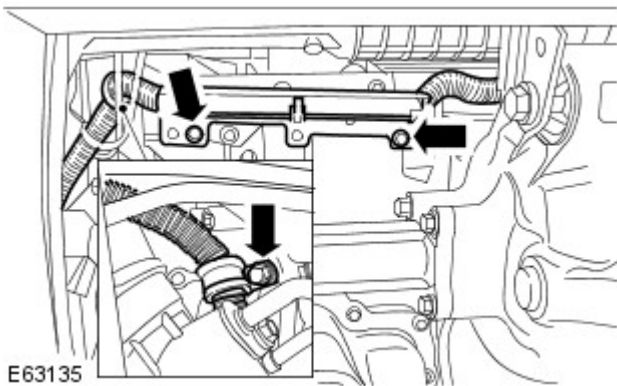
9. Remove the starter motor.
For additional information, refer to: [Starter Motor](#) (303-06A Starting System - TDV6 2.7L Diesel, Removal and Installation).

10. Remove the oil strainer pick-up assembly.

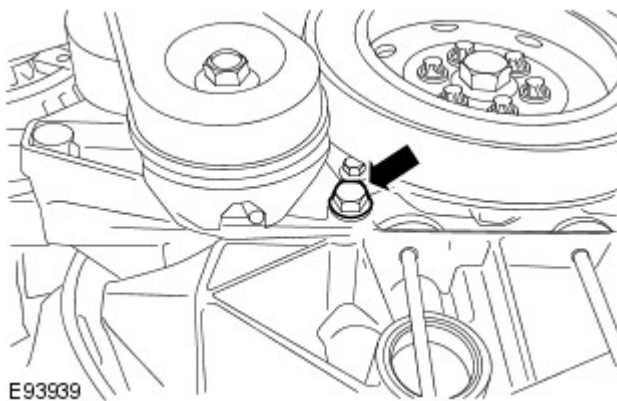
- Remove the bolt.
- Remove and discard the O-ring seal.



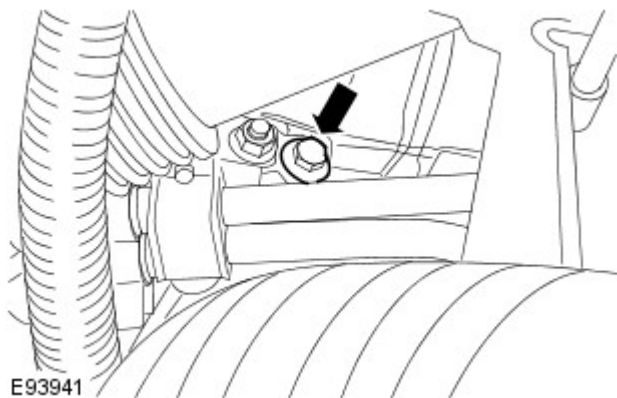
11. Remove the 3 bolts from the battery to starter motor solenoid cable.

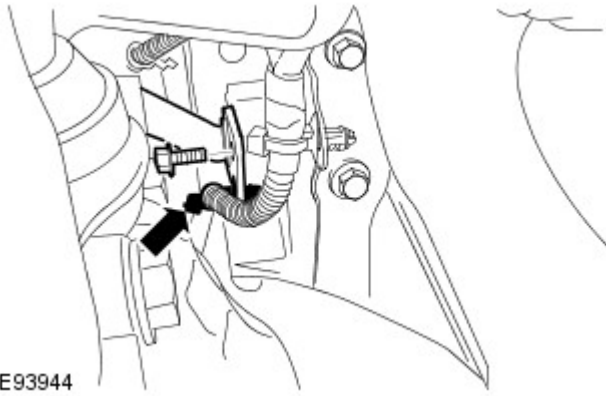


12. Remove the bolt from the accessory drive belt tensioner bracket.



13. Remove the lower bolt from the air conditioning (A/C) compressor.

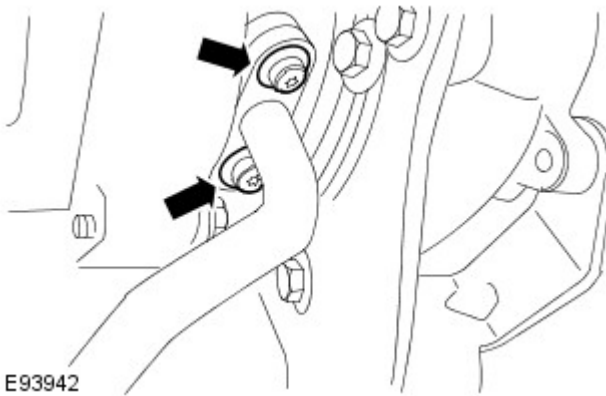




E93944

14. Release the turbocharger oil return tube.

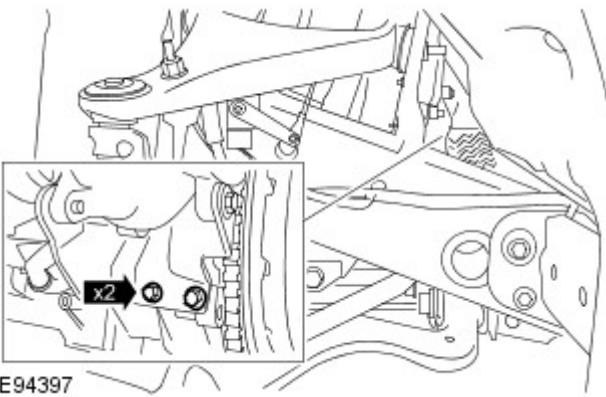
- Release the wiring harness clip.
- Remove the bolt.



E93942

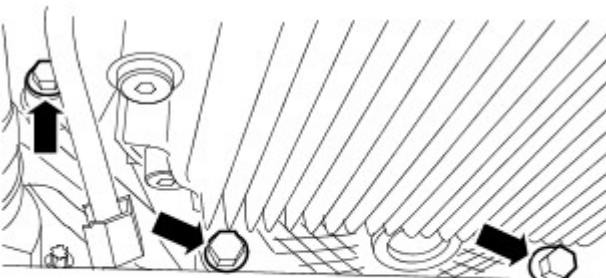
15. Remove the turbocharger oil return tube.

- Remove the 2 bolts.
- Remove and discard the gasket.
- Remove and discard the O-ring seals.
- Install blanking caps to the exposed ports.



E94397

16. Remove the 2 bolts from the turbocharger support bracket.

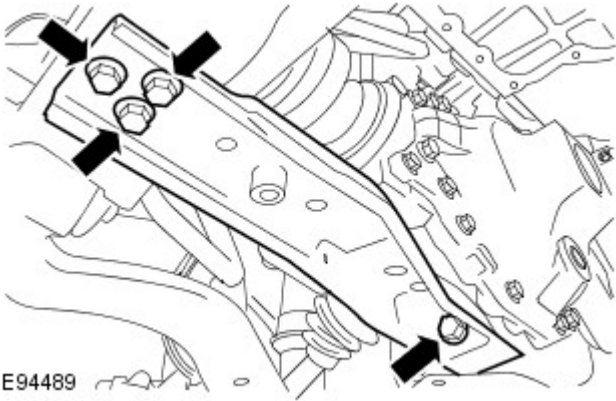


E94398

17. Remove the 3 lower bolts from the transmission to the engine.

18. Remove the front axle crossmember.

- Remove the 4 bolts.

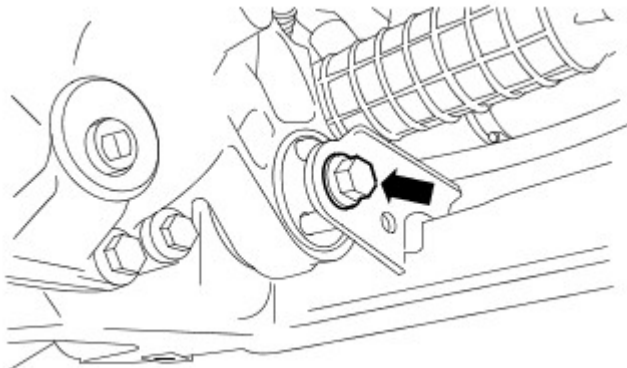


E94489

19. Using a transmission jack, support the front axle assembly.

20. Remove the front axle assembly front mounting bolt.

- Carefully lower the front axle assembly.

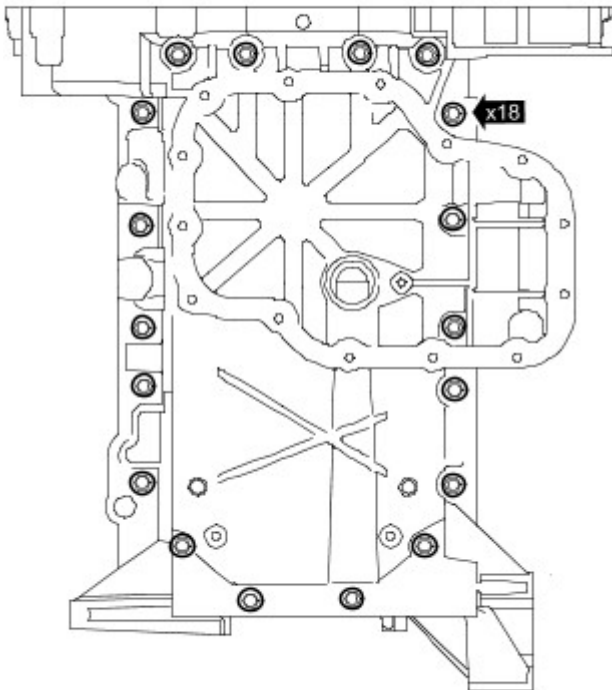


E94490

21. NOTE: Note the fitted position of the retaining bolts prior to removal.

Remove the oil pan extension.

- Remove the 18 bolts.
- Remove and discard the gasket.



E93945

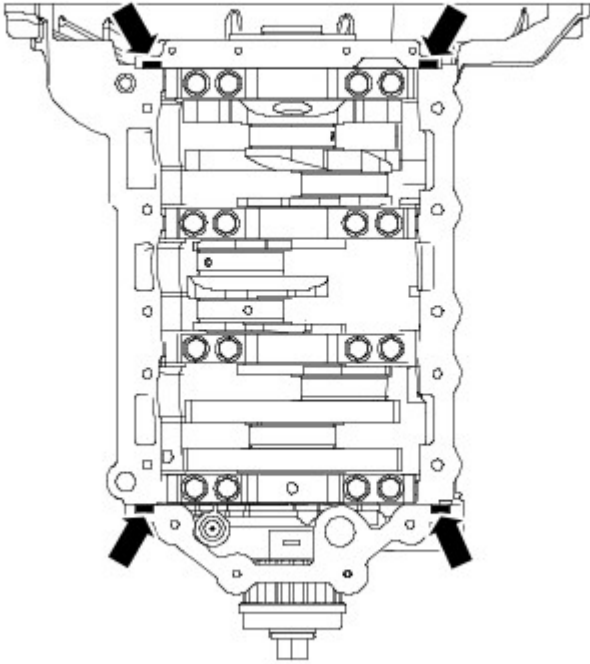
Installation

1. NOTE: Make sure that all the component mating faces are clean.

• NOTE: It is important that the oil pan extension is bolted to the crankshaft main bearing carrier within twenty minutes of applying the sealant.

Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

- Use WSS-M4G323-A4-RTV sealant.



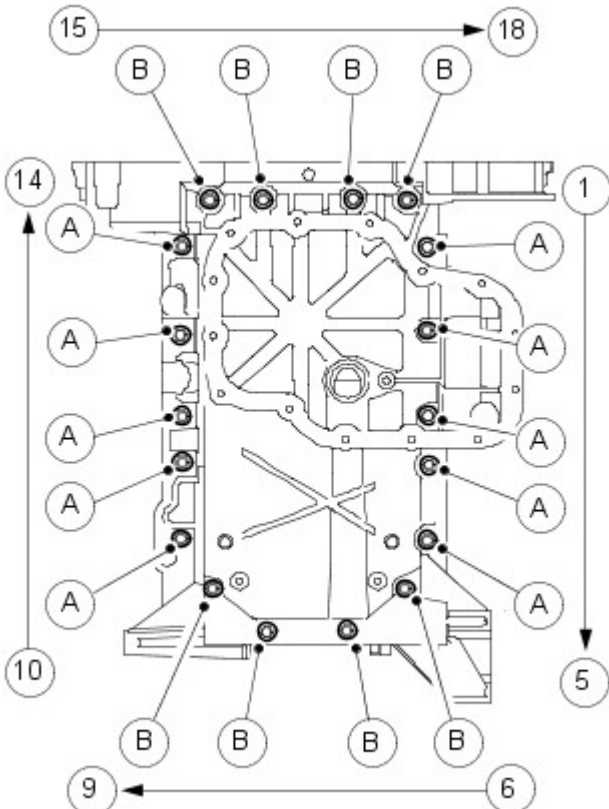
E93678

2. Install the oil pan extension.

- Install a new gasket.
- Loosely install all oil pan extension retaining bolts.

3. Tighten the retaining bolts in the sequence shown.

1. Tighten bolts A to 10 Nm (7 lb.ft). Tighten bolts B to 4 Nm (2 lb.ft).
2. Tighten bolts A to 24 Nm (18 lb.ft). Tighten bolts B to 10 Nm (7 lb.ft).



E93962

4. Align and secure the front axle assembly.

- Tighten the M14 bolt to 105 Nm (77 lb.ft).

5. Install the front axle crossmember.

- Tighten the 4 bolts to 115 Nm (85 lb.ft).

6. Install the 3 lower bolts from the transmission to the engine.

- Tighten the bolts to 45 Nm (33 lb.ft).

7. Install the 2 bolts to the turbocharger support bracket.

- Tighten the 2 bolts to 23 Nm (17 lb.ft).

8. NOTE: Make sure that all the component mating faces are clean.

- NOTE: Remove and discard the blanking caps.

Install the turbocharger oil return tube.

- Install new O-ring seals.
- Install a new gasket.
- Tighten the 2 bolts to 10 Nm (7 lb.ft).

9. Install the bolt to the turbocharger oil return tube.

- Secure the wiring harness to the turbocharger oil return tube.

10. Install the lower bolt to the A/C compressor.

- Tighten the bolt to 24 Nm (18 lb.ft).

11. Install the bolt to the accessory drive belt tensioner bracket.

- Tighten the new bolt to 24 Nm (18 lb.ft).

12. Secure the battery to starter motor solenoid cable.

- Tighten the M8 bolt to 22 Nm (16 lb.ft).
- Tighten the M6 bolts to 10 Nm (7 lb.ft).

13. NOTE: Make sure that all the component mating faces are clean.

Install the oil strainer pick-up assembly.

- Install a new O-ring seal.
- Tighten the bolt to 10 Nm (7 lb.ft).

14. Install the starter motor.

For additional information, refer to: [Starter Motor](#) (303-06A Starting System - TDV6 2.7L Diesel, Removal and Installation).

15. Install the oil pan.

For additional information, refer to: [Oil Pan](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

16. Install the front axle tube.

For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).

17. Install the front wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

18. NOTE: Make sure that all the component mating faces are clean.

Secure the oil level indicator and tube into the oil pan extension.

- Install a new O-ring seal.
- Install the bolt.

19. Reposition the injector sound proofing.

20. Install the engine compartment upper heat shield.

- Install the screw.

21. Connect the battery ground cable.

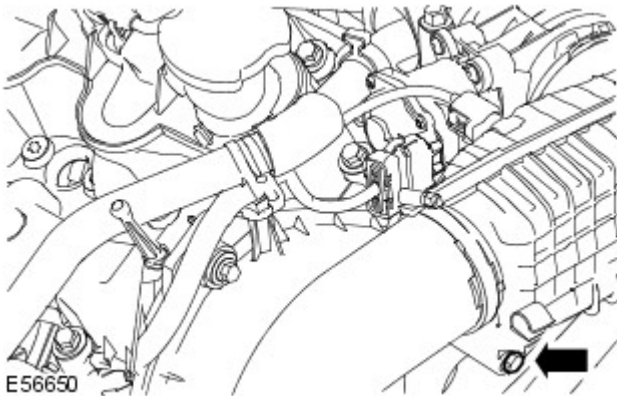
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Timing Belt Cover

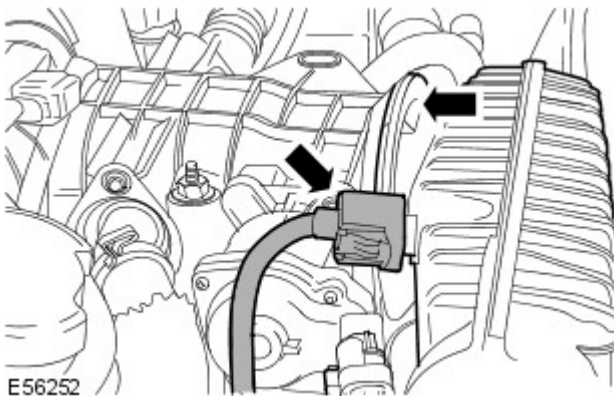
In-vehicle Repair

Removal

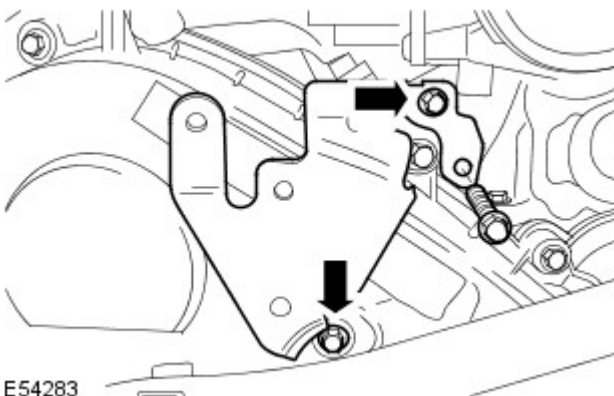
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the intake air shutoff throttle elbow.
 - Remove the retaining bolt.



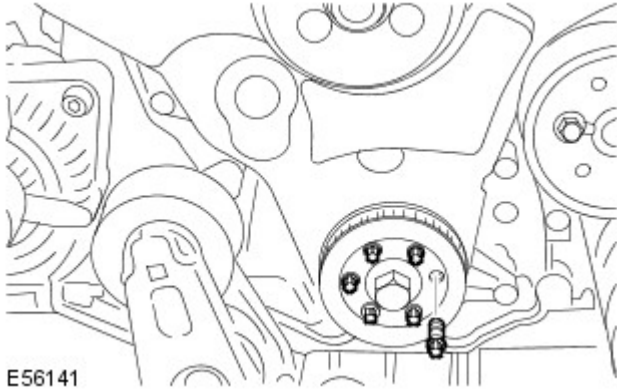
4. Release the intake air shutoff throttle elbow.
 - Release the retaining clip.
 - Disconnect the electrical connector.



5. Remove the intake air shutoff throttle elbow support bracket.
 - Remove the three retaining bolts.




6. Remove the fan cowl.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).



7. Remove the crankshaft damper.

- Remove the six retaining bolts.

8.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

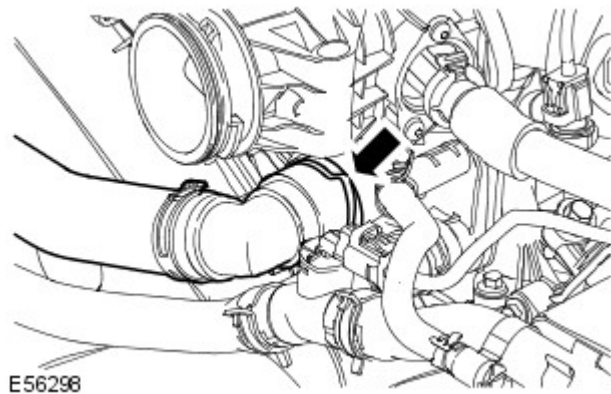
Raise and support the vehicle.

9. Drain the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

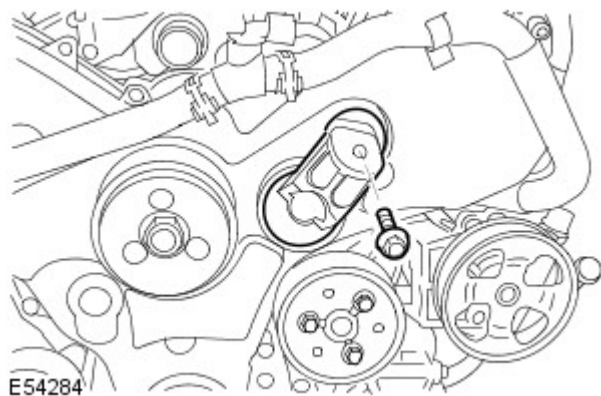
10. Disconnect the coolant hose from the cylinder head coolant outlet elbow.

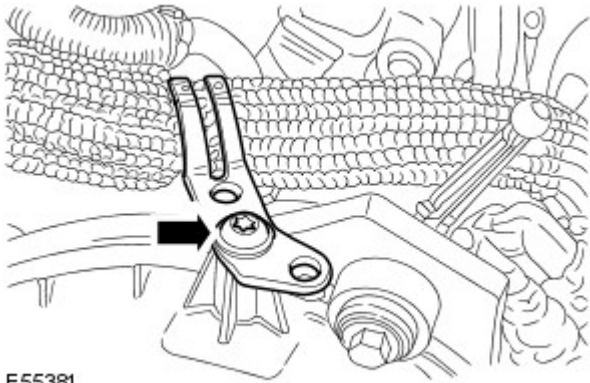
- Release the coolant hose retaining clip.
- Reposition the coolant top hose.



11. Remove the accessory drive belt idler.

- Remove the retaining bolt.

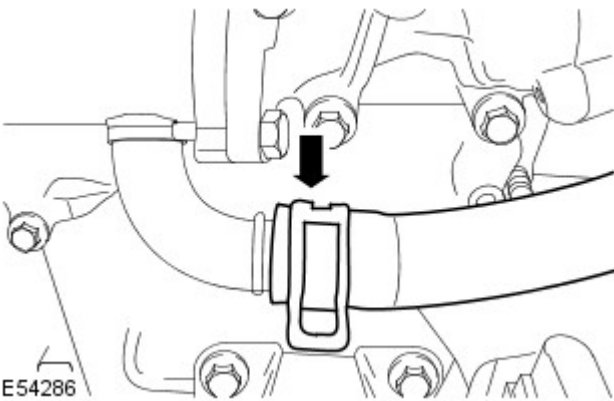




12. NOTE: Right-hand shown, left-hand similar.

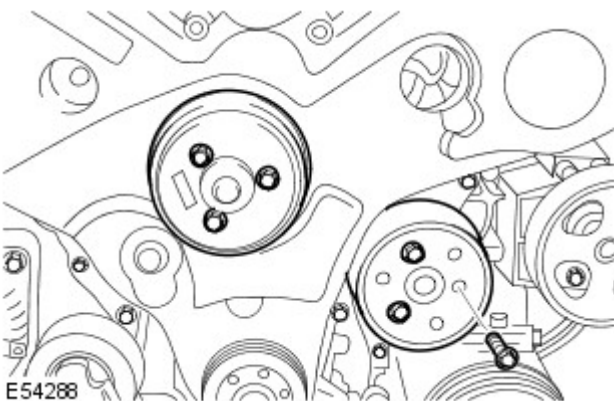
Release the exhaust gas recirculation (EGR) valve outlet tube clamps from the timing cover.

- Remove the retaining bolt.



13. Disconnect the right-hand EGR coolant inlet hose from the EGR cooler.

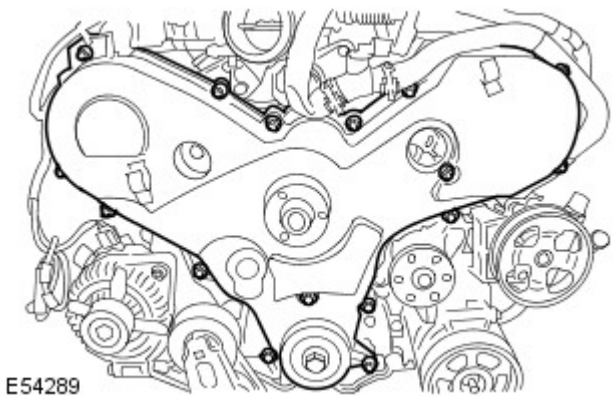
- Release the coolant hose retaining clip.



14. Position the EGR coolant hose aside for access.

15. Remove the coolant pump and accessory drive belt idler pulleys.

- Remove the six retaining bolts.



16. Remove the timing belt cover.

- Fully loosen the 16 timing belt cover retaining bolts.
- Release the 2 wiring harness clips.





Installation

1. Install the timing belt cover.

- Attach the 2 wiring harness clips.
 - Tighten the 16 timing belt cover retaining bolts to 10 Nm (7 lb.ft).
2. Install the coolant pump and accessory drive belt idler pulleys.
 - Tighten the six retaining bolts to 23 Nm (17 lb.ft).
 3. Connect the right-hand EGR coolant inlet hose to the EGR cooler.
 - Install the coolant hose retaining clip.
 4. Secure the EGR valve outlet tube clamps to the timing cover.
 - Install the two retaining bolts.
 5. Connect the coolant hose to the cylinder head coolant outlet elbow.
 - Install the retaining clip.
 6. Install the accessory drive belt idler.
 - Install the retaining bolt and tighten to 47 Nm (35 lb.ft).
 7. Install the crankshaft damper.
 - Tighten the six retaining bolts to 23 Nm (17 lb.ft).
 8. Install the fan cowl.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
 9. Install the intake air shutoff throttle elbow support bracket.
 - Install the three retaining bolts and tighten to 10 Nm (7 lb.ft).
 10. Secure the intake air shutoff throttle elbow.
 - Install the retaining clip.
 - Install the retaining bolt.
 - Connect the electrical connector.
 11. Install the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 12. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 13. Refill and bleed the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).


Engine - TDV6 2.7L Diesel - Timing Belt

In-vehicle Repair

Special Tool(s)	
 <p>303-1132</p> <p>E54557</p>	<p>Check Pin - Camshaft Pulleys</p> <p>303-1132</p>
 <p>303-1126</p> <p>E54551</p>	<p>Timing Pin - Camshaft Pulleys</p> <p>303-1126</p>
 <p>303-1117</p> <p>E54540</p>	<p>Timing Pin - Automatic Transmission</p> <p>303-1117</p>
 <p>303-1116</p> <p>E54539</p>	<p>Timing Pin - Manual Transmission</p> <p>303-1116</p>

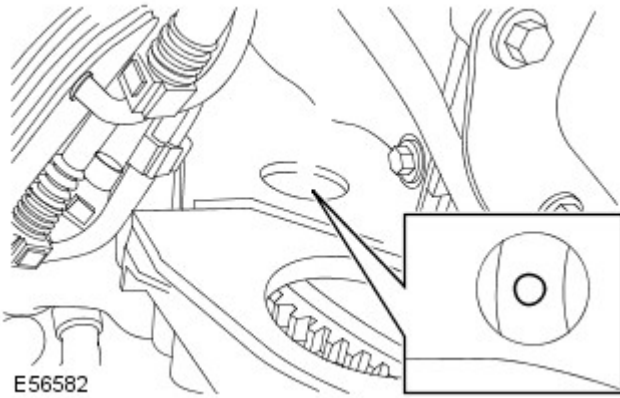
Removal

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the timing belt cover.
For additional information, refer to: [Timing Belt Cover](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
4. Remove the starter motor.
For additional information, refer to: [Starter Motor](#) (303-06A Starting System - TDV6 2.7L Diesel, Removal and Installation).
5. Remove the crankshaft timing alignment grommet from the engine block.
6. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the block aperture.

7. Check the camshaft pulley alignment holes are correctly aligned. If the alignment holes are not aligned, rotate the crankshaft one full turn clockwise.

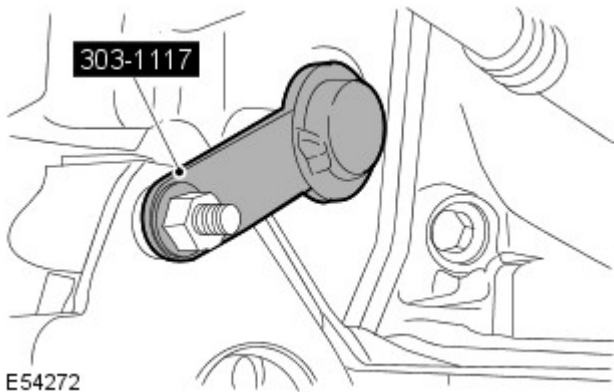


E56582

Vehicles with automatic transmission

8. Using the special tool, lock the flexplate.

- Install a starter motor bolt to retain the special tool.

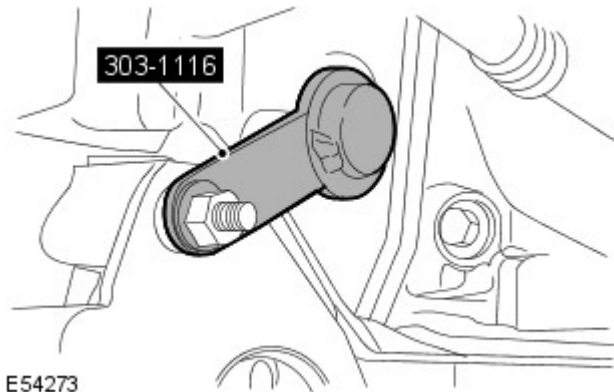


E54272

Vehicles with manual transmission

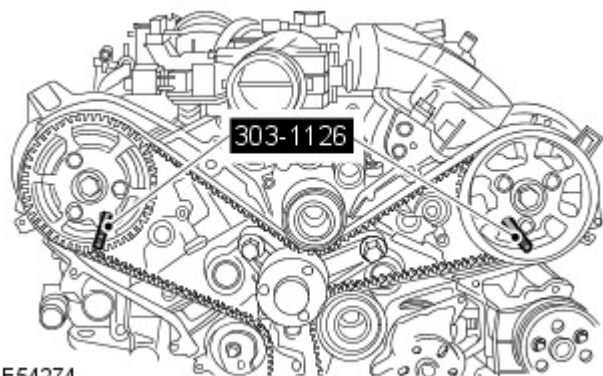
9. Using the special tool, lock the flywheel.

- Install a starter motor bolt to retain the special tool.

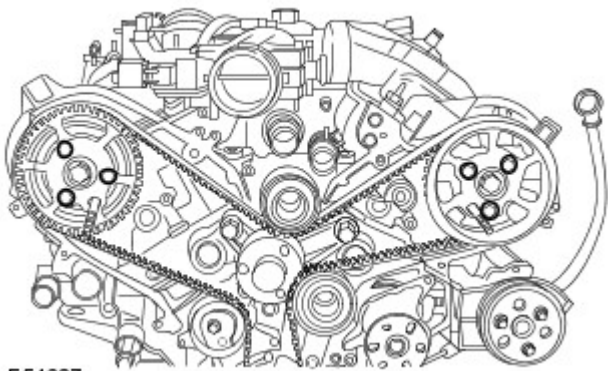


E54273


10. Install the special tools to the exhaust camshaft pulleys.



E54274

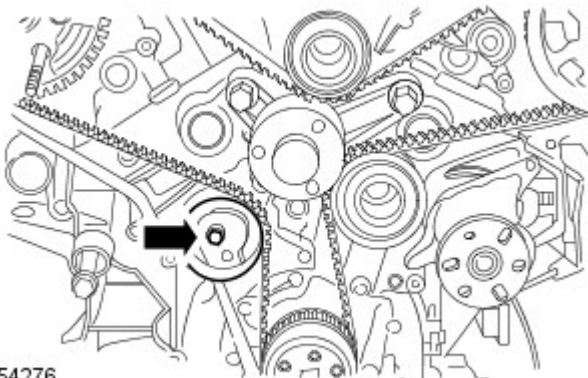


E54627

11.  **CAUTION:** Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

Loosen the six exhaust camshaft pulley damper retaining bolts.

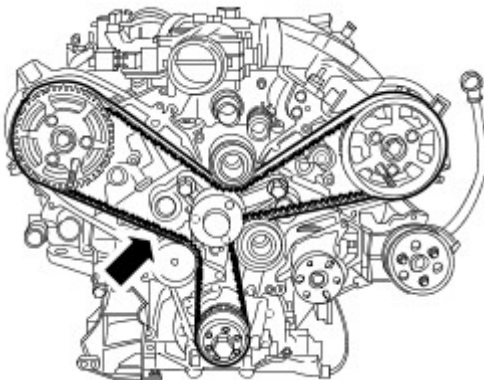
- Using a suitable tool, counterhold the camshaft pulley center retaining bolts.



E54276

12. Remove and discard the timing belt tensioner.

- Remove and discard the bolt.



E 54277

13. Remove and discard the timing belt.

Installation

All vehicles


1. Rotate both camshaft pulleys clockwise.



E 54278

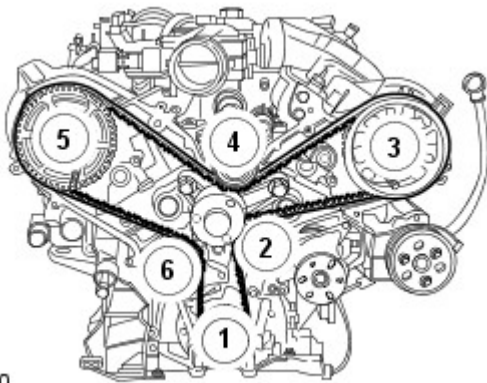
2. Install a new timing belt tensioner.

- Install a new bolt, but do not fully tighten at this stage.

3.  CAUTION: Make sure the camshaft pulleys remain in the clockwise position.

Install the new timing belt.

- Starting at the crankshaft pulley, install the timing belt in a counter-clockwise direction, in the sequence shown.
- Stage one: Attach the timing belt to the crankshaft pulley.
- Stage two: Attach the timing belt to the idler pulley.
- Stage three: Attach the timing belt to the left-hand camshaft pulley.
- Stage four: Attach the timing belt to the idler pulley.
- Stage five: Attach the timing belt to the RH camshaft pulley.
- Stage six: Attach the timing belt to the timing belt tensioner.

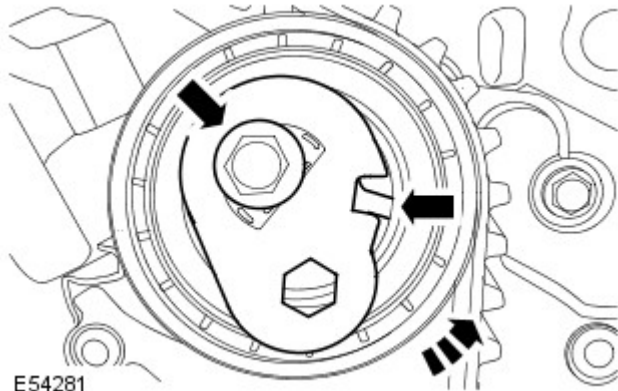


E54280


4.  CAUTION: Make sure the timing belt tensioner window is aligned with the groove.

Tension the timing belt.

- Rotate the tensioner assembly counterclockwise.
- Tighten to 24 Nm (18 lb.ft).

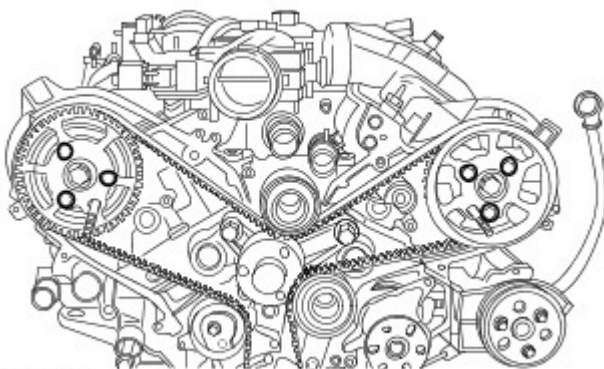


E54281

5.  CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

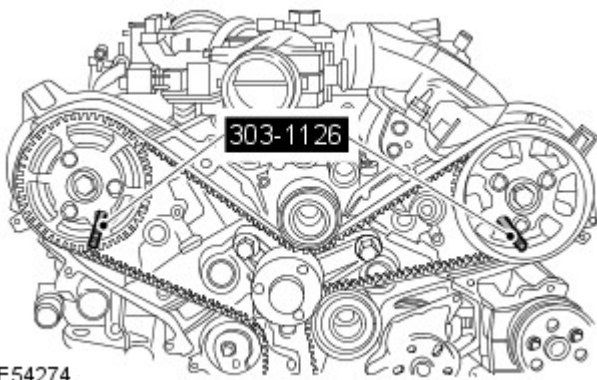
Using a suitable tool, counterhold the camshaft pulley center retaining bolts.

- Tighten the six exhaust camshaft pulley damper retaining bolts.
- Tighten the bolts to 23 Nm (17 lb.ft).



E54627

6. Remove the special tools from the camshaft pulleys.



E54274

Vehicles with manual transmission

7. Remove the special tool from the flywheel.

Vehicles with automatic transmission

8. Remove the special tool from the flexplate.

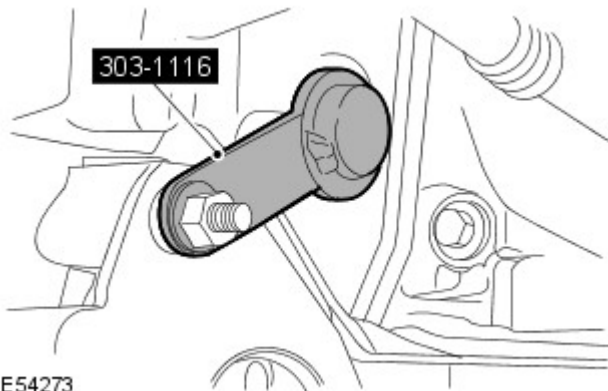
All vehicles

9. Rotate the engine two complete turns clockwise.

Vehicles with manual transmission

10. Using the special tool, lock the flywheel.

- Install a starter motor bolt to retain the special tool.

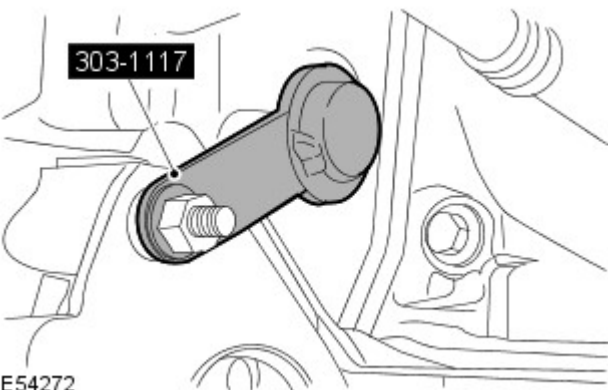


E54273

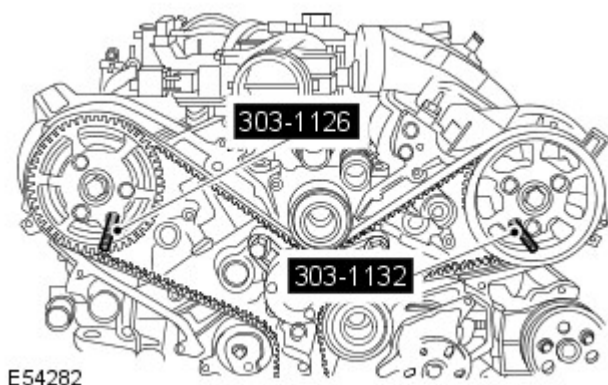
Vehicles with automatic transmission

11. Using the special tool, lock the flexplate.

- Install a starter motor bolt to retain the special tool.



E54272



12. Install the special tools to the exhaust camshaft pulleys.

- If the special tool does not fit correctly, repeat the timing belt installation procedure.
- Remove the special tools from the camshaft pulleys.

Vehicles with manual transmission

13. Remove the special tool from the flywheel.

- Install the grommet.

Vehicles with automatic transmission

14. Remove the special tool from the flexplate.

- Install the grommet.

All vehicles

15. Install the starter motor.

For additional information, refer to: [Starter Motor](#) (303-06A Starting System - TDV6 2.7L Diesel, Removal and Installation).

16. Install the timing belt cover.

For additional information, refer to: [Timing Belt Cover](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

17. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Exhaust Manifold LH

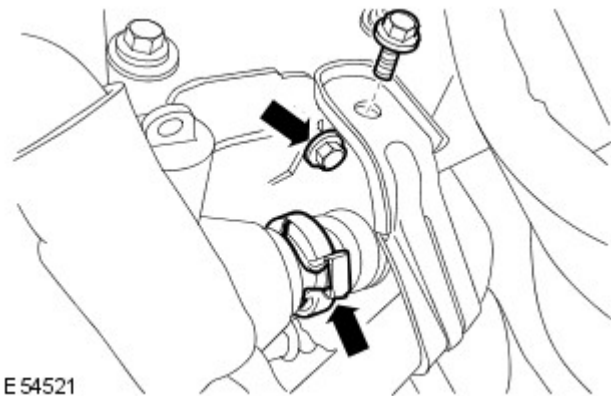
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the turbocharger.
For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).
3. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
4. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
5. Remove the LH EGR valve outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
6. Disconnect the coolant outlet hose from the LH EGR valve.
 - Release the clip.

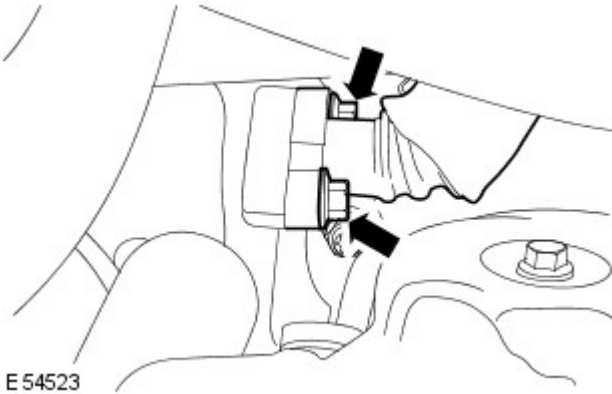


7. Release the LH EGR valve inlet tube.
 - Remove the two support bracket retaining bolts.
 - Remove the support bracket.
 - Remove and discard the retaining clip.



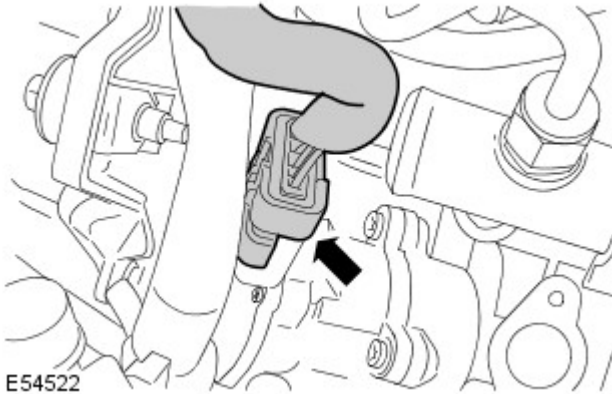
8. Remove the LH EGR valve inlet tube.

- Remove the two retaining bolts.
- Remove and discard the gasket.



E54523

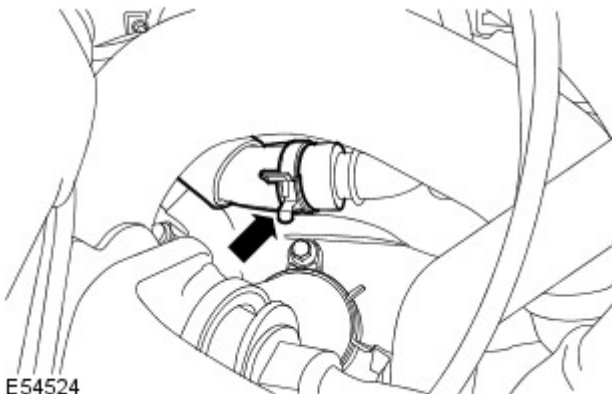
9. Disconnect the LH EGR valve electrical connector.



E54522

10. Disconnect the coolant inlet hose from the LH EGR valve.

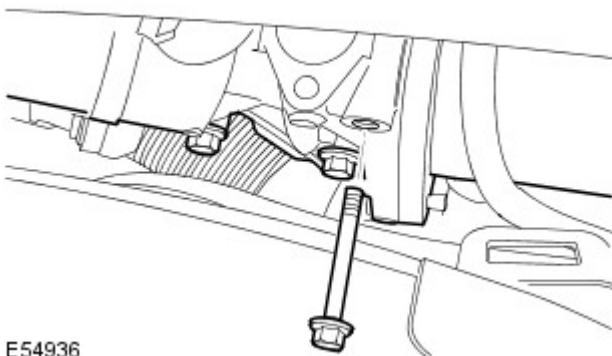
- Release the clip.



E54524

11. Remove the LH EGR valve.

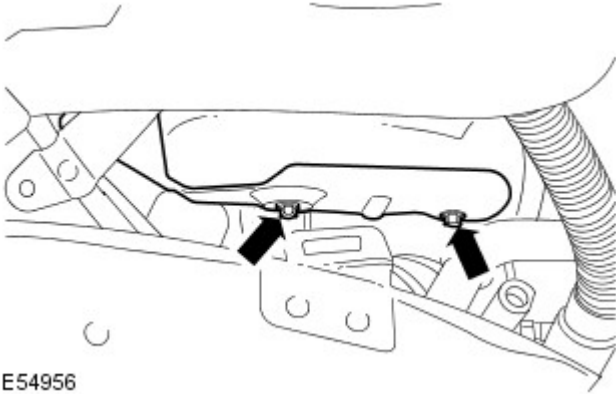
- Remove the three retaining bolts.



E54936

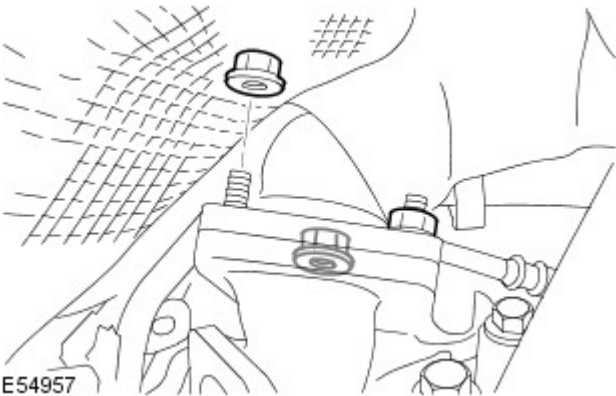
12. Remove the LH exhaust manifold heat shield.

- Remove the two retaining bolts.



E54956

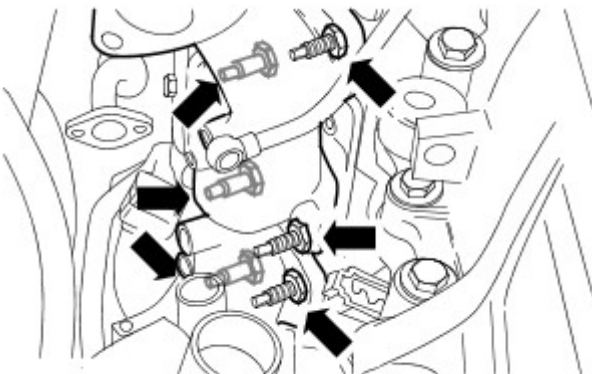
13. Remove the three exhaust cross-over pipe retaining nuts.



E54957

14. Remove the LH exhaust manifold.

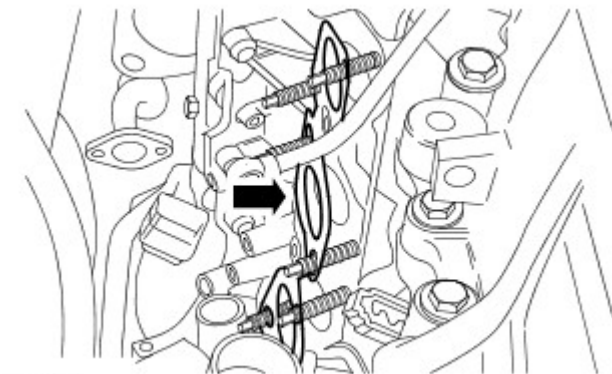
- Remove the six retaining nuts.



E54958

15. Remove and discard the LH exhaust manifold gasket.

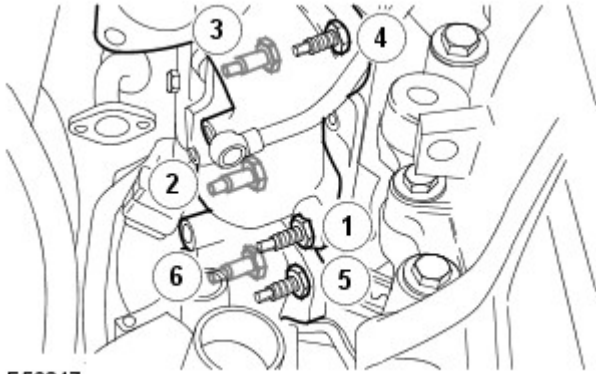
- Remove and discard the studs.



E54959

Installation

1. Tighten the LH exhaust manifold retaining studs to 13 Nm (10 lb.ft).



E56247

- Install a new gasket.

2. NOTE: Tighten the retaining nuts in the sequence shown.

Install the LH exhaust manifold.

- Tighten the nuts to 24 Nm (18 lb.ft).

3. Install the three exhaust cross-over pipe retaining nuts.

- Tighten the nuts to 24 Nm (18 lb.ft).

4. Install the LH exhaust manifold heat shield.

- Install the two retaining bolts and tighten to 10 Nm (7 lb.ft).

5. Install the LH EGR valve.

- Install the three EGR valve retaining bolts, but do not fully tighten at this stage.

6. NOTE: Do not fully close the retaining clip at this stage.

Install the LH EGR valve inlet tube.

- Install a new retaining clip.
- Install a new gasket.
- Loosely install the two EGR valve inlet tube retaining bolts.

7. Fully close the retaining clip.

8. Tighten the two EGR valve inlet tube retaining bolts to 10 Nm (7 lb.ft).

9. Tighten the three EGR valve retaining bolts to 10 Nm (7 lb.ft).

10. Install the support bracket.

- Tighten the two retaining bolts to 10 Nm (7 lb.ft).

11. Connect the coolant inlet hose to the LH EGR valve.

12. Connect the LH EGR valve electrical connector.

13. Connect the coolant outlet hose to the LH EGR valve.

14. Install the LH EGR valve outlet tube.

For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

15. Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

16. Install the turbocharger.

For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).

17. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


18. Refill and bleed the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

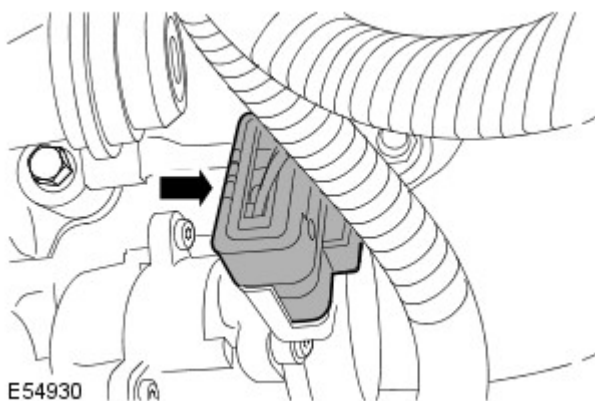
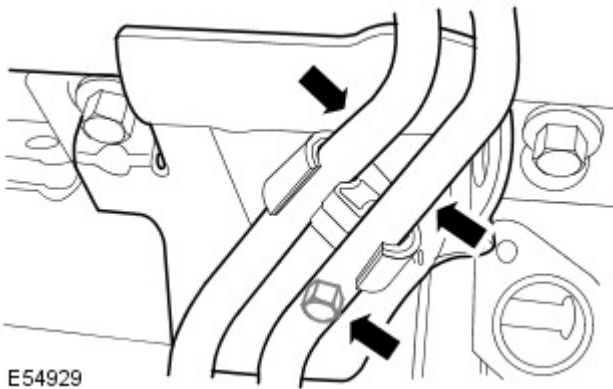
Engine - TDV6 2.7L Diesel - Exhaust Manifold RH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

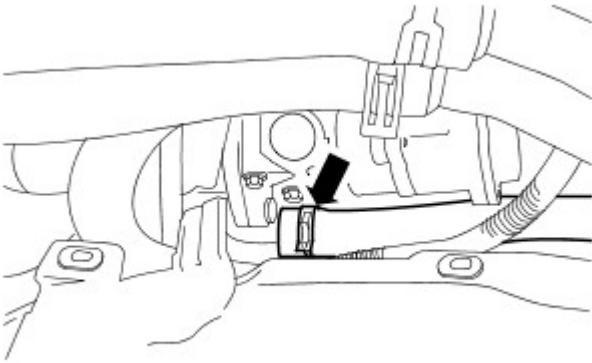
Raise and support the vehicle.
3. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
4. Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
5. Remove the RH exhaust gas recirculation (EGR) valve outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
6. Remove the fuel line bracket.
 - Release the fuel lines.
 - Remove the bolt.



7. Disconnect the EGR valve electrical connector.

8. Disconnect the coolant inlet hose from the EGR valve.

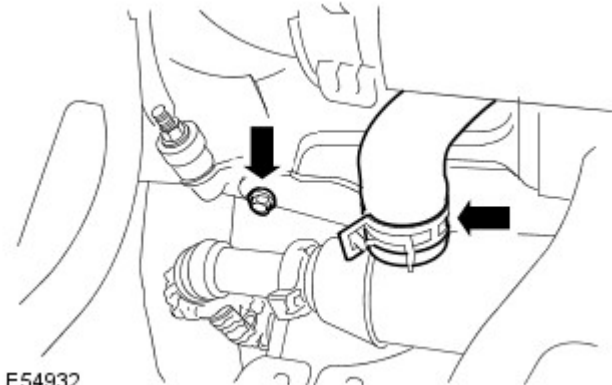
- Release the clip.



E54931

9. Disconnect the coolant outlet hose from the EGR valve.

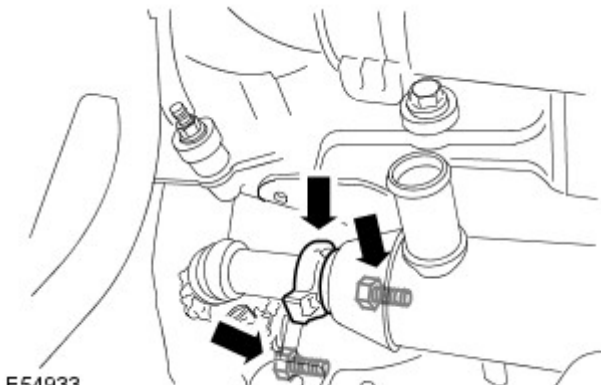
- Remove the bolt.
- Release the clip.



E54932

10. Remove the EGR valve inlet tube.

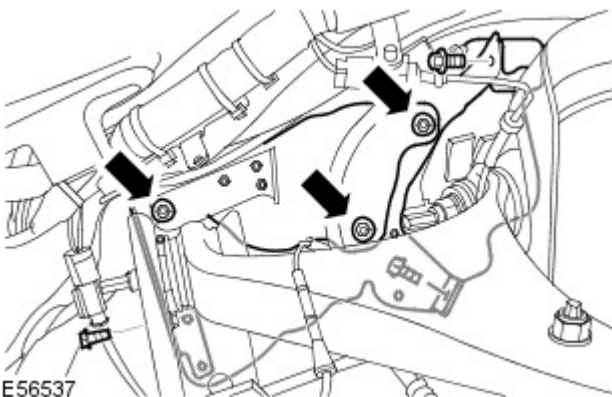
- Release the clip.
- Remove the 2 bolts.
- Remove and discard the gasket.
- Remove and discard the clip.



E54933

11. Remove the RH front wheel and tire.

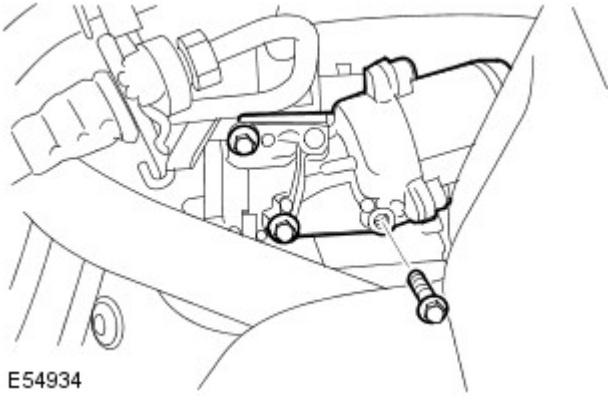
12. Remove the upper suspension arm and brake line heat shields for access.



E56537

13. Remove the RH EGR valve and cooler assembly.

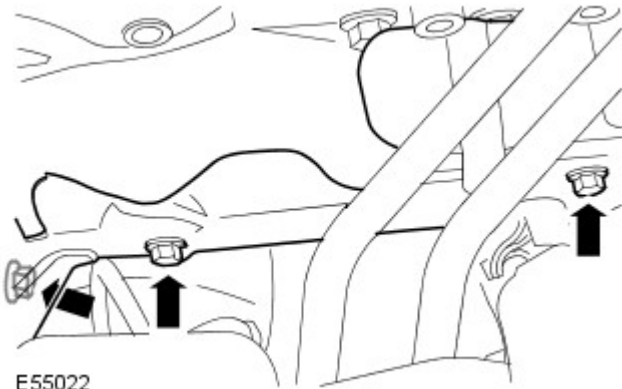
- Remove the 3 bolts.



E54934

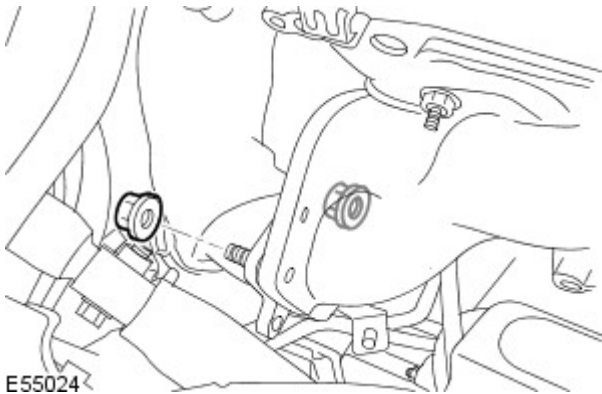
14. Remove the RH exhaust manifold heat shield.

- Remove the 3 bolts.



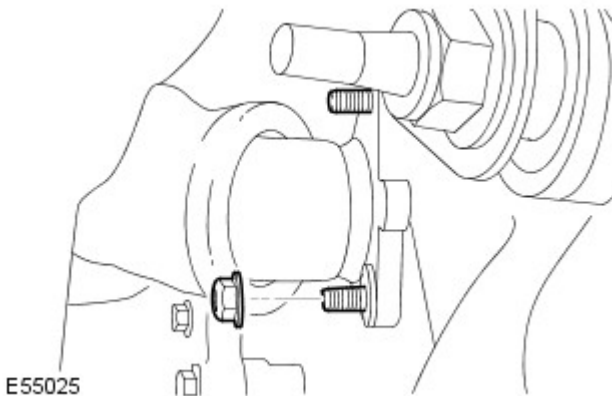
E55022

15. Remove the 2 exhaust cross-over pipe nuts.

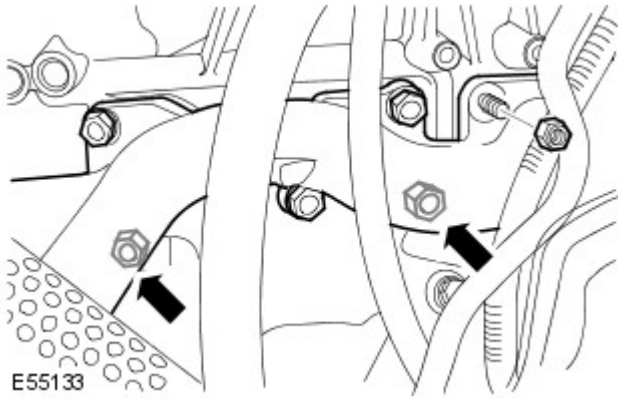


E55024

16. Remove the remaining exhaust cross-over pipe nut.



E55025



17. Remove the RH exhaust manifold.

- Remove the 6 nuts.
- Remove and discard the gasket.
- Remove and discard the studs.

Installation

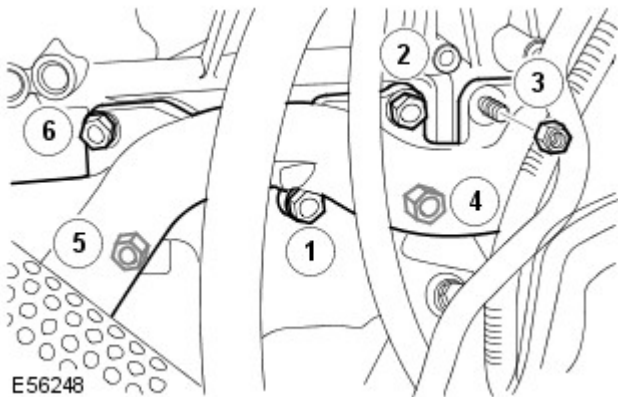
1. Tighten the exhaust manifold studs to 13 Nm (10 lb.ft).

- Install a new gasket.

2. **NOTE:** Tighten the retaining nuts in the sequence shown.

Install the RH exhaust manifold.

- Tighten the nuts to 24 Nm (18 lb.ft).



3. Tighten the exhaust cross-over pipe nut to 24 Nm (18 lb.ft).

4. Tighten the 2 exhaust cross-over pipe nuts to 24 Nm (18 lb.ft).

5. Install the RH exhaust manifold heat shield.

- Install the bolts and tighten to 10 Nm (7 lb.ft).

6. Install the RH EGR valve and cooler assembly.

- Install the EGR valve bolts, but do not fully tighten at this stage.

7. **NOTE:** Do not fully close the retaining clip at this stage.

Install the EGR valve inlet tube.

- Install a new gasket.
- Install a new clip.
- Loosely install the 2 EGR valve inlet tube bolts.

8. Fully close the clip.

9. Tighten the two EGR valve inlet tube bolts to 10 Nm (7 lb.ft).

10. Tighten the three EGR valve bolts to 10 Nm (7 lb.ft).

11. Install the upper suspension arm and brake line heat shields.

12. Install the wheel and tire.

13. Tighten the EGR valve bolt to 10 Nm (7 lb.ft).

14. Connect the coolant outlet hose to the EGR valve.

15. Connect the coolant inlet hose to the EGR valve.

16. Connect the EGR valve electrical connector.

17. Install the fuel line bracket.

- Install the fuel line retaining bracket bolt and tighten to 10 Nm (7 lb.ft).
- Secure the fuel lines.

18. Install the RH EGR valve outlet tube.

For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

19. Install the auxiliary battery tray.

For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

20. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

21. Fill and bleed the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

Engine - TDV6 2.7L Diesel - Oil Filter Housing


In-vehicle Repair

1. Refer to oil cooler.
For additional information, refer to: [Oil Cooler](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

Engine - TDV6 2.7L Diesel - Exhaust Manifold Crossover Pipe

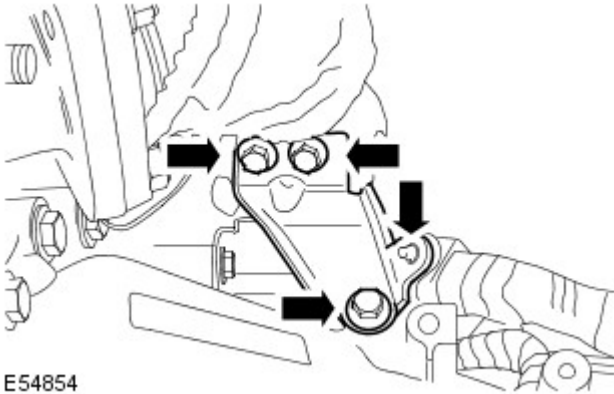
Removal and Installation

Removal

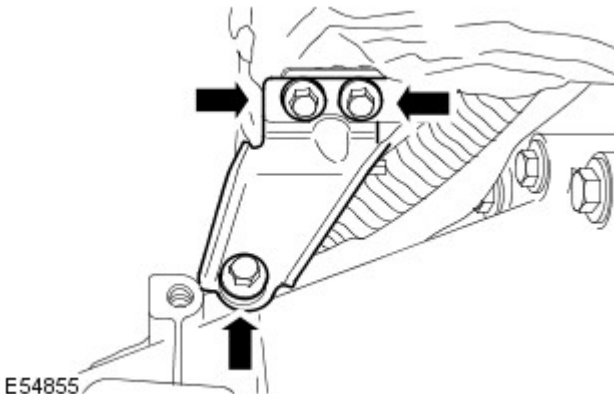
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the transmission support crossmember.
For additional information, refer to: [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
4. Remove the exhaust system. For additional information, refer to: (309-00A Exhaust System - TDV6 2.7L Diesel)

[Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (Removal and Installation),
[Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (Removal and Installation).
5. Lower the rear of the transmission for access.
6. Remove the exhaust manifold crossover pipe LH support bracket.
 - Release the wiring harness.
 - Remove the 3 bolts.

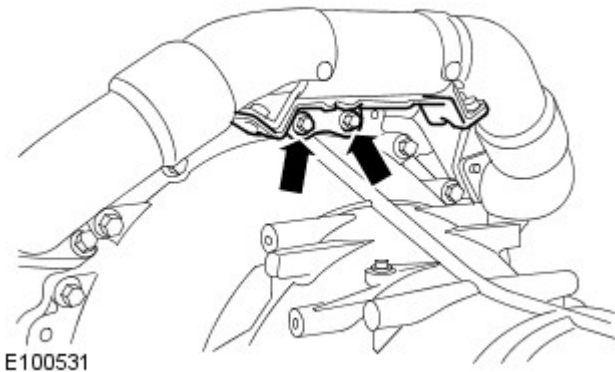



7. Remove the exhaust manifold crossover pipe RH support bracket.
 - Remove the 3 bolts.



8. Remove the exhaust manifold crossover pipe center support bracket.

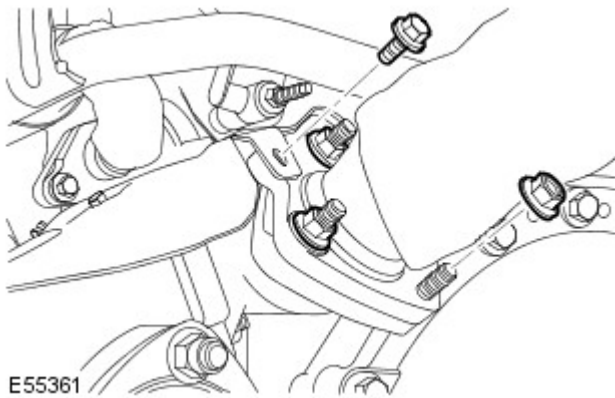
- Remove the 2 bolts.



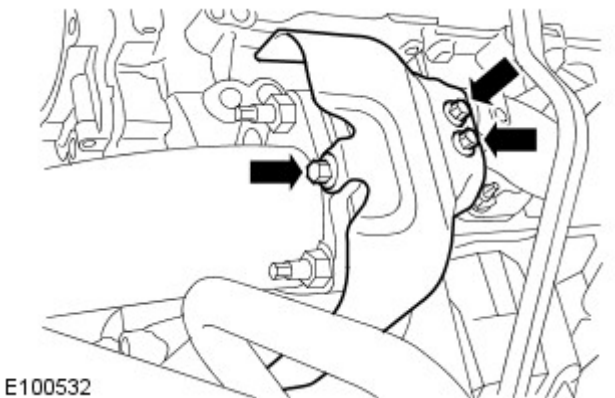
9.  **CAUTION:** Take care when handling the crossover pipe as damage to the insulating material may occur.

Release the exhaust manifold crossover pipe from the turbocharger.

- Remove the turbocharger heat shield bolt.
- Remove and discard the 3 nuts.

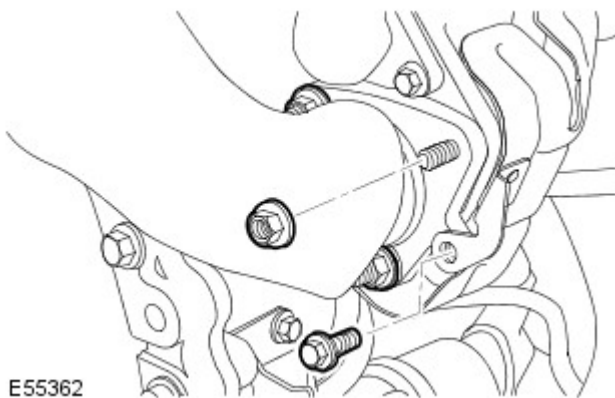


10. Remove the RH exhaust manifold heat shield.




11. Remove the exhaust manifold crossover pipe.

- Remove and discard the 3 nuts.
- Remove and discard the 2 gaskets.



Installation

1. Install new exhaust manifold studs.
2. Install new turbocharger studs.

3.  **CAUTION:** Take care when handling the crossover pipe as damage to the insulating material may occur.

Install the exhaust manifold crossover pipe.

- Clean the component mating faces.
- Install new gaskets.
- Install new nuts.
- Tighten the 6 nuts to 24 Nm (18 lb. ft).

4. Install the exhaust manifold crossover pipe center support bracket.

- Loosely install the 2 bolts.

5. Install the exhaust manifold crossover pipe RH support bracket.

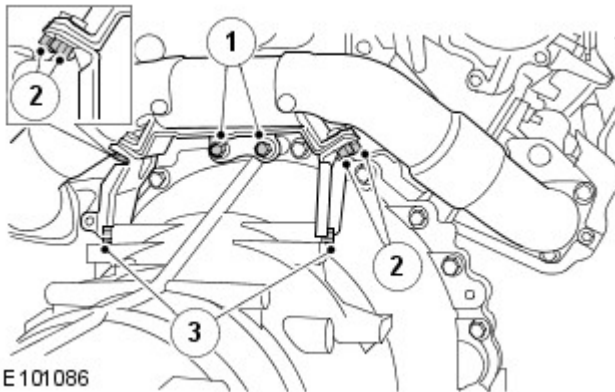
- Loosely install the 3 bolts.

6. Install the exhaust manifold crossover pipe LH support bracket.

- Loosely install the 3 bolts.

7. Tighten the exhaust manifold crossover pipe mounting bracket bolts in the following sequence.

- Tighten the 2 bolts marked 1 to 10 Nm (7 lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 2 bolts marked 3 to 10 Nm (7lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 4 bolts maked 2 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts maked 1 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts maked 3 to 25 Nm (18 lb. ft).
- Attach the wiring harness.



8. Install the RH exhaust manifold heat shield.

- Tighten the 3 bolts to 10 Nm (7 lb.ft).

9. Install the turbocharger heat shield.

- Tighten the bolt to 10 Nm (7 lb.ft).

10. Install the exhaust system. For additional information, refer to: (309-00A Exhaust System - TDV6 2.7L Diesel)

[Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\) \(Removal and Installation\)](#),
[Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\) \(Removal and Installation\)](#).

11. Install the transmission support crossmember.

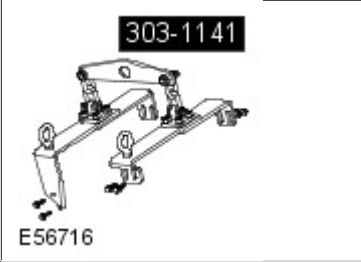
For additional information, refer to: [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

12. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 2.7L Diesel - Engine Vehicles With: 6HP28 6-Speed Automatic Transmission/6HP26 6-Speed Automatic Transmission

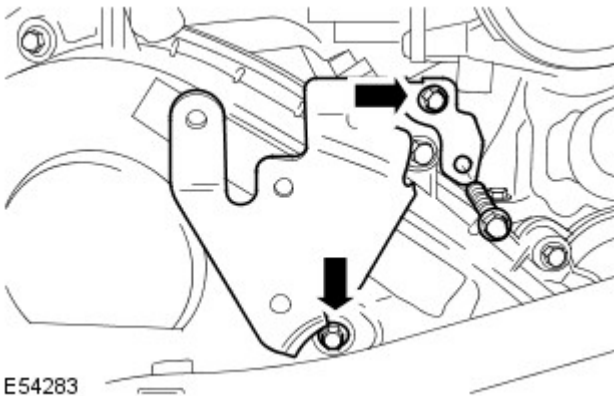
Removal

Special Tool(s)	
	Engine lifting cradle 303-1141

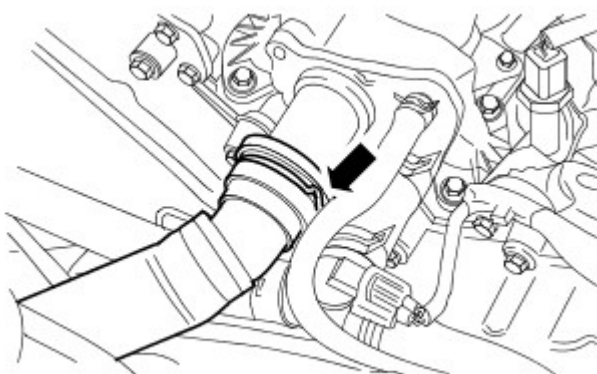
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the wheels and tires.
4. Remove the body.
For additional information, refer to: [Body - TDV6 3.0L Diesel/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
5. Remove the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
6. Remove the intake air shutoff throttle.
For additional information, refer to: [Intake Air Shutoff Throttle](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).
7. Remove the intake air shutoff throttle elbow support bracket.
 - Remove the 3 bolts.



E54283



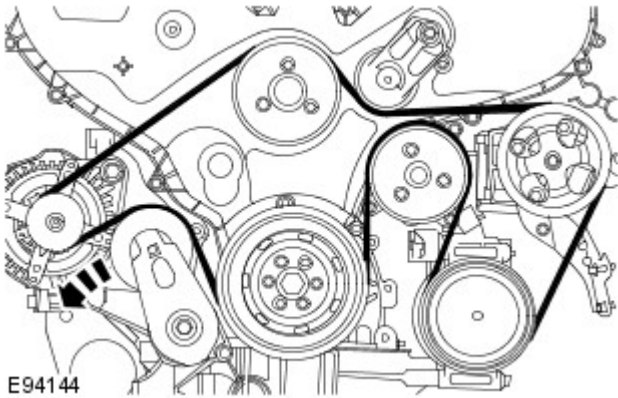
E56395

8. Disconnect the upper coolant hose from the coolant distribution manifold.
 - Remove the clip.



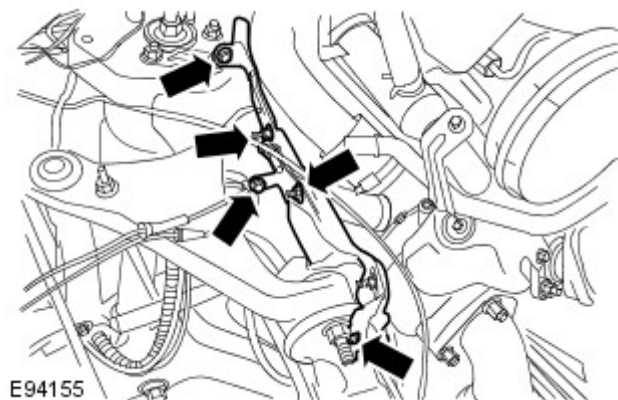
9. Disconnect the RH exhaust gas recirculation (EGR) coolant hose.

- Release the clip.



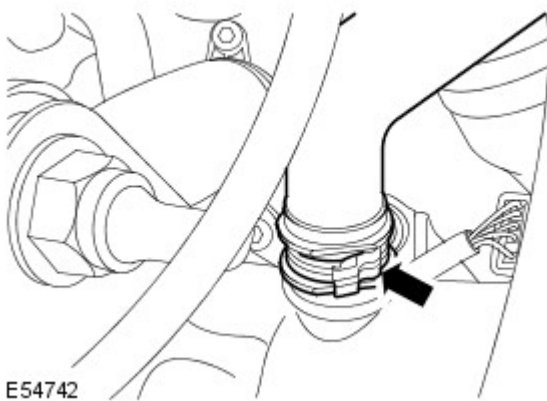
10. Remove the accessory drive belt.

- Rotate the accessory drive belt tensioner counter-clockwise.



11. Remove the 2 LH upper suspension arm and brake line heat shields.

- Remove the 2 nuts.
- Remove the 3 bolts.

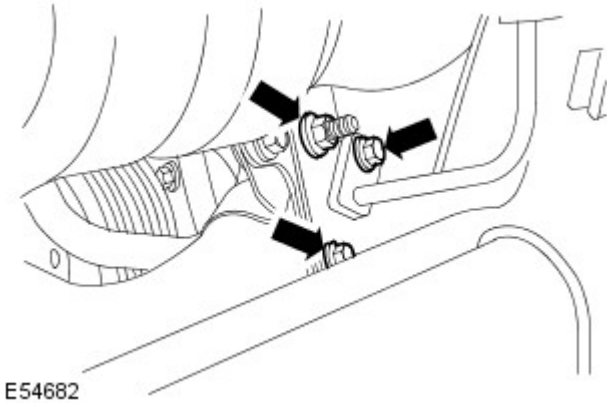


12. Disconnect the breather hose.

- Release the clip.

13. Release the charge air cooler inlet pipe.

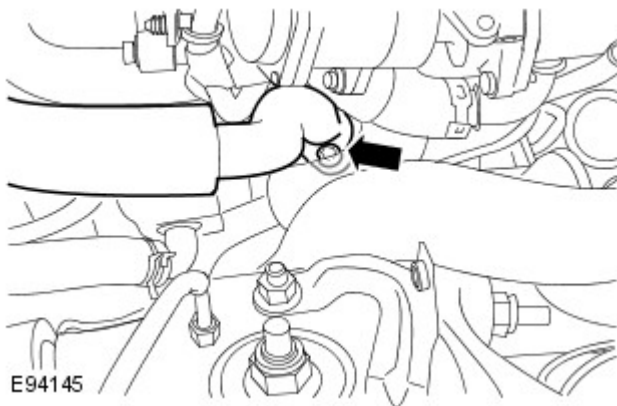
- Remove the nut.
- Remove the 2 bolts.



14.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

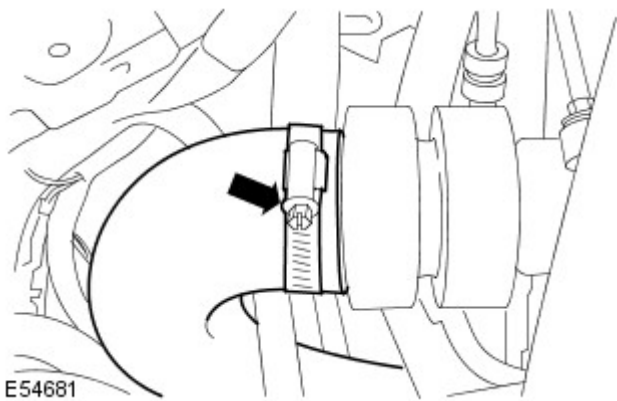
Disconnect the air conditioning (A/C) compressor low-pressure line.

- Remove the bolt.
- Remove and discard the O-ring seal.



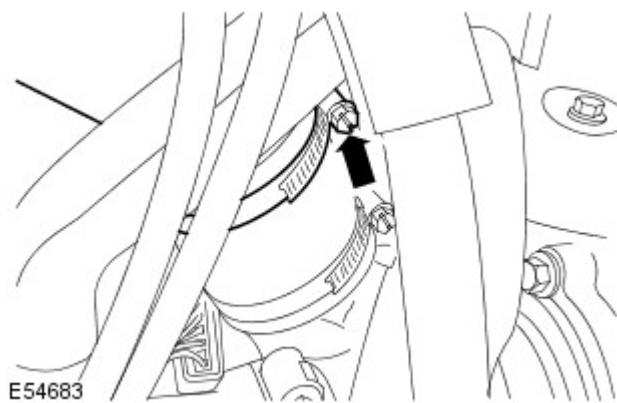
15. Disconnect the charge air cooler inlet hose.

- Loosen the clip.



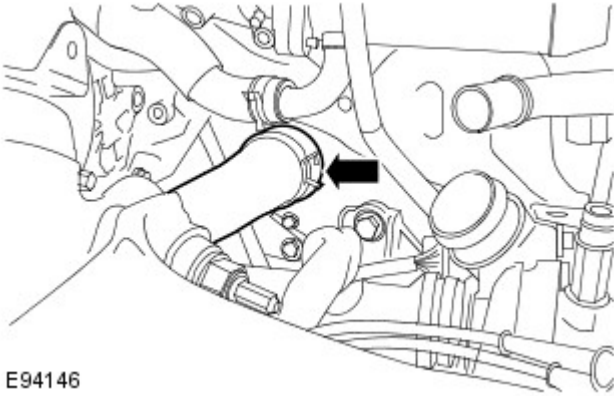
16. Disconnect the charge air cooler inlet hose.

- Loosen the clip.



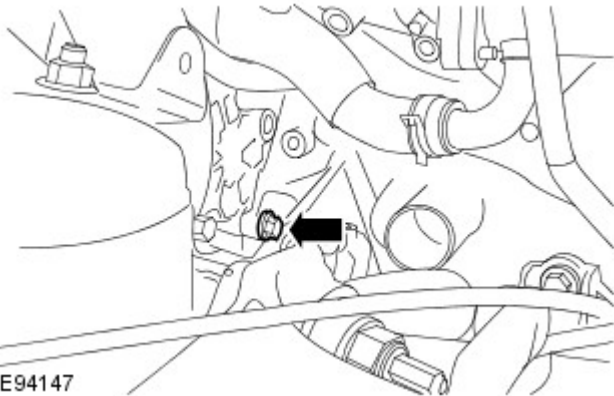
17. Disconnect the coolant lower hose.

- Release the clip.



E94146

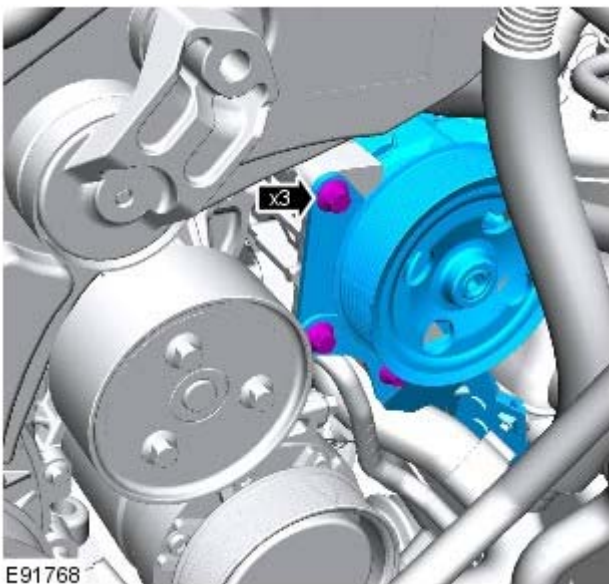
18. Remove the power steering pump rear bolt.



E94147

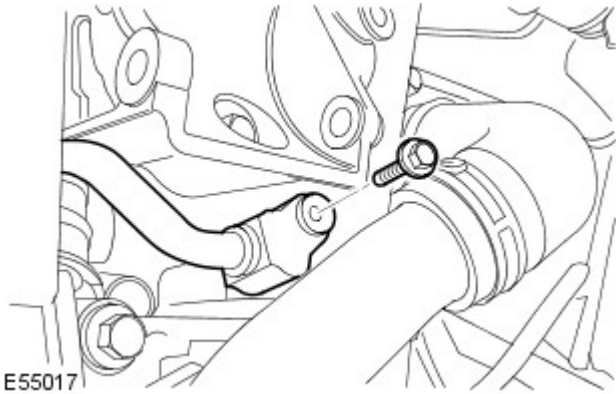
19. Reposition the power steering pump.

- Remove the 3 bolts.



E91768

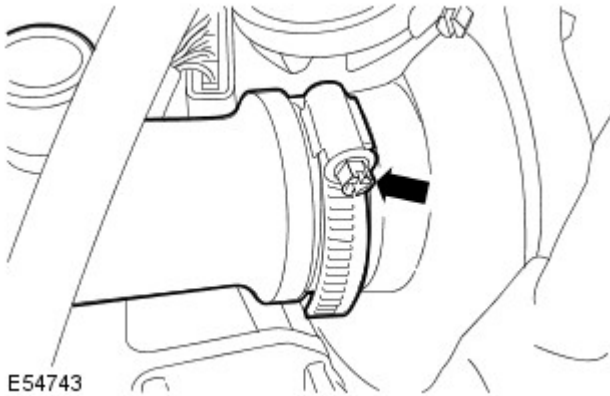
20. Remove the charge air cooler inlet pipe.



21.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Disconnect the A/C compressor high-pressure pipe.

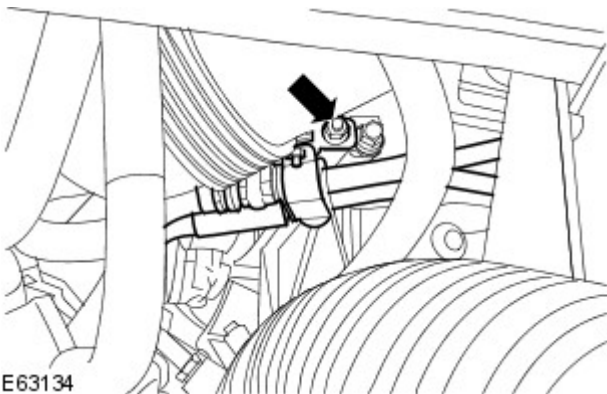
- Remove the bolt.
- Remove and discard the O-ring seal.



22. Reposition the lower coolant hose.

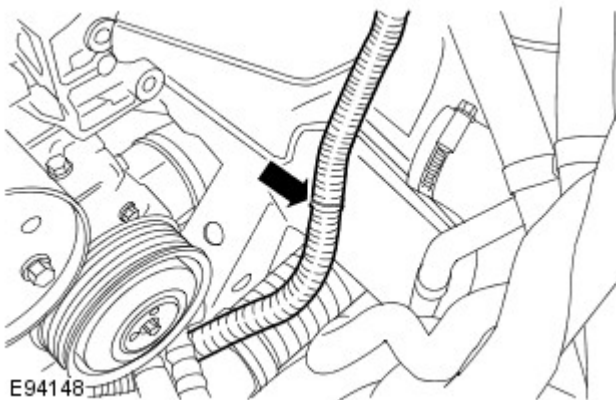
23. Remove the turbocharger intake tube.

- Loosen the clip.



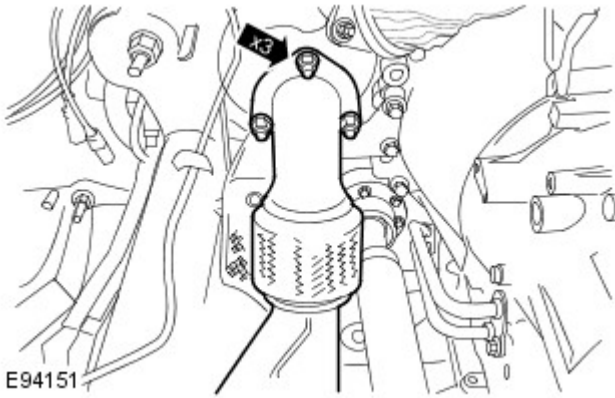
24. Release the transmission fluid lines.

- Remove the nut.



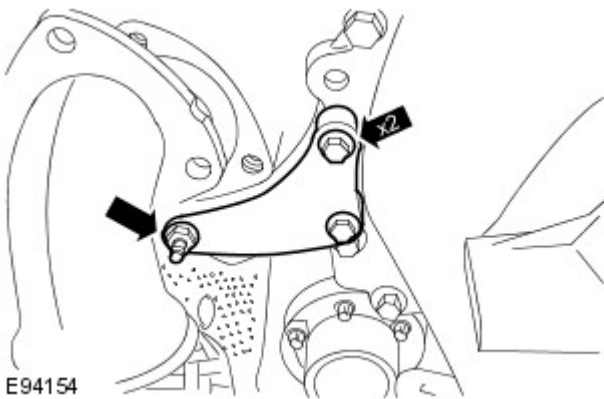
25. Release the battery positive cable.

- Release the clip.



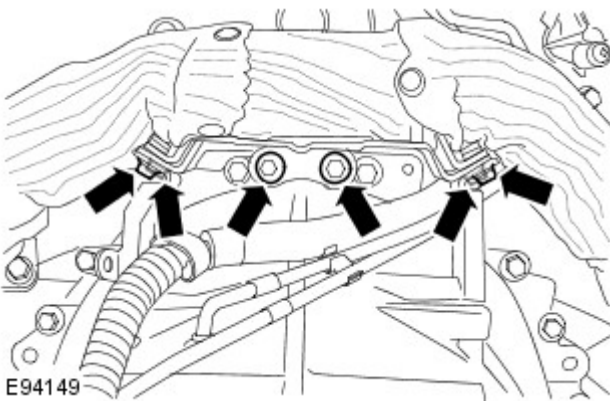
26. Release the exhaust from the turbocharger.

- Remove and discard the 3 nuts.
- Remove and discard the gasket.



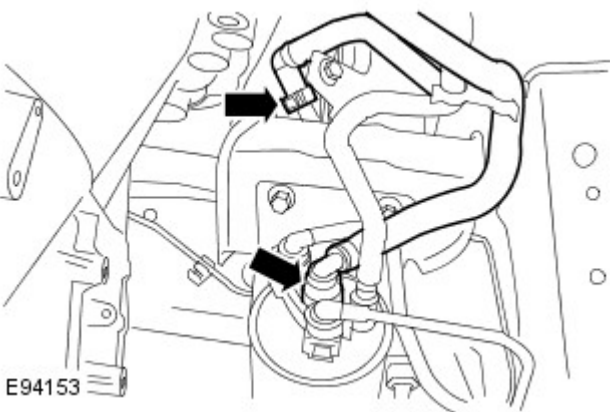
27. Remove the turbocharger support bracket.


- Remove the 2 bolts.
- Remove the nut.



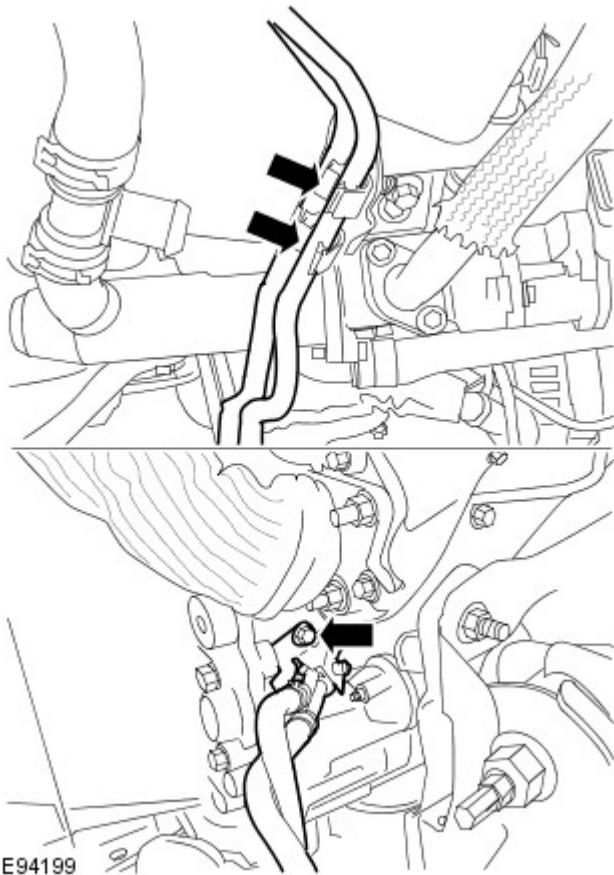
28. Release the exhaust cross-over pipe bracket.

- Remove the 6 bolts.



29.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Disconnect the 2 fuel lines.



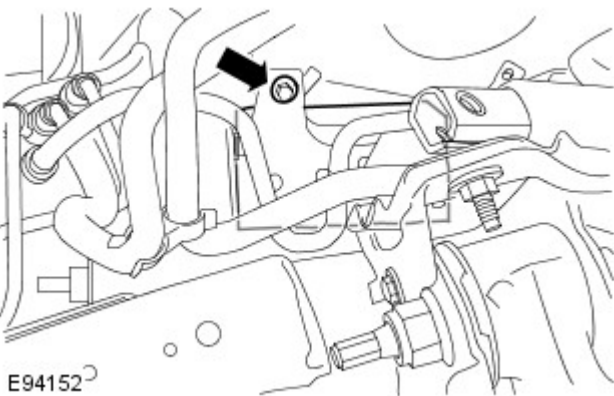
30. Release the 2 fuel lines.

- Remove the bolt.
- Release from the 2 clips.



31. Release the transmission breather lines.

- Remove the bolt.

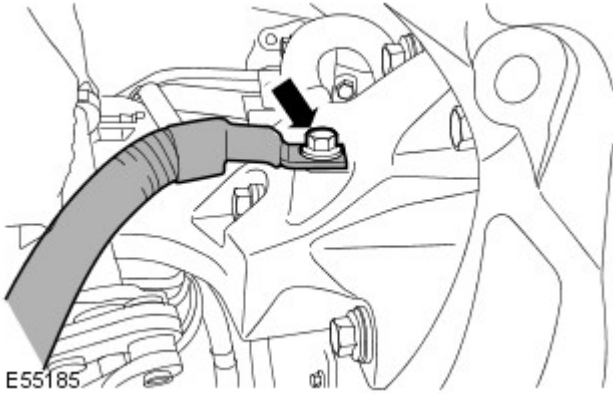


32. Release and reposition the fuel cooler.

- Remove the bolt.

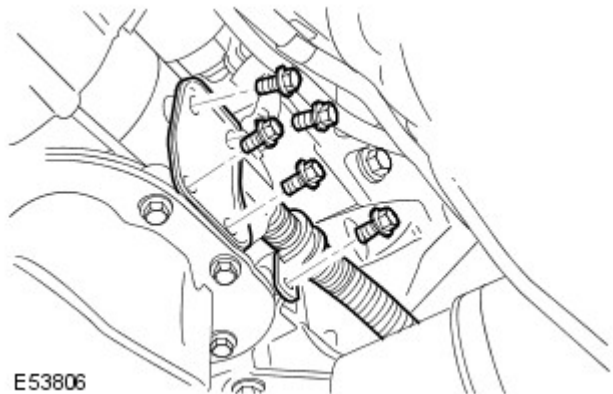
33. Release the engine ground cable.

- Remove the bolt.



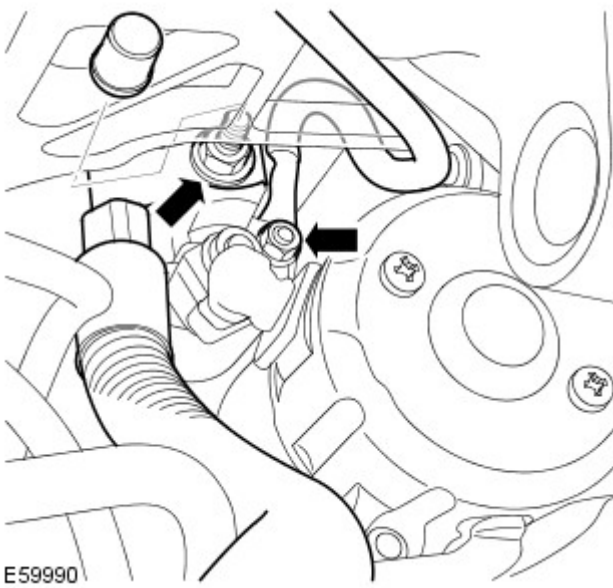
34. Remove the starter motor support bracket.

- Remove the 4 bolts.



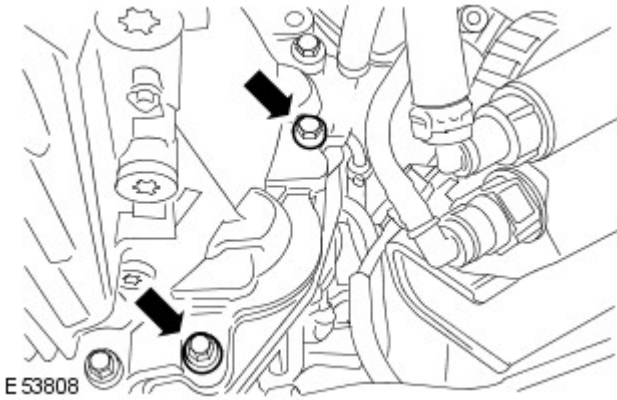
35. Disconnect the 2 starter motor wiring harness connectors from the starter motor solenoid.

- Remove the rubber insulator.
- Remove the 2 nuts.



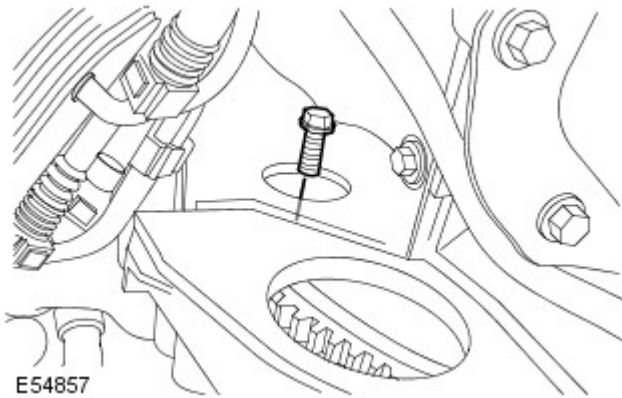
36. Remove the starter motor.

- Remove the 2 bolts.

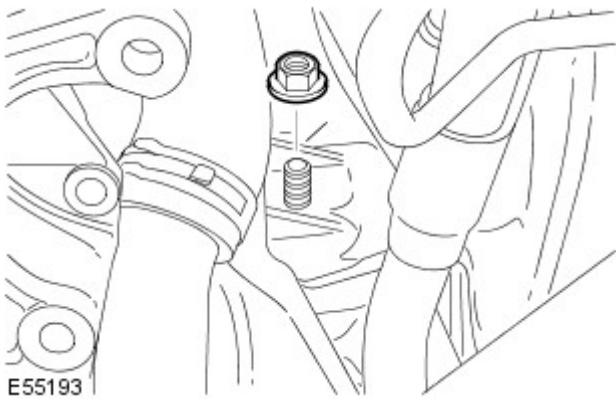


37. Release the flexplate.

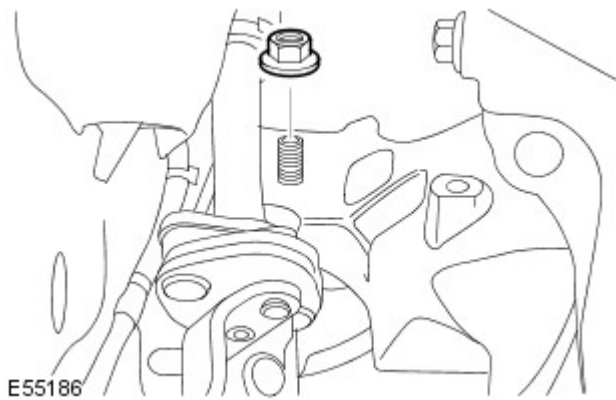
- Remove the access plug.
- Remove and discard the 4 bolts.



38. Remove the LH engine mount nut.

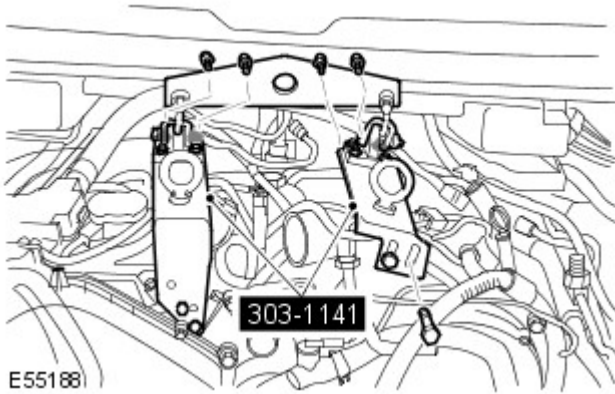


39. Remove the RH engine mount nut.



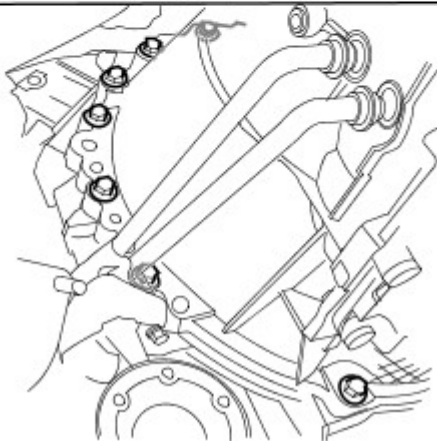
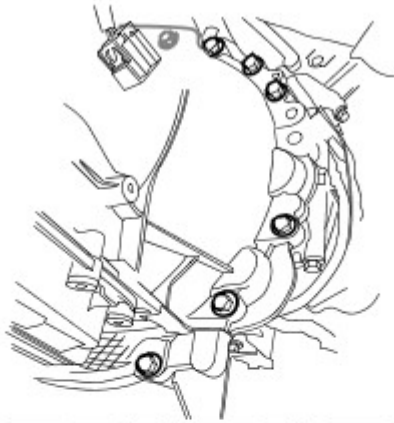
40. Install the special tool.

- Install and tighten the bolts.



41. Release the transmission from the engine.

- Remove the 14 bolts.



E61164

42. NOTE: Note the routing of the battery positive cable.

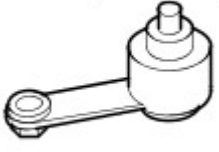


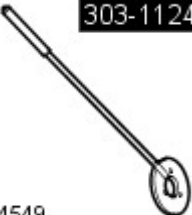
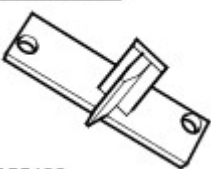
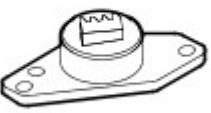
- NOTE: Note the routing of the transmission wiring harness.

With assistance, carefully remove the engine.

- Using a suitable hydraulic jack, support the transmission.
- Carefully guide the transmission wiring harness out as the engine is being removed.
- Carefully guide the battery positive cable out as the engine is being removed.

Engine - TDV6 2.7L Diesel - Engine


Disassembly

Special Tool(s)	
 <p>303-1117</p> <p>E54540</p>	<p>Timing Pin - Automatic Transmission</p> <p>303-1117</p>
 <p>303-1116</p> <p>E54539</p>	<p>Timing Pin - Manual Transmission</p> <p>303-1116</p>
 <p>303-1145/1</p> <p>E60399</p>	<p>Camshaft pulley holding tool</p> <p>303-1145/1</p>
 <p>303-1124</p> <p>E54549</p>	<p>Holder - Camshaft Pulleys Front</p> <p>303-1124</p>
 <p>303-947</p> <p>E55482</p>	<p>Flex plate locking tool</p> <p>303-947</p>
 <p>303-1123</p> <p>E 54546</p>	<p>Locking Tool - Flywheel</p> <p>303-1123</p>

Disassembly

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Drain the engine oil.

For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures).

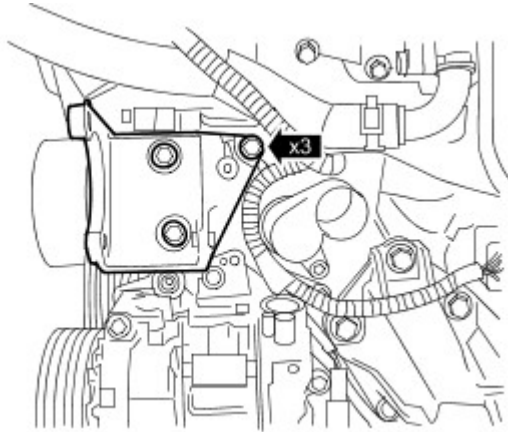
4. Remove the engine.

For additional information, refer to: [Engine - Vehicles With: 6HP28 6-Speed Automatic Transmission/6HP26 6-Speed Automatic Transmission](#) (303-01A Engine - TDV6 2.7L Diesel, Removal) / [Engine - Vehicles With: Manual Transmission](#) (303-01 Engine - 2.7L Diesel, Removal).

5. Install the engine to a suitable engine stand.

6. Remove the power steering pump bracket.

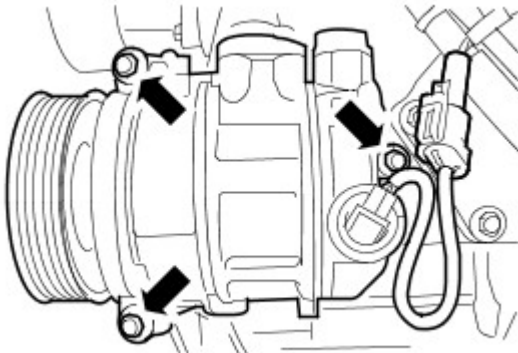
- Remove the 3 bolts.



E96773

7. Remove the air conditioning (A/C) compressor.

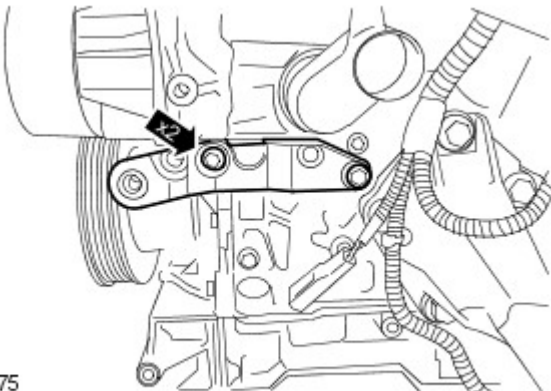
- Disconnect the electrical connector.
- Remove the 3 bolts.



E96774

8. Remove the A/C compressor bracket.

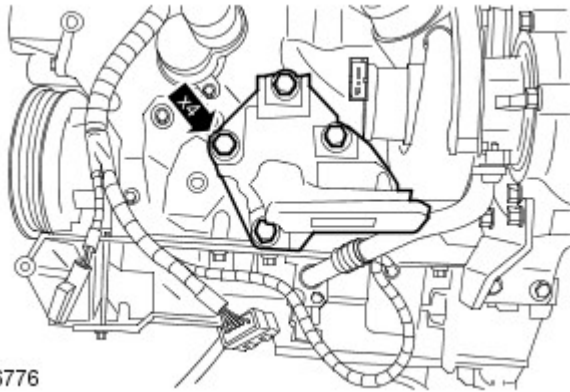
- Remove the 2 bolts.



E96775

9. Remove the LH engine mount bracket.

- Remove the 4 bolts.

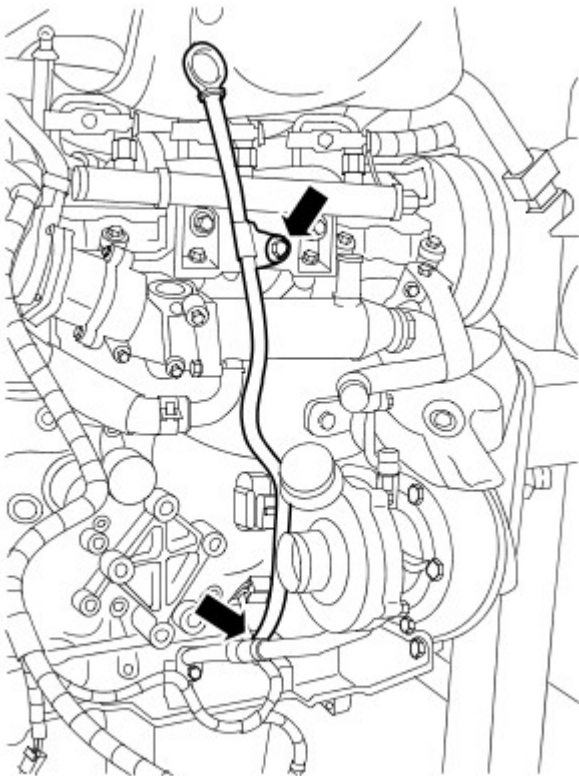


E96776

10.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Remove the oil level indicator and tube.

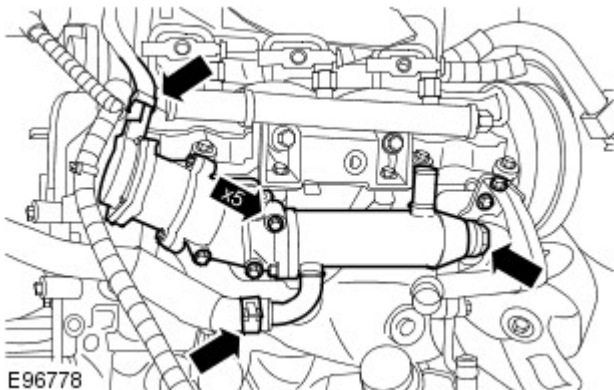
- Release the wiring harness clip.
- Remove the bolt.
- Remove and discard the O-ring seal.



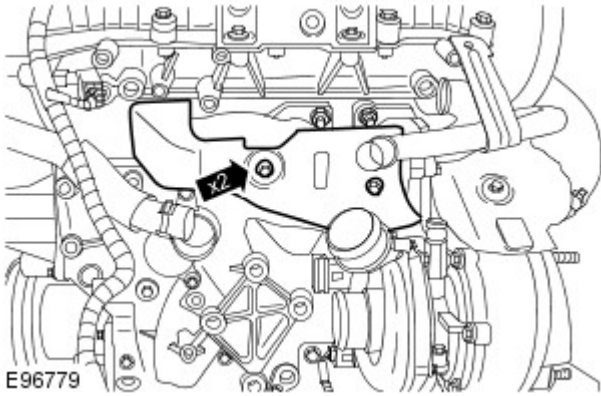
E96777

11. Remove the LH exhaust gas recirculation (EGR) valve and cooler assembly.

- Disconnect the electrical connector.
- Remove and discard the clip.
- Release the clip and disconnect the coolant hose.
- Remove the 5 bolts.
- Collect the bracket.

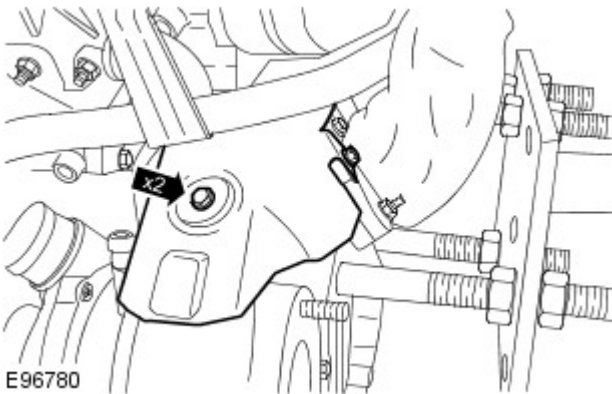


E96778



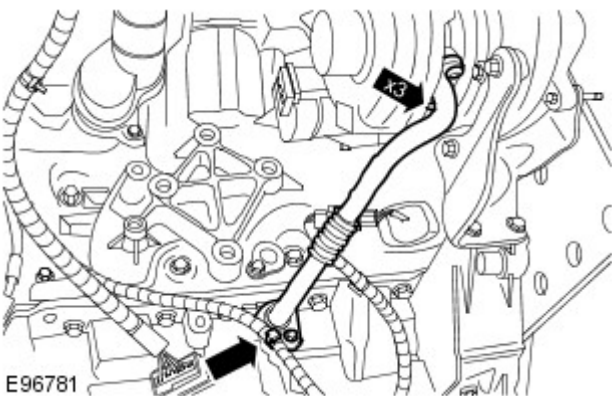
12. Remove the LH exhaust manifold heat shield.


- Remove the 2 bolts.



13. Remove the turbocharger heat shield.

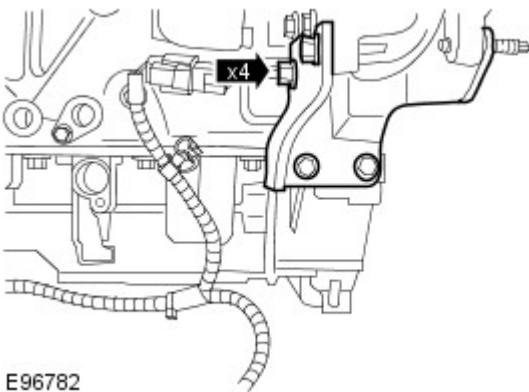
- Remove the 2 bolts.



14.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

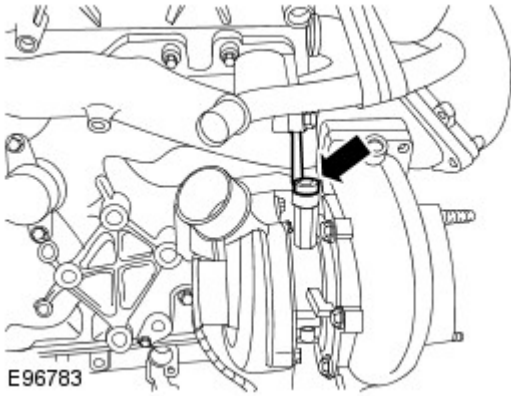
Remove the turbocharger oil return tube.


- Release the wiring harness clip.
- Remove the 3 bolts.
- Remove and discard the gasket.
- Remove and discard the O-ring seal.



15. Release the turbocharger support bracket.

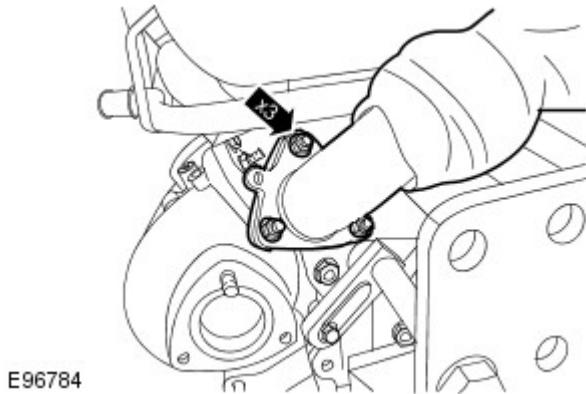
- Remove the 4 bolts.



16.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

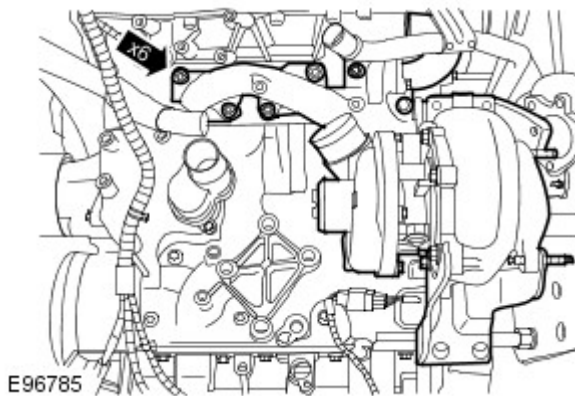
Disconnect the turbocharger oil supply tube.

- Remove the banjo bolt.
- Remove and discard the 2 sealing washers.



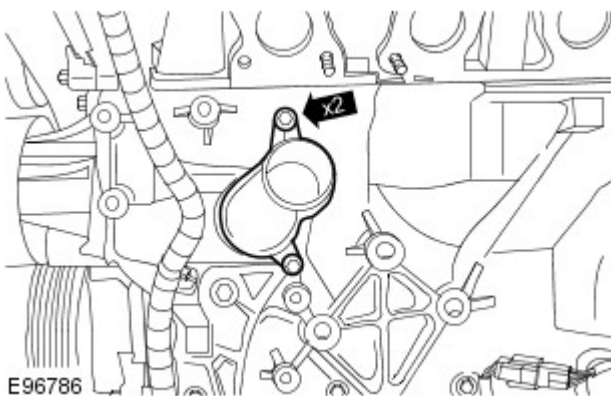
17. Release the exhaust cross-over pipe from the LH exhaust manifold.

- Remove and discard the 3 nuts.
- Remove and discard the gasket.



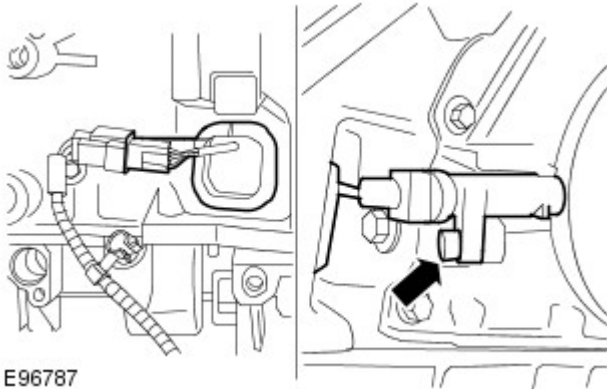
18. Remove the LH exhaust manifold and turbocharger assembly.

- Remove and discard the 6 nuts.
- Remove and discard the gasket.



19. Remove the cylinder block coolant inlet pipe.

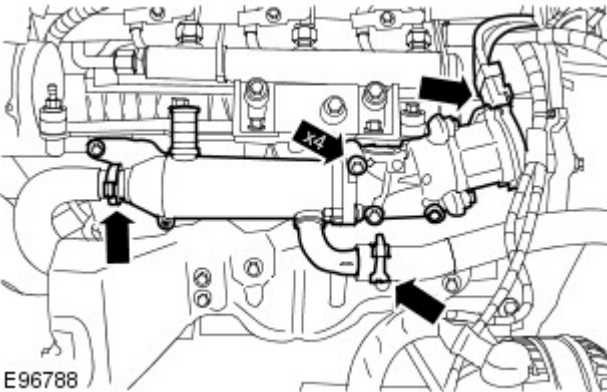
- Remove the 2 bolts.
- Remove and discard the O-ring seal.



E96787

20. Remove the crankshaft position (CKP) sensor.

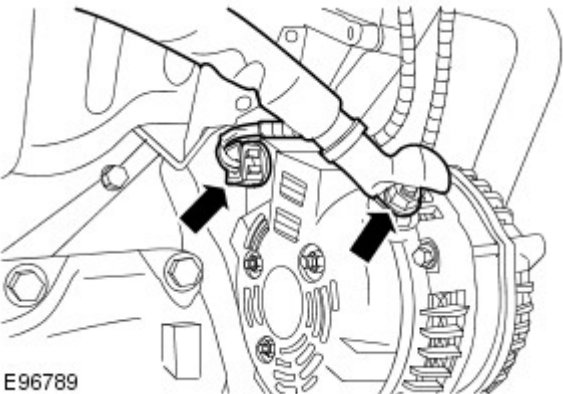
- Disconnect the electrical connector.
- Reposition the access cover.
- Remove the bolt.



E96788

21. Remove the RH EGR valve and cooler assembly.

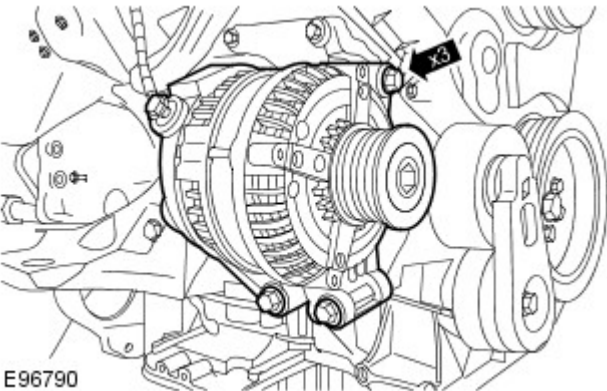
- Disconnect the electrical connector.
- Remove and discard the clip.
- Release the clip and disconnect the coolant hose.
- Remove the 4 bolts.



E96789

22. Disconnect the generator electrical connectors.

- Reposition the rubber insulator.
- Remove the nut.



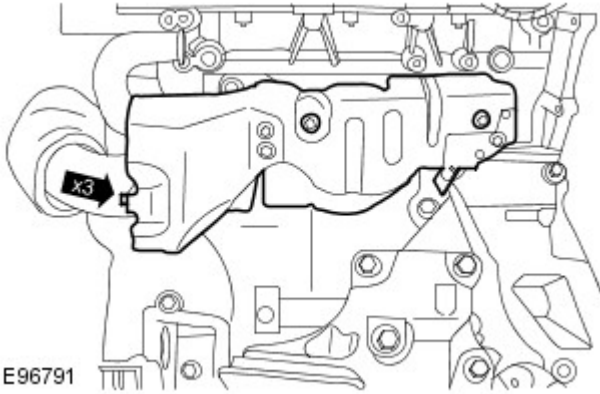
E96790

23. Remove the generator.

- Remove the 3 bolts.

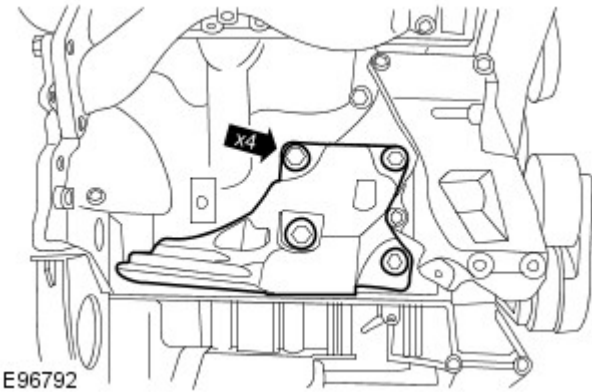
24. Remove the RH exhaust manifold heat shield.

- Remove the 3 bolts.



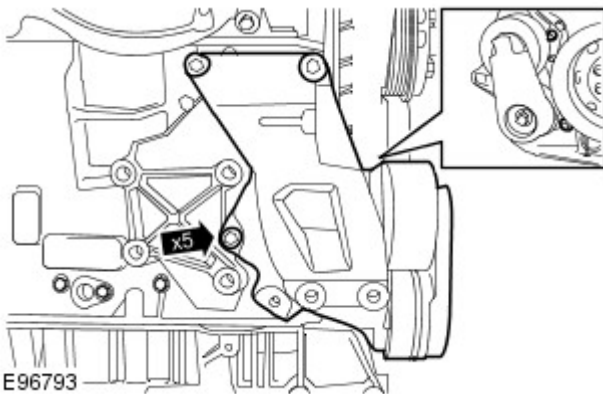
25. Remove the RH engine mount bracket.

- Remove the 4 bolts.



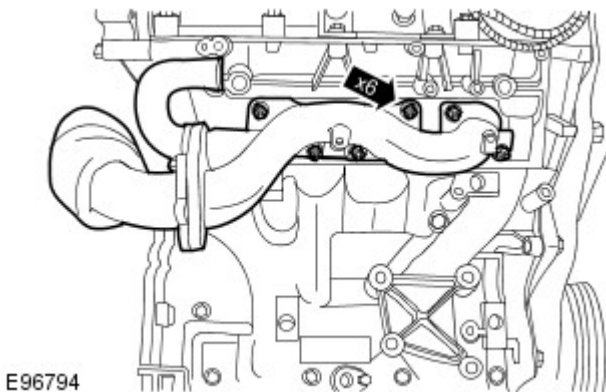
26. Remove the generator bracket.

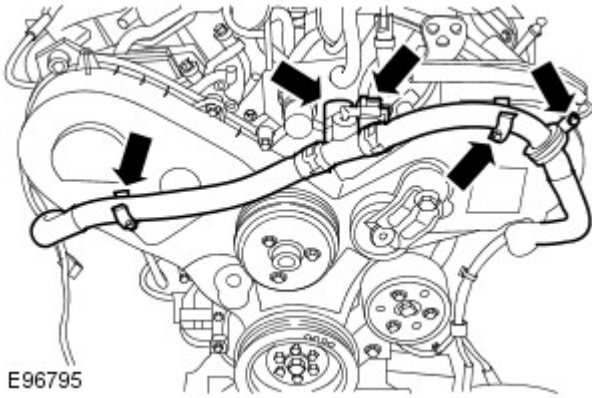
- Remove the 5 bolts.



27. Remove the RH exhaust manifold and exhaust cross-over pipe assembly.

- Remove and discard the 6 nuts.
- Remove and discard the gasket.

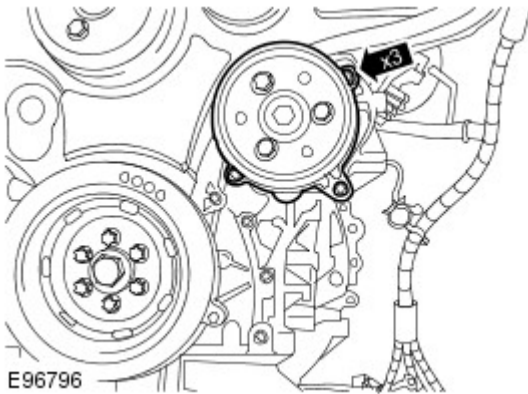




E96795

28. Remove the EGR valve coolant pipe.

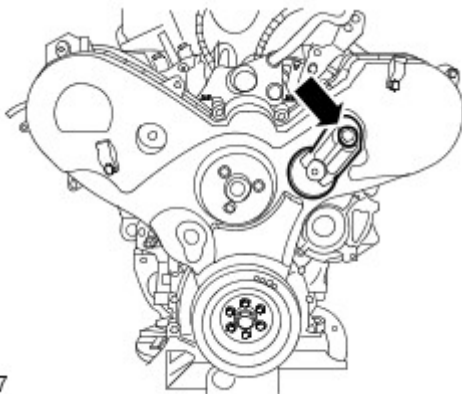
- Remove the bolt.
- Disconnect the electrical connector.
- Release from the 2 clips.
- Release the clip.



E96796

29. Remove the coolant pump.

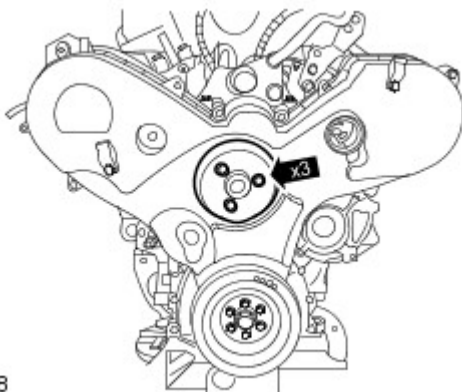
- Remove the 3 bolts.
- Remove and discard the O-ring seal.



E96797

30. Remove the accessory drive belt idler pulley.

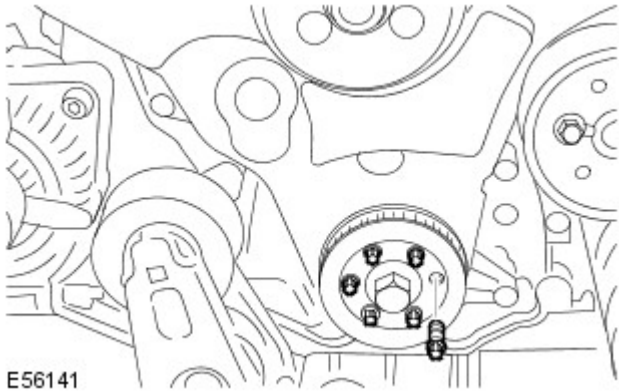
- Remove the bolt.



E96798

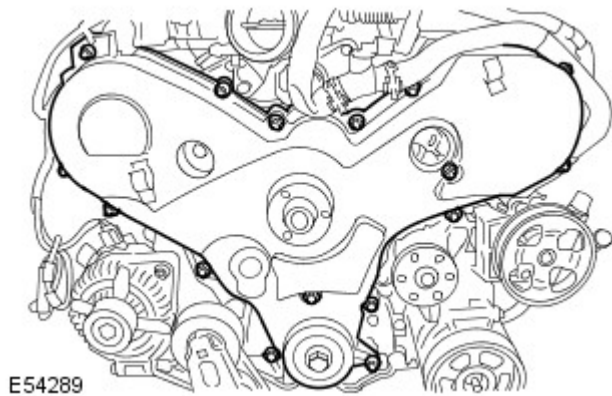
31. Remove the cooling fan pulley.

- Remove the 3 bolts.



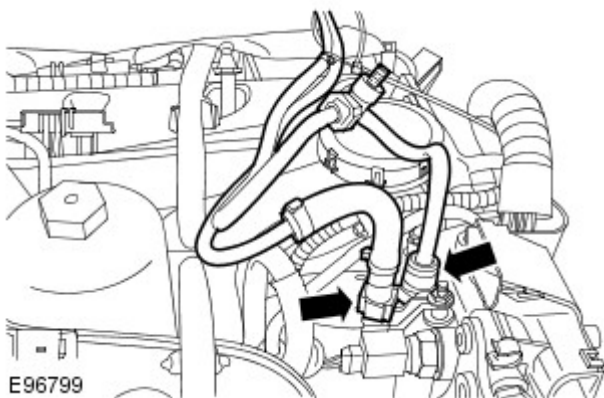
32. Remove the crankshaft pulley.

- Remove the 6 bolts.



33. Remove the timing belt cover.

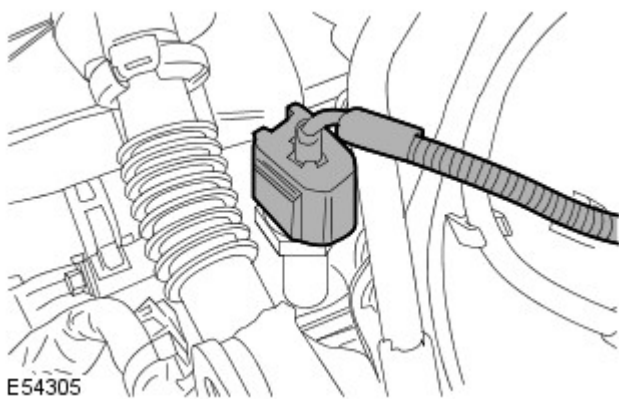
- Fully loosen the 16 bolts.



34. NOTE: Note the fitted position.

Remove the 2 low pressure fuel pipes.

- Disconnect the 2 quick release connectors.



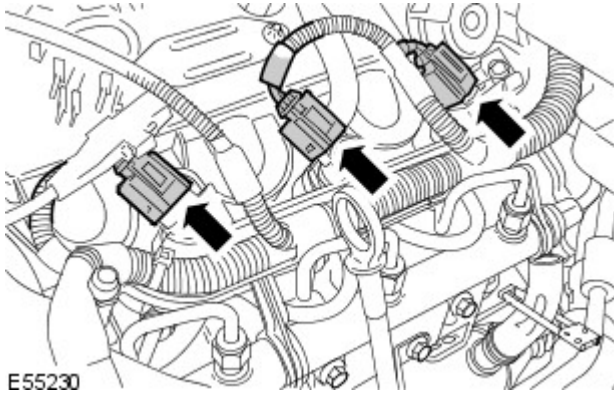
35. Disconnect the engine oil pressure (EOP) sensor electrical connector.

- Release the wiring harness clip.

36. NOTE: LH shown, RH is similar

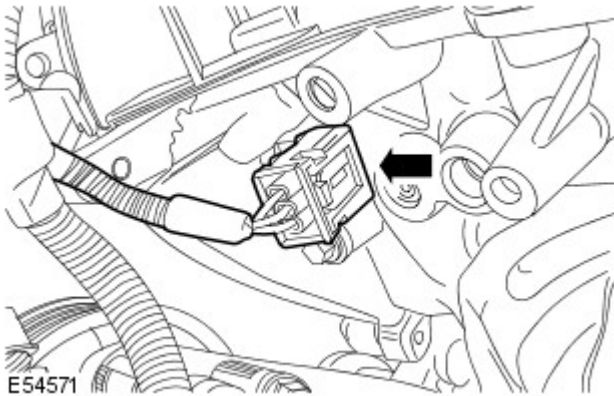
Disconnect the 6 fuel injector electrical connectors.

- Release the 4 wiring harness clips.



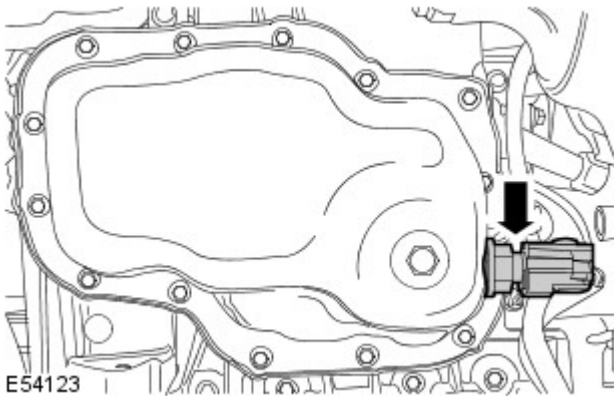
37. Disconnect the camshaft position (CMP) sensor electrical connector.

- Release the wiring harness clip.



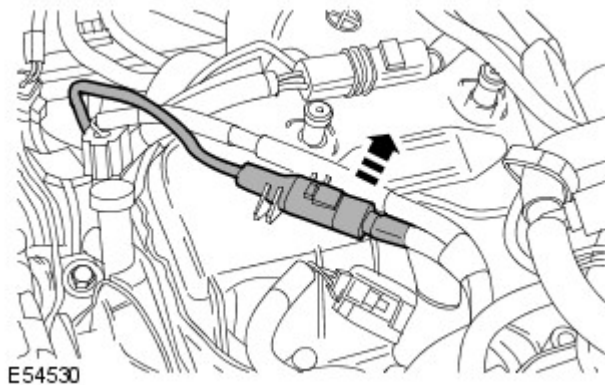
38. Disconnect the engine oil temperature sensor electrical connector.

- Release the wiring harness clip.

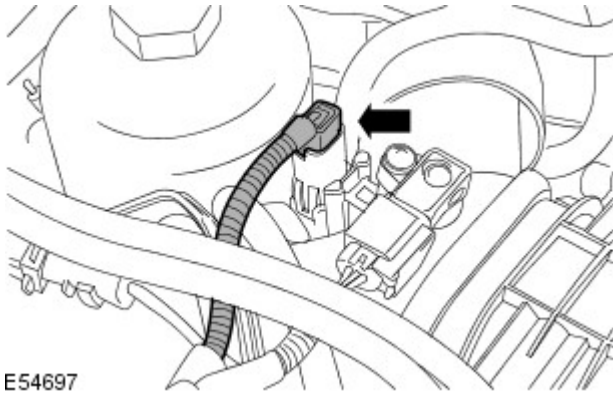


39. NOTE: LH shown, RH is similar.

Disconnect the 2 knock sensor (KS) electrical connectors.



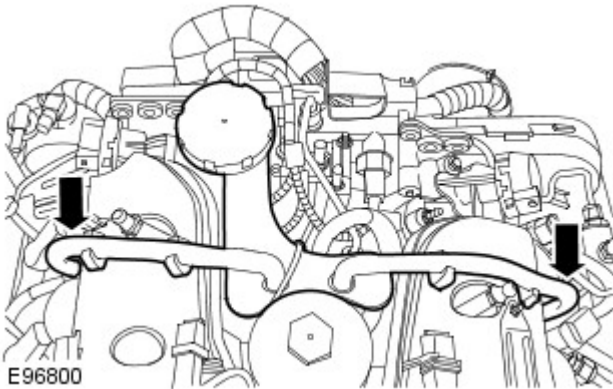
40. Disconnect the fuel temperature sensor electrical connector.



E54697

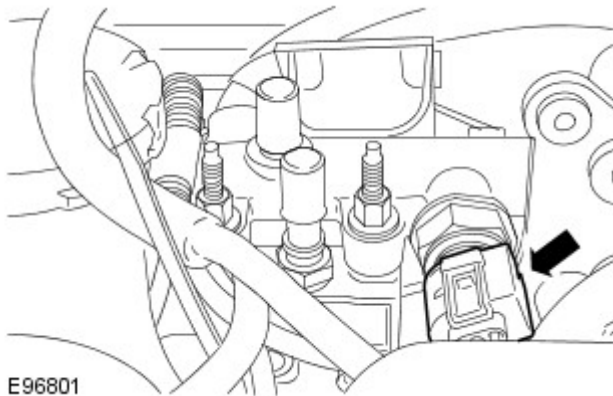
41. Remove the crankcase vent oil separator.

- Disconnect and release the 2 breather hoses.



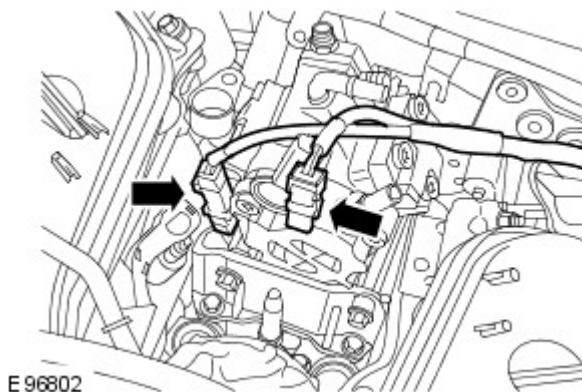
E96800

42. Disconnect the fuel rail pressure (FRP) sensor electrical connector.

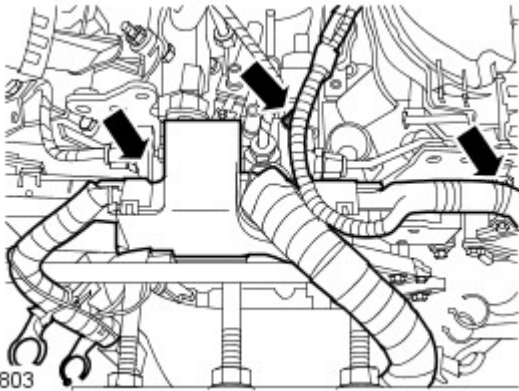


E96801

43. Disconnect the 2 fuel injection pump electrical connectors.



E 96802

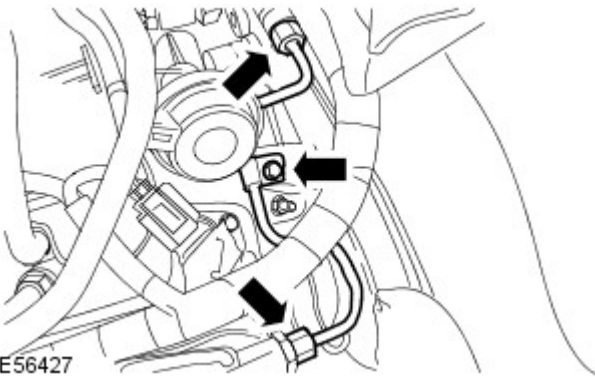


E96803


44. Remove the engine wiring harness.

- Remove the nut.
- Release the 2 clips.

Vehicles built up to 12/2006



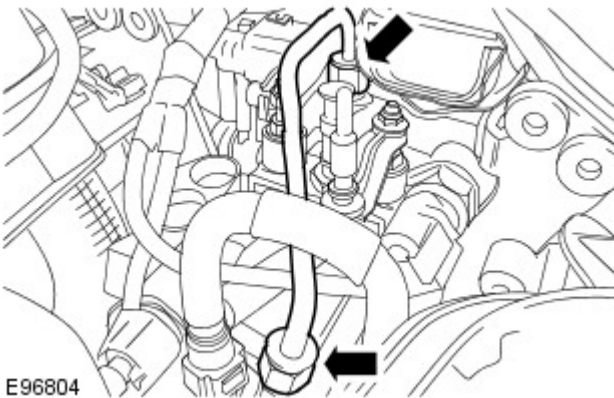
E56427

45.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

- NOTE: RH shown, LH is similar

Remove and discard the 2 high-pressure fuel rail supply lines.

- Release the 2 clips.

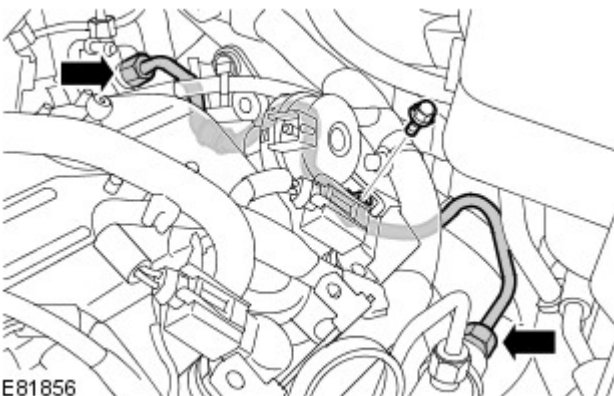


E96804


46.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the high-pressure fuel diverter rail supply line.

Vehicles built 01/2007 onwards



E81856

47.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.


- NOTE: LH shown, RH is similar


Remove and discard the 2 high-pressure fuel rail supply lines.

- Release the clip.

All vehicles

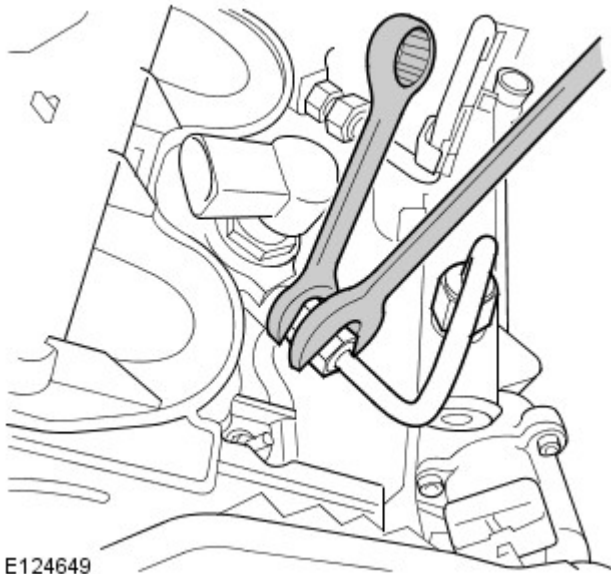
48. CAUTIONS:

 Make sure the high-pressure fuel supply line remains in contact with both the fuel injector and the fuel injection supply manifold until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Make sure that the fuel injector adaptor union does not move when loosening the high-pressure fuel supply lines. Failure to follow this instruction may result in damage to the fuel injector or the fuel injector adaptor union.

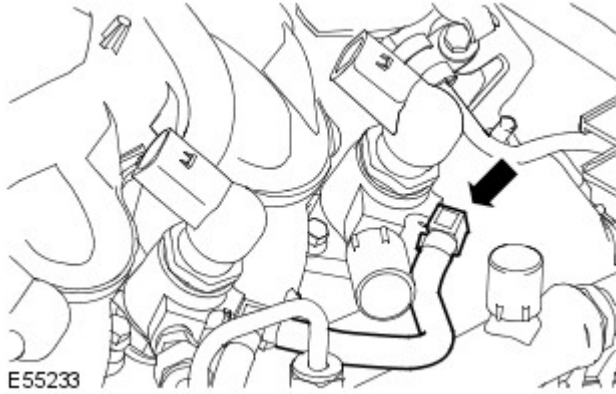
 Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the 6 high-pressure fuel supply lines.

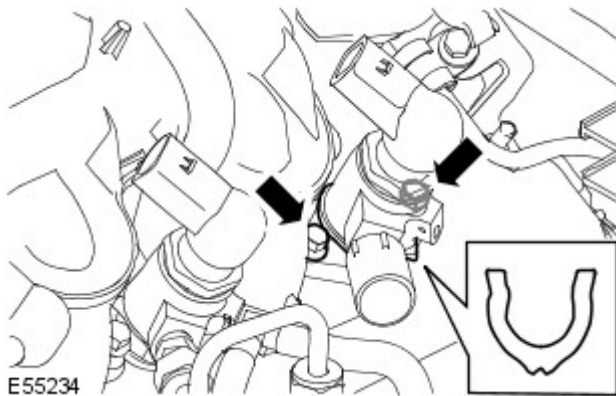


49. Disconnect the fuel return line from the fuel injectors.

- Remove and discard the 6 clips.




50. Remove the two fuel injector bolts.

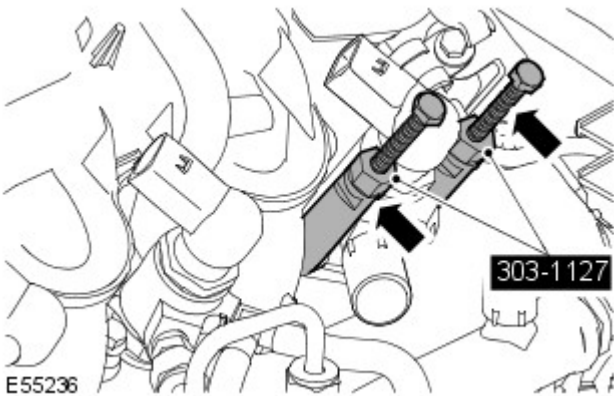


51. Install the special tool studs.



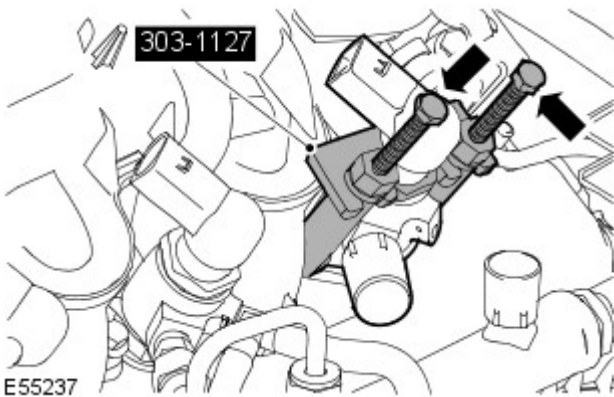
52.  CAUTION: Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

Install the special tool remover legs to the studs.



53. Remove the fuel injector.

- Rotate the special tool bolts evenly, in a clockwise direction.
- Remove the special tool.
- Remove and discard the fuel injector clamp.
- Remove and discard the sealing washer.

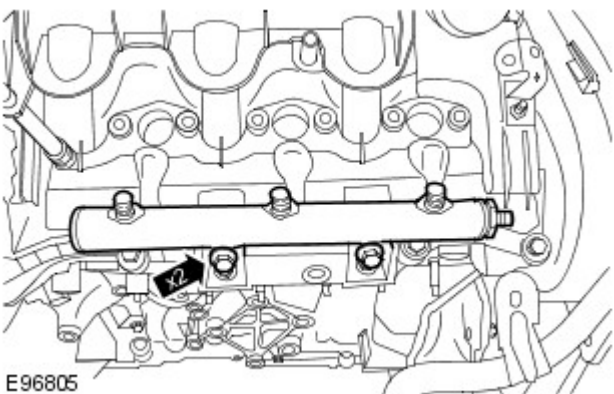


54. Remove the remaining fuel injectors.

55. NOTE: LH shown, RH is similar.

Remove the 2 fuel rails.

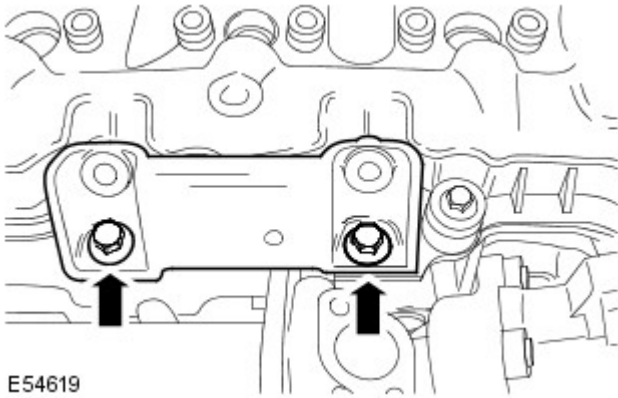
- Remove the 4 bolts.



56. NOTE: RH shown, LH is similar

Remove the 2 fuel rail brackets.

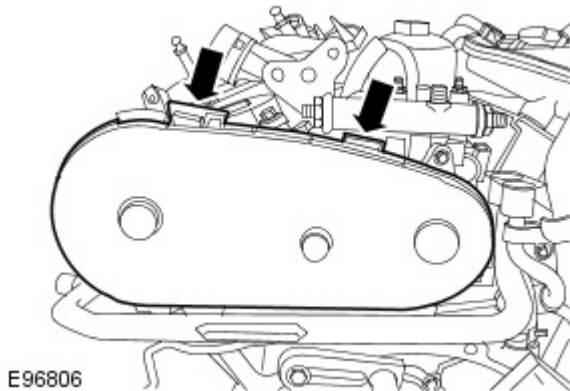
- Remove the 4 bolts.



E54619

57. Remove the fuel injection pump belt cover.

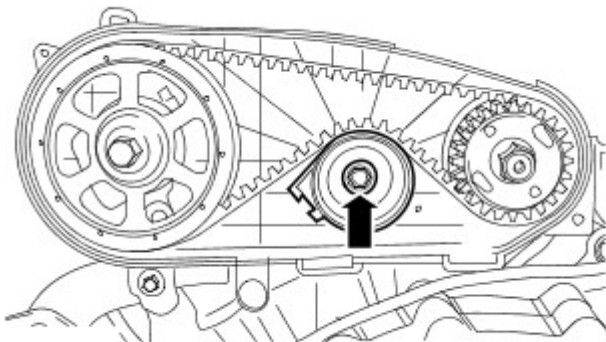
- Release the 2 clips.



E96806

58. Remove and discard the fuel injection pump belt tensioner.

- Remove the bolt.

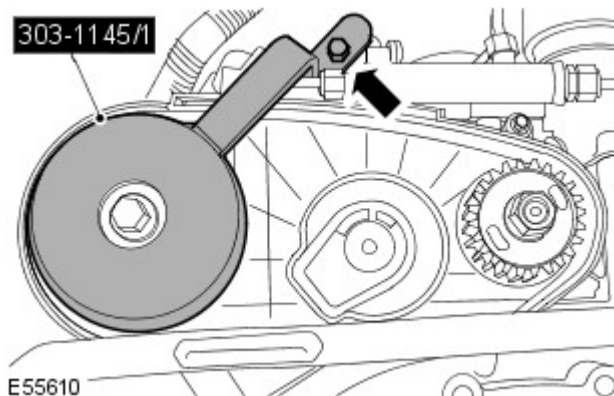


E82035

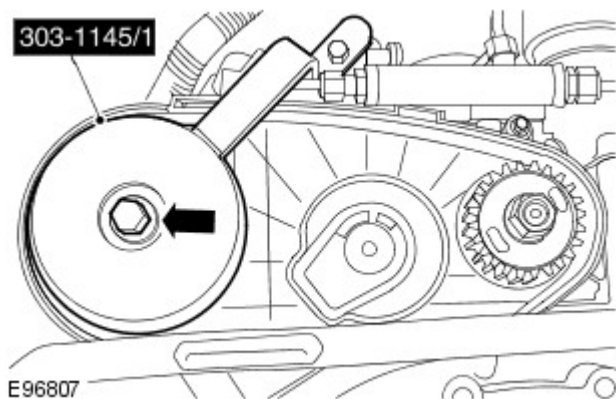
59. Remove and discard the fuel injection pump belt.

60. Install the special tool to the camshaft rear pulley.

- Rotate the crankshaft to align the special tool to the engine lifting bracket.
- Install and tighten the bolt.

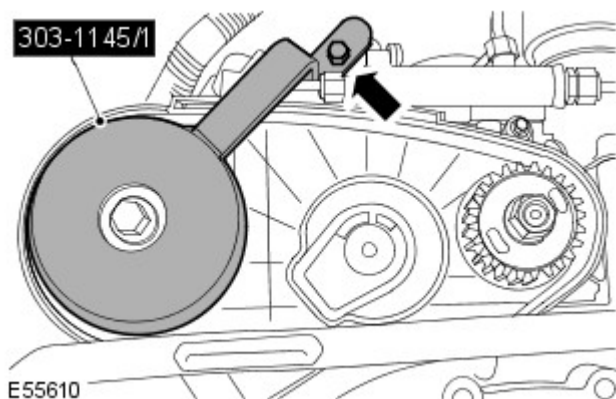


E55610



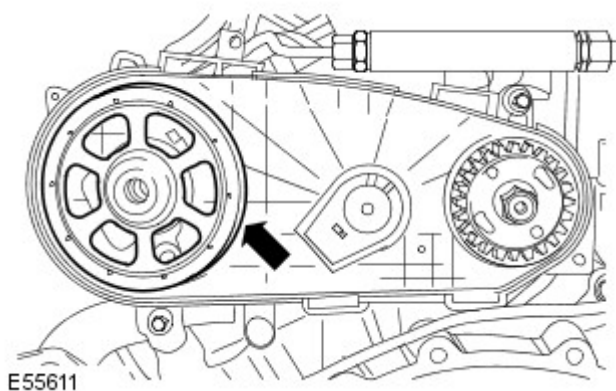
61. NOTE: Discard the bolt.

Using the special tool, remove the camshaft rear pulley bolt.

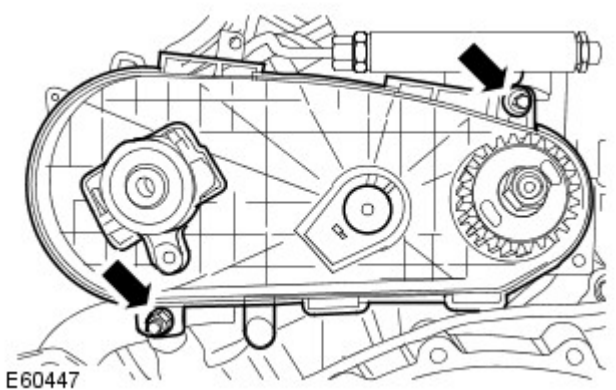


62. Remove the special tool.

- Remove the bolt.



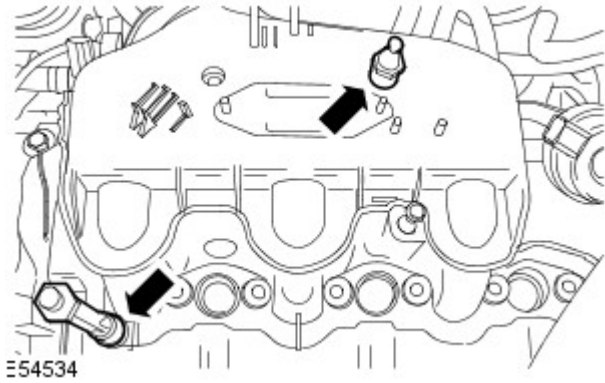
63. Remove the camshaft rear pulley.



64. Remove the fuel injection pump belt rear cover.

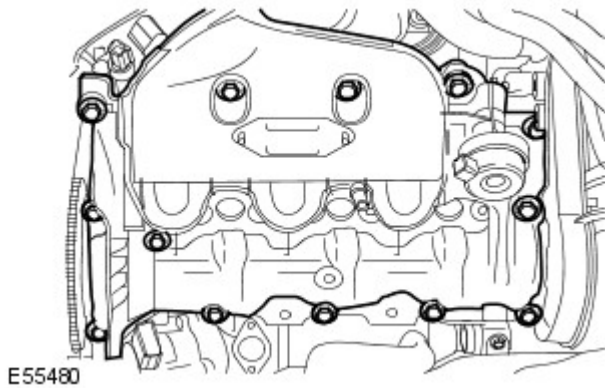
- Fully loosen the 2 bolts.

65. Remove the LH engine cover locating studs.



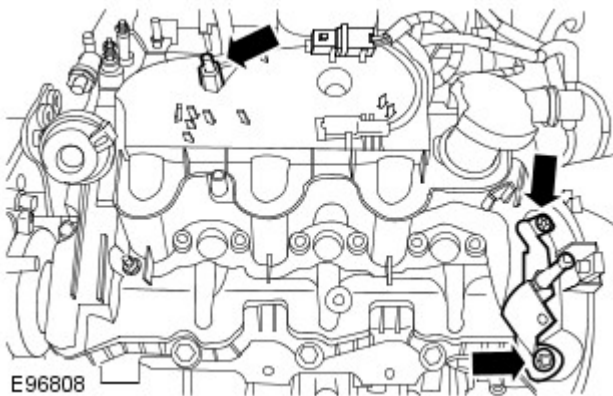
66. Remove the LH valve cover.

- Release the KS electrical connector from the valve cover.
- Fully loosen the 13 bolts.
- Remove the fuel line support bracket.
- Remove and discard the gasket.



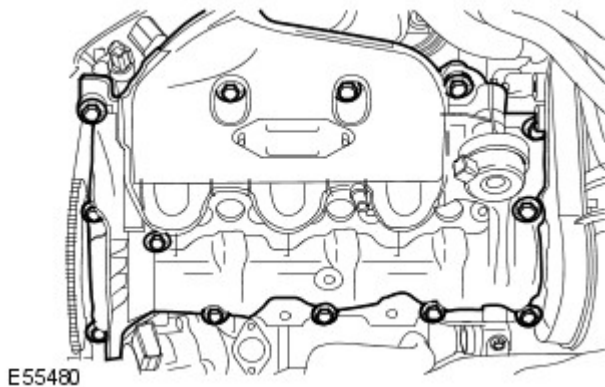
67. Remove the RH engine cover locating studs.

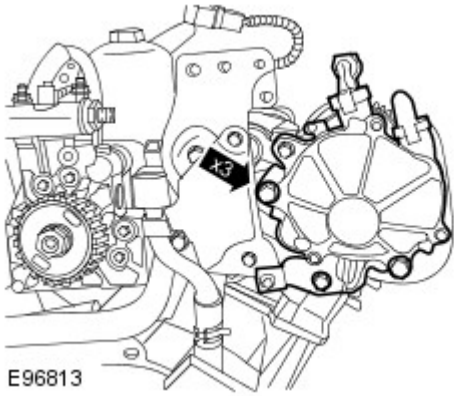
- Remove the nut.
- Remove the bolt.
- Remove the bracket.



68. Remove the RH valve cover.

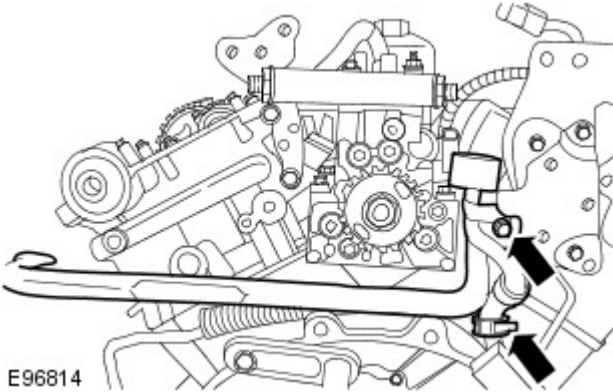
- Release the glow plug electrical connector from the valve cover.
- Release the KS electrical connector from the valve cover.
- Fully loosen the 13 bolts.
- Remove and discard the gasket.





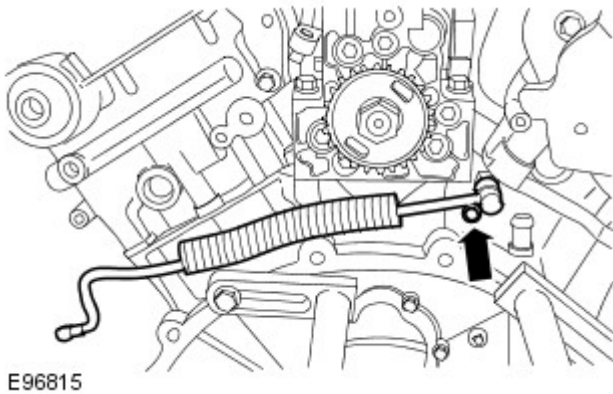
69. Remove the brake vacuum pump.

- Remove the 3 bolts.
- Remove the bracket.
- Remove and discard the gasket.



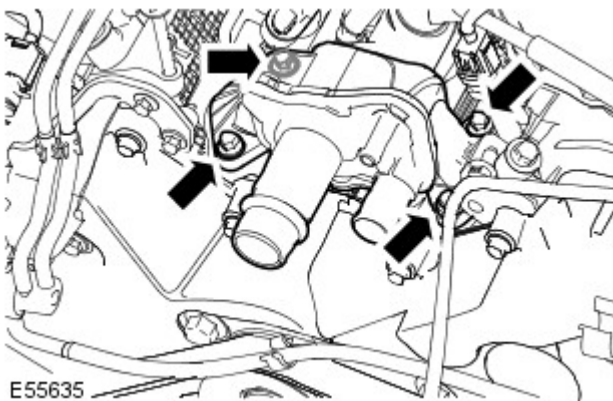
70. Remove the breather line.

- Remove the bolt.
- Release the clip.



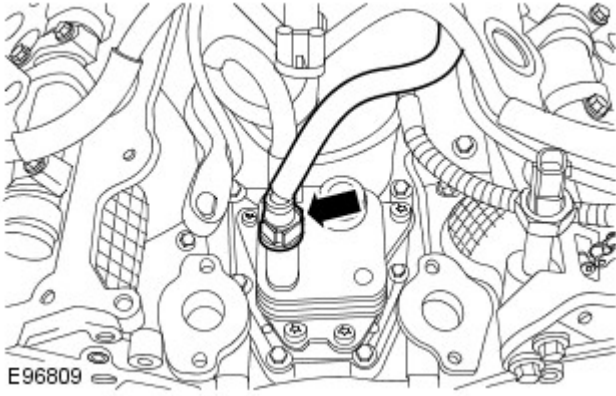
71. Remove the turbocharger oil supply line.


- Remove the bolt.
- Remove and discard the 2 O-ring seals.



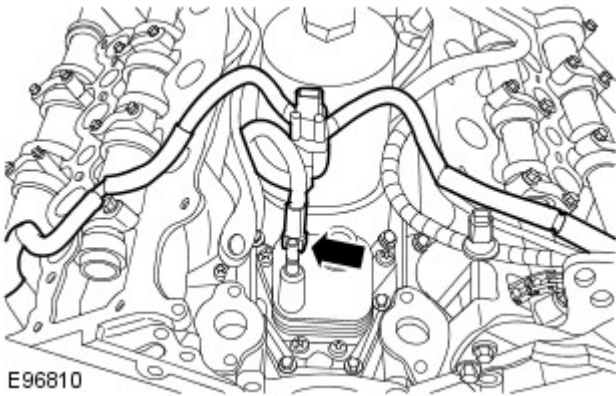
72. Remove the cylinder head coolant outlet assembly.


- Remove the 4 bolts.
- Remove and discard the O-ring seal.



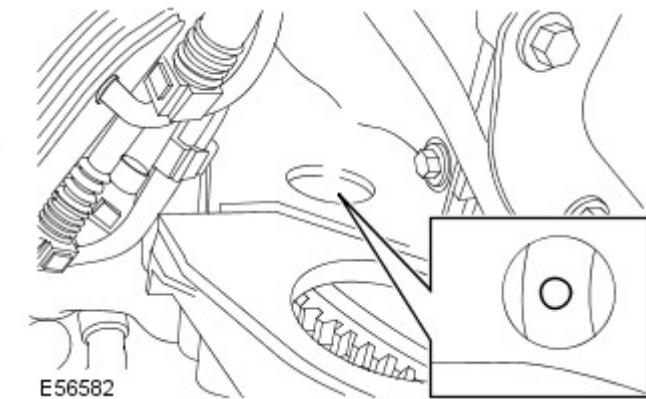
73.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Disconnect the fuel pipe from the fuel cooler.



74.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Remove and discard the fuel injector return line.



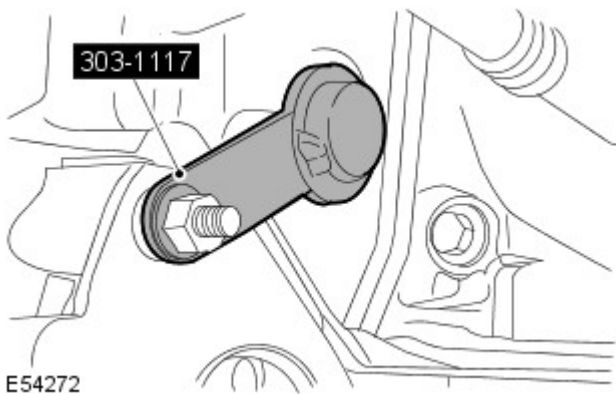
75. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the cylinder block aperture.

76. Check the camshaft pulley alignment holes are correctly aligned. If the alignment holes are not aligned, rotate the crankshaft one full turn clockwise.

Vehicles with automatic transmission

77. Using the special tool, lock the flexplate.

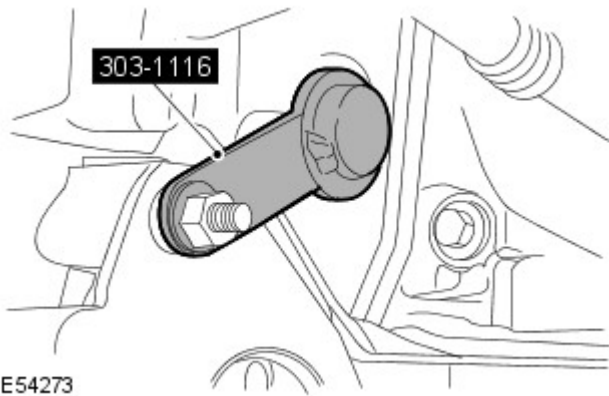
- Install a starter motor bolt to retain the special tool.



Vehicles with manual transmission


78. Using the special tool, lock the flywheel.

- Install a starter motor bolt to retain the special tool.

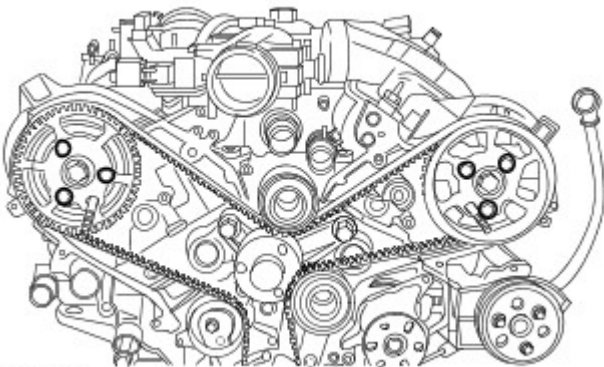


E54273

All vehicles

79.  CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

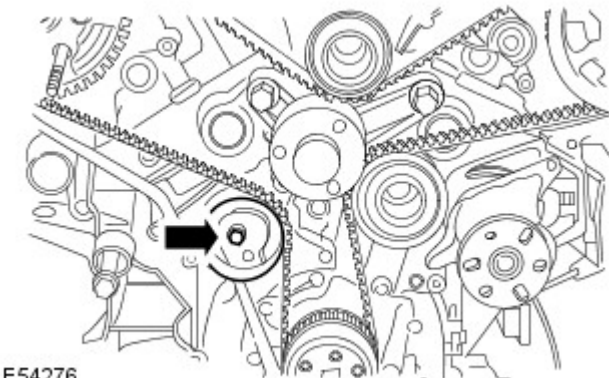
Loosen the 6 exhaust camshaft pulley bolts.



E54627

80. Remove and discard the timing belt tensioner.

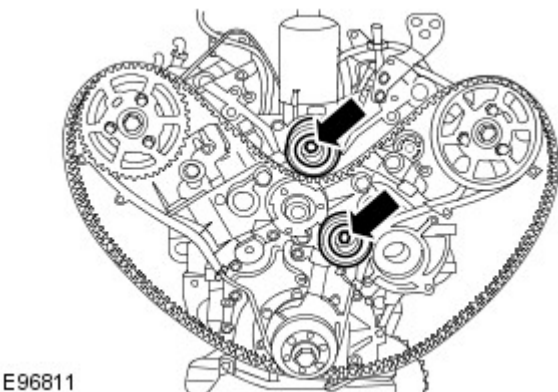
- Remove the bolt.



E54276

81. Remove the 2 timing belt idler pulley's.

- Remove the 2 bolts.
- Collect the plastic shield from behind the upper idler pulley.



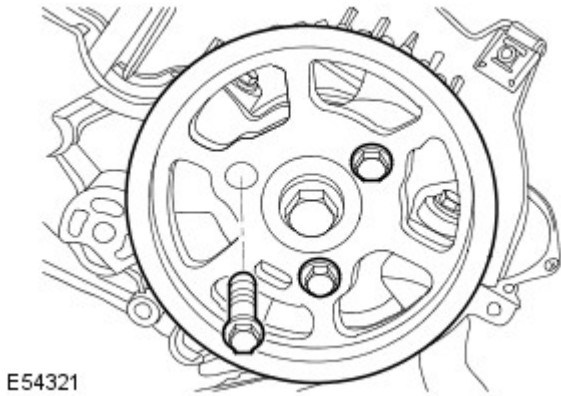
E96811

82. Remove and discard the timing belt.

83. NOTE: LH shown, RH is similar.

Remove the 2 camshaft pulleys.

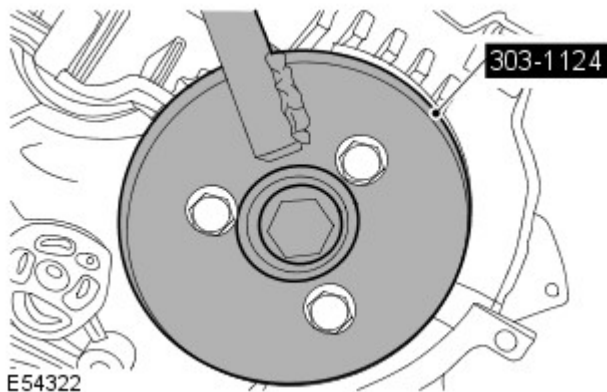
- Remove the 6 bolts.



E54321

84. Using the special tool, remove the 2 camshaft pulley hubs.

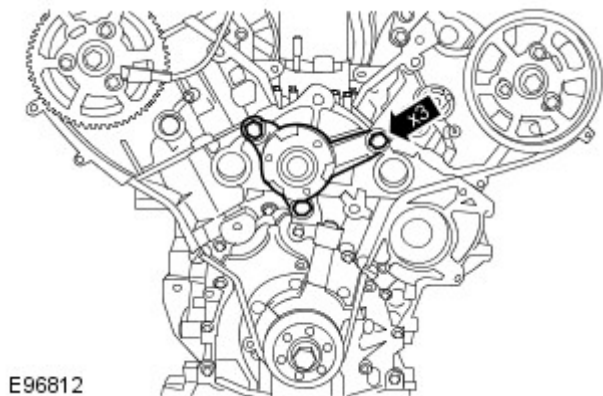
- Remove and discard the 2 bolts.



E54322

85. Remove the cooling fan drive hub bearing.

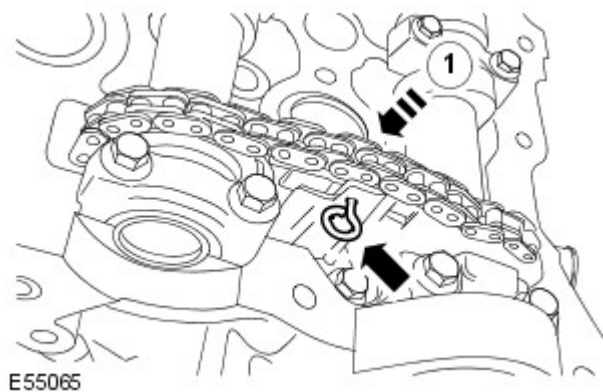
- Remove the 3 bolts.



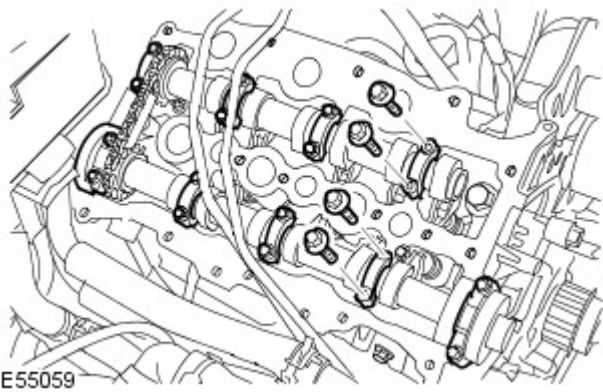
E96812

86. Retain the RH secondary timing chain tensioner piston.

- Reposition the secondary timing chain tensioner.
- Install a 1.5 mm (0.060 in.) diameter pin into the secondary timing chain tensioner piston.



E55065

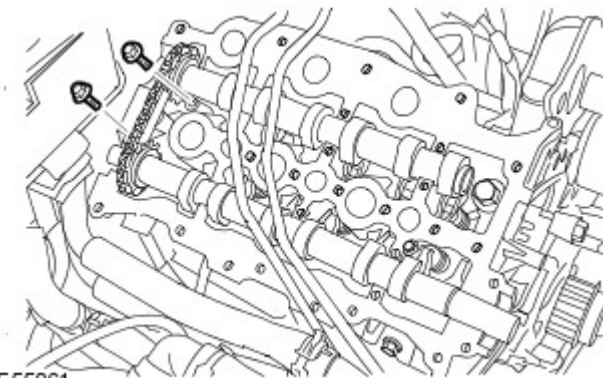


87.  **CAUTION:** Evenly and progressively, release the camshaft bearing caps.

Remove the RH bank camshaft bearing caps.

- Remove the 18 bolts.

E55059

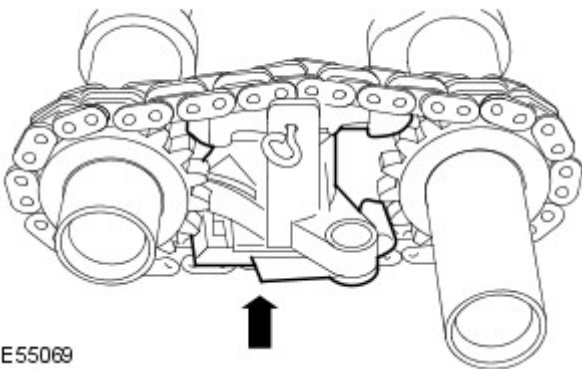


88. Remove the RH bank camshafts and secondary timing chain tensioner assembly.

- Remove the 2 bolts.
- Release the RH secondary timing chain tensioner.

E55061

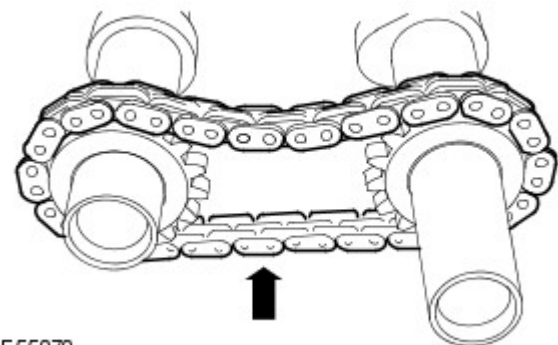
89. Remove the RH bank secondary timing chain tensioner.



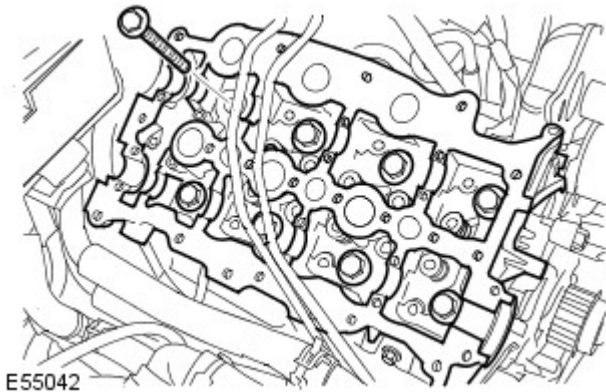
E55069

90. Remove the RH bank camshafts.


- Release the secondary timing chain from the RH camshafts.
- Remove and discard the seal.



E55070



91. CAUTIONS:

 The cylinder head must not be placed mating face down. Failure to follow this instruction may result in damage to the vehicle.

 Only use a plastic scraper to clean off the old gasket.

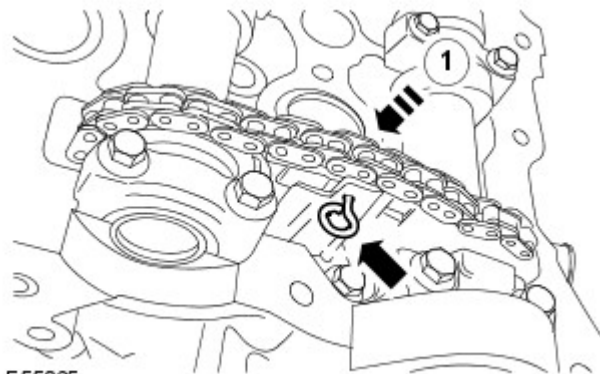
Remove the RH cylinder head assembly.

- Remove and discard the 8 bolts.
- Remove and discard the gasket.

E55042

92. Retain the LH secondary timing chain tensioner piston.

- Reposition the secondary timing chain tensioner.
- Install a 1.5 mm (0.060 in.) diameter pin into the secondary timing chain tensioner piston.

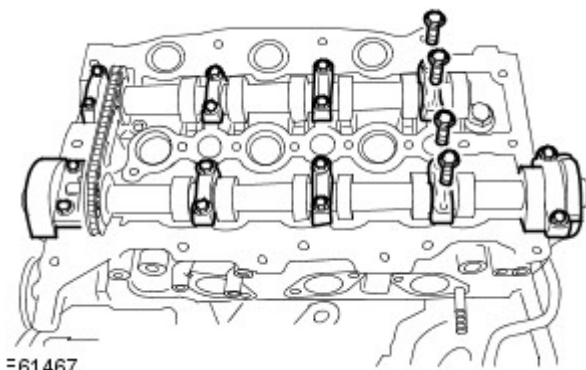


E55065

93.  CAUTION: Evenly and progressively, release the camshaft bearing caps.

Remove the LH bank camshaft bearing caps.

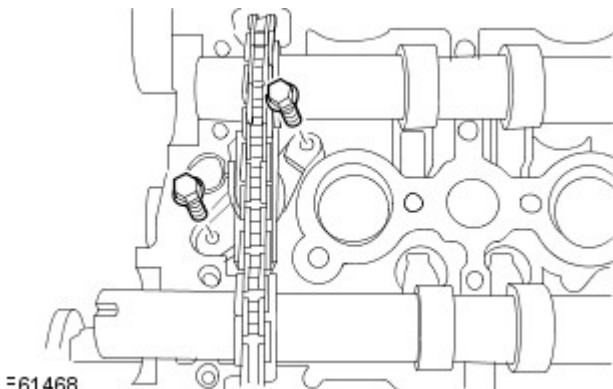
- Remove the 18 bolts.



E61467

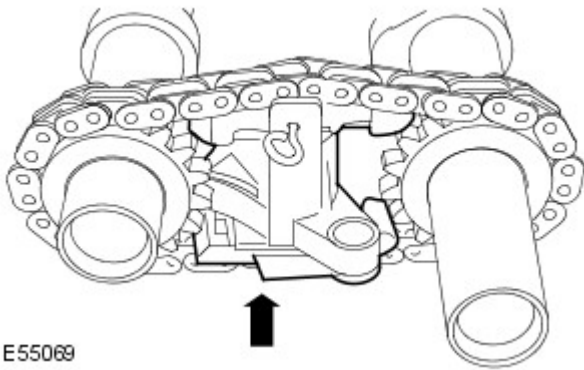
94. Remove the LH bank camshafts and secondary timing chain tensioner assembly.

- Release the LH secondary timing chain tensioner.
- Remove the 2 bolts.



E61468

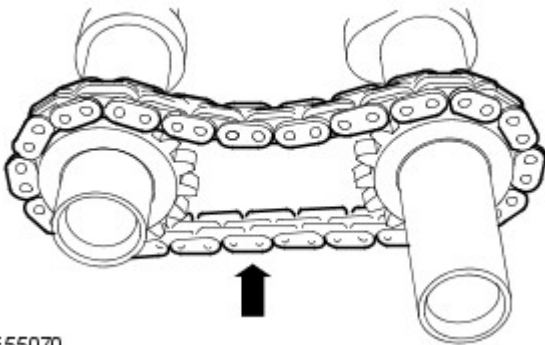
95. Remove the LH bank secondary timing chain tensioner.



E55069


96. Remove the LH bank camshafts.

- Release the secondary timing chain from the LH camshafts.
- Remove and discard the 2 seals.



E55070

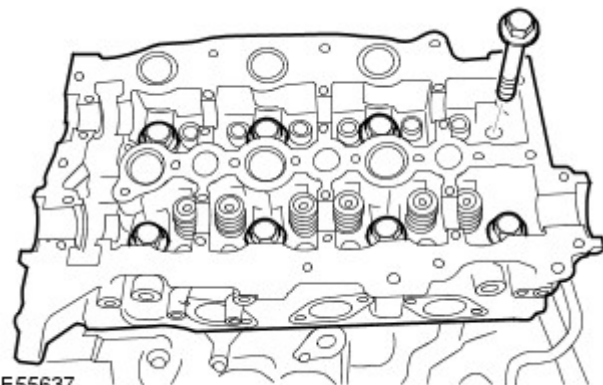
97. CAUTIONS:

 The cylinder head must not be placed mating face down. Failure to follow this instruction may result in damage to the vehicle.

 Only use a plastic scraper to clean off the old gasket.

Remove the LH cylinder head assembly.

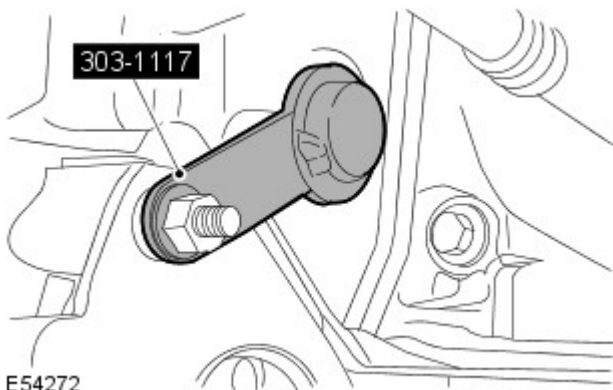
- Remove and discard the 8 bolts.
- Remove and discard the gasket.



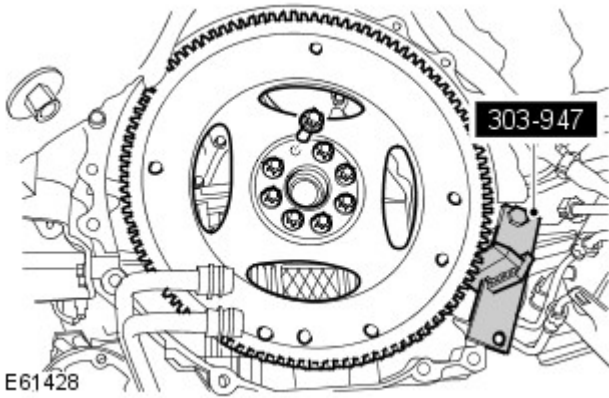
E55637

Vehicles with automatic transmission

98. Remove the special tool from the flexplate.



E54272

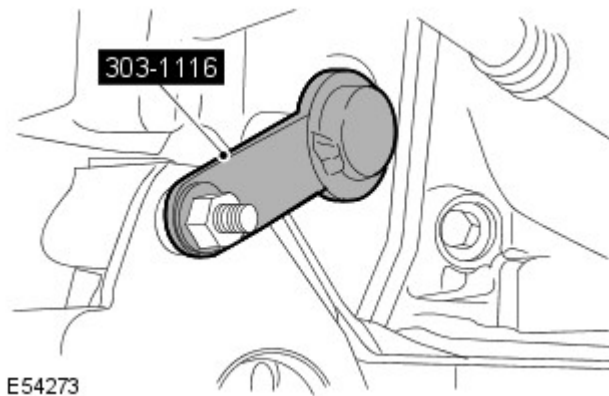


99. Remove the flexplate.

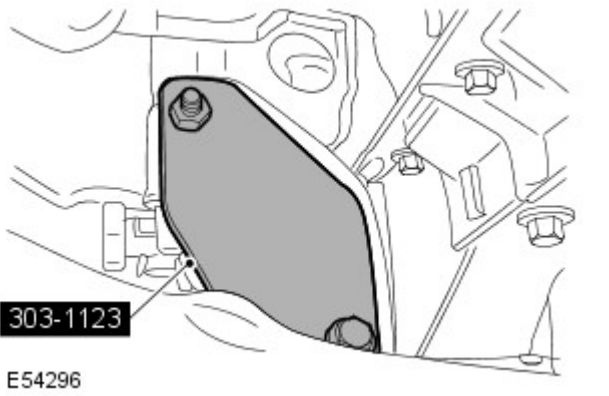
- Using the special tool, lock the flexplate.
- Remove the 8 bolts.

Vehicles with manual transmission

100. Remove the special tool from the flexplate.



101. Install the special tool.

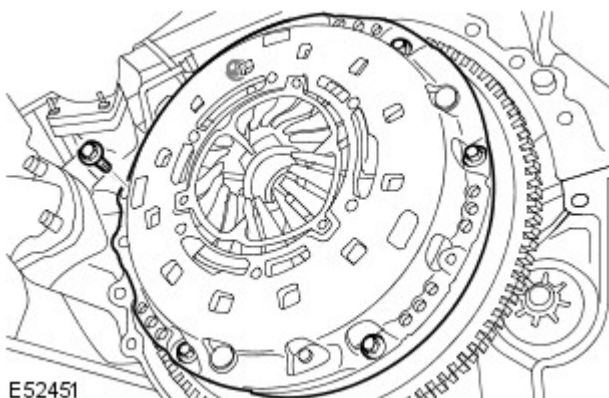


102.  CAUTION: Working in a diagonal sequence, progressively loosen the bolts.

- NOTE: Restrain the flywheel.

Remove the clutch disc and pressure plate.

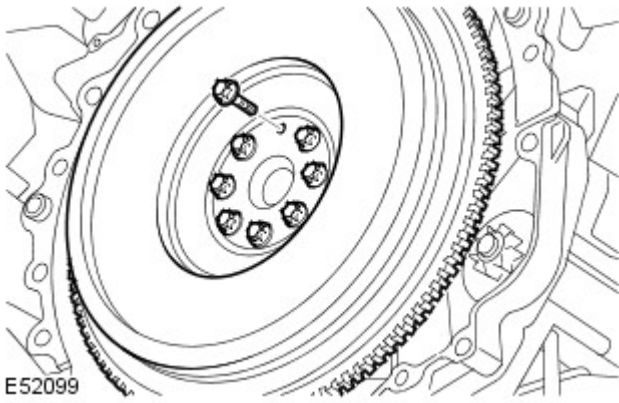
- Remove the 6 bolts.



103. NOTE: Restrain the flywheel.

Remove the flywheel.

- Remove the 8 bolts.



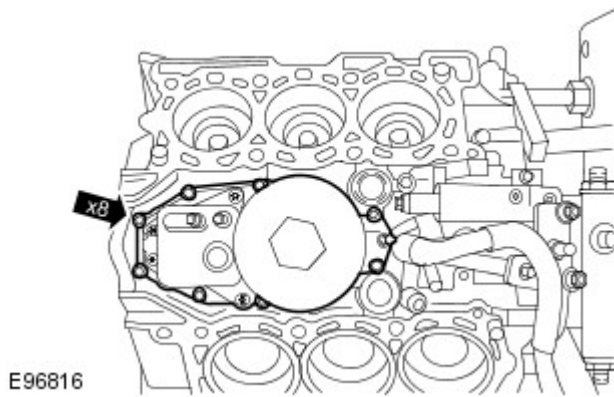
104. Remove the special tool.



All vehicles

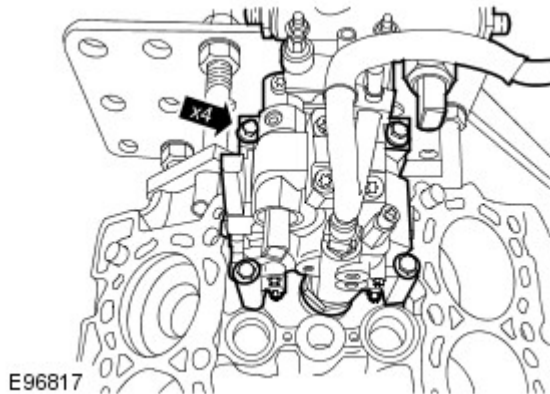
105. Remove the oil cooler assembly.

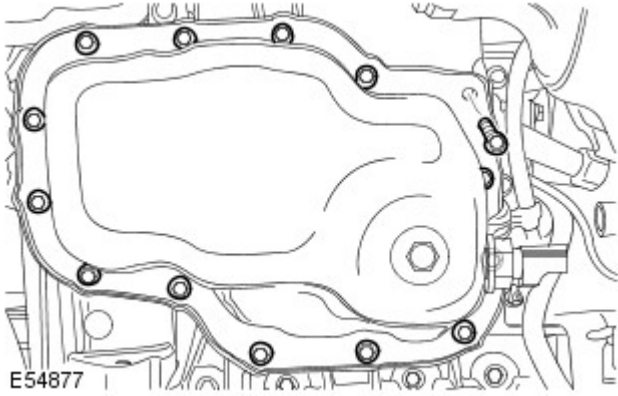
- Remove the 8 bolts.
- Remove and discard the gasket.



106. Remove the fuel injection pump.

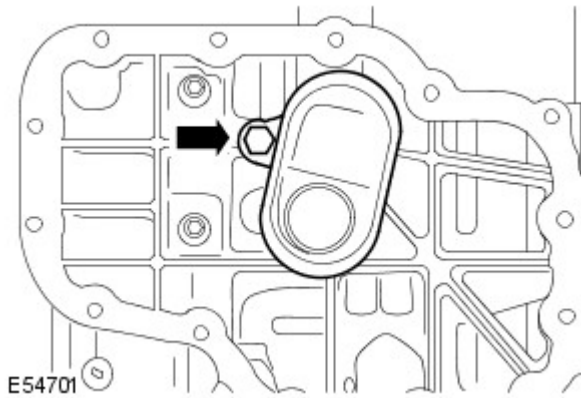
- Remove the 4 bolts.





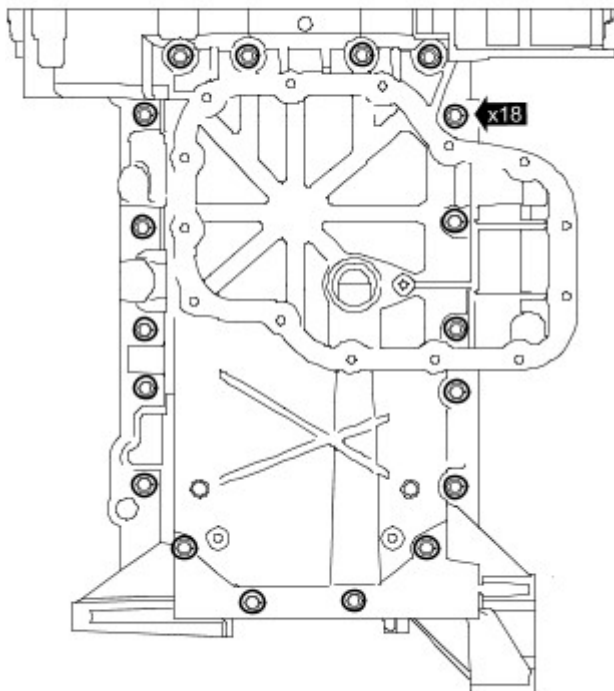
107. Remove the oil pan.

- Remove the 14 bolts.
- Remove and discard the gasket.



108. Remove the oil pump screen and pickup tube.

- Remove the bolt.
- Remove and discard the 2 O-ring seals.



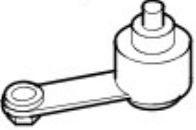

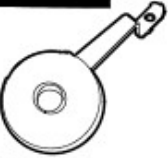
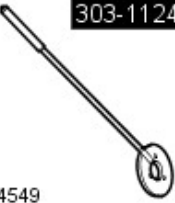
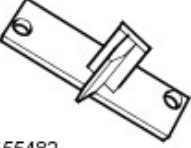
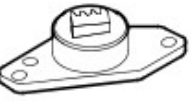

109. Remove the oil pan extension.

- Remove the 18 bolts.
- Remove and discard the gasket.

E93945

Engine - TDV6 2.7L Diesel - Engine

Assembly

Special Tool(s)	
 <p>303-1117</p> <p>E54540</p>	Timing Pin - Automatic Transmission 303-1117
 <p>303-1116</p> <p>E54539</p>	Timing Pin - Manual Transmission 303-1116
 <p>303-1145/1</p> <p>E60399</p>	Camshaft pulley holding tool 303-1145/1
 <p>303-1124</p> <p>E54549</p>	Holder - Camshaft Pulleys Front 303-1124
 <p>303-947</p> <p>E55482</p>	Flex plate locking tool 303-947
 <p>303-1123</p> <p>E 54546</p>	Locking Tool - Flywheel 303-1123
 <p>303-1126</p> <p>E54551</p>	Timing Pin - Camshaft Pulleys 303-1126

Assembly

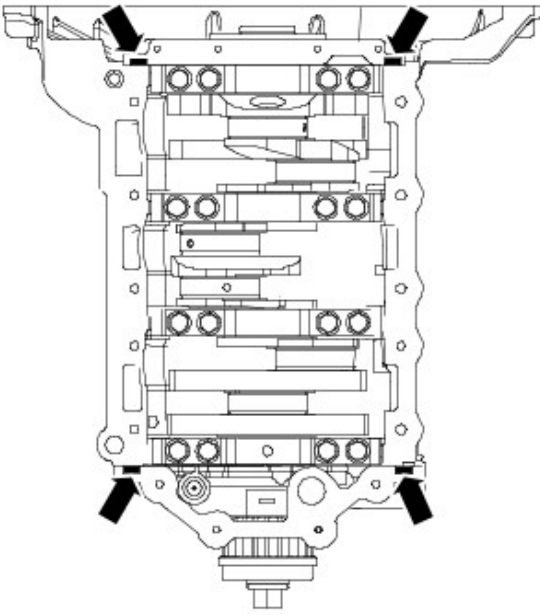
All vehicles

1. NOTE: Clean the component mating faces.

• NOTE: It is important that the oil pan extension is bolted to the crankshaft main bearing carrier within twenty minutes of applying the sealant.

Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

- Use WSS-M4G323-A4-RTV sealant.

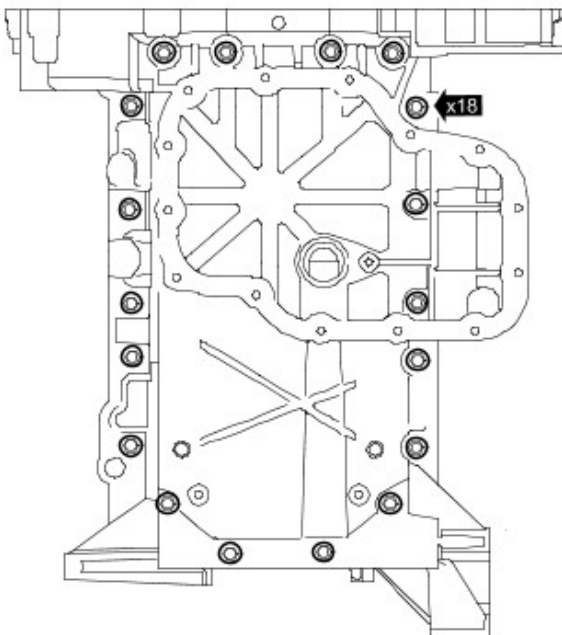


E93678

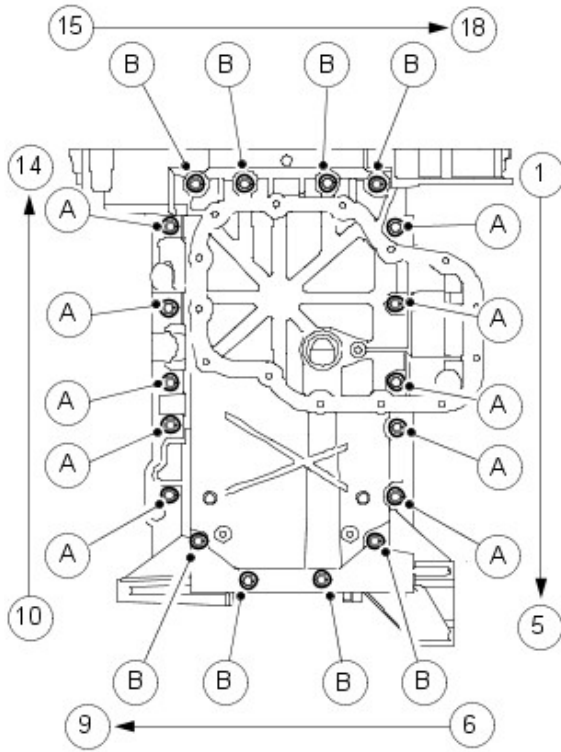
2. NOTE: Clean the component mating faces.

Install the oil pan extension.

- Install a new gasket.
- Loosely install the bolts.



E93945



E93962

3.  CAUTION: Tighten the bolts in the indicated sequence in 2 stages.

Secure the oil pan extension.

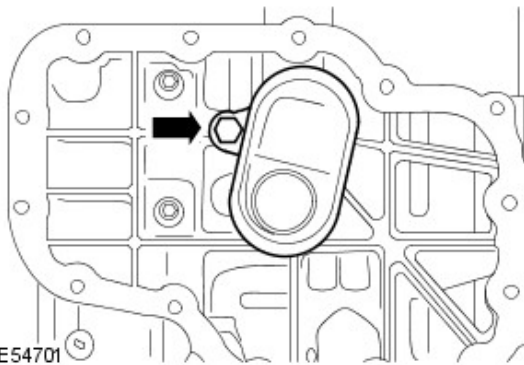
1. Tighten bolts A to 10 Nm (7 lb.ft). Tighten bolts B to 4 Nm (2 lb.ft).
2. Tighten bolts A to 24 Nm (18 lb.ft). Tighten bolts B to 10 Nm (7 lb.ft).

4. NOTE: Lubricate the new seals with clean engine oil.

• NOTE: Clean the components.

Install the oil pump screen and pickup tube.

- Clean the components.
- Install new O-ring seals.
- Tighten the bolt to 10 Nm (7 lb.ft).

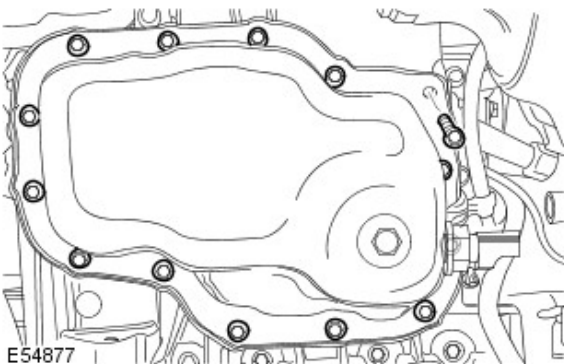


E54701

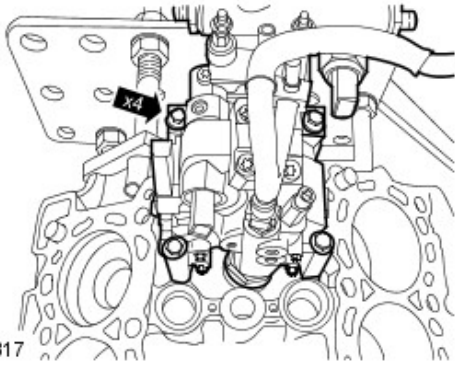
5. NOTE: Clean the component mating faces.

Install the oil pan.

- Install a new gasket.
- Evenly and progressively tighten the bolts to 10 Nm (7 lb.ft).



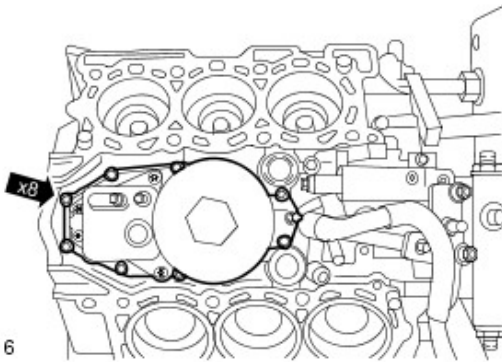
E54877




E96817

6. Install the fuel injection pump.

- Tighten the bolts to 23 Nm (17 lb.ft).



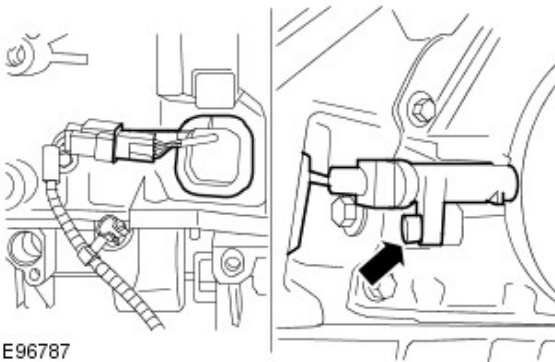
E96816

7.  CAUTION: Make sure the gasket is installed correctly.

- NOTE: Clean the component mating faces.

Install the oil cooler assembly.

- Install a new gasket.
- Install a new O-ring seal.
- Tighten the bolts to 10 Nm (7 lb.ft).




E96787

8. Install the crankshaft position (CKP) sensor.

- Tighten the bolt to 5 Nm (4 lb.ft).
- Connect the electrical connector.
- Reposition the access cover.

Vehicles with automatic transmission

9. CAUTIONS:

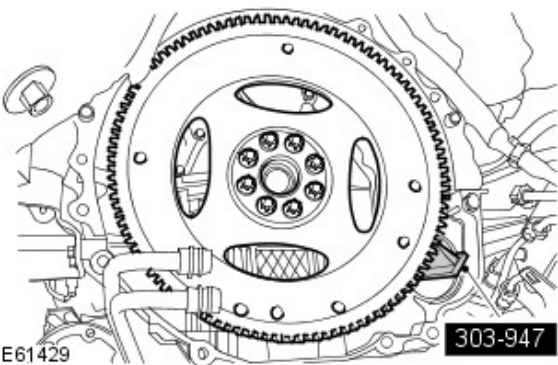
-  Tighten the bolts in a diagonal sequence.

-  Tighten the bolts in the stages shown.

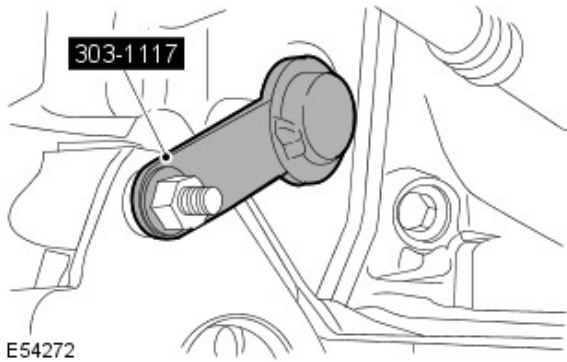
- NOTE: Clean the component mating faces.

Install the flexplate.

- Using the special tool, lock the flexplate.
- Stage 1: Tighten the bolts to 50 Nm (37 lb.ft).
- Stage 2: Tighten the bolts 45 degrees.
- Stage 3: Tighten the bolts a further 45 degrees.
- Remove the special tool.



E61429

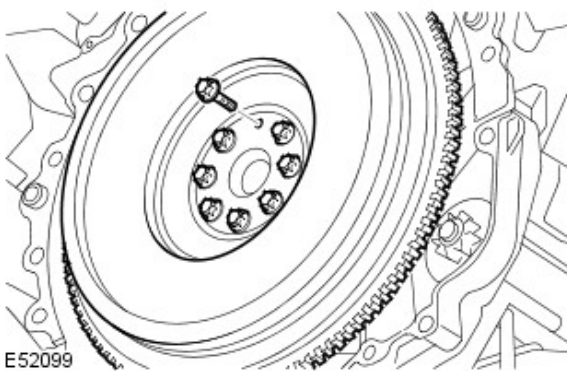
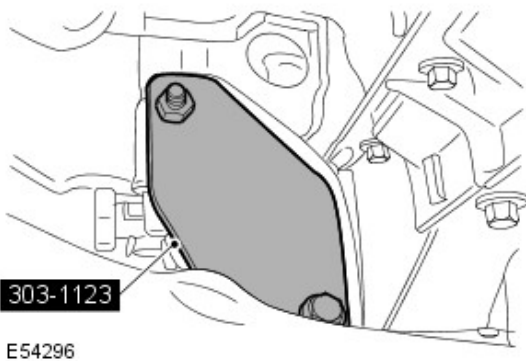


10. Using the special tool, lock the flexplate.

- Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the cylinder block aperture.
- Install a starter motor bolt to retain the special tool.

Vehicles with manual transmission

11. Install the special tool.



12. CAUTIONS:

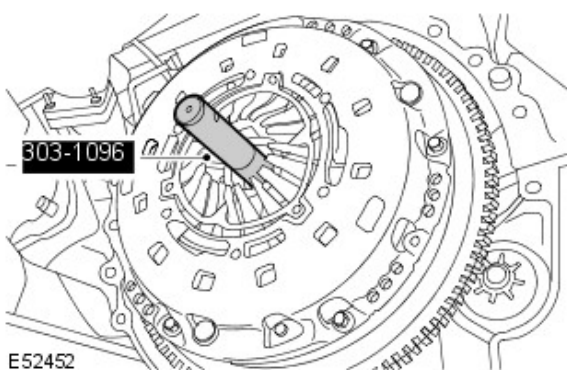
 Tighten the bolts in a diagonal sequence.

 Tighten the bolts in the stages shown.

• NOTE: Clean the component mating faces.

Install the flywheel.

- Stage 1: Tighten the bolts to 50 Nm (37 lb.ft).
- Stage 2: Tighten the bolts 45 degrees.
- Stage 3: Tighten the bolts a further 45 degrees.



13. CAUTIONS:

 Install the clutch disc with 'TRANSMISSION SIDE' marking against the clutch cover.

 Use the special tool to align the components.

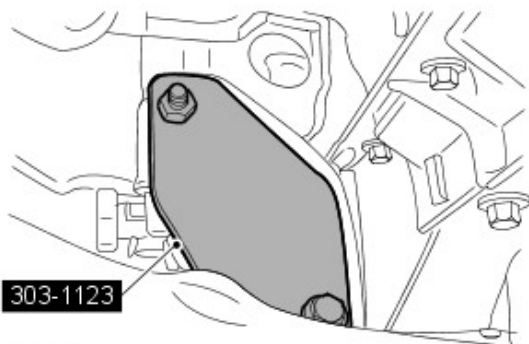
 Working in a diagonal sequence, progressively tighten the bolts.

• NOTE: Clean the component mating faces.

Using the special tool, install the clutch disc and pressure plate.

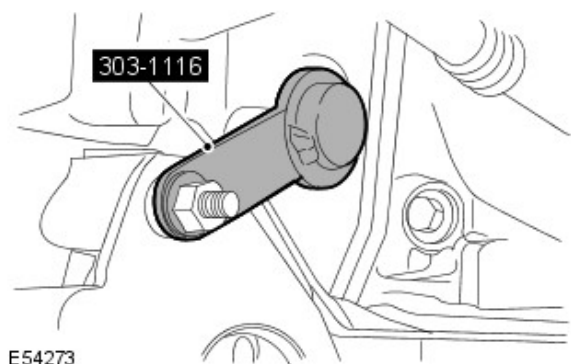
- Tighten the bolts to 25 Nm (18 lb.ft).

14. Remove the special tool.



15. Using the special tool, lock the flywheel.

- Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the cylinder block aperture.
- Install a starter motor bolt to retain the special tool.



All vehicles


16. Check the LH cylinder head face for distortion, across the center and from corner to corner.

17. NOTE: The cylinder head gasket must be installed over the cylinder head to cylinder block dowels.

- NOTE: Clean the component mating faces.

Install a new LH cylinder head gasket.

18. CAUTIONS:

 Use care when installing the cylinder head. Damage to the cylinder block, cylinder head or cylinder head gasket may result.

 Make sure that new bolts are installed.

• NOTE: The cylinder head gasket must be installed over the cylinder head to cylinder block dowels.

• NOTE: Make sure the cylinder head is installed in its original position.

• NOTE: Tighten the bolts in the indicated sequence in 4 stages.

• NOTE: Clean the component mating face.

Install the LH cylinder head assembly.

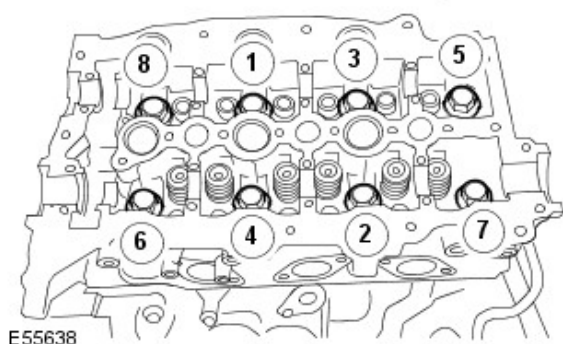
- Stage 1: Tighten the bolts to 20 Nm (15 lb.ft).
- Stage 2: Tighten the bolts to 40 Nm (30 lb.ft).
- Stage 3: Tighten the bolts to 80 Nm (59 lb.ft).
- Stage 4: Tighten the bolts a further 180 degrees.

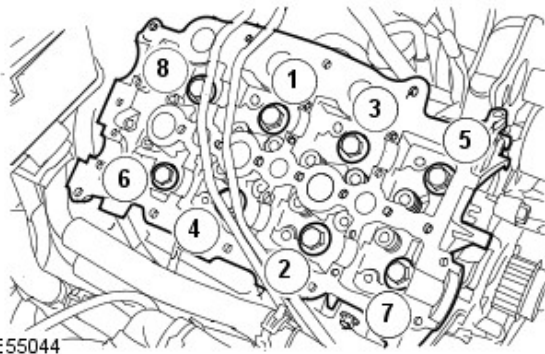
19. Check the RH cylinder head face for distortion, across the center and from corner to corner.

20. NOTE: The cylinder head gasket must be installed over the cylinder head to cylinder block dowels.

- NOTE: Clean the component mating faces.


Install a new RH cylinder head gasket.





E55044

21. CAUTIONS:

 Use care when installing the cylinder head. Damage to the cylinder block, cylinder head or cylinder head gasket may result.


 Make sure that new bolts are installed.

- NOTE: The cylinder head gasket must be installed over the cylinder head to cylinder block dowels.
- NOTE: Make sure the cylinder head is installed in its original position.
- NOTE: Tighten the bolts in the indicated sequence in four stages.

Install the RH cylinder head assembly.

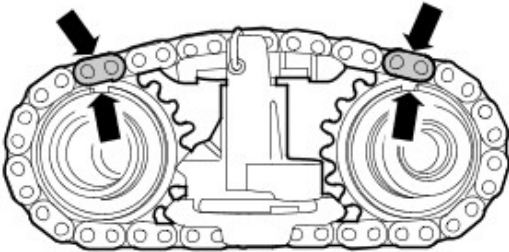
- Stage 1: Tighten to 20 Nm (15 lb.ft).
- Stage 2: Tighten to 40 Nm (30 lb.ft).
- Stage 3: Tighten to 80 Nm (59 lb.ft).
- Stage 4: Tighten a further 180 degrees.

22. Install the secondary timing chain to the RH bank camshafts.

23.  **CAUTION:** Do not release the secondary timing chain tensioner locking pin until all of the camshaft bearing caps have been installed.

Install the RH bank secondary timing chain tensioner.

- Align the marks on the camshafts with the marks on the secondary timing chain.



E55062

24. NOTE: Clean the components.

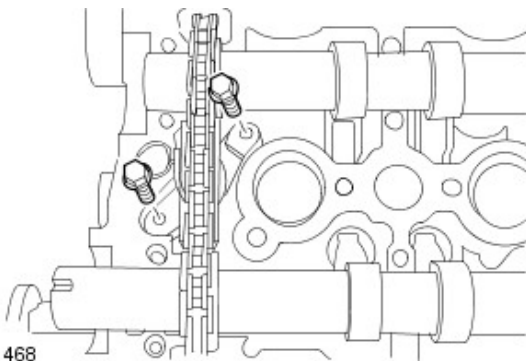
- NOTE: Install a new seal.

Install the RH bank camshafts and secondary timing chain tensioner assembly.

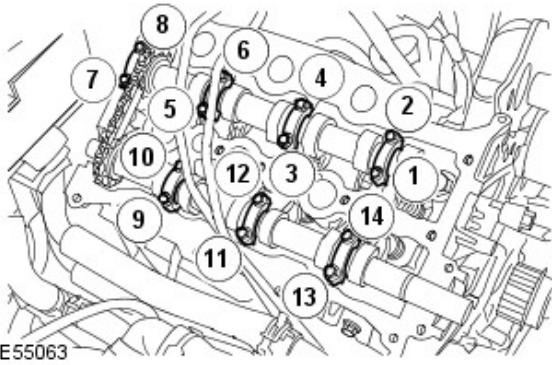
- Lubricate the journals and camshaft lobes.

25. Secure the RH bank secondary timing chain tensioner.

- Tighten the bolts to 10 Nm (7 lb.ft).



E61468



26.  **CAUTION:** Tighten the bolts evenly in 3 stages in the sequence shown.

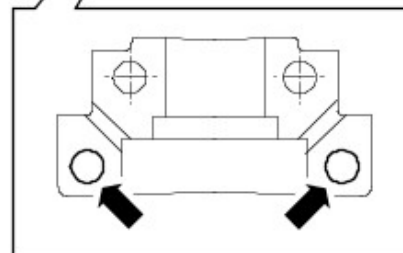
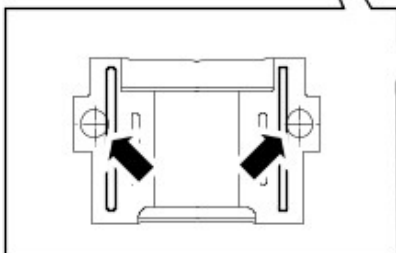
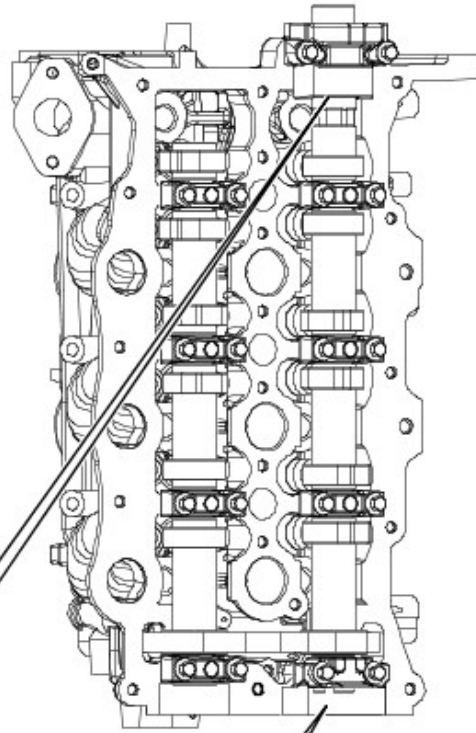
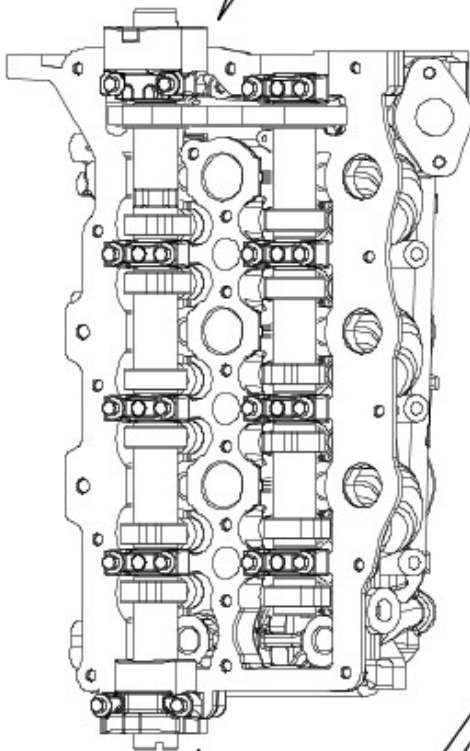
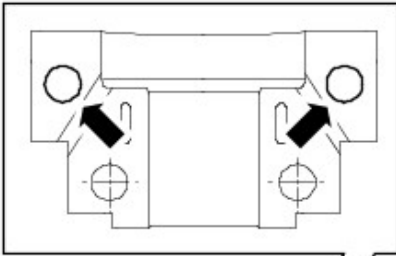
• **NOTE:** Do not install the two exhaust camshaft end bearing caps at this stage.

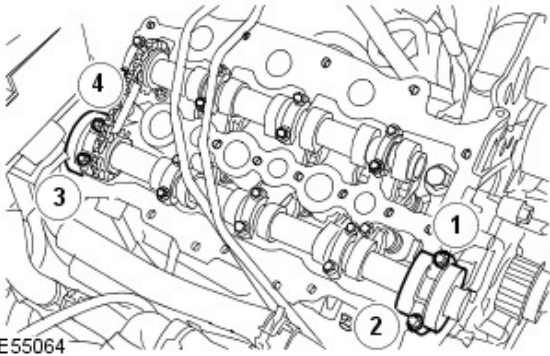
• **NOTE:** Clean the component mating faces.

Install the RH bank camshaft bearing caps.

- Stage 1: Tighten to 1 Nm (1 lb.ft).
- Stage 2: Tighten to 5 Nm (4 lb.ft).
- Stage 3: Tighten to 10 Nm (7 lb.ft).

27. Apply sealant to the RH exhaust camshaft end bearing cap at the positions shown.





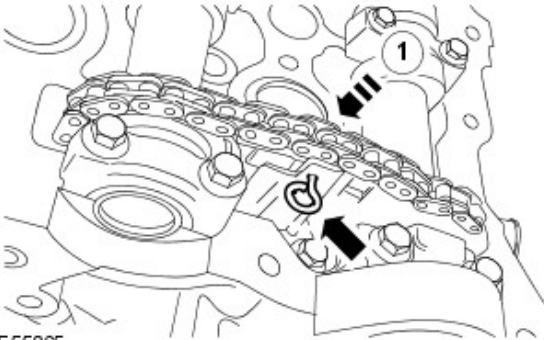
E55064

28.  CAUTION: Tighten the bolts in the sequence shown.

• NOTE: Clean the component mating faces.

Install the RH bank exhaust camshaft end bearing caps.

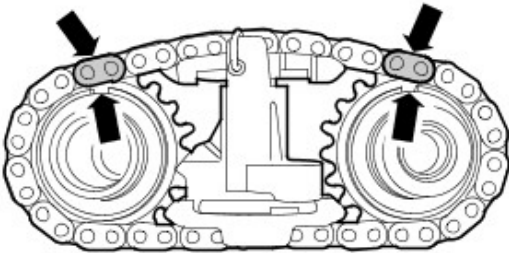
- Stage 1: Tighten to 1 Nm (1 lb.ft).
- Stage 2: Tighten to 5 Nm (4 lb.ft).
- Stage 3: Tighten to 10 Nm (7 lb.ft).



E55065


29. Release the RH bank secondary timing chain tensioner piston.

- Remove the locking pin.



E55062

30. Install the secondary timing chain to the LH bank camshafts.

31.  CAUTION: Do not release the secondary timing chain tensioner locking pin until all of the camshaft bearing caps have been installed.

Install the LH bank secondary timing chain tensioner.

- Align the marks on the camshafts with the marks on the secondary timing chain.

32. NOTE: Clean the components.

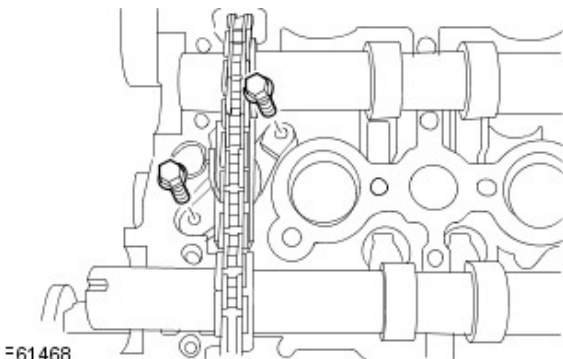
• NOTE: Install new seals.

Install the LH bank camshafts and secondary timing chain tensioner assembly.

- Lubricate the journals and camshaft lobes.

33. Secure the LH bank secondary timing chain tensioner.

- Tighten the bolts to 10 Nm (7 lb.ft).



E61468

34.  **CAUTION:** Tighten the bolts evenly in 3 stages in the sequence shown.

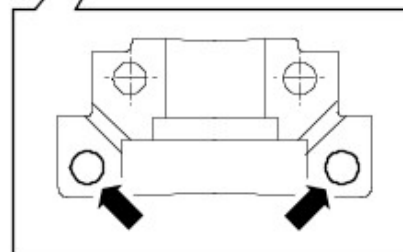
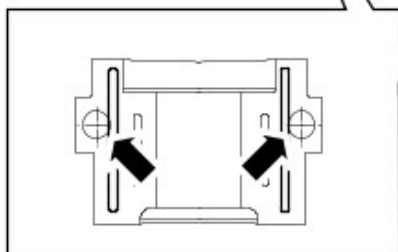
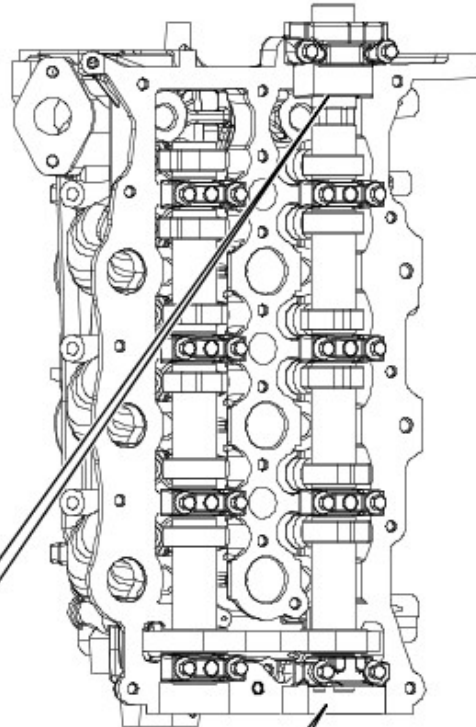
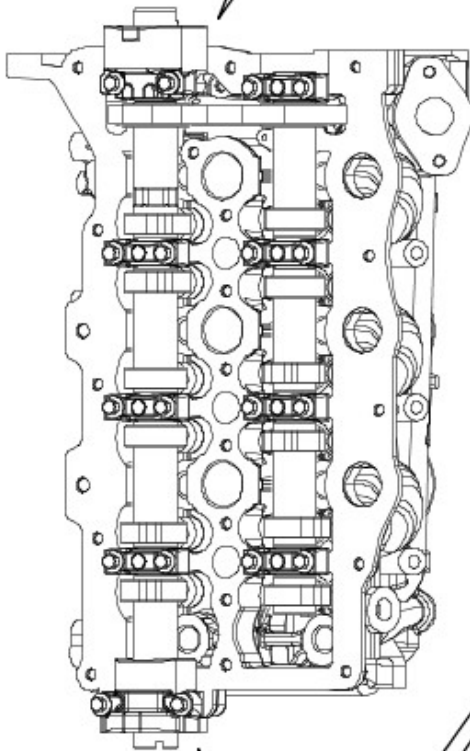
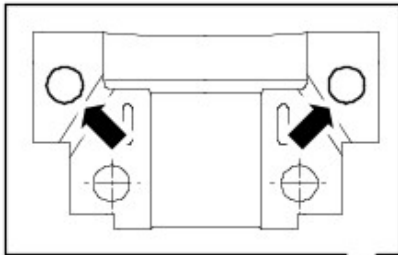
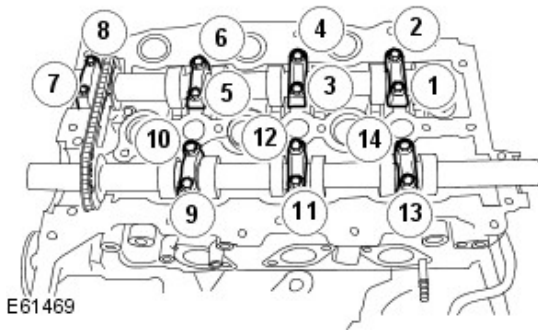
• **NOTE:** Do not install the two exhaust camshaft end bearing caps at this stage.

• **NOTE:** Clean the component mating faces.

Install the LH bank camshaft bearing caps.

- Stage 1: Tighten to 1 Nm (1 lb.ft).
- Stage 2: Tighten to 5 Nm (4 lb.ft).
- Stage 3: Tighten to 10 Nm (7 lb.ft).

35. Apply sealant to the 2 LH exhaust camshaft end bearing caps at the positions shown.

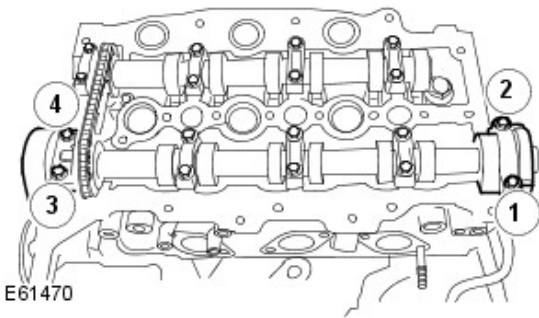


36.  CAUTION: Tighten the bolts in the sequence shown.

• NOTE: Clean the component mating faces.

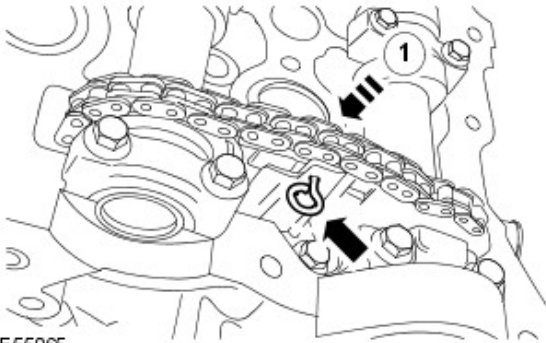
Install the LH bank exhaust camshaft end bearing caps.

- Stage 1: Tighten the bolt to 1 Nm (1 lb.ft).
- Stage 2: Tighten the bolt to 5 Nm (4 lb.ft).
- Stage 3: Tighten the bolt to 10 Nm (7 lb.ft).



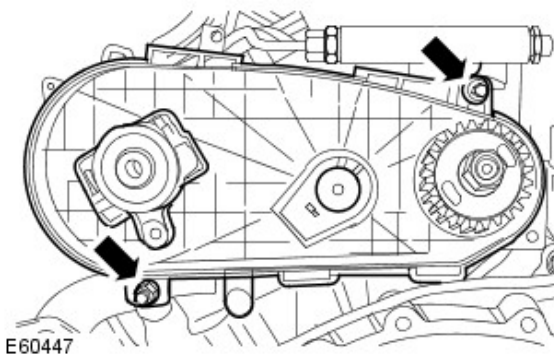
37. Release the LH bank secondary timing chain tensioner piston.

- Remove the locking pin.



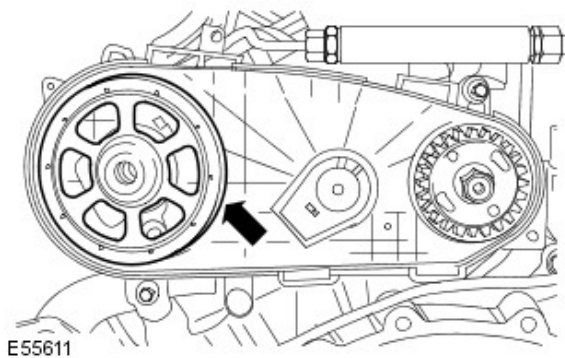
38. Install the fuel injection pump belt rear cover.

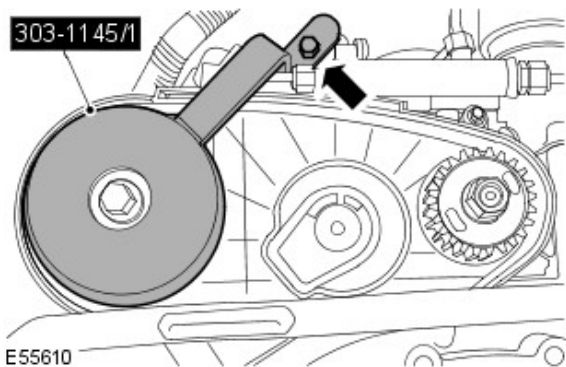
- Tighten the bolts to 10 Nm (7 lb.ft).



39. Install the camshaft rear pulley.

- Install a new camshaft pulley bolt.





40. Install the special tool to the camshaft rear pulley.

- Install and tighten the bolt.

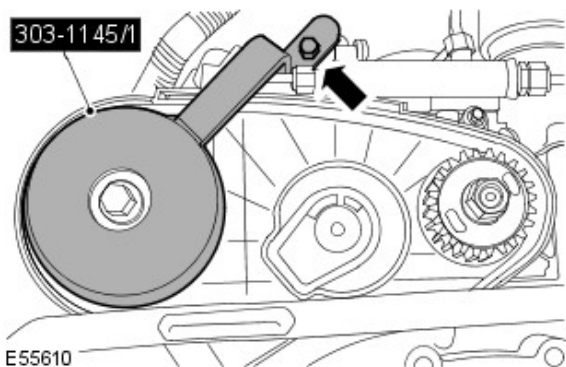
41.  CAUTION: Tighten the bolts in the stages shown.


Secure the camshaft rear pulley.

- Stage 1: Tighten the bolt to 40 Nm (30 lb.ft).
- Stage 2: Tighten the bolt to 75 Nm (56 lb.ft).

42. Remove the special tools.

- Remove the bolt.




43.  CAUTION: Do not install the new fuel injection pump belt to the pulleys with the fuel pump belt tensioner installed. Failure to follow this instruction may result in damage to the fuel pump belt.

• NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Install the new fuel injection pump belt.

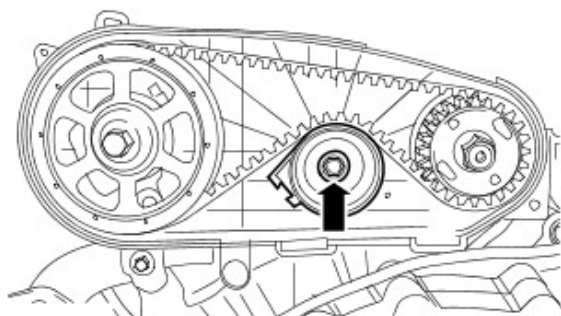
44. CAUTIONS:

 Make sure that the fuel injection pump belt tensioner locking pin is not removed until the fuel injection pump belt tensioner is fully installed.

 Make sure that the fuel injection pump belt tensioner tang is correctly located to the fuel injection pump belt rear cover. Failure to follow this instruction may result in damage to the engine.

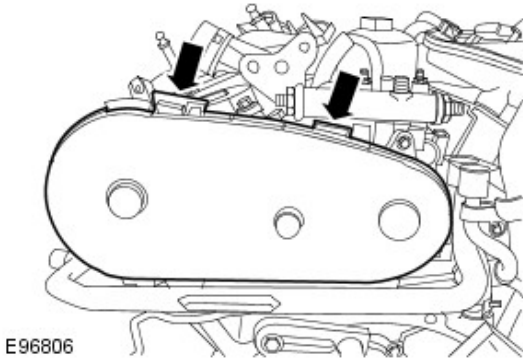
Install a new fuel injection pump belt tensioner.

- Locate the tang on the new fuel injection pump belt tensioner into the fuel injection pump rear cover.
- Tighten the bolt to 25 Nm (18 lb.ft).
- Remove and discard the fuel injection pump belt tensioner locking pin.



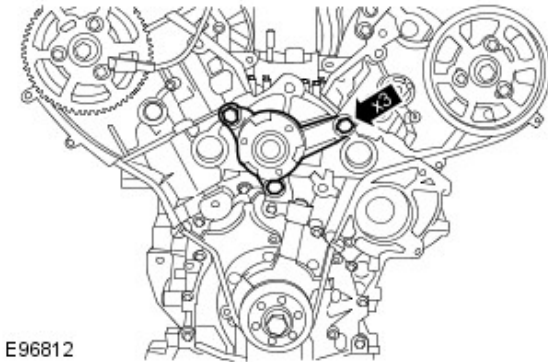
E82035


45. Install the fuel injection pump belt cover.



46. Install the cooling fan drive hub bearing.

- Tighten the bolts to 90 Nm (66 lb.ft).

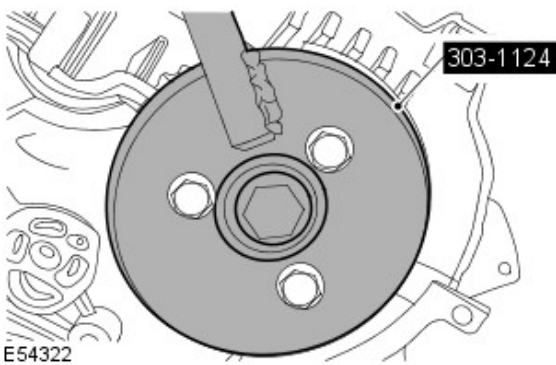


47.  CAUTION: Make sure that new bolts are installed.

- NOTE: LH is shown, RH is similar.
- NOTE: Clean the component mating faces.

Using the special tool, install the 2 camshaft pulley hubs.

- Stage 1: Tighten to 80 Nm (59 lb.ft).
- Stage 2: Tighten a further 90 degrees.

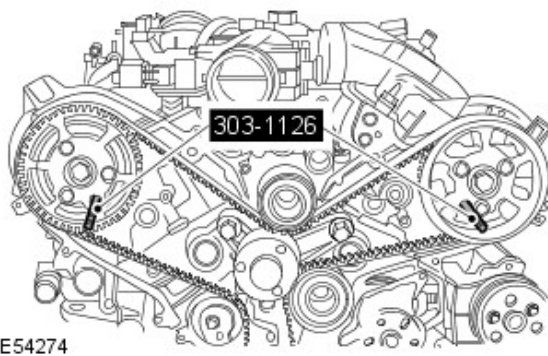


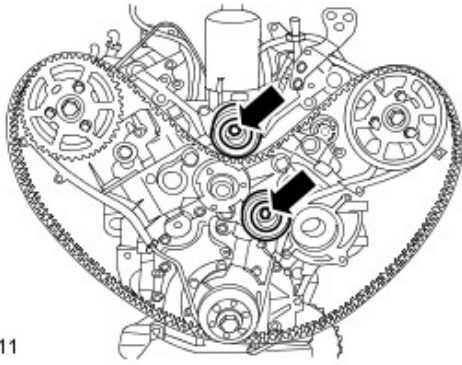
48. Install the 2 exhaust camshaft pulleys.

- Install the bolts, but do not tighten fully at this stage.

49. Install the special tools.

- Rotate the camshafts.

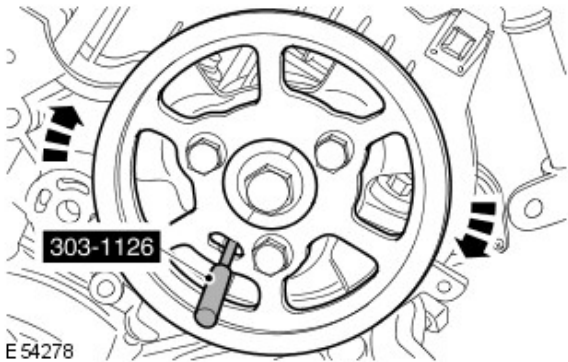




E96811

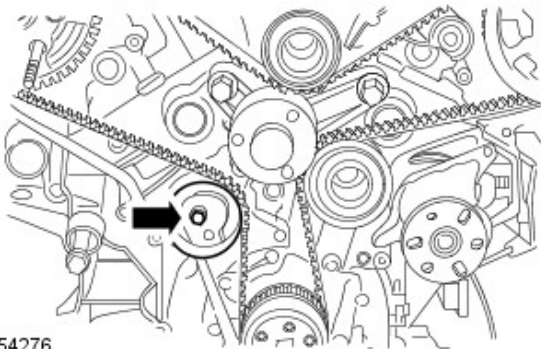
50. Install the 2 timing belt idler pulleys.

- Install the plastic shield behind the upper idler pulley.
- Tighten the bolts to 45 Nm (33 lb.ft).



E54278

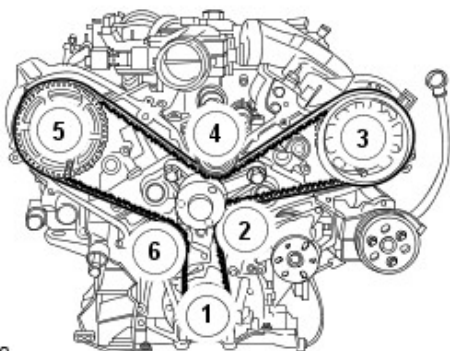
51. Rotate both camshaft pulleys clockwise.



E54276

52. Install a new timing belt tensioner.

- Install a new bolt, but do not fully tighten at this stage.

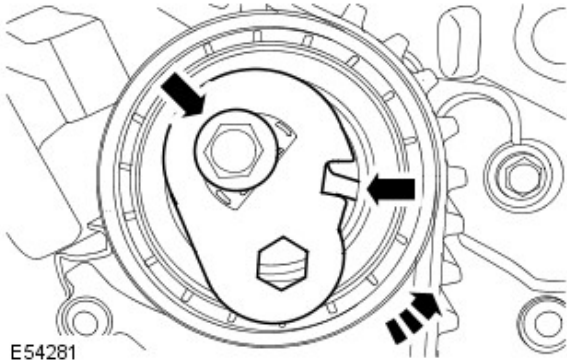


E54280

53.  **CAUTION:** Make sure the camshaft pulleys remain in the clockwise position.

Install the new timing belt.

- Starting at the crankshaft pulley, install the timing belt in a counter-clockwise direction, in the sequence shown.
- Stage 1: Attach the timing belt to the crankshaft pulley.
- Stage 2: Attach the timing belt to the idler pulley.
- Stage 3: Attach the timing belt to the left-hand camshaft pulley.
- Stage 4: Attach the timing belt to the idler pulley.
- Stage 5: Attach the timing belt to the RH camshaft pulley.
- Stage 6: Attach the timing belt to the timing belt tensioner.

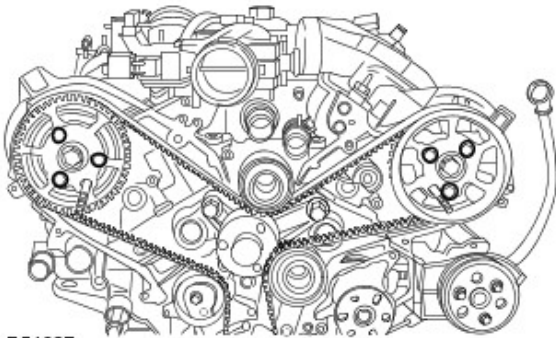


E54281


54.  CAUTION: Make sure the timing belt tensioner window is aligned with the groove.

Tension the timing belt.

- Rotate the tensioner assembly counter-clockwise.
- Tighten the bolt to 24 Nm (18 lb.ft).

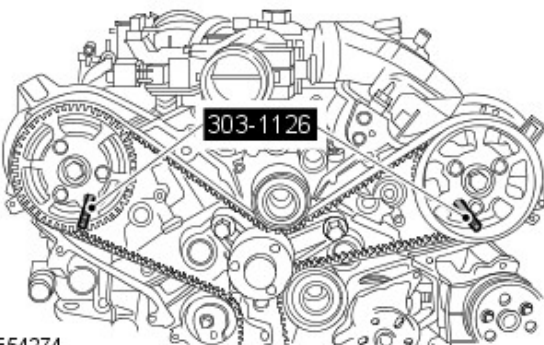


E54627

55.  CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

Secure the camshaft pulleys.

- Using a suitable tool, hold the camshaft pulley center bolts.
- Tighten the bolts to 23 Nm (17 lb.ft).



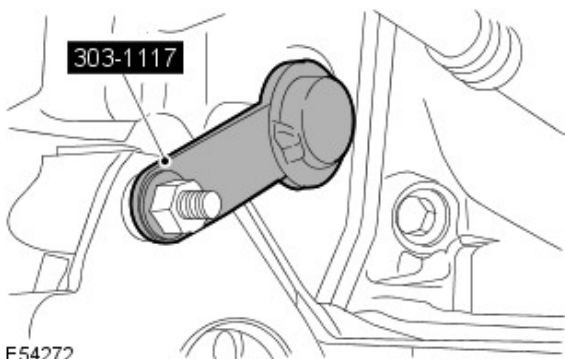
E54274

56. Remove the special tools.

Vehicles with automatic transmission

57. Remove the special tool.

- Remove the bolt.

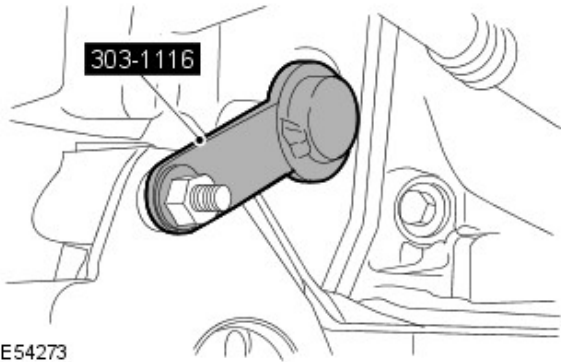


E54272

Vehicles with manual transmission

58. Remove the special tool.

- Remove the bolt.



E54273

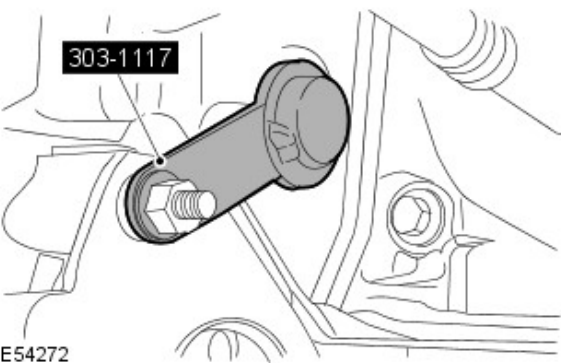
All vehicles

59. Rotate the engine two complete turns clockwise.

Vehicles with automatic transmission

60. Using the special tool, lock the flexplate.

- Install a starter motor bolt to retain the special tool.

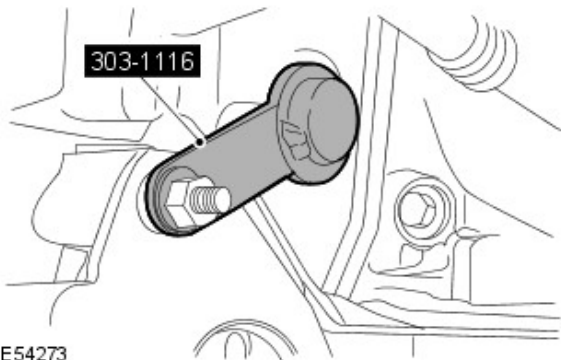


E54272

Vehicles with manual transmission

61. Using the special tool, lock the flywheel.

- Install a starter motor bolt to retain the special tool.

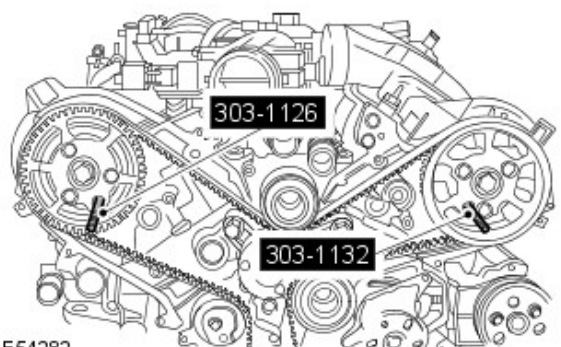


E54273

All vehicles

62. Install the special tools to the exhaust camshaft pulleys.

- If the special tool does not fit correctly, repeat the timing belt installation procedure.
- Remove the special tools from the camshaft pulleys.

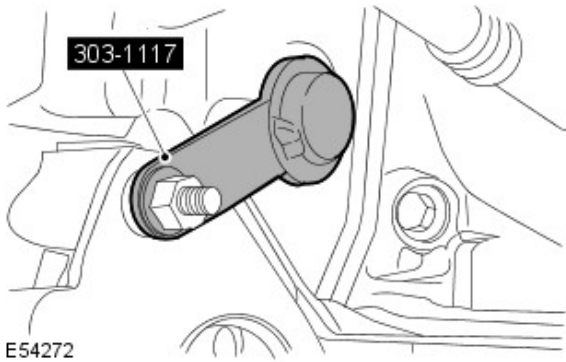


E54282

Vehicles with automatic transmission

63. Remove the special tool.

- Remove the bolt.

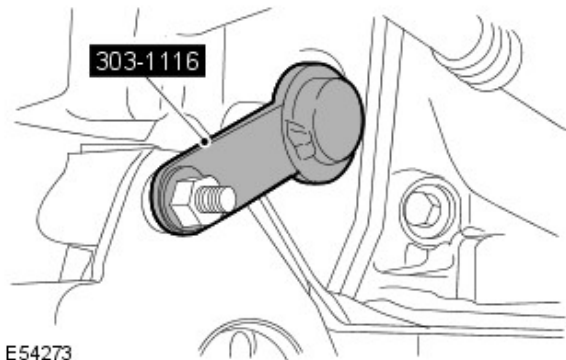


E54272

Vehicles with manual transmission

64. Remove the special tool.

- Remove the bolt.

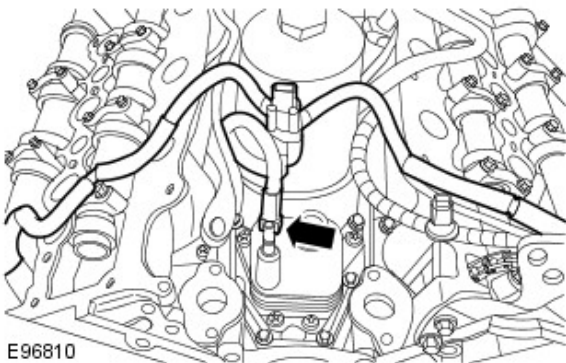


E54273

All vehicles

65. NOTE: Remove and discard the blanking caps.

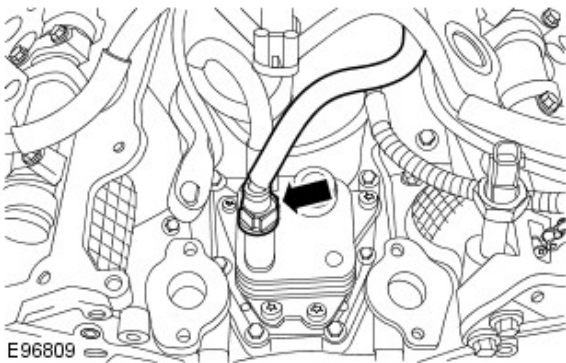
Install a new fuel injector return line.



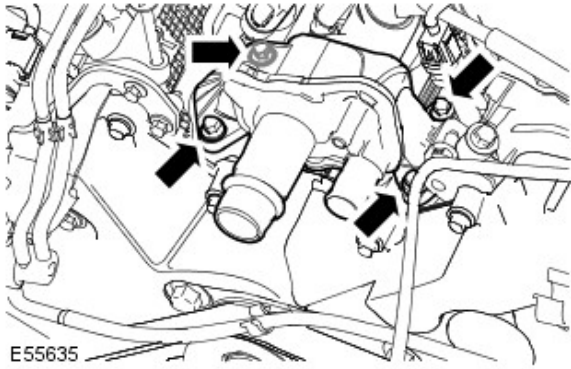
E96810

66. NOTE: Remove and discard the blanking caps.

Connect the fuel pipe to the fuel cooler.



E96809

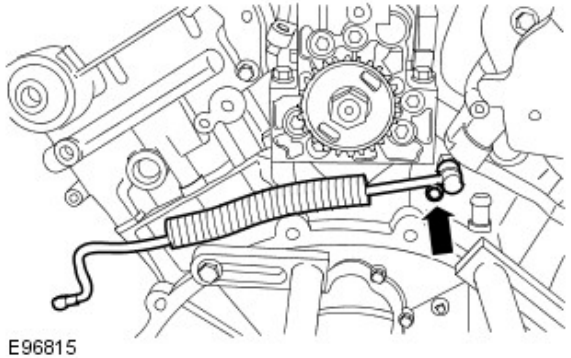


67. NOTE: Install new O-ring seals.

- NOTE: Clean the component mating faces.

Install the cylinder head coolant outlet assembly.

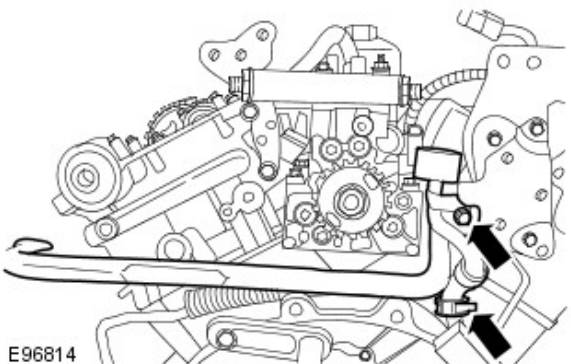
- Tighten the bolts to 10 Nm (7 lb.ft).



68. NOTE: Install new O-ring seals.

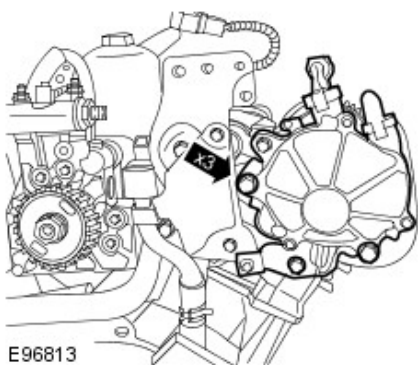
Install the turbocharger oil supply line.

- Tighten the bolts to 10 Nm (7 lb.ft).



69. Install the breather line.

- Secure the clip.
- Tighten the bolt to 10 Nm (7 lb.ft).



70. NOTE: Clean the component mating faces.

- NOTE: Install a new gasket.

Install the brake vacuum pump.

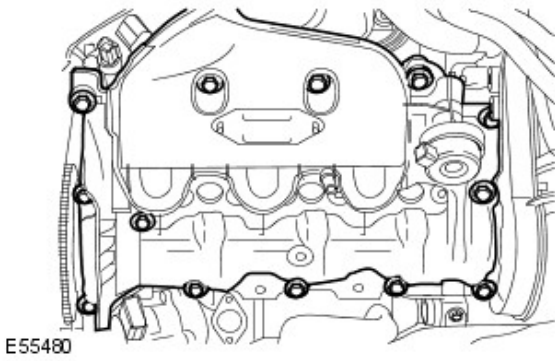
- Install the bracket.
- Tighten the bolts to 23 Nm (17 lb.ft).

71. NOTE: Clean the component mating faces.

- **NOTE:** Install a new gasket.

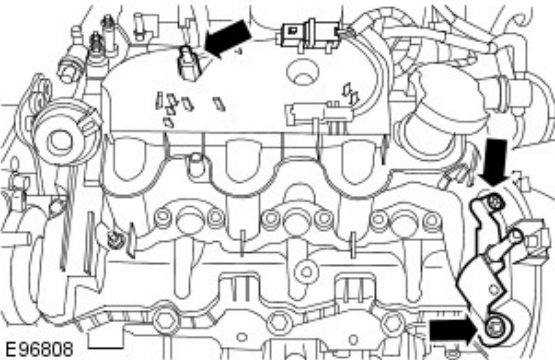
Install the RH valve cover.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Secure the glow plug electrical connector in the valve cover.
- Secure the knock sensor (KS) electrical connector in the valve cover.



72. Install the RH engine cover locating studs.

- Install the bracket.
- Tighten the nut to 10 Nm (7 lb.ft).
- Tighten the bolt to 10 Nm (7 lb.ft).

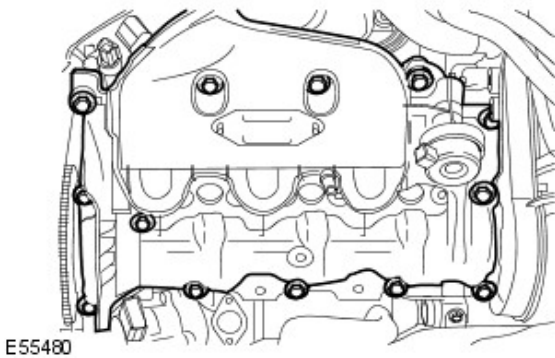


73. NOTE: Clean the component mating faces.

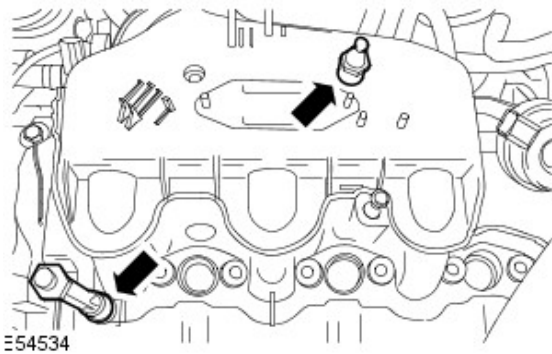
- **NOTE:** Install anew gasket.

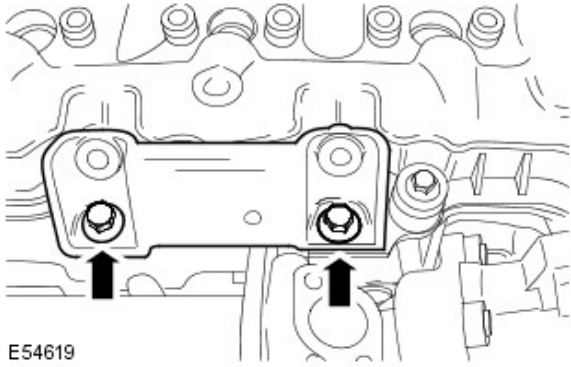
Install the LH valve cover.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Secure the KS electrical connector in the valve cover.



74. Install the LH engine cover locating studs.

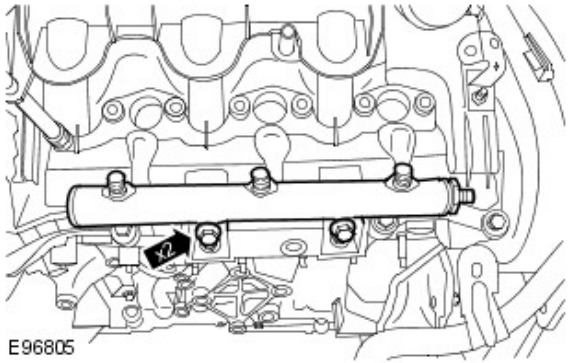




E54619

75. Install the fuel rail brackets.

- Tighten the bolts to 23 Nm (17 lb.ft).



E96805

76. Install the fuel rails.

- Install the bolts, but do not tighten fully at this stage.

Vehicles built up to 12/2007

77. NOTE: Remove and discard the blanking caps.

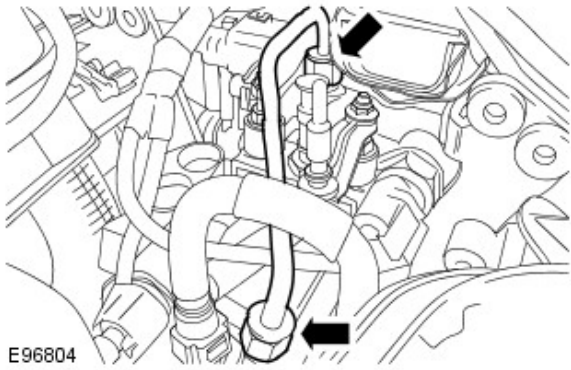
Install the new RH fuel rail high-pressure supply line.

- Tighten the fuel injection supply manifold retaining bolts to 23 Nm (17 lb.ft).
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 30 Nm (22 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel rail to 30 Nm (22 lb.ft).
- Secure the clip.

78. NOTE: Remove and discard the blanking caps.

Install the new LH fuel rail high-pressure supply line.

- Tighten the fuel injection supply manifold retaining bolts to 23 Nm (17 lb.ft).
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 30 Nm (22 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel rail to 15 Nm (11 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel rail to 30 Nm (22 lb.ft).
- Secure the clip.



E96804

79. NOTE: Remove and discard the blanking caps.

Install the new fuel diverter rail high-pressure supply line.

- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection pump to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection pump to 30 Nm (22 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 30 Nm (22 lb.ft).

Vehicles built 01/2007 onwards

80. NOTE: Remove and discard the blanking caps.

Install the new RH fuel rail high-pressure supply line.

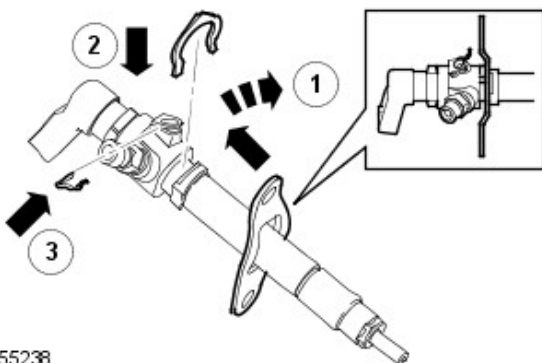
- Tighten the fuel injection supply manifold retaining bolts to 23 Nm (17 lb.ft).
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection pump to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection pump to 30 Nm (22 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel rail to 30 Nm (22 lb.ft).
- Secure the clip.

81. NOTE: Remove and discard the blanking caps.

Install the new LH fuel rail high-pressure supply line.

- Tighten the fuel injection supply manifold retaining bolts to 23 Nm (17 lb.ft).
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection pump to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection pump to 30 Nm (22 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel rail to 30 Nm (22 lb.ft).
- Secure the clip.

All vehicles



E55238

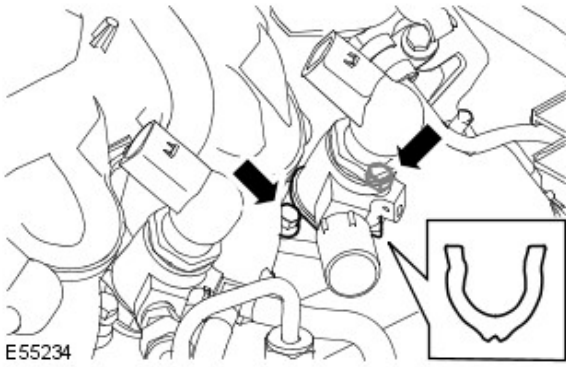
82. CAUTIONS:

⚠ Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

⚠ Do not use tools to install the new fuel return line retaining clip. Failure to follow this instruction will result in damage to the retaining clip.

Install a new fuel injector clamp.

- 1. Install the fuel injector retaining clamp spacer.
- 2. Install a new fuel return line retaining clip.
- 3. Install a new sealing washer.




E55234


83. Install the fuel injector.


- Tighten the bolts to 10 Nm (7 lb.ft).

84. Install the remaining fuel injectors.

85. CAUTIONS:

 Do not allow the unions to hit the olive ends of the high-pressure fuel supply line as this may damage the ends of the line and allow foreign matter to enter the fuel injection system.

 Maintain pressure on the high-pressure fuel supply lines to keep the olives in contact with the fuel injectors and the fuel rail cones while installing the unions.

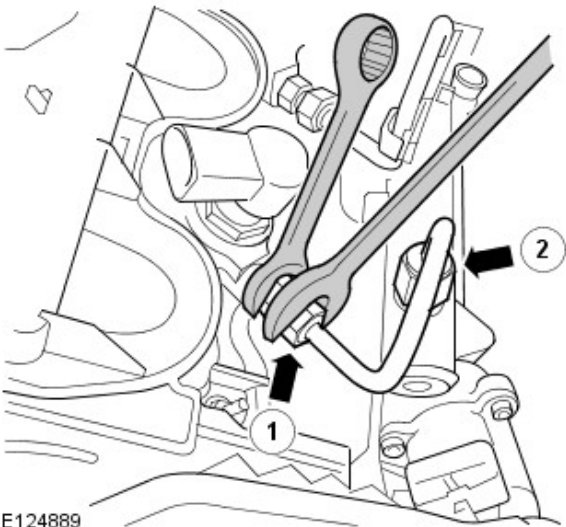
 Do not use any aggressive cleaning fluid or a wire brush to clean the fluid injector nozzle.

• NOTE: Remove and discard the blanking caps.


Install new high-pressure fuel supply lines.

1. Install the new high-pressure fuel supply line, tighten the fuel supply line unions finger tight.

- Tighten the high-pressure fuel supply line in the sequence shown:
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 15 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 15 Nm.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 30 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 30 Nm.

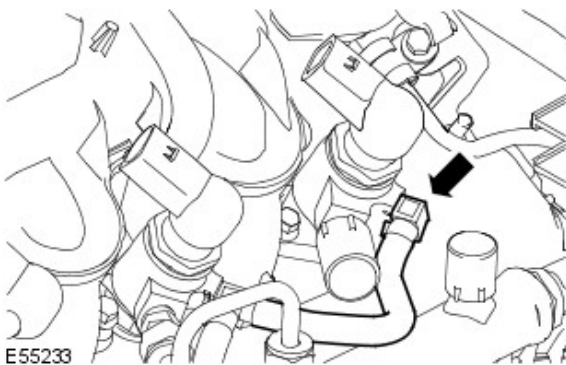


E124889

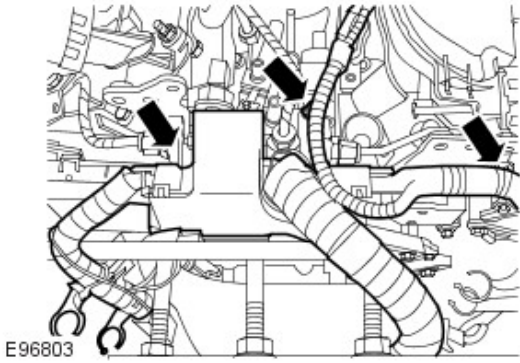
86.  CAUTION: Make sure the fuel return line retaining clip is correctly installed to the fuel injector before installing the return line.

Connect the fuel return line to the fuel injectors.

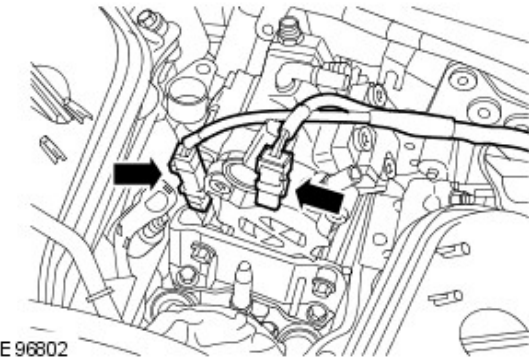
- Apply a light coating of petroleum jelly to the fuel return line O-ring seals.



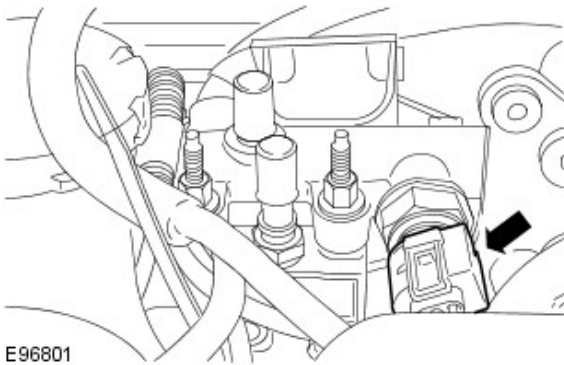
E55233



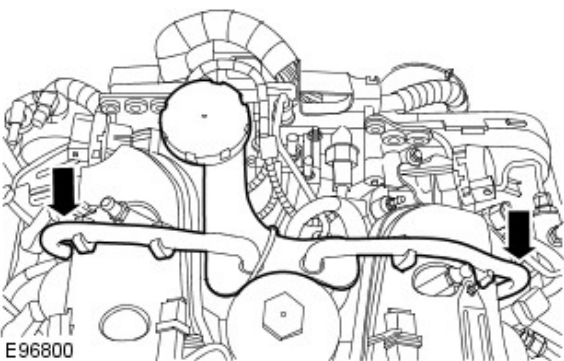
- 87.** Install the engine wiring harness.
- Tighten the nut to 10 Nm (7 lb.ft).
 - Secure the clips.



- 88.** Connect the fuel injection pump electrical connectors.

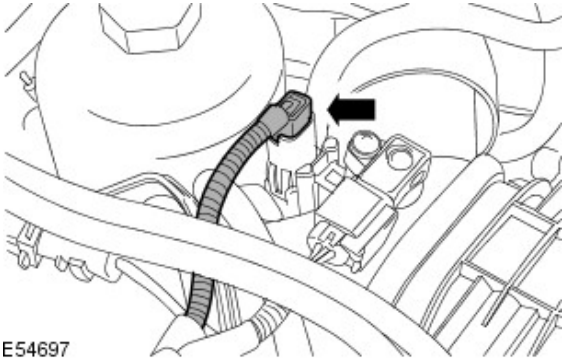


- 89.** Connect the fuel rail pressure (FRP) sensor electrical connector.



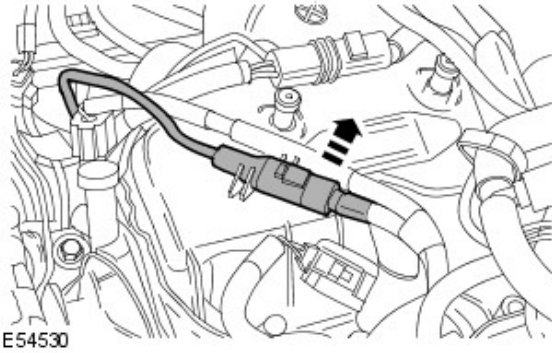
- 90.** Install the crankcase vent oil separator.
- Connect and secure the 2 breather hoses.

91. Connect the fuel temperature sensor electrical connector.



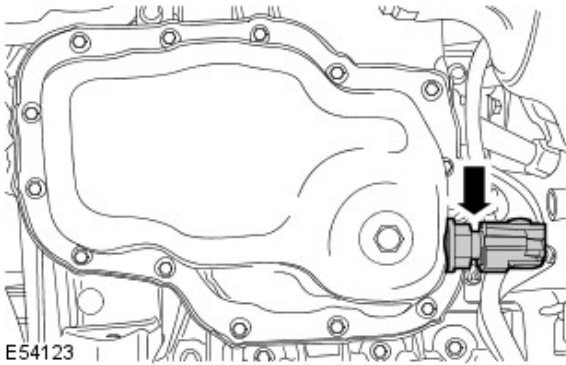
92. NOTE: LH shown, RH is similar.

Connect the 2 KS electrical connectors.



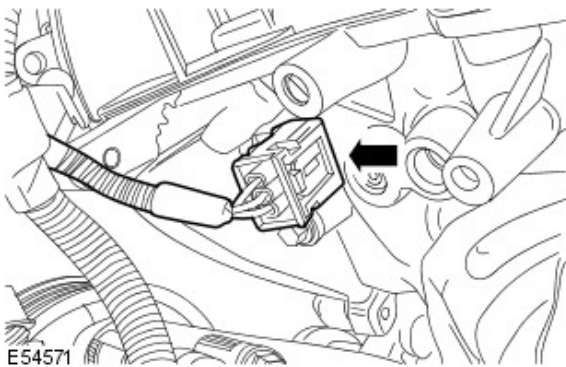
93. Connect the engine oil temperature sensor electrical connector.

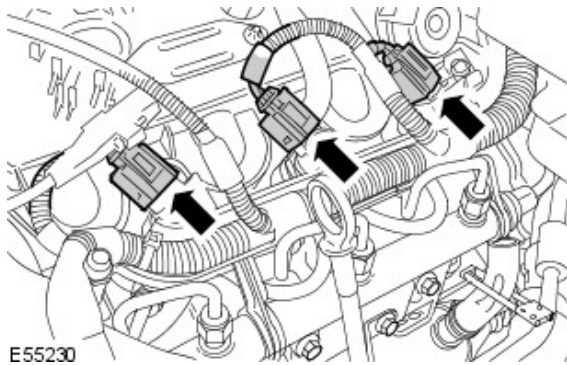
- Secure the wiring harness clip.



94. Connect the camshaft position (CMP) sensor electrical connector.

- Secure the wiring harness clip.

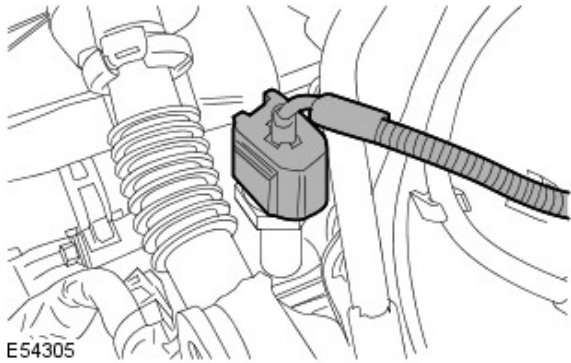




95. NOTE: RH shown, LH is similar

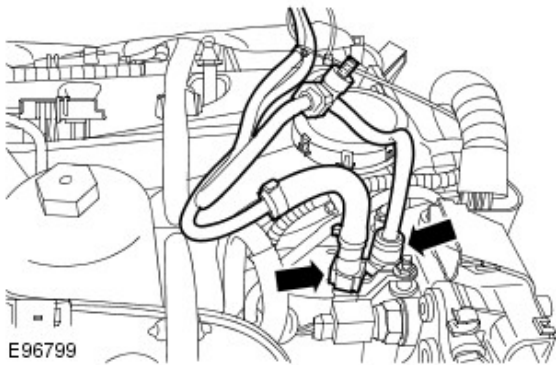
Connect the 6 fuel injector electrical connectors.

- Secure the 4 wiring harness clips.

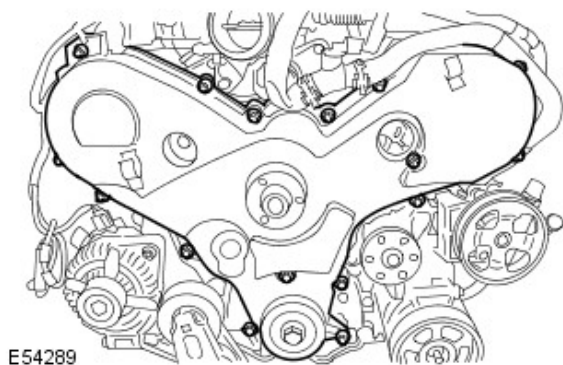


96. Connect the engine oil pressure (EOP) sensor electrical connector.

- Secure the wiring harness clip.

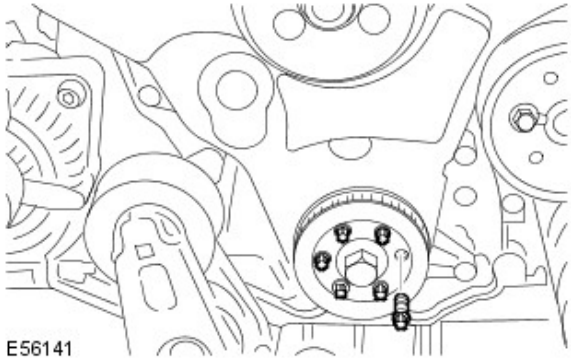


97. Install the 2 low pressure fuel pipes.



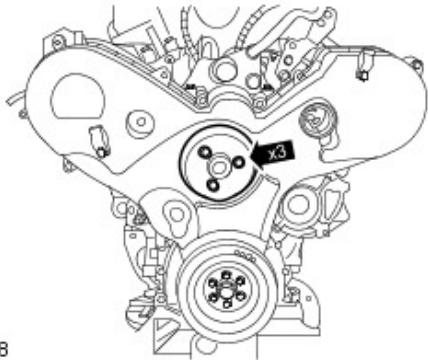
98. Install the timing belt cover.

- Tighten the bolts to 10 Nm (7 lb.ft).



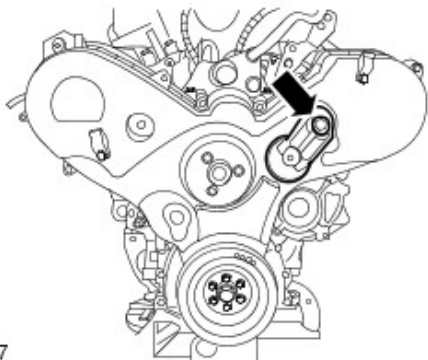
99. Install the crankshaft pulley.

- Tighten the bolts to 14 Nm (10 lb.ft).



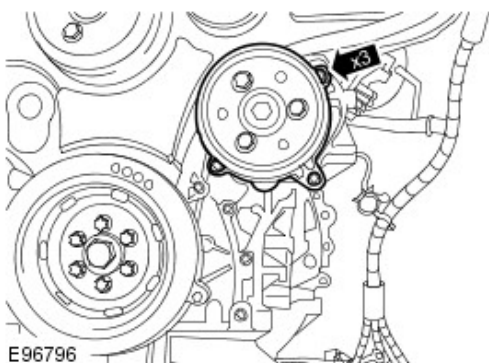
100. Install the cooling fan pulley.

- Tighten the bolts to 23 Nm (17 lb.ft).



101. Install the accessory drive belt idler.

- Tighten the bolt to 47 Nm (35 lb.ft).

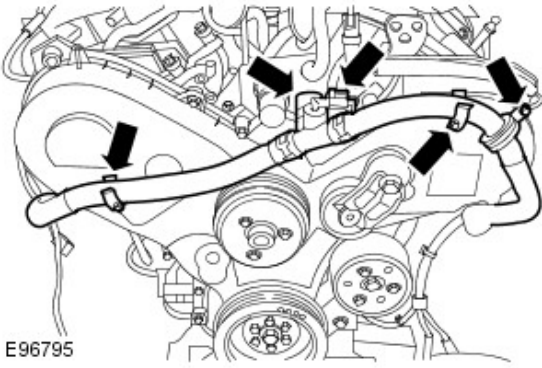


102. NOTE: Clean the component mating faces.

- NOTE: Install a new O-ring seal.

Install the coolant pump.

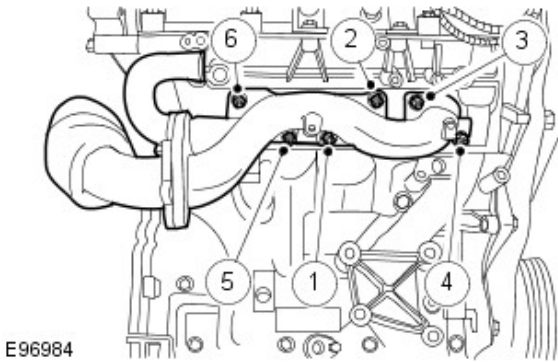
- Tighten the bolts to 10 Nm (7 lb.ft).



E96795

103. Install the exhaust gas recirculation (EGR) valve coolant pipe.

- Install the bolt.
- Connect the electrical connector.
- Secure in the 2 clips.
- Secure the clip.



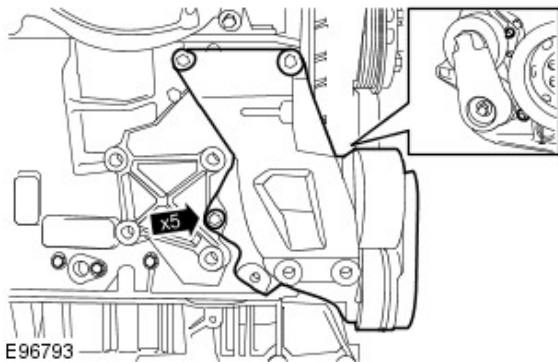
E96984

104.  CAUTION: Make sure that new nuts are installed.

- NOTE: Tighten the nuts in the sequence shown.
- NOTE: Install a new gasket.

Install the RH exhaust manifold and exhaust cross-over pipe assembly.

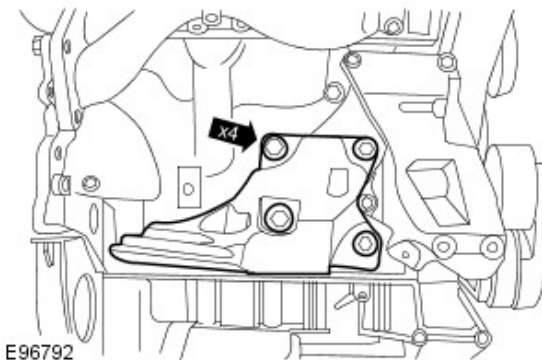
- Tighten the nuts to 24 Nm (18 lb.ft).



E96793

105. Install the generator bracket.

- Tighten the bolts to 23 Nm (17 lb.ft).



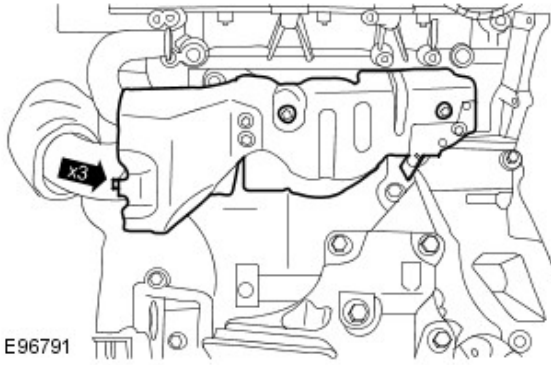
E96792

106. Install the RH engine mount bracket.

- Tighten the bolts to 110 Nm (81 lb.ft).

107. Install the RH exhaust manifold heat shield.

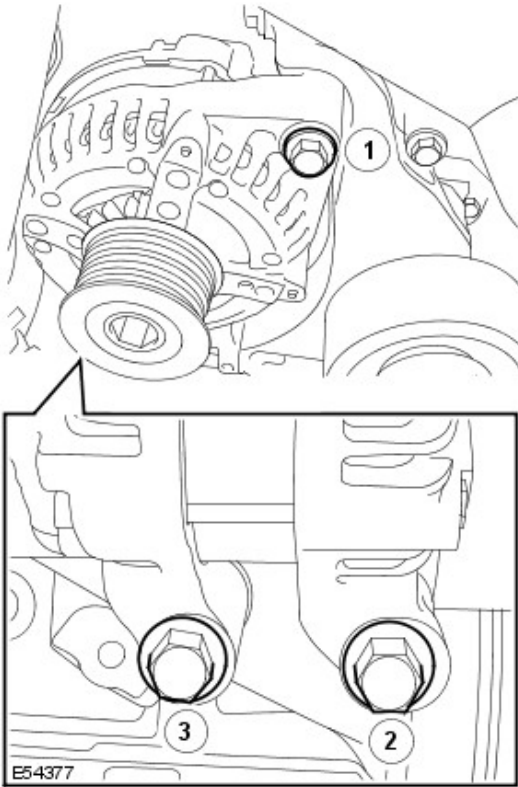
- Tighten the bolts to 10 Nm (7 lb.ft).



108.  CAUTION: Tighten the bolts in the sequence shown.

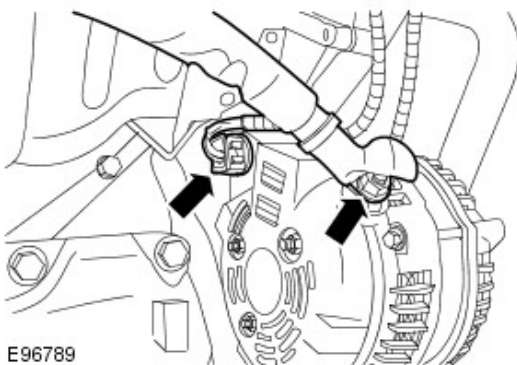
Install the generator.

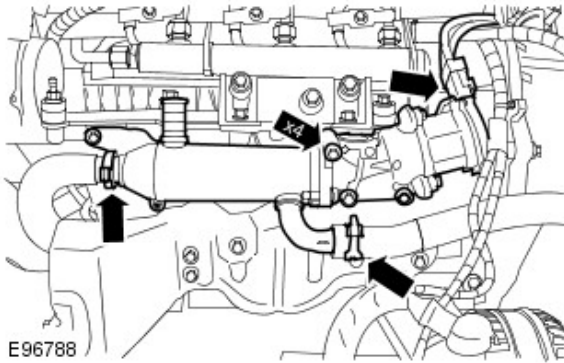
- Tighten the bolts to 47 Nm (35 lb.ft).



109. Connect the generator electrical connectors.

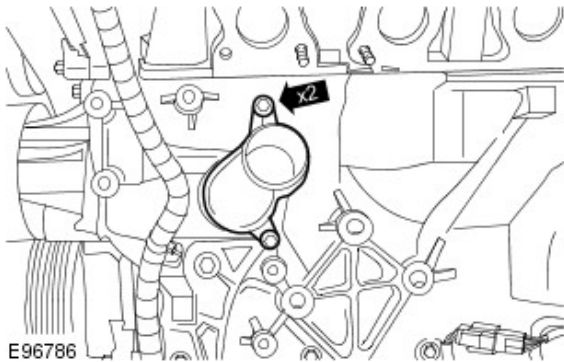
- Tighten the nut to 12 Nm (9 lb.ft).
- Reposition the rubber insulator.





110. Install the RH EGR valve and cooler assembly.

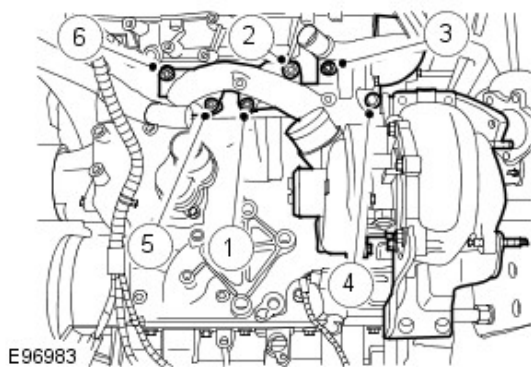
- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect the coolant hose and secure with the clip.
- Connect the electrical connector.
- Install and secure the new clip.



111. NOTE: Install a new O-ring seal.

Install the cylinder block coolant inlet pipe.

- Tighten the bolts to 10 Nm (7 lb.ft).

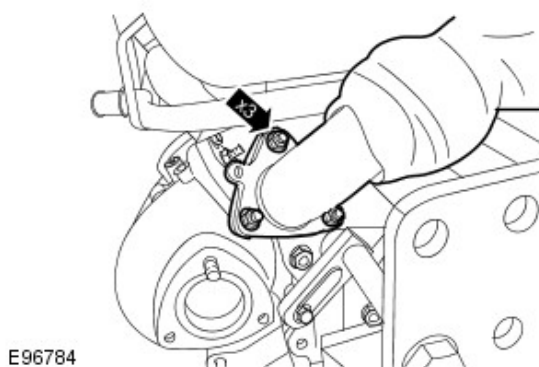


112.  **WARNING:** Make sure that new nuts are installed.

- NOTE: Tighten the nuts in the sequence shown.
- NOTE: Install a new gasket.

Install the LH exhaust manifold and turbocharger assembly.

- Tighten the nuts to 24 Nm (18 lb.ft).

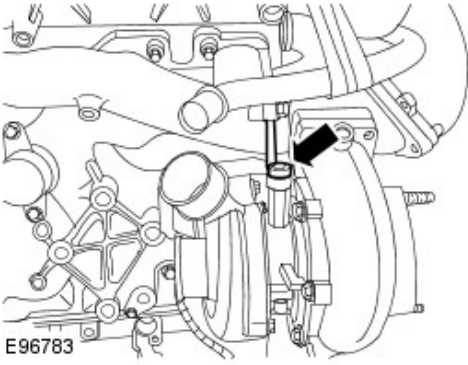


113.  **CAUTION:** Make sure that new nuts are installed.

- NOTE: Install a new gasket.

Secure the exhaust cross-over pipe to the LH exhaust manifold.

- Tighten the nuts to 24 Nm (18 lb.ft).

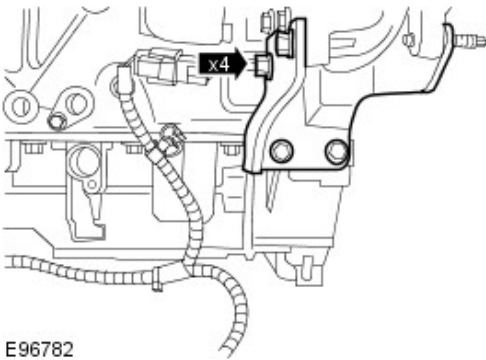


114. NOTE: Remove and discard the blanking caps.

- NOTE: Install new sealing washers.

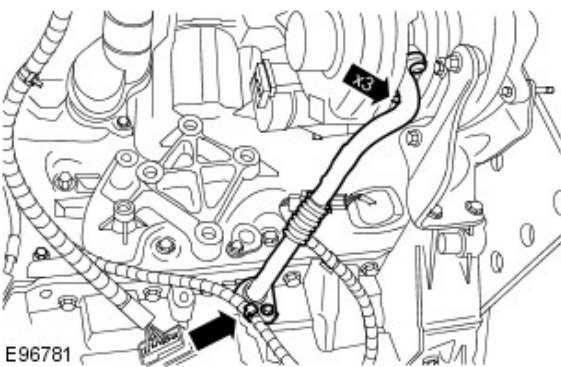
Connect the turbocharger oil supply tube.

- Tighten the banjo bolt to 30 Nm (22 lb.ft).



115. Secure the turbocharger support bracket.

- Tighten the bolts to 23 Nm (17 lb.ft).



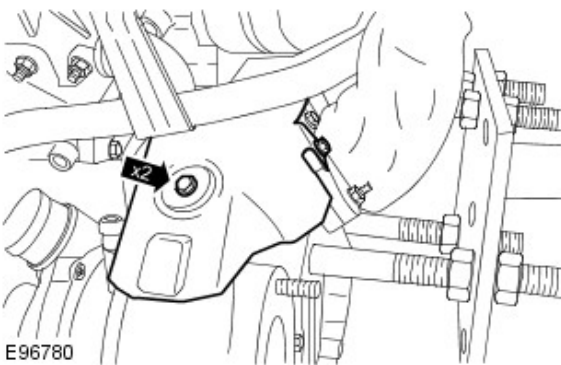
116. NOTE: Remove and discard the blanking caps.

- NOTE: Install a new O-ring seal.

- NOTE: Install a new gasket.

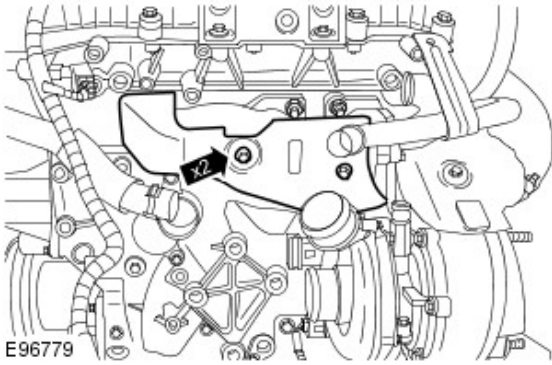
Install the turbocharger oil return tube.

- Tighten the bolts to 10 Nm (7 lb.ft).



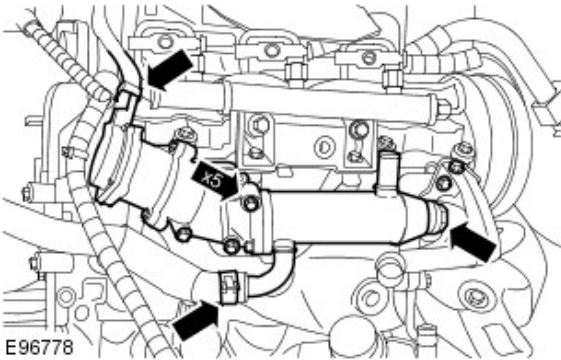
117. Install the turbocharger heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).



118. Install the LH exhaust manifold heat shield.

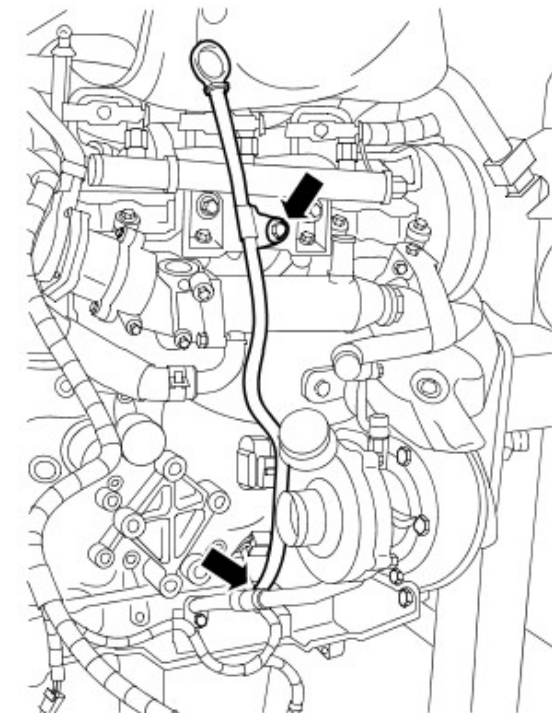
- Tighten the bolts to 10 Nm (7 lb.ft).



119. NOTE: Install a new clip.

Install the LH EGR valve and cooler assembly.

- Install the support bracket.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect the coolant hose and secure with the clip.
- Connect the electrical connector.
- Install and secure the clip.

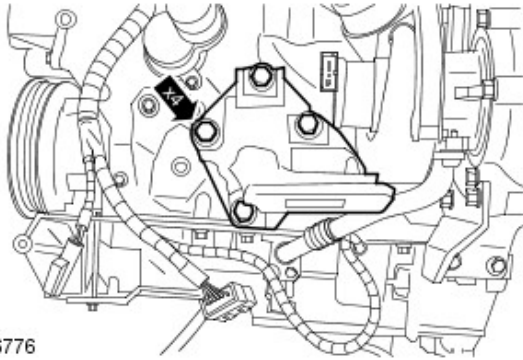


120. NOTE: Remove and discard the blanking caps.

• NOTE: Install a new O-ring seal.

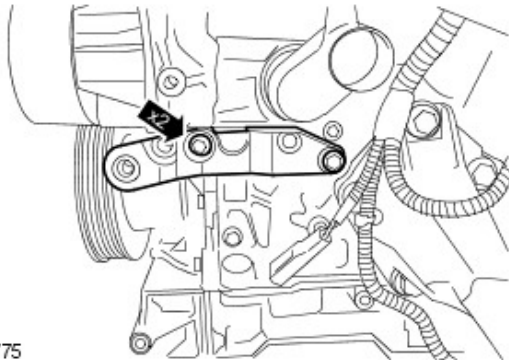
Install the oil level indicator and tube.

- Tighten the bolt to 10 Nm (7 Lb.ft).
- Secure the wiring harness clip.



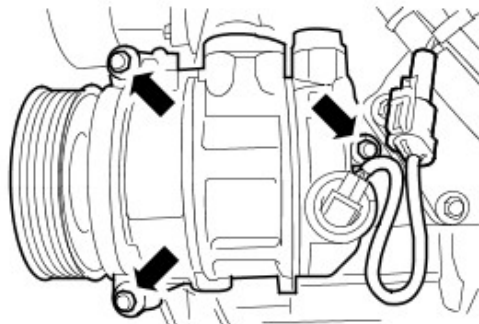
E96776

121. Install the LH engine mount bracket.
- Tighten the bolts to 110 Nm (81 lb.ft).



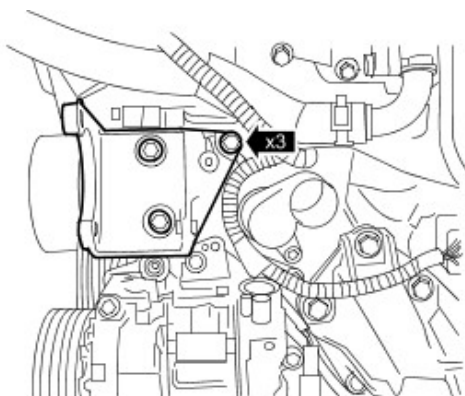
E96775

122. Install the air conditioning (A/C) compressor bracket.
- Tighten the bolts to 23 Nm (17 lb.ft).



E96774

123. Install the A/C compressor.
- Tighten the bolts to 23 Nm (17 lb.ft).
 - Connect the electrical connector.



E96773

124. Install the power steering pump bracket.
- Tighten the bolts to 23 Nm (17 lb.ft).

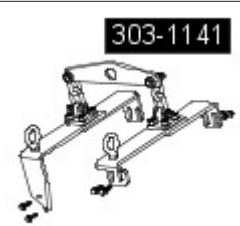
125. Remove the engine from the engine stand.

126. Install the engine.
 For additional information, refer to: [Engine - Vehicles With: 6HP28 6-Speed Automatic Transmission/6HP26 6-Speed Automatic Transmission](#) (303-01A Engine - TDV6 2.7L Diesel, Installation) / [Engine - Vehicles With: Manual Transmission \(303-01 Engine - 2.7L V6 - TdV6, Installation\)](#).

127. Fill the engine with the recommended oil to the correct level.
 For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures).

Engine - TDV6 2.7L Diesel - Engine Vehicles With: 6HP28 6-Speed Automatic Transmission/6HP26 6-Speed Automatic Transmission

Installation

Special Tool(s)	
 <p>303-1141</p> <p>E56716</p>	<p>Engine lifting Cradle</p> <p>303-1141</p>

Installation

1. CAUTIONS:



Apply grease of the correct specification to the torque converter spigot.



Make sure the torque converter is fully located into the oil pump drive.

With assistance, carefully install the engine.

- Clean the component mating faces.
- Carefully guide the transmission wiring harness in as the engine is being installed.
- Carefully guide the battery positive cable in as the engine is being installed.



CAUTION: Make sure the torque converter remains connected to the transmission.

Secure the engine to the transmission.

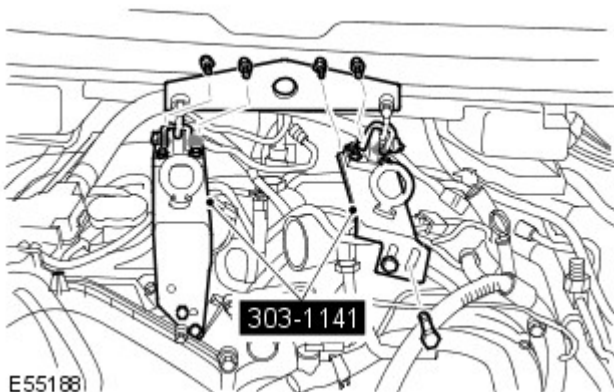
- Tighten the bolts to 45 Nm (33 lb.ft).
- Remove the jack supporting the transmission.

3. Secure both the LH and the RH engine mounts.

- Lower the engine onto its mounts.
- Tighten the nuts to 90 Nm (66 lb.ft).

4. Remove the special tool.

- Remove the bolts.



5. NOTE: Make sure that new bolts are installed.

6. Install the starter motor.

Secure the flexplate to the torque converter.

- Tighten the bolts to 48 Nm (35 lb.ft).
- Tighten the bolts to 45 Nm (33 lb.ft).

7. Connect the 2 starter motor wiring harness connectors to the starter solenoid.

- Install the cross plug.

- Tighten the solenoid terminal integral connector nut to 8 Nm (6 lb.ft).
- Tighten the battery positive cable nut to 11 Nm (8 lb.ft).
- Install the rubber insulator.

8. Install the starter motor support bracket.

- Tighten the bolts to 10 Nm (7 lb.ft).

9. Secure the engine ground cable.

- Tighten the bolt to 22 Nm (16 lb.ft).

10. Secure the fuel cooler.

- Tighten the bolt to 10 Nm (7 lb.ft).

11. NOTE: Remove and discard the blanking caps.

Connect the fuel lines.

12. Secure the fuel lines.

- Tighten the bolt to 22 Nm (16 lb.ft).
- Secure in the clips.

13. Secure the transmission breather lines.

- Tighten the bolt to 7 Nm (5 lb.ft).

14. Install the turbocharger support bracket.

- Tighten the bolts to 48 Nm (35 lb.ft).
- Tighten the nut to 22 Nm (16 lb.ft).

15. NOTE: Make sure that new nuts are installed.

• NOTE: Make sure that all the component mating faces are clean.

Secure the exhaust to the turbocharger.

- Install a new gasket.
- Tighten the nuts to 48 Nm (35 lb.ft).

16. Install the exhaust manifold crossover pipe center support bracket.

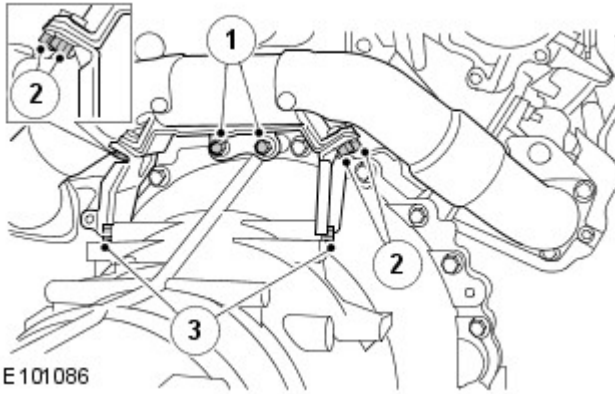
- Loosely install the 2 bolts.

17. Install the exhaust manifold crossover pipe RH support bracket.

- Loosely install the 3 bolts.

18. Install the exhaust manifold crossover pipe LH support bracket.

- Loosely install the 3 bolts.



19. Tighten the exhaust manifold crossover pipe mounting bracket bolts in the following sequence.

- Tighten the 2 bolts marked 1 to 10 Nm (7 lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 2 bolts marked 3 to 10 Nm (7lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 4 bolts marked 2 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts marked 1 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts marked 3 to 25 Nm (18 lb. ft).
- Attach the wiring harness.

20. Secure the battery positive cable.

- Secure with the clip.

21. Secure the transmission fluid lines.

- Tighten the nut to 10 Nm (7 lb.ft).

22. Install the turbocharger intake tube.

- Tighten the clip.

23. Reposition the lower coolant hose.

24. NOTE: Remove and discard the blanking caps.

Connect the A/C compressor high-pressure line.

- Install a new O-ring seal.
- Tighten the bolt to 9 Nm (7 lb.ft).

25. Install the charge air cooler inlet pipe.

26. Position the power steering pump to the power steering pump bracket.

- Loosely install the rear bolt.

27. Secure the power steering pump.

- Tighten the 3 front bolts to 22 Nm (16 lb.ft).
- Loosen the 3 front bolts by a quarter of a turn.
- Tighten the rear bolt to 22 Nm (16 lb.ft).
- Tighten the 3 front bolts to 22 Nm (16 lb.ft).

28. Connect the coolant lower hose.

- Secure with the clip.

29. Connect the charge air cooler inlet hoses.

- Tighten the clips.

30. NOTE: Remove and discard the blanking caps.

Connect the A/C compressor low-pressure pipe.

- Install a new O-ring seal.
- Tighten the bolt to 9 Nm (7 lb.ft).

31. Secure the charge air cooler inlet pipe.

- Tighten the bolts to 10 Nm (7 Lb.ft).
- Tighten the nut to 10 Nm (7 lb.ft).

33. Connect the breather hose
Install the LH upper suspension arm and brake line heat shields.

- Secure with the clip.

- Tighten the bolts to 10 Nm (7 Lb.ft).
 - Tighten the nuts to 10 Nm (7 Lb.ft).
- 34.** Install the accessory drive belt.
- Rotate the accessory drive belt tensioner counter-clockwise.
- 35.** Connect the RH EGR coolant hose.
- Secure with the clip.
- 36.** Connect the upper coolant hose to the coolant distribution manifold.
- Install the clip.
- 37.** Install the intake air shutoff throttle elbow support bracket.
- Tighten the bolts to 10 Nm (7 Lb.ft).
- 38.** Install the intake air shut off valve.
For additional information, refer to: [Intake Air Shutoff Throttle](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).
- 39.** Install the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
- 40.** Install the body.
For additional information, refer to: [Body - 2.7L V6 - TdV6](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
- 41.** Install the wheels and tires.
- Tighten the wheel nuts to 140 Nm (103 lb.ft).
- 42.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 3.0L Diesel -

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (EEC) (SAE)	Maximum Engine Power (EEC) (SAE)	Compression Ratio	Bore	Stroke
60° "Vee" • 6 Cylinder • 24 Valves	2993 ccm	600 Nm at 2000 RPM	180 kW at 4000 RPM	16.1:1 ± 0.5	84	90

Engine Firing Order

Firing Order
1:4:2:5:3:6

Glow Plug

Specification
9X2Q-6M090-AC

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Engine oil (EUR)	5W/30 – WSS–M2C934–B
Engine oil (ROW)	5W/30 – WSS–M2C913–B or C
Sealant	WSE–M4G323–A5
Core plug and stub pipe retainer	WSK–M2G349–A7
Jaguar premium cooling system fluid	WSS–M97B44–D

Capacities

Description	Liters
Engine oil initial fill	6.75
Engine oil service fill with oil filter change	5.9

Cylinder Head and Valve Train

Item	Specification
Valve guide inner diameter (mm)	5.980 ± 0.010
Intake valve effective length (mm) (tip to gauge line)	94.99mm +/- 0.15
Exhaust valve effective length (mm) (tip to gauge line)	94.45mm +/-0.15
Valve stem to guide clearance intake diametrical (mm)	0.027 - 0.063
Valve stem to guide clearance exhaust diametrical (mm)	0.037 - 0.073
Valve head diameter intake (mm)	27.8mm +/-0.1
Valve head diameter exhaust (mm)	25.2mm +/-0.1
Intake valve face angle (degrees)	44 deg 52 min +/-7min30sec
Exhaust valve face angle (degrees)	44 deg 52 min +/-7min30sec
Valve stem diameter intake (mm)	5.935±0.008
Valve stem diameter exhaust (mm)	5.925±0.008
Valve spring free length (mm) - inlet	38.9mm
Valve spring free length (mm) - exhaust	38.9mm
Valve spring installed height (mm) - inlet	31.22mm
Valve spring installed height (mm) - exhaust	31.22mm
Camshaft lobe max lift intake (mm)	3.75187mm
Camshaft lobe max lift exhaust (mm)	3.80999mm
Camshaft journal to cylinder head bearing surface clearance diametrical (mm)	0.040-0.090
Camshaft journal diameter - all positions	26.015±0.015
Bearing diameter - all positions	25.950±0.010
Camshaft journal maximum run out limit (mm)	0.030mm
Camshaft journal maximum out of round (mm) - all journals	0.010mm

Cylinder Head Gasket

Identification	Gasket Thickness (mm)	Piston Protrusion (mm)
2	1.17	0.552 - 0.603
3	1.22	0.604 - 0.655
4	1.27	0.656 - 0.707
5	1.32	0.708 - 0.760

Torque Specification

- NOTE: A = refer to procedure for correct torque sequence

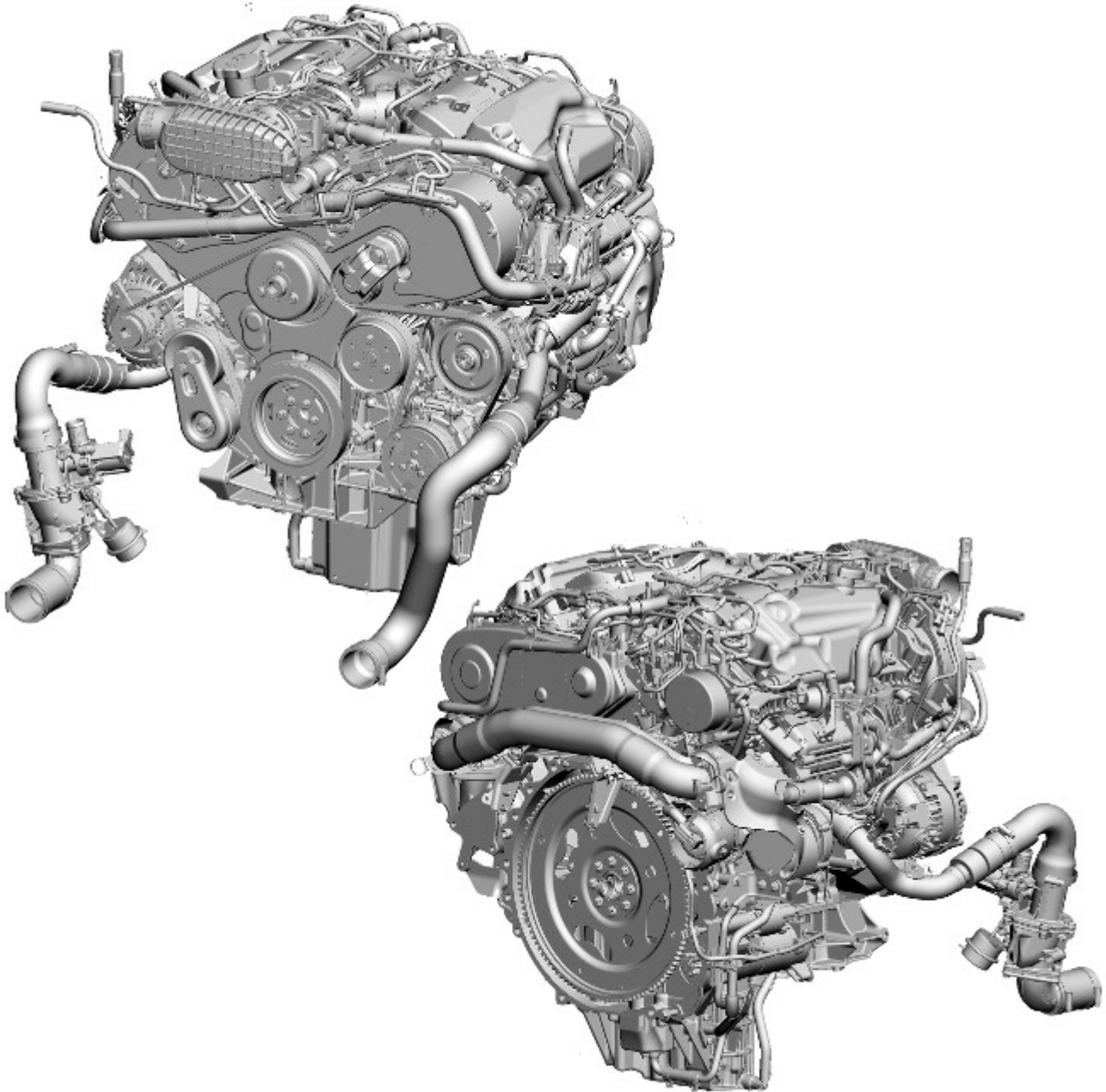
Description	Nm	lb-ft	lb-in
Piston cooling nozzle	10	7	-
Engine coolant drain plug	18	13	-
Cylinder head retaining bolts	A	-	-
Oil filter housing retaining bolts	10	7	-
Fuel injection pump cradle retaining bolts	23	17	-
Fuel injection pump to cradle retaining bolts	23	17	-
Fuel injection pump bracket to cradle retaining bolts	10	7	-
Fuel injection pump to bracket retaining bolts	10	7	-
Oil pump retaining bolts	10	7	-
Crankshaft rear oil seal housing retaining bolts	10	7	-
Oil pan retaining bolts M6	10	7	-
Oil pan retaining bolts M8	23	17	-
Oil pump pick up pipe retaining bolts	10	7	-

Description	Nm	lb-ft	lb-in
Engine oil level sensor retaining nuts	10	7	-
Crankshaft timing belt pulley retaining bolt	A	-	-
Crankshaft position sensor (CKP) retaining bolt	5	-	44
Timing chain tensioner retaining bolts	10	7	-
Camshaft bearing cap retaining bolts	A	-	-
Timing belt idler pulley retaining bolt	45	33	-
Fuel injection pump belt rear cover retaining bolts	10	7	-
Fuel injection pump sprocket retaining nut	50	37	-
Coolant outlet pipe retaining bolts	10	7	-
Coolant pump retaining bolts	10	7	-
Timing belt tensioner retaining bolt	26	19	-
Engine lifting eye bolts	23	17	-
Camshaft rear end accessory drive (READ) pulley hub retaining bolt	Stage 1 - 80 Stage 2 - 80 degrees	Stage 1 - 59 Stage 2 - 80 degrees	-
Camshaft front timing pulley hub retaining bolt	80 + 80°	59 + 80 °	-
Camshaft READ pulley retaining bolt	23	17	-
Camshaft front timing pulley retaining bolt	23	17	-
Fuel injection pump timing belt tensioner bolt	23	17	-
Camshaft position sensor (CMP) retaining bolt	10	7	-
Intake manifold / camshaft cover retaining bolts	10	7	-
Brake vacuum pump retaining bolts	23	17	-
Engine oil pressure (EOP) switch	14	10	-
Glow plug	11	8	-
Fuel rail retaining bolts	23	17	-
Fuel rail bracket retaining bolts	23	17	-
Fuel injector retaining bolts	A	-	-
High pressure fuel line union nuts	A	-	-
High pressure fuel line bracket retaining bolts	9	-	80
Turbocharger assembly to exhaust manifold retaining nuts	24	18	-
Exhaust manifold to cylinder head retaining nuts	A	-	-
Exhaust manifold heatshield retaining bolts	11	8	-
Turbocharger heatshield retaining bolts	11	8	-
Exhaust gas recirculation (EGR) valve retaining bolts M6	10	7	-
Accessory drive belt idler pulley bracket retaining bolts	83	61	-
Timing belt covers retaining bolts	10	7	-
Engine mount bracket to engine retaining bolts	115	85	-
Exhaust cross over pipe retaining nuts	24	18	-
Engine coolant inlet pipe retaining bolts	10	7	-
Coolant pump pulley retaining bolts	25	18	-
Crankshaft pulley/vibration damper retaining bolts	25	18	-
Throttle body retaining threaded stud	10	7	-
Wiring harness retaining nuts	10	7	-
Vacuum hose assembly retaining bolts	10	7	-
Flexplate retaining bolts	A	-	-
Accessory drive component bracket retaining bolts	23	17	-
Power steering pump retaining bolts	23	17	-
Generator retaining bolts	47	35	-
Accessory drive belt tensioner retaining bolt	47	35	-
Accessory drive belt idler pulley retaining bolt	47	35	-
Air conditioning compressor bracket retaining bolts	23	17	-
Air conditioning compressor retaining bolts	23	17	-

Engine - TDV6 3.0L Diesel - Engine - Component Location

Description and Operation

External Views



E120969

Engine - TDV6 3.0L Diesel - Engine - Overview

Description and Operation

OVERVIEW

The 3.0 liter diesel engine is a V6 configuration unit with 2 banks of 3 cylinders arranged at 60 degrees to each other. There are 4 valves per cylinder, which are operated by 2 overhead camshafts per cylinder bank.

The cylinder block is cast in compacted graphite iron, which uses less material to produce compared to a conventional cast iron block. This provides reduced weight and length with superior structural capabilities.

The cylinder heads are cast aluminum with a moulded plastic camshaft cover with an integral air intake. The single-piece structural oil pan is high pressure die cast from aluminum. The exhaust manifolds are cast from an iron alloy. A moulded plastic acoustic cover is fitted over the upper engine to absorb engine-generated noise.

A low compression ratio of 16:1 contributes to improved emissions quality, quieter combustion and compatibility with the engine's unique forced induction system. For additional information refer to Intake Air distribution and Filtering.

The low compression ratio also means less heat build-up in the piston bowl and more efficient fuel burn, resulting in the production of lower levels of pollutants. It also assists with cold starting allowing a faster cranking speed.

The engine is available in two power output forms. The power difference is achieved by changes to the engine calibration within the [ECM \(engine control module\)](#) and other vehicle control modules.

- NOTE: It is not possible to re-configure a lower power output engine to the higher output specification.

Engine - TDV6 3.0L Diesel - Engine - System Operation and Component Description

Description and Operation

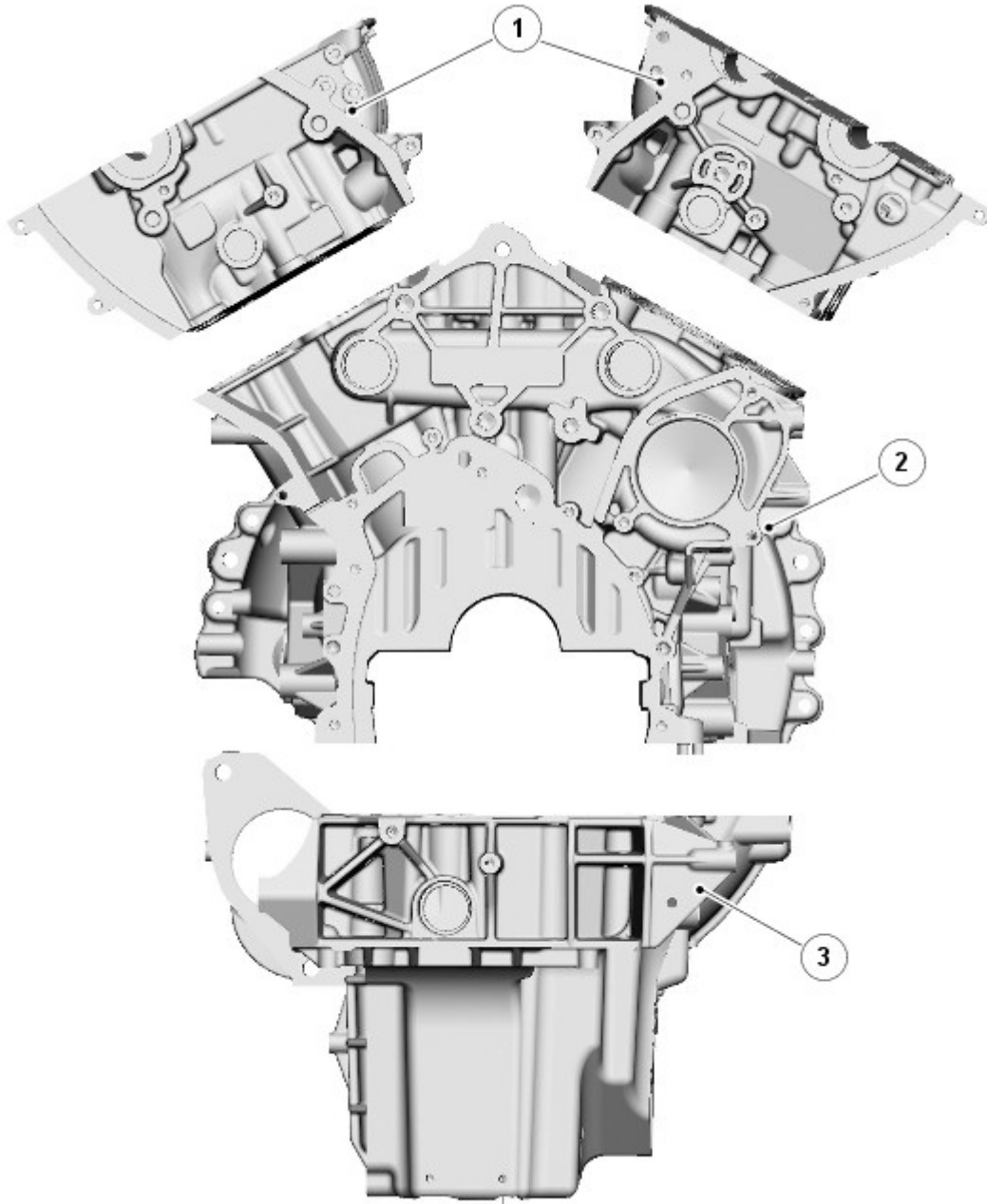
System Operation

OPERATION

Operation of the engine is controlled by the [ECM \(engine control module\)](#). For additional information refer to 303-14A Electronic Engine Controls.

Component Description

ENGINE STRUCTURE



E120983

ItemDescription

- | | |
|---|----------------|
| 1 | Cylinder heads |
| 2 | Cylinder block |
| 3 | Oil pan |

CYLINDER BLOCK COMPONENTS

The cylinder block is a single cast construction with a hollow beam structure, cast from compact graphite iron. This type of construction provides outstanding strength and durability and uses less material than a conventional cast iron block, therefore reducing engine weight and length.

The use of compact graphite iron allows the cross sectional areas of the casting to be reduced, compared with a conventional gray cast iron block. This ensures reduced engine weight and length, with higher structural capabilities.

To maintain the stiffness of the bottom end of the cylinder block and crankshaft system, the cylinder block has a deep skirt and bearing cap design. Each of the main bearing caps is double bolted at each side of the crankshaft bearing and cross bolted back to the cylinder block.

Lubrication oil is distributed through the cylinder block, via a main oil gallery and channels bored in the block, to all critical moving parts. These channels divert oil to the main and connecting rod bearings via holes machined into the crankshaft.

A tapping at the rear of the cylinder block connects a pipe to the turbochargers by means of banjo connections. Oil is supplied, under pressure via this tapping, from the oil pump to provide lubrication for the bearings of the turbochargers.

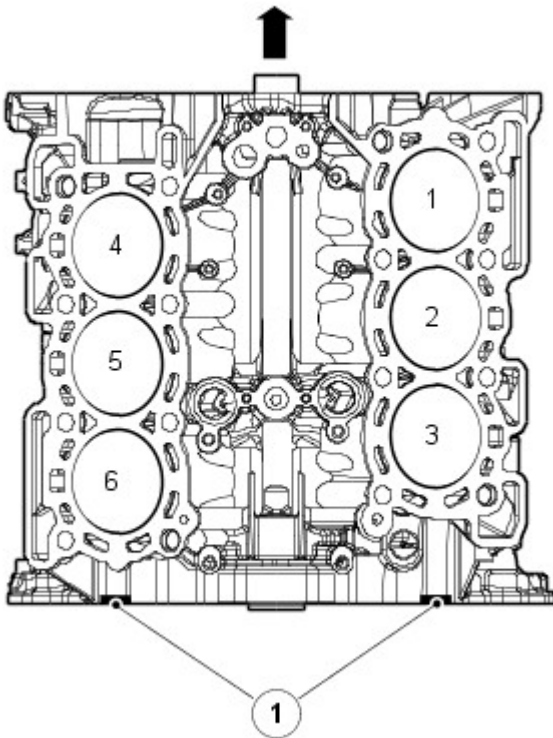
Cylinder cooling is achieved by coolant circulating through chambers in the cylinder block casting.

Two hollow metal dowels are used to locate the cylinder heads to the cylinder block, 1 on each side at the rear of the unit.

A port is included at the **RH (right-hand)** and **LH (left-hand)** side of the cylinder block, below each of the turbochargers, to connect the turbochargers oil return pipe to the oil pan.

Two coolant drain plugs are installed in the cylinder block; one is fitted in the rear **RH** side, and the other is fitted in the middle of the cylinder block on the **LH** side.

Engine Data



E44217

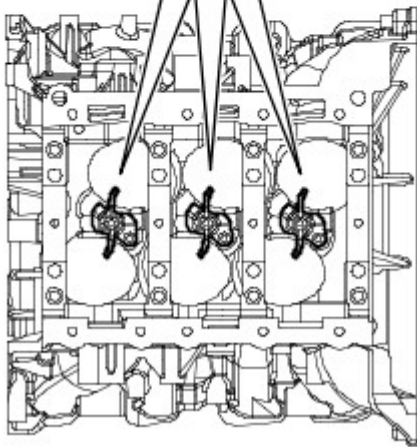
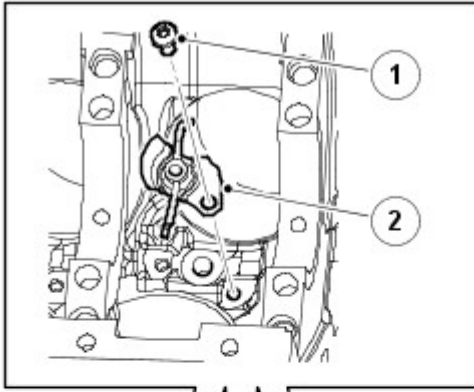
NOTE: Arrow indicates front of engine

ItemDescription

1 Engine data locations

Engine data is marked at 2 locations at the back of the cylinder block. Component diameters are represented by alphabetical and numerical codes; keys to the codes are in the removal and installation section of this manual.

Piston Cooling Jets



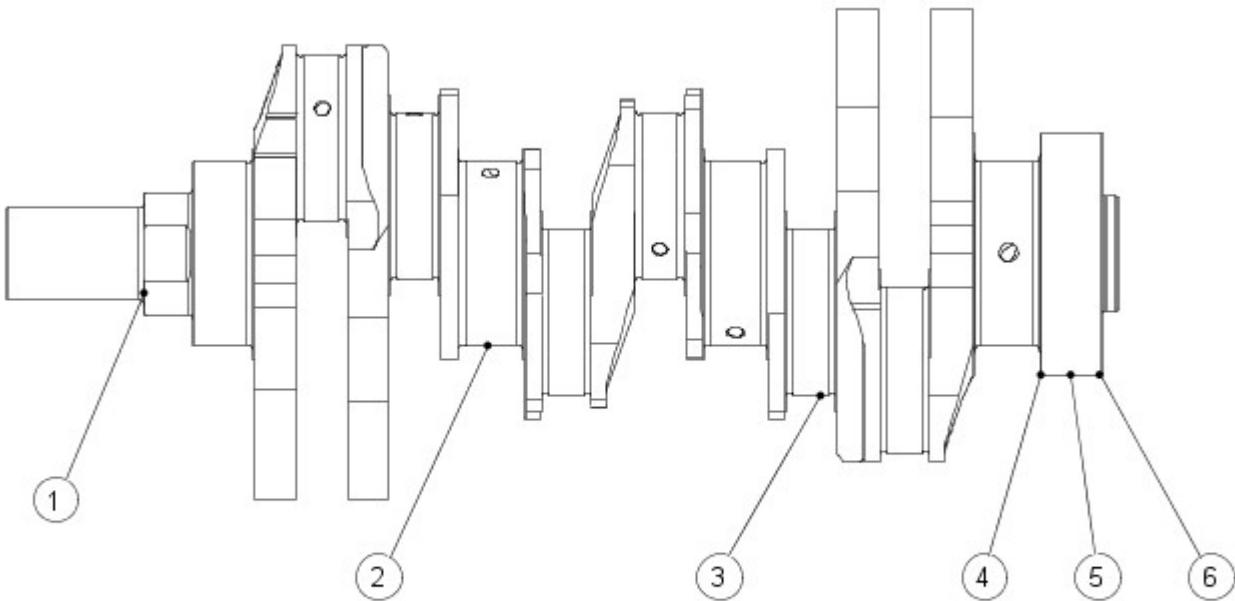
E44219

ItemDescription

- 1 Bolt
- 2 Cooling jet

Jets located in the cylinder block provide piston and piston pin lubrication and cooling. These jets spray oil on to the inside of the piston, the oil then flows through 2 internal wave shaped channels to help cool each piston crown.

CRANKSHAFT



E52135

ItemDescription

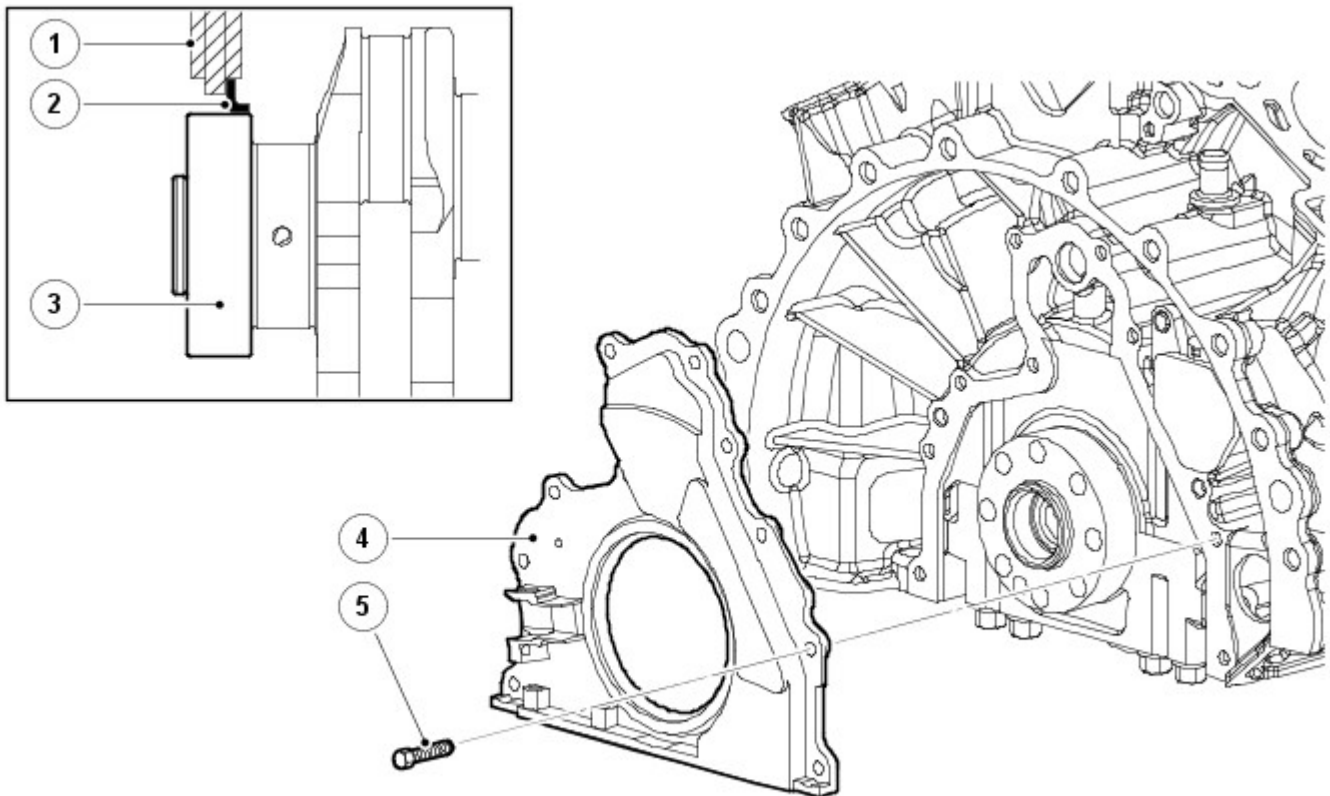
- 1

Oil pump drive
2 Main bearing Journal
3 Connecting rod bearing journal
4 Rear drive flange
5 Rear oil seal location
6 Trigger wheel location

The crankshaft is forged steel and fillet rolled with induction hardened journals, which run in 4 bearings with clamped 2 layer bearing shells. The upper and lower shells of bearing number 4 are flanged, which limits the end float of the crankshaft. The main bearing caps are double bolted and cross bolted to increase the strength and rigidity of the engine block.

The main bearings are aluminum/tin split plain selective bearings. An oil groove in the top half of each bearing transfers oil into the crankshaft for lubrication of the connecting rod bearings. The upper and lower shells of bearing number 4 contain integral thrust washers, which limits the end float of the crankshaft.

Rear Crankshaft Oil Seal



E44227

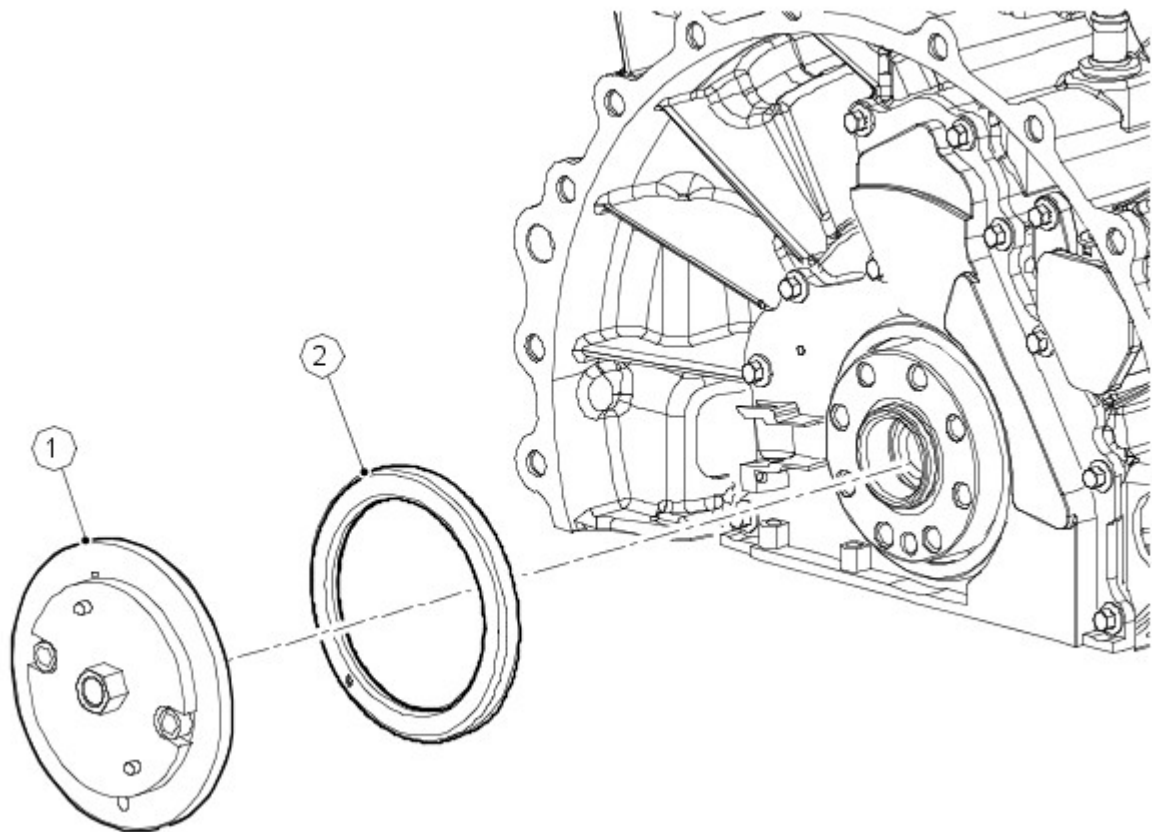
ItemDescription

1	Housing
2	Seal
3	Crankshaft
4	Rear oil seal retainer
5	Bolt (10 off)

The rear main oil seal and retainer assembly is a one-piece unit and is supplied with its own plastic fitting sleeve. The seal and retainer have 2 locating dowels, 10 fixing bolts and a rubber seal. In addition, the retainer has a location for the crankshaft position sensor. For additional information refer to 303-14A Electronic Engine Controls.

A torsional vibration crankshaft damper pulley is bolted to the front of the crankshaft.

Crankshaft Trigger Wheel



E52137

ItemDescription

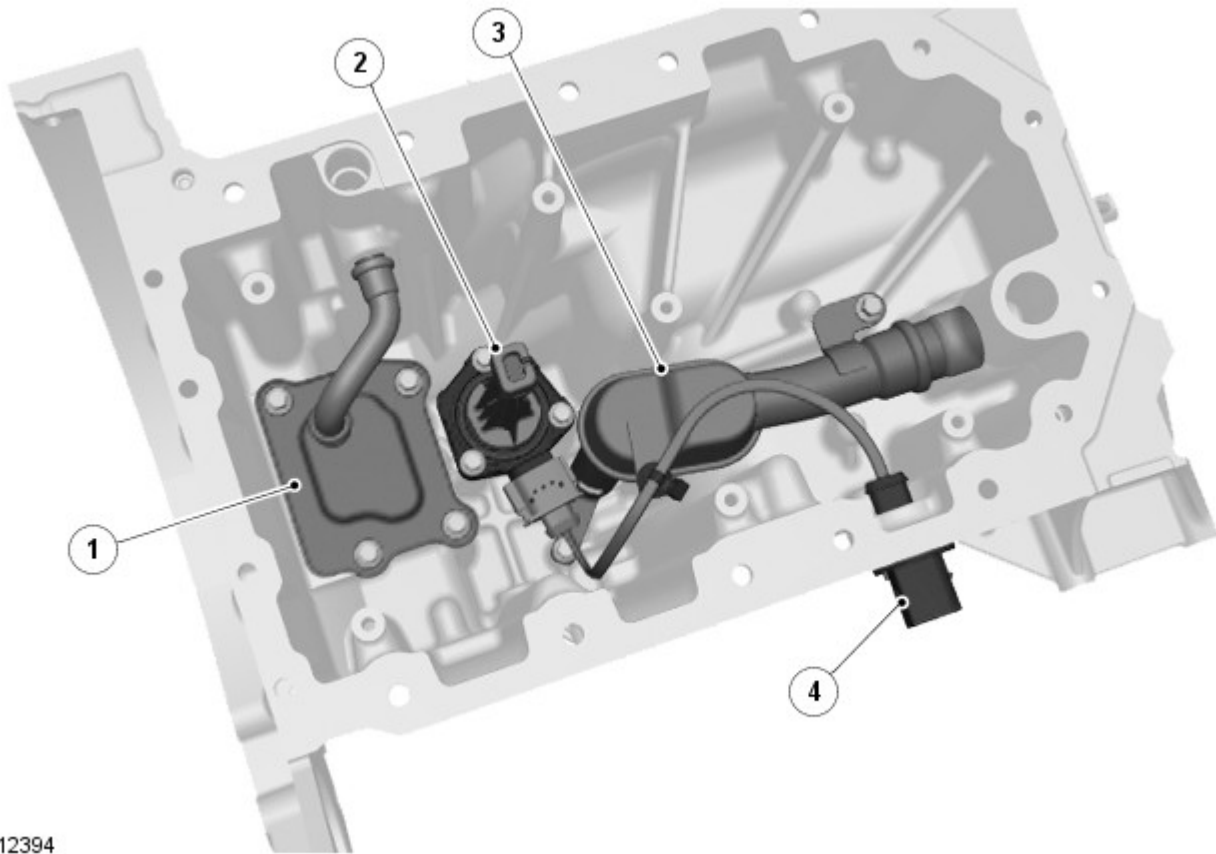
- | | |
|---|---------------|
| 1 | Special Tool |
| 2 | Trigger wheel |

The crankshaft trigger wheel is located on the rear of the crankshaft. It is pressed onto the crank using a special tool, which also precisely aligns the trigger wheel for crankshaft position and timing.

The trigger wheel consists of 60 magnets minus 2 for [ECM](#) crankshaft position reference and synchronization. The magnets cannot be seen on the trigger wheel, which therefore can only be positioned using a special tool. For additional information refer to 303-14A Electronic Engine Controls.

If the trigger is removed for any reason, then a new trigger wheel must be fitted.

OIL PAN COMPONENTS



E112394

ItemDescription

1	Oil scavenge reservoir
2	Oil level and temperature sensor
3	Oil pick-up pipe
4	Oil level and temperature sensor connector

The structural oil pan is of a single piece die cast aluminum construction and is fitted to the lower cylinder block to stiffen the base structure of the engine, helping to reduce noise, vibration and harshness. The oil pan also incorporates an oil baffle plate to reduce oil foaming and splash.

The oil pan is secured to the cylinder block with 2 dowels, 2 locator pins for the gasket and 18 retaining bolts; 3 different lengths of bolts are used:

- M6 x 20 (6 off)
- M8 x 75 (4 off)
- M6 x 105 (8 off).

Iron inserts, cast into the main bearing supports of the stiffening frame, minimize main bearing clearance changes due to heat expansion.

A gasket seals the joint between the oil pan and the cylinder block.

An oil pick-up pipe with integral strainer locates in the oil pan to provide oil to the crankshaft driven oil pump.

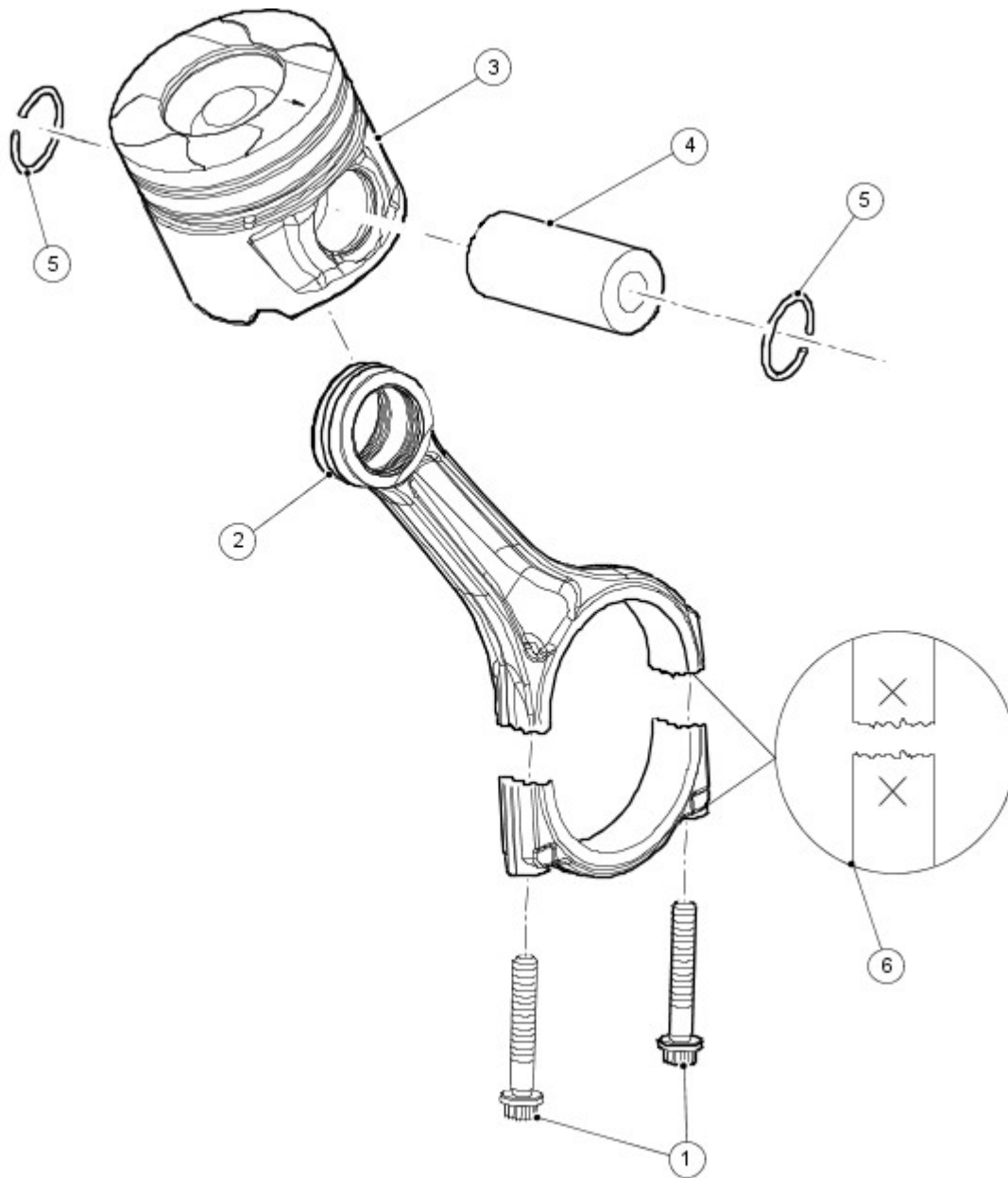
An ultrasonic sensor provides an electronic indication when the oil in the oil pan is low or high. This removes the requirement for the mechanical dipstick. An advantage in comparison with the static 'dipstick' method is that all marginal influences, for example vehicle being on a slope, lateral and longitudinal acceleration, are compensated for by averaging.

The values determined can be used to signal that the minimum oil level has been reached or to display the current oil level if required.

The sensor is mounted inside the oil pan where it sends an ultrasonic pulse vertically upward, it then measures the time for the pulse to be reflected back from the top surface of the oil.

Warnings will be displayed in the message center if the oil level is not maintained within the safe operating levels (minimum and maximum). A warning will also be displayed if there is a fault with the oil level monitoring system.

PISTON AND CONNECTING ROD ASSEMBLY



E52134

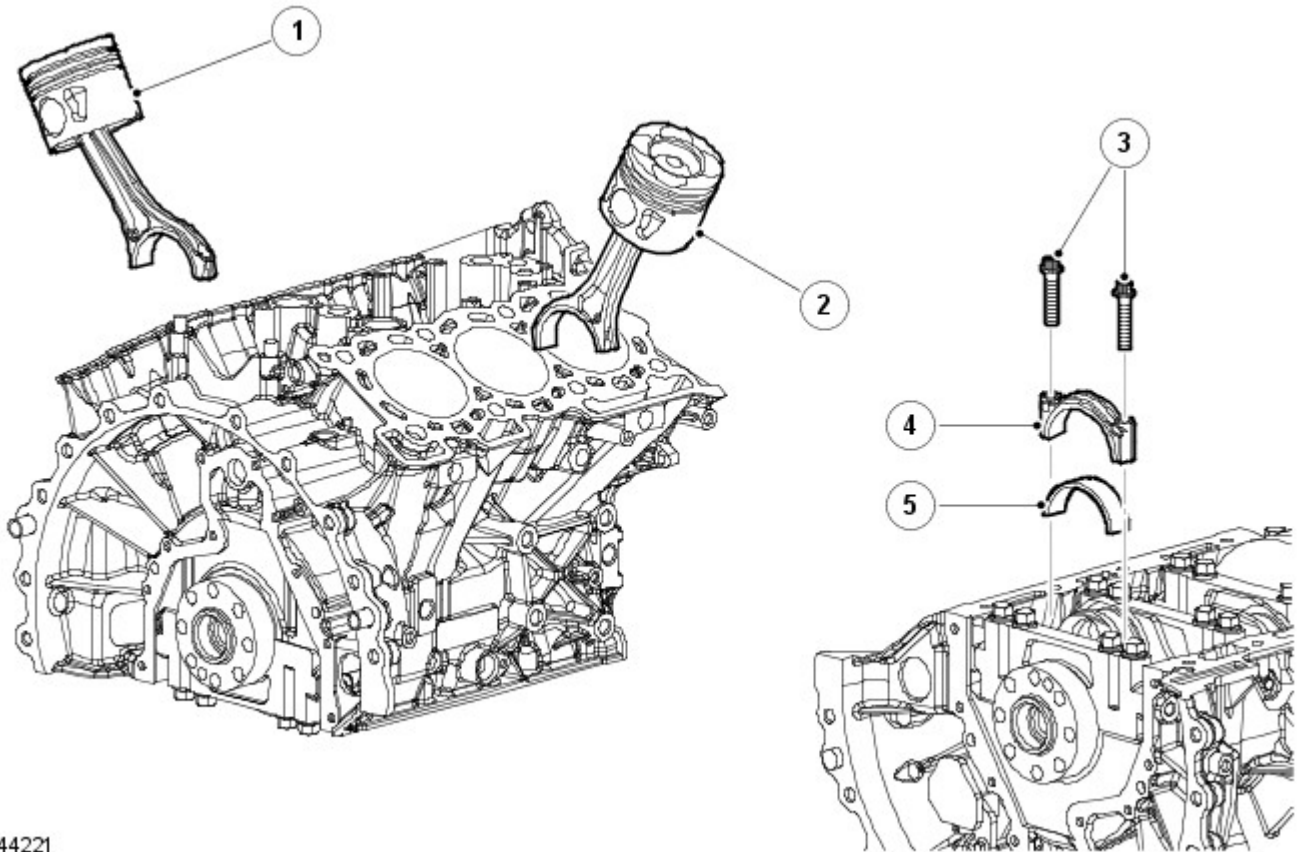
ItemDescription

1	Connecting rod bolts (2 off)
2	Connecting rod
3	Piston
4	Piston pin
5	Circlips
6	Connecting rod identification

The connecting rods are manufactured from sinter-forged steel and have fracture-split bearing caps. The bearing caps are produced by fracturing the opposing sides of the connecting rod at the bearing horizontal centre-line. As well as being easier to manufacture, when reassembled the fractured surfaces interlock to form a strong seamless joint. The cylinder position is etched on adjoining sides of the joint to identify matching connecting rods and bearing caps. The selective connecting rod bearings are aluminum/tin split plain bearings. The connecting rod bearing is 'sputter coated', which is a manufacturing process that layers the bearing material to produce a higher load capacity for improved durability.

• NOTE: The connecting rods are not selective.

Piston and Connecting Rod Orientation



E44221

ItemDescription

1	Piston and connecting rod assembly, cylinders 4-6
2	Piston and connecting rod assembly, cylinders 1-3
3	Bolts (12 off)
4	Connecting rod bearing cap (6 off)
5	Connecting rod lower bearing (6 off)

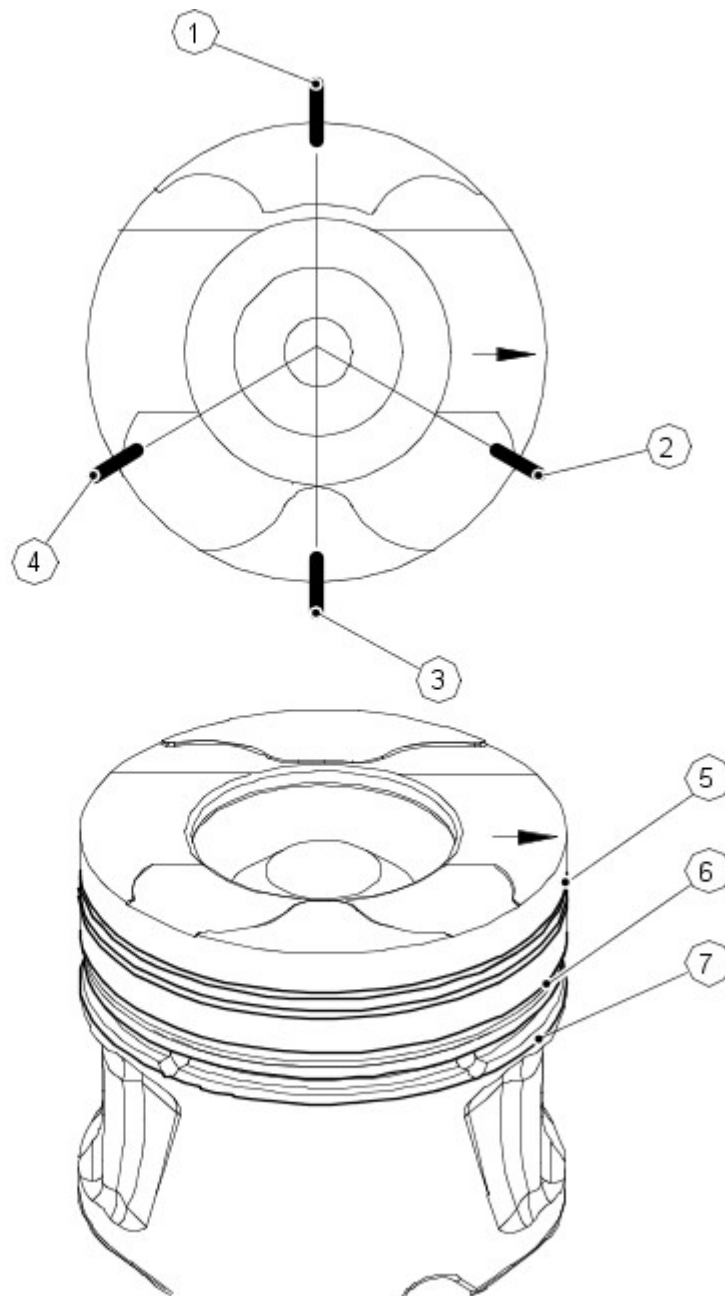
When installing a connecting rod, ensure the back of the connecting rod faces the center of the 'vee'.

The pistons are made from aluminum alloy and are fitted with 3 rings. The piston crown incorporates a pronounced bowl; this forms the combustion chamber, which promotes swirl and turbulence necessary for good combustion and improved emissions. In addition, the piston skirt has a molybdenum-coated surface, which counteracts scoring of the cylinder bore and piston.

The piston also incorporates a double wave gallery within the piston crown to enhance piston cooling. The pistons are supplied oil by means of spray jets located in the cylinder block oil gallery. These jets ensure optimum piston cooling to counteract the high temperatures generated by the combustion process.

Each piston is installed on a piston pin located in a aluminum/tin bushing in the connecting rod.

Piston Ring Orientation



552133

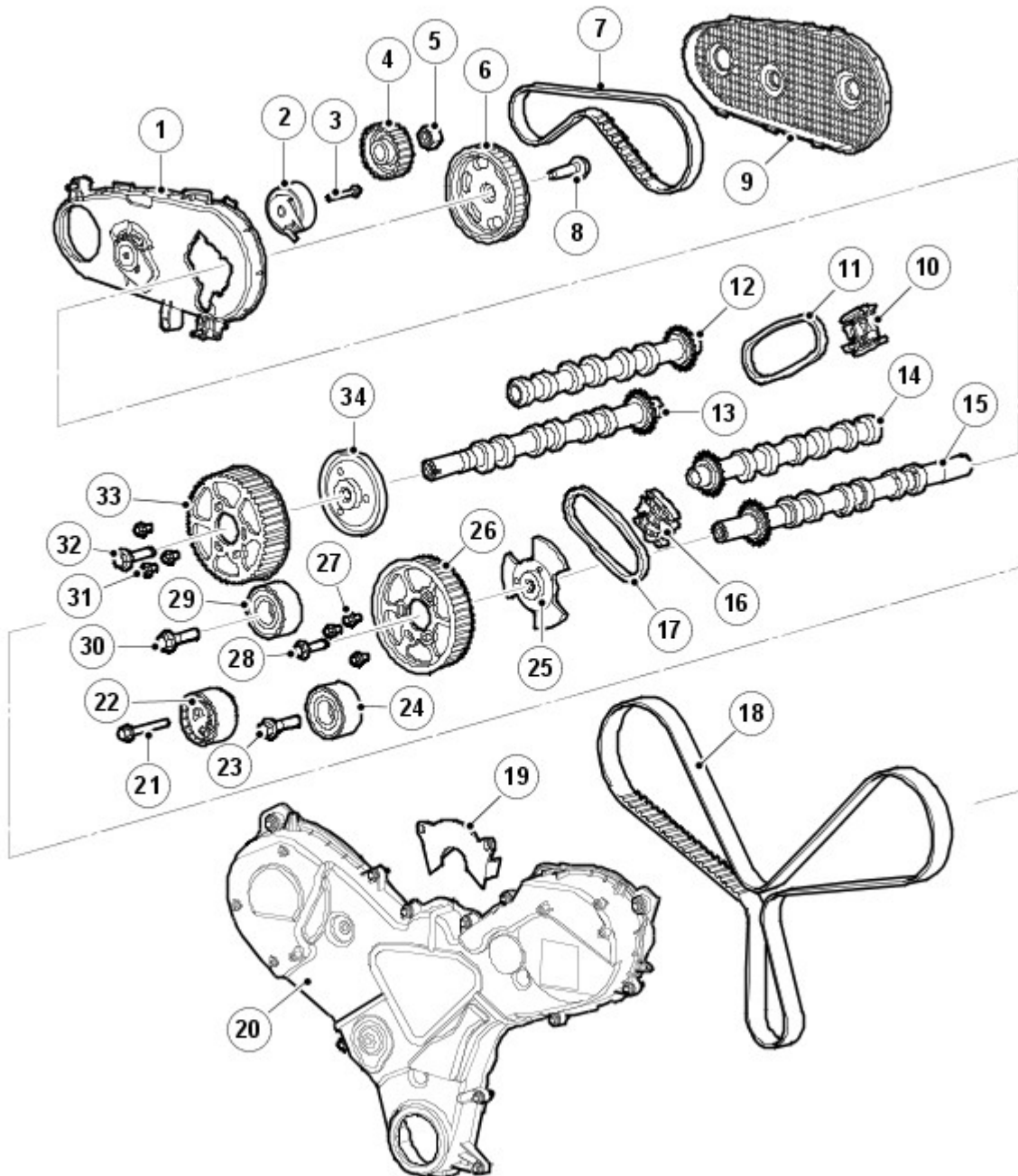
ItemDescription

1	Ring gap oil control
2	Ring gap upper compression
3	Spiral joint oil control
4	Ring gap lower compression
5	Upper compression ring
6	Lower compression ring
7	Oil control ring

When installing pistons ensure the arrows on the piston crowns all point to the front of the engine. All pistons are common single grade/single part number for all engines.

The piston top ring is a taper type and is fitted with the taper to the top of the piston. All rings marked 'top' are assembled with 'top' uppermost. All rings must be spaced evenly around the piston before installing. The circumference gap of the double bevelled oil control ring must be opposite the spiral control joint.

CAMSHAFT TIMING COMPONENTS



E94884

ItemDescription

1	Rear engine accessory drive rear cover
2	Rear engine accessory drive tensioner
3	Bolt
4	Fuel pump pulley
5	Nut
6	Rear engine accessory drive camshaft pulley
7	Rear engine accessory drive belt
8	Bolt
9	Rear engine accessory drive front cover
10	RH chain tensioner
11	RH timing chain
12	RH intake camshaft
13	RH exhaust camshaft
14	LH intake camshaft
15	LH exhaust camshaft
16	LH chain tensioner
17	LH timing chain
18	Timing belt

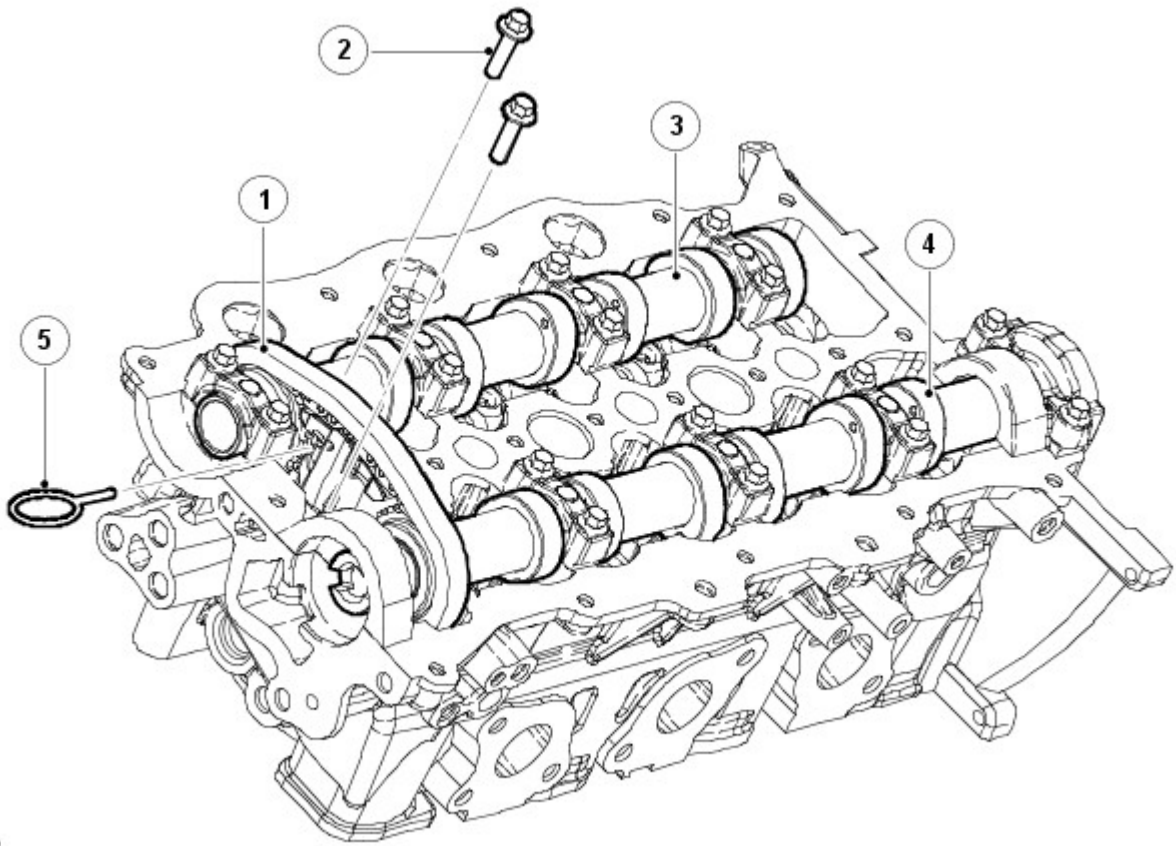
Front cover bridge
20 Primary drive cover
21 Bolt
22 Tensioner
23 Bolt
24 Idler
25 Camshaft hub
26 LH camshaft timing pulley
27 Bolt (3 off)
28 Bolt
29 Idler
30 Bolt
31 Bolt (3 off)
32 Bolt
33 RH camshaft timing pulley
34 Camshaft hub

Primary drive is provided by a single toothed belt from the crankshaft to the exhaust camshaft gears of each cylinder bank via 2 idler pulleys and a tensioner.

Timing belt adjustment is carried out by an eccentric type tensioner mounted on the RH front face of the cylinder block.

A primary drive cover is made up from 3 separate plastic mouldings. The covers are secured to the front of the cylinder block and cylinder heads with 15 bolts and 1 stud and nut. The 2 upper covers are partially sealed with a rubber seal.

Secondary Drive



E44233

Item	Description
1	Timing chain
2	Bolts
3	Intake camshaft
4	Exhaust camshaft
5	Tensioner firing pin

Secondary drive is provided by 2 short crossover chains, which transfer drive from the exhaust camshaft gears to the intake camshaft gears. The crossover drives are located at the rear of the RH cylinder bank and the front of the LH cylinder bank. This allows for a much shorter and simpler run for the main camshaft drive belt at the front of the engine.

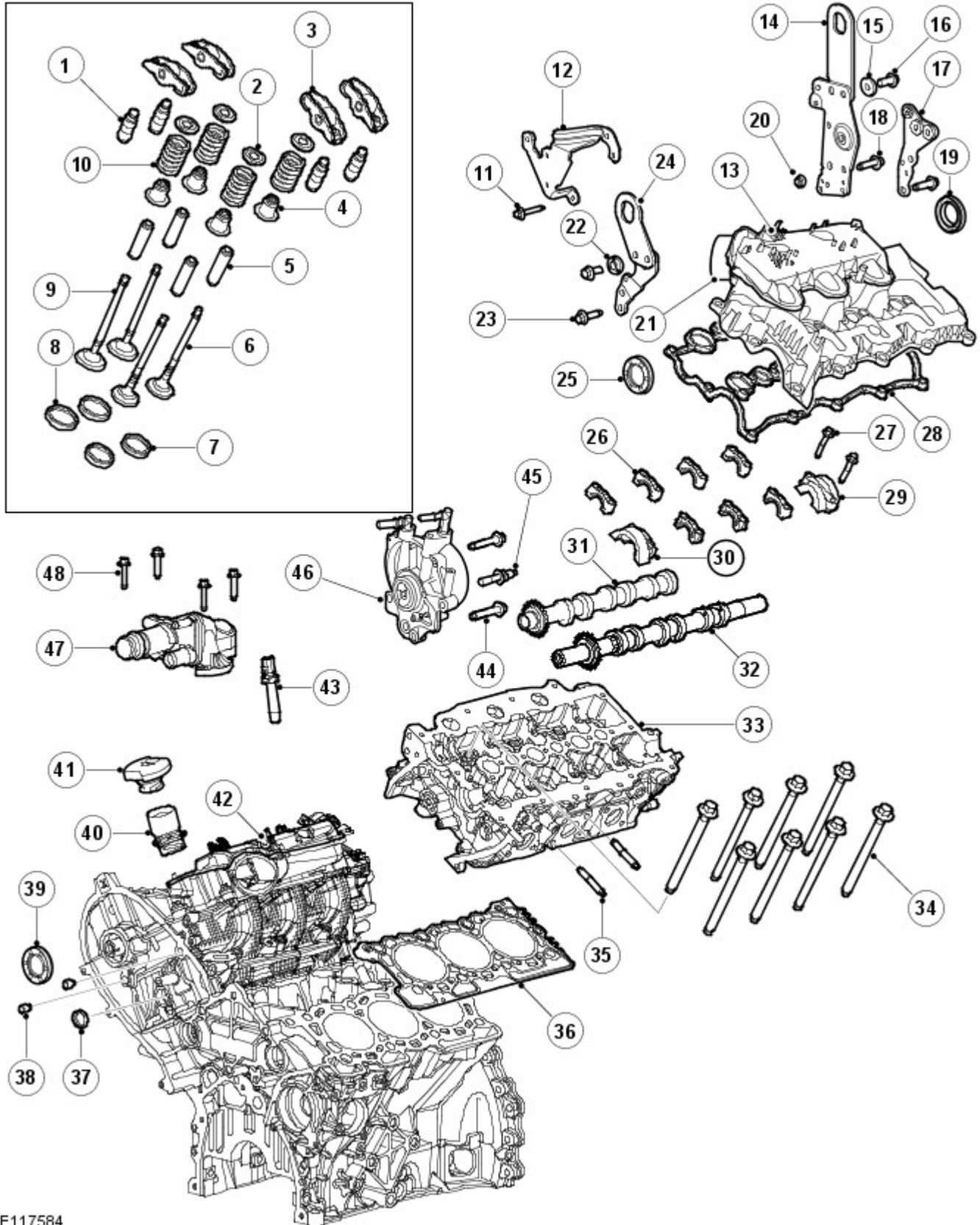
Each crossover chain is tensioned via an automatic chain tensioner, which acts directly on the chains via a guide rail. The

tensioners are located between the exhaust and intake camshafts at the front or rear of the cylinder head, depending on the cylinder bank.

The tensioner firing pin holds the automatic chain tensioner in a compressed state to aid installation.

CYLINDER HEAD COMPONENTS

• NOTE: [LH](#) cylinder head shown; [RH](#) cylinder head similar.

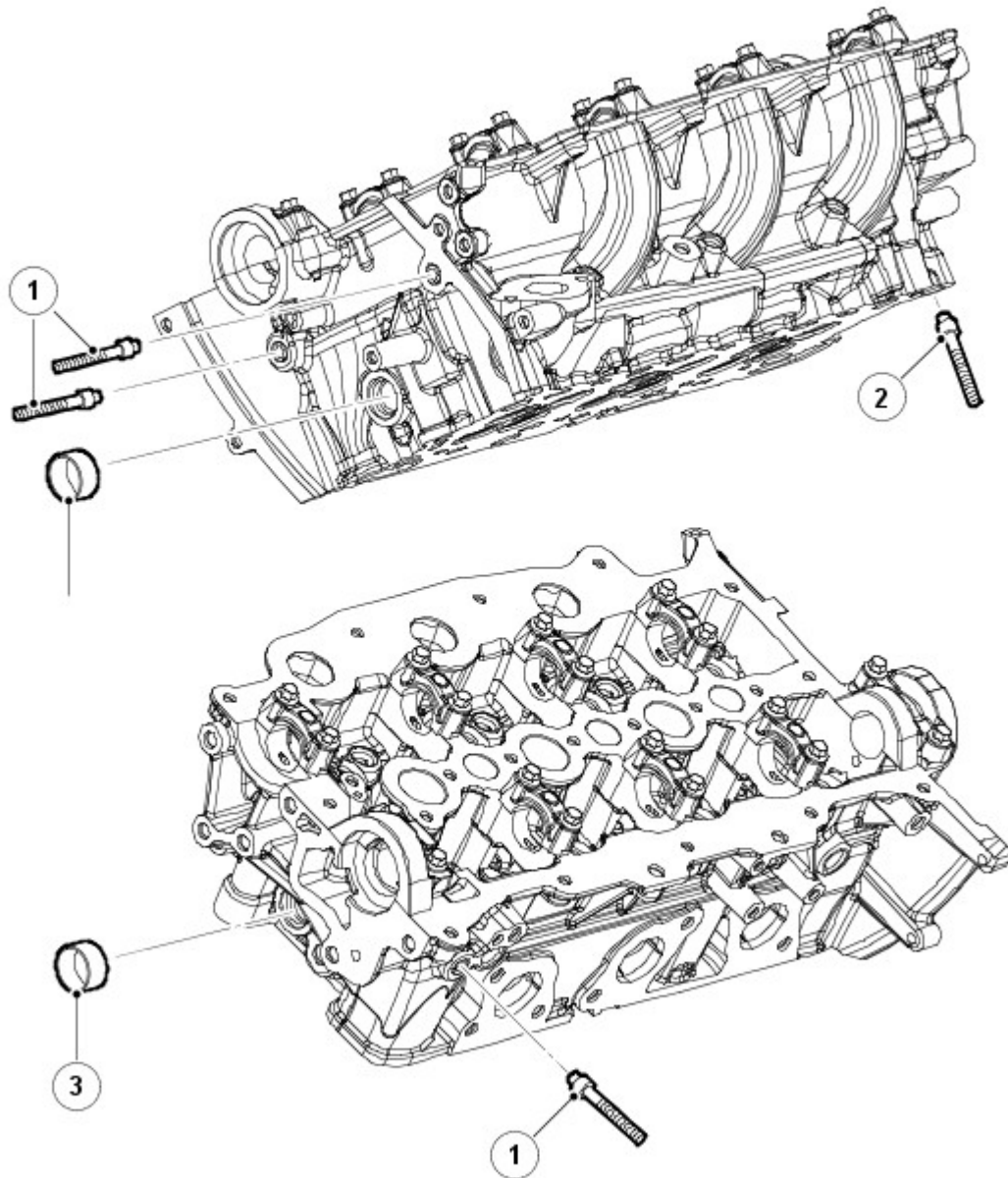


E117584

ItemDescription

Hydraulic lash adjusters (12 off)
2 Valve spring retainers (12 off)
3 Roller rockers (12 off)
4 Valve stem seals (12 off)
5 Valve guides (12 off)
6 Exhaust valves (6 off)
7 Intake valve seats (6 off)
8 Exhaust valve seats (6 off)
9 Intake valves (6 off)
10 Valve springs (12 off)
11 Bolt
12 Bracket
13 Intake manifold
14 Lifting eye
15 Washer
16 Bolt
17 Bolt
18 Bolt
19 Seal
20 Cap
21 Intake manifold cover assembly
22 Washer
23 Bolt
24 Lifting eye
25 Seal
26 Camshaft bearing caps (7 off)
27 Bolts (18 off)
28 Gasket
29 Camshaft bearing cap and seal housing
30 Camshaft bearing cap and seal housing
31 Intake camshaft
32 Exhaust camshaft
33 Cylinder head
34 Cylinder head bolts (8 off)
35 Exhaust manifold studs (6 off)
36 Cylinder head gasket
37 Core plug
38 Plug
39 Seal
40 Oil filler tube
41 Oil filler cap
42 Intake manifold
43 Injectors (3 off)
44 Bolt (2 off)
45 Bolt
46 Tandem pump
47 Water outlet assembly
48 Bolt (4 off)

Cylinder Heads



E44236

ItemDescription

1	Studs
2	Bolts
3	Blanking plug

The aluminum gravity die cast cylinder heads are unique to each cylinder bank. Eight deep-seated bolts help reduce distortion and secure each cylinder head to the cylinder block. The cylinder head bolts are located beneath the camshafts, 4 under the intake camshaft and 4 under the exhaust camshaft. Two hollow dowels align each cylinder head with the cylinder block.

• **NOTE:** The cylinder heads cannot be reworked.

The cylinder head gasket is a 3-layer, laminated steel type and is available in 5 different thicknesses. The choice of gasket thickness is dependent on the maximum piston protrusion. Gasket thickness is identified by serrations cut into the front end of the gasket.

The cylinder head has 4 ports machined at each cylinder location, 2 exhaust ports and 2 intake ports. One of the intake ports is helical and functions as a swirl port, the other is arranged laterally as a tangential port and functions as a charge port.

The camshafts are of a hollow steel tube construction, with pressed on sintered lobes. Each camshaft is retained by aluminum alloy caps, 5 for the exhaust camshafts and 4 for the intake camshafts. Location letters, A to I for the intake camshaft and R to Z for the exhaust camshaft, are marked on the outer faces of the caps for each cylinder head.

The LH cylinder bank exhaust camshaft is machined to accept a rear camshaft gear. The rear camshaft gear provides drive for the high-pressure fuel pump. For additional information refer to 303-04A Fuel Charging and Controls.

The exhaust camshaft gear of the [LH](#) cylinder head also incorporates a trigger wheel, which is used in conjunction with the camshaft sensor to measure engine position. For additional information refer to 303-14A Electronic Engine Controls.

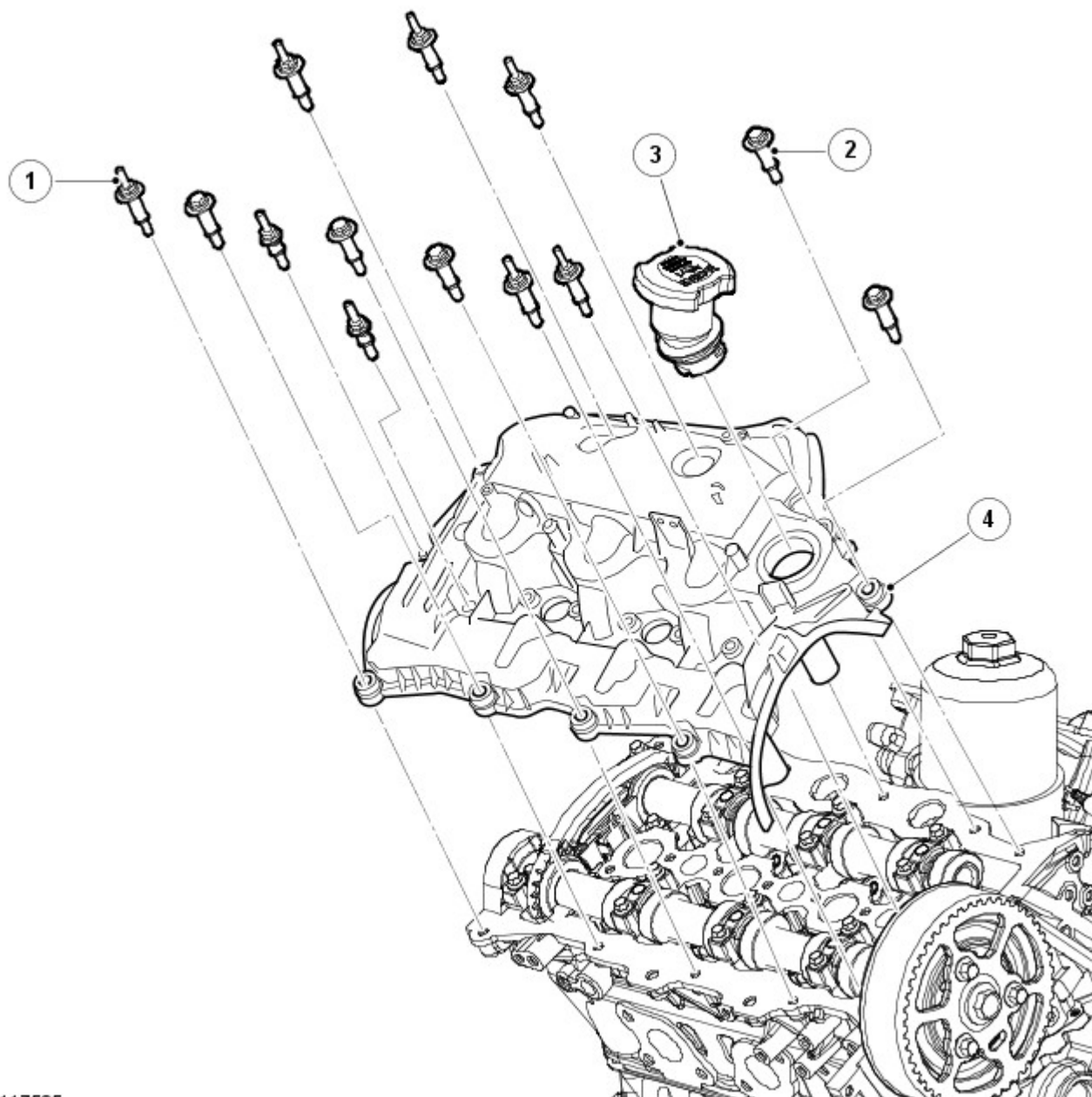
The [RH](#) cylinder head exhaust camshaft is machined at the rear end to provide a drive connection for the tandem pump.

The fuel injection nozzles are centrally mounted above each cylinder. For additional information refer to 303-04A Fuel Charging and Controls.

The glow plugs are arranged centrally on the intake side of the cylinder heads, between the 2 intake ports of each cylinder. For additional information refer to 303-07D Glow Plug System.

The engine lifting eyes are bolted to the cylinder head, 1 at the front and 2 at the rear, 1 per cylinder head.

Camshaft Covers



E117585

ItemDescription

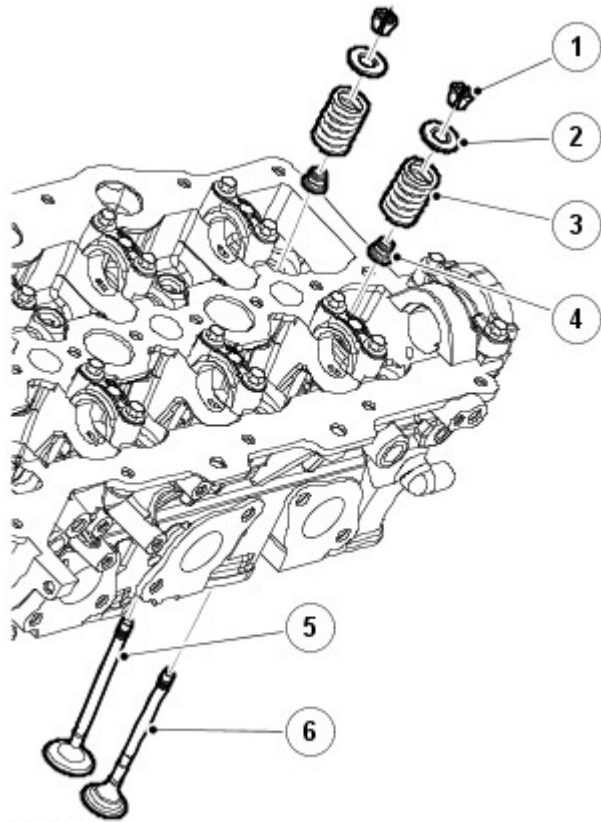
1	Stud bolt M6 x 40 (6 off)
2	Bolt M6 x 40 (7 off)
3	Oil filler cap
4	RH camshaft cover assembly

The camshaft covers are manufactured from vinyl ester composite. The [RH](#) bank camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. The [LH](#) bank camshaft cover incorporates an outlet for the part load engine breather. For additional information refer to 303-08A engine Emission Control.

Silicon rubber in-groove gaskets seal the joints between the camshaft covers and the cylinder heads. Together with spacers and seals on the camshaft cover fasteners, they also isolate the covers from direct contact with the cylinder

heads, to reduce noise.

Intake and Exhaust Valves



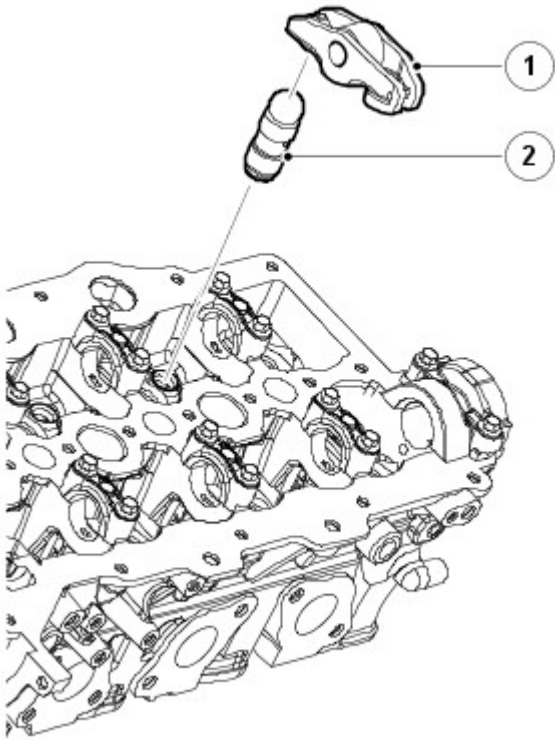
E44239

ItemDescription

1	Valve spring collet (24 off, 12 per cylinder head)
2	Valve spring retainer (24 off, 12 per cylinder head)
3	Valve spring (24 off, 12 per cylinder head)
4	Valve stem seal (24 off, 12 per cylinder head)
5	Intake valve (12 off, 6 per cylinder head)
6	Exhaust valve (12 off, 6 per cylinder head)

Each cylinder head incorporates 2 overhead camshafts operating 4 valves per cylinder via steel roller rockers with hydraulic lash adjusters.

Roller Rockers with Hydraulic Lash Adjusters



E44238

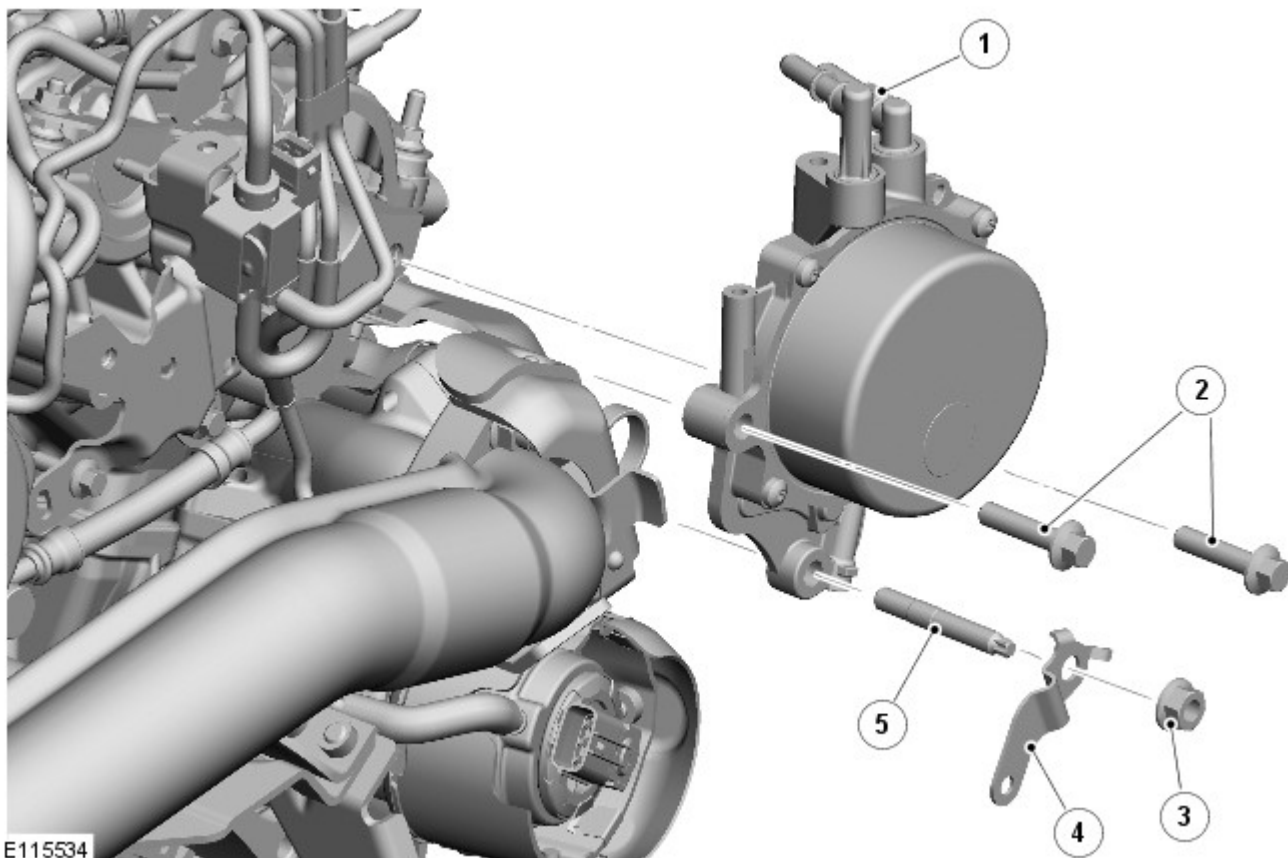
ItemDescription

1 Roller rocker (24 off, 12 per cylinder head)

2 Hydraulic lash adjuster (24 off, 12 per cylinder head)

The lightweight valve gear provides good economy and noise levels. Valve head diameters are 31 mm (1.220 in) for the exhaust and 35 mm (1.378 in) for the intake. All valves have 5 mm (0.197 in) diameter stems supported in sintered metal seats and guide inserts. Collets, valve collars and spring seats locate single valve springs on both intake and exhaust valves. Valve stem seals are integrated into the spring seats.

Tandem Pump



E115534

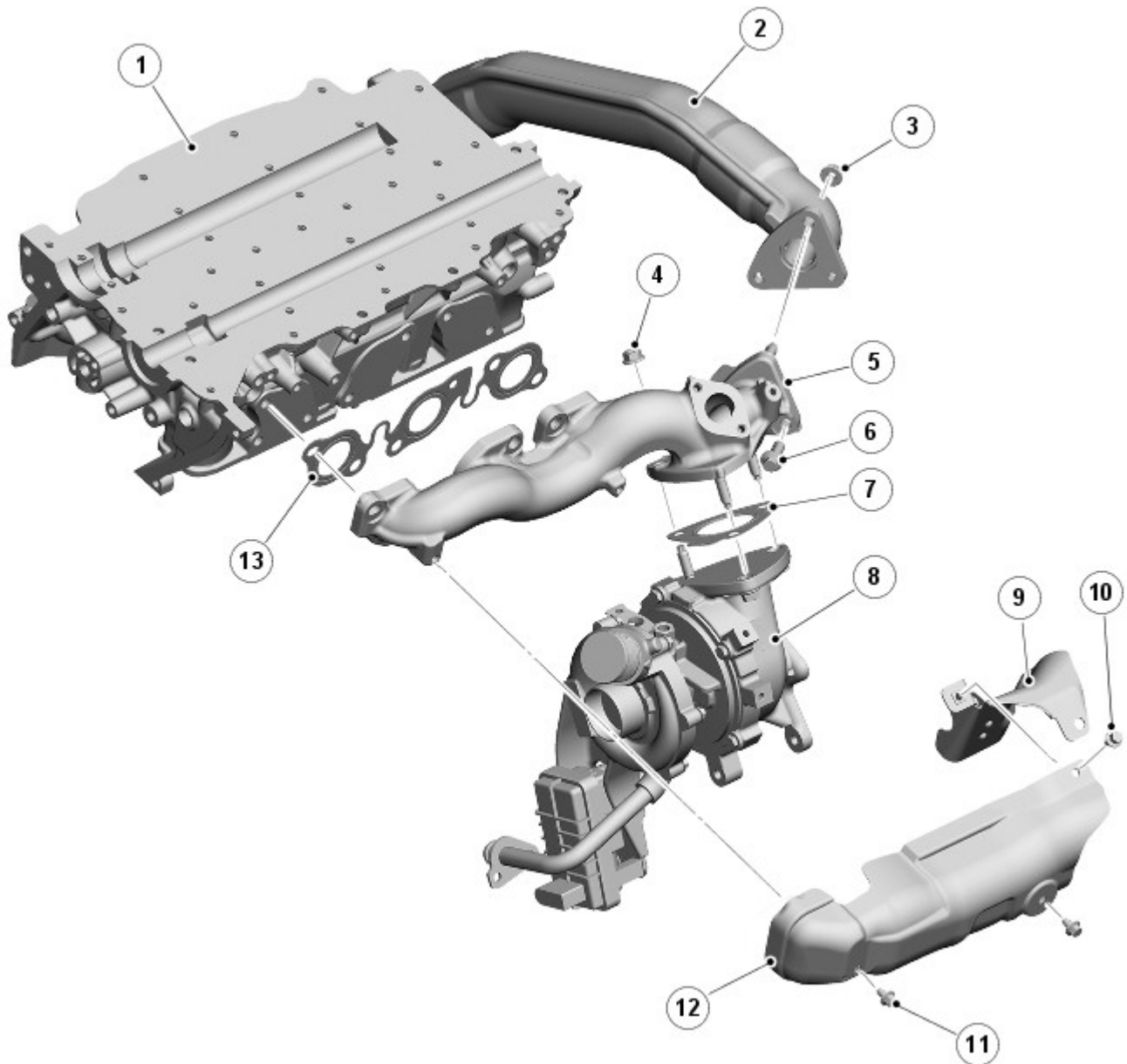
ItemDescription

1	Tandem pump connections
2	Bolt (2 off)
3	Nut
4	Bracket (emission hose)
5	Stud

The tandem pump is a combined vacuum and oil scavenge pump. The scavenge pump is g-rotor type pump that drains oil from the secondary turbocharger to accommodate vehicle tilt. The pump is located at the rear of the [RH](#) side cylinder head and is driven from the exhaust camshaft.

Exhaust Manifolds

- NOTE: [LH](#) exhaust manifold shown; [RH](#) exhaust manifold similar.



E115531

ItemDescription

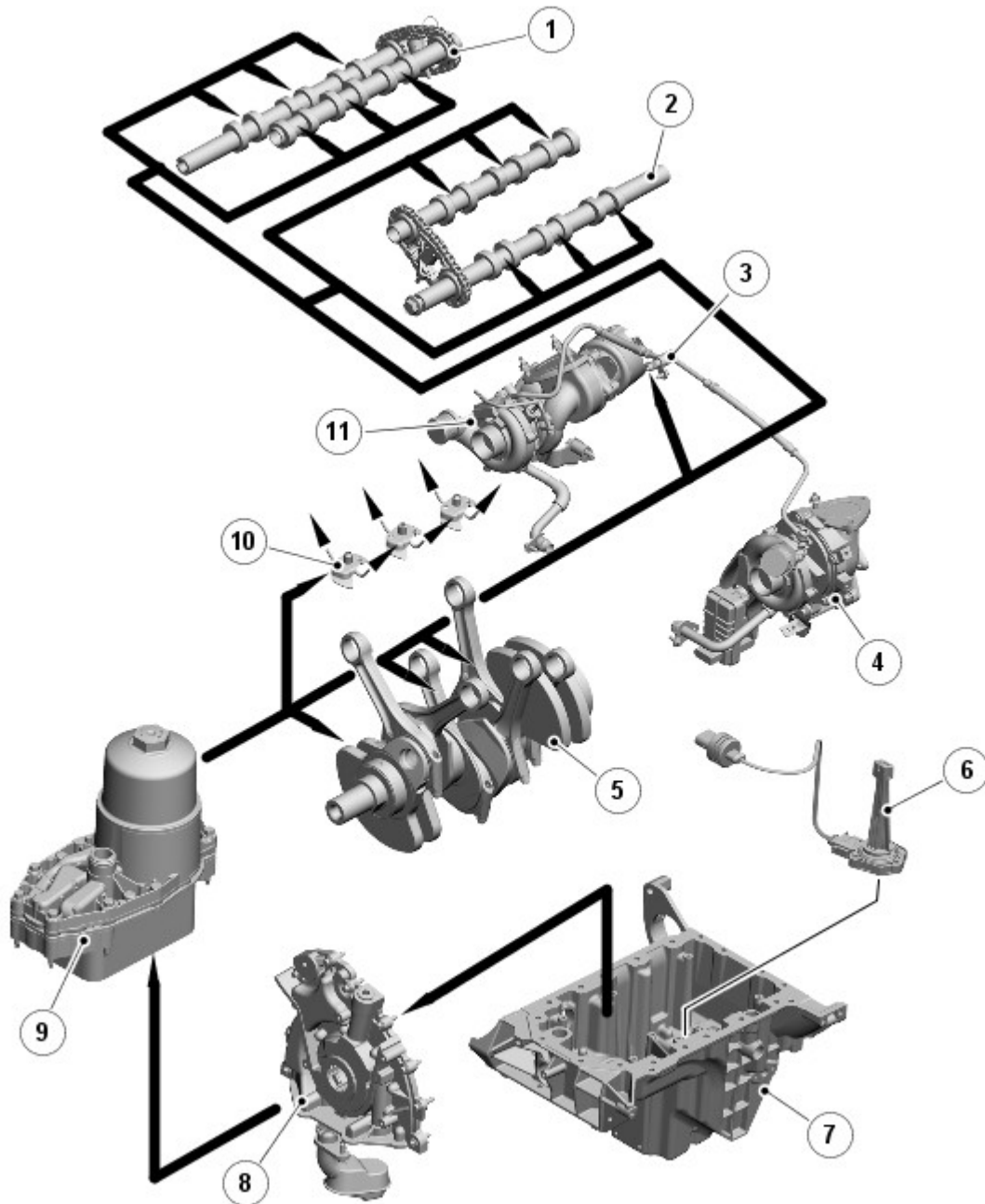
1	Cylinder head
2	Connecting pipe
3	Nut (2 off)
4	Nut (3 off)
5	Exhaust manifold
6	Bolt
7	Gasket
8	Turbocharger (primary turbocharger shown)
9	Manifold rear heat shield
10	Bolt
11	Bolt (2 off)
12	Manifold heat shield

The exhaust manifolds are cast from an iron alloy with a high nickel content giving excellent heat and corrosion resistance properties. They are sealed to the cylinder head by means of a steel gasket. Sacrificial plastic sleeves are used to align the manifolds. These sleeves must be changed when refitting the manifolds. Spacers on the securing bolts allow the manifolds to expand and retract with changes of temperature while maintaining the clamping loads.

Each manifold has a connection for the [EGR \(exhaust gas recirculation\)](#) transfer pipe.

The engine is fitted with twin variable geometry turbochargers, which fix to the exhaust manifolds by a 3-hole flange with a steel gasket.

LUBRICATION SYSTEM



E117573

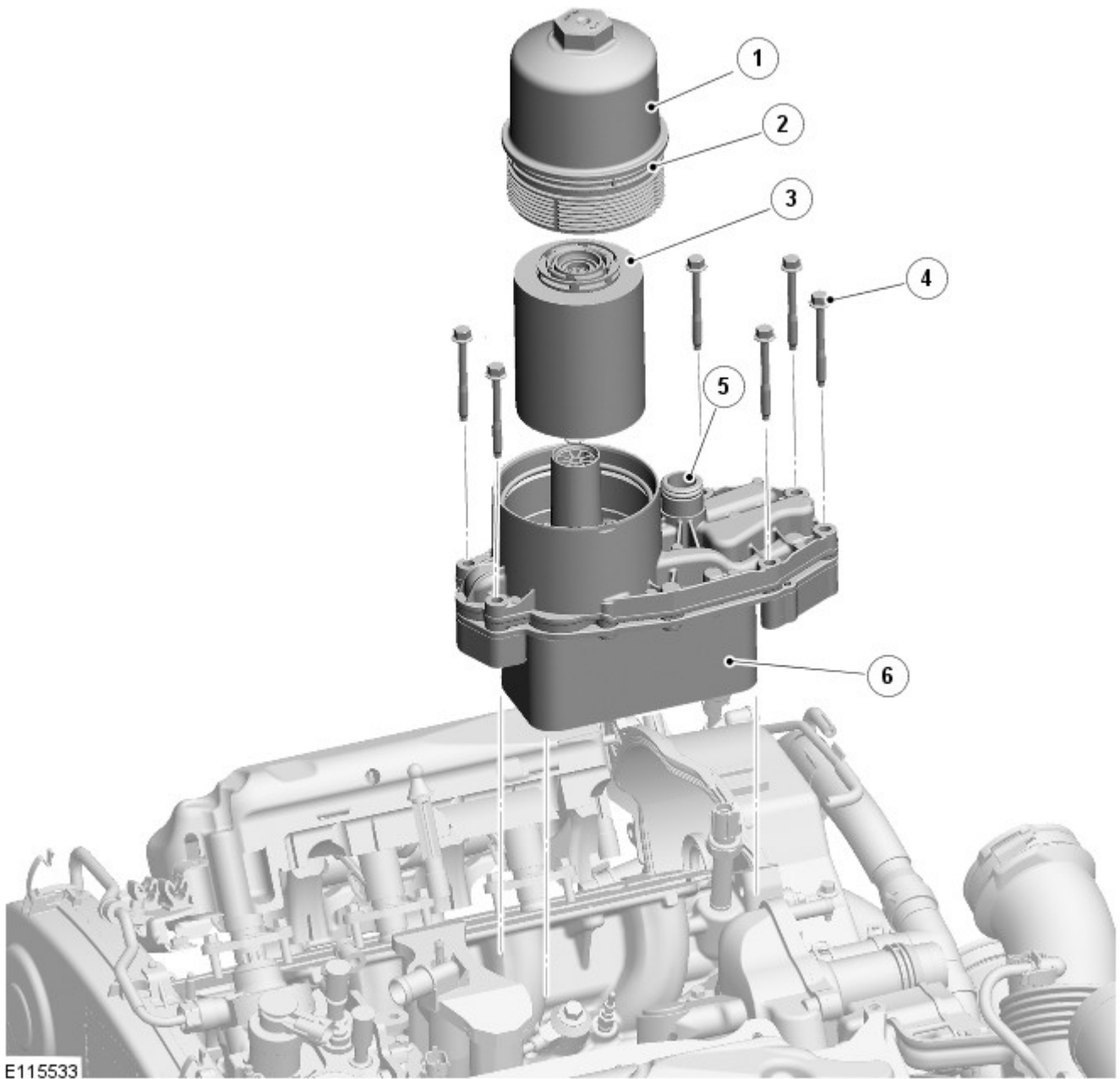
ItemDescription

1	Inlet camshaft
2	Exhaust camshaft
3	Turbocharger oil supply
4	Primary turbocharger
5	Crankshaft and connecting rods
6	Oil level and temperature sensor
7	Oil pan
8	Oil pump
9	Oil cooler and filter assembly
10	Piston cooling jets
11	Secondary turbocharger

Oil is drawn from the oil pan and pressurized by the oil pump. The output from the oil pump is then filtered and distributed through internal oil passageways.

All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for operation of the hydraulic adjusters and the timing gear chain tensioners.

Oil Cooler and Filter Assembly



E115533

ItemDescription

1	Filter housing
2	'O' ring seal
3	Paper element
4	Retaining bolt (6 off)
5	Coolant outlet connection
6	Cooler assembly

The engine is lubricated by a force-feed oil circulation system with a full flow oil filter. The oil cooler forms a unit with the oil filter, which is mounted centrally in the middle of the cylinder block between the 2 banks of cylinders. The engine oil is cooled using the engine cooling system. This eliminates the need for an additional engine oil cooler remotely mounted.

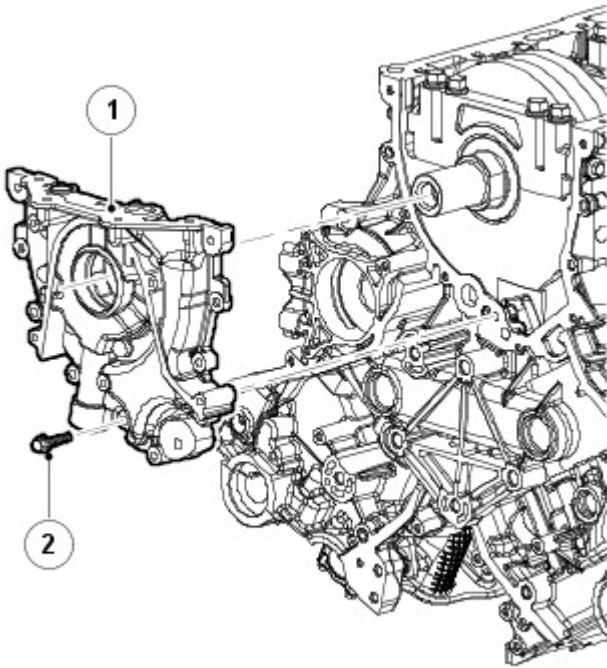
Oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the quick return of the oil, reducing the volume of oil required and enabling an accurate check of the contents soon after the engine stops.

System replenishment is through the oil filler cap on the [RH](#) camshaft cover.

The moulded composite oil pick-up is immersed in the oil reservoir to provide a supply to the oil pump during all normal vehicle attitudes. A mesh screen in the inlet prevents debris from entering the oil system.

• NOTE: Fuel cooling is facilitated by a blast air fuel cooler in the return line to the fuel tank.

Oil Pump



E44230

ItemDescription

1	Oil pump
2	Bolt (10 off)

The oil pump is a gear type pump and is bolted and dowelled to the front of the cylinder block. It is sealed by means of a rubber gasket, which is recessed into the oil pump housing. The pump inlet and outlet ports align with oil passages in the stiffening frame.

The pumping element is an eccentric rotor, which is directly driven by flats on the crankshaft. An integral pressure relief valve regulates pump outlet pressure at 4.5 bar (65.25 lb/in²).

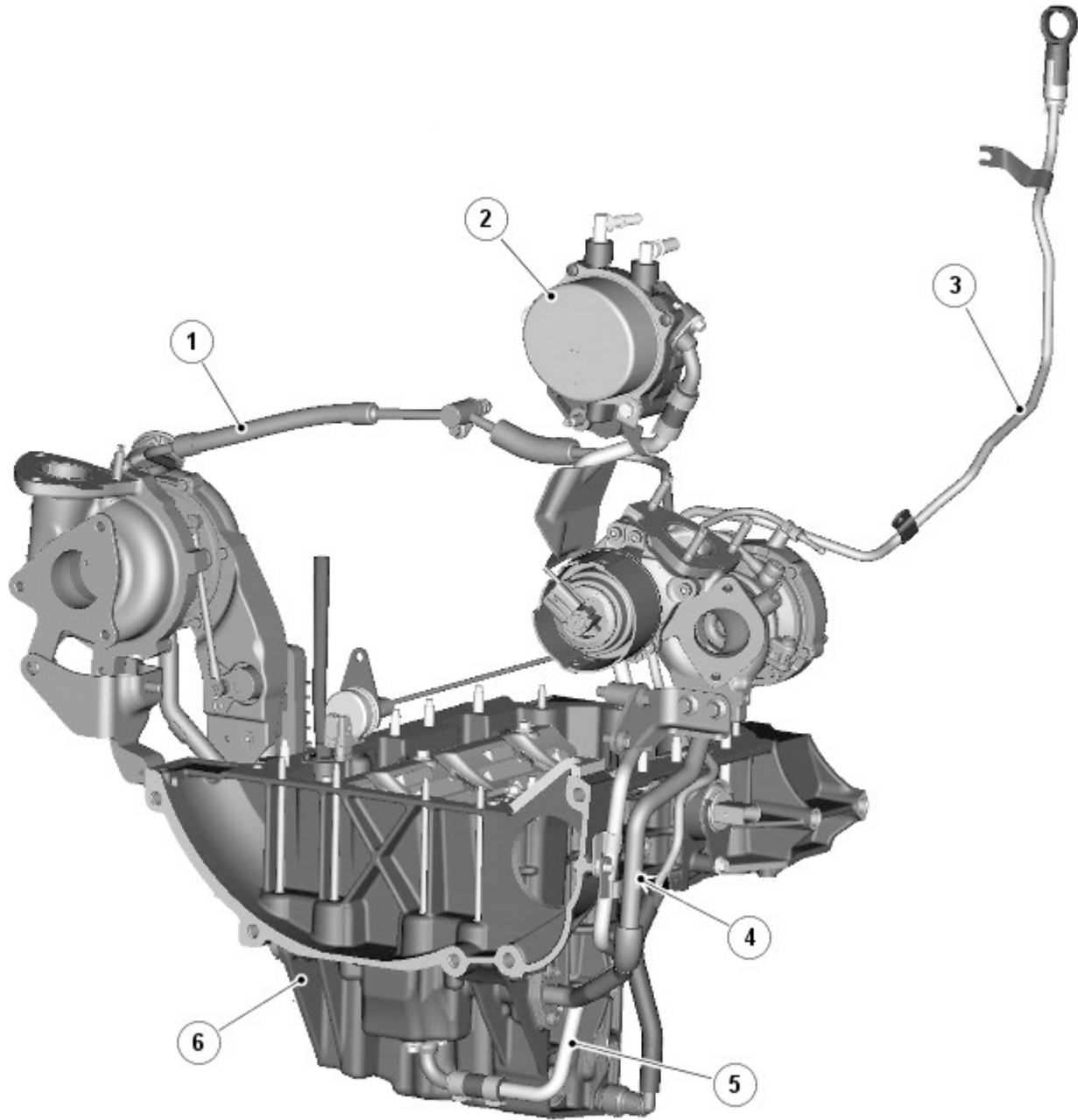
The front crankshaft oil seal is housed in the oil pump casing and is fitted such that its front face is 1 mm (0.04 in) under flush with the machined front face of the oil pump.

• **NOTE:** The seal is not to be pushed all the way into the bore as this will block the seal drains.

Due to the wide range of inclines Land Rover vehicles operate across, the geometry of the oil pan has been configured to guarantee oil pick-up across all operating angles. An oil-scavenge system has been developed to guarantee excellent oil flow through the turbochargers on severe side-slopes. Whilst the 60-degree cylinder bank angle of a V6 engine allows the turbochargers to be packaged relatively higher in the vehicle, to obtain the best configuration for the V6 engine, the turbochargers must be sited much lower. At extreme angles, there is a risk they may be below the oil level on the oil pan, restricting oil return flow.

To overcome this, the engine uses:

- the oil pump to supply oil to the turbocharger bearings from the main oil reservoir (oil pan)
- a secondary reservoir to receive oil from the turbocharger bearings
- a tandem pump to urge oil to flow from the turbocharger bearings into the secondary reservoir and to pump the oil back from the secondary reservoir to the primary reservoir (oil pan)



E107569

ItemDescription

1	Turbocharger oil feed pipe
2	Tandem pump
3	Oil evacuation tube
4	Turbocharger oil return pipe
5	Oil scavenge pipe
6	Oil pan

An additional feature of this system is that the tandem pump used to pump oil back from the secondary reservoir can also be used as a source of vacuum for a vacuum operated system.

A semi-synthetic, low SAPS (sulphated ash, phosphorus and sulphur) oil is specified, which reduces the ash loading in the [DPF \(diesel particulate filter\)](#). Ash cannot be burnt off like soot so it remains in the [DPF](#) for life. Without the use of low SAPS oil, the [DPF](#) will not be a 'fit for life' component.

This low SAPS oil is also more resistant to temperature-related degradation than conventional mineral oil. It has lower viscosity at low temperatures and improved lubrication performance at higher temperatures.

Engine - TDV6 3.0L Diesel - Engine

Diagnosis and Testing

For additional information, refer to Diagnosis and Testing, Engine - 3.0L Diesel.

Engine - TDV6 3.0L Diesel - Engine Oil Draining and Filling

General Procedures

Draining



WARNING: The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.



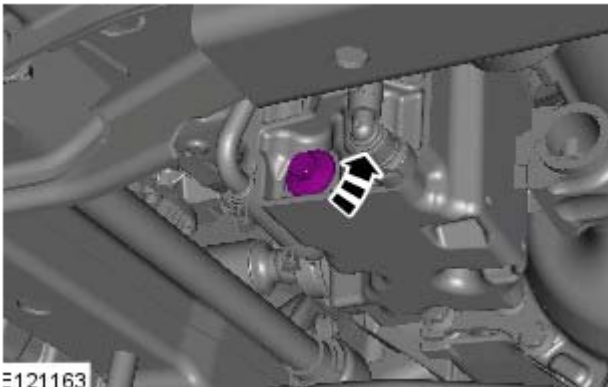
CAUTION: Make sure the engine is warm.

1. Refer to: [Oil Filter Element](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

2. **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



4. **WARNING:** Observe due care when draining engine oil as the oil can be very hot.

• **CAUTIONS:**



Be prepared to collect escaping oil.



Discard the bolt.



Allow at least 10 minutes for the engine oil to drain.

Drain the engine oil.

Filling

1. **5. CAUTIONS:**

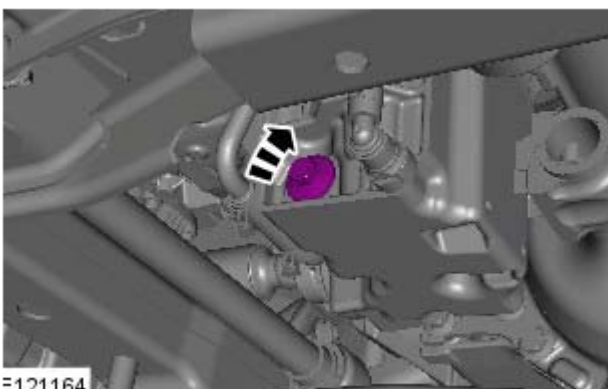


Make sure that the component is clean, free of foreign material and lubricant.



Make sure that a new bolt is installed.

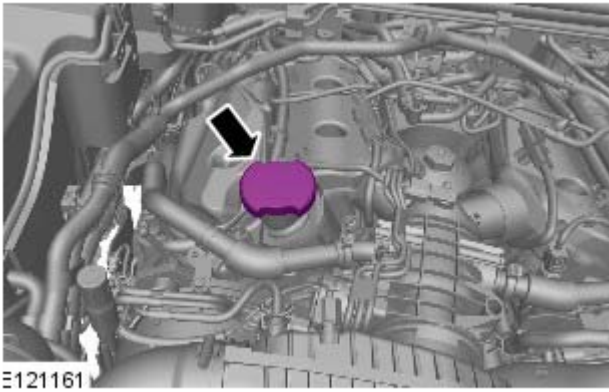
Torque: 23 Nm




2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

3. Lower the vehicle.

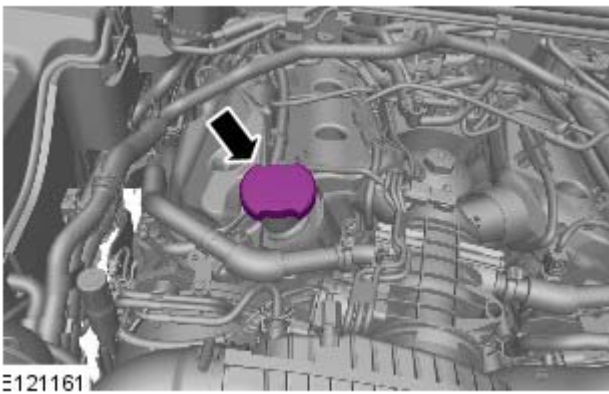
4. Refer to: [Oil Filter Element](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).



5. Fill the engine with oil.

6. **10.**  **CAUTION:** Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum, before starting the engine. To check engine oil level follow steps 9-12.

Clean any residual engine oil from the oil filler cap area.



7.

- 8.
- Start the engine and allow to run for 10 minutes, stop the engine.
 - Check for leaks.

9. **13.** **CAUTIONS:**

 Make sure that the vehicle is parked on level ground.

 Make sure that the selector lever and the gearshift mechanism are in the park (P) position.

 Make sure that the hood is open.

• **NOTE:** Allow 10 minutes from the engine switch off for the engine oil level to stabilize.

- Turn the ignition on.

10.

- Press the right-hand directional button to access the instrument cluster menu.



E123926

11.

- Press the right-hand OK button.



E123925



12.

- Press the right-hand directional button to access the Oil Level Display.

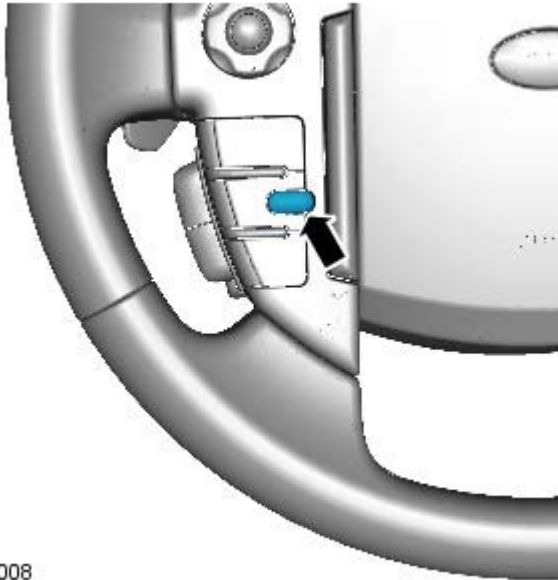
E123927



13.

- Press the right-hand OK button and follow the instructions.

E123928



E121008

14.

- Press the cruise control cancel button twice within 2 seconds.



15.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Take a reading from the level display and, if necessary, top up with oil as instructed.



E123929

16. Turn the ignition off.

17. **21.** NOTE: Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

- Turn the ignition on.



18.

- Press the right-hand directional button to access the instrument cluster menu.



E123926



19.

- Press the right-hand OK button.

E123925

20.

- Press the right-hand directional button to access the Oil Level Display.



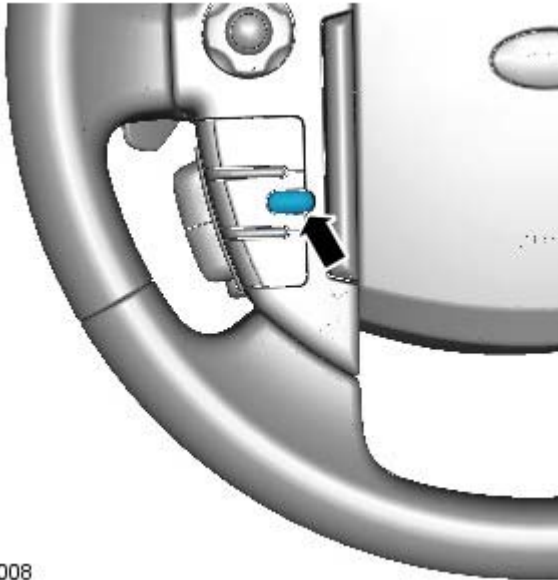
E123927

21.

- Scroll through the trip menu to access the engine oil level display.



E123929



E121008

22.

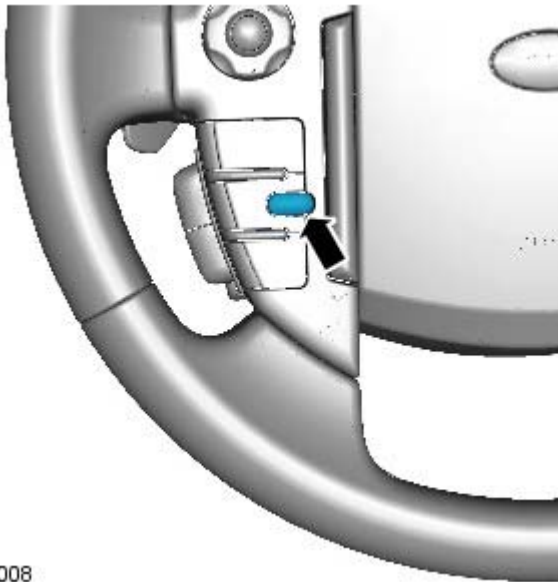
- Press the cruise control cancel button twice within 2 seconds.



E123929

23. **27.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- The message center display will revert to the normal display in the trip computer.
- Scroll through the trip menu to access the engine oil level display.
- This display is now the live reading of the engine oil level.
- Take a reading from the level display and, if necessary, top up with oil as instructed.



E121008

24.

- Press and hold the cruise control cancel button for more than 2 seconds.

25.

- The message center display will revert to the normal display in the trip computer.

26. Turn the ignition off.

27. Turn the ignition on.

28. **32.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- Scroll through the trip menu to access the engine oil level display.
- Make sure that the average oil level value has now been updated.





E123929

29. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

Engine - TDV6 3.0L Diesel - Engine Oil Vacuum Draining and Filling

General Procedures

Special Tool(s)

 <p>E129630</p>	<p>303-1484 Vacuum Pump, Oil Drain</p>
 <p>E129631</p>	<p>303-1484-01 Adapter for 303-1484</p>

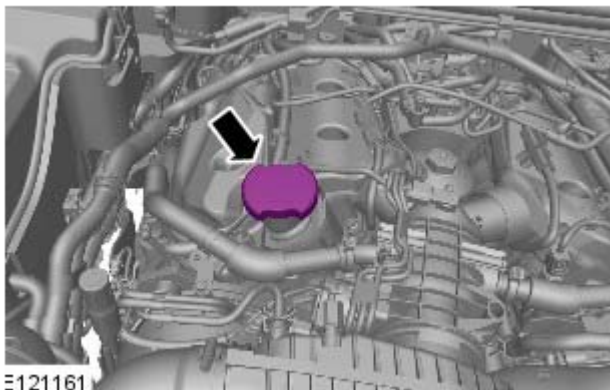
Draining



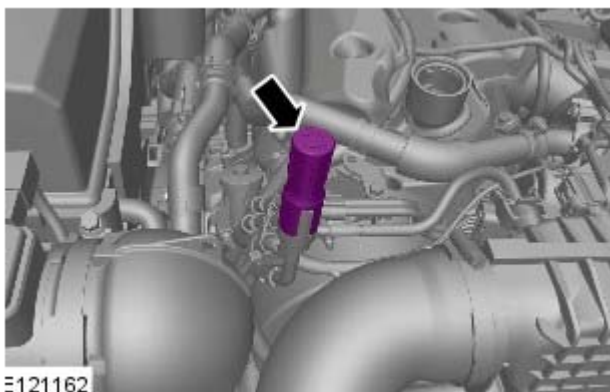
WARNING: The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.

- NOTE: Make sure that the vehicle is parked on level ground.
- NOTE: Clean the components general area prior to dismantling.

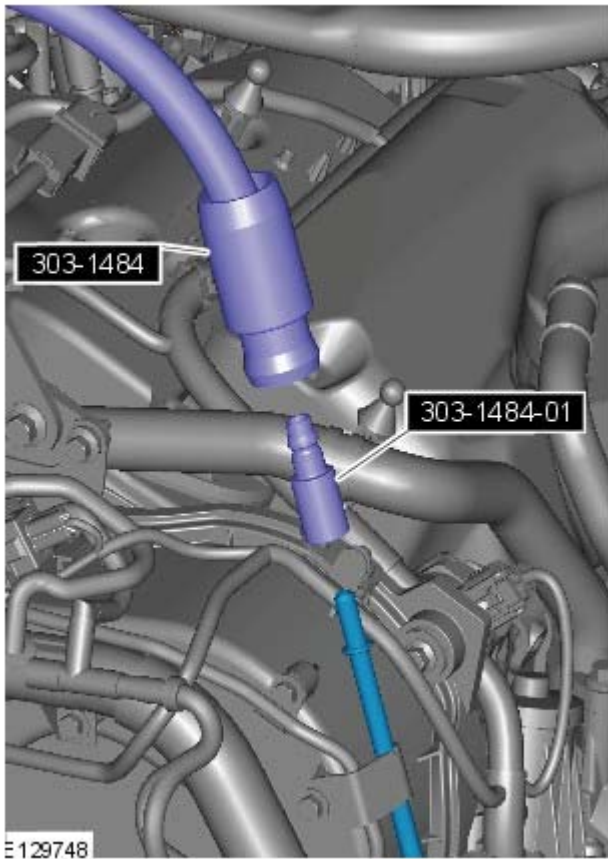
1. Refer to: [Oil Filter Element](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).



2.



3.  **CAUTION:** Allow 10 minutes from turning the engine off before starting oil extraction.



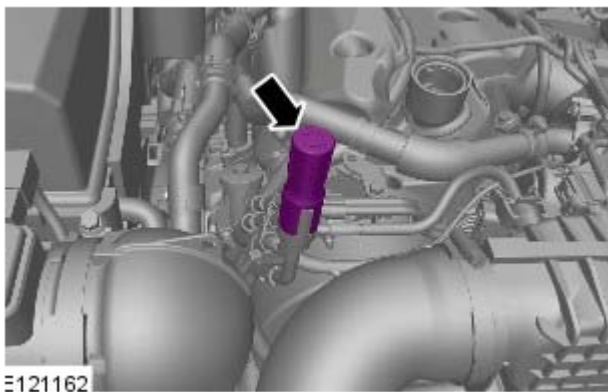
4.
 - Using the oil vacuum pump drain the oil out through the oil extraction tube.

Special Tool(s): [303-1484](#), [303-1484-01](#)

5.
 - Remove the oil vacuum pump.


Filling

1. Refer to: [Oil Filter Element](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

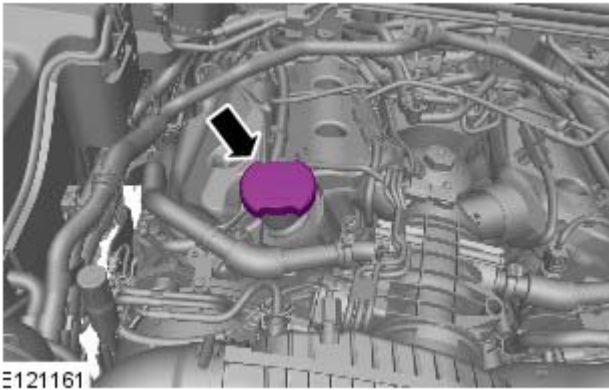



- 2.

3. Fill the engine with oil.

4. **9.**  **CAUTION:** Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum, before starting the engine. To check engine oil level follow steps 8-10.

Clean any residual engine oil from the oil filler cap area.



5. **10.**  **CAUTION:** Correct installation of the oil filler cap can be obtained by tightening the cap until an audible click is heard.

- 6.
- Start the engine and allow to run for 10 minutes, stop the engine.
 - Check for leaks.

7. **12. CAUTIONS:**



Make sure that the vehicle is parked on level ground.



Make sure that the selector lever and the gearshift mechanism are in the park (P) position.



Make sure that the hood is open.

• **NOTE:** Allow 10 minutes from the engine switch off for the engine oil level to stabilize.

- Turn the ignition on.

8.

- Press the right-hand directional button to access the instrument cluster menu.





E123925

- 9.
- Press the right-hand OK button.



- 10.
- Press the right-hand directional button to access the Oil Level Display.



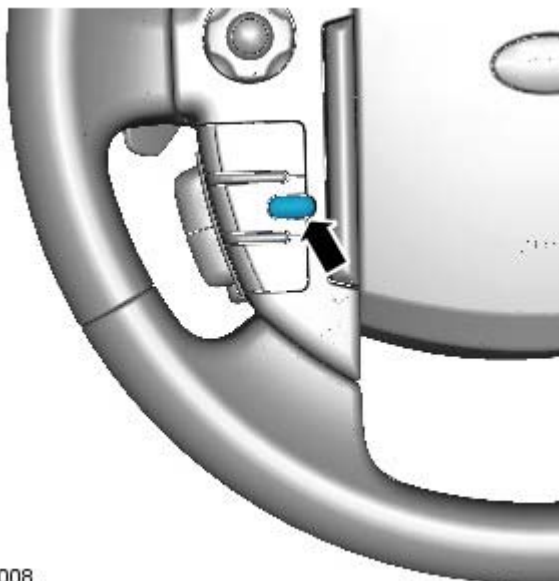
E123927



E123928

11.

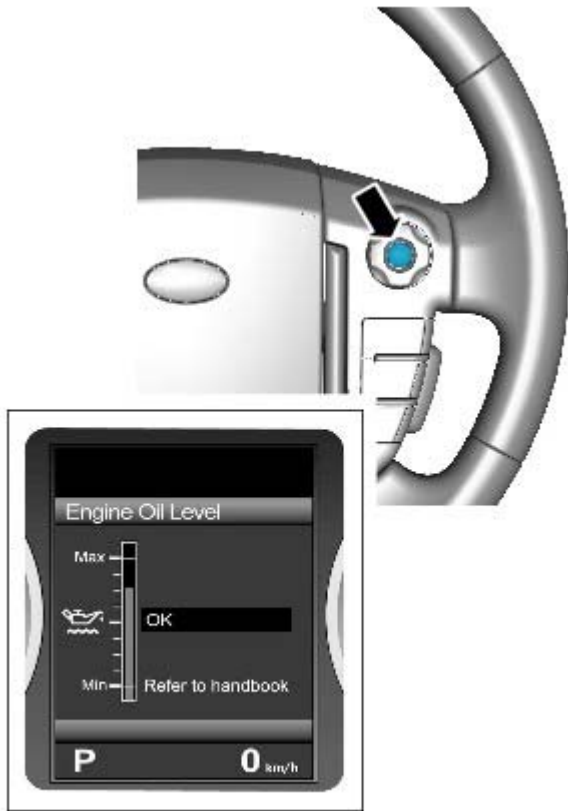
- Press the right-hand OK button and follow the instructions.



E121008

12.

- Press the cruise control cancel button twice within 2 seconds.



E123929

13.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes, switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.

14. Turn the ignition off.

15. **20. NOTE:** Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.

Turn the ignition on.

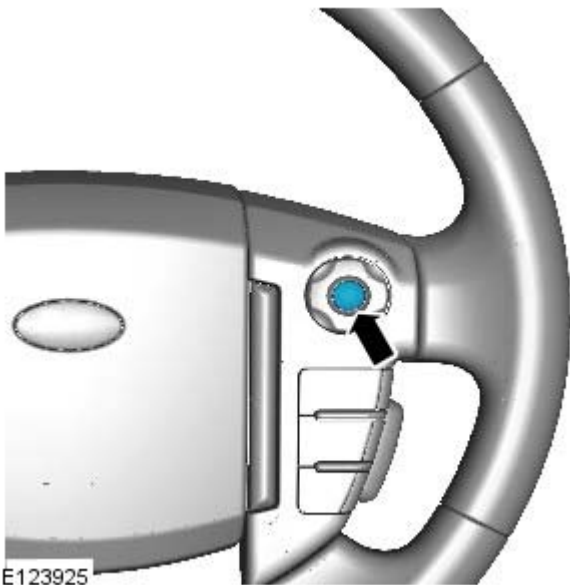


16.

- Press the right-hand directional button to access the instrument cluster menu.



E123926



17.

- Press the right-hand OK button.

E123925



E123927

18.

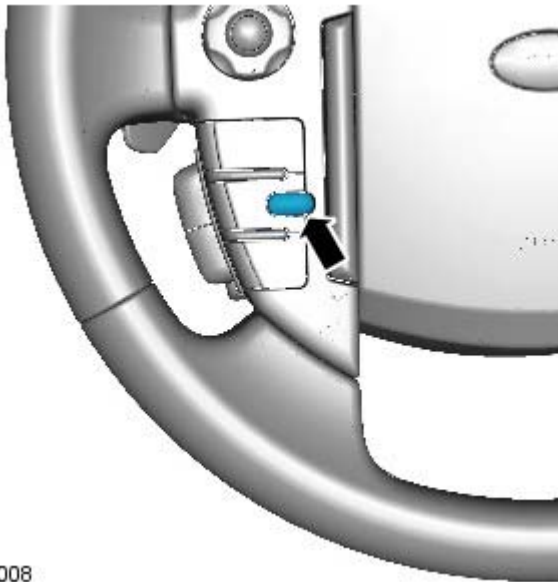
- Press the right-hand directional button to access the Oil Level Display.



E123928

19.

- Press the right-hand OK button and follow the instructions.



E121008

20.

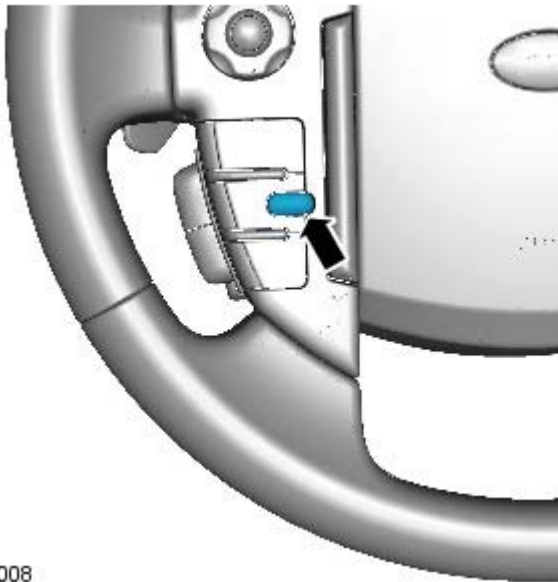
- Press and hold the cruise control cancel button for more than 2 seconds.



E123929

21. **26.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- This display is now the live reading of the engine oil level.
- Take a reading from the level display and, if necessary, top up with oil as instructed.



E121008

22.

- Press and hold the cruise control cancel button for more than 2 seconds.

23. The message center display will revert to the normal display in the trip computer.

24. Turn the ignition off.

25. Turn the ignition on.

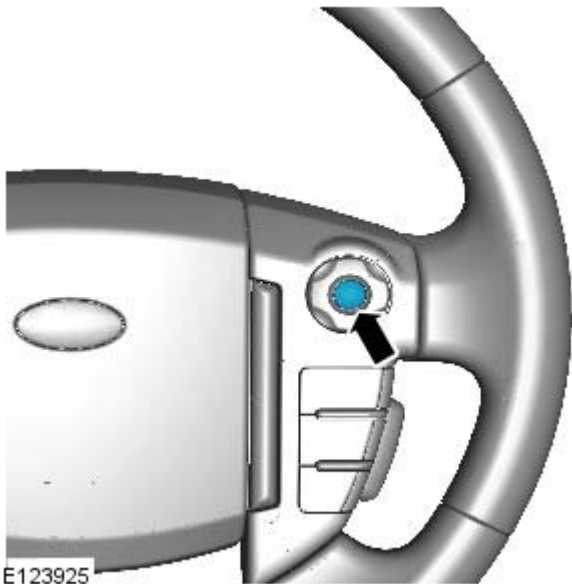


26.

- Press the right-hand directional button to access the instrument cluster menu.



E123926



27.

- Press the right-hand OK button.

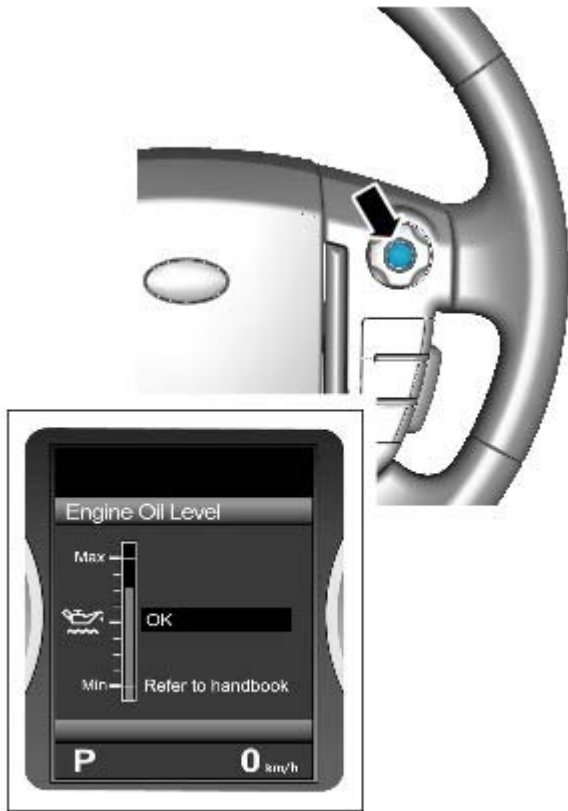


28.

- Press the right-hand directional button to access the Oil Level Display.



E123927



E123929

29. **34.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.


- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.

30. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

Engine - TDV6 3.0L Diesel - Camshaft LH

Removal and Installation

Special Tool(s)

 <p>303-1145/2 E60429</p>	<p>303-1145/2 Remover, Camshaft Rear Pulley Bolt</p>
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Removal

1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to: [Rear End Accessory Drive \(READ\)](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

4. Install the special tool.



5. Install the special tool.

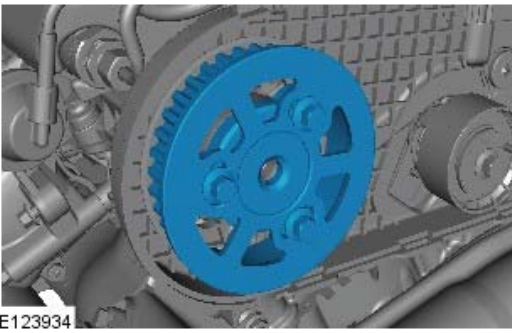


6. Using the special tool, remove the rear camshaft pulley retaining bolt.

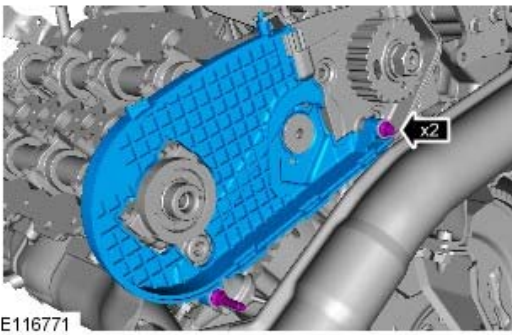


7. Remove the special tools.

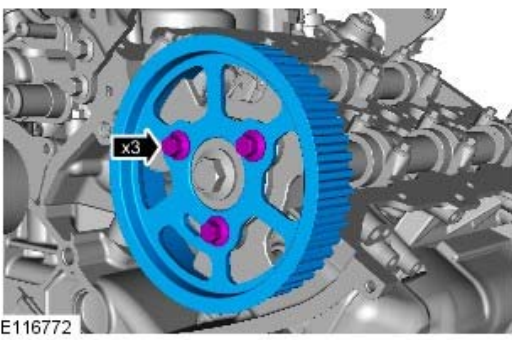
8.

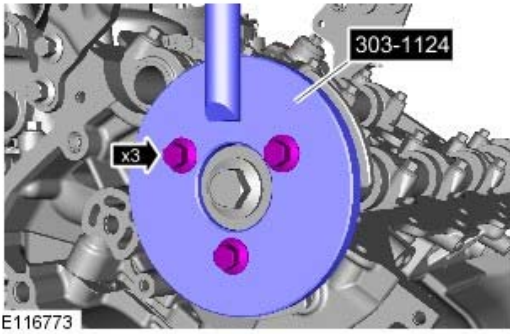


9.

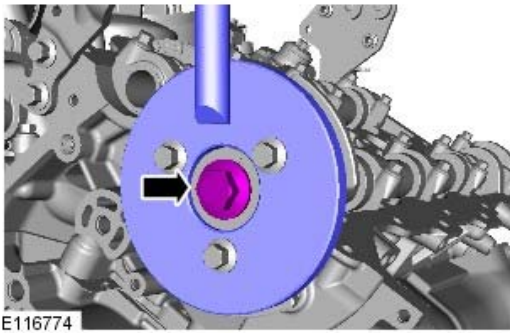


10.

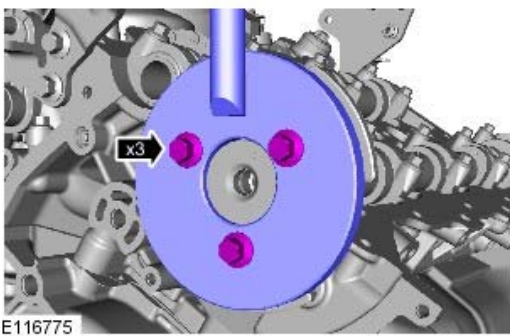




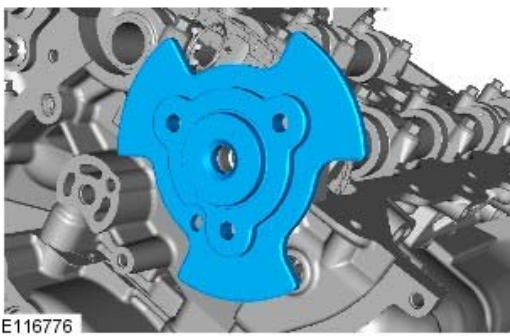
11. Install the special tool.



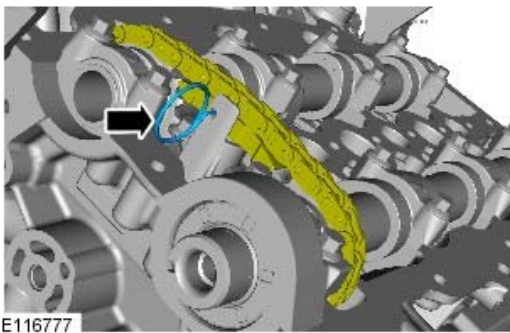
12.



13. Remove the special tool.

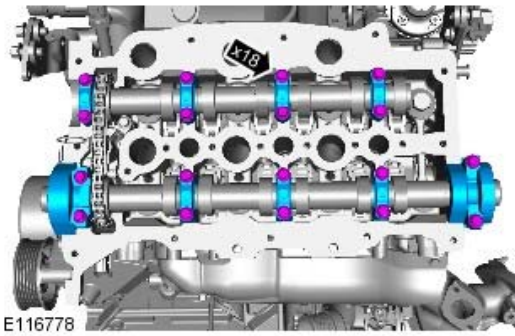


14.

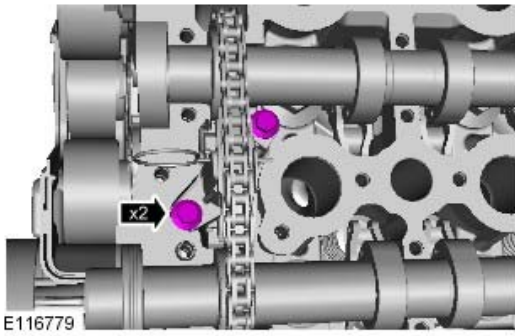


15.

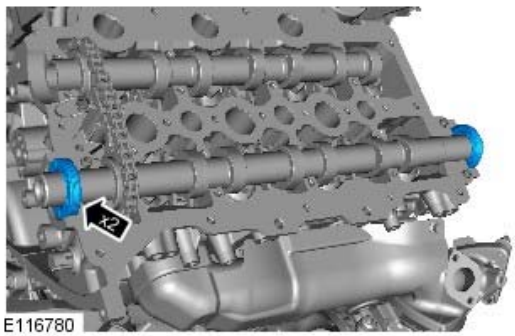
- Reposition the secondary timing chain tensioner.
- Retain the secondary timing chain tensioner plunger.



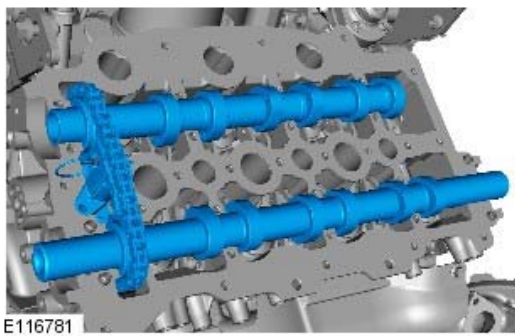
16. Remove the camshaft bearing caps evenly.



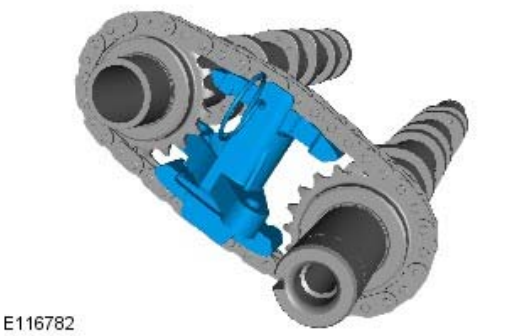
17.



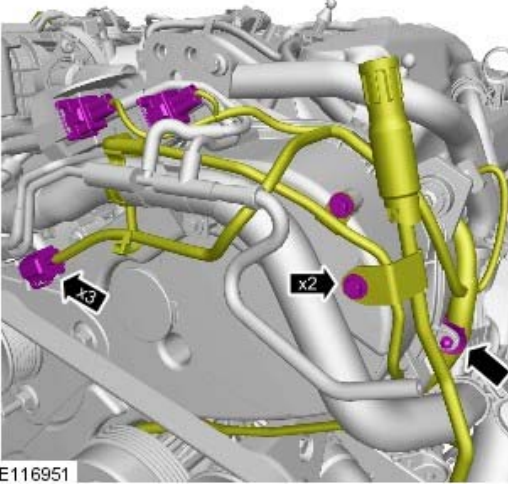
18. **18.**  CAUTION: Discard the seals.



19.

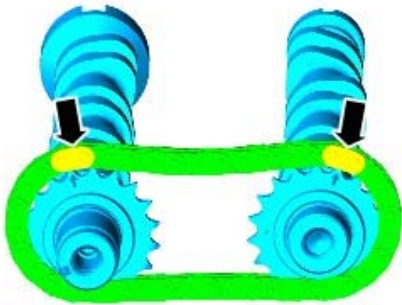


20.

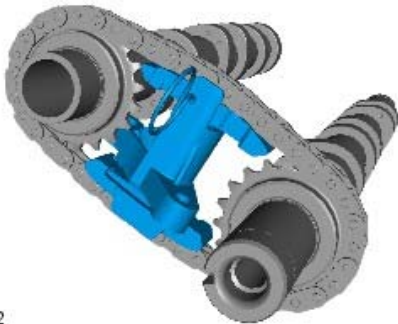


E116951

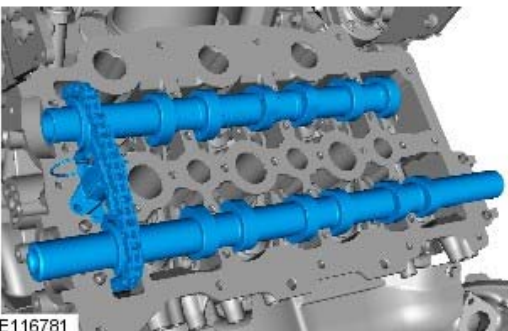
Installation



E86461




E116782



E116781

1. Install the secondary timing chain onto the camshafts.

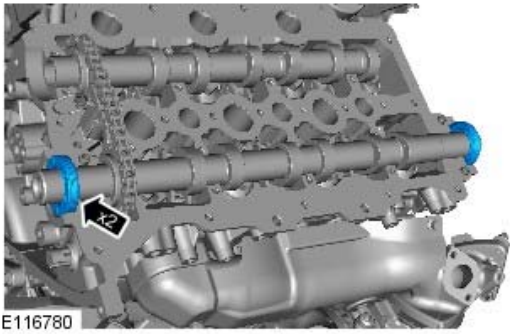
2. Install the secondary timing chain tensioner assembly.

3. **3.**  **CAUTION:** Make sure that the dots on the camshafts are aligned at the 12 o'clock position. Failure to follow this instruction may result in damage to the engine.

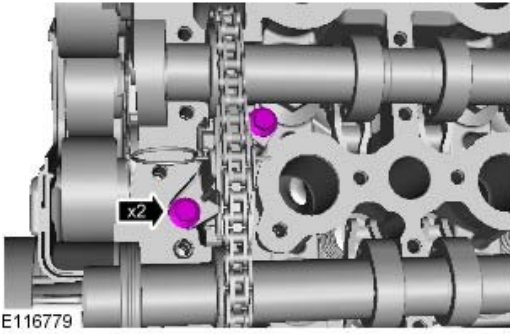
- NOTE: Lubricate the camshafts and the camshaft bearing caps with oil meeting Jaguar specification prior to installation.

- NOTE: Use hypoid oil to lubricate the camshafts.

Install the camshafts.



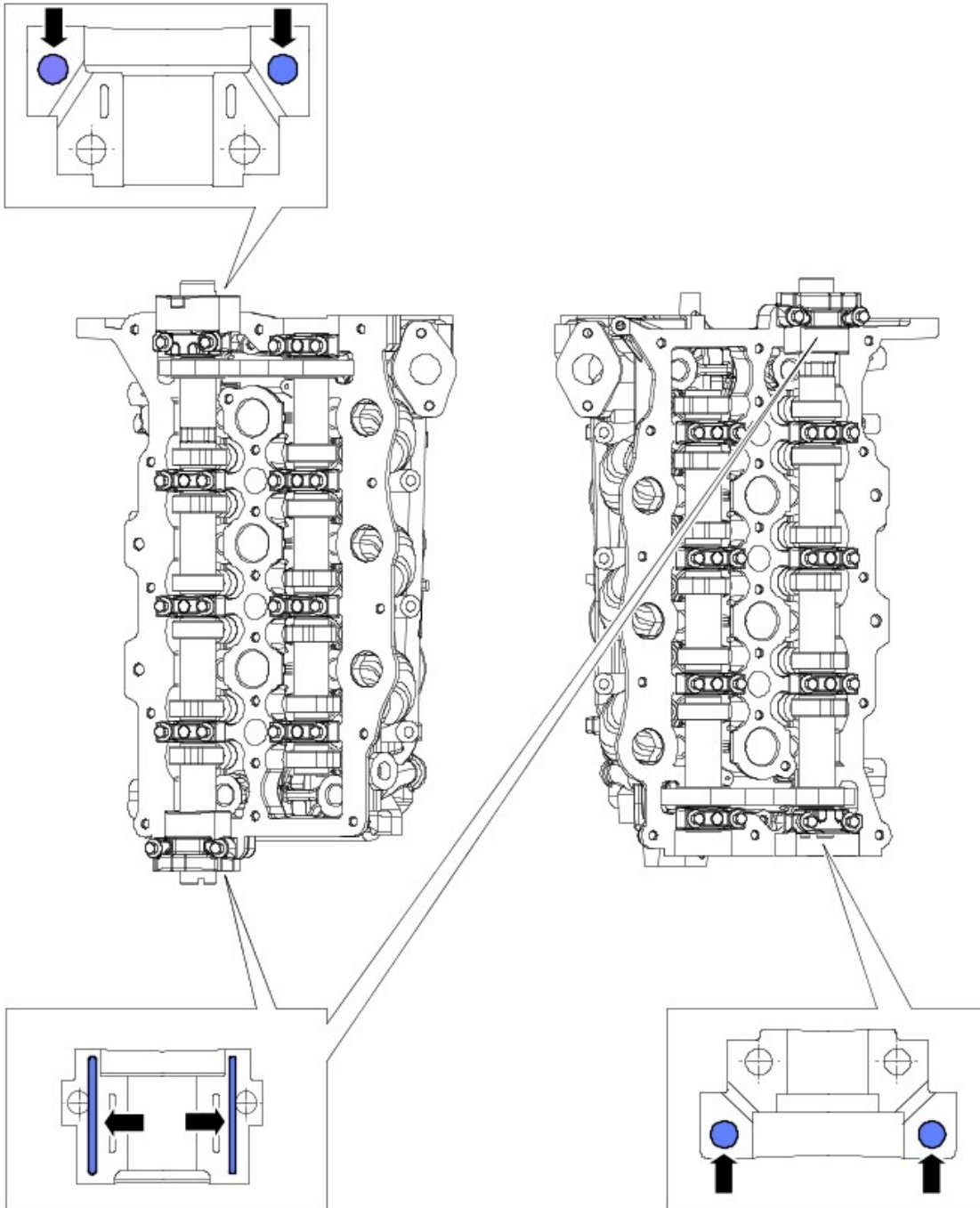
4. **4. NOTE:** Install new seals.



5. *Torque:* 10 Nm

6.

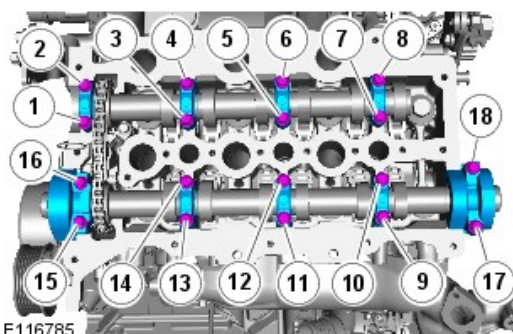
- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



E116784

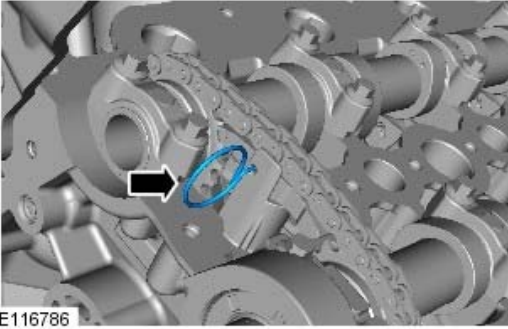
7. **7. NOTE:** Tighten the bolts in the indicated sequence.

- Install the camshaft bearing caps in their original positions.
- Stage 1: Bolts 1 to 14, 1 Nm.
- Stage 2: Bolts 1 to 14, 5 Nm.
- Stage 3: Bolts 1 to 14, 10 Nm.
- Stage 4: Bolts 15 to 18, 1 Nm.
- Stage 5: Bolts 15 to 18, 5 Nm.
- Stage 6: Bolts 15 to 18, 10 Nm.



E116785

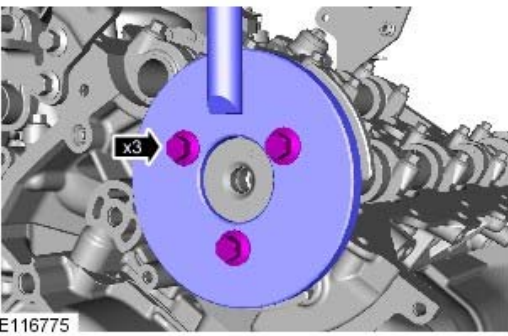
8. Remove the secondary timing chain tensioner retaining pin.



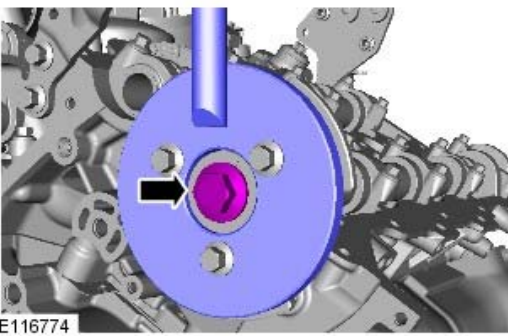
9.



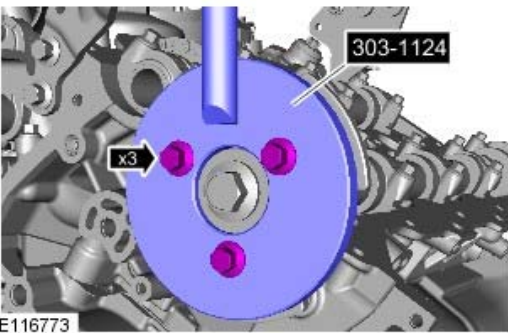
10. Install the special tool.

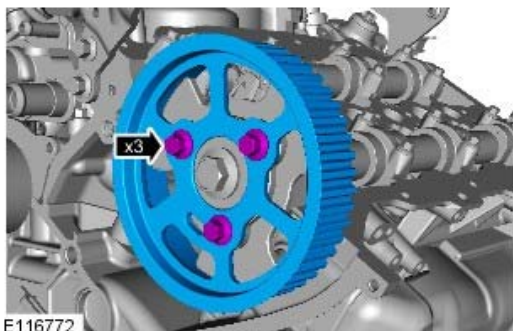


11. Torque:
Stage 1: 80 Nm
Stage 2: 80°



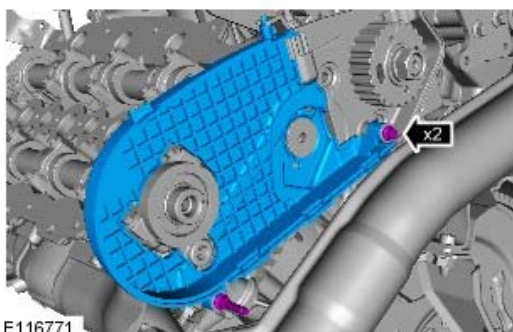
12. Remove the special tool.





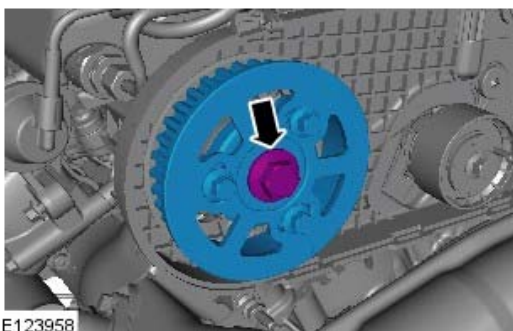
E116772

13. **13.** ⚠ CAUTION: Only tighten the bolt finger-tight at this stage.



E116771

14. *Torque: 10 Nm*



E123958

15. **15.** ⚠ CAUTION: Only tighten the bolt finger-tight at this stage.

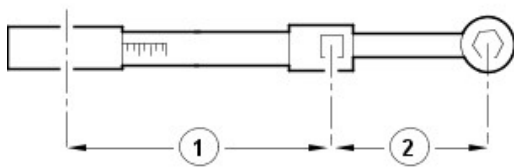


E123893

16. Install the special tool.



17. Install the special tool.



18. **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Calculate the setting for the torque wrench.

E37107



19. **CAUTION:** Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

- Using the special tool, install the camshaft rear pulley retaining bolt.
- *Special Tool(s):* [303-1145/2](#)
- *Torque:*
 - Stage 1: 80 Nm
 - Stage 2: 80°

20. Remove the special tools.

21. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

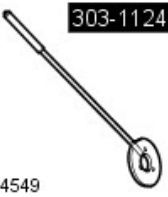
22. Refer to: [Rear End Accessory Drive \(READ\)](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

23. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 3.0L Diesel - Camshaft RH

Removal and Installation

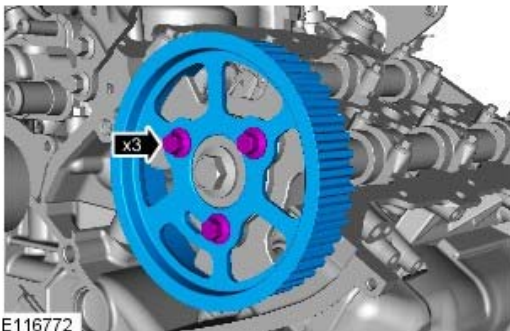
Special Tool(s)

 <p>303-1124</p> <p>E54549</p>	<p>303-1124 Holding Tool, Camshaft Front Pulley</p>
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Removal

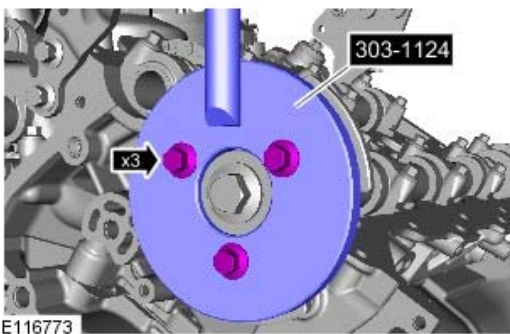
1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to: [Brake Vacuum Pump - TDV6 3.0L Diesel](#) (206-07 Power Brake Actuation, Removal and Installation).
3. Refer to: [Valve Cover RH](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

5. **5. NOTE:** LH illustration shown, RH is similar.

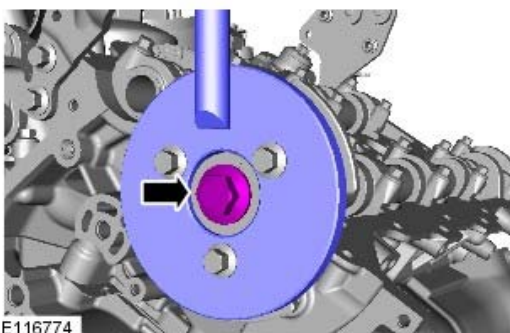


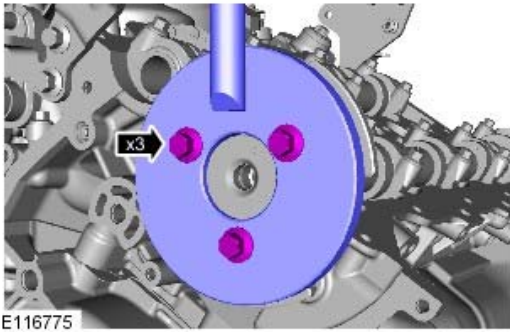
6. **6. NOTE:** LH illustration shown, RH is similar.

Special Tool(s): [303-1124](#)



7. **7. NOTE:** LH illustration shown, RH is similar.

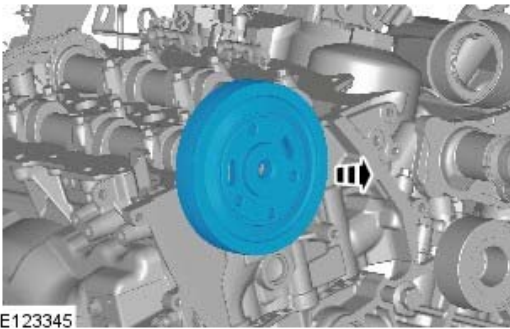




E116775

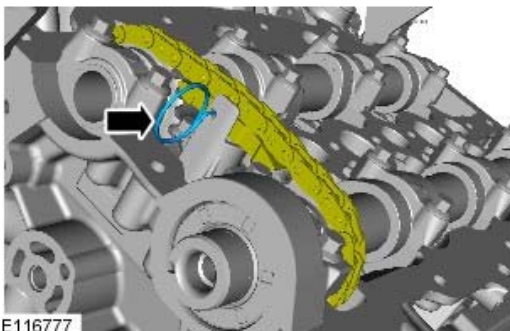
8. **8.** NOTE: LH illustration shown, RH is similar.

Special Tool(s): [303-1124](#)



E123345

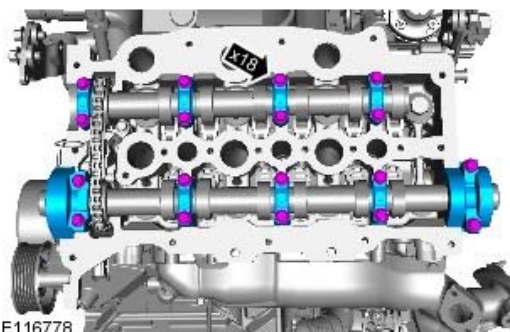
9.



E116777

10. **10.** NOTE: LH illustration shown, RH is similar.

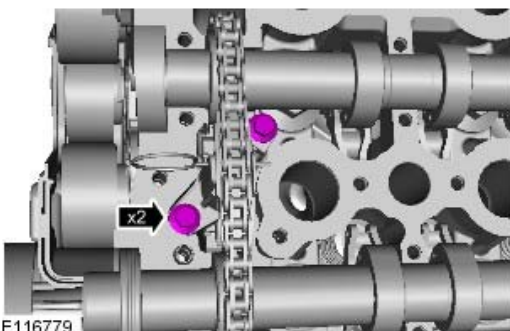
- Reposition the secondary timing chain tensioner.
- Retain the secondary timing chain tensioner plunger.



E116778

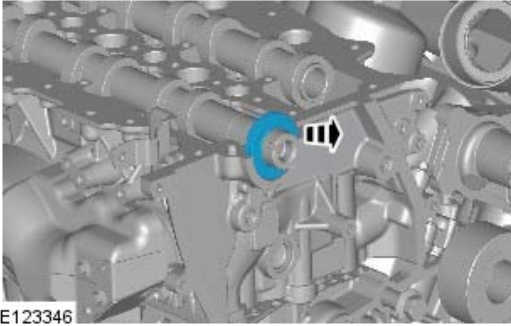
11. **11.**  CAUTION: Evenly and progressively, release the camshaft bearing caps.

- NOTE: LH illustration shown, RH is similar.



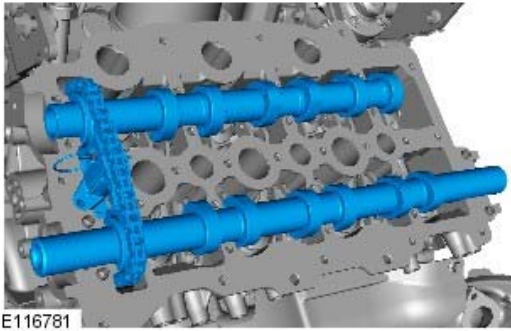
E116779

12. **12.** NOTE: LH illustration shown, RH is similar.



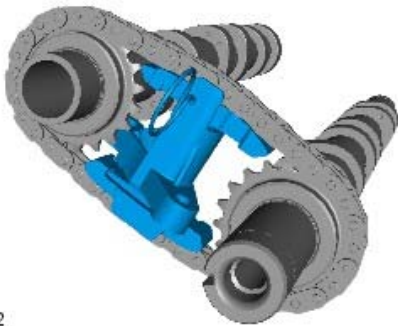
E123346

13. **13.**  CAUTION: Discard the seals.



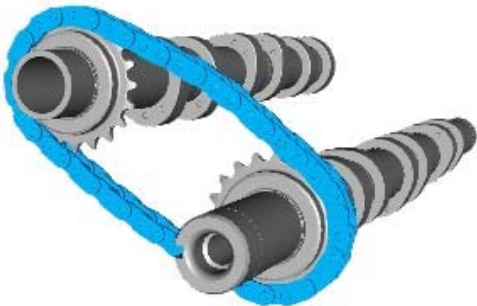
E116781

14. **14.** NOTE: LH illustration shown, RH is similar.



E116782

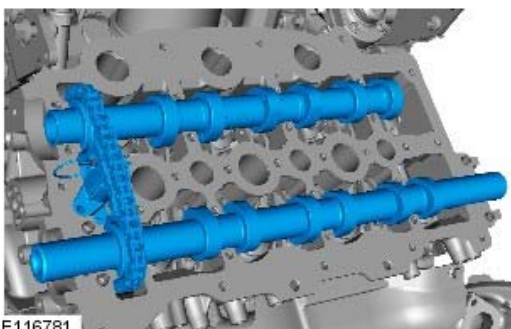
15.



E116783


16.

Installation

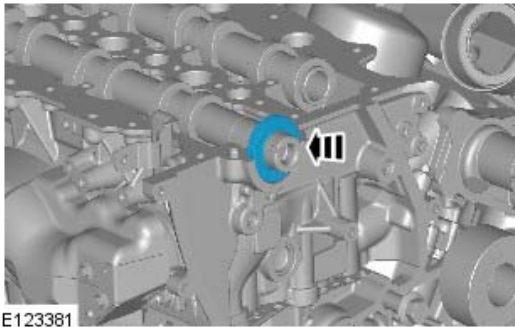


E116781

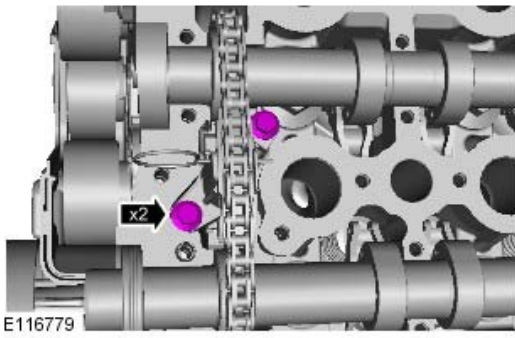
1.

2. **3.**  CAUTION: Make sure that the dots on the camshafts are aligned at the 12 o'clock position. Failure to follow this instruction may result in damage to the engine.

- NOTE: Use hypoid oil to lubricate the camshafts.



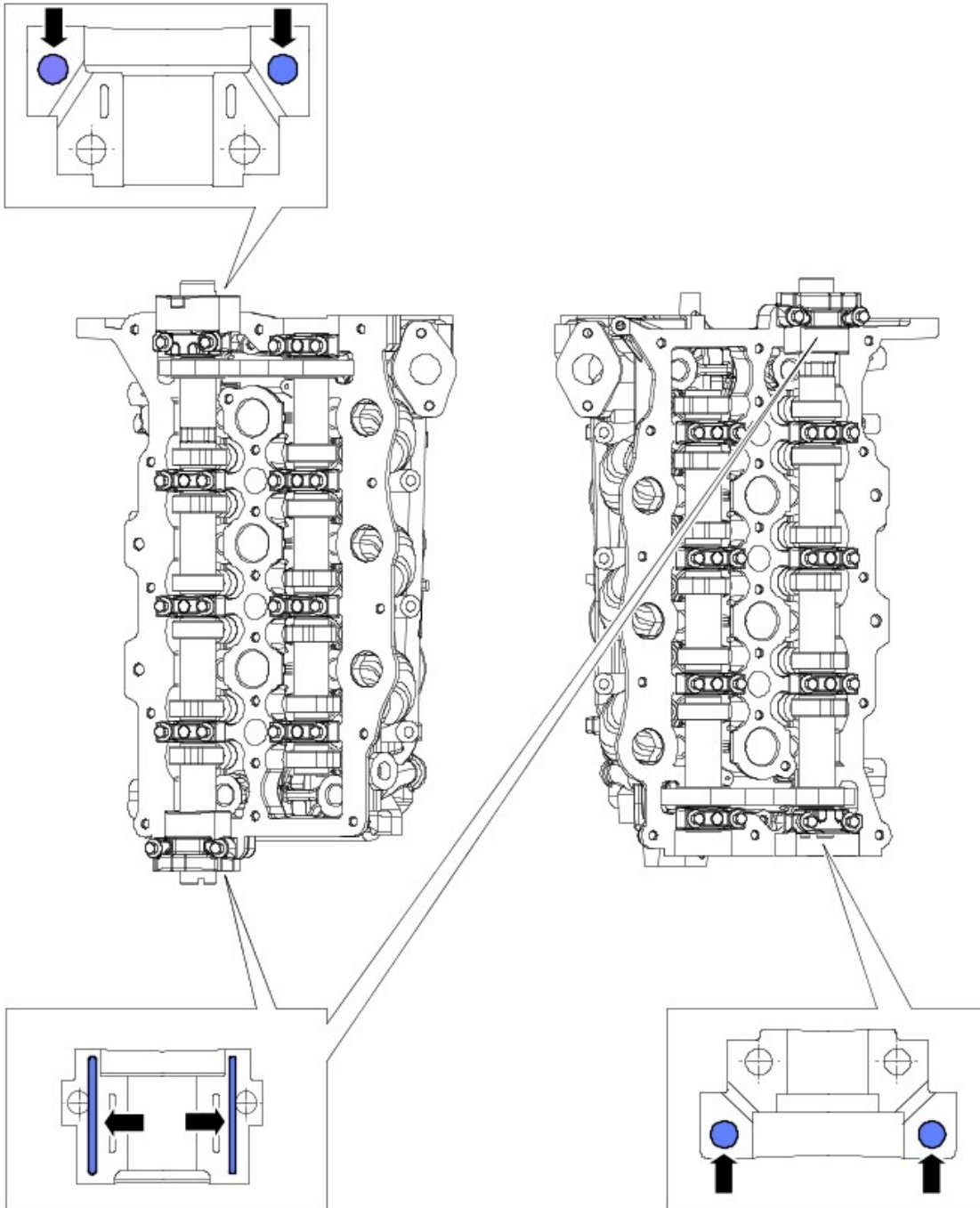
4. **4. NOTE:** Install new seals.



5. *Torque: 10 Nm*

6.

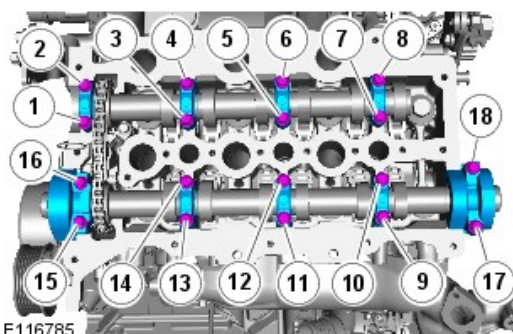
- Apply Loctite 518 sealant to the exhaust camshaft seal bearing caps.
- Apply Loctite 518 sealant, 2 mm wide, to the LH rear and RH front camshaft bearing caps.
- Apply Loctite 518 sealant, 7 mm diameter, to the LH front and RH rear camshaft bearing caps.



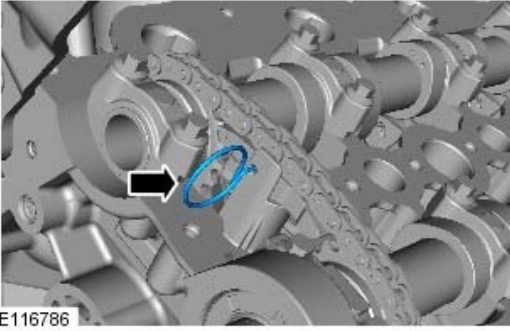
E116784

7. **7. NOTE:** Tighten the bolts in the indicated sequence.

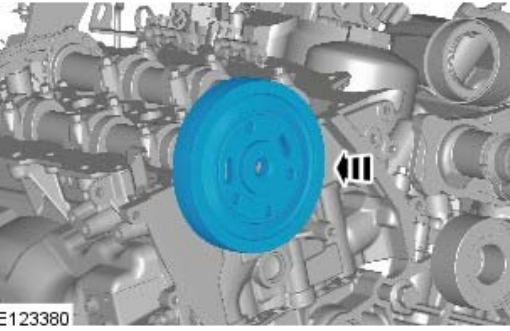
- Install the camshaft bearing caps in their original positions.
- Stage 1: Bolts 1 to 14, 1 Nm.
- Stage 2: Bolts 1 to 14, 5 Nm.
- Stage 3: Bolts 1 to 14, 10 Nm.
- Stage 4: Bolts 15 to 18, 1 Nm.
- Stage 5: Bolts 15 to 18, 5 Nm.
- Stage 6: Bolts 15 to 18, 10 Nm.



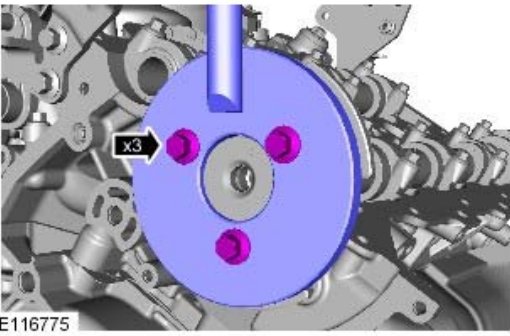
E116785



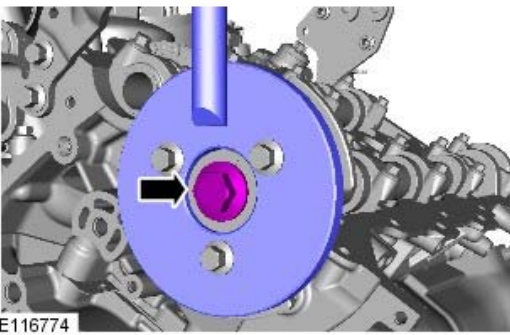
8.



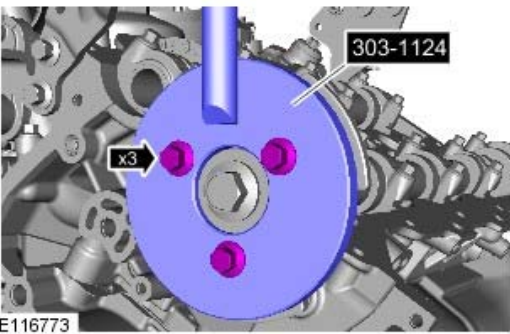
9.



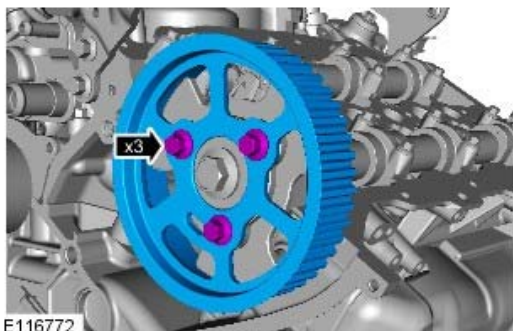
10. *Special Tool(s):* [303-1124](#)



11. *Torque:*
Stage 1:80 Nm
Stage 2:80°



12. *Special Tool(s):* [303-1124](#)







13. **13.**  CAUTION: Only tighten the bolt finger-tight at this stage.

14. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
15. Refer to: [Valve Cover RH](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
16. Refer to: [Brake Vacuum Pump - TDV6 3.0L Diesel](#) (206-07 Power Brake Actuation, Removal and Installation).
17. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 3.0L Diesel - Camshaft Front Seal

Removal and Installation

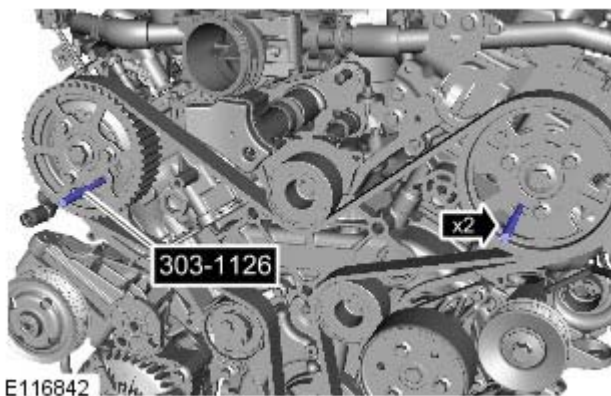
Special Tool(s)


 <p>303-1118</p> <p>E54541</p>	<p>303-1118 Remover, Camshaft Seal</p>
 <p>303-1119</p> <p>E54542</p>	<p>303-1119 Installer, Camshaft Seal</p>
 <p>303-1124</p> <p>E54549</p>	<p>303-1124 Holding Tool, Camshaft Front Pulley</p>
 <p>303-1126</p> <p>E54551</p>	<p>303-1126 Timing Peg, Camshaft Pulley</p>

Removal

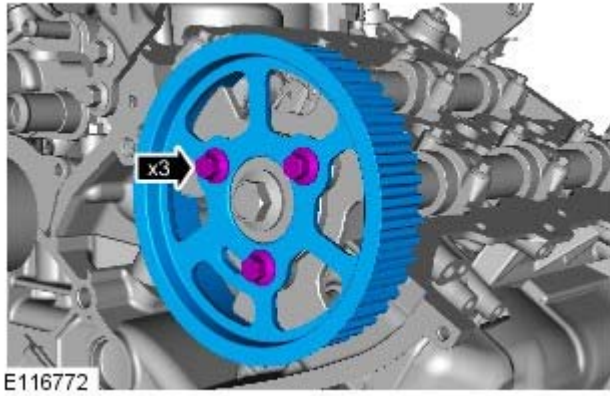
• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

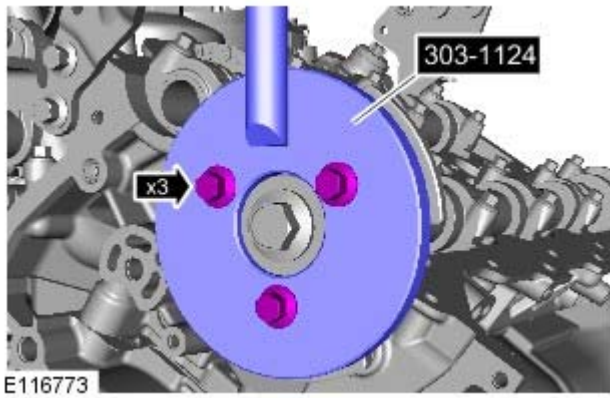


3.  CAUTION: Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

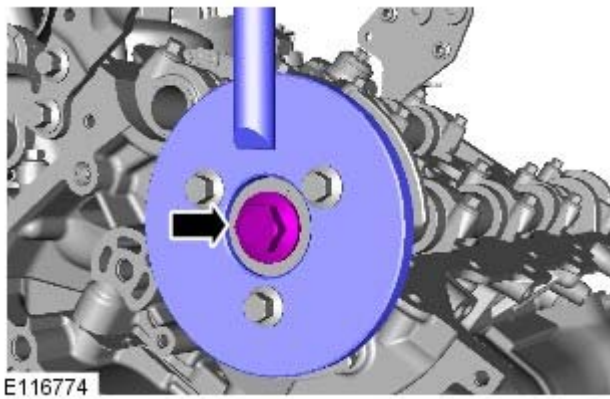
Special Tool(s): [303-1126](#)



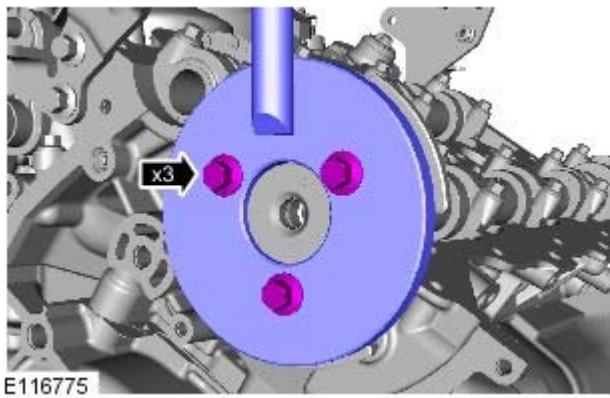
4.



5. *Special Tool(s):* [303-1124](#)



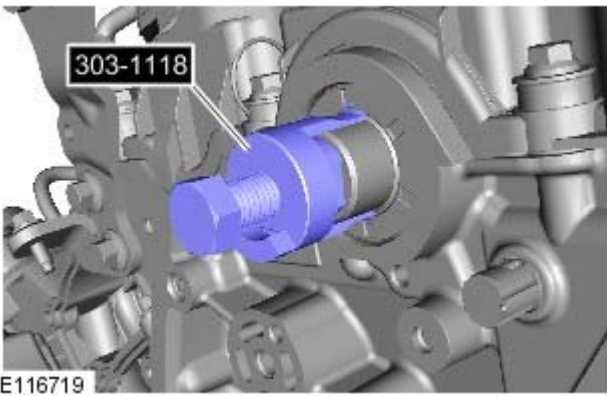
6.




7. *Special Tool(s):* [303-1124](#)

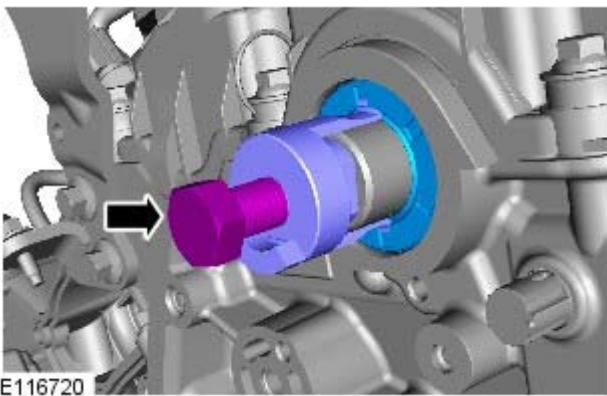


8.



9.  CAUTION: Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

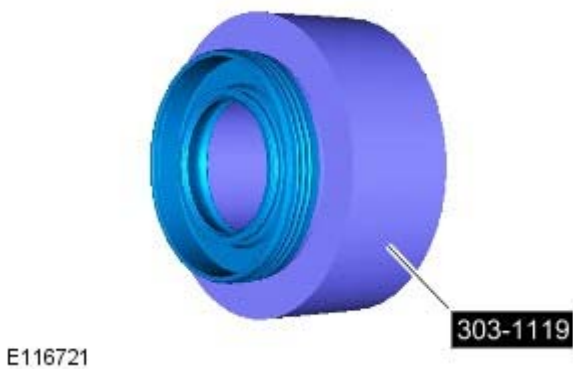
Special Tool(s): [303-1118](#)

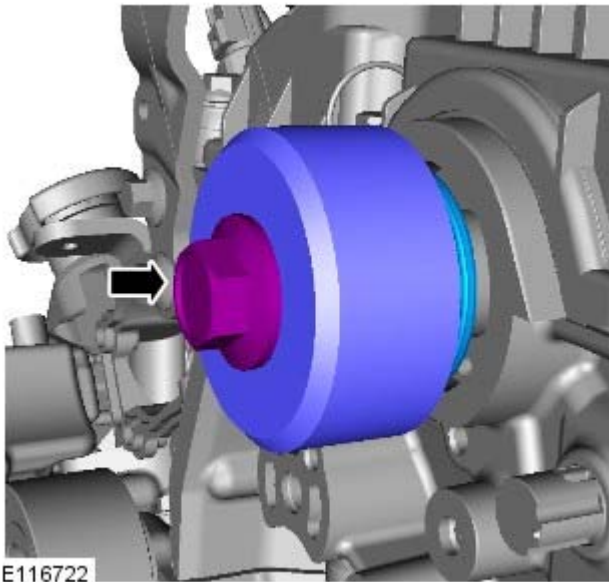


10.

Installation


1. *Special Tool(s):* [303-1119](#)






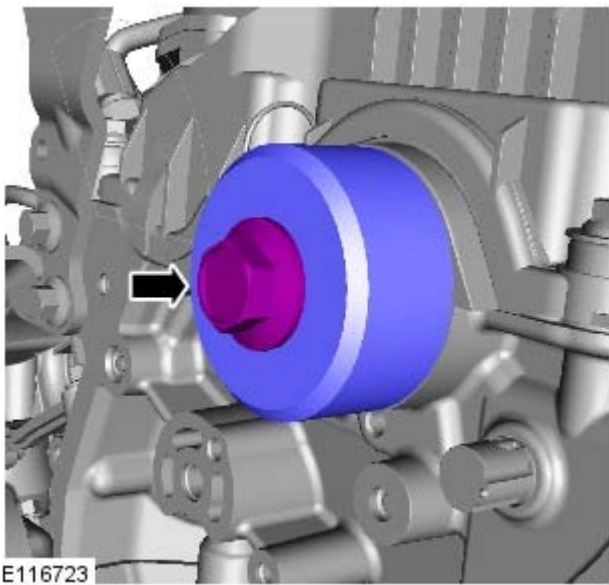
2. 2. CAUTIONS:

 Make sure the seal is installed correctly.

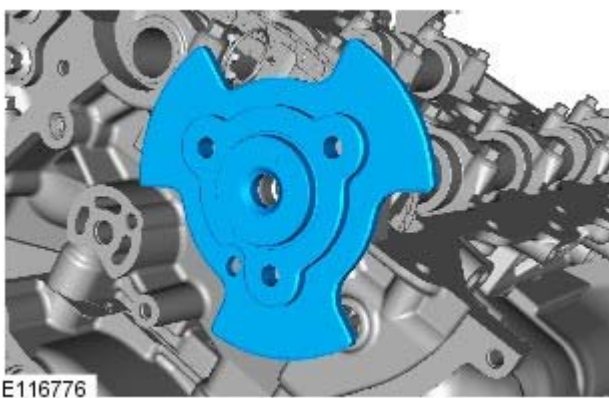
 Make sure that the mating faces are clean and free of corrosion and foreign material.

 Do not use any lubricant on the camshaft front seal or the camshaft. Failure to follow this instruction may result in damage to the vehicle.

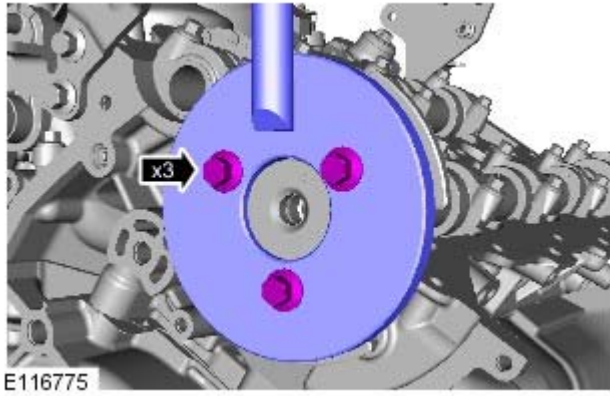
• NOTE: Make sure that the seal is 1mm below the face of the cylinder head.



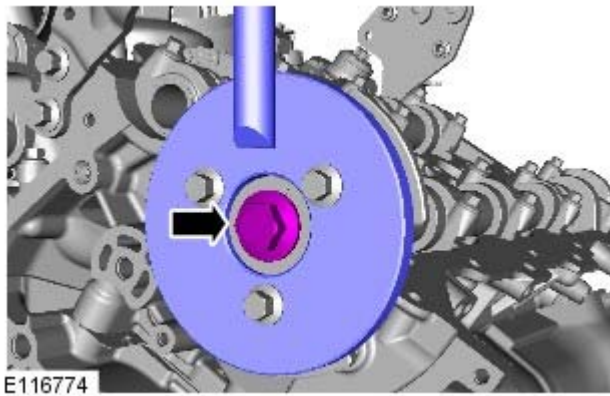
3. *Special Tool(s):* [303-1119](#)



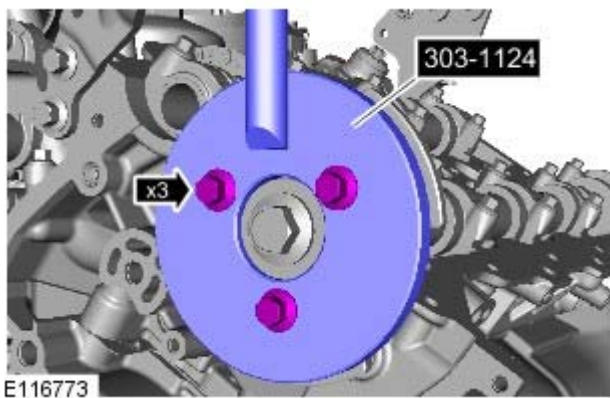
4.



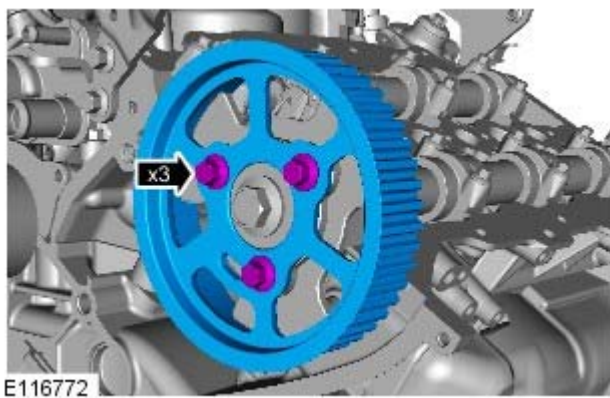
5. *Special Tool(s):* [303-1124](#)



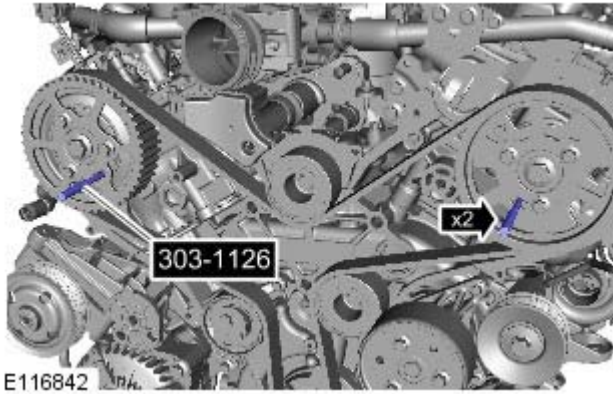
6. *Torque:*
Stage 1:80 Nm
Stage 2:80°




7. *Special Tool(s):* [303-1124](#)



8.  **CAUTION:** Only tighten the bolt finger-tight at this stage.



9.  **CAUTION:** Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.

Special Tool(s): [303-1126](#)

10. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
11. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 3.0L Diesel - Camshaft Rear Seal

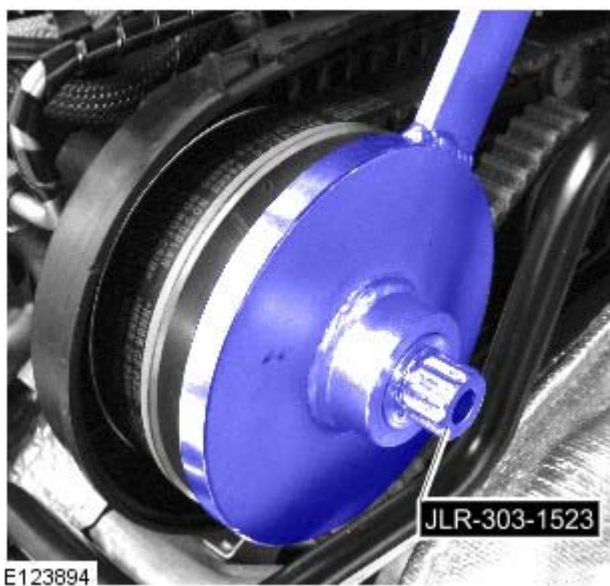
Removal and Installation

Removal

1. Refer to: [Rear End Accessory Drive \(READ\)](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).



2. Install the special tool.

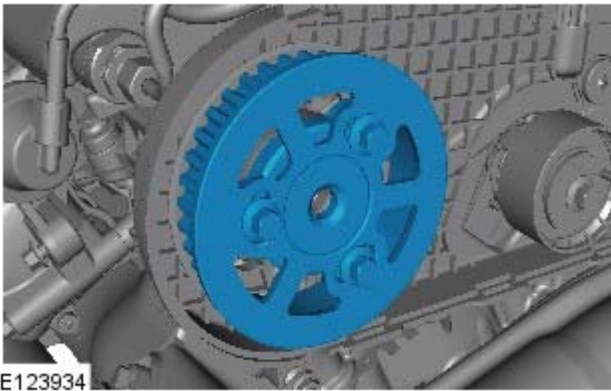


3. Install the special tool.

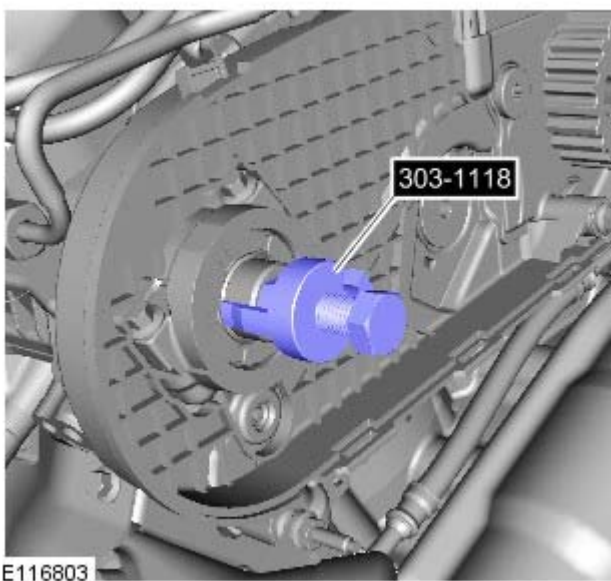



- Using the special tool, remove the rear camshaft pulley retaining bolt.

- Remove the special tools.

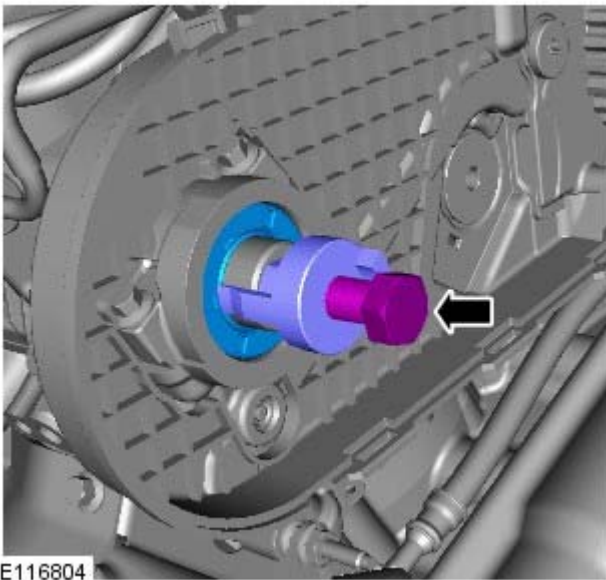


-



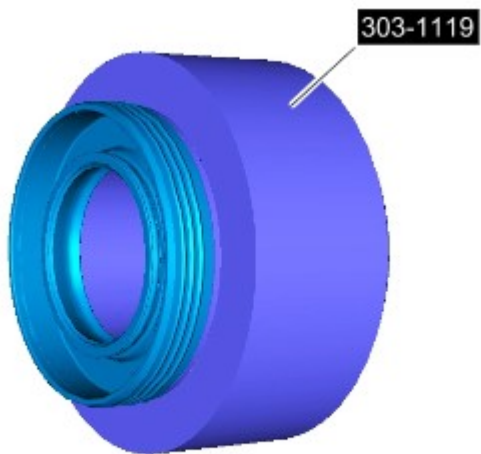
- 7.**  **CAUTION:** Make sure the special tool is correctly seated behind the camshaft seal. Failure to follow this instruction may result in damage to the special tool.

Install the special tool.



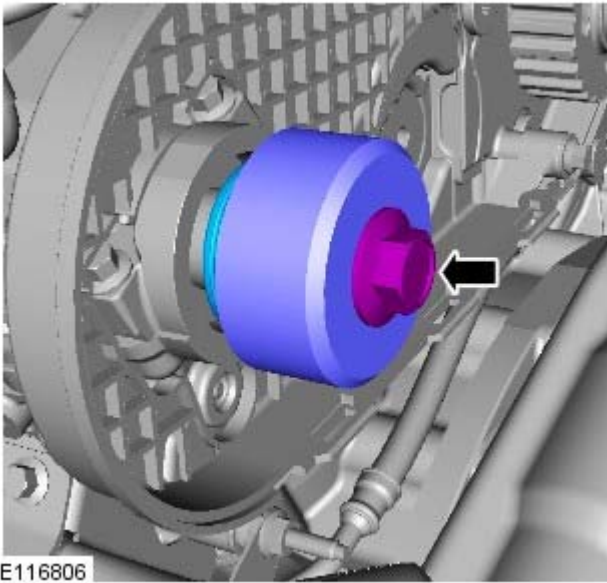
8.

Installation




1. Install with the special tool.


E116805



2. **2. CAUTIONS:**

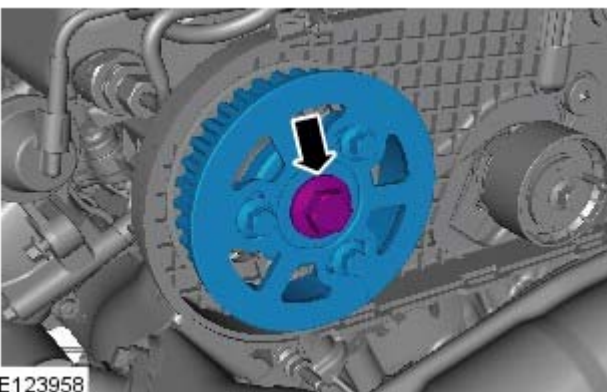
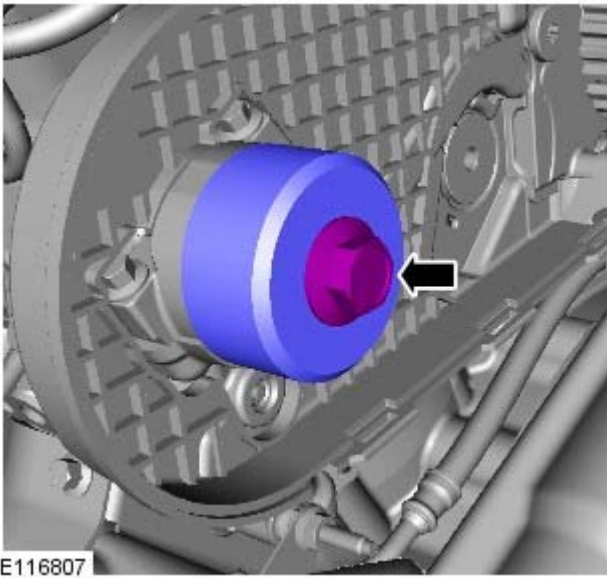
 Make sure the seal is installed correctly.

 Make sure that the mating faces are clean and free of corrosion and foreign material.

 Do not use any lubricant on the camshaft rear seal or the camshaft. Failure to follow this instruction may result in damage to the vehicle.

• **NOTE:** Make sure that the seal is 1mm below the face of the cylinder head.

3. Remove the special tool.



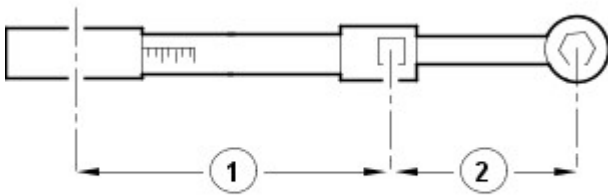
4.  **CAUTION:** Only tighten the bolt finger-tight at this stage.




5. Install the special tool.



6. Install the special tool.




7.  CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Calculate the setting for the torque wrench.

E37107



8.  CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.
 - Using the special tool, install the camshaft rear pulley retaining bolt.
 - Stage one: Tighten to 80 Nm (59 lb.ft).
 - Stage two: Tighten a further 80 degrees.




9. Refer to: [Rear End Accessory Drive \(READ\)](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

10. Remove the special tools.

Engine - TDV6 3.0L Diesel - Crankshaft Front Seal

Removal and Installation

Special Tool(s)

 <p>303-1120</p> <p>E54543</p>	<p>303-1120 Remover, Crankshaft Front Seal</p>
 <p>E52717</p>	<p>303-1121 Crankshaft Seal Installer</p>
 <p>303-1122</p> <p>E54545</p>	<p>303-1122 Installer, Crankshaft Front Seal</p>

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

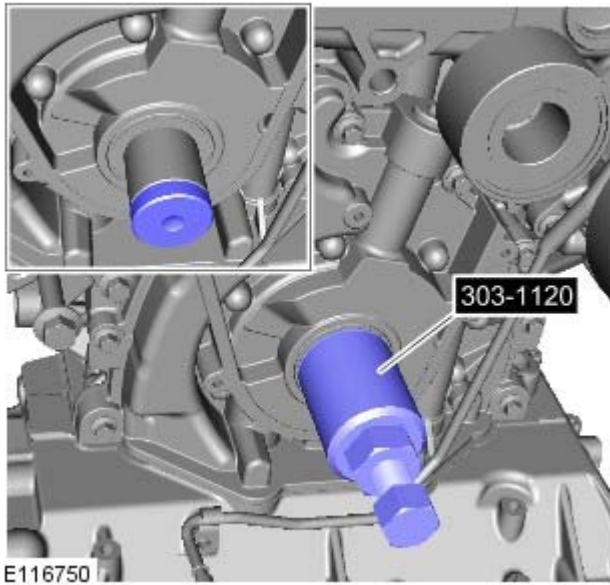
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

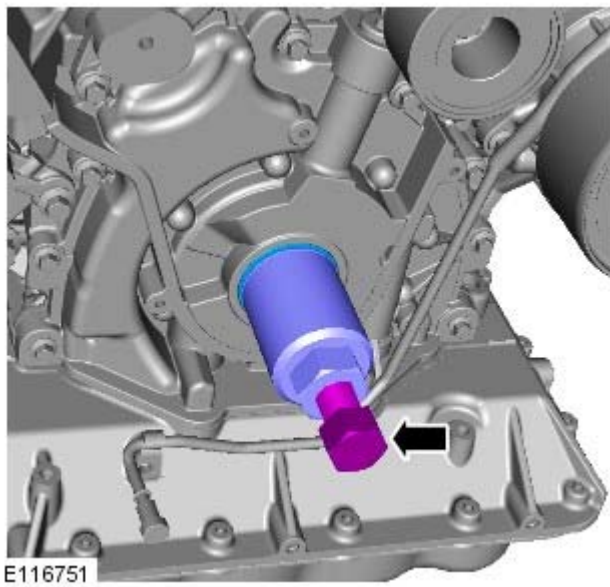
Raise and support the vehicle.


3. Refer to: [Crankshaft Pulley](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).



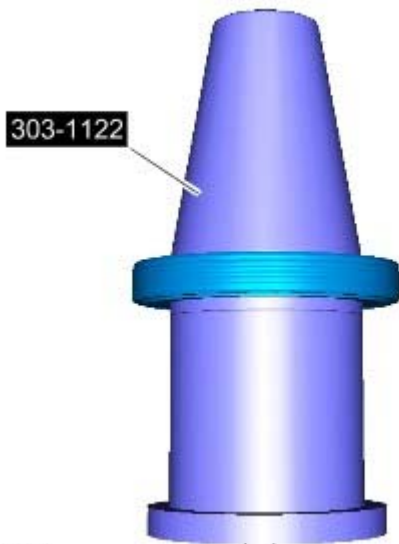
4. Install the special tool.


Special Tool(s): [303-1120](#)



5.  **CAUTION:** Discard the seal.
Using the special tool, remove the crankshaft front seal.

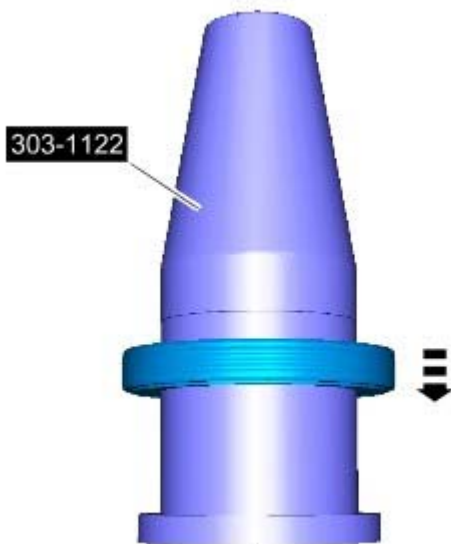
Installation



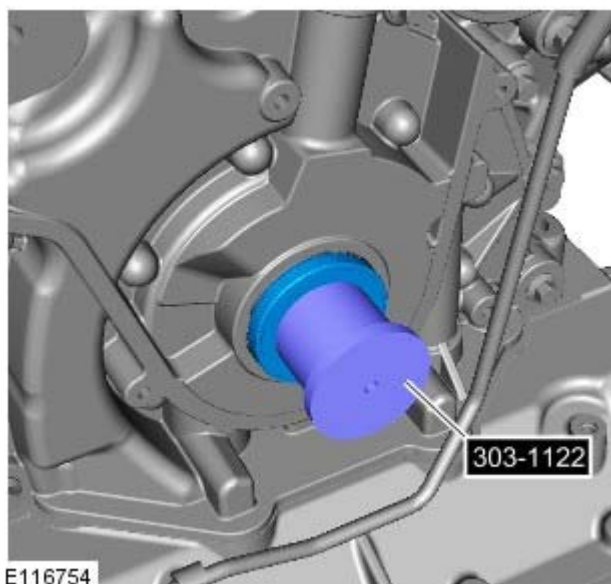
1.  **CAUTION:** Do not use any lubricant on the crankshaft front seal, special tools or the crankshaft. Failure to follow this instruction may result in damage to the vehicle.
 - **NOTE:** Make sure that all the component mating faces are clean.

Install a new crankshaft front seal to the special tool.

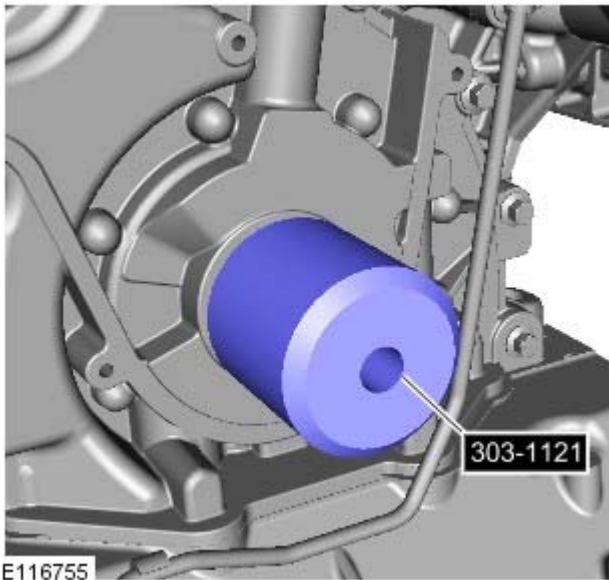
Special Tool(s): [303-1122](#)



2. Reposition the crankshaft front seal along the special tool.

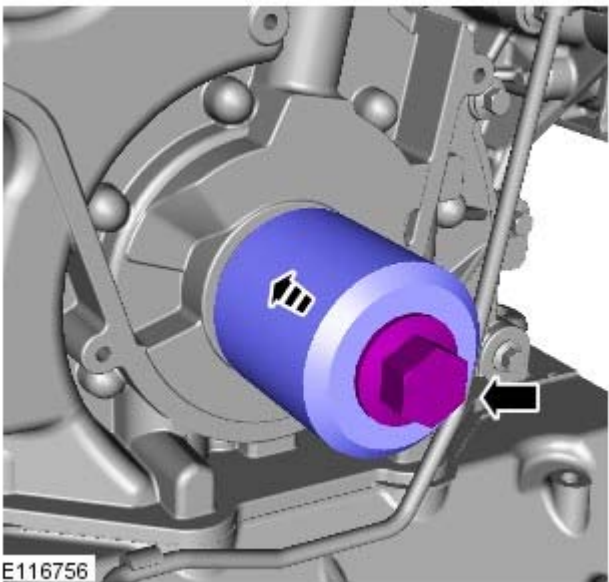


3. Install the special tool to the crankshaft.



4. Install the special tool to the crankshaft.

Special Tool(s): [303-1121](#)



5. **5. CAUTIONS:**



Make sure the seal is installed correctly.

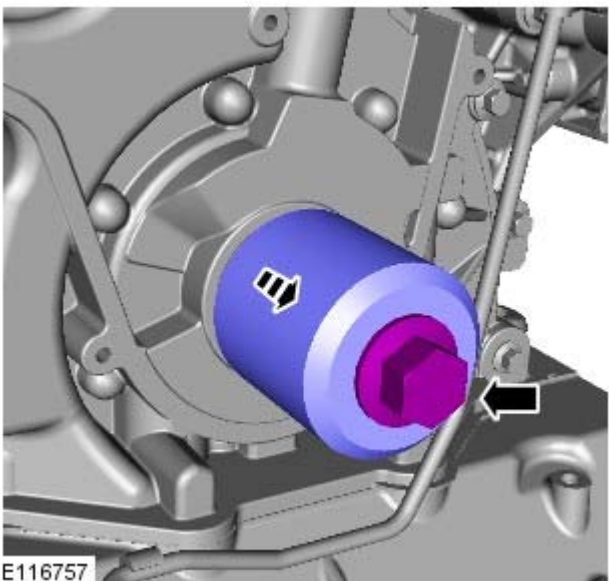


Make sure that the seal is seated 1mm under flush.



Discard the bolt.

Using the special tool, install the crankshaft front seal.



6. Remove the special tool.

Special Tool(s): [303-1121](#)

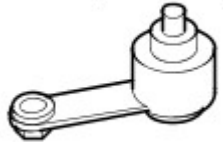
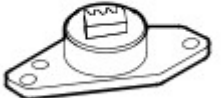

7. Refer to: [Crankshaft Pulley](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
8. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Engine - TDV6 3.0L Diesel - Crankshaft Pulley

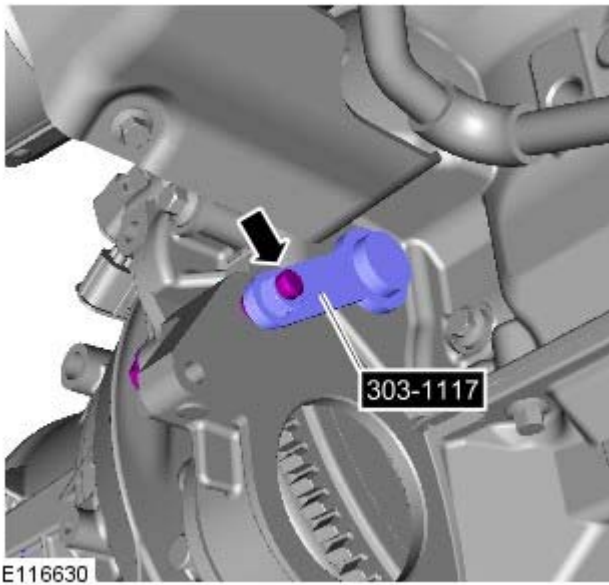
Removal and Installation

Special Tool(s)

 <p>303-1117</p> <p>E54540</p>	<p>303-1117 Timing Peg, Automatic Transmission</p>
 <p>303-1123</p> <p>E 54546</p>	<p>303-1123 Locking Tool, Flywheel</p>
 <p>303-D121</p> <p>E64849</p>	<p>303-D121 Puller, General Purpose</p>

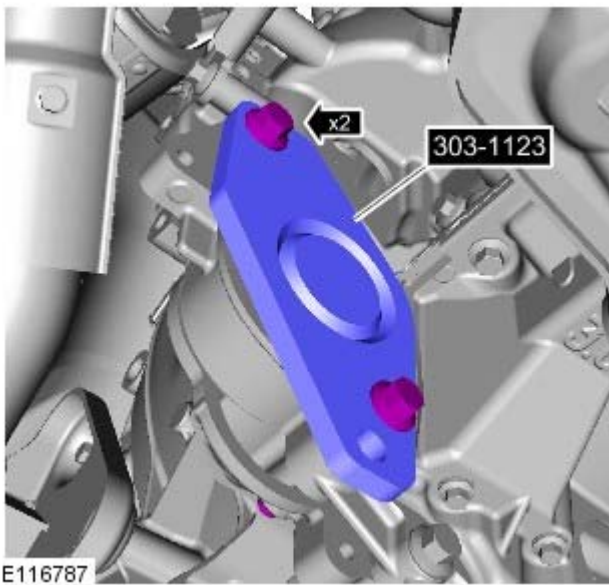
Removal

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).



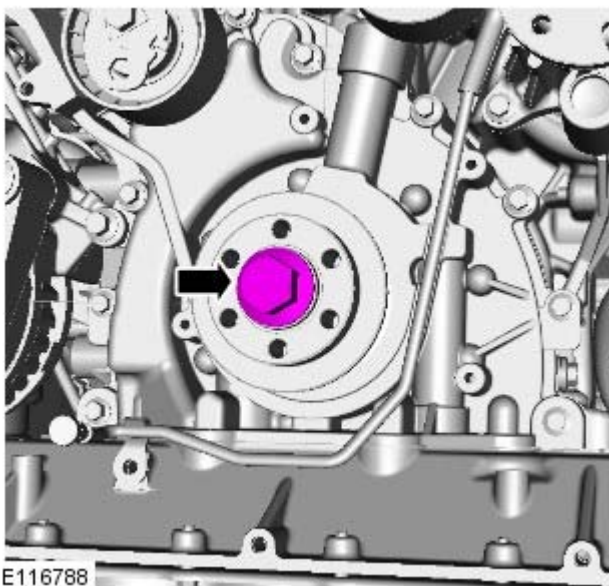
4.

- Remove the special tool.
- *Special Tool(s):* [303-1117](#)

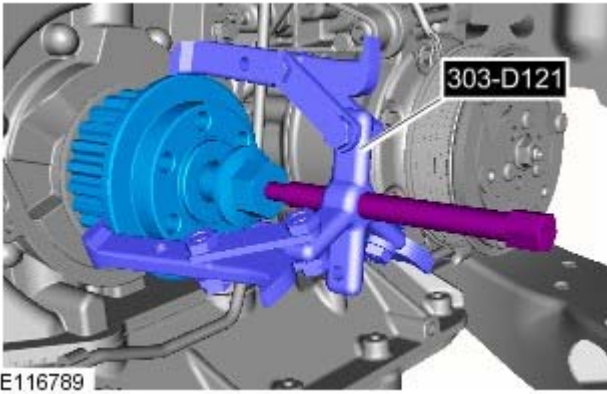


5.

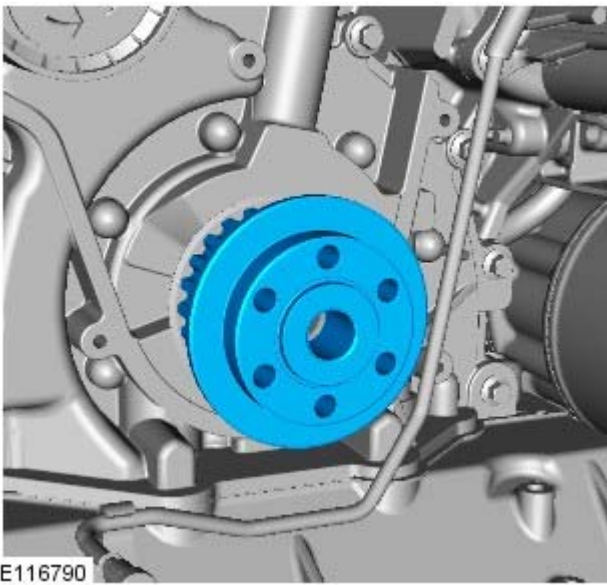
- Install the special tool.
- *Special Tool(s):* [303-1123](#)



6.

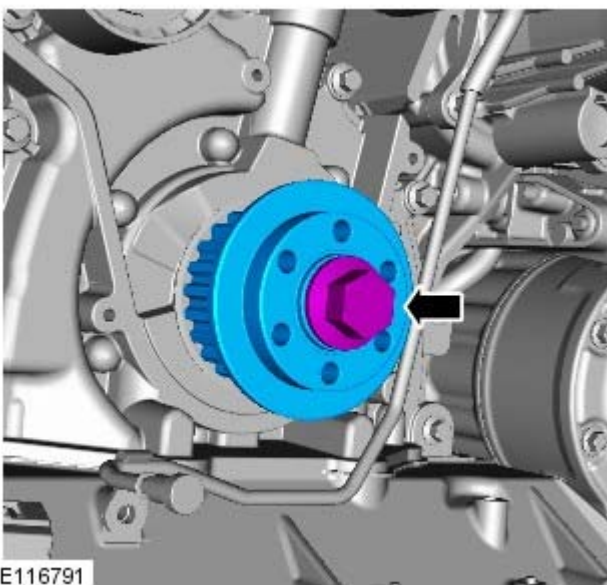


7.
 - Install the special tool.
 - *Special Tool(s)*: [303-D121](#)




8.  CAUTION: Discard the bolt.


Installation



1. **1. CAUTIONS:**

 Make sure that the pulley washer is correctly seated before installing the pulley.

 Do not lubricate the components.

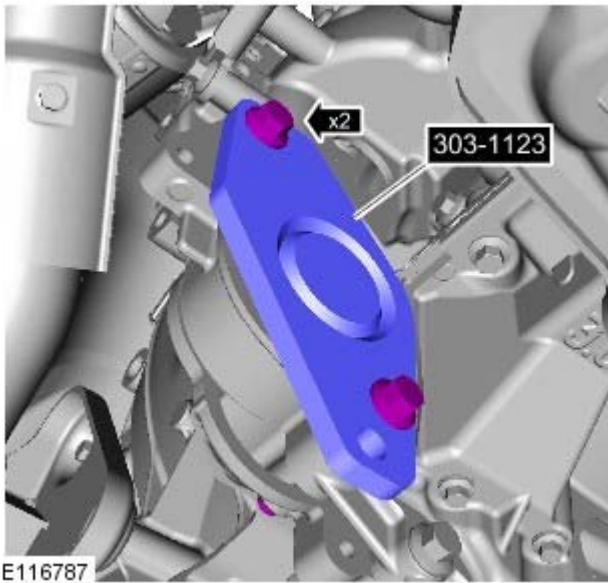
 Make sure that a new bolt is installed.

Torque:

Stage 1: 150 Nm

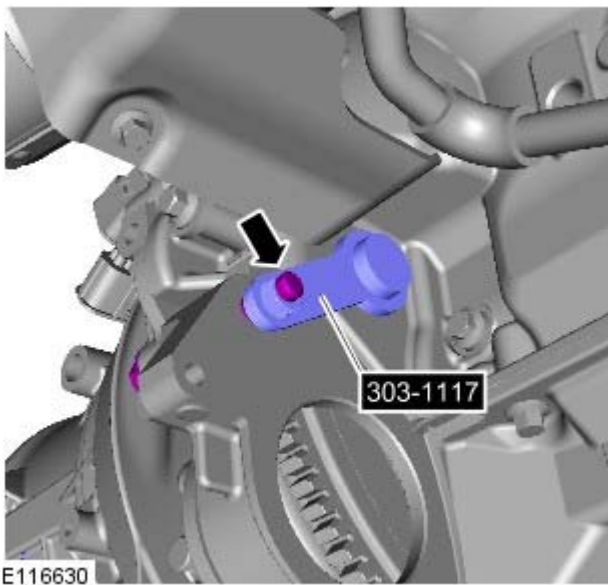
Stage 2: 300 Nm

Stage 3: 90°



2.

- Remove the special tool.
- *Special Tool(s):* [303-1123](#)



3.

- Install the special tool.
- *Special Tool(s):* [303-1117](#)

4. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: [Timing Belt](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

Engine - TDV6 3.0L Diesel - Crankshaft Rear Seal

Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

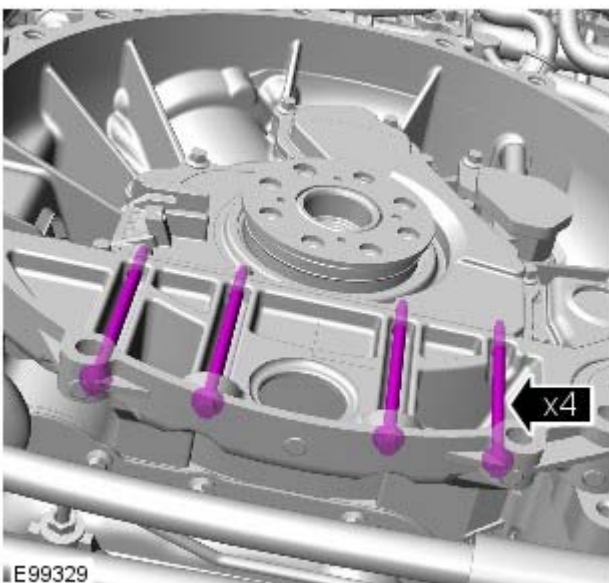
Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

2.  WARNING: Make sure to support the vehicle with axle stands.

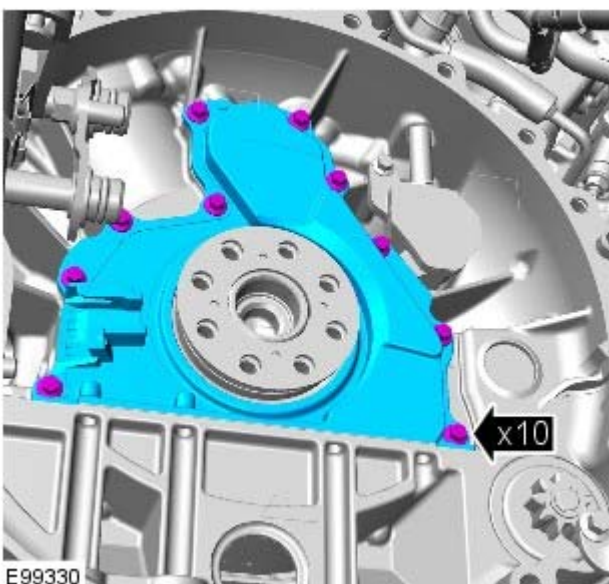
Raise and support the vehicle.

3. Refer to: [Crankshaft Position \(CKP\) Sensor Ring](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Removal and Installation).

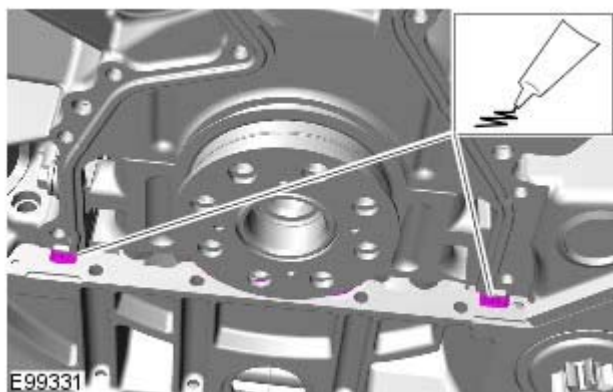
- 4.




5.  CAUTION: Discard the seal.



Installation

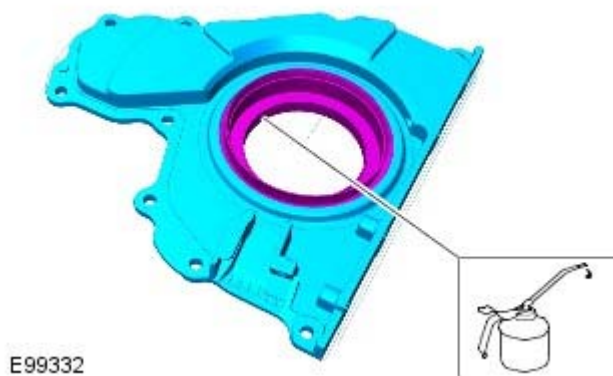


1. CAUTIONS:

 Make sure that the crankshaft rear oil seal is correctly located.

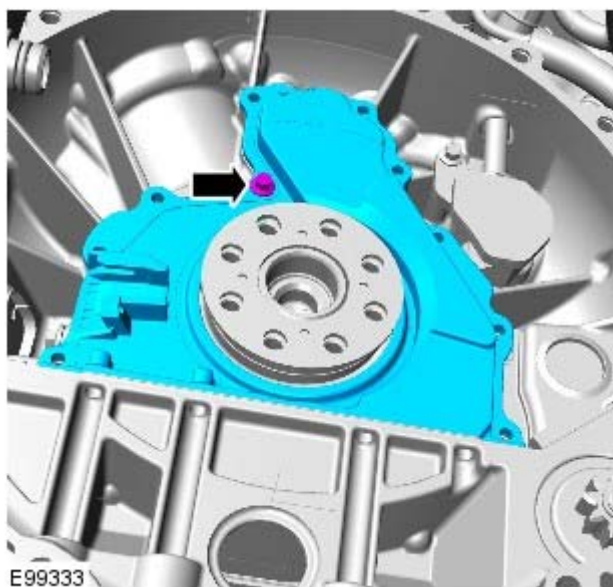
 Make sure the crankshaft seal mating faces are clean and dry.

Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

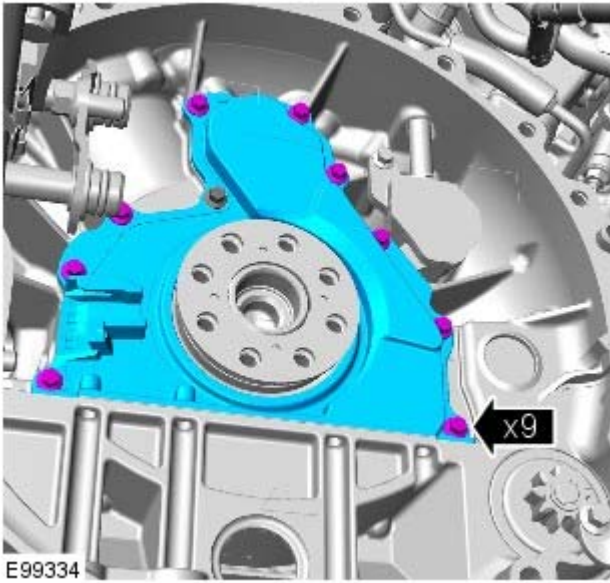


2.

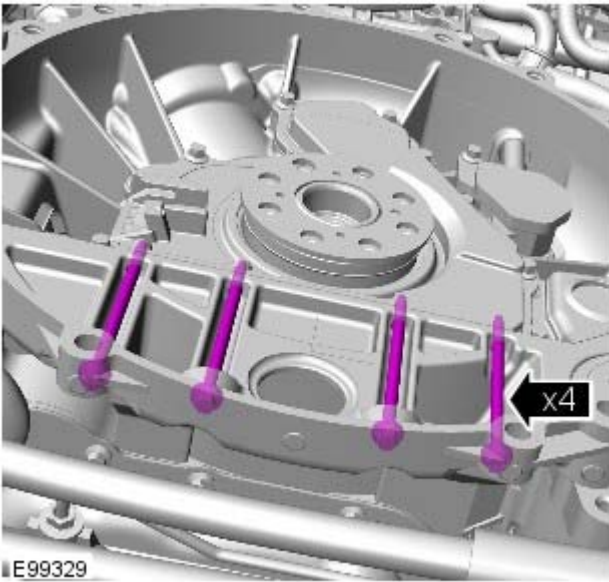
- Lubricate the oil seal.



3. Torque: 10 Nm



4. Torque: 10 Nm



5. Torque: 10 Nm

6. Refer to: [Crankshaft Position \(CKP\) Sensor Ring](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Removal and Installation).

7. Connect the battery ground cable.

Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

Engine - TDV6 3.0L Diesel - Cylinder Head

Removal and Installation

Removal

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

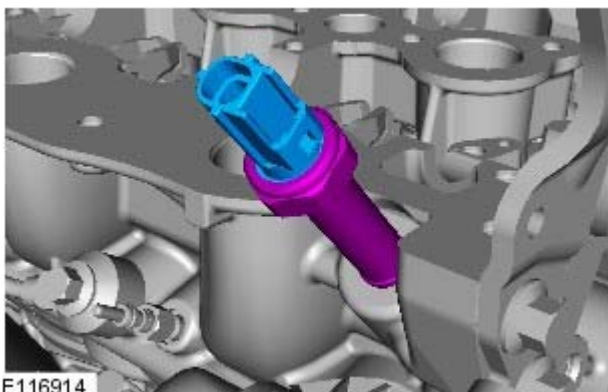
Raise and support the vehicle.

3. Refer to: [Camshaft LH](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

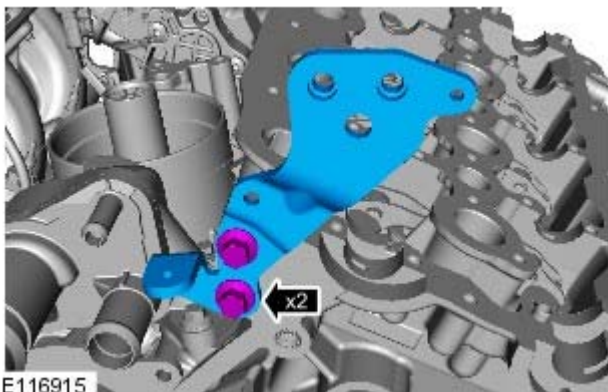
4. Refer to: [Glow Plugs](#) (303-07D Glow Plug System - TDV6 3.0L Diesel, Removal and Installation).

5. Refer to: [Exhaust Manifold](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

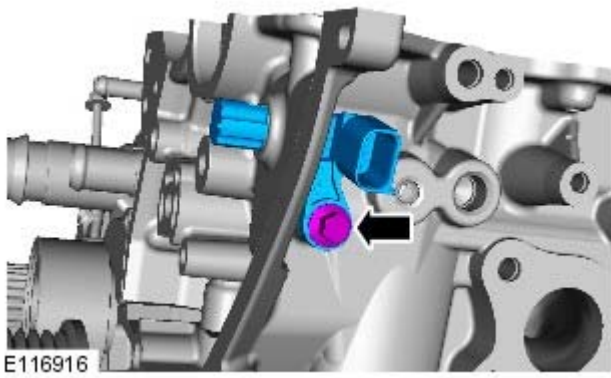
- 6.



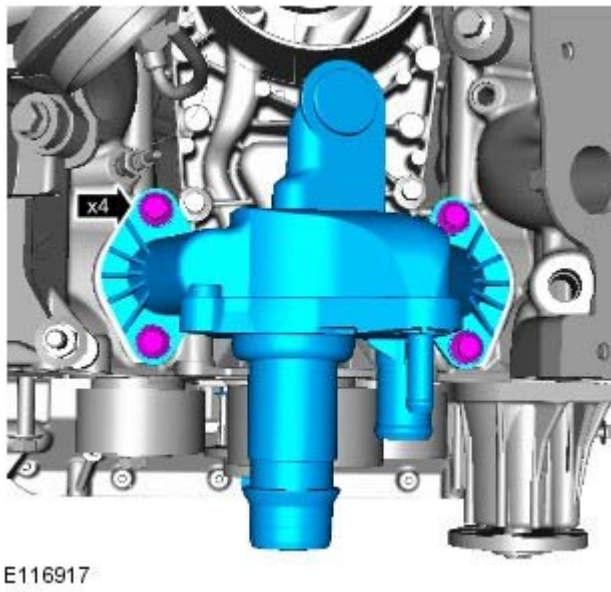
- 7.



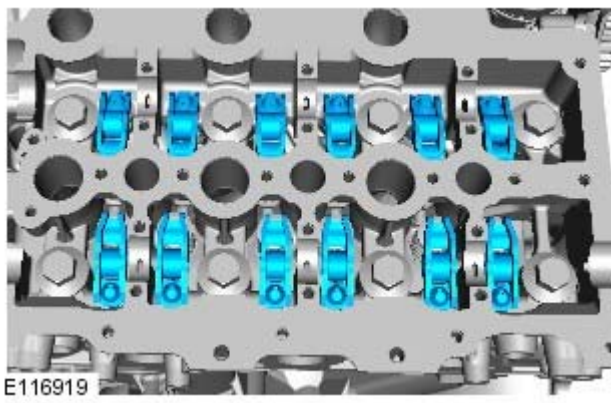
8.

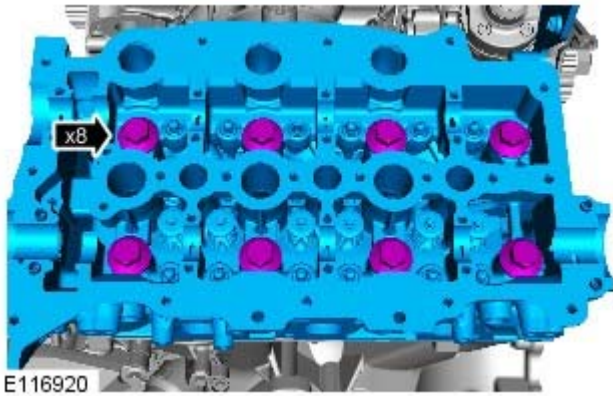


9.




10.



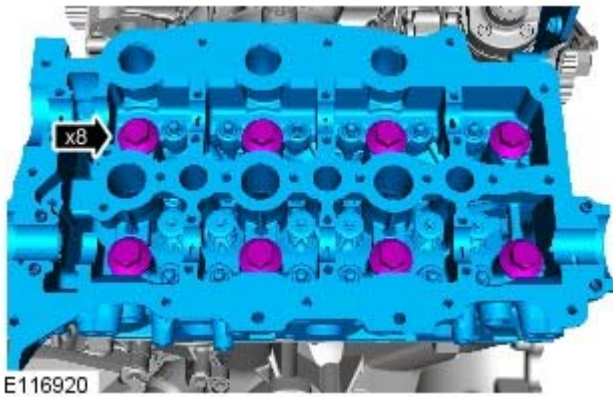


11. **11.**  CAUTION: Discard the bolts.
- NOTE: Discard the gasket.

Installation

1. **1.**  CAUTION: Make sure that the mating faces are clean and free of foreign material.


Clean and inspect the cylinder head and cylinder block.




2. **2.** CAUTIONS:

 Only tighten the bolts finger-tight at this stage.

 Make sure that new bolts are installed.

 Use care when installing the cylinder head. Damage to the cylinder block, cylinder head or cylinder head gasket may result.

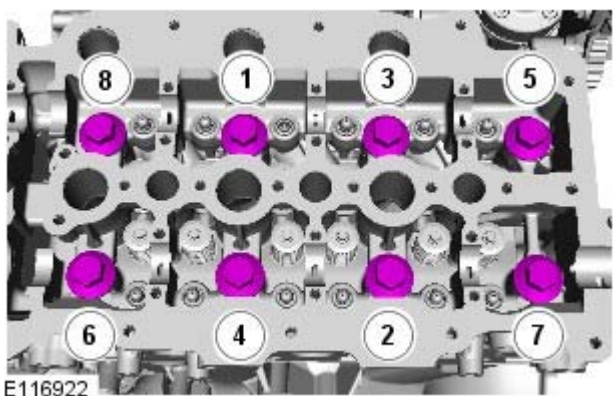
 The head gasket must be installed over the cylinder block dowels.

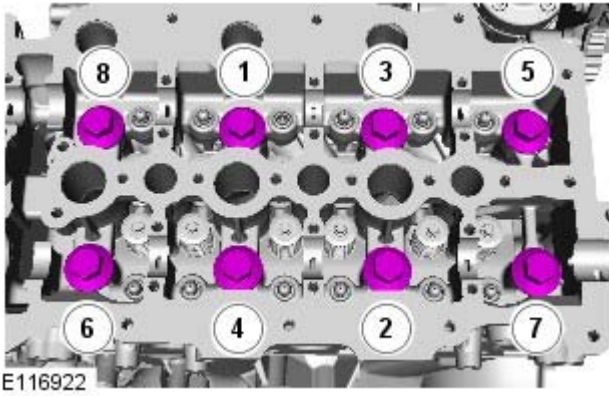
- NOTE: Install a new gasket.

- NOTE: No additional lubrication to the cylinder head bolts is required.

3. **3.** NOTE: Tighten the bolts in the indicated sequence.

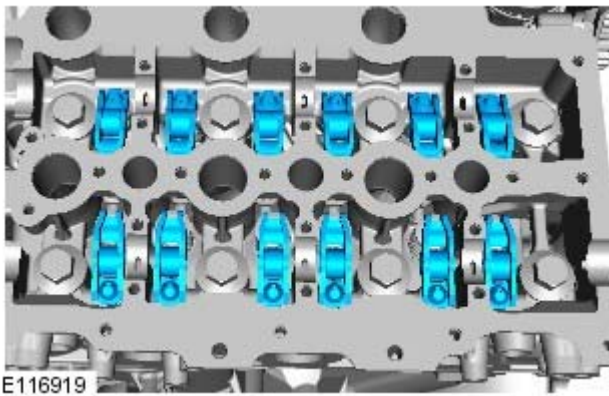
- Torque: 80 Nm



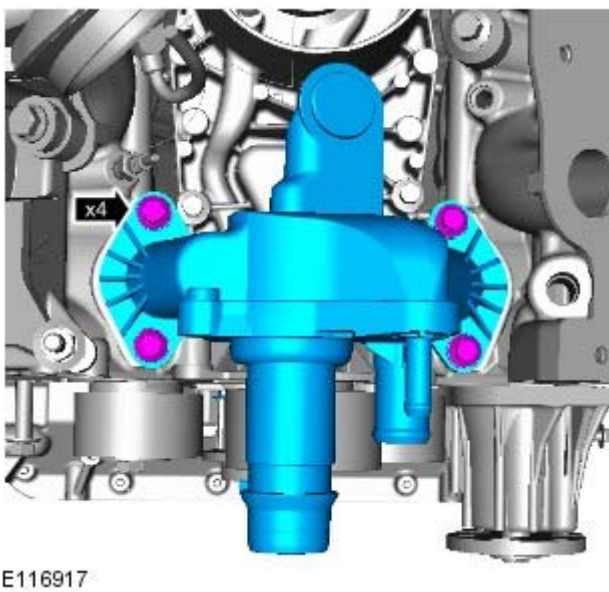


4. **4.** NOTE: Tighten the bolts in the indicated sequence.

- Torque: 180°



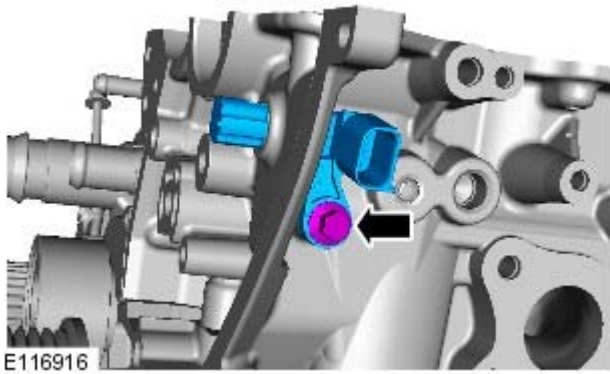
5. .



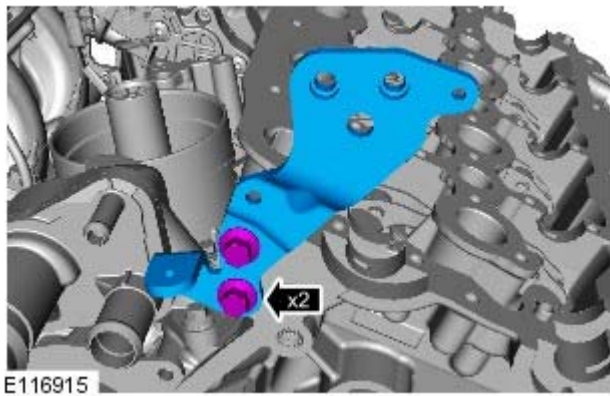
6. **6.**  CAUTION: Install the new seals.

Torque: 10 Nm

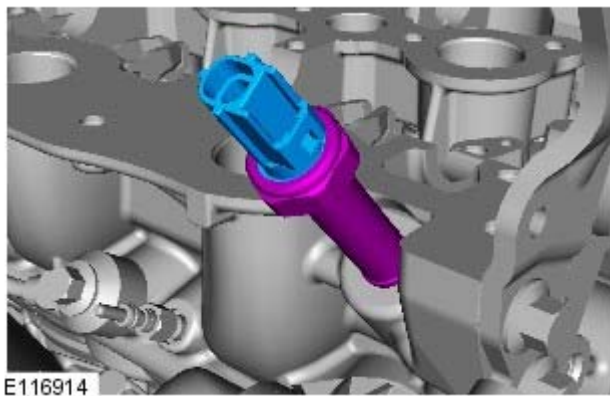
7. Torque: 10 Nm



8. Torque: 24 Nm



9. Torque: 14 Nm



10. Refer to: [Exhaust Manifold](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
11. Refer to: [Glow Plugs](#) (303-07D Glow Plug System - TDV6 3.0L Diesel, Removal and Installation).
12. Refer to: [Camshaft LH](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
13. Connect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 3.0L Diesel - Engine Mount LH

Removal and Installation

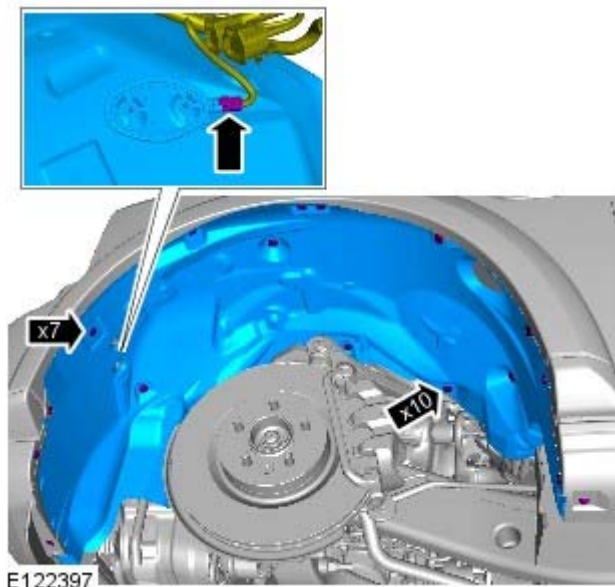
Removal

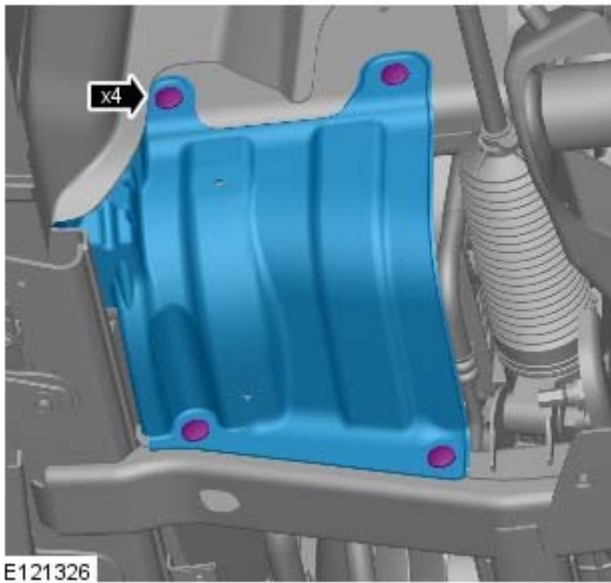
• NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Cooling Fan Shroud](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).
2.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
3. Refer to: [Catalytic Converter](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
4. Remove the LH front wheel and tire.

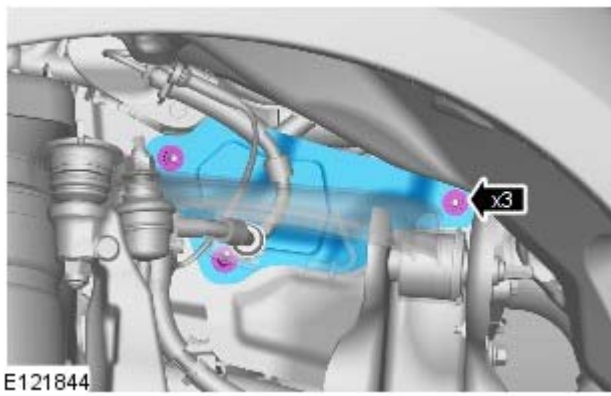
Torque: 140 Nm

5.

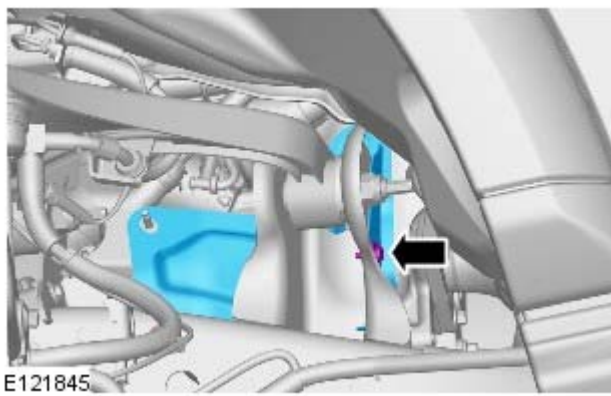




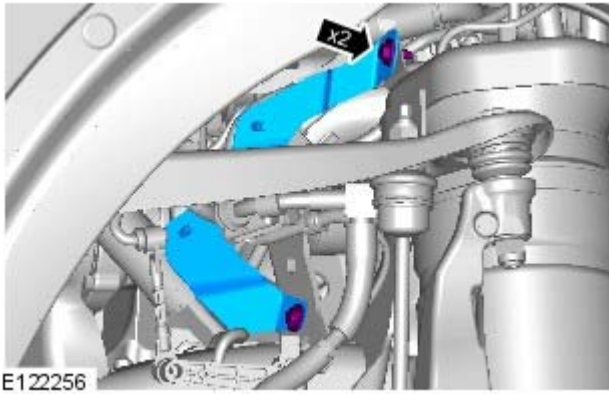
6.



7. Torque: 9 Nm

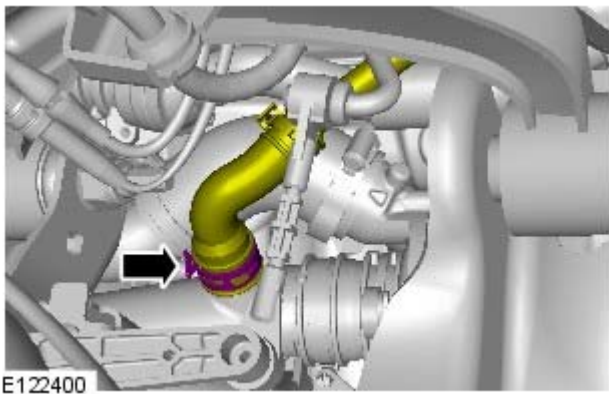



8. Torque: 9 Nm

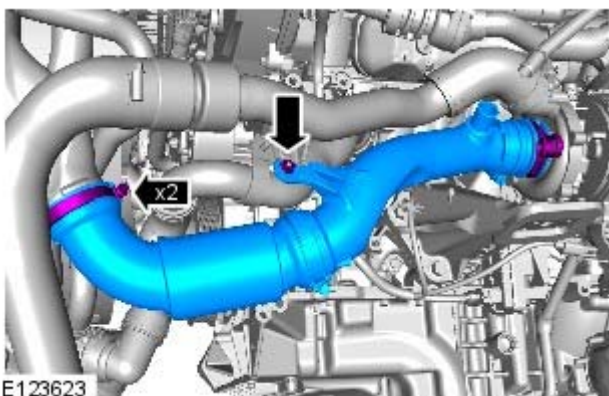



9. **9.** NOTE: RH illustration shown, LH is similar.

Torque: 9 Nm



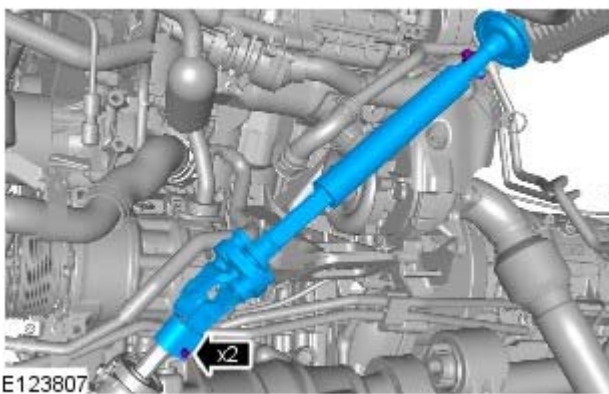
10. **10.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



11. **11.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

• NOTE: Engine shown removed for clarity.

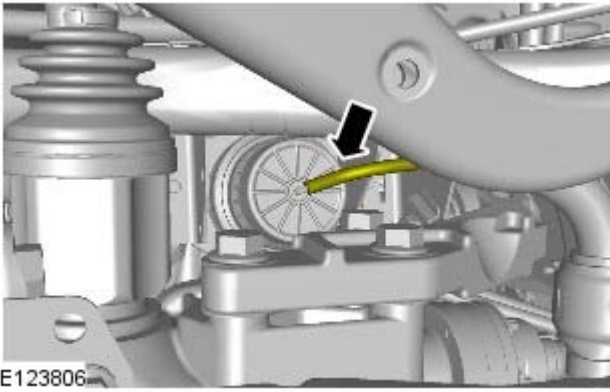
Torque: 10 Nm



12. **12.**  CAUTION: Make sure that new bolts are installed.

• NOTE: Engine shown removed for clarity.

Torque: 30 Nm



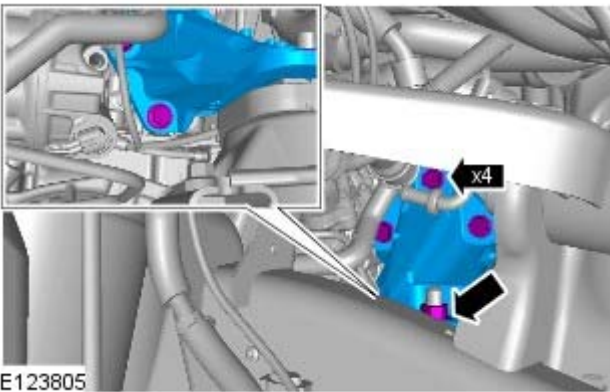
13. **13.**  CAUTION: Make sure that all openings are sealed.

14. **14.** CAUTIONS:

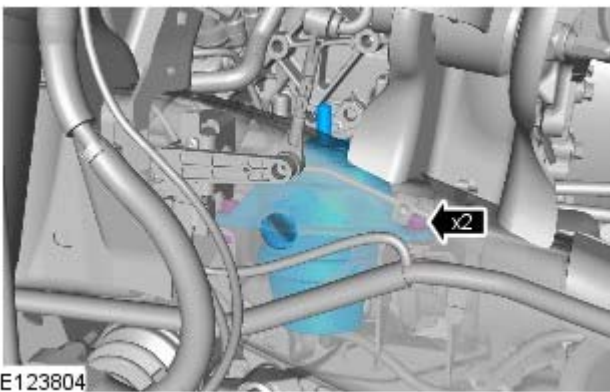
 Use a wooden block to protect the oil pan when supporting the engine.

 Protect the radiator during this operation.

Using a suitable hydraulic jack, raise and support the engine.



15. *Torque:*
Bolts 115 Nm
nut 90 Nm



16. *Torque:*
Stage 1: 45 Nm
Stage 2: 60°

Installation

1. To install, reverse the removal procedure.

Engine - TDV6 3.0L Diesel - Engine Mount RH

Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect both battery cables.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

4. Refer to: [Generator](#) (414-02B Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

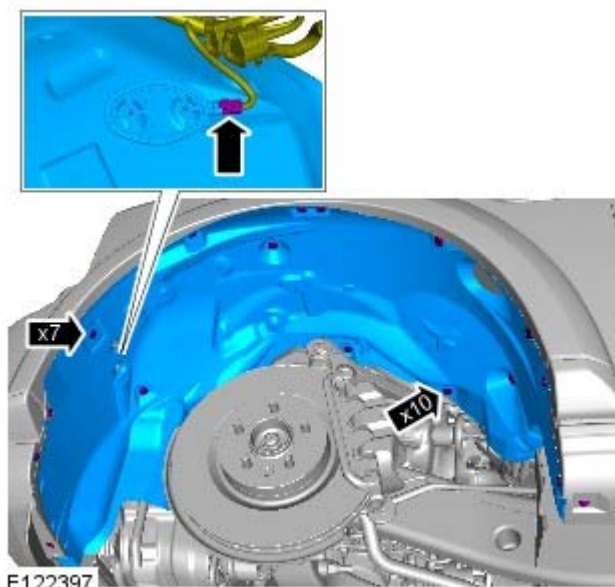
5.  **WARNING:** Make sure to support the vehicle with axle stands.

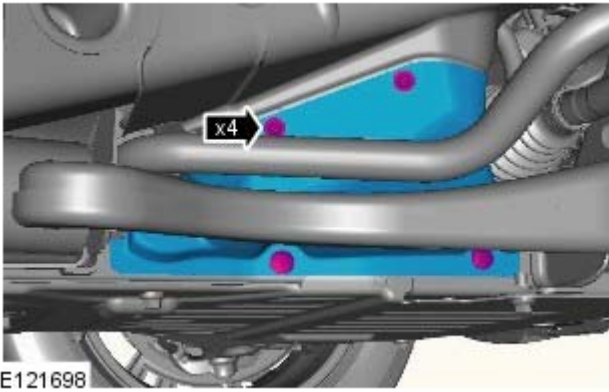
Raise and support the vehicle.

6. Remove the RH front wheel and tire.

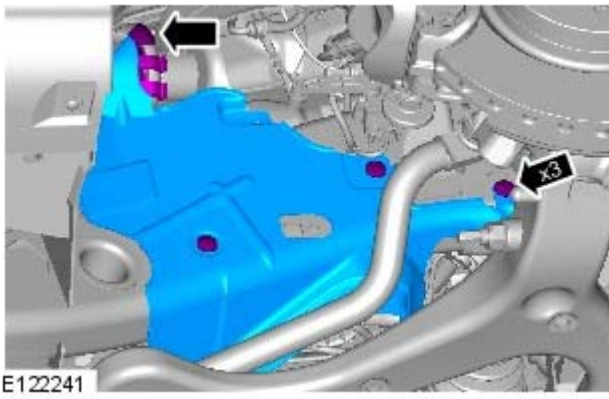
Torque: 140 Nm

- 7.

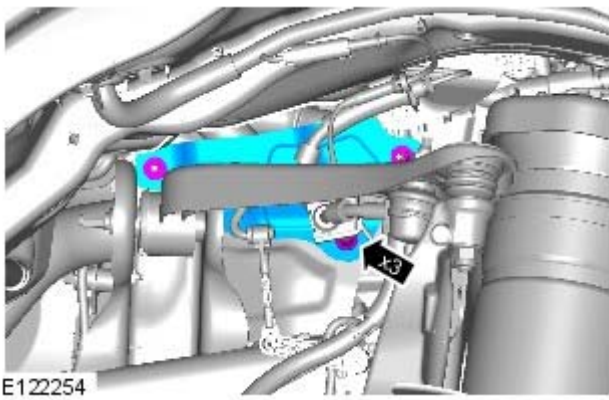




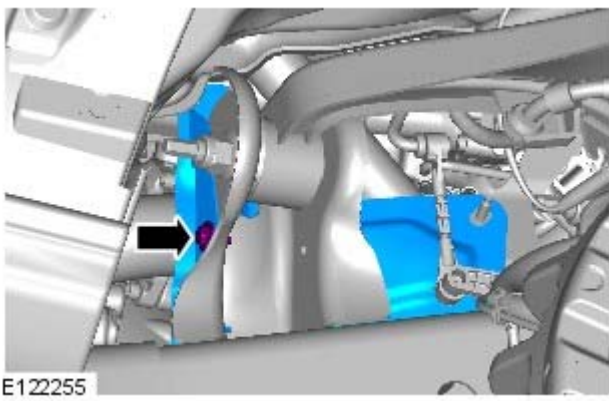
8.



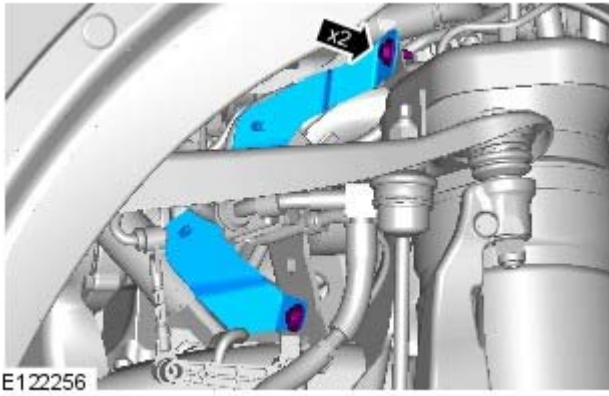
9.



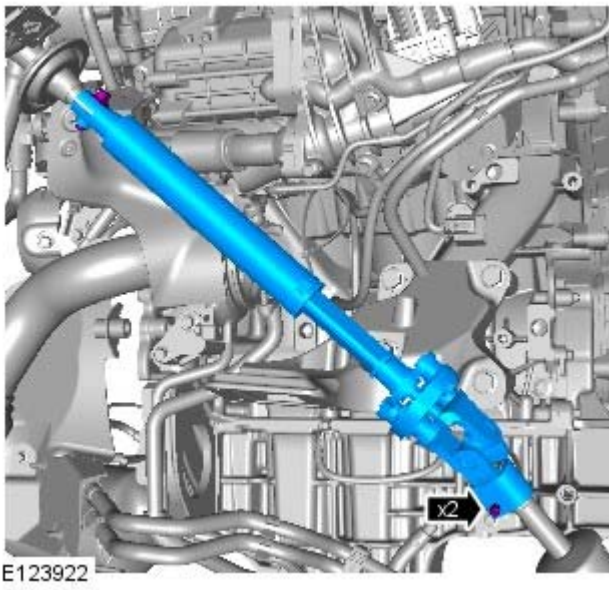
10. Torque: 9 Nm



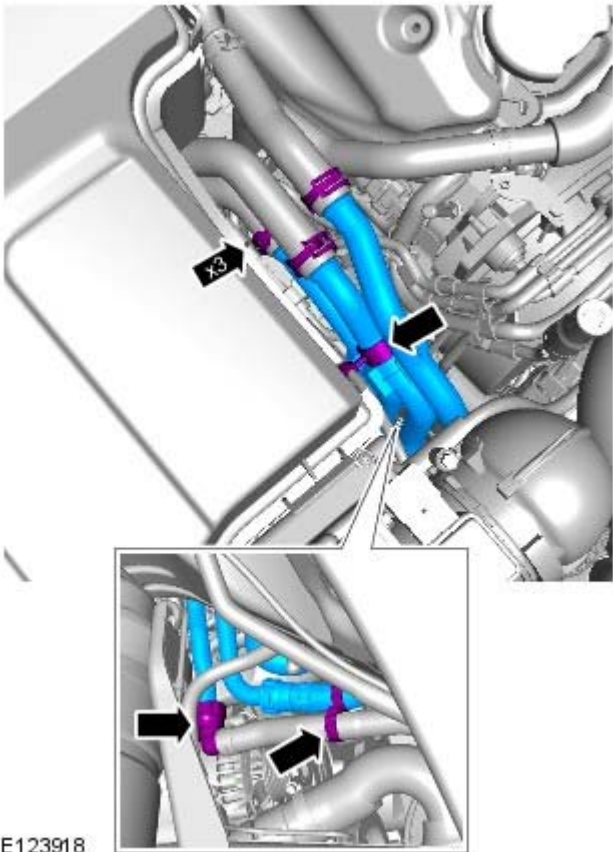
11. Torque: 9 Nm



12. Torque: 9 Nm

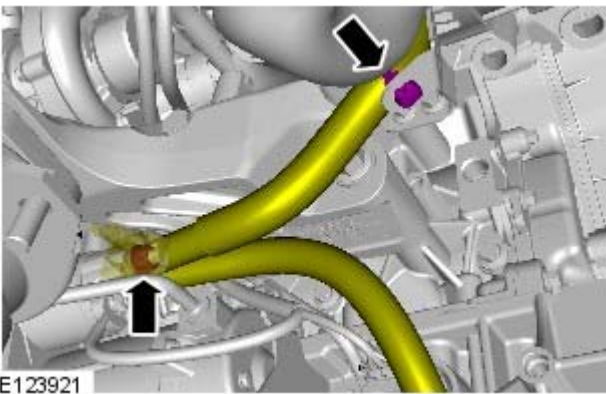


13. **13.** NOTE: Engine shown removed for clarity.
Torque: 30 Nm



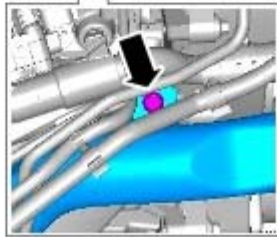
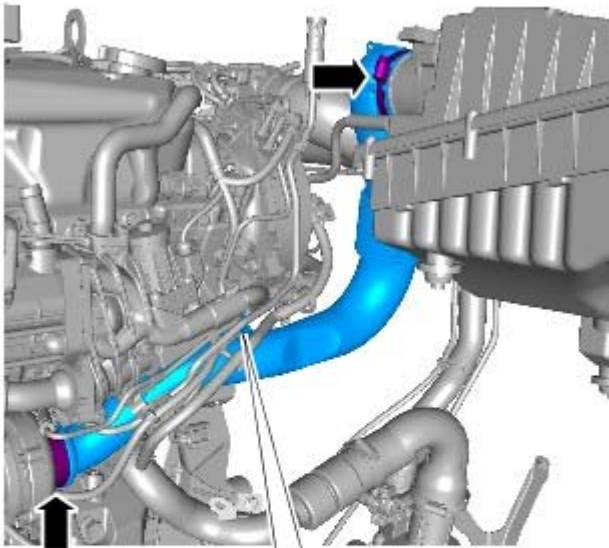
E123918

14.



E123921

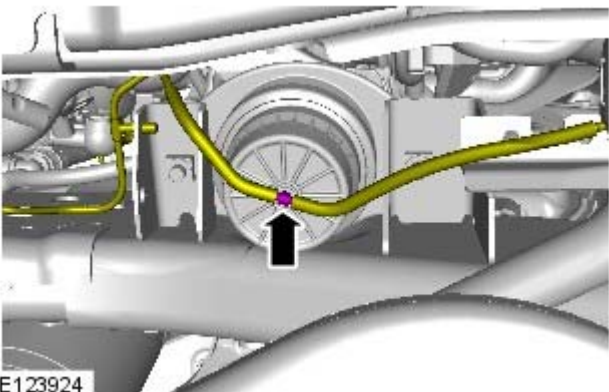
15. *Torque:* 10 Nm



E123923

16. **16.** NOTE: Engine shown removed for clarity.

Torque: 10 Nm



17.

18. **18.** CAUTIONS:

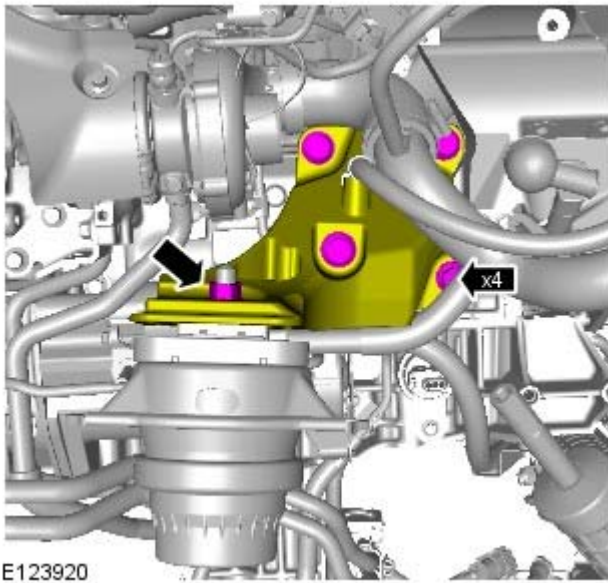


Use a wooden block to protect the oil pan when supporting the engine.



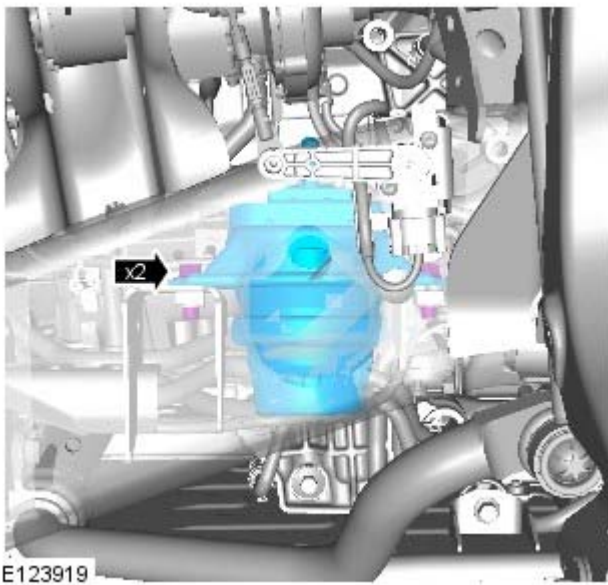
Protect the radiator during this operation.

Using a suitable hydraulic jack, raise and support the engine.

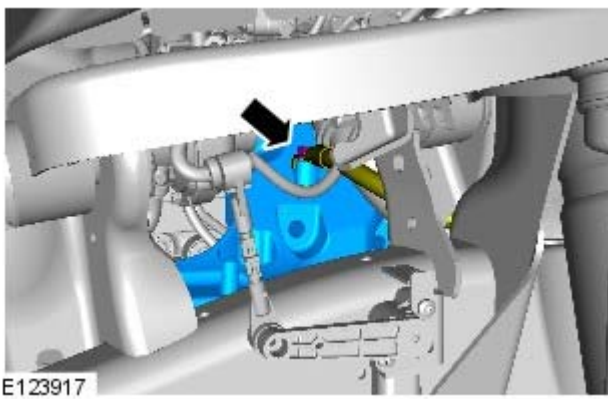


19. **19.** NOTE: Engine shown removed for clarity.

Torque:
Bolts 115 Nm
nut 90 Nm



20. *Torque:* 45 Nm



21. *Torque:* 10 Nm

Installation

1. To install, reverse the removal procedure.

Engine - TDV6 3.0L Diesel - Exhaust Manifold

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

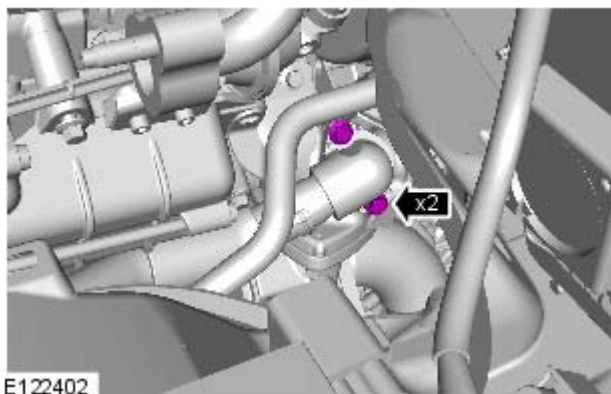
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

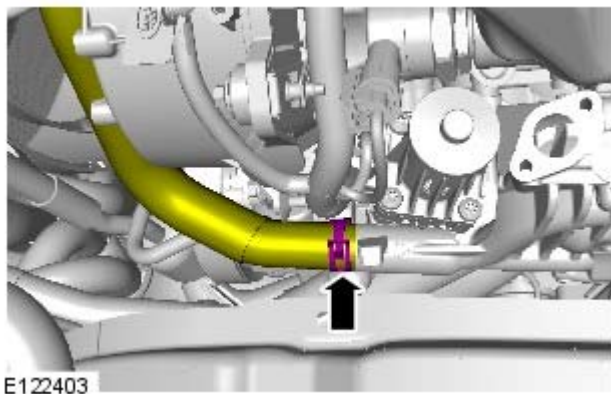
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

3. Refer to: [Turbocharger LH](#) (303-04D Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Removal and Installation).

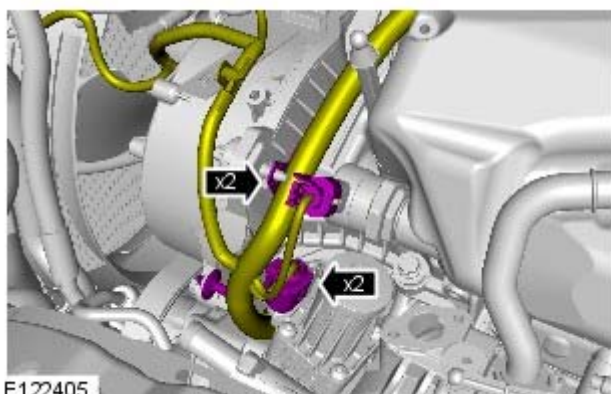
- 4.

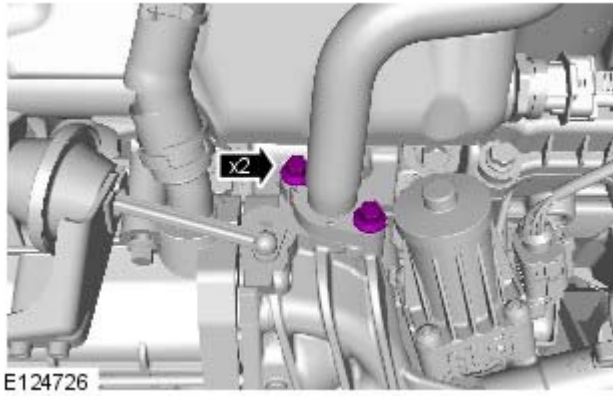


- 5.

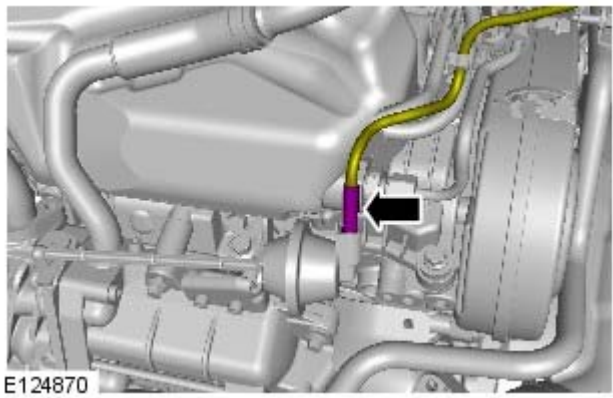


- 6.

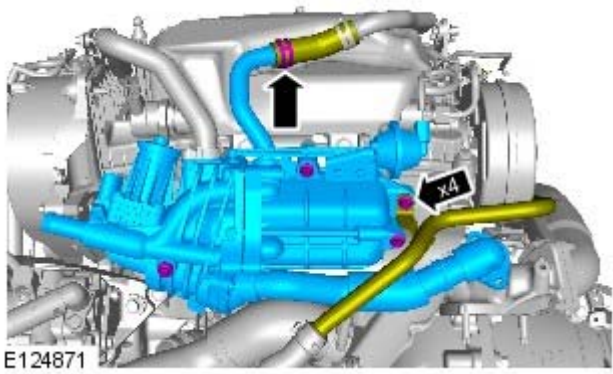




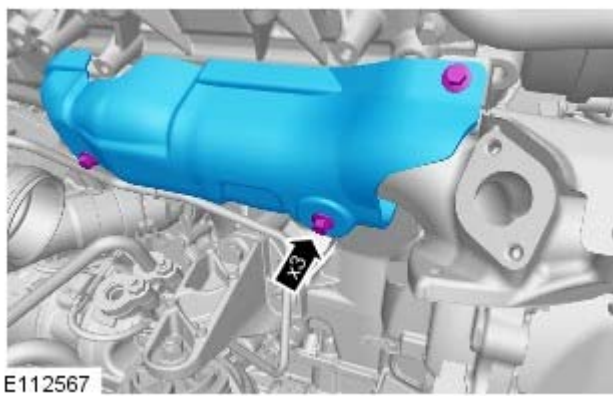
7. 7. NOTE: RH illustration shown, LH is similar.



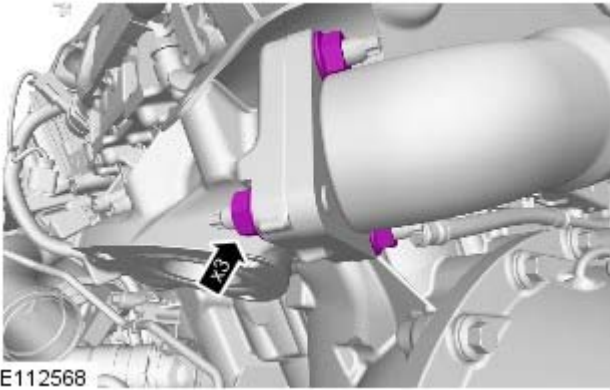
8.



9. 9. NOTE: Remove and discard the gasket.

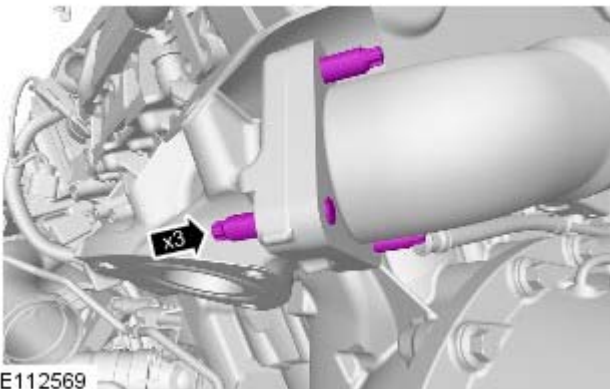


10.



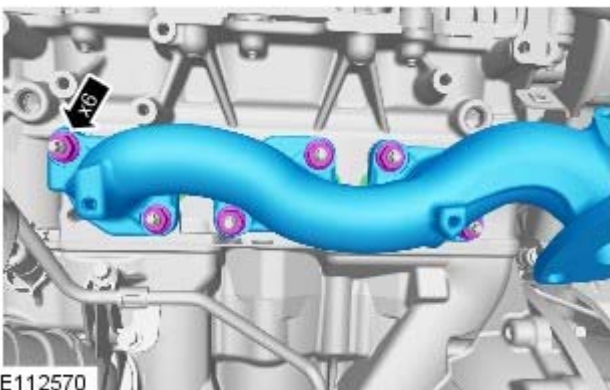
E112568

11. **11.**  CAUTION: Discard the nuts.




E112569

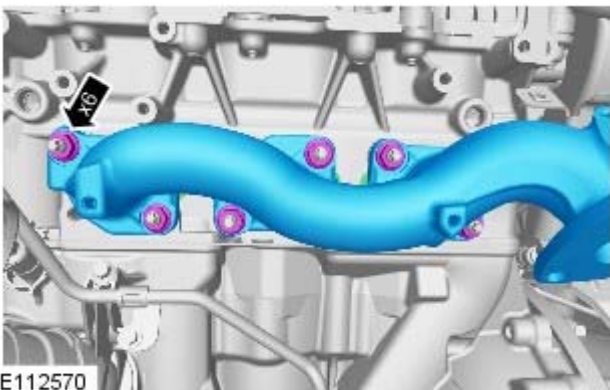
12. **12.**  CAUTION: Discard the studs.




E112570


13. **13.**  CAUTION: Discard the nuts.
• NOTE: Discard the gasket.

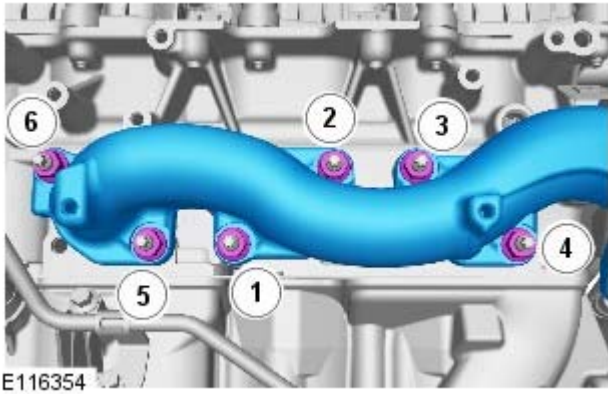
Installation



E112570

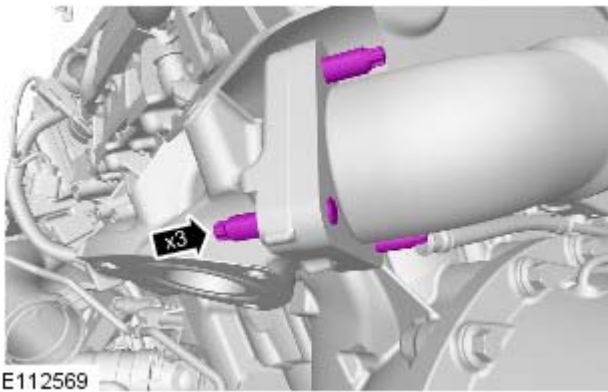
- 1.**  WARNING: Make sure that new nuts are installed.

 CAUTION: Install the nuts finger tight before final tightening.
• NOTE: Install a new gasket.



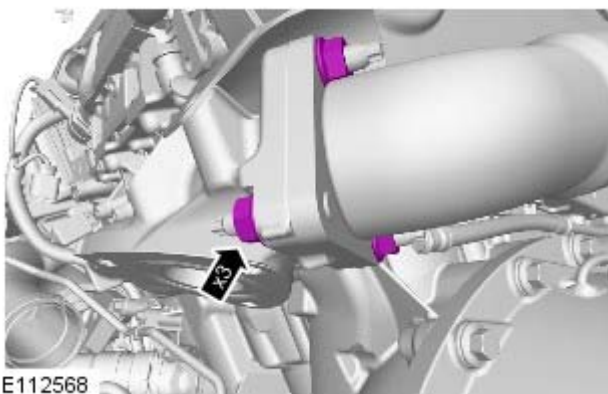
2. **NOTE:** Tighten the bolts in the indicated sequence.

Torque: 28 Nm



3.  **CAUTION:** Install new studs.

Torque: 24 Nm



4.  **WARNING:** Make sure that new nuts are installed.

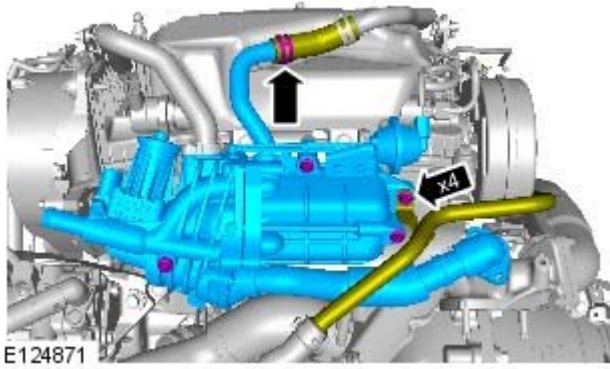
Torque: 24 Nm



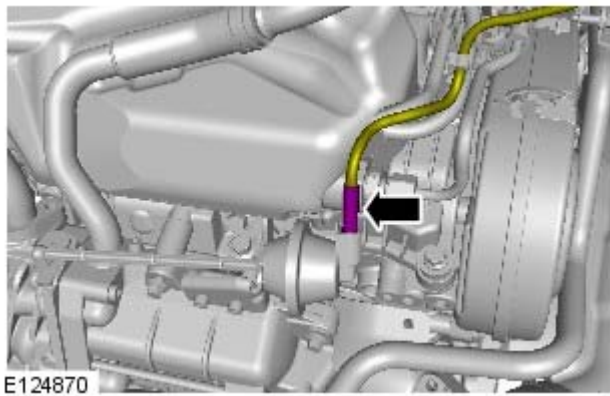
5. *Torque:* 10 Nm

6. **6.** NOTE: Install new gaskets.

Torque: 10 Nm

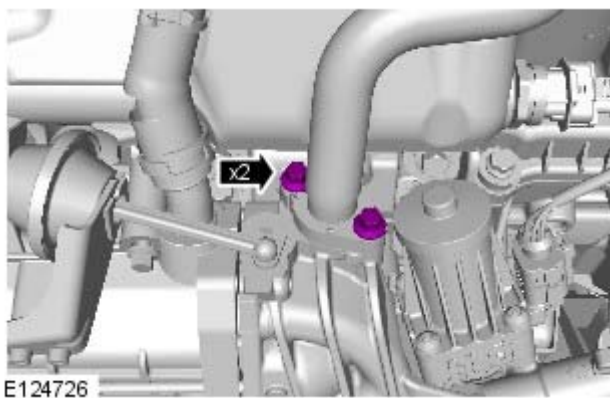


7.

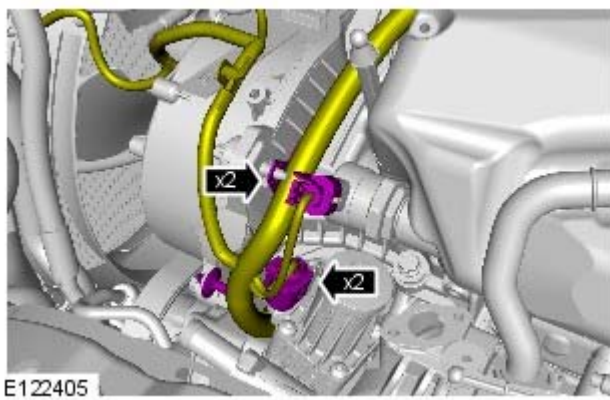


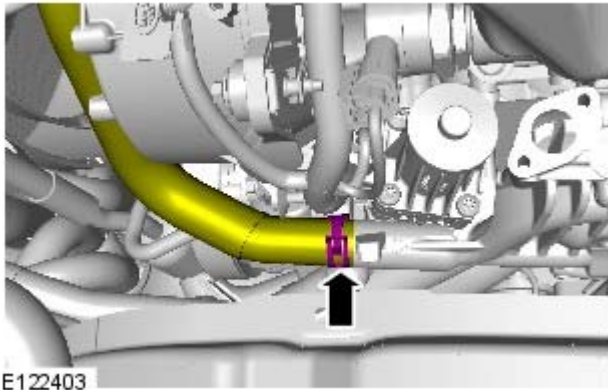
8. **8.** NOTE: RH illustration shown, LH is similar.

Torque: 10 Nm

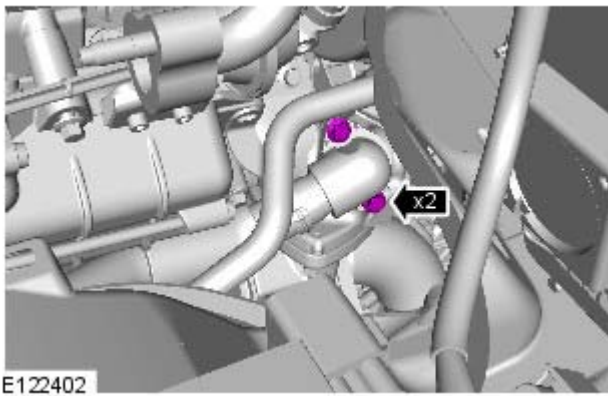


9.





10.



11. *Torque:* 10 Nm

12. Refer to: [Turbocharger LH](#) (303-04D Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Removal and Installation).
13. Connect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
14. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

Engine - TDV6 3.0L Diesel - Exhaust Manifold Crossover Pipe

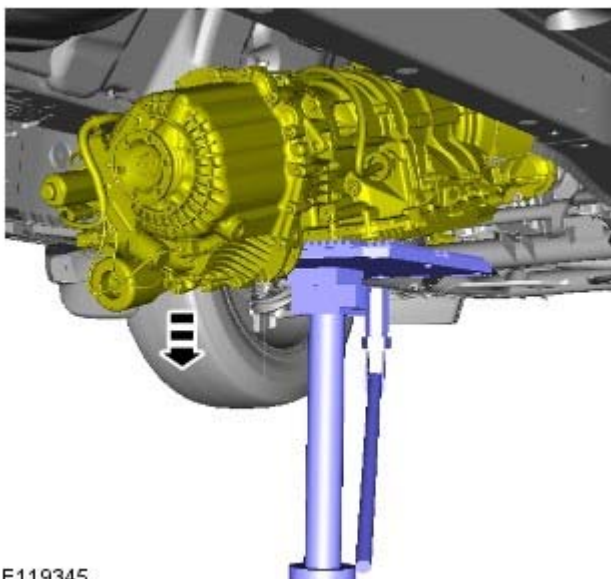
Removal and Installation

Removal

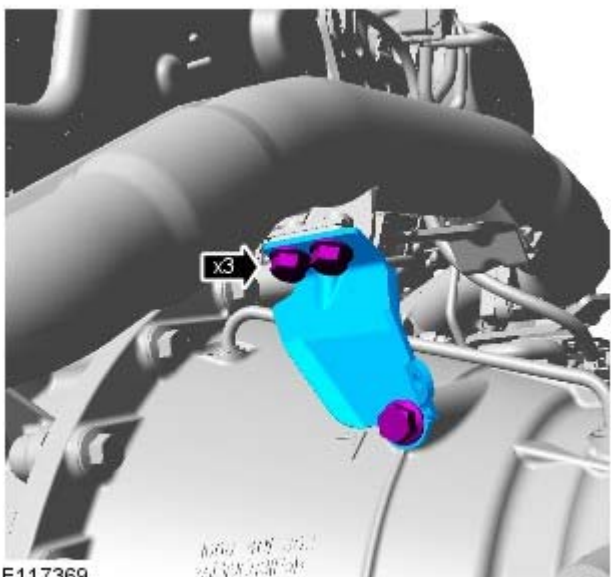
 **CAUTION:** Take care when handling the cross-over pipe as damage to the insulating material may occur.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel \(502-02 Full Frame and Body Mounting, Removal and Installation\)](#).
3. Refer to: [Exhaust System \(309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation\)](#).

4. **NOTE:** The transmission is lowered for access.

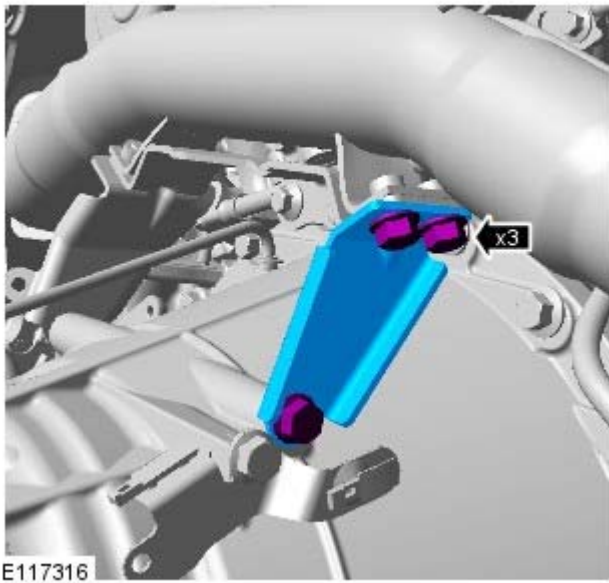


E119345

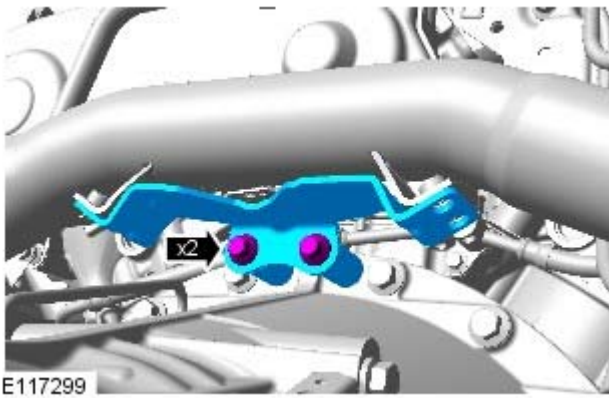


E117369

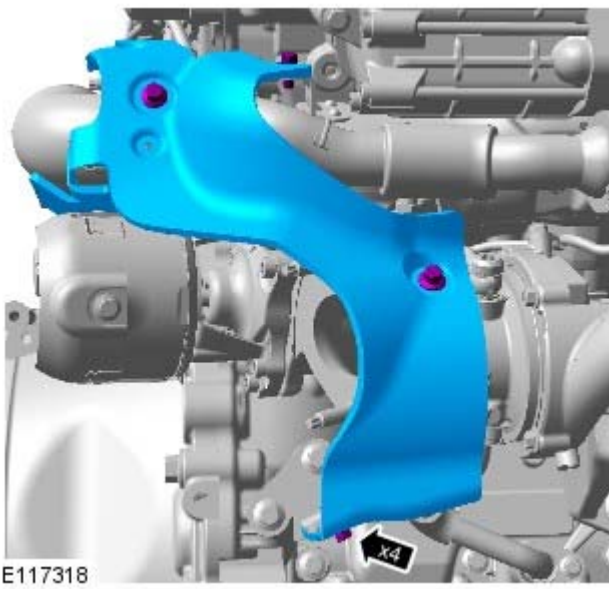
5.



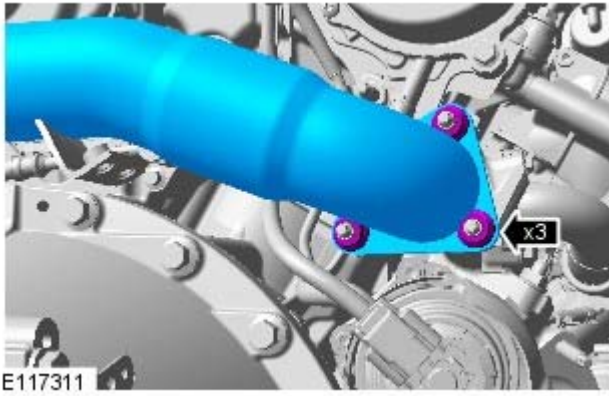
6.



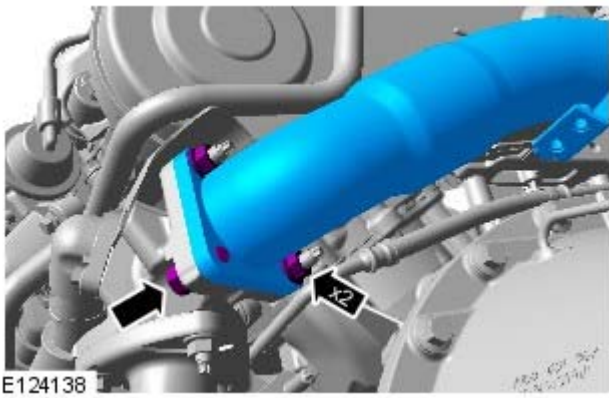
7.



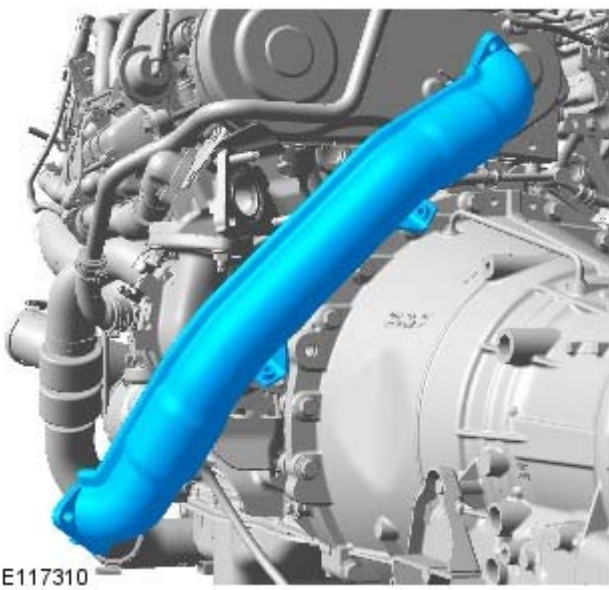
8.



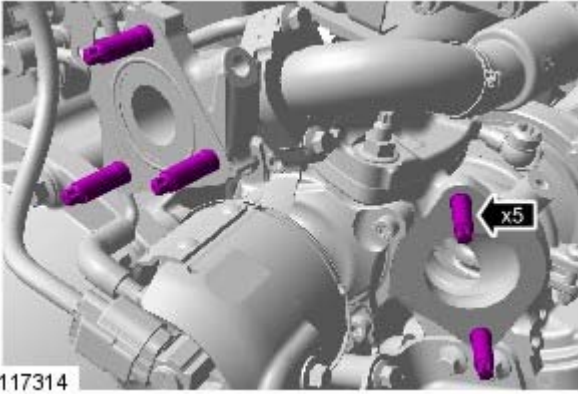
9.  CAUTION: Discard the nuts.



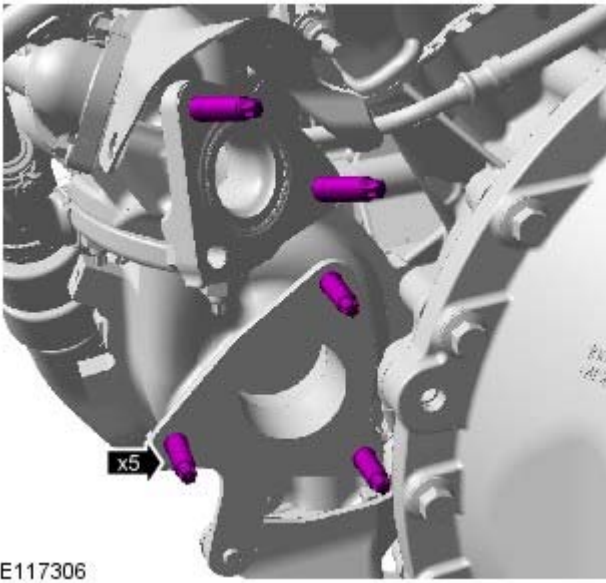
10.  CAUTION: Discard the nuts and bolt.



11.



12. **12.**  CAUTION: Discard the studs.



13. **13.**  CAUTION: Discard the studs.



14. **14.** NOTE: Discard the gasket.

Installation

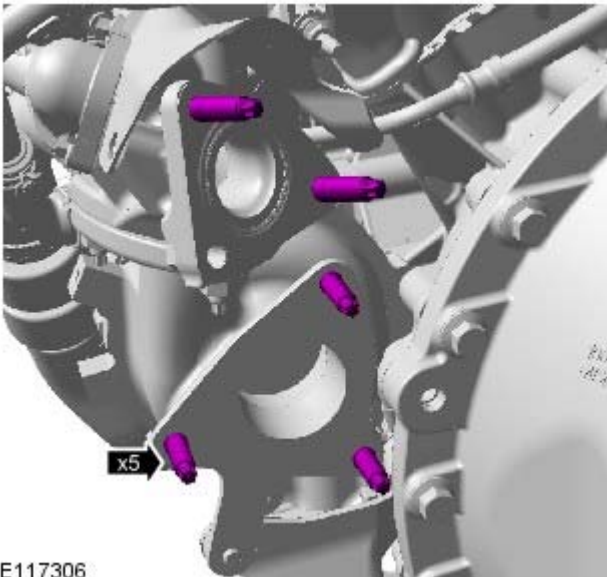
1. **NOTE:** Install new gaskets.



E124137

2. **NOTE:** New exhaust manifold retaining studs must be fitted if the old studs are removed.

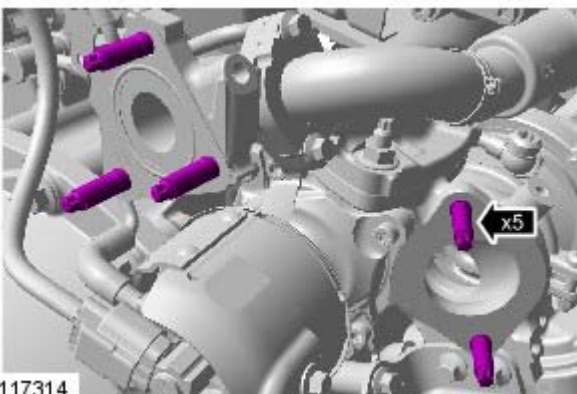
Torque: 13 Nm



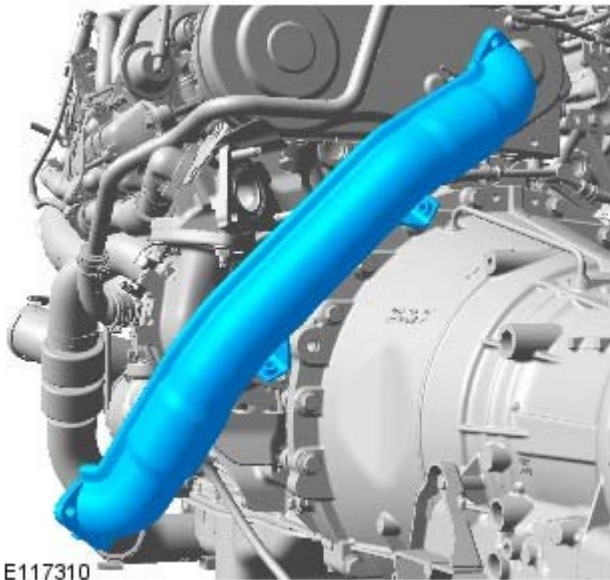
E117306

3. **NOTE:** New exhaust manifold retaining studs must be fitted if the old studs are removed.

Torque: 13 Nm

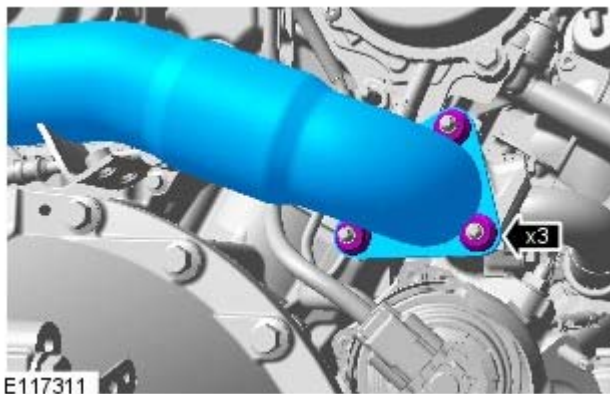


E117314




E117310

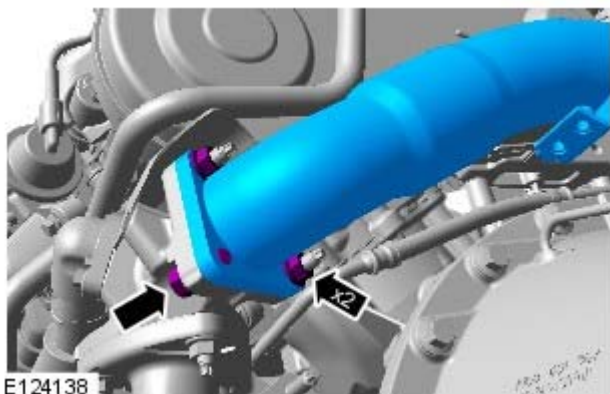
4.



E117311

5.  **WARNING:** Make sure that new nuts are installed.

 **CAUTION:** Only tighten the nuts finger-tight at this stage.

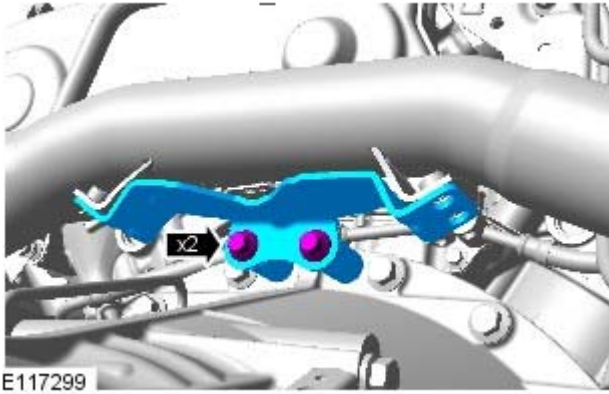


E124138

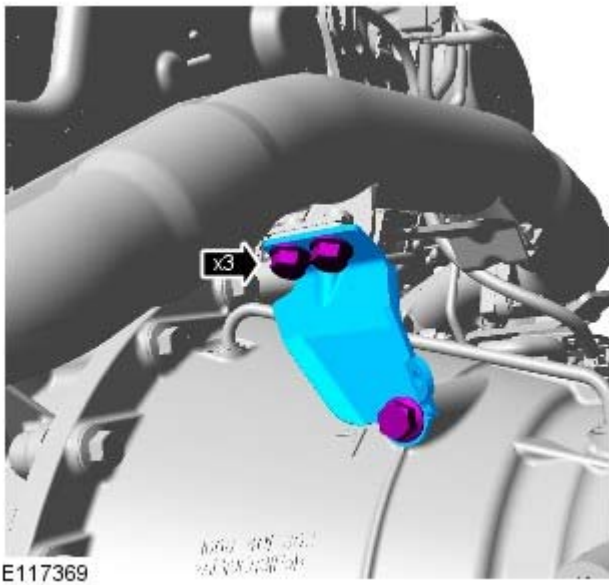
6. **6. CAUTIONS:**

 Only tighten the nuts and bolt finger-tight at this stage.

 Make sure that new nuts and bolt are installed.

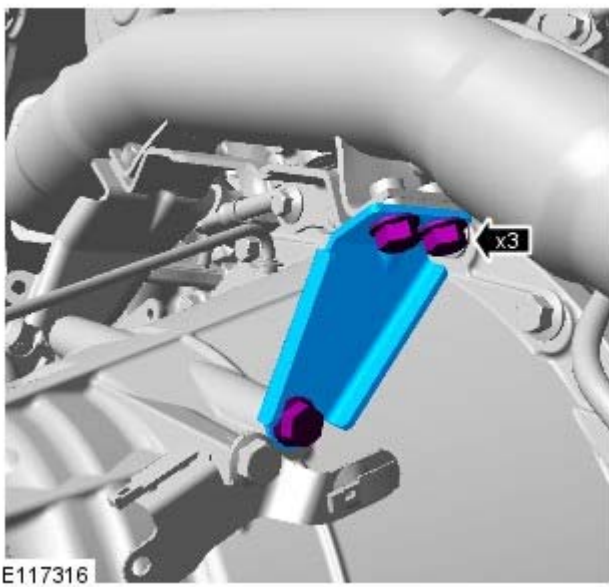


7.  CAUTION: Only tighten the bolts finger-tight at this stage.



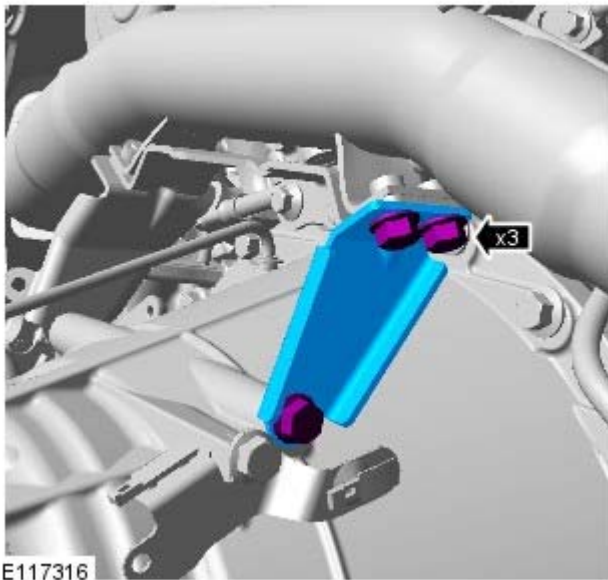
8.  CAUTION: Only tighten the bolts finger-tight at this stage.

Check for correct alignment.

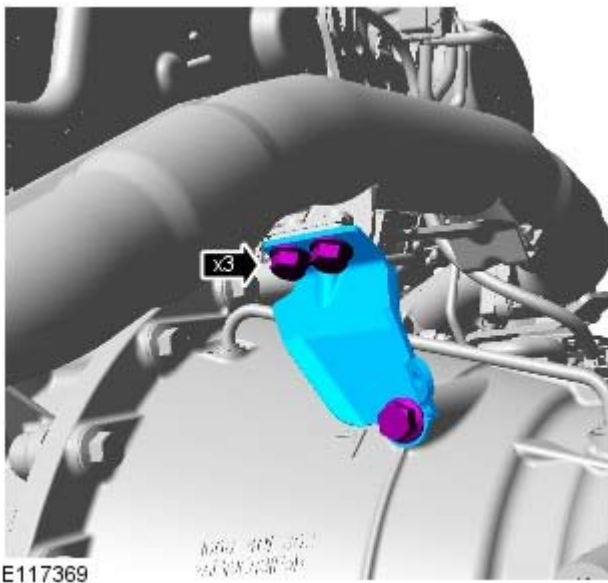


9.  CAUTION: Only tighten the bolts finger-tight at this stage.

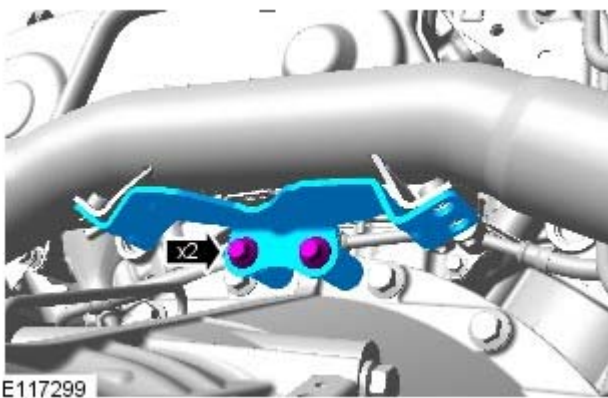
Check for correct alignment.



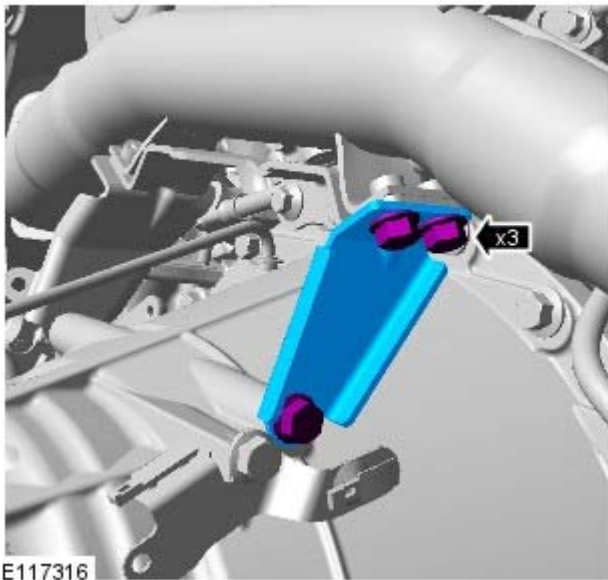
10. Remove the exhaust cross-over pipe RH support bracket.



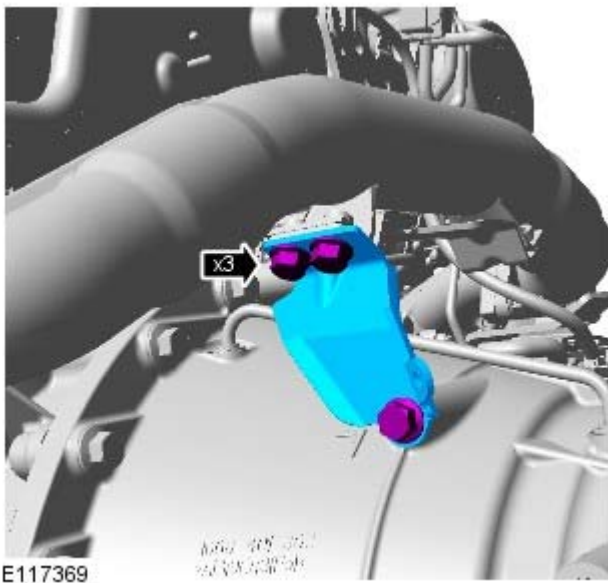
11. Remove the exhaust cross-over pipe LH support bracket.



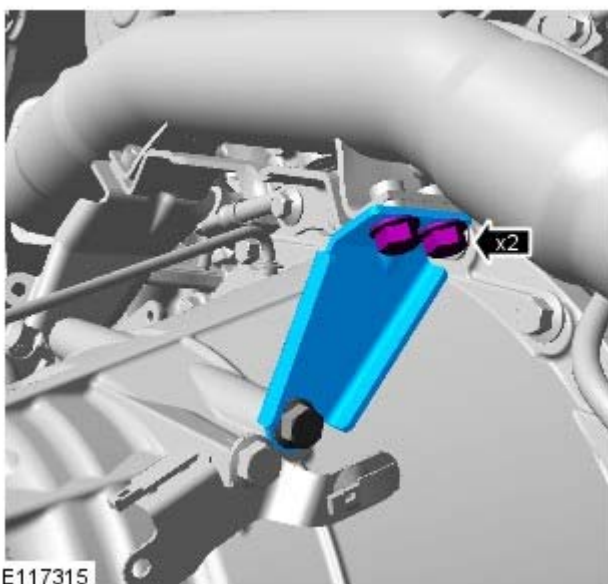
12. Torque: 23 Nm



13. **13.**  CAUTION: Only tighten the bolts finger-tight at this stage.

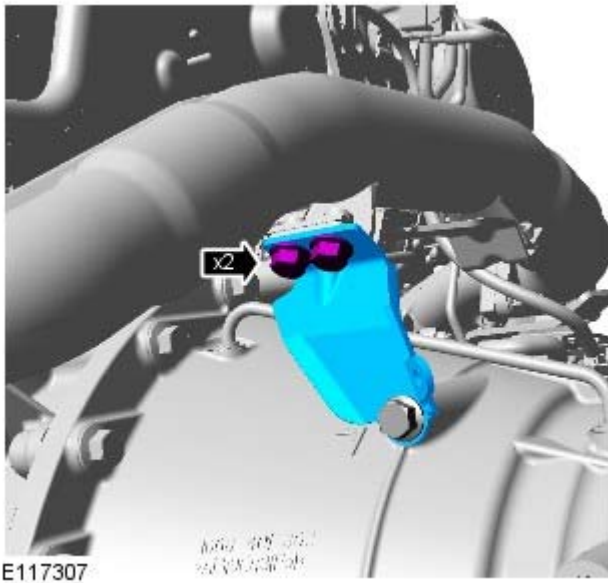


14. **14.**  CAUTION: Only tighten the bolts finger-tight at this stage.

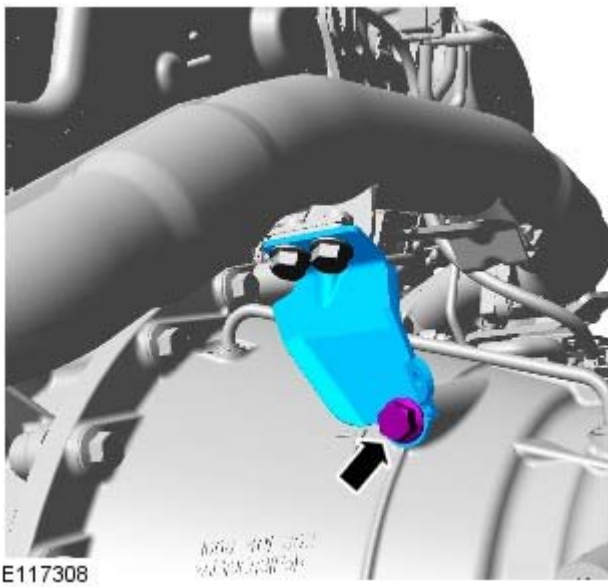


15. *Torque: 23 Nm*

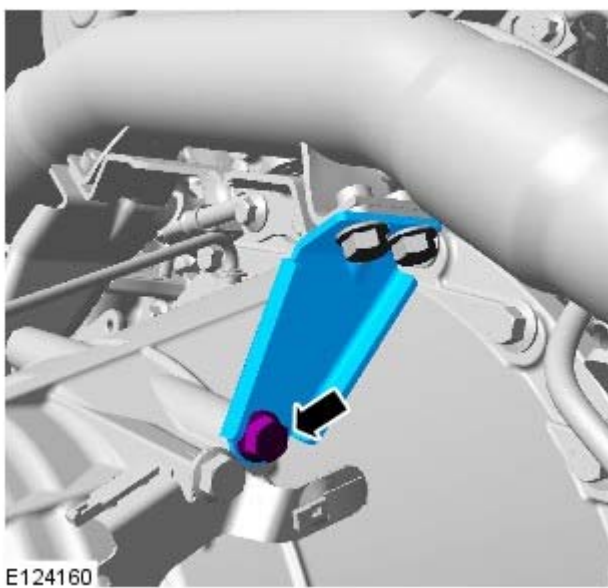
16. Torque: 23 Nm

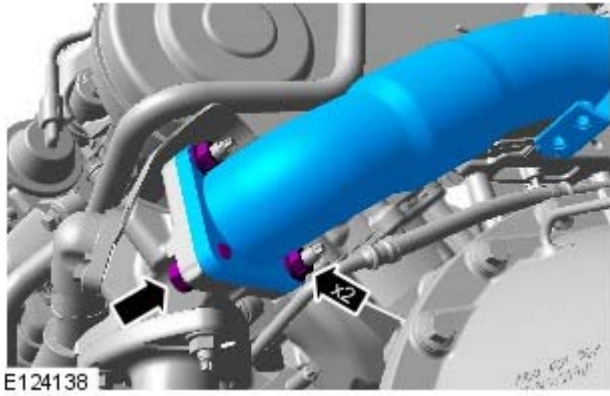


17. Torque: 23 Nm

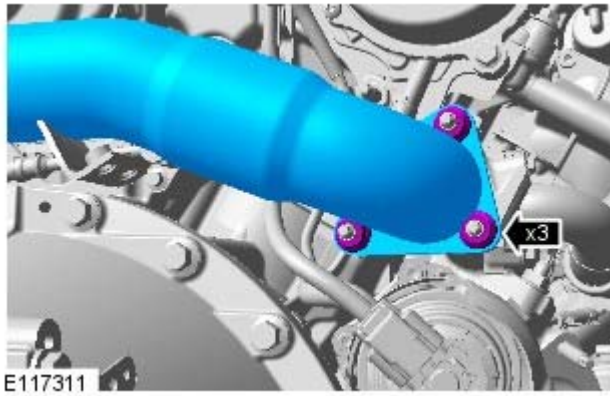


18. Torque: 23 Nm

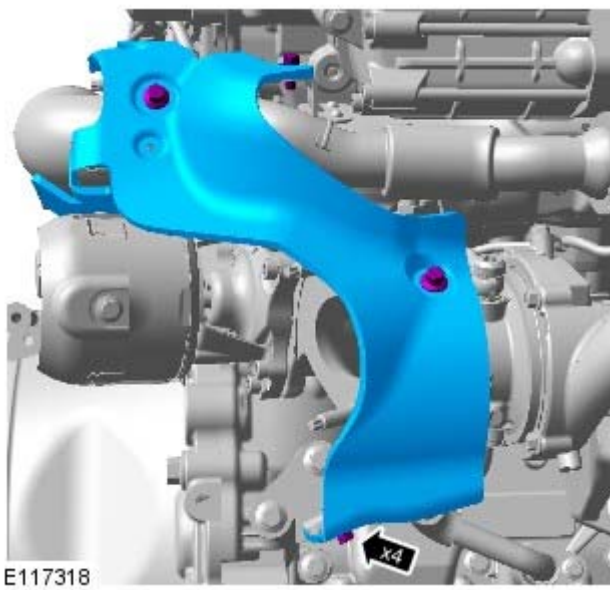




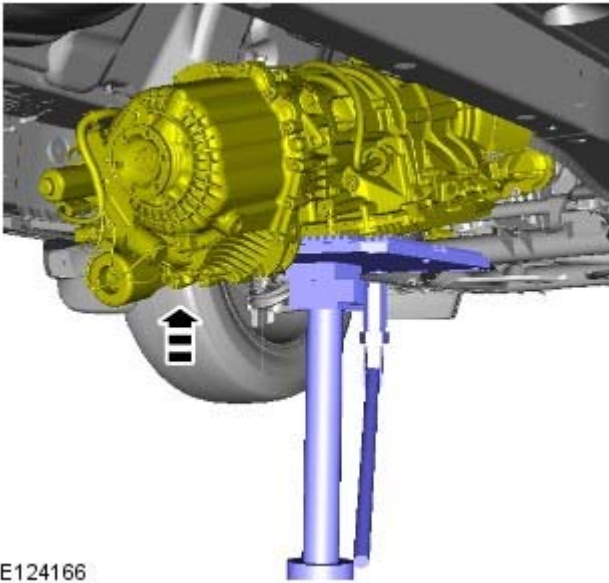
19. Torque: 23 Nm



20. Torque: 23 Nm



21. Torque: 11 Nm



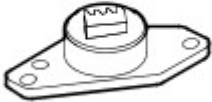
22.

23. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
24. Refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Engine - TDV6 3.0L Diesel - Flexplate

Removal and Installation

Special Tool(s)

 <p>303-1123 Locking Tool, Flywheel</p> <p>E 54546</p>	<p>303-1123 Locking Tool, Flywheel</p>
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Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

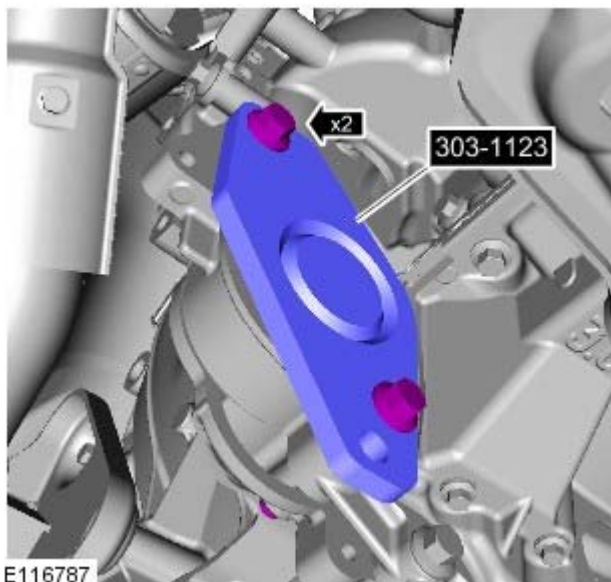
Raise and support the vehicle.

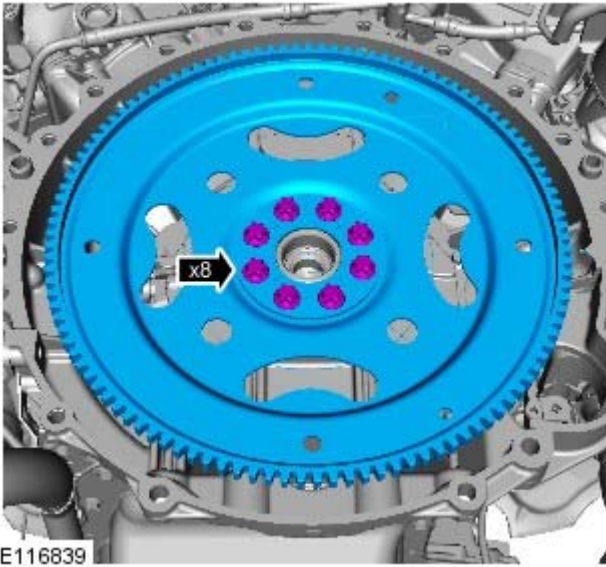
3. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).


4. Refer to: [Transmission - TDV6 3.0L Diesel](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal).

5.


- Install the special tool.
- *Special Tool(s):* [303-1123](#)

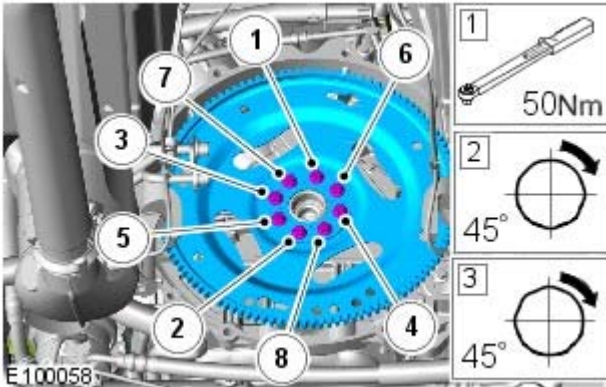





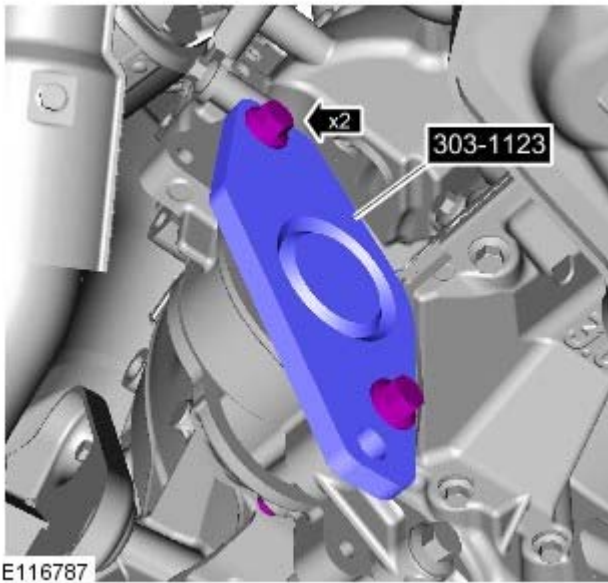
6.  CAUTION: Discard the bolts.
 - NOTE: Prevent the flexplate from rotating.

Installation

1.  CAUTION: Make sure that new bolts are installed.
 - NOTE: Make sure that all the component mating faces are clean.
 - NOTE: Loosely install all retaining bolts.
 - Prevent the flexplate from rotating.



2.  CAUTION: Tighten the bolts evenly in the stages shown.
 - Stage 1: Tighten to 50 Nm.
 - Stage 2: Tighten to 45 degrees.
 - Stage 3: Tighten to 45 degrees.



3.

- Remove the special tool.
- *Special Tool(s):* [303-1123](#)

4. Refer to: [Transmission - TDV6 3.0L Diesel](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Installation).
5. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).
6. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 3.0L Diesel - Oil Filter Element

Removal and Installation

Removal



CAUTION: Make sure that the correct tools are used to remove and install the oil filter element cap.

- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



E113950

2.

- Rotate the oil filter element housing six complete turns counter-clockwise.
- Allow the engine oil to drain from the oil filter element housing for two minutes.
- Remove the oil filter element housing.

3. **NOTE:** Remove and discard the O-ring seal.




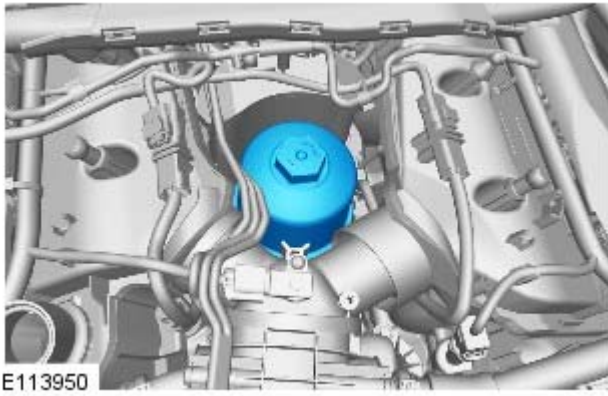
E113951

Installation



E113952

1.  **CAUTION:** A new O-ring seal is to be installed.
 - **NOTE:** Lubricate the O-ring seal with clean engine oil.



2. *Torque:* 28 Nm

3. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
4. Start and run the engine.
5. Check and top-up the engine oil.

Engine - TDV6 3.0L Diesel - Oil Pan

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

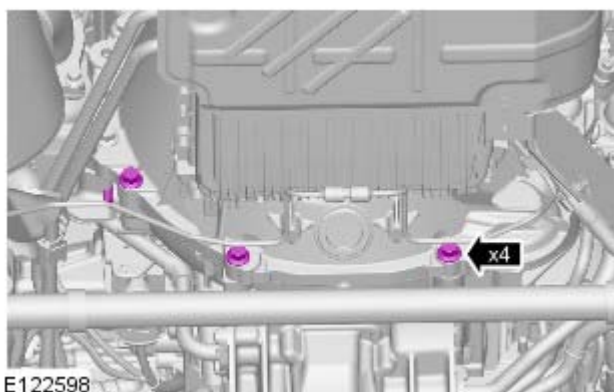
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

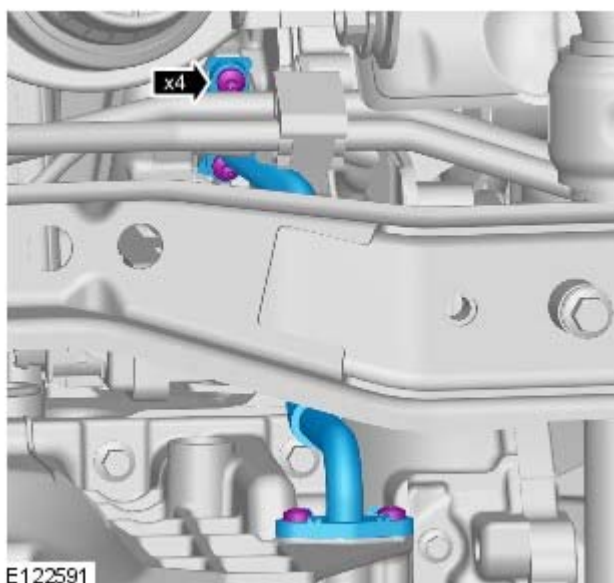
3. Refer to: [Engine Oil Draining and Filling](#) (303-01B Engine - TDV6 3.0L Diesel, General Procedures).

4. Refer to: [Axle Assembly](#) (205-03 Front Drive Axle/Differential, Removal and Installation).

5. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).

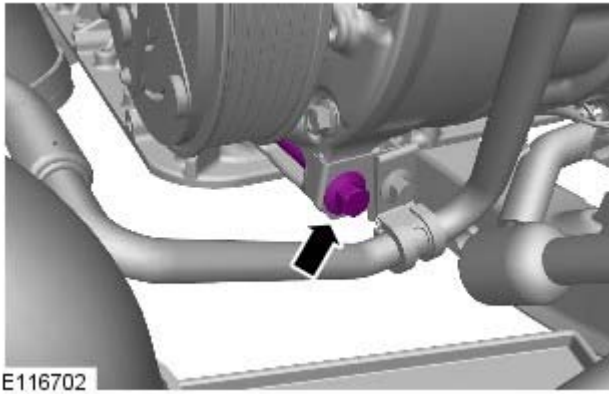


6. *Torque:*
M10 40 Nm
M8 24 Nm

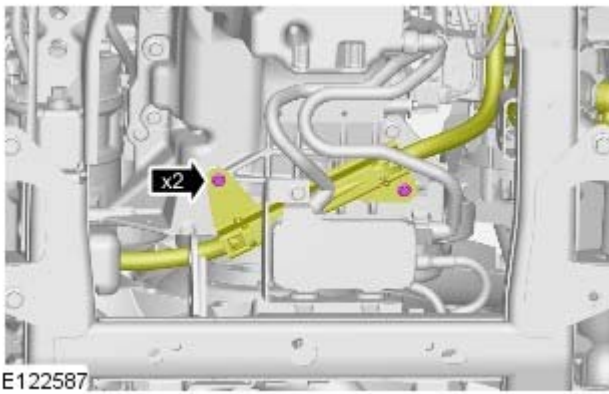


7.  **CAUTION:** Make sure that the gaskets are correctly located.

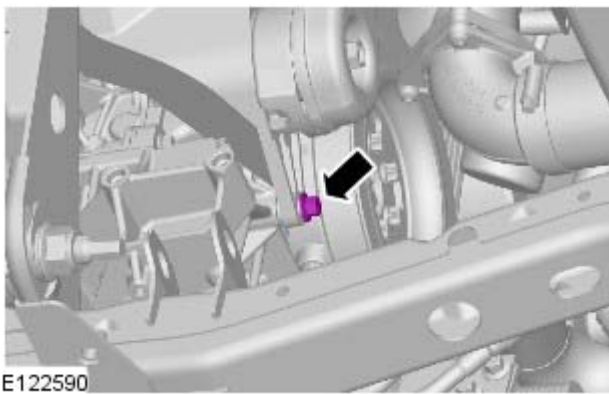
Torque: 10 Nm



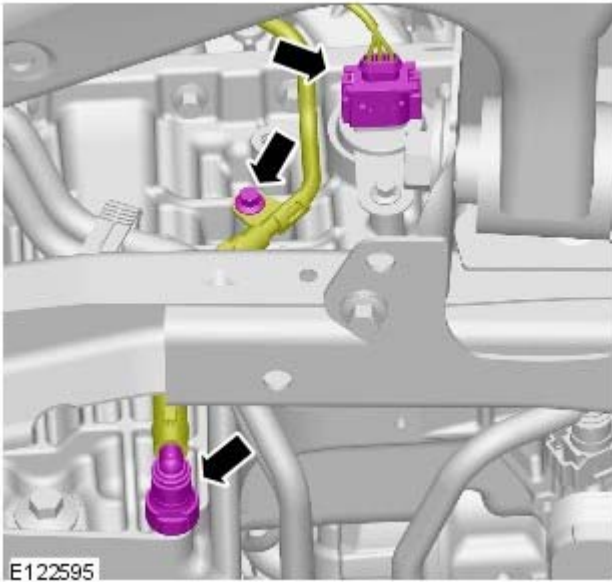
8. Torque: 25 Nm



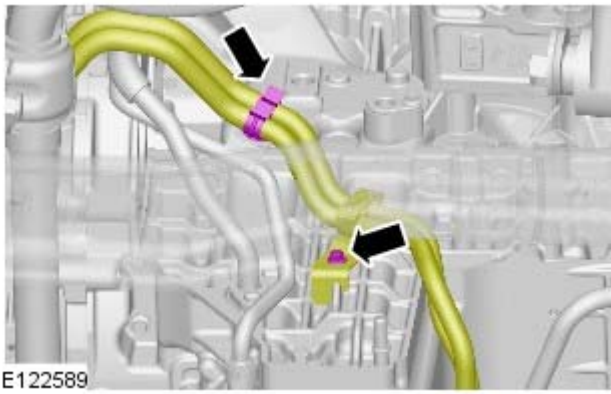
9. Torque: 10 Nm



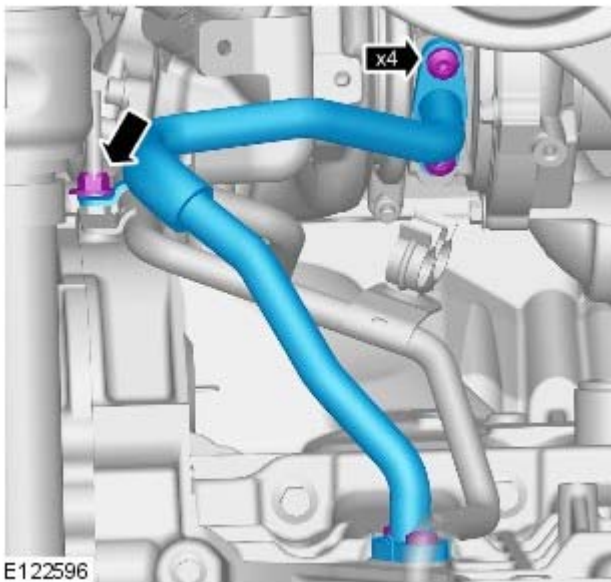
10. Torque: 24 Nm



11. Torque: 10 Nm

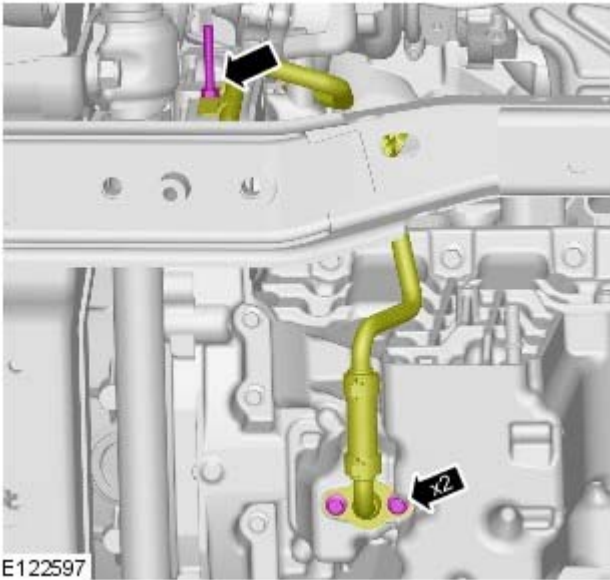


12. Torque: 10 Nm



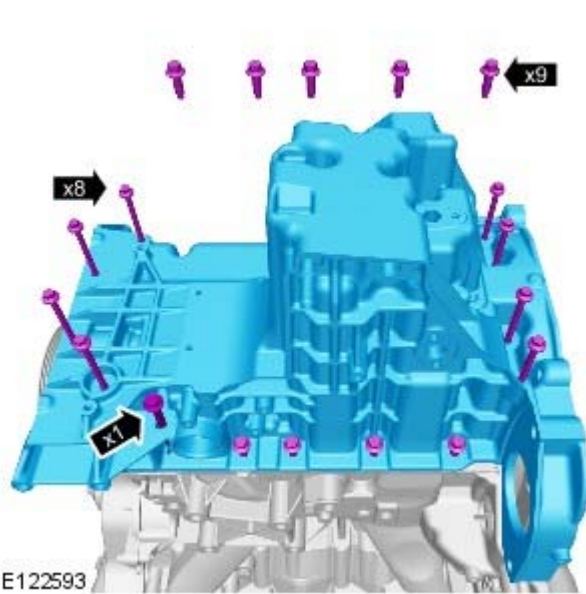
13. **⚠ CAUTION:** Make sure that the gaskets are correctly located.

Torque: 10 Nm



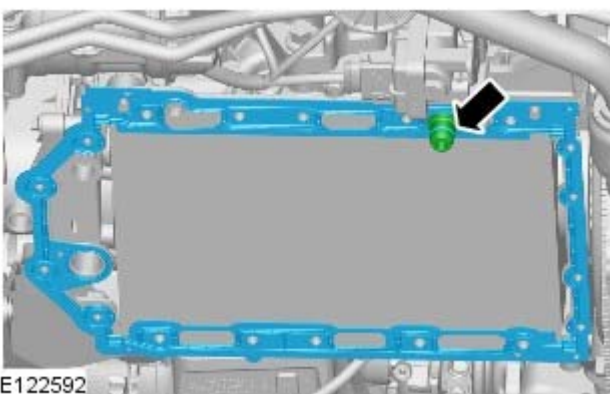
14. **14.** NOTE: Remove and discard the gasket.

Torque: 10 Nm

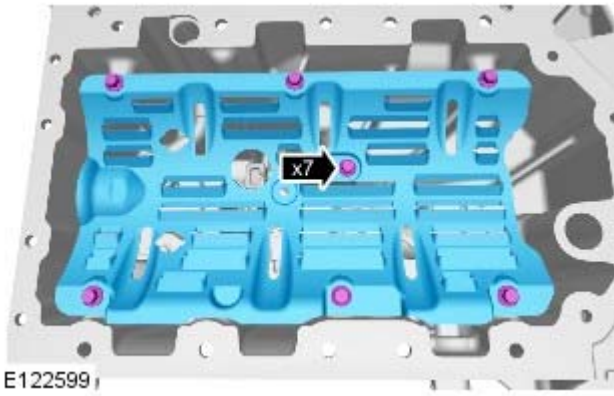


15. **15.**  CAUTION: Note the position of the bolts, prior to removal.

Torque:
M8 23 Nm
M6 10 Nm

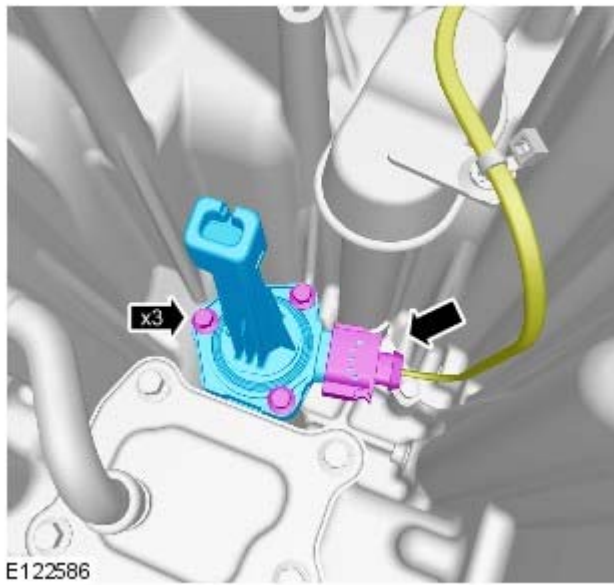


16. **16.** NOTE: Remove and discard the O-ring seal.

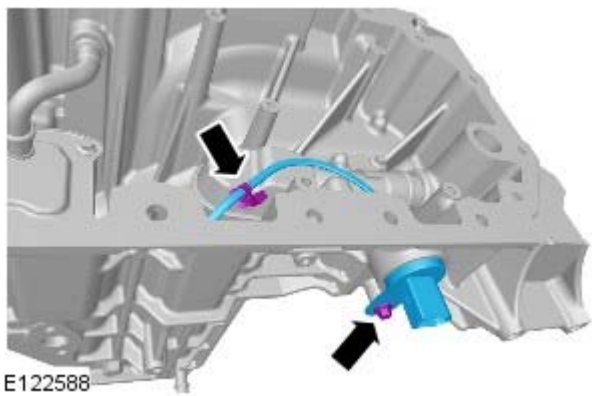


17. **17.** NOTE: Do not disassemble further if the component is removed for access only.

Torque: 10 Nm

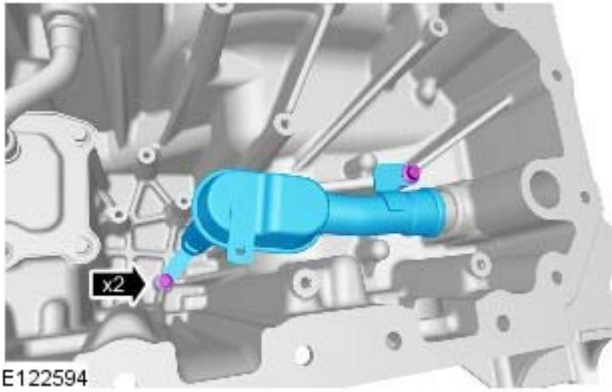


18. *Torque:* 10 Nm



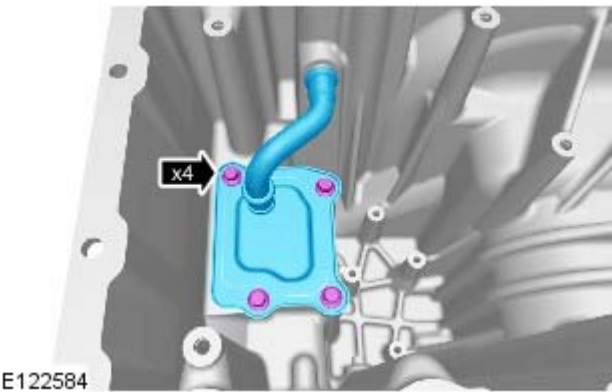
19. **19.** NOTE: Remove and discard the O-ring seal.

Torque: 10 Nm



20. **20.** NOTE: Remove and discard the O-ring seal.

Torque: 10 Nm

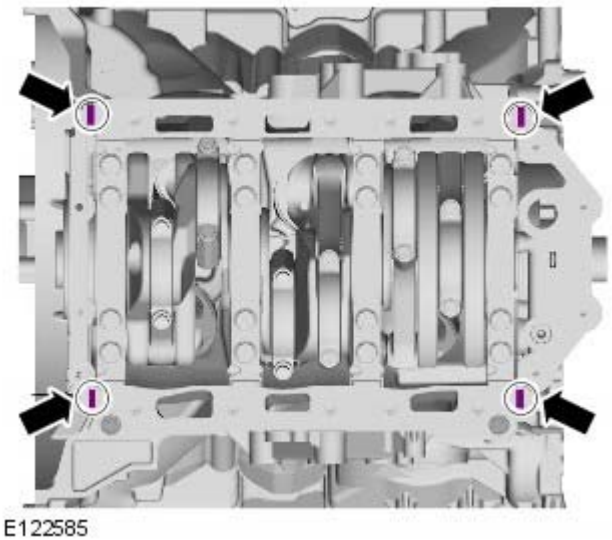


21. **21.** NOTE: Remove and discard the O-ring seals.


• NOTE: Discard the gasket.


Torque: 10 Nm

Installation



1. **1.** CAUTIONS:

 Make sure that the mating faces are clean and free of corrosion and foreign material.

 Installation of the oil pan and tightening must be carried out within 7 minutes of applying the sealant.


Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

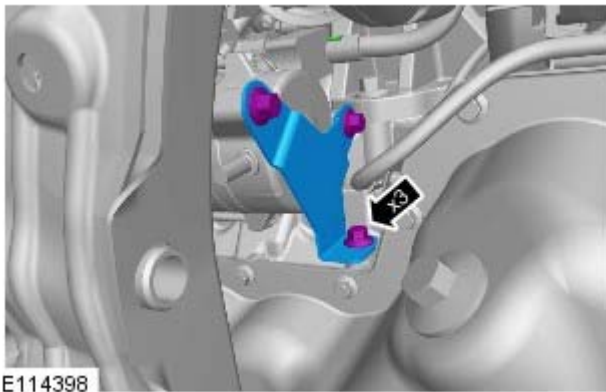
2. To install, reverse the removal procedure.

Engine - TDV6 3.0L Diesel - Oil Pan Extension

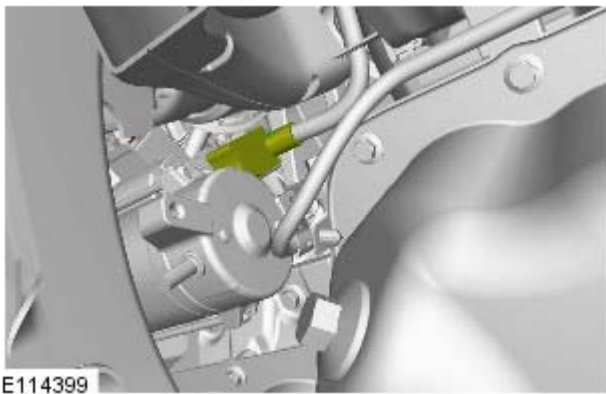
Removal and Installation

Removal

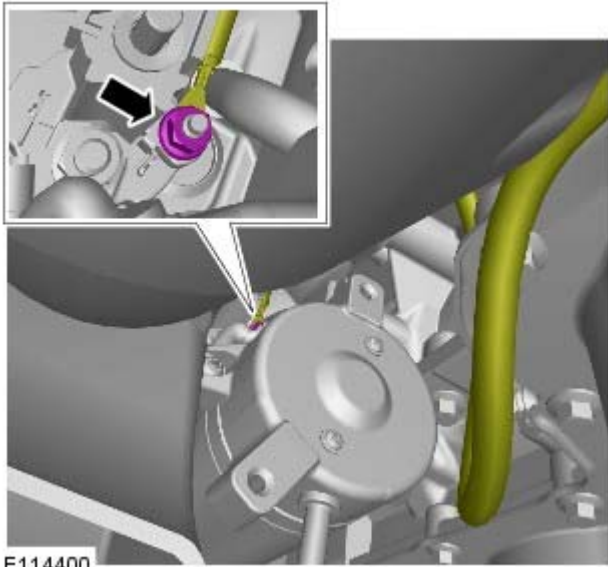
1. Refer to: Battery Disconnect and Connect (414-01, General Procedures).
2.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
3. Refer to: Transmission - 3.0L (307-01, Removal).
4. Refer to: [Oil Pan](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).



5.

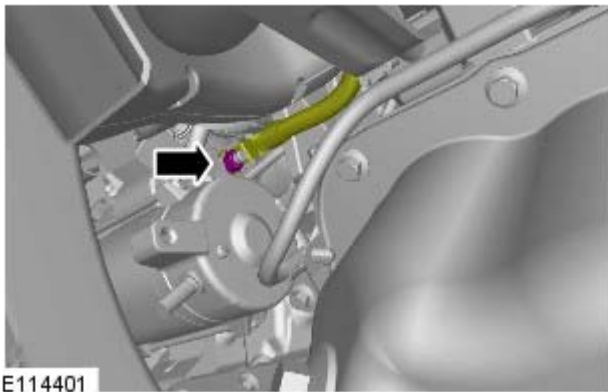


6.



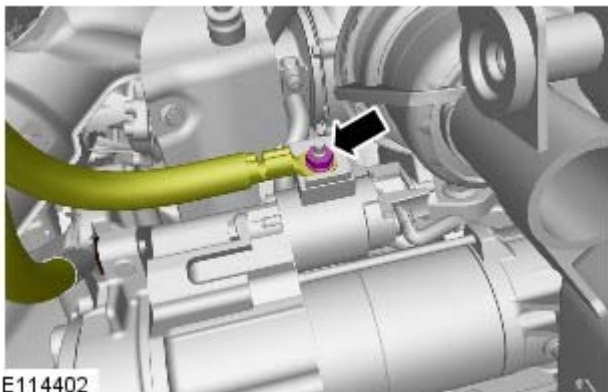
E114400

7.



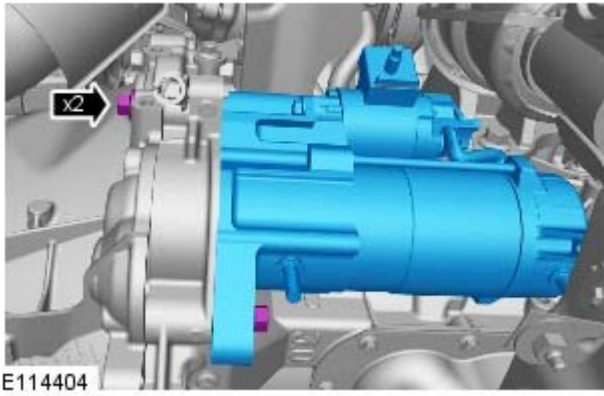
E114401

8.

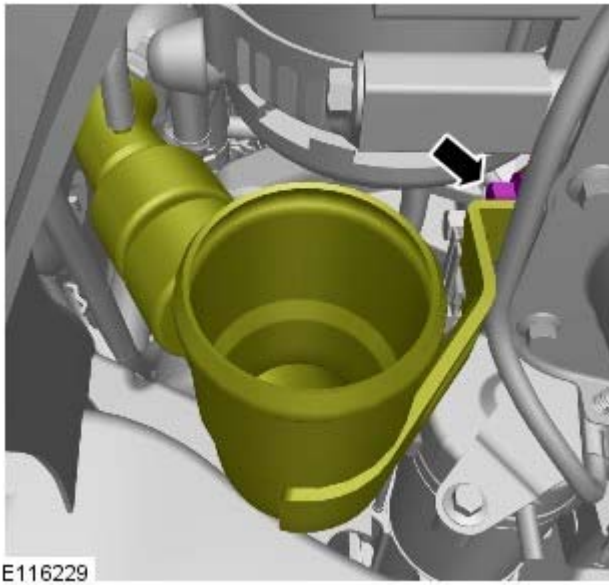


E114402

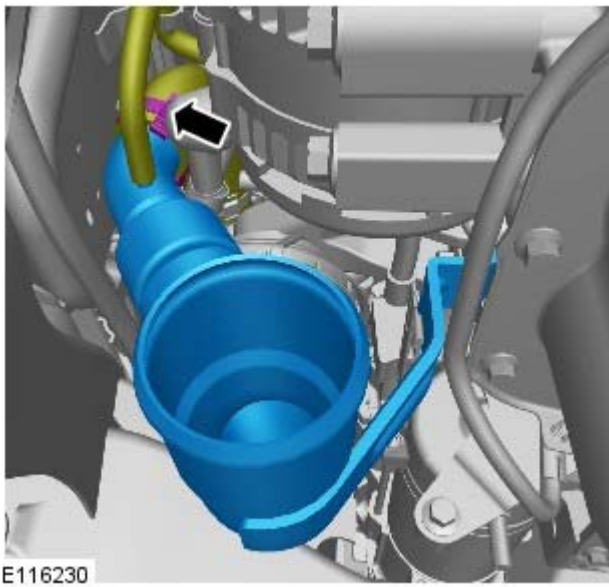
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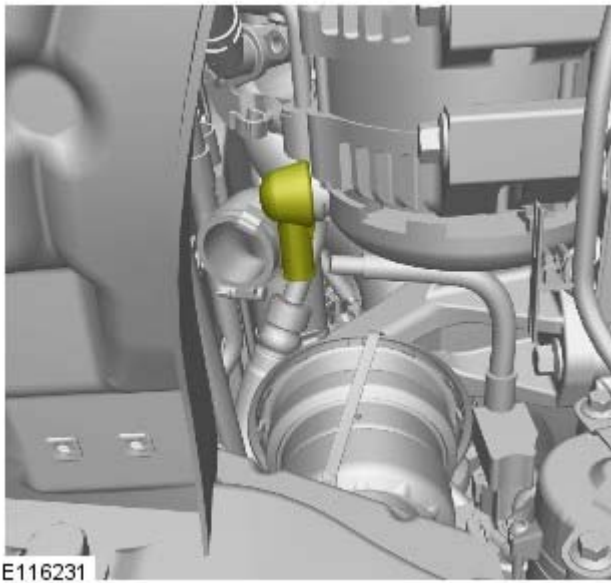
10. **10.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



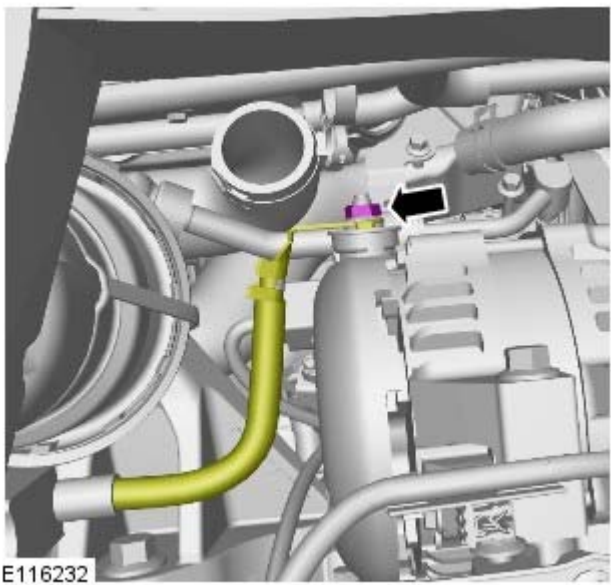
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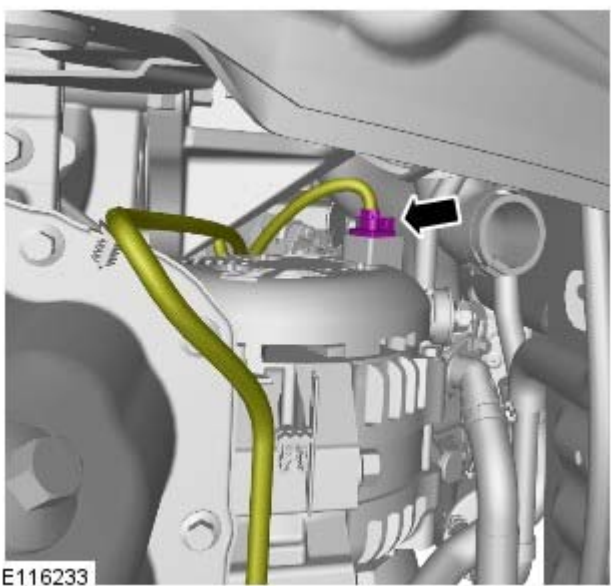
12. **12.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



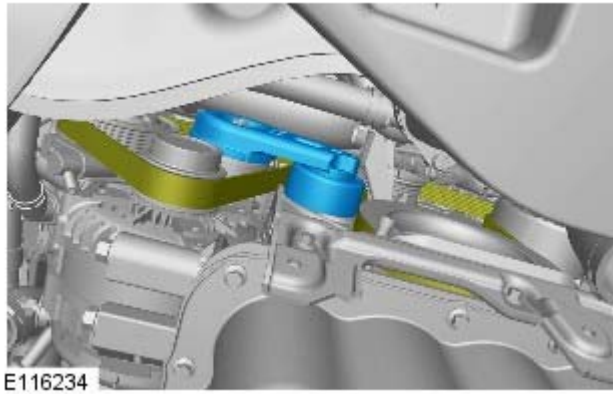
13.



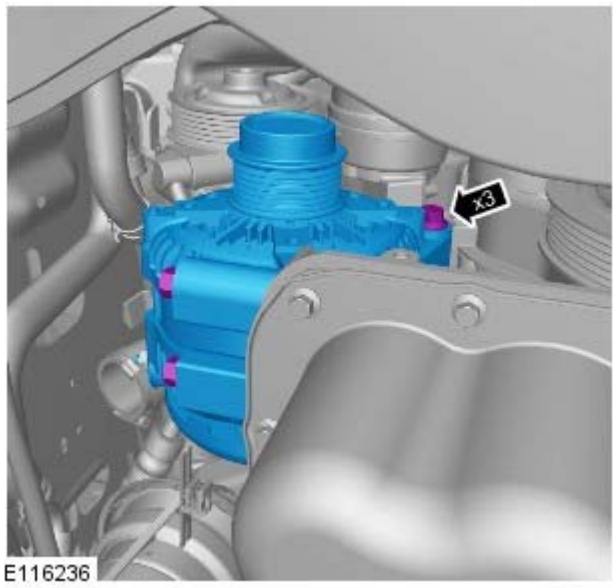
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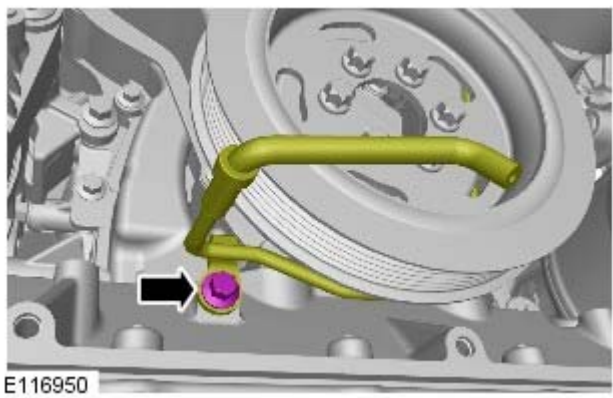
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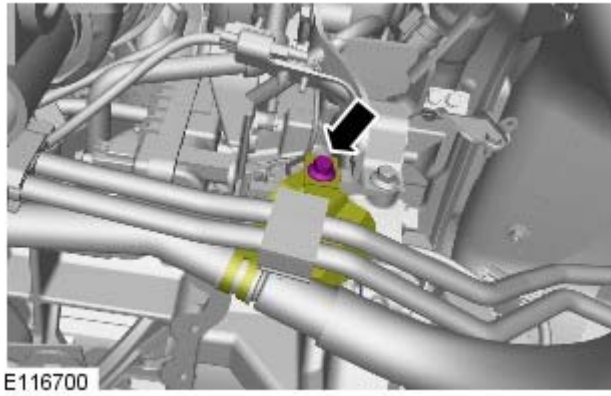
16.



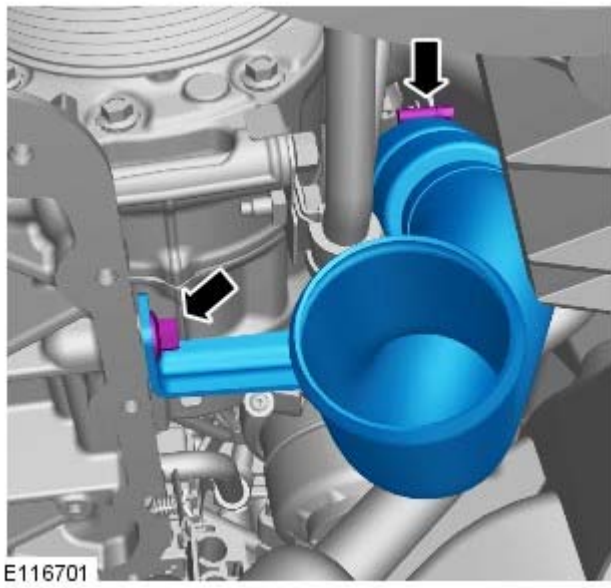
17.



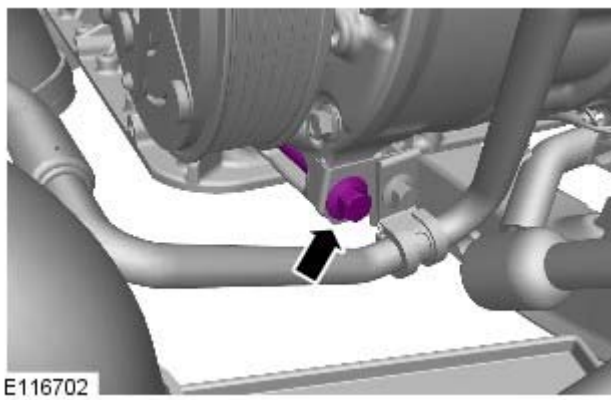
18.



19.

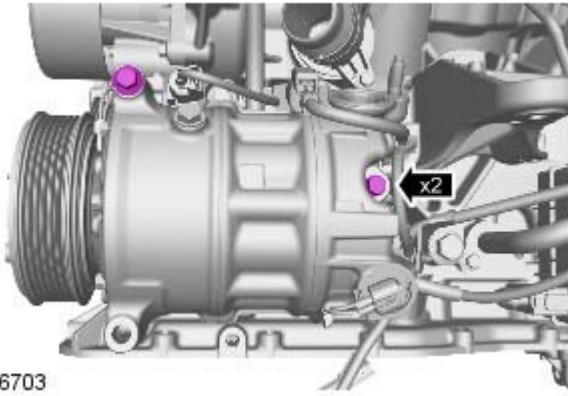


20.



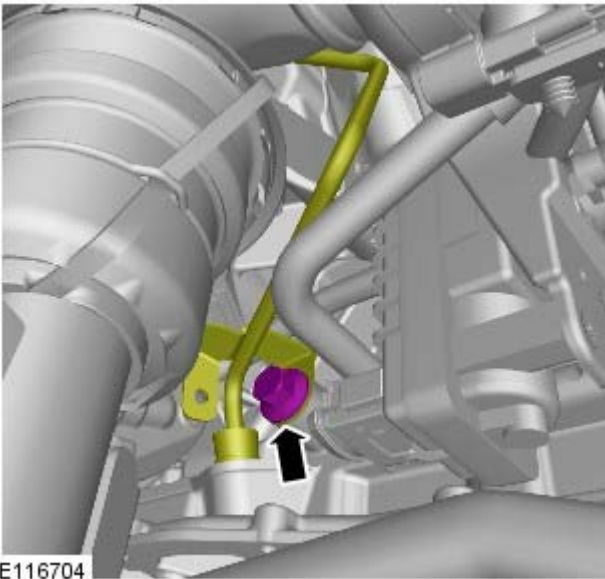
21.

22. **22.** NOTE: Loosen the bolt, but do not fully remove.



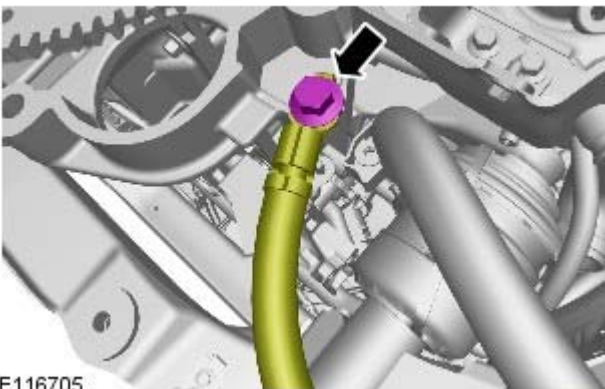
E116703

23.

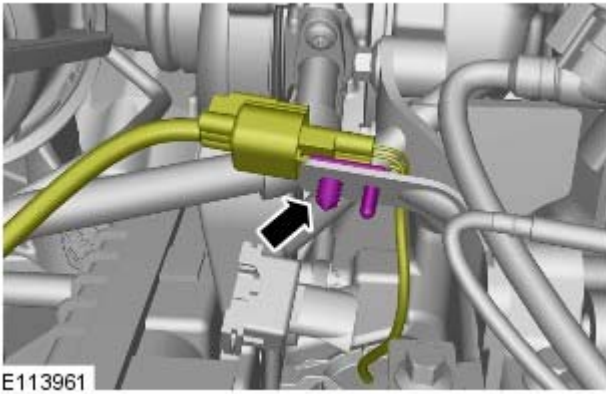


E116704

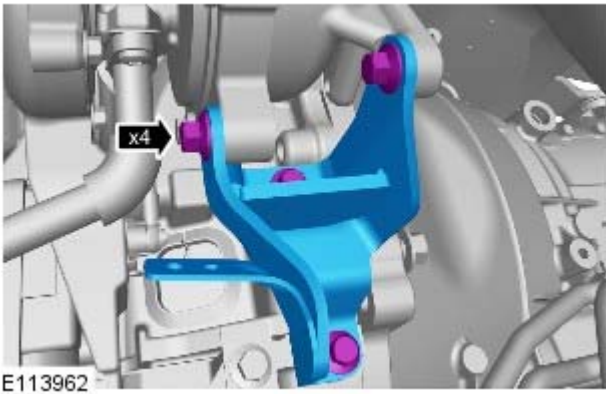
24.



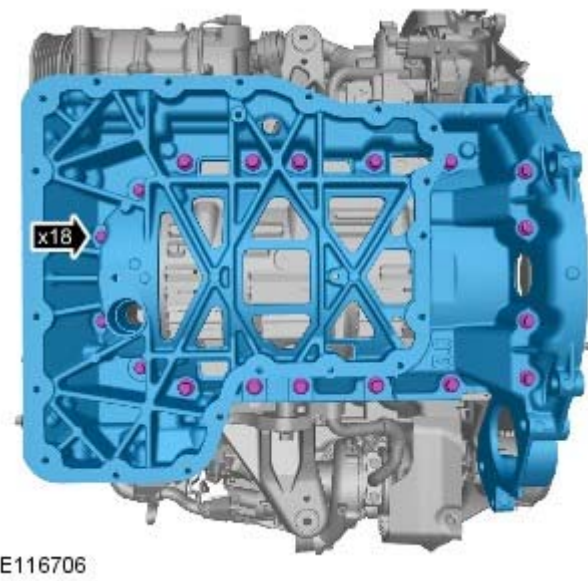
E116705



25.




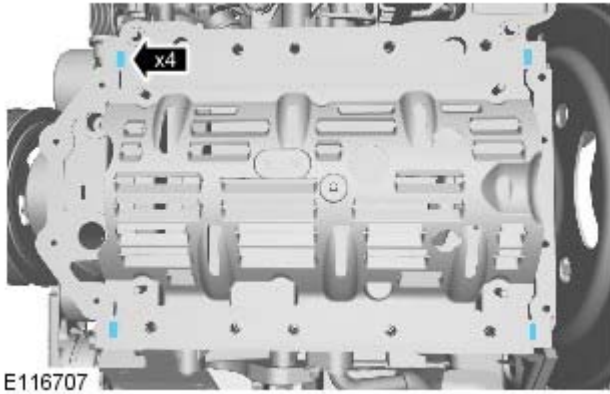
26.



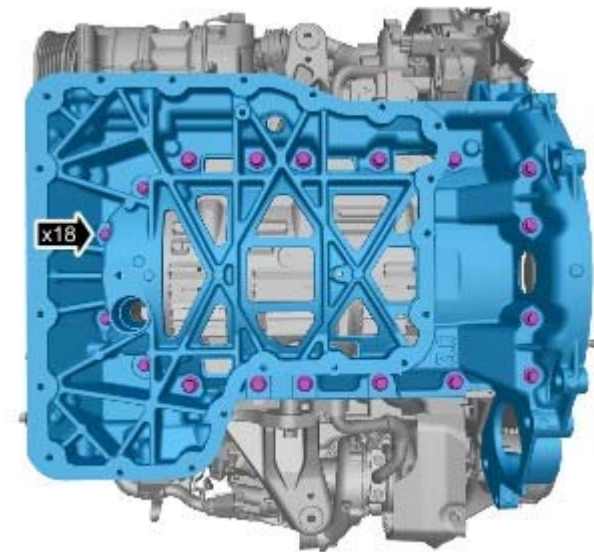
27. **27.** NOTE: Discard the gasket.

Installation

1.  CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.



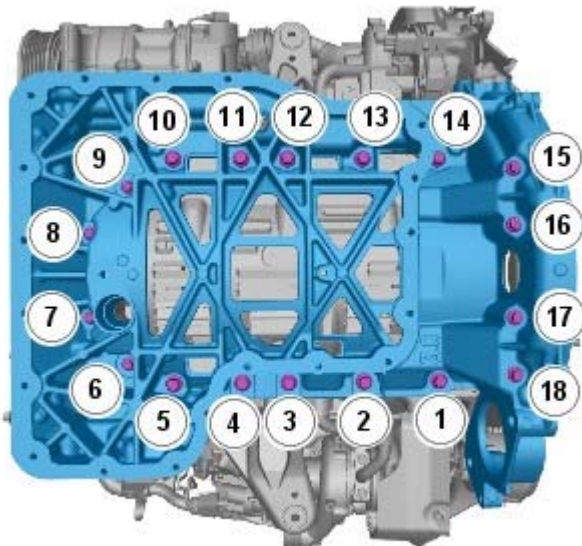
2. Apply the sealant as shown.



3.  CAUTION: Only tighten the bolt finger-tight at this stage.

- NOTE: Install a new gasket.

E116706



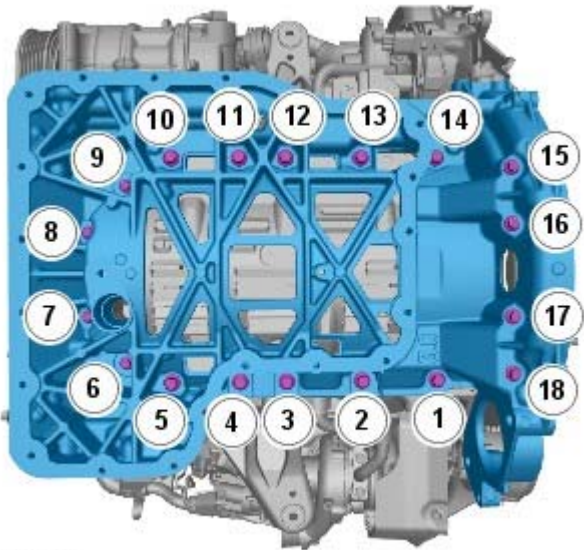
4. 4. NOTE: Tighten the bolts in the indicated sequence.

Torque:
 M8 10 Nm
 M6 4 Nm

E116708

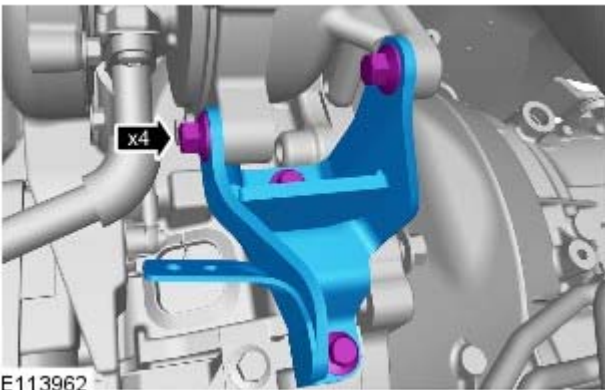
5. **5. NOTE:** Tighten the bolts in the indicated sequence.

Torque:
M8 24 Nm
M6 10 Nm



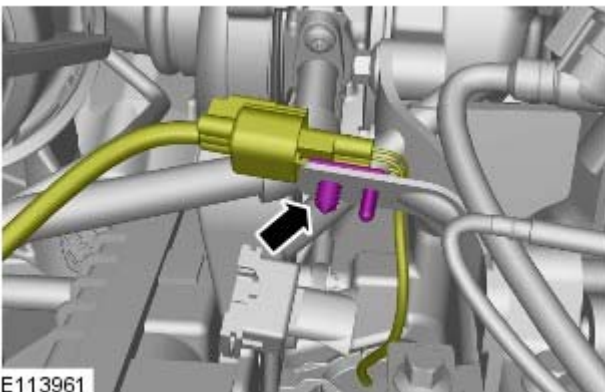
E116708

6. *Torque:* 24 Nm

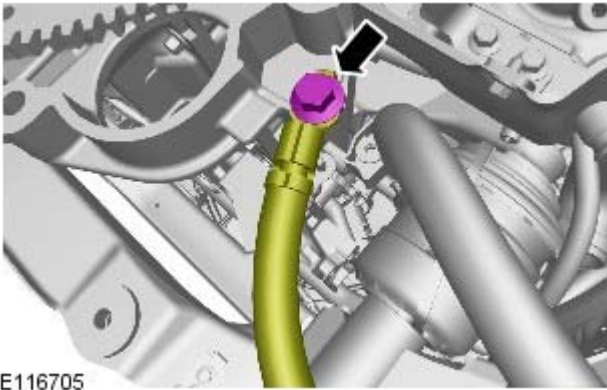


E113962

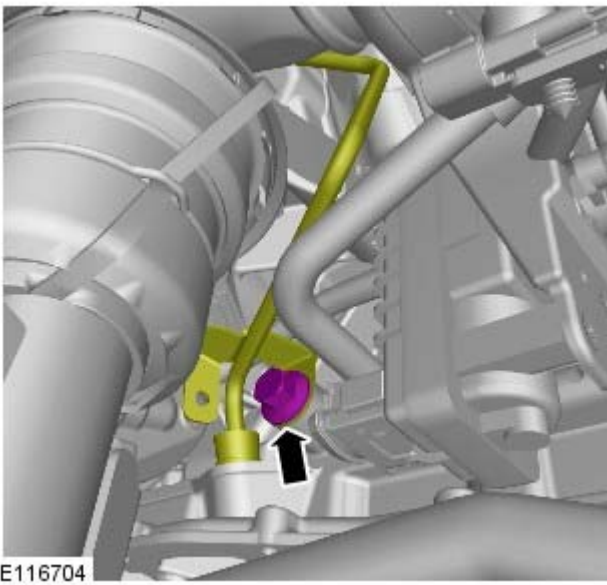
- 7.



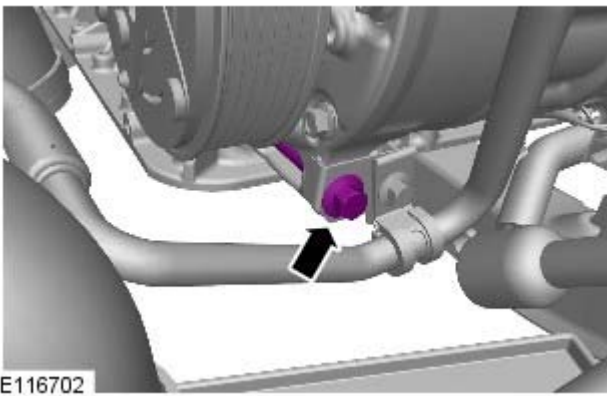
E113961



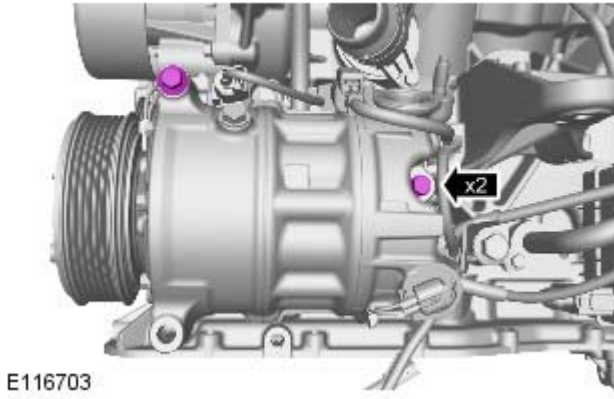
8. Torque: 25 Nm



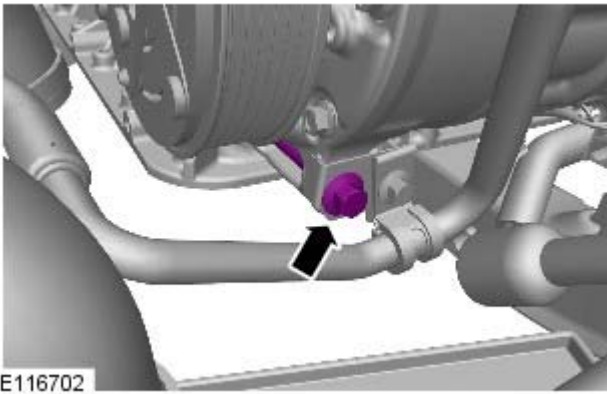
9. Torque: 24 Nm



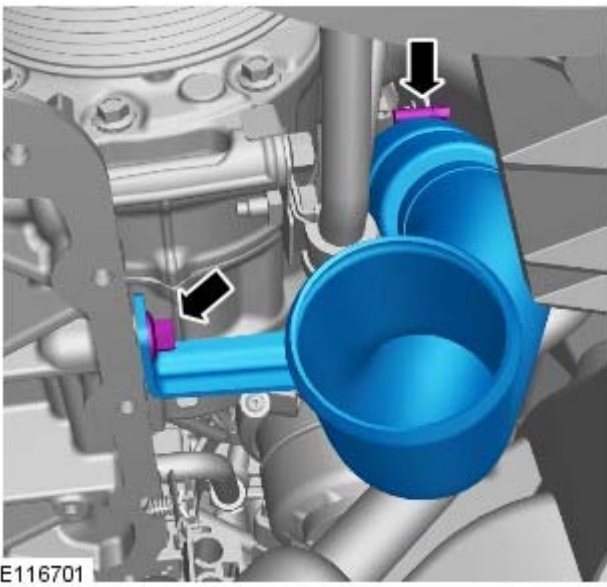
10.  CAUTION: Only tighten the bolts finger-tight at this stage.



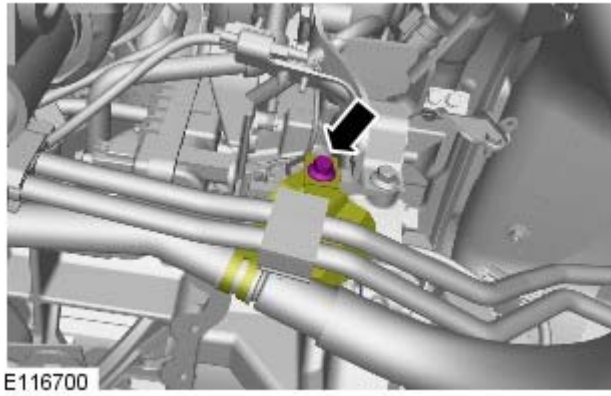
11. Torque: 24 Nm



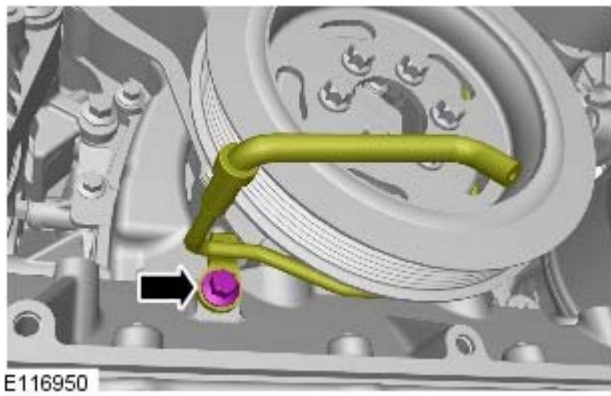
12. Torque: 24 Nm



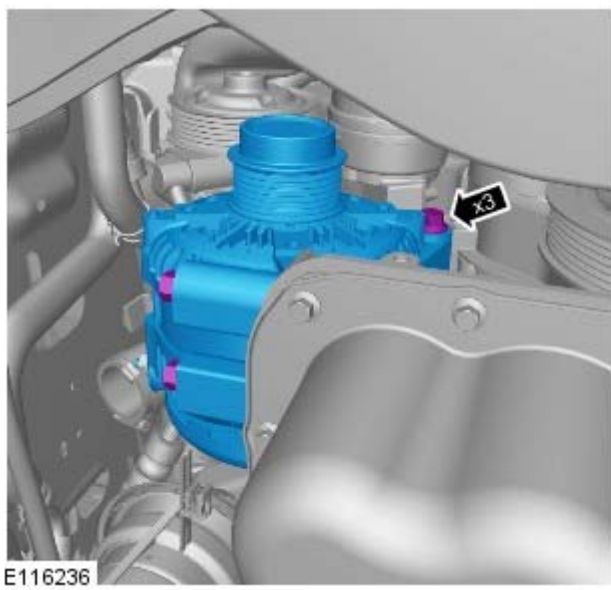
13. Torque:
M6 10 Nm
Clip 7 Nm



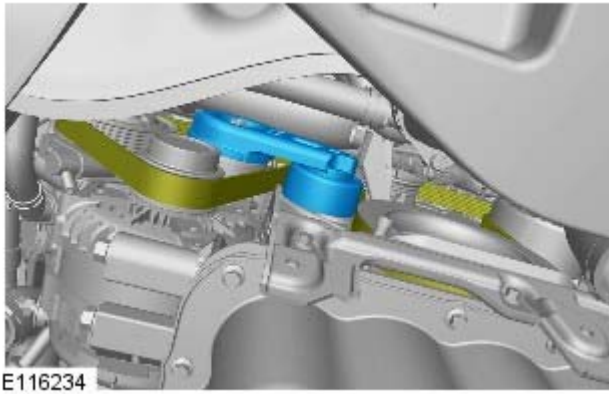
14. Torque: 10 Nm



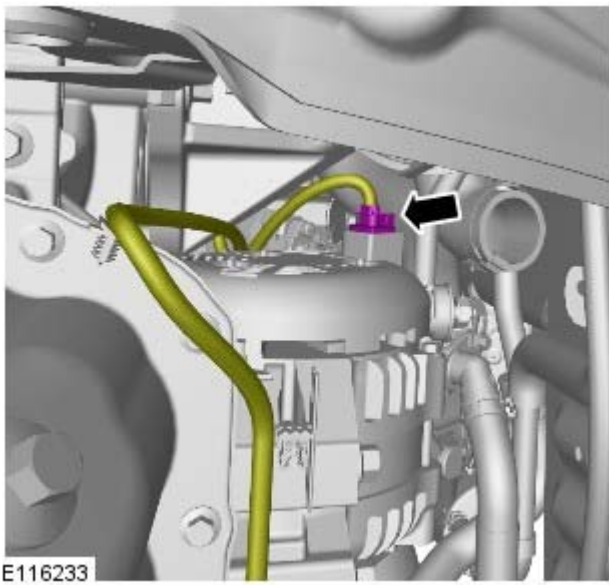
15. Torque: 10 Nm



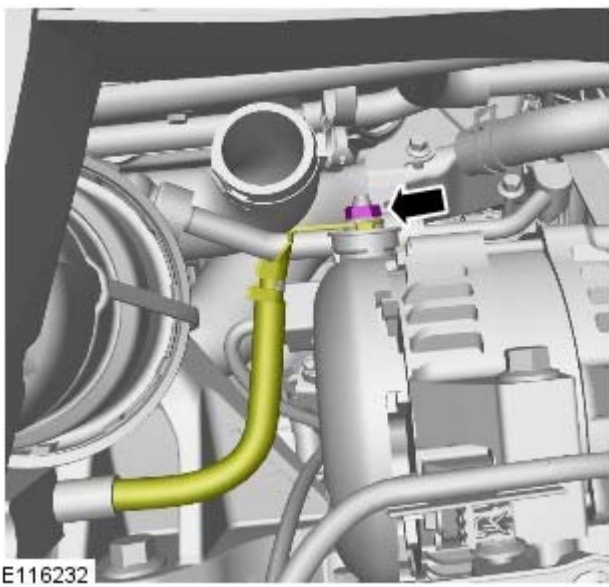
16. Torque: 47 Nm



17.

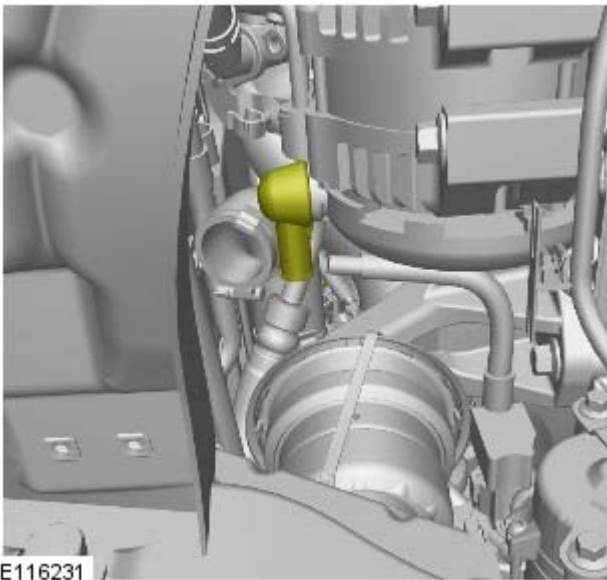


18.



19. Torque: 15 Nm

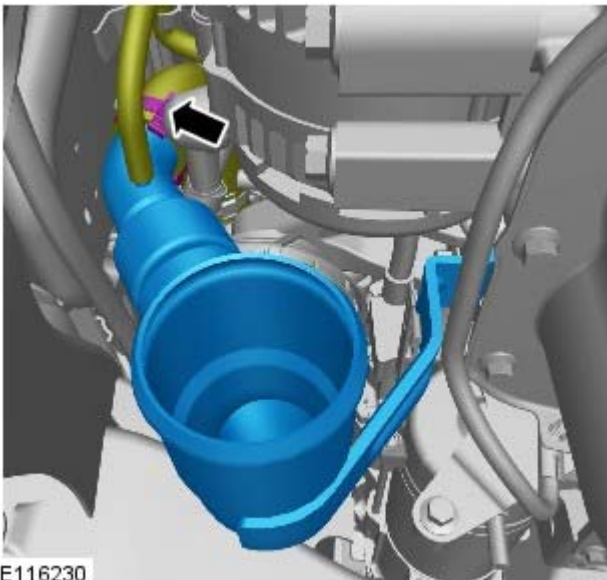
20.



E116231

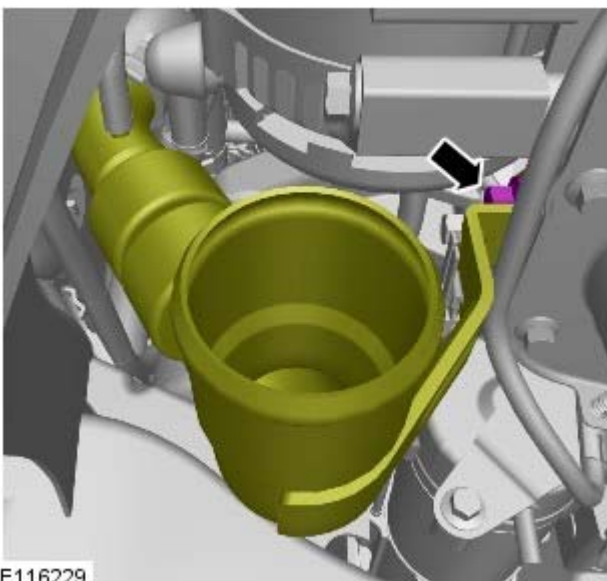
21. **21.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 7 Nm

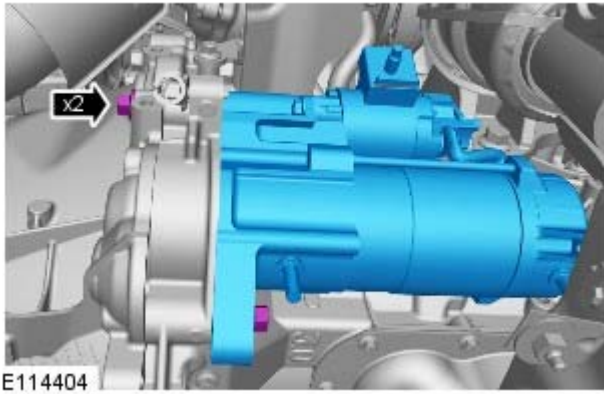


E116230

22. *Torque: 10 Nm*

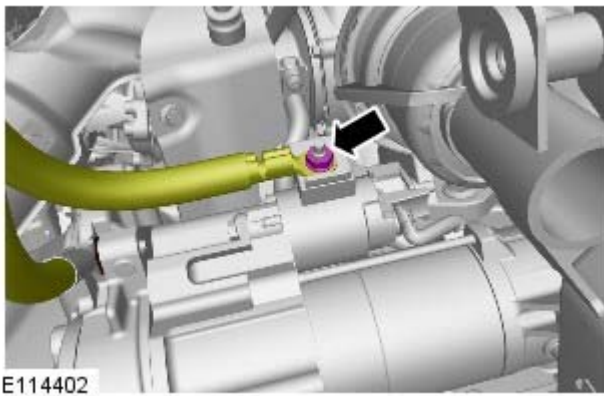


E116229

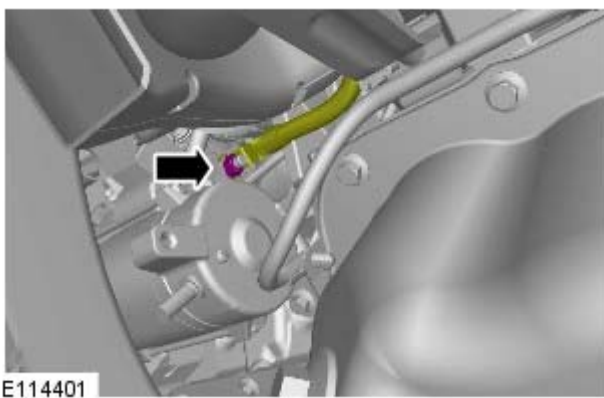


23. **23.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 48 Nm

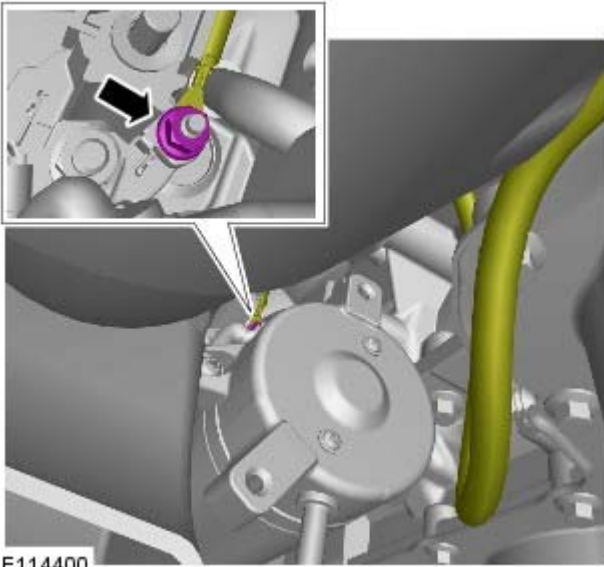


24. *Torque:* 10 Nm

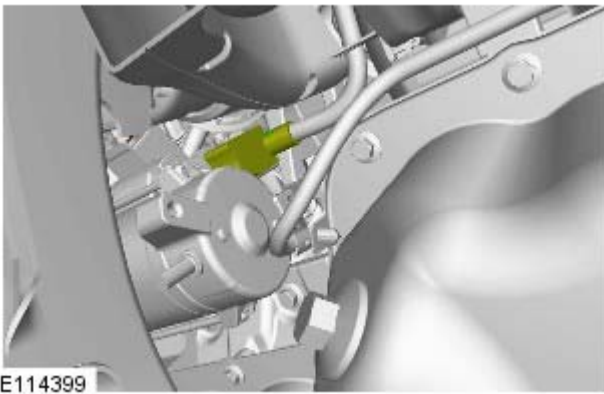


25. *Torque:* 10 Nm

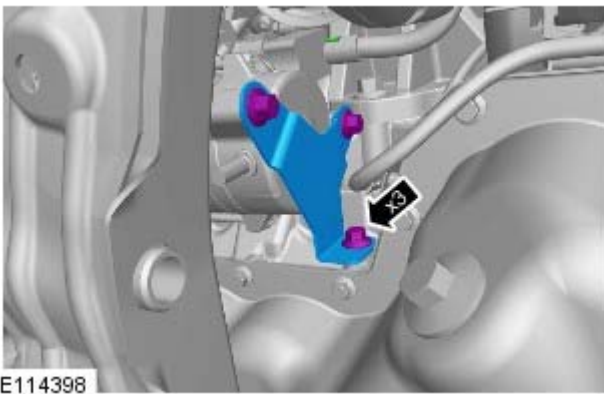
26. Torque: 7 Nm



27.



28. Torque: 23 Nm



29. Refer to: Transmission - 3.0L (307-01, Removal).

30. Refer to: [Oil Pan](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

31. Refer to: Battery Disconnect and Connect (414-01, General Procedures).

Engine - TDV6 3.0L Diesel - Oil Pump

Removal and Installation

Removal

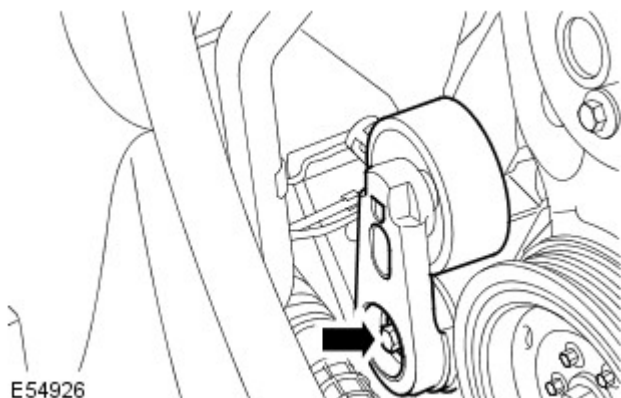
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the generator.

Refer to: [Generator](#) (414-02B Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

3. Remove the accessory drive belt tensioner.



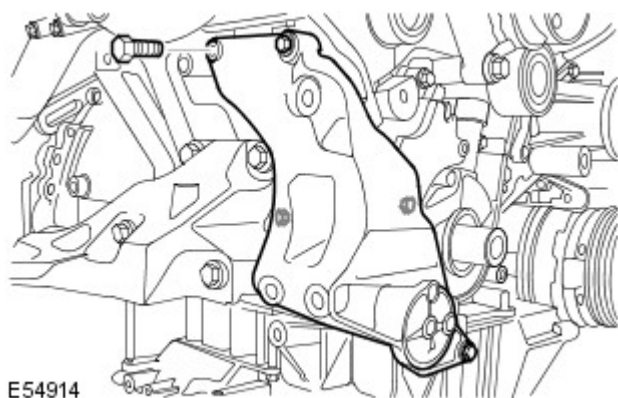
E54926

4. Remove the oil pan extension.

Refer to: [Oil Pan Extension](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

5. Remove the crankshaft front oil seal.

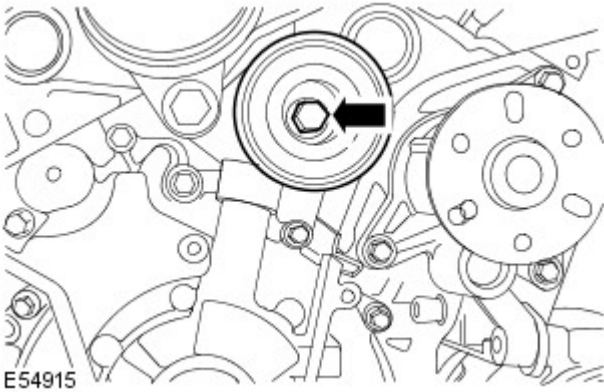
Refer to: [Crankshaft Front Seal](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).



E54914

6. Remove the generator mounting bracket.

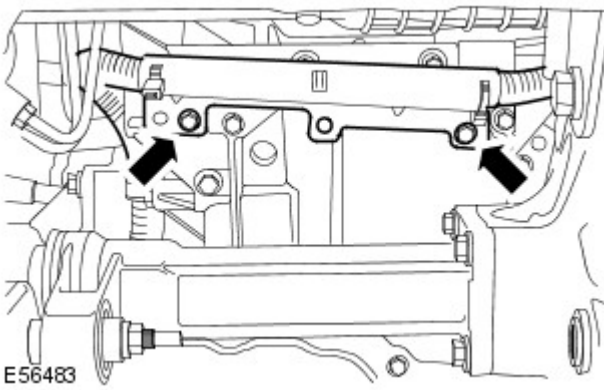
7. Remove the timing belt idler pulley.



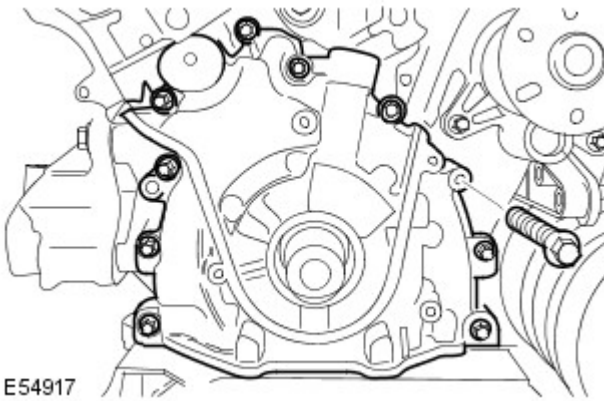
8.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

9. Release the battery positive cable.



10. Remove the oil pump.




Installation

1. Prime the oil pump.



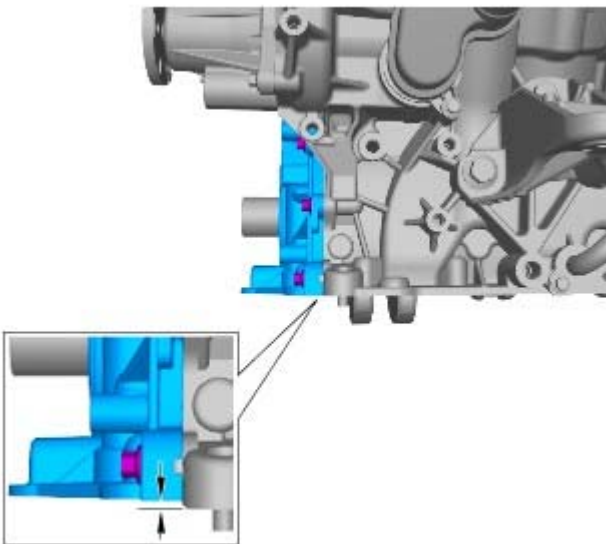
E123911

2. 2. CAUTIONS:


 Make sure that the mating faces are clean and free of foreign material.

 Make sure the gasket is installed correctly.

Install the oil pump.

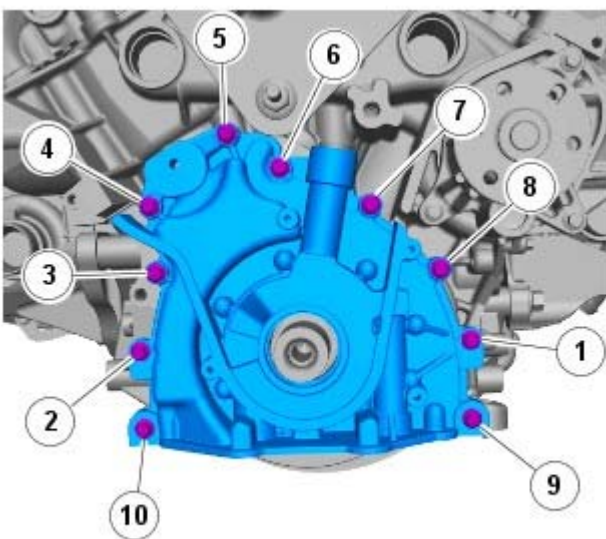


E123913

3.  CAUTION: Make sure the base of the oil pump is aligned within 0.2 mm of the base of the engine block. Failure to follow this instruction may result in damage to the vehicle.

• NOTE: Vehicles fitted with oil pumps without dowels.

Check the oil pump to engine block alignment.



E123912

4. Tighten the bolts in the sequence shown to 10 Nm .

5. Install the battery positive cable.

6. Install the timing belt idler pulley.

7. Install the crankshaft front oil seal.

Refer to: [Crankshaft Front Seal](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

8. Install the oil pan extension.

Refer to: [Oil Pan Extension](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

9. Install the generator mounting bracket.

10. Install the accessory drive belt tensioner.

11. Install the generator.

Refer to: [Generator](#) (414-02B Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).

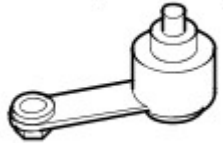

12. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Engine - TDV6 3.0L Diesel - Timing Belt

Removal and Installation

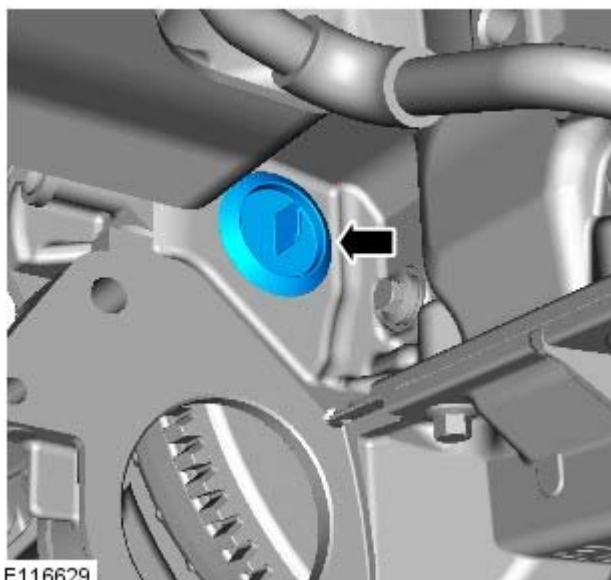
Special Tool(s)

 <p>303-1117</p> <p>E54540</p>	<p>303-1117 Timing Peg, Automatic Transmission</p>
 <p>303-1126</p> <p>E54551</p>	<p>303-1126 Timing Peg, Camshaft Pulley</p>

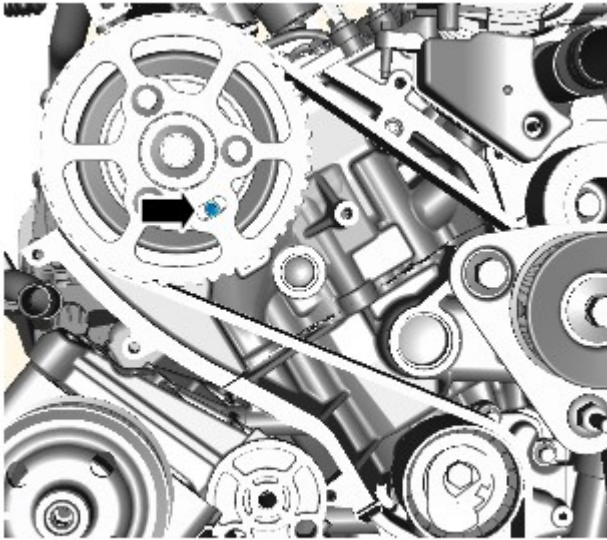
Removal

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Timing Cover](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: [Starter Motor](#) (303-06D Starting System - V8 5.0L Petrol, Removal and Installation).

4.

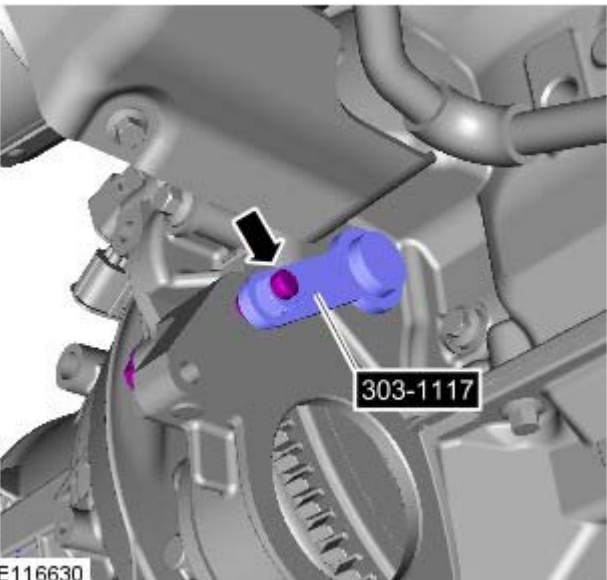


5. Rotate the crankshaft clockwise to align the crankshaft alignment hole in the flywheel or flexplate with the block aperture.



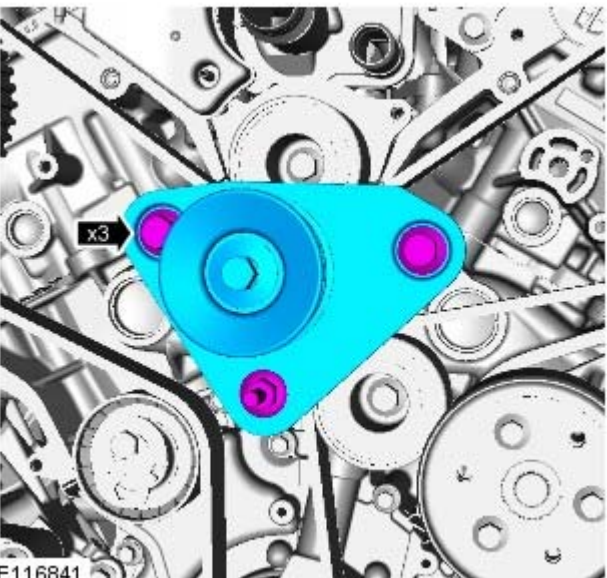
E116840

6. Check the camshaft pulley alignment holes are correctly aligned. If the alignment holes are not aligned, rotate the crankshaft one full turn clockwise.



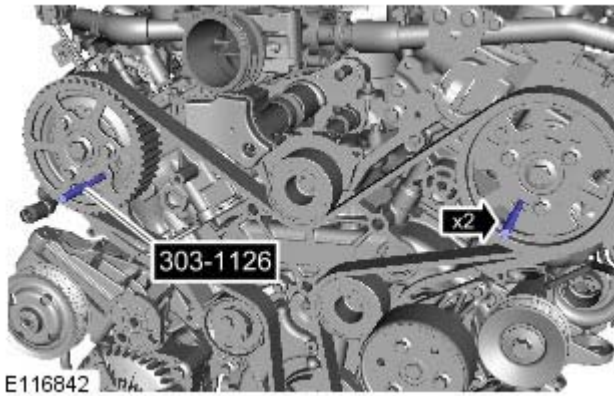
E116630

7. *Special Tool(s):* [303-1117](#)

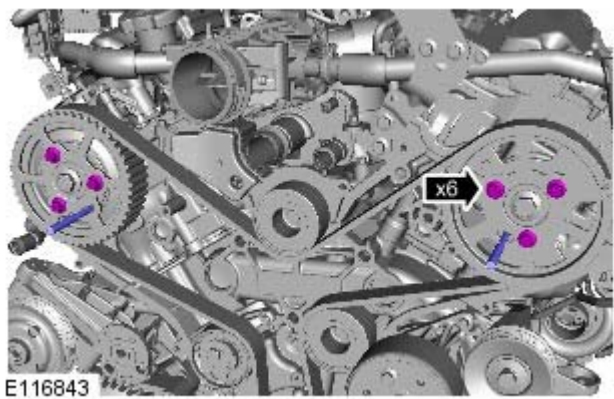



E116841

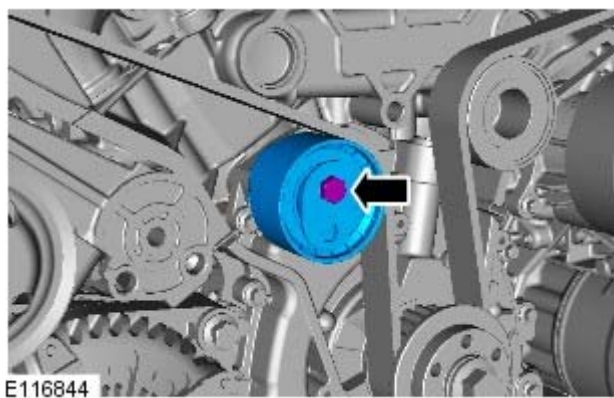
- 8.





9. *Special Tool(s):* [303-1126](#)

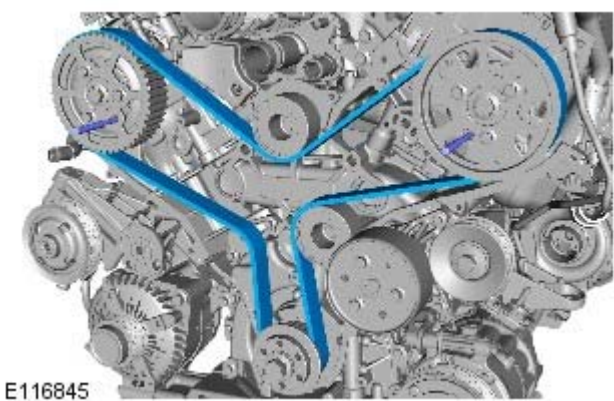


10.  **CAUTION:** Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.
- **NOTE:** Do not loosen the bolts more than 2 turns.



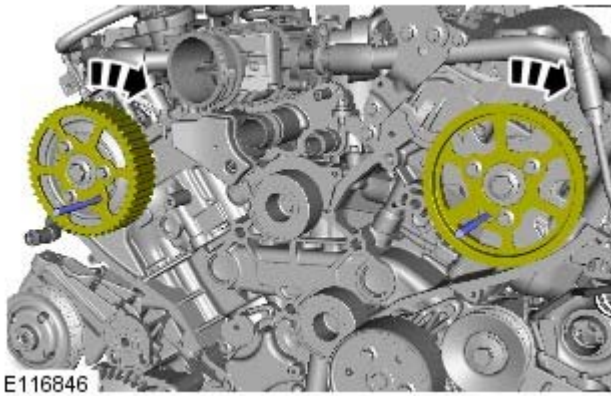
11. **11. CAUTIONS:**

-  Discard the component.
-  Discard the bolt.

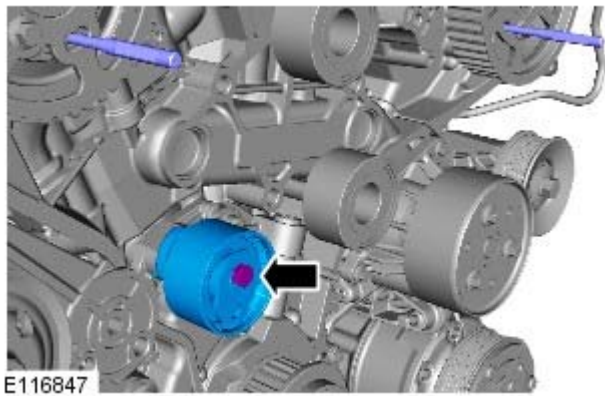


12. **12.**  **CAUTION:** Discard the component.

Installation

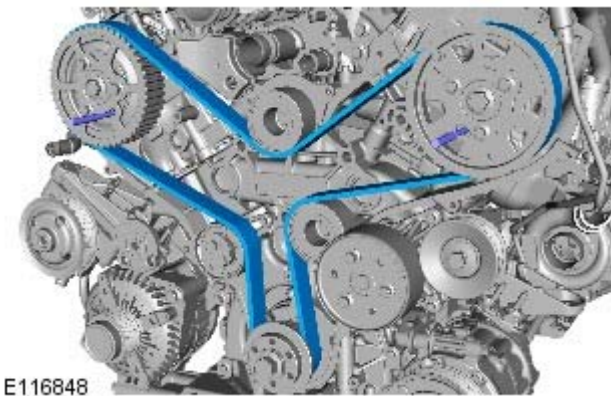


1.

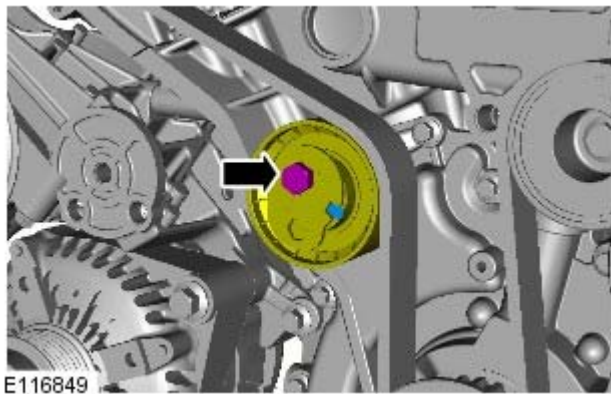


2. CAUTIONS:

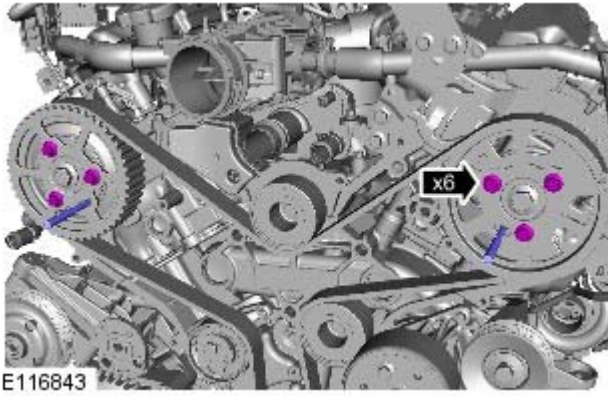
- ⚠ Make sure that a new bolt is installed.
- ⚠ Only tighten the bolts finger-tight at this stage.




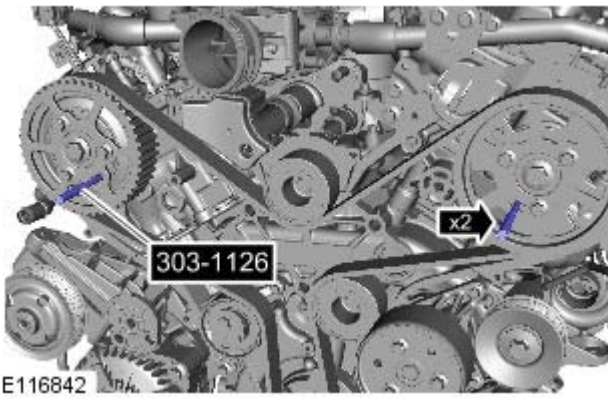
3. ⚠ CAUTION: Make sure the camshaft pulleys remain in the clockwise position.
- Install the new timing belt.
 - Starting at the crankshaft pulley, install the timing belt in a counter-clockwise direction, in the sequence shown.
 - Stage one: Attach the timing belt to the crankshaft pulley.
 - Stage two: Attach the timing belt to the idler pulley.
 - Stage three: Attach the timing belt to the left-hand camshaft pulley.
 - Stage four: Attach the timing belt to the idler pulley.
 - Stage five: Attach the timing belt to the RH camshaft pulley.
 - Stage six: Attach the timing belt to the timing belt tensioner.



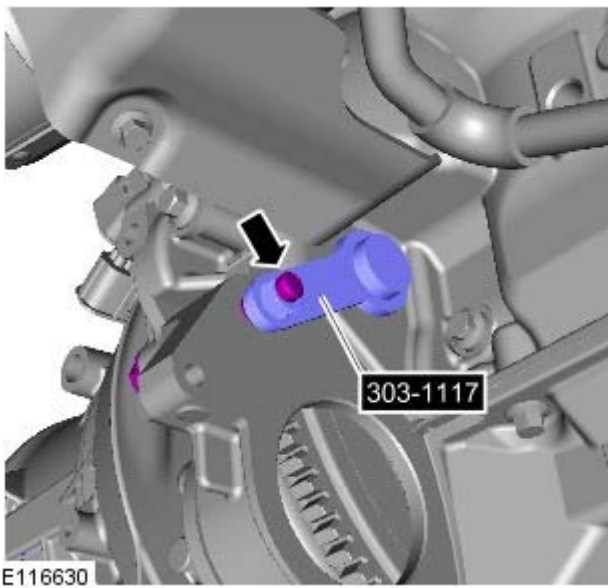
4. ⚠ CAUTION: Make sure the timing belt tensioner window is aligned with the groove as illustrated.
- Tension the timing belt.
 - Rotate the tensioner assembly counter-clockwise.
 - Torque: 26 Nm




5.  **CAUTION:** Do not use the special tools to lock the camshafts. Failure to follow this instruction may result in damage to the engine or the special tools.
 - Using a suitable tool, counterhold the camshaft pulley center retaining bolts.
 - *Torque:* 23 Nm

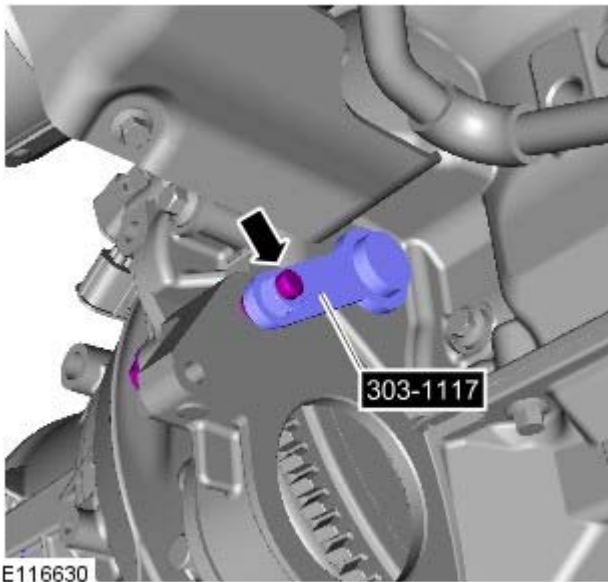


6. *Special Tool(s):* [303-1126](#)

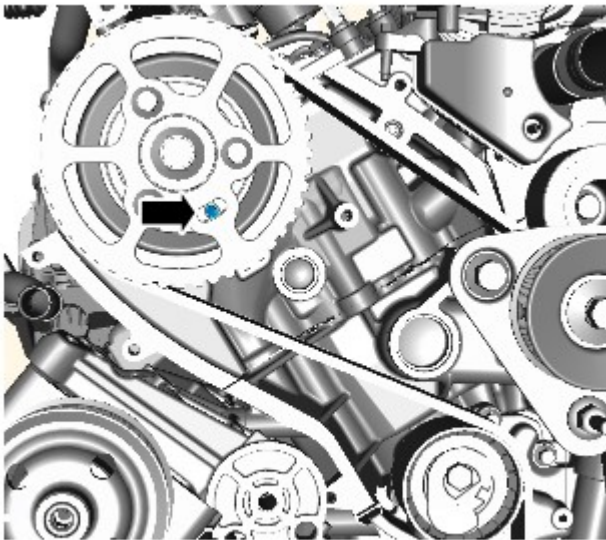


7. *Special Tool(s):* [303-1117](#)

8.  **CAUTION:** Only rotate the crankshaft clockwise.
Rotate the engine two complete turns clockwise.



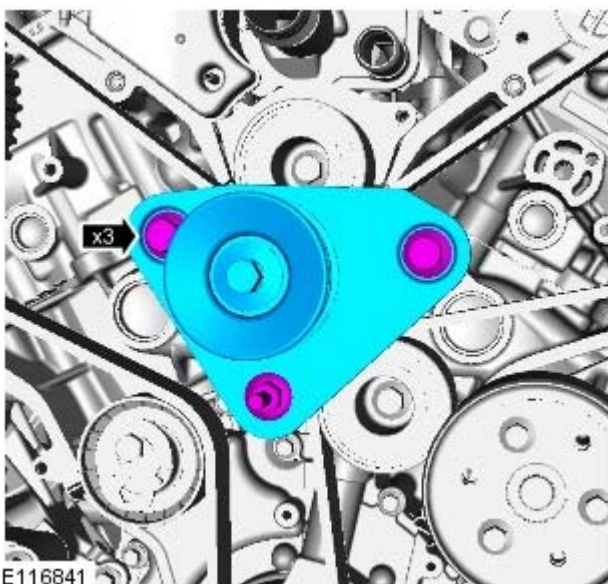
9. *Special Tool(s):* [303-1117](#)



10.

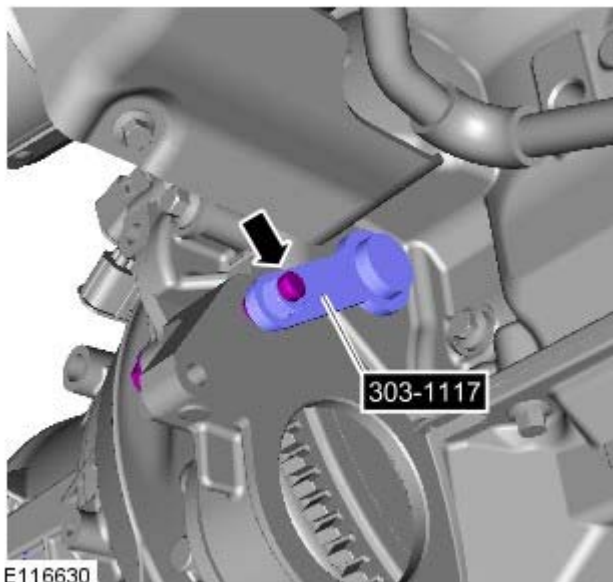
- Install the special tools to the exhaust camshaft pulleys.
- If the special tool does not fit correctly, repeat the timing belt installation procedure.
- Remove the special tools from the camshaft pulleys.

E116840

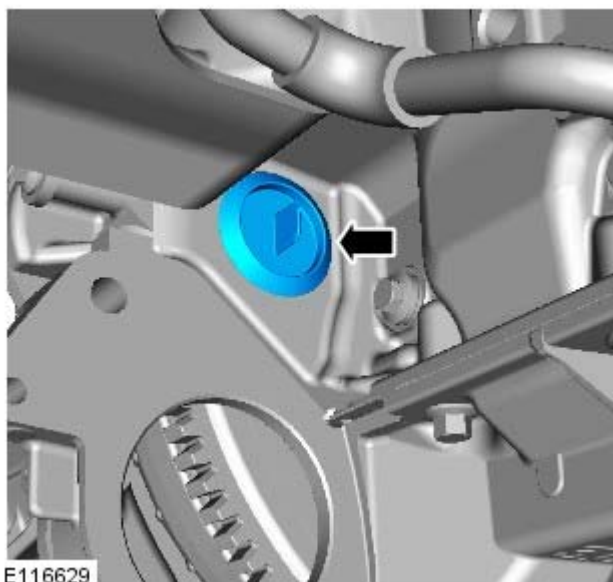


11. *Torque:* 80 Nm

12. *Special Tool(s):* [303-1117](#)



13.



14. Refer to: [Starter Motor](#) (303-06D Starting System - V8 5.0L Petrol, Removal and Installation).

15. Refer to: [Timing Cover](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

Engine - TDV6 3.0L Diesel - Timing Cover

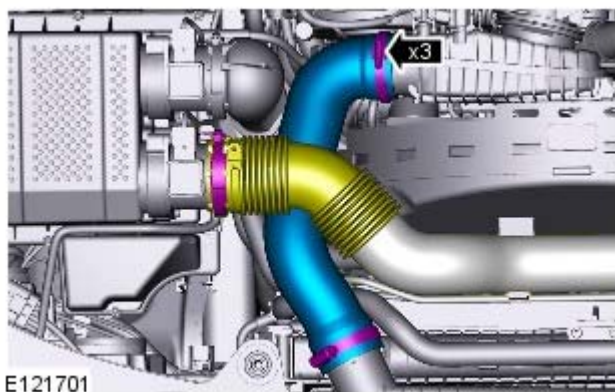
Removal and Installation

Removal

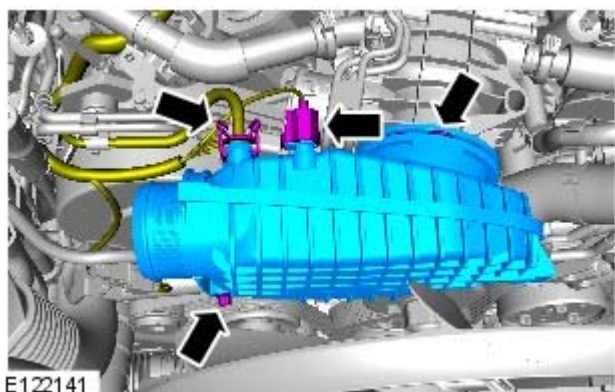
• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

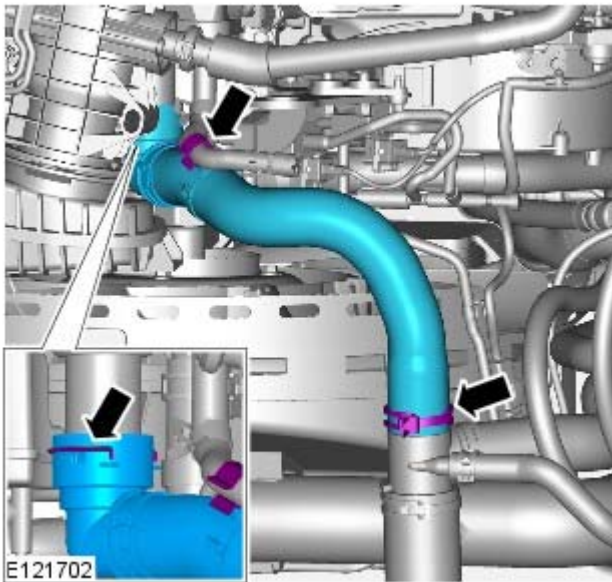
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
3. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).



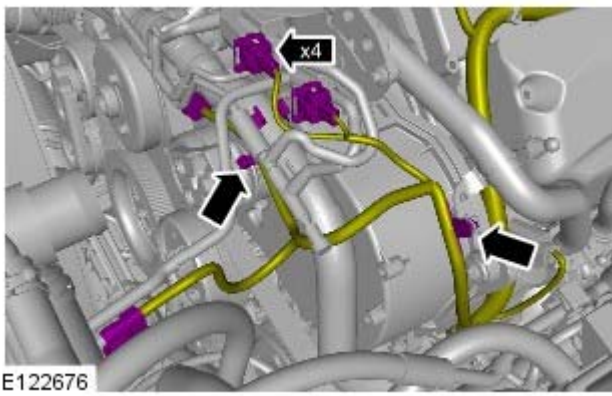
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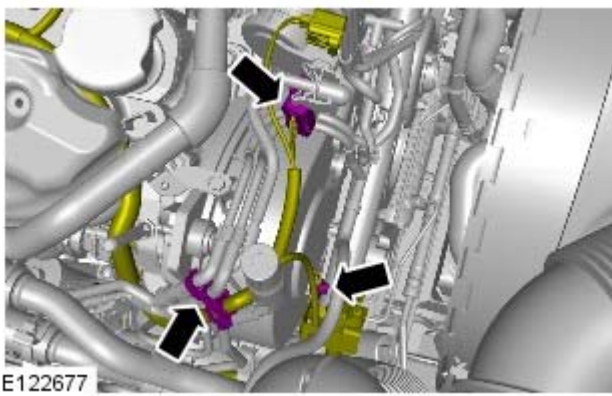
6. Torque: 10 Nm



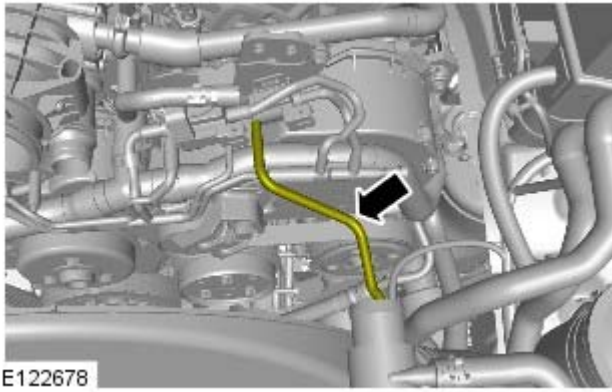
7.



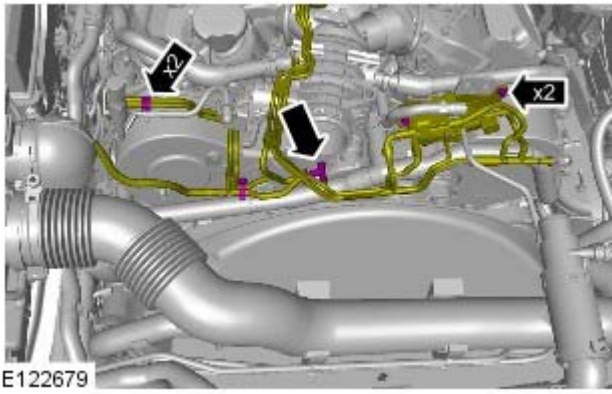
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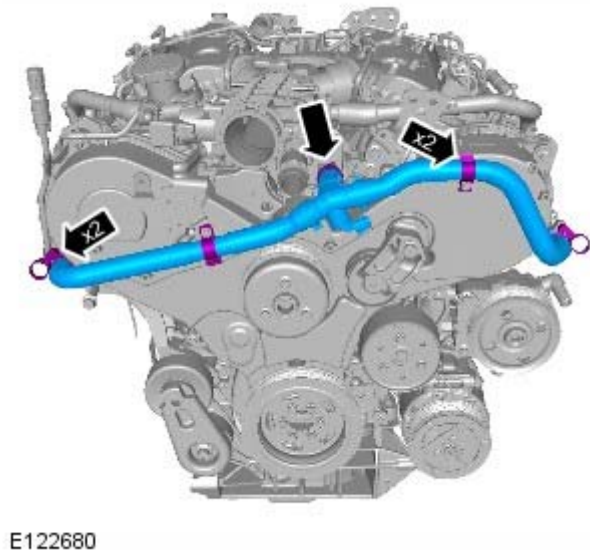
9. Torque: 3 Nm



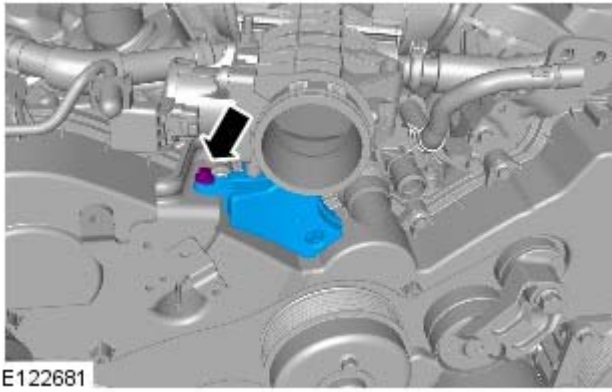
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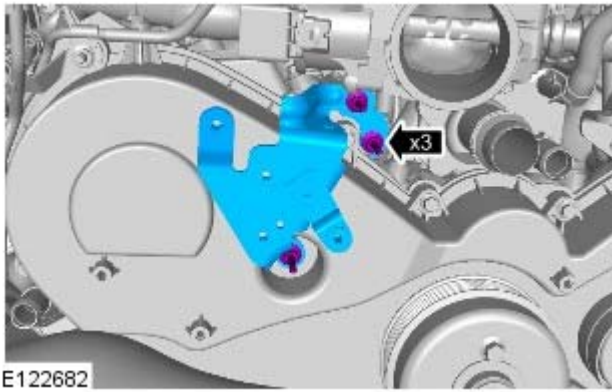
11. *Torque: 8 Nm*



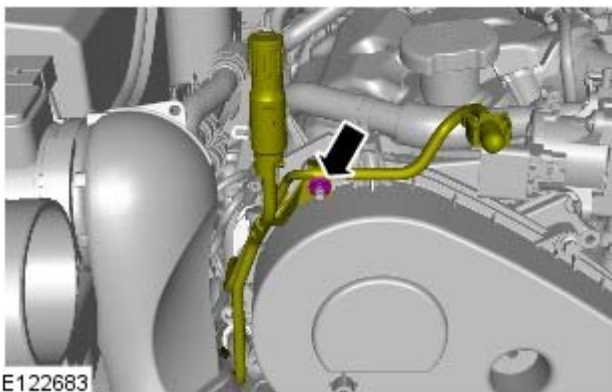
12. **12.** NOTE: Engine shown removed for clarity.



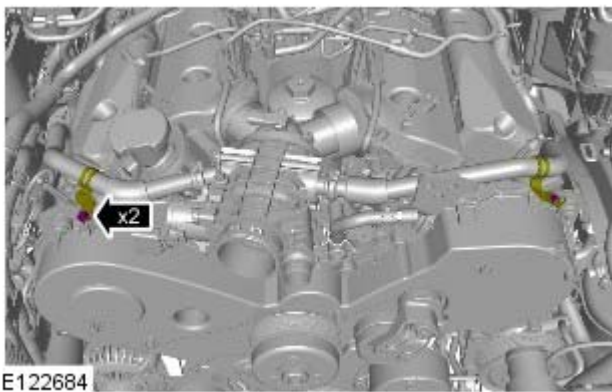
13. Torque: 8 Nm



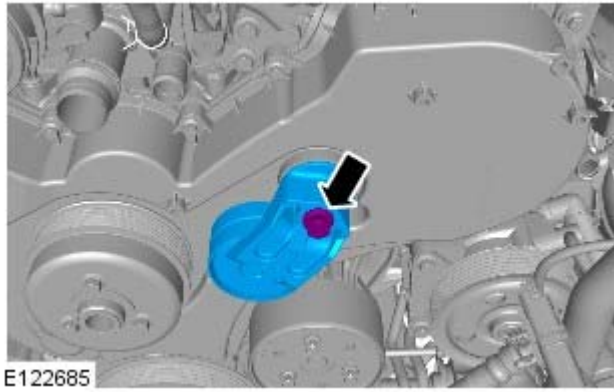
14. Torque: 8 Nm



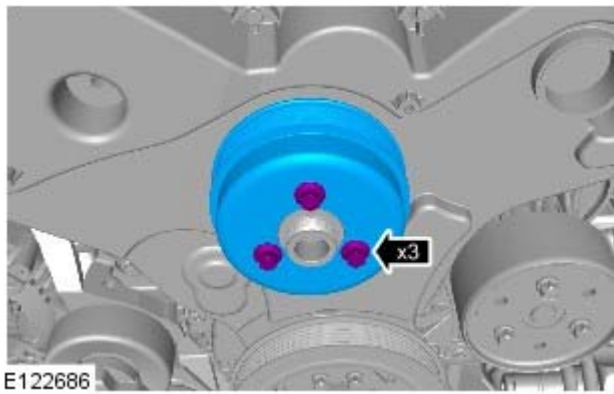
15. Torque: 8 Nm



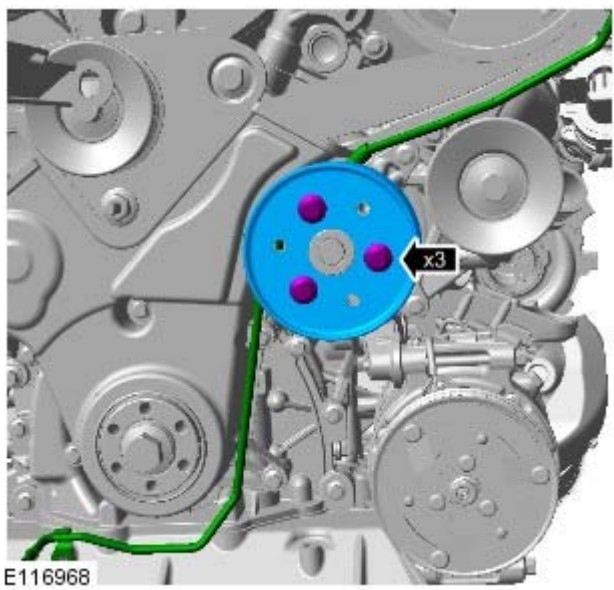
16. Torque: 5 Nm



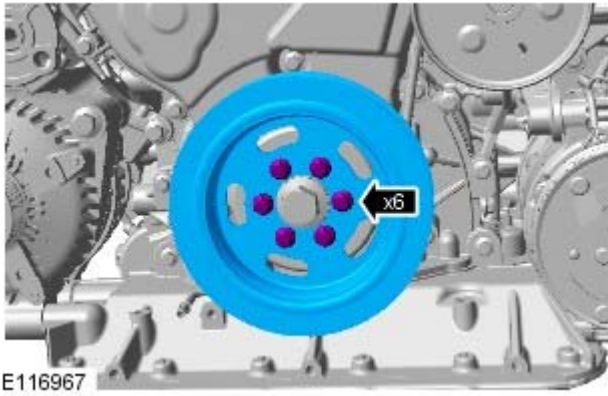
17. Torque: 47 Nm



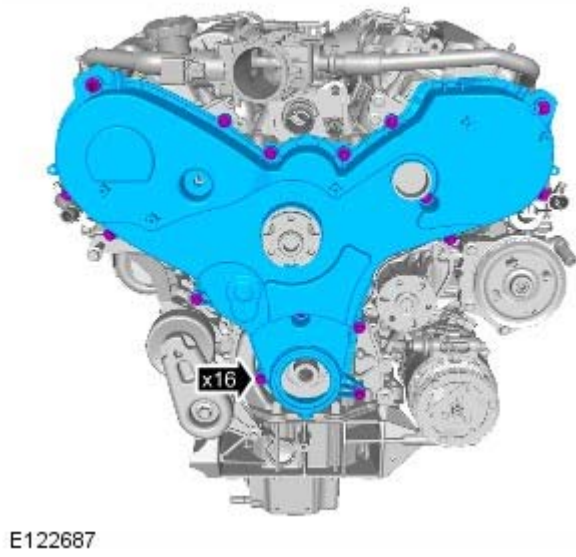
18. Torque: 24 Nm



19. Torque: 24 Nm



20. Torque: 25 Nm



21. **21.** NOTE: Engine shown removed for clarity.

Torque: 10 Nm

Installation

1. To install, reverse the removal procedure.

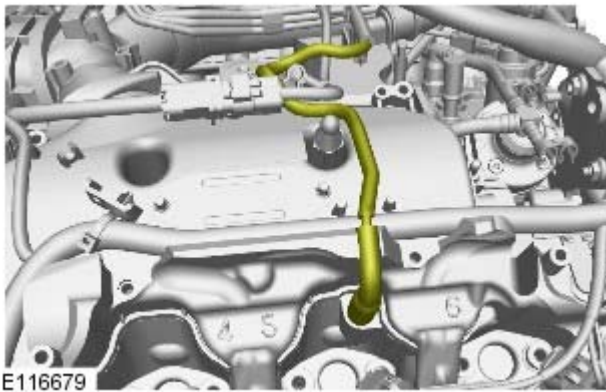
Engine - TDV6 3.0L Diesel - Valve Cover LH

Removal and Installation

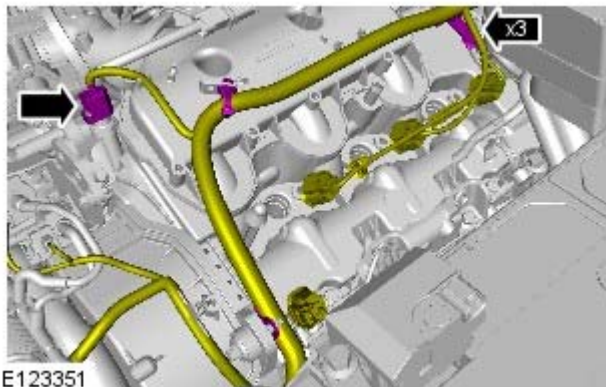
Removal

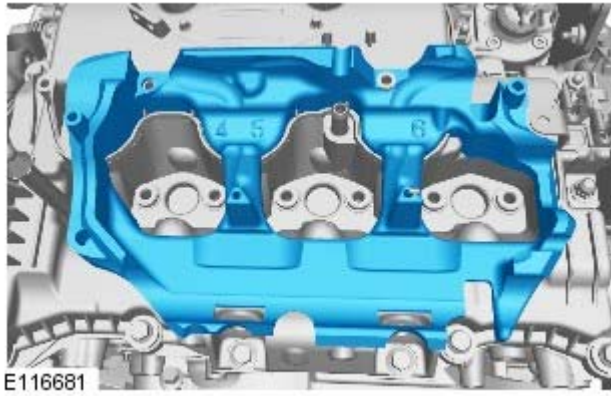
1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
4. Refer to: [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: [Fuel Rail LH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
6. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
7. Refer to: [Timing Cover](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
8. Refer to: [Fuel Injectors LH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

9.

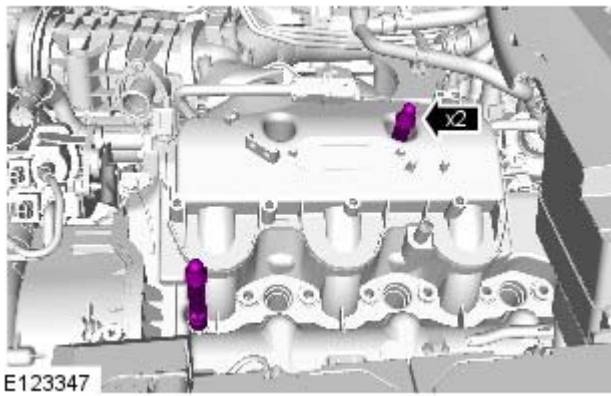


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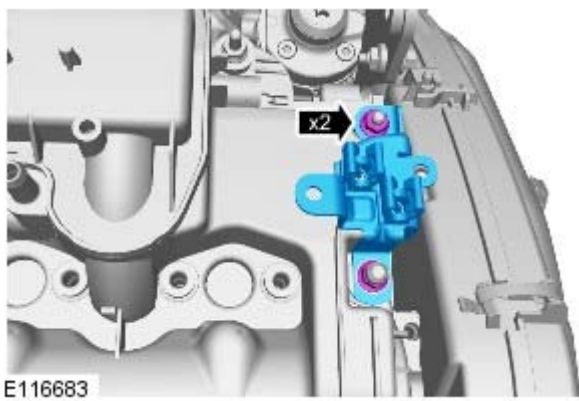




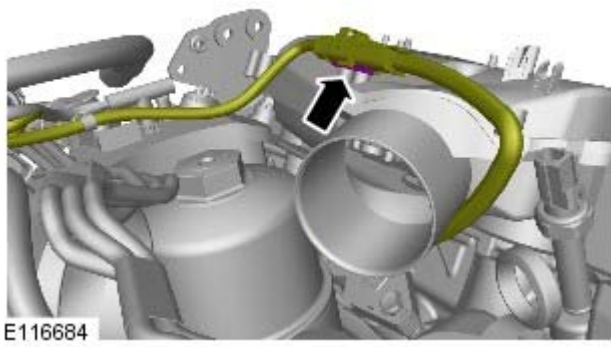
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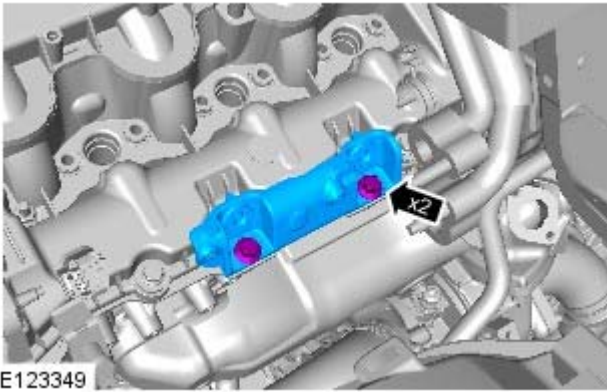
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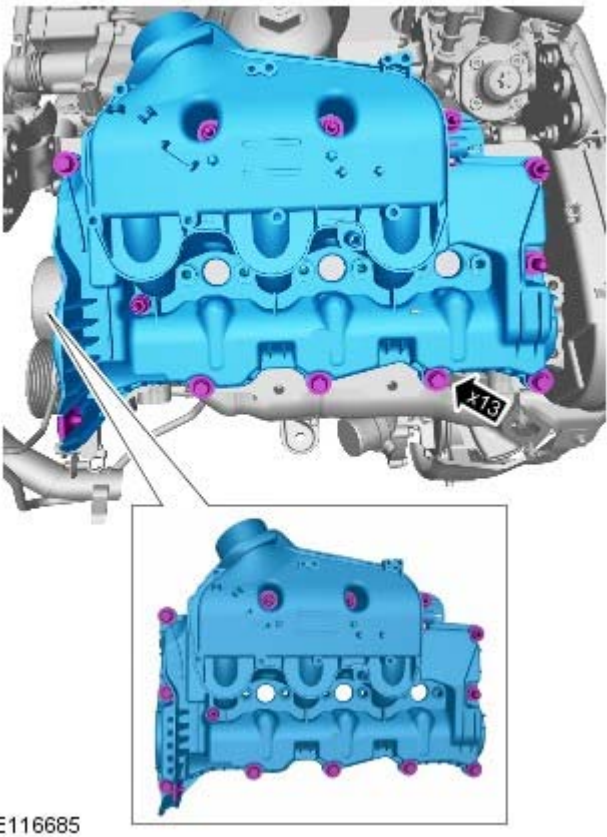
13.



14.

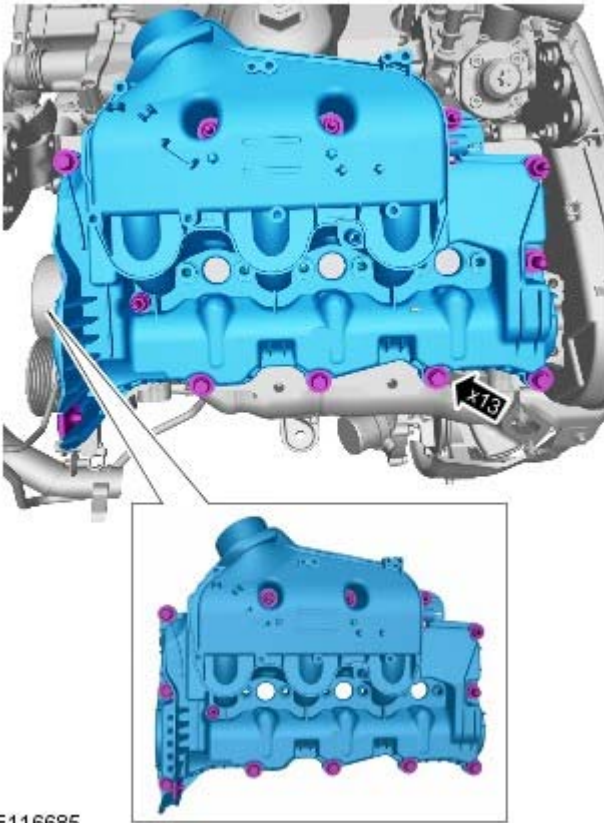


15.




16. **⚠ CAUTION:** Make sure that the mating faces are clean and free of corrosion and foreign material.
- NOTE: Discard the gasket.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Installation



E116685

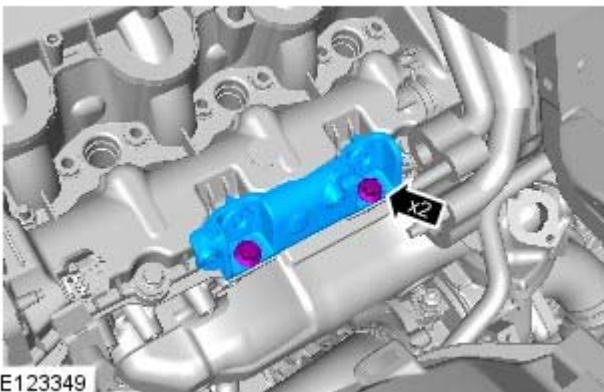
1. 1. CAUTIONS:

 Make sure that the mating faces are clean and free of corrosion and foreign material.

 Install all the bolts finger tight before final tightening.

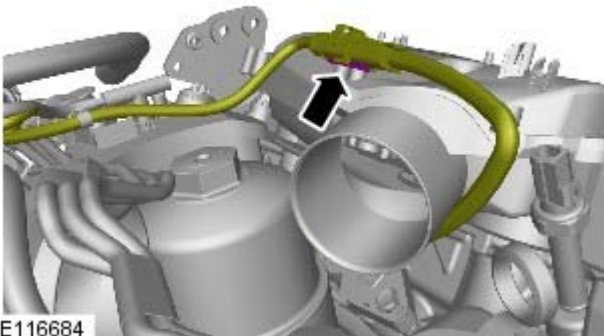
• NOTE: Install a new gasket.

Torque: 10 Nm



E123349

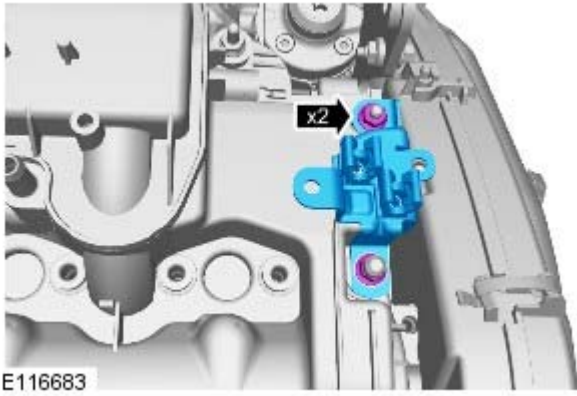
2. Torque: 23 Nm



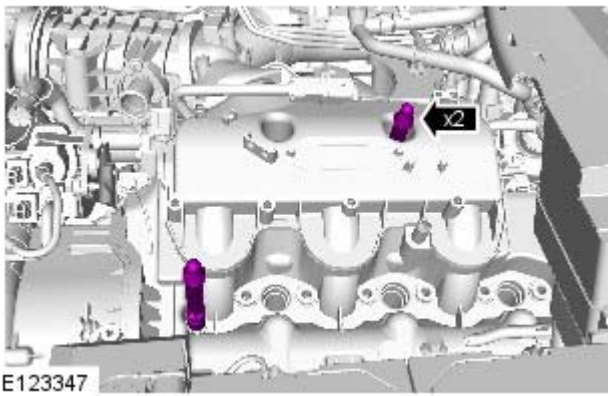
E116684

3.

4. Torque: 10 Nm



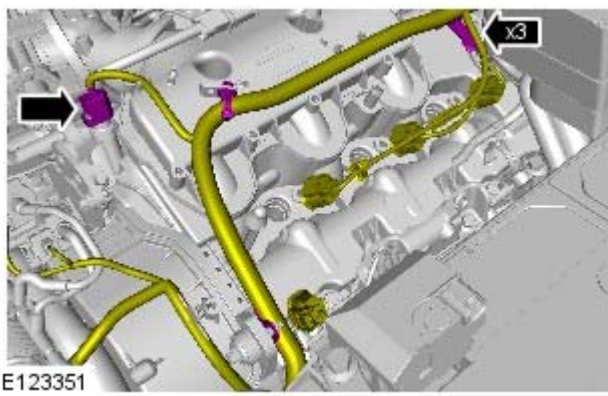
5. Torque: 5 Nm

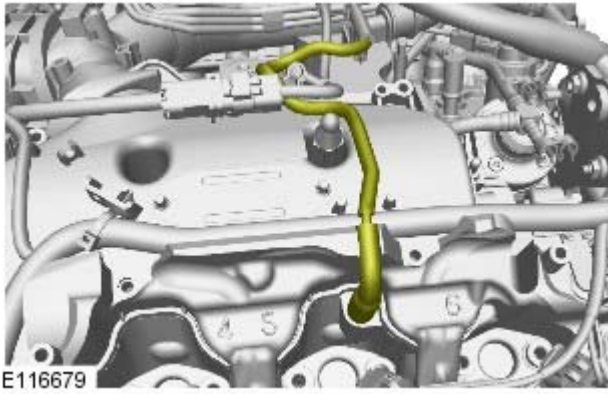


6.



7.





8.

9. Refer to: [Fuel Injectors LH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
10. Refer to: [Timing Cover](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
11. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
12. Refer to: [Fuel Rail LH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
13. Refer to: [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
14. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
15. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
16. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

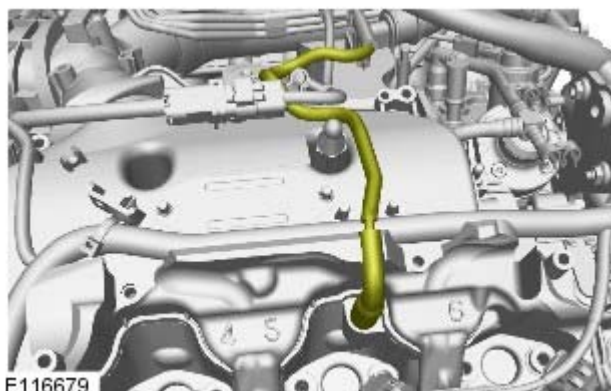
Engine - TDV6 3.0L Diesel - Valve Cover RH

Removal and Installation

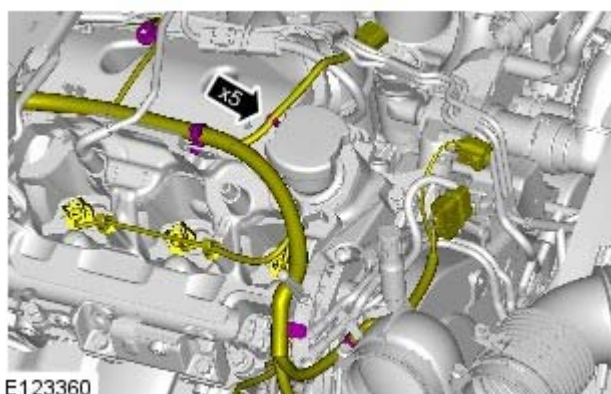
Removal

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

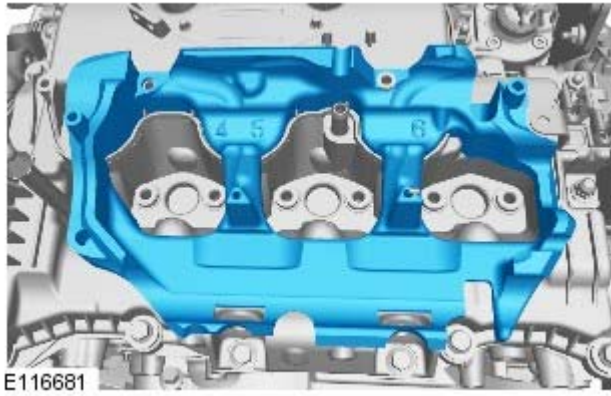
1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to: [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: [Fuel Rail RH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
5. Refer to: [Timing Cover](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
6. Refer to: [Fuel Injectors RH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).



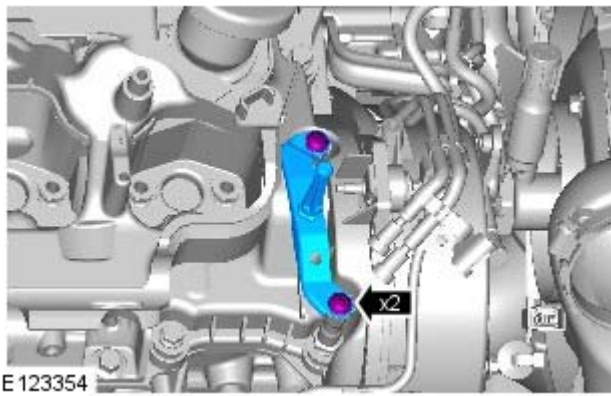
7.



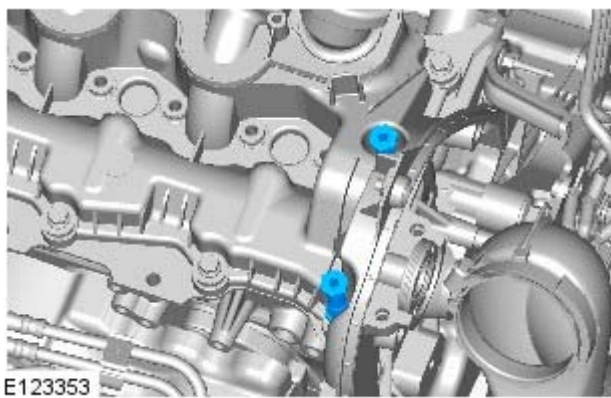
8.



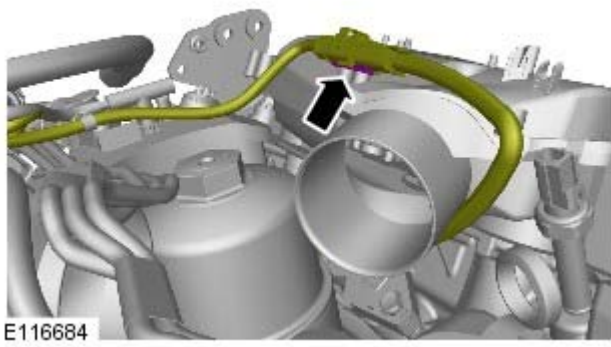
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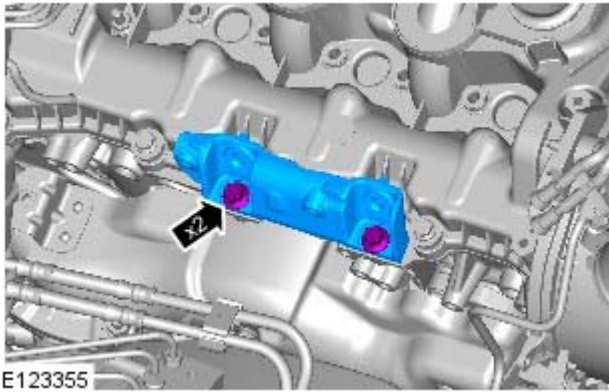
10.



11.




12.

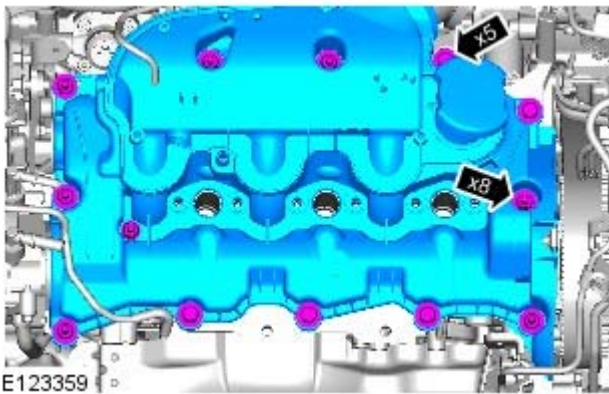


13.




14.  CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.
- NOTE: Discard the gasket.

Installation



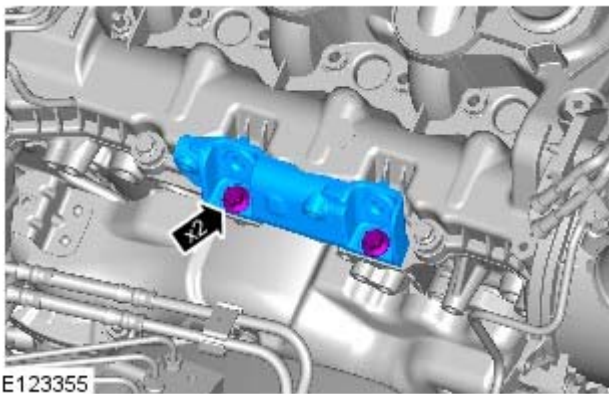
1. 1. CAUTIONS:

 Make sure that the mating faces are clean and free of corrosion and foreign material.

 Install all the bolts finger tight before final tightening.

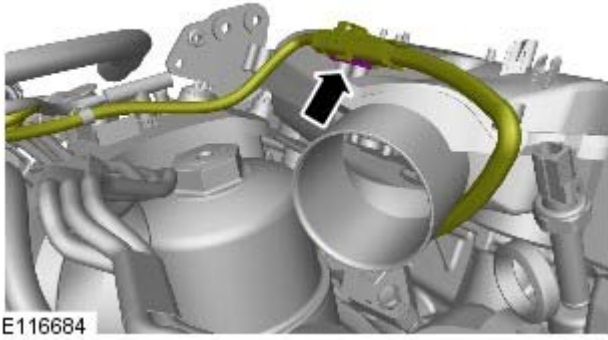
- NOTE: Install a new gasket.

Torque: 10 Nm

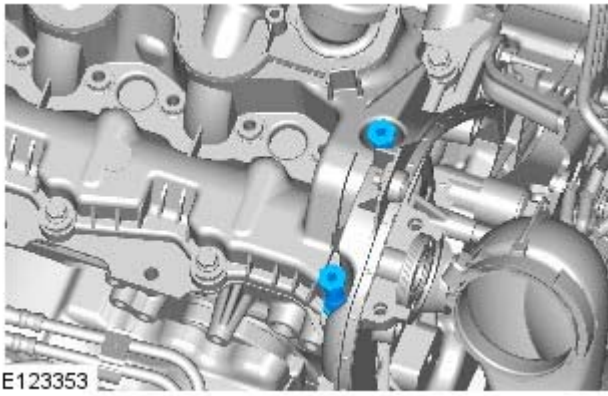


2. Torque: 23 Nm

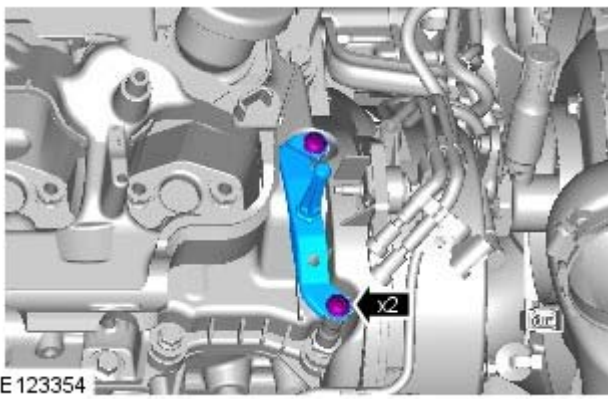
3.



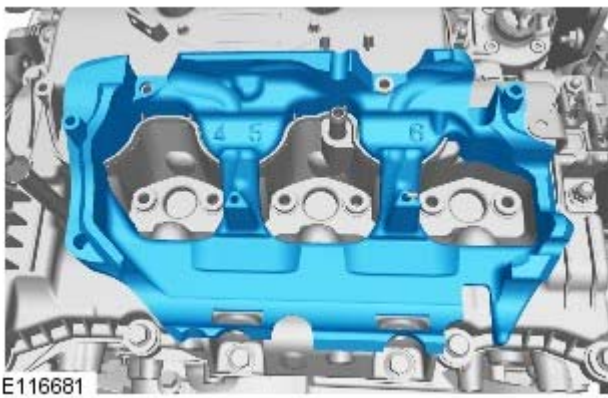
4. Torque: 7 Nm

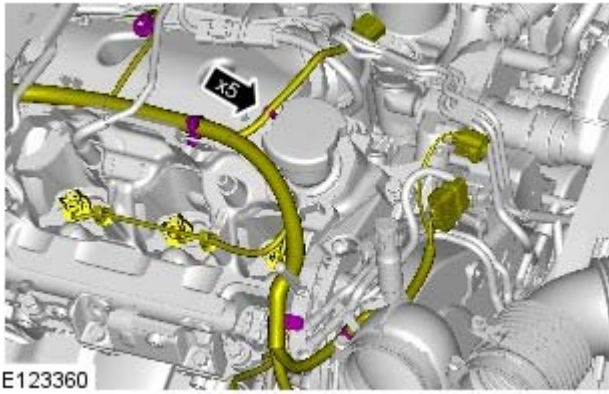


5. Torque: 7 Nm



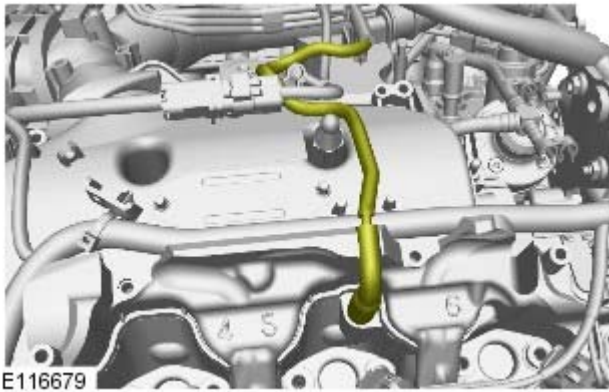
6.





E123360

7.



E116679

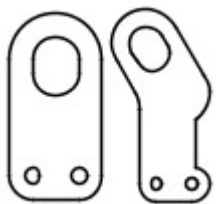

8.

9. Refer to: [Fuel Injectors RH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
10. Refer to: [Timing Cover](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
11. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
12. Refer to: [Fuel Rail RH](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
13. Refer to: [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
14. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - TDV6 3.0L Diesel - Engine

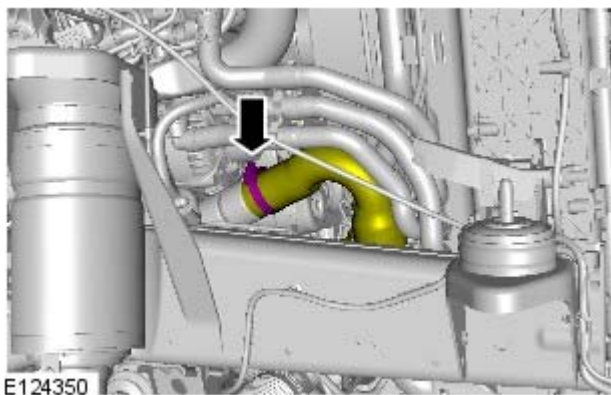
Removal


Special Tool(s)

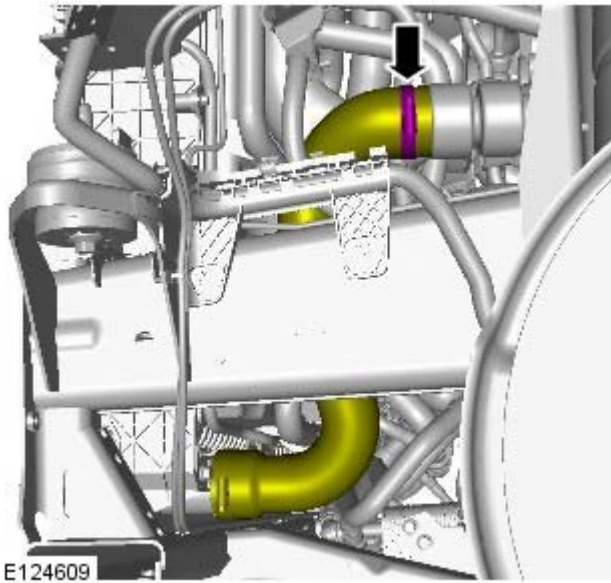
 E54554	303-1129 Engine Lifting Brackets
 E116925	303-1497 Left-Hand Rear Engine Lifting Bracket


• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

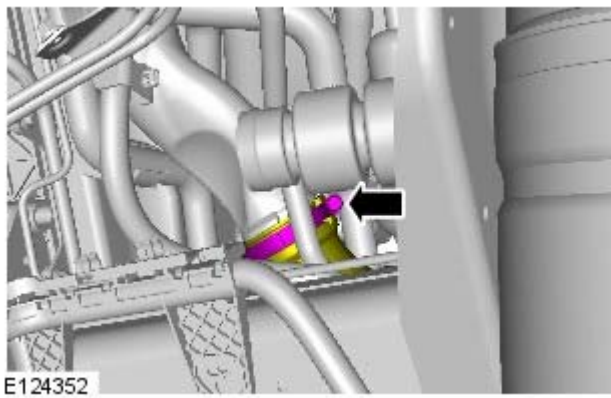
1. Refer to: [Body - TDV6 3.0L Diesel/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
2. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).




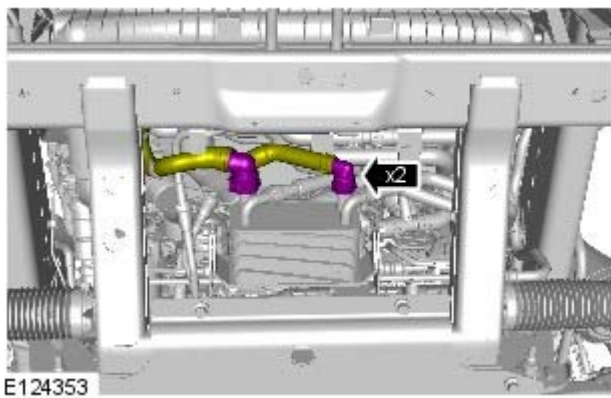
3.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.




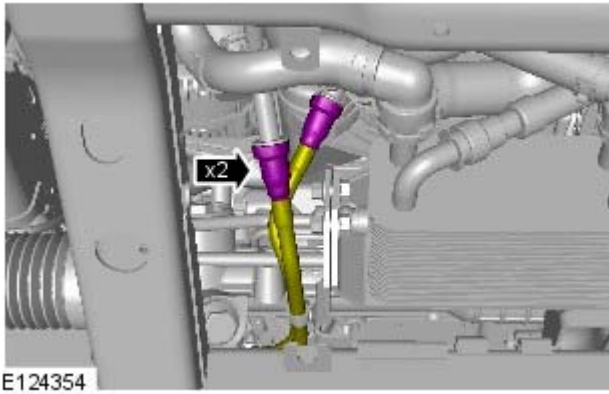
4.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.




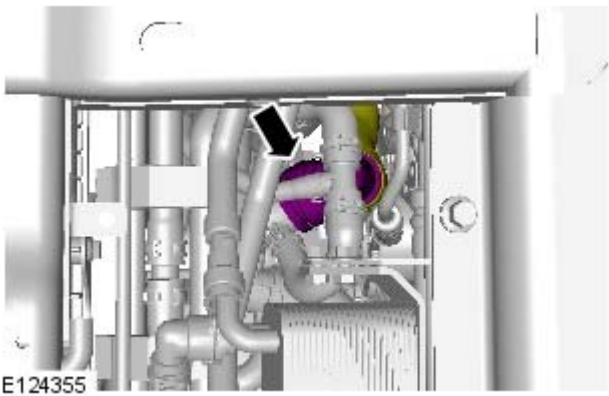
5.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



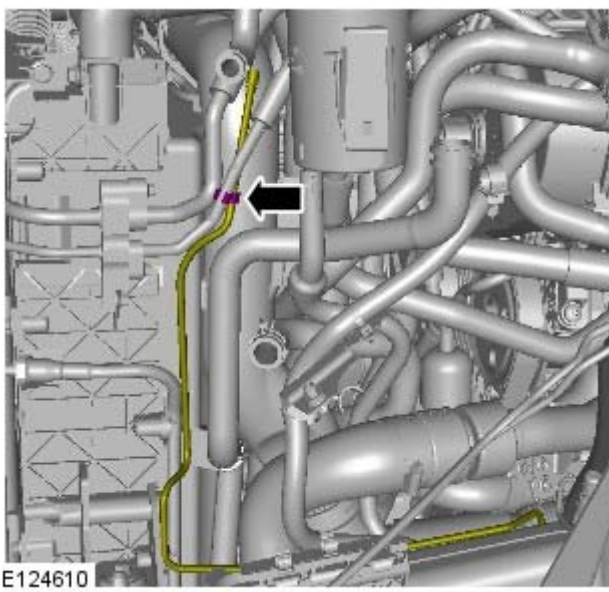
6.  CAUTION: Be prepared to collect escaping coolant.



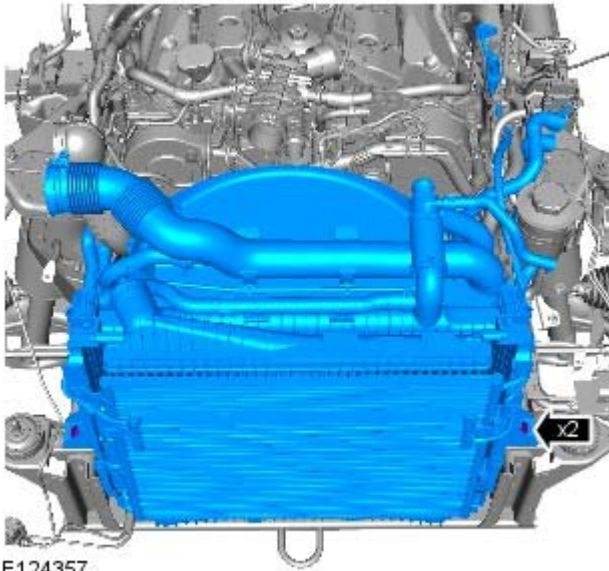
7.  CAUTION: Be prepared to collect escaping coolant.



8.  CAUTION: Be prepared to collect escaping coolant.

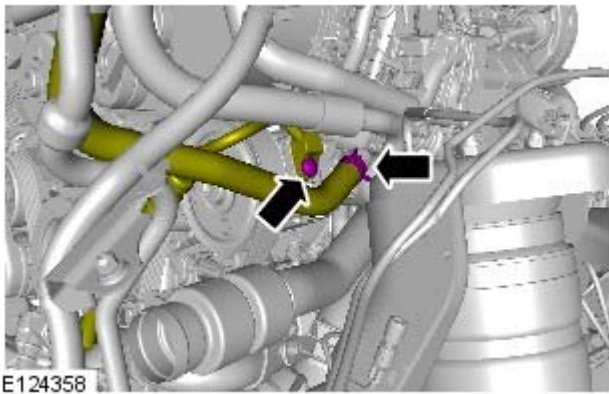


- 9.



E124357

10.



E124358

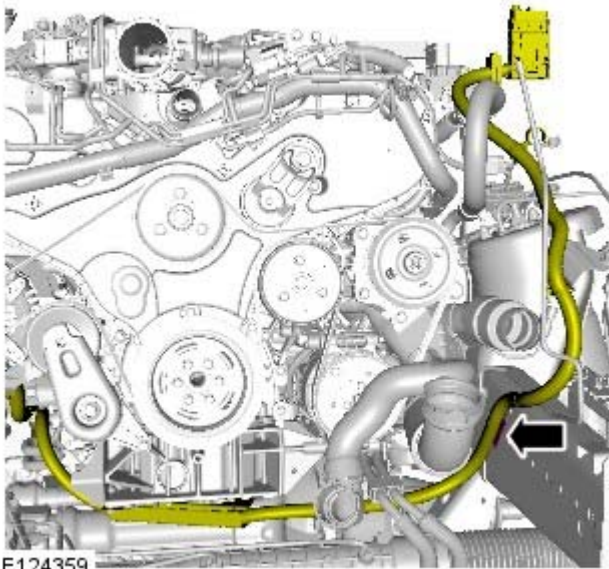
11. **11. CAUTIONS:**



Be prepared to collect escaping fluids.

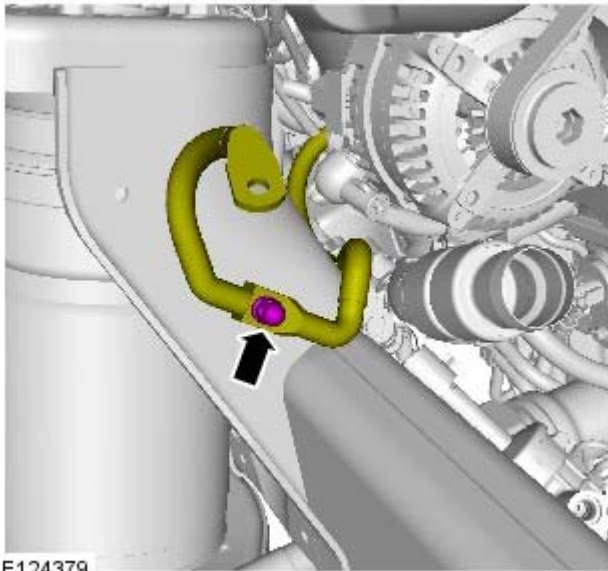


Make sure that all openings are sealed. Use new blanking caps.



E124359

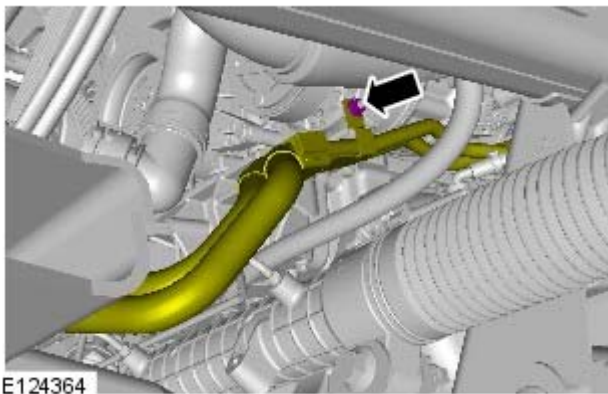
12.



E124379

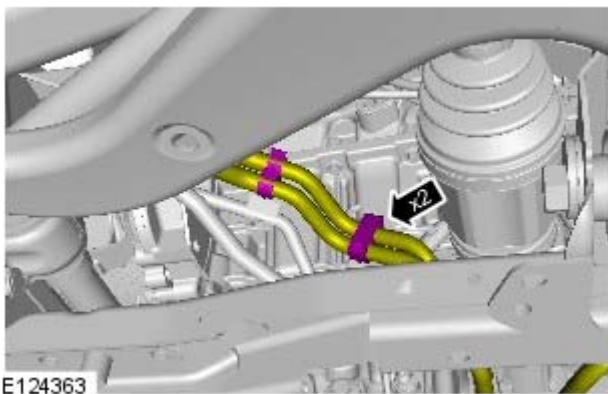
13.

14. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).



E124364

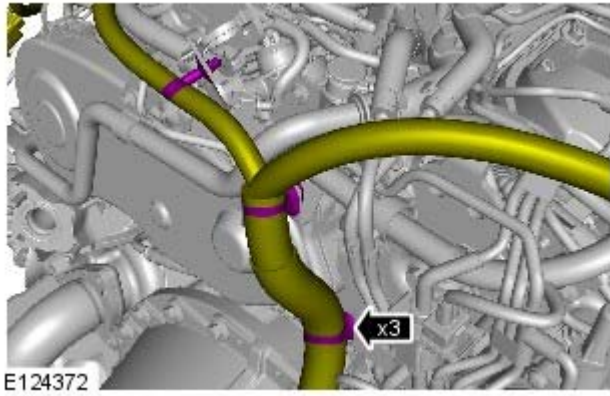
15.



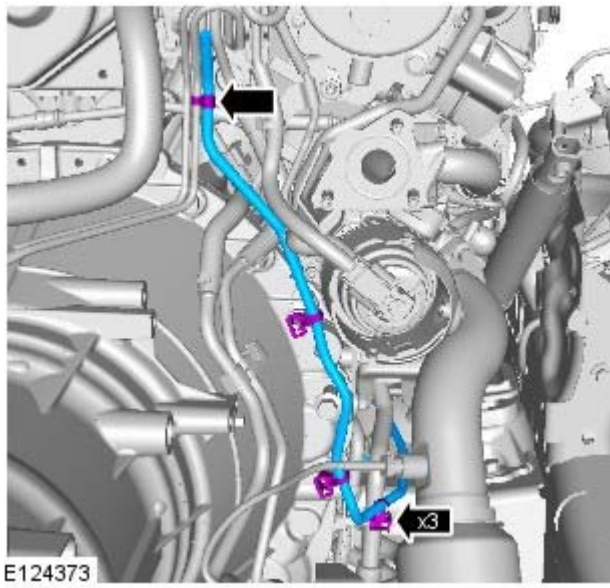
E124363

16.

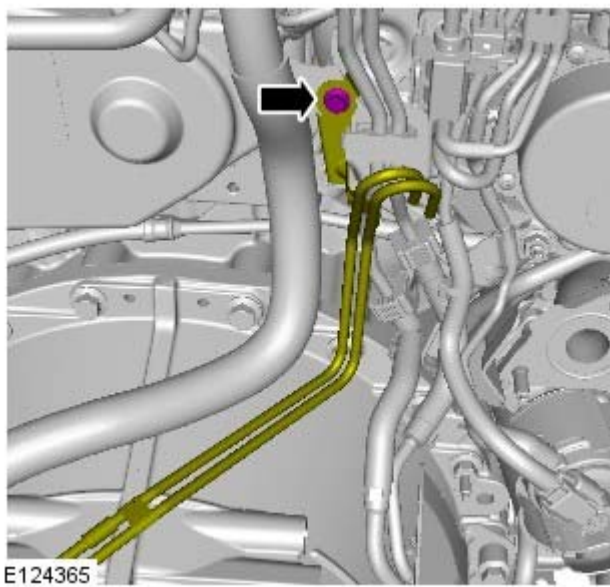
17. Refer to: [Exhaust Manifold Crossover Pipe](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).



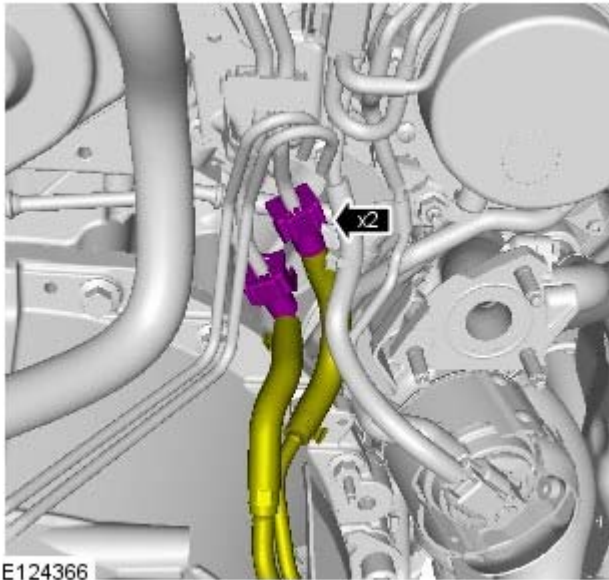
18.



19.



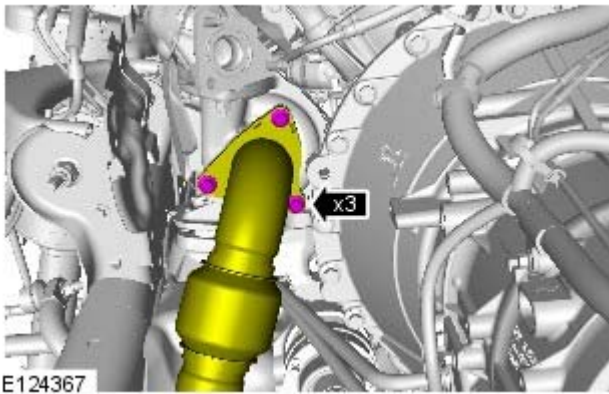
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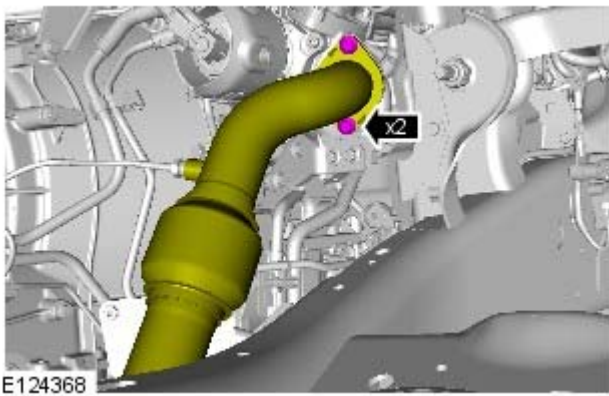
21. **21. CAUTIONS:**

 Be prepared to collect escaping fuel.

 Make sure that all openings are sealed. Use new blanking caps.

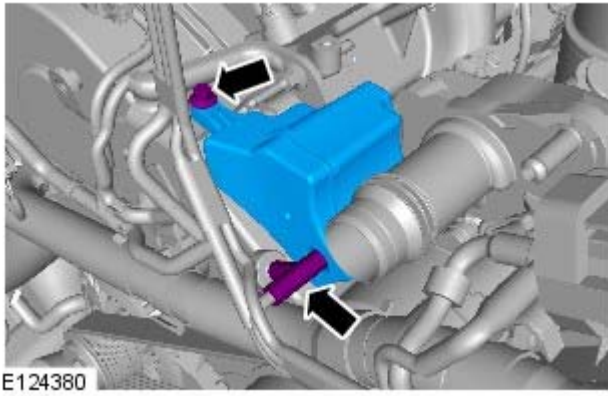


22. **22. NOTE:** Remove and discard the gasket.

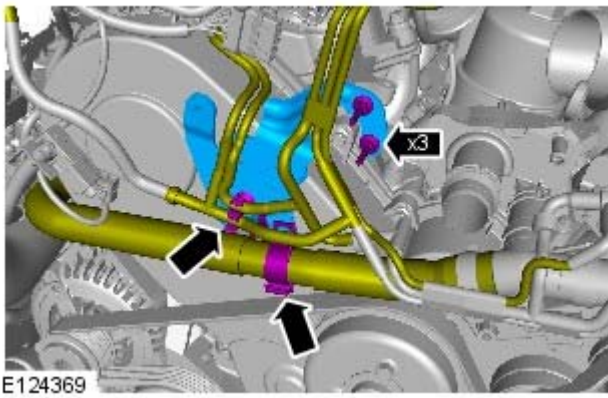


23. **23. NOTE:** Remove and discard the gasket.

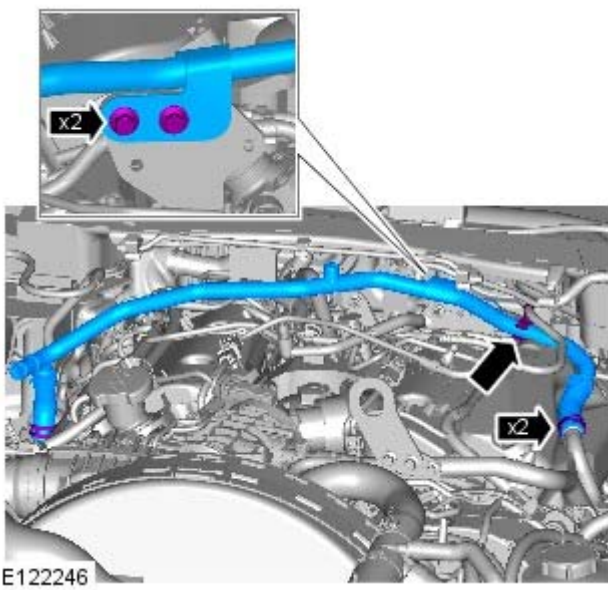
24. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).




25.

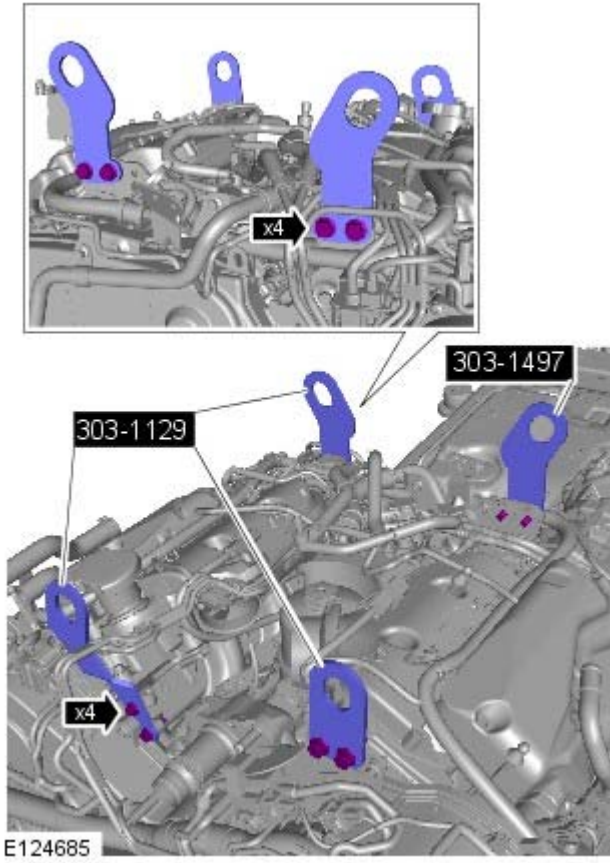


26.

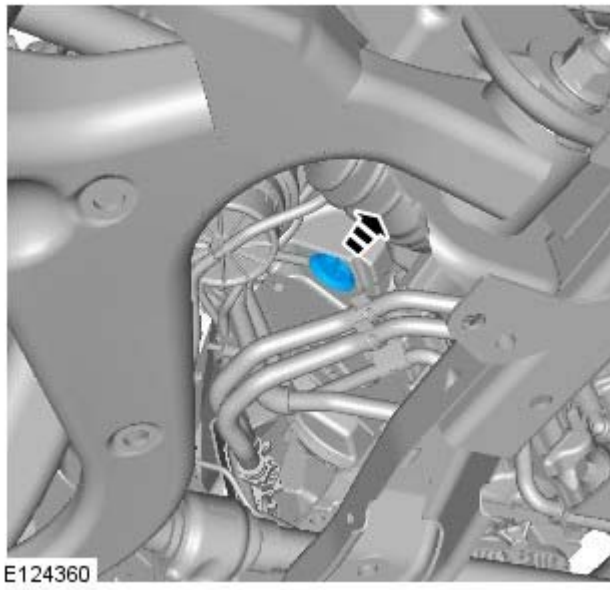


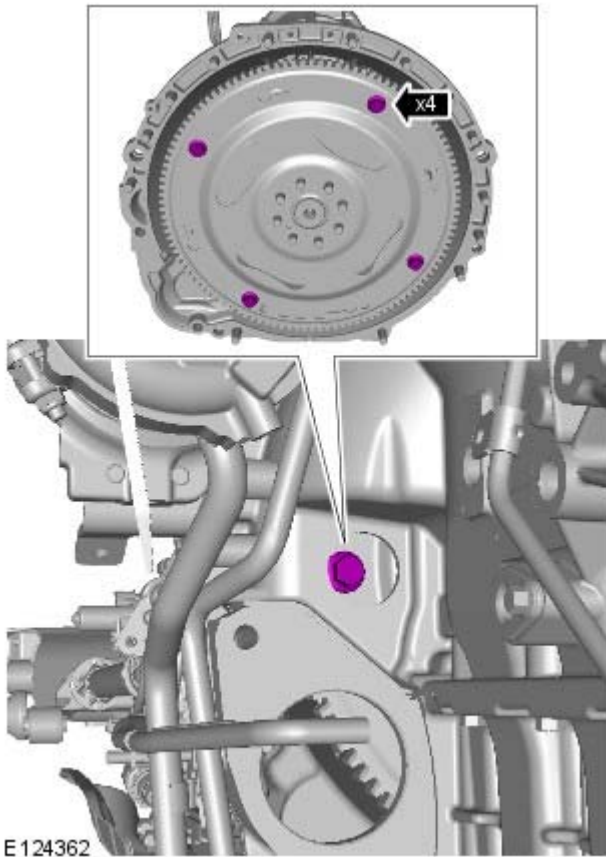
27.  CAUTION: Make sure that all openings are sealed.

28. *Special Tool(s):* [303-1129](#), [303-1497](#)

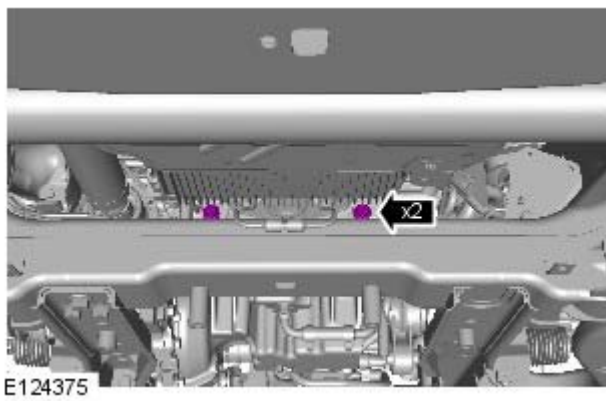


29.

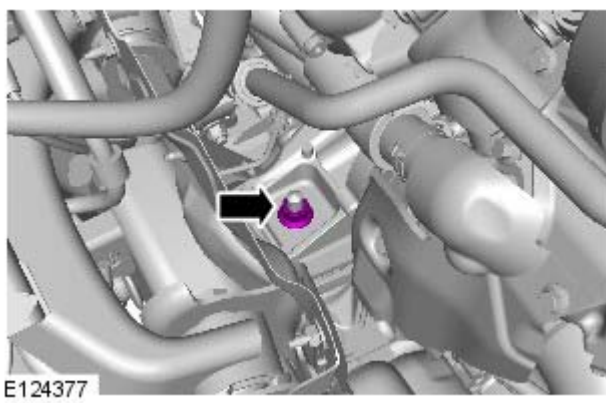




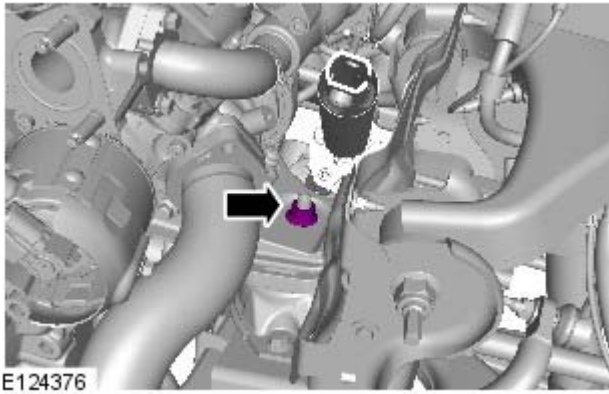
30.  CAUTION: Discard the bolts.



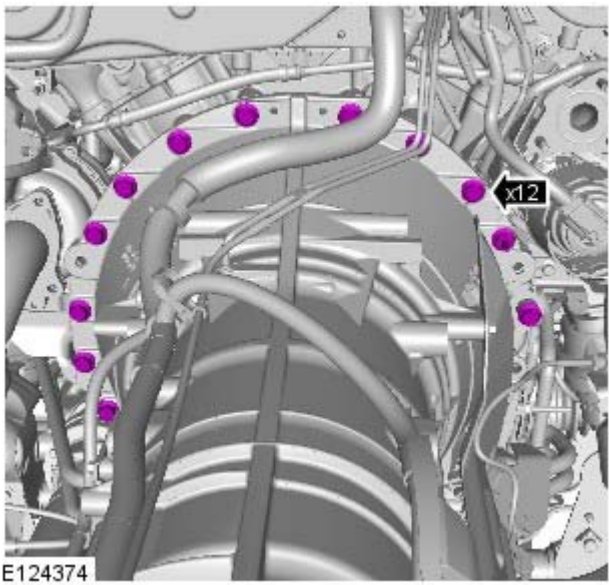
31.



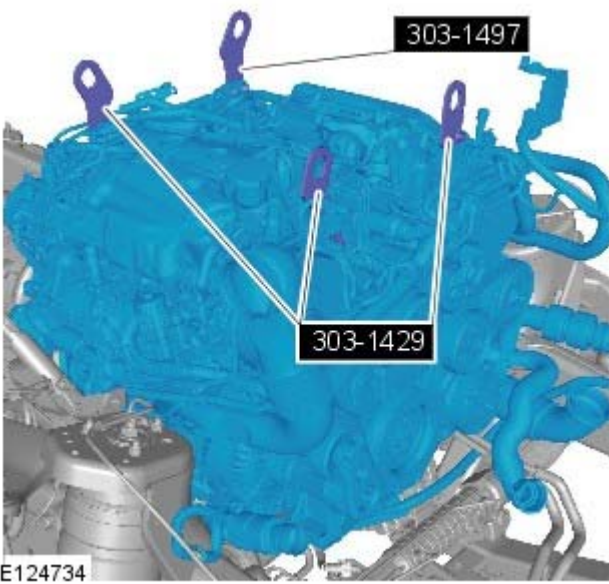
32.



33.

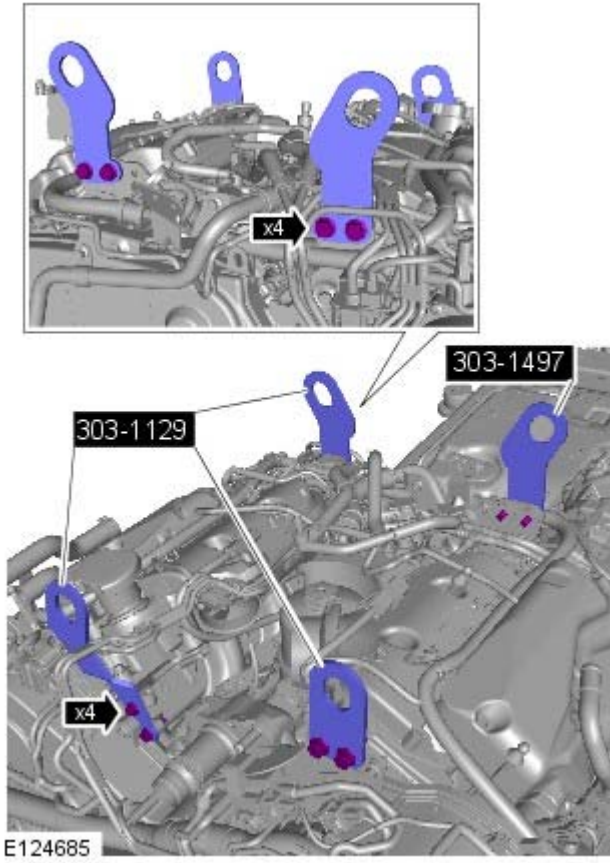


34. Using a suitable tool, support the transmission.



35. **35.** NOTE: Note the routing of the battery positive cable.
- NOTE: Note the routing of the transmission wiring harness.
 - NOTE: This step requires the aid of another technician.

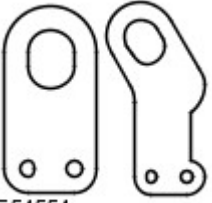

36. *Special Tool(s):* [303-1129](#), [303-1497](#)



Engine - TDV6 3.0L Diesel - Engine

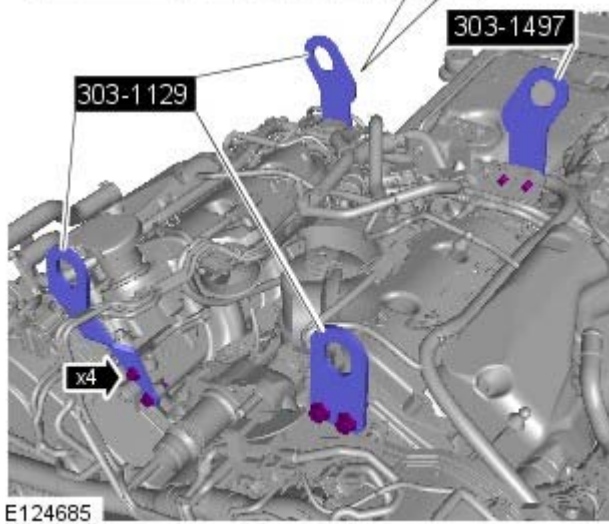
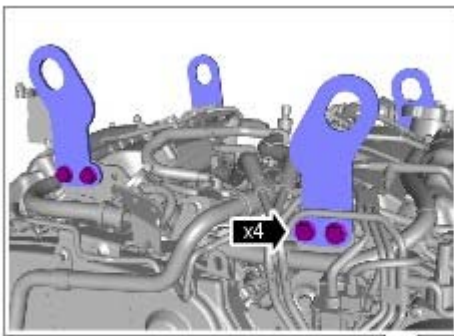
Installation

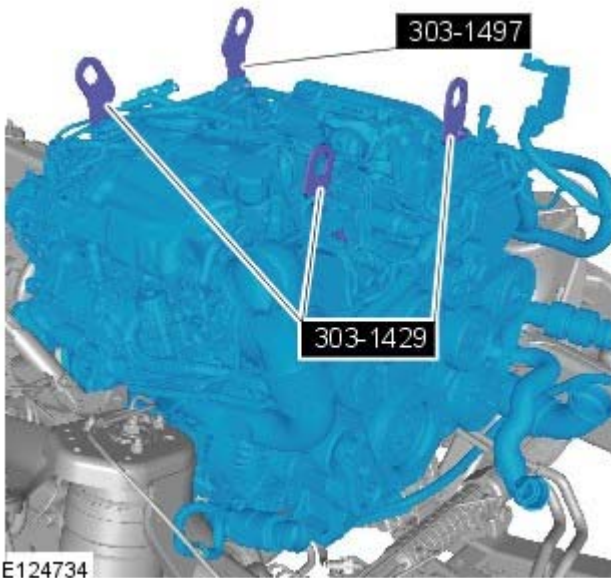
Special Tool(s)

 E54554	303-1129 Engine Lifting Brackets
 E116925	303-1497 Left-Hand Rear Engine Lifting Bracket

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.


1. *Special Tool(s):* [303-1129](#), [303-1497](#)






E124734

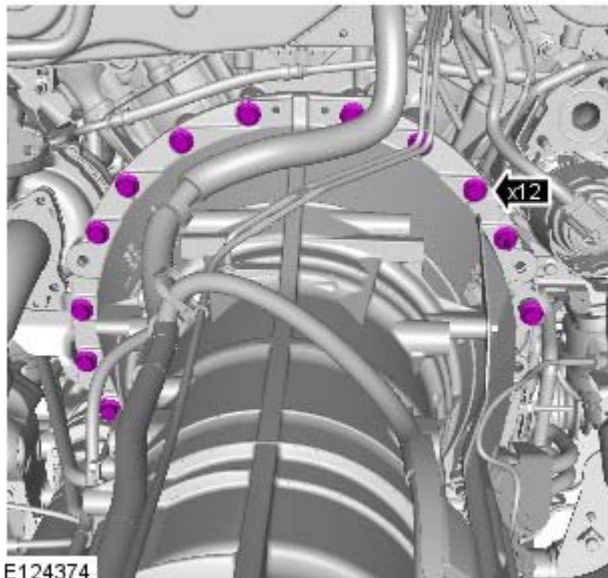
2. **2. CAUTIONS:**

 Apply grease of the correct specification to the torque converter spigot.


 Make sure the torque converter is fully located into the oil pump drive.

 Make sure that the mating faces are clean and free of foreign material.

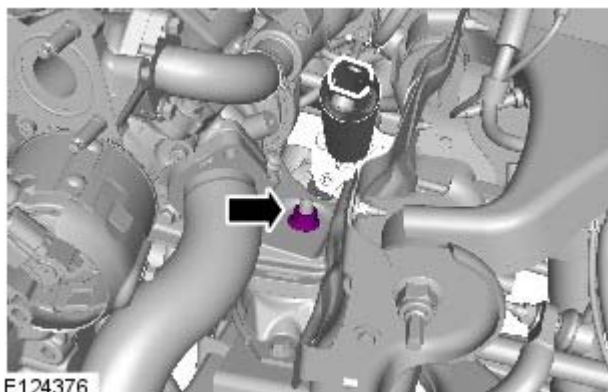
• **NOTE:** This step requires the aid of another technician.



E124374

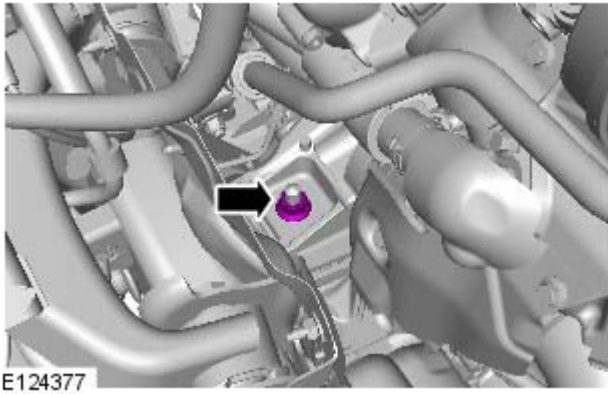
3.  **CAUTION:** Make sure the torque converter remains connected to the transmission.

Torque: 40 Nm

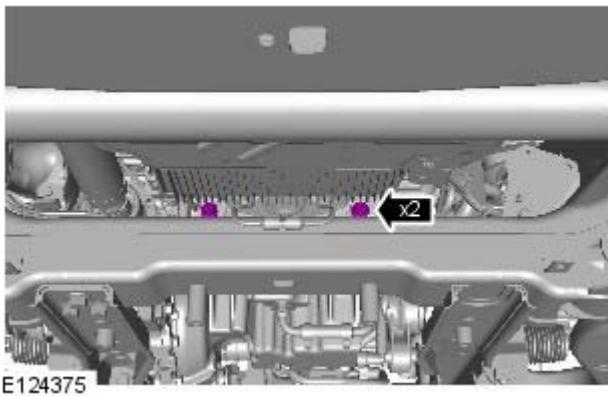


E124376

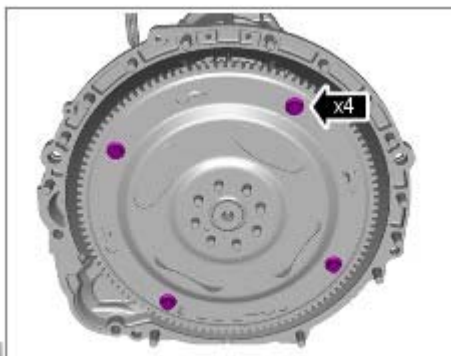
4. *Torque:* 90 Nm



5. Torque: 90 Nm



6. Torque: 40 Nm



7. **7. CAUTIONS:**

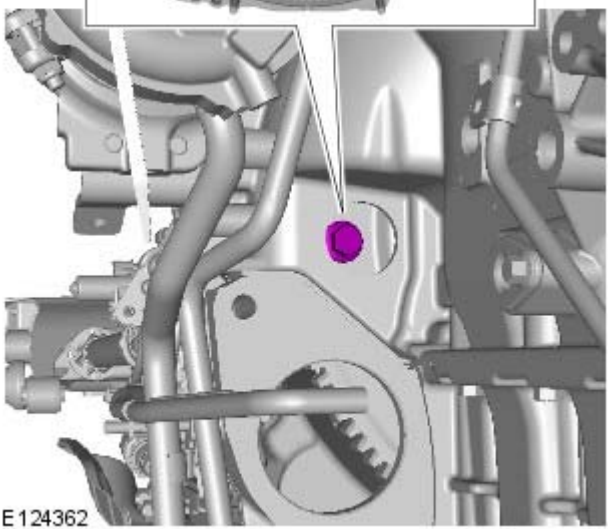


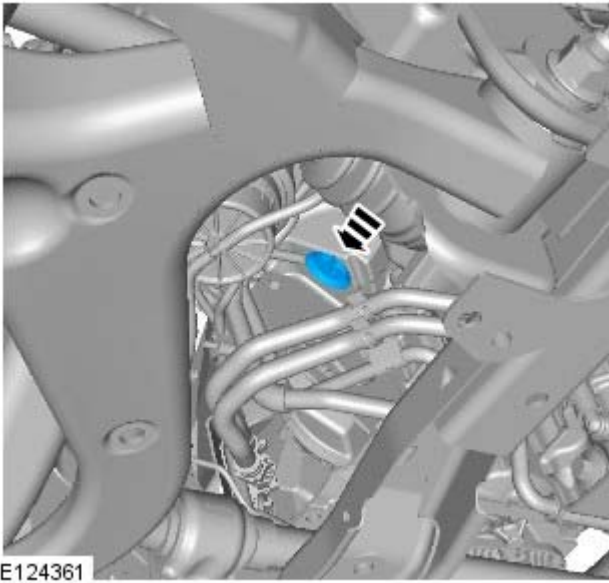
Only rotate the crankshaft clockwise.



Make sure that new bolts are installed.

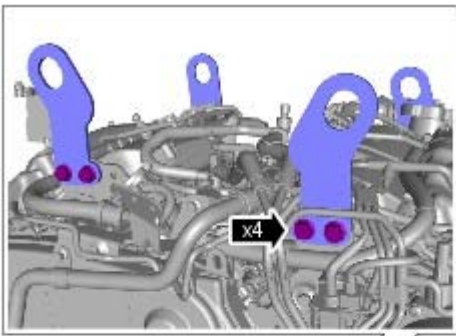
Torque: 63 Nm



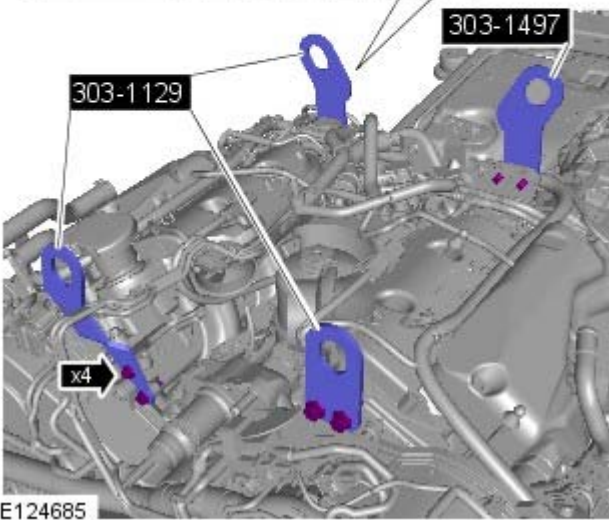


E124361

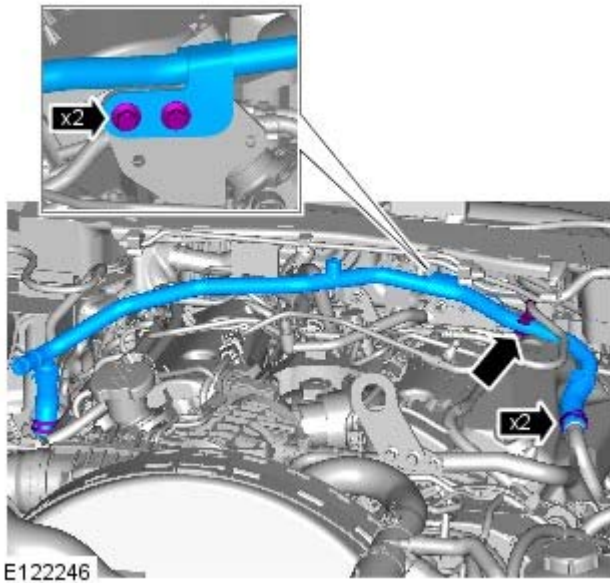
8.



9. *Special Tool(s):* [303-1129](#), [303-1497](#)

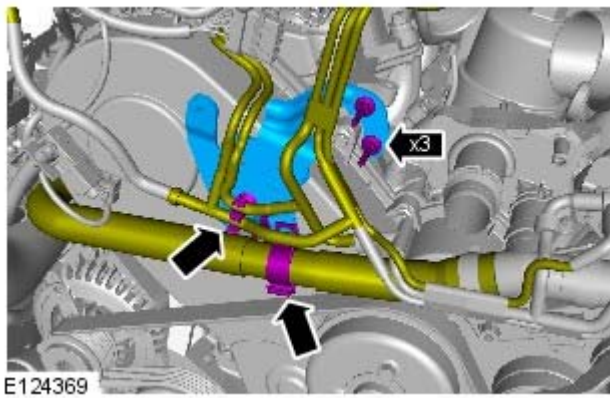


E124685

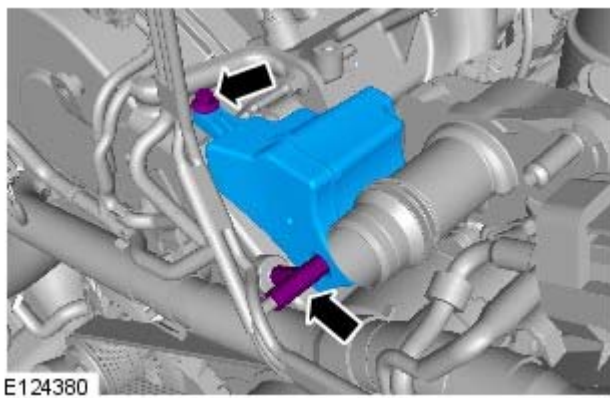


10. **10.** NOTE: Remove and discard the blanking caps.

Torque: 10 Nm



11. *Torque:* 8 Nm



12. *Torque:* 8 Nm

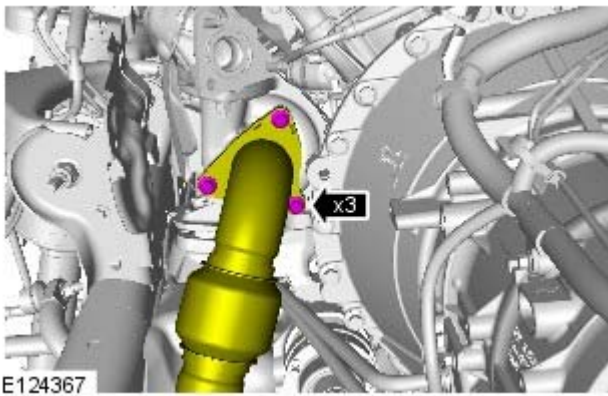
13. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).



14. **14.** NOTE: Make sure that all the component mating faces are clean.

- NOTE: Install a new gasket.

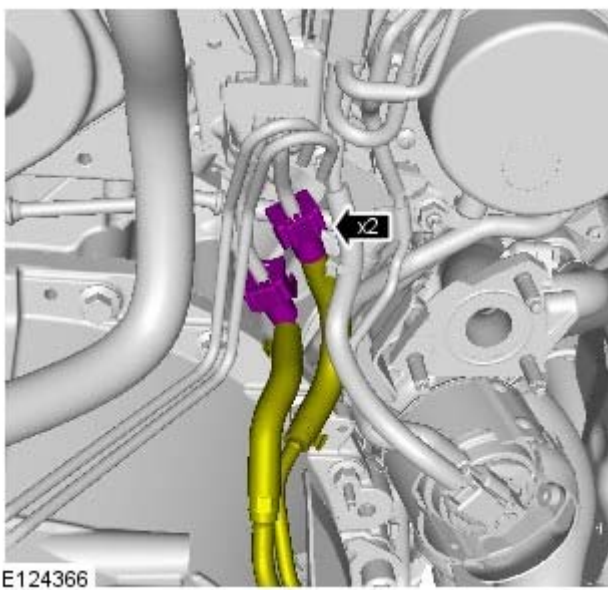
Torque: 28 Nm



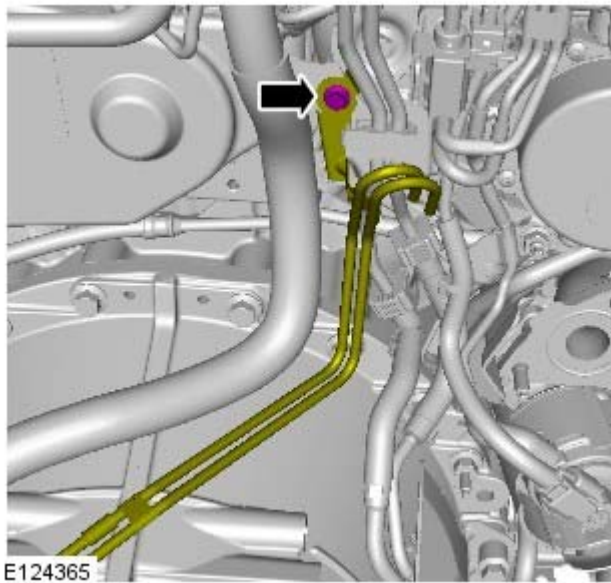
15. **15.** NOTE: Make sure that all the component mating faces are clean.

- NOTE: Install a new gasket.

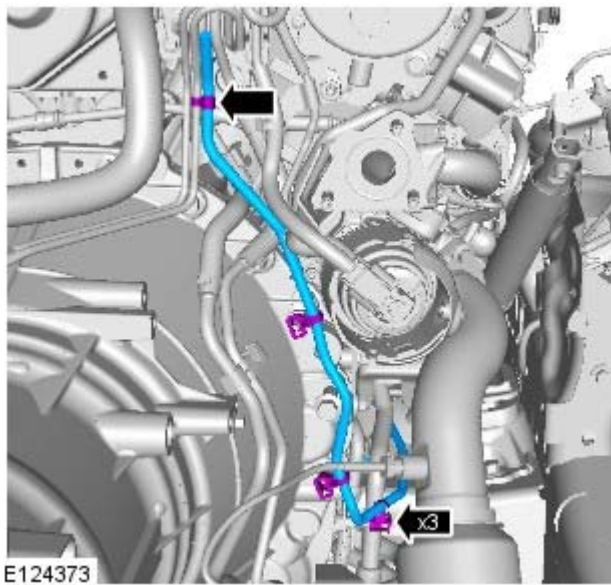
Torque: 28 Nm



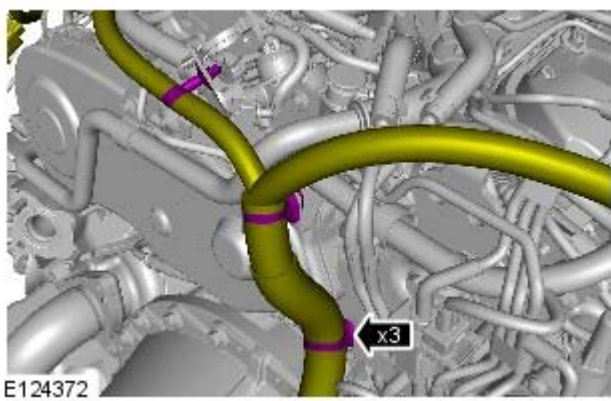
16. **16.** NOTE: Remove and discard the blanking caps.



17. Torque: 7 Nm

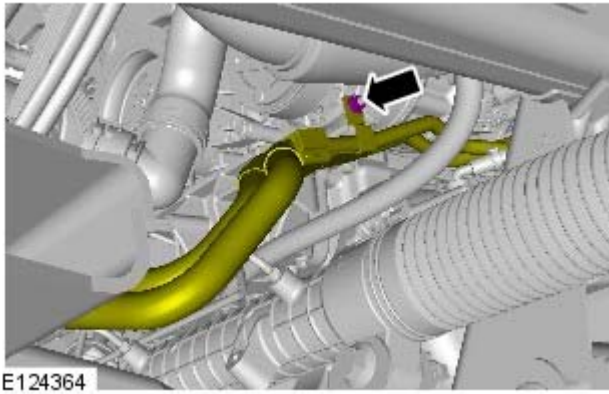


18.

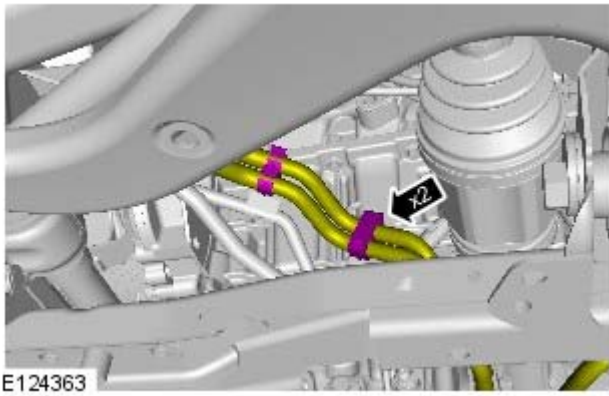


19.

20. Refer to: [Exhaust Manifold Crossover Pipe](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

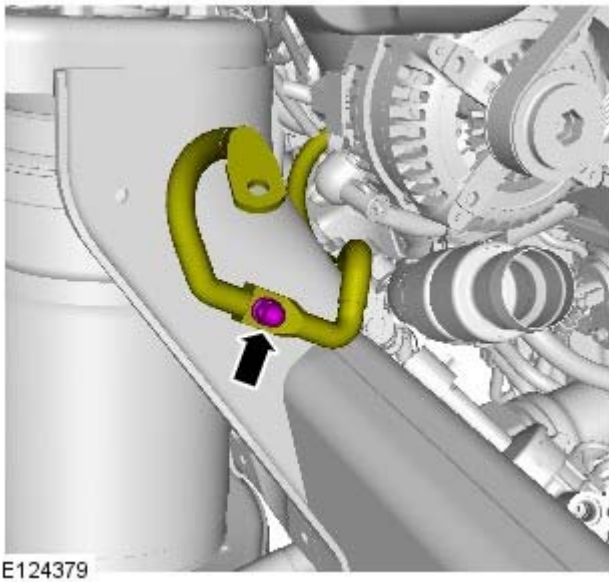


21. Torque: 10 Nm



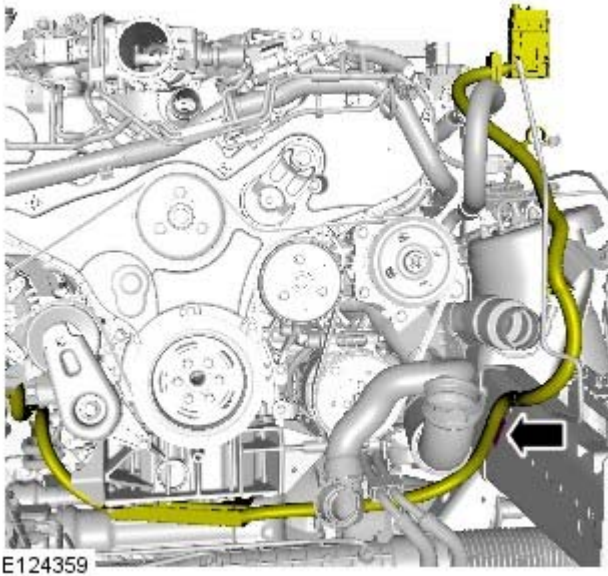
22.

23. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).



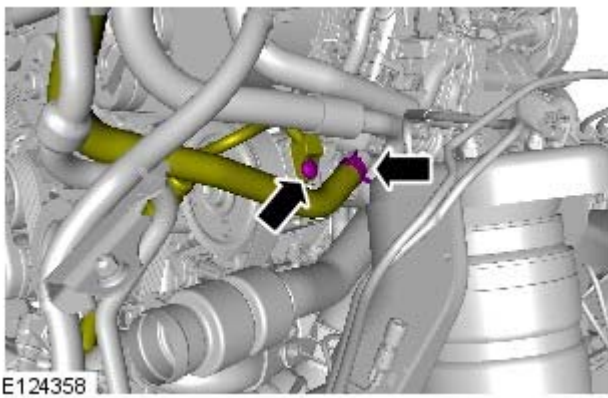
24. Torque: 22 Nm

25.

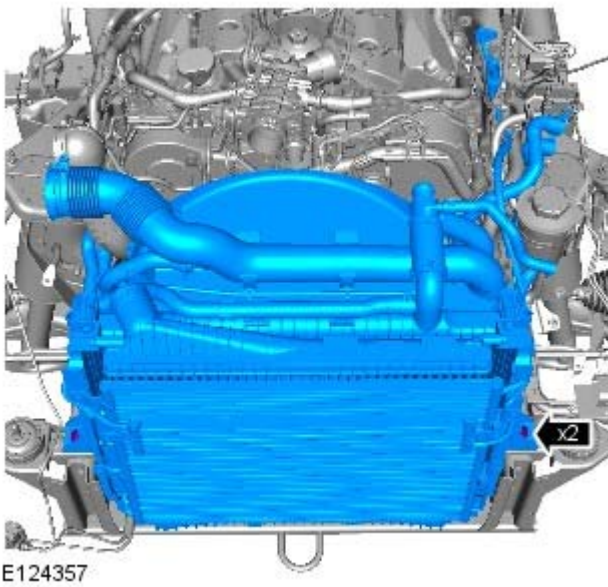


26. **26.** NOTE: Remove and discard the blanking caps.

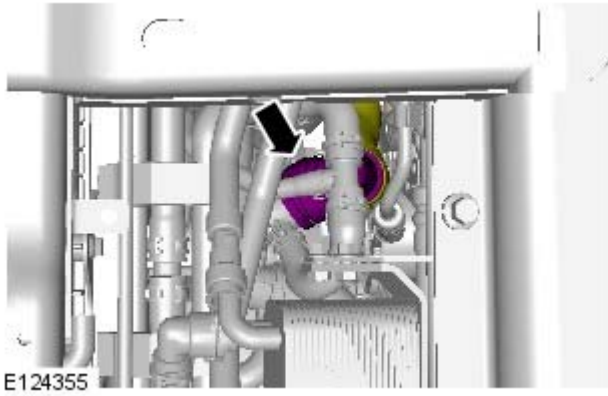
Torque: 25 Nm



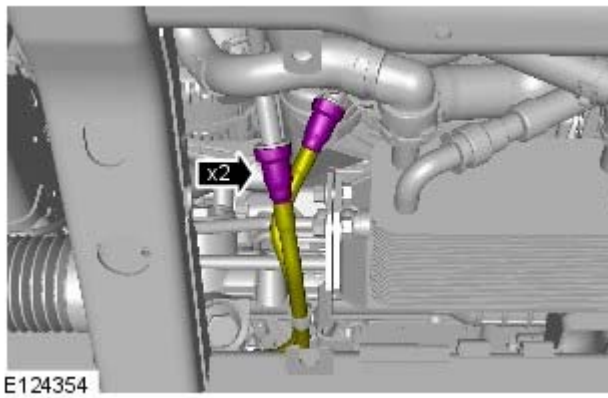
27. *Torque: 15 Nm*



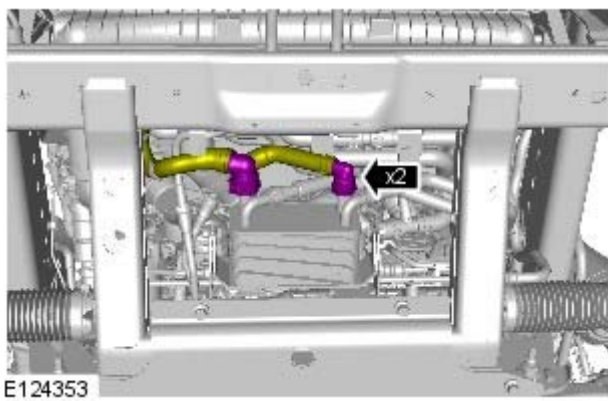
28.



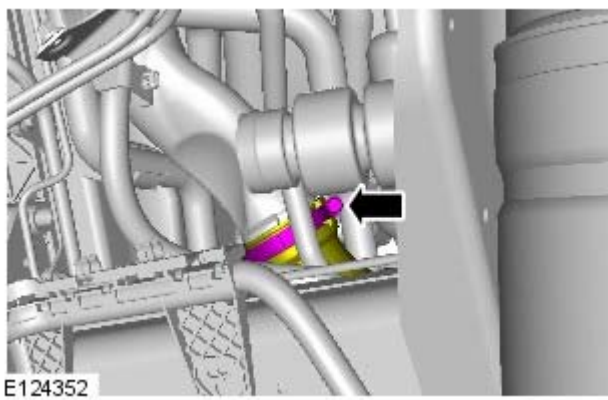
29.

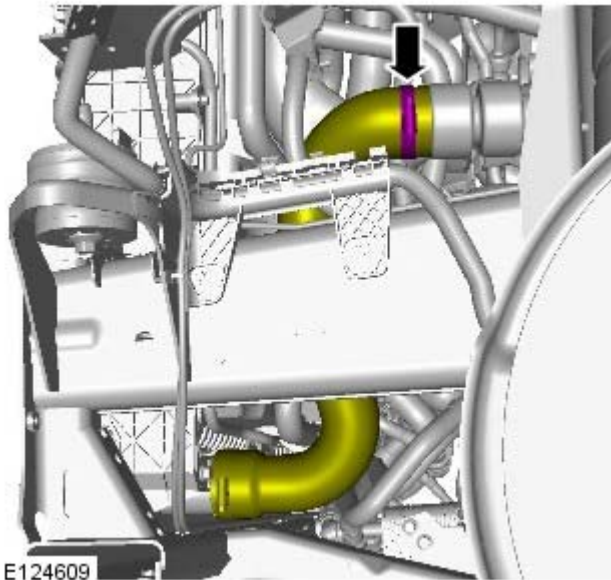


30.



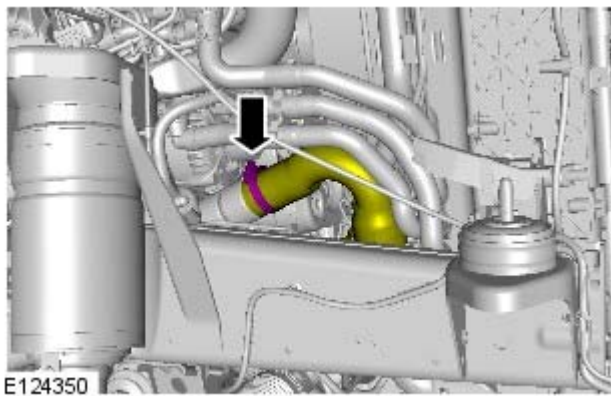
31. **31.** NOTE: Remove and discard the blanking caps.





32. **32.** NOTE: :Remove and discard the blanking caps.

Torque: 5 Nm



33. **33.** NOTE: Remove and discard the blanking caps.

Torque: 5 Nm

34. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).

35. Refer to: [Body - TDV6 3.0L Diesel/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

36. Refer to: [Power Steering System Filling and Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Engine - V6 4.0L Petrol -

Sealers

Item	Land Rover Part No.
Engine timing cover to cylinder block	STC 50550
Rear main bearing cap to cylinder block	8510302

Lubricant - UK, Europe and ROW - Not NAS/Japan

Item	Specification
* Recommended lubricant	The use of 5W/30 oil to Specification WSS - M2C929-A is preferred. Where oil to this specification is not available, then 5W/30 oil meeting specifications ACEA A1/A3 or API SJ or SL may be used.

* **WSS is a Ford prefix to the oil specification**

Lubricant - NAS/Japan

Item	Specification
* Recommended lubricant	Use 5W/30 oil meeting Specification WSS-M2C929-A (GF4) and 'Certified for Gasoline Engines' by the American Petroleum Institute (API).

* **WSS is a Ford prefix to the oil specification**

Capacity

Item	Capacity
Dry fill including filter	6.4 litres (11.2 pints) (6.7 US quarts)
Oil and filter change - Maximum	5.7 litres (10.0 pints) (6.0 US quarts)
Amount of oil required to bring the level from the lower to the upper holes on the dipstick	1.4 litres (2.4 pints) (1.5 US quarts)

General Specification

Item	Specification
Type	4.0 litre, 60 degree 'V', petrol engine, single overhead camshaft per cylinder head, 2 valves per cylinder
Cylinder arrangement	V6, when looking towards the rear of the engine, cylinders 5 and 6 are at the rear.
Cylinder numbering	Number 1, 3, 5 cylinder - right hand bank; Number 2, 4, 6 cylinder - left hand bank
Bore - nominal	100.4 mm (3.952 in)
Stroke	84.4 mm (3.322 in)
Capacity	4009 cm ³ (244.5 in ³)
Firing order	1 - 2 - 3 - 4 - 5 - 6
Compression ratio	9.75:1
Direction of rotation	Anti-clockwise viewed from rear of engine
Maximum power	156 Kw (209 bhp) @ 4750 rev/min
Maximum torque	346 Nm (255 lb-ft) @ 3500 rev/min
Dimensions:	
Length	669 mm (26.3 in)
Width	712 mm (28.0 in)
Height	747 mm (29.4 in)
Maximum permissible cylinder head warp	0.08 mm (0.003 in)
Engine oil pressure:	
At Idle	1.8 - 2.0 bars (180 - 200 kPa) (26.0 - 29.0 lb/in ²)
At 3500 rev/min	3.3 to 3.6 bars (330 - 360 kPa) (48.0 - 52.0 lb/in ²)

Torque Specifications

Description	Nm	lb-ft
Engine RH mounting bracket bolts	80	59
Engine RH mounting bracket nut	90	66
* Engine RH mounting to bracket bolts:		
Stage 1	45	33
Stage 2	Further 60°	Further 60°
+ LH and RH Exhaust manifold nuts	25	18
Dipstick tube bolt	10	7
* Exhaust system to exhaust manifold bolts	40	30
+ RH valve cover bolts/studs	10	7
+ LH valve cover bolts/studs	10	7
CMP sensor bolt	6	4
++ LH/RH camshaft cap bolts:		
Stage 1	6	4
Stage 2	16	12
*+ # Cylinder head bolts:		
Stage 1 - M12 bolts	30	22
Stage 2 - M12 Bolts	Further 80°	Further 80°
Stage 3 - M12 bolts	Further 80°	Further 80°
M8 bolts	35	26
Cylinder head coolant flange bolts	10	7
RH Cylinder head ground connector bolt	10	7
Generator mounting bracket bolts	45	33
+ Generator bolts	45	33

Description	Nm	lb-ft
Generator electrical connector nut	10	7
A/C compressor mounting bracket bolts	45	33
Knock sensor bracket bolt	10	7
Knock sensor retaining clip bolt	10	7
Electrical harness bridge bolt	45	33
EGR pipe nuts:		
Stage 1	Lightly tighten	Lightly tighten
Stage 2	40	30
Battery terminal clamp nut(s)	5	3.5
Wiring harness clamp bolt - RHD only	10	7
Oil pick-up pipe Torx screws	10	7
Oil strainer bolt	10	7
Oil pump Torx screws	20	15
Oil cooler lines nut and bolt	25	18
Oil cooler adapter	60	44
Transmission fluid lines bolt	10	7
Transmission fluid lines nut	10	7
Transmission support bracket nut	20	15
Transmission bolts	45	33
Engine front cover:		
M6 bolts	10	7
M8 bolts and studs	20	15
Coolant pump bolts	10	7
Ground cable nut	20	15
+ Cylinder block cradle:		
Stage 1	Lightly tighten 2 rear bolts	Lightly tighten 2 rear bolts
Stage 2	Loosen 2 rear bolts	Loosen 2 rear bolts
Stage 3	Lightly tighten 2 rear bolts	Lightly tighten 2 rear bolts
Stage 4 - Outer bolts, nuts and Torx screws	10	7
Stage 5 - 2 rear bolts	43	32
Stage 6 - Cylinder block cradle set screws	7	5
Stage 7 - Cylinder block cradle bolts	15	11
Stage 8 - Cylinder block cradle bolts	34	25
* Crankshaft pulley bolt:		
Stage 1	55	40
Stage 2	Further 85°	Further 85°
LH and RH camshaft sprocket bolts:		
Stage 1	20	15
Stage 2	Further 100°	Further 100°
Oil temperature sensor	20	15
Radiator access panel bolts	10	7
Oil pan bolts	10	7
Wiring harness to oil pan nuts	6	4
** Balance shaft Torx bolts	29	21
LH camshaft drive cassette chain guide bolt	25	18
RH camshaft drive cassette bolt	12	9
* RH cassette jackshaft drive sprocket bolt (Rear):		
Stage 1	40	35
Stage 2	Further 45°	Further 45°
* Jackshaft sprocket Torx bolt (Front):		
Stage 1	45	33
Stage 2	Further 70°	Further 70°
Crankshaft position sensor (CKP) bolt	8	6
* Steering column lower universal joint 'Patchlok' bolts	25	18
Jackshaft thrust plate Torx bolts	10	7
Oil pump drive gear bolt	20	15
LH and RH hydraulic timing chain tensioner	45	33
Primary timing chain tensioner bolt	10	7
Oil filter	18	13
Oil drain plug	37	27
+ * Starter motor cable nut	10	7
Starter motor bolts	45	33
Fuel rail bolts	25	18
Valve cover fuel line clip bolt	10	7
+ Intake manifold bolts	10	7
* RH catalytic converter to the exhaust manifold bolts	22	16
* LH catalytic converter to the exhaust manifold bolts	22	16
Flexplate to torque converter Torx bolts	45	33
Road wheel nuts	140	103

*** New nuts/bolt(s) must be fitted**

**** New Torx bolts must be fitted**

+ Bolts/Torx bolts/studs must be tightened in sequence

++ Bolts must be tightened in a diagonal sequence commencing with the 2 centre bearing caps

Lubricate threads of bolts with engine oil prior to fitting

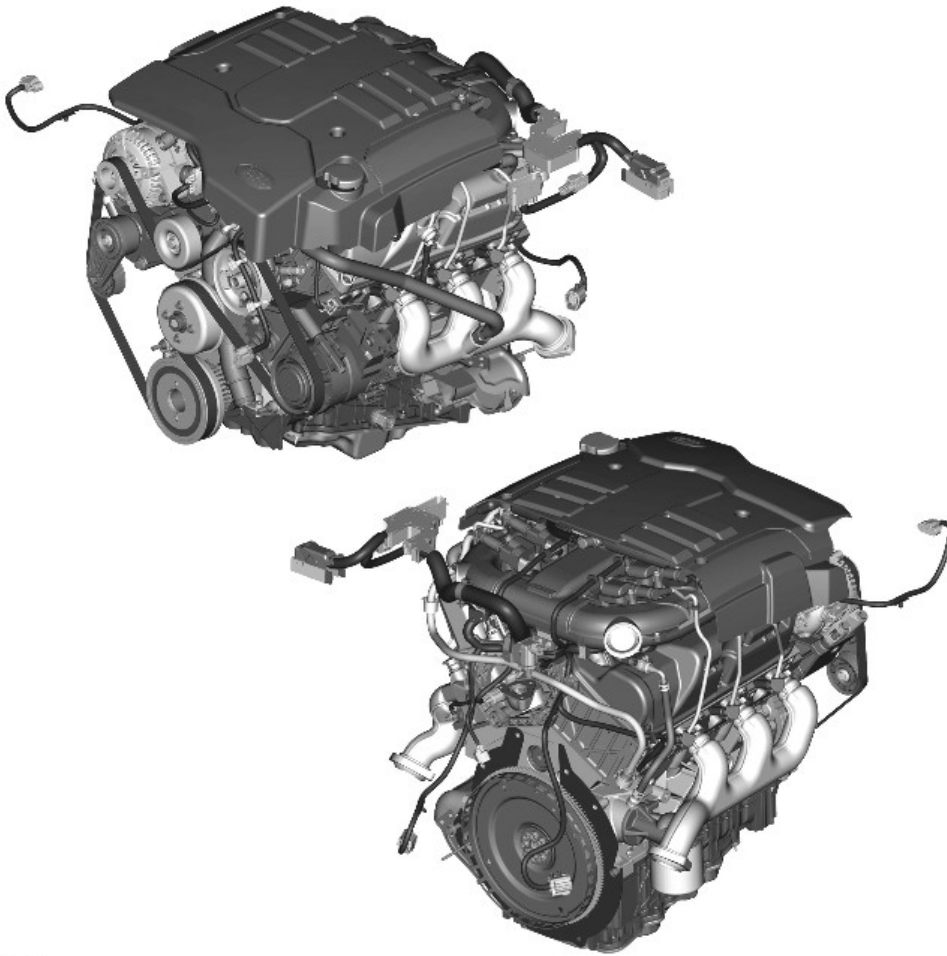
+ * Damage to internal components will result if this torque is exceeded

Engine - V6 4.0L Petrol - Engine

Description and Operation

External View

• NOTE: Variant without oil cooler shown.



E50486

GENERAL

The V6 petrol engine is a 4.0 litre, 6 cylinder, 60 degrees 'V' unit, with 2 valves per cylinder, operated by a single overhead camshaft. The engine emissions comply with ECD4 (European Commission Directive) and USA Tier 2 Bin 8 legislative requirements and employs catalytic converters, electronic engine management control, positive crankcase ventilation and exhaust gas recirculation to limit the emission of pollutants. The cooling system is a low volume, high velocity system. The fuel injection system is controlled by the Engine Control Module (ECM).

The cylinder block is of cast iron construction with a cast aluminum ladder frame and balance shaft assembly bolted to the bottom of the block. The cylinder heads are cast aluminum with vinyl ester composite camshaft covers. The single-piece oil sump is formed from pressed steel. The intake manifold is manufactured from cast aluminum and incorporates a central chamber with six inlet port tracts.

For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation). The dual wall stainless steel exhaust manifolds are unique for each cylinder bank and a moulded plastic acoustic cover is fitted over the upper engine to reduce engine-generated noise.

Technical Features

The technical features include:

- A six cylinder, 60 degree 'V' configuration liquid cooled cast iron cylinder block
- Pistons comprise two compression rings and a three piece oil control ring
- Two aluminum cylinder heads, each incorporating a single hollow camshaft
- Rocker valve arms with hydraulic lash adjusters
- Engine front cover manufactured from aluminum which accommodates the coolant pump assembly
- Each camshaft is driven by a separate single row chain
- Electronically controlled vacuum operated Exhaust Gas Recirculation (EGR) valve
- Exhaust re-treatment by means of catalytic converters
- Cast aluminum engine ladder frame assembly
- A fully counter balanced cast iron crankshaft
- An advanced engine management system incorporating electronic throttle control
- Electronic Intake Manifold Tuning Valve (IMTV) with ECM control
- Emissions comply with ECD4 (European Commission Directive) and USA Tier 2 Bin 8 legislative requirements.

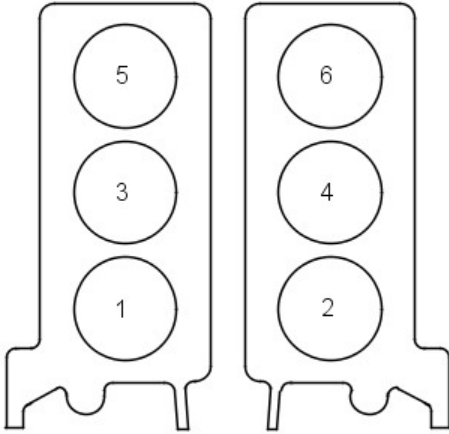
Engine Data

The technical data is detailed below.

	DESCRIPTION	TYPE
Configuration	60 degree V6	
Maximum power	156 kW at 4750 rpm	
Maximum torque	346 Nm at 3000 rpm	
Displacement	4009cc	
Stroke/bore	84.4mm/100.4mm	
Compression ratio	9.7:1	
Firing order	1 2 3 4 5 6	
Oil capacity	6.4 litres	

CYLINDER NUMBERING

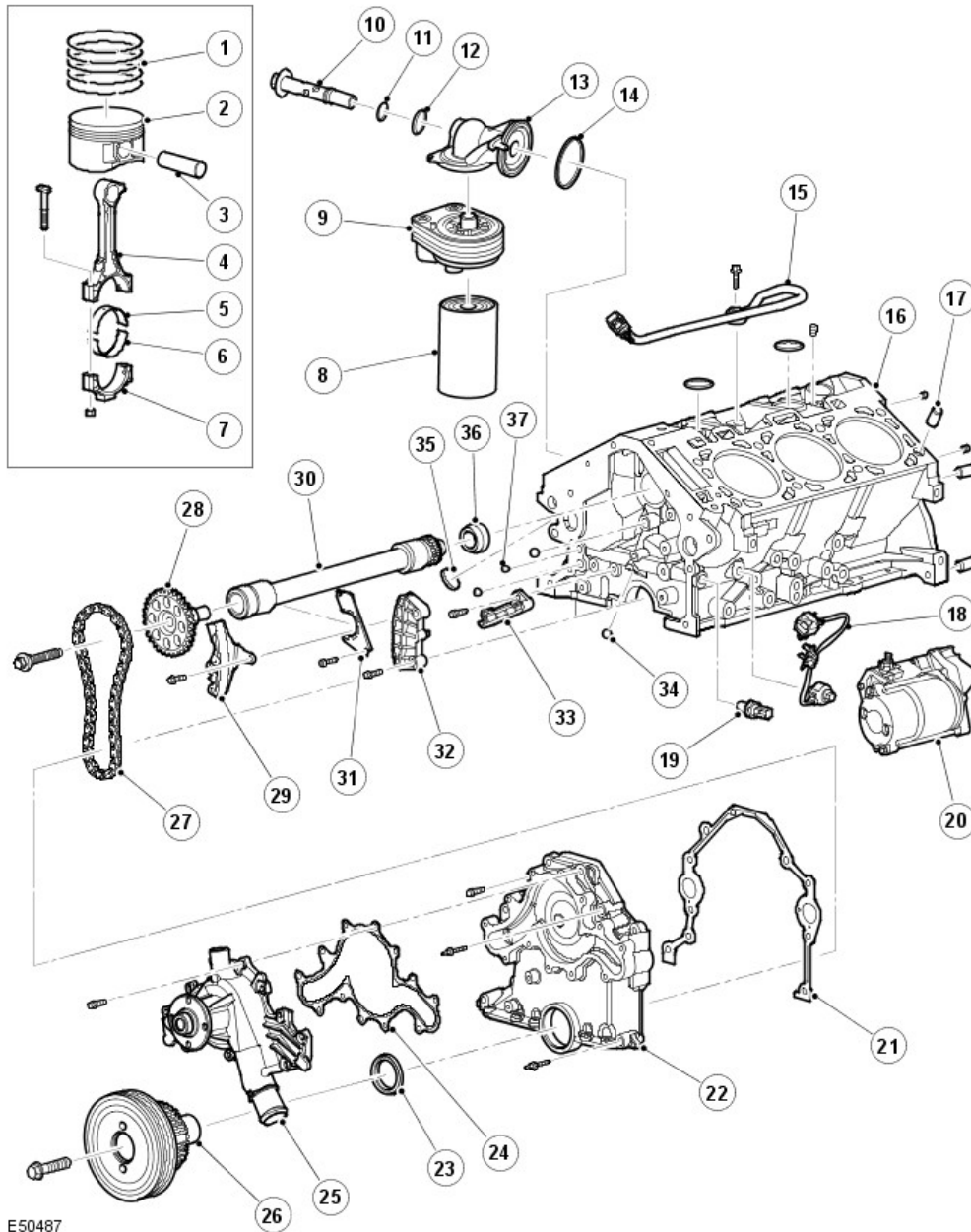
The cylinders are numbered as shown below, with cylinders 1 and 2 at the front of the engine.



E133974

CYLINDER BLOCK COMPONENTS

• NOTE: Variant with oil cooler shown.



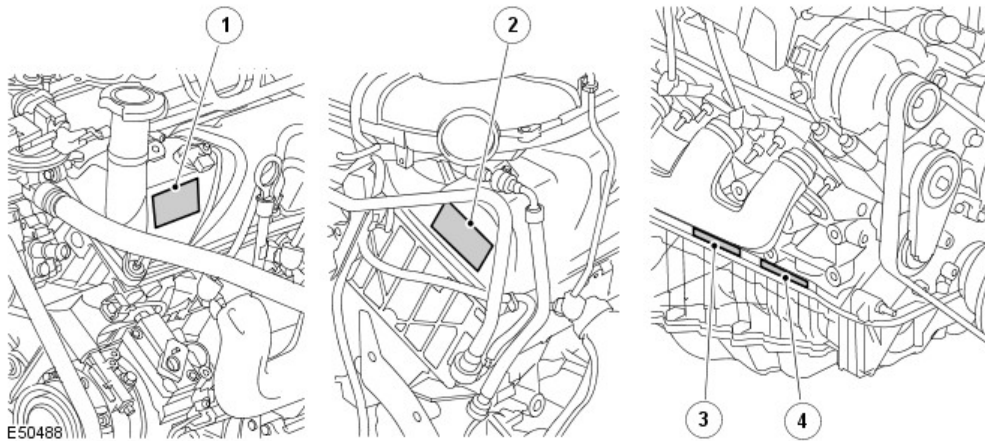
E50487

Item	Part Number	Description
1	-	Piston Rings
2	-	Piston
3	-	Piston pin
4	-	Connecting rod
5	-	Connecting rod bearing - upper
6	-	Connecting rod bearing - lower
7	-	Connecting rod cap
8	-	Oil filter
9	-	Oil cooler (if fitted)
10	-	Oil filter adapter mounting bolt
11	-	O ring
12	-	O ring
13	-	Oil filter adapter
14	-	O ring
15	-	Knock sensor
16	-	Cylinder block
17	-	Locating dowel
18	-	Knock sensor
19	-	Oil pressure switch
20	-	Starter motor
21	-	Gasket
22	-	Front cover
23	-	Seal
24	-	Gasket
25	-	Water pump
26	-	Crankshaft pulley
27	-	Jackshaft shaft chain
28	-	Jackshaft shaft sprocket
29	-	Chain tensioner
30	-	Jackshaft shaft
31	-	Jackshaft thrust plate
32	-	Chain guide
33	-	Chain guide
34	-	Oil gallery plug
35	-	Plug
36	-	Spacer
37	-	Oil gallery plug

Cylinder Block

The cylinder block is a 'V' design, which provides an inherently rigid structure with good vibration levels. A low volume coolant jacket improves warm-up times and piston noise levels; the longitudinal flow design of the jacket, with a single cylinder head coolant transfer port in each bank, improves rigidity and head gasket sealing.

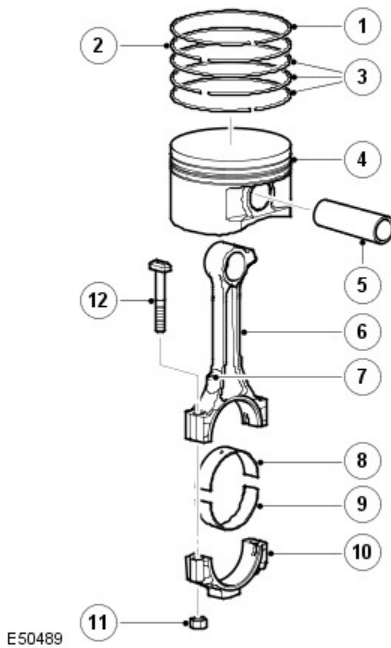
Engine Data Locations



Item	Part Number	Description
1	-	Engine data
2	-	Engine data
3	-	Vehicle Identification Number (primary location)
4	-	Vehicle Identification Number(secondary location)

Engine data is marked at three locations.

Pistons and Connecting Rod Assembly



Item	Part Number	Description
1	-	Piston ring, upper compression
2	-	Piston ring, lower compression
3	-	Piston rings, oil control
4	-	Piston
5	-	Piston pin
6	-	Connecting rod
7	-	Oil squirt hole
8	-	Connecting rod bearing, upper
9	-	Connecting rod bearing, lower
10	-	Connecting rod cap
11	-	Nut
12	-	Bolt

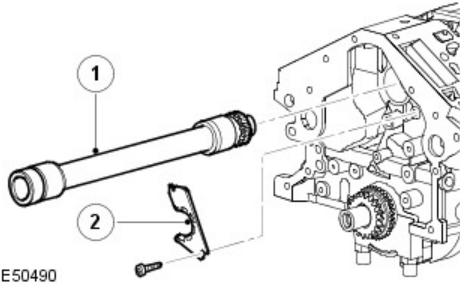
The aluminum alloy, thermal expansion, lightweight pistons, with semi-floating piston pins, are offset to the thrust side and are carried on forged steel connecting rods. Pistons are supplied in four grades, 1, 2, 3 and 4. The pistons are marked to ensure they are correctly oriented in the cylinder bore; the 'arrow' mark should be toward the front of the engine.

The V6 petrol engine utilizes forged steel H-sectioned connecting rods, with the piston pin being an interference fit in the small end of the connecting rod. The big ends are horizontally split.

Selective bearing shells with two grades of thickness; standard and 0.25 mm undersize, control big end bearing diametric clearance. The big-end upper and lower bearing shells are plain with locating tags.

Each piston is fitted with two compression rings and an oil control ring. The top compression ring has a nitrided surface, a process that involves the diffusion of nitrogen into the surface layers of a low carbon steel. The formation of nitrides provides an increased hardness. The 2nd compression ring is chrome-plated. The oil control rings have stainless steel top and bottom rails and integral expander rings.

Jackshaft Assembly

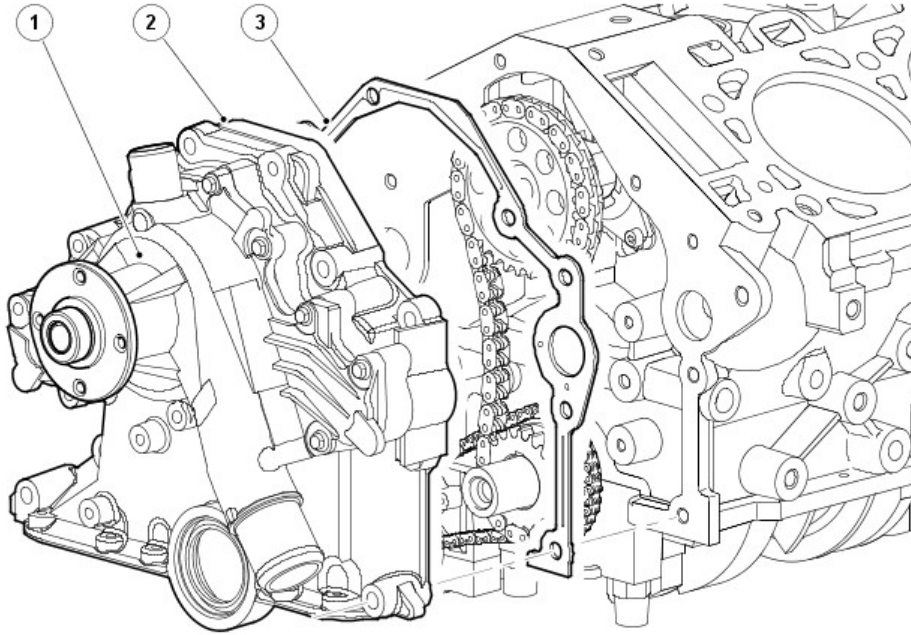


E50490

Item	Part Number	Description
1	-	Jackshaft
2	-	Thrust plate

The Jackshaft assembly is located centrally in the upper part of the cylinder block. The assembly is used to supply drive to each camshaft, via a chain. The LH camshaft is driven from the front of the Jackshaft and the RH camshaft is driven from the rear. The Jackshaft assembly is driven, via a chain, by the crankshaft gear at the front of the engine. The assembly is held in position by a thrust plate.

Front Cover and Water Pump Assembly



E50491

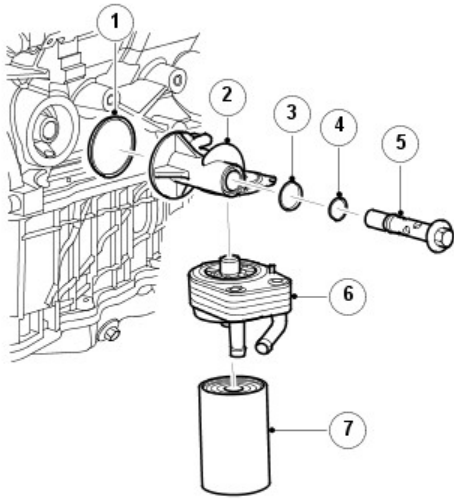
Item	Part Number	Description
1	-	Water pump assembly
2	-	Engine front cover
3	-	Gasket

The aluminum front cover assembly is secured to the engine block by five bolts and five studs and is sealed via a gasket. The front cover also houses the crankshaft front seal.

The water pump is attached to the engine front cover assembly and is secured and sealed, to the front cover, by twelve bolts and a gasket. A poly-vee belt drives the water pump via the crankshaft.

Oil Cooler (If Fitted) and Filter Assembly

- NOTE: Variant with oil cooler shown.



E50492

Item	Part Number	Description
1	-	O ring
2	-	Adapter
3	-	O ring
4	-	O ring
5	-	Adapter mounting bolt
6	-	Cooler assembly (if fitted)
7	-	Oil filter

A full-flow, disposable canister-type oil filter is attached to the oil cooler assembly (if fitted).

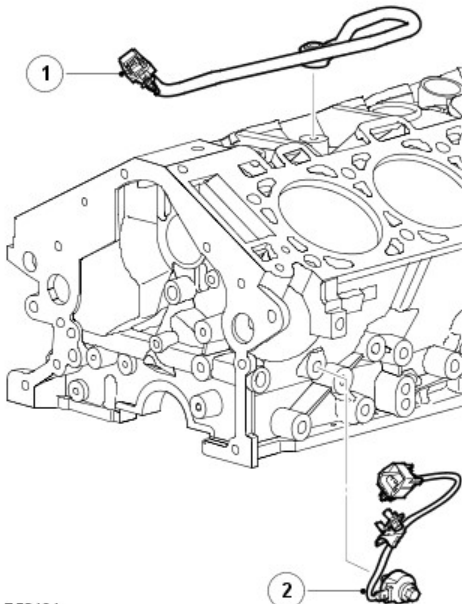
The oil filter and cooler assembly (if fitted) is attached the rear RH side of the cylinder block and consists a full-flow, disposable canister-type filter, cooler (if fitted) and an adapter.

The filter adapter-mounting bolt locates in the cylinder block oil gallery and is sealed by an 'O' ring. The filter adapter houses the adapter bolt and is also sealed to the cylinder block by an 'O' ring.

The oil cooler (if fitted) keeps the engine lubrication oil cool, under heavy loads and high ambient temperatures and is cooled by the engine cooling system.

Oil is delivered to and from the oil cooler (if fitted) through galleries in the cylinder block. Hoses from the engine cooling system are connected to two pipes on the oil cooler for the supply and return of coolant.

Knock Sensors



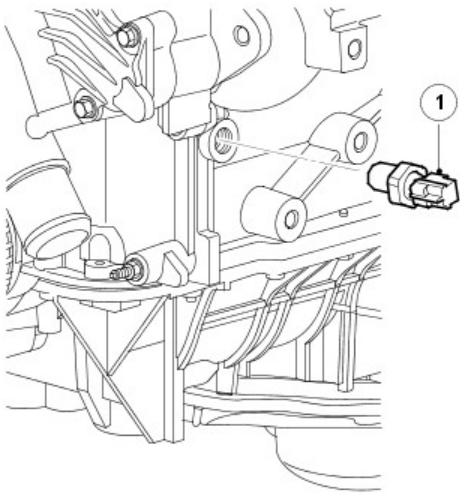
E50494

Item	Part Number	Description
1	-	RH knock sensor
2	-	LH knock sensor

The knock sensors are installed in the cylinder block in two different locations. One is located on the inboard of the RH cylinder bank and one is located at the front of the LH side of the cylinder block, next to the oil pressure switch. They are piezo-electric sensors that provide inputs to detect and locate detonation during combustion.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Oil Pressure Switch

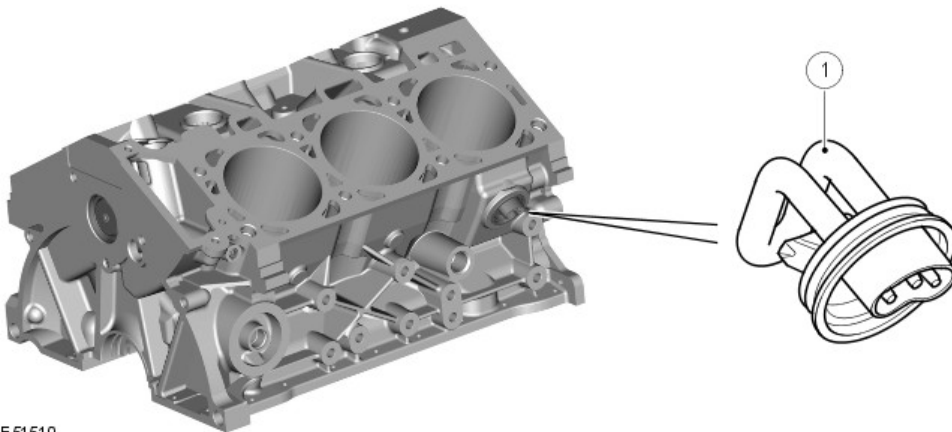


E50495

Item	Part Number	Description
1	-	Oil Pressure Switch

The oil pressure switch is located in a port at the front LH side of the cylinder block. It detects when a safe operating pressure has been reached during engine starting and initiates the illumination of a warning light in the instrument cluster if the oil pressure drops below a given value. The switch operates at a pressure of 0.15 to 0.41 bar (2.2 to 5.9 psi).

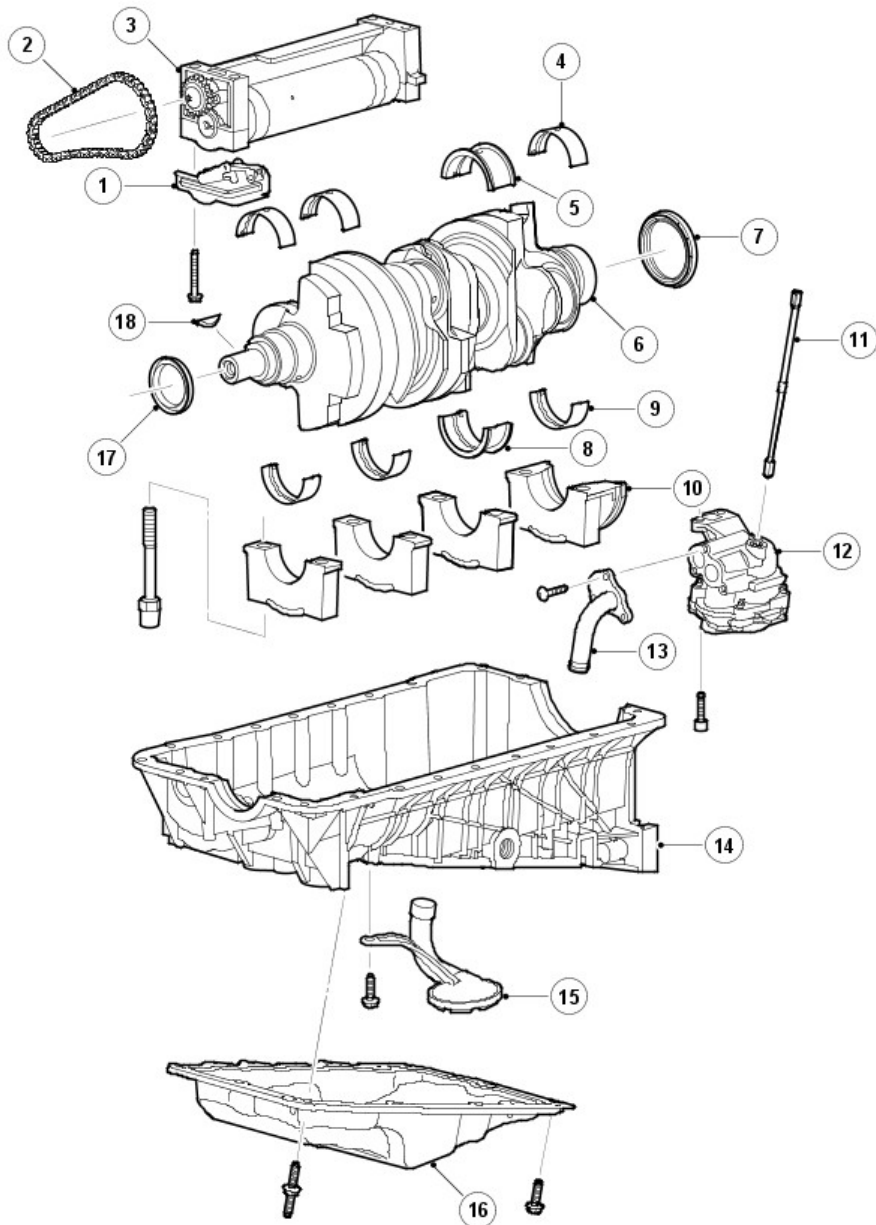
Engine Block Heater



E51510

For cold climate markets an engine block heater is fitted, which is located at the front of the LH side of the cylinder block.

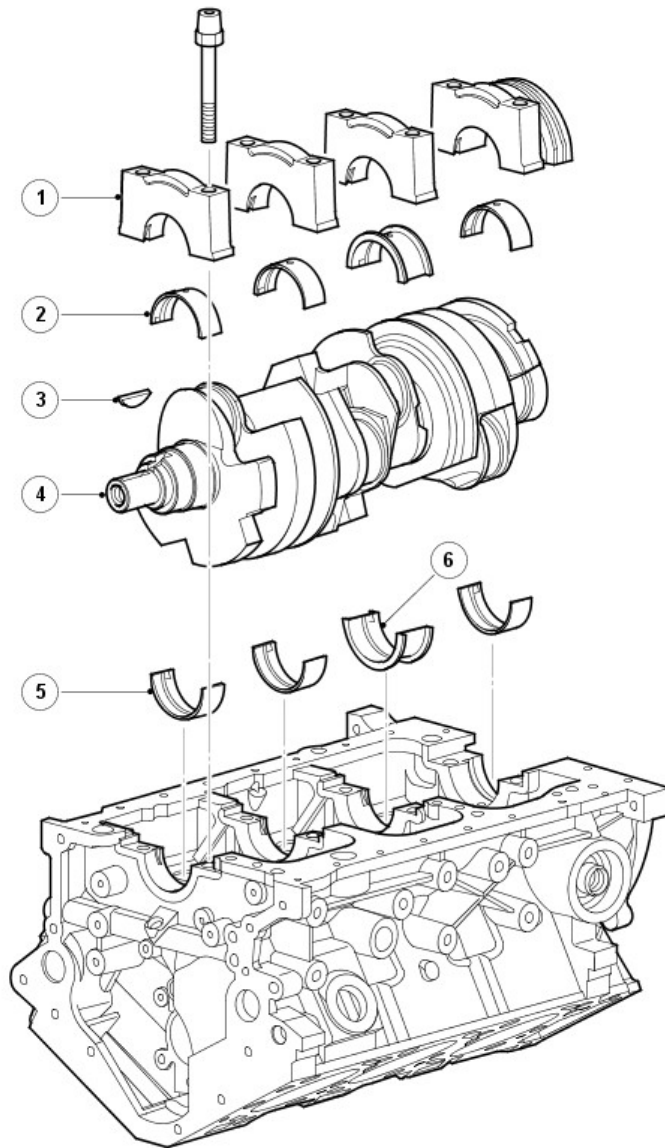
CRANKSHAFT, SUMP AND OIL PUMP COMPONENTS



E50497

Item	Part Number	Description
1	-	Tensioner
2	-	Chain
3	-	Balance shaft assembly
4	-	Main bearing, upper
5	-	Main thrust bearing, upper
6	-	Crankshaft
7	-	Crankshaft oil seal, rear
8	-	Main thrust bearing, lower
9	-	Main bearing, lower
10	-	Main bearing cap, rear
11	-	Intermediate shaft
12	-	Oil pump
13	-	Pick-up pipe adapter
14	-	Ladder frame
15	-	Oil pick-up pipe
16	-	Sump
17	-	Crankshaft oil seal, front
18	-	Key

Crankshaft and Main Bearings



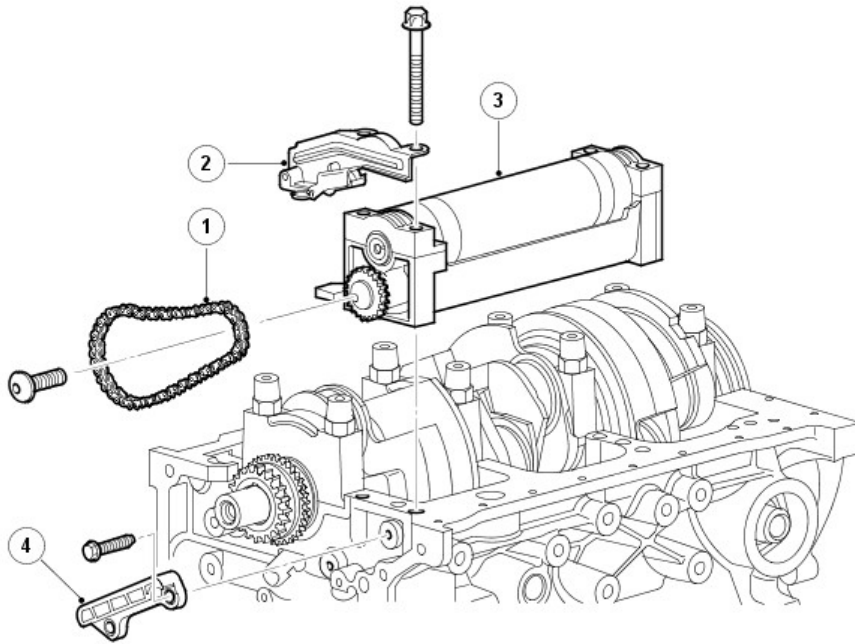
E50498

Item	Part Number	Description
1	-	Main bearing cap
2	-	Main bearing, lower
3	-	Key
4	-	Crankshaft
5	-	Main bearing, upper
6	-	Main bearing, thrust

The crankshaft is supported on four main bearings, with each pair of crankpins mutually offset by 30 degrees to give equal firing intervals. Cast in Spheroidal Graphite (SG) iron, the crankshaft has cold rolled fillets on all journals, except the outer mains, for toughness and failure resistance. The nine crankshaft counterweights increase smoothness and reduce bearing wear by splitting the loads evenly across the bearings. Thrust washer halves at the top and bottom of number three main bearing control end-float.

Oil grooves are provided in the upper and lower halves of all the main bearing shells to supply oil, via drillings in the crankshaft, to the connecting rod big-end bearings.

Balance Shaft Assembly



E50500

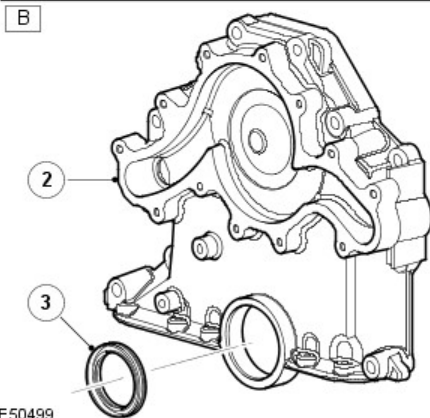
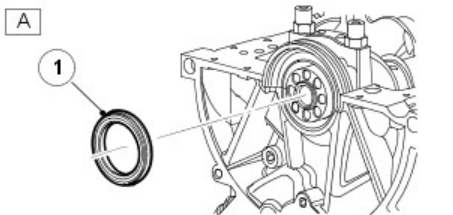
Item	Part Number	Description
1	-	Drive chain
2	-	Tensioner assembly
3	-	Balance assembly
4	-	Chain guide

A 60 degree V6 is often thought of inherently balanced, because its first-order forces can be compensated by crankshaft counter-weighting. However, the V6 4.0L engine generates a second-order unbalanced at twice the crank speed.

To achieve the desired smoothness, the V6 4.0L engine includes a unique counter-rotating balance shaft, which is chain driven by the crankshaft and runs at twice engine speed. The shaft produces an opposite second-order force, which cancels the inherent unbalance.

Since the balance shaft is positioned on the bottom the cylinder block, on the RH side and is secured by 4 bolts. Because the unit is near the engine oil level, it is encased in a steel tube to avoid aerating the oil. The balance shaft attaches to the engine as an assembled unit, including an integrated gear and lubrication system. The gear is needed to rotate the shaft in the same direction as the unbalanced force.

Crankshaft Oil Seals

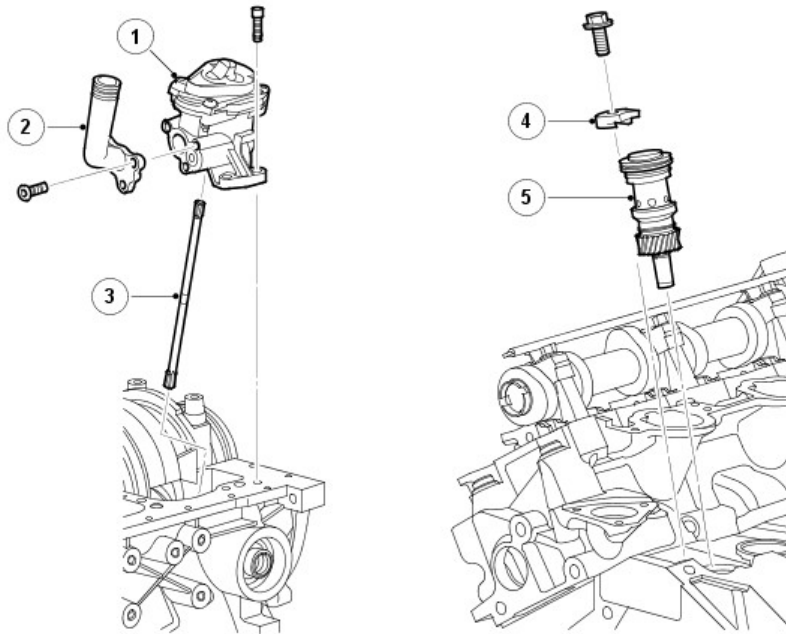


E50499

Item	Part Number	Description
A	-	Rear
B	-	Front
1	-	Rear seal
2	-	Front cover
3	-	Front seal

The rear crankshaft oil seal is a press fit in the rear of the cylinder block. The front crankshaft oil seal is located in the engine front cover assembly, just below the water pump.

Oil Pump

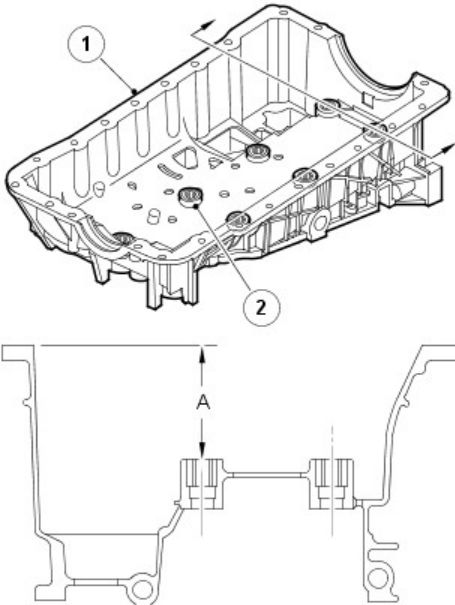


E50501

Item	Part Number	Description
1	-	Oil pump
2	-	Pick-up pipe adapter assembly
3	-	Intermediate shaft
4	-	Clamp
5	-	Drive assembly

The oil pump is located on the RH rear underside of the cylinder block, contained within the ladder frame assembly, and is secured by two bolts. The unit is driven by the jackshaft, via an intermediate shaft, and receives its oil feed from the main gallery via drillings in the cylinder block. The intermediate shaft locates through the cylinder block and is connected to the drive assembly, which is situated in the 'V' at the rear of the engine and held in place via a clamp. The oil pump housing includes the oil pressure relief valve.

Engine Ladder Frame Assembly



E50502

Item	Part Number	Description
A	-	69.8 mm minimum
1	-	Engine bulkhead housing
2	-	Crankshaft main bearing cap adjustment screw

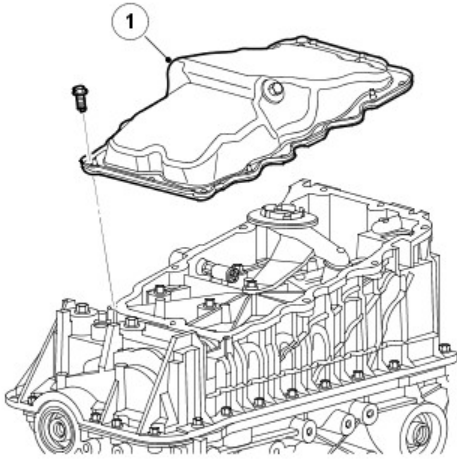
The ladder frame is fitted to the lower cylinder block, via 20 bolts and 2 studs and nuts, to stiffen the base structure thus helping to reduce Noise, Vibration and Harshness (NVH). The frame is made of high-pressure die cast aluminum.

Located in the bulkhead housing are eight crankshaft main bearing cap adjustment screws.

A gasket seals the joint between the bulkhead housing and the cylinder block.

A port for the oil level gauge tube is included in the casting on the LH side of the cylinder block.

Sump

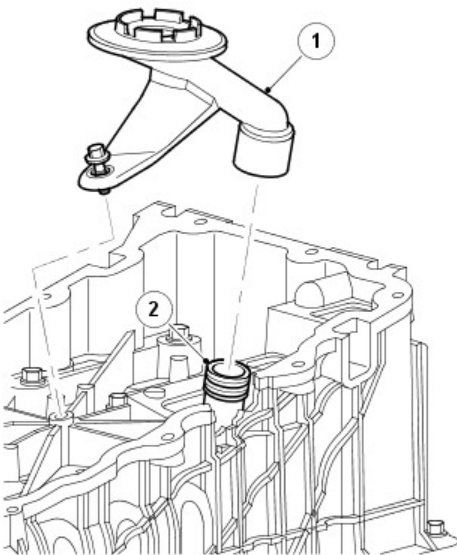


E50503

Item	Part Number	Description
1	-	Sump

The pressed steel sump is a wet-type, sealed to the ladder frame using a gasket and 10 bolts.

Oil Pick-up

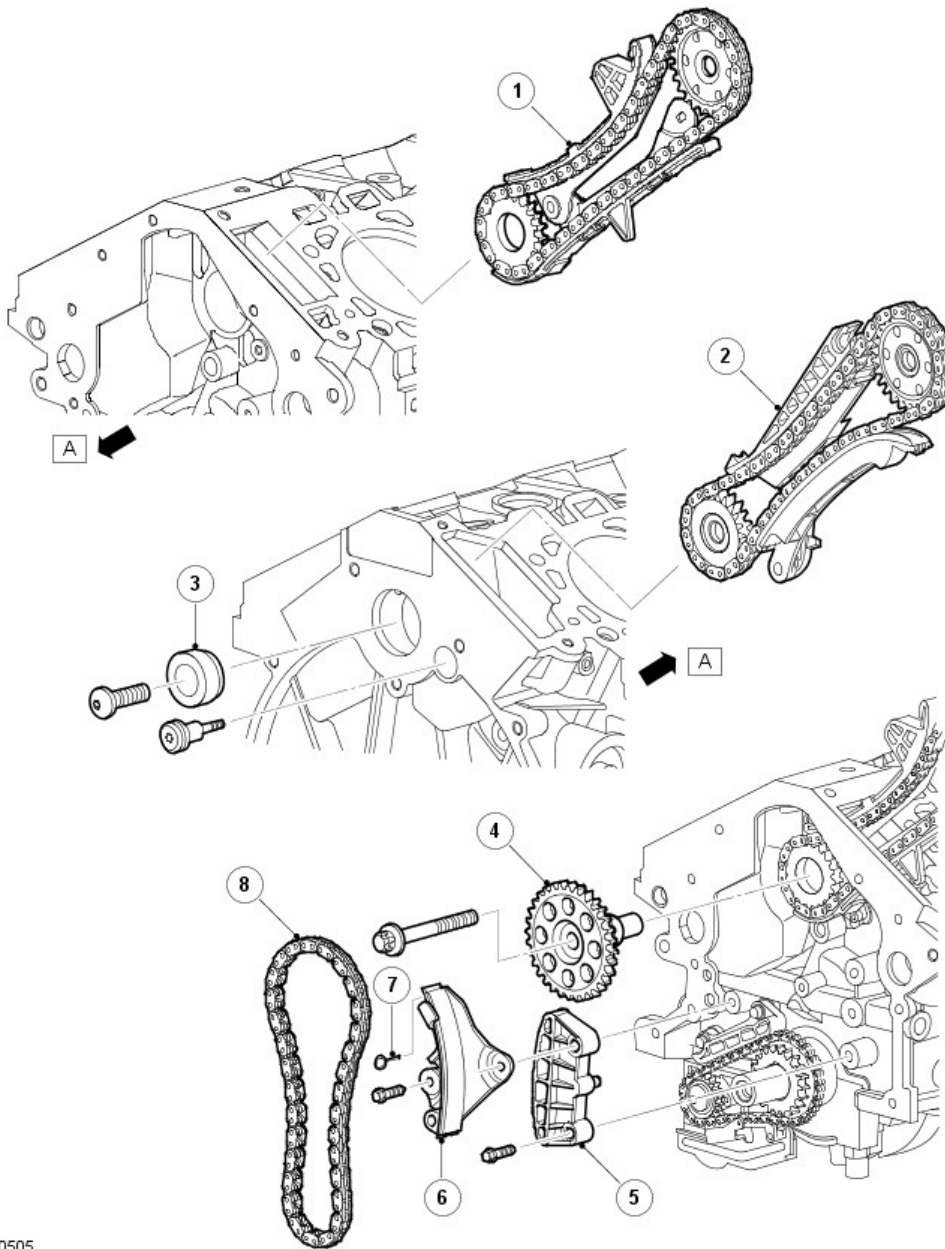


E50504

Item	Part Number	Description
1	-	Oil pick-up

The oil pick-up is a two-piece unit with strainer located in the center of the sump oil well, as a source for the supply of engine lubrication oil to the oil pump. Oil is drawn through the end of the pick-up and strained to prevent solid matter from entering the oil pump.

CAMSHAFT TIMING COMPONENTS



E50505

Item	Part Number	Description
A	-	Front of engine
1	-	LH camshaft drive assembly
2	-	RH camshaft drive assembly
3	-	Spacer
4	-	Jackshaft sprocket
5	-	Chain guide
6	-	Jackshaft chain tensioner
7	-	Tensioner pin
8	-	Jackshaft chain

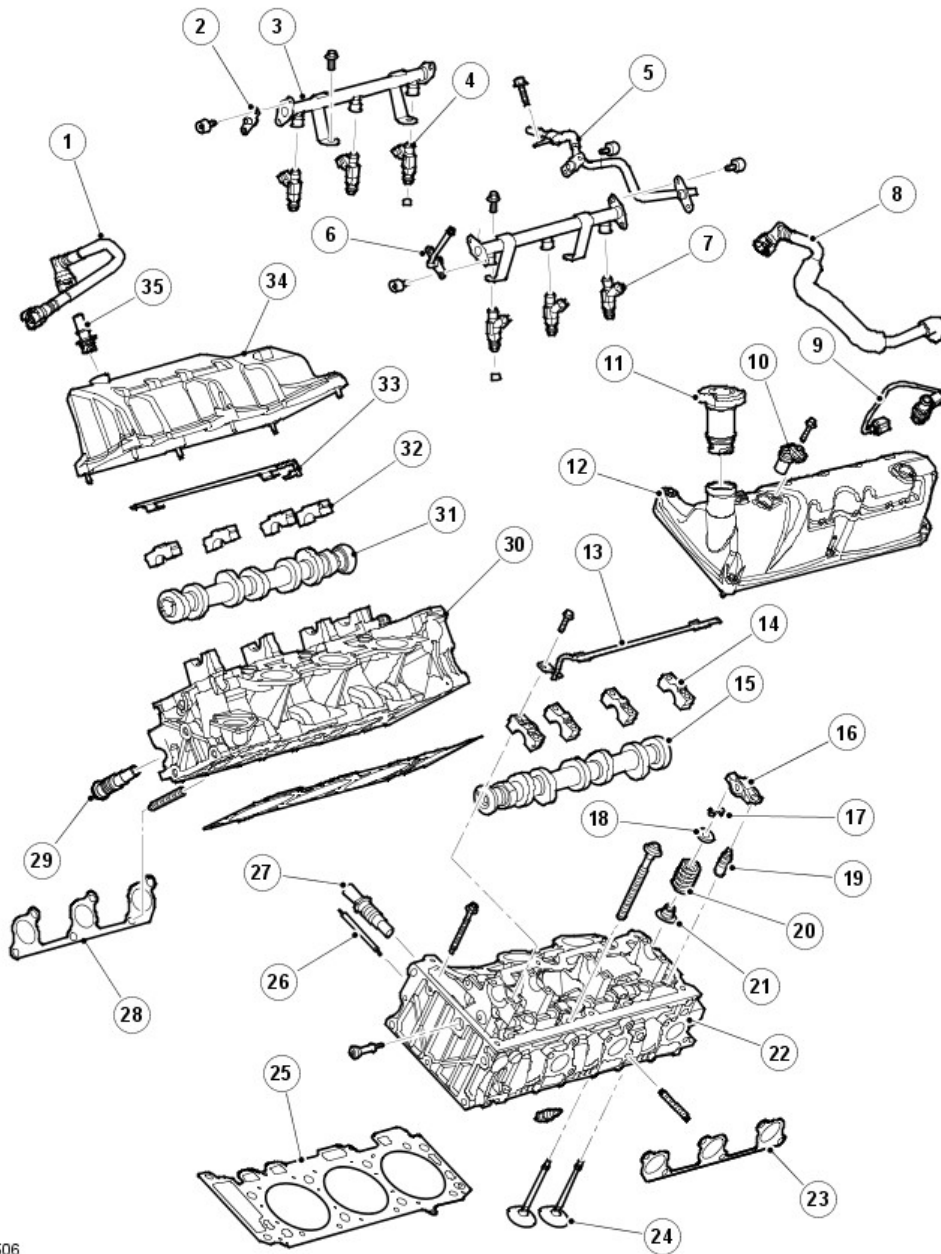
Camshaft Drive Assembly

Each camshaft drive assembly comprises:

- A jackshaft gear
- A camshaft gear
- A drive chain
- A chain guide

The LH drive assembly is driven from the front of the jackshaft and the RH assembly from the rear.

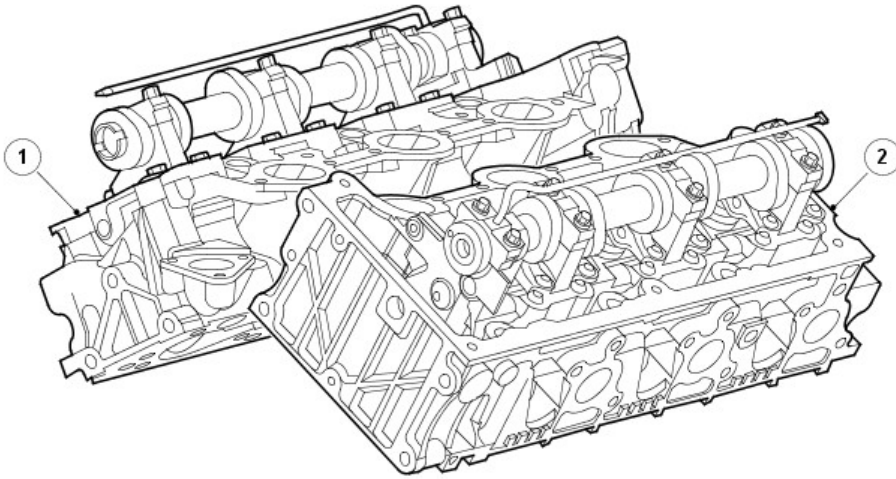
CYLINDER HEAD COMPONENTS



E50506

Item	Part Number	Description
1	-	Hose, crankcase emissions, RH camshaft cover to intake manifold
2	-	End cover
3	-	RH Fuel rail
4	-	LH injectors (3 of)
5	-	Fuel supply line
6	-	Schrader valve
7	-	RH injectors (3 of)
8	-	Hose, crankcase emissions, LH camshaft cover to intake manifold
9	-	Electrically heated positive crankcase ventilation valve
10	-	Camshaft position (CMP) sensor
11	-	Oil filler cap
12	-	LH camshaft cover
13	-	LH valve rocker arm oil supply tube
14	-	LH camshaft bearing caps
15	-	LH camshaft
16	-	Valve rocker arm
17	-	Collet
18	-	Valve spring retainer seat
19	-	Hydraulic lash adjuster
20	-	Valve spring
21	-	Valve stem seal
22	-	LH cylinder head
23	-	LH exhaust manifold gasket
24	-	Valves
25	-	Cylinder head gasket
26	-	Volume reduction plug/valves
27	-	Timing chain tensioner
28	-	RH exhaust manifold gasket
29	-	Timing chain tensioner
30	-	RH cylinder head
31	-	RH camshaft
32	-	RH camshaft bearing caps
33	-	RH valve rocker arm oil supply tube
34	-	RH camshaft cover
35	-	Crankcase ventilation valve

Cylinder Heads



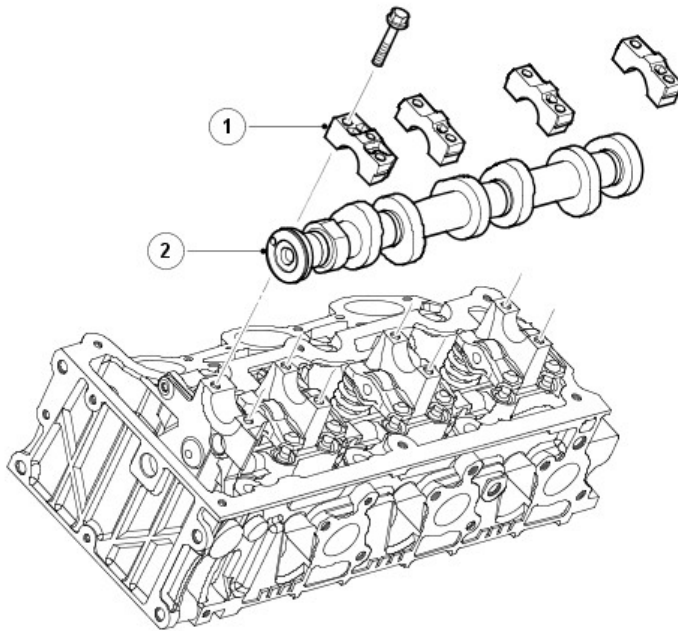
E50507

Item	Part Number	Description
1	-	RH cylinder head
2	-	LH cylinder head

The cross-flow cylinder heads are based on a twin valve, central spark plug combustion chamber, with the inlet ports designed to induce swirl and control the speed of the induction charge. This serves to improve combustion and hence fuel economy, performance and exhaust emissions.

LH and RH cylinder heads are identical castings.

Camshafts



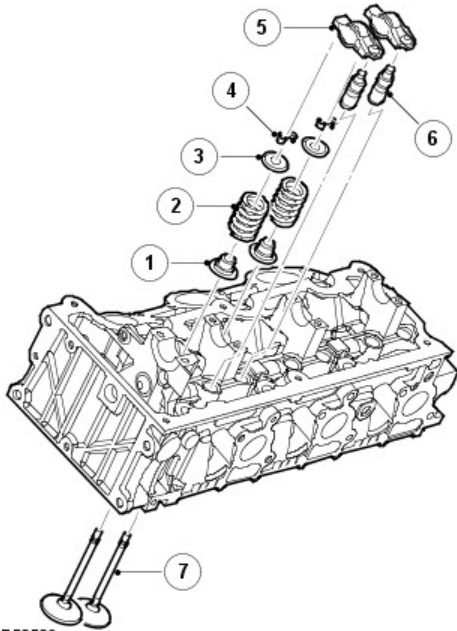
E50508

Item	Part Number	Description
1	-	Bearing cap
2	-	Camshaft

A single camshaft on each cylinder bank is retained by a camshaft carrier, line bored with the cylinder head. The camshafts are located by a flange, which also controls end-float.

The LH camshaft incorporates a reluctor, which is used in conjunction with the Camshaft Position (CMP) sensor to measure engine position.

Valves and Hydraulic Lash Adjusters



E50509

Item	Part Number	Description
1	-	Valve stem seal
2	-	Valve spring
3	-	Valve spring retainer seat
4	-	Valve spring retainer key
5	-	Rocker arm
6	-	Hydraulic lash adjuster
7	-	Valve

The valve springs are made from spring steel and are of the parallel single-coil type. The bottom end of each spring rests on the flange of a spring retainer, which has an integral valve stem seal. The top end of the spring is held in place by a spring retainer, which is held in position at the top end of the valve stem by split taper collets. The taper collets have grooves on the internal bore that locate to grooves ground into the upper stems of the valves.

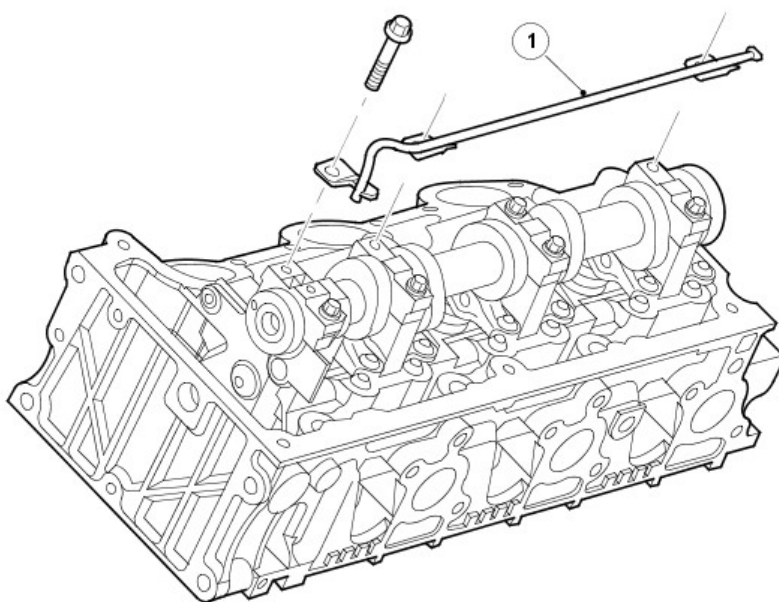
Valve seats and valve guides are an interference fit in the cylinder head.

The valves are operated through roller-type finger rockers and hydraulic lash adjusters, actuated by the camshaft lobes. When the camshaft lobe presses down on the top of a finger rocker, roller mechanism, the respective valve is forced down, opening the affected inlet or exhaust valve. The use of this type of actuation method helps reduce friction in the valve timing mechanism.

The body of the hydraulic lash adjusters contains a plunger and two chambers for oil feed and pressurized oil. The pressurized oil is supplied to the lash adjusters via the main oil galleries in the cylinder head and through a hole in the side of the lash adjuster body. The oil passes into a feed chamber in the lash adjuster and then through to a separate pressure chamber via a one way ball valve.

Oil flow from the pressure chamber is determined by the amount of clearance between the lash adjuster outer body and the center plunger. Oil escapes up the side of the plunger every time the lash adjuster is operated, the downward pressure on the plunger forcing a corresponding amount of oil in the lash adjuster body to be displaced. When the downward pressure from the camshaft and finger rocker is removed (i.e. after the trailing flank of the camshaft lobe has passed), oil pressure forces the lash adjuster's plunger up again. This pressure is not sufficient to effect the valve operation, but eliminates the clearance between the finger rocker and top of the valve stem.

Valve Rocker Arm Oil Supply Tube

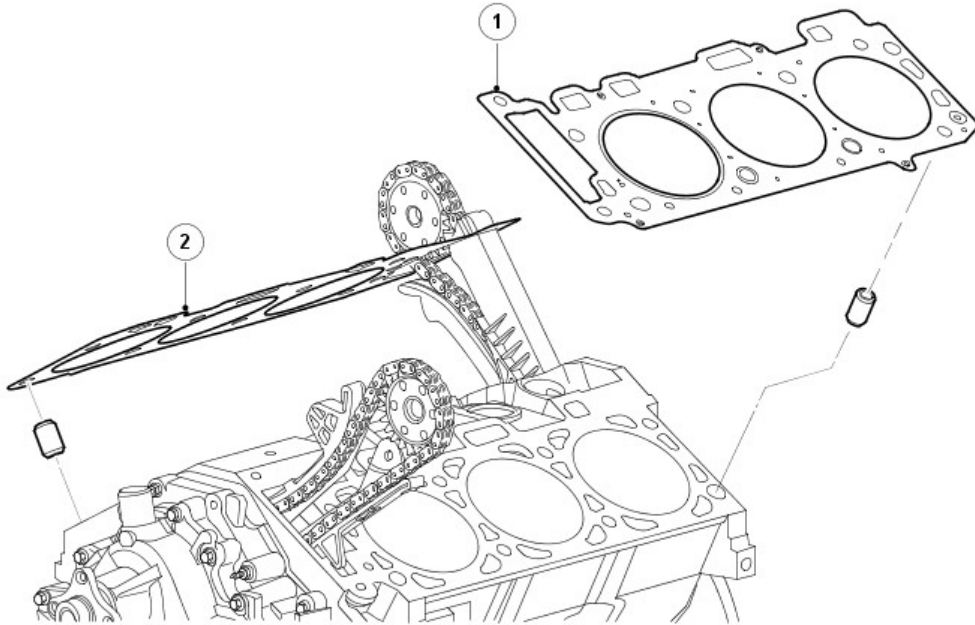


E50510

Item	Part Number	Description
1	-	Valve rocker arm oil supply tube

The valve rocker arm oil supply tube locates on top of each camshaft and is secured by two bolts to the front and rear camshaft bearing caps. Oil is supplied to the tube via a gallery in the cylinder head and is distributed to each rocker arm through adjacent spray holes in the tube.

Cylinder Head Gasket

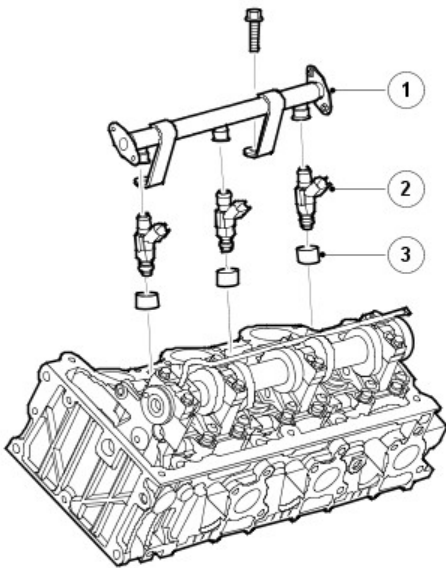


E50511

Item	Part Number	Description
1	-	LH cylinder head gasket
2	-	RH cylinder head gasket

The multi-layered steel cylinder head gasket has cylinder specific water flow cross-sections for uniform coolant flow.

Fuel Injectors



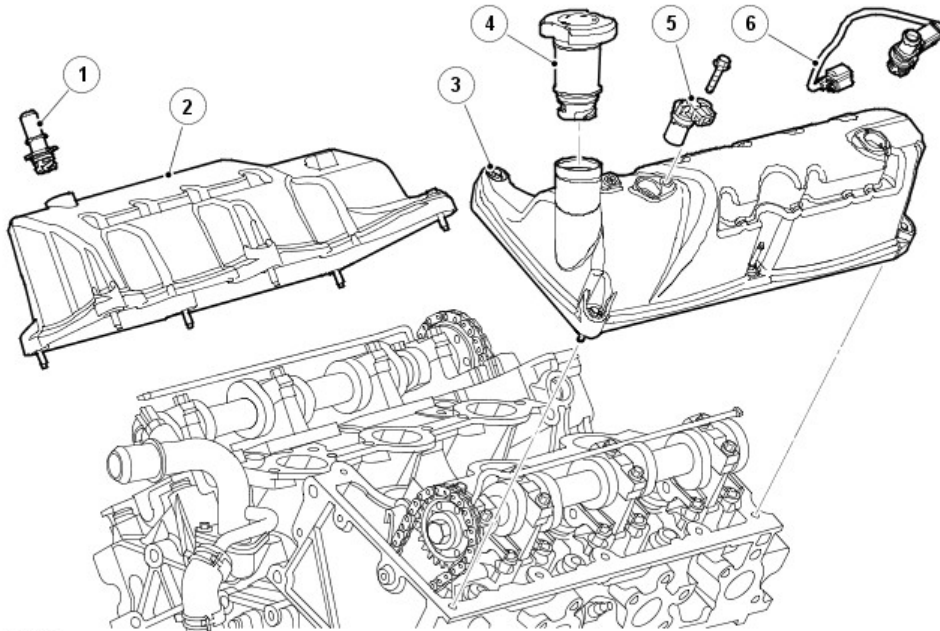
E50512

Item	Part Number	Description
1	-	Fuel rail
2	-	Injector
3	-	Adapter

The fuel injectors are installed in each of the two fuel rails, one per cylinder head. The injectors are electromagnetic solenoid valves controlled by the ECM. Each injector nozzle locates in the cylinder head via an injector insert adapter. An 'O' ring seals each injector to the fuel rail. The fuel jets from the injectors are directed onto the back of the intake valves.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Camshaft Cover

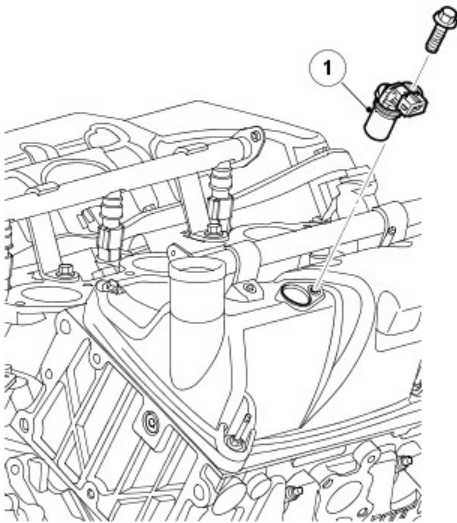


E50513

Item	Part Number	Description
1	-	Crankcase ventilation valve
2	-	RH camshaft cover
3	-	LH camshaft cover
4	-	Oil filler cap and extension
5	-	Camshaft Position (CMP) sensor
6	-	Electrically heated positive crankcase ventilation valve

The camshaft covers are manufactured from thermo-plastic. The LH cover incorporates a hole, located directly above the camshaft reluctor, for the camshaft position sensor. The LH cover also incorporates the engine oil filler aperture.

Camshaft Position (CMP) Sensor



E50514

Item	Part Number	Description
1	-	CMP sensor

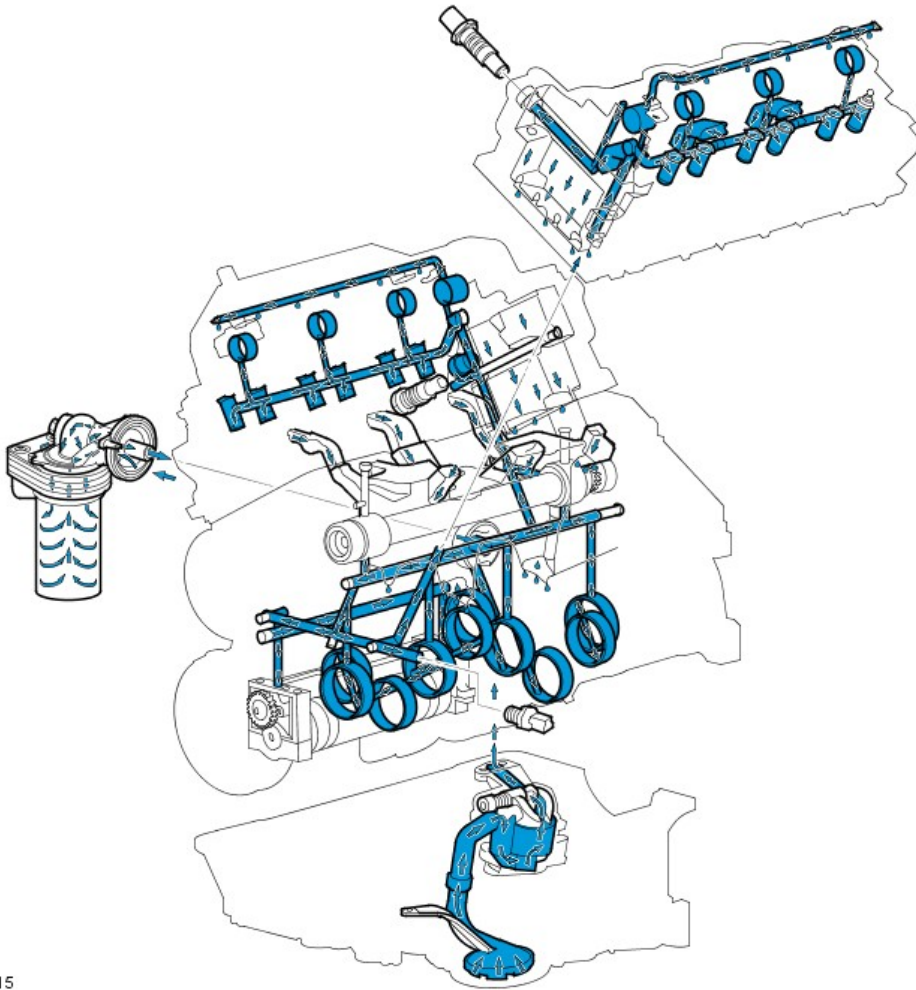
The CMP sensor is installed at the front of the LH camshaft cover. It is a variable reluctance sensor that provides an input to the ECM regarding the position of the camshaft.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

The reluctor for the camshaft position sensor is located at the front of the LH camshaft. A flat, machined surface near the front of each camshaft, enables the camshafts to be locked during the valve timing procedure.

LUBRICATION SYSTEM

- NOTE: Variant with oil cooler shown.



E50515

The lubrication system is of the full-flow filtration, force-fed type.

Oil is drawn, via a strainer and pick-up pipe in the sump into the jackshaft driven oil pump which has an integral pressure relief valve. The strainer in the pick-up pipe prevents any ingress of foreign particles from passing through to the inlet side of the oil pump and damaging the oil pump and restricting oil drillings. The oil pressure relief valve in the oil pump opens if the oil pressure becomes excessive and diverts oil back around the pump.

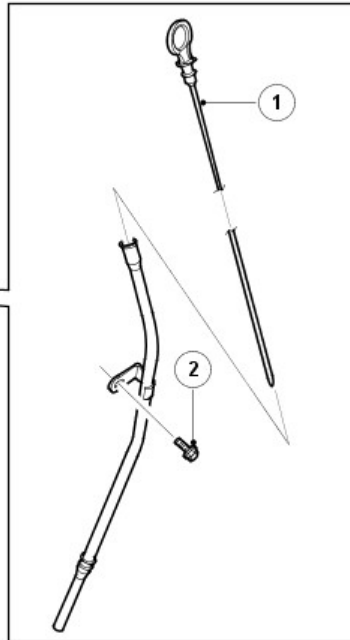
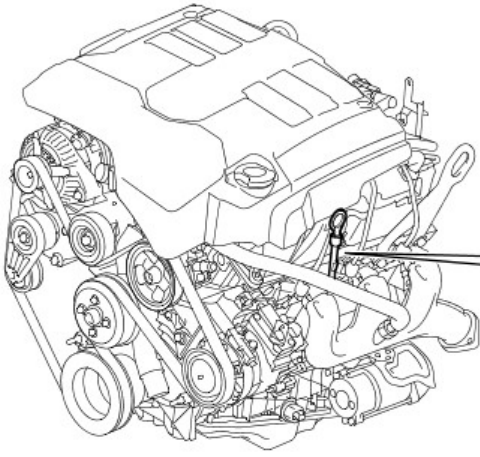
Pressurized oil is pumped through the oil filter, mounted on the oil pump housing. The lubrication system is designed so that a higher proportion of oil flow is directed to the cylinder block main oil gallery while a lower proportion of oil flow, (controlled by a restrictor in the oil filter housing), is directed to the engine oil cooler (if fitted). The remainder of the oil flow from the outlet side of the oil filter is combined with the return flow from the oil cooler (if fitted) before being passed into the cylinder block main oil gallery.

The main oil gallery has drillings that direct the oil to each cylinder head and the main bearings. Cross drillings in the crankshaft main bearings carry the oil to the connecting rod big-end bearings. Oil galleries in the cylinder head carry the oil to the camshafts and the hydraulic lash adjusters.

The oil pressure switch is located in the cylinder block to sense the oil pressure level before the oil flow enters the main gallery in the cylinder block. A warning lamp in the instrument cluster is illuminated if low oil pressure is detected.

Oil at reduced pressure is directed to each cylinder bank via two restrictors in the cylinder block/cylinder head locating dowels, one at the front on the LH bank and the other at the rear on the RH bank. Oil then passes through a drilling in the cylinder head to the camshaft carrier, where it is directed via separate galleries to the camshaft bearings and hydraulic tappet housings. Return oil from the cylinder head drains into the sump via the cylinder head bolt passages.

Oil Level Gauge

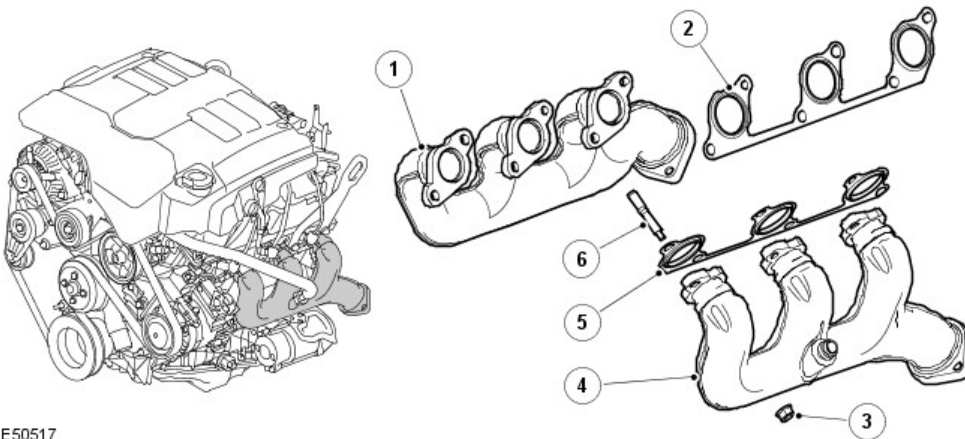


E50516

Item	Part Number	Description
1	-	Oil level gauge
2	-	Oil level gauge tube

The oil level gauge locates along the LH side of the cylinder block, supported in a tube installed in the sump. Two holes in the end of the gauge indicate the minimum and maximum oil levels. There is a difference of approximately 1.5 litres (1.58 US quart) between the two levels.

EXHAUST MANIFOLD



E50517

The dual wall stainless steel exhaust manifolds are unique for each cylinder bank.

The exhaust manifolds are sealed to the cylinder heads via metal gaskets.

Engine - V6 4.0L Petrol - Engine

Diagnosis and Testing


For additional information.

REFER to: [Engine - V6 4.0L Petrol](#) (303-00 Engine System - General Information, Diagnosis and Testing).

Engine - V6 4.0L Petrol - Engine Oil Draining and Filling

General Procedures

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

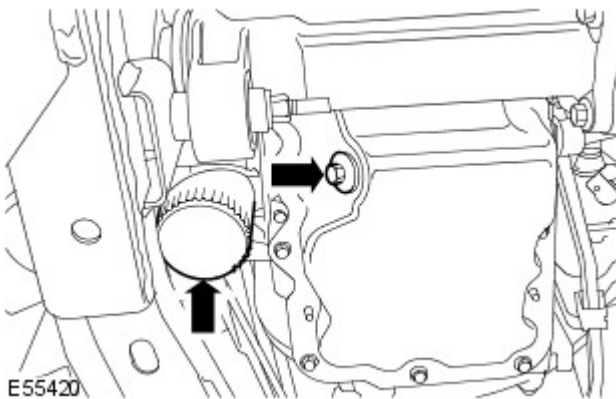
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

4. Remove the oil pan drain plug.
 - Position a container to collect the fluid.
 - Discard the oil drain plug seal.

5. Remove the oil filter.
 - Position a container to collect the fluid.
 - Discard the oil filter.



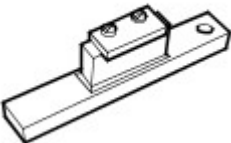
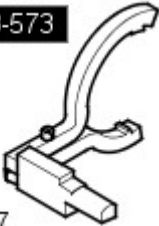





6. To install, reverse the removal procedure.
 - Lubricate the oil filter seal with clean engine oil and tighten to 18 Nm.
 - Install a new seal.
 - Tighten the drain plug to 37 Nm.

7. Fill the engine with oil.

8. Check and top-up the engine oil.

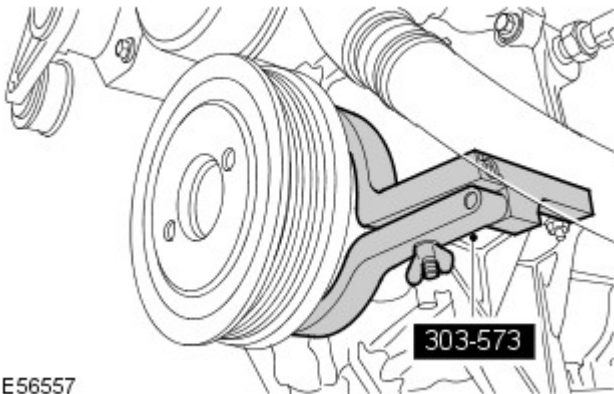
Engine - V6 4.0L Petrol - Camshaft Timing

General Procedures

Special Tool(s)	
<p>303-1146</p>  <p>E56552</p>	<p>Camshaft timing checking tool</p> <p>303-1146</p>
<p>303-573</p>  <p>E54427</p>	<p>Crankshaft TDC timing/locking tool</p> <p>303-573</p>
<p>303-575</p>  <p>E56553</p>	<p>Camshaft Bolt Tool</p> <p>303-575</p>
<p>303-565</p>  <p>E56554</p>	<p>Camshaft Bolt Socket</p> <p>303-565</p>
<p>303-576</p>  <p>E56555</p>	<p>Camshaft locking tool adaptor</p> <p>303-576</p>
<p>303-597-01</p>  <p>E56556</p>	<p>Camshaft sprocket adjusting/locking tool</p> <p>303-597-01</p>
<p>303-571</p>  <p>E56551</p>	<p>Camshaft timing chain tensioning tool</p> <p>303-571</p>

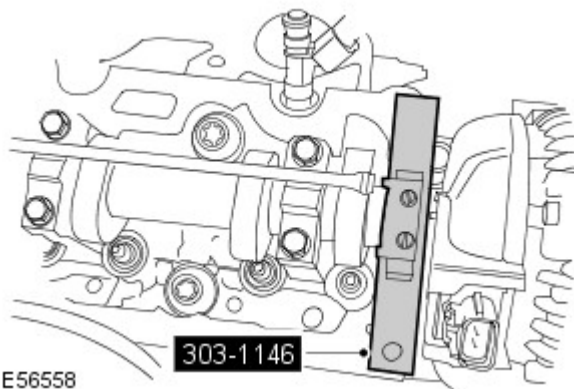
1. Check the camshaft timing.

2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove both valve covers.
4. Rotate the crankshaft clockwise, until number one cylinder is on TDC. Check the camshaft lobes are on the back of the cam.
5. Lock the crankshaft.
 - Install the special tool.
 - Tighten the screw.



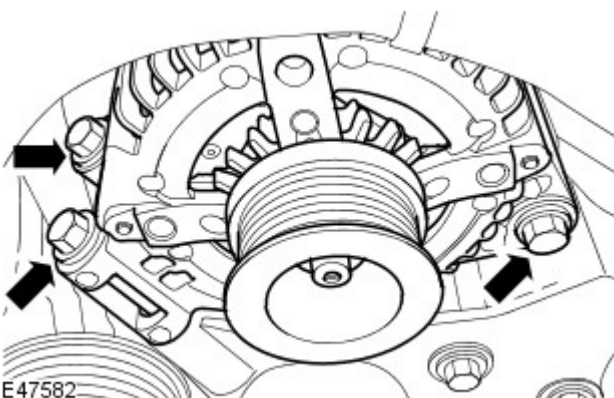
E56557

6. Install the special tool to the slot in the camshaft, the base of the special tool must remain in contact with the cylinder head. If the special tool can be passed from one side of the cylinder head to the other without resistance then the camshaft is correctly timed. Repeat the procedure on the other camshaft. If both camshafts are found to be correct, then no further action is required.

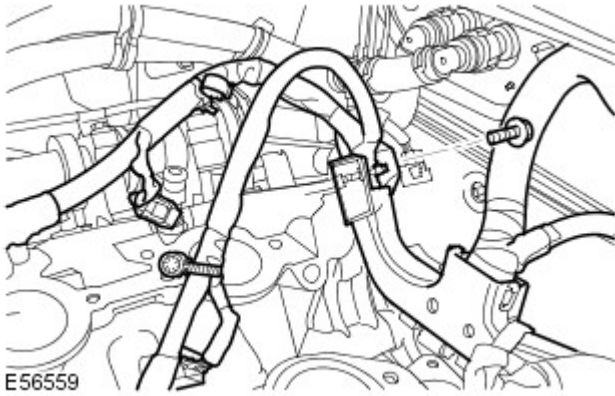


E56558

7. If the camshaft timing is found to be incorrect, proceed with the adjustment. Note both camshafts must be re-timed with the camshaft roller followers removed.
8. Remove the camshaft roller followers.
For additional information, refer to: [Camshaft Roller Follower](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
9. Position the generator aside for access.
 - Remove the 3 bolts.

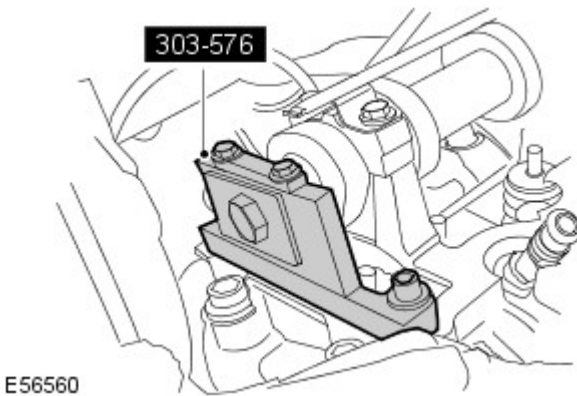


E47582



10. Remove the RH cylinder head harness carrier bolt.

- Position the harness carrier aside for access.

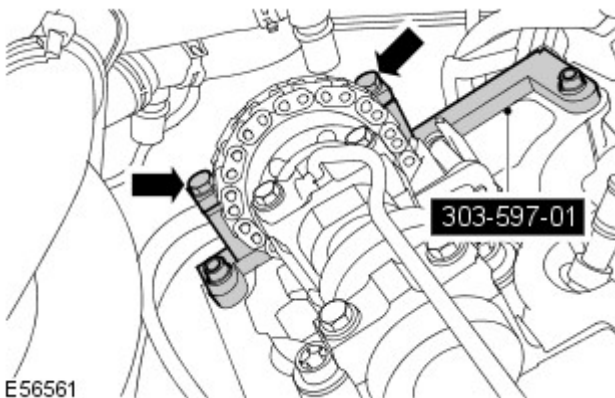


11. **⚠ CAUTION:** Damage to the camshaft will occur if the alignment tool is used to release the camshaft sprocket bolt.

- NOTE: The camshaft timing slot is off center. Correctly timed the slot will be horizontal and below the center line.

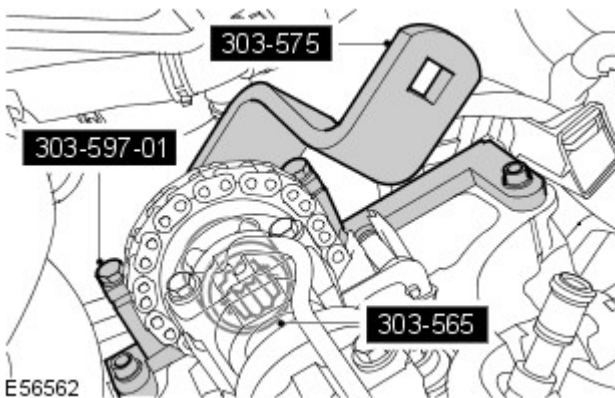
Install the camshaft alignment special tool.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Lock the camshaft, tighten the special tool bolt to 45 Nm (33 lb.ft).



12. Install the special tool to the RH cylinder head.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Tighten the saddle clamp bolts to 10 Nm (7 lb.ft).

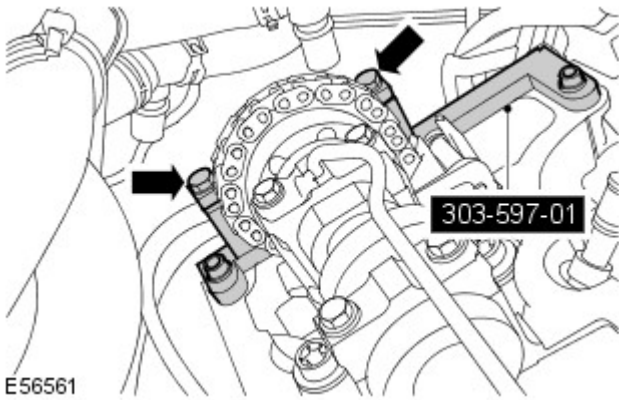



13. **⚠ CAUTION:** The RH camshaft sprocket bolt has a left hand thread.

Using the special tool, loosen the RH camshaft sprocket bolt.

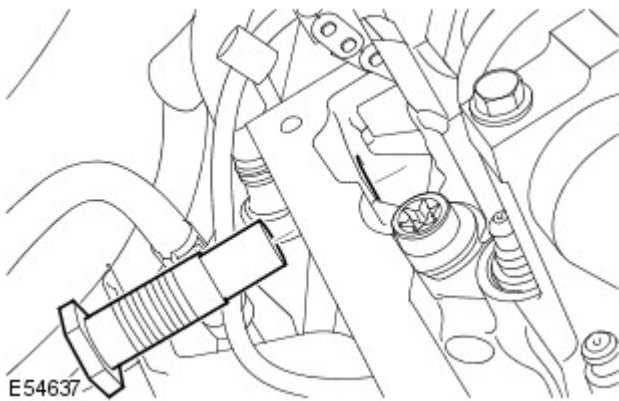
- Remove and discard the bolt.

14. Loosen the special tool saddle clamp bolts.



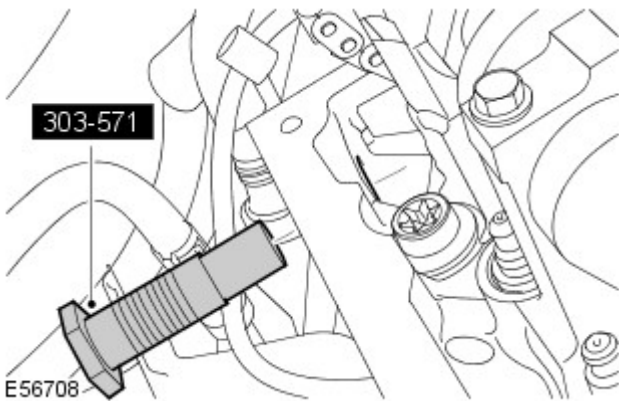
15.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the RH hydraulic timing chain tensioner.

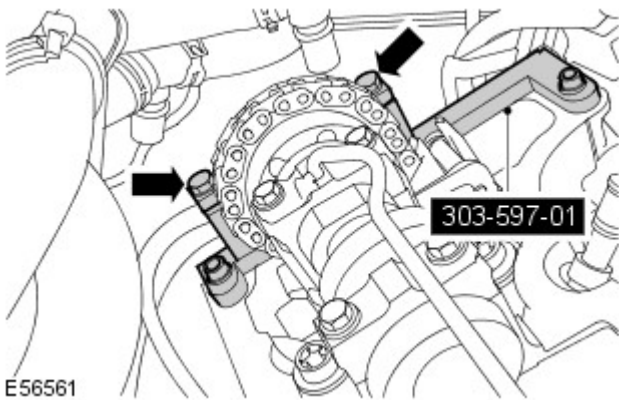


16. Install the special tool.

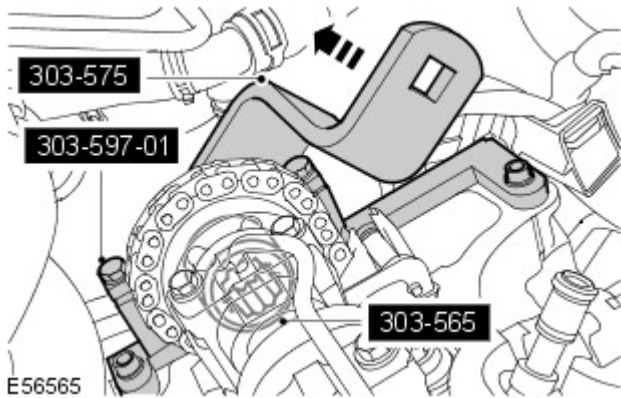
- Clean the component mating faces.



17. Tighten the saddle clamp bolts to 10 Nm (7 lb.ft).



18. Using the special tool, tighten the camshaft sprocket bolt to 20 Nm (15 lb.ft), then a further 100 degrees.




19. Remove the special tools.
20. Install the RH hydraulic timing chain tensioner.
- Install a new seal.
 - Clean the component mating faces.
 - Tighten the tensioner to 44 Nm (32 lb.ft).

21. NOTE: If either camshaft is disturbed, both camshafts MUST be retimed.

- NOTE: The LH camshaft sprocket bolt has a right hand thread.

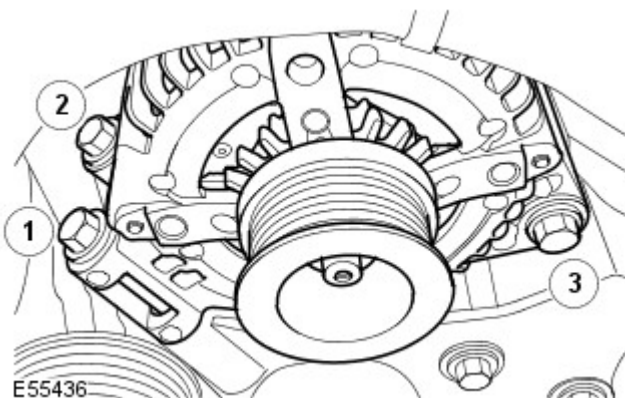
Repeat the above procedure to adjust the LH camshaft timing.

22. Install the camshaft roller followers.
For additional information, refer to: [Camshaft Roller Follower](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

23.  CAUTION: Tighten the bolts in the sequence shown.

Install the generator.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).



24. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Camshaft RH

In-vehicle Repair

Removal

- NOTE: Removal of the LH camshaft is similar to this procedure.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Refer to valve timing check and adjust.
For additional information, refer to: [Camshaft Timing](#) (303-01, In-vehicle Repair).

3. Remove the camshaft sprocket bolt.

- Position the sprocket and chain aside.

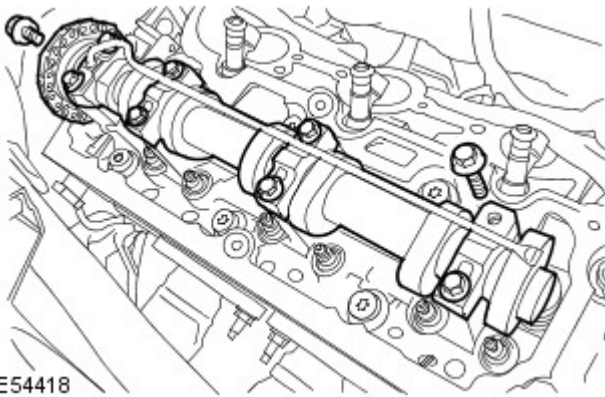
4. NOTE: Remove the camshaft bearing caps evenly and in stages.

- NOTE: Note the fitted position.

Remove the camshaft bearing caps.

- Remove the 8 bolts.
- Collect the camshaft oil supply line.

5. Remove the camshaft.



Installation

1. Install the camshaft.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. NOTE: Note the fitted position.

Install the camshaft bearing caps.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

3. NOTE: After installing the bolts check the camshaft is free to rotate.

Install the camshaft oil supply line.

- Thoroughly clean and inspect the oil supply line.
- Prime the oil supply line with clean engine oil.
- Working in a diagonal sequence, evenly and progressively tighten the bolts in 2 stages.
- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the bolts to 16 Nm (12 lb.ft).

4. Install the camshaft sprocket bolt.

- Install the bolt, but do not tighten fully at this stage.

5. Adjust the valve timing.

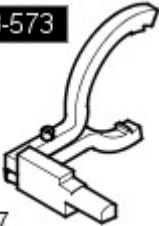
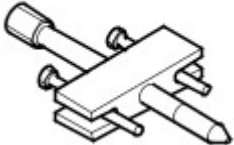


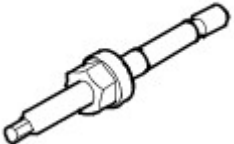
For additional information, refer to: Camshaft Timing (303-01, In-vehicle Repair).

6. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

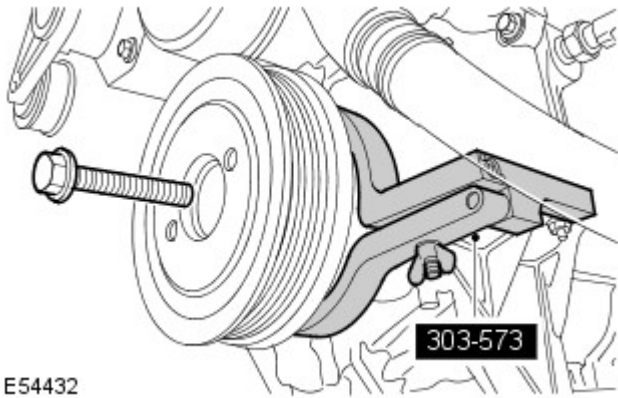
Engine - V6 4.0L Petrol - Crankshaft Pulley

In-vehicle Repair

Special Tool(s)	
 <p>303-573</p> <p>E54427</p>	<p>Crankshaft TDC timing/locking tool</p> <p>303-573</p>
 <p>303-1149</p> <p>E54428</p>	<p>Remover crankshaft damper pulley</p> <p>303-1049</p>
 <p>303-107</p> <p>E54429</p>	<p>Remover oil seal front cover</p> <p>303-107</p>
 <p>303-1148</p> <p>E54430</p>	<p>Installer oil seal front cover</p> <p>303-1148</p>
 <p>303-102</p> <p>E54431</p>	<p>Installer - crankshaft damper pulley</p> <p>303-102</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Using the special tool, retain the crankshaft front pulley.

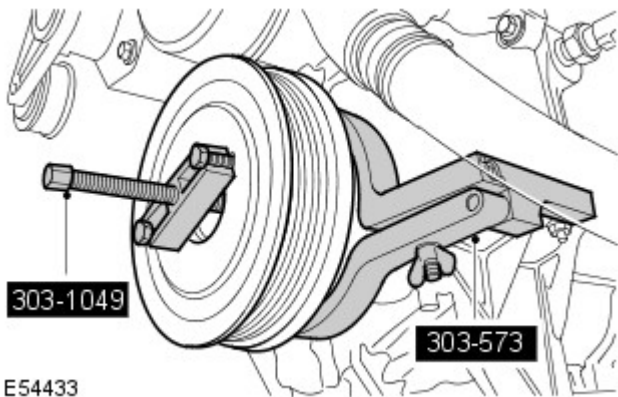


E54432

4. NOTE: The crankshaft pulley retaining bolt will be very tight.

Remove the crankshaft pulley retaining bolt.

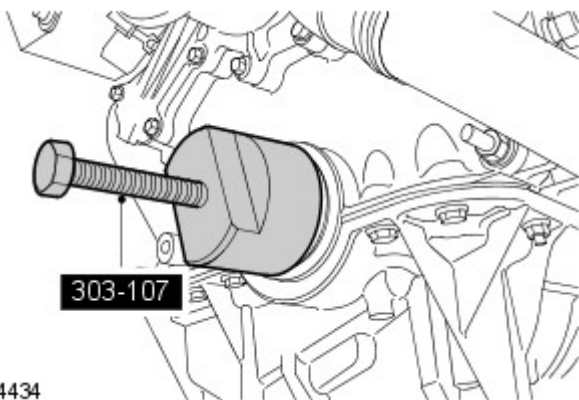
- Discard the bolt.



E54433

5. Using the special tools, remove the crankshaft pulley.

- Collect the washer.
- Remove the special tools.



E54434

6. Using the special tool, remove the crankshaft front seal.

7. Check the crankshaft damper pulley and the washer for damage.

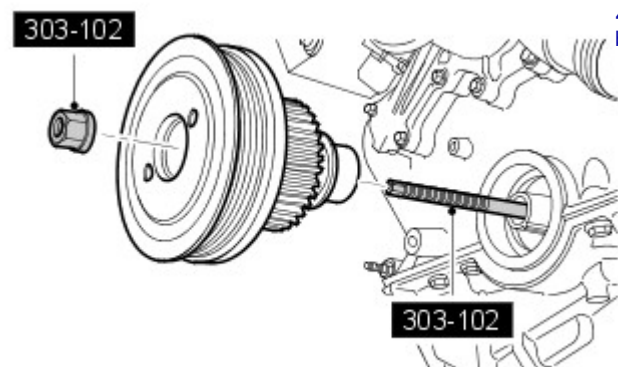
Installation

1. Clean all the crankshaft pulley mating faces.

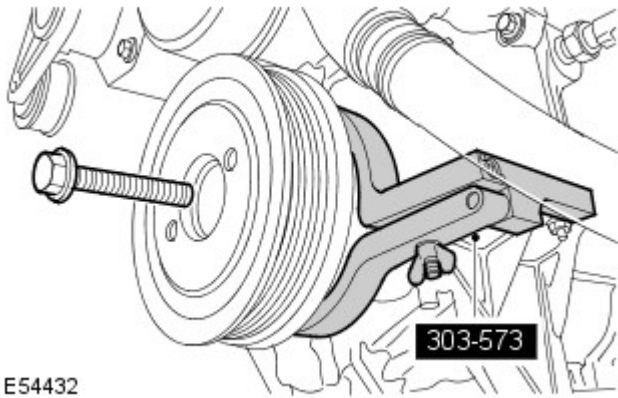
2. Using the special tool, install the crankshaft front seal.

4.  **CAUTION:** The seal with head in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

- Remove the special tool.
- Install, but do not tighten, the new crankshaft pulley bolt.



E54436



5. Tighten the crankshaft pulley bolt.

- Install the special tool.
- Tighten the bolt to 55 Nm (40 lb.ft).
- Tighten the bolt a further 85 degrees.
- Remove the special tool.

6. Install the accessory drive belt.

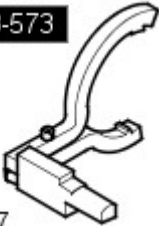
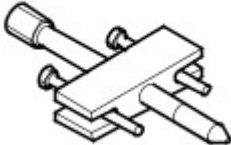


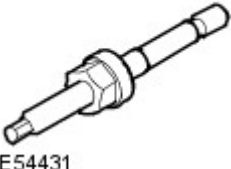
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Crankshaft Front Seal

In-vehicle Repair

Special Tool(s)	
 <p>303-573</p> <p>E54427</p>	<p>Crankshaft TDC timing/locking tool</p> <p>303-573</p>
 <p>303-1149</p> <p>E54428</p>	<p>Remover crankshaft damper pulley</p> <p>303-773</p>
 <p>303-107</p> <p>E54429</p>	<p>Remover oil seal front cover</p> <p>303-107</p>
 <p>303-1148</p> <p>E54430</p>	<p>Installer oil seal front cover</p> <p>303-1148</p>
 <p>303-102</p> <p>E54431</p>	<p>Installer crankshaft damper pulley</p> <p>303-102</p>

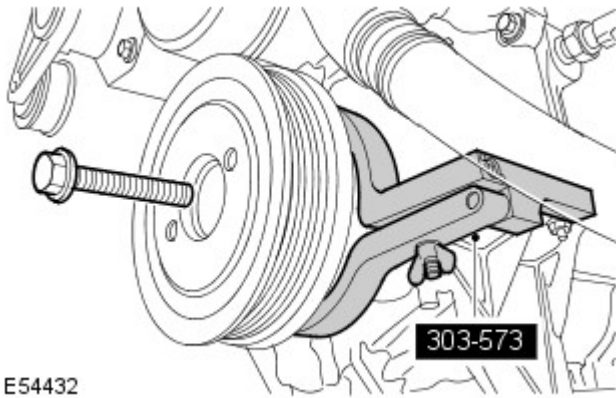
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Using the special tool, retain the crankshaft front pulley.

4. NOTE: The crankshaft pulley retaining bolt will be very tight.

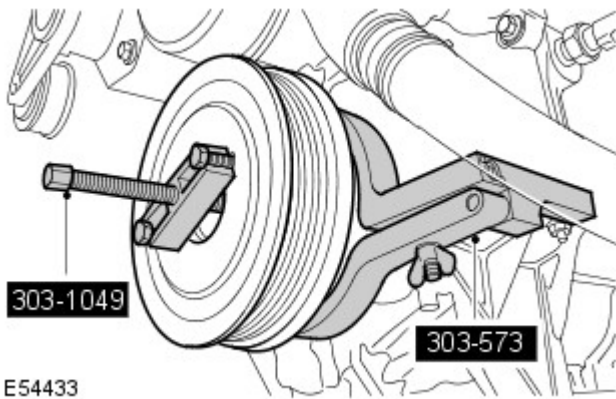
Remove the crankshaft pulley retaining bolt.

- Discard the bolt.



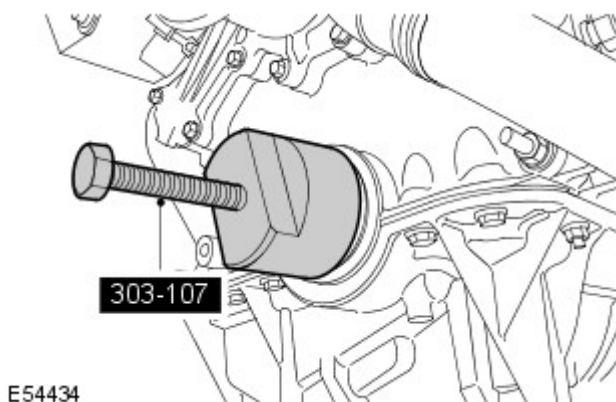
5. Using the special tools, remove the crankshaft pulley.

- Collect the washer.



6. Remove the special tools from the crankshaft pulley.

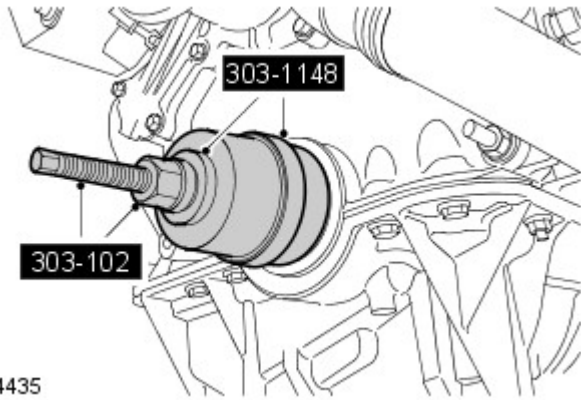
7. Using the special tool, remove the crankshaft front seal.



8. Check the crankshaft damper pulley and the washer for damage.

Installation

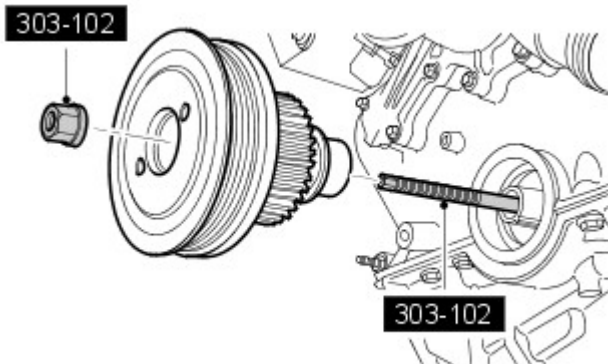
1. Clean all the crankshaft pulley mating faces.



E54435

2. Using the special tool, install the crankshaft front seal.

- Lubricate the seal with clean engine oil.



E54436

3. Using the special tool, install the crankshaft pulley.

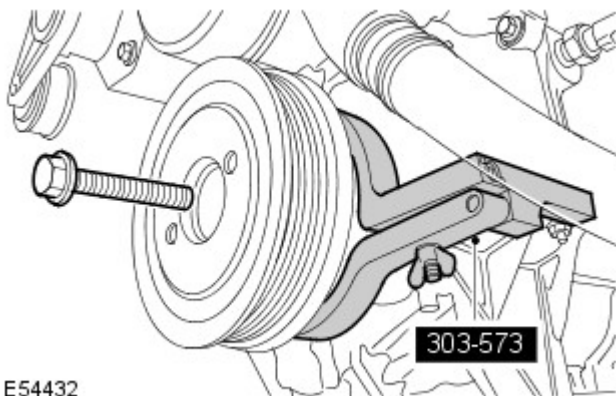
- Lubricate the seal with clean engine oil.
- Remove the special tool.

4.  **CAUTION:** The screw thread in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

Install, but do not tighten, a new crankshaft pulley bolt.

5. Tighten the crankshaft pulley bolt.

- Install the special tool.
- Tighten the bolt to 45 Nm (33 lb.ft).
- Tighten the bolt a further 85 degrees.
- Remove the special tool.



E54432

6. Install the accessory drive belt.





For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Engine - V6 4.0L Petrol - Crankshaft Rear Seal

In-vehicle Repair

Special Tool(s)	
 <p>303-903 E50940</p>	<p>Oil seal remover 303-903 (LRT-12-092)</p>
 <p>303-527 E55109</p>	<p>Crankshaft rear oil seal installer 303-527</p>
 <p>303-525 E55110</p>	<p>Crankshaft rear oil seal installer 303-525</p>
 <p>303-579 E55111</p>	<p>Crankshaft rear oil seal installer 303-579</p>

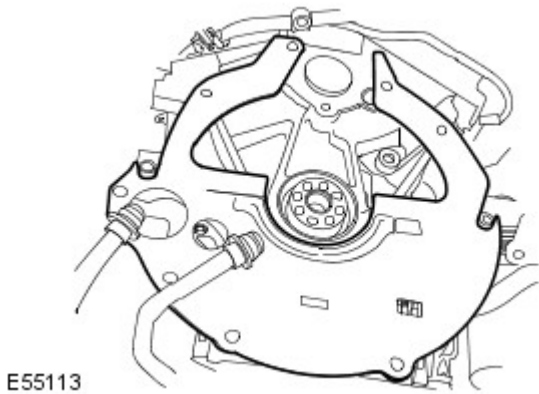
Removal


- NOTE: The seal installation tools are available individually or as a set 303-S524

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

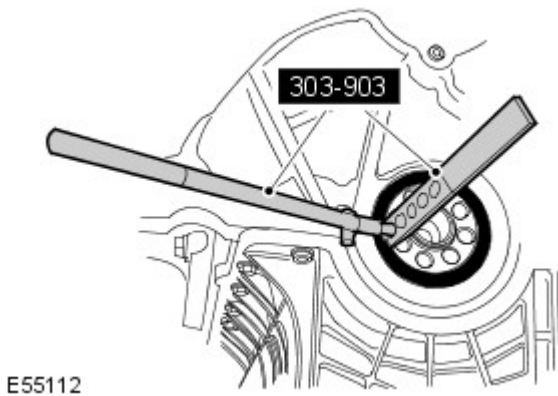
Raise and support the vehicle.
3. Remove the torque converter flexplate.
For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

4. Remove the closing plate.



5.  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.


Using the special tools, remove and discard the crankshaft rear oil seal.



Installation

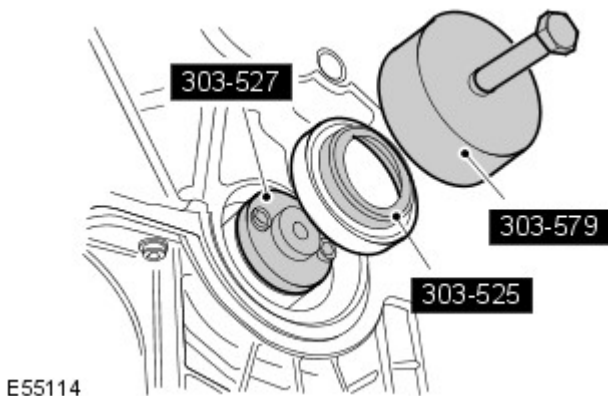
1. Install the special tool, 303-527.

- Make sure the components are clean and dry.
- Tighten the 2 Allen screws.

2.  **CAUTION:** Make sure the seal is installed parallel

Using the special tool, install the crankshaft rear oil seal.

- Lubricate the seal with clean engine oil.
- Partially install the crankshaft rear oil seal.
- Tighten the bolt to fully install the seal.



3. Install the closing plate.

- Clean the components.

4. Install the torque converter flexplate.

For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).


5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


6. Check and top-up the engine oil.

Engine - V6 4.0L Petrol - Cylinder Block Cradle

In-vehicle Repair

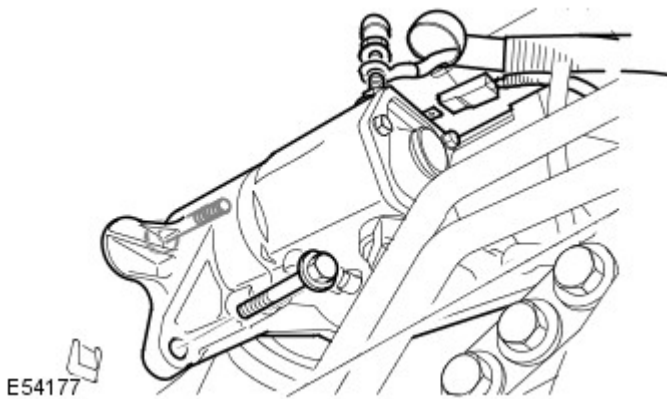
Special Tool(s)	
 <p>303-596</p> <p>E54344</p>	<p>Cylinder block cradle insert adjustment tool</p> <p>303-596</p>

Removal

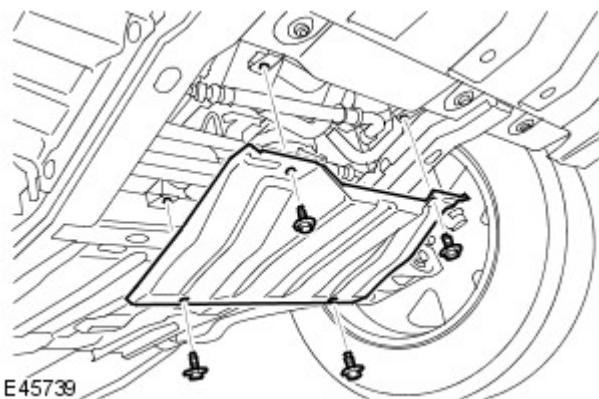
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the RH front wheel and tire.
4. Position the starter motor to one side.
 - Remove the 2 bolts.
 - Remove the terminal upper cover.
 - Remove the terminal lower cover.
 - Remove the nut.
 - Disconnect the 2 electrical connectors.



5. Remove the front axle tube.
For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).
6. Remove the oil pan.
For additional information, refer to: [Oil Pan](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
7. Remove the front stabilizer bar.
8. Remove the radiator access panel.
 - Remove the 4 bolts.






9. Release the engine oil cooler lines.

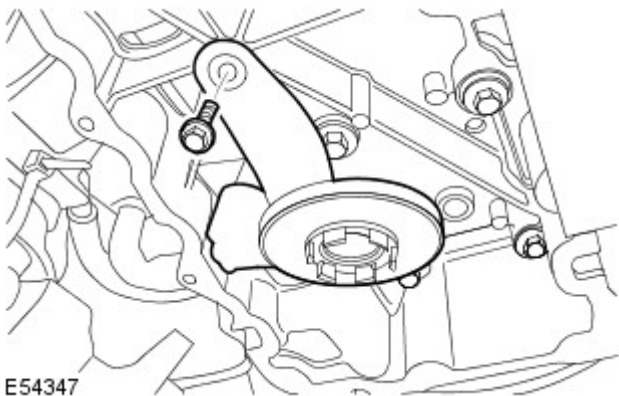
- Remove the bolt.
- Remove the nut.
- Tie the lines aside.



10.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the oil temperature sensor.

- Disconnect the electrical connector.
- Remove and discard the O-ring seal.



11. Remove the oil strainer pick-up assembly.

- Remove the bolt.

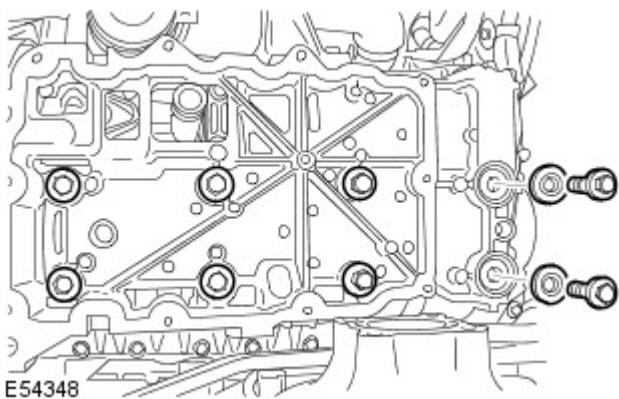
12. Remove the dipstick.

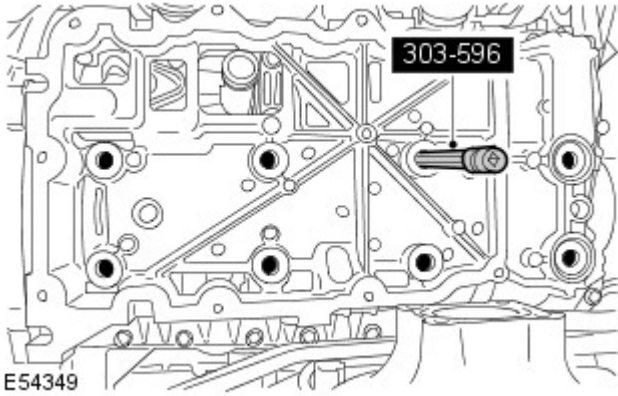
13. Using suitable ties, secure the transmission fluid lines and the wiring harness clear of the cylinder block cradle flange.


14. **NOTE:** Note the fitted position of the 2 sealing washers.

Remove the 8 cylinder block cradle bolts.

- Remove and discard the 2 sealing washers.



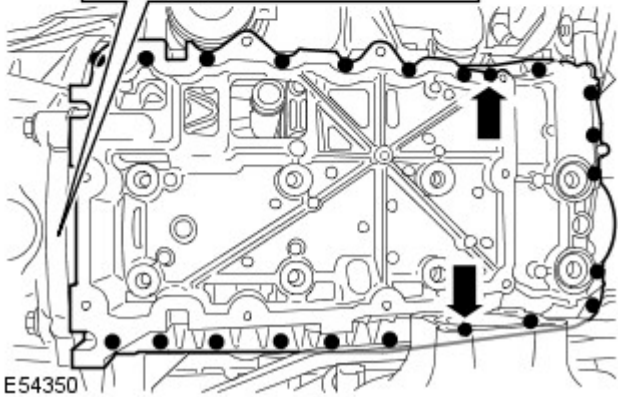
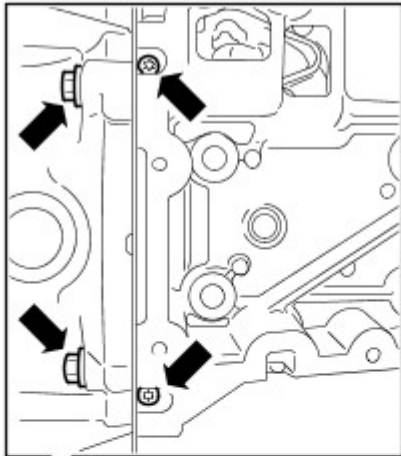


15.  **CAUTION:** Failure to loosen the set screws may result in damage to the cylinder block cradle.

Using the special tool, loosen the 8 cylinder block cradle set screws.

16. Remove the cylinder block cradle.

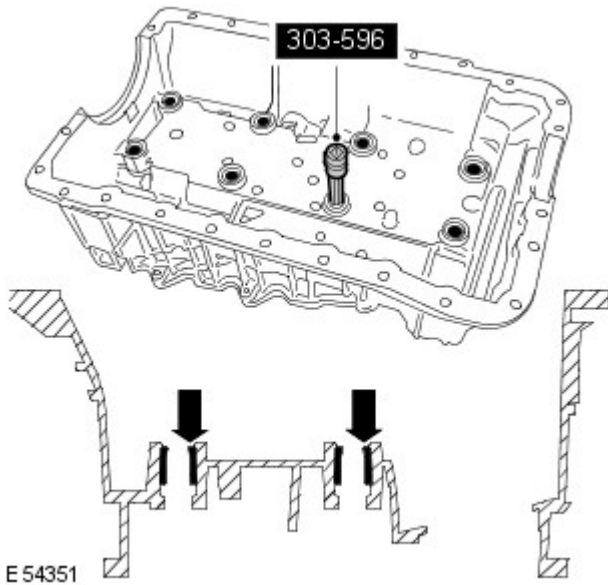
- Remove the 2 rear bolts.
- Remove the 2 Torx screws.
- Remove the 2 nuts.
- Remove the 20 bolts.
- Remove and discard the gasket.



Installation

1. Clean the cylinder block cradle.

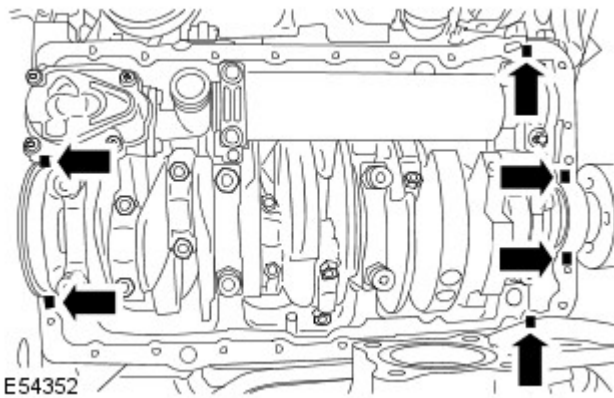
- Clean the component mating faces.
- Remove the sealant from the main bearing cap cavities.



2. **⚠ CAUTION:** Failure to loosen the set screws may result in damage to the cylinder block cradle.

Position the cylinder block cradle set screws.

- Using the special tool, adjust the set screws until they are below the cylinder block cradle boss face.



3. **NOTE:** The cradle must be installed within 20 minutes of the sealant application.

Apply sealant to the cylinder block cradle.

- Apply sealant to the 6 places shown.

4. **⚠ CAUTION:** Make sure the gasket is installed correctly.

Install the cylinder block cradle.

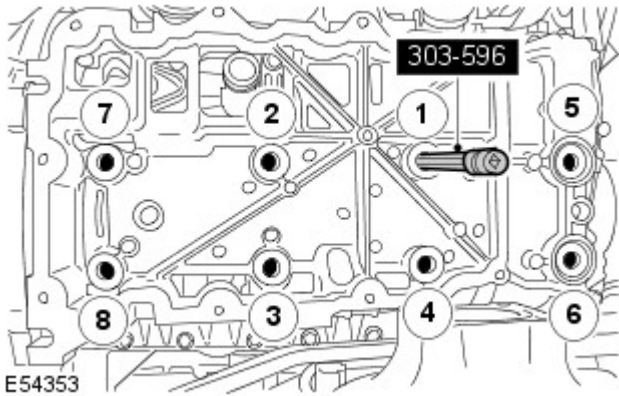
- Install a new gasket.
- Install, then evenly and progressively lightly tighten the outer bolts, nuts and Torx screws.

5. Align the cylinder block cradle to the cylinder block rear face.

- Install and tighten the 2 rear bolts.
- Loosen the 2 rear bolts.
- Lightly tighten the 2 rear bolts.

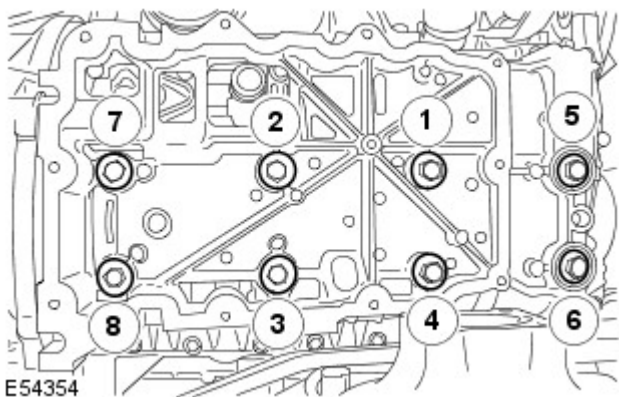
6. Evenly and progressively, tighten the outer bolts, nuts and Torx screws to 10 Nm (7 lb.ft).

7. Tighten the 2 rear bolts to 43 Nm (32 lb.ft).



8. Using the special tool, tighten the 8 cylinder block cradle set screws.

- Tighten the set screws in the sequence shown to 7 Nm (5 lb.ft).



9. NOTE: The sealing washers are fitted to the silver coloured bolts. The silver coloured bolts are fitted in the 2 forward holes.

Install the 8 cylinder block cradle bolts and tighten in 2 stages.

- Install 2 new sealing washers.
- Tighten the bolts in sequence to 15 Nm (11 lb.ft).
- Tighten the bolts in sequence to 34 Nm (25 lb.ft).

10. NOTE: Lubricate new seals with clean engine oil.

Install the oil strainer pick-up assembly.

- Clean the components.
- Tighten the bolt to 10 Nm (7 lb.ft).

11. Install the oil pan.

For additional information, refer to: [Oil Pan](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

12. Install the dipstick.

- Clean the component.

13. NOTE: Lubricate new seals with clean engine oil.

Install the oil temperature sensor.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the oil temperature sensor to 20 Nm (15 lb.ft).
- Connect the electrical connector.

14. Position the engine oil cooler lines.

- Tighten the bolt and the nut to 25 Nm (18 lb.ft).

15. Install the radiator access panel.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).

16. Install the front stabilizer bar.

17. Install the front axle tube.

For additional information, refer to: [Axle Tube](#) (205-03 Front Drive Axle/Differential, In-vehicle Repair).

18. Install the starter motor.

- Clean the component mating faces.

- Connect the electrical connectors.
- Tighten the nut to 10 Nm (7 lb.ft).
- Install the terminal lower cover.
- Install the terminal upper cover.
- Tighten the bolts to 45 Nm (33 lb.ft).

19. Install the RH front wheel and tire.

20. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

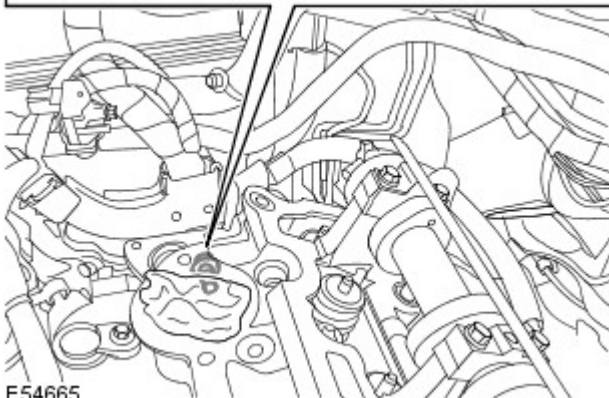
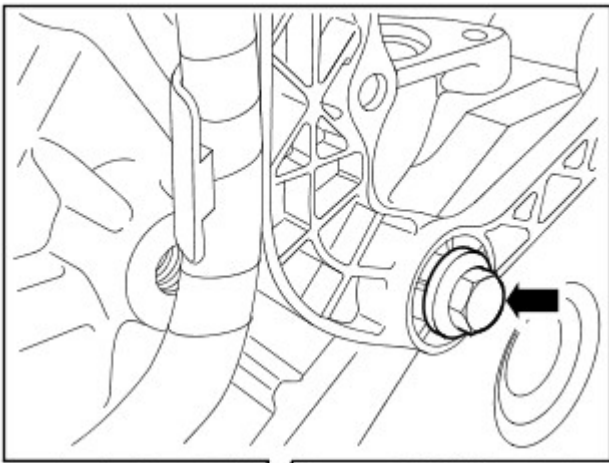
Engine - V6 4.0L Petrol - Cylinder Head LH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the coolant.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
3. Refer to camshaft timing. For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Remove the exhaust manifold.
For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Release the harness bridge for access.

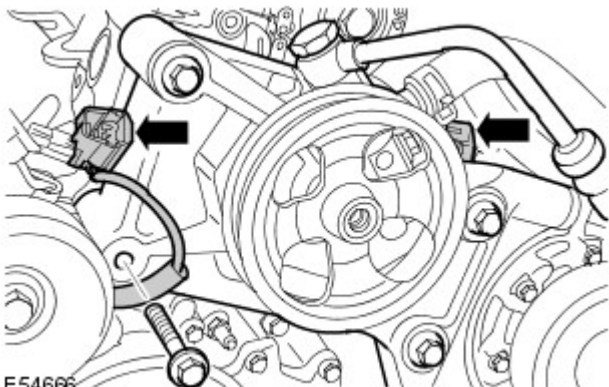
- Remove the bolt.



E54665

6. Position the A/C compressor mounting bracket assembly aside.

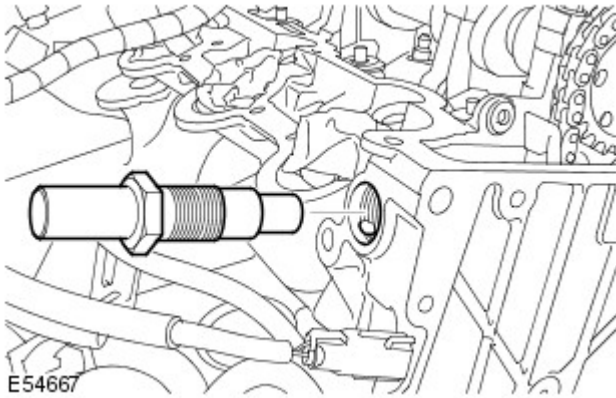
- Remove the 4 bolts.
- Release the knock sensor electrical connector retaining clips.
- Tie the bracket aside.



E54666

7. Remove the LH hydraulic timing chain tensioner.

- Clean the component mating faces.

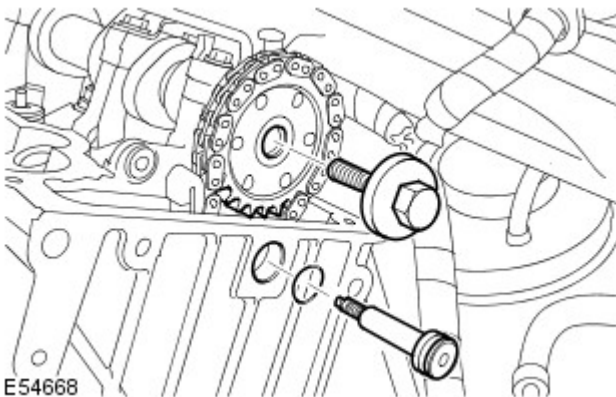


8. Remove the Torx bolt retaining the chain guide.

- Remove and discard the O-ring seal.

9. Remove the camshaft sprocket bolt.

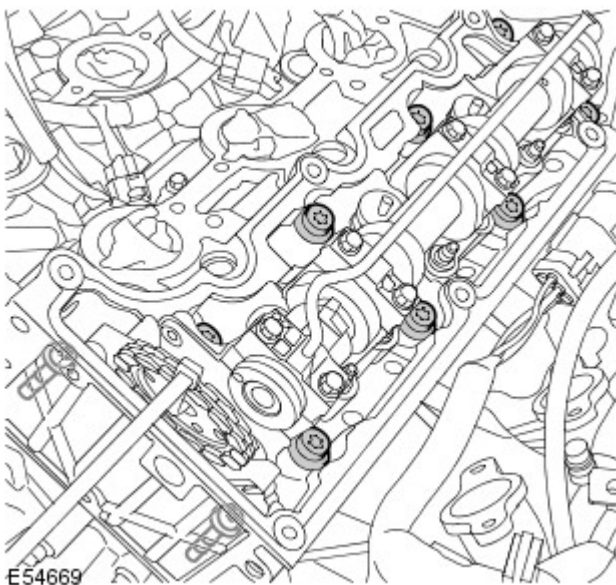
- Remove the camshaft sprocket.
- Secure the chain to the guide with a cable tie.

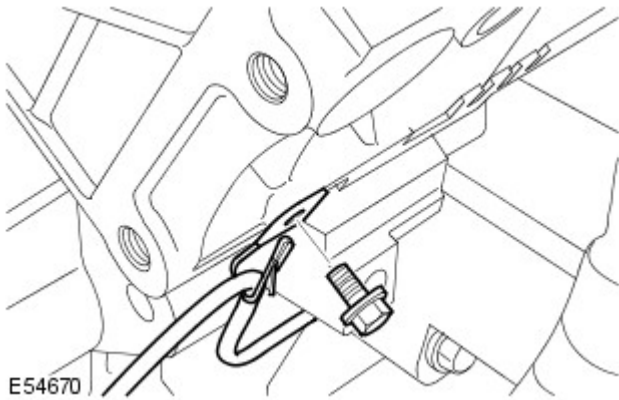


10.  **CAUTION:** Working in a diagonal sequence, progressively loosen the bolts.

Remove the 10 cylinder head bolts.

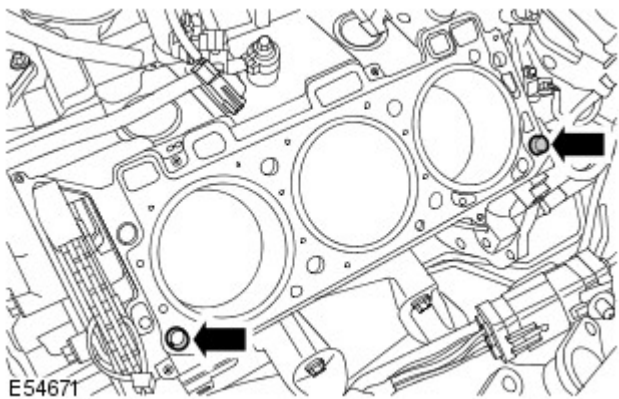
- Discard the bolts.





11. Remove the cylinder head LH assembly.

- Release the KS electrical harness clip.
- Remove the bolt.



12. Remove and discard the cylinder head gasket.

- Clean the cylinder head locating dowels.
- Clean and inspect the cylinder head and cylinder block.

13. NOTE: Remove the camshaft bearing caps evenly and in stages.

- NOTE: Note the fitted position.
- NOTE: Do not disassemble further if the component is removed for access only.

Remove the camshaft bearing caps.

- Remove the 8 bolts.
- Collect the camshaft oil supply line.

14. Remove the camshaft.

Installation

1. Install the camshaft.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. NOTE: Note the fitted position.

Install the camshaft bearing caps.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

3. NOTE: After installing the bolts check the camshaft is free to rotate.

Install the camshaft oil supply line.

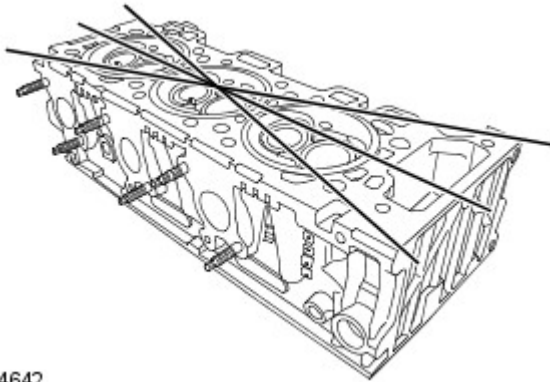
- Thoroughly clean and inspect the oil supply line.
- Prime the oil supply line with clean engine oil.
- Tighten the bolts evenly in 2 stages to the sequence shown.
- Tighten the bolts to 6 Nm (4 lb.ft).

- Tighten the bolts to 16 Nm (12 lb.ft).

4. Clean the component mating faces.

5. Check cylinder head face for distortion, across the center and from corner to corner.

For additional information, refer to: [Specifications](#) (303-01C Engine - V6 4.0L Petrol, Specifications).



E54642

6.  **CAUTION:** The head gasket must be installed over the cylinder block dowels.

Install a new cylinder head gasket.

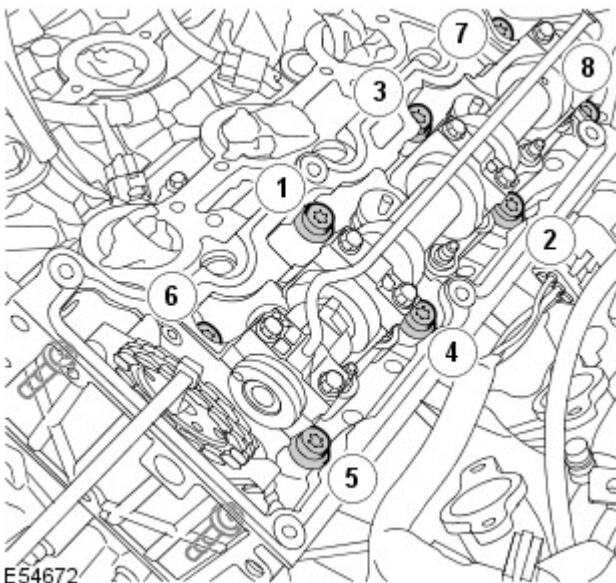
7. Install the cylinder head LH assembly.

- Install the knock sensor bracket.
- Tighten the bolt to 10 Nm (7 lb.ft).

8. **NOTE:** Tighten the bolts 1 to 8 in the sequence shown. The M12 bolts are tightened in 3 stages.

Install the cylinder head bolts.

- Lubricate the new cylinder head bolt threads with clean engine oil.
- Tighten the M12 bolts to 30 Nm (22 lb.ft), then a further 80 degrees.
- Tighten the M12 bolts a further 80 degrees.
- Tighten the M8 bolts to 35 Nm (26 lb.ft).



E54672

9. Install the exhaust manifold.

For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

10. Install the Torx bolt retaining the chain guide.

- Install a new O-ring seal.
- Tighten the bolt to 10 Nm (7 lb.ft).
- Clean the component mating faces.

11. Install the A/C compressor mounting bracket assembly.

13. ~~Adjust the cable tension.~~ For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedure) the bolts to 45 Nm (33 lb.ft).

14. Install the electrical harness bridge.

- Secure the wiring harness.
- Tighten the bolt to 45 Nm (33 lb.ft).
- Tighten the RS clip retaining bolt to 10 Nm (7 lb.ft).

15. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

16. Refill and bleed the cooling system.

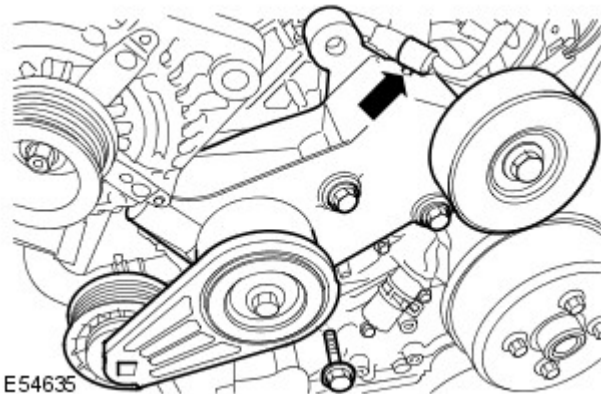
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

Engine - V6 4.0L Petrol - Cylinder Head RH

In-vehicle Repair

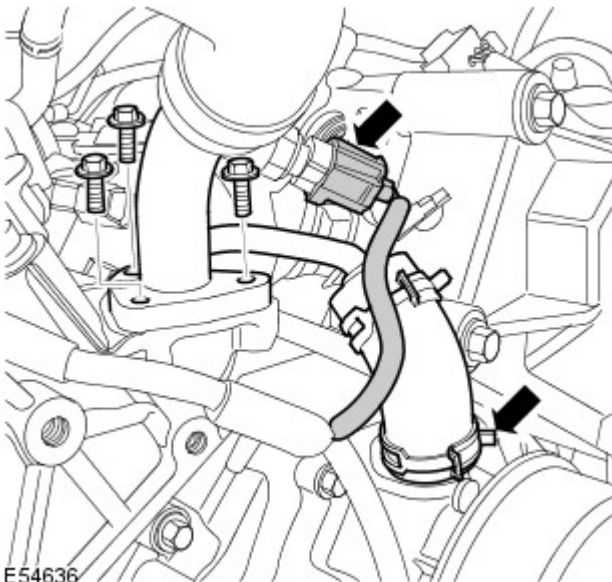
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the coolant.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
3. Refer to camshaft timing. For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Remove the exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Position the generator mounting bracket aside.



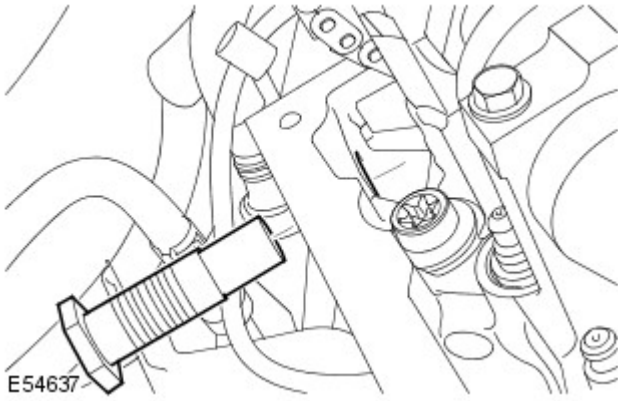
- Remove the 3 bolts.
- Release the wiring harness clip.
- Disconnect the engine coolant temperature (ECT) sensor electrical connector.

6. Remove the cylinder block coolant outlet elbow.



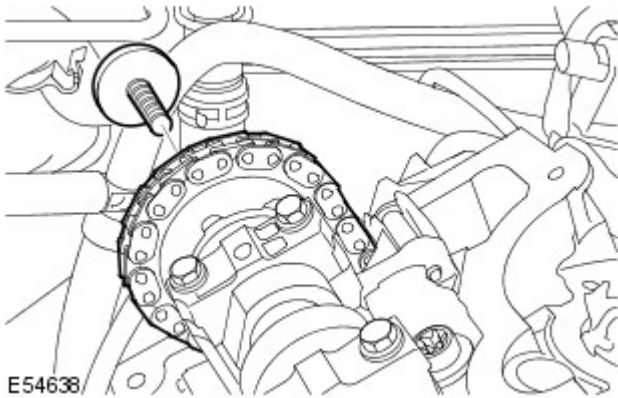
- Disconnect the engine coolant temperature (ECT) sensor electrical connector.
- Release the clip securing the coolant pump hose.
- Remove the 3 bolts.


7. Remove the RH hydraulic timing chain tensioner.



8. Remove the camshaft sprocket bolt.

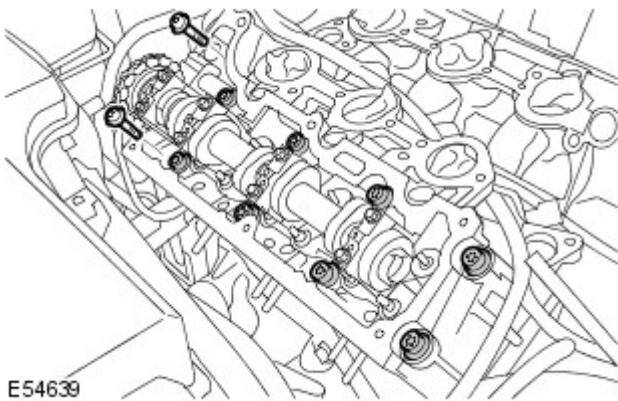
- Remove the camshaft sprocket.
- Secure the chain to the guide with a cable tie.



9.  **CAUTION:** Working in a diagonal sequence, progressively loosen the bolts.

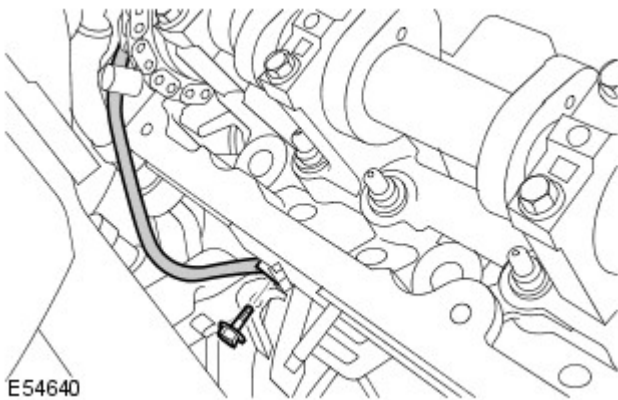
Remove the 10 cylinder head bolts.

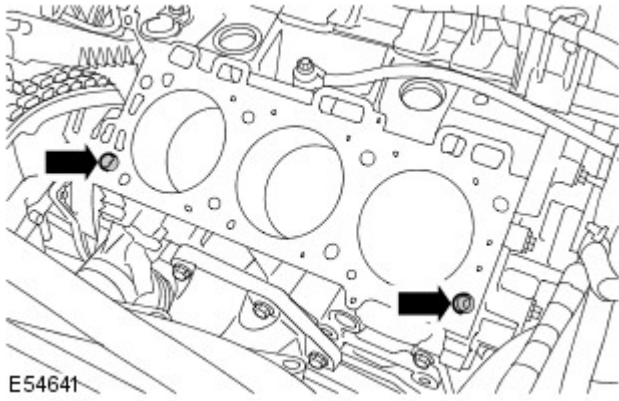
- Discard the bolts.



10. Remove the RH cylinder head assembly.

- Disconnect the cylinder head earth connector.
- Remove the bolt.





11. Remove and discard the cylinder head gasket.

- Clean the cylinder head locating dowels.
- Clean and inspect the cylinder head and cylinder block.

12. NOTE: Remove the camshaft bearing caps evenly and in stages.

- NOTE: Note the fitted position.
- NOTE: Do not disassemble further if the component is removed for access only.

Remove the camshaft bearing caps.

- Remove the 8 bolts.
- Collect the camshaft oil supply line.

13. Remove the camshaft.

Installation

1. Install the camshaft.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. NOTE: Note the fitted position.

Install the camshaft bearing caps.

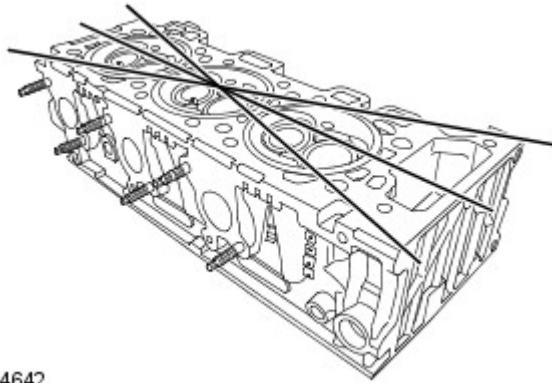
- Clean the component mating faces.
- Lubricate the components with clean engine oil.

3. NOTE: After installing the bolts check the camshaft is free to rotate.

Install the camshaft oil supply line.

- Thoroughly clean and inspect the oil supply line.
- Prime the oil supply line with clean engine oil.
- Tighten the bolts evenly in 2 stages to the sequence shown.
- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the bolts to 16 Nm (12 lb.ft).

4. Clean the component mating faces.



E54642

5. Check cylinder head face for distortion, across the center and from corner to corner.
For additional information, refer to: [Specifications](#) (303-01C Engine - V6 4.0L Petrol, Specifications).

6.  **CAUTION:** The head gasket must be installed over the cylinder block dowels.

Install a new cylinder head gasket.

7. **NOTE:** Care must be taken when installing the ground connections. The engine will fail to start on either or both banks if the ground is poor.

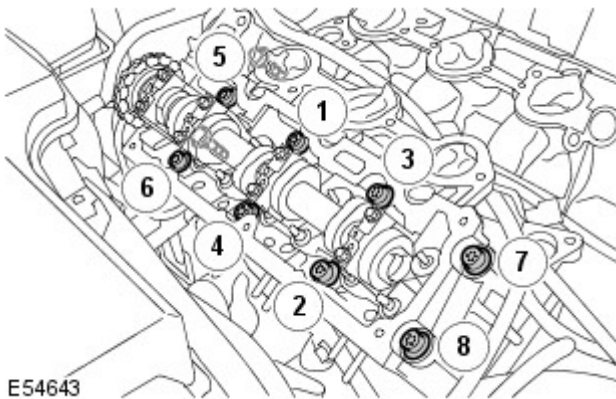
Install the cylinder head RH assembly.

- Connect the cylinder head earth ground connector.
- Tighten the bolt to 10 Nm (7 lb.ft).

8. **NOTE:** Tighten the bolts 1 to 8 in the sequence shown. The M12 bolts are tightened in 3 stages.

Install the cylinder head bolts.

- Lubricate the new cylinder head bolt threads with clean engine oil.
- Tighten the M12 bolts to 30 Nm (22 lb.ft), then a further 80 degrees.
- Tighten the M12 bolts a further 80 degrees.
- Tighten the M8 bolts to 35 Nm (26 lb.ft).



E54643

9. Install the exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

10. **NOTE:** The thread is left handed.

Install the camshaft sprocket bolt.

- Remove and discard the cable tie.
- Clean the component mating faces.
- Install and lightly tighten the camshaft sprocket bolt.

11. Install the RH hydraulic timing chain tensioner.

- Tighten the tensioner to 45 Nm (33 lb.ft).

12. Install the cylinder head coolant flange.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Secure the hose with the clip.
- Connect the ECT sensor electrical connector.

13. Install the generator mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).
- Secure the wiring harness.
- Connect the ECT sensor electrical connector.

14. Adjust the valve timing. For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).

15. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

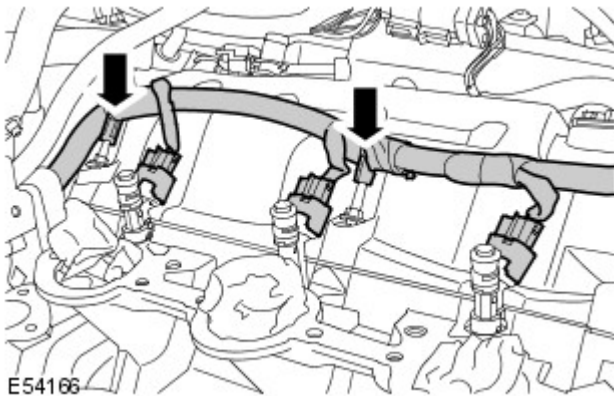
16. Refill and bleed the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

Engine - V6 4.0L Petrol - Valve Cover LH

In-vehicle Repair

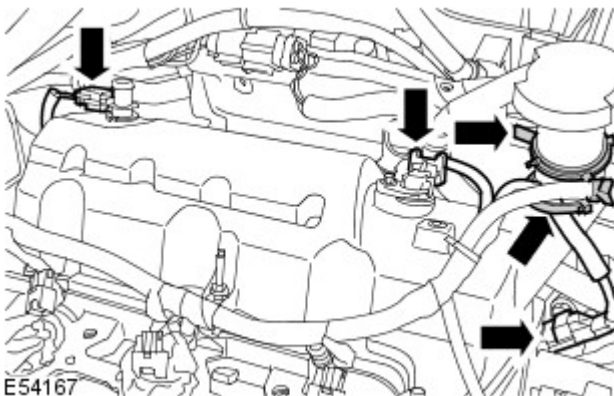
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the fuel rail.
For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).
3. Position the injector harness aside.




- Release the 2 clips.
- Disconnect the 3 fuel injector electrical connectors.

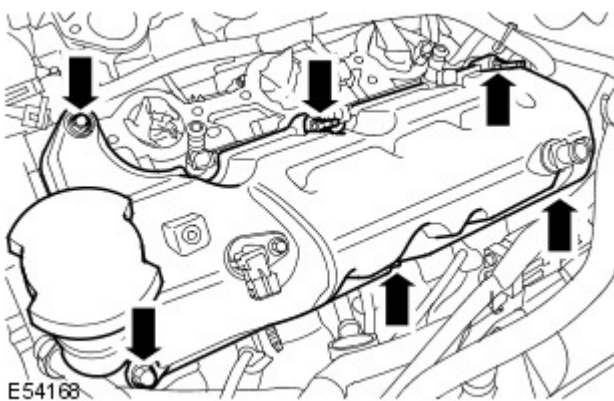
4. Disconnect the 3 electrical connectors.



- Release the harness clip from the filler neck.
- Noting the installed position of the Knock sensor electrical harness in relation to the oil filler tube, remove and discard the cable tie.

5.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the valve cover.



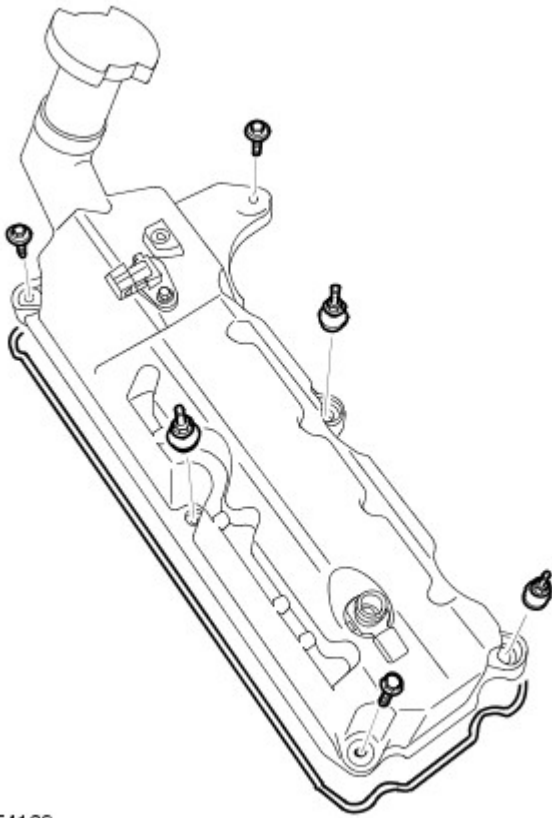
- Remove the 3 bolts.
- Remove the 3 studs.

6. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove and discard the gasket.

7. NOTE: Note the fitted position.

Remove the bolts and studs. Remove and discard the seals.



E54169

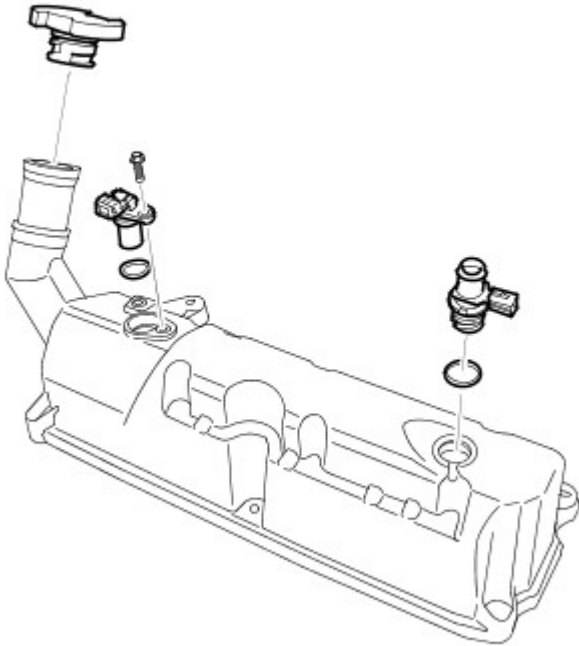
8. Remove the camshaft position (CMP) sensor.

- Remove the bolt.
- Remove and discard the O-ring seal.

9. Remove the engine breather valve.


- Remove and discard the O-ring seal.

10. Remove the oil filler cap.



E54170

Installation

1. Install the oil filler cap.
2. Install the engine breather valve.
 - Install a new O-ring seal.
3. Install the CMP sensor.
 - Install a new O-ring seal.
 - Tighten the bolt to 6 Nm (4 lb.ft).
4. Install the bolts and studs.
 - Install the new O-ring seals.
 - Install the new gasket.
5. Install the valve cover.
 - Clean the component mating faces.
 - Evenly and progressively tighten the bolts and studs, in the sequence shown, to 10 Nm (7 lb.ft).
 - Secure the electrical harness with the clip.
6.  **CAUTION:** Make sure the knock sensor electrical harness is returned to the original fitted position.

Install the injector harness.

 - Secure with the clips.
 - Connect the fuel injector electrical connectors.
 - Connect the 3 electrical connectors.
 - Install a new cable tie.
7. Install the fuel rail.

For additional information, refer to: [Fuel Rail](#) (303-04E Fuel

Charging and Controls - V6 4.0L Petrol, Removal and Installation).

- 8.** Connect the battery ground cable.

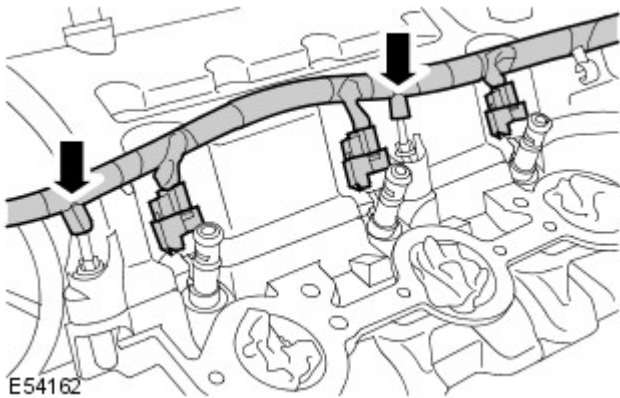
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Valve Cover RH

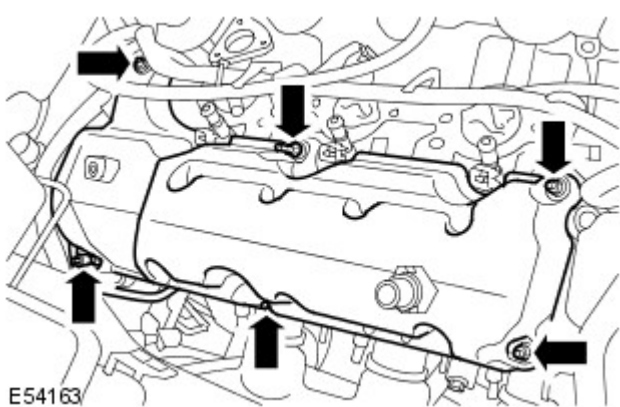
In-vehicle Repair


Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the fuel rail.
For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).
3. Position the injector harness aside.



- Release the 2 clips.
- Disconnect the 3 fuel injector electrical connectors.



4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the valve cover.

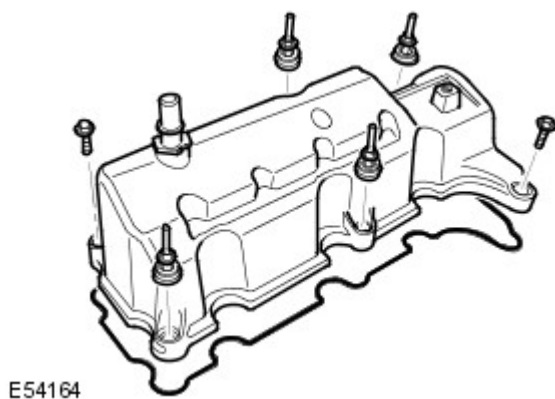
- Release the wiring harness retaining clip.
- Remove the 2 bolts.
- Remove the 4 studs.

5. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove and discard the gasket.

6. **NOTE:** Note the fitted position.

Remove the bolts and studs. Remove and discard the seals.



Installation

1. Install the bolts and studs.

- Install the new O-ring seals.

- Install the new gasket.

2. Install the valve cover.

- Clean the component mating faces.

- Evenly and progressively tighten the bolts and studs, in the sequence shown, to 10 Nm (7 lb.ft).

- Secure the electrical harness with the clip.

3. Install the injector harness.

- Secure with the clips.

- Connect the fuel injector electrical connectors.

4. Install the fuel rail.


For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).

5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Camshaft Roller Follower

In-vehicle Repair

Special Tool(s)	
	Camshaft roller follower remover/replacer
	303-581

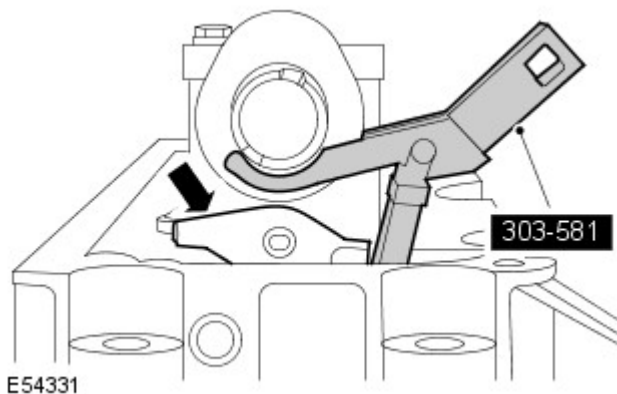
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH valve cover.
For additional information, refer to: [Valve Cover LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the RH valve cover.
For additional information, refer to: [Valve Cover RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
5. **NOTE:** Make sure the camshaft lobe is opposite the camshaft roller follower, prior to removal.

- **NOTE:** Mark each camshaft roller follower and lash adjuster. Make sure each component is returned to its original fitted position.

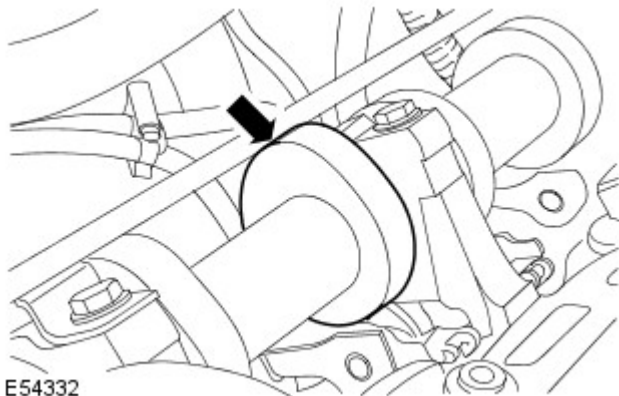
Using the special tool, remove the camshaft roller followers.

- Depress the valve spring.



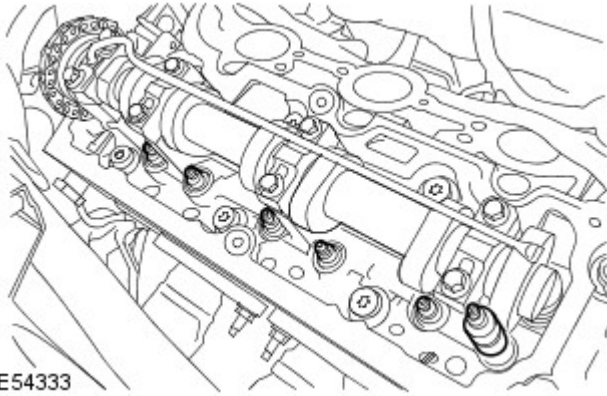
E54331

6. Rotate the engine as required to access the remaining camshaft roller followers.



E54332

7. Remove the hydraulic lash adjusters.



Installation

1. **NOTE:** Install the components to their original fitted positions.

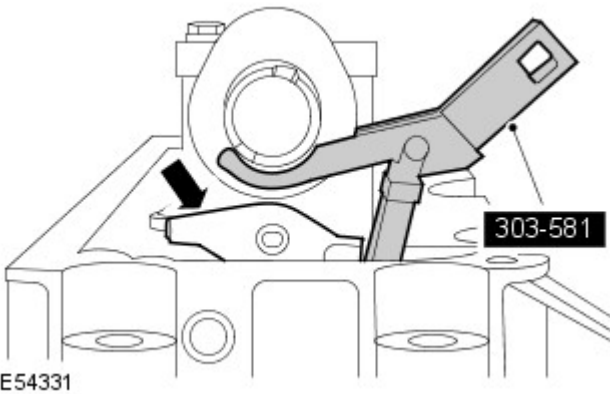
Install the hydraulic lash adjusters.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.

2. **NOTE:** Install the components to their original fitted positions.

Using the special tool, install the camshaft roller followers.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.
- To install, reverse the removal procedure.



3. Rotate the engine as required to access the remaining camshaft roller followers.

4. Install the viscous fan assembly.

For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).

5. Install the RH valve cover.

For additional information, refer to: [Valve Cover RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

6. Install the LH valve cover.

For additional information, refer to: [Valve Cover LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

7. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine Mount LH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


3. Remove the LH exhaust manifold.
For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

4. Release the starter motor cable.

- Release the terminal cover.
- Remove the terminal nut insulator.
- Remove the nut.

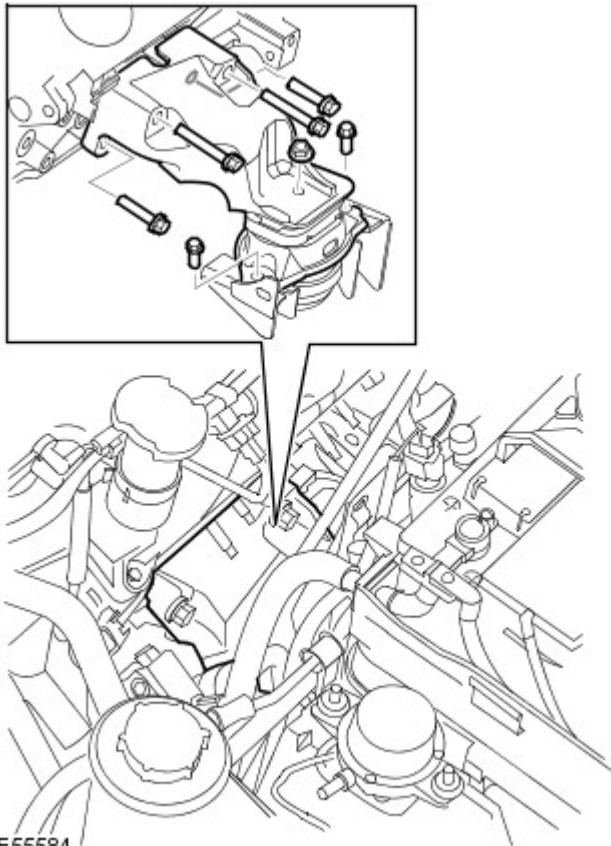


E45827

5.  **CAUTION:** Protect the engine during this operation.

Remove the engine mount bracket.

- Support the engine.
- Remove the 4 bolts.



E55584

6. Remove the engine mount.

- Remove and discard the 2 bolts.

Installation

1. Install the engine mount.

- Clean the component mating faces.
- Tighten the new bolts to 45 Nm (33 lb.ft), then a further 60 degrees.

2. Install the engine mount bracket.

- Clean the component mating faces.
- Tighten the bolts to 80 Nm (59 lb.ft).
- Remove the engine support.

3. Connect the starter motor cable.

- Tighten the nut to 10 Nm (7 lb.ft).
- Install the terminal nut insulator.
- Install the cover.

4. Install the exhaust manifold.

For additional information, refer to: [Exhaust Manifold LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).


5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine Mount RH


In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

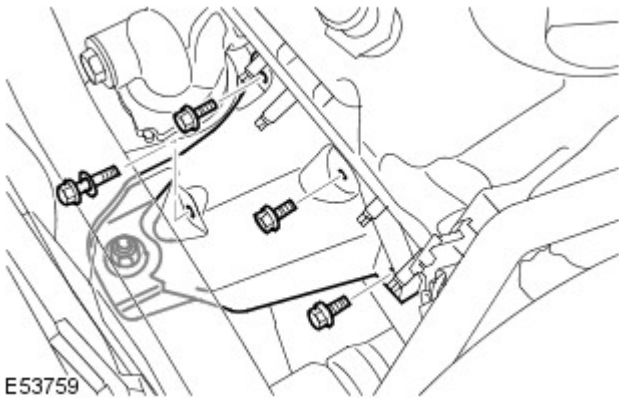
Raise and support the vehicle.

3. Remove the RH exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

4.  **CAUTION:** Protect the engine during this operation.

Remove the engine mount bracket.

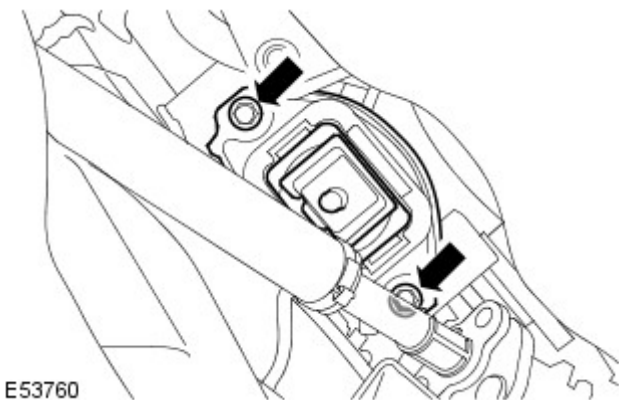
- Support the engine.
- Remove the nut.
- Remove the 4 bolts.



E53759

5. Remove the engine mount.

- Remove and discard the 2 bolts.



E53760


Installation

1. Install the engine mount.
 - Clean the component mating faces.
 - Tighten the new bolts to 45 Nm (33lb.ft), then a further 60 degrees.
2. Install the engine mount bracket.
 - Clean the component mating faces.
 - Tighten the bolts to 80 Nm (59 lb.ft).
 - Remove the engine support.
 - Tighten the nut to 90 Nm (66 lb.ft).
3. Install the exhaust manifold.
For additional information, refer to: [Exhaust Manifold RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Flexplate

In-vehicle Repair

Special Tool(s)	
 <p>303-947</p> <p>E55482</p>	<p>Flex plate locking tool</p> <p>303-947 (LRT-12-145)</p>

Removal

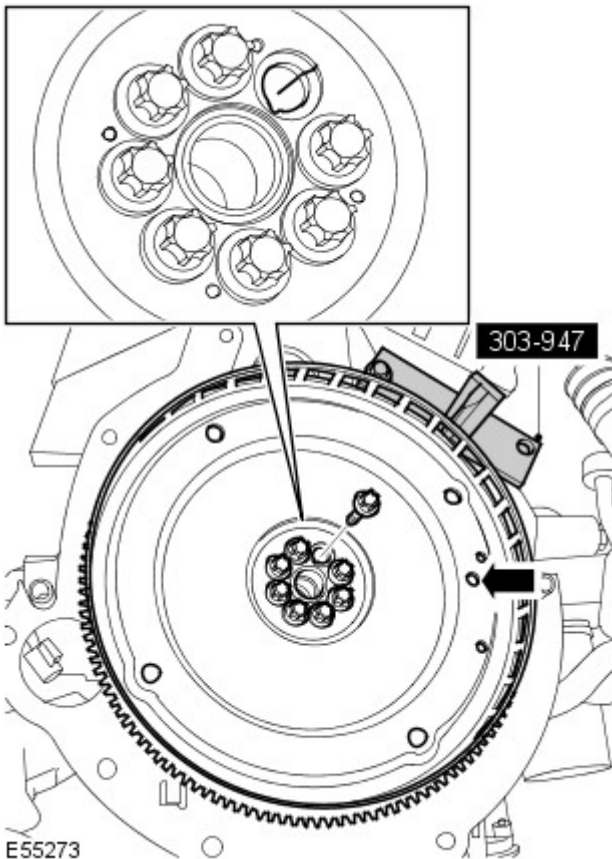
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

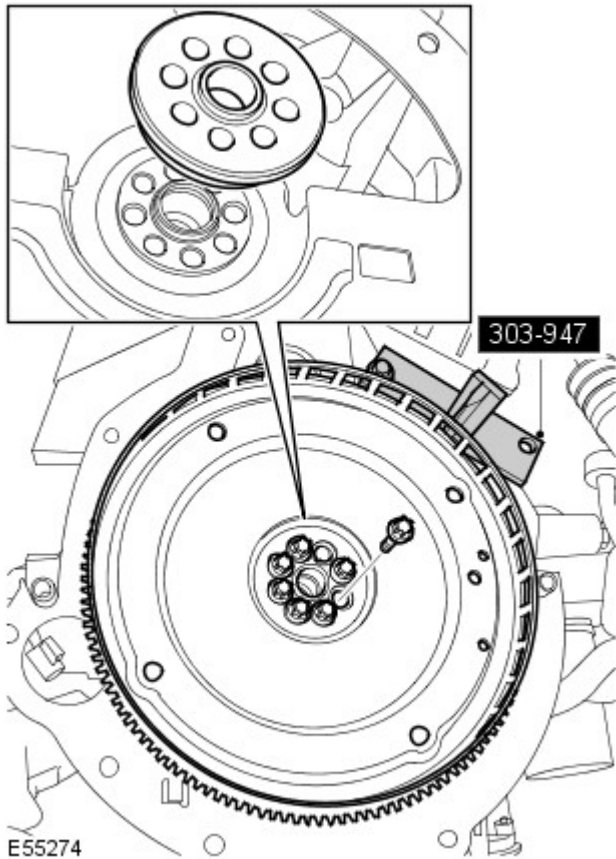
Raise and support the vehicle.

3. Remove the transmission.
For additional information, refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).

4. Flexplate alignment.

- Rotate the crankshaft until number 1 cylinder is at TDC. The timing hole in the flexplate will be horizontal as shown.
- Using the special tool, lock the flexplate.
- Remove the Torx bolt shown to reveal the timing notch.
- Mark the position of the bolt hole with the notch in relation to the crankshaft.

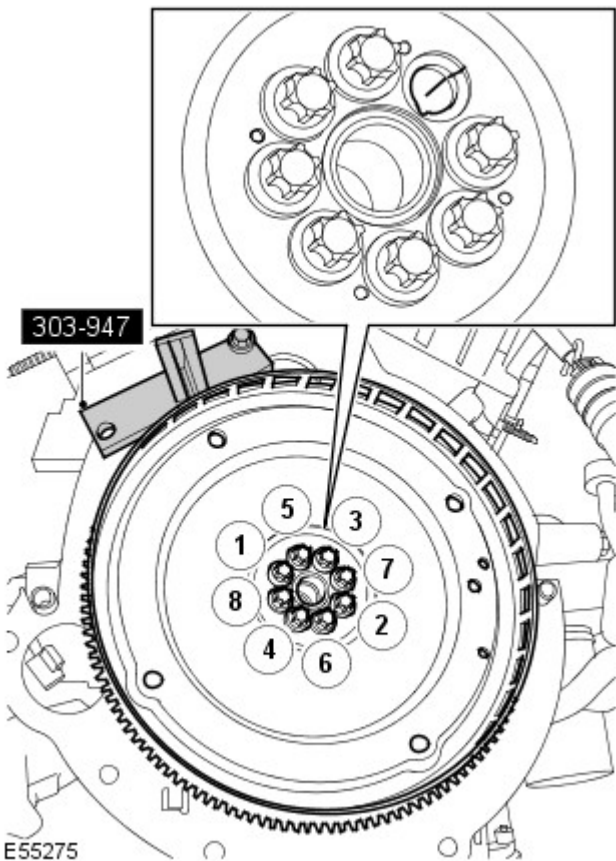




5. Remove the torque converter flexplate.
 - Remove the 7 remaining Torx bolts.
 - Remove the spacer.

Installation

1. Install the torque converter flexplate.



- Clean the component mating faces.
- Install the spacer.
- Align the bolt hole with the alignment notch, to the mark previously made on the crankshaft.
- Using the special tool, lock the flexplate.
- Tighten the Torx bolts evenly in 2 stages, in the sequence shown.
- Tighten the Torx bolts to 15 Nm (11 lb.ft).
- Tighten the Torx bolts to 72 Nm (53 lb.ft)


2. Install the transmission.
For additional information, refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).

- 3.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Oil Pump

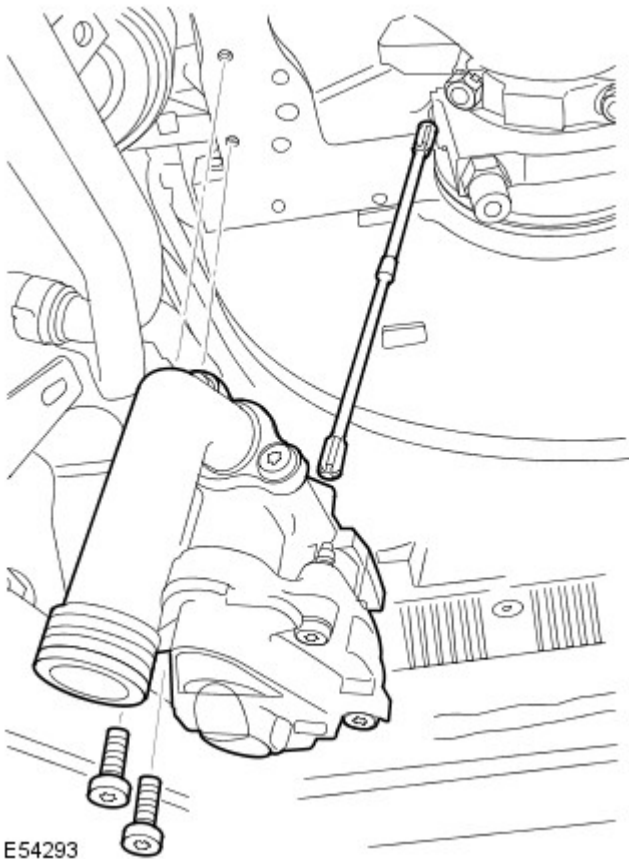
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the front wheels and tires.
4. Remove the cylinder block cradle.
For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Remove the oil pump assembly.
 - Remove the 2 Torx screws.
 - Remove the driveshaft.

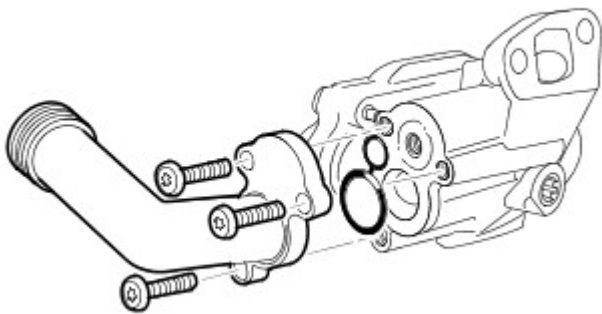


E54293

6. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the oil pickup pipe.

- Remove the 3 Torx screws.
- Remove and discard the seal.



E54294

Installation

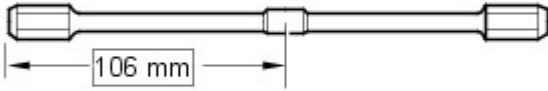
1. Install the oil pickup pipe.

- Clean the component mating faces.
- Install a new seal.
- Tighten the Torx screws to 10 Nm (7 lb.ft).

2.  CAUTION: The oil pump driveshaft is not symmetrical. The longer end shown, is fitted into the oil pump.

Install the oil pump assembly.

- Clean the component mating faces.
- Prime the oil pump.
- Install the driveshaft.
- Tighten Torx screws to 20 Nm (15 lb.ft).




E54292

3. Install the cylinder block cradle.
For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Install the front wheels and tires.
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Oil Pan

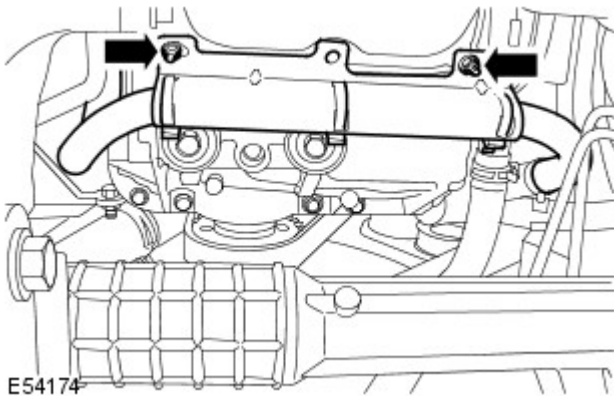
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

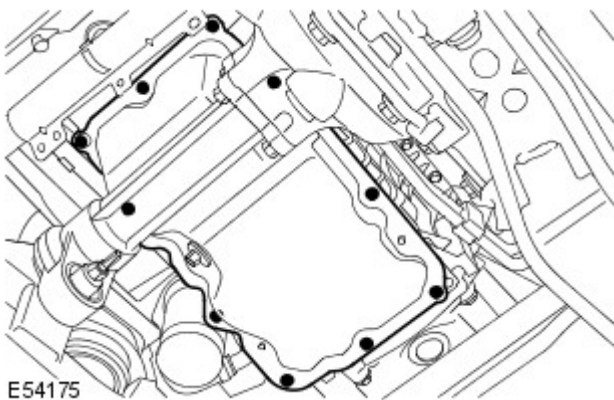
Raise and support the vehicle.
3. Drain the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Release the harness bracket.

- Remove the 2 nuts.



5. Remove the oil pan.

- Remove the 10 bolts.
- Remove and discard the gasket.




Installation

1. Install the oil pan.
 - Clean the component mating faces.
 - Install a new gasket.
 - Evenly and progressively tighten the bolts to 10 Nm (7 lb.ft).
2. Install the harness bracket.
 - Tighten the nuts to 6 Nm (4 lb.ft).
3. Fill the engine with oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Oil Cooler

In-vehicle Repair

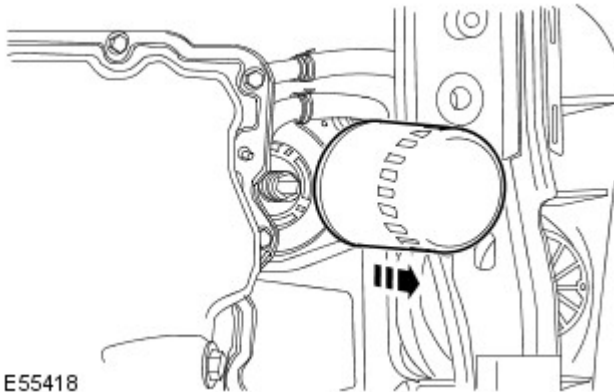
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the oil filter.

- Position a container to collect the fluid.



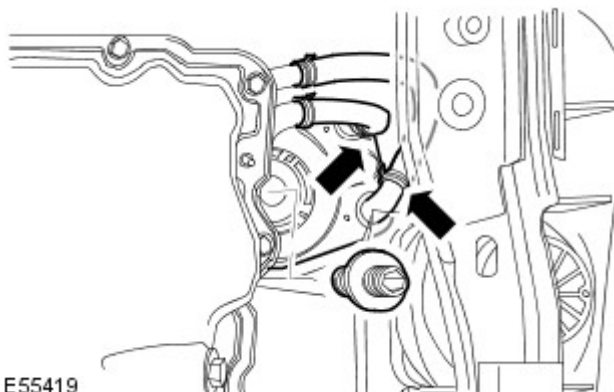
E55418

4. **NOTE:** Note the fitted position of the oil cooler assembly.

Remove the oil filter adapter.

- Release the cooler from the oil filter head.

5. Clamp, then disconnect the coolant hoses from the oil cooler.



E55419

6. Remove the oil cooler.

Installation

1. **NOTE:** Fill the oil cooler with coolant to eliminate the air, prior to connecting the coolant hoses.

To install, reverse the removal procedure.

- Tighten the adapter to 60 Nm (44 lb.ft)
- Lubricate the oil filter seal with clean engine oil and tighten to 18 Nm (13 lb.ft).

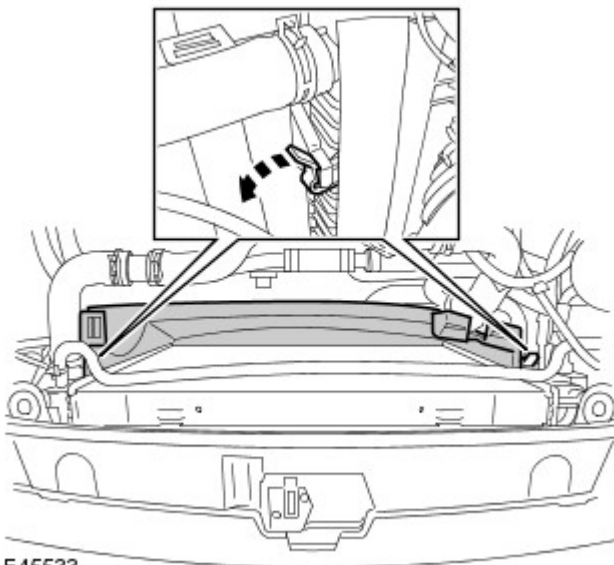
2. Check and top-up the engine oil.
3. Top-up and bleed the coolant.

Engine - V6 4.0L Petrol - Engine Front Cover

In-vehicle Repair

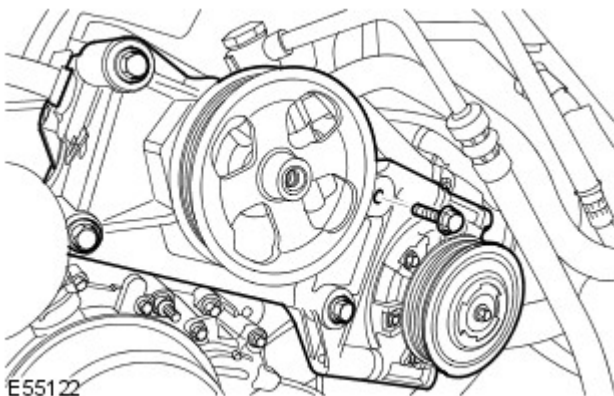
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
3. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the crankshaft pulley.
For additional information, refer to: [Crankshaft Pulley](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Remove the cooling fan lower shroud.
 - Release 2 clips from the cooling fan lower shroud.
 - Release and remove the cooling fan lower shroud from the cooling pack.

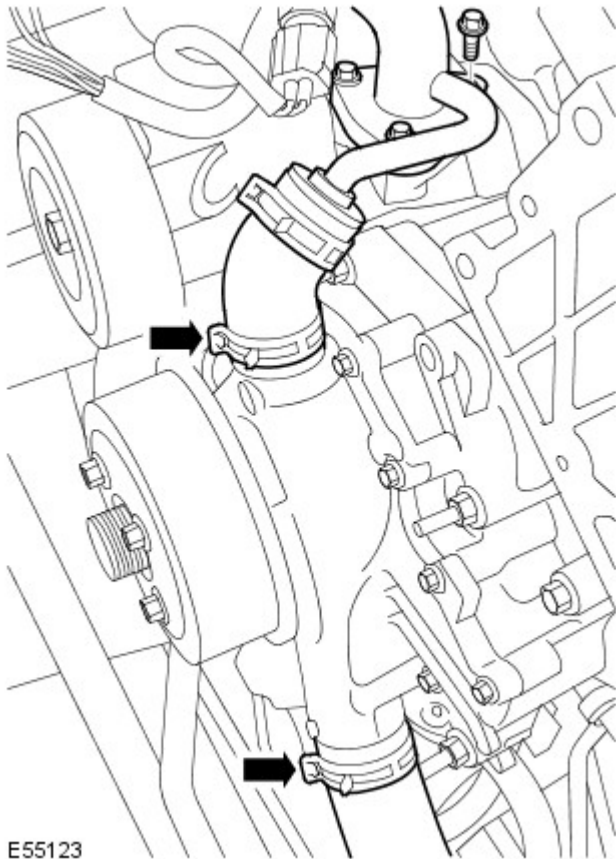


E45533

6. Position the A/C compressor mounting bracket assembly aside.
 - Remove the 4 bolts.
 - Tie aside.

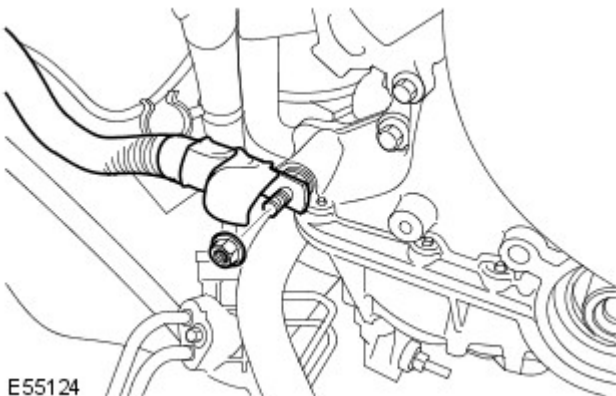


E55122



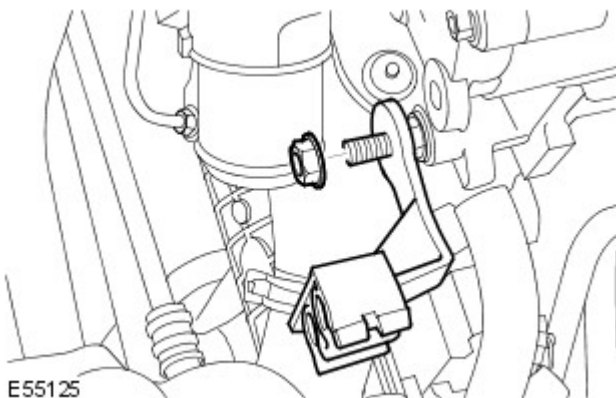
7. Disconnect the 2 hoses from the coolant pump.

- Release the cylinder head coolant flange, to aid coolant hose removal.
- Remove the 3 bolts.
- Position the coolant hoses aside for access.



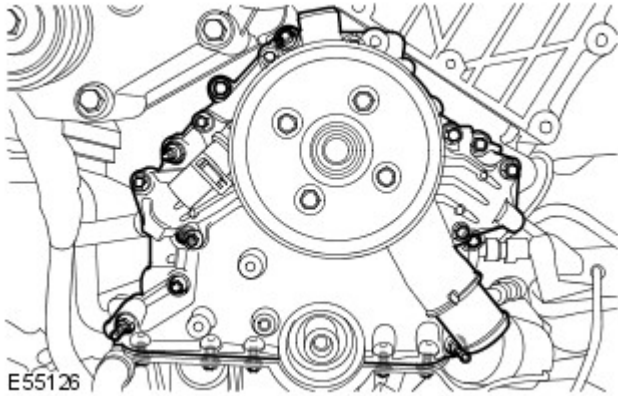
8. Disconnect the engine ground cable.

- Remove the nut.



9. Release the transmission line support bracket.

- Remove the nut.
- Position aside.



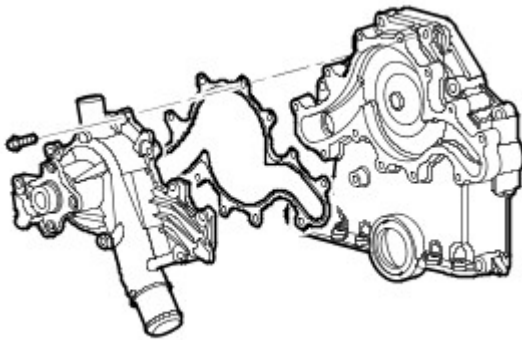
10. Remove the engine front cover.

- Remove the 5 studs.
- Remove the 4 bolts.
- Remove the 5 cylinder cradle bolts.
- Remove and discard the gasket.

11. NOTE: Do not disassemble further if the component is removed for access only.

Remove the coolant pump.

- Remove the 12 bolts.
- Remove and discard the gasket.




E55127

Installation

1. Install the coolant pump.

- Clean the component mating faces.
- Install the new gasket.
- Tighten the bolts to 10 Nm (7 lb.ft).

2.  **CAUTION:** Care must be taken when removing sealant from gasket faces, prevent damage to the mating faces.

• **NOTE:** The component must be installed within 20 minutes of the sealant application.

• **NOTE:** Make sure the cylinder block cradle gasket is located correctly around the front oil seal.

Install the engine front cover.

- Clean the component mating faces.
- Spirit wipe the gasket mating faces.
- Install a new gasket.
- Apply sealant to the 4 places shown.

3. NOTE: Tighten the bolts in two stages.

Install the engine front cover bolts.

- Evenly and progressively tighten the bolts and studs to 8 Nm (6 lb.ft).
- Tighten the M6 bolts to 10 Nm (7 lb.ft).
- Tighten the M8 bolts and studs to 20 Nm (15 lb.ft).

4. Install the transmission support bracket.

- Tighten the nut to 20 Nm (15 lb.ft).

5. NOTE: Care must be taken when installing the ground connections. The engine will fail to start on either or both banks if the ground is poor.

Connect the engine ground cable, make sure the mating faces are clean.

- Tighten the nut to 20 Nm (15 lb.ft).

6. Install the A/C compressor mounting bracket assembly.

- Release the cable tie.
- Tighten the bolts to 45 Nm (33 lb.ft).

7. Install the crankshaft pulley.

For additional information, refer to: [Crankshaft Pulley](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

8. Install the cooling fan shroud.

9. Install the intake manifold.

For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

10. Refill and bleed the cooling system.


For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

11. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Timing Drive Components

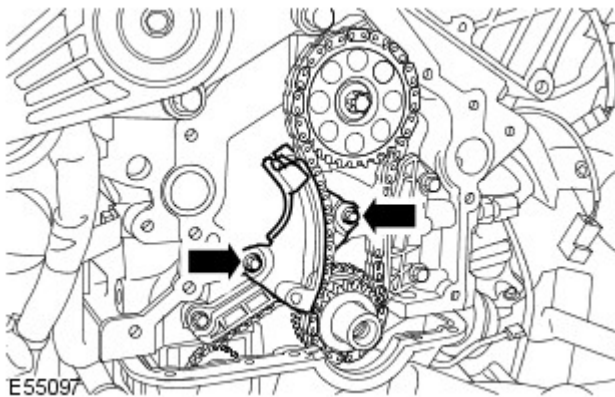
In-vehicle Repair

Special Tool(s)	
 <p>303-674</p> <p>E55101</p>	<p>Crankshaft rotating tool</p> <p>303-674</p>

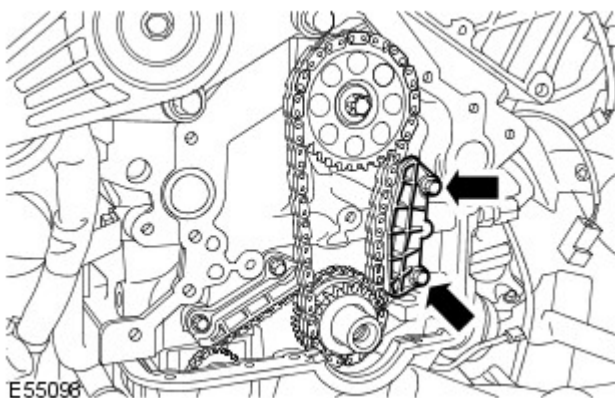
Removal

• NOTE: This procedure covers the removal and installation of the following components: Primary timing chain tensioner, timing chain guide, jackshaft sprocket, crankshaft sprocket and timing chain.

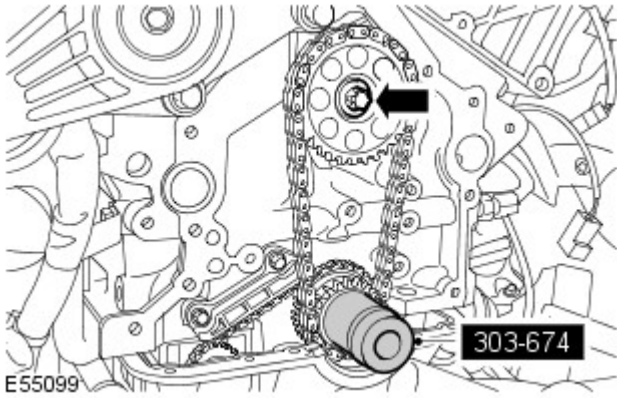
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine front cover.
For additional information, refer to: [Engine Front Cover](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the primary timing chain tensioner.
 - Remove the 2 bolts.



4. Remove the primary timing chain tensioner guide.
 - Remove the 2 bolts.

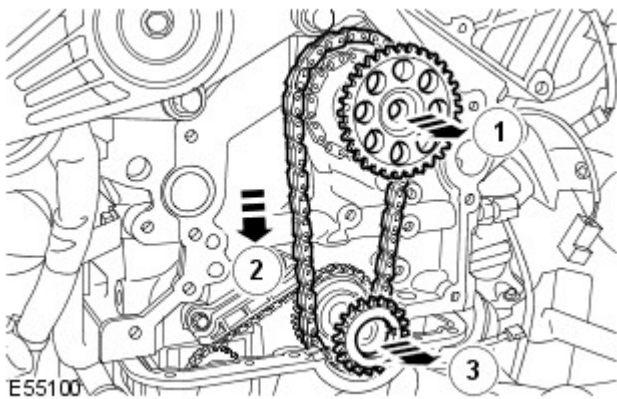


5. Install the special tool to the crankshaft.



6. Remove the jackshaft sprocket.

- Using an additional wrench and the special tool, restrain the jackshaft sprocket.
- Remove and discard the Torx bolt.



7. NOTE: Note the fitted position.

Remove the crankshaft sprocket.

- Remove the primary timing chain.

Installation

1. Install the primary timing chain.

- Clean the component mating faces.
- Install the crankshaft sprocket, the recessed face locates to the crankshaft side.
- Install the special tool to the crankshaft.

2. Install the jackshaft sprocket.

- Clean the component mating faces.
- Locate the primary timing chain to the sprockets.
- Install a new Torx bolt, lightly tighten at this stage.

3. Install the timing chain guide.

- Clean the component mating faces.
- Tighten the bolts to 20 Nm (15 lb.ft).

4. Install the timing chain tensioner.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).

5. Tighten the new Torx bolt to 45 Nm (33 lb.ft), then a further 70 degrees.

6. Install the engine front cover.

For additional information, refer to: [Engine Front Cover](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

7. Adjust the valve timing.

For additional information, refer to: [Camshaft Timing](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).

8. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information,

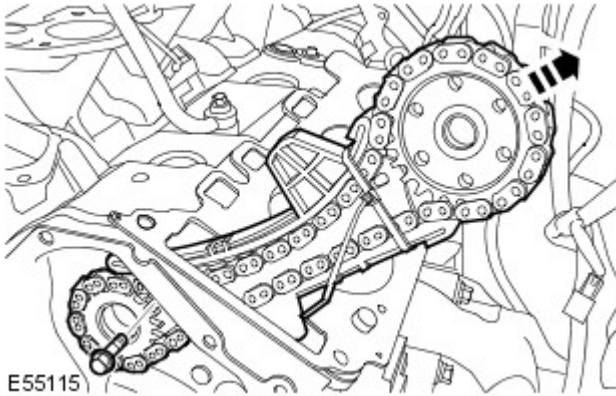
Specifications).

Engine - V6 4.0L Petrol - Camshaft Drive Cassette LH

In-vehicle Repair

Removal

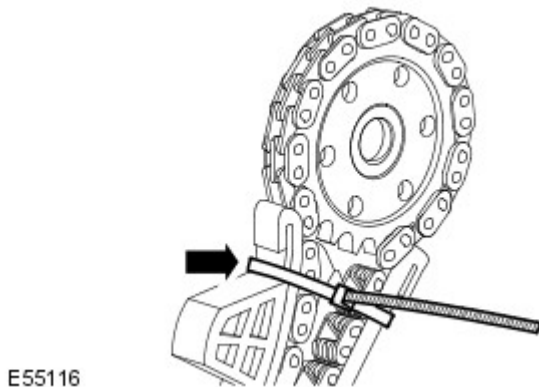
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the cylinder head LH assembly.
For additional information, refer to: [Cylinder Head LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the timing drive components.
For additional information, refer to: [Timing Drive Components](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the camshaft drive cassette assembly.
 - Remove the bolt retaining the chain guide.



5. **NOTE: Do not disassemble further if the component is removed for access only.**

Disassemble the cassette assembly.

- Release the cable tie.
- Remove the sprockets and the chain.
- Clean and inspect the components for deterioration.




Installation

1. Assemble the cassette assembly.
 - Install the chain and the sprockets.
 - Secure with a cable tie.
2. Install the camshaft drive cassette assembly.
 - Tighten the bolt to 25 Nm (18 lb.ft).
3. Install the timing drive components.
For additional information, refer to: [Timing Drive Components](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Install the cylinder head LH assembly.
For additional information, refer to: [Cylinder Head LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Camshaft Drive Cassette RH

In-vehicle Repair

Special Tool(s)	
 E55195	Sprocket holding tool RH rear cassette 303-643

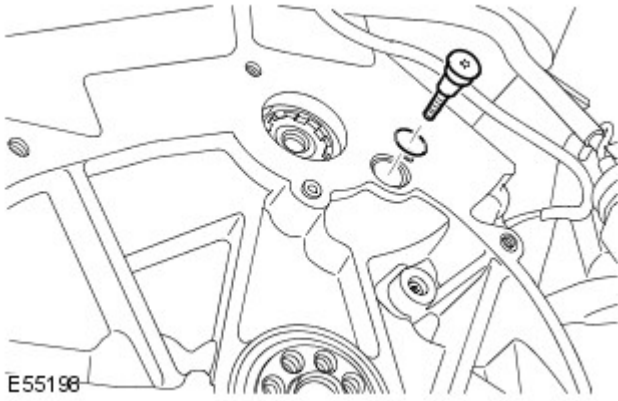
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the RH cylinder head assembly.
For additional information, refer to: [Cylinder Head RH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the torque converter flexplate.
For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the cylinder block jackshaft plug.
 - Drift to release.



5. Using the special tool, remove the RH cassette jackshaft drive, sprocket bolt.
 - Remove and discard the Torx bolt.





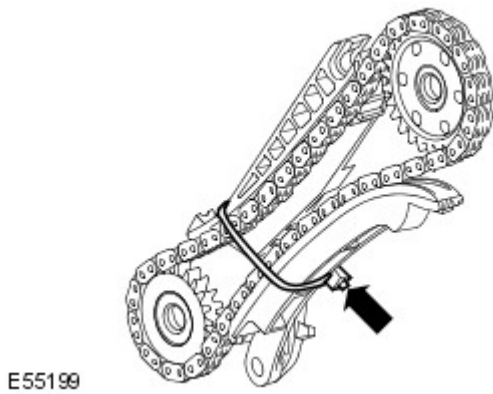
6. Remove the camshaft drive cassette assembly.

- Remove the bolt retaining the chain guide.
- Remove and discard the O-ring seal.

7. **NOTE:** Do not disassemble further if the component is removed for access only.

Disassemble the cassette assembly.

- Release the cable tie.
- Remove the sprockets and the chain.
- Clean and inspect the components for deterioration.



Installation

1. Assemble the cassette assembly.

- Install the chain and the sprockets.
- Secure with a cable tie.

2. Install the camshaft drive cassette assembly.

- Install a new O-ring seal.
- Tighten the bolt to 12 Nm (9 lb.ft).

3. Using the special tool, tighten the new jackshaft sprocket bolt to 40 Nm (30 lb.ft), then a further 45 degrees.



4. Install the cylinder block jackshaft plug.

- Clean the component mating faces.

5. Install the torque converter flexplate.

For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

6. Install the cylinder head RH assembly.

For additional information, refer to: [Cylinder Head RH](#) (303-01C

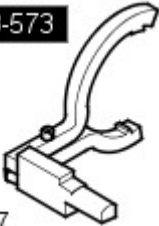
Engine - V6 4.0L Petrol, In-vehicle Repair).

7. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine Dynamic Balance Shaft

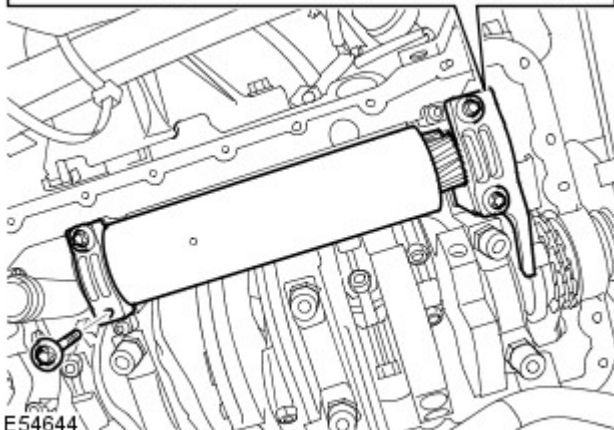
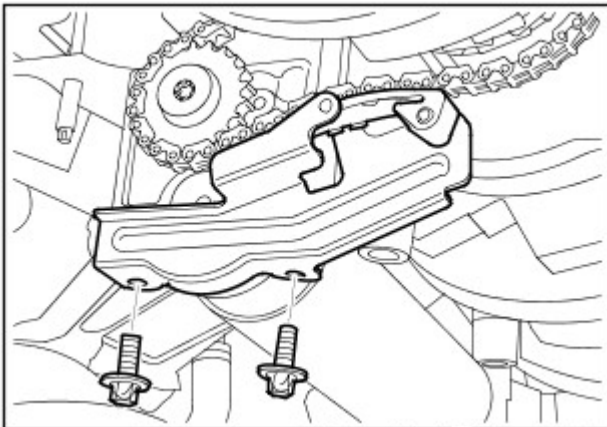
In-vehicle Repair

Special Tool(s)	
 <p>303-573</p> <p>E54427</p>	Crankshaft TDC timing/locking tool
	303-573

Removal

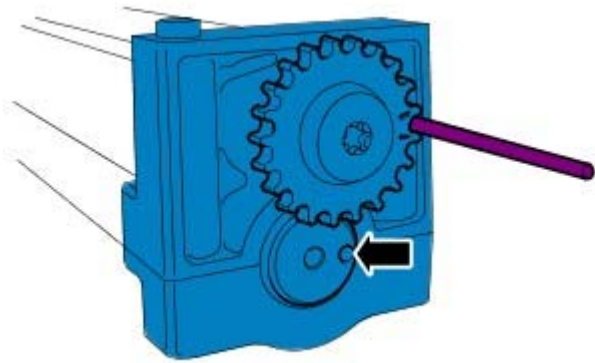
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the front wheels and tires.
4. Remove the cylinder block cradle.
For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
5. Remove the balance shaft.
 - Remove the 4 Torx bolts.
 - Remove the drive chain tensioner.
 - Remove the tensioner blade.



E54644

Installation



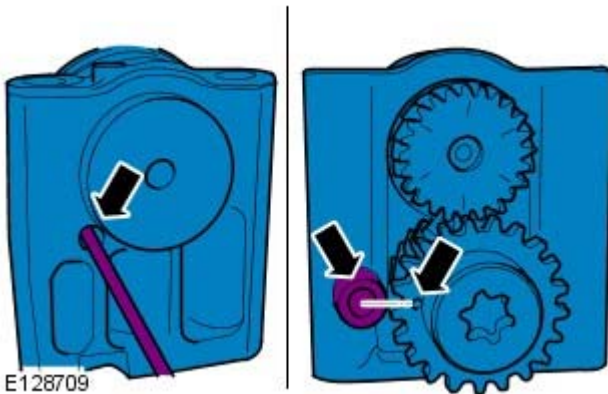
E54645

1. NOTE: Vehicles fitted with early type balance shaft.

- NOTE: Due to the gear ratio, it may be necessary to rotate the balance shaft up to 7 complete turns to find the correct position.

Align the balance shaft.

- Clean the components.
- Lubricate the components.
- Install a 4 mm (0.16 in) pin to lock the shaft as shown.



E128709

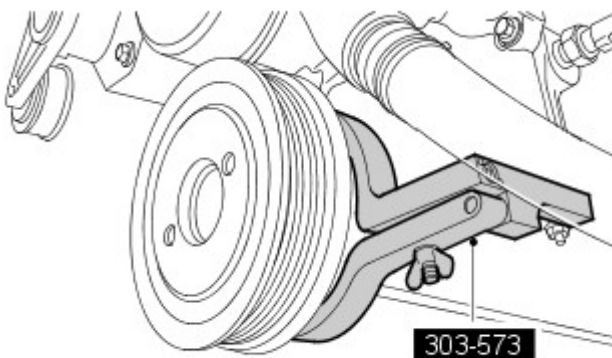
2. NOTE: Vehicles fitted with later type balance shaft.

- NOTE: If a new balance shaft is being fitted make sure the timing pin is not removed prior to fitting.

- NOTE: Due to the gear ratio, it may be necessary to rotate the balance shaft up to 7 complete turns to find the correct position.

Align the balance shaft.

- Clean the components.
- Lubricate the components.
- Install a 4 mm (0.16 in) pin to lock the shaft as shown and that the shaft can not rotate.
- Make sure the drive gear timing marks are aligned as shown.



E54646

3. Rotate crankshaft clockwise until number one cylinder is at TDC and install the special tool.

4. Install the balance shaft.

- Clean the component mating faces.
- Engage the drive chain.
- Install the drive chain tensioner.
- Tighten the Torx bolts to 15 Nm (11 lb.ft).
- Tighten a further 90 degrees.
- Remove the locking pin.
- Remove the special tool.

5. Install the cylinder block cradle.

For additional information, refer to: [Cylinder Block Cradle](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).


6. Install the front wheels and tires.

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

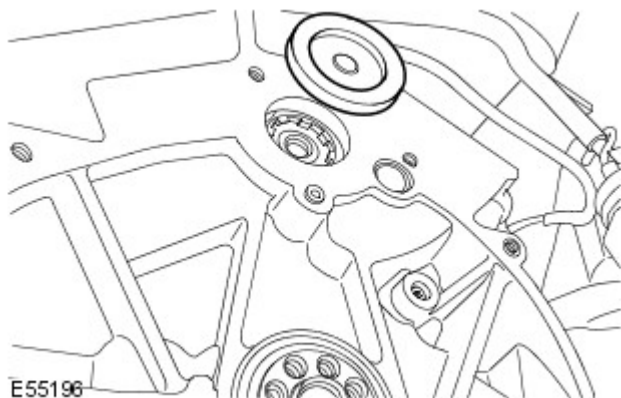
Engine - V6 4.0L Petrol - Jackshaft

In-vehicle Repair

Special Tool(s)	
 <p>303-634</p> <p>E55195</p>	Sprocket holding tool RH rear cassette 303-643

Removal

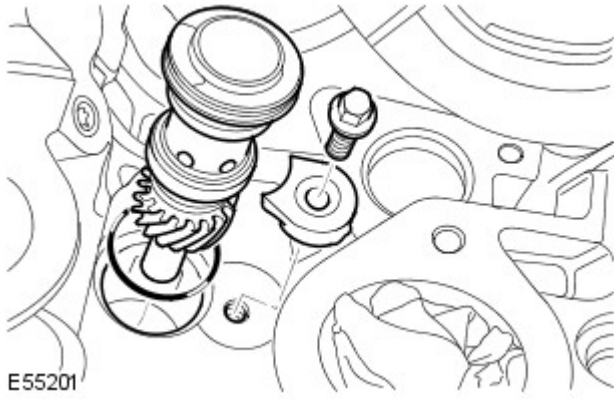
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the torque converter flexplate.
For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the cylinder block jackshaft plug.
 - Drift to release.



4. Using the special tool, remove the RH cassette jackshaft drive, sprocket bolt.
 - Remove and discard the Torx bolt.

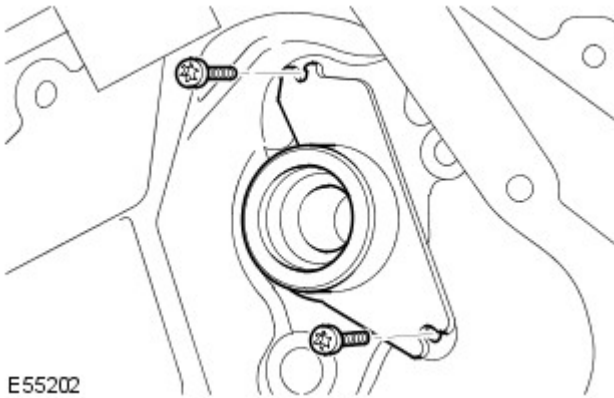


5. Remove the camshaft drive cassette LH assembly.
For additional information, refer to: [Camshaft Drive Cassette LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).



6. Remove the oil pump drive gear.

- Remove the bolt.
- Remove the clamp.
- Remove and discard the O-ring seal.



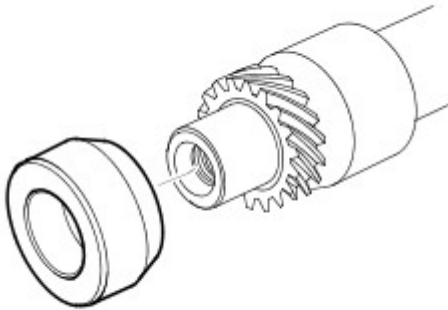
7. Remove the jackshaft thrust plate.

- Remove the 2 Torx bolts.

E55202

8. Remove the jackshaft.

- Collect the spacer.



E55203

Installation

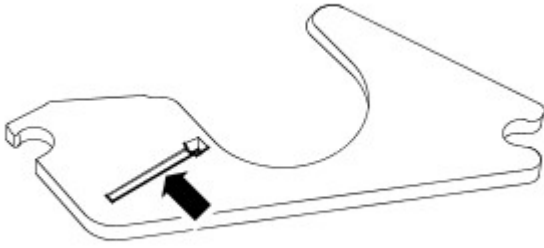
1. Install the jackshaft.

- Clean the component mating faces.
- Install the jackshaft spacer.
- Lubricate the components with clean engine oil.

2. NOTE: The groove in the thrust plate must face the cylinder block.

Install the jackshaft thrust plate.

- Clean the component mating faces.
- Lubricate the components with clean engine oil.
- Tighten the Torx bolts to 10 Nm (7 lb.ft).



E55204

3. Install the oil pump drive gear.

- Clean the components.
- Lubricate the components with clean engine oil.
- Install a new O-ring seal.
- Install the clamp.
- Tighten the bolt to 20 Nm (15 lb.ft).

4. Install the camshaft drive cassette LH assembly.

For additional information, refer to: [Camshaft Drive Cassette LH](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

5. Using the special tool, install the RH cassette jackshaft drive, sprocket bolt.

- Clean the component mating faces.
- Using the special tool, tighten the new jackshaft sprocket bolt to 40 Nm (30 lb.ft), then a further 45 degrees.



E55200

6. Install the cylinder block jackshaft plug.

- Clean the component mating faces.

7. Install the torque converter flexplate.

For additional information, refer to: [Flexplate](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).

8. Connect the battery ground cable.

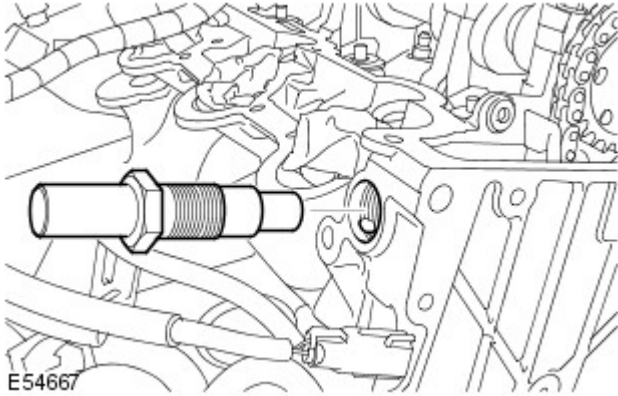
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Engine - V6 4.0L Petrol - Hydraulic Timing Chain Tensioner LH

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).



3.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the LH hydraulic timing chain tensioner.

Installation


1. Install the LH hydraulic timing chain tensioner.
 - Clean the component mating faces.
 - Tighten the tensioner to 45 Nm (33 lb.ft).
2. Install the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Hydraulic Timing Chain Tensioner RH

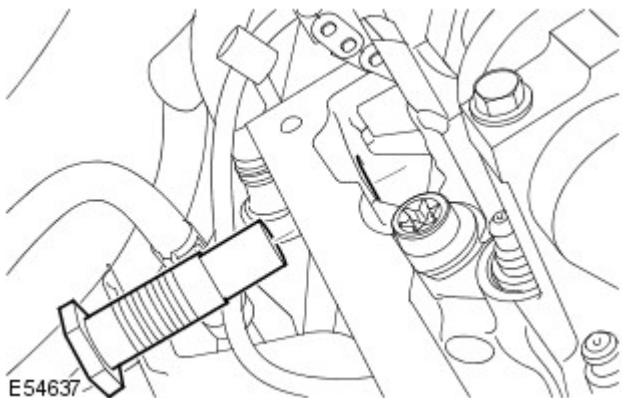
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the RH hydraulic timing chain tensioner.




Installation

1. Install the RH hydraulic timing chain tensioner.
 - Clean the component mating faces.
 - Tighten the tensioner to 45 Nm (33 lb.ft).
2. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Intake Manifold

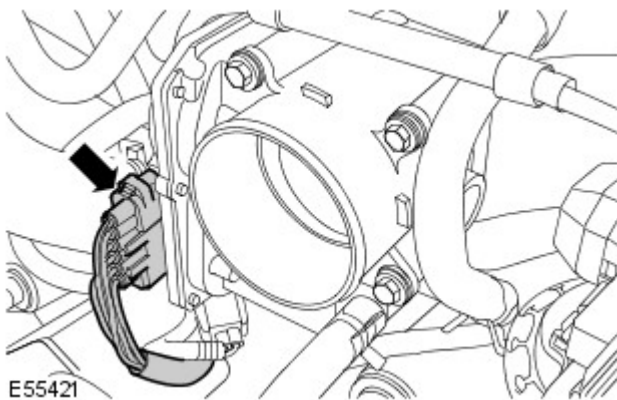
In-vehicle Repair

Special Tool(s)	
	Fuel spring lock decoupling tool
	310-044

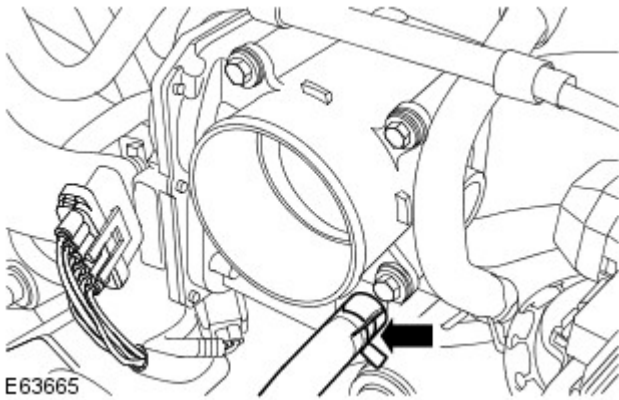
Removal

• **NOTE:** Removal of the intake manifold on early vehicles will involve the partial dismantling of the fuel rail and the removal of the purge valve and mounting bracket. Once removed, it will also be necessary to remove some excess material from the intake manifold, see 'installation' steps 1 and 2.

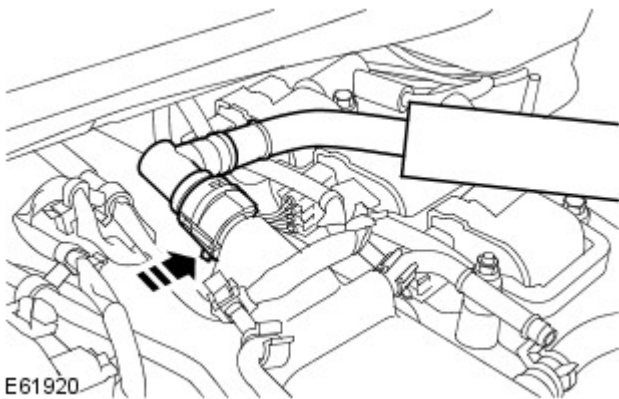
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Secure the hood in the service position.
 - Release the support struts.
3. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
5. Disconnect the throttle body electrical connector.




6. Disconnect the intake manifold coolant hose.
 - Clamp the relevant hose, to minimise coolant loss.
 - Release the clip.

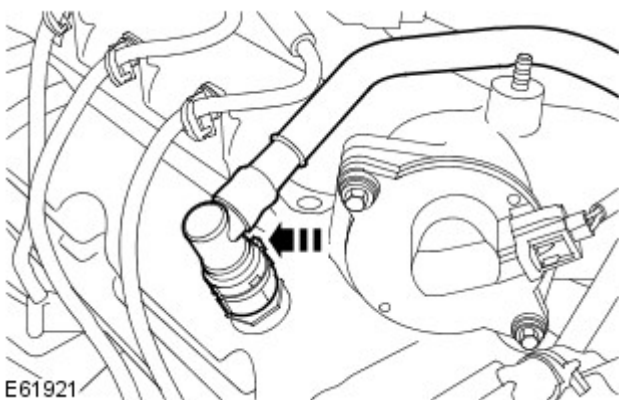


7. Disconnect the throttle body coolant hose.
 - Clamp the hose to minimise coolant loss.
 - Release the clip.

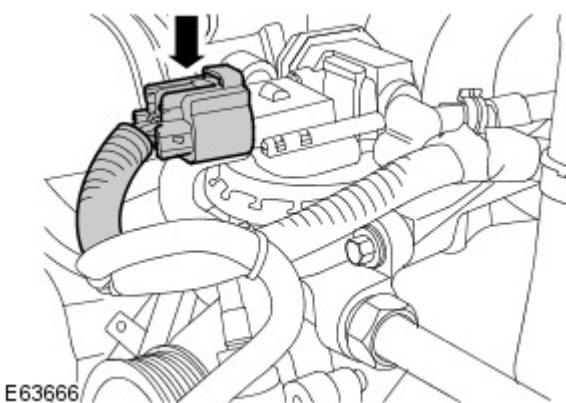


8.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

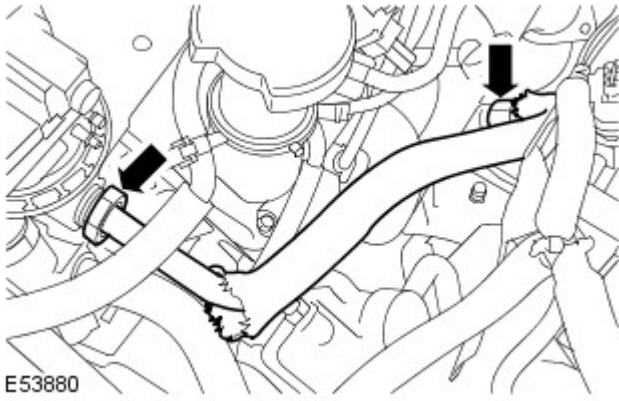
Disconnect the crankcase vent hose.



9. Remove the RH crankcase vent hose.

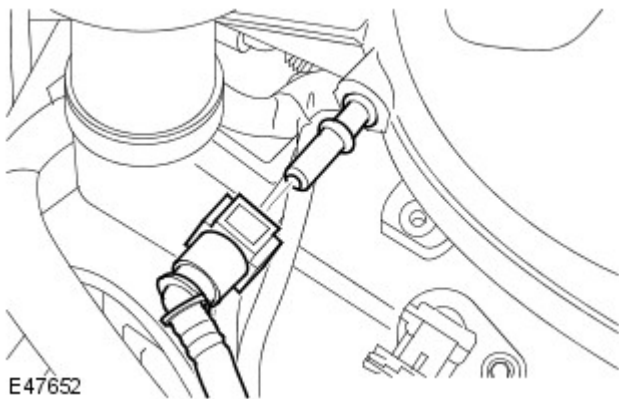


10. Disconnect the EGR valve electrical connector.



11. Disconnect the EGR valve feed pipe.

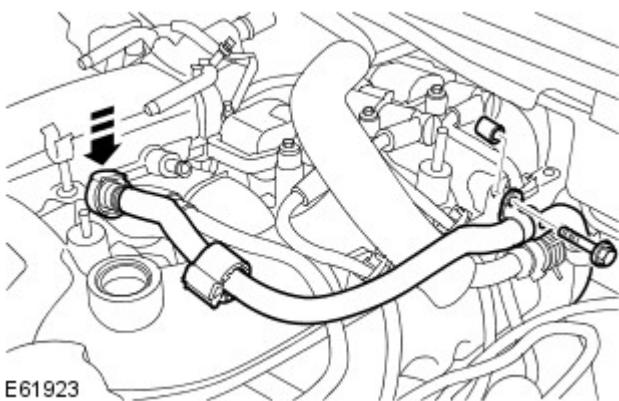
- Loosen the EGR valve feed pipe union nut, at the exhaust manifold.
- Disconnect the union nut, securing the EGR pipe to the valve.



12. Disconnect the intake manifold vacuum pipe assembly.

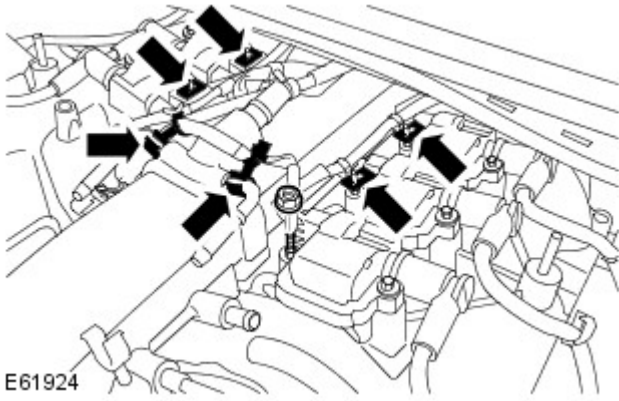


13. Disconnect the intake manifold tuning valve electrical connector.



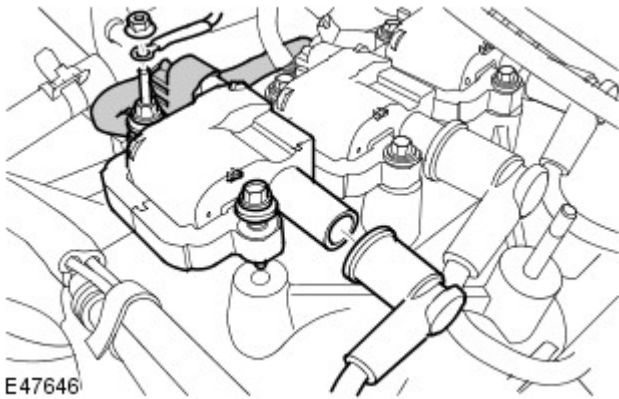
14. Release the purge line from the intake manifold.

- Remove the clip retaining bolt.
- Collect the spacer.



15. Release the coil wiring harness.

- Release the 6 clips.
- Remove the 2 coil harness ground nuts.

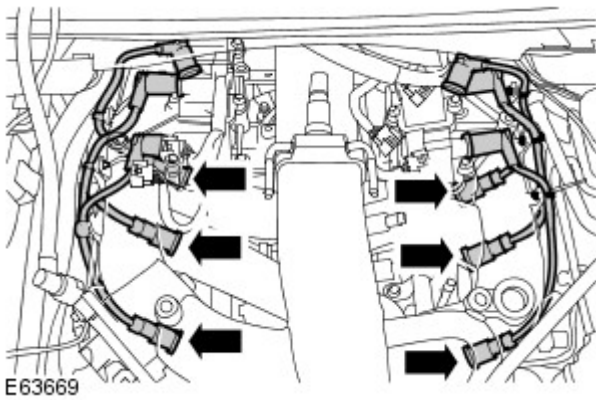


16. Disconnect the 6 coil electrical connectors.

17. NOTE: Note the fitted position of the fasteners.

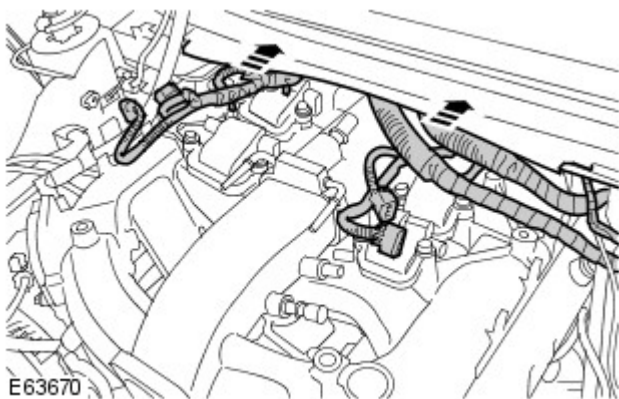
Remove the 2 rear ignition coils.

- Disconnect the sparking plug lead elbows at the coils.
- Remove the 2 bolts and 2 studs.
- Discard the fastener O-rings to aid installation.



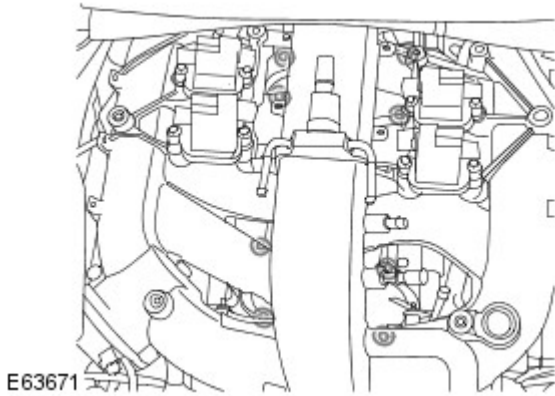
18. Disconnect the HT leads at the sparking plugs.

- Position the leads aside.



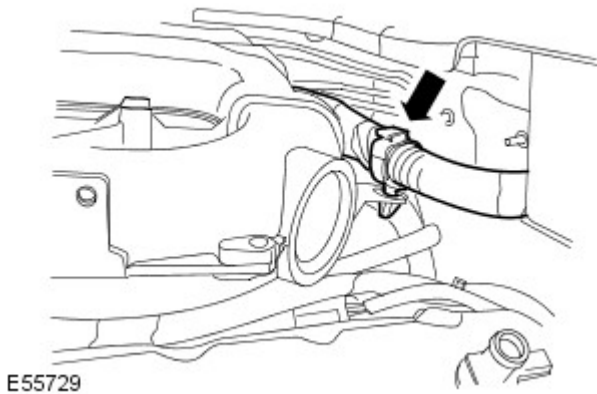
19. Position the engine wiring harness aside for access.

20. Remove the 8 intake manifold bolts.




21. NOTE: The type of clip may vary depending on the hand of drive.


Release the intake manifold wiring harness clip.




22. WARNINGS:

 Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.

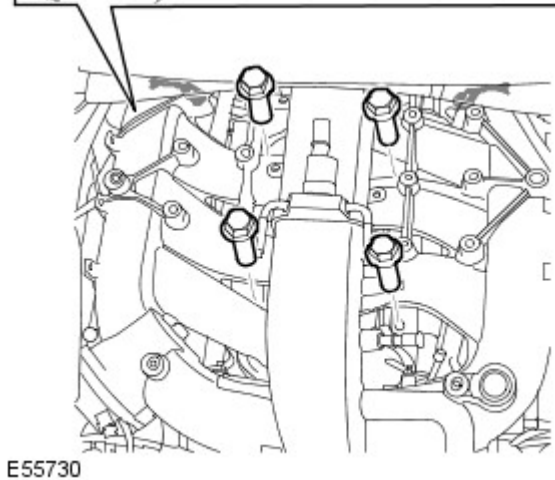
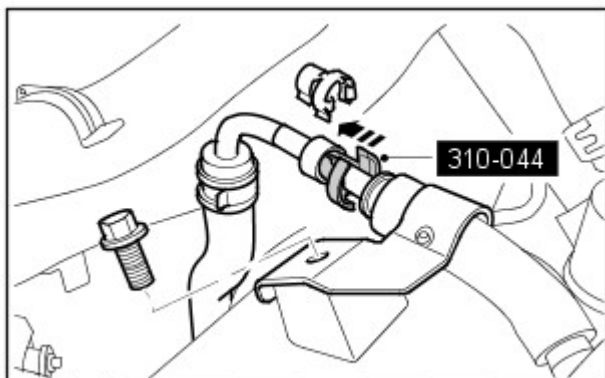
 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

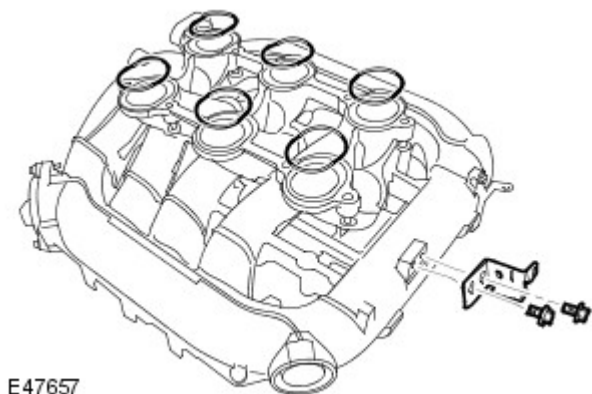
 Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.

 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.

Using the special tool, disconnect the fuel line.

- Remove the security clip.
- Early vehicles only: Remove 4 bolts and release the fuel rail and injectors.
- Early vehicles only: Disconnect the LH and RH cylinder head, rear fuel injector electrical connectors.
- Early vehicles only: Remove the bolt and release the valve cover fuel line clip.
- Early vehicles only: Cable tie the purge valve to the wiring harness.





E47657

23. CAUTIONS:

⚠ Early vehicles only: The purge valve and mounting bracket are bolted to the rear of the intake manifold and foul the fuel rail crossover link. Damage will occur if force is used when attempting to remove the intake manifold. If this occurs, remove the LH side, battery tray inner wall and base, for access to the purge valve bolt.

⚠ Care must be taken to avoid damaging the purge valve assembly during removal of the intake manifold.

• NOTE: Due to the lack of access it may be necessary to break the engine and transmission wiring harness clips, care must be taken not to damage the wiring harnesses.

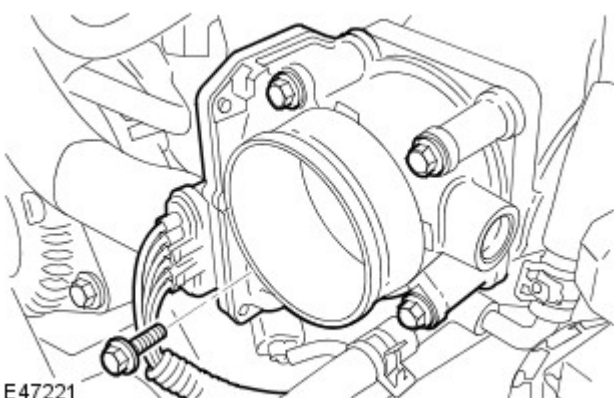
Release and then remove the intake manifold.

- Discard the gaskets.
- Install blanking caps to the exposed ports.

24. NOTE: Do not disassemble further if the component is removed for access only.

Remove the throttle body.

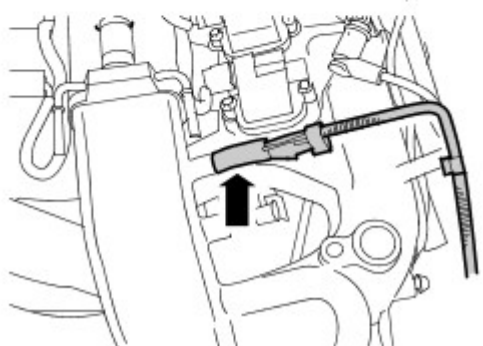
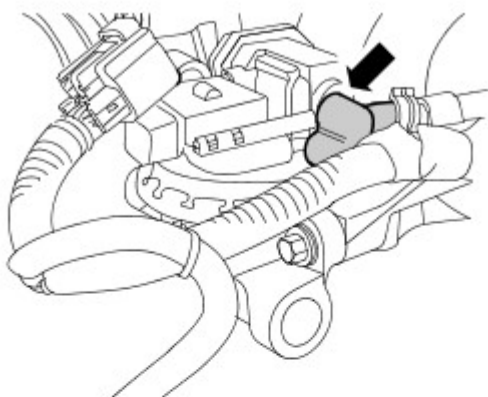
- Remove the 4 bolts.
- Remove and discard the throttle body gasket.
- Disconnect the coolant hose.



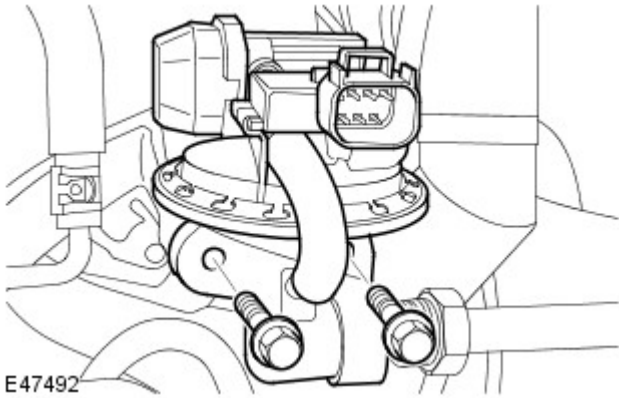
E47221

25. Disconnect the EGR valve vacuum hose.

- Disconnect and remove the vacuum hose at the intake manifold.



E63832

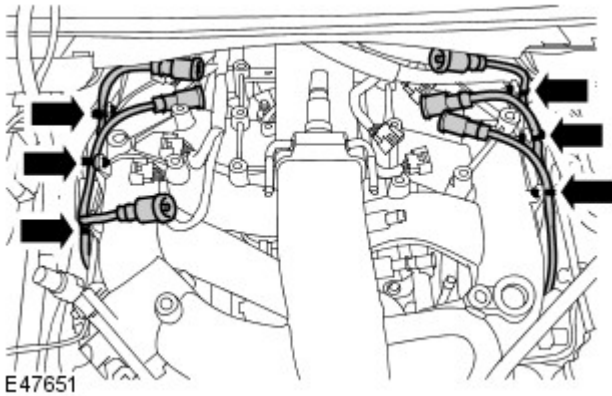


26. Remove the EGR valve.

- Remove the 2 bolts.
- Collect and discard the gasket.

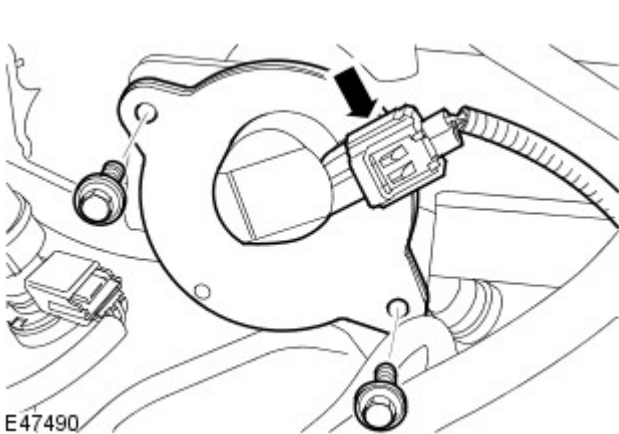
27. Remove the remaining ignition coils.

- Disconnect the sparking plug lead elbows at the coils.
- Remove the bolts and studs. Remove and discard the seals.



28. Remove the HT leads.

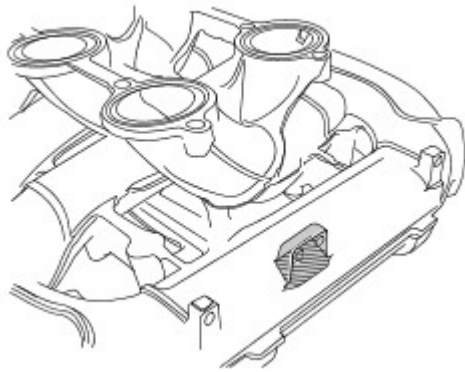
- Release the 6 plug lead clips.



29. Remove the intake manifold tuning valve.

- Remove the 2 bolts.
- Discard the O-ring seal.

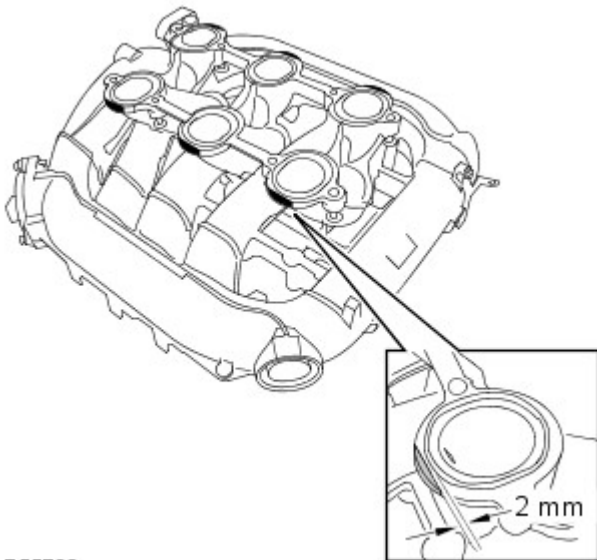
Installation



E55731

1.  **WARNING:** Make sure there are no sharp edges after removing material.

Early vehicles only: Remove the center casting lug.



E55732

2. Early vehicles only: Remove excess material from the outside edges of the 6 intake manifold flange faces; file to within 2 mm of the gasket edge.

3. Early vehicles only: Install the fuel rail and injectors.

- Clean the component mating faces.
- Tighten the bolts to 25 Nm (18 lb.ft).
- Connect the fuel injector electrical connectors.
- Tighten the M6 bolt to 10 Nm (7 lb.ft).

4. Install the intake manifold tuning valve.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the bolts to 10 Nm (7 lb.ft).

5. Secure the HT leads to the intake manifold with clips.

6. **NOTE:** Note the fitted position of the fasteners.

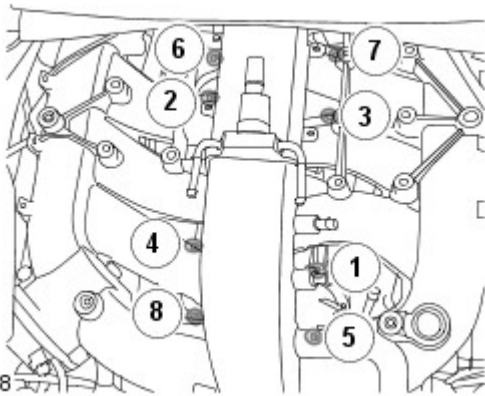
Install the 4 ignition coils.

- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the studs to 6 Nm (4 lb.ft).
- Connect the HT electrical connections.


7. Install the EGR valve.

- Clean the component mating faces.
- Install a new gasket.
- Tighten the bolts to 25 Nm (18 lb.ft).

8. Connect the vacuum hose to the EGR valve.
9. Connect the EGR vacuum hose to the intake manifold.
 - Clean the component mating faces.
 - Connect the vacuum hose to the EGR valve.
10. Install the throttle body.
 - Clean the component mating faces.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
11. Install the throttle body coolant hose.
 - Secure the clip.
 - Remove the hose clamp.
12. Secure the wiring harness to the intake manifold.
 - Secure the wiring harness clip.



E47658

13.  **CAUTION:** Care must be taken prior to tightening the intake manifold bolts. Make sure the electrical harness, vacuum and purge valve lines are not trapped.

- **NOTE:** To aid installation: Position a Torx drive and extension, to the rear LH bank intake manifold Torx bolt, prior to installing the intake manifold. Retain with tape.
- **NOTE:** The ignition coils are removed from the illustration for clarity.

Install the intake manifold.

- Clean the component mating faces.
 - Install the gaskets.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).
14. Install the remaining ignition coils.
 - Tighten the bolts to 6 Nm (4 lb.ft).
 - Tighten the studs to 6 Nm (4 lb.ft).
 - Connect the HT electrical connections.
 15. Connect the ignition coil electrical connectors.
 16. Connect the fuel line to the fuel rail.
 - Clean the component mating faces.
 - Install the clip.
 17. Secure the coil wiring harness.
 - Connect the coil harness ground cables.
 - Tighten the nuts to 6 Nm (4 lb.ft).
 - Position and secure the clips.
 18. Connect the intake manifold tuning valve electrical connector.
 19. Connect the vacuum pipe to the inlet manifold.
 20. Secure the purge line to the intake manifold.
 - Install the spacer.
 - Install the bolt.
 - Tighten the bolt to 6 Nm (4 lb.ft).
 21. Connect the crankcase vent hose.
 - Clean the component mating faces.

- Secure the clip.
- Remove the hose clamp.

23. Install the air intake resonator.

For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).

24. Install the engine cover.

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

25. Connect the hood support struts.

26. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

27. Check and top-up the coolant.

Engine - V6 4.0L Petrol - Exhaust Manifold LH

In-vehicle Repair

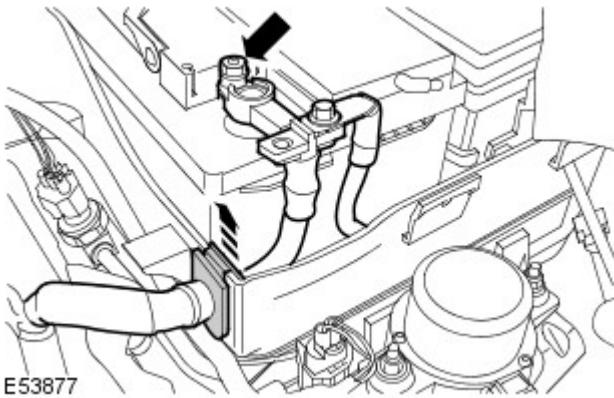
Removal

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

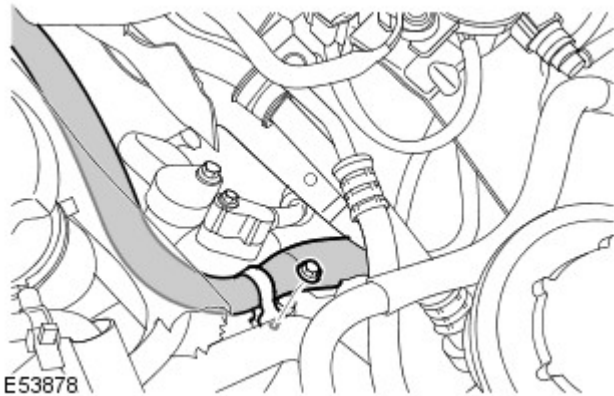
Right-hand drive vehicles

3. Release the battery positive cable.
 - Loosen the clamp.
 - Release the grommet.




Right-hand drive vehicles

4. Release the wiring harness clip.
 - Remove the bolt.



All vehicles

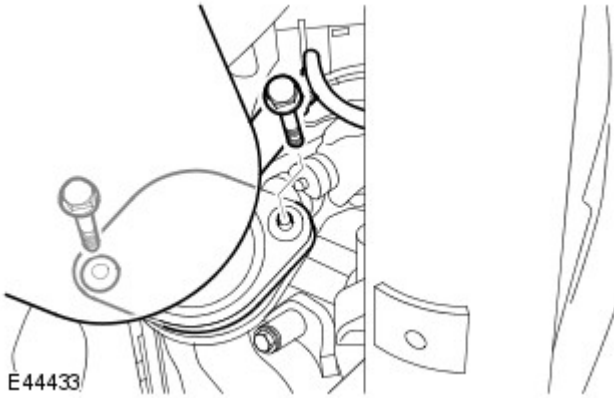
5.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


6. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

7. Release the exhaust system from the exhaust manifold.

- Remove and discard the 2 bolts.

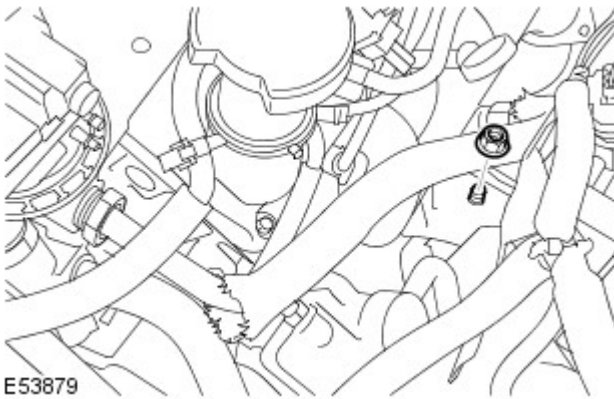



8. Lower the vehicle.

9.  CAUTION: Protect the engine during this operation.

Raise the engine clear of its LH mount.

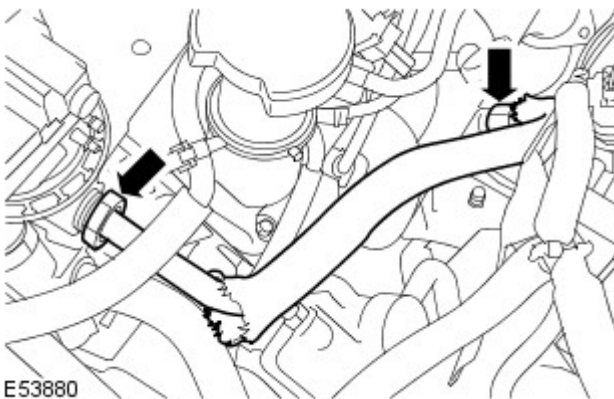
- Remove the nut.



10.  CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the EGR pipe.

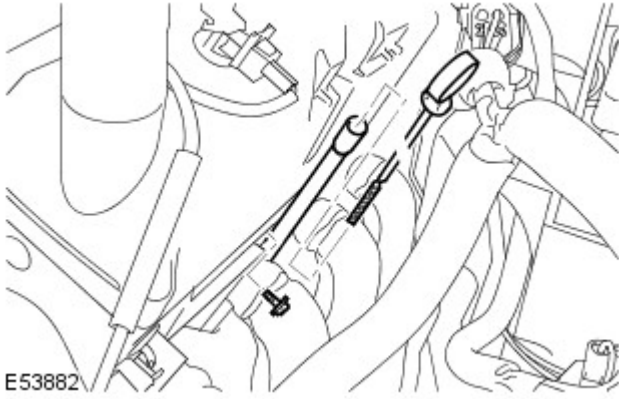
- Release the 2 union nuts.




11. Disconnect the high tension (HT) electrical connectors.

- Move the leads aside for access.

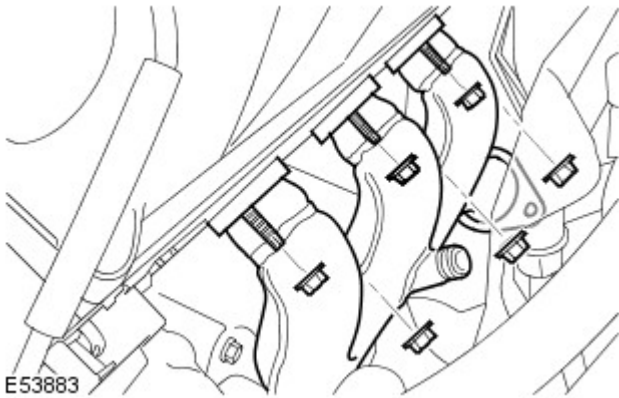




12.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the dipstick tube.

- Remove the dipstick.
- Remove the bolt.
- Discard the O-ring seal.



13. Remove the exhaust manifold.

- Remove the 6 nuts.
- Remove and discard the gasket.

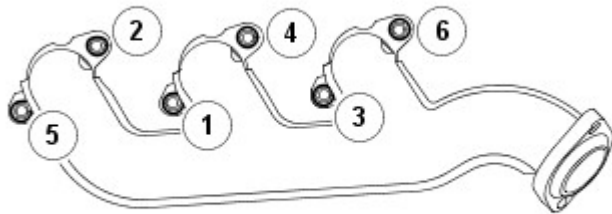
Installation

All vehicles

1. **NOTE:** The exhaust manifold gasket connecting links must be positioned to the lower edge of the manifold.

Install the exhaust manifold.

- Install a new gasket.
- Clean the component mating faces.
- Tighten the nuts evenly in the sequence shown to 25 Nm (18 lb.ft).



E53884

2. Install the dipstick tube.

- Clean the component mating faces.
- Install a new O-ring seal.
- Lubricate the seal with clean engine oil.
- Tighten the bolt to 10 Nm (7 lb.ft).
- Install the dipstick.

3. Connect the HT electrical connectors.

4. Install the EGR pipe.

- Clean the component mating faces.
- Initially, finger tighten the nuts.
- Finally, tighten the nuts to 40 Nm (30 lb.ft).

5. Lower the engine onto its mount.
 - Tighten the nut to 90 Nm (66 lb.ft).
6. Raise the vehicle.
7. Install the exhaust system.
 - Clean the component mating faces.
 - Install new bolts and tighten to 40 Nm (30 lb.ft).
8. Install the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
9. Lower the vehicle.

Right-hand drive vehicles

10. **NOTE:** Apply petroleum jelly to the battery terminals.

Connect the battery positive cable.

- Clean the component mating faces.
- Install the grommet.
- Tighten the clamp nut to 10 Nm (7 lb.ft).

Right-hand drive vehicles

11. Secure the wiring harness clip.
 - Tighten the bolt to 10 Nm (7 lb.ft).


All vehicles

12. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
13. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Exhaust Manifold RH

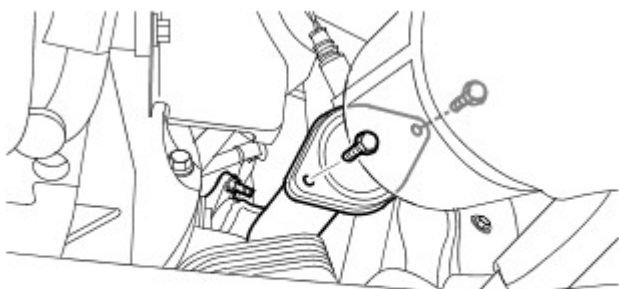
In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

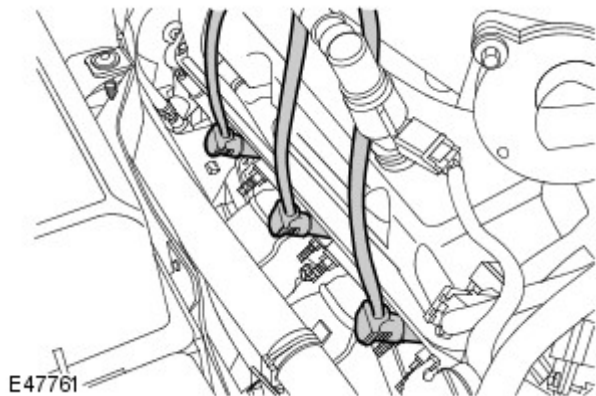
Raise and support the vehicle.

4. Release the exhaust system from the exhaust manifold.
 - Remove and discard the 2 bolts.



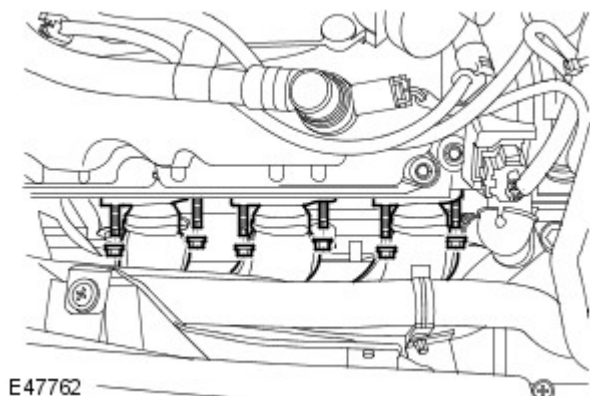
E47760

5. Lower the vehicle.
6. Disconnect the high tension (HT) electrical connectors.
 - Move the leads aside for access.



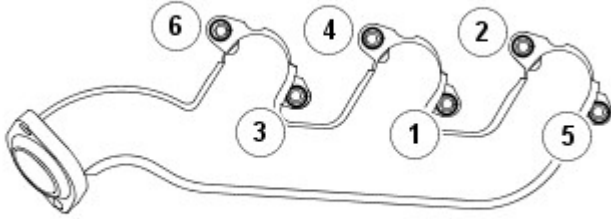
E47761

7. Remove the exhaust manifold.
 - Remove the 6 nuts.
 - Remove and discard the gasket.



E47762

Installation



E47773

1. Install the exhaust manifold.

- Clean the component mating faces.
- Install a new gasket.
- Evenly and progressively, tighten the nuts to 25 Nm (18 lb.ft).

2. Connect the HT electrical connectors.

3. Raise the vehicle.

4. Install the exhaust system.

- Clean the component mating faces.
- Install new bolts and tighten to 40 Nm (30 lb.ft).

5. Lower the vehicle.

6. Install the engine cover.


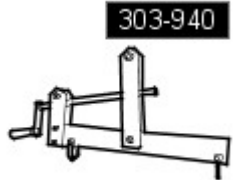

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V6 4.0L Petrol - Engine

Removal

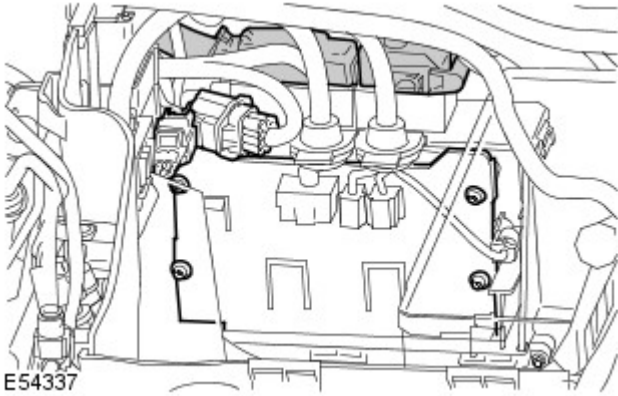
Special Tool(s)	
 <p>303-1147</p> <p>E55563</p>	<p>Engine lifting cradle - 4.0L</p> <p>303-1147</p>
 <p>303-940</p> <p>E61659</p>	<p>Engine lifting bracket</p> <p>303-940 (LRT-12-138)</p>
 <p>303-940/1</p> <p>E61731</p>	<p>Lifting chains</p> <p>303-940/1</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Secure the hood in the service position.
3. Raise and support the vehicle.
4. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
5. Drain the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
6. **NOTE:** Early vehicles will require the partial release of the fuel rail, to allow the intake manifold to be removed.

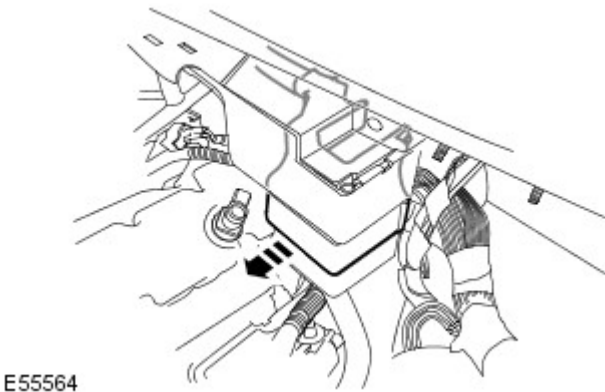
Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
7. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

8. Disconnect the 2 ECM electrical connectors.



9. Release the wiring harness from the plenum.

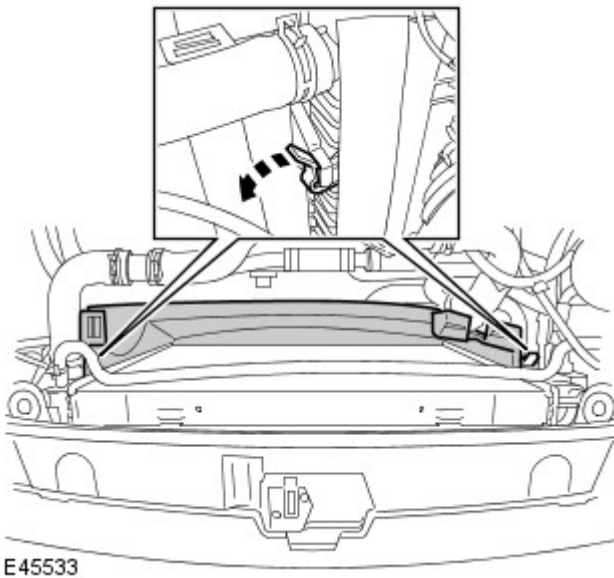
- Release the 2 clips.
- Position the wiring harness aside.



10. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

11. Remove the lower fan shroud.

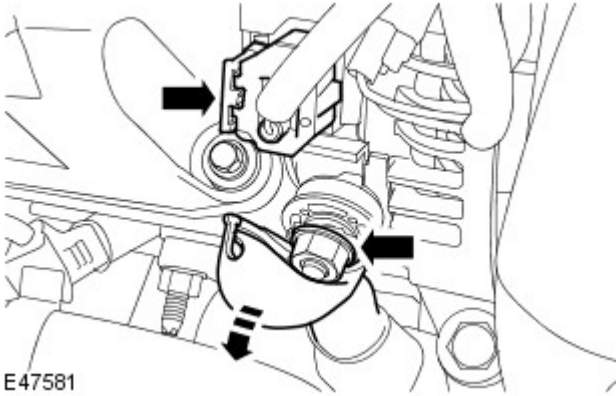
- Release 2 clips from the cooling fan lower shroud.



12. Install a shield to protect the radiator core from damage.

13. Disconnect the generator electrical connectors.

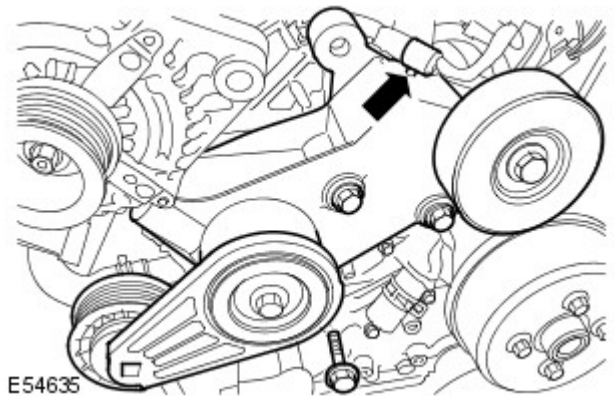
- Disconnect the electrical connector.




E47581

14. Position the generator mounting bracket aside.

- Remove the 3 bolts.
- Release the wiring harness clip.
- Remove and discard the cable tie.

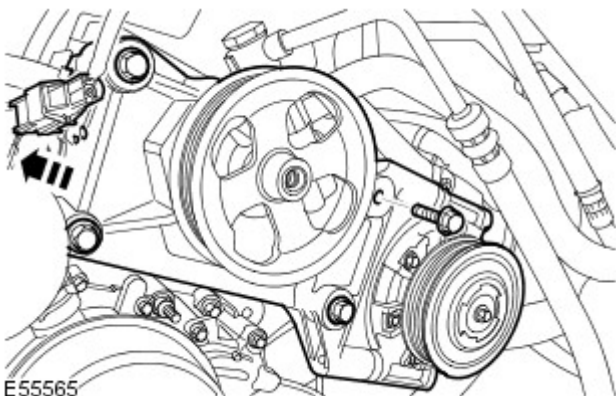


E54635

15.  CAUTION: The A/C system will remain fully charged during this procedure, care must be taken when positioning the assembly aside.

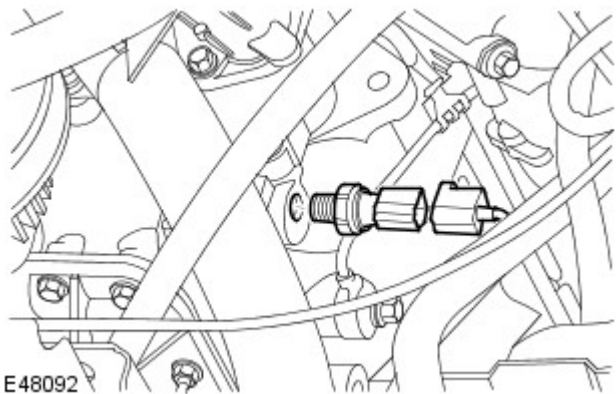
Position the A/C compressor mounting bracket assembly aside.

- Disconnect the A/C compressor electrical connector.
- Release the LH KS electrical connector retaining clip.
- Remove the 4 bolts.



E55565

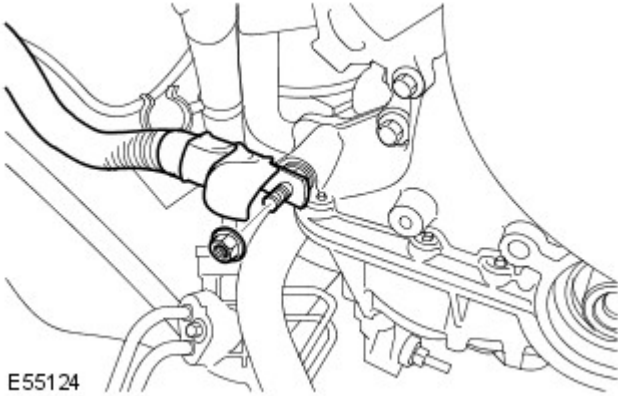
16. Disconnect the engine oil pressure (EOP) sensor electrical connector.



E48092

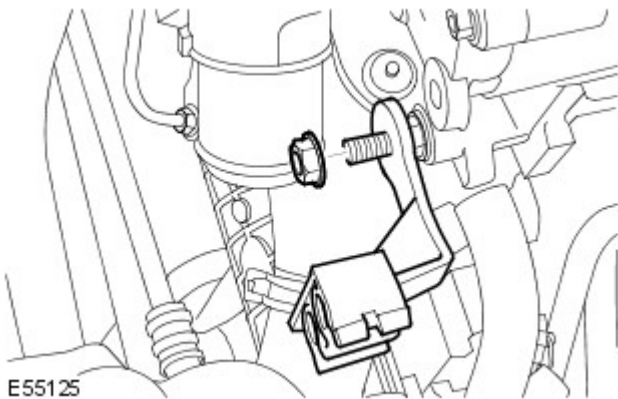
17. Disconnect the engine ground cable.

- Remove the nut.



18. Release the transmission cooler pipes.

- Remove the nut.
- Position aside.



19. Remove the EGR pipe.

- Loosen the EGR union nut and release the pipe.



20. Check the road wheels are in the straight ahead position, then remove the upper clamp bolt.

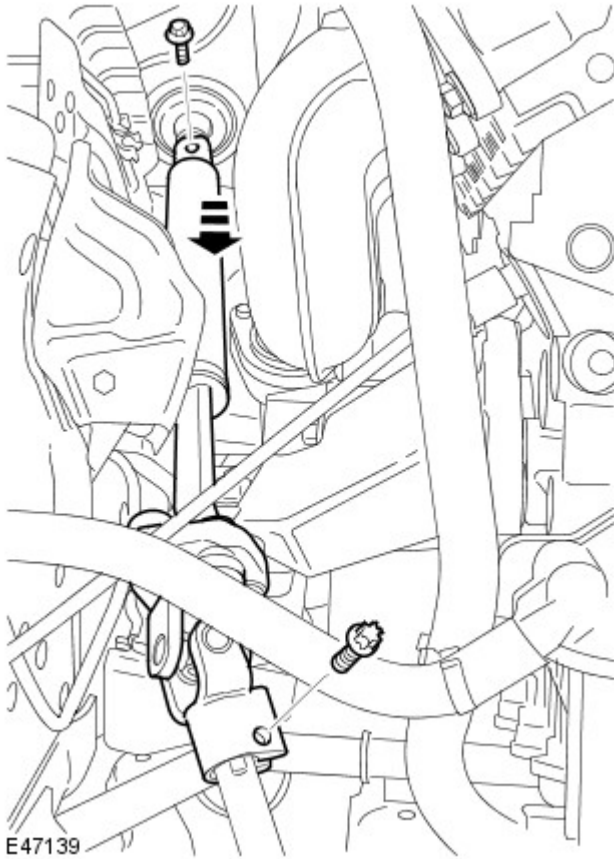
- Discard the retaining bolt.

21. Remove the steering gear universal joint clamp bolt.

- Discard the retaining bolt.

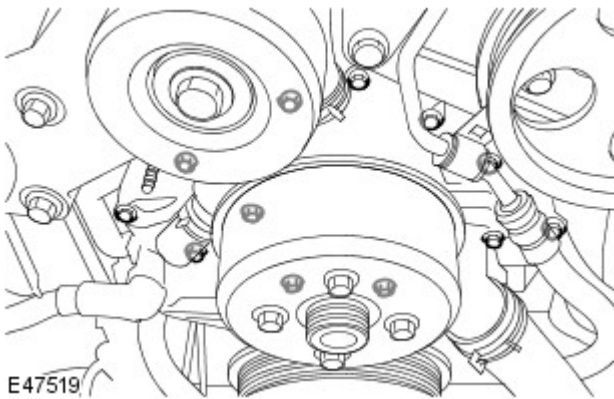
22. Release the upper steering column shaft.

23. Release and remove the shaft and joint assembly.



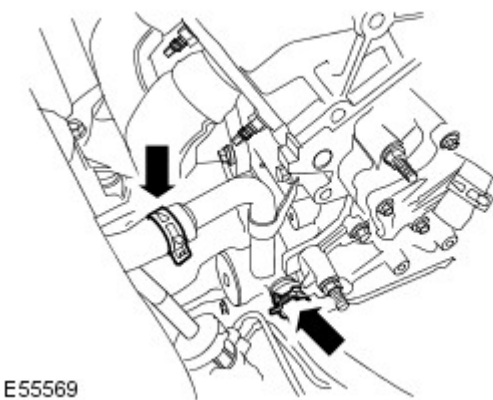
24. Release the coolant pump hose.

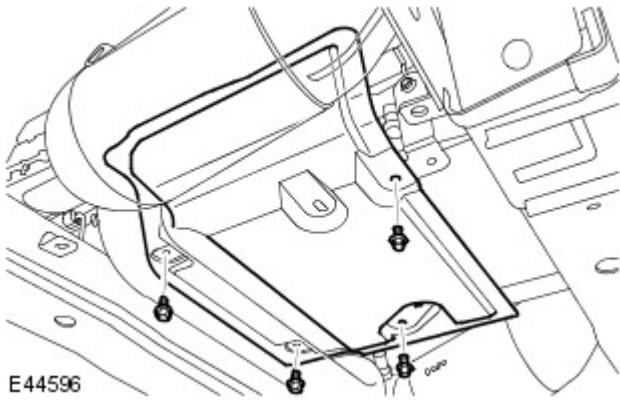
- Position aside.
- Release from the clip.



25. Disconnect the 2 engine oil cooler, coolant hoses.

- Release the 2 clips.





26. Remove the transmission heat shield.

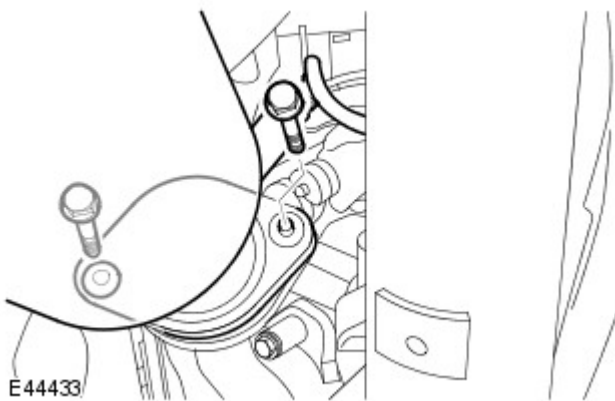
- Remove the 4 bolts.

27. Disconnect the LH catalyst monitor sensor electrical connector.

- Release HO2S harness from bracket.

28. Disconnect the LH catalytic converter from the exhaust manifold.

- Remove the 2 bolts.

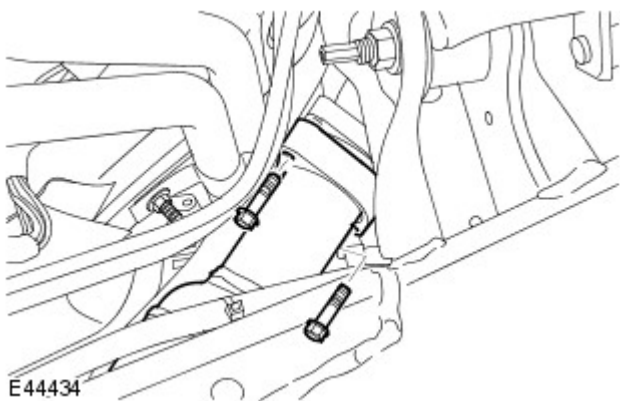


29. Disconnect the RH catalyst monitor sensor electrical connector.

- Release HO2S harness from bracket.

30. Disconnect the RH catalytic converter from the exhaust manifold.

- Remove the 2 bolts.

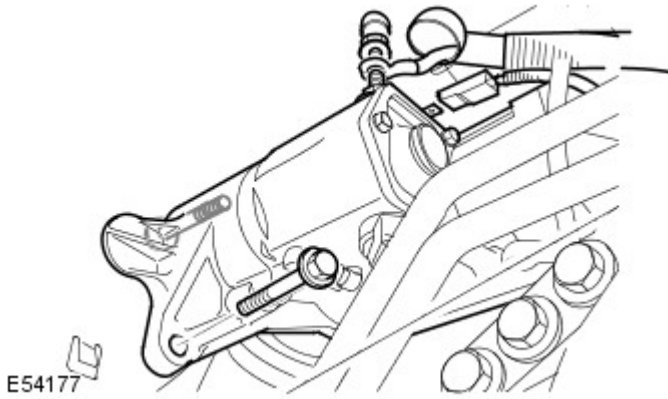




31. Disconnect the engine oil temperature sensor electrical connector.

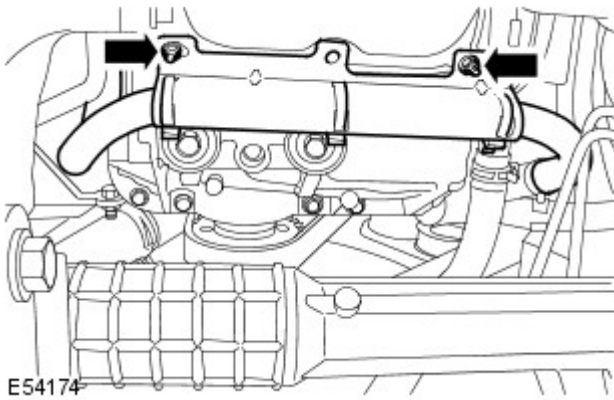
32. Release the starter motor.

- Remove the 2 bolts.

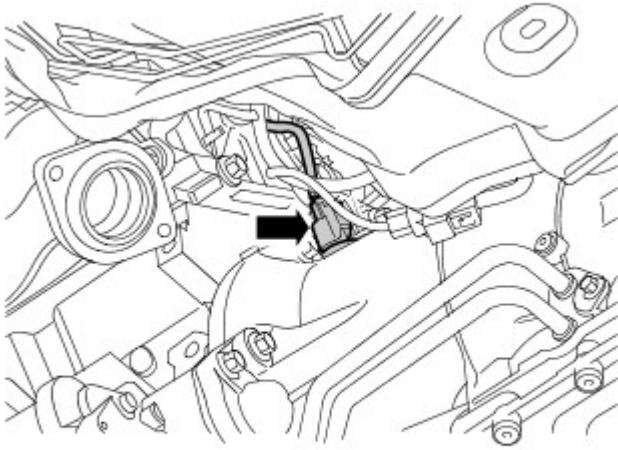


33. Release the harness bracket.

- Remove the 2 nuts.



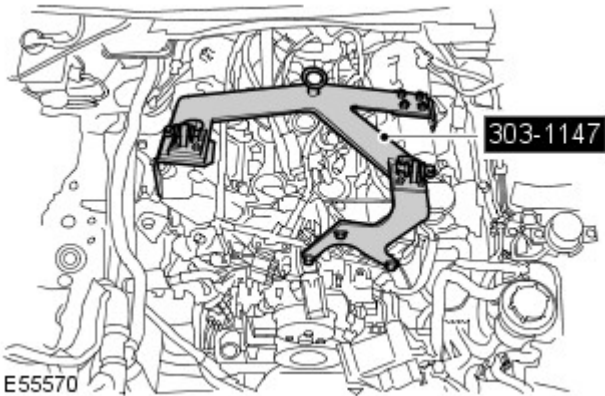
34. Disconnect the crankshaft position (CKP) sensor electrical connector.



E63835

35. Install the engine lifting bracket.

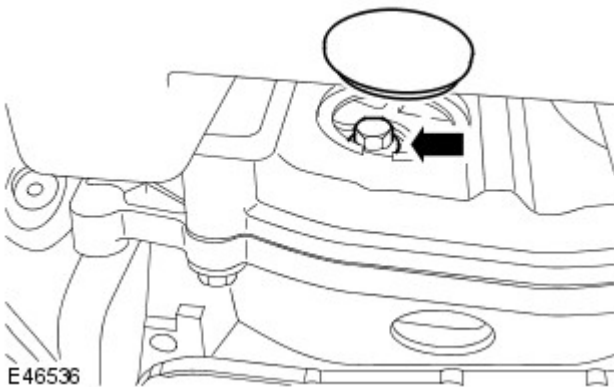
- Tighten the bolts to 45 Nm (33 lb.ft).
- Evenly and progressively, tighten the nuts to 25 Nm (18 lb.ft).



E55570

36. Release the flexplate.

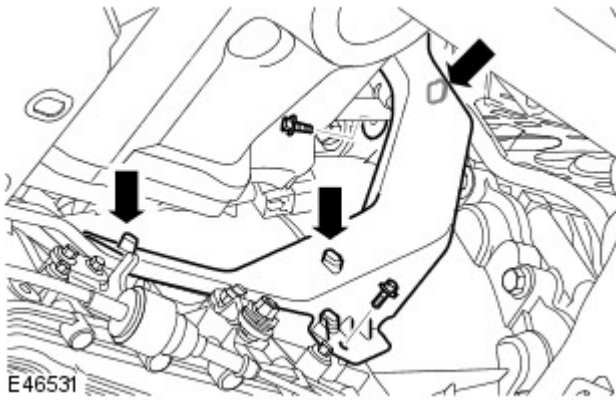
- Rotate the crankshaft to access the retaining bolts.
- Remove the 4 bolts.




E46536

37. Release the fuel pipe and purge line heat shield.

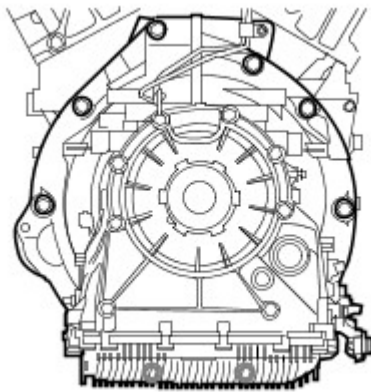
- Remove the 2 bolts.
- Position the fuel line shield aside for access.




38.  **WARNING:** Support the engine. The engine will fall forward when the transmission is removed.

Remove the transmission bolts.

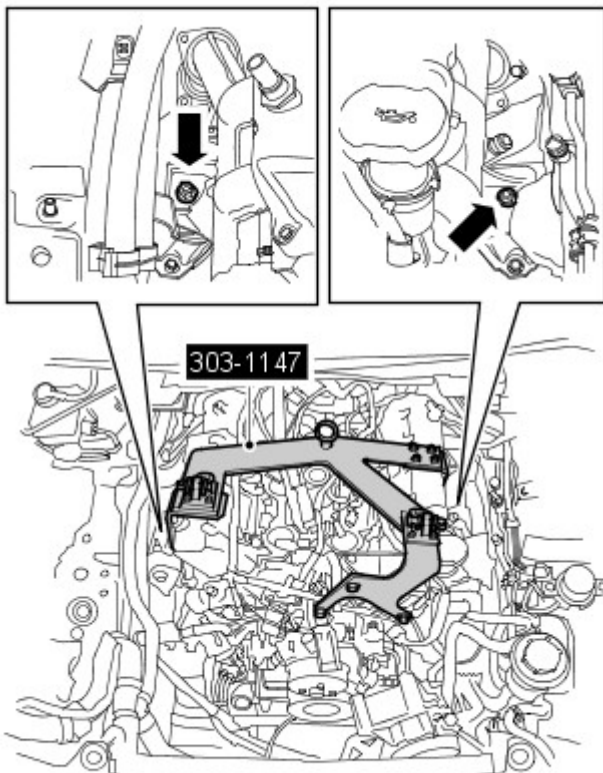
- Connect the lifting chains.
- Support the transmission.
- Remove the 8 bolts.



39.  **WARNING:** Make sure the torque converter remains with the transmission.

Remove the engine.


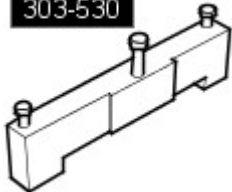


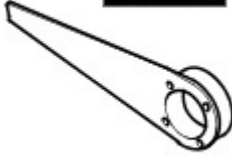

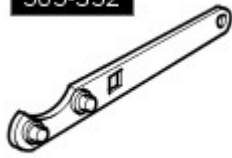
- Remove the 2 engine mount nuts.
- Remove the engine RH mount.
- Raise the engine.
- With assistance, carefully remove the engine.



40. Install the torque converter retainer.

Engine - V6 4.0L Petrol - Engine

Disassembly

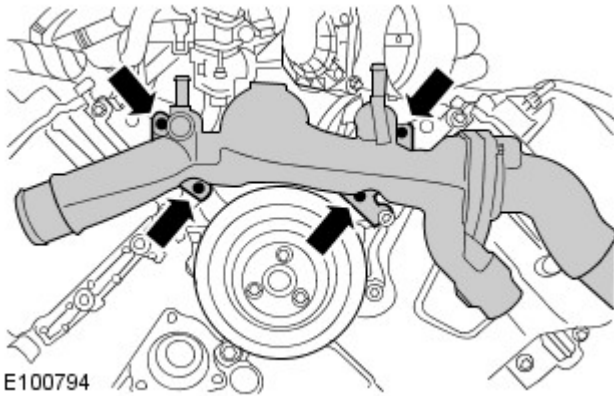
Special Tool(s)	
<p>303-645</p>  <p>E46881</p>	<p>Timing Setting tool</p> <p>303-645</p>
<p>303-530</p>  <p>E46879</p>	<p>Camshaft setting/locking tool</p> <p>303-530</p>
<p>303-1100-01</p>  <p>E67144</p>	<p>Adapter - Crankshaft seal installer</p> <p>303-1100-01</p>
<p>303-191-03</p>  <p>E46730</p>	<p>Adapter</p> <p>303-191-03</p>
<p>303-893</p>  <p>E46728</p>	<p>Holding Tool Crankshaft Pulley</p> <p>303-893(LRT-12-080)</p>
<p>303-191-04</p>  <p>E59251</p>	<p>Bolts and spacers</p> <p>303-191-04</p>
<p>303-532</p>  <p>E46880</p>	<p>Timing chain tensioning tool</p> <p>303-532</p>

Disassembly

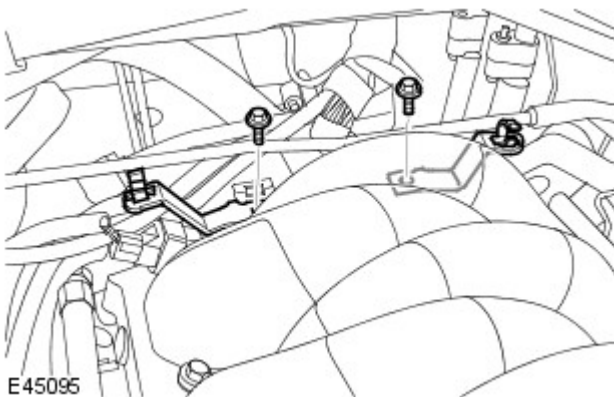
1. Remove the engine assembly.
2. Secure the engine to the engine stand.
 - Align the engine to the engine stand.
 - Adjust the engine stand legs into position.
 - Mount the engine to an engine stand.
 - Fully tighten the engine stand leg nuts.
3. Release the camshaft position (CMP) sensor connector block from the intake manifold assembly.



4. Remove the coolant manifold.
 - Remove the 4 bolts.
 - Disconnect the electrical connector.



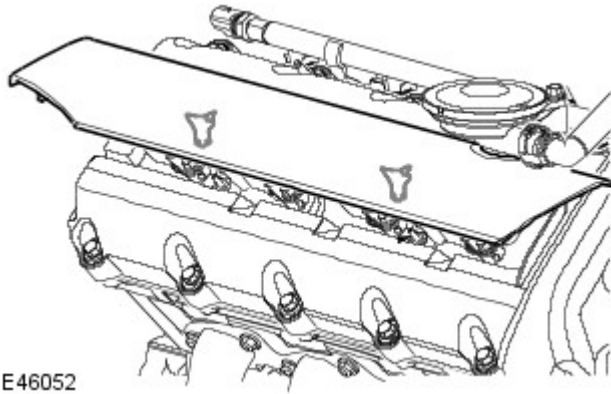
5. Position the wiring harness support bracket aside for access.
 - Remove the 2 bolts.



6. NOTE: RH illustration shown, LH is similar.

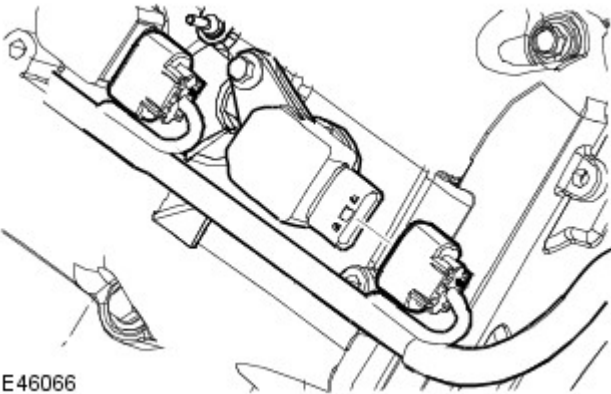
Remove both the ignition coil-on-plug covers.

- Release from the 2 clips.



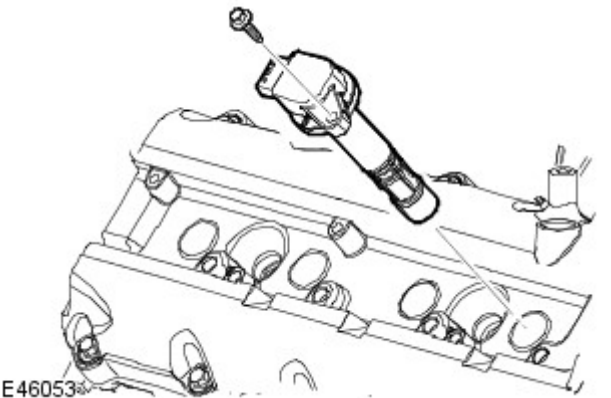
7. NOTE: RH illustration shown, LH is similar.

Disconnect the 8 ignition coil-on-plug electrical connectors.



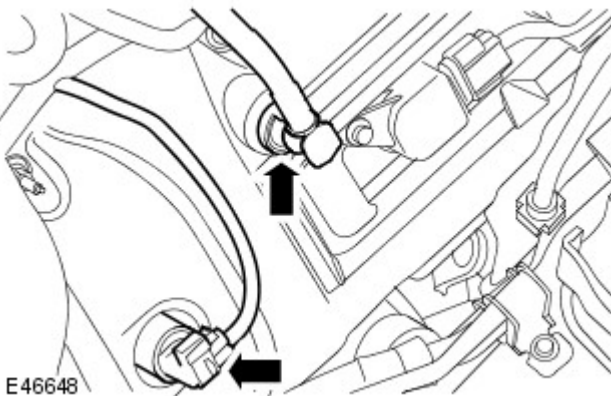
8. Remove the 8 ignition coil-on-plugs.

- Remove the 8 bolts.



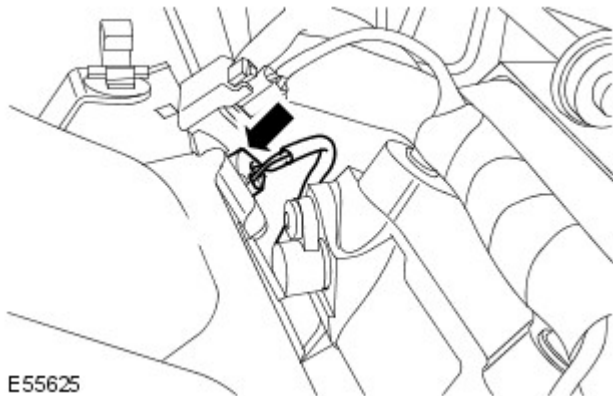
9. Disconnect the valve cover breather hose.

- Disconnect the variable camshaft timing (VCT) oil control solenoid electrical connector.
- Repeat the operation for the other side.



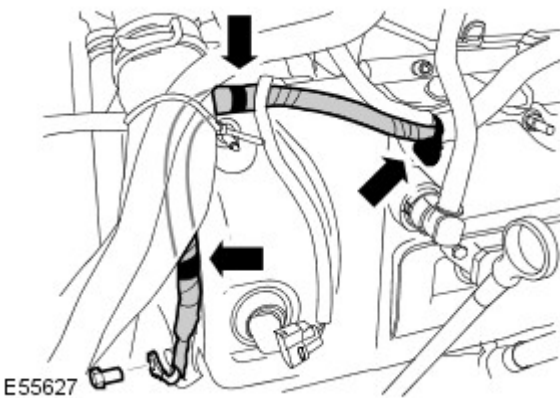


10. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



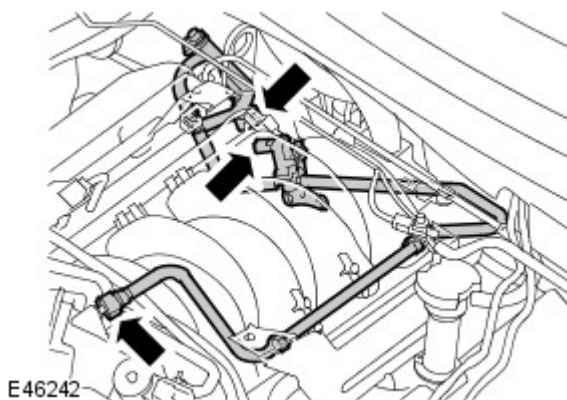
11. Disconnect the CMP sensor electrical connector.

- Repeat the above procedure for the RH side.



12. Disconnect the cylinder head earth connector.

- Remove the bolt.
- Release the 3 clips.

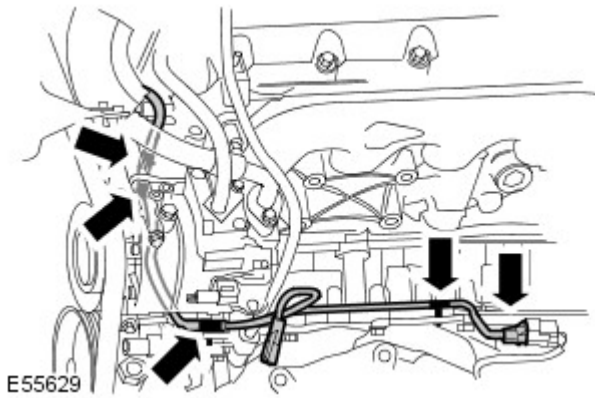


13. Disconnect the knock sensors (KS) electrical connector.

14. Release the purge valve from the mounting bracket.

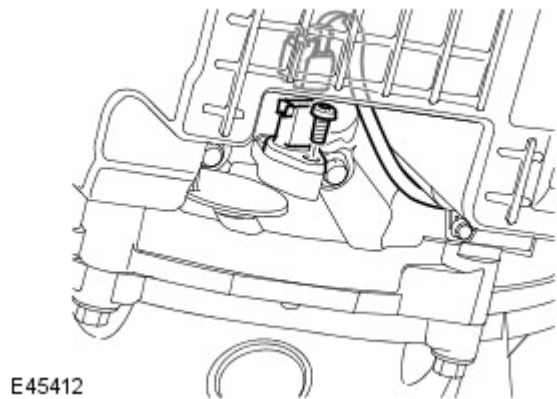
- Disconnect the quick release connector.
- Disconnect the electrical connector.
- Remove the bolt.

15. Release the 5 air conditioning (A/C) harness retaining clips.



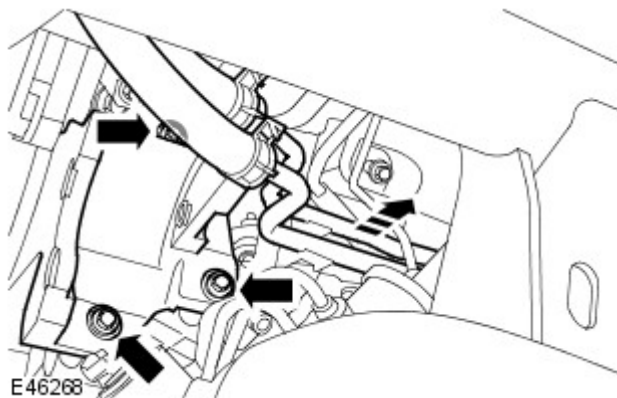
16. Remove the crankshaft position (CKP) sensor.

- Disconnect the electrical connector.
- Remove the Torx screw.



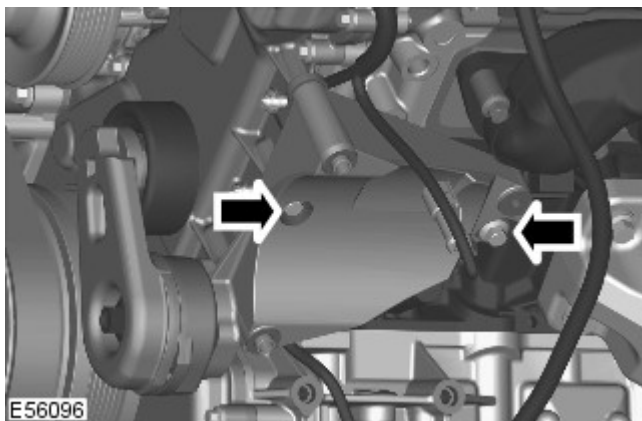
17. Remove the power steering pump mounting bracket.

- Remove the 3 bolts.
- Release the transmission cooler pipe clips.

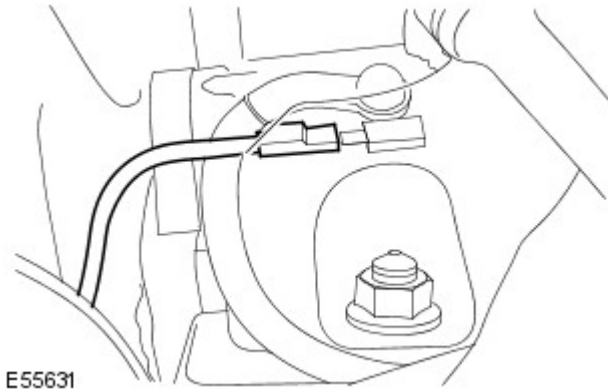


18. Remove the A/C compressor mounting bracket.

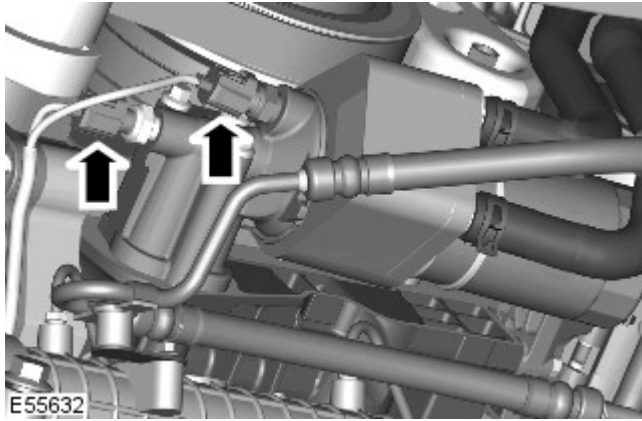
- Remove the 2 bolts.



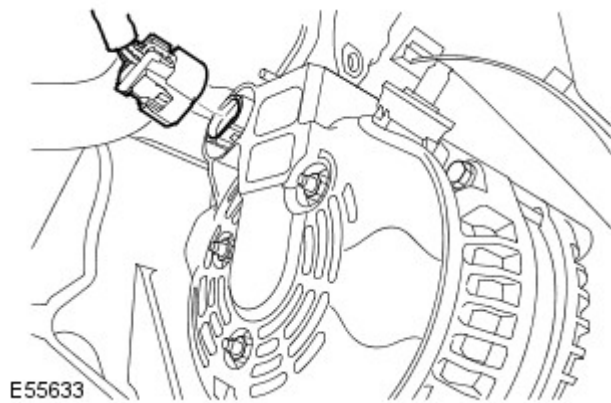
19. Disconnect the starter motor connector.



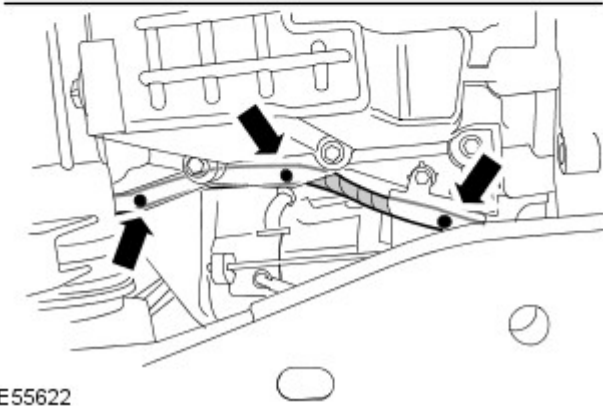
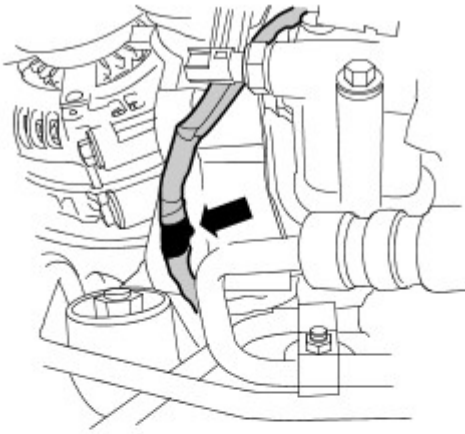
20. Disconnect the oil temperature and oil pressure sensors.



21. Disconnect the generator connector.

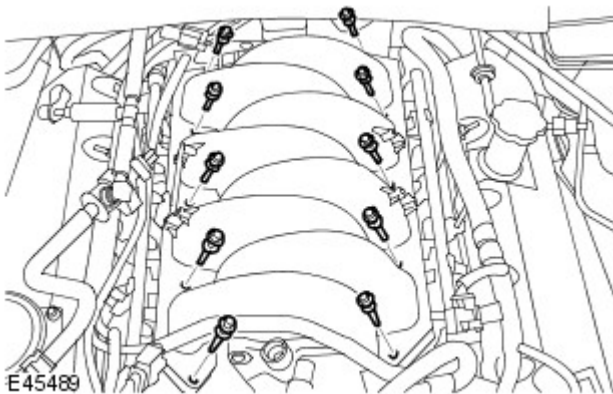


22. Release the 4 clips securing the generator harness.




E55622

23. Remove the 10 intake manifold bolts.

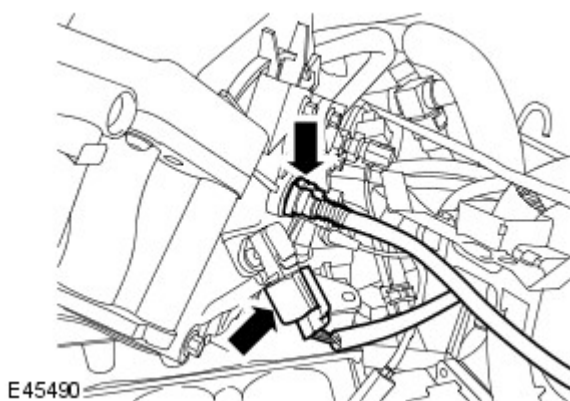


E45489

24.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the intake manifold.

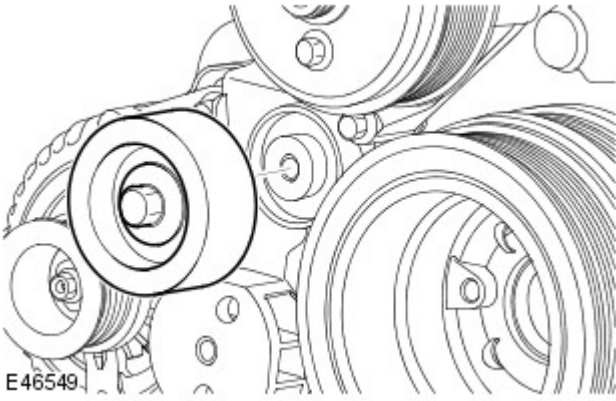
- Disconnect the brake booster vacuum hose from the intake manifold.
- Discard the gaskets.
- Disconnect the manifold absolute pressure (MAP) sensor electrical connector.



E45490

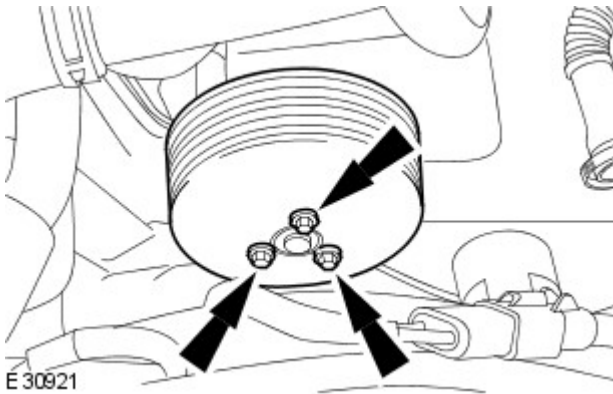
25. Remove the accessory drive belt idler pulley.

- Remove the bolt.

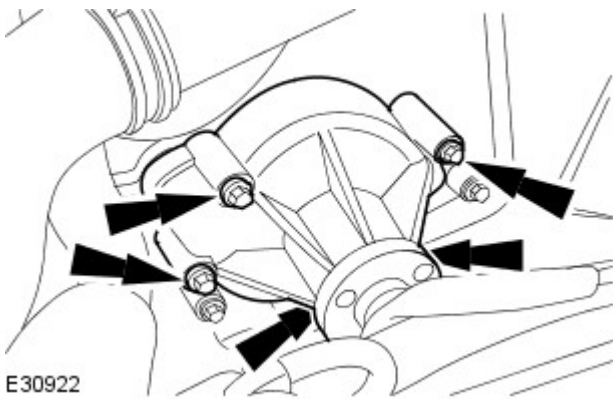


26. Remove the coolant pump pulley.

- Remove the 3 bolts.

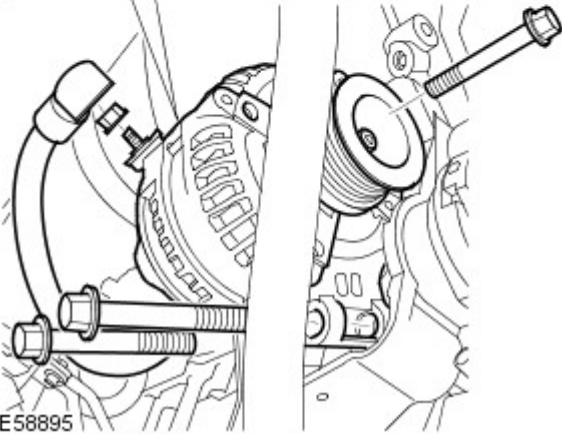
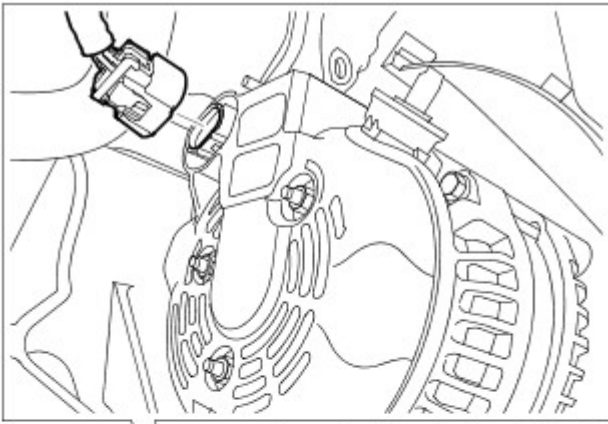


27. Remove the coolant pump.



28. Remove the generator.

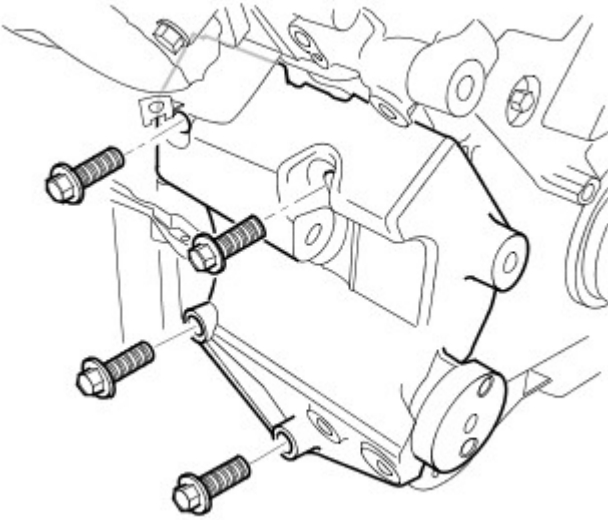
- Disconnect the electrical connector.
- Remove the 3 bolts.



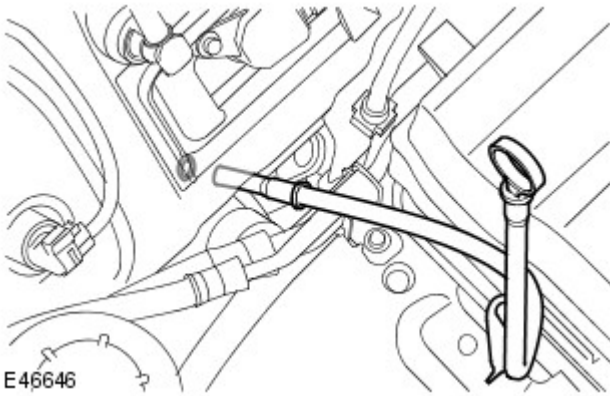
E58895

29. Remove the generator mounting bracket.

- Remove the 4 bolts.

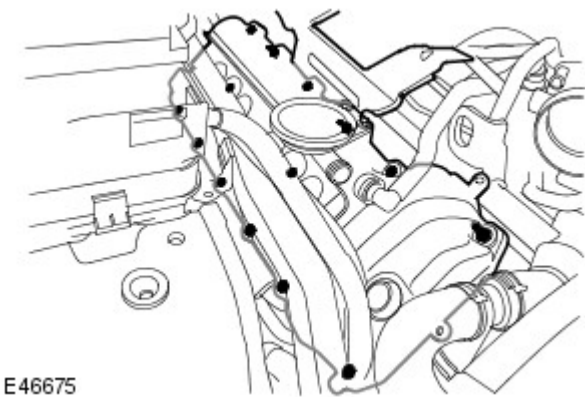


E58798



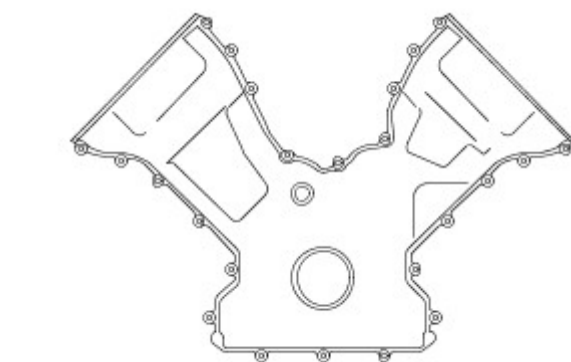
30. Remove the oil level indicator and tube.

- Remove the nut.
- Discard the O-ring seal.



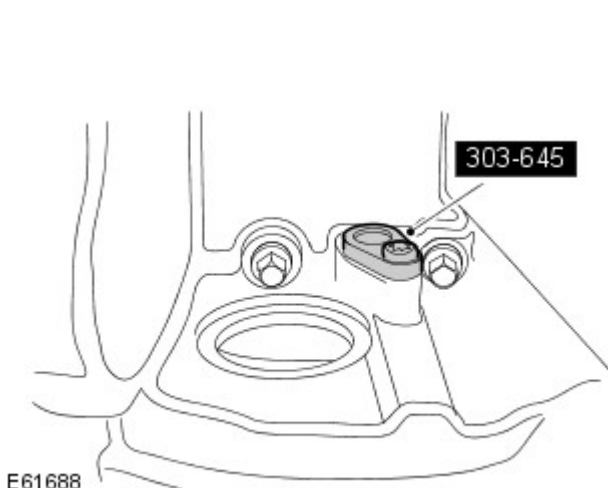
31. Remove the RH valve cover.

- Remove the 14 valve cover retaining bolts.
- Remove and discard the valve cover gasket.
- Remove and discard the valve cover plug aperture seals.
- Repeat the operation for the LH side.



32. Remove the engine front cover.

- Release the engine wiring harness clips.
- Remove the 24 bolts.
- Remove and discard the gasket.

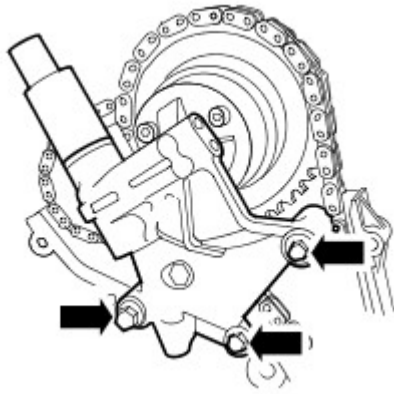


33. Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

34. NOTE: The engine is now in the SAFE position.

Lock the crankshaft.

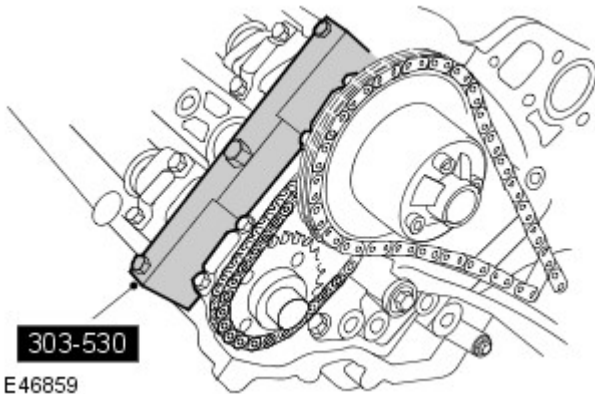
- Install the special tool.
- Install the screw.



E46858

35. Remove the RH VCT control unit.

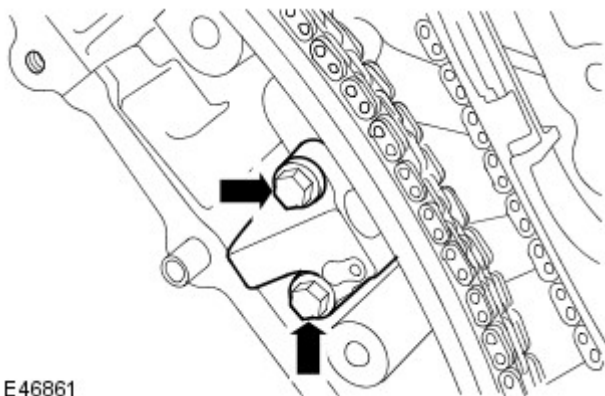
- Remove the 3 bolts.
- Remove and discard the O-ring seals.



E46859

36. Install the special tool to the RH cylinder head.

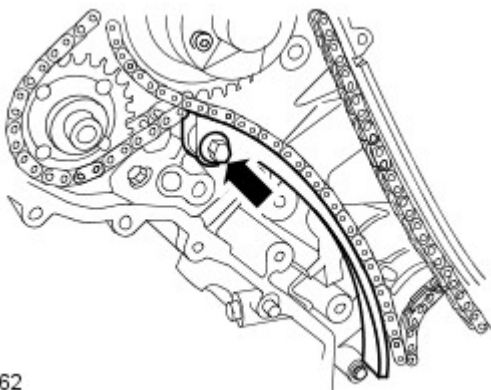
- Install the 3 bolts.



E46861

37. Remove the RH primary timing chain tensioner assembly.

- Remove the 2 bolts.

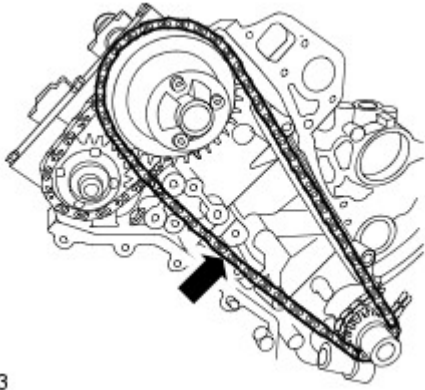


E46862

38. Remove the RH primary timing chain tensioner guide.

- Remove the bolt.

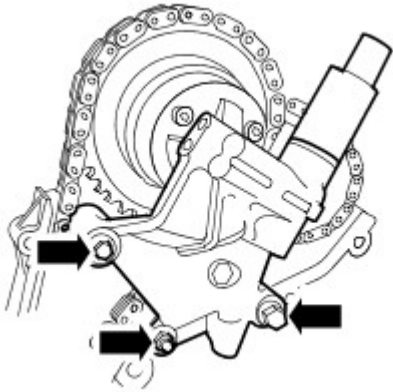
39. Remove the RH primary timing chain.



E46863

40. Remove the LH VCT control unit.

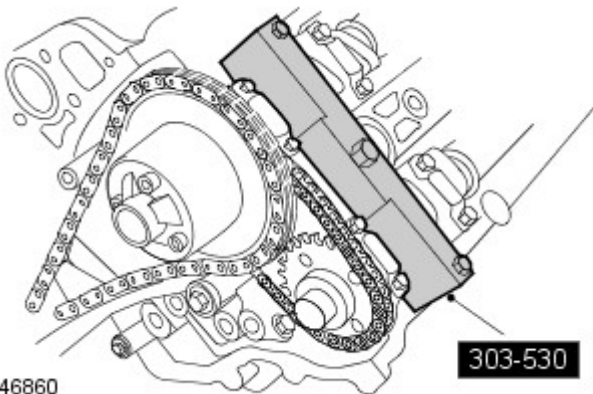
- Remove the 2 bolts.
- Remove the nut.
- Remove and discard the O-ring seals.



E48360

41. Install the special tool to the LH cylinder head.

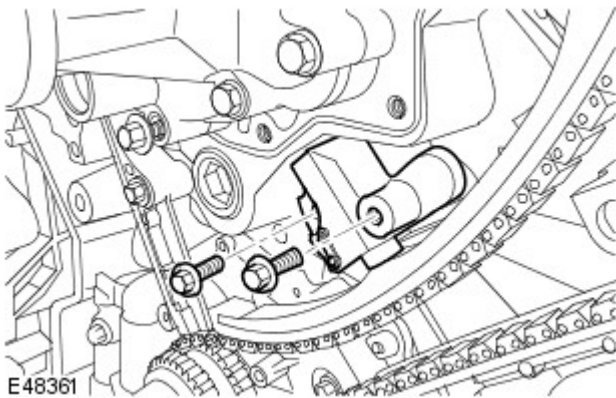
- Install the 3 bolts.



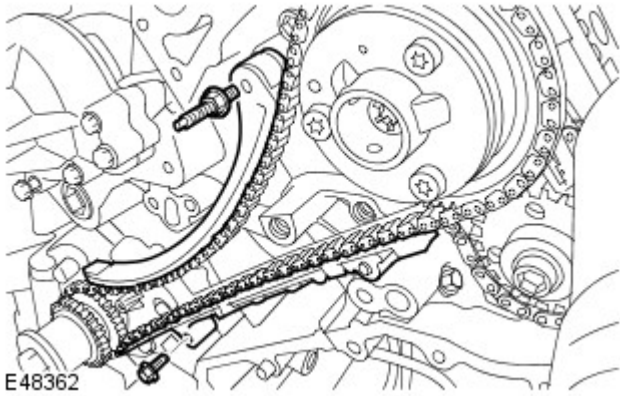
E46860

42. Remove the LH primary timing chain tensioner.

- Remove the 2 bolts.

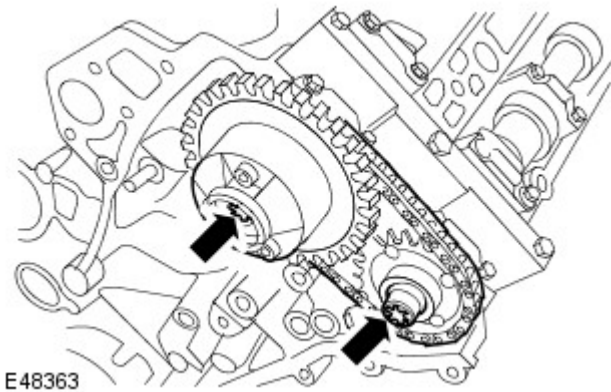


E48361



43. Remove the LH upper and lower primary timing chain tensioner guides.

- Remove the stud.
- Remove the bolt.

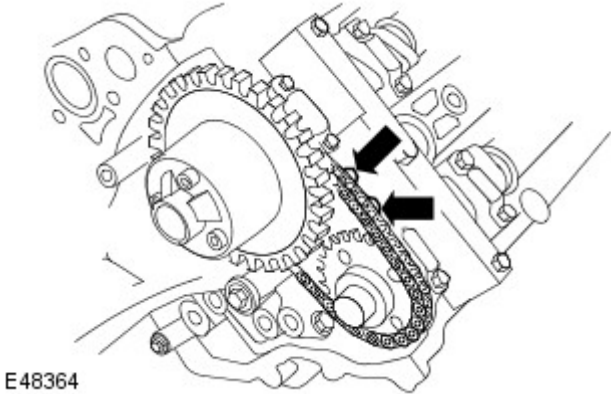


44. Remove the LH primary timing chain.

45.  **CAUTION:** Discard the bolts.

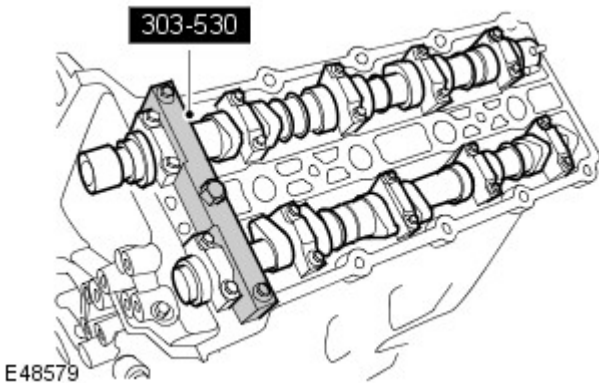
Remove the camshaft sprockets.

- Remove the 2 bolts.



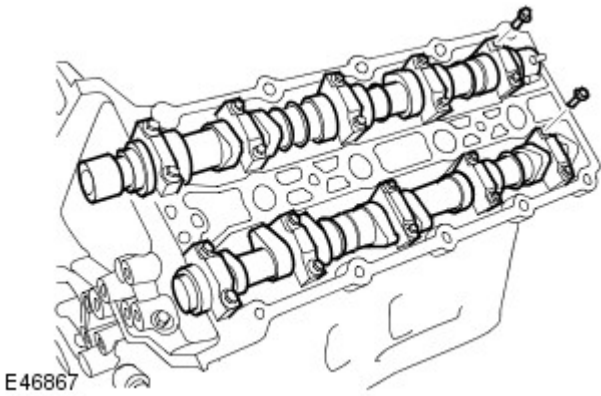
46. Remove the secondary timing chain tensioner and the secondary timing chain.

- Remove the 2 bolts.



47. Remove the special tool from the LH cylinder head.

- Remove the 3 bolts.



48.  **CAUTION:** Evenly and progressively, release the camshaft bearing caps.

• **NOTE:** Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

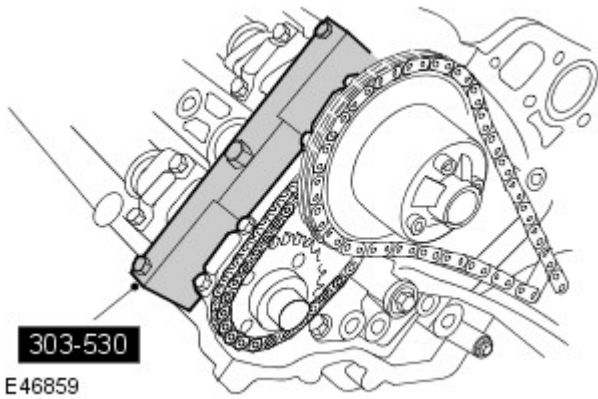
Remove the camshaft bearing caps.

- Remove the 20 bolts.

49. Remove the camshafts.

50. Install the special tool to the RH cylinder head.

- Install the 3 bolts.

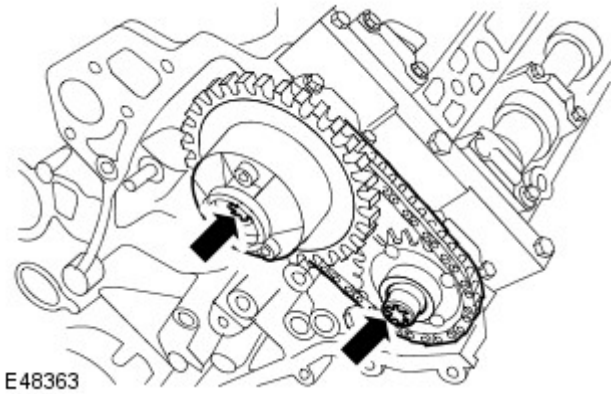


51.  **CAUTION:** Discard the bolts.

• **NOTE:** LH illustration shown, RH is similar.

Remove the camshaft sprockets.

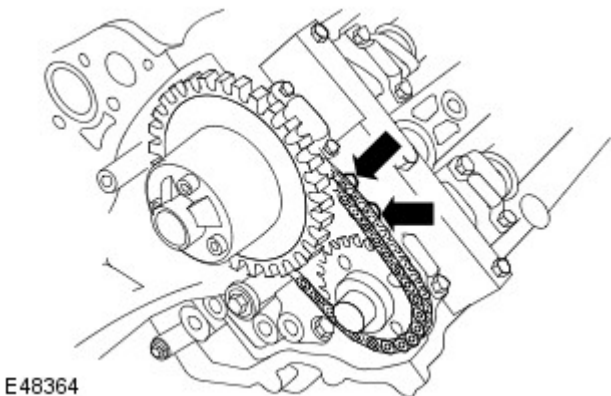
- Remove the 2 bolts.

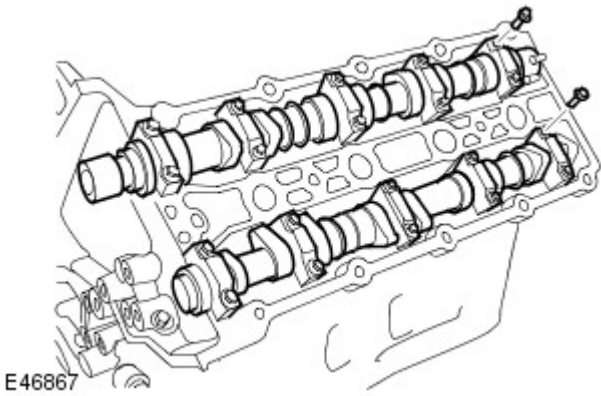


52. **NOTE:** LH illustration shown, RH is similar.

Remove the secondary timing chain tensioner and the secondary timing chain.

- Remove the 2 bolts.





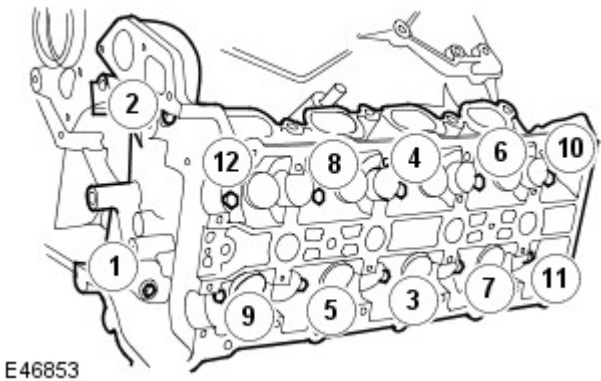
53. ⚠ CAUTION: Evenly and progressively, release the camshaft bearing caps.

• NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

• NOTE: LH illustration shown, RH is similar.

Remove the camshaft bearing caps.

- Remove the 20 bolts.



54. CAUTIONS:

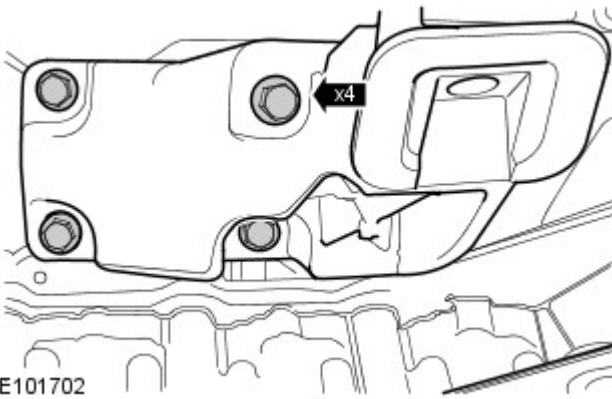
⚠ Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

⚠ The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.

Remove the LH cylinder head assembly.

- Remove the 12 cylinder head bolts.
- With assistance remove the cylinder head.
- Remove and discard the cylinder head gasket.
- Clean the cylinder head locating dowels.
- Clean the component mating faces.
- Repeat the operation for the RH side.

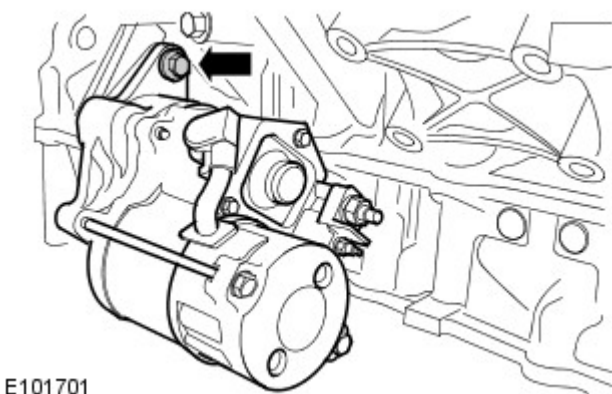
55. Remove 4 bolts securing the engine mount bracket to the cylinder block.



56. ⚠ CAUTION: Note the position of the bolt.

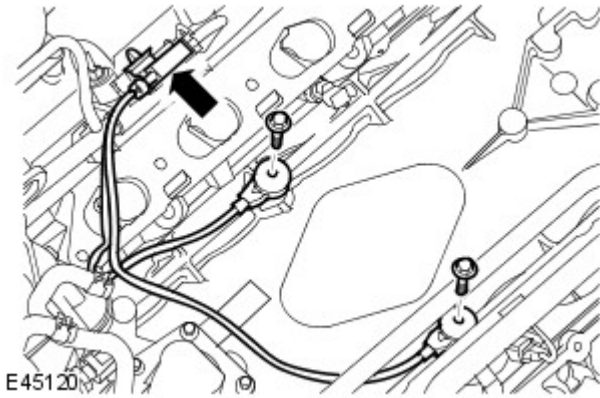
Remove the starter motor.

- Remove the remaining starter motor bolt.



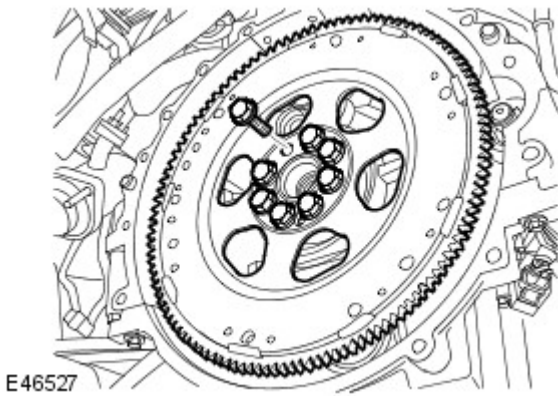
E101701

57. Remove the KS.



58. Remove the flexplate.

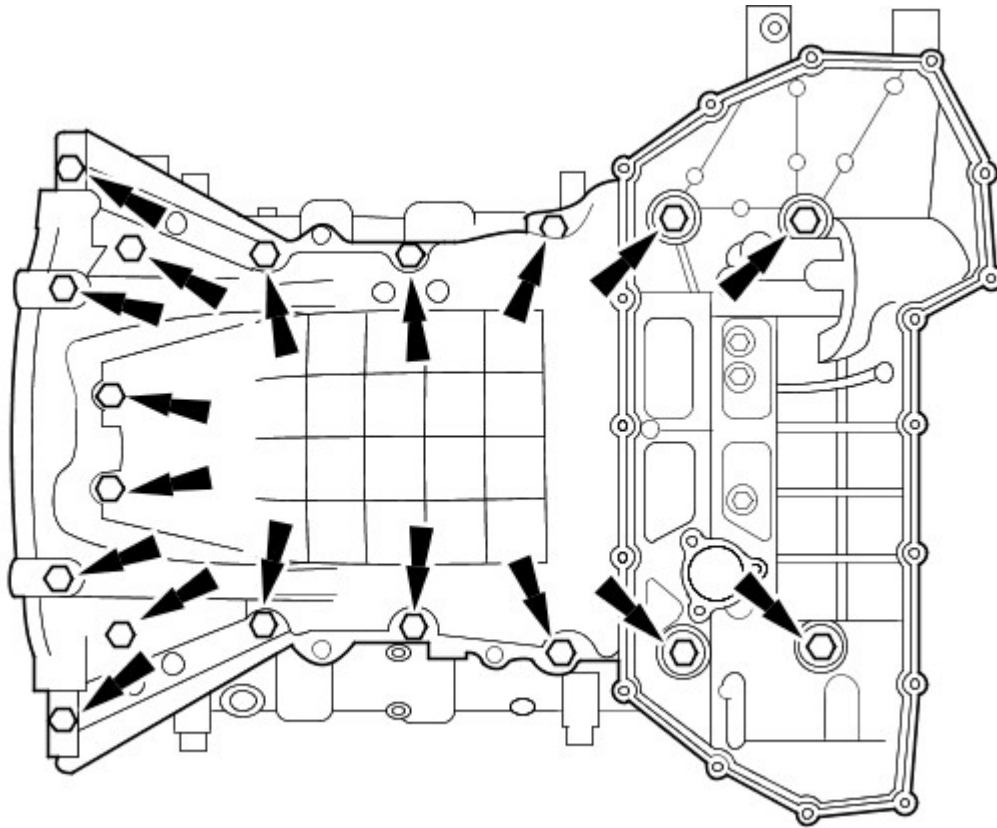
- Remove and discard the 8 bolts.



59. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the oil pan.

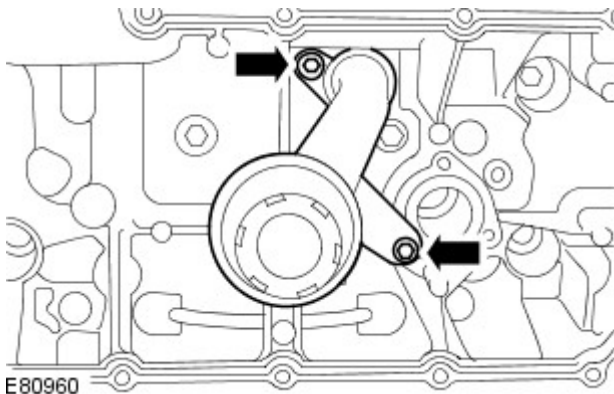
- Remove the 18 bolts.
- Clean all the mating faces and reusable parts thoroughly and check for damage.



VUJ0002435

60. Remove the oil strainer pick-up assembly.

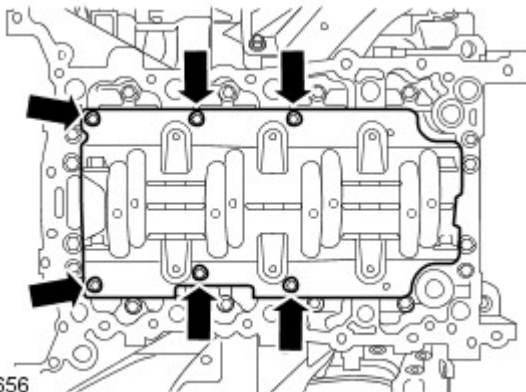
- Remove the 2 bolts.
- Remove and discard the O-ring seal.



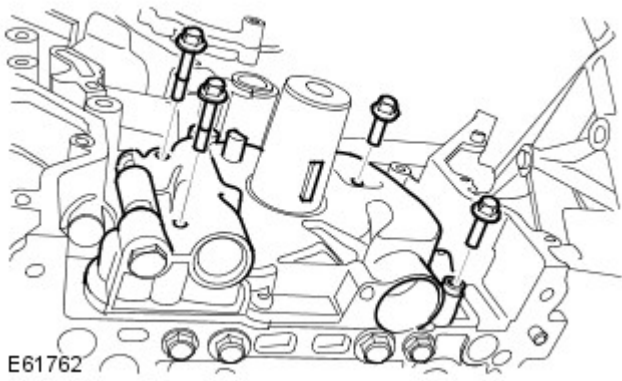
E80960

61. Remove the baffle plate.

- Remove the 6 bolts.



E82656



62. Remove the oil pump assembly.

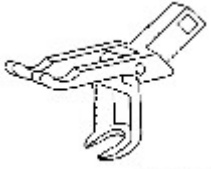

- Remove the 4 bolts.
- Remove and discard the gasket.
- Clean the component mating faces.

63. Remove the engine from the engine stand.

- With assistance, remove the engine block from the stand.

Engine - V6 4.0L Petrol - Cylinder Head

Disassembly and Assembly of Subassemblies

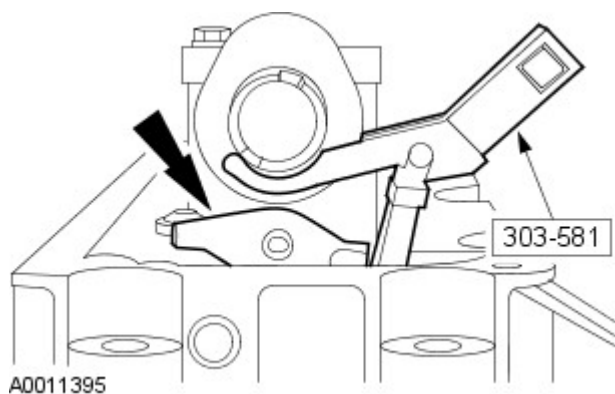
Special Tool(s)	
 <p>ST1330-A</p>	Compressor, Valve Spring 303-581 (T97T-6565-A)
 <p>ST1824-A</p>	Installer, Valve Stem Oil Seal 303-370 (T90T-6571-A)

Materials

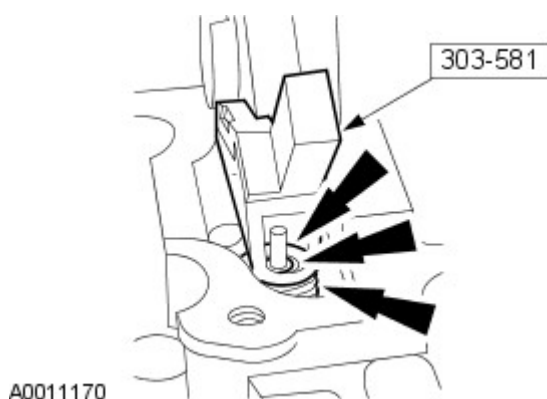
Name	Specification
Super Premium SAE 5W-30 Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

Disassembly

1. Remove the spark plugs.
2. Using the special tool, remove the camshaft roller followers.

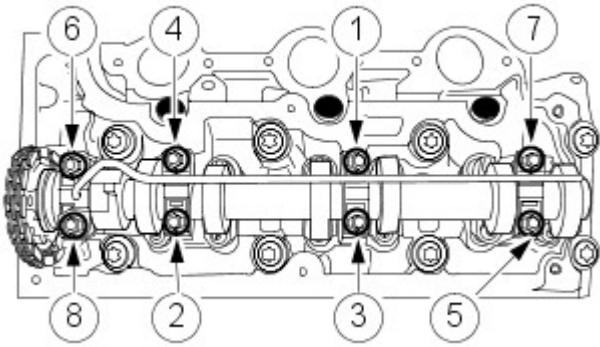


3. Using the special tool, remove the valve spring retainer keys, the valve spring and the retainer.



4. Remove the valve.
5. Repeat the procedure until all of the valves are removed.
6. Remove the valve stem seals.

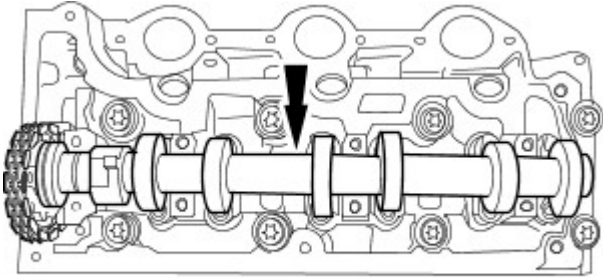
7. NOTE: Mark the position of the camshaft bearing caps so they can be installed in the original position.



GA2294A

Remove the bolts in the sequence shown and remove the camshaft bearing caps.

8. Remove the camshaft.



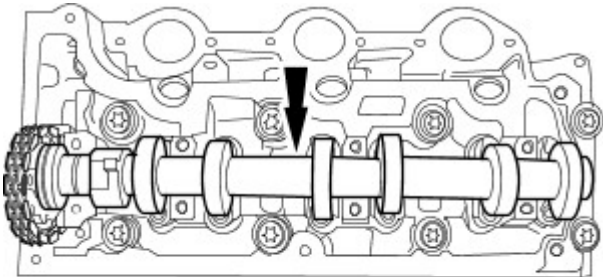
GA2295-A

9. Inspect the cylinder head. For additional information, refer to For additional information, refer to: [Cylinder Head Distortion](#) (303-00 Engine System - General Information, General Procedures).

Assembly

• NOTE: Prior to assembly, coat all of the valve train components with clean engine oil.

1. Install the camshaft.



GA2295-A

2. NOTE: The camshaft bearing caps must be installed in the original position.

• NOTE: After installing the bolts, check the camshaft for free rotation.

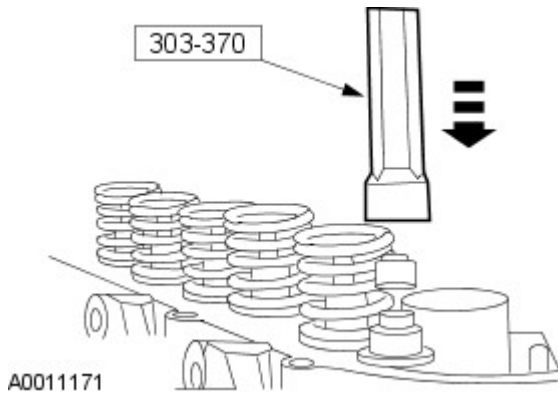
Position the oil supply tube, the camshaft bearing caps, and bolts.

- Tighten in the sequence shown in two stages:
- Stage 1: Tighten to 6 Nm (53 lb-in).
- Stage 2: Tighten to 16 Nm (12 lb-ft).

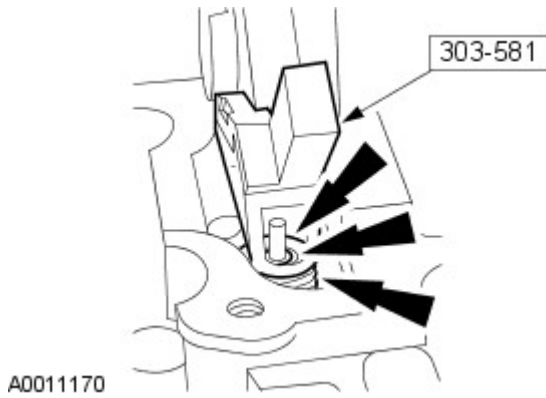
E134851

3. Install the valve.

4. Using the special tool, install the valve stem seals.

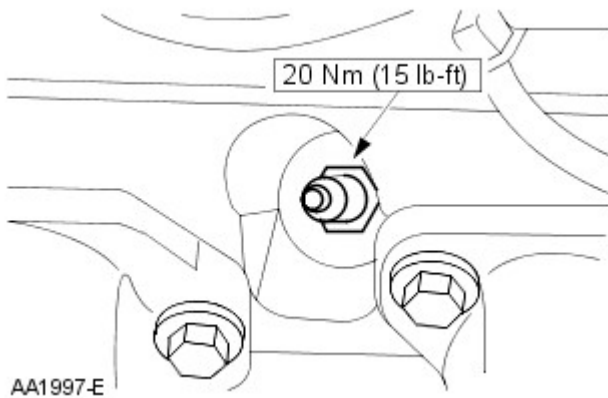


5. Using the special tool, install the valve spring, the retainer and the retainer keys.



6. Repeat the procedure until all of the valves are installed.


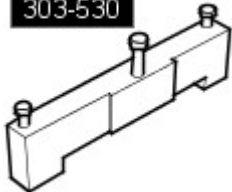


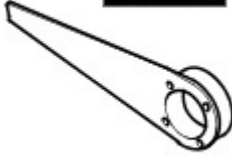

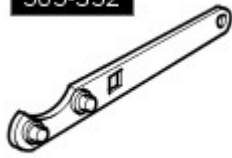
7. Install the spark plugs.



8. Install the camshaft roller followers only when the cylinder head is installed in the vehicle and the timing procedure has been carried out.

Engine - V6 4.0L Petrol - Engine

Assembly

Special Tool(s)	
 <p>303-645</p> <p>E46881</p>	<p>Timing Setting tool</p> <p>303-645</p>
 <p>303-530</p> <p>E46879</p>	<p>Camshaft setting/locking tool</p> <p>303-530</p>
 <p>303-1100-01</p> <p>E67144</p>	<p>Adapter - Crankshaft seal installer</p> <p>303-1100-01</p>
 <p>303-191-03</p> <p>E46730</p>	<p>Adapter</p> <p>303-191-03</p>
 <p>303-893</p> <p>E46728</p>	<p>Holding Tool Crankshaft Pulley</p> <p>303-893(LRT-12-080)</p>
 <p>303-191-04</p> <p>E59251</p>	<p>Bolts and spacers</p> <p>303-191-04</p>
 <p>303-532</p> <p>E46880</p>	<p>Timing chain tensioning tool</p> <p>303-532</p>

Assembly

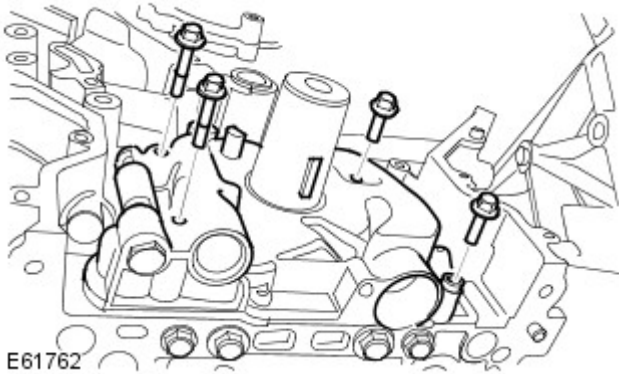
1. Secure the engine to the engine stand.

- Align the engine to the engine stand.
- Adjust the engine stand legs into position.
- Mount the engine to an engine stand.
- Fully tighten the engine stand leg nuts.

2. NOTE: Install a new gasket.

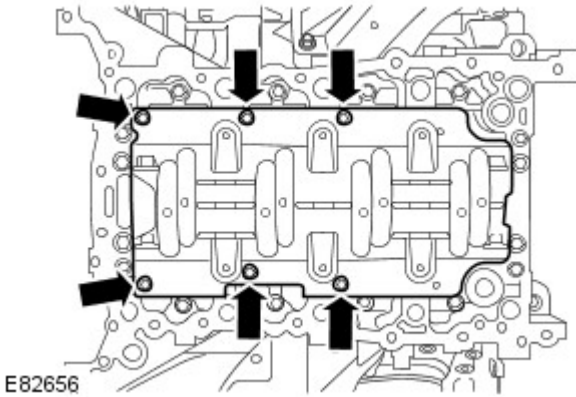
Install the oil pump assembly.

- Clean the component mating faces.
- Install the gasket.
- Tighten the bolts to 10 Nm.



3. Install the baffle plate.

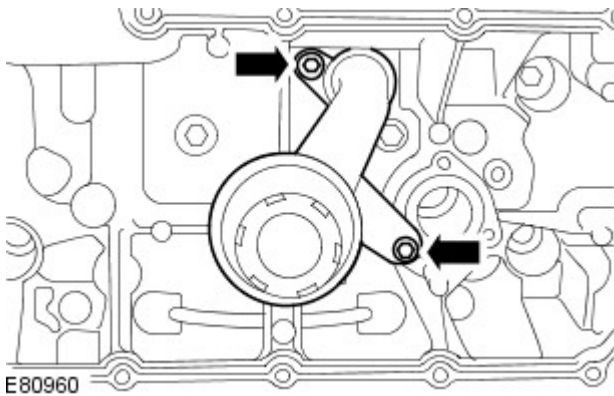
- Tighten the 6 bolts to 6 Nm.



4. NOTE: Install a new O-ring seal.

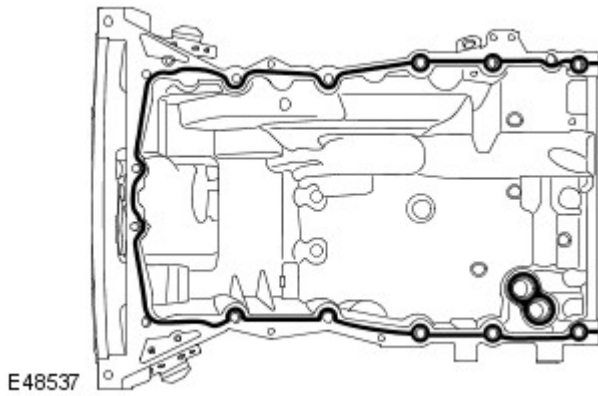
Install the oil strainer pick-up assembly.

- Install the O-ring seal.
- Tighten the M6 bolt to 10 Nm.
- Apply sealant to the M5 bolts.
- Tighten the M5 bolts to 6 Nm.



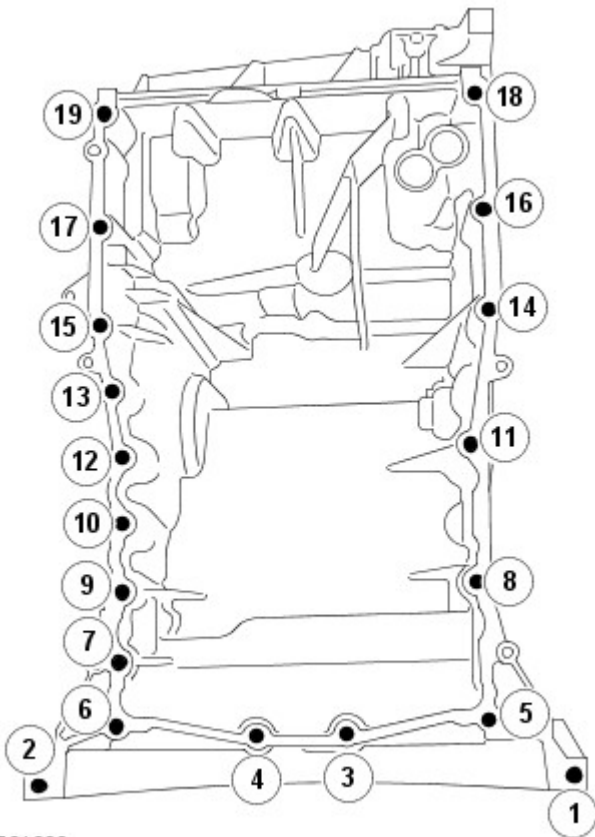
5. Install the oil pan.

- Clean the component mating faces.
- Apply a 3 mm diameter bead of sealant, to the area indicated.
- Install the bolts, but do not tighten fully at this stage.



E48537

6. Tighten the oil pan bolts in the sequence shown to 20 Nm.

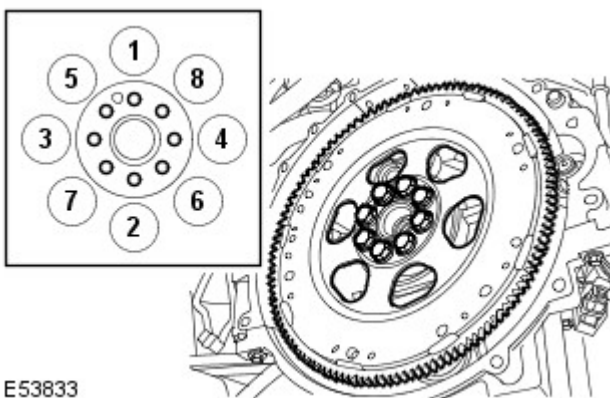


E61699

7. NOTE: Prevent the flexplate from rotating.

Install the flexplate.

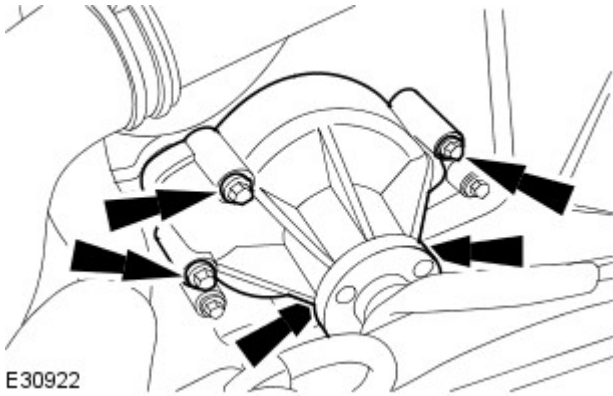
- Clean the component mating faces.
- Tighten the bolts evenly in 2 stages to the sequence shown.
- Tighten the bolts to 15 Nm.
- Tighten the bolts to 110 Nm.



E53833

8. Install the coolant pump.

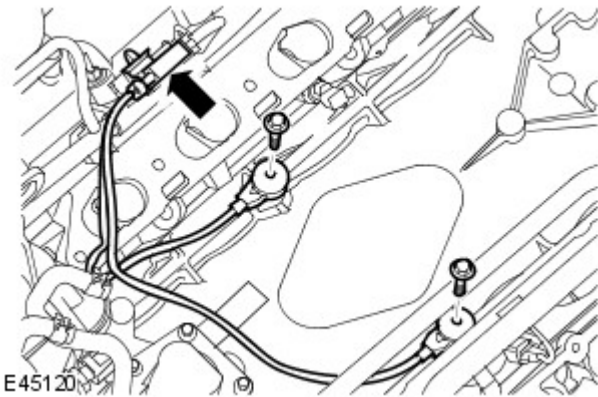
- Tighten the 5 bolts to 10 Nm.



9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Install the knock sensors (KS).

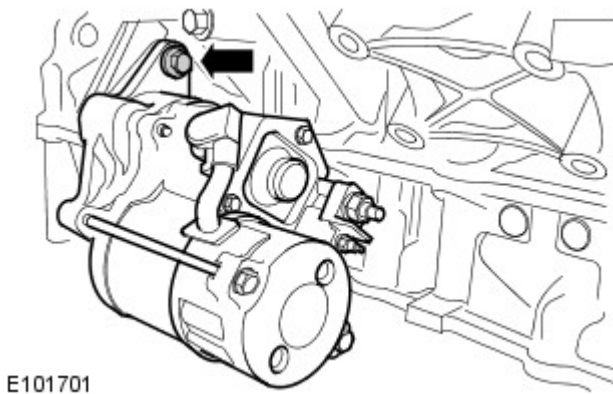
- Tighten the bolts to 20 Nm.



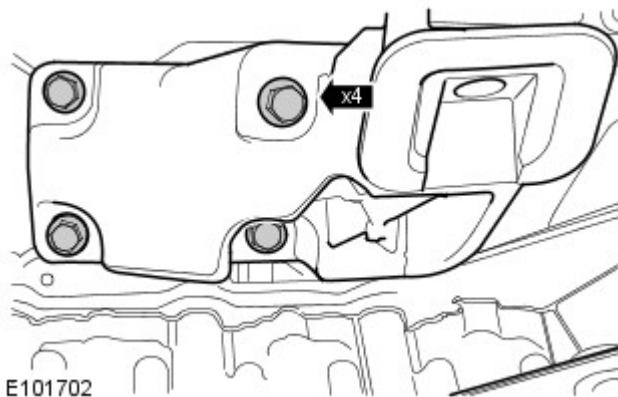
10. Position the starter motor.

- Install the starter motor.

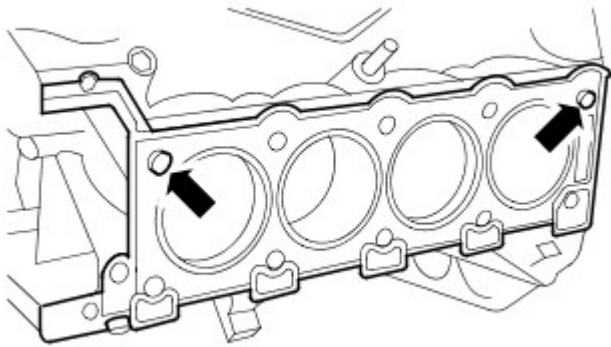
1. Tighten the bolt to 45 Nm.



11. Attach the engine mounting bracket.



12. NOTE: The cylinder head gaskets must be installed over the cylinder head to block dowels.



E46854

Install the RH cylinder head.

- Clean the component mating faces.
- Clean the cylinder head locating dowels.
- Install a new cylinder head gasket.
- With assistance install the cylinder head.
- Repeat the operation for the LH side.

13. ⚠ CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be installed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

- NOTE: Tighten the bolts 1 to 10 in the sequence shown.
- NOTE: LH illustration shown, RH is similar.

Install the cylinder head bolts.

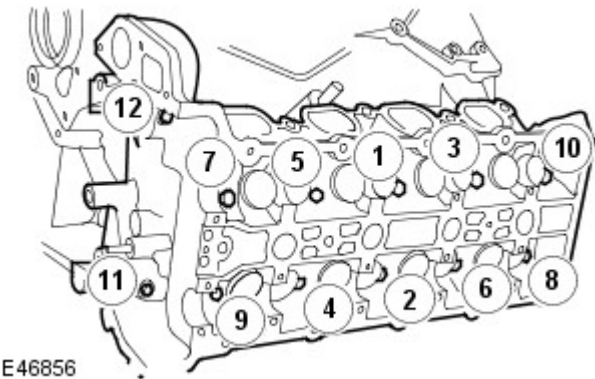
- Tighten the bolts to 20 Nm.
- Tighten the bolts to 35 Nm.
- Tighten the bolts 1 to 10, a further 90 degrees.
- Tighten the bolts 1 to 10, a further 90 degrees.
- Tighten the M8 bolts 11 and 12, to 25 Nm.
- Repeat the operation for the LH side.

14. Install the LH camshafts.

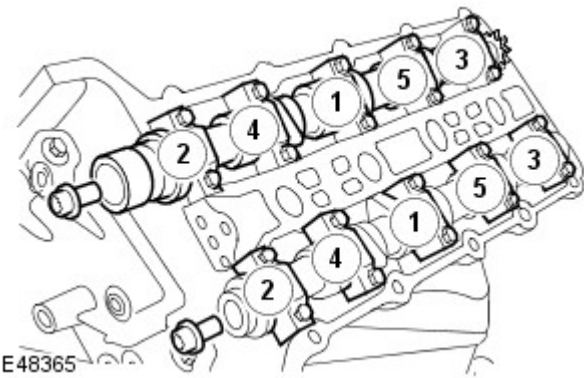
- Clean the component mating faces.
- Lubricate the journals and camshaft lobes.

15. Install the camshaft bearing caps.

- Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.

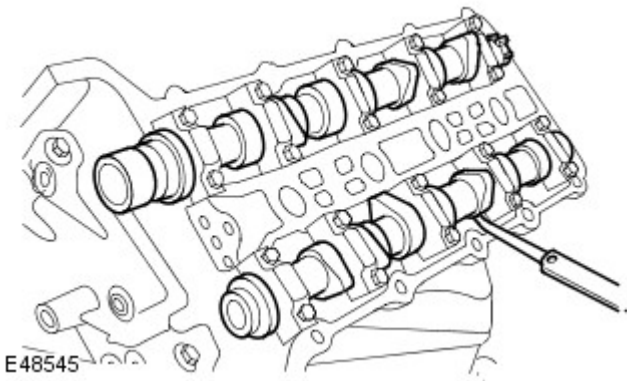



E46856



E48365

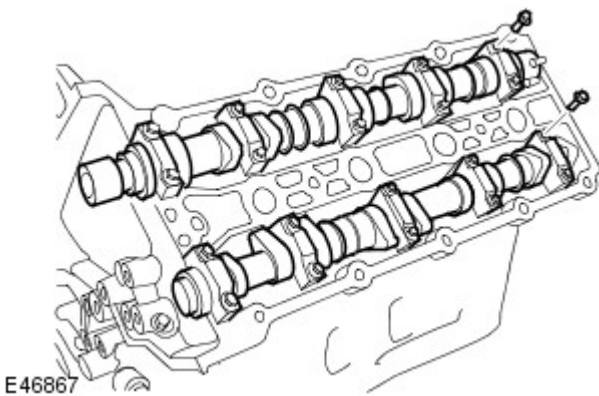
16. Install the sprocket retaining Torx bolts to the camshafts.



17.  **CAUTION:** Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

Measure and record the tappet clearances.

- Rotate the camshafts using the Torx bolts.



18. **NOTE:** Remove the camshaft bearing caps evenly and in stages.

• **NOTE:** Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

Remove the camshafts.

- Remove the 20 bolts.

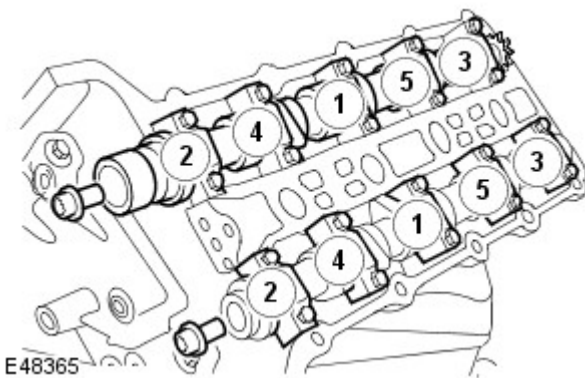
19. Remove the valve tappets, replace with selected tappets.


20. Install the camshafts.

- Lubricate the journals and camshaft lobes.
- Clean the component mating faces.

21. Install the camshaft bearing caps.

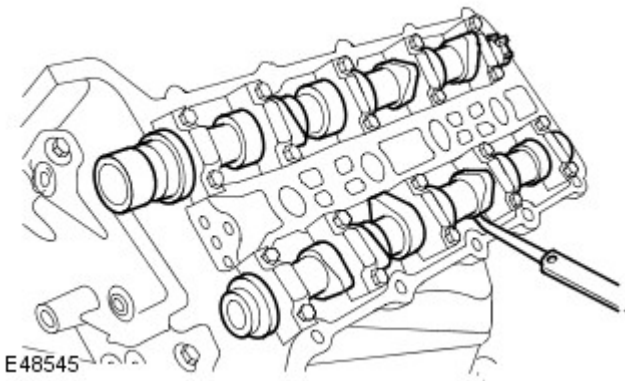
- Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.



22.  CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

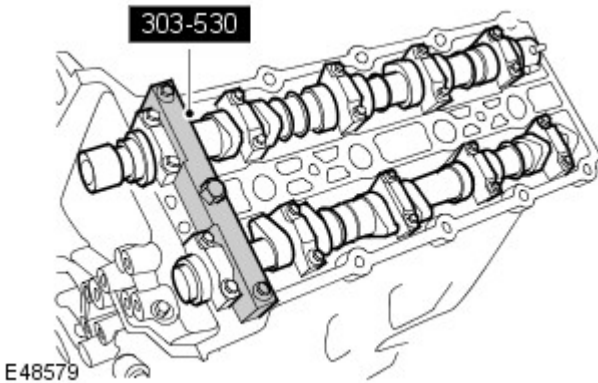
Check valve tappet clearances are correct.

- Rotate the camshafts using the Torx bolts.
- Remove the camshaft Torx bolts after the check is complete.



23. Repeat the operation for the RH camshafts.

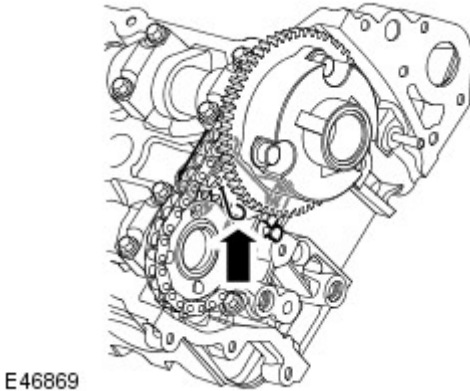
24. Install the special tool to the LH cylinder head.



25. NOTE: RH illustration shown, LH is similar.

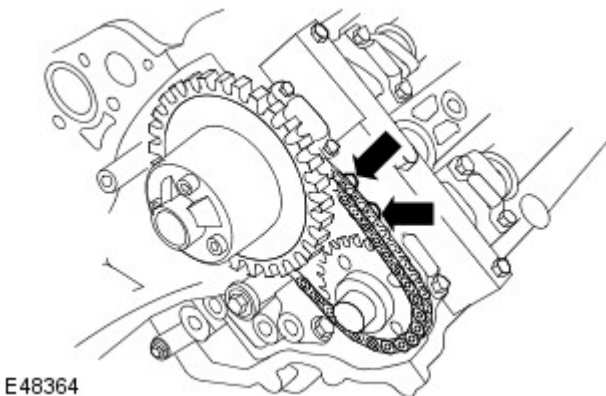
Depress the LH secondary timing chain tensioner piston.

- Using 1 mm diameter metal rod, retain the chain tensioner piston.



26. Install the LH secondary timing chain tensioner retaining bolts.

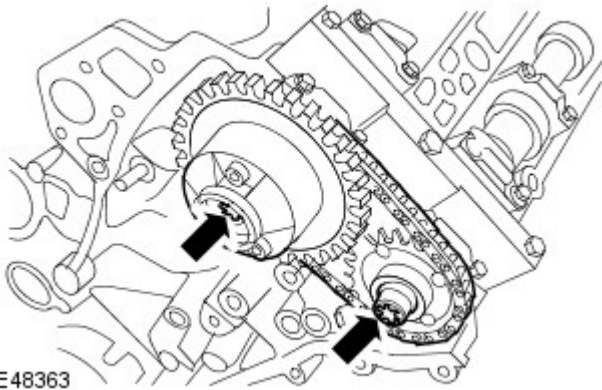
- Tighten the bolts to 12 Nm.



27. NOTE: Lightly tighten the camshaft sprocket Torx bolts, the sprockets **MUST** be free to move.

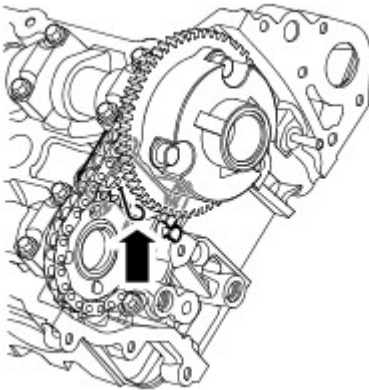
Install the LH secondary timing chain and sprockets to the camshafts.

- Install the sprocket retaining Torx bolts to the camshafts.



28. Tension the secondary timing chain.

- Remove the retaining rod.

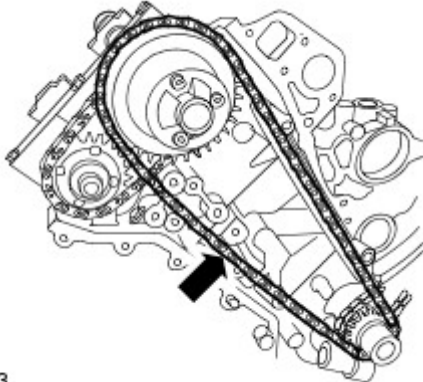


29. Repeat the operation for the RH camshafts.

30. NOTE: RH illustration shown, LH is similar.

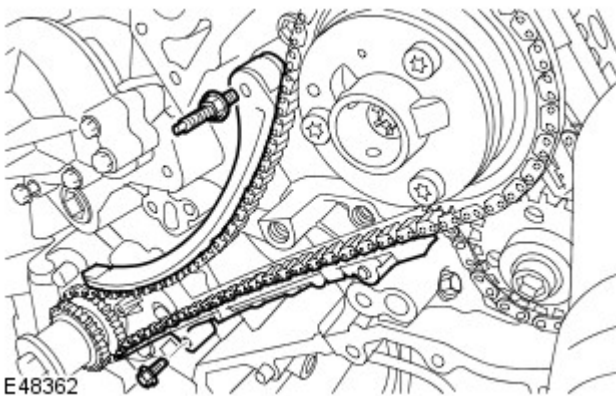
Install the LH primary timing chain.

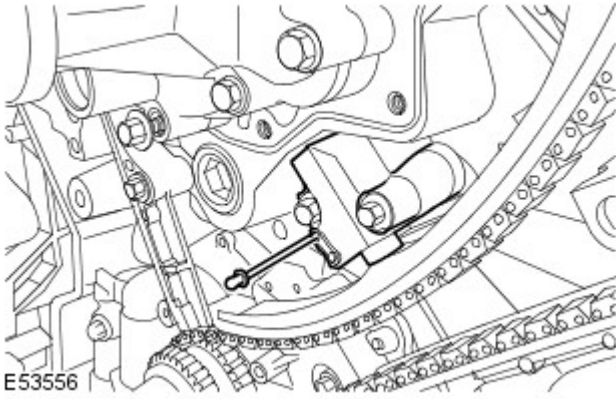
- Make sure the timing chain slack is on the tensioner side of the timing chain.




31. Install the LH primary chain tensioner guide.

- Tighten the stud to 12 Nm.






32.  **CAUTION:** During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.


Install the LH primary timing chain tensioner.

- Using 3 mm diameter metal rod, retain the chain tensioner piston.
- Tighten the bolts to 12 Nm.
- Remove the retaining rod.

E53556

33. CAUTIONS:

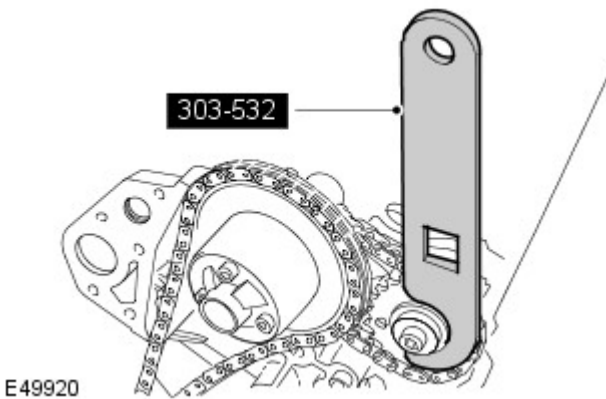
 Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

 The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

 Make sure that new bolts are installed.

Install the special tool to the exhaust camshaft sprocket.

- Tighten the intake camshaft sprocket bolt to 20 Nm then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm then a further 90 degrees.

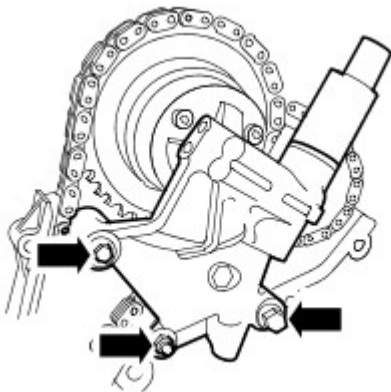


E49920

34. Install the LH variable camshaft timing (VCT) oil control unit.

- Install the new O-ring seals.
- Tighten the new bolts to 22 Nm.
- Tighten the nut to 10 Nm.

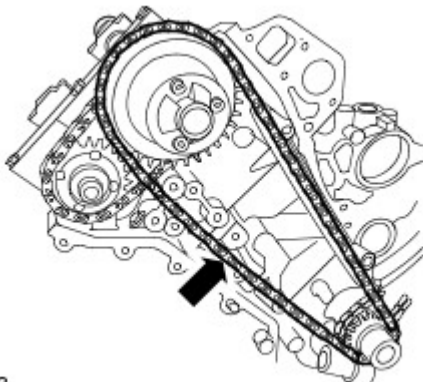
E48360



35. Install the RH primary timing chain.

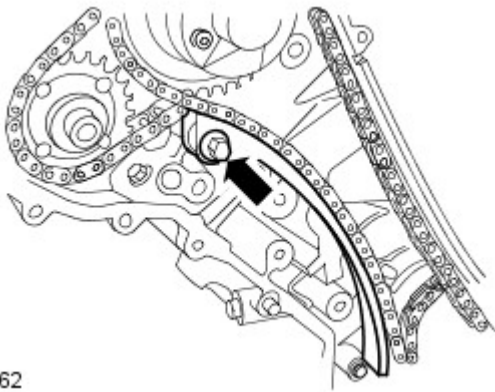
- Make sure the timing chain slack is on the tensioner side of the timing chain.

E46863




36. Install the RH primary timing chain tensioner guide.

- Tighten the bolts to 12 Nm.

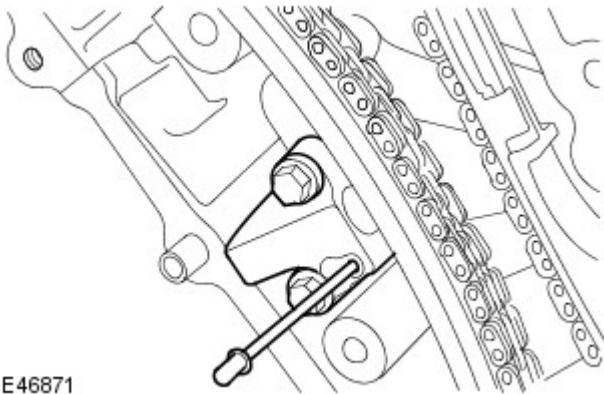


E46862

37.  **CAUTION:** During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.


Install the RH primary timing chain tensioner.


- Using 3 mm diameter metal rod, retain the chain tensioner piston.
- Tighten the bolts to 12 Nm.
- Remove the retaining rod.



E46871

38. **CAUTIONS:**

 Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

 The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

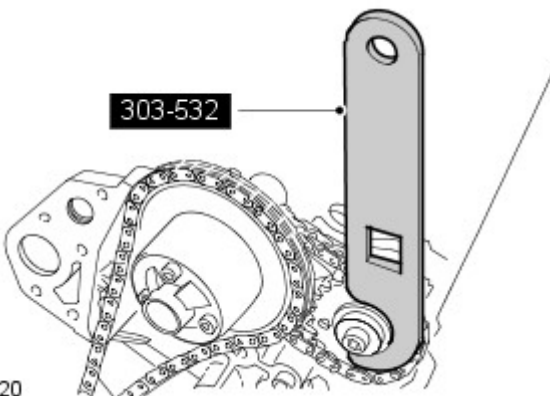
 Make sure that new bolts are installed.

Install the special tool to the exhaust camshaft sprocket.

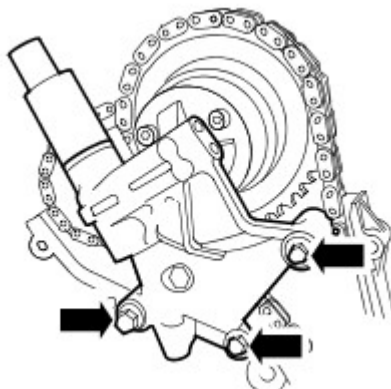
- Tighten the intake camshaft sprocket bolt to 20 Nm then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm then a further 90 degrees.

39. Install the RH VCT oil control unit.

- Install the new O-ring seals.
- Tighten the new bolts to 22 Nm.

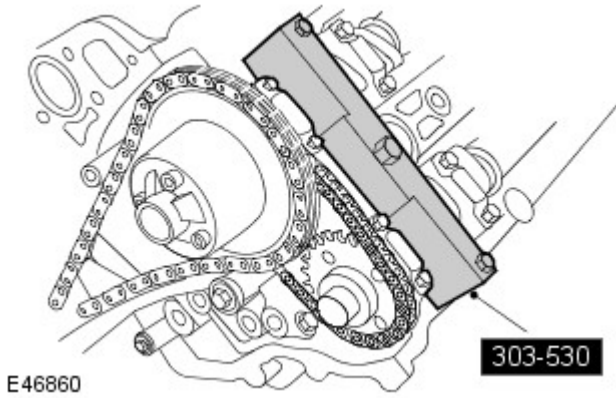


E49920

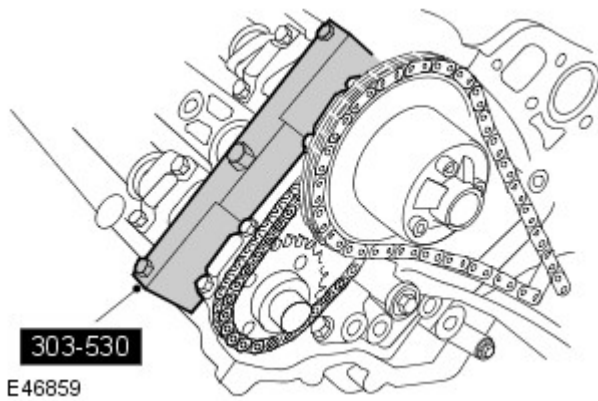


E46858

40. Remove the special tool from the LH cylinder head.

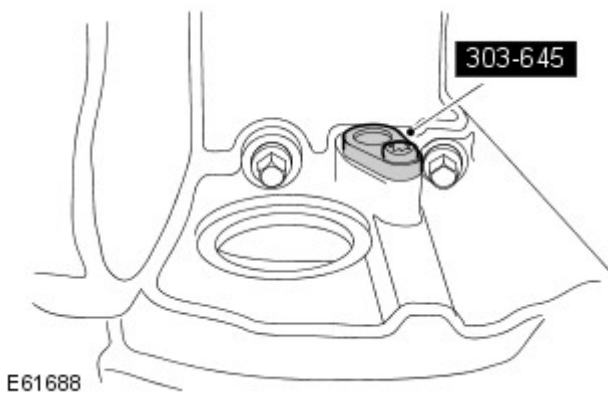


41. Remove the special tool from the RH cylinder head.



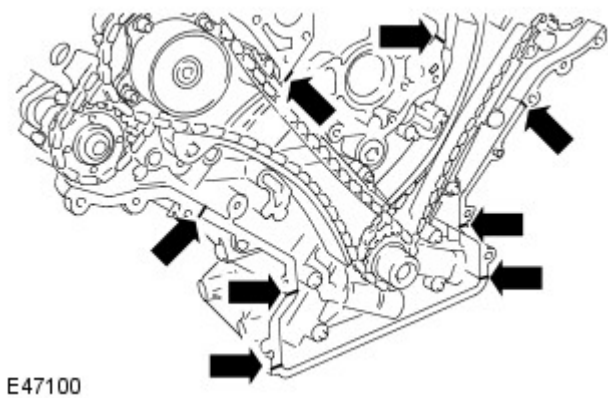
42. Remove the crankshaft locking tool.

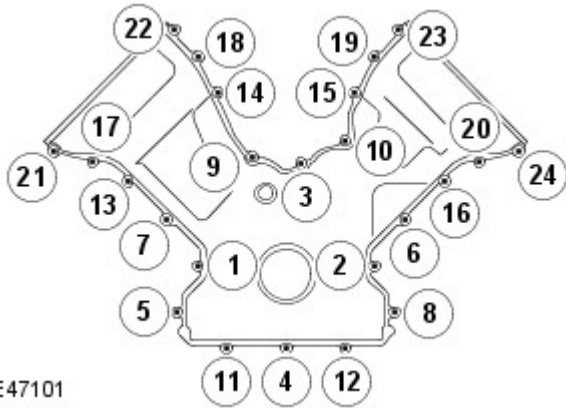
- Remove the screw.



43. Install the engine front cover.

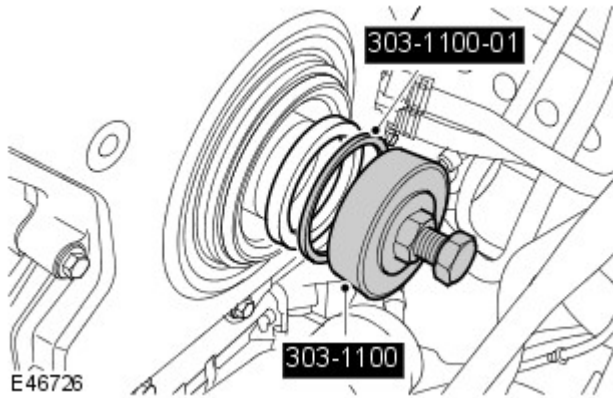
- Clean the component mating faces.
- Apply a bead of sealant 3 mm diameter, by 12 mm long, to the 8 places indicated.





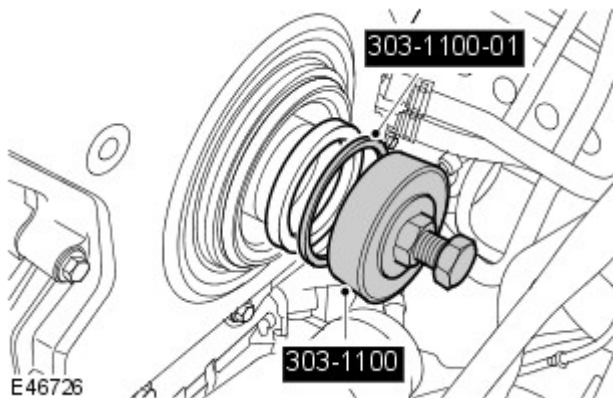
E47101

44. Evenly and progressively tighten the bolts in the sequence shown to 12 Nm.



45. Using the special tools, install the crankshaft front seal.

- Clean the component mating faces.
- Lubricate the seal with clean engine oil.
- Use the discarded crankshaft bolt with the service tool.




46. Using the special tools, install the crankshaft front seal.

- Clean the component mating faces.

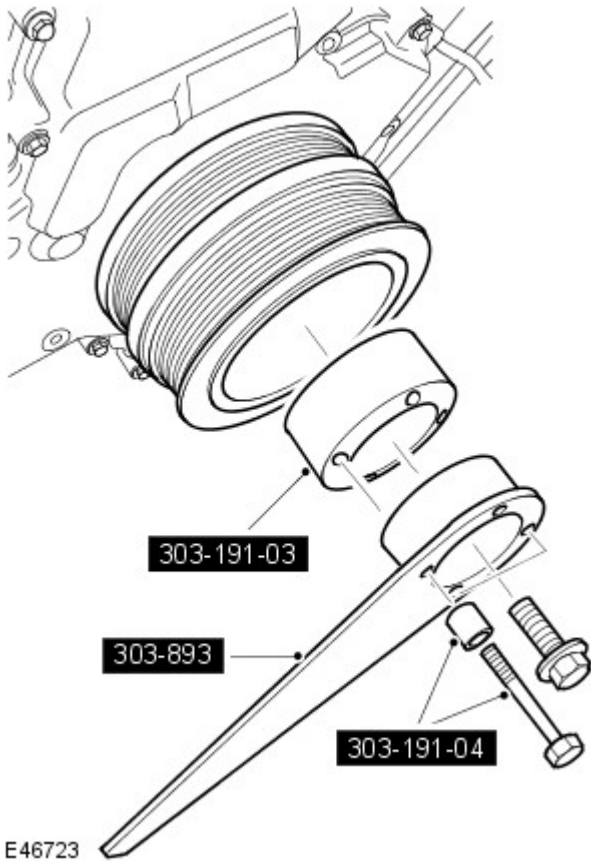
47. Install the crankshaft pulley.

- Lubricate the seal with clean engine oil.

48. Install the crankshaft pulley locking ring.

49.  **CAUTION:** The screw thread in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

Install, but do not tighten, the new crankshaft pulley bolt.



50. **⚠ CAUTION:** Under no circumstances should the crankshaft setting peg, 303-645, be used in the following operations, to restrain the crankshaft.

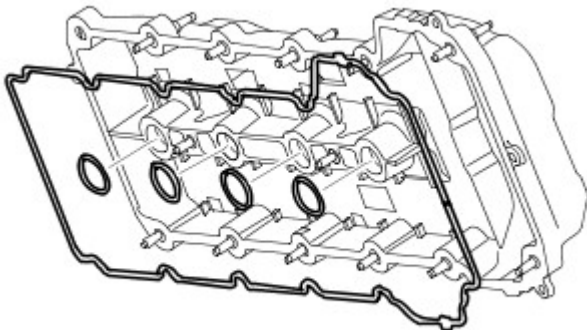
Using the special tools, retain the crankshaft pulley.

- Tighten the crankshaft pulley bolt to 380 Nm.

51. Remove the special tools.

52. Install new valve cover plug aperture gaskets.

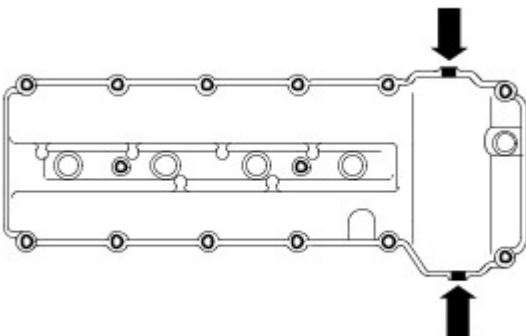
- Install a new valve cover gasket.



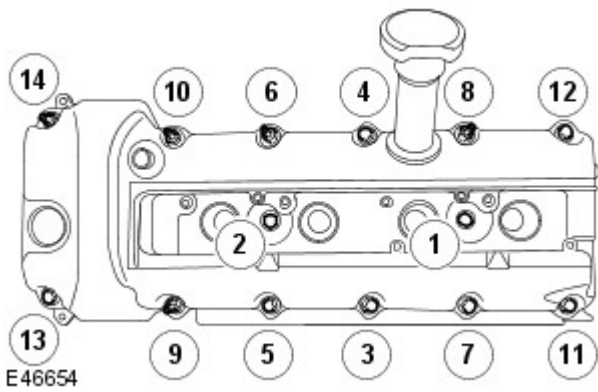
53. **NOTE:** Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

Install the valve cover.

- Clean the component mating faces.

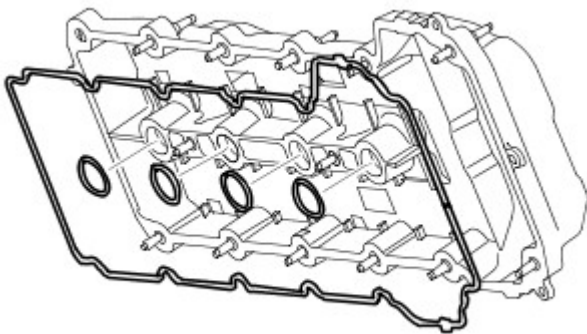


E49922



54. Install the valve cover retaining bolts.

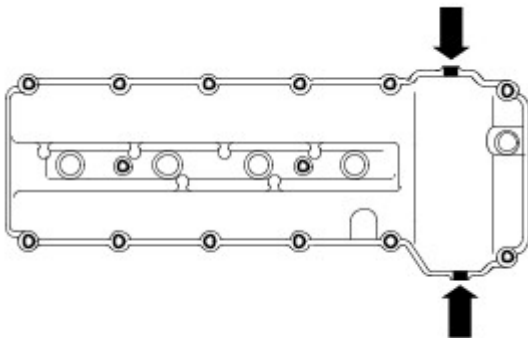
- Install valve cover retaining bolts to their position previously noted.
- Complete the tightening sequence as illustrated.
- Tighten the bolts to 12 Nm.



55. Install new valve cover plug aperture gaskets.

- Install a new valve cover gasket.

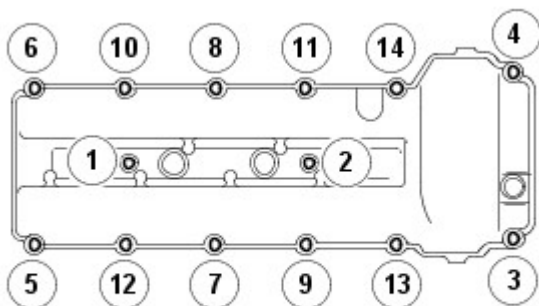
56. NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.



Install the valve cover.

- Clean the component mating faces.

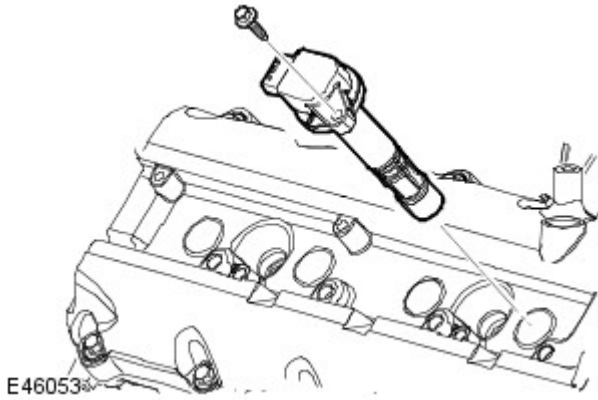
57. Install the valve cover retaining bolts.



- Install valve cover retaining bolts to their position previously noted.
- Tighten the bolts to 12 Nm.
- Complete the tightening sequence as illustrated.

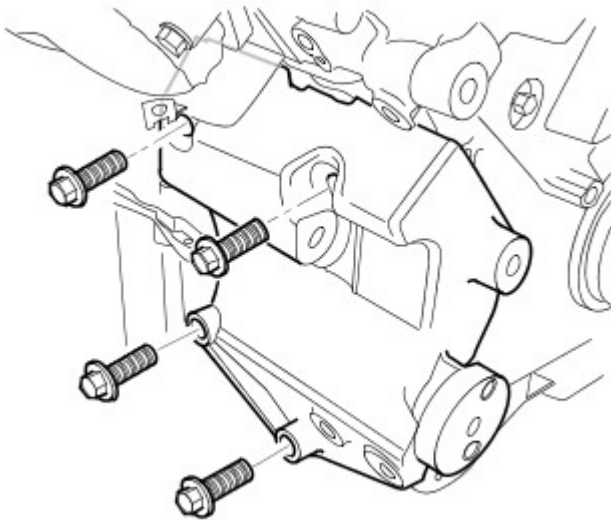
58. Install the 8 ignition coil-on-plugs.

- Install the 8 bolts.
- Tighten the bolts to 6 Nm.



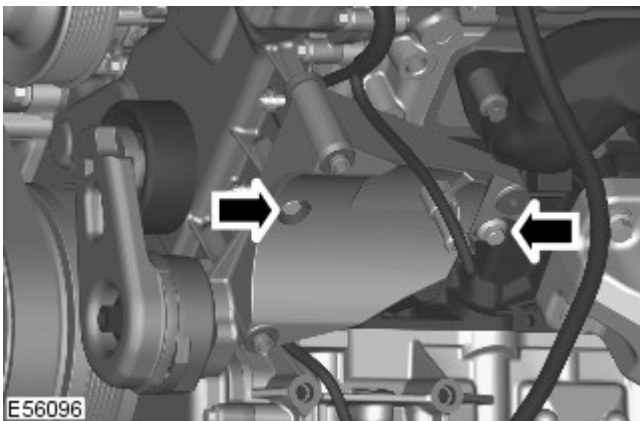
59. Install the generator mounting bracket.

- Clean the locating dowels.
- Clean the component mating faces.
- Tighten the bolts to 45 Nm.



E58798

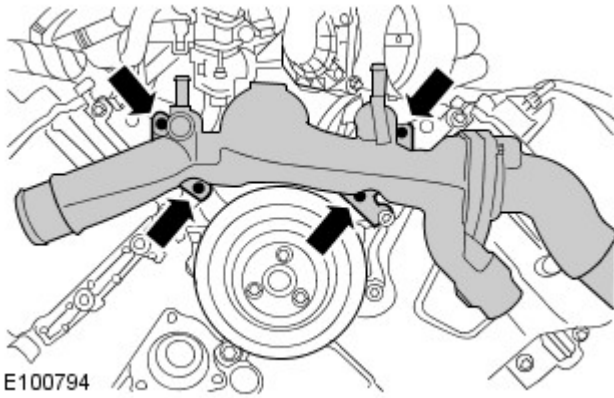
60. Install the A/C mounting bracket.



E56096

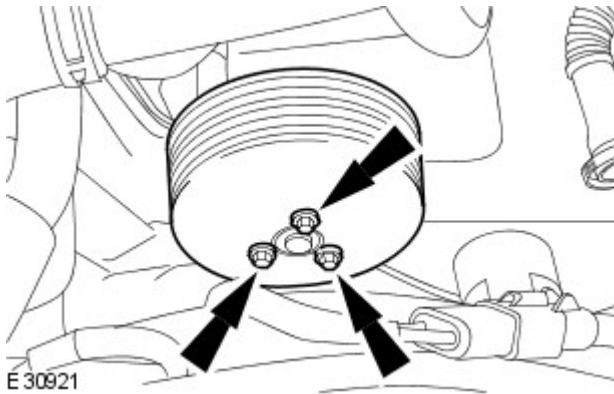
61. Install the coolant manifold.

- Tighten the bolts to 6 Nm.



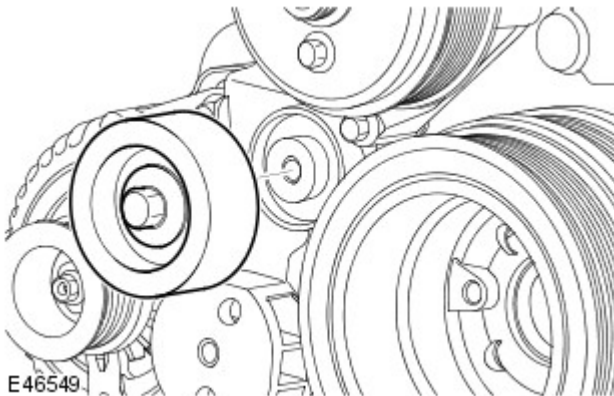
62. Install the coolant pump pulley.

- Tighten the bolts to 10 Nm.



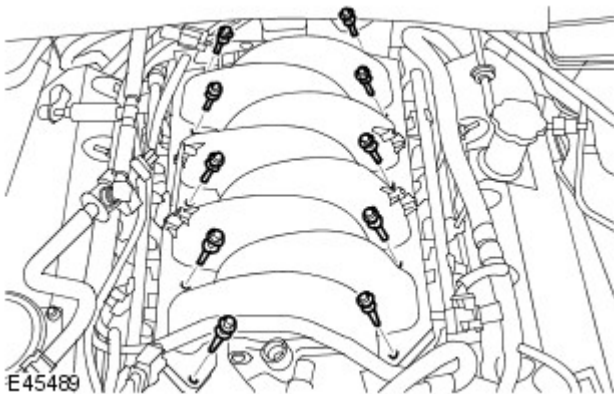
63. Install the accessory drive belt idler pulley.

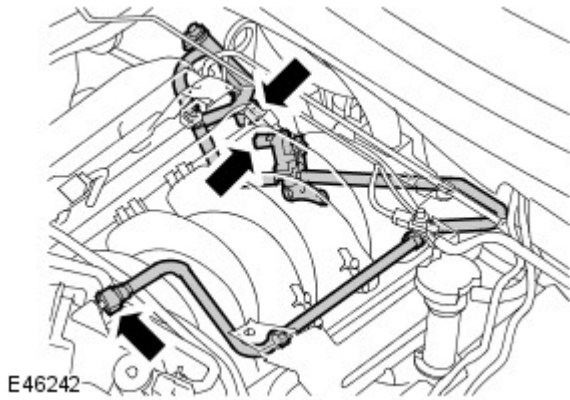
- Tighten the bolt to 25 Nm.



64. With assistance, install the intake manifold.

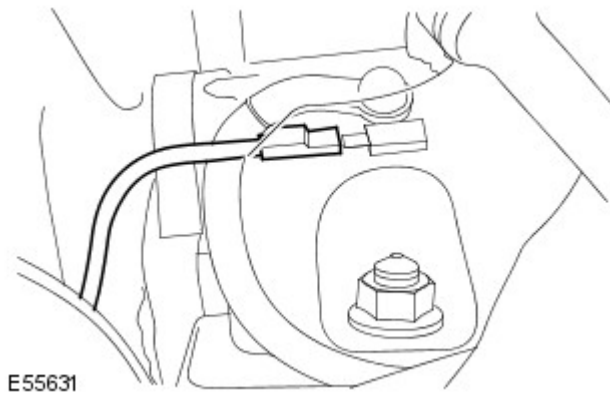
- Install the gaskets.
- Evenly and progressively tighten the bolts to 20 Nm.





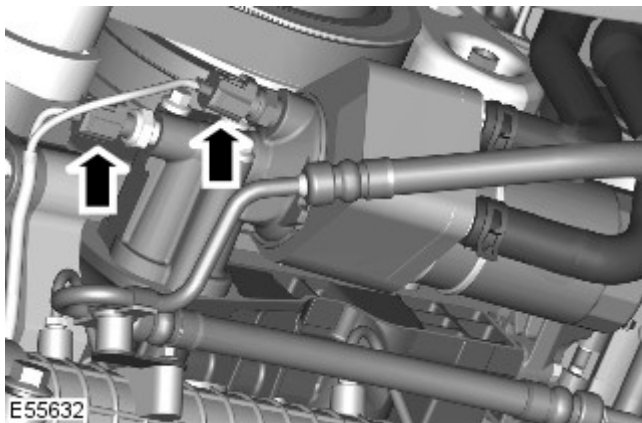
65. Install the purge valve.

- Secure the electrical harness with the clip.
- Tighten the bolt to 6 Nm.
- Connect and secure the electrical connector.

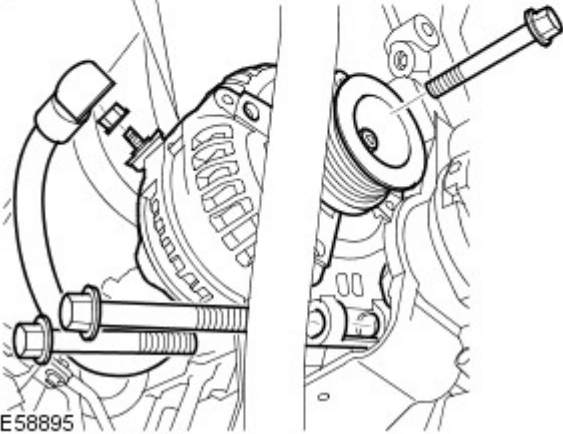
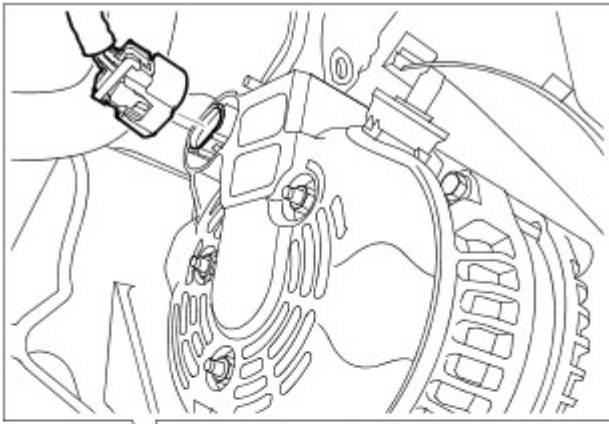


66. Connect the starter motor positive cable.

- Secure the cover.



67. Connect the oil temperature and oil pressure sensors.

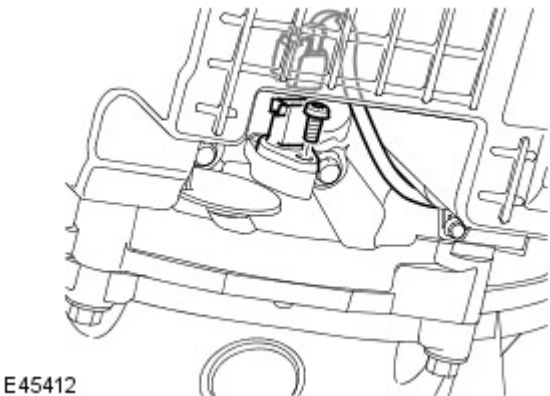


68. Install the generator.

- Clean the component mating faces.
- Tighten the bolts to 48 Nm.
- Connect the generator electrical connector.
- Secure the clips.

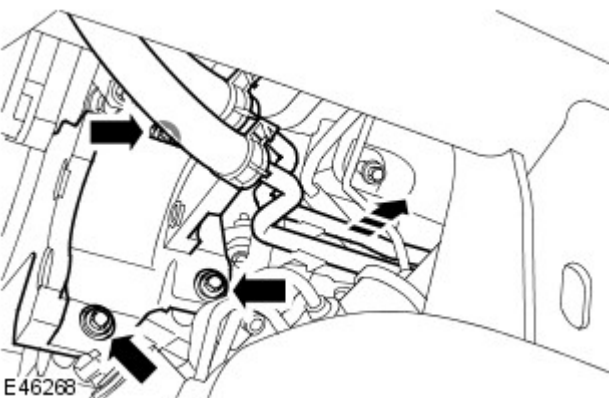
69. Install the crankshaft position (CKP) sensor electrical connector.

- Connect the CKP sensor electrical connector.



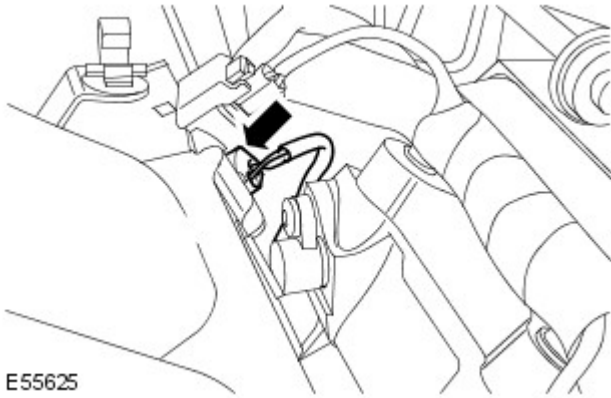
70. Install the power steering pump mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 25 Nm.
- Secure the transmission cooler pipes into clips.



71. Connect and secure the CMP sensor electrical connectors.

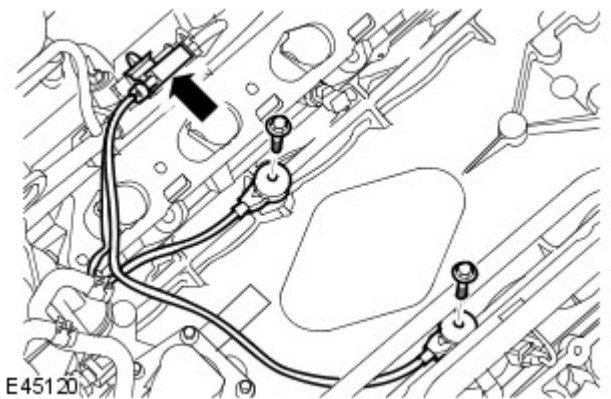
- Repeat the operation for the RH side.



E55625

72. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Connect the KS electrical connector.



E45120

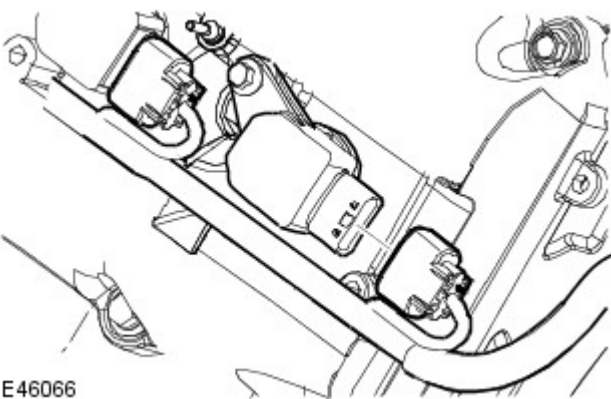
73. Connect the engine coolant temperature (ECT) sensor electrical connector.



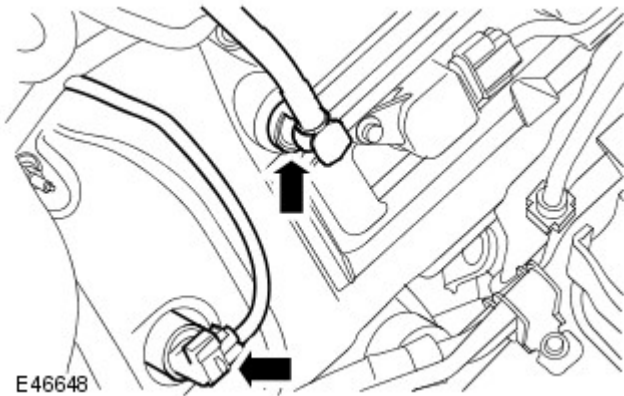
E44468

74. Connect the ignition coil-on-plug electrical connections.

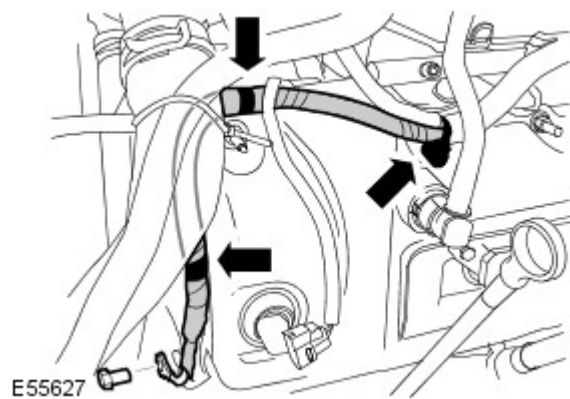
- Install the clips.
- Repeat the above procedure for the other side.



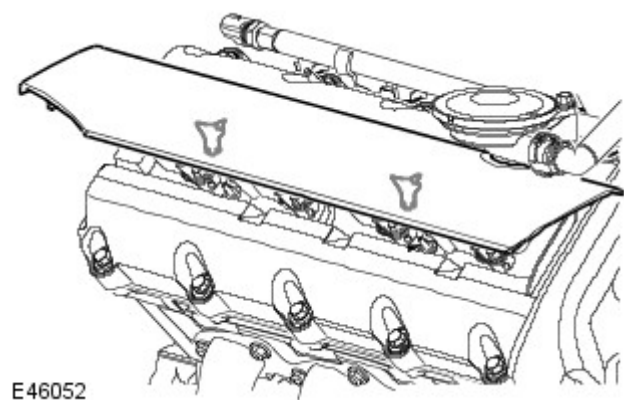
E46066



- 75.** Connect the VCT oil solenoid electrical connector.
- Repeat the above procedure for the other side.
 - Connect the valve cover breather hose.



- 76.** Connect the cylinder head earth ground connector.
- Install the bolt.
 - Secure the 3 clips.



- 77.** Install the ignition coil-on-plug cover.
- Secure the clips.
 - Repeat the above procedure for the other side.

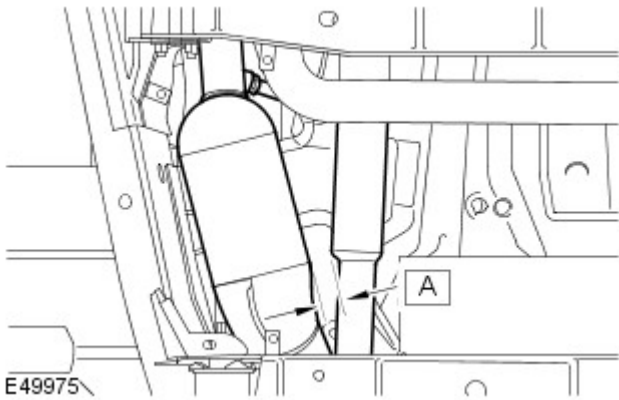
- 78.** Remove the engine from the engine stand.
79. Install the engine assembly.


Engine - V6 4.0L Petrol - Engine

Installation

Installation

1. Remove the torque converter retainer.
2. Install the engine.
 - Connect the lifting chains.
 - Carefully lower the engine until approximately 35mm above engine mounts.
 - With assistance align the engine to the transmission and engine mounts.
3. Install the RH engine mount.
4. Install the transmission retaining bolts.
 - Clean the component mating faces.
 - Remove the guide pins.
 - Tighten the bolts to 45 Nm (33 lb.ft).
5. Tighten the engine mount nuts to 90 Nm (66 lb.ft).
6. Remove the engine lifting bracket.
 - Disconnect the lifting chains.
 - Remove the 7 bolts.
 - Remove the 12 nuts.
7. Attach the flexplate to the torque converter.
 - Rotate the crankshaft to access the retaining bolts.
 - Tighten the bolts to 45 Nm (33 lb.ft).
 - Install the grommet.
8. Connect the CKP sensor electrical connector.
 - Clean the component mating faces.
9. Connect the HO2S electrical connectors.
10. Install the engine wiring harness support bracket.
11. Connect the engine oil temperature sensor electrical connector.
12. Install the starter motor.
 - Clean the component mating faces.
 - Tighten the bolts to 45 Nm (33 lb.ft).
13. Position the fuel pipe and purge line heat shield and secure with bolts.
14. Position the RH catalytic converter to the exhaust manifold.
 - Clean the components.
 - Tighten the new bolts to 22 Nm (16 lb.ft).



15.  **CAUTION:** Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

16. Install the transmission heat shield.

17. Connect the engine oil cooler hoses.

- Secure with the clips.

18. Connect the coolant pump hose.

- Secure with the clip.

19. Install the steering column lower universal joint assembly.

- Install new patchlock bolts and tighten to 25 Nm (18 lb.ft).

20. Connect the ECT sensor electrical connector.

21. Install the EGR pipe.

- Clean the component mating faces.
- Install to the exhaust manifold, but do not fully tighten the union nut at this stage.

22. Install the transmission cooler pipes.

- Install the support bracket.
- Tighten the nut to 10 Nm (7 lb.ft).

23. Connect the engine ground cable, make sure the mating faces are clean.

- Tighten the nut to 25 Nm (18 lb.ft).
- Install the cover.

24. Install the A/C compressor mounting bracket assembly.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).
- Install the KS electrical connector clip.
- Connect the A/C compressor electrical connection.

25. Install the generator mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).
- Secure the clip.
- Install a new cable tie.

26. Connect the EOP sensor electrical connector.

27. Connect the generator electrical connectors.

28. Install the accessory drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

- 29.** Install the cooling fan lower shroud.
 - Remove the radiator protection.
 - Position and secure in the clips.
- 30.** Install the wiring harness to the plenum.
 - Secure with the clips.
- 31.** Connect the ECM electrical connectors.
- 32.** Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- 33.** Install the intake manifold.

For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
- 34.** Tighten the nuts securing the EGR pipe to the exhaust manifold and EGR valve to 25 Nm (18 lb.ft).
- 35.** Fill the engine with oil.

For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01C Engine - V6 4.0L Petrol, General Procedures).
- 36.** Refill and bleed the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
- 37.** Return the hood from the service position.
 - Release the 2 clips.
 - Connect the struts and secure with the clips.
- 38.** Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- 39.** Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Engine - V8 5.0L Petrol -

Engine Data

Engine Description	Engine Capacity	Maximum Engine Torque (EEC)	Maximum Engine Power (EEC)	Compression Ratio	Bore	Stroke
• 90° "Vee" • 8 Cylinder • 32 Valves	4.999 ccm	510 Nm at 3.500 RPM	276 kW at 6.500 RPM	11.5 ± 0.5	92.5 mm	93 mm

Engine Firing Order

Firing Order
1:2:7:3:4:5:6:8

Engine Valve Clearance (cold)

Intake Valve	Exhaust Valve
N/A	0.25 mm ± 0.02

Spark Plugs

Specification	Spark Plug Gap
ILKR6C-10	1 mm

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Engine Oil	WSS-M2C925-A
Sealant	WSE-M4G323-A6
Core plug and stub pipe retainer	WSK-M2G349-A7

Capacities

Description	Liters
Engine oil, initial fill	9.5
Engine oil, service fill with oil filter change	8.0

Cylinder Head and Valve Train

Item	Specification
Cylinder head maximum permitted warp (mm) (flatnes specification) overall	0.08
over 150x150 mm area	0.05
over 25x25 mm area	0.02
Valve guide inner diameter (mm)	5.51 ± 0.01
Intake valve effective length (mm) (tip to gauge line)	97.63 ± 0.1
Exhaust valve effective length (mm) (tip to gauge line)	94.39 ± 0.1
Valve stem to guide clearance intake diametrical (mm)	0.022 - 0.057
Valve stem to guide clearance exhaust diametrical (mm)	0.03 - 0.065
Valve head diameter intake (mm)	36 ± 0.1
Valve head diameter exhaust (mm)	30 ± 0.1
Intake valve face angle (degrees)	44.875 ± 0.125
Exhaust valve face angle (degrees)	44.875 ± 0.125
Valve stem diameter intake (mm)	5.4705 ± 0.0075
Valve stem diameter exhaust (mm)	5.4625 ± 0.0075
Valve spring free length (mm) - inlet	43.43
Valve spring free length (mm) - exhaust	46.1
Valve spring installed height (mm) - inlet	34.49
Valve spring installed height (mm) - exhaust	35.1
Camshaft lobe lift intake (mm)	5.5 (low) 10.53 (high)
Camshaft lobe lift exhaust (mm)	9.36
Camshaft journal to cylinder head bearing surface clearance diametrical (mm)	0.025 - 0.065
Camshaft journal diameter - all positions	26.965 ± 0.01
Bearing diameter - all positions	27.01 ± 0.01
Camshaft journal maximum run out limit (mm)	
Camshaft journals to end journals	0.03
Camshaft journals to adjacent journals	0.015
Camshaft journal maximum out of round (mm) - all journals	0.005

Torque Specifications

- NOTE: A = Refer to procedure for correct torque sequence.

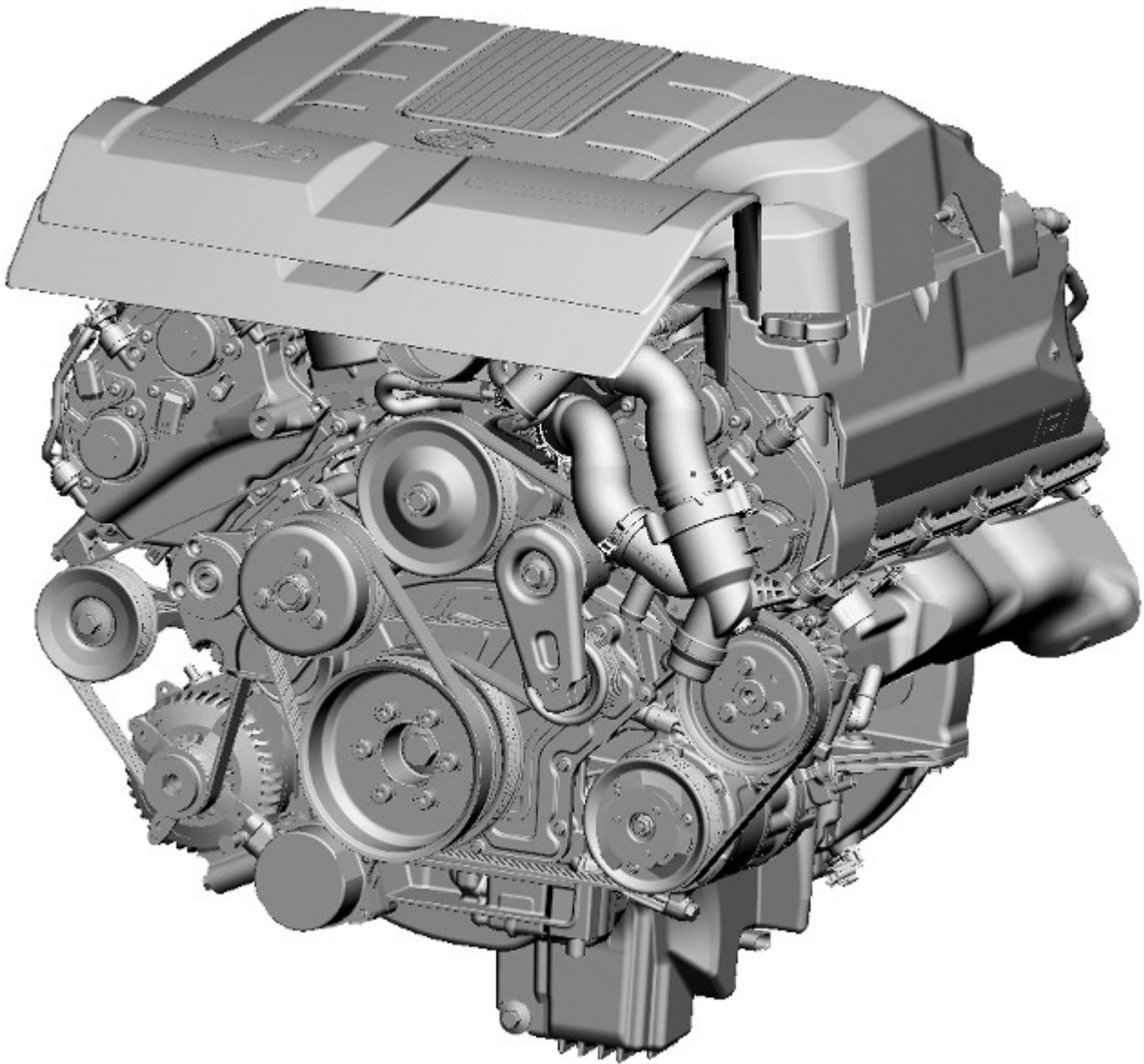
Description	Nm	lb-ft	lb-in
Engine cover mounting bolts	10	7	-
Accessory drive belt tensioner retaining bolt	40	30	-
Supercharger belt idler/tensioner bracket retaining bolts	25	18	-
Secondary drive belt idler retaining bolts	40	30	-
Power steering pump pulley retaining bolts	25	18	-
Power steering pump retaining bolts	25	18	-
Power steering pump bracket to engine retaining bolts	25	18	-
Generator retaining bolts	48	35	-
Starter motor retaining bolts	40	30	-
Air conditioning compressor retaining bolts	25	18	-
Engine mounting to engine mounting bracket retaining nuts	100	74	-
Engine mounting to subframe retaining bolts	56	41	-

Description	Nm	lb-ft	lb-in
Engine mounting bracket to engine retaining bolts	45 + 60°	33 + 60°	-
Crankshaft damper pulley retaining LH threaded bolt	200 + 270°	148 + 180°	-
Flexplate retaining bolts	45 + 90°	33 + 90°	-
Exhaust manifold heat shield retaining bolts	A	-	-
Exhaust manifold retaining bolts	A	-	-
Engine wiring harness bracket retaining bolts	10	7	-
Coolant outlet pipe	10	7	-
Intercooler retaining bolts	25	18	-
Intake manifold retaining bolts	25	18	-
Oil Cooler retaining bolts	13	10	-
Knock sensor (KS) retaining bolt	20	14	-
Ignition coil retaining bolts	8	-	71
Spark plugs	20	15	-
Fuel rail retaining bolts	A	-	-
High pressure fuel pipe retaining bolts	A	-	-
High pressure fuel pump retaining bolts	12	9	-
Oil filter housing assembly retaining bolts	12	9	-
Oil filter cap	25	18	-
Lifting eye bolts	25 + 90°	18 + 90°	-
Manifold absolute pressure and temperature (MAPT) sensor sensor retaining bolts	5	-	44
Coolant pump retaining bolts	12	9	-
Variable valve timing (VVT) oil control solenoid retaining bolts	10	7	-
Camshaft position (CMP) sensor retaining bolts	10	7	-
Camshaft cover retaining bolts	13	10	-
Front upper timing cover retaining bolts	12	9	-
Front lower timing cover retaining bolts	A	-	-
Engine rear cover retaining bolts	A	-	-
VVT to camshaft retaining bolts	32	24	-
Camshaft bearing caps retaining bolts	11	8	-
Primary timing chain fixed guide retaining bolts	12	9	-
Primary timing chain tensioner retaining bolts	12	9	-
Primary timing chain tensioner guide blade retaining bolts	25	18	-
Auxiliary chain tensioner guide retaining bolts	21	15	-
Auxiliary chain fixed guide retaining bolt	12	9	-
Oil pump sprocket retaining bolt	21	15	-
Cylinder head retaining bolts	A	-	-
Engine oil level (EOL) sensor retaining bolt	12	9	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Oil sump body to engine retaining bolts	25	18	-
Oil pan drain plug	24	18	-
Oil transfer tube to Oil pan body retaining bolts	11	8	-
Oil pump to engine block retaining bolts	25	18	-
Pick-up pipe to oil pump retaining bolts	12	9	-
Windage tray retaining bolts	25	18	-
Piston cooling jet retaining bolts	12	9	-
Engine block coolant draining plug	50	37	-
Cooling fan pulley	25	18	-

Engine - V8 5.0L Petrol - Engine

Description and Operation

EXTERNAL VIEW



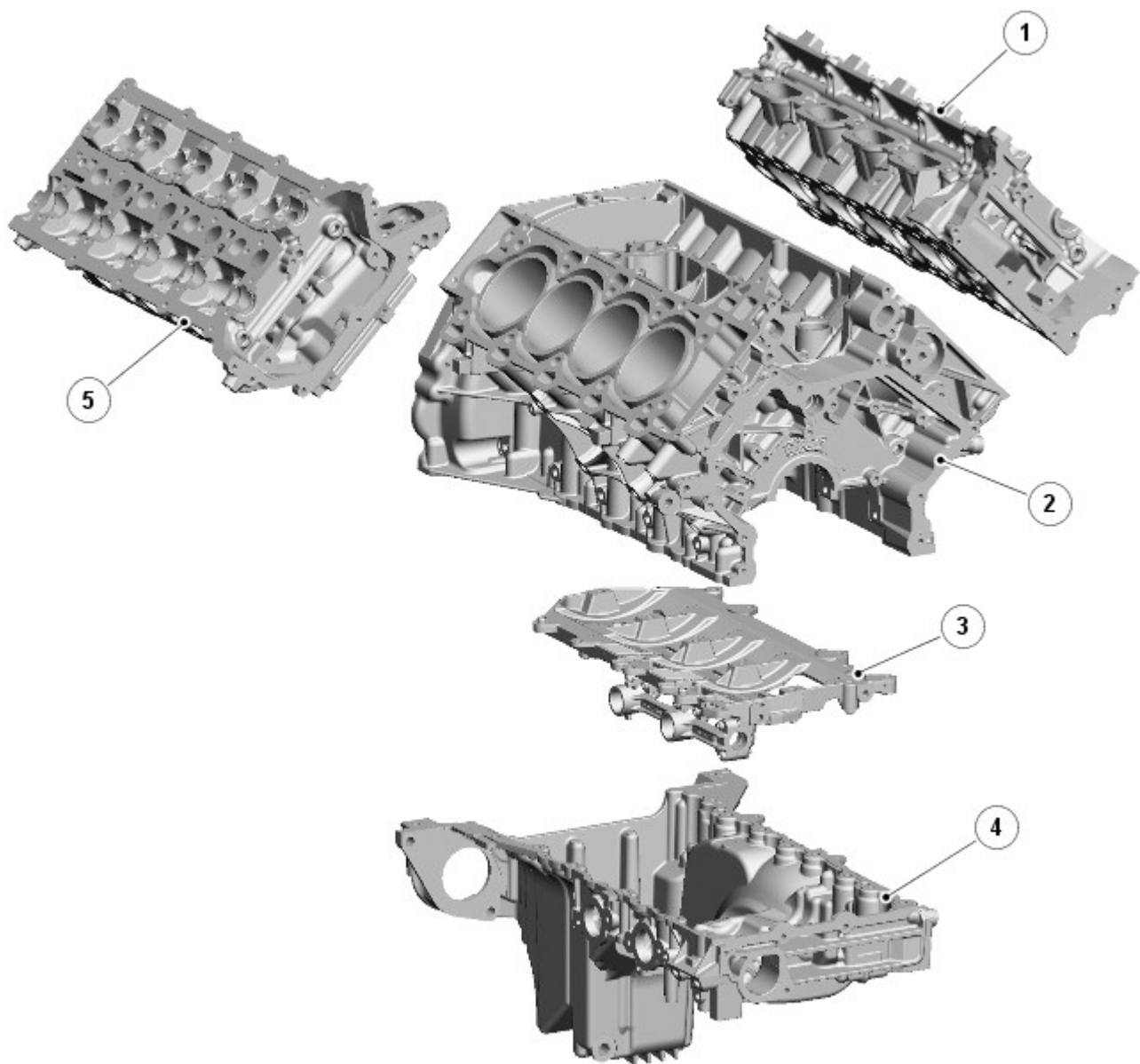
E122432

INTRODUCTION

The 5.0L NA (naturally aspirated) gasoline engine is a liquid cooled V8 unit featuring direct fuel injection, four overhead camshafts and four valves per cylinder. All four camshafts incorporate **VCT (variable camshaft timing)**. The intake camshafts and valves also incorporate CPS (camshaft profile switching).

The main structural components of the engine are all manufactured from aluminum alloy. The engine is built around a very stiff, lightweight, enclosed V, deep skirt cylinder block. A structural windage tray is bolted to the bottom of the cylinder block to further improve the block stiffness, minimize **NVH (noise, vibration and harshness)** and help reduce oil foaming. To further enhance the stiffness of the lower engine structure, a heavily ribbed sump is installed. The sump also helps to reduce engine noise.

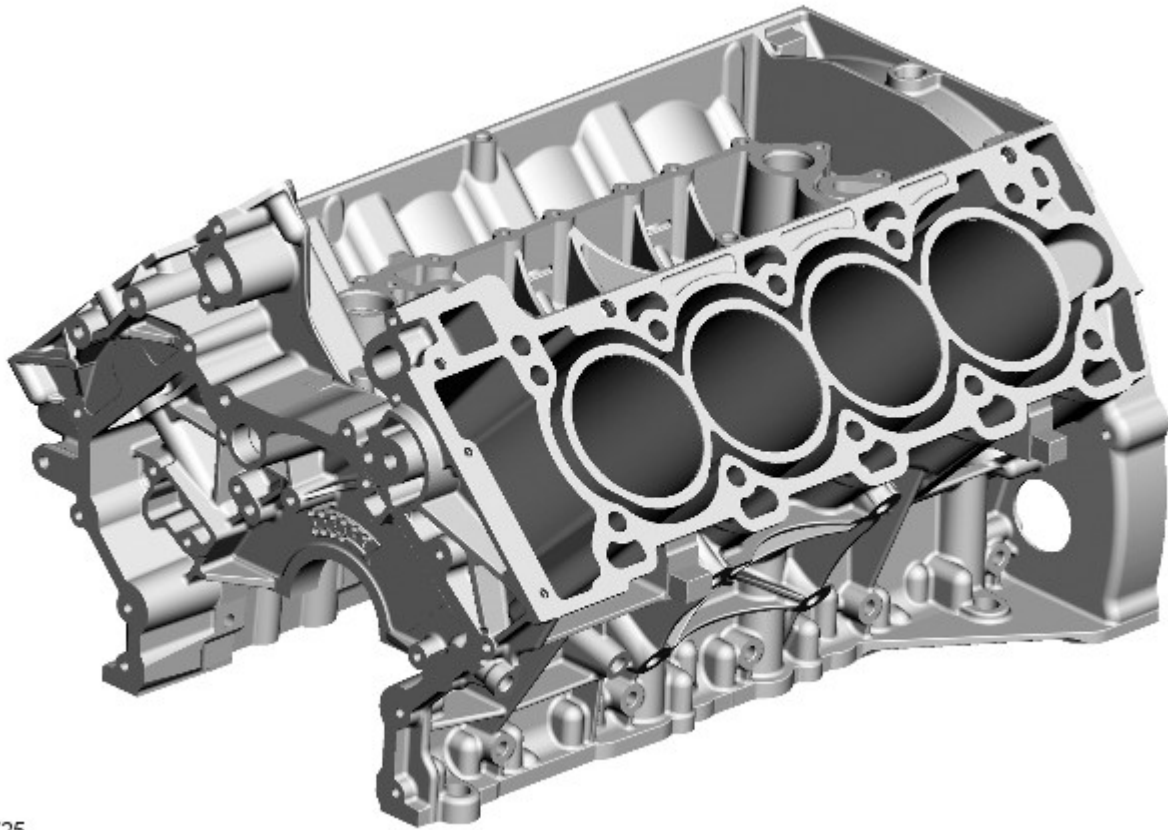
Engine Structure



E121104

Item	Part Number	Description
1	-	LH (left hand) cylinder head (bank B)
2	-	Cylinder block
3	-	Windage tray
4	-	Sump
5	-	RH (right hand) cylinder head (bank A)

CYLINDER BLOCK

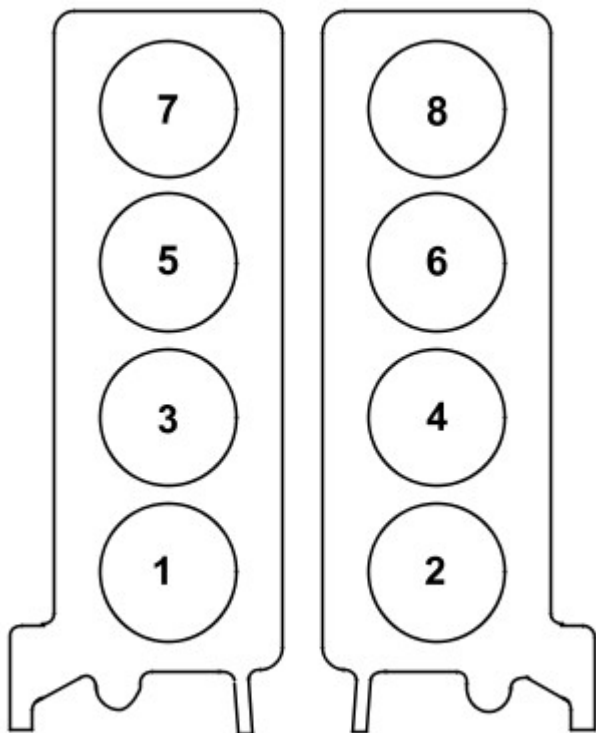


E106725

The cylinder block is a 90 degree configuration with cast-in iron cylinder liners and an open deck die-cast coolant jacket. The low volume coolant jacket gives good warm-up times and low piston noise levels. The longitudinal flow design of the coolant jacket, with a single cylinder head coolant transfer port in each bank, provides good rigidity and head gasket sealing.

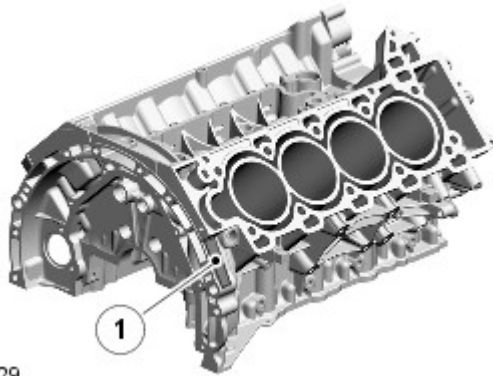
Cylinder Numbering

The cylinders are numbered as shown below, with cylinders 1 and 2 at the front of the engine.



E133972

Engine Data Location

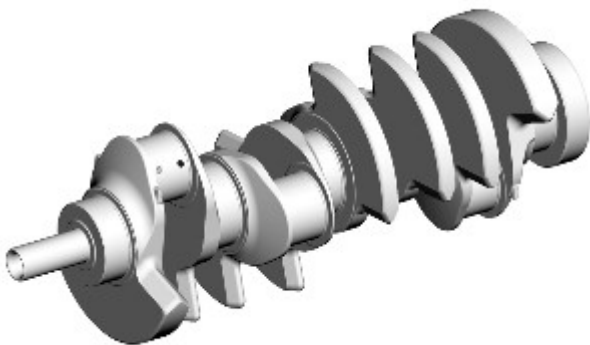


E108429

Item	Part Number	Description
1	-	Engine data location

Engine data is marked on the cylinder block at the rear of the [RH \(right-hand\)](#) cylinder bank.

CRANKSHAFT

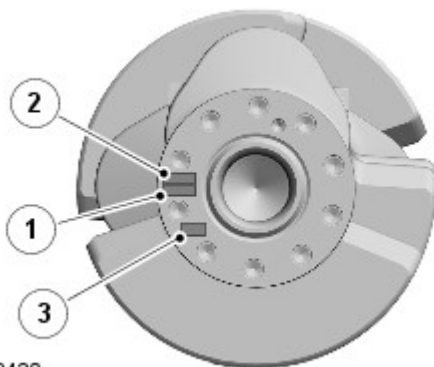


E106729

The crankshaft is made from spheroidal graphite cast iron, which, compared with grey cast iron, has higher mechanical strength, ductility and increased shock resistance. The undercut and rolled fillets also improve strength. Eight counter-balance weights ensure low vibration levels and the large, cross-drilled main bearing journals are designed to contribute to stiffness.

An oil groove in the upper half of each main bearing transfers the oil into the crankshaft for lubrication of the connecting rod bearings. A thrust washer is installed each side of the top half of the center main bearing.

Crankshaft Data Location



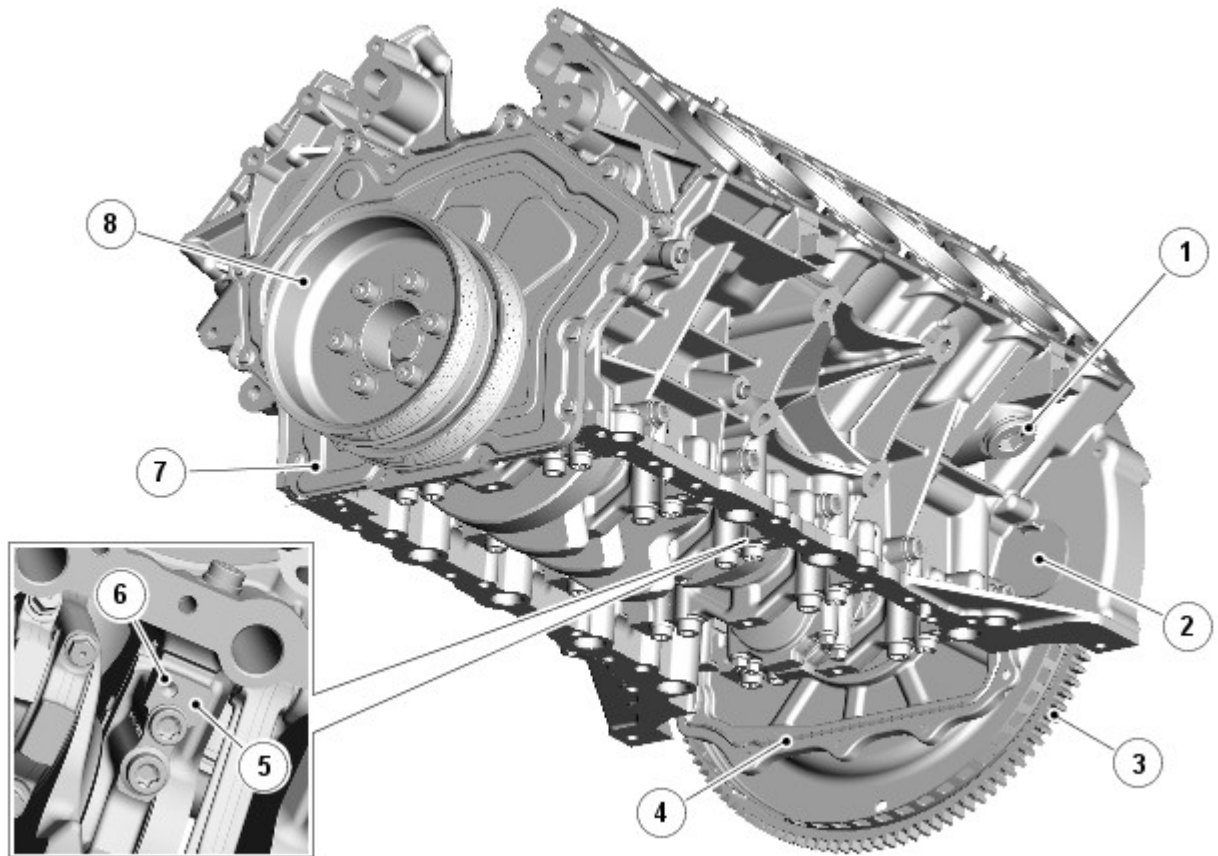
E108430

Item	Part Number	Description
1	-	Pin journal classification and plant identification
2	-	Main journal classification
3	-	Date and time codes

The main bearings are numbered 1 to 5 starting from the front of the engine. There are five grades of main bearing available, each being color coded. Journal sizes are marked on the rear of the crankshaft.

For additional information, refer to: [Crankshaft Main Bearing Journal Clearance](#) (303-00 Engine System - General Information, General Procedures).

Crankshaft Installation



E122349

Item	Part Number	Description
1	-	Coolant drain plug
2	-	Torque converter access plug
3	-	Drive plate
4	-	Rear cover
5	-	Main bearing cap
6	-	Identification mark
7	-	Front cover
8	-	Front pulley

The main bearing caps are made from cast iron and are cross bolted to increase rigidity. An identification mark on the bearing cap faces the front of the engine.

At the front of the crankshaft, a tuned torsional vibration damper is incorporated into the crankshaft front pulley. At the rear of the crankshaft a pressed steel drive plate, with a steel starter ring gear, is installed to transfer drive from the engine to the transmission. The reluctor ring for the [CKP \(crankshaft position\)](#) sensor is integrated into the perimeter of the drive plate.

The crankshaft seals are located in the front and rear covers.

PISTONS AND CONNECTING RODS



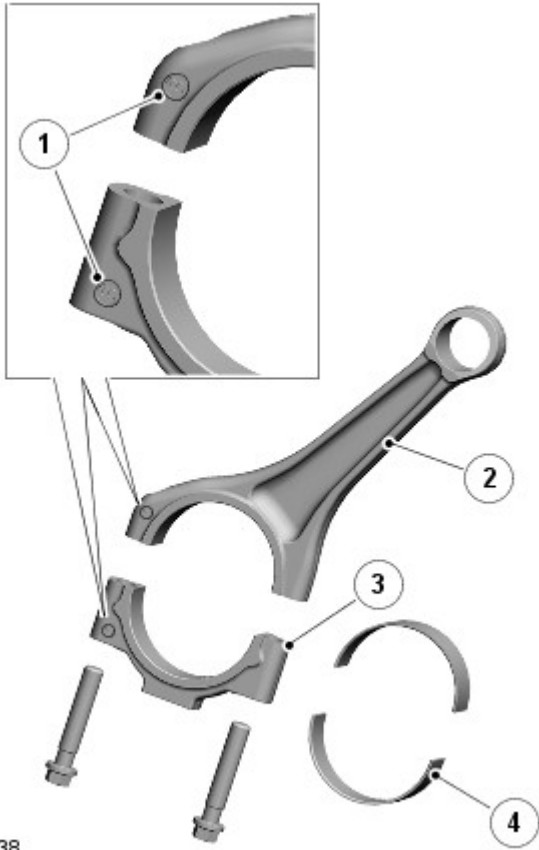
E115619

The diameter of each piston is graded and precisely matched to each cylinder bore to help reduce noise. In the vertical plane, the pistons have a slight barrel form, which helps to ensure a reliable oil film is maintained between the piston and the cylinder bore. A solid film lubricant coating is applied to both reaction faces of the piston to reduce wear and improve fuel economy.

A three-ring piston-sealing system is used. The steel top ring is treated with a PVD (physical vapor deposition) peripheral coating. PVD is a coating technique where material can be deposited with improved properties to ensure good cylinder bore compatibility and wear resistance. A Napier center ring helps cylinder pressure and oil management, while the three-piece oil control lower ring is produced from nitrided steel.

The connecting rods are forged from high strength steel. The cap is fracture-split from the rod to ensure precision re-assembly for bearing shell alignment. There are three grades of large end bearing available, each being color coded. For additional information, refer to: [Connecting Rod Large End Bore](#) (303-00 Engine System - General Information, General Procedures).

Cap Alignment with Connecting Rod

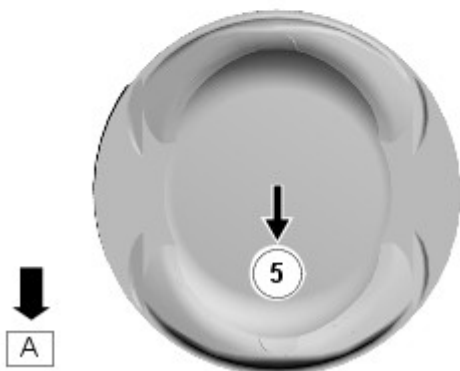
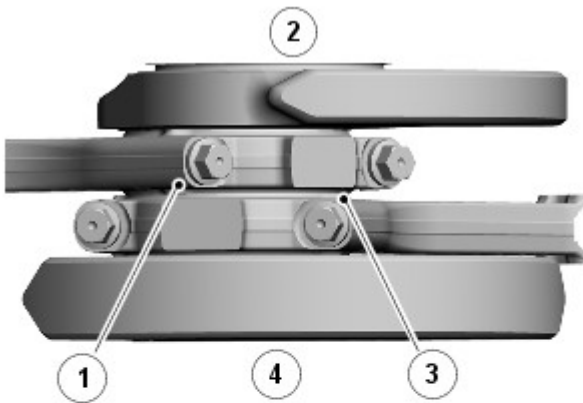


E108438

Item	Part Number	Description
1	-	Alignment marks
2	-	Connecting rod
3	-	Cap
4	-	Bearings

The correct alignment of the cap with the connecting rod is indicated by marks on adjacent faces of the two components.

Connecting Rod and Piston Orientation



E108439

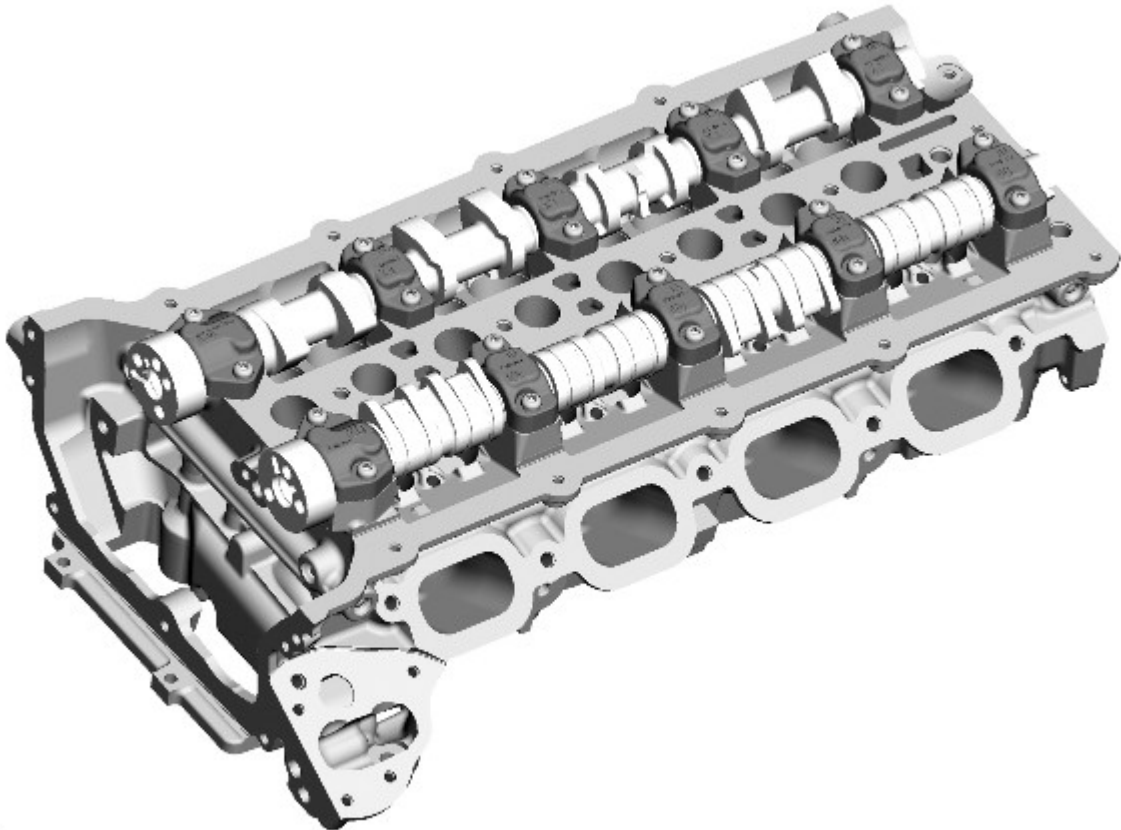
Item	Part Number	Description
A	-	Front of engine
1	-	Alignment mark
2	-	LH side (bank B)
3	-	Alignment mark
4	-	RH side (bank A)
5	-	Piston orientation arrow

The orientation of the connecting rods and pistons on the crankshaft are given below:

- Bank A - The arrow on the piston crown must face the front of the engine and the cap and connecting rod alignment marks must face the rear of the engine.
- Bank B - The arrow on the piston crown must face the front of the engine and the cap and connecting rod alignment marks must face the front of the engine.

CYLINDER HEADS

- NOTE: [RH](#) (A bank) cylinder head shown, [LH](#) (left-hand) (B bank) cylinder head similar.



E106732

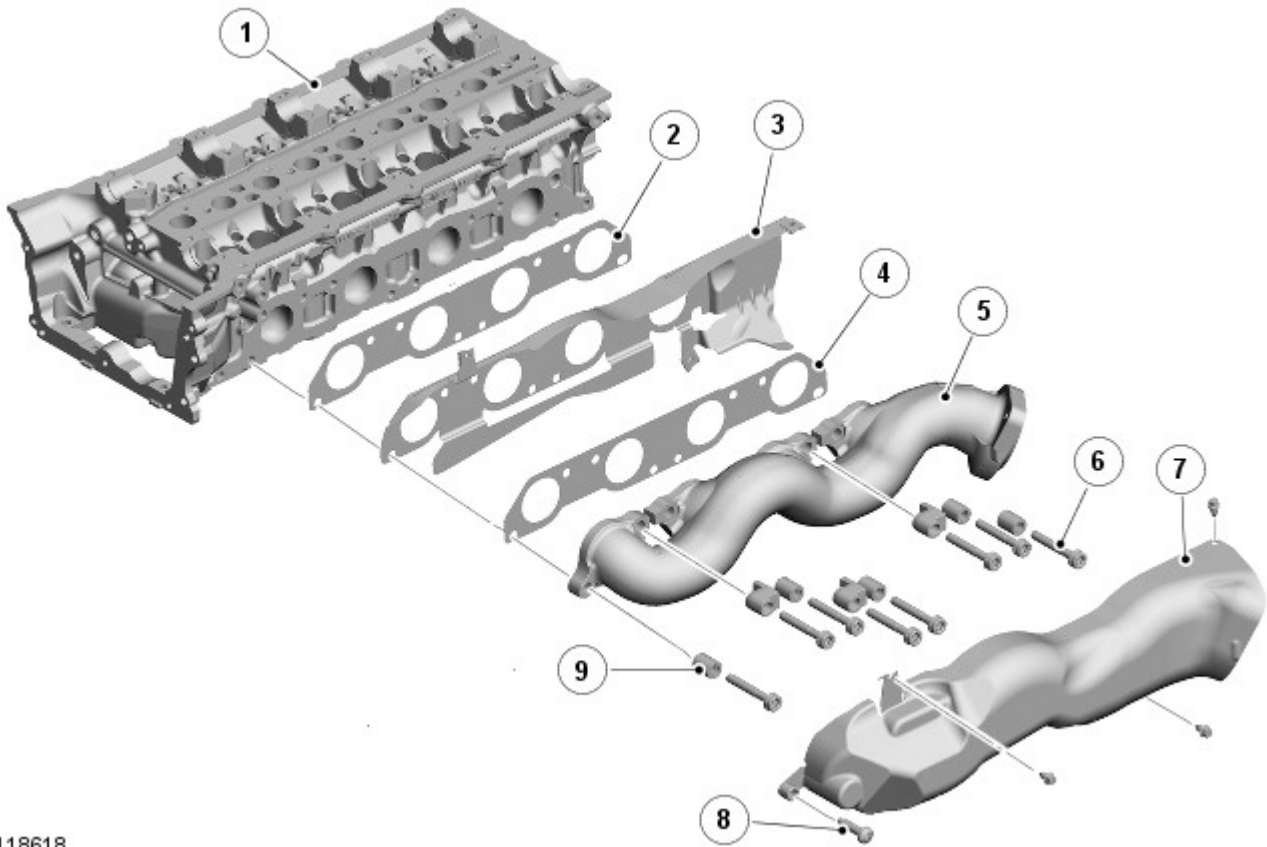
The cylinder heads are manufactured in gravity die cast aluminum alloy and are unique for each cylinder bank. Deep-seated bolts reduce distortion and secure the cylinder heads to the cylinder block.

Each cylinder is served by four valves. To help achieve the required gas-flow characteristics, these are arranged asymmetrically around the cylinder bore. Each cylinder has a centrally mounted fuel injector and spark plug.

The cylinder head gasket is of a multi-layer steel construction.

EXHAUST MANIFOLD

- NOTE: [LH](#) (B bank) installation shown, [RH](#) (A bank) installation similar.

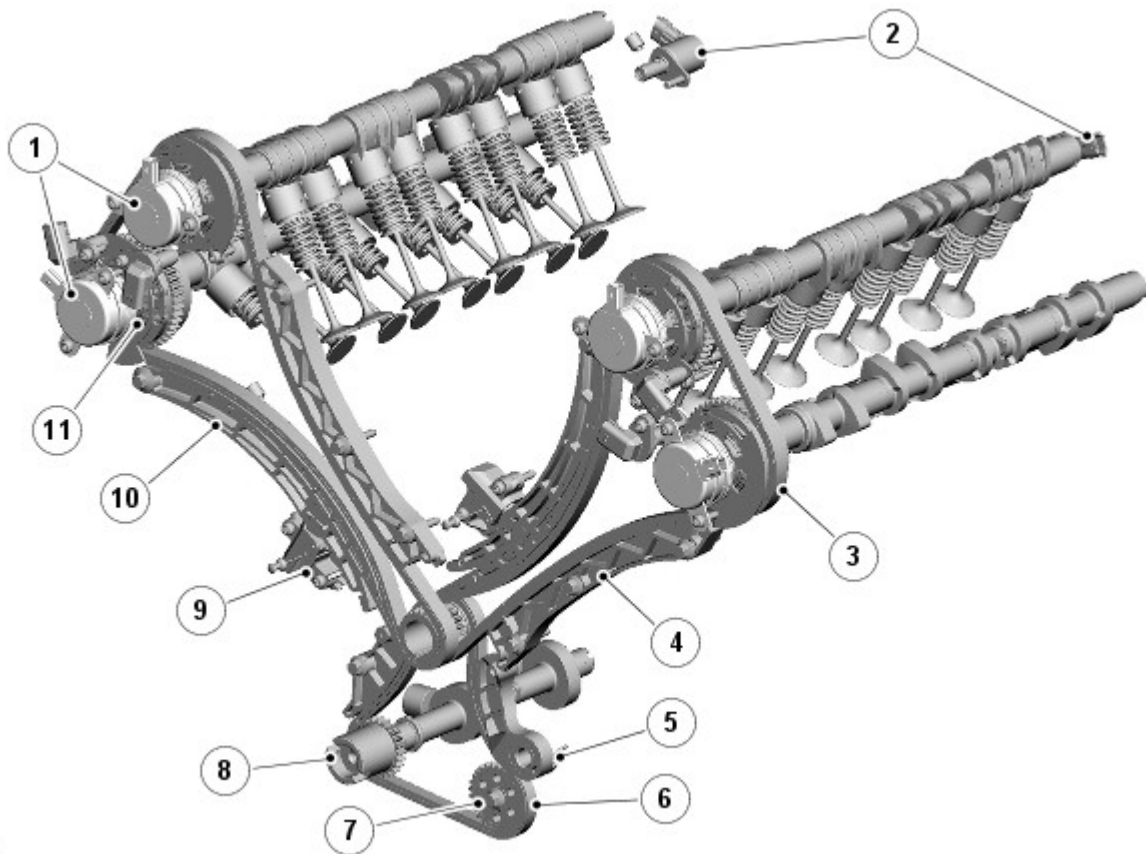


E118618

Item	Part Number	Description
1	-	Cylinder head
2	-	Gasket
3	-	Heat shield
4	-	Gasket
5	-	Exhaust manifold
6	-	Bolt (8 off)
7	-	Heat shield
8	-	Bolt (4 off)
9	-	Spacer (8 off)

The high SiMo (silicon molybdenum) cast iron exhaust manifolds are unique for each cylinder bank. Each exhaust manifold installation includes two metal gaskets and two heat shields. Spacers on the securing bolts allow the manifolds to expand and contract with changes of temperature while maintaining the clamping loads.

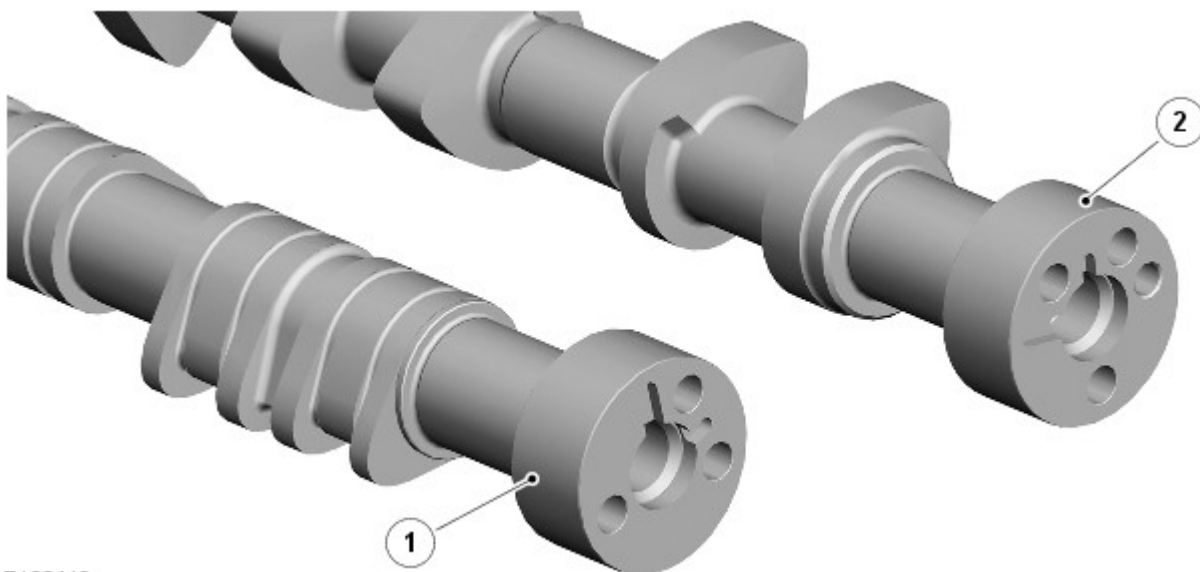
VALVE TRAIN



E106733

Item	Part Number	Description
1	-	VCT solenoids
2	-	CPS solenoids
3	-	Inverted tooth timing chain
4	-	Nylon chain guide
5	-	Auxiliary chain tensioner
6	-	Auxiliary drive chain
7	-	Oil pump drive
8	-	Auxiliary drive camshaft
9	-	Timing chain tensioner
10	-	Tensioner lever
11	-	VCT unit

Camshafts



E108443

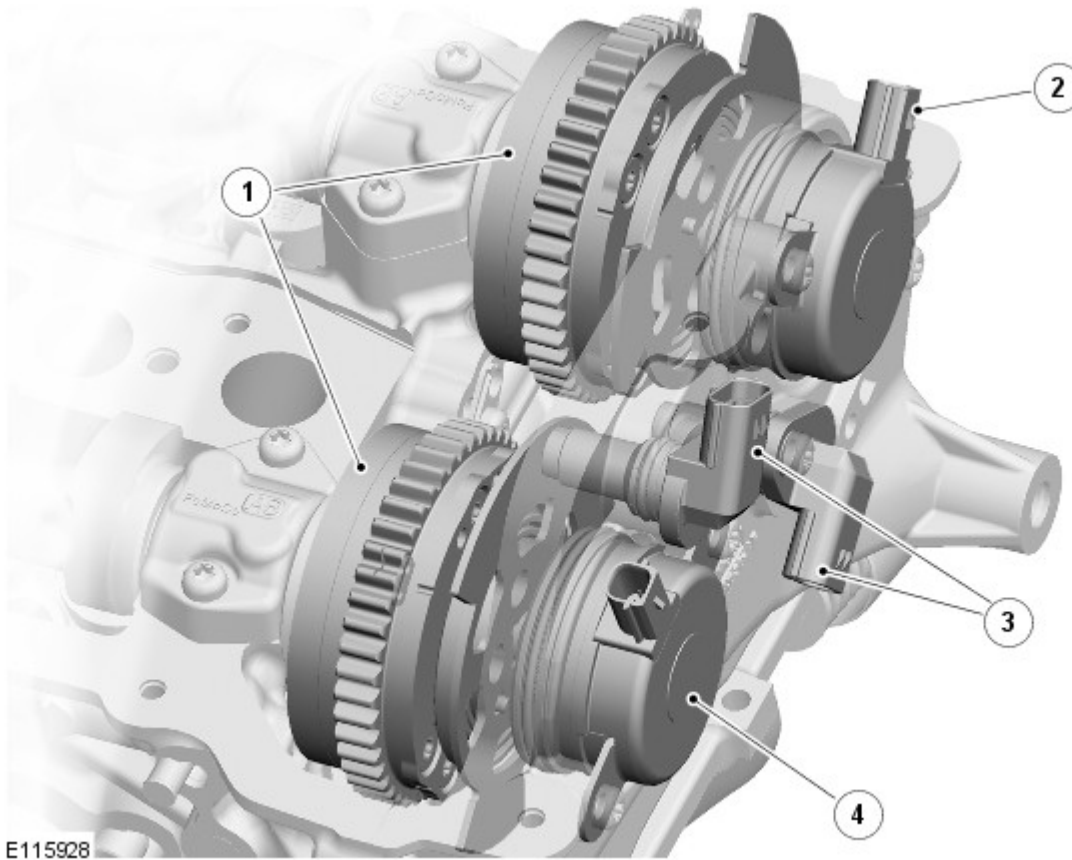
Item	Part Number	Description
1	-	Intake camshaft
2	-	Exhaust camshaft

The lightweight valve train provides good economy and noise levels and is chain driven from the crankshaft.

Double overhead camshafts on each cylinder head operate the valves. For each cylinder head, an inverted tooth timing chain transfers drive from the crankshaft to the [VCT](#) unit on the front of each camshaft. Graded tappets enable setting of exhaust valve clearances. Switchable tappets with hydraulic lash adjusters are installed on the intake valves.

Each timing chain has a hydraulic tensioner operated by engine oil pressure. The chain tensioners incorporate a ratchet mechanism, which maintains tension while the engine is stopped to eliminate start-up noise. The chains are lubricated with engine oil from jets located at the front of the engine block. Nylon chain guides control chain motion on the drive side.

Variable Camshaft Timing



E115928

Item	Part Number	Description
1	-	VCT units
2	-	Intake camshaft VCT solenoid
3	-	Camshaft position sensors
4	-	Exhaust camshaft VCT solenoid

The [VCT](#) system varies the timing of the intake and exhaust camshafts to deliver optimum engine power, efficiency and emissions. The timing of the intake camshafts has a range of 62 degrees of crankshaft angle. The timing of the exhaust camshafts has a range of 50 degrees of crankshaft angle.

In the base timing position:

- The intake camshafts are fully retarded.
- The exhaust camshafts are fully advanced.

VCT Operating Ranges

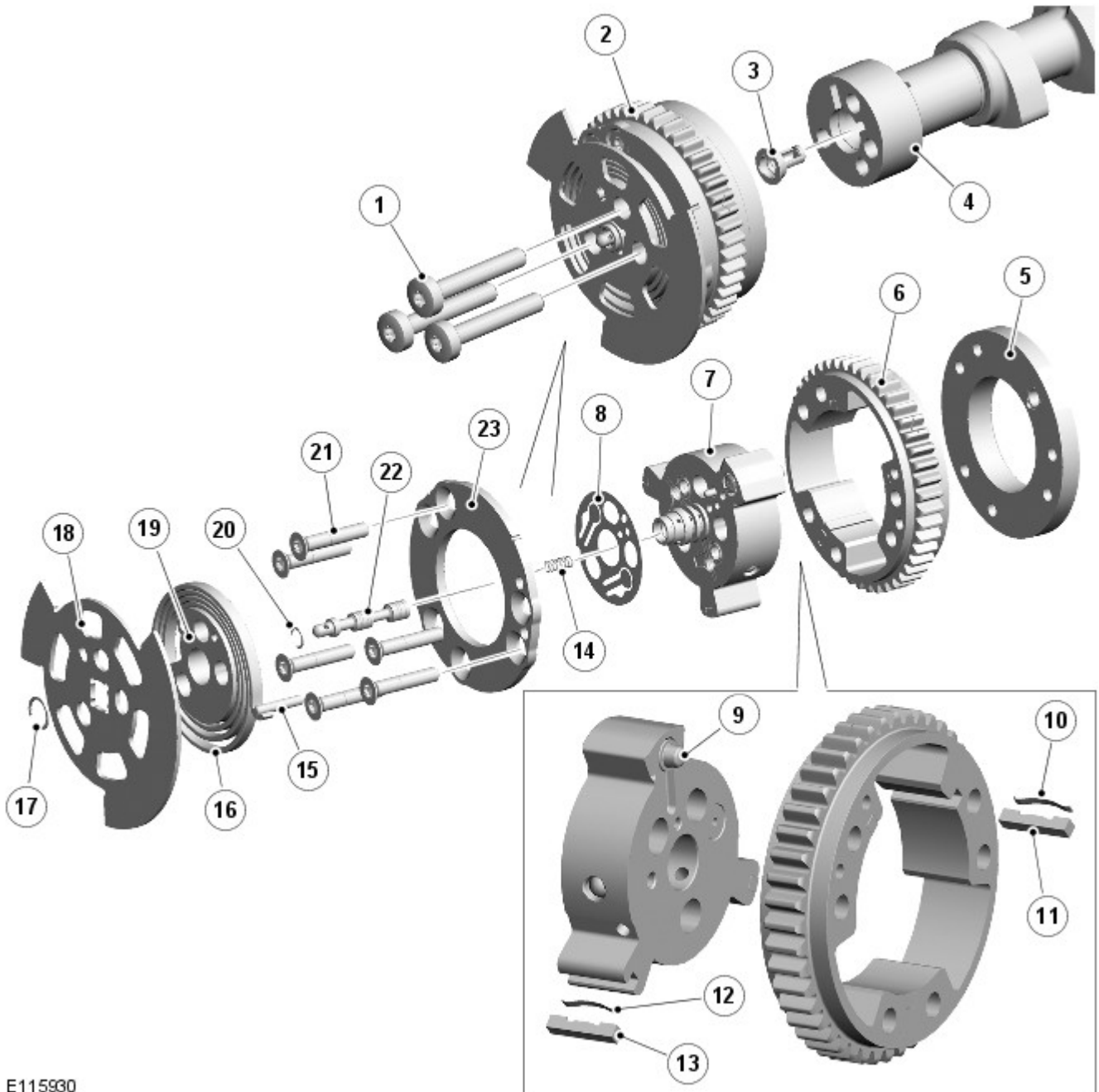
Camshaft	Valve Opens	Valve Closes
Intake - Low Lift	27 degrees BTDC (before top dead center) to 35 degrees ATDC (after top dead center)	187 to 249 degrees ATDC
Intake - High Lift	37 degrees BTDC to 25 degrees ATDC	213 to 275 degrees ATDC
Exhaust	244 to 194 degrees BTDC	6 to 56 degrees ATDC

The system consists of a [VCT](#) unit and a [VCT](#) solenoid for each camshaft. The [ECM](#) (engine control module) controls the system using [PWM](#) (pulse width modulation) signals to the [VCT](#) solenoids.

The torsional energy generated by the valve springs and the inertia of the valve train components are used to operate the system.

Variable Camshaft Timing Units

The [VCT](#) units change the position of the camshafts in relation to the timing chains.



E115930

Item	Part Number	Description
1	-	Bolt (3 off)
2	-	VCT unit
3	-	Filter
4	-	Camshaft
5	-	Inner plate
6	-	Housing and sprocket
7	-	Rotor assembly
8	-	Reed plate
9	-	Spring and lock pin
10	-	Spring (3 off)
11	-	Tip seal (3 off)
12	-	Spring (2 off)
13	-	Tip seal (2 off)
14	-	Spring
15	-	Dowel pin
16	-	Bias spring
17	-	Snap ring
18	-	Reluctor ring
19	-	Center plate
20	-	Snap ring
21	-	Screw (6 off)
22	-	Spool valve
23	-	Outer plate

Each [VCT](#) unit is attached to the camshaft by three bolts. A rotor assembly and a reed plate are installed inside a sprocket

housing, which consists of a sprocket, an outer plate and an inner plate held together by six screws.

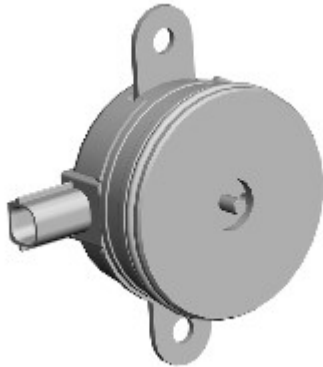
A reluctor ring, for the [CMP \(camshaft position\)](#) sensor, a center plate and a bias spring are installed at the front of the [VCT](#) unit. The ends of the bias spring locate on the center plate assembly and the sprocket housing, to give a turning moment to the camshaft in the advance direction. A snap ring locates the reluctor ring on to a sleeve installed in the center of the rotor assembly. The opposite end of the sleeve locates in a bore in the front face of the camshaft, which contains a filter.

A spring and spool valve are installed in the rotor assembly sleeve and retained by a snap ring. The spring keeps the spool valve in contact with the armature of the related [VCT](#) solenoid.

Each [VCT](#) unit is supplied with engine oil from an oil gallery in the cylinder head, through the camshaft front bearing cap and a bore in the center of the camshaft.

Variable Camshaft Timing Solenoids

The [VCT](#) solenoids control the position of the spool valves in the [VCT](#) units.



E115929

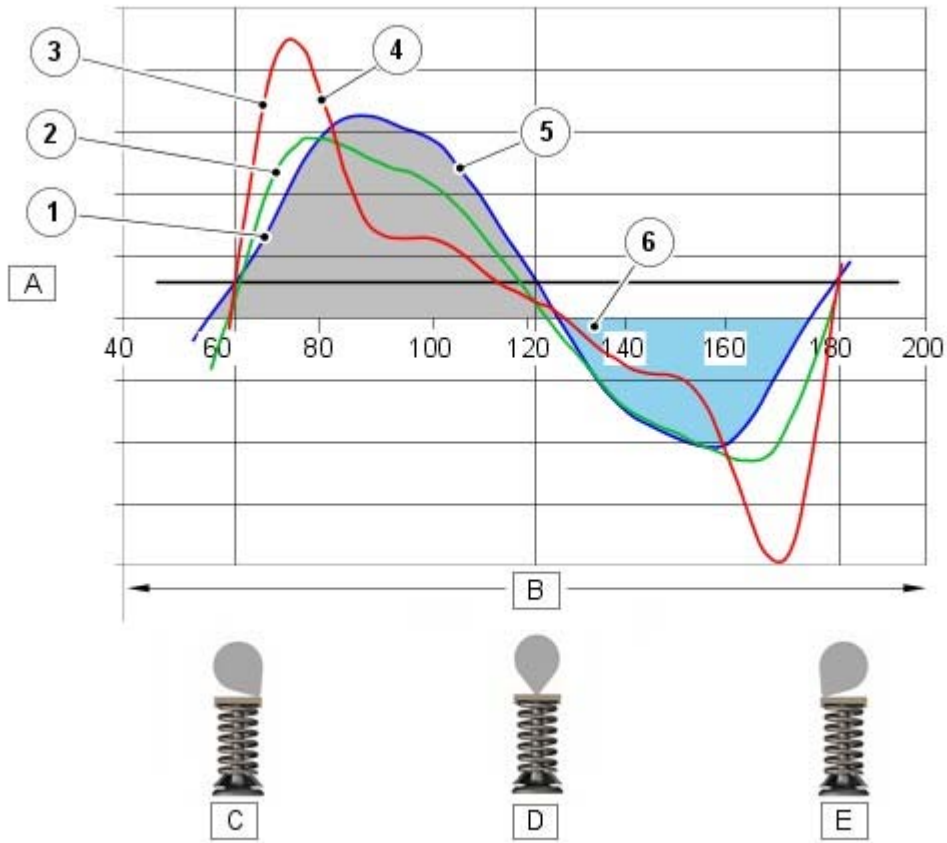
The [VCT](#) solenoids are installed in the front upper timing covers, immediately in front of their related [VCT](#) units. Each [VCT](#) solenoid is secured with two screws and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

Each [VCT](#) solenoid incorporates a spindle that acts on the spool valve in the related [VCT](#) unit to advance and retard the camshaft timing. The [VCT](#) solenoids operate independently and are controlled by a [PWM](#) signal from the [ECM](#).

Variable Camshaft Timing Operation

When the engine is running, the compression and expansion of the valve springs causes momentary increases and decreases in the torque acting on the camshafts. These momentary changes of torque are sensed in the [VCT](#) units and used to change the camshaft timing.

Camshaft Torsional Energy (For a Single Valve Event)

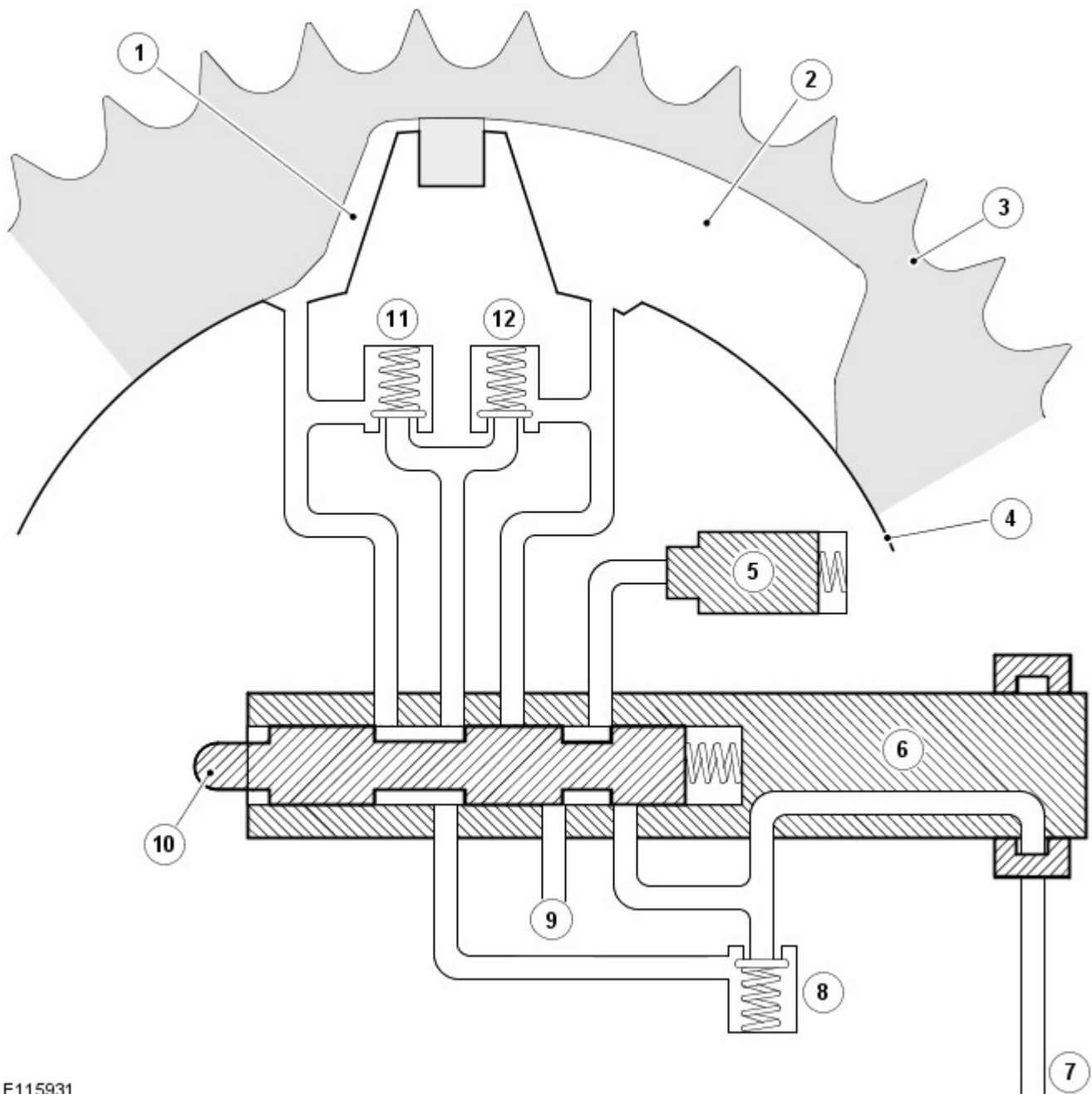


E112406

Item	Part Number	Description
A	-	Camshaft torque
B	-	Camshaft rotation (degrees)
C	-	Valve opening
D	-	Peak lift
E	-	Valve closing
1	-	1000 rev/min
2	-	4000 rev/min
3	-	7000 rev/min
4	-	Inertia effects from valve train rotating components
5	-	Force caused by valve spring
6	-	Bias torque from friction

Variable Camshaft Timing Unit Schematic - Base Timing

- NOTE: Intake camshaft [VCT](#) unit shown. For exhaust camshaft [VCT](#) unit, read advance for retard and retard for advance.



E115931

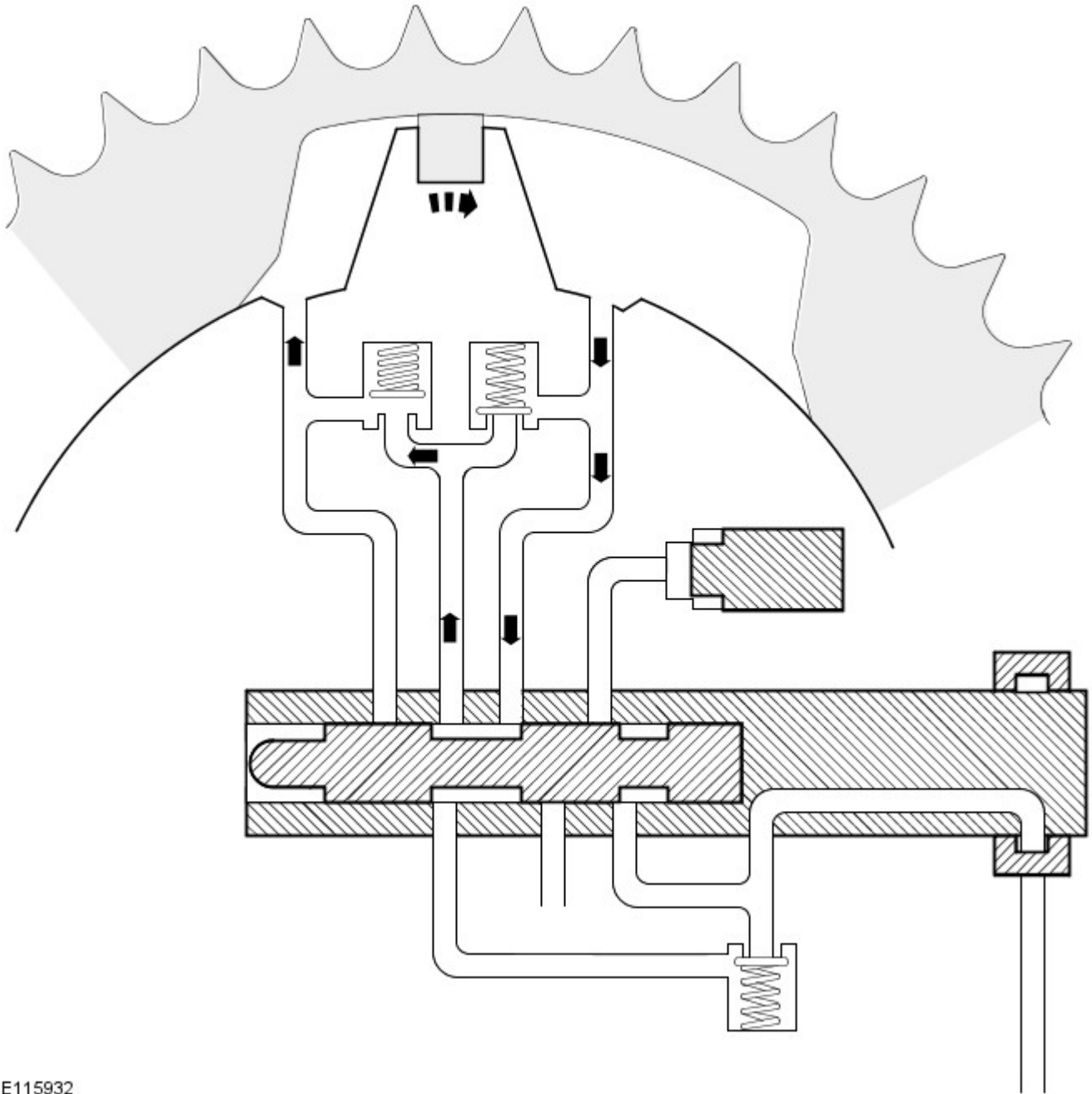
Item	Part Number	Description
1	-	Advance chamber
2	-	Retard chamber
3	-	Sprocket housing
4	-	Rotor assembly
5	-	Lock pin
6	-	Sleeve
7	-	Engine oil supply from camshaft
8	-	Inlet check valve
9	-	Lock pin drain
10	-	Spool valve
11	-	Advance check valve
12	-	Retard check valve

• NOTE: The following description is for intake camshaft [VCT](#) units. For exhaust camshaft [VCT](#) units, read advance for retard, and retard for advance.

At engine start-up, once the engine oil pressure in the camshaft is sufficient to open the inlet check valve, engine oil flows across the spool valve, through the advance and retard check valves and into the advance and retard chambers. During the start cycle, the [ECM](#) signals the [VCT](#) solenoid to move the spool valve into the sleeve and connect the lock pin to inlet oil pressure. The inlet oil pressure causes the lock pin to retract from the inner plate and unlock the rotor assembly and camshaft from the sprocket housing.

There is a constant supply of oil to the [VCT](#) to ensure the unit remains filled during operation.

Variable Camshaft Timing Unit Schematic - Advance

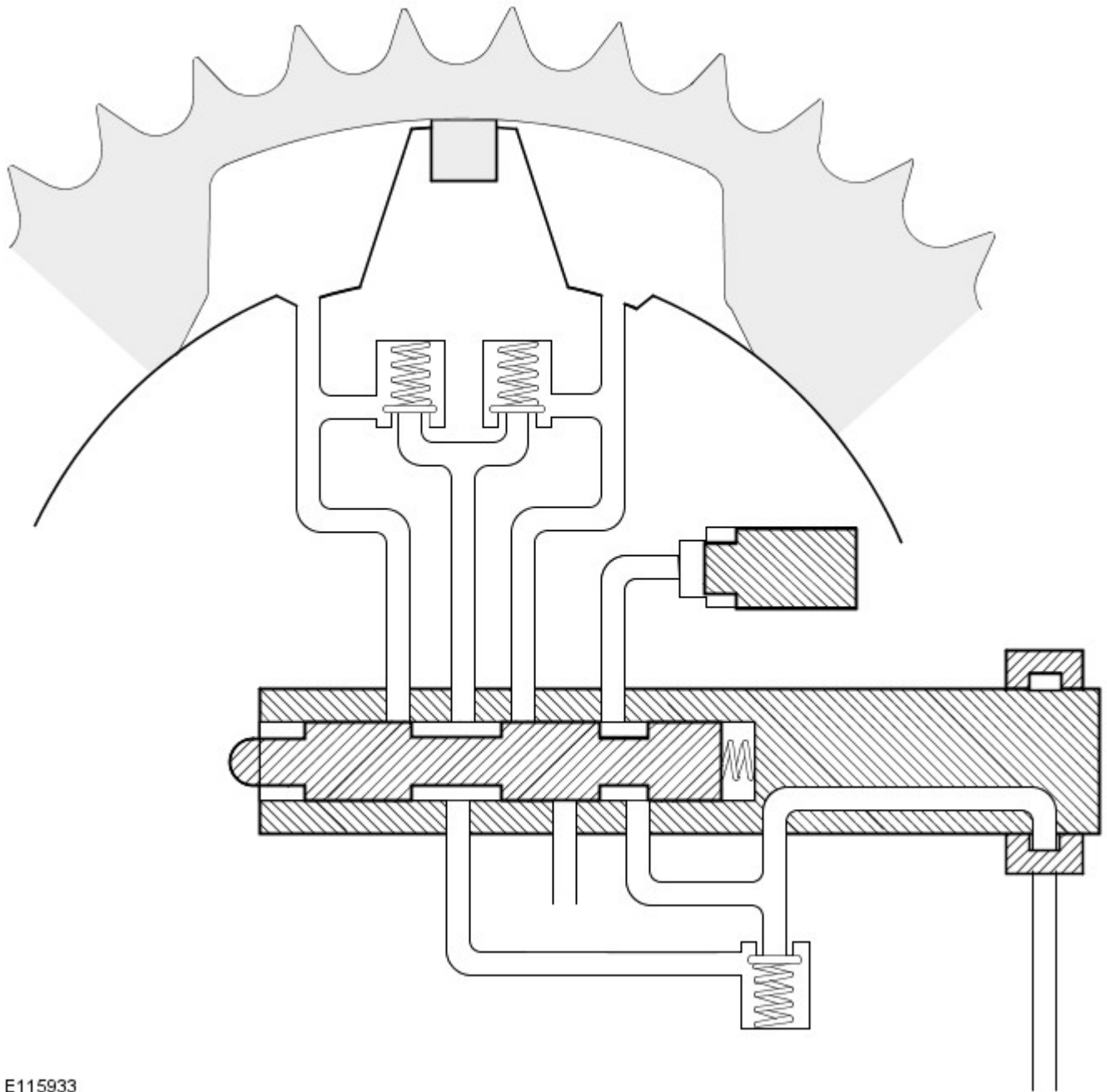


E115932

To advance the camshaft timing, the [ECM](#) adjusts the signal to the [VCT](#) solenoid to move the spool valve so that the advance chamber oil passage is closed and the retard chamber oil passage is connected to inlet oil.

Each momentary increase of the torque acting on the camshaft generates a pressure pulse in the retard chamber. Oil moves from the retard chamber, through the spool valve and the advance check valve to the advance chamber, to equalize the pressures in the two chambers. The displacement of oil from the retard chamber causes the rotor assembly to advance in relation to the sprocket housing. Each momentary decrease of torque acting on the camshaft also generates a pressure pulse in the advance chamber, but, with the advance chamber oil passage closed, no movement of oil between the advance and retard chambers occurs and the rotor assembly cannot move in the retard direction.

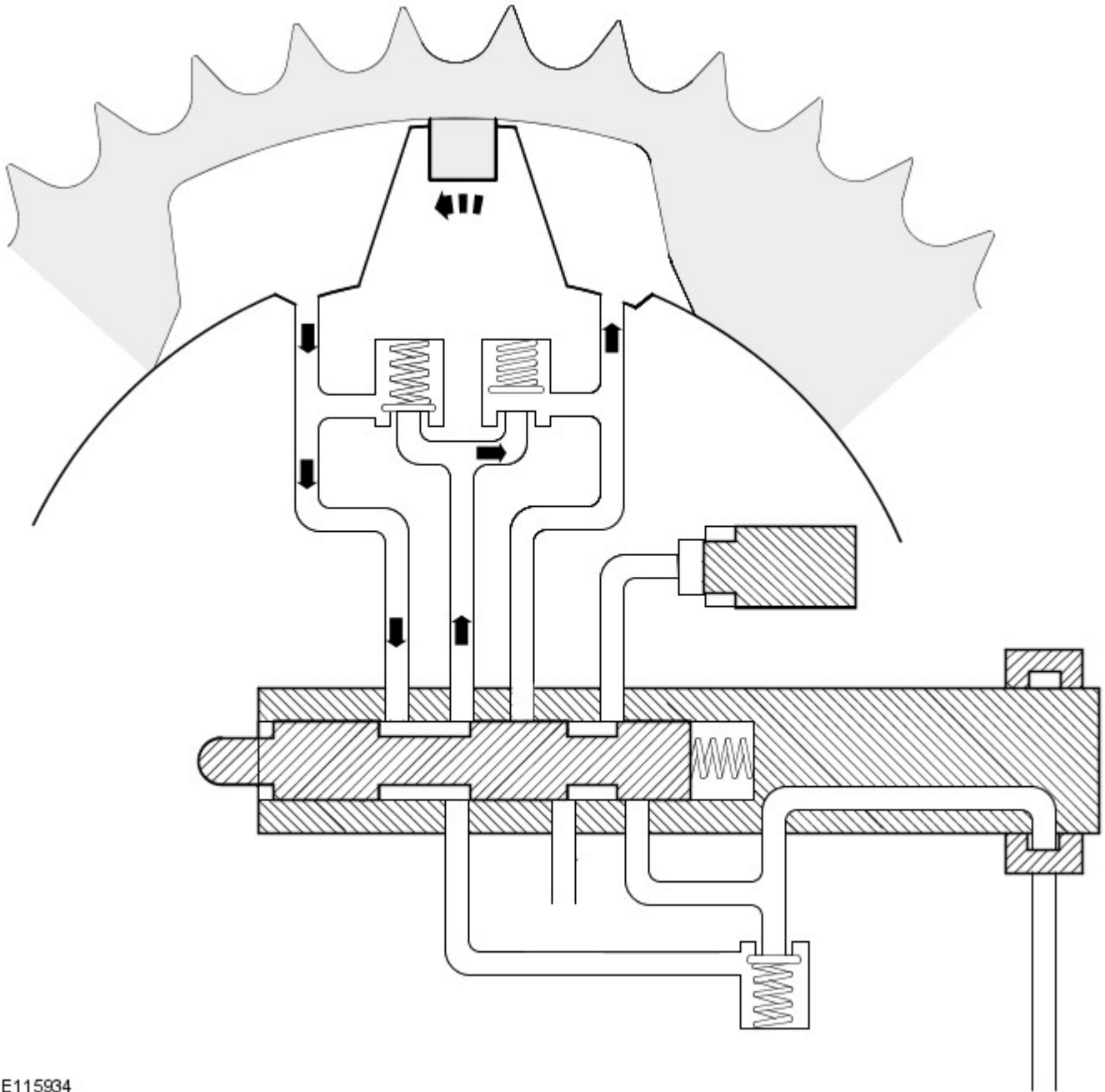
Variable Camshaft Timing Unit Schematic - Null



E115933

Once the camshaft has reached the required timing position the [ECM](#) adjusts the signal to the [VCT](#) solenoid to set the spool valve in the null position. In the null position, the advance and retard chamber oil passages are both closed by the spool valve and the rotor assembly is hydraulically locked to the sprocket housing.

Variable Camshaft Timing Unit Schematic - Retard

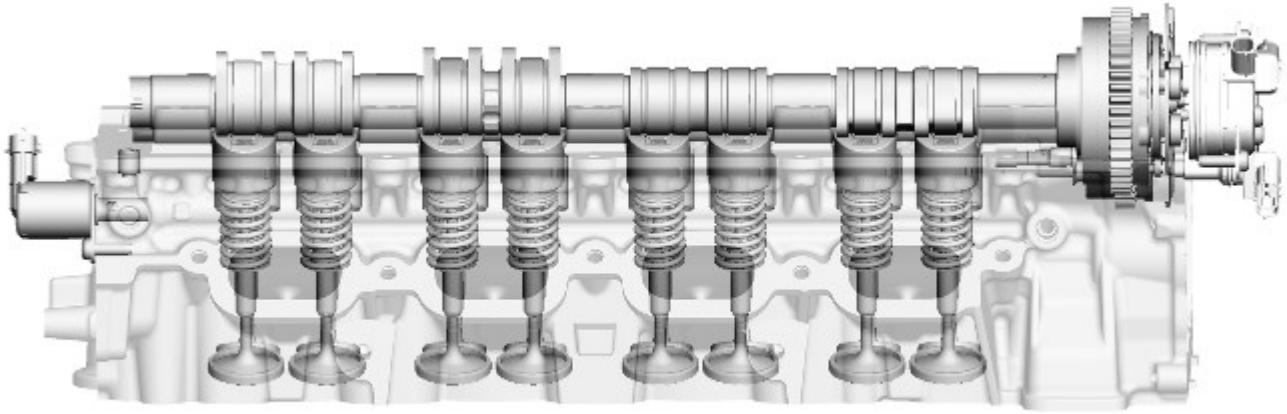


E115934

To retard the camshaft timing, the [ECM](#) adjusts the signal to the [VCT](#) solenoid to move the spool valve to close the retard chamber oil passage and connect the advance chamber oil passage to the inlet oil.

Each momentary decrease of the torque acting on the camshaft causes oil to transfer from the advance chamber, through the spool valve and the retard check valve to the retard chamber, and so retard the camshaft timing.

Camshaft Profile Switching

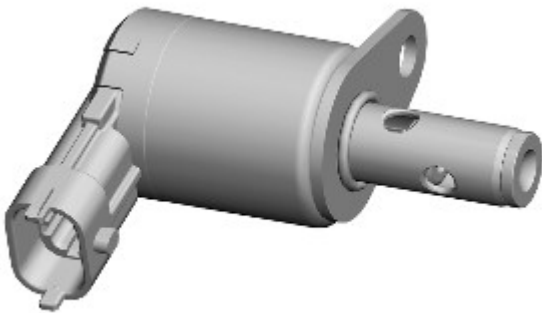


E106735

The CPS (camshaft profile switching) system switches the intake valves between two cam profiles which have different lift and period. The low lift profile improves driveability and emissions at lower engine speeds. The high lift profile improves power and torque output at higher engine speeds.

The intake camshafts have three lobes for each valve. The two outer lobes have identical profiles that produce the high lift of 10.53 mm (0.415 in.). The central lobe produces the low lift of 5.50 mm (0.217 in.). Switching between cam profiles is performed by a switchable tappet on each intake valve. The switchable tappets are operated by engine oil controlled by a CPS solenoid on each cylinder head. Operation of the CPS solenoids is controlled by the [ECM](#).

Camshaft Profile Switching Solenoids



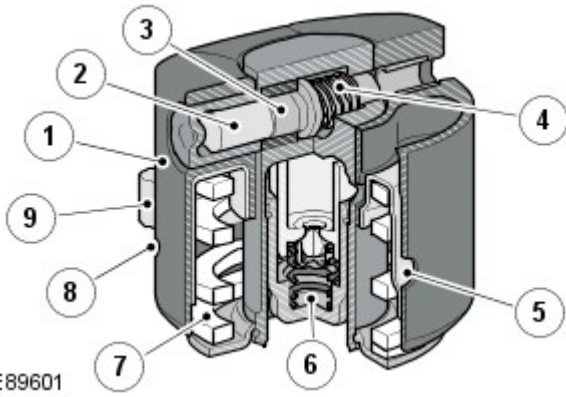
E115935

The CPS solenoids control the supply of engine oil pressure to the locking pins in the switchable tappets, to switch the tappets between the two cam profiles.

A CPS solenoid is installed on the rear of each cylinder block. Each CPS solenoid has a pintle installed in a sleeve, which incorporates oil inlet and outlet holes. The sleeve is installed at the junction of oil galleries in the cylinder head, with the oil inlet and outlet holes aligned with the galleries. Movement of the pintle in the sleeve controls a connection between the oil galleries. When the CPS solenoid is energized, the pintle connects an oil supply gallery to the gallery along the outboard side of the switchable tappets. When the CPS solenoid is de-energized, the oil gallery along the outboard side of the switchable tappets is connected to drain.

The CPS solenoids receive a fused battery supply from the main relay. The [ECM](#) switches a ground connection to operate the solenoids.

Switchable Tappets



E89601

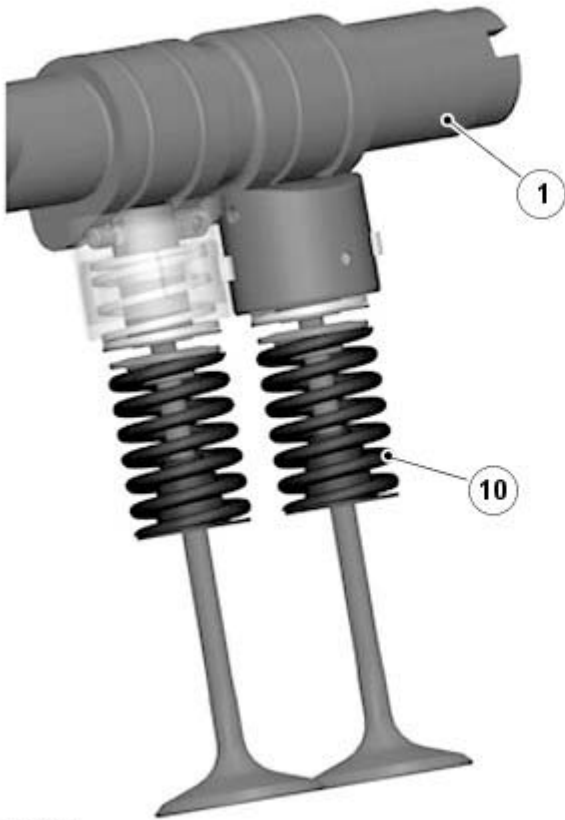
Item	Part Number	Description
1	-	Outer tappet
2	-	Outer locking pin
3	-	Inner locking pin
4	-	Return spring
5	-	Lash adjuster oil inlet
6	-	Lash adjuster
7	-	Lost motion spring
8	-	CPS oil inlet
9	-	Anti-rotation lug

The switchable tappets are installed on the intake valves, in bores in the cylinder heads. The cylinder heads incorporate engine oil galleries along the inboard and outboard sides of the bores. The inboard oil galleries (between the tappets and the spark plug/fuel injector bores) supply an oil feed to the locking pins in the switchable tappets. The outboard oil galleries (over the inlet ports) supply an oil feed to the hydraulic lash adjusters in the switchable tappets.

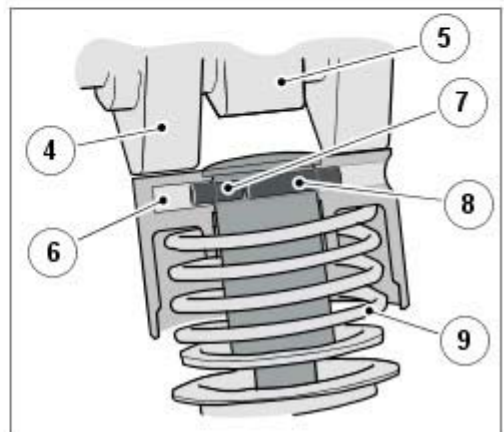
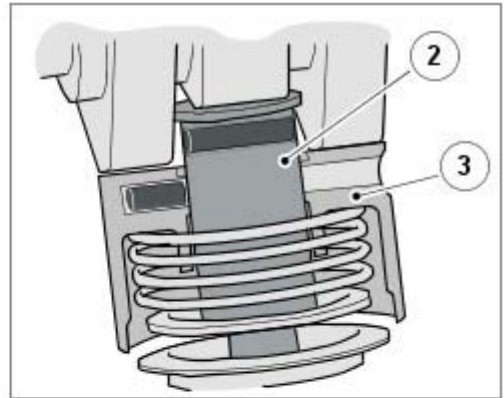
Each switchable tappet consists of inner and outer tappets, which can operate independently or be locked together by locking pins. A hydraulic lash adjuster on the bottom of the inner tappet locates on the intake valve stem.

In low lift, the intake valve lift is controlled by the inner tappets, which run on the center lobes of the intake camshafts. The outer tappets run on the outer lobes of the intake camshafts, and move up and down the inner tappets without affecting the valve lift. The lost motion springs keep the outer tappets in contact with the outer lobes. Movement of the inner tappets is transferred to the intake valves through the hydraulic lash adjusters.

In high lift, engine oil is supplied to the locking pins, which lock the outer tappets to the inner tappets. Intake valve lift is controlled by the outer tappets, which run on the outer lobes of the intake camshafts. Movement of the outer tappets is transferred to the intake valves through the locking pins, the inner tappets and the hydraulic lash adjusters.



E108445



Item	Part Number	Description
------	-------------	-------------

1	-	Intake camshaft
2	-	Inner tappet
3	-	Outer tappet
4	-	Outer cam profile (high lift)
5	-	Inner cam profile (low lift)
6	-	Locking pin oil pressure inlet
7	-	Outer locking pin
8	-	Inner locking pin
9	-	Outer tappet lost motion spring
10	-	Valve spring

Camshaft Profile Switching Operation

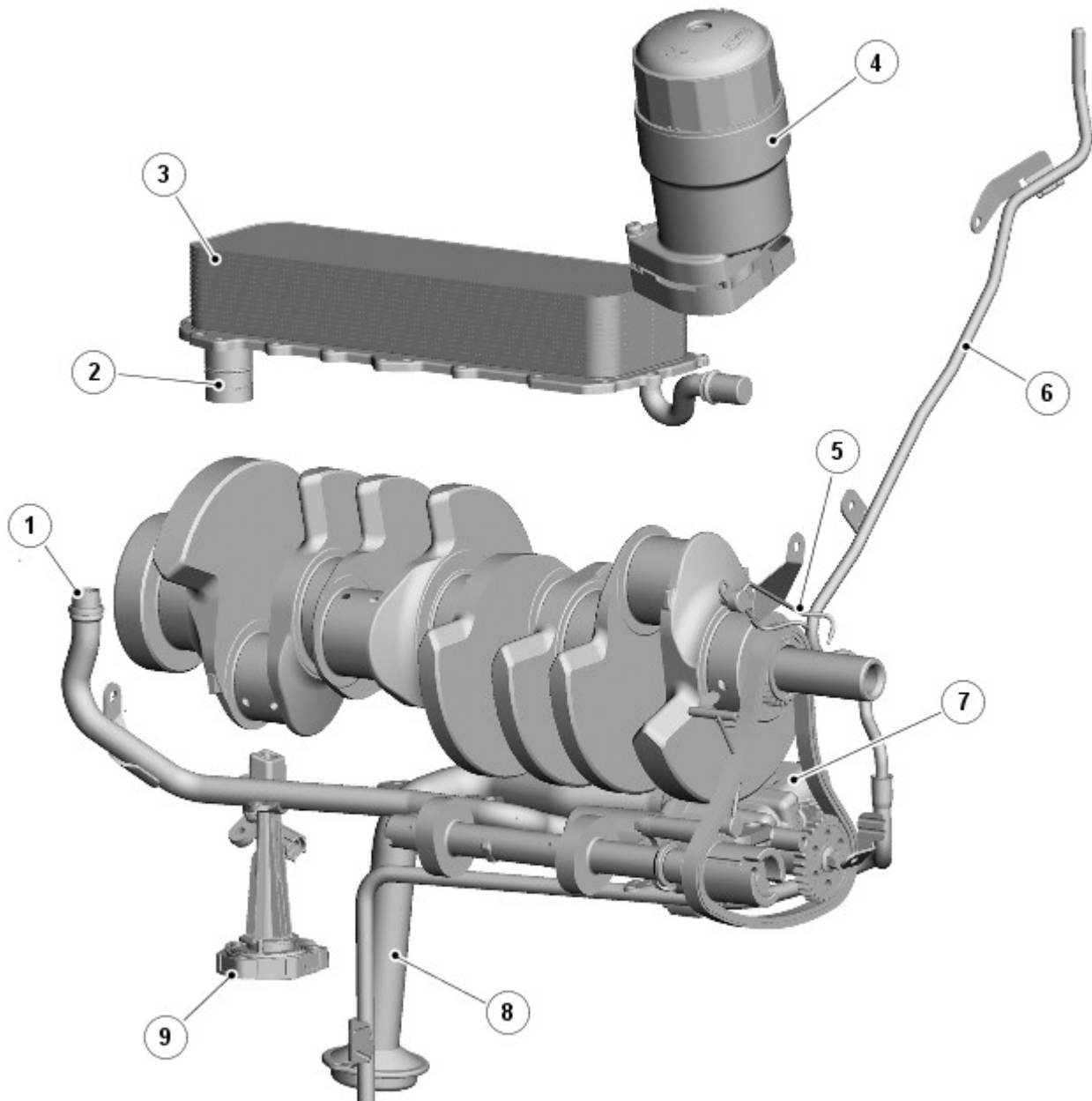
The switching point is speed and load dependent. This strategy ensures that switching occurs at air flow neutral points in the engine's operation and is imperceptible to the driver.

At engine speeds from idle up to the range of 2825 - 4250 rev/min (depending on engine load), the CPS solenoids are de-energized and the switchable tappets are set to low lift. At engine speeds above the 2825 - 4250 rev/min range, the CPS solenoids are energized by the [ECM](#) and the switchable tappets are set to high lift. There is a 200 rev/min hysteresis when switching from high lift to low lift with decreasing engine speed. Switching between lift settings occurs within one revolution of the camshaft.

Switching is only enabled at engine oil temperatures of 20 °C (68 °F) and above. At oil temperatures below 20 °C (68 °F), CPS operation is disabled and the switchable tappets remain in the low lift setting. CPS operation is also disabled if a CPS solenoid fails. When CPS operation is disabled, engine speed is limited to 5000 rev/min.

The [ECM](#) can diagnose the operation of the CPS solenoids and store fault related [DTC \(diagnostic trouble code\)](#) if it detects a failure.

LUBRICATION SYSTEM



E118619

Item	Part Number	Description
1	-	Oil pump outlet tube
2	-	Anti-drain valve
3	-	Oil cooler
4	-	Oil filter
5	-	Timing chain lubrication jet (2 off)
6	-	Oil evacuation tube
7	-	Oil pump
8	-	Oil pick-up
9	-	Oil temperature and level sensor

The oil pump is attached to the underside of the windage tray. The input shaft of the oil pump is driven from the front of the crankshaft, by the auxiliary chain, at 0.87 engine speed.

The oil pump draws oil from the sump through a centrally mounted pick-up pipe. The oil is pressurized and pumped through an output tube to the cylinder block. After passing through an anti-drain valve and a plate type oil cooler, the oil is filtered by a replaceable cartridge installed on the front of the [RH](#) cylinder head.

The output from the oil filter is distributed through oil galleries in the cylinder heads and cylinder block. All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for the [VCT](#) system, the CPS system, the timing chain tensioners and the timing chain lubrication jets.

The oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the rapid return of the oil to the sump. System replenishment is through the oil filler cap on the [LH](#) cylinder head cover.

An oil evacuation tube is installed to allow oil to be drawn from the sump. The upper end of the oil evacuation tube is located under the oil filler cap.

An oil drain plug is installed in the [RH](#) side of the sump.

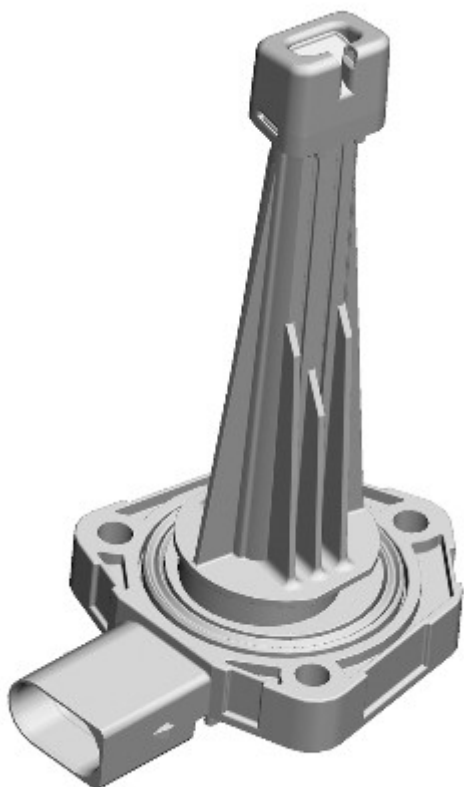
Oil Pump Nominal Operating Pressures

Engine Speed, rev/min	Temperature, °C (°F)	Pressure, bar (lbf/in ²)
Idle	20 (68)	2.0 (29.0)
1500	20 (68)	6.0 (87.0)
3000	40 (104)	6.2 (90.0)
3000	110 (230)	5.0 (72.5)
3000	130 (266)	4.0 (58.0)

Oil Level Monitoring

Oil level monitoring is provided by an oil level and temperature sensor that measures the oil level in the sump. The oil level can be displayed in the message center of the instrument cluster.

Oil Level and Temperature Sensor



E115936

The oil level and temperature sensor supplies the [ECM](#) with a signal containing the level and temperature of the oil in the sump. The oil level and temperature sensor is secured to the bottom of the sump with three screws and sealed with a gasket.

The oil level and temperature sensor sends an ultrasonic pulse vertically upward and measures the time taken for the pulse to be reflected back from the top surface of the oil. This time is compared with the time taken for an ultrasonic pulse to travel a reference distance within the oil level and temperature sensor to determine the oil level. The oil level reading is combined with the oil temperature reading and transmitted in a [PWM](#) signal to the [ECM](#).

Oil Level and Temperature Sensor Specifications

Feature	Details
Power Source	Battery Voltage
Level Accuracy	±2 mm (±0.08 in.) at temperatures of -30 °C (-22 °F) and above; (±4 mm (±0.16 in.) at temperatures below -30 °C (-22 °F))
Temperature Accuracy	±2 °C (±3.6 °F)
Operating Level Range	116 to 147 mm (4.57 to 5.79 in.)
Operating Temperature Range	-40 to 160 °C (-40 to 320 °F)

Oil Level Check

For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).

For accuracy, oil level checks should be performed with the vehicle on level ground when the oil is hot. The vehicle needs to stand for approximately 10 minutes, after the engine is switched off, to allow the oil to drain back into the sump and the oil level to stabilize. The oil level system will not give a reading until the oil level has stabilized.

To check the oil level, make sure that the ignition is on, the engine stopped and the transmission is in P (park). Access the vehicle information and settings menu, then select **Oil Level Display** from the **Service Menu**. An **Engine Oil Level** sight glass will be displayed in the message center. The current oil level will be displayed in the sight glass. One of the following messages will also be displayed:

- If the oil level is within acceptable limits, the message **Level OK** is displayed.
- If the oil level is less than acceptable, a message advising how much oil to add is displayed e.g. **Add 1 Litre**, or **Add 1 Quart**, depending on the market.
- If the message **Overfilled** is displayed, the oil level must be reduced to within acceptable limits before starting the engine again.
- If the message **Not available** is displayed, the oil level is still stabilizing. Wait 10 minutes and then recheck level.



E121582

Engine - V8 5.0L Petrol - Engine

Diagnosis and Testing

For additional information, refer to Diagnosis and Testing, Engine - 5.0L

REFER to: [Engine - V8 5.0L Petrol](#) (303-00 Engine System - General Information, Diagnosis and Testing).

Engine - V8 5.0L Petrol - Engine Oil Draining and Filling


General Procedures

Draining

 **WARNING:** The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.

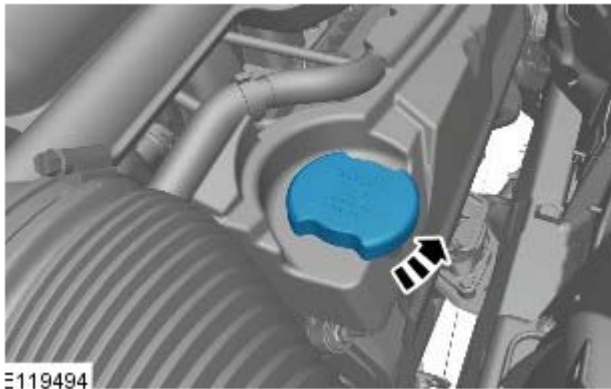
 **CAUTION:** Correct installation of the oil filler cap can be obtained by tightening the cap until hard stop.

• **NOTE:** Clean the components general area prior to dismantling.

1.  **CAUTION:** Make sure the engine is warm.

Start the engine and allow to run for 10 minutes, stop the engine.

2.

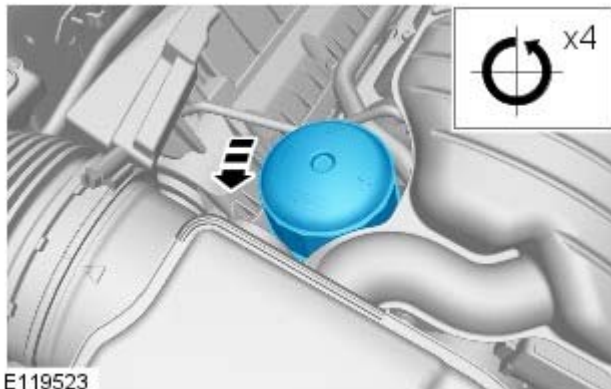


E119494

3. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).


4.

- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.
- Make sure that the O-ring seal is exposed.



E119523

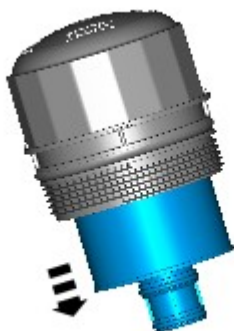
5. **NOTE:** Allow 10 minutes for the engine oil to drain from the oil filter housing.

6. Remove and discard the oil filter element.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always use the vehicle's safety stands.

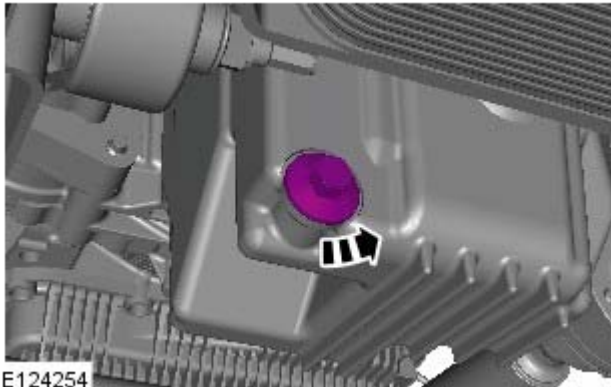
Raise and support the vehicle.



8. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



E107394



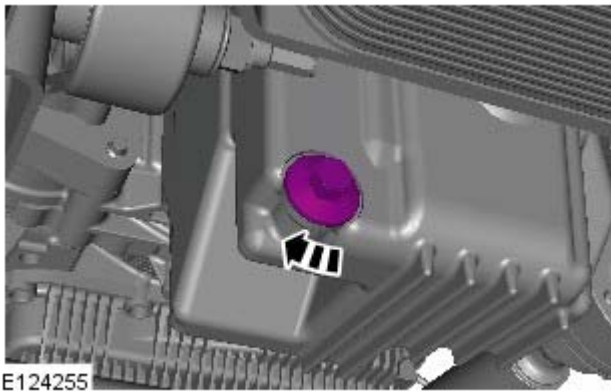
9. **9. CAUTIONS:**


 Be prepared to collect escaping oil.

 Allow at least 10 minutes for the engine oil to drain.

• NOTE: Discard the sealing washer.

Filling



1.  **10. CAUTION:** Make sure that the area around the component is clean and free of foreign material.

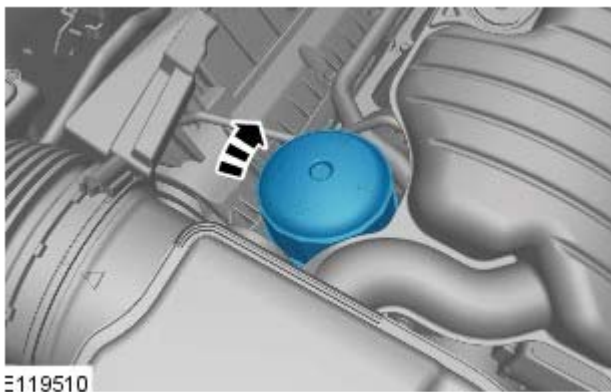
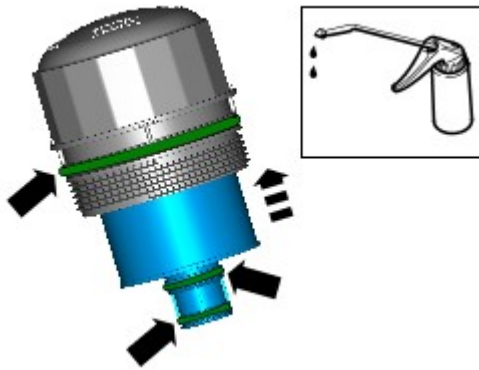
• NOTE: Install a new sealing washer.

Torque: 24 Nm

2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).


3. **12. NOTE:** Install new O-ring seals.

Lubricate the oil filter element O-ring seal with clean engine oil.



4.  **13. CAUTION:** Tighten the component finger tight first.

• *Torque: 25 Nm*

5. **14.**  **CAUTION:** Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 9-15), before starting the engine.

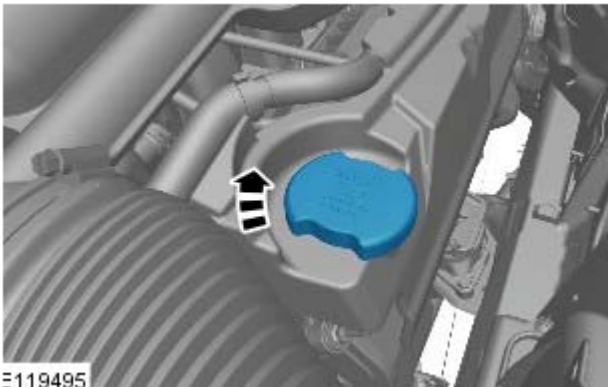
- Fill the engine with oil - for filling values on vehicles without supercharger:

Refer to: [Specifications](#) (303-01D Engine - V8 5.0L Petrol, Specifications).


- Fill the engine with oil - for filling values on vehicles with supercharger:

Refer to: [Specifications](#) (303-01D Engine - V8 5.0L Petrol, Specifications).

- Clean any residual engine oil from the oil filler cap area.



6.

7. **16.**  **CAUTION:** Make sure that the vehicle has been left for 5 minutes from filling with oil.

Follow the Steps 9-15 before starting the engine.

- 8.
- Start the engine and allow to run for 10 minutes, stop the engine.
 - Check for leaks.

9. **18.** **CAUTIONS:**



Make sure that the selector lever and the gearshift mechanism are in the park (P) position.



Make sure that the hood is open.

- Turn the ignition on.



10.

- Press the right-hand directional button to access the instrument cluster menu.



E123926



11.

- Press the right-hand OK button.

E123925



E123927

12.

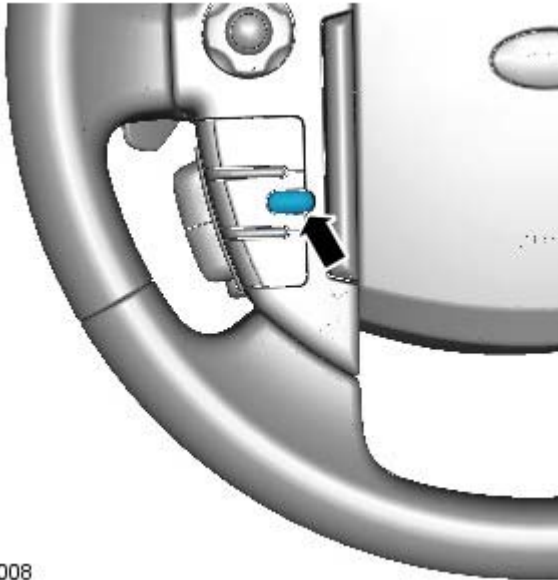
- Press the right-hand directional button to access the Oil Level Display.



E123928

13.

- Press the right-hand OK button and follow the instructions.



E121008

14.

- Press the cruise control cancel button twice within 2 seconds.



15.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 8), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.

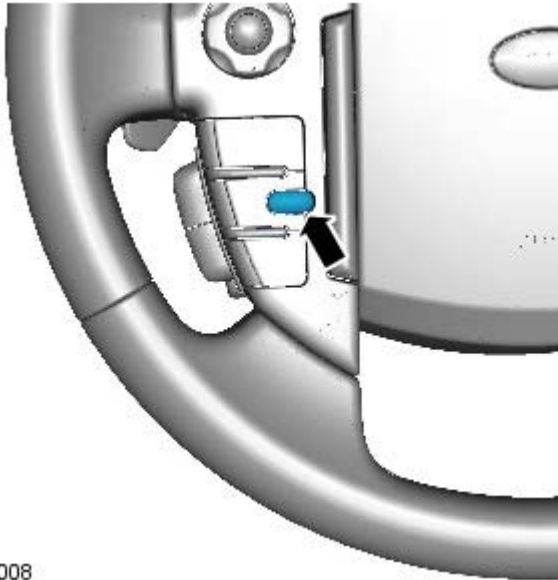


E123929

16. **25.** NOTE: If instructed to follow Steps 9-15 in a previous step, return to Step 8 and continue the procedure.

Turn the ignition off.

17. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.



E121008

18. **27. NOTE:** The following steps are to update the average oil level value.

- Turn the ignition on.
- Press and hold the cruise control cancel button for more than 2 seconds.

19.

- The message center display will revert to the normal display in the trip computer.

20. Turn the ignition off.

21. Turn the ignition on.

22.

- Press the right-hand directional button to access the instrument cluster menu.



E123926



23.

- Press the right-hand OK button.

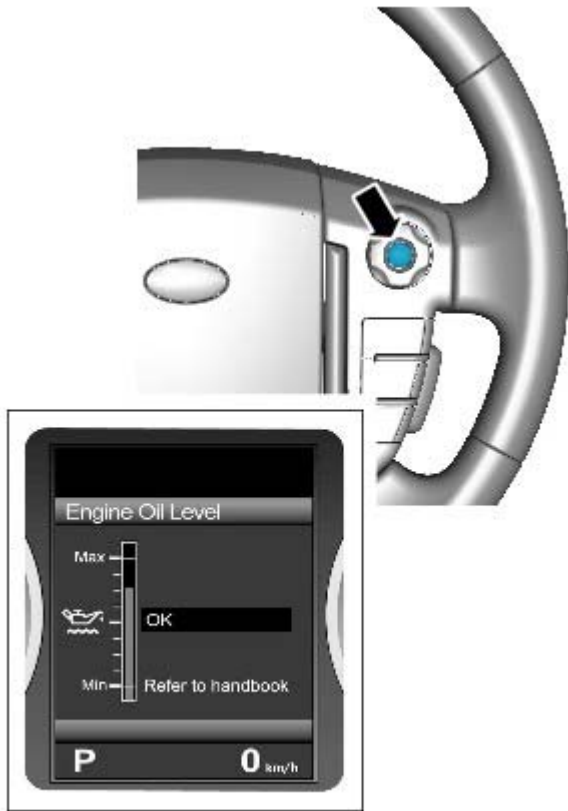


24.

- Press the right-hand directional button to access the Oil Level Display.



E123927



E123929

25.


- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.

26. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

Engine - V8 5.0L Petrol - Engine Oil Vacuum Draining and Filling

General Procedures

Special Tool(s)

 <p>E129630</p>	<p>303-1484 Vacuum Pump, Oil Drain</p>
 <p>E129631</p>	<p>303-1484-01 Adapter for 303-1484</p>

Draining



WARNING: The spilling of hot engine oil is unavoidable during this procedure, care must be taken to prevent scalding.



CAUTION: Correct installation of the oil filler cap can be obtained by tightening the cap until hard stop.

- NOTE: Make sure that the vehicle is parked on level ground.
- NOTE: Clean the components general area prior to dismantling.

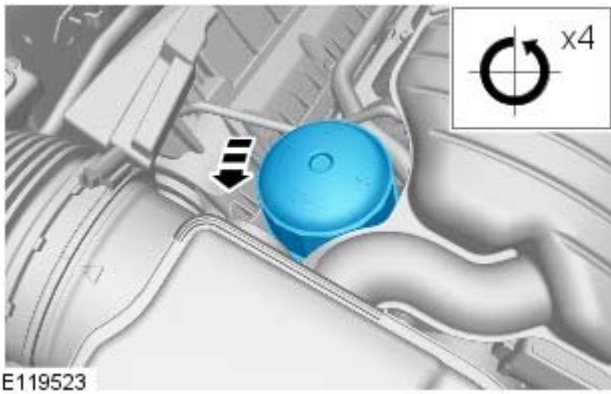
1.

- Start the engine and allow to run for 10 minutes, stop the engine.

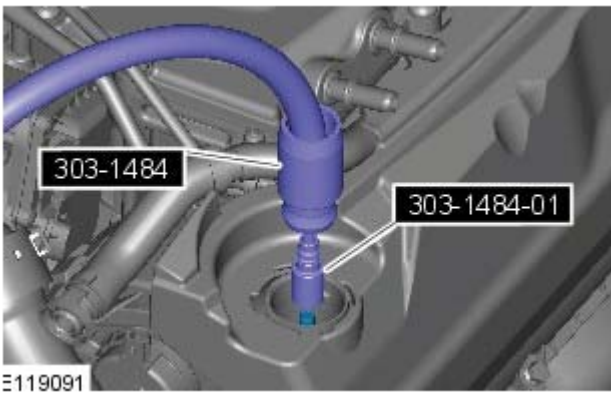


2.  **CAUTION:** Allow 10 minutes from turning the engine off before starting oil extraction.

3. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).



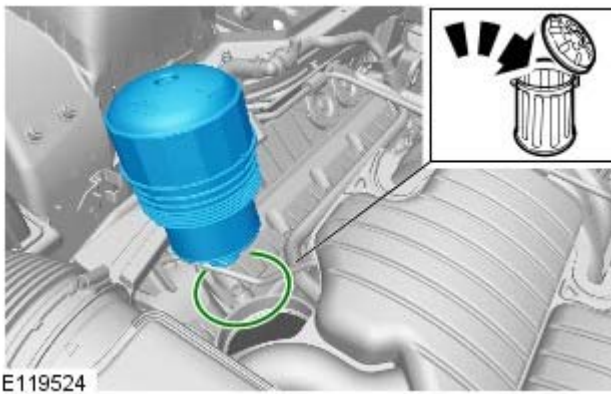
4.
 - Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.



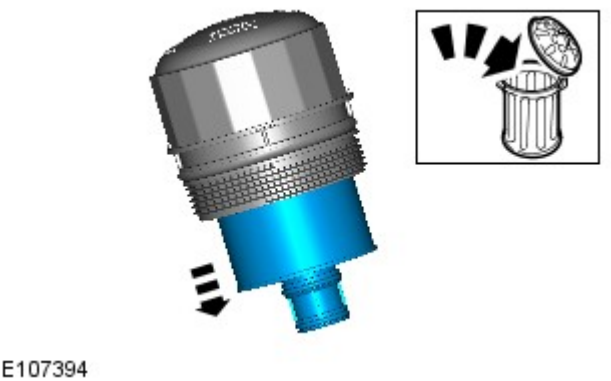
5.
 - Using the oil vacuum pump drain the oil out through the oil extraction tube.

Special Tool(s): [303-1484](#), [303-1484-01](#)

6.
 - Remove the oil vacuum pump.



- 7.

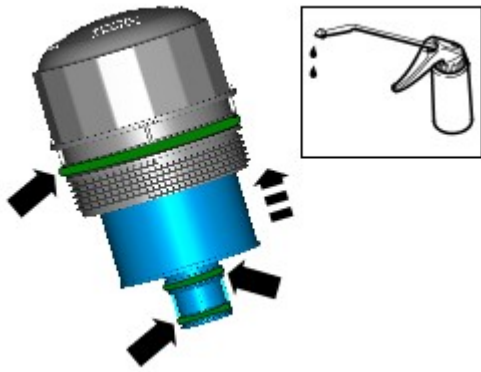


8. **8. NOTE:** Discard the O-ring seals.

Filling

1. **9.** NOTE: Install new O-ring seals.

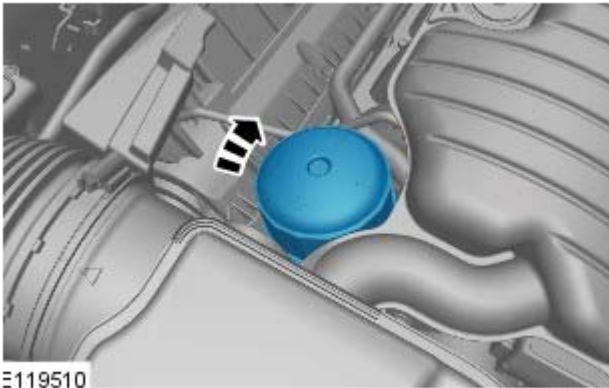
Lubricate the oil filter element O-ring seal with clean engine oil.




E107727

2. **10.**  CAUTION: Tighten the component finger tight first.

- Torque: 25 Nm



E119510

3. **11.**  CAUTION: Make sure that the vehicle is left for 5 minutes from filling with oil and that the engine oil level is reading at least minimum (by following Steps 7-13), before starting the engine.

- Fill the engine with oil - for filling values on vehicles without supercharger:

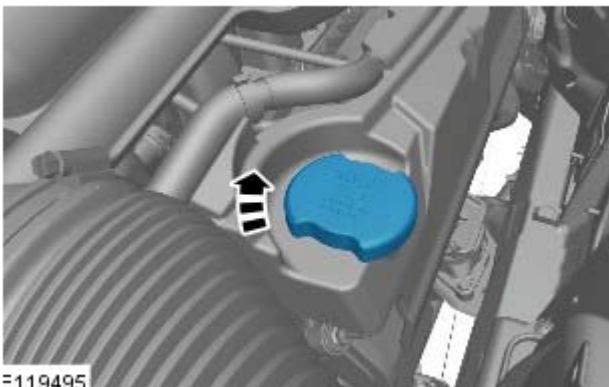
Refer to: [Specifications](#) (303-01D Engine - V8 5.0L Petrol, Specifications).

- Fill the engine with oil - for filling values on vehicles with supercharger:


Refer to: [Specifications](#) (303-01D Engine - V8 5.0L Petrol, Specifications).

- Clean any residual engine oil from the oil filler cap area.

- 4.



E119495

5. **13.**  CAUTION: Make sure that the vehicle has been left for 5 minutes from filling with oil.

Follow the Steps 7-13 before starting the engine.

6.
 - Start the engine and allow to run for 10 minutes, stop the engine.
 - Check for leaks.

7. **15. CAUTIONS:**



Make sure that the selector lever and the gearshift mechanism are in the park (P) position.



Make sure that the hood is open.

- Turn the ignition on.

8.

- Press the right-hand directional button to access the instrument cluster menu.





E123925

- 9.
- Press the right-hand OK button.



- 10.
- Press the right-hand directional button to access the Oil Level Display.



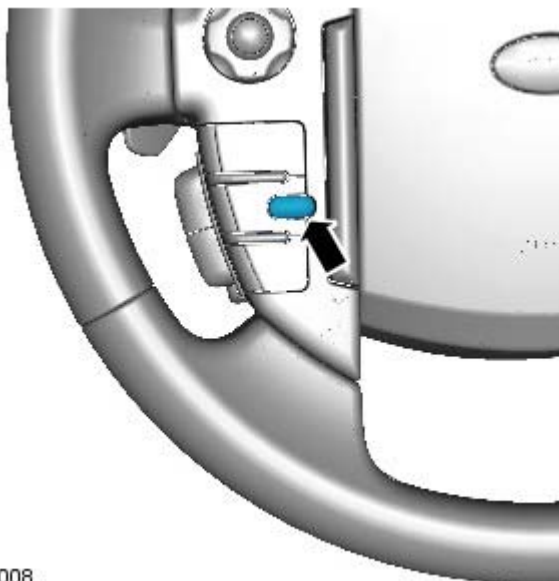
E123927



E123928

11.

- Press the right-hand OK button and follow the instructions.



E121008

12.

- Press the cruise control cancel button twice within 2 seconds.



E123929

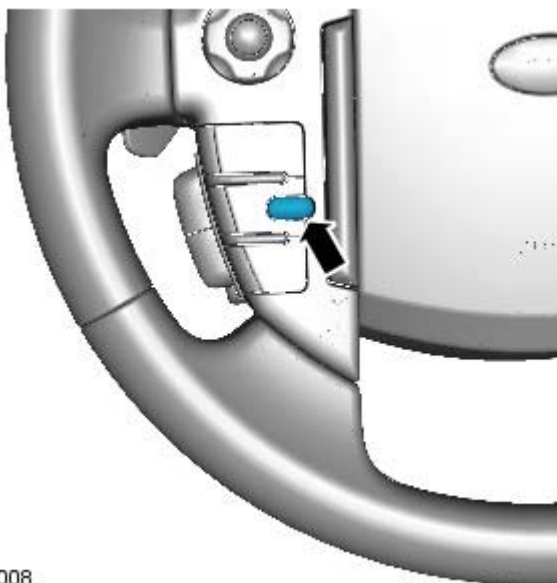
13.

- The message center display will revert to the normal display in the trip computer.
- Press the right-hand OK button and follow the instructions.
- Check that the oil level display shows an oil level reading.
- Only after having started and run the engine for 10 minutes (as indicated in Step 6), switch off the engine, then stabilizing for 10 minutes, take a reading from the oil level display and, if necessary top up with engine oil.

14. **22.** NOTE: If instructed to follow Steps 7-13 in a previous step, return to Step 6 and continue the procedure.

Turn the ignition off.

15. Allow 10 minutes for the engine oil level to stabilize if there has been additional oil top up.



E121008

16. **24.** NOTE: The following steps are to update the average oil level value.

- Turn the ignition on.
- Press and hold the cruise control cancel button for more than 2 seconds.

17.

- The message center display will revert to the normal display in the trip computer.

18. Turn the ignition off.



20.

- Press the right-hand directional button to access the instrument cluster menu.



E123926



21.

- Press the right-hand OK button.

E123925

22.

- Press the right-hand directional button to access the Oil Level Display.



E123927

23.

- Press the right-hand OK button and follow the instructions.
- Make sure that the average oil level value has now been updated.




E123929

24. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Engine - V8 5.0L Petrol - Camshaft LH

Removal and Installation

Removal

 **CAUTION:** Make sure that the orientation and code on the top of the camshaft bearing caps is noted (along with the bank - A or B), so that on installation the components are installed to their original position. Failure to follow this instruction may cause damage to the vehicle.

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

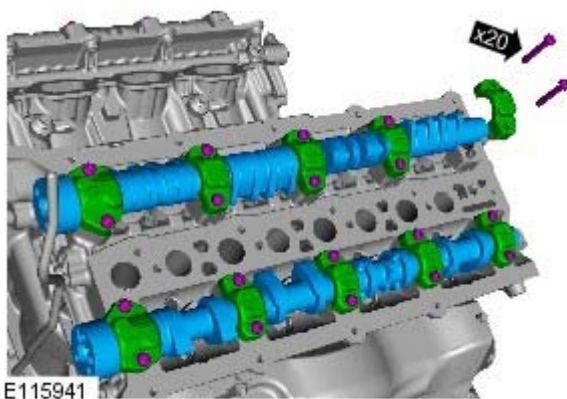
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Timing Drive Components - Assembly Part Number: INA Timing Drive](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



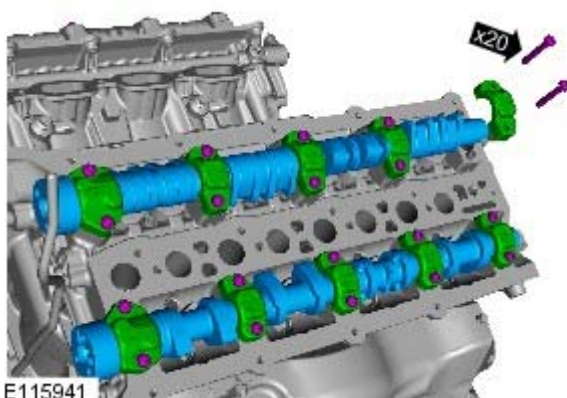
4. **4. CAUTIONS:**

 Rotate the camshafts until all the valves are at their minimum open point.

 Evenly and progressively, release the camshaft bearing caps.


- NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

Installation



1. **1. CAUTIONS:**

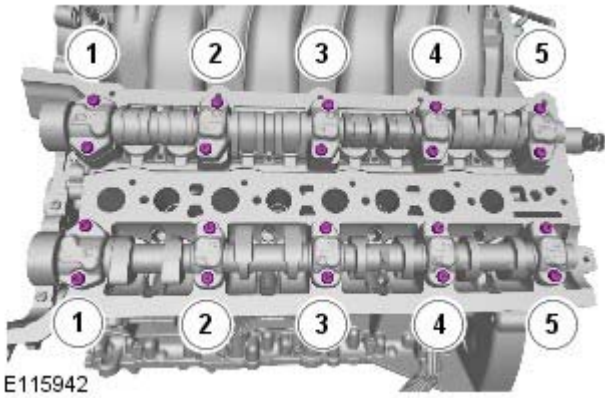
 Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

 Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

 Evenly and progressively install and tighten the camshaft bearing caps.

- NOTE: Lubricate the camshafts and the camshaft bearing caps with EP90 oil (or 75/90 viscosity oil will suffice) prior to installation.

Torque: 3 Nm



E115942

2. **NOTE:** Tighten the bolts in the indicated sequence.

Torque: 12 Nm

3. **CAUTION:**  Only rotate the crankshaft clockwise.

Rotate the crankshaft until the camshaft lobe on the valve being checked is 180 degrees from the maximum opening position.

4. **NOTE:** If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

• **NOTE:** On vehicles without supercharger the inlet camshaft valve clearances cannot be checked.

Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

5. **CAUTIONS:**



Do not use a magnet to remove the tappet.



Use the following formula to calculate the required bucket thickness. Original thickness + measured clearance - desired clearance = required bucket thickness.

Remove the tappet and measure the thickness.

6. **NOTE:** If a new tappet is installed then go back to step 1 of the install procedure.

Install a new tappet if required.

7. Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

8. Refer to: [Timing Drive Components - Assembly Part Number: INA Timing Drive](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

9. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Camshaft RH

Removal and Installation

Removal

! CAUTION: Make sure that the orientation and code on the top of the camshaft bearing caps is noted (along with the bank - A or B), so that on installation the components are installed to their original position. Failure to follow this instruction may cause damage to the vehicle.

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

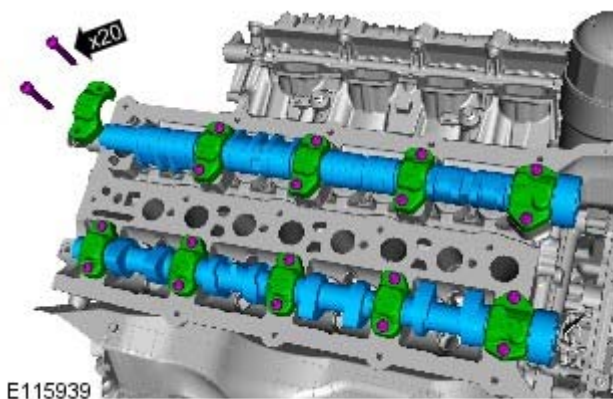
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. **!** WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Timing Drive Components - Assembly Part Number: INA Timing Drive](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



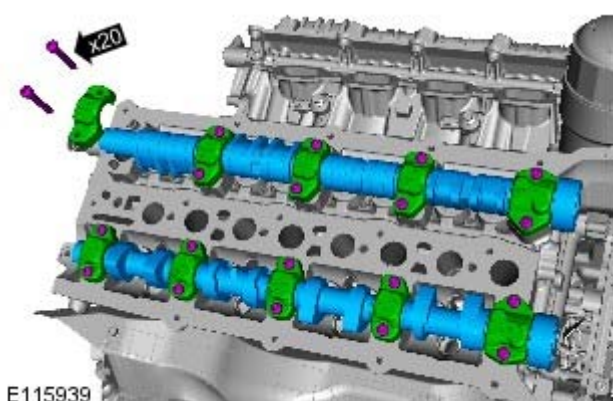
4. 4. CAUTIONS:

! Rotate the camshafts until all the valves are at their minimum open point.

! Evenly and progressively, release the camshaft bearing caps.

- NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

Installation



1. 1. CAUTIONS:

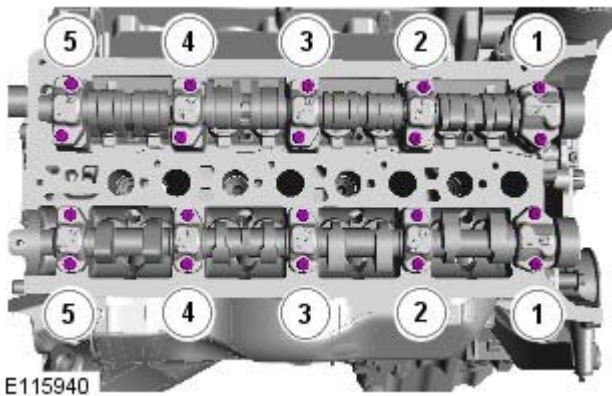
! Prior to installing the camshafts, position the crankshaft 45 degrees ATDC cylinder 1A to prevent valve/piston collision.

! Make sure that the camshafts and camshaft bearing caps are installed in their original locations.

! Evenly and progressively install and tighten the camshaft bearing caps.

- NOTE: Lubricate the camshafts and the camshaft bearing caps with EP90 oil (or 75/90 viscosity oil will suffice) prior to installation.

Torque: 3 Nm



2. **2. NOTE:** Tighten the bolts in the indicated sequence.

Torque: 12 Nm

3. **3.**  **CAUTION:** Only rotate the crankshaft clockwise.

Rotate the crankshaft until the camshaft lobe on the valve being checked is 180 degrees from the maximum opening position.

4. **4. NOTE:** If the valve clearance is incorrect, continue to the next step. If the valve clearance is correct, continue to step 8.

• **NOTE:** On vehicles without supercharger the inlet camshaft valve clearances cannot be checked.

Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

5. **5. CAUTIONS:**



Use the following formula to calculate the required bucket thickness. Original thickness + measured clearance - desired clearance = required bucket thickness.



Do not use a magnet to remove the tappet.

Remove the tappet and measure the thickness.

6. **6. NOTE:** If a new tappet is installed then go back to step 1 of the install procedure.

Install a new tappet if required.

7. Using feeler gauge check the gap between the tappet and the camshaft lobe and check against specifications table.

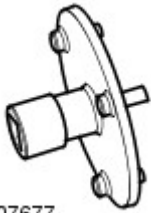
8. Refer to: [Timing Drive Components - Assembly Part Number: INA Timing Drive](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

9. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Crankshaft Front Seal

Removal and Installation

Special Tool(s)

 <p>E107677</p>	<p>303-1434 Installer/remover, Front Crankshaft Seal</p>
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Removal

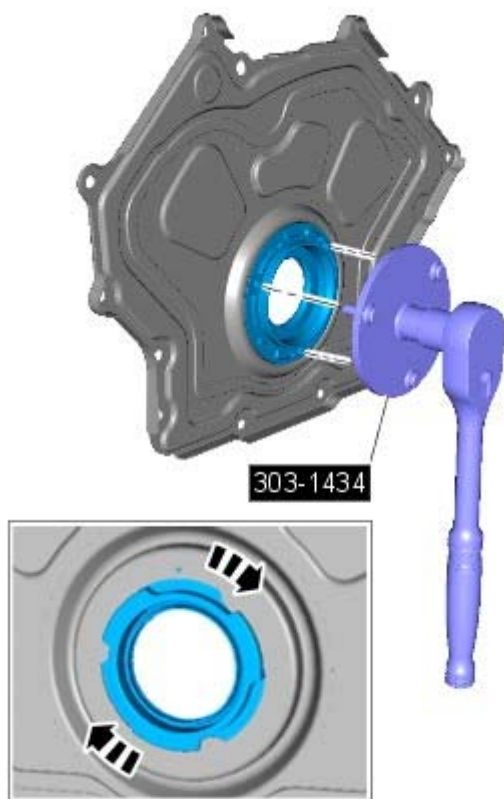
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Crankshaft Pulley](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

3. *Special Tool(s):* [303-1434](#)
Torque: 26 Nm



E112056

Installation

1. **1. CAUTIONS:**



Do not over tighten the crankshaft front seal. Failure to follow this instruction may result in damage to the vehicle.



Take extra care not to damage the seal.

To install, reverse the removal procedure.

Engine - V8 5.0L Petrol - Crankshaft Pulley

Removal and Installation

Special Tool(s)

 <p>E115256</p>	<p>303-1437 Crankshaft Damper Remover/Installer</p>
 <p>E115257</p>	<p>303-1438 Crankshaft Damper Bolt Remover/Installer</p>
 <p>E115258</p>	<p>303-1439 Crankshaft Damper Removal Plate</p>
 <p>E115259</p>	<p>303-1440 Crankshaft Damper Removal/Installation Stud</p>
 <p>E115260</p>	<p>303-1441 Crankshaft Damper Remover/Installer Body</p>
 <p>E115266</p>	<p>303-1448 Locking Tool</p>
 <p>E119168</p>	<p>303-1500 Installer, Stretchy Belt</p>

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

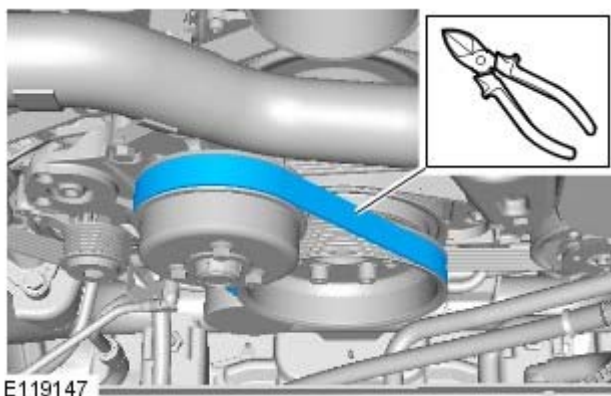
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

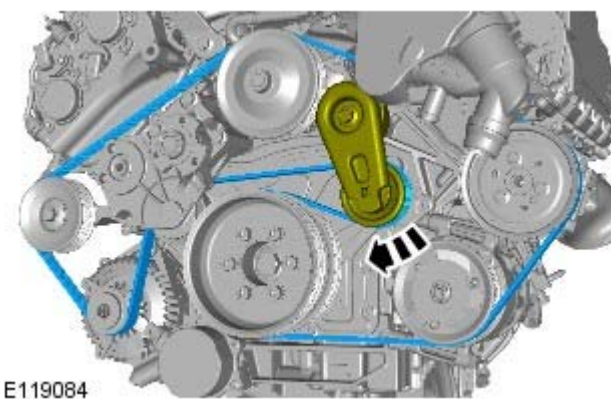
Raise and support the vehicle.

3. Refer to: [Radiator](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

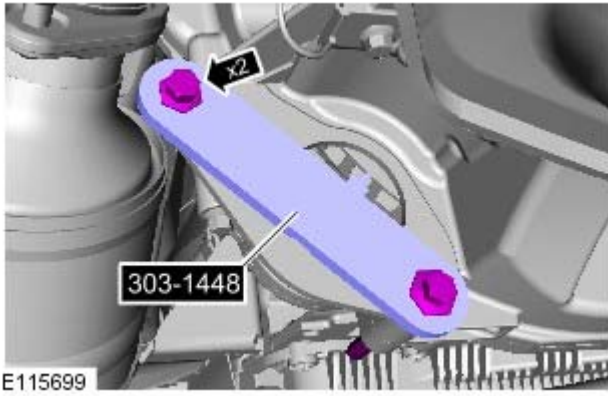
4. Refer to: [Starter Motor](#) (303-06D Starting System - V8 5.0L Petrol, Removal and Installation).



- 5.




- 6.



7. Install the special tool.

Special Tool(s): [303-1448](#)

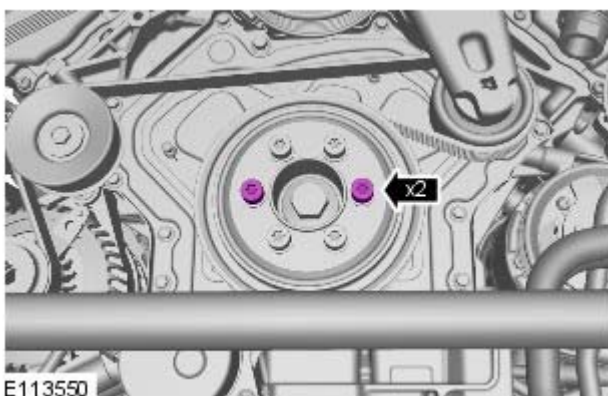


8.  **CAUTION:** Before removing the crankshaft pulley bolt, note the numbers on the bolt head. If the bolt head shows 10.9, the bolt must be removed counter clockwise. If the bolt head shows 12.9, the bolt must be removed clockwise. Failure to follow this instruction may result in damage to the crankshaft.

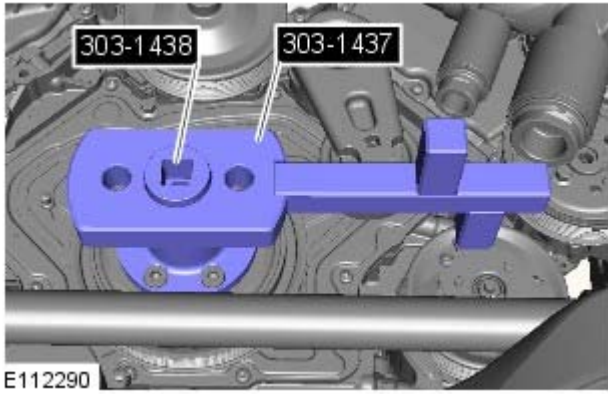
Note the markings on the crankshaft pulley bolt.



E120873

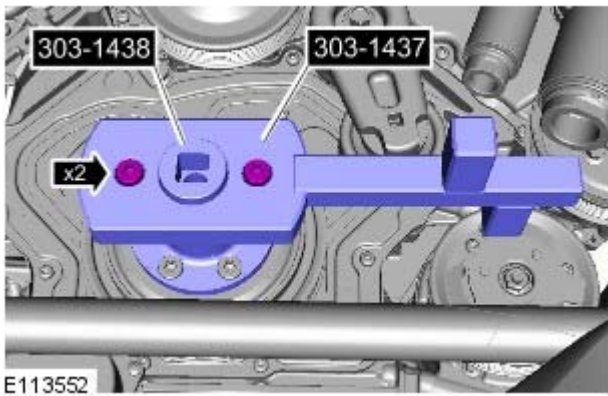


9.

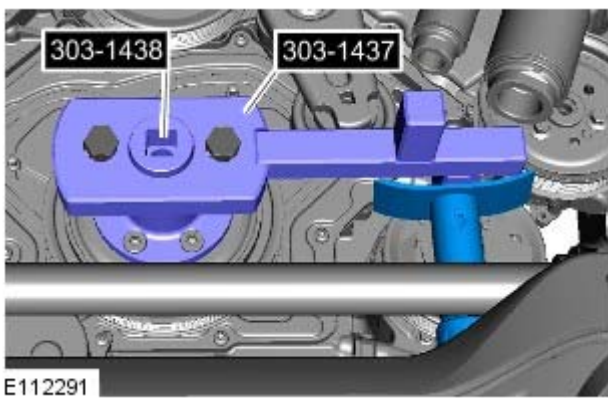


10. Install the special tool.

Special Tool(s): [303-1437](#), [303-1438](#)

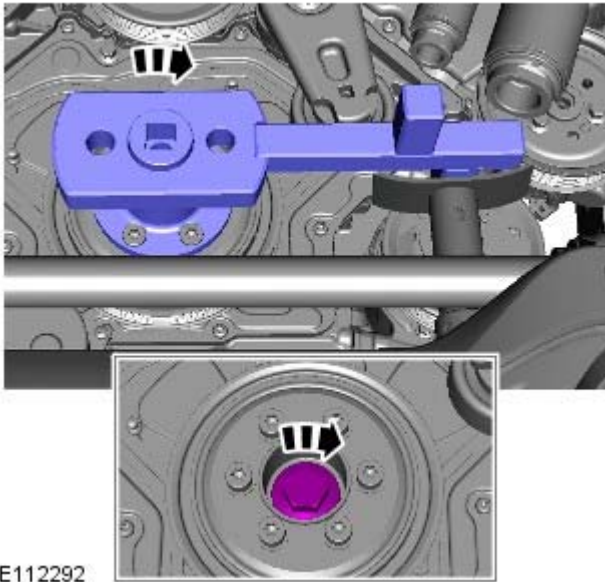


11. *Torque:* 65 Nm



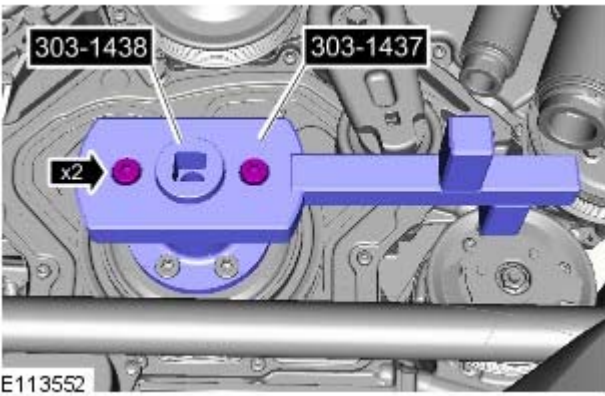
12. **12. NOTE:** The graphic shows the tool position for LH thread only, RH thread will be the opposite.

Using a suitable stand, support the special tool.

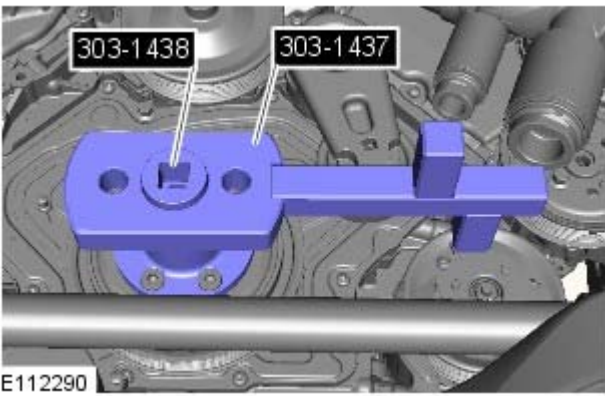


13. **13.** NOTE: Discard the bolt after removal.

- NOTE: The graphic shows the step for LH thread only, RH thread will be the opposite.

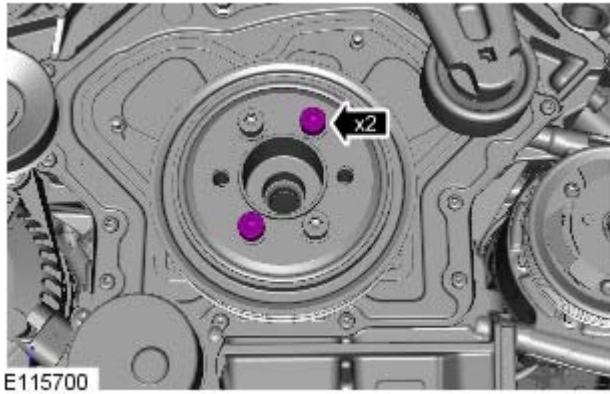


14.

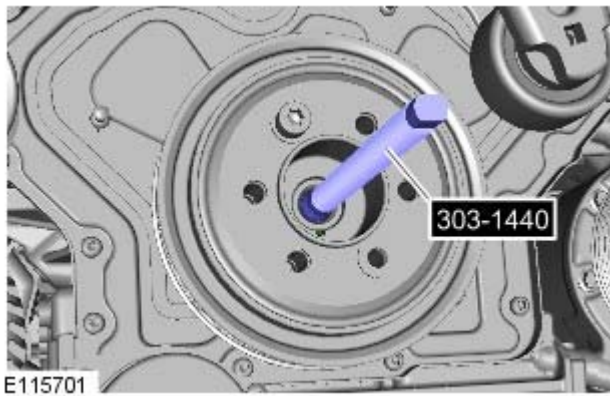


15. **15.** NOTE: If the crankshaft damper is fitted with an early RH thread crankshaft bolt then the pulley can be removed with a standard puller.

Remove the special tool.

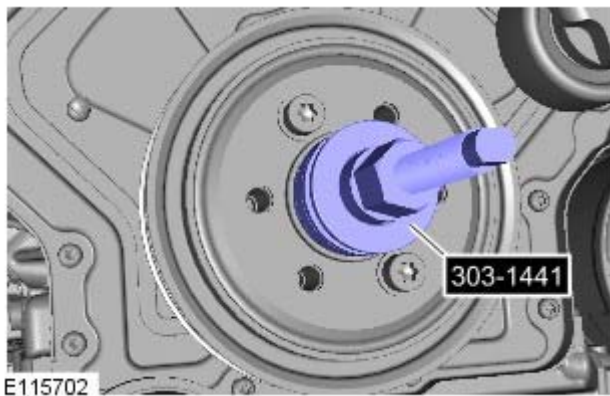


16.



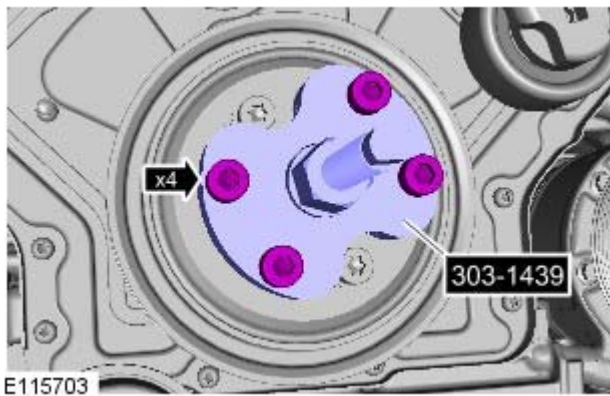
17. Install the special tool.

Special Tool(s): [303-1440](#)



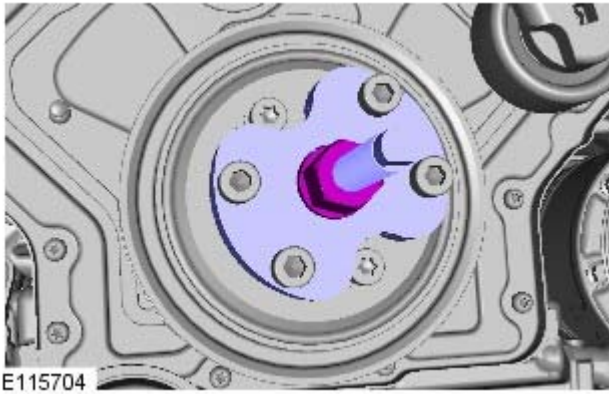
18. Install the special tool.

Special Tool(s): [303-1441](#)

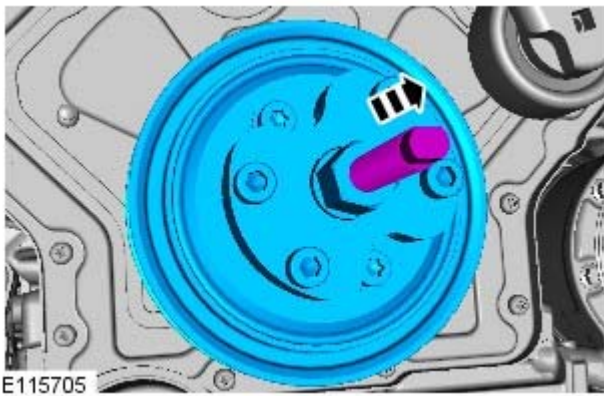


19. Install the special tool.

Special Tool(s): [303-1439](#)

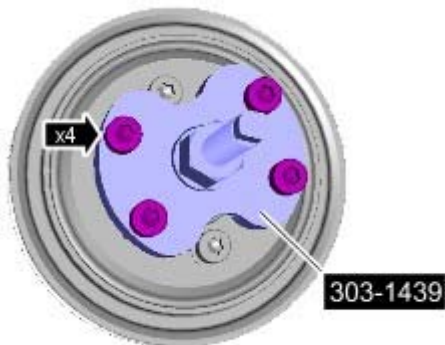


20.



21. **⚠ CAUTION:** Discard the friction washer after removing the crankshaft pulley.
- **NOTE:** Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.

22.



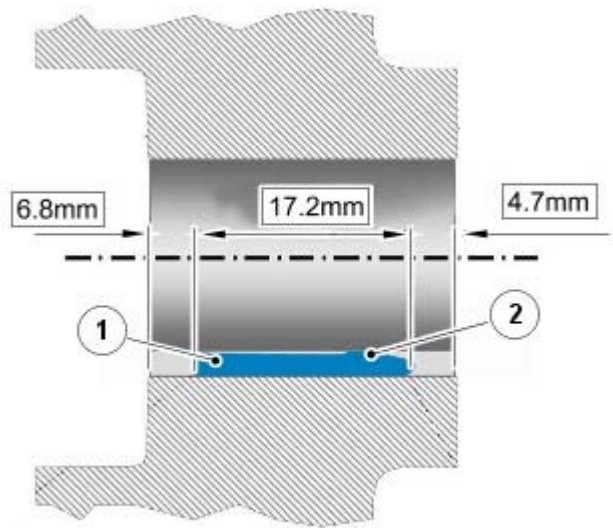
E115706

23.



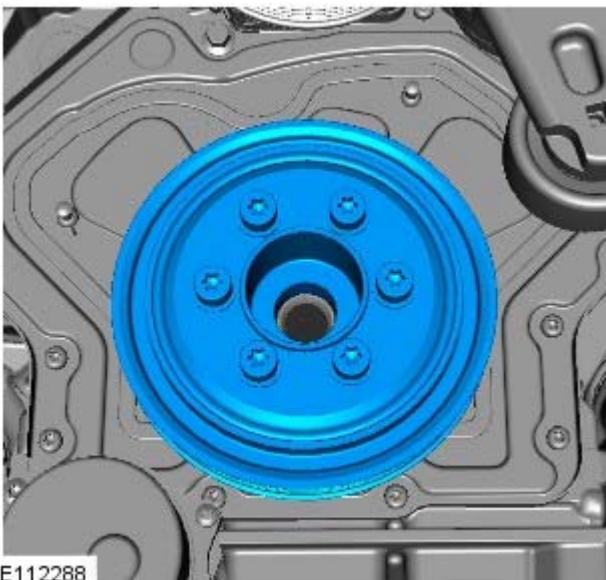
E115707

Installation




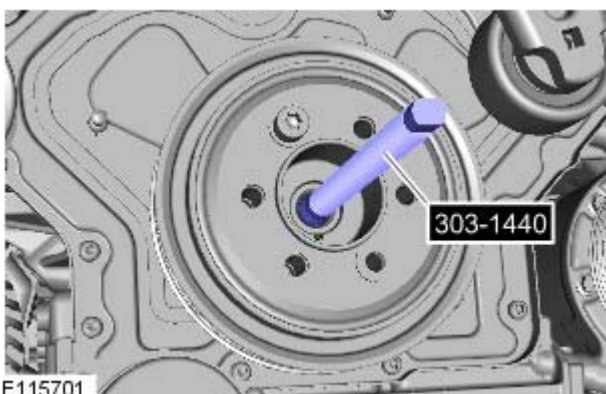
E115889

1.
 - Apply RTV sealant to the crankshaft pulley keyway.
 - Make sure that the RTV sealant is applied in a 2mm diameter bead.
 - Make sure that when the RTV sealant is applied that the RTV sealant is level with the top of the keyway.



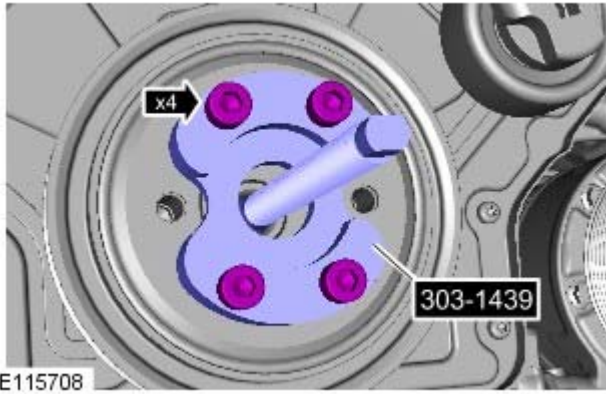
E112288

2.  **CAUTION:** Install a new friction washer before installing the crankshaft pulley.
 - **NOTE:** Make sure to clean the threads in the end of the crankshaft and that the crank nose is free of any foreign materials.
 - **NOTE:** Skip to step 11 for engines fitted with early RH thread crankshaft bolt.



E115701

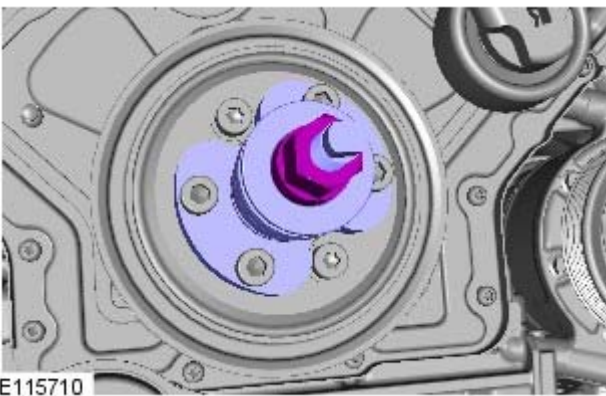
3. Install the special tool.




4. Install the special tool.



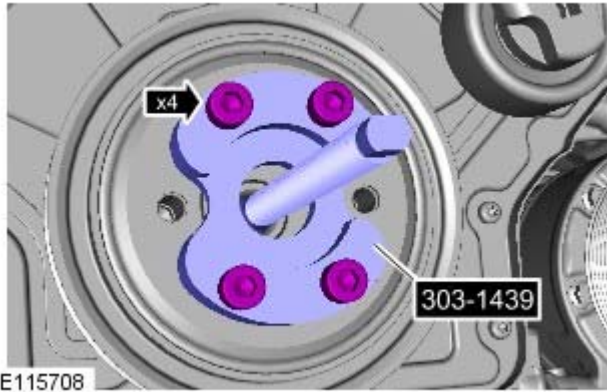
5. Install the special tool.



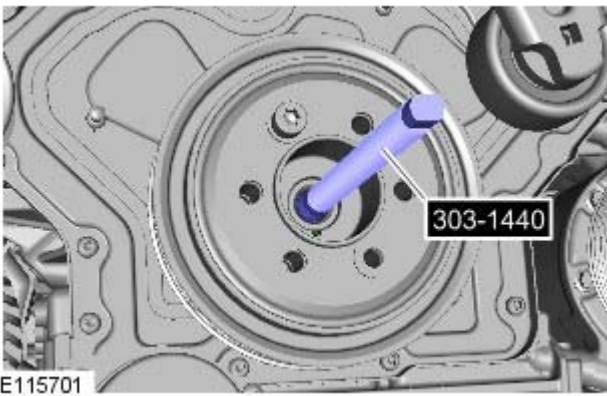
6.  **CAUTION:** Rotate the crankshaft pulley installation tool anti-clockwise until the pulley is fully located, do not over tighten. Failure to do this may result in damage to the components.



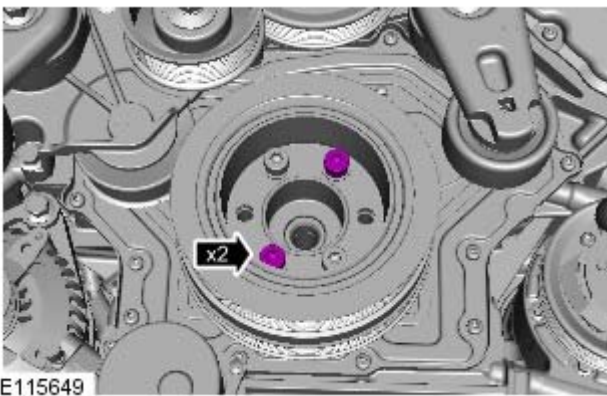
7. Remove the special tool.




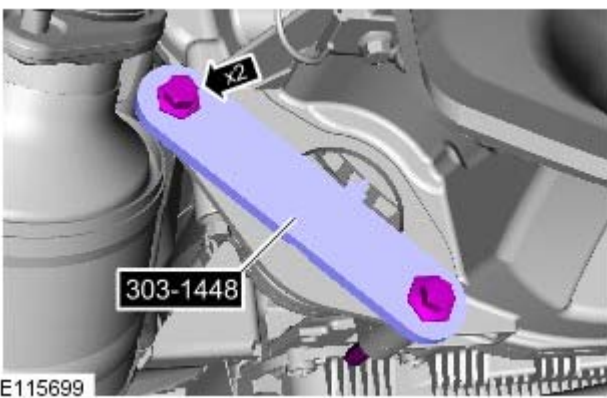
8.
 - Remove the special tool.
 - *Torque: 15 Nm*



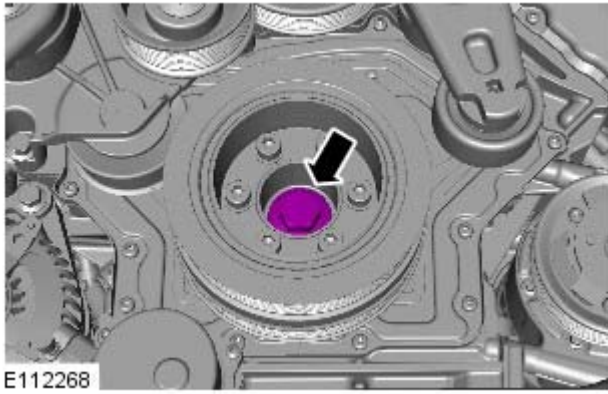
9. Remove the special tool.



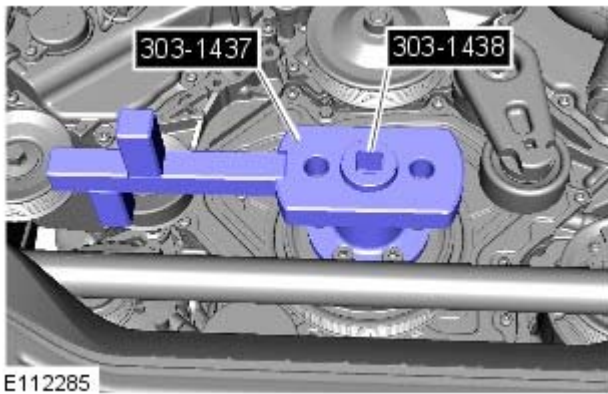
10. **10.**  **WARNING:** Make sure that a new bolt is installed.
 - Apply loctite 270 to the thread of the bolts.
 - *Torque: 65 Nm*



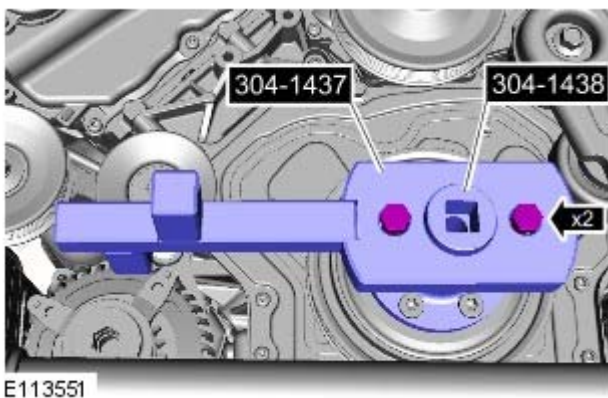
11. Remove the special tool.



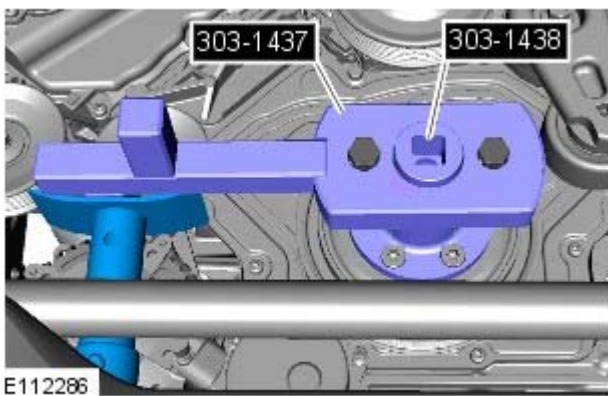
12. **12.**  **WARNING:** Make sure that a new bolt is installed.



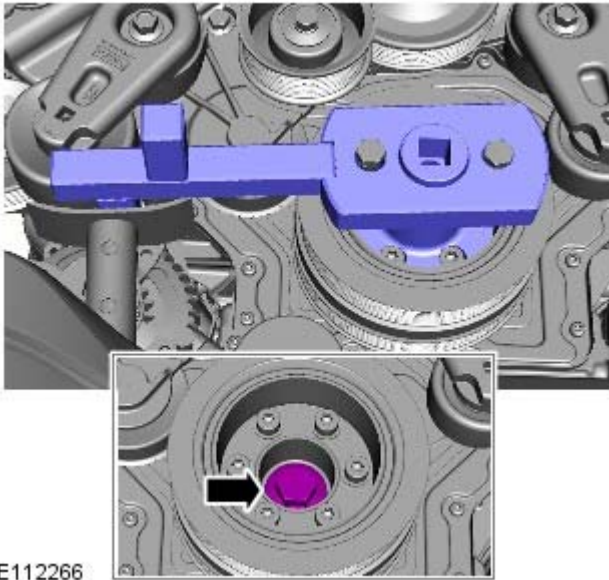
13. Install the special tool.



14. *Torque:* 65 Nm

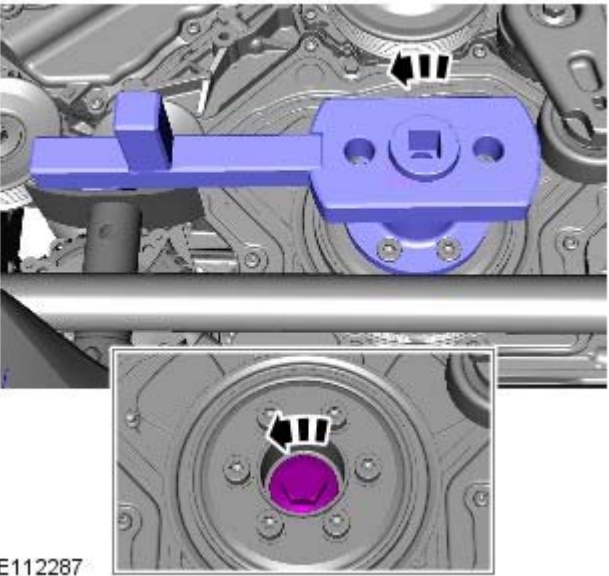


15. **15.** **NOTE:** The graphic shows the tool position for LH thread only, RH thread will be the opposite.
Using a suitable stand, support the special tool.



E112266

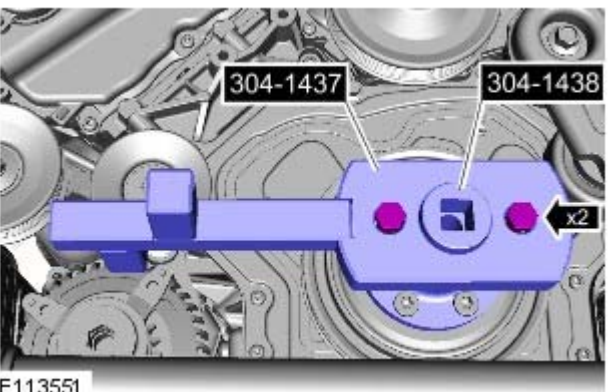
16. Torque: 200 Nm



E112287

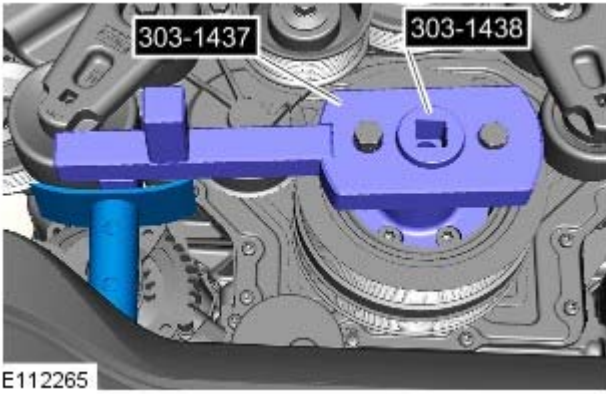
17. **17.** NOTE: The use of a torque multiplier capable of 600Nm will be required.

- Torque: 270°
- Make sure that the socket is turned through 270 degrees not the torque wrench.

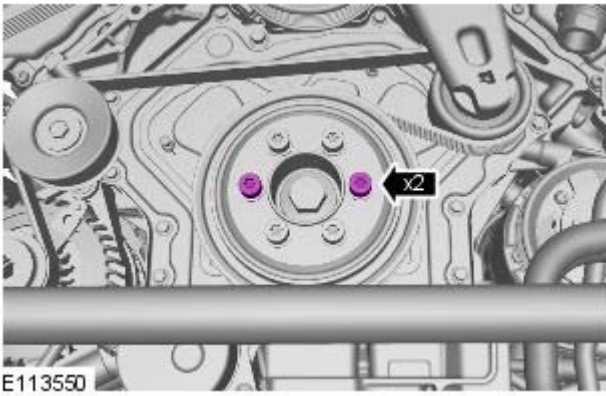


E113551

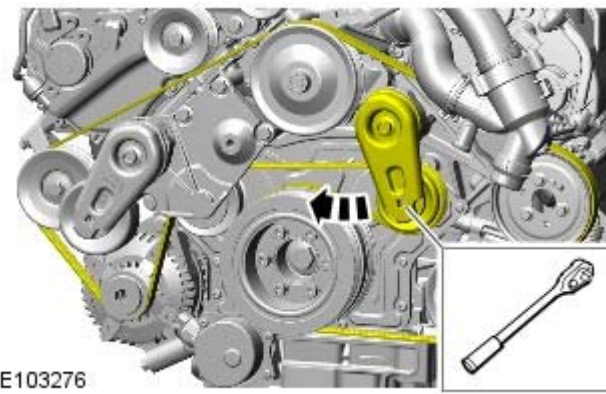
18.



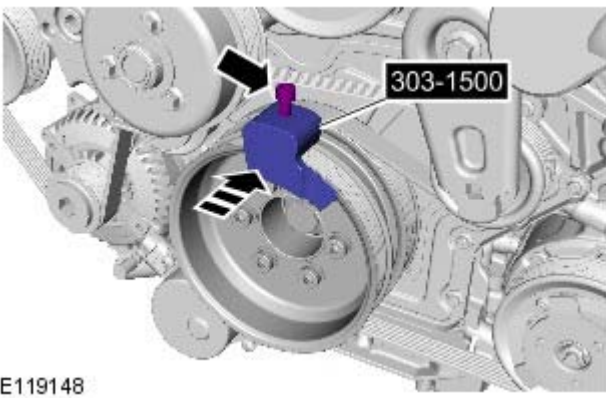
19. Remove the special tool.



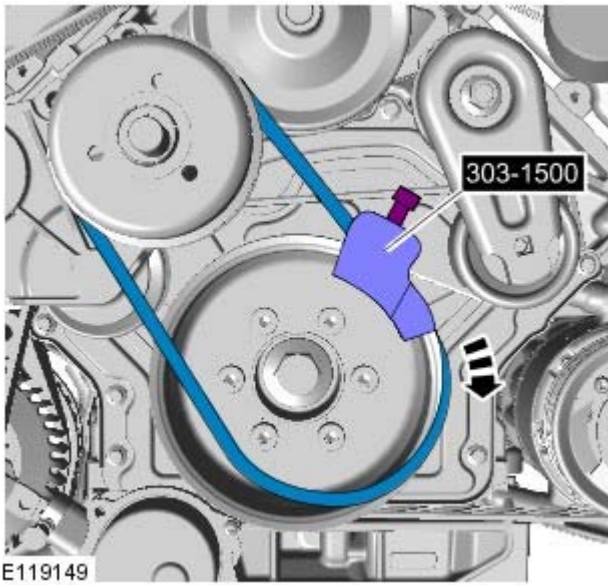
- 20.
- Apply loctite 270 to the thread of the bolts.
 - *Torque:* 65 Nm



21.



22. *Special Tool(s):* [303-1500](#)



23.

- Install the cooling fan belt.
- Install the tool at the 12 o'clock position.
- Rotate the engine clockwise twice, making sure that the belt is seated on both pulleys correctly.
- Remove the special tool.

24. Refer to: [Starter Motor](#) (303-06D Starting System - V8 5.0L Petrol, Removal and Installation).

25. Refer to: [Radiator](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).



26. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Crankshaft Rear Seal

Removal and Installation

Special Tool(s)

 <p>E107678</p>	<p>303-1442 Rear Crankshaft Seal Installer</p>
 <p>E107679</p>	<p>303-1443 Rear Crankshaft Cover Alignment Tool</p>

Removal

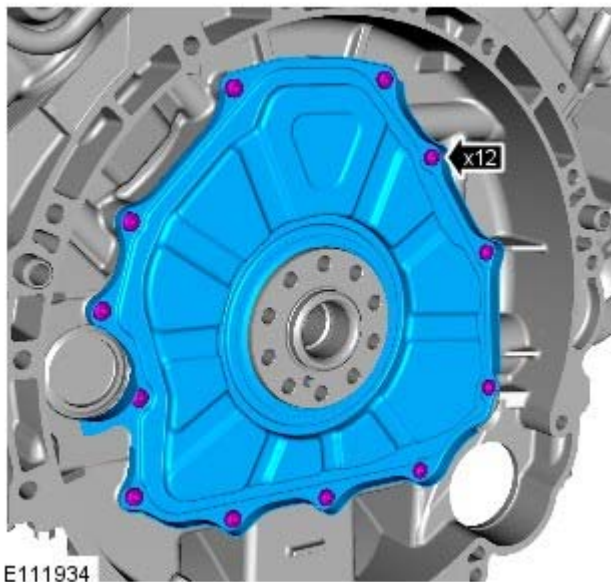
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

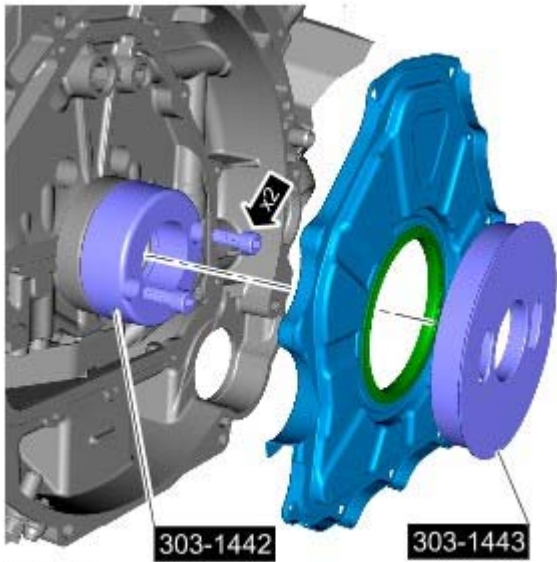
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Flexplate](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

3.



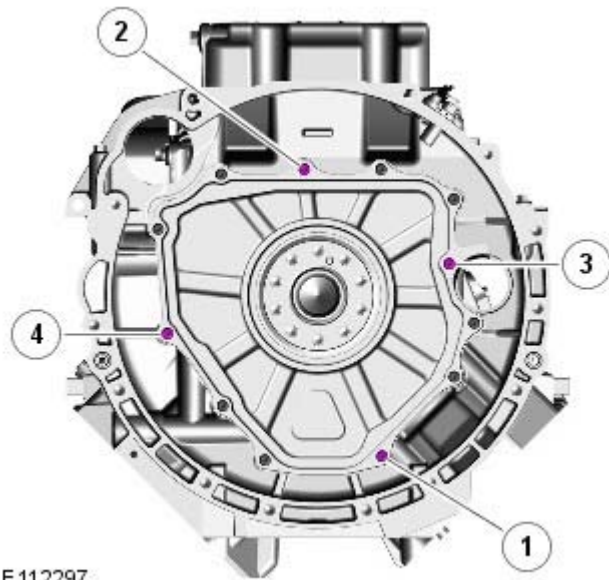
Installation



E111935

1. Install the special tool.

Special Tool(s): [303-1442](#), [303-1443](#)



E112297

2. **2.** NOTE: Tighten the bolts in the indicated sequence.

Torque: 11 Nm



E112306

3. *Torque:* 11 Nm

4.

5. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Cylinder Head LH

Removal and Installation

Removal

- NOTE: Some illustrations may show the engine removed for clarity.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Remove the battery for access.

Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

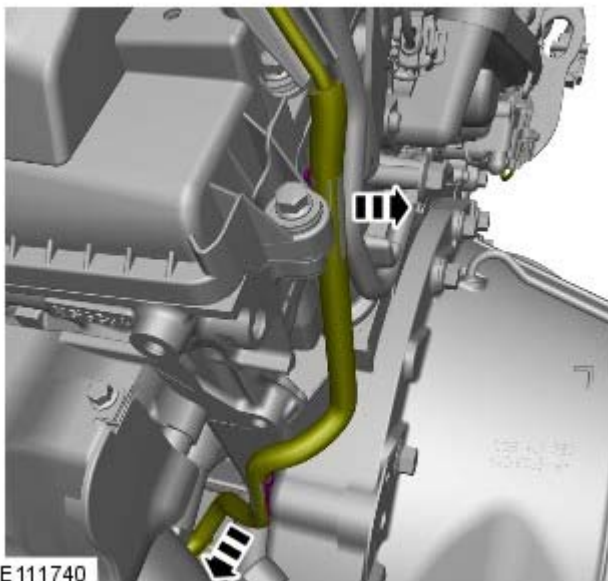
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

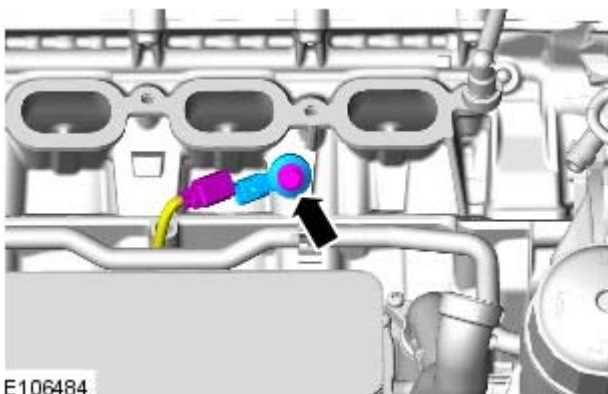
3. Refer to: [Camshaft LH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

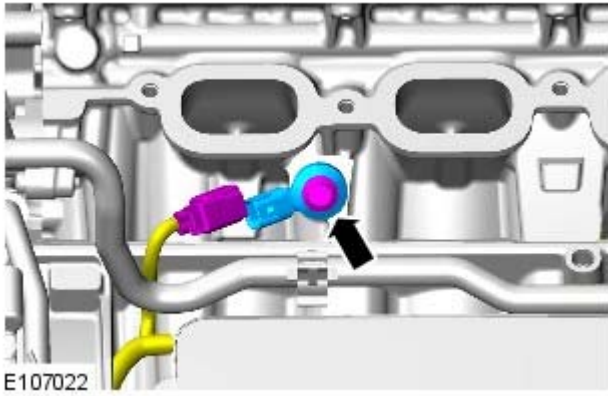
4. Refer to: [Exhaust Manifold LH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

5.

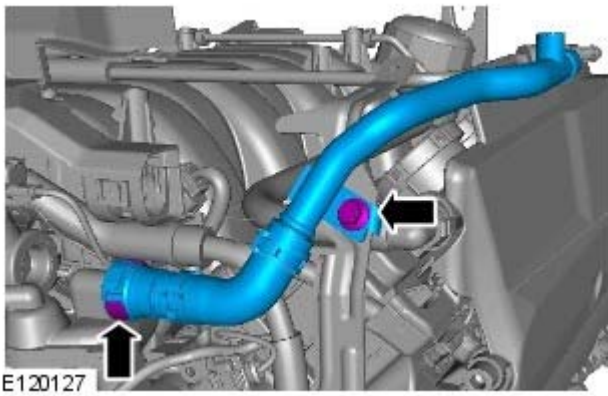


6.

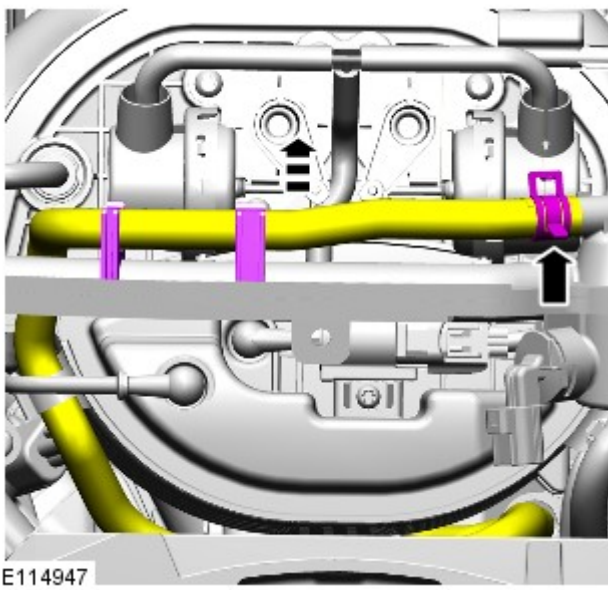




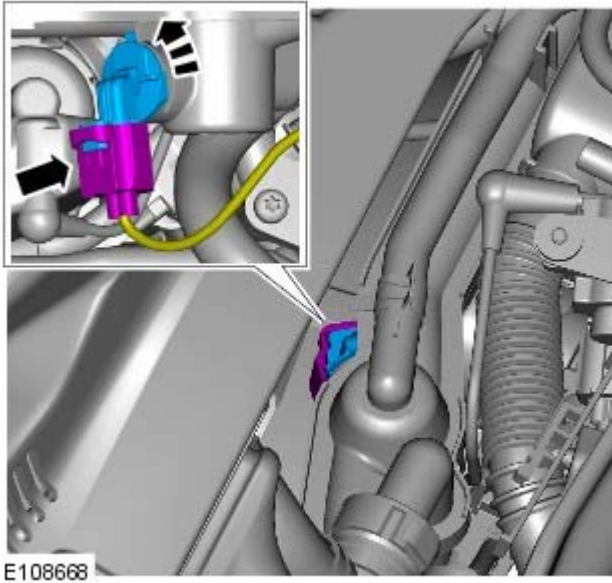
7.



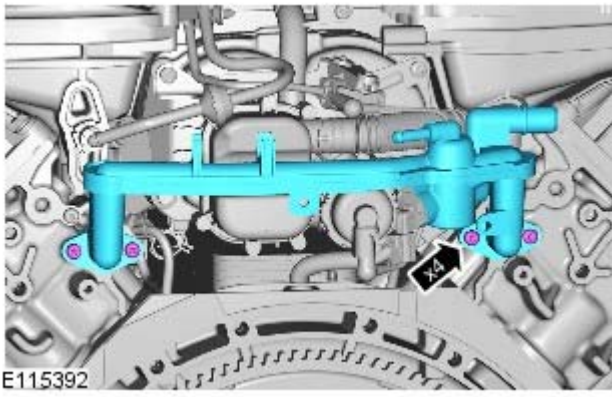
8.  CAUTION: Be prepared to collect escaping coolant.



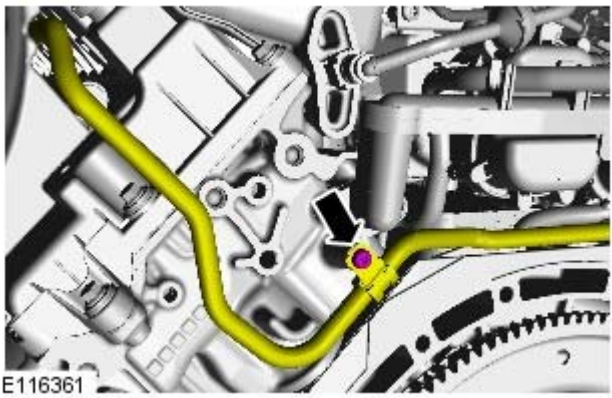
9. **9.** NOTE: Clamp the hose to minimize coolant loss.



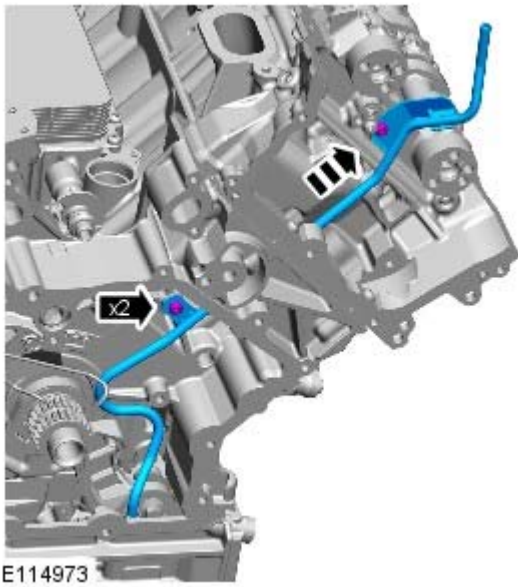
10.




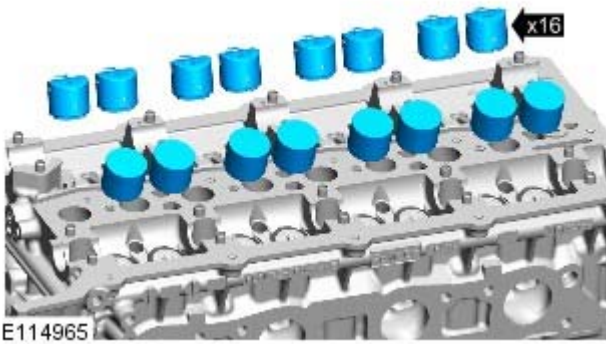
11.  CAUTION: Discard the seals.



12.




13. **13.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



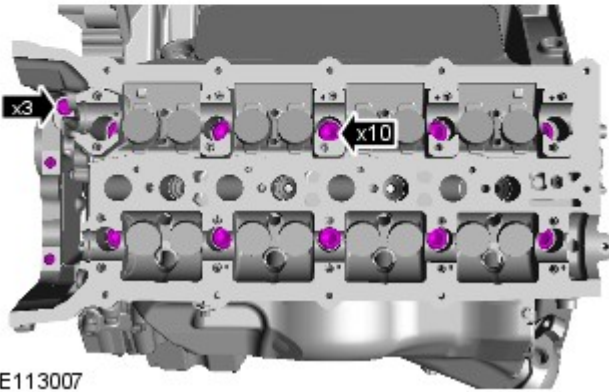
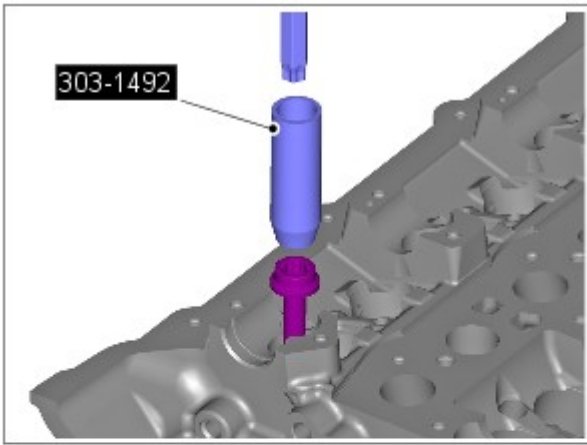
14. **14.** CAUTIONS:

 If a new cylinder head has been installed then new tappets must be installed.

 If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

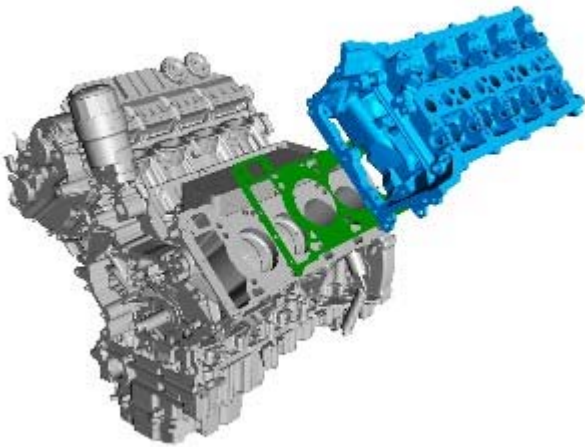
- NOTE: Left-hand shown, right-hand similar.

15.



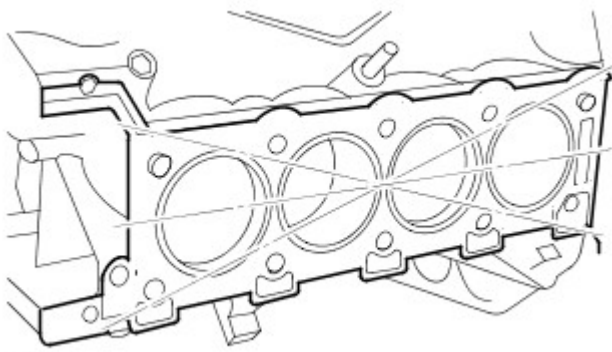
E113007

16.




E113006

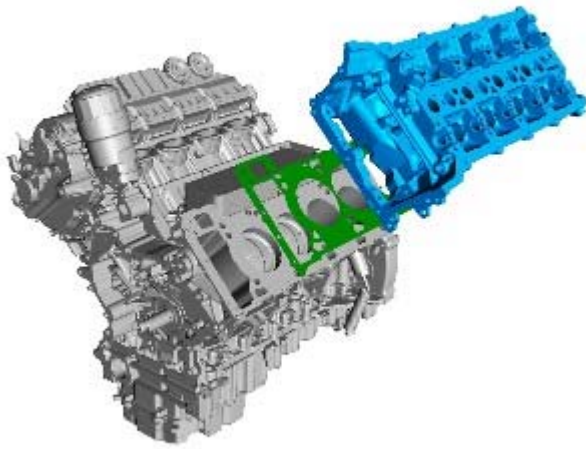
Installation




E46855

1.  CAUTION: An acceptable flatness of the cylinder head is 0.1mm.


Check cylinder head face for distortion, across the center and from corner to corner.




E113006

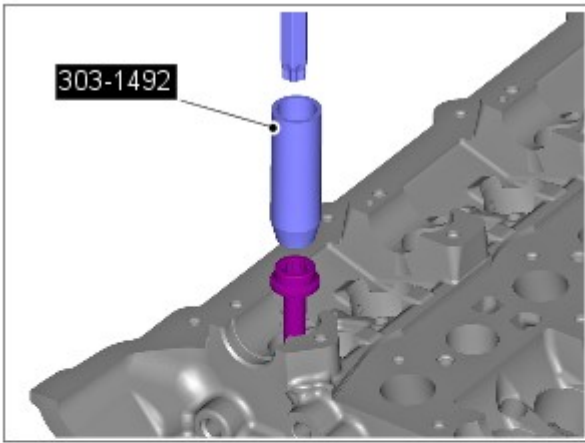
2.  WARNING: Make sure care is taken when handling the cylinder head gasket.


- CAUTIONS:

 The head gasket must be installed over the cylinder block dowels.

 Make sure that the mating faces are clean and free of foreign material.

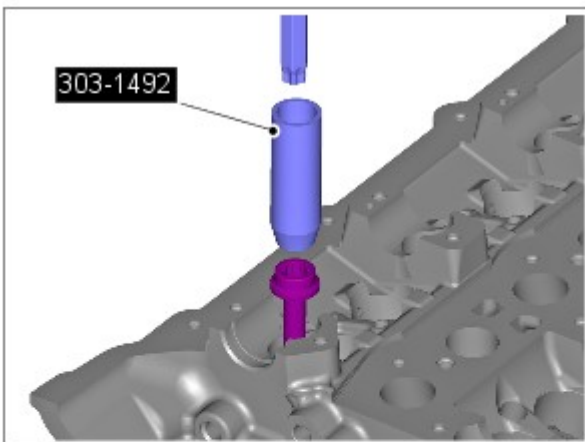
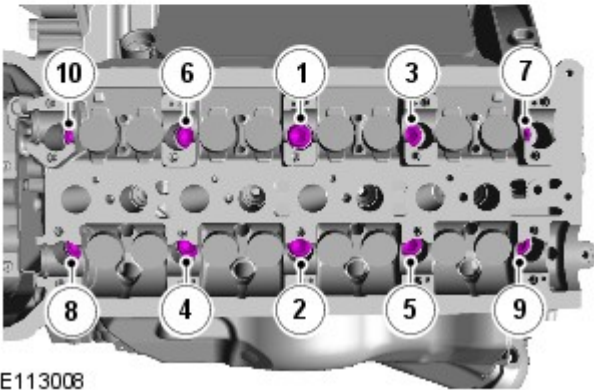
- NOTE: Install a new cylinder head gasket.



3.  CAUTION: Make sure that new cylinder head bolts are installed.

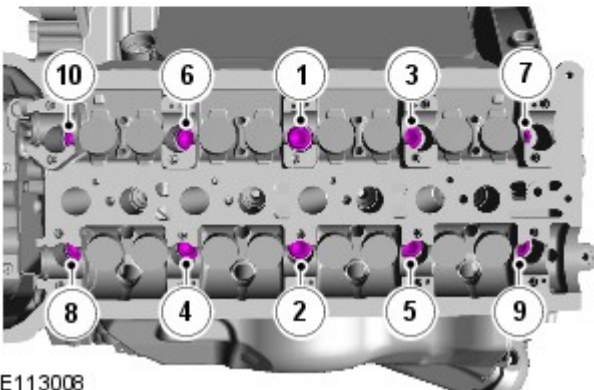
- NOTE: Tighten the bolts in the indicated sequence.

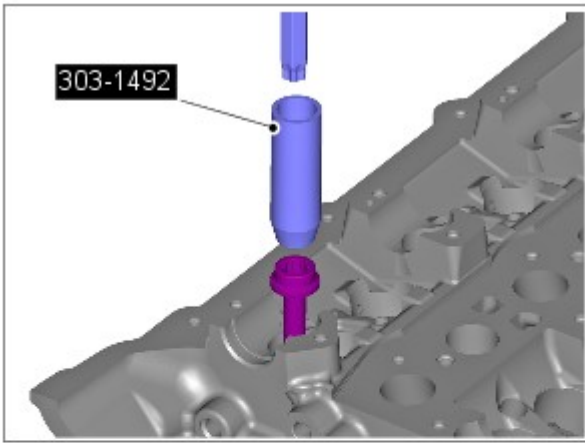
Torque: 20 Nm



4. 4. NOTE: Tighten the bolts in the indicated sequence.

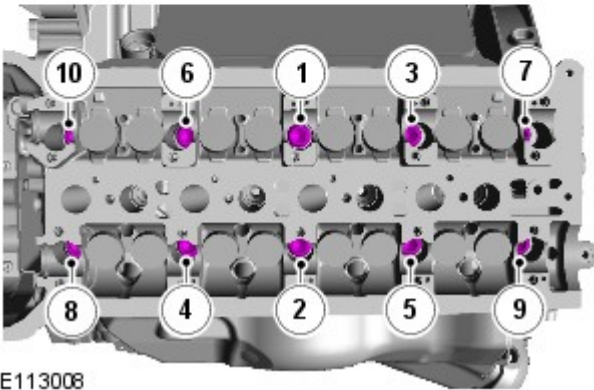
Torque: 35 Nm



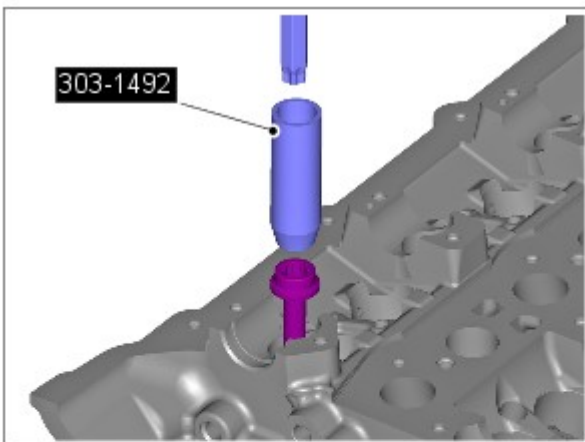


5. **5. NOTE:** Tighten the bolts in the indicated sequence.

Tighten the bolts 1 to 10, a further 90 degrees.

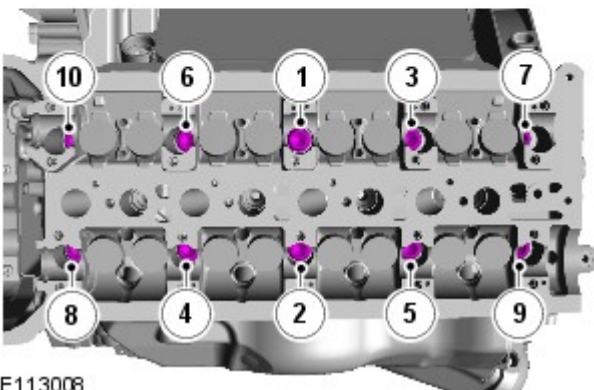


E113008

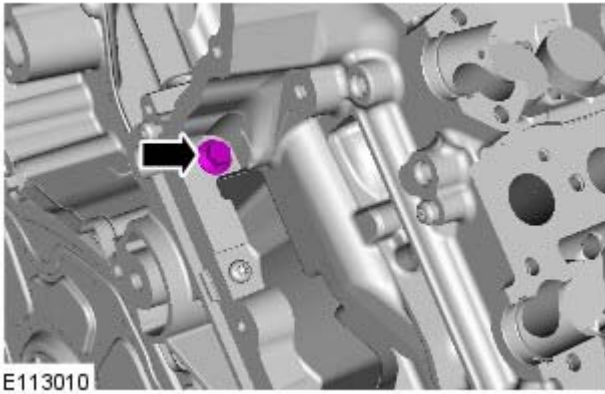


6. **6. NOTE:** Tighten the bolts in the indicated sequence.

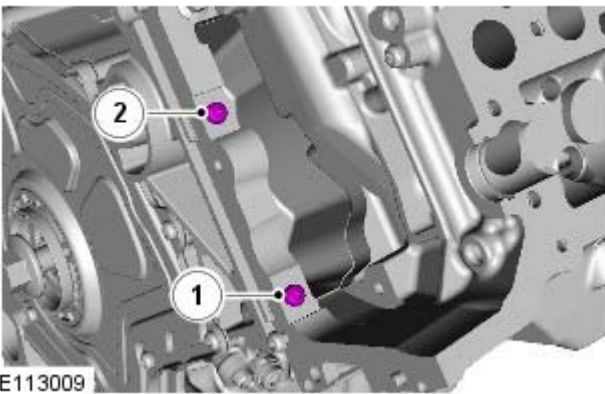
Tighten the bolts 1 to 10, a further 120 degrees.



E113008



7. Torque: 25 Nm




8. **8.** NOTE: Tighten the bolts in the indicated sequence.

Torque: 12 Nm



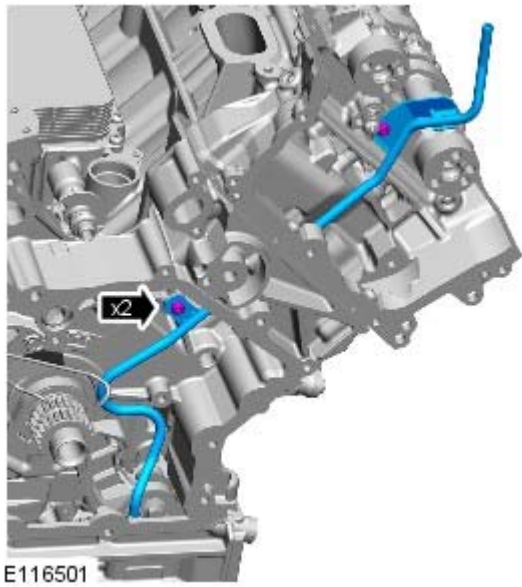
9. **9.** CAUTIONS:

 If a new cylinder head has been installed then new tappets must be installed.

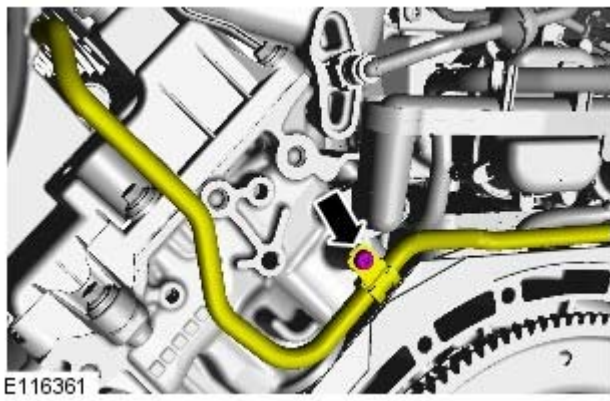
 If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

Lubricate the valve tappets with clean engine oil.

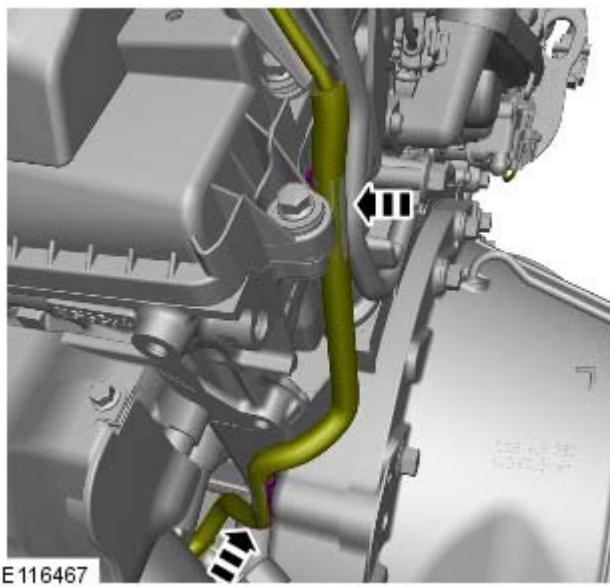
10. Refer to: [Camshaft LH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



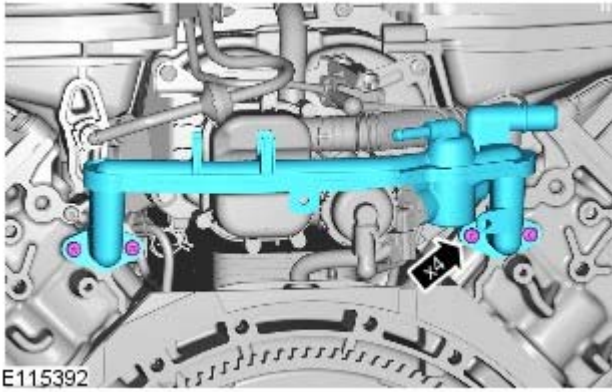
11. Torque: 12 Nm



12. Torque: 10 Nm

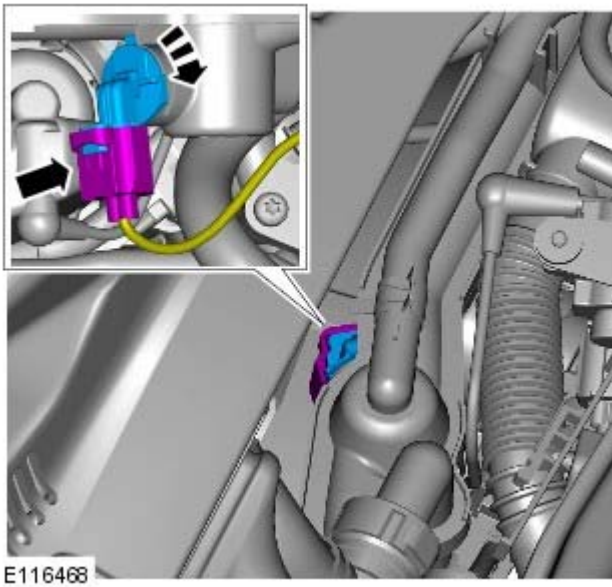


13.

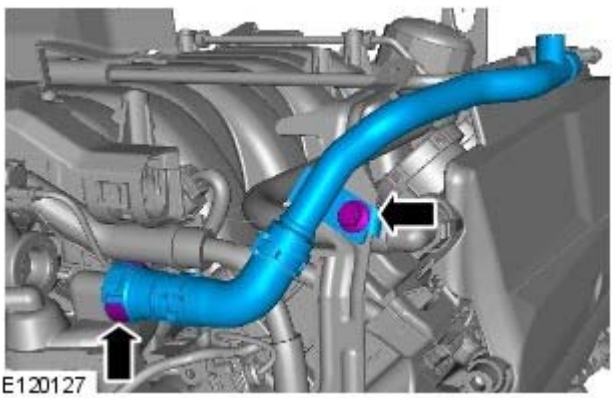


14. **14.**  CAUTION: Install the new seals.

Torque: 10 Nm

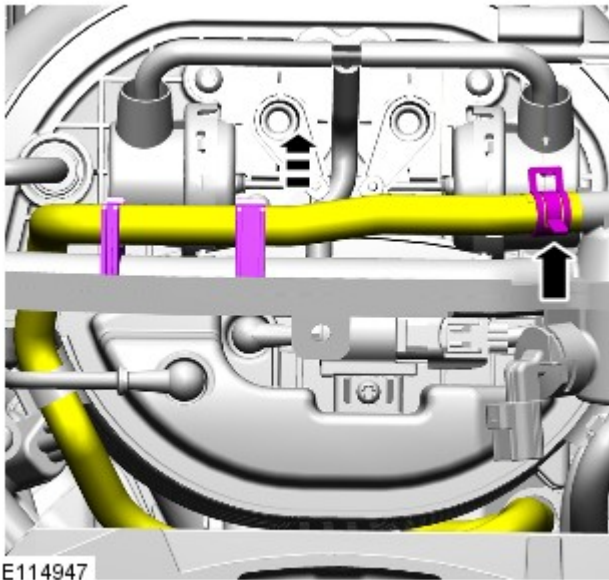


15.

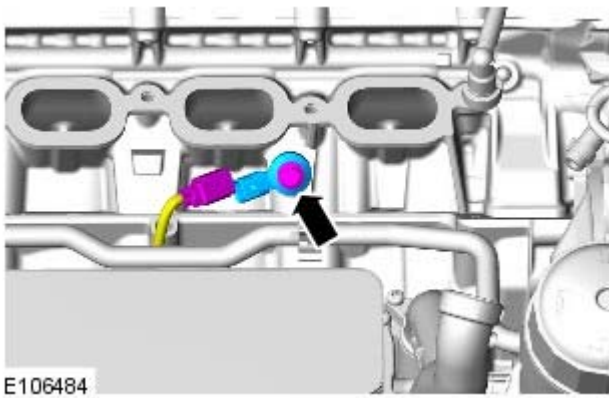


16. **16.**  CAUTION: Be prepared to collect escaping coolant.

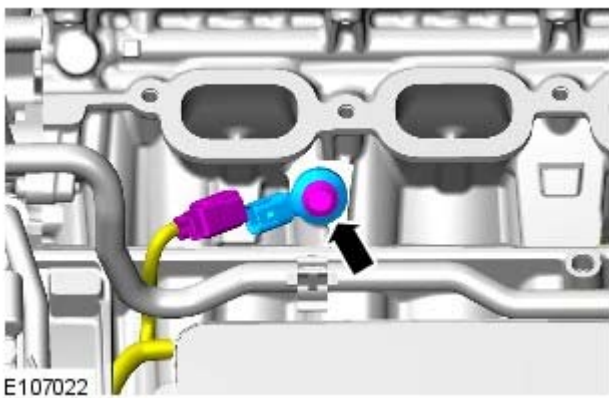
Torque: 10 Nm



17.



18. Torque: 20 Nm



19. Torque: 20 Nm

20. Refer to: [Exhaust Manifold LH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

21. Install the battery.

Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

Engine - V8 5.0L Petrol - Cylinder Head RH


Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

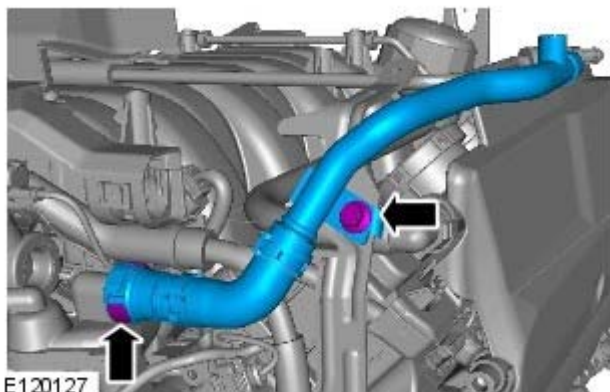
1. Disconnect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

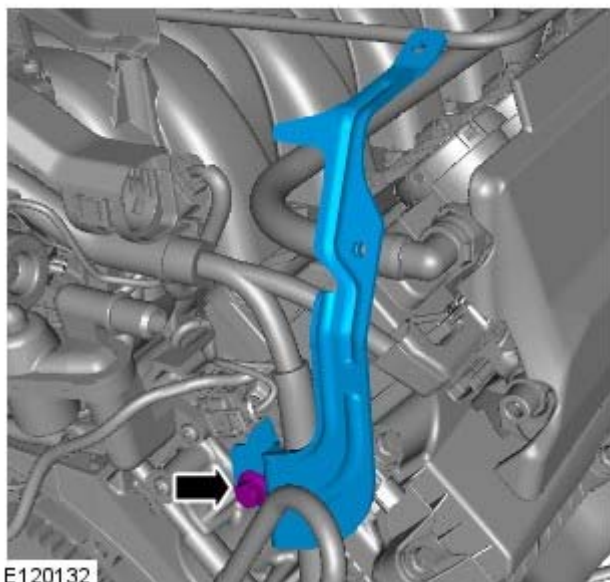
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

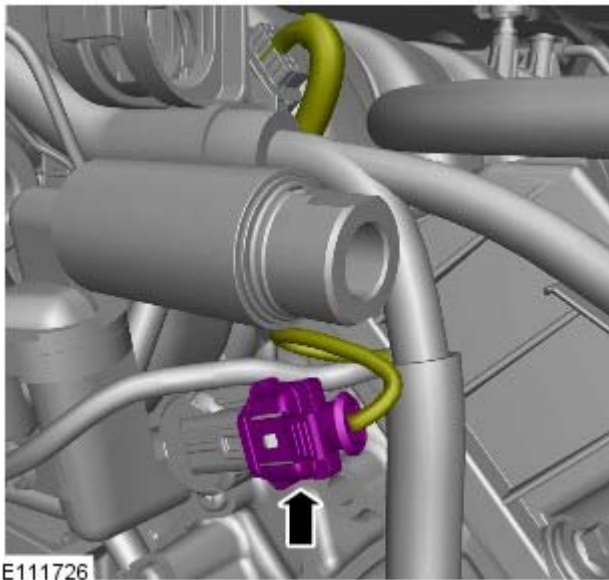
3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
4. Refer to: [Camshaft RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
5. Refer to: [Exhaust Manifold RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



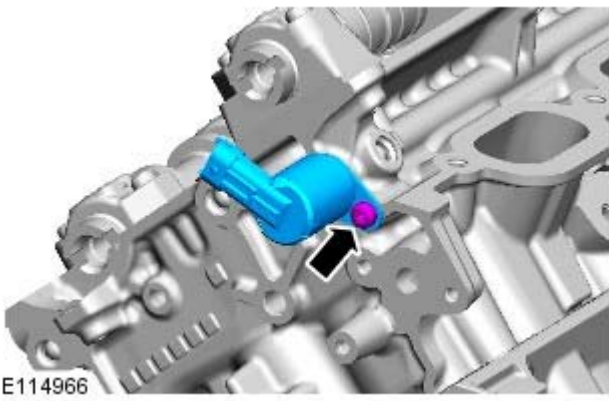
6.  **CAUTION:** Be prepared to collect escaping coolant.



- 7.



8.



9. CAUTIONS:

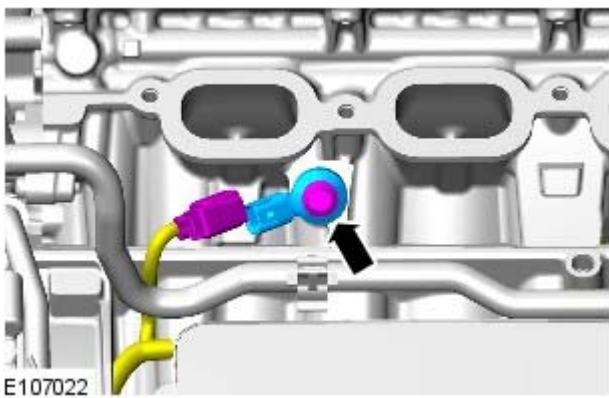


Discard the seal.

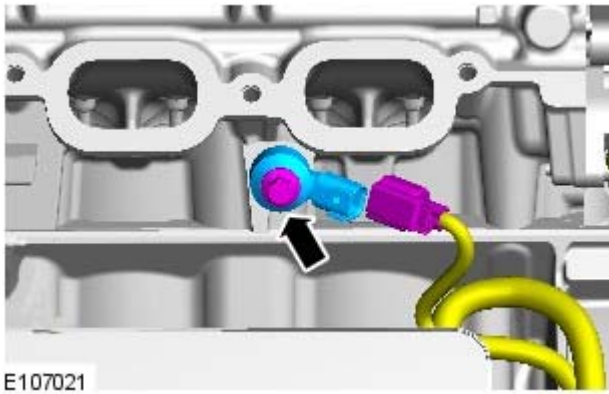


LH illustration shown, RH is similar.

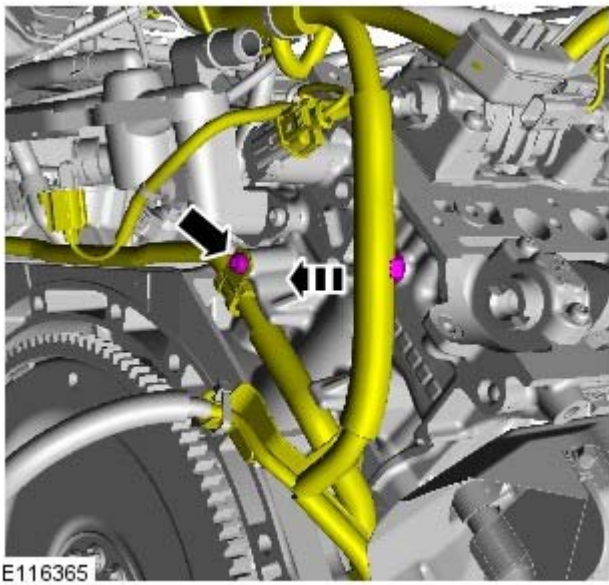
- NOTE: Engine shown removed for clarity.



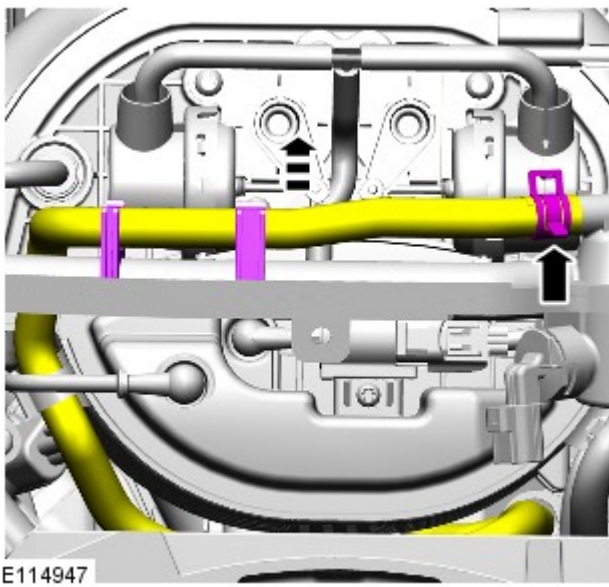
10.



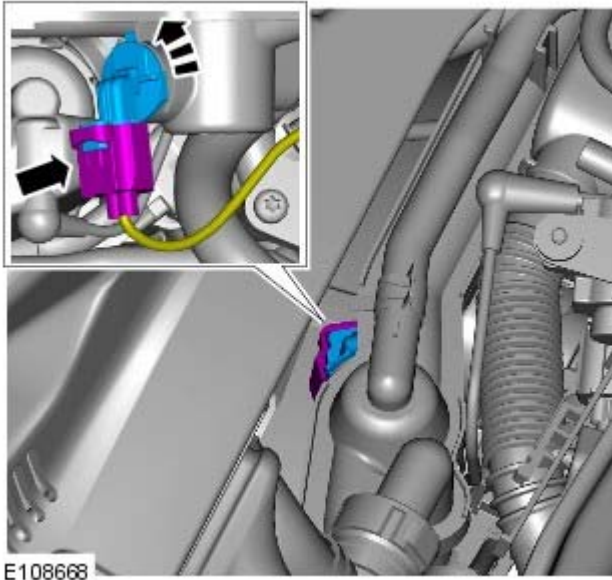
11.



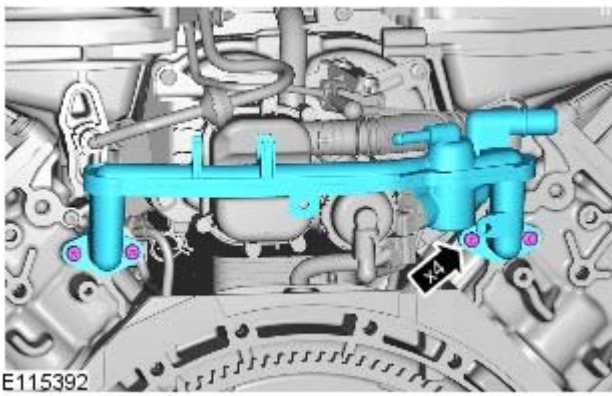
12.



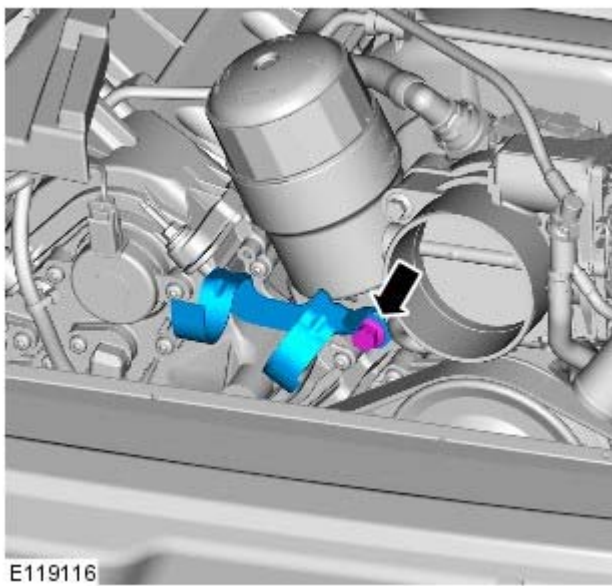
13. **13.** NOTE: Clamp the hose to minimize coolant loss.



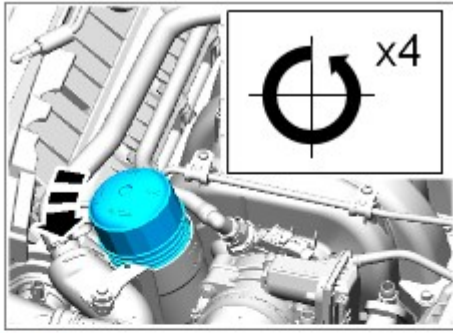
14.



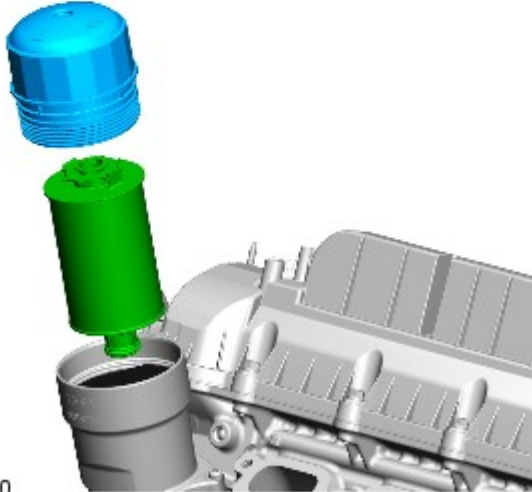
15.  CAUTION: Discard the seals.



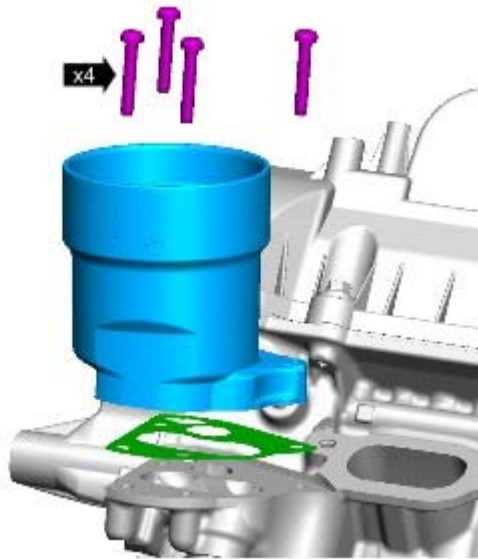
16.



17. **17.** NOTE: Remove and discard the O-ring seal.



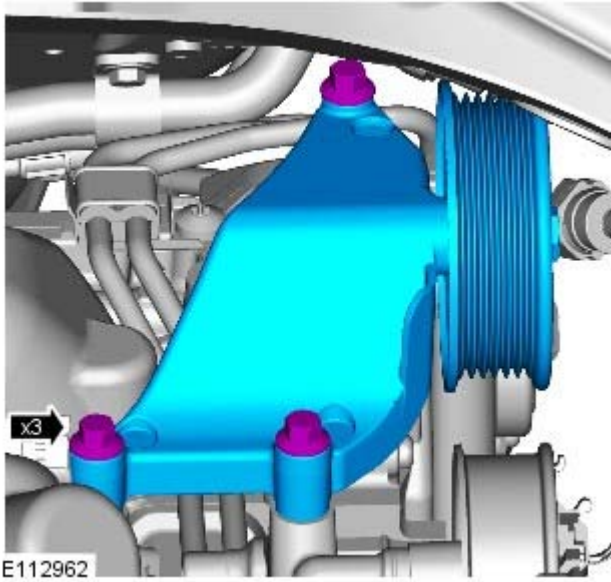
E114960



18. **18.** NOTE: Discard the gasket.

E114959

19.



20. **20. CAUTIONS:**

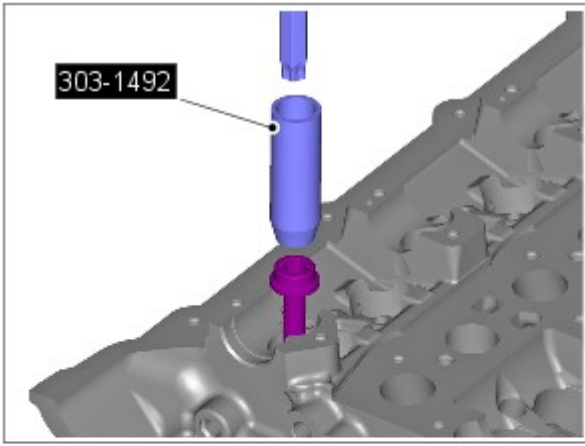


If a new cylinder head has been installed then new tappets must be installed.

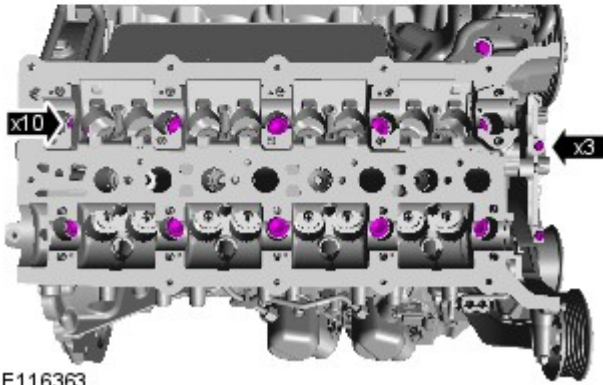


If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.



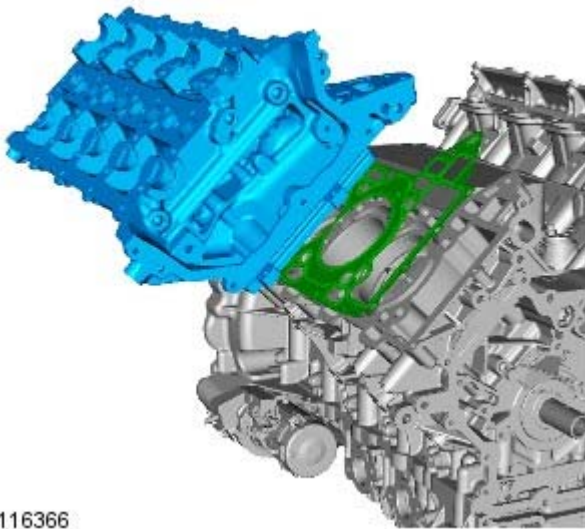


21. **21.**  CAUTION: Discard the bolts.

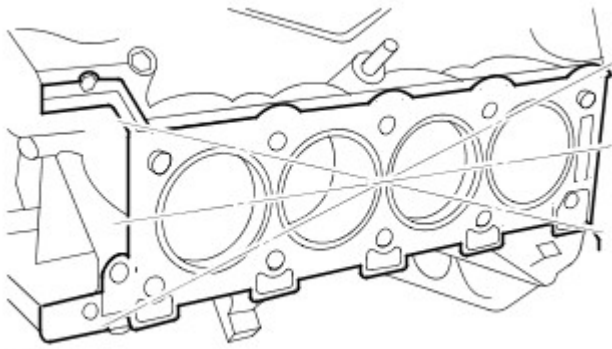


E116363


22. **22.** NOTE: Discard the gasket.



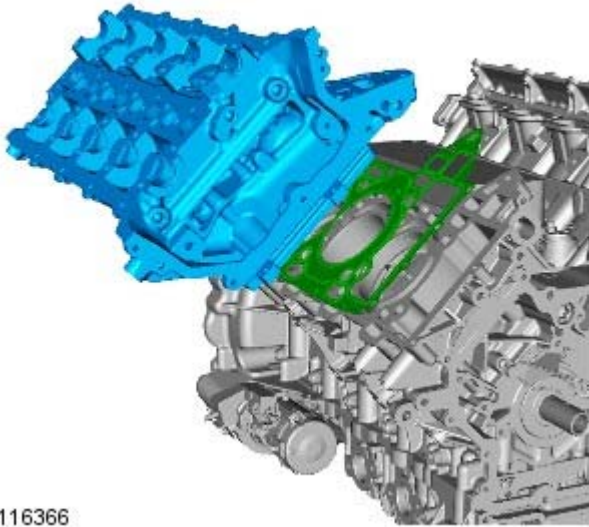
Installation




E46855

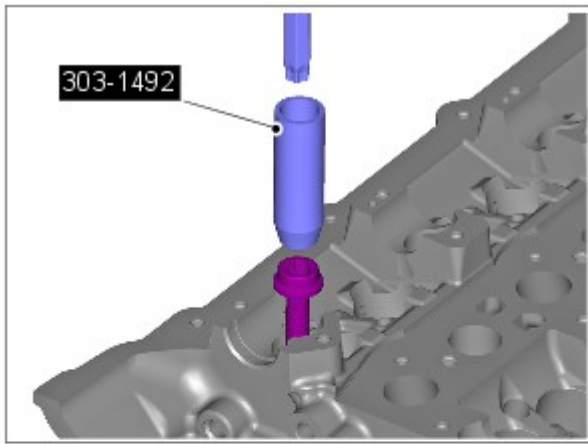
1.  CAUTION: An acceptable flatness of the cylinder head is 0.1mm.
 - NOTE: For cylinder head with distortion above the maximum allowance, the cylinder head material must be measured.


Check cylinder head face for distortion, across the center and from corner to corner.



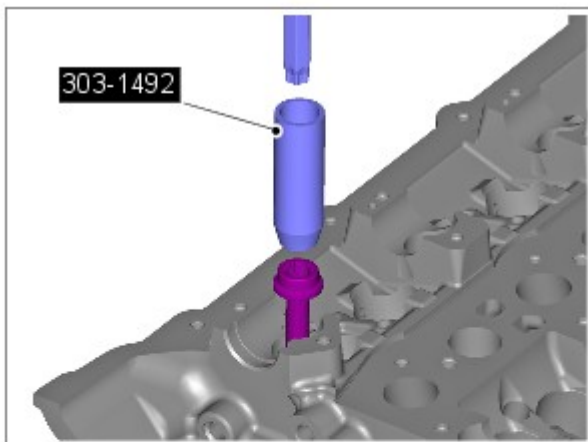
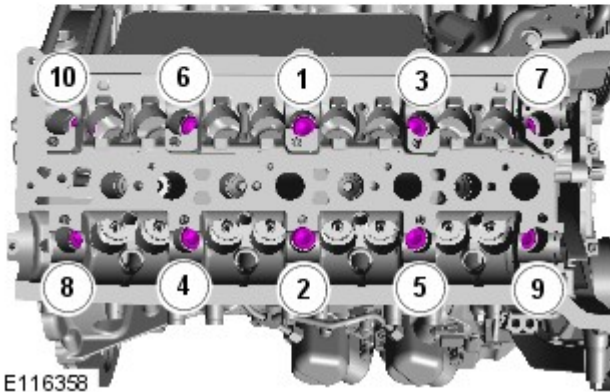
E116366

2.  WARNING: Make sure care is taken when handling the cylinder head gasket.
 - NOTE: Install a new gasket.

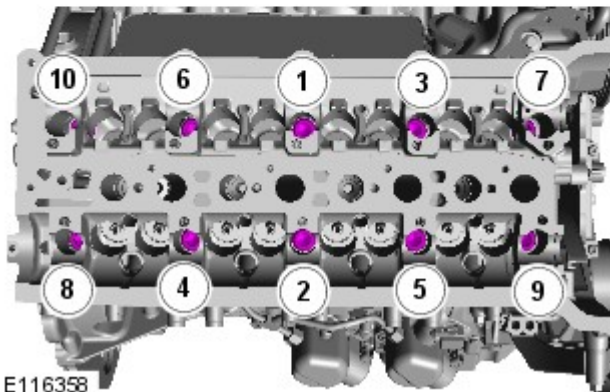


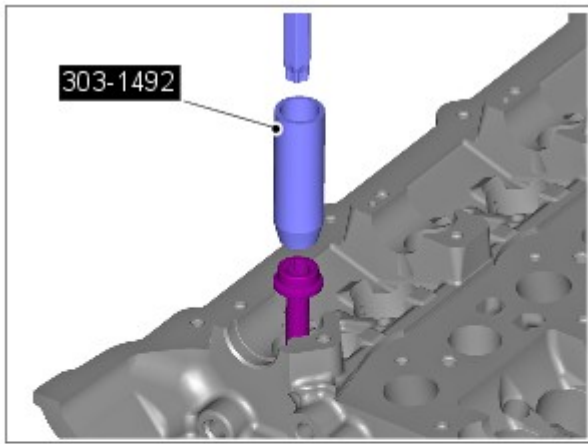
3.  CAUTION: Make sure that new cylinder head bolts are installed.

Torque: 20 Nm

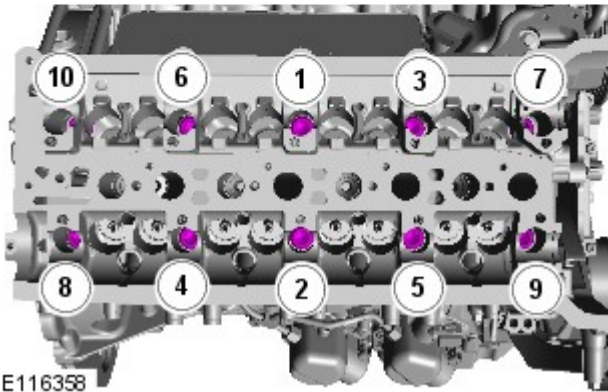


4. *Torque: 35 Nm*

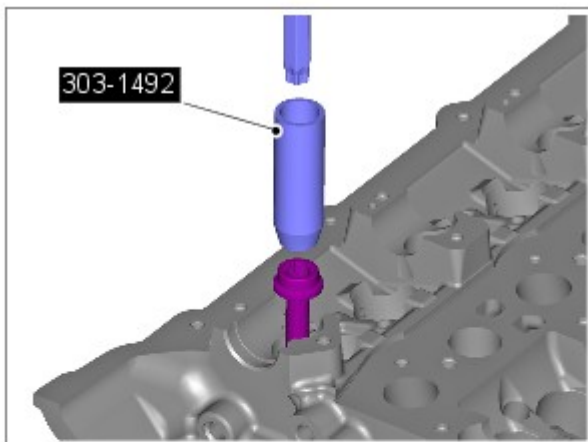




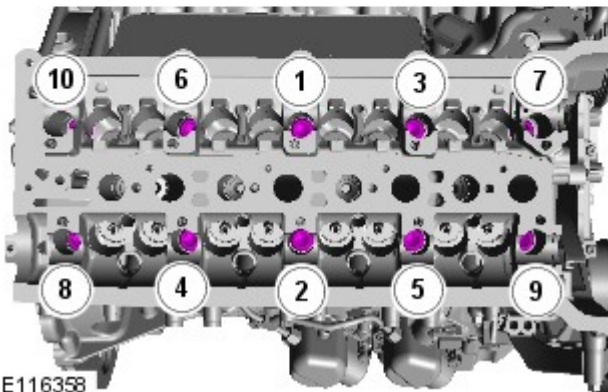
5. Tighten the bolts 1 to 10, a further 90 degrees.



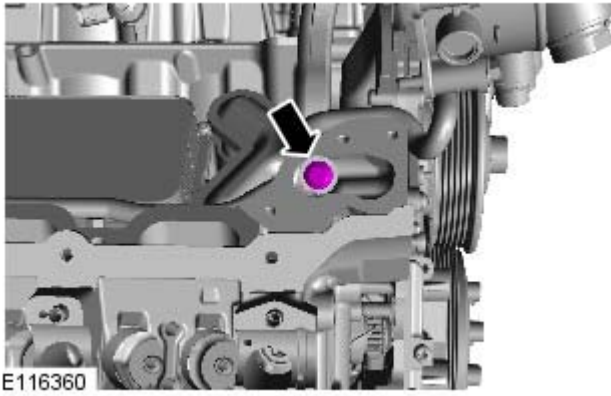
E116358



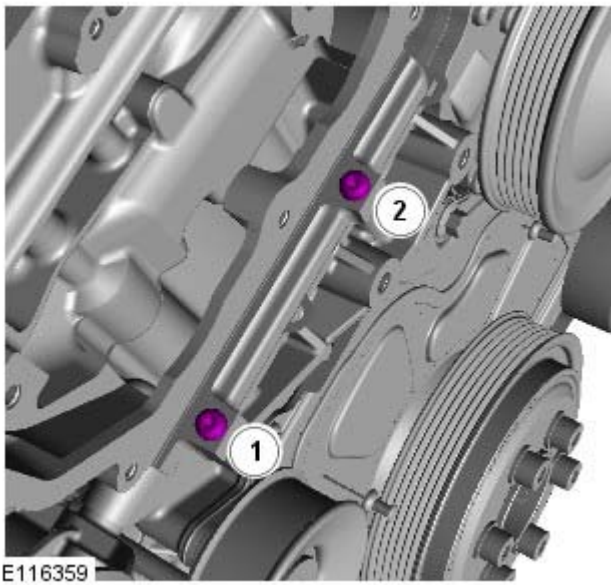
6. Tighten the bolts 1 to 10, a further 120 degrees.



E116358



7. Torque: 25 Nm



8. Torque: 12 Nm



9. **9. CAUTIONS:**

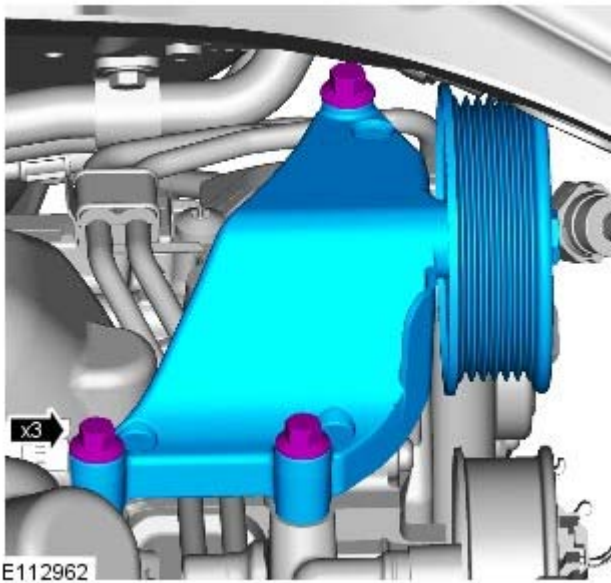


If a new cylinder head has been installed then new tappets must be installed.



If the cylinder head is being removed without a new component being installed, the tappets must be installed in their original positions.

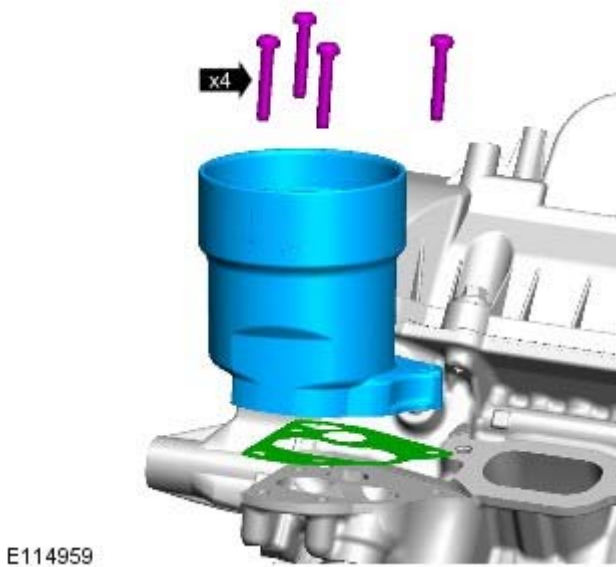
Lubricate the valve tappets with clean engine oil.

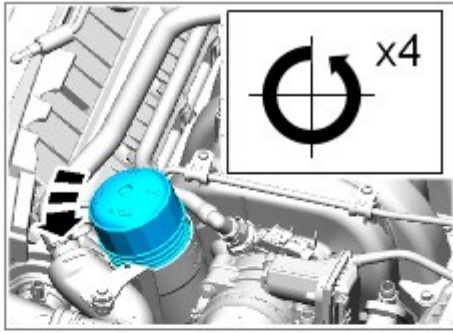



10. Torque: 25 Nm

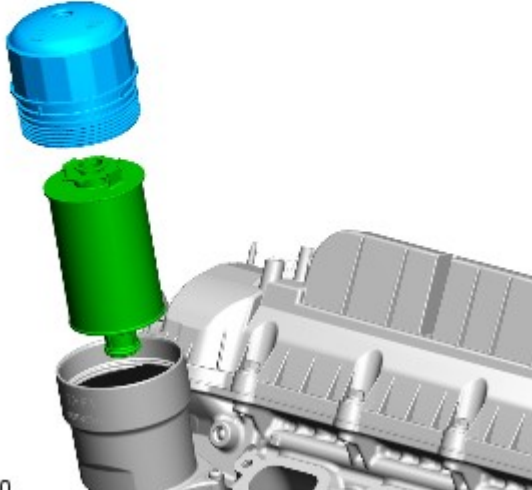
11. Refer to: [Camshaft RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

12. **12.** NOTE: Install a new gasket.

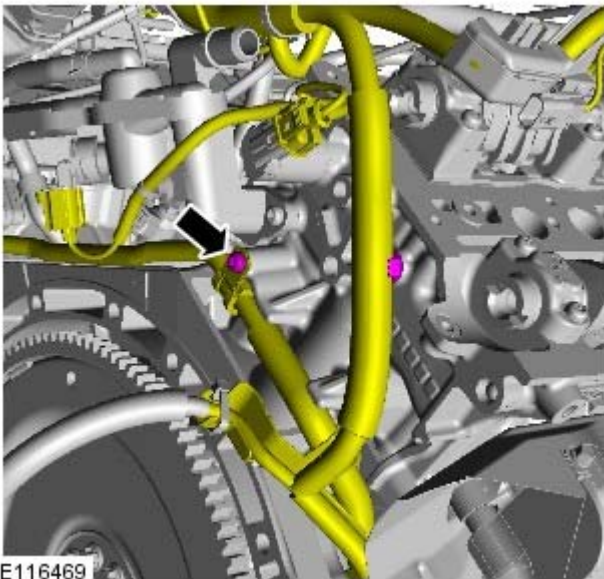




13. **13.**  CAUTION: A new O-ring seal is to be installed.
- NOTE: Install a new engine oil filter.

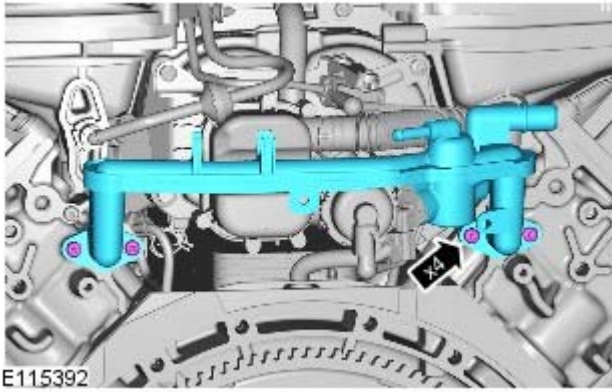


E114960



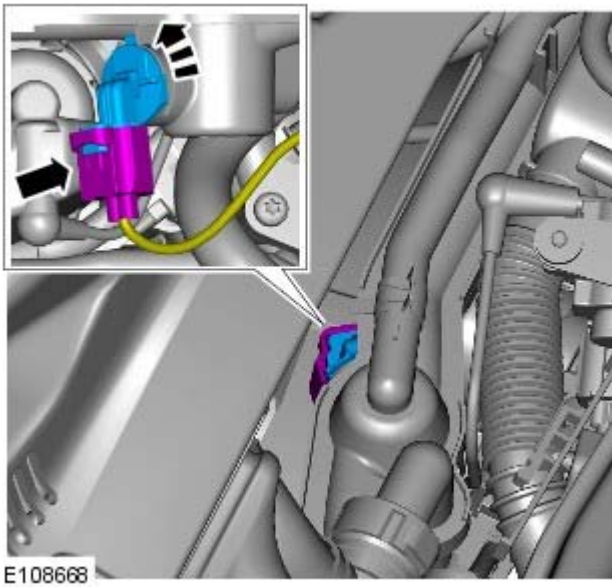
E116469

14. *Torque:* 12 Nm

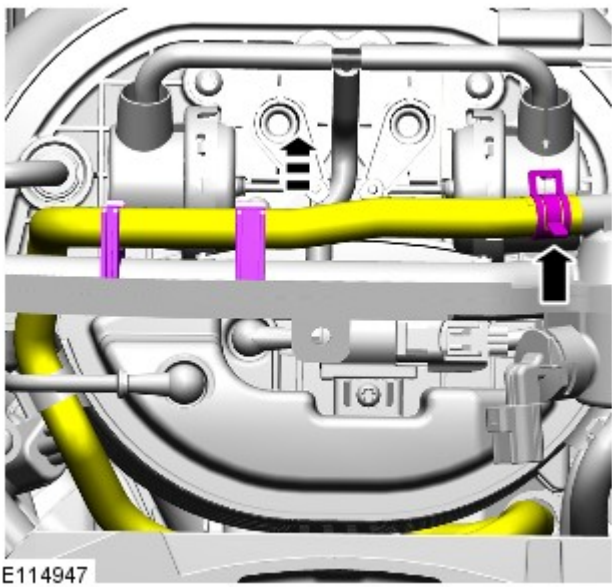


15. **15.**  CAUTION: Install the new seals.

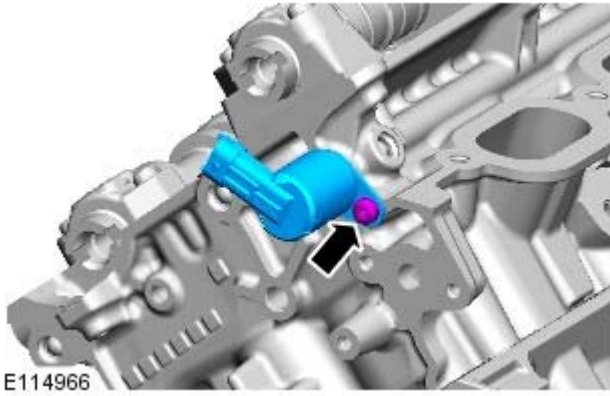
Torque: 10 Nm



16.




17. **17.** NOTE: Clamp the hose to minimize coolant loss.

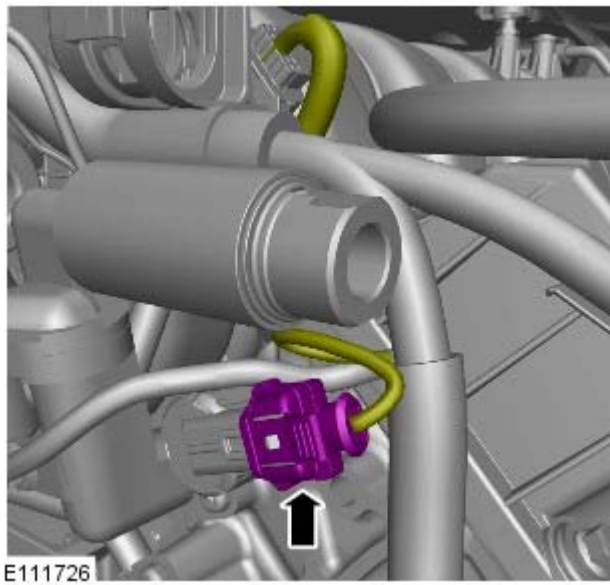


18. **18. CAUTIONS:**

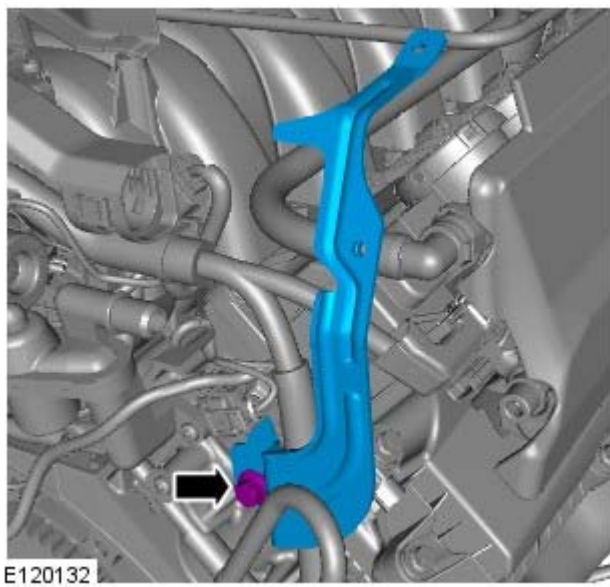
 Install a new seal.

 LH illustration shown, RH is similar.

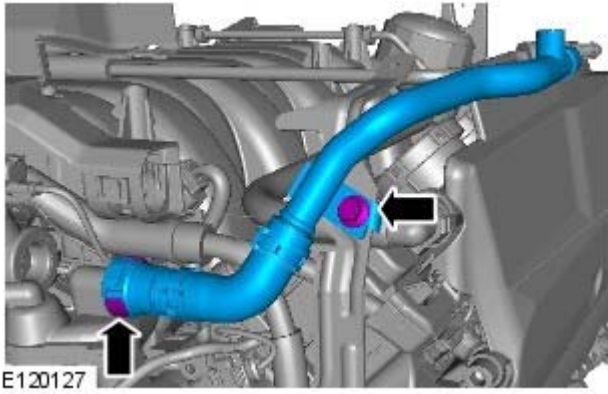
Torque: 12 Nm



19.

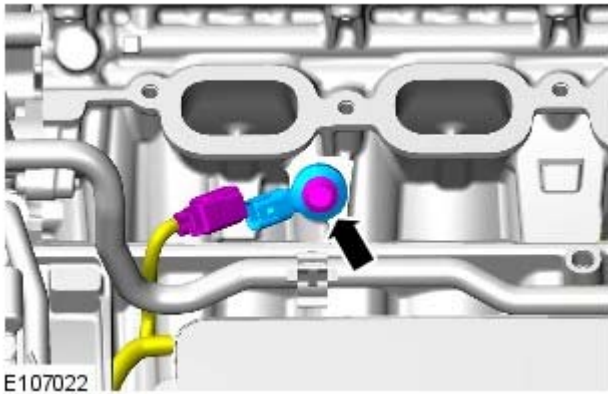


20.

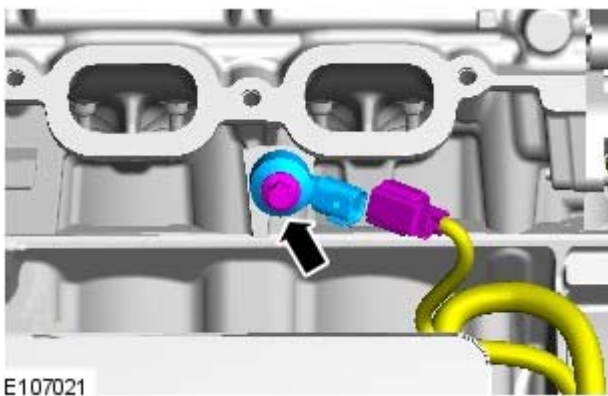


21. **21.**  CAUTION: Be prepared to collect escaping coolant.

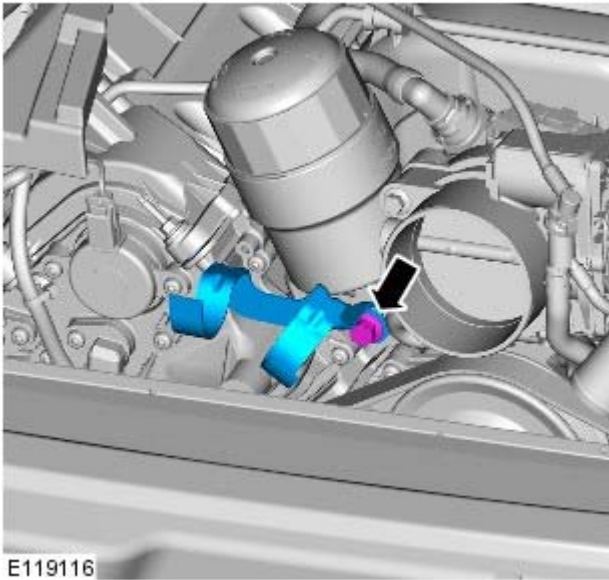
Torque: 10 Nm



22. *Torque:* 20 Nm



23. *Torque:* 20 Nm



24. Torque: 25 Nm

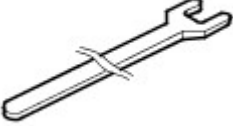

25. Refer to: [Exhaust Manifold RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
26. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
27. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Engine Mount LH

Removal and Installation

Special Tool(s)

 <p>303-1142</p> <p>E46076</p>	<p>303-1142 Viscous Coupling Wrench</p>
 <p>303-1143</p> <p>E55382</p>	<p>303-1143 Viscous Coupling Holding Tool</p>

Removal

- NOTE: Some illustrations may show the engine removed for clarity.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

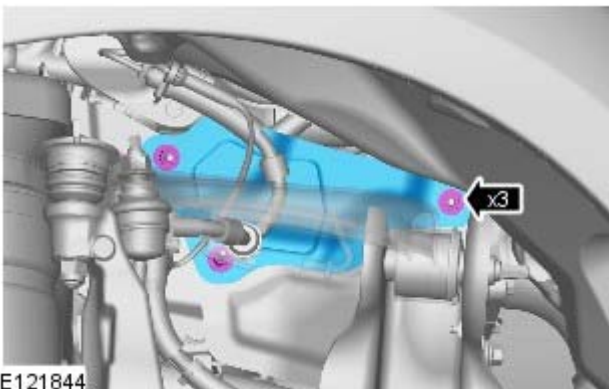
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

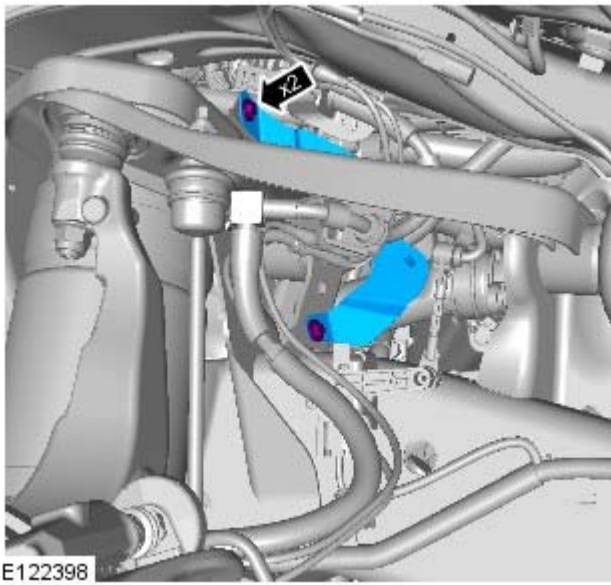
3. Refer to: [Catalytic Converter LH](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

4. Remove the LH front wheel and tire.

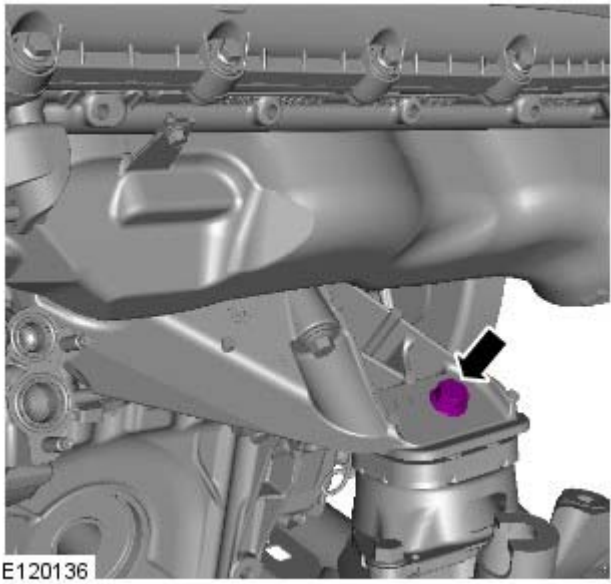
- 5.



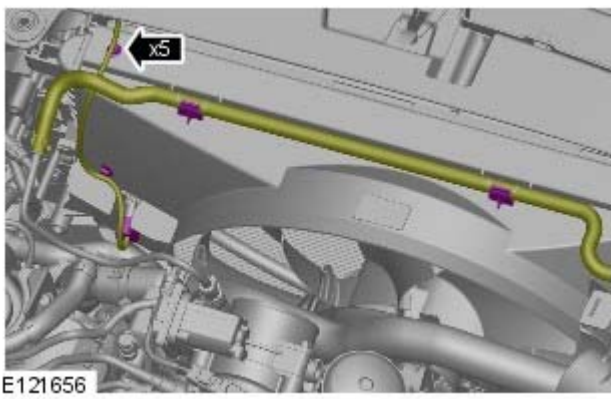
E121844



6.

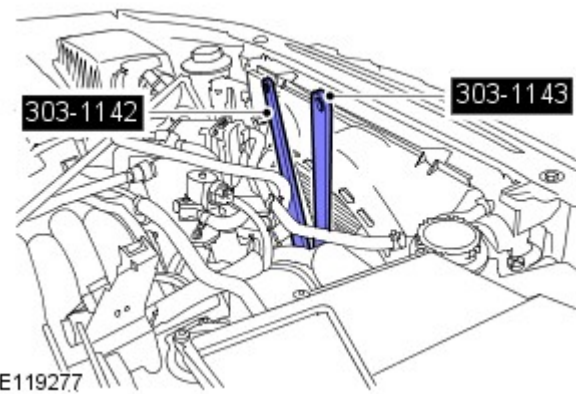
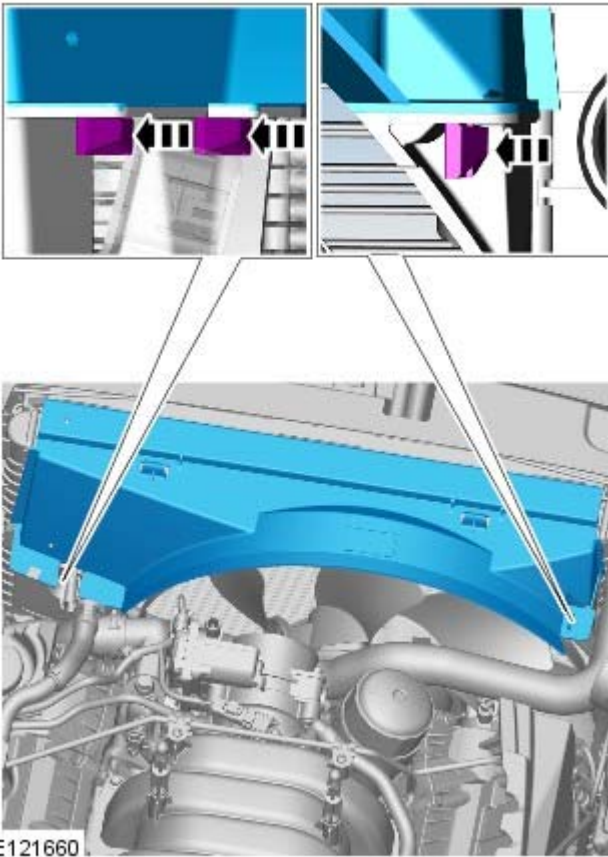



7.




8.

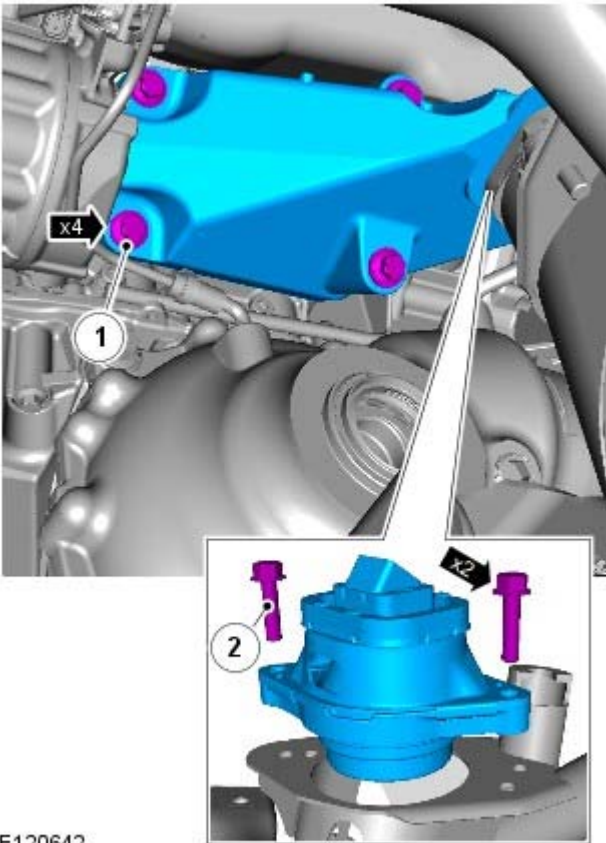
9.



10. **10.**  **CAUTION:** Always protect the cooling pack elements to prevent accidental damage.
- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

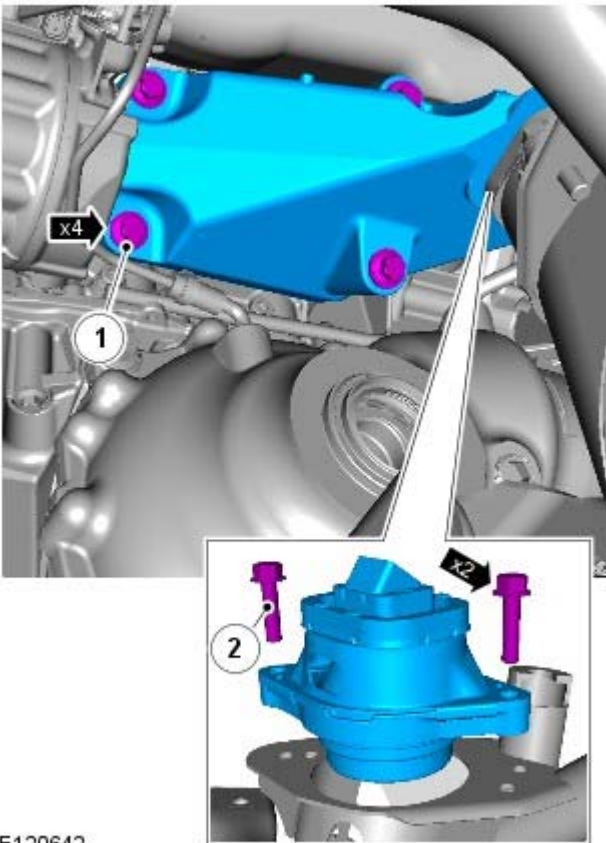
11. **11.**  **CAUTION:** Use a wooden block to protect the oil pan when supporting the engine.
- Using a suitable hydraulic jack, raise and support the engine.

12.



E120642

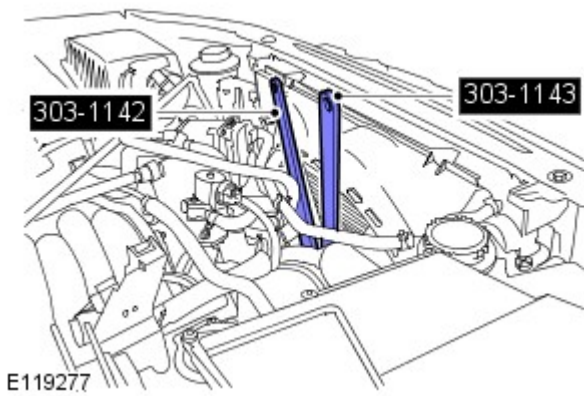
Installation




E120642

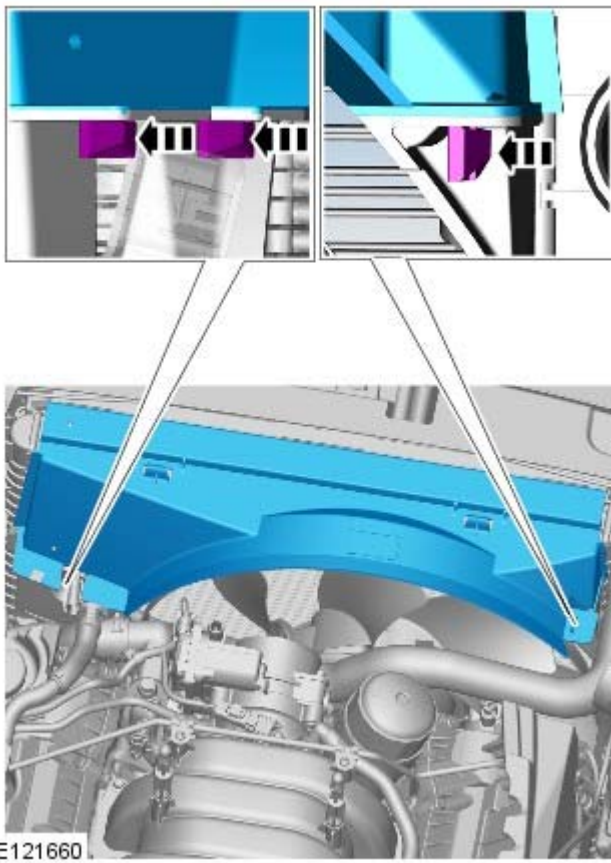
1.

- *Torque:*
 - 1 45 Nm
 - 1 60°
 - 2 56 Nm

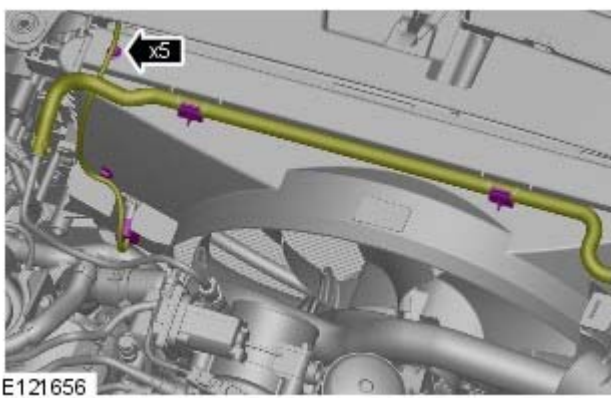


2.  CAUTION: Always protect the cooling pack elements to prevent accidental damage.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

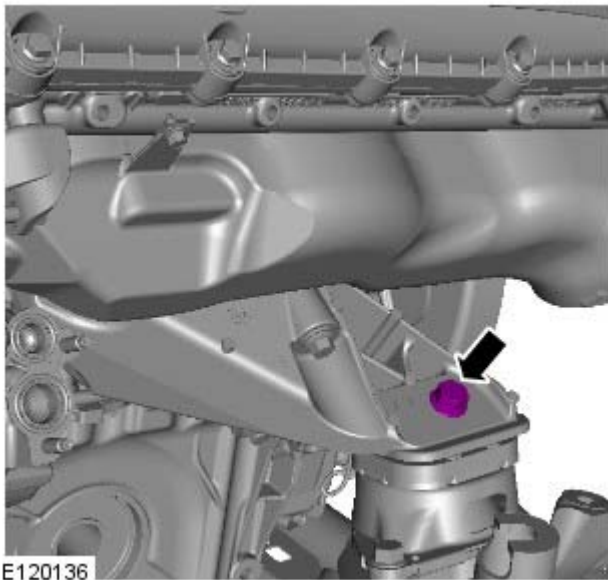
Special Tool(s): [303-1142](#), [303-1143](#)
Torque: 65 Nm



3.

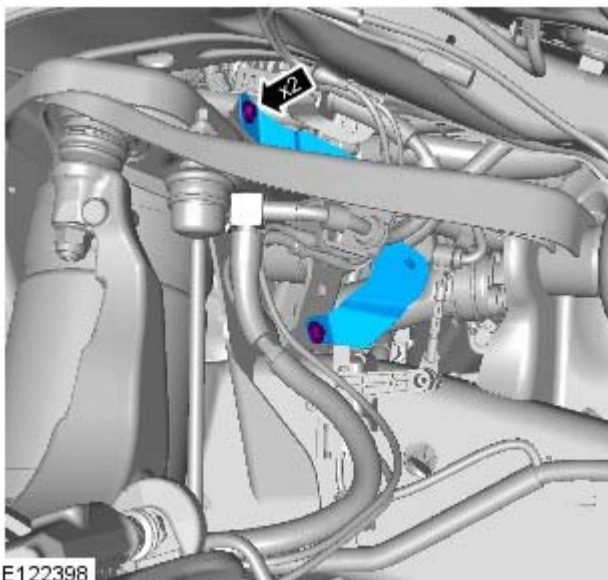


4.



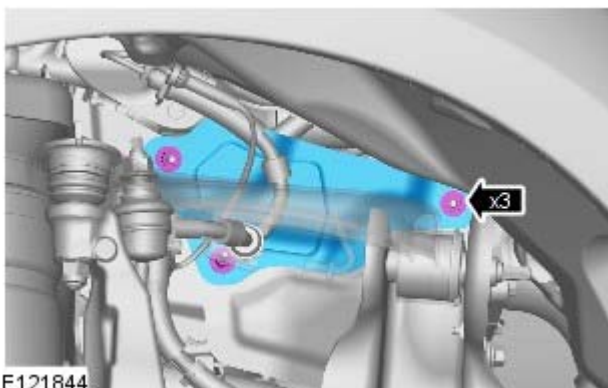
E120136

5. Torque: 100 Nm



E122398

6. Torque: 12 Nm



E121844

7. Torque: 12 Nm

8. Install the LH front wheel and tire.

9. Refer to: [Catalytic Converter LH](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

10. Lower the vehicle.

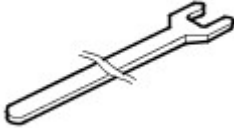

11. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Engine Mount RH


Removal and Installation

Special Tool(s)

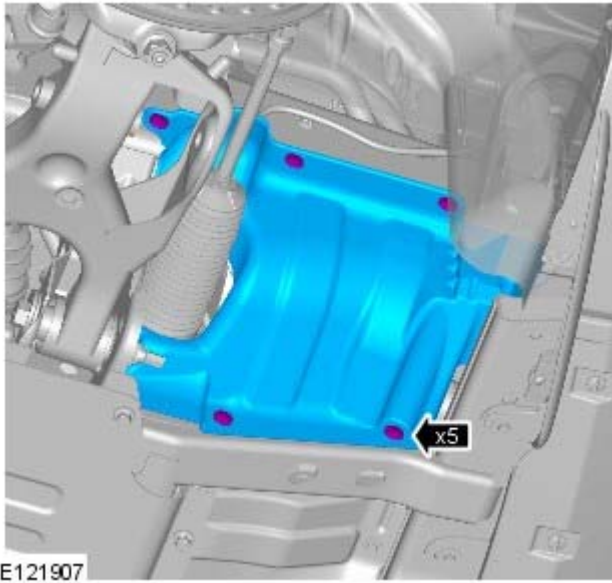
 <p>303-1142</p> <p>E46076</p>	<p>303-1142 Viscous Coupling Wrench</p>
 <p>303-1143</p> <p>E55382</p>	<p>303-1143 Viscous Coupling Holding Tool</p>

Removal

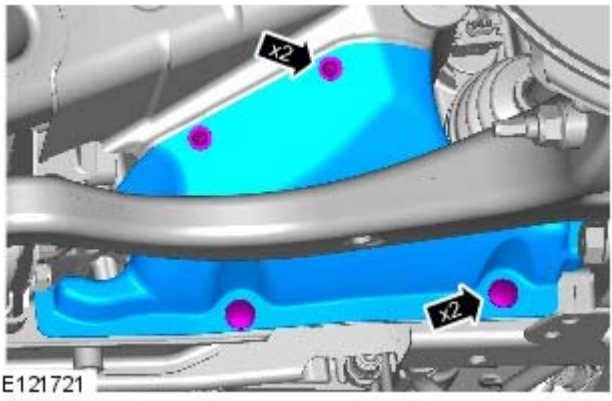
- NOTE: Some illustrations may show the engine removed for clarity.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Disconnect the battery ground cable.

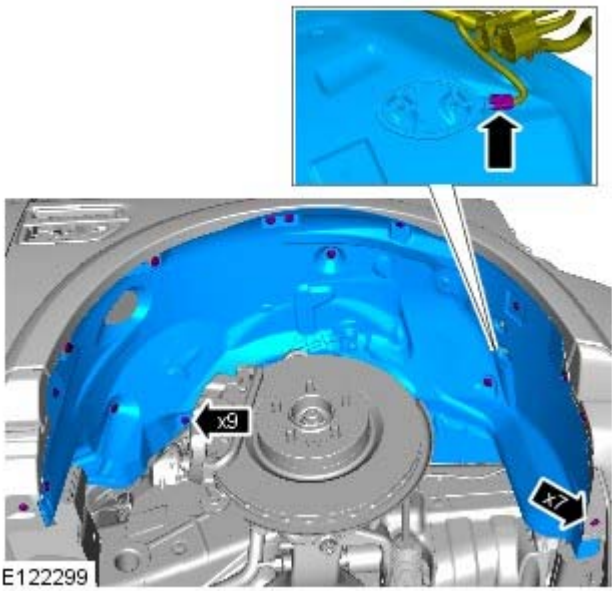
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove the RH front wheel and tire.
4. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).
5. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).



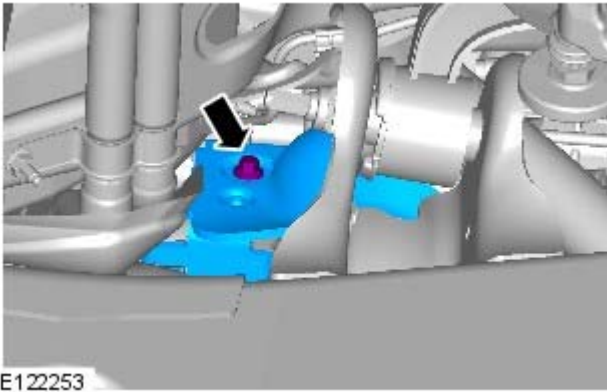
6.



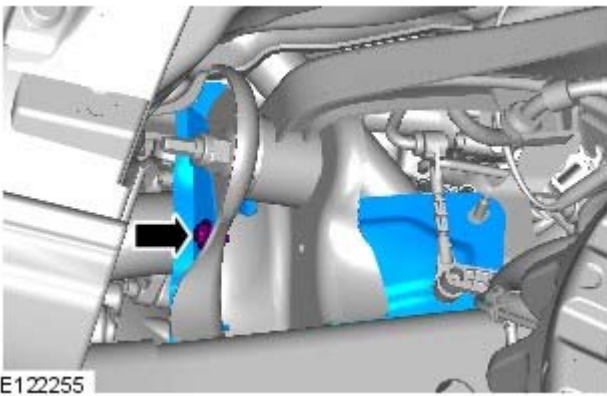
7.



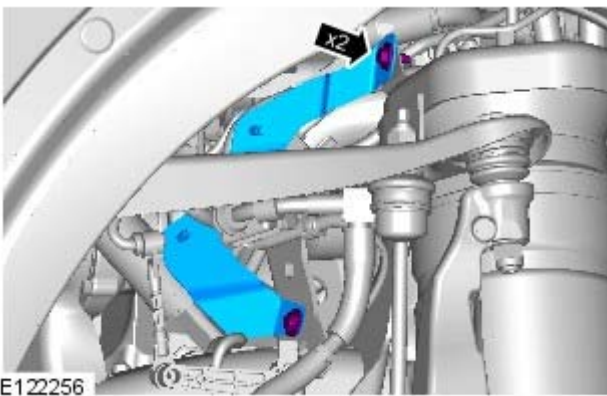
8.



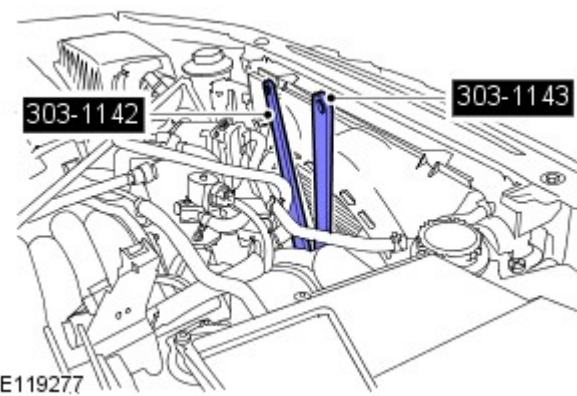
9.



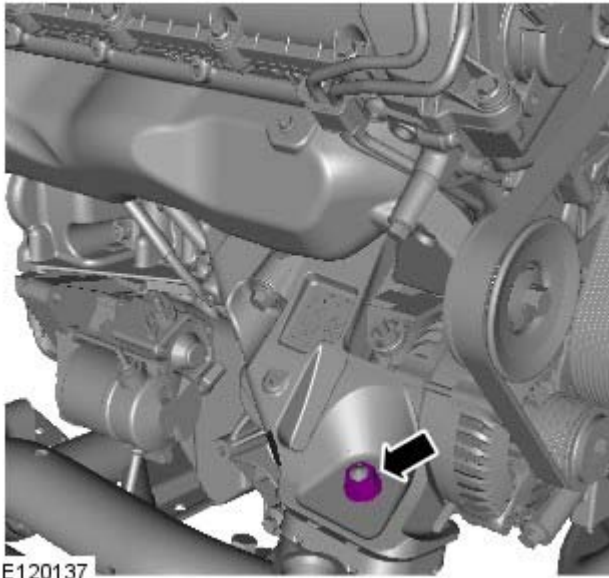
10.



11.



12. **⚠ CAUTION:** Always protect the cooling pack elements to prevent accidental damage.
- NOTE: The thread is right handed.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

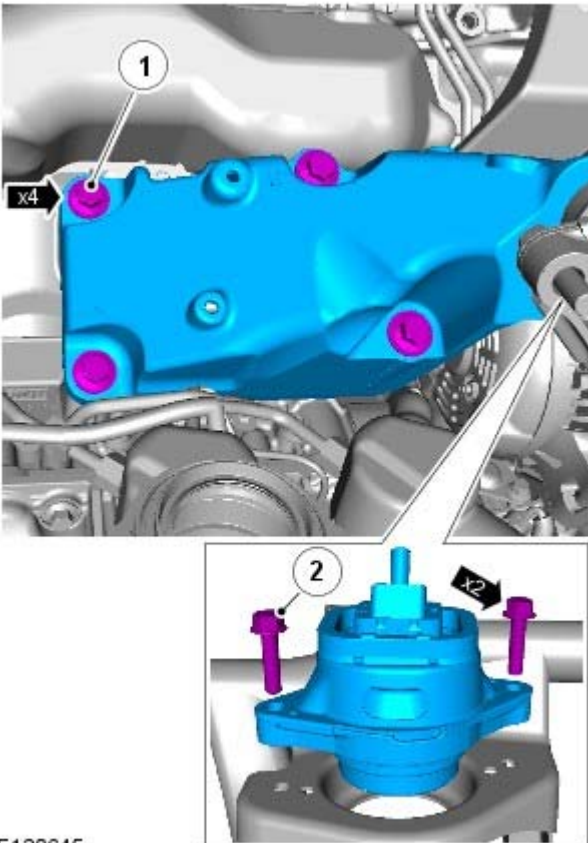


E120137

13.

14. **14.**  CAUTION: Use a wooden block to protect the oil pan when supporting the engine.

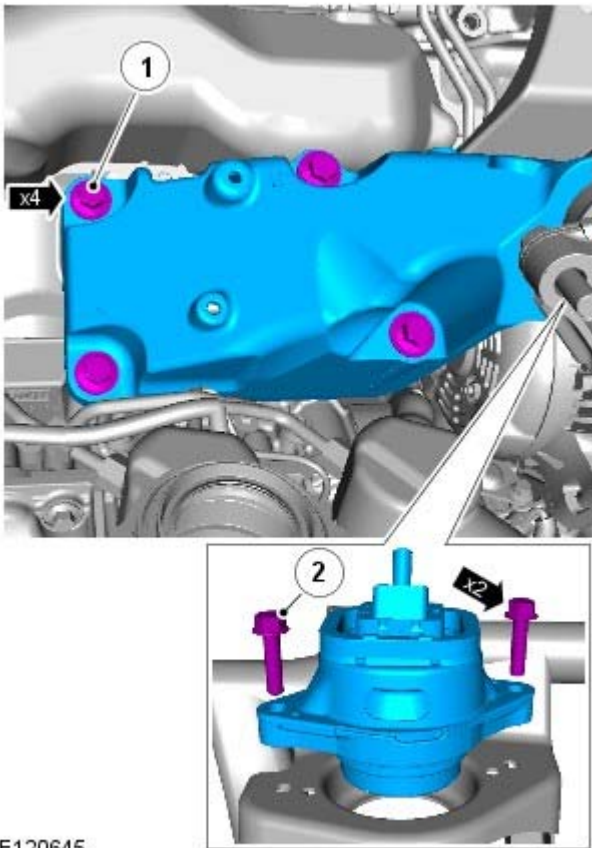
Using a suitable hydraulic jack, raise and support the engine.



E120645

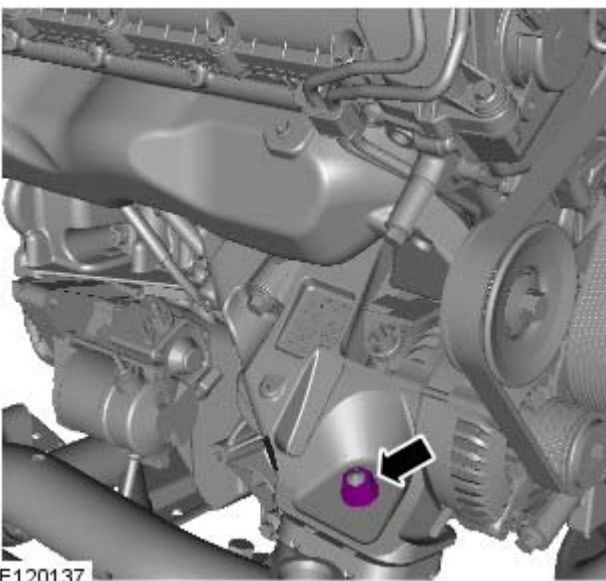
15.

Installation



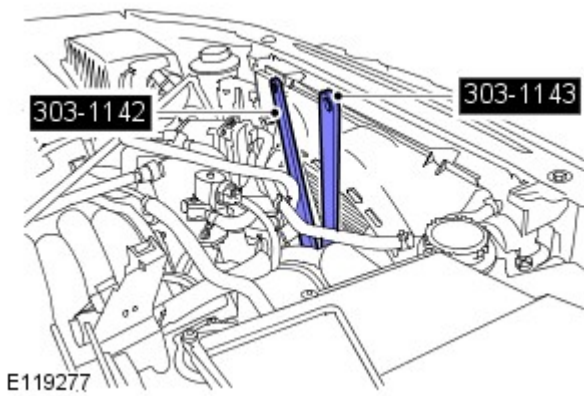
E120645


1. *Torque:*
 - 1 45 Nm
 - 1 60°
 - 2 56 Nm



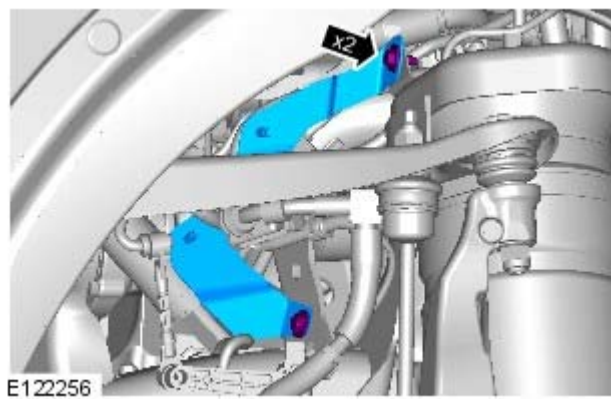
E120137

2. *Torque:* 100 Nm

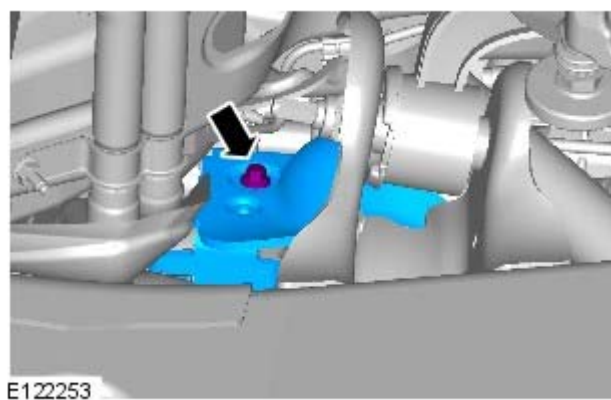


3.  **CAUTION:** Always protect the cooling pack elements to prevent accidental damage.
 - NOTE: The thread is right handed.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

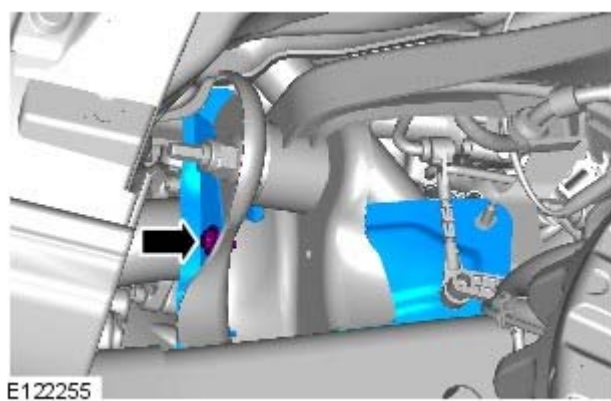
Special Tool(s): [303-1142](#), [303-1143](#)
Torque: 65 Nm



4.

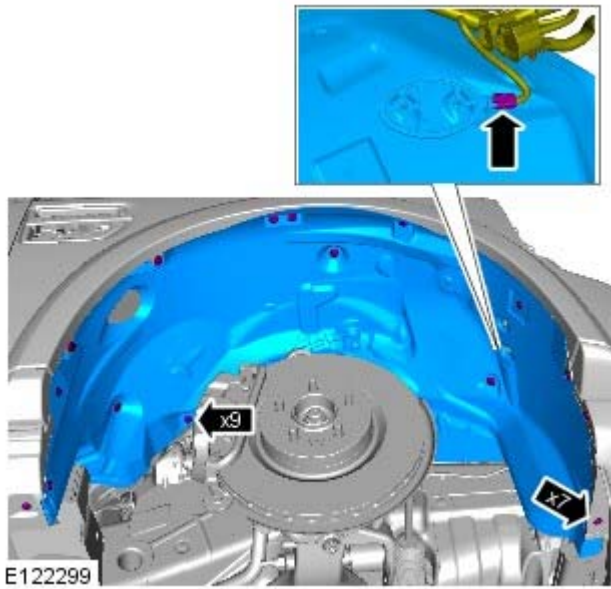


5.

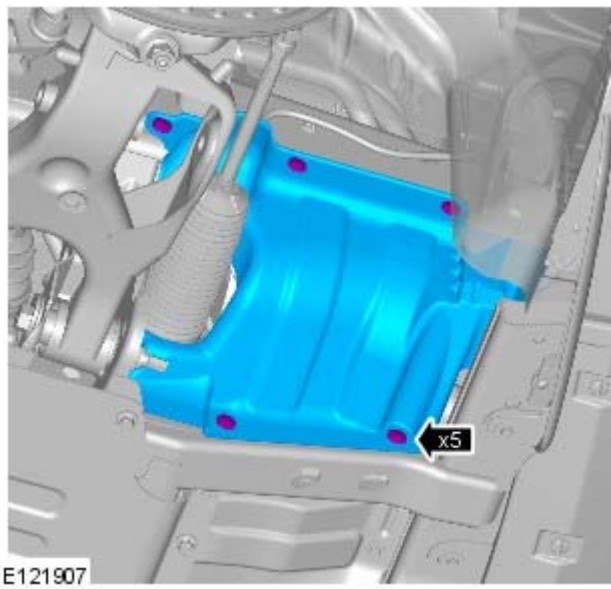


6.

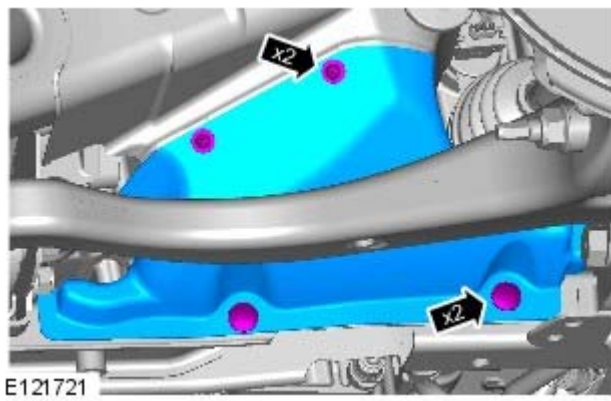
7.



8.



9.



10. Install the RH front wheel and tire.

11. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

12. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol,

Removal and Installation).


13. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Exhaust Manifold LH

Removal and Installation

Special Tool(s)


 <p>E115261</p>	<p>303-1444-01 Exhaust Manifold Installation Guide Pins - Threaded</p>
 <p>E115262</p>	<p>303-1444-02 Exhaust Manifold Installation Guide Pins - Unthreaded</p>

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

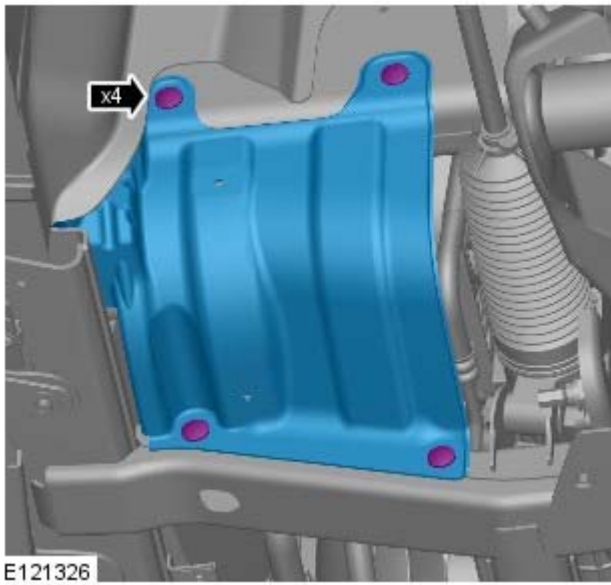
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

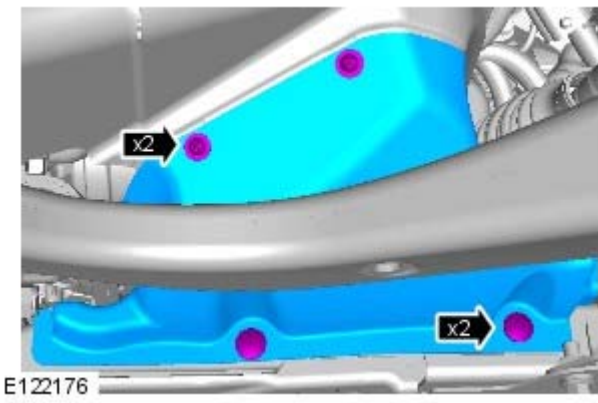
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

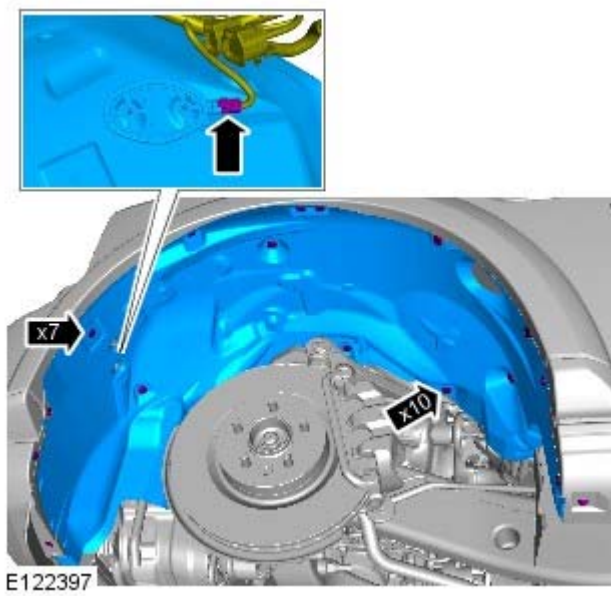
3. Refer to: [Power Steering Pump - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).
4. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).



5.

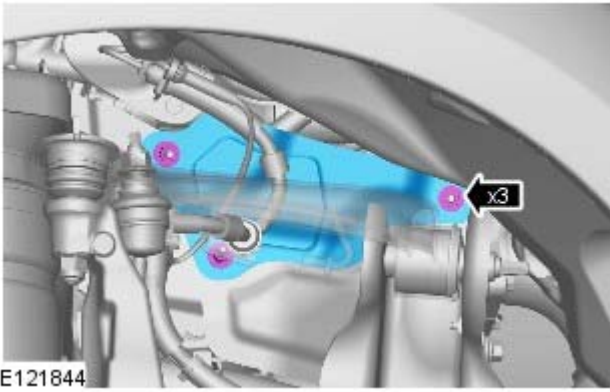


6.

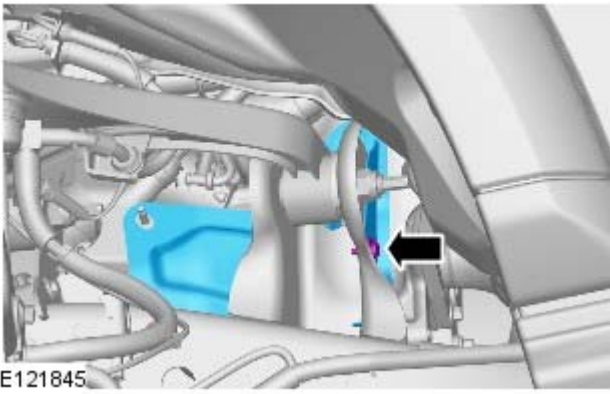


7.

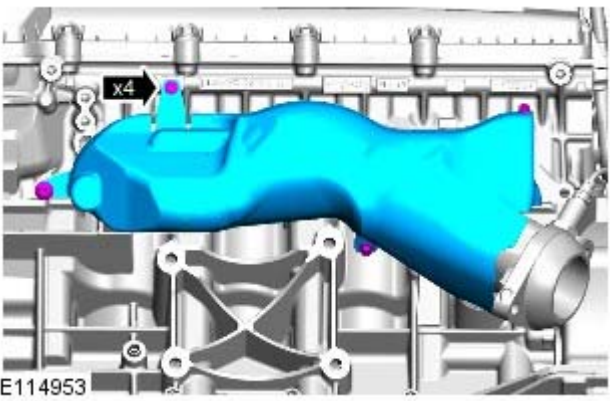
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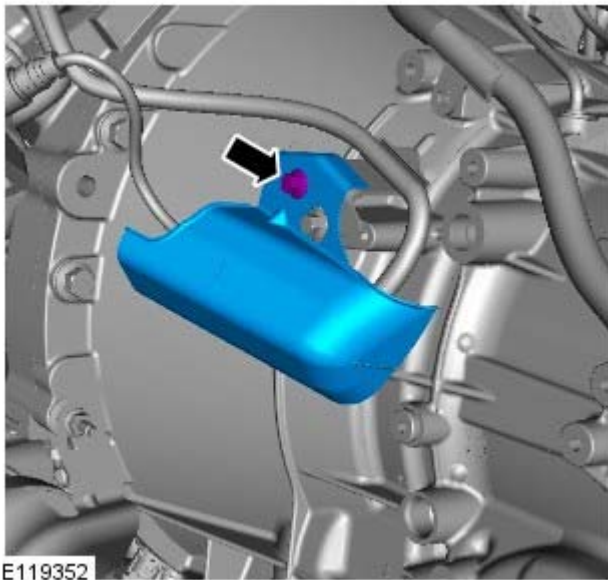


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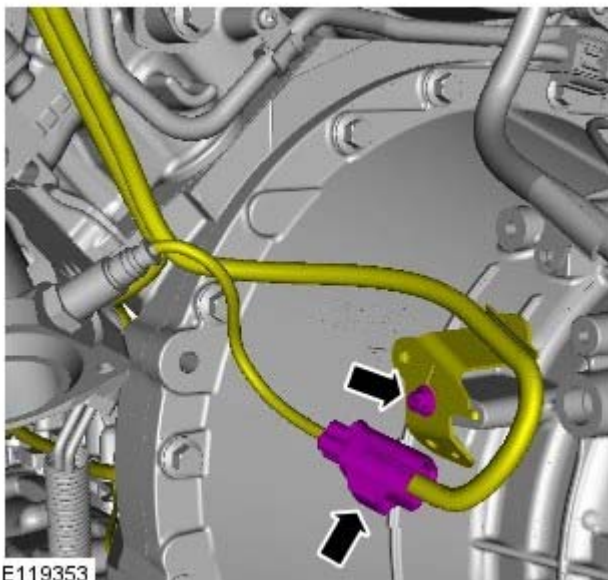
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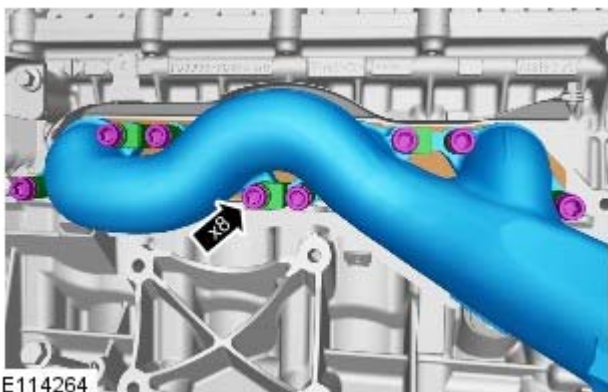
E119352

11.




E119353

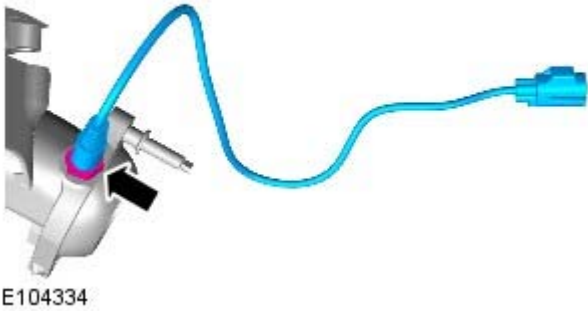
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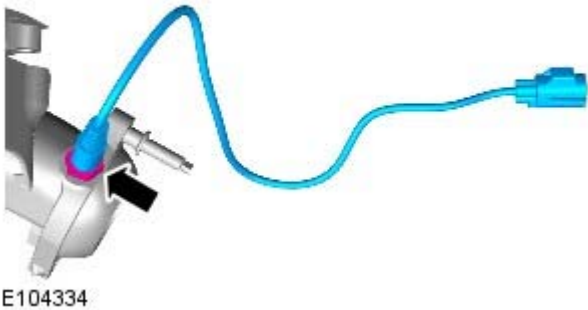
E114264

13. **13.**  CAUTION: Discard the bolts.
- NOTE: Discard the gasket.
 - NOTE: Make sure that the position of the spacers is noted before removal of the manifold.


14. **14.** NOTE: Do not disassemble further if the component is removed for access only.



Installation




1. **1.** CAUTIONS:

 Make sure that the mating faces are clean and free of foreign material.

 Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.

 If accidentally dropped or knocked install a new sensor.

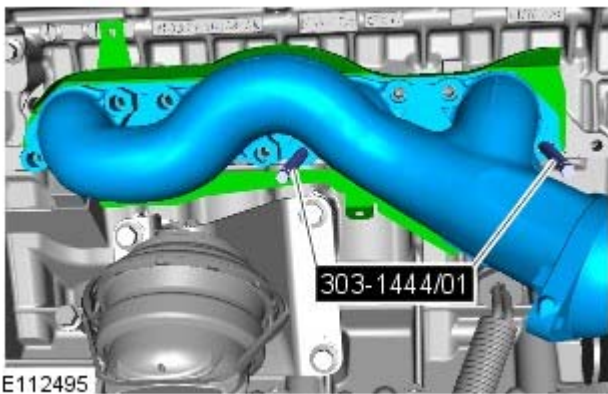
 Make sure the catalyst monitor sensor wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

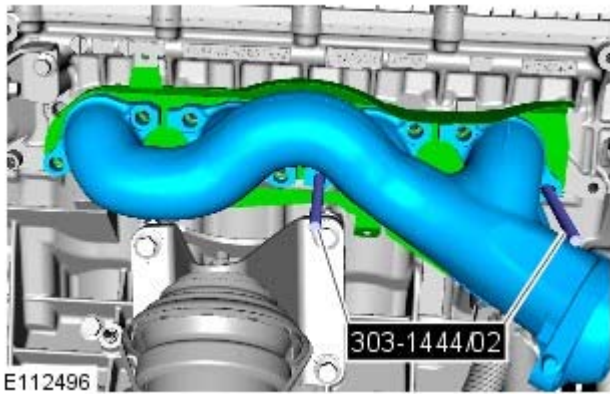
• NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

Torque: 45 Nm

2. **2.** NOTE: Install a new gasket.

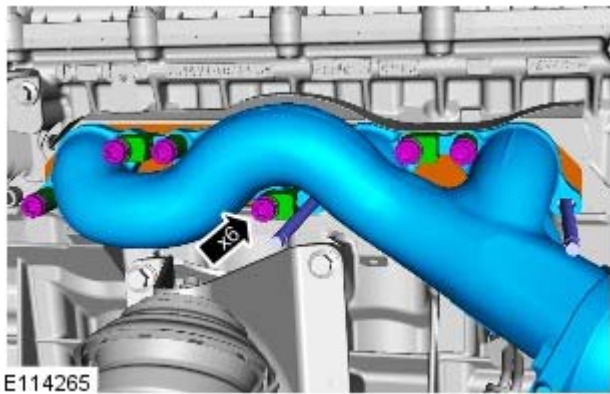
Special Tool(s): [303-1444-01](#)





3. **NOTE:** If a new cylinder head is installed use the special tools in the illustration.

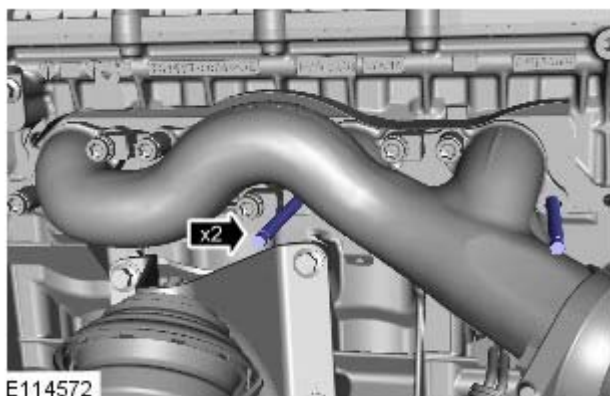
Special Tool(s): [303-1444-02](#)



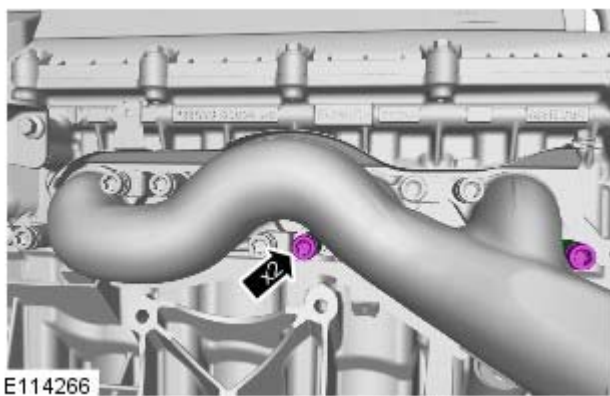
4. **CAUTION:** Make sure that new bolts are installed.

• **NOTE:** Install the spacers in the noted position.

Torque: 10 Nm



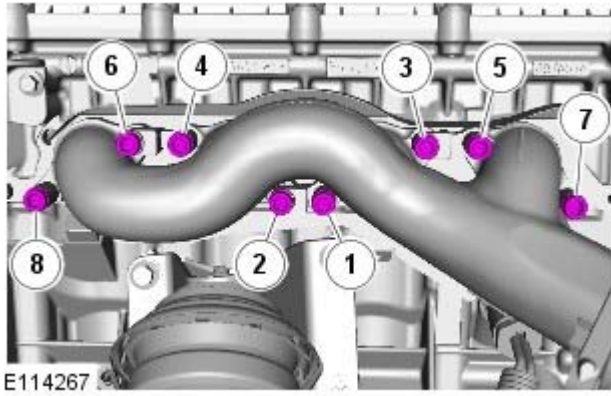
5. Remove the special tool.



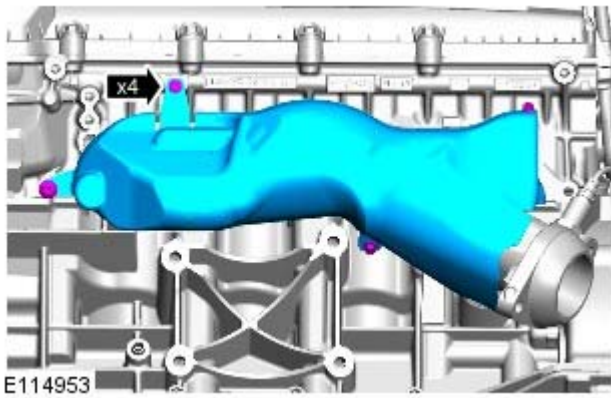
6. **CAUTION:** Make sure that new bolts are installed.

• **NOTE:** Install the spacers in the noted position.

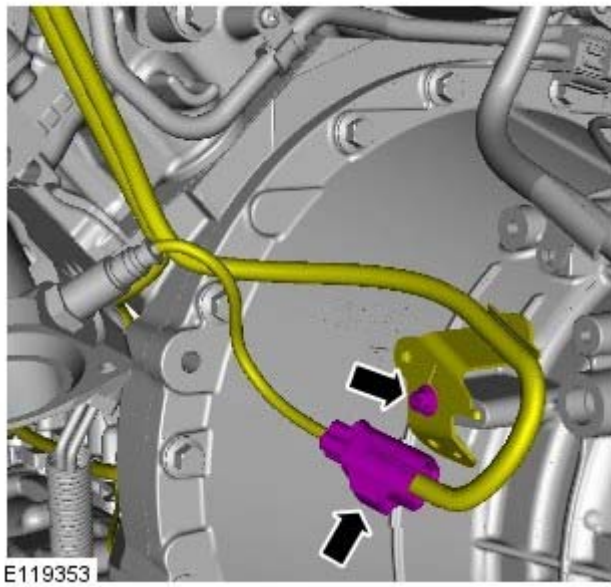
Torque: 10 Nm



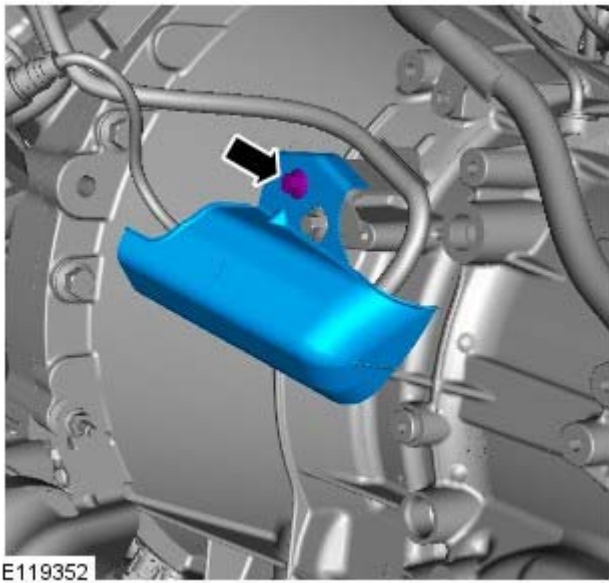
7. Torque: 18 Nm



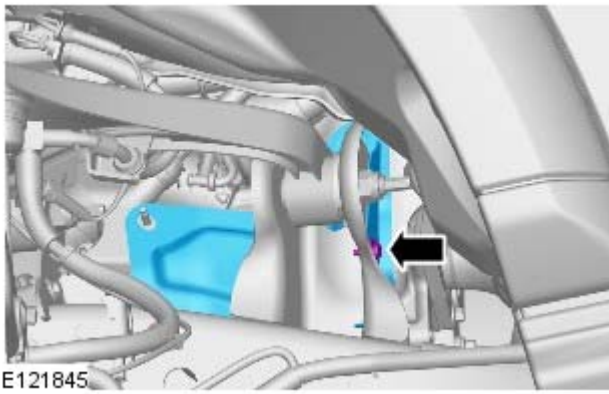
8. Torque: 3 Nm



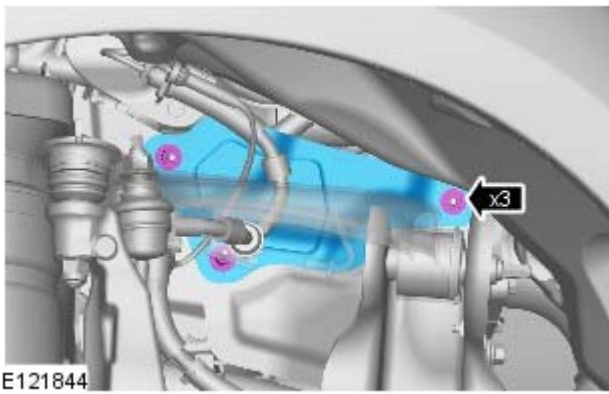
9. Torque: 10 Nm



10. Torque: 10 Nm

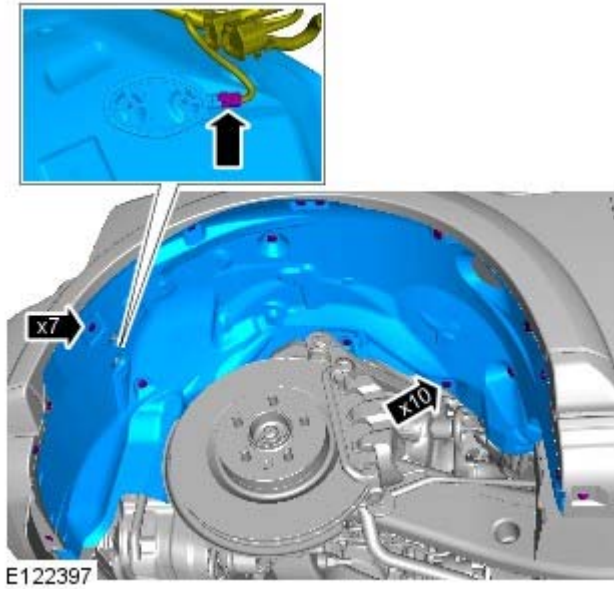


11.

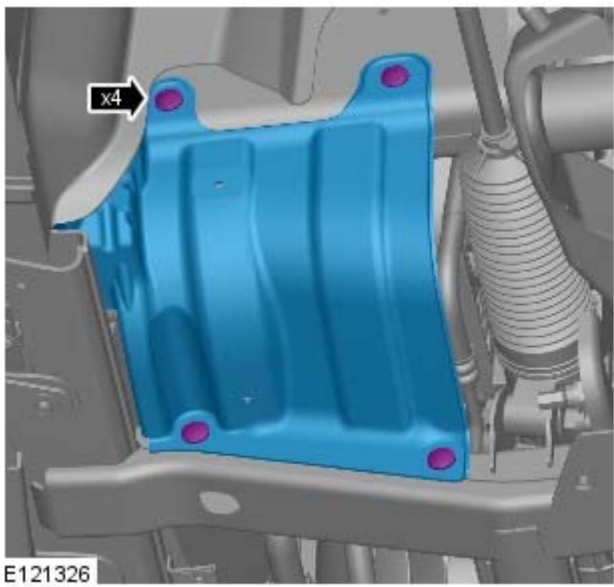


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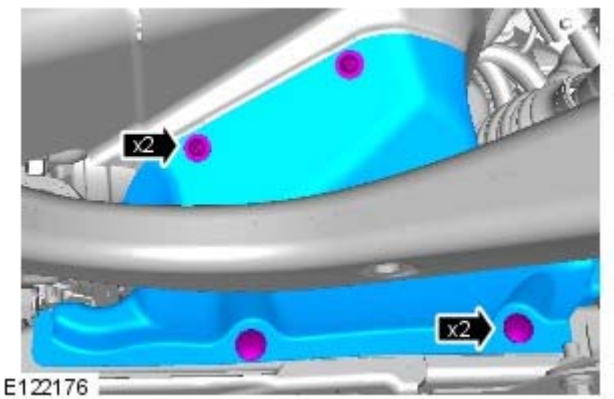
13.



14.



15.



16. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

17. Refer to: [Power Steering Pump - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).


18. Install the battery.

Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

Engine - V8 5.0L Petrol - Exhaust Manifold RH

Removal and Installation

Special Tool(s)

 <p>E115261</p>	<p>303-1444-01 Exhaust Manifold Installation Guide Pins - Threaded</p>
 <p>E115262</p>	<p>303-1444-02 Exhaust Manifold Installation Guide Pins - Unthreaded</p>

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the engine removed for clarity.

1. Disconnect the battery ground cable.

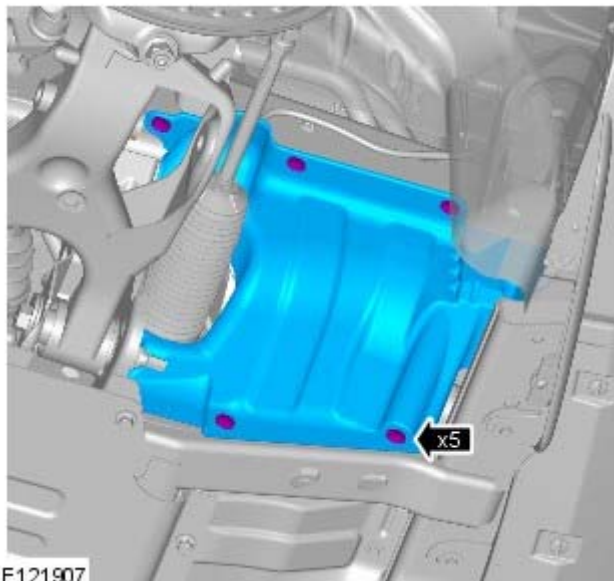
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

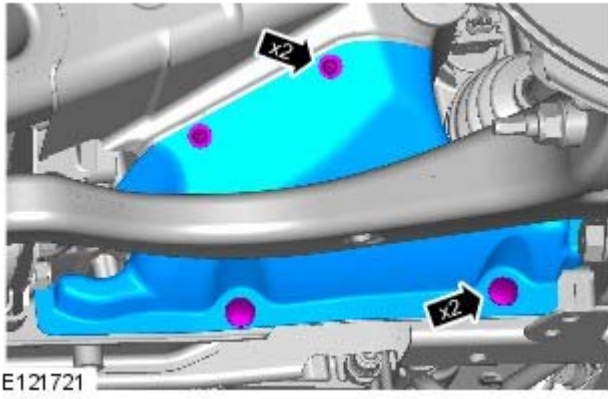
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

4.



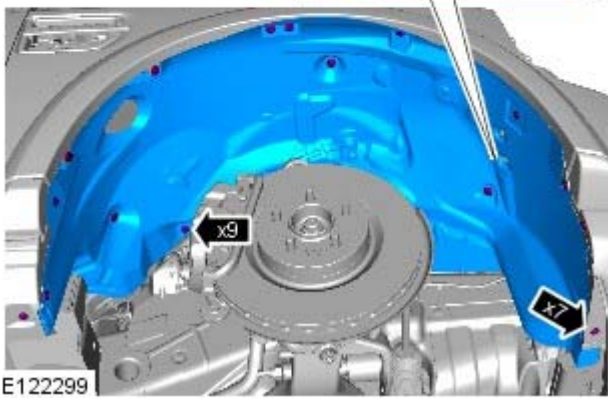


E121721

5.

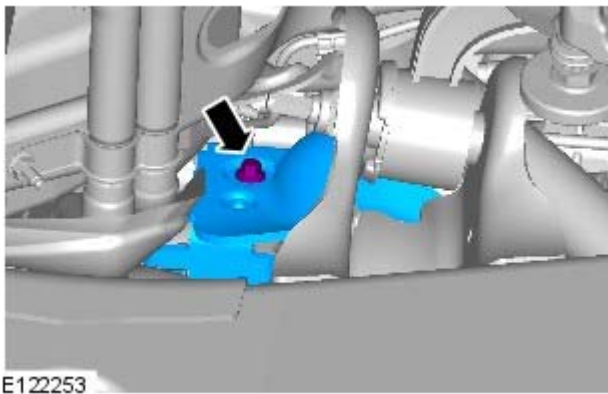


6.

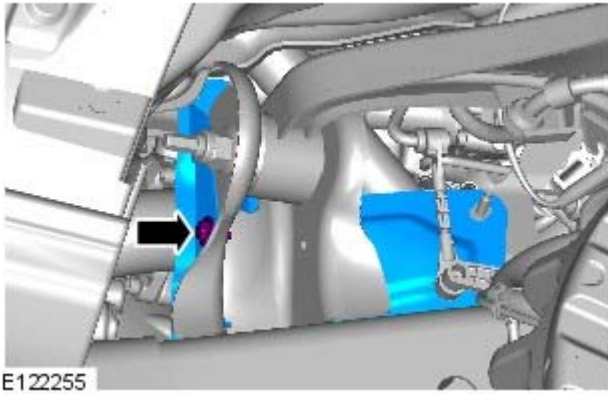


E122299

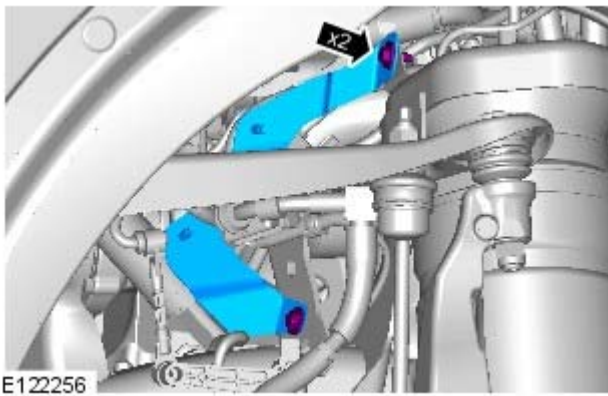
7.



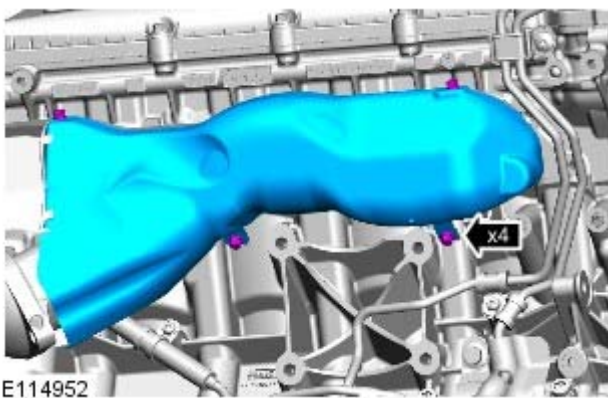
E122253



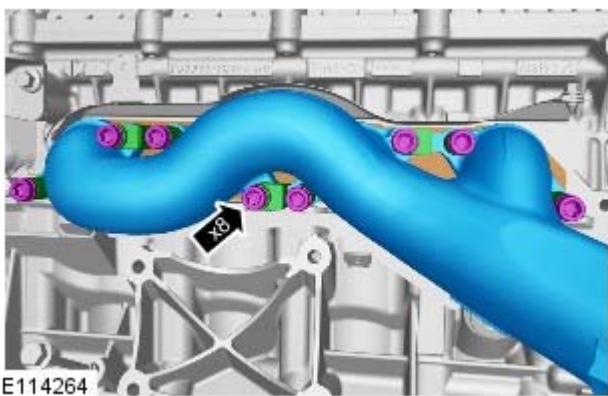
8.



9.



10.



11. **11. CAUTIONS:**



Discard the bolts.

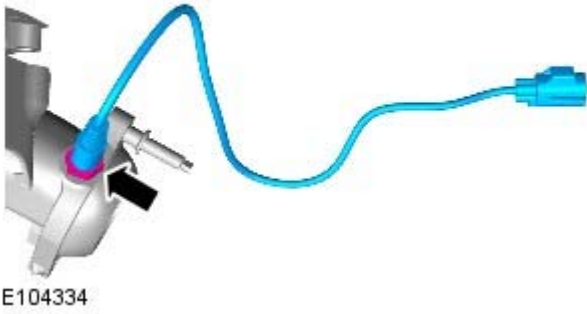


LH illustration shown, RH is similar.

• NOTE: Discard the gasket.

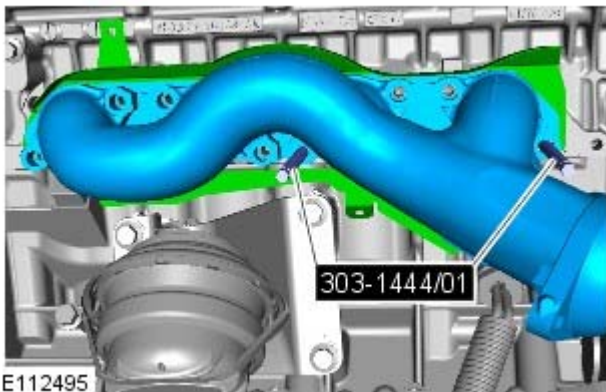
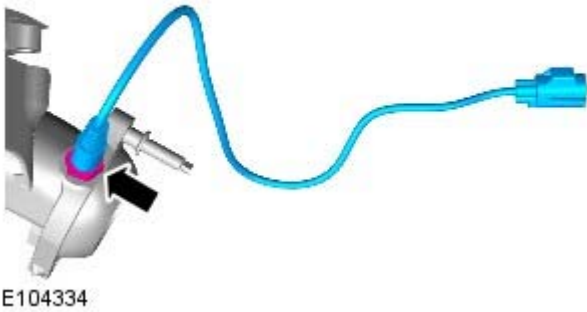
• NOTE: Make sure that the position of the spacers is noted before removal of the manifold.


12. **12.** NOTE: Do not disassemble further if the component is removed for access only.



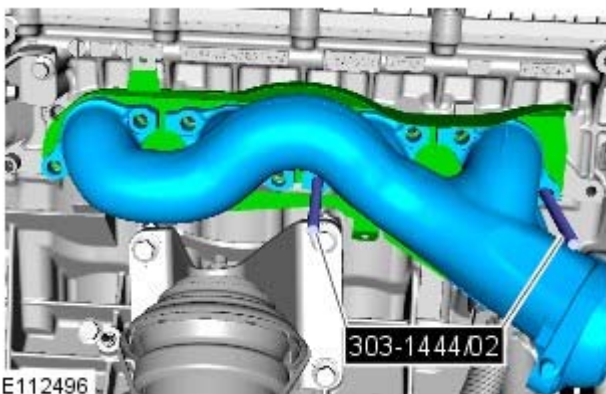
Installation


1. Torque: 45 Nm



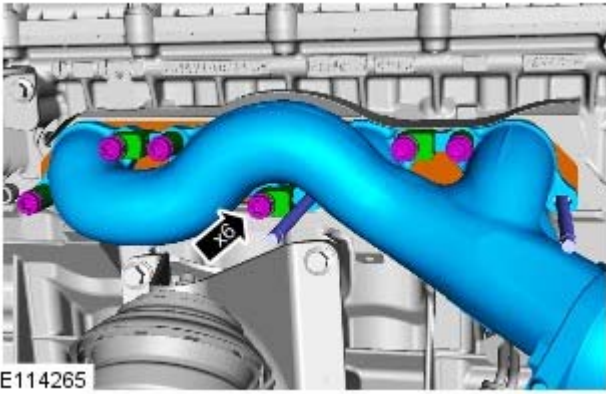
2. **2.**  CAUTION: LH illustration shown, RH is similar.
• NOTE: Install a new gasket.
Install the special tool.

Special Tool(s): [303-1444-01](#)



3. **3.**  CAUTION: LH illustration shown, RH is similar.
• NOTE: If a new cylinder head is installed use the special tools in the illustration.
Install the special tool.

Special Tool(s): [303-1444-02](#)



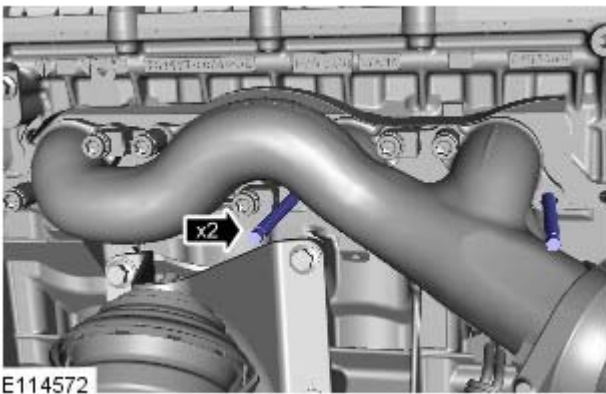
4. 4. CAUTIONS:

Make sure that new bolts are installed.

LH illustration shown, RH is similar.

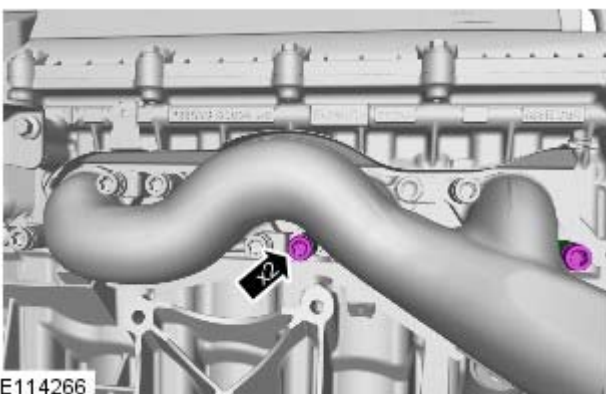
• NOTE: Install the spacers in the noted position.

Torque: 10 Nm



5. 5. CAUTION: LH illustration shown, RH is similar.

Remove the special tool.



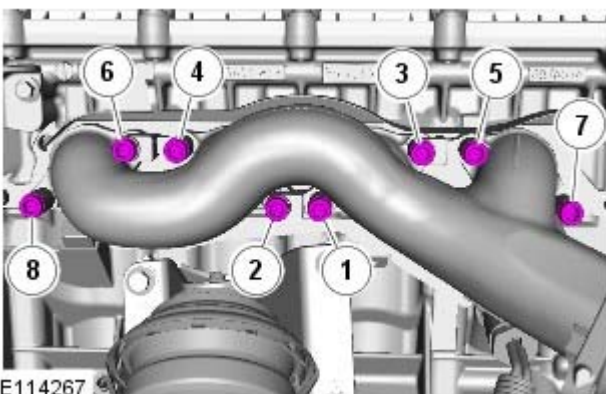
6. 6. CAUTIONS:

Make sure that new bolts are installed.

LH illustration shown, RH is similar.

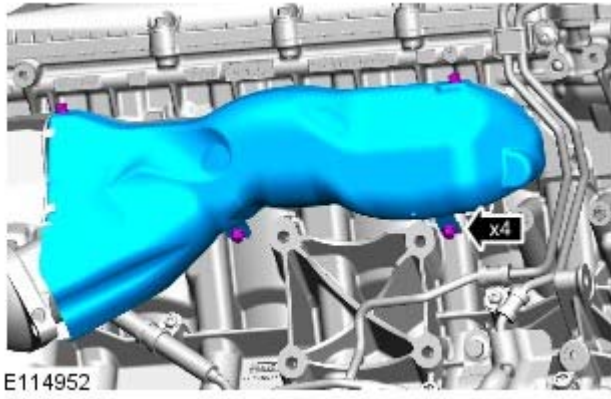
• NOTE: Install the spacers in the noted position.

Torque: 10 Nm

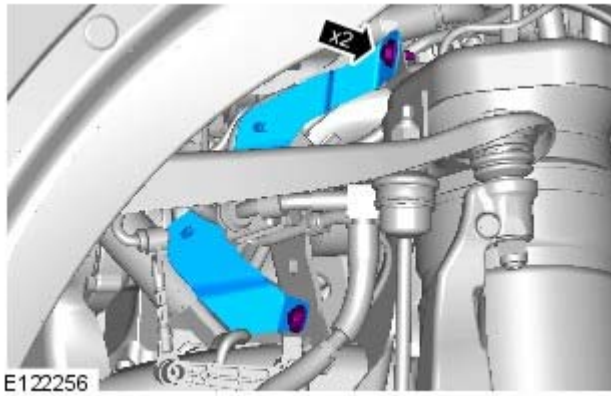


7. 7. CAUTION: LH illustration shown, RH is similar.

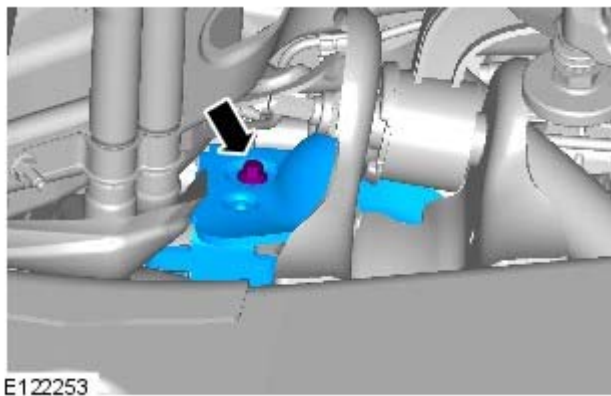
Torque: 18 Nm



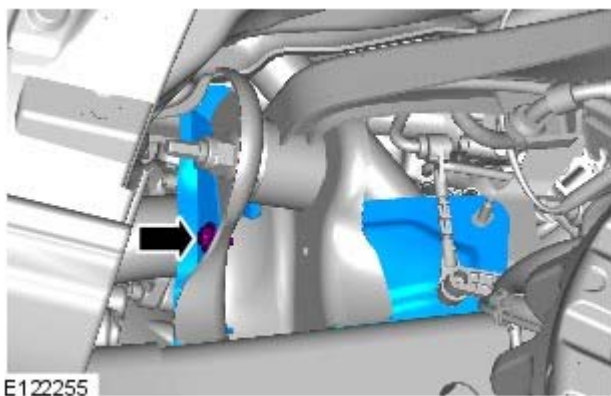
8.



9.

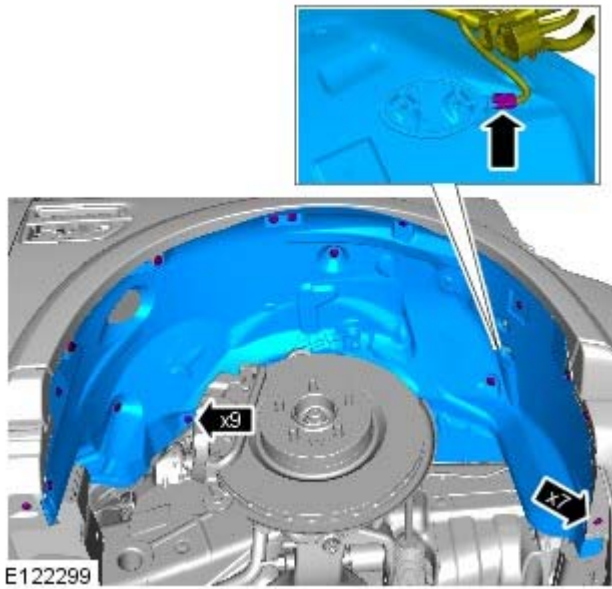


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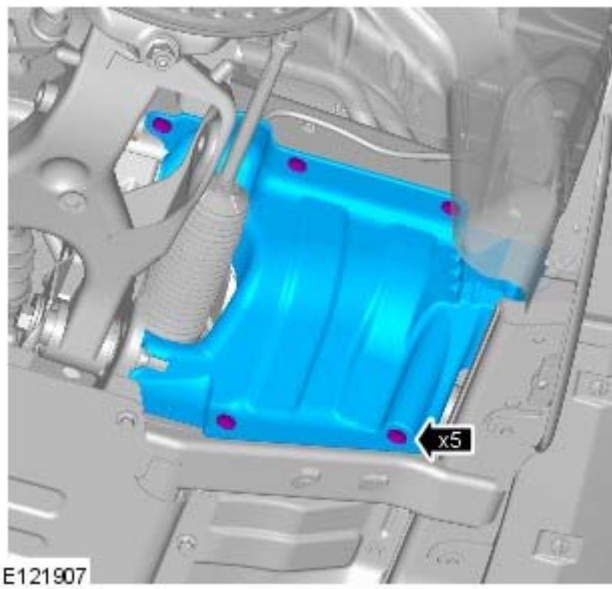


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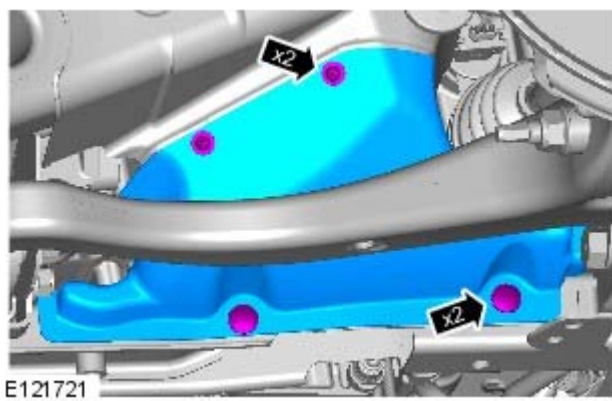
12.



13.



14.



15. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

16. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System -

General Information, Specifications).

Engine - V8 5.0L Petrol - Flexplate

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.


Raise and support the vehicle.

3. Refer to: [Transmission - V8 5.0L Petrol](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal).



4. **4. CAUTIONS:**

 Install all the bolts finger tight before final tightening.

 The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.

 Make sure that no components fall off during removal.

 Install the bolts in the noted position.

- NOTE: Make sure that the crankshaft is not rotated.

- NOTE: Make sure the crankshaft and flexplate mating faces are clean before installation.

- NOTE: Tighten the retaining bolts working diagonally.

Torque:

Stage 1: 45 Nm

Stage 2: 90°

Installation

1. To install, reverse the removal procedure.

Engine - V8 5.0L Petrol - Intake Manifold

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

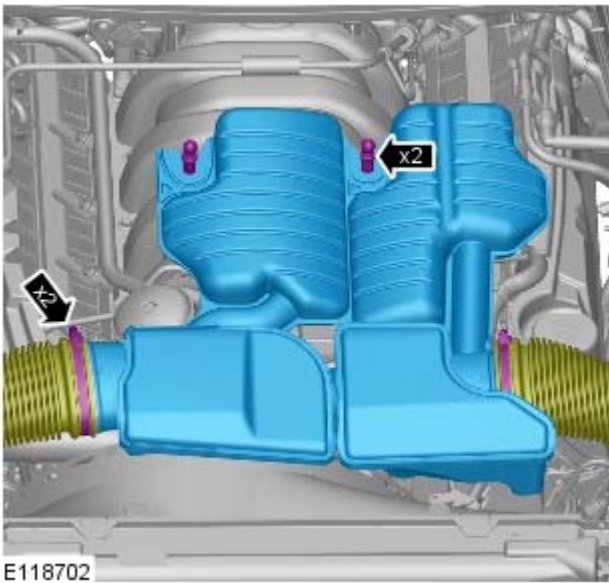
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornementation, Removal and Installation).

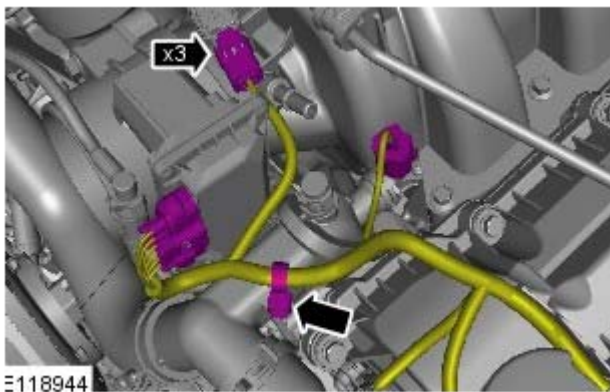
3.  **WARNING:** Make sure to support the vehicle with axle stands.

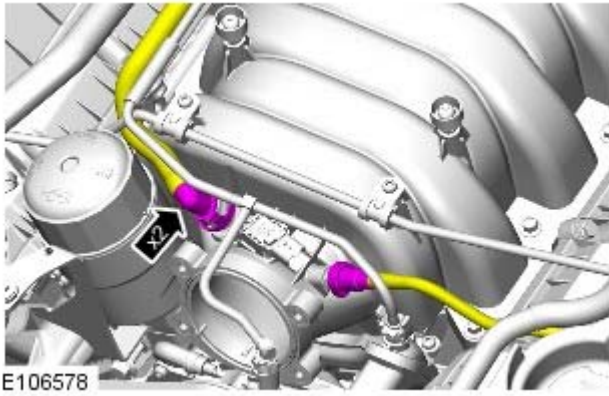
Raise and support the vehicle.

- 4.



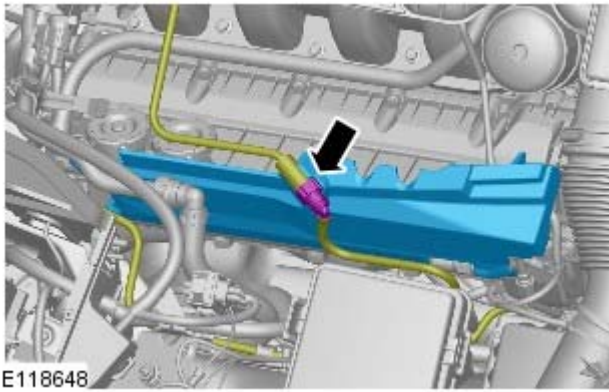
- 5.





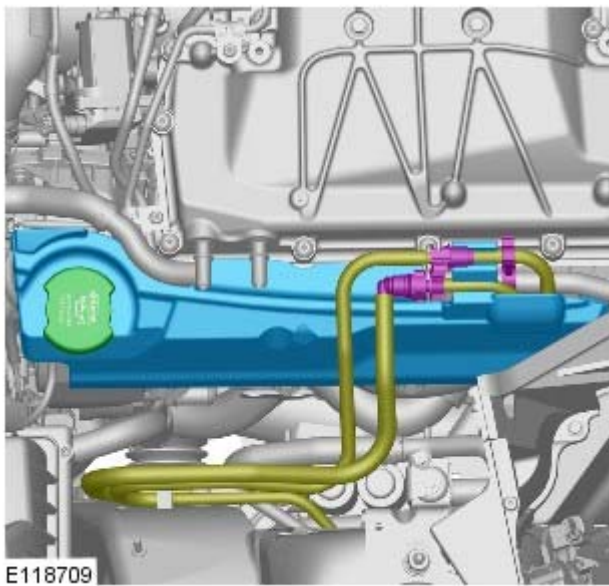
E106578

6.



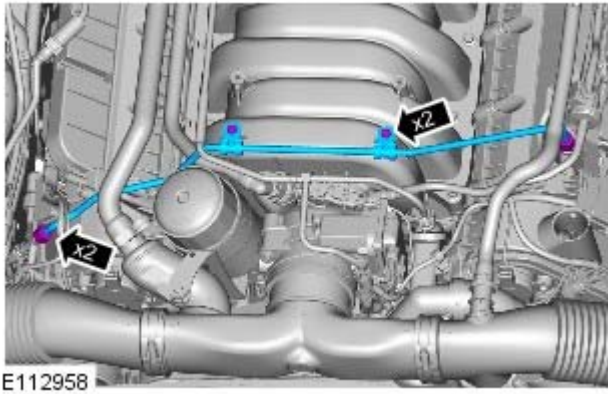
E118648

7.



E118709

8.



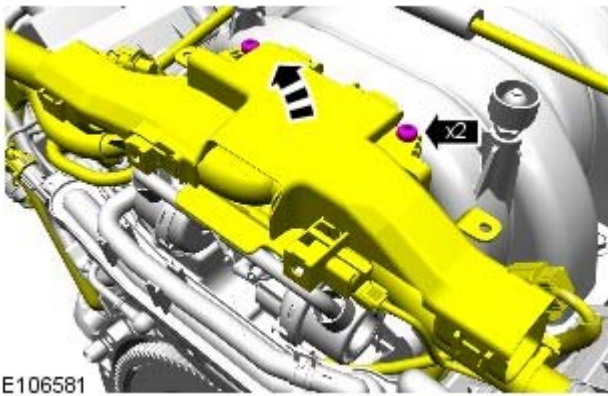
9. 9. CAUTIONS:



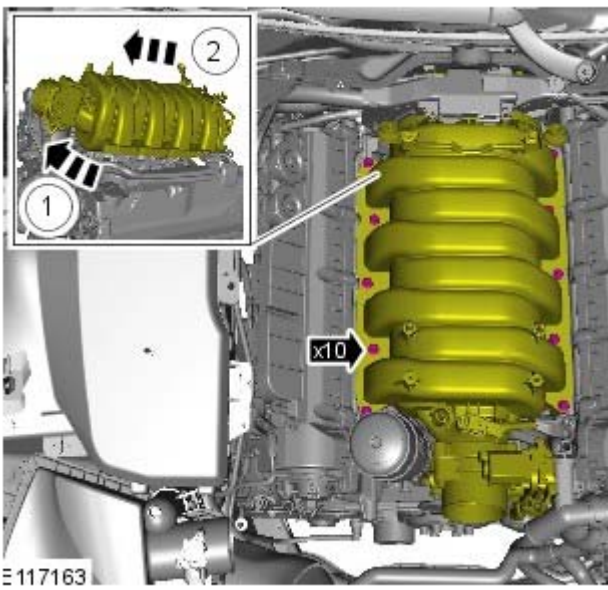
Be prepared to collect escaping fluids.



Make sure that all openings are sealed. Use new blanking caps.

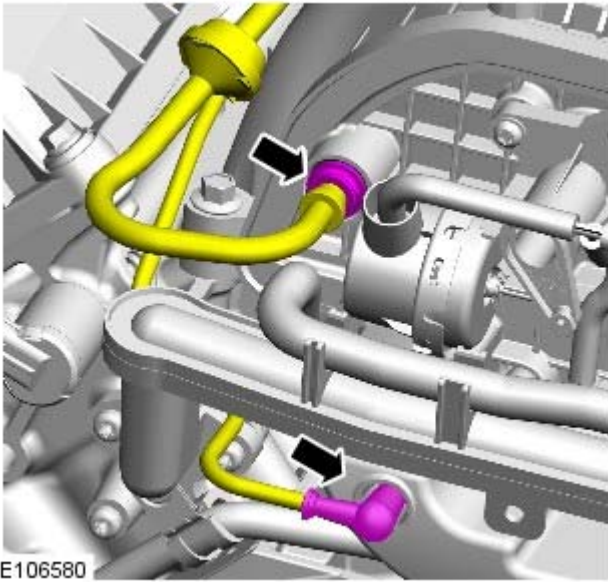


10.



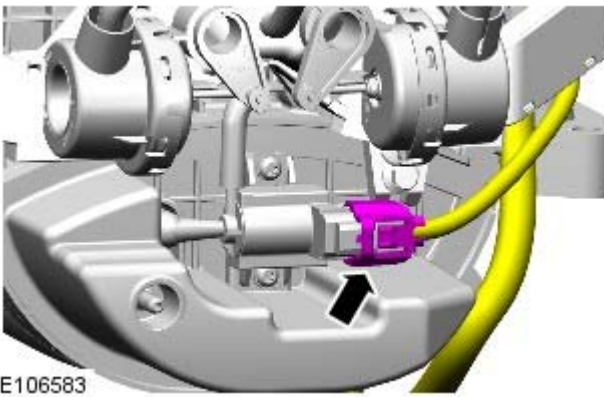
11.

12.



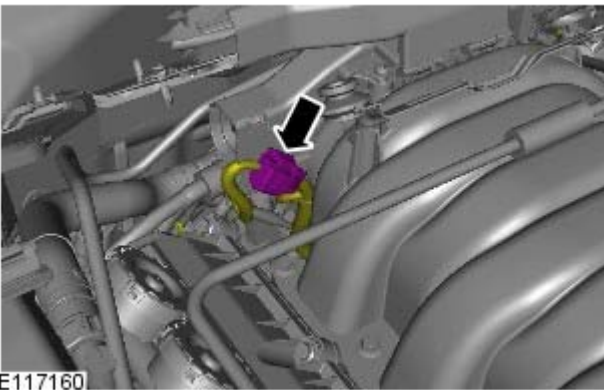
E106580

13.



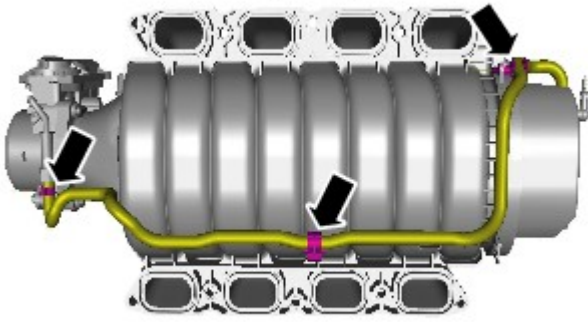
E106583

14.



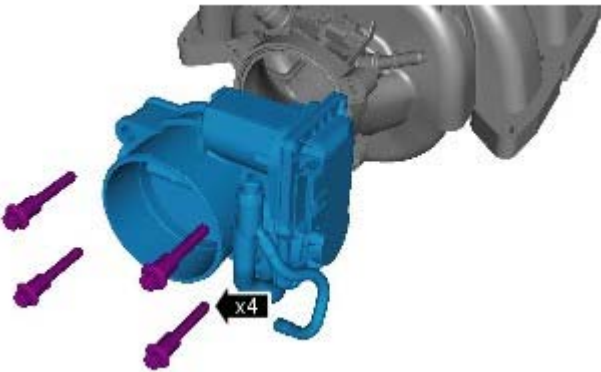
E117160

15.



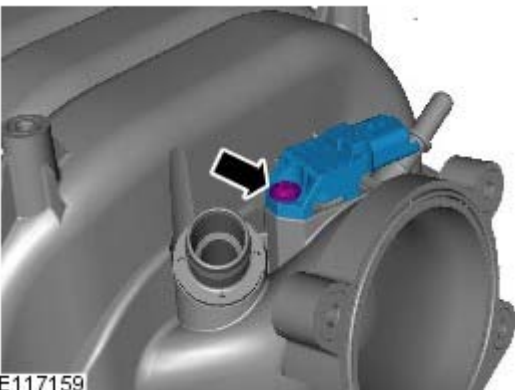
E117161

16. **16.** NOTE: Remove and discard the O-ring seal.



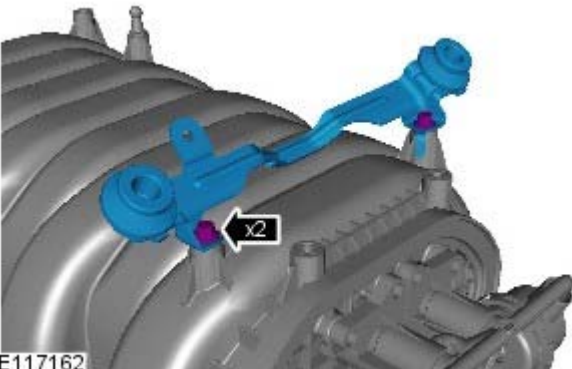
E117158

17.

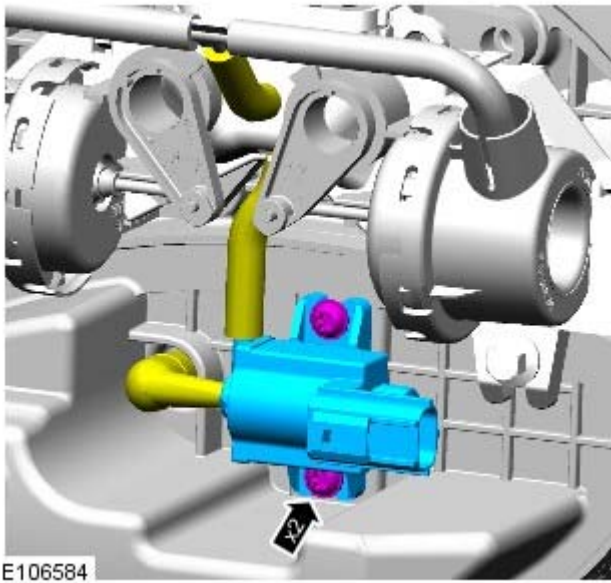


E117159

18.

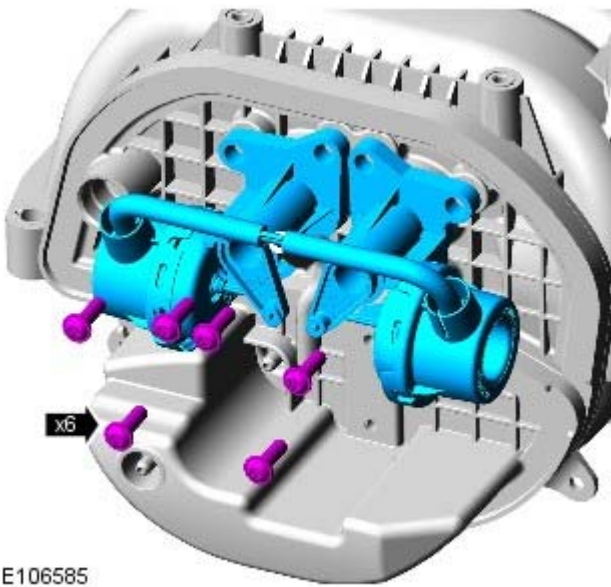


E117162



E106584

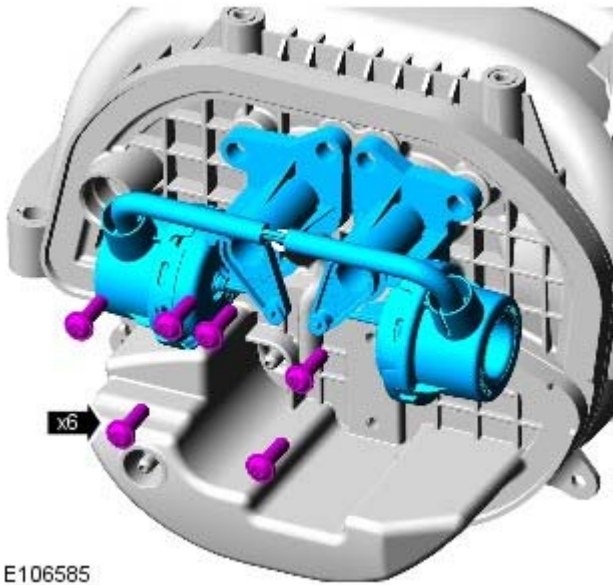
19.



E106585

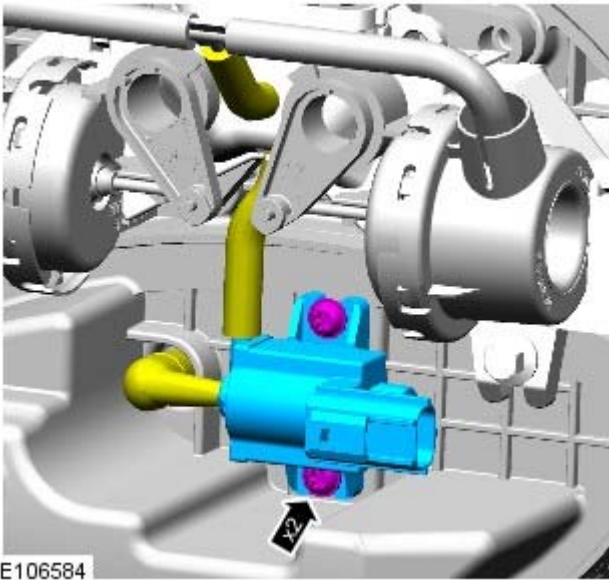
20.

Installation



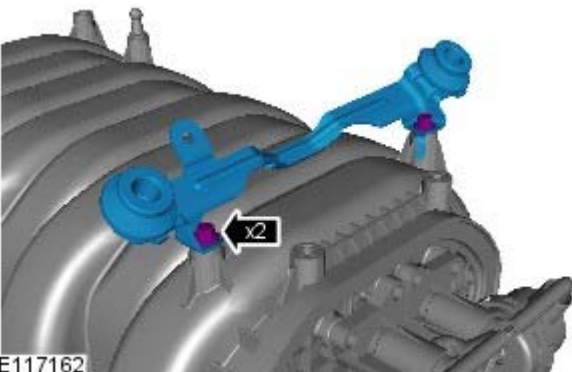
E106585

1. Torque: 5 Nm



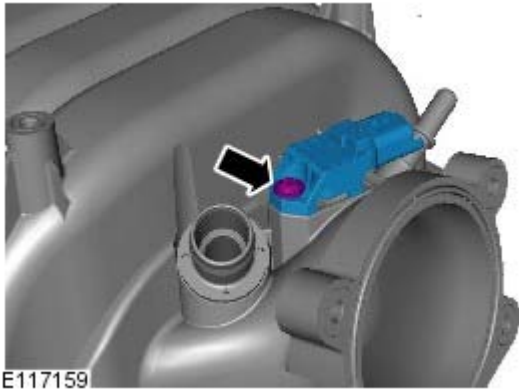
E106584

2. Torque: 10 Nm

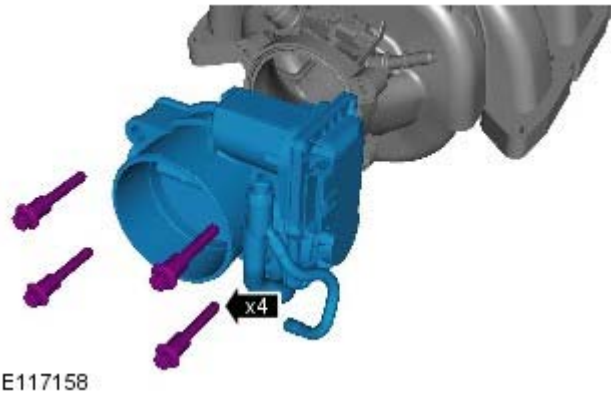


E117162

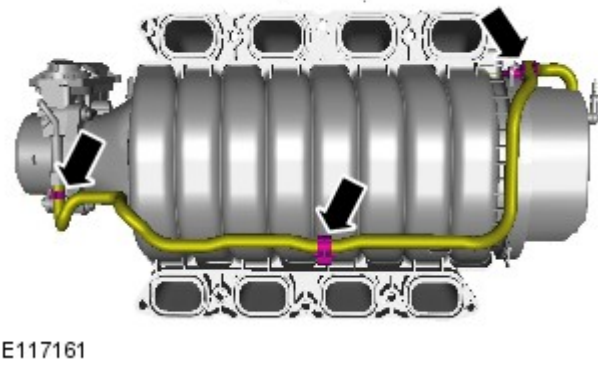
3. Torque: 10 Nm



4. Torque: 5 Nm

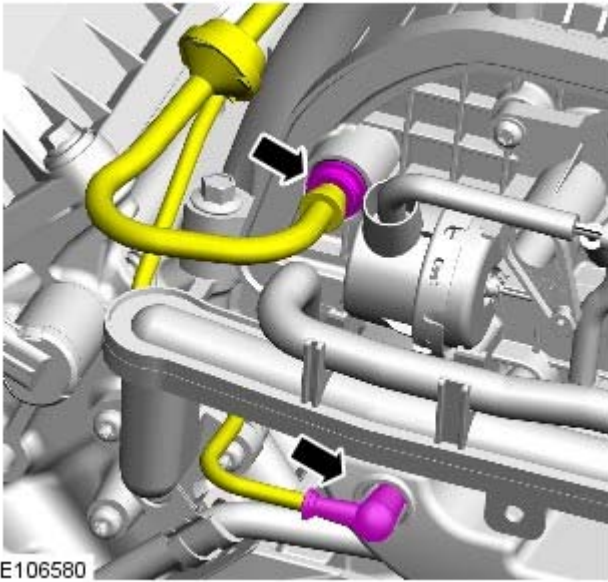


5.  CAUTION: A new O-ring seal is to be installed.
Torque: 18 Nm



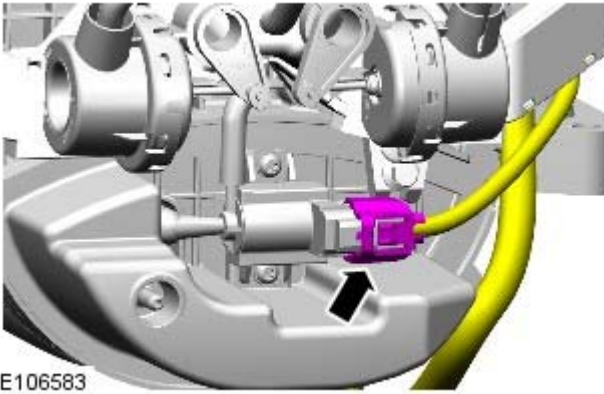
6.

7.



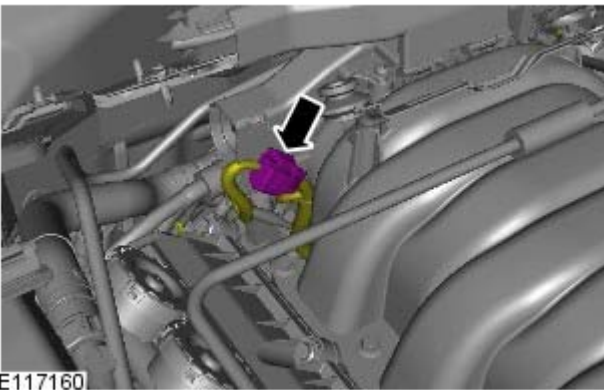
E106580

8.

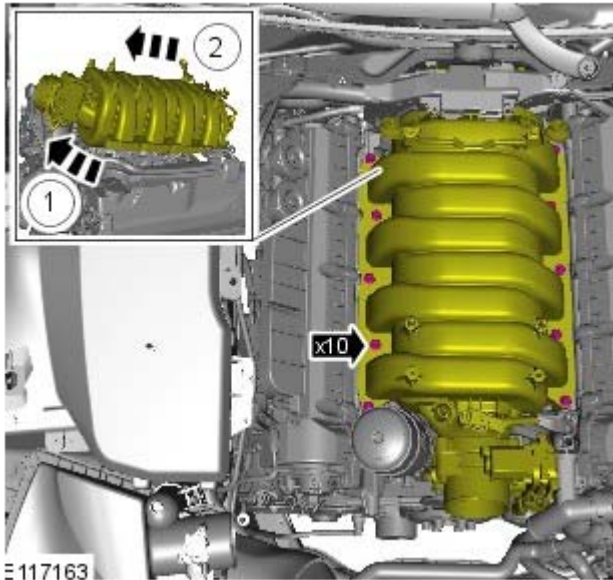


E106583


9.



E117160

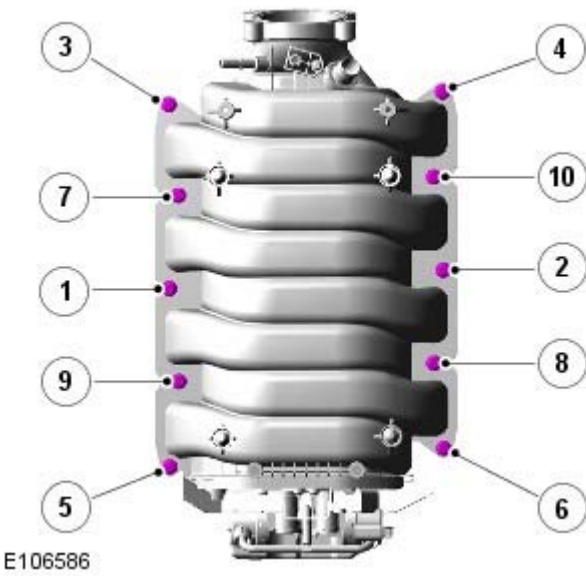


10. **10. CAUTIONS:**

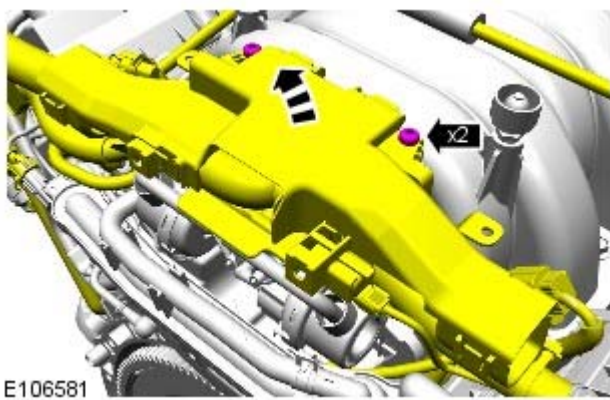
 Make sure that the mating faces are clean and free of corrosion and foreign material.

 Install new o-ring seals

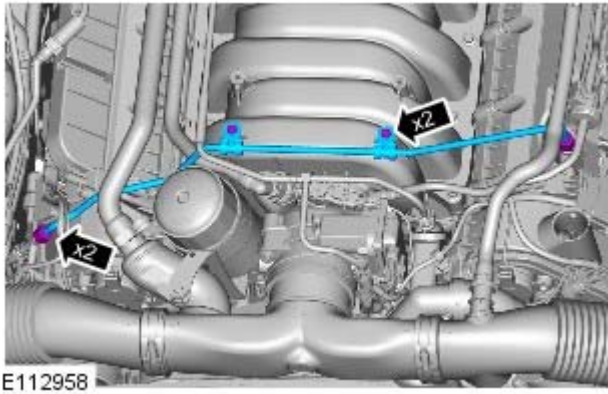
• NOTE: Do not tighten at this stage.



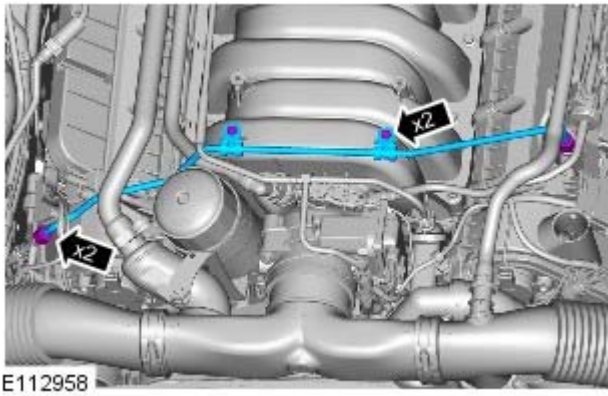
11. *Torque: 25 Nm*



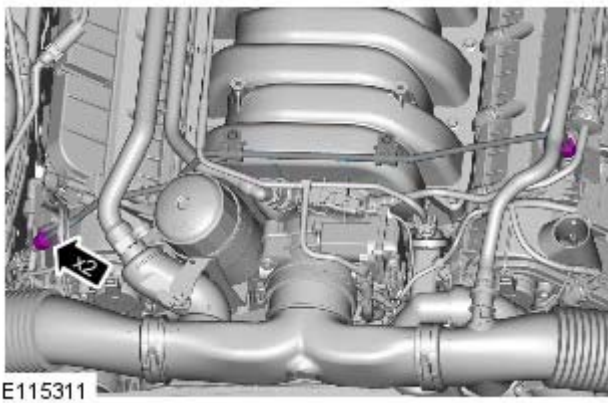
12. *Torque: 8 Nm*



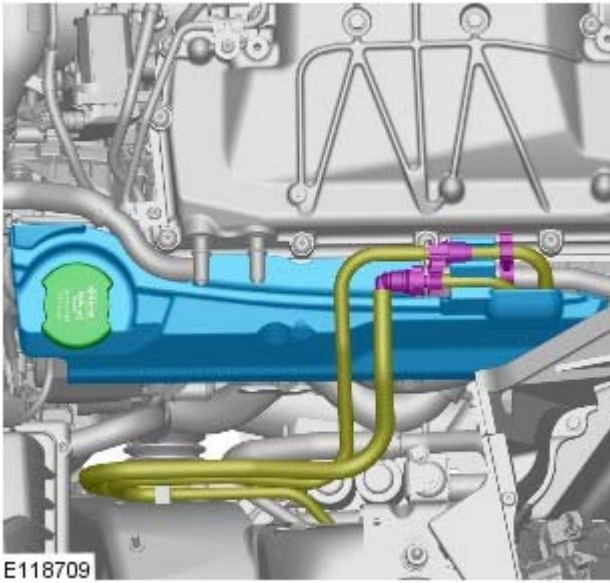
13. **13.** NOTE: Do not tighten at this stage.
- NOTE: Remove and discard the blanking caps.



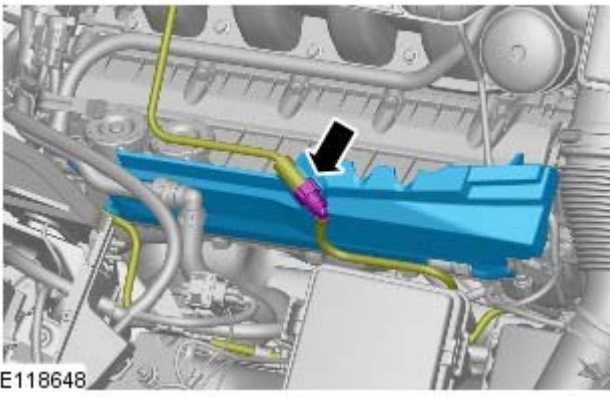
- 14.
- *Torque:*
Unions 21 Nm
Bolts 8 Nm



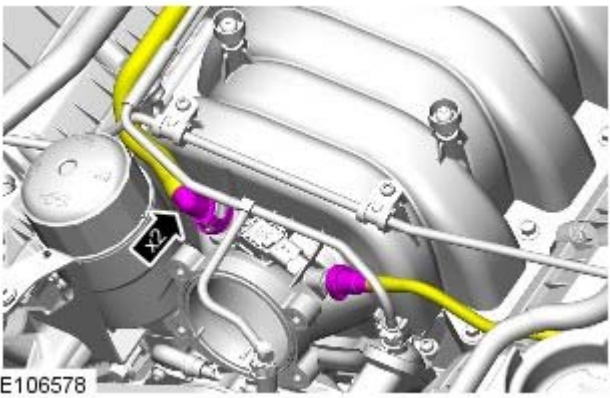
- 15.
- *Torque:* 21 Nm



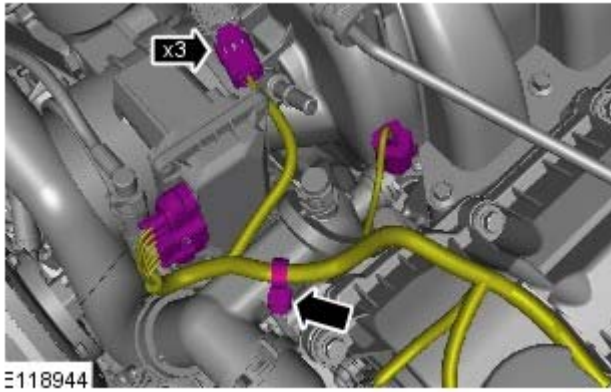
16.



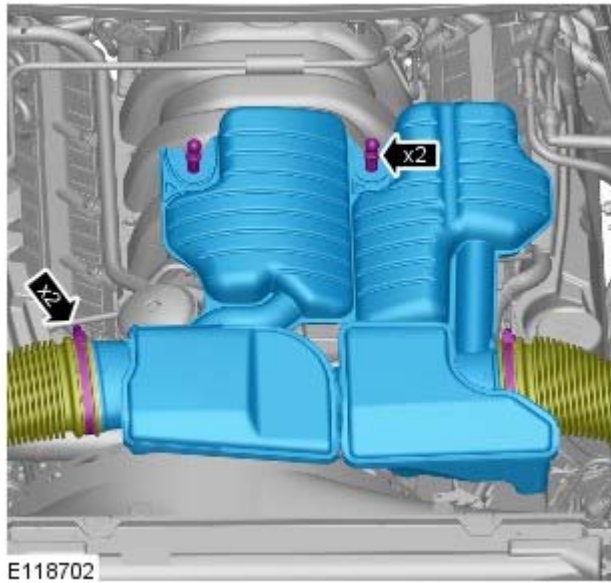
17.



18.



19.



20. Torque: 10 Nm

21. Lower the vehicle.

22. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornementation, Removal and Installation).

23. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Oil Cooler

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

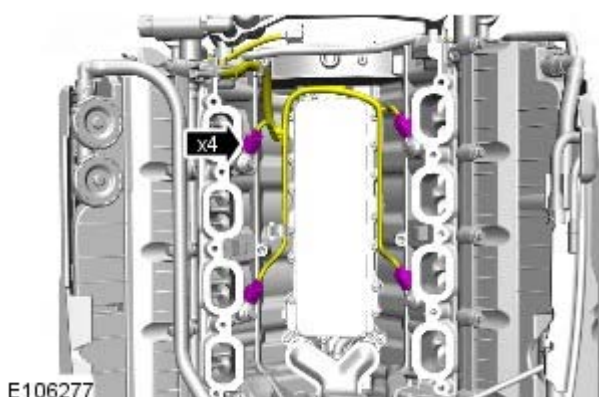
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

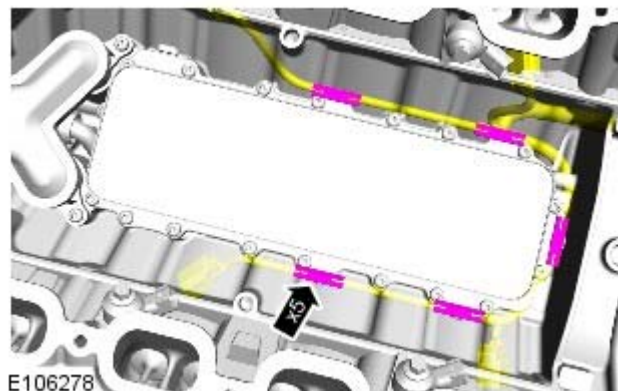
Raise and support the vehicle.

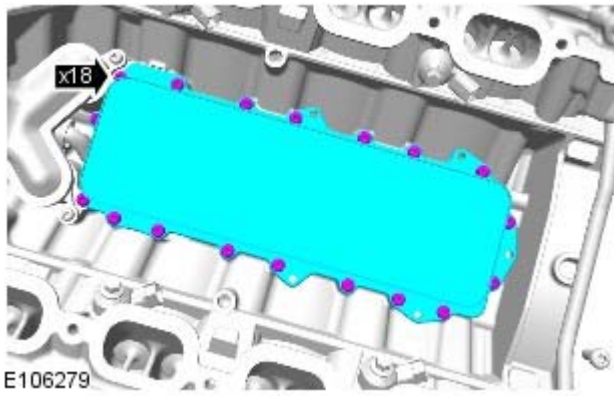
3. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).
4. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
5. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

6.



7.



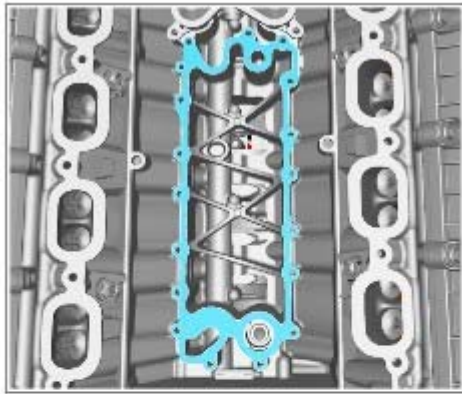



8. **8. CAUTIONS:**

 Be prepared to collect escaping oil.

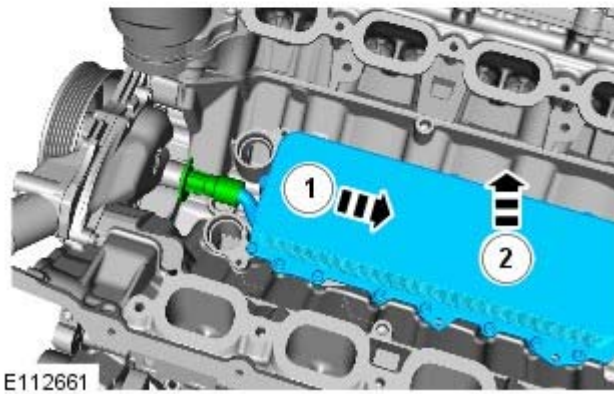
 Be prepared to collect escaping coolant.

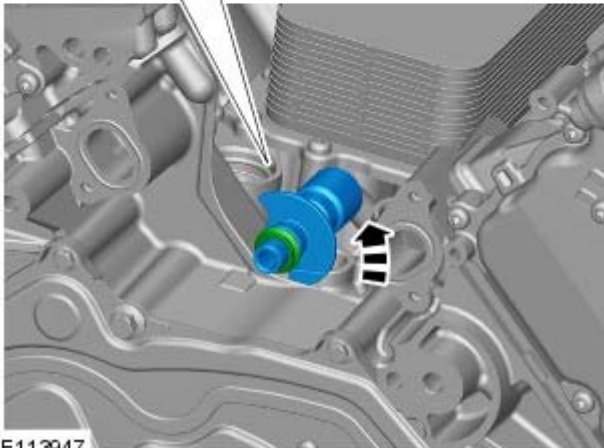
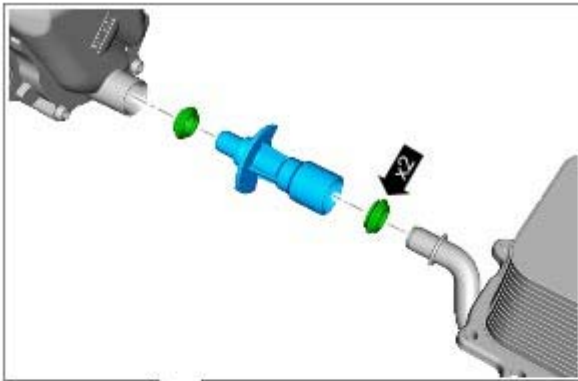
Torque: 13 Nm



9.  **CAUTION:** Make sure that these components are installed to the noted removal position.



- **NOTE:** Install a new gasket.



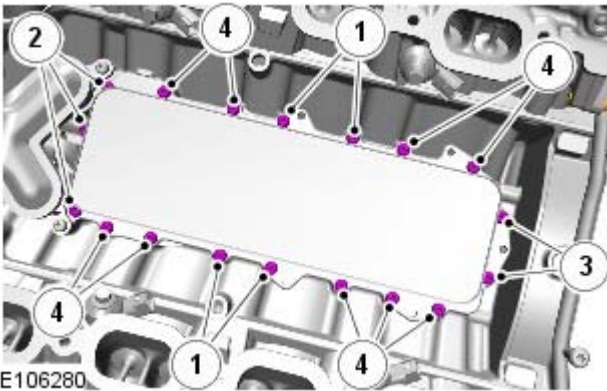


E113947

10. 10. CAUTIONS:




-  Make sure that these components are installed to the noted removal position.
-  Install new o-ring seals

Installation



E106280

1. 1. CAUTIONS:

-  Install all the bolts finger tight before final tightening.
-  Make sure that the area around the component is clean and free of foreign material.
-  Install the new seals.

• NOTE: Tighten the bolts in the indicated sequence.

To install, reverse the removal procedure.

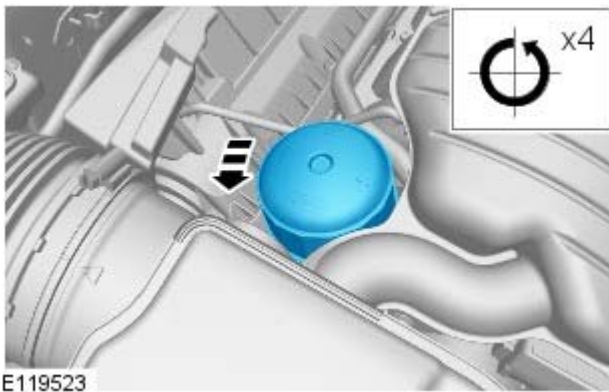
Engine - V8 5.0L Petrol - Oil Filter Element

Removal and Installation

Removal

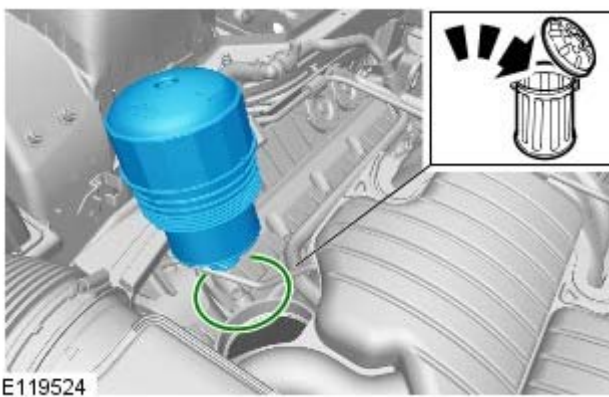
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

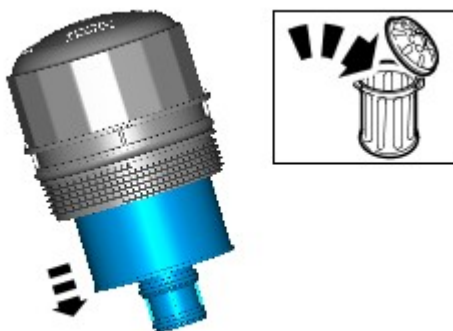


2.

- Allow the engine oil to drain from the oil filter element housing for two minutes.

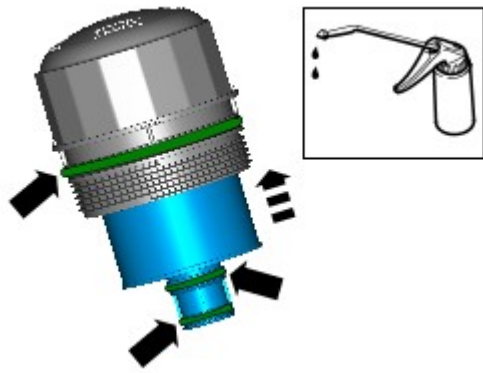


3.



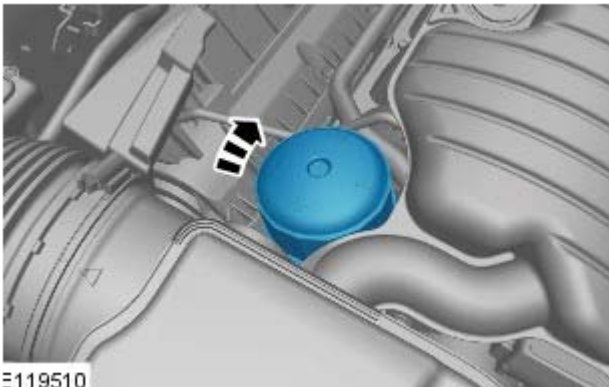
4.

Installation



E107727

1.



E119510






2. *Torque: 25 Nm*

3. Check and top-up the engine oil.
4. Start and run the engine.
5. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

Engine - V8 5.0L Petrol - Oil Pan Extension

Removal and Installation

Special Tool(s)

 <p>E107676</p>	<p>303-1433 Lower Timing Cover Alignment tool</p>
 <p>E107678</p>	<p>303-1442 Rear Crankshaft Seal Installer</p>
 <p>E107679</p>	<p>303-1443 Rear Crankshaft Cover Alignment Tool</p>
 <p>E115266</p>	<p>303-1448 Locking Tool</p>
 <p>E119168</p>	<p>303-1500 Installer, Stretchy Belt</p>

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

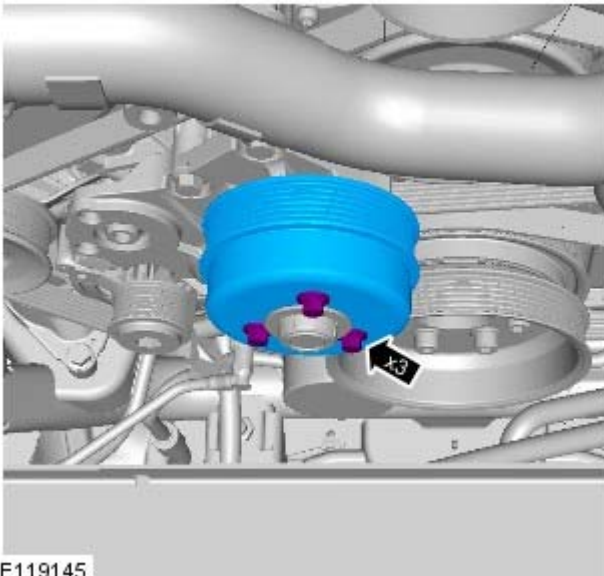
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

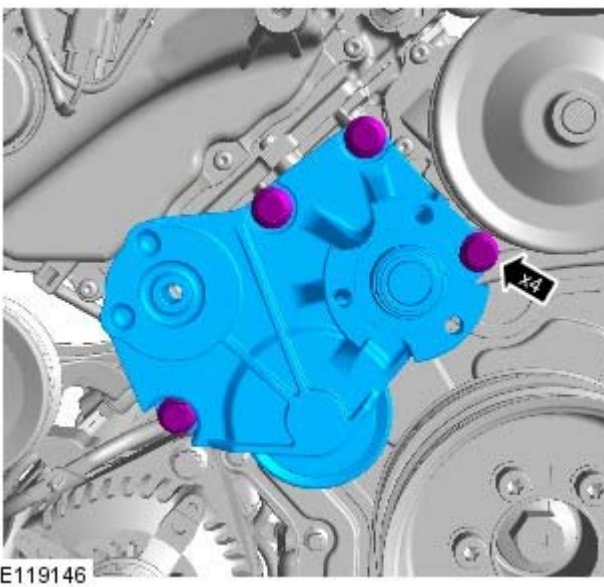
3. Refer to: [Crankshaft Pulley](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

4. Refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Removal).

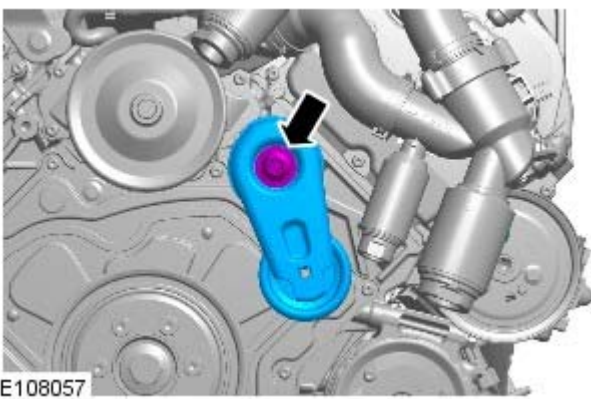
5.

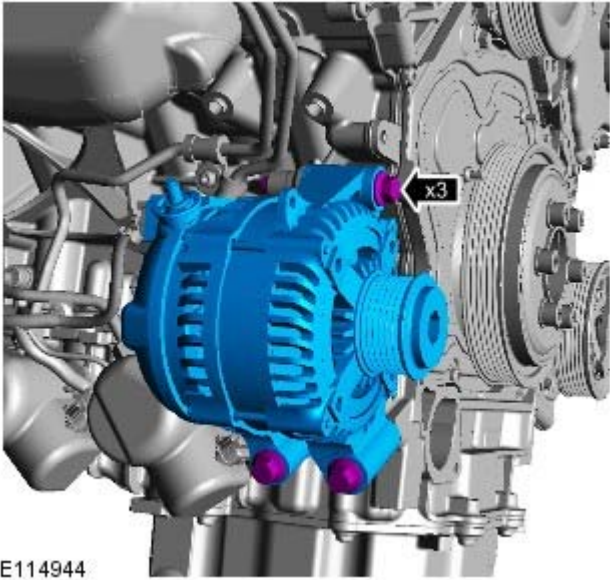


6.



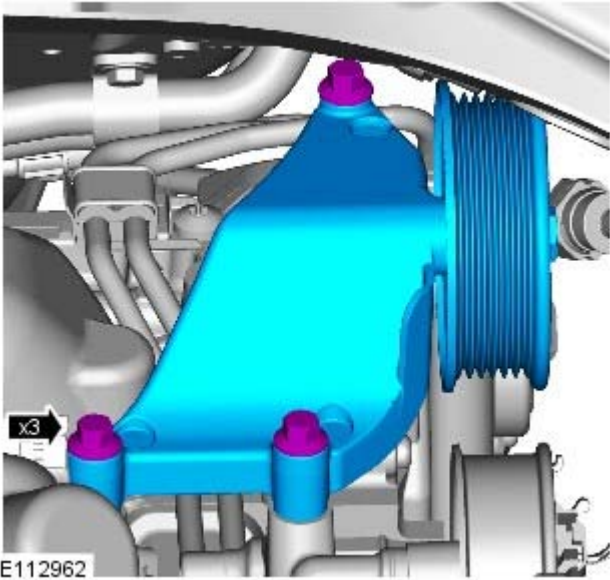
7.





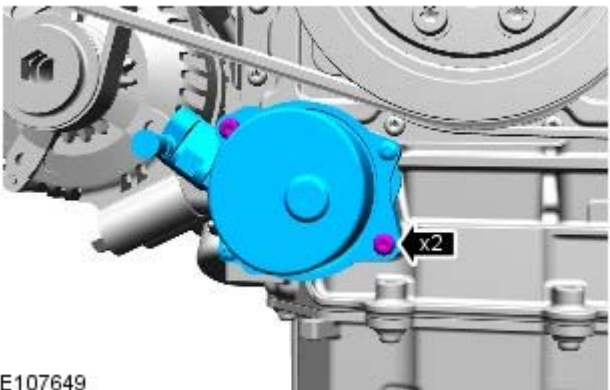
E114944

8.



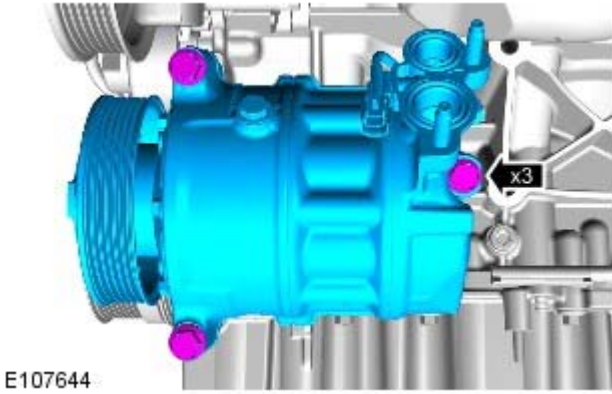
E112962

9.

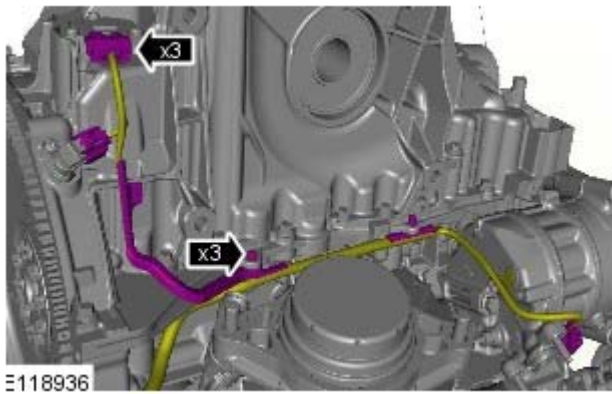


E107649

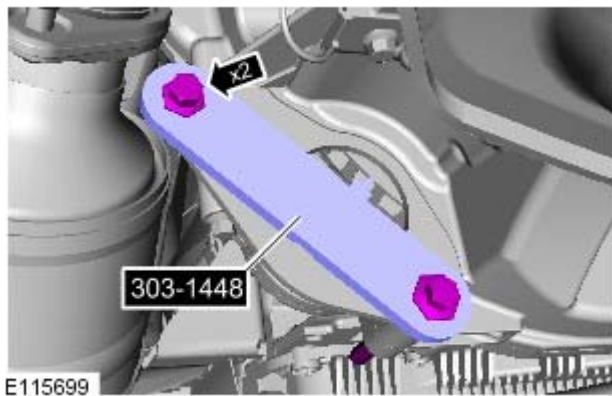
10.



11.



12.




13.

- Install the special tool.
- *Special Tool(s):* [303-1448](#)

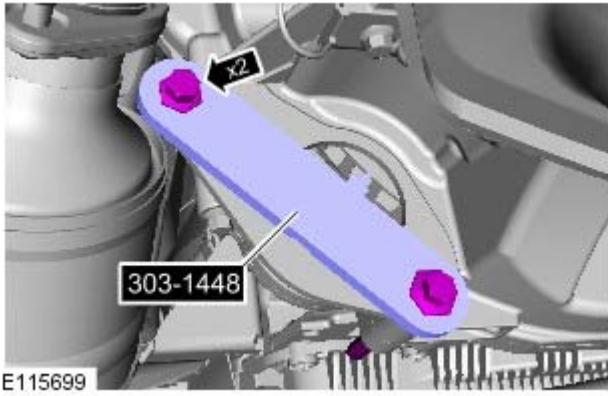


14. **14. CAUTIONS:**

 The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.

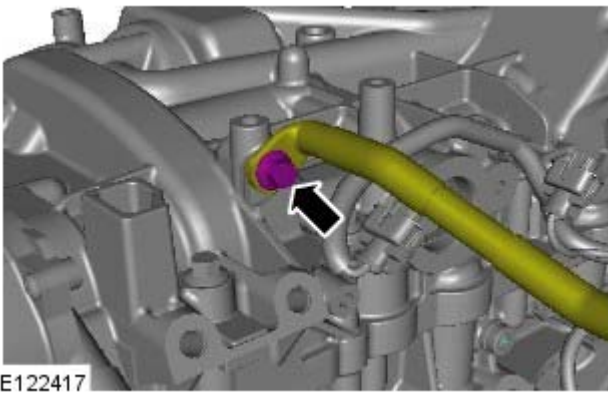
 Make sure that no components fall off during removal.

- NOTE: Make sure that the crankshaft is not rotated.
- NOTE: Make sure the crankshaft and flexplate mating faces are clean before installation.

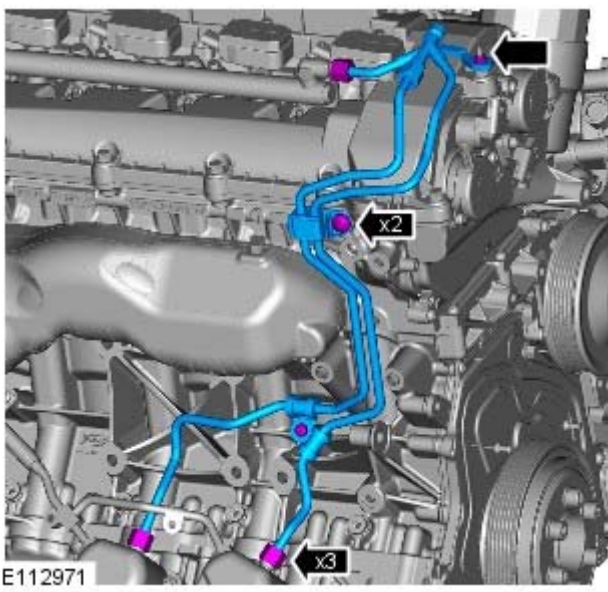


15.

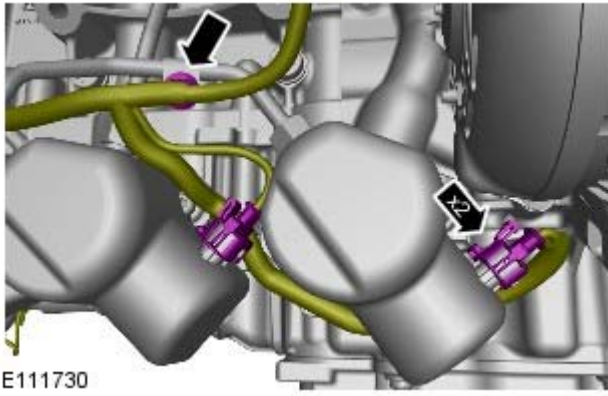
- Remove the special tool.
- *Special Tool(s):* [303-1448](#)



16.

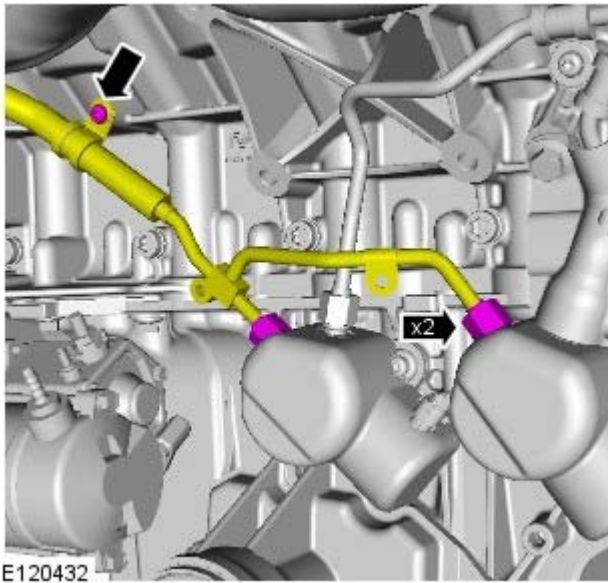


17.



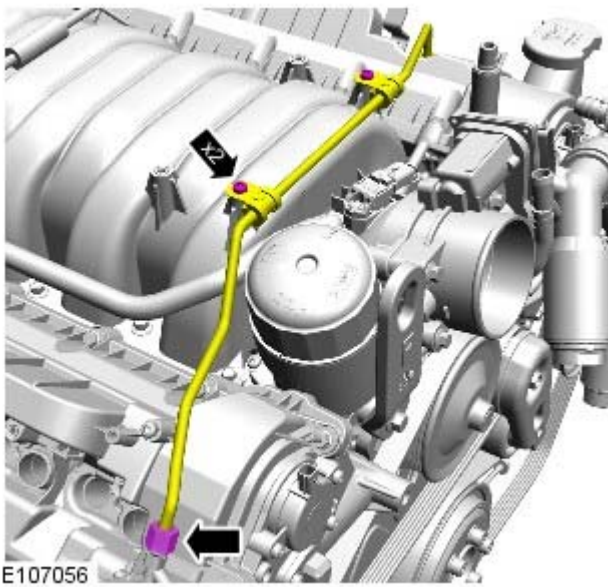
E111730

18.



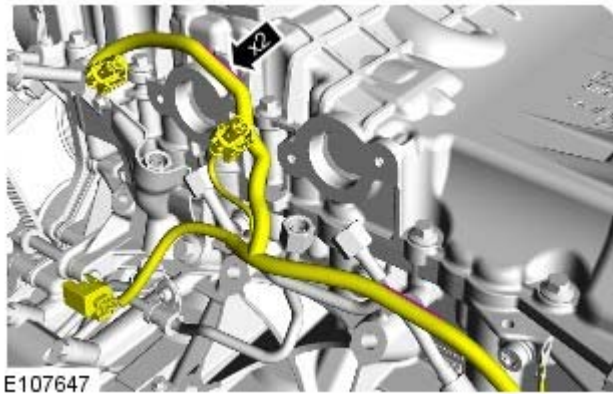
E120432

19.

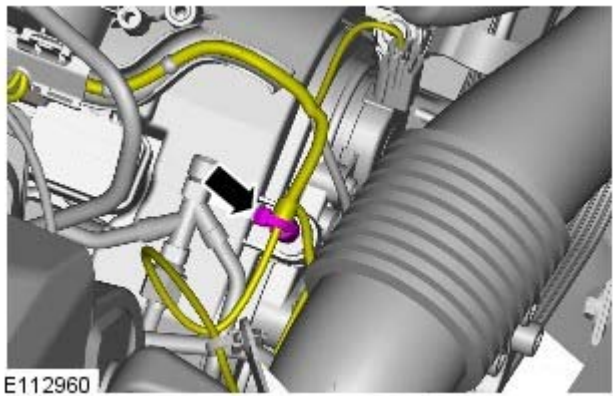


E107056

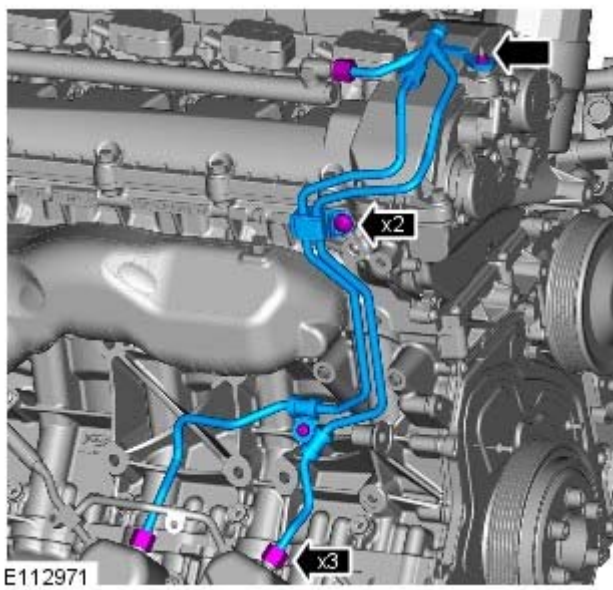
20.



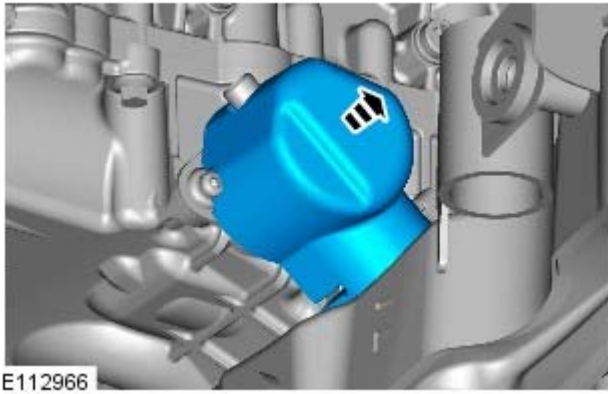
21. **21.** NOTE: The high-pressure fuel pumps are removed from the illustration for clarity.



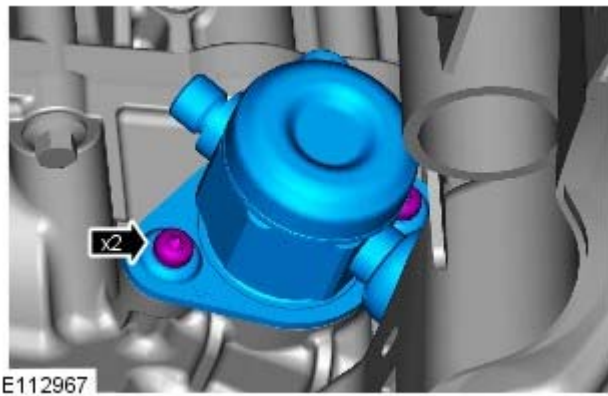
22.



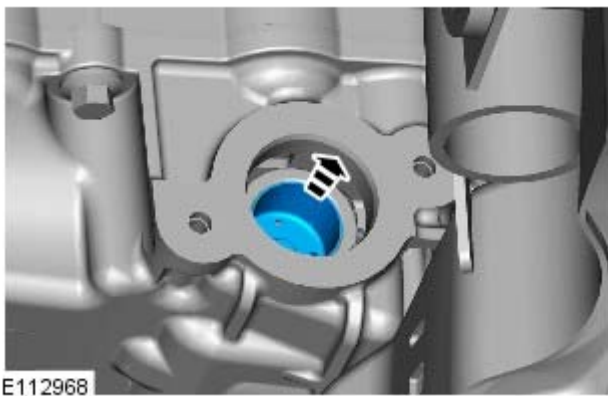
23.




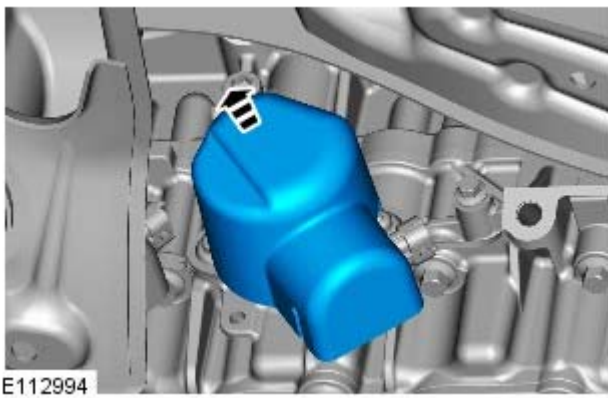
24.



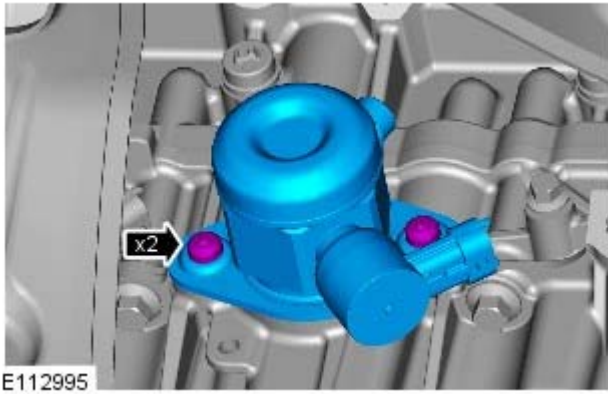
25. **25.**  CAUTION: Be prepared to collect escaping fluids.



26. **26.**  CAUTION: Be prepared to collect escaping fluids.




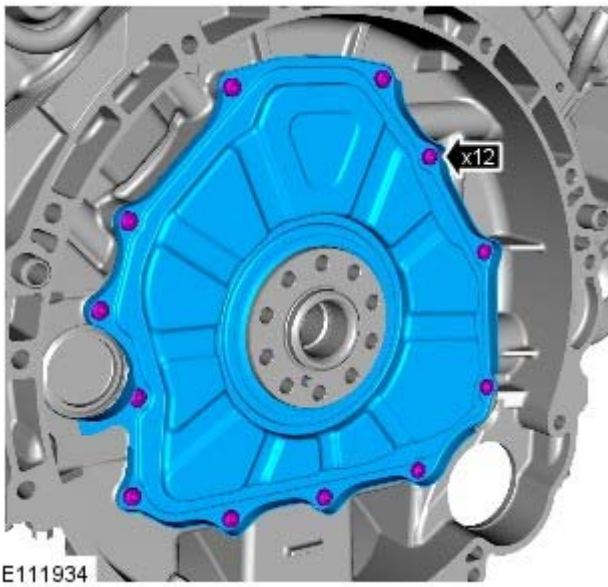
27.



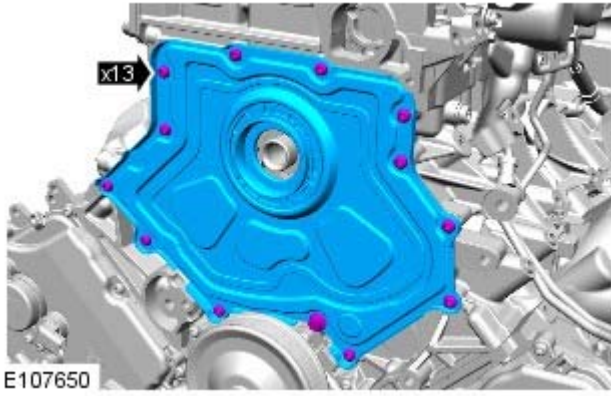
28. **28.**  CAUTION: Be prepared to collect escaping fluids.



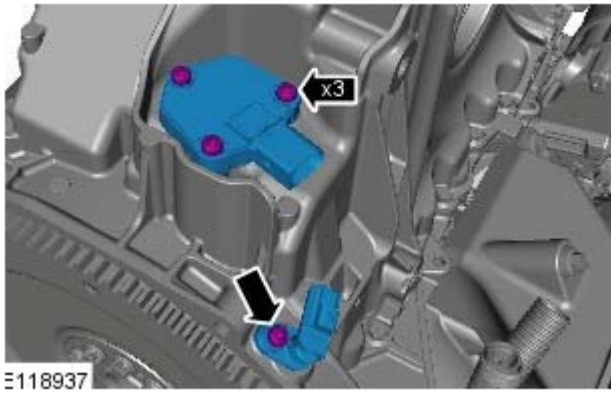
29. **29.**  CAUTION: Be prepared to collect escaping fluids.



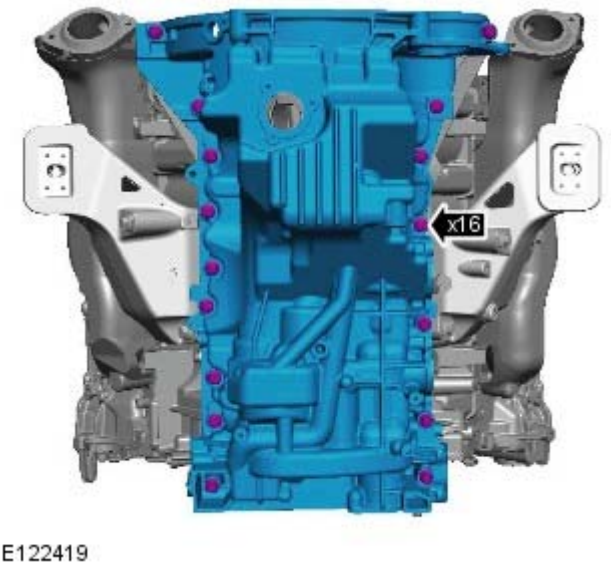
30.



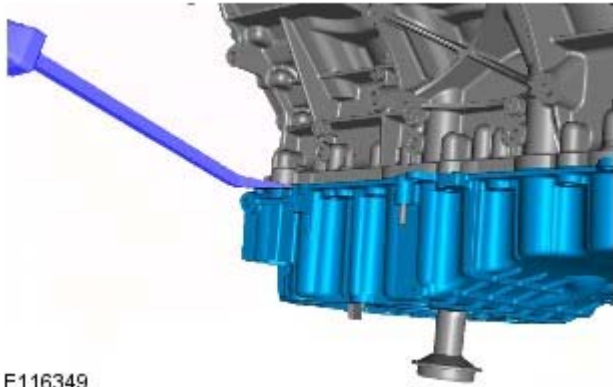
31. 31. NOTE: Discard the component.



32.

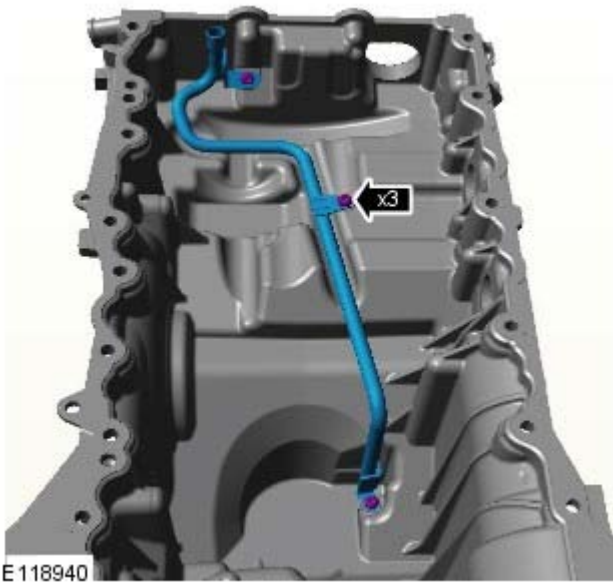


33.



E116349

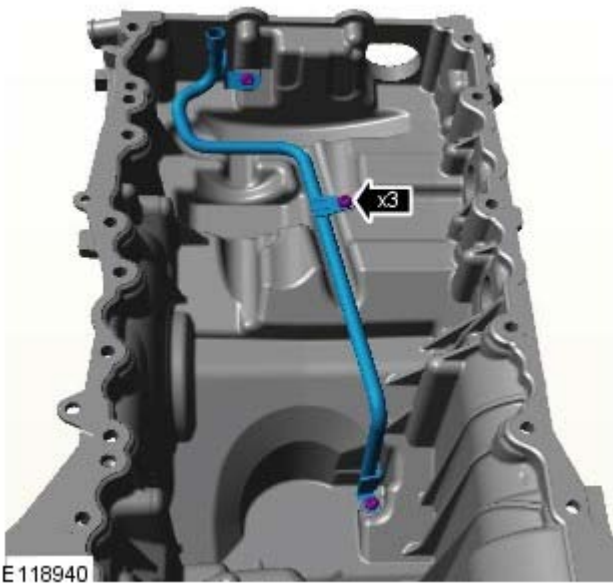
34. **34.** NOTE: Make sure to use the aluminium lug provided on the oil pan extension to lever against.



E118940

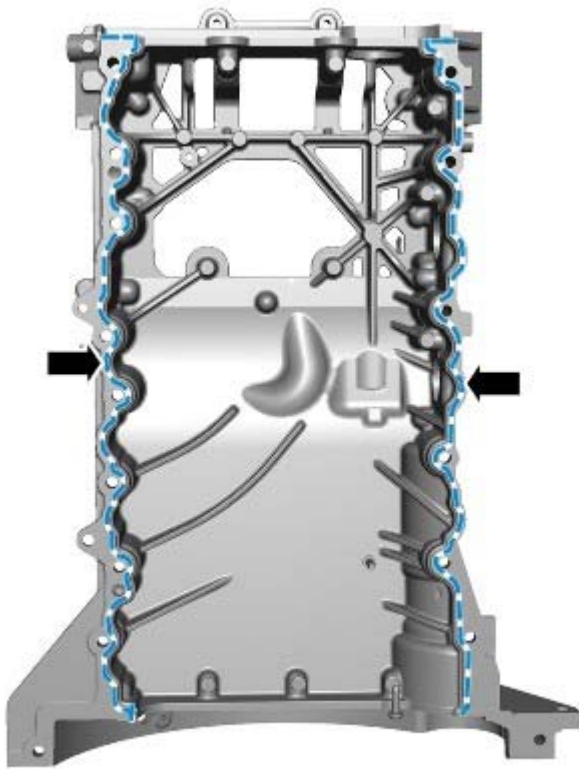
35. **35.** NOTE: Do not disassemble further if the component is removed for access only.

Installation




E118940

1. *Torque:* 10 Nm



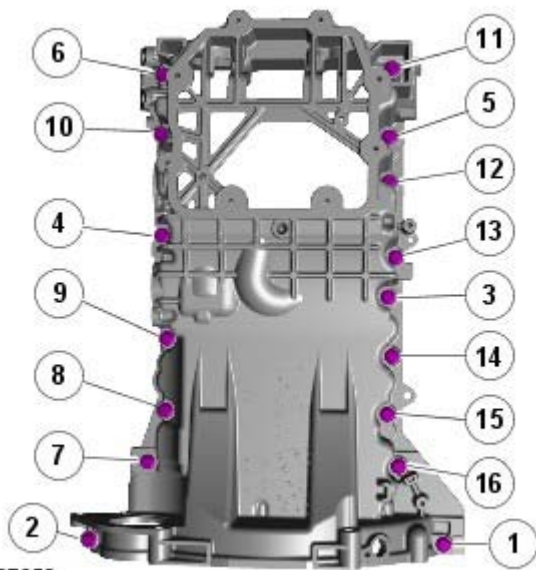
E107654

2. **2. CAUTIONS:**

 Make sure that the mating faces are clean and free of foreign material.

 Use only a plastic scraper when removing the sealing material.

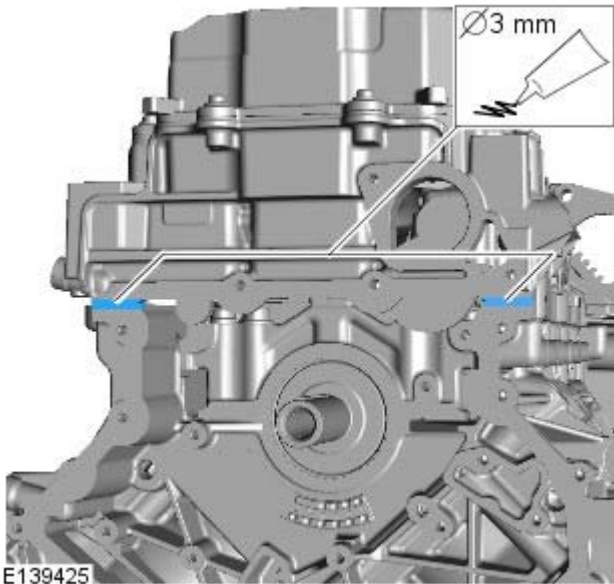
- Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.




E107653

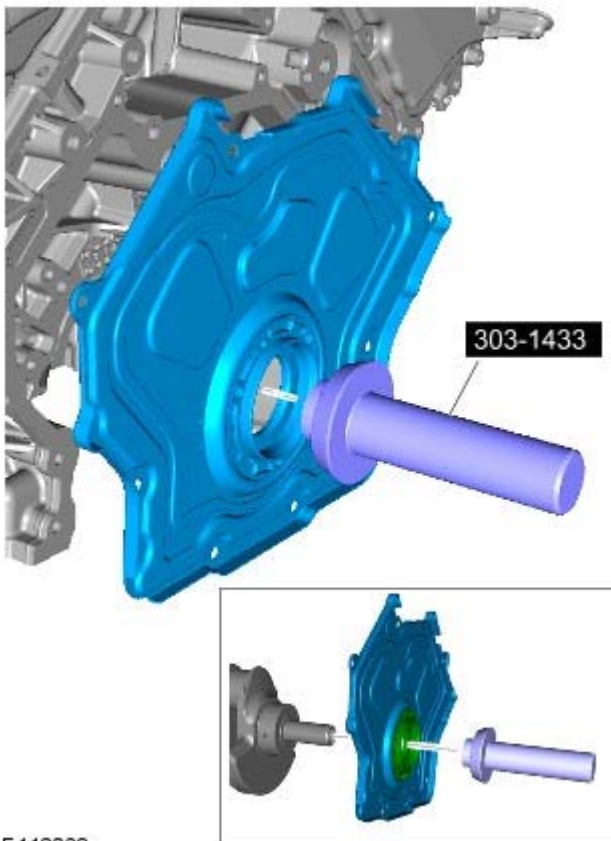
3. **3. NOTE:** Tighten the bolts in the indicated sequence.


Torque: 25 Nm



4.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



5.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

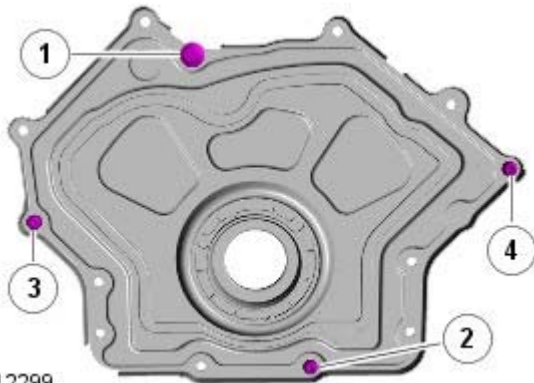
- **NOTE:** Install new lower timing cover.

Install the bolts, but do not tighten fully at this stage.

Special Tool(s): [303-1433](#)

6. **6.** NOTE: Tighten the bolts in the indicated sequence.

- *Torque:*
M8 20 Nm
M6 12 Nm



E112299

7. Remove the special tools.

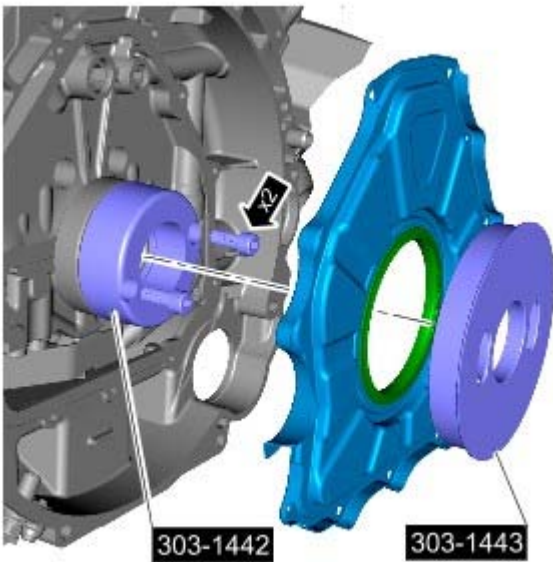


E112300

8. *Torque:* 12 Nm

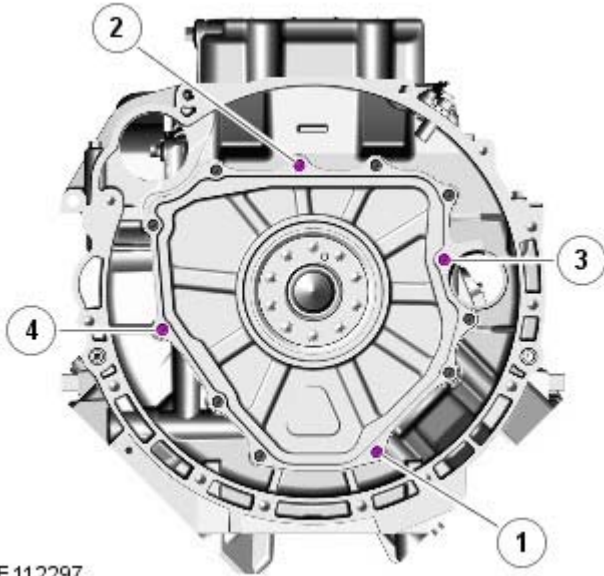
9.

- *Special Tool(s):* [303-1442](#)
- *Special Tool(s):* [303-1443](#)



E111935

10. Remove the special tool.



E 112297

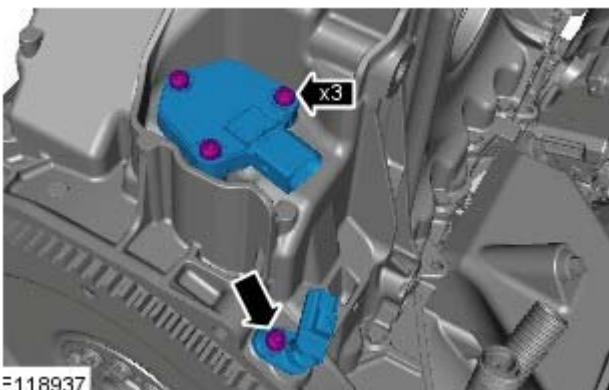
11. **11.** NOTE: Tighten the bolts in the indicated sequence.

Torque: 11 Nm



E 112306

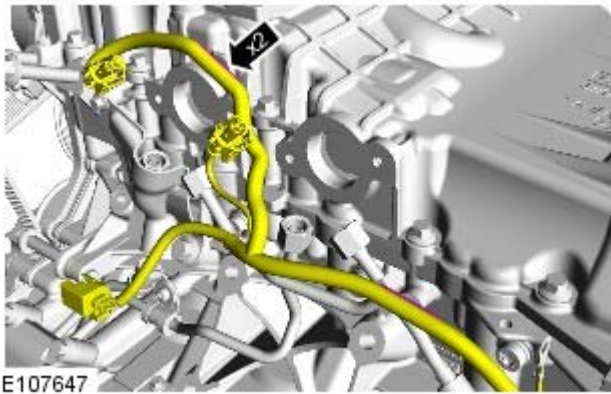
12. Torque: 11 Nm



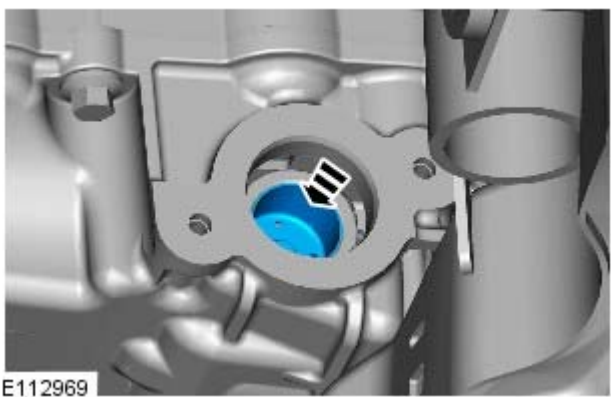
E 118937

13.

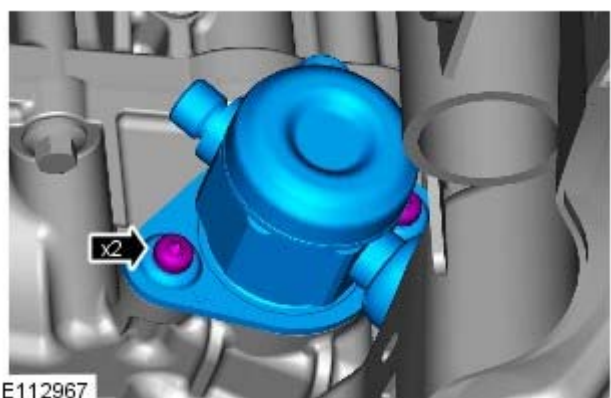
• Torque: 11 Nm




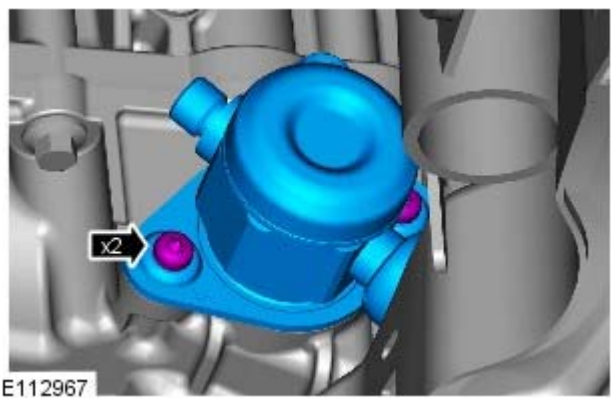
14. **14.** NOTE: The high-pressure fuel pumps are removed from the illustration for clarity.



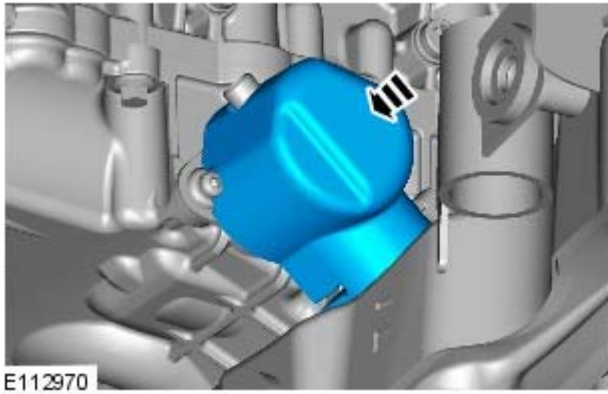
15. **15.** NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



16. **16.**  CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.
- NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.
 - Torque: 11 Nm



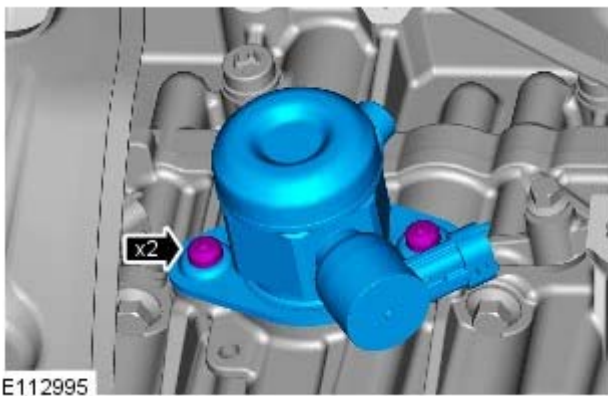
17. Loosen the Torx screws half a turn each.




18.



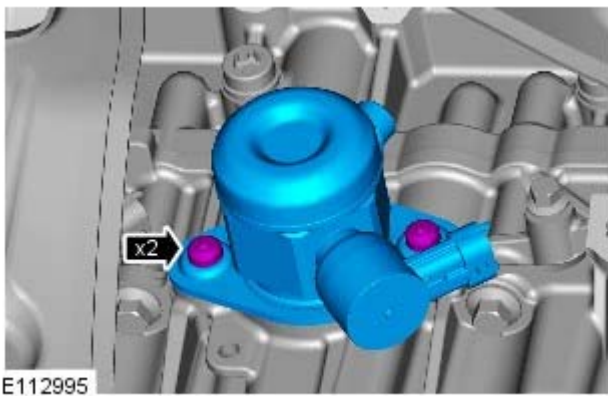
19. **19.** NOTE: Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



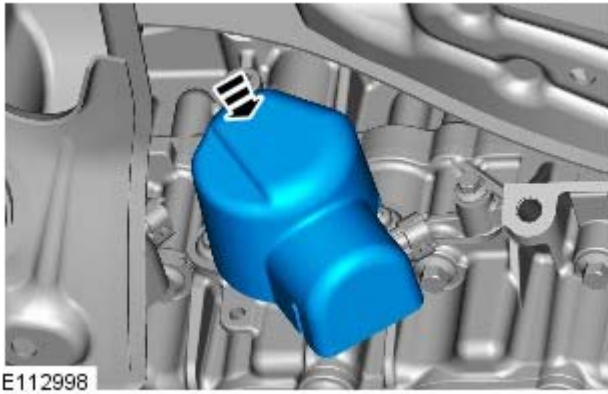
20. **20.**  CAUTION: Tighten the Torx screws a turn at a time until the correct torque is achieved.

• NOTE: Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

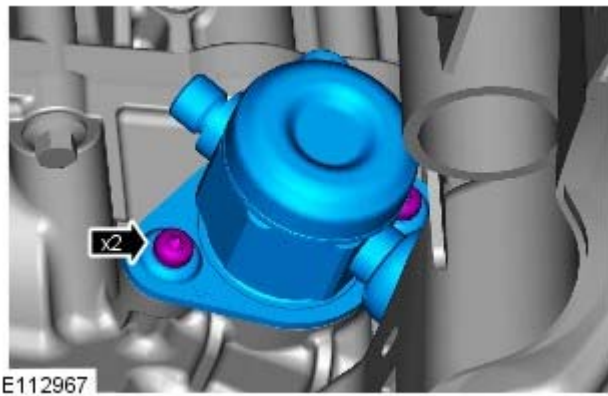
- Torque: 11 Nm



21. Loosen the Torx screws half a turn each.



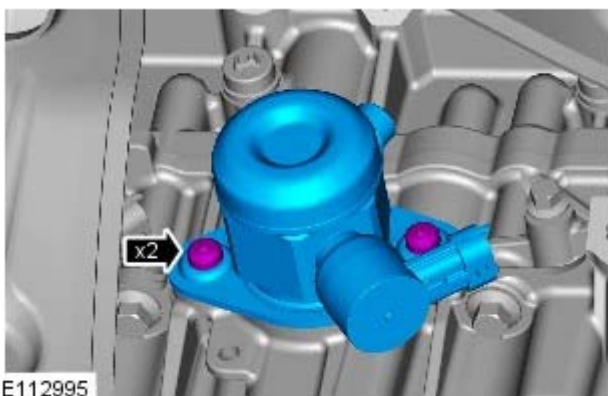
22.



23. **⚠ CAUTION:** Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

• NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

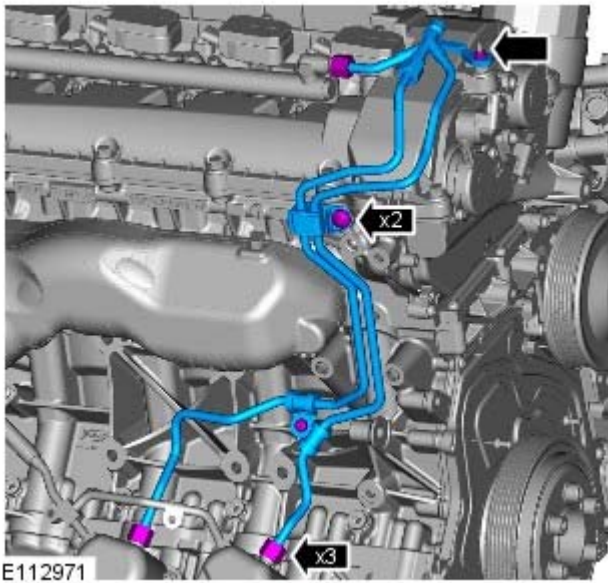
- Torque: 11 Nm



24. **⚠ CAUTION:** Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.


• NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

- Torque: 11 Nm



25. **25. CAUTIONS:**

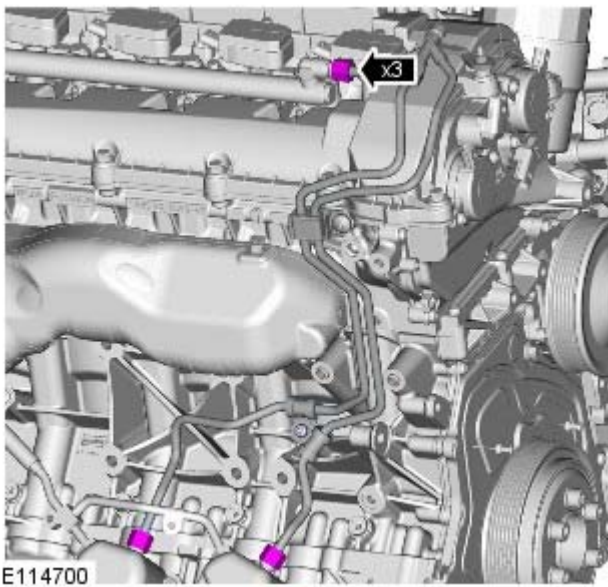
 Install new high-pressure fuel supply lines.

 Lubricate only the union threads with clean engine oil.

- NOTE: Remove and discard the blanking caps.

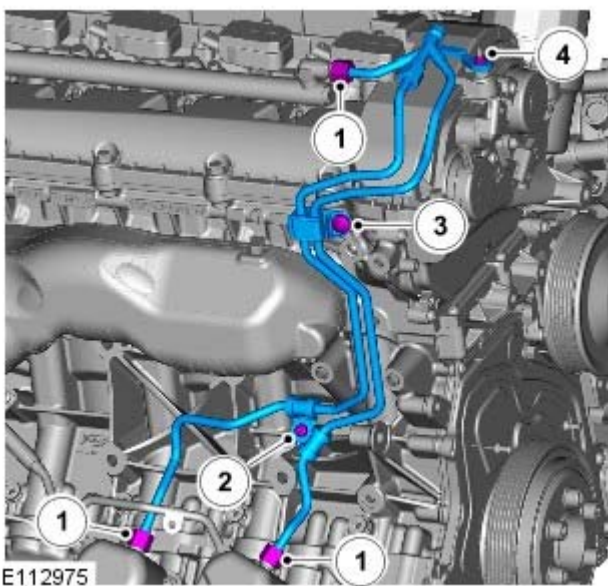
- NOTE: Install the bolt and unions fully finger tight before final tightening.

Do not fully tighten at this stage.



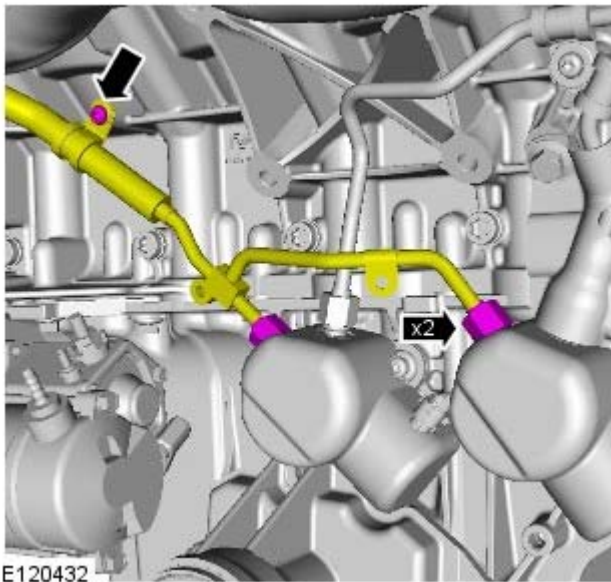
26.

- Torque: 21 Nm



27.

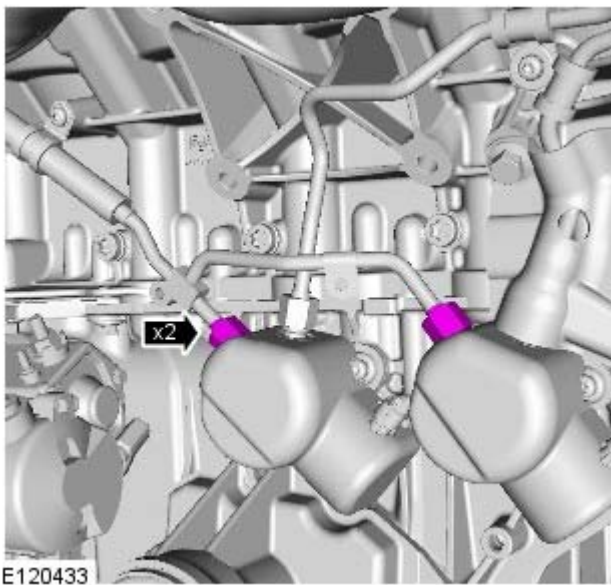
- Torque:
 - Unions (1) 21 Nm
 - M6 (2) 11 Nm
 - M8 (3) 25 Nm
 - M5 nut (4) 6 Nm




28. **28.** NOTE: Install the bolt and unions finger tight before final tightening.

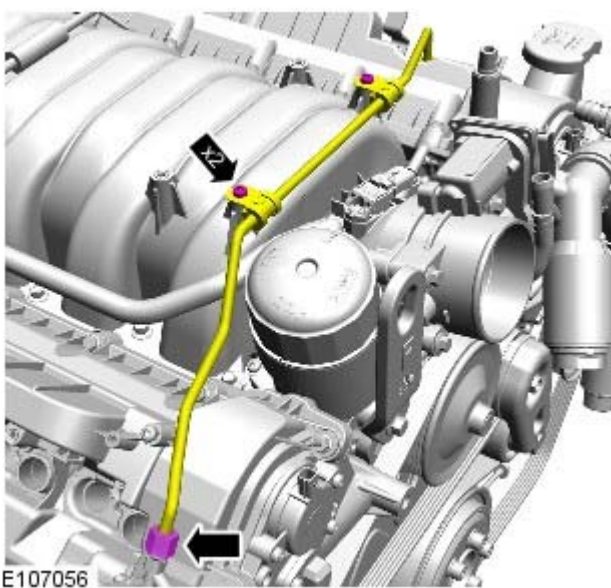
- NOTE: Remove and discard the blanking caps.

- Torque:
Unions 21 Nm
M6 11 Nm

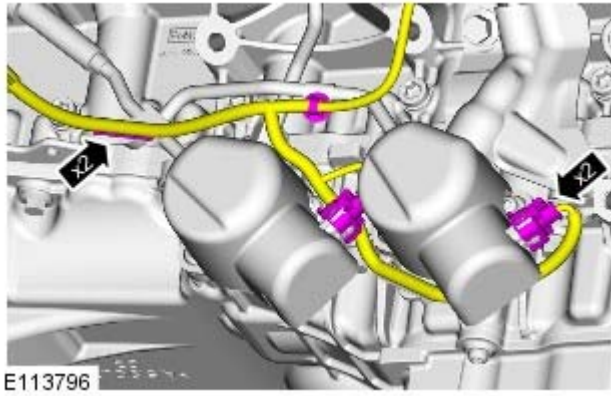


29. **29.**  CAUTION: Make sure that a new component is installed.

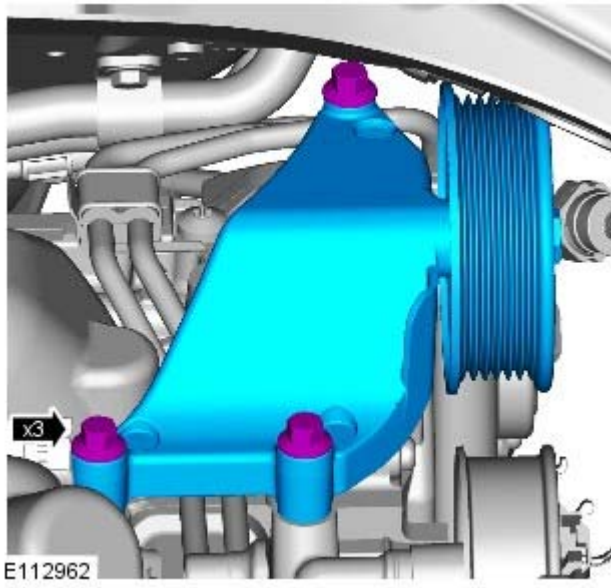
- Torque: 21 Nm



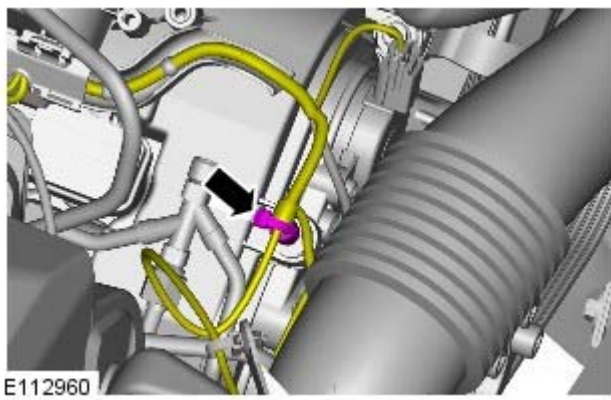
30. Torque:
Unions 21 Nm
M6 8 Nm



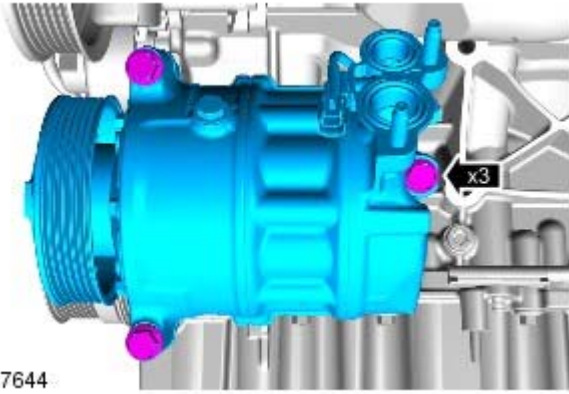
31.




32. Torque: 25 Nm

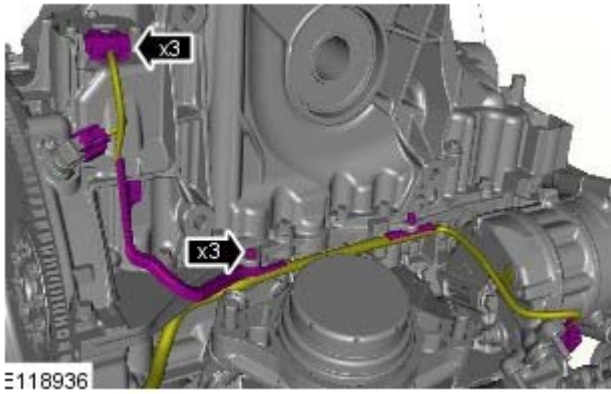


33.

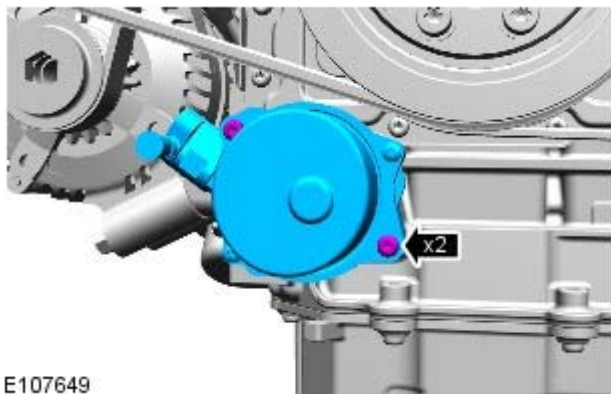


34. **34.**  CAUTION: Install all the bolts finger tight before final tightening.

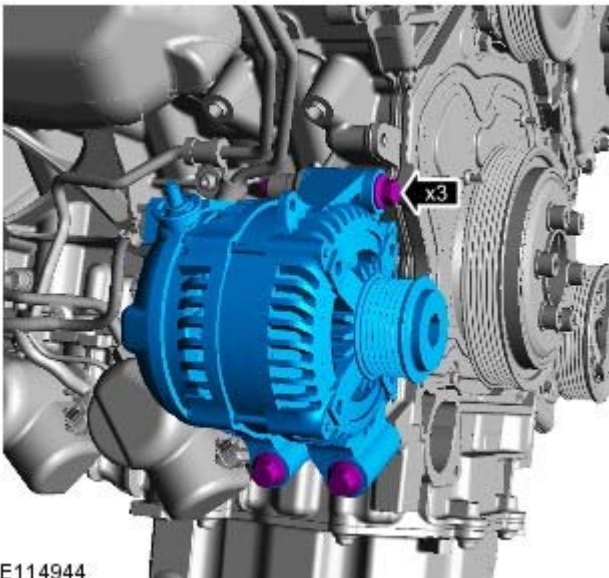
Torque: 25 Nm




- 35.

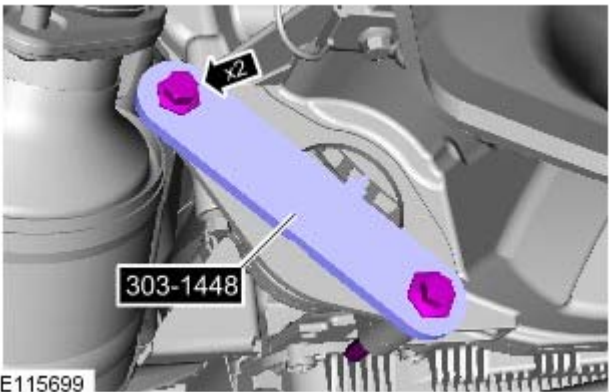


36. *Torque: 12 Nm*



E114944

37. **37.**  **CAUTION:** Install all the bolts finger tight before final tightening.
- **NOTE:** Tighten the bolts in the indicated sequence.
- Torque:* 48 Nm






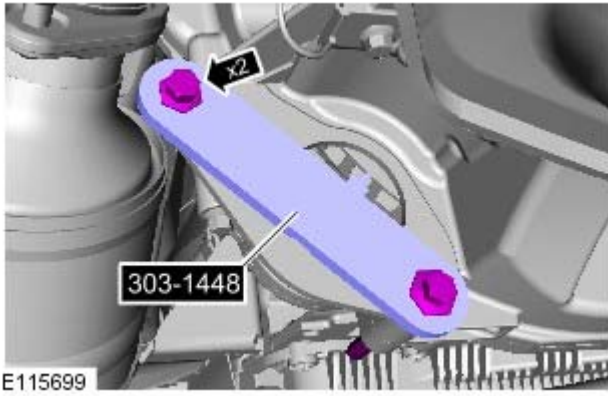
E115699

- 38.
- Install the special tool.
 - *Special Tool(s):* [303-1448](#)

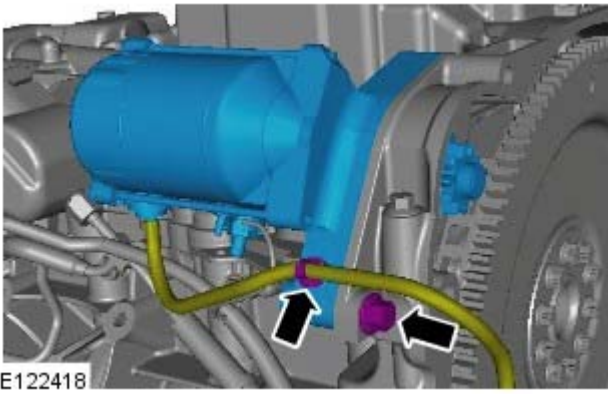


E104700

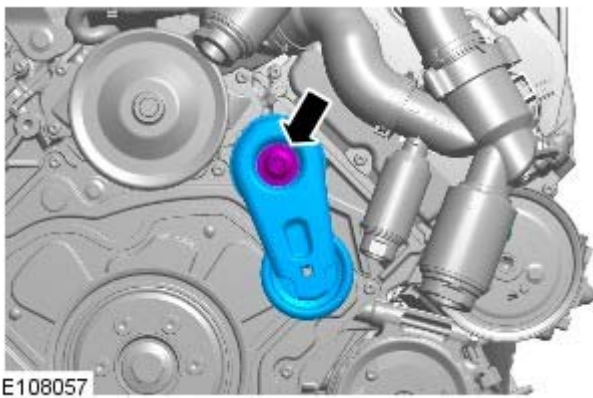
39. **39. CAUTIONS:**
-  Install all the bolts finger tight before final tightening.
 -  The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.
 -  Install the bolts in the noted position.
 - **NOTE:** Make sure that the crankshaft is not rotated.
 - **NOTE:** Make sure the crankshaft and flexplate mating faces are clean before installation.
 - **NOTE:** Tighten the retaining bolts working diagonally.
- Torque:*
 Stage 1: 45 Nm
 Stage 2: 90°



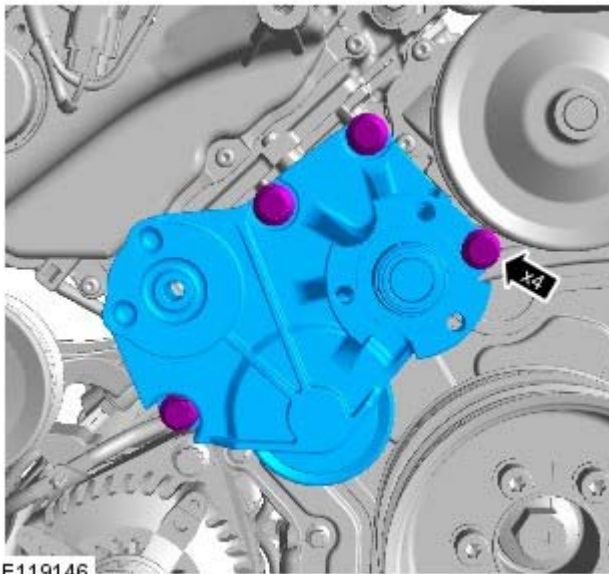
- 40.
- Remove the special tool.
 - *Special Tool(s):* [303-1448](#)



41. *Torque:* 48 Nm



42. **42.** NOTE: Install the bolt finger tight before final tightening.
Torque: 40 Nm



E119146

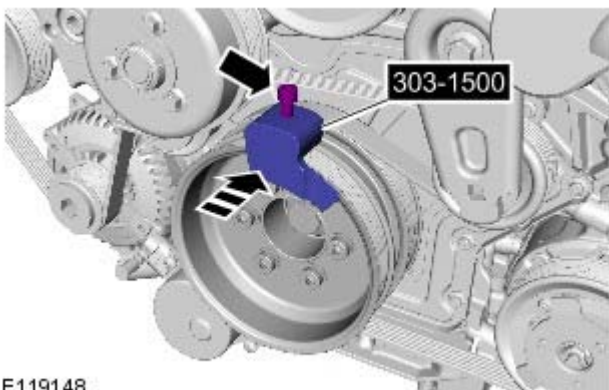
43. Torque: 25 Nm



E119145

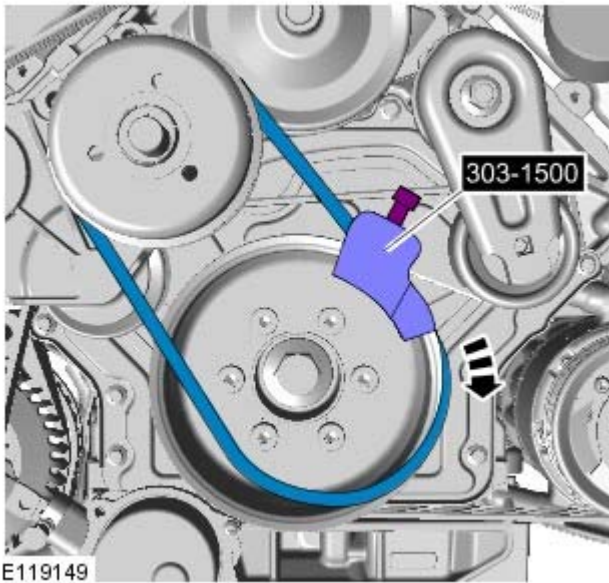
44. Torque: 25 Nm

45. Refer to: [Crankshaft Pulley](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



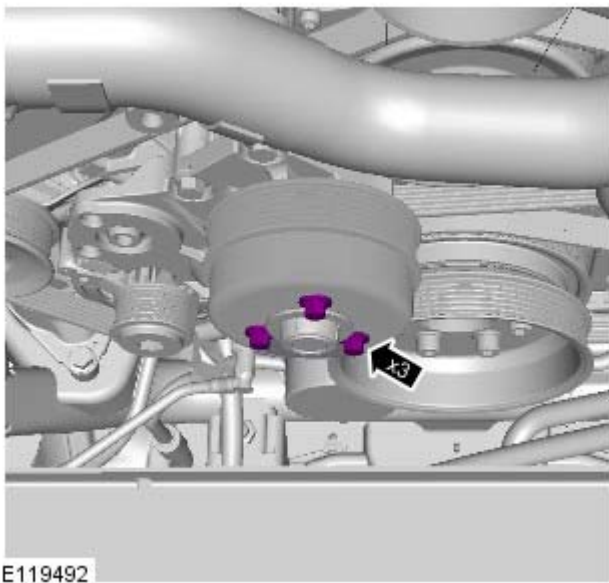
E119148

46. Special Tool(s): [303-1500](#)



47.

- Install the cooling fan belt.
- Rotate the engine clockwise twice, making sure that the belt is seated on both pulleys correctly.
- Remove the special tool.



48. *Torque:* 25 Nm

49. Refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Removal).

50. Lower the vehicle.

51. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Oil Pump

Removal and Installation

Removal

1. Disconnect the battery ground cable.

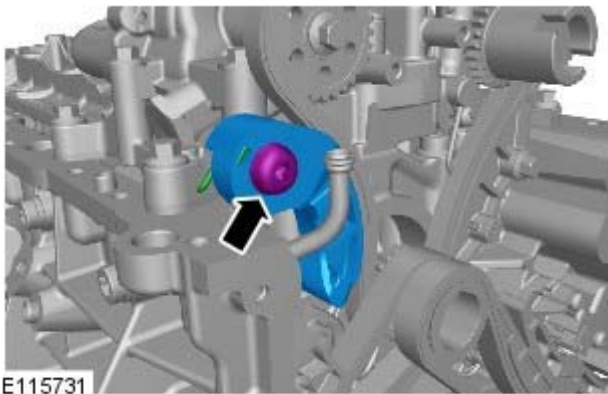
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

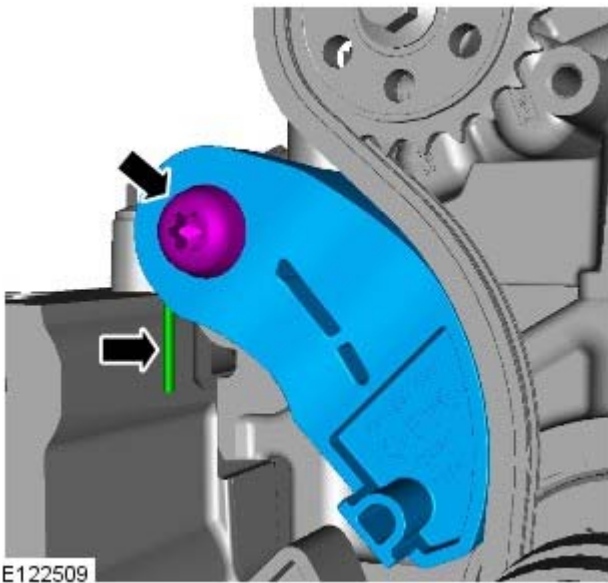
Raise and support the vehicle.

3. Refer to: [Oil Pan Extension](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

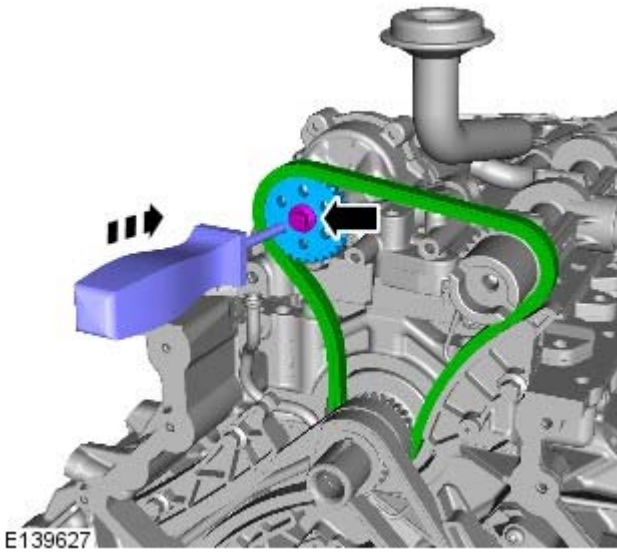
4. **NOTE:** Tsubaki timing drive only.



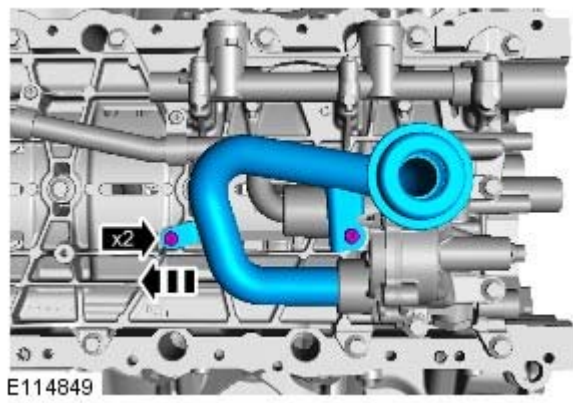
5. **NOTE:** INA timing drive only.




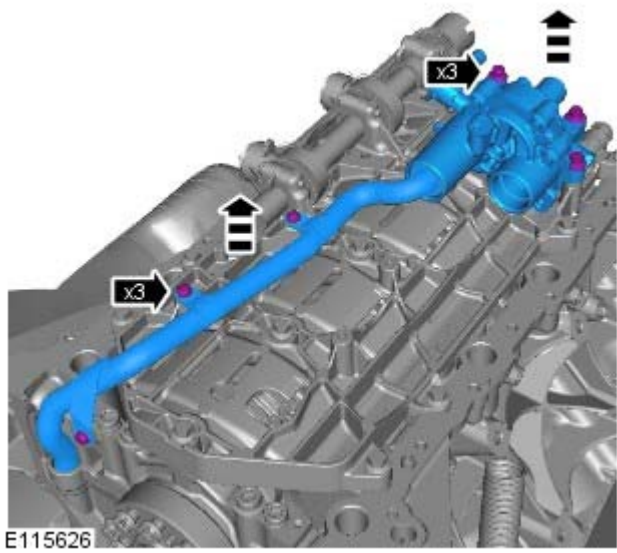
6.



7. **7.** NOTE: Remove and discard the O-ring seal.



8. **8.**  CAUTION: Remove and discard the O-ring seals.



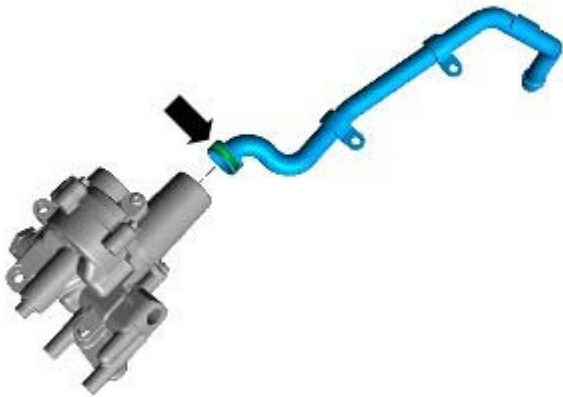
9. **9.** NOTE: Remove and discard the O-ring seal.



E139628

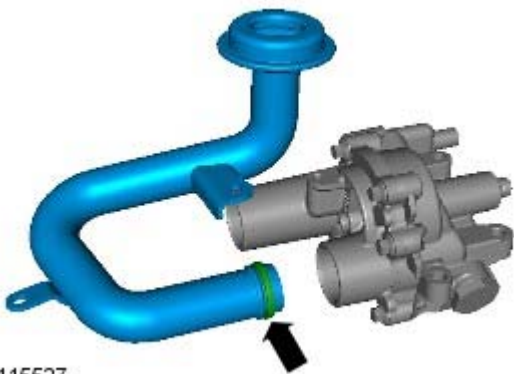
Installation

1. Lubricate and install the new O-ring seals.



E139628

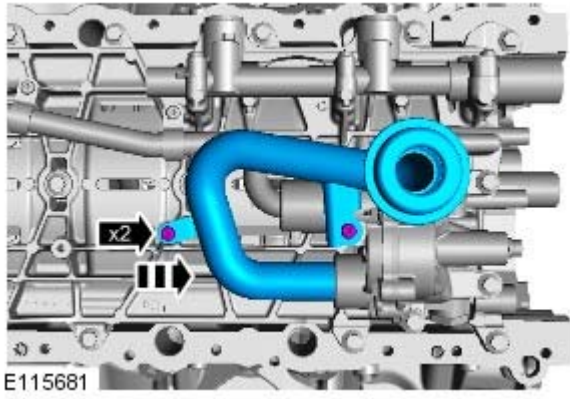
2. ~~Lubricate~~ Lubricate and install a new O-ring seal.
M8 25 Nm
M6 12 Nm



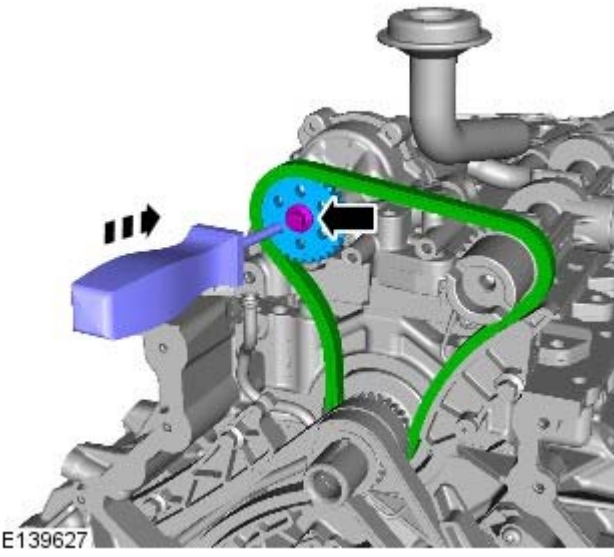
E115527



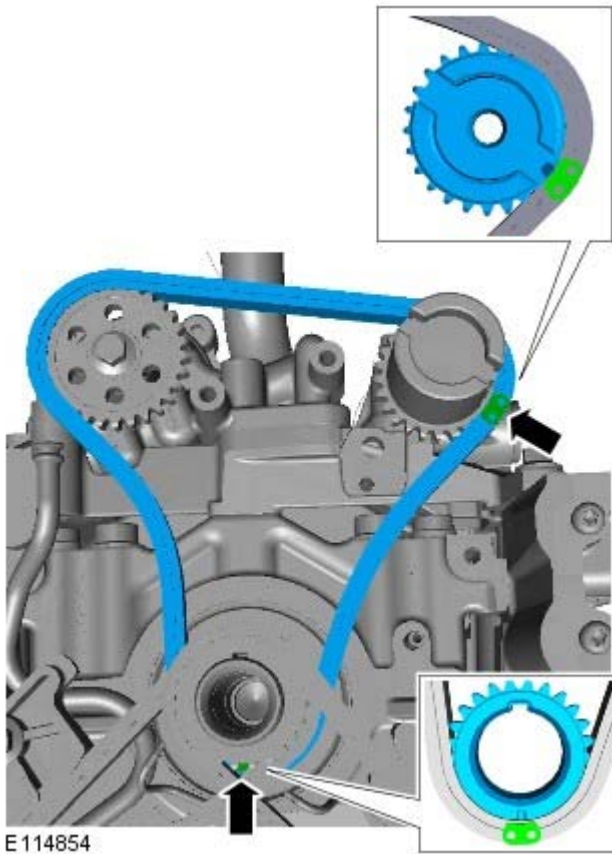
E115680



4. *Torque:* 12 Nm



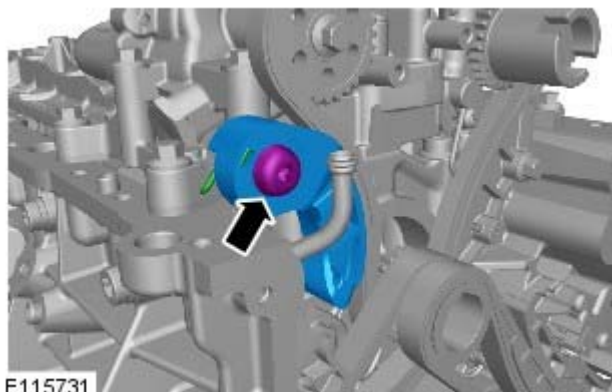
5. *Torque:* 21 Nm



E114854

6. **6. NOTE:** Tsubaki timing drive only.

Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.

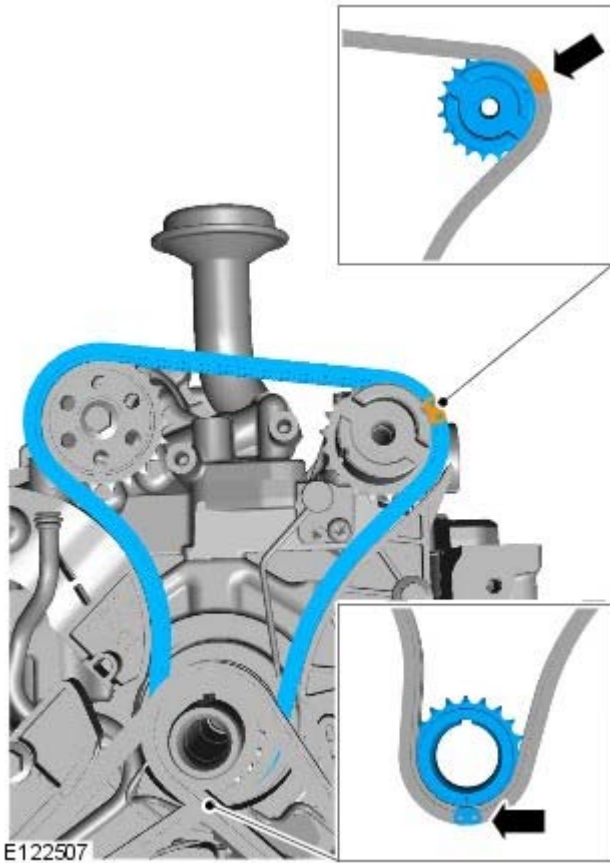


E115731

7. **7. ⚠ CAUTION:** Make sure that the tensioner spring is correctly located.

- NOTE: Tsubaki timing drive only.

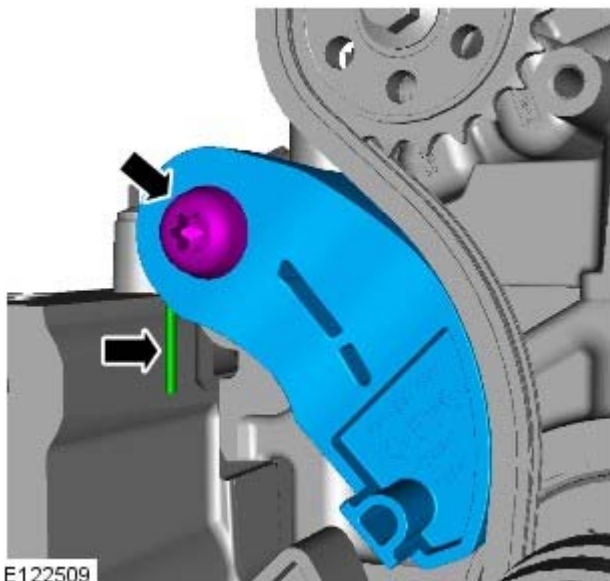
Torque: 21 Nm



E122507

8. **NOTE:** INA timing drive only.

Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.



E122509

9. **CAUTION:** Make sure that the tensioner spring is correctly located.

- **NOTE:** INA timing drive only.

Torque: 21 Nm

10. Refer to: [Oil Pan Extension](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

11. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Oil Restrictor

Removal and Installation

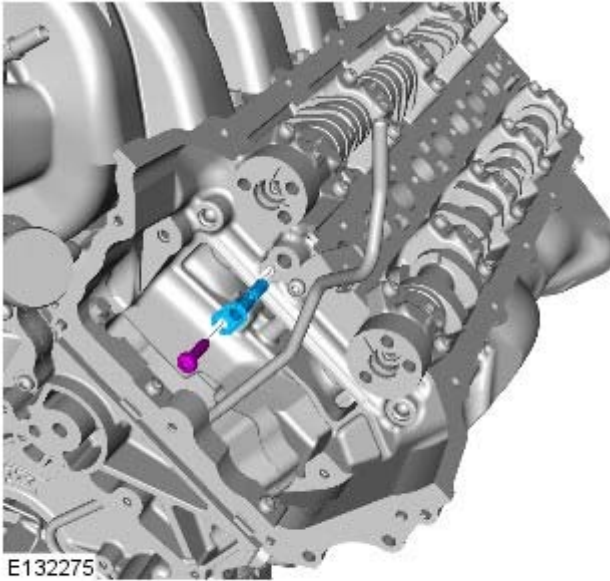
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Timing Drive Components - Assembly Part Number: INA Timing Drive](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
Refer to: [Timing Drive Components - Assembly Part Number: Tsubaki Timing Drive](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

2.

- Torque: 7 Nm




Installation

1. To install, reverse the removal procedure.

Engine - V8 5.0L Petrol - Timing Cover

Removal and Installation

Special Tool(s)

 E107676	303-1433 Lower Timing Cover Alignment tool
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Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

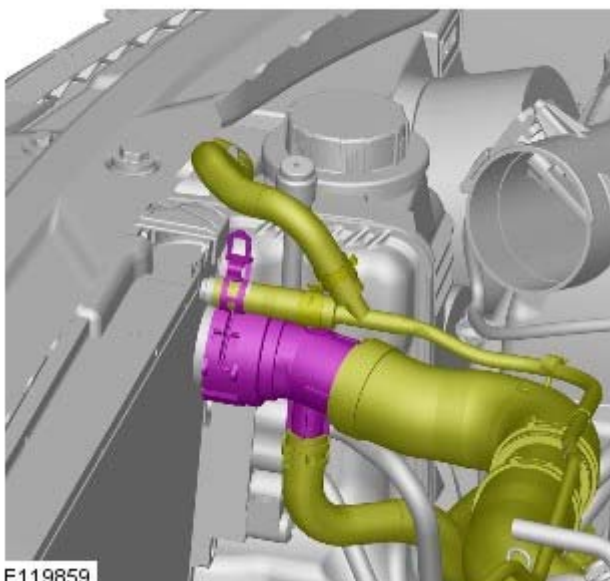
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

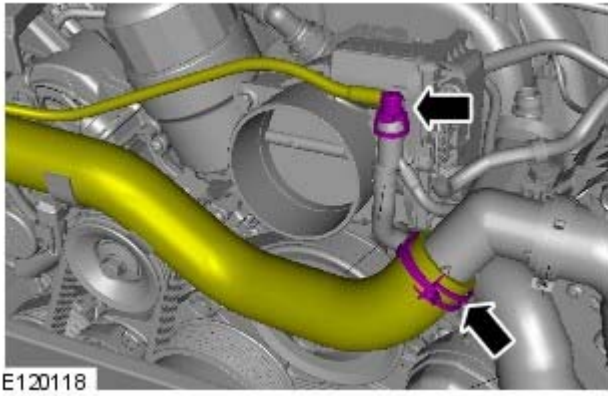
Raise and support the vehicle.

3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
4. Refer to: [Crankshaft Pulley](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
5. Refer to: [Valve Cover LH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
6. Refer to: [Valve Cover RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

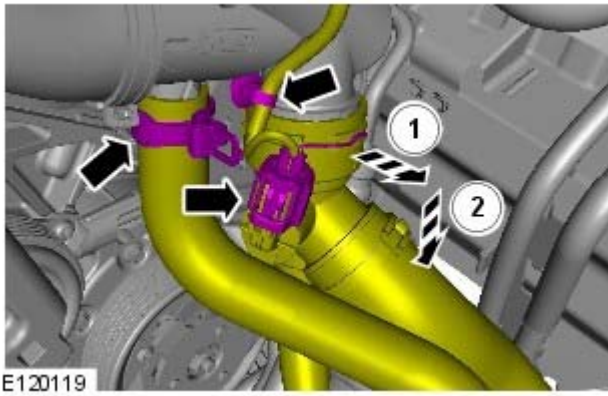
7.



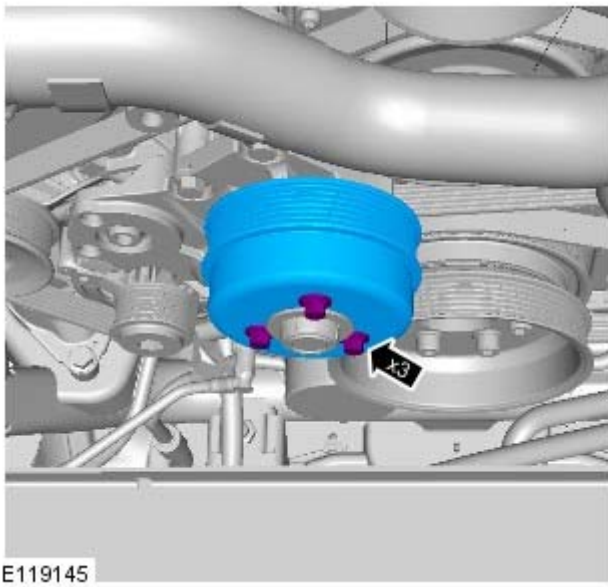
E119859



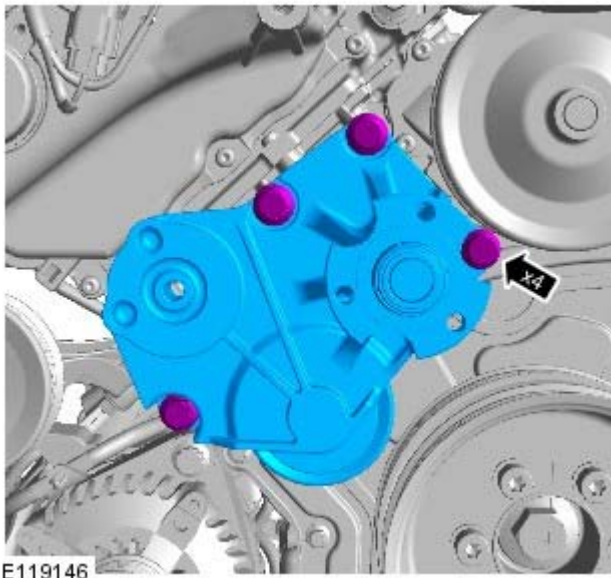
8.



9.  CAUTION: Be prepared to collect escaping coolant.

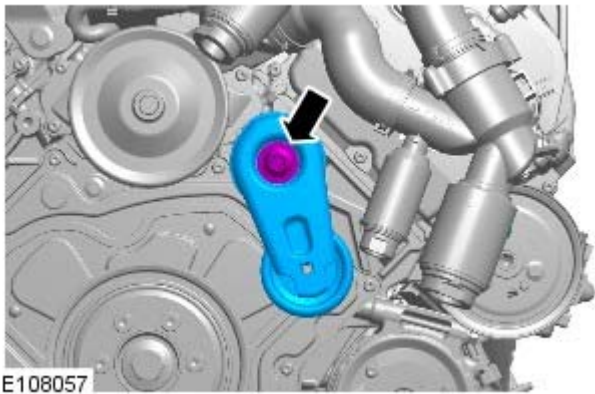


10.



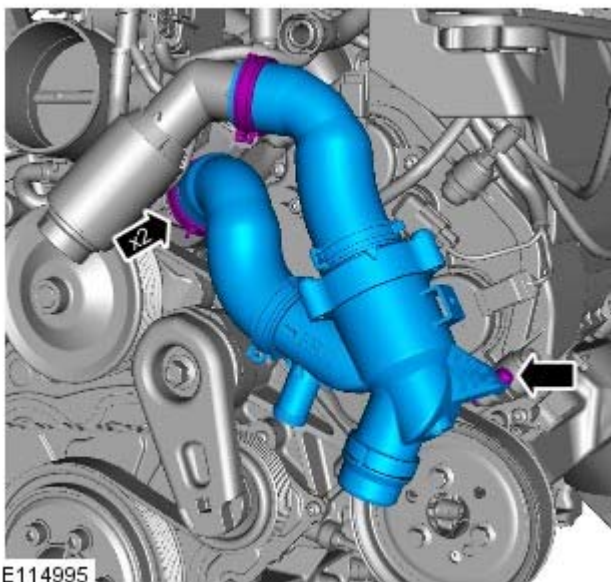
E119146

11.



E108057

12.

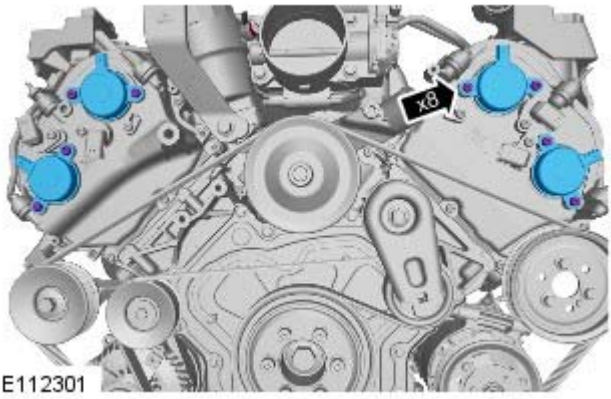


E114995

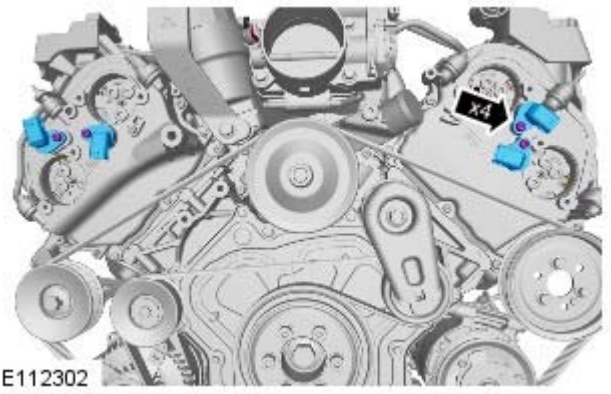
13.



14.



15.



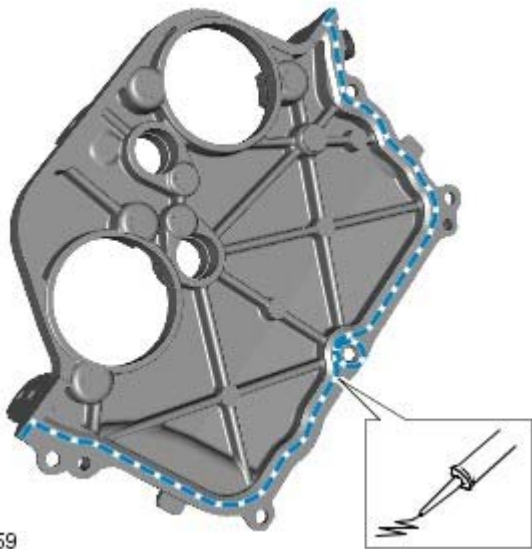
16.

17.




E112055

Installation




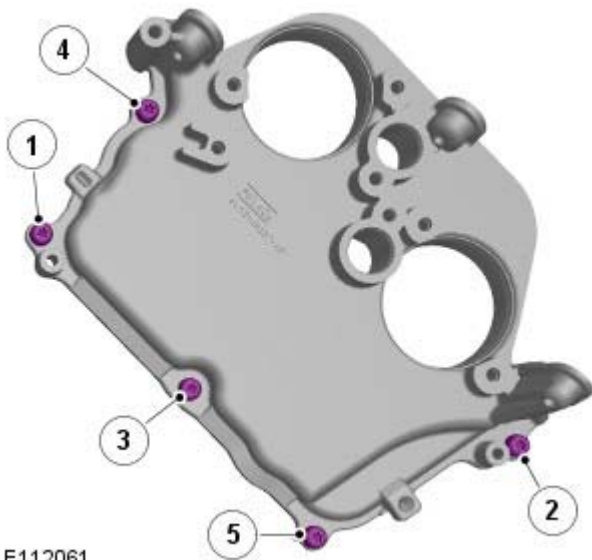
E112059

1.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.
 - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



E112060

2.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.
 - Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



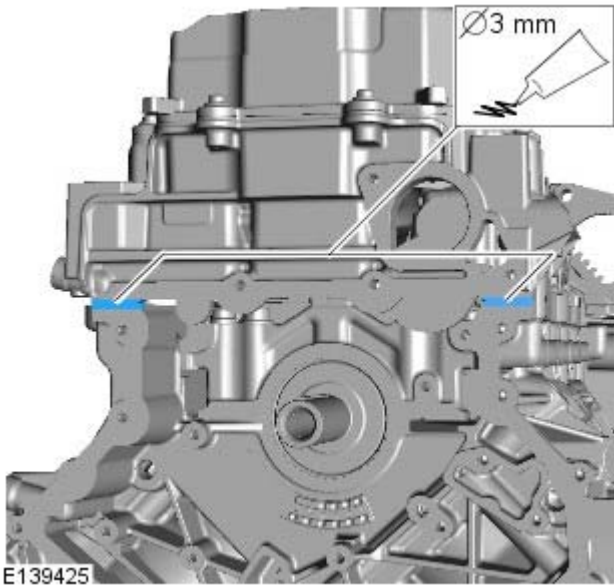
E112061


3. **3. NOTE:** Tighten the bolts in the indicated sequence.
Torque: 12 Nm



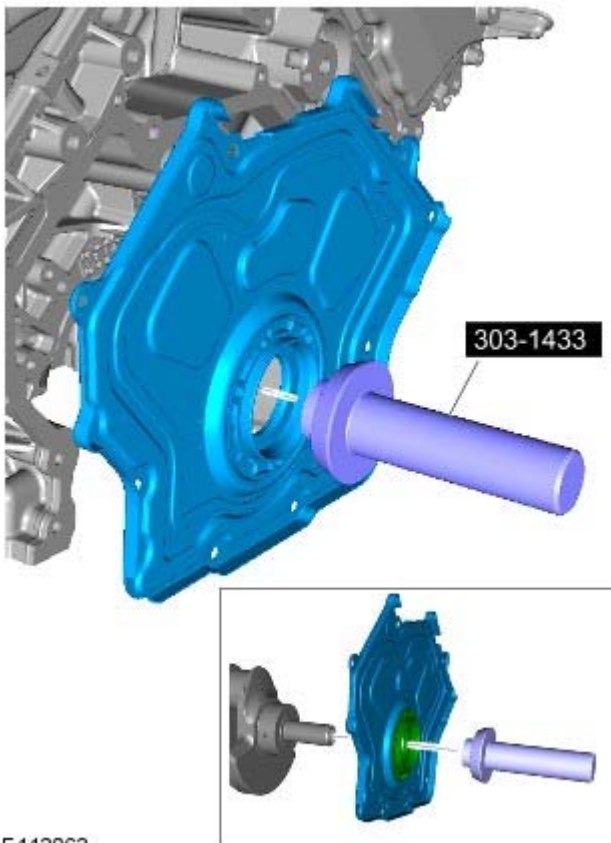
E112062


4. **4. NOTE:** Tighten the bolts in the indicated sequence.
Torque: 12 Nm



5.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

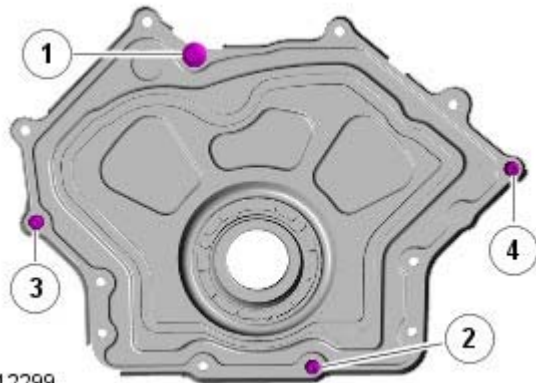
Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G) to the areas shown, and tighten the bolts within 7 minutes.



6.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Install the bolts, but do not tighten fully at this stage.

Special Tool(s): [303-1433](#)



E112299

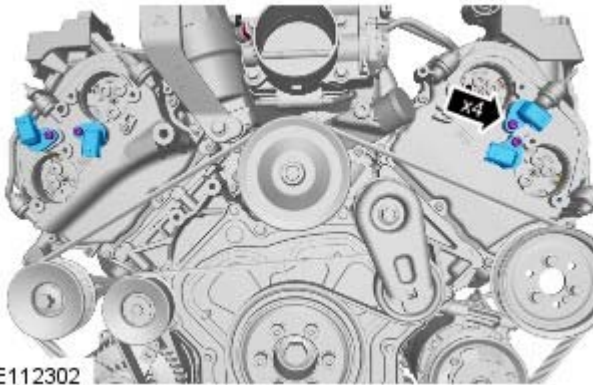
7. Torque:
M6 12 Nm
M8 20 Nm

8. Remove the special tools.



E112300

9. Torque: 12 Nm

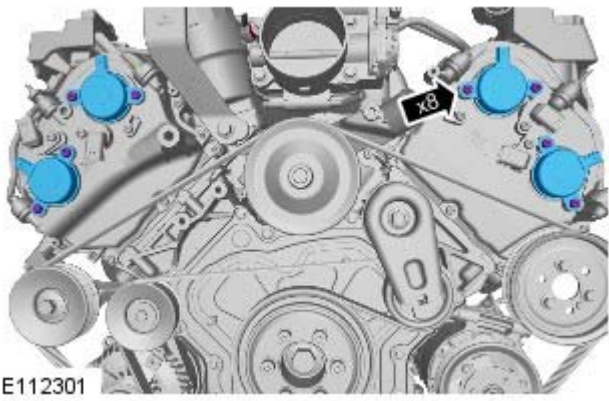


E112302

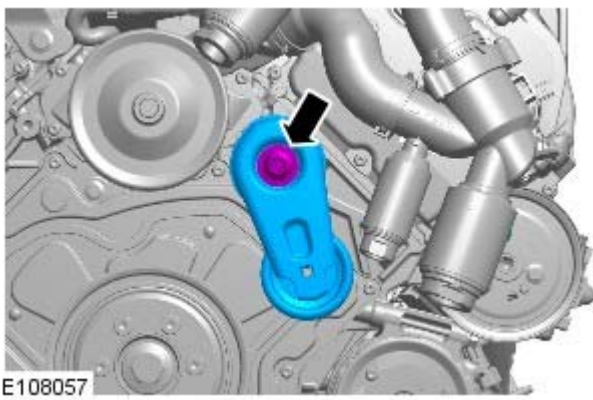
10. Torque: 12 Nm



11. *Torque:* 25 Nm



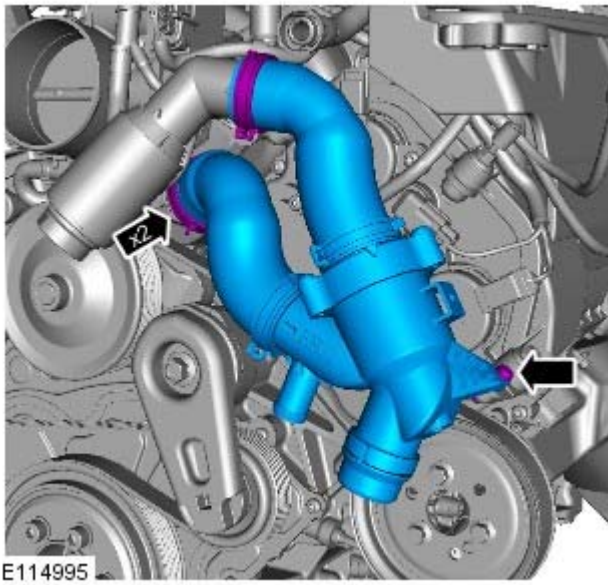
12. *Torque:* 12 Nm



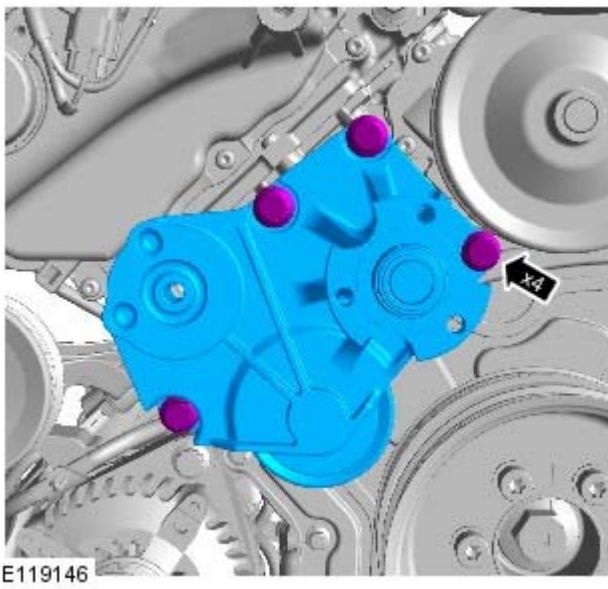
13. **13.** *NOTE:* Install the bolt finger tight before final tightening.

Torque: 40 Nm

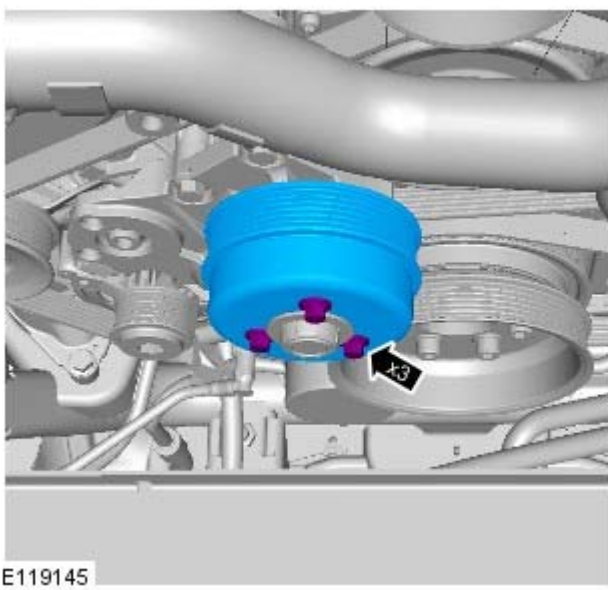
14.

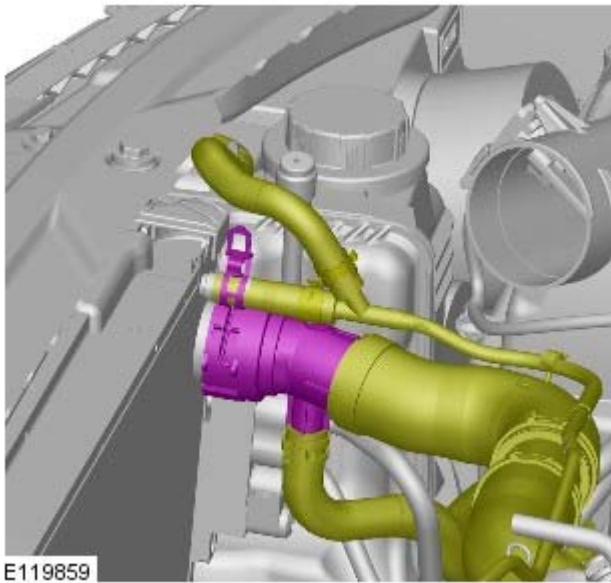


15. Torque: 25 Nm

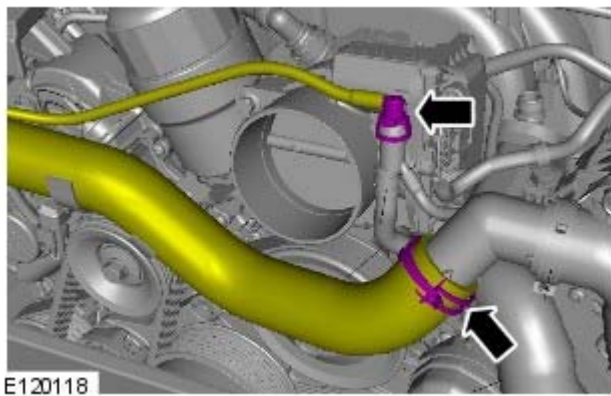


16. Torque: 25 Nm

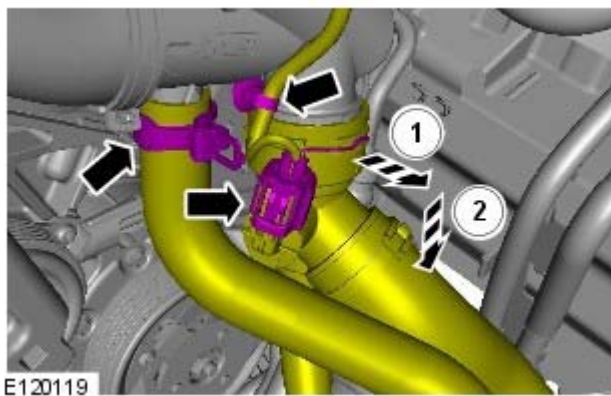




17.



18.



19.

20. Refer to: [Valve Cover LH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
21. Refer to: [Valve Cover RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
22. Refer to: [Crankshaft Pulley](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
23. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).






24. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Timing Drive Components Assembly Part Number: INA Timing Drive

Removal and Installation

Special Tool(s)

 <p>E115263</p>	<p>303-1445 Timing Tool – Camshaft Alignment</p>
 <p>E115265</p>	<p>303-1447 Timing Tool</p>
 <p>E115266</p>	<p>303-1448 Locking Tool</p>
 <p>E115270</p>	<p>303-1452 Camshaft Rotating Tool</p>
 <p>E115271</p>	<p>303-1482 Tensioner Tool</p>


Removal

 **CAUTION:** Check all timing components for wear and install new components if required.

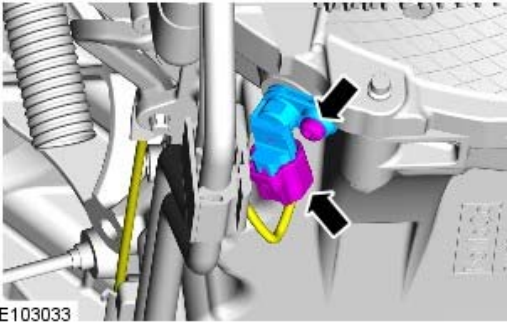
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

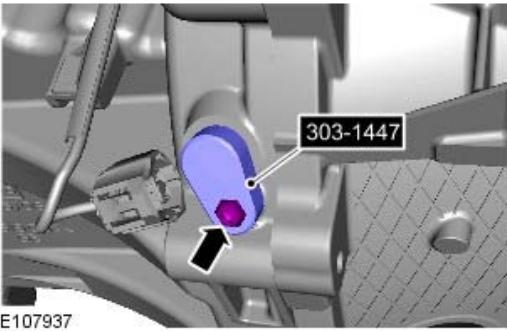
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.

3. Refer to: [Timing Cover](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



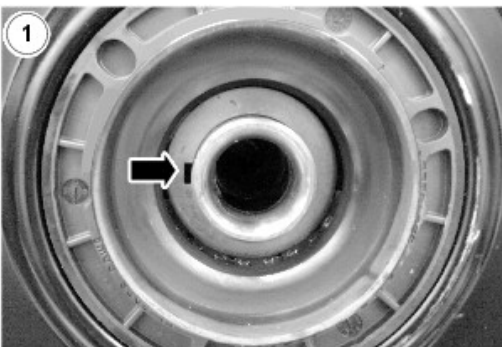
4.




5.  CAUTION: Only rotate the crankshaft clockwise.

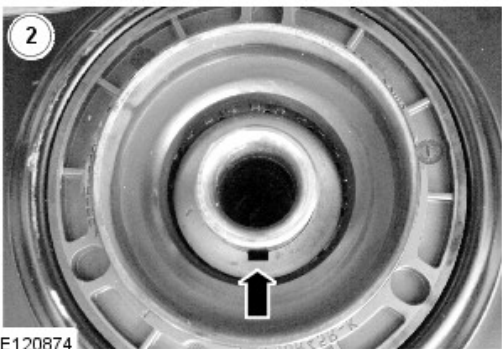
Install the special tool.

Special Tool(s): [303-1447](#)



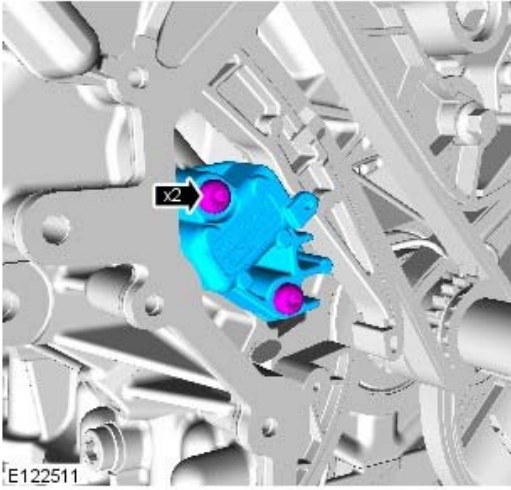
6.  CAUTION: If the noted position of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step.

Note the position of the crankshaft woodruff key.

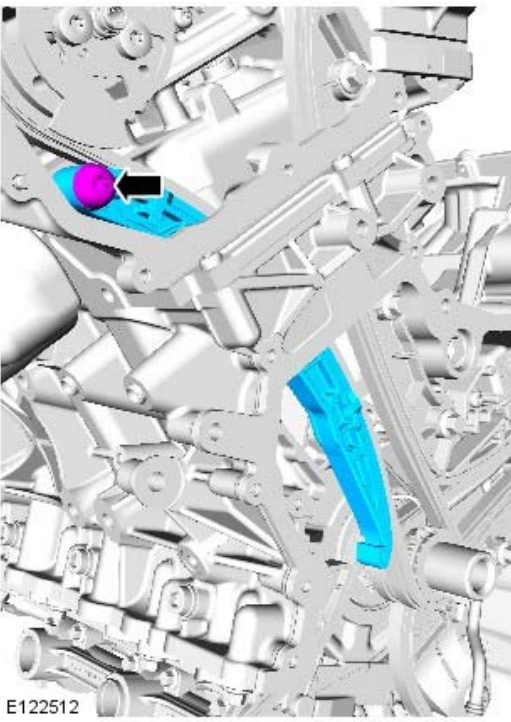


E120874

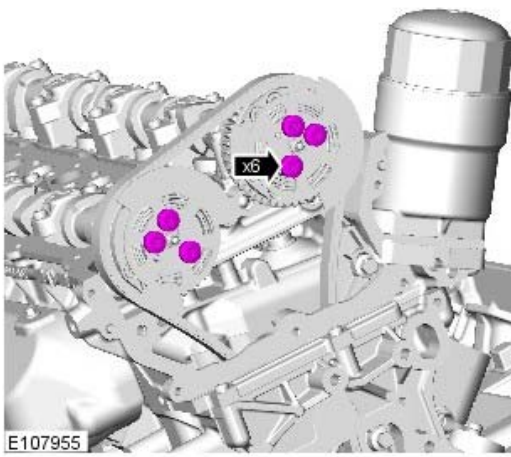
7.

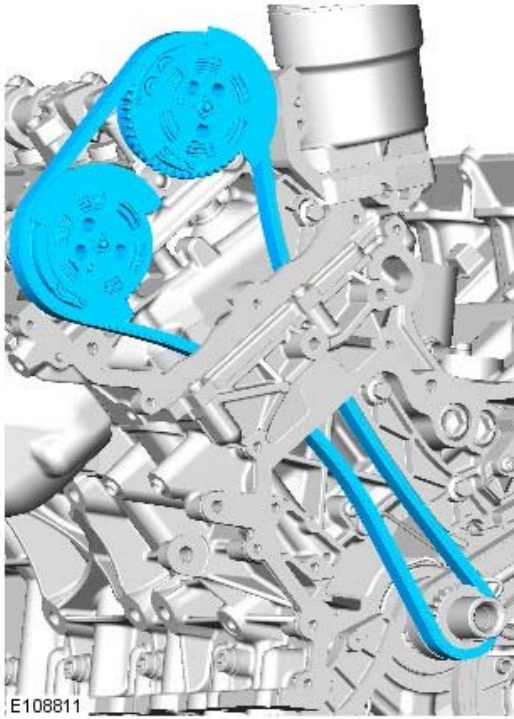


8.



9.

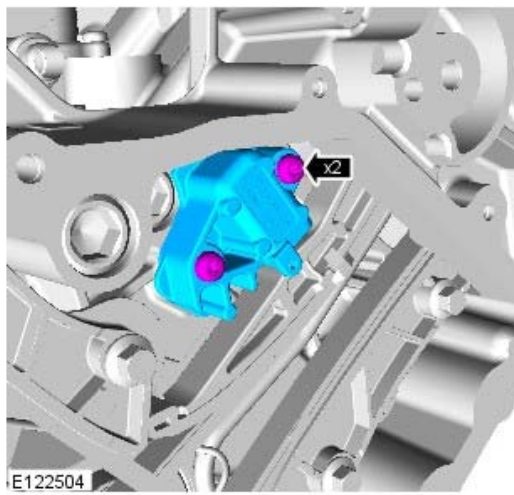




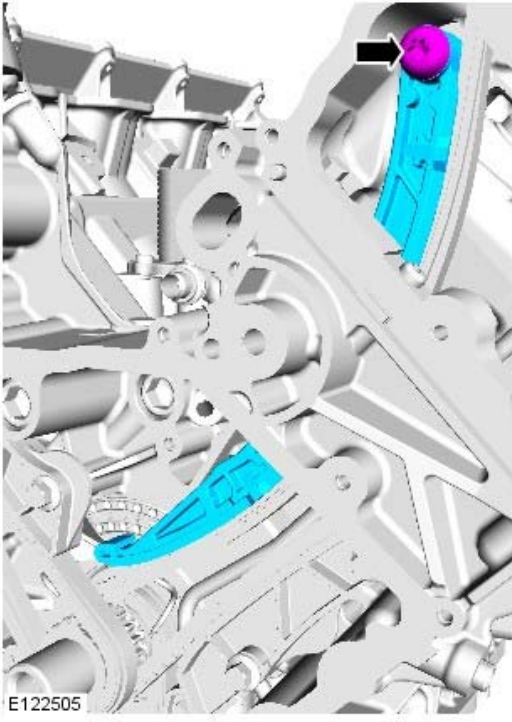
10. **10.**  CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

Remove the timing chain with the VVT units.

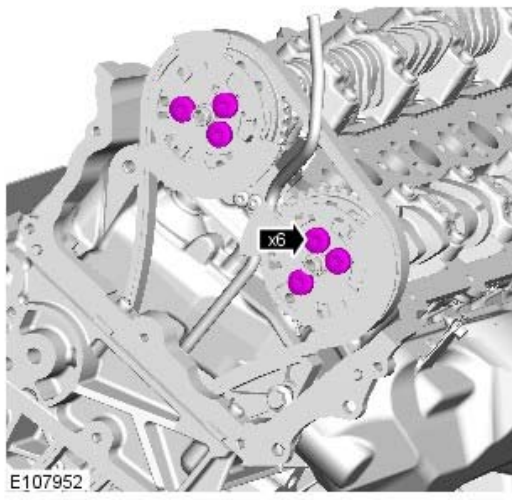
- 11.



12.



13.

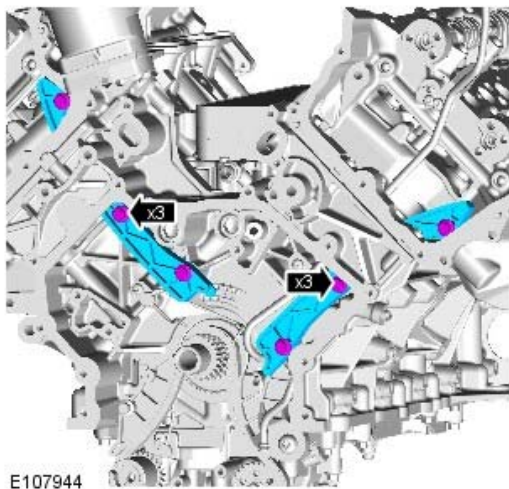




E108810

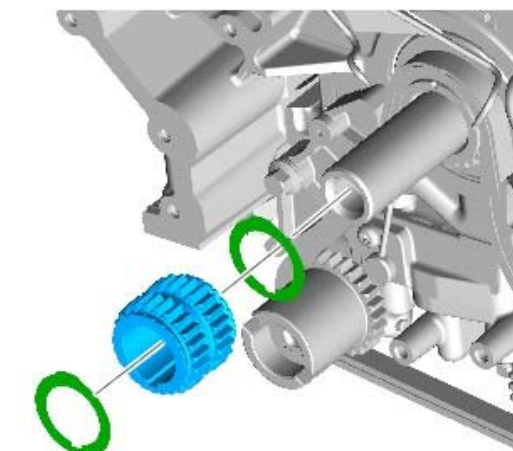
14. **14.**  CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

Remove the timing chain with the VVT units.



E107944

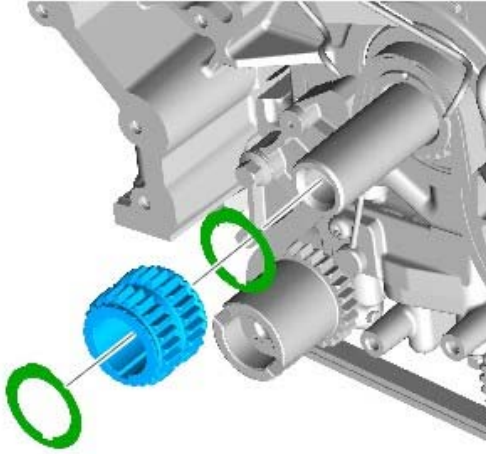
- 15.



E107945

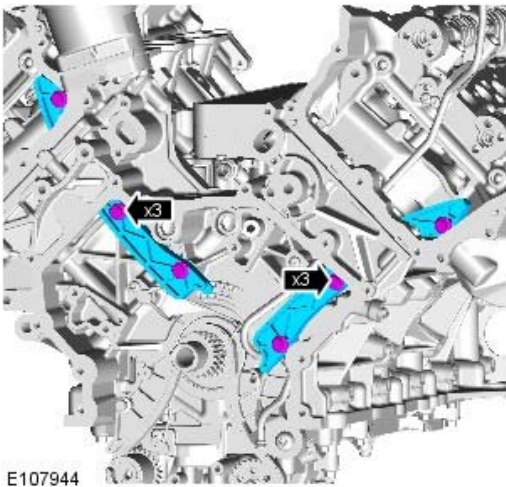
16. **16.**  CAUTION: Discard the friction washer.

Installation



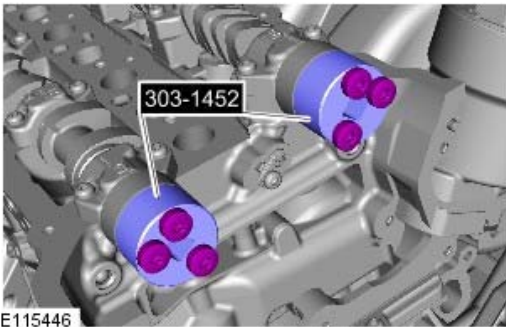
E107945

1.  CAUTION: Install a new friction washer.



E107944

2. Torque: 12 Nm



E115446

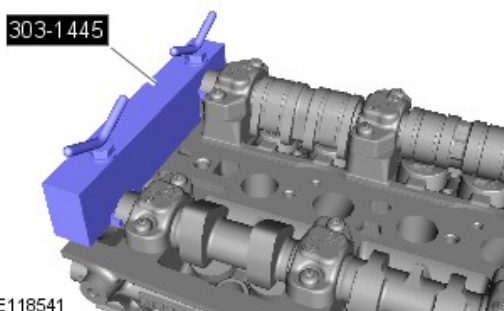
3.
 - Install the special tool to each Camshaft.
 - *Special Tool(s):* [303-1452](#)
 - *Torque:* 10 Nm



E118546

4.

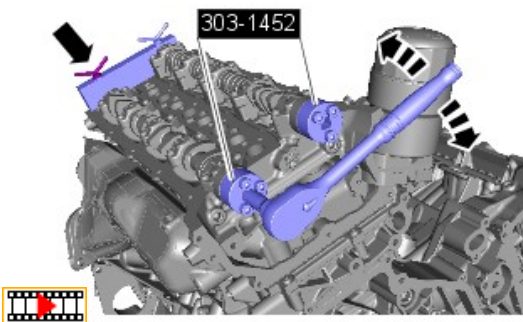
- Carefully rotate the camshafts if the position is not as shown.



E118541

5.

- Install the special tool 303-1445 to the rear of the camshafts making sure the key way's are correctly located into each slot on each of the camshafts.



6. **6. CAUTIONS:**



Do not overturn the camshafts.



Tighten the wing nuts finger tight. Failure to follow this instruction may result in damage to the components.

- Using a suitable tool, carefully rock the camshaft clockwise then anti-clockwise. Turn the special tool locking nuts until there is no movement left in camshafts.
- Repeat steps 3- 6 for the camshafts on the other cylinder head.

7. 7. CAUTIONS:



Do not allow the camshaft to rotate.



If the VVT is knocked or dropped then the VVT must be replaced.

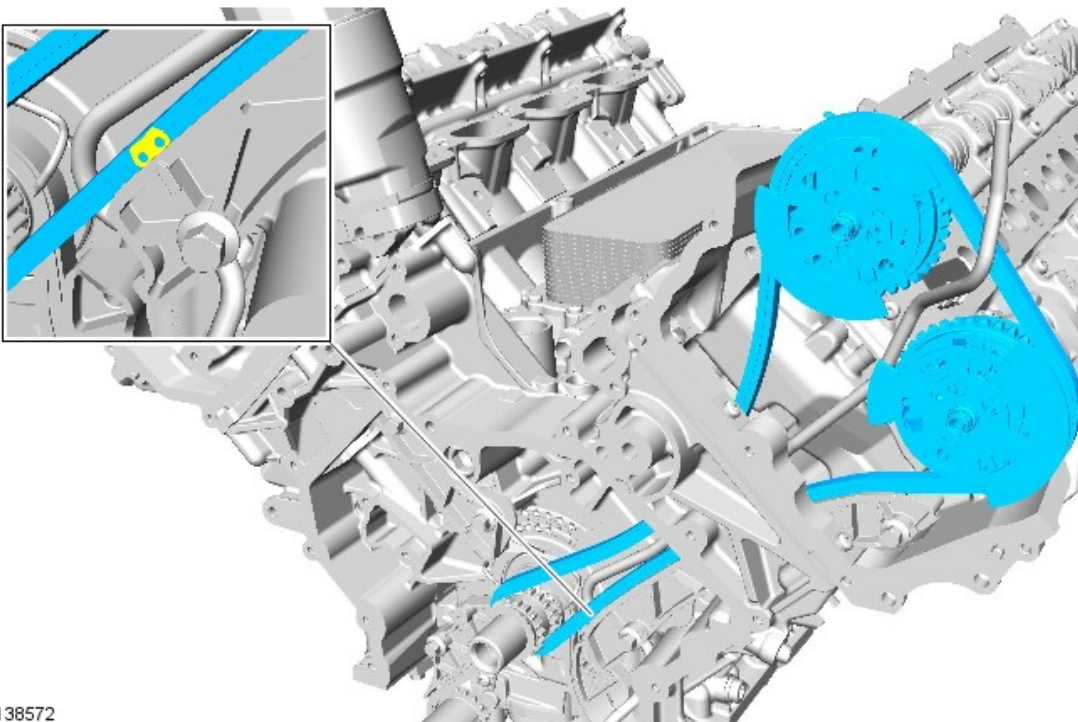
• NOTE: Do not tighten at this stage.

- Install the timing chain with the variable valve timing (VVT) units.

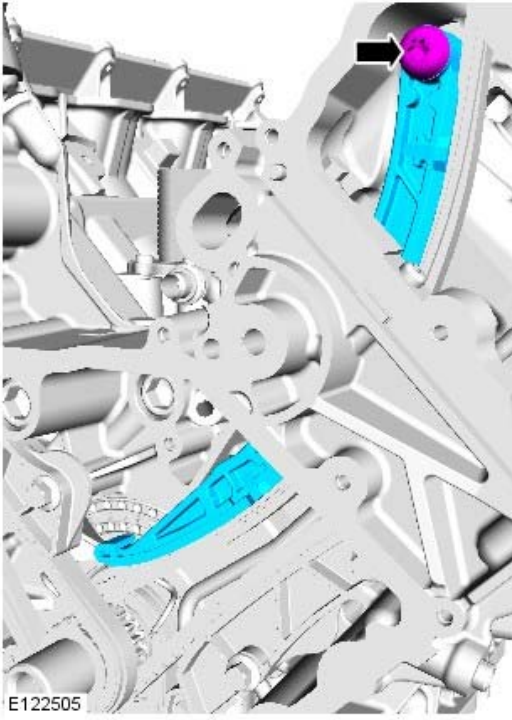


8.

- Make sure that all the timing chain alignment marks are in the positions shown.

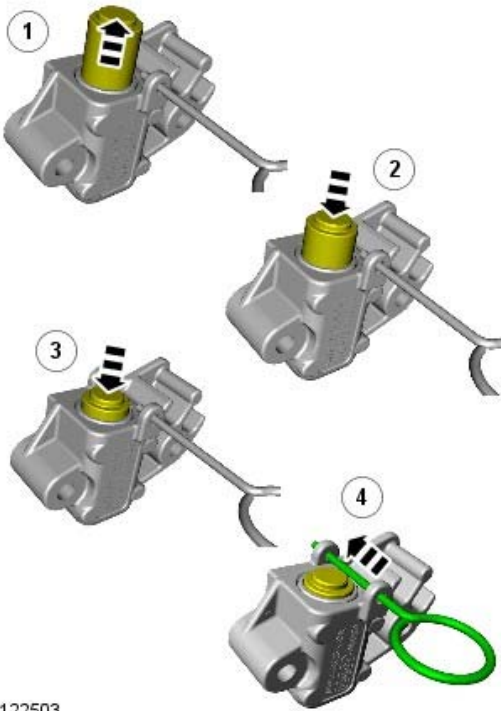


9. Torque: 25 Nm

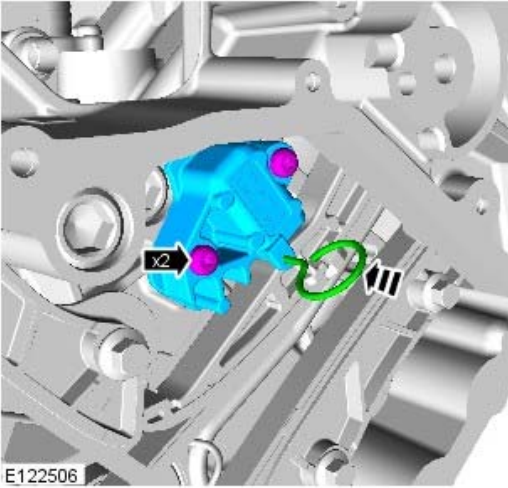



E122505

10. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.



E122503



11. **11.**  CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm



12. **12.** CAUTIONS:

 Do not allow the camshafts to rotate.

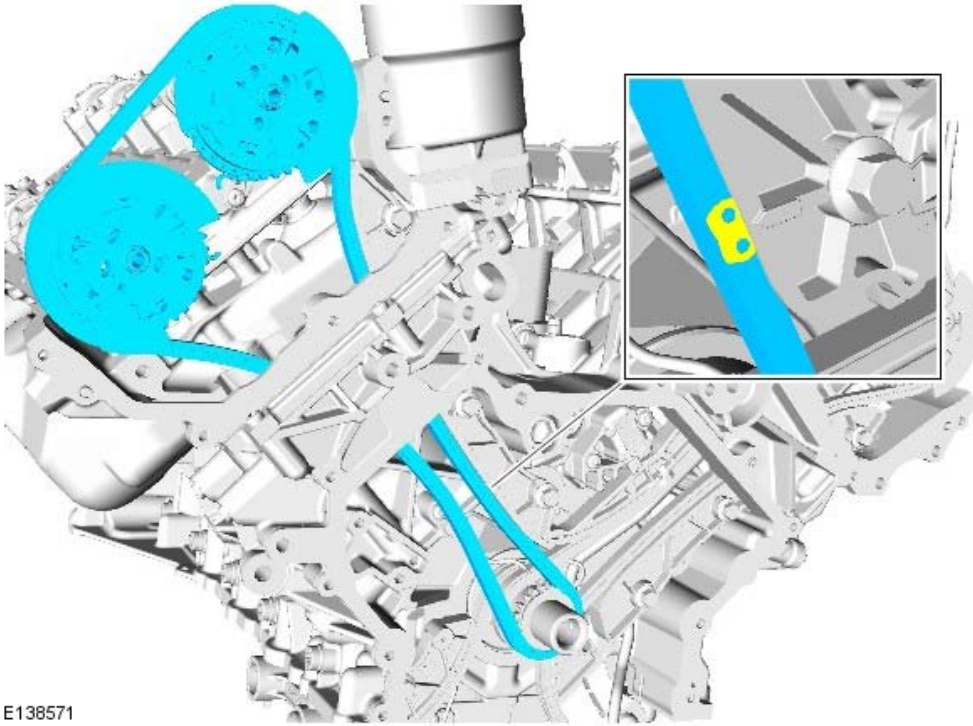
 If the VVT is knocked or dropped then the VVT must be replaced.

• NOTE: Do not tighten at this stage.

- Install the timing chain with the VVT units.

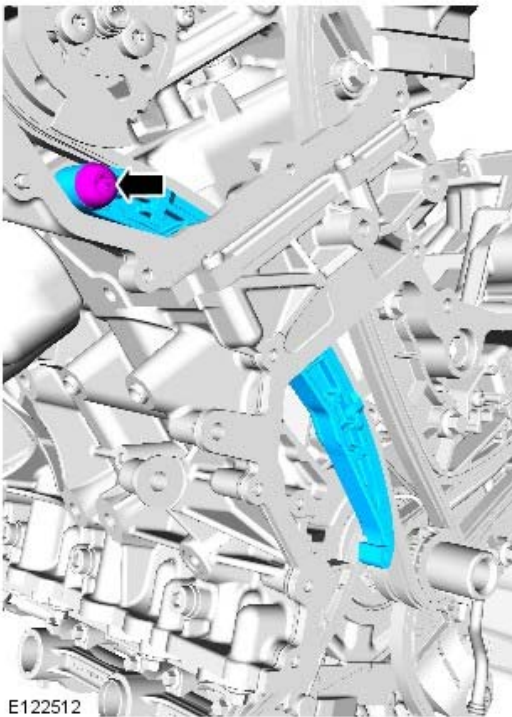
13.

- Make sure that all the timing chain alignment marks are in the positions shown.

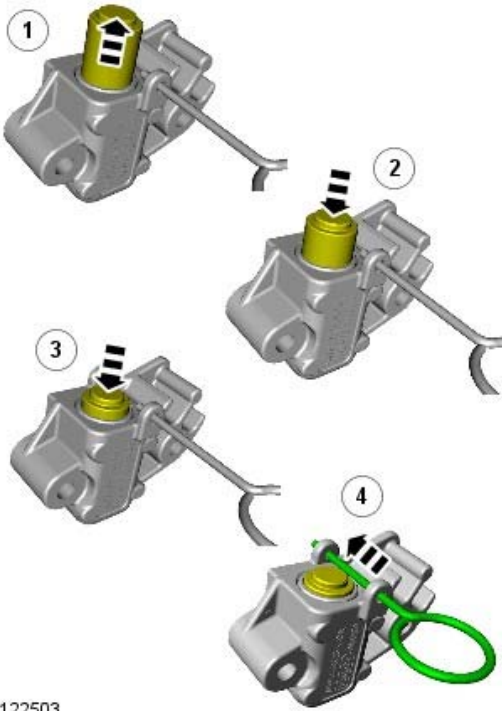


E138571

14. *Torque: 25 Nm*

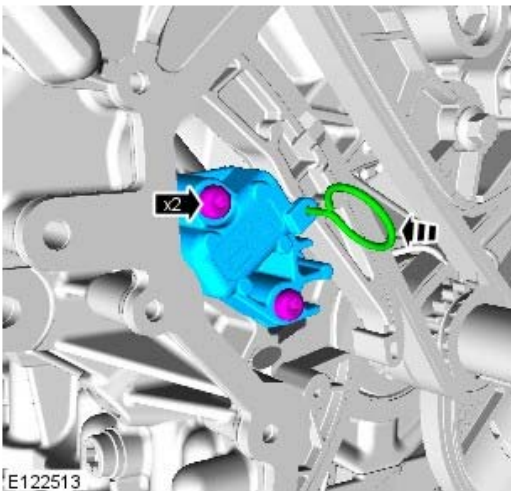


E122512



E122503

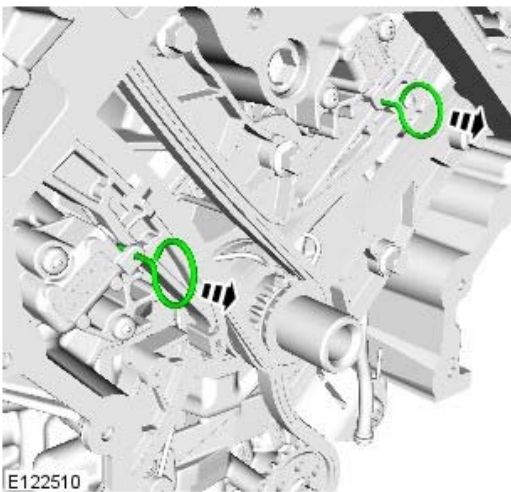
15. Make sure the tensioner piston is fully extended. Then fully depress and lock the tensioner piston with the grenade pin before installation, failure to do this may result in damage to the engine.



E122513

16. **16.** CAUTION: Do not release the timing chain tensioner locking pin at this stage.

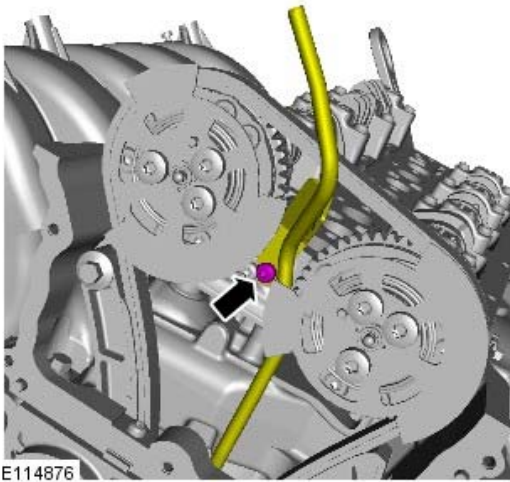
Torque: 10 Nm



E122510

- 17.

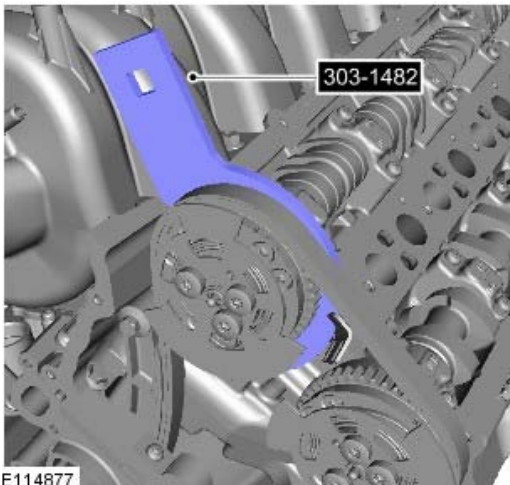
18. **18.** CAUTION: Do not use mechanical force. Make sure that the tensioners are fully deployed.



E114876

19.

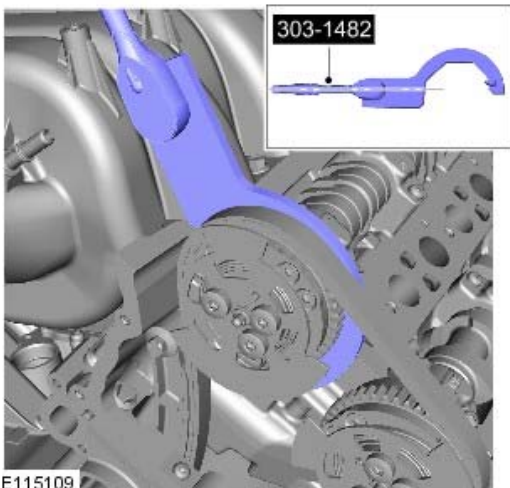
- Release and reposition the oil suction tube to one side.



E114877

20.

- Install the special tool.
- *Special Tool(s):* [303-1482](#)



E115109

21. **21. CAUTIONS:**

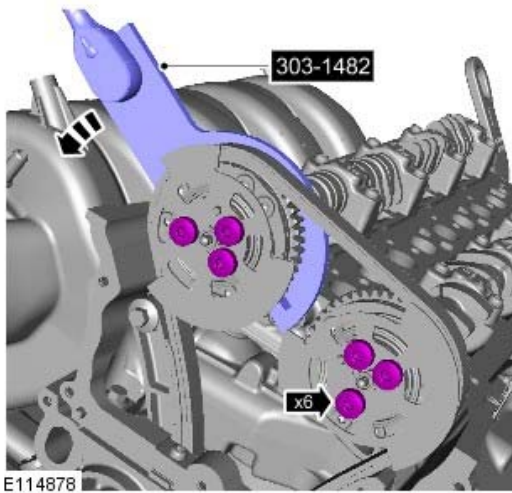



Apply the torque to the end of the special tool.



Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.

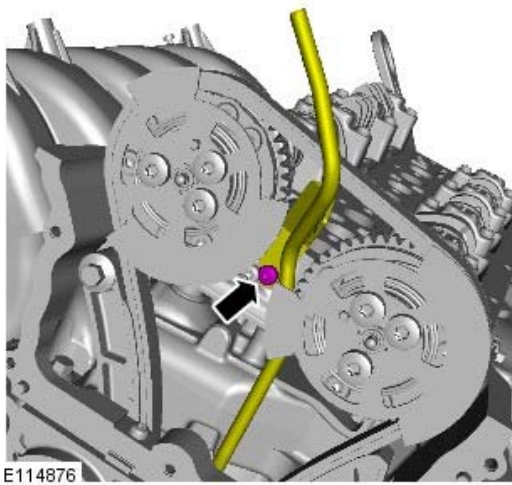
- Install the torque wrench to the special tool.
- *Torque:* 35 Nm



22. **22.**  CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.

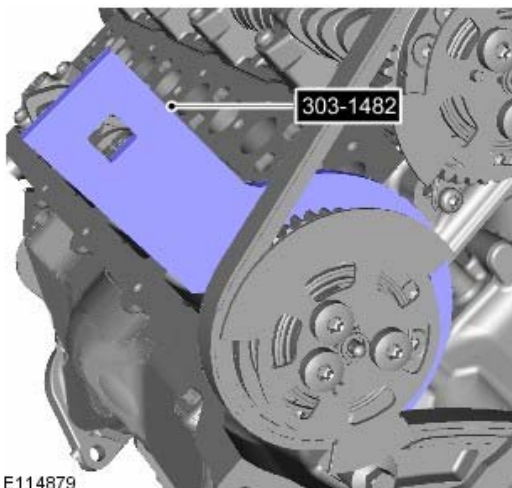
• NOTE: Make sure to tighten the exhaust VVT unit bolts first.

- Torque: 32 Nm
- Special Tool(s): [303-1482](#)



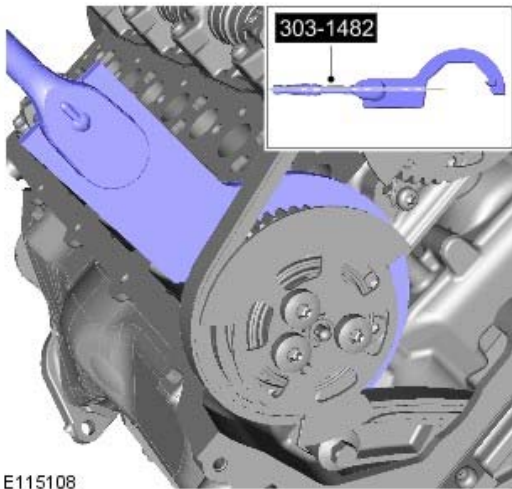
23.

- Install the oil suction tube.
- Torque: 10 Nm



24.

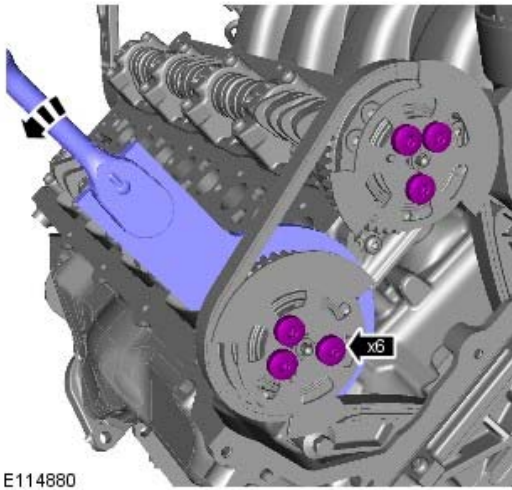
- Install the special tool.
- Special Tool(s): [303-1482](#)



E115108

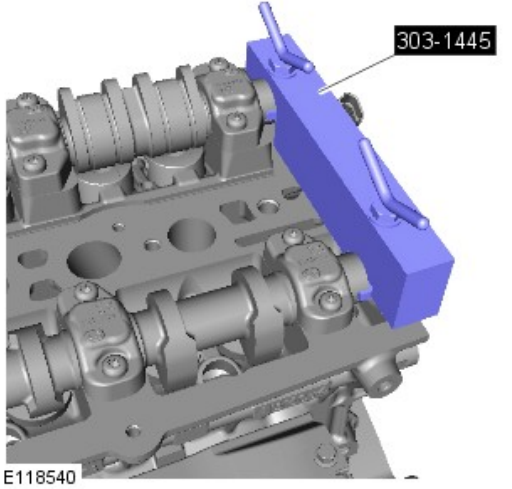
25. 25. CAUTIONS:

- ⚠ Apply the torque to the end of the special tool.
- ⚠ Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.
 - Install the torque wrench to the special tool.
 - Torque: 35 Nm



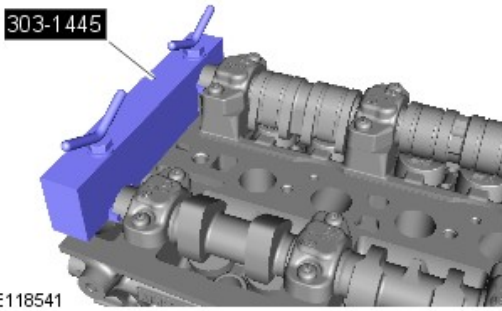
E114880

26. ⚠ CAUTION: Make sure that the torque wrench does not move whilst tightening the VVT bolts.
- NOTE: Make sure to tighten the inlet VVT unit bolts first.
- Torque: 32 Nm

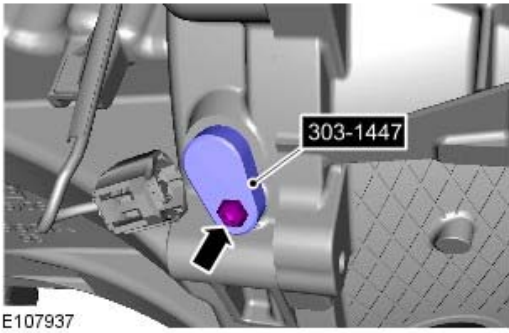


E118540

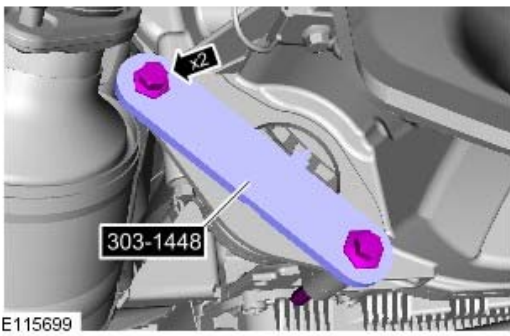
- 27.
- Remove the special tool.



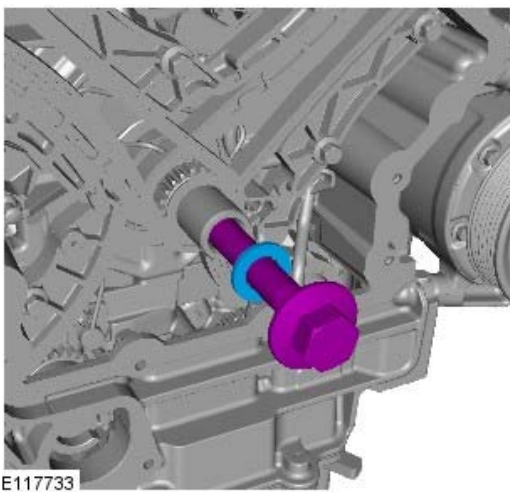
- 28.
- Remove the special tool.



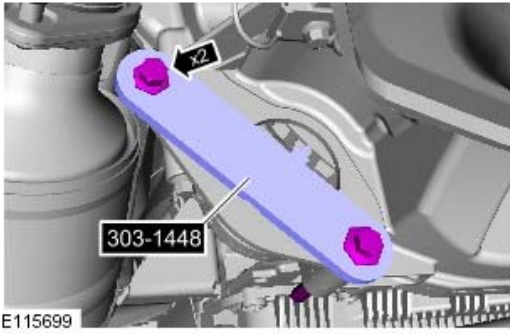
- 29.
- Remove the special tool.
 - *Special Tool(s):* [303-1447](#)



- 30.
- Install the special tool.
 - *Special Tool(s):* [303-1448](#)



31. **31.**  **CAUTION:** Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.
- Torque:* 50 Nm

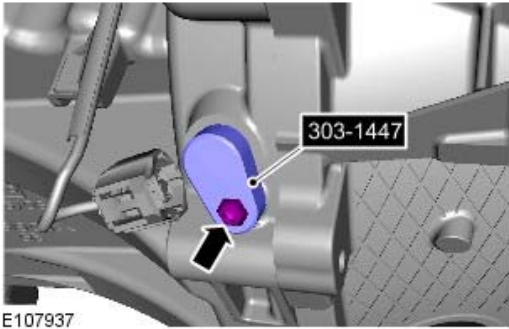


E115699

32.

- Remove the special tool.
- *Special Tool(s):* [303-1448](#)

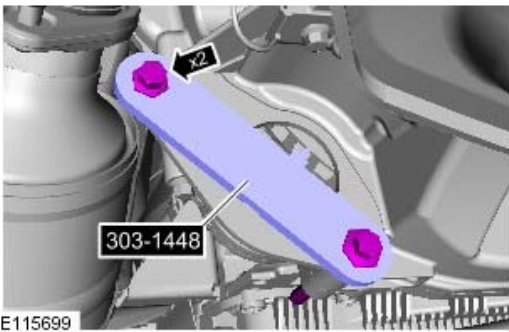
33. Rotate the engine two complete turns clockwise.



E107937

34. **34.**  **CAUTION:** Only rotate the crankshaft clockwise.

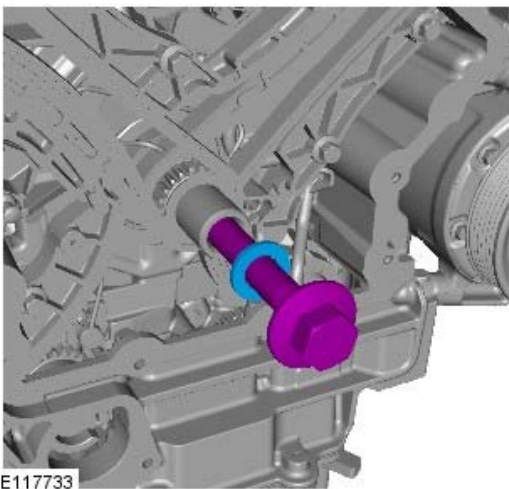
- Install the special tool.
- *Special Tool(s):* [303-1447](#)



E115699

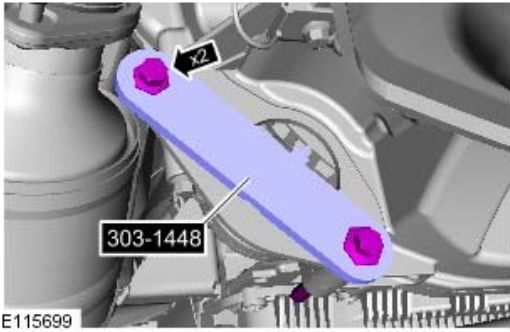
35.

- Install the special tool.
- *Special Tool(s):* [303-1448](#)



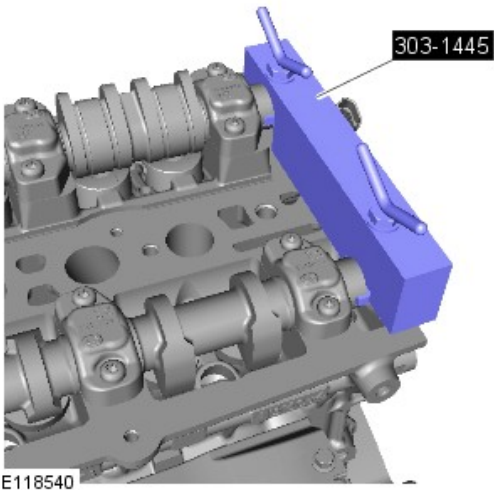
E117733

36.





37.

- Remove the special tool.
- *Special Tool(s):* [303-1448](#)



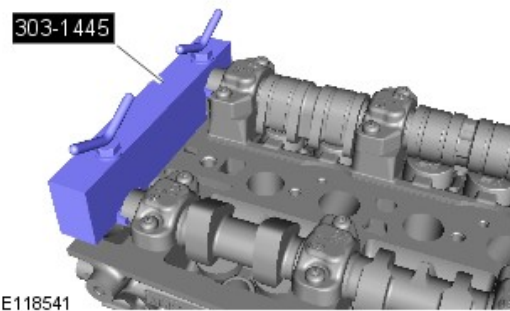
38. **38. CAUTIONS:**

 If the special tool cannot be installed, return to step 22 of the installation until the special tool 303-1445 is installed correctly.

 If directed to step 22, make sure that the VVT unit retaining bolts are loosened prior to installing the special tool(s).

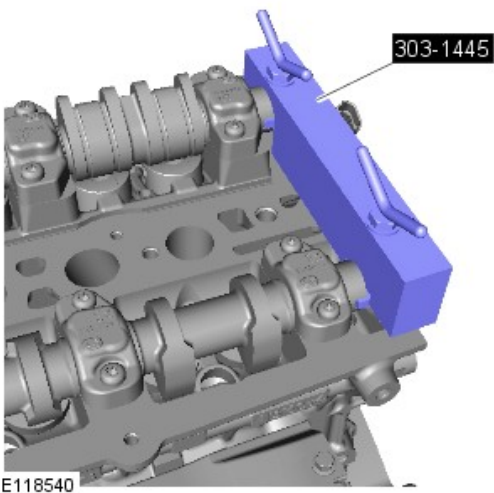
Install the special tool.

Special Tool(s): [303-1445](#)



39. **39.  CAUTION:** If the special tool cannot be installed, the timing chain installation steps must be repeated.

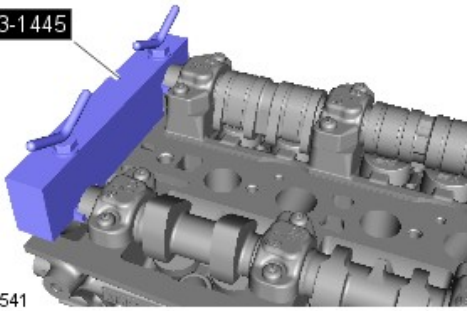
Install the special tool.



40.

- Remove the special tool.

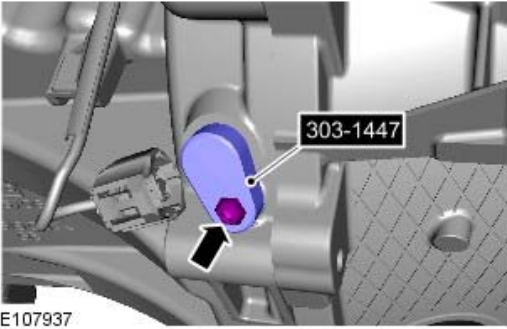
303-1445



E118541

41.

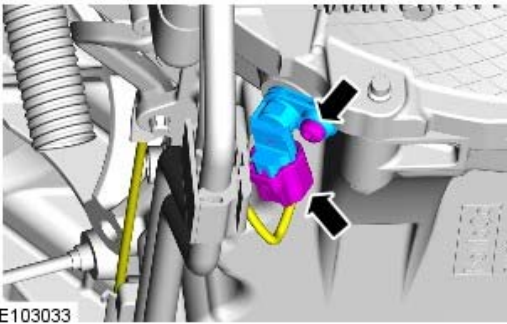
- Remove the special tool.



E107937

42.

- Remove the special tool.
- *Special Tool(s):* [303-1447](#)



E103033

43. *Torque:* 10 Nm

44. Refer to: [Timing Cover](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).





45. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Timing Drive Components Assembly Part Number: Tsubaki Timing Drive

Removal and Installation

Special Tool(s)

 <p>E115263</p>	<p>303-1445 Timing Tool – Camshaft Alignment</p>
 <p>E115265</p>	<p>303-1447 Timing Tool</p>
 <p>E115266</p>	<p>303-1448 Locking Tool</p>
 <p>E115270</p>	<p>303-1452 Camshaft Rotating Tool</p>
 <p>E115271</p>	<p>303-1482 Tensioner Tool</p>

Removal

 **CAUTION:** Check all timing components for wear and install new components if required.

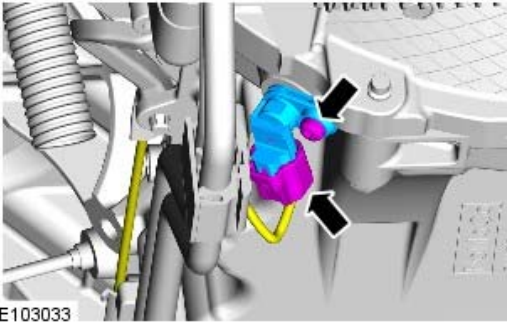
• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

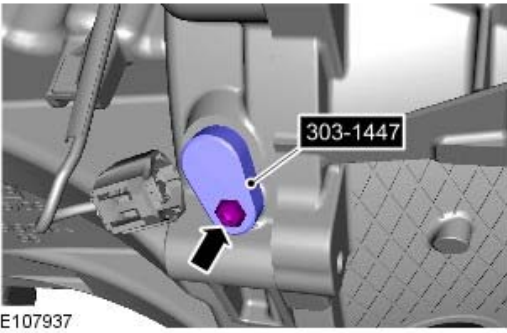
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


2.  **WARNING:** Make sure to support the vehicle with axle stands.

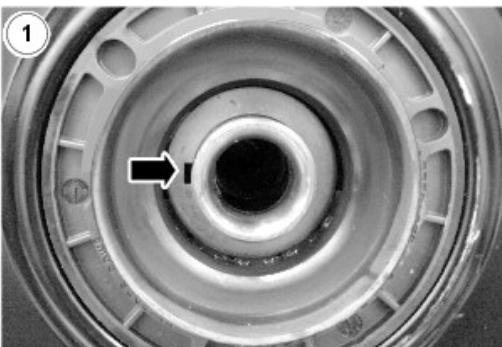
Raise and support the vehicle.




3.

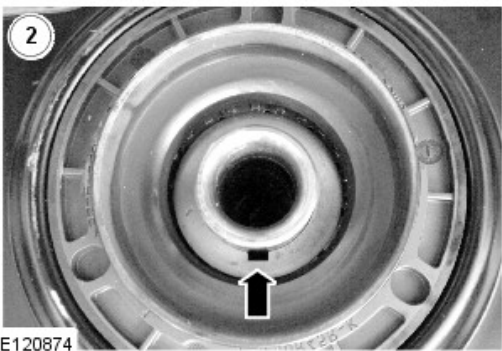


4.  CAUTION: Only rotate the crankshaft clockwise.
Install the special tool.



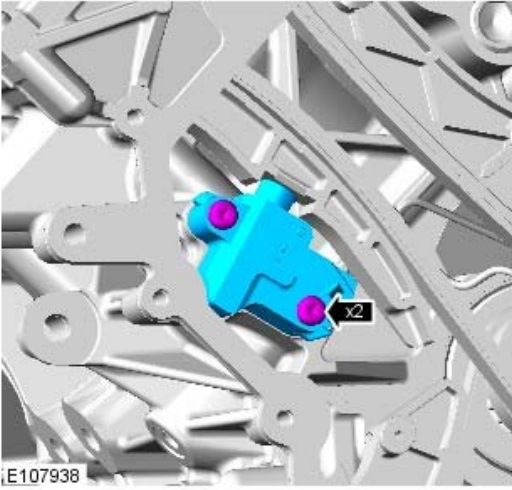
5.  CAUTION: If the noted position of the woodruff key is at the 9 o'clock position, then a new flexplate must be installed. If the woodruff key is in the 6 o'clock position then proceed with the next step.

Note the position of the crankshaft woodruff key.

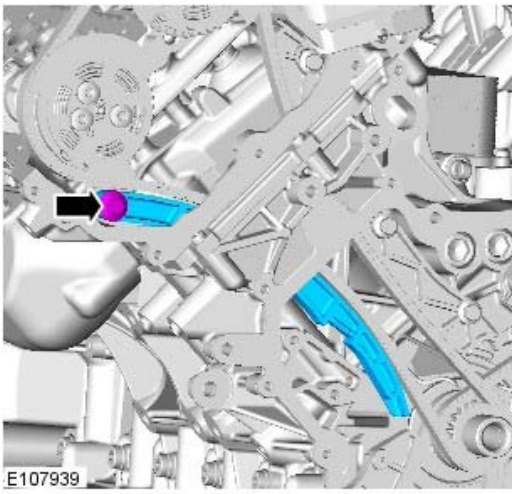


6. Refer to: [Timing Cover](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

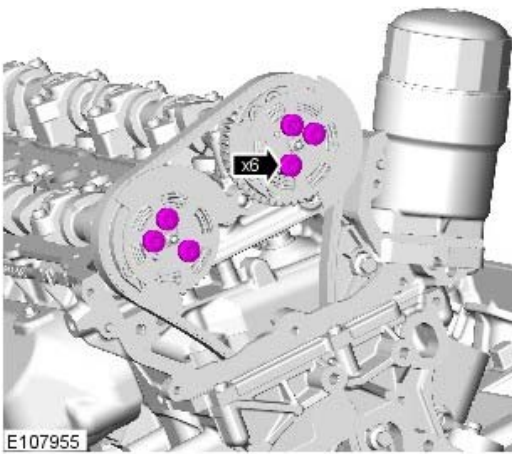
7.

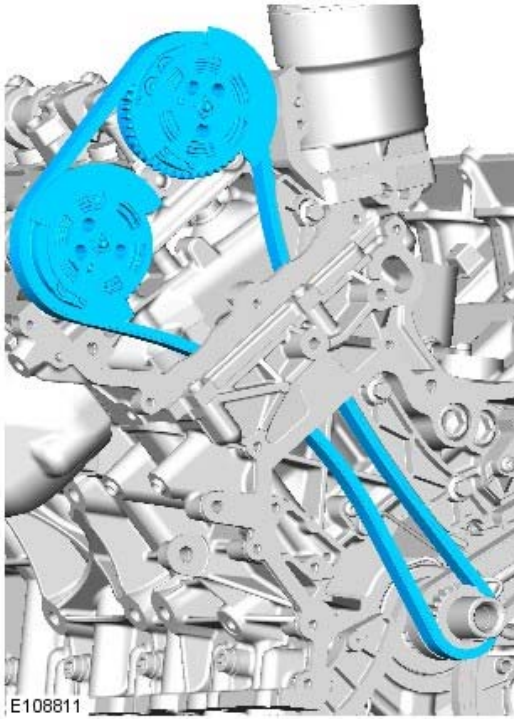



8.



9.

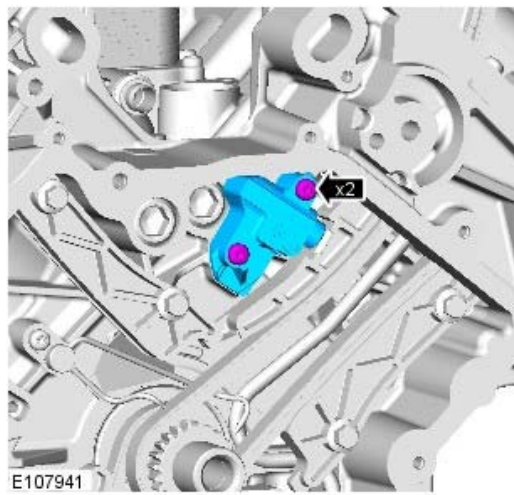




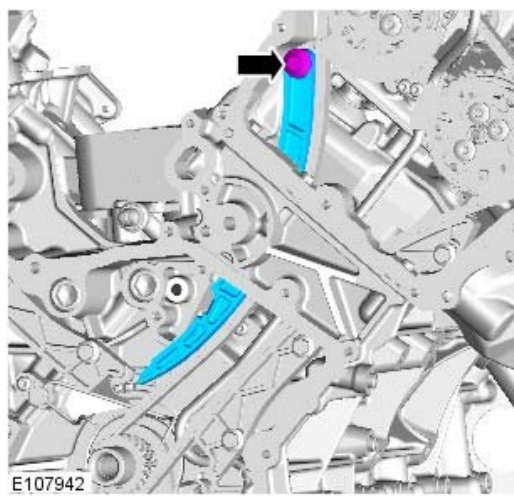
10. **10.**  CAUTION: If the variable valve timing (VVT) units are knocked or dropped then the VVT must be replaced.

Remove the timing chain with the VVT units.

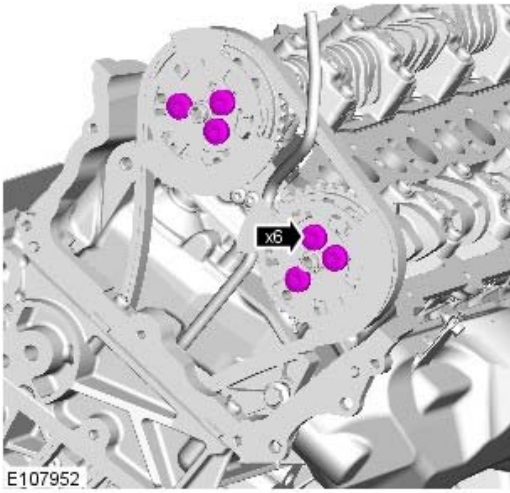
11.



12.

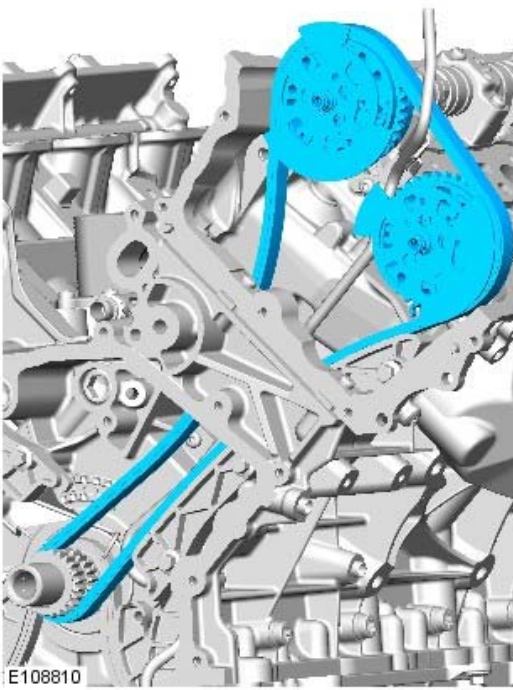


13.

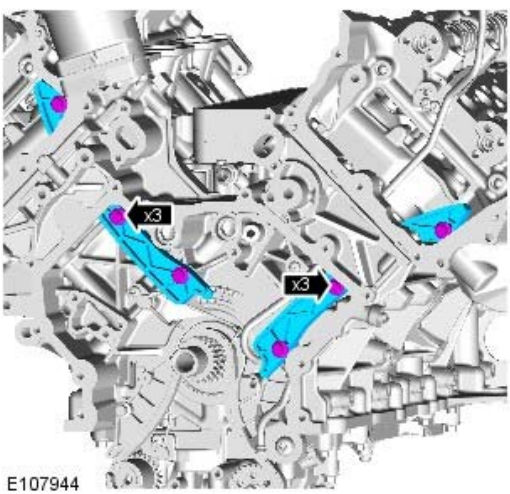


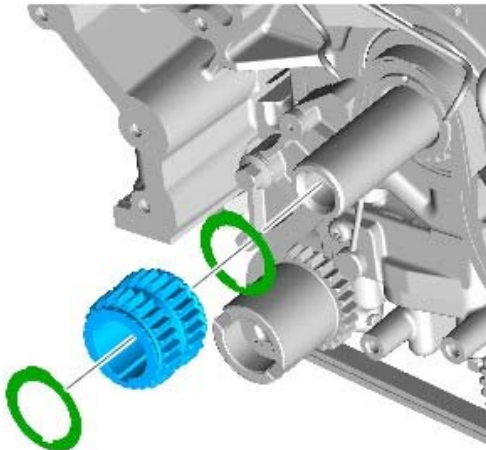
14. **14.**  CAUTION: If the VVT is knocked or dropped then the VVT must be replaced.

Remove the timing chain with the VVT units.



15.

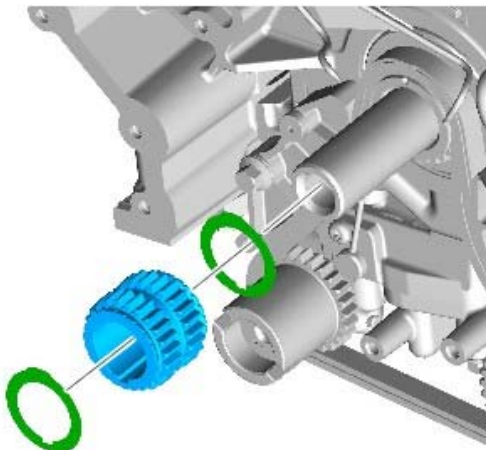




E107945

16. **16.**  CAUTION: Discard the friction washers.

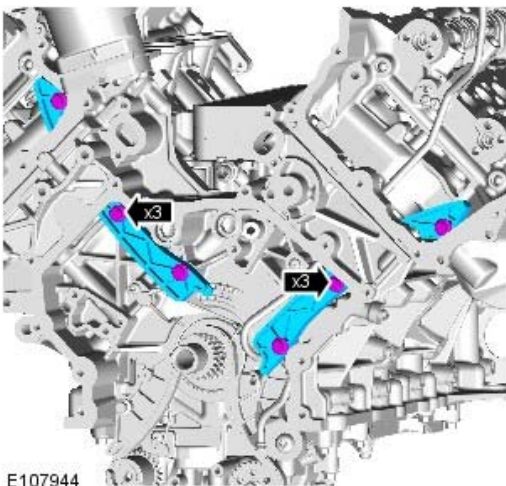
Installation



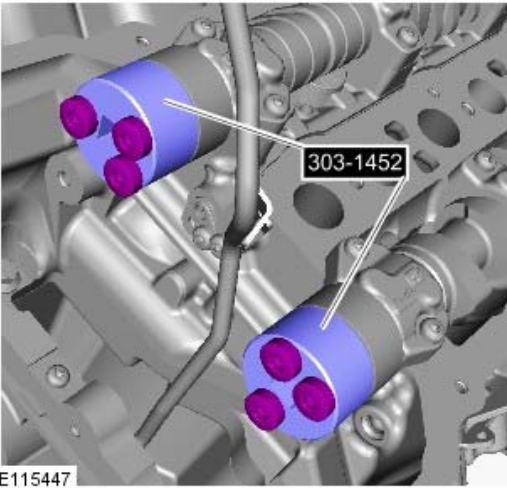
E107945

1. **1.**  CAUTION: Install new friction washers.

2. *Torque: 12 Nm*



E107944



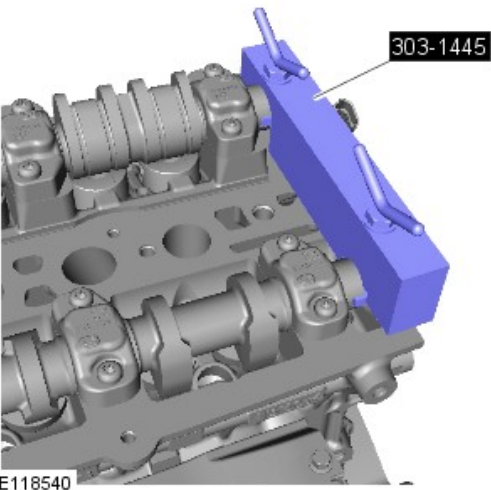
3.

- Install the special tool to the LH bank Camshafts.
- *Special Tool(s):* [303-1452](#)
- *Torque:* 10 Nm



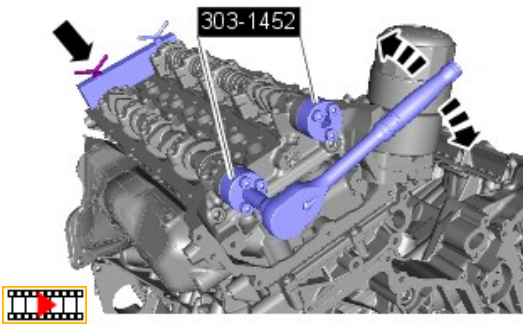
4.

- Carefully rotate the camshafts if the position is not as shown.



5.

- Install the special tool 303-1445 to the rear of the camshafts making sure the key way's are correctly located into each slot on each of the camshafts.



6. 6. CAUTIONS:

 Do not overturn the camshafts.

 Tighten the wing nuts finger tight. Failure to follow this instruction may result in damage to the components.

- Using a suitable tool, carefully rock the camshaft clockwise then anti-clockwise. Turn the special tool locking nuts until there is no movement left in camshafts.
- Repeat steps 3- 6 for the camshafts on the other cylinder head.

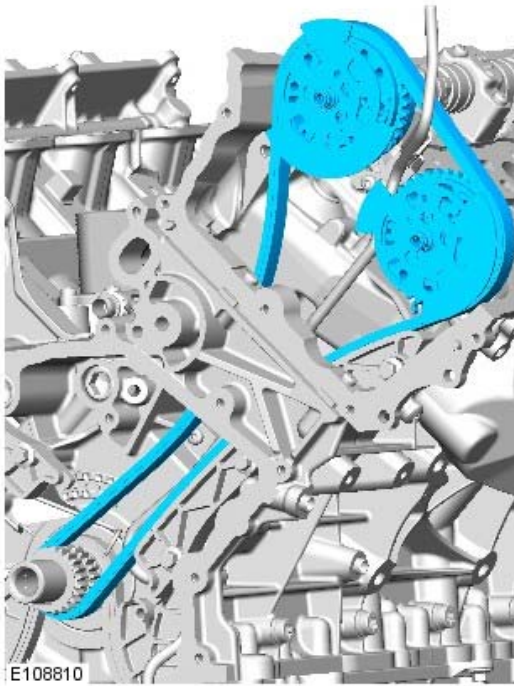
7. 7. CAUTIONS:

 Do not allow the camshaft to rotate.

 If the VVT is knocked or dropped then the VVT must be replaced.

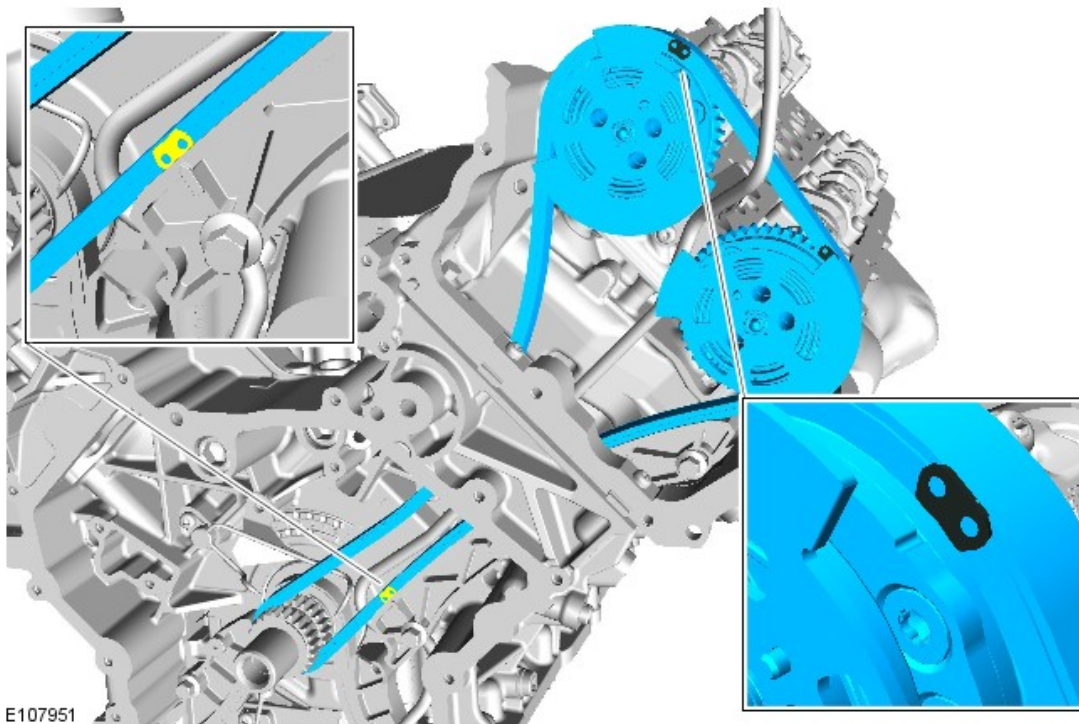
• NOTE: Do not tighten at this stage.

- Install the timing chain with the variable valve timing (VVT) units.



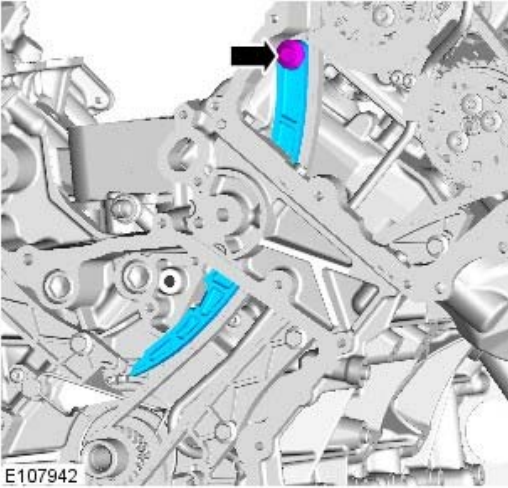
8.


- Make sure that all the timing chain alignment marks are in the positions shown.



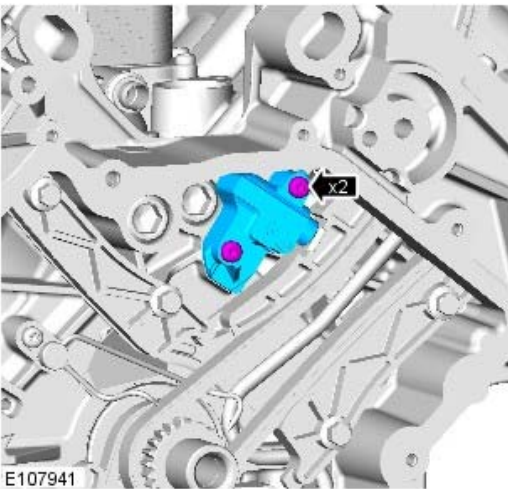
E107951

9. *Torque: 25 Nm*



10. **10.**  CAUTION: Do not release the timing chain tensioner locking pin at this stage.

Torque: 10 Nm



11. **11.** CAUTIONS:

 Do not allow the camshafts to rotate.

 If the VVT is knocked or dropped then the VVT must be replaced.

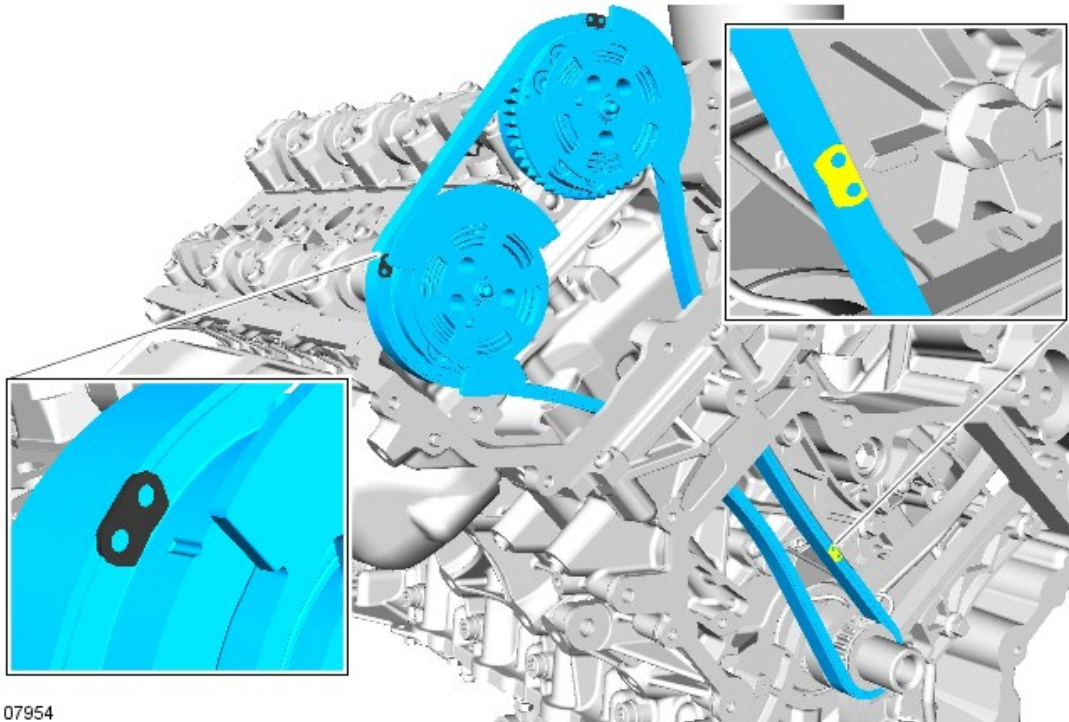
• NOTE: Do not tighten at this stage.

- Install the timing chain with the VVT units.



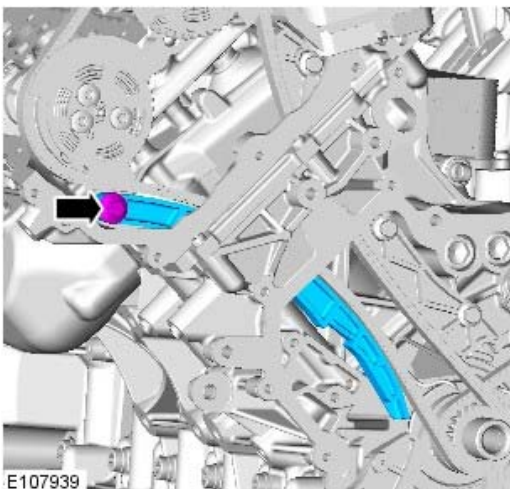
12.

- Make sure that all the timing chain alignment marks are in the positions shown.




E107954

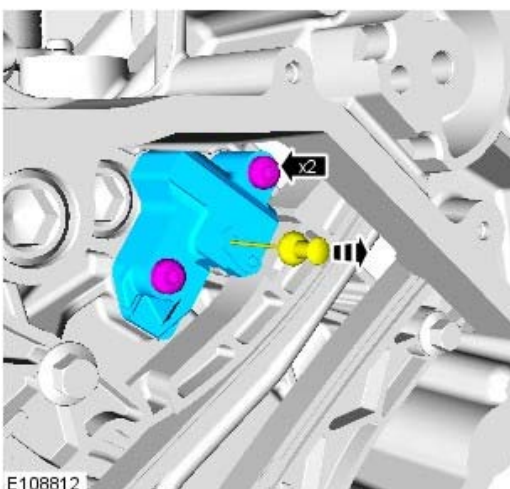
13. *Torque: 25 Nm*



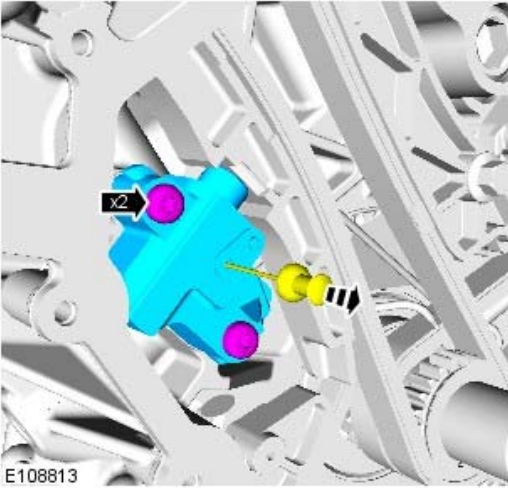
E107939


14. **14.**  **CAUTION:** Do not use mechanical force. Make sure that the tensioners are fully deployed.

Torque: 10 Nm

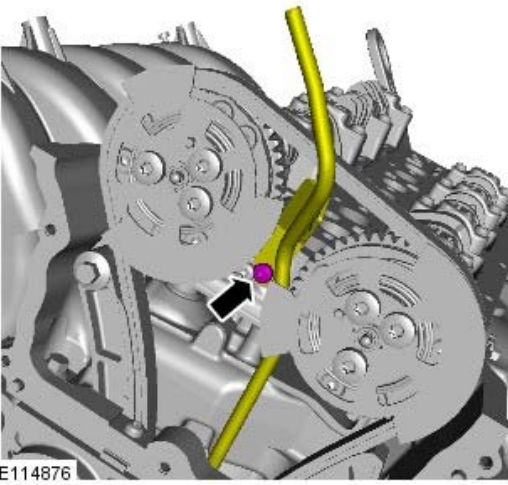


E108812

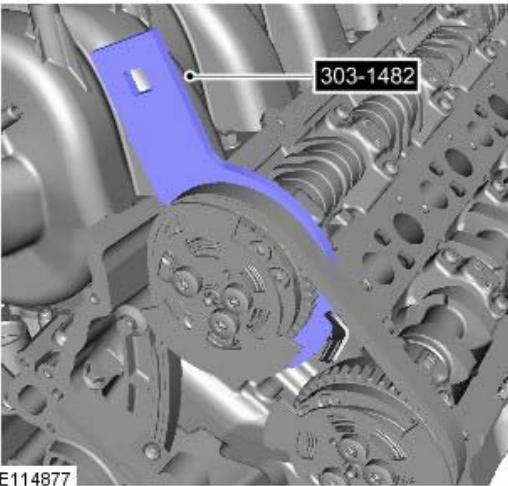


15. **15.**  **CAUTION:** Do not use mechanical force.
Make sure that the tensioners are fully deployed.

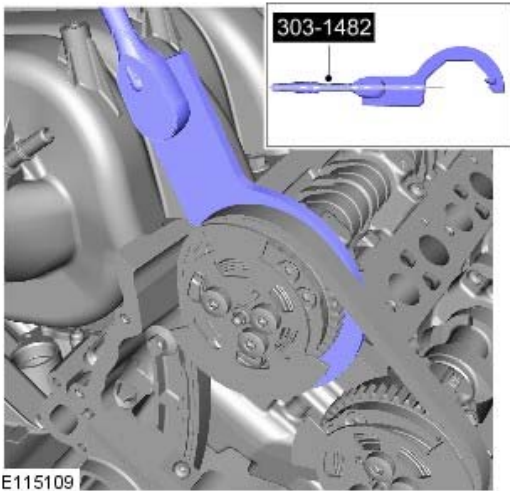
Torque: 10 Nm



- 16.
- Release and reposition the oil suction tube to one side.

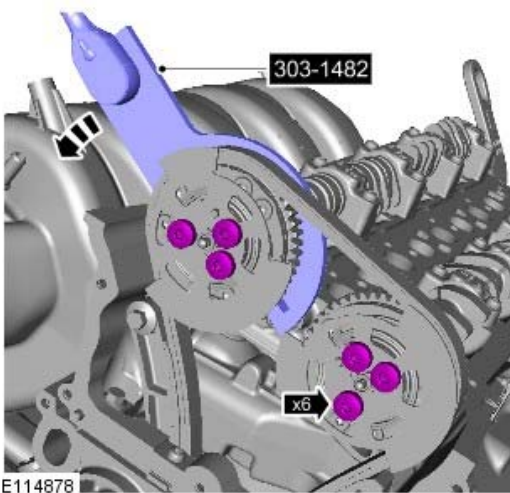


- 17.
- Install the special tool.
 - *Special Tool(s):* [303-1482](#)



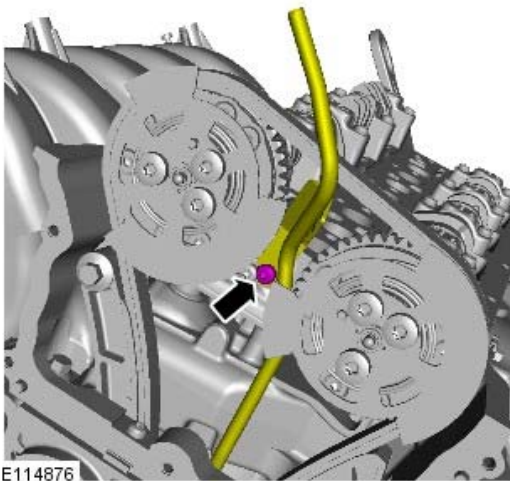
18. **18. CAUTIONS:**

- ⚠ Apply the torque to the end of the special tool.
- ⚠ Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.
 - Install the torque wrench to the special tool.
 - Torque: 35 Nm



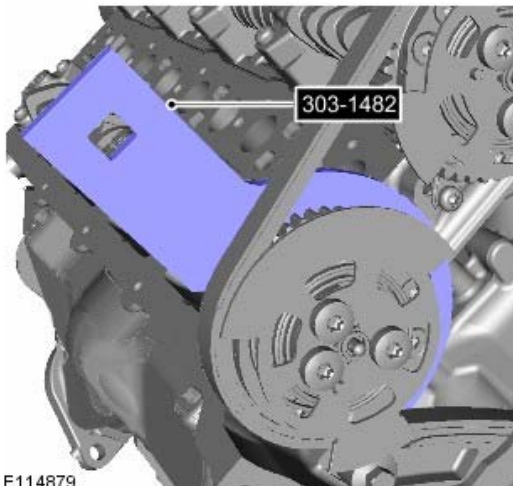
19. **19. ⚠ CAUTION:** Make sure that the torque wrench does not move whilst tightening the VVT bolts.

- NOTE: Make sure to tighten the exhaust VVT unit bolts first.
 - Torque: 32 Nm
 - Special Tool(s): 303-1482



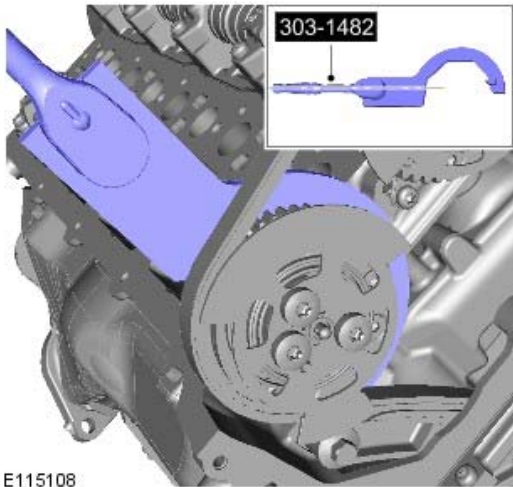
20.

- Install the oil suction tube.
- Torque: 10 Nm



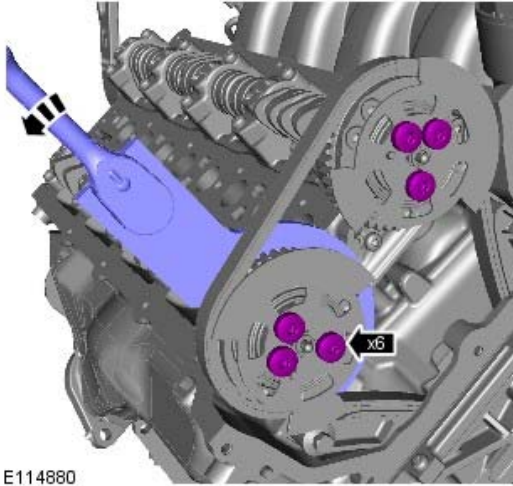
E114879

- 21.
- Install the special tool.
 - *Special Tool(s):* [303-1482](#)



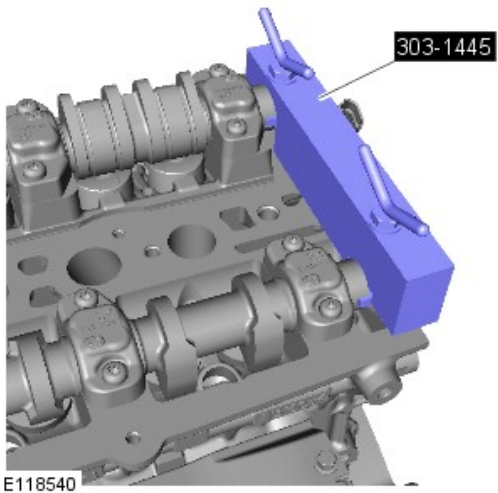
E115108

22. **22. CAUTIONS:**
- ⚠ Apply the torque to the end of the special tool.
 - ⚠ Make sure that the torque wrench is aligned with the special tool as illustrated in the graphic.
 - Install the torque wrench to the special tool.
 - *Special Tool(s):* [303-1482](#)
 - *Torque:* [35 Nm](#)



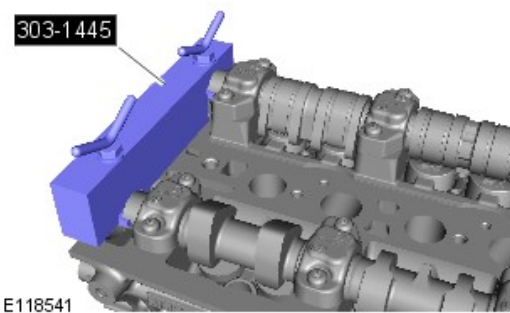
E114880

23. **23. ⚠ CAUTION:** Make sure that the torque wrench does not move whilst tightening the VVT bolts.
- **NOTE:** Make sure to tighten the inlet VVT unit bolts first.
- Torque:* [32 Nm](#)



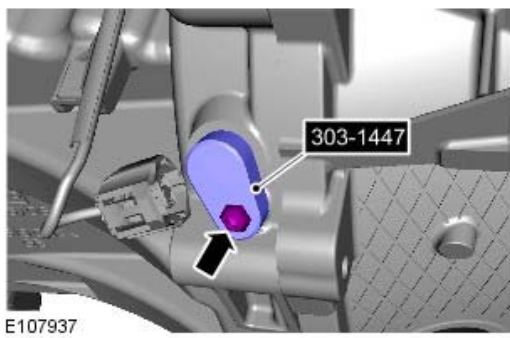
24.

- Remove the special tool.



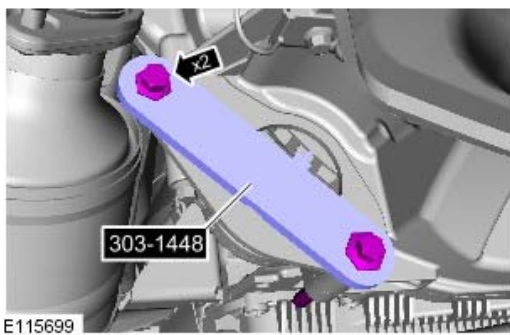
25.

- Remove the special tool.



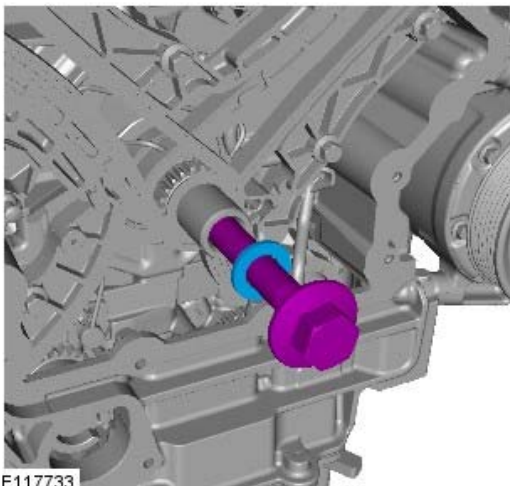
26.

- Remove the special tool.
- *Special Tool(s):* [303-1447](#)



27.

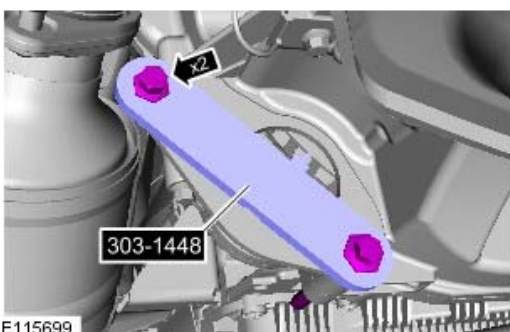
- Install the special tool.
- *Special Tool(s):* [303-1448](#)



E117733

28. **28.**  **CAUTION:** Install the crankshaft pulley bolt with an M16 washer to prevent damage to the crankshaft on installation.

Torque: 50 Nm

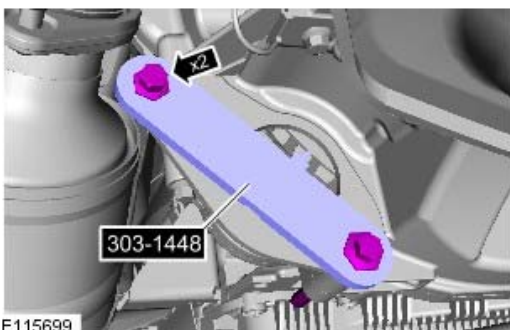


E115699

29.

- Remove the special tool.
- *Special Tool(s):* [303-1448](#)

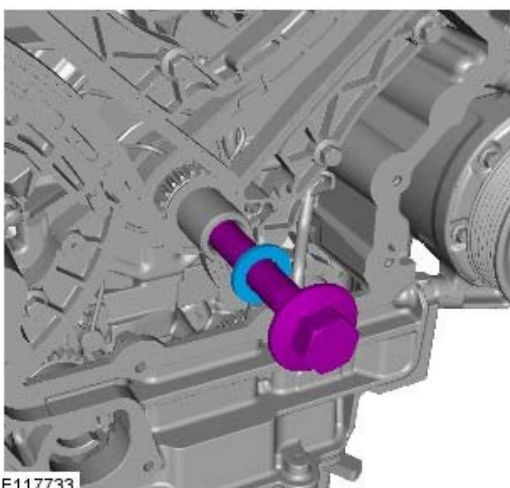
30. Rotate the engine two complete turns clockwise.



E115699

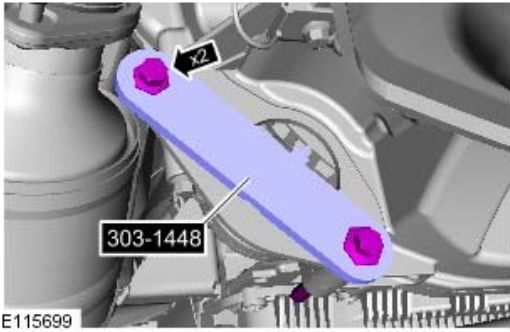
31.

- Install the special tool.
- *Special Tool(s):* [303-1448](#)



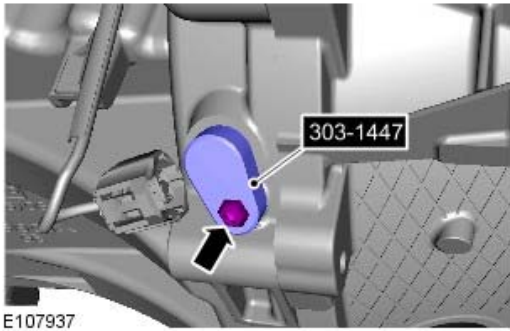
E117733

32.



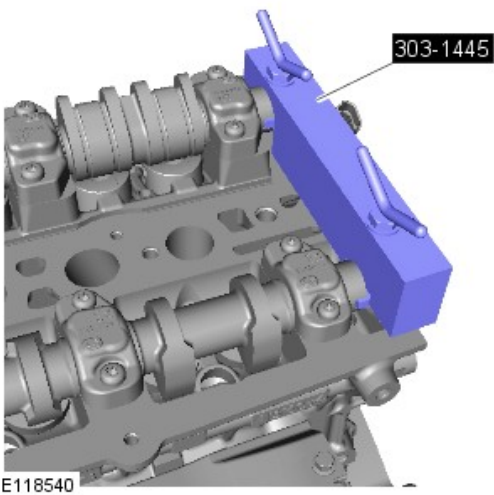
33.

- Remove the special tool.
- *Special Tool(s):* [303-1448](#)





34. **34.**  **CAUTION:** Only rotate the crankshaft clockwise.

- Install the special tool.
- *Special Tool(s):* [303-1447](#)

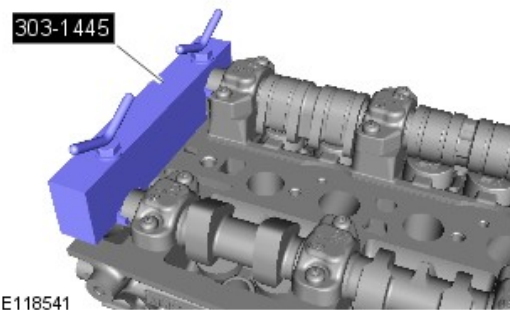


35. **35.** CAUTIONS:

 If the special tool cannot be installed, return to step 22 of the installation until the special tool 303-1445 is installed correctly.

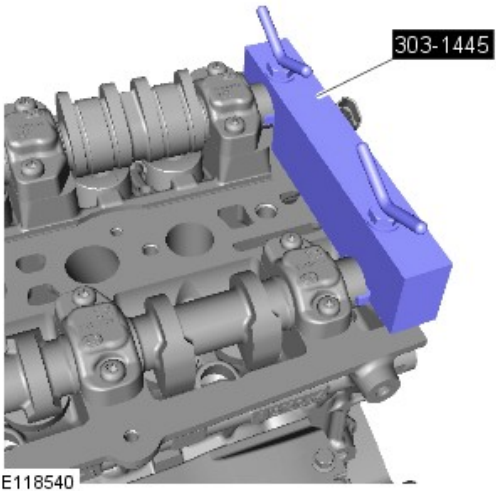
 If directed to step 22, make sure that the VVT unit retaining bolts are loosened prior to installing the special tool(s).

Install the special tool.

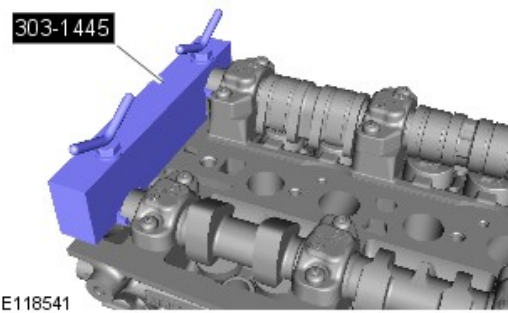


36. **36.**  **CAUTION:** If the special tool cannot be installed, the timing chain installation steps must be repeated.

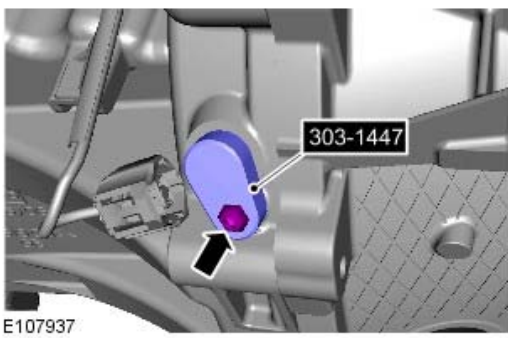
Install the special tool.



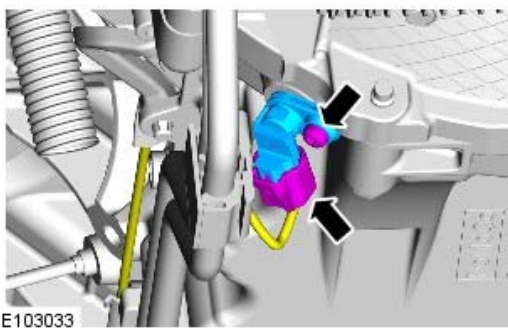
- 37.
- Remove the special tool.



- 38.
- Remove the special tool.
 - *Special Tool(s):* [303-1445](#)



- 39.
- Remove the special tool.
 - *Special Tool(s):* [303-1447](#)



40. *Torque:* 10 Nm

41. Refer to: [Timing Cover](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

42. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Valve Cover LH

Removal and Installation

Special Tool(s)

 <p>E116982</p>	<p>303-1446 Valve Cover Alignment Tool</p>
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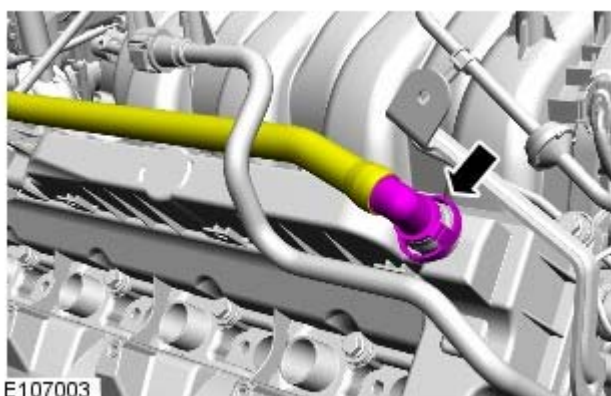
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

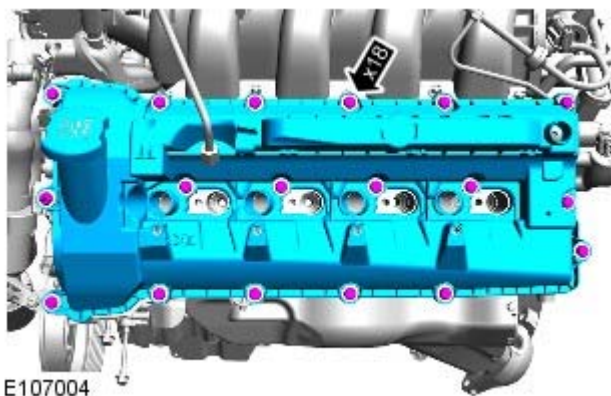
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Air Cleaner LH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
3. Refer to: [Fuel Rail LH](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Removal and Installation).

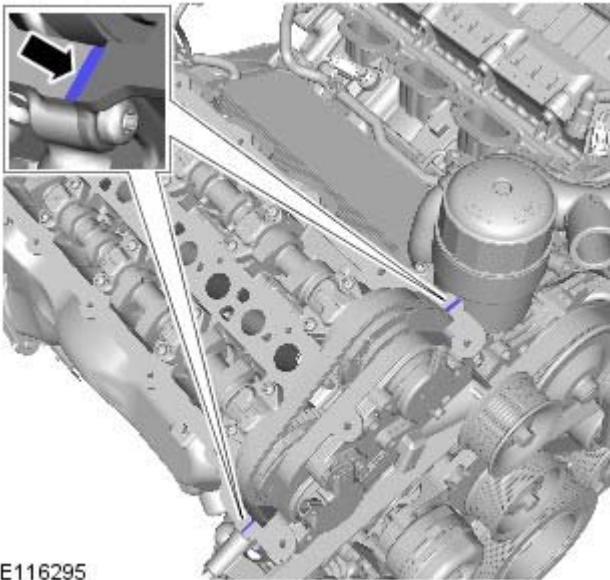


- 4.



- 5.

Installation



E116295

1. **1. CAUTIONS:**

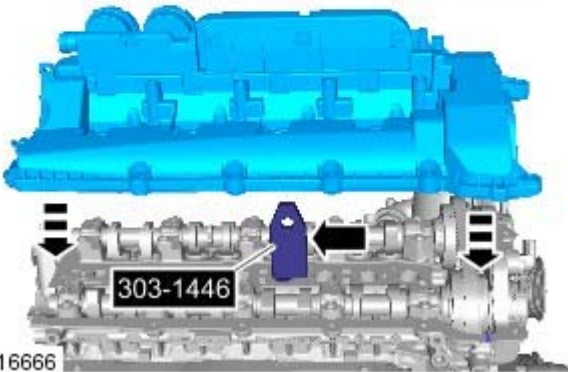
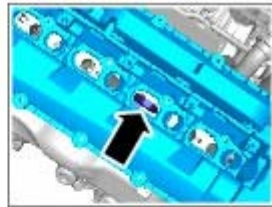
- Use only a plastic scraper when removing the sealing material.
- Use lint free cloth.
- Make sure that the mating faces are clean and free of corrosion and foreign material.
- Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

- NOTE: Apply two beads of silicone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

- NOTE: RH illustration shown, LH is similar.

To install, reverse the removal procedure.

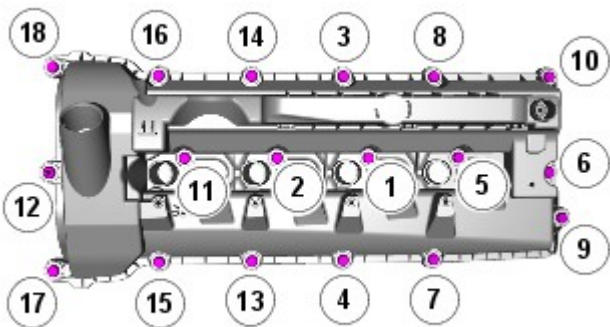
2. *Special Tool(s):* [303-1446](#)



E116666

3. **3. NOTE:** Tighten the bolts in the indicated sequence.

Torque: 13 Nm




E107006

Engine - V8 5.0L Petrol - Valve Cover RH

Removal and Installation

Special Tool(s)

 E116982	303-1446 Valve Cover Alignment Tool
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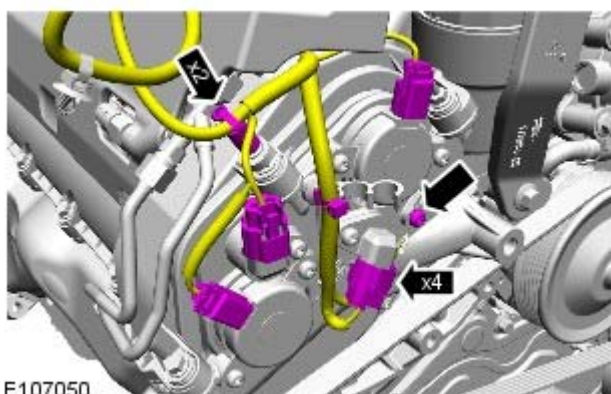
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

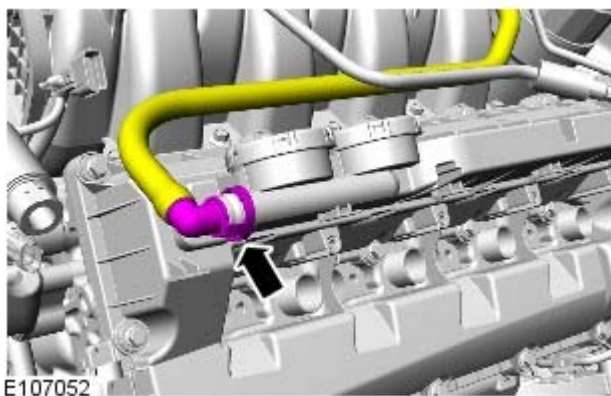
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

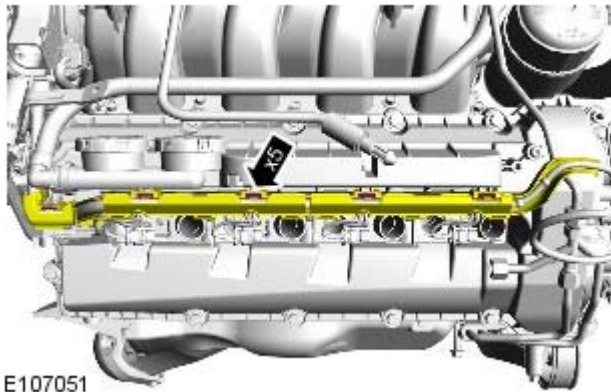
2. Refer to: [Air Cleaner RH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
3. Refer to: [Fuel Rail RH](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Removal and Installation).



4.



5.



E107051

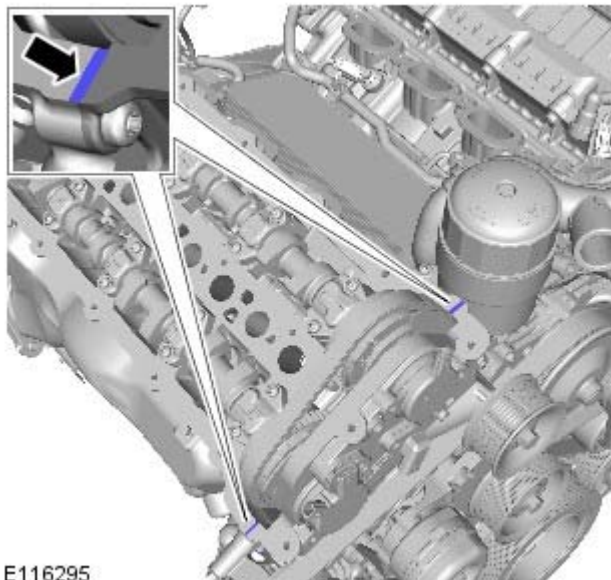
6.



E107057

7.

Installation



E116295

1. 1. CAUTIONS:



Use only a plastic scraper when removing the sealing material.



Use lint free cloth.



Make sure that the mating faces are clean and free of corrosion and foreign material.

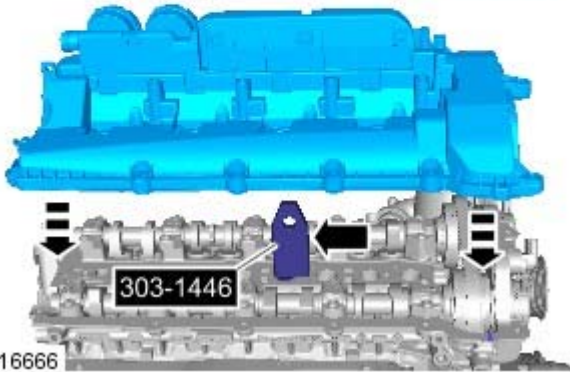
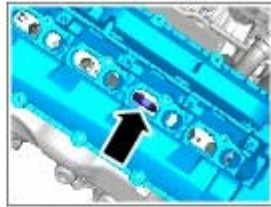


Installation of the valve cover and tightening must be carried out within 7 minutes of applying the sealant.

• NOTE: Apply two beads of silicone gasket sealant (Loctite 5901) as shown on the illustration. The application of the sealant must be 1.5mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

To install, reverse the removal procedure.

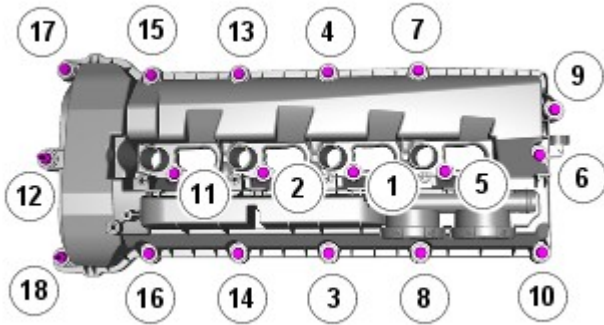
2. *Special Tool(s):* [303-1446](#)



E116666

3. **3.** NOTE: Tighten the bolts in the indicated sequence.

Torque: 13 Nm



E107058

Engine - V8 5.0L Petrol - Cylinder Block Oil Gallery Plug

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

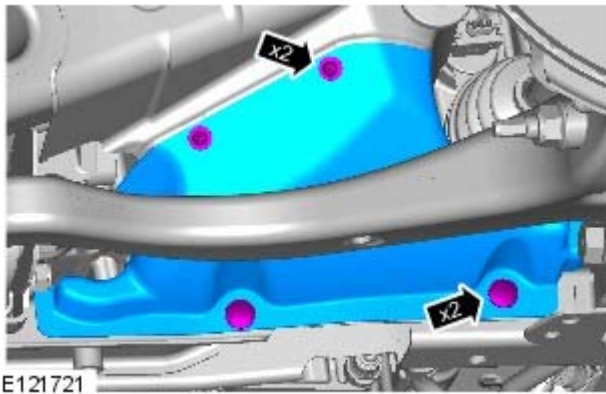
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

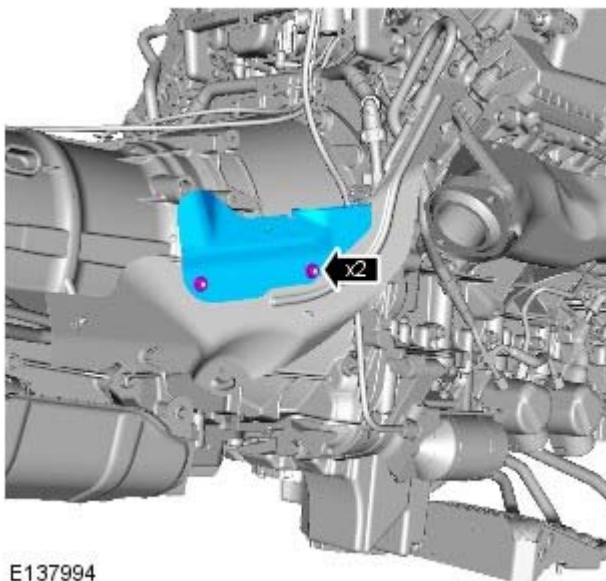
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

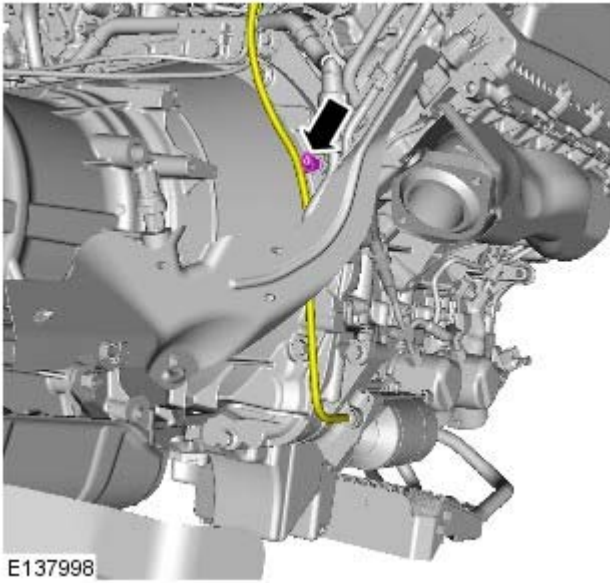
3. Refer to: [Catalytic Converter RH](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).



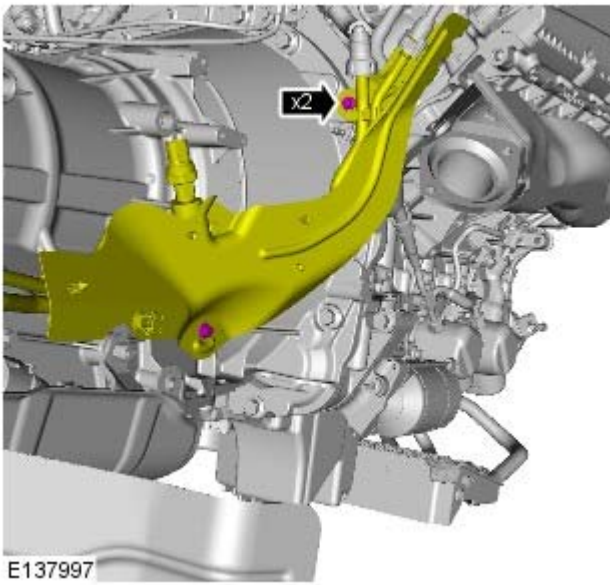
- 4.



- 5.

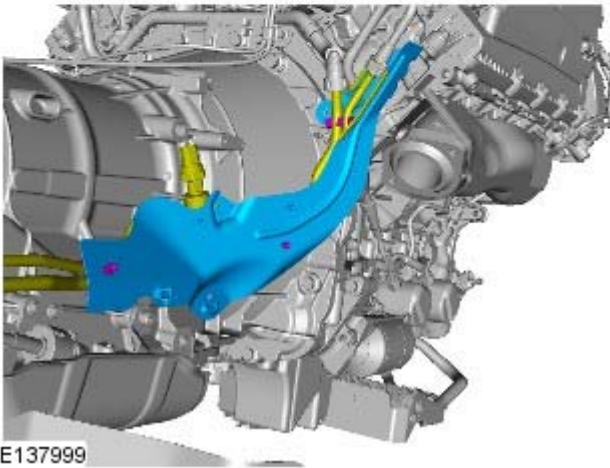
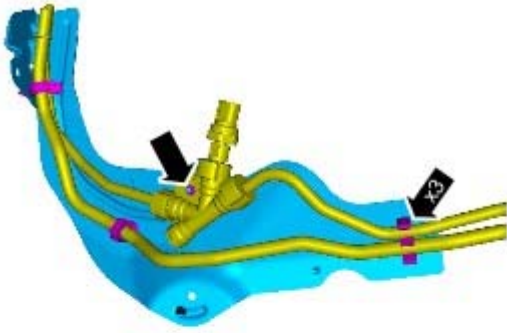


6.



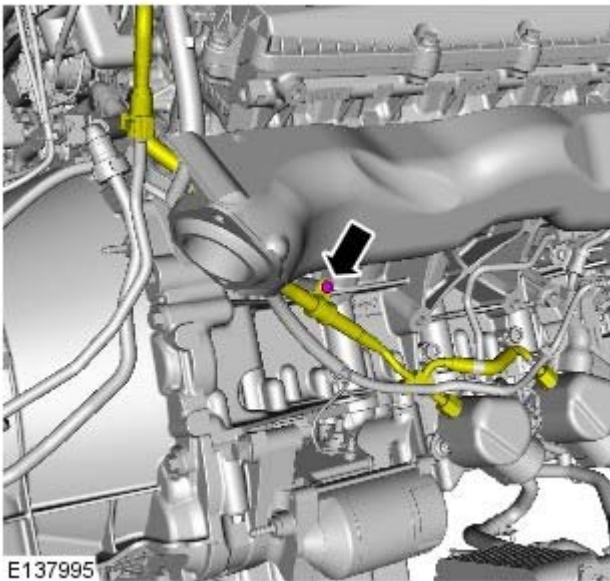
7. Torque: 10 Nm

8. Torque: 10 Nm

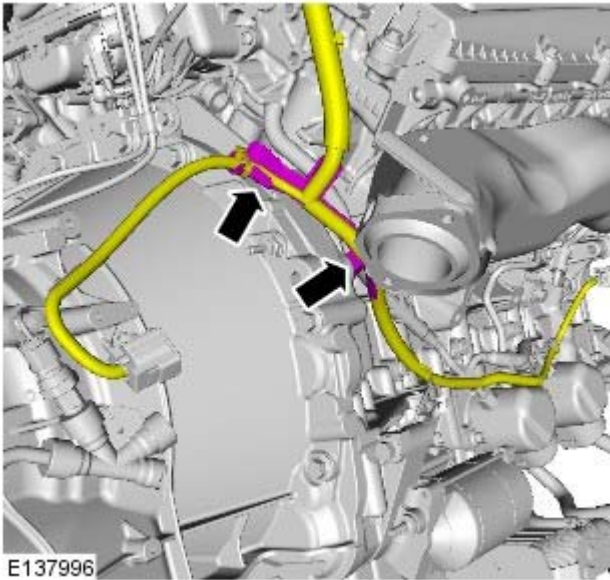


E137999

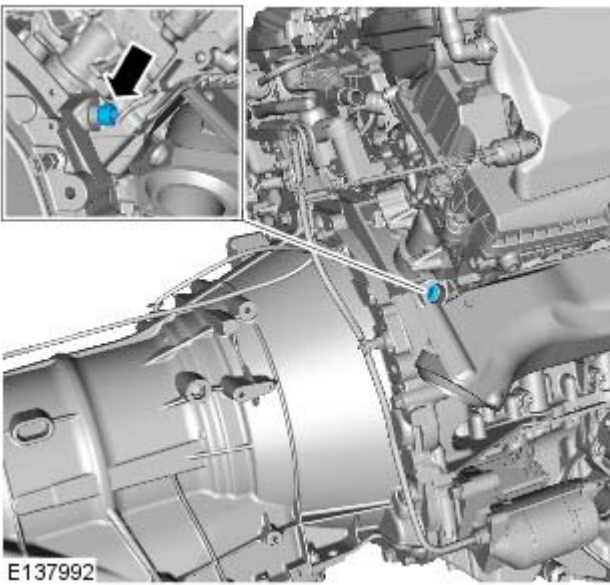
9. Torque: 12 Nm



E137995



10.



11. **⚠ CAUTION:** Make sure that the mating faces are clean and free of corrosion and foreign material.

Torque:
Stage 1: 40 Nm
Stage 2: 180°

Installation

1. To install, reverse the removal procedure.

Engine - V8 5.0L Petrol - Fuel Pump Camshaft Assembly Part Number: INA Timing Drive

Removal and Installation

Removal

• NOTE: Some illustrations may show the engine removed for clarity.

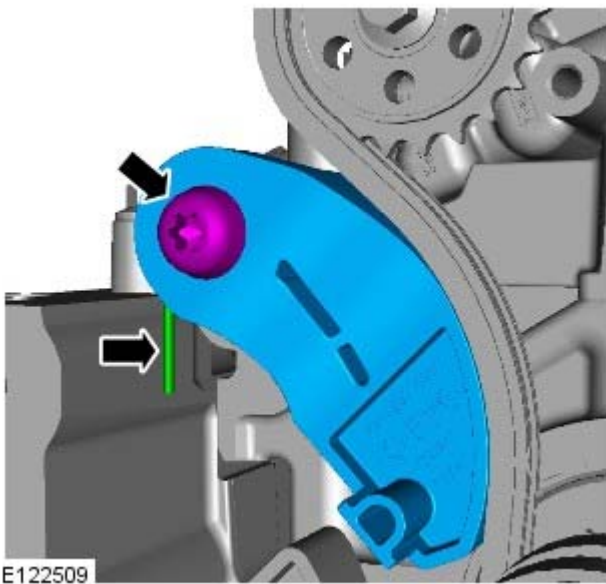
1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

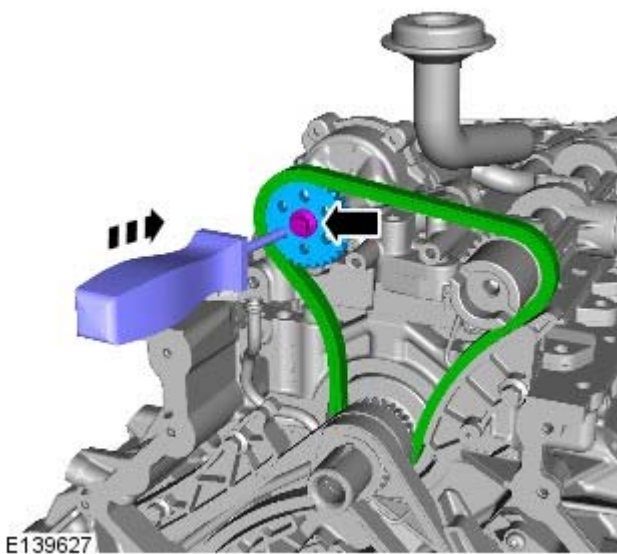
Raise and support the vehicle.

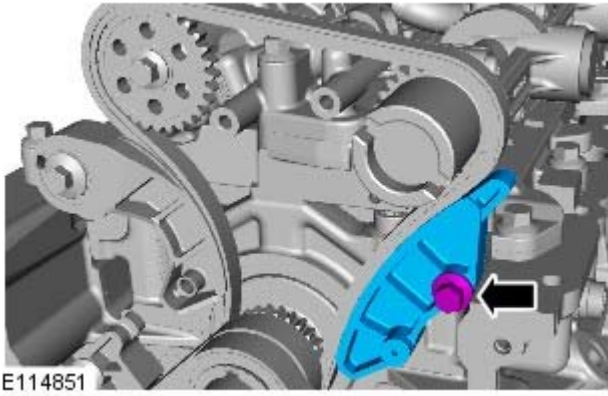
3. Refer to: [Oil Pan Extension](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

4.

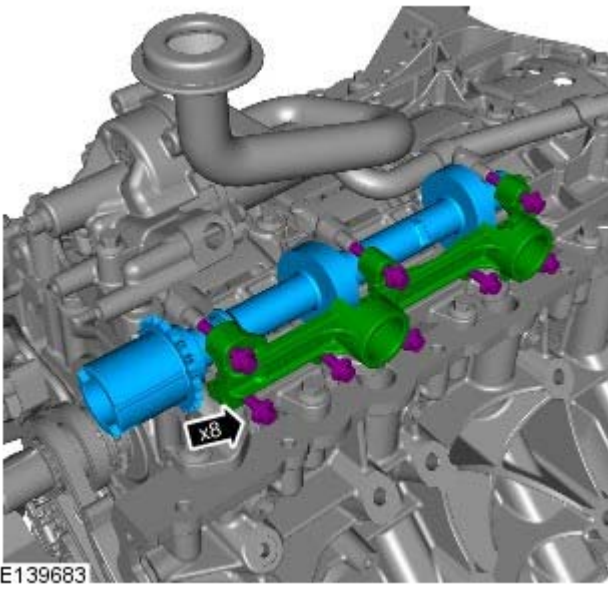



5.






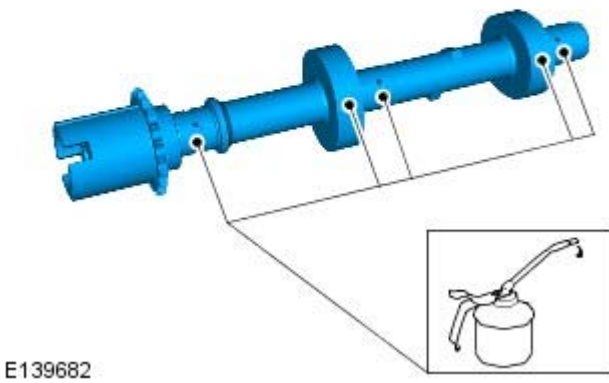
6.

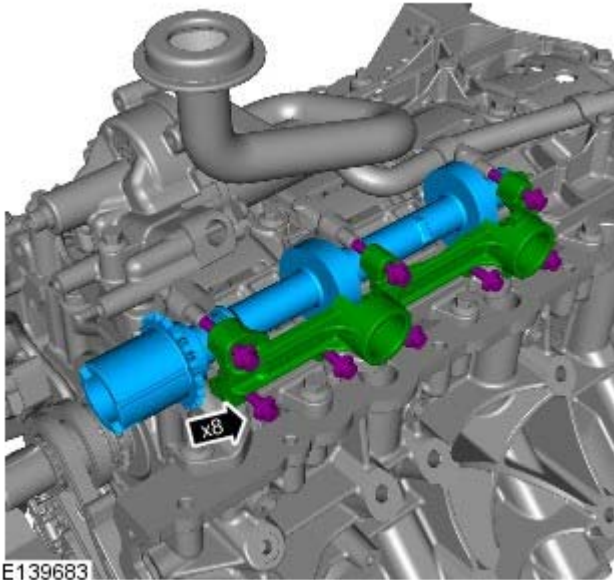


7.  CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

Installation

1.  CAUTION: Make sure that the mating faces are clean and free of foreign material.

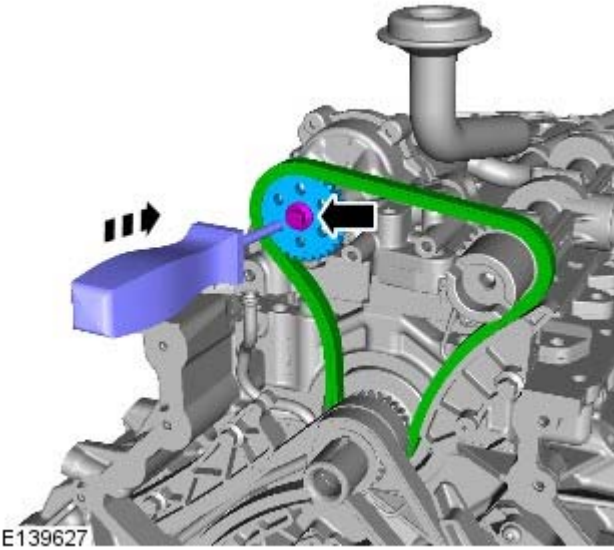




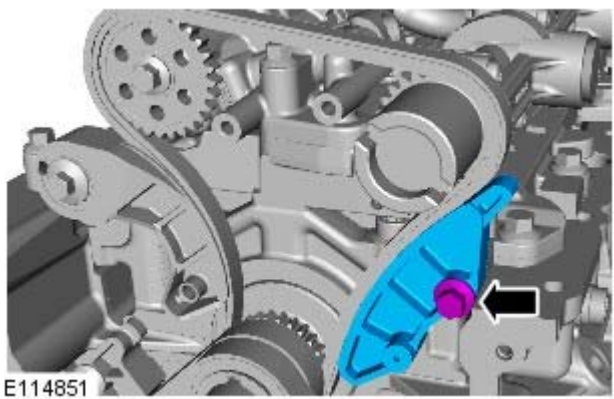
2.  CAUTION: Take extra care not to damage the mating faces.

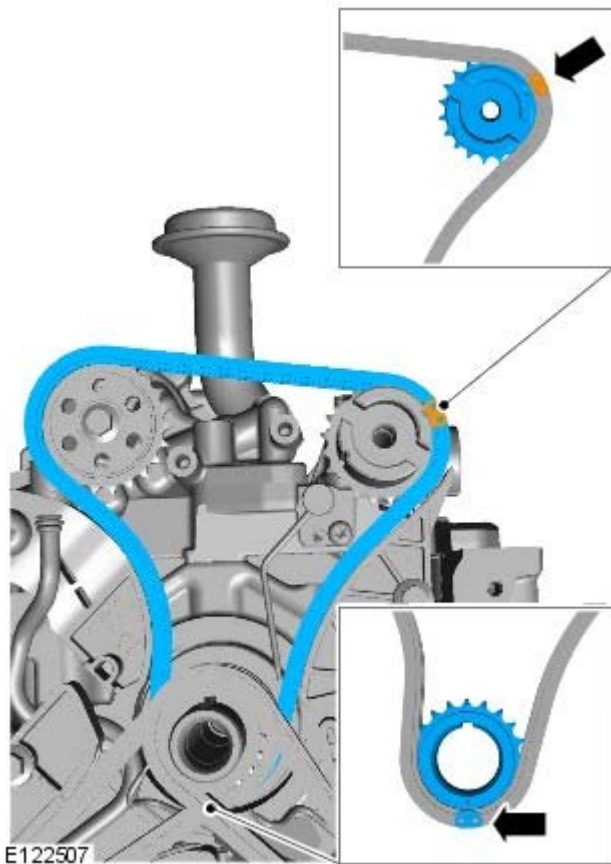
Torque: 12 Nm

3. *Torque:* 21 Nm

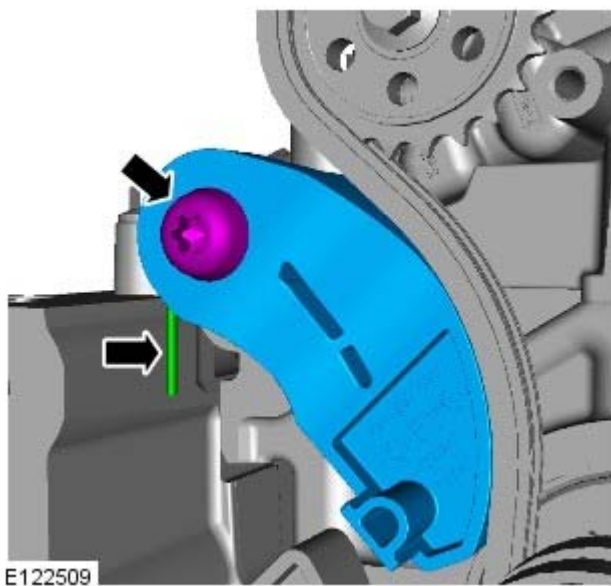


4. *Torque:* 12 Nm





5. Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.



6.  CAUTION: Make sure that the tensioner spring is correctly located.

Torque: 21 Nm

7. Refer to: [Oil Pan Extension](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

8. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Fuel Pump Camshaft Assembly Part Number: Tsubaki Timing Drive

Removal and Installation

Removal

- NOTE: Some illustrations may show the engine removed for clarity.

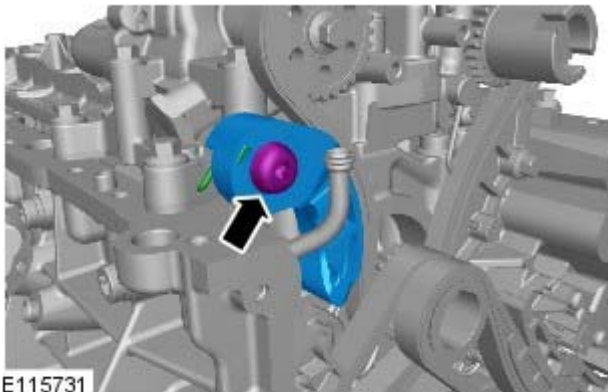
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

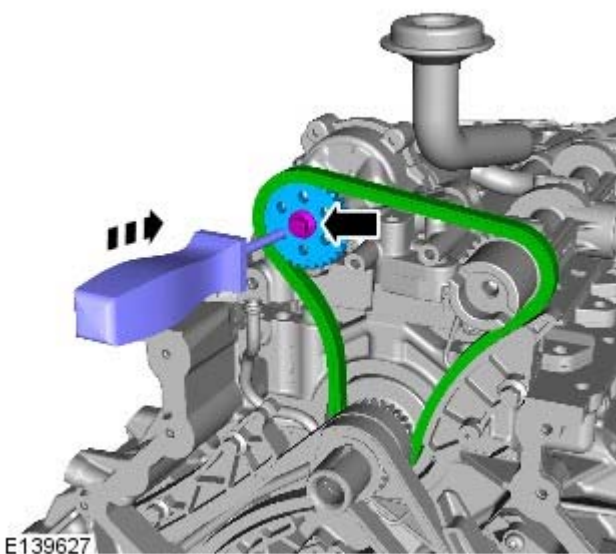
2.  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

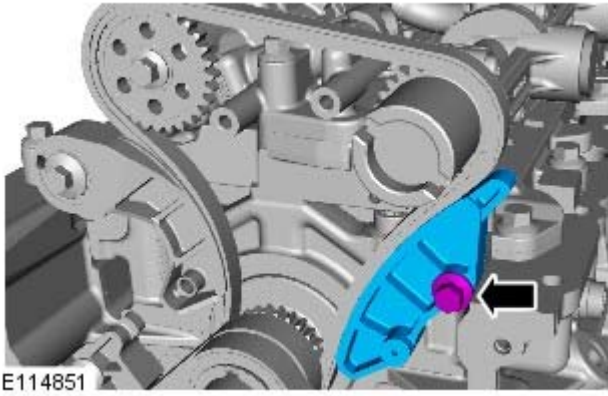
3. Refer to: [Oil Pan Extension](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



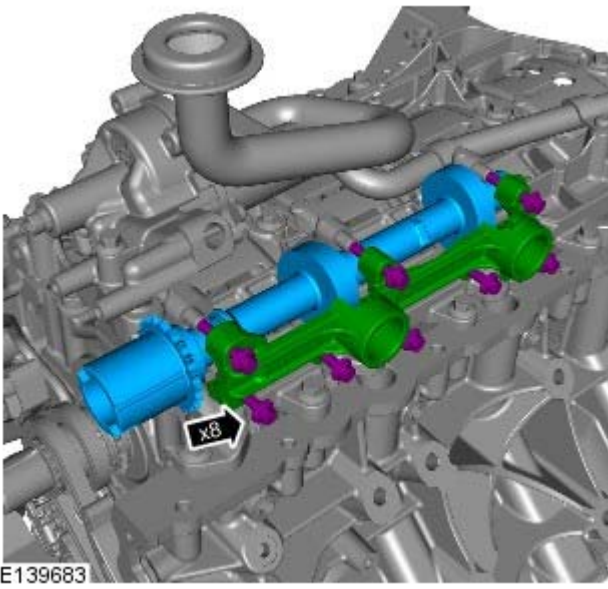
- 4.




- 5.




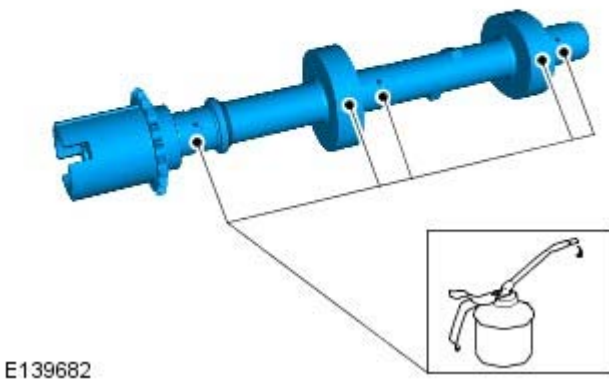
6.

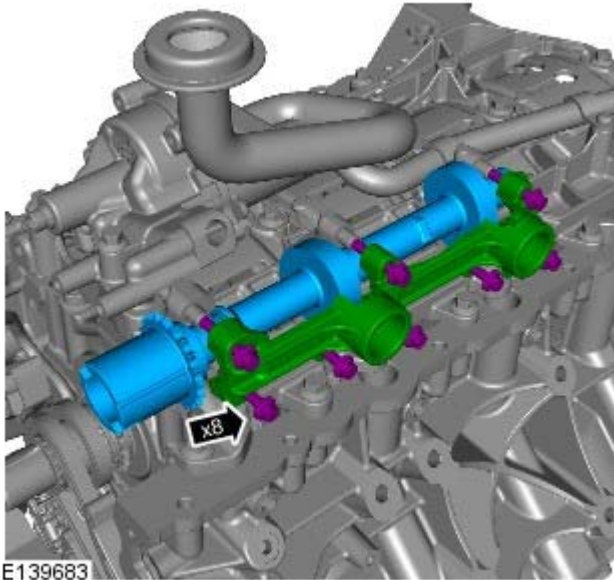


7.  CAUTION: Take extra care when removing the component, prevent damage to the mating faces.

Installation

1.  CAUTION: Make sure that the mating faces are clean and free of foreign material.

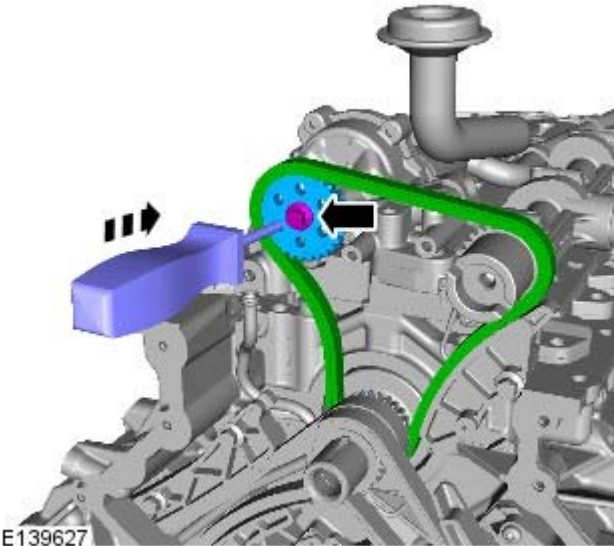




E139683

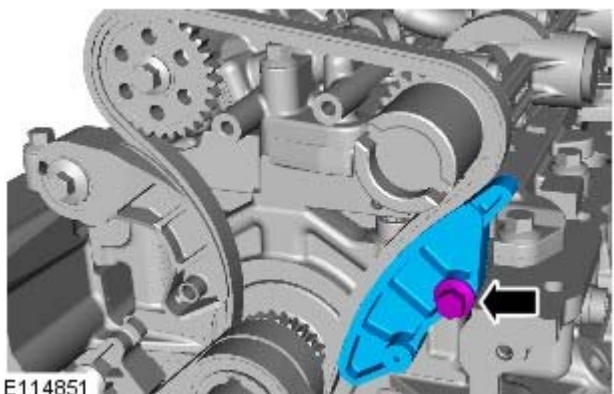
2.  CAUTION: Take extra care not to damage the mating faces.

Torque: 12 Nm



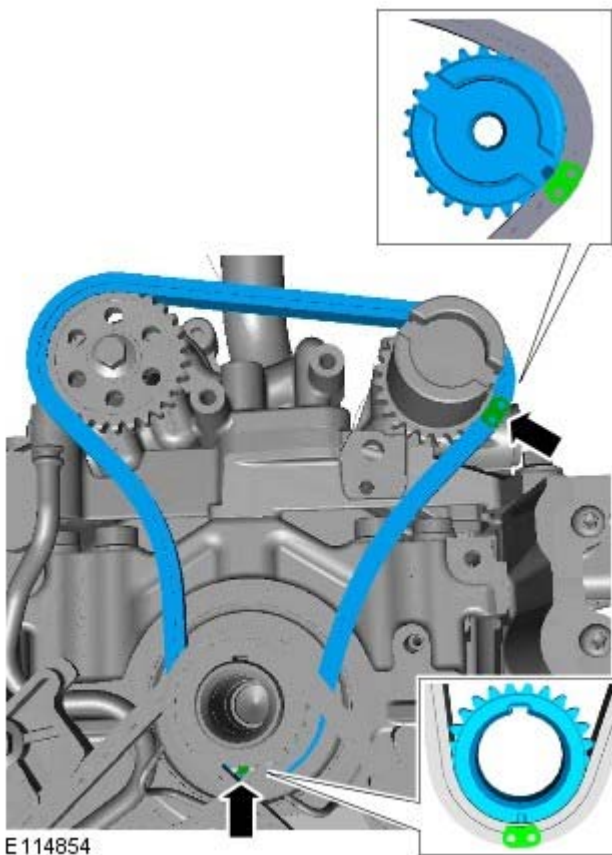
E139627

3. *Torque:* 21 Nm



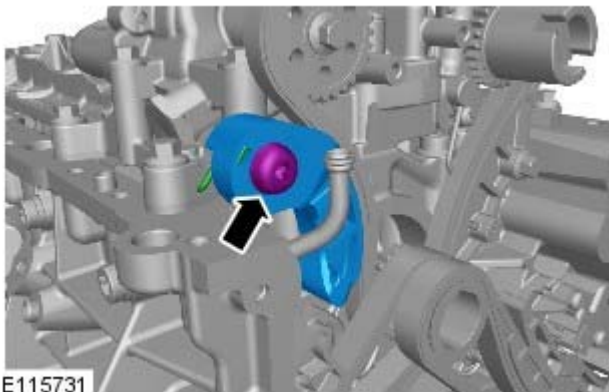
E114851

4. *Torque:* 12 Nm




E114854

5. Install the lower timing chain making sure the coloured chain links align correctly with the fuel rail high-pressure fuel pumps camshaft and crankshaft sprocket markings.



E115731

6.  CAUTION: Make sure that the tensioner spring is correctly located.

Torque: 21 Nm

7. Refer to: [Oil Pan Extension](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

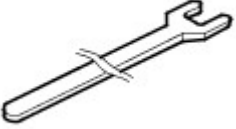

8. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine - V8 5.0L Petrol - Engine

Removal

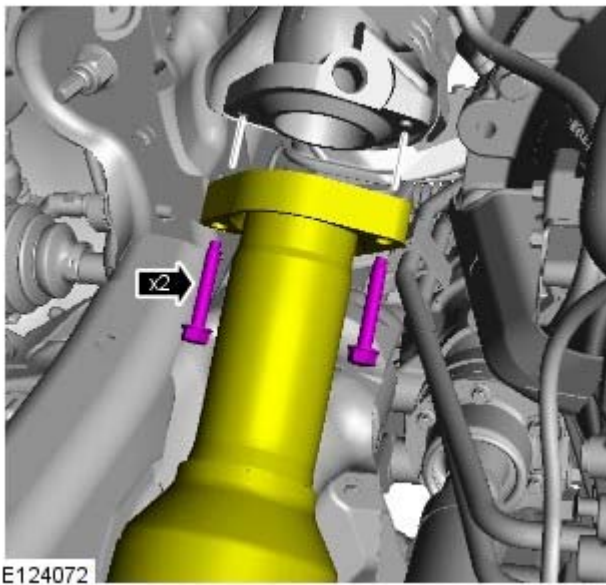
Special Tool(s)

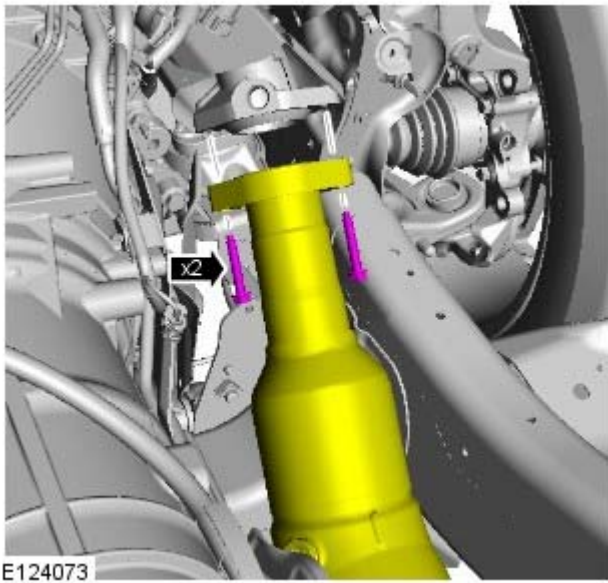
 <p>303-1142 E46076</p>	303-1142 Viscous Coupling Wrench
 <p>303-1143 E55382</p>	303-1143 Viscous Coupling Holding Tool

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

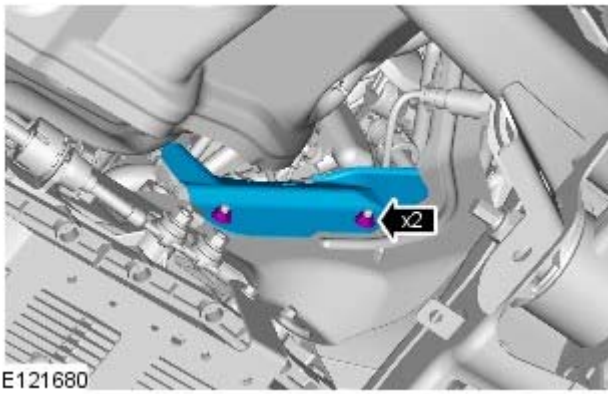
1. Refer to: [Body - V6 4.0L Petrol/V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

2.

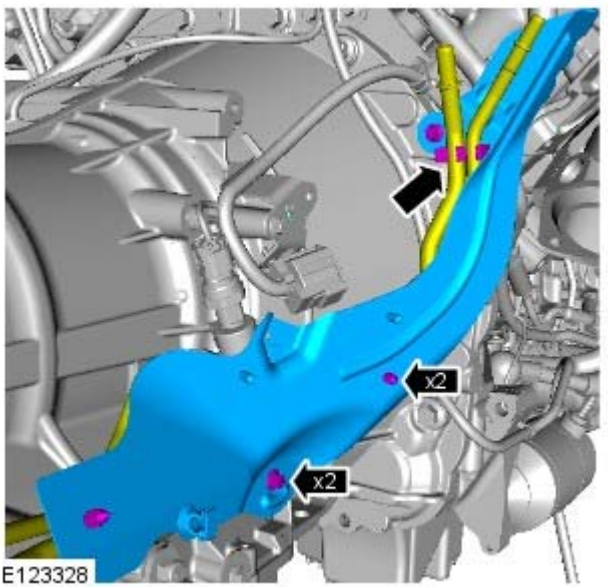




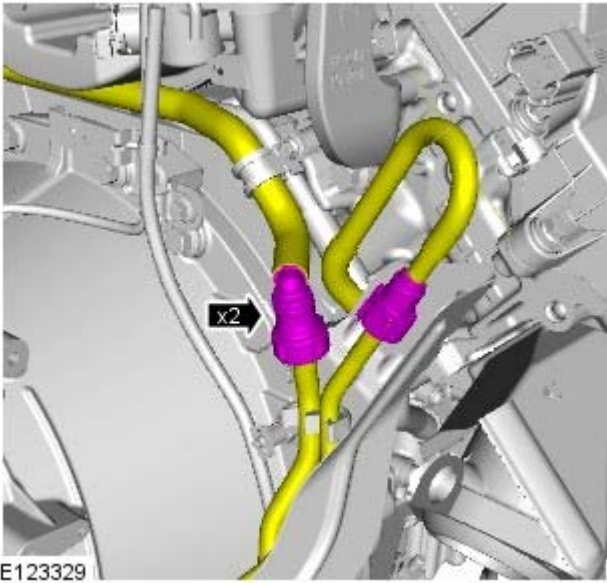
3.




4.

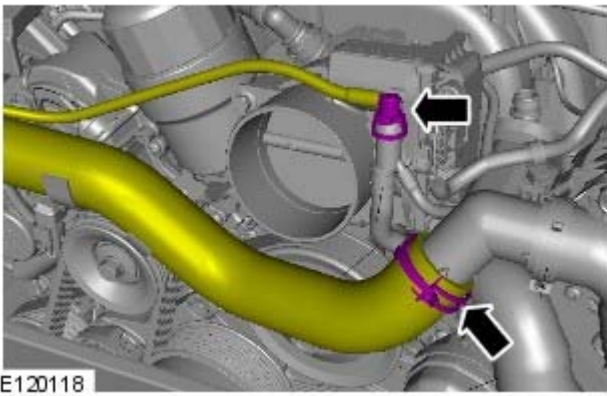


5.

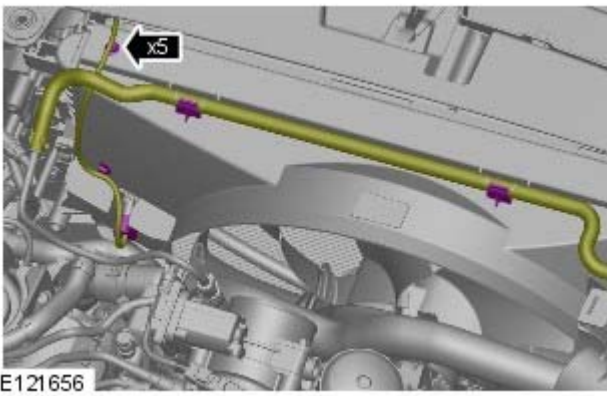


6.  **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 **CAUTION:** Be prepared to collect escaping fluids.

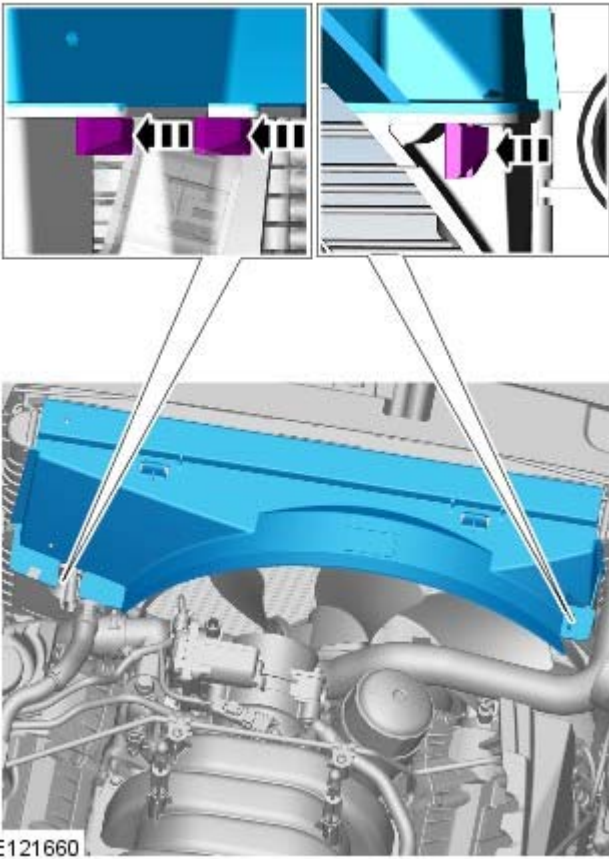


7.  **CAUTION:** Be prepared to collect escaping coolant.



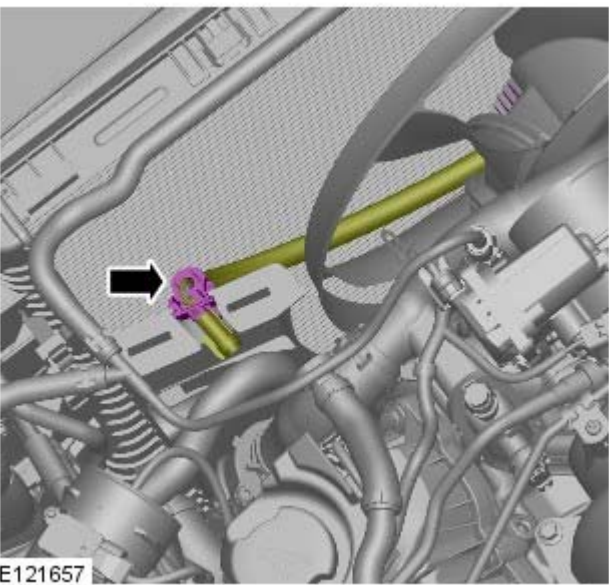
- 8.

9.

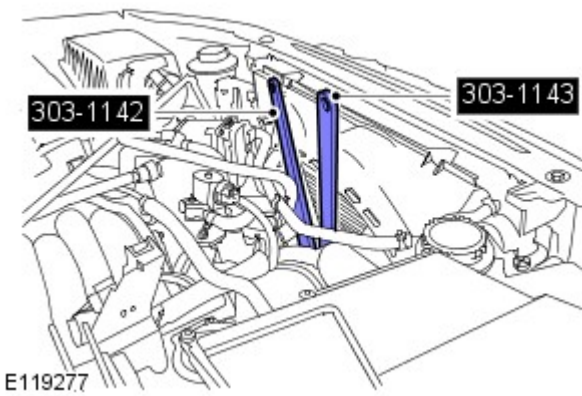



E121660

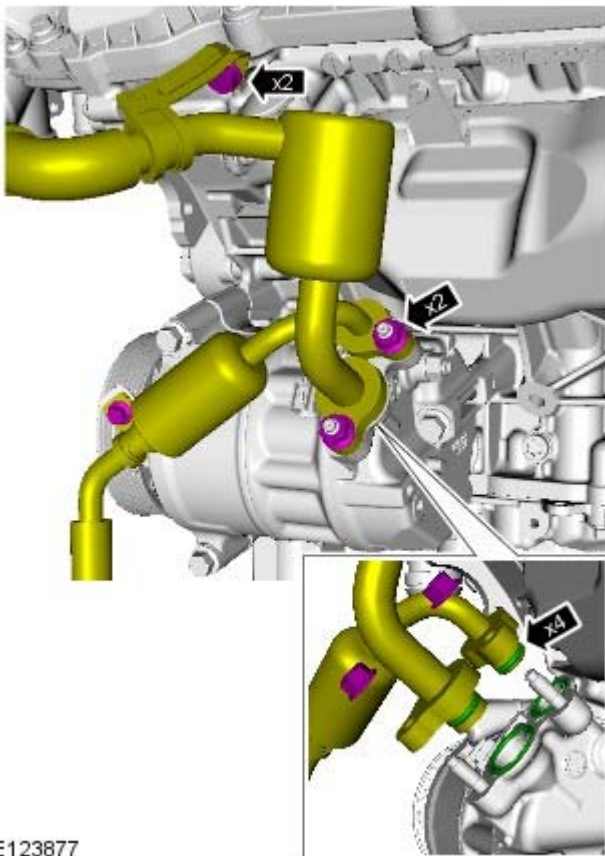
10.



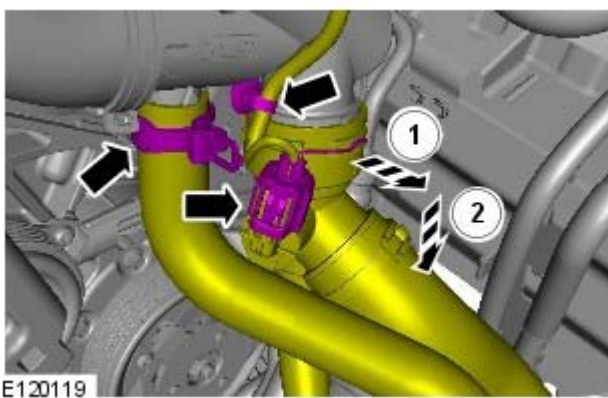
E121657




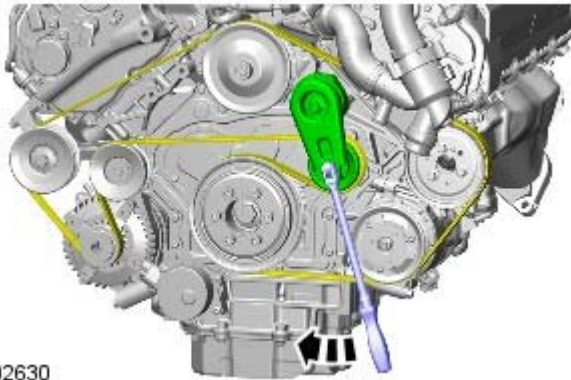
11. **11.**  **CAUTION:** Always protect the cooling pack elements to prevent accidental damage.
- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.
- Special Tool(s):* [303-1142](#), [303-1143](#)



- 12.
- Remove and discard the 4 O-ring seals.

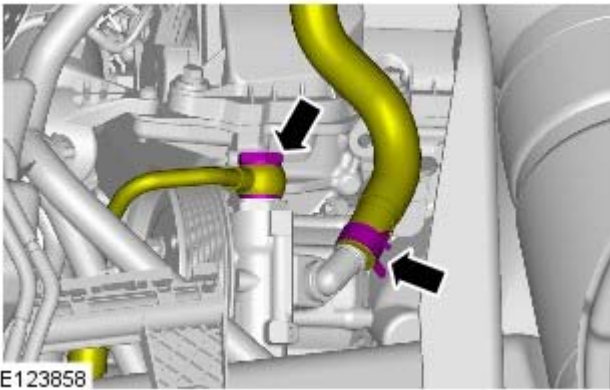


13. **13.**  **CAUTION:** Be prepared to collect escaping coolant.




E102630

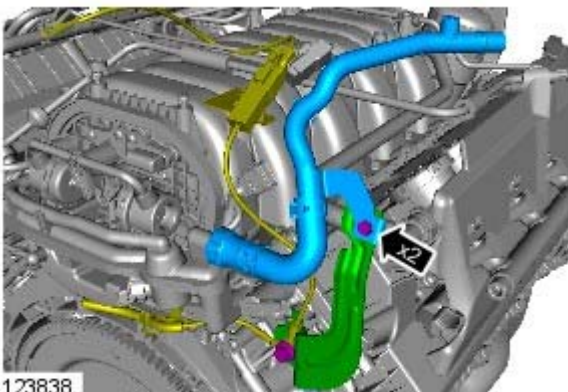
14.



E123858

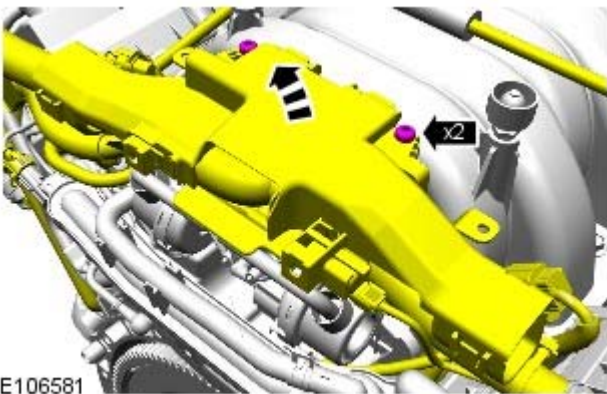
15.  **WARNING:** Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.



E123838

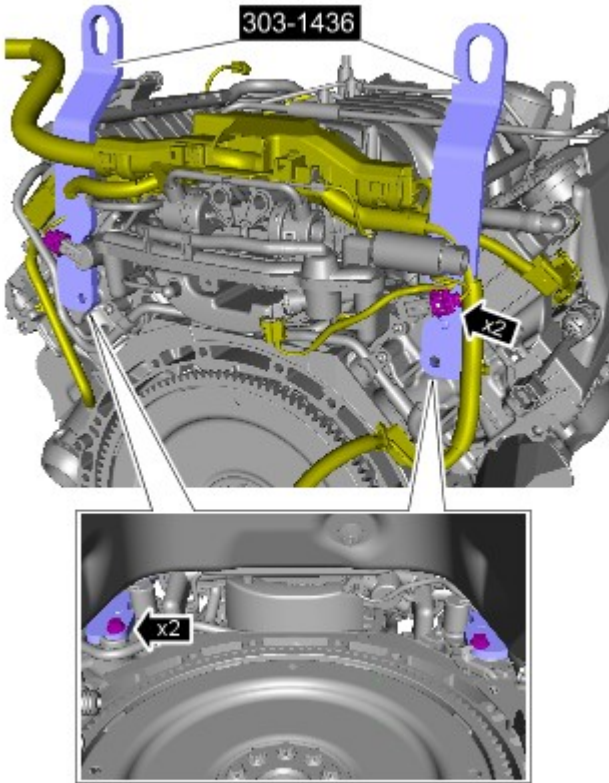
16.



E106581

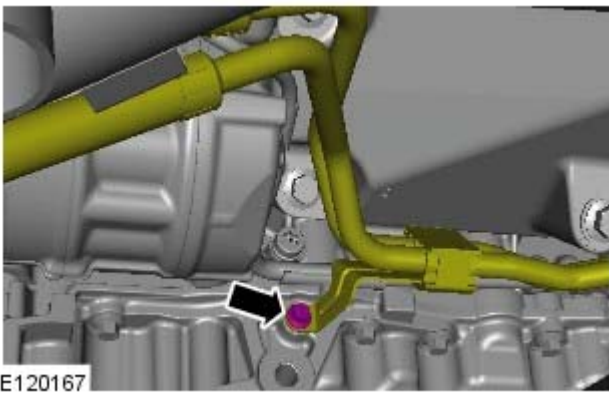
17.

18. Torque: 25 Nm

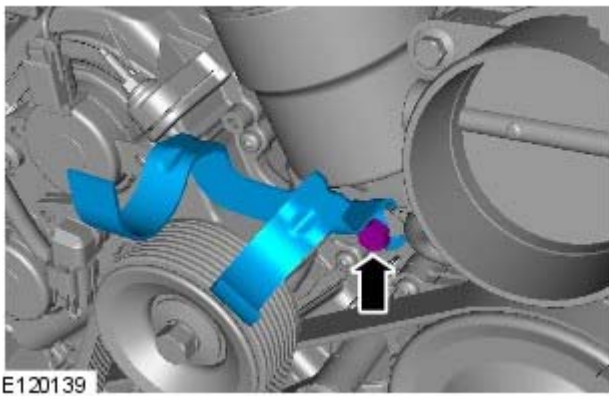


E117619

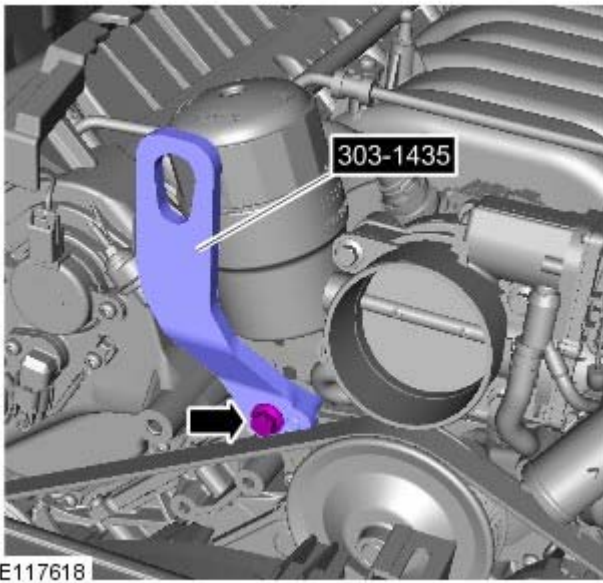
19.



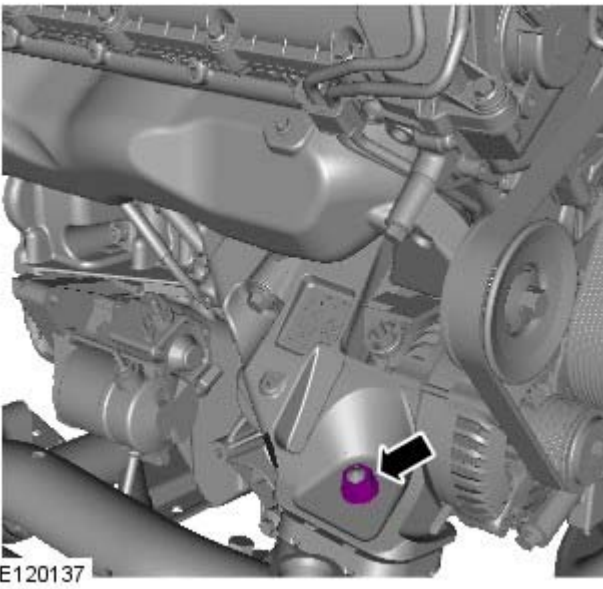
20.



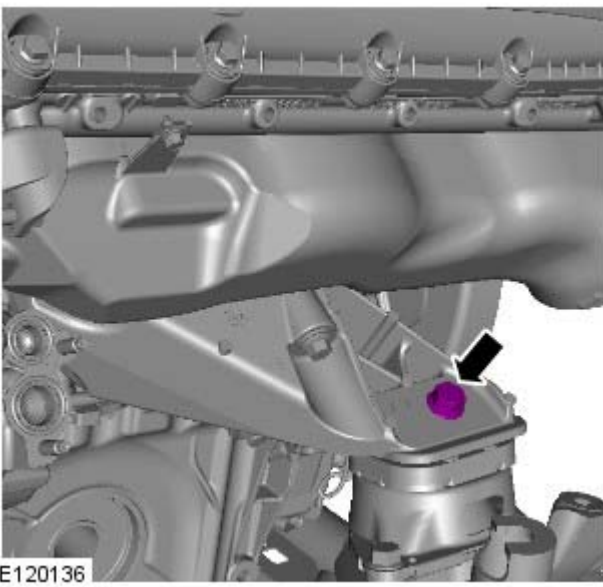
21. Torque: 25 Nm

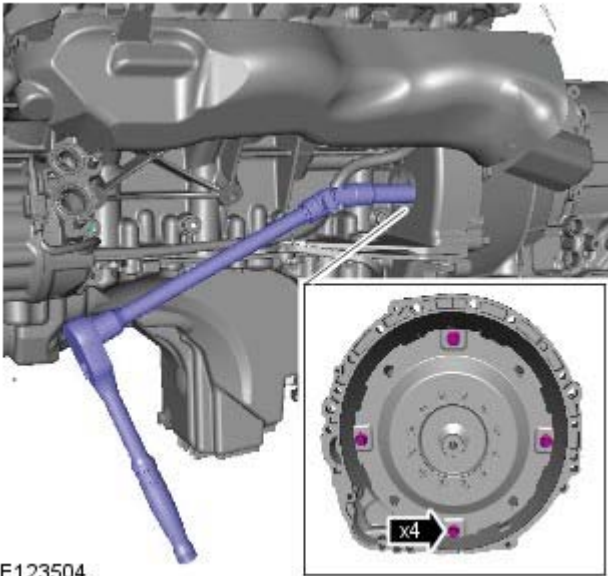


22.



23.

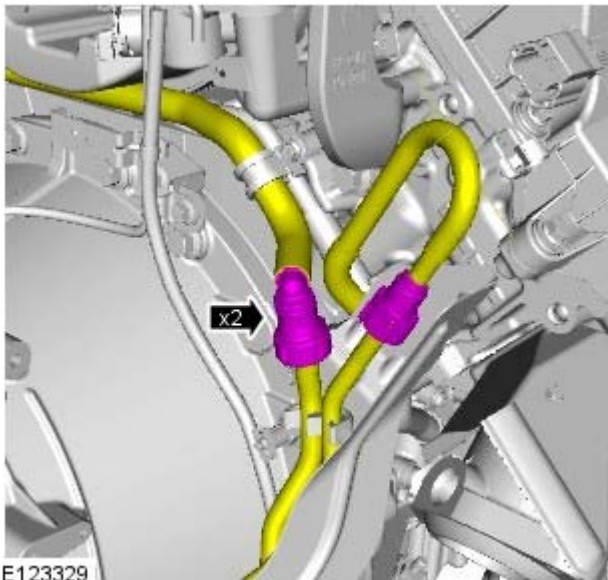





E123504

24. **24.**  **CAUTION:** Only rotate the crankshaft clockwise.

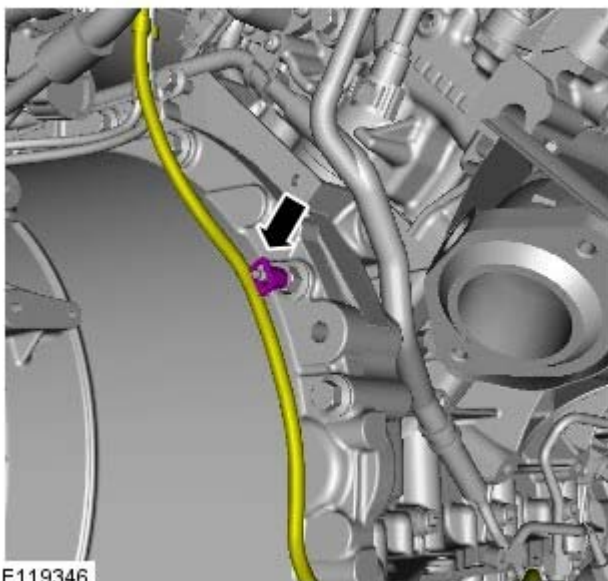
- Mark the torque converter and flexplate when removing the last torque converter bolt. Make sure that the alignment mark is visible through the inspection hole.



E123329

25. **25.**  **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

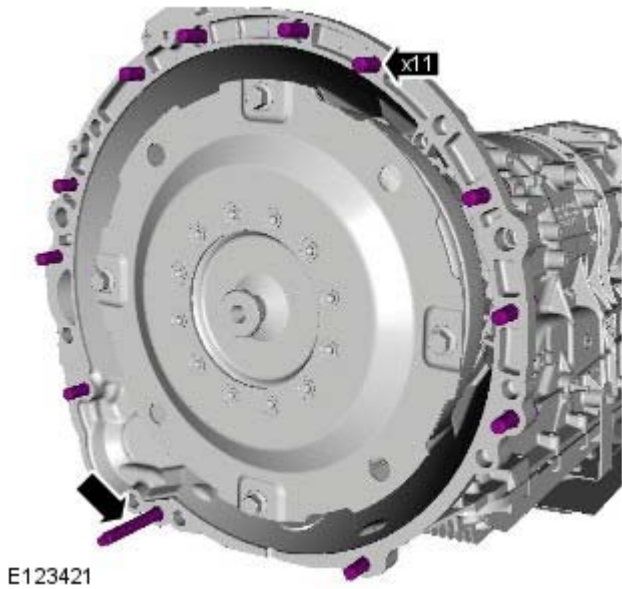
 **CAUTION:** Be prepared to collect escaping fluids.



E119346

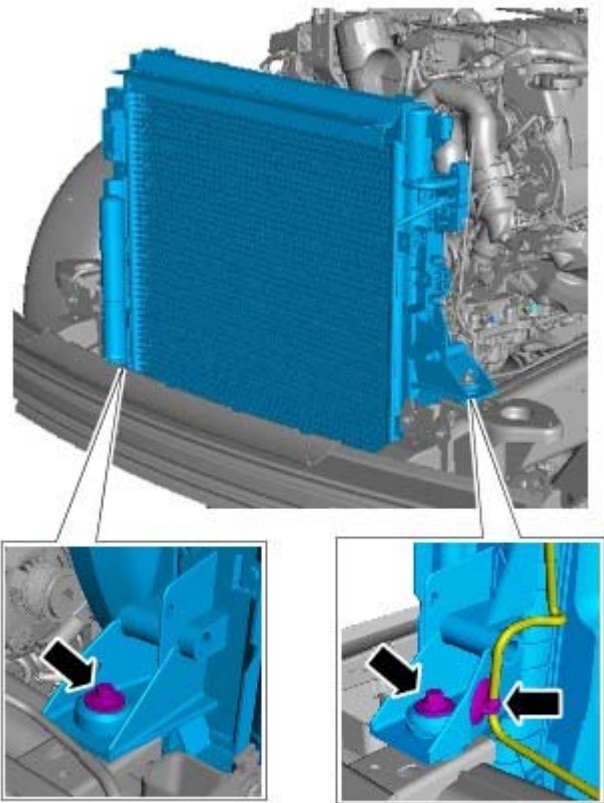
26.

27.

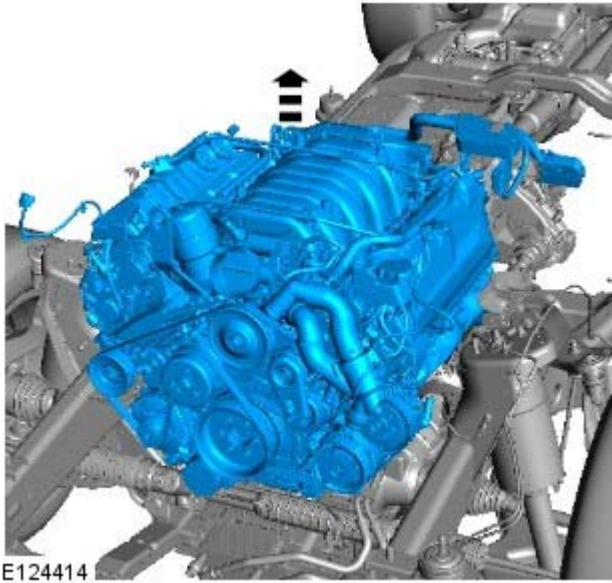


E123421

28.



E124068

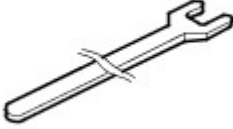



29. **29.** NOTE: This step requires the aid of another technician.

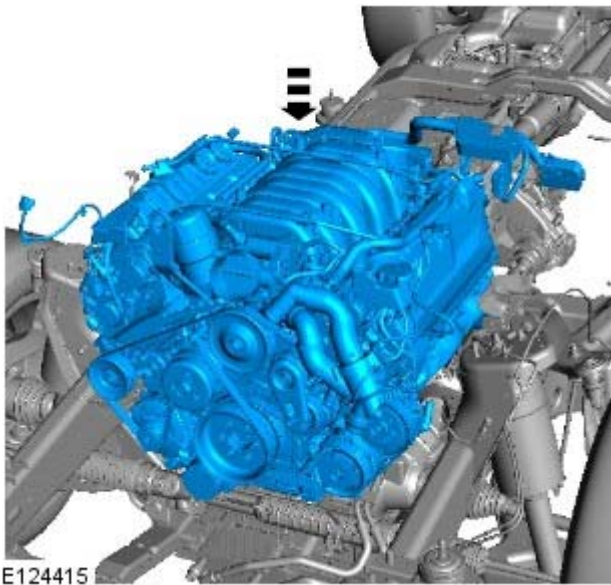
Engine - V8 5.0L Petrol - Engine

Installation

Special Tool(s)

 <p>303-1142</p> <p>E46076</p>	<p>303-1142 Viscous Coupling Wrench</p>
 <p>303-1143</p> <p>E55382</p>	<p>303-1143 Viscous Coupling Holding Tool</p>

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: If a new engine is to be installed, remove the intake manifold to access the top transmission retaining bolts.

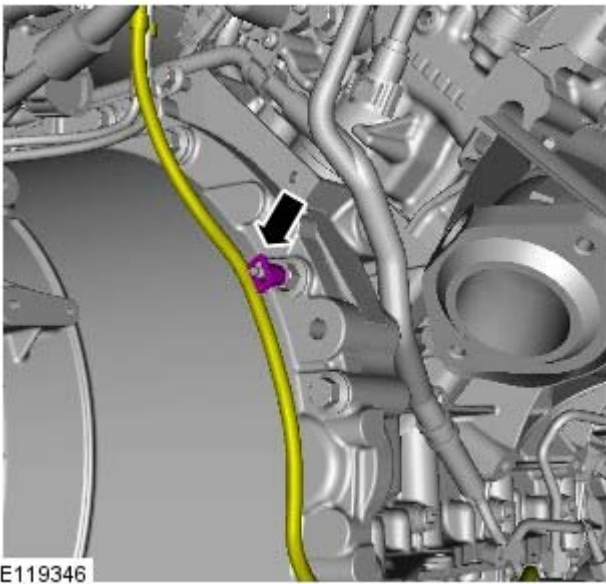


1. NOTE: This step requires the aid of another technician.

2. *Torque: 40 Nm*

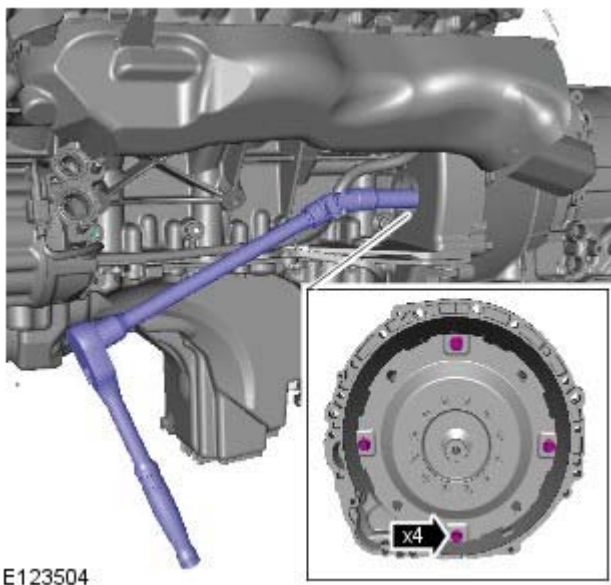


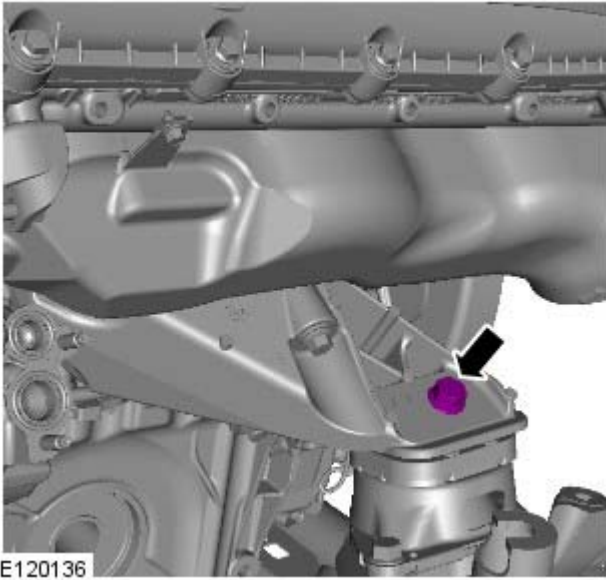
3.



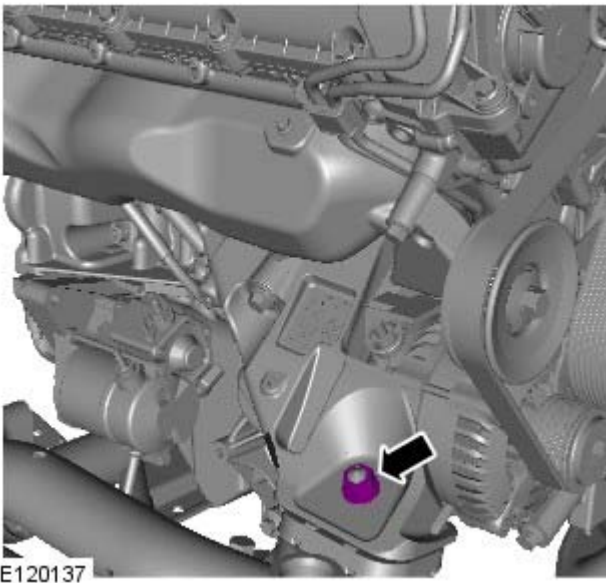
4. **⚠ CAUTION: Only rotate the crankshaft clockwise.**
- Make sure that the alignment mark is visible through the inspection hole on installation of the first torque converter bolt.

Torque: 63 Nm

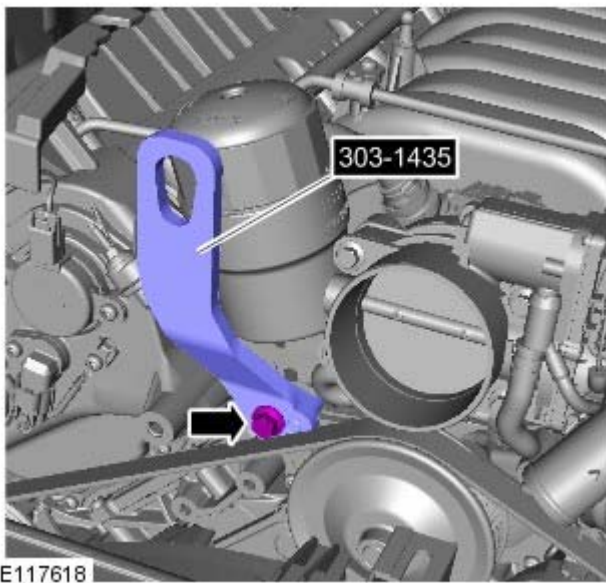




5. Torque: 100 Nm

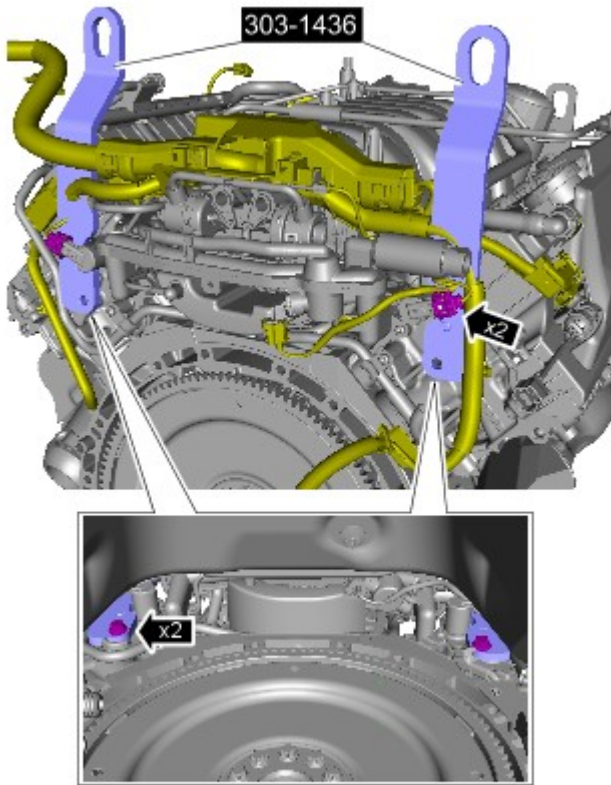


6. Torque: 100 Nm

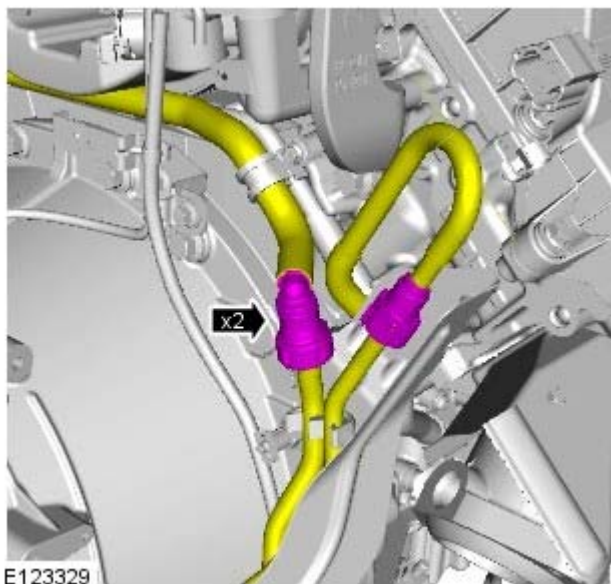


7. Torque: 25 Nm


8. Torque: 25 Nm

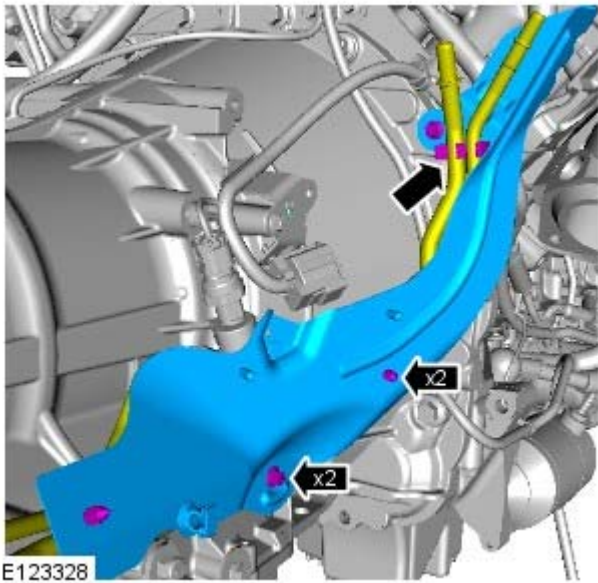


E117619



E123329

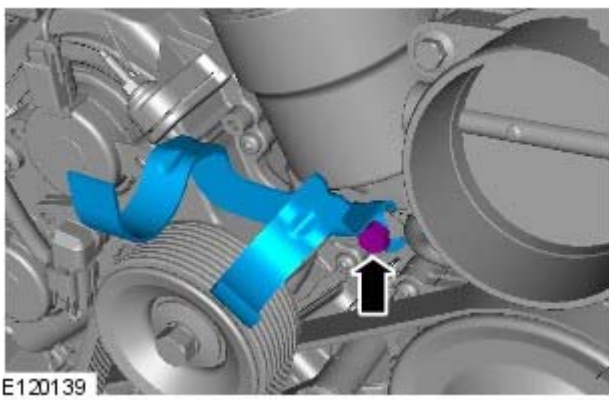
9.  **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



10. Torque: 10 Nm

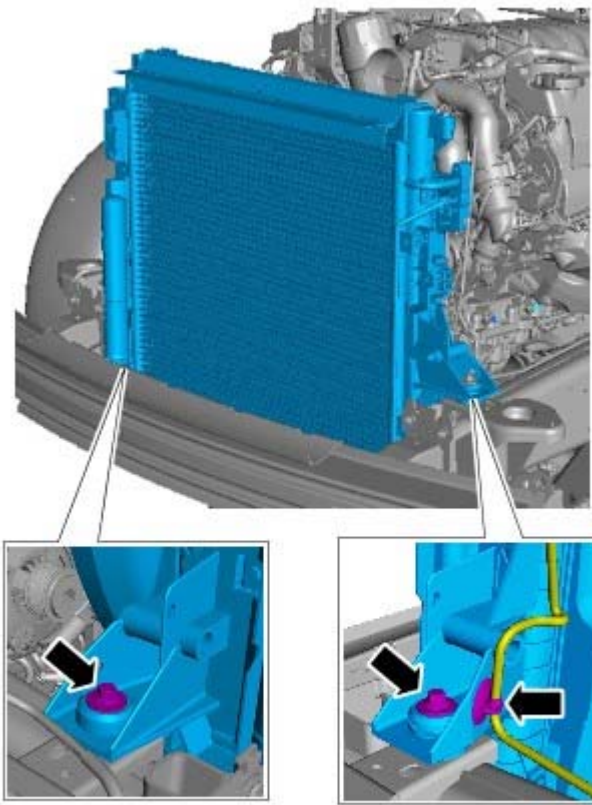


11. Torque: 10 Nm



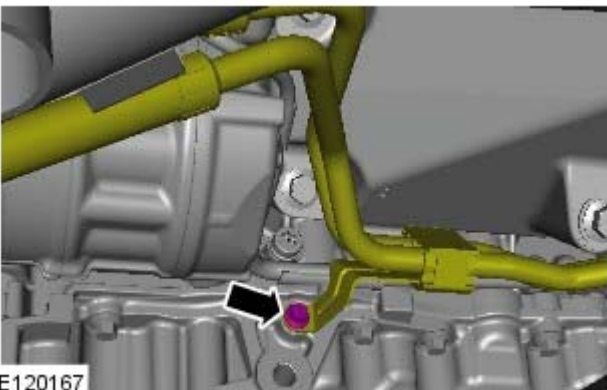
12. Torque: 25 Nm

13. Torque: 25 Nm



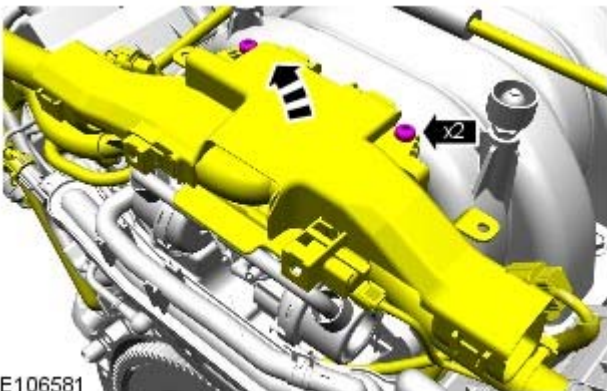
E124068

14. Torque: 12 Nm

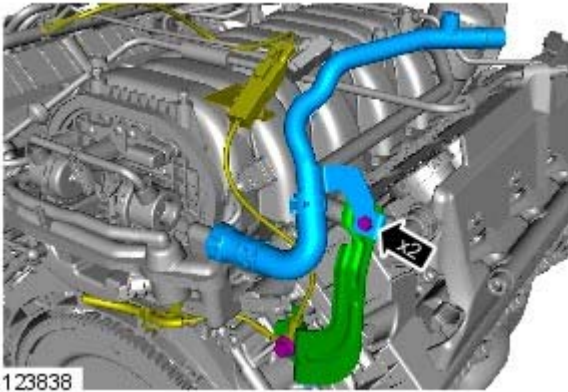


E120167

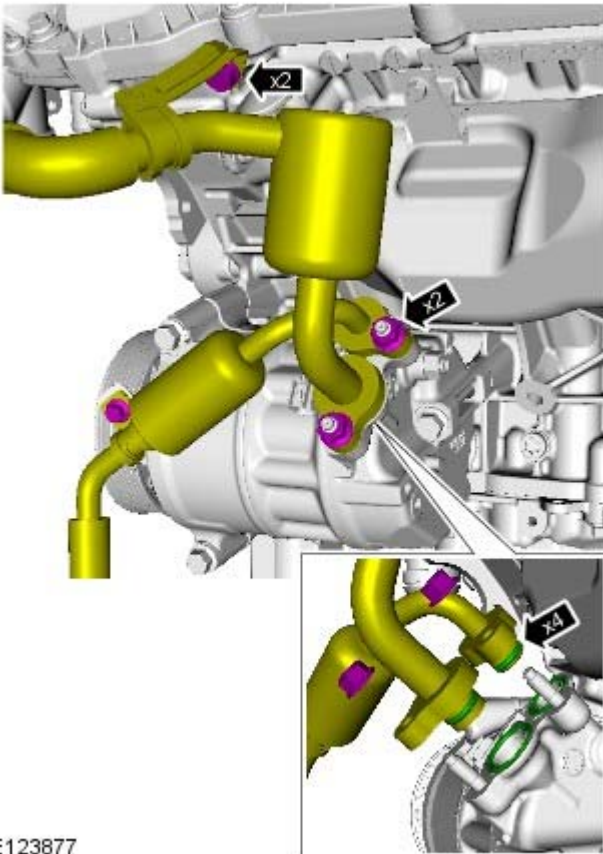
15. Torque: 10 Nm



E106581

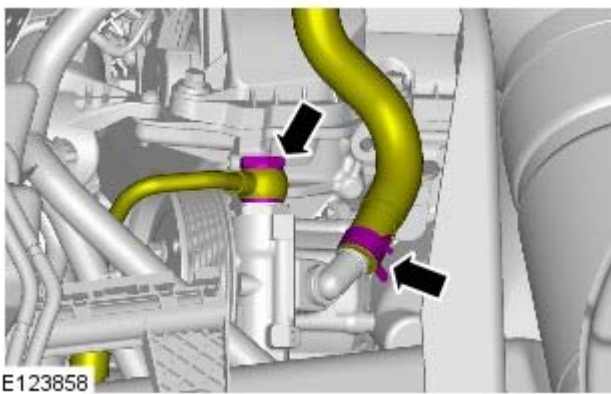


16. *Torque:*
 M8 Bolt 25 Nm
 M6 Bolt 10 Nm



17. ● Remove and discard the 4 O-ring seals.

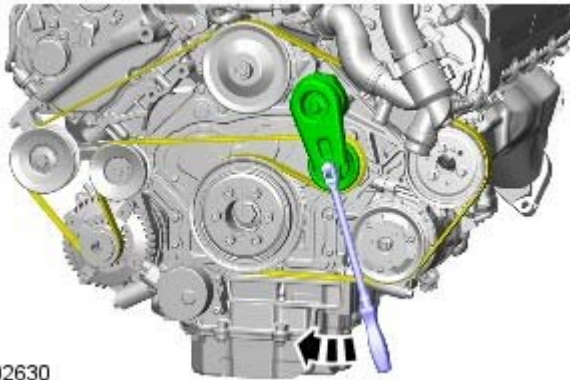
Torque:
 M8 Nut 9 Nm
 M8 Bolt 25 Nm
 M6 bolt 10 Nm



18. **⚠ WARNING:** Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

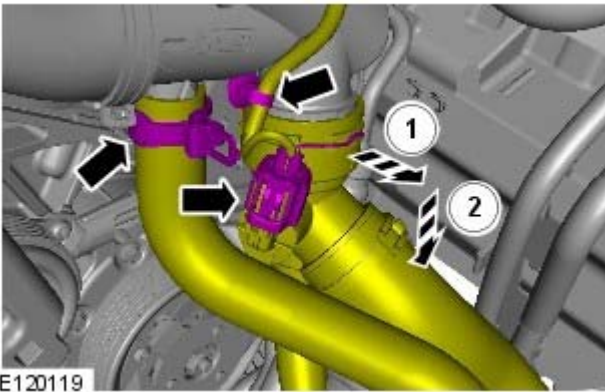
⚠ CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Torque: 25 Nm




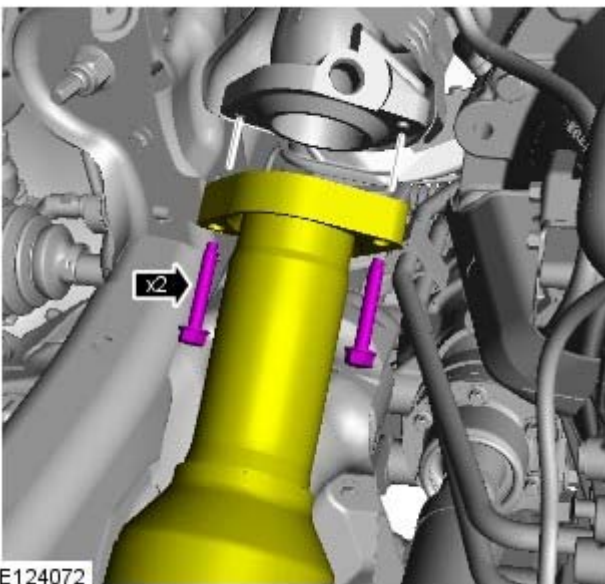
E102630

19.



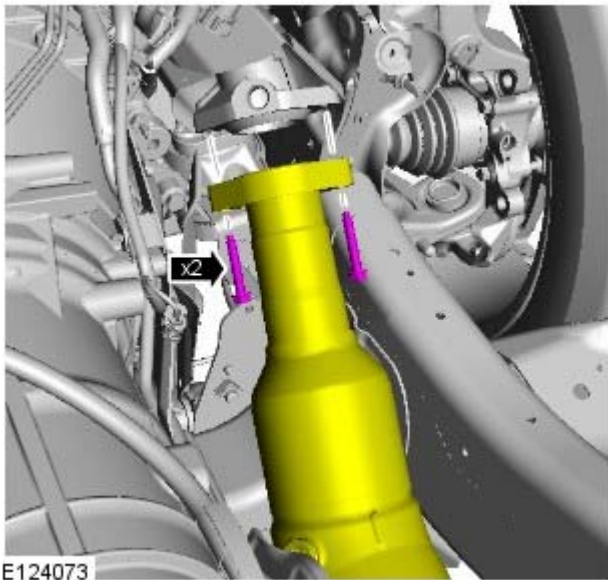
E120119

20.  CAUTION: Be prepared to collect escaping coolant.

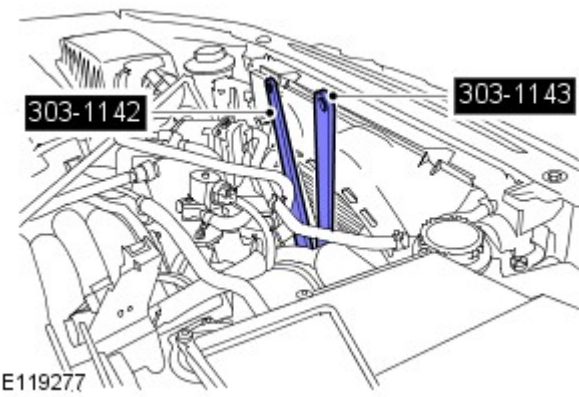


E124072

21. Torque: 22 Nm

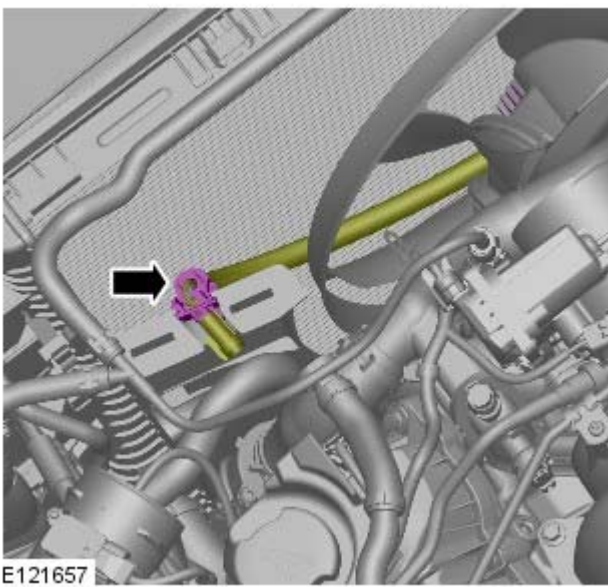


22. Torque: 22 Nm



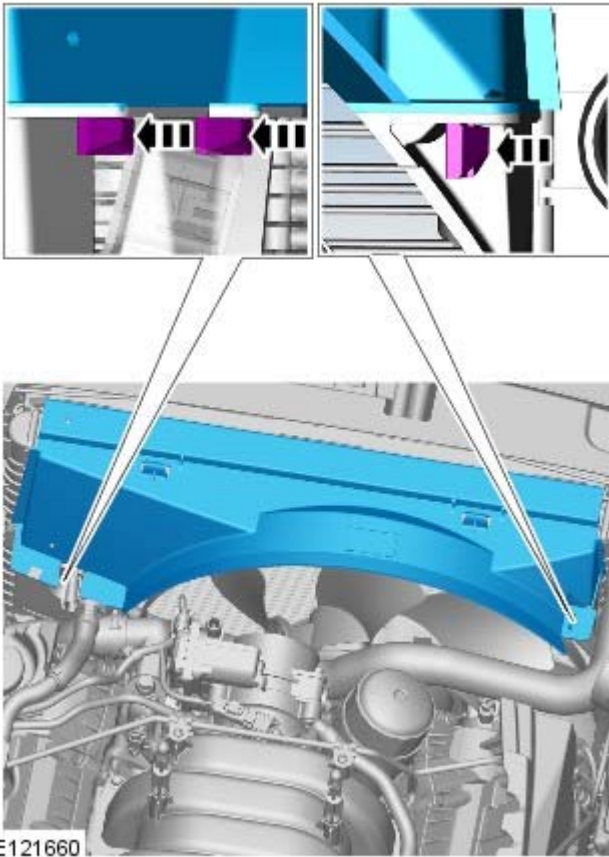
23. **⚠ CAUTION:** Always protect the cooling pack elements to prevent accidental damage.

Special Tool(s): [303-1142](#), [303-1143](#)
Torque: 65 Nm

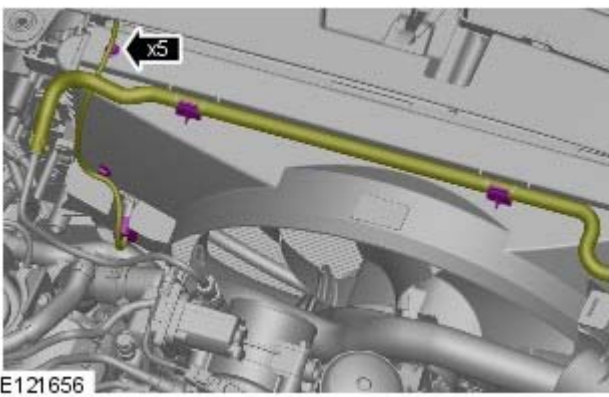


24.

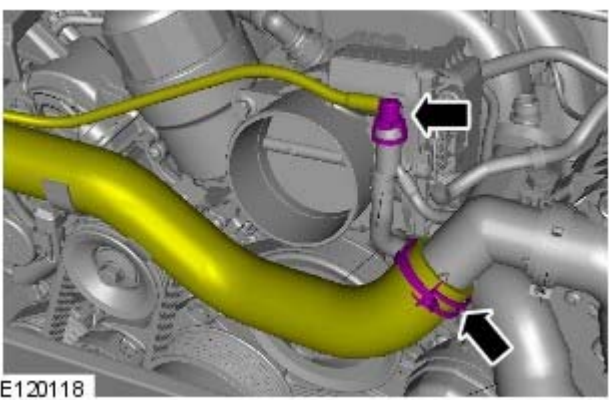
25.



26.



27.



28. Refer to: [Body - V6 4.0L Petrol/V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

29. Using the approved diagnostic equipment, clear the powertrain

control module (PCM) adaptations.

Engine Cooling - TDV6 2.7L Diesel -

Fluids and Capacities

Item	Specification
* Anti-freeze	Havoline Extended Life Coolant (XLC) or any ethylene glycol based anti-freeze containing no methanol with only Organic Acid Technology (OAT) corrosion inhibitors
Anti-freeze concentration - Will provide frost protection to -40°C (-40°F)	50%
Specific gravity of coolant at 20°C (68°F), to protect against frost down to -40°C (-40°F)	1.068
Amount of anti-freeze to use for 50% concentration:	
Without rear passenger compartment heater or fuel burning heater	4.7 litres (8.25 pints) (4.9 US quarts)
With rear passenger compartment heater but without fuel burning heater	6.0 litres (10.6 pints) (6.4 US quarts)
Without rear passenger compartment heater but with fuel burning heater	5.1 litres (9.1 pints) (5.4 US quarts)
With rear passenger compartment heater and fuel burning heater	6.5 litres (11.5 pints) (6.9 US quarts)



CAUTION: * No other anti-freeze should be used with Havoline Extended Life Coolant.

Capacity

Item	Capacity
Without rear passenger compartment heater or fuel burning heater	9.4 litres (16.5 pints) (9.9 US quarts)
With rear passenger compartment heater but without fuel burning heater	12.15 litres (21.4 pints) (12.8 US quarts)
Without rear passenger compartment heater but with fuel burning heater	10.35 litres (18.2 pints) (10.9 US pints)
With rear passenger compartment heater and fuel burning heater	13.1 litres (23.0 pints) (13.8 US quarts)

General Specifications

Item	Specification
Cooling system type	Pressurised, thermostatically controlled with remote header tank
Radiator	Cross flow with integral transmission fluid and charge air coolers
Expansion tank	Remote - fitted with a bleed screw and low coolant level sensor
Pressure cap rating	110 kPa (1.1 bar) (16 lbf/in ²)
Thermostat:	
Starts to open	88° C (190° F)
Fully open	95° C (203° F)
Cooling fan	Engine driven, viscous coupled with electronic control
Cooling fan diameter	500 mm (19.6 in)
Direction of rotation	Clockwise when viewed from front of engine
Coolant pump	Centrifugal flow impellor, belt driven from crankshaft

Torque Specifications

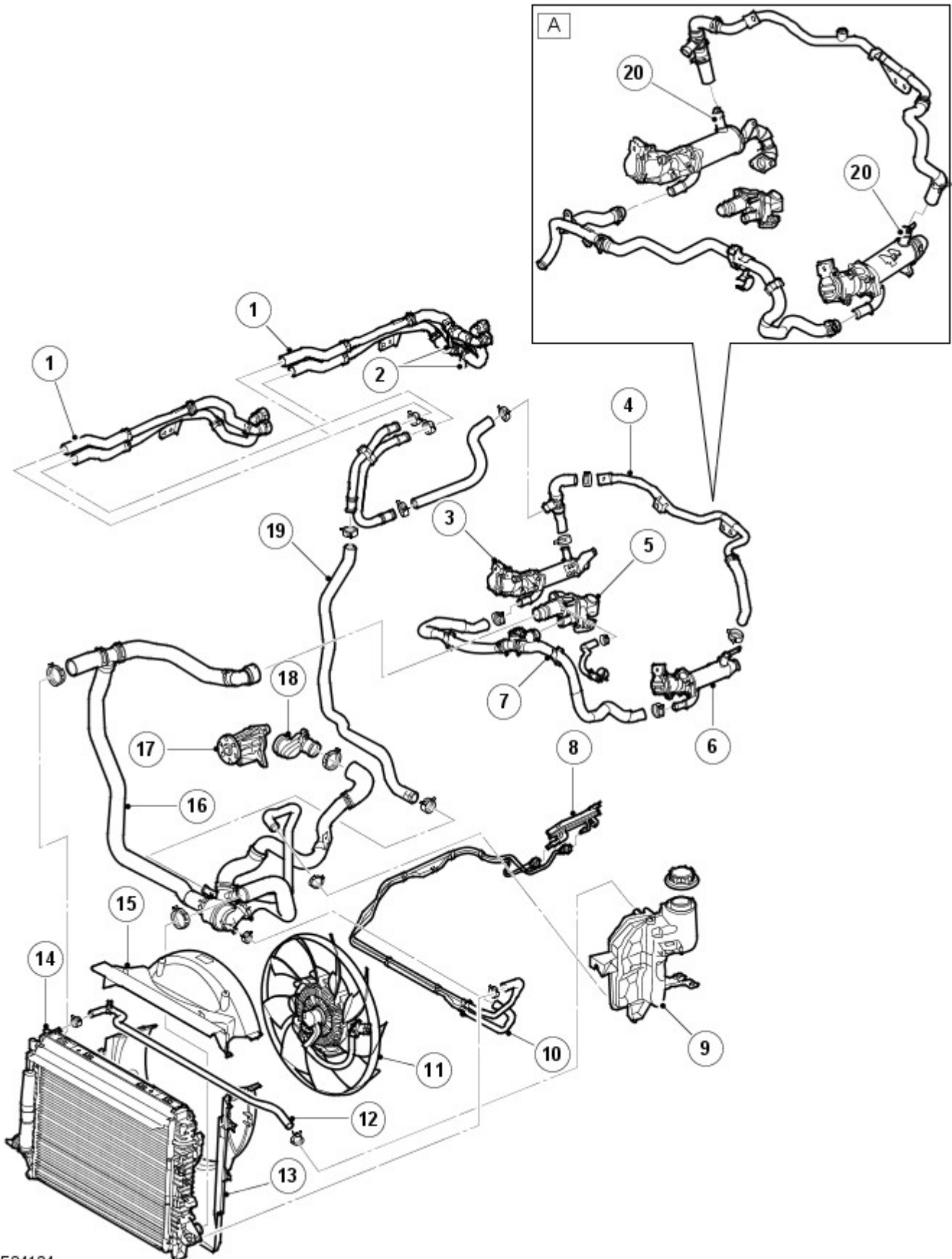
Description	Nm	lb-ft
Coolant expansion tank bolts	10	7
Radiator access panel	10	7
Coolant pump bolts	10	7
Coolant pump pulley bolts	25	18
Radiator securing bolts	25	18
Air Conditioning (A/C) condenser bolts	6	4
Charge air outlet hose clip	10	7
Charge air inlet hose clip	10	7
Cooling fan to viscous coupling bolts	10	7
* Cooling fan assembly	65	48
Coolant bleed screw(s)	3	2

* **Note:** Left-hand thread

Engine Cooling - TDV6 2.7L Diesel - Engine Cooling

Description and Operation

Cooling System Component Layout – Manual Gearbox Without Fuel Burning Heater (FBH)

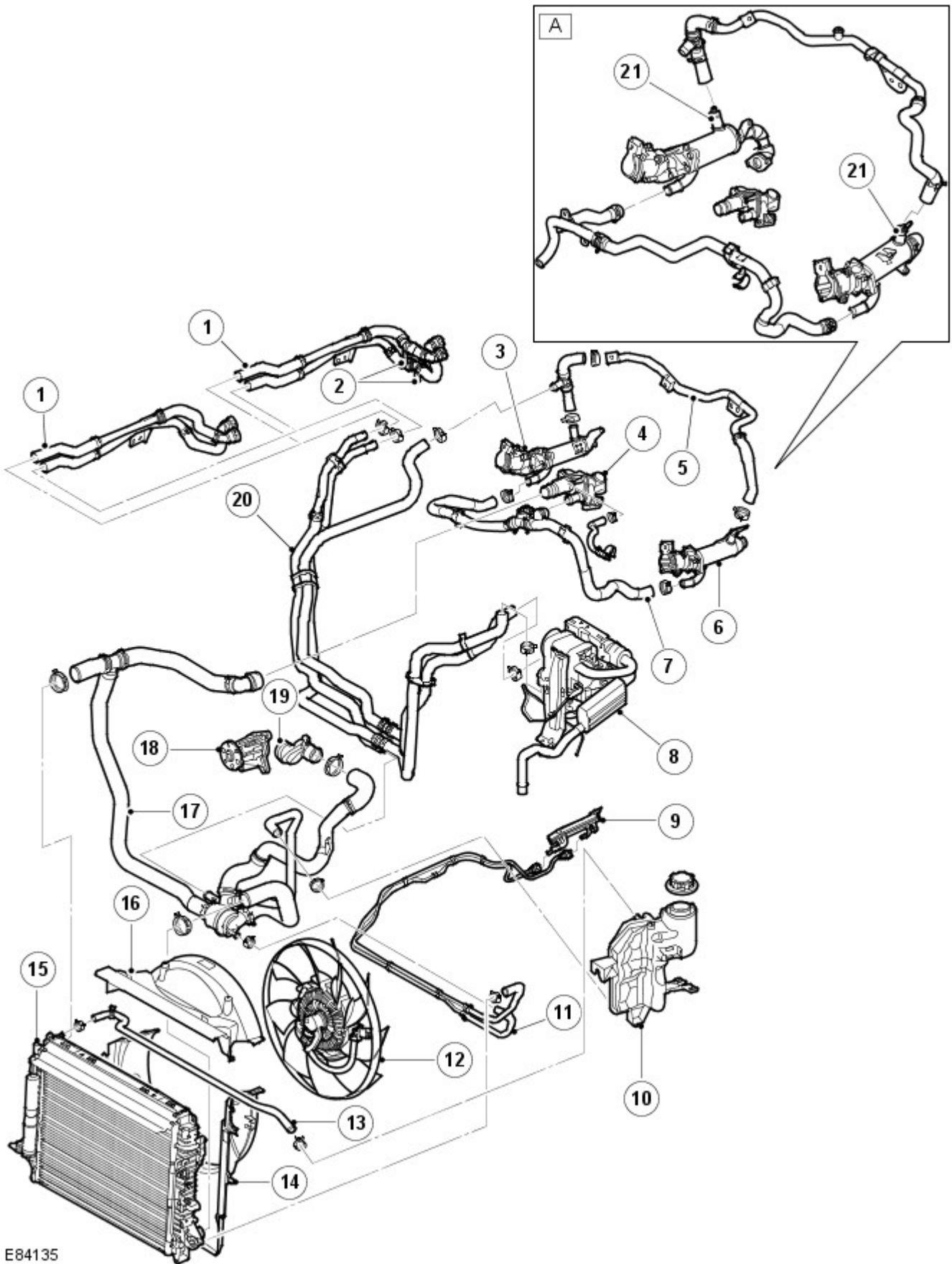


E84134

Item	Part Number	Description
A	-	2007 model year onwards

1	-	Heater hose, in and out
2	-	Heater hose, in and out, for vehicles with rear heater (optional)
3	-	EGR valve
4	-	Hose, EGR
5	-	Water outlet assembly
6	-	EGR valve
7	-	Hose, EGR inlet
8	-	Fuel cooler
9	-	Expansion tank
10	-	Hose, fuel cooler
11	-	Cooling fan
12	-	Hose, radiator to expansion tank
13	-	Shroud, lower
14	-	Radiator
15	-	Shroud, upper
16	-	Hose and thermostat assembly
17	-	Water pump
18	-	Water inlet connector
19	-	Heater hose, thermostat
20	-	EGR thermostat, 2 off (2007 model year onwards)

Cooling System Component Layout – Manual Gearbox, With FBH

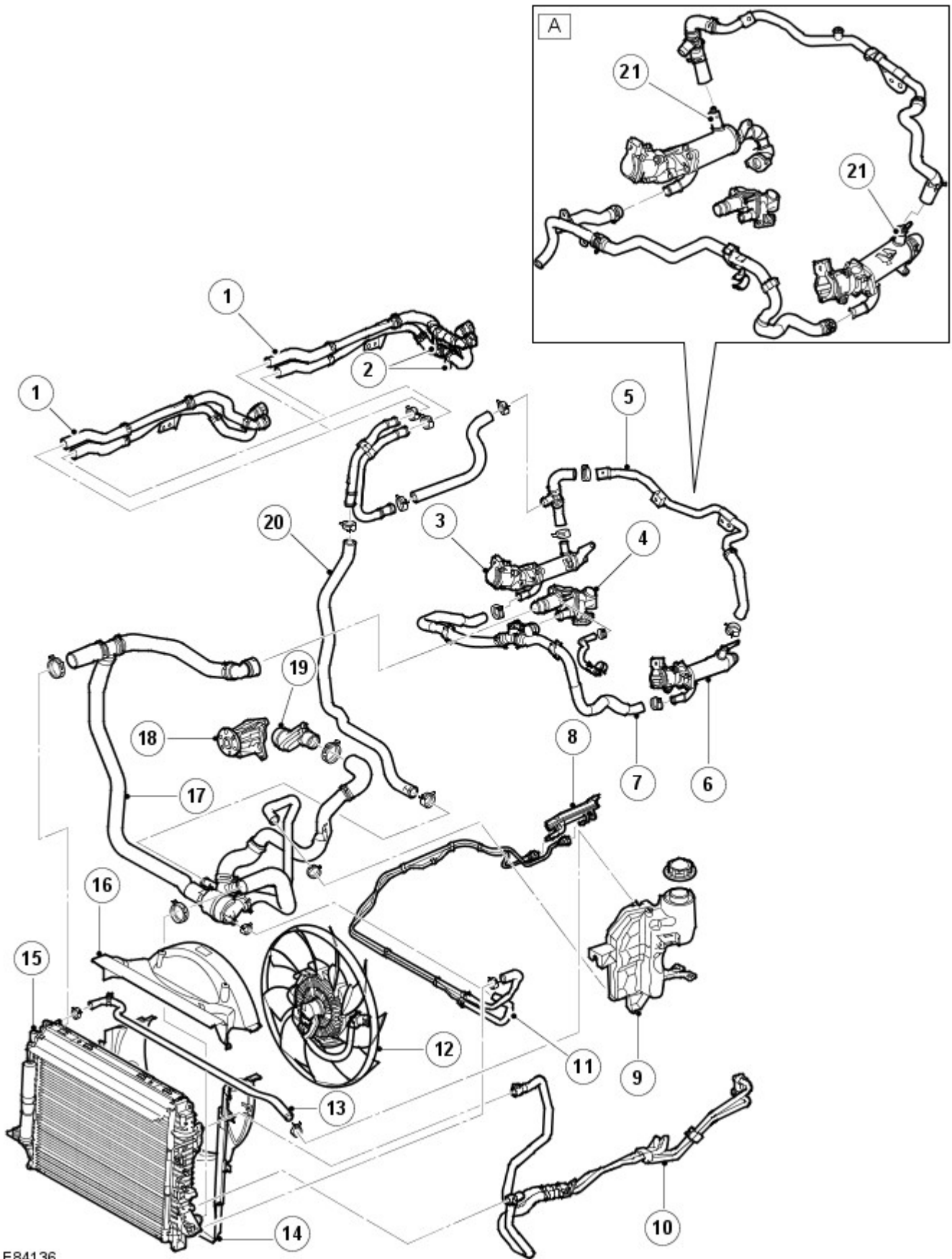


E84135

Item	Part Number	Description
A	-	2007 model year onwards
1	-	Heater hose, in and out
2	-	Connections for rear heater (optional)
3	-	EGR valve
4	-	Water outlet assembly
5	-	Hose, EGR
6	-	EGR valve
7	-	Hose, EGR inlet

8	-	FBH
9	-	Fuel cooler
10	-	Expansion tank
11	-	Hose, fuel cooler
12	-	Cooling fan
13	-	Hose, radiator to expansion tank
14	-	Shroud, lower
15	-	Radiator
16	-	Shroud, upper
17	-	Hose and thermostat assembly
18	-	Water pump
19	-	Water inlet connector
20	-	FBH hose, in and out
21	-	EGR thermostat, 2 off (2007 model year onwards)

Cooling System Component Layout – Automatic Gearbox Without FBH

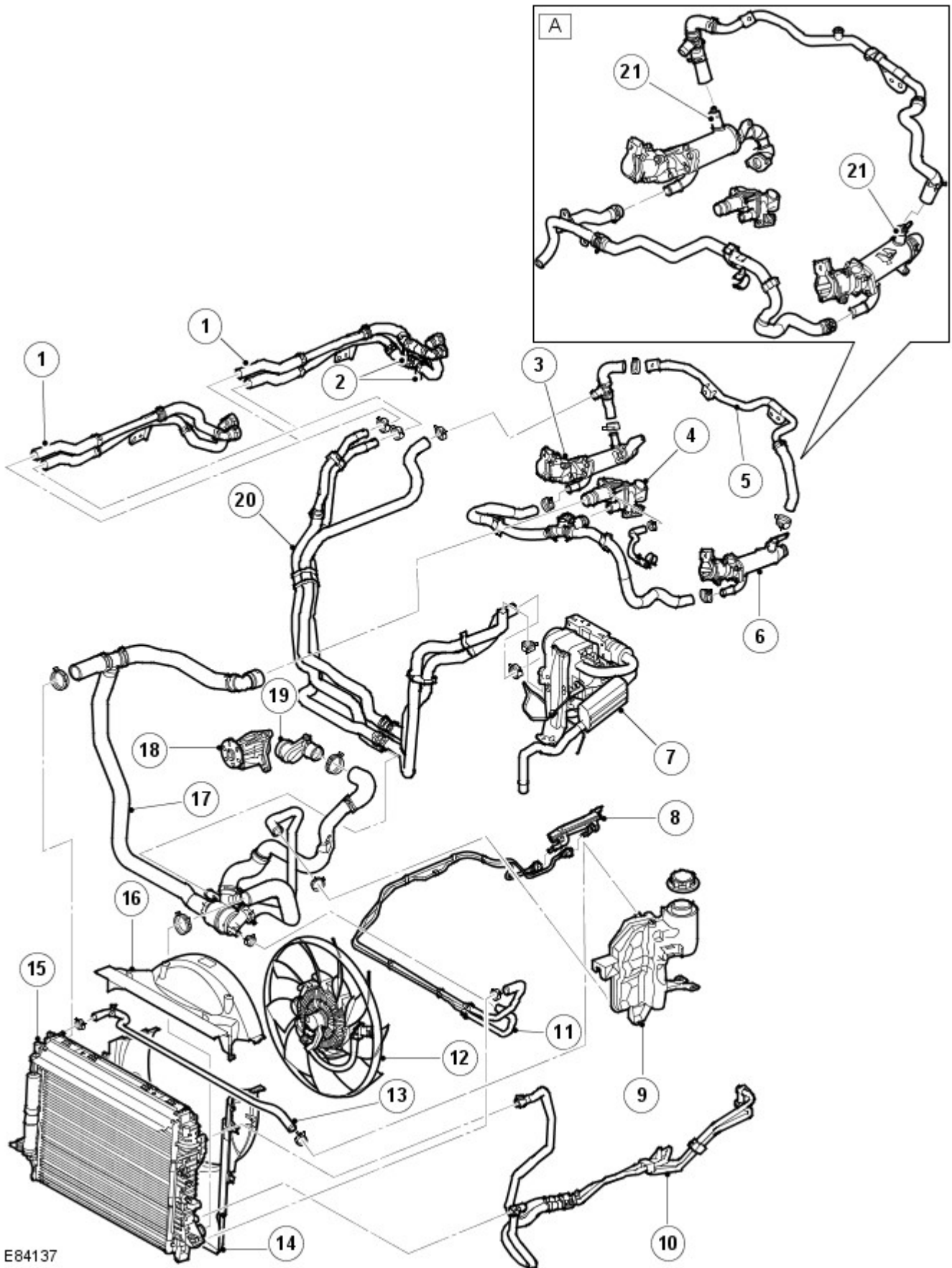


E84136

Item	Part Number	Description
A	-	2007 model year onwards
1	-	Heater hose, in and out
2	-	Connections for rear heater (optional)
3	-	EGR valve
4	-	Water outlet assembly
5	-	Hose, EGR
6	-	EGR valve
7	-	Hose, EGR inlet

8	-	Fuel cooler
9	-	Expansion tank
10	-	Transmission oil cooler pipes
11	-	Hose, fuel cooler
12	-	Cooling fan
13	-	Hose, radiator to expansion tank
14	-	Shroud, lower
15	-	Radiator
16	-	Shroud, upper
17	-	Hose and thermostat assembly
18	-	Water pump
19	-	Water inlet connector
20	-	Heater hose, thermostat
21	-	EGR thermostat, 2 off (2007 model year onwards)

Cooling System Component Layout – Automatic Gearbox, With FBH



E84137

Item	Part Number	Description
A	-	2007 model year onwards
1	-	Heater hose, in and out
2	-	Connections for rear heater (optional)
3	-	EGR valve
4	-	Water outlet assembly
5	-	Hose, EGR
6	-	EGR valve
7	-	FBH

8	-	Fuel cooler
9	-	Expansion tank
10	-	Transmission oil cooler pipes
11	-	Hose, fuel cooler
12	-	Cooling fan
13	-	Hose, radiator to expansion tank
14	-	Shroud, lower
15	-	Radiator
16	-	Shroud, upper
17	-	Hose and thermostat assembly
18	-	Water pump
19	-	Water inlet connector
20	-	FBH hose, in and out
21	-	EGR thermostat, 2 off (2007 model year onwards)

GENERAL

The cooling system employed is of the pressure relief by-pass type, which allows coolant to circulate around the engine and the heater circuit while the thermostat main valve is closed. The primary function of the cooling system is to maintain the engine within an optimum temperature range under changing ambient and engine operating conditions. Secondary functions are to provide heating for the passenger compartment and cooling for the transmission fluid and engine oil.

The cooling system comprises:

- A radiator
- An intercooler
- A passenger compartment heater matrix
- Two fuel coolers
- Two Exhaust Gas Recirculation (EGR) coolers
- A Fuel Burning Heater (FBH) (Market dependant)
- A coolant pump
- A Pressure Relief Thermostat (PRT)
- An expansion tank
- An electro-viscous fan
- Connecting hoses and pipes.

ENGINE COOLING SYSTEM

The coolant is circulated by a centrifugal type pump mounted on the front of the engine and driven by the ancillary drive 'polyvee' belt. The coolant pump circulates coolant around the cylinder block and cylinder heads via a chamber located in the 'vee' of the engine. Some of the coolant flow is diverted through the integrated fuel and engine oil coolers. Having passed through the engine and oil coolers, the coolant returns to the thermostat housing via the by-pass pipe. Coolant also circulates through the EGR coolers to the heater matrix and returns to the engine side of the PRT.

On vehicles fitted with FBH, the coolant circulates through the EGR coolers to the FBH unit (whether active or not) and then on to the heater matrix. The coolant then returns to the engine side of the PRT.

On vehicles from 2007 model year, there is a thermostat located in each EGR cooler outlet spigot. These thermostats control coolant flow through the EGR coolers benefitting both engine emissions and engine/heater warm-up.

The PRT housing contains a normal thermostat, which is positioned such that the wax's temperature is controlled by both the coolant from the radiator and the bypass. This results in the thermostat being able to vary its opening temperature dependant on ambient conditions. The PRT also contains a sprung loaded valve, which limits the amount flow using the bypass. This means that the engine can run without coolant flowing through the bypass temporarily, to improve heater performance.

The radiator is a cross flow type with an aluminium matrix and has a drain tap on the lower RH rear face. The lower radiator mountings are located part way up the end tanks. The mountings are fitted with rubber bushes, which sit on the upper chassis rails. The radiator upper is mounted by pins, which are pushed through rubber bushes mounted in the Front End Carrier (FEC) above the radiator.

The intercooler is attached to the bottom of the radiator by two pins, which locate into fittings in the radiator end tanks.

The radiator top hose is connected to the PRT by the bypass hose and the bottom hose is directly connected to the outlet side of the thermostat housing.

The expansion tank is fitted forward of the LH suspension turret in the engine compartment. The expansion tank allows for the expansion of the coolant as the engine gets hot and also supplies the engine with coolant as the coolant in the engine contracts. The tank also allows any air trapped in the coolant to be removed.

The liquid cooled transmission fluid cooler (automatic models only) is mounted in the cold side radiator end tank. It is positioned in the middle of the LH end tank.

The 2nd fuel cooler is fed from the cold side end tank of the radiator from a sub cooled section and returns into the PRT housing on the radiator side.

On vehicles fitted with a FBH, the unit is located forward of the LH suspension turret. Coolant flows through the FBH whether it is active or not. The exhaust from the burner is vented into the front LH wheel arch. For additional information, refer to: Auxiliary Heater (412-02B Auxiliary Heating, Description and Operation).

For additional airflow through the radiator matrix, particularly when the vehicle is stationary, there is an engine driven electro-viscous fan unit fitted to the rear of the radiator. The fan is used for engine cooling and for Air Conditioning (A/C) system cooling. This unit functions as a normal viscous fan, but with electronic control over the level engagement of the clutch. The Engine Control Module (ECM), which determines the required fan speed, controls the level of clutch

engagement. The ECM determines engagement based on the coolant, charge air, ambient and transmission oil temperatures and the A/C pressure. The fan is mounted using a left hand thread.

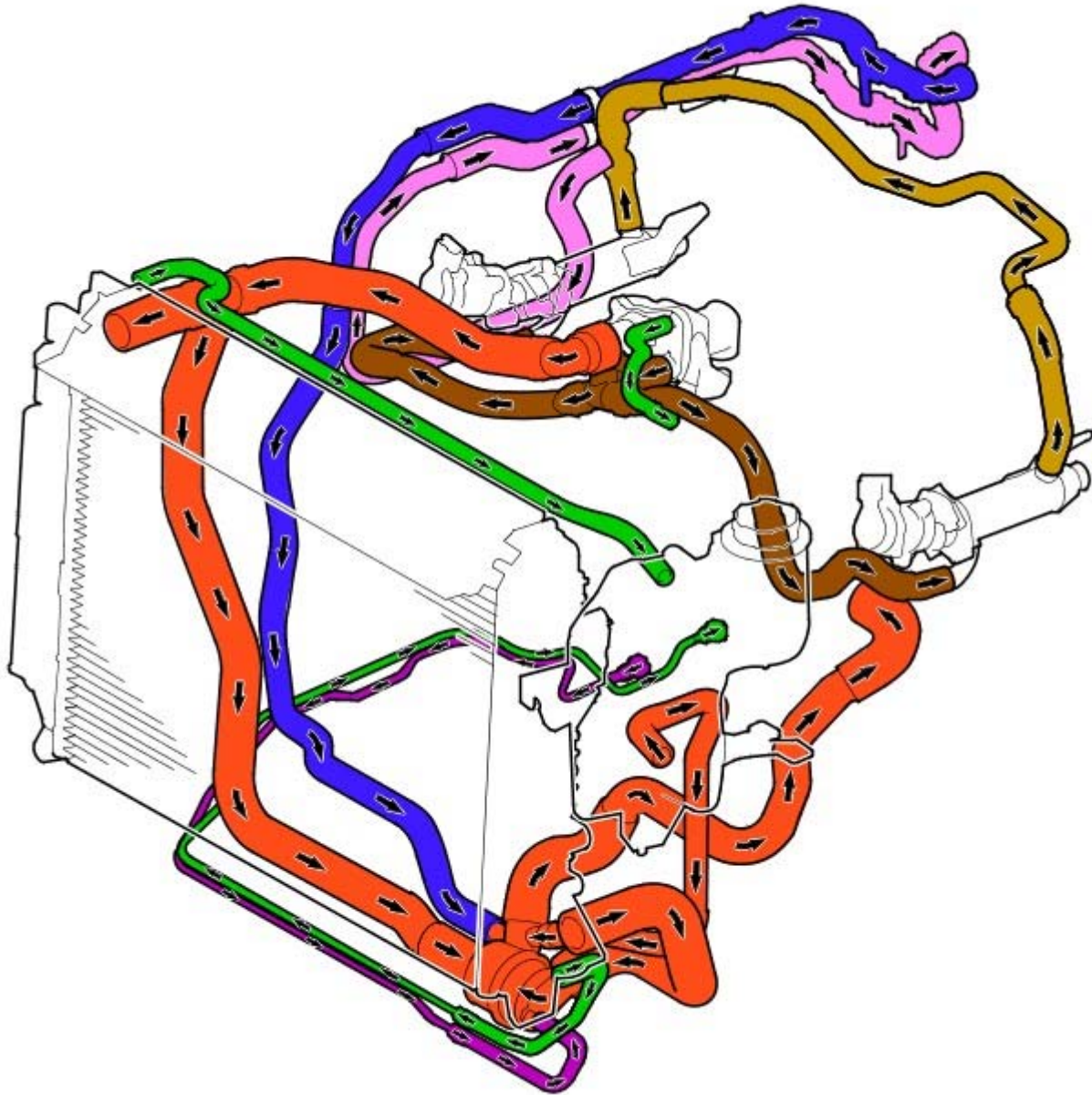
The viscous fan unit is electronically controlled by the ECM to optimise fan speed for all operating conditions.

• NOTE: If the electrical connections to the viscous fan are disconnected the fan will 'idle' and overheating may result. The ECM stores the appropriate fault codes in this case.

ENGINE COOLING SYSTEM OPERATION

Cooling System Coolant Flow – Manual Gearbox Without FBH

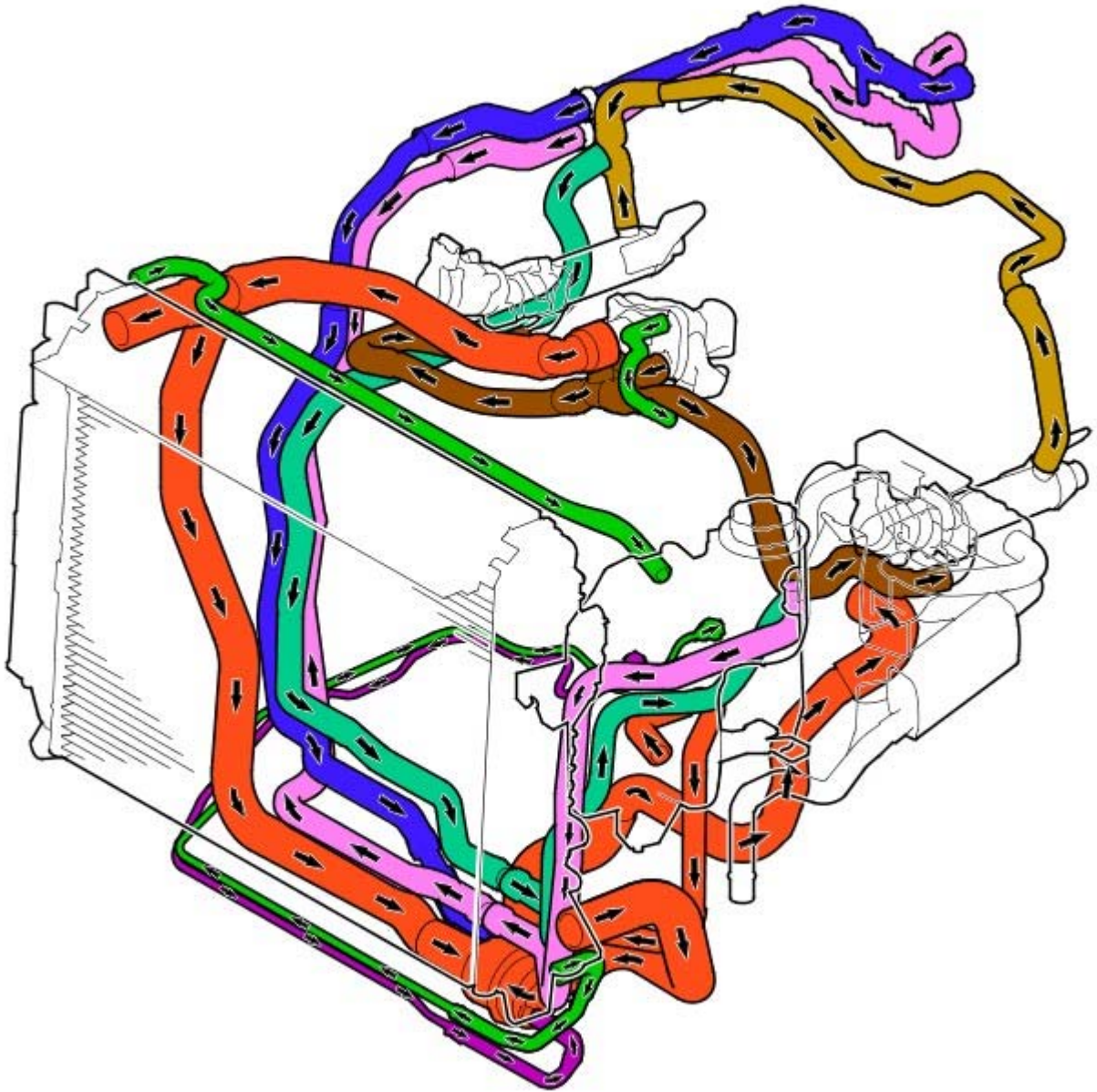
• NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E43016

Cooling System Coolant Flow – Manual Gearbox With FBH

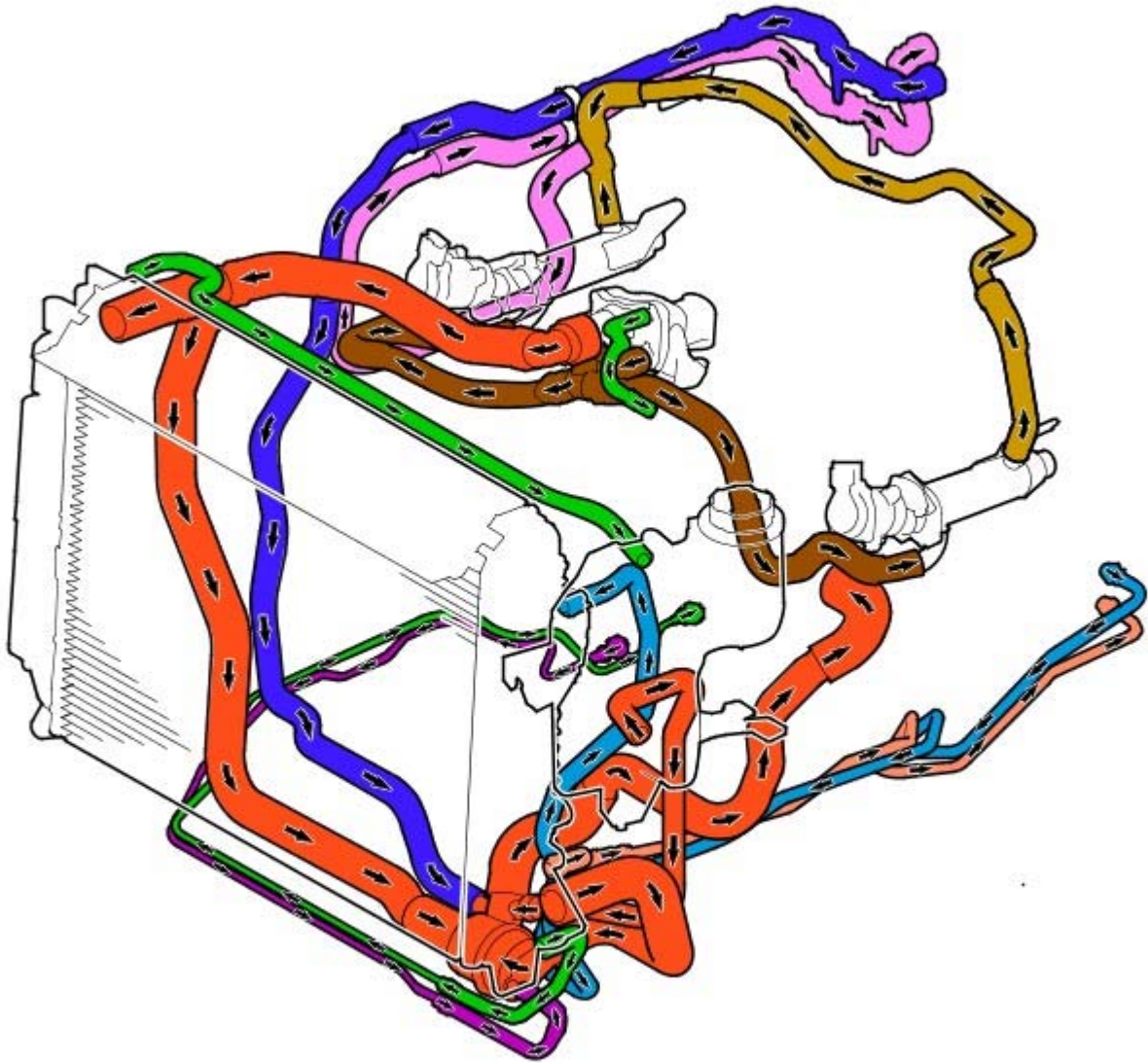
• NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E43017

Cooling System Coolant Flow – Automatic Gearbox Without FBH

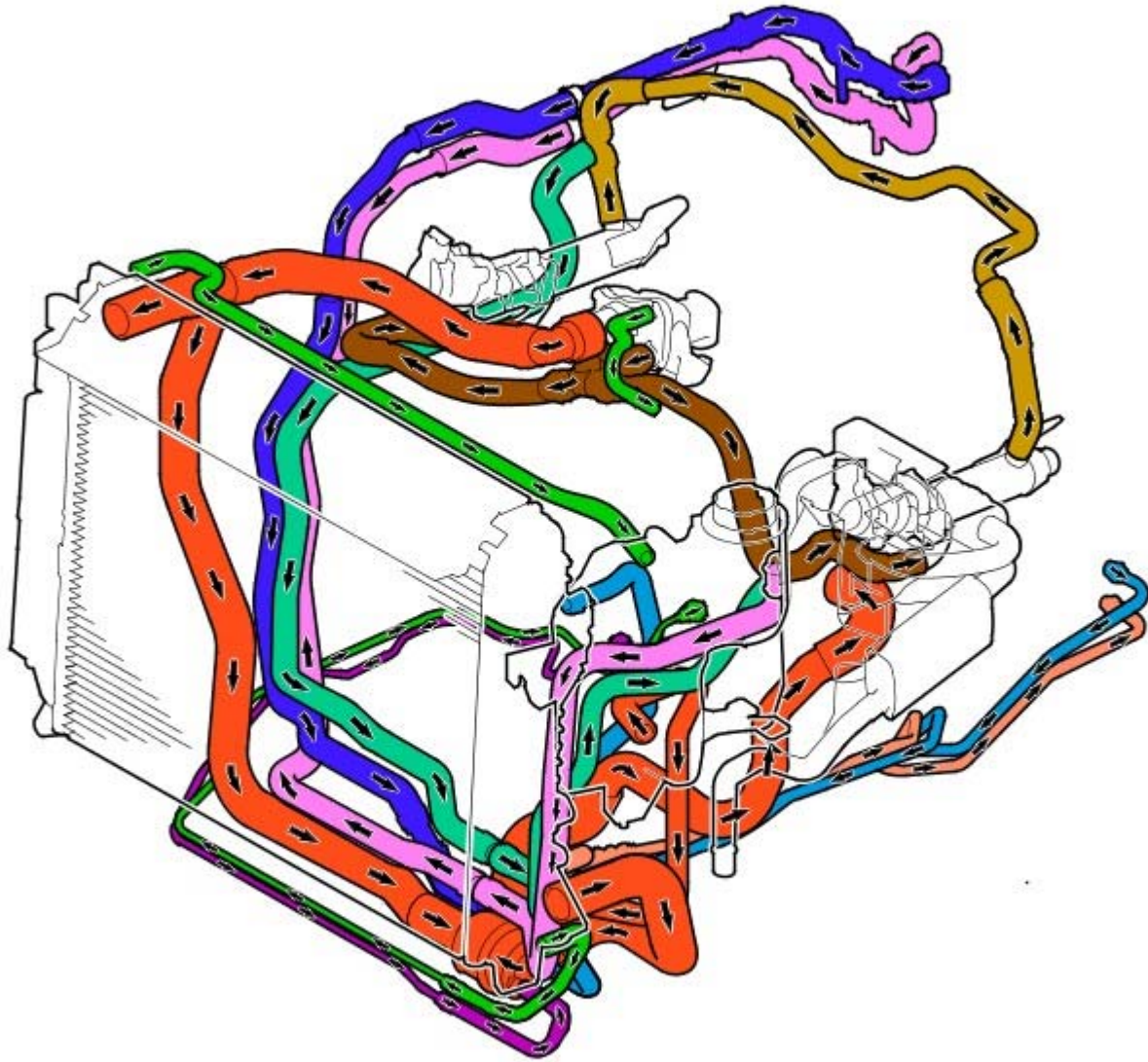
- NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E43018

Cooling System Coolant Flow – Automatic Gearbox With FBH

- NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E 43019

When the engine is running the coolant pump is driven by the ancillary drive belt. This forces coolant to circulate around the engine and heater, while the thermostat and bypass valve are shut. As the temperature and pressure increases the bypass valve is forced open allowing coolant to circulate through the bypass valve. When the temperature reaches 82°C (180°F) the main thermostat begins to open, allowing coolant to circulate through the main radiator. As the thermostat progressively opens (fully open at 95°C (203°F)), the bypass valve progressively closes forcing any coolant through the heater or radiator. Once coolant is allowed to circulate through the radiator, the transmission fluid (automatic models only) and fuel coolers begin to receive coolant flow.

The increased coolant volume, created by heat expansion, is directed to the expansion tank through a bleed hose from the top of the radiator. The expansion tank has an outlet hose which is connected into the coolant circuit. This outlet hose returns the coolant to the system when the engine cools.

Coolant flows through the radiator from the top right hand tank to the bottom left hand tank and is cooled by air passing through the matrix. The temperature of the cooling system is monitored by the ECM via the Engine Coolant temperature (ECT) sensor located in the cylinder head. The ECM uses signals from this sensor to control the cooling fan operation and adjust fuelling according to engine temperature.

For additional information, refer to: Electronic Engine Controls (303-14C Electronic Engine Controls - 2.7L Diesel, Description and Operation).

To control the cooling fan, the ECM sends a Pulse Width Modulated (PWM) signal to the cooling fan module (integral to the ECM). The frequency of the PWM signal is used by the cooling fan module to determine the output voltage supplied to the fan motor.

The ECM varies the duty cycle of the PWM signal between 0 and 100% to vary the fan speed. If the PWM signal is outside the 0 to 100% range, the cooling fan module interprets the signal as an open or short circuit and runs the fans at maximum speed to ensure the engine and gearbox do not overheat.

The ECM operates the fan in response to inputs from the ECT sensor, the transmission oil temperature sensor, the charge air temperature sensor, the A/C switch and the A/C pressure sensor.

For additional information, refer to: Air Conditioning (412-03A Air Conditioning - 4.0L, Description and Operation).

The speed of the cooling fan is also influenced by vehicle road speed. The ECM adjusts the speed of the cooling fans, to compensate for the ram effect of vehicle speed, using the Controller Area Network (CAN) road speed signal received from the Anti-lock Braking System (ABS) module.

Pressure Relief Thermostat (PRT)

The thermostat is exposed to 85% hot coolant from the engine on one side and 15% cold coolant returning from the radiator bottom hose on the other side. This allows the thermostat to react to the ambient conditions and provide coolant control for both winter and summer use. Hot coolant from the engine passes via holes in the by-pass flow valve into a tube which surrounds 85% of the thermostat sensitive area. Cold coolant from the radiator conducts through the remaining 15% of the sensitive area. In cold ambient conditions, the engine temperature is raised by approximately 10°C (50°F) to compensate for the heat loss of 15% exposure to the cold coolant returning from the bottom hose. This improves heater performance and engine warm-up.

The by-pass flow valve is held closed by a light spring and operates to further assist engine and heater warm-up. When the main valve is closed and the engine speed is at idle, the coolant pump does not produce sufficient flow and pressure to overcome the spring and open the valve. In this condition the valve prevents coolant circulating through the by-pass circuit and directs coolant through the heater matrix only. This provides a higher flow of coolant through the heater matrix improving passenger comfort in cold conditions.

When the engine speed increases above idle, the coolant pump produces a greater flow and pressure than the heater circuit can accommodate. The build up of pressure acts on the flow valve, overcoming the spring pressure, opening the valve and relieving the pressure in the heater circuit. The valve then modulates to provide maximum coolant flow through the heater matrix and allowing excess coolant to flow into the by-pass circuit to provide the engine's cooling requirements at higher engine speeds. The thermostat then regulates the flow through the radiator to maintain the engine at the optimum temperature. Maximum opening of the thermostat, and therefore maximum flow through the radiator, occurs if the coolant temperature reaches 95°C (203°F).

Engine Cooling - TDV6 2.7L Diesel - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

Engine Cooling (303-03 Engine Cooling - 2.7L Diesel, Description and Operation),
[Engine Cooling](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Coolant leaks ● Coolant Hoses ● Coolant expansion tank ● Radiator ● Heater core ● Accessory drive belt ● Viscous fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Loose or corroded connector(s) ● Engine Coolant Temperature (ECT) sensor

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	<ul style="list-style-type: none"> ● Hoses ● Hose connections ● Radiator ● Water pump ● Heater core ● Gaskets ● Engine casting cracks ● Engine block core plugs 	Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary.
Overheating	<ul style="list-style-type: none"> ● Low/Contaminated coolant ● Thermostat ● Viscous fan ● ECT sensor ● Restricted air flow over the radiator 	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	<ul style="list-style-type: none"> ● Thermostat ● Viscous fan ● Thermostat ● Electric fan ● Fan speed module 	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Engine Cooling - TDV6 2.7L Diesel - Cooling System Draining, Filling and Bleeding

General Procedures

All vehicles

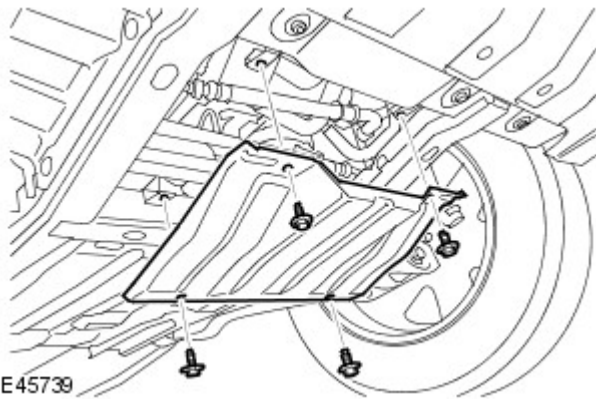
1. Position the vehicle on a lift.
2. Set the heater controls to maximum.
3. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Remove the coolant expansion tank cap.

6. Remove the radiator access panel.

- Remove the 4 bolts.

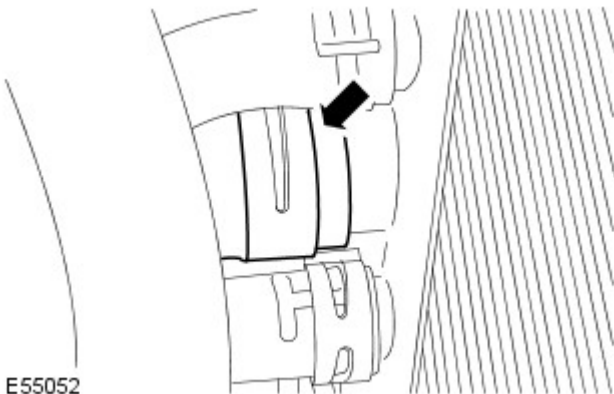


E45739

7. Position a container to collect the fluid.

8.  **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Release the clip and disconnect the radiator lower hose, allow the coolant to drain.



E55052

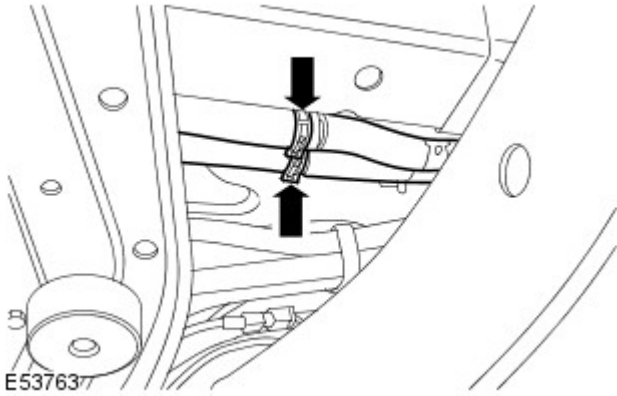
9. Remove the container.

Vehicles with auxiliary climate control

10. Remove the spare wheel and tire.

- Remove the tool kit.
- Access the winch.

11. Position a container to collect the fluid.



12. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.

13. Remove the container.

14. Connect the rear heater coolant hoses.

- Secure the two clips.

15. Install the spare wheel and tire.

- Stow the tool kit.

All vehicles

16. Connect and secure the radiator lower hose.

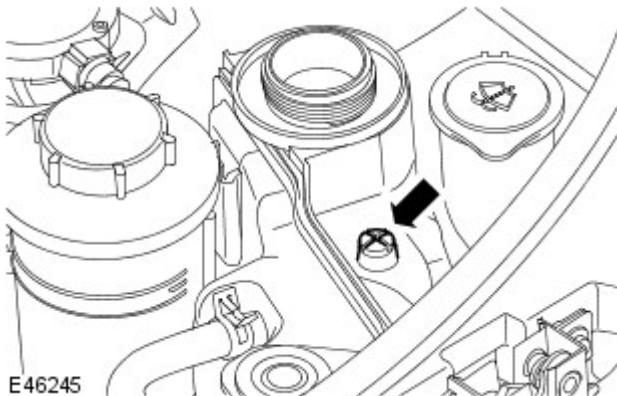
- Secure with the clip.

17. Connect the battery ground cable.

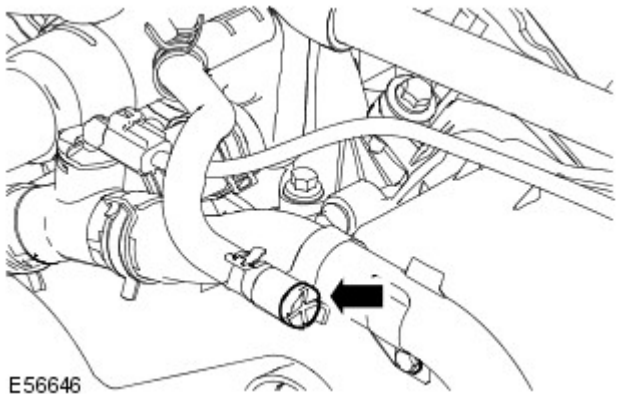
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

18. Connect exhaust extraction hoses to the tail pipes.

19. Loosen the coolant expansion tank bleed screw.



20. Loosen the cylinder head bleed hose bleed screw.




21. Refill the cooling system.

22. Tighten the bleed screws to 14 Nm (10 lb.ft).

23. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

24. NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top up the expansion tank to 30mm above the maximum level.

Install the coolant expansion tank cap.

25.  WARNING: Release the cooling system pressure by slowly turning the expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

Start and run the engine.

- Hold the engine speed at 3,000 RPM for one minute.
- Return the engine to idle for five minutes.
- Hold the engine speed at 3,000 RPM for one minute.
- Run the engine until the thermostat opens.
- Remove coolant expansion tank cap, allow float to settle and top-up coolant if required. Install cap.

26. Switch the engine off and allow to cool.

27. Install the engine cover.

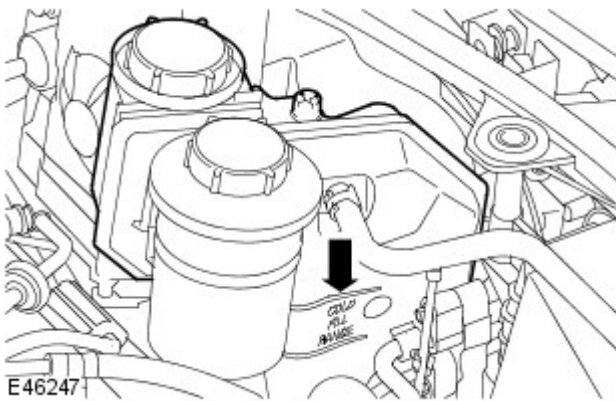
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

28. Clean any remaining coolant from the chassis and surrounding area.

29. Install the radiator access panel.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).

30. Check and top-up the coolant if required.



Engine Cooling - TDV6 2.7L Diesel - Cooling System Draining and Vacuum

Filling

General Procedures

⚠ WARNING: To avoid having scalding hot coolant or steam blowing out of the cooling system, use extreme care when removing the coolant pressure cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant pressure cap and turn it slowly until the pressure begins to release. Step back while the pressure is released from the system. When certain all the pressure has been released (still with a cloth) turn and remove the coolant pressure cap from the coolant expansion tank. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

⚠ The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage. Failure to follow this instruction may result in damage to the engine.

⚠ Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

1. Set the heater controls to maximum HOT.

2. **⚠ WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

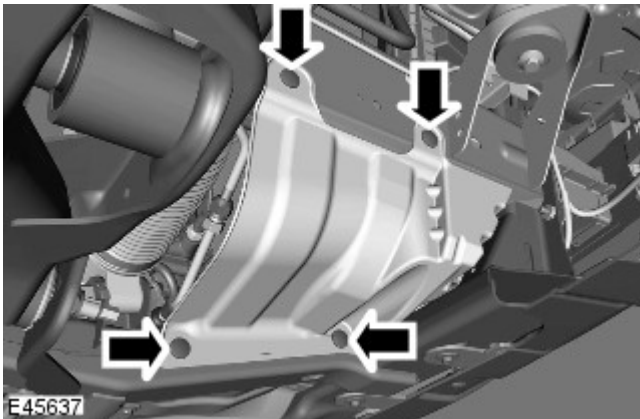
Remove the coolant expansion tank cap.

3. **⚠ WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

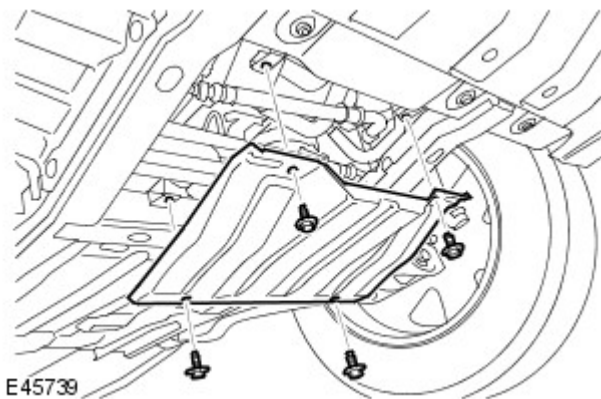
4. Remove the front LH splash shield.

- Remove the 4 clips.

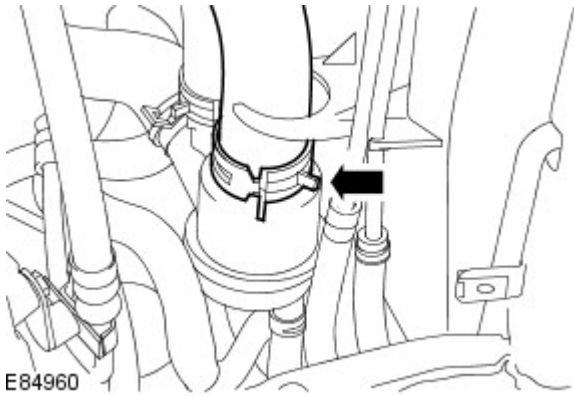


5. Remove the radiator access panel.

- Remove the 4 bolts.

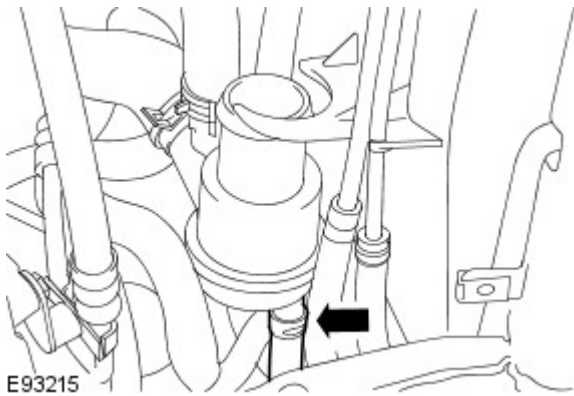


6. Position a container to collect the fluid.



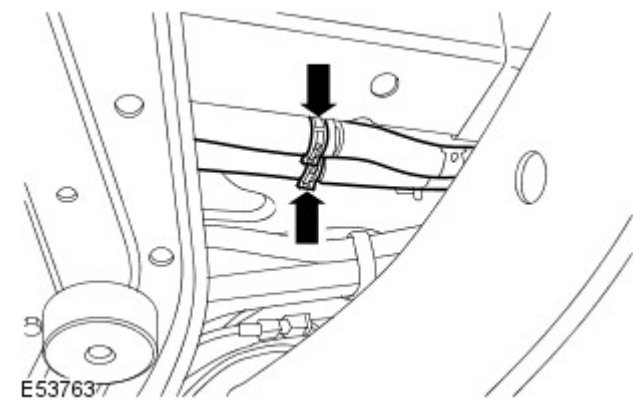
7. Disconnect the coolant hose from the thermostat.

- Release the clip.
- Allow the coolant to drain.



8. Disconnect the coolant hose from the thermostat.

- Release the clip.
- Allow the coolant to drain.



9. Remove the spare wheel and tire.

- Remove the tool kit.
- Access the winch.

10. Position a container to collect the fluid.

11. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.

12. Connect the rear heater coolant hoses.

- Secure the clips.

13. Install the spare wheel and tire.

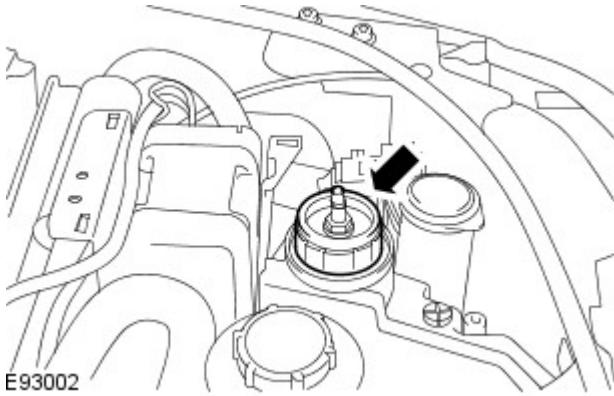
- Stow the tool kit.

14. Connect the thermostat housing coolant hoses.

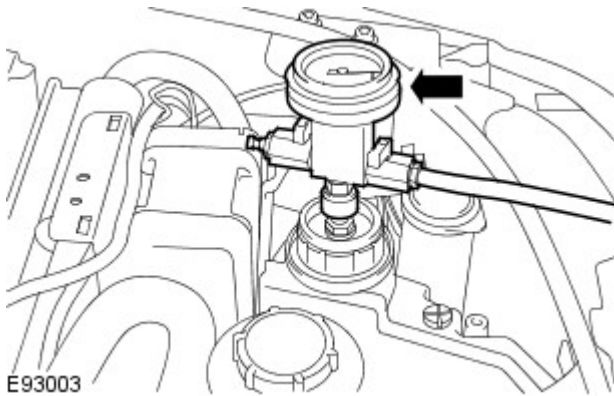
- Secure with the clip.

15. Prepare a sufficient amount of coolant to the specified concentration.

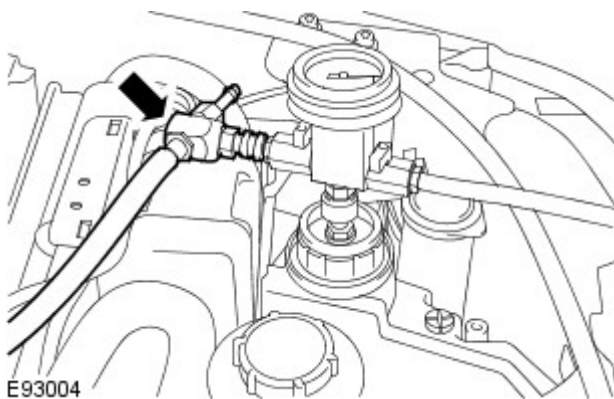
16. Install the cooling system vacuum refill adaptor to the expansion tank.



17. Install the vacuum filler gauge to the cooling system vacuum refill adaptor.



18. Install the venturi tube assembly to the vacuum filler gauge.

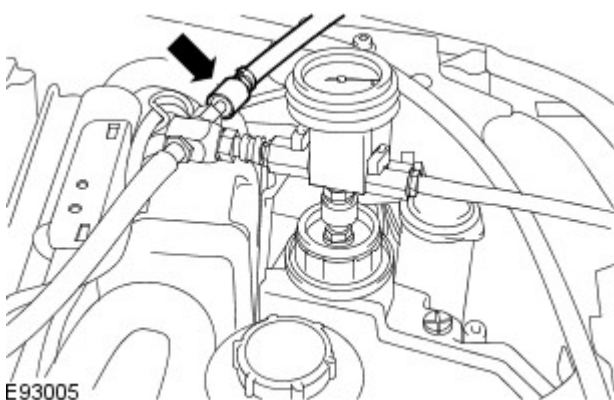


19. NOTE: Make sure both valves on gauge assembly are in the closed position.

- NOTE: The coolant vacuum fill tool needs an air pressure of 6 to 8 bar (87 to 116 psi) to operate correctly.

- NOTE: Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

Connect a regulated compressed air supply to the venturi tube assembly.

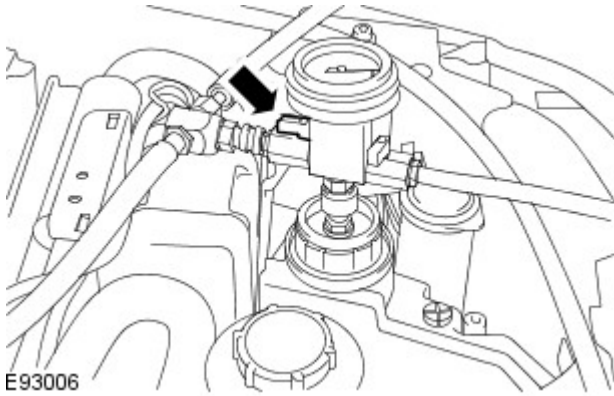


20. NOTE: Make sure air cannot enter the hose.

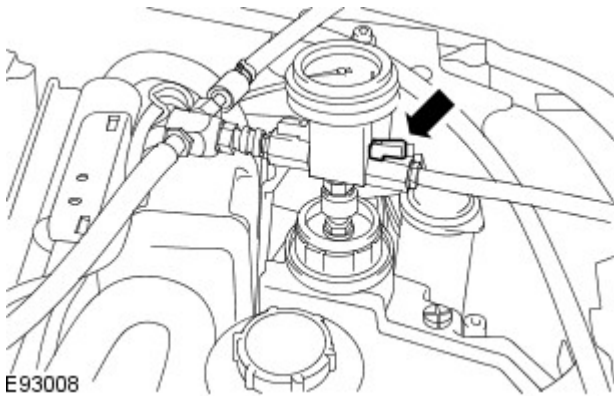
Position the coolant pick-up pipe into a container of clean coolant.

21. Position the evacuated air hose into a container.

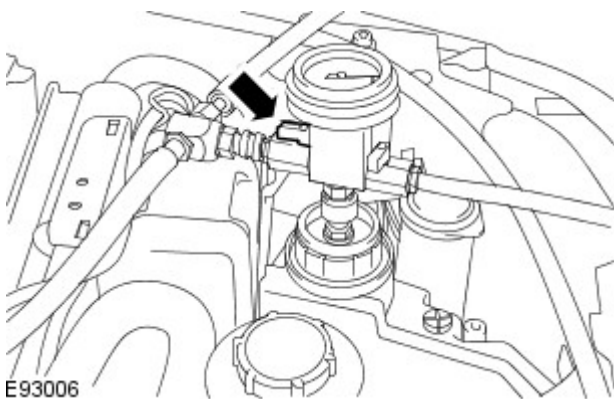
22. Open the air supply valve.



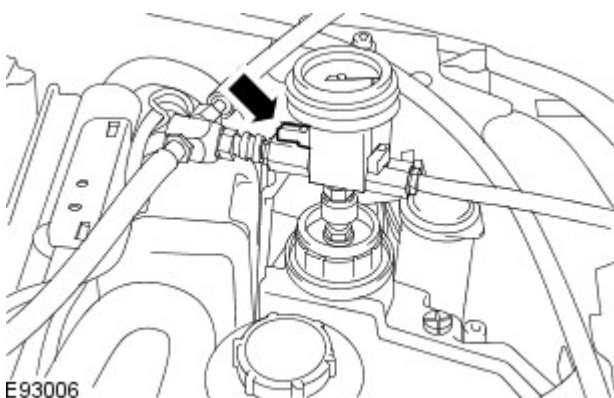
23. Open the coolant supply valve for 2 seconds to prime the coolant supply hose.

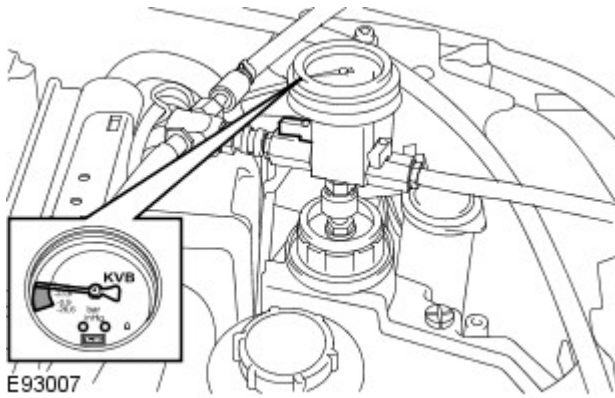


24. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.



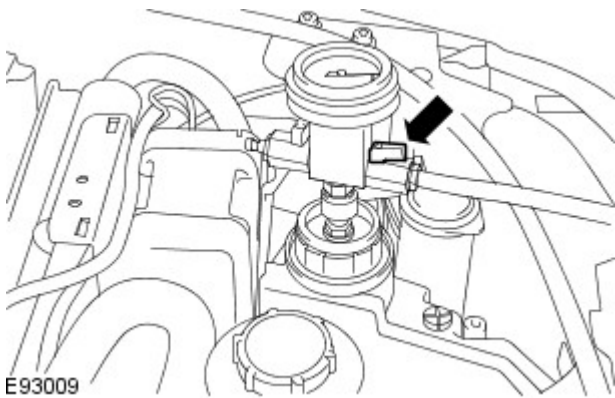
25. Close the air supply valve.





26. Allow one minute to check the vacuum is held.

- Disconnect the compressed air supply.



27. NOTE: Close the coolant supply valve when the coolant expansion tank MAX mark is reached or coolant movement has ceased.

Open the coolant supply valve and allow the coolant to be drawn into the system.

28. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.

29. Connect exhaust extraction hoses to the tail pipes.

30. Check and top-up the coolant if required.

31. Install the coolant expansion tank cap.

32. Start and run the engine.

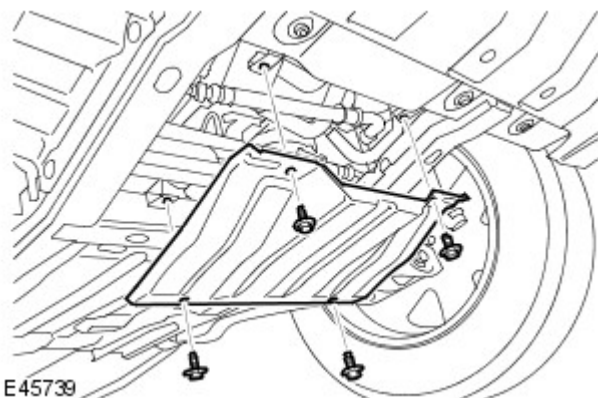
- Hold the engine speed at 3,000 RPM for one minute.
- Return the engine to idle for five minutes.
- Hold the engine speed at 3,000 RPM for one minute.
- Run the engine until the thermostat opens.

33. Switch the engine off and allow to cool.

34. Clean any spilt coolant from the vehicle.

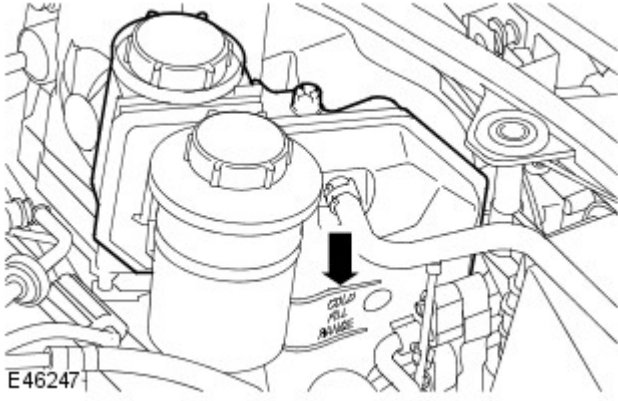
35. Install the radiator access panel.


- Tighten the 4 bolts to 10 Nm (7 lb.ft).



36. Install the front LH splash shield.

- Install the clips.



37.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Check and top-up the coolant if required.


Engine Cooling - TDV6 2.7L Diesel - Cooling System Pressure Test

General Procedures

• NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

• NOTE: It will be necessary to use the cooling system test kit, Part Number LR-218, which is available under the equipment programme.

1. Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Disconnect the coolant expansion tank bleed hose.

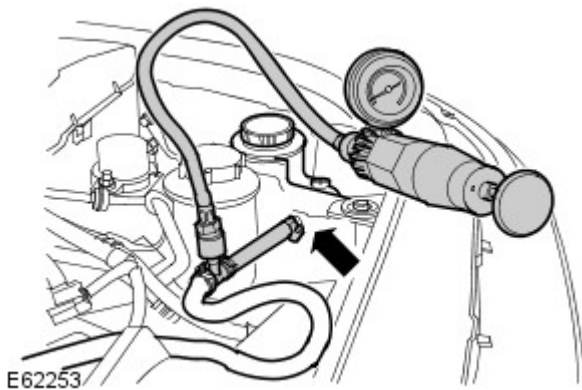
- Release the clip.

3. Install the 'T' piece adaptor (part of the cooling system test kit) between the coolant expansion tank and the coolant bleed hose.

- Secure with the 2 clips.

4. Install the coolant pressure pump assembly.

- Connect to the 'T' piece.




5. Pressurize the cooling system.

- Slowly pressurize the cooling system to 1.0 bar (100 kPa) (14.5 psi).
- Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
- During the pressure drop check, listen for a hissing noise from the expansion tank cap.

6. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

Depressurize the cooling system.

- Disconnect the 'T' piece.
- Connect the coolant expansion tank bleed hose.
- Secure the clip.

7.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Remove the coolant expansion tank cap.

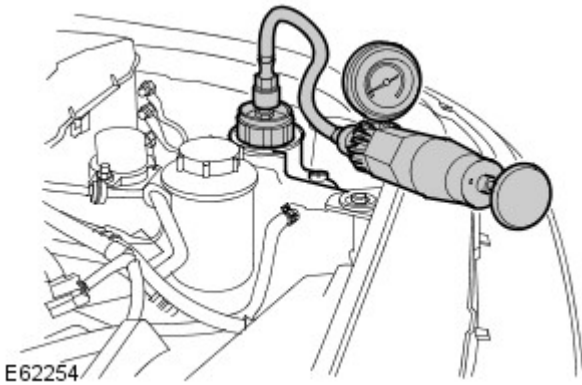
8. NOTE: This adaptor is part of the cooling system test kit.

Install adaptor K83 to the coolant expansion tank.

- Clean the component mating faces.
- Lubricate the seal.

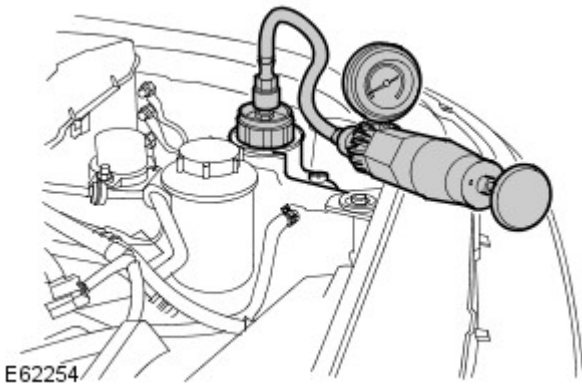
9. Install the coolant pressure pump assembly.

- Slowly pressurize the cooling system to 1.5 bar (150kPa) (22 psi), check the pressure over a 5 minute period. A small pressure decay of approximately 0.15 bar (15 »kPa) (1 psi) over the first minute is normal, as the air in the expansion tank cools.
- If the pressure continues to drop after the initial tolerance, there is a coolant leak.



10. Depressurize and remove the pressure pump and gauge.

- Install the coolant expansion tank cap.

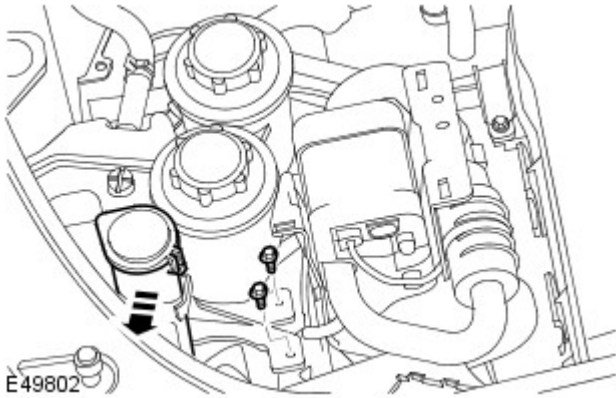


Engine Cooling - TDV6 2.7L Diesel - Coolant Expansion Tank


Removal and Installation


Removal

1. Remove the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
2. Release the windshield washer reservoir filler neck.
3. Release the coolant expansion tank.
 - Remove the 2 bolts.



4. Release the power steering fluid reservoir.

5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

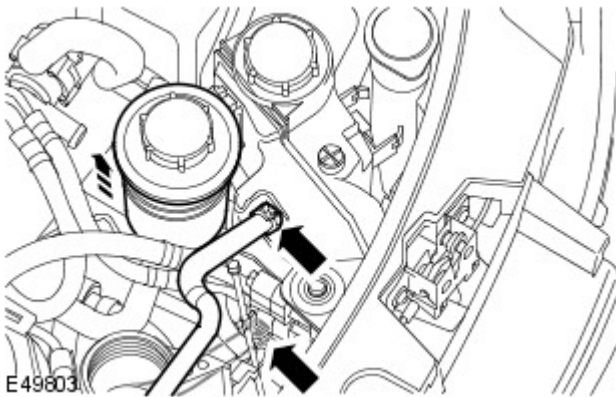
 **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Disconnect the 2 hoses from the coolant expansion tank.

- Position an absorbent cloth to collect fluid spillage.
- Position a container to collect the fluid.
- Clamp the hoses
- Release the 2 clips.

6. Remove the coolant expansion tank.

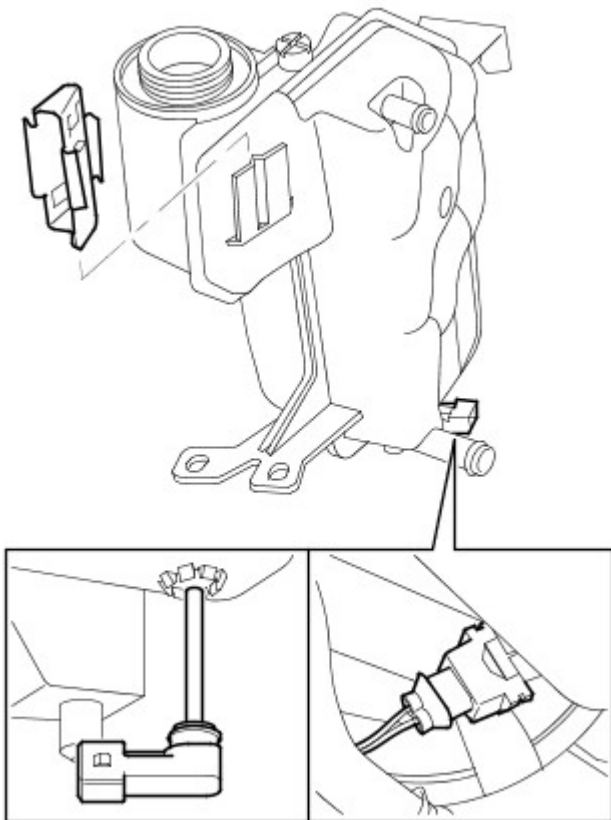
- Disconnect the coolant low level sensor electrical connector.



7. NOTE: Do not disassemble further if the component is removed for access only.

Remove the coolant low level sensor.

- Remove the coolant expansion tank support bracket.



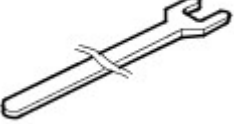

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Installation

1. Install the bracket.
2. Install the coolant low level sensor.
3. Install the coolant expansion tank.
 - Connect the coolant low level sensor electrical connector.
4. Connect the coolant hoses to the expansion tank.
 - Secure with the clips.
5. Top-up the coolant.
 - Loosen the coolant expansion tank bleed screw.
 - Fill the coolant expansion tank until coolant emerges from the cooling system air bleed screw.
 - Remove the hose clamps.
 - Tighten the bleed screw to 8 Nm (6 lb.ft).
6. Secure the coolant expansion tank.
 - Tighten the bolts to 10 Nm (7 lb.ft).
7. Check and top-up the coolant.
 - Install the coolant expansion tank pressure cap.
8. Secure the power steering fluid reservoir.
 - Attach to the mounting bracket.
9. Secure the windshield washer reservoir filler neck.
 - Locate in clip.
10. Install the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly \(417-01 Exterior Lighting, Removal and Installation\)](#).

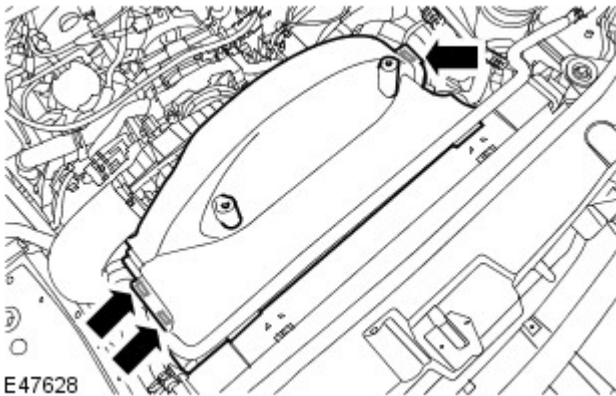
Engine Cooling - TDV6 2.7L Diesel - Cooling Fan

Removal and Installation

Special Tool(s)	
 <p>303-1142 E46076</p>	<p>Viscous coupling spanner 303-905 (LRT-12-094)</p>
 <p>303-1143 E55382</p>	<p>Viscous coupling pulley retaining tool 303-1143</p>

Removal

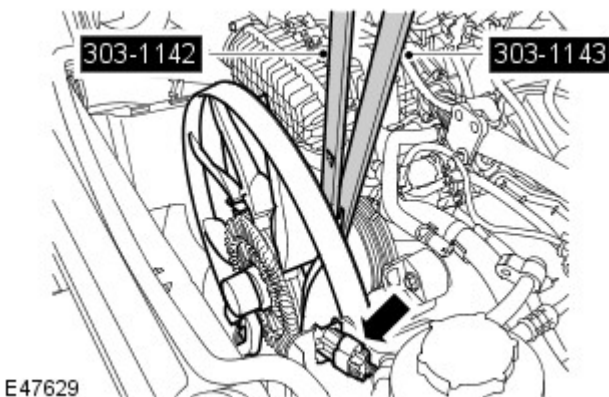
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air cleaner assembly.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
3. Remove the cooling fan shroud.
 - Release the coolant hose.
 - Release the 3 clips.



4. **NOTE: The thread is left handed.**

Remove the cooling fan assembly.

- Disconnect the electrical connector.
- Use the special tools.





5. NOTE: Do not disassemble further if the component is removed for access only.

Remove the viscous coupling.

- Remove the 4 bolts.

Installation

1. Install the viscous coupling.
 - Clean the component mating faces.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the cooling fan assembly.
 - Clean the component mating faces.
 - Tighten the cooling fan assembly to 65 Nm (48 lb.ft).
 - Connect the electrical connector.
3. Install the cooling fan shroud.
4. Install the air cleaner assembly.


For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Cooling - TDV6 2.7L Diesel - Cooling Fan Shroud

Removal and Installation

Removal

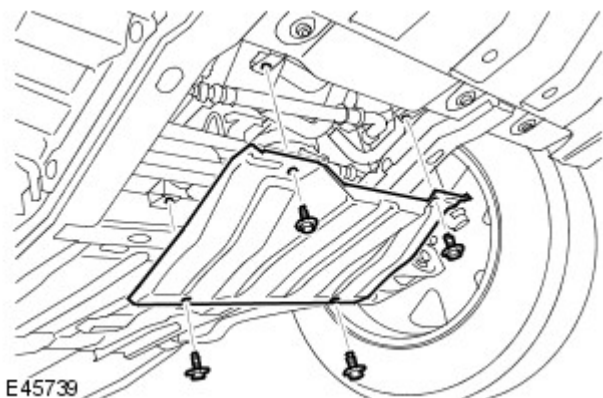
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

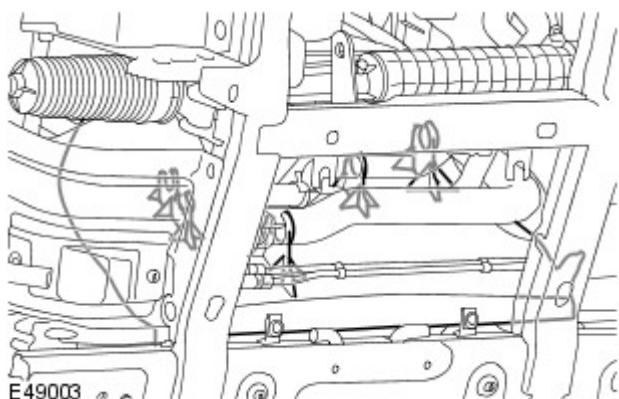
2. Remove the cooling fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

3. Remove the radiator access panel.

- Remove the 4 bolts.

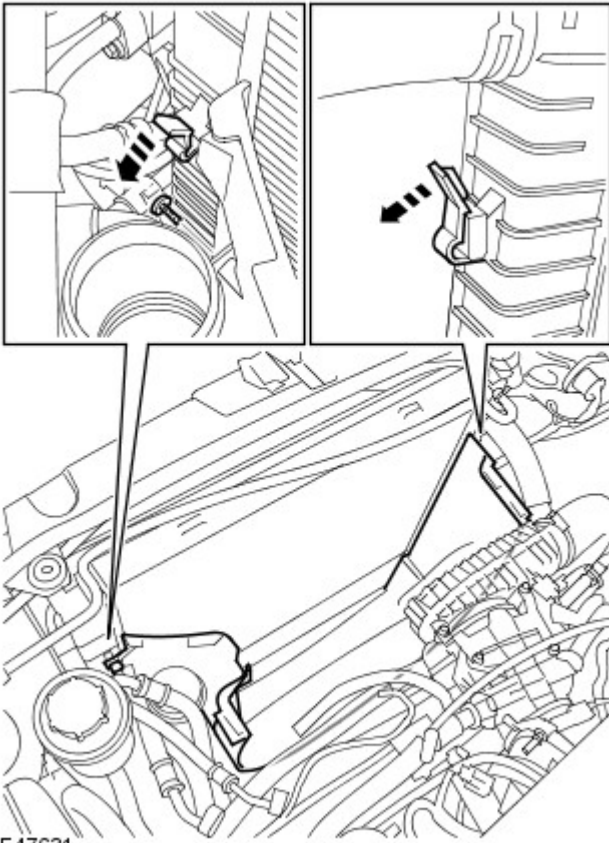


4. Release the coolant pipes and hoses from the lower shroud.



5. Remove the cooling fan lower shroud.

- Release the 2 clips.
- Remove the screw.



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Installation

1. Install the cooling fan lower shroud.

- Tighten the screw.
- Secure with the clips.

2. Install the coolant pipes and hoses to the lower shroud.

3. Install the radiator access panel.

- Tighten the bolts to 10 Nm (7 lb.ft).

4. Install the cooling fan assembly.

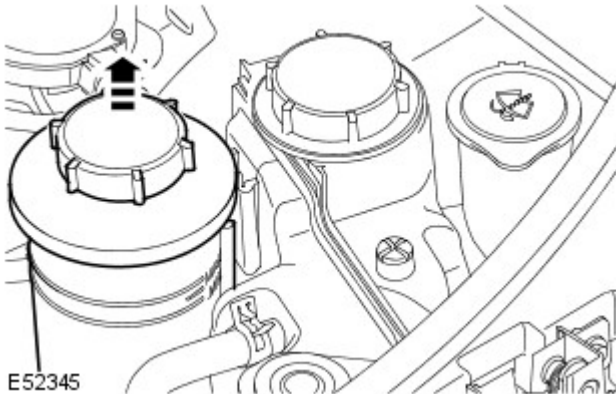
For additional information, refer to: [Cooling Fan](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

Engine Cooling - TDV6 2.7L Diesel - Engine Coolant Level Switch

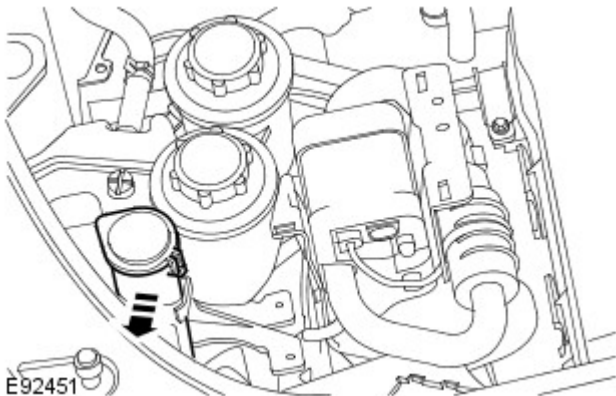
Removal and Installation

Removal

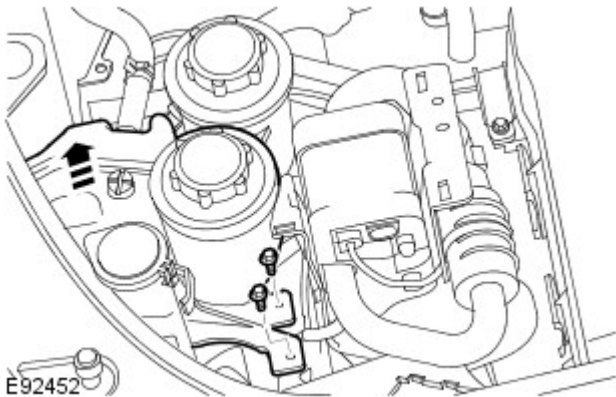
1. Release the power steering fluid reservoir from the bracket.



2. Release the windshield washer reservoir filler neck.



3. Reposition the coolant expansion tank.
 - Remove the 2 bolts.



4. Remove the engine coolant level switch.

Installation

1. NOTE: Disconnect the engine coolant level switch electrical connector. **CAUTION: Make sure the click can be heard when the engine coolant level switch is correctly installed.**

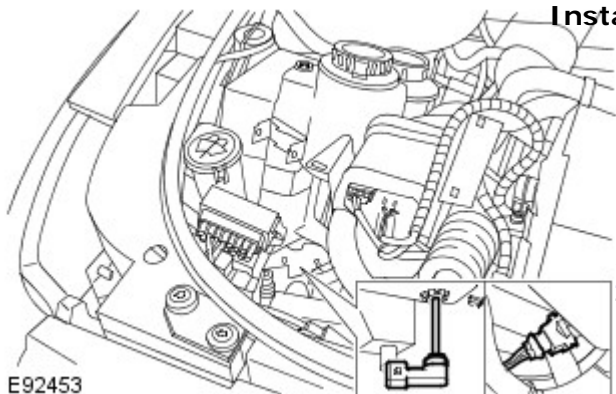
Install the engine coolant level switch.

- Connect the engine coolant level switch electrical connector.

3. Secure the windshield washer reservoir filler neck.
2. **CAUTION: Make sure that the component is correctly located on the locating peg.** Secure the power steering fluid reservoir to the bracket.

Secure the coolant expansion tank.

- Tighten the bolts to 10 Nm (7 lb.ft).




Engine Cooling - TDV6 2.7L Diesel - Radiator


Removal and Installation

Removal

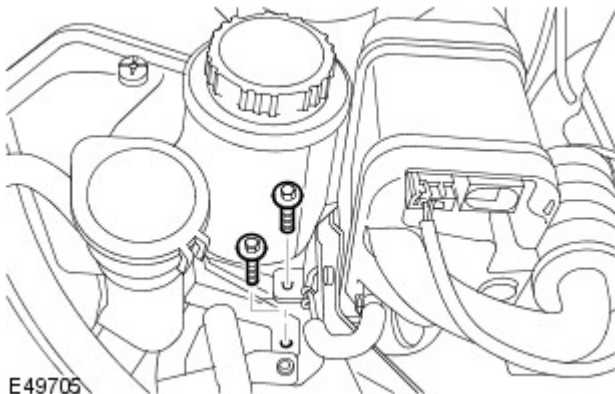
All vehicles

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

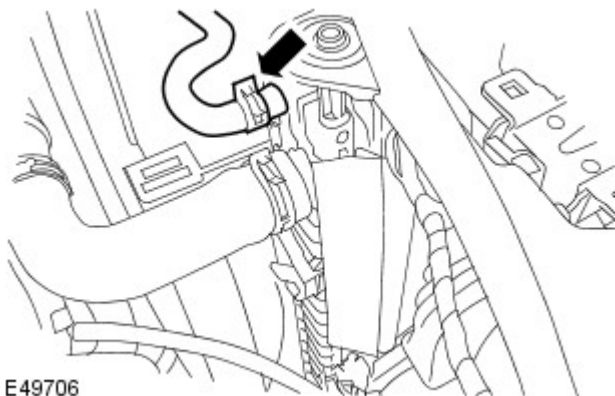
Raise and support the vehicle.

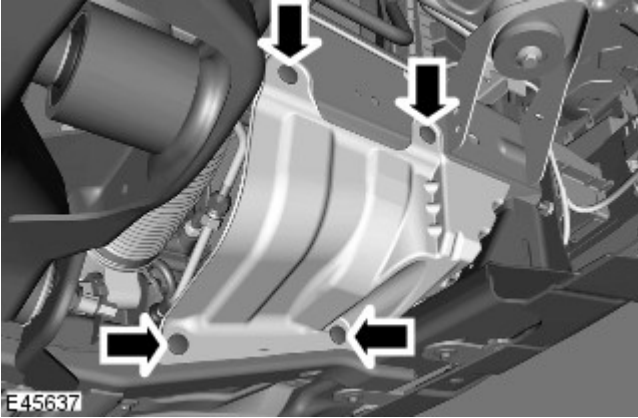
2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
4. Remove the cooling fan lower shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
5. Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
6. Remove the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
7. Release the coolant expansion tank.
 - Remove the 2 bolts.



8. Disconnect the radiator bleed hose.
 - Release the clip.





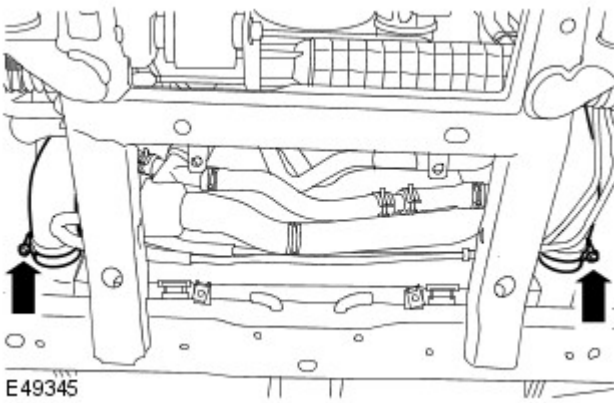
9. Remove the front RH splash shield.

- Remove the 4 retaining clips.

10.  CAUTION: Always plug any open connections to prevent contamination.

Disconnect the charge air cooler inlet hose.

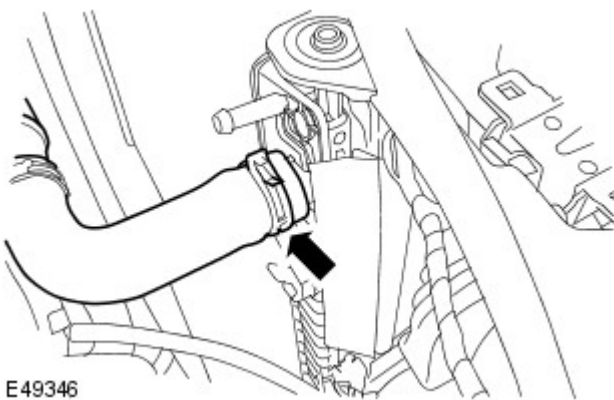
- Loosen the clip.
- Tie aside.



11.  CAUTION: Always plug any open connections to prevent contamination.

Disconnect the charge air cooler outlet hose.

- Loosen the clip.
- Tie aside.

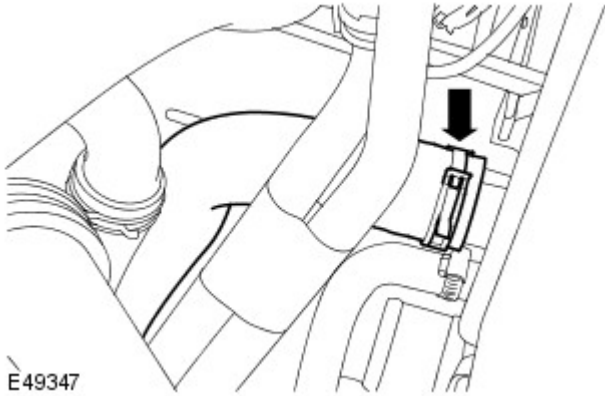


12. Disconnect the radiator upper hose.

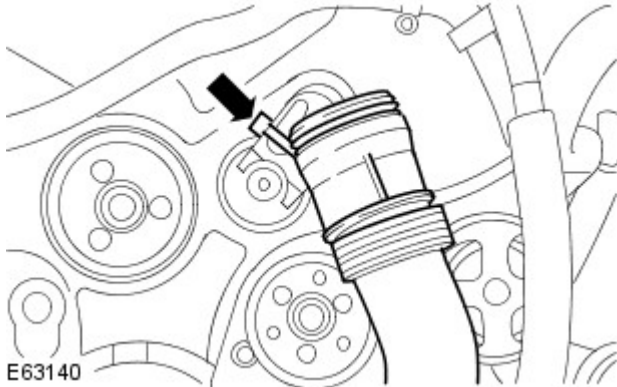
- Release the clip.
- Tie aside.

13. Disconnect the radiator lower hose.

- Release the clip.
- Tie aside.



14. Tie the engine air intake duct towards the engine.

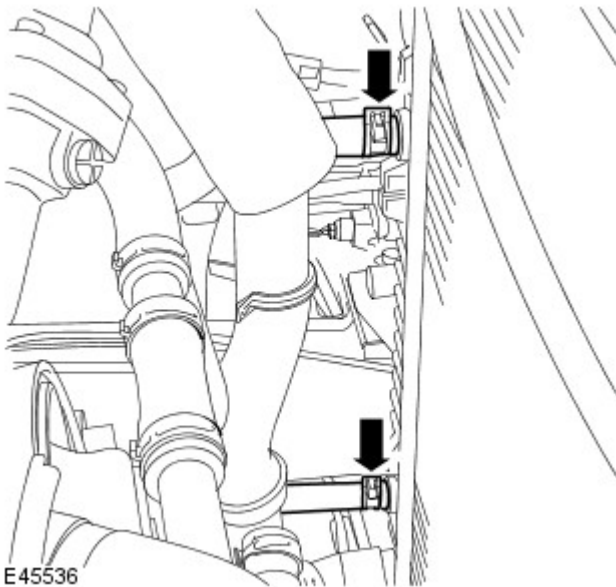


Vehicles with automatic transmission

15.  CAUTION: Always plug any open connections to prevent contamination.

Disconnect the 2 transmission fluid cooler pipes.

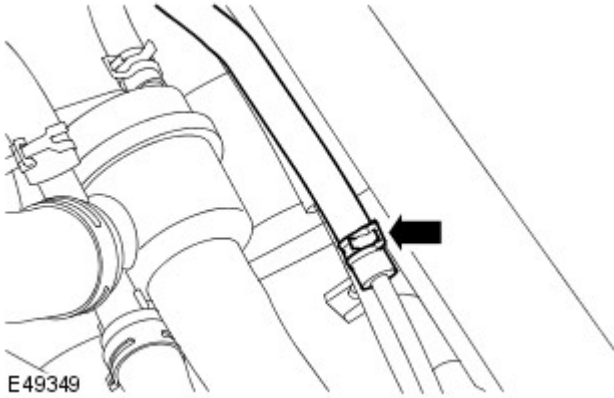
- Release the clips.
- Position a container to collect the fluid spillage.
- Tie aside.



All vehicles

16. Disconnect the fuel cooler line.

- Release the clip.



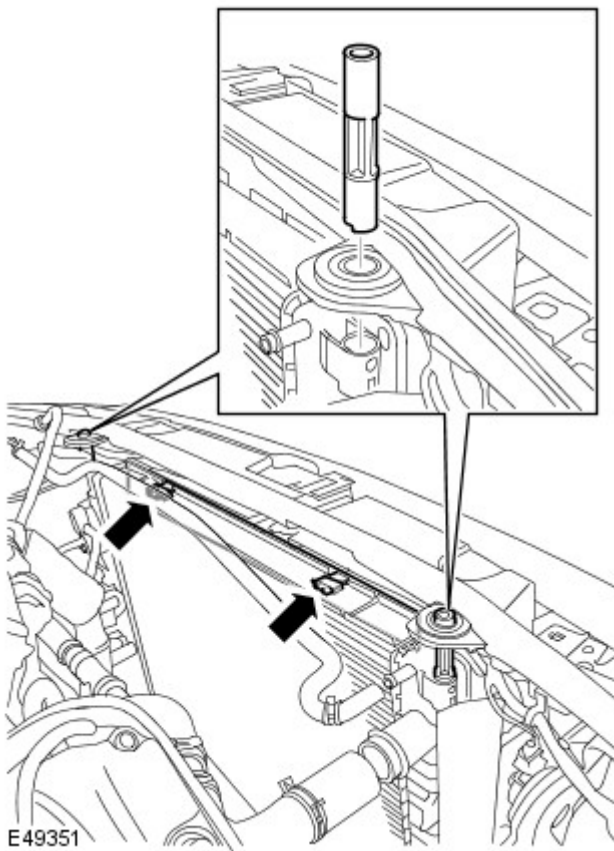
E49349

17. Remove the radiator securing pegs.

- Release the clips.

18. Remove the radiator upper deflector.

- Release the 2 clips.

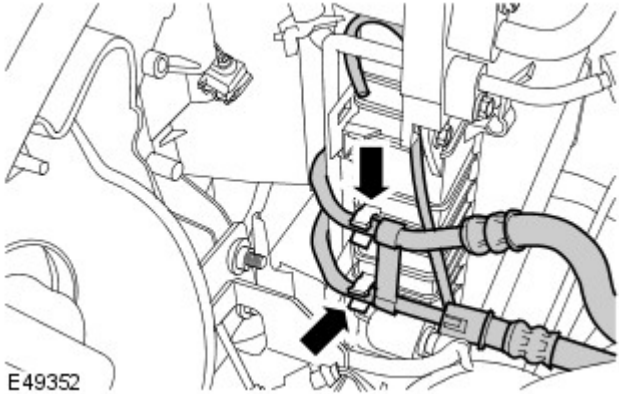


E49351

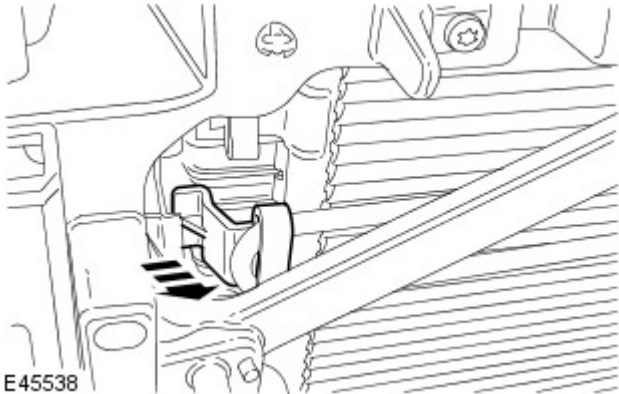
19. Release the power steering fluid cooler.

- Release the 2 clips.
- Tie the line aside.

20. Release the front differential breather line.

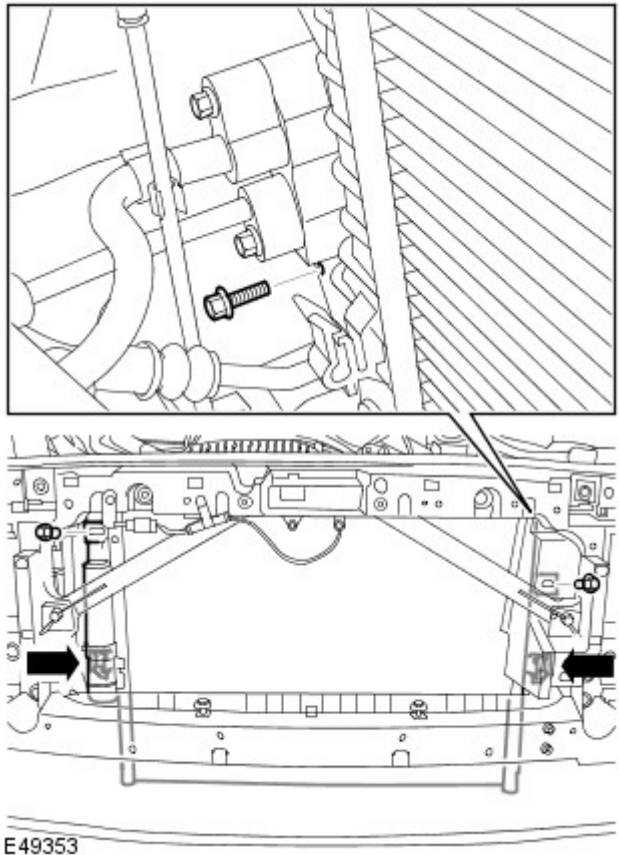


21. Remove the power steering fluid cooler line retaining clip.



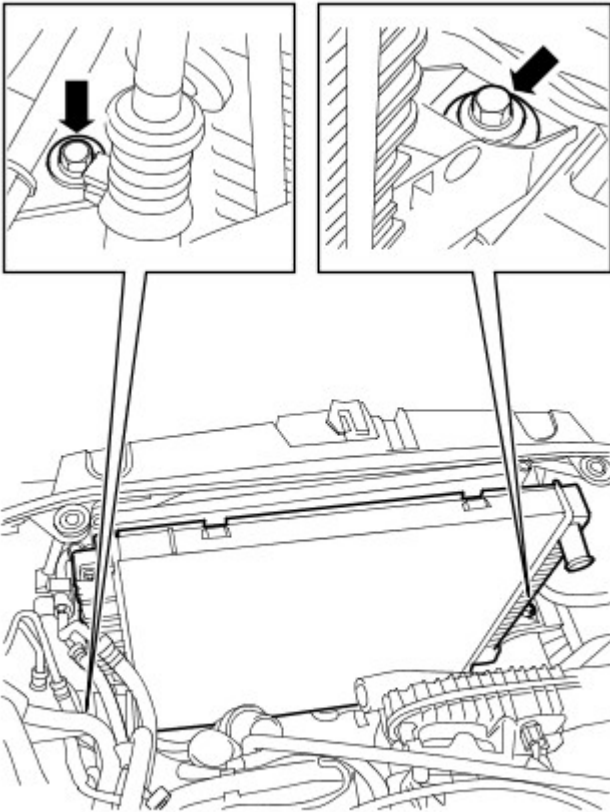
22. Release the A/C condenser.

- Remove the 3 bolts.
- Release the 2 clips.



23. Release the radiator.

- Remove the 2 bolts.
- Lift the radiator clear of its mountings.

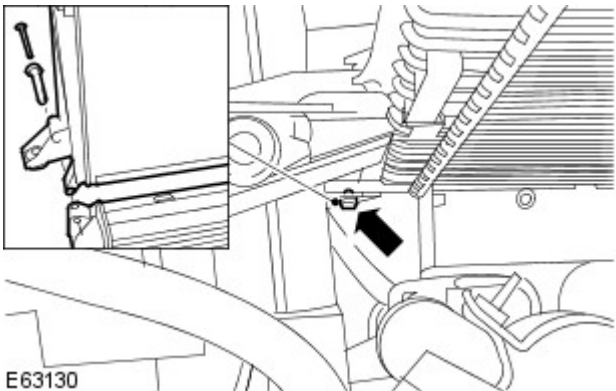


E49354


24. Tie the A/C condenser forwards, clear of the radiator.

25. NOTE: Left-hand shown, right-hand similar.

Remove the 2 clips retaining the radiator to the charge air cooler.



E63130

26.  CAUTION: Protect the radiator during this operation.

- NOTE: Do not disassemble further if the component is removed for access only.

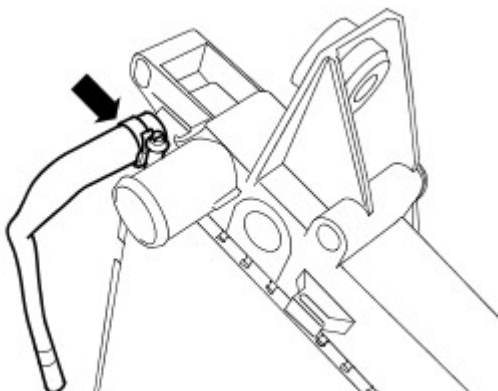
Carefully remove the radiator.

27. NOTE: Note the fitted position.

28. Remove the radiator lower deflector.

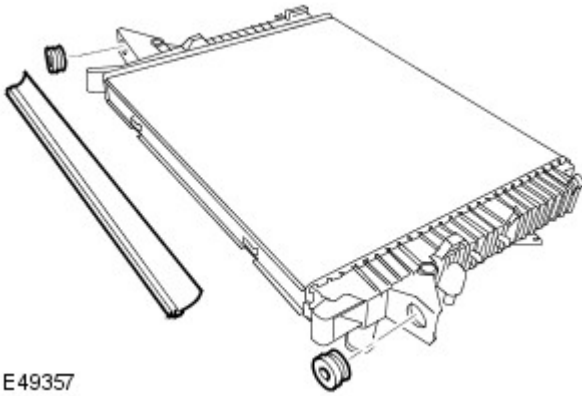
Remove the fuel cooler hose.

- Loosen the clip.



E49356


29. Remove the radiator rubber insulators.



E49357

Installation

All vehicles

1. Install the rubber insulators.
2. Install the radiator lower deflector.
3. Install the fuel cooler hose.
 - Tighten the clip.
4.  **CAUTION:** Protect the radiator during this operation.

Carefully install the radiator.

5. Install the 2 clips, to retain the charge air cooler to the radiator.
6. Position the radiator.
 - Lift the radiator onto its mountings.
 - Tighten the bolts to 25 Nm (18 lb.ft).
7. Attach the A/C condenser.
 - Remove and discard the 2 cable ties.
 - Lift it into the clips.
 - Tighten the bolt to 6 Nm (4 lb.ft).
8. Position the front differential breather line.
9. Attach the power steering fluid cooler.
 - Secure into the 3 clips.
10. Install the radiator upper deflector.
11. Install the radiator securing pegs.
12. Connect the fuel cooler line.
 - Secure with the clip.

Vehicles with automatic transmission

13. Connect the transmission fluid cooler coolant hoses.
 - Install the clips.

All vehicles

14. Install the radiator lower hose.
 - Secure with the clip.
15. Release the air intake duct.
 - Remove and discard the cable tie.
16. Connect the radiator upper hose.

- Remove and discard the cable tie.
 - Secure with the clip.
- 17.** Connect the radiator lower hose.
- Remove and discard the cable tie.
 - Secure with the clip.
- 18.** Connect the charge air outlet hose.
- Tighten the clip to 10 Nm (7 lb.ft).
- 19.** Connect the charge air inlet hose.
- Tighten the clip to 10 Nm (7 lb.ft).
- 20.** Install the front RH splash shield.
- Install the four clips.
- 21.** Secure the coolant expansion tank.
- Tighten the two retaining bolts to 10 Nm (7 lb.ft).
- 22.** Connect the radiator bleed hose.
- Secure with the clip.
- 23.** Install the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
- 24.** Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- 25.** Install the cooling fan lower shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
- 26.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- 27.** Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

Vehicles with automatic transmission

- 28.** Check automatic transmission fluid level.

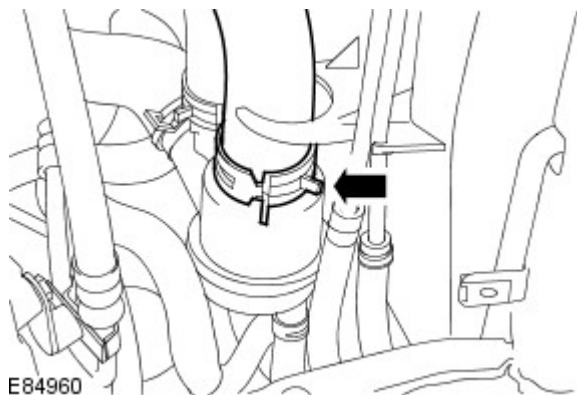
Engine Cooling - TDV6 2.7L Diesel - Thermostat

Removal and Installation

Removal

1. Drain the cooling system.
2. Position a container to collect the fluid spillage.
3. Disconnect the radiator upper hose from the thermostat.

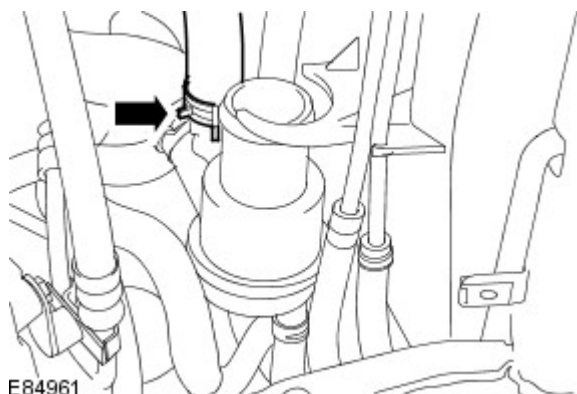
- Release the clip.



E84960

4. Disconnect the heater hose from the thermostat.

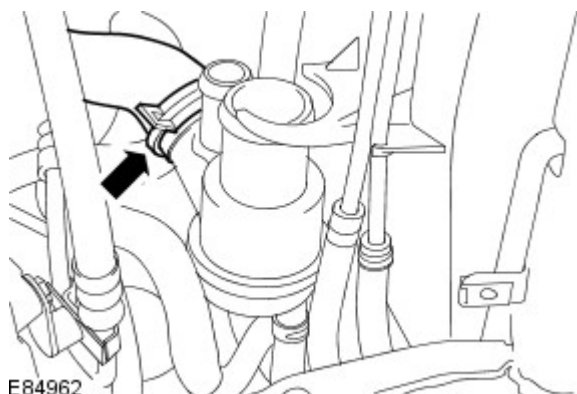
- Release from the clip.



E84961

5. Disconnect the engine inlet hose from the thermostat.

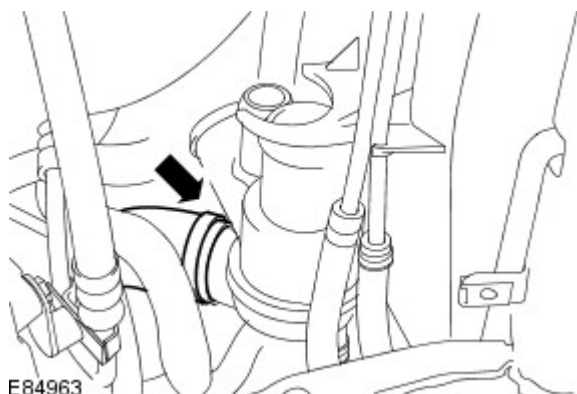
- Release the clip.



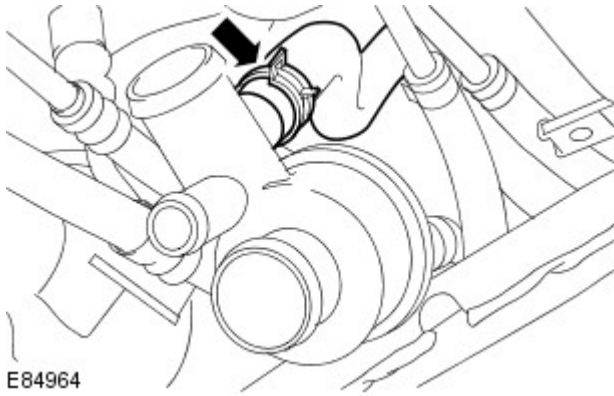
E84962

6. Disconnect the radiator lower hose from the thermostat.

- Release the clip.

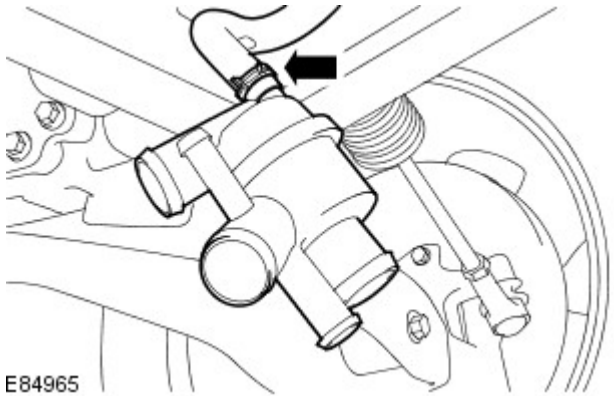


E84963



7. Disconnect the coolant expansion tank hose from the thermostat.

- Release the clip.



8. Remove the thermostat.

- Disconnect the coolant hose from the thermostat.

9. Remove the container.

Installation

1. Install the thermostat.

- Connect the coolant hose to the thermostat.
- Secure with the clip.

2. Connect the coolant expansion tank hose to the thermostat.

- Secure with the clip.

3. Connect the radiator lower hose to the thermostat.

- Secure with the clip.

4. Connect the engine inlet hose to the thermostat.

- Secure with the clip.

5. Connect the heater hose to the thermostat.

- Secure with the clip.

6. Connect the radiator upper hose to the thermostat.

- Secure with the clip.
- Position the radiator upper hose to the cooling fan shroud.

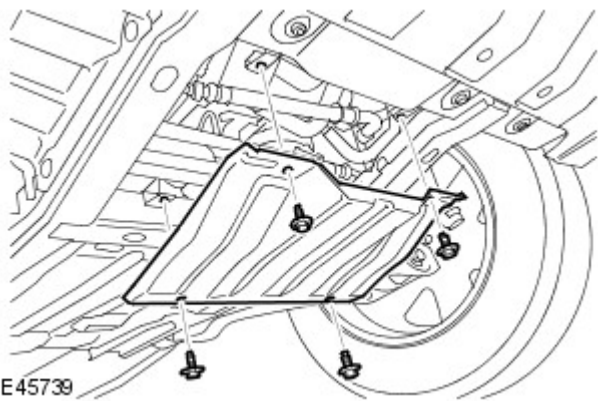
7. Refill and bleed the cooling system.

Engine Cooling - TDV6 2.7L Diesel - Thermostat Housing

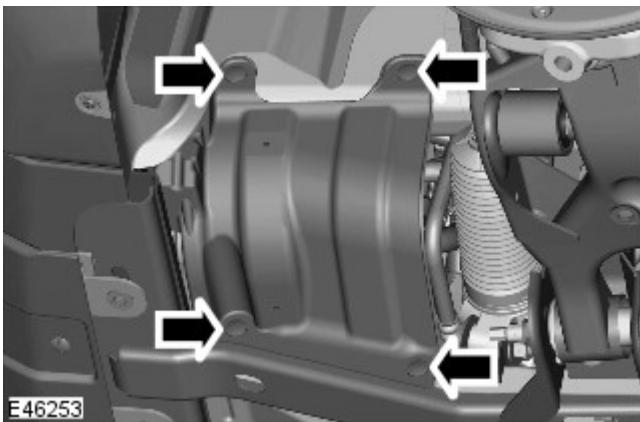
Removal and Installation

Removal

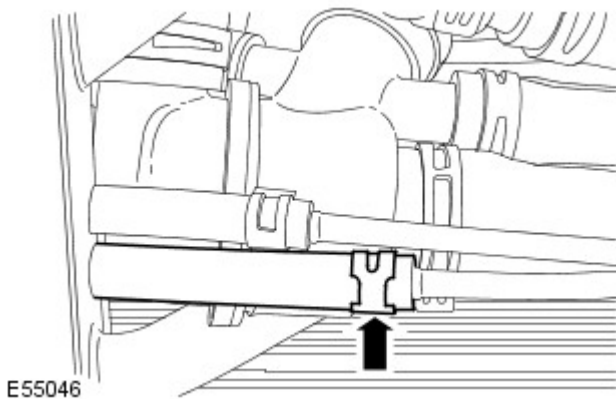
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
3. Remove the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
4. Remove the radiator access panel.
 - Remove the four retaining bolts.



5. Remove the front LH splash shield.
 - Remove the four clips.

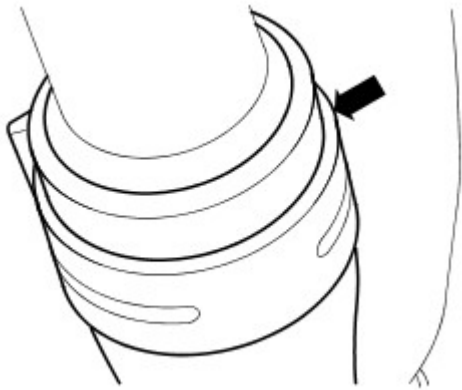


6. Disconnect the fuel cooler return hose from the thermostat.
 - Release the clip.



7. Disconnect the heater return hose from the heater return pipe.

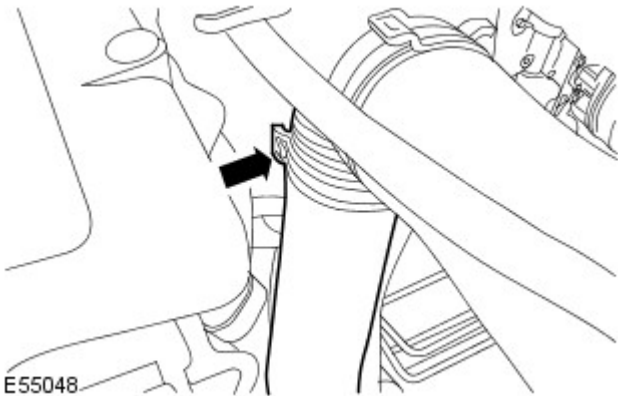
- Release from the clip.



E55056

8. Disconnect the thermostat to top hose 'T' piece hose.

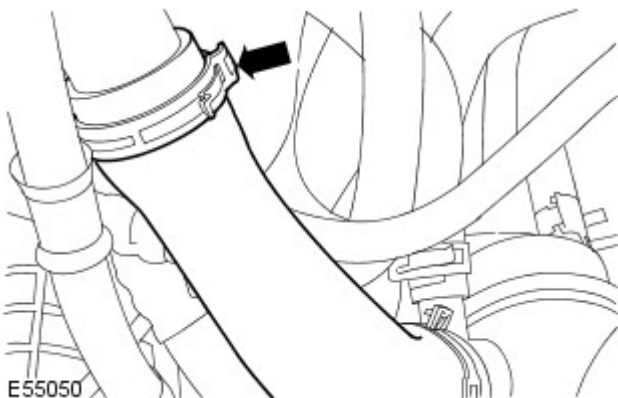
- Release from the clip.



E55048

9. Disconnect the thermostat hose from the engine coolant rail.

- Release the clip.



E55050

10. Disconnect the thermostat to fuel fired heater hose from the fuel fired heater.

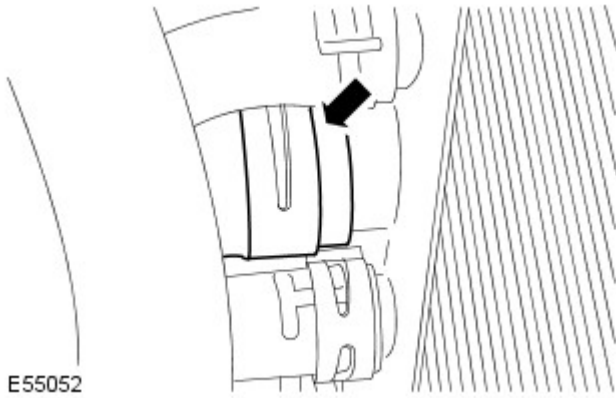
- Release the clip.



E55051

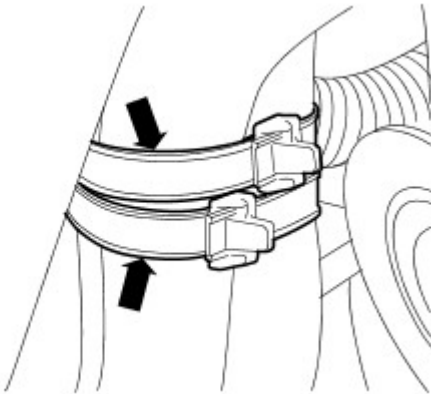
11. Disconnect the radiator lower hose from the radiator.

- Release the clip.



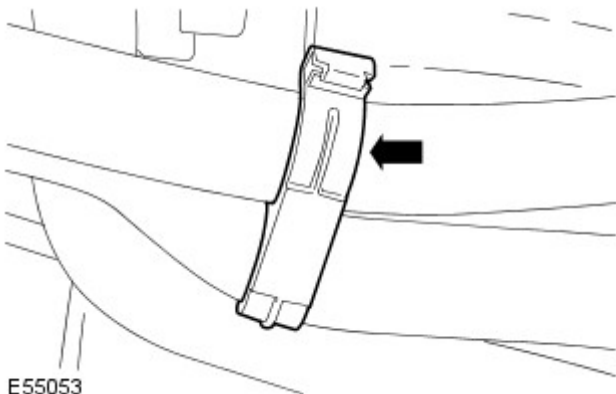
E55052

12. Release the securing straps.



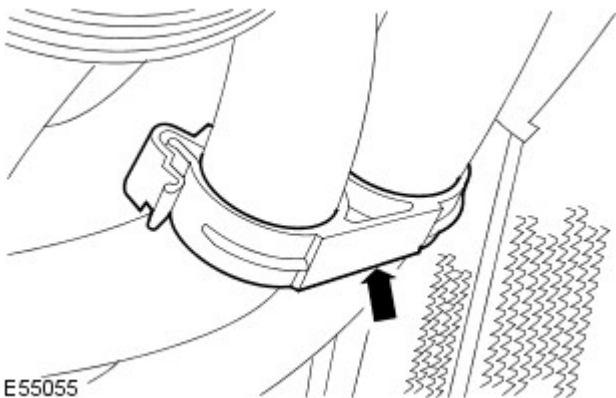
E55054

13. Release the coolant hose retaining clip.



E55053

14. Release the coolant hose retaining clip.



E55055

15. Remove the thermostat and hose assembly.

Installation

1. Install the thermostat and hose assembly.

2. Install the coolant hose retaining clip.
3. Install the coolant hose retaining clip.
4. Install the securing straps.
5. Connect the radiator lower hose to the radiator.
6. Connect the thermostat to fuel fired heater hose to the fuel fired heater.
7. Connect the thermostat hose to the engine coolant rail.
8. Connect the thermostat to top hose 'T' piece hose.
9. Connect the heater return hose to the heater return pipe.
10. Connect the fuel cooler return hose to the thermostat.
11. Install the front LH splash shield.
 - Install the four clips.
12. Install the radiator access panel.
 - Install the four retaining bolts.
13. Install the cooling fan shroud.

For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
14. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
15. Refill and bleed the cooling system.

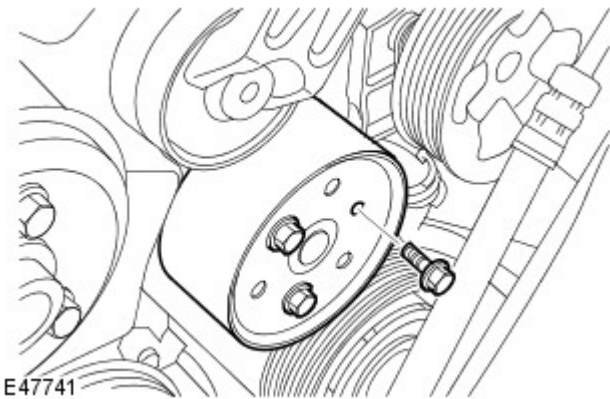
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

Engine Cooling - TDV6 2.7L Diesel - Coolant Pump

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
3. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. **NOTE:** Loosen the bolts prior to removing the accessory drive belt.

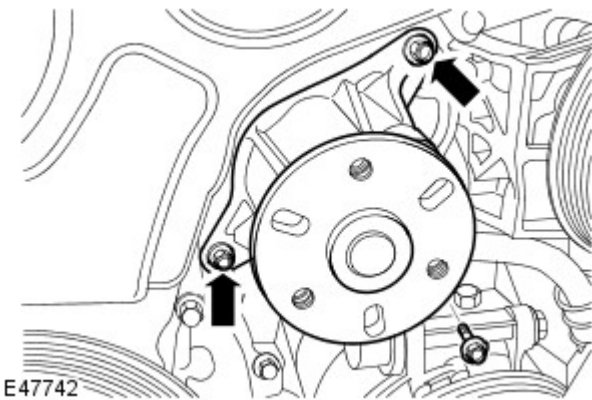


Remove the coolant pump pulley.

- Remove the 3 bolts.

5. Remove the coolant pump.

- Remove the 3 bolts.
- Discard the O-ring seal.



Installation

1. Install the coolant pump.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the coolant pump pulley.
 - Clean the components.
 - Tighten the bolts to 25 Nm (18 lb.ft).
3. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. Refill and bleed the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

Diesel, General Procedures).

Engine Cooling - TDV6 2.7L Diesel - Water Pump

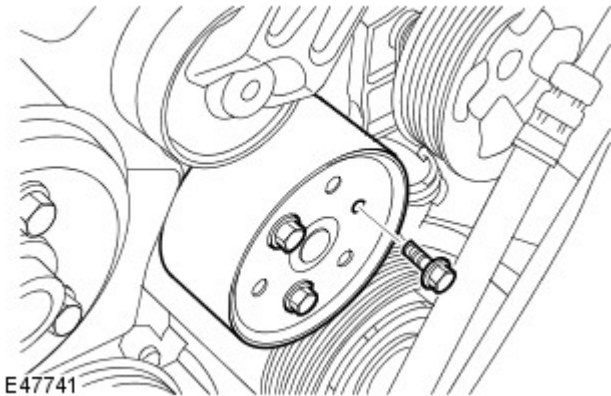
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
3. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. **NOTE:** Loosen the bolts prior to removing the accessory drive belt.

Remove the coolant pump pulley.

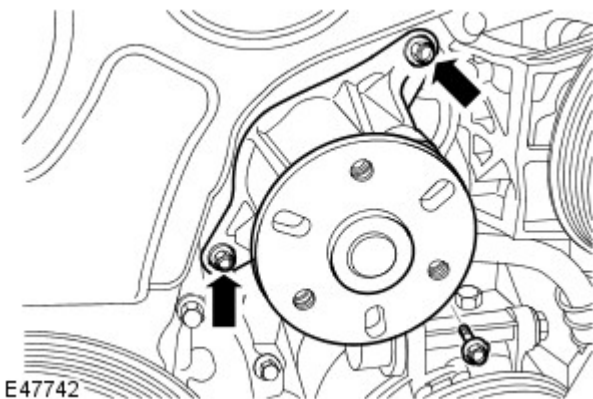
- Remove the 3 bolts.



E47741

5. Remove the coolant pump.

- Remove the 3 bolts.
- Discard the O-ring seal.



E47742

Installation

1. Install the coolant pump.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the coolant pump pulley.
 - Clean the components.
 - Tighten the bolts to 25 Nm (18 lb.ft).
3. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. Refill and bleed the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

Engine Cooling - TDV6 3.0L Diesel -

Description	Specification
Land Rover premium cooling system fluid	WSS M97B44-D
Land Rover premium cooling system flush	EGR-M14P7-A

Capacities

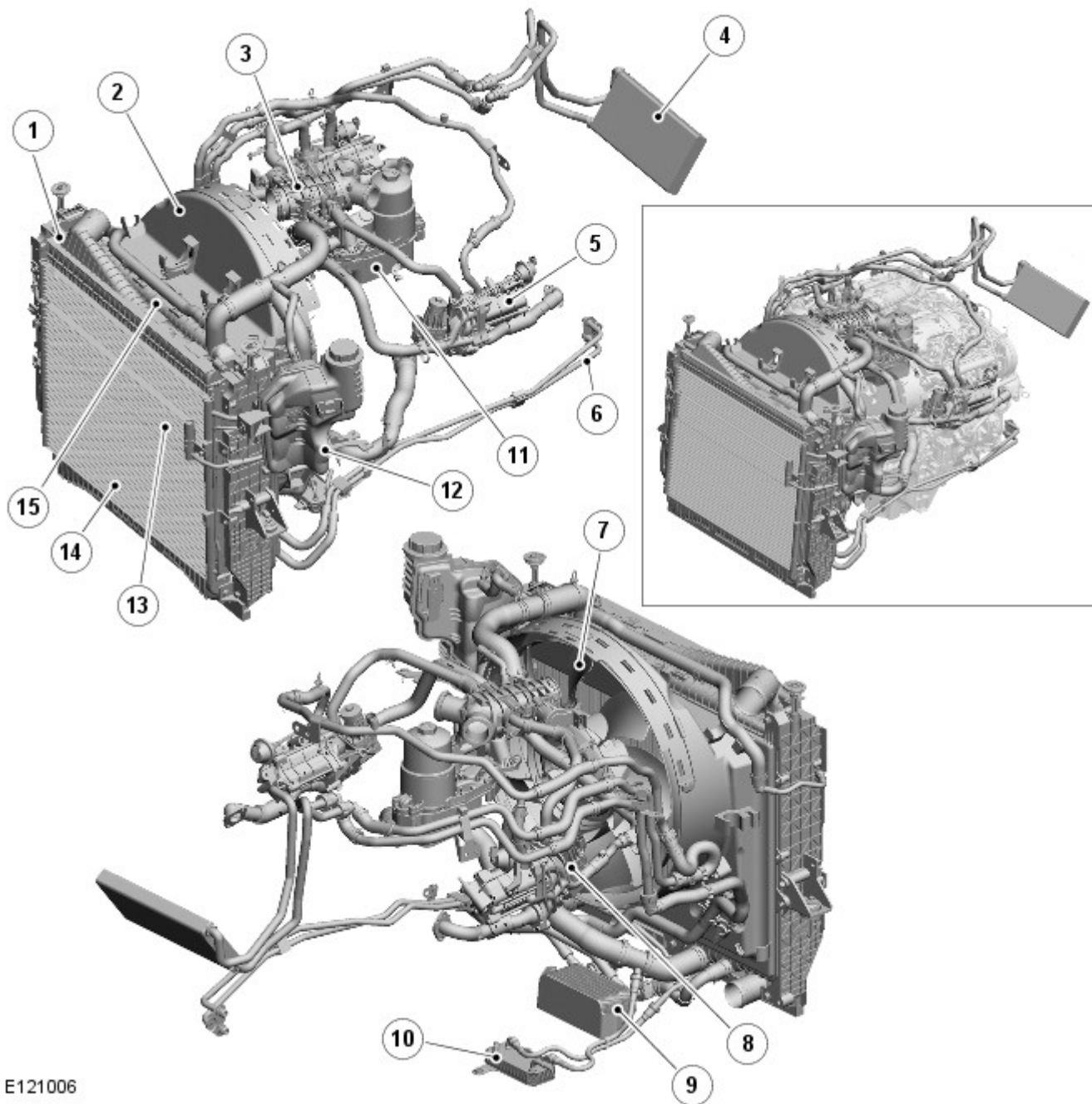
Item	Specification
Vehicles fitted with 4 zone air conditioning (A/C)	16.6L (dry capacity)
Vehicles fitted with 2 zone A/C	15.9L (dry capacity)

Description	Nm	lb-ft	lb-in
Coolant expansion tank bolt	10	7	-
Water outlet assembly bolts	10	7	-
Water inlet hose bolts	10	7	-
Coolant pump bolts	10	7	-
Cooling fan nut	65	48	-
Thermostat housing upper to lower bolts	4	-	35
Fuel cooler bolts	5	-	44
A/C radiator core bolts	5	-	44
Engine cooling module bolts	15	11	-
Cooling fan shroud M6 bolts	5	-	44
Cooling fan shroud M8 bolts	15	11	-
Charge air cooler bolts	15	11	-
Coolant bleed screw(s)	3	-	27

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling - Component Location

Description and Operation

Component Location - without Fuel Fired Burning Heater



E121006

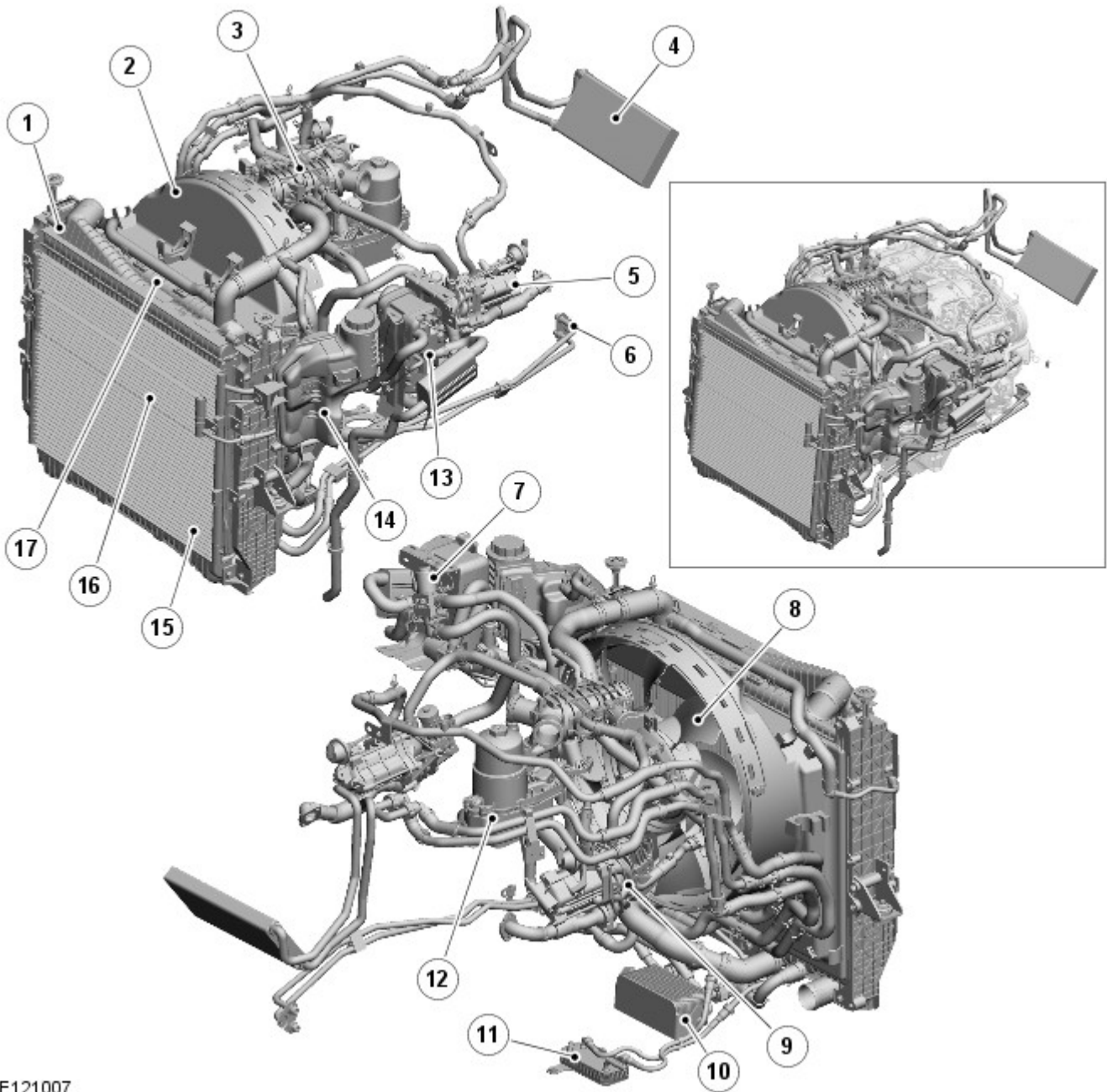
ItemDescription

1	Intercooler
2	Fan cowl
3	Throttle body
4	Heater core
5	LH (left-hand)EGR (exhaust gas recirculation) cooler
6	Transmission oil cooler pipes
7	Viscous fan
8	RH (right-hand)EGR cooler
9	Transmission oil cooler
10	Fuel sub-cooler
11	Engine oil cooler
12	Expansion tank
13	Fuel cooler

Condenser

15 Radiator

Component Location - with Fuel Fired Burning Heater and Park Heating



E121007

ItemDescription

1	Intercooler
2	Fan cowling
3	Throttle body
4	Heater core
5	LHEGR cooler
6	Transmission oil cooler pipes
7	Park heating valve assembly
8	Viscous fan
9	RHEGR cooler
10	Transmission oil cooler
11	Fuel sub-cooler
12	Engine oil cooler
13	FFBH (fuel fired burning heater)
14	Expansion tank
15	Condenser

Fuel cooler

17 Radiator

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling - Overview

Description and Operation

OVERVIEW

The engine cooling system maintains the engine within an optimum temperature range under changing ambient and engine operating conditions. It also provides:

- Heating for the passenger compartment.
Refer to: [Heating and Ventilation](#) (412-02A Heating and Ventilation, Description and Operation).
- Cooling for:
 - The engine oil
 - The fuel
 - The [EGR \(exhaust gas recirculation\)](#) systemRefer to: [Engine Emission Control](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).
- The transmission fluid.

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling - System Operation and Component Description

Description and Operation

System Operation

COOLANT CIRCUIT FLOW

When the engine is running the coolant is circulated around the engine cooling system by the coolant pump. From the coolant pump, coolant flows through the cylinder block and the cylinder heads. Some of the coolant in the cylinder block is diverted through the engine oil cooler before returning to the 5-way connector via the water outlet.

From the 5-way connector, the majority of the coolant flows to the pressure relief thermostat, either directly or via the radiator, depending on the temperature of the coolant. From the outlet of the thermostat the coolant flows to the inlet of the coolant pump.

A separate hose from the radiator allows extra-cooled coolant from the radiator to flow through the transmission oil cooler. The coolant from the cooler is returned to the system via a branch in the bottom radiator hose.

Coolant from the water outlet also flows through the [EGR \(exhaust gas recirculation\)](#) coolers and then to the heater core. From the heater core outlet, the coolant flows to the outlet zone of the pressure relief thermostat.

The expansion tank allows expansion of coolant due to temperature increases to pass excess coolant back to the expansion tank. A small hose is connected from the water outlet to the expansion tank for this purpose. As the coolant cools, the coolant is allowed back into the system from the tank via a hose from the expansion tank into the radiator bottom hose.

PRESSURE RELIEF THERMOSTAT (PRT)

The thermostat is closed at temperatures below approximately 82°C (179°F). When the coolant temperature reaches approximately 82°C the thermostat starts to open and is fully open at approximately 96°C (204°F). In this condition the full flow of coolant is directed through the radiator. The thermostat is exposed to 90% hot coolant from the engine on one side and 10% cold coolant returning from the radiator bottom hose on the other side. Hot coolant from the engine passes from the by-pass pipe through four sensing holes in the flow valve into a tube surrounding 90% of the thermostat sensitive area. Cold coolant returning from the engine, cooled by the radiator, conducts through 10% of the sensitive area.

In cold ambient temperatures, the engine temperature is raised by approximately 10°C (50°F) to compensate for the heat loss of 10% exposure to the cold coolant returning from the bottom hose.

The by-pass flow valve is held closed by a light spring. It operates to further aid heater warm-up. When the main valve is closed and the engine speed is at idle, the coolant pump does not produce sufficient flow and pressure to open the valve. In this condition the valve prevents coolant circulating through the by-pass circuit and forces the coolant through the heater matrix only. This provides a higher flow of coolant through the heater matrix to improve passenger comfort in cold conditions. When the engine speed increases above idle, the coolant pump produces a greater flow and pressure than the heater circuit can take. The pressure acts on the by-pass flow valve and overcomes the valve spring pressure, opening the valve and limiting the pressure in the heater circuit. The valve modulates to provide maximum coolant flow through the heater core and yet allowing excess coolant to flow into the by-pass circuit to provide the engine's cooling needs at higher engine speeds.

COOLING FAN

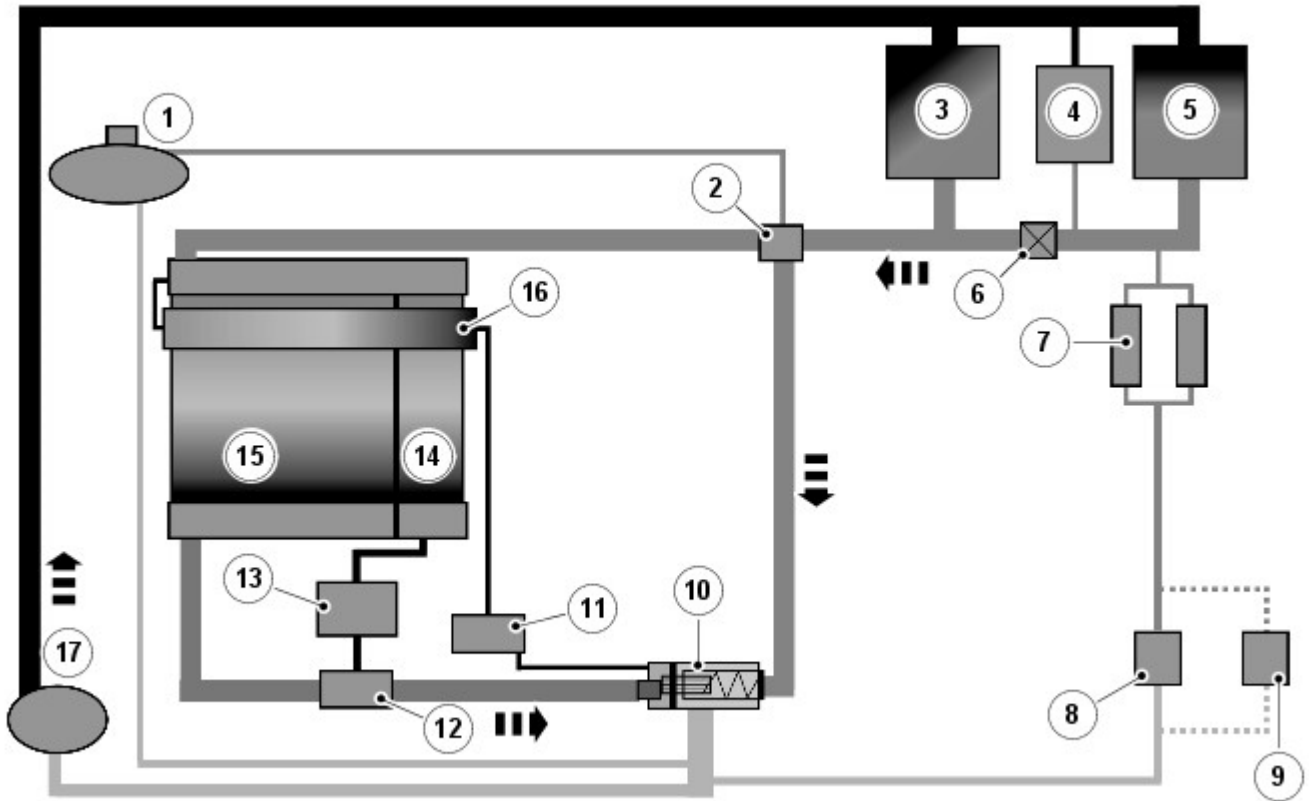
For additional airflow through the radiator matrix, particularly when the vehicle is stationary, there is an engine driven electro-viscous fan unit fitted to the rear of the radiator. The fan is used for engine cooling and for [A/C \(air conditioning\)](#) system cooling. This unit functions as a normal viscous fan, but with electronic control over the level engagement of the clutch. The [ECM \(engine control module\)](#), which determines the required fan speed, controls the level of clutch engagement. The [ECM](#) determines engagement based on the coolant, charge air, ambient and transmission oil temperatures and the [A/C](#) pressure. The fan is mounted using a left hand thread.

The viscous fan unit is electronically controlled by the [ECM](#) to optimize fan speed for all operating conditions.

• **NOTE:** If the electrical connections to the viscous fan are disconnected the fan will 'idle' and overheating may result. The ECM stores the appropriate fault codes in this case.

SCHEMATIC FLOW DIAGRAMS

ENGINE COOLING WITHOUT FUEL FIRED BURNING HEATER

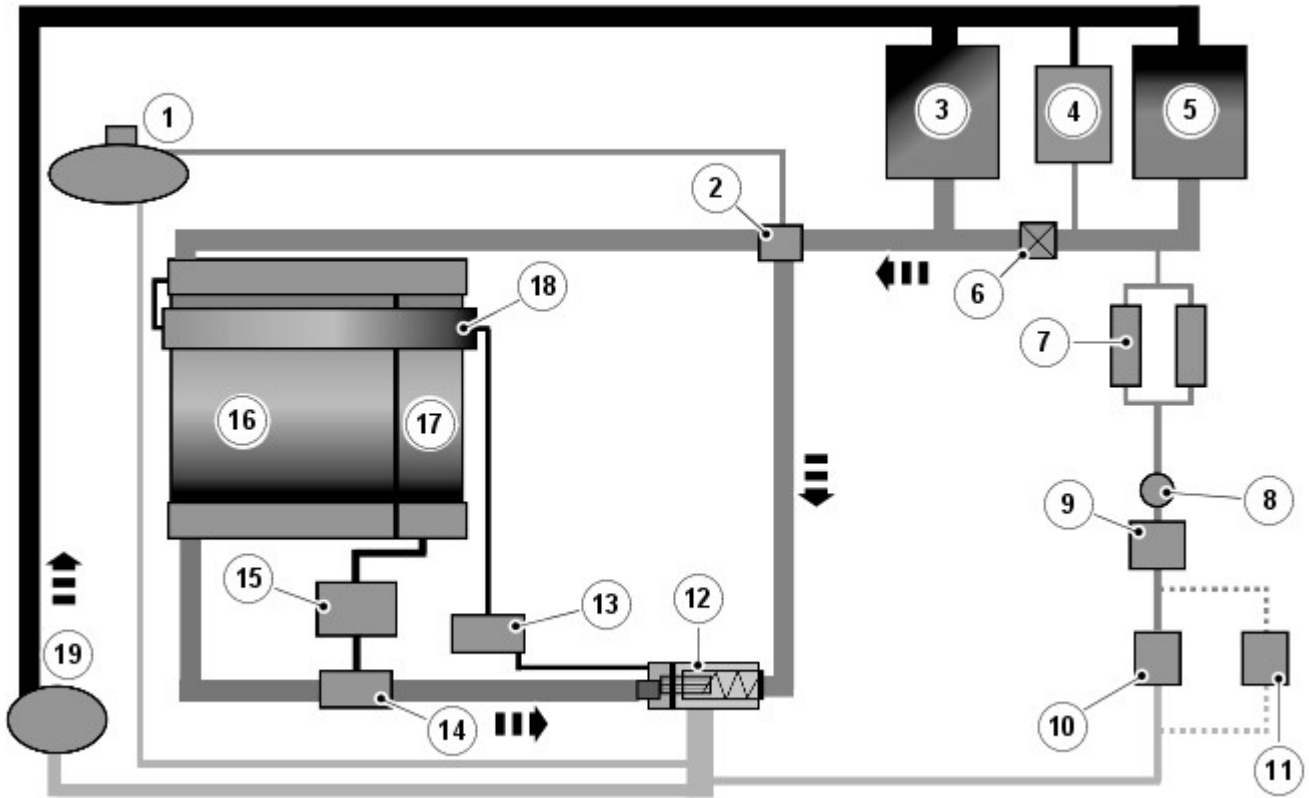


E107588

ItemDescription

1	Expansion tank
2	Degas connector
3	Cylinder head
4	Engine oil cooler
5	Cylinder head
6	Static bleed point
7	EGR coolers
8	Cabin heater
9	Rear heater
10	Pressure Relief Thermostat (PRT)
11	Fuel cooler
12	Venturi connector
13	Transmission oil cooler
14	Transmission oil sub-cooler
15	Radiator
16	Fuel sub-cooler
17	Water pump

ENGINE COOLING WITH FUEL FIRED BURNING HEATER - SCHEMATIC FLOW DIAGRAM

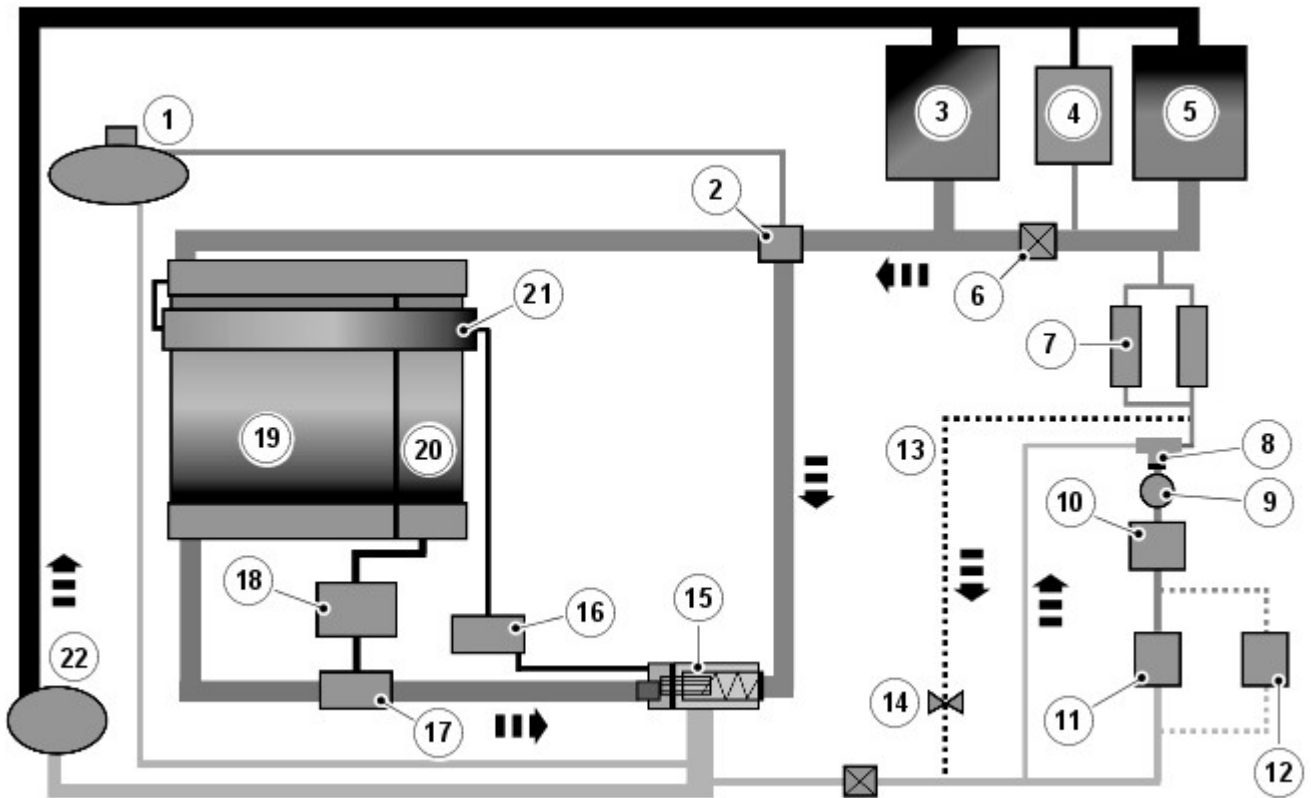


E107589

ItemDescription

1	Expansion tank
2	Degas connector
3	Cylinder head
4	Engine oil cooler
5	Cylinder head
6	Static bleed point
7	EGR coolers
8	Pump
9	FFBH (fuel fired burning heater)
10	Cabin heater
11	Rear heater
12	PRT
13	Fuel cooler
14	Venturi connector
15	Transmission oil cooler
16	Radiator
17	Transmission oil sub-cooler
18	Fuel sub-cooler
19	Water pump

ENGINE COOLING WITH FUEL FIRED BURNING HEATER AND PARK HEATING - SCHEMATIC FLOW DIAGRAM



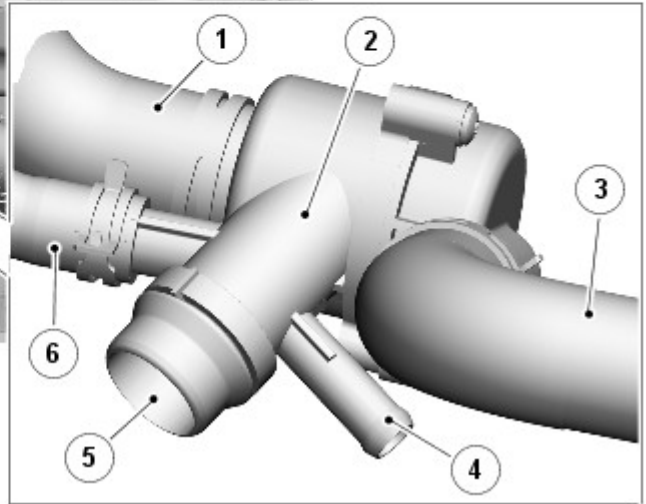
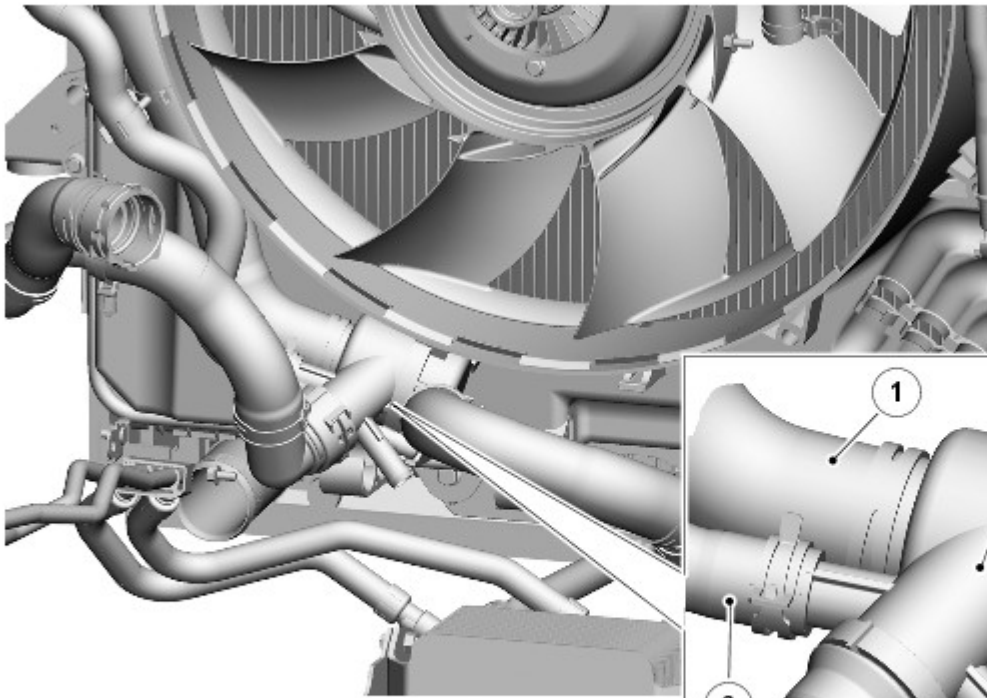
E107590

ItemDescription

1	Expansion tank
2	Degas connector
3	Cylinder head
4	Engine oil cooler
5	Cylinder head
6	Static bleed point
7	EGR coolers
8	3-way valve
9	Pump
10	FFBH (fuel fired burning heater)
11	Cabin heater
12	Rear heater
13	Heater by-pass
14	Restrictor
15	PRT
16	Fuel cooler
17	Venturi connector
18	Transmission oil cooler
19	Radiator
20	Transmission oil sub-cooler
21	Fuel sub-cooler
22	Water pump

Component Description

PRESSURE RELIEF THERMOSTAT (PRT)



E121136

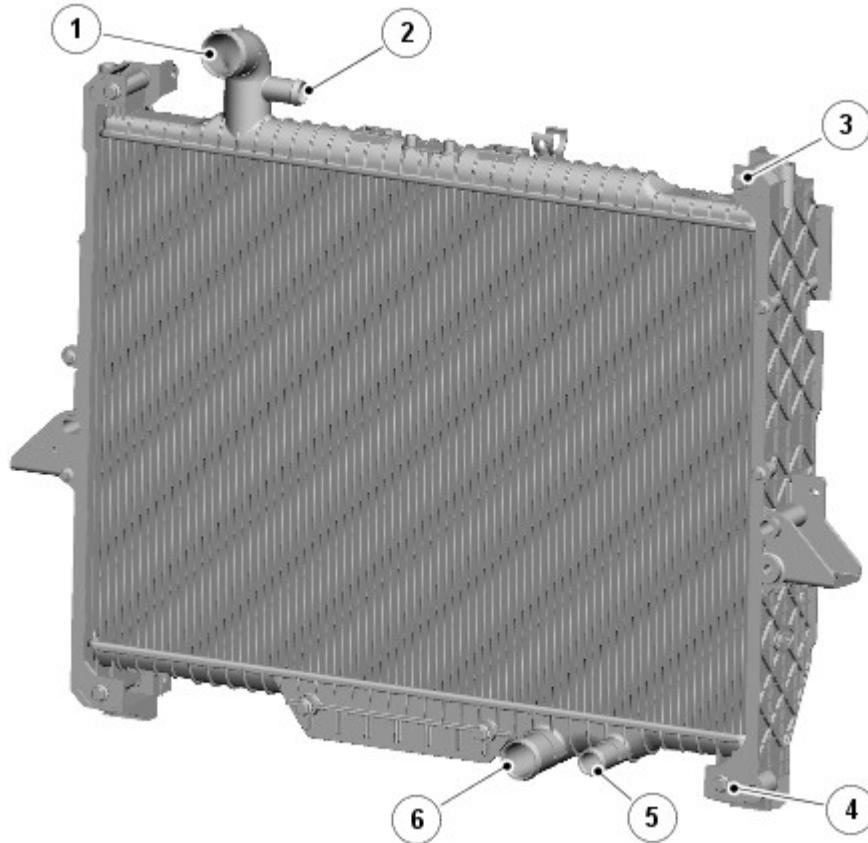
ItemDescription

1	Connection to radiator top hose
2	PRT body
3	Connection from radiator bottom hose
4	Heater core return connection
5	Connection to cylinder block water inlet
6	Connection to expansion tank

A plastic thermostat housing is located behind the radiator. The housing has 5 connections which locate the radiator bottom hose, top hose from the 5-way connector, coolant pump feed hose to the cylinder block and return feed from the heater core. The housing contains a wax element and a spring loaded by-pass flow valve.

The thermostat is used to maintain the coolant at the optimum temperature for efficient combustion and to aid engine warm-up.

RADIATOR



E121137

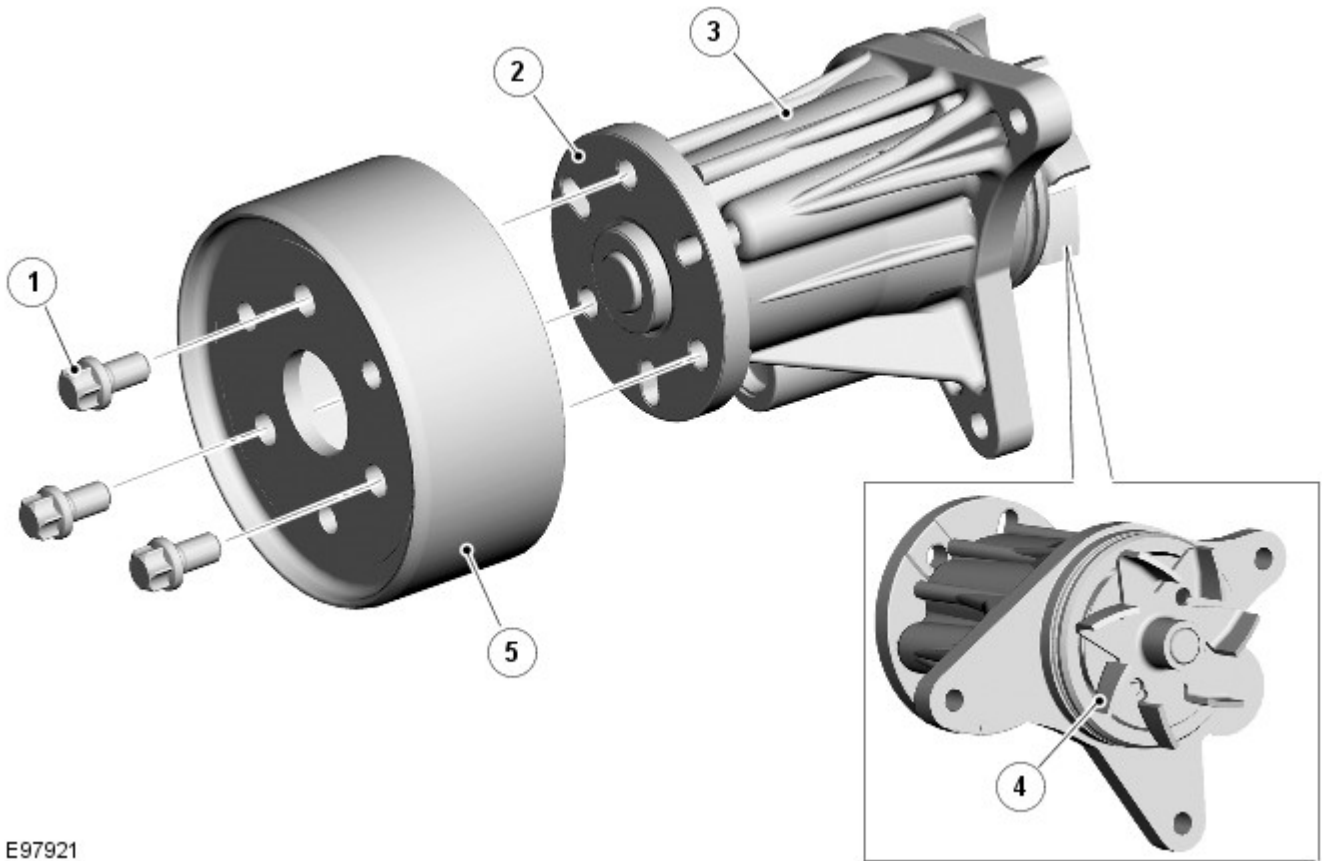
ItemDescription

1	Coolant inlet
2	Coolant outlet to fuel cooler
3	Support - upper (2 off)
4	Support - lower (2 off)
5	Coolant outlet to transmission oil cooler
6	Coolant outlet to pressure relief thermostat

The radiator is a vertical-flow type with an aluminum core and plastic end tanks. The radiator is located in the vehicle by locating spigots and supports integrated into the cooling pack end frames. The lower supports are installed in rubber bushes in the upper chassis rails. The upper locating spigots are installed in rubber bushes in the front end carrier. Coolant inlet and outlet connections are incorporated into the upper and lower end tanks respectively.

The lower end tank also has a connection for coolant outlet to the transmission fluid cooler.

COOLANT PUMP



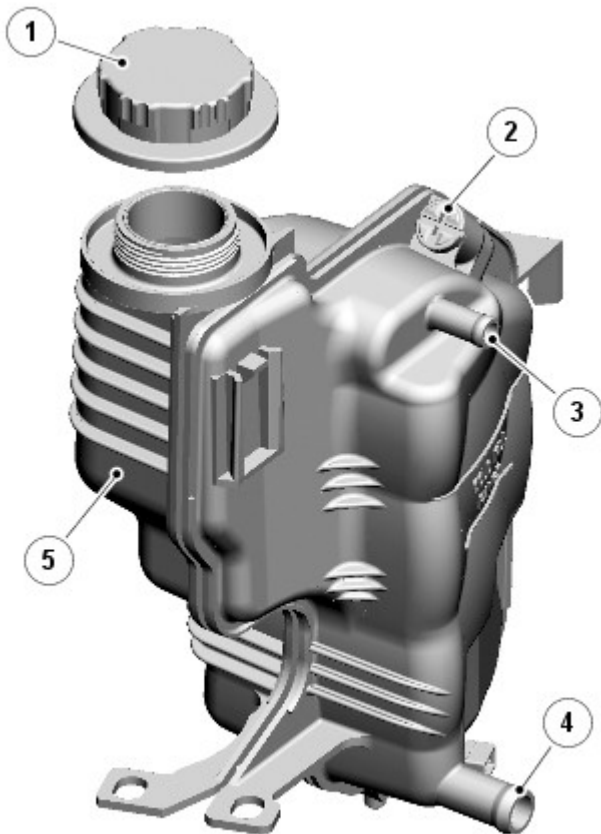
E97921

ItemDescription

1	Bolt (3 off)
2	Drive hub
3	Housing
4	Impeller
5	Pulley

The coolant pump has a housing that supports a shaft with an impeller attached to one end and a drive hub at the other. The housing is attached to the front of the cylinder block with the impeller located in a pumping chamber. The pump is driven by a pulley attached to the drive hub and driven by the accessory drive belt. For additional information refer to Accessory Drive 303-05B.

EXPANSION TANK



E121138

ItemDescription

1	Filler cap
2	Bleed screw
3	Vent hose connection
4	Expansion hose connection
5	Expansion tank

A pressurized expansion tank system is used which continuously separates the air from the cooling system and replenishes the system through a hose connected between the expansion tank and the heater return hose. A continuous vent into the expansion tank, through a hose connected to the engine's coolant outlet connector, prevents air locks from forming in the cooling system.

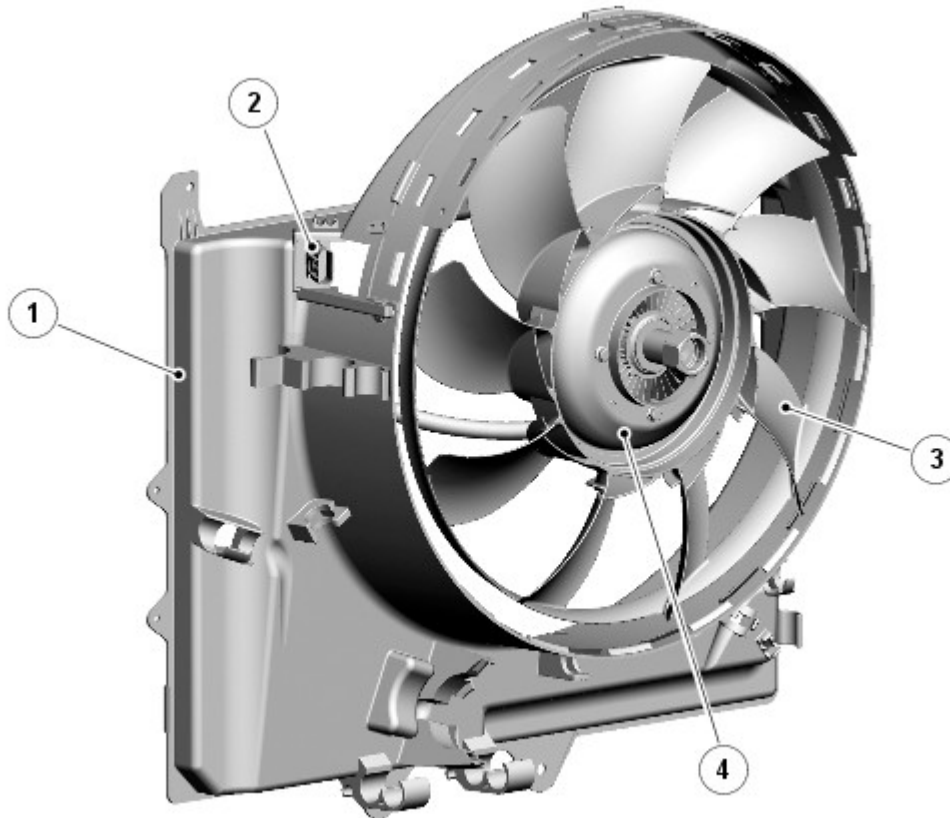
The expansion tank is installed behind the top right corner of the radiator. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded into the interior of the tank below the filler cap.

The expansion tank provides the following functions:

- Service fill
- Coolant expansion during warm-up
- Air separation during operation
- System pressurization by the filler cap

The expansion tank has an air space of approximately 0.5 to 1 liter (1.06 to 2,11 US pints), above the MAX level, to allow for coolant expansion.

COOLING FAN



E121139

ItemDescription

1	Shroud
2	Electrical connector
3	Fan
4	Viscous unit

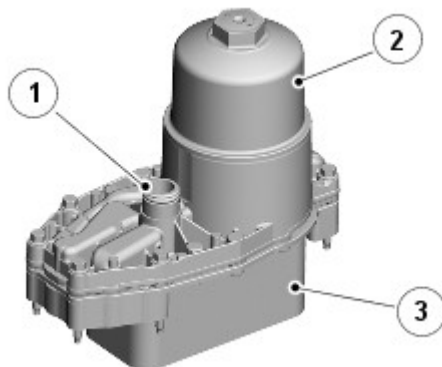
To control the cooling fan, the [ECM](#) sends a [PWM \(pulse width modulation\)](#) signal to the cooling fan module (integral to the [ECM](#)). The frequency of the [PWM](#) signal is used by the cooling fan module to determine the output voltage supplied to the fan motor.

The [ECM](#) varies the duty cycle of the [PWM](#) signal between 0 and 100% to vary the fan speed. If the [PWM](#) signal is outside the 0 to 100% range, the cooling fan module interprets the signal as an open or short circuit and runs the fans at maximum speed to ensure the engine and transmission do not overheat.

The [ECM](#) operates the fan in response to inputs from the [ECT \(engine coolant temperature\)](#) sensor, the transmission oil temperature sensor, the charge air temperature sensor, the [A/C](#) switch and the [A/C](#) pressure sensor.

The speed of the cooling fan is also influenced by vehicle road speed. The [ECM](#) adjusts the speed of the cooling fans, to compensate for the ram effect of vehicle speed, using the [CAN \(controller area network\)](#) road speed signal received from the [ABS \(anti-lock brake system\)](#) module.

ENGINE OIL COOLER



E115007

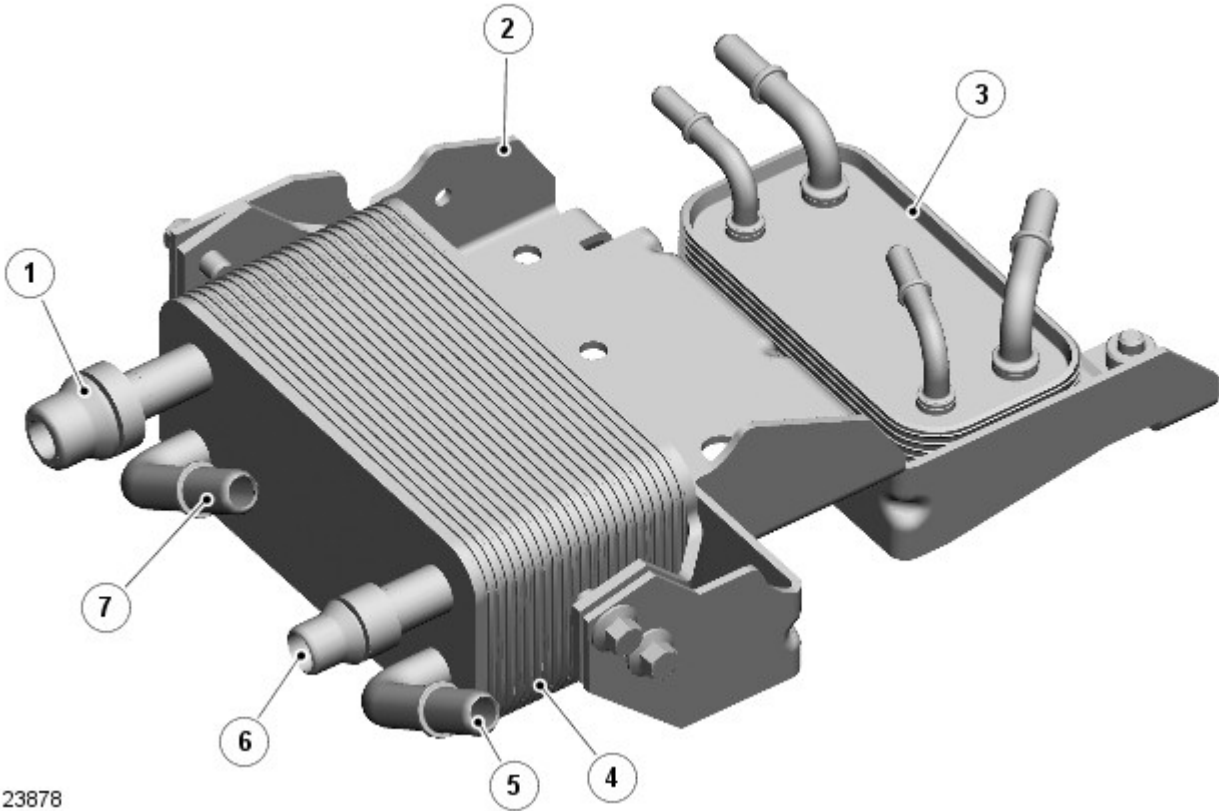
ItemDescription

1	Coolant outlet
2	Engine oil filter
3	

Engine oil cooler

The engine oil cooler is attached to a common adapter assembly located in the vee of the cylinder block. Inlet and outlet ports for engine oil, and an inlet port for coolant, are incorporated into the cylinder block mating face of the adapter assembly. A metal gasket seals the joint between the adapter assembly and the cylinder block. From the cylinder block, coolant flows through the adapter assembly and into the cooler. After passing through the cooler, the coolant then flows into the engine coolant water outlet.

TRANSMISSION FLUID COOLER



E123878

ItemDescription

1	Coolant inlet from radiator
2	Mounting bracket
3	Fuel cooler
4	Transmission fluid cooler
5	Transmission fluid inlet
6	Coolant outlet to radiator bottom hose
7	Transmission fluid outlet

The transmission fluid cooler is located on chassis cross member behind the radiator, sharing a bracket with the fuel cooler. The cooler is connected to the cooling system with two hoses and receives cooled fluid from the lower section of the radiator, which flows through the cooler, reducing the temperature of the transmission fluid.

ENGINE COOLANT

The coolant is silicate free and must not be mixed with conventional engine coolant.

Engine Cooling - TDV6 3.0L Diesel - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-03B Engine Cooling - TDV6 3.0L Diesel)

[Engine Cooling](#) (Description and Operation),
[Engine Cooling](#) (Description and Operation),
[Engine Cooling](#) (Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Coolant leaks ● Coolant Hoses ● Coolant expansion tank ● Radiator ● Heater core ● Accessory drive belt ● Viscous fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Loose or corroded connector(s) ● Engine Coolant Temperature (ECT) sensor

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	<ul style="list-style-type: none"> ● Hoses ● Hose connections ● Radiator ● Water pump ● Heater core ● Gaskets ● Engine casting cracks ● Engine block core plugs 	Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary.
Overheating	<ul style="list-style-type: none"> ● Low/Contaminated coolant ● Thermostat ● Viscous fan ● ECT sensor ● Restricted air flow over the radiator 	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	<ul style="list-style-type: none"> ● Thermostat ● Viscous fan ● Thermostat ● Electric fan ● Fan speed module 	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation).

Engine Cooling - TDV6 3.0L Diesel - Cooling System Draining, Filling and Bleeding

General Procedures

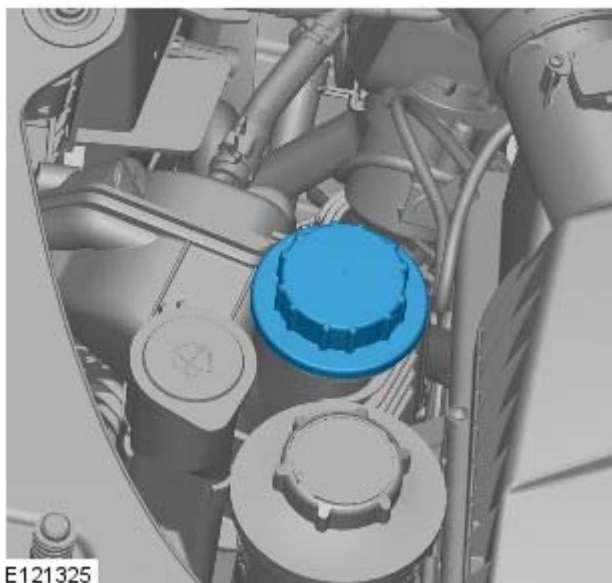
Draining


• NOTE: Removal steps in this procedure may contain installation details.

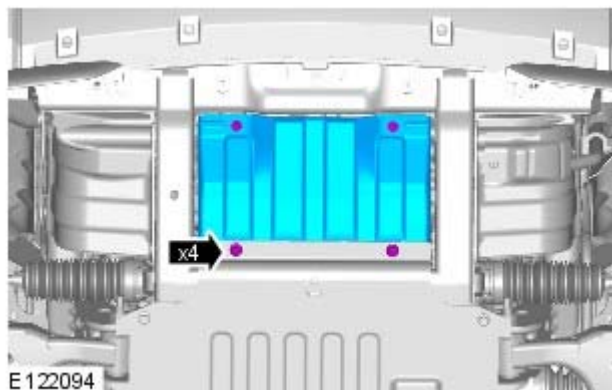
1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

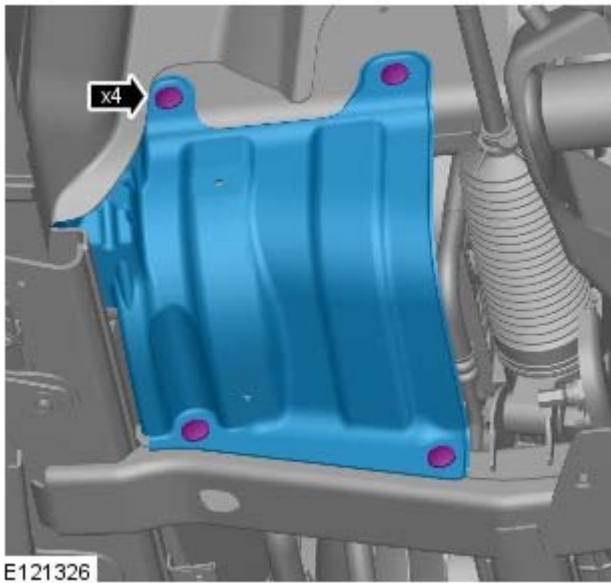
Raise and support the vehicle.



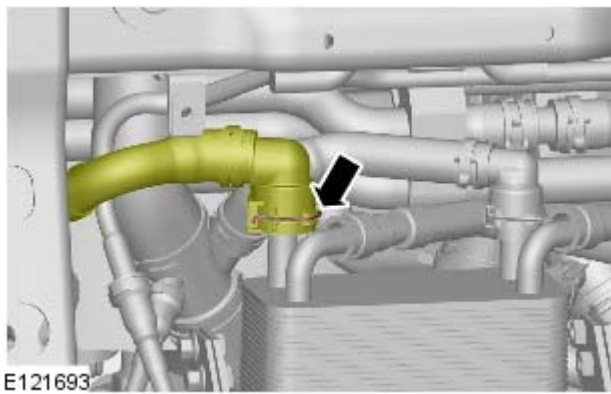
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.



4. Remove the 4 bolts.

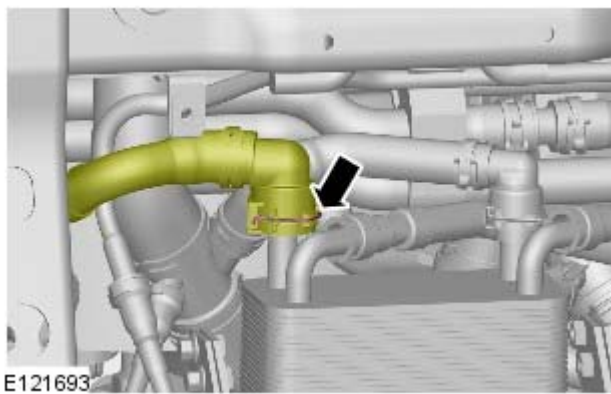


5.

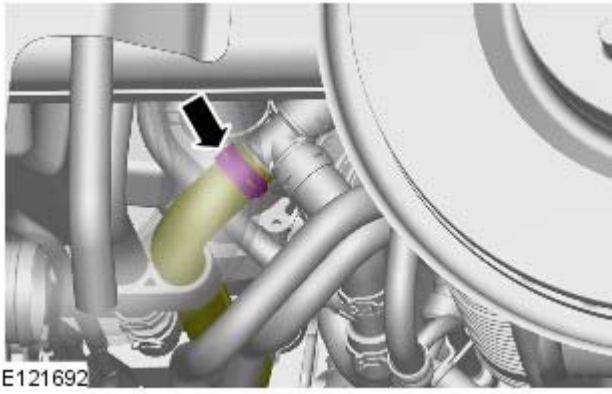


6.  CAUTION: Be prepared to collect escaping coolant.

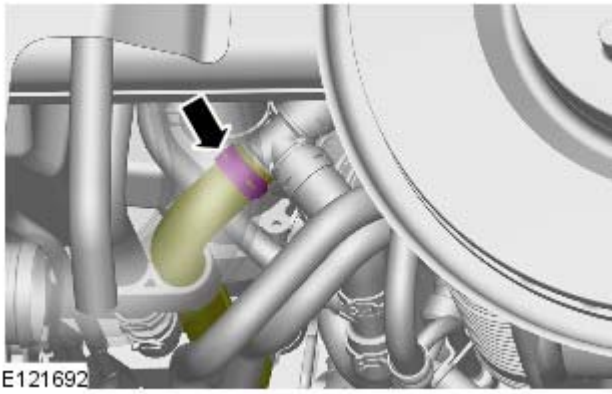
Position a container to collect the fluid.



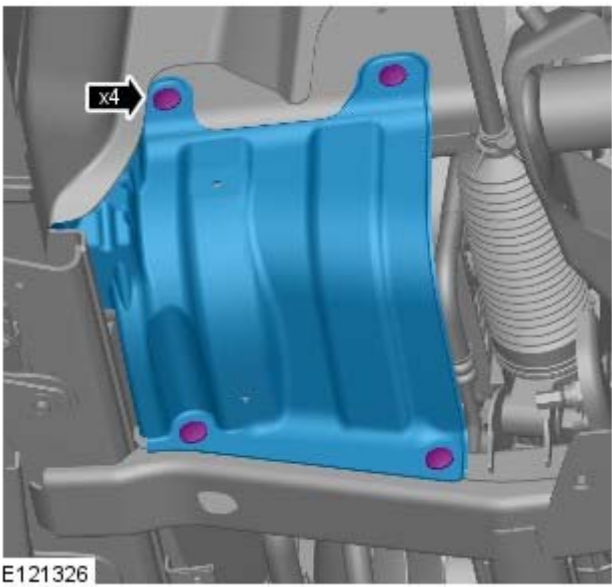
7. Connect the transmission fluid cooler coolant hose.



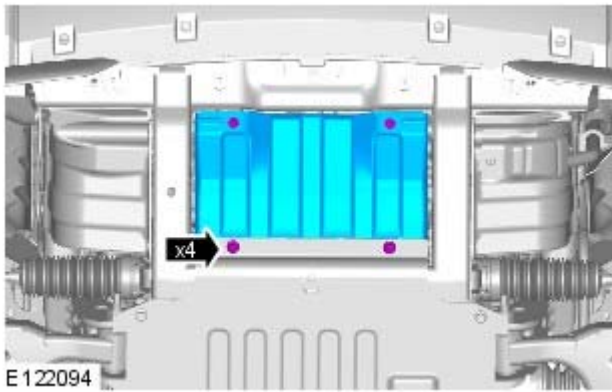
8.  CAUTION: Be prepared to collect escaping coolant.



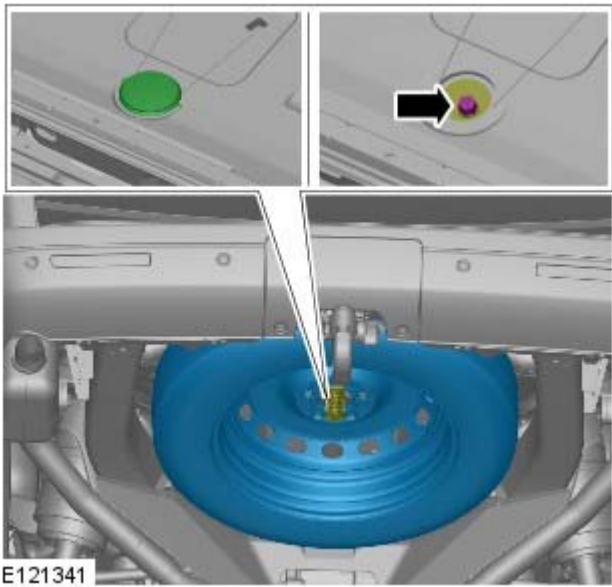
9. Install the coolant hose.



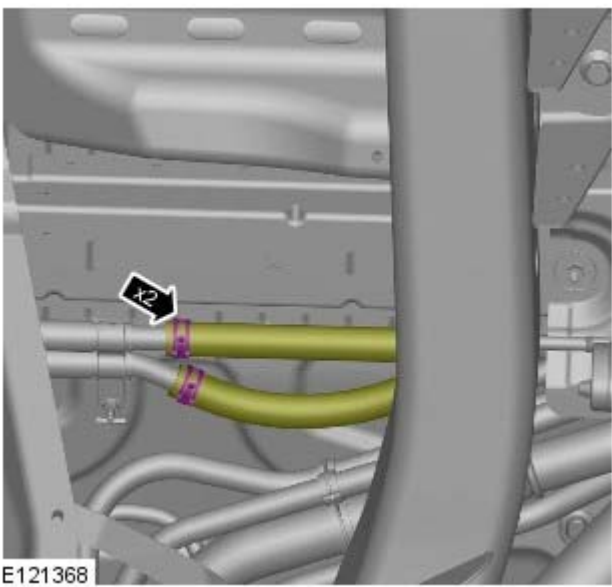
10. Install the LH splash shield.




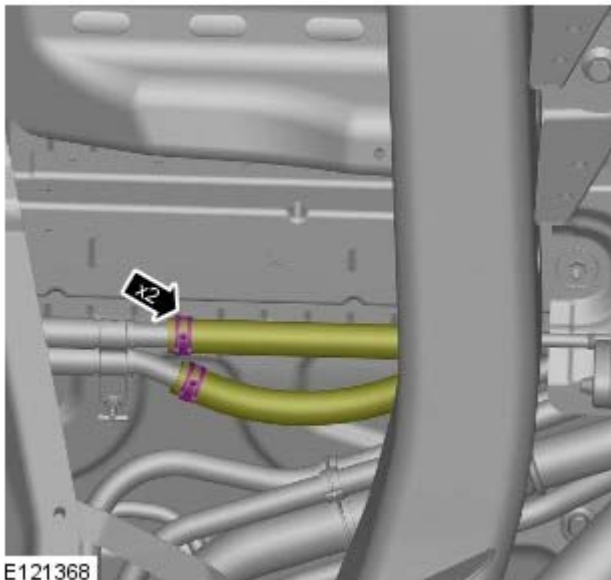
11.
 - Install the radiator access panel.
 - *Torque:* 10 Nm



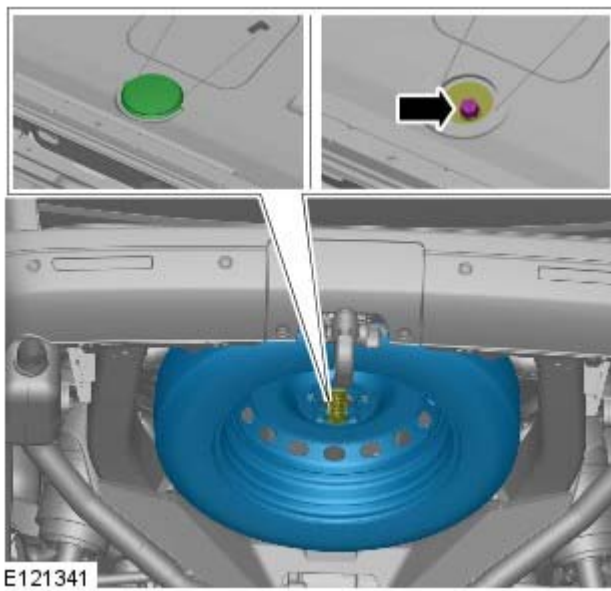
12. Remove the spare wheel and tire.



13.  **CAUTION:** Be prepared to collect escaping coolant.



14. Install the coolant hoses.

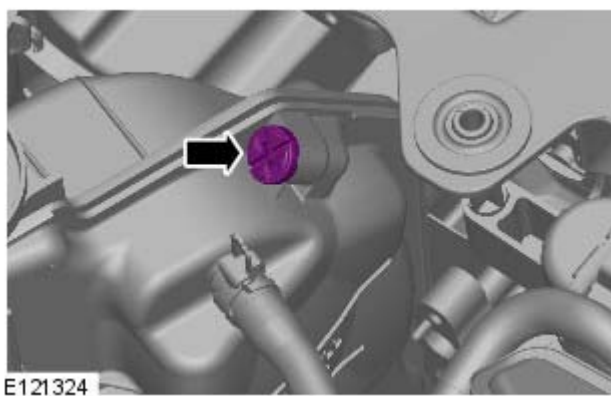


15. Install the spare wheel and tire.

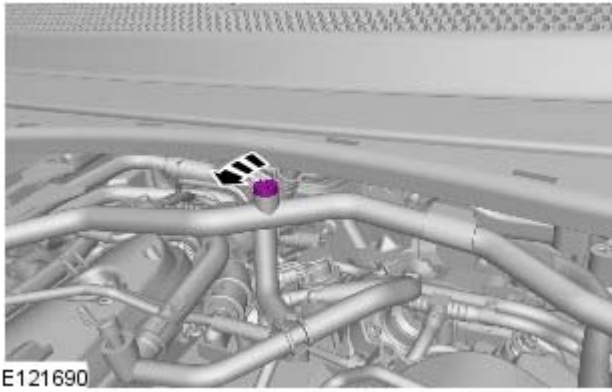
Filling

• NOTE: Removal steps in this procedure may contain installation details.

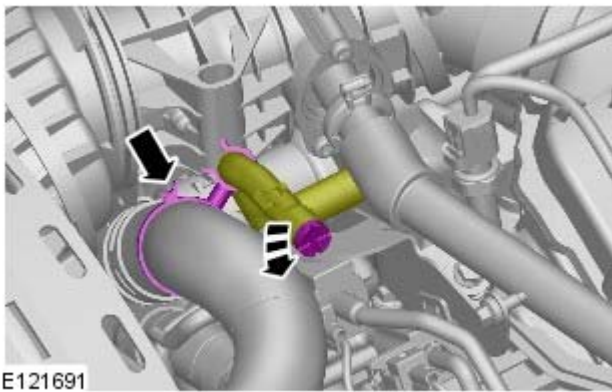
1. Lower the vehicle.



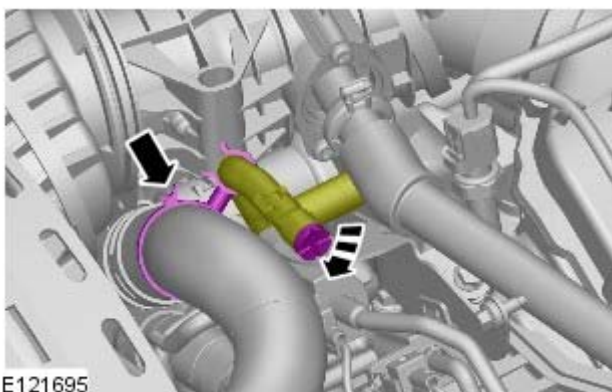
2.



3.



4.



5. **20. CAUTIONS:**

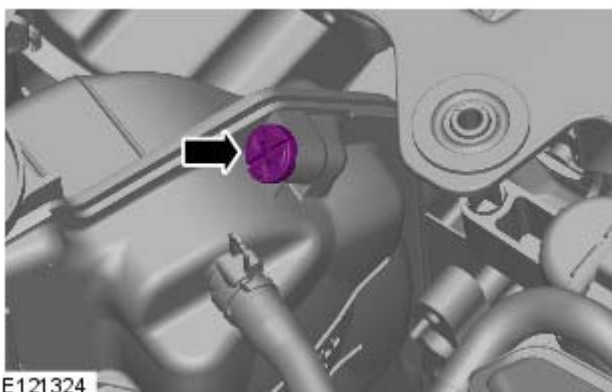


Anti-freeze concentration must be maintained at 50%.



Be prepared to collect escaping coolant.

Fill the coolant expansion tank until coolant appears through the bleed ports.



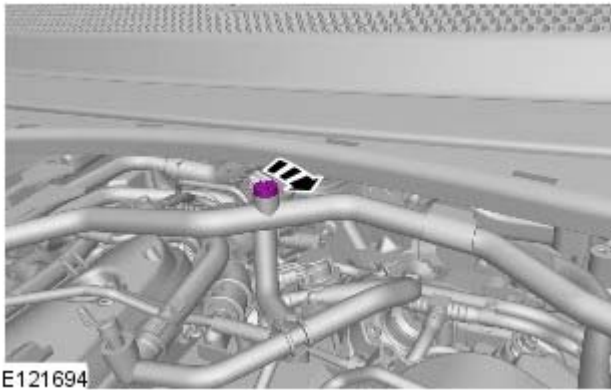
6. **21. CAUTION:** Be prepared to collect escaping coolant.


Fill the coolant expansion tank until coolant appears through the bleed ports.

7. Set the heater controls to maximum.

8. Start the engine and continue to fill the coolant until the maximum

level is reached.

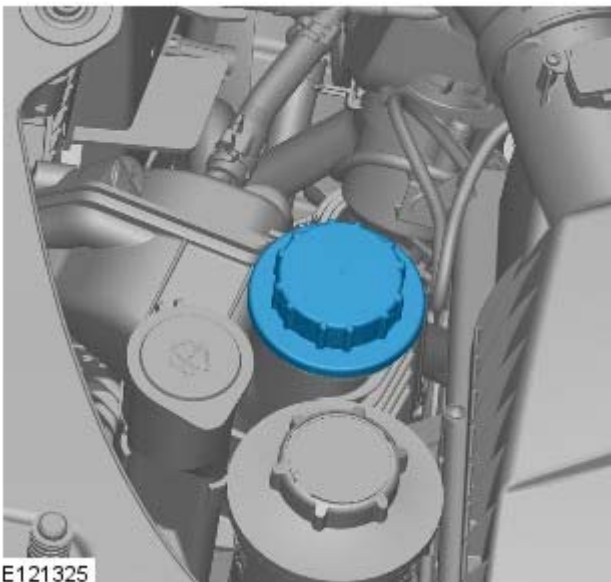



9. **24.**  **CAUTION:** Be prepared to collect escaping coolant.

Fill the coolant expansion tank until coolant appears through the bleed ports.

10. Increase engine speed to 2500rpm and cycle between this and idle.


11. Continue to top-up with coolant with the engine at idle.



12. **27.**  **CAUTION:** Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

13. Allow the engine to idle, until hot air is emitted at the face registers.

14. Once the front heater is warm, check if the rear heater is warm (if equipped). If no heat is felt, increase the engine speed to 3000 rpm for 30 seconds and return to idle.

15. **30.**  **CAUTION:** Switch off the engine and allow the coolant temperature to go cold.

16. Visually check the engine and cooling system for signs of coolant leakage.

17. **32.**  **WARNING:** When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

• **CAUTIONS:**

 Since injury such as scalding could be caused by escaping

steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure



Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

- NOTE: When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

Check and top-up the coolant if required.

18. Install the engine cover.

Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

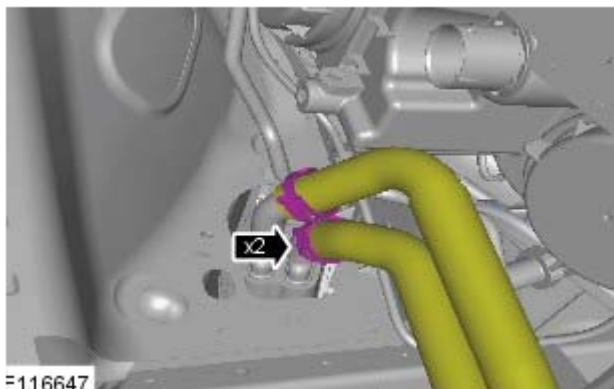
Engine Cooling - TDV6 3.0L Diesel - Auxiliary Radiator


Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: Battery Disconnect and Connect (414-01, General Procedures).
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

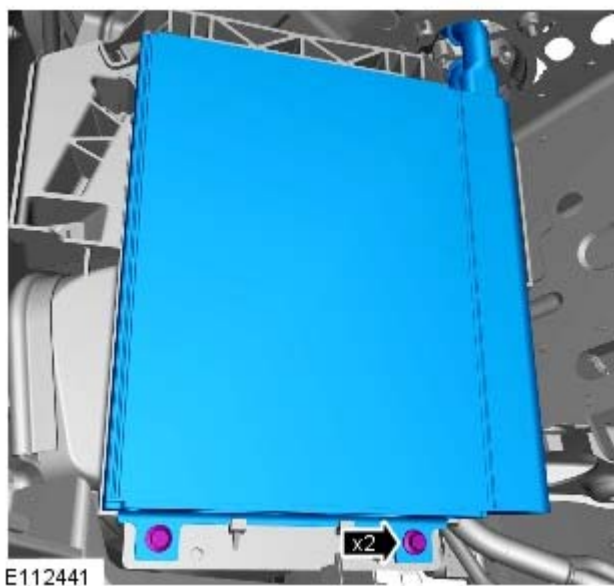


3.  CAUTION: Be prepared to collect escaping coolant.

4.  WARNING: Make sure to support the vehicle with axle stands.

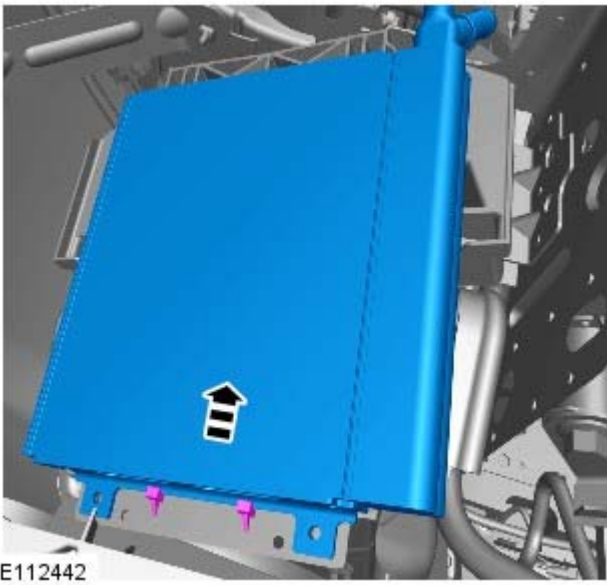
Raise and support the vehicle.

5. Refer to: Fender Splash Shield (501-02, Removal and Installation).



6. Torque: 7 Nm

7.



Installation

1. To install, reverse the removal procedure.

Engine Cooling - TDV6 3.0L Diesel - Coolant Expansion Tank

Removal and Installation

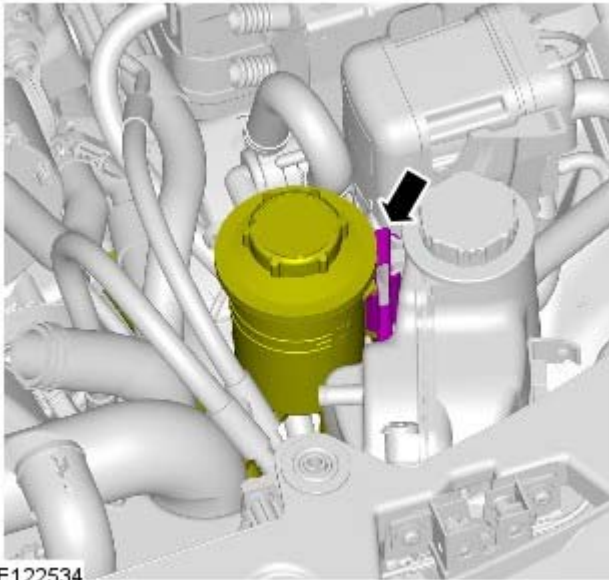
Removal


- NOTE: Removal steps in this procedure may contain installation details.

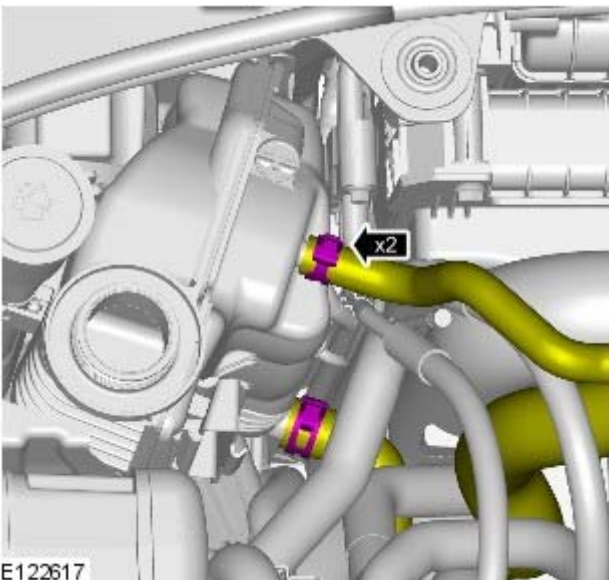
1.  **WARNING:** Make sure to support the vehicle with axle stands.

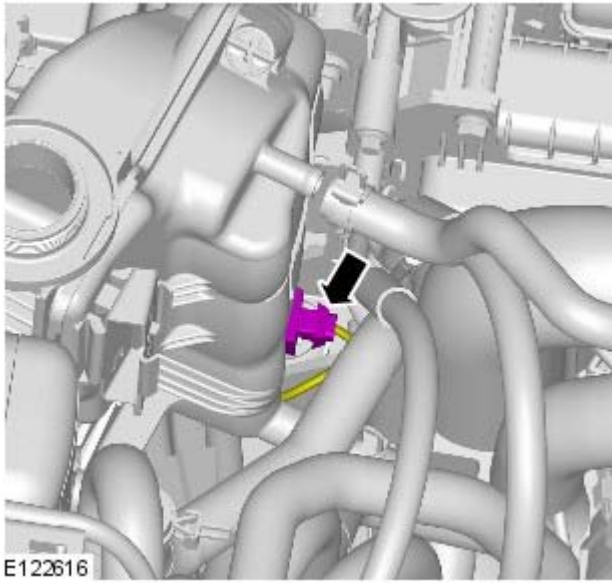
Raise and support the vehicle.

2.

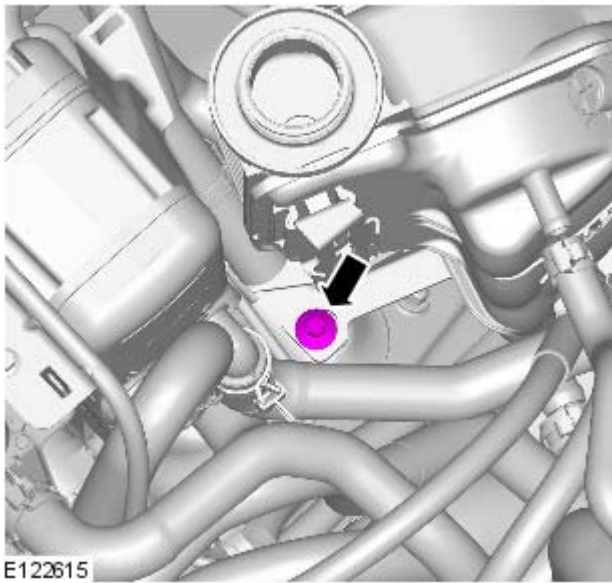


3.  **CAUTION:** Be prepared to collect escaping coolant.

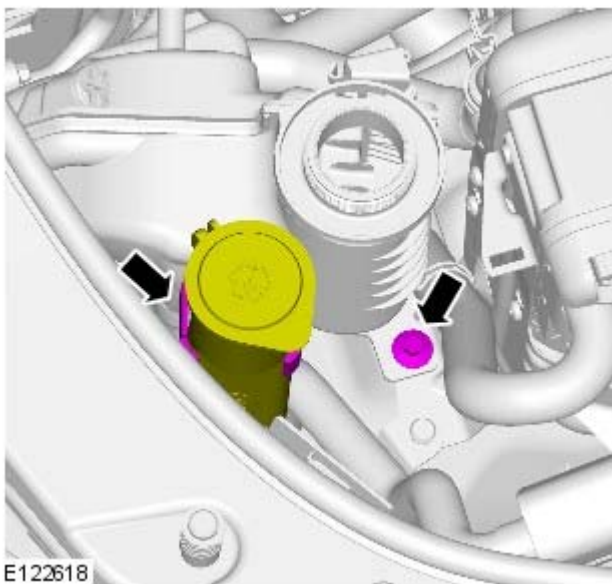




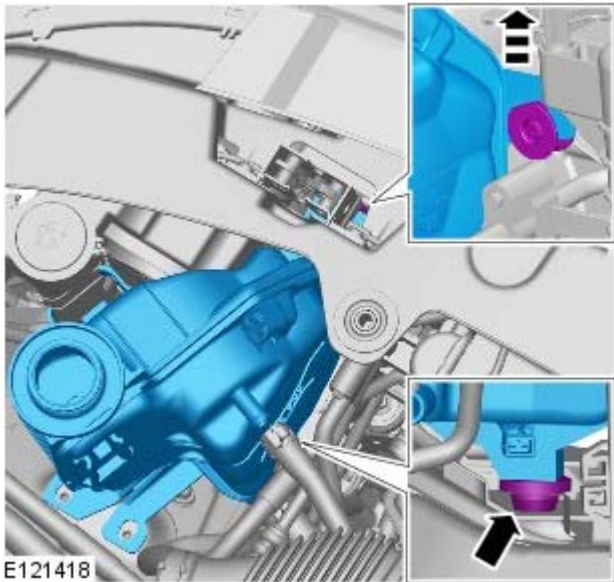
4.



5. Torque: 10 Nm

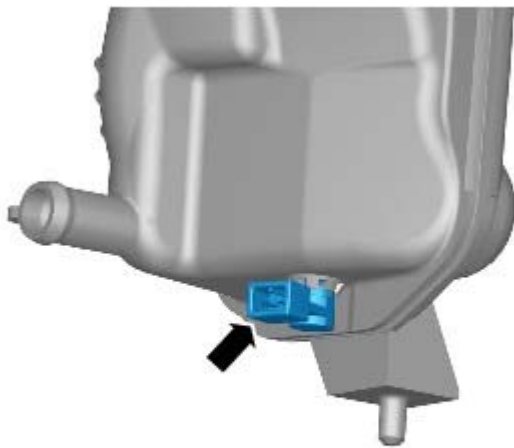


6. Torque: 10 Nm



E121418

7. **7.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



E121420

8. **8.** NOTE: Do not disassemble further if the component is removed for access only.



E122619

- 9.

Installation


1. To install, reverse the removal procedure.

Engine Cooling - TDV6 3.0L Diesel - Coolant Pump

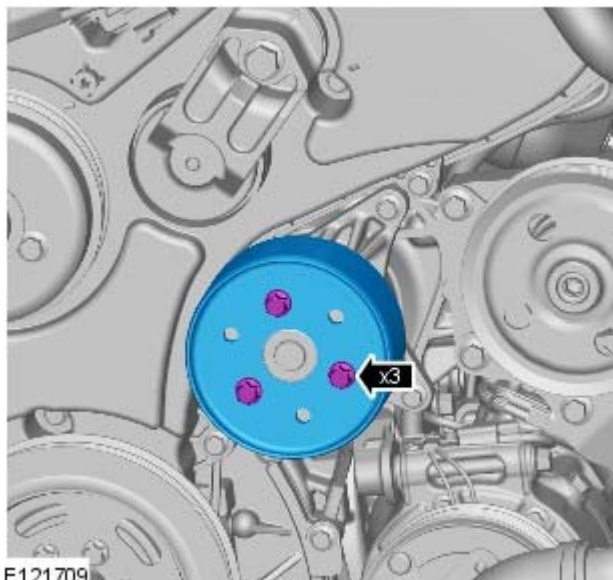
Removal and Installation


Removal

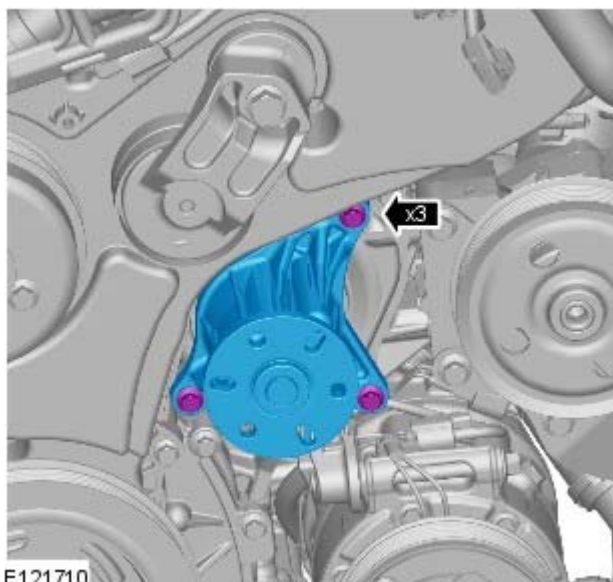
• NOTE: Removal steps in this procedure may contain installation details.


1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.
3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
4. Refer to: [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).



5.  **CAUTION:** Discard the bolts.
 - Using a suitable 6mm bar, retain the coolant pump pulley.
 - *Torque:* 25 Nm



6.  **CAUTION:** Discard the seal.
 - *Torque:* 10 Nm

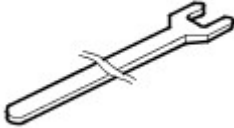

Installation

1. To install, reverse the removal procedure.

Engine Cooling - TDV6 3.0L Diesel - Cooling Fan

Removal and Installation

Special Tool(s)

 <p>303-1142 E46076</p>	303-1142 Viscous Coupling Wrench
 <p>303-1143 E55382</p>	303-1143 Viscous Coupling Holding Tool

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

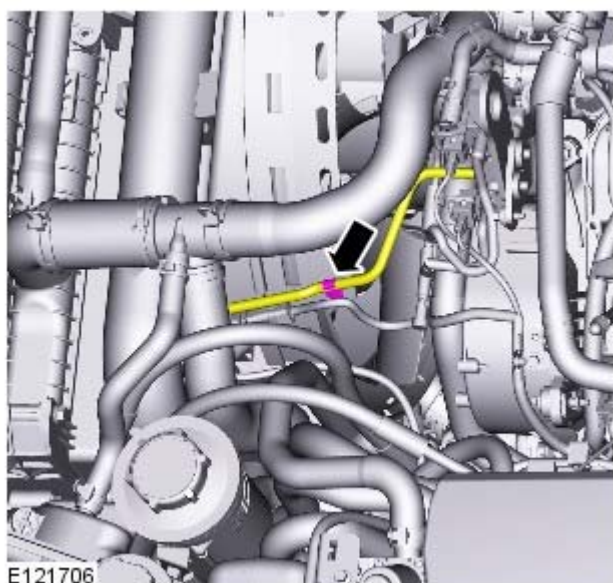
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

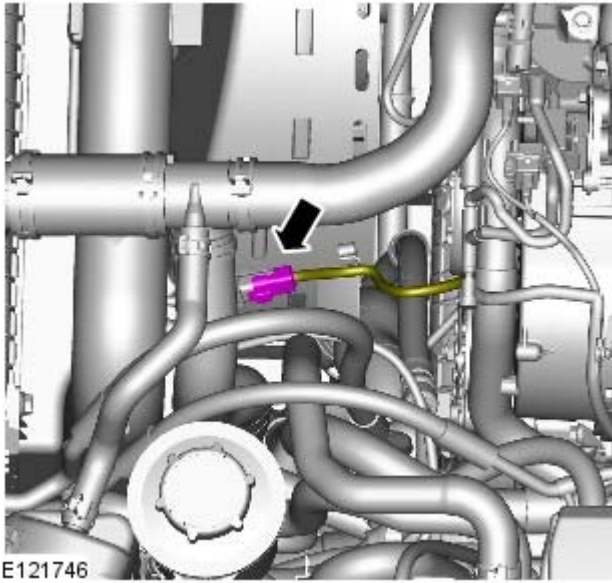
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

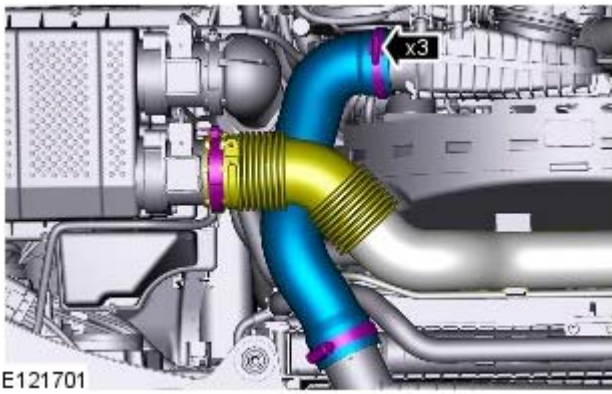
3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

- 4.

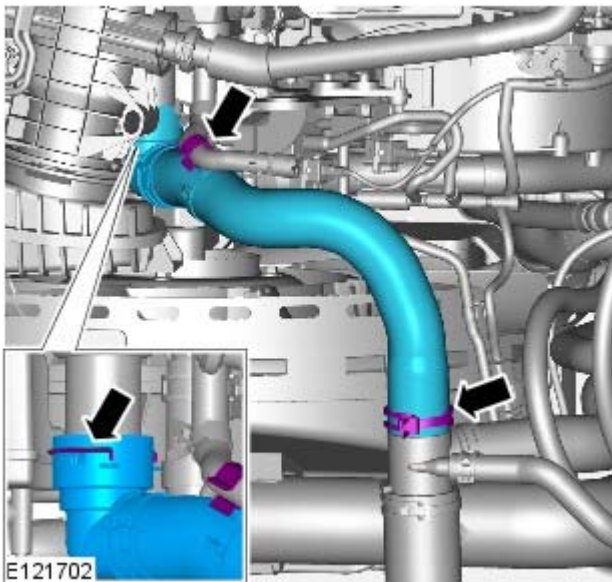




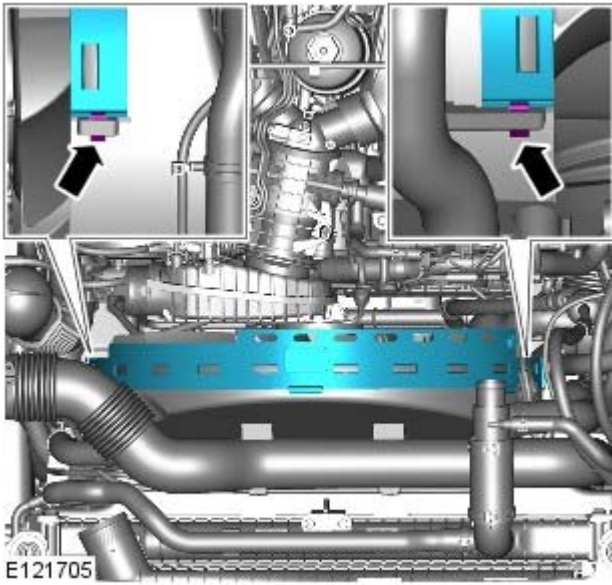
5.



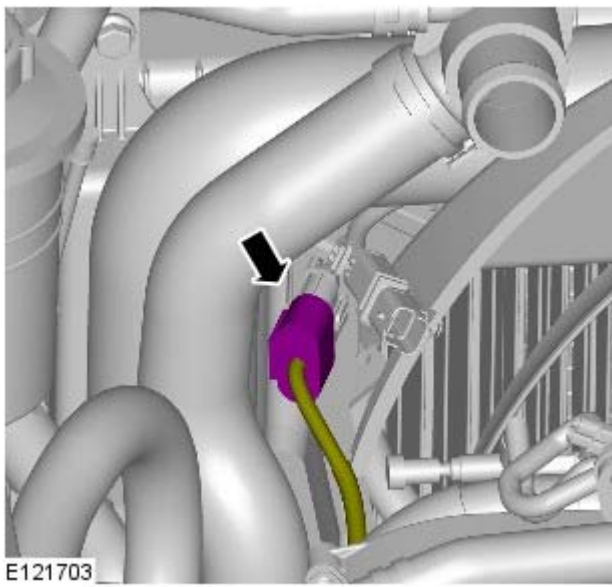
6. Torque: 3.5 Nm



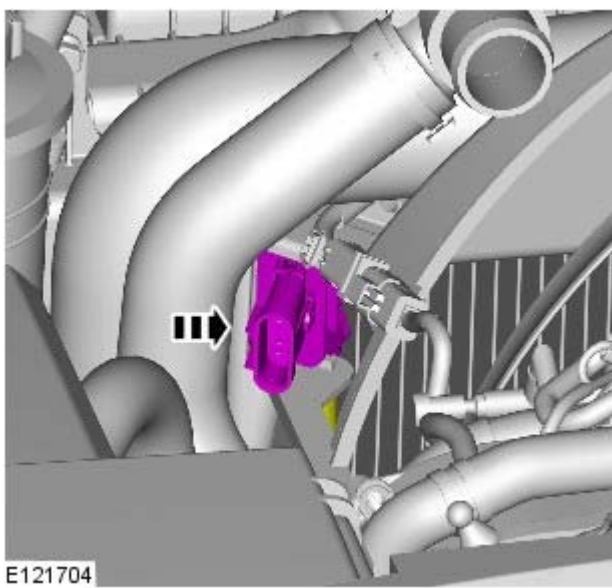
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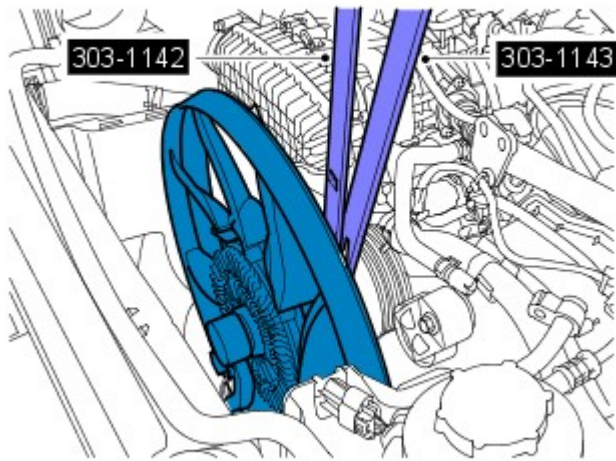
8.



9.



10.



E121707

Installation

11. **!** CAUTION: Always protect the cooling pack elements to prevent accidental damage.
 - NOTE: The thread is left handed.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Special Tool(s): [303-1142](#), [303-1143](#)
Torque: 65 Nm

1. To install, reverse the removal procedure.


Engine Cooling - TDV6 3.0L Diesel - Cooling Fan Shroud

Removal and Installation

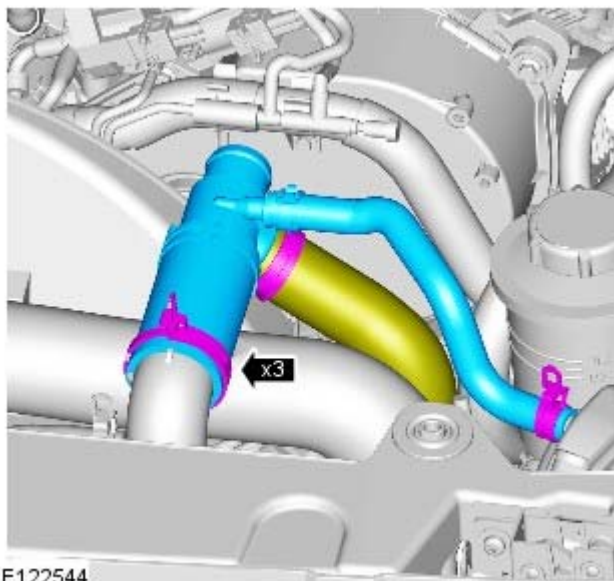
Removal

- NOTE: Removal steps in this procedure may contain installation details.


All vehicles

1.  **WARNING:** Make sure to support the vehicle with axle stands.

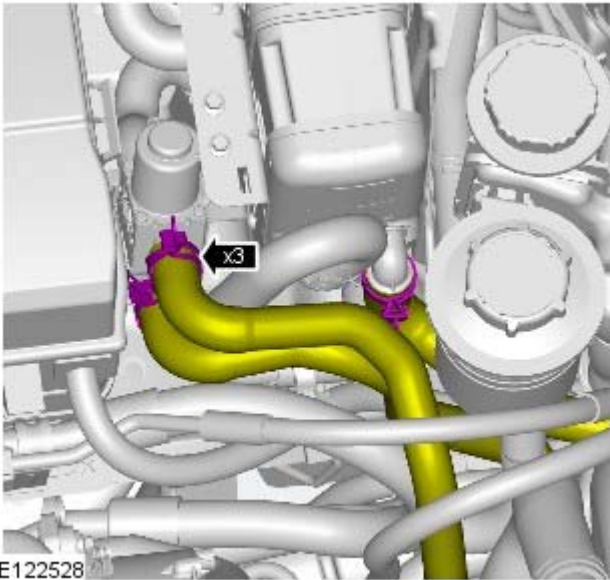
Raise and support the vehicle.
2. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).
3. Refer to: [Turbocharger Bypass Valve](#) (303-04D Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: [Transmission Fluid Cooler - TDV6 3.0L Diesel](#) (307-02C Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal and Installation).




E122544

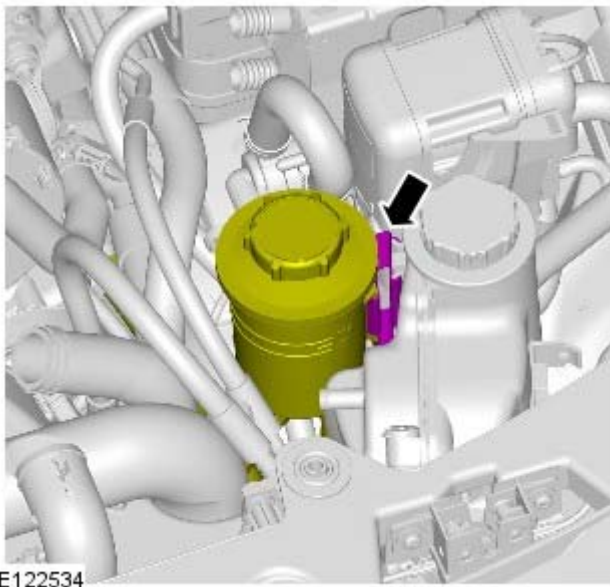
5.  **CAUTION:** Be prepared to collect escaping coolant.

Vehicles with fuel fired booster heater

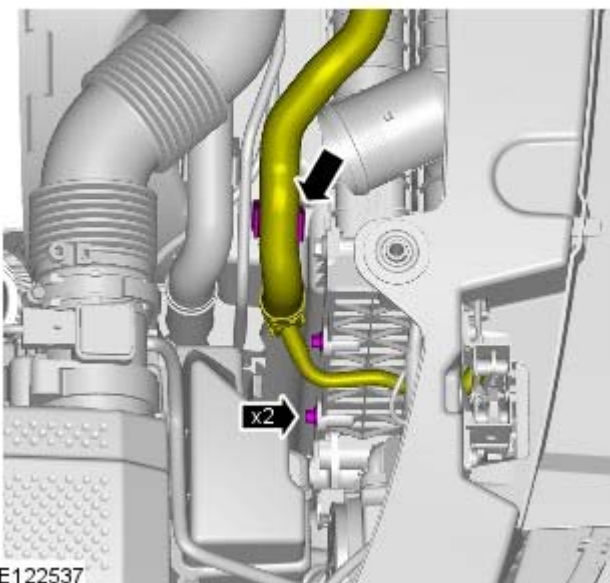



6.  CAUTION: Be prepared to collect escaping coolant.

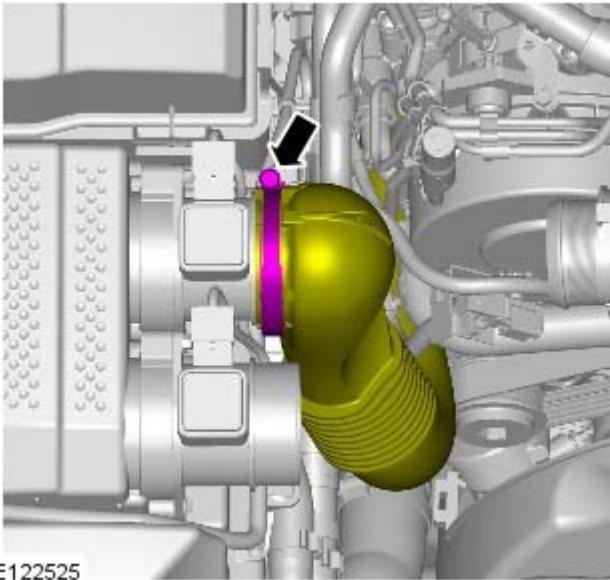
All vehicles



7. 7. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

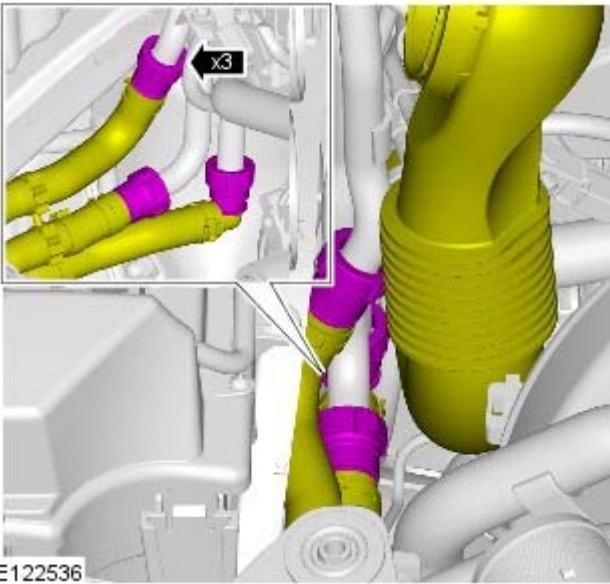



9. Torque: 5 Nm
 8.  CAUTION: Be prepared to collect escaping coolant.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



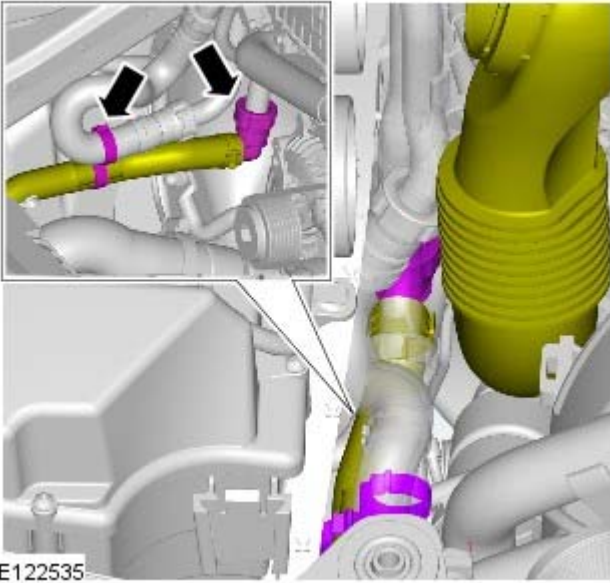
10. Torque: 3.5 Nm

Vehicles with fuel fired booster heater




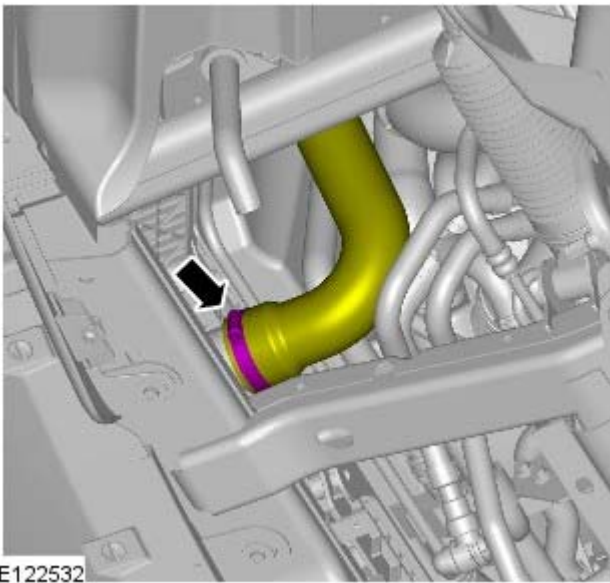
11.  CAUTION: Be prepared to collect escaping coolant.

All vehicles



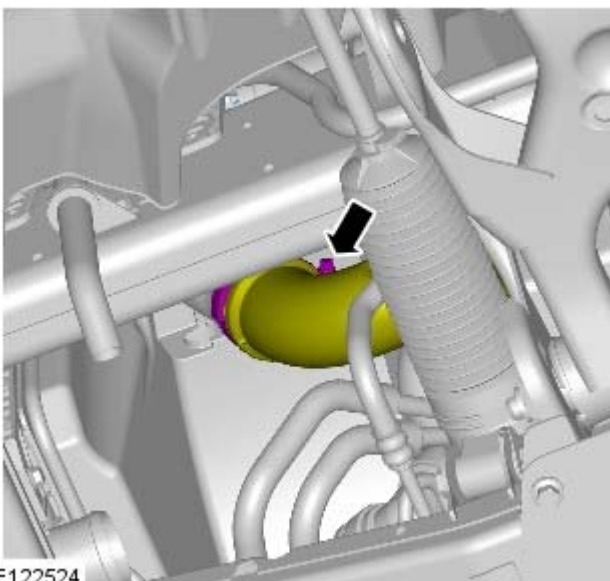
E122535

12. **12.**  CAUTION: Be prepared to collect escaping coolant.



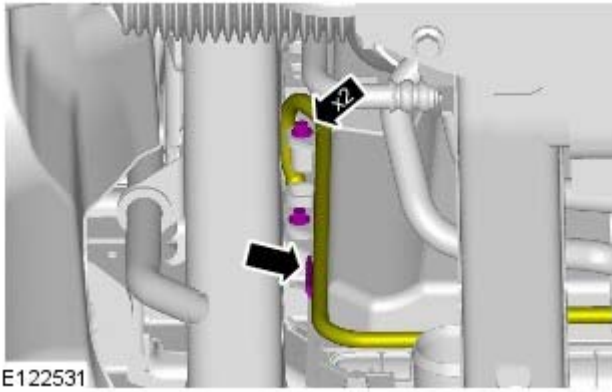
E122532

- 13.



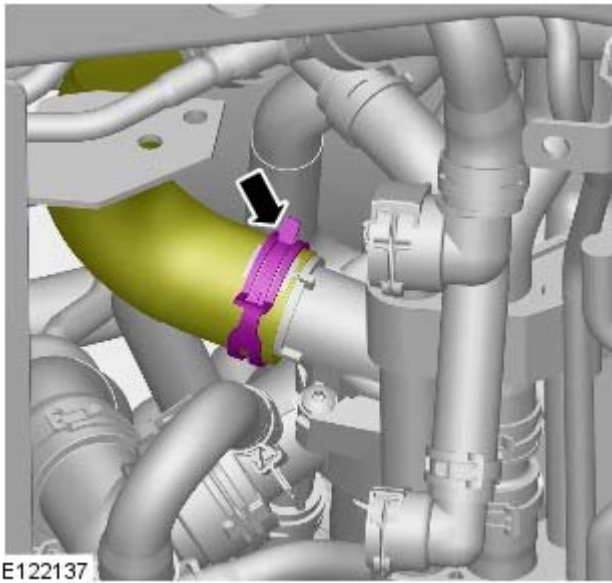
E122524

- 14.




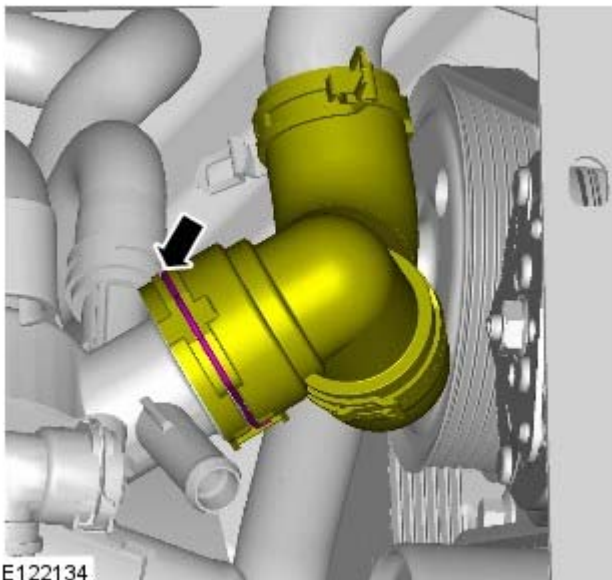
E122531

15. Torque: 5 Nm




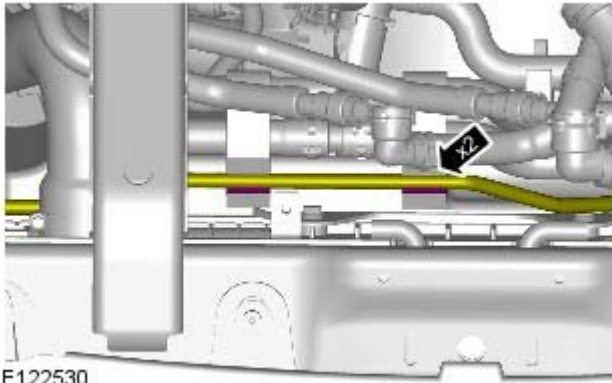
E122137

16.  CAUTION: Be prepared to collect escaping coolant.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

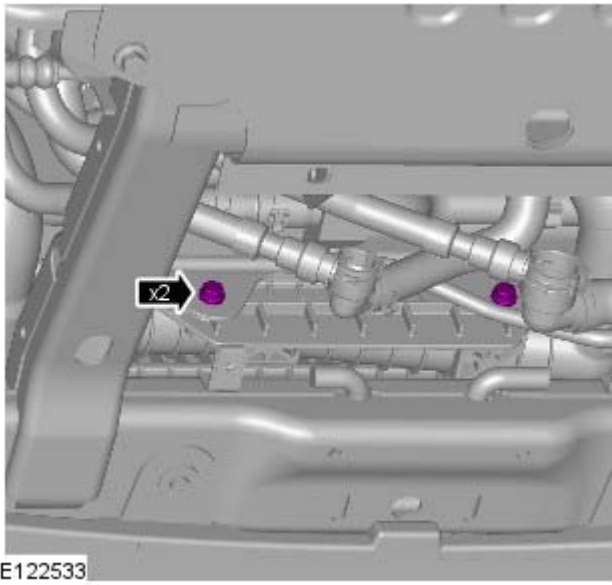


E122134

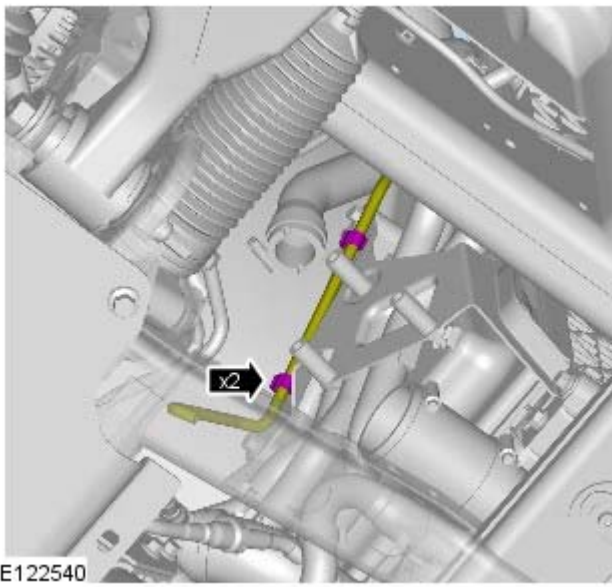
17.  CAUTION: Be prepared to collect escaping coolant.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



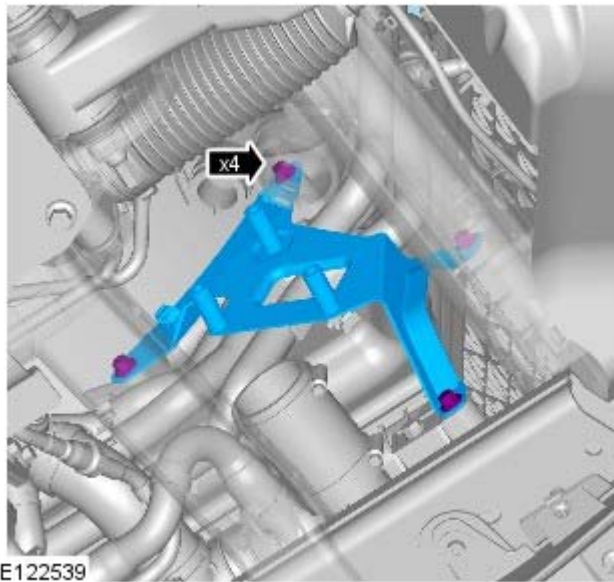
18.



19. Torque: 15 Nm

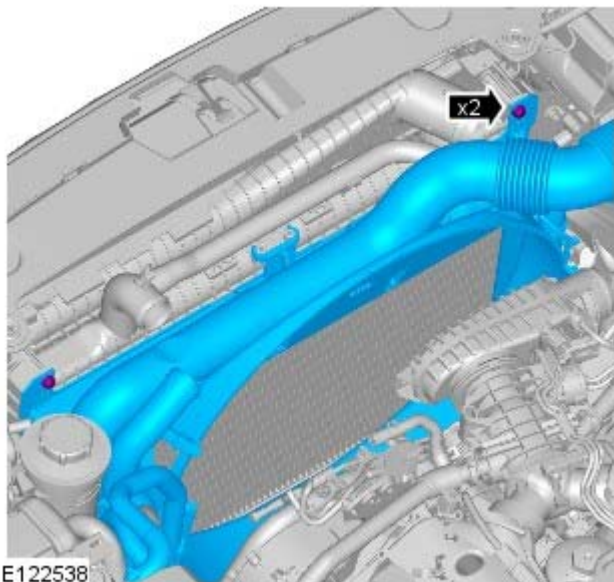


20.



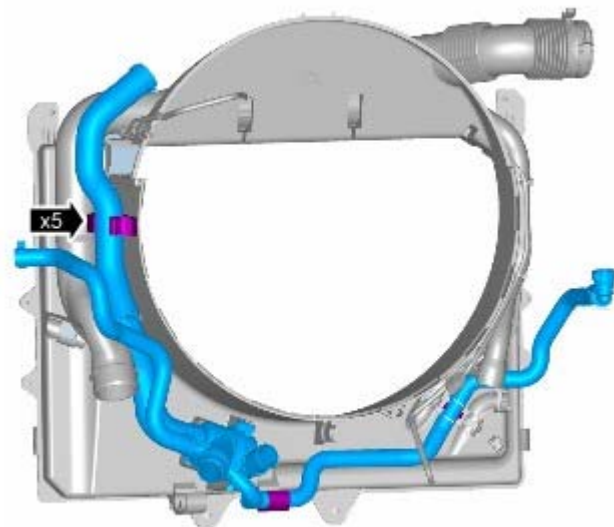
E122539

21. Torque: 15 Nm



E122538

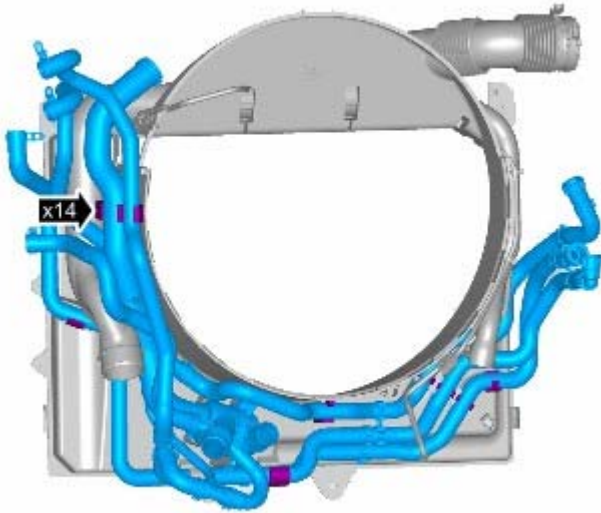
22. Torque: 15 Nm



E122541

23. **23.** NOTE: Do not disassemble further if the component is removed for access only.

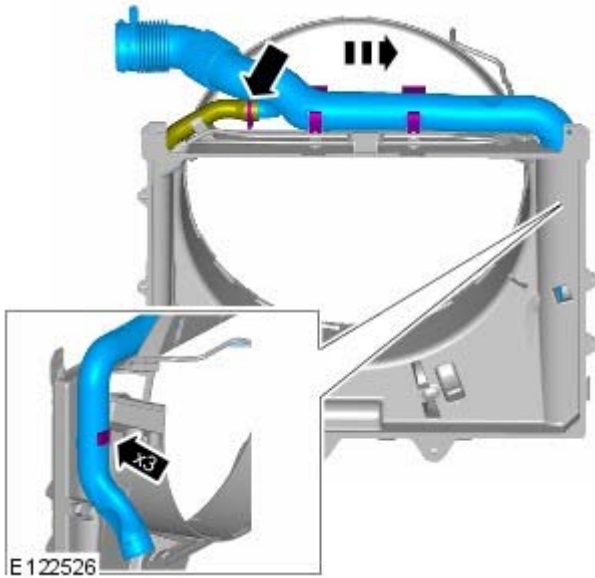
24.



E122542

All vehicles

25.

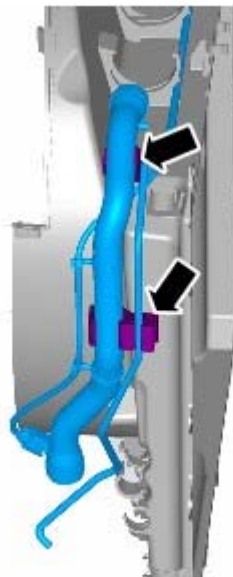


E 122526

Installation

26.

1. To install, reverse the removal procedure.




E122527

Engine Cooling - TDV6 3.0L Diesel - Radiator

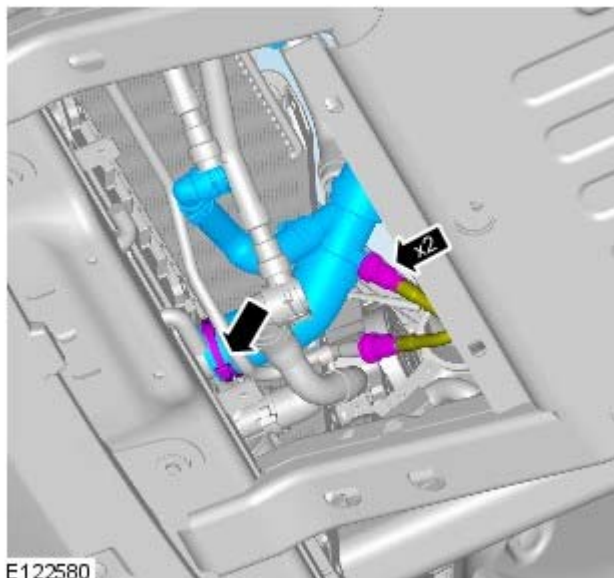
Removal and Installation


Removal

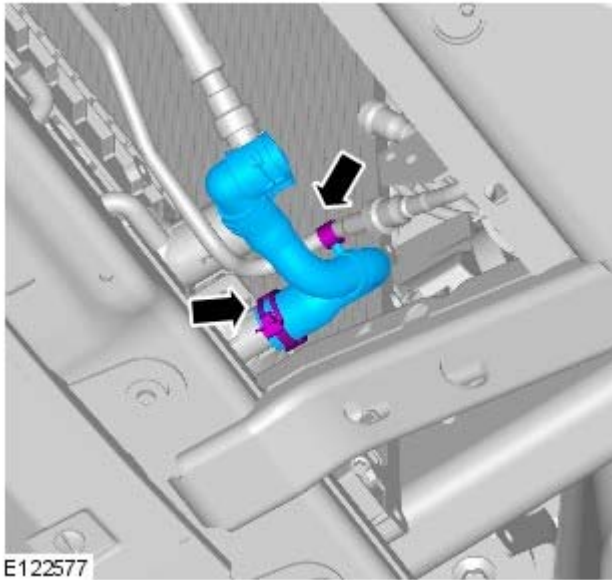
• NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.


Raise and support the vehicle.
2. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3. Refer to: [Cooling Fan Shroud](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

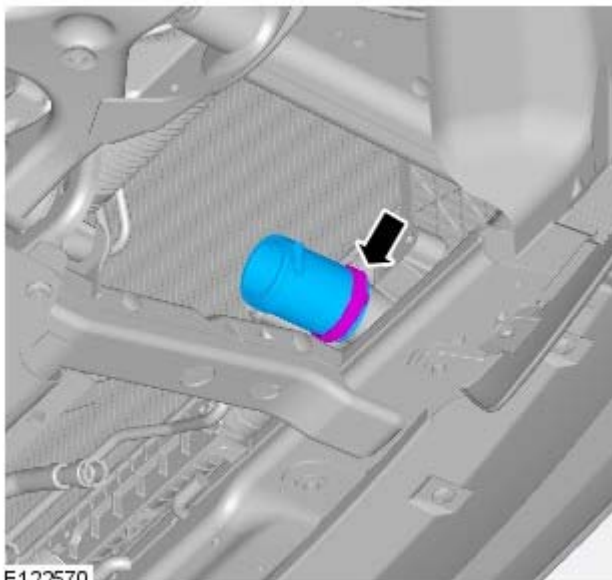


5.  **CAUTION:** Be prepared to collect escaping coolant.



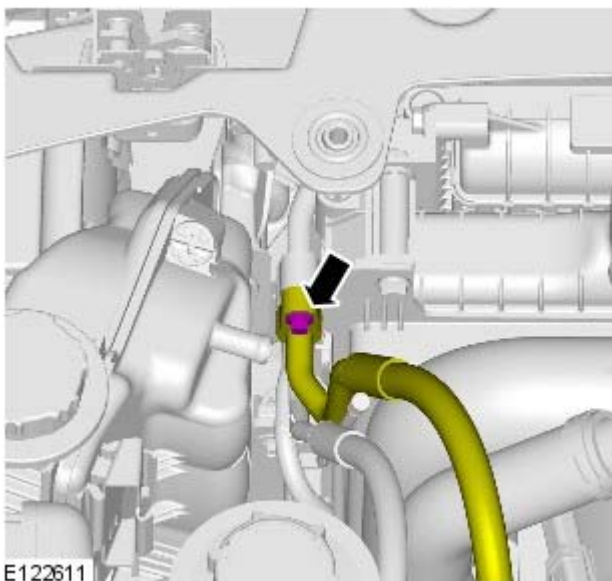
E122577

6.  CAUTION: Be prepared to collect escaping coolant.



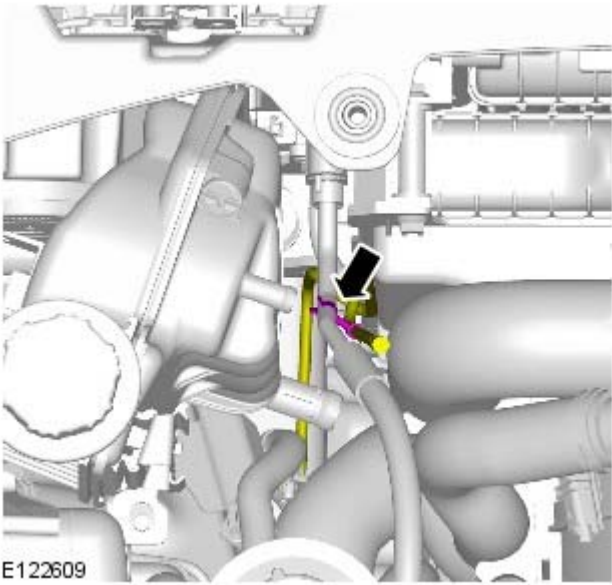
E122570

- 7.

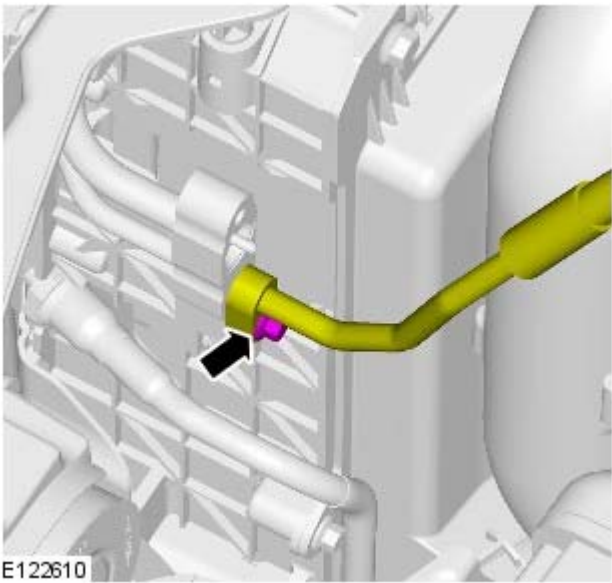


E122611

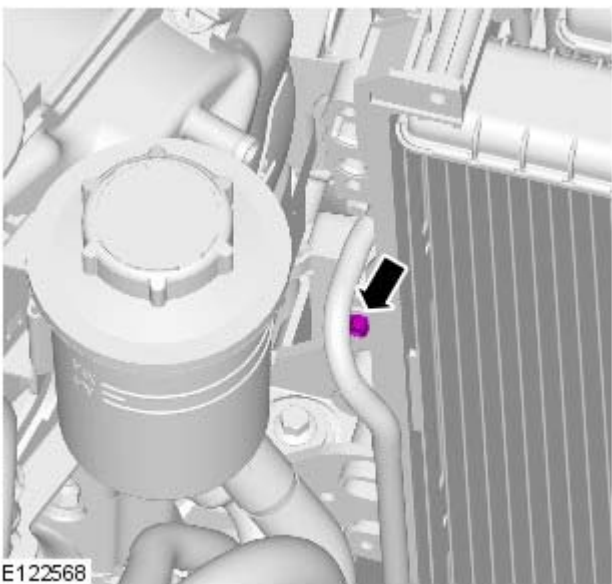
8. Torque: 6 Nm



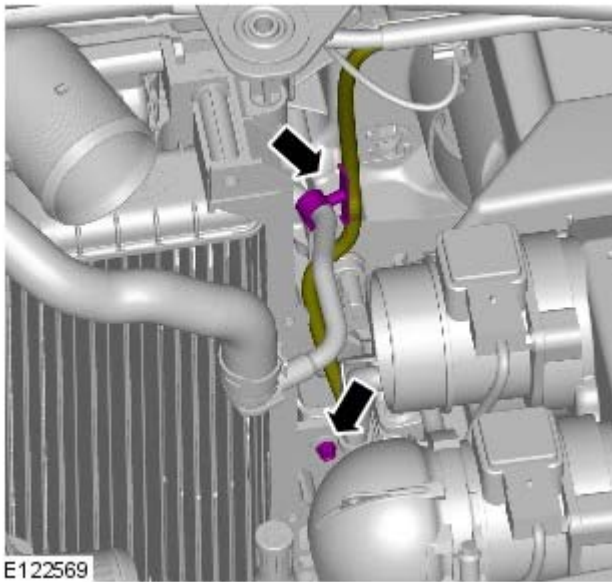
9.



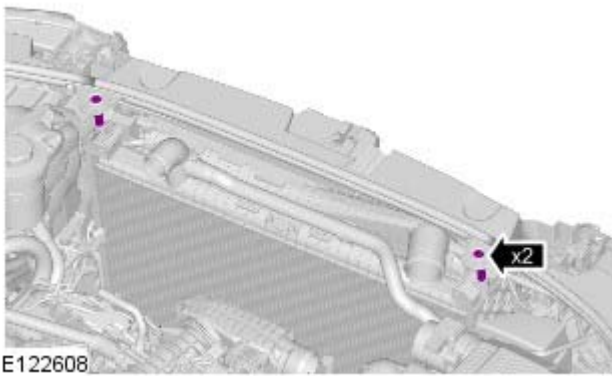
10. Torque: 6 Nm



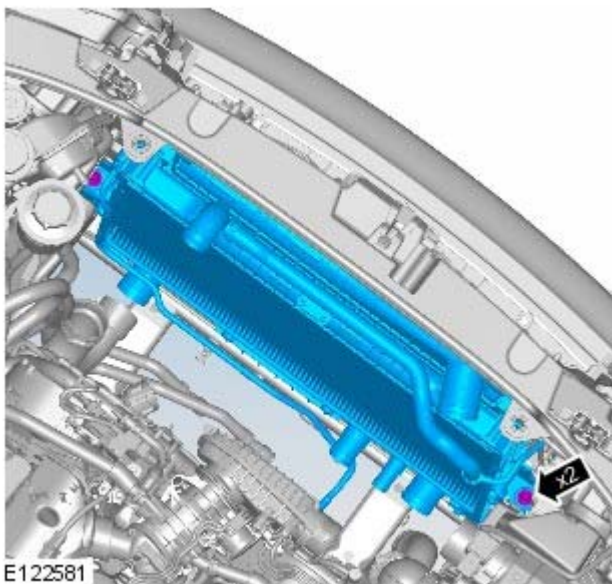
11. Torque: 5 Nm



12. Torque: 5 Nm



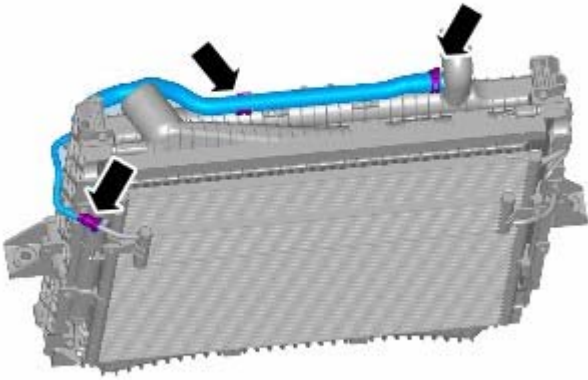
13.



14. **14.**  CAUTION: Always protect the cooling pack elements to prevent accidental damage.

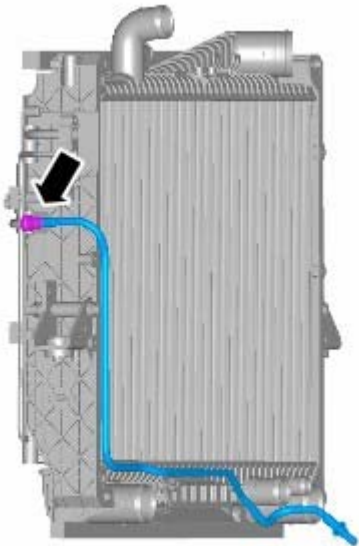
Torque: 25 Nm

15. **15.** NOTE: Do not disassemble further if the component is removed for access only.



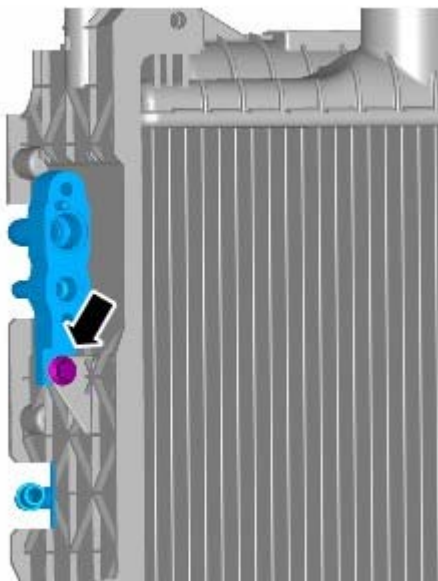
E122579

- 16.



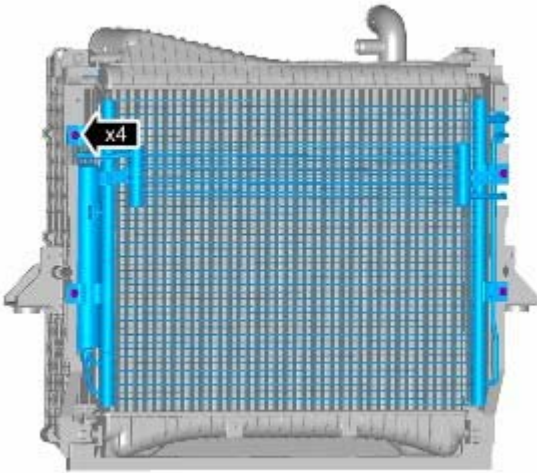
E122578

17. Torque: 5 Nm



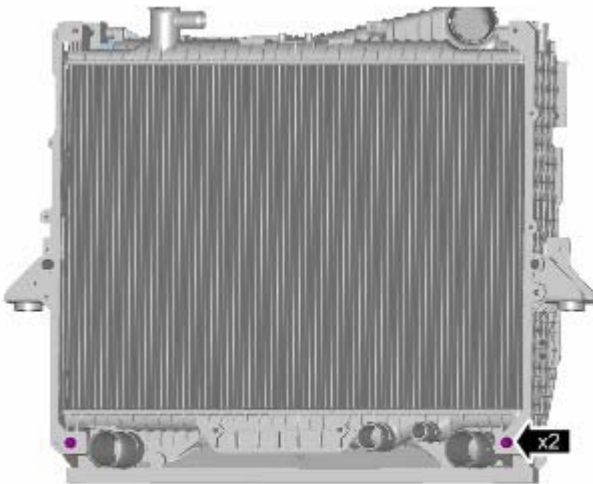
E122572

18. Torque: 5 Nm



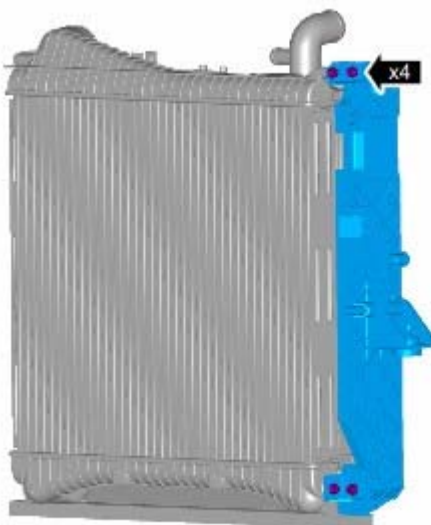
E122573

19. Torque: 15 Nm



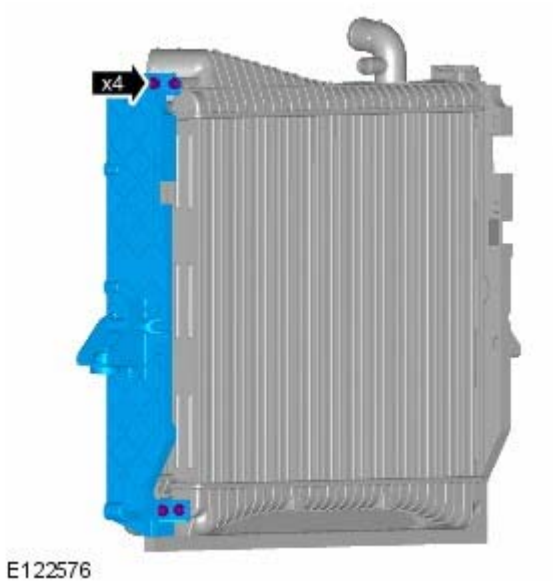
E122575

20. Torque: 15 Nm



E122574

21. Torque: 15 Nm



Installation


1. To install, reverse the removal procedure.

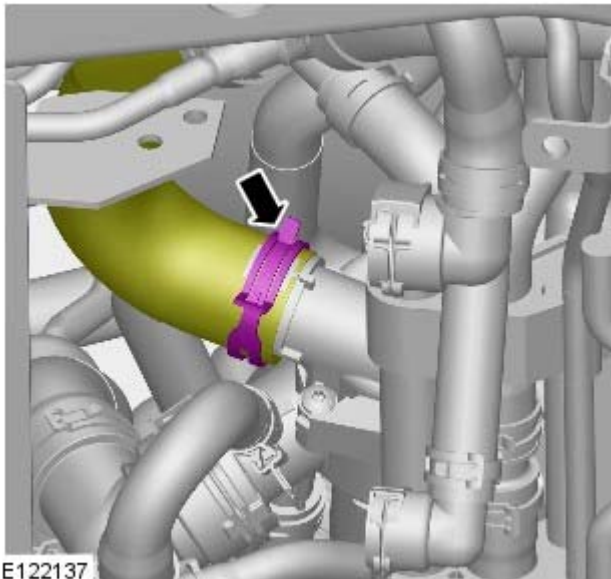
Engine Cooling - TDV6 3.0L Diesel - Thermostat


Removal and Installation

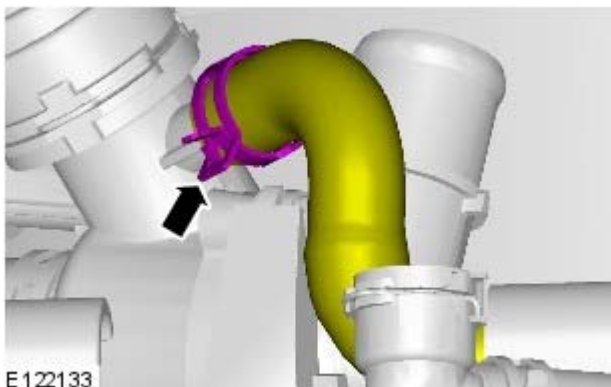
Removal


• NOTE: Removal steps in this procedure may contain installation details.

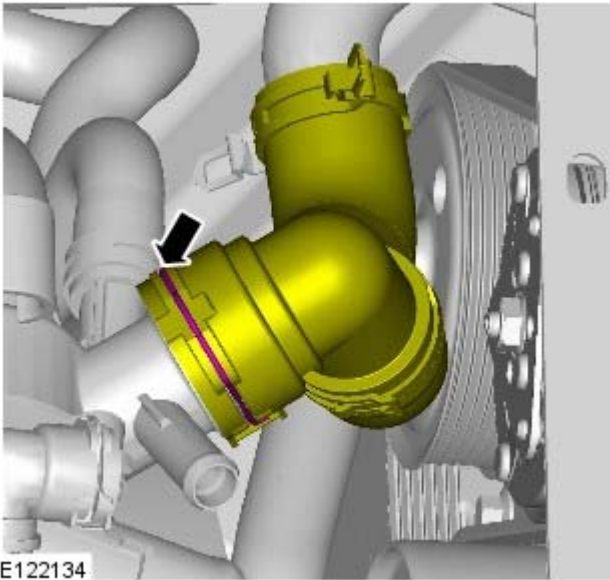
1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
3. Refer to: [Transmission Fluid Cooler - TDV6 3.0L Diesel](#) (307-02C Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal and Installation).



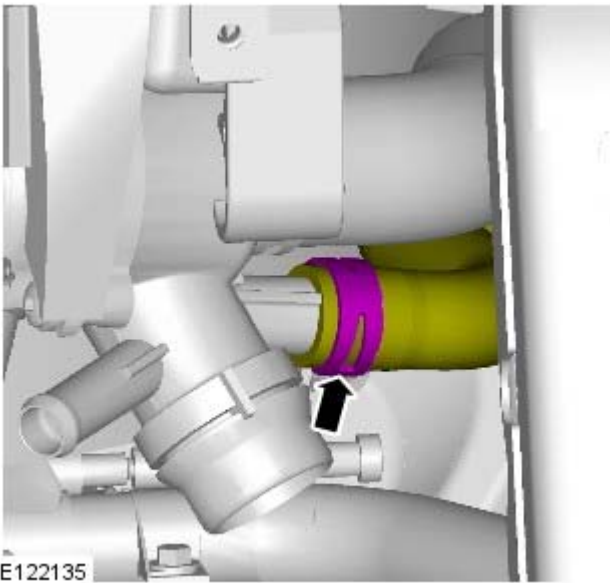
4.  **CAUTION:** Be prepared to collect escaping coolant.



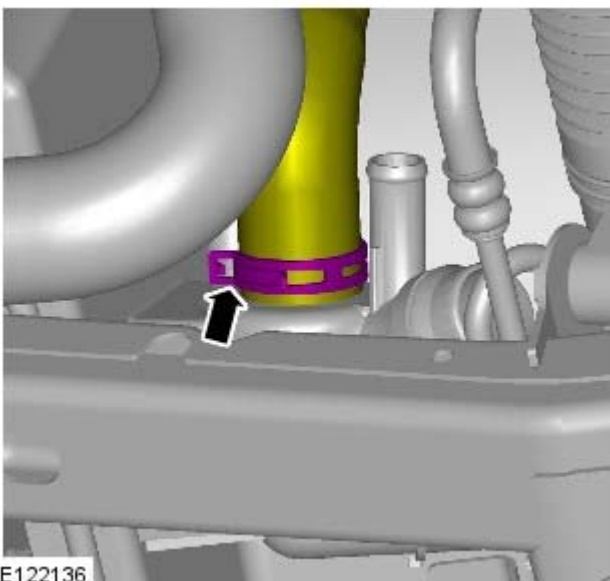
5.  **CAUTION:** Be prepared to collect escaping coolant.




6.  CAUTION: Be prepared to collect escaping coolant.

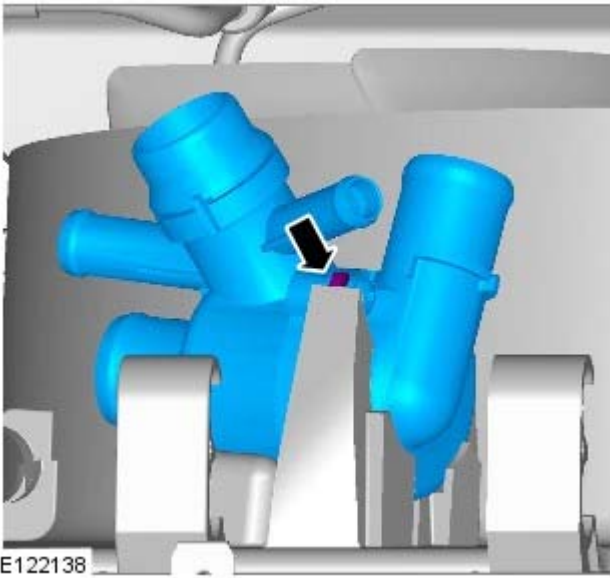


7.  CAUTION: Be prepared to collect escaping coolant.

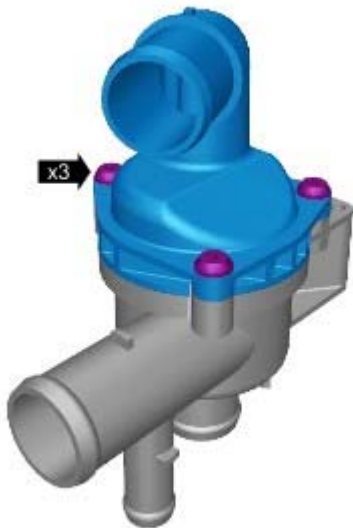


8.  CAUTION: Be prepared to collect escaping coolant.

9.



10. *Torque: 4 Nm*



E116577

11.  CAUTION: Discard the seal.



Installation

1. To install, reverse the removal procedure.

Engine Cooling - V6 4.0L Petrol -

Fluids

Item	Specification
* Anti-freeze	Havoline Extended Life Coolant (XLC) or any ethylene glycol based anti-freeze containing no methanol with only Organic Acid Technology (OAT) corrosion inhibitors
Anti-freeze concentration - Will provide frost protection to -40°C (-40°F)	50%
Specific gravity of coolant at 20°C (68°F), to protect against frost down to -40°C (-40°F)	1.068
Amount of anti-freeze to use for 50% concentration:	
Without rear passenger compartment heater	4.2 litres (6.7 pints) (4.0 US quarts)
With rear passenger compartment heater	5.6 litres (8.9 pints) (5.35 US quarts)



CAUTION: No other anti-freeze should be used with Havoline Extended Life Coolant.

Capacity

Item	Capacity
Without rear passenger compartment heater	8.4 litres (13.4 pints) (8.0 US quarts)
With rear passenger compartment heater	11.1 litres (17.8 pints) (10.7 US quarts)

General Specifications

Item	Specification
Cooling system type	Pressurised, thermostatically controlled with remote header tank
Radiator	Cross flow with integral transmission oil cooler
Expansion tank	Remote - fitted with a bleed screw and low coolant level sensor
Pressure cap rating	110 kPa (1.1 bar) (16 lbf/in ²)
Thermostat:	
Starts to open	88° C (190° F)
Fully open	95° C (203° F)
Cooling fan	Engine driven, viscous coupled with electronic control
Cooling fan diameter	470 mm (18.5 in)
Direction of rotation	Counter clockwise
Coolant pump	Centrifugal flow impellor, belt driven from crankshaft

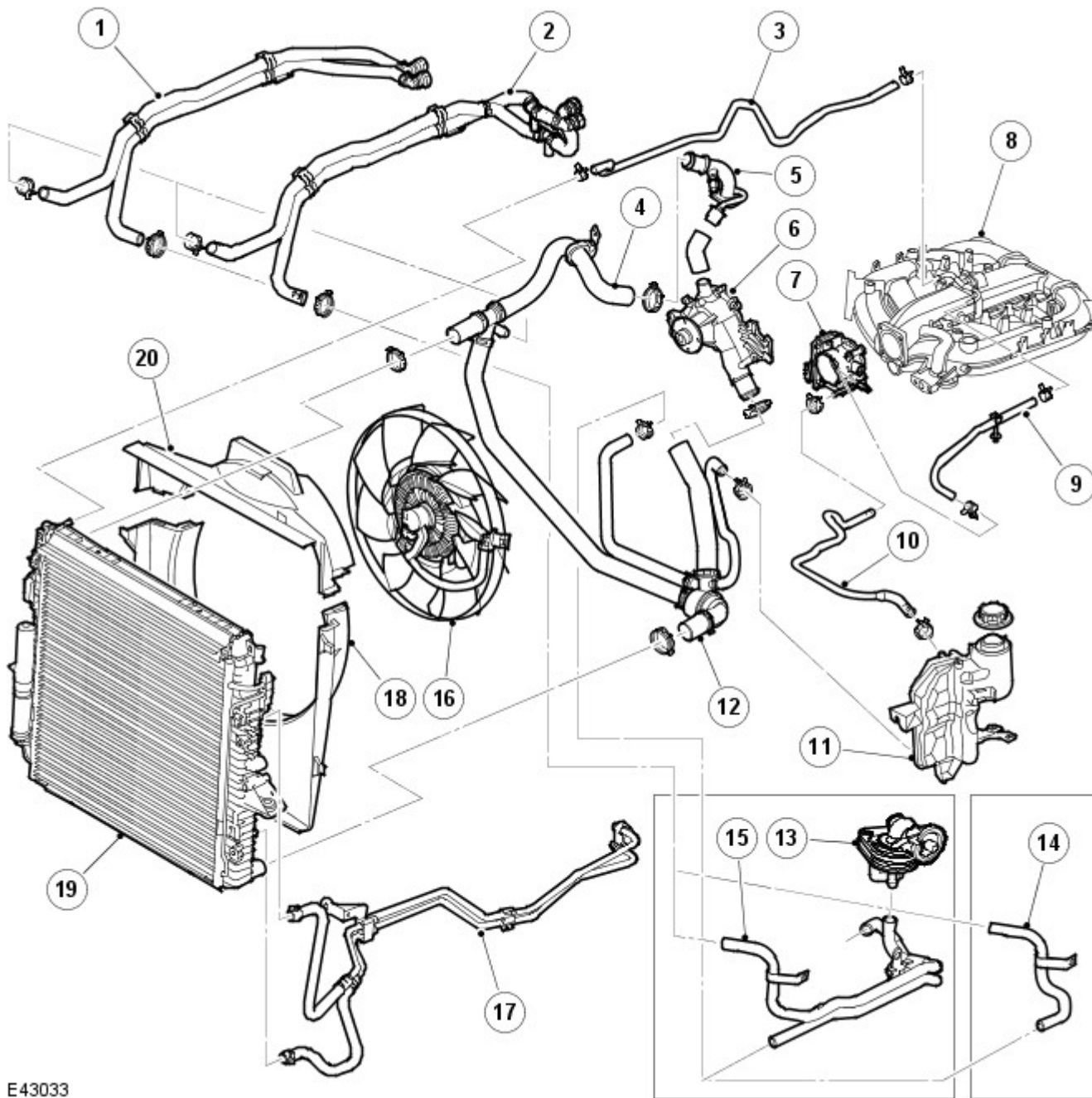
Torque Specifications

Description	Nm	lb-ft
Coolant pump bolts	10	7
Coolant pump pulley bolts	25	18
Power steering pipe clip bolt	10	7
Coolant expansion tank bolt	10	7
Vacuum pump bolts	10	7
Radiator bolts	25	18
Air Conditioning (A/C) condenser bolt	6	4
Radiator access panel bolts	10	7
Cooling fan viscous coupling bolts	10	7
Cooling fan assembly	65	48
Coolant bleed screw(s)	3	2

Engine Cooling - V6 4.0L Petrol - Engine Cooling

Description and Operation

Cooling System Component Layout



E43033

Item	Part Number	Description
1	-	Heater hose, inlet and outlet
2	-	Heater hose, inlet and outlet for vehicles with rear heater (optional)
3	-	Hose, radiator to intake manifold
4	-	Radiator top hose
5	-	Engine Coolant Temperature (ECT) sensor
6	-	Water pump
7	-	Throttle body
8	-	Inlet manifold
9	-	Throttle body coolant hose
10	-	Hose, engine to expansion tank
11	-	Expansion tank
12	-	Radiator bottom hose
13	-	Engine oil cooler (if fitted)
14	-	Hose (for vehicles without engine oil cooler)
15	-	Hose, inlet and outlet (for vehicles with engine oil cooler)
16	-	Cooling fan
17	-	Transmission oil cooler pipes

18	-	Radiator cowl, lower
19	-	Radiator
20	-	Radiator cowl, upper

GENERAL

The cooling system employed is of the pressure relief by-pass type, which allows coolant to circulate around the engine and the heater circuit while the thermostat main valve is closed. The primary function of the cooling system is to maintain the engine within an optimum temperature range under changing ambient and engine operating conditions. Secondary functions are to provide heating for the passenger compartment and cooling for the transmission fluid and engine oil.

The cooling system comprises:

- A radiator
- A passenger compartment heater matrix
- An Engine Oil Cooler (EOC)
- A coolant pump
- A Pressure Relief Thermostat (PRT)
- An expansion tank
- A viscous fan
- Connecting hoses and pipes.

ENGINE COOLING SYSTEM

The coolant is circulated by a centrifugal pump mounted on the front of the engine and driven by an ancillary drive 'polyvee' belt. The coolant pump circulates coolant through the cylinder block and cylinder heads via a chamber located in the 'vee' of the engine. Having passed through the engine the coolant returns to the thermostat housing via the bypass pipe. Coolant also circulates through the top hose to the heater matrix. The coolant returns via the EOC to the engine side of the PRT.

The PRT housing contains a normal thermostat, which is positioned such that the wax's temperature is controlled by both the coolant from the radiator and the bypass. This results in the thermostat being able to vary its opening temperature dependant on ambient conditions. The PRT also contains a sprung loaded valve, which limits the amount flow using the bypass. This means that the engine can run without coolant flowing through the bypass temporarily, to improve heater performance.

The radiator is a cross flow type with an aluminium matrix and has a drain tap on the lower right-hand rear face. The lower radiator mountings are located part way up the end tanks. The mountings are fitted with rubber bushes, which sit on the upper chassis rails. The radiator upper is mounted by pins, which are pushed through rubber bushes mounted in the Front End Carrier (FEC) above the radiator. The radiator also incorporates two connections for the transmission oil cooler pipes.

The radiator top hose is connected to the PRT by the bypass hose and the bottom hose is directly connected to the outlet side of the thermostat housing.

The expansion tank is fitted forward of the LH suspension turret in the engine compartment. The expansion tank allows for the expansion of the coolant as the engine gets hot and also supplies the engine with coolant as the coolant in the engine contracts. The tank also allows any air trapped in the coolant to be removed.

The liquid cooled transmission fluid cooler is mounted in the cold side radiator end tank. It is positioned in the middle of the LH end tank.

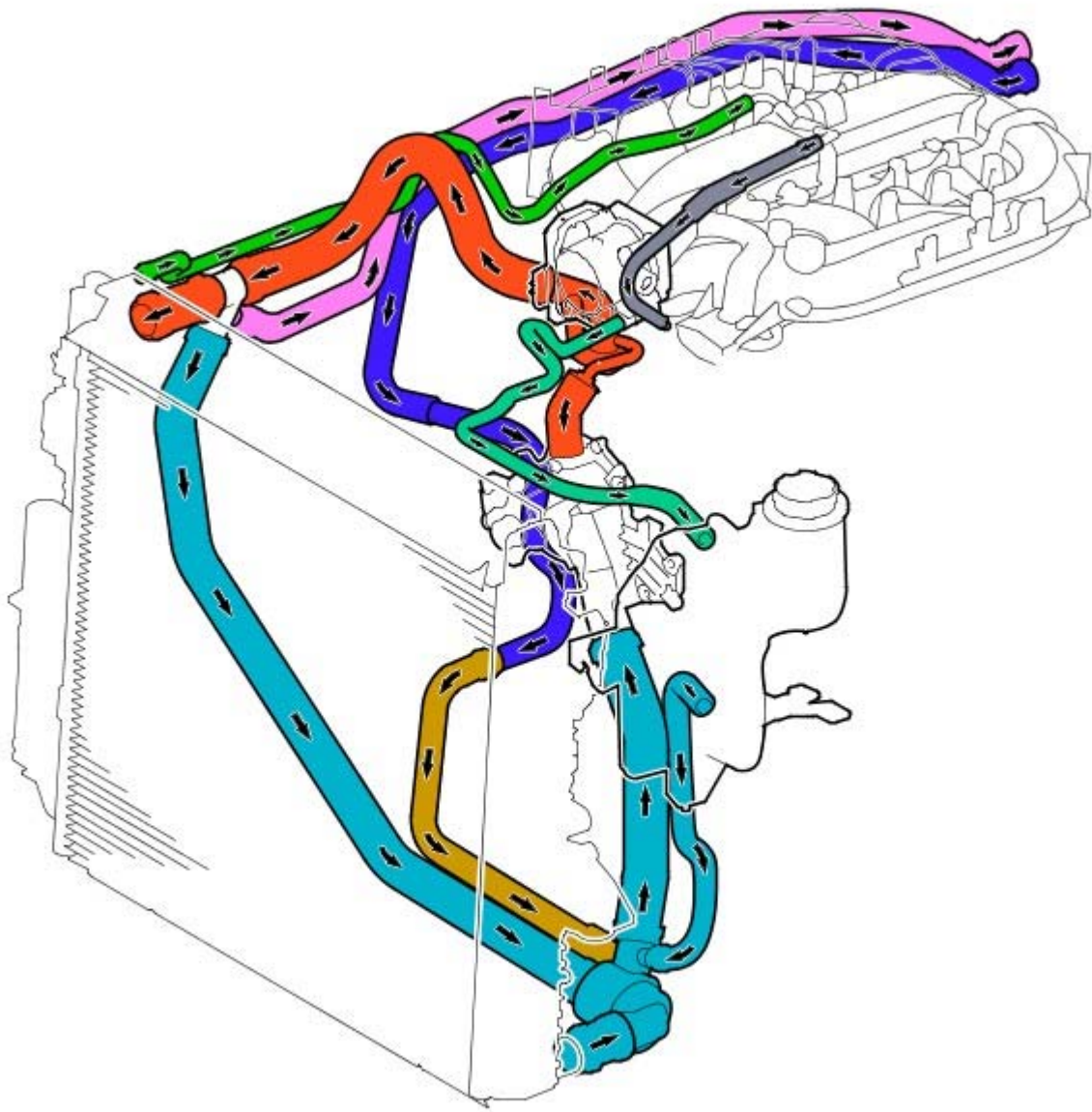
For additional airflow through the radiator matrix, particularly when the vehicle is stationary, there is an engine driven Viscous fan unit fitted to the rear of the radiator. The fan is used for engine cooling and for Air Conditioning (A/C) system cooling. The fan is mounted using a left hand thread.

The viscous fan unit is electronically controlled by the ECM to optimise fan speed for all operating conditions.

• **NOTE:** If the electrical connections to the viscous fan are disconnected the fan will 'idle' and overheating may result. The ECM stores the appropriate fault codes in this case.

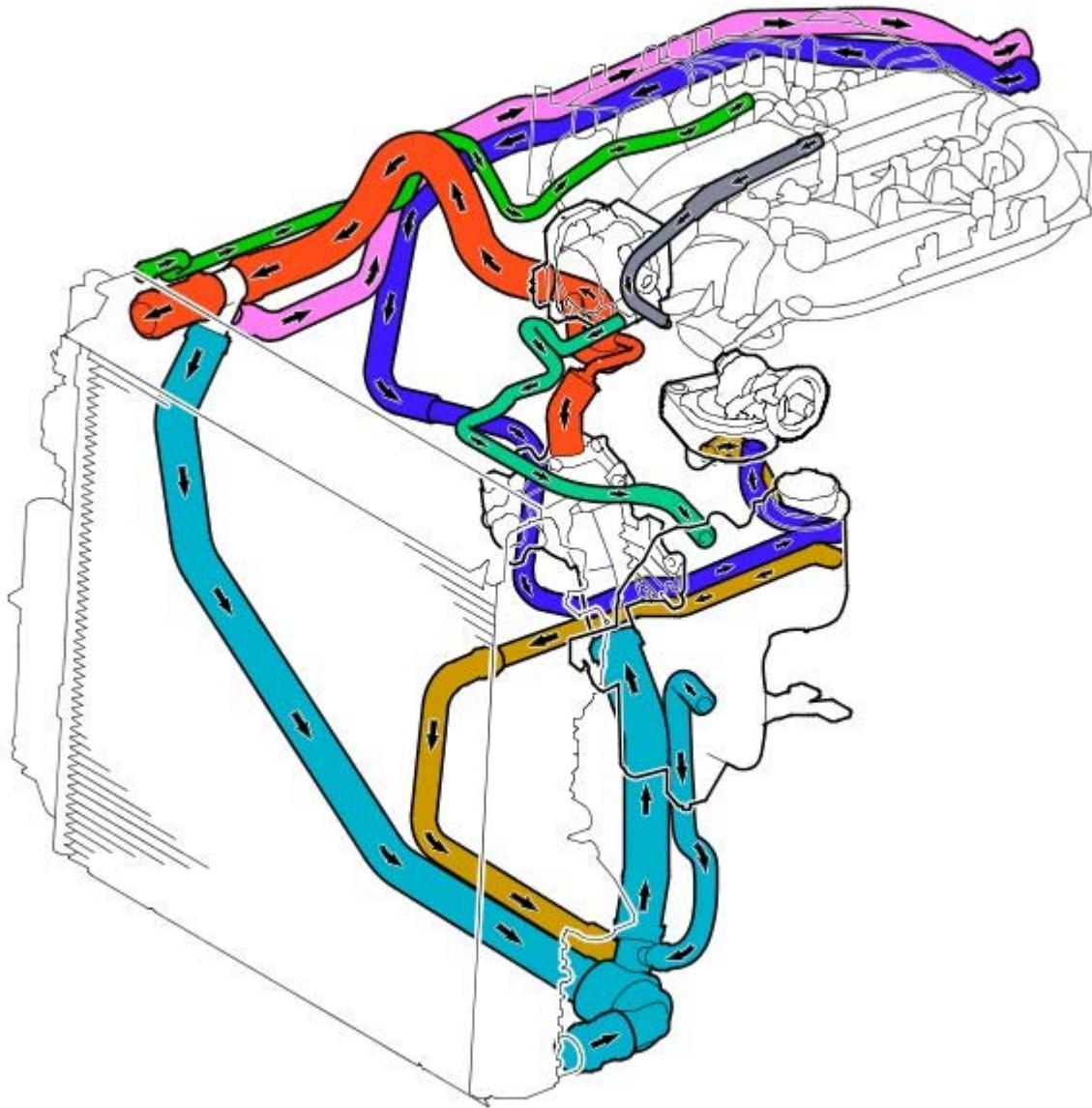
ENGINE COOLING SYSTEM OPERATION

Cooling System Coolant Flow, Without Engine Oil Cooler



E43034

Cooling System Coolant Flow, With Engine Oil Cooler



E43035

When the engine is running the coolant pump is driven by the ancillary drive belt. This forces coolant to circulate around the engine, heater and EOC, while the thermostat and bypass valve are shut. As the temperature and pressure increases the bypass valve is forced open allowing coolant to circulate through the bypass valve. When the temperature reaches 82°C (180°F) the main thermostat begins to open, allowing coolant to circulate through the main radiator. As the thermostat progressively opens (fully open at 95°C (203°F)), the bypass valve progressively closes forcing any coolant through the heater or radiator. Once coolant is allowed to circulate through the radiator, the transmission fluid cooler begins to receive coolant flow.

The increased coolant volume, created by heat expansion, is directed to the expansion tank through a bleed hose from the top of the radiator. The expansion tank has an outlet hose which is connected into the coolant circuit. This outlet hose returns the coolant to the system when the engine cools.

Coolant flows through the radiator from the top right hand tank to the bottom left hand tank and is cooled by air passing through the matrix. The temperature of the cooling system is monitored by the Engine Control Module (ECM) via the Engine Coolant temperature (ECT) sensor located in the cylinder head. The ECM uses signals from this sensor to adjust fuelling according to engine temperature.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

To control the cooling fan, the ECM sends a Pulse Width Modulated (PWM) signal to the cooling fan module (integral to the ECM). The frequency of the PWM signal is used by the cooling fan module to determine the output voltage supplied to the fan motor.

The ECM varies the duty cycle of the PWM signal between 0 and 100% to vary the fan speed. If the PWM signal is outside the 0 to 100% range, the cooling fan module interprets the signal as an open or short circuit and runs the fans at maximum speed to ensure the engine and gearbox do not overheat.

The speed of the cooling fan is also influenced by vehicle road speed. The ECM adjusts the speed of the cooling fans, to compensate for the ram effect of vehicle speed, using the Controller Area Network (CAN) road speed signal received from

the Anti-lock Braking System (ABS) module.

Pressure Relief Thermostat (PRT)

The thermostat is exposed to 85% hot coolant from the engine on one side and 15% cold coolant returning from the radiator bottom hose on the other side. This allows the thermostat to react to the ambient conditions and provide coolant control for both winter and summer use. Hot coolant from the engine passes via holes in the by-pass flow valve into a tube which surrounds 85% of the thermostat sensitive area. Cold coolant from the radiator conducts through the remaining 15% of the sensitive area. In cold ambient conditions, the engine temperature is raised by approximately 10°C (50°F) to compensate for the heat loss of 15% exposure to the cold coolant returning from the bottom hose. This improves heater performance and engine warm-up.

The by-pass flow valve is held closed by a light spring and operates to further assist engine and heater warm-up. When the main valve is closed and the engine speed is at idle, the coolant pump does not produce sufficient flow and pressure to overcome the spring and open the valve. In this condition the valve prevents coolant circulating through the by-pass circuit and directs coolant through the heater matrix only. This provides a higher flow of coolant through the heater matrix improving passenger comfort in cold conditions.

When the engine speed increases above idle, the coolant pump produces a greater flow and pressure than the heater circuit can accommodate. The build up of pressure acts on the flow valve, overcoming the spring pressure, opening the valve and relieving the pressure in the heater circuit. The valve then modulates to provide maximum coolant flow through the heater matrix and allowing excess coolant to flow into the by-pass circuit to provide the engine's cooling requirements at higher engine speeds. The thermostat then regulates the flow through the radiator to maintain the engine at the optimum temperature. Maximum opening of the thermostat, and therefore maximum flow through the radiator, occurs if the coolant temperature reaches 95°C (203°F).

Engine Cooling - V6 4.0L Petrol - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Cooling](#) (303-03C Engine Cooling - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Coolant leaks ● Coolant Hoses ● Coolant expansion tank ● Radiator ● Heater core ● Accessory drive belt ● Viscous fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Loose or corroded connector(s) ● Engine Coolant Temperature (ECT) sensor

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	<ul style="list-style-type: none"> ● Hoses ● Hose connections ● Radiator ● Water pump ● Heater core ● Gaskets ● Engine casting cracks ● Engine block core plugs 	Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary.
Overheating	<ul style="list-style-type: none"> ● Low/Contaminated coolant ● Thermostat ● Viscous fan ● ECT sensor ● Restricted air flow over the radiator 	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	<ul style="list-style-type: none"> ● Thermostat ● Viscous fan ● Thermostat ● Electric fan ● Fan speed module 	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Engine Cooling - V6 4.0L Petrol - Cooling System Draining, Filling and Bleeding

General Procedures

⚠ WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

All vehicles

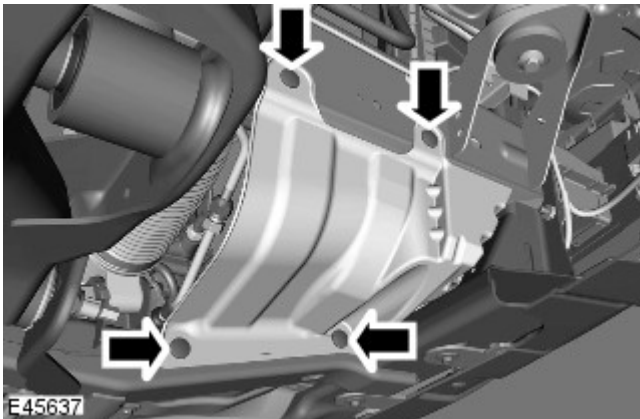
1. Position the vehicle on a lift.
2. Set the heater controls to maximum.
3. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

⚠ WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Remove the coolant expansion tank cap.

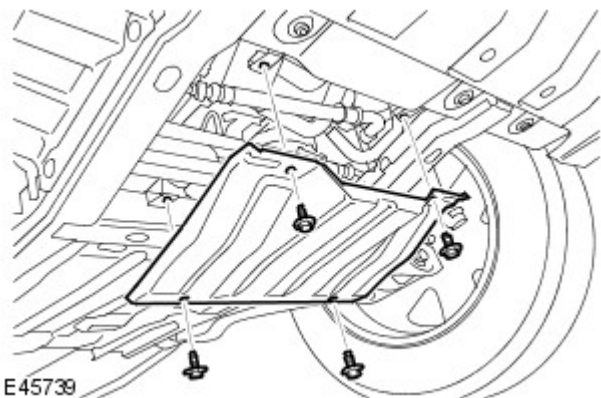
6. Remove the front LH splash shield.

- Remove the 4 clips.



7. Remove the radiator access panel.

- Remove the 4 bolts.



8. Position a container to collect the fluid.



9.  **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Release the clip and disconnect the radiator lower hose, allow the coolant to drain.

Vehicles with auxiliary climate control

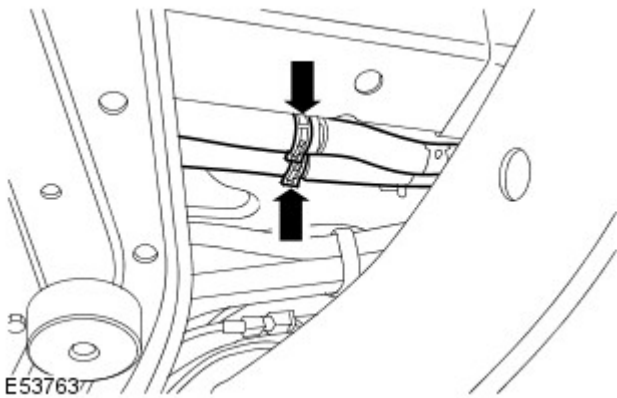
10. Remove the spare wheel and tire.

- Remove the tool kit.
- Access the winch.

11. Position a container to collect the fluid.

12. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.



Vehicles with auxiliary climate control

13. Connect the rear heater coolant hoses.

- Secure the clips.

14. Install the spare wheel and tire.

- Stow the tool kit.

15. Connect and secure the radiator lower hose.

- Secure with the clip.

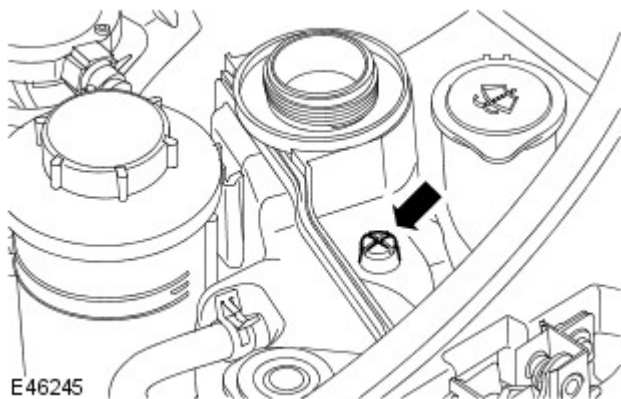
All vehicles

16. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

17. Connect exhaust extraction hoses to the tail pipes.

18. Loosen the coolant expansion tank bleed screw.



19. Refill the cooling system.

20. Start and run the engine.

- Hold the engine speed at 2,500 RPM for 30 seconds.
- Return the engine to idle for 30 seconds.
- Repeat the above procedure a further four times.

21. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank until a steady stream of coolant is seen returning to the expansion tank. Tighten the expansion tank bleed screw.

- Hold the engine speed at 3,000 RPM for one minute.

22. NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top-up the expansion tank to 30mm above the maximum level.

Install the coolant expansion tank cap.

23. Run the engine until the thermostat opens.

24. Switch the engine off and allow to cool.

25. Install the engine cover.

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

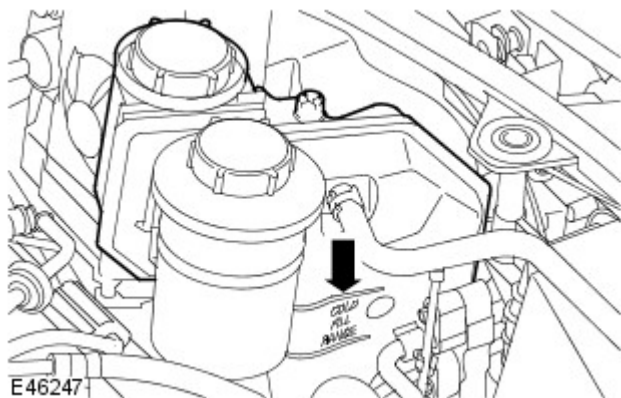
26. Clean any remaining coolant from the chassis and surrounding area.

27. Install the radiator access panel.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).

28. Install the front LH splash shield.

29. Check and top-up the coolant if required.



Engine Cooling - V6 4.0L Petrol - Cooling System Draining and Vacuum

Filling

General Procedures

⚠ WARNING: To avoid having scalding hot coolant or steam blowing out of the cooling system, use extreme care when removing the coolant pressure cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant pressure cap and turn it slowly until the pressure begins to release. Step back while the pressure is released from the system. When certain all the pressure has been released (still with a cloth) turn and remove the coolant pressure cap from the coolant expansion tank. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

⚠ The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage. Failure to follow this instruction may result in damage to the vehicle.

⚠ Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

1. Set the heater controls to maximum HOT.

2. **⚠ WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

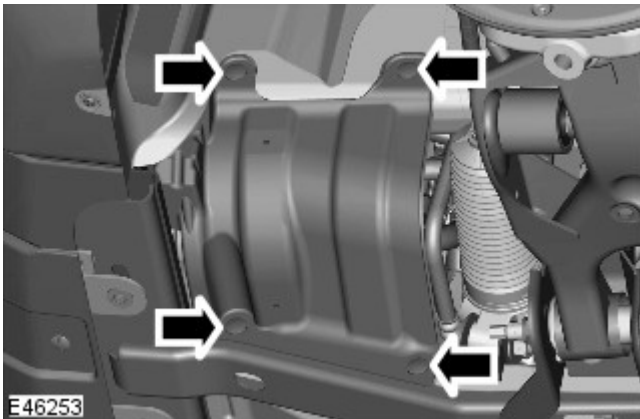
Remove the coolant expansion tank cap.

3. **⚠ WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

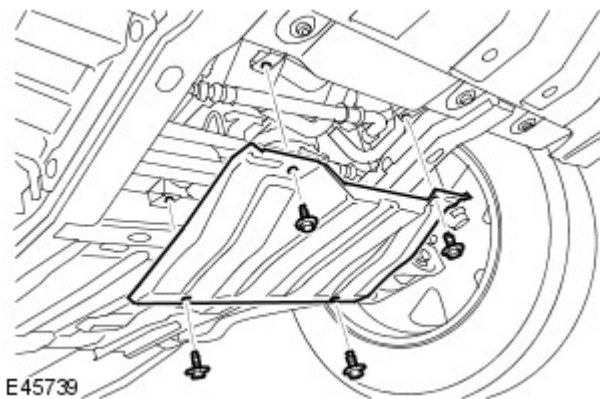
4. Remove the front LH splash shield.

- Remove the 4 clips.

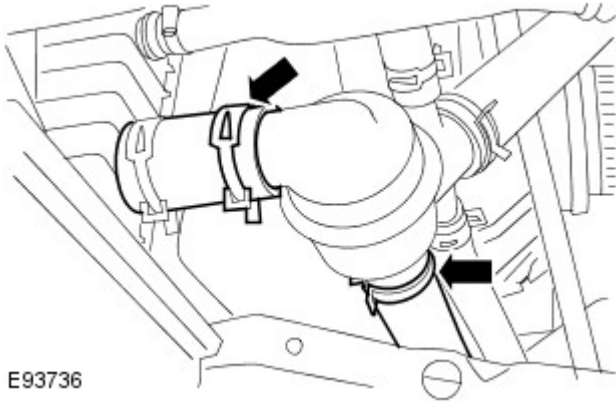


5. Remove the radiator access panel.

- Remove the 4 bolts.



6. Position a container to collect the fluid.



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7. Disconnect the coolant hoses from the thermostat housing.

- Release the 2 clips.
- Allow the coolant to drain.

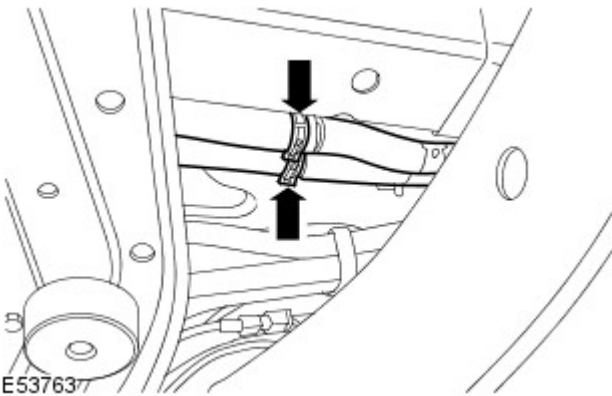
8. Remove the spare wheel and tire.

- Remove the tool kit.
- Access the winch.

9. Position a container to collect the fluid.

10. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.



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11. Connect the rear heater coolant hoses.

- Secure the clips.

12. Install the spare wheel and tire.

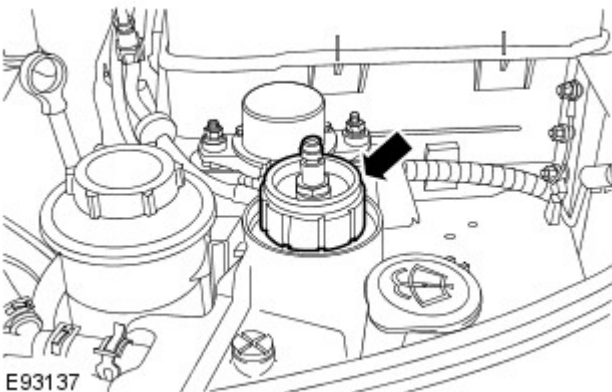
- Install the tool kit.

13. Connect the coolant hoses to the thermostat housing.

- Secure with the clips.

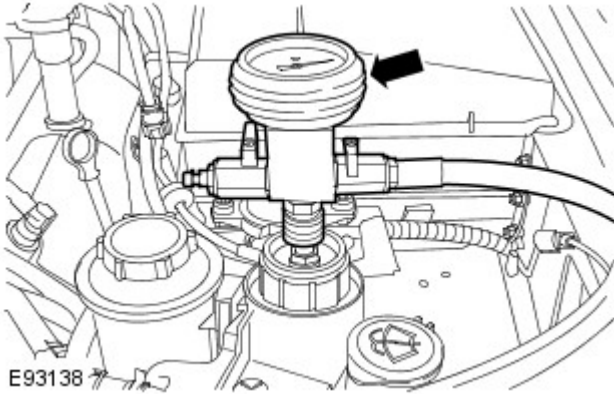
14. Prepare a sufficient amount of coolant to the specified concentration.

15. Install the cooling system vacuum refill adaptor to the expansion tank.

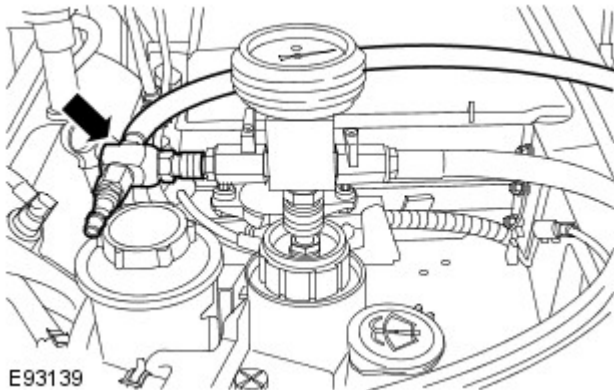


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16. Install the vacuum filler gauge to the cooling system vacuum refill adaptor.



17. Install the venturi tube assembly to the vacuum filler gauge.

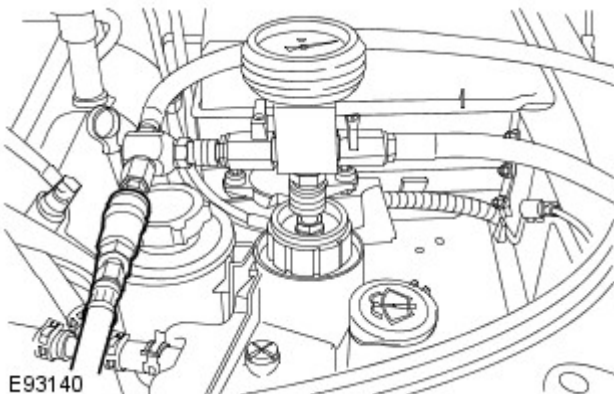


18. NOTE: Make sure both valves on gauge assembly are in the closed position.

- NOTE: Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

- NOTE: The coolant vacuum fill tool needs an air pressure of 6 to 8 bar (87 to 116 psi) to operate correctly.

Connect a regulated compressed air supply to the venturi tube assembly.

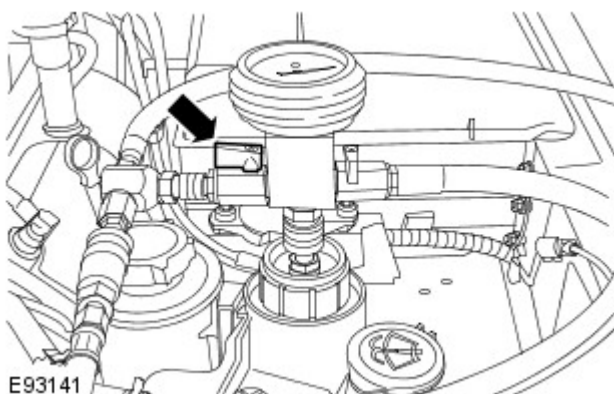


19. NOTE: Make sure air cannot enter the hose.

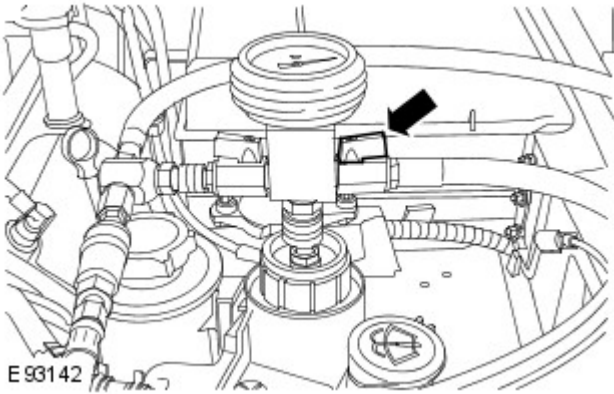
Position the coolant pick-up pipe into a container of clean coolant.

20. Position the evacuated air hose into a container.

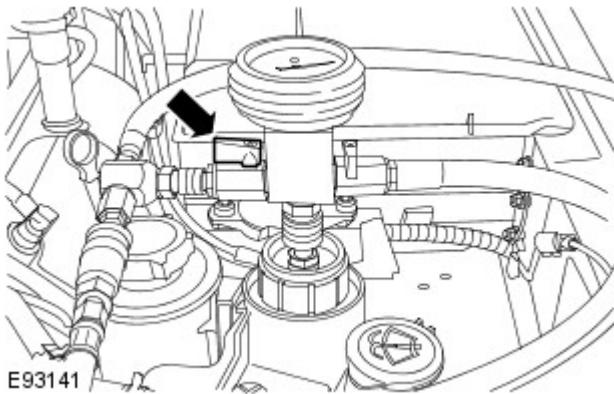
21. Open the air supply valve.



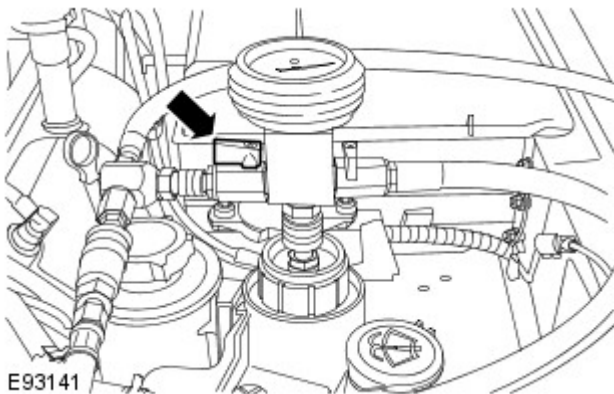
22. Open the coolant supply valve for 2 seconds to prime the coolant supply hose.



23. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.

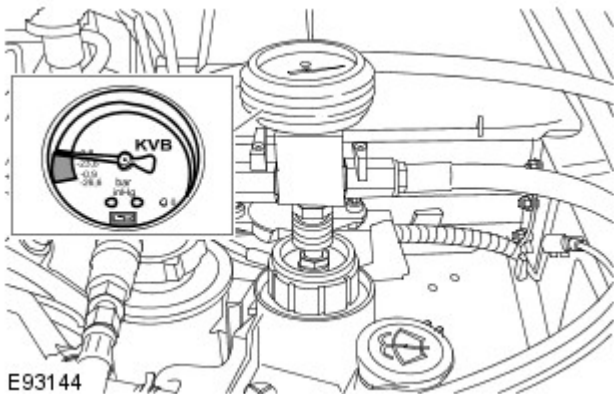


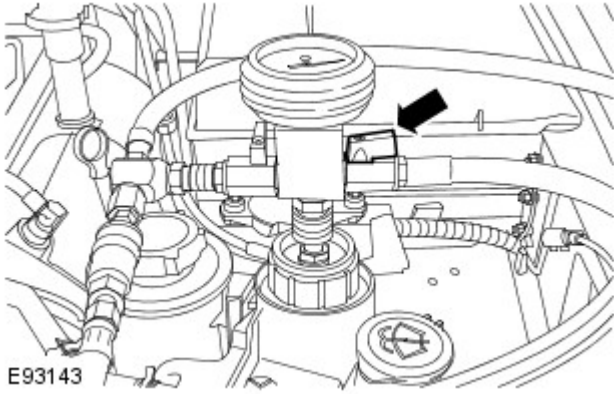
24. Close the air supply valve.



25. Allow one minute to check the vacuum is held.

- Disconnect the compressed air supply.





26. NOTE: Close the coolant supply valve when the coolant expansion tank MAX mark is reached or coolant movement has ceased.

Open the coolant supply valve and allow the coolant to be drawn into the system.

27. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.

28. Connect exhaust extraction hoses to the tail pipes.

29. Start and run the engine.

- Hold the engine speed at 2,500 RPM for 30 seconds.
- Return the engine to idle for 30 seconds.
- Repeat the above procedure a further 4 times.

30. Keep the coolant level in the expansion tank at the maximum level mark until a steady stream of coolant can be seen returning.

31. NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top-up the expansion tank to 30mm above the maximum level.

Install the coolant expansion tank cap.

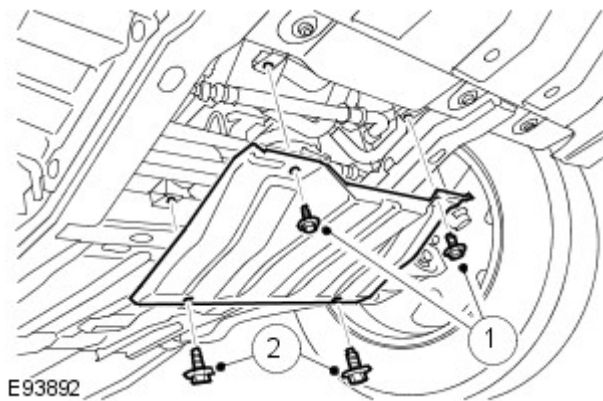
32. Run the engine until the thermostat opens.

33. Switch the engine off and allow to cool.

34. Clean any spilt coolant from the vehicle.

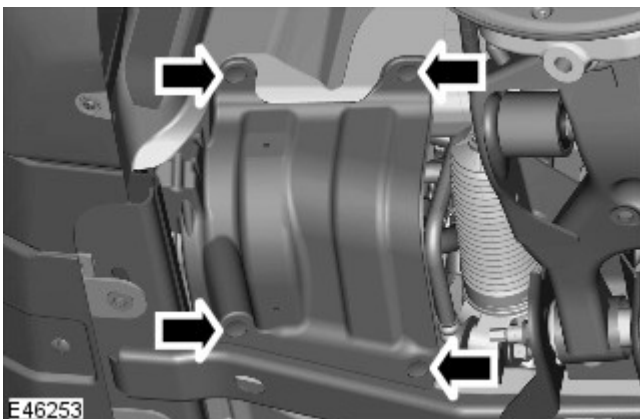
35. Install the radiator access panel.

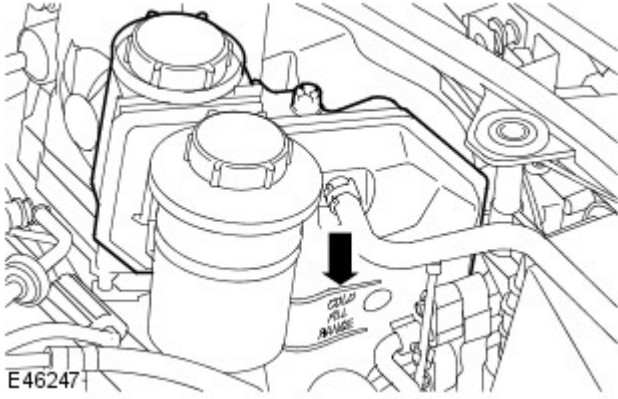
1. Tighten the 2 bolts to 10 Nm (7 lb.ft).
2. Tighten the 2 bolts to 62 Nm (46 lb.ft).




36. Install the front LH splash shield.

- Install the 4 clips.





37.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Check and top-up the coolant if required.


Engine Cooling - V6 4.0L Petrol - Cooling System Pressure Test

General Procedures

• NOTE: The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

• NOTE: It will be necessary to use the cooling system test kit, Part Number LR-218, which is available under the equipment programme.

1. Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Disconnect the coolant expansion tank bleed hose.

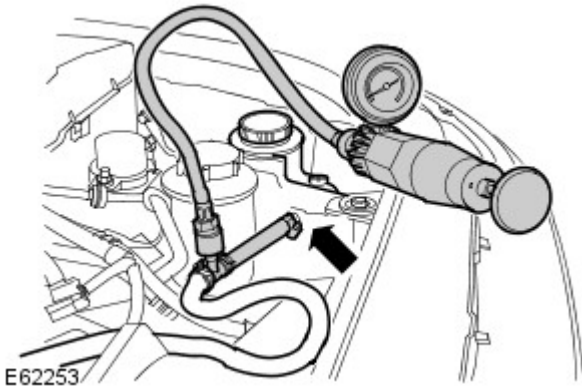
- Release the clip.

3. Install the 'T' piece adaptor (part of the cooling system test kit) between the coolant expansion tank and the coolant bleed hose.

- Secure with the 2 clips.

4. Install the coolant pressure pump assembly.

- Connect to the 'T' piece.




5. Pressurize the cooling system.

- Slowly pressurize the cooling system to 1.0 bar (100 kPa) (14.5 psi).
- Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
- During the pressure drop check, listen for a hissing noise from the expansion tank cap.

6. NOTE: If the coolant expansion tank cap is found to be leaking, replace the cap.

Depressurize the cooling system.

- Disconnect the 'T' piece.
- Connect the coolant expansion tank bleed hose.
- Secure the clip.

7.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Remove the coolant expansion tank cap.

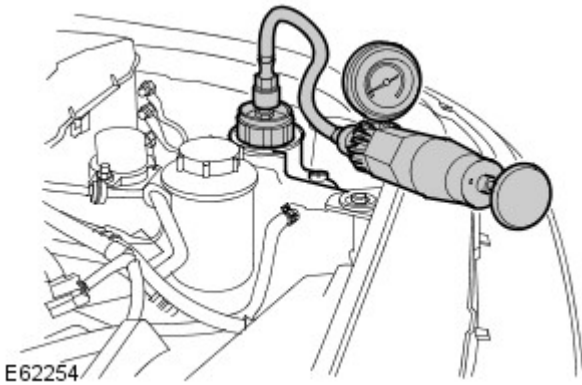
8. NOTE: This adaptor is part of the cooling system test kit.

Install adaptor K83 to the coolant expansion tank.

- Clean the component mating faces.
- Lubricate the seal.

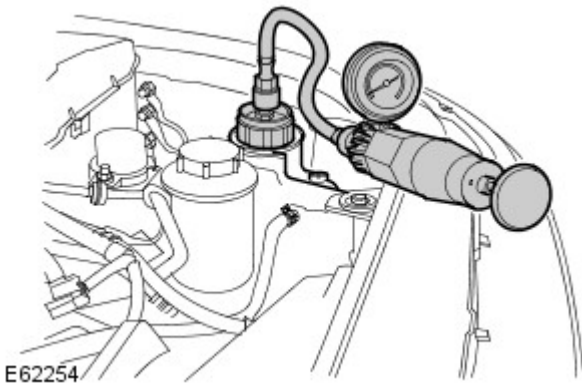
9. Install the coolant pressure pump assembly.

- Slowly pressurize the cooling system to 1.5 bar (150kPa) (22 psi), check the pressure over a 5 minute period. A small pressure decay of approximately 0.15 bar (15 »kPa) (1 psi) over the first minute is normal, as the air in the expansion tank cools.
- If the pressure continues to drop after the initial tolerance, there is a coolant leak.



10. Depressurize and remove the pressure pump and gauge.

- Install the coolant expansion tank cap.

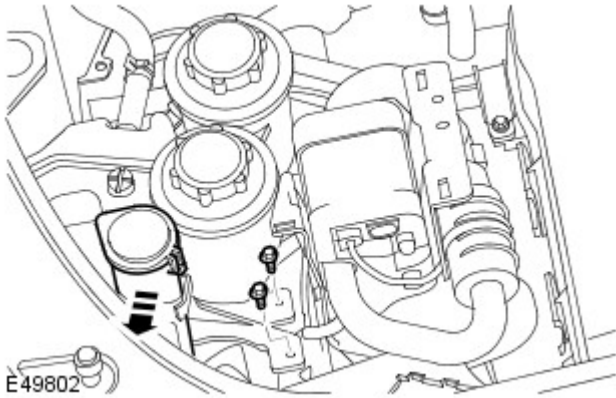


Engine Cooling - V6 4.0L Petrol - Coolant Expansion Tank


Removal and Installation


Removal

1. Remove the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
2. Release the windshield washer reservoir filler neck.
3. Release the coolant expansion tank.
 - Remove the 2 bolts.



4. Release the power steering fluid reservoir.

5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

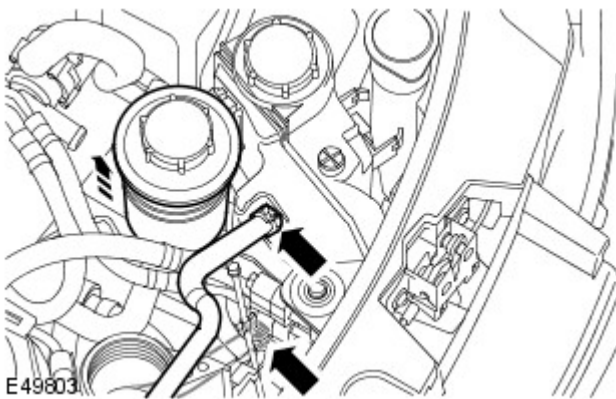
 **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Disconnect the 2 hoses from the coolant expansion tank.

- Position an absorbent cloth to collect fluid spillage.
- Position a container to collect the fluid.
- Clamp the hoses
- Release the 2 clips.

6. Remove the coolant expansion tank.

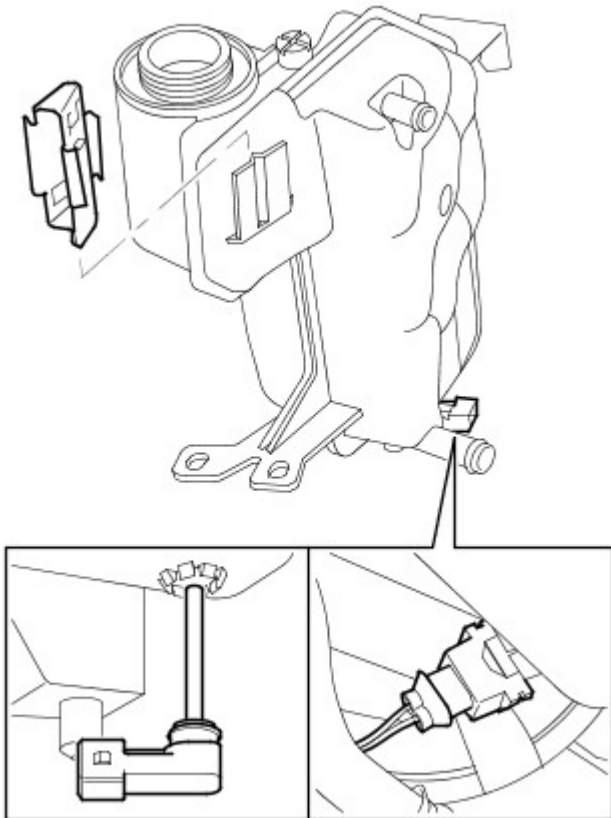
- Disconnect the coolant low level sensor electrical connector.



7. NOTE: Do not disassemble further if the component is removed for access only.

Remove the coolant low level sensor.

- Remove the coolant expansion tank support bracket.



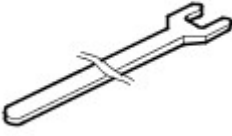
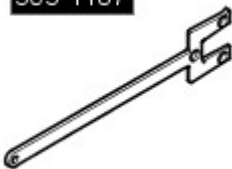
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Installation

1. Install the bracket.
2. Install the coolant low level sensor.
3. Install the coolant expansion tank.
 - Connect the coolant low level sensor electrical connector.
4. Connect the coolant hoses to the expansion tank.
 - Secure with the clips.
5. Top-up the coolant.
 - Loosen the coolant expansion tank bleed screw.
 - Fill the coolant expansion tank until coolant emerges from the cooling system air bleed screw.
 - Remove the hose clamps.
 - Tighten the bleed screw to 8 Nm (6 lb.ft).
6. Secure the coolant expansion tank.
 - Tighten the bolts to 10 Nm (7 lb.ft).
7. Check and top-up the coolant.
 - Install the coolant expansion tank pressure cap.
8. Secure the power steering fluid reservoir.
 - Attach to the mounting bracket.
9. Secure the windshield washer reservoir filler neck.
 - Locate in clip.
10. Install the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly \(417-01 Exterior Lighting, Removal and Installation\)](#).

Engine Cooling - V6 4.0L Petrol - Cooling Fan

Removal and Installation

Special Tool(s)	
 <p>303-1142 E46076</p>	<p>Viscous coupling spanner 303-1142</p>
 <p>303-1167 E46075</p>	<p>Viscous coupling pulley retaining tool 303-1167</p>

Removal

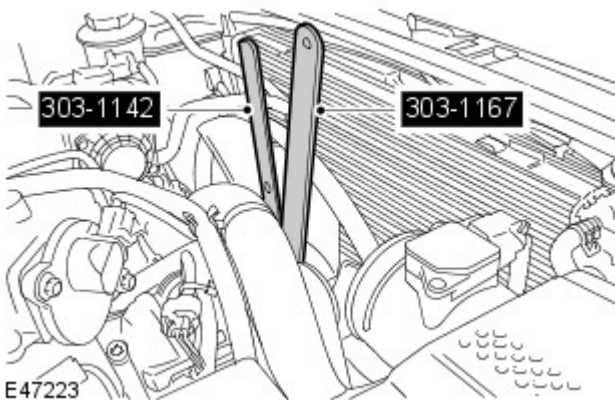
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
3. Disconnect the cooling fan control electrical connector.

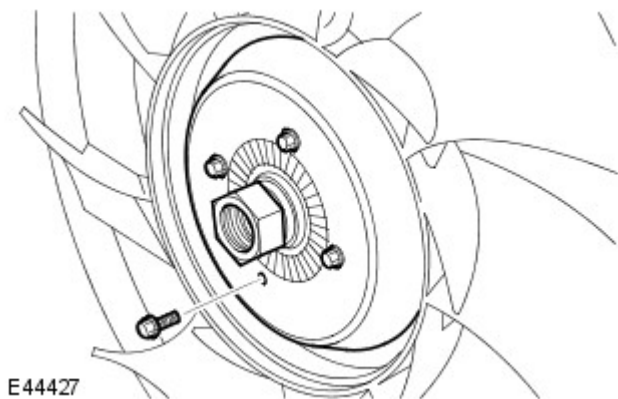


4. **NOTE:** The thread is right handed.

Using the special tools, remove the cooling fan.

- Remove the cooling fan assembly.





5. NOTE: Do not disassemble further if the component is removed for access only.

Remove the viscous coupling from the cooling fan.

- Remove the 4 bolts.

Installation

1. To install, reverse the removal procedure.

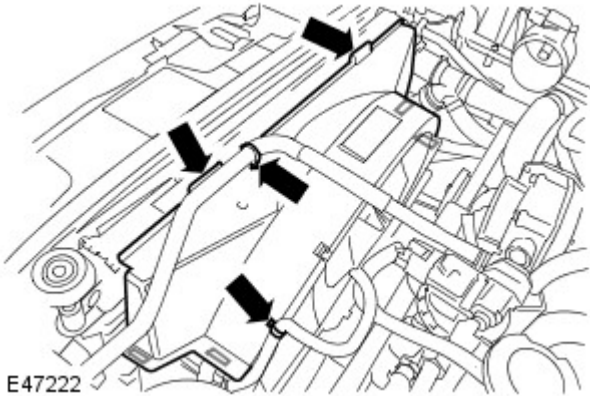
- Install the cooling fan to the viscous coupling, tighten the bolts to 10 Nm (7 lb.ft).
- Tighten the cooling fan assembly to 65 Nm (48 lb.ft).

Engine Cooling - V6 4.0L Petrol - Cooling Fan Shroud

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
3. Remove the upper fan shroud.
 - Release the coolant expansion hose.
 - Release the fan wiring harness clip.
 - Release the 4 fan shroud clips.



E47222

Installation

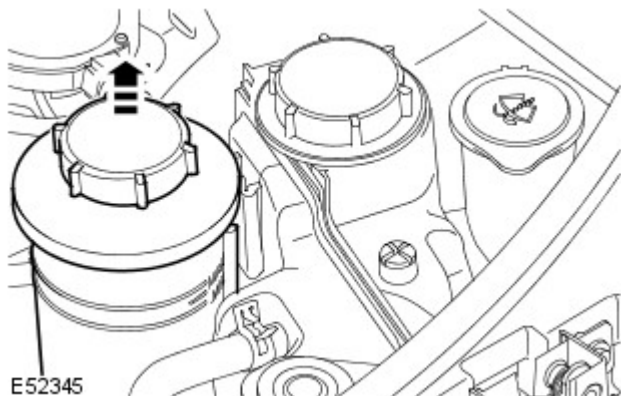
1. To install, reverse the removal procedure.

Engine Cooling - V6 4.0L Petrol - Engine Coolant Level Switch

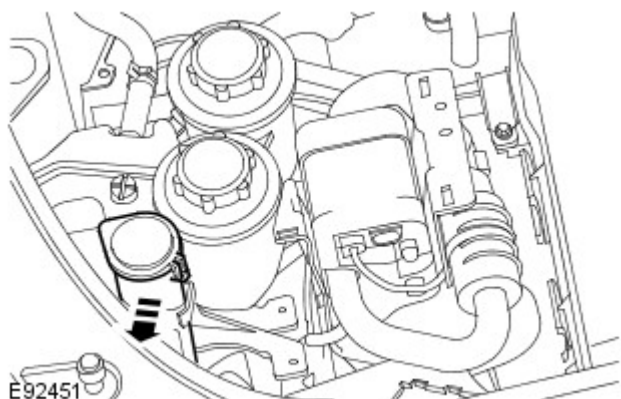
Removal and Installation

Removal

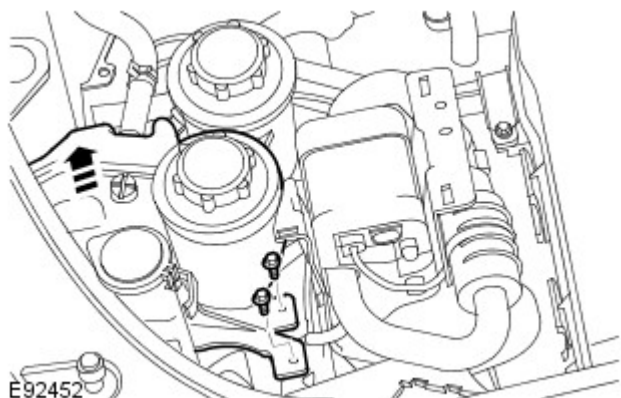
1. Release the power steering fluid reservoir from the bracket.



2. Release the windshield washer reservoir filler neck.



3. Reposition the coolant expansion tank.
 - Remove the 2 bolts.



4. Remove the engine coolant level switch.

Installation

1. NOTE: Disconnect the engine coolant level switch electrical connector. **CAUTION: Make sure the click can be heard when the engine coolant level switch is correctly installed.**

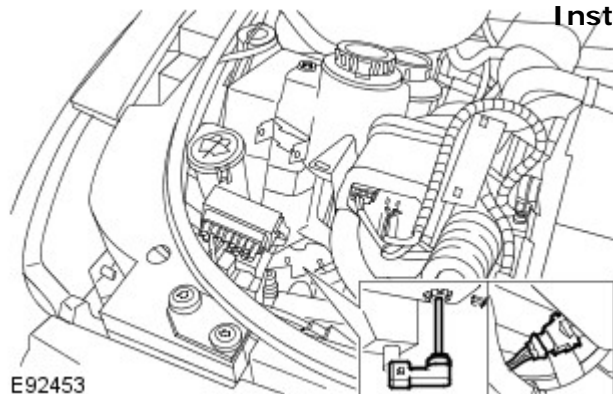
Install the engine coolant level switch.

- Connect the engine coolant level switch electrical connector.

3. Secure the windshield washer reservoir filler neck.
2. **CAUTION: Make sure that the component is correctly located on the locating peg.** Secure the power steering fluid reservoir to the bracket.

Secure the coolant expansion tank.

- Tighten the bolts to 10 Nm (7 lb.ft).



Engine Cooling - V6 4.0L Petrol - Radiator

Removal and Installation

Removal



WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.



CAUTION: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

• **NOTE:** Always protect the cooling pack elements to prevent accidental damage.



1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Disconnect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Drain the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).

4. Remove the viscous fan assembly.

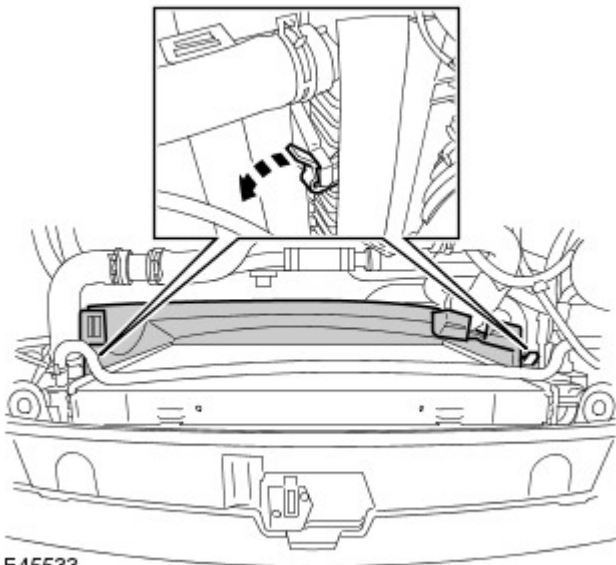
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).

5. Remove the radiator grille.

For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Remove the lower fan shroud.

- Release the 4 clips.
- Release the coolant hose.



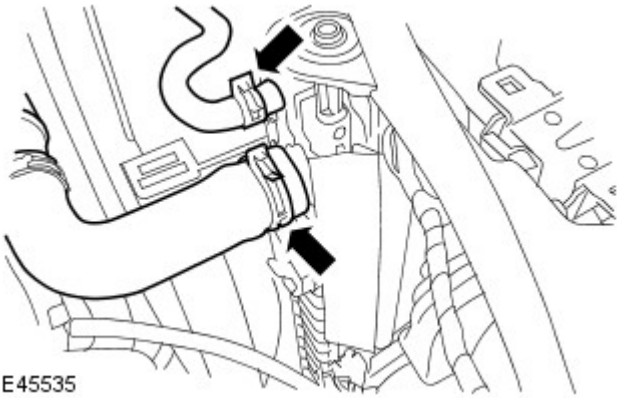
E45533

7. Disconnect the coolant expansion tank hose.

- Release the clip.

8. Disconnect the radiator upper hose.

- Release the clip.



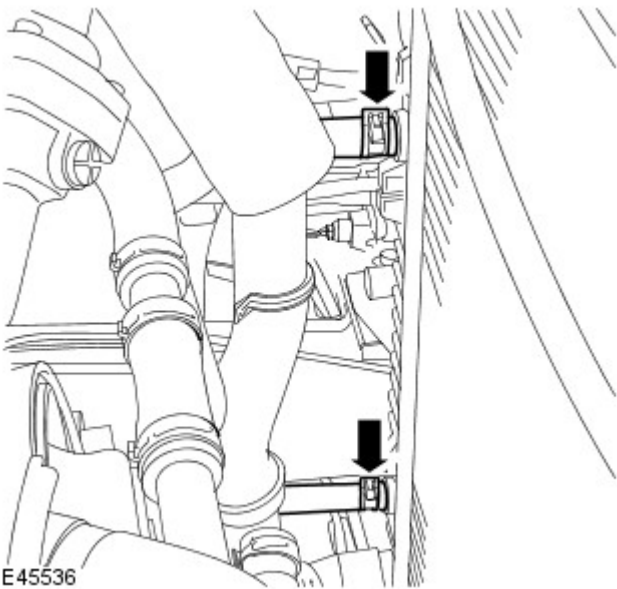
E45535

9.  CAUTION: Always plug any open connections to prevent contamination.

- NOTE: Some fluid spillage is inevitable during this operation.

Disconnect the transmission cooler hoses.

- Release the 2 clips.
- Position a container to collect the fluid.

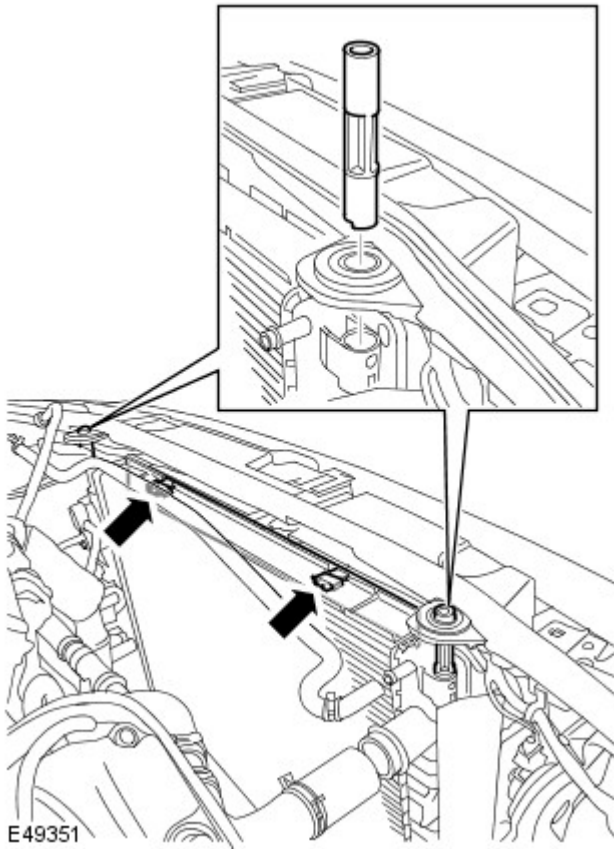


E45536

10. Remove the radiator securing pegs.

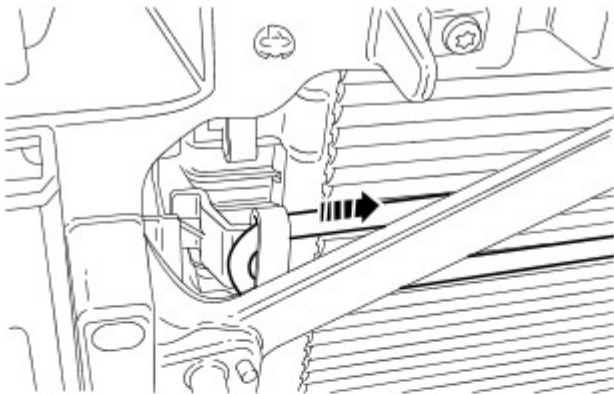
11. Remove the radiator upper deflector.

- Release the 2 clips.

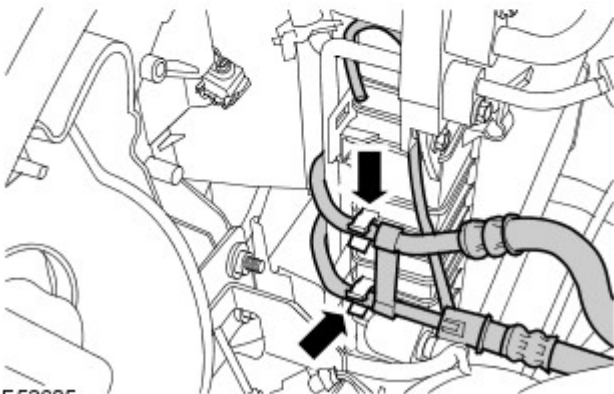


12. Release the power steering fluid cooler.

- Release the clips.
- Tie the line aside.

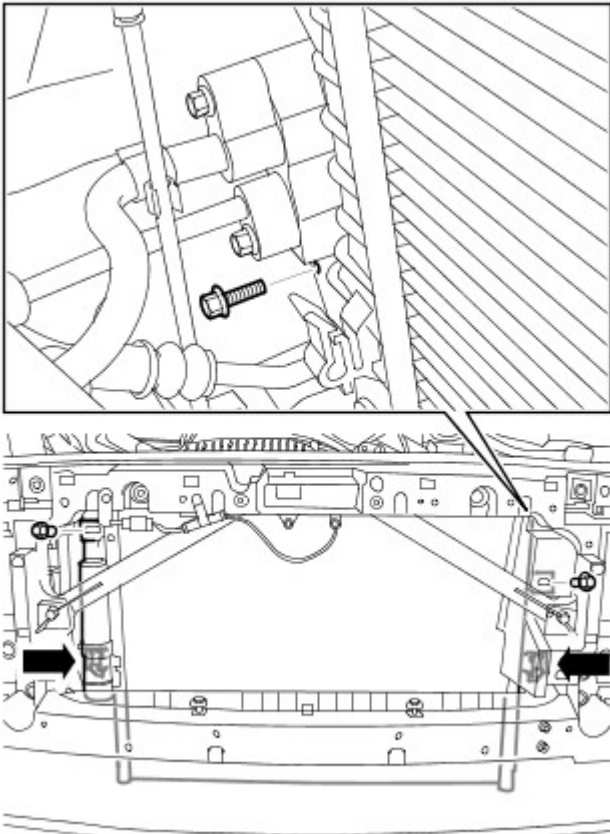


13. Release the front differential breather line.



14. Release the A/C condenser.

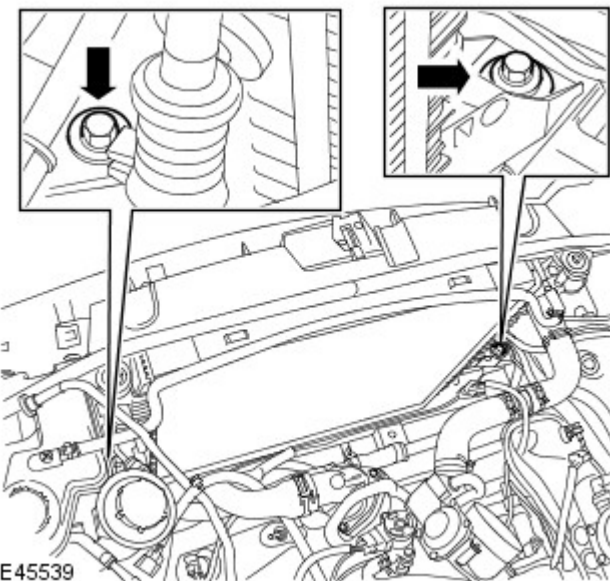
- Remove the 2 screws.
- Remove the bolt.
- Release from the 2 clips.



E49353

15. Remove the radiator.

- Protect the elements from damage.
- Remove the 2 radiator retaining bolts.



E45539

16. NOTE: Do not disassemble further if the component is removed for access only.

Remove the power steering fluid cooler line clip.

Installation

1. Install the power steering fluid cooler line clip.
2. Install the radiator.
 - Remove the element protection.
 - Tighten the bolts to 25 Nm (18 lb.ft).
3. Install the radiator upper deflector.
4. Install the A/C condenser.

- Secure in the clips.
 - Tighten the screws.
 - Tighten the bolt to 6 Nm (4 lb.ft).
5. Install the power steering fluid cooler.
- Secure in the 3 clips.
6. Install the radiator securing pegs.
7. Install the transmission cooler hoses.
- Install the clips.
8. Connect the radiator upper hose.
- Secure with the clip.
9. Connect the expansion tank hose.
- Secure with the clip.
10. Install the lower fan shroud.
- Secure in the clips.
 - Secure the coolant hose.
11. Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
12. Install the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
13. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
14. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
15. Check automatic transmission fluid level.
For additional information, refer to: [Transmission Fluid Level Check](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Engine Cooling - V6 4.0L Petrol - Thermostat

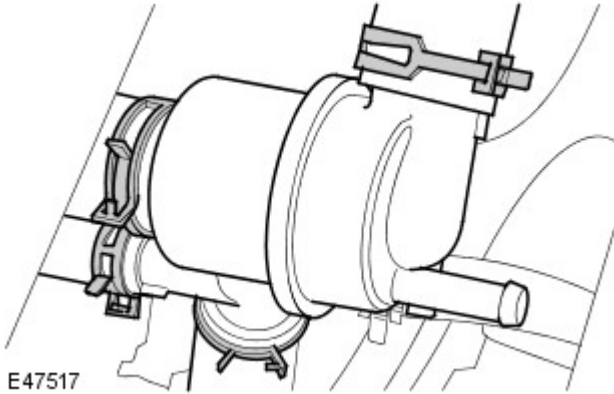
Removal and Installation

Removal

1. Drain the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling - 4.4L, General Procedures).

2. Remove the thermostat.

- Release the clips and disconnect the 4 remaining coolant hoses.



Installation

1. To install, reverse the removal procedure.

2. Refill the cooling system.

For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03 Engine Cooling - 4.4L, General Procedures).

3. **NOTE:** For NAS vehicles only.


If required, carry out a long drive cycle.


For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Engine Cooling - V6 4.0L Petrol - Coolant Pump

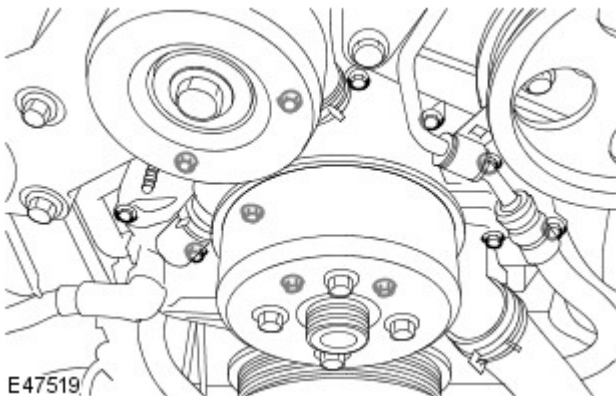
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

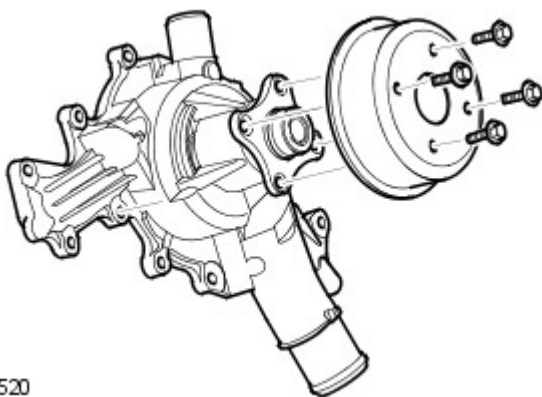
Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
4. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
5. Remove the bolt from the power steering pipe clip.
 - Position the pipe aside when removing the coolant pump.
6. Remove the coolant pump.
 - Disconnect the coolant rail hose from the coolant pump.
 - Remove the 12 bolts.
 - Discard the gasket.



7. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the coolant pump drive pulley.

- Remove and discard the 4 bolts.
- Remove the coolant pump capping hose.



Installation


1. To install, reverse the removal procedure.
 - Tighten the coolant pump retaining bolts.
 - Install the coolant pump pulley.
 - Clean the component mating faces.
3. Tighten the coolant pump pulley retaining bolts.
 - Install a new gasket.


- Tighten to 25 Nm (18 lb.ft).
4. Install the power steering pipe.
 - Tighten the bolt to 10 Nm (7 lb.ft).
 5. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
 6. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
 7. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Cooling - V6 4.0L Petrol - Water Pump

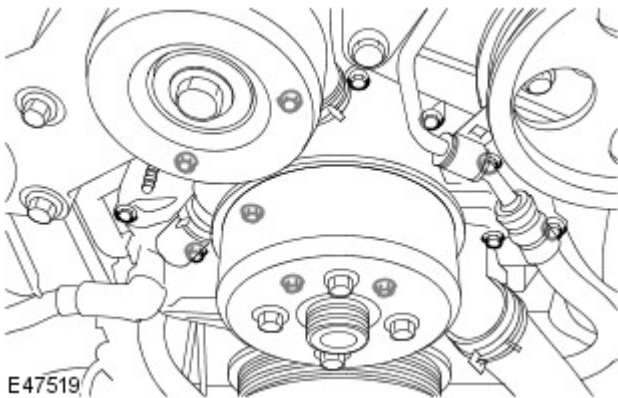
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
4. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
5. Remove the bolt from the power steering pipe clip.
 - Position the pipe aside when removing the coolant pump.
6. Remove the coolant pump.
 - Disconnect the coolant rail hose from the coolant pump.
 - Remove the 12 bolts.
 - Discard the gasket.

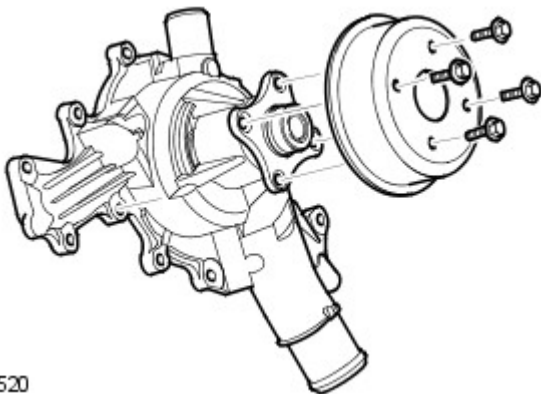


E47519

7. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the coolant pump drive pulley.

- Remove the 4 bolts.
- Remove the coolant pump capping hose.



E47520

Installation

1. To install, reverse the removal procedure.
 - Tighten the coolant pump retaining bolts.
 - Install the coolant pump pulley.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Clean the component mating faces.
3. Tighten the coolant pump pulley retaining bolts.
 - Install a new gasket.

- Tighten the bolts to 25 Nm (18 lb.ft).
4. Install the power steering pipe.
 - Tighten the bolt to 10 Nm (7 lb.ft).
 5. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
 6. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
 7. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Cooling - V8 5.0L Petrol -**Lubricants**

Description	Specification
Anti-freeze	Havoline Extended Life Coolant (XLC)
Anti-freeze concentration	50%

Capacities

Item	Specification
Vehicles fitted with 4 zone air conditioning (A/C)	16.6L (dry capacity)
Vehicles fitted with 2 zone A/C	15.9L (dry capacity)

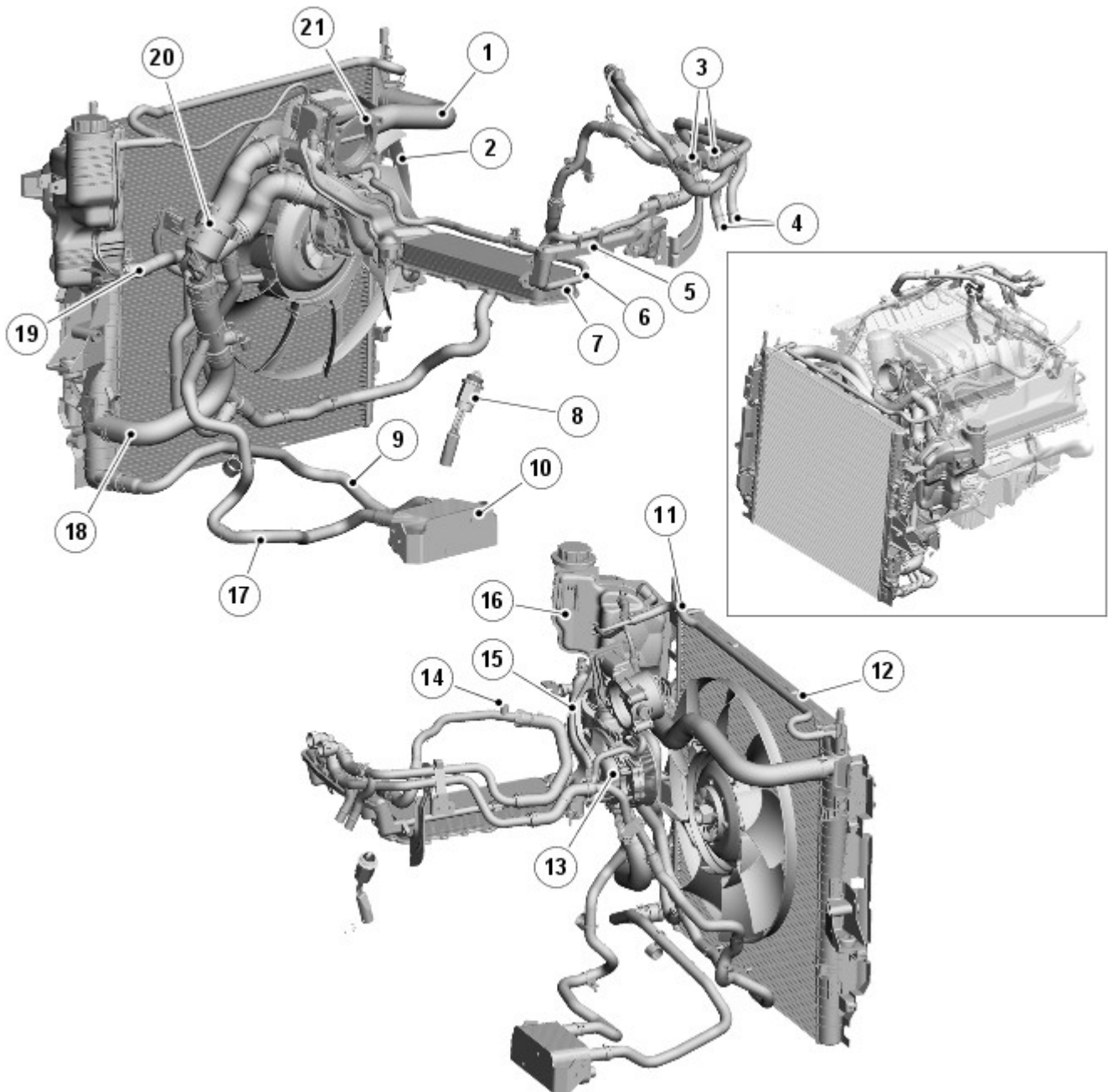
Torque Specifications

Description	Nm	lb-ft	lb-in
Coolant expansion tank retaining bolt	10	7	-
Cooling fan retaining nut	65	48	-
Thermostat housing retaining bolt	10	7	-
Coolant pump retaining bolts	12	9	-
Radiator air deflector retaining bolts	9	-	80
Refrigerant line to condenser core retaining bolts	10	7	-
Radiator retaining bolts	25	18	-
Condenser core to radiator bolts	10	7	-
Coolant bleed screw(s)	3	-	27

Engine Cooling - V8 5.0L Petrol - Engine Cooling

Description and Operation

COMPONENT LOCATION



E121152

Item	Part Number	Description
1	-	Radiator upper hose
2	-	Cooling fan
3	-	Heater system supply and return hoses
4	-	FFBH (fuel fired booster heater) supply and return connections (where fitted)
5	-	Heater manifold
6	-	Throttle body heater hose
7	-	Engine oil cooler
8	-	Engine block heater (230 V version shown) or drain plug
9	-	Transmission fluid cooler supply hose
10	-	Transmission fluid cooler
11	-	Bleed hoses
12	-	Radiator
13	-	Coolant pump
14	-	Bleed screw
15	-	Outlet tube
16	-	Coolant expansion tank
17	-	Transmission fluid cooler return hose

18	-	Radiator lower hose
19	-	Coolant supply/expansion hose
20	-	Thermostat
21	-	Throttle

INTRODUCTION

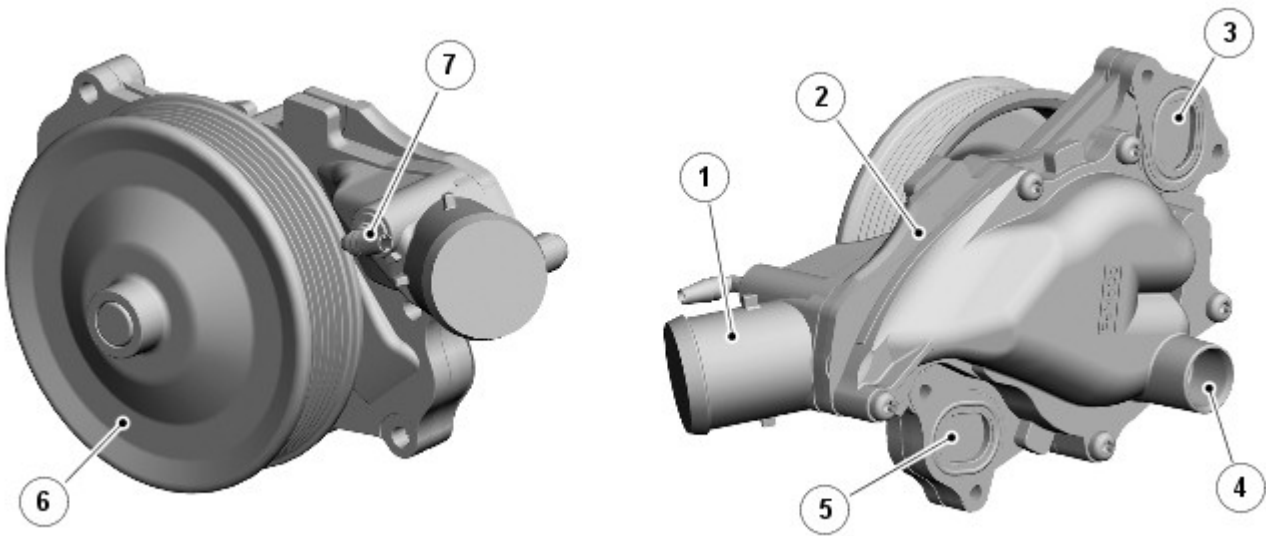
The engine cooling system maintains the engine within an optimum temperature range under changing ambient and engine operating conditions. The system is a pressurized expansion tank system with continuous bleeds to separate air from the coolant and prevent the formation of air locks. The engine cooling system also provides:

- Heating for:
 - The passenger compartment.
 - The throttle body.
- Cooling for:
 - The engine oil cooler.
 - The transmission fluid cooler.

The primary components of the engine cooling system are the:

- Coolant pump.
- Thermostat.
- Radiator.
- Cooling fan.
- Expansion tank.
- Outlet tube and heater manifold.
- Connecting hoses and pipes.

COOLANT PUMP



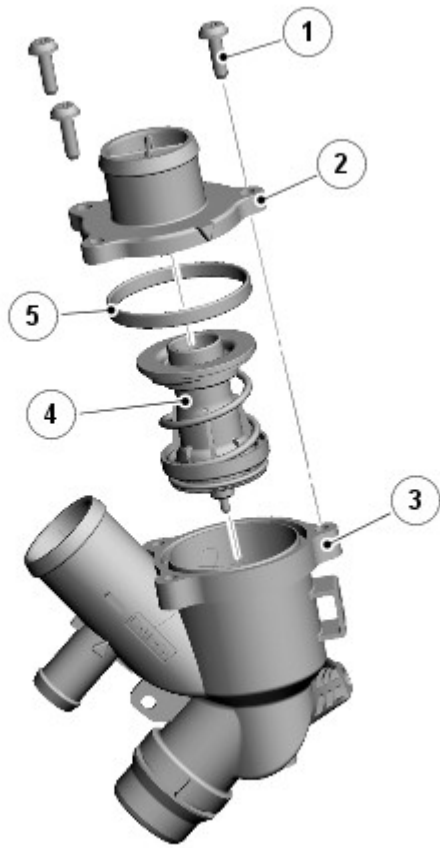
E115013

Item	Part Number	Description
1	-	Inlet connection
2	-	Pump body
3	-	Outlet flange to RH cylinder head
4	-	Outlet to engine oil cooler
5	-	Outlet flange to LH cylinder head
6	-	Pulley
7	-	Bleed pipe connection (containing check valve)

The body of the coolant pump contains an impeller attached to a shaft supported in a bearing assembly. The impeller is driven by a pulley, pressed on to the front of the shaft, which is driven by the accessory drive belt. For additional information, refer to: [Accessory Drive](#) (303-05D Accessory Drive - V8 5.0L Petrol, Description and Operation).

Two coolant outlet flanges attach the coolant pump to the front of the cylinder heads. A pipe connects a further coolant outlet to a pipe from the engine oil cooler. A bleed connector is installed in the front of the coolant pump, adjacent to the coolant inlet connection from the thermostat. A check valve is incorporated into the bleed connection.

THERMOSTAT



E115014

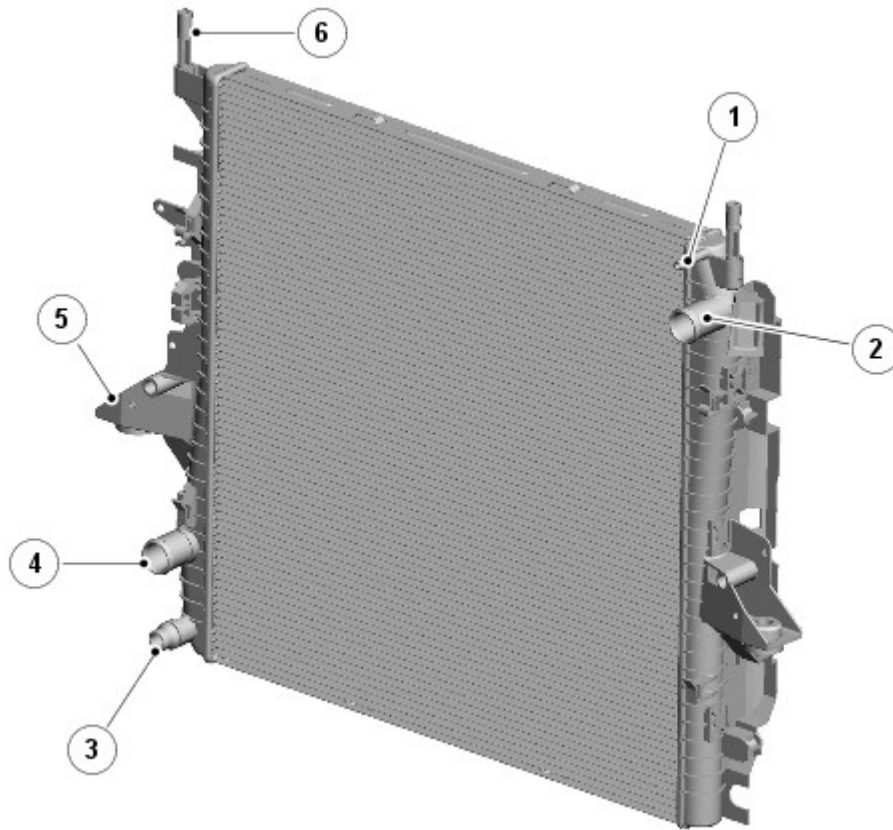
Item	Part Number	Description
1	-	Screw (3 off)
2	-	Lower body
3	-	Upper body
4	-	Thermostat
5	-	Seal

The thermostat is a multi-stage device located in the coolant pump inlet to provide fast response and control of the engine outlet temperature.

The thermostat allows rapid engine warm-up by preventing coolant flow through the radiator and by limiting coolant flow through the cylinder block when the engine is cold. During warm-up and at engine speeds above approximately 1800 rev/min, a by-pass valve opens to control the coolant flow and pressure, to protect the engine components. When the thermostat opening reaches 6 mm (0.24 in.), the by-pass flow is shut-off. When the thermostat opening exceeds 6 mm (0.24 in.), the radiator coolant flow is further controlled up to the point where the thermostat is fully open. At this point maximum radiator coolant flow is achieved to provide maximum cooling.

The thermostat begins to open at 88 - 90 °C (190 - 194 °F) and is fully open at 102 °C (216 °F).

RADIATOR



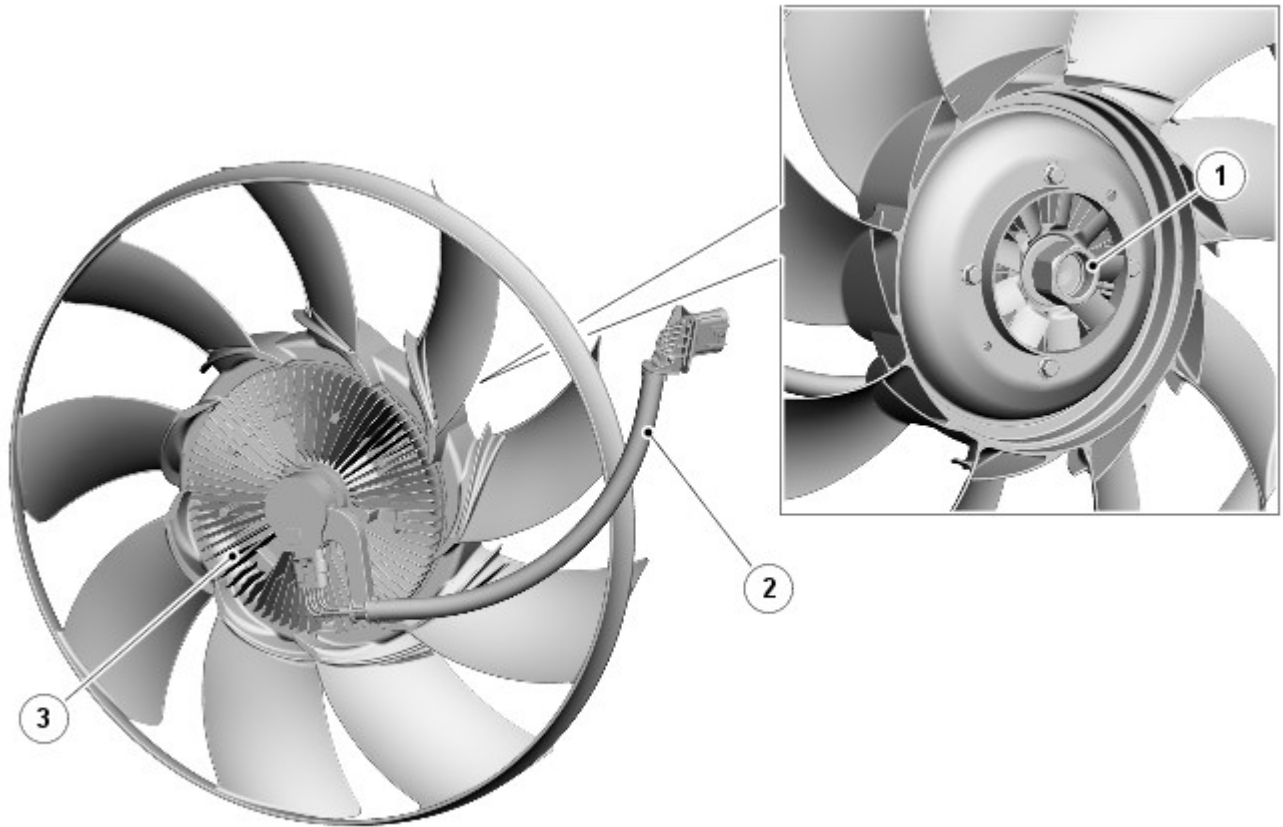
E121154

Item	Part Number	Description
1	-	Bleed hose connection
2	-	Upper hose connection
3	-	Transmission fluid cooler supply hose connection
4	-	Lower hose connection
5	-	Radiator lower support (2 off)
6	-	Radiator upper support (2 off)

The radiator is an aluminum cross flow type with plastic end tanks. Upper and lower supports locate the radiator in the radiator support assembly and the front crush siderails respectively.

Connections are incorporated into the end tanks for the upper and lower hoses, the supply hose of the transmission fluid cooler and a bleed hose.

COOLING FAN



E118879

Item	Part Number	Description
1	-	Securing nut
2	-	Harness
3	-	Electro-viscous drive unit

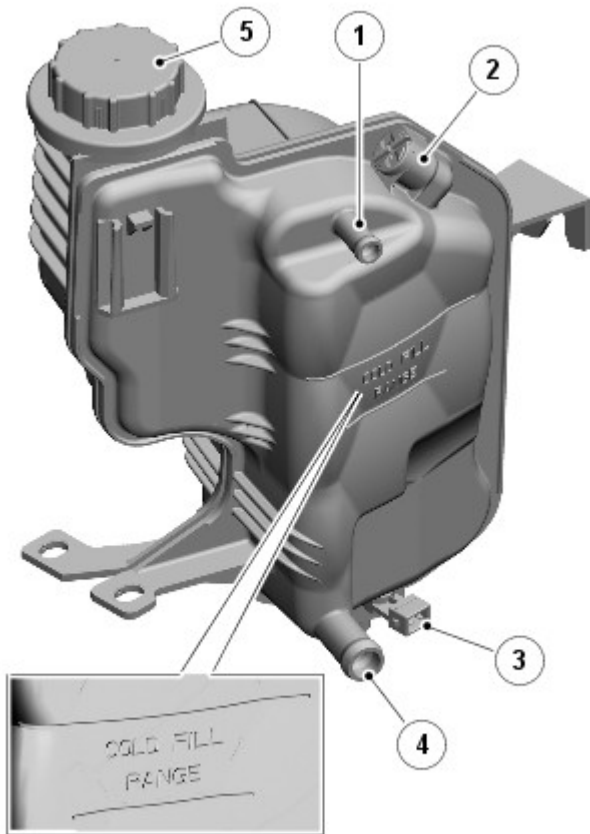
For additional airflow through the radiator, particularly when the vehicle is stationary or moving slowly, there is an engine driven electro-viscous cooling fan. The cooling fan functions as a normal viscous fan, but with electronic control over the level of engagement of the viscous clutch. The [ECM \(engine control module\)](#) controls the level of engagement to optimize fan speed for all operating conditions.

A securing nut attaches the cooling fan to a drive pulley, which is mounted on the front of the engine and driven by the accessory drive system.

- **NOTE:** The securing nut has a LH (left-hand) thread.

The blades of the cooling fan are located in a fan cowl attached to the rear of the radiator frame. Brushes around the circumference of the aperture in the fan cowl provide a seal with the blade shroud. An electrical connector in the top left corner of the fan cowl provides the interface between the cooling fan harness and the vehicle wiring.

EXPANSION TANK



E121155

Item	Part Number	Description
1	-	Bleed hose connection
2	-	Bleed screw
3	-	Level sensor
4	-	Coolant supply/expansion hose connection
5	-	Filler cap

The expansion tank is installed on the **LH** side of the cooling module, attached to the radiator support assembly and the floor sidemember. A filler cap, bleed screw and level sensor are incorporated into the expansion tank. MAX and MIN level markings are molded onto the exterior of the tank.

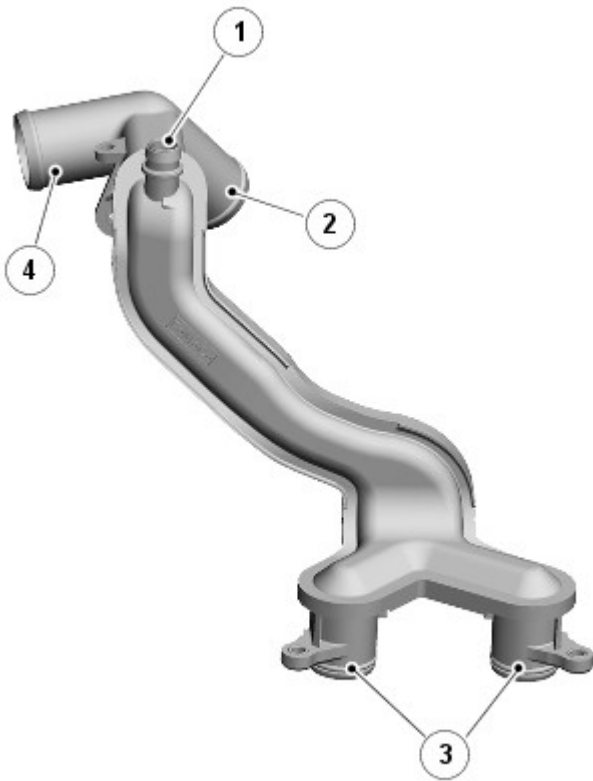
The expansion tank provides the following functions:

- Service fill.
- Coolant expansion during warm-up.
- Air separation during operation.
- System pressurization by the filler cap.

The expansion tank has an air space of approximately 1.1 liters (1.16 US quarts), above the MAX level, to allow for coolant expansion.

OUTLET TUBE AND HEATER MANIFOLD

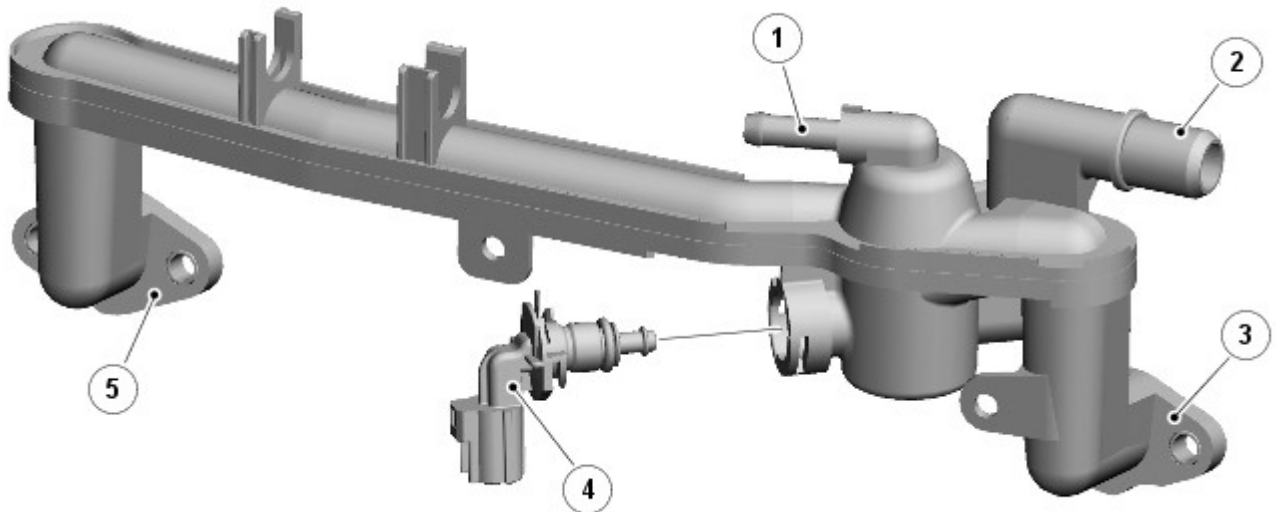
Outlet Tube



E123842

Item	Part Number	Description
1	-	Bleed spigot (fitted with blanking plug)
2	-	Radiator upper hose connection
3	-	Cylinder block connections
4	-	Thermostat hose connection

Heater Manifold



E115021

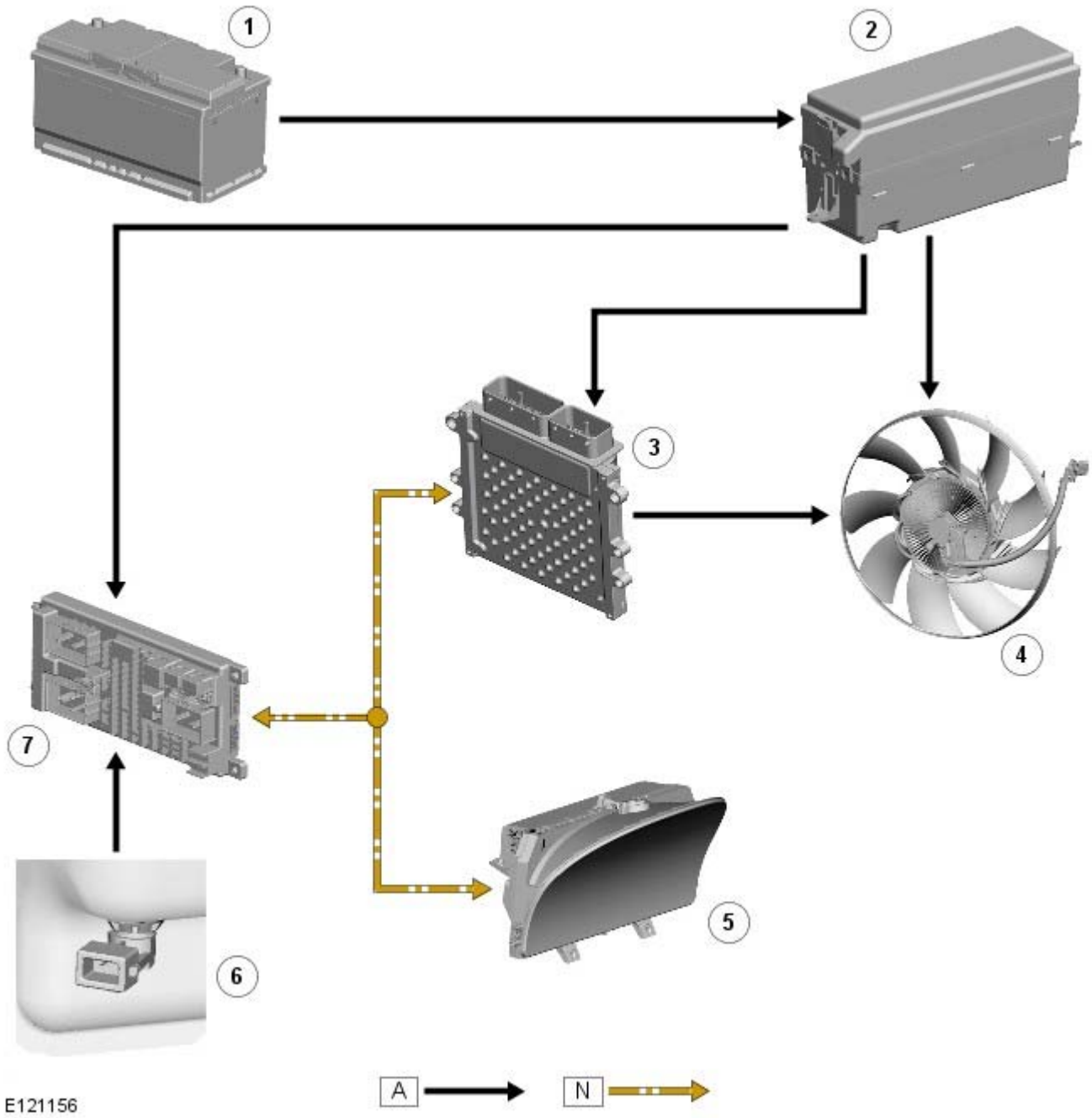
Item	Part Number	Description
1	-	Throttle body heater hose connection
2	-	Heater core supply hose connection
3	-	RH cylinder head connection
4	-	Engine coolant temperature sensor
5	-	LH cylinder head connection

ENGINE COOLANT

The engine coolant is formulated to last for ten years or 240,000 km (150,000 miles). The coolant is silicate free and must not be mixed with conventional engine coolant.

CONTROL DIAGRAM

• NOTE: A = Hardwired; N = Medium speed CAN (controller area network).

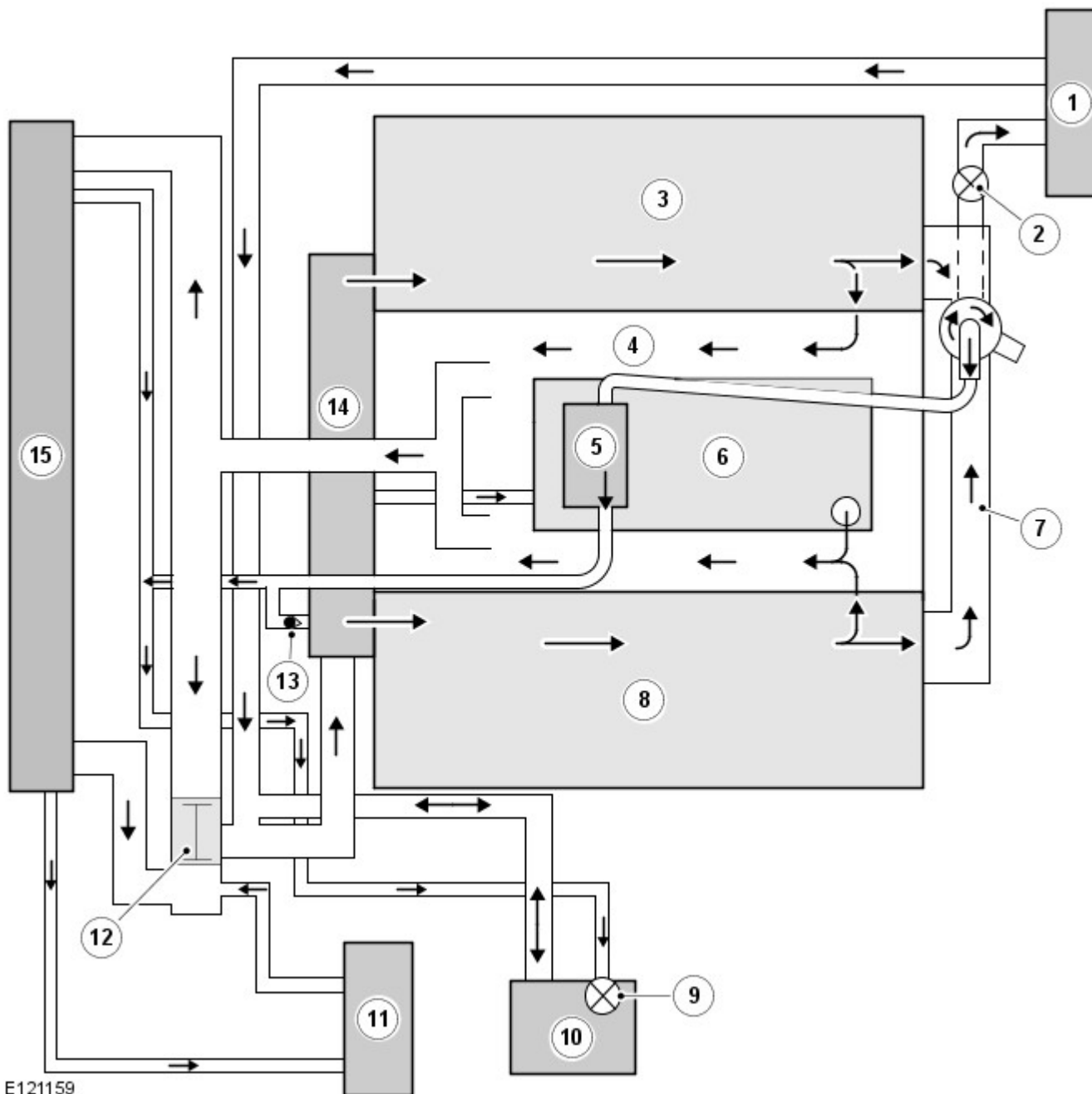


E121156

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	ECM (engine control module)
4	-	Cooling fan
5	-	Instrument cluster
6	-	Coolant level sensor
7	-	CJB (central junction box)

OPERATION

Engine Cooling Flow Diagram



E121159

Item	Part Number	Description
1	-	Heater system
2	-	Bleed screw
3	-	RH cylinder head
4	-	Cylinder block
5	-	Throttle
6	-	Engine oil cooler
7	-	Heater manifold
8	-	LH cylinder head
9	-	Bleed screw
10	-	Expansion tank
11	-	Transmission fluid cooler
12	-	Thermostat
13	-	Check valve
14	-	Coolant pump
15	-	Radiator

When the engine is running, the coolant is circulated around the engine cooling system by the coolant pump. From the coolant pump, coolant flows through the cylinder heads and the engine oil cooler into the cylinder block and the heater manifold.

In the cylinder block, the coolant flows forwards to the outlet tube. When the coolant is cold, the thermostat is closed and the coolant flows direct from the outlet tube back to the coolant pump. Once the coolant reaches operating temperature the thermostat begins to open, to control system temperature, and coolant flows from the outlet tube to the coolant pump via the radiator. When the thermostat is open, the coolant flow through the radiator also generates a coolant flow through the transmission fluid cooler.

From the heater manifold the coolant flows through the electronic throttle and the heater core, in parallel circuits that are unaffected by the position of the thermostat. From the electronic throttle, the coolant merges with bleed coolant from the coolant pump and flows to the expansion tank. From the heater system, the coolant flows back to the inlet of the coolant pump.

Expansion and contraction of the coolant is accommodated by an air space in the expansion tank and the compliance of the flexible hoses.

If the coolant level in the expansion tank decreases below a predetermined value, the coolant level sensor connects a ground to the [CJB \(central junction box\)](#), which sends a message to the instrument cluster on the medium speed [CAN](#) bus to display the message COOLANT LEVEL LOW in the message center.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

To control the cooling fan, the [ECM](#) sends a [PWM \(pulse width modulation\)](#) signal to the cooling fan drive unit. The [ECM](#) varies the duty cycle of the [PWM](#) signal between 0 and 100% to vary the clutch engagement and thus fan speed. The [ECM](#) determines the required fan speed from:

- Coolant, ambient air and transmission fluid temperatures
- [A/C \(air conditioning\)](#) system condenser cooling fan demand
- Road speed
- Terrain optimization mode.

If the electrical connections to the viscous fan are disconnected the fan will idle and the engine may overheat. If the [ECM](#) detects a cooling fan fault it stores the appropriate [DTC \(diagnostic trouble code\)](#) and signals the instrument cluster on the medium speed [CAN](#) bus to display the message COOLING SYSTEM FAULT MONITOR GAUGE in the message center.

Engine Cooling - V8 5.0L Petrol - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Cooling](#) (303-03D Engine Cooling - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Coolant leaks ● Coolant Hoses ● Coolant expansion tank ● Radiator ● Heater core ● Accessory drive belt ● Viscous fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Loose or corroded connector(s) ● Engine Coolant Temperature (ECT) sensor

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Coolant loss	<ul style="list-style-type: none"> ● Hoses ● Hose connections ● Radiator ● Water pump ● Heater core ● Gaskets ● Engine casting cracks ● Engine block core plugs 	Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary.
Overheating	<ul style="list-style-type: none"> ● Low/Contaminated coolant ● Thermostat ● Viscous fan ● ECT sensor ● Restricted air flow over the radiator 	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	<ul style="list-style-type: none"> ● Thermostat ● Viscous fan ● Thermostat ● Electric fan ● Fan speed module 	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - V8 5.0L Petrol, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Engine Cooling - V8 5.0L Petrol - Cooling System Draining and Vacuum Filling

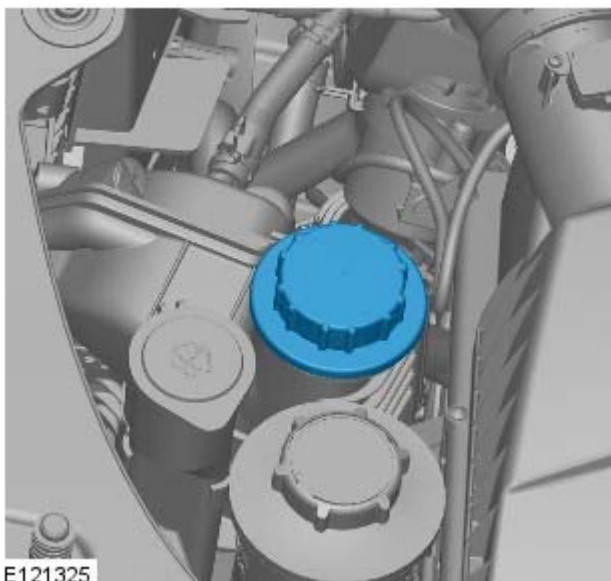
General Procedures


Draining

1. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).


2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

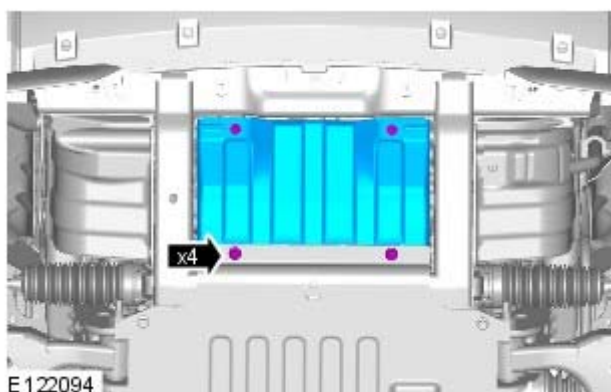


3.  **WARNING:** Release the cooling system pressure by slowly turning the coolant expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

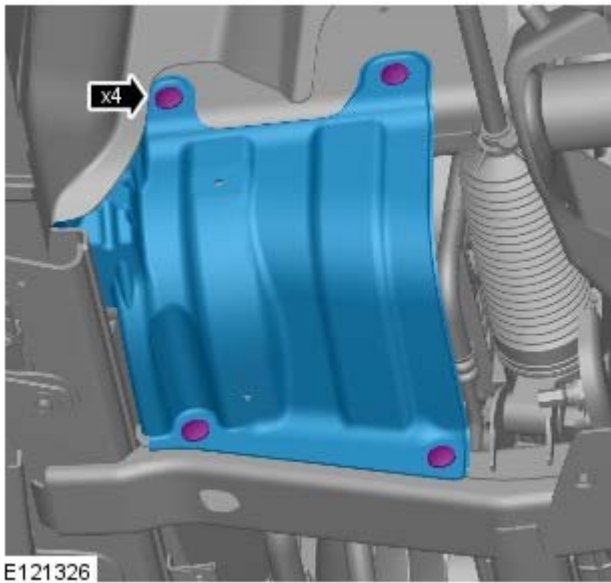
• CAUTIONS:

 Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

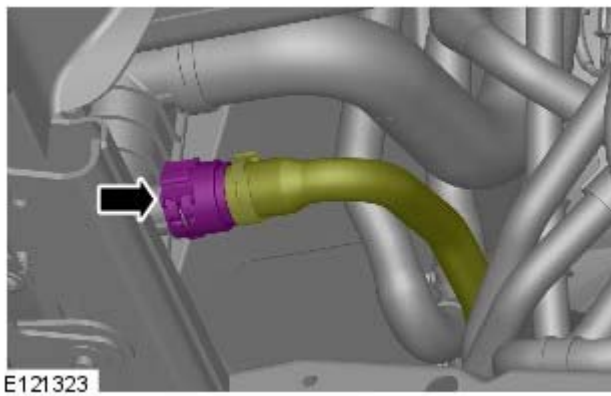
 Be prepared to collect escaping coolant.




4. Remove the 4 bolts.

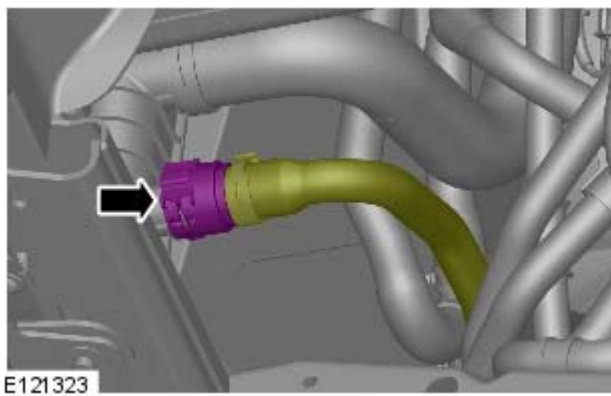


5.

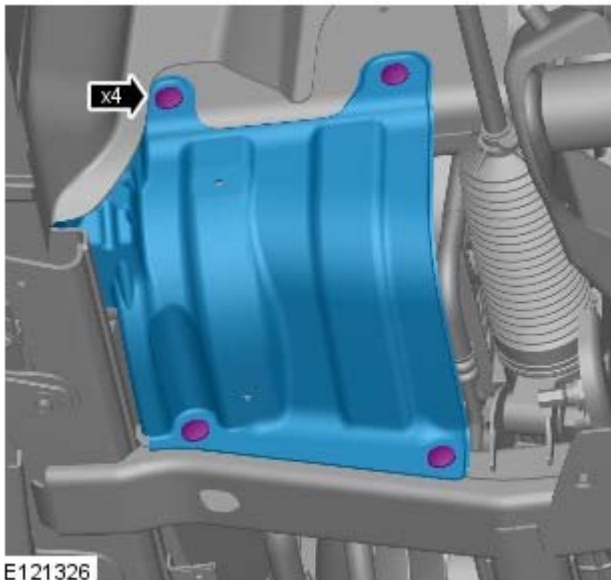


6.  CAUTION: Be prepared to collect escaping coolant.

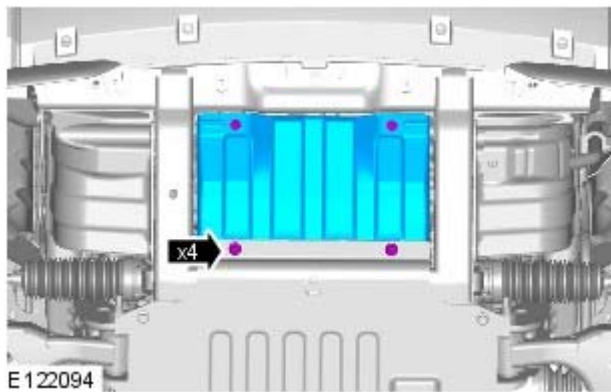
Position a container to collect the fluid.



7. Install the lower coolant hose to the radiator.




8. Install the LH splash shield.



9. Torque: 10 Nm

Filling

1. Lower the vehicle.
2. **11.**  **CAUTION:** Anti-freeze concentration must be maintained at 50%.
 - Install the cooling system vacuum refill adaptor to the expansion tank.
 - Install the vacuum filler gauge to the cooling system vacuum refill adaptor.
 - Install the venturi tube assembly to the vacuum filler gauge.
3. **12.** **NOTE:** Make sure the coolant supply valve is in the closed position on the vacuum filler gauge assembly.
 - **NOTE:** The coolant vacuum fill tool needs an air pressure of 6 to 8 bar (87 to 116 psi) to operate correctly.
 - **NOTE:** Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.Connect a regulated compressed air supply to the venturi tube assembly.
4. Position the evacuated air hose into a container.
5. Open the air supply valve.

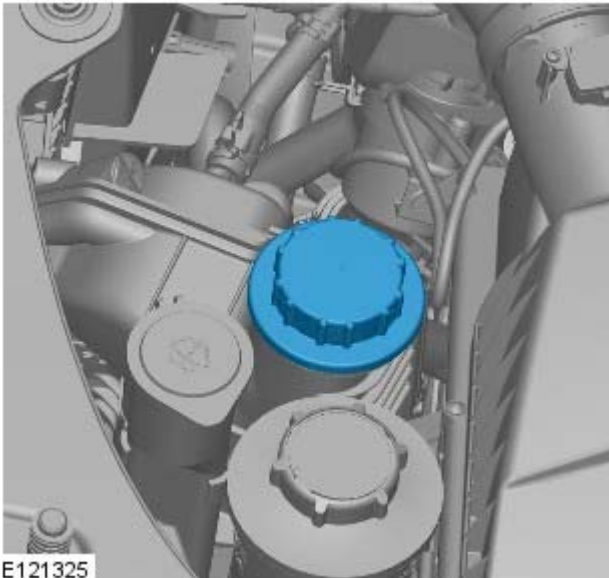
6. **15.** NOTE: Make sure the coolant supply hose is positioned into a container of fifty percent mixture of Jaguar Premium Cooling System Fluid or equivalent, meeting Jaguar specification WSS M97B44-D and fifty percent water. Make sure no air can enter the coolant supply hose.


Open the coolant supply valve for 2 seconds to prime the coolant supply hose.

7. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.
8. Disconnect the compressed air supply line.
9. **18.** NOTE: Close the coolant supply valve when the coolant expansion tank MAX mark is reached or coolant movement has ceased.


Open the coolant supply valve and allow the coolant to be drawn into the system.

10. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.



11. **20.**  CAUTION: Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.


12. Set the heater controls to maximum.

13. **22.**  CAUTION: Observe the engine temperature gauge. If the engine starts to over-heat switch off immediately and allow to cool. Failure to follow this instruction may cause damage to the vehicle

Start the engine and idle until hot air is emitted at the face registers.

14. Switch the heater off.

15. Raise the engine speed to 2000 RPM for eight minutes.

16. **25.**  CAUTION: Switch off the engine and allow the coolant temperature to go cold.

Switch the engine off.

17. Visually check the engine and cooling system for signs of coolant leakage.

18. **27.**  **WARNING:** When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

• **CAUTIONS:**



Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure



Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

• **NOTE:** When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

Check and top-up the coolant if required.

Engine Cooling - V8 5.0L Petrol - Cooling System Draining, Filling and Bleeding

General Procedures

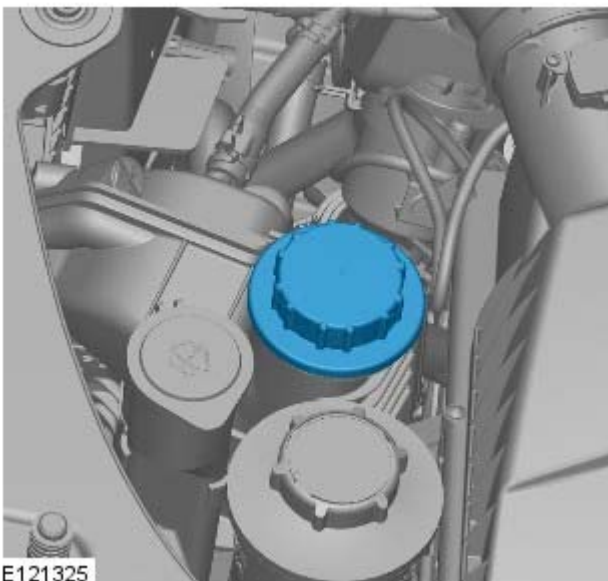
Draining


1. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

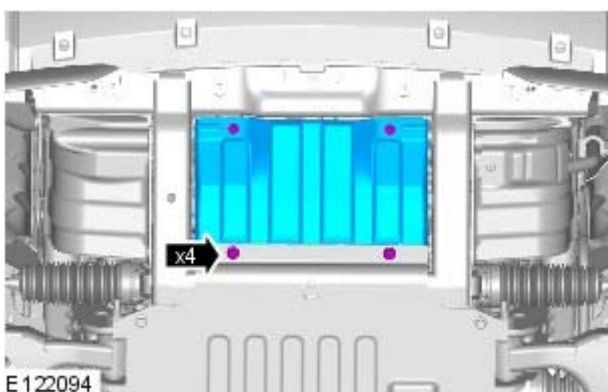
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

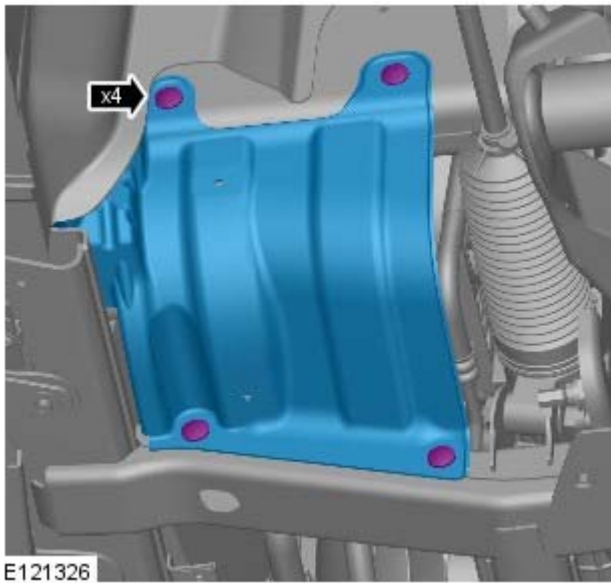
3. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



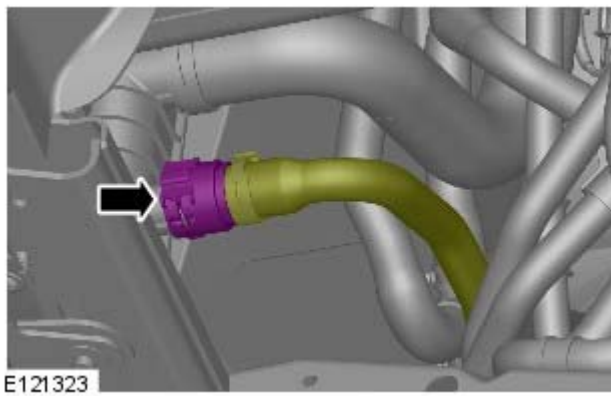
4.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.



5. Remove the 4 bolts.

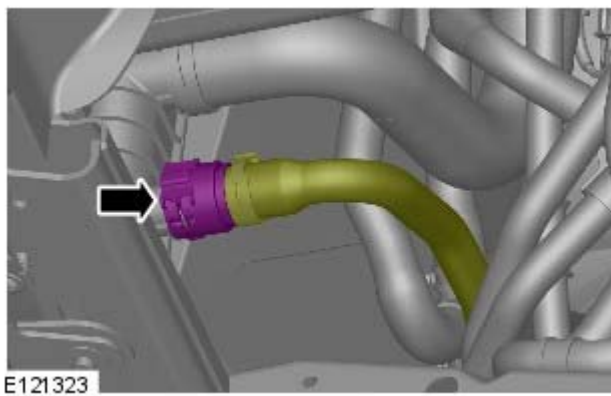


6.

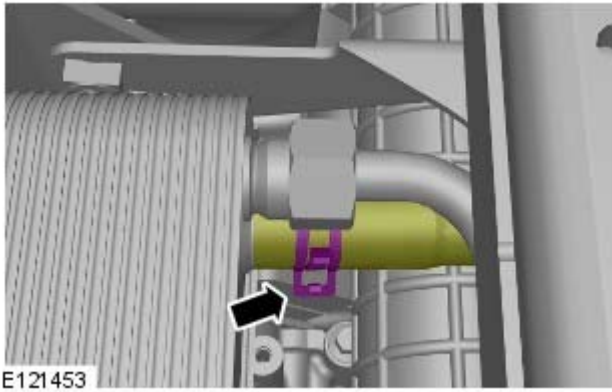


7.  CAUTION: Be prepared to collect escaping coolant.

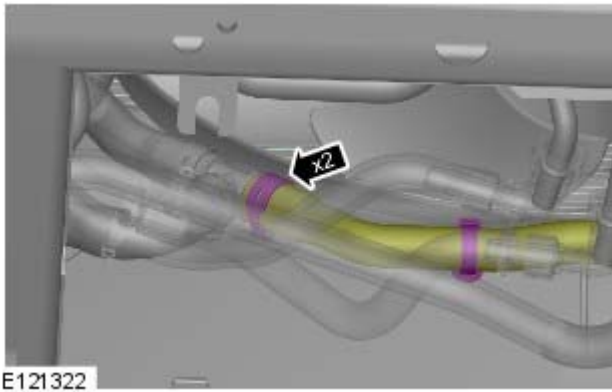
Position a container to collect the fluid.



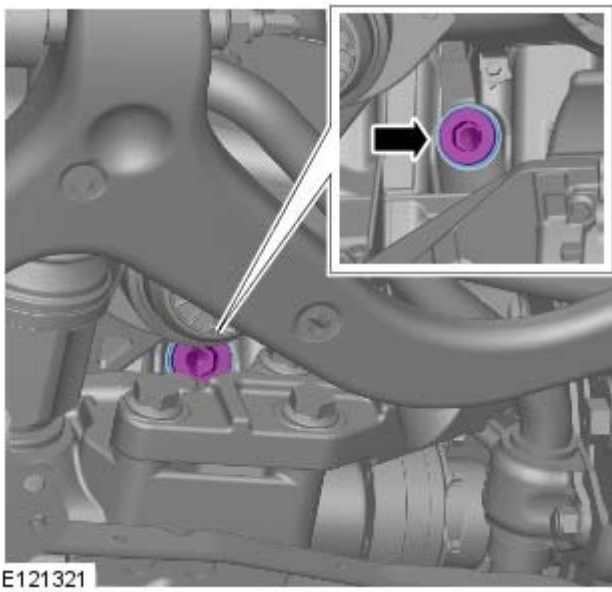
8. Install the lower coolant hose to the radiator.



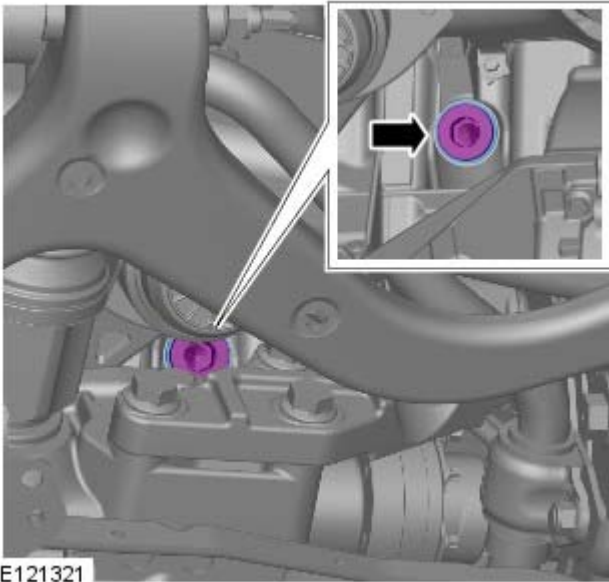
9.  CAUTION: Be prepared to collect escaping coolant.




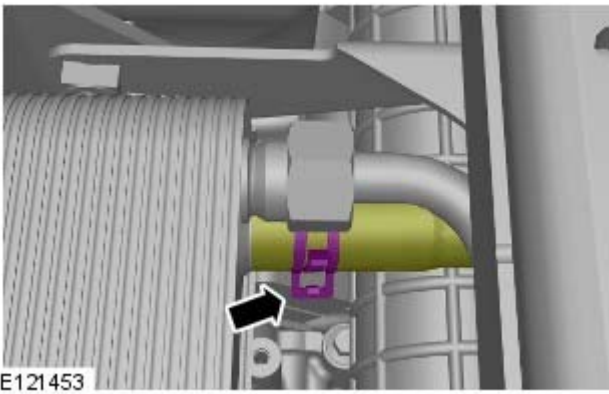
10.  CAUTION: Be prepared to collect escaping coolant.



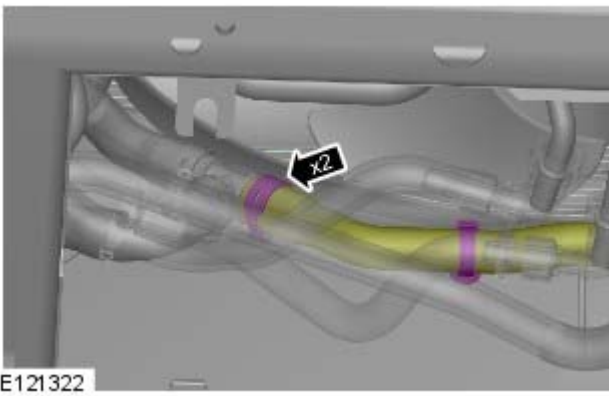
11.  CAUTION: Be prepared to collect escaping coolant.



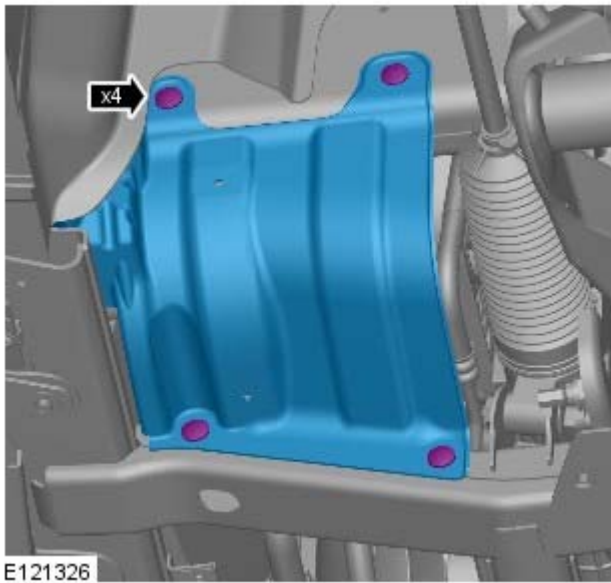
12. **12.**  CAUTION: Install a new seal.
Torque: 50 Nm



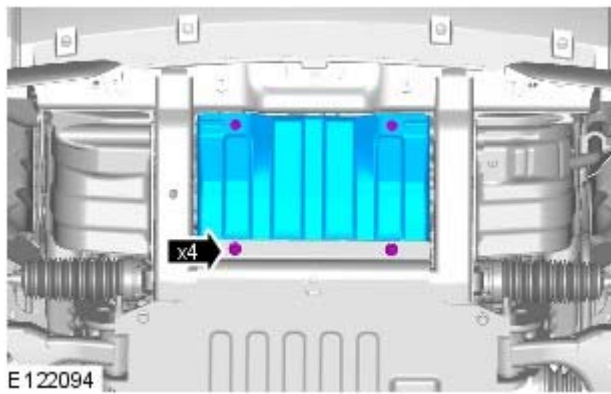
13. Install the coolant hose.



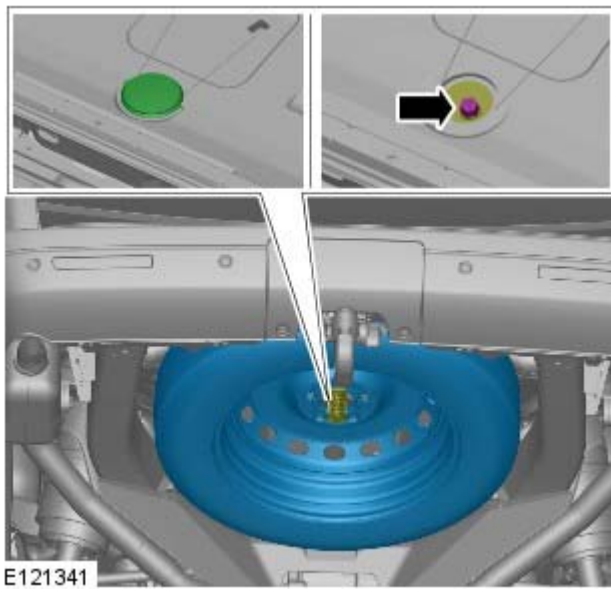
14. Install the coolant hose.



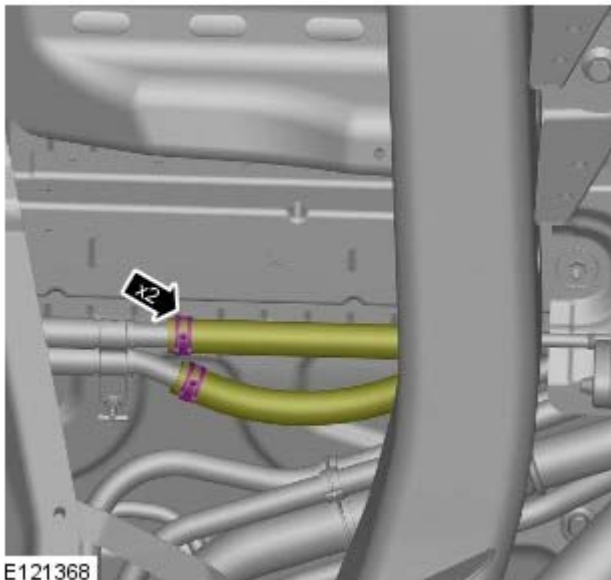
15. Install the LH splash shield.




16. Torque: 10 Nm

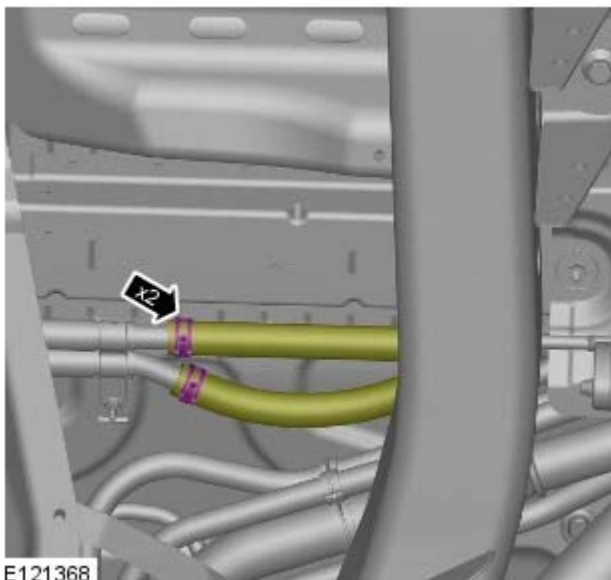


17. Remove the spare wheel and tire.



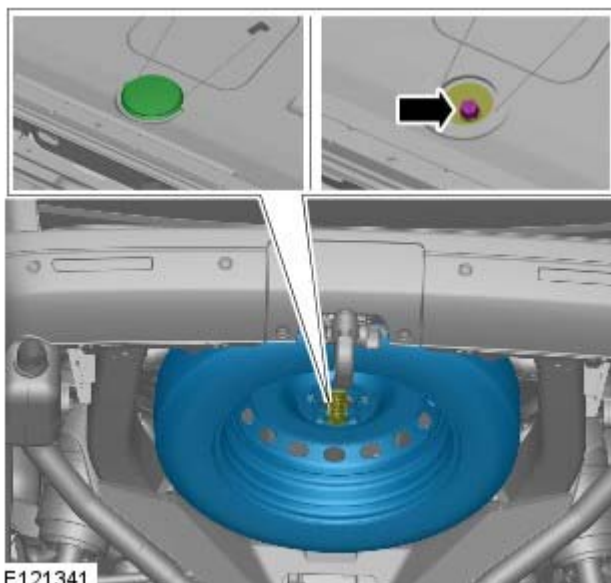
E121368

18. **18.**  CAUTION: Be prepared to collect escaping coolant.



E121368

19. Install the coolant hoses.



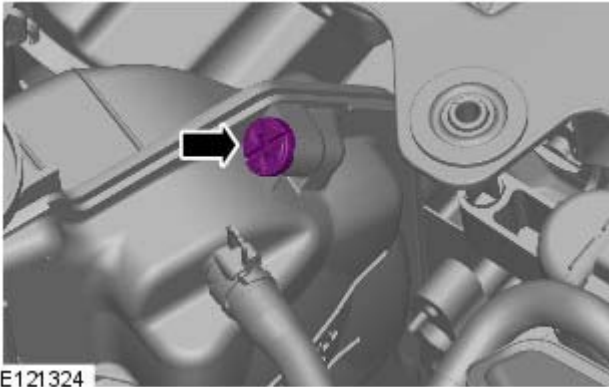
E121341

20. Install the spare wheel and tire.

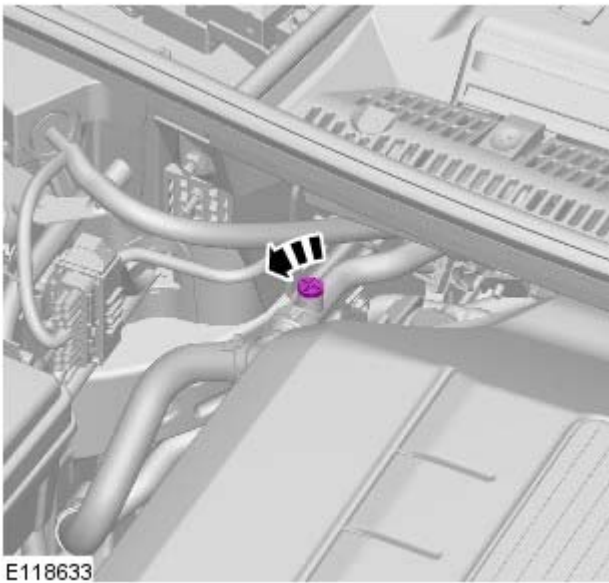
Filling

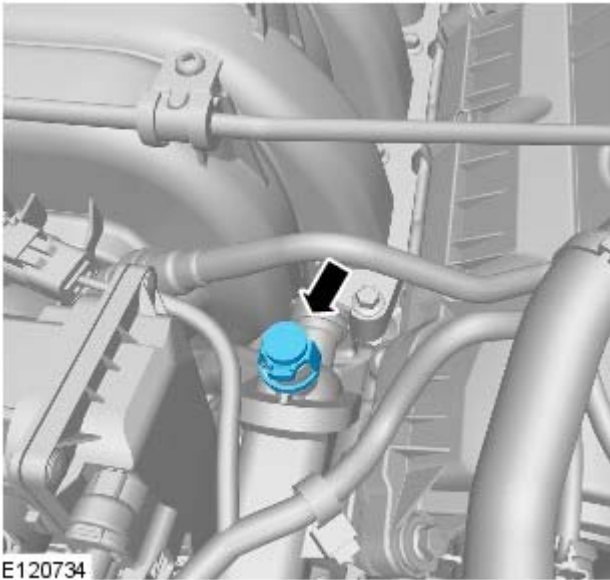
1. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
2. Lower the vehicle.
3. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

4.

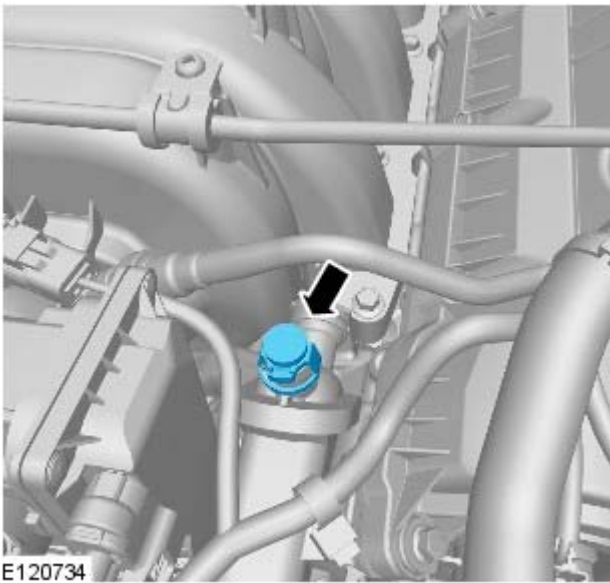


5. **25.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.





6.



7. **27. CAUTIONS:**



Anti-freeze concentration must be maintained at 50%.



Be prepared to collect escaping coolant.

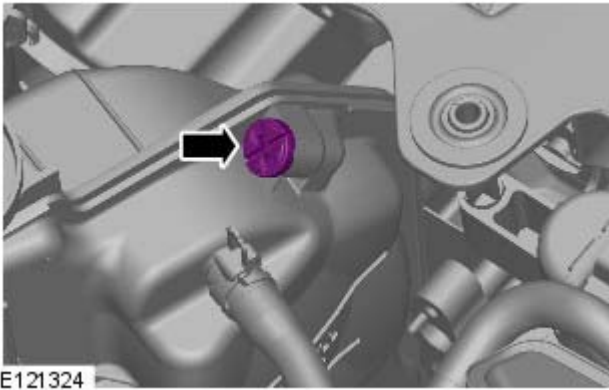
Fill the coolant expansion tank until coolant appears through the bleed ports.



8. **28. CAUTION:** Be prepared to collect escaping coolant.

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

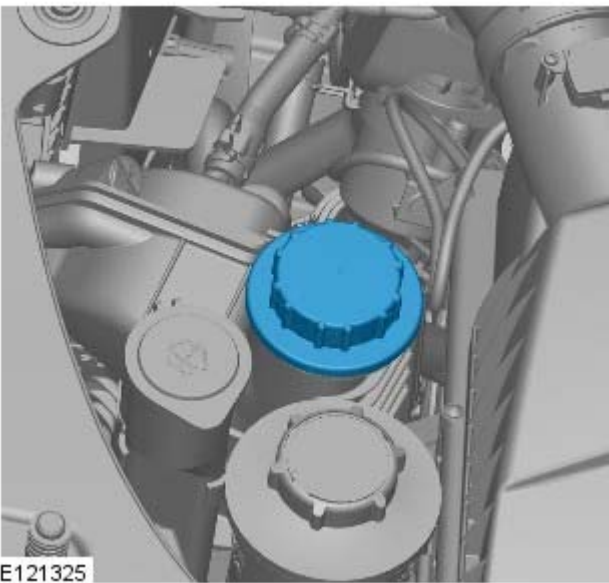
Fill the coolant expansion tank until coolant appears through the bleed ports.




9. **29.**  **CAUTION:** Be prepared to collect escaping coolant.

Fill the coolant expansion tank until coolant appears through the bleed ports.

10. Set the heater controls to maximum.
11. Start the engine and continue to fill the coolant until the maximum level is reached.
12. Increase the engine speed to 1500 rpm.
13. Check if the front heater is warm after 2 minutes, if warm proceed to step 15.
14. If not, turn the engine off for 10 seconds and then start the engine and return to step 12.
15. Once the front heater is warm, check if the rear heater is warm (if equipped). If no heat is felt, increase the engine speed to 3000 rpm for 30 seconds and return to idle.
16. Once heat is felt at the rear heater, continue filling with coolant until the level stops dropping and top up to 65mm below rim (to top rib on back of the coolant expansion tank).




17. **37.**  **CAUTION:** Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.

18. Switch the heater off.
19. Raise the engine speed to 2000 RPM for eight minutes.


20. **40.**  **CAUTION:** Switch off the engine and allow the coolant temperature to go cold.

Switch the engine off and allow to cool.

21. Visually check the engine and cooling system for signs of coolant leakage.

22. **42.**  **WARNING:** When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

• **CAUTIONS:**

 Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

 Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

• **NOTE:** When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

Check and top-up the coolant if required.

Engine Cooling - V8 5.0L Petrol - Coolant Expansion Tank

Removal and Installation

Removal

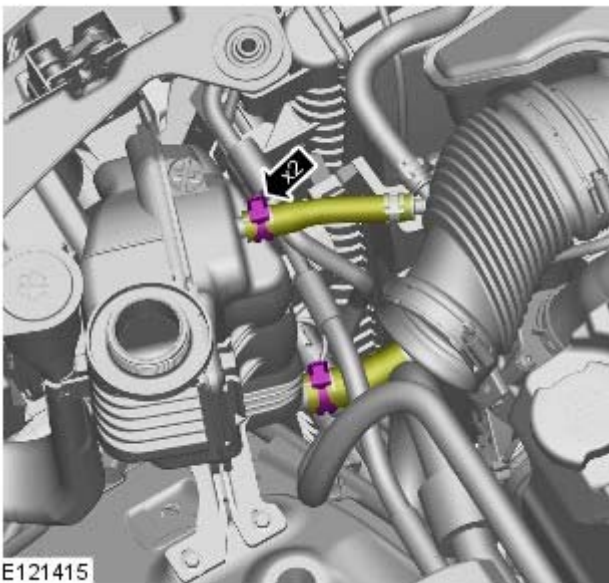
- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

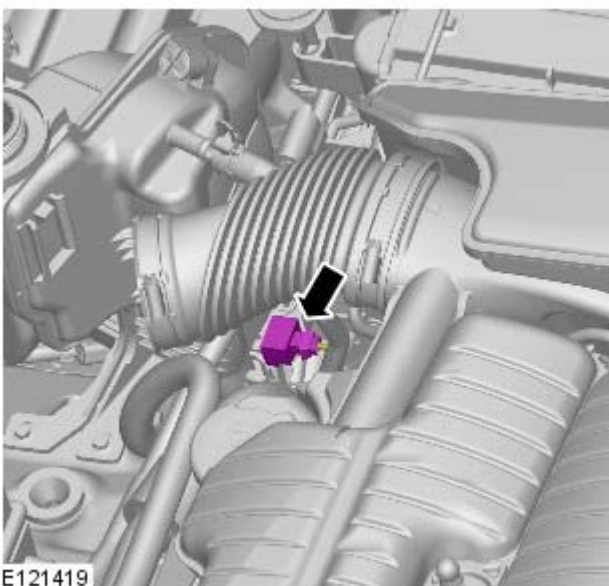
Raise and support the vehicle.

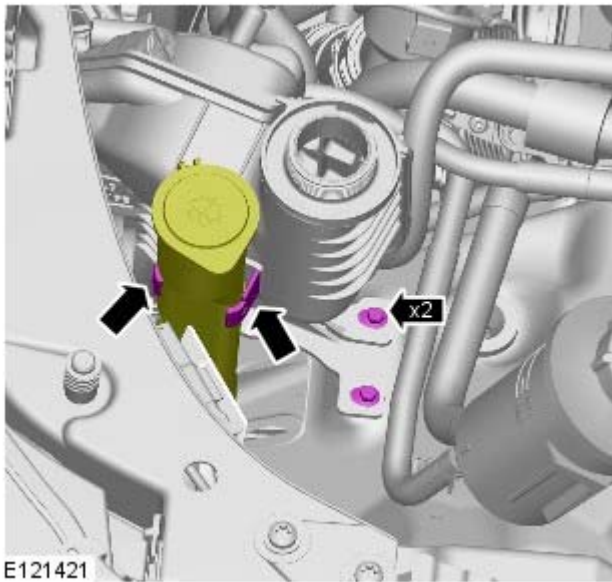
2. Refer to: [Air Cleaner LH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

3.

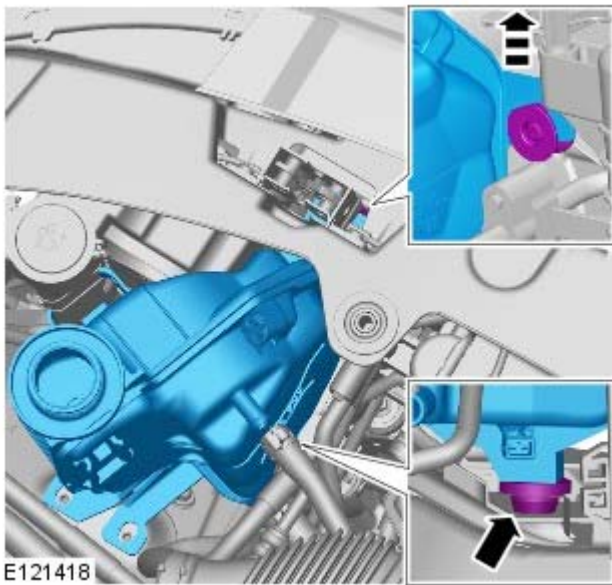


4.

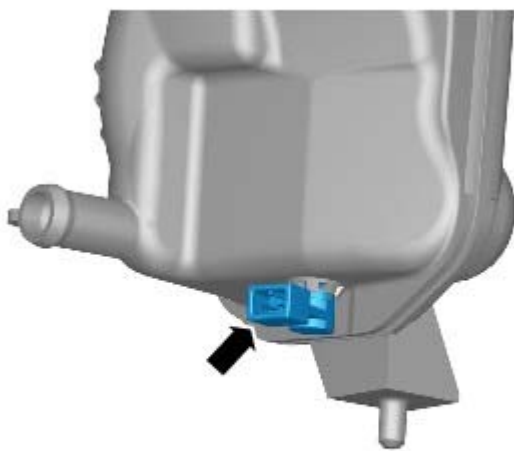




5. Torque: 9 Nm



6.



7. **7.** NOTE: Do not disassemble further if the component is removed for access only.

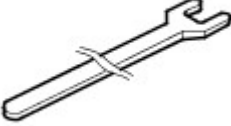

Installation

1. To install, reverse the removal procedure.

Engine Cooling - V8 5.0L Petrol - Cooling Fan

Removal and Installation

Special Tool(s)

<p>303-1142</p>  <p>E46076</p>	<p>303-1142 Viscous Coupling Wrench</p>
<p>303-1143</p>  <p>E55382</p>	<p>303-1143 Viscous Coupling Holding Tool</p>

Removal

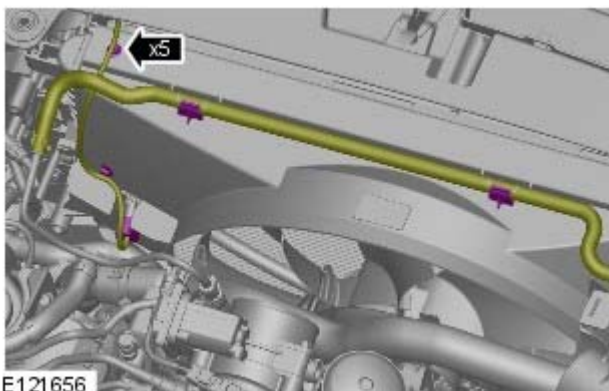
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

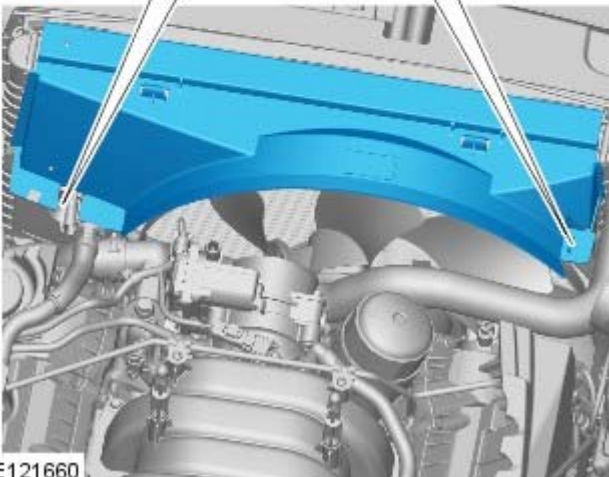
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
3. Refer to: [Air Cleaner Outlet Pipe LH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
4. Refer to: [Air Cleaner Outlet Pipe RH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

- 5.

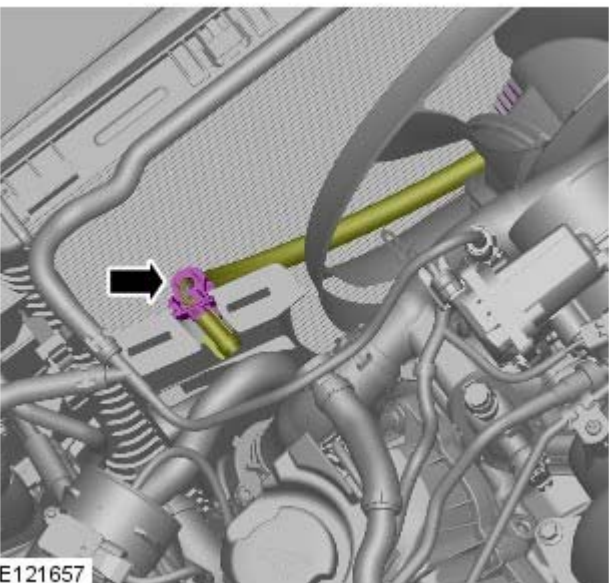


6.

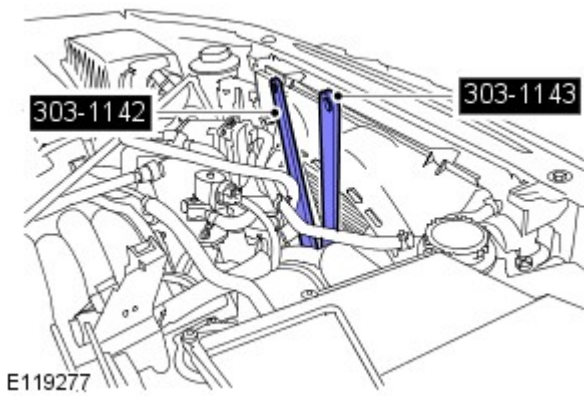



E121660

7.



E121657



8.  **CAUTION:** Always protect the cooling pack elements to prevent accidental damage.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
 - NOTE: The thread is left handed.

Special Tool(s): [303-1142](#), [303-1143](#)
Torque: 65 Nm

Installation

1. To install, reverse the removal procedure.

Engine Cooling - V8 5.0L Petrol - Coolant Pump

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

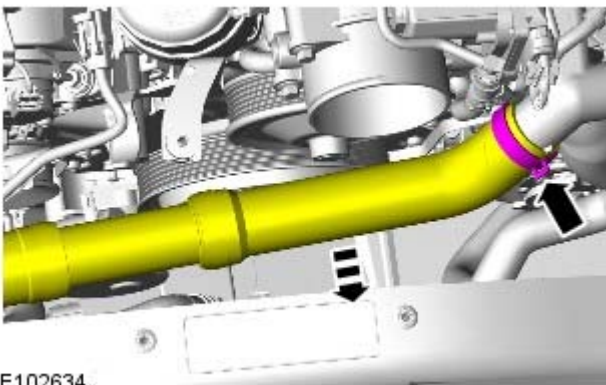
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

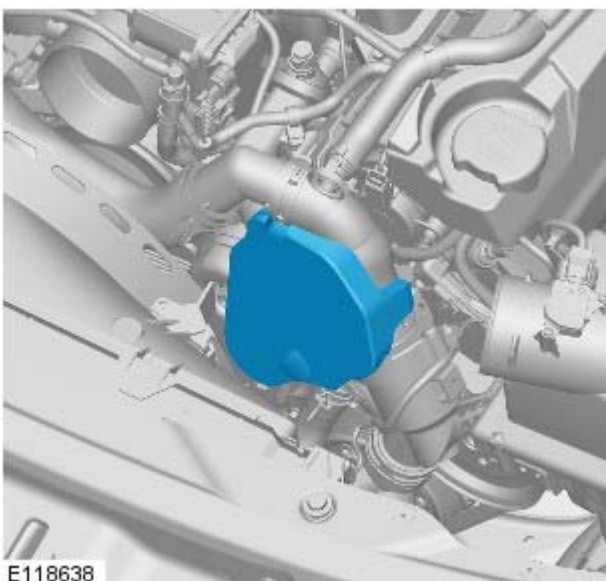
Raise and support the vehicle.

3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

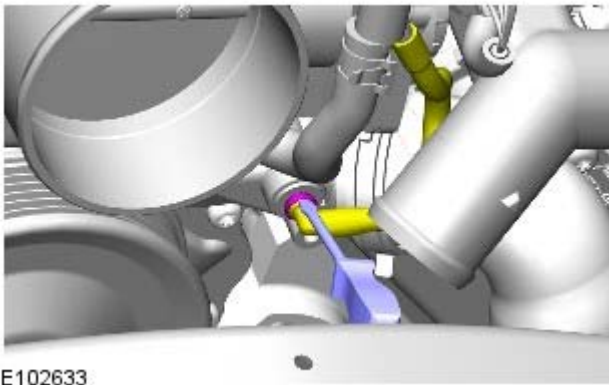


4. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

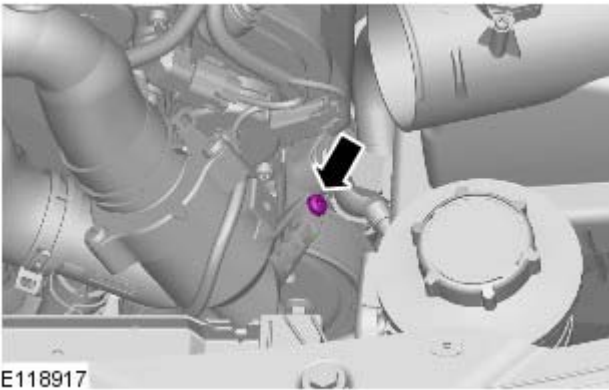
5. Refer to: [Accessory Drive Belt](#) (303-05D Accessory Drive - V8 5.0L Petrol, Removal and Installation).



- 6.

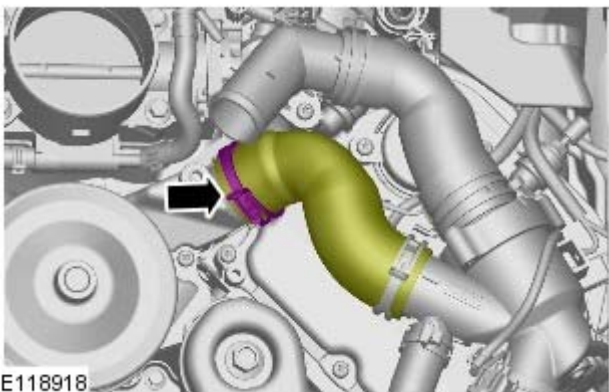


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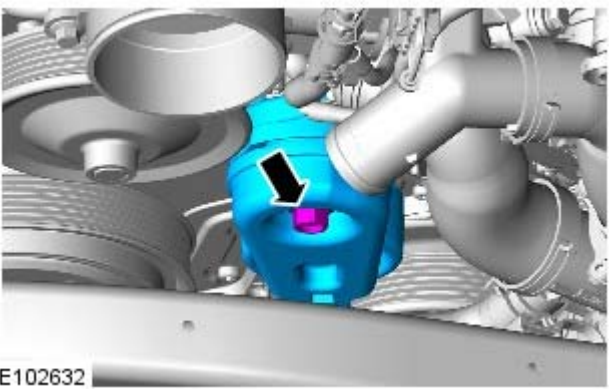


8. **8.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

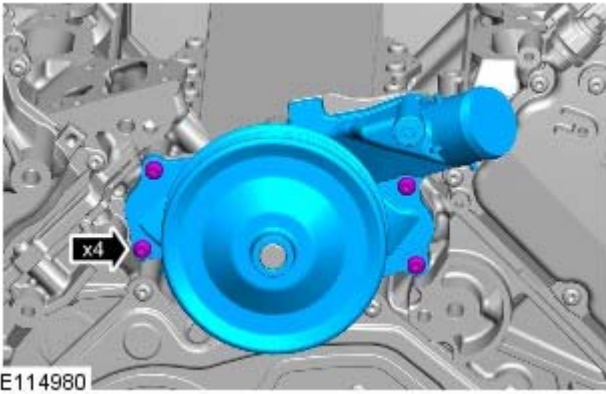
- *Torque:* 10 Nm




9.



10. *Torque:* 40 Nm

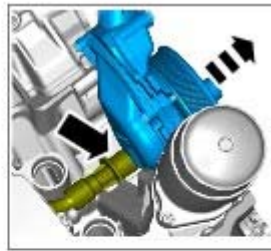


11. **11.**  **WARNING:** Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

 **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

- **NOTE:** Engine shown removed for clarity.

- *Torque:* 12 Nm

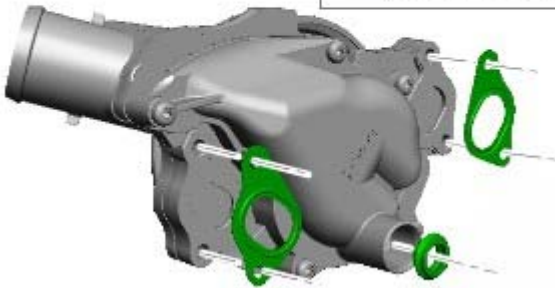


12. **12.** **CAUTIONS:**

 Note the fitted position of the component prior to removal.

 A new O-ring seal is to be installed.

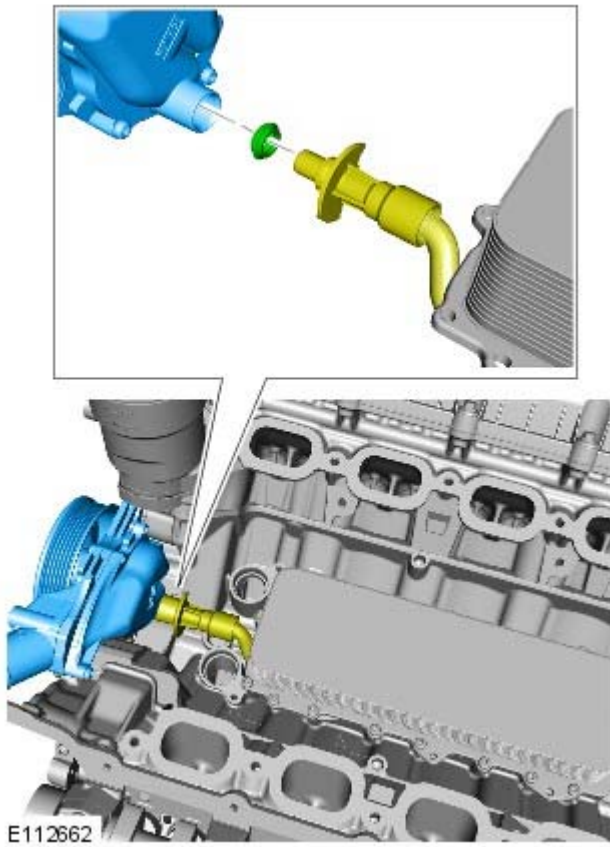
- **NOTE:** Install new gaskets.



E102636

Installation

1. **1.** NOTE: Engine shown removed for clarity.



2. To install, reverse the removal procedure.

Engine Cooling - V8 5.0L Petrol - Radiator

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

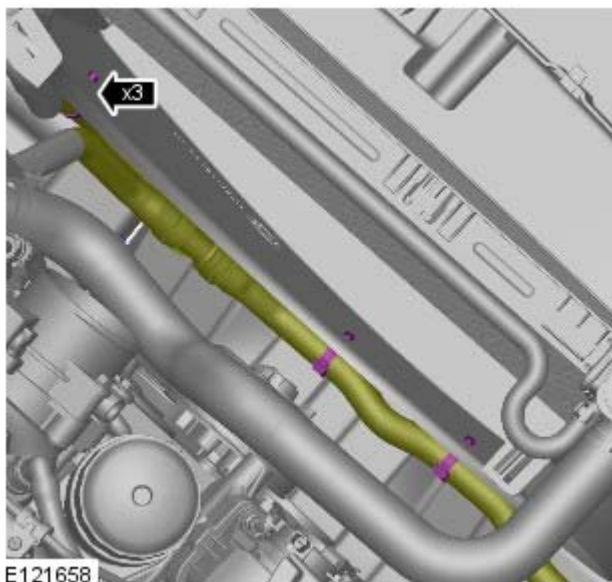
3. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

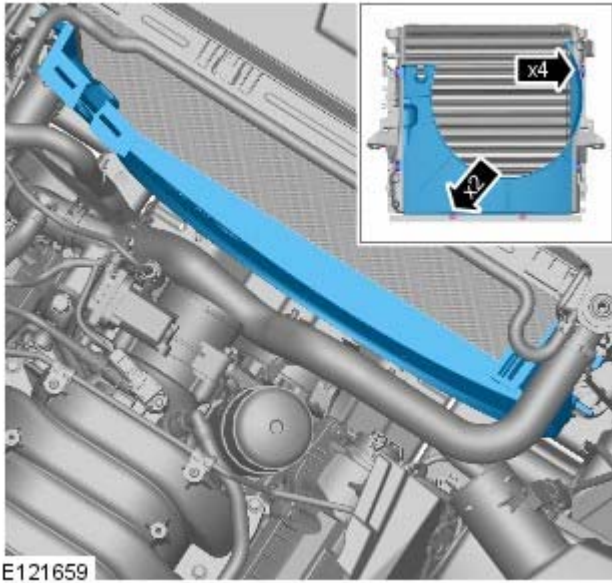
4. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

5. Refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

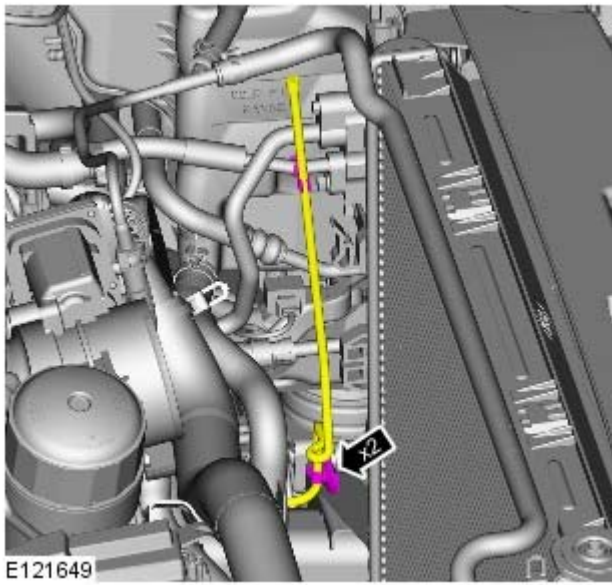
6. Refer to: [Cooling Fan](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

7.

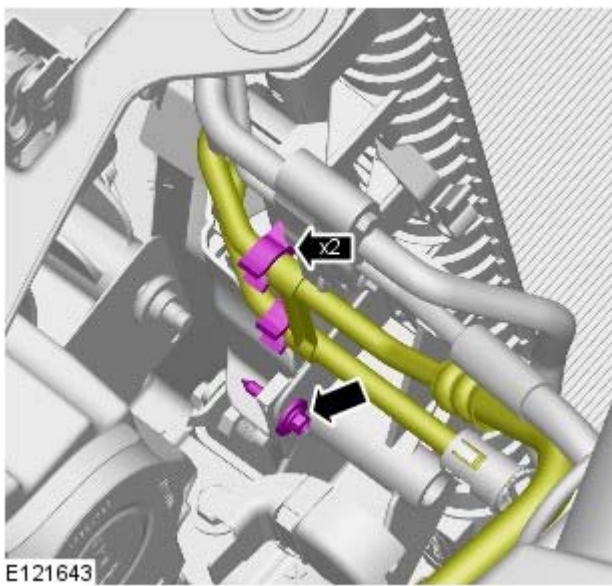




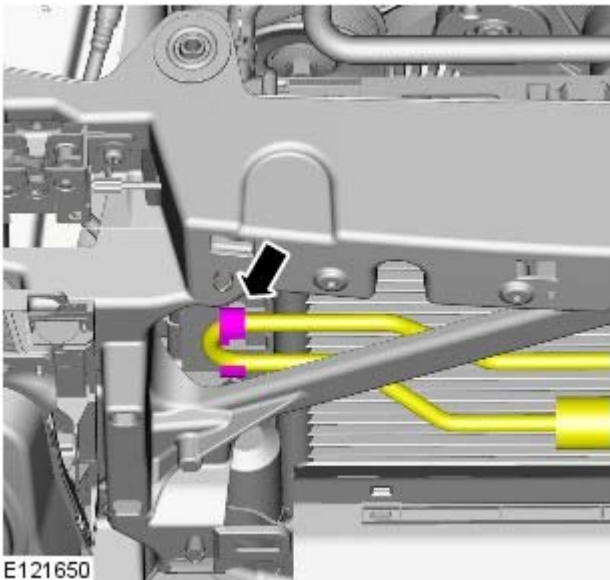
8.



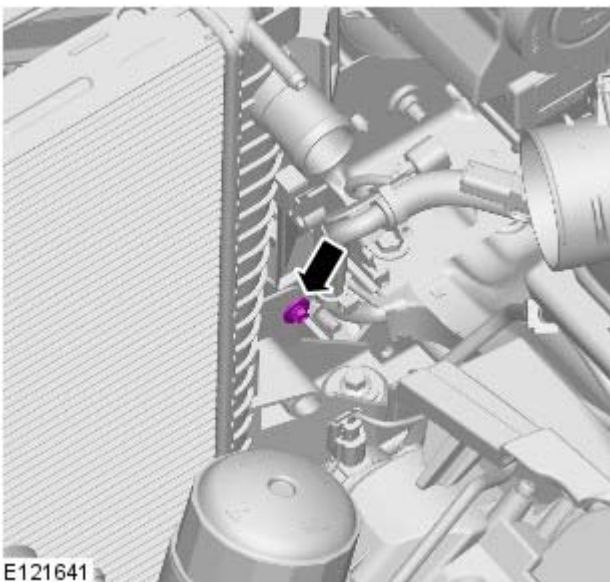
9.



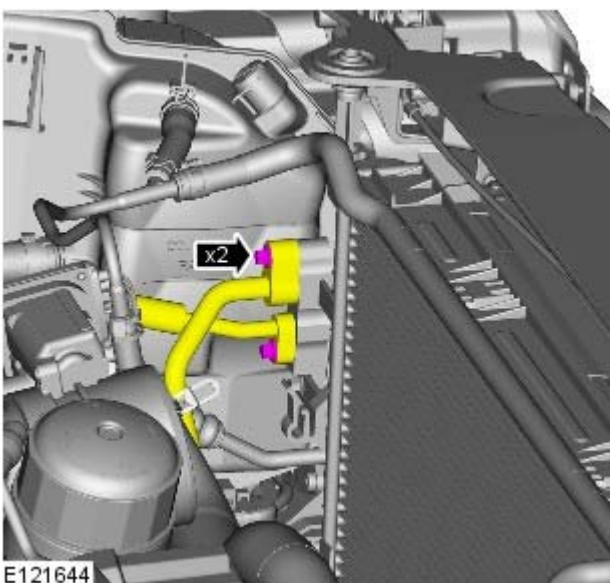
10. Torque: 9 Nm



11.



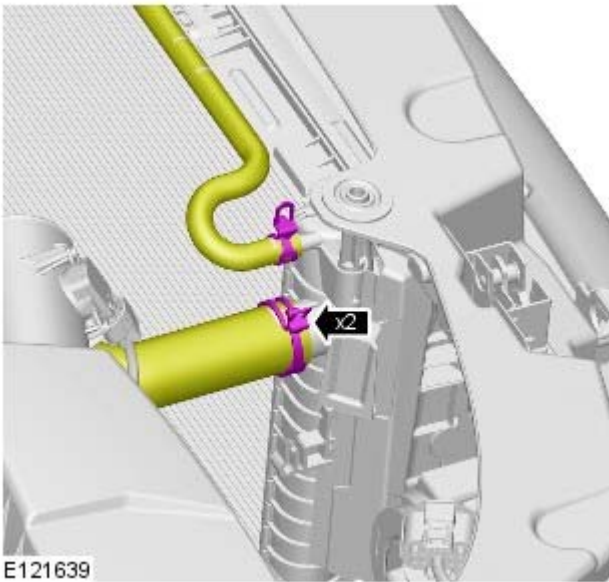
12. *Torque: 9 Nm*



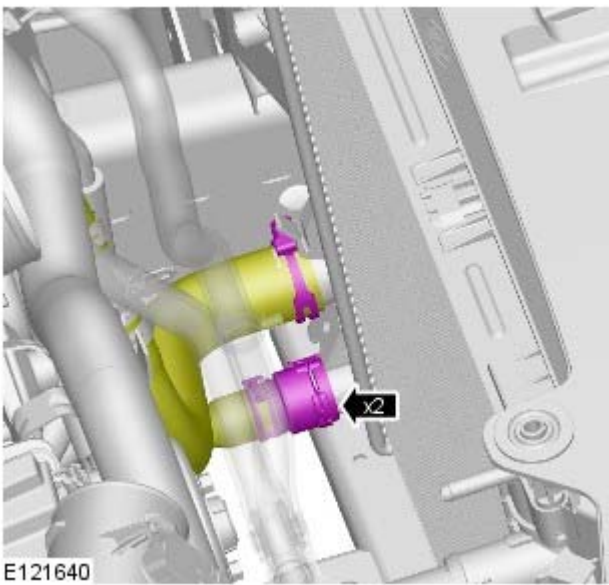
13. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Torque: 10 Nm

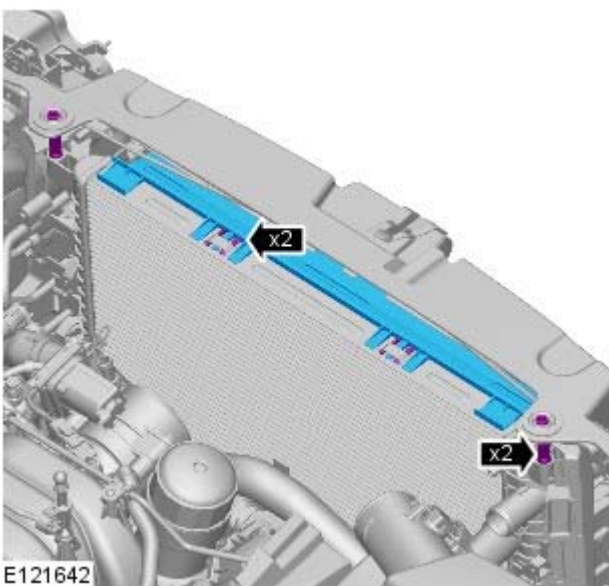
14.

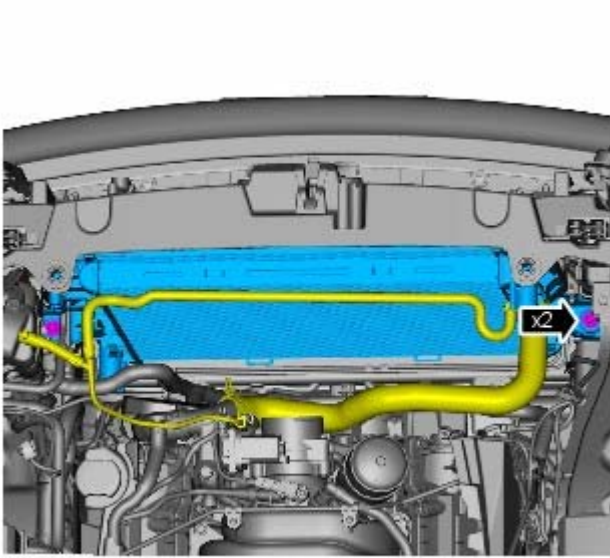


15.



16.

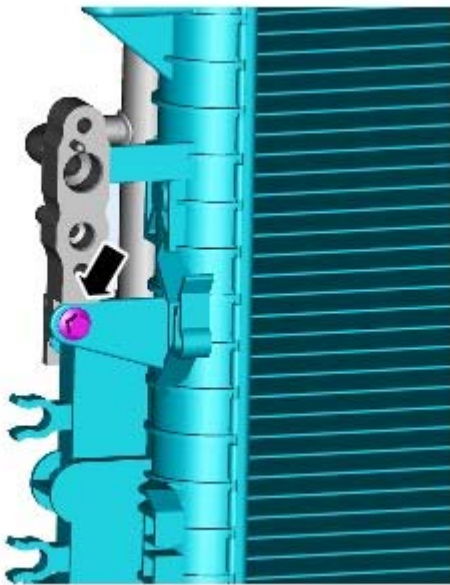




E121645

17. **17.**  CAUTION: Always protect the cooling pack elements to prevent accidental damage.

Torque: 25 Nm



E121647

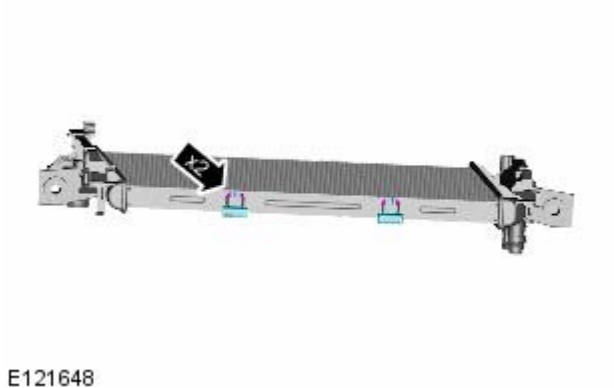
18. **18.** NOTE: Do not disassemble further if the component is removed for access only.

Torque: 10 Nm



E121646

19. *Torque:* 10 Nm



E121648

Installation

1. To install, reverse the removal procedure.

Engine Cooling - V8 5.0L Petrol - Thermostat Housing

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

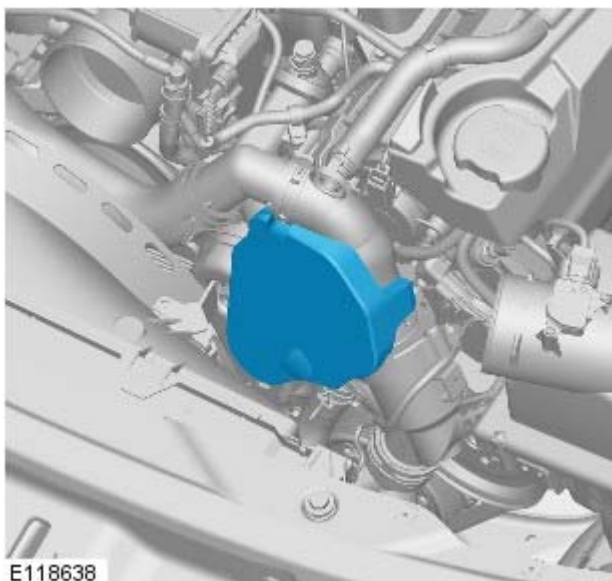
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

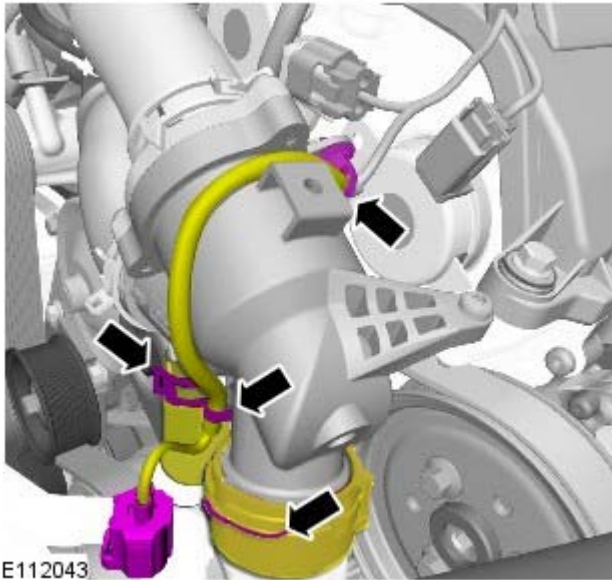
2.  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

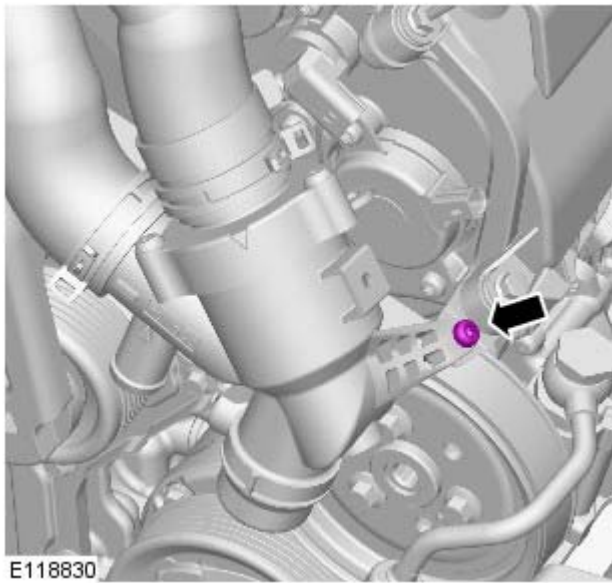
3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
4. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
5. Refer to: [Air Cleaner Outlet Pipe LH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

6.



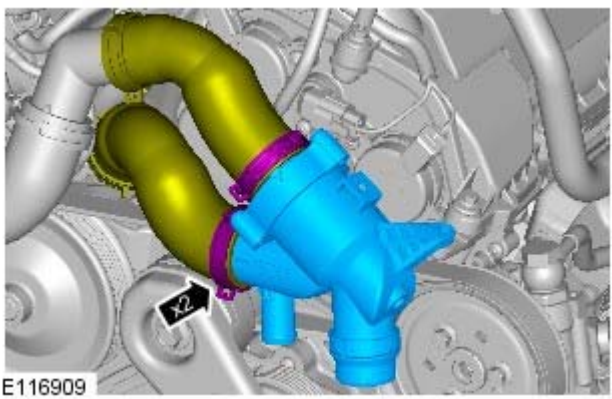


7. **7.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



8. **8.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 10 Nm



9. **9.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
 - NOTE: The retaining clips cannot be removed from the pipe.

Installation

1. To install, reverse the removal procedure.

Fuel Charging and Controls - TDV6 2.7L Diesel -

General Specification

Item	Description
* Recommended fuel	Diesel or Automotive Gas Oil (AGO) to EN590 Specification

* This engine is NOT compatible with 'Bio-diesel' fuel

Torque Specifications

Description	Nm	lb-ft
High pressure fuel supply lines to injector and supply manifold unions:		
Stage 1 - Union to injector	15	11
Stage 2 - Union to supply manifold	15	11
Stage 3 - Union to injector	30	22
Stage 4 - Union to supply manifold	30	22
High pressure fuel supply lines to supply manifold and diverter rail unions:		
Stage 1 - Union to supply manifold	15	11
Stage 2 - Union to diverter rail	15	11
Stage 3 - Union to supply manifold	35	26
Stage 4 - Union to diverter rail	35	26
Fuel injection diverter rail studs	23	17
Fuel supply line retaining bolts	10	7
Crankcase vent oil separator locating stud	10	7
EGR coolant cross-over pipe bolts	13	10
Intake air shut-off throttle retaining stud	10	7
Intake air shut-off throttle elbow retaining bolt	10	7
Fuel injection pump pulley nut	50	37
Fuel injection pump securing bolts	23	17
Fuel injection pump belt rear cover retaining bolt	7	5
Fuel injection pump belt tensioner retaining bolt	25	18
Fuel injector retaining bolts	10	7

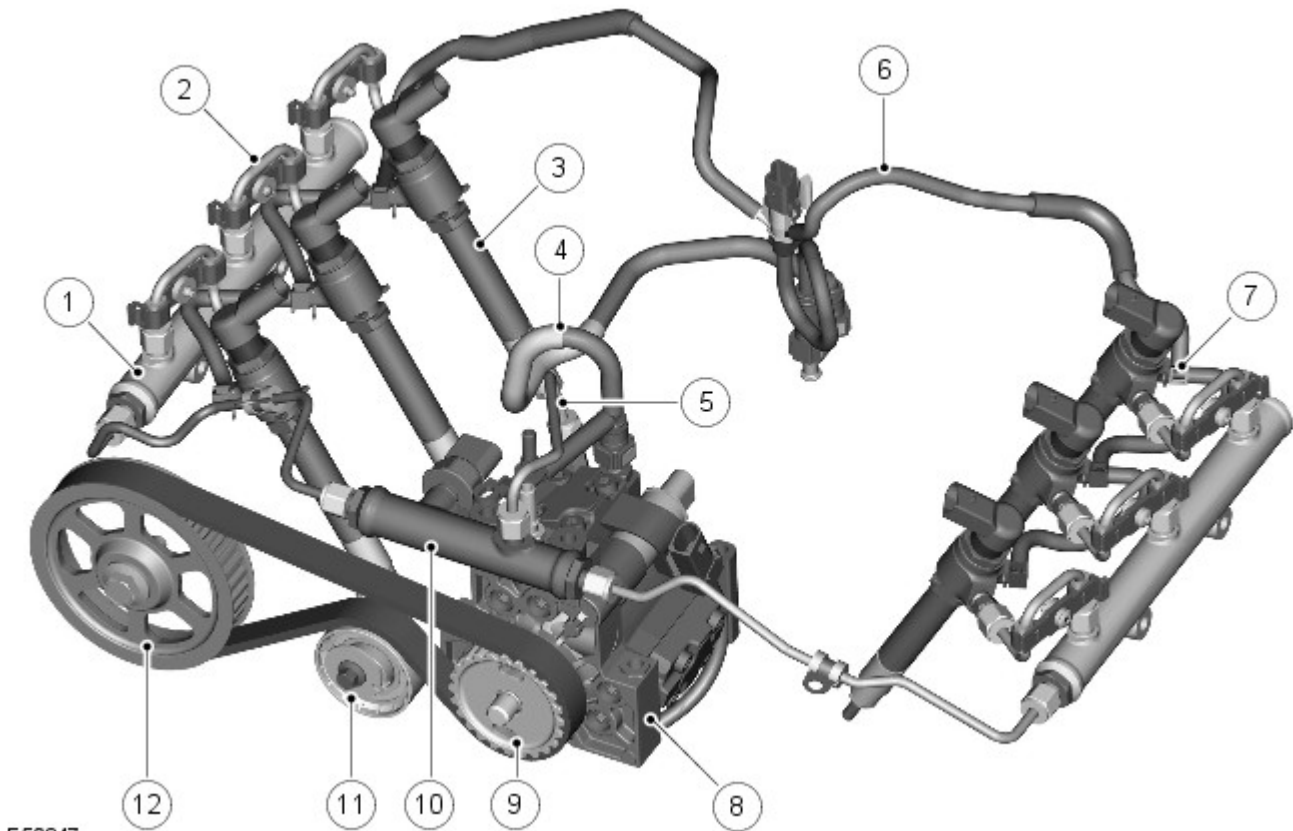
Fuel Pressures

Component	bar	psi
Fuel pump	0.5	7.25
High pressure fuel injection pump	1650 maximum	23931 maximum

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Charging and Controls

Description and Operation

Component Locations



E50847

Item	Part Number	Description
1	-	High-pressure (HP) fuel rail (2 of)
2	-	HP pipe - Fuel rail to injector (6 of)
3	-	Injectors (6 of)
4	-	Low Pressure (LP) pipe - Fuel return
5	-	HP pipe - High Pressure Pump (HPP) to fuel diverter rail
6	-	LP pipe - Injector leak-back
7	-	Connector to injector (part of 6)
8	-	HPP
9	-	HPP pulley
10	-	HP diverter rail
11	-	Rear Engine Accessory Drive (READ) belt tensioner
12	-	LH exhaust camshaft pulley

GENERAL

The TdV6 is equipped with a High-Pressure (HP) common rail fuel injection system. With this fuel injection process, a High-Pressure Pump (HPP) delivers a uniform level of pressure to the shared fuel lines (the common rails), which serve all six fuel injectors. Pressure is controllable, to the optimum level for smooth operation, up to 1650 bar.

The common rail system supports a pre-injection (pilot) phase, which reduces combustion noise and mechanical load.

Fuel injection pressure is generated independently of engine speed and fuel injection events.

The fuel injection timing and volume are calculated by the Engine Control Module (ECM), which then energizes the appropriate piezo actuated injector.

The common rail fuel injection system has the following features:

- High fuel injection pressures of up to 1650 bar for greater atomisation of fuel (increasing performance and lowering emissions)
- Variable injection to optimise combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system

The fuel system is divided into 2 sub systems:

- Low-Pressure (LP) system
- HP system.

The LP system features the following components:

- In-tank fuel pump
- Fuel pressure regulator (integral to the fuel delivery module)
- Fuel filter
- Return pipes and fuel cooler
- Injector return pipes
- Fuel coolers (engine and vehicle)

The LP system pressure is regulated to 0.5 bar.

The HP system features the following components:

- HPP
- Common rails and diverter rail
- HP fuel pipes
- Injectors.

LP SYSTEM

In-tank Fuel Pump

The electric fuel pump is located inside the fuel tank. Fuel is pumped from the tank via the in-tank fuel pump, to the HPP via the fuel filter.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation).

Fuel Filter

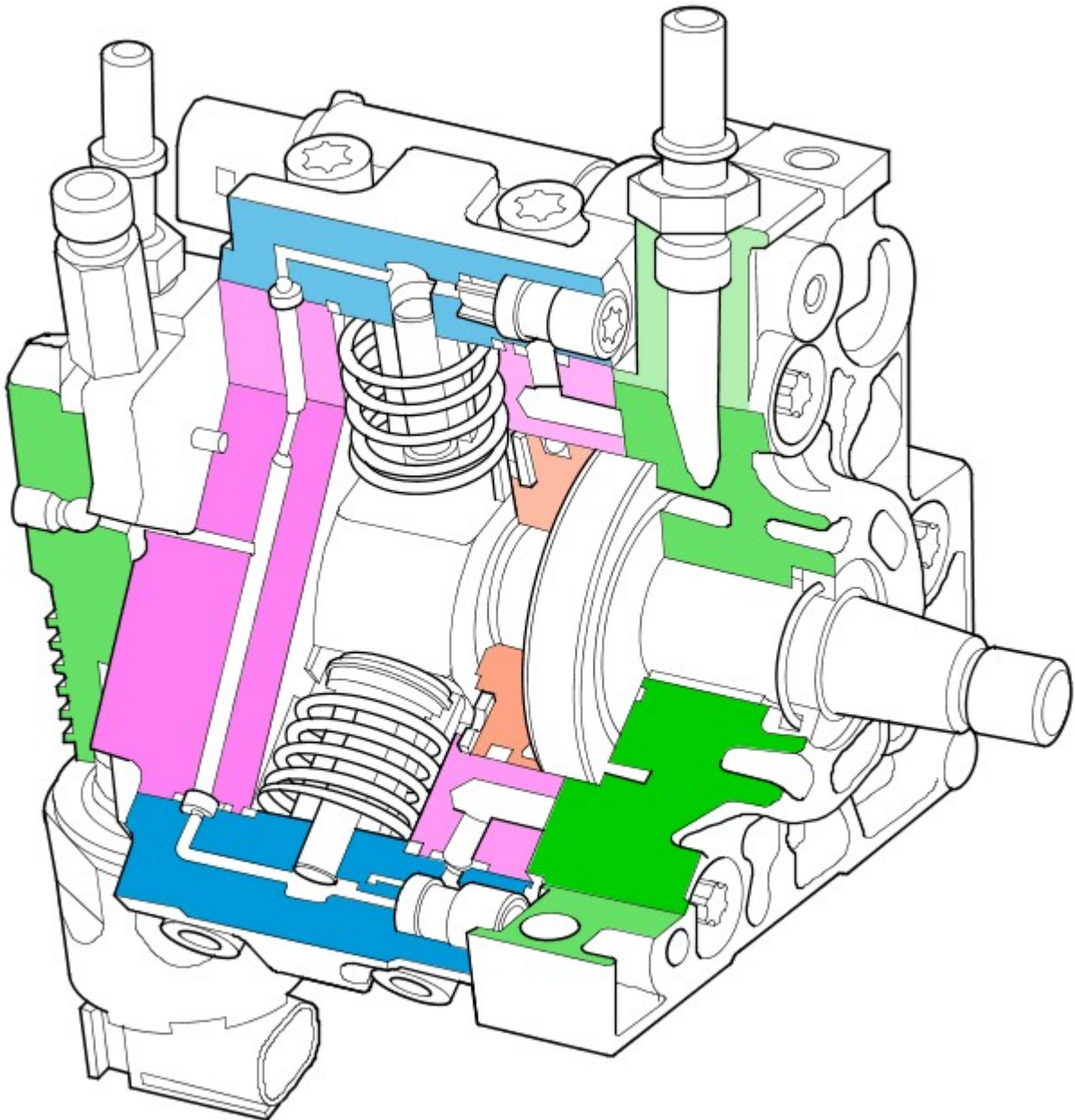
The fuel filter is located in the engine compartment on the left hand side, packaged to be protected against damage. Incorporated in the fuel filter housing is a bimetallic temperature valve, which will start to close at 30°C (86°F) and will fully close at 50°C (122°F). This allows pre-heated diesel fuel to circulate inside the fuel filter to prevent waxing in cold operating conditions.

Fuel Cooler

Two fuel coolers are fitted to the vehicle. One is located in the 'vee' of the engine block, and has a coolant system connection to aid heat transfer. The second cooler is located in the fuel return line and is a fuel to air cooler. For additional information, refer to: [Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation).

HP SYSTEM

HPP



E50833

The HPP is a three-piston (120 degree apart) radial plunger pump with a HP displacement of 0.8 cc. As mentioned, it has the ability to produce a maximum pressure of 1650 bar. The housing is cast from iron, the flange is cast from aluminium.

The pump is driven from the camshaft via a toothed belt. It does not need to be timed to the engine during belt replacement in service.

The required supply pressure to the HPP is -0.3 bar to +0.5 bar gauge. The return pressure is -0.3 bar to +0.8 bar gauge.

The pump is sized to deliver sufficient fuel to the HP rails for all engine-operating conditions.

The HPP consists of the following components:

- Internal Transfer Pump (ITP)
- Volume Control Valve (VCV)
- HP pumping elements (3 of)
- Pressure Control Valve (PCV)

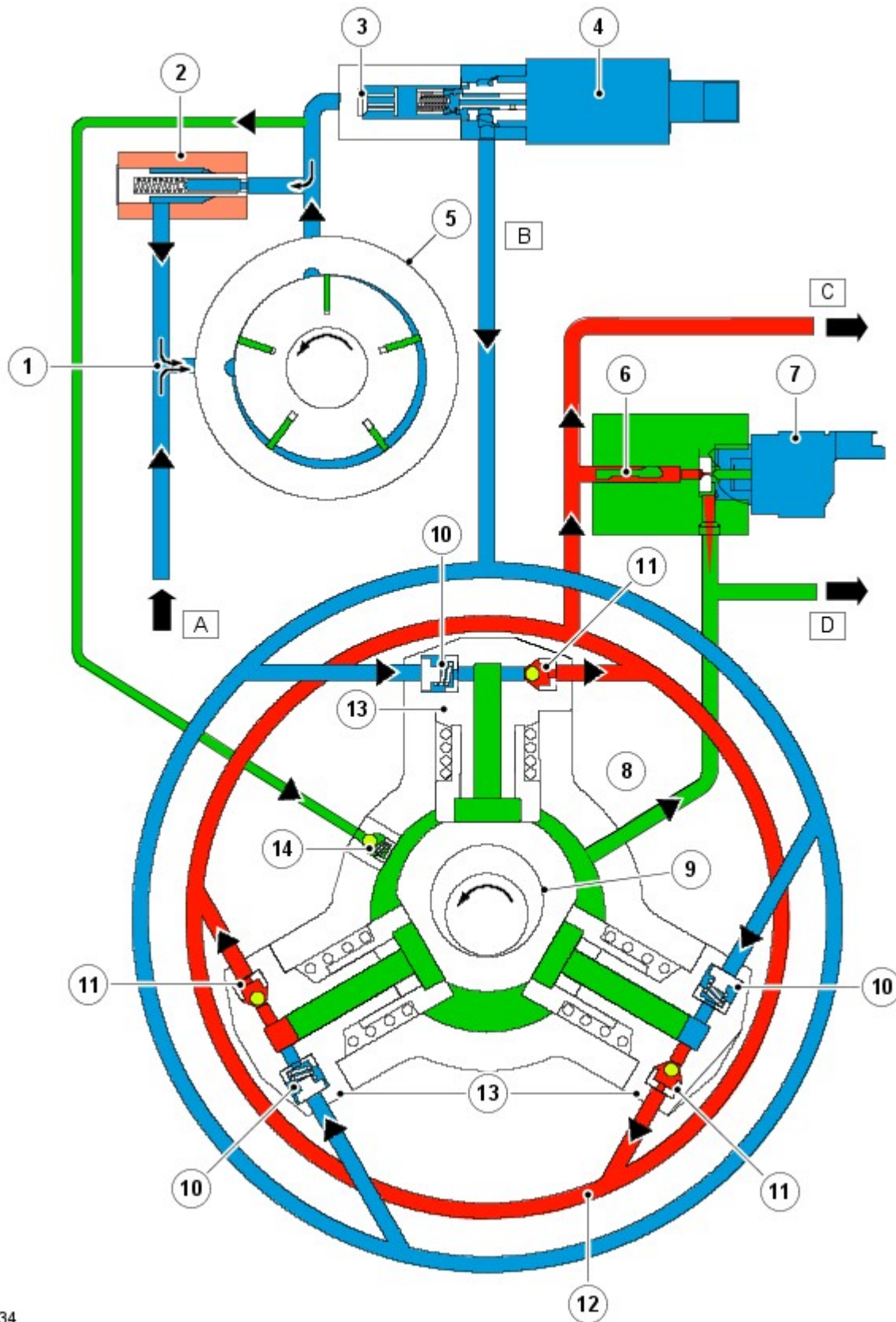
The ITP is a 5 vane pump. This conveys fuel to the VCV.

The VCV is a variable position solenoid valve electronically controlled by the ECM. The VCV is located between the ITP and the HP pumping elements. The VCV determines the amount of fuel that is delivered to the HP pumping elements. When there is no signal to the VCV the valve is closed, therefore no fuel delivery.

The 3 HP pumping elements are connected together in a fuel ring circuit within the pump. There is a single HP outlet connection for the HP pipe to the HP diverter rail.

The PCV is a variable position solenoid valve electronically controlled by the ECM. The PCV is located between the HP pumping elements and the HP outlet connection. The PCV regulates the amount of fuel pressure in the fuel rails and is controlled by the ECM. When there is no signal to the PCV the valve is open, therefore no rail pressure can be generated.

High Pressure Fuel Flow



E50834

Item	Part Number	Description
A	-	LP fuel supply
B	-	Fuel supply to the HP pumping elements
C	-	HP outlet connection to the HP diverter rail
D	-	LP fuel return (spill)
1	-	LP side of ITP
2	-	ITP pressure relief valve
3	-	Screen filter
4	-	VCV
5	-	ITP

6	-	Edge filter (to protect PCV)
7	-	PCV
8	-	N/A
9	-	Eccentric on HPP drive shaft
10	-	Pumping element inlet valve
11	-	Pumping element outlet valve
12	-	HP ring line
13	-	HPP elements (3 of)
14	-	Lubricating valve

The fuel induced by the ITP (5) is conveyed to the VCV (4) and the lubricating valve (14).

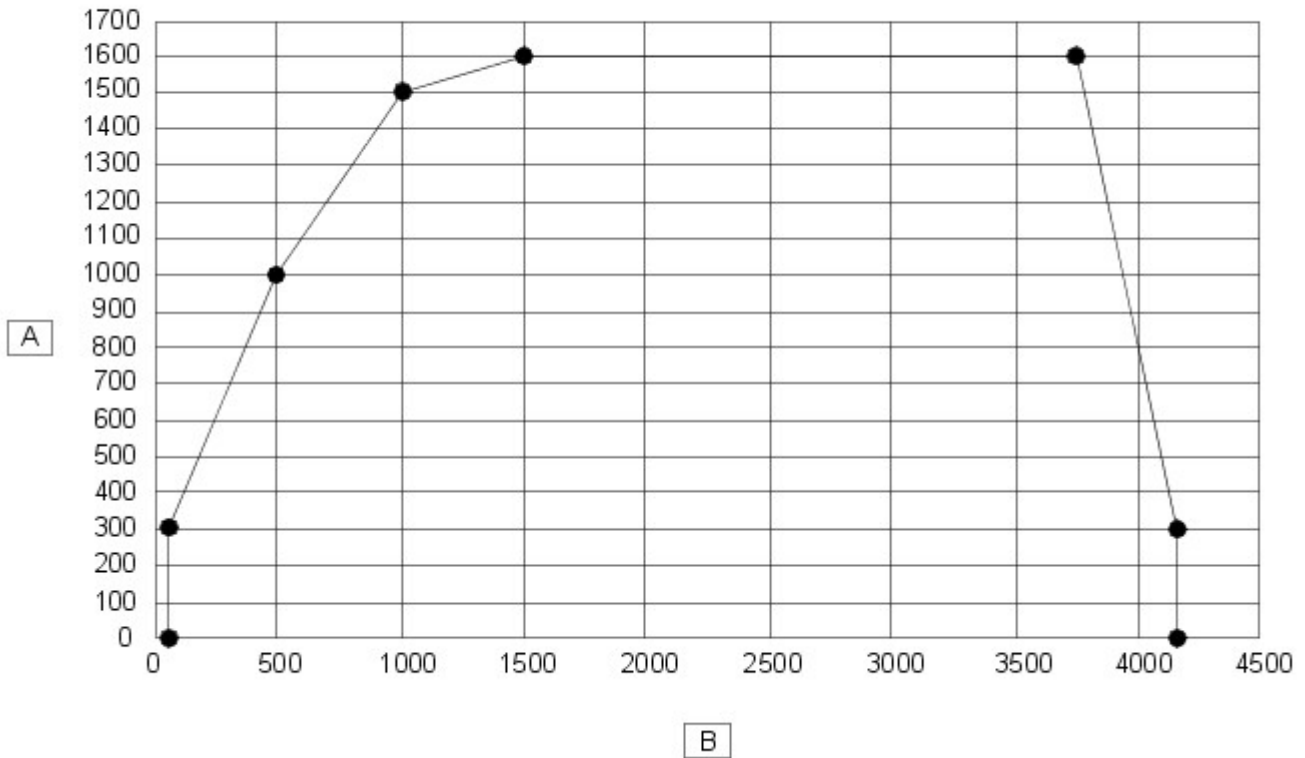
When the VCV is closed, the ITP pressure relief valve (2), lying parallel to the transfer pump, opens and conveys the fuel back to the LP side (1) of the transfer pump.

The fuel passes through the lubricating valve (14) into the interior of the HPP and from there to the fuel return (D). The fuel is used to lubricate the pump.

The VCV (4) determines the quantity of fuel (B) that is supplied to the pumping elements (13).

The fuel from the HP outlets (11) of the three pumping elements comes together in a ring line (12) and is conveyed through the HP outlet of the HPP (C) to the rails.

The PCV (7) regulates the fuel pressure in the fuel rails. Reducing rail pressure via the PCV results in fuel from the rail returning to the LP fuel return (D).



E50835

Item	Part Number	Description
A	-	Pump pressure (bar)
B	-	Pump speed (rpm)

The HPP can supply up to 1600 bar fuel pressure continuously with short excursions to 1650 bar. Pump speed is 5/6 engine speed. However it is calibrated to deliver fuel pressure dependant upon engine speed and load and is always under full control.

When the HPP is rotated, pressure is created when the VCV is open and the PCV is closed. The VCV and PCV are variable position to allow variable fuel delivery and pressure control.

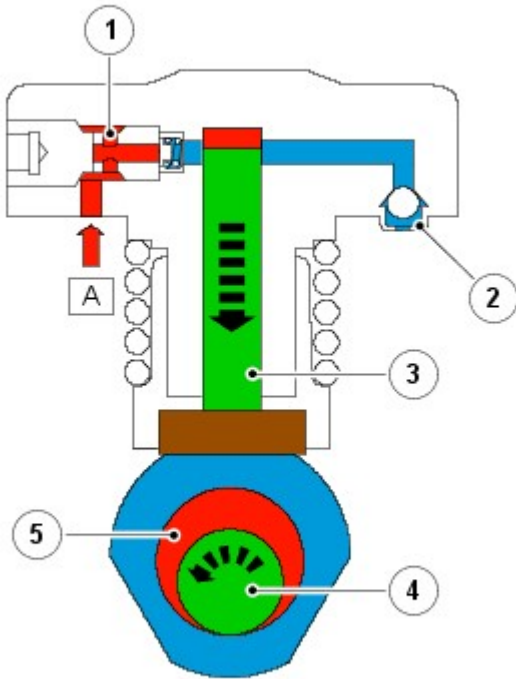
When the ECM actuates the piezo actuators, the rail pressure drop is off-set by additional fuel being delivered to the HP rails by the PCV.

Pressure Reduction After Engine Has Stopped

The fuel pressure in the system is reduced within a few seconds after the engine has stopped as the PCV no longer has the holding current it requires, and therefore opens. No residual pressure remains in the system and the fuel is returned to the fuel return line (D) through the open PCV. The system is pressureless.

Function of High A Pressure Element

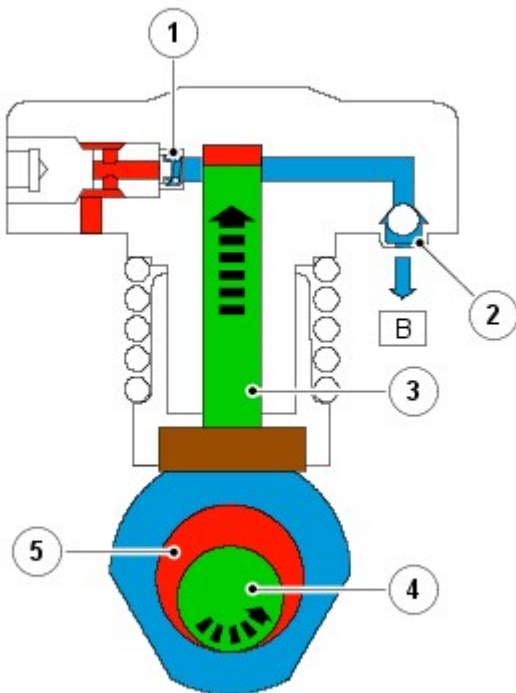
Fuel Induction



E50836

During the downward motion of the piston (3), a vacuum in the pump cylinder is generated, which opens the inlet valve (1) against the force exerted by the valve spring. The fuel (A), which is flowing past the VCV, is sucked in. At the same time the outlet valve (2) is closed due to the pressure difference between the pump cylinder and the HP fuel in the ring line.

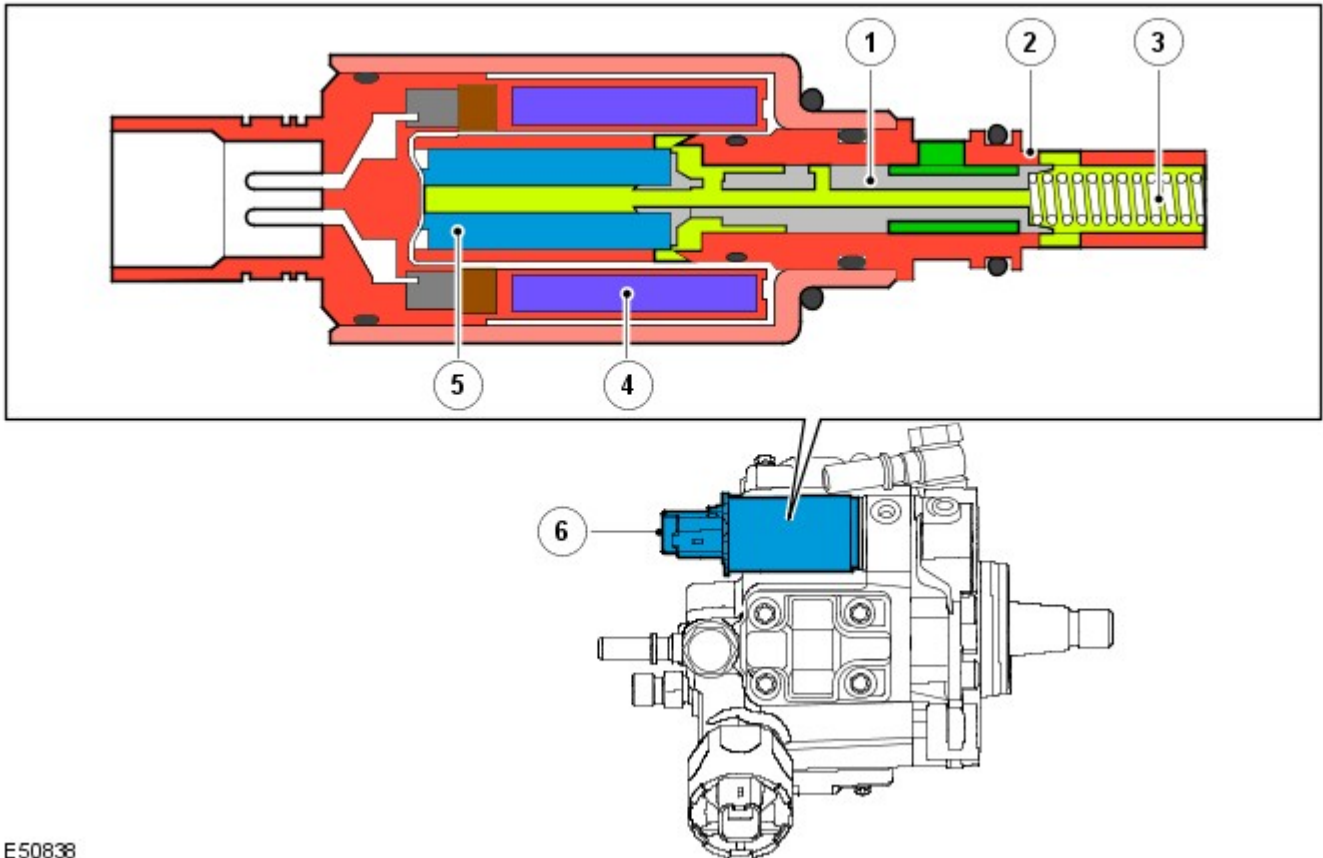
Fuel Delivery



E50837

The eccentric on the HPP driveshaft (5) presses the piston (3) upwards. The inlet valve (1) is then closed through the force exerted by the valve spring and the pressure being built up in the pump cylinder. The outlet valve (2) opens when the pressure in the pump cylinder is greater than the fuel pressure in the ring line (B).

Volume Control Valve (VCV)



E50838

Item	Part Number	Description
1	-	Piston
2	-	Sleeve
3	-	Compression spring
4	-	Coil
5	-	Armature
6	-	VCV

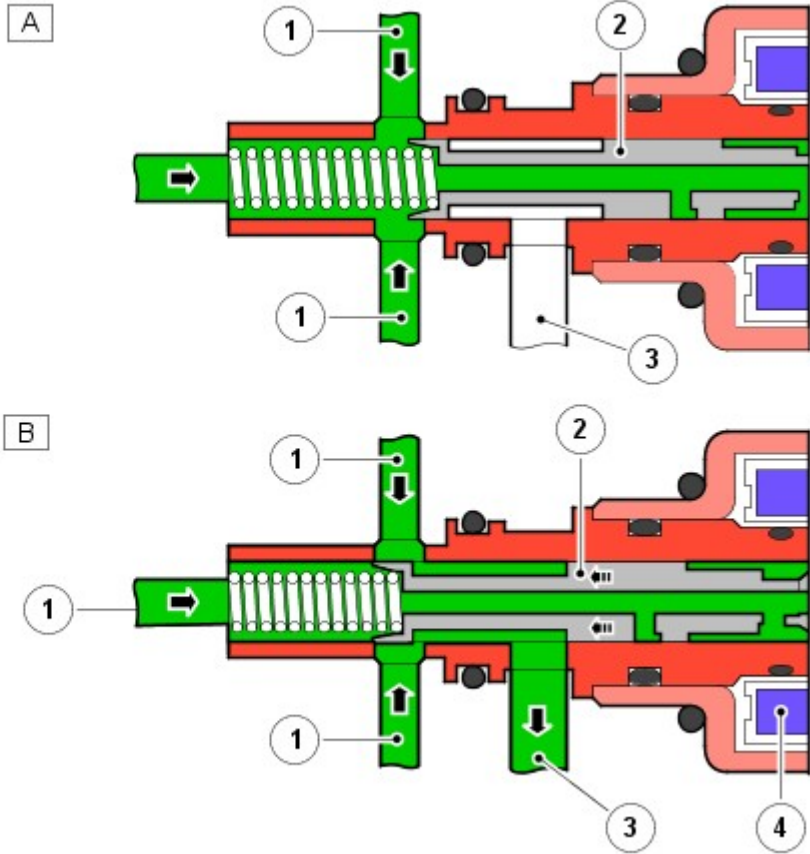
The VCV is fixed directly to the HPP.

The VCV regulates the fuel supply (and hence the quantity of fuel) from the transfer pump to the HPP elements, depending on the fuel pressure in the rail.

This makes it possible to match the delivery of the HPP to the requirements of the engine from the low-pressure side. The quantity of fuel flowing back to the main fuel supply line is kept to a minimum.

In addition, this adjustment reduces the power consumption of the HPP, improving the efficiency of the engine.

- NOTE: The fuel volume control valve default is closed without electrical supply. An open circuit connector will prevent the engine from running.
- NOTE: The VCV cannot be replaced as a separate component in service.



E50839

Item	Part Number	Description
A	-	VCV not actuated
B	-	VCV actuated
1	-	Fuel supply from the transfer pump
2	-	Piston
3	-	Fuel supply to the HPP
4	-	Coil energised
5	-	Quantity of fuel
6	-	Control current
7	-	VCV at constant engine speed

VCV Not Actuated (A)

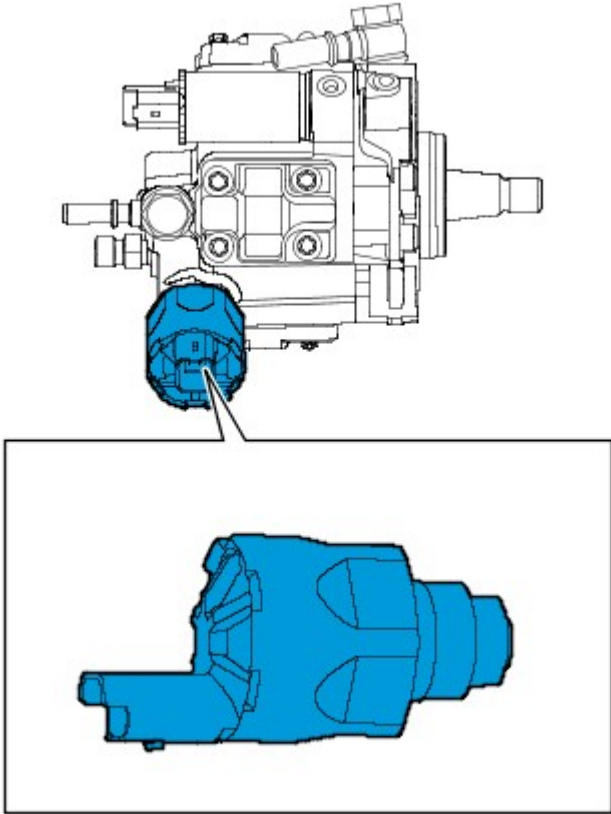
When there is no power supplied, the piston (2) closes the opening between the two connections (1) and (3) through the force of the compression spring. The fuel supply to the HPP is interrupted.

VCV Actuated (B)

The ECM energizes the coil (4) of the valve, according to the engines requirements. The armature force is proportional to the control current and counteracts the compression spring through the moving piston (2).

As a result, the opening between the two connections (1) and (3) and hence the quantity of fuel (5) supplied through the connector (3) to the HPP is also proportional to the control current (6). This means that the greater the opening cross-section, the greater the quantity of fuel supplied.

Pressure Control Valve (PCV)



E50840

The PCV is located on the HPP. It governs the fuel pressure at the HP outlet of the HPP and thus, the fuel pressure within the rail. In addition, the PCV dampens the fluctuations in the pressure, which occur during the delivery of fuel through the HPP and through the injection process.

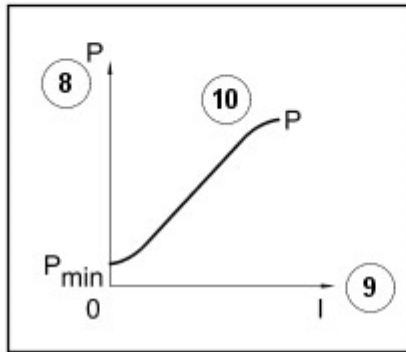
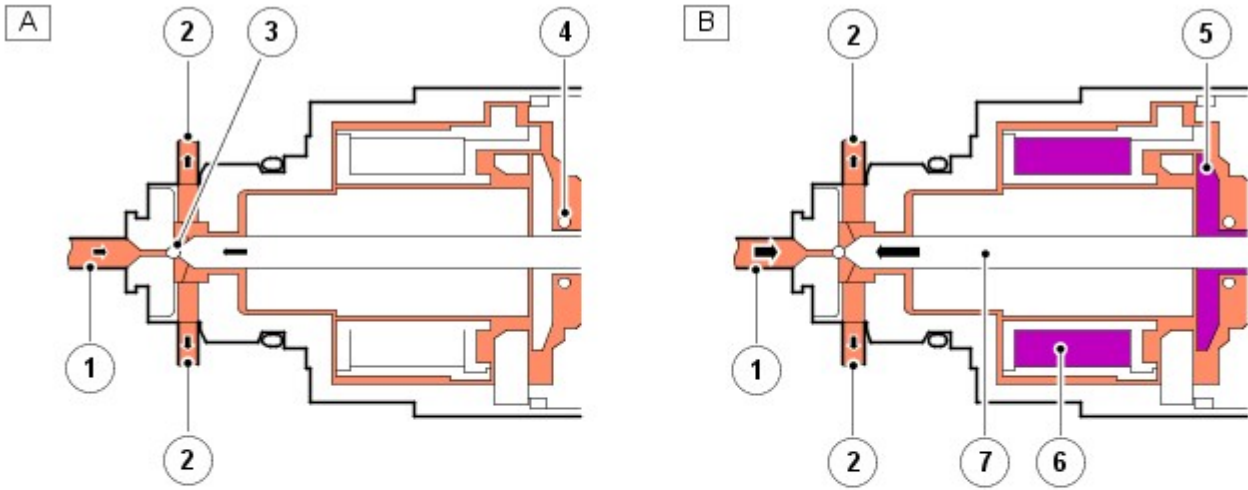
The PCV ensures that optimum pressure exists in the rail for every operating condition of the engine.

The PCV is an electro-magnetically operated valve with spring support.

The electrical current supplied by the ECM through the solenoid pulls back the control pin. This allows the diesel fuel to pass the ball valve and thus the fuel flow into the common rails.

The entire armature is coated with fuel for lubrication and cooling.

- NOTE: The PCV cannot be replaced as a separate component in service.



E50841

Item	Part Number	Description
A	-	PCV non-controlled
B	-	PCV controlled
1	-	Fuel from the HPP
2	-	To fuel return
3	-	Ball valve
4	-	Compression spring
5	-	Armature
6	-	Coil energised
7	-	Control pin
8	-	High pressure fuel
9	-	Control current
10	-	Characteristic of the PCV

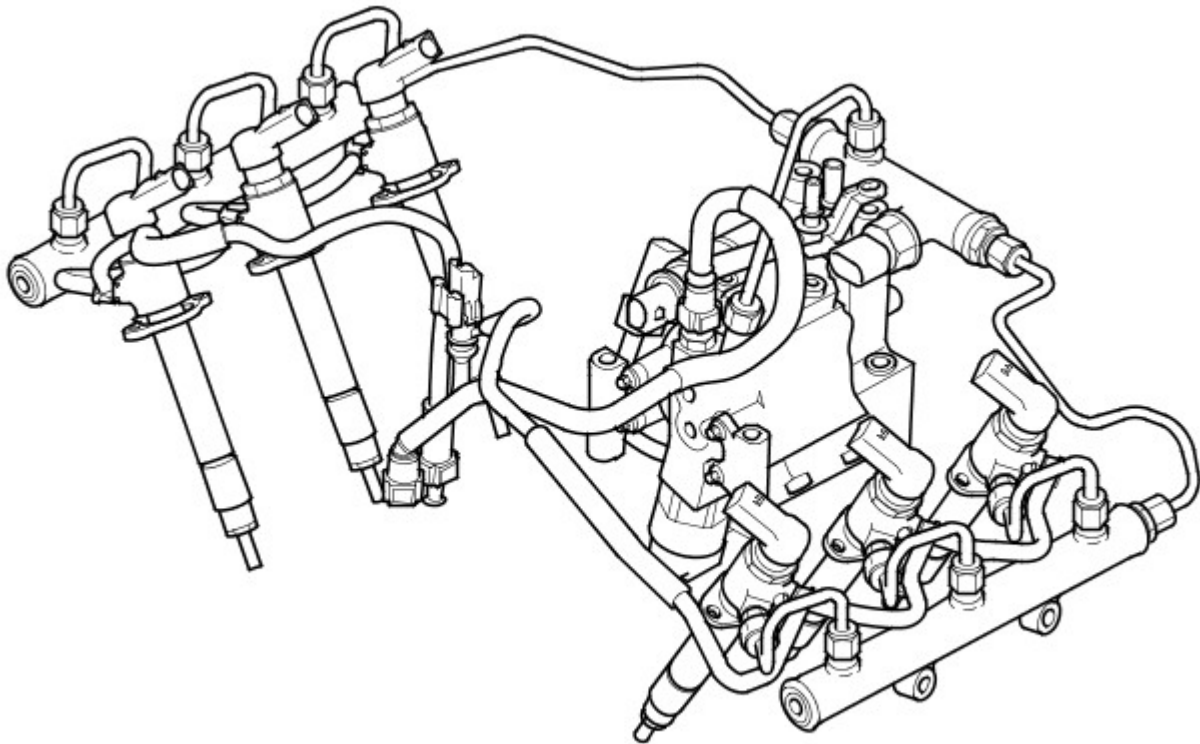
PCV Non-controlled (A)

The ball valve (3) will only be operated through the force exerted upon it by the spring (4). Thereby, the PCV is classed as open.

PCV Controlled (B)

The current flowing through the solenoid (6) draws the pin (7) down. This in turn transfers the magnetic force via the pin to the ball valve (3). The pull of the pin, and the pressure on the ball valve, is proportional to the valve flow (9).

HP Common Fuel Rails

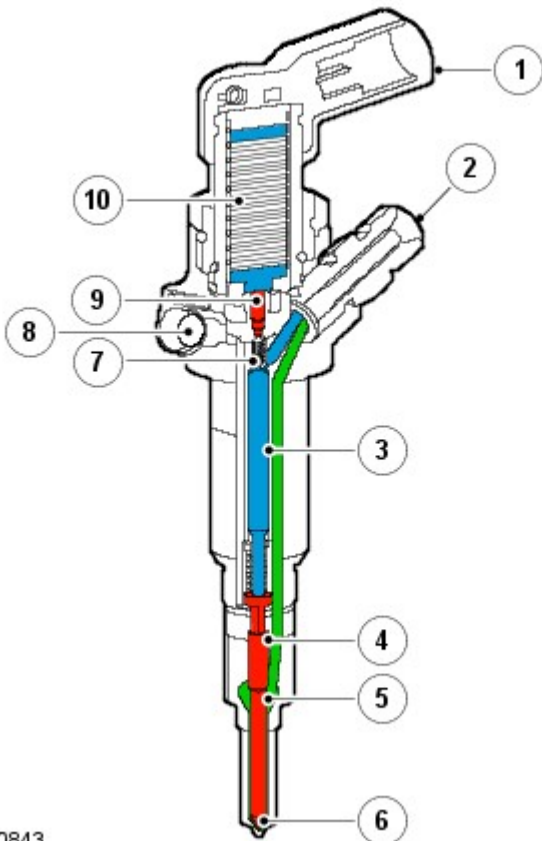


E50842

The fuel rails are manufactured from forged steel. They store the fuel at high pressure and prevent pressure fluctuations in the HP system.

All HP pipes have an internal diameter of 2.5mm except the pipes to the injectors, which are 3.0mm. Total rail volume is 33cc.

FUEL INJECTORS



E50843

Item	Part Number	Description
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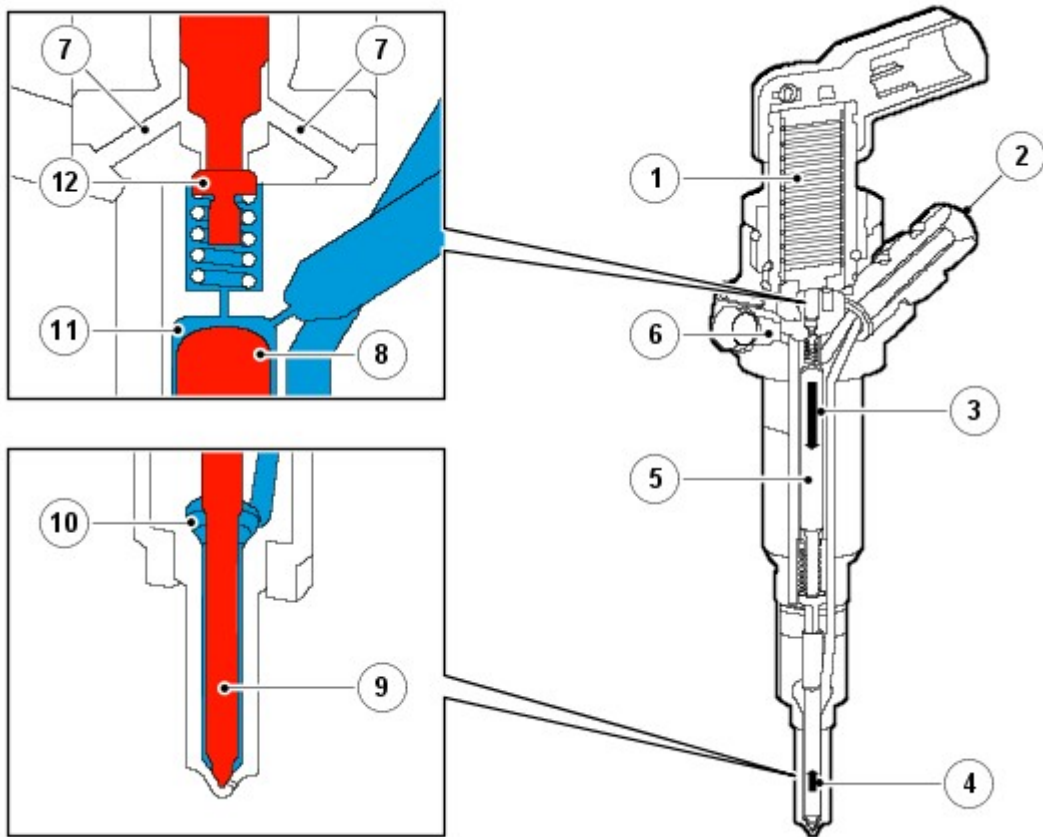
1	-	Harness connection
2	-	HP connection
3	-	Control piston
4	-	Nozzle needle
5	-	Nozzle HP chamber
6	-	Nozzle spray holes
7	-	Valve mushroom
8	-	Fuel return
9	-	Valve piston
10	-	Piezo actuator

The fuel injectors are operated directly by the ECM for fuel metering (start of injection and quantity of fuel injected).

The operating components of the piezo fuel injectors are:

- The piezo actuator
 - The injector body containing the hydraulic servo system
 - The fuel injector nozzle
- NOTE: New injectors can be installed in any cylinder and DO NOT have to be configured.
- NOTE: Each Injection event is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from, the injector. Never disconnect the wiring connector when the vehicle is running. The injector may remain open thus causing engine damage.
- NOTE: For safety reasons, the engine must be at standstill for 30 seconds before starting work on the HP fuel systems.

Fuel Injector Not Actuated (Not Injecting Fuel)



E50844

Item	Part Number	Description
1	-	Piezo actuator
2	-	HP connection
3	-	Hydraulic force applied on control piston
4	-	Hydraulic force acting on tip of nozzle
5	-	Control piston
6	-	Fuel return
7	-	Fuel return
8	-	Control piston
9	-	Nozzle needle
10	-	High pressure chamber of nozzle
11	-	Control chamber
12	-	Valve mushroom

The HP fuel from the fuel-rail passes through the HP connection (2) into the control chamber (11) and into the HP chamber (10) of the fuel injector nozzle.

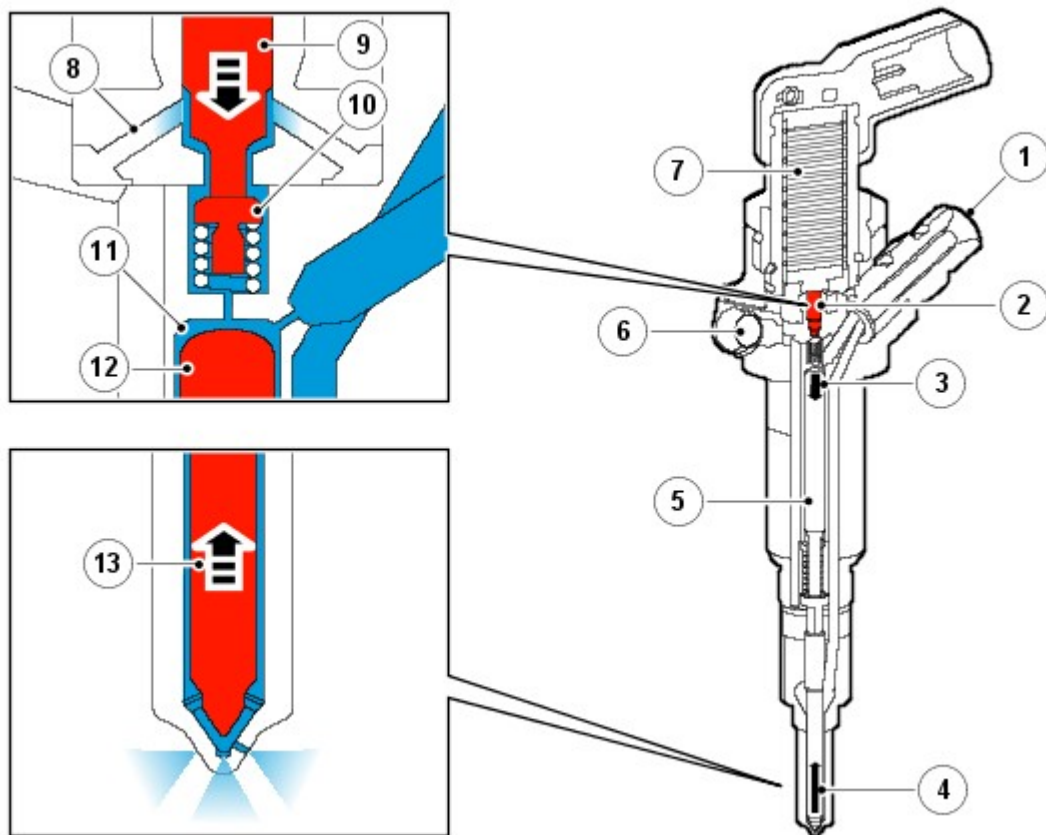
The piezo actuator (1) is currentless and the valve mushroom (12) closes the bore to the fuel return (7) by means of spring

pressure.

There is however a continuous fuel return (6) to vent internal leakage within the injector.

The hydraulic force (3), which is now applied on the control piston by the fuel under high pressure in the control chamber (11) through the control piston (8), is greater than the hydraulic force (4) acting on the tip of the nozzle (since the area of the control piston in the control chamber is greater than the area of the tip of the nozzle).

Fuel Injector Actuated (Injecting Fuel)



E50845

Item	Part Number	Description
1	-	High pressure supply
2	-	Valve piston
3	-	Hydraulic force applied on control piston
4	-	Hydraulic force acting on tip of nozzle
5	-	Control piston
6	-	Fuel return
7	-	Piezo actuator
8	-	Fuel return
9	-	Valve piston
10	-	Valve mushroom
11	-	Control chamber
12	-	Control piston
13	-	Nozzle needle

The piezo actuator (7) energized by the ECM extends (charging phase) and presses on the valve piston (9). The valve mushroom (10) opens the bore, which connects the control chamber (11) to the fuel return (8 then 6).

As a result, the pressure in the control chamber drops, and the hydraulic force (4) acting on the tip of the nozzle needle is now greater than the force (3) acting on the control piston in the control chamber.

The nozzle needle (13) moves upwards and the fuel passes through the six spray holes into the combustion chamber.

Engine Starting

During starting, the fuel rail pressure must be at least 150 bar. Should the pressure be below this figure, the injectors will not operate, resulting in the vehicle not starting.

Engine Stopped

To stop the engine the ECM stops energising the piezo actuators, therefore, no fuel is injected and the engine speed drops to zero.

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Charging and Controls

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Fuel Charging and Controls](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification

• WARNINGS:



Do **NOT** carry out any work on the fuel system with the engine running. The fuel pressure within the system can be as high as 1600 bar (23,206 lb/in²). Failure to follow this instruction may result in personal injury.



Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow this instruction may result in personal injury.



After carrying out repairs, the fuel system must be checked visually for leaks. This should be done after the engine has been run, but with the engine switched **OFF**. Failure to follow this instruction may result in personal injury.



If taken internally, **DO NOT** induce vomiting. Seek immediate medical attention. Failure to follow this instruction may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention. Failure to follow this instruction may result in personal injury.



Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention. Failure to follow this instruction may result in personal injury.

• CAUTIONS:



Before disconnecting any part of the system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into the fuel system. Failure to follow this instruction may result in damage to the vehicle.



The fuel pipes between the injectors and the rail must be discarded after each use, and new pipes installed. Failure to follow this instruction may result in damage to the vehicle.



It is essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.



Make sure that the workshop area in which the vehicle is being worked on is as clean and dust-free as possible. Areas in which work on clutches, brakes or where welding or machining are carried out are not suitable in view of the risk of contamination to the fuel system. Failure to follow this instruction may result in damage to the vehicle.



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material. Failure to follow this instruction may result in damage to the vehicle.



Make sure that any protective gloves worn are new and are of the non-powdered latex type. Failure to follow this instruction may result in damage to the vehicle.



Make sure that clean, non-plated tools are used. Clean tools using a new brush that will not lose it's bristles and fresh cleaning fluid prior to starting work on the vehicle. Failure to follow this instruction may result in damage to the vehicle.



Use a steel-topped work bench and cover it with clean, lint-free, non-flocking material. Failure to follow this instruction may result in damage to the vehicle.



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor

vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel level ● Contaminated fuel ● Fuel supply line(s) ● Fuel return line(s) ● High-pressure fuel supply line(s) ● Fuel tank filler pipe ● Fuel leak(s) ● Fuel tank ● Fuel filler cap ● Fuel filter ● Push connect fittings ● Fuel rail ● Fuel injection pump ● Exhaust Gas Recirculation (EGR) system 	<ul style="list-style-type: none"> ● Glow plug indicator ● Inertia switch ● Fuel pump module ● Sensor(s) ● Engine Control Module (ECM) ● Fuel volume control valve (FVCV) ● Fuel pressure control valve (FPCV) ● Fuel rail pressure (FRP) sensor ● Fuel temperature sensor ● Fuel injector(s) ● Exhaust Gas Recirculation (EGR) system

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> ● Inertia fuel shutoff switch ● Low/Contaminated fuel ● Air leakage ● Low-pressure fuel system fault ● Fuel pump module (lift pump) fault ● Blocked fuel filter ● Fuel volume regulator blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel pump fault ● Crankshaft position (CKP) sensor 	Check that the inertia switch has not tripped. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.
Difficult to start	<ul style="list-style-type: none"> ● Glow plug system fault (very cold conditions) ● Low/Contaminated fuel ● Air leakage ● Fuel pump module (lift pump) fault ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Rough idle	<ul style="list-style-type: none"> ● Intake air system fault ● Low/Contaminated fuel ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.

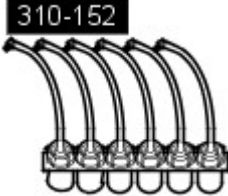

Symptom	Possible Causes	Action
	valve(s) fault	
Lack of power when accelerating	<ul style="list-style-type: none"> ● Intake air system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust gas recirculation (EGR) valve(s) fault ● Turbocharger actuator fault 	Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary. Check for DTCs indicating a fuel pressure fault. Check the EGR system. Check turbocharger actuator.
Engine stops/stalls	<ul style="list-style-type: none"> ● Air leakage ● Low/Contaminated fuel ● Low-pressure fuel system fault ● High pressure fuel leak ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Engine judders	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Air ingress ● Low-pressure fuel system fault ● Fuel metering valve blocked/contaminated ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● High pressure fuel leak ● Fuel pump fault 	Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	<ul style="list-style-type: none"> ● Low-pressure fuel system fault ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel temperature sensor leak ● High pressure fuel leak ● Injector(s) fault ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the EGR system.

DTC Index

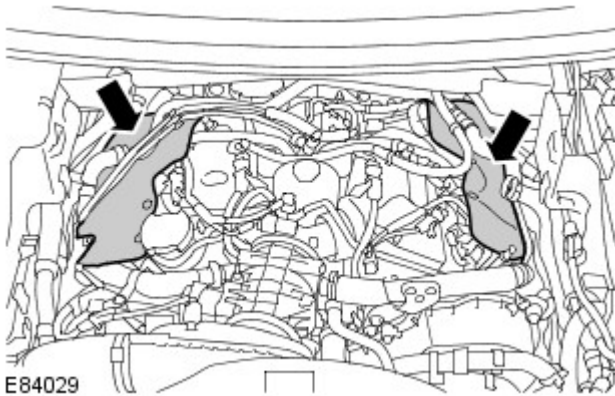
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Injector Balance and Spill Check

General Procedures

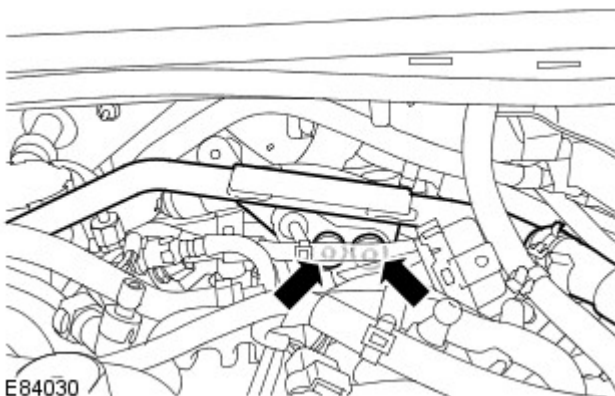
Special Tool(s)	
 <p>310-152</p> <p>E84154</p>	<p>Fuel Injector Spill Test Kit 310-152</p>
 <p>310-152-02</p> <p>E84153</p>	<p>Fuel Return Blanking Caps 310-152-02</p>

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: Engine Cover - 2.7L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the injector sound proofing.

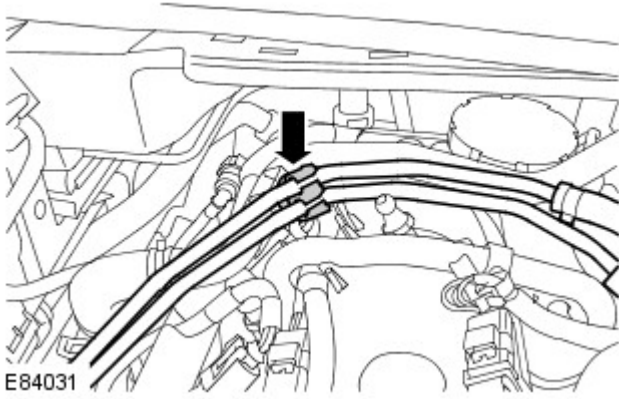


4. Release the EGR coolant cross-over pipe.

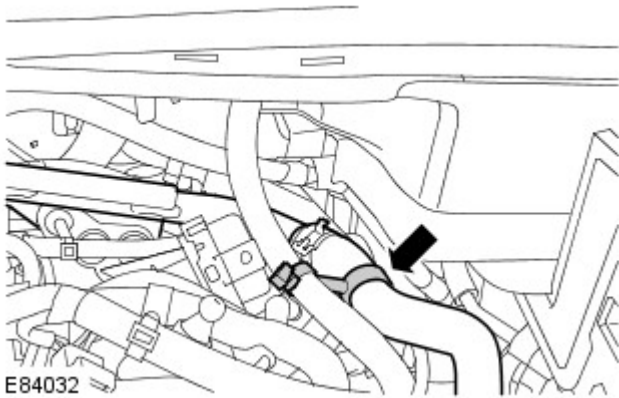
- Remove the 2 bolts.



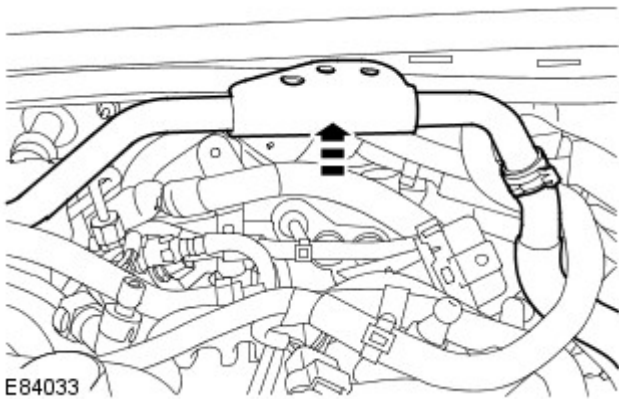
5. Release the fuel supply and fuel return clips from the heater hose.



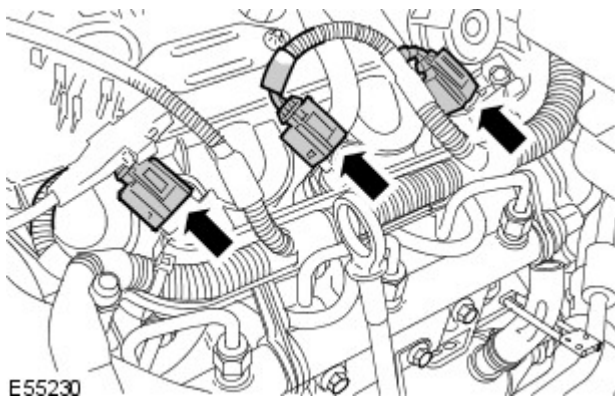
6. Release the engine harness and heater hose from clip.



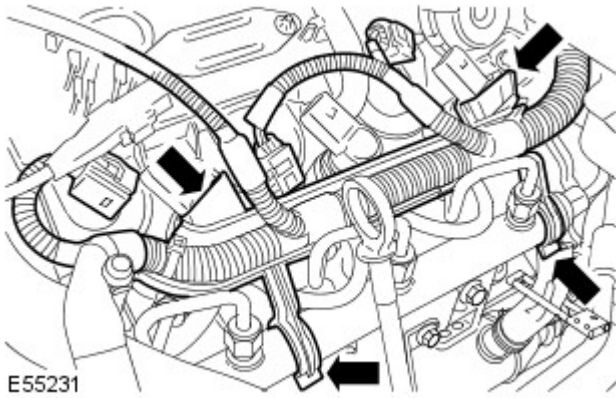
7. Release the coolant pipe on bulkhead and position aside. Do not disconnect the coolant pipe.



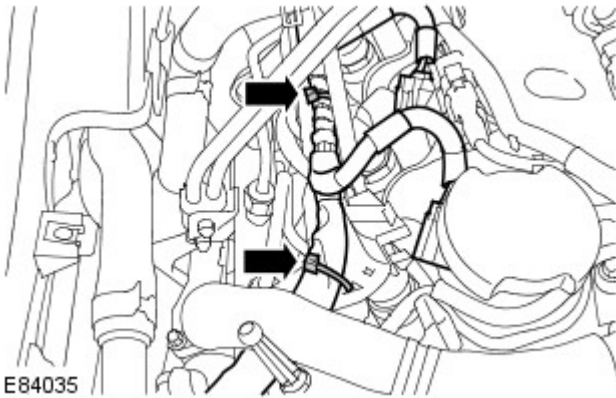
8. Disconnect the fuel injector electrical connectors.



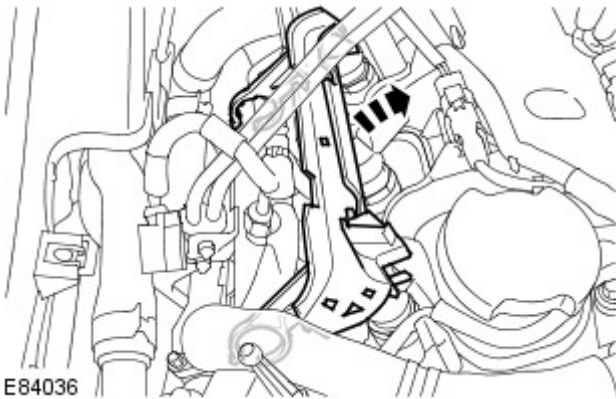
9. Detach the fuel injection wiring harness.



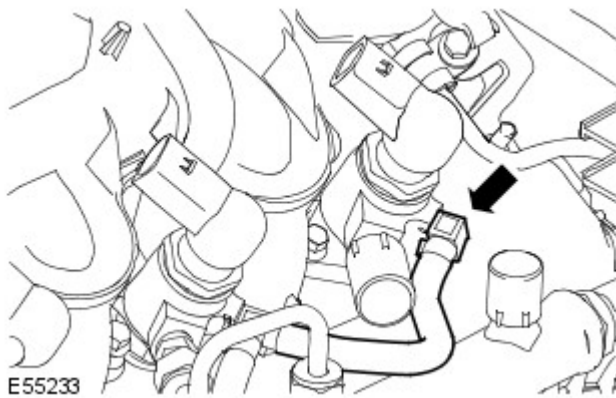
10. Cut and remove cable ties securing harness to support tray.



11. Release the harness bracket clips and remove the support trays.



12. Disconnect the fuel return line from the fuel injectors.

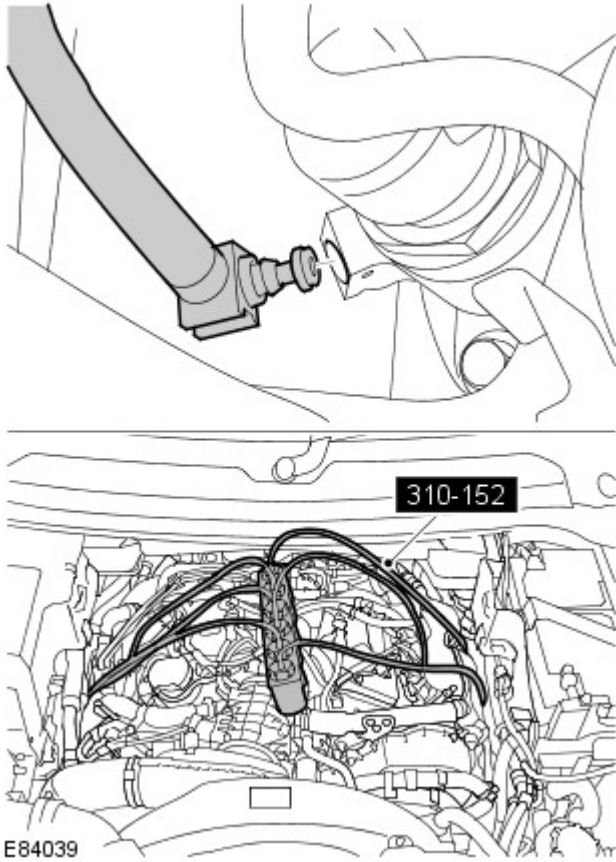


13. Blank-off each spill return with plugs from kit.



14. Connect the fuel injector electrical connectors.

15. Connect spill bottle to each of the injectors.




16. Connect the battery ground cable.

17. Connect Land Rover approved diagnostic equipment to vehicle.

18. Run cylinder balance test from 'live data'.

- Injector balance limits are between 700 and 1.3 k.
- Note any injector that is outside of these figures (a figure below the limit will usually mean a reduction in fuelling, and a figure above will result in an increase to fuelling).

19.  **WARNING:** Before starting engine, ensure all connectors are properly secure.

 **CAUTION:** Do not reject any of the injectors if the spill rates are even but outside of the correct rates shown. The spill rate can be affected by varying fuel rail pressure and fuel temperature. Only suspect a faulty injector(s) if the amount of fuel collected is significantly higher than the others. A faulty injector could fill a bottle within 2 minutes.

- **NOTE:** The figures shown are to be used as a guide only.


Start the engine and immediately check the spill rate into the bottles. If possible, allow engine to run for 2 minutes. If any bottle is filling at a very fast rate and is likely to fill before 2 minutes is reached, stop engine and note which injector the fuel is coming from.

Time	Flow Rate
1 minute idle	Min rate 10 ml - Max rate 25 ml
4 minute idle	Min rate 15 ml - Max rate 26 ml

20. Disconnect the battery ground cable.

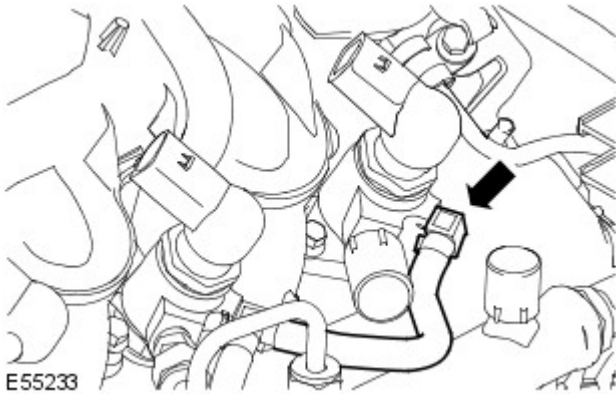
21. Disconnect all spill pipes and bottles. Replace an injector(s) that has either excessive spill or failed the balance check.

22. Remove blank-off plugs from spill return pipes.

23.  **CAUTION:** Make sure the fuel return line retaining clip is correctly installed to the fuel injector before installing the return line.

Connect the fuel return line to the fuel injector.

- Visually inspect the fuel return line O-ring seals for damage.
- Apply a light coating of petroleum jelly to the fuel return line O-ring seals.



24. Disconnect the injector electrical connectors and release the wiring harness.

25. Install the injector harness support trays and secure with cable ties.

26. Connect and secure the fuel injector wiring harness electrical connectors.

27. Secure the engine harness to heater hose clip.

28. Secure the fuel supply and fuel return to heater hose clips.

29. Refit coolant pipe to mounting at rear of engine.

30. Install the EGR coolant cross-over pipe.

- Tighten the bolts to 13 Nm (10 lb.ft).

31. Install the injector sound proofing.

32. Install the engine cover.

For additional information, refer to: Engine Cover - 2.7L Diesel (501-05 Interior Trim and Ornamentation, Removal and Installation).

33. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Injection Component Cleaning

General Procedures

• WARNINGS:



Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1700 bar (24,656 lb-sq-in). Failure to follow this instruction may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

• CAUTIONS:



Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.



Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.



Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh cleaning fluid, prior to starting work on the vehicle.



Use a steel topped workbench and cover it with clean, lint-free non-flocking material.





Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

• NOTE: Pneumatic vacuum gun

1. Using a new brush that will not lose its bristles, brush cleaning fluid onto the components being removed and onto the surrounding area.
2. Using a pneumatic vacuum gun, remove all traces of cleaning fluid and foreign material.
3. Dispose of any used cleaning fluid and the brush after completing the repair.





Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel PumpVIN Range:**SALLA000304->END OF 06MY**

Removal and Installation





Special Tool(s)	
 <p>310-139 E54548</p>	<p>Holder - Fuel Pump Pulley 310-139</p>
 <p>310-138 E54547</p>	<p>Reaction Arm - Fuel Pump Pulley 310-138</p>

Removal

• WARNINGS:

-  Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.
-  Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

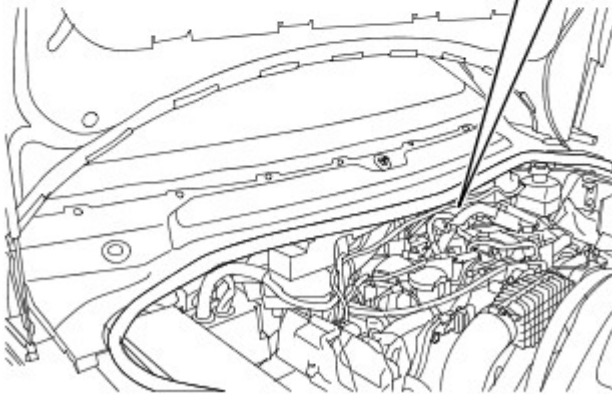
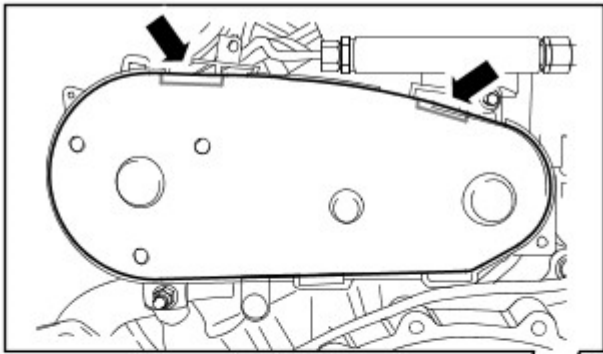
• CAUTIONS:

-  Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.
-  Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the crankcase vent oil separator.
For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

3. Remove the fuel injection pump belt cover.

- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.

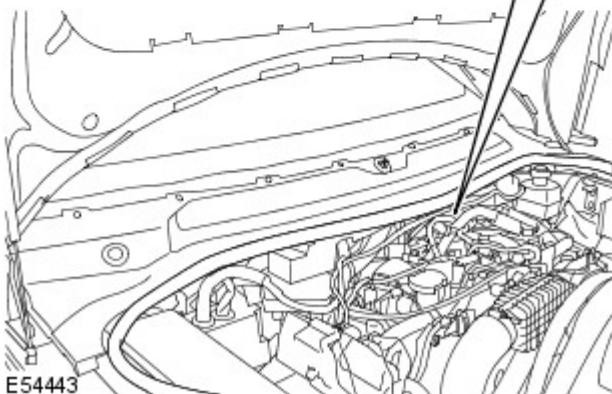
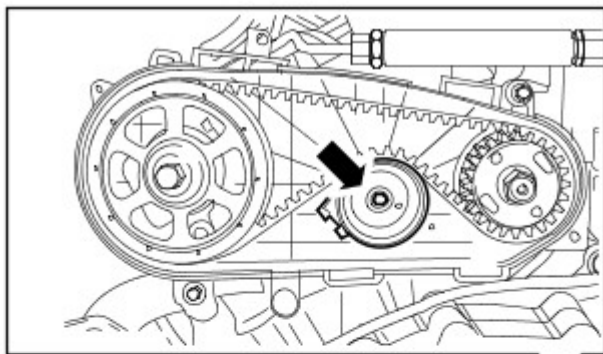


E54442

4. NOTE: The fuel injection pump belt is not timed to the engine.

Remove and discard the fuel injection pump belt tensioner.

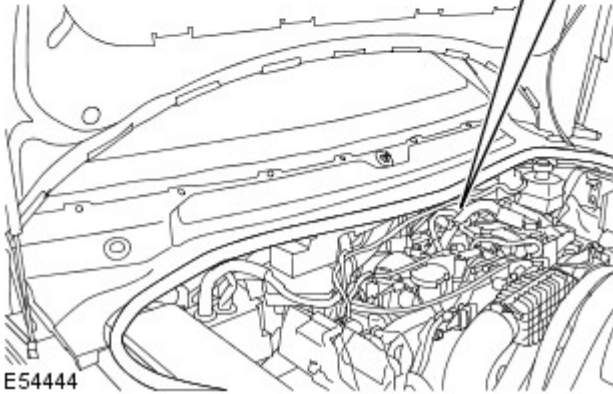
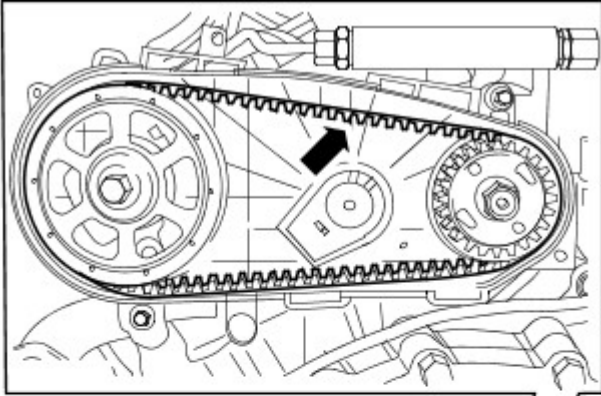
- Remove the LH retaining bolt.



E54443

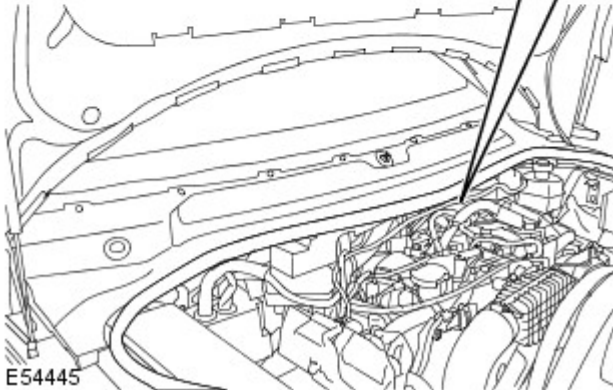
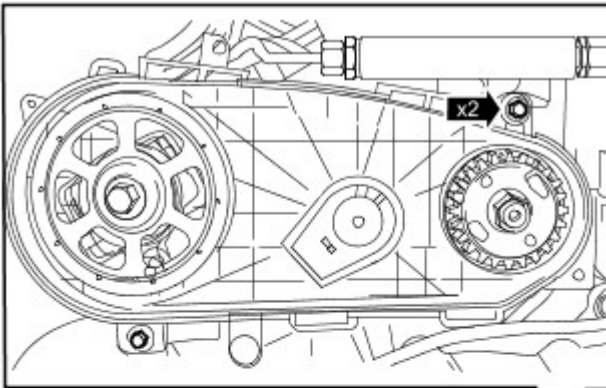
5. NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Remove and discard the fuel injection pump belt.



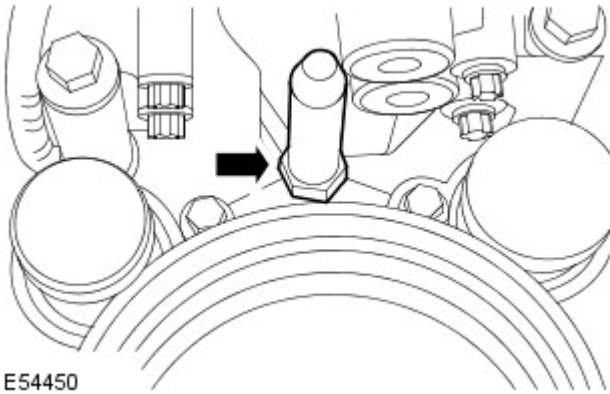
E54444

6. Remove the fuel injection pump belt rear cover retaining bolts.



E54445

7. Remove the crankcase vent oil separator locating stud.




E54450

8. NOTE: Left-hand shown, right-hand similar.

Release the high-pressure fuel supply lines.

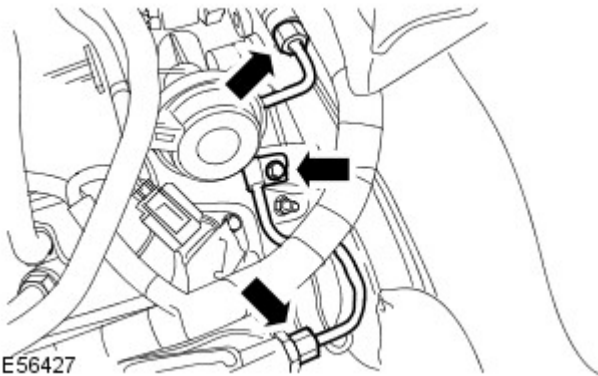
- Remove the LH retaining bolt.

9.  CAUTION: Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

• NOTE: Left-hand shown, right-hand similar.

Remove and discard the high-pressure fuel supply lines.

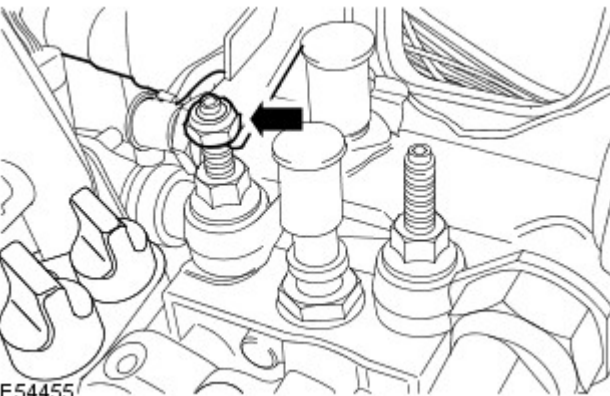
- Install blanking caps to the exposed ports.



E56427

10. Release the fuel charging wiring harness.

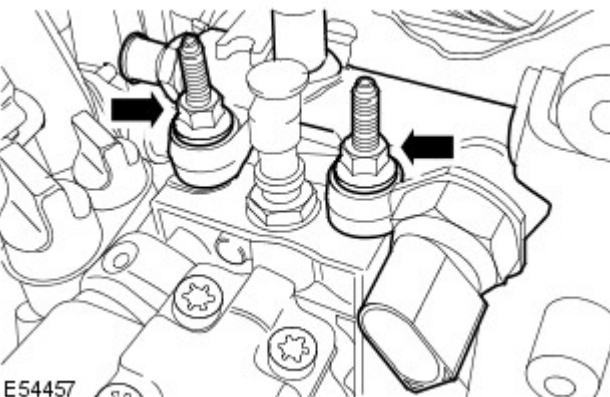
- Remove the retaining nut.



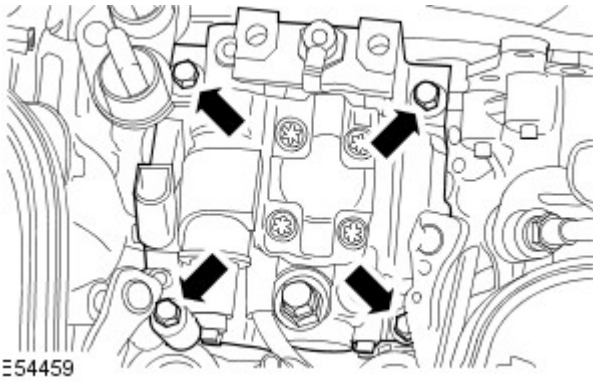
E54455

11. Remove the fuel injection diverter rail.

- Remove the 2 studs.



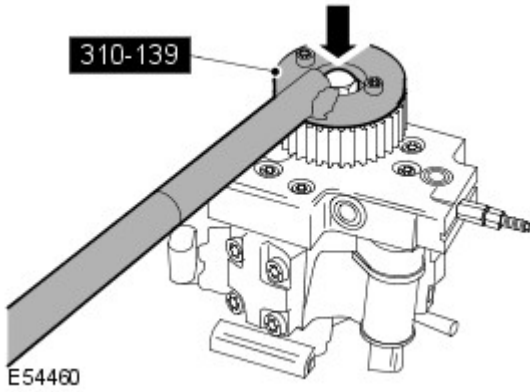
E54457



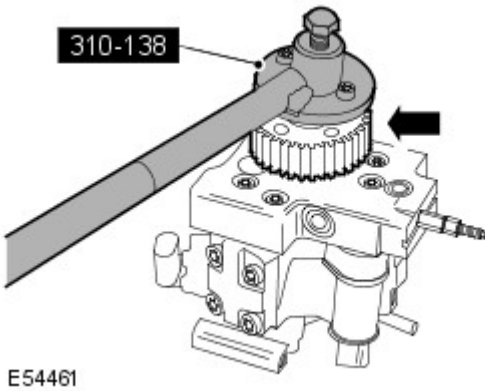
12. Remove the fuel injection pump.
 - Remove the four retaining bolts.

13. NOTE: Do not disassemble further if the component is removed for access only.

Using the special tool, remove the fuel injection pump pulley retaining nut.

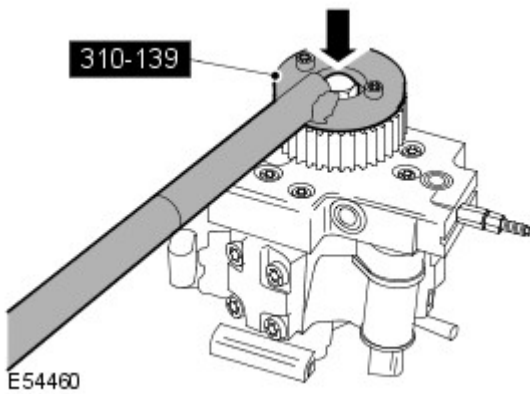


14. Using the special tool, remove the fuel injection pump pulley.



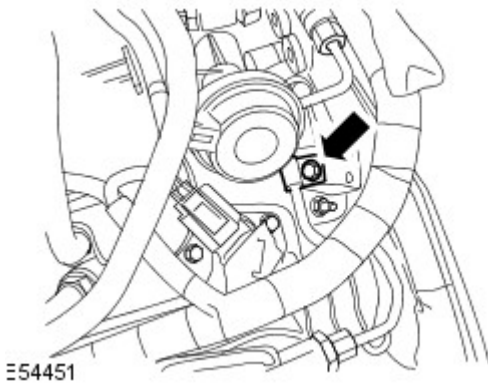
Installation


1. Using the special tool, install the fuel injection pump pulley.
 - Tighten to 50 Nm (37 lb.ft).



2. Install the fuel injection pump.
 - Tighten the bolts to 23 Nm (17 lb.ft).

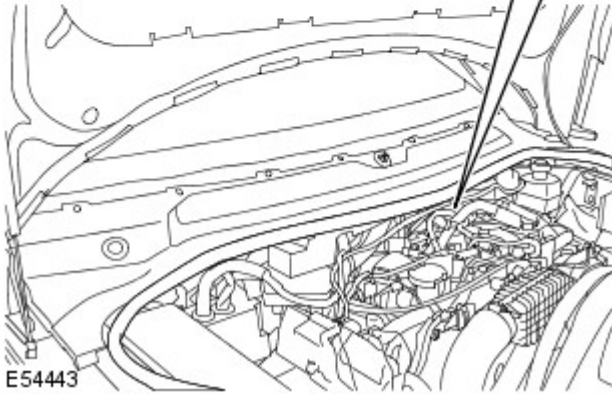
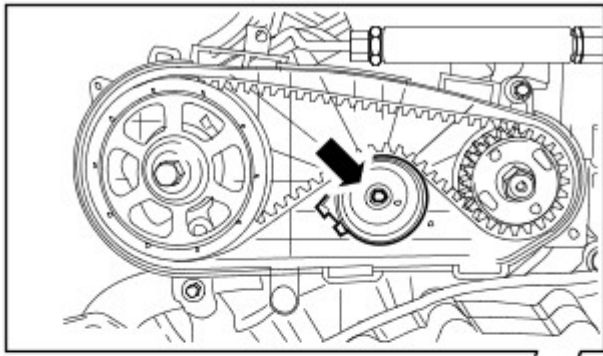
3. Install the fuel injection diverter rail.
 - Install the two retaining studs, but do not fully tighten at this stage.
4. Attach the fuel charging wiring harness.
 - Install the retaining nut.
5. Install the new high-pressure fuel supply lines.
 - Remove the blanking caps from the ports.
 - Loosely install the new high-pressure fuel supply lines.
 - Tighten the fuel injection diverter rail retaining studs to 23 Nm (17 lb.ft).
 - Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).
 - Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
 - Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 35 Nm (26 lb.ft).
 - Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection pump to 35 Nm (26 lb.ft).




6. Attach the high-pressure fuel supply lines.
 - Install the two retaining bolts.
 - Tighten to 10 Nm (7 lb.ft).
7. Install the crankcase vent oil separator locating stud.
 - Tighten the stud to 10 Nm (7 lb.ft).
8. Install the fuel injection pump belt rear cover retaining bolts.
 - Tighten to 7 Nm (5 lb.ft).
9.  **CAUTION:** Do not install the new fuel injection pump belt to the pulleys with the fuel pump belt tensioner installed. Failure to follow this instruction may result in damage to the fuel pump belt.

• **NOTE:** The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Install the new fuel injection pump belt.



10.  **CAUTION:** Make sure that the fuel injection pump belt tensioner tang is correctly located to the fuel injection pump belt rear cover. Failure to follow this instruction may result in damage to the engine.

Install a new fuel injection pump belt tensioner.

- Locate the tang on the new fuel injection pump belt tensioner into the fuel injection pump rear cover.
- Tighten to 25 Nm (18 lb.ft).
- Remove and discard the fuel injection pump belt tensioner locking pin.

11. Install the fuel injection pump belt cover.

- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.

12. Install the crankcase vent oil separator.

For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

13. Connect the battery ground cable.



For additional information, refer to: Specifications (414-00, Specifications).

14. Bleed the fuel system.

For additional information, refer to: [Low-Pressure Fuel System Bleeding](#) (310-00 Fuel System - General Information, General Procedures).





Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel PumpVIN Range: 07**MODEL YEAR->CURRENT**

Removal and Installation





Special Tool(s)	
 <p>310-161 E83080</p>	Holding tool 310-161
 <p>310-160 E83081</p>	Remover 310-160

Removal

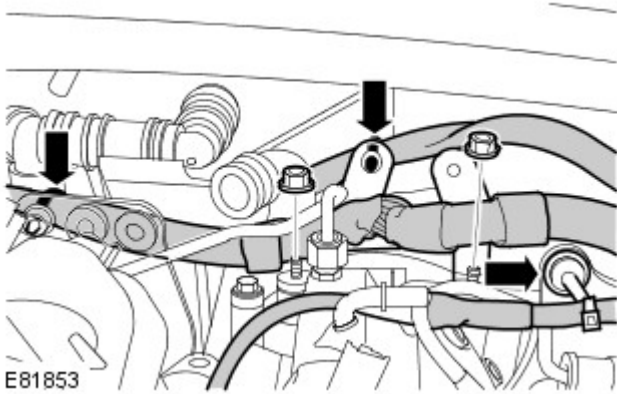
• WARNINGS:

-  Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.
-  Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

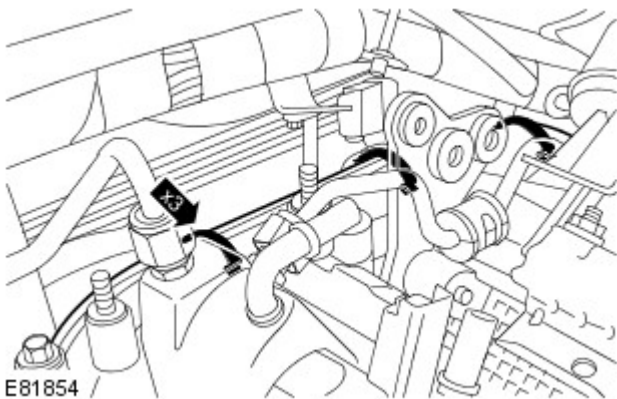
-  Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.
-  Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the crankcase vent oil separator.
For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).



3. Release the fuel charging wiring harness.

- Release the 3 clips.
- Remove the 2 nuts.



4. Remove the fuel injection pump belt cover.

- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.
- Release the 3 clips.

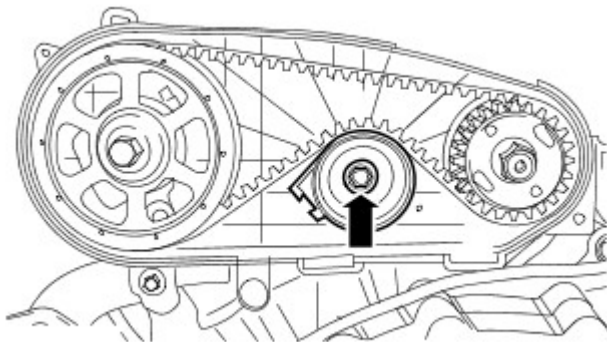
5. NOTE: The fuel injection pump belt is not timed to the engine.

Remove and discard the fuel injection pump belt tensioner.

- Remove and discard the bolt.

6. NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Remove and discard the fuel injection pump belt.

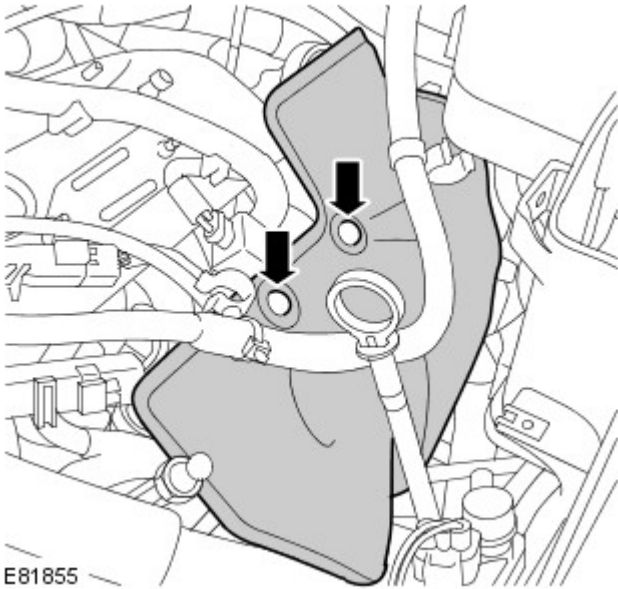


E82035

7. NOTE: Left-hand shown, right-hand similar.

Remove the injector sound proofing.


- Remove the 4 clips.



8. NOTE: Left-hand shown, right-hand similar.

Release the high-pressure fuel supply lines.

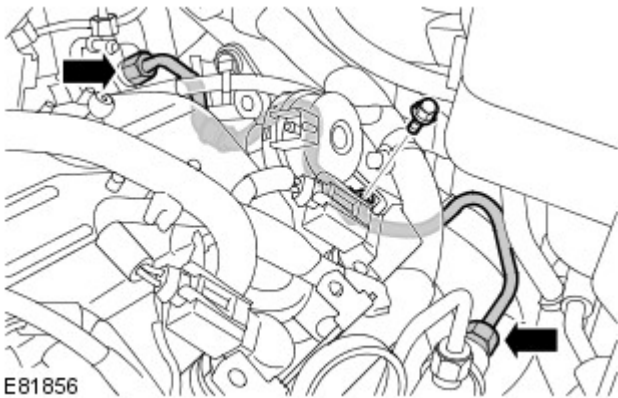
- Remove the bolt.

9.  CAUTION: Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection pump until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

● NOTE: Left-hand shown, right-hand similar.

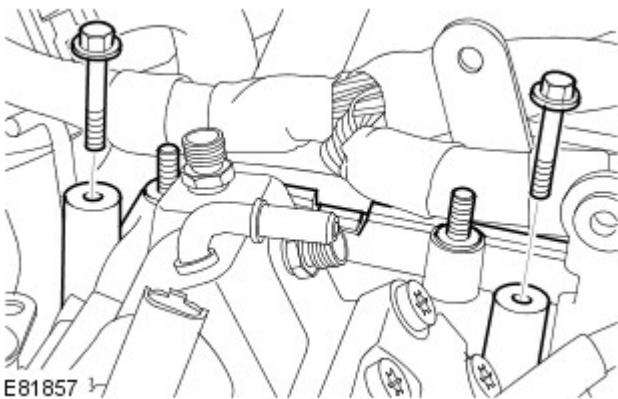
Remove and discard the high-pressure fuel supply lines.

- Install blanking caps to the exposed ports.



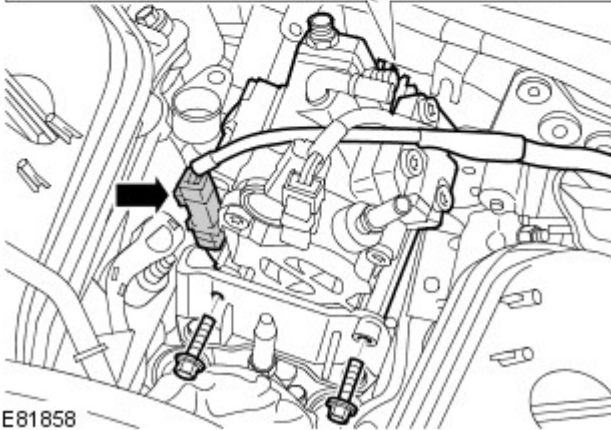
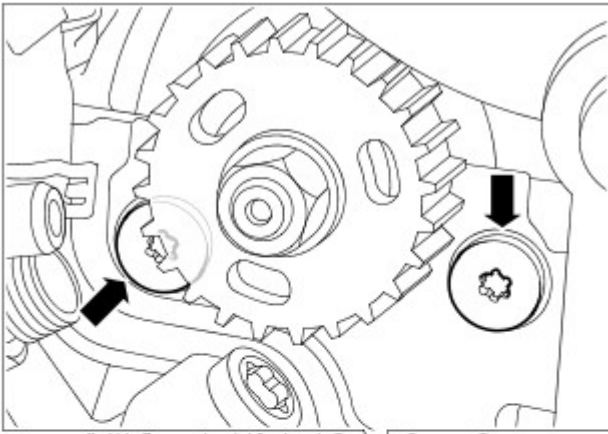
10. Remove the timing belt rear cover access panel.

- Remove the 2 bolts.



11. Remove the fuel injection pump.

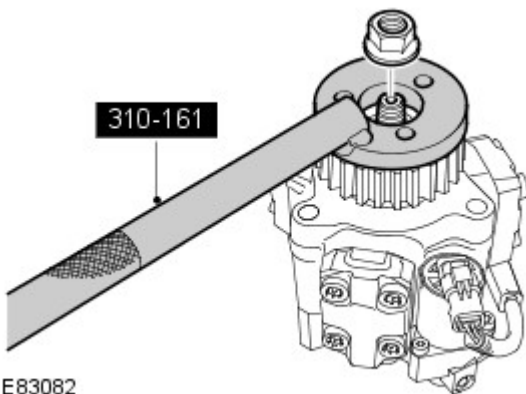
- Remove and discard the 2 Torx bolts.
- Remove and discard the 2 bolts.
- Release the electrical connector.



E81858

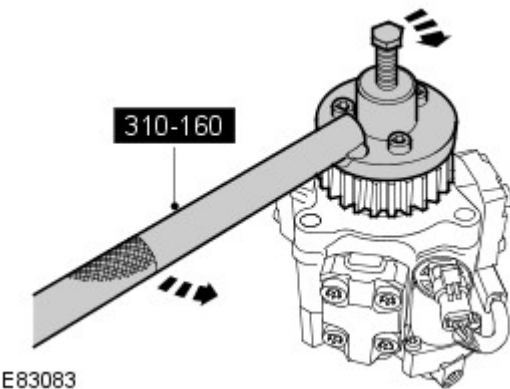
12. NOTE: Do not disassemble further if the component is removed for access only.

Using the special tool, remove the fuel injection pump pulley retaining nut.



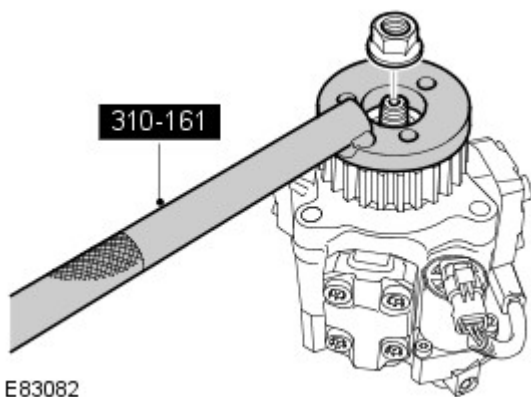
E83082

13. Using the special tool, remove the fuel injection pump pulley.



E83083

Installation



1. Using the special tool, install the fuel injection pump pulley.

- Clean the component mating faces.
- Tighten the nut to 50 Nm (37 lb.ft).

2. Install the fuel injection pump.

- Clean the component mating faces.
- Loosely install the new bolts.
- Stage 1: Tighten the Torx bolts to 23 Nm (17 lb.ft).
- Stage 2: Tighten the M8 bolts to 23 Nm (17 lb.ft).
- Connect the electrical connector.

3. Install the timing belt rear cover access panel.

- Tighten the bolts to 10 Nm (7 lb.ft).

4. Install the new high-pressure fuel supply lines.

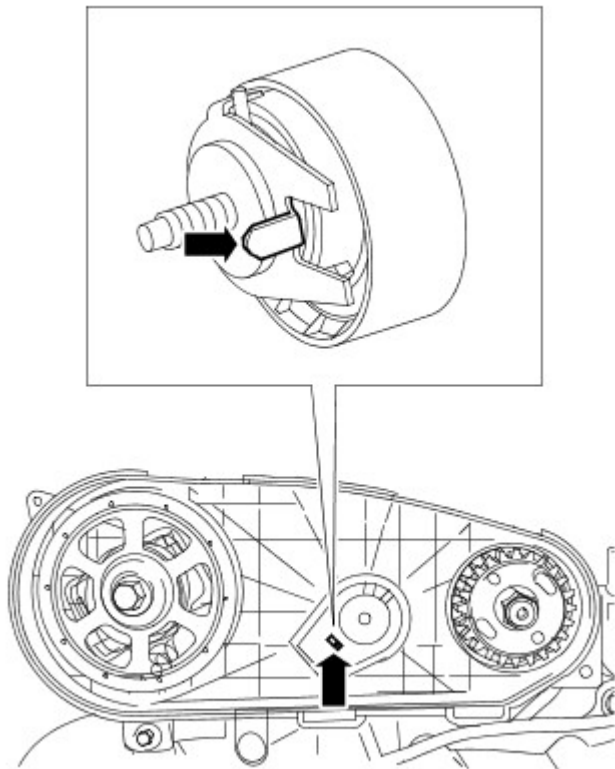
- Remove the blanking caps from the ports.
- Clean the components mating faces.
- Loosely install the new high-pressure fuel supply lines.
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection pump to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 35 Nm (26 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection pump to 35 Nm (26 lb.ft).

5. Attach the high-pressure fuel supply lines.


- Align the 2 clips.
- Tighten the bolts to 10 Nm (7 lb.ft).

6. Install the injector sound proofing.

- Secure the 4 clips.




E81861

7.  CAUTION: Make sure that the fuel injection pump belt tensioner tang is correctly located to the fuel injection pump belt rear cover. Failure to follow this instruction may result in damage to the engine.

• NOTE: Do not remove the fuel injection pump belt tensioner locking pin at this stage.

Install a new fuel injection pump belt tensioner.

- Clean the components mating faces.
- Locate the tang on the new fuel injection pump belt tensioner into the fuel injection pump rear cover.
- Tighten the bolt to 25 Nm (18 lb.ft).

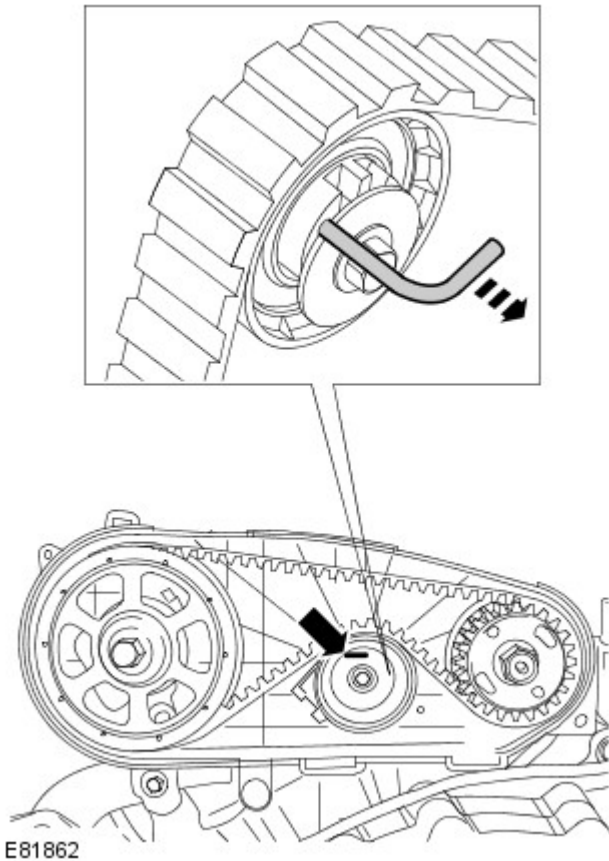
8.  CAUTION: Do not install the new fuel injection pump belt to the pulleys with the fuel pump belt tensioner locking pin removed. Failure to follow this instruction may result in damage to the fuel pump belt.

• NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Install the new fuel injection pump belt.

- Make sure the components are clean and dry.

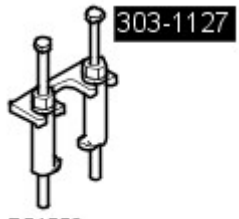
9. Remove and discard the fuel injection pump belt tensioner locking pin.



10. Install the fuel injection pump belt cover.
- Secure with the 3 clips.
 - Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.
11. Attach the fuel charging wiring harness.
- Secure with the 3 clips.
 - Tighten the nuts to 10 Nm (7 lb.ft).
12. Install the crankcase vent oil separator.
For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
13. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
14. Bleed the fuel system.
For additional information, refer to: [Low-Pressure Fuel System Bleeding](#) (310-00 Fuel System - General Information, General Procedures).


Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Injector

Removal and Installation


Special Tool(s)	
 <p>303-1127</p> <p>E54552</p>	<p>Fuel Injector remover</p> <p>303-1127</p>


Removal

• WARNINGS:


 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.


 Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.

• CAUTIONS:

 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

 Do not disconnect the fuel injector electrical connectors with the engine running. Failure to follow this instruction may result in serious damage to the engine.

 Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

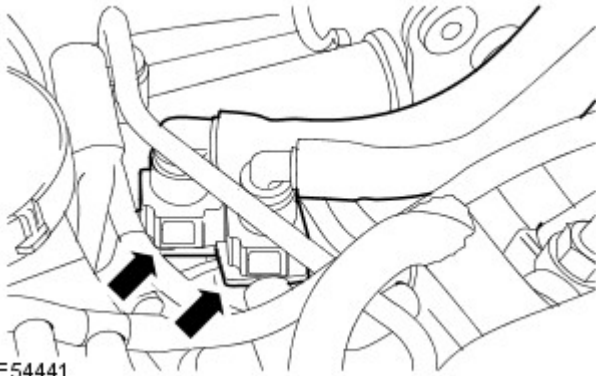
 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Disconnect the low-pressure fuel lines.

- Install blanking caps to the exposed ports.



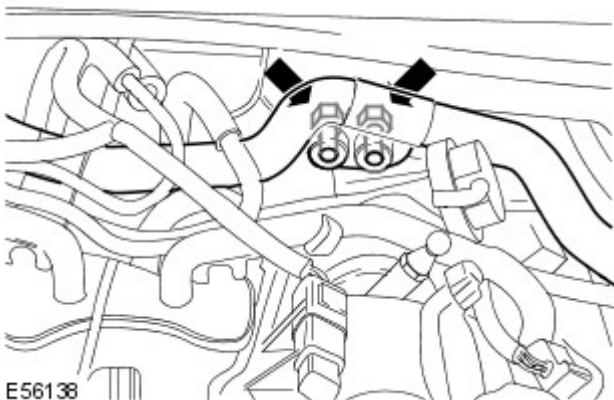
4. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

- Clamp the EGR coolant hoses to minimize coolant loss.



5. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.

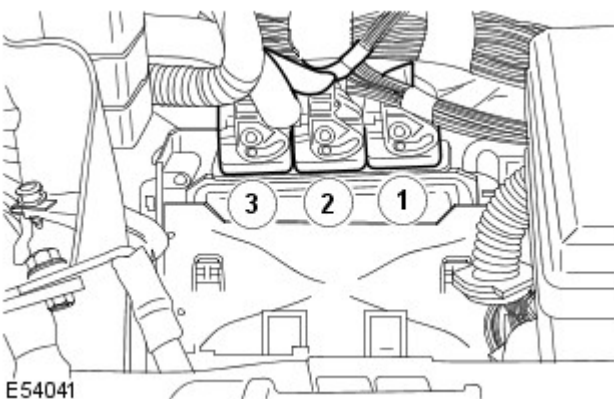


6. Remove the battery.

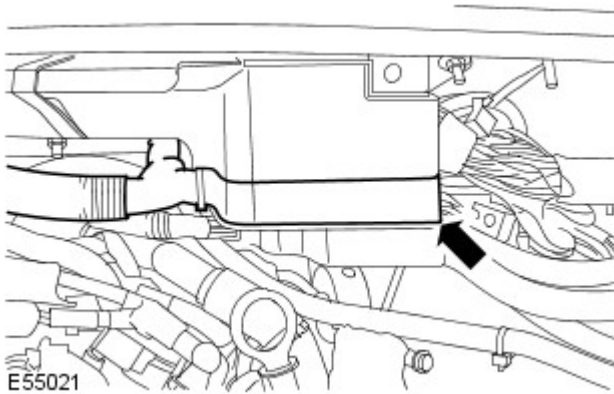
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

7. NOTE: Right hand drive shown, for Left hand drive reverse the sequence.

Disconnect the three engine harness electrical connectors in the order shown.

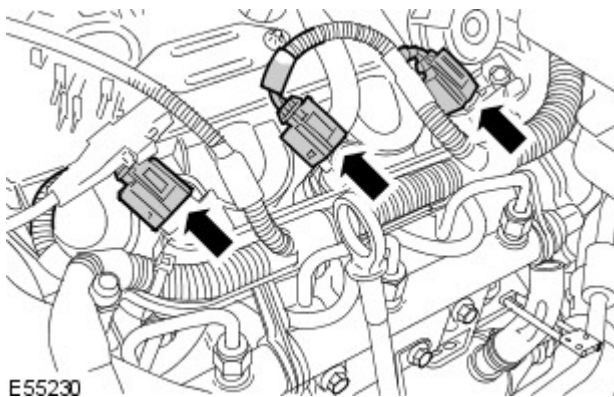


8. Release the engine wiring harness from the bulkhead.



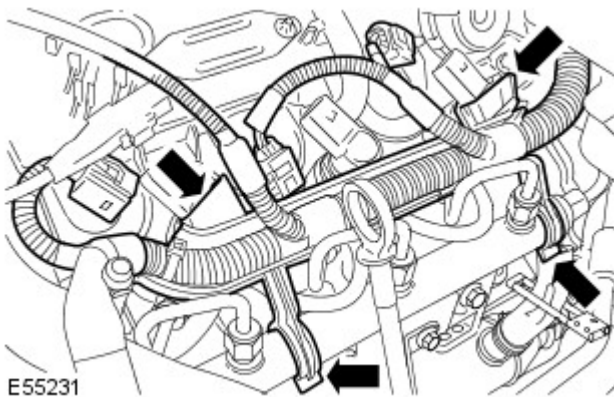
9. Remove the injector sound proofing.

10. Disconnect the fuel injector electrical connectors.




11. Release the engine wiring harness.

- Release the 4 clips.

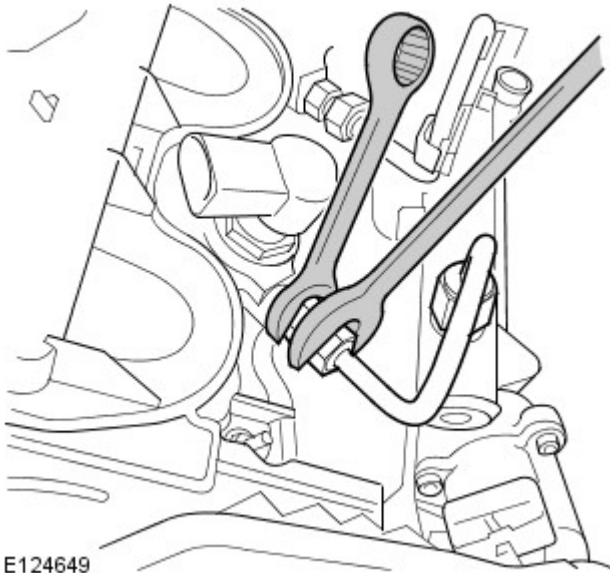


12. CAUTIONS:

 Make sure that the high-pressure fuel supply line remains in contact with the fuel pump and fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not use any aggressive cleaning fluid or a wire brush to clean the fuel injector nozzle.

Using the pneumatic vacuum gun, vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel injection supply manifold.
For additional information, refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).

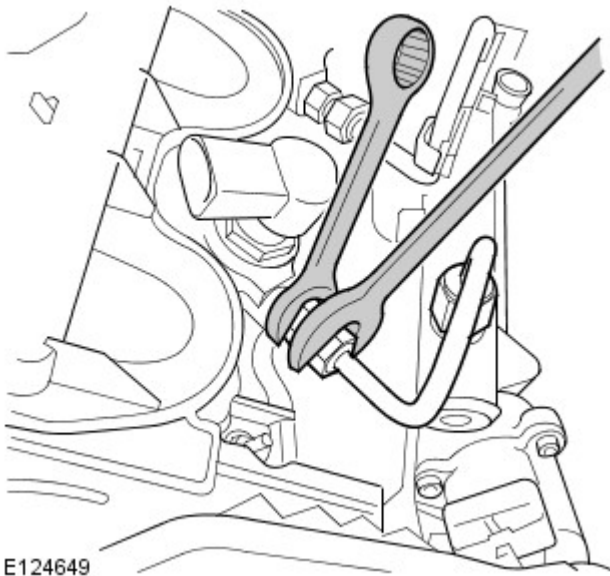


13. CAUTIONS:

⚠ Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

⚠ Make sure that the fuel injector adaptor union does not move when loosening the high-pressure fuel supply lines. Failure to follow this instruction may result in damage to the fuel injector or the fuel injector adaptor union.

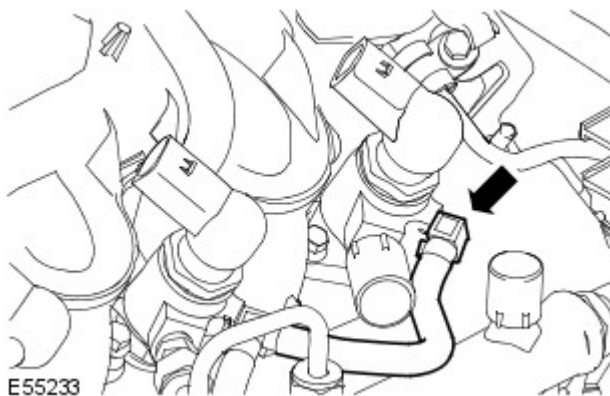
Loosen the high-pressure fuel supply line from the fuel injector and fuel rail.



14. **⚠** CAUTION: Make sure that all openings are sealed. Use new blanking caps.

• NOTE: Right-hand shown, left-hand similar.

Remove and discard the high-pressure fuel supply line.



15. Disconnect the fuel return line from the fuel injector.

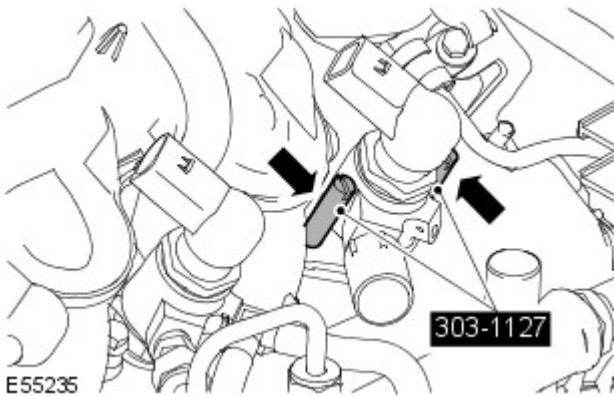
- Remove and discard the fuel return line retaining clip.


16. Remove the two fuel injector retaining bolts.

- Remove the fuel injector retaining clamp spacer.

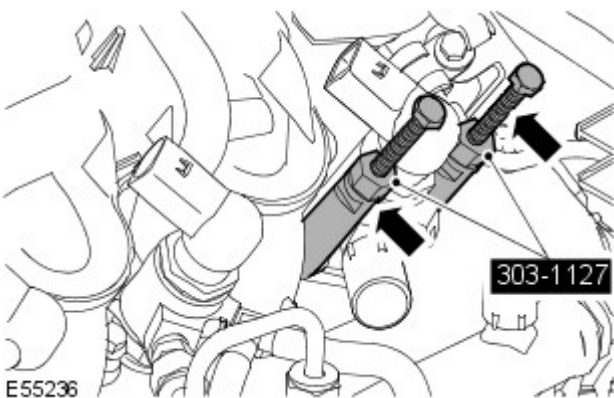



17. Install the special tool studs.



18.  CAUTION: Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

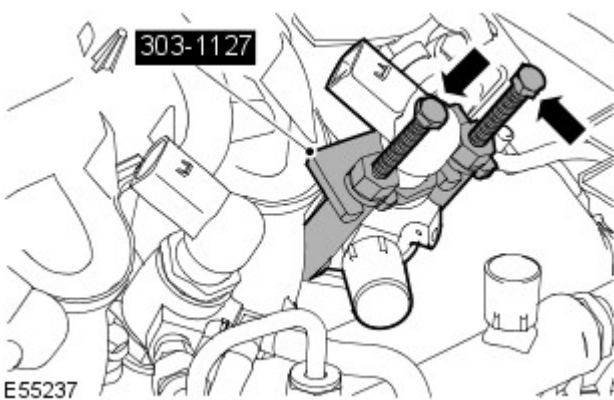
Install the special tool remover legs to the studs.



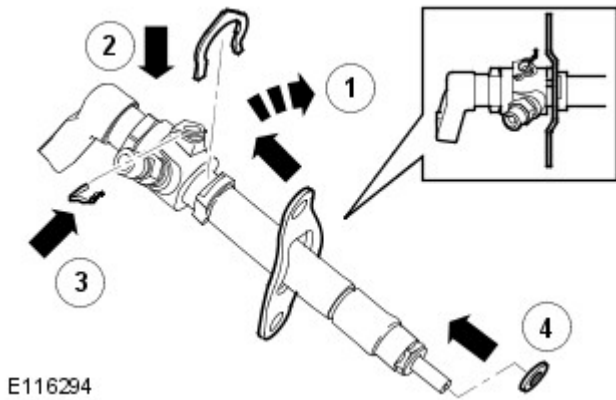
19.  CAUTION: Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

Remove the fuel injector.

- Rotate the special tool bolts evenly, in a clockwise direction.
- Remove the special tool.
- Remove and discard the fuel injector retaining clamp.
- Remove and discard the sealing washer.



Installation



E116294

1. CAUTIONS:

⚠ Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

⚠ Do not use tools to install the new fuel return line clip. Failure to follow this instruction will result in damage to the retaining clip.

Install a new fuel injector retaining clamp.

1. Install a new fuel injector retaining clamp.
2. Install the fuel injector retaining clamp spacer.
3. Install a new fuel return line retaining clip.
4. Install a new sealing washer.

2. Install the fuel injector.

- Install the two bolts and tighten to 10 Nm (7 lb.ft).

⚠ CAUTION: Make sure the fuel return line retaining clip is correctly installed to the fuel injector before installing the return line.

Connect the fuel return line to the fuel injector.

- Visually inspect the fuel return line O-ring seals for damage.
- Apply a light coating of petroleum jelly to the fuel return line O-ring seals.

4. CAUTIONS:

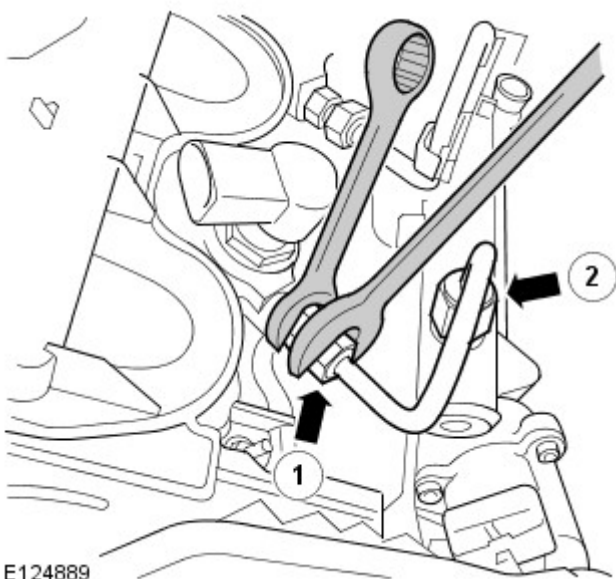
⚠ Do not allow the unions to hit the olive ends of the high-pressure fuel supply line as this may damage the ends of the line and allow foreign matter to enter the fuel injection system.

⚠ Maintain pressure on the high-pressure fuel supply lines to keep the olives in contact with the fuel rail and the fuel injector cones while installing unions.

- NOTE: Remove and discard the blanking caps.

Install the new high-pressure fuel supply lines.

- Install the new high-pressure fuel supply line, tighten the fuel supply line unions finger tight.
- Tighten the high-pressure fuel supply line in the shown sequence.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 15 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 15 Nm.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 35 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 35 Nm.



E124889

5. Attach the engine wiring harness.

6. Connect the fuel injector electrical connectors.

7. Install the injector sound proofing.

8. Attach the engine wiring harness to the bulkhead.

9. Connect the three engine harness electrical connectors.

10. Install the battery.

For additional information, refer to: [Battery](#) (414-01 Battery,

Mounting and Cables, Removal and Installation).

11. Install the EGR coolant cross-over pipe.

- Install the two retaining bolts.
- Tighten the bolts to 13 Nm (10 lb.ft).

12. Connect both EGR coolant cross-over pipe hoses.

- Remove the EGR coolant hose clamps.

13. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

14. Connect the battery ground cable.

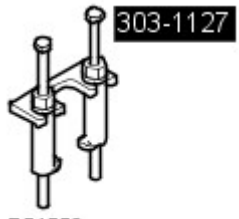
For additional information, refer to: Specifications (414-00, Specifications).

15. Check and top-up the coolant.

16. Bleed the fuel system.


Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Injectors

Removal and Installation


Special Tool(s)	
 <p>303-1127</p> <p>E54552</p>	<p>Fuel Injector remover</p> <p>303-1127</p>


Removal

• WARNINGS:


 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.


 Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.

• CAUTIONS:

 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

 Do not disconnect the fuel injector electrical connectors with the engine running. Failure to follow this instruction may result in serious damage to the engine.

 Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

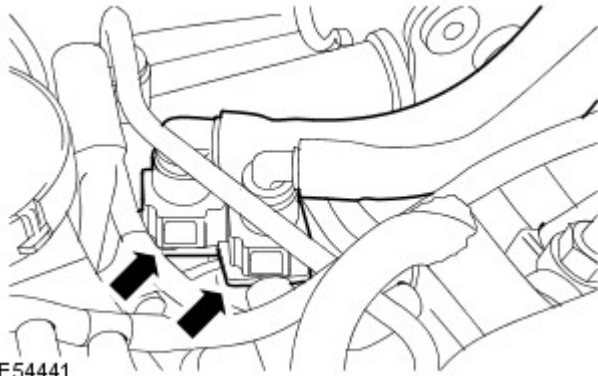
 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Disconnect the low-pressure fuel lines.

- Install blanking caps to the exposed ports.



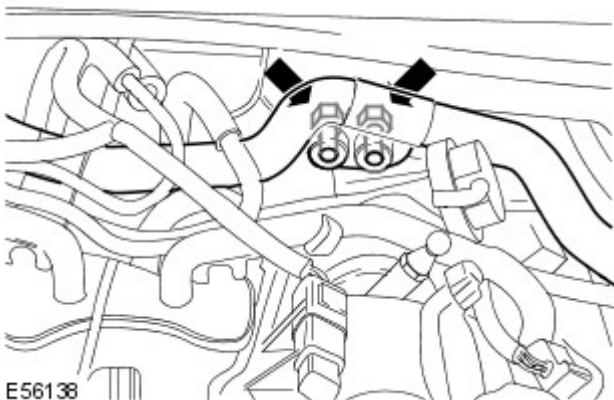
4. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

- Clamp the EGR coolant hoses to minimize coolant loss.



5. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.

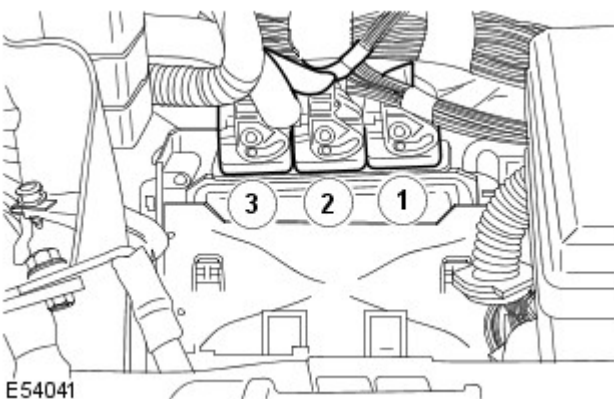


6. Remove the battery.

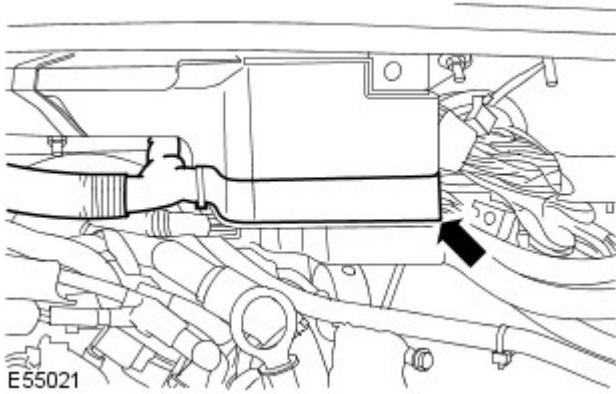
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

7. NOTE: Right hand drive shown, for Left hand drive reverse the sequence.

Disconnect the three engine harness electrical connectors in the order shown.

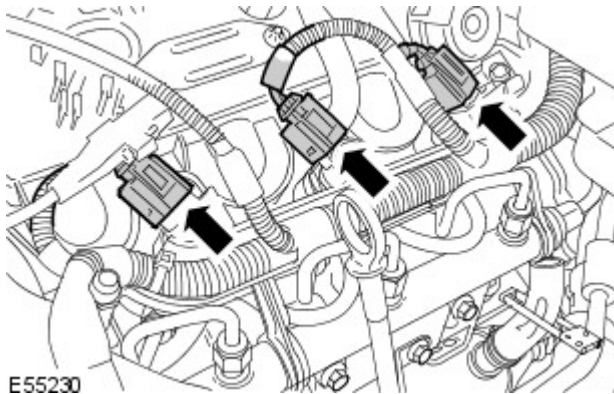


8. Release the engine wiring harness from the bulkhead.



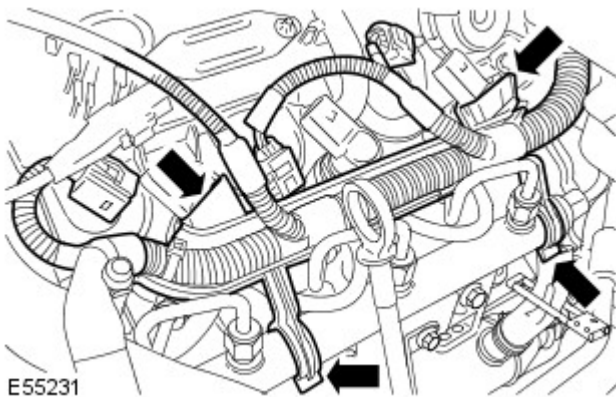
9. Remove the NVH pads from each cylinder bank.

10. Disconnect the fuel injector electrical connectors.




11. Release the engine wiring harness.

- Release the 4 clips.

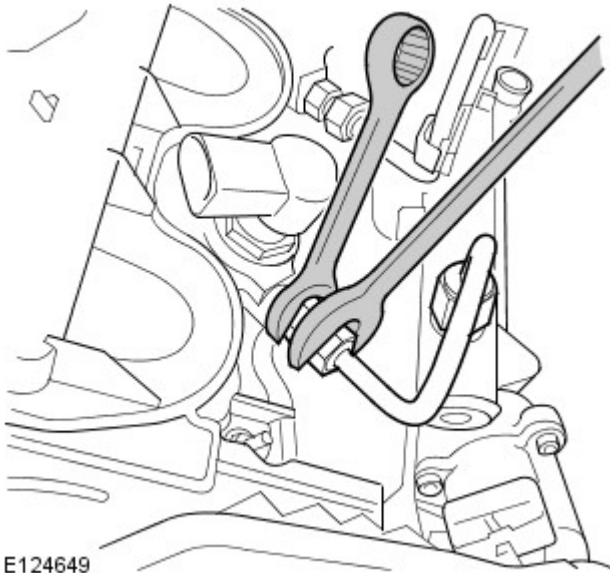


12. CAUTIONS:

 Make sure that the high-pressure fuel supply line remains in contact with the fuel pump and fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not use any aggressive cleaning fluid or a wire brush to clean the fuel injector nozzle.

Using the pneumatic vacuum gun, vacuum foreign material from the high-pressure fuel supply line, the fuel injector and the fuel injection supply manifold.



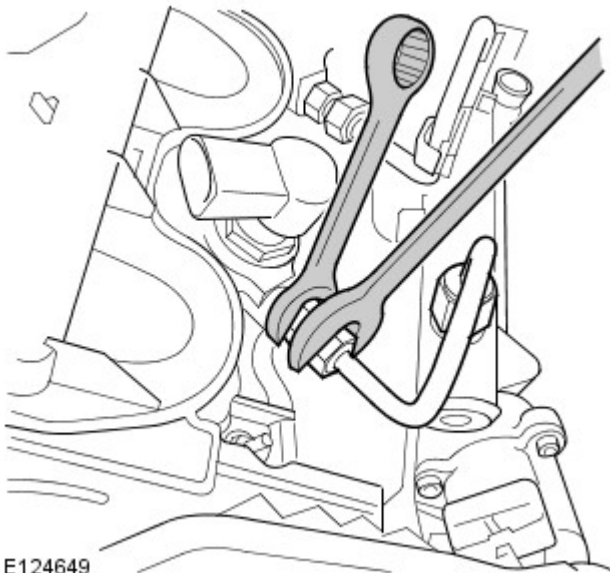
E124649

13. CAUTIONS:

⚠ Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

⚠ Make sure that the fuel injector adaptor union does not move when loosening the high-pressure fuel supply lines. Failure to follow this instruction may result in damage to the fuel injector or the fuel injector adaptor union.

Loosen the high-pressure fuel supply line from the fuel injector and fuel rail.

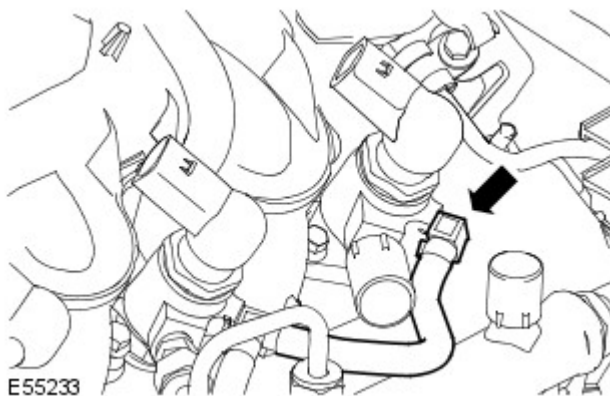


E124649

14. ⚠ CAUTION: Make sure that all openings are sealed. Use new blanking caps.

• **NOTE:** Right-hand shown, left-hand similar.

Remove and discard the high-pressure fuel supply line.



E55233

15. Disconnect the fuel return line from the fuel injector.

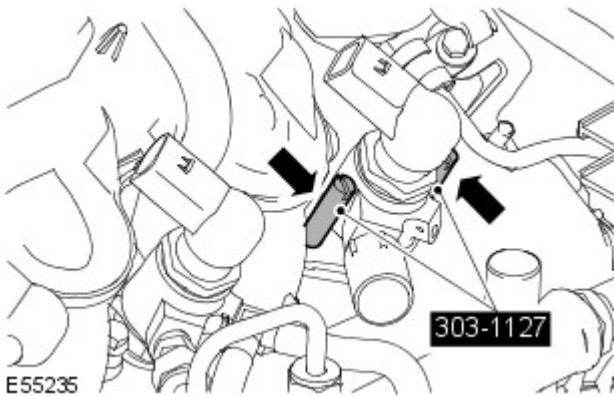
- Remove and discard the fuel return line retaining clip.


16. Remove the two fuel injector retaining bolts.

- Remove the fuel injector retaining clamp spacer.

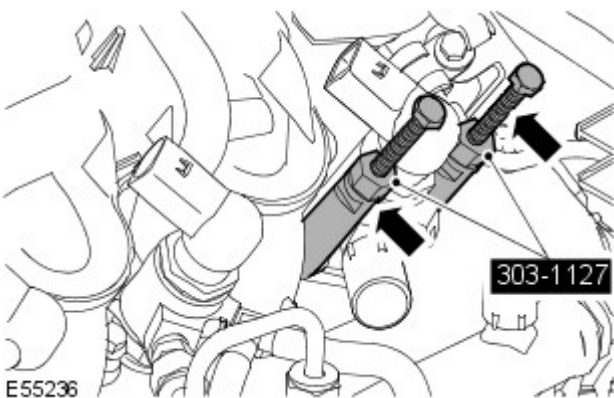



17. Install the special tool studs.



18.  CAUTION: Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

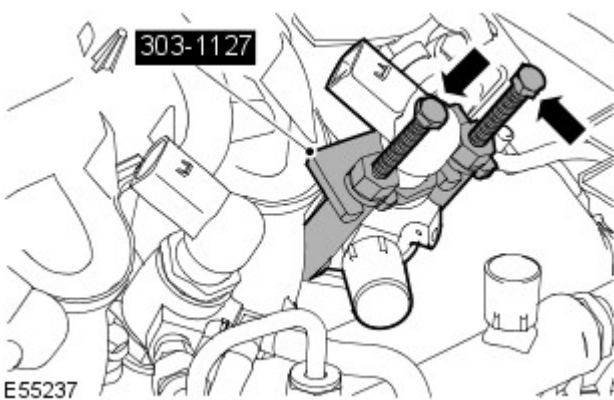
Install the special tool remover legs to the studs.



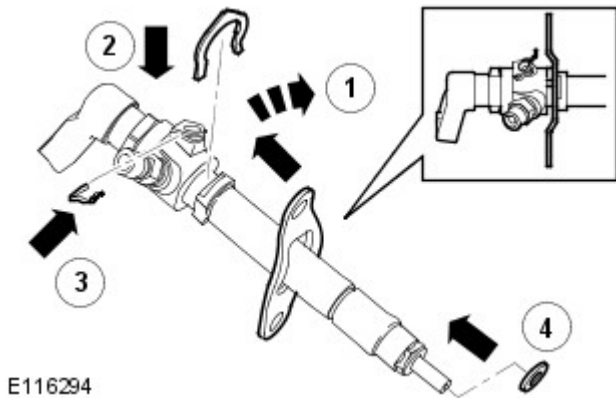
19.  CAUTION: Make sure the fuel injector remover legs are correctly engaged to the fuel injector. Failure to follow this instruction may result in damage to the component.

Remove the fuel injector.

- Rotate the special tool bolts evenly, in a clockwise direction.
- Remove the special tool.
- Remove and discard the fuel injector retaining clamp.
- Remove and discard the sealing washer.



Installation



E116294

1. CAUTIONS:

⚠ Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

⚠ Do not use tools to install the new fuel return line clip. Failure to follow this instruction will result in damage to the retaining clip.

Install a new fuel injector retaining clamp.

1. Install a new fuel injector retaining clamp.
2. Install the fuel injector retaining clamp spacer.
3. Install a new fuel return line retaining clip.
4. Install a new sealing washer.

2. Install the fuel injector.

- Install the two bolts and tighten to 10 Nm (7 lb.ft).

⚠ CAUTION: Make sure the fuel return line retaining clip is correctly installed to the fuel injector before installing the return line.

Connect the fuel return line to the fuel injector.

- Visually inspect the fuel return line O-ring seals for damage.
- Apply a light coating of petroleum jelly to the fuel return line O-ring seals.

4. CAUTIONS:

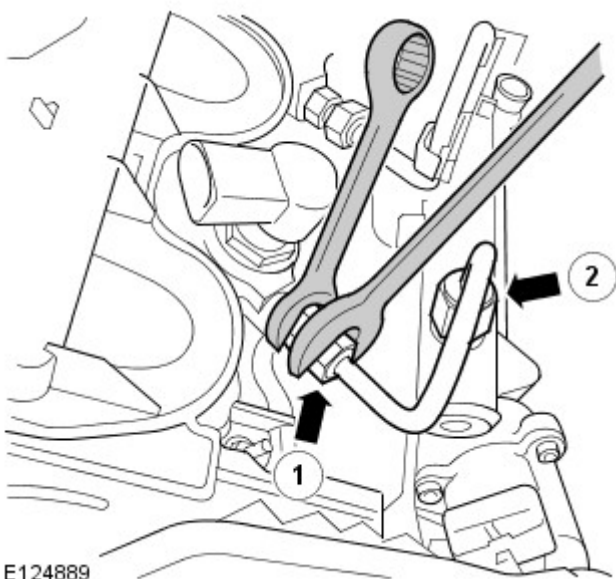
⚠ Do not allow the unions to hit the olive ends of the high-pressure fuel supply line as this may damage the ends of the line and allow foreign matter to enter the fuel injection system.

⚠ Maintain pressure on the high-pressure fuel supply lines to keep the olives in contact with the fuel rail and the fuel injector cones while installing unions.

- NOTE: Remove and discard the blanking caps.

Install the new high-pressure fuel supply lines.

- Install the new high-pressure fuel supply line, tighten the fuel supply line unions finger tight.
- Tighten the high-pressure fuel supply line in the shown sequence.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 15 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 15 Nm.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 35 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 35 Nm.



E124889

5. Attach the engine wiring harness.

6. Connect the fuel injector electrical connectors.

7. Install the NVH pads on the cylinder banks.

8. Attach the engine wiring harness to the bulkhead.

9. Connect the three engine harness electrical connectors.

10. Install the battery.

For additional information, refer to: [Battery](#) (414-01 Battery,

Mounting and Cables, Removal and Installation).

11. Install the EGR coolant cross-over pipe.

- Install the two retaining bolts.
- Tighten the bolts to 13 Nm (10 lb.ft).

12. Connect both EGR coolant cross-over pipe hoses.

- Remove the EGR coolant hose clamps.

13. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

14. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

15. Check and top-up the coolant.

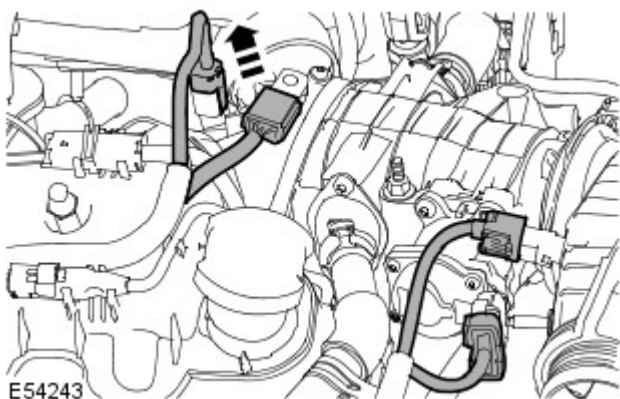
16. Bleed the fuel system.

Fuel Charging and Controls - TDV6 2.7L Diesel - Intake Air Shutoff Throttle

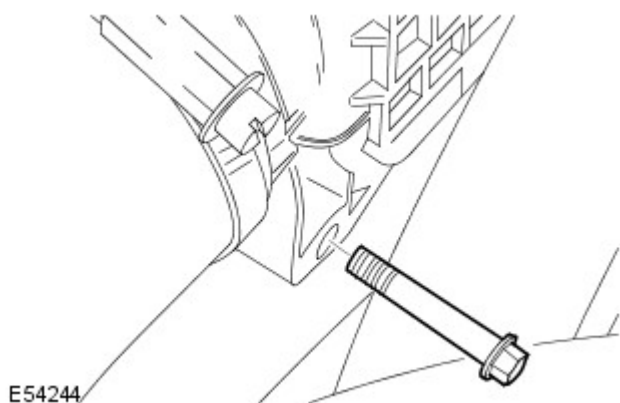
Removal and Installation

Removal

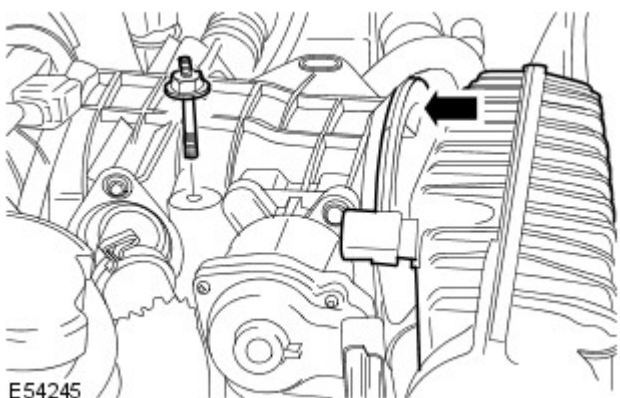
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the three electrical connectors.
 - Release the fuel return line valve.



4. Remove the intake air shutoff throttle elbow retaining bolt.

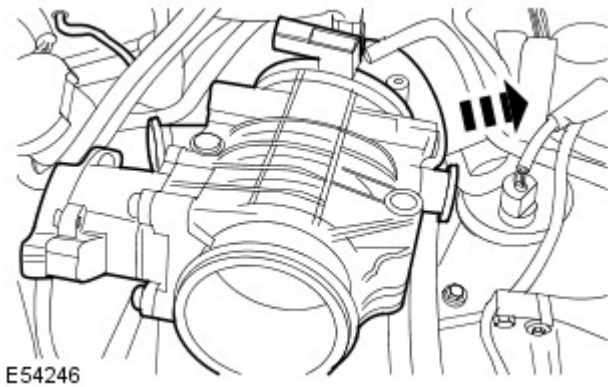


5. Release the intake air shutoff throttle elbow.
 - Remove the intake air shutoff throttle retaining stud.

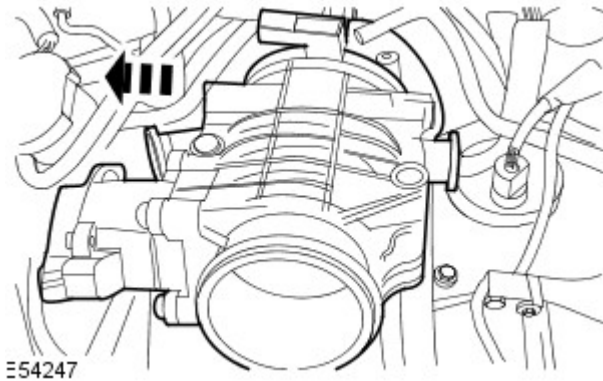


6. Release the LH EGR valve outlet tube retaining clip.
7. Release the RH EGR valve outlet tube retaining clip.

8. Reposition the intake air shutoff throttle.

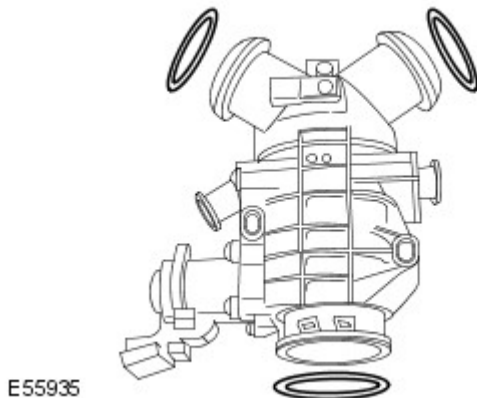


9. Remove the intake air shutoff throttle.



10. NOTE: Do not disassemble further if the component is removed for access only.

Remove and discard the O-ring seals.



Installation

1.  CAUTION: The O-ring seals are to be reused unless damaged.

Install the intake air shutoff throttle.

2. Align the intake air shutoff throttle.

3. Secure the RH EGR valve outlet tube.

4. Secure the LH EGR valve outlet tube.

5. Secure the intake air shutoff throttle elbow.

- Tighten the intake air shutoff throttle retaining stud to 10 Nm (7 lb.ft).

6. Tighten the intake air shutoff throttle elbow retaining bolt to 10 Nm (7 lb.ft).

7. Connect the three electrical connectors.

- Secure the fuel line return valve.

8. Install the engine cover.

For additional information, refer to: [Engine Cover - TDV6 3.0L](#)

[Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

9. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Charging and Controls - TDV6 2.7L Diesel - Fuel Diverter Rail


Removal and Installation


General Equipment


Pneumatic vacuum gun


Removal

• WARNINGS:


 Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

 Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.

• CAUTIONS:

 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

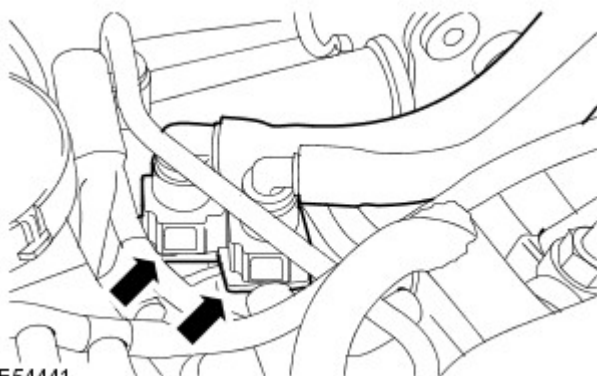
 Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not remove the fuel rail pressure sensor from the fuel injection diverter rail.

• NOTE: If a new fuel rail pressure sensor is to be installed, a new fuel injection diverter rail and fuel rail pressure sensor must be installed as an assembly.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Oramentation, Removal and Installation).
3. Disconnect the low-pressure fuel lines.
 - Install blanking caps to the exposed ports.

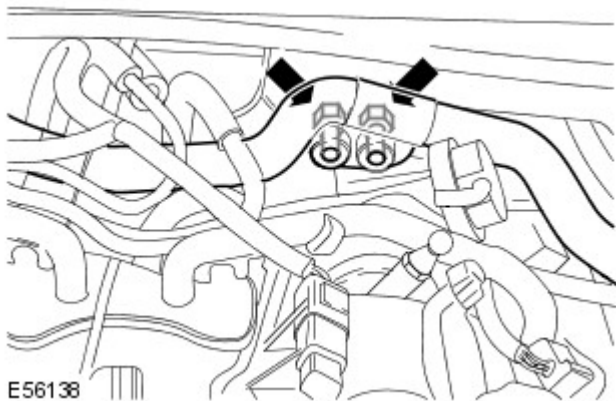


E54441



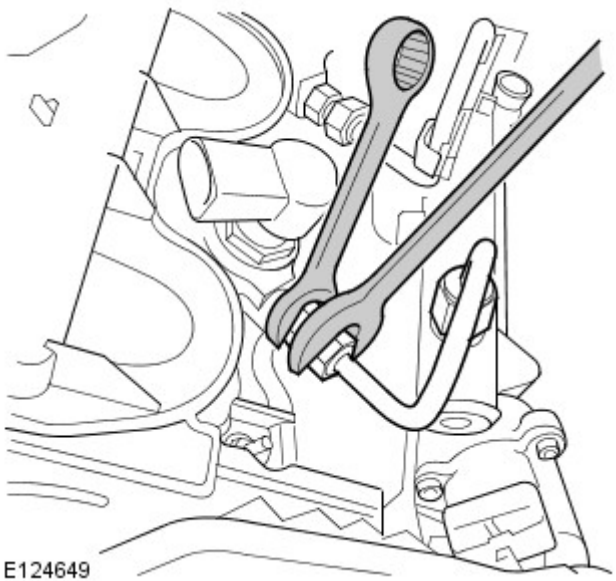
4. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

- Clamp the EGR coolant hoses to minimize coolant loss.



5. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.

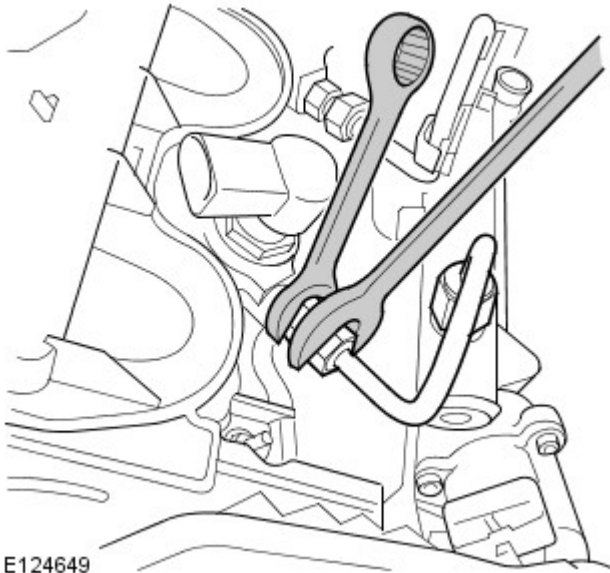



6. CAUTIONS:

⚠ Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

⚠ Make sure that the fuel injector adaptor union does not move when loosening the high-pressure fuel supply lines. Failure to follow this instruction may result in damage to the fuel injector or the fuel injector adaptor union.

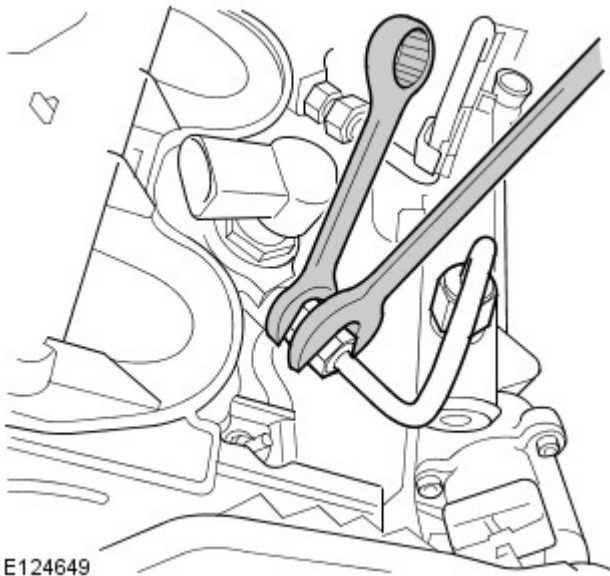
Loosen the high-pressure fuel supply line from the fuel injector and fuel rail.




7.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

• NOTE: Right-hand shown, left-hand similar.

Remove and discard the high-pressure fuel supply line.




8.  CAUTION: Make sure that the high-pressure fuel supply line remains in contact with the fuel pump and fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

• NOTE: Crankcase vent oil separator shown removed for clarity.

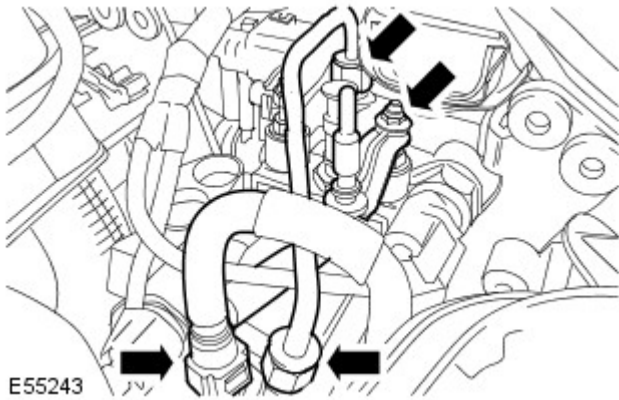
Remove and discard the high-pressure fuel supply line.

- Install blanking caps to the exposed ports.

9.  CAUTION: Make sure that the high-pressure fuel supply line remains in contact with the fuel injection supply manifold and the fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

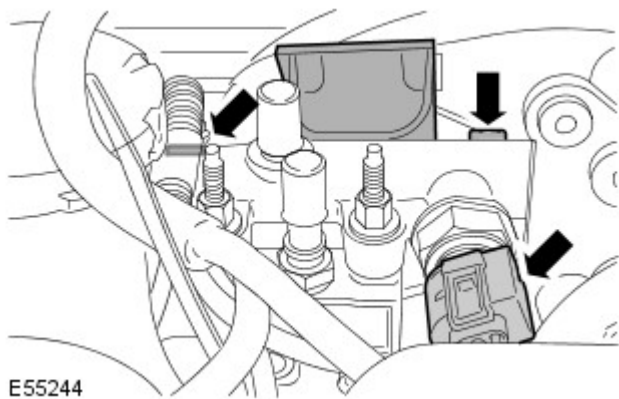
Using the pneumatic vacuum gun, vacuum foreign material from the high-pressure fuel supply line, the fuel injectors and the fuel rail.

For additional information, refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).



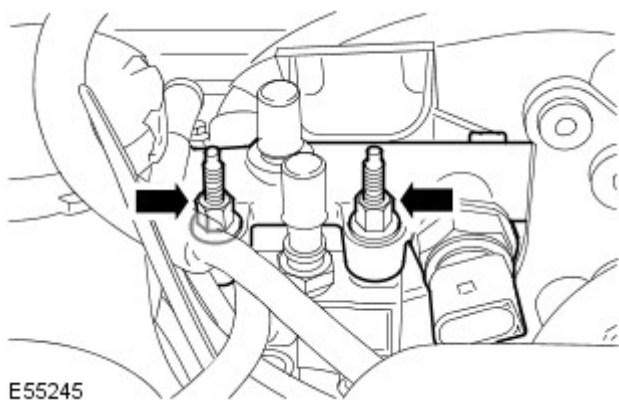
10. Release the low-pressure fuel line.

- Disconnect the low-pressure fuel line.
- Install blanking caps to the exposed ports.



11. Disconnect the fuel rail pressure (FRP) sensor electrical connector.

- Release the fuel charging wiring harness.



12. Remove the FRP and fuel injection diverter rail assembly.

- Remove the 2 studs.

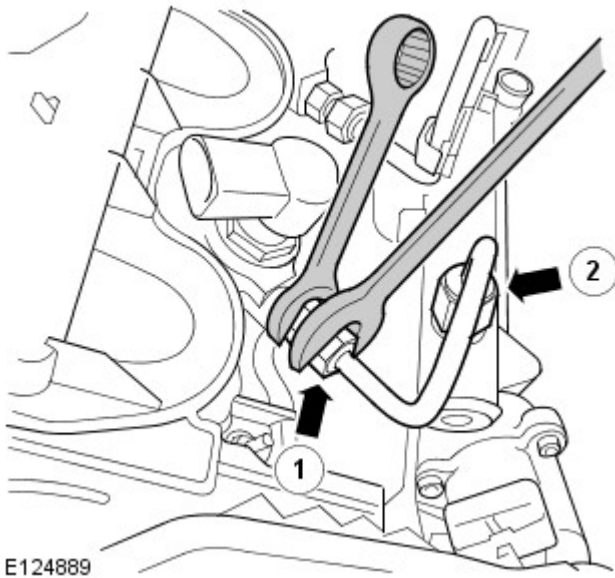
Installation

1. Install the FRP and fuel injection diverter rail assembly.

- Install the two retaining studs, but do not fully tighten at this stage.

2. Connect the FRP sensor electrical connector.

- Attach the fuel charging wiring harness.



3. CAUTIONS:

⚠ Do not disassemble the fuel injectors or clean the nozzles, even with an ultrasonic cleaner. Always install new fuel injectors when required.

⚠ Do not use any aggressive cleaning fluid or a wire brush to clean the fuel injector nozzle.

Install the new high-pressure fuel supply line.

- Install the new high-pressure fuel supply line, tighten the fuel supply line unions finger tight.
- Tighten the high-pressure fuel supply line in the shown sequence.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 15 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 15 Nm.
- Tighten the high-pressure fuel supply line union 1 to fuel injector to 35 Nm.
- Tighten the high-pressure fuel supply line union 2 to fuel rail to 35 Nm.

4. Attach the low-pressure fuel line.

- Remove the blanking caps from the ports.
- Connect the low-pressure fuel line.

5. Install the new high-pressure fuel supply lines.

- Remove the blanking caps from the ports.
- Loosely install the new high-pressure fuel supply lines.
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel injection supply manifold to 35 Nm (26 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 35 Nm (26 lb.ft).

6. Secure the high-pressure fuel supply lines.

- Tighten the two retaining bolts to 10 Nm (7 lb.ft).

7. Install the EGR coolant cross-over pipe.

- Install the two EGR coolant cross-over pipe retaining bolts.
- Tighten to 13 Nm (10 lb.ft).

8. Connect both EGR coolant cross-over pipe hoses.

- Remove the EGR coolant hose clamps.

9. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

10. Install the engine cover.

For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

11. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

12. Bleed the fuel system.

For additional information, refer to: [Low-Pressure Fuel System](#)

[Bleeding](#) (310-00 Fuel System - General Information, General Procedures).

13. Check and top-up the coolant.

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel -

Torque Specifications

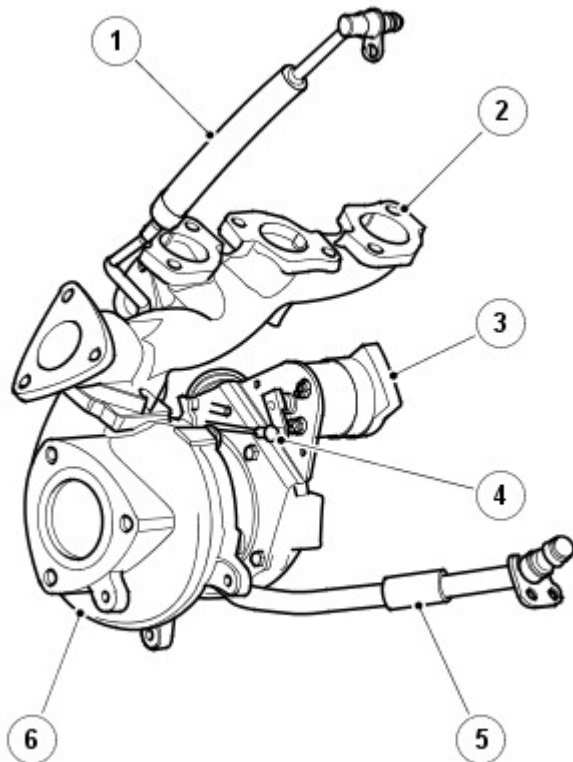
Description	Nm	lb-ft
Oil supply tube union to turbocharger retaining bolt	30	22
Oil supply tube to cylinder block retaining bolt	10	7
Oil return tube to turbocharger retaining bolts	10	7
Oil return tube to cylinder block retaining bolt	10	7
Exhaust gas recirculation (EGR) valve to cylinder head retaining bolts	10	7
EGR cooler mount bracket retaining bolt	10	7
EGR valve tube to exhaust manifold retaining bolts	10	7
* Turbocharger to exhaust manifold retaining nuts	24	18
Turbocharger heatshield retaining bolts	10	7
* Exhaust manifold retaining studs	13	10
*+ Exhaust manifold retaining nuts	24	18
Differential mounting bracket heat shield bolts	10	7
Exhaust heat shield bolts	10	7
Exhaust heat shield nut	10	7
Oil level indicator tube retaining bolt	10	7
Turbocharger securing bracket stud	13	10
Turbocharger securing bracket bolts	32	24
Turbocharger to transmission support bracket nut	25	18
Turbocharger to transmission support bracket bolts	48	35

+ Nuts must be tightened in sequence

*** New nuts/studs must be installed**

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel - Turbocharger

Description and Operation



E50590

Item	Part Number	Description
1	-	Oil feed pipe
2	-	LH exhaust manifold
3	-	Actuator motor
4	-	Actuator lever
5	-	Oil return pipe
6	-	Turbocharger

The variable vane turbocharger, fitted to the LH exhaust manifold of the TdV6 engine, makes it possible to vary the exhaust gas flow of the turbine, dependent on engine operation. This improves the power transfer to the turbine wheel and compressor, particularly at low engine speeds, thus increasing the boost pressure. The guide vanes are opened progressively as the engine speed increases so that the power transfer always remains in balance with the required charger speed and the required boost pressure level. Variable vanes facilitate better use of the exhaust gas energy so as to further improve the efficiency of the turbocharger and thus of the engine, compared to the more conventional 'wastegate control'.

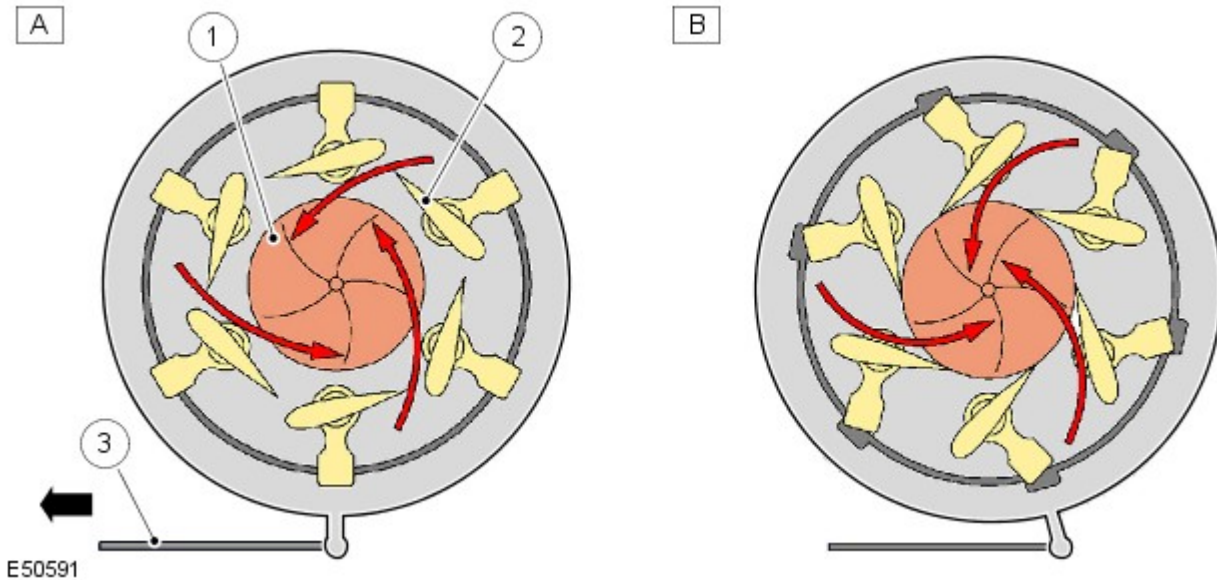
Advantages:

- High torque at both high and low engine speeds
- Continuous and optimum adjustment for all engine speeds
- No wastegate valve required, exhaust energy is better utilised, less back-pressure in conjunction with same compressor work
- Low thermal and mechanical load improves engine power output
- Low emissions
- Optimised fuel consumption over the entire engine speed range

The turbochargers construction is similar to the unit fitted to the Freelander Td4 engine. However, a stepper motor instead of a vacuum diaphragm electronically controls the variable vanes.

The DC rotary actuator motor operates a drive shaft. The drive shaft is connected to the vanes by an actuating lever. Adjustment of the vanes is achieved by moving the actuating lever. When the drive shaft is turned, a signal is created at the end of the drive shaft; this feedback signal is used to determine the angular position of the vanes. This information is transmitted to the Engine Control Module (ECM).

There is a temperature sensor in the control unit, which drives the stepper motor to a safe position (vanes fully opened) if the maximum temperature is exceeded. The ECM detects any malfunctions in the stepper motor and generates Diagnostic Trouble Codes (DTC).



Item	Part Number	Description
A	-	Closed (fast)
B	-	Open (slow), default position
1	-	Turbine
2	-	Vanes
3	-	Actuator lever

At low engine speeds, because of the flat setting of the vanes, the relatively low flow of exhaust gases are accelerated and routed in such a way that they meet the vanes of the turbine wheel at the outermost edge. Consequently, a high torque is produced at the turbine wheel, and a high turbine speed is therefore achieved.

At high engine speeds the vanes are progressively opened, so that a large flow of exhaust gas is delayed and is directed more and more towards the centre of the turbine wheel.

The torque at the turbine wheel is artificially lowered. In this way the turbine speed, and therefore the air quantity required by the engine, are matched to engine speed. Consequently, the boost pressure is approximately constant over the whole engine speed range.

The operating parameters are controlled electronically by the ECM using powertrain sensors and driver inputs. For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

The turbocharger is designed for fail safe operation. If a fault occurs regarding the control of the unit, the vanes default to the fully open position so as to produce minimum boost.

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel -

Turbocharger

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



WARNING: The following tests may involve working in close proximity to hot components. Make sure adequate protection is used. Failure to follow this instruction may result in personal injury.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Intake air system ● Hose(s)/hose connections ● General engine condition. 	<ul style="list-style-type: none"> ● Circuit(s) ● Engine control module (ECM) ● Electrical connections and harnesses

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor performance	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Restricted air intake system ● General engine condition ● Engine control module failure 	Check the fuel level and condition. Check the air intake for restriction. Check the engine condition, compressions, etc. Refer to the relevant section of the workshop manual. Check for DTCs. Refer to the warranty policy and procedures manual if an engine control module is suspect.
No boost	<ul style="list-style-type: none"> ● Electrical connections and harnesses ● Restricted air intake system ● Charge air cooler restricted/leaking ● Engine control module failure 	Check the electrical connections and harnesses. Check the air intake for restriction/leakage (see visual inspection). Refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if an engine control module is suspect.

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel - Turbocharger

Removal and Installation

Removal

All vehicles


-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Raise and support the vehicle.

- Open the hood.

Left-hand drive vehicles

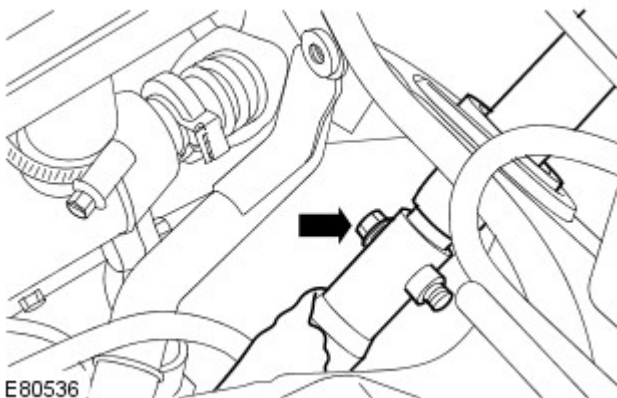
3. CAUTIONS:

 Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

 Make sure the steering is in the straight ahead position.

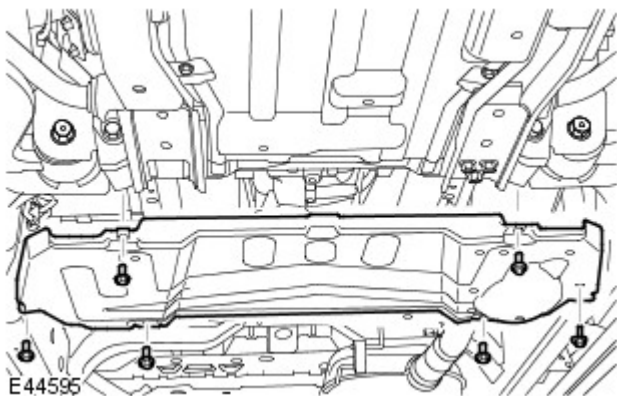
- NOTE:** Note the fitted position.

Loosen the steering column lower shaft to steering column upper shaft bolt.



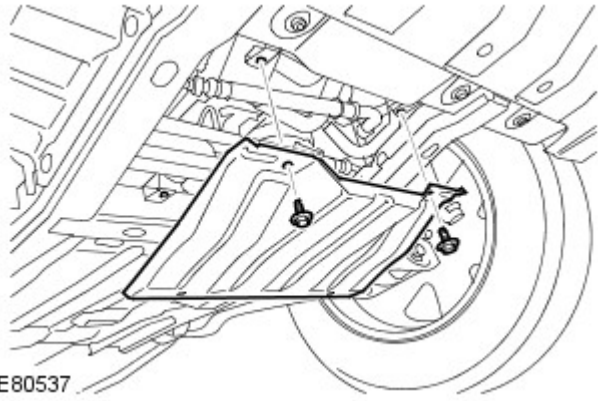
All vehicles

- Remove the LH front wheel and tire.
- Remove the transmission undershield.
 - Remove the 6 bolts.



- Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

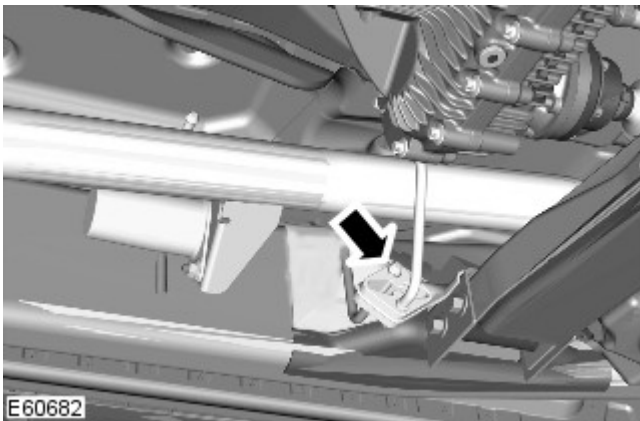
Left-hand drive vehicles



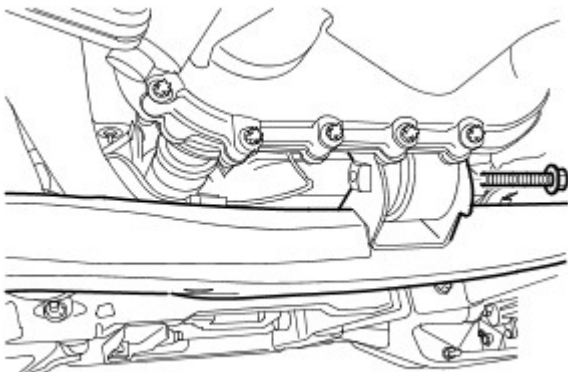
7. Remove the radiator access panel.

- Remove the 2 bolts.

All vehicles

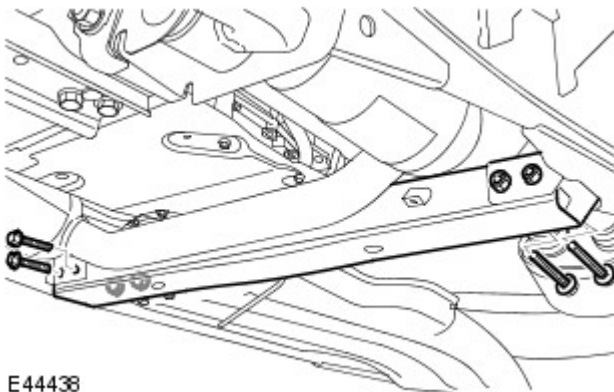


8. Release the downpipe catalytic converter support insulator.



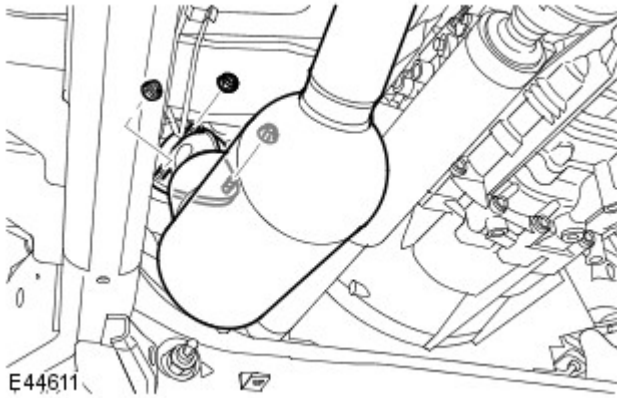
9. Remove the transmission support insulator through-bolt.

- Using a transmission jack, support the transmission.



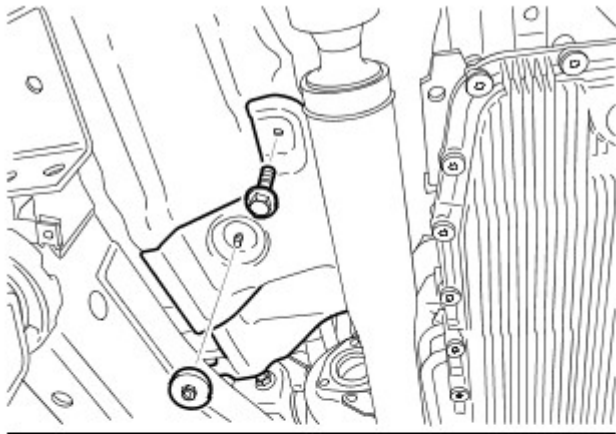
10. With assistance, remove the transmission support crossmember.

- Remove the 4 nuts and bolts.



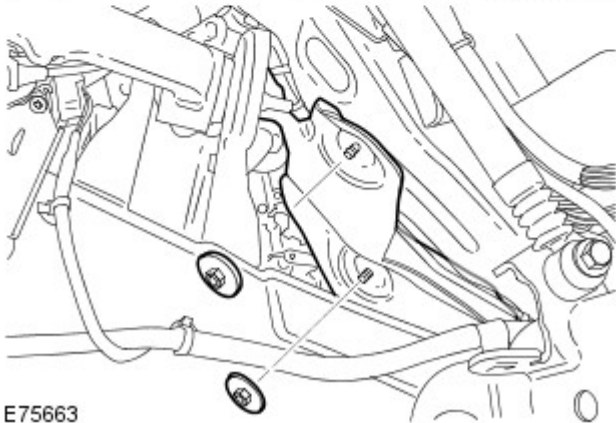
11. With assistance, remove the downpipe catalytic converter.

- Loosen the clamp.
- Remove and discard the 3 nuts.
- Remove and discard the gasket.



12. Remove the exhaust front heat shield.

- Remove the 3 nuts.
- Remove the bolt.

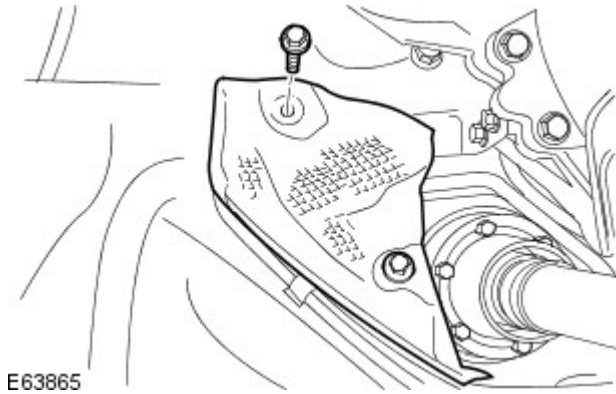


13. Install the transmission support crossmember.

- Install but do not fully tighten at this stage the 2 transmission support crossmember bolts.
- Install but do not fully tighten at this stage the transmission support insulator through-bolt.
- Remove the transmission jack.

14. Remove the differential mounting bracket heat shield.

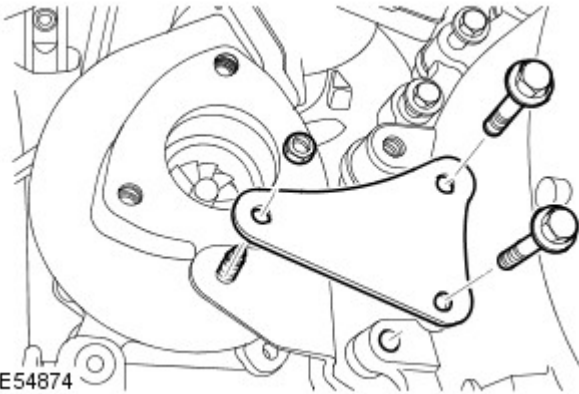
- Remove the 2 bolts.



E63865

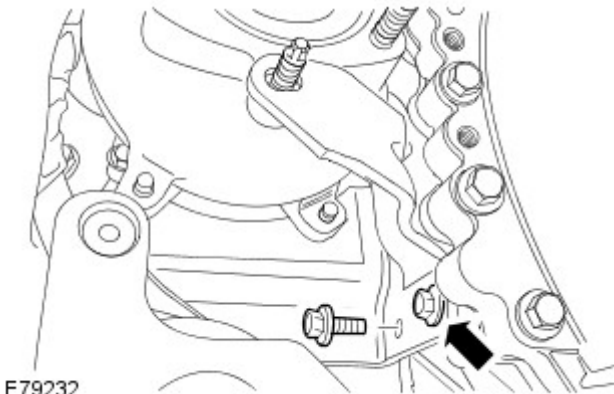
15. Remove the turbocharger support bracket.

- Remove the 2 bolts.
- Remove the nut.



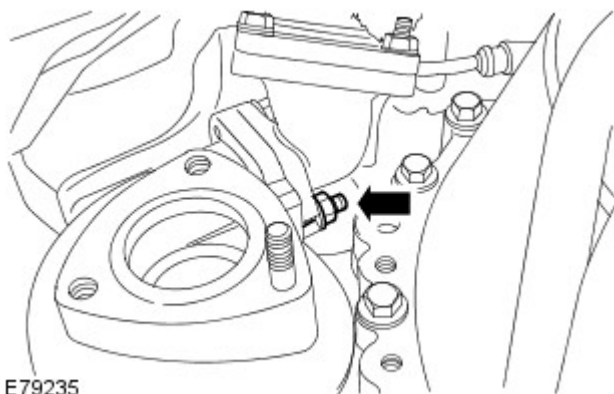
E54874

16. Remove the 2 bolts from the turbocharger support bracket.



E79232

17. Loosen the turbocharger lower nut.



E79235


18. Remove the LH upper arm.

For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).

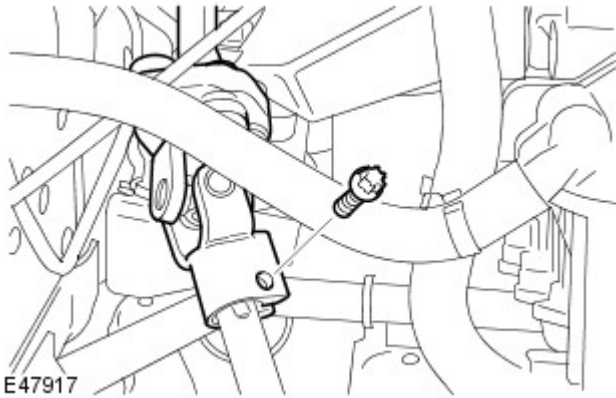
19. Turn the ignition key to position I.

- Turn the steering wheel until the head of the steering column lower shaft bolt can be seen through the LH wheel

arch.

20.  **CAUTION:** Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

Remove and discard the steering column lower shaft bolt.

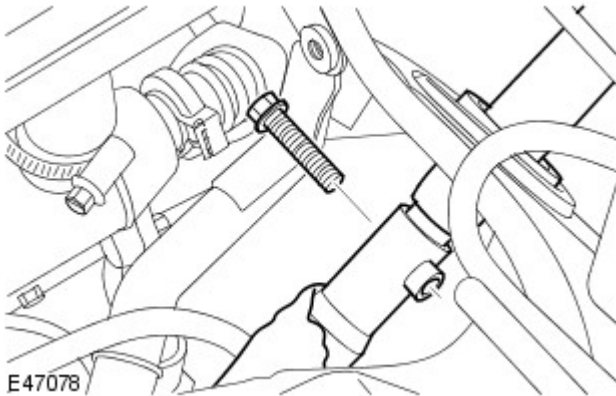


21. Turn the steering wheel to the straight ahead position.

- Remove the ignition key.

22. Remove the steering column lower shaft.

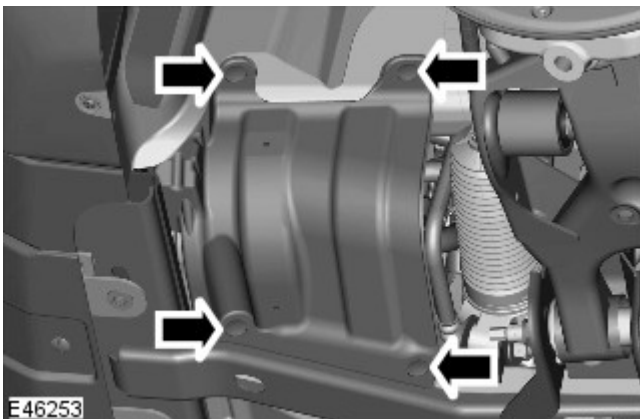
- Remove and discard the steering column lower shaft upper bolt.



All vehicles

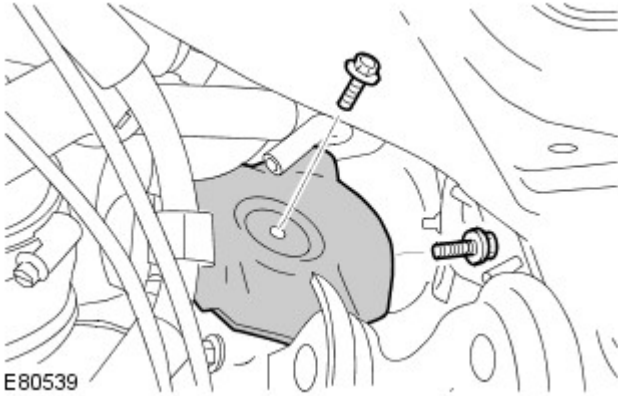
23. Remove the fender splash shield lower trim.

- Remove the 4 clips.



24. Remove the turbocharger heat shield.

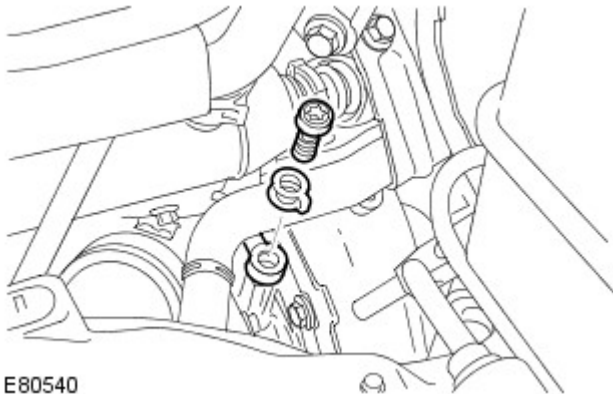
- Remove the 2 bolts.



25.  CAUTION: Always plug any open connections to prevent contamination.

Disconnect the turbocharger oil supply tube.

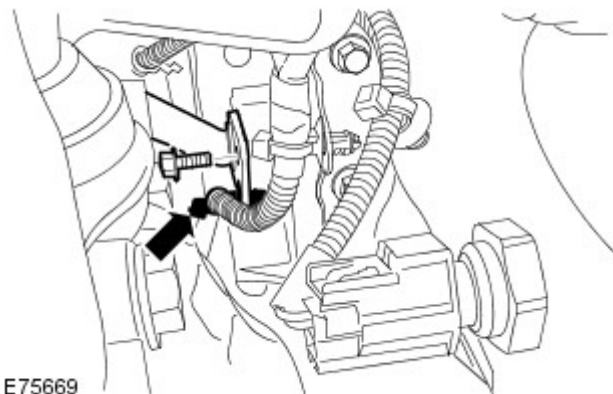
- Remove the turbocharger banjo bolt.
- Remove and discard the sealing washers.



26.  CAUTION: Always plug any open connections to prevent contamination.

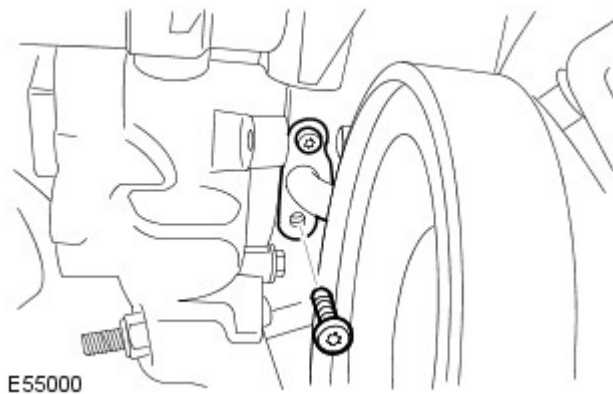
Remove the turbocharger oil return tube bolt.

- Release the wiring harness clip.



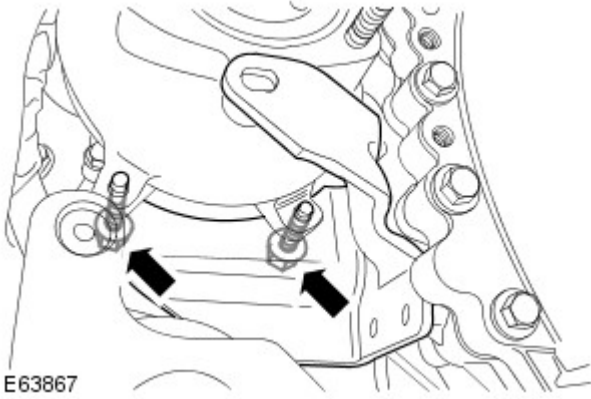
27. Remove the turbocharger oil return tube.

- Remove the 2 bolts.
- Remove and discard the gasket.
- Remove and discard the O-ring seal.

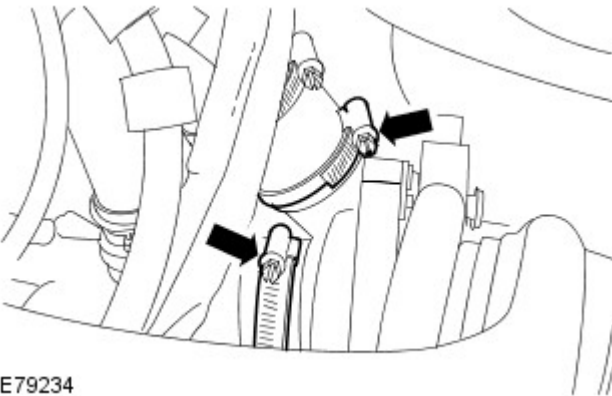


28. Remove the turbocharger support bracket.

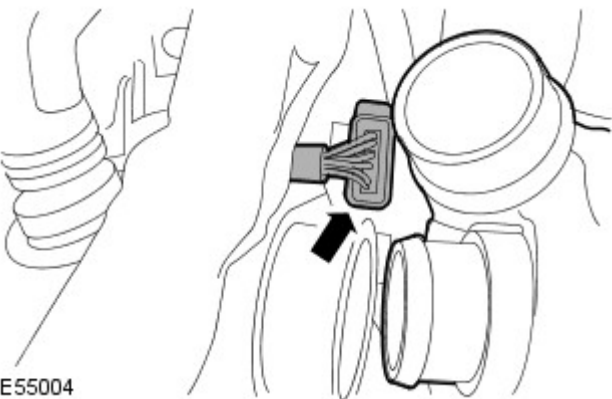
- Remove the 2 bolts.



29. Loosen the turbocharger intake and outlet pipe clips.




30. Disconnect the turbocharger electrical connector.



31.  **WARNING:** Eye protection must be worn.

• **CAUTIONS:**

 Make sure that only the turbocharger studs are drilled.

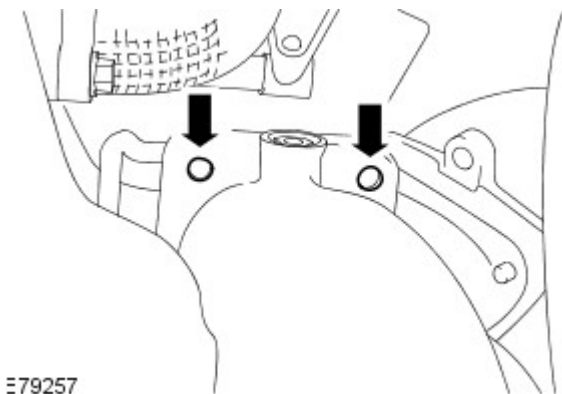
 Make sure that the depth of the drill does not exceed 14 mm (0.6 inch).

Carefully drill the turbocharger 2 upper studs.

- Center punch the turbocharger 2 upper studs.
- Drill a pilot hole in the center of the turbocharger studs progressively drill out the studs until a 8 mm (0.3 inch) hole is achieved.

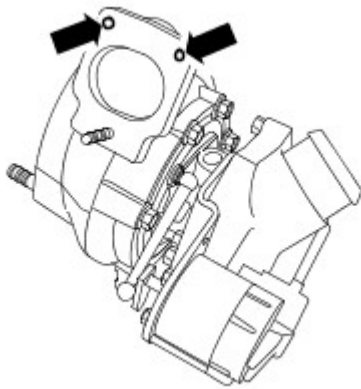
32. With assistance, remove the turbocharger.

- Loosen the turbocharger lower nut.



Installation

All vehicles



E55006

1. WARNINGS:



Eye protection must be worn.



Never direct a high-pressure nozzle at the skin as the high-pressure air may penetrate to the underlying tissue, and cause serious injury.




CAUTION: Always keep high-pressure equipment in good condition, and regularly maintained, particularly at joints and unions.

Drill two 8 mm (0.3 inches) holes in the turbocharger as shown.

- Clean the turbocharger and blow out with an air line.
2. Install a new stud to turbocharger lower hole.
 3. With assistance, install the turbocharger.
 - Clean the turbocharger mating faces.
 - Align the turbocharger intake and outlet pipes.
 4. With assistance, tighten the turbocharger upper nuts and bolts to 24 Nm (18 lb.ft).
 5. Tighten the turbocharger lower nut to 24 Nm (18 lb.ft).
 6. Connect the turbocharger electrical connector.
 7. Tighten the turbocharger intake and outlet pipe clips.
 8. Install the turbocharger support bracket.
 - Tighten the bolts to 23 Nm (17 lb.ft).
 9. Connect the turbocharger oil supply tube.
 - Install new sealing washers.
 - Tighten the turbocharger oil supply tube bolt to 30 Nm (22 lb.ft).
 10. Install the turbocharger heat shield.
 - Install the 2 bolts.
 11. Install the 2 turbocharger oil return tube bolts.
 - Install a new gasket.
 - Install a new O-ring seal.
 - Tighten the 2 bolts to 10 Nm (7 lb.ft).
 12. Install the turbocharger oil return tube bolt.
 - Attach the wiring harness clip.
 13. Install the fender splash shield lower trim.
 - Install the 4 clips.

Left-hand drive vehicles

14. Install the steering column lower shaft.
 - Connect the steering column lower shaft to the steering column upper shaft.
 - Connect the universal joint to the steering gear.
15. Install but do not fully tighten at this stage a new steering column lower shaft to steering column upper shaft bolt.

16.  **CAUTION:** Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

Turn the ignition key to position I.

- Turn the steering wheel until the steering column lower shaft bolt hole can be seen through the LH wheel arch.

17. Install the steering column lower shaft to steering gear bolt.

- Install a new bolt and tighten to 30 Nm (22 lb.ft).

18. Turn the steering wheel to the straight ahead position.

- Remove the ignition key.

19. Tighten the steering column lower shaft to steering column upper shaft bolt to 30 Nm (22 lb.ft).

All vehicles

20. Install the LH upper arm.

For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).

21. Install the 2 turbocharger support bracket bolts.

- Tighten the 2 bolts to 23 Nm (17 lb.ft).

22. Install the turbocharger support bracket.

- Install the turbocharger support bracket stud.
- Tighten the 2 bolts to 48 Nm (35 lb.ft).
- Tighten the nut to 25 Nm (18 lb.ft).

23. Install the differential mounting bracket heat shield.

- Install the 2 bolts and tighten to 10 Nm (7 lb.ft).

24. Remove the transmission support crossmember.

- Using a transmission jack, support the transmission.

25. Install the exhaust front heat shield.

- Install the 3 nuts.
- Install the bolt.

26. With assistance, install the downpipe catalytic converter.

- Install new studs and nuts.
- Install a new gasket.
- Tighten the downpipe catalytic converter nuts and clamp to 48 Nm (35 lb.ft).

27. Install the transmission support crossmember.

- Tighten the nuts and bolts to 90 Nm (66 lb.ft).
- Install the transmission support insulator through-bolt and tighten to 175 Nm (129 lb.ft).
- Remove the transmission jack.

28. Attach the downpipe catalytic converter hanger.

Left-hand drive vehicles

29. Install the radiator access panel.

- Tighten the 2 bolts to 10 Nm (7 lb.ft).

All vehicles

30. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#)
(501-02 Front End Body Panels, Removal and Installation).

31. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).

32. Install the LH front wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

33. Check and top-up the engine oil.

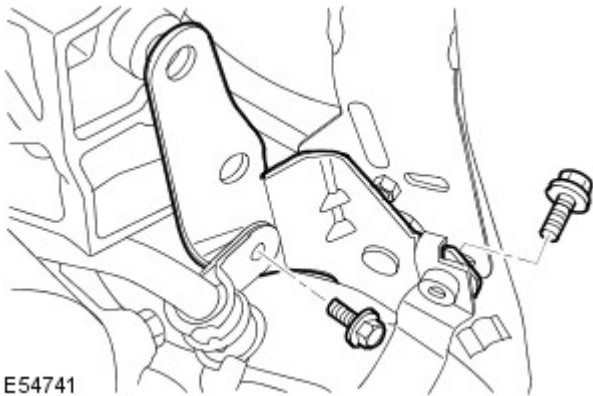
34. Close the hood.

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel - Turbocharger Intake Tube


Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the power steering pump.
For additional information, refer to: Power Steering Pump - 2.7L Diesel (211-02, Removal and Installation).
3. Remove the support bracket.
 - Remove the two retaining bolts.

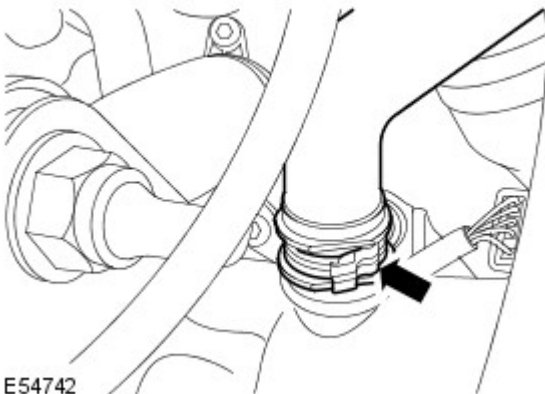


E54741

4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

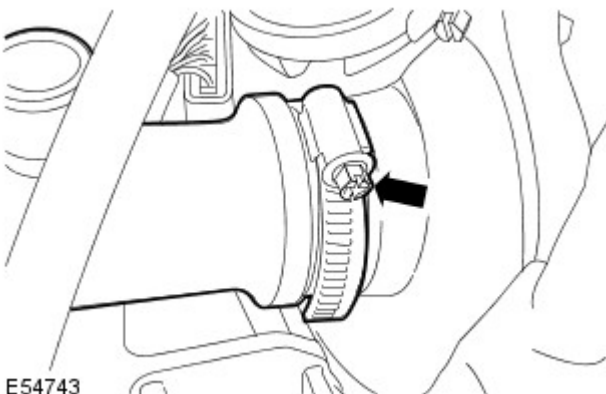
Raise the vehicle.

5. Disconnect the breather hose.
 - Release the clip.



E54742

6. Disconnect the turbocharger intake tube.
 - Loosen the clip.



E54743

7. Remove the charge air cooler intake pipe.

- With assistance, reposition the turbocharger intake tube.

8. With assistance, remove the turbocharger intake tube.

Installation

1. To install, reverse the removal procedure.

- Tighten the two retaining bolts to 10 Nm (7 lb.ft).

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel - Turbocharger Actuator Rod


Removal and Installation

Removal

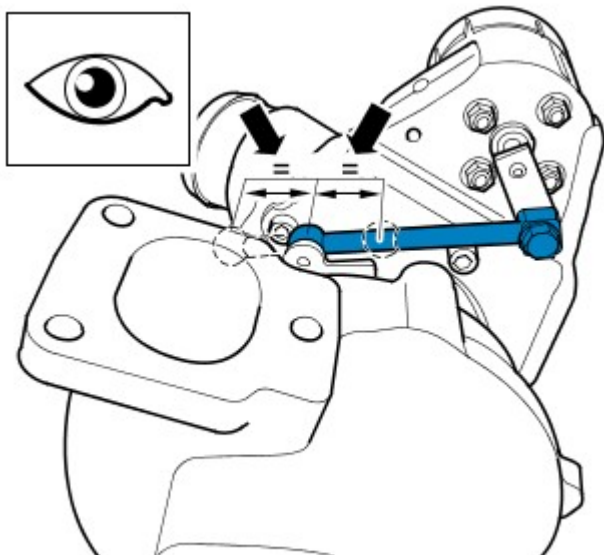
 **CAUTION:** Always plug any open connections to prevent contamination.

• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the turbocharger. For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).

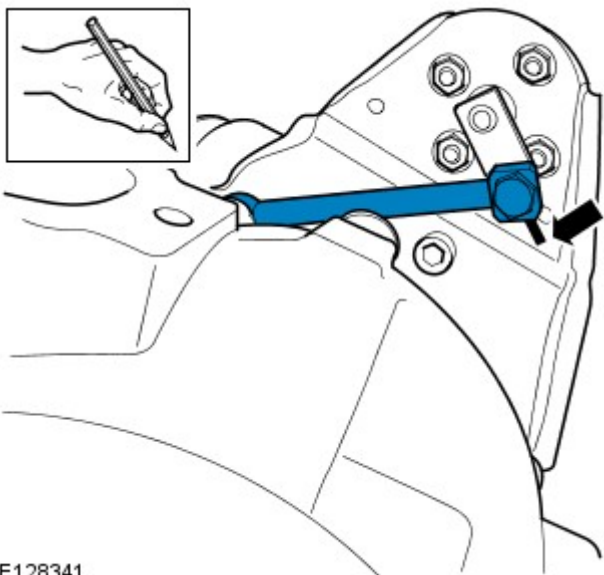
2.  **CAUTION:** Make sure that no parts of the turbocharger actuator linkage are allowed to move beyond the normal operating limits. Failure to follow this instruction may result in damage to the vehicle.

Position the turbocharger actuator connecting rod to the mid point position.

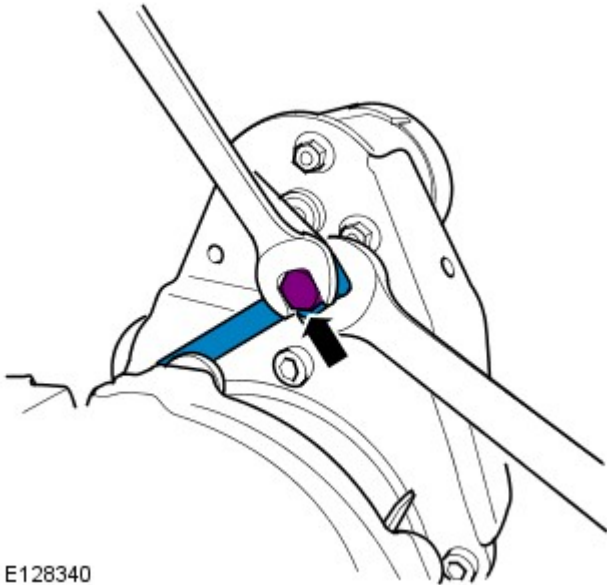


E128338


3. Using a suitable marker, mark the mid point position of the actuator arm.



E128341

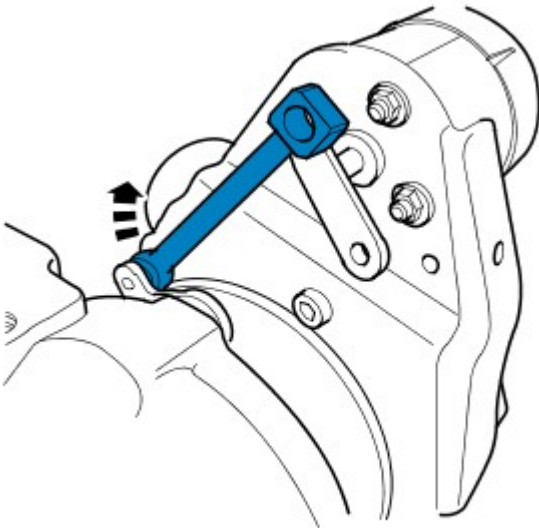


E128340

4.  CAUTION: Make sure that two spanners are used to remove the bolt. Failure to follow this instruction may result in damage to the vehicle.

Remove the bolt.


5. Remove the turbocharger actuator connecting rod.




E128339

Installation

1. CAUTIONS:

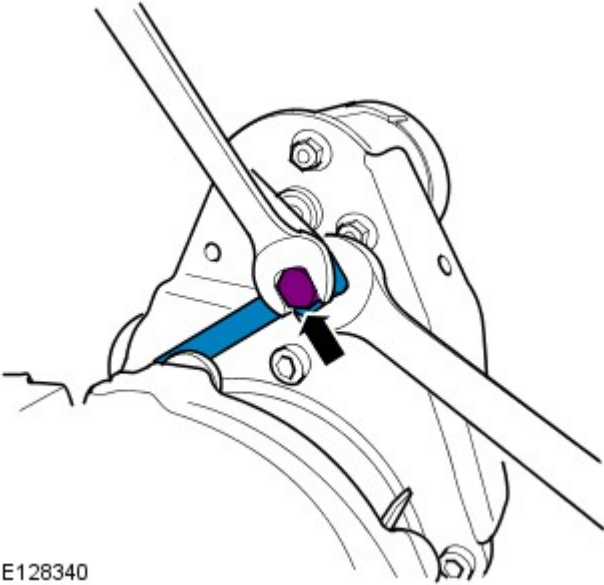
 Make sure that no parts of the turbocharger actuator linkage are allowed to move beyond the normal operating limits. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that the marks are aligned. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that two spanners are used to install the bolt. Failure to follow this instruction may result in damage to the vehicle.

To install, reverse the removal procedure.

2. Tighten the bolt to 5 Nm.



E128340

3. Install the turbocharger. For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).

Fuel Charging and Controls - TDV6 3.0L Diesel -

Torque Specification

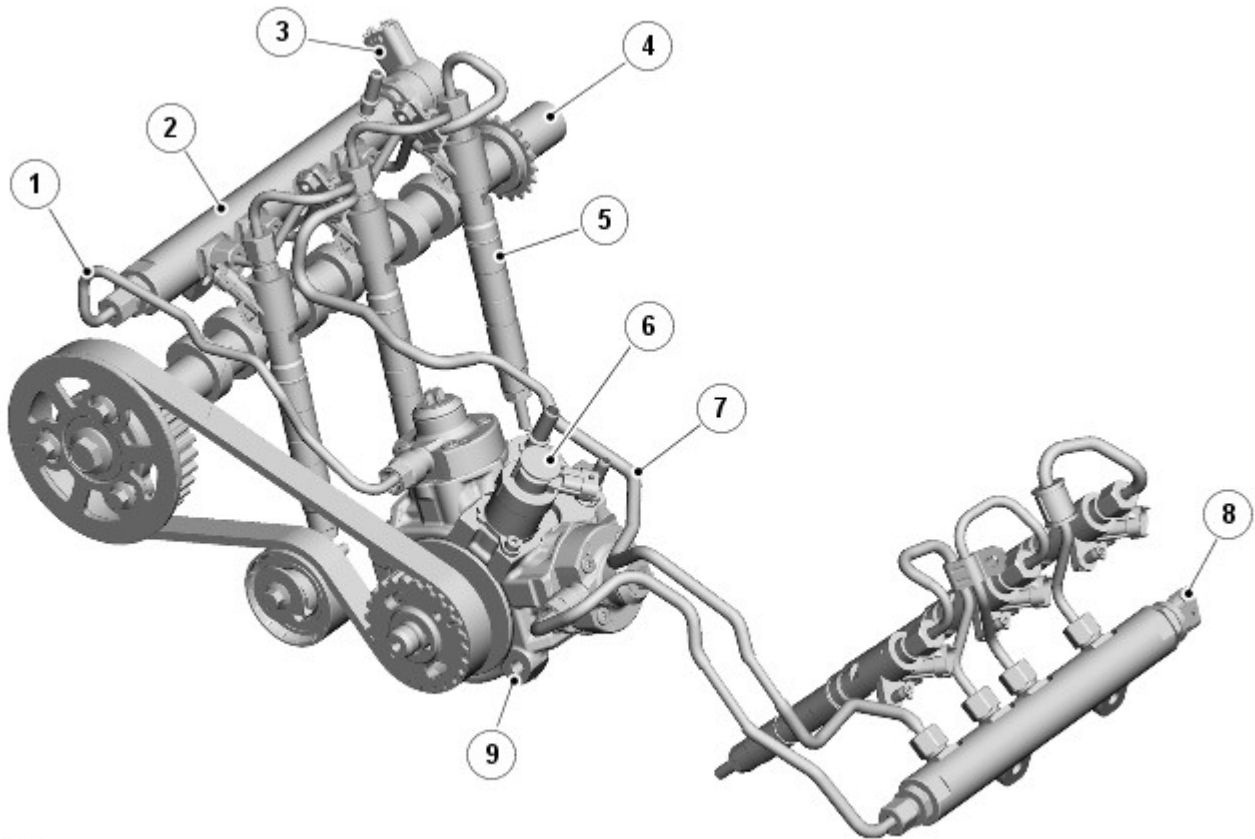
- NOTE: A = refer to procedure for the correct torque sequence.

Description	Nm	lb-ft	lb-in
Fuel injection pump cradle bolts	23	16	-
Fuel injection pump retaining bolts	23	16	-
Fuel injection pump bracket	9	-	80
Fuel injection pump sprocket bolt	50	37	-
Inlet manifold retaining bolts	9	-	80
Fuel injection pump belt rear cover retaining bolts	9	-	80
Camshaft rear end accessory drive (READ) pulley hub retaining bolt	A	-	-
Fuel injection pump belt tensioner retaining bolt	23	16	-
Camshaft READ pulley retaining bolt	A	-	-
Fuel rail bracket retaining bolts	23	16	-
Fuel injector retaining bolts	10	-	-
Fuel rail retaining bolts	25	-	-
High-pressure fuel line bracket retaining bolts	9	-	80
High-pressure fuel line union nuts	A	-	-
Fuel rail supply tube union nuts	A	-	-
Fuel crossover line union nuts	A	-	-
Exhaust gas recirculation (EGR) valve retaining bolts	9	-	80

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls - Component Location

Description and Operation

Component Location



E107576

ItemDescription

1	High pressure fuel supply
2	Common fuel rail
3	Fuel pressure control valve
4	Exhaust camshaft
5	Injectors
6	Volume control valve
7	Fuel rail balance pipe
8	Fuel pressure sensor
9	High pressure fuel pump

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls

- Overview

Description and Operation

OVERVIEW

The 3.0L V6 diesel engine is equipped with a HP (high pressure) common rail fuel injection system. With this fuel injection process, a HP pump delivers a uniform level of pressure to the shared fuel lines (the common rails), which serve all 6 fuel injectors. Pressure is controlled to the optimum level for smooth operation.

The common rail system supports a pre and pilot injection depending on engine operating conditions, which reduces combustion noise levels, more commonly referred to as 'diesel knock'.

Fuel injection pressure is generated independently of engine speed and fuel injection events.

The fuel injection timing and volume are calculated by the [ECM \(engine control module\)](#), which then energizes the appropriate piezo actuated injector. The common rail fuel injection system has the following features:

- High fuel injection pressures of up to 2000 bar (29007 lbf/in²) for greater atomization of fuel (increasing performance and lowering emissions).
- Variable injection to optimize combustion in all engine operating conditions
- Low tolerances and high precision throughout the life of the system.

The fuel system is divided into two sub systems:

- LP (low pressure) system
- HP system.

The LP system features the following components:

- In-tank fuel pump
- Fuel pressure regulator (integral to the fuel delivery module)
- Fuel filter
- Return pipes
- Injector return pipes
- Fuel coolers (engine and vehicle).

The LP system is regulated to 0.5 bar (7.25 lbf/in²).

The HP system features the following components:

- HP pump
- Fuel rails and diverter rail
- HP fuel pipes
- Injectors.

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls - System Operation and Component Description

Description and Operation

System Operation

ENGINE STARTING

During starting, the fuel rail pressure must be at least 150 bar (2175 lbf/in²). Should the pressure be below this figure, the injectors will not operate, resulting in the vehicle not starting.

ENGINE STOPPING

To stop the engine the [ECM \(engine control module\)](#) stops energizing the actuators in the fuel injectors, therefore, no fuel is injected and the engine speed drops to zero.

Refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

HP FUEL PUMP

When the HP fuel pump is rotated, pressure is created when the volume control valve is open and the pressure control valve is closed. Both valves are electronically controlled by the [ECM](#) to allow variable fuel delivery and pressure control. When the [ECM](#) actuates the piezo actuators, the fuel rail pressure drop is off-set by additional fuel being delivered to the fuel rails by the pressure control valve. The fuel pressure in the system is reduced within a few seconds after the engine has stopped as the pressure control valve no longer has the holding current it requires, and therefore opens. No residual pressure remains in the system and the fuel is returned to the LP fuel return line to the fuel filter through the open pressure control valve.

Component Description

LOW PRESSURE (LP) SYSTEM

LP Fuel Pump

The electric fuel pump is located inside the fuel tank. Fuel is pumped from the tank via the in-tank fuel pump, to the HP pump via the fuel filter.

Refer to: Fuel Tank and Lines (310-01 Fuel Tank and Lines - 3.0L Diesel, Description and Operation).

Fuel Filter

The fuel filter assembly is located in front of the fuel tank and is mounted on a bracket which is attached to the top face of the transfer box chassis cross member.

Fuel returning from the HP pump passes through the fuel cooler before returning to the filter to maintain the fuel at an optimum temperature. The returning fuel is re-circulated through the filter to help prevent waxing in cold operating conditions. Fuel pressure and fuel delivery is maintained by the in-tank pump and regulator via the tank fuel feed line.

The filter has an air bleed return to the fuel tank which returns excess air and fuel to the tank.

The filter element has a capacity of 200cm³ (12.2in³). The filtration element has the capacity to filter particulate matter larger than 5 microns.

The fuel filter is also fitted with a water sensor to detect when moisture which has collected in the filter has reached an unacceptable level.

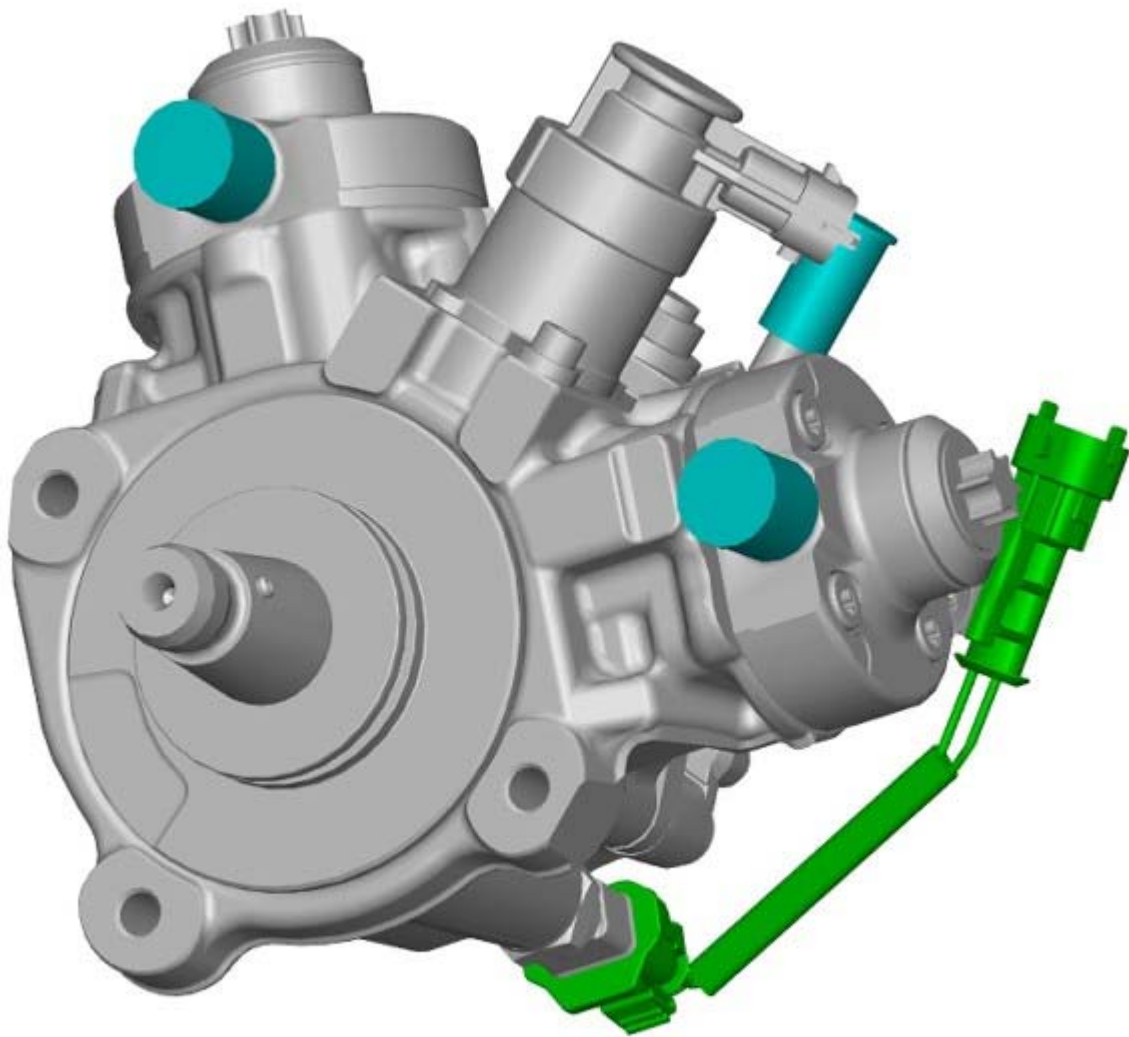
Refer to: Fuel Tank and Lines (310-01 Fuel Tank and Lines - 3.0L Diesel, Description and Operation).

Fuel Cooler

An air blast fuel cooler is located off the engine crossmember at the front of the engine oil pan. The fuel cooler has 2 connections; one is an inlet which allows heated fuel from the HP pump to be cooled, the second allows the cooled fuel to be fed from the cooler into the supply pipe from the LP fuel pump in the fuel tank, via a 'Y' connector back to the fuel filter.

HIGH PRESSURE (HP) SYSTEM

HP Fuel Pump



E108848

The HP pump is a 2 piston radial plunger pump. The pump has the ability to produce a maximum pressure of 2000 bar (29007 lbf/in²). The housing is cast from iron, the flange is cast from aluminum.

The HP pump is driven from the [LH \(left-hand\)](#) cylinder bank exhaust camshaft via a toothed belt. The drive from the belt rotates a cam within the pump which operates a plunger within each pumping element. A procedure and special tools are required for pump or belt replacement to time the pump.

The high-pressure pump comprises 2 high pressure pumping elements, a volume control valve, an internal transfer pump and a fuel temperature sensor.

The fuel is delivered to the internal transfer pump via the external fuel filter and an electric fuel pump which is located in the fuel tank.

The volume control valve is mounted on the high-pressure pump, and located in the feed port between the high pressure pump elements and the internal transfer pump. The volume control valve is a variable position solenoid-operated valve that is controlled by the [ECM](#). The volume control valve determines the amount of fuel that is delivered from the internal transfer pump to the HP pumping elements. When there is no signal to the volume control valve, the valve is closed and there is no fuel delivery.

The fuel from the internal transfer pump is passed to the HP pumping elements at a constant pressure known as transfer pressure. The transfer pressure is controlled by an internal pressure relief valve. Once the fuel enters each of the HP pump elements the pressure rises rapidly, with each element providing a HP supply to one of the fuel rails. The high pressure is controlled by the high pressure regulator valve and the fuel rail pressure sensor.

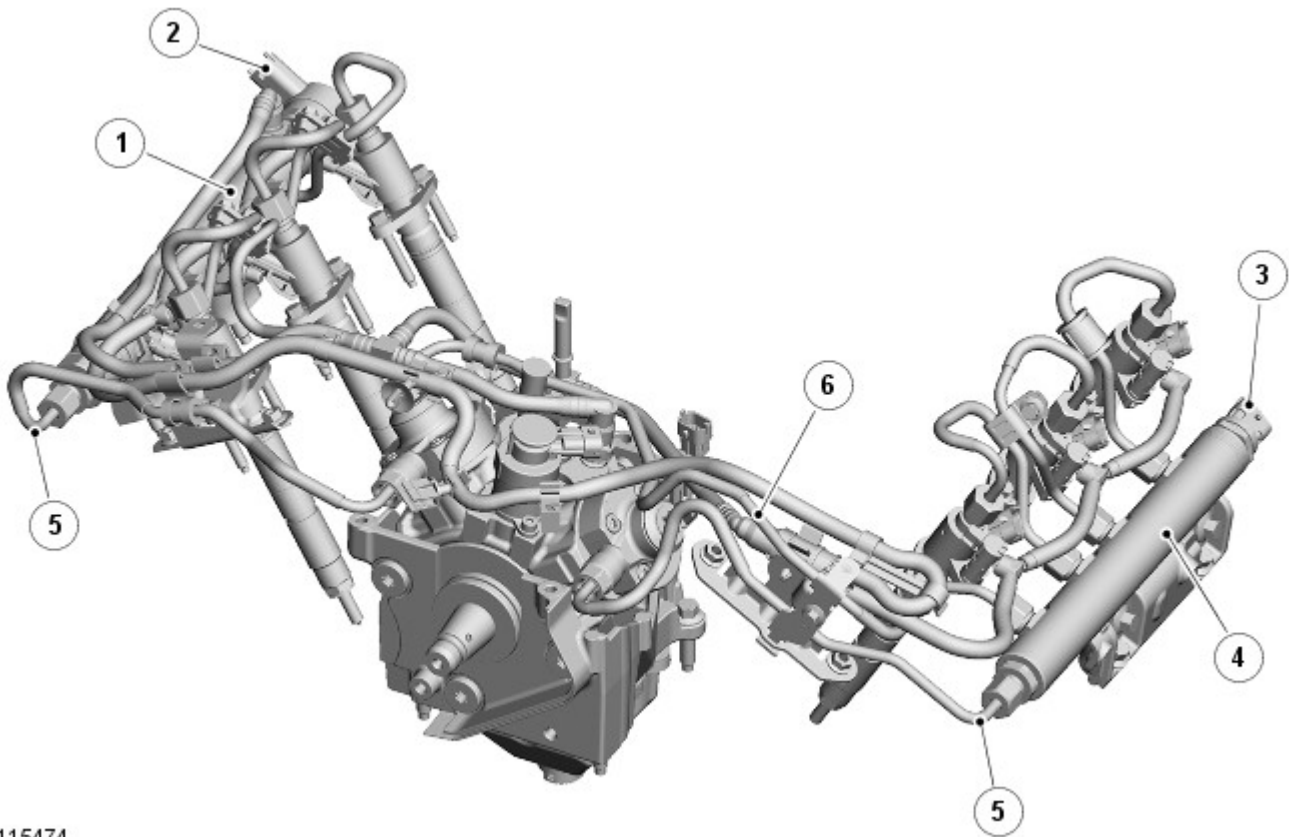
A controlled amount of fuel is allowed to leak-off from the internal transfer pump. This fuel is delivered to the pump internal components to provide cooling and lubrication and is passed back the fuel filter via the LP feed line.

The pressure control valve is located in one of the fuel rails. The fuel pressure is monitored by a pressure sensor located in the other fuel rail. The [ECM](#) controls the pressure control valve using the received signals from the pressure sensor.

Reducing the pressure in the fuel rails via the pressure control valve results in fuel returning from the fuel rails to the LP fuel return to the fuel filter.

The fuel temperature sensor is located on the rear of the HP pump. It measures the fuel temperature in the low-pressure side of the HP pump. The [ECM](#) continually monitors this signal to determine the fuel temperature to prevent overheating of the fuel system. The [ECM](#) will also make fine adjustments to fuel injection quantity to adjust for fuel temperature.

Fuel Rails



E115474

ItemDescription

1	LH fuel rail
2	Fuel pressure control valve
3	Fuel pressure sensor
4	RH (right-hand) fuel rail
5	HP fuel connection from HP pump
6	Fuel rail balance pipe

The fuel rails are steel fabrications and are similar in their construction. Two fuel rails are used with each rail supplying high pressure fuel to 3 fuel injectors.

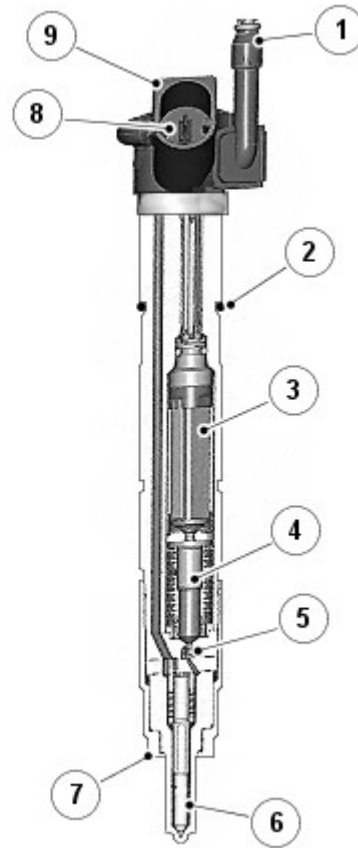
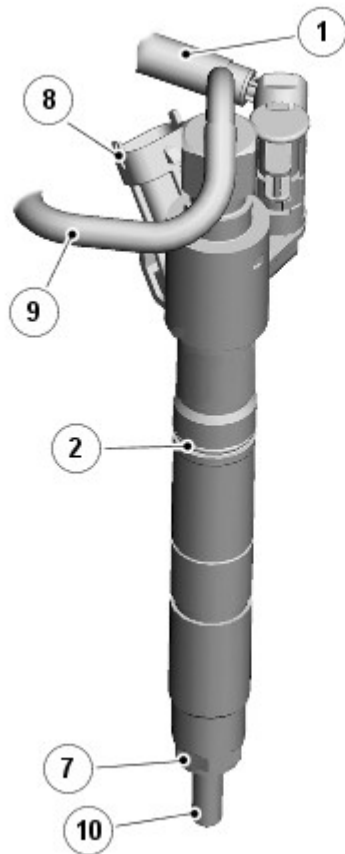
Each rail has 5 threaded connections which provide for the attachment of the high pressure fuel supply from the HP pump, the balance pipe and connections for the 3 injectors supplied with fuel from that rail.

The fuel pressure in the rails is detected by a fuel pressure sensor which is located in the end of the [RH](#) rail. The [LH](#) rail houses a pressure control valve. The [ECM](#) controls the pressure control valve using signals from the pressure sensor.

The fuel rail pressure sensor is a piezo-resistive type sensor containing an actuating diaphragm. Deflection of the diaphragm provides a proportional signal (output) voltage to the [ECM](#), dependant on the fuel pressure within the fuel rail.

Both rails are connected together with a balance pipe which ensures the pressure in both rails is equal, even though each rail is supplied from a different pumping element in the HP pump.

Fuel Injectors



E115475

ItemDescription

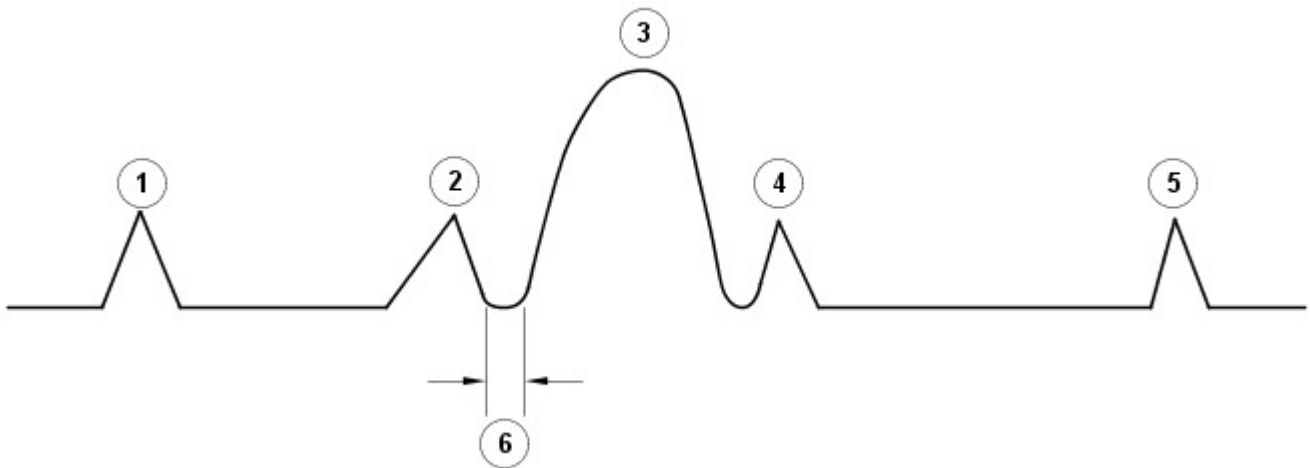
1	Fuel return
2	O-ring seal
3	Piezo stack actuator
4	Hydraulic coupler
5	Control valve
6	Nozzle body
7	Copper sealing washer
8	Electrical connector
9	High pressure feed
10	Nozzle

Six fuel injectors are used in the fuel system. A piezo actuator in each injector is electronically controlled by the [ECM](#) to operate the injector in response to engine speed and load conditions.

Each injector has an electrical connector which connects the injector to the engine harness. A fuel connection on the top of the injector provides for the high pressure fuel inlet from the HP pump. A second fuel connection allows fuel leakage within the injector to return to the HP pump.

Each injector is located in a machined hole in the cylinder head and is sealed in the cylinder head with a copper sealing washer and an O-ring seal. The injector is retained in the cylinder head with a clamp plate and 2 bolts. If an injector is removed or replaced, a new copper sealing washer and a clamp plate must be used when refitting the injector.

The injector can operate up to 5 times during one combustion cycle depending on engine speed and load. The injection sequence can occur as follows:



E107577

- Pilot injection - occurs before the main injection and improves fuel and air mixing
- Pre-injection - shortens the main injection's ignition delay and therefore reduces the generation of nitrous oxides
- Main injection - delivers the required engine torque
- After injection - occurs after the Main injection and assists the re-burn of any remaining particulate matter
- Post injection - helps manage the temperature of the exhaust gas for more effective exhaust-gas after-treatment
- Injection delay 0.4 ms.

Each injector is calibrated to the [ECM](#) and applicable the cylinder to which it is fitted. Therefore, if an injector is removed it must be refitted to the cylinder from which it was removed. If a new injector is fitted, a calibration routine using Land Rover approved diagnostic equipment must be performed to calibrate the injector unique code to the [ECM](#).

The operating voltage of the injector is between 110 and 163 volts depending on engine speed and load and care must be taken when working in the vicinity of the injectors. The voltage increases linearly from 200 to 2000 bar.

Each injector has an electrical resistance value of between 150 - 250 kOhms.



CAUTION: Each injector operation is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from the injector. Never disconnect the wiring connection when the engine is running. The injector can remain open thus causing engine damage.

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Fuel Charging and Controls](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).

Inspection and Verification



WARNING: Make sure that all suitable safety precautions are observed when carrying out any work on the fuel system. Failure to observe this warning may result in personal injury.

• CAUTIONS:



Make sure that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Fuel supply/return line(s) ● Fuel tank and filler pipe ● Fuel leak(s) ● Fuel filler cap ● Fuel filter ● Push connect fittings ● Fuel rail ● Fuel pump ● Exhaust Gas Recirculation (EGR) system 	<ul style="list-style-type: none"> ● Fuses ● Glow plug indicator ● Inertia fuel shutoff switch ● Fuel pump module ● Sensor(s) ● Powertrain Control Module (PCM) ● Fuel volume control valve ● Fuel pressure control valve ● Fuel Rail Pressure (FRP) sensor ● Fuel temperature sensor ● Fuel injector(s) ● Exhaust Gas Recirculation (EGR) system

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> ● Inertia fuel shutoff switch ● Low/Contaminated fuel ● Air leakage ● Low-pressure fuel system fault ● Fuel pump module (lift pump) fault ● Blocked fuel filter ● Fuel volume regulator blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel pump fault ● Crankshaft position (CKP) sensor 	Check that the inertia switch has not tripped. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.
Difficult to start	<ul style="list-style-type: none"> ● Glow plug system fault (very cold conditions) ● Low/Contaminated fuel ● Air leakage ● Fuel pump module (lift pump) fault 	Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a

Symptom	Possible Causes	Action
	<ul style="list-style-type: none"> ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	fuel volume or pressure control valve fault. Check the EGR system.
Rough idle	<ul style="list-style-type: none"> ● Intake air system fault ● Low/Contaminated fuel ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Lack of power when accelerating	<ul style="list-style-type: none"> ● Intake air system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust gas recirculation (EGR) valve(s) fault ● Turbocharger actuator fault 	Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary. Check for DTCs indicating a fuel pressure fault. Check the EGR system. Check turbocharger actuator.
Engine stops/stalls	<ul style="list-style-type: none"> ● Air leakage ● Low/Contaminated fuel ● Low-pressure fuel system fault ● High pressure fuel leak ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Engine judders	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Air ingress ● Low-pressure fuel system fault ● Fuel metering valve blocked/contaminated ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● High pressure fuel leak ● Fuel pump fault 	Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	<ul style="list-style-type: none"> ● Low-pressure fuel system fault ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel temperature sensor leak ● High pressure fuel leak ● Injector(s) fault ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the EGR system.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation).

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injection Component Cleaning

General Procedures

• WARNINGS:



Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1700 bar (24,656 lb-sq-in). Failure to follow this instruction may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

• CAUTIONS:



Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.



Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.



Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh cleaning fluid, prior to starting work on the vehicle.



Use a steel topped workbench and cover it with clean, lint-free non-flocking material.



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

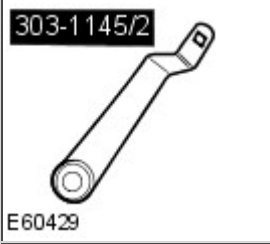


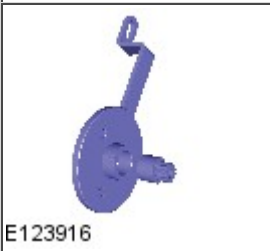
• NOTE: Pneumatic vacuum gun

1. Using a new brush that will not lose its bristles, brush cleaning fluid onto the components being removed and onto the surrounding area.
2. Using a pneumatic vacuum gun, remove all traces of cleaning fluid and foreign material.
3. Dispose of any used cleaning fluid and the brush after completing the repair.

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injection Pump

Removal and Installation

Special Tool(s)

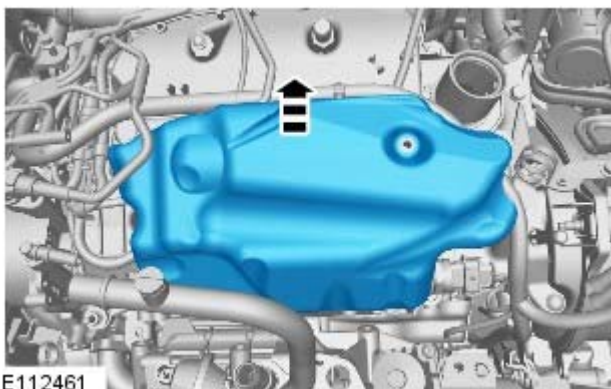
 <p>303-1145/2 E60429</p>	<p>303-1145/2 Remover, Camshaft Rear Pulley Bolt</p>
 <p>E117205</p>	<p>310-138A Holding Tool, Fuel Pump Pulley</p>
 <p>E117206</p>	<p>310-139A Holding Tool, Fuel Pump Pulley</p>
 <p>E123916</p>	<p>JLR-303-1523 Remover/Installer, Camshaft Rear Pulley</p>

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

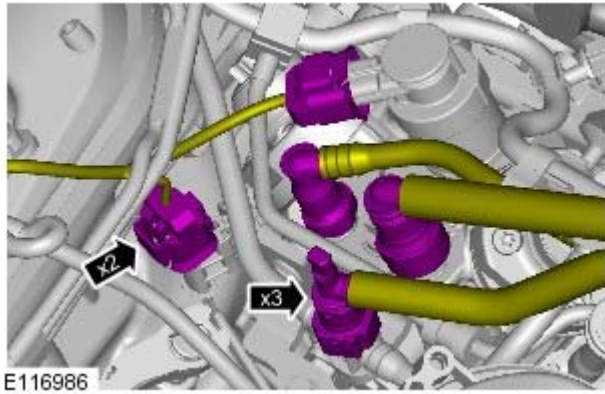
1. Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).
2. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. **3.** NOTE: Left-hand shown, right-hand similar.

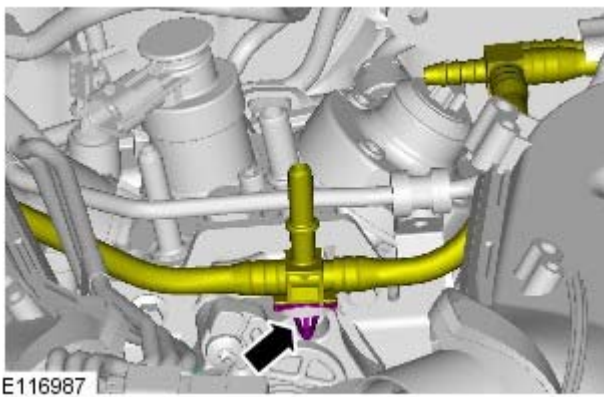


E112461

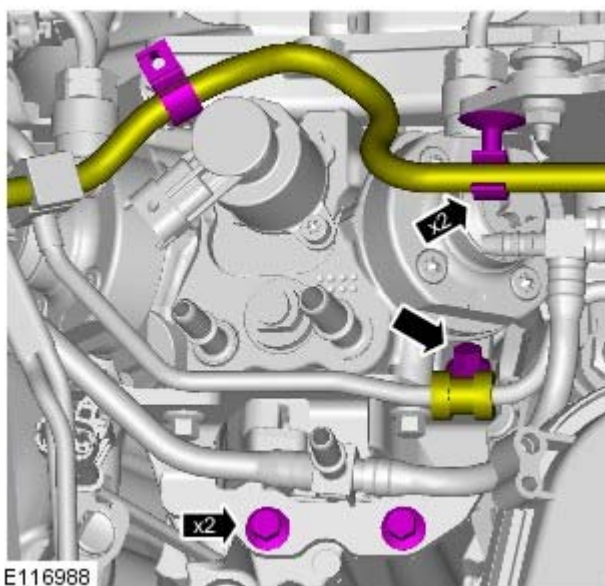
4. Refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).
5. Refer to: [Rear End Accessory Drive \(READ\)](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
6. Refer to: [Crankcase Vent Oil Separator](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).



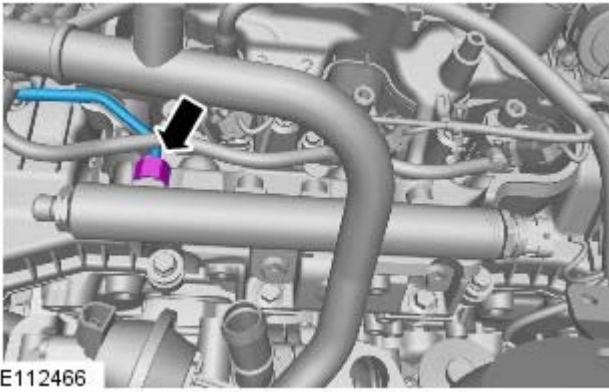
7. **7.**  CAUTION: Be prepared to collect escaping fuel.



8. **8.**  CAUTION: Be prepared to collect escaping fuel.



- 9.

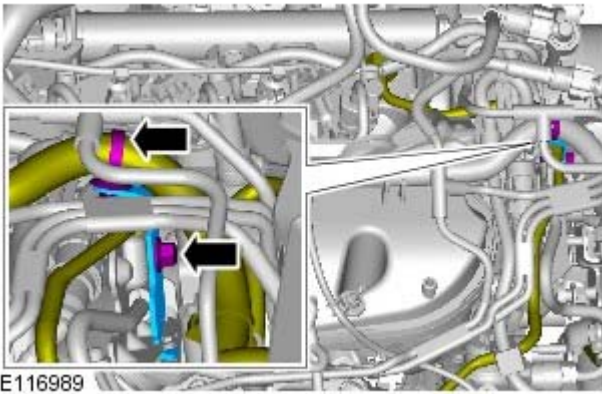


10. **10. CAUTIONS:**

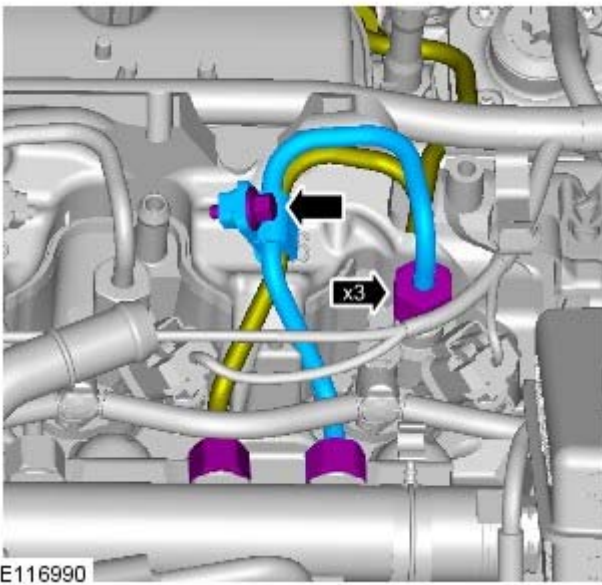
 Be prepared to collect escaping fuel.

 Discard the component.

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



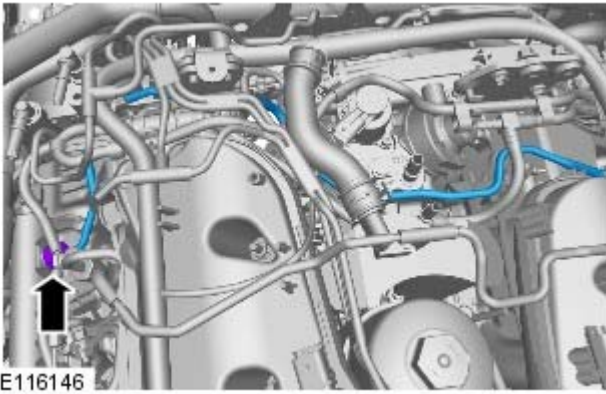
11.





12. **12. CAUTIONS:**

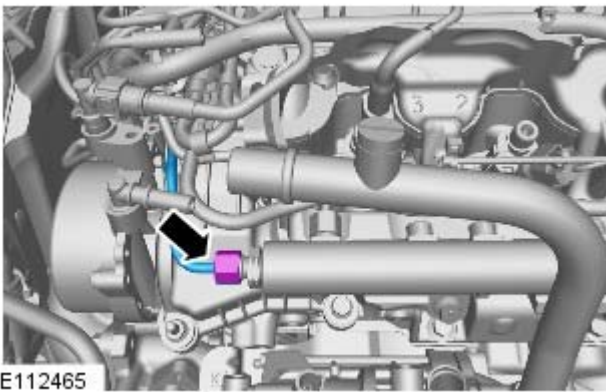
 Be prepared to collect escaping fuel.

 Discard the component.



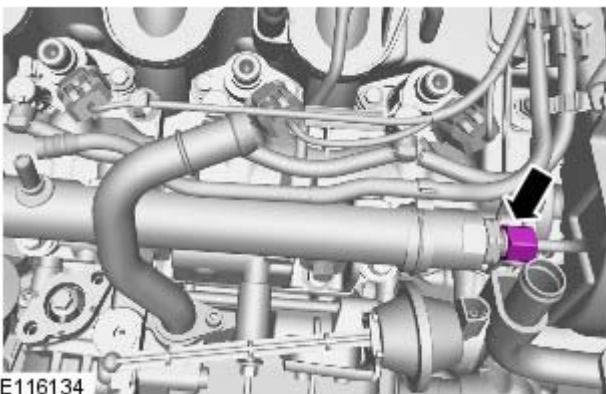
13. **13. CAUTIONS:**


-  Be prepared to collect escaping fuel.
-  Discard the component.



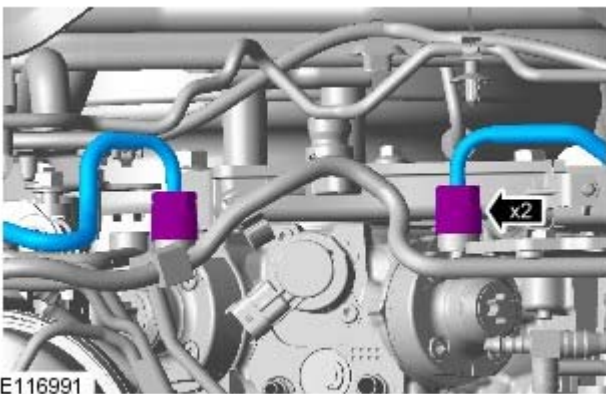
14. **14.  CAUTION:** Be prepared to collect escaping fuel.

- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.





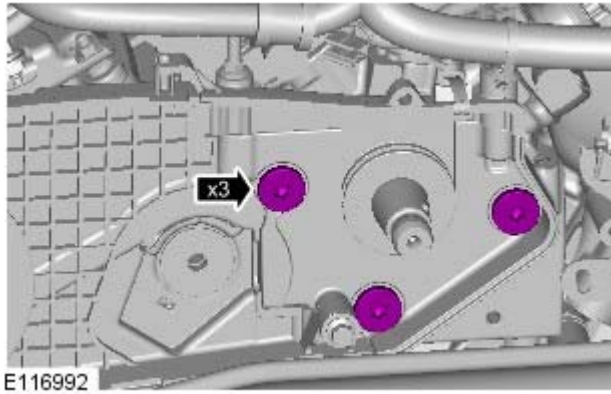
15. **15.  CAUTION:** Be prepared to collect escaping fuel.

- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

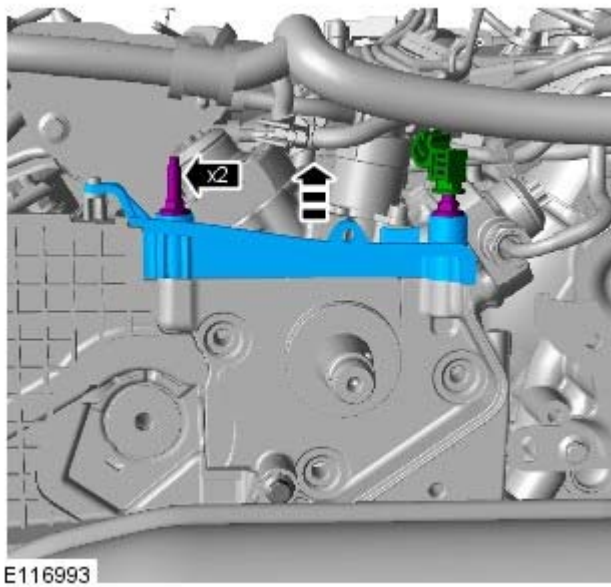


16. **16. CAUTIONS:**

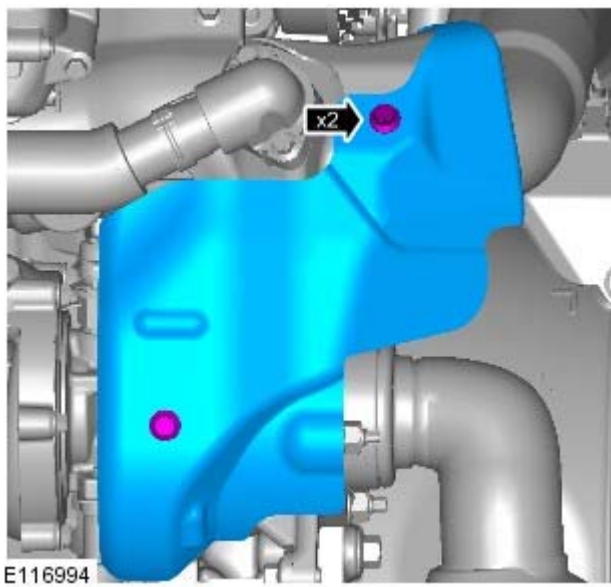
-  Be prepared to collect escaping fuel.
-  Discard the components.



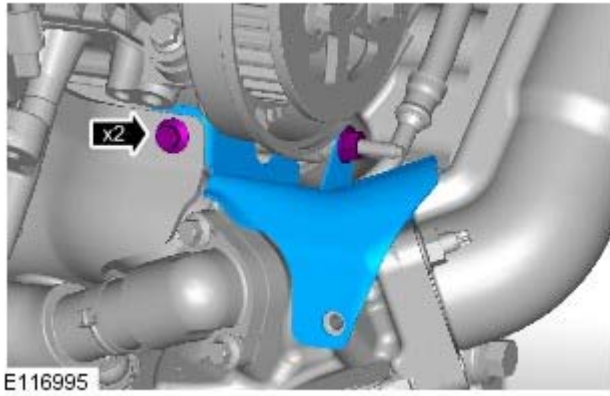
17. **17.** NOTE: Fuel injection pump pulley shown removed for clarity.



18. **18.** NOTE: Fuel injection pump pulley shown removed for clarity.



19.



20.



21. *Special Tool(s):* [JLR-303-1523](#)
Torque: 10 Nm



22. *Special Tool(s):* [JLR-303-1523](#)



E123895

23. Remove the rear camshaft pulley retaining bolt.

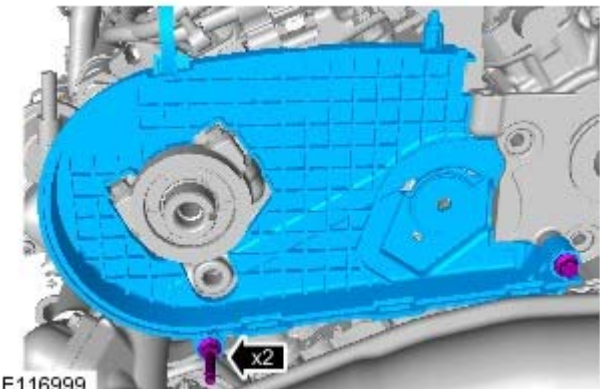
Special Tool(s): [303-1145/2](#)

24. Remove the special tools.



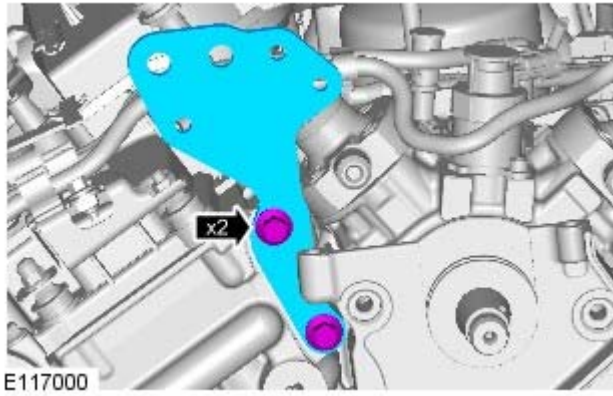
E123934

25.

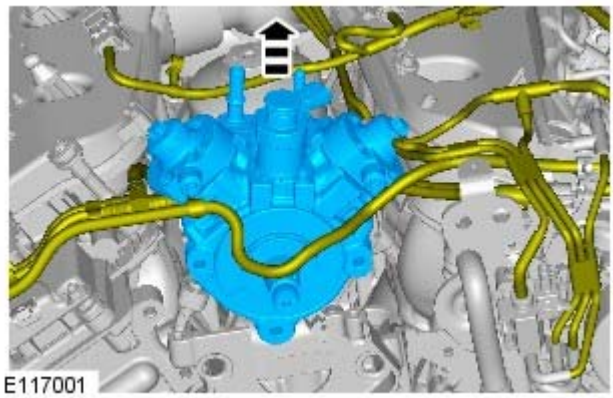


E116999

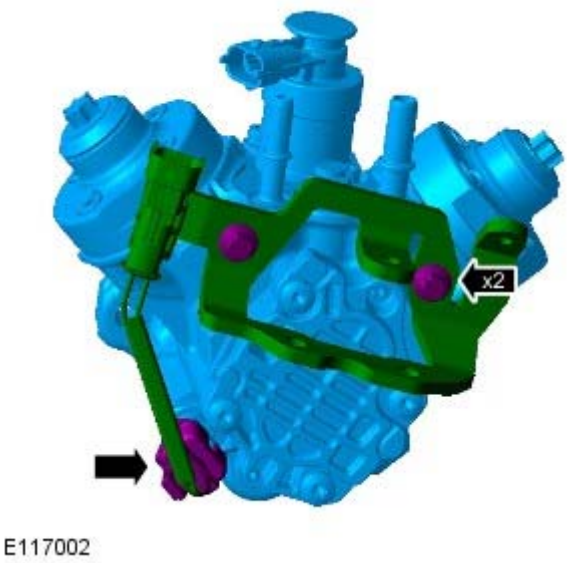
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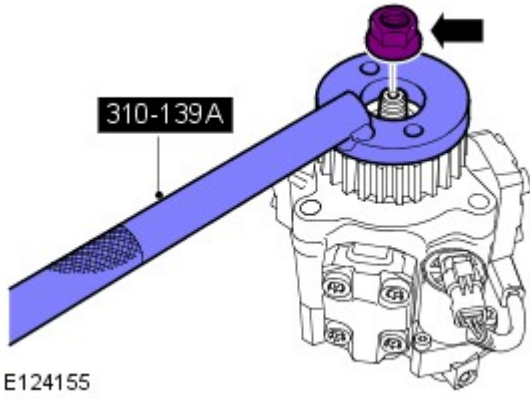
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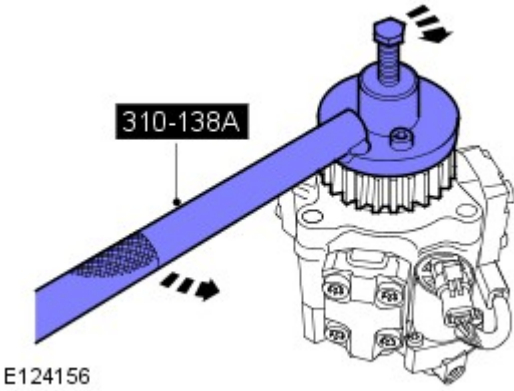
28.



29. **29.** NOTE: Do not disassemble further if the component is removed for access only.

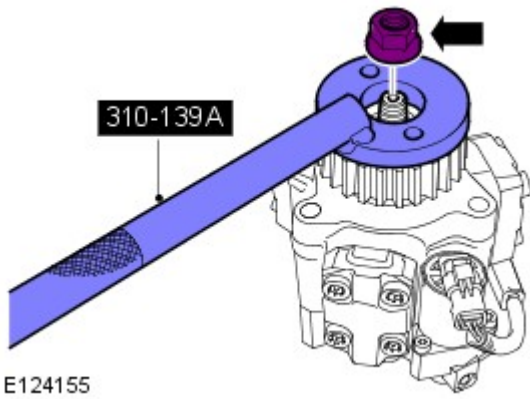


30. *Special Tool(s):* [310-139A](#)



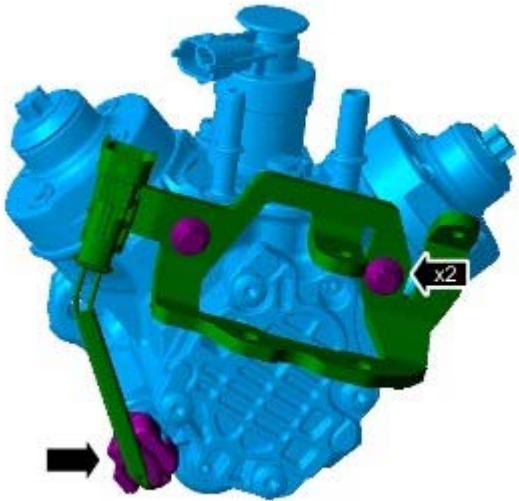
31. *Special Tool(s):* [310-138A](#)

Installation



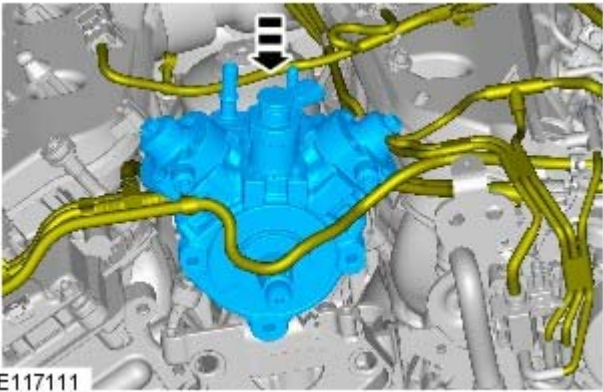
1. *Special Tool(s):* [310-139A](#)
Torque: 50 Nm

2. Torque: 3 Nm



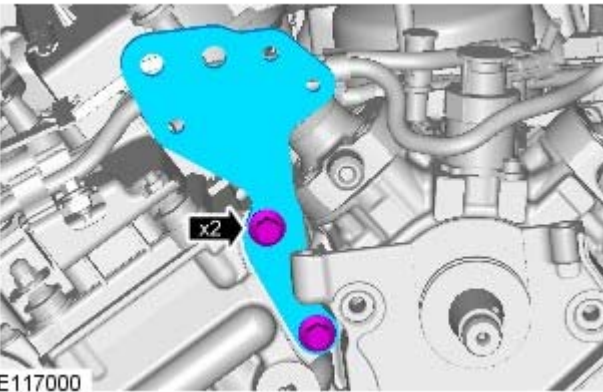
E117002

3.

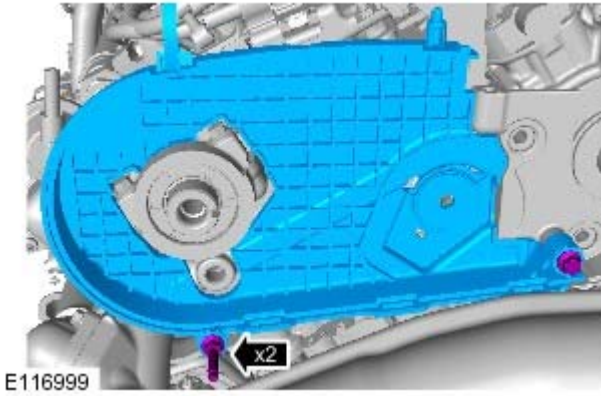


E117111

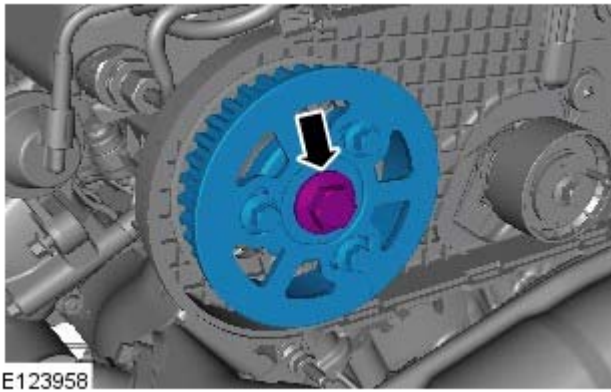
4. Torque: 23 Nm



E117000




5. Torque: 10 Nm



6. **6. CAUTIONS:**

 Apply loctite 242 (ESK-M4G247-A1) to the new camshaft pulley bolt.

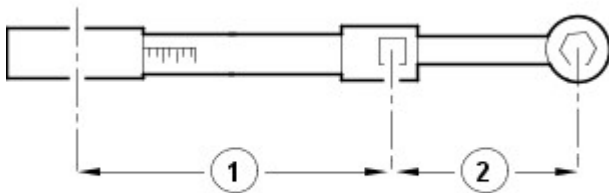
 Install the bolt finger tight.




7. Torque: 10 Nm



8.




9.  CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

- Calculate the setting for the torque wrench:
- **Stage 1:** Multiply the required torque by the effective length of the torque wrench (1).
- **Stage 2:** Add the effective length of the special tool (2) to the effective length of the torque wrench.
- **Stage 3:** Divide the total of stage 1 by the total of stage 2.
- **Stage 4:** Set the torque wrench to the figure arrived at in stage 3.

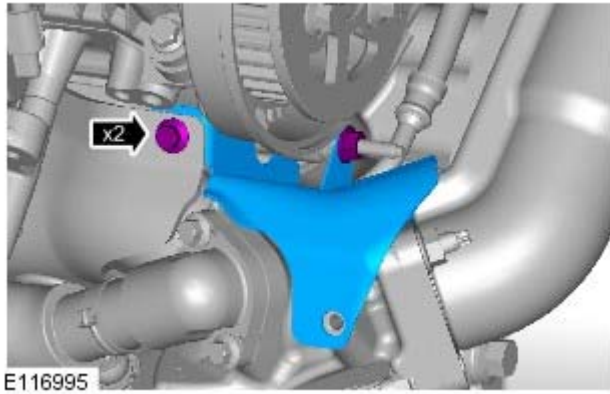
E37107



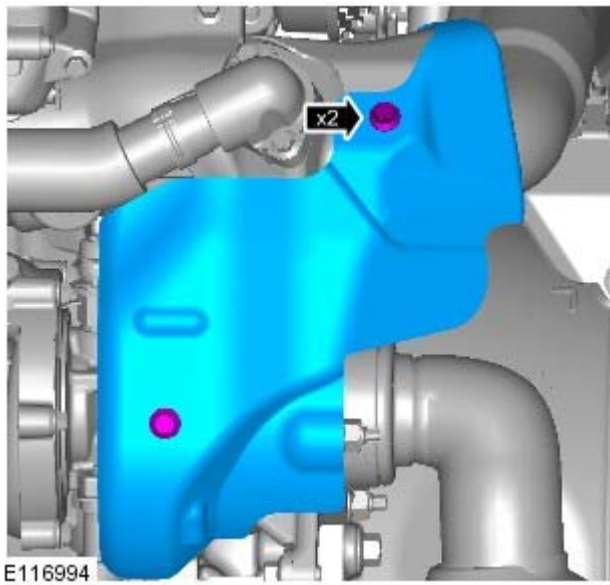
10.  CAUTION: Make sure the torque wrench setting procedure is followed correctly. Failure to follow this instruction may result in damage to the vehicle.

Torque:
 Stage 1: 80 Nm
 Stage 2: 80°

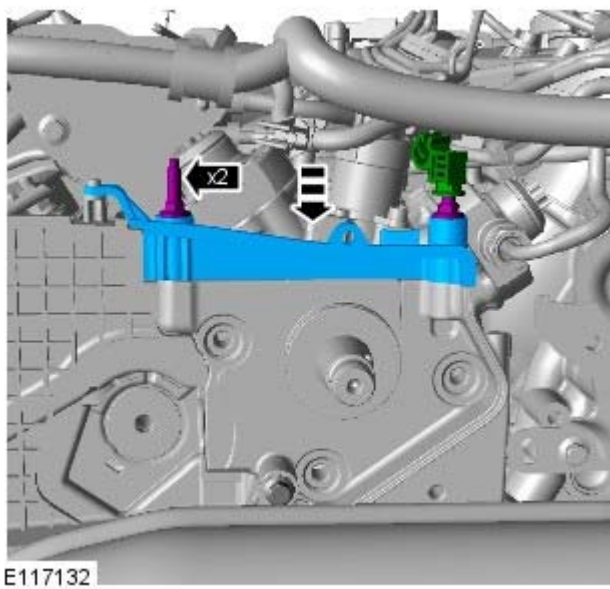
11. Remove the special tools.



12. Torque: 10 Nm

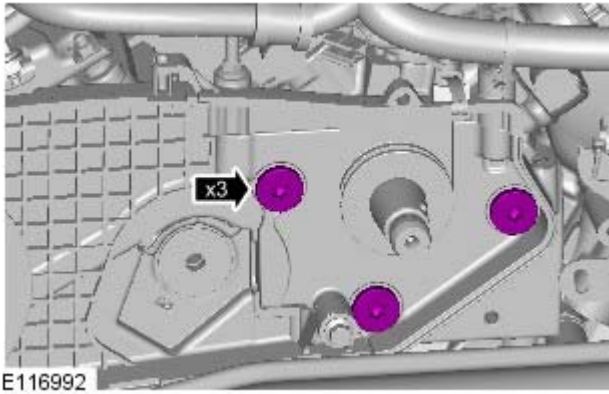


13. Torque: 10 Nm



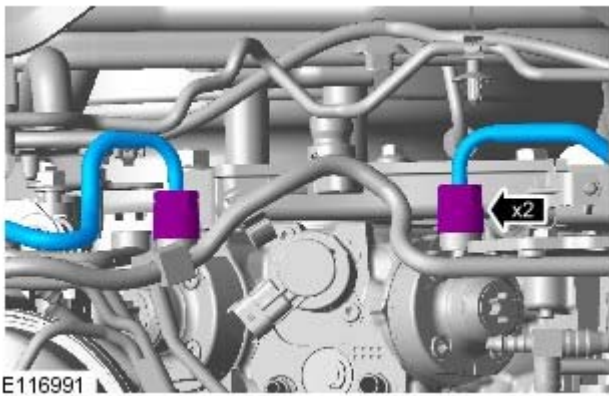
14. **14.** NOTE: Fuel injection pump pulley shown removed for clarity.

Torque: 10 Nm





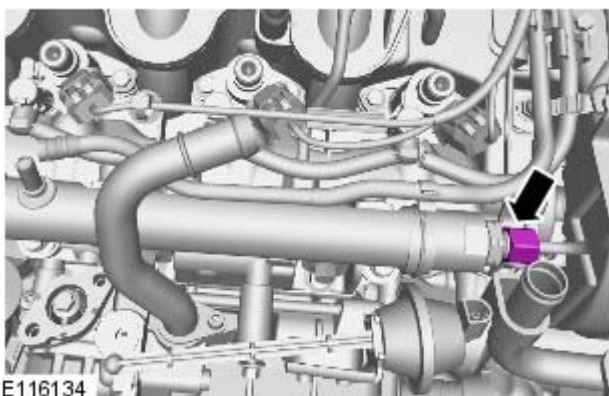
15. **15.** NOTE: Fuel injection pump pulley shown removed for clarity.

Torque: 23 Nm





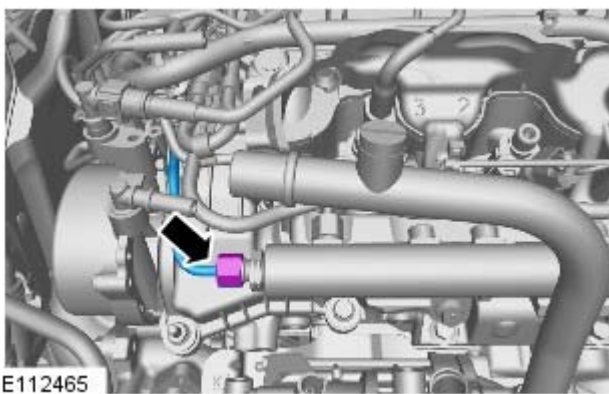
16. **16.** CAUTIONS:

-  Tighten the fuel supply line unions finger tight.
-  Make sure that a new component is installed.





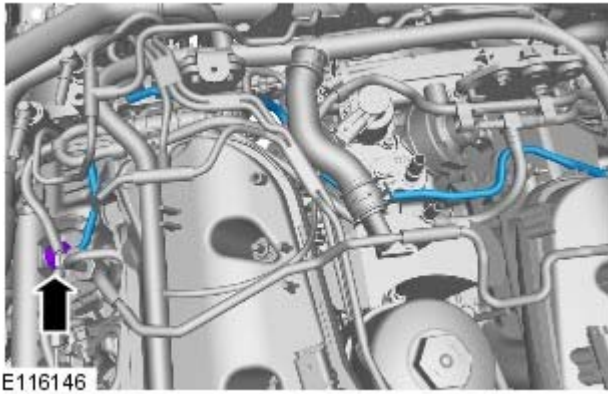
17. **17.** CAUTIONS:

-  Make sure that a new component is installed.
 -  Tighten the fuel supply line unions finger tight.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.





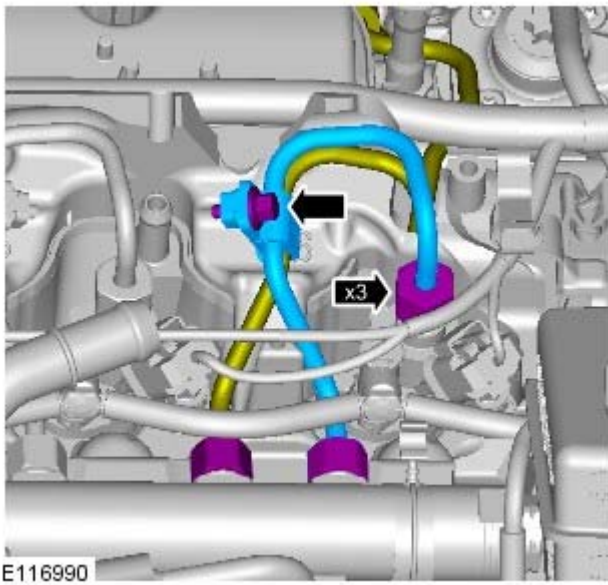
18. **18.** CAUTIONS:

-  Make sure that a new component is installed.
 -  Tighten the fuel supply line unions finger tight.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.





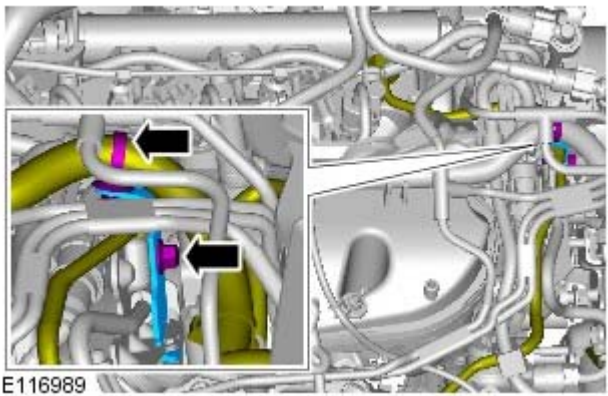
19. **19. CAUTIONS:**

-  Make sure that a new component is installed.
-  Tighten the fuel supply line unions finger tight.

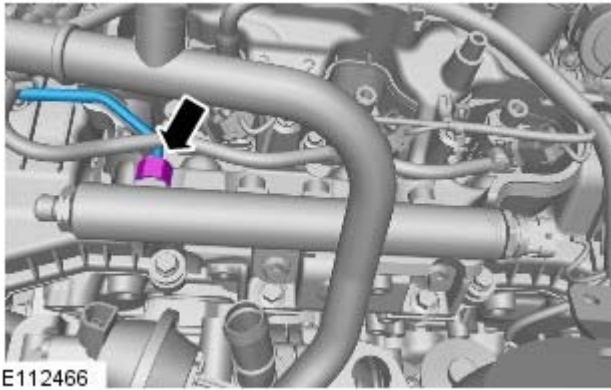


20. **20. CAUTIONS:**

-  Tighten the fuel supply line unions finger tight.
-  Make sure that new components are installed.



21. *Torque: 10 Nm*

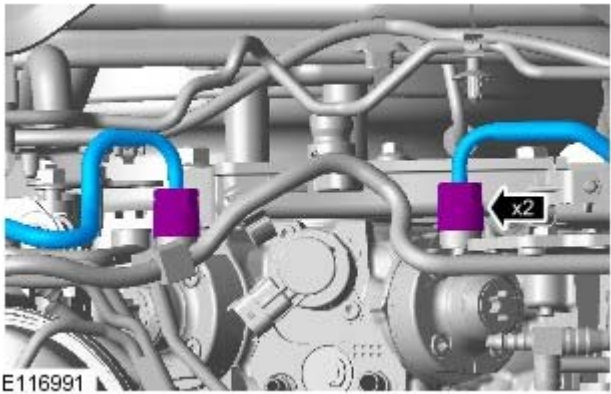


22. **22. CAUTIONS:**

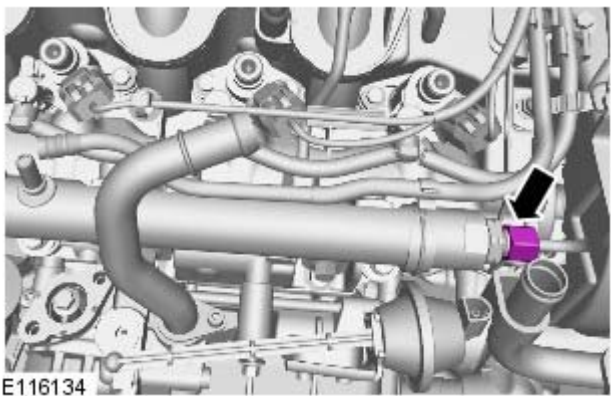
 Make sure that a new component is installed.

 Tighten the fuel supply line unions finger tight.

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

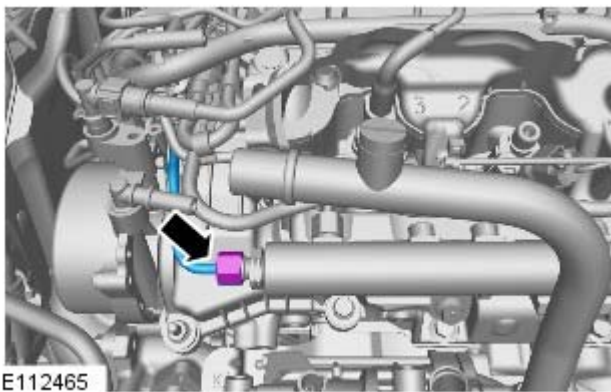


23. Tighten the high-pressure fuel lines union to 15Nm.



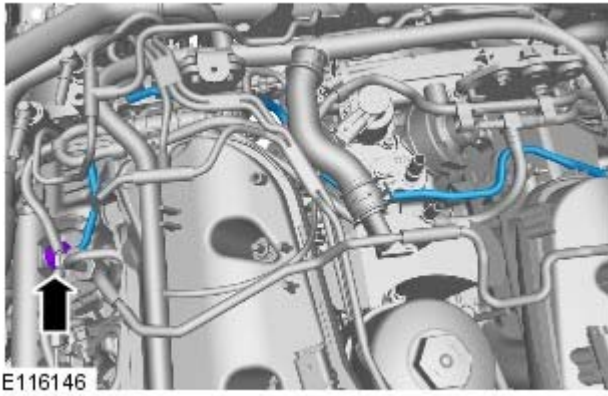
24. **24. NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Tighten the high-pressure fuel lines union to 15Nm.

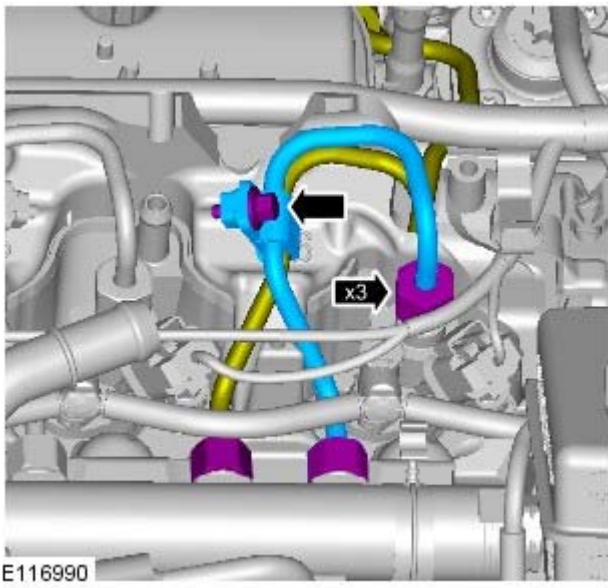


25. **25. NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

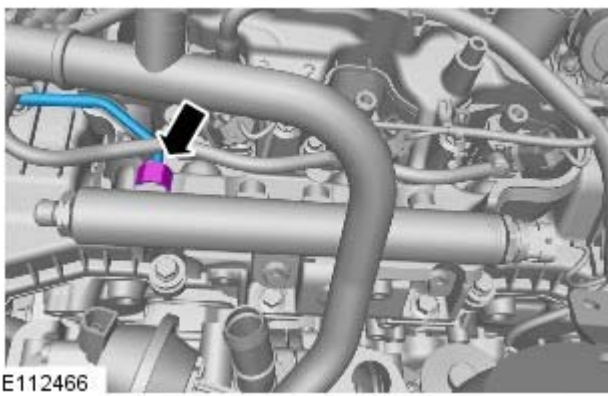
Tighten the high-pressure fuel lines union to 15Nm.



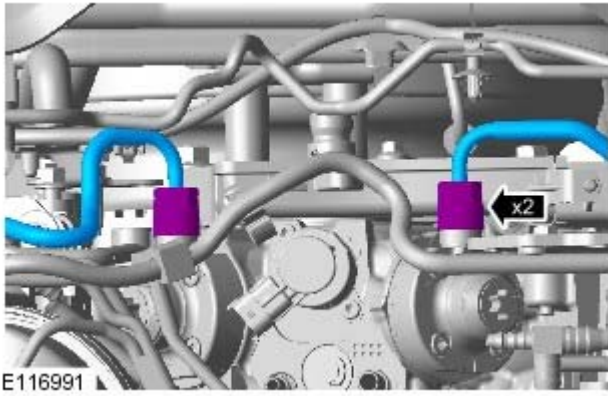
26. Tighten the high-pressure fuel lines union to 15Nm.



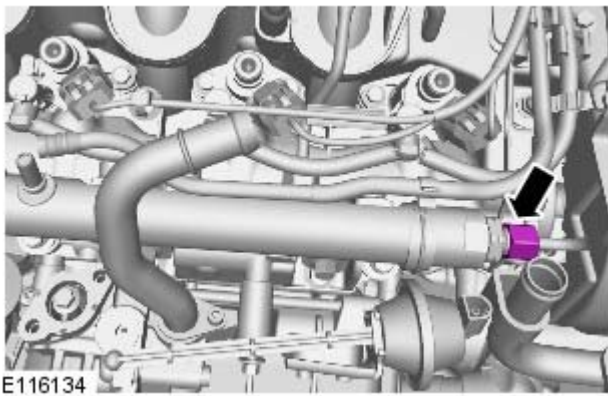
27. Tighten the high-pressure fuel lines union to 15Nm.



28. **28.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
Tighten the high-pressure fuel lines union to 15Nm.

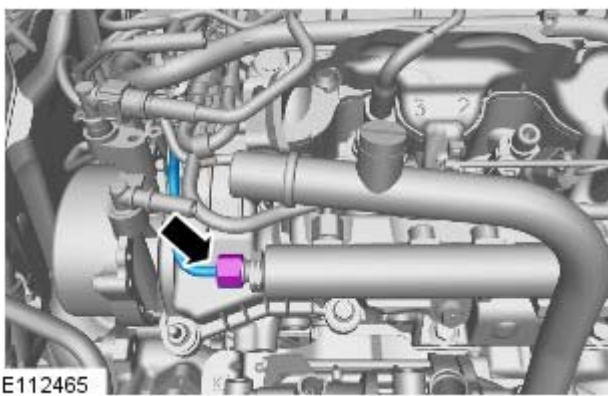


29. Tighten the high-pressure fuel line union to 35Nm.



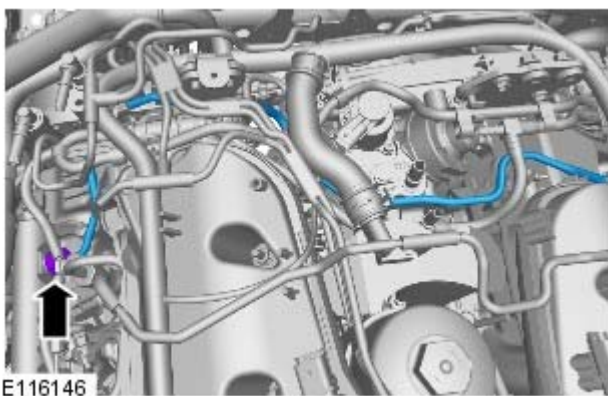
30. **30.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Tighten the high-pressure fuel line union to 35Nm.

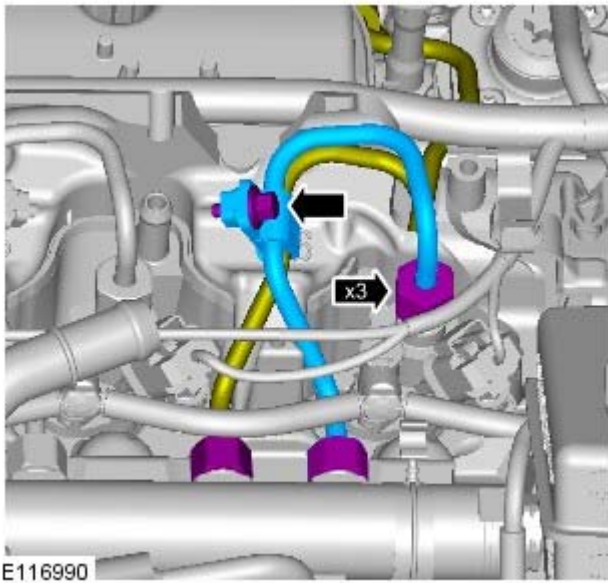


31. **31.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

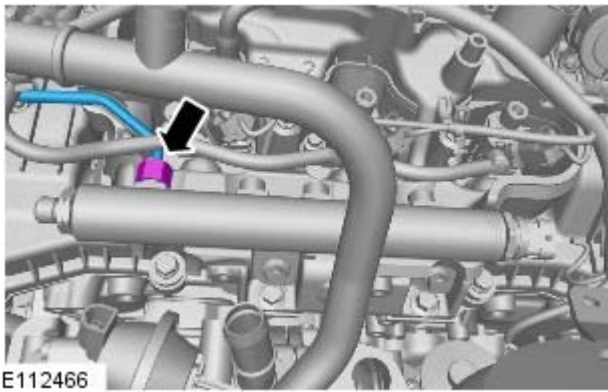
Tighten the high-pressure fuel line union to 35Nm.



32. Tighten the high-pressure fuel line union to 35Nm.

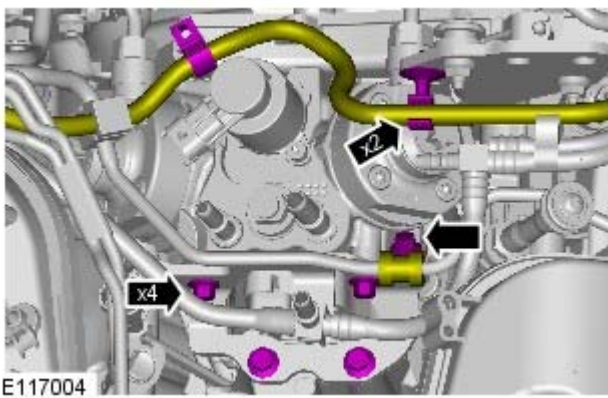


33. Tighten the high-pressure fuel line union to 35Nm.

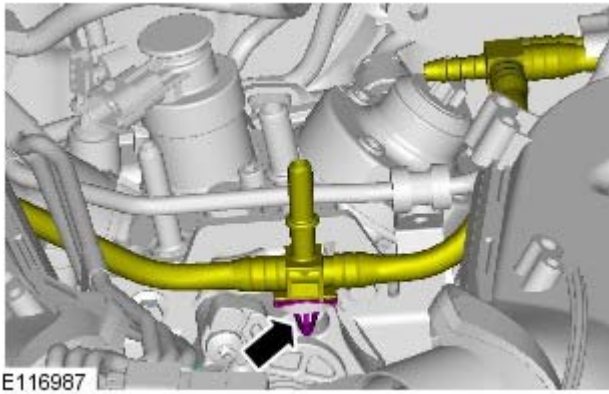


34. **34.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

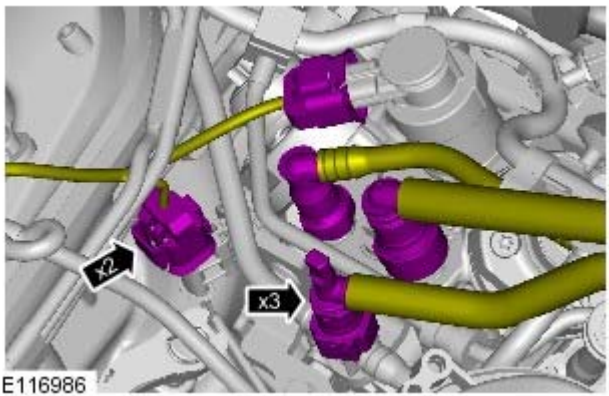
Tighten the high-pressure fuel line union to 35Nm.



35. Torque: 10 Nm



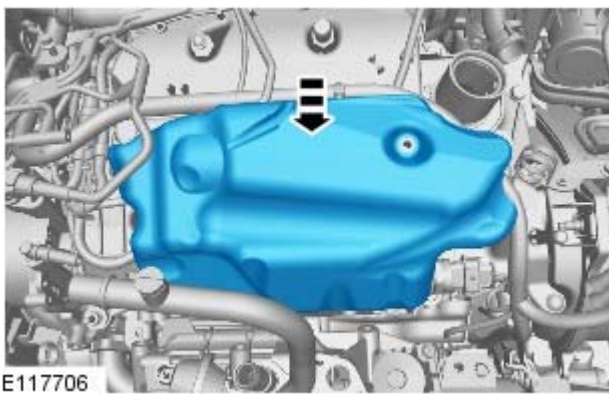
36.



37.

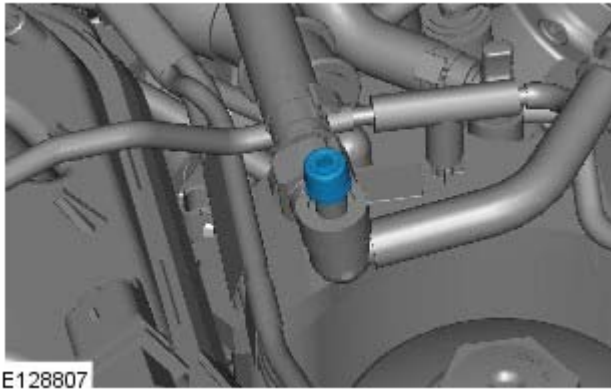
38. Refer to: [Crankcase Vent Oil Separator](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

39. Refer to: [Rear End Accessory Drive \(READ\)](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).

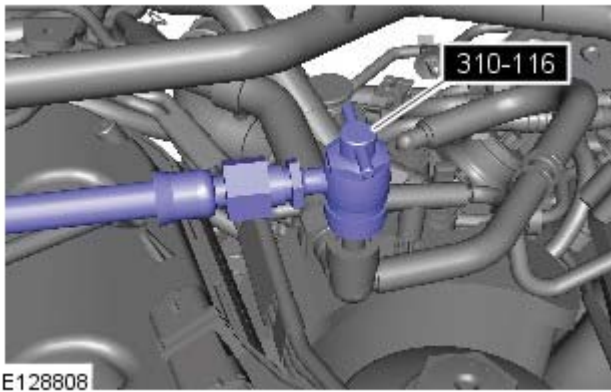


40. **40.** NOTE: Left-hand shown, right-hand similar.

41. Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).



42.



43. **43.** NOTE: The gauge component of the special tool must be removed before installing to the schröder valve.

- NOTE: Using a suitable container, place the end of the special tool into it to collect any fluid.

Install the pipe from special tool 310-116 to the schröder valve.

44.

1. NOTE: A minimum of 12 litres of fuel in the fuel tank is required for the following Steps.

Make sure the fuel tank has a sufficient amount of fuel to carry out the following Steps.

2. NOTE: Do not start the vehicle.

2. NOTE: Allow 15 seconds between **each** ignition cycle (between each ignition **ON** and ignition **OFF**) to allow the fuel tank pump to pump fuel to the fuel injection pump correctly.




Turn the ignition on and off four times.

3. Crank the engine until it starts.
4. Remove the special tool and suitable container.
5. Install the schröder valve cap.
6. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
7. Road test the vehicle for at least 10 miles (16 Km).
8. Check the diagnostic trouble codes (DTC)s using the approved diagnostic tool. Clear or repair as necessary.

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injectors LH

Removal and Installation

Special Tool(s)

 <p>100-012</p> <p>E54135</p>	<p>100-012 Slide Hammer</p>
 <p>E116924</p>	<p>310-213 Fuel Injector Removal Adaptor</p>
 <p>E124125</p>	<p>JLR-310-237 Remover, Fuel Injector</p>

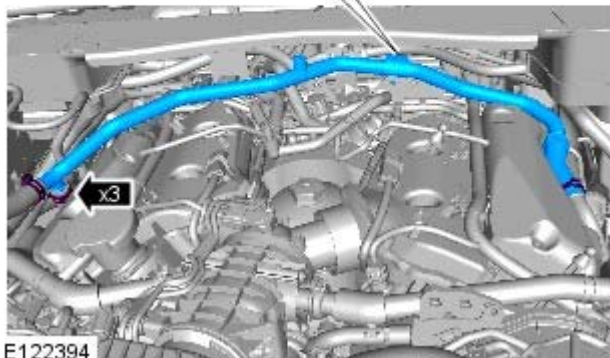
Removal



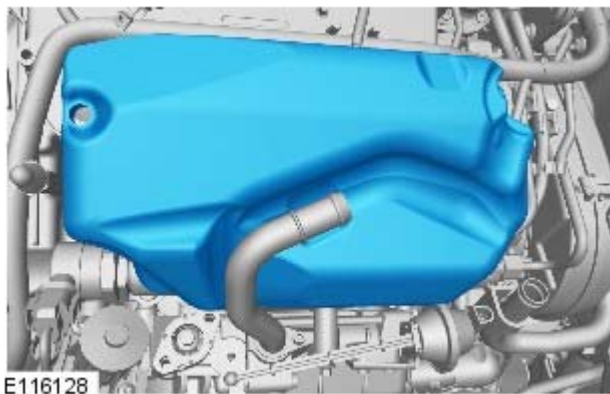
WARNING: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

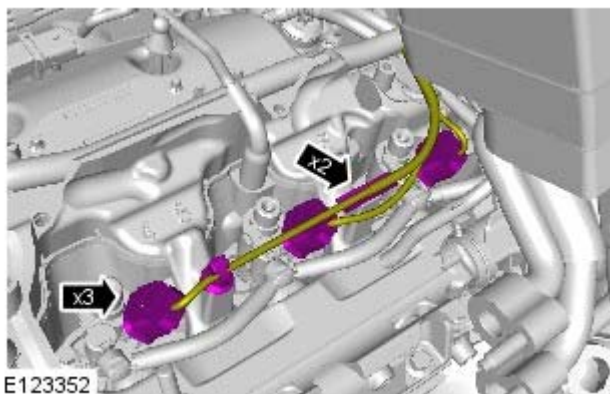
1. Refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).
2. Disconnect the battery earth lead.
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).
4. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).




E122394



E116128

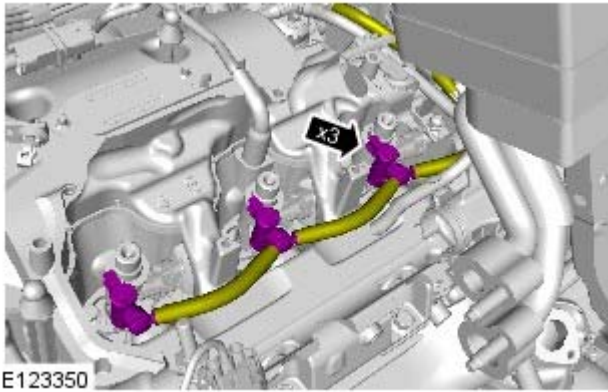


E123352

5.  CAUTION: Be prepared to collect escaping coolant.

6.

7.



8. **8. CAUTIONS:**

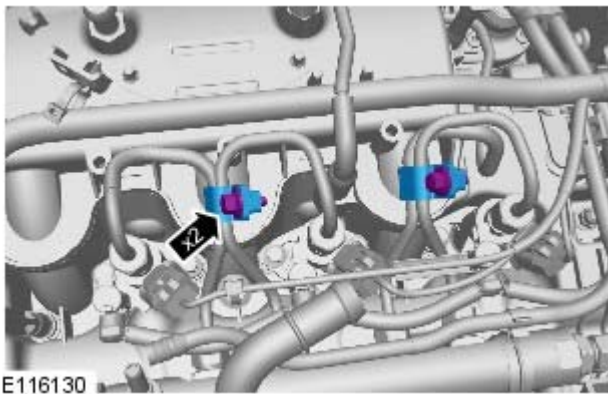


Be prepared to collect escaping fuel.

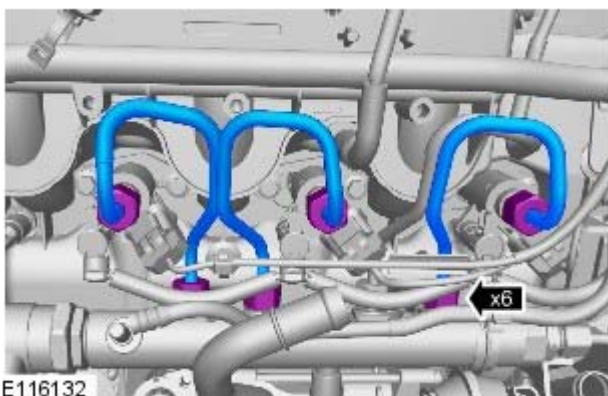


Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.



9.



10. **10. CAUTIONS:**



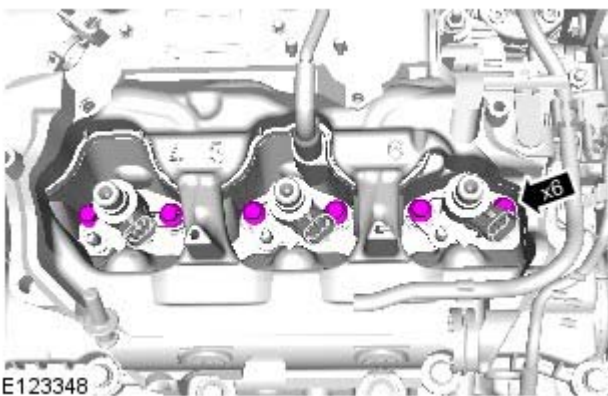
Be prepared to collect escaping fuel.



Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.

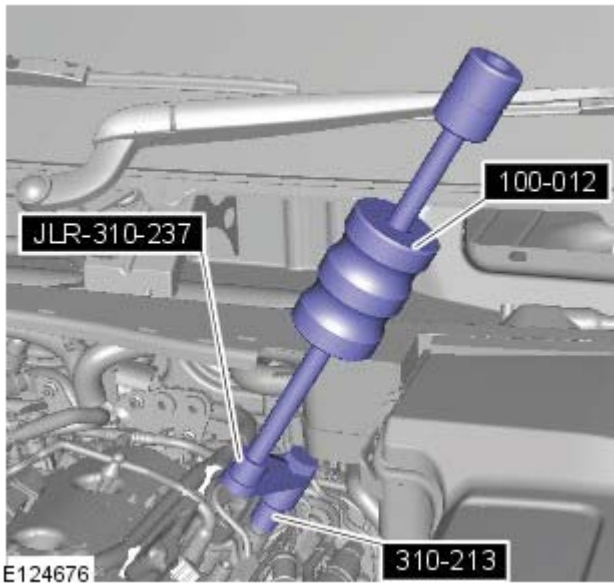


Remove and discard the high-pressure fuel supply lines.



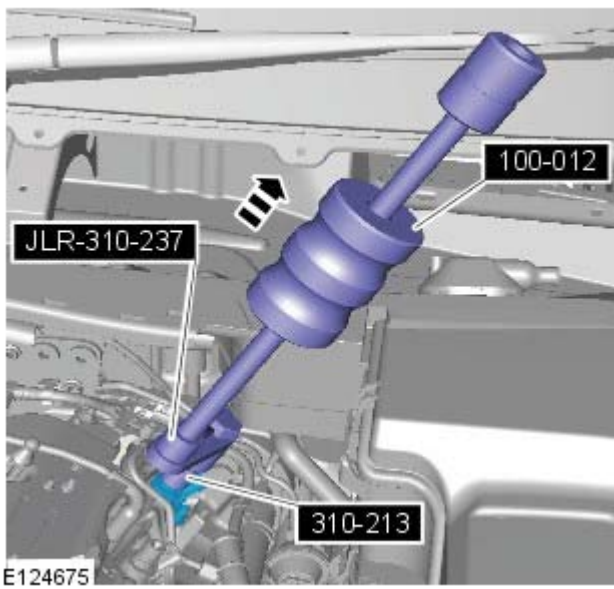
11.

12. Install the special tool.

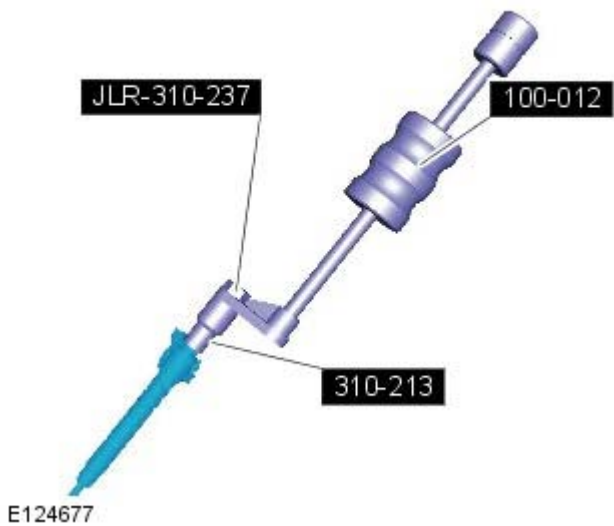


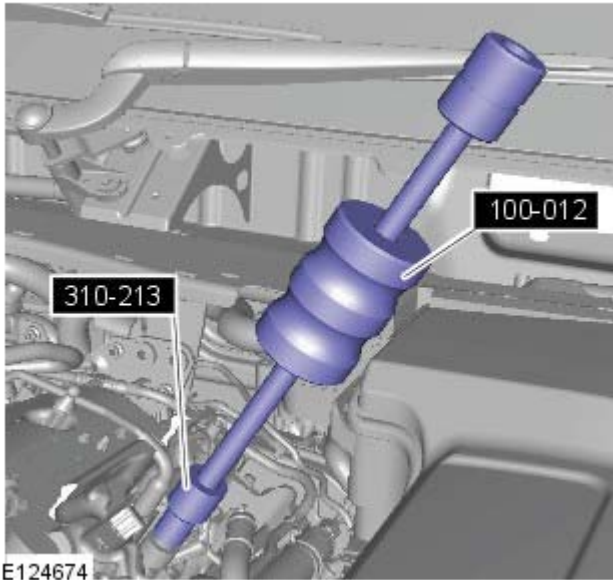
13.

- *Special Tool(s):* [JLR-310-237](#)
- *Special Tool(s):* [310-213](#)
- *Special Tool(s):* [100-012](#)

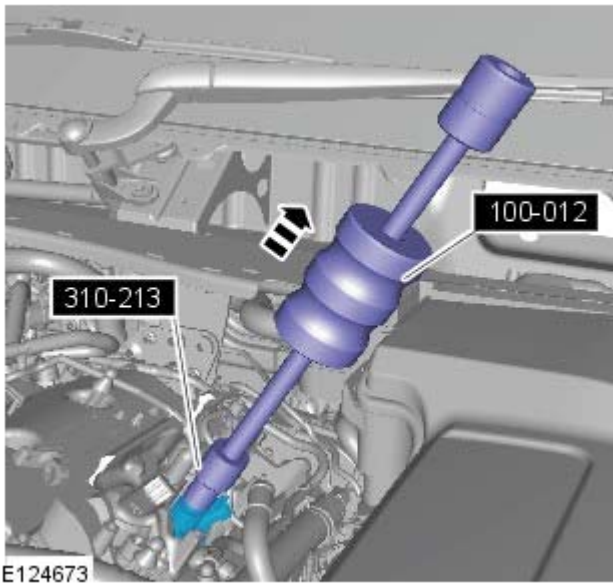


14. Remove the special tool.



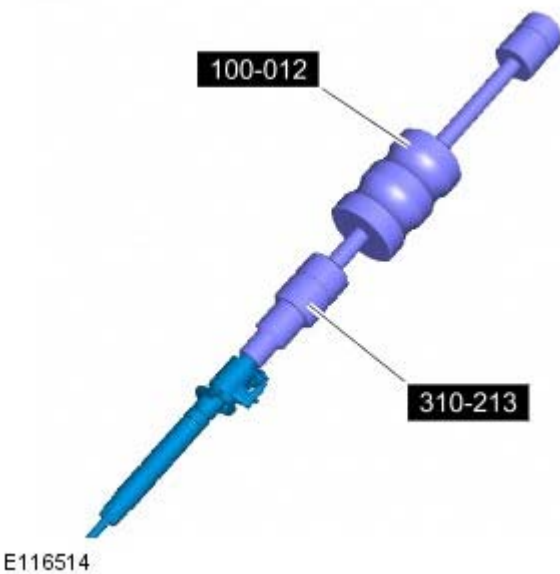


15. Install the special tool.



16.

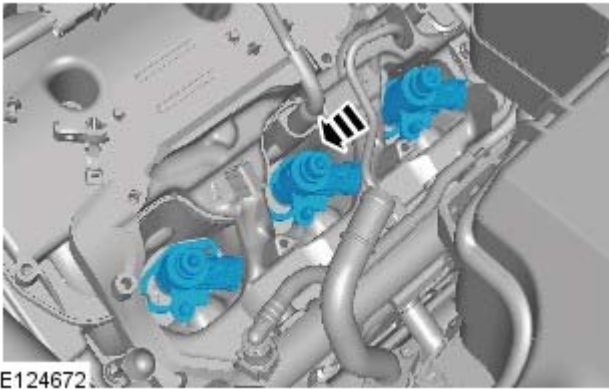
- *Special Tool(s):* [310-213](#)
- *Special Tool(s):* [100-012](#)




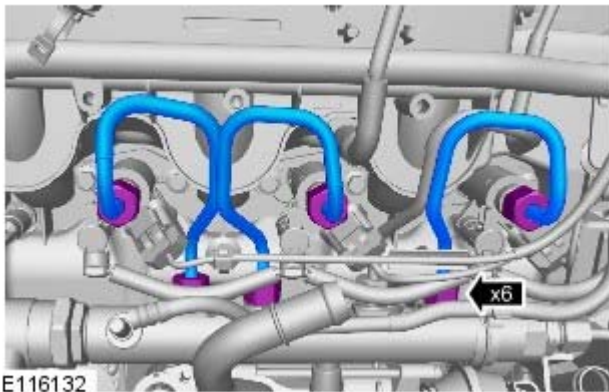
17. Remove the special tool.

Installation

18. Repeat the above procedure for the remaining injectors.



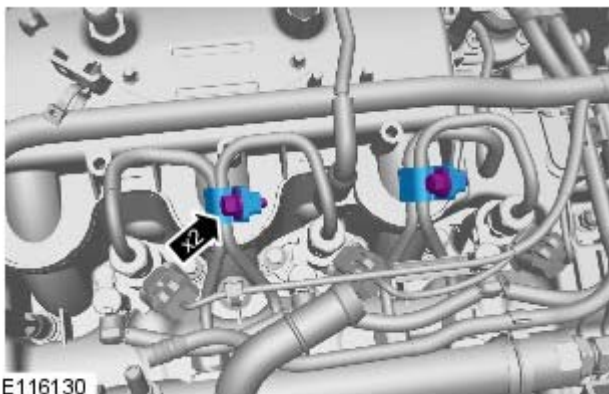
1.  CAUTION: Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.



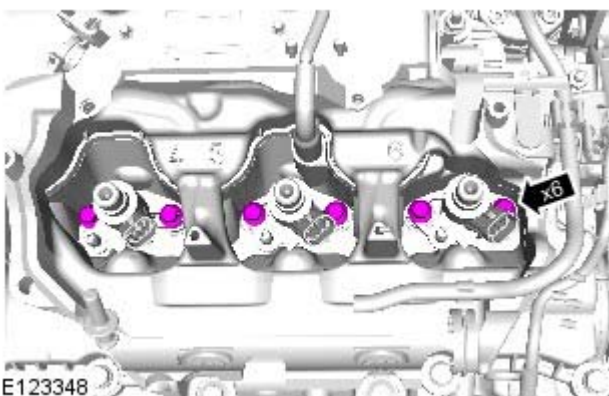
2. CAUTIONS:

 Make sure that a new component is installed.

 Only tighten the unions finger-tight at this stage.

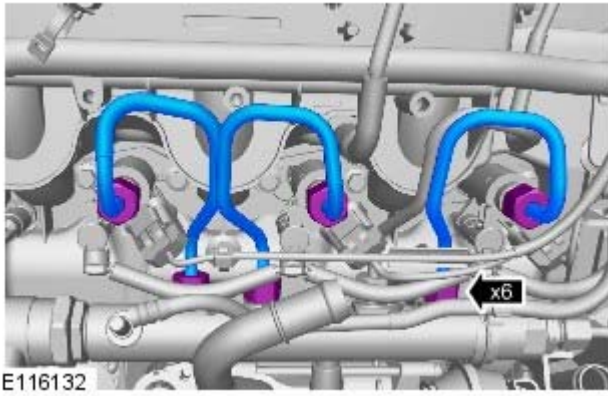


3. Torque: 10 Nm

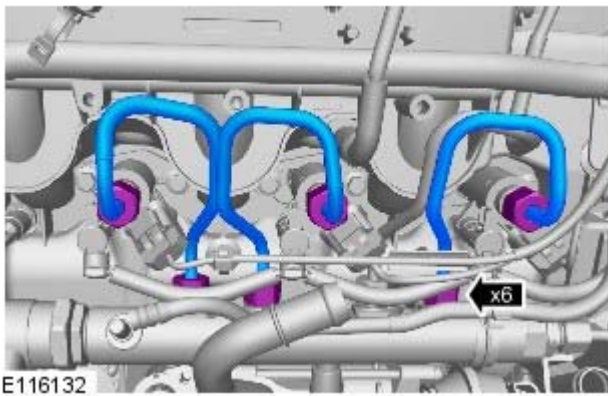


4. NOTE: Tighten the retaining bolts evenly and progressively.

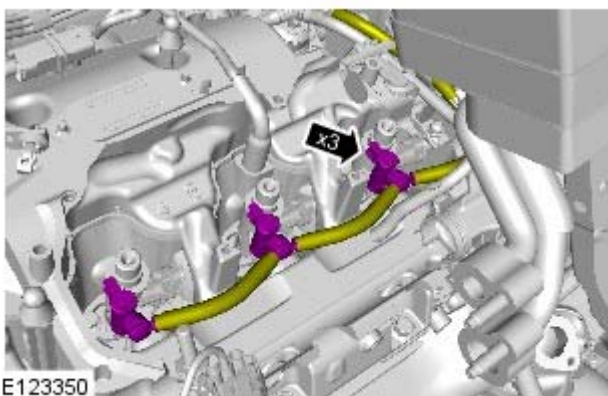
Torque: 9 Nm



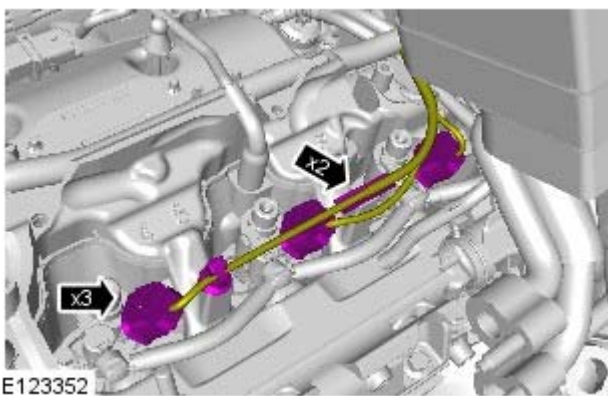
5.
 - Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
 - Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.



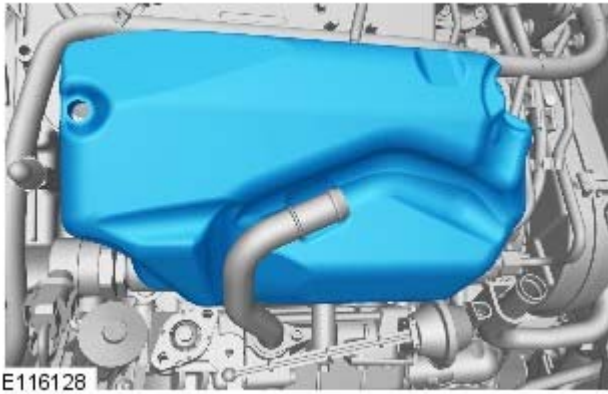
6.
 - Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
 - Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



7. **NOTE:** Make sure that the fuel injector return line has a maximum of 8 uses.

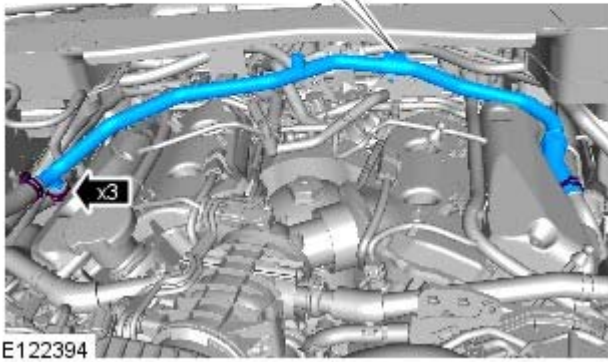


- 8.



9.

10. *Torque:* 10 Nm




11. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
12. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).
13. Connect the battery earth lead.
14. If a new unit is installed, configure using the approved diagnostic tool.

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Injectors RH

Removal and Installation

Special Tool(s)

 <p>100-012</p> <p>E54135</p>	<p>100-012 Slide Hammer</p>
 <p>E116924</p>	<p>310-213 Fuel Injector Removal Adaptor</p>
 <p>E124125</p>	<p>JLR-310-237 Remover, Fuel Injector</p>

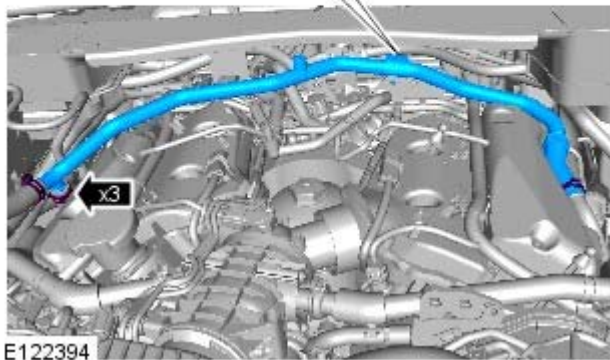
Removal



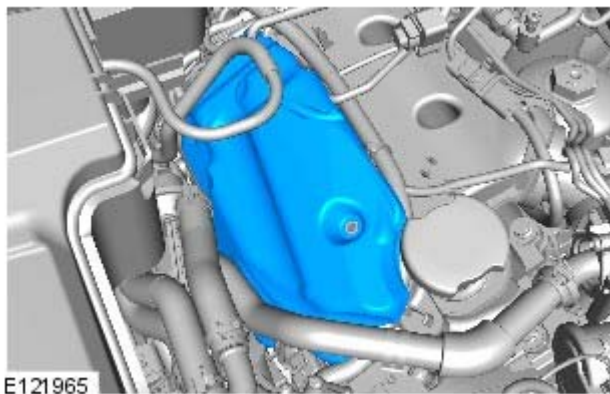
WARNING: Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

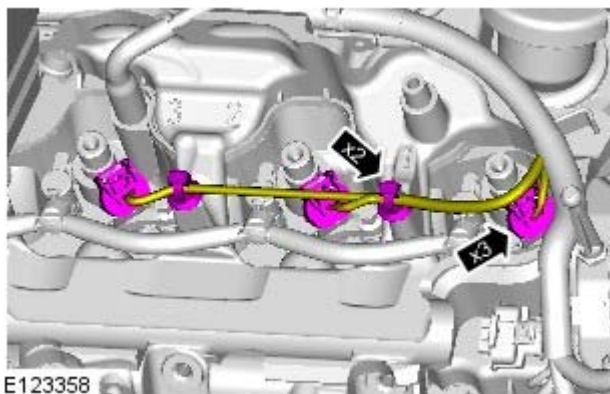
1. Refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).
2. Disconnect the battery earth lead.
3. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).



E122394



E121965



E123358

5.  CAUTION: Be prepared to collect escaping coolant.


6.

7.



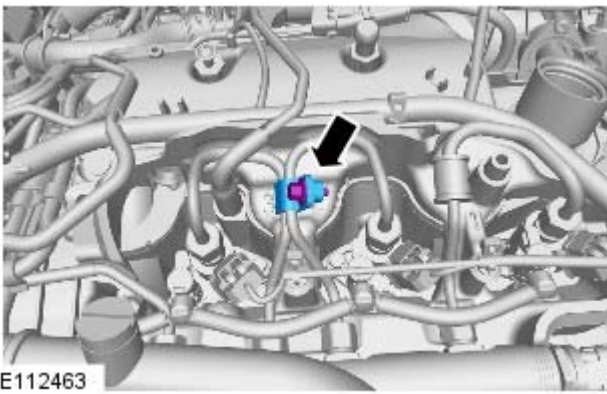
8. **8. CAUTIONS:**

 Be prepared to collect escaping fuel.

 Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.


• NOTE: Make sure that the fuel injector return line has a maximum of 8 uses.

9.

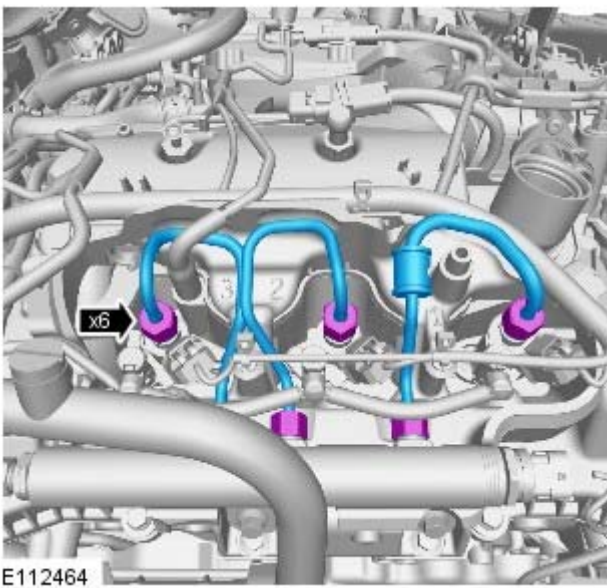


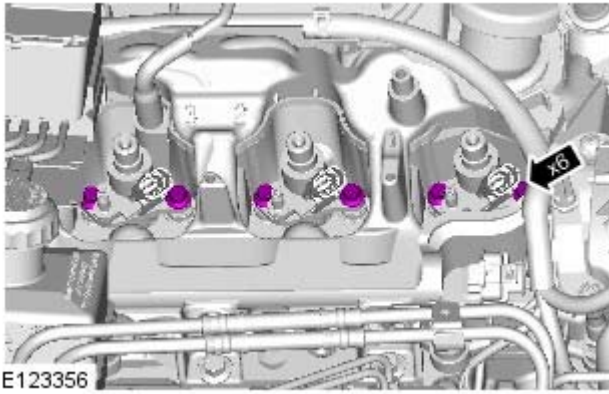
10. **10. CAUTIONS:**

 Be prepared to collect escaping fuel.

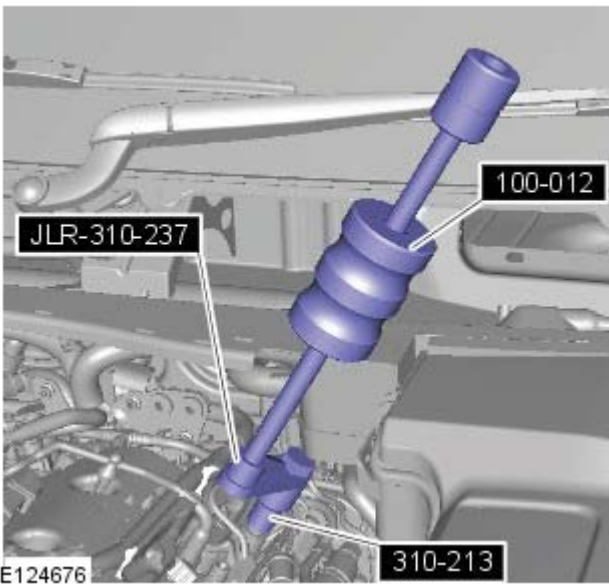
 Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean.


 Remove and discard the high-pressure fuel supply lines.

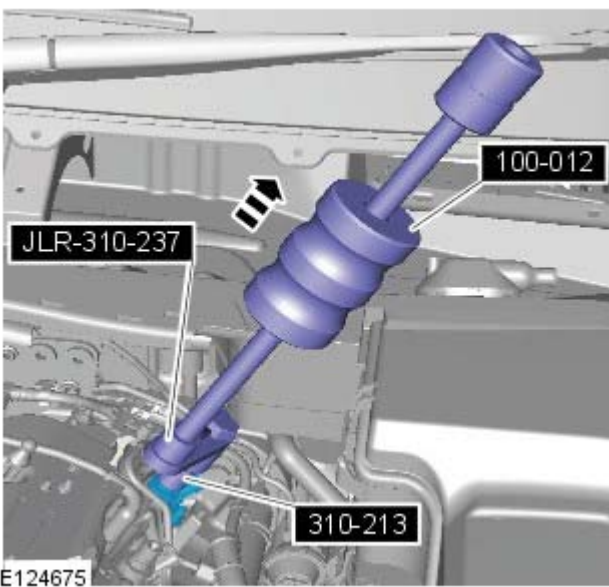





11.



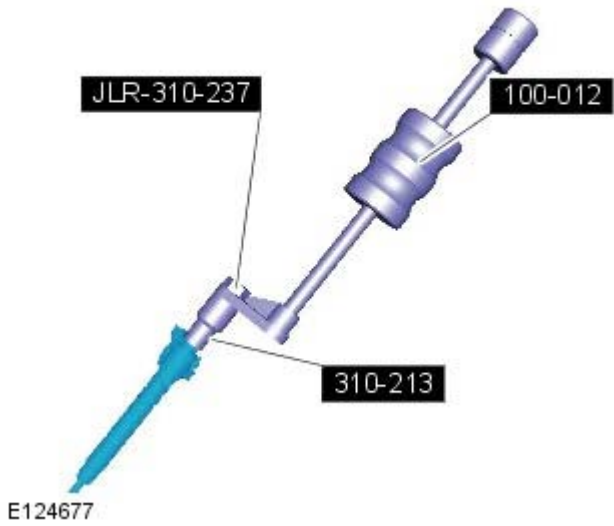
12. **12.**  CAUTION: LH illustration shown, RH is similar.
Install the special tool.




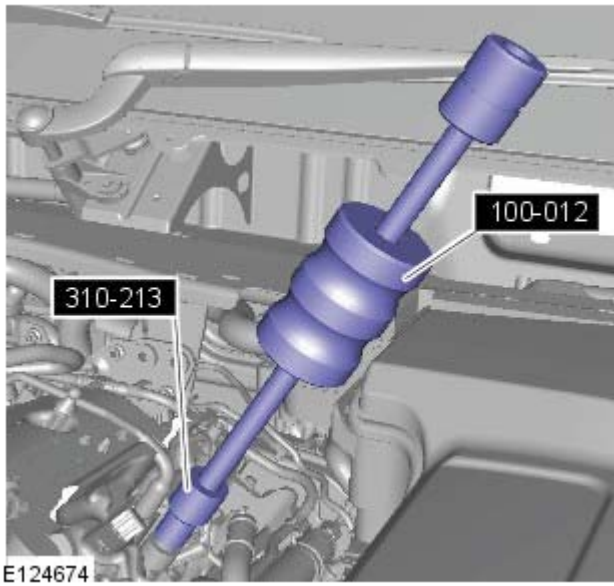
13. **13.**  CAUTION: LH illustration shown, RH is similar.

- Special Tool(s): [100-012](#)
- Special Tool(s): [JLR-310-237](#)
- Special Tool(s): [310-213](#)

14. Remove the special tool.

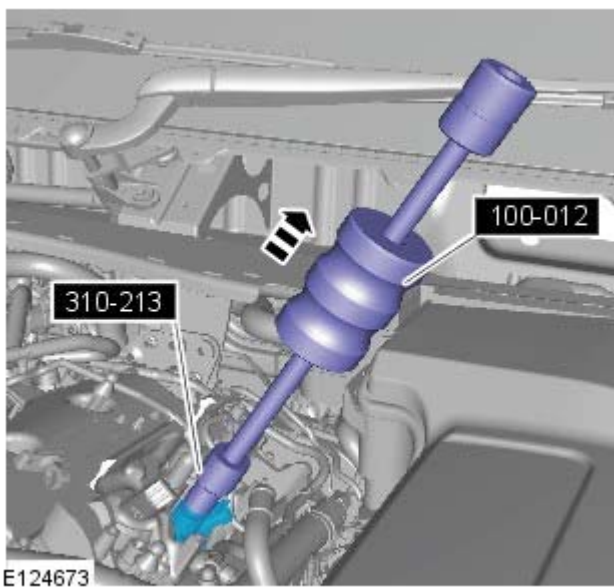


15. **15.**  CAUTION: LH illustration shown, RH is similar.
Install the special tool.

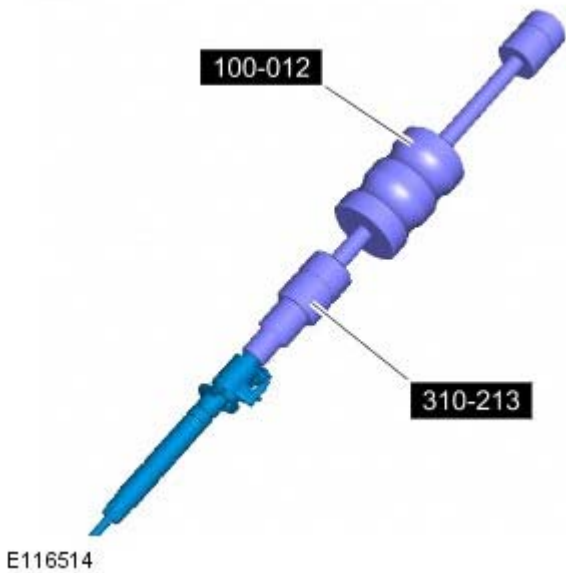


16. **16.**  CAUTION: LH illustration shown, RH is similar.

- *Special Tool(s):* [310-213](#)
- *Special Tool(s):* [100-012](#)

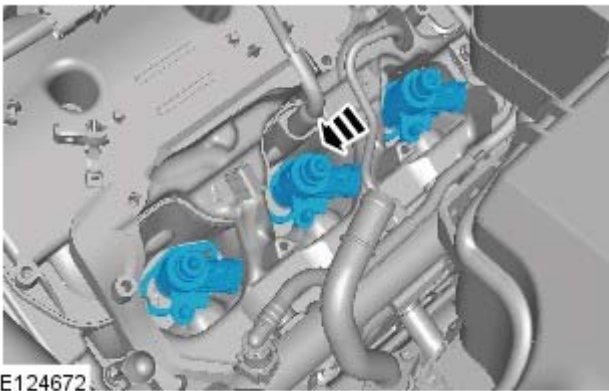


17. Remove the special tool.




18. Repeat the above procedure for the remaining injectors.

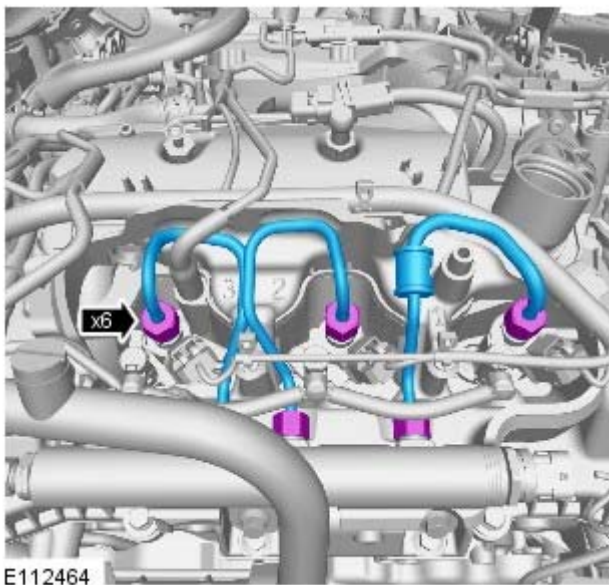
Installation



1. 1. CAUTIONS:

 Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.

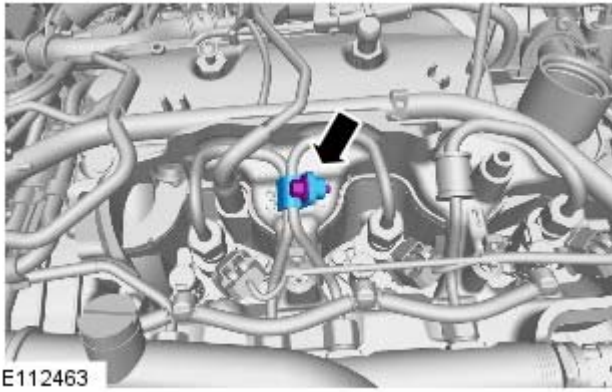
 LH illustration shown, RH is similar.



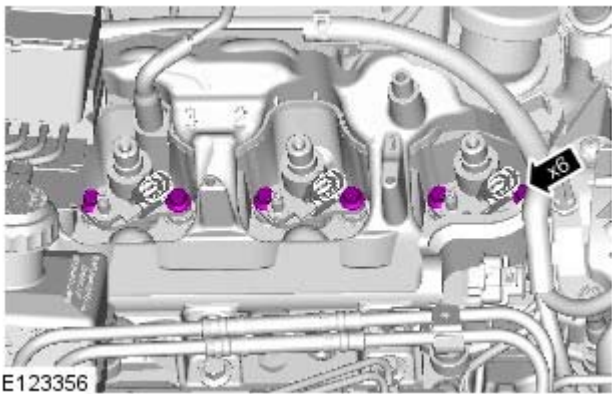
2. 2. CAUTIONS:

 Make sure that a new component is installed.

 Only tighten the unions finger-tight at this stage.

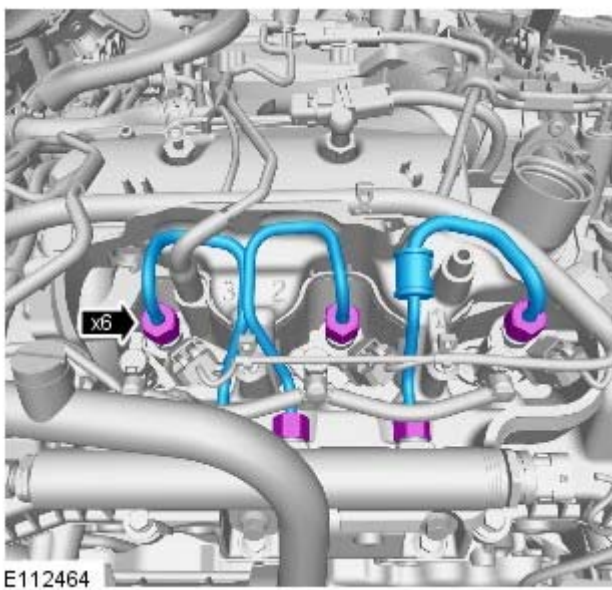


3. *Torque: 10 Nm*



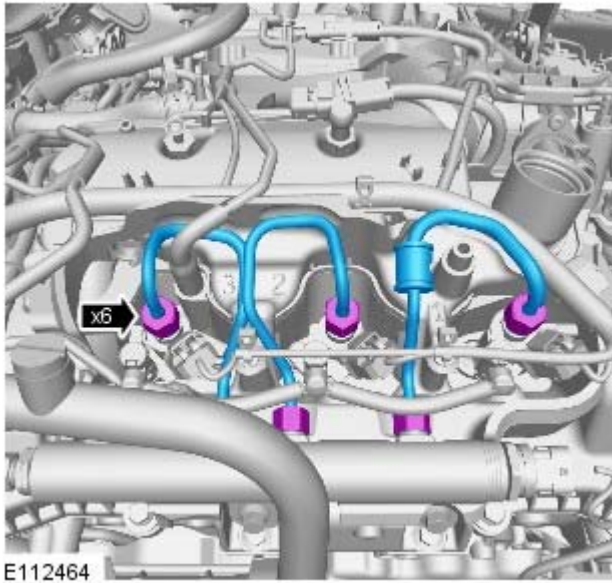
4. **NOTE:** Tighten the retaining bolts evenly and progressively.

Torque: 9 Nm

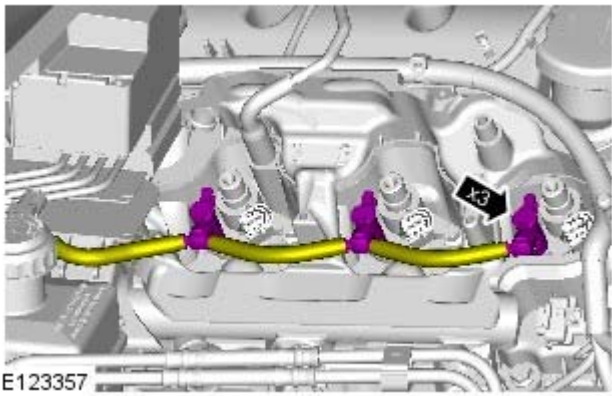


5.

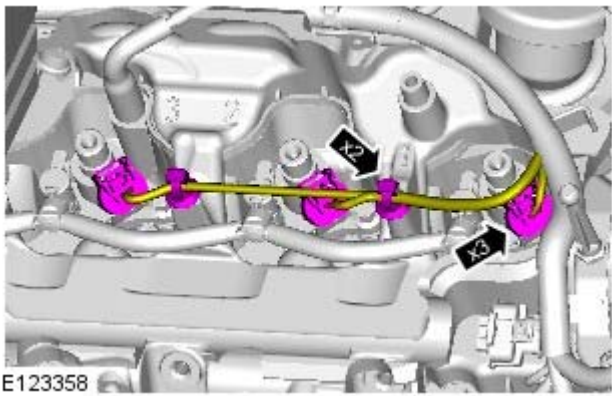
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.



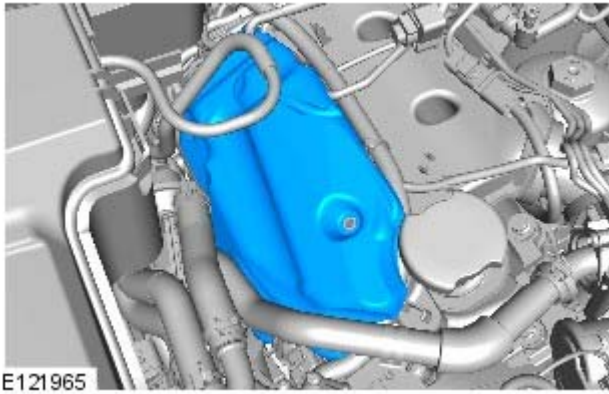
6.
 - Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
 - Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



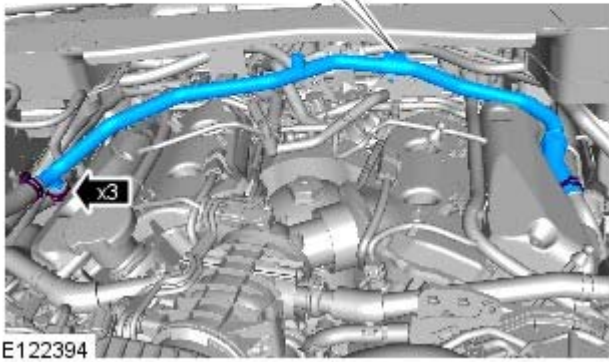
7. **7. NOTE:** Make sure that the fuel injector return line has a maximum of 8 uses.



- 8.



9.



10. *Torque:* 10 Nm


11. Refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
12. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
13. Connect the battery earth lead.
14. If a new unit is installed, configure using the approved diagnostic tool.

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Rail LH

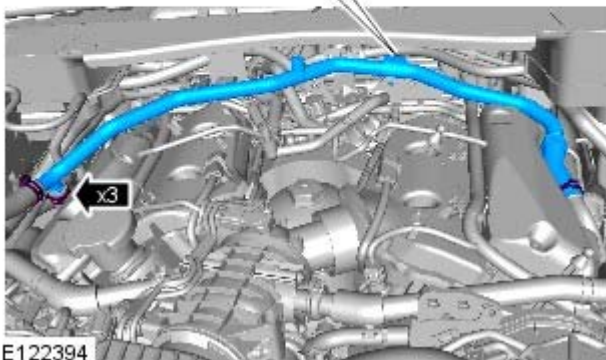
Removal and Installation

Removal

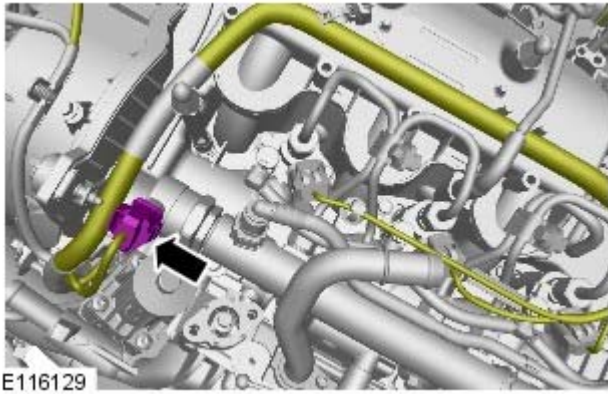
• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Disconnect the battery ground cable.
3. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).
4. Refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).

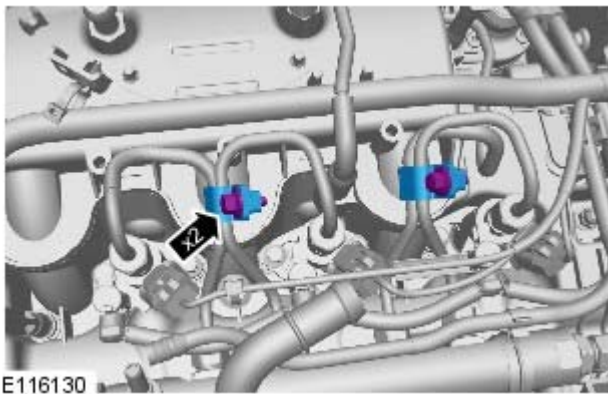
5.



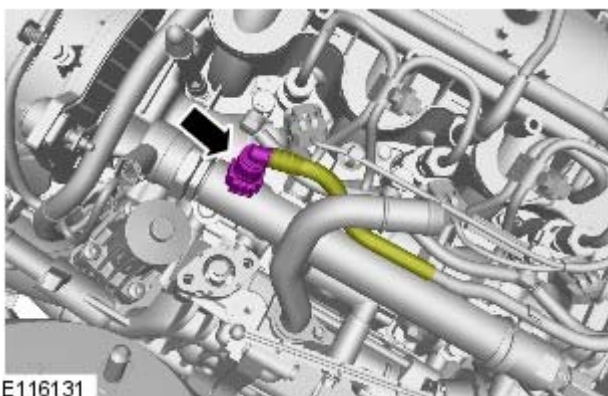
6. **6.** NOTE: Left-hand shown, right-hand similar.





7.

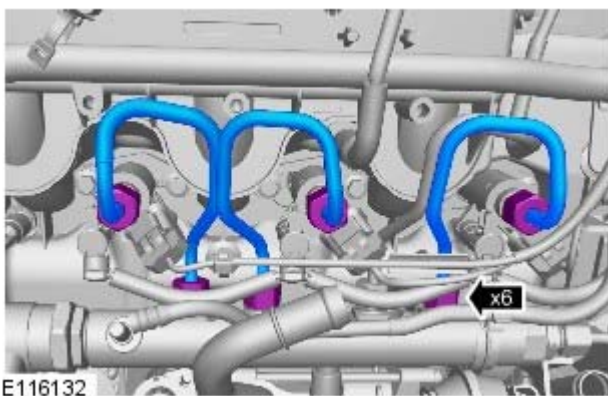


8.





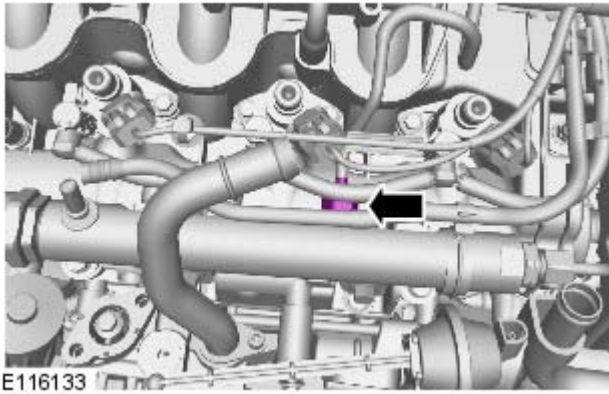
9. **9. CAUTIONS:**

-  Be prepared to collect escaping fuel.
-  Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



10. **10. CAUTIONS:**

-  Be prepared to collect escaping fuel.
-  Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



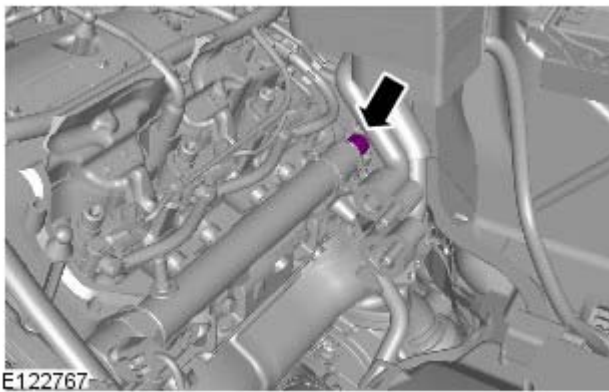
11. **11. CAUTIONS:**



Be prepared to collect escaping fuel.



Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



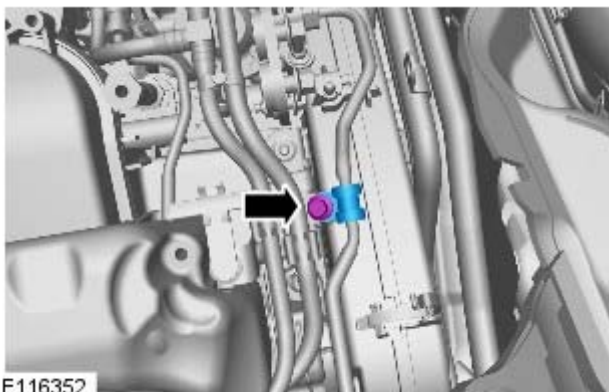
12. **12. CAUTIONS:**



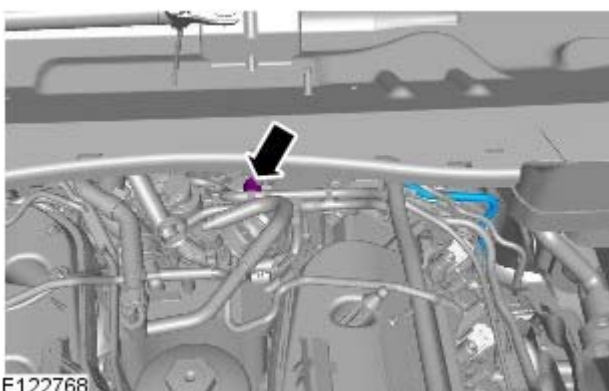
Be prepared to collect escaping fuel.




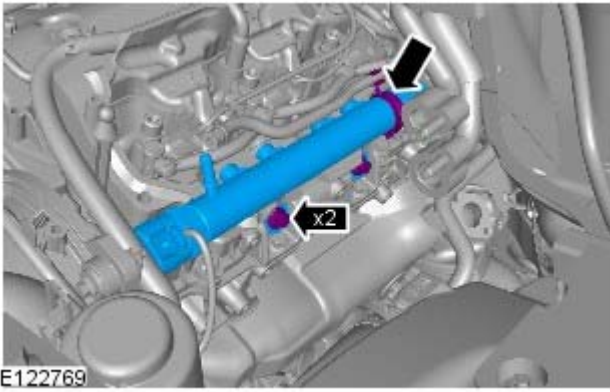
Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.




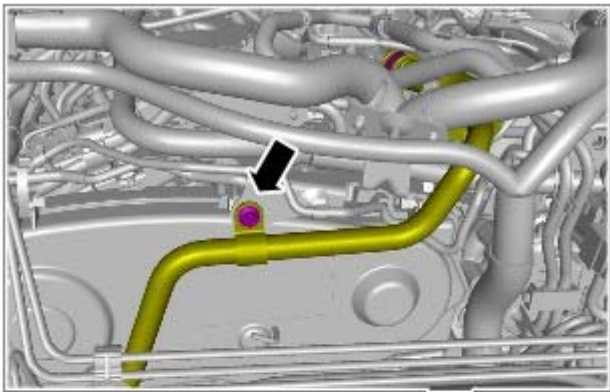
13.



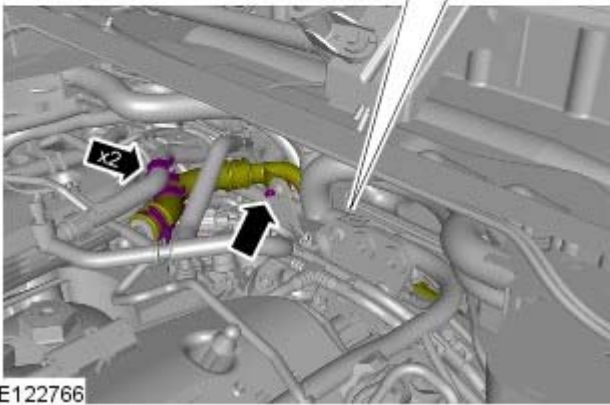
14. **14.**  **CAUTION:** Be prepared to collect escaping fuel.




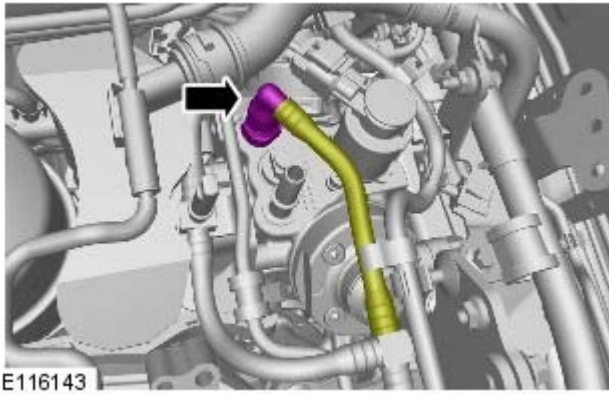
15. **15.**  CAUTION: Be prepared to collect escaping fuel.




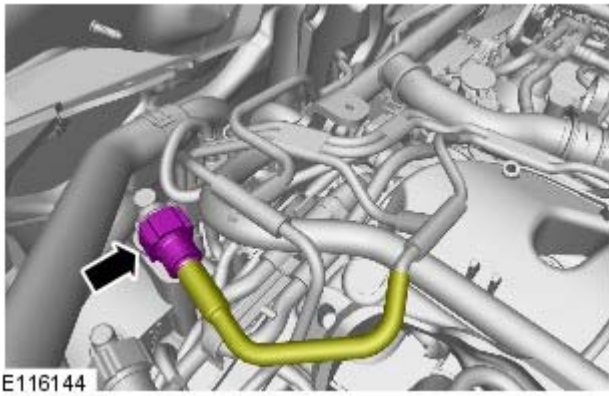
- 16.



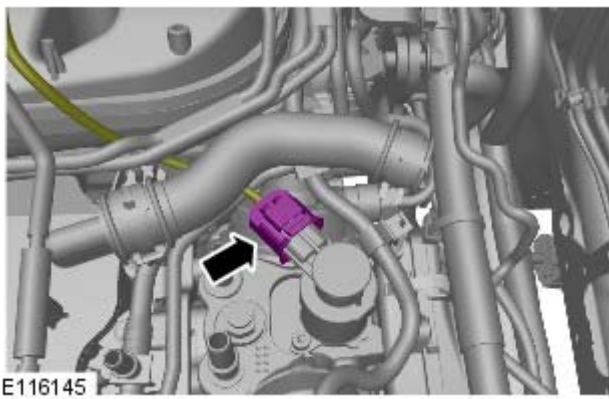
17. **17.**  CAUTION: Be prepared to collect escaping fuel.



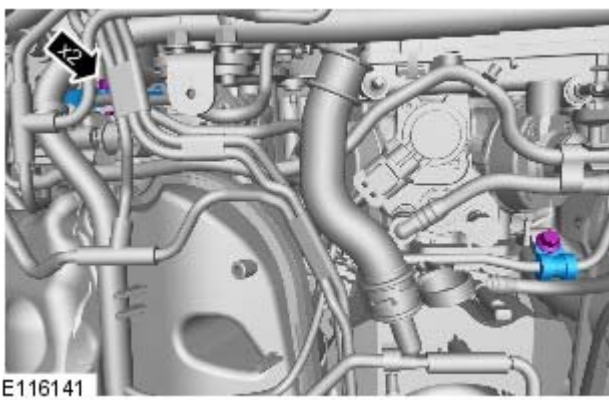
18. **18.**  CAUTION: Be prepared to collect escaping fuel.



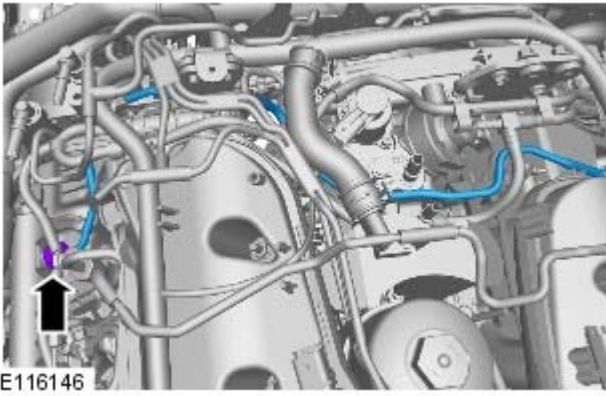
19.




20.

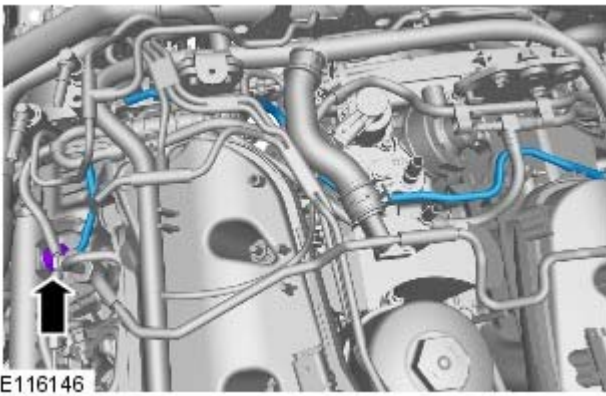


21.





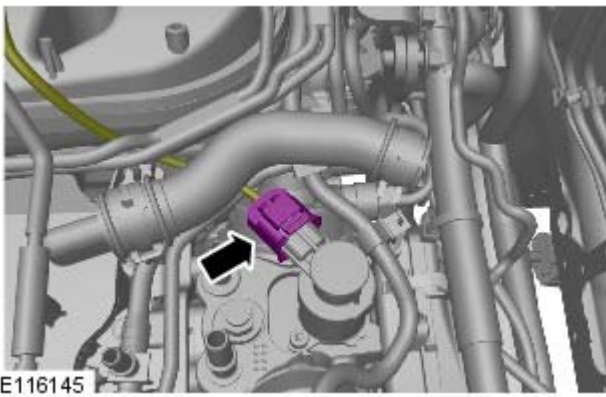
22.  CAUTION: Be prepared to collect escaping fuel.

Installation

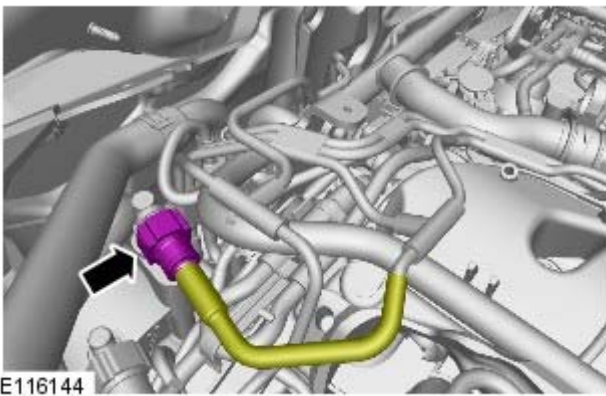


1. 1. CAUTIONS:

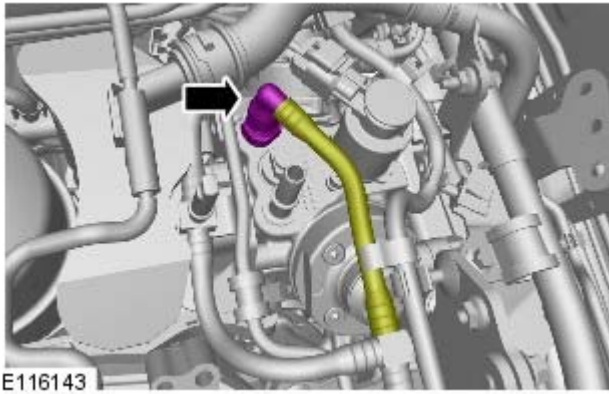
-  Make sure that a new component is installed.
-  Tighten the fuel supply line unions finger tight.



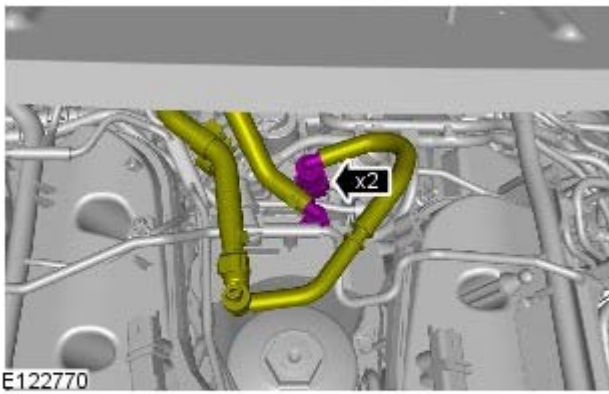
- 2.



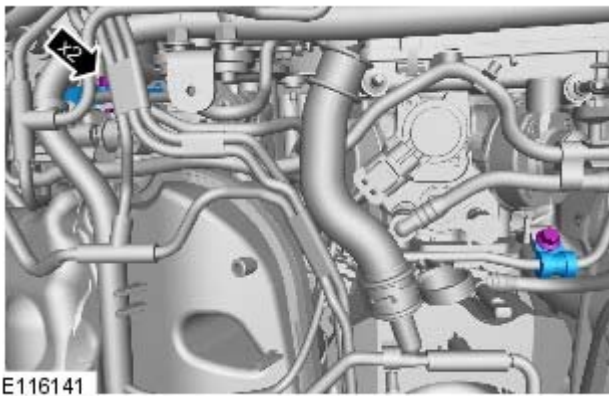
- 3.



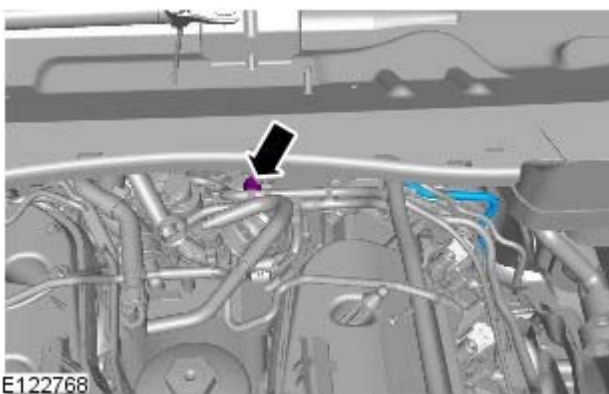
4.



5.



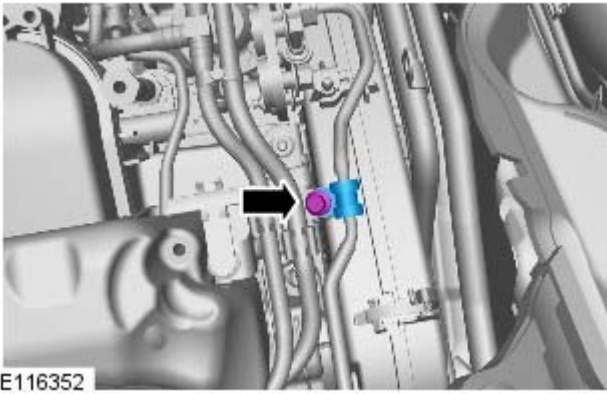
6.  CAUTION: Only tighten the bolts finger-tight at this stage.



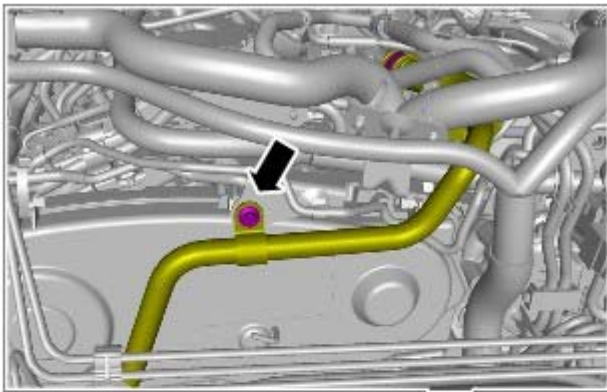
7. 7. CAUTIONS:

 Make sure that a new component is installed.

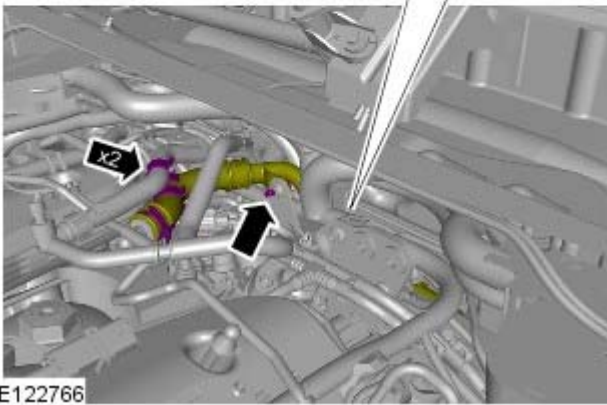
 Tighten the fuel supply line unions finger tight.



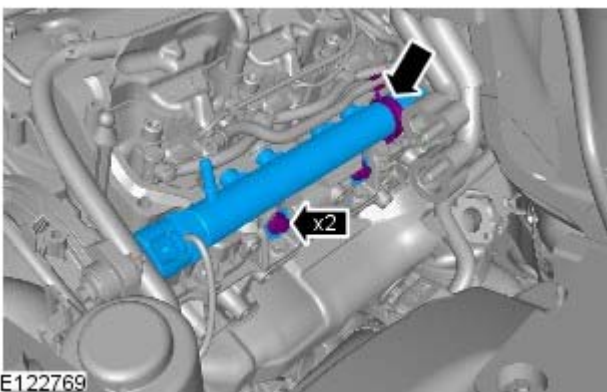
8.  CAUTION: Only tighten the bolts finger-tight at this stage.



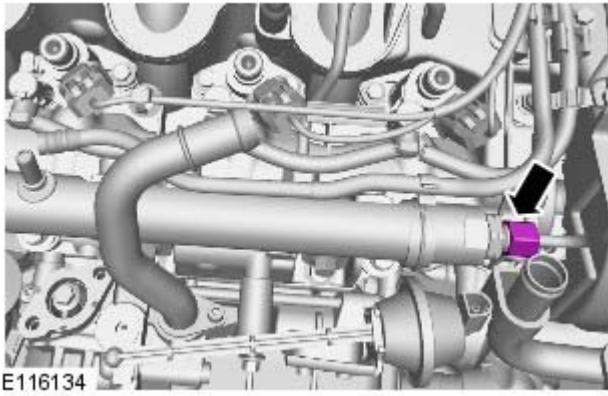
9. Torque: 10 Nm



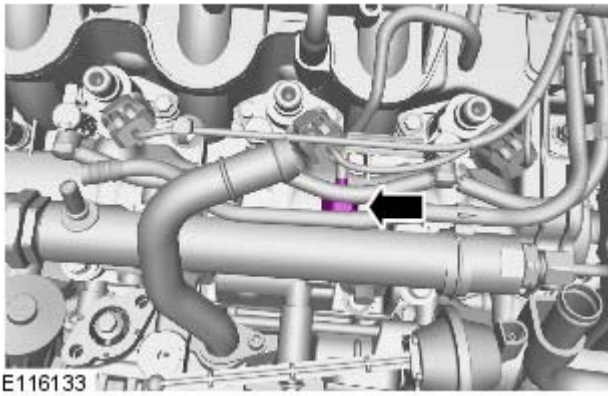
E122766



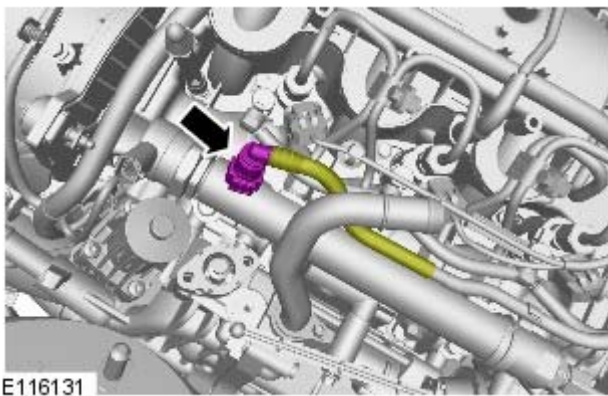
10. Torque: 24 Nm



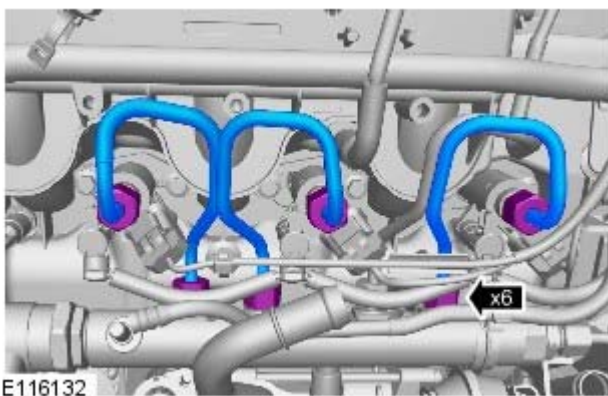
11. **11.**  CAUTION: Tighten the fuel supply line unions finger tight.



12. **12.**  CAUTION: Tighten the fuel supply line unions finger tight.



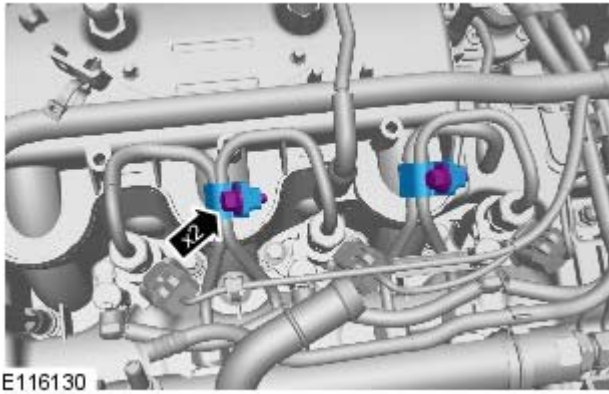
- 13.



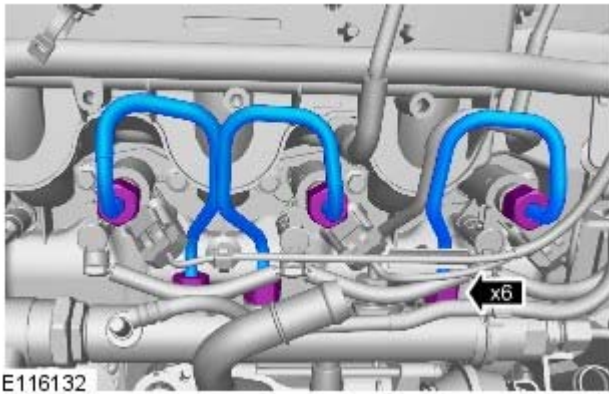
14. **14.** CAUTIONS:

 Make sure that a new component is installed.

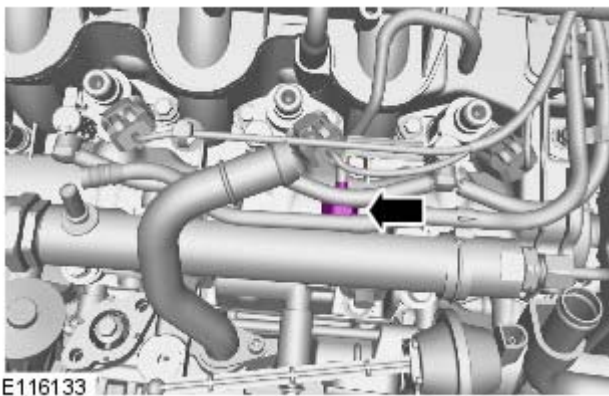
 Tighten the fuel supply line unions finger tight.



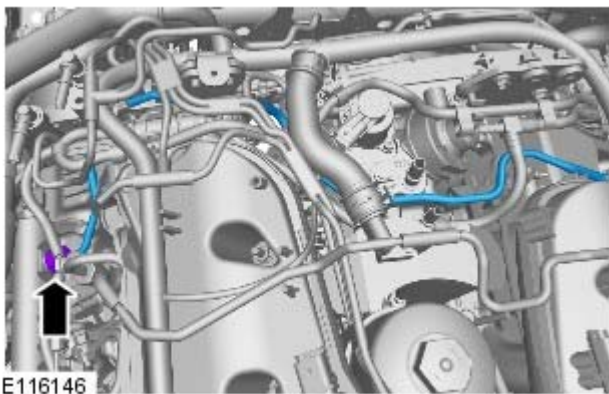
15. **15.**  **CAUTION:** Only tighten the bolt finger-tight at this stage.



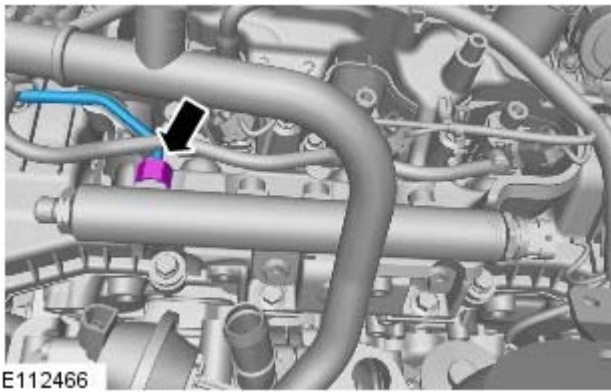
- 16.
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
 - Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.



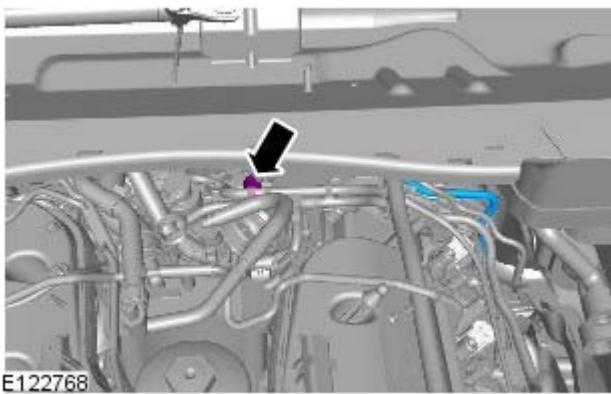
17. Tighten the high-pressure fuel lines union to 15Nm.



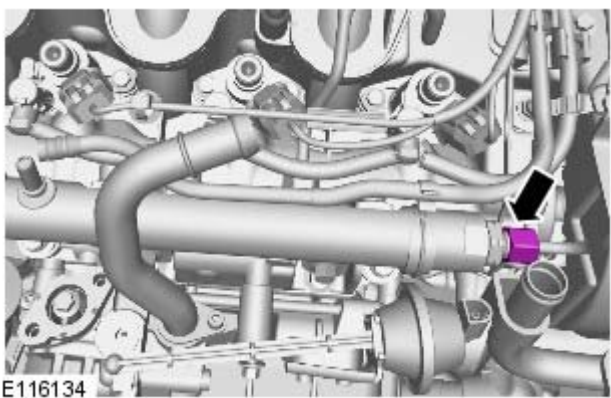
18. Tighten the high-pressure fuel lines union to 15Nm.



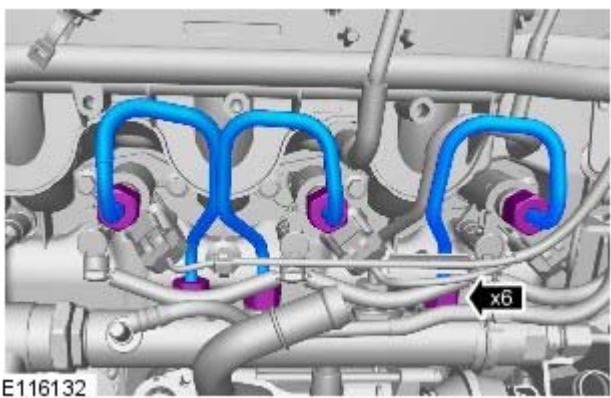
19. Tighten the high-pressure fuel lines union to 15Nm.



20. Tighten the high-pressure fuel lines union to 15Nm.

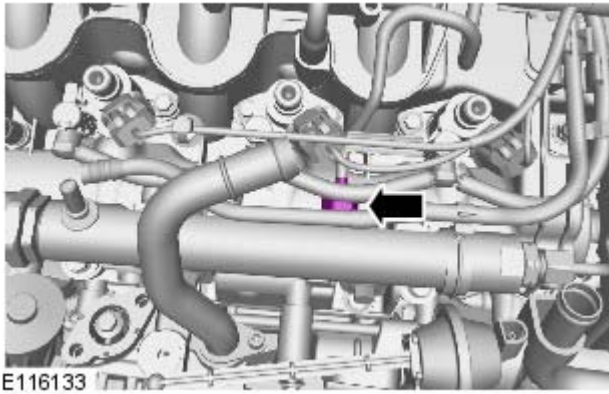


21. Tighten the high-pressure fuel lines union to 15Nm.

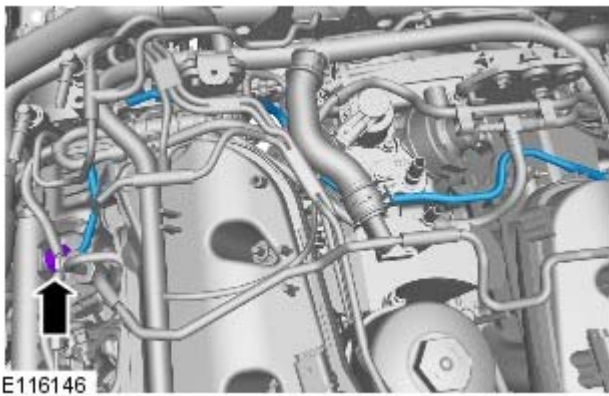


22.

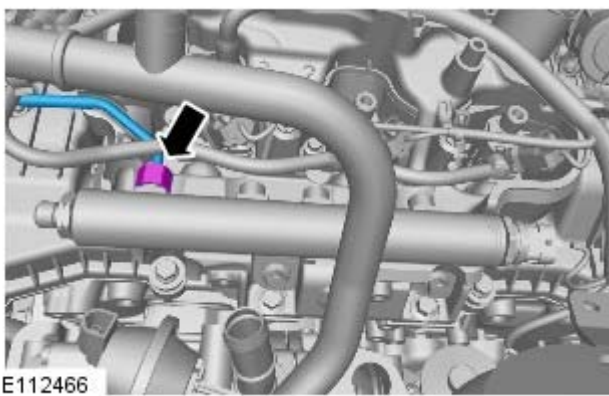
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



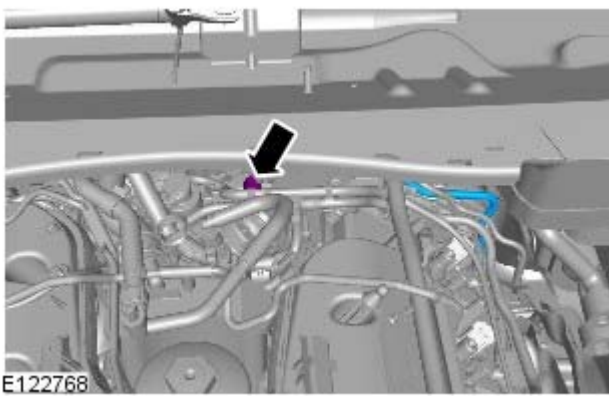
23. Tighten the high-pressure fuel line union to 30 Nm.



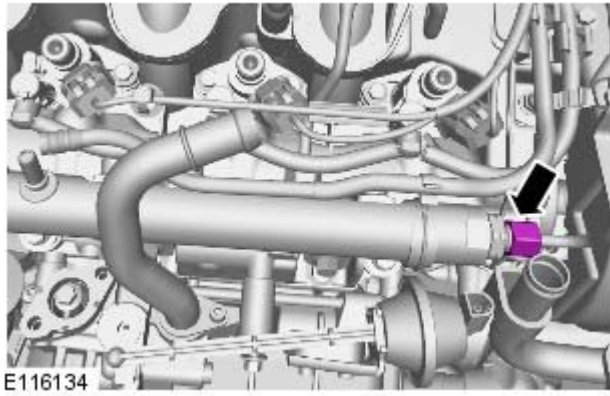
24. Tighten the high-pressure fuel line union to 30 Nm.



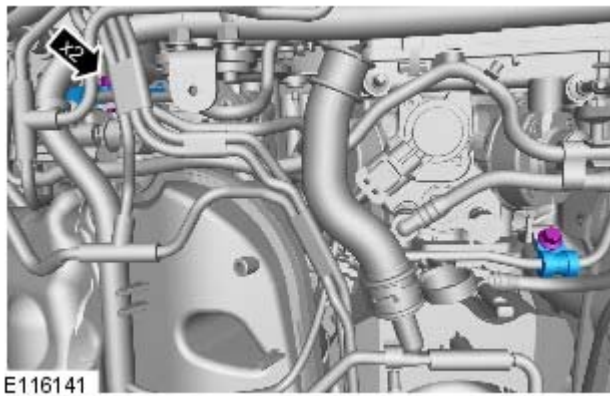
25. Tighten the high-pressure fuel line union to 30 Nm.



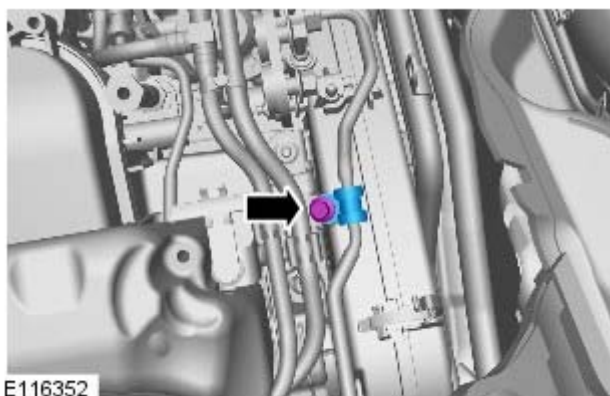
26. Tighten the high-pressure fuel line union to 30 Nm.



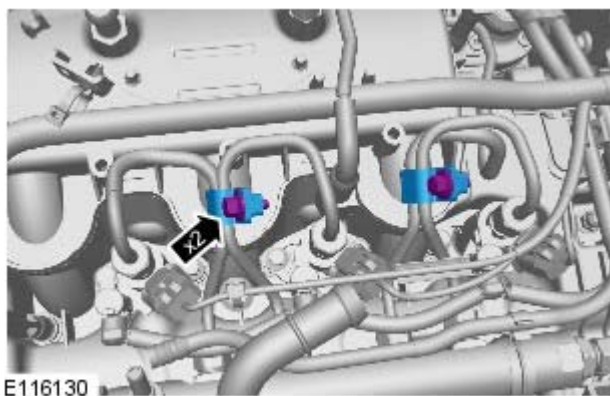
27. Tighten the high-pressure fuel line union to 30 Nm.



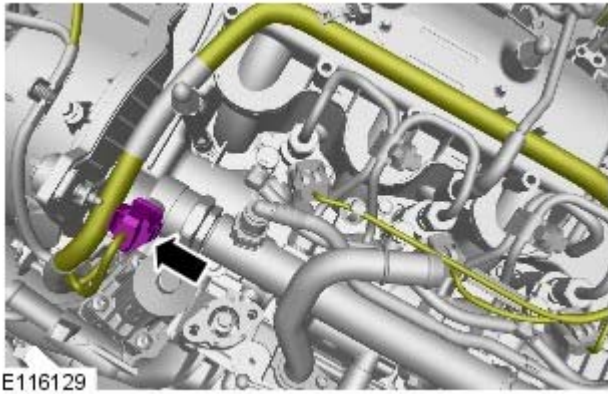
28. Torque: 10 Nm



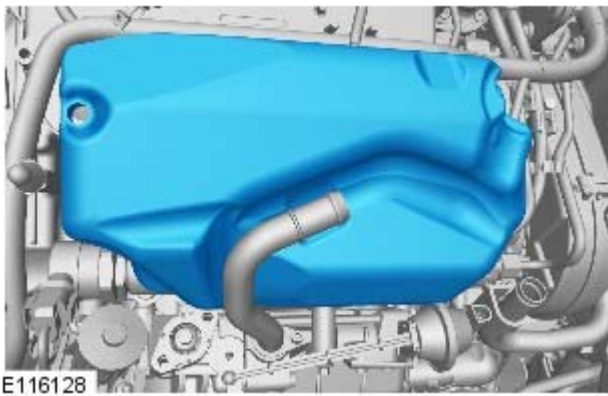
29. Torque: 10 Nm



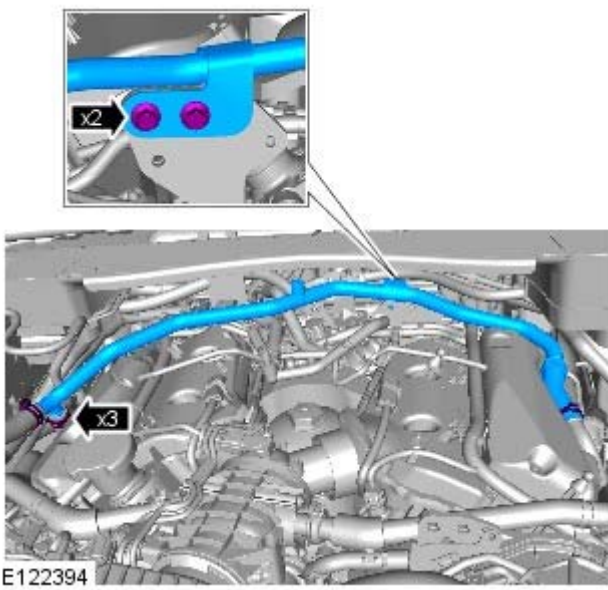
30. Torque: 10 Nm



31.



32. **32.** NOTE: Left-hand shown, right-hand similar.



33.

34. Refer to: Engine Cover - TDV6 3.0L Diesel (501-05, Removal and Installation).

35. Disconnect the battery ground cable.

Fuel Charging and Controls - TDV6 3.0L Diesel - Fuel Rail RH

Removal and Installation

Removal

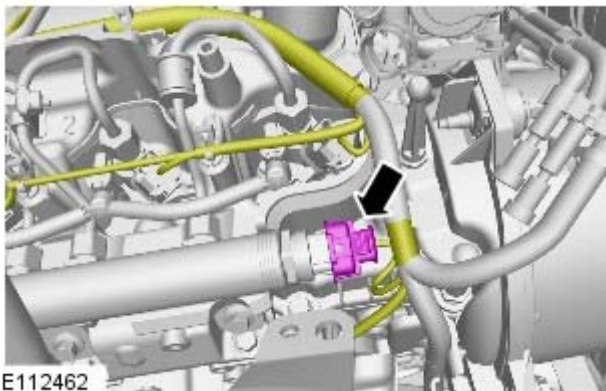
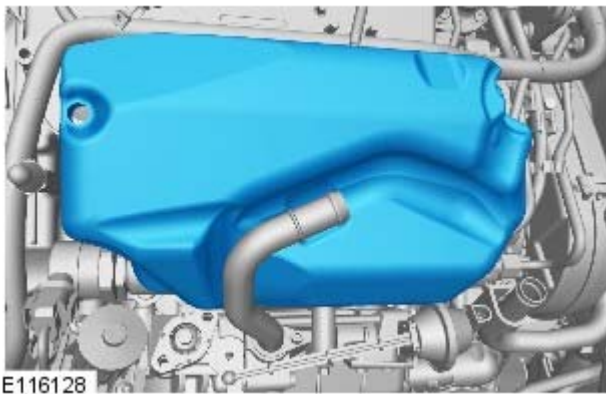
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

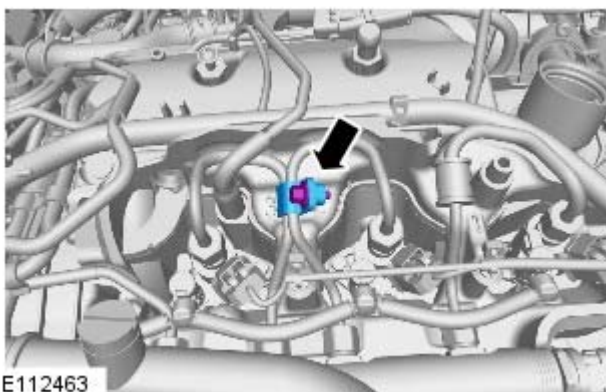
2.

3. Refer to: [Fuel Injection Component Cleaning](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, General Procedures).

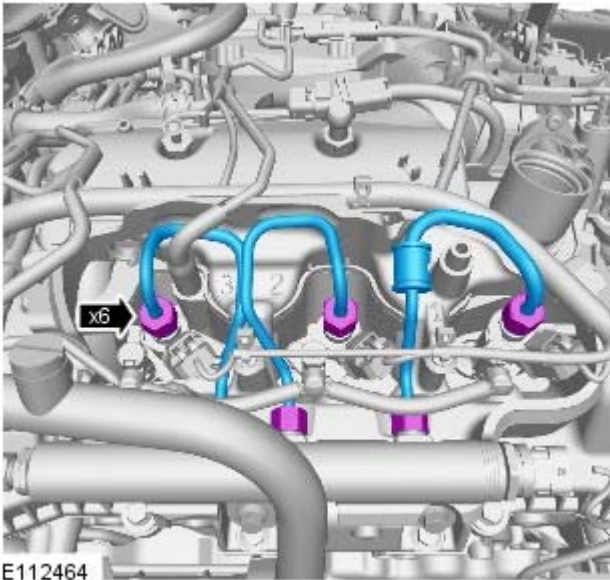
4. **4.** NOTE: Left-hand shown, right-hand similar.



5.






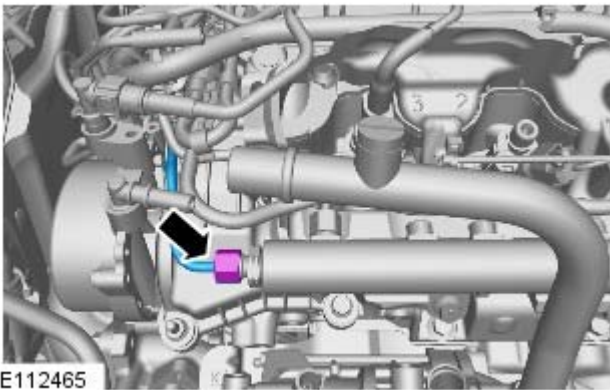
6.



E112464



7. **7. CAUTIONS:**

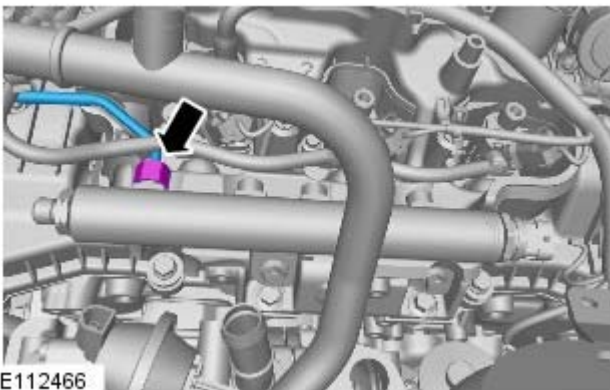
-  Be prepared to collect escaping fuel.
-  Discard the component.
-  Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



E112465



8. **8. CAUTIONS:**

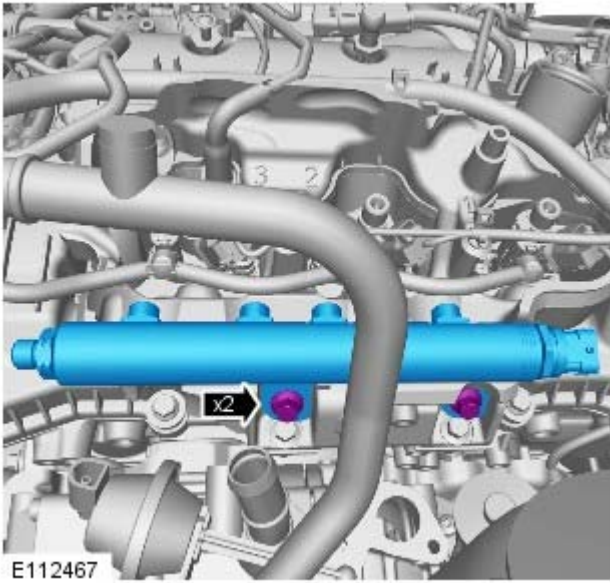
-  Be prepared to collect escaping fuel.
-  Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.




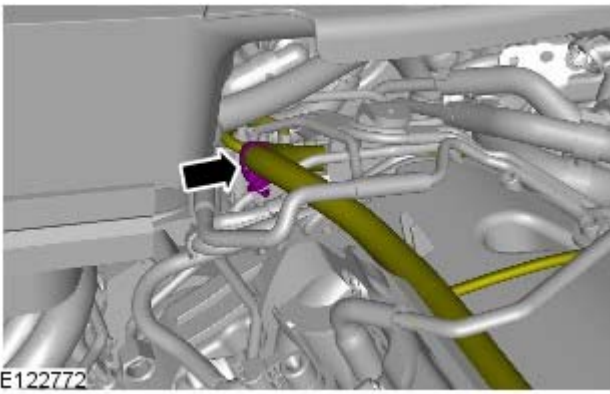
E112466

9. **9. CAUTIONS:**

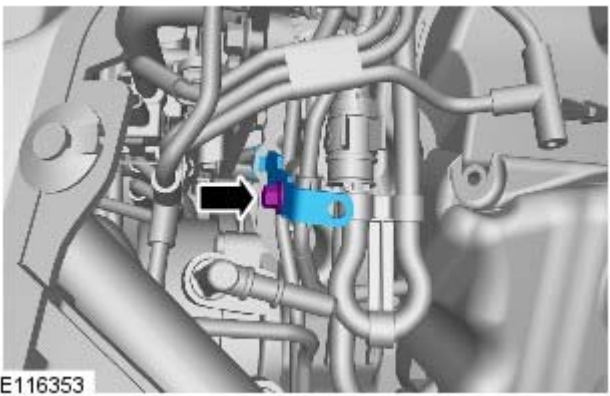
-  Be prepared to collect escaping fuel.
-  Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



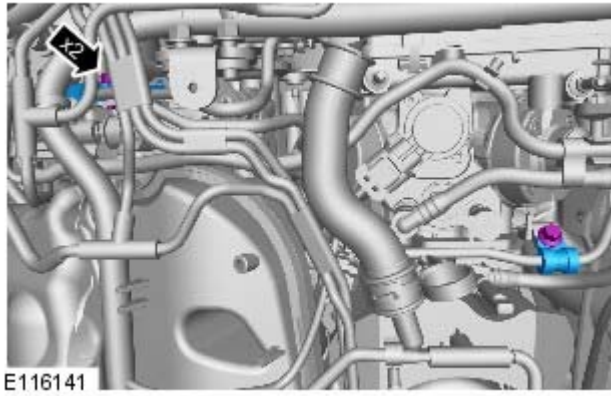
10. **10.**  CAUTION: Be prepared to collect escaping fuel.



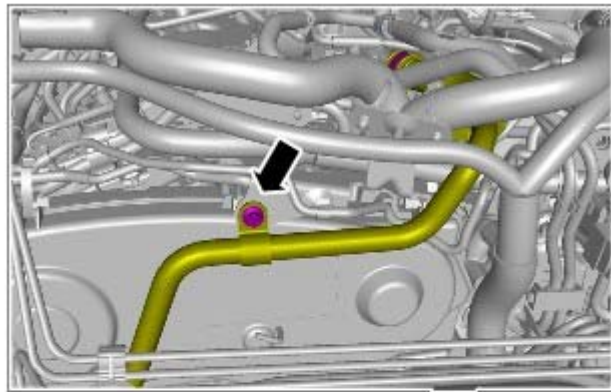
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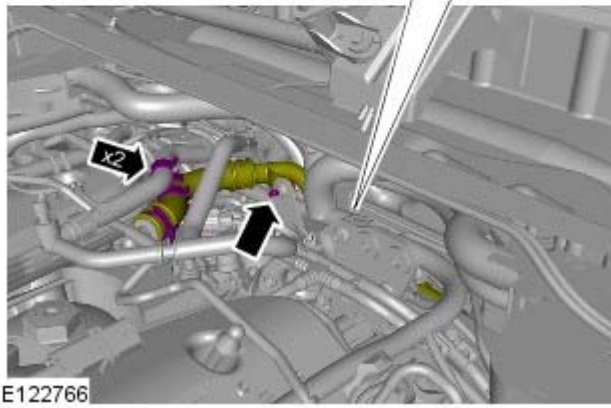
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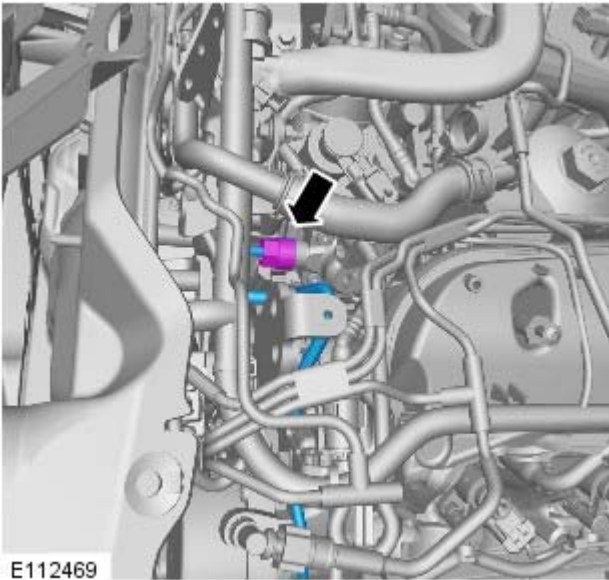


13.



14.

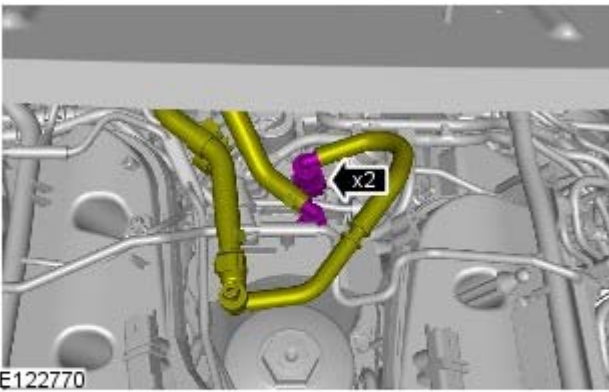




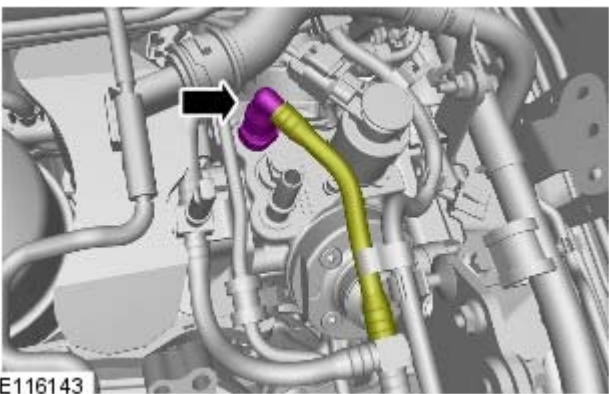
15. **15. CAUTIONS:**

 Be prepared to collect escaping fuel.

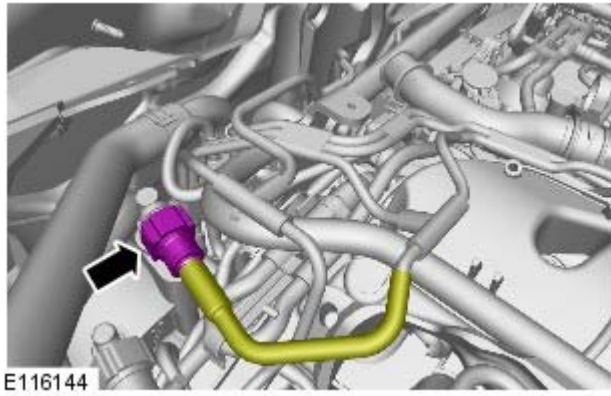
 Discard the component.



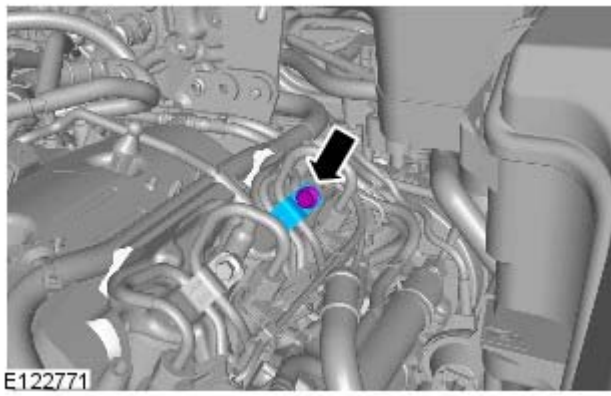
16. **16.**  **CAUTION:** Be prepared to collect escaping fuel.



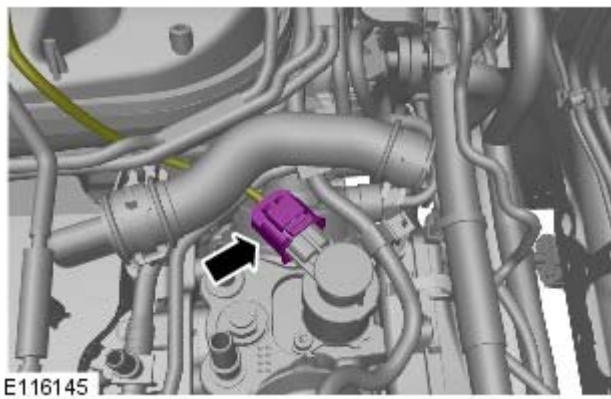
17. **17.**  **CAUTION:** Be prepared to collect escaping fuel.



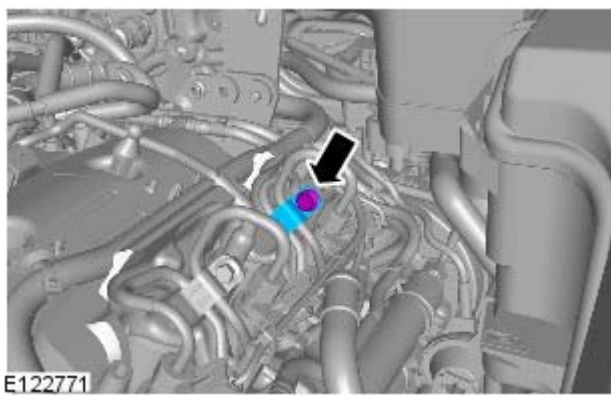
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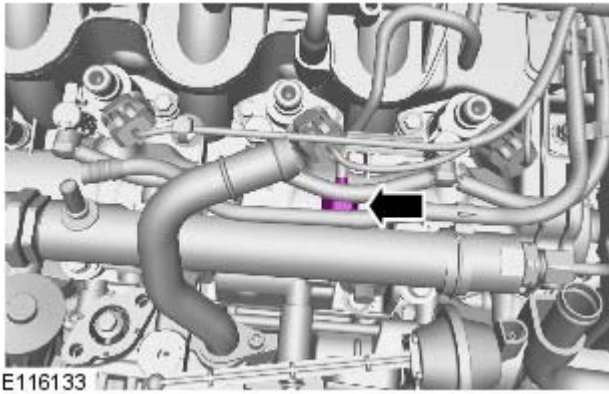
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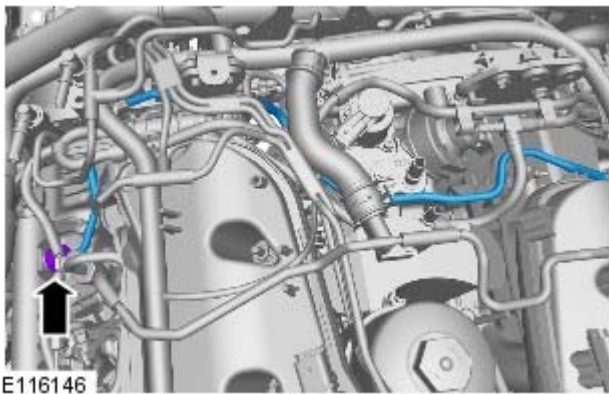
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21.



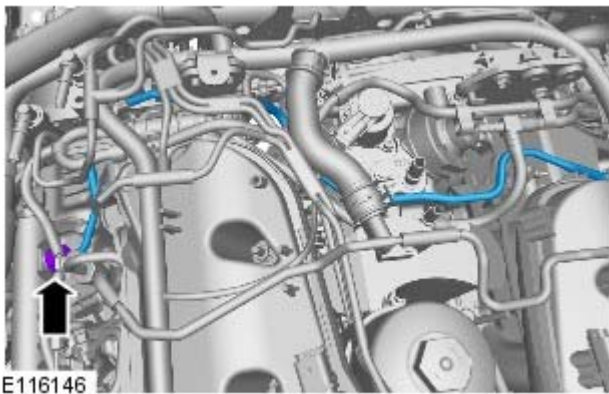
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23. **23. CAUTIONS:**

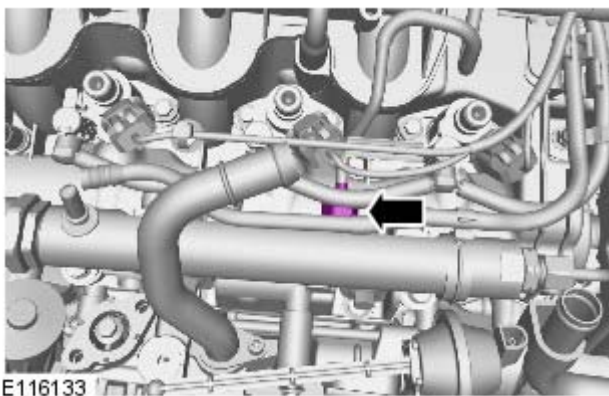
-  Be prepared to collect escaping fuel.
-  Discard the component.

Installation

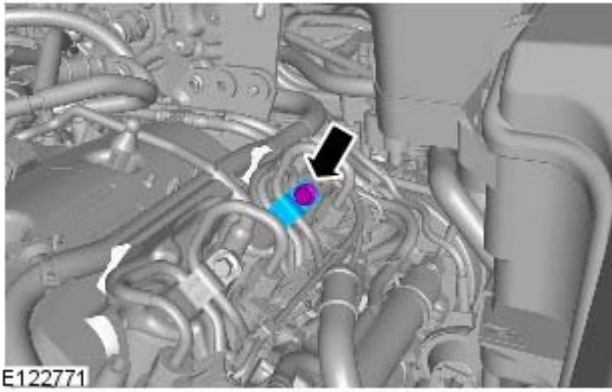


1. **1. CAUTIONS:**

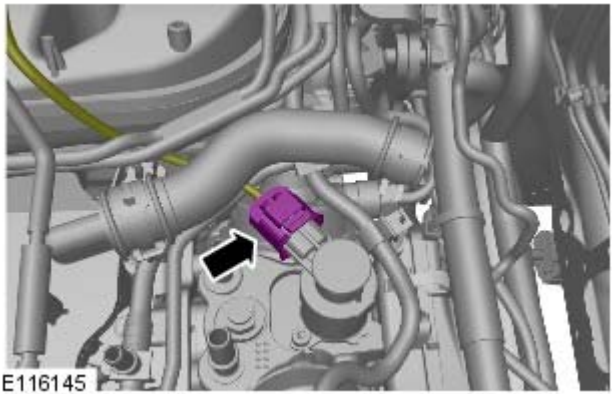
-  Make sure that a new component is installed.
-  Tighten the fuel supply line unions finger tight.



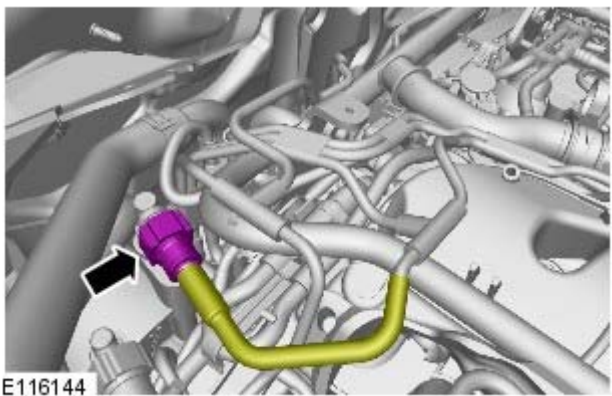
2.  **CAUTION:** Only tighten the unions finger-tight at this stage.



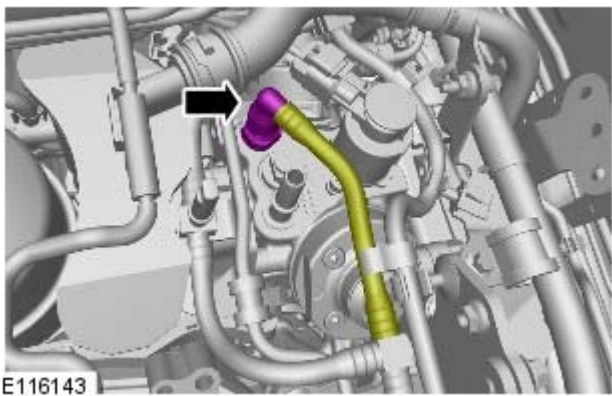
3.  CAUTION: Only tighten the bolt finger-tight at this stage.



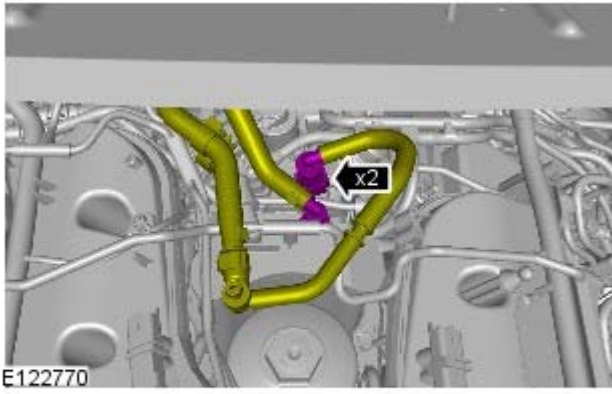
- 4.



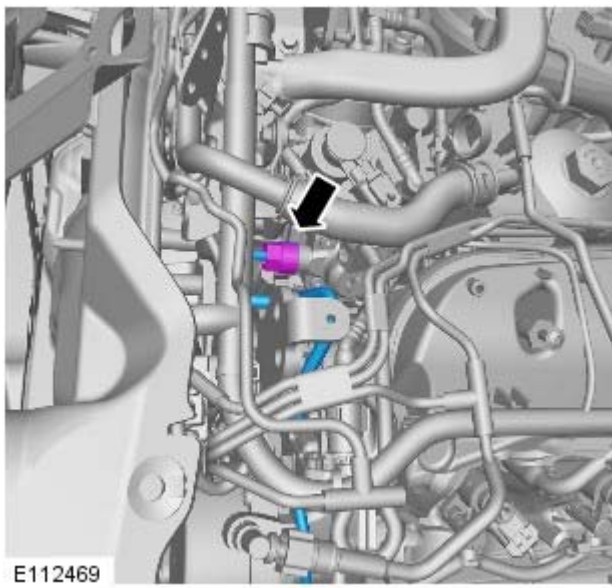
- 5.





- 6.

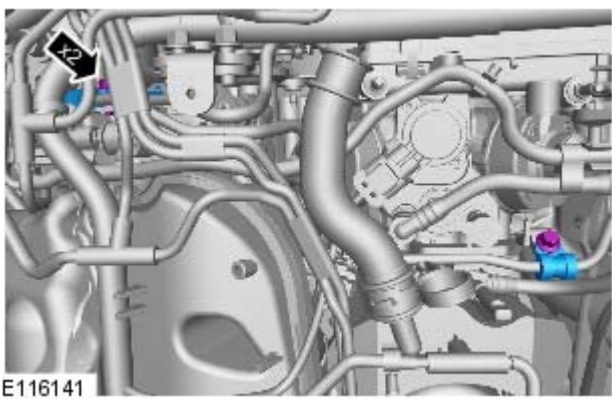


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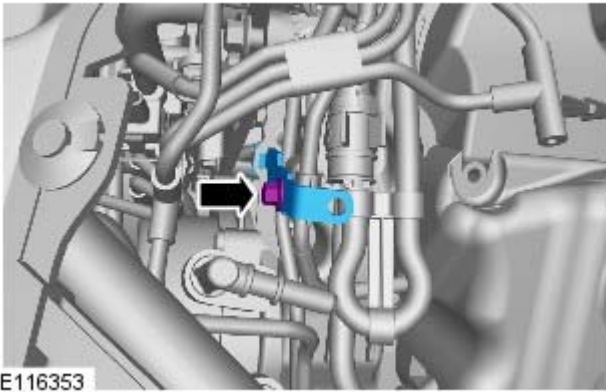


8. **8. CAUTIONS:**

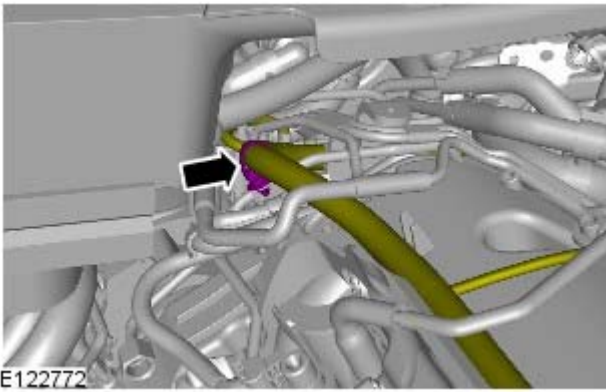
-  Make sure that a new component is installed.
-  Tighten the fuel supply line unions finger tight.



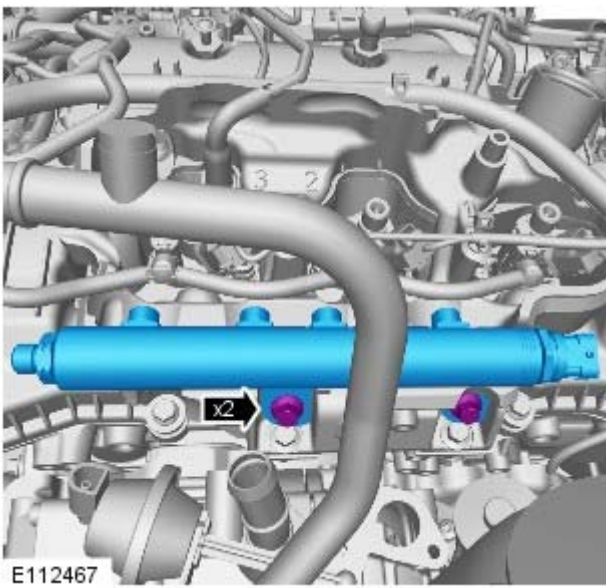
9.  **CAUTION:** Only tighten the bolts finger-tight at this stage.



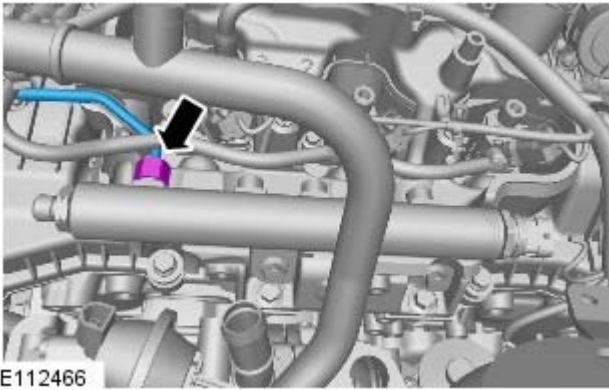
10. **10.**  **CAUTION:** Only tighten the bolts finger-tight at this stage.



- 11.



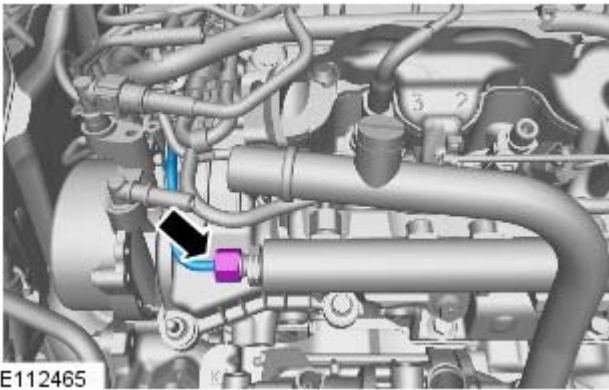
12. *Torque:* 24 Nm



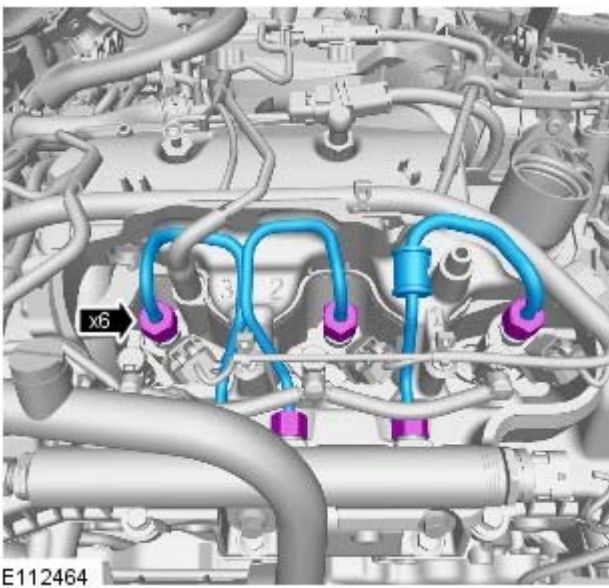
13. **13. CAUTIONS:**

 Tighten the fuel supply line unions finger tight.

 Make sure that a new component is installed.



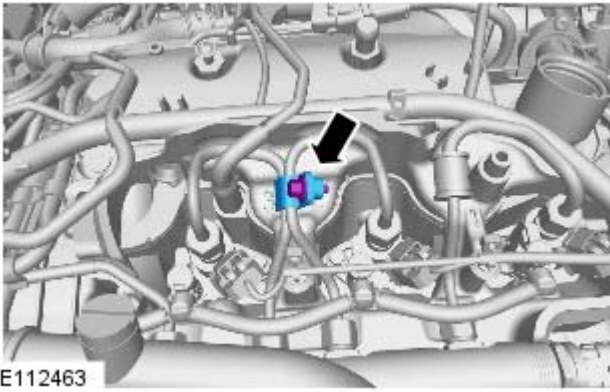
14. **14.  CAUTION:** Tighten the fuel supply line unions finger tight.



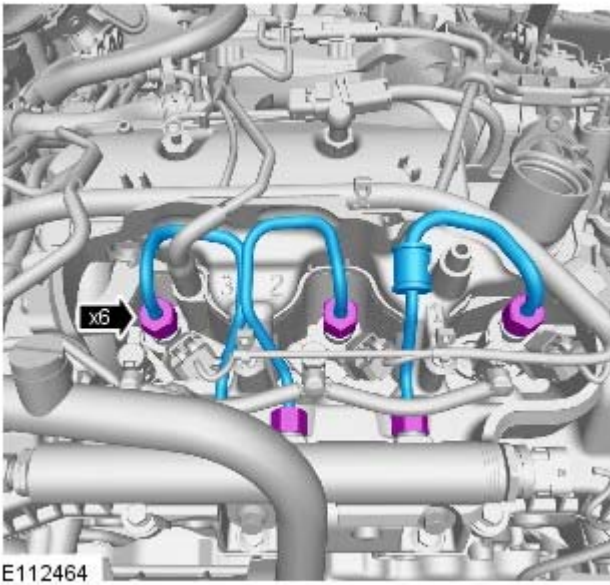
15. **15. CAUTIONS:**

 Make sure that a new component is installed.

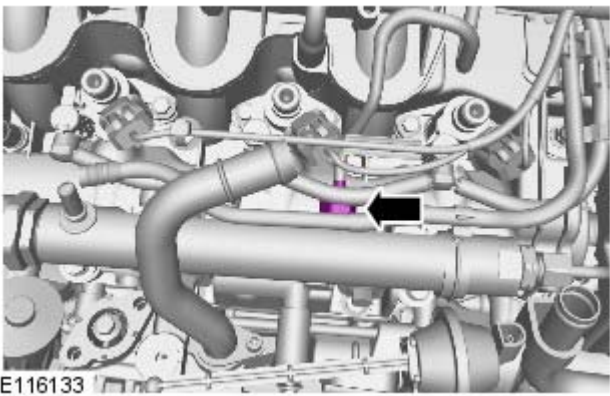
 Tighten the fuel supply line unions finger tight.



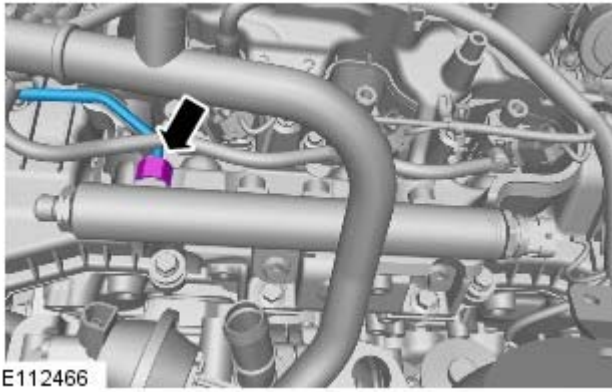
16. **16.**  **CAUTION:** Only tighten the bolt finger-tight at this stage.



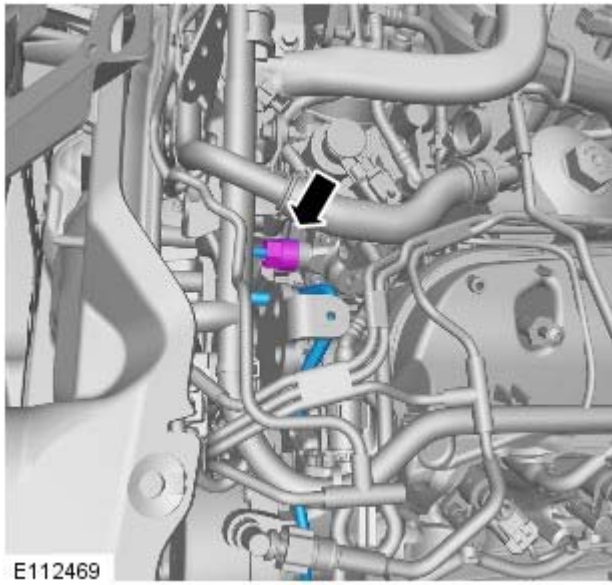
- 17.
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 15Nm.
 - Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 15Nm.



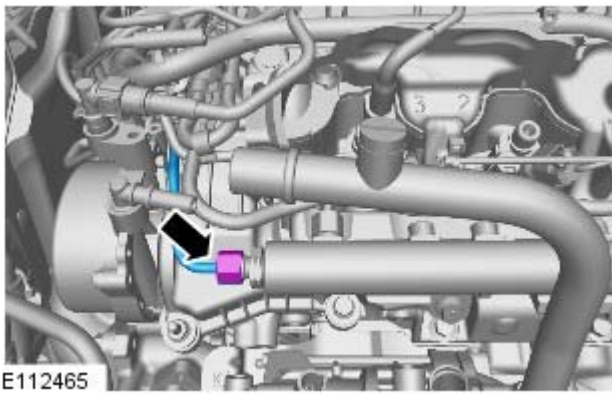
18. Tighten the high-pressure fuel lines union to 15Nm.



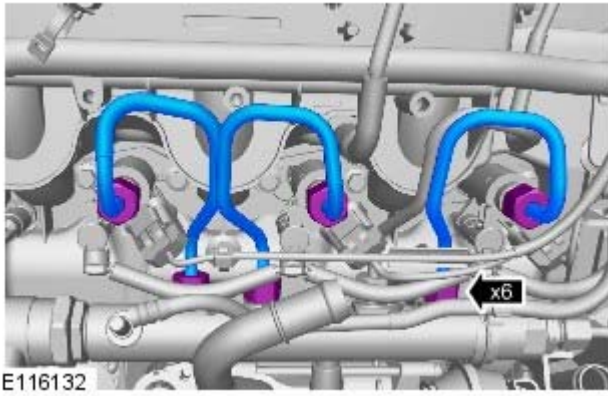
19. Tighten the high-pressure fuel lines union to 15Nm.



20. Tighten the high-pressure fuel lines union to 15Nm.

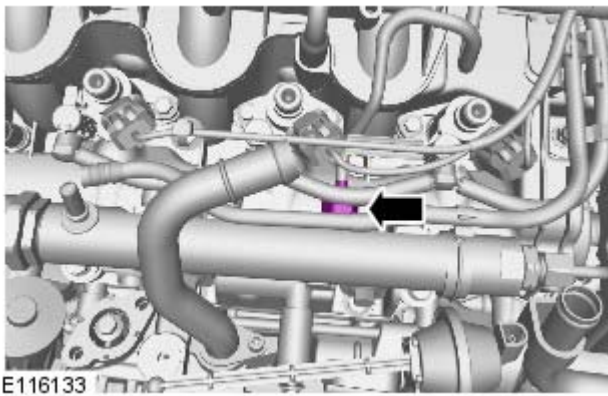


21. Tighten the high-pressure fuel lines union to 15Nm.

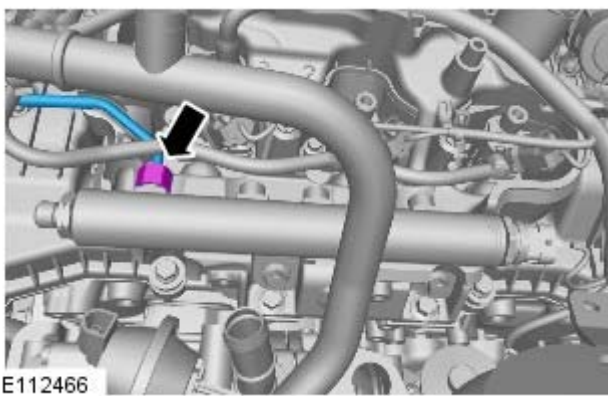


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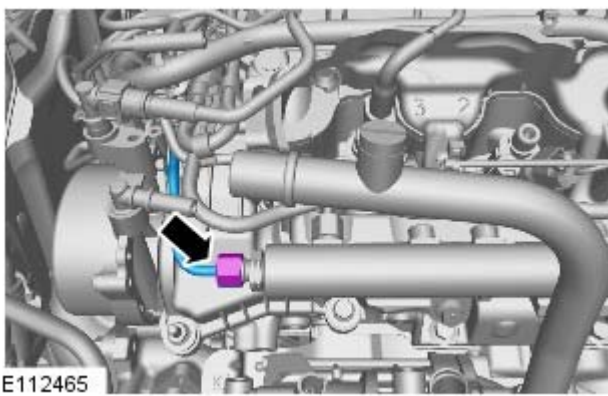
- Stage 1: Tighten the high-pressure fuel supply line unions at the fuel rail to 35Nm.
- Stage 2: Tighten the high-pressure fuel supply line unions at the injector to 35Nm.



23. Tighten the high-pressure fuel line union to 30Nm.

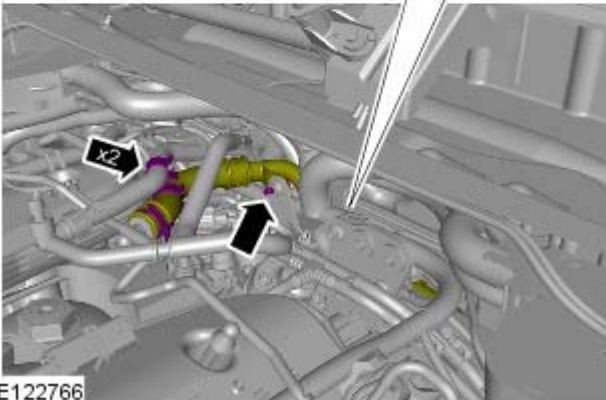
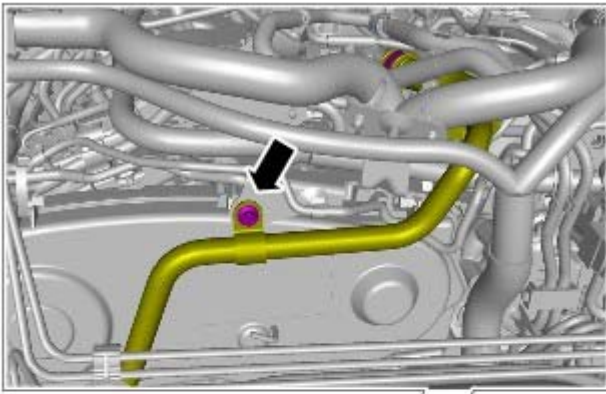


24. Tighten the high-pressure fuel line union to 30Nm.



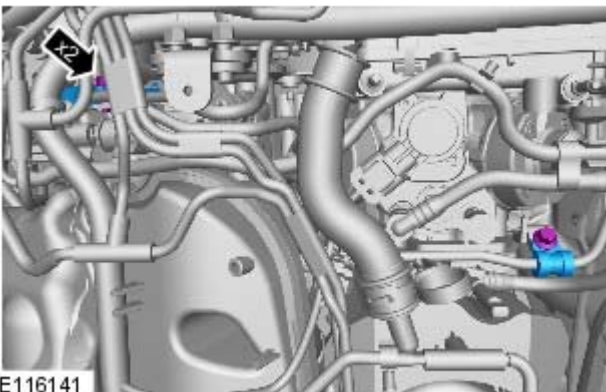
25. Tighten the high-pressure fuel line union to 30Nm.

26.



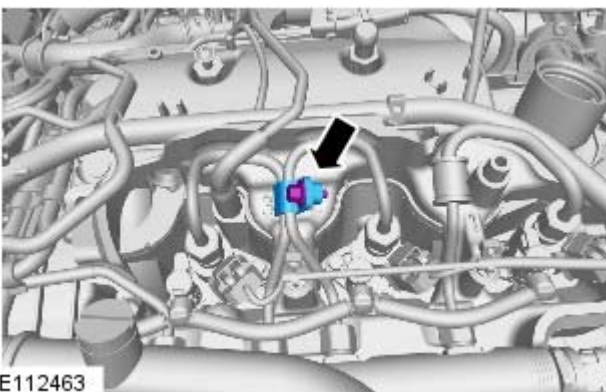
E122766

27. Torque: 10 Nm



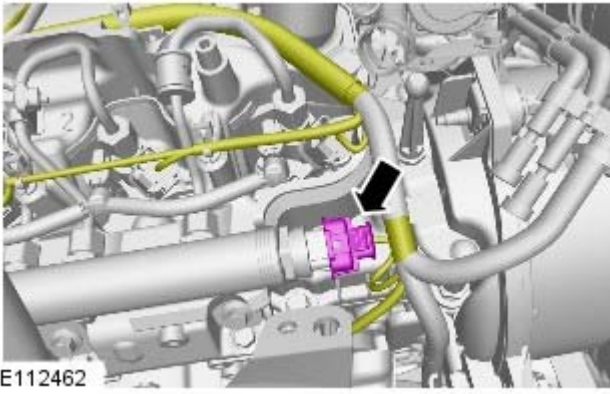
E116141

28. Torque: 10 Nm

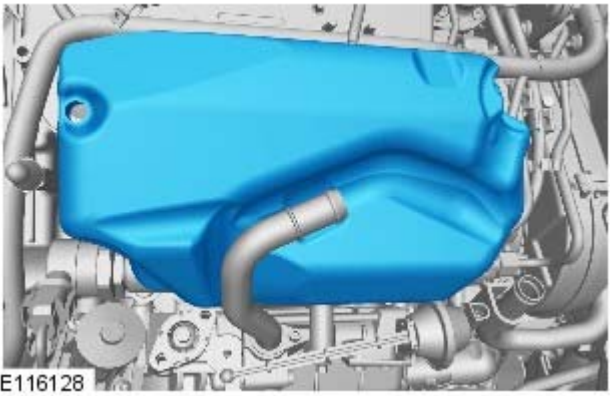


E112463

29.



30. **30.** NOTE: Left-hand shown, right-hand similar.



31.

32. Connect the battery ground cable.

Fuel Charging and Controls - TDV6 3.0L Diesel - Intake Air Shutoff Throttle

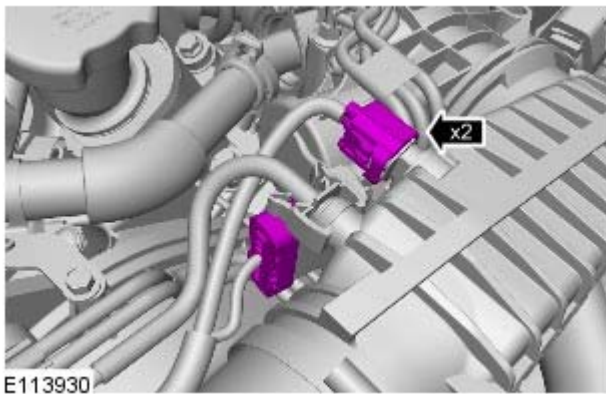
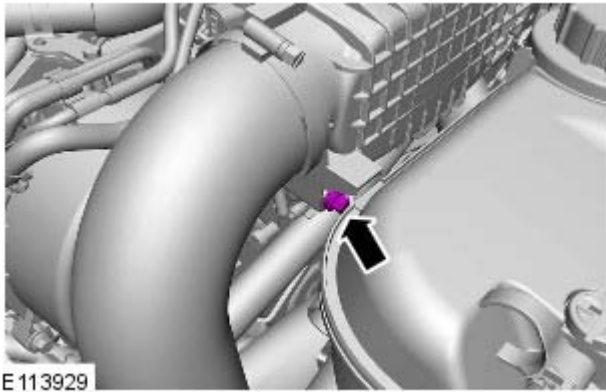
Removal and Installation

Removal

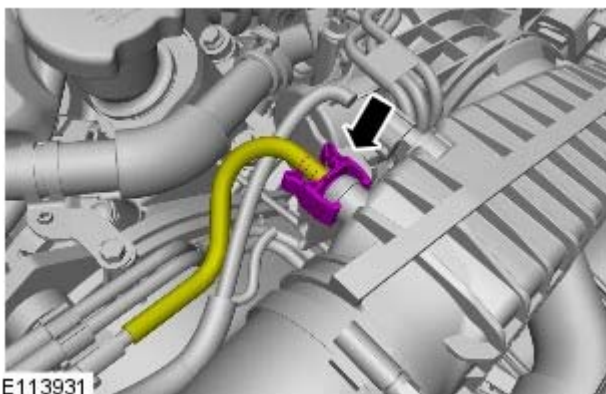
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

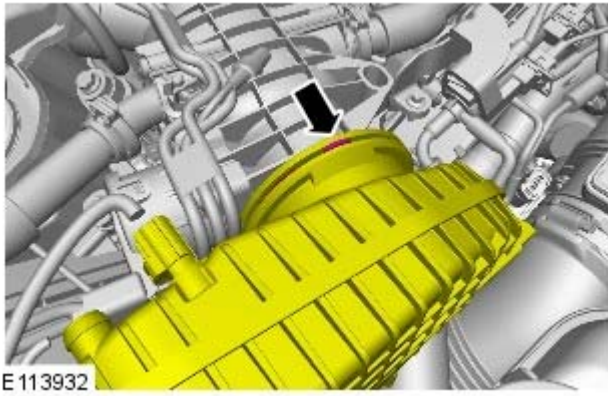
2. *Torque:* 10 Nm



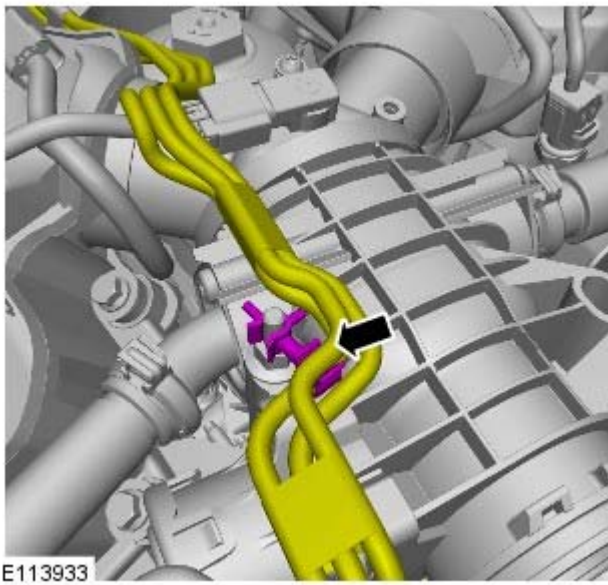
- 3.



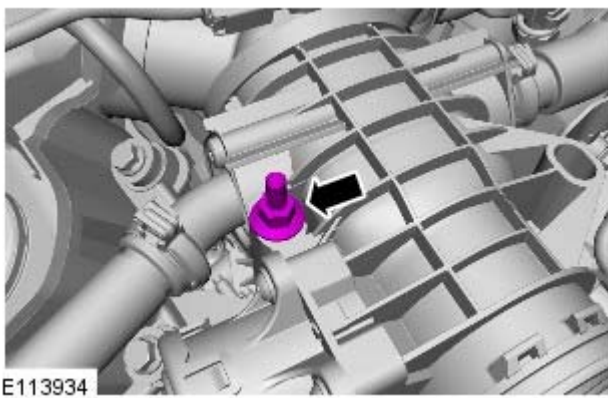
- 4.



5.

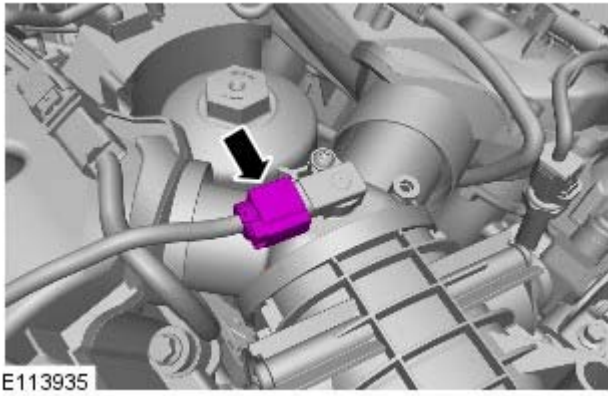


6.

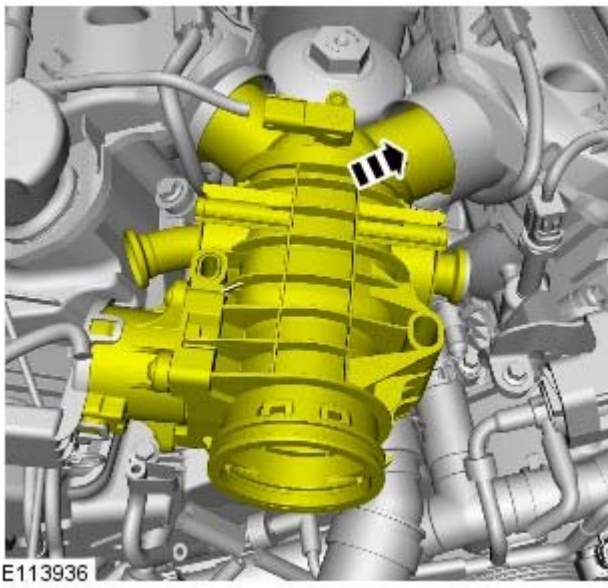


7. *Torque:* 10 Nm

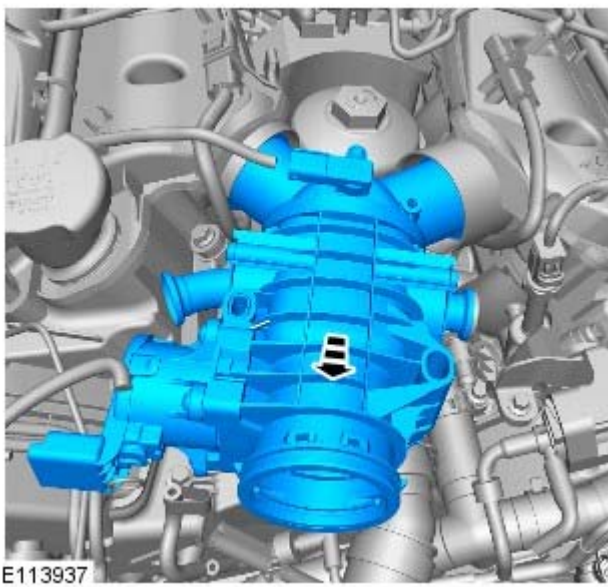
8. Refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube LH](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
9. Refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube RH](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).



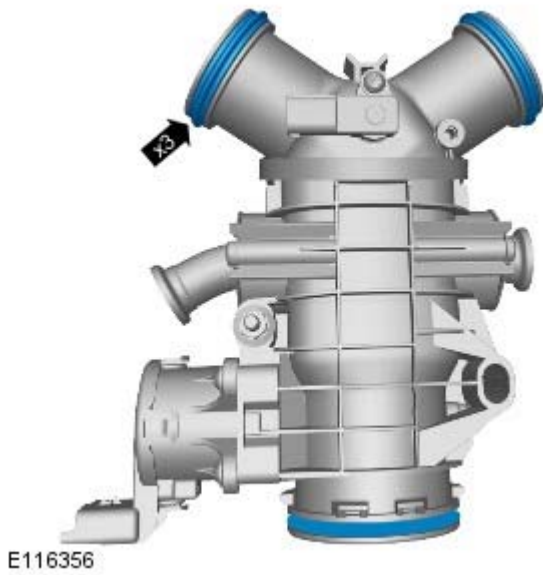
10.



11.



12.



13.  CAUTION: Install the new seals.

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure using the approved diagnostic tool.

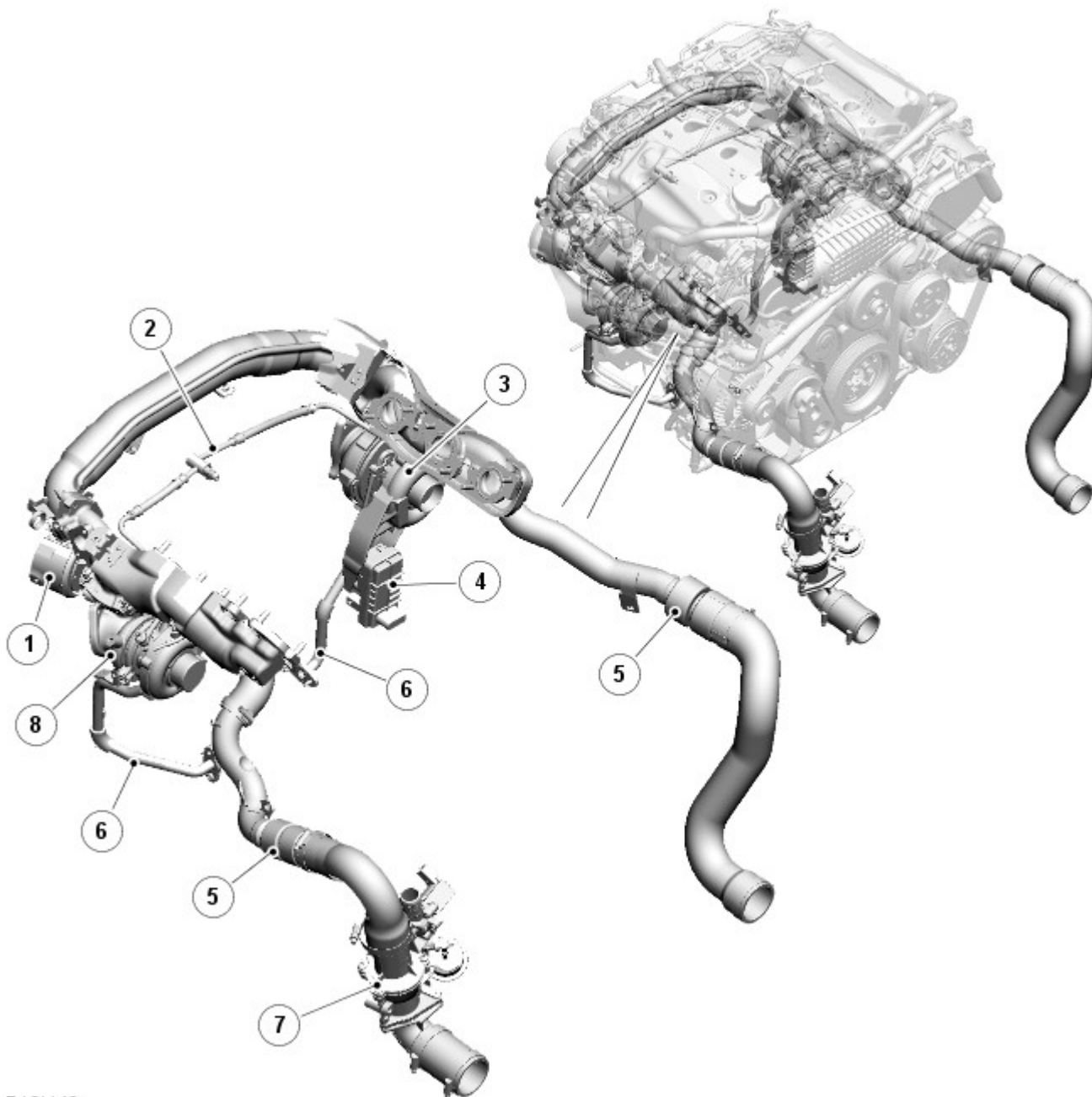
Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel -**Torque Specification**

Description	Nm	lb-ft	lb-in
Exhaust manifold threaded stud	13	10	-
Exhaust manifold retaining nuts	24	18	-
Turbocharger oil return tube to turbocharger retaining bolt	9	-	80
Turbocharger oil return tube to engine retaining bolt	9	-	80
Turbocharger bracket retaining bolts	23	17	-
Turbocharger to exhaust manifold retaining nuts	24	18	-
Exhaust manifold heatshield retaining bolt	11	8	-
Exhaust heatshield retaining bolt	9	-	80
Exhaust heatshield retaining nut	10	-	7
Turbocharger oil supply tube retaining bolt	9	-	80
Turbocharger oil supply tube union bolt	30	22	-
Exhaust gas recirculation (EGR) valve retaining bolts	9	-	80
EGR valve tube to exhaust manifold retaining bolts	9	-	80

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger - Component Location

Description and Operation

COMPONENT LOCATION



E121149

ItemDescription

1	Secondary turbocharger turbine shut-off valve
2	Turbocharger oil supply
3	Primary turbocharger (variable vane)
4	Primary turbocharger control module (variable vane actuator)
5	Charge air tube
6	Turbocharger oil drain
7	Secondary turbocharger recirculation valve and shut-off valve
8	Secondary turbocharger (fixed vane)

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger - Overview

Description and Operation

INTRODUCTION

The 3.0L V6 diesel engine uses two turbochargers; a fixed vane type (secondary) and a variable vane (primary) type. The fixed vane turbocharger is fitted to the **RH (right-hand)** cylinder bank and the variable vane turbocharger is fitted to the **LH (left-hand)** cylinder bank.

Both turbochargers are used in a parallel sequential turbocharging system which enables the engine to achieve quick throttle response at low engine speeds and efficient use of exhaust gas energy at high engine speeds.

The variable vane turbocharger has an **ECM (engine control module)** controlled electronic rotary actuator. The rotary actuator adjusts the turbine vanes to optimize the exhaust gas flow and velocity onto the turbine wheel to maintain the required boost pressure.

The parallel sequential turbocharging system comprises the two turbochargers and the **ECM**. The primary variable nozzle turbine operates through the entire engine speed range but is at its most efficient at engine speeds of up to 2800 rpm. At engine speeds above 2800 rpm under load, the fixed vane secondary turbine comes into operation, with both of the turbochargers now running in a parallel bi-turbo mode.

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger - System Operation and Component Description

Description and Operation

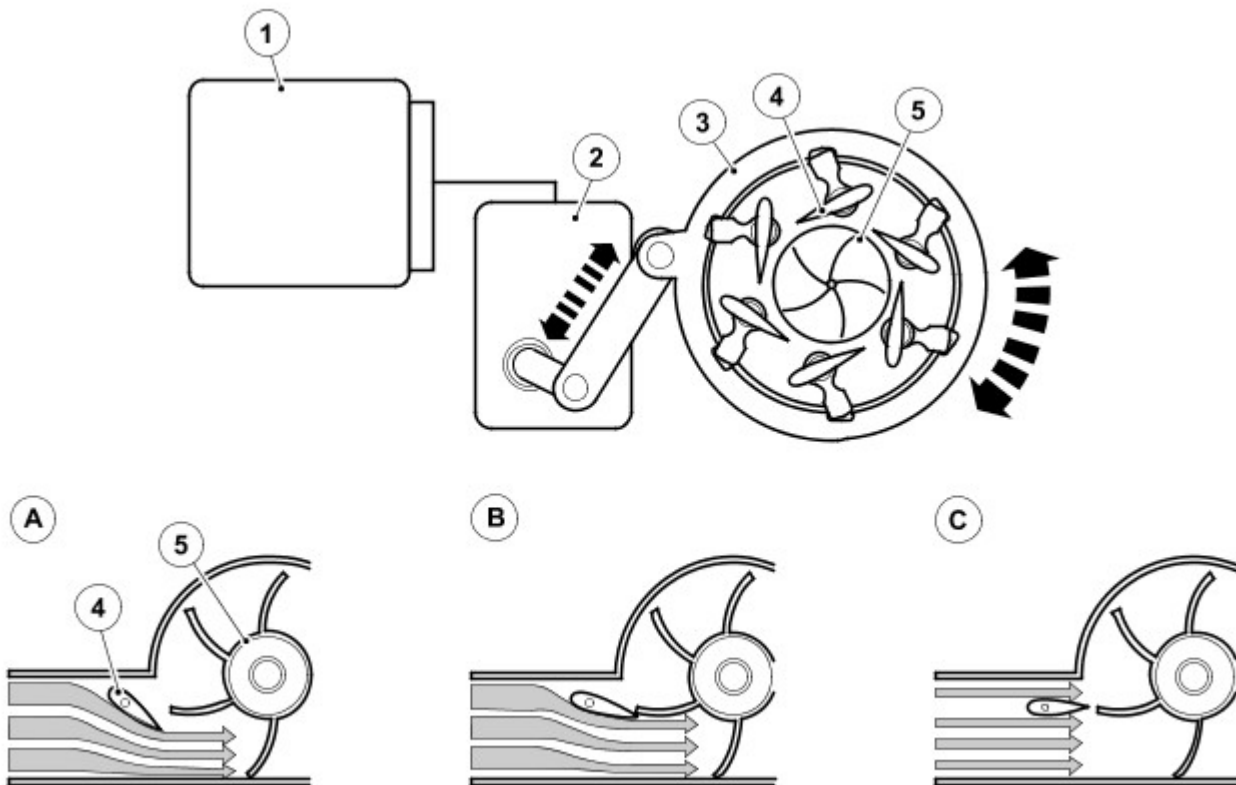
System Operation

TURBOCHARGERS

The turbine wheel of the turbocharger uses the engine's exhaust gasses to drive the compressor wheel. The compressor wheel draws in fresh air which is supplied to the engine cylinders in a compressed form.

The primary variable vane turbocharger allows the optimum inlet geometry (inlet area and flow angle) to be used over a wide range of engine operating conditions. This allows a rapid speed of response and higher boost pressures at low engine speeds. The variable vane angle determines both the inlet area as well as the flow angle, as controlled by the [ECM \(engine control module\)](#). The variable vanes allow efficient use of the exhaust gas energy which in turn improves turbocharger and engine efficiency.

Principles of Variable Vane Operation



E107579

ItemDescription

A	Low engine speed
B	Intermediate engine speed
C	High engine speed
1	ECM
2	Electronic rotary actuator
3	Turbine housing
4	Variable vanes
5	Compressor wheel

The variable vanes in the primary turbocharger are controlled by the [ECM](#). The [ECM](#) controls a rotary electronic actuator attached to the primary turbocharger which is used to adjust the pitch angle of the vanes by rotating the turbine housing. The electronic rotary actuator also provides the [ECM](#) with a feedback signal to determine the pitch angle of the vanes.

The variable vanes in the primary turbocharger improve the exhaust gas power transfer to the turbine wheel which in turn drives the compressor wheel. At low engine speeds this greatly assists the increase in turbocharger boost pressure.

As engine speed, and therefore the exhaust gas velocity, increases, the vanes are opened. The amount of opening is determined by the [ECM](#) to ensure that the power transfer from the turbine wheel to the compressor wheel is within the turbocharger speed and boost pressure requirements.

At high engine speed and exhaust gas flow, the [ECM](#) increases the vane opening to avoid overspeed of the turbines and

provide a smooth high speed operation. At this point the dual mode boosting system comes into affect by utilizing the secondary (fixed vane) turbocharger.

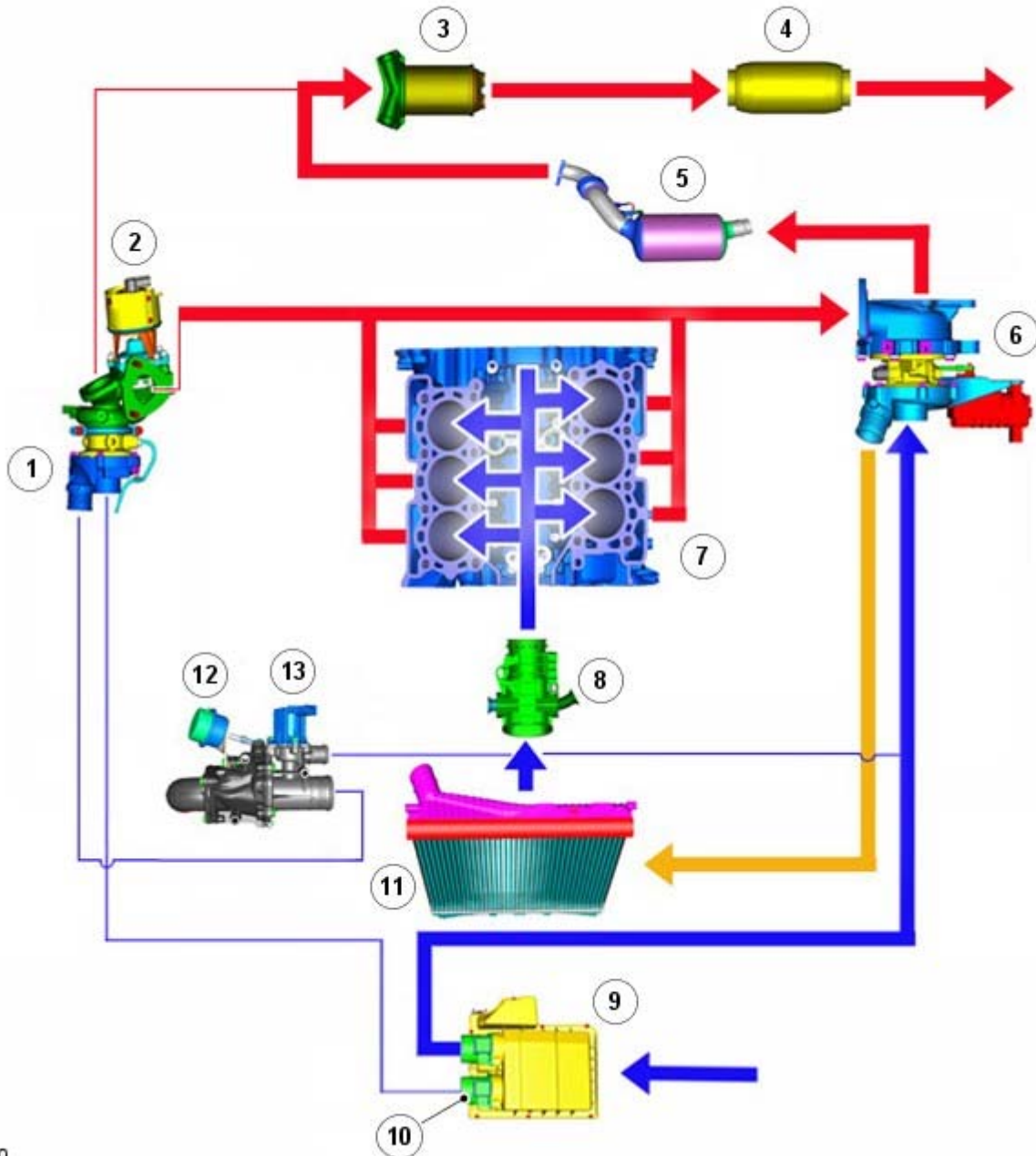
The fixed vane turbocharger incorporates an outlet temperature sensor, which is located adjacent the oxygen sensor in the close coupled catalytic converter and, an outlet pressure sensor which receives inputs from the APP (accelerator pedal position) and ECM.

Refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Dual Mode Boosting

The dual mode boosting system comprises two turbochargers and software within the ECM. The two turbochargers can operate in two modes; mono turbocharger operation or bi-turbocharger operation.

Mono Turbocharger Schematic Diagram



E107580

ItemDescription

1	Fixed vane turbine
2	Turbine shut-off valve
3	DPF (diesel particulate filter)
4	Flexible center resonators
5	Catalytic converter
6	Variable vane turbocharger
7	Engine
8	Throttle
9	
10	
11	
12	
13	

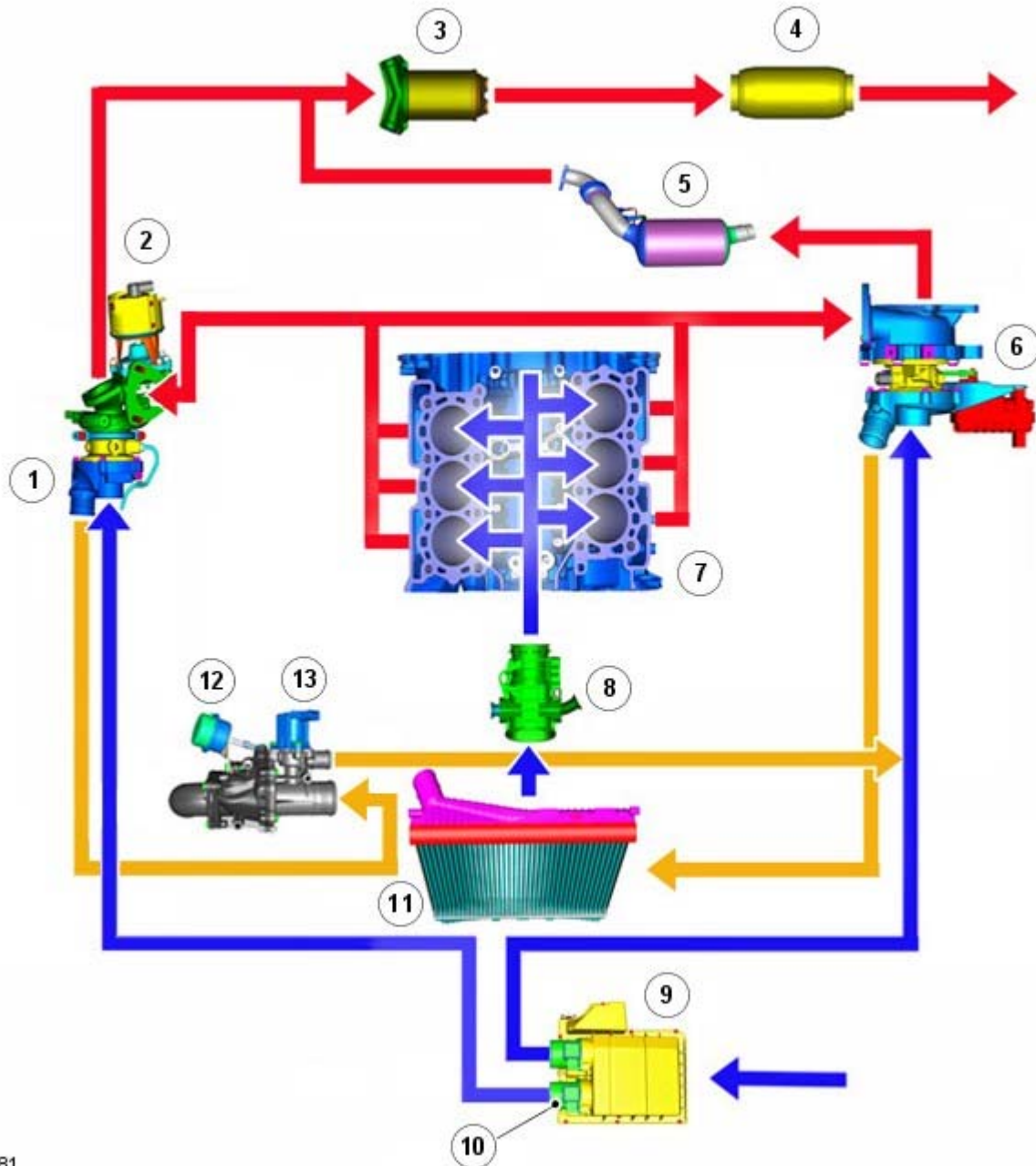
Air filter

- 10 MAF (mass air flow) meter
- 11 Charge air cooler
- 12 Compressor shut-off valve
- 13 Recirculation valve

Fresh air is drawn through the air filter and the MAF meter to the primary turbocharger compressor. The compressed air is then passed through the charge air cooler and into the engine.

The turbine shut-off valve on the secondary turbocharger is closed and therefore exhaust gasses are unable to operate the secondary turbocharger turbine. In this condition all turbocharging boost pressure is produced by the primary turbocharger.

Bi-Turbocharger Switching Schematic Diagram



E107581

ItemDescription

- 1 Fixed vane turbine
- 2 Turbine shut-off valve
- 3 DPF
- 4 Flexible center resonators
- 5 Catalytic Converter
- 6 Variable vane turbocharger
- 7 Engine
- 8 Throttle

Air filter

10 [MAF](#) meter

11 Charge air cooler

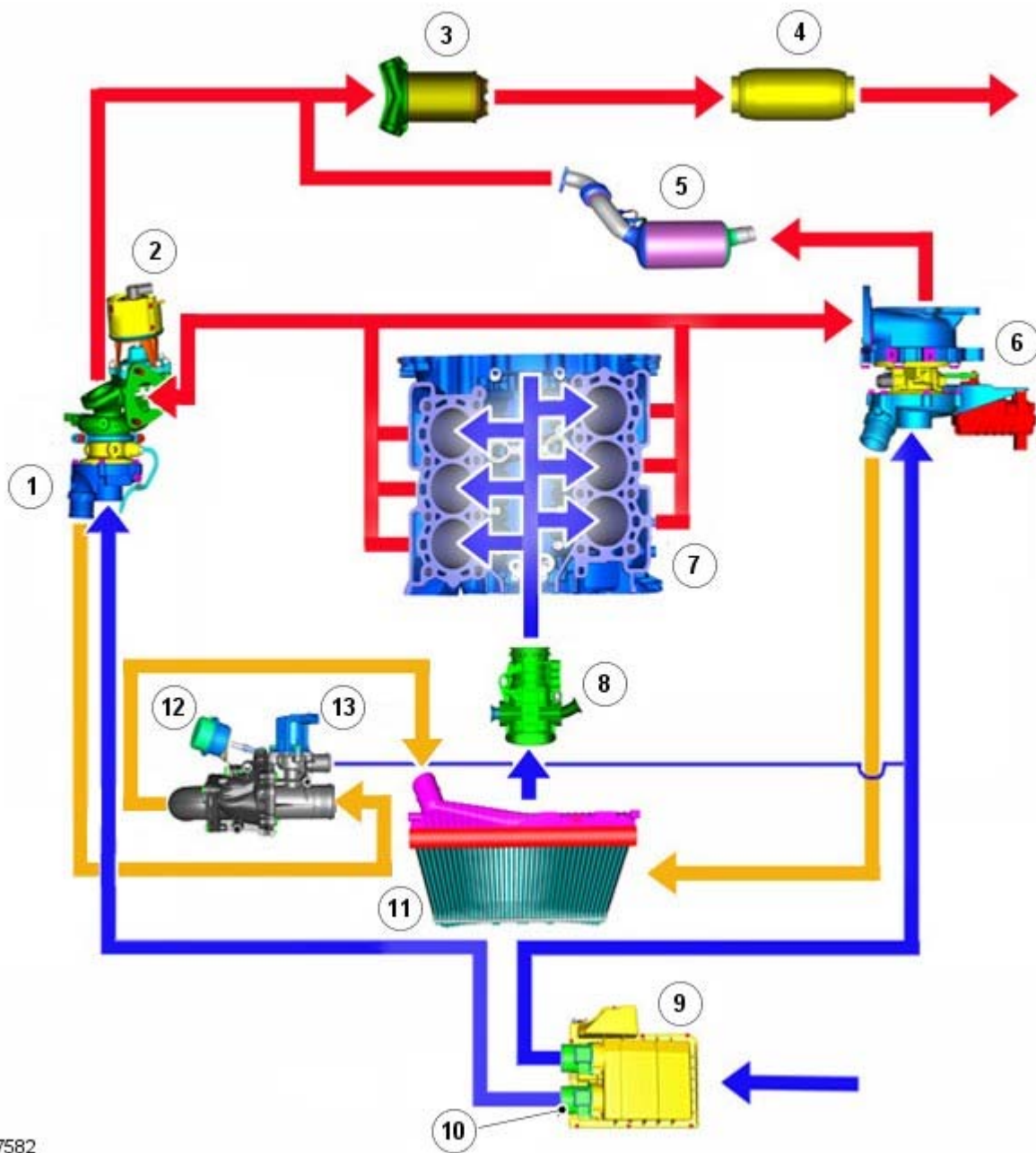
12 Compressor shut-off valve

13 Recirculation valve

When the engine operating parameters approach the limits (approximately 2800 rpm under load) of the primary turbocharger, dual mode boosting control software within the [ECM](#) begins the switch to parallel bi-turbocharger operation. The secondary turbocharger is brought into operation by the opening of the turbine shut-off valve which allows exhaust gasses to flow through the turbine.

Initially, the secondary turbocharger does not produce a boost pressure to equal that of the primary turbocharger. Therefore, the initial boost pressure from the secondary turbocharger is fed via the recirculation valve into the clean air inlet for the primary turbocharger. As the secondary turbocharger boost pressure output increases, the recirculation valve is then closed and the compressor shut-off valve is opened to increase the boost pressure from the secondary turbocharger which is directed into the charge air cooler.

Bi-Turbocharger Schematic Diagram



E107582

ItemDescription

1 Fixed vane turbine

2 Turbine shut-off valve

3 [DPF](#)

4 Flexible center resonators

5

Catalytic Converter
6 Variable vane turbocharger
7 Engine
8 Throttle
9 Air filter
10 MAF meter
11 Charge air cooler
12 Compressor shut-off valve
13 Recirculation valve

When the secondary turbocharger has reached the required operating parameters, the recirculation valve is closed and the compressor shut-off valve is opened. The [ECM](#) will maintain the engine operating in bi-turbocharger operation with both primary and secondary turbochargers contributing to the air charge induction. When the dual mode boosting software determines that the engine operating parameters no longer require the use of dual mode boosting, the system switches back to mono turbocharger operation.

If the engine idles for more than 3 minutes, the secondary turbocharger is actuated to ensure correct lubrication. This is achieved by pressurizing the turbine shaft bearing cavities through a pipe, which is connected to the air intake system and periodically opening the turbine shut-off valve to operate the turbocharger.

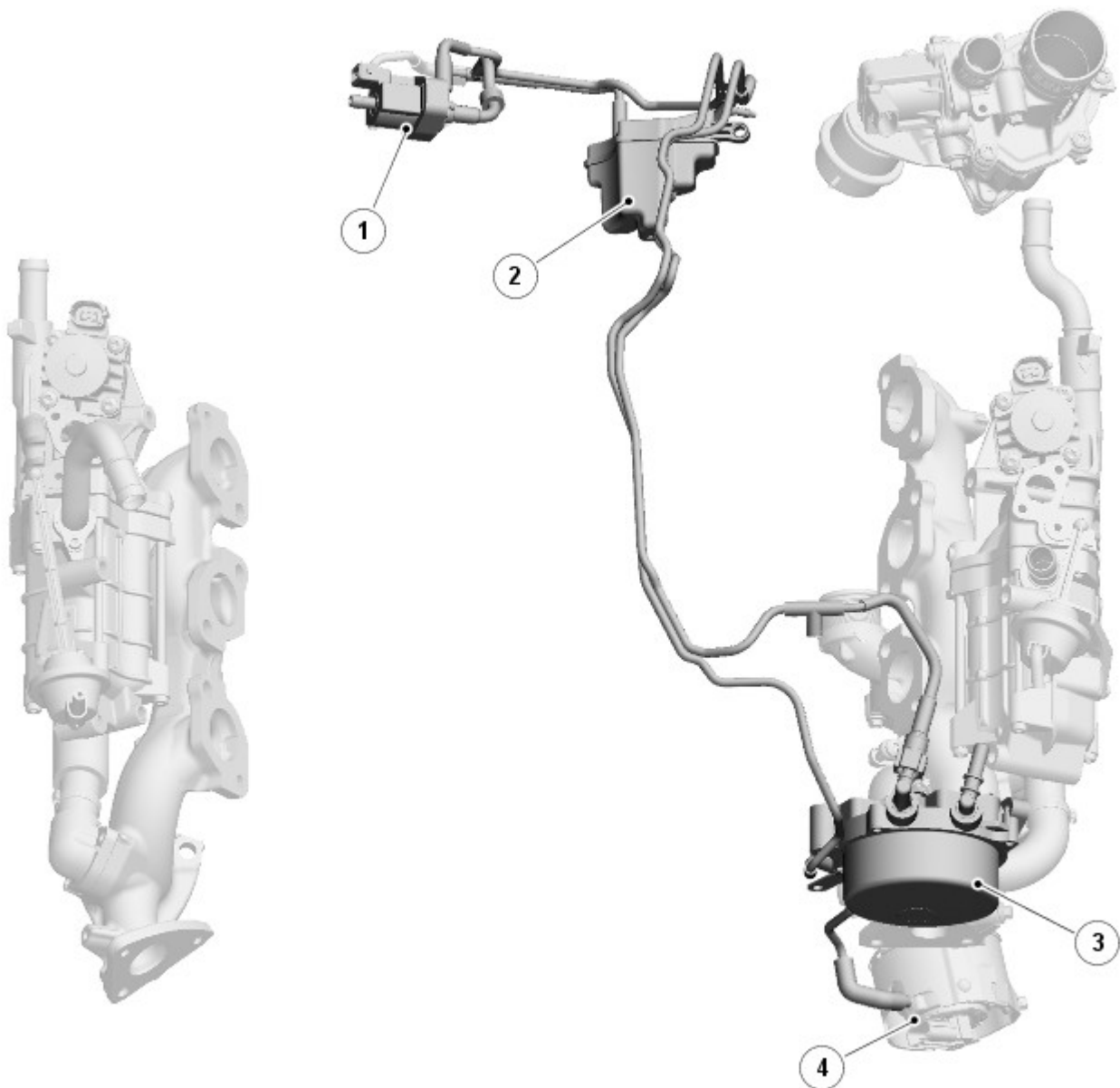


CAUTION: Ensure both ends of the pipe are securely connected to the secondary turbo and the air intake system to prevent damage to the turbo components.

Turbine and Compressor Shut-off Valve Control

The secondary turbocharger turbine shut-off valve and compressor shut-off valve are controlled by the [ECM](#) through a vacuum system. The secondary turbo turbine shut-off valve also incorporates a position sensor.

Secondary Turbocharger Turbine Shut-off Valve Vacuum Control



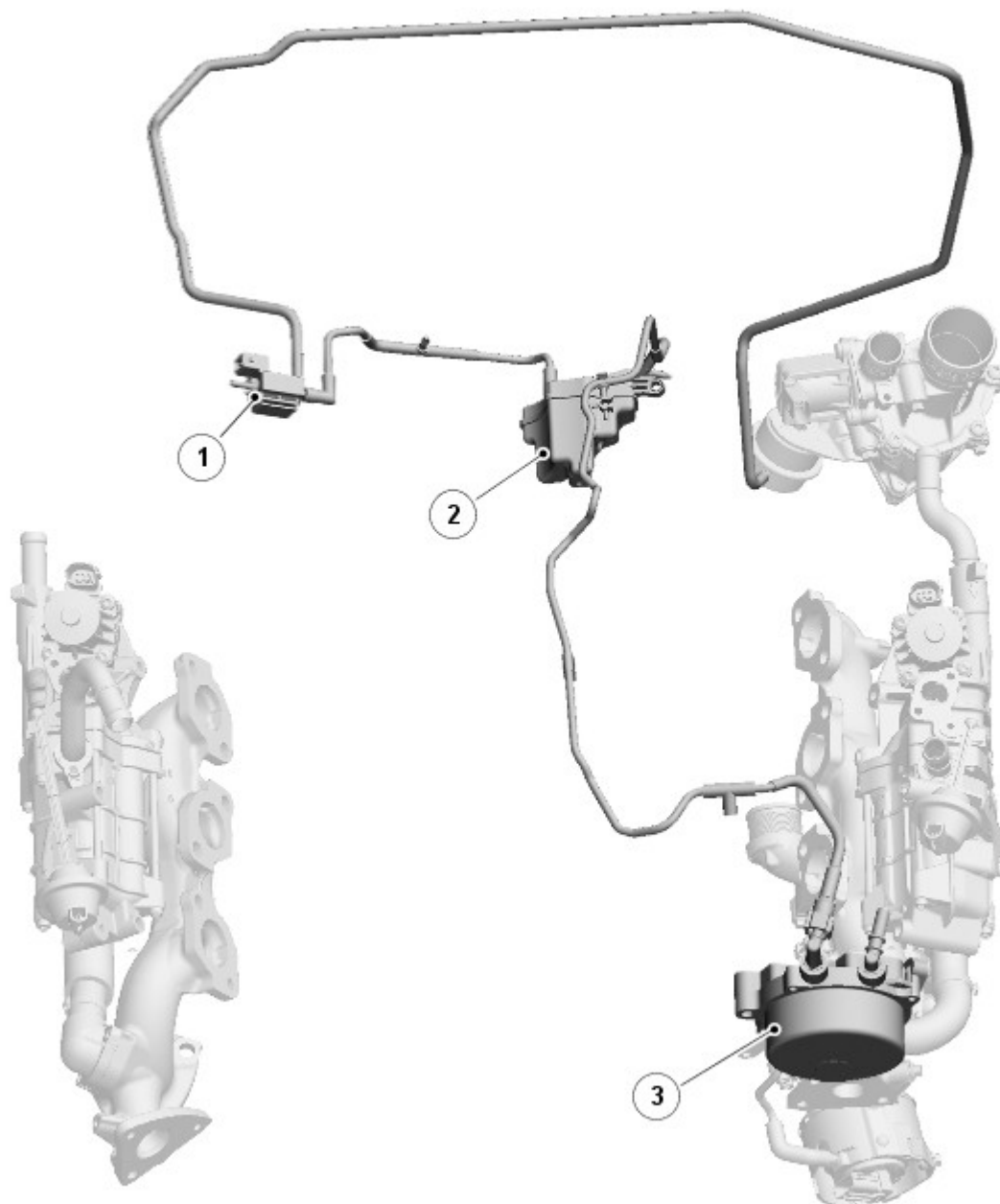
E117413

ItemDescription

1	Secondary turbine shut-off solenoid valve
2	Vacuum reservoir
3	Vacuum pump
4	Secondary turbine shut-off valve

If vacuum is lost to the shut-off valve it will default to the closed position. The position sensor will inform the [ECM](#), which will initiate mono-turbo mode, restricted performance and record [DTC \(diagnostic trouble code\)](#).

Compressor Shut-off Valve Vacuum Control



E117414

ItemDescription

1	Compressor shut-off valve solenoid valve
2	Vacuum reservoir
3	Vacuum pump

If the system develops a fault, for example an air leak, the compressor shut-off valve will default to the closed position. In the default position, mono-turbo operation and restricted engine torque is initiated.

• NOTE: When fault finding the vacuum system, always check for trapped/split/disconnected pipework. Any vacuum fault will cause the engine to default to limited torque mode.

Component Description

Each turbocharger consists of two turbo elements, a turbine wheel and compressor wheel, enclosed separately in cast housings and mounted on a common shaft, which rotates in two semi-floating bearings.

VARIABLE VANE TURBOCHARGER (PRIMARY)

The variable vane turbocharger is attached to the **LH (left-hand)** exhaust manifold and secured to 3 studs on a flange on the manifold with nuts. On production, no gasket is used to seal the joint between turbocharger and the manifold. In-service vehicles will require a service gasket to be fitted if the joint between the turbocharger and the manifold is disturbed.

A second flange on the turbocharger has 3 integral studs and provides for the attachment of the **LH** catalytic converter inlet pipe. Three nuts secure the inlet pipe to the flange studs and a gasket seals the joint between the components.

The compressor end of the turbocharger has two hose connections. The central connection provides a clean air supply from the air filter to the compressor. The second connection on the outside of the housing provides for a pipe connection from

the turbocharger to the charge air cooler

The turbocharger is a conventional design with both the turbine wheel and the compressor wheel sharing a common shaft which is supported on bearings. The turbocharger receives an engine oil feed via a pipe from the cylinder block. The pipe supplies both turbochargers with an oil supply for lubrication purposes. An oil drain pipe from the turbocharger allows oil to drain from the turbocharger into the cylinder block.

An integral bracket houses the variable vane electronic rotary actuator. The rotary actuator is connected to an eccentric lever which moves the turbine housing to adjust the position of the vanes. When the rotary actuator operates a boss is rotated, which in turn moves the lever and changes rotary motion into linear motion. The lever is connected to the outside of the turbine housing and the linear motion is converted back to rotary motion of the housing. Operation of the electronic rotary actuator is controlled by the [ECM](#).

FIXED VANE TURBOCHARGER (SECONDARY)

The fixed vane turbocharger is attached to the [RH \(right-hand\)](#) exhaust manifold and is secured to 3 studs on a flange on the manifold with nuts. On production, no gasket is used to seal the joint between turbocharger and the manifold. In-service vehicles will require a service gasket to be fitted if the joint between the turbocharger and the manifold is disturbed.

A second flange on the turbocharger has 2 integral studs and provides for the attachment of the [RH](#) exhaust system downpipe. Two nuts secure the downpipe to the flange studs and a gasket seals the joint between the downpipe and the turbocharger.

The compressor end of the turbocharger has two hose connections; the central connection provides the clean air supply from the air filter. The second connection on the outside of the turbocharger housing allows the connection from the turbocharger to the charge air cooler.

Attached to the rear of the turbocharger is a turbine shut-off valve. The valve is vacuum operated and electronically controlled by the [ECM](#). The valve is closed when the system is operating in mono-turbocharger mode, diverting exhaust gasses from the [RH](#) exhaust manifold, via the exhaust cross-over duct to the [LH](#) exhaust manifold. When bi-turbocharger operation is required, the [ECM](#) electronically operates the valve allow vacuum to open the shut-off valve allowing exhaust gasses from the [RH](#) exhaust manifold to drive the turbine of the fixed vane turbocharger.

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel -

Turbocharger

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-04D Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel)

[Turbocharger](#) (Description and Operation),
[Turbocharger](#) (Description and Operation),
[Turbocharger](#) (Description and Operation).

Inspection and Verification



WARNING: The following tests may involve working in close proximity to hot components. Make sure adequate protection is used. Failure to follow this instruction may result in personal injury.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Intake air system ● Hose(s)/hose connections ● General engine condition. 	<ul style="list-style-type: none"> ● Circuit(s) ● Engine control module (ECM) ● Electrical connections and harnesses

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor performance	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Restricted air intake system ● General engine condition ● Engine control module failure 	Check the fuel level and condition. Check the air intake for restriction. Check the engine condition, compressions, etc. Refer to the relevant section of the workshop manual. Check for DTCs. Refer to the warranty policy and procedures manual if an engine control module is suspect.
No boost	<ul style="list-style-type: none"> ● Electrical connections and harnesses ● Restricted air intake system ● Charge air cooler restricted/leaking ● Engine control module failure 	Check the electrical connections and harnesses. Check the air intake for restriction/leakage (see visual inspection). Refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if an engine control module is suspect.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation).

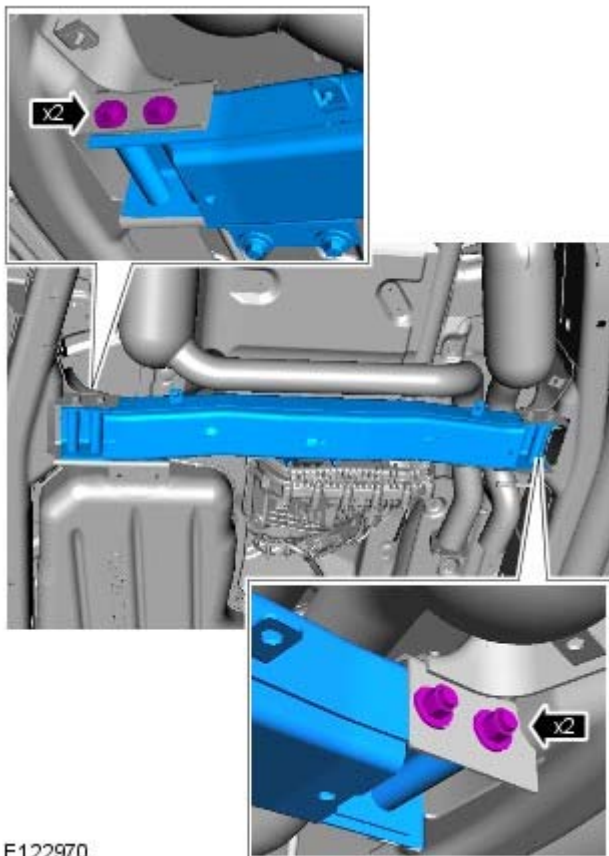
Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger LH

Removal and Installation

Removal

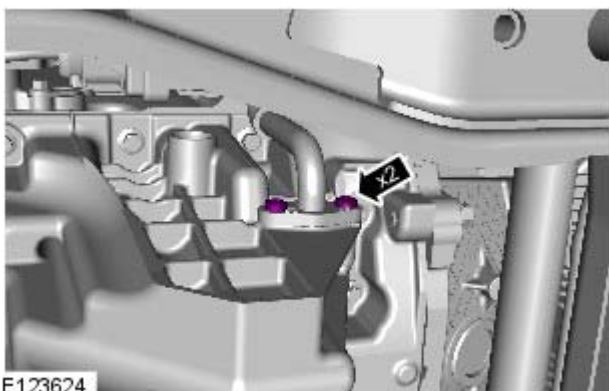
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).



E122970


2.  CAUTION: Only tighten the bolts finger tight at this stage.



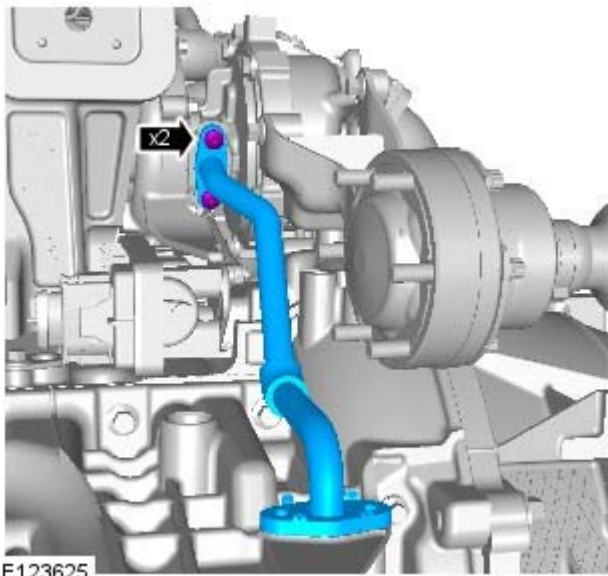
E123624

3. **3. CAUTIONS:**

 Make sure that all openings are sealed. Use new blanking caps.

 Make sure that the area around the component is clean and free of foreign material.

Torque: 9 Nm



4. **4. CAUTIONS:**

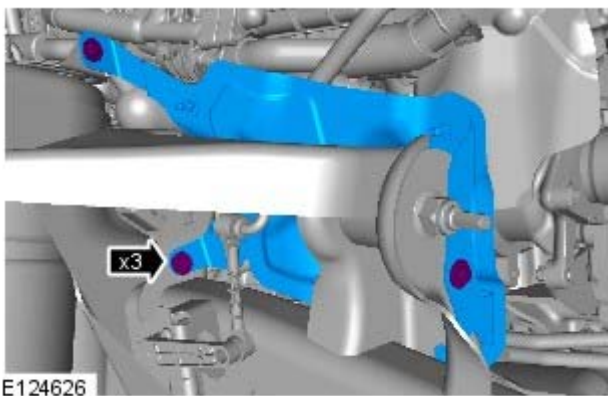
 Make sure that the area around the component is clean and free of foreign material.

 Make sure that all openings are sealed. Use new blanking caps.

• NOTE: Engine shown removed for clarity.

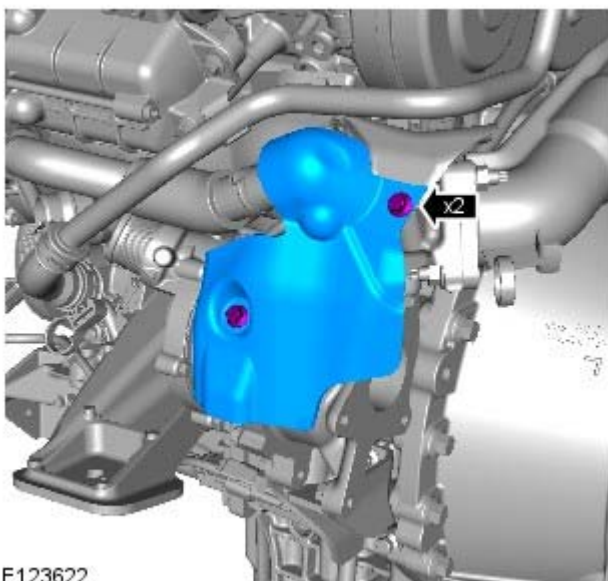
Torque: 9 Nm

5. Refer to: [Body - TDV6 3.0L Diesel/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).



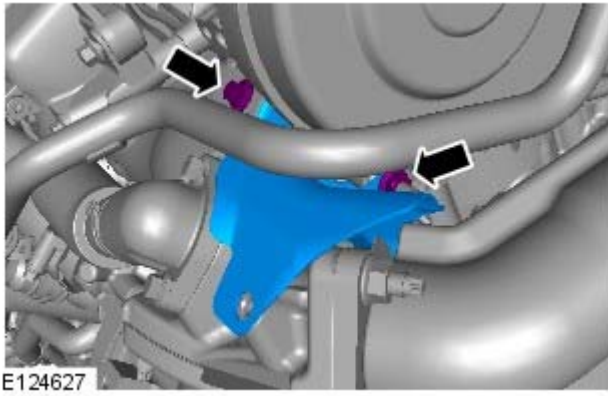
6. **6. NOTE:** The heatshield consists of 3 parts.

Torque: 9 Nm

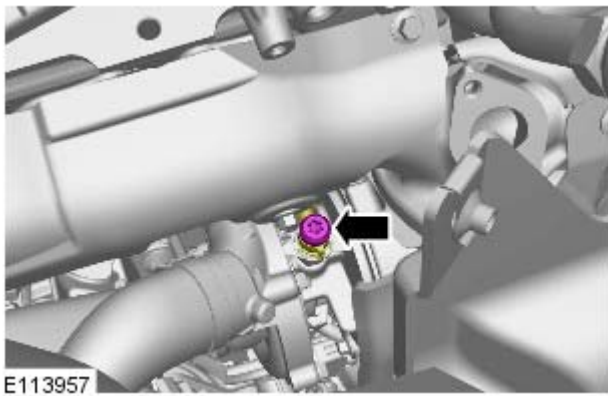



7. **7. NOTE:** Engine shown removed for clarity.

Torque: 9 Nm

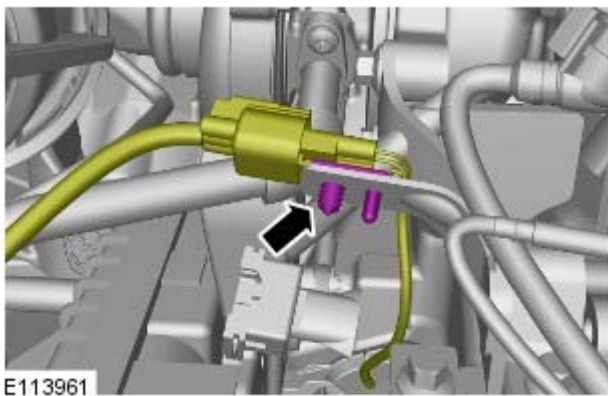


8. Torque: 9 Nm

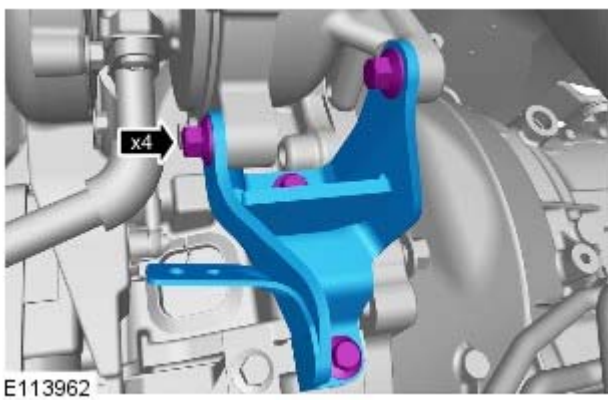


9.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

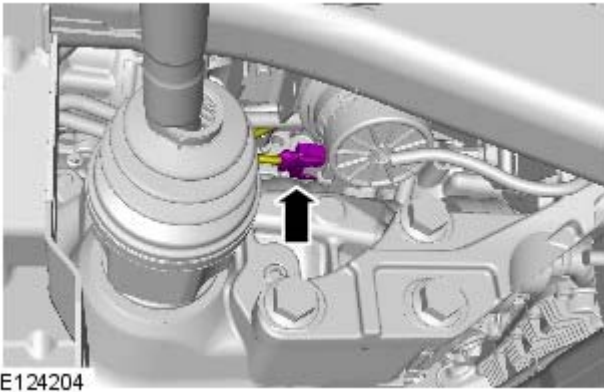
Torque: 30 Nm



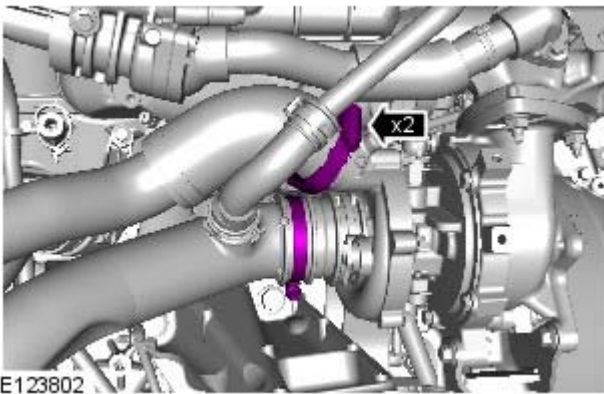
10.



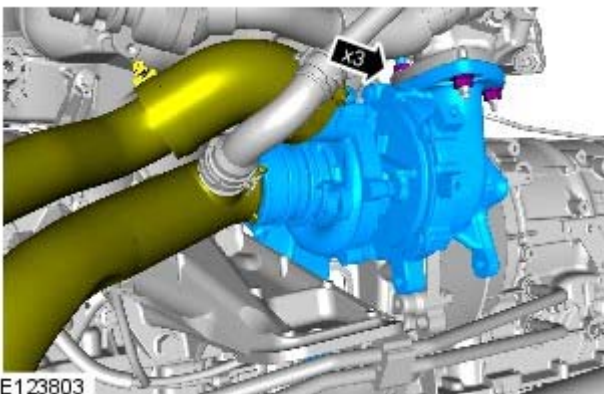
11. Torque: 32 Nm




12.



13. **13.** NOTE: Engine shown removed for clarity.



14. **14.**  WARNING: Make sure that new nuts are installed.

• CAUTIONS:

 Make sure that the area around the component is clean and free of foreign material.

 Discard the nuts.

 Make sure that all openings are sealed. Use new blanking caps.

 Install a new turbocharger to exhaust manifold gasket every time the turbocharger is removed.

• NOTE: Remove and discard the gasket.

• NOTE: Engine shown removed for clarity.

Torque: 24 Nm

Installation

1. To install reverse the removal procedure.

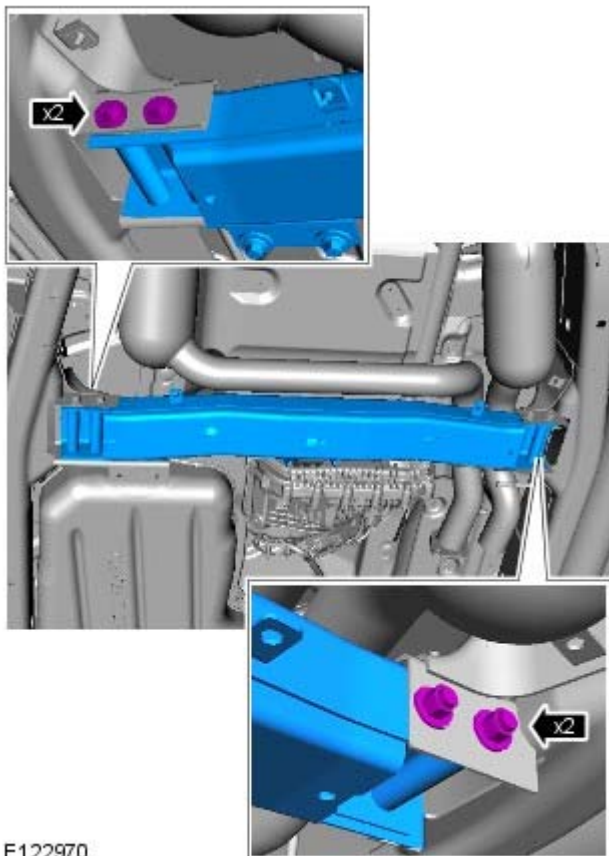
Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger RH

Removal and Installation

Removal

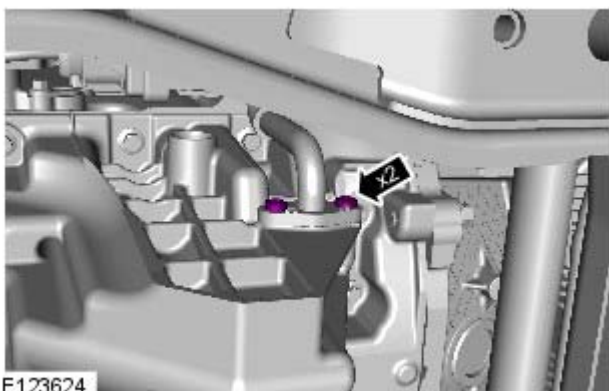
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).



E122970

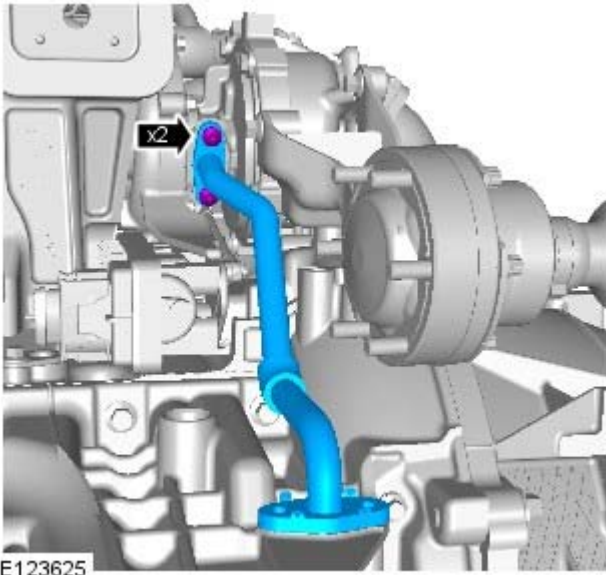
2.  CAUTION: Only tighten the bolts finger tight at this stage.




E123624

3.  CAUTION: LH illustration shown, RH is similar.

Torque: 9 Nm

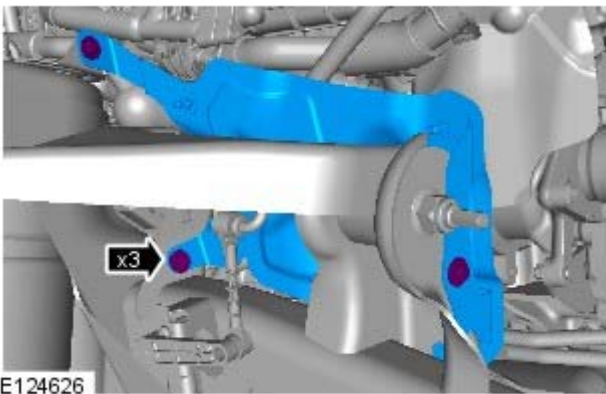


E123625

4.  CAUTION: LH illustration shown, RH is similar.
 - NOTE: Engine shown removed for clarity.
 - NOTE: Install new gaskets.

Torque: 9 Nm

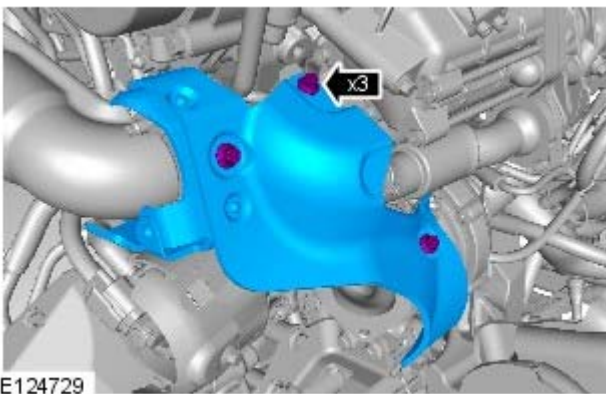
5. Refer to: [Body - TDV6 3.0L Diesel/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).



E124626

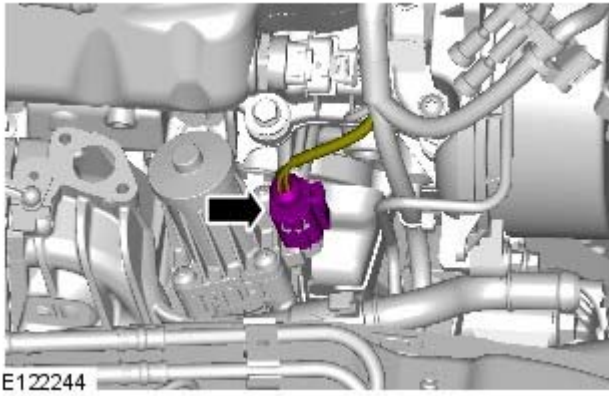
6.  CAUTION: LH illustration shown, RH is similar.
 - NOTE: The heatshield consists of 3 parts.

Torque: 9 Nm

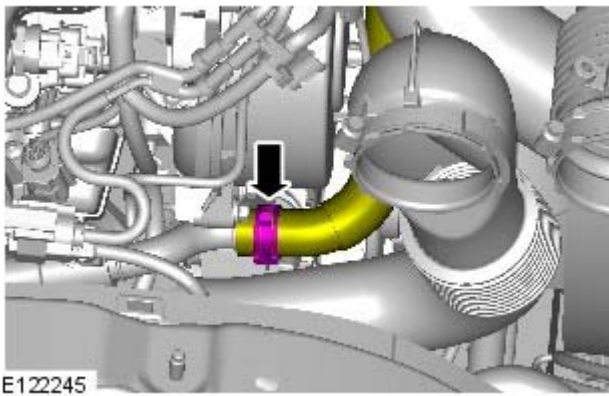


E124729

7. *Torque: 9 Nm*



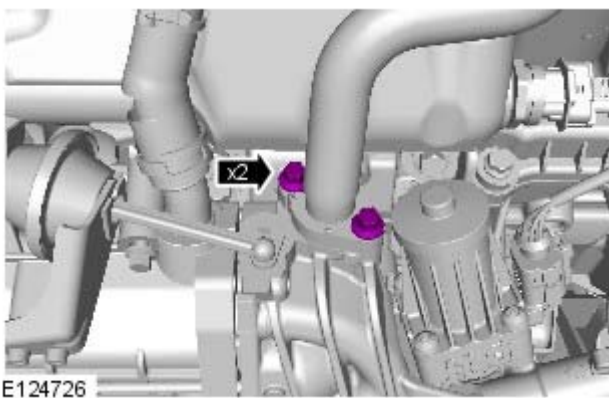
8.



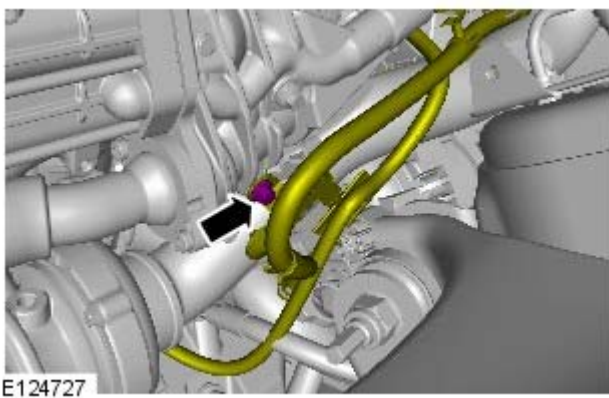
9. **9. CAUTIONS:**

 Be prepared to collect escaping coolant.

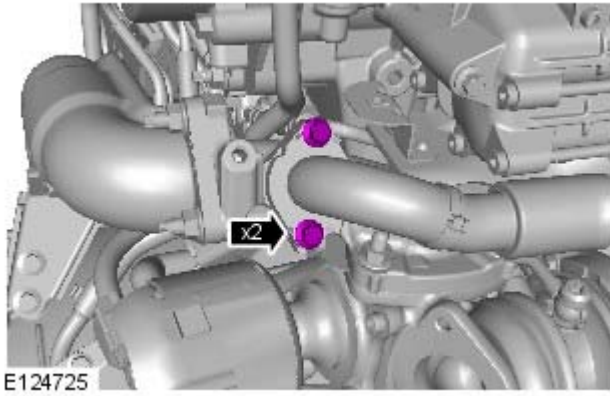
 Make sure that all openings are sealed. Use new blanking caps.



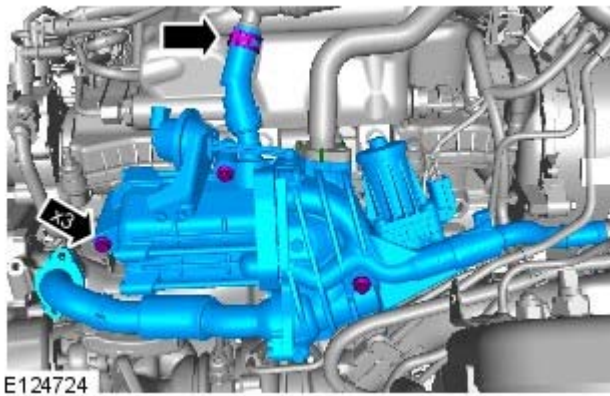
10. *Torque:* 10 Nm



11. *Torque:* 10 Nm



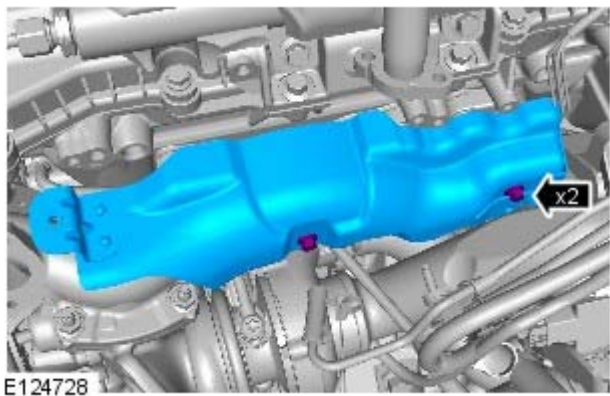
12. Torque: 10 Nm



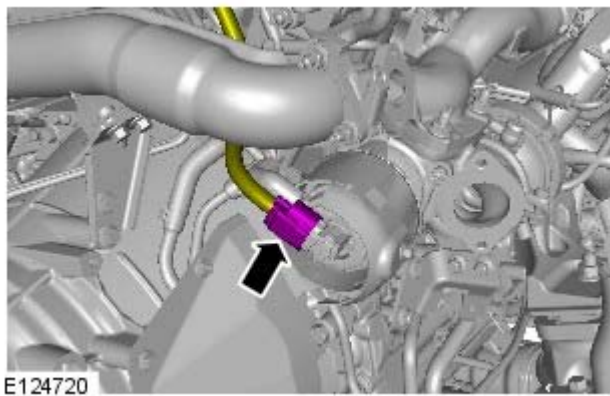
13. **⚠ CAUTION:** Be prepared to collect escaping coolant.

- NOTE: Install new gaskets.

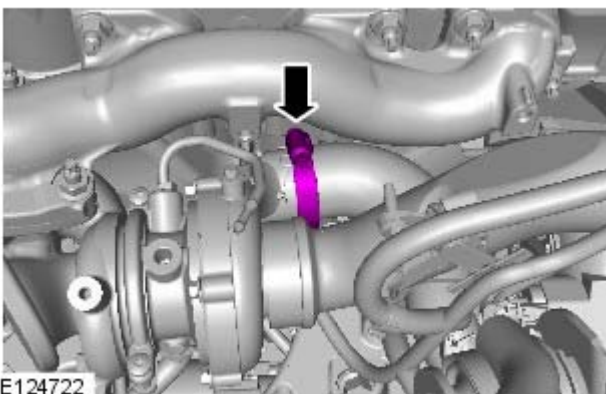
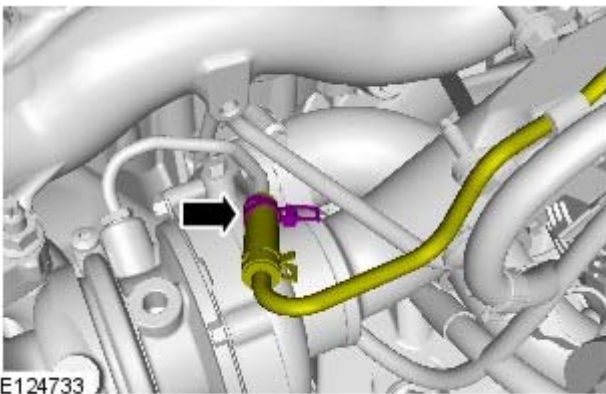
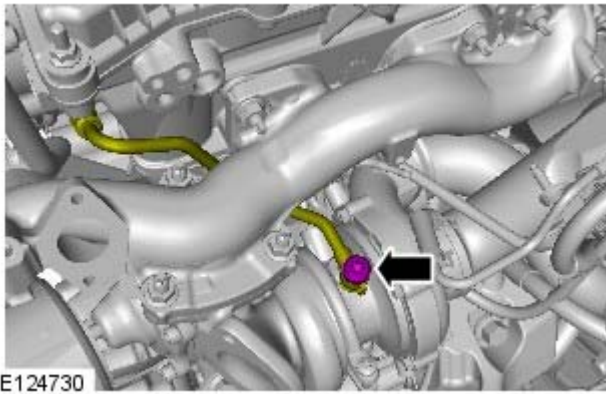
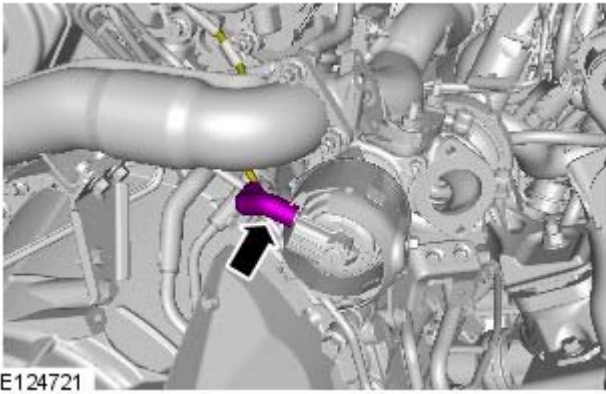
Torque: 10 Nm



14. Torque: 11 Nm








15.




16.

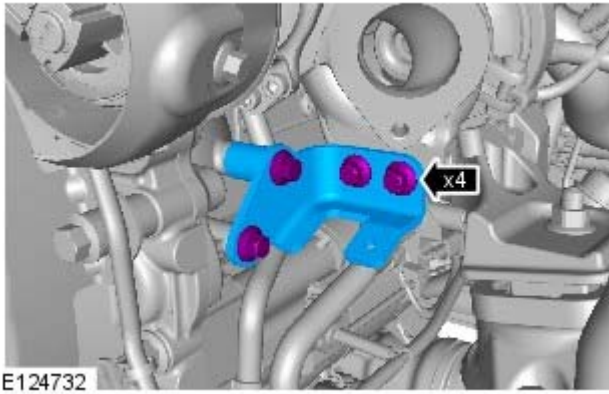
17. **17. CAUTIONS:**

-  Be prepared to collect escaping oil.
-  Make sure that all openings are sealed. Use new blanking caps.
-  Make sure that the area around the component is clean and free of foreign material.
-  Make sure that new sealing washers are installed.
-  Make sure that a new bolt is installed.

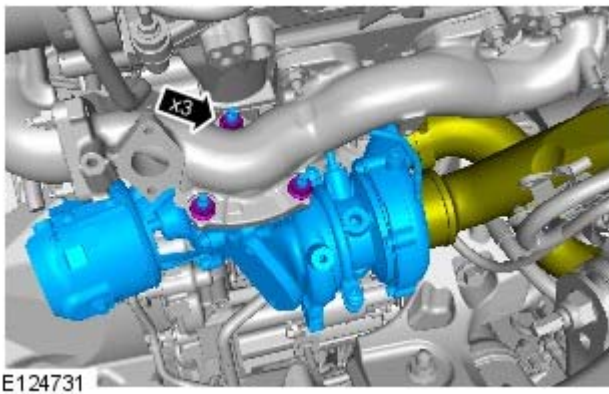
Torque: 30 Nm

18.  **18. CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

19.



20. Torque: 32 Nm



21. **⚠** WARNING: Make sure that new nuts are installed.

• CAUTIONS:

⚠ Discard the nuts.

⚠ Make sure that all openings are sealed. Use new blanking caps.

⚠ Make sure that the area around the component is clean and free of foreign material.

⚠ Install a new turbocharger to exhaust manifold gasket every time the turbocharger is removed.

• NOTE: Remove and discard the gasket.

Torque: 24 Nm

Installation

1. To install, reverse the removal procedure.
2. If a new unit is installed, configure the fixed vane turbocharger actuator using the approved diagnostic tool.

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Fixed Vane Turbocharger Actuator

Removal and Installation

Removal

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

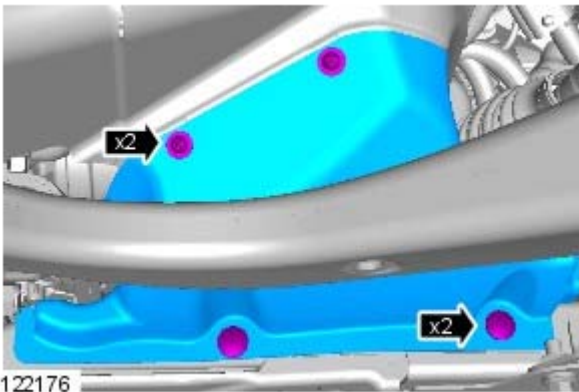
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

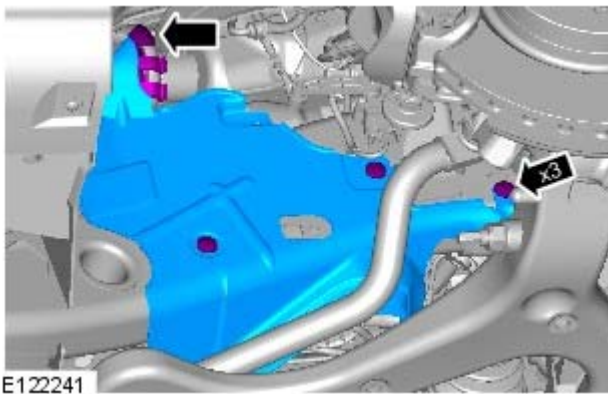
2. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

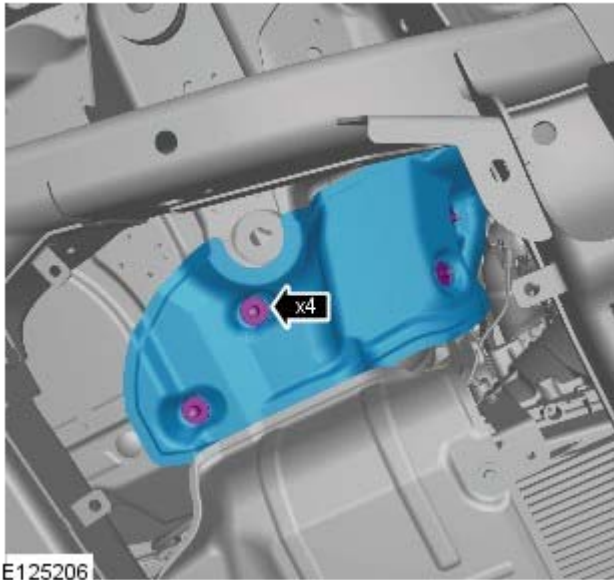
3. Remove the RH front wheel and tire.

4.



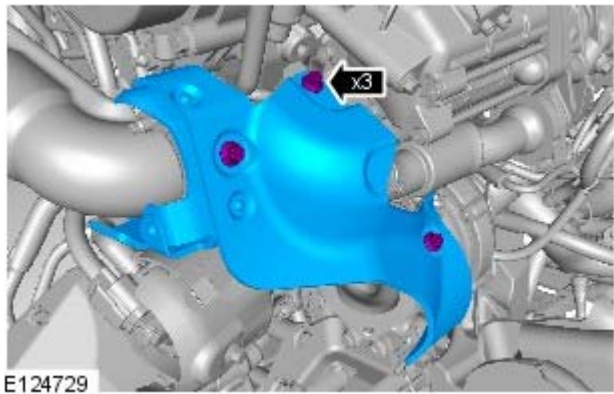
5.





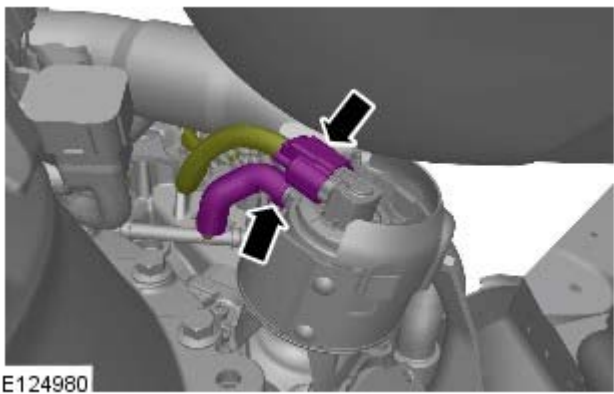
E125206

6.



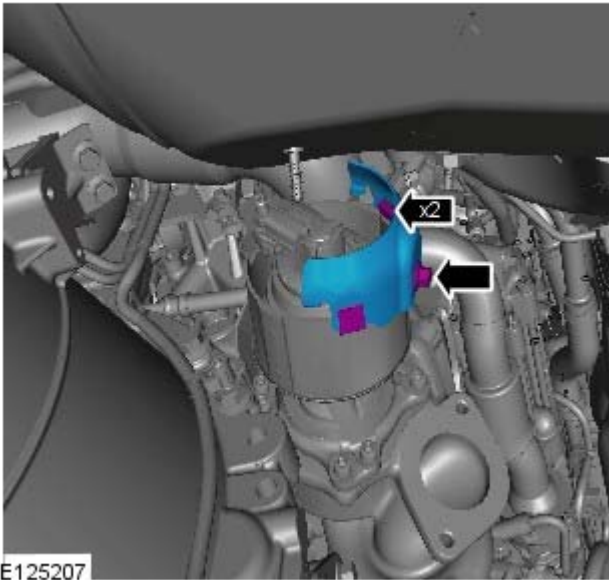
E124729

7. 7. NOTE: Engine shown removed for clarity.



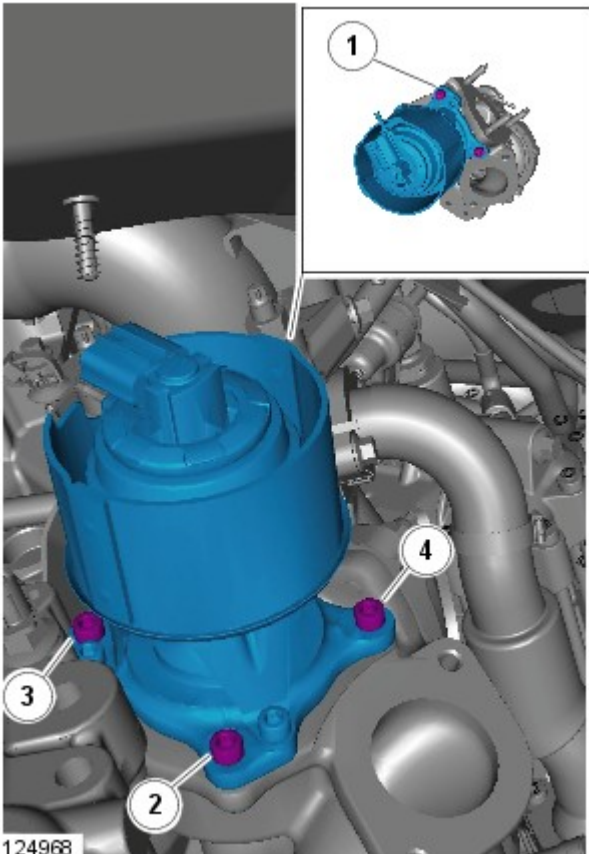
E124980

8.



E125207

9.



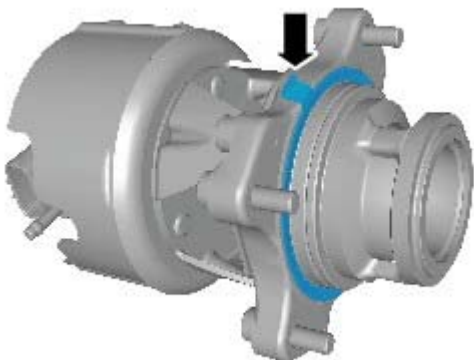
E124968

10. **10. CAUTIONS:**

 Remove the Torx screws evenly and progressively.

 Make sure component mating faces are not damaged during removal.

Using a suitable 130mm T30 Torx socket, remove the retaining bolts.



E124969

11. **11. NOTE:** Make a note of the orientation of the gasket tang.

• NOTE: Remove and discard the gasket using the gasket tang.



E124972

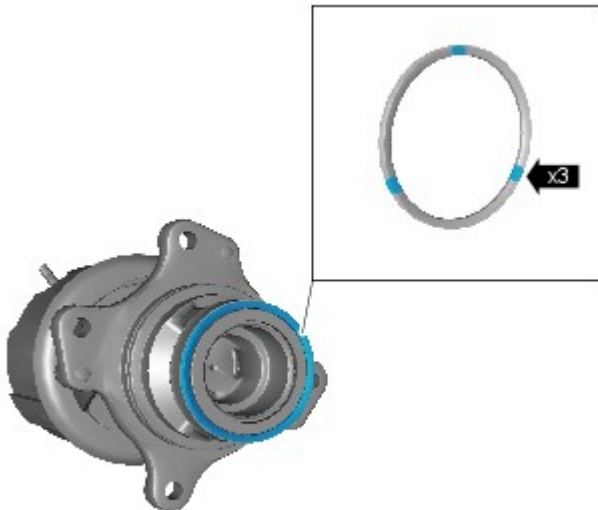
12. **NOTE:** Remove and discard the gasket.
 - **NOTE:** Turbocharger shown removed for clarity.

Installation



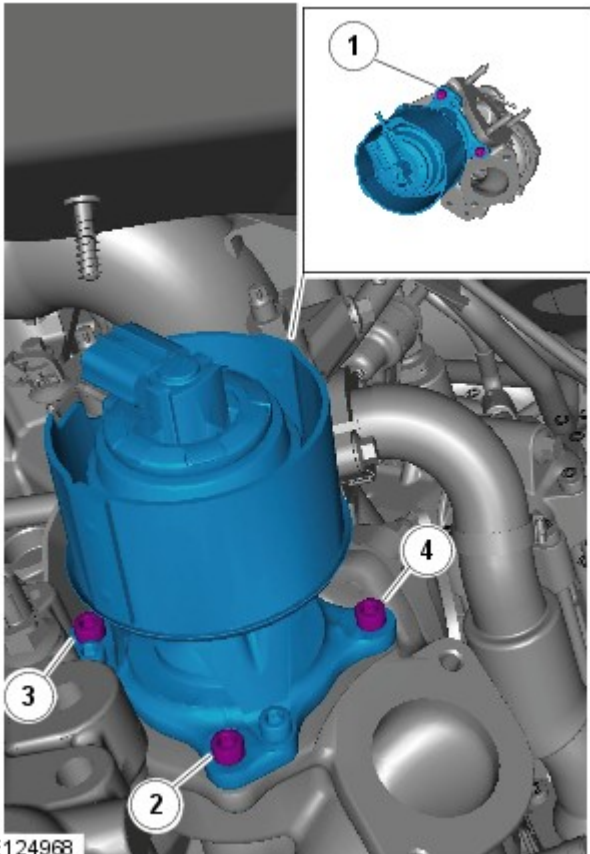
E124969

1. **CAUTION:** Make sure that the mating faces are clean and free of corrosion and foreign material.
 - **NOTE:** Install a new gasket.
 - **NOTE:** Make sure that the gasket tang is installed in the correct orientation as noted in the removal step.



E124970

2. **CAUTION:** Make sure that the mating faces are clean and free of corrosion and foreign material.
 - **NOTE:** Install a new gasket.
 - **NOTE:** Apply a small amount of grease in the areas indicated to allow the gasket to remain in the position for installation.

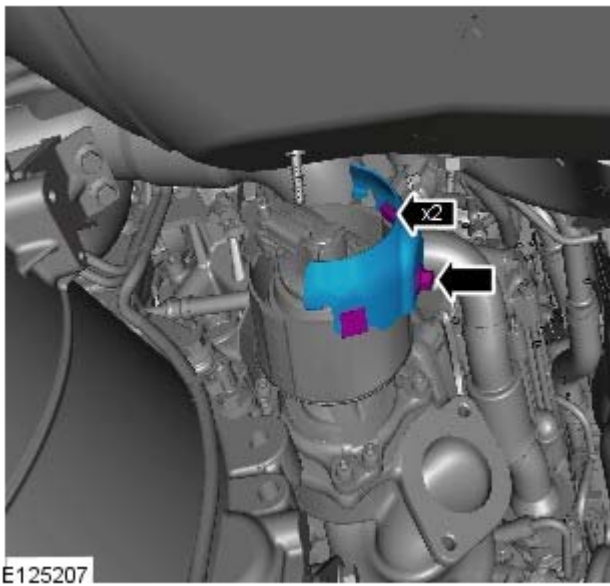


3. **3. CAUTIONS:**

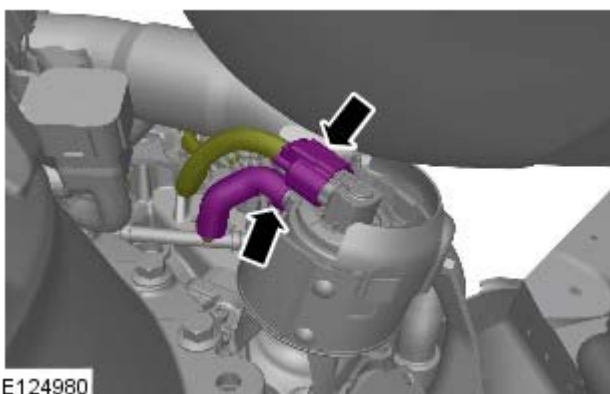
 Install all the bolts finger tight before final tightening.

 Tighten the Torx screws evenly and progressively.

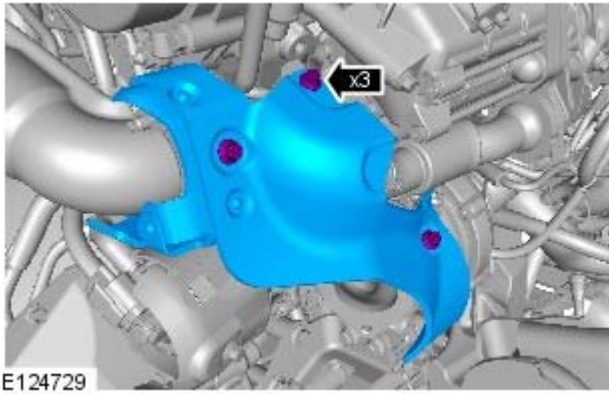
Using a suitable 130mm T30 Torx socket, Install the retaining bolts.



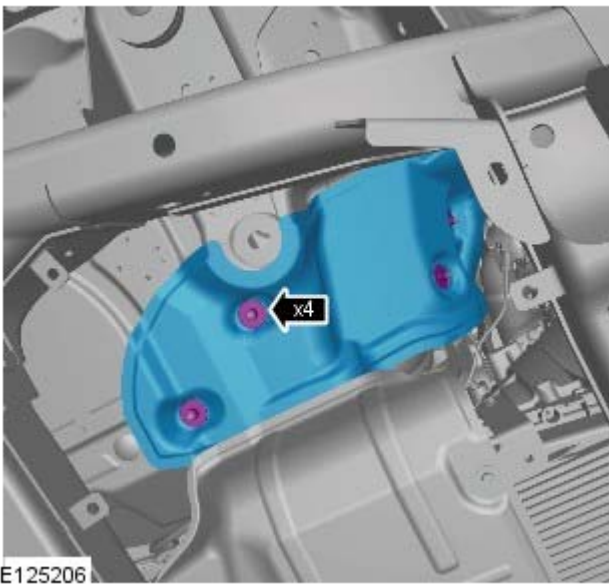
4. *Torque: 9 Nm*



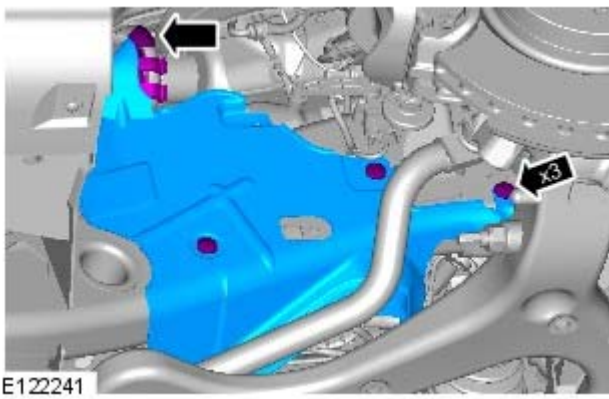
5.



6. Torque: 9 Nm

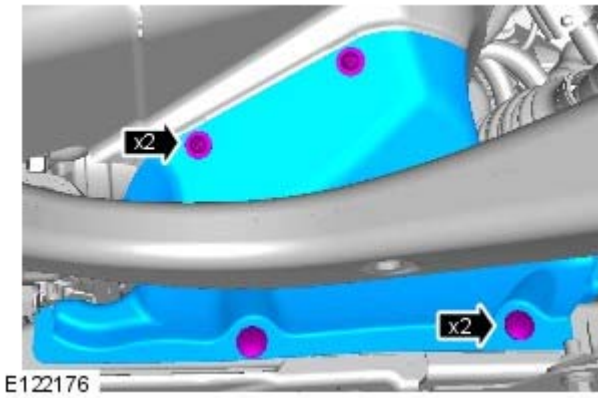


7. Torque: 10 Nm



8.

9.



10. Install the RH front wheel and tire.
11. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
12. If a new fixed vane turbocharger actuator is installed, carry out the reset procedure for the fixed vane turbocharger actuator using approved diagnostic tool.

Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel - Turbocharger Bypass Valve

Removal and Installation

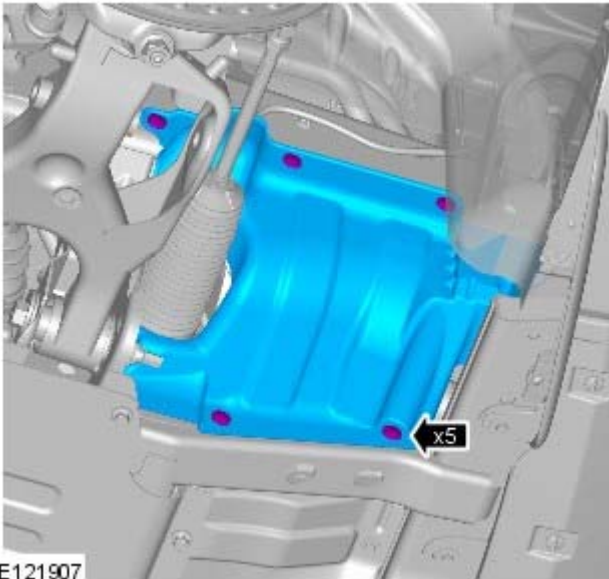
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

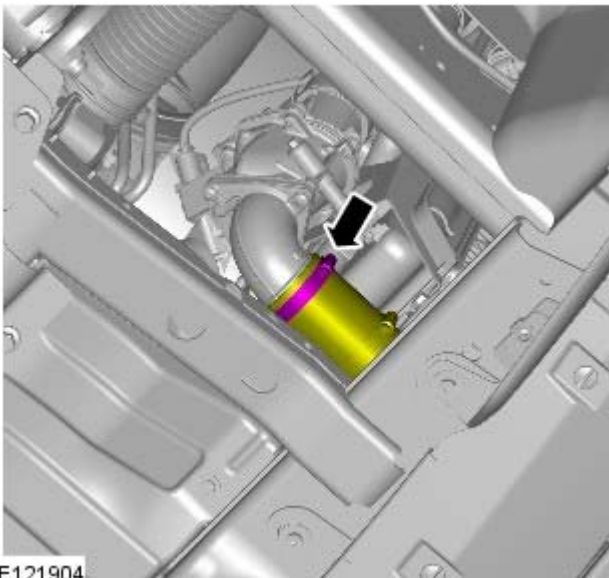
Raise and support the vehicle.

2.

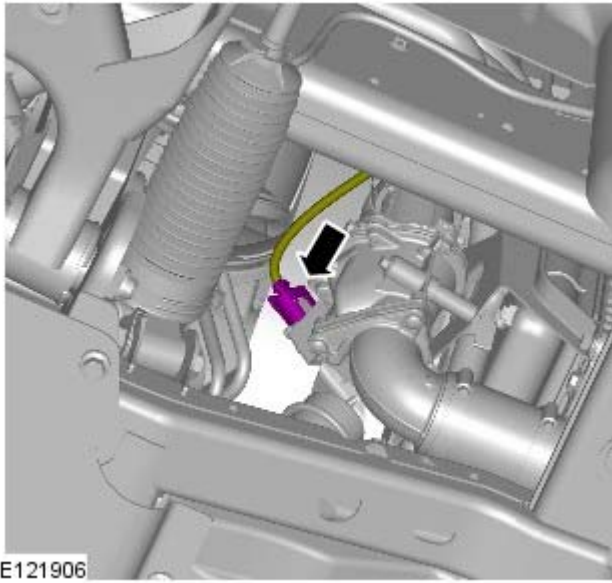


E121907

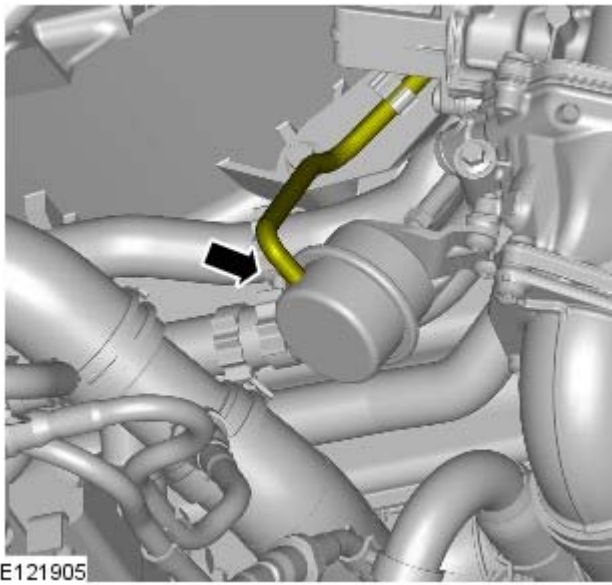
3. Torque: 5 Nm



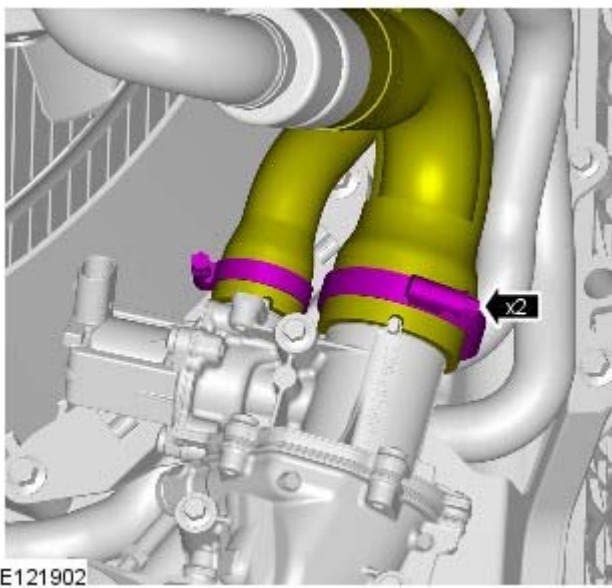
E121904



4.

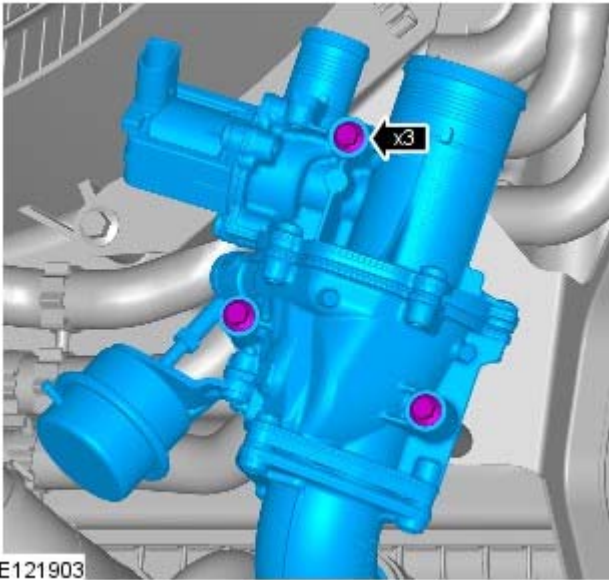


5.



6. Torque: 5 Nm

7. Torque: 10 Nm



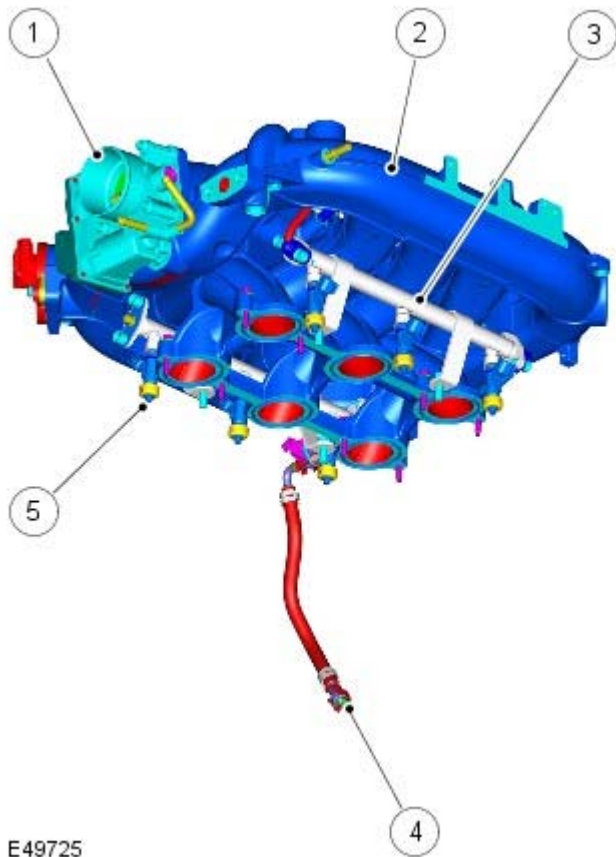
Installation

1. To install, reverse the removal procedure.

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Charging and Controls

Description and Operation

Component Locations



E49725

Item	Part Number	Description
1	-	Throttle body
2	-	Intake manifold
3	-	Fuel rail
4	-	Fuel jump hose
5	-	Fuel injectors (6 of)

GENERAL

The major components of the fuel charging and control system comprise an intake manifold, a fuel pump, a fuel rail and six injectors. The fuel pump supplies fuel from the tank at a constant pressure, via a pipe routed along the underside of the vehicle, to the fuel rail. The fuel rail distributes the fuel equally to each of the six injectors.

INTAKE MANIFOLD

The intake manifold is located on top of the engine. The manifold is manufactured from a composite material with metal insert fixings. The manifold comprises a central chamber with six tracts leading to the inlet ports on the engine. For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

FUEL PUMP

The submersible electric pump fuel pump and the fuel pressure regulator are located in the fuel tank. A pump module flange on top of the fuel tank allows access to the fuel pump for removal and installation.

The fuel pump, when running, outputs fuel at a constant pressure to the fuel rail. The pressure regulator controls the pressure. Excess fuel from the pressure regulator is directed to the front jet pump. The controlled pressure provides more fuel to the fuel rail than the maximum requirement of the engine; therefore a constant pressure is maintained in the rail under all operating conditions.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01C Fuel Tank and Lines - V6 4.0L Petrol, Description and Operation).

The fuel pump is controlled by the ECM via a fuel pump relay, which is located in the Battery Junction Box (BJB).

When the ignition is switched to position II, the ECM provides an earth path for the coil of the fuel pump relay on pin 95 of ECM connector C0634. The relay is energised for a short period to pressurise the fuel system. When the ECM senses that the engine is being cranked by receipt of a valid signal from the Crankshaft Position (CKP) sensor, the ECM energises the fuel pump relay for as long as the engine is running.

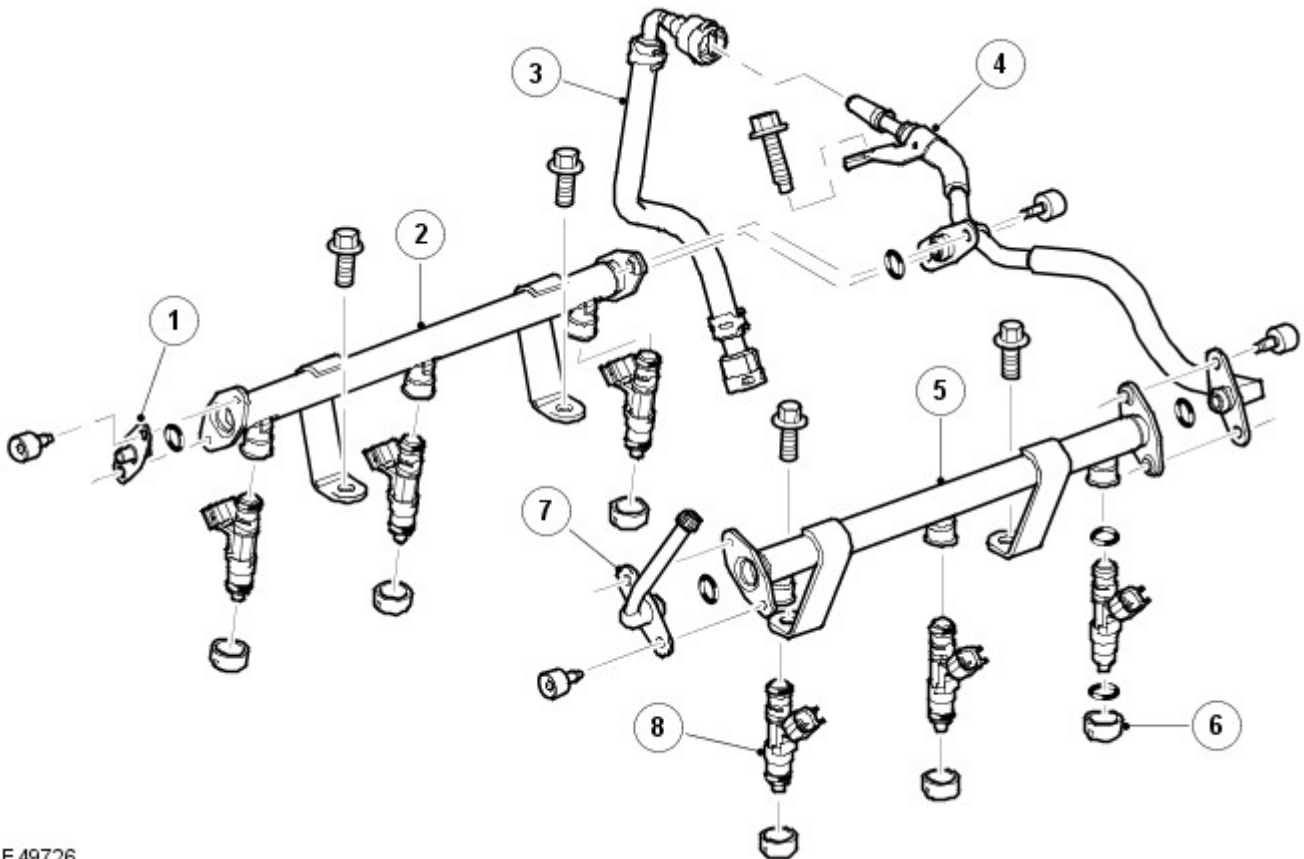
For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol,

Description and Operation).

THROTTLE BODY

The throttle body is located centrally at the front of the intake manifold. The engine torque is controlled by the electronic throttle body. An electronic pedal assembly determines throttle opening. The signal from the pedal assembly is sent to the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body. Sensors in the throttle body are used to determine the position of the throttle plate and the rate of change in its angle. For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

FUEL RAIL



E 49726

Item	Part Number	Description
1	-	End cover
2	-	RH fuel rail
3	-	Fuel jump hose
4	-	Fuel supply pipe
5	-	LH fuel rail
6	-	Injector seat inserts
7	-	Schraeder valve
8	-	Injectors (6 of)

Each fuel rail maintains a constant fuel pressure of 4.5bar (65 psi) and is attached to each cylinder head with two bolts. Three fuel injectors are installed in each cylinder head and connected to the fuel rail. 'O' ring seals are used to seal the injectors in both the fuel rails and cylinder heads. A quick release coupling connects the feed pipe from the fuel tank to the fuel rail via the fuel jump hose.

A flange with two threaded holes on the rear of the LH and RH fuel rails provide attachment for the fuel supply pipe. The fuel supply pipe has two metal-flanged ends, which locate on the fuel rail. A seal prevents leakage and each flange is secured with two bolts.

A Schraeder valve is installed in the front end of the LH fuel rail to provide a pressure test connection for maintenance.

INJECTORS

Six injectors are held between the fuel rails and each cylinder head. The injectors are sealed to the fuel rail and cylinder head by 'O' ring seals, which should be renewed whenever an injector is refitted to an engine. A small amount of engine oil can be applied to the 'O' rings to aid installation. No other form of lubrication should be used. Each injector sits on an insert that also needs to be renewed each time an injector is replaced.

Each injector contains a solenoid-operated needle valve, which is closed while the solenoid winding is de-energised. The solenoid winding is connected to a power feed from the main relay and to an earth through the ECM. The ECM switches the earth to control the opening and closing of the needle valve. While the needle valve is open, fuel is sprayed into the cylinder inlet tract onto the back of the inlet valves. The ECM meters the amount of fuel injected by adjusting the time that the needle valve is open.

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Fuel Charging and Controls](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel leaks ● Damaged fuel lines ● Damaged push connect fittings ● Fuel level ● Fuel contamination/grade/quality ● Throttle body ● Damaged fuel tank filler pipe cap ● Damaged fuel tank filler pipe 	<ul style="list-style-type: none"> ● Fuses ● Inertia switch ● Loose or corroded electrical connectors ● Harnesses ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Ignition system ● Fuel system ● Crankshaft Position (CKP) sensor ● Harness ● Engine Control Module fault 	Check the fuel level and condition. For ignition system tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For CKP and harness tests, refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if a module is suspect.
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel system ● Spark plugs ● Ignition coil failure(s) 	For purge valve tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For ignition system tests, refer to the relevant section of the workshop manual.
Difficult to start cold	<ul style="list-style-type: none"> ● Check coolant anti-freeze content ● Battery ● Crankshaft position (CKP) sensor ● Fuel system ● Evaporative emissions purge valve 	For battery information, refer to the relevant section of the workshop manual. For CKP sensor tests, refer to the relevant section of the workshop manual. Check for injector DTCs. For purge valve tests, refer to the relevant section of the workshop manual.
Difficult to start hot	<ul style="list-style-type: none"> ● Injector leak ● Fuel system ● Fuel temperature sensor ● Intake air temperature (IAT) sensor ● Mass air flow (MAF) sensor ● Evaporative emissions purge valve ● Ignition system 	Check for injector DTCs. For fuel temperature sensor, intake air temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For purge valve and ignition system tests, refer to the relevant section of the workshop manual.

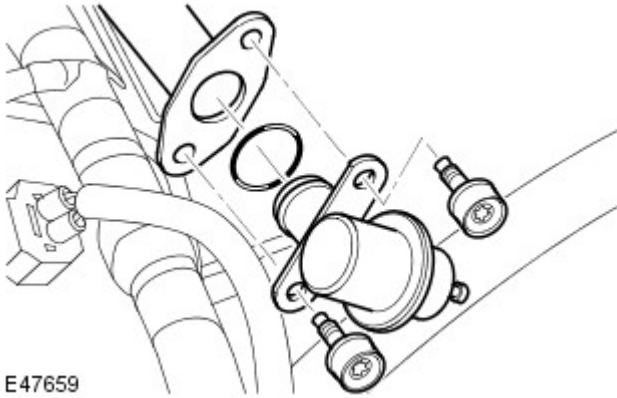
Symptom	Possible Causes	Action
Difficult to start after hot soak (vehicle standing after engine has reached operating temperature)	<ul style="list-style-type: none"> ● Injector leak ● Fuel system ● Fuel temperature sensor ● Intake air temperature sensor ● Mass Air Flow sensor ● Evaporative emissions purge valve ● Ignition system 	Check for injector DTCs. For fuel temperature sensor, intake air temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For purge valve and ignition system tests, refer to the relevant section of the workshop manual.
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Engine control module relay ● Mass Air Flow sensor ● Fuel rail pressure (FRP) sensor ● Ignition system ● Air filter restricted ● Air leakage ● Fuel lines 	Check the engine breather system. Check the engine control module relay operation. For Mass Air Flow sensor and fuel rail pressure sensor and ignition system tests, refer to the relevant section of the workshop manual. For air intake and fuel line information, refer to the relevant section of the workshop manual.
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Injector leak ● Fuel pressure ● Air leakage ● Throttle position (TP) sensors ● Accelerator pedal position (APP) sensor ● Throttle motor ● Ignition system ● HO2 sensors ● Transmission malfunction ● Restricted pedal travel (carpet, etc) 	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. Check for injector DTCs. For intake system checks, throttle position sensor and accelerator pedal position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system. For ignition system tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For transmission information, refer to the relevant section of the workshop manual. Check the accelerator pedal travel.
Engine backfires	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Air leakage ● Mass Air Flow sensor ● Accelerator pedal position sensor ● HO2 sensors ● Ignition system 	For fuel pump and fuel line and intake system information, refer to the relevant section of the workshop manual. For Mass Air Flow sensor and accelerator pedal position sensor tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For ignition system tests, refer to the relevant section of the workshop manual.
Engine surges	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Mass Air Flow sensor ● Harness ● Throttle position sensors ● Throttle motor ● Ignition system 	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. For Mass Air Flow sensor and throttle position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system. For ignition system tests, refer to the relevant section of the workshop manual.
Engine detonates/knocks	<ul style="list-style-type: none"> ● Fuel pump ● Fuel lines ● Fuel quality ● Knock sensor (KS)/circuit malfunction ● Fuel rail pressure sensor ● Mass Air Flow sensor ● HO2 sensors ● Air leakage ● BARO sensor malfunction (internal engine control module fault) 	For fuel pump and fuel line information, refer to the relevant section of the workshop manual. For fuel rail pressure sensor, Mass Air Flow sensor and knock sensor tests, refer to the relevant section of the workshop manual. Check for DTCs relating to HO2 sensors, refer to the DTC index. For intake system, refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if a module is suspect.
No throttle response	<ul style="list-style-type: none"> ● Accelerator pedal position sensor malfunction ● Throttle position sensors ● Throttle motor 	For accelerator pedal position sensor and throttle position sensor tests, refer to the relevant section of the workshop manual. For throttle motor tests refer to the guided diagnostic routine on the approved diagnostic system.
Poor throttle response	<ul style="list-style-type: none"> ● Accelerator pedal position sensor malfunction ● Throttle position sensors 	For accelerator pedal position sensor, throttle position sensor, engine coolant temperature sensor and Mass Air Flow sensor tests, refer to the relevant section of the workshop manual. For intake system checks refer to the relevant section of the workshop manual. For breather system checks, refer to the relevant section of the workshop manual.
DTC Index For a list of Diagnostic Trouble Codes (DTCs) that could be triggered on this format, please refer to the relevant section of the workshop manual. For Intake system checks refer to the relevant section of the workshop manual.	<ul style="list-style-type: none"> ● Mass Air Flow sensor ● Transmission malfunction ● Traction control event ● Air leakage ● Breather system disconnected/restricted 	For a list of Diagnostic Trouble Codes (DTCs) that could be triggered on this format, please refer to the relevant section of the workshop manual. For Intake system checks refer to the relevant section of the workshop manual.

Fuel Charging and Controls - V6 4.0L Petrol - Fuel Pressure Regulator

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: Intake Manifold Assembly (303-04, Removal and Installation).
3. Remove the fuel pressure regulator.
 - Remove the 2 Torx bolts.
 - Remove and discard the O-ring seal.




E47659

Installation

1. Install the fuel pressure regulator.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 6 Nm (4 lb.ft).
2. Install the intake manifold.
For additional information, refer to: Intake Manifold Assembly (303-04, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Fuel Charging and Controls - V6 4.0L Petrol - Fuel Rail

Removal and Installation

Special Tool(s)	
	Fuel spring lock decoupling tool
	310-044


Removal

• WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

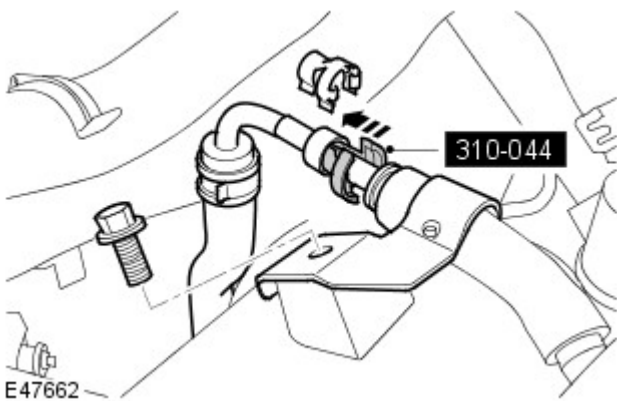
 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Release the fuel supply line.
 - Remove the bolt.

4.  **WARNING:** The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

Using the special tool, disconnect the fuel line.

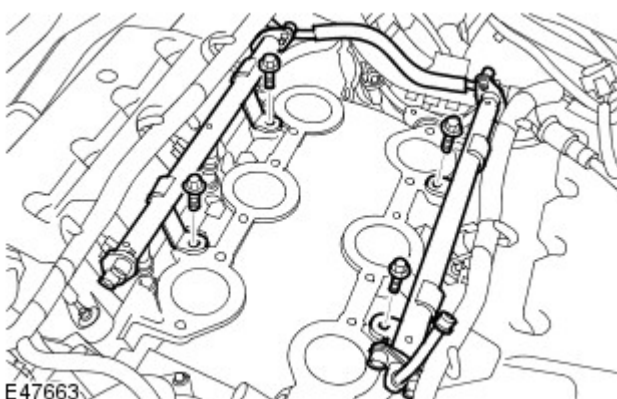
- Position an absorbent cloth to collect fluid spillage.
- Depress the quick release connector.

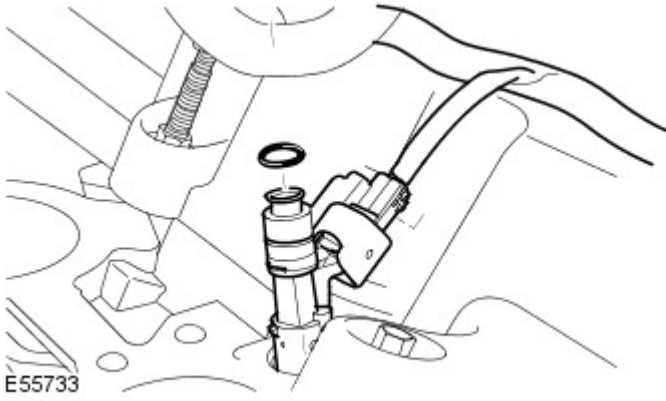


5.  **WARNING:** The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

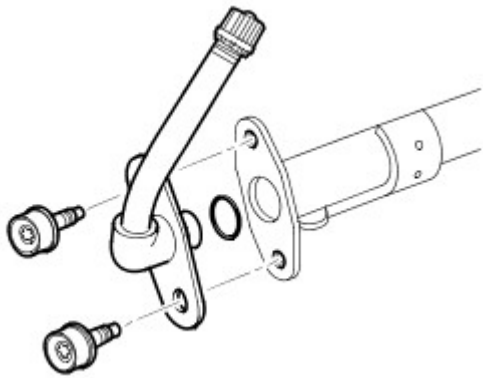
Remove the fuel rail.

- Remove the 4 bolts.
- Position an absorbent cloth to collect fluid spillage.





6. Release and remove the fuel injectors.
 - Remove and discard the fuel injector O-ring seals.



7. Remove the schraeder valve.
 - Remove the 2 Torx bolts.
 - Discard the O-ring seal.

E47665

Installation

1. Install the schraeder valve.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 6 Nm (4 lb.ft).
2. Clean the components.
3. Install the fuel rail.
 - Install fuel injector O-ring seals.
 - Lubricate the O-ring seals.
 - Tighten the bolts to 25 Nm (18 lb.ft).
4. Connect the fuel line to the fuel rail.
 - Clean the component mating faces.
 - Install the clip.
 - Tighten the bolt to 6 Nm (4 lb.ft).
5. Install the intake manifold.
 For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
6. Connect the battery ground cable.
 For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

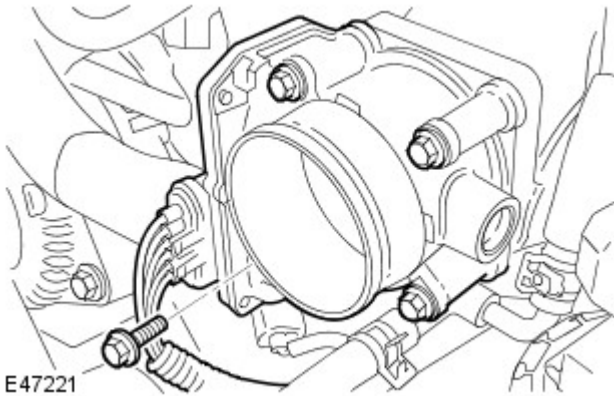
Fuel Charging and Controls - V6 4.0L Petrol - Throttle Body Gasket

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
4. Remove the throttle body.

- Remove the 4 bolts.
- Remove and discard the throttle body gasket.



Installation

1. Install the throttle body.
 - Clean the components.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
2. Install the air intake resonator.
For additional information, refer to: [Intake Air Resonator](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).


Fuel Charging and Controls - V6 4.0L Petrol - Fuel Injector


Removal and Installation


Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

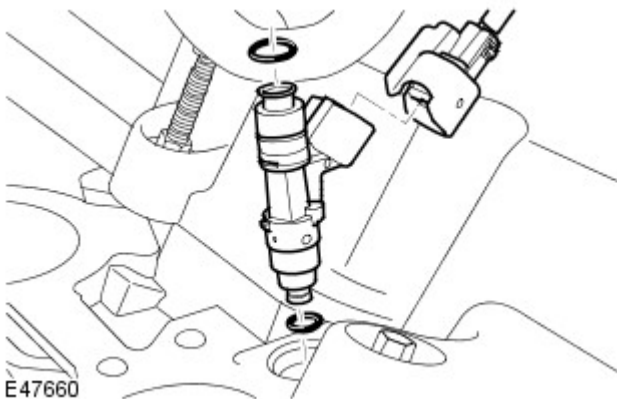
 **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the fuel rail.

For additional information, refer to: [Fuel Rail](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).

3. Remove the fuel injector.

- Release the injector.
- Disconnect the electrical connector.
- Remove and discard the O-ring seal.



Installation

1. Clean the component mating faces.
2. To install, reverse the removal procedure.
 - Lubricate the new O-ring seal with clean engine oil.

Fuel Charging and Controls - V8 5.0L Petrol -

Torque Specifications

- WARNINGS:



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Before any work is carried out on the fuel system, ground the vehicle to earth and maintain the ground connection until the work is complete.



CAUTION: Before disconnecting or removing components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

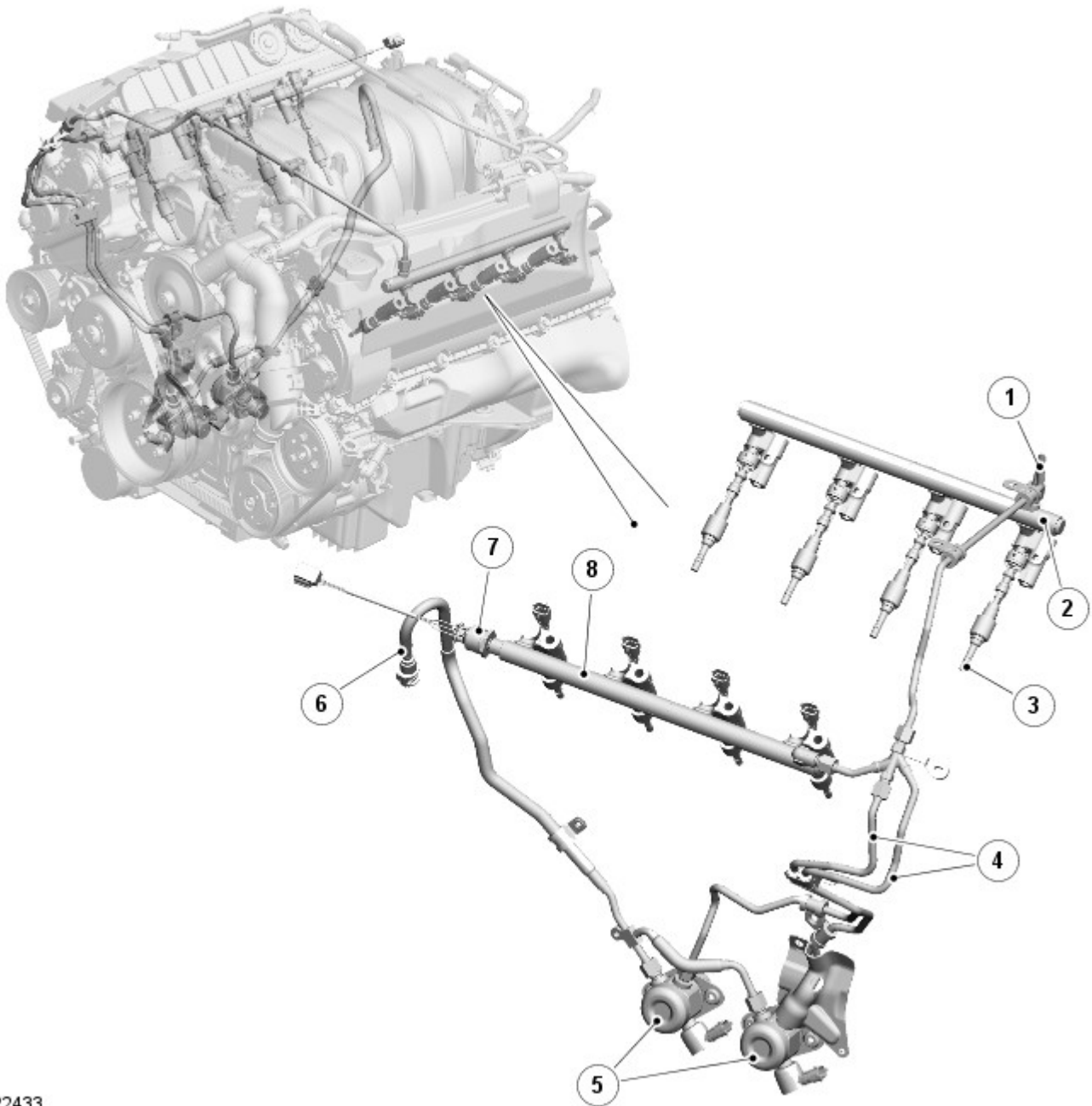
- NOTE: Tighten the fuel rail high pressure fuel pump fuel line unions and fuel rail crossover pipe unions as it is instructed in service manual.

Description	Nm	lb-ft	lb-in
Ignition coil-on-plugs retaining bolts	7	-	62
Spark plugs	20	15	-
Fuel rail retaining bolt	Stage 1 - 20 Stage 2 - 30	Stage 1 - 15 Stage 2 - 22	-
Fuel rail crossover pipe unions	21	15	-
Fuel rail crossover pipe retaining bolts	8	-	71
Fuel pressure regulator	33	24	-
Fuel rail high pressure fuel pump fuel line unions	21	15	-
Fuel rail high pressure fuel pump fuel line M8 bolt	25	18	-
Fuel rail high pressure fuel pump fuel line M6 bolt	11	8	-
Fuel rail high pressure fuel pump fuel line M5 nut	6	-	53
Fuel rail high pressure fuel pump fuel line shield M10 bolt	29	21	-
Fuel rail high pressure fuel pump torx bolts	11	9	-
Throttle body retaining bolts	17	13	-

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Charging and Controls

Description and Operation

COMPONENT LOCATION



E122433

Item	Part Number	Description
1	-	Crossover tube
2	-	LH (left hand) fuel rail
3	-	Fuel injector (8 off)
4	-	HP (high pressure) fuel lines
5	-	HP fuel pumps and covers
6	-	LP (low pressure) fuel lines
7	-	FRP (fuel rail pressure) sensor
8	-	RH (right hand) fuel rail

INTRODUCTION

The fuel charging and controls system is a gasoline DI (direct injection) system controlled by the [ECM \(engine control module\)](#).

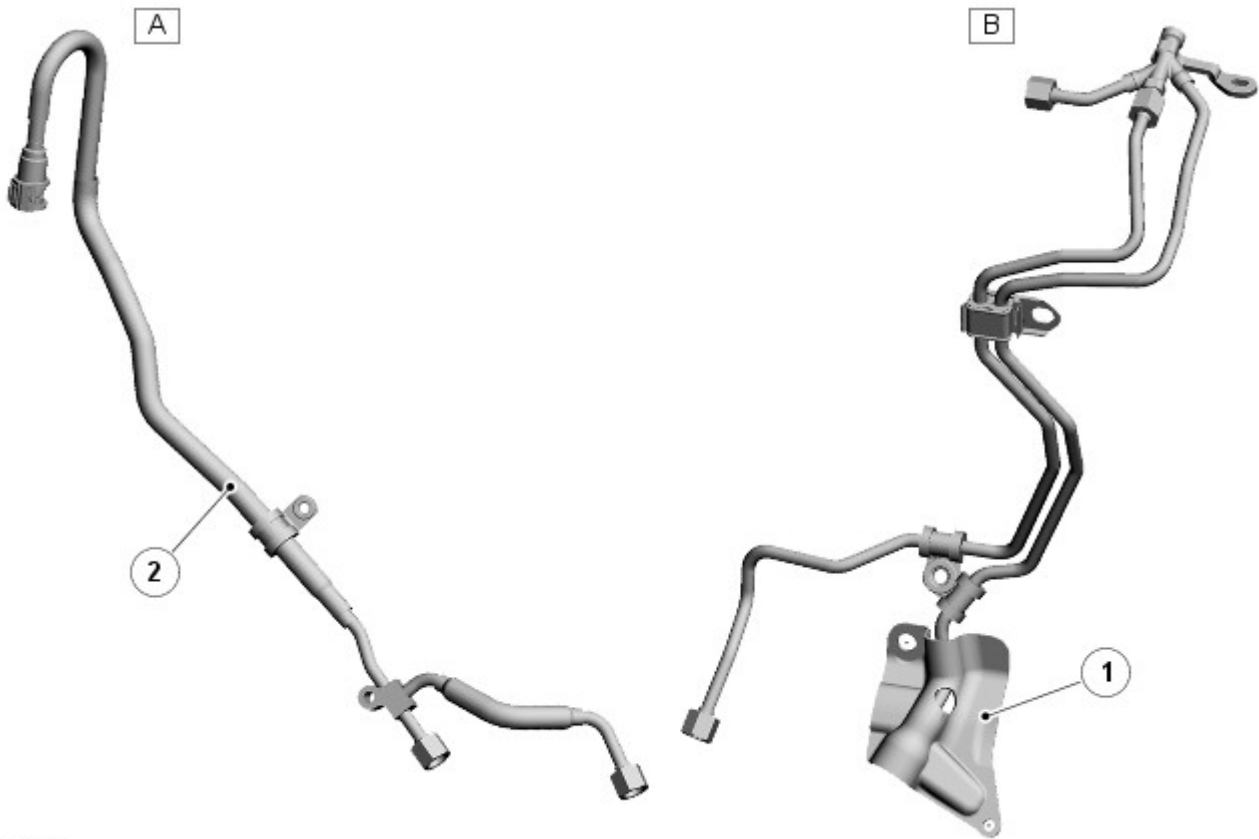
The fuel charging and controls system consists of:

- LP and HP fuel lines.
- Two HP fuel pumps.

- Two fuel rails and a crossover tube.
- A FRP (fuel rail pressure) sensor.
- Eight fuel injectors.

LP fuel from the pump in the fuel tank is pressurized by the HP fuel pumps and supplied to the fuel injectors via the fuel rails and crossover tube. The ECM controls the fuel injectors and HP fuel pumps to inject the required volume of fuel into the combustion chambers.

LOW AND HIGH PRESSURE FUEL LINES



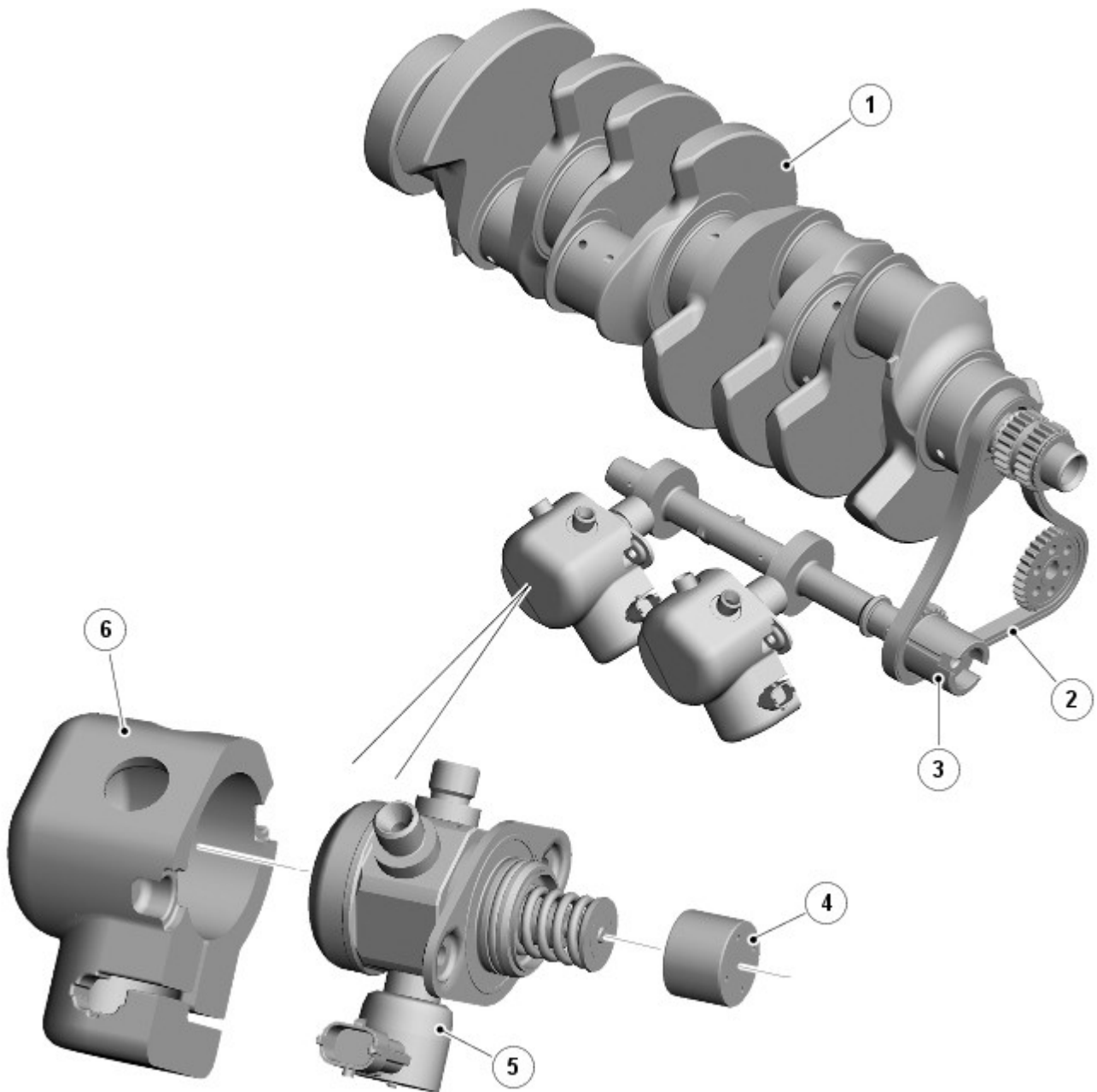
E122675

Item	Part Number	Description
A	-	LP fuel lines
B	-	HP fuel lines
1	-	Acoustic cover
2	-	Heat reflective and insulation sleeves

The LP fuel line connects the HP fuel pumps to the fuel delivery line from the fuel tank and lines system. A quick release connector at the start of the LP fuel line is held in a clip integrated into the LH (left-hand) ignition coils cover. P-clips secure the LP fuel line to the rear of each cylinder head and to the RH (right-hand) side of the cylinder block. A heat reflective and insulation sleeves are installed on the LP fuel line where it runs behind the RH exhaust manifold.

The HP fuel lines connect the HP fuel pumps to the RH fuel rail and the crossover tube. Two P-clips and a pipe clamp attach the HP fuel lines to the cylinder block and the RH cylinder head respectively. An integral bracket on the front HP fuel line is attached to a stud on the front-upper RH timing cover. An acoustic cover is installed on the bottom of the front HP fuel line.

HIGH PRESSURE FUEL PUMPS



E114701

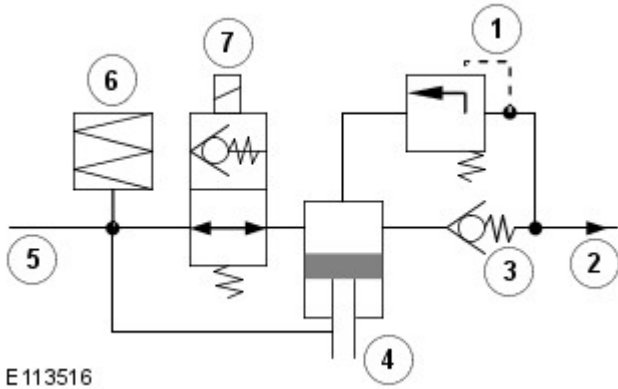
Item	Part Number	Description
1	-	Crankshaft
2	-	Auxiliary drive chain
3	-	Auxiliary camshaft
4	-	Tappet
5	-	HP fuel pump
6	-	Acoustic cover

The two HP fuel pumps are identical mechanically-driven pumps installed on the **RH** side of the sump body, behind the generator. An O-ring seals each of the HP fuel pumps in the sump body. The front HP fuel pump is identified as No. 1 pump; the rear HP fuel pump is identified as No. 2 pump. An acoustic cover is installed on each of the HP fuel pumps.

The HP fuel pumps are single-plunger pumps. The plunger of each pump extends through the sump body and the carrier of the auxiliary camshaft. A tappet on the end each plunger is operated by a two-lobe cam on the auxiliary camshaft. A spring installed on the outside of the plunger ensures the plunger and tappet remain in contact with the cam.

The auxiliary camshaft is driven by the crankshaft, via the auxiliary drive chain, at engine speed. The auxiliary camshaft is timed to match the pump delivery strokes with crankshaft position.

HP Fuel Pump Schematic



E113516

Item	Part Number	Description
1	-	PRV (pressure relief valve)
2	-	To HP fuel lines
3	-	Check valve
4	-	Plunger
5	-	From LP fuel lines
6	-	Damper chamber
7	-	Fuel metering valve

In addition to the plunger, each HP fuel pump contains:

- A damper chamber
- A fuel metering valve
- A check valve
- A PRV.

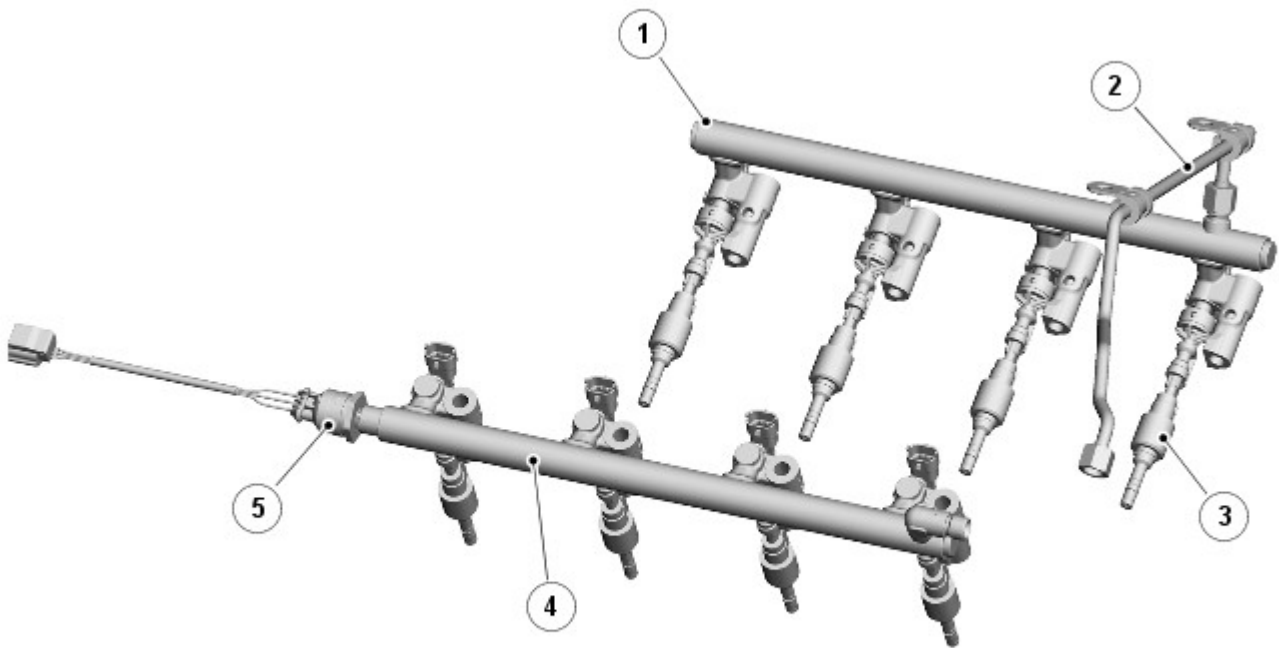
The damper absorbs pressure pulses from the plunger when the fuel metering valve is open at the start of the delivery stroke.

The fuel metering valve regulates the output pressure from the HP fuel pump. The fuel metering valve is a normally open solenoid valve controlled by the [ECM](#). During the inlet stroke of the plunger the fuel metering valve is de-energized, which allows LP fuel into the pumping chamber. The [ECM](#) energizes the fuel metering valve closed during the delivery stroke of the plunger, which forces the fuel in the pumping chamber through the check valve into the HP lines. By changing the closing point of the fuel metering valve, the [ECM](#) can determine the volume of fuel output during the delivery stroke, and thus the pressure in the HP side of the system.

The check valve prevents the return of HP fuel to the pumping chamber during the inlet stroke of the plunger.

The PRV protects the HP side of the system from excessive pressure if there is a failure of the fuel metering valve. If the pump delivery pressure increases to 195 - 204 bar (2828 - 2959 lbf/in²), the PRV opens and returns fuel to the inlet side of the plunger.

FUEL RAILS AND CROSSOVER TUBE



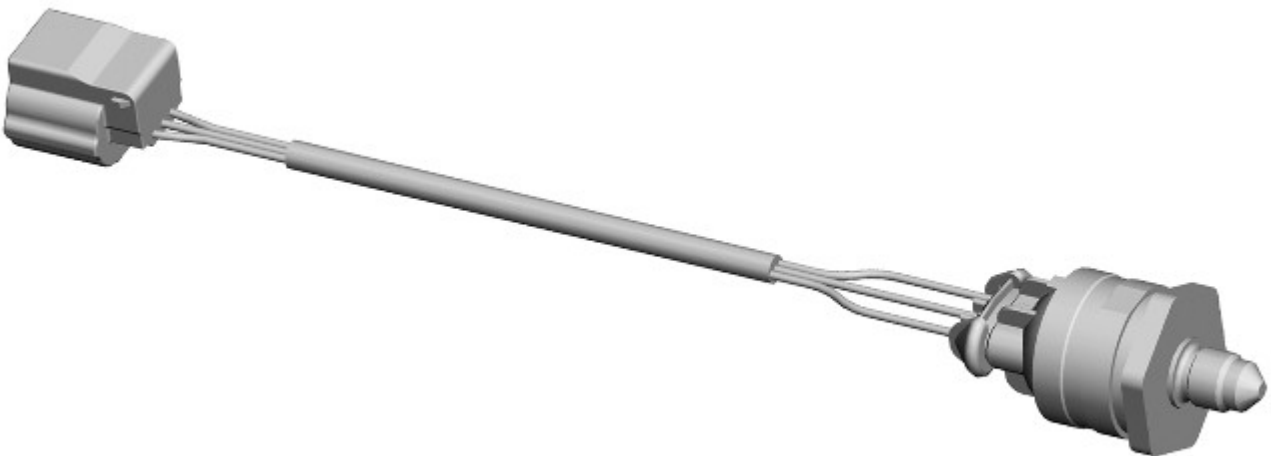
E113522

Item	Part Number	Description
1	-	LH fuel rail
2	-	Crossover tube
3	-	Fuel injector
4	-	RH fuel rail
5	-	FRP sensor

The fuel rails and crossover tube are made from stainless steel. Bolts attach each fuel rail to the related cylinder head. The crossover tube connects the front high pressure line to the [LH](#) fuel rail, which ensures there is equal pressure in the two fuel rails. Two P-clips attach the crossover tube to the intake manifold.

The rear of the [RH](#) fuel rail incorporates a threaded boss for installation of the [FRP](#) sensor.

FUEL RAIL PRESSURE SENSOR

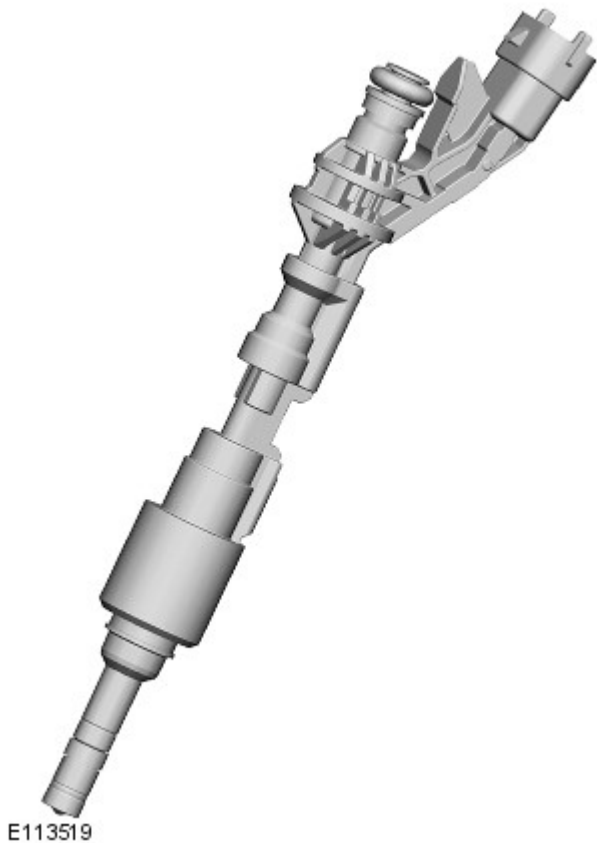


E113518

The [FRP](#) sensor provides the [ECM](#) with a continuous signal of fuel rail pressure. The [FRP](#) sensor is installed in the rear of the [RH](#) fuel rail. The [FRP](#) sensor is screwed into a threaded boss in the fuel rail. A flying lead and three pin connector provides the interface with the engine harness.

The [FRP](#) sensor contains a steel diaphragm fitted with strain gages, which are incorporated into a Wheatstone bridge. The output from the Wheatstone bridge is processed by the [ECM](#) to derive a pressure value.

FUEL INJECTORS



The fuel injectors spray fuel from the fuel rail directly into the combustion chambers. The fuel injectors are installed close to the center of the combustion chambers, between the inlet and exhaust valves and next to the spark plug.

The fuel injectors are a push fit in the fuel rails and the cylinder heads. On each fuel injector, a rubber O-ring seals the head of the fuel injector in the fuel rail. A teflon ring seals the nozzle of the fuel injector in the cylinder head. A clamp locks each fuel injector to the fuel rail.

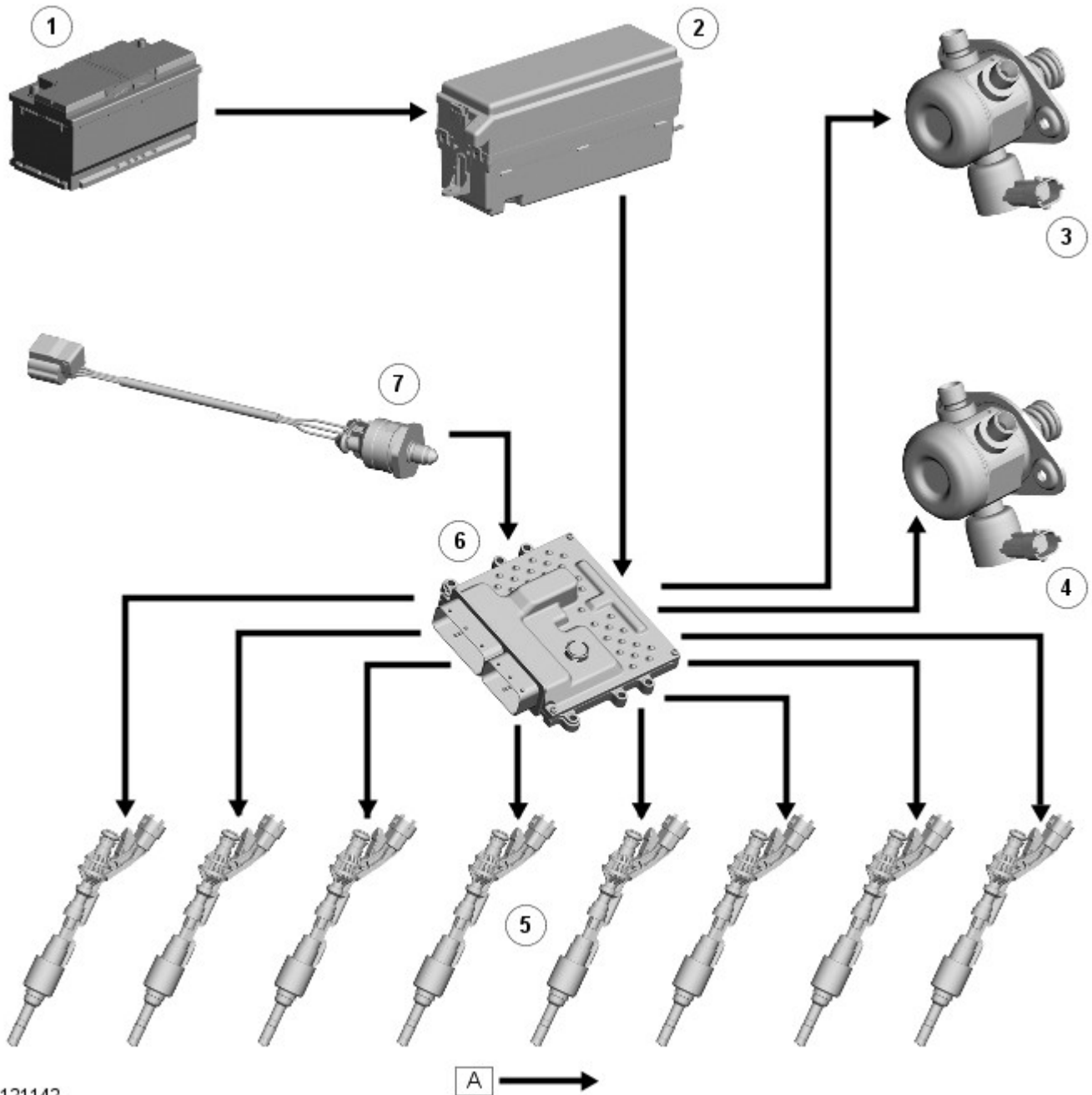
Each fuel injector contains a solenoid-operated needle valve, which opens when the solenoid winding is energized. While the needle valve is open, fuel is sprayed into the combustion chamber. The solenoid winding is connected to a power feed and a ground from the [ECM](#), which operates the fuel injectors with a two stage power supply. Initially the [ECM](#) supplies the fuel injectors with 65 V, then once the boost current reaches 11 A the power supply is switched to battery voltage. The [ECM](#) meters the amount of fuel injected into the combustion chambers by adjusting the time that the solenoid winding is energized.

There are six holes around the tip of the nozzle through which the fuel is sprayed. Two of the holes direct fuel below the spark plug. The other four holes direct fuel evenly around the remainder of the combustion chamber.

If a fuel injector fails, the engine will suffer from unstable idle speed, poor [NVH \(noise, vibration and harshness\)](#) and poor emissions performance.

CONTROL DIAGRAM

- NOTE: A = Hardwired



E121142

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	No. 1 HP fuel pump
4	-	No. 2 HP fuel pump
5	-	Fuel injectors
6	-	ECM
7	-	FRP sensor

PRINCIPLES OF OPERATION

The [ECM](#) controls the output from the HP fuel pumps to deliver the required volume of fuel at pressures up to 150 bar (2175 lbf/in²).

The [ECM](#) also uses the signal from the [FRP](#) sensor to calculate the time the fuel injectors need to be energized to deliver the correct mass of fuel to the combustion chambers.

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Charging and Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Fuel Charging and Controls](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel level ● Fuel leaks ● Damaged fuel lines ● Damaged push connect fittings ● Fuel contamination/grade/quality ● Throttle body ● Damaged fuel tank filler pipe cap ● Damaged fuel tank filler pipe 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors ● Harnesses ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

Symptom	Possible Causes	Action
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● ECM relay ● Electronic engine control ● Ignition system ● Air intake system restricted ● Air leakage ● Fuel lines 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> ● Fuel pressure, fuel pump, fuel lines ● Injector leak ● Air leakage ● Electronic engine control ● Throttle motor ● Restricted accelerator pedal travel (carpet, etc) ● Ignition system ● EGR valve stuck open ● Transmission malfunction 	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls ● Ignition system ● Sticking variable camshaft timing (VCT) hub 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and VCT system related DTCs and refer to the relevant DTC Index
Engine surges	<ul style="list-style-type: none"> ● Fuel pump/lines ● Electronic engine controls ● Throttle motor ● Ignition system 	Check for fuel system failures. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls ● Sticking VCT hub 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	<ul style="list-style-type: none"> ● Electronic engine controls ● Throttle motor 	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Electronic engine control ● Transmission malfunction ● Traction control event ● Air leakage 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - V8 5.0L Petrol, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Injection Component Cleaning

General Procedures

General Equipment

Pneumatic vacuum gun

Cleaning

• WARNINGS:



Do not carry out any repairs to the fuel system with the engine running. Failure to follow this instruction may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

• CAUTIONS:



Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.



Make sure that all parts removed from the vehicle are placed on the lint-free non-flocking material.



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.



Make sure that clean non-plated tools are used. Clean tools using a new brush that will not lose its bristles, prior to starting work on the vehicle.



Use a steel topped workbench and cover it with clean, lint-free non-flocking material.



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

1. Using a new brush that will not lose its bristles, brush the components being removed and the surrounding area.
2. Using a pneumatic vacuum gun, remove all traces of foreign material.

General Equipment: [Pneumatic vacuum gun](#)

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Injection Component Cleaning Using Pressure Cleaner

General Procedures

Cleaning

• WARNINGS:



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

• CAUTIONS:



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material.




Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

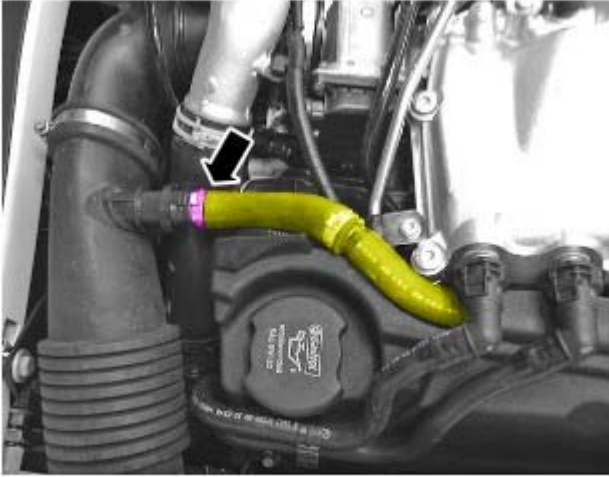


Before using the cleaning fluid, protect all electrical components and connectors with lint-free non-flocking material.


• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1.  CAUTION: Make sure the correct additive is used in this step. Failure to carry out this instruction may cause damage to the vehicle.
 - Open the fuel filler door and remove the cap.
 - Empty the fuel additive into the fuel filler pipe.
 - Install the fuel filler cap and close the fuel filler door.
2. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Release the breather from the air intake elbow.



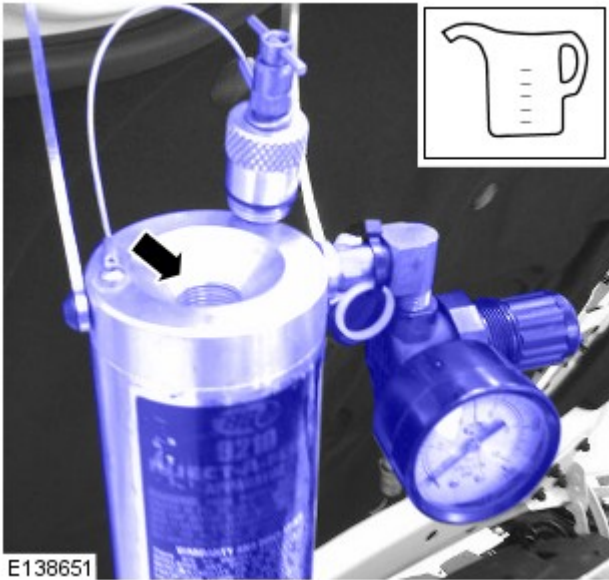
E138648

4.  CAUTION: Make sure the correct additive is used in this step. Failure to carry out this instruction may cause damage to the vehicle.

Install the cleaning equipment to a suitable location under the hood.



E138649



E138651

- 5.
- Remove the cleaning equipment filler cap.
 - Empty the induction system cleaning fluid into the cleaning equipment.
 - Install the filler cap.



E138650

6. Position the intake system cleaning tool into intake elbow and secure with the clamp.



E138652

- 7.
- Connect a suitable compressed air line to the cleaning equipment.
 - Set the pressure to 4 bar.

8. Start and run the engine.

9.

- Open the ball valve on the cleaning equipment and allow the cleaning fluid to spray into the intake elbow.
- Raise the engine speed to 1200 rpm and hold until the cleaning fluid spray has stopped.



E138653

10.

- Close the ball valve.
- Release the air pressure in the cleaning equipment.
- Disconnect the air line.

11. Connect the breather to the air intake elbow.



E138648

12. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

13.

- Start the engine.
- Allow the engine to idle for 30 seconds.

- Raise the engine speed to 1500 rpm and hold for 3 minutes until a temperature of 70°C is achieved.
- Allow the engine to idle for 30 seconds.
- Switch off the engine.

14. Connect the approved diagnostic equipment to the vehicle.

15. Follow on screen prompts and check for DTC's (Diagnostic Trouble Codes).

16. Clear the DTC's following the on screen procedure.

17. Disconnect the approved diagnostic equipment from the vehicle.

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Injectors

Removal and Installation

Removal

1. Refer to: [Fuel Rail LH](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Removal and Installation).




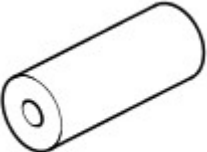
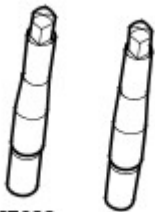
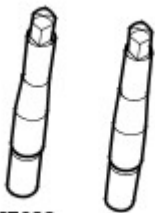
Installation

1. Refer to: [Fuel Rail LH](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Removal and Installation).

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Rail LH

Removal and Installation

Special Tool(s)

 <p>E115268</p>	<p>303-1450 Spark Plug Remover/Installer</p>
 <p>E114526</p>	<p>310-197 Fuel Injector Remover</p>
 <p>E107680</p>	<p>310-198 Teflon seal installer</p>
 <p>E107681</p>	<p>310-199 Teflon seal re-shape tool</p>
 <p>E 107682</p>	<p>310-200-01 Fuel Rail Installation Guide Pins - Threaded</p>
 <p>E 107682</p>	<p>310-200-02 Fuel Rail Installation Guide Pins - Unthreaded</p>

Removal

- CAUTIONS:



Make sure that tools and equipment are clean and free of foreign material and lubricant.



Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

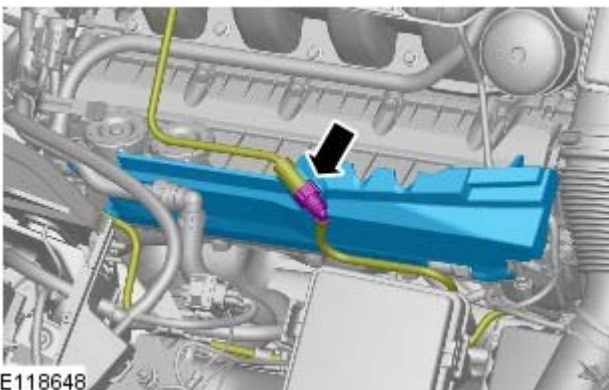
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**


All vehicles

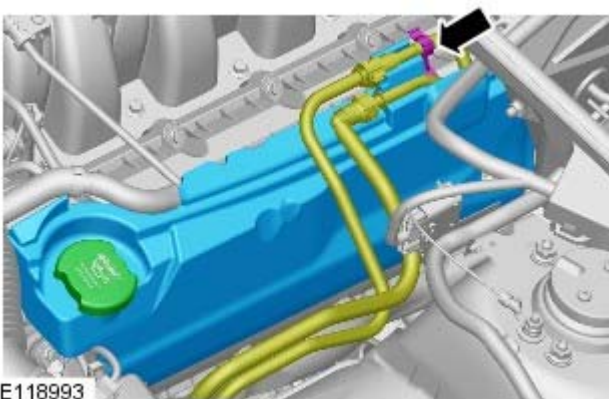
1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Refer to: [Fuel System Pressure Release - V8 5.0L Petrol](#) (310-00 Fuel System - General Information, General Procedures).
3. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
4. Disconnect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

5. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
6. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

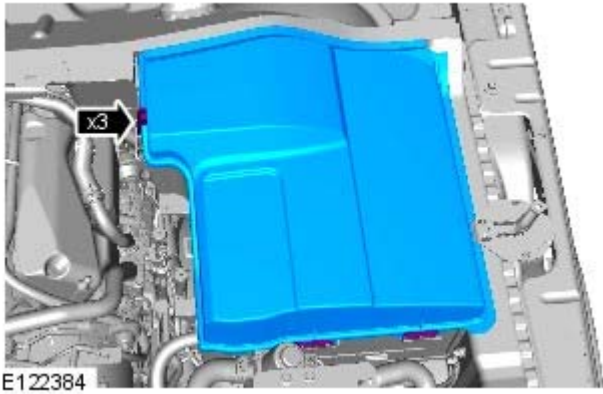


7.  CAUTION: Be prepared to collect escaping fluids.



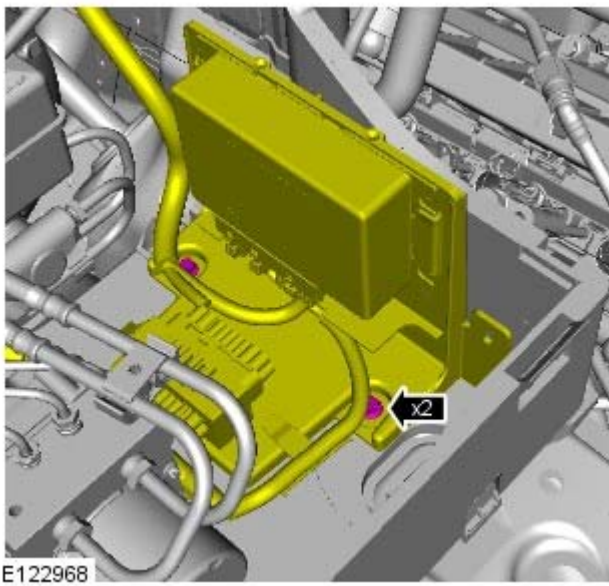
8.  CAUTION: Be prepared to collect escaping fluids.

9. Refer to: [Evaporative Emission Canister Purge Valve](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Removal and Installation).

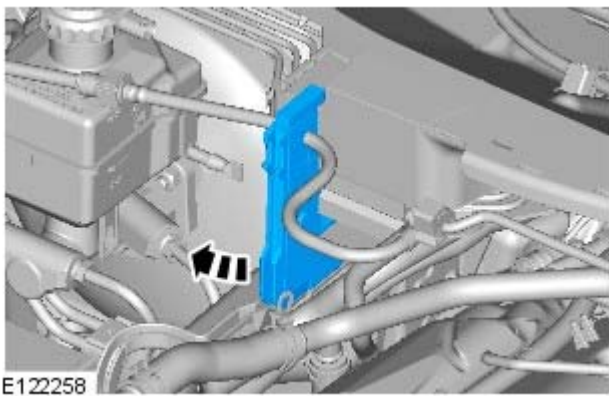


10.

Left-hand drive vehicles



11. **11.** NOTE: Right-hand shown, left-hand similar.

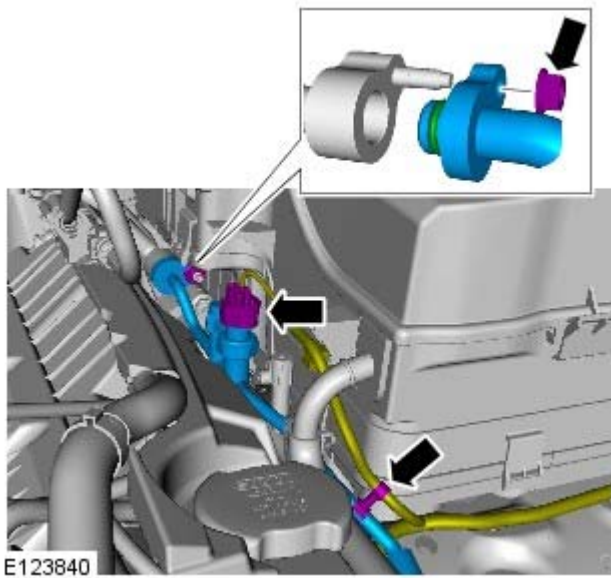



12. **12.** NOTE: Right-hand shown, left-hand similar.

Right-hand drive vehicles

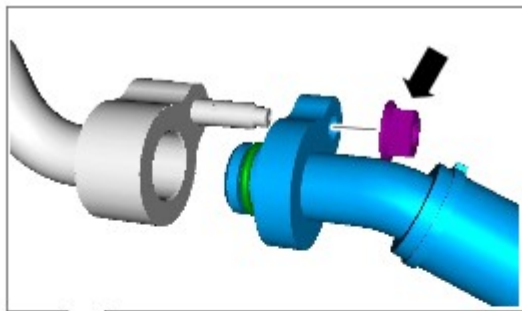
13. Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).


All vehicles



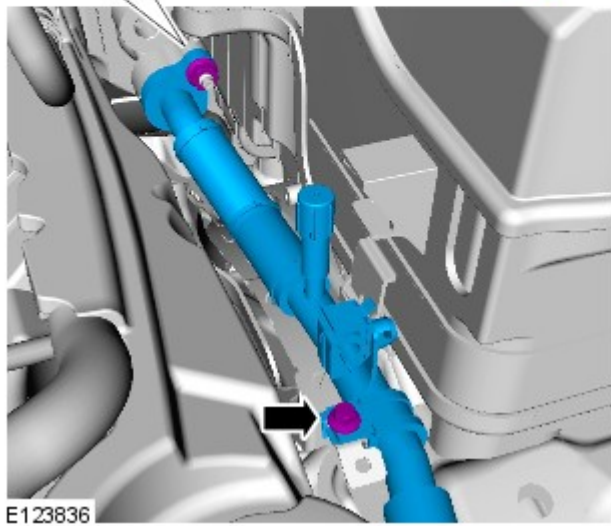
14. **14.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

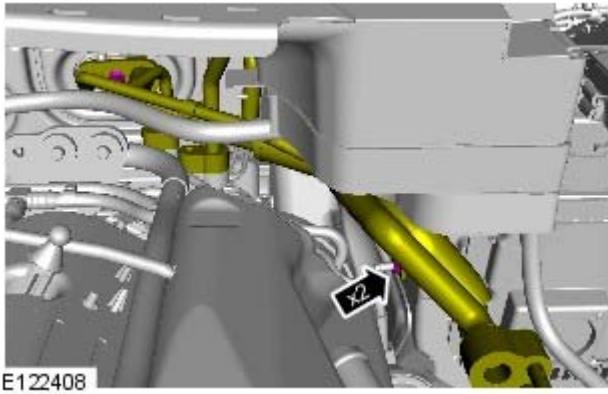
Discard the O-ring seal.




15. **15.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

Discard the O-ring seal.

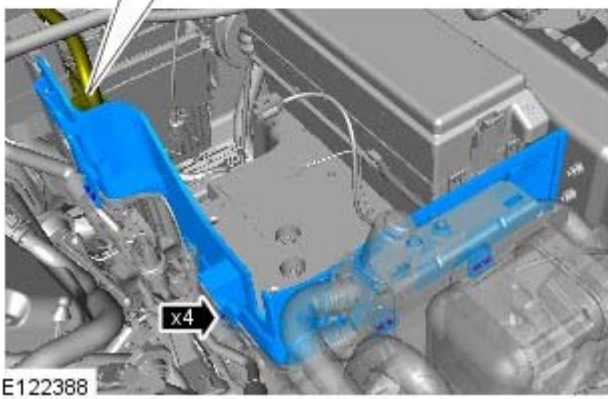
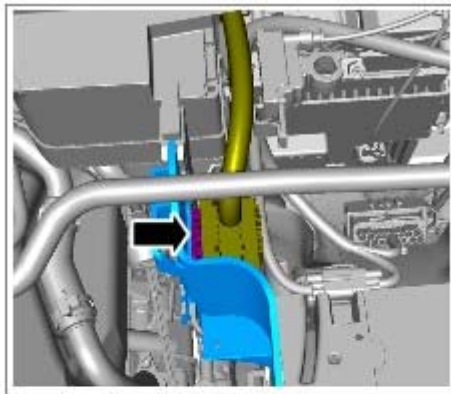




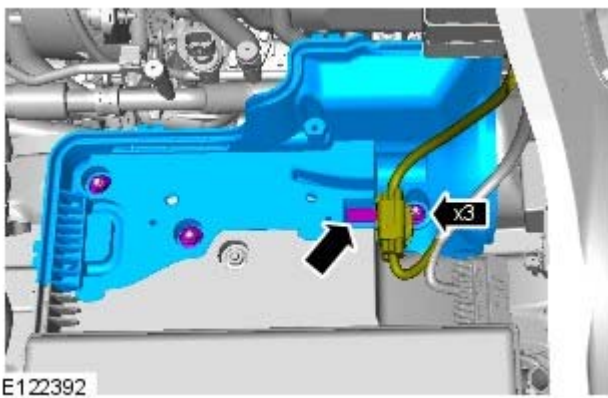
16. **16.**  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

Discard the O-ring seal.

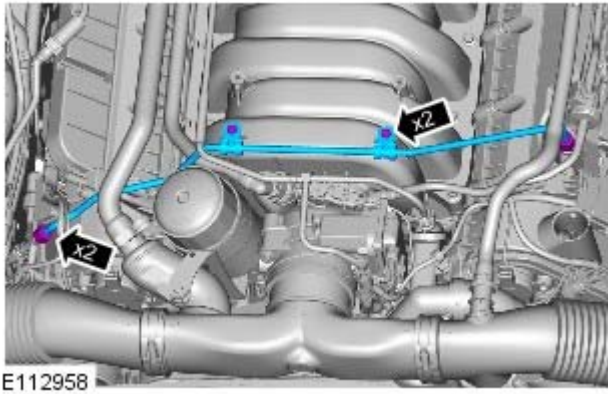
- 17.



- 18.



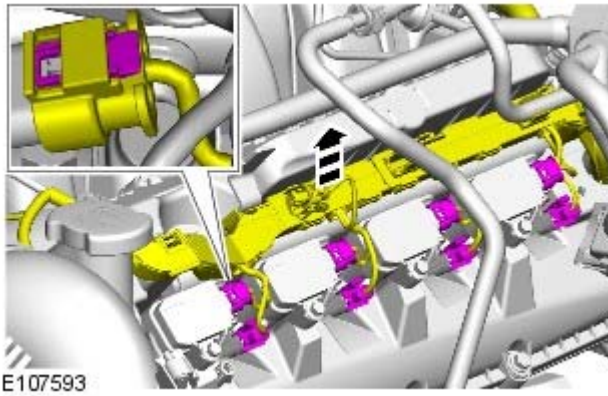
19. Refer to: [Fuel Injection Component Cleaning](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).



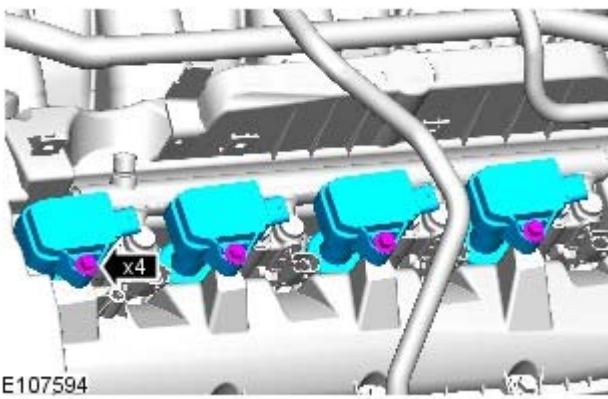
20. **20. CAUTIONS:**

 Be prepared to collect escaping fluids.

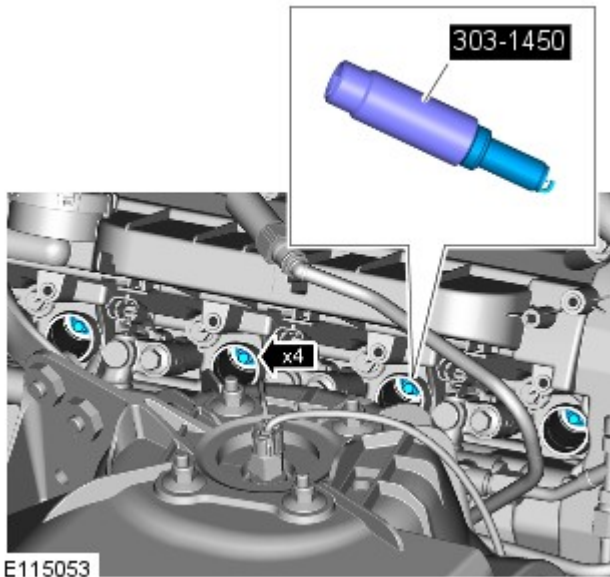
 Make sure that all openings are sealed. Use new blanking caps.



21.

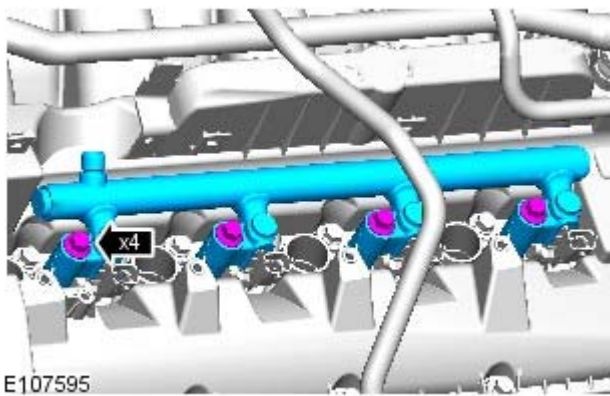



22.

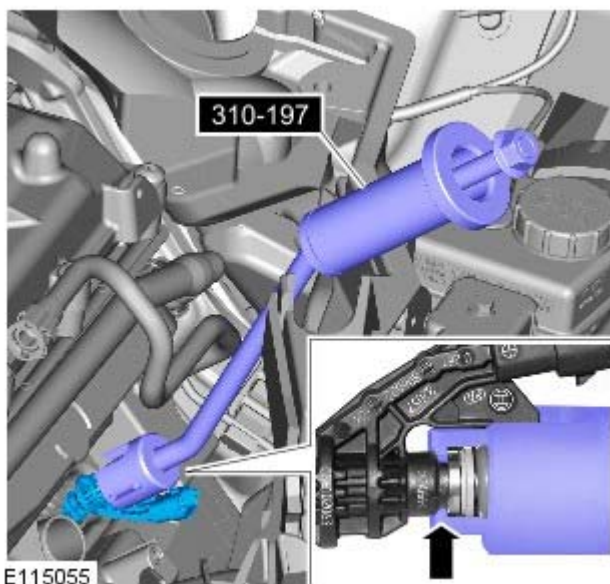


23. **23.** NOTE: RH illustration shown, LH is similar.


Special Tool(s): [303-1450](#)



24. **24.**  CAUTION: Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.



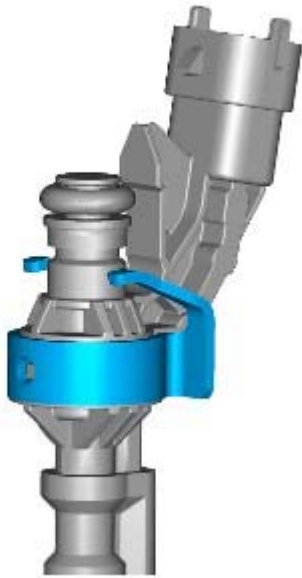
25. **25.** CAUTIONS:

 Make sure that the special tool is located correctly to the fuel injector prior to removing the fuel injector.


 Make sure that the special tool is held square to the fuel injector during removal.

 Make sure that all open ports are covered to prevent any foreign material ingress.

Special Tool(s): [310-197](#)




E115057

26. **26.**  CAUTION: If the fuel injector is being removed without a new component being installed, the fuel injector clamp must remain with the fuel injector it is removed with.




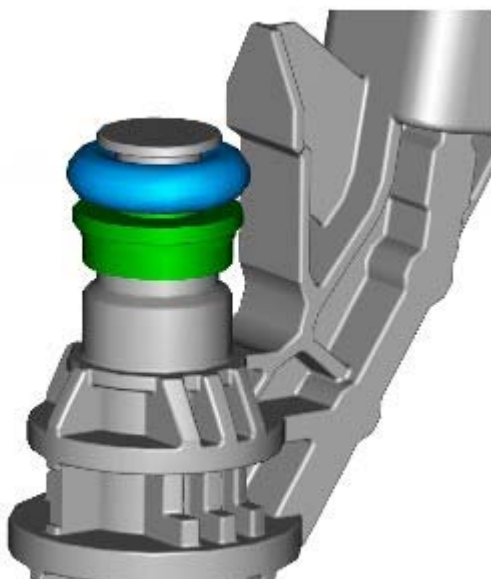
E115058

27. **27.** CAUTIONS:


 Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

 Do not cut the Teflon seal too deep as damage could occur to the fuel injector.

 Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.

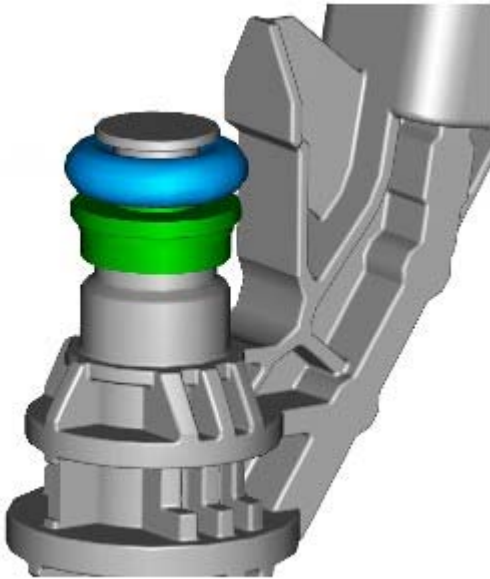


E115059

28. **28.**  CAUTION: Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.

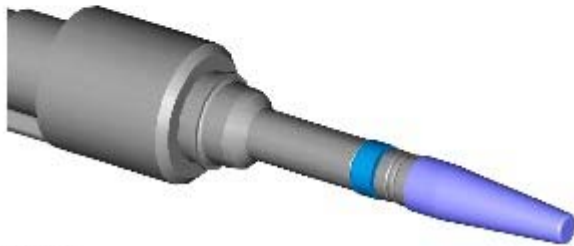
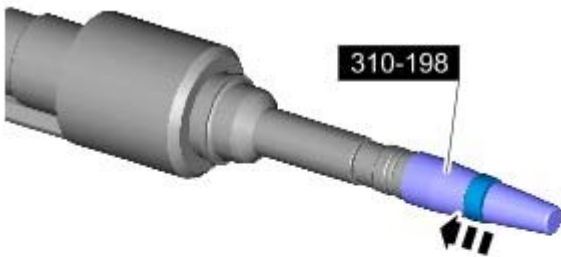
All vehicles

1.



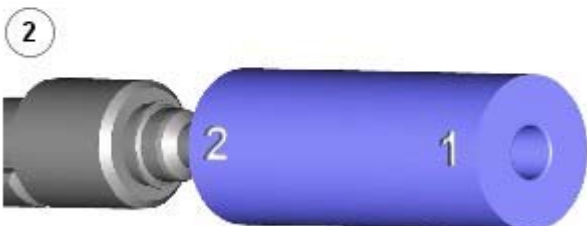
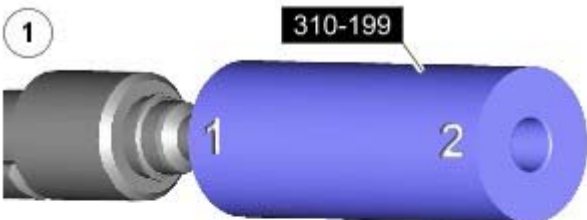
E115059

2. *Special Tool(s):* [310-198](#)

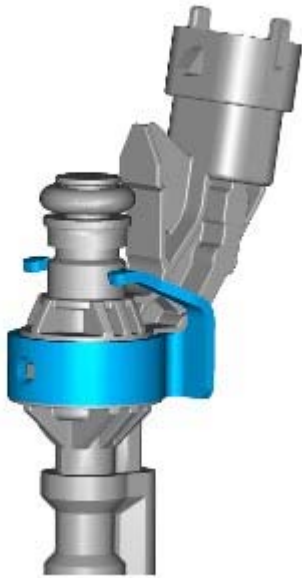


E115060


3. *Special Tool(s):* [310-199](#)

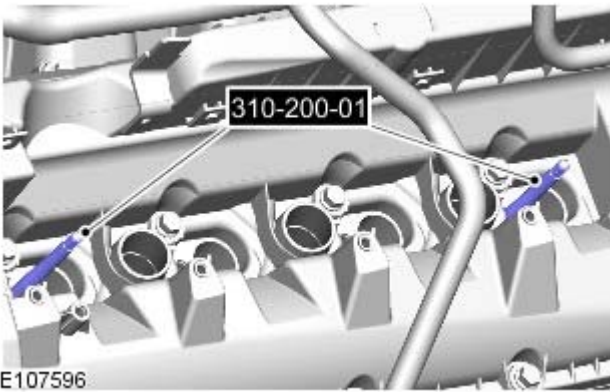


E115062




E115057

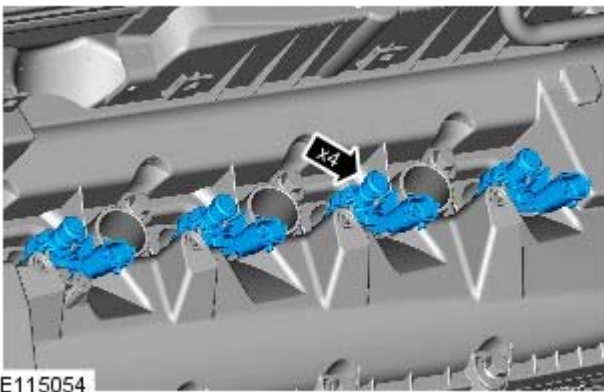
4.  CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must be installed with the fuel injector it was removed with.



E107596


5.  CAUTION: If a new cylinder head has been installed then the special tool 310-200-02 without the thread must be used to install the fuel rail.


Special Tool(s): [310-200-01](#), [310-200-02](#)

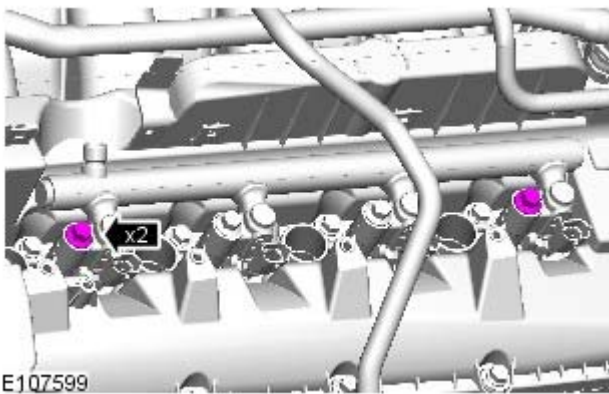
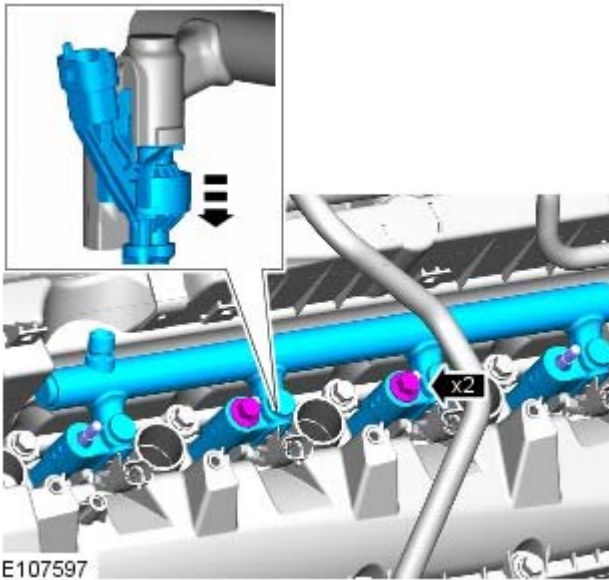


E115054

6. 6. CAUTIONS:


 Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.


 When installing the fuel injector(s), make sure that the Teflon seal is clean and free of foreign material and lubricant.



7. **7. CAUTIONS:**

 If new fuel injectors are installed, a new injector clamp must be installed.

 Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

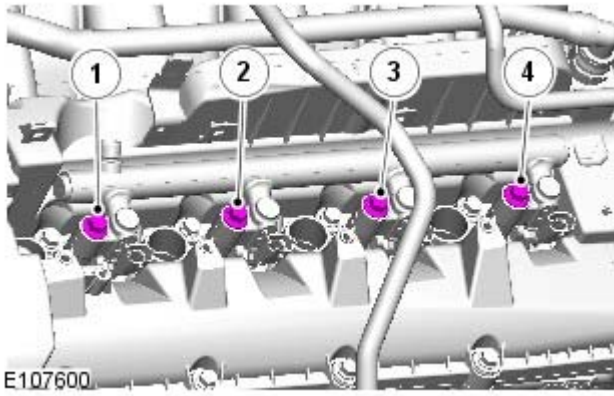
 Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

• NOTE: Lubricate the fuel injector O-ring seals with clean engine oil.

Torque: 20 Nm

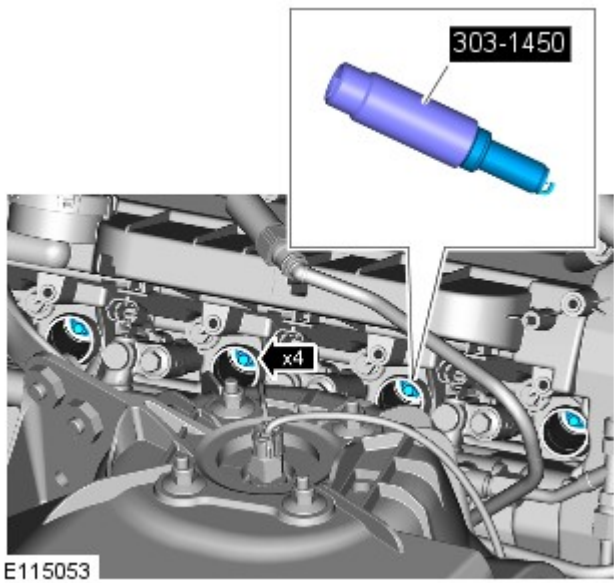
8. *Special Tool(s):* [310-200-01](#), [310-200-02](#)

9. *Torque:* 20 Nm



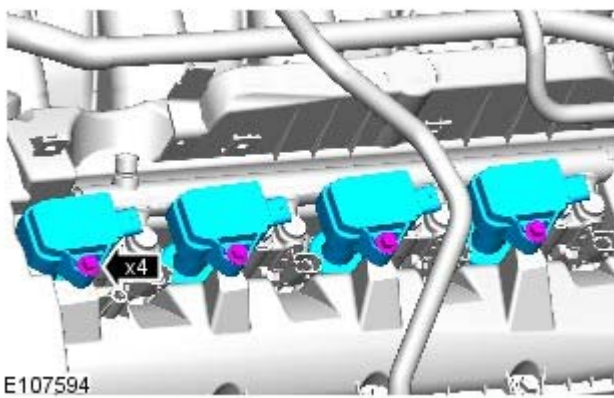
10. **10.** NOTE: Tighten the bolts in the indicated sequence.

- *Torque:*
Bolt 2 30 Nm
Bolt 3 30 Nm
Bolt 1 30 Nm
Bolt 4 30 Nm

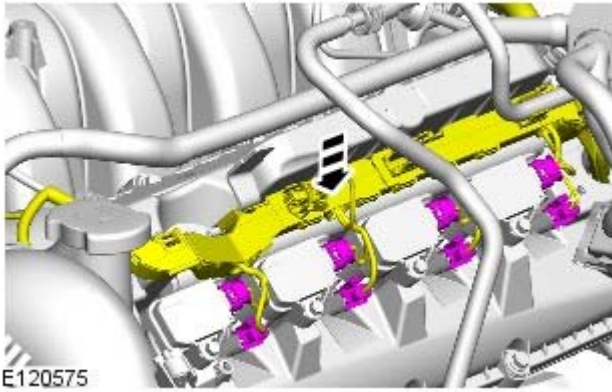


11. **11.** NOTE: RH illustration shown, LH is similar.

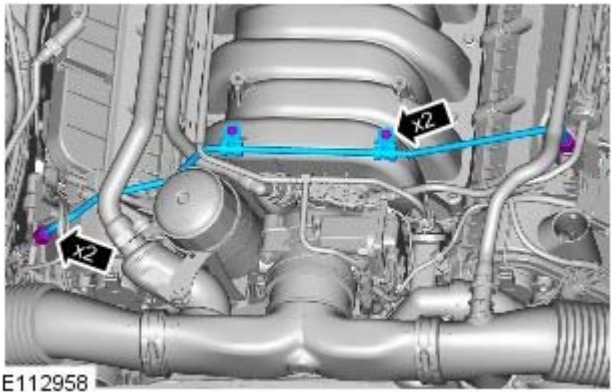
Special Tool(s): [303-1450](#)
Torque: 20 Nm




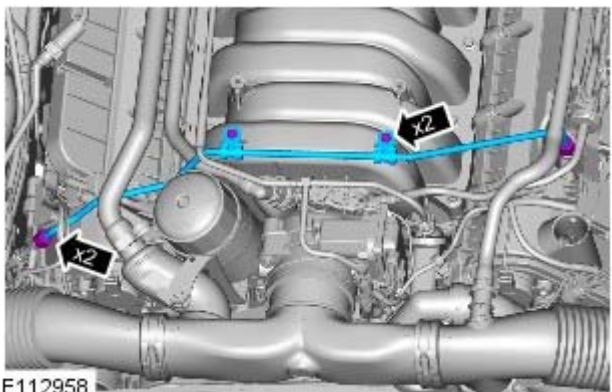
12. *Torque:* 7 Nm



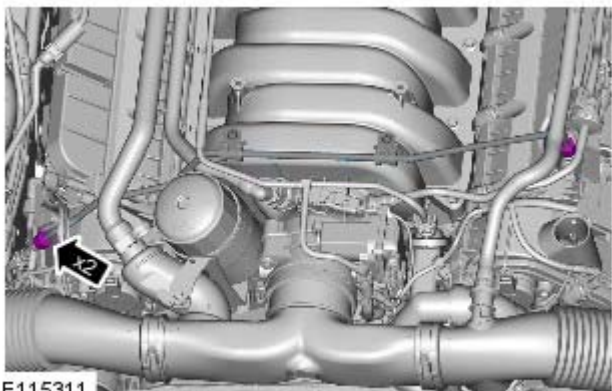
13.



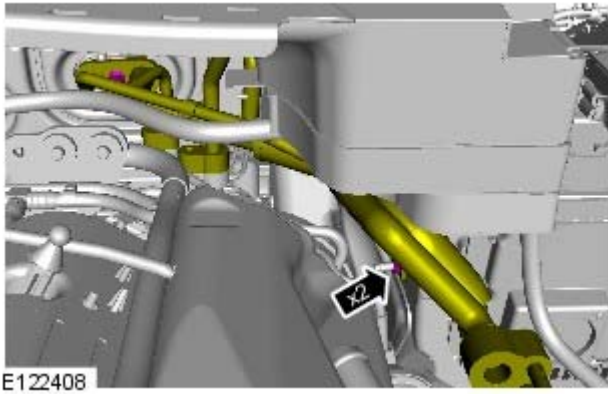
14.  CAUTION: Lubricate only the union threads with clean engine oil.
- NOTE: Do not tighten at this stage.
 - NOTE: Remove and discard the blanking caps.



15. Torque:
Unions 21 Nm
Bolts 8 Nm

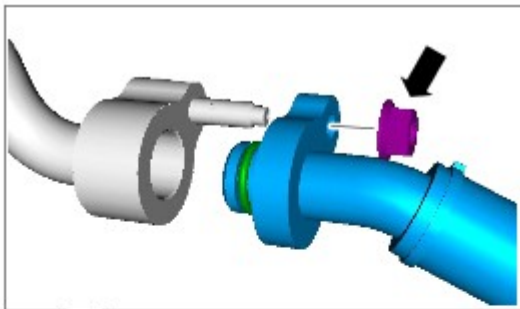


16. Torque: 21 Nm



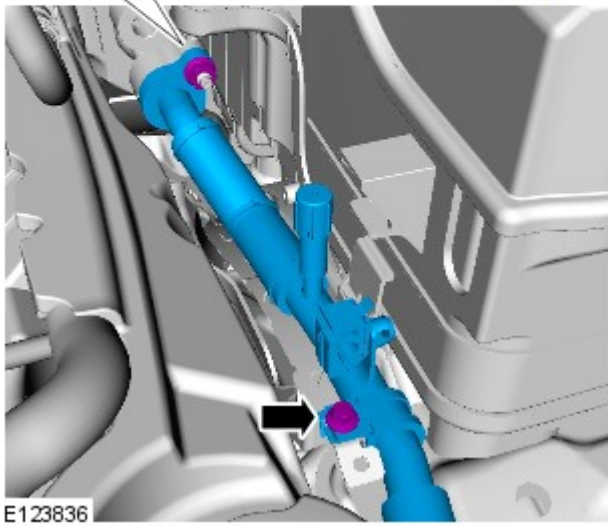
17. Install new O-ring seals.

Torque: 12 Nm



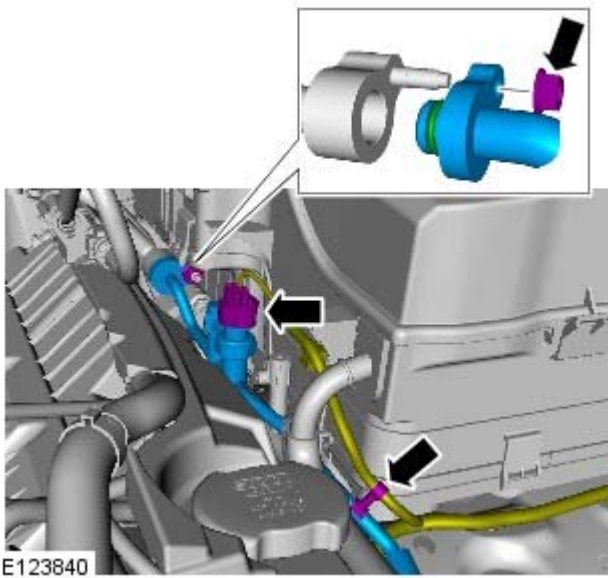
18. Install new O-ring seals.

Torque: 12 Nm

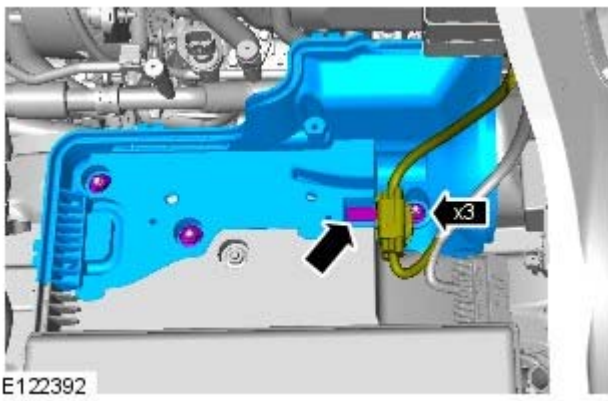


19. Install new O-ring seals.

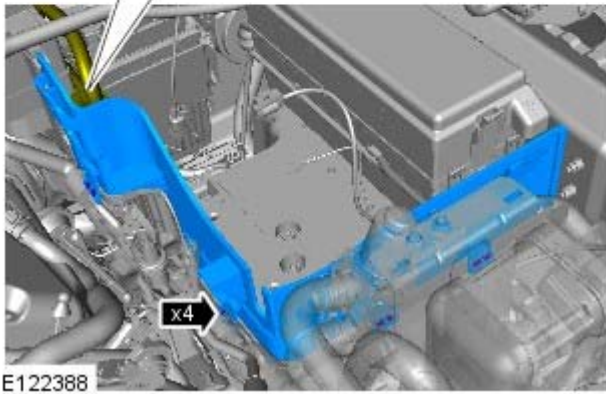
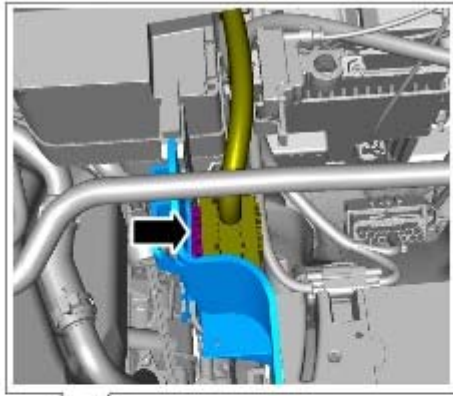
Torque: 12 Nm



20. *Torque: 12 Nm*



21.



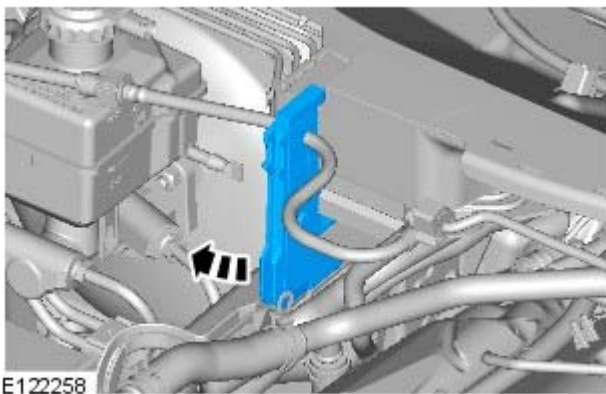
E122388

Right-hand drive vehicles

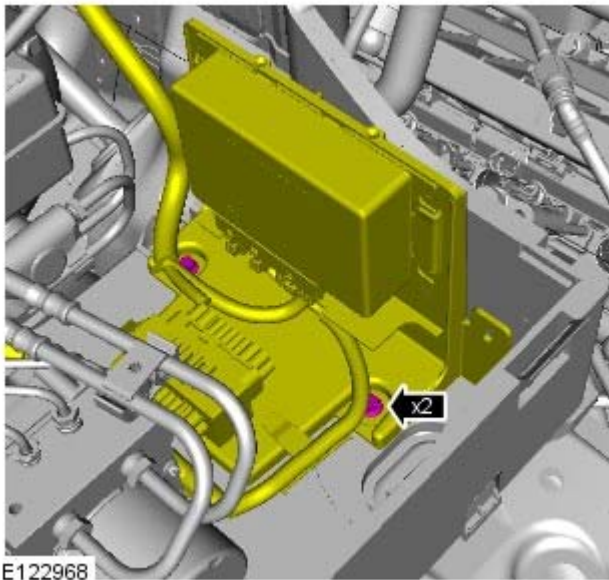
22. Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

Left-hand drive vehicles

23. **23.** NOTE: Right-hand shown, left-hand similar.



E122258

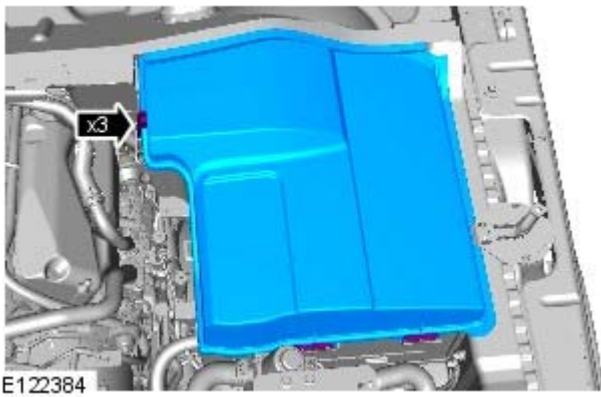


24. **24.** NOTE: Right-hand shown, left-hand similar.

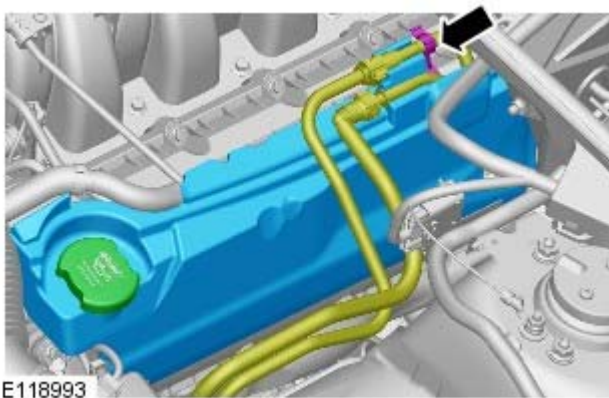
Torque: 10 Nm

All vehicles

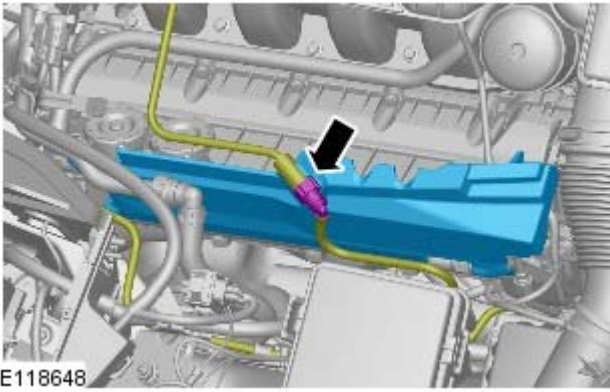
25. Refer to: [Evaporative Emission Canister Purge Valve](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Removal and Installation).



26.



27.



28. **28.**  CAUTION: Be prepared to collect escaping fluids.




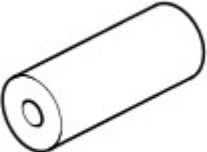
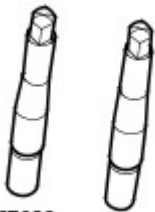
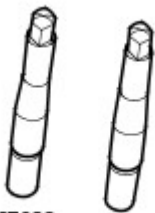
29. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
30. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
31. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
32. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Charging and Controls - V8 5.0L Petrol - Fuel Rail RH

Removal and Installation

Special Tool(s)

 <p>E115268</p>	<p>303-1450 Spark Plug Remover/Installer</p>
 <p>E114526</p>	<p>310-197 Fuel Injector Remover</p>
 <p>E107680</p>	<p>310-198 Teflon seal installer</p>
 <p>E107681</p>	<p>310-199 Teflon seal re-shape tool</p>
 <p>E 107682</p>	<p>310-200-01 Fuel Rail Installation Guide Pins - Threaded</p>
 <p>E 107682</p>	<p>310-200-02 Fuel Rail Installation Guide Pins - Unthreaded</p>

Removal

• CAUTIONS:



Make sure that tools and equipment are clean and free of foreign material and lubricant.



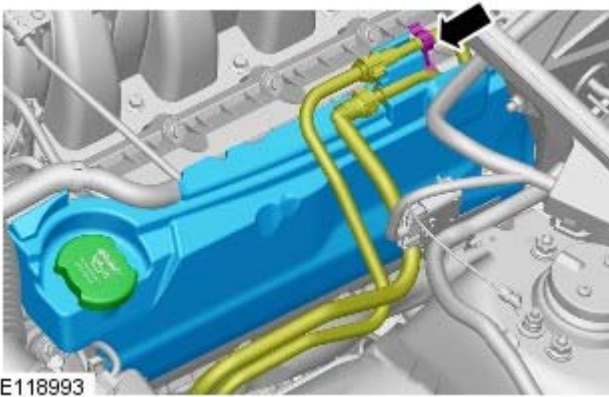
Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

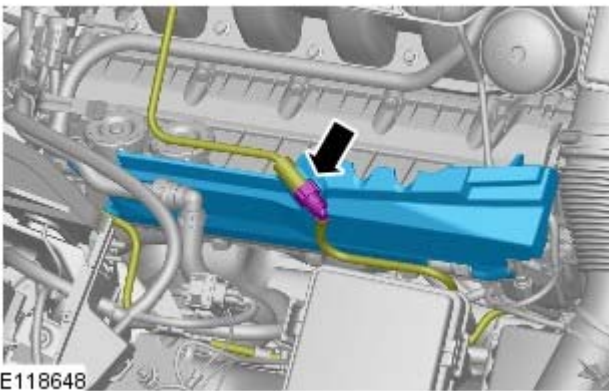
All vehicles


1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Refer to: [Fuel System Pressure Release - V8 5.0L Petrol](#) (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

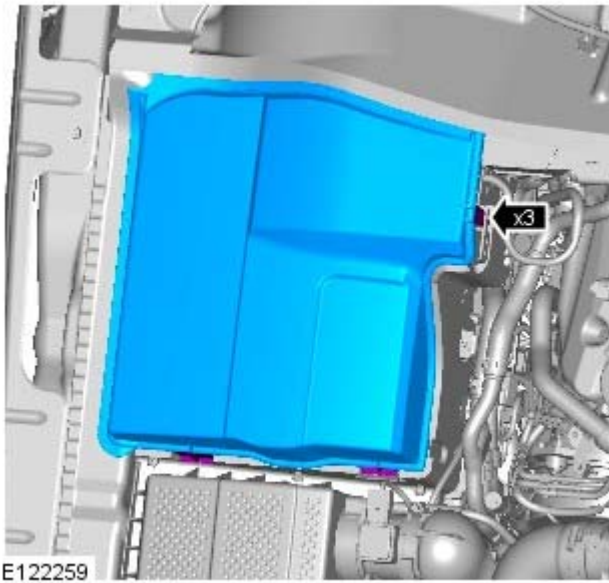
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
5. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).



6.  CAUTION: Be prepared to collect escaping fluids.



7.  CAUTION: Be prepared to collect escaping fluids.

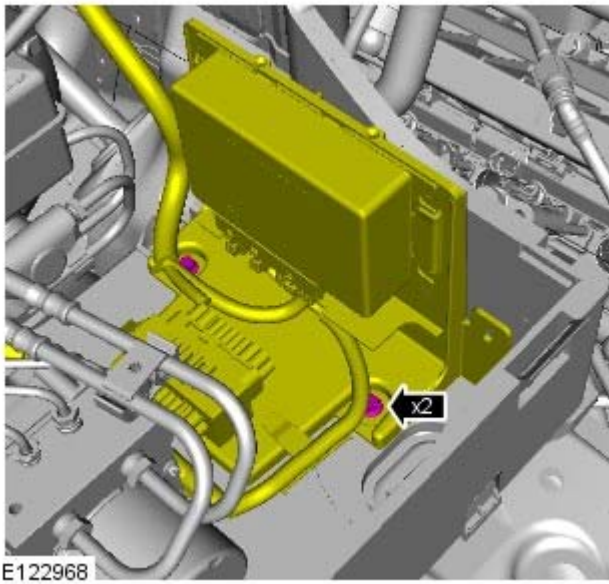


8.

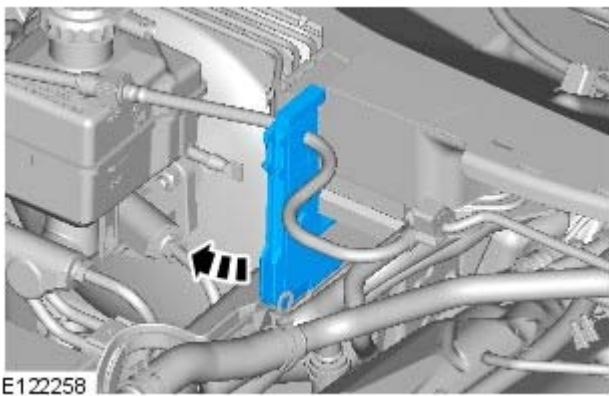
Left-hand drive vehicles

9. Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

Right-hand drive vehicles



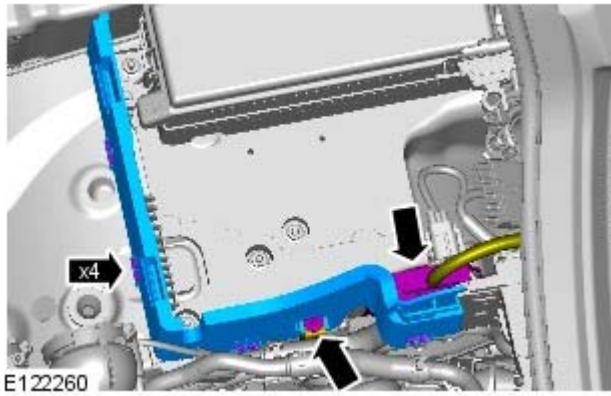
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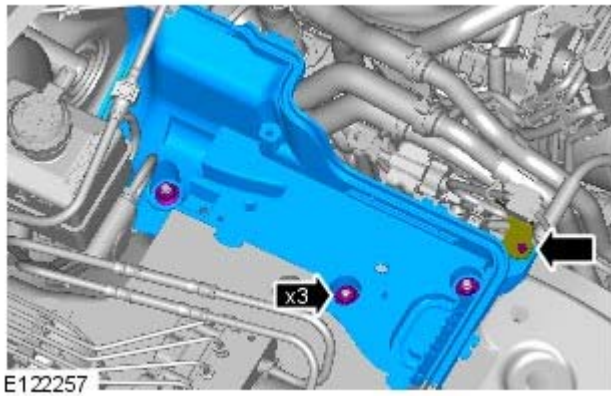
11.

All vehicles

12.



13.



14. Refer to: [Fuel Injection Component Cleaning](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).

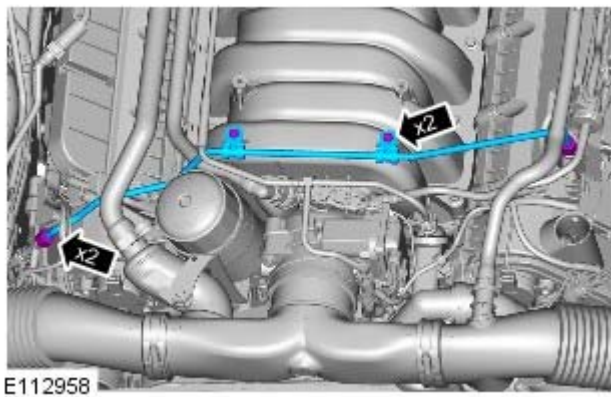
15. **15. CAUTIONS:**



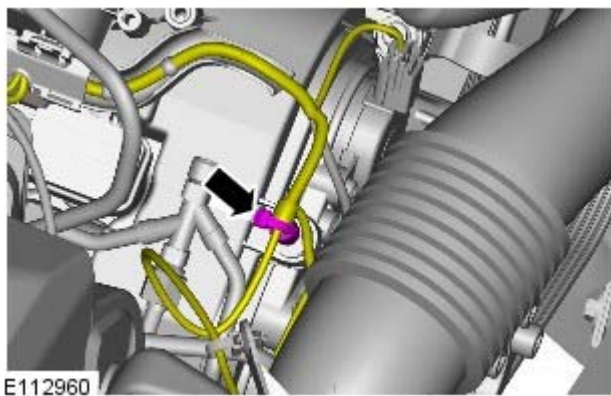
Be prepared to collect escaping fluids.

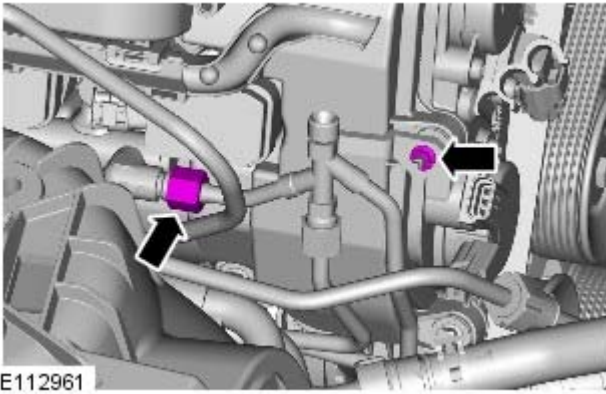


Make sure that all openings are sealed. Use new blanking caps.






16.





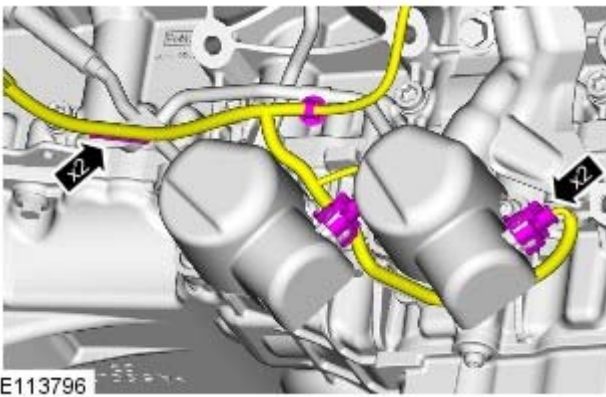
17. **17. CAUTIONS:**

-  Be prepared to collect escaping fluids.
-  Make sure that all openings are sealed. Use new blanking caps.

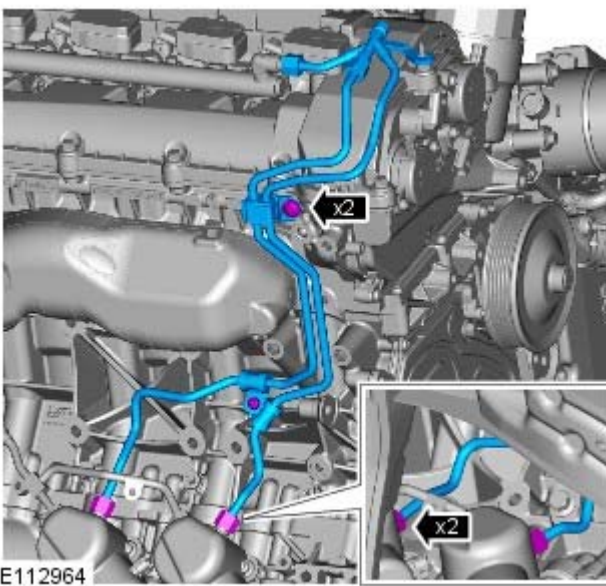
18. **18.**  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.



19. Refer to: [Steering Gear - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).



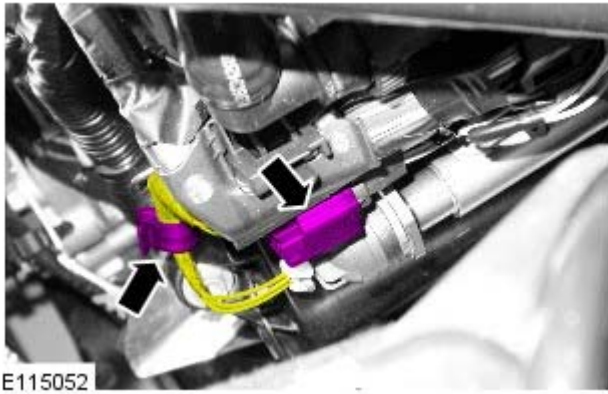
20. **20. NOTE:** Engine shown removed for clarity.



21. **21. CAUTIONS:**

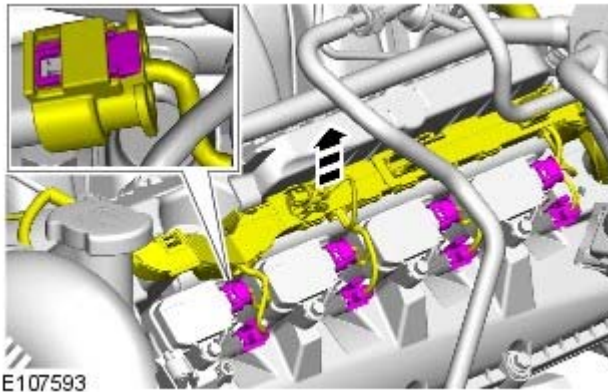
-  Be prepared to collect escaping fluids.
-  Make sure that all openings are sealed. Use new blanking caps.
- **NOTE:** Engine shown removed for clarity.

22. Lower the vehicle.



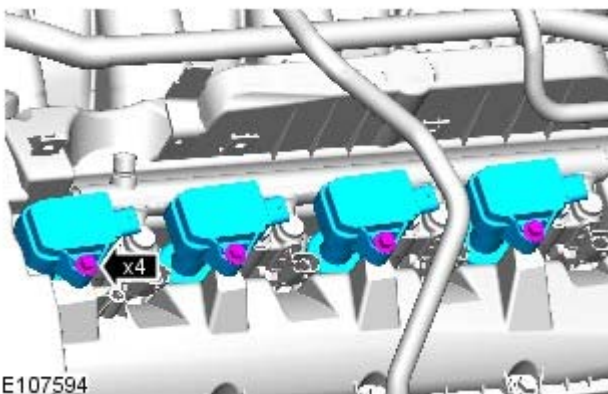
E115052

23.



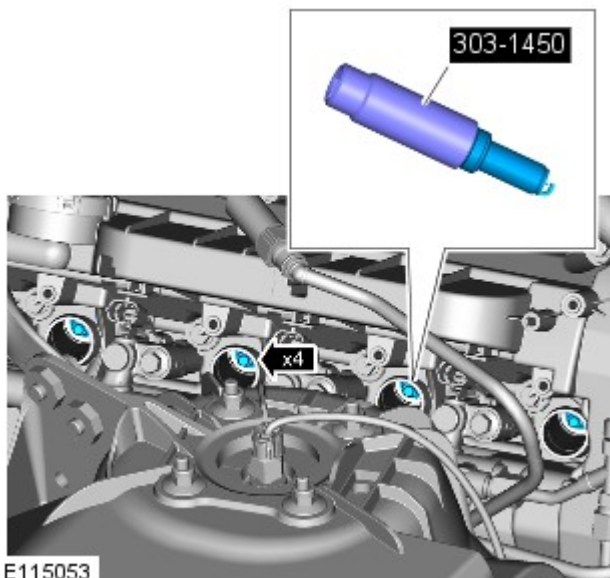
E107593

24. 24. NOTE: LH illustration shown, RH is similar.

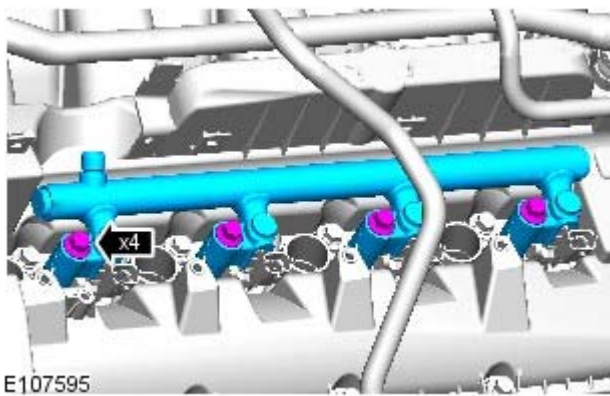


E107594

25. 25. NOTE: LH illustration shown, RH is similar.

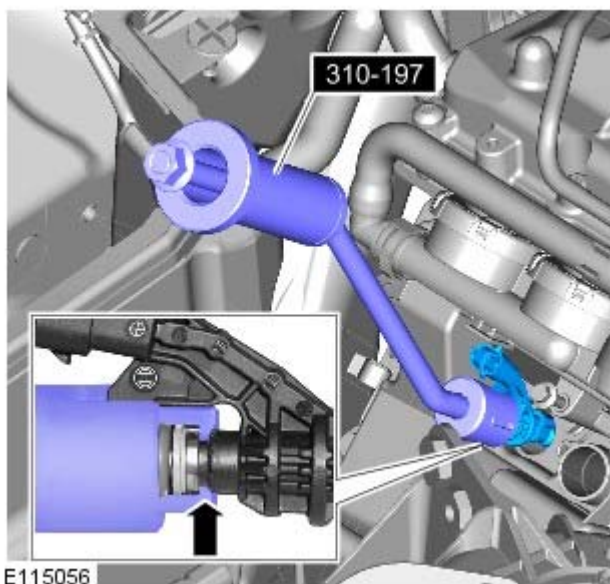


26. *Special Tool(s):* [303-1450](#)



27. **⚠ CAUTION:** Make a note of the fuel injector clamp alignment to the fuel rail prior to removal.

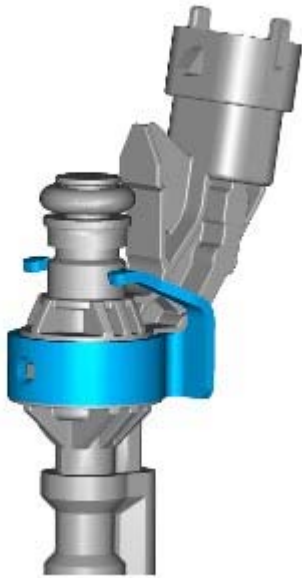
- NOTE: LH illustration shown, RH is similar.




28. **28. CAUTIONS:**

- ⚠** Make sure that the special tool is located correctly to the fuel injector prior to removing the fuel injector.
- ⚠** Make sure that the special tool is held square to the fuel injector during removal.
- ⚠** Make sure that all open ports are covered to prevent any foreign material ingress.

Special Tool(s): [310-197](#)




E115057

29. **29.**  **CAUTION:** If the fuel injector is being removed without a new component being installed, the fuel injector clamp must remain with the fuel injector it is removed with.




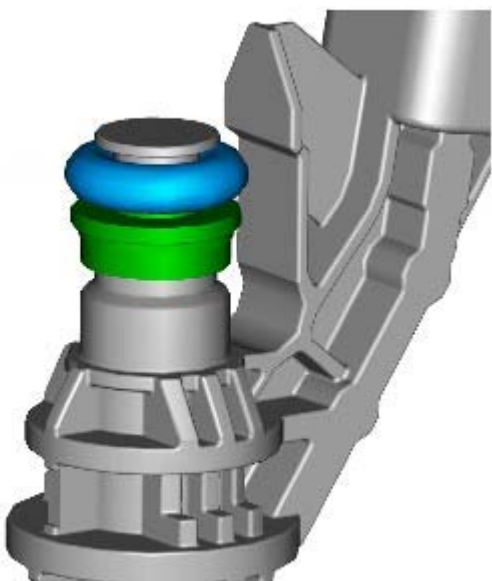
E115058

30. **30.** **CAUTIONS:**


 Do not use a knife to remove the Teflon seal as damage could occur to the fuel injector.

 Do not cut the Teflon seal too deep as damage could occur to the fuel injector.

 Pinch the Teflon seal to allow the tool to cut the Teflon seal without damaging the fuel injector.

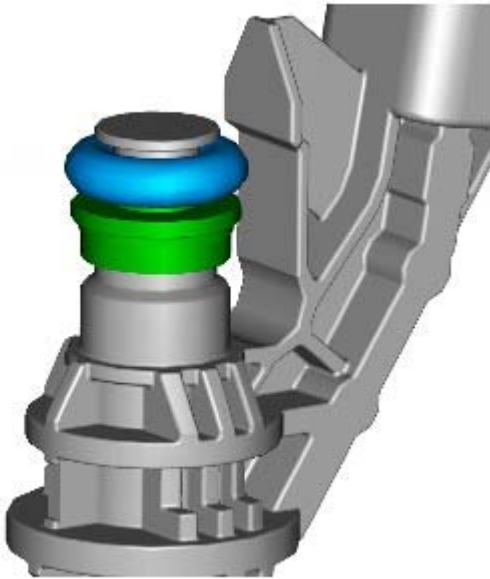


E115059

31. **31.**  **CAUTION:** Do not use any sharp tools to remove the O-ring seal as damage could occur to the fuel injector.

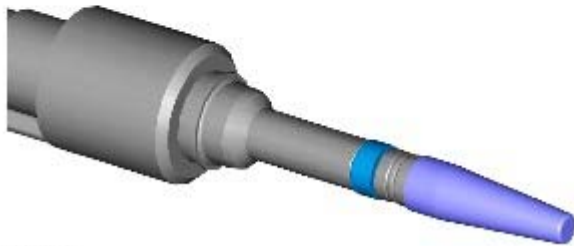
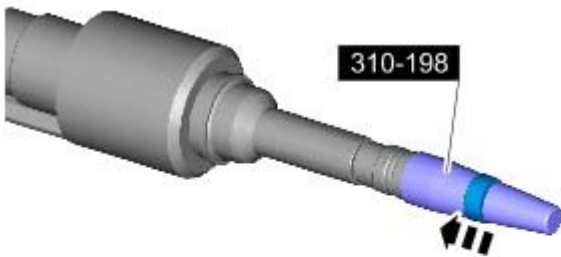
All vehicles

1.



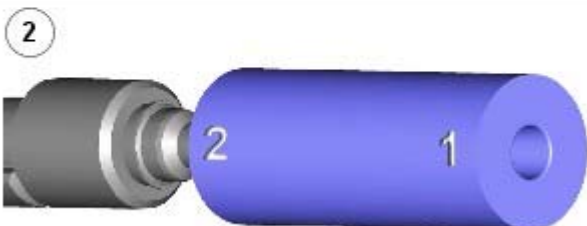
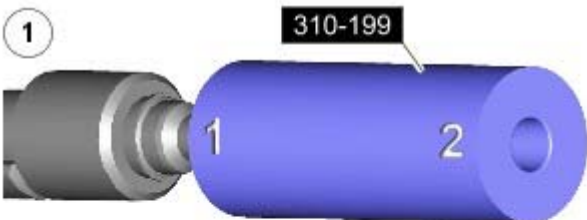
E115059

2. *Special Tool(s):* [310-198](#)

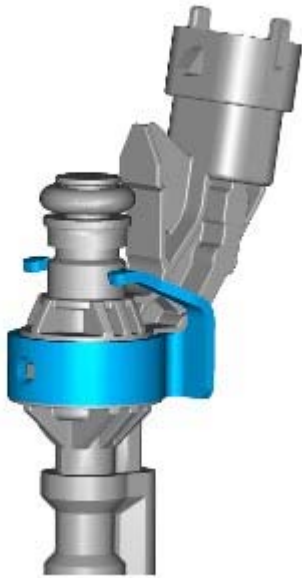


E115060


3. *Special Tool(s):* [310-199](#)

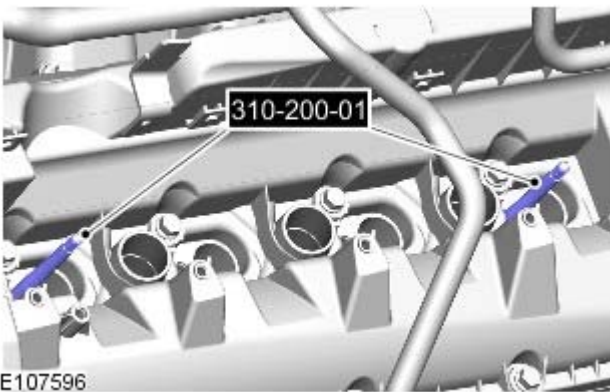


E115062




E115057

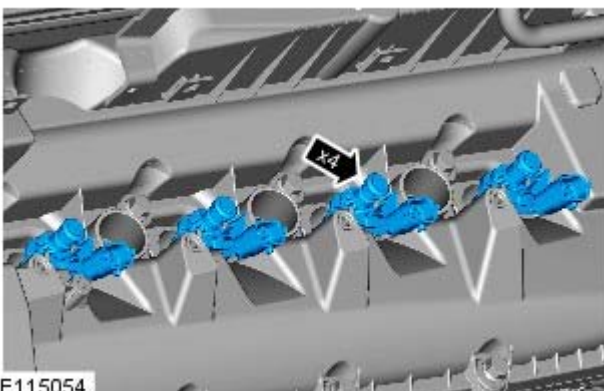
4.  CAUTION: If the original fuel injector is being installed, the original fuel injector clamp must be installed with the fuel injector it was removed with.



E107596


5.  CAUTION: If a new cylinder head has been installed then the special tool 310-200-02 without the thread must be used to install the fuel rail.
 - NOTE: LH illustration shown, RH is similar.


Special Tool(s): [310-200-01](#), [310-200-02](#)



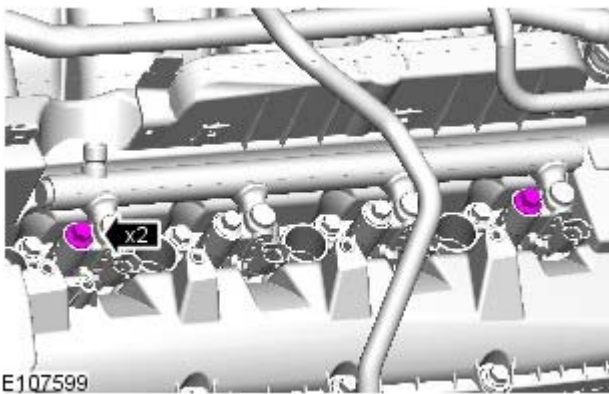
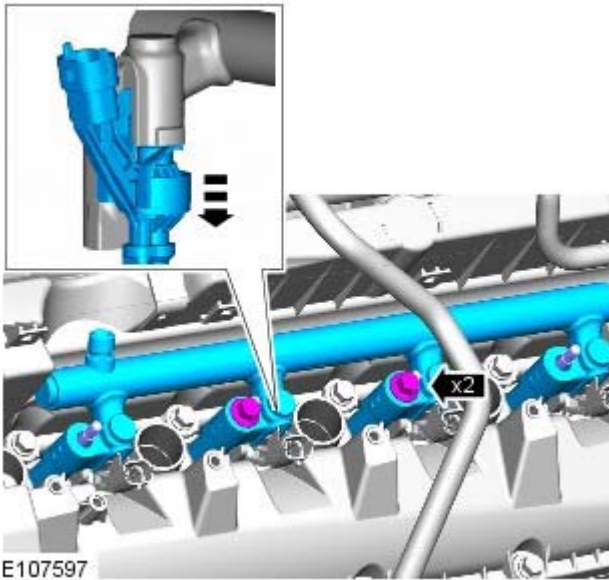
E115054

6. 6. CAUTIONS:


 Make sure that the area around the open fuel injector ports are clean and free of foreign material and lubricant prior to installing the fuel injector.


 When installing the fuel injector(s), make sure that the Teflon seal is clean and free of foreign material and lubricant.


- NOTE: LH illustration shown, RH is similar.



7. **7. CAUTIONS:**

 If new fuel injectors are installed, a new injector clamp must be installed.

 Make sure that the fuel injector is aligned and installed into the fuel rail correctly, as noted in the removal step.

 Tighten the fuel rail retaining bolts a turn at a time until the correct torque is achieved.

• NOTE: Lubricate the fuel injector O-ring seals with clean engine oil.

• NOTE: LH illustration shown, RH is similar.

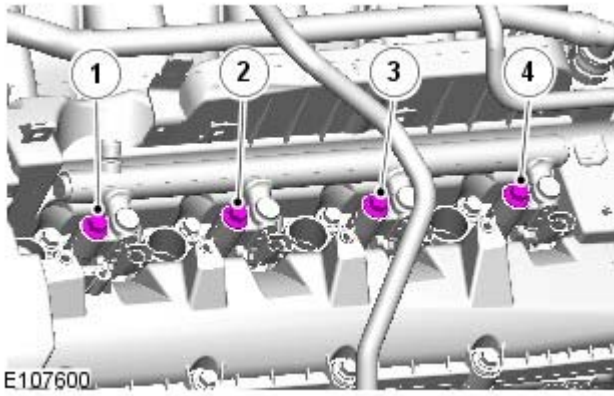
Torque: 20 Nm

8. **8. NOTE:** LH illustration shown, RH is similar.

Special Tool(s): [310-200-01](#), [310-200-02](#)

9. **9. NOTE:** LH illustration shown, RH is similar.

Torque: 20 Nm



10. **10.** NOTE: Tighten the bolts in the indicated sequence.

• NOTE: LH illustration shown, RH is similar.

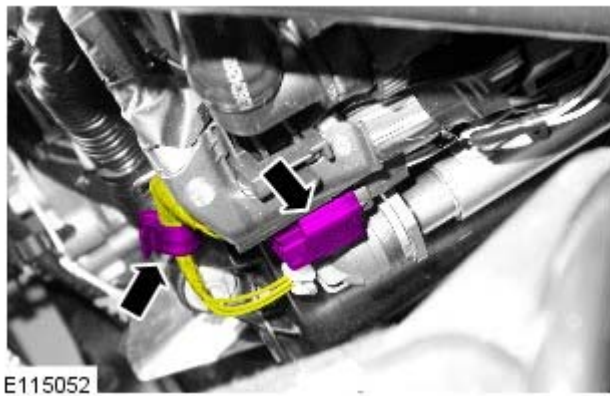
• *Torque:*

Bolt 2 30 Nm

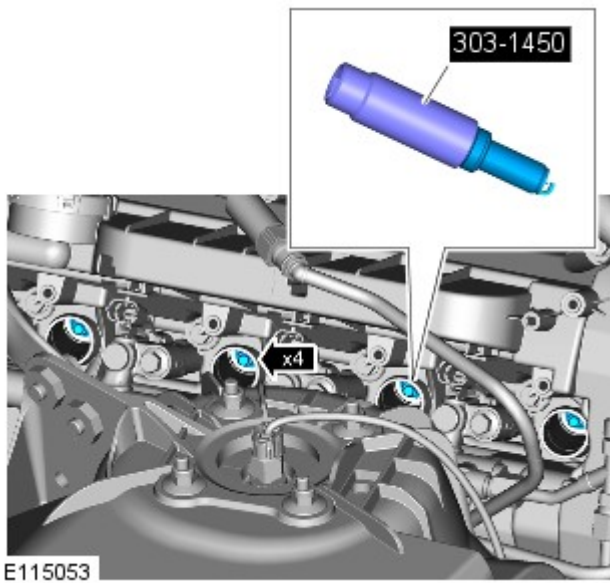
Bolt 3 30 Nm

Bolt 1 30 Nm

Bolt 4 30 Nm

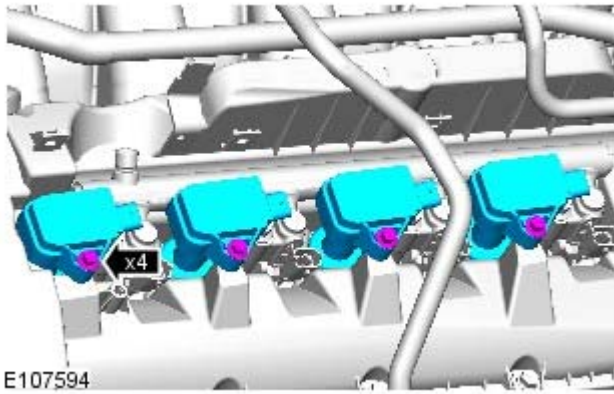


11.



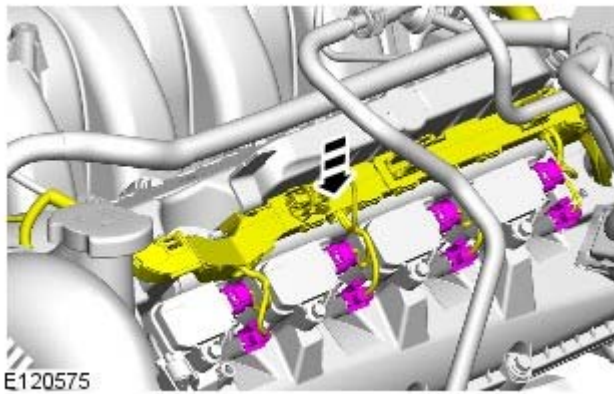
12. *Special Tool(s):* [303-1450](#)

Torque: 20 Nm




13. **13.** NOTE: LH illustration shown, RH is similar.

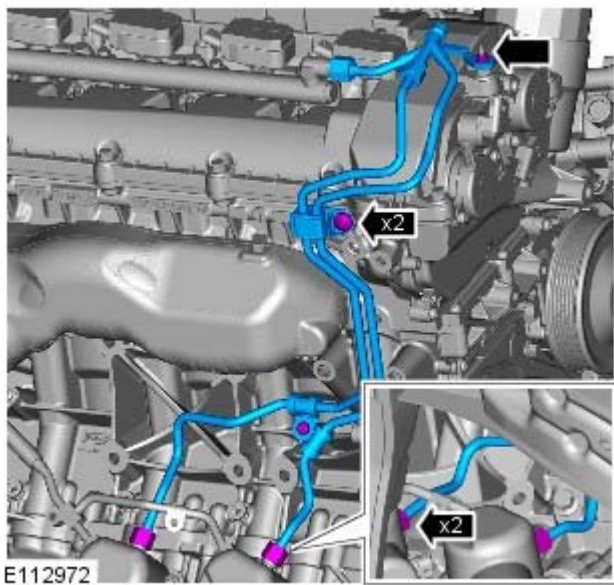
Torque: 7 Nm




14. **14.** NOTE: LH illustration shown, RH is similar.

15. **15.**  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

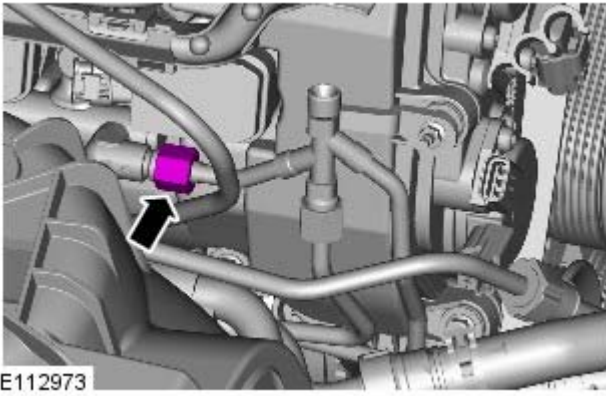
Raise and support the vehicle.




16. **16.**  **CAUTION:** Lubricate only the union threads with clean engine oil.

- NOTE: Engine shown removed for clarity.
- NOTE: Install the bolt and unions finger tight before final tightening.
- NOTE: Remove and discard the blanking caps.

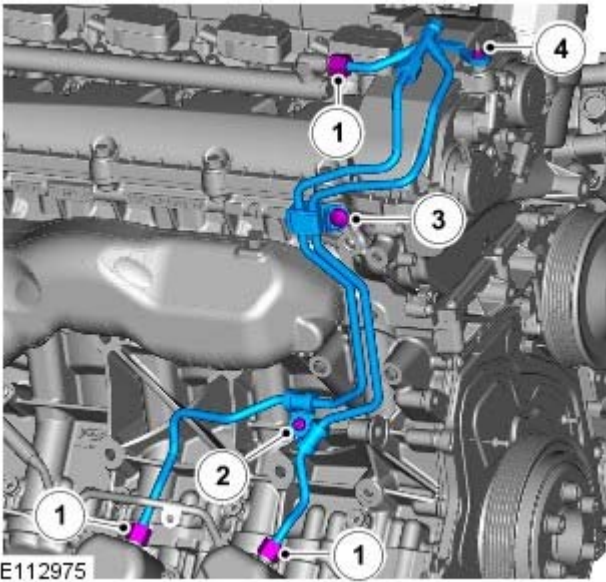
17. Lower the vehicle.



18. **18.** NOTE: Do not tighten at this stage.
- NOTE: Remove and discard the blanking caps.

19. **19.**  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

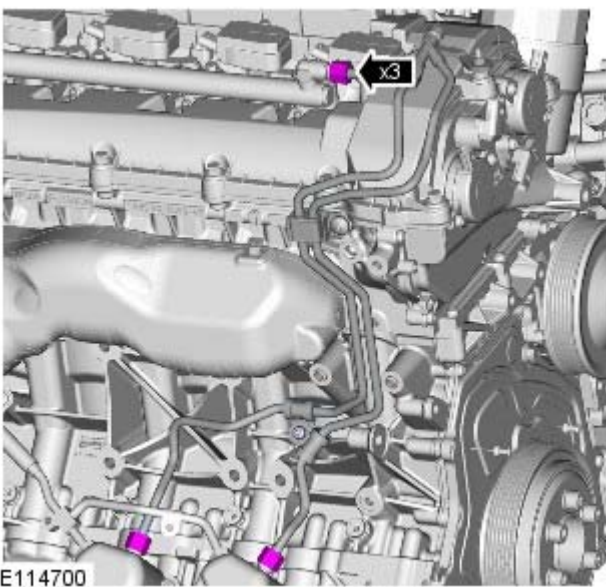
Raise and support the vehicle.



20. **20.** NOTE: Engine shown removed for clarity.

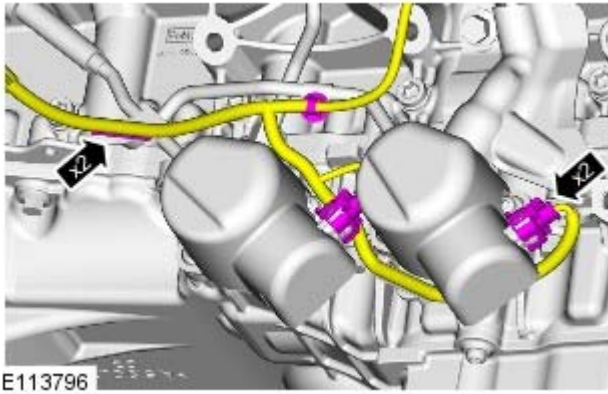
Torque:

- Unions (1) 21 Nm
- M6 (2) 11 Nm
- M8 (3) 25 Nm
- M5 nut (4) 6 Nm



21. **21.** NOTE: Engine shown removed for clarity.

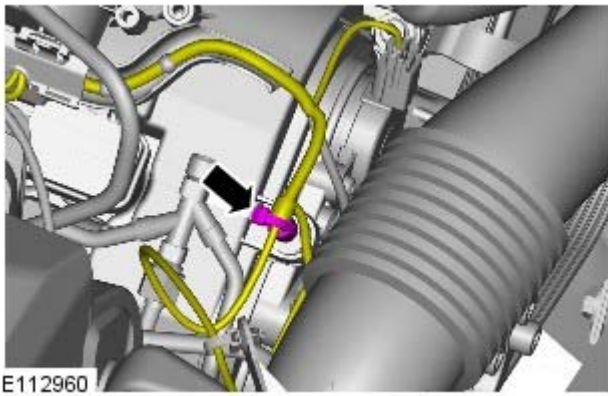
Torque: 21 Nm



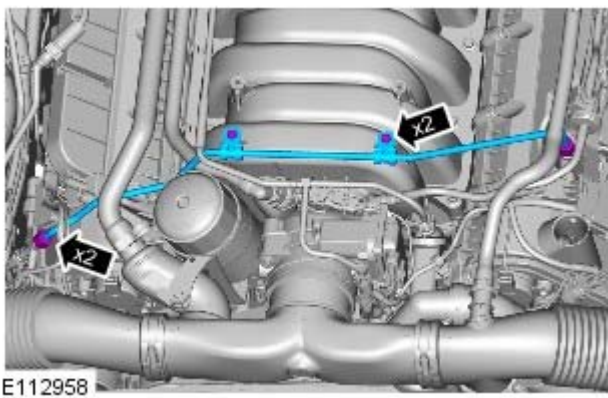
22. **22.** NOTE: Engine shown removed for clarity.


23. Refer to: [Steering Gear - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).

24. Lower the vehicle.

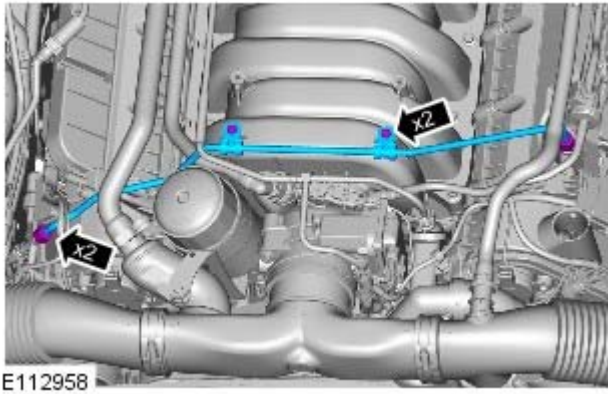


25.

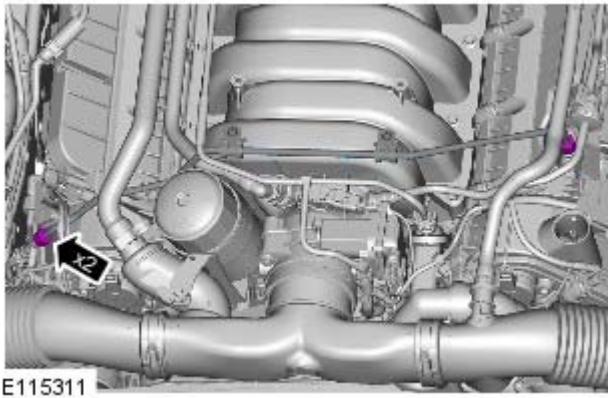


26. **26.**  CAUTION: Lubricate only the union threads with clean engine oil.

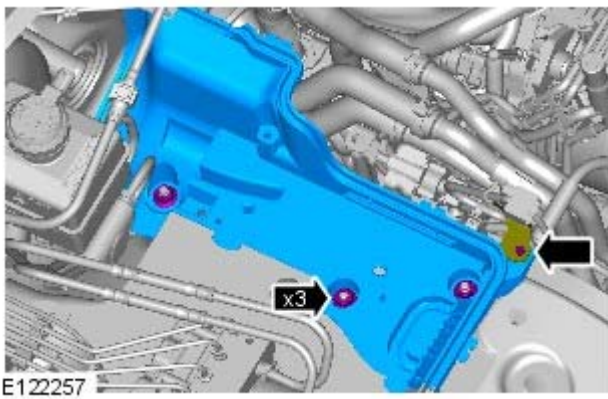
- NOTE: Do not tighten at this stage.
- NOTE: Remove and discard the blanking caps.



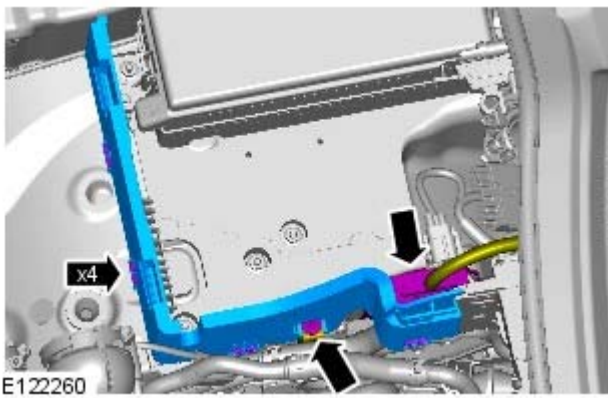
27. *Torque:*
Unions 21 Nm
Bolts 8 Nm



28. *Torque:* 21 Nm

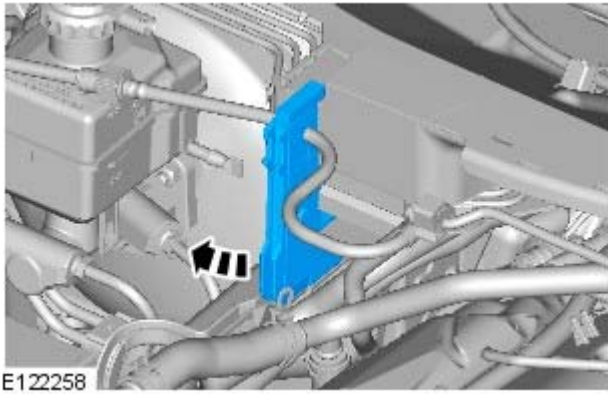


29. *Torque:* 12 Nm

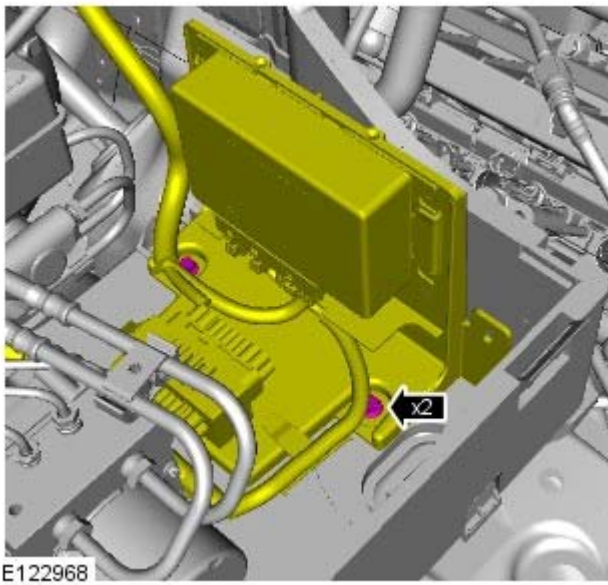


- 30.

Right-hand drive vehicles



31.

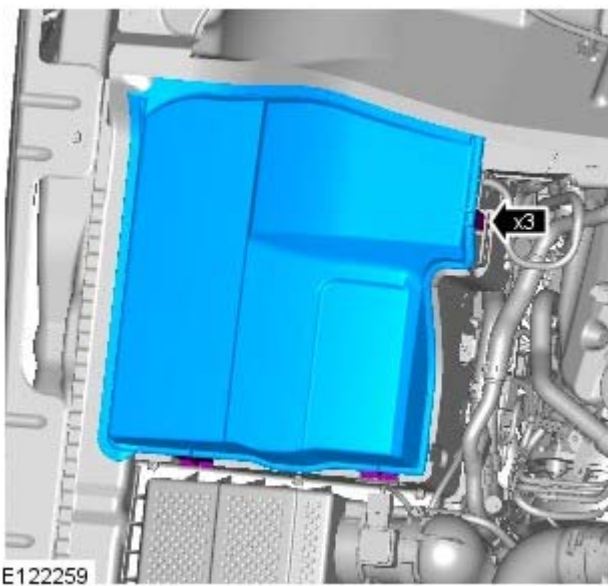


32. Torque: 10 Nm

Left-hand drive vehicles

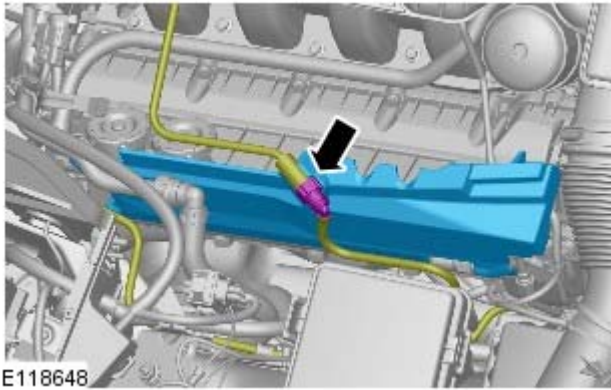
33. Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

All vehicles

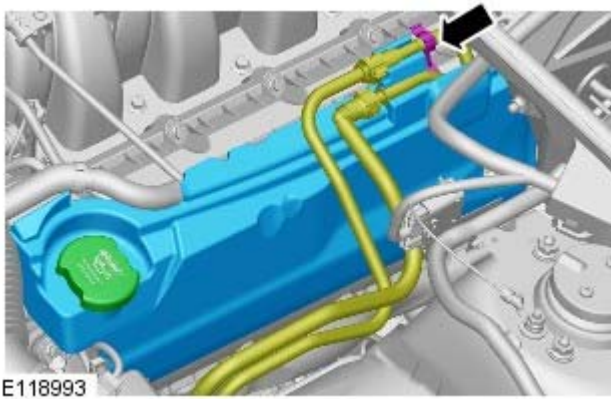


34.

35.



36.



37. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

38. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

39. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Charging and Controls - V8 5.0L Petrol - Left-Hand Fuel Rail High-Pressure Fuel Pump

Removal and Installation

Removal

• CAUTIONS:



Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Make sure that tools and equipment are clean, free of foreign material and lubricant.

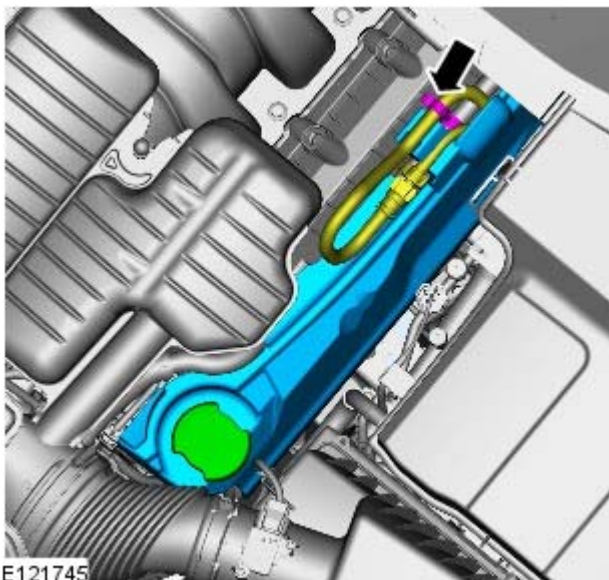
• NOTE: Removal steps in this procedure may contain installation details.


• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

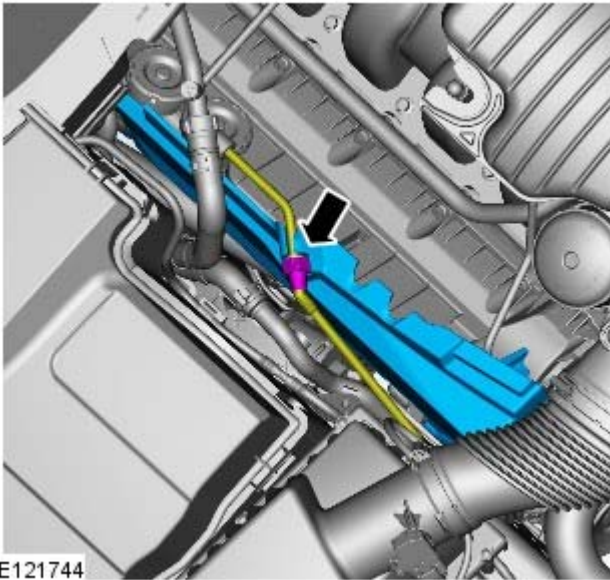
1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Refer to: [Fuel System Pressure Release - V8 5.0L Petrol](#) (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

4. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).



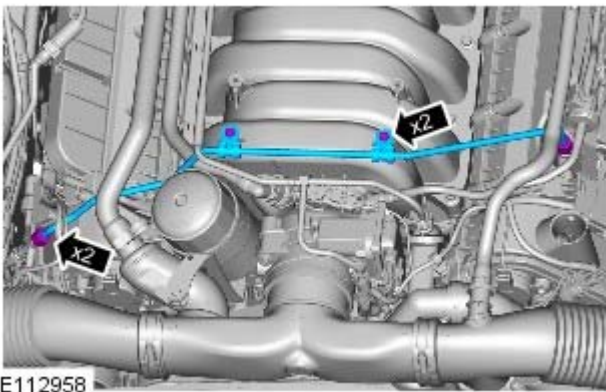
5.  CAUTION: Be prepared to collect escaping fluids.



E121744

6.

7. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
8. Refer to: [Fuel Injection Component Cleaning](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).



E112958

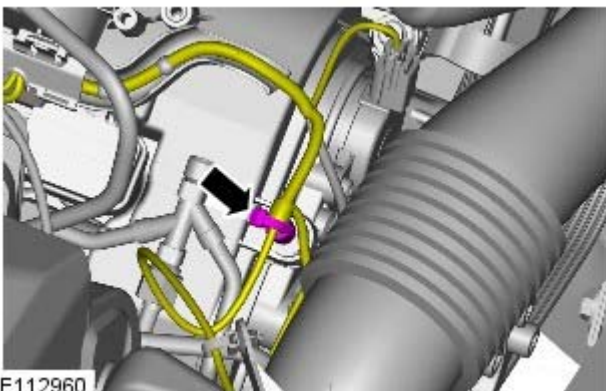
9. **9. CAUTIONS:**



Be prepared to collect escaping fluids.

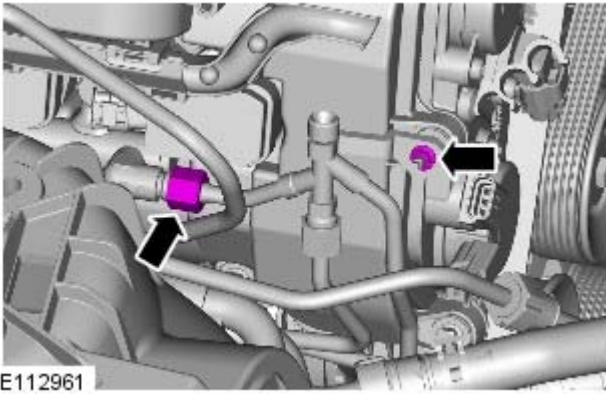


Make sure that all openings are sealed. Use new blanking caps.



E112960

10.




11. **11. CAUTIONS:**



Be prepared to collect escaping fluids.

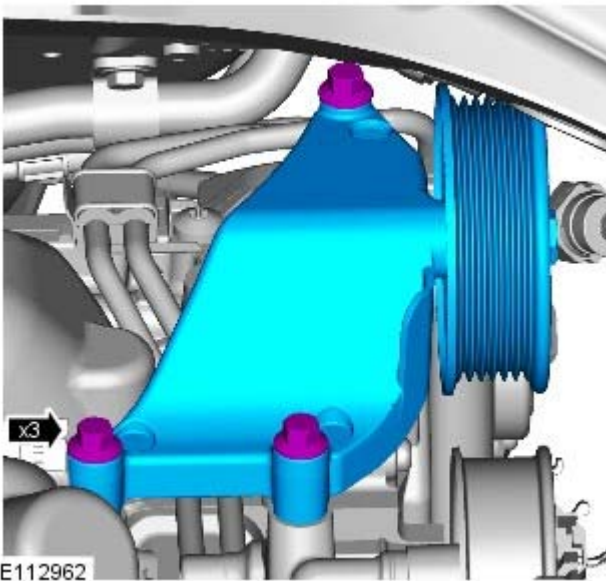


Make sure that all openings are sealed. Use new blanking caps.

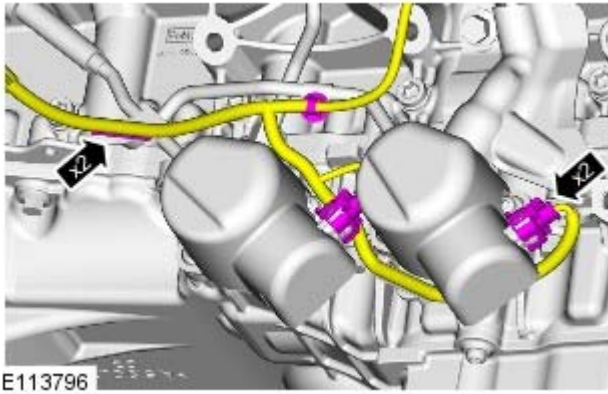
12. **12.**  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

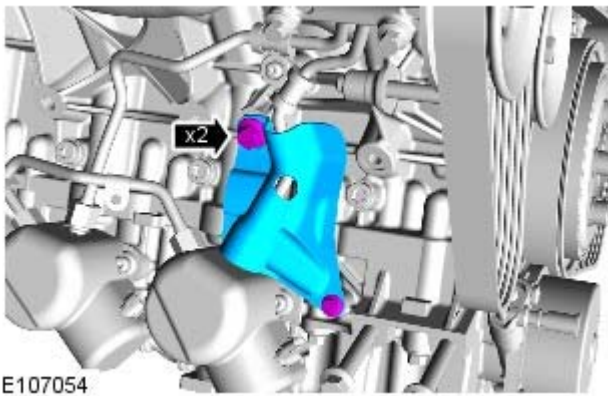
13. Refer to: [Steering Gear - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).
14. Refer to: [Engine Mount RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
15. Refer to: [Generator](#) (414-02D Generator and Regulator - V8 5.0L Petrol, Removal and Installation).



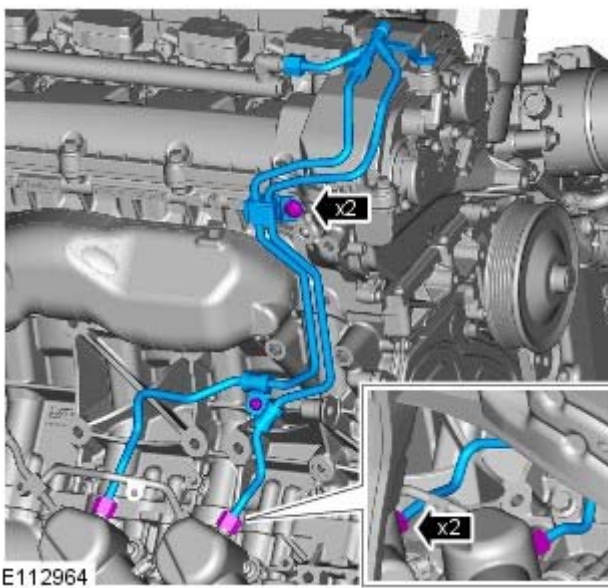
16.






17. **17.** NOTE: Engine shown removed for clarity.



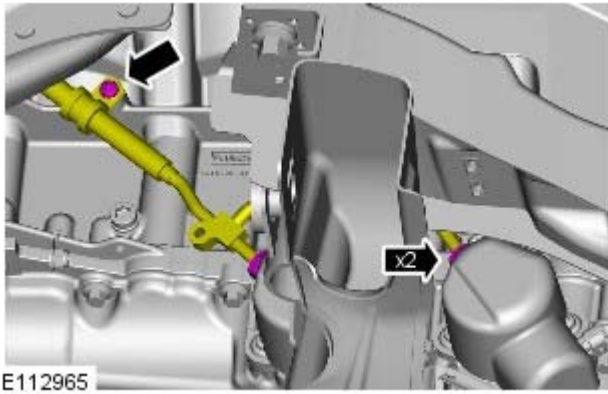
18. **18.** NOTE: Engine shown removed for clarity.



19. **19.** CAUTIONS:

-  Be prepared to collect escaping fluids.
-  Make sure that all openings are sealed. Use new blanking caps.
-  Remove and discard the high-pressure fuel supply lines.

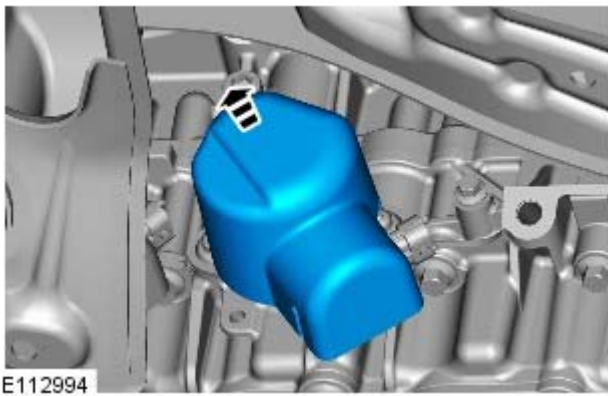
• NOTE: Engine shown removed for clarity.



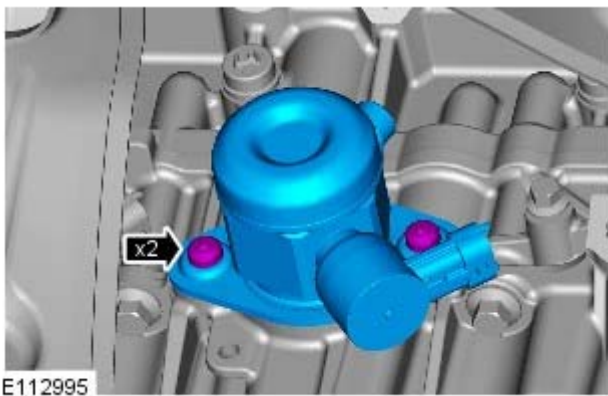
20. **20. CAUTIONS:**


 Be prepared to collect escaping fluids.

 Make sure that all openings are sealed. Use new blanking caps.




21.



22. **22.  CAUTION:** Be prepared to collect escaping fluids.

Loosen the Torx screws a turn each at a time.

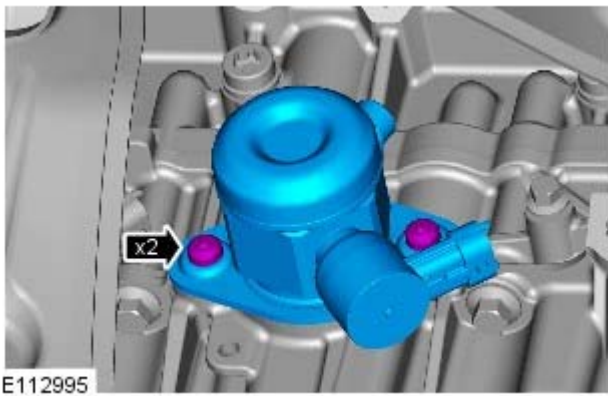



23. **23.  CAUTION:** Be prepared to collect escaping fluids.

Installation



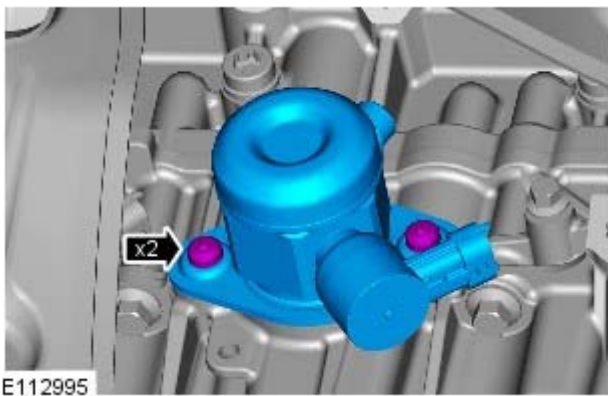
1. **NOTE:** Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



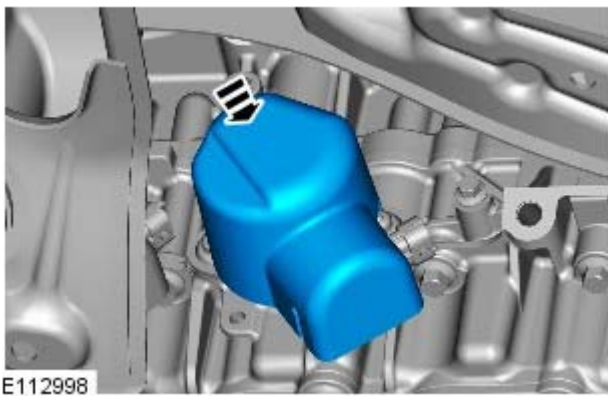
2.  **CAUTION:** Tighten the Torx screws a turn at a time until the correct torque is achieved.

- **NOTE:** Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

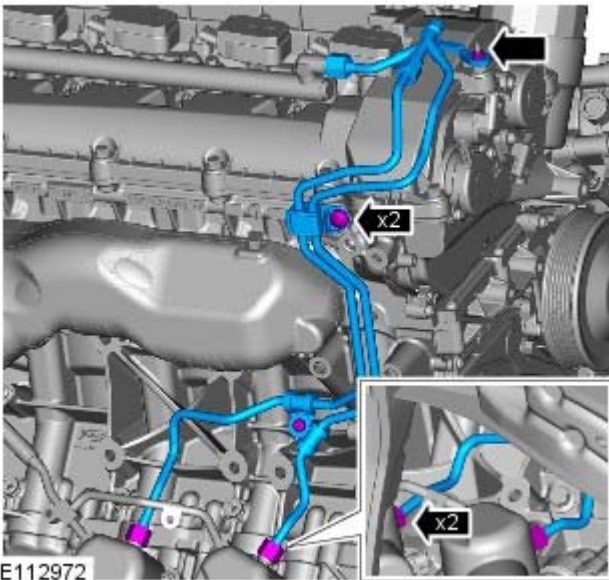
Torque: 11 Nm



3. Loosen the Torx screws half a turn each.




- 4.



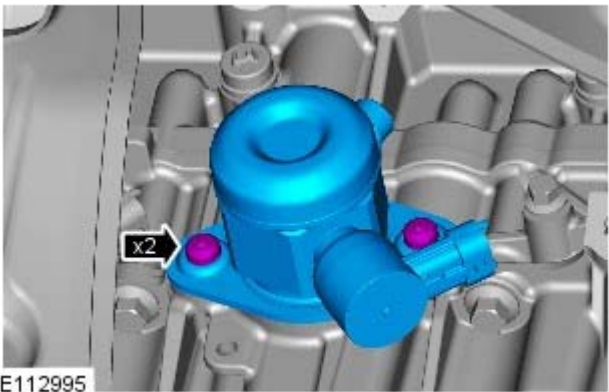
E112972

5. 5. CAUTIONS:


 Install new high-pressure fuel supply lines.

 Lubricate only the union threads with clean engine oil.

- NOTE: Remove and discard the blanking caps.
- NOTE: Engine shown removed for clarity.
- NOTE: Install the bolt and unions fully finger tight before final tightening.



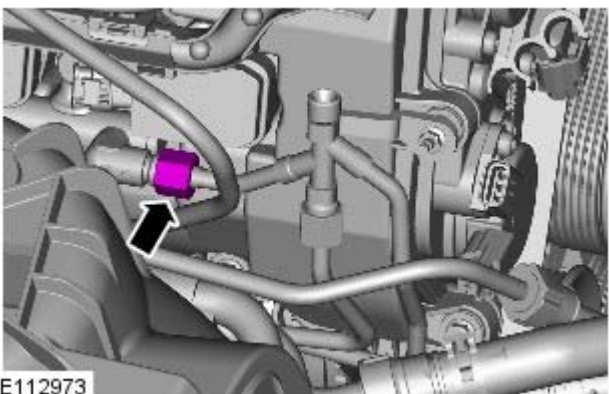
E112995

6.  CAUTION: Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

- NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

Torque: 11 Nm

7. Lower the vehicle.



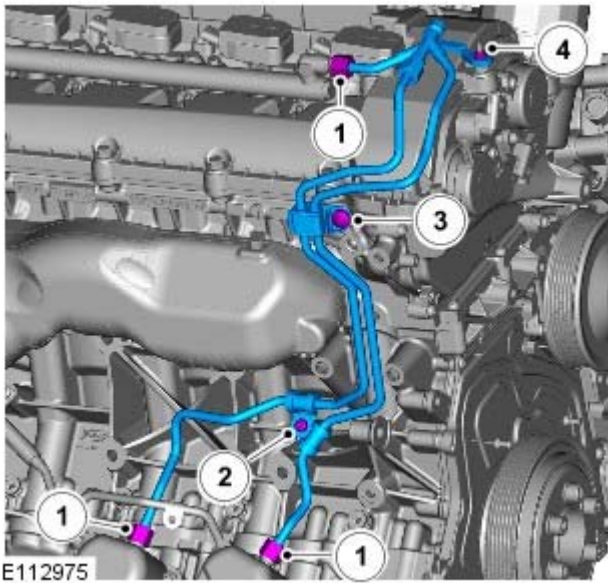
E112973

8. 8. NOTE: Do not tighten at this stage.

- NOTE: Remove and discard the blanking caps.

9.  WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

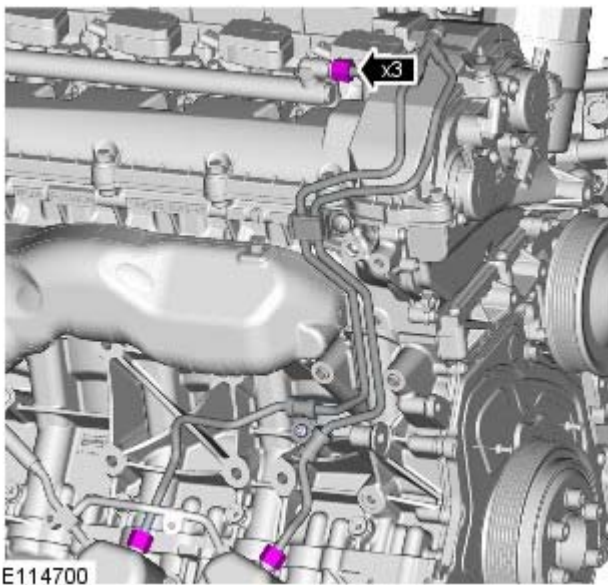
Raise and support the vehicle.



10. **10.** NOTE: Engine shown removed for clarity.

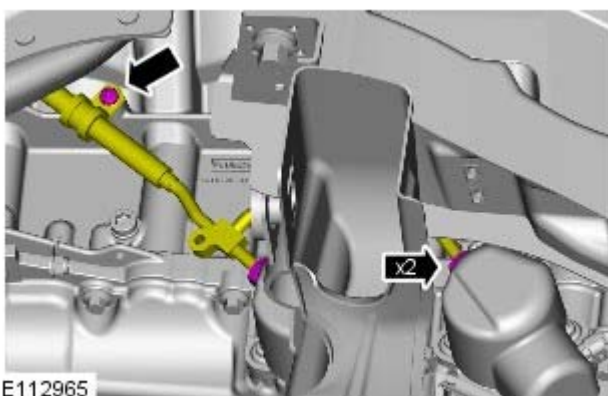
Torque:

- Unions (1) 21 Nm
- M6 (2) 11 Nm
- M8 (3) 25 Nm
- M5 nut (4) 6 Nm



11. **11.** NOTE: Engine shown removed for clarity.

Torque: 21 Nm

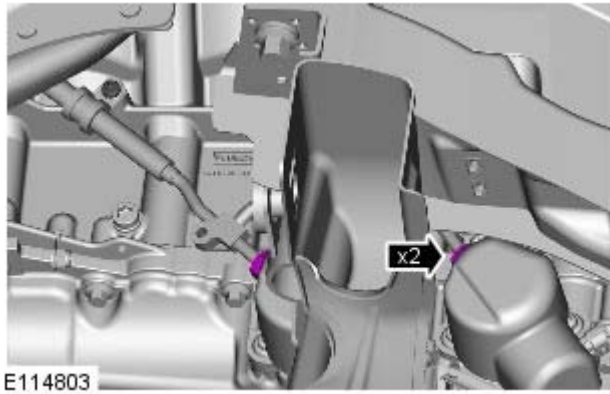


12. **12.** NOTE: Install the bolt and unions finger tight before final tightening.

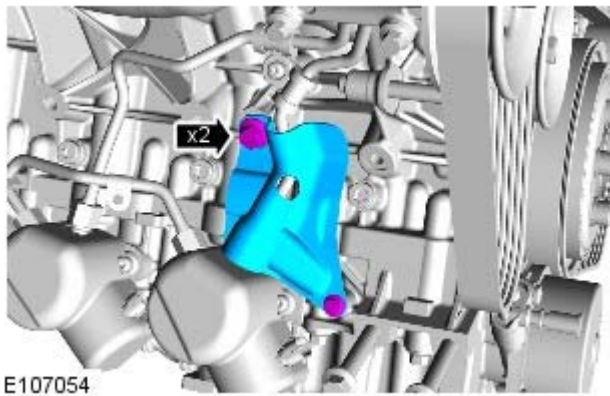
- NOTE: Remove and discard the blanking caps.

Torque:

- Unions 21 Nm
- M6 11 Nm

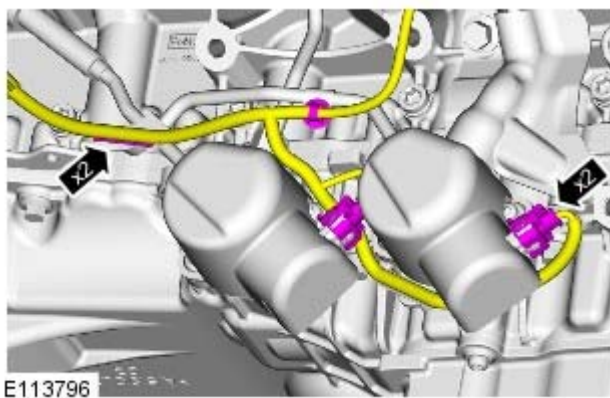


13. Torque: 21 Nm

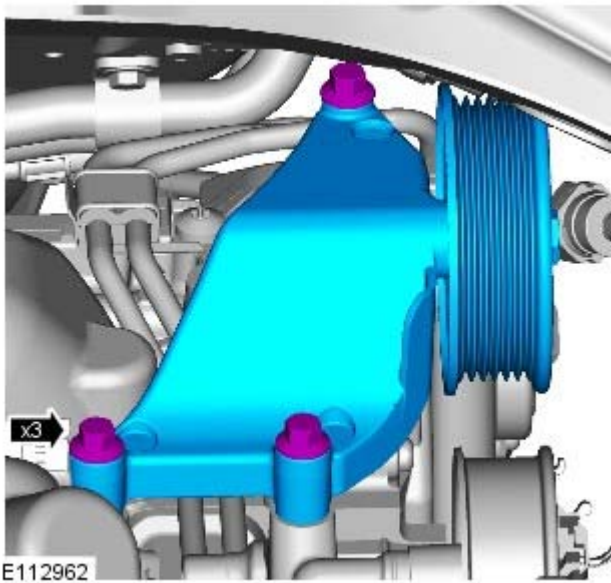


14. **14.** NOTE: Engine shown removed for clarity.

Torque:
M10 29 Nm
M6 11 Nm



15. **15.** NOTE: Engine shown removed for clarity.



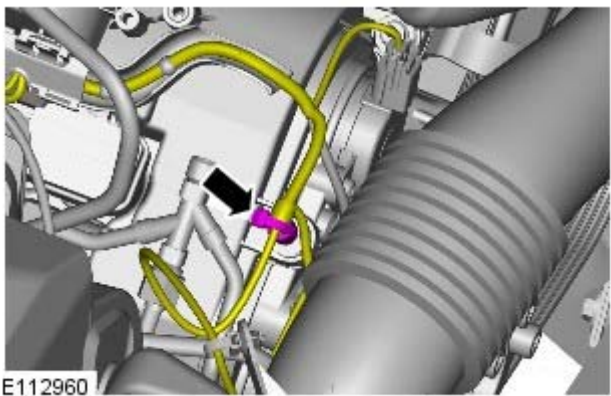
16. Torque: 25 Nm

17. Refer to: [Generator](#) (414-02D Generator and Regulator - V8 5.0L Petrol, Removal and Installation).

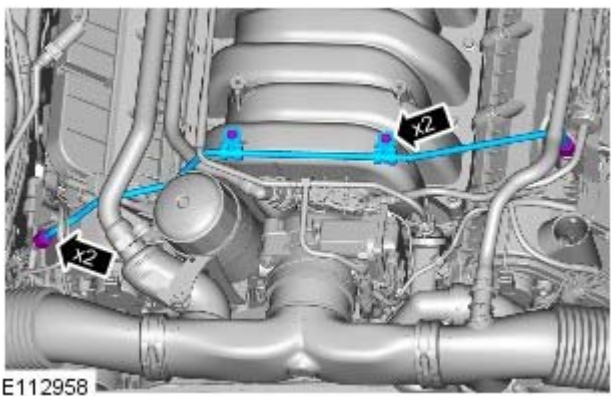
18. Refer to: [Engine Mount RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

19. Refer to: [Steering Gear - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).

20. Lower the vehicle.

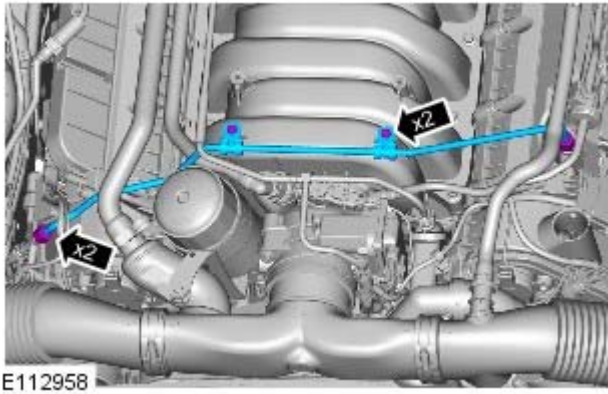


21.

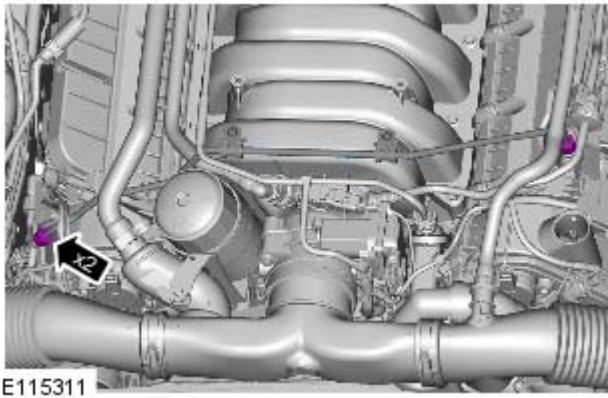


22. **22.** NOTE: Lubricate the union threads with clean engine oil.

- NOTE: Do not tighten at this stage.
- NOTE: Remove and discard the blanking caps.

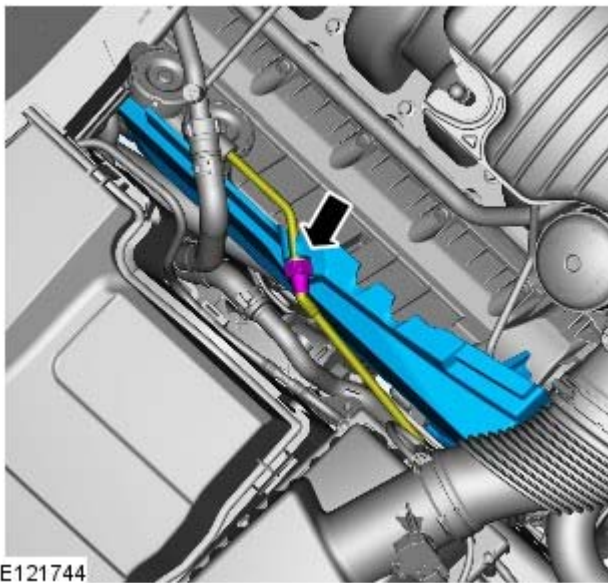


23. *Torque:*
Unions 21 Nm
Bolts 8 Nm

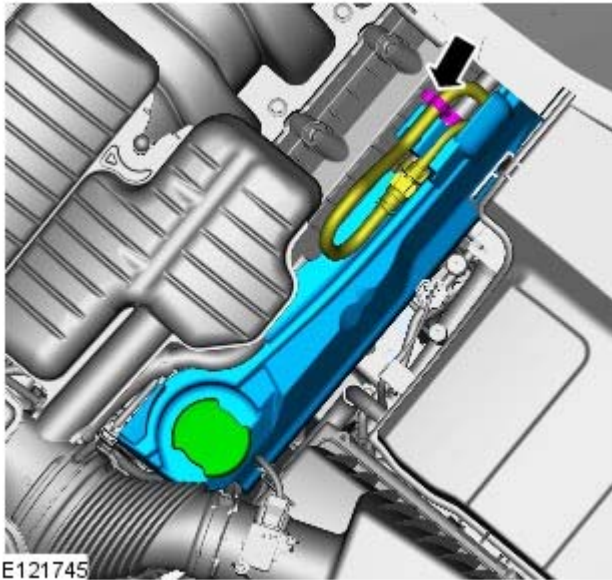


24. *Torque:* 21 Nm

25. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).



- 26.



27.

28. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).

29. Connect the battery ground cable.

Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

Fuel Charging and Controls - V8 5.0L Petrol - Right-Hand Fuel Rail High-Pressure Fuel Pump

Removal and Installation

Removal

• CAUTIONS:



Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



Make sure that tools and equipment are clean, free of foreign material and lubricant.

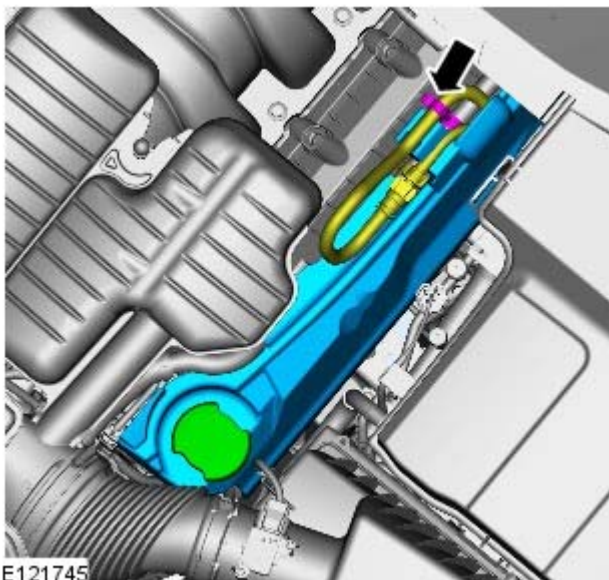
• NOTE: Removal steps in this procedure may contain installation details.


• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

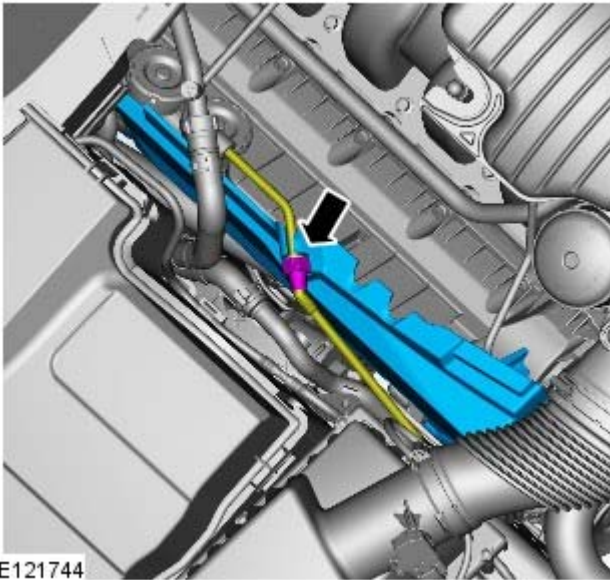
1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Refer to: [Fuel System Pressure Release - V8 5.0L Petrol](#) (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

4. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).



5.  CAUTION: Be prepared to collect escaping fluids.

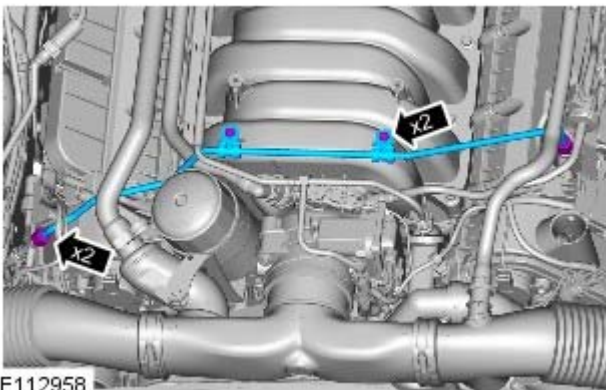


E121744

6.

7. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

8. Refer to: [Fuel Injection Component Cleaning](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).

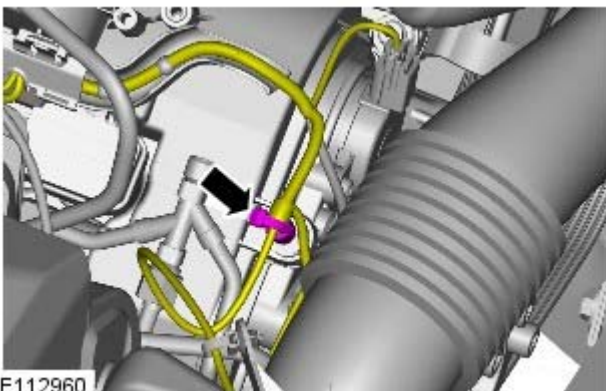


E112958

9. **9. CAUTIONS:**

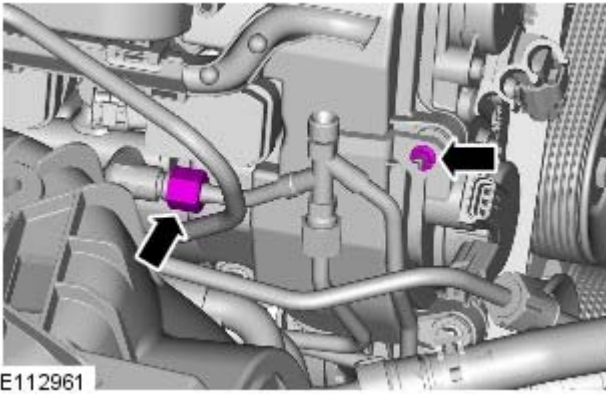
 Be prepared to collect escaping fluids.

 Make sure that all openings are sealed. Use new blanking caps.



E112960

10.




11. **11. CAUTIONS:**



Be prepared to collect escaping fluids.

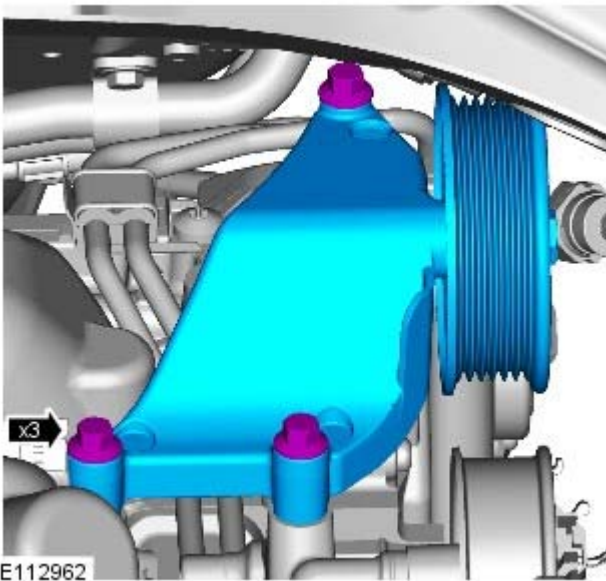


Make sure that all openings are sealed. Use new blanking caps.

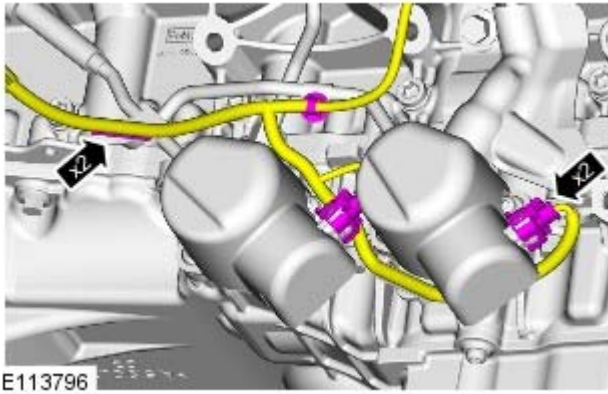
12. **12.**  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

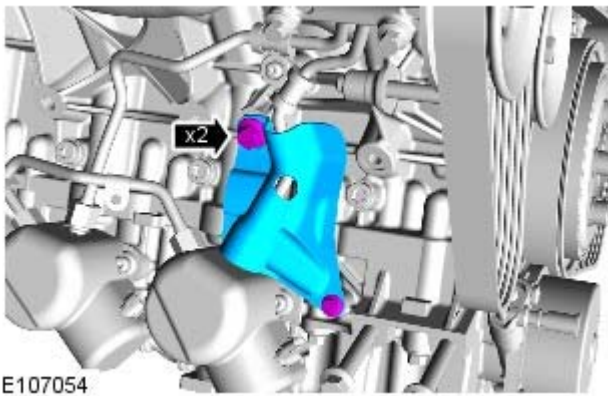
13. Refer to: [Steering Gear - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).
14. Refer to: [Engine Mount RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).
15. Refer to: [Generator](#) (414-02D Generator and Regulator - V8 5.0L Petrol, Removal and Installation).



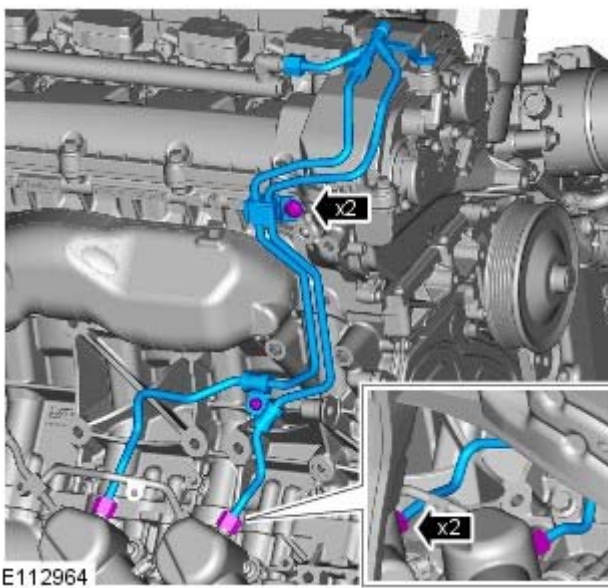
16.






17. **17.** NOTE: Engine shown removed for clarity.



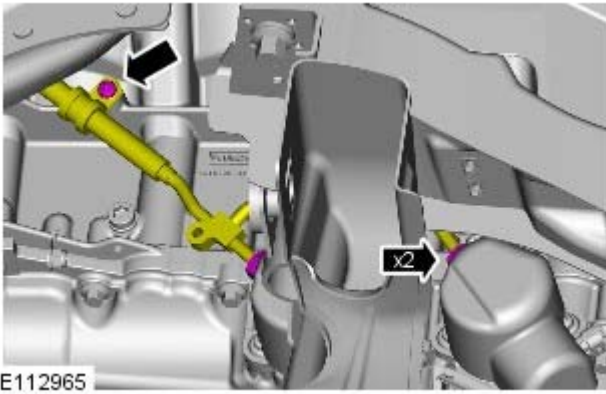
18. **18.** NOTE: Engine shown removed for clarity.



19. **19.** CAUTIONS:

-  Be prepared to collect escaping fluids.
-  Make sure that all openings are sealed. Use new blanking caps.
-  Remove and discard the high-pressure fuel supply lines.

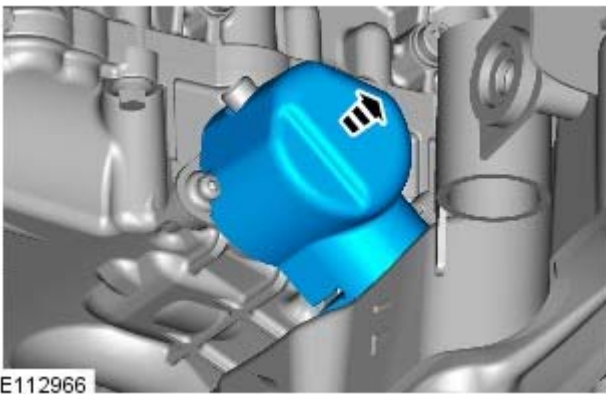
• NOTE: Engine shown removed for clarity.



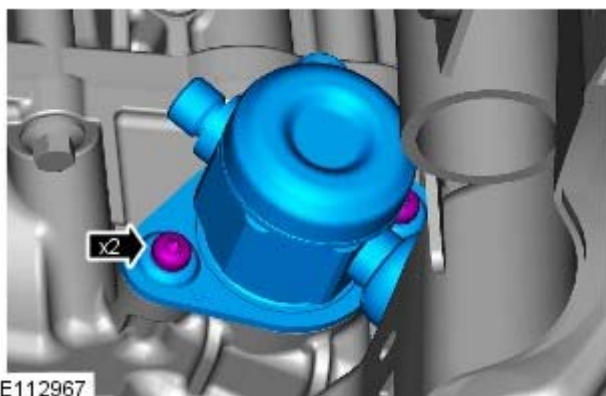
20. 20. CAUTIONS:


 Be prepared to collect escaping fluids.

 Make sure that all openings are sealed. Use new blanking caps.

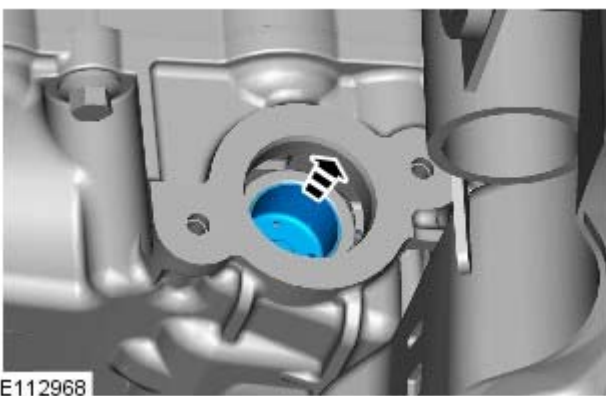



21.



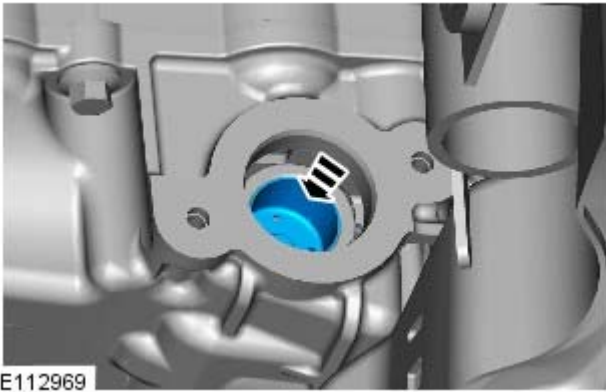
22.  CAUTION: Be prepared to collect escaping fluids.

Loosen the Torx screws a turn each at a time.

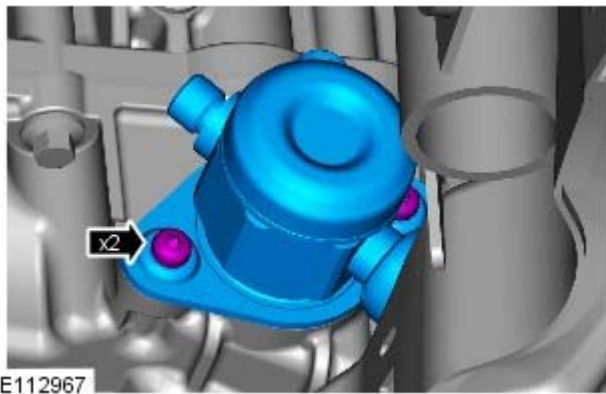


23.  CAUTION: Be prepared to collect escaping fluids.

Installation



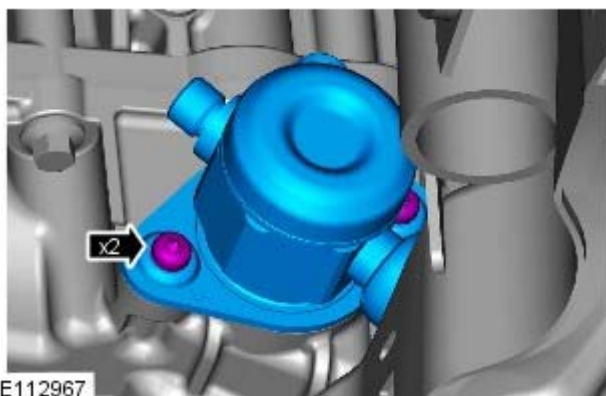
1. **NOTE:** Lubricate the fuel rail high-pressure fuel pump bucket with clean engine oil.



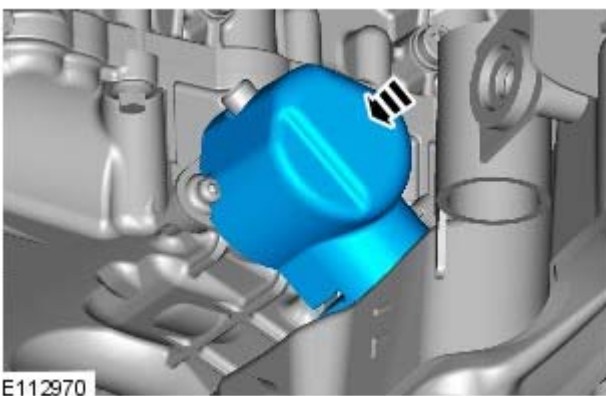
2. **CAUTION:** Tighten the Torx screws a turn at a time until the correct torque is achieved.

- **NOTE:** Lubricate the fuel rail high-pressure fuel pump O-ring seal with clean engine oil.

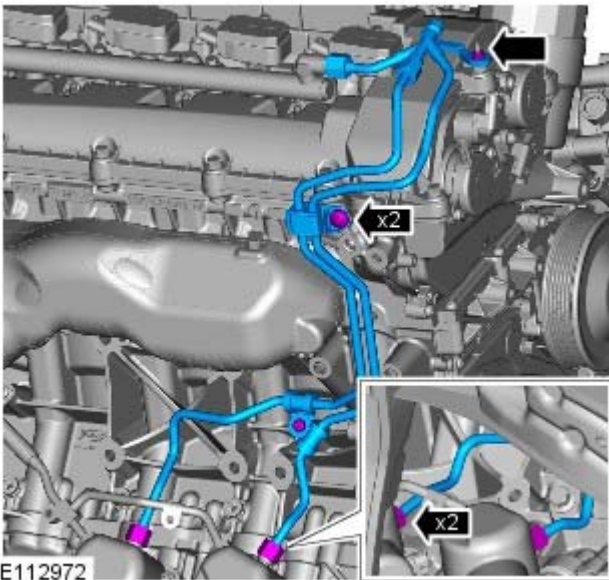
Torque: 11 Nm



3. Loosen the Torx screws half a turn each.




- 4.



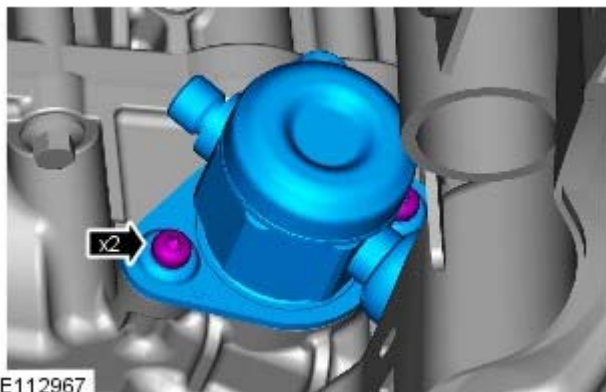
E112972

5. **5. CAUTIONS:**


 Install new high-pressure fuel supply lines.

 Lubricate only the union threads with clean engine oil.

- NOTE: Remove and discard the blanking caps.
- NOTE: Engine shown removed for clarity.
- NOTE: Install the bolt and unions fully finger tight before final tightening.



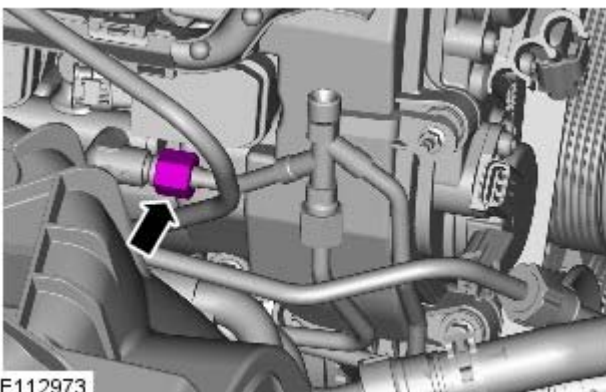
E112967

6.  **CAUTION:** Care must be taken when positioning the fuel rail high-pressure fuel pump cover to one side.

- NOTE: Fuel rail high-pressure fuel pump cover shown removed for clarity.

Torque: 11 Nm

7. Lower the vehicle.



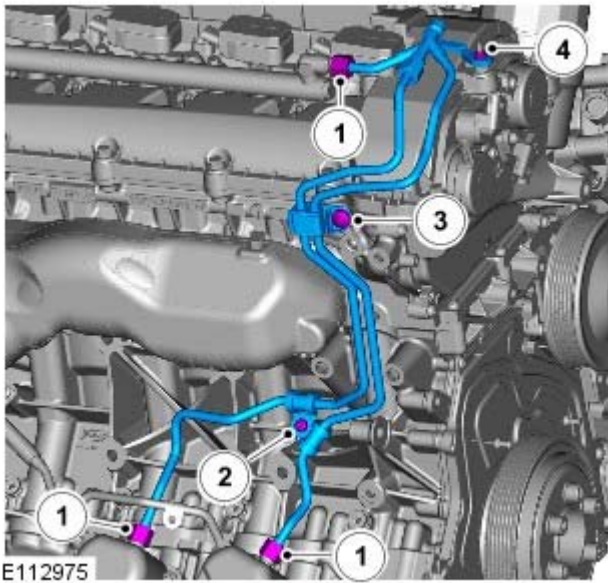
E112973

8. **8. NOTE:** Do not tighten at this stage.

- NOTE: Remove and discard the blanking caps.

9.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

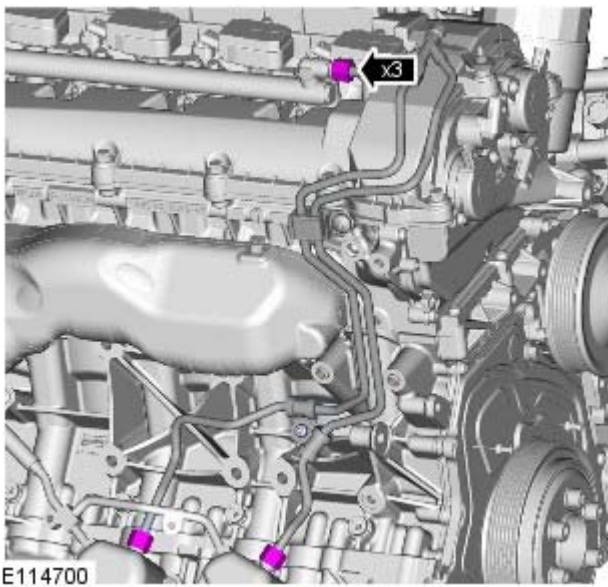
Raise and support the vehicle.



10. **10.** NOTE: Engine shown removed for clarity.

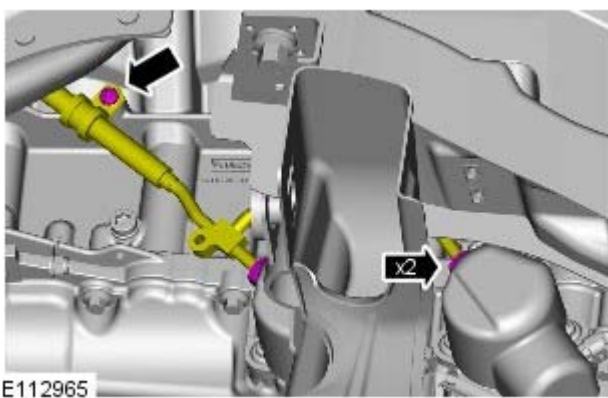
Torque:

- Unions (1) 21 Nm
- M6 (2) 11 Nm
- M8 (3) 25 Nm
- M5 nut (4) 6 Nm



11. **11.** NOTE: Engine shown removed for clarity.

Torque: 21 Nm

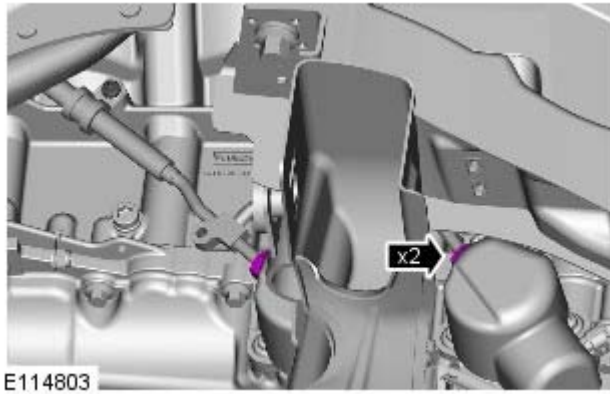


12. **12.** NOTE: Install the bolt and unions finger tight before final tightening.

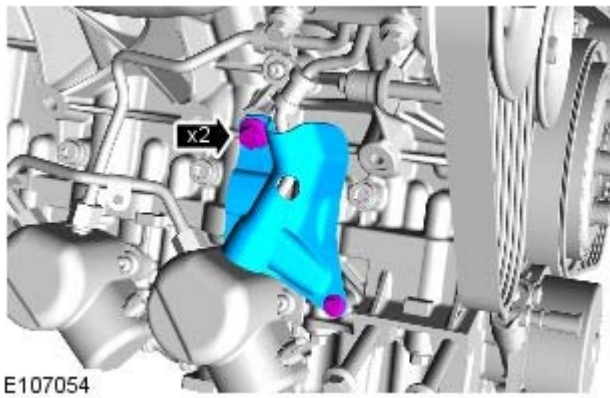
- NOTE: Remove and discard the blanking caps.

Torque:

- Unions 21 Nm
- M6 11 Nm

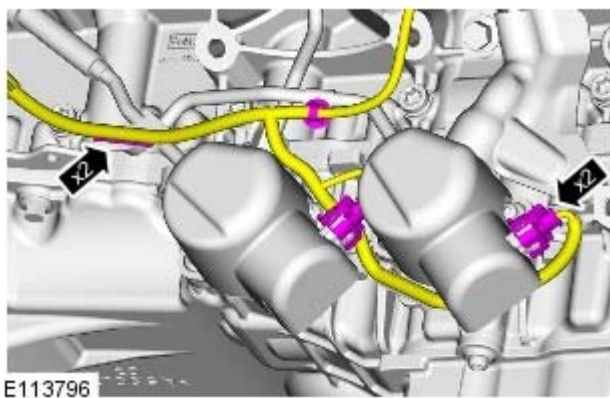


13. Torque: 21 Nm

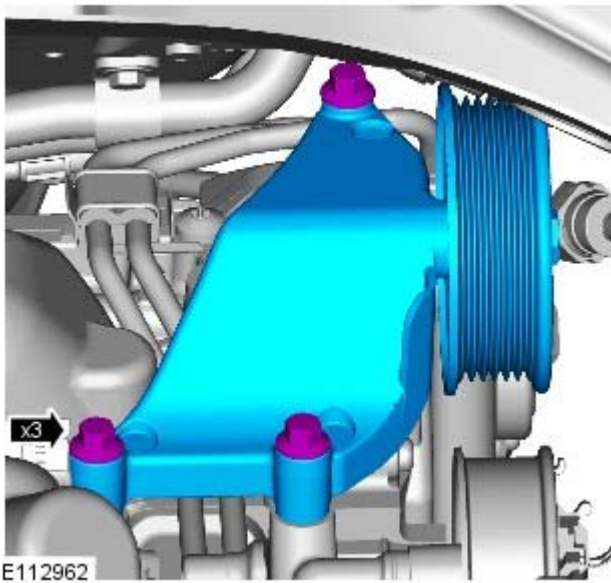


14. **14.** NOTE: Engine shown removed for clarity.

Torque:
M10 29 Nm
M6 11 Nm



15. **15.** NOTE: Engine shown removed for clarity.



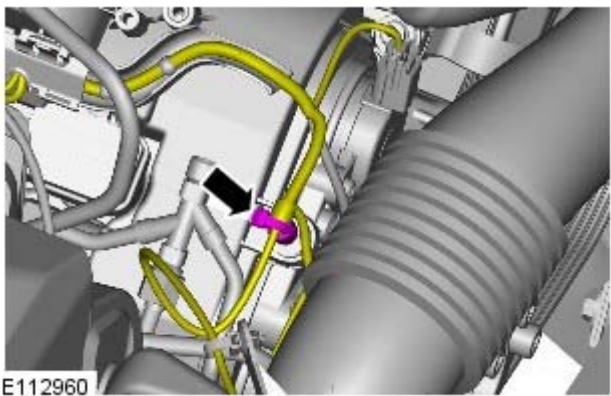
16. Torque: 25 Nm

17. Refer to: [Generator](#) (414-02D Generator and Regulator - V8 5.0L Petrol, Removal and Installation).

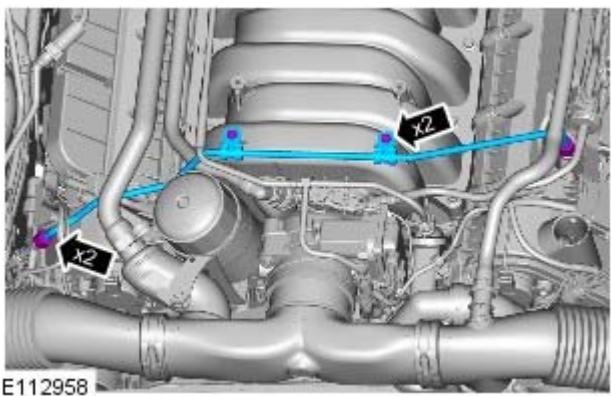
18. Refer to: [Engine Mount RH](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

19. Refer to: [Steering Gear - V8 5.0L Petrol](#) (211-02 Power Steering, Removal and Installation).

20. Lower the vehicle.

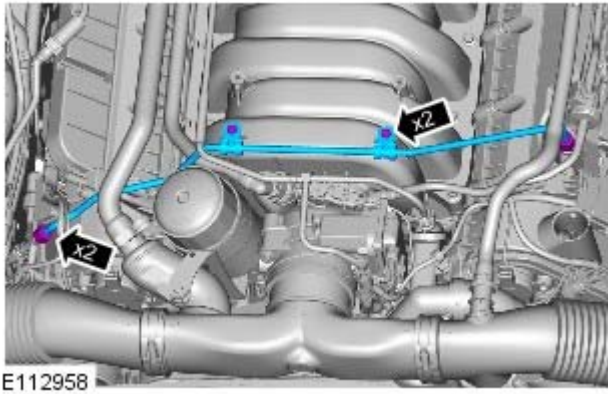


21.

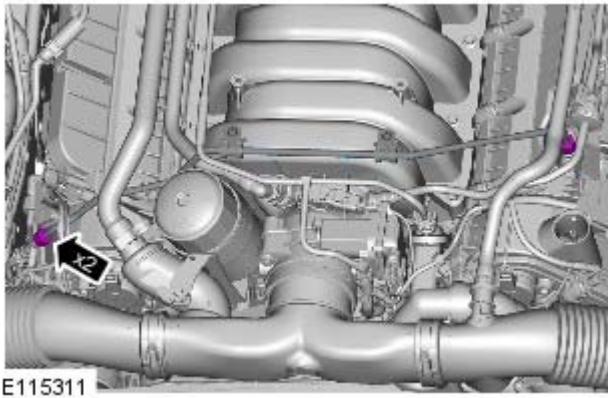


22. **22.** NOTE: Lubricate the union threads with clean engine oil.

- NOTE: Do not tighten at this stage.
- NOTE: Remove and discard the blanking caps.

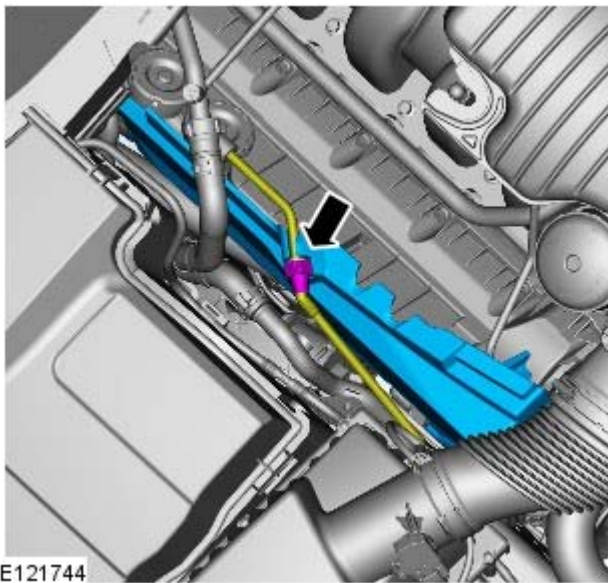


23. *Torque:*
Unions 21 Nm
Bolts 8 Nm

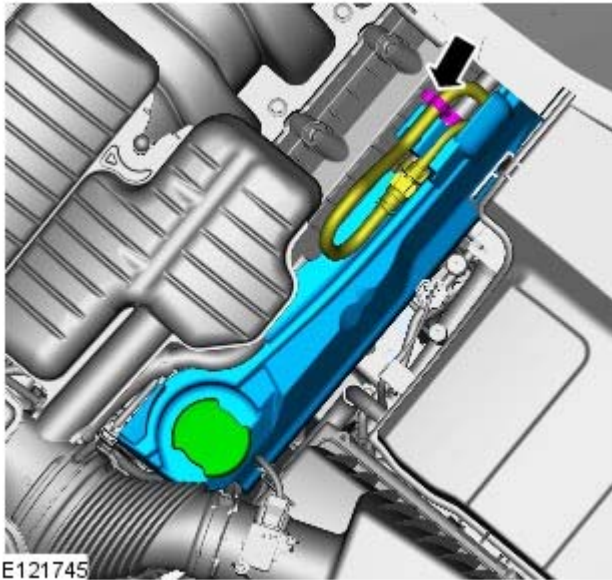


24. *Torque:* 21 Nm

25. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).



- 26.



27.

28. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).

29. Connect the battery ground cable.

Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

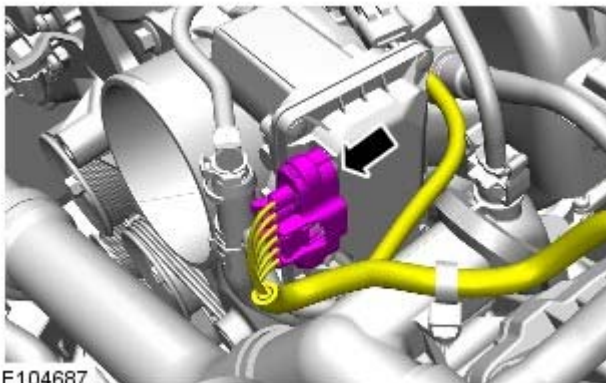
Fuel Charging and Controls - V8 5.0L Petrol - Throttle Body

Removal and Installation

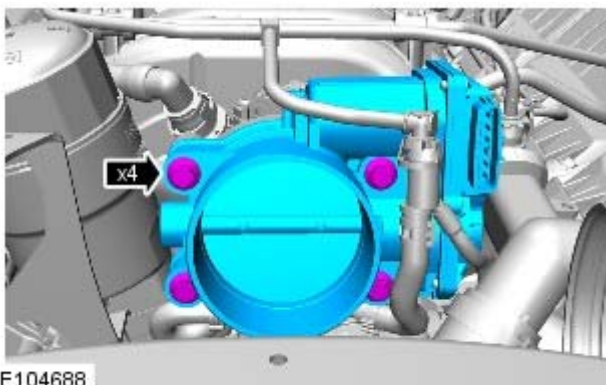
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

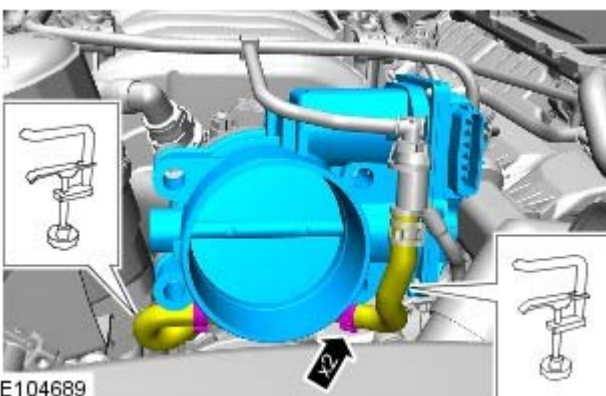


2. **2.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.




3. **3.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 17 Nm



4. **4. CAUTIONS:**

 Do not attempt to clean the throttle body bore, build up of deposits reduces air leakage past the throttle plate at the fully closed position.

 Be prepared to collect escaping fluids.

- NOTE: Clamp the hose to minimize coolant loss.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Installation

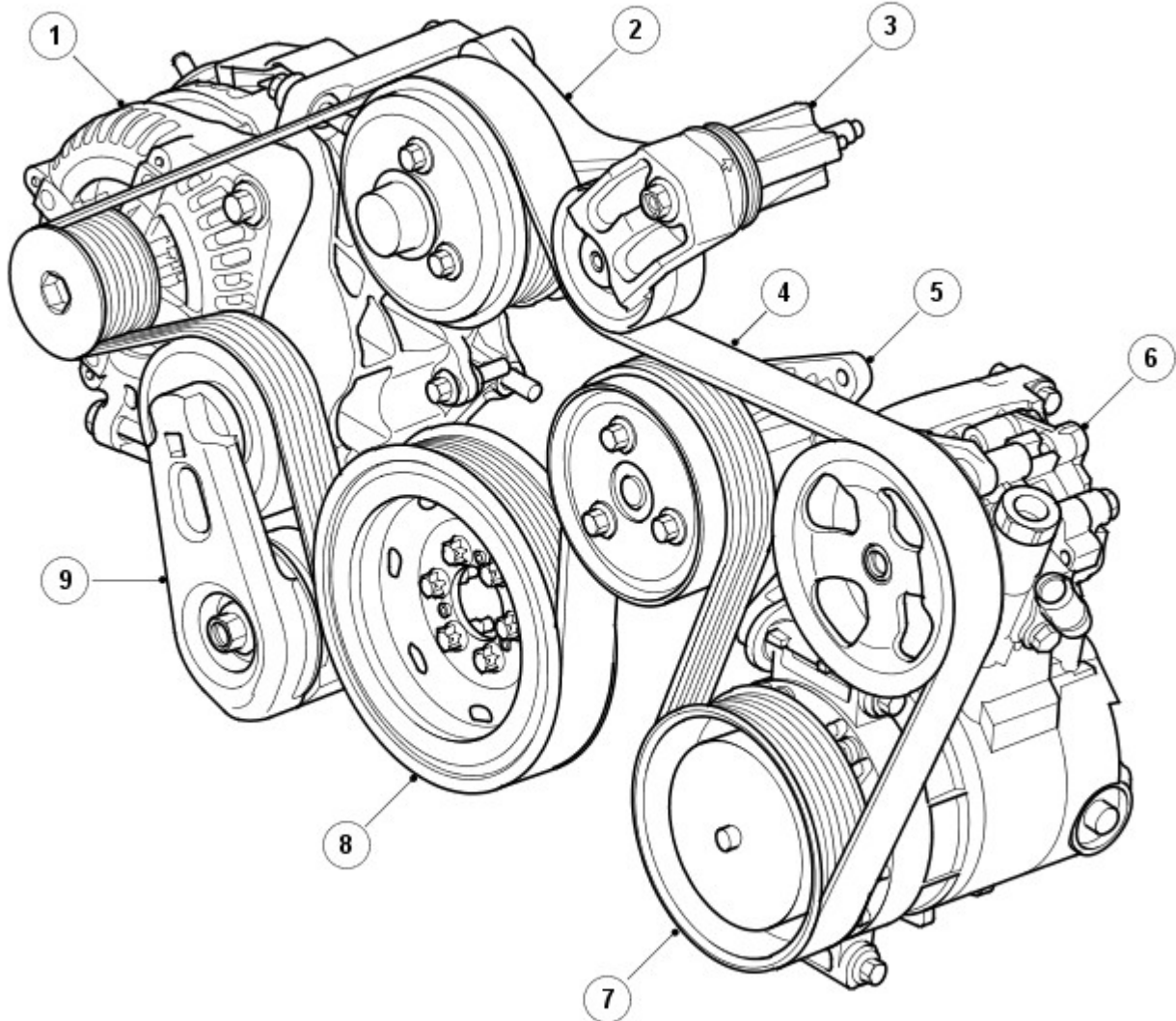
1. To install, reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Accessory Drive - TDV6 2.7L Diesel -**Torque Specifications**

Description	Nm	lb-ft
Accessory drive belt tensioner pulley Torx bolt	25	18
Accessory drive belt tensioner retaining bolt	45	33
Accessory drive belt idler retaining bolt	45	33
Fuel injection high pressure pump drive belt tensioner	25	18
EGR coolant cross over pipe	22	16

Accessory Drive - TDV6 2.7L Diesel - Accessory Drive

Description and Operation



E50593

Item	Part Number	Description
1	-	Generator
2	-	Engine cooling fan
3	-	Tensioner assembly
4	-	Accessory drive belt
5	-	Engine coolant pump
6	-	Power steering pump
7	-	A/C compressor
8	-	Torsional vibration damper
9	-	Tensioner assembly

The engine crankshaft pulley drives the accessory components, which comprise the torsional vibration damper, generator, power steering pump, A/C compressor and coolant pump, via the accessory drive belt.

The belt, which is maintenance free poly-V type belts, are automatically pre-loaded by the tensioning rollers and are routed over deflection pulleys in order to maintain sufficient adhesion about the drive wheels. This ensures slip-free drive of the accessory components.

Accessory Drive - TDV6 2.7L Diesel - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Accessory Drive](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Drive belt condition (cracking/damage/contamination) ● Idler assembly ● Generator ● Engine cooling fan ● Tensioner assembly ● Engine coolant pump ● Power steering pump ● Air Conditioning (A/C) compressor ● Torsional vibration damper ● Dynamic response pump ● Tensioner assembly ● Accessory drive belt ● Security/Correct installation of the fuel injection pump cover ● Fuel injection pump belt condition (cracking/damage/contamination) ● Fuel injection pump belt tensioner assembly ● Fuel injection pump ● Fuel injection pump belt

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.



CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart (accessory drive belt)

Symptom	Possible Causes	Action
Noise	<ul style="list-style-type: none"> ● Belt condition ● Belt tension ● Pulleys misaligned ● Driven components (including tensioners) 	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary.
Drive belt does not hold tension	<ul style="list-style-type: none"> ● Belt condition ● Tensioner fault 	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.

Symptom Chart (fuel injection pump belt)

Symptom	Possible Causes	Action
Noise	<ul style="list-style-type: none"> ● Belt condition ● Belt fouling cover ● Tensioner bearing failure ● Fuel injection pump failure 	Check the belt condition (see visual inspection). Check the belt cover for indications of fouling (this may indicate a pump misalignment), refer to the relevant workshop manual section. The belt tensioner must be renewed if the belt is removed, making a check of the bearing impractical. Remove the belt, check the fuel injection pump pulley for security. Check the fuel injection pump for excessive resistance to rotation (excessive resistance in the pump will cause the pulley securing nut to loosen as a design feature). Check for diagnostic trouble codes (DTCs) indicating a pump malfunction.

Symptom	Possible Causes	Action
Drive belt does not hold tension	<ul style="list-style-type: none"> ● Belt condition ● Tensioner fault 	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.
Loss of drive (with no drive to the fuel injection pump, the engine will not run)	<ul style="list-style-type: none"> ● Belt broken/stripped teeth ● Drive pulleys loose 	Investigate the cause of the belt breakage/damage (a belt broken at a 45 degree angle normally indicates a shear, a break straight across the belt normally indicates that the belt has been crimped). Check the fuel injection pump for excessive resistance to rotation (excessive resistance in the pump will cause the pulley securing nut to loosen as a design feature). Check for DTCs indicating a pump malfunction.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.


Accessory Drive - TDV6 2.7L Diesel - Fuel Injection Pump Belt VIN Range:

SALLA000304->END OF 06 MY

Removal and Installation

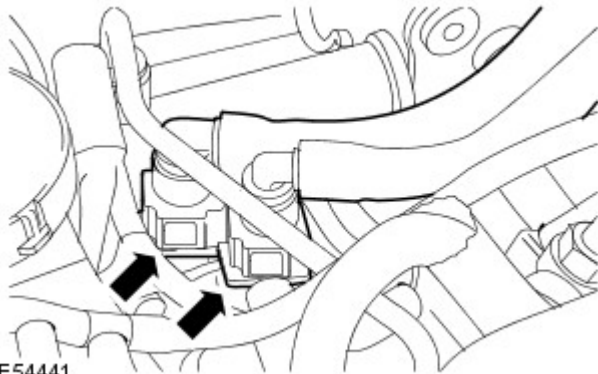
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

Disconnect the two fuel lines.

- Install blanking caps to the exposed ports.



E54441

4. Clamp the exhaust gas recirculation (EGR) coolant hoses to minimize coolant loss.



E53902

5. Disconnect the coolant hoses.

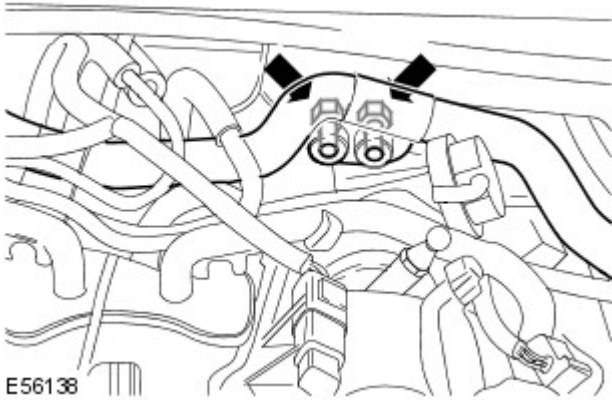
- Release the clips.



E53903

6. Remove the EGR coolant cross-over pipe.

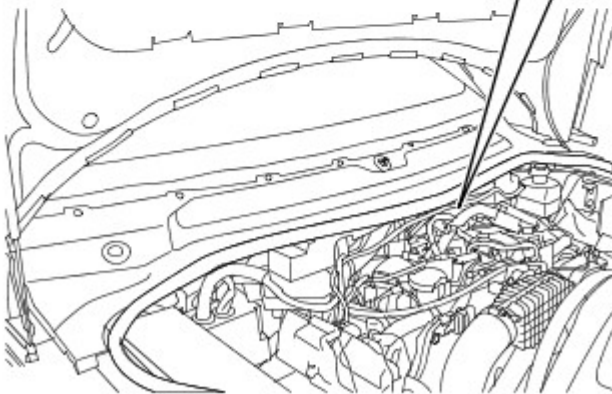
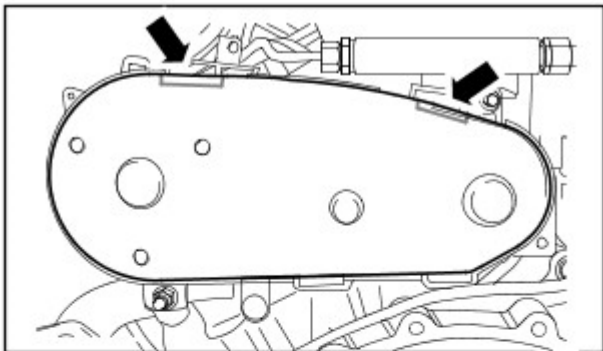
- Remove the two retaining bolts.



E56136

7. Remove the fuel injection pump belt cover.

- Reposition the fuel charging wiring harness to allow access to the fuel injection pump belt cover.

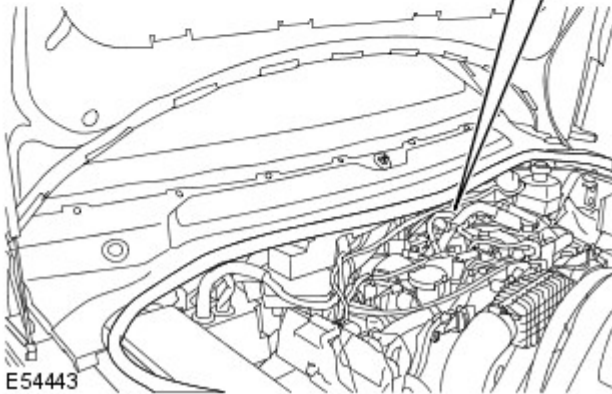
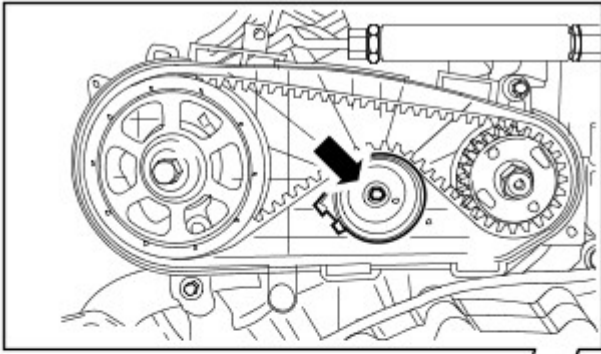


E54442

8. NOTE: The fuel injection pump belt is not timed to the engine.

Remove and discard the fuel injection pump belt tensioner.

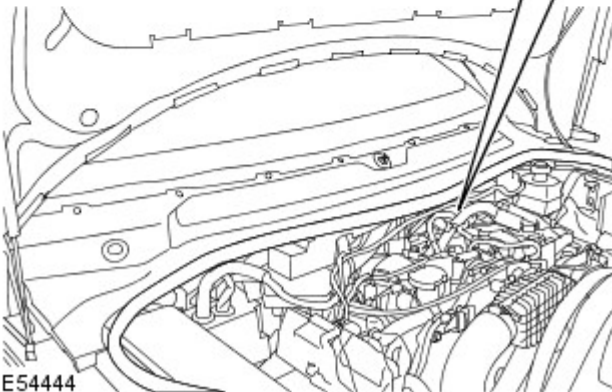
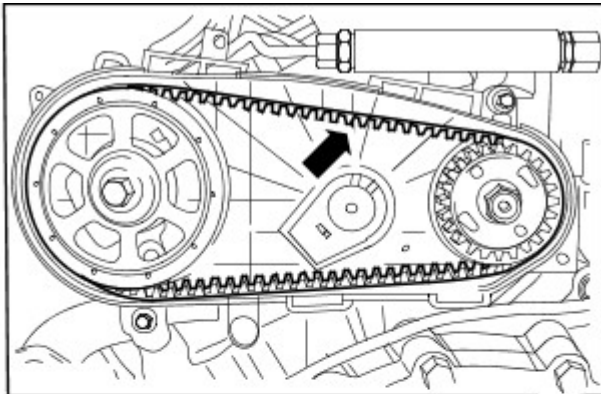
- Remove the retaining bolt.



E54443

9. NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Remove and discard the fuel injection pump belt.



E54444


Installation

- 1. ⚠ CAUTION:** Do not install the new fuel injection pump belt to the pulleys with the fuel pump belt tensioner installed. Failure to follow this instruction may result in damage to the fuel pump

belt.

- NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Install the new fuel injection pump belt.

2.  CAUTION: Make sure that the fuel injection pump belt tensioner tang is correctly located to the fuel injection pump belt rear cover. Failure to follow this instruction may result in damage to the engine.

Install a new fuel injection pump belt tensioner.





- Locate the tang on the new fuel injection pump belt tensioner into the fuel injection pump rear cover.
 - Tighten to 25 Nm (18 lb.ft).
 - Remove and discard the fuel injection pump belt tensioner locking pin.
3. Install the fuel injection pump belt cover.
- Reposition the fuel charging wiring harness back onto the diverter rail.
4. Install the EGR coolant cross-over pipe.
- Install the two retaining bolts.
 - Tighten the bolts to 22 Nm (16 lb.ft).
5. Connect the coolant hoses.
- Remove the hose clamps.
6. Attach the fuel lines.
- Connect the two fuel lines.
 - Remove the blanking caps from the ports.
7. Install the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
8. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
9. Check and top-up the coolant.

Accessory Drive - TDV6 2.7L Diesel - Fuel Injection Pump Belt VIN Range: 07 MODEL YEAR->CURRENT





Removal and Installation

Removal

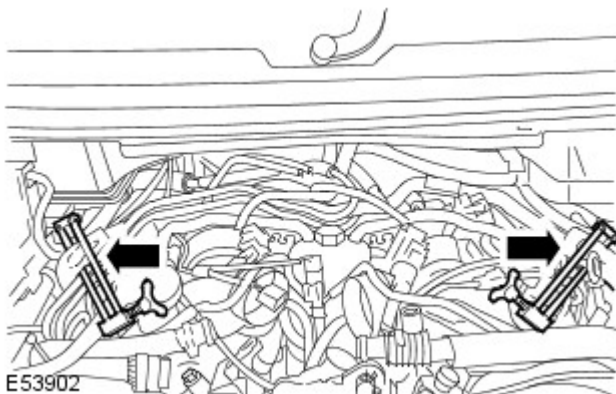
• WARNINGS:

-  Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.
-  Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

-  Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.
-  Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Clamp the exhaust gas recirculation (EGR) coolant hoses to minimize coolant loss.



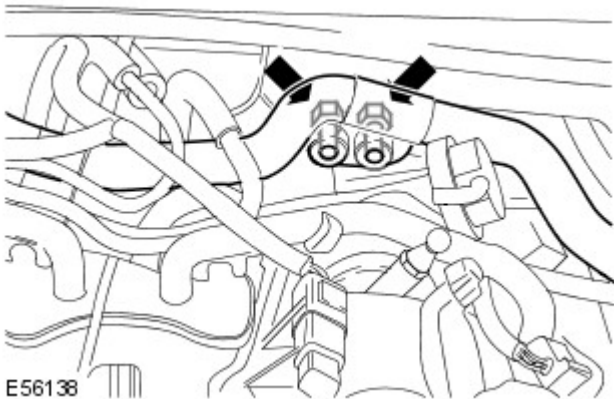
4. Disconnect the coolant hoses.

- Release the clips.



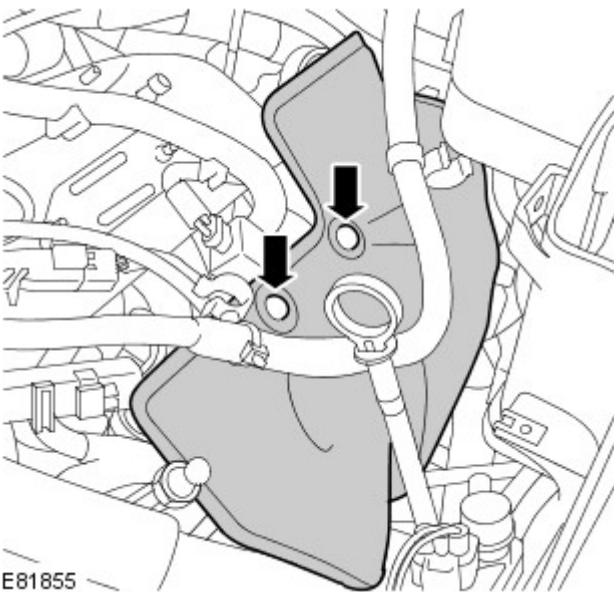
5. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.



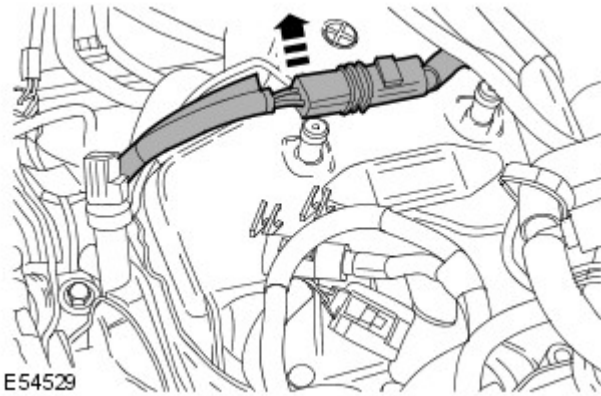
6. Remove the injector sound proofing.

- Remove the 2 clips.

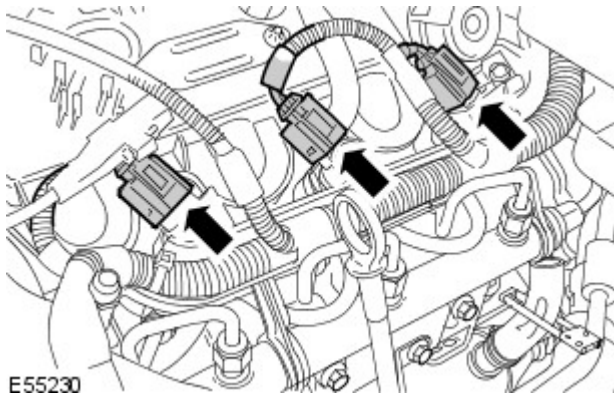


7. Release the knock sensor (KS) harness from the valve cover.

8. Release the glow plug harness from the valve cover.

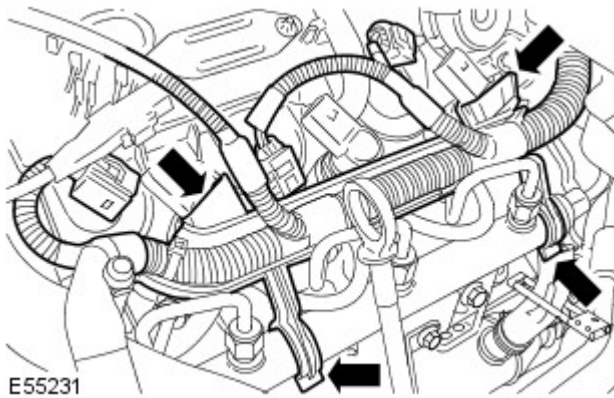


9. Disconnect the fuel injector electrical connectors.



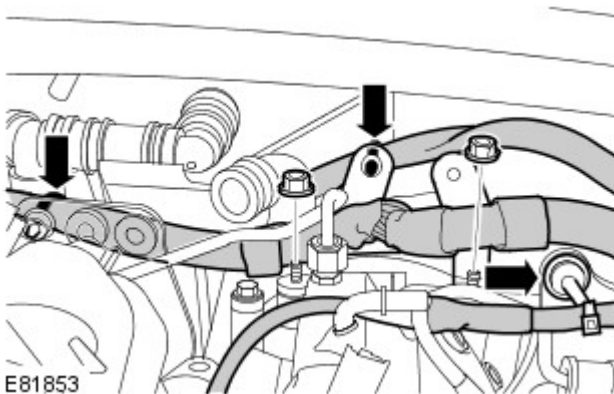
10. Release the engine wiring harness.

- Release the four clips.



11. Release the fuel charging wiring harness.

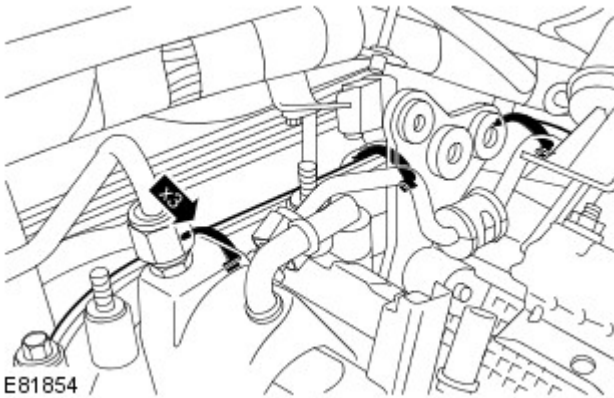
- Release the 3 clips.
- Remove the 2 nuts.





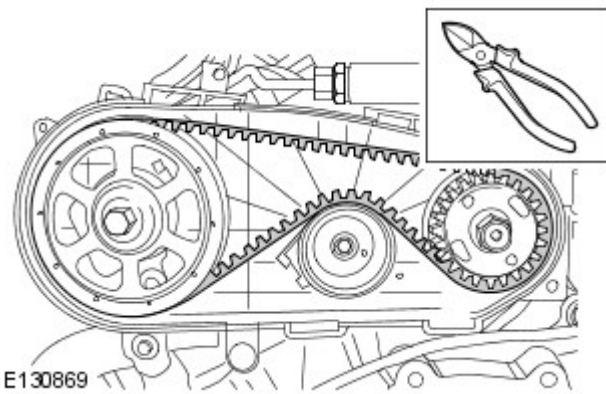
12. Disconnect the breather line.

- Release the clip.



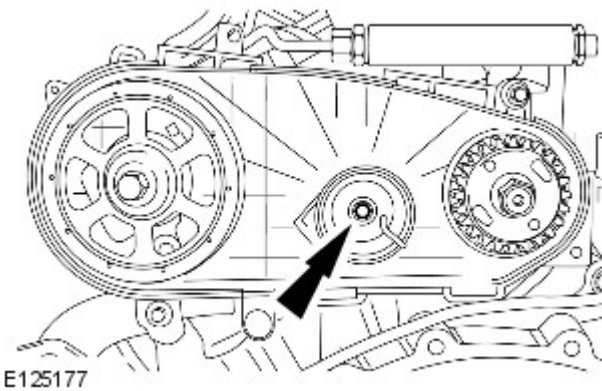
13. Remove the fuel injection pump belt cover.

- Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.
- Release the 3 clips.



14. NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Cut off and discard the fuel injection pump belt.

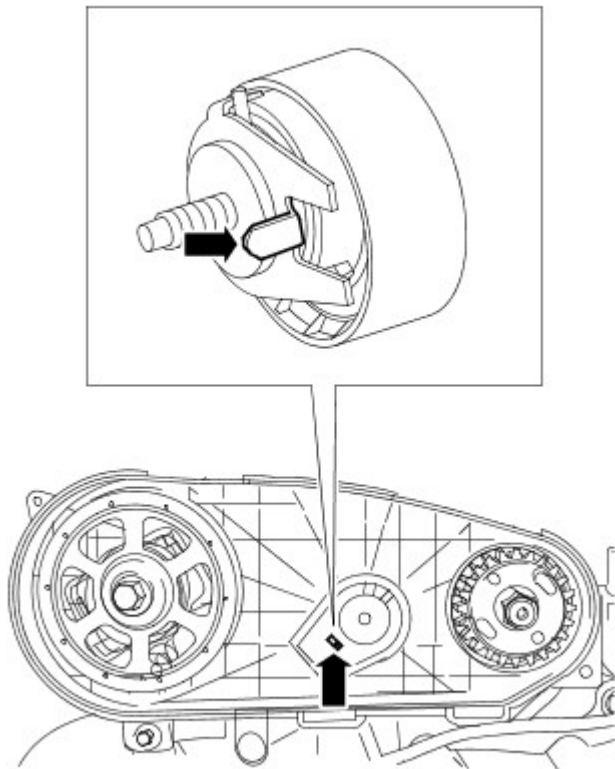


15. NOTE: The fuel injection pump belt is not timed to the engine.


Remove and discard the fuel injection pump belt tensioner.

- Remove and discard the bolt.

Installation




E81861

1.  CAUTION: Make sure that the fuel injection pump belt tensioner tang is correctly located to the fuel injection pump belt rear cover. Failure to follow this instruction may result in damage to the engine.

• NOTE: Do not remove the fuel injection pump belt tensioner locking pin at this stage.

Install a new fuel injection pump belt tensioner.

- Clean the components mating faces.
- Locate the tang on the new fuel injection pump belt tensioner into the fuel injection pump rear cover.
- Tighten the bolt to 25 Nm (18 lb.ft).

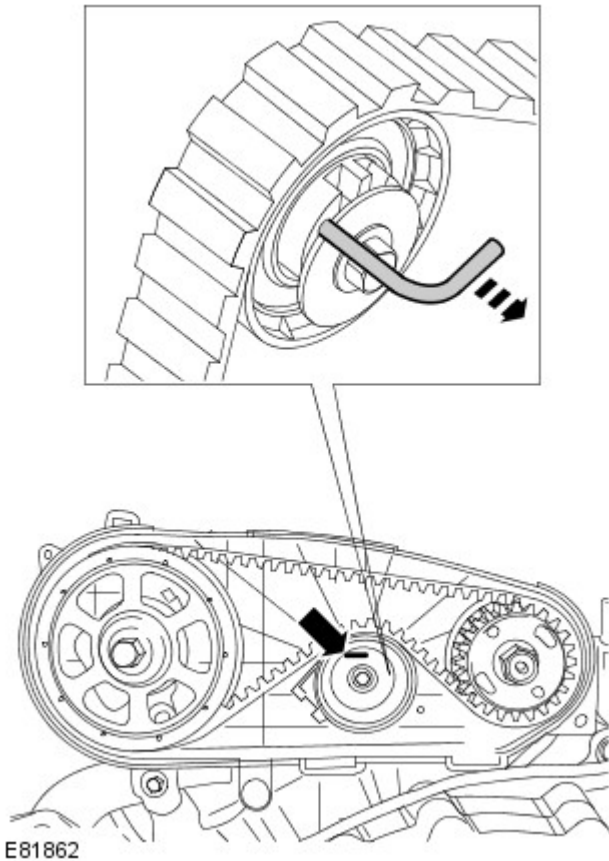
2.  CAUTION: Do not install the new fuel injection pump belt to the pulleys with the fuel pump belt tensioner locking pin removed. Failure to follow this instruction may result in damage to the fuel pump belt.

• NOTE: The fuel injection pump rotates in a counter-clockwise direction when viewed from the rear of the engine.

Install the new fuel injection pump belt.

- Make sure the components are clean and dry.

3. Remove and discard the fuel injection pump belt tensioner locking pin.



4. Install the fuel injection pump belt cover.
 - Secure with the 3 clips.
 - Reposition the engine wiring harness to allow access to the fuel injection pump belt cover.
5. Attach the fuel charging wiring harness.
 - Secure with the 3 clips.
 - Tighten the nuts to 10 Nm (7 lb.ft).
6. Secure the engine wiring harness.
7. Connect the fuel injector electrical connectors.
8. Secure the glow plug wiring harness.
9. Secure the KS wiring harness.
10. Install the injector sound proofing.
 - Secure with the 2 clips.
11. Connect the breather line.
 - Secure with the clip.
12. Install the EGR coolant cross-over pipe.
 - Install the two retaining bolts.
 - Tighten to 13 Nm (10 lb.ft).
13. Connect both EGR coolant cross-over pipe hoses.
 - Remove the EGR coolant hose clamps.
14. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
15. Check and top-up the coolant.

Accessory Drive - TDV6 2.7L Diesel - Accessory Drive Belt

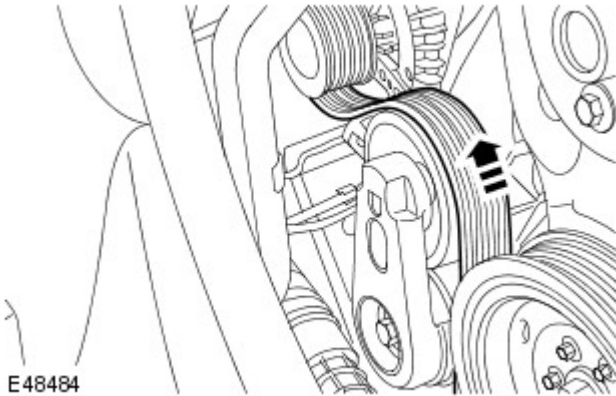
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the cooling fan.
For additional information, refer to: [Cooling Fan](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
3. **NOTE:** Using a 3/8 square drive wrench, rotate the tensioner counter clockwise.

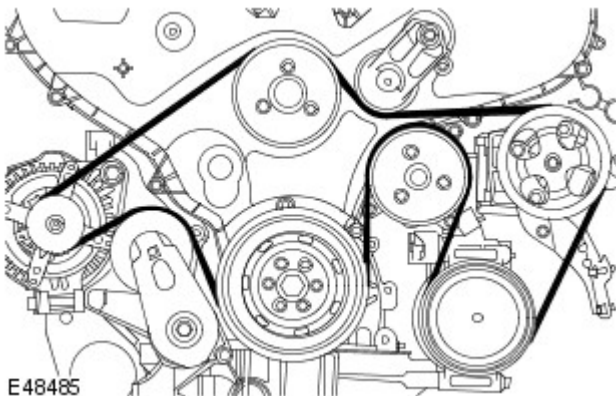
Remove the accessory drive belt.

- Release the tension from the belt.



Installation

1. To install, reverse the removal procedure.
 - Clean and inspect the drive pulleys for damage.

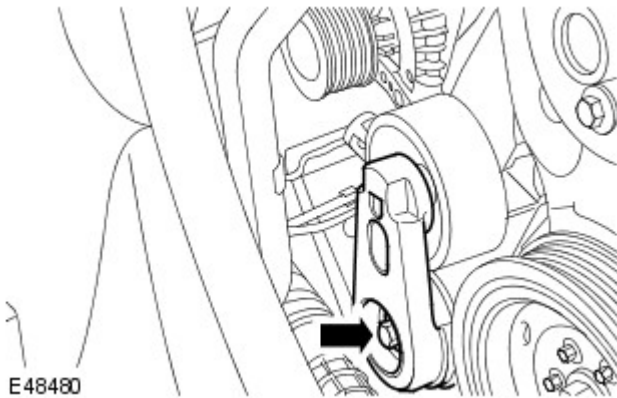


Accessory Drive - TDV6 2.7L Diesel - Accessory Drive Belt Tensioner

Removal and Installation

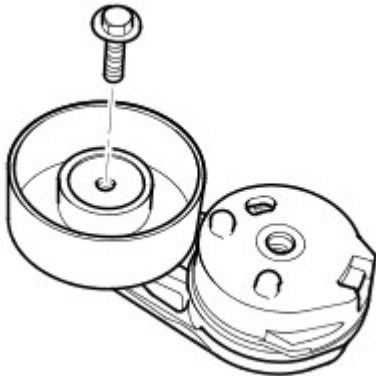
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
3. Remove the accessory drive belt tensioner.
 - Remove the bolt.



E48480

4. Remove the accessory drive belt tensioner pulley.
 - Remove the Torx bolt.



E48481

Installation

1. Install the accessory drive belt tensioner pulley.
 - Clean the components.
 - Tighten the bolt to 25 Nm (18 lb.ft).
2. Install the accessory drive belt tensioner.
 - Clean the components.
 - Tighten the bolt to 45 Nm (33 lb.ft).
3. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

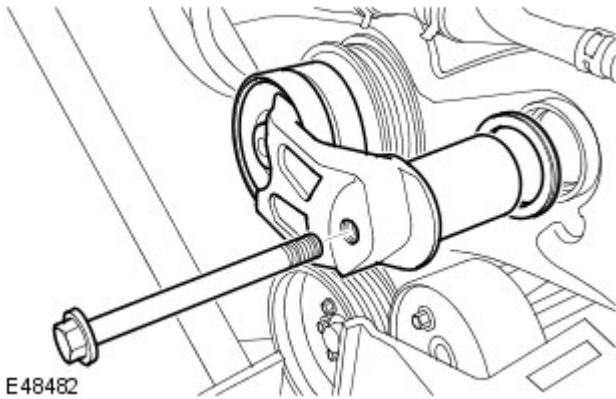
Accessory Drive - TDV6 2.7L Diesel - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

1. Disconnect the battery ground cable.
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

3. Remove the accessory drive belt idler.
 - Remove the bolt.
 - Remove and discard the seal.



E48482

4. Remove the accessory drive belt idler pulley.
 - Remove the bolt cover.
 - Remove the Torx bolt.



E48483

Installation

1. Install the accessory drive belt idler pulley.
 - Clean the components.
 - Tighten the Torx bolt to 25 Nm (18 lb.ft).
 - Install the bolt cover.
2. Install the accessory drive belt idler.
 - Clean the components.
 - Install a new seal.
 - Tighten the bolt to 45 Nm (33 lb.ft).
3. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).

Accessory Drive - TDV6 2.7L Diesel - Fuel Injection Pump Pulley

Removal and Installation

Removal

1. Refer to Fuel Pump.
For additional information, refer to: [Fuel Pump - VIN Range: SALLA000304->END OF 06MY](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

Installation

1. Refer to Fuel Pump.
For additional information, refer to: [Fuel Pump - VIN Range: SALLA000304->END OF 06MY](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

Accessory Drive - TDV6 3.0L Diesel -

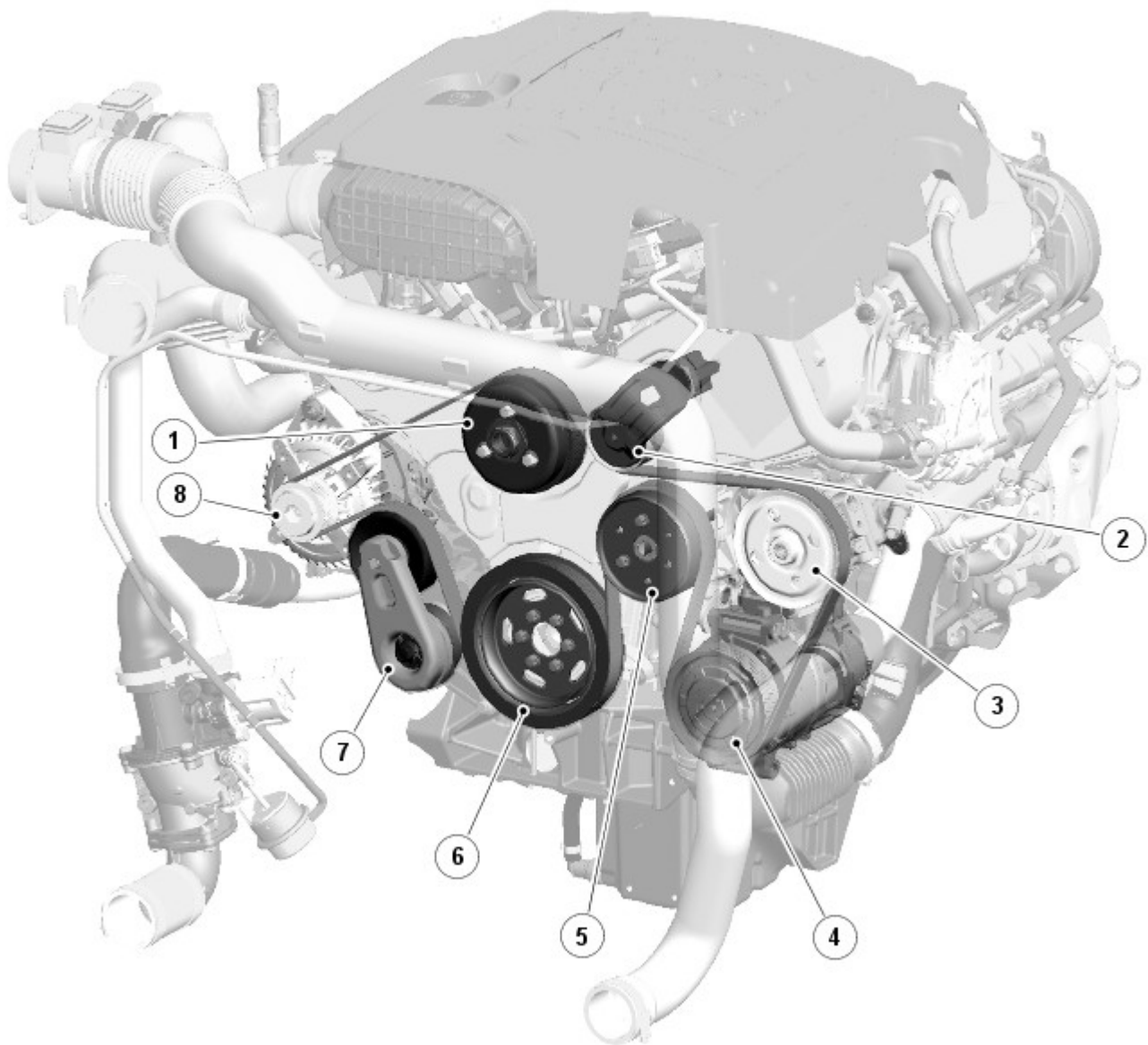
Torque Specification

- NOTE: **A** = refer to procedure for correct torque sequence

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	47	35	-
Accessory drive belt idler pulley retaining bolt	50	37	-
Fuel injection pump sprocket retaining nut	A	-	-
Camshaft rear hub bolt	Stage 1 - 80 Stage 2 - 80 degrees	Stage 1 - 59 Stage 2 - 80 degrees	-
Camshaft rear pulley retaining bolts	23	17	-
Rear end accessory drive belt (READ) belt tensioner retaining bolt	23	17	-

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive - Component Location

Description and Operation



E107566

ItemDescription

1	Viscous fan pulley
2	Idler
3	Power steering pump
4	A/C (air conditioning) compressor
5	Coolant pump
6	Crankshaft pulley
7	Belt tensioner
8	Generator

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive - Overview

Description and Operation

OVERVIEW

The crankshaft pulley drives a six ribbed poly V belt which in turn drives all of the engine mounted accessories.

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive - System Operation and Component Description

Description and Operation

System Operation

OPERATION

The crankshaft pulley is attached to and rotates with the crankshaft. The pulley provides the drive for the accessory drive vee belt which in turn provides rotational power for the front mounted accessories such as the generator, power steering pump, coolant pump and the [A/C \(air conditioning\)](#) compressor.

The crankshaft pulley is a combined pulley and torsional vibration damper.

Component Description

DESCRIPTION

The accessory drive belt, which is a maintenance free poly-V type belt, is automatically pre-loaded by the belt tensioner and routed over idlers in order to maintain sufficient friction around the drive wheels. This ensures slip-free drive of the accessory components.

The torsional vibration damper incorporates compressed rubber between its inner and outer diameters to reduce peak levels of torsional vibration within the crankshaft.

The belt tensioner is calibrated to provide the correct amount of tension to the belt for a given drive system. Unless a spring within the tensioner assembly breaks, or some other mechanical part of the tensioner fails, there is no need to check the tensioner for correct tension.

The accessory drive belt should be inspected at every routine service for excessive wear and damage.

The belt tensioner consists of an idler pulley, which is free to rotate on a bearing located at the end of a spring-loaded pivot arm.

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-05B Accessory Drive - TDV6 3.0L Diesel)

[Accessory Drive](#) (Description and Operation),
[Accessory Drive](#) (Description and Operation),
[Accessory Drive](#) (Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Drive belt condition (cracking/damage/contamination) ● Idler assembly ● Generator ● Engine cooling fan ● Tensioner assembly ● Engine coolant pump ● Power steering pump ● Air Conditioning (A/C) compressor ● Torsional vibration damper ● Dynamic response pump ● Tensioner assembly ● Accessory drive belt ● Security/Correct installation of the fuel injection pump cover ● Fuel injection pump belt condition (cracking/damage/contamination) ● Fuel injection pump belt tensioner assembly ● Fuel injection pump ● Fuel injection pump belt

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.



CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart (accessory drive belt)

Symptom	Possible Causes	Action
Noise	<ul style="list-style-type: none"> ● Belt condition ● Belt tension ● Pulleys misaligned ● Driven components (including tensioners) 	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary.
Drive belt does not hold tension	<ul style="list-style-type: none"> ● Belt condition ● Tensioner fault 	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.

Symptom Chart (fuel injection pump belt)

Symptom	Possible Causes	Action
Noise	<ul style="list-style-type: none"> ● Belt condition ● Belt fouling cover ● Tensioner bearing failure ● Fuel injection pump failure 	Check the belt condition (see visual inspection). Check the belt cover for indications of fouling (this may indicate a pump misalignment), refer to the relevant workshop manual section. The belt tensioner must be renewed if the belt is removed, making a check of the bearing impractical. Remove the belt, check the fuel injection pump pulley for security. Check the fuel injection pump for excessive resistance to rotation (excessive resistance in the pump will cause the pulley securing nut to loosen as a design feature). Check for diagnostic

Symptom	Possible Causes	Action
		trouble codes (DTCs) indicating a pump malfunction.
Drive belt does not hold tension	<ul style="list-style-type: none"> ● Belt condition ● Tensioner fault 	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.
Loss of drive (with no drive to the fuel injection pump, the engine will not run)	<ul style="list-style-type: none"> ● Belt broken/stripped teeth ● Drive pulleys loose 	Investigate the cause of the belt breakage/damage (a belt broken at a 45 degree angle normally indicates a shear, a break straight across the belt normally indicates that the belt has been crimped). Check the fuel injection pump for excessive resistance to rotation (excessive resistance in the pump will cause the pulley securing nut to loosen as a design feature). Check for DTCs indicating a pump malfunction.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

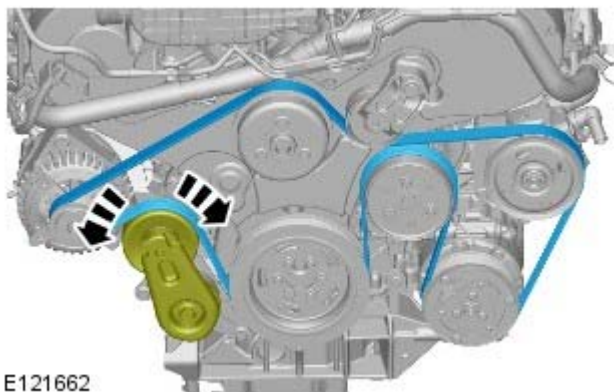
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).





3. **3.** NOTE: Note the fitted position of the accessory drive belt.

Installation



1. **1.** CAUTIONS:

 Make sure that the accessory drive belt is correctly located on each pulley.

 Clean and inspect the accessory drive belt pulleys for damage.

- NOTE: Engine shown removed for clarity.

To install, reverse the removal procedure.

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Idler Pulley

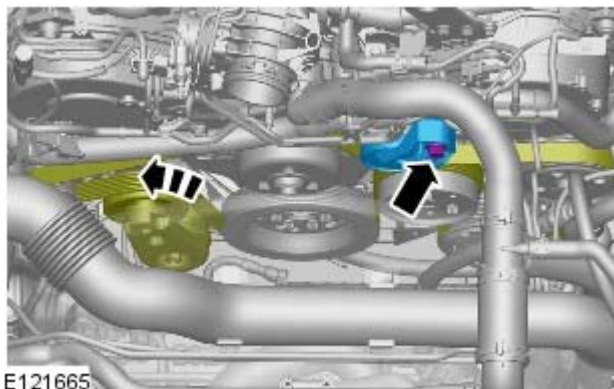
Removal and Installation

Removal

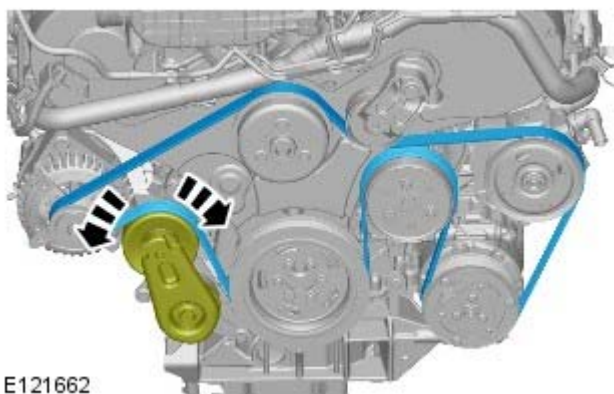
• NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).


2. *Torque:* 50 Nm




Installation



1. **1. CAUTIONS:**

 Clean and inspect the accessory drive belt pulleys for damage.

 Make sure that the accessory drive belt is correctly located on each pulley.

• NOTE: Engine shown removed for clarity.

To install, reverse the removal procedure.

Accessory Drive - TDV6 3.0L Diesel - Accessory Drive Belt Tensioner

Removal and Installation

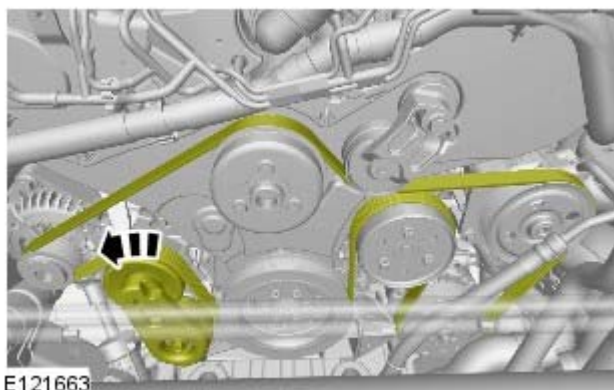
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).

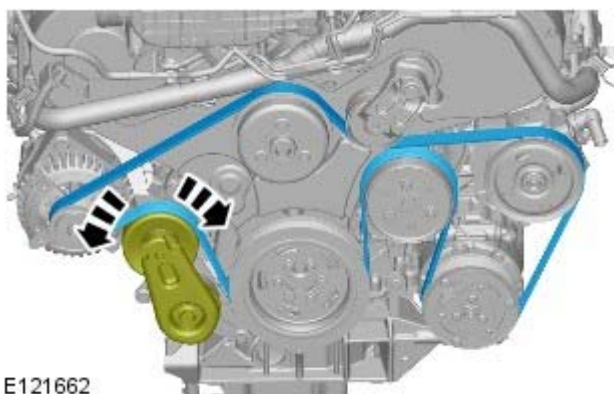


3. **NOTE:** Note the fitted position of the accessory drive belt.





4.
 - Torque: 47 Nm

Installation



1. **CAUTIONS:**

 Make sure that the accessory drive belt is correctly located on each pulley.

 Clean and inspect the accessory drive belt pulleys for damage.

- NOTE: Engine shown removed for clarity.

To install, reverse the removal procedure.

Accessory Drive - TDV6 3.0L Diesel - Fuel Injection Pump Pulley

Removal and Installation

Removal

1. Refer to: [Fuel Injection Pump](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

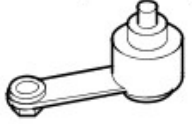

Installation

1. To install, reverse the removal procedure.

Accessory Drive - TDV6 3.0L Diesel - Rear End Accessory Drive (READ)


Removal and Installation


Special Tool(s)

 <p>303-1117 E54540</p>	<p>303-1117 Timing Peg, Automatic Transmission</p>
 <p>E116926</p>	<p>310-212 Rear End Accessory Drive (READ) belt Timing Tool</p>

Removal

• WARNINGS:

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


 Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.


 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

 Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Do not disassemble or clean inside the fuel pump, even with an ultrasonic cleaner. Always install a new fuel pump when required.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

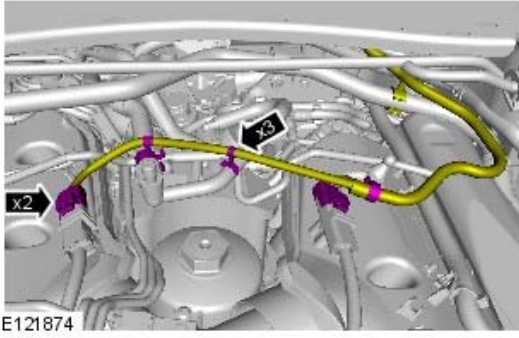
3.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

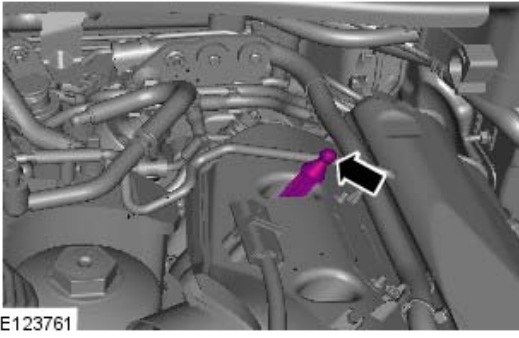
4. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).

5. Lower the vehicle.

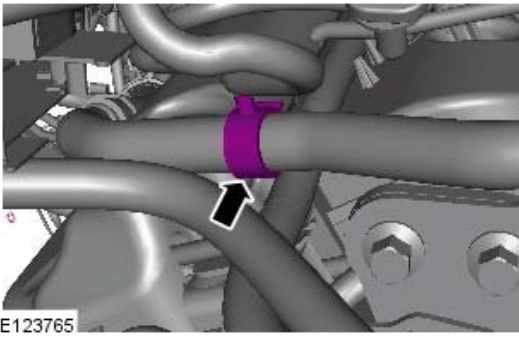
6.



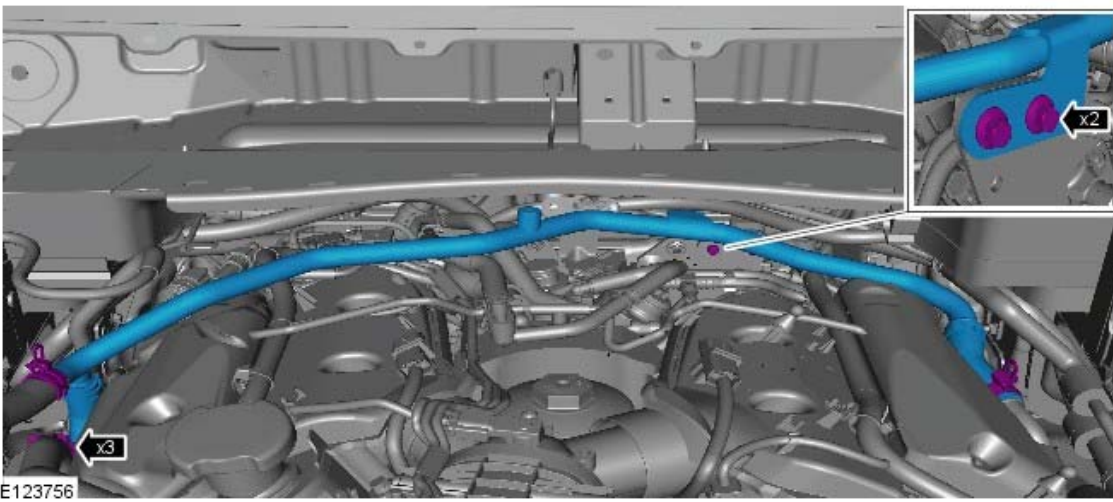
7.



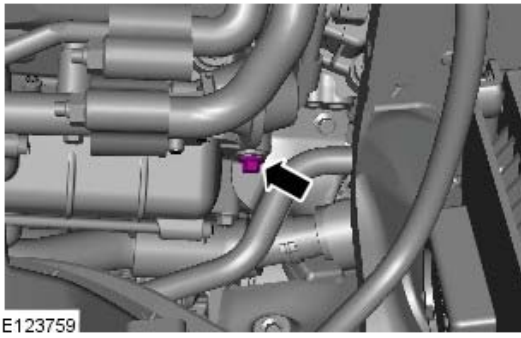
8. **8.** NOTE: Engine shown removed for clarity.



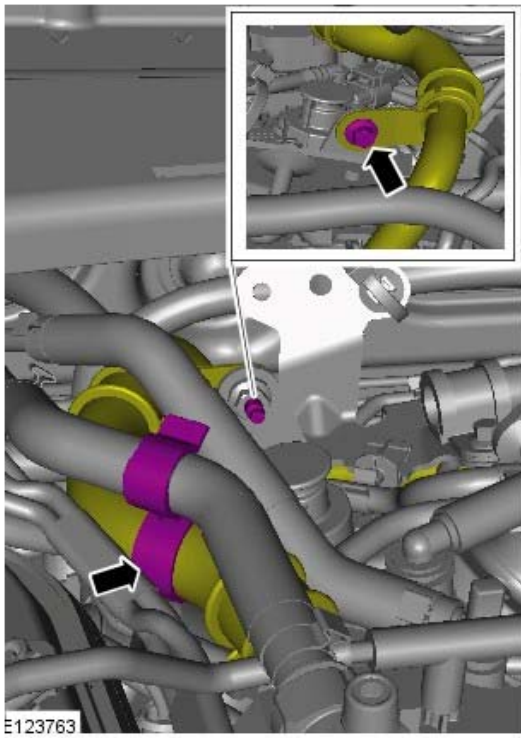
9.



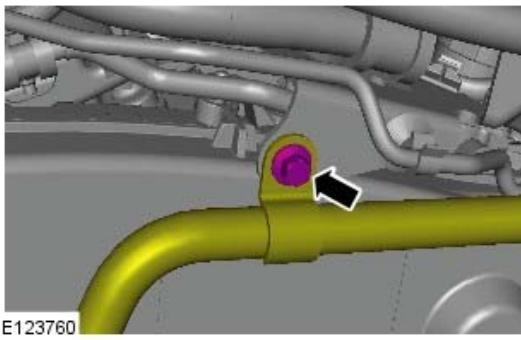
10.



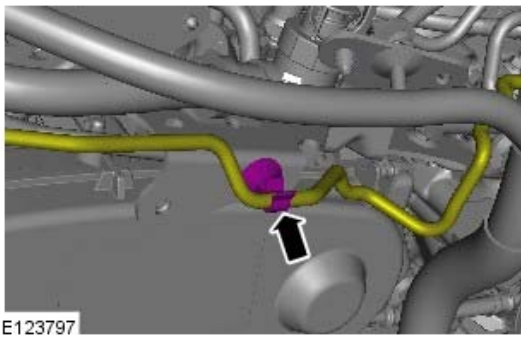
11.

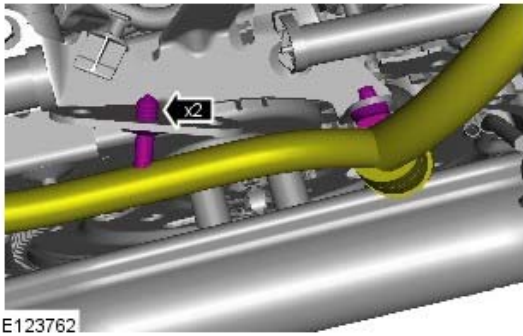


12. **12.** NOTE: Engine shown removed for clarity.

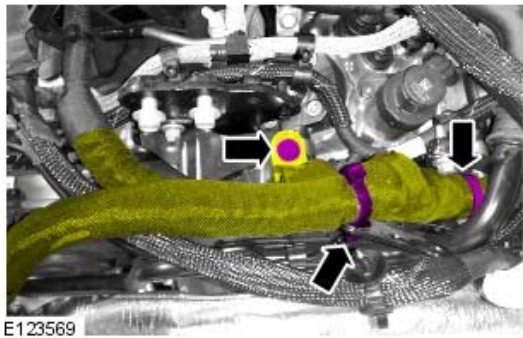


13. **13.** NOTE: Engine shown removed for clarity.

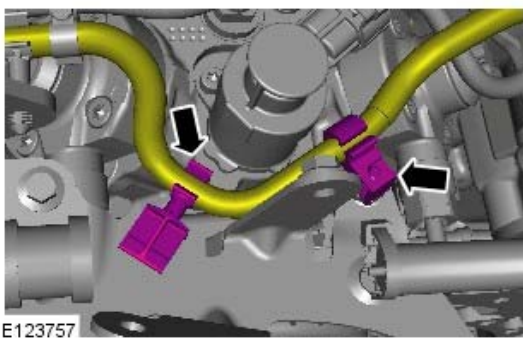




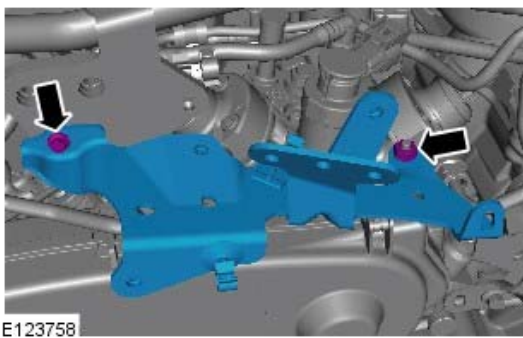
14. **14.** NOTE: Engine shown removed for clarity.



15. **15.** NOTE: Engine shown removed for clarity.

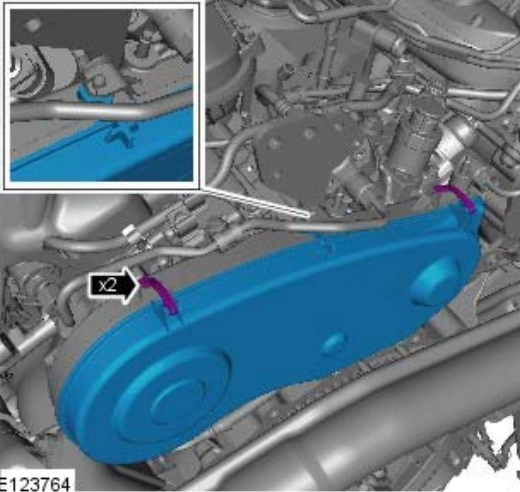


16. **16.** NOTE: Engine shown removed for clarity.




17. **17.** NOTE: Engine shown removed for clarity.

18.

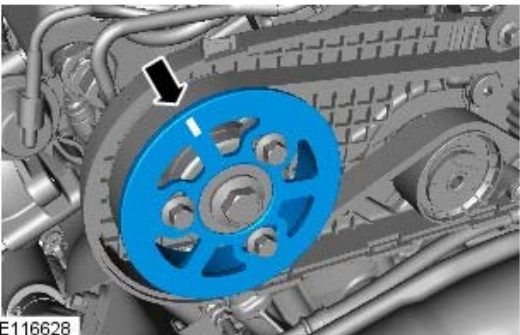


E123764


19. **19.**  CAUTION: Only rotate the crankshaft clockwise.

- NOTE: This step requires the aid of another technician.
- NOTE: Engine shown removed for clarity.

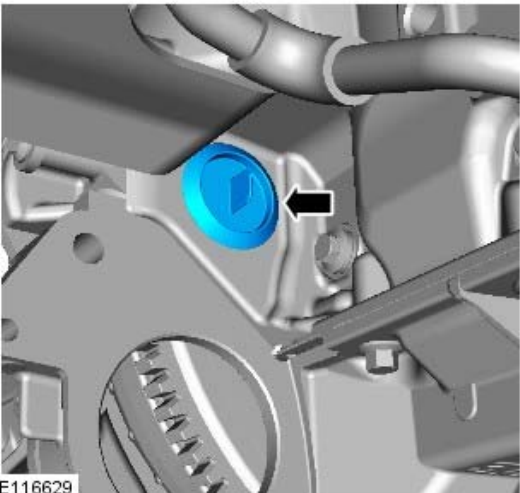
Rotate the crankshaft until the mark on the rear camshaft pulley is in the illustrated position.



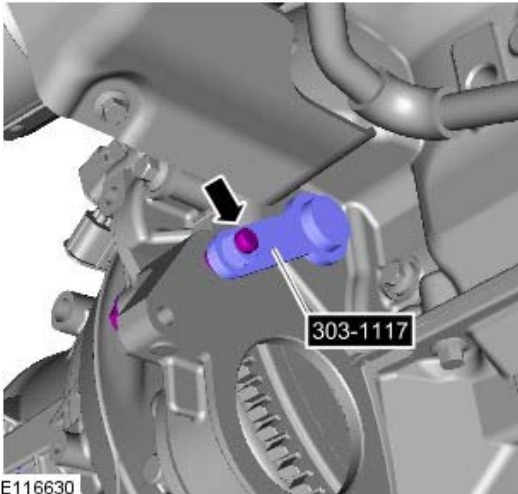
E116628

20. **20.**  WARNING: Make sure to support the vehicle with axle stands.
Raise and support the vehicle.

21.



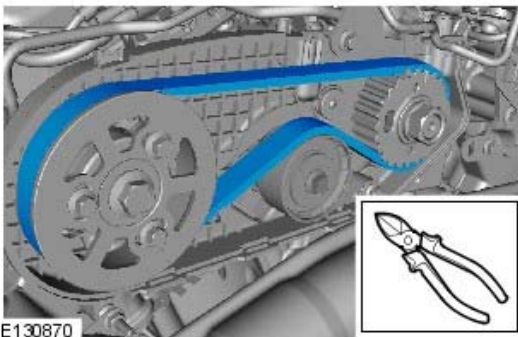
E116629



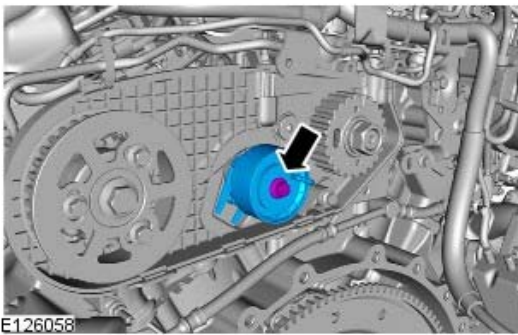
22.

- Install the special tool.
- *Special Tool(s):* [303-1117](#)

23. Lower the vehicle.

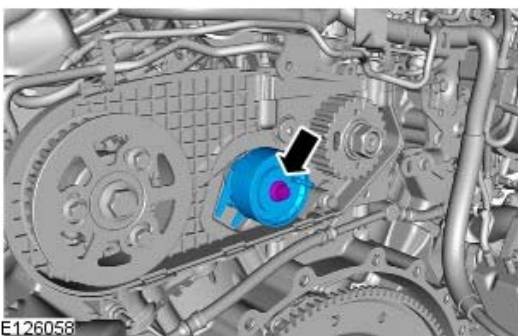



24. **24.** NOTE: Engine shown removed for clarity.



25. **25.** NOTE: Engine shown removed for clarity.

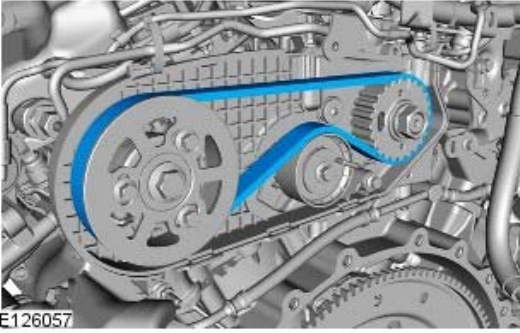
Installation




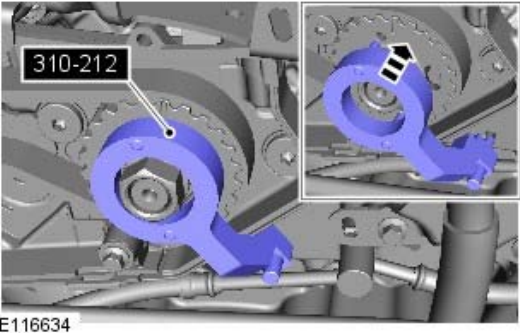
1. **1.**  CAUTION: Make sure that the READ belt tensioner tang is correctly located to the READ belt rear cover. Failure to follow this instruction may result in damage to the engine.

• NOTE: Make sure that the rear end accessory drive (READ) belt tensioner locking pin is not removed until the READ belt tensioner is fully installed.

- *Torque:* 23 Nm

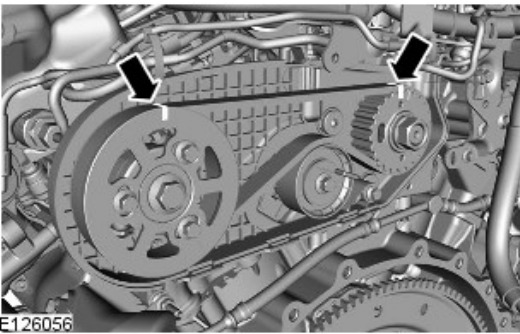


2.  CAUTION: Do not install the new READ belt to the pulleys with the READ belt tensioner installed. Failure to follow this instruction may result in damage to the READ belt.
 - NOTE: The READ rotates in a counter-clockwise direction when viewed from the rear of the engine.
 - NOTE: Make sure the new READ belt is correctly seated onto the camshaft and fuel pump pulleys.

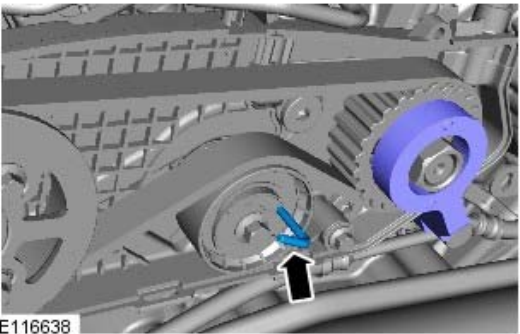


3. **3.** NOTE: Engine shown removed for clarity.
Install the special tool.

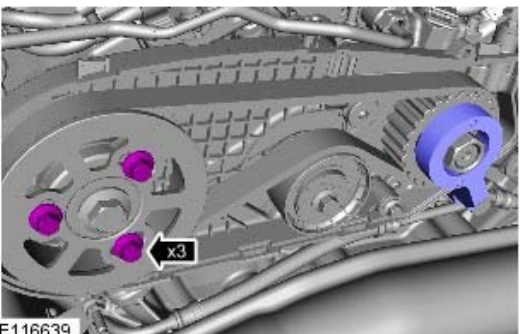
Special Tool(s): [310-212](#)



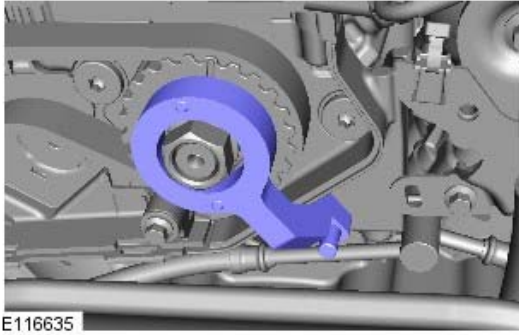
4. **4.** NOTE: Make sure that the READ belt tensioner locking pin is not removed until the READ belt tensioner is fully installed.
Make sure that the READ belt is aligned with the marks on the rear camshaft pulley and READ pulley as illustrated.



5. **5.** NOTE: Engine shown removed for clarity.




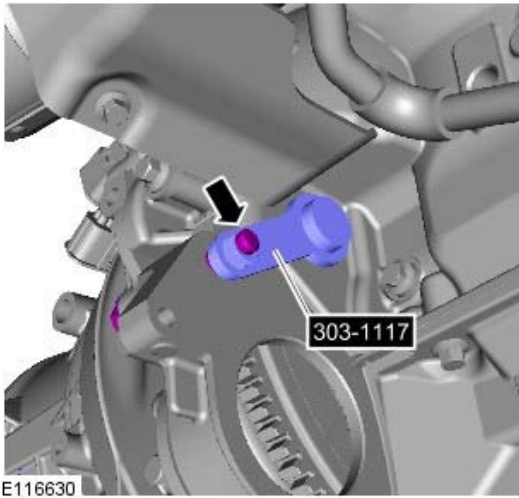
6. **6.** NOTE: Engine shown removed for clarity.
Torque: 23 Nm



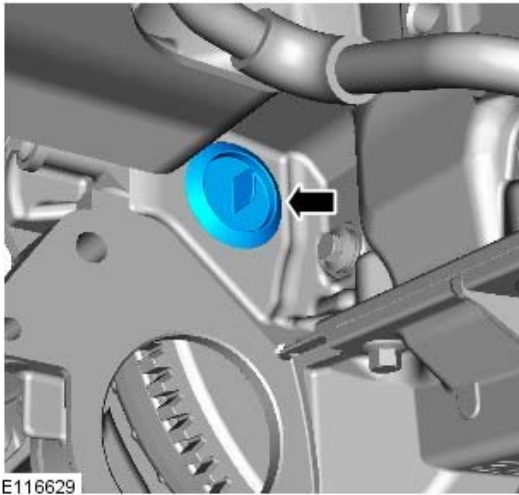
7. **7.** NOTE: Engine shown removed for clarity.

- Remove the special tool.

8. **8.**  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.



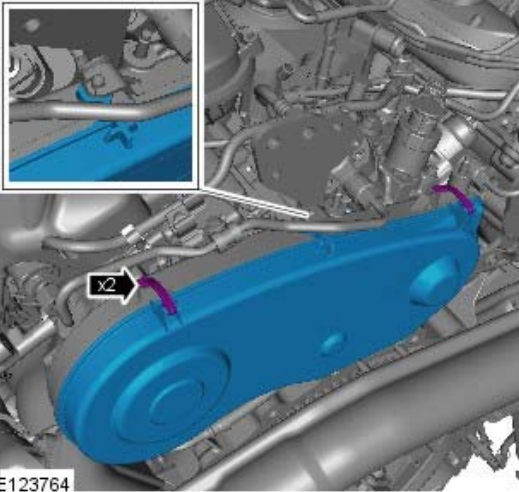
9. Remove the special tool.



10.

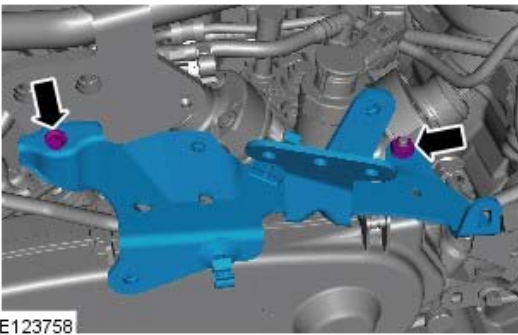
11. Lower the vehicle.

12.

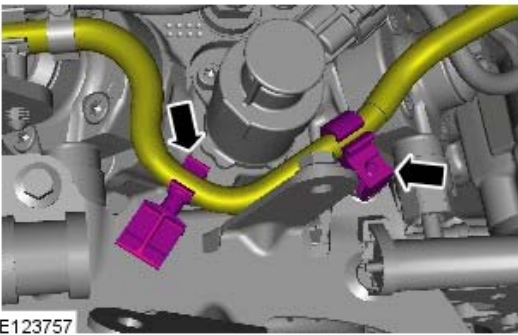


13. **13.** NOTE: Engine shown removed for clarity.

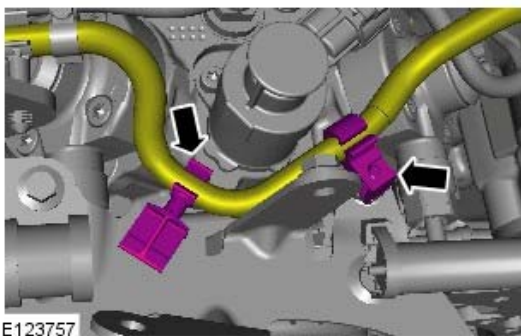
- Torque: 10 Nm

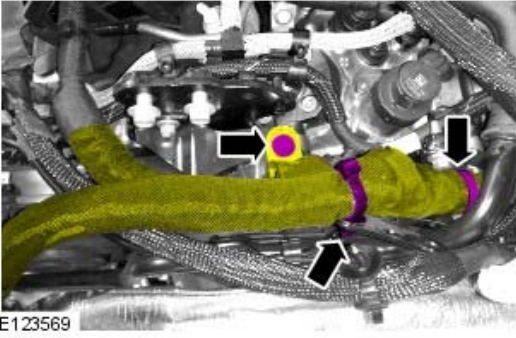


14. **14.** NOTE: Engine shown removed for clarity.



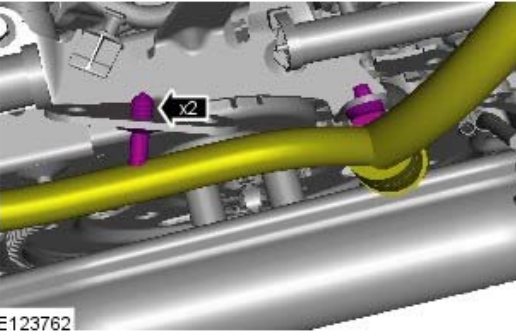
15. **15.** NOTE: Engine shown removed for clarity.



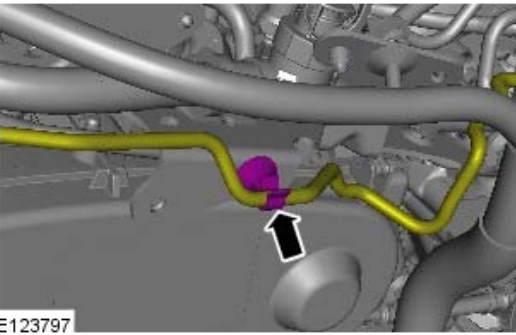


16. **16.** NOTE: Engine shown removed for clarity.

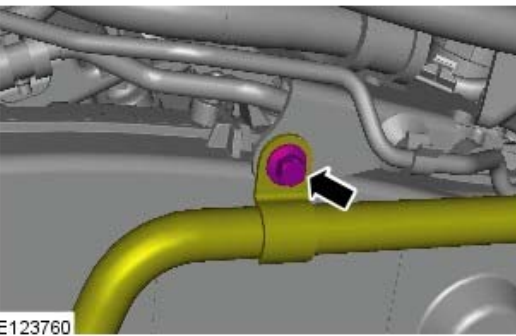
- Torque: 5 Nm



17. **17.** NOTE: Engine shown removed for clarity.



18. **18.** NOTE: Engine shown removed for clarity.

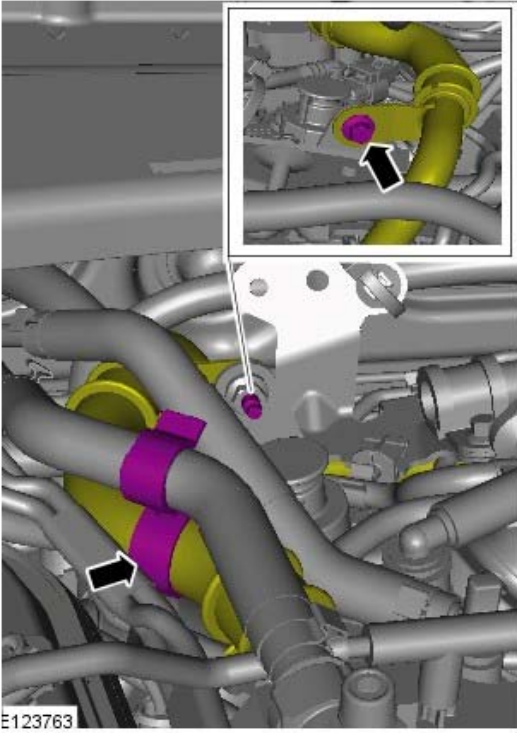


19. **19.** NOTE: Engine shown removed for clarity.

- Torque: 10 Nm

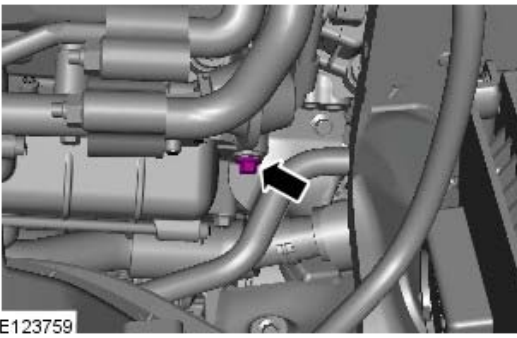
20.

- Torque: 10 Nm



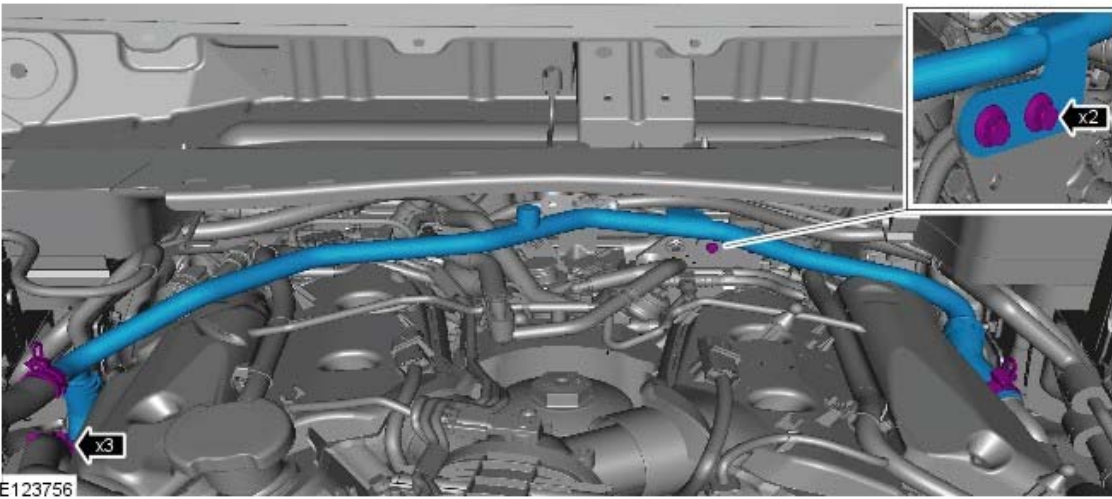
21.

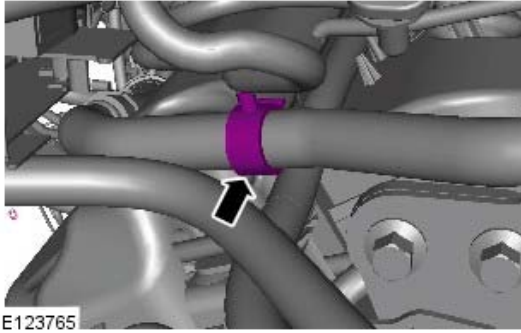
- Torque: 10 Nm



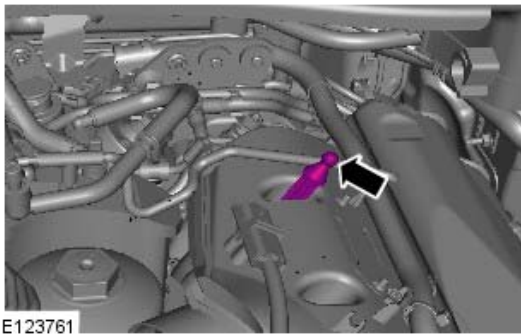
22.

- Torque: 10 Nm



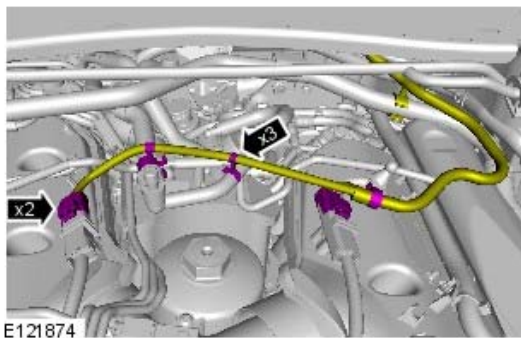


23. **23.** NOTE: Engine shown removed for clarity.



24.

- Torque: 5 Nm



25.

26. **26.**  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

27. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).

28. Lower the vehicle.

29. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

30. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

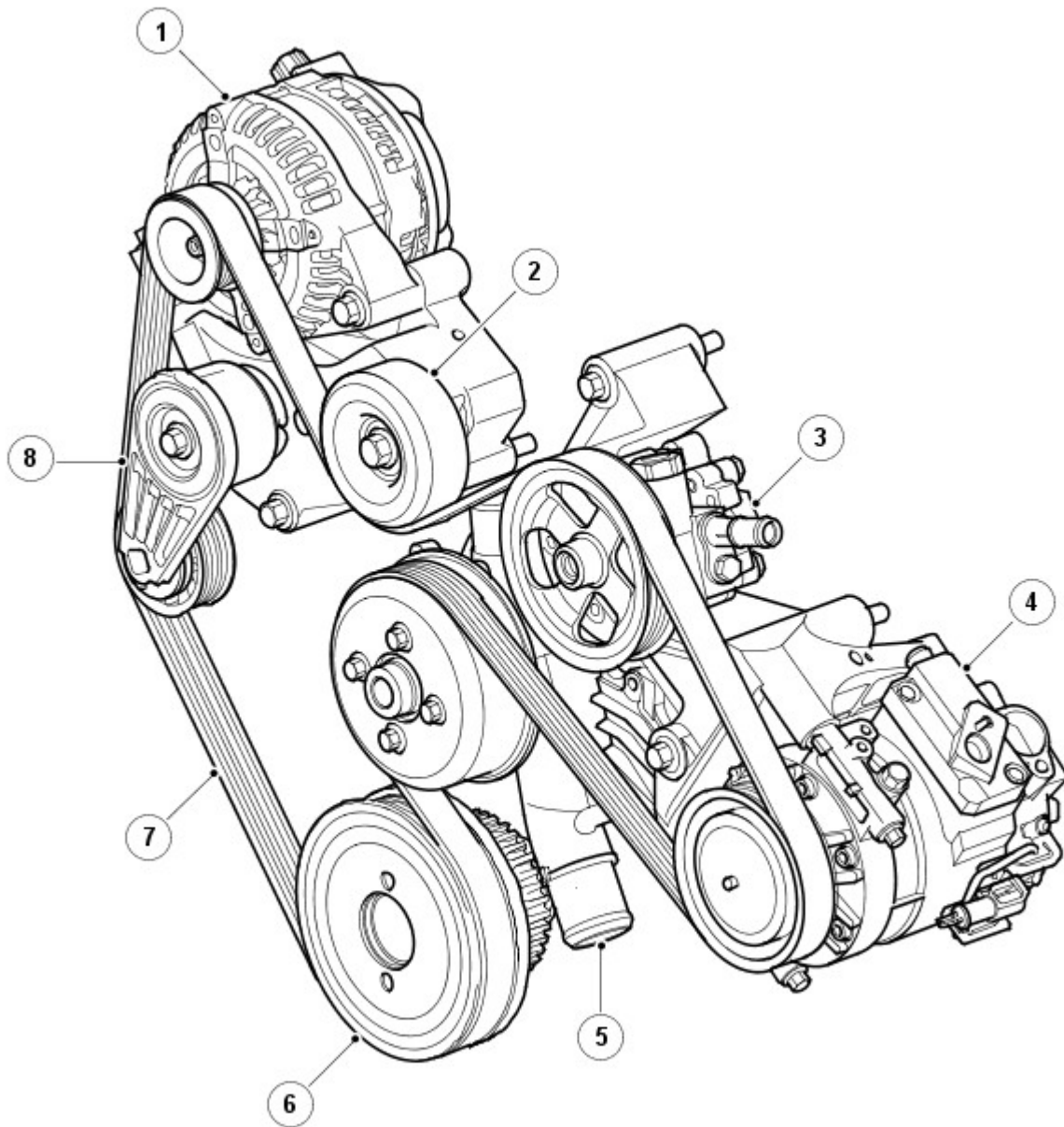
31. Check and top-up the coolant.

Accessory Drive - V6 4.0L Petrol -**Torque Specifications**

Description	Nm	lb-ft
Generator drive belt tensioner bolt	45	33
Accessory drive belt idler pulley bolt	45	33

Accessory Drive - V6 4.0L Petrol - Accessory Drive

Description and Operation



E50592

Item	Part Number	Description
1	-	Generator
2	-	Deflection pulley
3	-	Power steering pump
4	-	A/C compressor
5	-	Coolant pump
6	-	Crankshaft pulley
7	-	Accessory drive belt
8	-	Tensioner assembly

The engine crankshaft pulley drives the accessory components, which comprise the torsional vibration damper, generator, power steering pump, A/C compressor and coolant pump, via the accessory drive belt.

The belt, which is maintenance free poly-V type belts, are automatically pre-loaded by the tensioning rollers and are routed over deflection pulleys in order to maintain sufficient adhesion about the drive wheels. This ensures slip-free drive of the accessory components.

Accessory Drive - V6 4.0L Petrol - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Accessory Drive](#) (303-05C Accessory Drive - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Belt drive belt condition (cracking/damage/contamination) ● Belt tension ● Pulley alignment ● Coolant pump ● Belt tensioner assembly ● Air conditioning compressor ● Power steering pump ● Crankshaft pulley ● Generator ● Dynamic response pump pulley ● Deflection pulley ● Cooling fan pulley

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.



CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noise	<ul style="list-style-type: none"> ● Belt condition ● Belt tension ● Pulleys misaligned ● Driven components (including tensioners) 	Check the belt condition (see visual inspection). Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary.
Drive belt does not hold tension	<ul style="list-style-type: none"> ● Belt condition ● Tensioner fault 	Check the belt condition (see visual inspection). Check the tensioner function. Rectify as necessary.

DTC Index

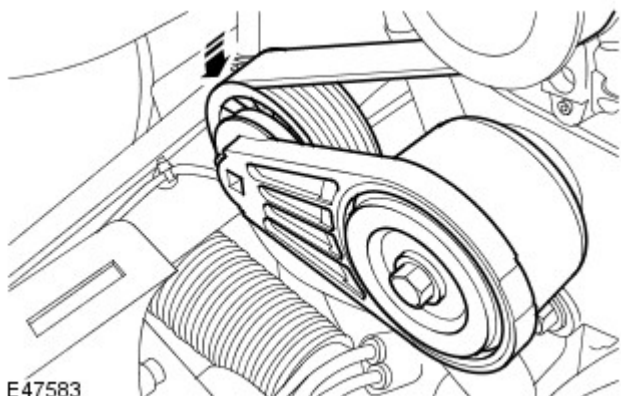
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Accessory Drive - V6 4.0L Petrol - Accessory Drive Belt

Removal and Installation

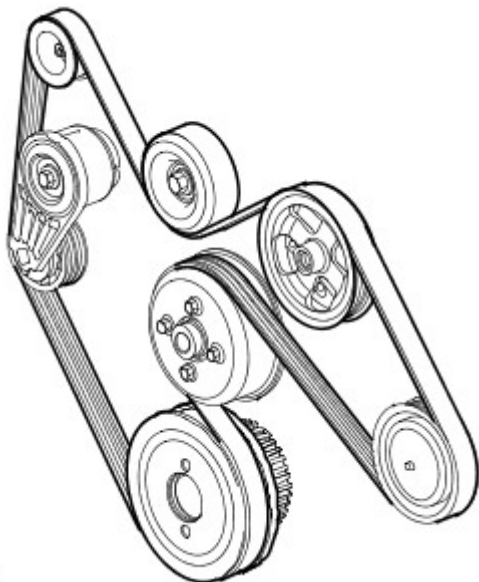
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
3. Release the accessory drive belt.
 - Rotate the accessory drive belt tensioner counterclockwise.
4. Remove the accessory drive belt.



Installation

1. To install, reverse the removal procedure.
 - Clean and inspect the drive pulleys for damage.



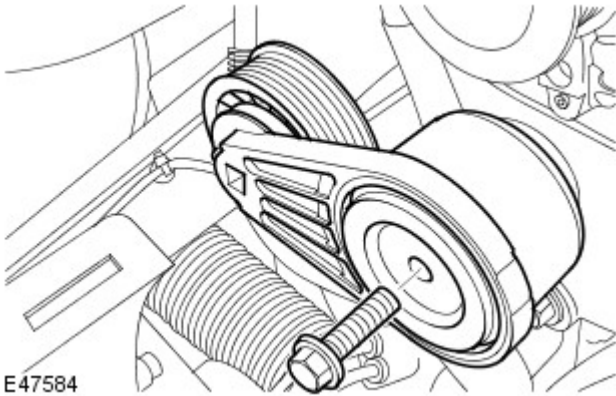
2. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Accessory Drive - V6 4.0L Petrol - Accessory Drive Belt Tensioner

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Remove the generator drive belt tensioner.
 - Remove the generator drive belt tensioner bolt.



Installation

1. Install the generator drive belt tensioner.
 - Clean the component mating faces.
 - Tighten the bolt to 45 Nm (33 lb.ft).
2. Install the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Connect the battery ground cable.

Accessory Drive - V6 4.0L Petrol - Accessory Drive Belt Idler Pulley

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Remove the accessory drive belt idler pulley.
 - Remove the bolt.



Installation

1. Install the accessory drive belt idler pulley.
 - Tighten the bolt to 45 Nm (33 lb.ft).
2. Install the generator drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

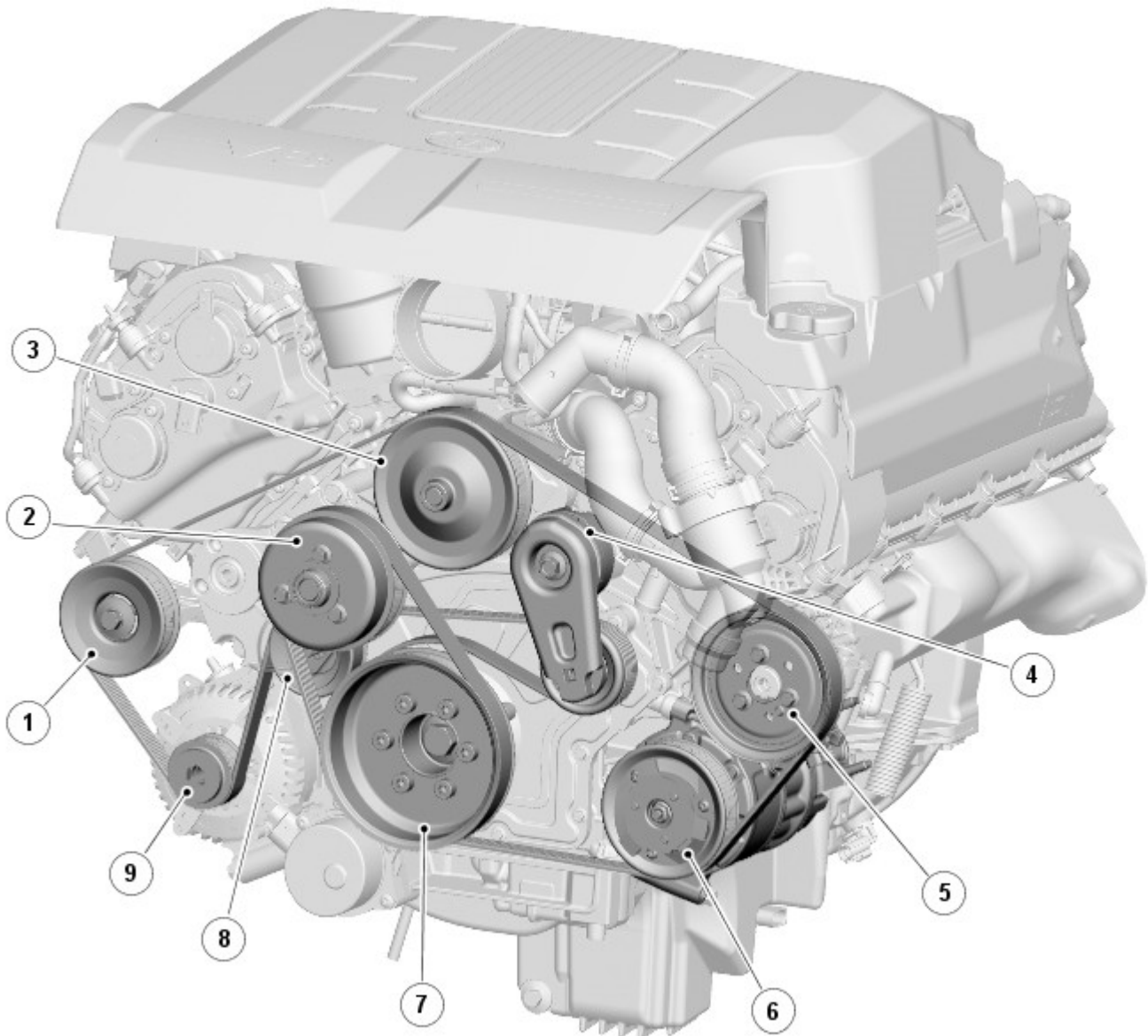
Accessory Drive - V8 5.0L Petrol -

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner retaining bolt	48	35	-
Accessory drive belt idler pulley retaining bolt - all vehicles	48	35	-
Accessory drive belt center idler pulley retaining bolt - vehicles without supercharger	25	19	-
Accessory drive belt idler pulley retaining bolt to tensioner bracket - vehicles with supercharger	48	35	-
Supercharger belt tensioner bracket retaining bolt	25	19	-
Supercharger belt tensioner retaining bolt	48	35	-
Supercharger belt idler pulley retaining bolt	48	35	-
Cooling fan pulley retaining bolts	25	19	
Cooling fan retaining nut	65	48	

Accessory Drive - V8 5.0L Petrol - Accessory Drive

Description and Operation

COMPONENT LOCATION



E106739

Item	Part Number	Description
1	-	Idler pulley
2	-	Viscous cooling fan pulley
3	-	Coolant pump
4	-	Belt tensioner
5	-	Power steering pump
6	-	A/C (air conditioning) compressor
7	-	Crankshaft pulley/torsional vibration damper
8	-	Idler pulley
9	-	Generator

INTRODUCTION

The accessory drive is a belt system powered by a pulley attached to the front of the crankshaft. The crankshaft pulley, which incorporates a torsional vibration damper, drives primary and secondary drive belts. An automatic belt tensioner in the primary belt run maintains the drive belt at the correct tension. Together with idler pulleys, the belt tensioner also guides the primary drive belt clear of obstructions and sets the correct 'wrap-around' of the accessory component drive pulleys to ensure a slip-free drive.

Primary Drive Belt

The primary drive belt is a six-ribbed poly-V belt that drives the:

- Coolant pump
- Power steering pump
- A/C (air conditioning) compressor
- Generator.

Secondary Drive Belt

The secondary drive belt is a six-ribbed poly-V belt that drives the pulley of the viscous cooling fan.

Belt Tensioner

The belt tensioner consists of an idler pulley on the end of a spring loaded pivot arm. The pivot arm can be turned for removal and installation of the belt.

The belt tensioner is calibrated to automatically maintain the correct tension in the drive belt.

Accessory Drive - V8 5.0L Petrol - Accessory Drive

Diagnosis and Testing

Principles of Operation

For a detailed description of the accessory drive system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Accessory Drive](#) (303-05D Accessory Drive - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Belt drive belt condition (cracking/damage/contamination) ● Belt tension ● Pulley alignment ● Coolant pump ● Belt tensioner assembly ● Air conditioning compressor ● Power steering pump ● Crankshaft pulley ● Generator ● Deflection pulley ● Cooling fan pulley

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.



CAUTION: If the engine is run without the accessory drive belts connected to eliminate driven components, diagnostic trouble codes, (DTCs) may be set which must be cleared before the vehicle is returned to the owner. The engine should not be run for more than 2-3 minutes with the belts disconnected. Failure to follow this instruction may result in damage to the vehicle.

4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noise	<ul style="list-style-type: none"> ● Belt condition ● Belt tension ● Pulleys misaligned ● Driven components (including tensioners) 	Check the belt condition. Check the tensioner function. Check the pulley alignment. Check the driven components for excessive resistance to rotation. Rectify as necessary.
Drive belt does not hold tension	<ul style="list-style-type: none"> ● Belt condition ● Tensioner fault 	Check the belt condition. Check the tensioner function. Rectify as necessary.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Accessory Drive - V8 5.0L Petrol - Accessory Drive Belt

Removal and Installation

Removal

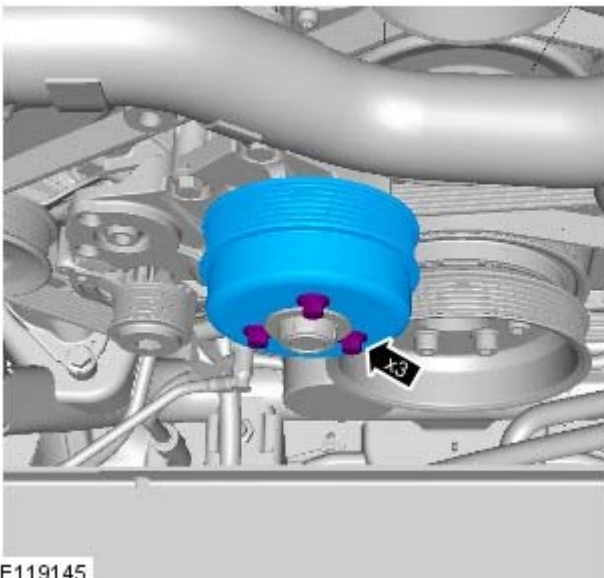
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

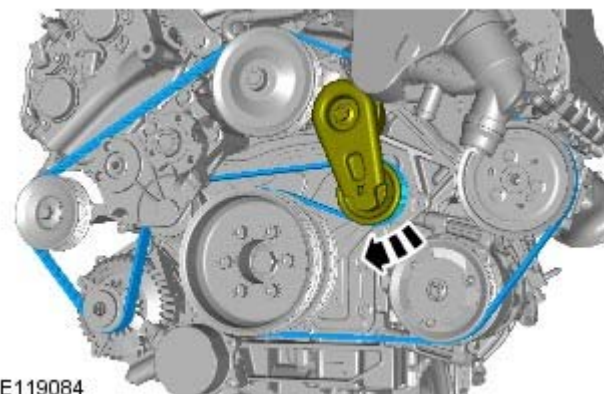
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

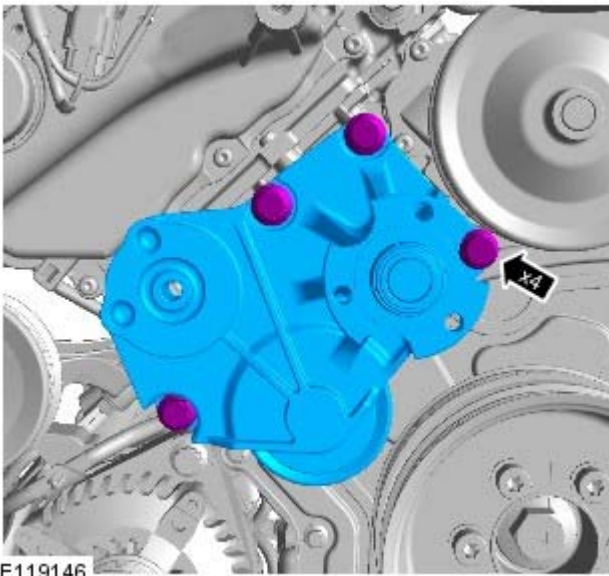
2. Refer to: [Cooling Fan Belt](#) (303-05D Accessory Drive - V8 5.0L Petrol, Removal and Installation).

3.



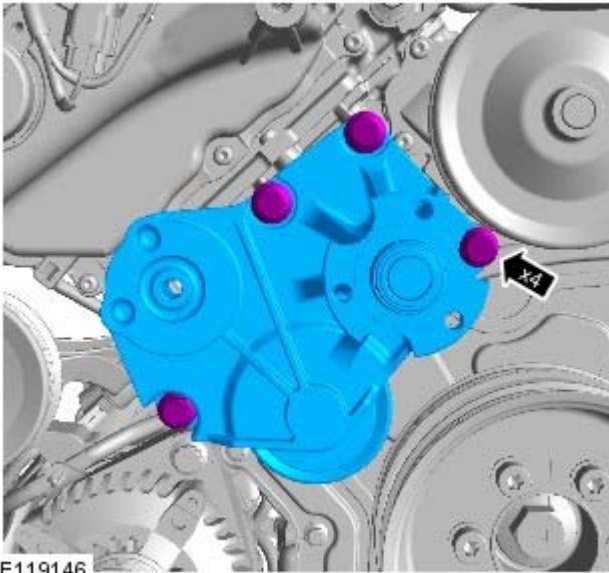
4. **4.** NOTE: Note the fitted position.





E119146

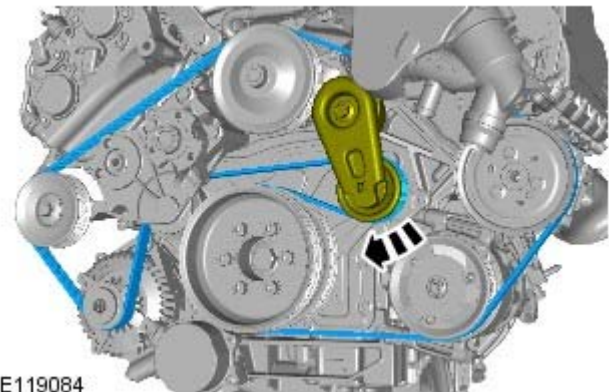
Installation



E119146

5.

1. Torque: 25 Nm



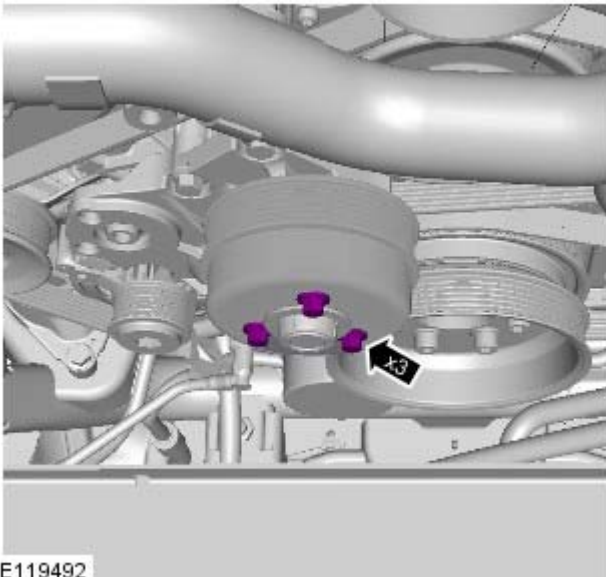
E119084

2. **2.** NOTE: Note the fitted position.



E119145

3. Torque: 25 Nm



E119492

4. Torque: 25 Nm

5. Refer to: [Cooling Fan Belt](#) (303-05D Accessory Drive - V8 5.0L Petrol, Removal and Installation).

6. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Accessory Drive - V8 5.0L Petrol - Accessory Drive Belt Idler Pulley

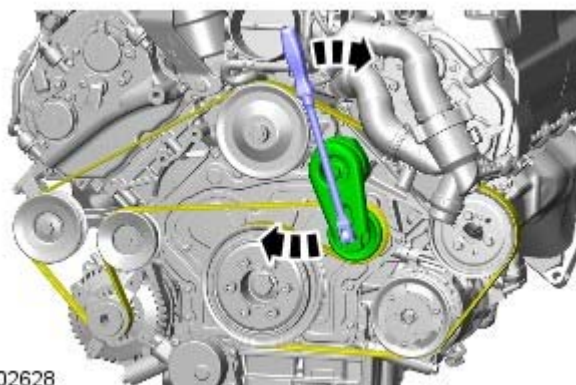
Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

2.



3. Torque: 48 Nm



Installation

1. To install, reverse the removal procedure.

Accessory Drive - V8 5.0L Petrol - Accessory Drive Belt Tensioner

Removal and Installation

Removal

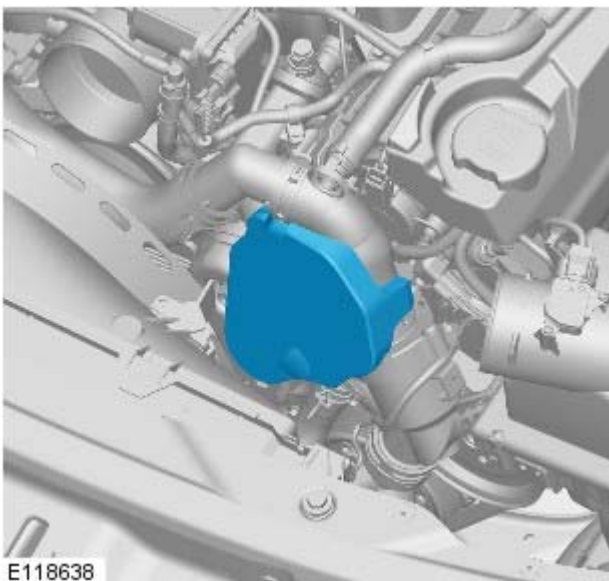
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

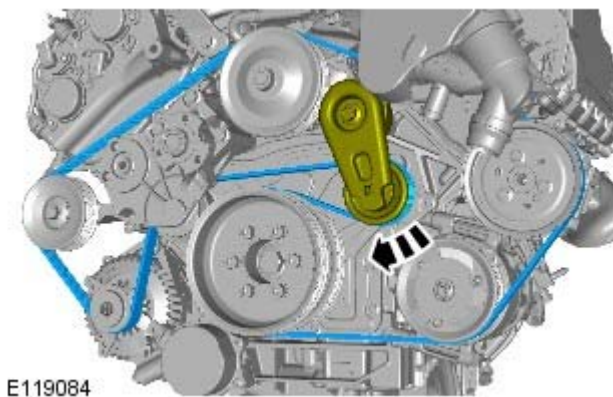
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

3.



4. **4.** NOTE: Note the fitted position.





5. *Torque:* 40 Nm

Installation

1. To install, reverse the removal procedure.

Accessory Drive - V8 5.0L Petrol - Cooling Fan Belt

Removal and Installation

Special Tool(s)

 E119168	303-1500 Installer, Stretchy Belt
--	--------------------------------------

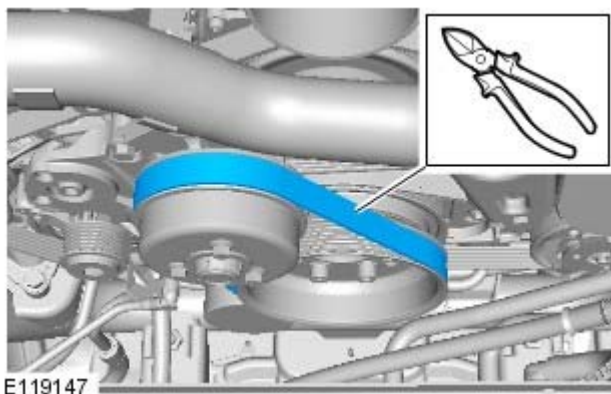
Removal

1. Disconnect the battery ground cable.

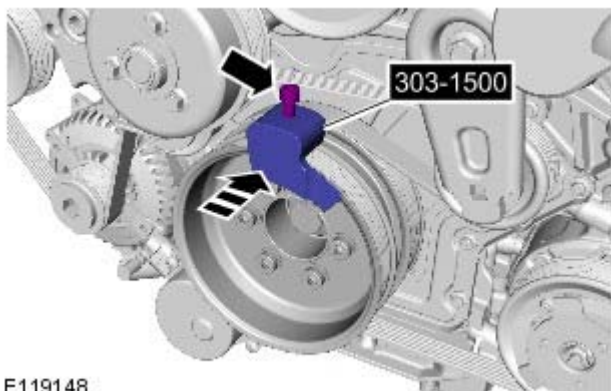
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Cooling Fan](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

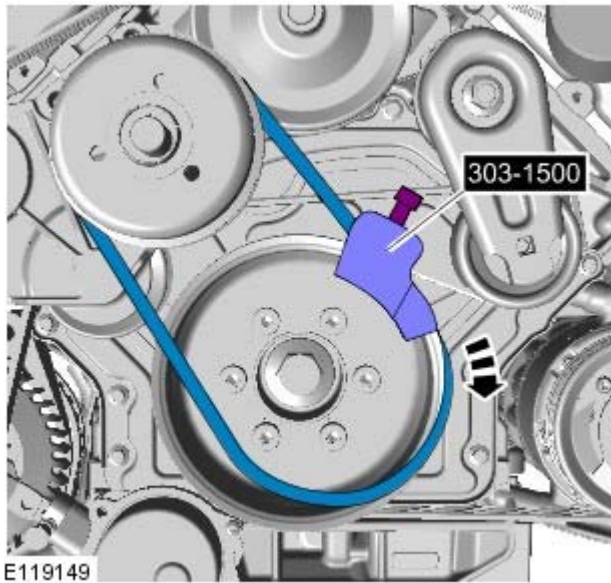
3.



Installation



1. *Special Tool(s):* [303-1500](#)



2. Install the cooling fan belt.

3.
 - Whilst rotating the engine, make sure that pressure is applied to the left hand side of the cooling fan belt to aid installation.
 - Rotate the engine until the special tool has reached the 9 o'clock position.
4. Remove the special tool.
5. Rotate the engine clockwise twice, making sure that the belt is seated on both pulleys correctly.
6. Refer to: [Cooling Fan](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).
7. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Starting System - TDV6 2.7L Diesel -**Starter Motor**

Item	Specification
Starter motor:	
Make	Denso
Type	P76S - Pre-engaged
Voltage	12
Current consumption	2.0 kW

Torque Specifications

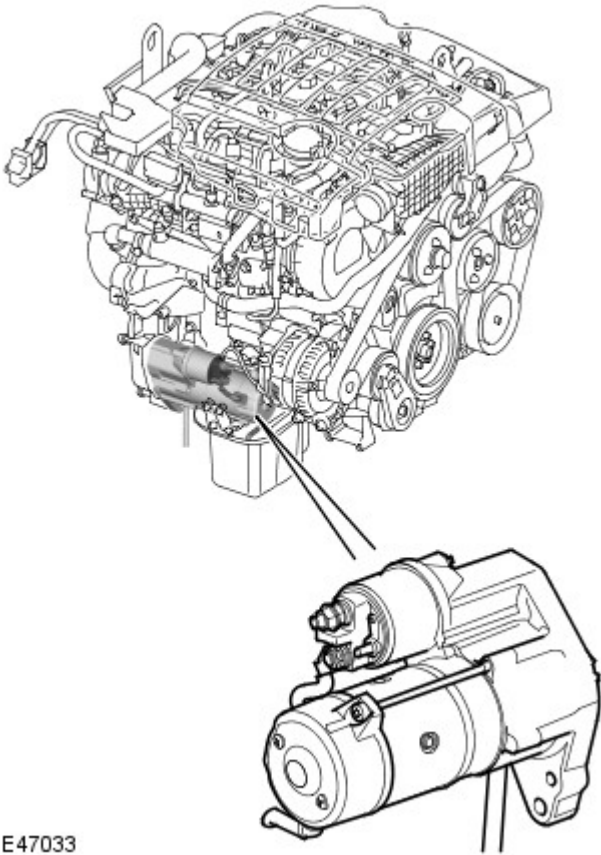
Description	Nm	lb-ft
Starter motor retaining bolts	48	35
* Battery positive terminal integral connector retaining nut	11	8
* Solenoid terminal integral connector retaining nut	7	5
Starter motor bracket retaining bolts	10	7
Fuel filter housing retaining bolts	10	7
Fuel cooler retaining bolts	10	7

Caution * Damage to the internal connections will occur if the torque values are exceeded.

Starting System - TDV6 2.7L Diesel - Starting System

Description and Operation

GENERAL



E47033

The starter motor is rated as 2.0 kW and is a Denso level three sealed unit. It is a P76S type starter motor and is of conventional design with the motor in line and the drive pinion and solenoid mounted above. Each starter motor is of the pre-engaged type and comprises of a series wound motor, an overrunning clutch and an integral solenoid. This starter incorporates labyrinth breathing tubes to help with sealing and drainage.

The starter solenoid is energised by a signal from the ECM when the ignition switch is moved to the crank position. When engine cranking is requested, the ECM checks that a valid key code has been received before granting the crank request. The power for starter operation is supplied on a substantial single cable connected direct from the battery positive terminal. The cable is connected to the solenoid via a copper threaded stud and secured with a nut.

The starter motor is located on the rear RH side of the engine block and protrudes through an aperture to drive the flywheel via a ring gear. The motor is secured to the cylinder block by two bolts and to the ladder frame by four bolts and a support bracket. The bracket provides crucial support for the starter motor and must not be omitted when installing or reinstalling the unit.

Starting System - TDV6 2.7L Diesel - Starting System

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Starting System](#) (303-06A Starting System - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Gear selector lever cable adjustment (vehicles with automatic transmission) ● Starter motor ● Engine (turns freely) 	<ul style="list-style-type: none"> ● Battery ● Fuses ● Starter relay ● Wiring harness(es) ● Damaged, loose or corroded connectors ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
The engine does not crank (starter motor does not turn)	<ul style="list-style-type: none"> ● Gear selector not in P or N position (vehicles with automatic transmission) ● Battery ● Starter relay ● Invalid key code received by Central Junction Box (CJB) ● Harness/Connectors ● Starter motor ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM) ● Engine seized 	Make sure the gear selector is in the P or N position and correctly adjusted. Check the battery condition and state of charge. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely.
The engine does not crank (starter motor does turn)	<ul style="list-style-type: none"> ● Starter motor installation ● Starter motor ● Flywheel/Drive plate ring gear 	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.
Engine cranks too slowly	<ul style="list-style-type: none"> ● Battery ● Harness/Connectors ● Starter motor ● Oil grade 	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition.
Engine cranks too fast	<ul style="list-style-type: none"> ● Low engine compression 	Check the engine compressions.
Excessive starter motor noise	<ul style="list-style-type: none"> ● Starter motor ● Flywheel/Drive plate ring gear ● Starter motor installation/casing 	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor casing condition. Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Starting System - TDV6 2.7L Diesel - Starting System Vehicles With: Smart Key

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system, refer to the relevant Description and Operation section in the workshop manual.

REFER to: Starting System (303-06A, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Steering column ● Brake pedal ● Smart key ● Steering Wheel 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Warning lamp operation ● Smart key operation ● Engine start operation

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTC's) and refer to the DTC Index.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the warranty policy and procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system)

• NOTE: When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the digital multimeter leads into account

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

• NOTE: If diagnostic trouble codes are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals

Symptom Chart

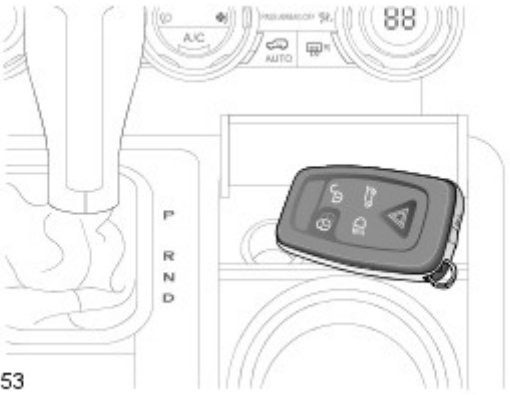
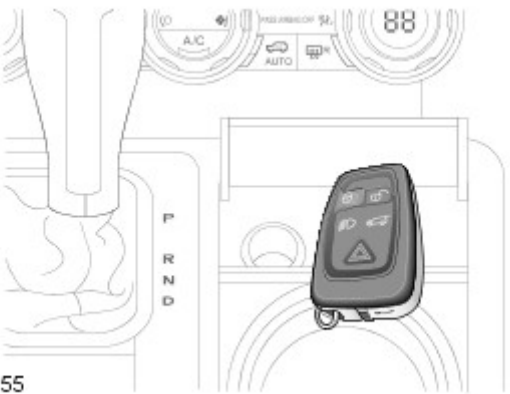
Symptom - Message Displayed	Symptom - Possible Cause	Action
Smart key not found - Refer to handbook	Ignition mode fails to switch on	GO to Pinpoint Test A.
• NOTE: Back up start - 10MY onwards	Ignition mode fails to switch on	GO to Pinpoint Test B.
Smart key not found - Refer to handbook		
Press start and brake	Engine fails to crank	GO to Pinpoint Test C.
Steering column locked	Ignition switches off after 3 seconds	GO to Pinpoint Test D.
• NOTE: For diesel engines	Ambient temperatures below zero	GO to Pinpoint Test E.
Engine still not cranking		

Pin Point Test

PINPOINT TEST A : SMART KEY NOT FOUND - REFER TO HANDBOOK	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: IGNITION MODE FAILS TO SWITCH ON	
• NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
1	Ensure the smart Key is within the cabin area. Check the smart key is not close to any electrical devices e.g. Smart phones, laptops, laptop cases, games consoles and game console bags, briefcases, metal objects etc. All can affect the system performance and may block its communication with the vehicle. If the smart key battery low warning message has been displayed it is likely that the smart

	key battery has insufficient charge. Refer to section 'Back Up Start' for 10MY onwards
Has the vehicle started?	
Yes	No further action required
No	Check and install a new battery as required. Clear the DTC and retest. If the problem persists, contact dealer technical support

PINPOINT TEST B : BACK UP START - 10MY ONWARDS - SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: IGNITION MODE FAILS TO SWITCH ON	
<ul style="list-style-type: none"> NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed 	
 <p>E138853</p>	
 <p>E138855</p>	<p>1 On pressing the start button, smart key not found. When this warning is displayed the smart key should be brought into close proximity with the immobilize antenna unit. For the location of the immobilize antenna unit, see illustration. Hold the key in the location and press the start button again. If this process fails the first time, try repositioning the key around the immobilize antenna unit location, repeat the sequence again</p>
	Has the vehicle started? Yes No further action required No Contact dealer technical support

PINPOINT TEST C : PRESS START AND BRAKE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: ENGINE FAILS TO CRANK	
<ul style="list-style-type: none"> NOTE: Conditions for starting in addition to pressing the start button are NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed NOTE: If the engine can be heard to crank there is no fault with the smart key NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation 	
	<p>1 Check that there is sufficient brake pressure, (Automatic transmission only). Attempt another start making sure that the brake pedal is pressed firmly so the message is no longer displayed. In certain conditions this may require a more effort than usual</p>
	Has the vehicle started? Yes No further action required No Contact dealer technical support

PINPOINT TEST D : STEERING COLUMN LOCKED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: IGNITION SWITCHES OFF AFTER 3 SECONDS	
• NOTE: Conditions for starting in addition to pressing the start button are	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
• NOTE: If the engine can be heard to crank there is no fault with the smart key	
• NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load	
• NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation	
	<ol style="list-style-type: none"> 1 Unlock the vehicle using the key fob, within 3 minutes of unlocking ensure the steering wheel can rotate freely. Perform a further lock and unlock check and attempt to start vehicle. If the steering 'column locked' message is still displayed, Lock the vehicle with the key fob and ensure the column is locked (If installed) by turning the steering wheel. Then unlock the vehicle ensuring the column Steering wheel can turn freely. Now perform another start attempt
	Did the engine start? Yes No further action required No Contact dealer technical support


PINPOINT TEST E : ENGINE STILL NOT CRANKING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: AMBIENT TEMPERATURES BELOW ZERO	
	<ol style="list-style-type: none"> 1 Hold the start button down for at least 4 seconds while starting the vehicle
	<ol style="list-style-type: none"> 2 Switch the ignition on, wet the windscreen and activate the wipers. when the wipers are in operation press the start button, If the wipers stop, the Engine is allowed to start
	Did the engine start? Yes No further action required No Contact dealer technical support

Starting System - TDV6 2.7L Diesel - Starter Motor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

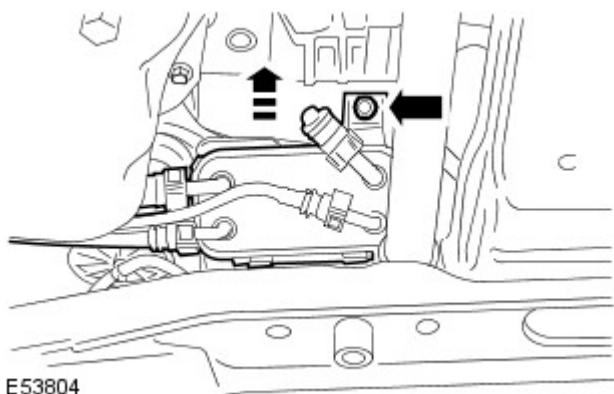
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

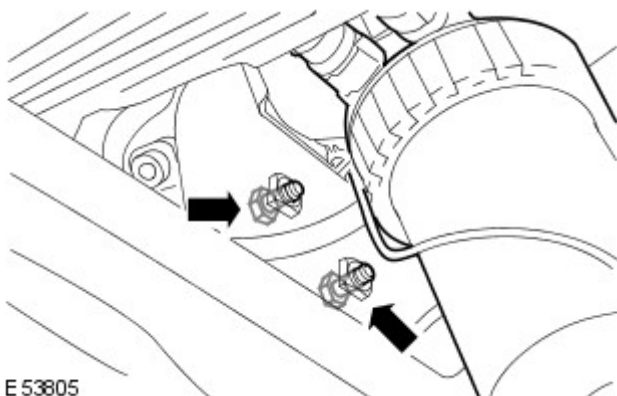
4. Release the fuel cooler.

- Remove the retaining bolt.



5. Reposition the fuel cooler and the fuel filter housing.

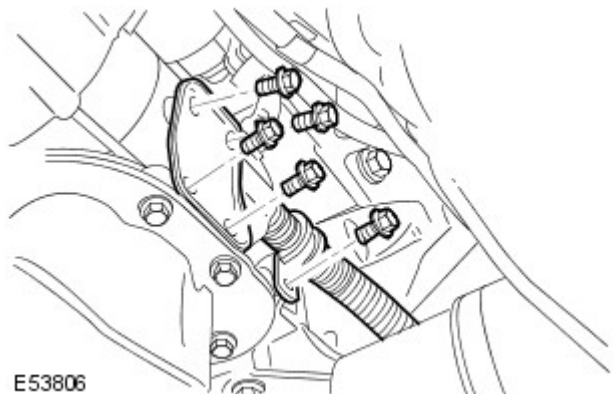
- Remove the two retaining bolts.

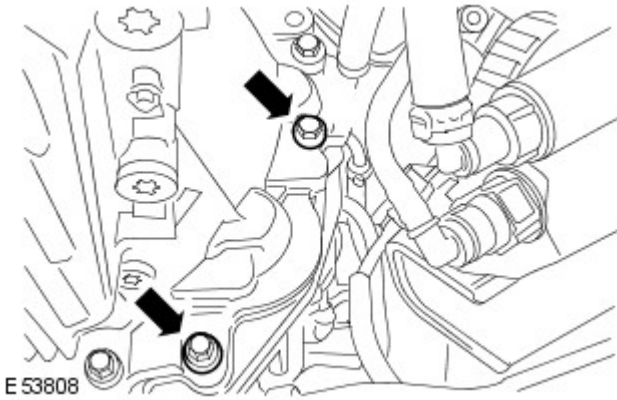


6. Remove the wiring harness retaining bolt.

7. Remove the starter motor retaining bracket.

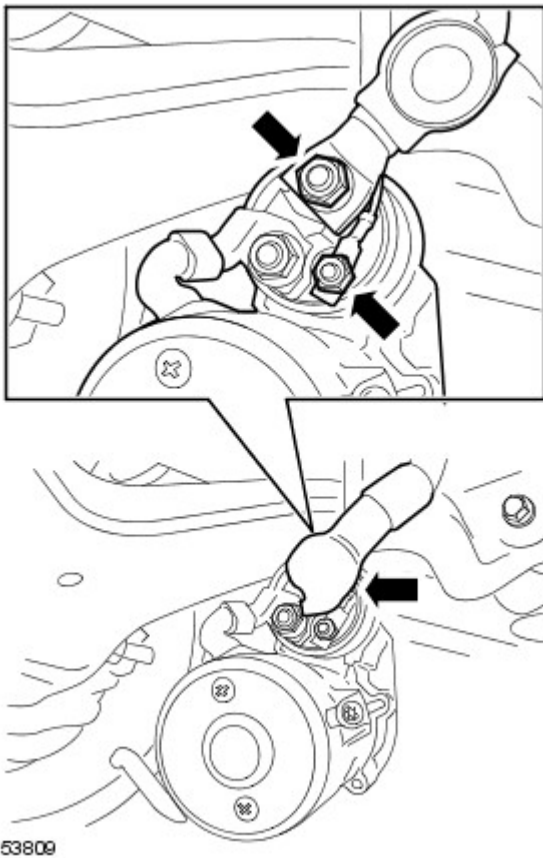
- Remove the four retaining bolts.





8. Reposition the starter motor.

- Remove the two retaining bolts.



9. Remove the starter motor.

- Reposition the rubber insulator.
- Remove the two starter motor harness retaining nuts.

Installation

1. Install the starter motor.

- Tighten the battery positive terminal integral connector retaining nut to 11 Nm (8 lb.ft).
- Tighten the solenoid terminal integral connector nut to 7 Nm (5 lb.ft).
- Reposition the rubber insulator.

2. Reposition the starter motor.

- Install the two retaining bolts.
- Tighten the bolts to 48 Nm (35 lb.ft).

3. Install the wiring harness retaining bolt.

- Tighten the bolt to 10 Nm (7 lb.ft).

4.  CAUTION: The starter motor retaining bracket must be

installed. Failure to follow this instruction may result in damage to the vehicle.

Install the starter motor retaining bracket.

- Install the 4 bolts and tighten to 10 Nm (7 lb.ft).

5. Reposition the fuel cooler and the fuel filter housing.

- Install the two bolts and tighten to 10 Nm (7 lb.ft).

6. Attach the fuel cooler.

- Install the bolt and tighten to 10 Nm (7 lb.ft).

7. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

8. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

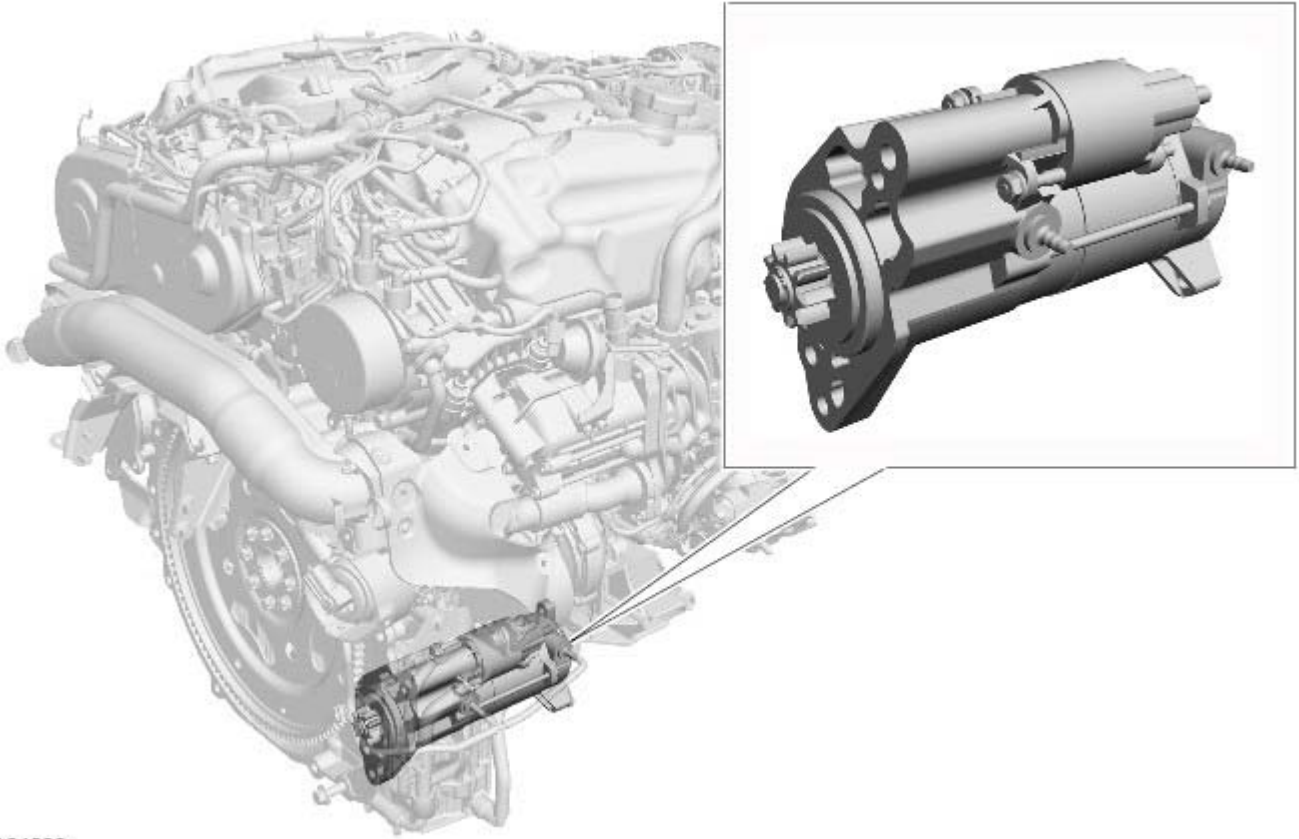
Starting System - TDV6 3.0L Diesel -

Description	Nm	lb-ft	lb-in
Starter motor to oil pan bolts	47	35	-
Battery positive terminal integral connector retaining nut	10	7	-
Solenoid terminal integral connector nut	7	-	62

Starting System - TDV6 3.0L Diesel - Starting System - Component Location

Description and Operation

Component Location



E124083

Starting System - TDV6 3.0L Diesel - Starting System - Overview

Description and Operation

OVERVIEW

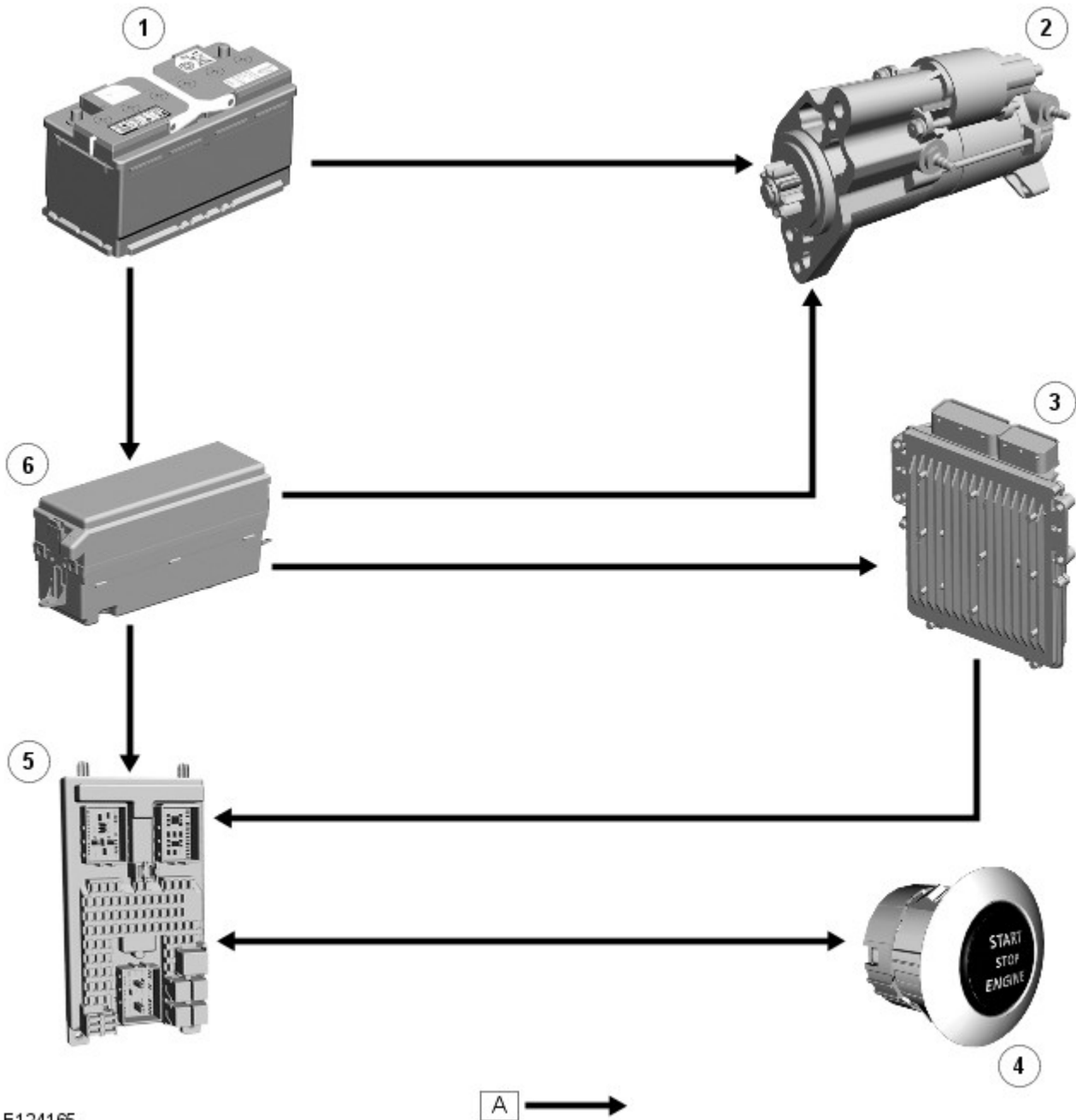
The starter motor is located on the rear [RH \(right-hand\)](#) side of the oil pan and protrudes through an aperture to drive the flywheel via a ring gear. The motor is secured to the oil pan by 2 bolts. The rear of the starter motor is attached to a support bracket which in turn is bolted to the oil pan. The bracket provides crucial support for the starter motor and must not be omitted when installing or reinstalling the unit.

Starting System - TDV6 3.0L Diesel - Starting System - System Operation and Component Description

Description and Operation

Control Diagram

• NOTE: A = Hardwired



E124165

A →

ItemDescription

1	Battery
2	Starter motor
3	ECM (engine control module)
4	Stop/start switch
5	CJB (central junction box)
6	EJB (engine junction box)

System Operation

OPERATION

The starter solenoid is energised by a signal from the [ECM](#) when the stop/start switch is pressed and the driver has depressed the brake pedal. When engine cranking is requested, the [ECM](#) checks that a valid key code has been received

before granting the crank request.

Once engine cranking has been granted, the [ECM](#) energizes the starter motor relay located in the engine compartment fusebox. The closing of the starter motor relay contacts causes battery voltage to be applied to the starter motor solenoid. The solenoid is energised and the pinion gear is pushed to engage with the flywheel ring gear. Simultaneously, the starter solenoid contacts close, causing current to flow into the motor brushes and armature which operates the motor. The armature rotational force is transferred to the engine's ring gear through the pinion gear, rotates the flywheel and starts the engine.

Component Description

DESCRIPTION

The Denso starter motor is rated as 2.2 kW. It is a conventional design with the motor and pinion in line and the solenoid mounted above.

The starter motor is of the pre-engaged type and comprises a series wound motor, an overrunning clutch and an integral solenoid. This starter incorporates labyrinth-breathing tubes to help with sealing and drainage.

The power for starter operation is supplied on a substantial single cable connected direct from the battery positive terminal, via a megafuse. The cable is connected to the solenoid via a copper threaded stud and secured with a nut.

Starting System - TDV6 3.0L Diesel - Starting System

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Starting System (303-06B, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Gear selector lever cable adjustment (vehicles with automatic transmission) ● Starter motor ● Engine (turns freely) 	<ul style="list-style-type: none"> ● Battery ● Fuses ● Starter relay ● Wiring harness(es) ● Damaged, loose or corroded connectors ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
The engine does not crank (starter motor does not turn)	<ul style="list-style-type: none"> ● Gear selector not in P or N position (vehicles with automatic transmission) ● Battery ● Starter relay ● Invalid key code received by Central Junction Box (CJB) ● Harness/Connectors ● Starter motor ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM) ● Engine seized 	Make sure the gear selector is in the P or N position and correctly adjusted. Check the battery condition and state of charge. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely.
The engine does not crank (starter motor does turn)	<ul style="list-style-type: none"> ● Starter motor installation ● Starter motor ● Flywheel/Drive plate ring gear 	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.
Engine cranks too slowly	<ul style="list-style-type: none"> ● Battery ● Harness/Connectors ● Starter motor ● Oil grade 	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition.
Engine cranks too fast	<ul style="list-style-type: none"> ● Low engine compression 	Check the engine compressions.
Excessive starter motor noise	<ul style="list-style-type: none"> ● Starter motor ● Flywheel/Drive plate ring gear ● Starter motor installation/casing 	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor casing condition. Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Starting System - TDV6 3.0L Diesel - Starting System Vehicles With: Smart Key

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system, refer to the relevant Description and Operation section in the workshop manual.

REFER to: Starting System (303-06A, Description and Operation).

Inspection and Verification

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Steering column ● Brake pedal ● Smart key ● Steering Wheel 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Warning lamp operation ● Smart key operation ● Engine start operation

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTC's) and refer to the DTC Index.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the warranty policy and procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system)

• NOTE: When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the digital multimeter leads into account

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

• NOTE: If diagnostic trouble codes are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals

Symptom Chart

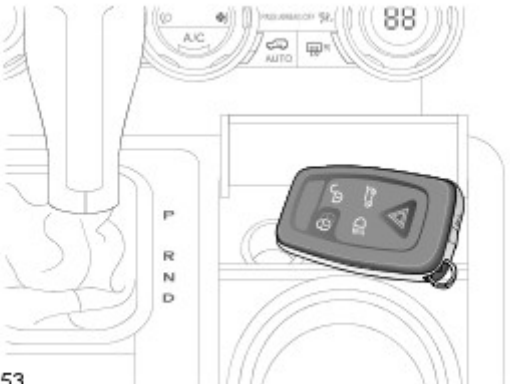

Symptom - Message Displayed	Symptom - Possible Cause	Action
Smart key not found - Refer to handbook	Ignition mode fails to switch on	GO to Pinpoint Test A.
• NOTE: Back up start - 10MY onwards	Ignition mode fails to switch on	GO to Pinpoint Test B.
Smart key not found - Refer to handbook		
Press start and brake	Engine fails to crank	GO to Pinpoint Test C.
Steering column locked	Ignition switches off after 3 seconds	GO to Pinpoint Test D.
• NOTE: For diesel engines	Ambient temperatures below zero	GO to Pinpoint Test E.
Engine still not cranking		

Pin Point Test

PINPOINT TEST A : SMART KEY NOT FOUND - REFER TO HANDBOOK	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: IGNITION MODE FAILS TO SWITCH ON	
• NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
1	Ensure the smart Key is within the cabin area. Check the smart key is not close to any electrical devices e.g. Smart phones, laptops, laptop cases, games consoles and game console bags, briefcases, metal objects etc. All can affect the system performance and may block its communication with the vehicle. If the smart key battery low warning message has been displayed it is likely that the smart

	key battery has insufficient charge. Refer to section 'Back Up Start' for 10MY onwards
Has the vehicle started?	
Yes	No further action required
No	Check and install a new battery as required. Clear the DTC and retest. If the problem persists, contact dealer technical support

PINPOINT TEST B : BACK UP START - 10MY ONWARDS - SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: IGNITION MODE FAILS TO SWITCH ON	
<ul style="list-style-type: none"> NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed 	
 <p>E138853</p>	
 <p>E138855</p>	<p>1 On pressing the start button, smart key not found. When this warning is displayed the smart key should be brought into close proximity with the immobilize antenna unit. For the location of the immobilize antenna unit, see illustration. Hold the key in the location and press the start button again. If this process fails the first time, try repositioning the key around the immobilize antenna unit location, repeat the sequence again</p>
	Has the vehicle started? Yes No further action required No Contact dealer technical support

PINPOINT TEST C : PRESS START AND BRAKE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: ENGINE FAILS TO CRANK	
<ul style="list-style-type: none"> NOTE: Conditions for starting in addition to pressing the start button are NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed NOTE: If the engine can be heard to crank there is no fault with the smart key NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation 	
	<p>1 Check that there is sufficient brake pressure, (Automatic transmission only). Attempt another start making sure that the brake pedal is pressed firmly so the message is no longer displayed. In certain conditions this may require a more effort than usual</p>
Has the vehicle started?	
Yes	No further action required
No	Contact dealer technical support

PINPOINT TEST D : STEERING COLUMN LOCKED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: IGNITION SWITCHES OFF AFTER 3 SECONDS	
• NOTE: Conditions for starting in addition to pressing the start button are	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
• NOTE: If the engine can be heard to crank there is no fault with the smart key	
• NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load	
• NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation	
	<ol style="list-style-type: none"> 1 Unlock the vehicle using the key fob, within 3 minutes of unlocking ensure the steering wheel can rotate freely. Perform a further lock and unlock check and attempt to start vehicle. If the steering 'column locked' message is still displayed, Lock the vehicle with the key fob and ensure the column is locked (If installed) by turning the steering wheel. Then unlock the vehicle ensuring the column Steering wheel can turn freely. Now perform another start attempt
	Did the engine start? Yes No further action required No Contact dealer technical support

PINPOINT TEST E : ENGINE STILL NOT CRANKING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: AMBIENT TEMPERATURES BELOW ZERO	
	<ol style="list-style-type: none"> 1 Hold the start button down for at least 4 seconds while starting the vehicle
	<ol style="list-style-type: none"> 2 Switch the ignition on, wet the windscreen and activate the wipers. when the wipers are in operation press the start button, If the wipers stop, the Engine is allowed to start
	Did the engine start? Yes No further action required No Contact dealer technical support

Starting System - TDV6 3.0L Diesel - Starter Motor

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

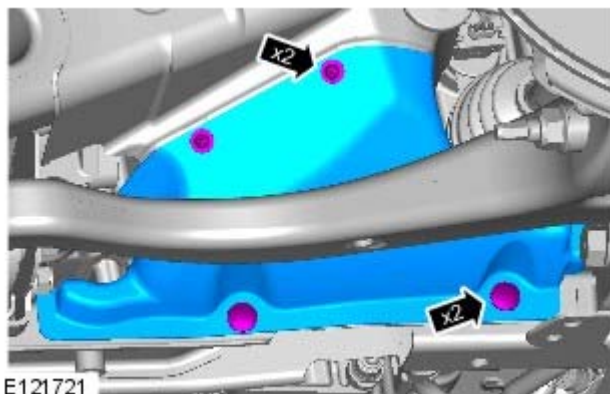
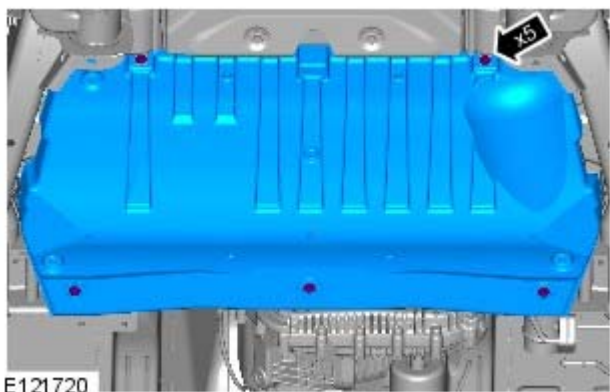
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

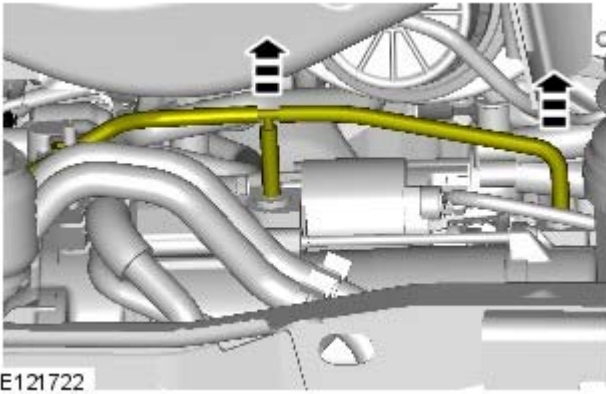
Raise and support the vehicle.

3. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

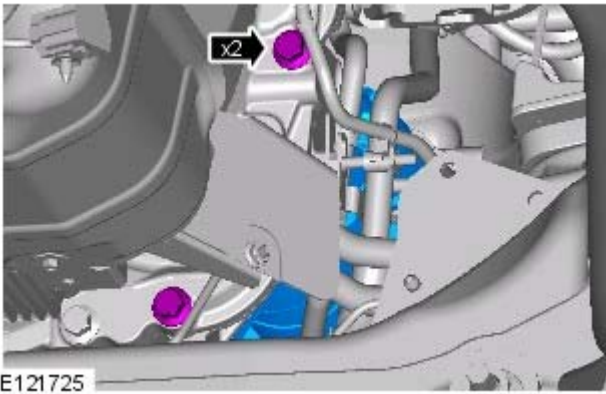
4. Torque: 62 Nm



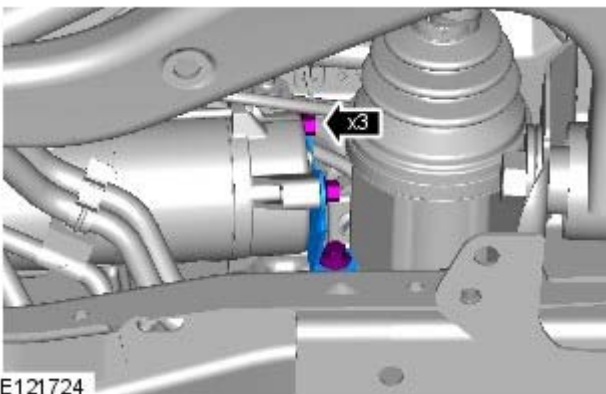
- 5.



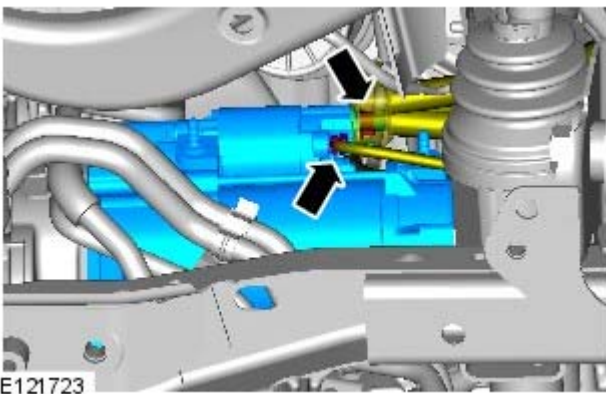
6.



7. Torque: 47 Nm



8. Torque: 47 Nm



9. Torque:
M8 10 Nm
M6 7 Nm

Installation

1. To install, reverse the removal procedure.

Starting System - V6 4.0L Petrol -

Starter Motor

Item	Specification
Starter motor:	
Make	Denso
Type	RA - Pre-engaged
Voltage	12
Current consumption	1.8 kW

Torque Specifications

Description	Nm	lb-ft
* Starter motor positive terminal nut	10	7
Starter motor bolts	45	33
** Lower steering column universal joint retaining bolt	25	18
Upper suspension arm and brake line heat shield nuts and bolts	10	7



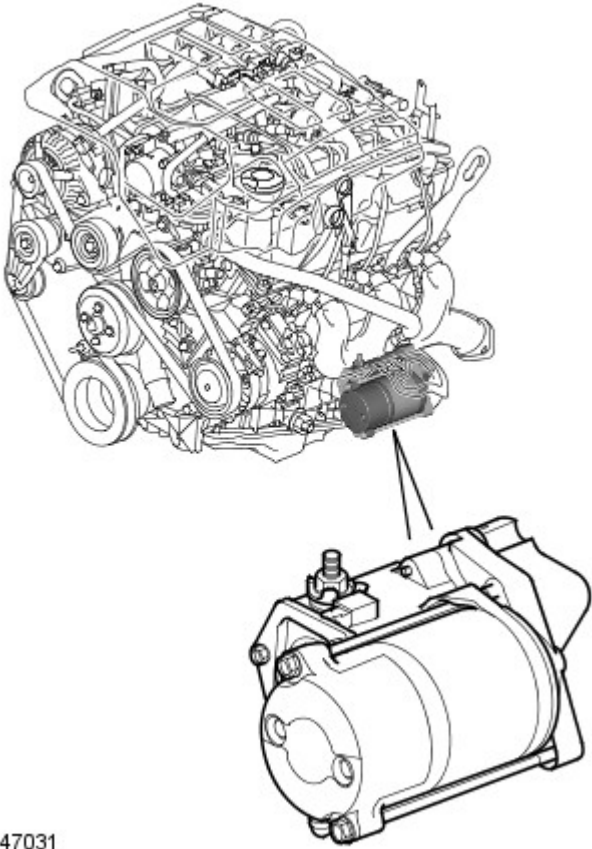
CAUTION: * Damage to the internal connections will occur if this torque is exceeded

**** New patchlok bolt must be installed**

Starting System - V6 4.0L Petrol - Starting System

Description and Operation

STARTER MOTOR



E47031

The starter motor is rated as a 1.8kW and is a Denso level three sealed unit. It is an RA type starter motor, which is of the offset design with the solenoid being directly behind the pinion to give a more positive engagement to the ring gear. The motor is geared directly to the pinion. Each starter motor is of the pre-engaged type and comprises of a series wound motor and an overrunning clutch. This starter incorporates labyrinth breathing tubes to help with sealing and drainage.

The starter solenoid is energised by a signal from the ECM when the ignition switch is moved to the crank position. When engine cranking is requested, the ECM checks that a valid key code has been received before granting the crank request.

The power for starter operation is supplied on a substantial single cable connected direct from the battery positive terminal. The cable is connected to the solenoid via a copper threaded stud with an anti-rotational device and secured with a nut.

The starter motor is located on the rear LH side of the engine block. The motor is secured to the block and protrudes through an aperture to drive the flywheel via a ring gear.

Starting System - V6 4.0L Petrol - Starting System

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Starting System](#) (303-06C Starting System - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Gear selector lever cable adjustment (vehicles with automatic transmission) ● Starter motor ● Engine (turns freely) 	<ul style="list-style-type: none"> ● Battery ● Fuses ● Starter relay ● Wiring harness(es) ● Damaged, loose or corroded connectors ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
The engine does not crank (starter motor does not turn)	<ul style="list-style-type: none"> ● Gear selector not in P or N position (vehicles with automatic transmission) ● Battery ● Starter relay ● Invalid key code received by Central Junction Box (CJB) ● Harness/Connectors ● Starter motor ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM) ● Engine seized 	Make sure the gear selector is in the P or N position and correctly adjusted. Check the battery condition and state of charge. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely.
The engine does not crank (starter motor does turn)	<ul style="list-style-type: none"> ● Starter motor installation ● Starter motor ● Flywheel/Drive plate ring gear 	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.
Engine cranks too slowly	<ul style="list-style-type: none"> ● Battery ● Harness/Connectors ● Starter motor ● Oil grade 	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition.
Engine cranks too fast	<ul style="list-style-type: none"> ● Low engine compression 	Check the engine compressions.
Excessive starter motor noise	<ul style="list-style-type: none"> ● Starter motor ● Flywheel/Drive plate ring gear ● Starter motor installation/casing 	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor casing condition. Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Starting System - V6 4.0L Petrol - Starting System Vehicles With: Smart Key

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system, refer to the relevant Description and Operation section in the workshop manual.

REFER to: Starting System (303-06A, Description and Operation).

Inspection and Verification

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Steering column ● Brake pedal ● Smart key ● Steering Wheel 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Warning lamp operation ● Smart key operation ● Engine start operation

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTC's) and refer to the DTC Index.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the warranty policy and procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system)

• NOTE: When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the digital multimeter leads into account

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

• NOTE: If diagnostic trouble codes are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals

Symptom Chart

Symptom - Message Displayed	Symptom - Possible Cause	Action
Smart key not found - Refer to handbook	Ignition mode fails to switch on	GO to Pinpoint Test A.
• NOTE: Back up start - 10MY onwards	Ignition mode fails to switch on	GO to Pinpoint Test B.
Smart key not found - Refer to handbook		
Press start and brake	Engine fails to crank	GO to Pinpoint Test C.
Steering column locked	Ignition switches off after 3 seconds	GO to Pinpoint Test D.
• NOTE: For diesel engines	Ambient temperatures below zero	GO to Pinpoint Test E.
Engine still not cranking		

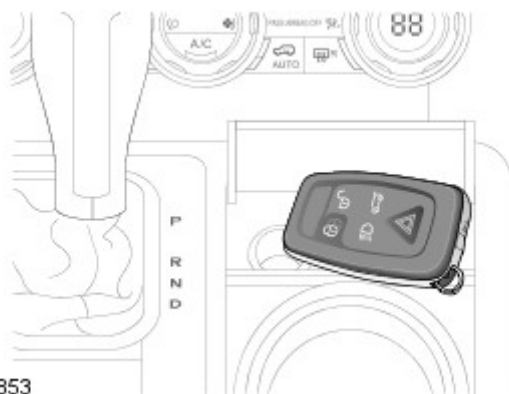

Pin Point Test

PINPOINT TEST A : SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: IGNITION MODE FAILS TO SWITCH ON	
• NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
1	Ensure the smart Key is within the cabin area. Check the smart key is not close to any electrical devices e.g. Smart phones, laptops, laptop cases, games consoles and game console bags, briefcases, metal objects etc. All can affect the system performance and may block its communication with the vehicle. If the smart key battery low warning message has been displayed it is likely that the smart key battery has insufficient charge. Refer to section 'Back Up Start' for 10MY onwards

	Has the vehicle started? Yes No further action required No Check and install a new battery as required. Clear the DTC and retest. If the problem persists, contact dealer technical support
--	---

PINPOINT TEST B : BACK UP START - 10MY ONWARDS - SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: IGNITION MODE FAILS TO SWITCH ON	
<ul style="list-style-type: none"> NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed 	
 <p>E138853</p>	
 <p>E138855</p>	<p>1 On pressing the start button, smart key not found. When this warning is displayed the smart key should be brought into close proximity with the immobilize antenna unit. For the location of the immobilize antenna unit, see illustration. Hold the key in the location and press the start button again. If this process fails the first time, try repositioning the key around the immobilize antenna unit location, repeat the sequence again</p>
	Has the vehicle started? Yes No further action required No Contact dealer technical support

PINPOINT TEST C : PRESS START AND BRAKE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: ENGINE FAILS TO CRANK	
<ul style="list-style-type: none"> NOTE: Conditions for starting in addition to pressing the start button are NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed NOTE: If the engine can be heard to crank there is no fault with the smart key NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation 	
	<p>1 Check that there is sufficient brake pressure, (Automatic transmission only). Attempt another start making sure that the brake pedal is pressed firmly so the message is no longer displayed. In certain conditions this may require a more effort than usual</p>
	Has the vehicle started? Yes No further action required No Contact dealer technical support

PINPOINT TEST D : STEERING COLUMN LOCKED


TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: IGNITION SWITCHES OFF AFTER 3 SECONDS	
• NOTE: Conditions for starting in addition to pressing the start button are	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
• NOTE: If the engine can be heard to crank there is no fault with the smart key	
• NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load	
• NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation	
	<ol style="list-style-type: none"> 1 Unlock the vehicle using the key fob, within 3 minutes of unlocking ensure the steering wheel can rotate freely. Perform a further lock and unlock check and attempt to start vehicle. If the steering 'column locked' message is still displayed, Lock the vehicle with the key fob and ensure the column is locked (If installed) by turning the steering wheel. Then unlock the vehicle ensuring the column Steering wheel can turn freely. Now perform another start attempt
	Did the engine start? Yes No further action required No Contact dealer technical support

PINPOINT TEST E : ENGINE STILL NOT CRANKING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: AMBIENT TEMPERATURES BELOW ZERO	
	<ol style="list-style-type: none"> 1 Hold the start button down for at least 4 seconds while starting the vehicle
	<ol style="list-style-type: none"> 2 Switch the ignition on, wet the windscreen and activate the wipers. when the wipers are in operation press the start button, If the wipers stop, the Engine is allowed to start
	Did the engine start? Yes No further action required No Contact dealer technical support

Starting System - V6 4.0L Petrol - Starter Motor

Removal and Installation

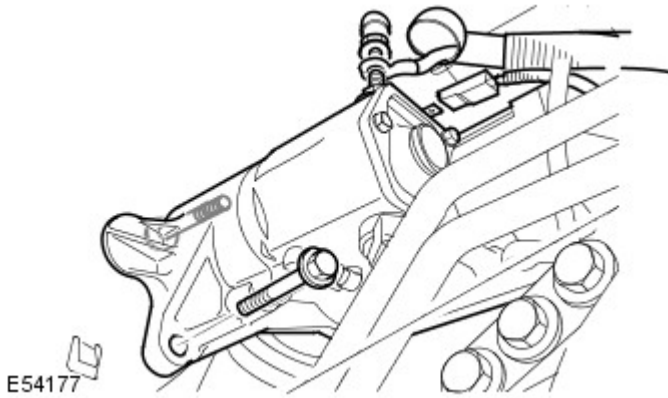
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
4. Remove the starter motor.

- Remove the 2 bolts.
- Remove the terminal upper cover.
- Remove the terminal lower cover.
- Remove the nut.
- Disconnect the 2 electrical connectors.



Installation

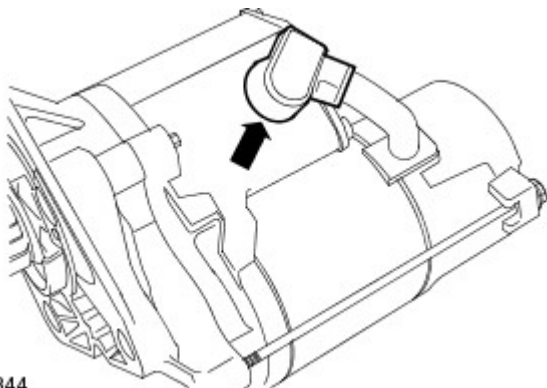
1. Install the starter motor.
 - Clean the component mating faces.
 - Connect the electrical connectors.
 - Tighten the nut to 10 Nm (7 lb.ft).
 - Install the terminal lower cover.
 - Install the terminal upper cover.
 - Tighten the bolts to 45 Nm (33 lb.ft).
2. Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Starting System - V6 4.0L Petrol - Starter Solenoid

Removal and Installation

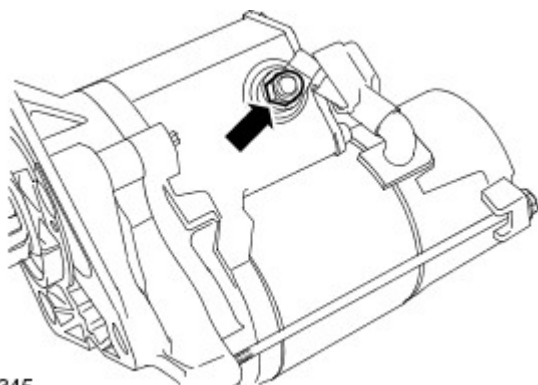
Removal

1. Remove the starter motor.
For additional information, refer to: [Starter Motor](#) (303-06C Starting System - V6 4.0L Petrol, Removal and Installation).
2. Release the starter motor terminal cover.



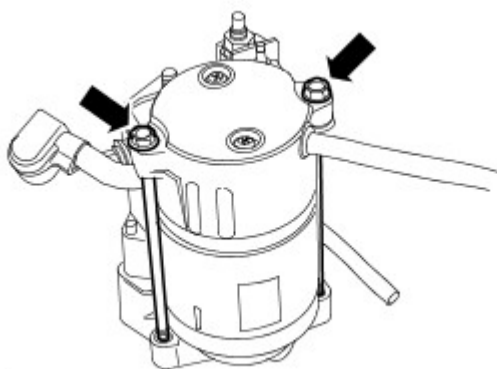
E92344

3. Release the starter motor terminal.
 - Remove the nut.




E92345

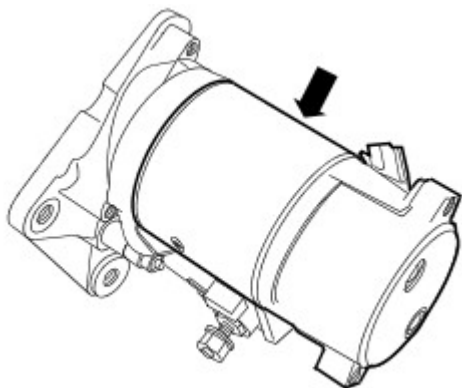
4. Remove the starter motor bolts.



E92220

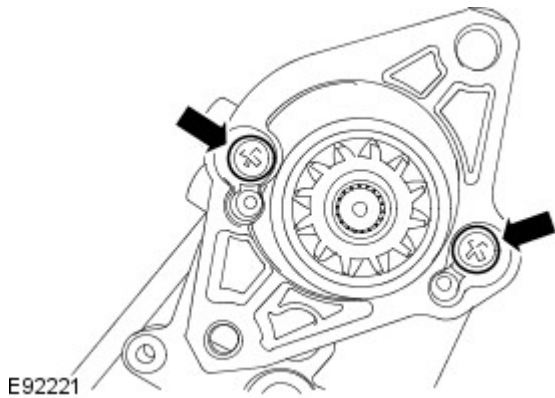
5.  **CAUTION:** Make sure the starter motor armature remains located inside the motor housing.

Remove the starter motor from the gear housing.




E92346

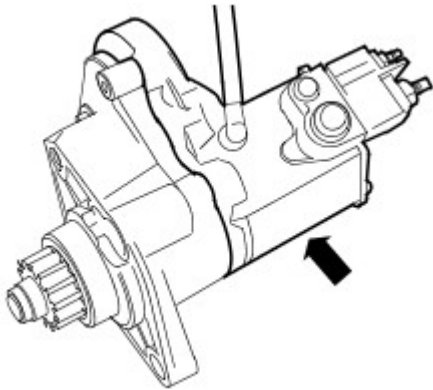
6. Remove the starter solenoid screws.



E92221


7.  CAUTION: Make sure the gears and bearings remain located in the gear housing.

Remove the starter solenoid.



E92222

Installation

1.  CAUTION: Make sure the gears and bearings remain located in the gear housing.

Fit the starter solenoid to the gear housing.

2. Fit the starter solenoid screws.

- Tighten to 10 Nm (7 lb.ft).

3. Install the starter motor to the gear housing.

4. Install the starter motor bolts.

- Tighten to 10 Nm (7 lb.ft).

5. Secure the starter motor terminal.

- Tighten the nut to 5 Nm (4 lb.ft).

6. Secure the starter motor terminal cover.

7. Install the starter motor.

For additional information, refer to: [Starter Motor](#) (303-06C Starting System - V6 4.0L Petrol, Removal and Installation).

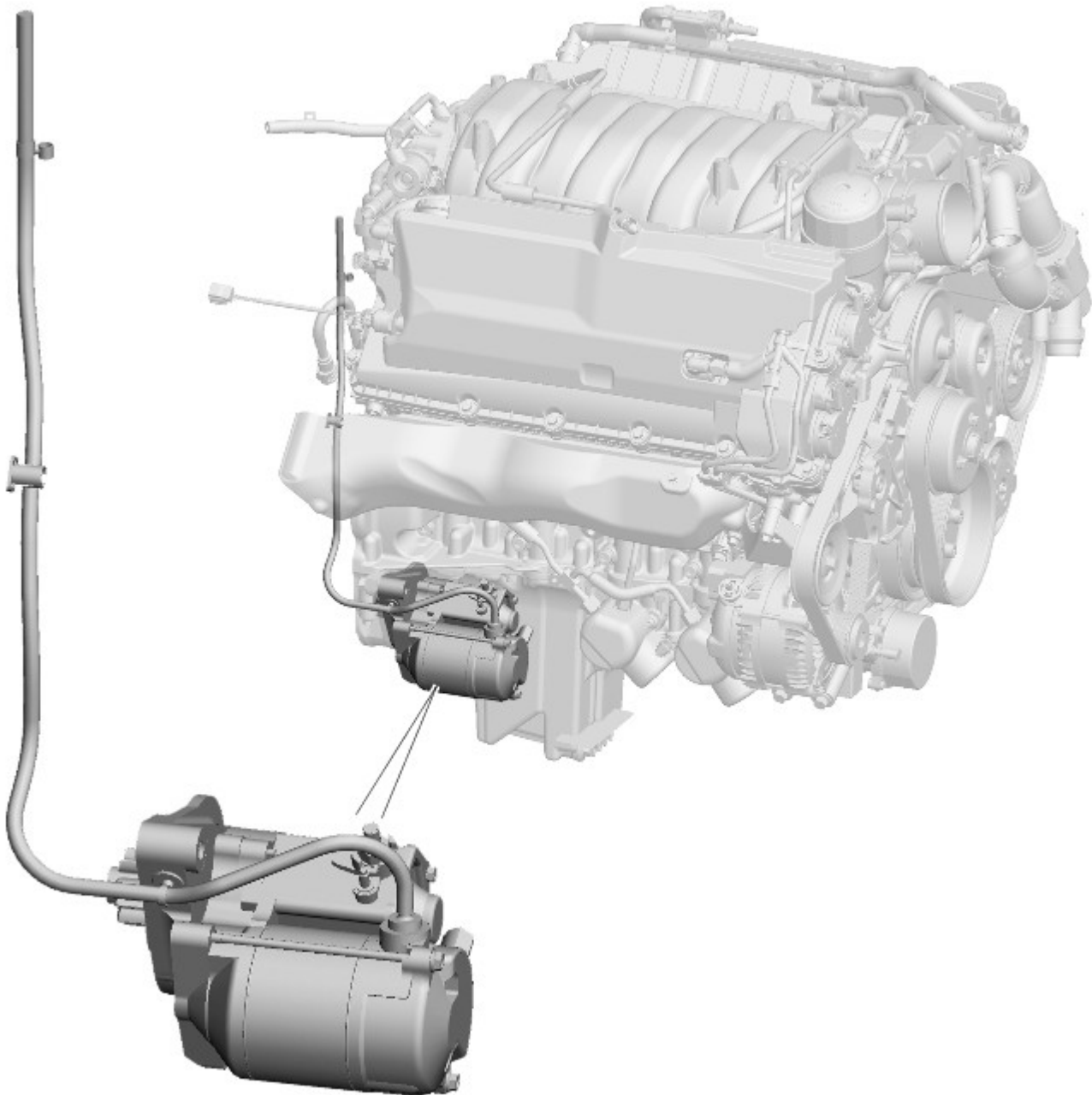
Starting System - V8 5.0L Petrol -

Description	Nm	lb-ft	lb-in
Starter motor retaining bolts	48	36	-
Battery positive terminal connector retaining nut	10	7	-
Solenoid terminal connector retaining nut	4	-	35

Starting System - V8 5.0L Petrol - Starting System

Description and Operation

COMPONENT LOCATION



E123712

INTRODUCTION

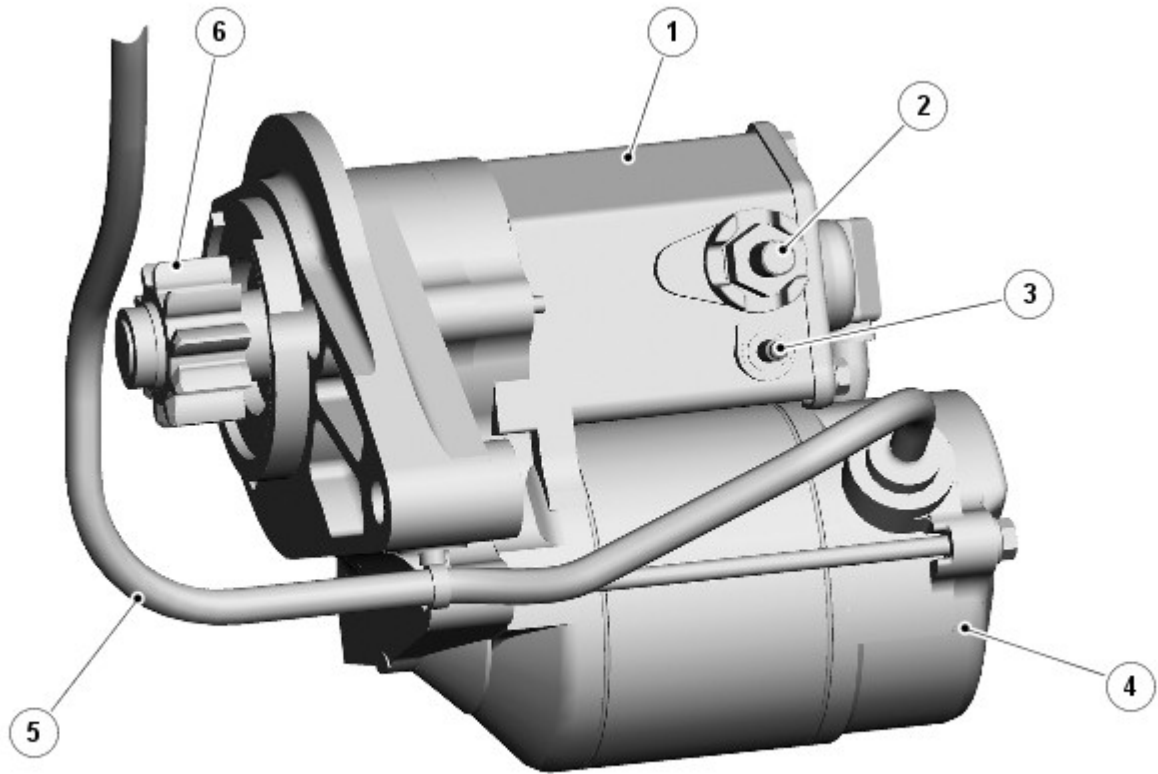
The starter motor is manufactured by Denso and is rated at 1.4 kW. The motor is geared directly to the pinion. The motor is a series wound motor with an overrunning clutch. The interior of the motor is ventilated through a breather tube attached to the rear of the engine.

The starter motor is located on the rear right side of the engine sump. The motor is installed in an aperture in the sump and the pinion is engaged with the ring gear of the crankshaft drive plate.

A heavy duty cable, which supplies the electrical power to turn the starter motor, is connected to the battery positive terminal via 500 A megafuse.

At the starter motor, the cable is connected to a terminal stud on the solenoid. The power feed from the starter relay, to energize the solenoid, is connected to a second terminal stud on the solenoid.

Starter Motor Assembly

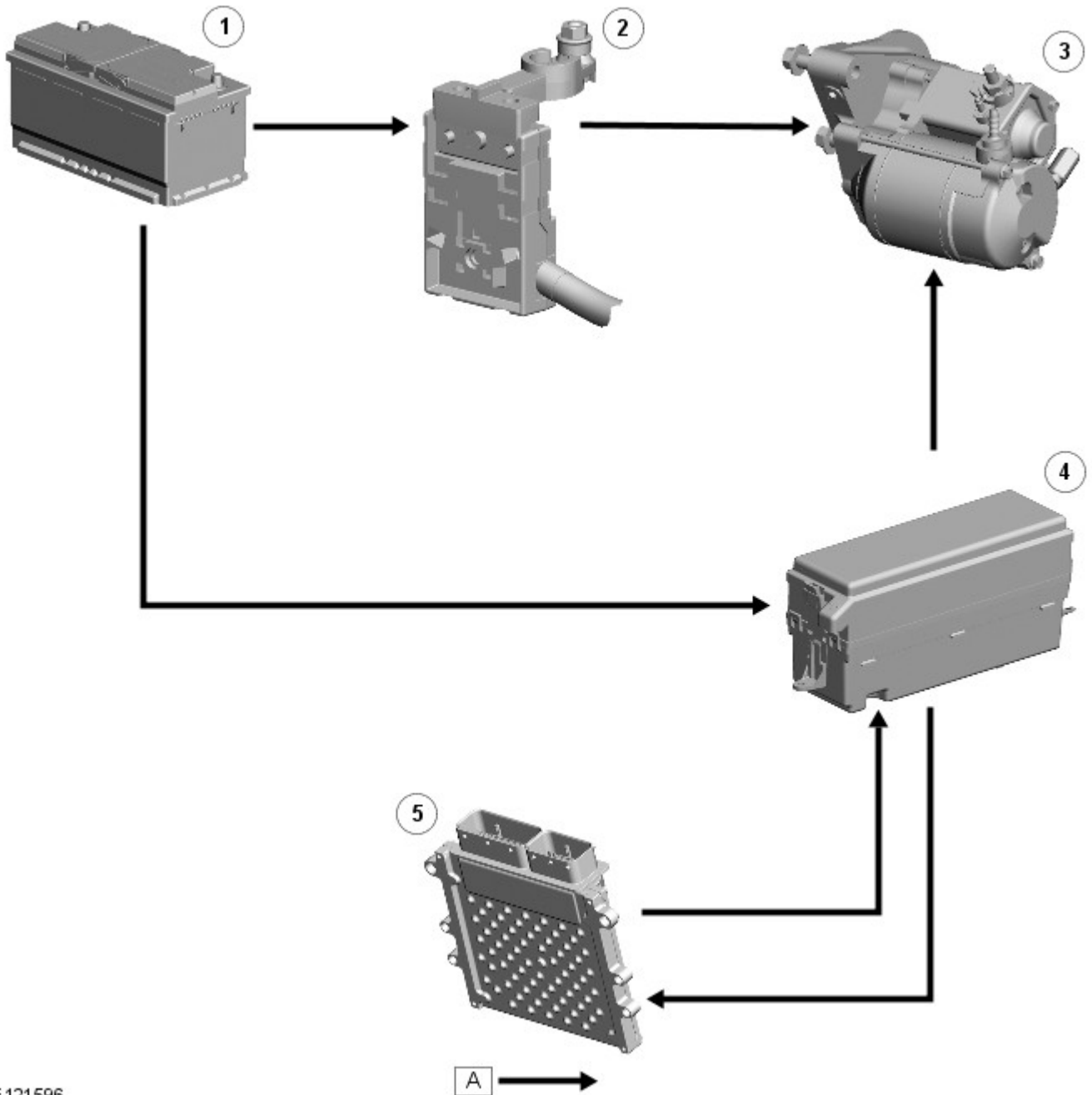


E120142

Item	Part Number	Description
1	-	Starter solenoid
2	-	Starter power terminal
3	-	Solenoid power terminal
4	-	Electric motor
5	-	Breather tube
6	-	Pinion gear

CONTROL DIAGRAM

- NOTE: A = Hardwired.



E121596

Item	Part Number	Description
1	-	Battery
2	-	Terminal post megafuse (500 A)
3	-	Starter motor
4	-	EJB (engine junction box) (starter relay)
5	-	ECM (engine control module)

OPERATION

Engine crank requests are monitored by the passive anti-theft system and, if valid, passed on to the [ECM \(engine control module\)](#).

For additional information, refer to: [Anti-Theft - Passive](#) (419-01B Anti-Theft - Passive, Description and Operation).

When the [ECM](#) receives a crank request, it energizes the starter relay in the [EJB \(engine junction box\)](#). The energized starter relay supplies 12 V power to energize the pull-in coil of the starter solenoid. Once activated, the pull-in coil engages the solenoid plunger, which engages the pinion gear with the ring gear. The plunger then closes the solenoid circuit, feeding power from the 500 A megafuse on the battery positive terminal to the starter motor.

Starting System - V8 5.0L Petrol - Starting System

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-06 Starting System - 5.0L)

Starting System (Description and Operation),
Starting System (Description and Operation),
Starting System (Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Gear selector lever cable adjustment (vehicles with automatic transmission) ● Starter motor ● Engine (turns freely) 	<ul style="list-style-type: none"> ● Battery ● Fuses ● Starter relay ● Wiring harness(es) ● Damaged, loose or corroded connectors ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
The engine does not crank (starter motor does not turn)	<ul style="list-style-type: none"> ● Gear selector not in P or N position (vehicles with automatic transmission) ● Battery ● Starter relay ● Invalid key code received by Central Junction Box (CJB) ● Harness/Connectors ● Starter motor ● Ignition switch ● Generator ● Transmission Control Module (TCM) ● Engine Control Module (ECM) ● Engine seized 	Make sure the gear selector is in the P or N position and correctly adjusted. Check the battery condition and state of charge. Check for DTCs indicating an immobilizer fault. Check the starter motor relay, ignition switch and generator circuits. Refer to the electrical guides. Check for TCM and ECM DTCs. Check that the engine turns freely.
The engine does not crank (starter motor does turn)	<ul style="list-style-type: none"> ● Starter motor installation ● Starter motor ● Flywheel/Drive plate ring gear 	Check the starter motor installation (fasteners tight, starter motor square to engine, etc). Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.
Engine cranks too slowly	<ul style="list-style-type: none"> ● Battery ● Harness/Connectors ● Starter motor ● Oil grade 	Check the battery condition and state of charge. Check the starter motor circuits. Refer to the electrical guides. Check the engine oil grade and condition.
Engine cranks too fast	<ul style="list-style-type: none"> ● Low engine compression 	Check the engine compressions.
Excessive starter	<ul style="list-style-type: none"> ● Starter motor ● Flywheel/Drive plate ring gear 	Check the starter motor installation (fasteners tight, motor square to engine, etc). Check the starter motor casing condition. Check the flywheel/drive plate ring gear teeth for damage, foreign objects, etc.
DTC Index	<ul style="list-style-type: none"> ● Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. 	
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - V8 5.0L Petrol, DTC: Engine Control Module (PCM) (100-00 General		

Information, Description and Operation).

Starting System - V8 5.0L Petrol - Starting System Vehicles With: Smart Key

Diagnosis and Testing

Principles of Operation

For a detailed description of the starting system, refer to the relevant Description and Operation section in the workshop manual.

REFER to: Starting System (303-06A, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Steering column ● Brake pedal ● Smart key ● Steering Wheel 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Warning lamp operation ● Smart key operation ● Engine start operation

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTC's) and refer to the DTC Index.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the warranty policy and procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• NOTE: Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system)

• NOTE: When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places and with a current calibration certificate. When testing resistance, always take the resistance of the digital multimeter leads into account

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

• NOTE: If diagnostic trouble codes are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals

Symptom Chart

Symptom - Message Displayed	Symptom - Possible Cause	Action
Smart key not found - Refer to handbook	Ignition mode fails to switch on	GO to Pinpoint Test A.
• NOTE: Back up start - 10MY onwards	Ignition mode fails to switch on	GO to Pinpoint Test B.
Smart key not found - Refer to handbook		
Press start and brake	Engine fails to crank	GO to Pinpoint Test C.
Steering column locked	Ignition switches off after 3 seconds	GO to Pinpoint Test D.
• NOTE: For diesel engines	Ambient temperatures below zero	GO to Pinpoint Test E.
Engine still not cranking		

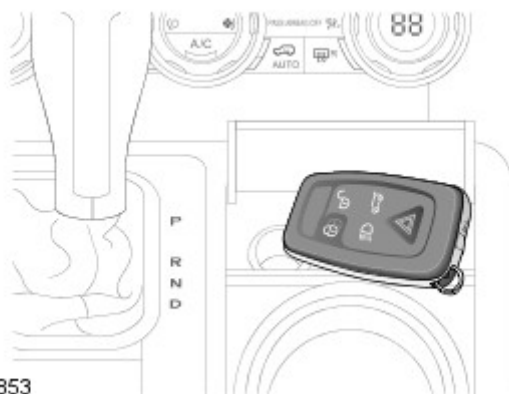

Pin Point Test

PINPOINT TEST A : SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: IGNITION MODE FAILS TO SWITCH ON	
• NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
1	Ensure the smart Key is within the cabin area. Check the smart key is not close to any electrical devices e.g. Smart phones, laptops, laptop cases, games consoles and game console bags, briefcases, metal objects etc. All can affect the system performance and may block its communication with the vehicle. If the smart key battery low warning message has been displayed it is likely that the smart key battery has insufficient charge. Refer to section 'Back Up Start' for 10MY onwards

	<p>Has the vehicle started?</p> <p>Yes No further action required</p> <p>No Check and install a new battery as required. Clear the DTC and retest. If the problem persists, contact dealer technical support</p>
--	--

PINPOINT TEST B : BACK UP START - 10MY ONWARDS - SMART KEY NOT FOUND - REFER TO HANDBOOK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: IGNITION MODE FAILS TO SWITCH ON	
<ul style="list-style-type: none"> NOTE: In normal operation, pressing the start button for one second will cause the vehicle to enter the ignition mode. If the procedures below are followed the engine should crank NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed 	
 <p>E138853</p>	
 <p>E138855</p>	<p>1 On pressing the start button, smart key not found. When this warning is displayed the smart key should be brought into close proximity with the immobilize antenna unit. For the location of the immobilize antenna unit, see illustration. Hold the key in the location and press the start button again. If this process fails the first time, try repositioning the key around the immobilize antenna unit location, repeat the sequence again</p>
	<p>Has the vehicle started?</p> <p>Yes No further action required</p> <p>No Contact dealer technical support</p>

PINPOINT TEST C : PRESS START AND BRAKE

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: ENGINE FAILS TO CRANK	
<ul style="list-style-type: none"> NOTE: Conditions for starting in addition to pressing the start button are NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected NOTE: For manual transmission vehicles ensure the clutch is fully depressed NOTE: If the engine can be heard to crank there is no fault with the smart key NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation 	
	<p>1 Check that there is sufficient brake pressure, (Automatic transmission only). Attempt another start making sure that the brake pedal is pressed firmly so the message is no longer displayed. In certain conditions this may require a more effort than usual</p>
	<p>Has the vehicle started?</p> <p>Yes No further action required</p> <p>No Contact dealer technical support</p>

PINPOINT TEST D : STEERING COLUMN LOCKED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: IGNITION SWITCHES OFF AFTER 3 SECONDS	
• NOTE: Conditions for starting in addition to pressing the start button are	
• NOTE: For automatic transmission vehicles, ensure the brake pedal is depressed and the park or neutral selected	
• NOTE: For manual transmission vehicles ensure the clutch is fully depressed	
• NOTE: If the engine can be heard to crank there is no fault with the smart key	
• NOTE: If the locking pin is still engaged, turn the steering wheel to overcome the side load	
• NOTE: Start authorisation defined as Ignition functions, Steering column lock engagement, Engine immobilize and smart key authorisation	
	<ol style="list-style-type: none"> 1 Unlock the vehicle using the key fob, within 3 minutes of unlocking ensure the steering wheel can rotate freely. Perform a further lock and unlock check and attempt to start vehicle. If the steering 'column locked' message is still displayed, Lock the vehicle with the key fob and ensure the column is locked (If installed) by turning the steering wheel. Then unlock the vehicle ensuring the column Steering wheel can turn freely. Now perform another start attempt
	Did the engine start? Yes No further action required No Contact dealer technical support

PINPOINT TEST E : ENGINE STILL NOT CRANKING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: AMBIENT TEMPERATURES BELOW ZERO	
	<ol style="list-style-type: none"> 1 Hold the start button down for at least 4 seconds while starting the vehicle
	<ol style="list-style-type: none"> 2 Switch the ignition on, wet the windscreen and activate the wipers. when the wipers are in operation press the start button, If the wipers stop, the Engine is allowed to start
	Did the engine start? Yes No further action required No Contact dealer technical support

Starting System - V8 5.0L Petrol - Starter Motor

Removal and Installation

Removal

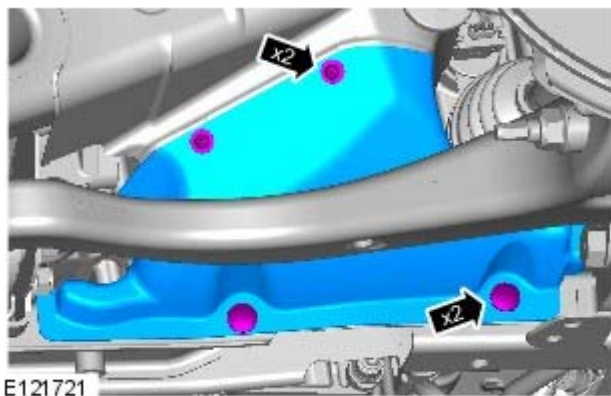
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

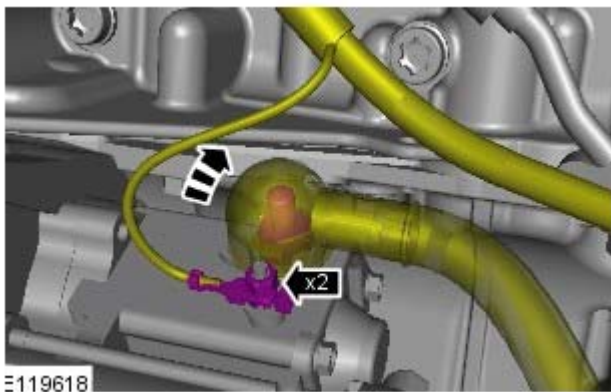
Raise and support the vehicle.

3. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



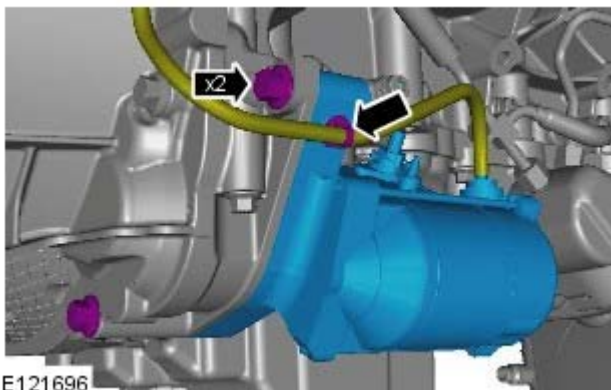
E121721

- 4.



E119618

5. Torque:
M8 10 Nm
M6 4 Nm



E121696

6. Torque: 48 Nm

Installation

1. To install, reverse the removal procedure.

Engine Ignition - V6 4.0L Petrol -

General Specification

Item	Specification
* Spark plugs - Platinum:	
Make	Motorcraft
Type	AGSF 24PM
** Gap	1.4 mm (0.055 in)
+ Spark plugs - Copper:	
Make	Motorcraft
Type	SGSF 22L
++ Gap	1.4 mm (0.055 in)
Ignition coils:	
Make	Denso
Type	'Coil near plug'

* May be used with either LEADED or UNLEADED fuels but if used with LEADED fuel, they must be replaced at 15,000 mile (24,000 km) intervals

** Plugs must not be 're-gapped' in service, if gap is not as specified, plug(s) must be replaced

+ May only be used with LEADED fuel

++ New plugs must have the gap set to 1.4 mm (0.055 in) prior to installation, plugs must not be 're-gapped' in service, if gap is not as specified, plug(s) must be replaced

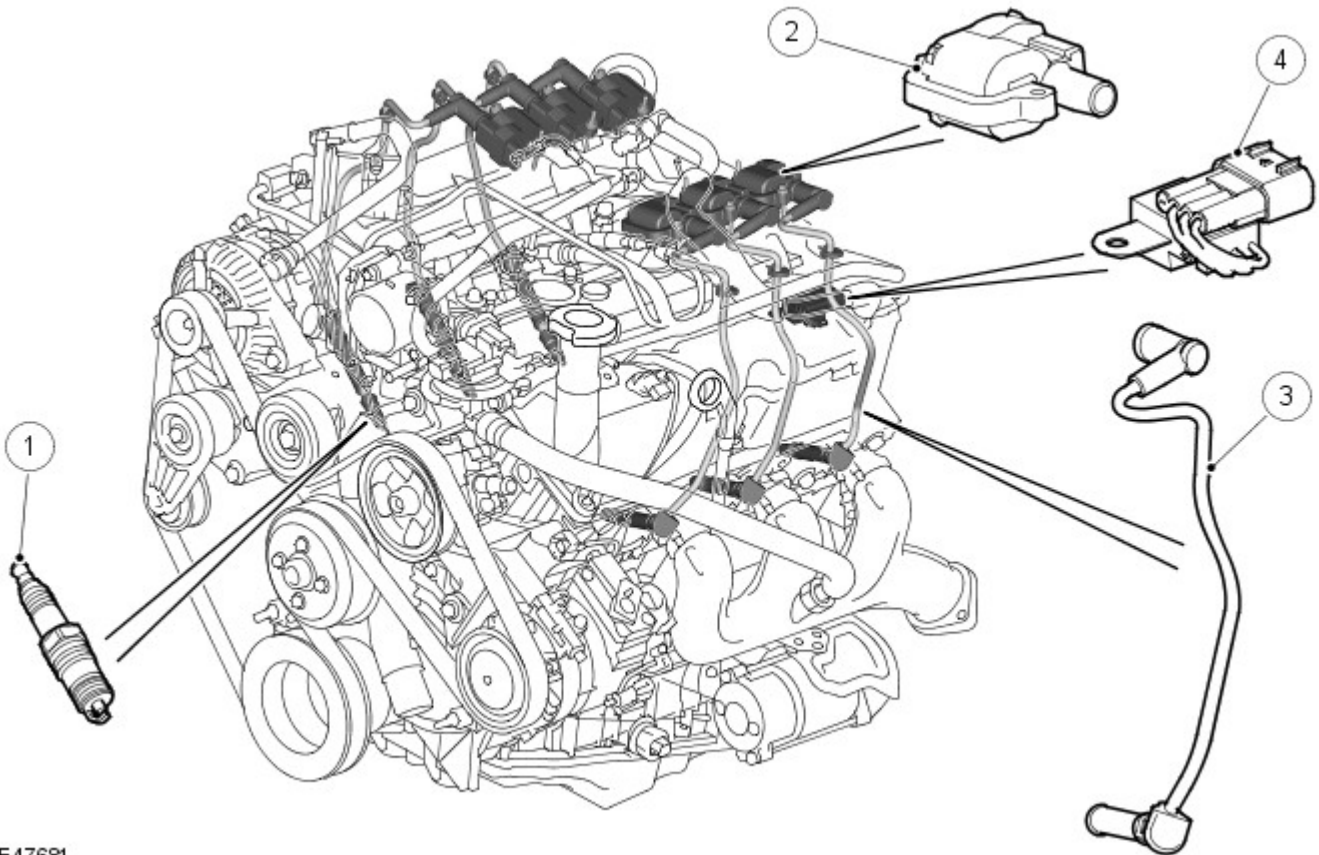
Torque Specifications

Description	Nm	lb-ft
Ignition coil bolt/stud	6	4
Spark plugs - Platinum or copper	18	13

Engine Ignition - V6 4.0L Petrol - Engine Ignition

Description and Operation

COMPONENT LOCATIONS



E47681

Item	Part Number	Description
1	-	Spark plug
2	-	Ignition coil
3	-	Spark plug wire
4	-	Capacitor

GENERAL

The 4.0L engine ignition system has a single platinum tipped spark plug per cylinder, with each spark plug powered by a separate remote ignition coil. The three ignition coils for each cylinder bank are grouped together on the related side of the air inlet manifold. The ignition coils are directly driven by the Engine Control Module (ECM).

Power for the ignition coils is supplied from the main relay and a fuse in the Battery Junction Box (BJB).

Each ignition coil contains a power stage to switch the current in the primary circuit. The ECM controls the switching with a signal to the power stage. A capacitor is connected in parallel with the power supplies to the ignition coils, to suppress Radio Frequency Interference (RFI). The ECM monitors operation of the ignition coils using a feedback signal from each of the power stages. If a fault is detected the ECM stores an appropriate fault code.

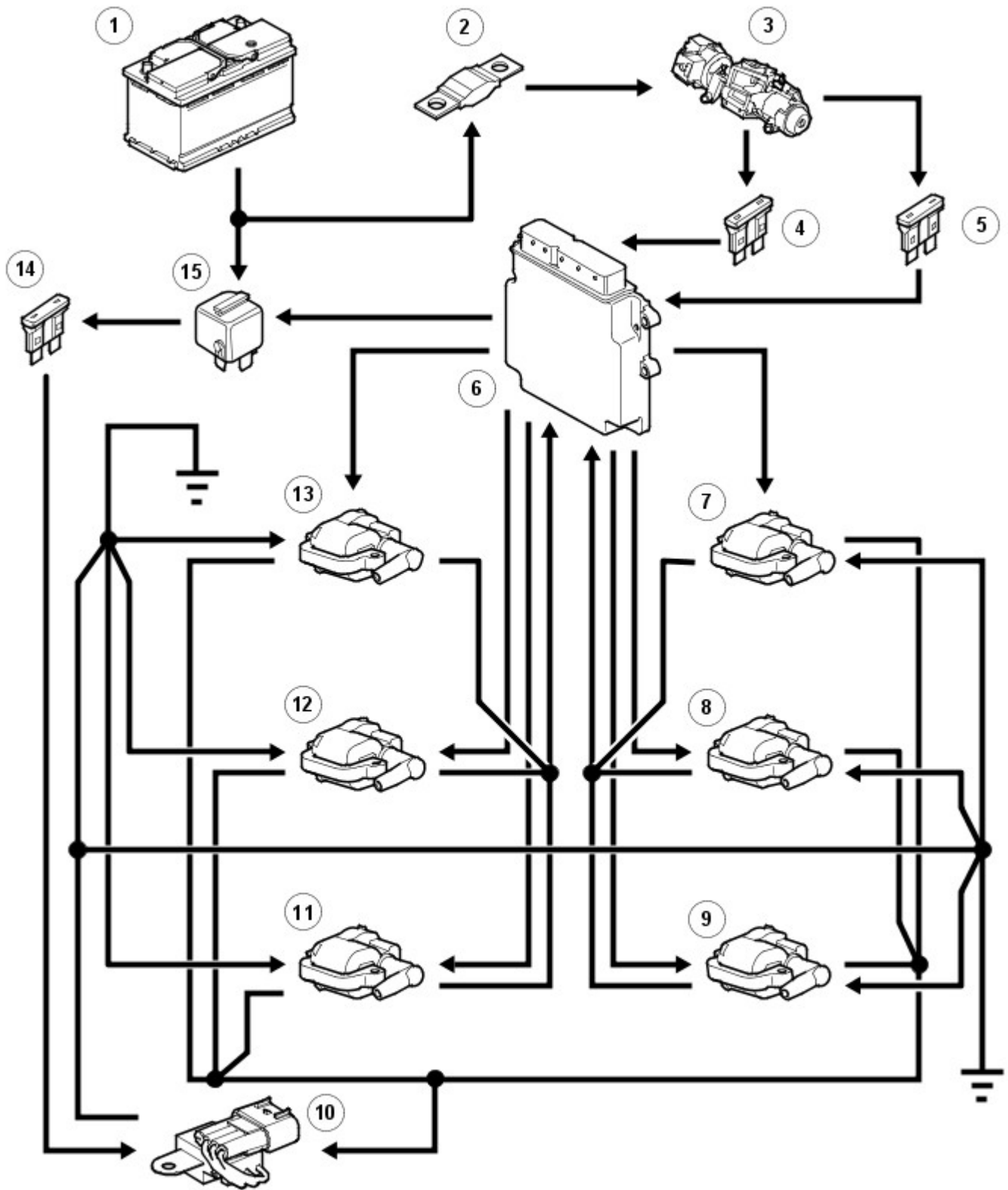
The ECM varies the dwell time of the ignition coils depending on battery voltage and engine speed, to ensure a constant energy level is produced in the secondary coil each time the power stage is switched. This ensures a good spark is always produced by the spark plug without excessive primary current flow, thus avoiding overheating or damage to the ignition coils.

The ECM calculates the ignition timing for individual cylinders from:

- Engine speed.
- Camshaft position.
- Engine load.
- Engine temperature.
- The knock control function.
- On automatic transmission models, the shift control function.
- The idle speed control function.

ENGINE IGNITION CONTROL DIAGRAM

• NOTE: A = Hardwired connections



A →

E47682

Item	Part Number	Description
1	-	Battery
2	-	Fusible link 11E, BJB
3	-	Ignition switch
4	-	Fuse 25P, ignition feed, Central Junction Box (CJB)
5	-	Fuse 60P, crank feed, CJB
6	-	ECM
7	-	Ignition coil 6
8	-	Ignition coil 5
9	-	Ignition coil 4
10	-	Capacitor
11	-	Ignition coil 1

12	-	Ignition coil 2
13	-	Ignition coil 3
14	-	Fuse 17E, BJB
15	-	Main relay

Engine Ignition - V6 4.0L Petrol - Engine Ignition

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine ignition system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Ignition](#) (303-07A Engine Ignition - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Exhaust gas recirculation (EGR) valves 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded electrical connectors ● Ignition coils ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

Symptom	Possible Causes	Action
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● ECM relay ● Electronic engine control ● Ignition system ● Air intake system restricted ● Air leakage ● Fuel lines 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> ● Fuel pressure, fuel pump, fuel lines ● Injector leak ● Air leakage ● Electronic engine control ● Throttle motor ● Restricted accelerator pedal travel (carpet, etc) ● Ignition system ● EGR valve stuck open ● Transmission malfunction 	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls ● Ignition system 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system related DTCs and refer to the relevant DTC Index
Engine surges	<ul style="list-style-type: none"> ● Fuel pump/lines ● Electronic engine controls ● Throttle motor ● Ignition system 	Check for fuel system failures. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls related DTCs and refer to the relevant DTC Index
No throttle response	<ul style="list-style-type: none"> ● Electronic engine controls ● Throttle motor 	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Electronic engine control ● Transmission malfunction ● Traction control event ● Air leakage 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Engine Ignition - V6 4.0L Petrol - Spark Plugs

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  **CAUTION:** It is important to twist the spark plug wire boot while pulling upward to avoid possible damage to the spark plug wire.

- **NOTE:** Note the fitted position.

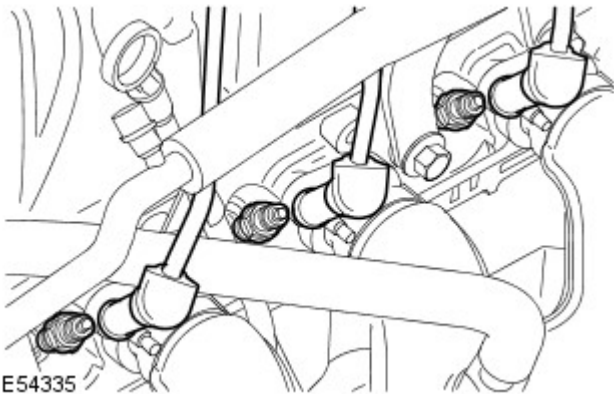
Disconnect the high tension (HT) electrical connectors.

4.  **WARNING:** Eye protection must be worn.


- **NOTE:** Use compressed air to remove any foreign material from the spark plug wells.

Clean the area surrounding the spark plugs.

5. Remove the spark plugs.



Installation

1.  **CAUTION:** Prior to fitting new copper spark plugs, check that the electrode gaps are set to 1.4 mm, adjust if necessary. Existing platinum or copper spark plugs must not be re-gapped in service; if the electrode gap is incorrect new spark plugs must be fitted.

- **NOTE:** Do not apply lubricant to the threads.

Install the spark plugs.

- Check the spark plug gap, refer to specifications.
- Tighten the spark plugs to 18 Nm (13 lb.ft).

2.  **CAUTION:** Install spark plug wires to positions noted on removal. Do not cross wires.

Connect the HT electrical connectors.

- Apply silicone grease to inside of spark plug boot.

3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00

Battery and Charging System - General Information,
Specifications).

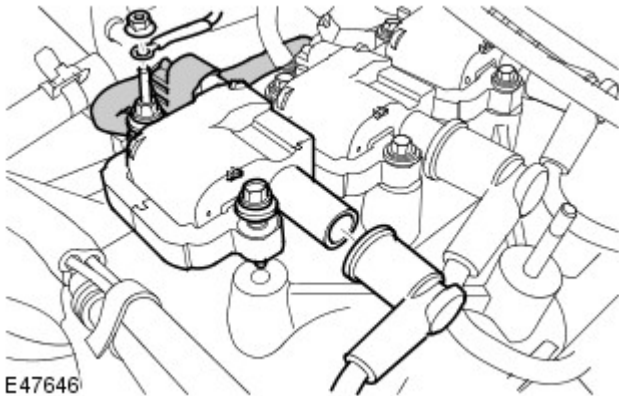
Engine Ignition - V6 4.0L Petrol - Ignition Coil

Removal and Installation

Removal

- NOTE: Note: Ignition coils 2 ,3, 5 & 6 have harness retaining clips that need to be detached before removal.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the ignition lead from the coil.
4. Remove the ignition coil.



- Disconnect the ignition coil electrical connector.
- Remove the nut.
- Remove the ground cable.
- Fully loosen the stud.
- Fully loosen the bolt.

Installation

1. To install, reverse the removal procedure.
 - Tighten the bolt to 6 Nm (4 lb.ft).
 - Tighten the stud to 6 Nm (4 lb.ft).
 - Install the ground cable.
 - Tighten the nut to 6 Nm (4 lb.ft).
 - Connect the ignition coil electrical connector.
 - Connect the ignition lead to the coil.

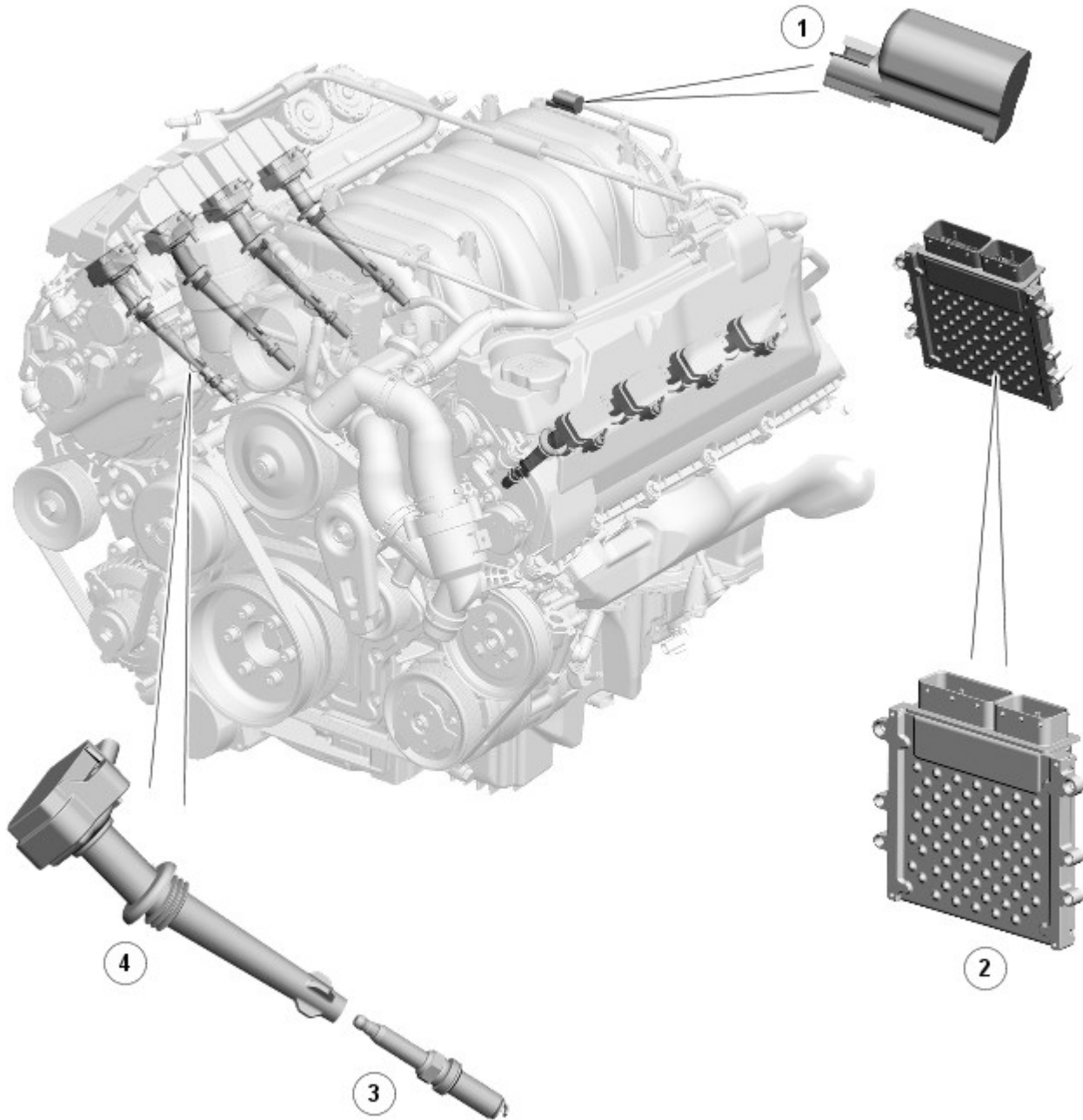
Engine Ignition - V8 5.0L Petrol -

Item	Specification		
Firing order	1:2:7:3:4:5:6:8		
Spark plug type	ILKAR6C-10		
Description	Nm	lb-ft	lb-in
Spark plugs	20	15	-
Ignition coil-on-plug retaining bolts	7	-	62

Engine Ignition - V8 5.0L Petrol - Engine Ignition

Description and Operation

COMPONENT LOCATION



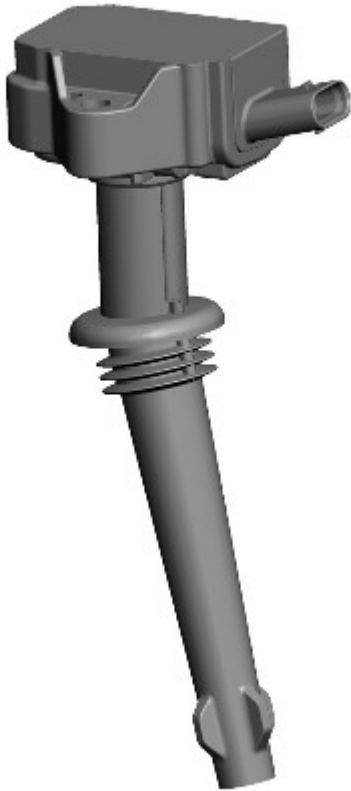
E122131

Item	Part Number	Description
1	-	RFI (radio frequency interference) suppressor
2	-	ECM (engine control module)
3	-	Spark plug (8 off)
4	-	Ignition coil (8 off)

INTRODUCTION

The engine ignition system is a coil-on-plug, single spark system controlled by the [ECM \(engine control module\)](#). An iridium tipped spark plug is installed in each combustion chamber, between the inlet and exhaust valves, and an ignition coil is installed on each spark plug. A RFI (radio frequency interference) suppressor is connected to the power feed to the ignition coils.

IGNITION COILS

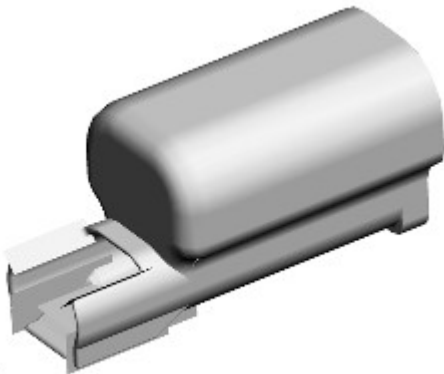


E116147

The ignition coils are installed in the cylinder head covers, under the [NVH \(noise, vibration and harshness\)](#) covers. Each ignition coil locates on a spark plug and is secured to the related cylinder head cover with a single screw. Each ignition coil incorporates a three pin electrical connector for connection to the engine harness.

Each ignition coil contains a primary and a secondary winding. The primary winding receives electrical power from the ignition relay in the power distribution box. A power stage in the primary winding allows the [ECM](#) to interrupt the power supply, to induce a voltage in the secondary winding and thus the spark plug. A diode in the ground side of the secondary winding reduces any undesirable switch-on voltage, to prevent misfiring into the intake manifold. The power stage limits the maximum voltage and current in the primary winding, to protect the power stage and limit the voltage in the secondary winding.

RFI SUPPRESSOR

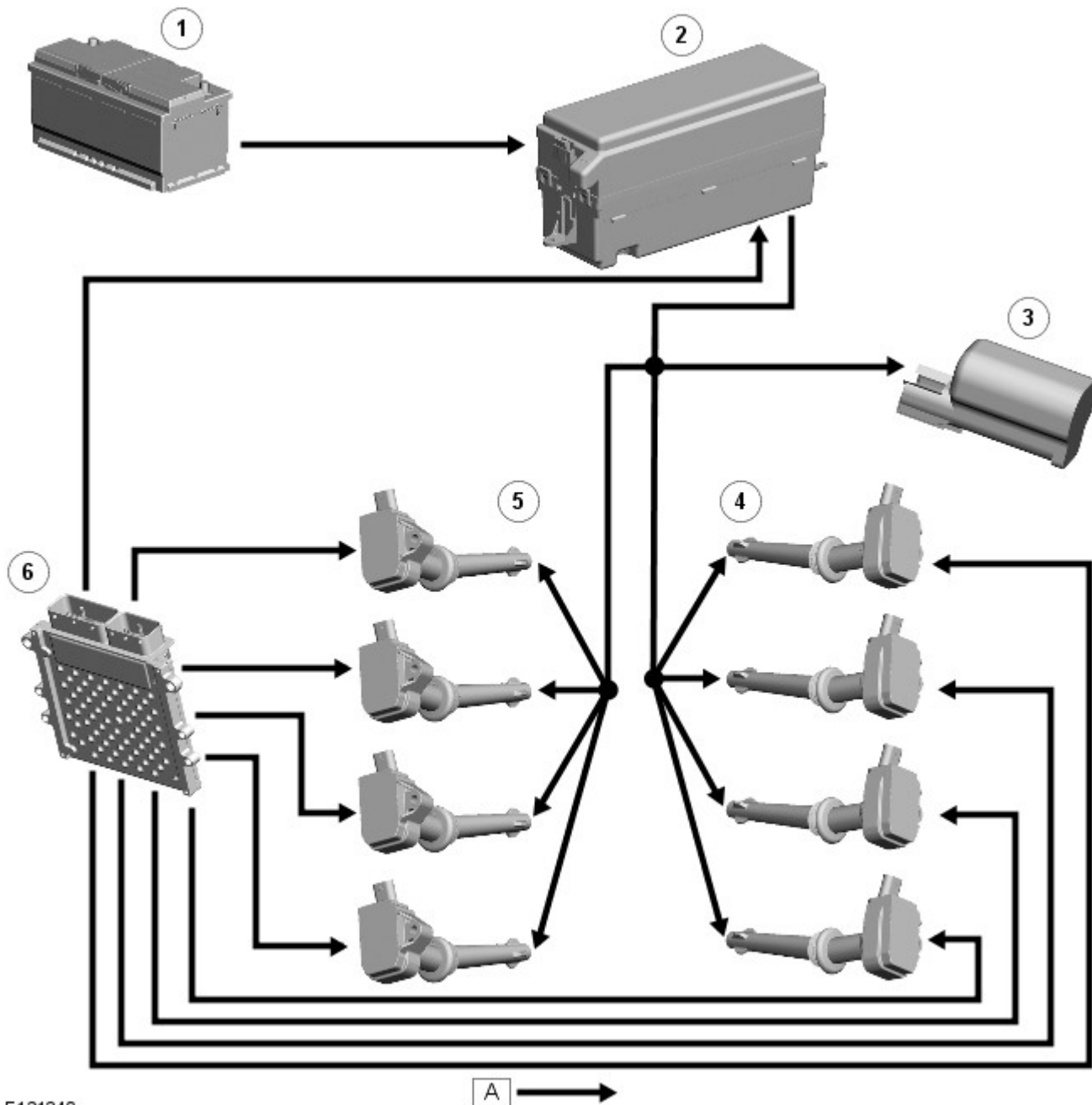


E108416

The RFI (radio frequency interference) suppressor is installed on the engine harness carrier at the rear of the engine.

CONTROL DIAGRAM

- NOTE: A = Hardwired



E121340

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	RFI suppressor
4	-	LH (left hand) cylinder bank ignition coil (4 off)
5	-	RH (right hand) cylinder bank ignition coil (4 off)
6	-	ECM

OPERATION

The ignition coils are supplied with electrical power from the battery via the [ECM](#) relay in the [EJB](#) (engine junction box). The [ECM](#) controls the operation of the [ECM](#) relay.

The [ECM](#) sends a separate signal to each ignition coil to trigger the power stage switching. The [ECM](#) calculates the dwell time from the battery voltage and engine speed, to ensure a constant energy level is produced in the secondary coil each time the power stage is switched. This ensures sufficient spark energy is available without excessive primary current flow, which avoids overheating and damage to the ignition coils.

The [ECM](#) calculates the ignition timing for individual cylinders from:

- Engine speed
- Camshaft position
- Engine load
- Engine temperature
- The knock control function
- The shift control function
- The idle speed control function.

Engine Ignition - V8 5.0L Petrol - Engine Ignition

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine ignition system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Ignition](#) (303-07B Engine Ignition - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Exhaust gas recirculation (EGR) valves 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded electrical connectors ● Ignition coils ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

Symptom	Possible Causes	Action
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● ECM relay ● Electronic engine control ● Ignition system ● Air intake system restricted ● Air leakage ● Fuel lines 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> ● Fuel pressure, fuel pump, fuel lines ● Injector leak ● Air leakage ● Electronic engine control ● Throttle motor ● Restricted accelerator pedal travel (carpet, etc) ● Ignition system ● EGR valve stuck open ● Transmission malfunction 	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls ● Ignition system ● Sticking variable camshaft timing (VCT) hub 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and VCT system related DTCs and refer to the relevant DTC Index
Engine surges	<ul style="list-style-type: none"> ● Fuel pump/lines ● Electronic engine controls ● Throttle motor ● Ignition system 	Check for fuel system failures. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls ● Sticking VCT hub 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	<ul style="list-style-type: none"> ● Electronic engine controls ● Throttle motor 	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Electronic engine control ● Transmission malfunction ● Traction control event ● Air leakage 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - V8 5.0L Petrol, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Engine Ignition - V8 5.0L Petrol - Ignition Coil-On-Plug

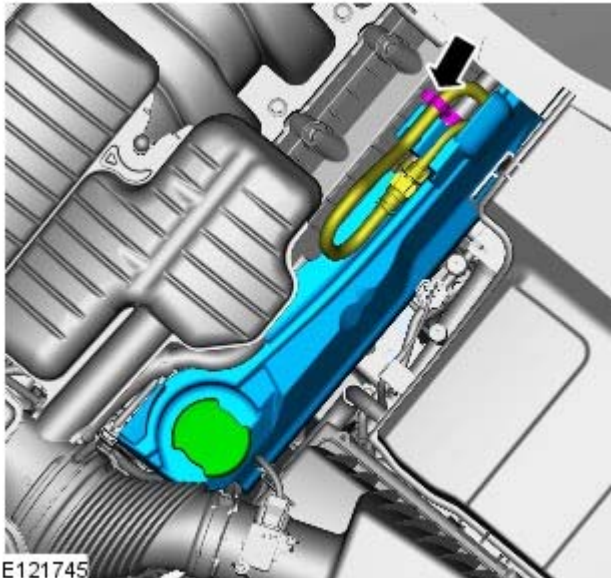
Removal and Installation

Removal

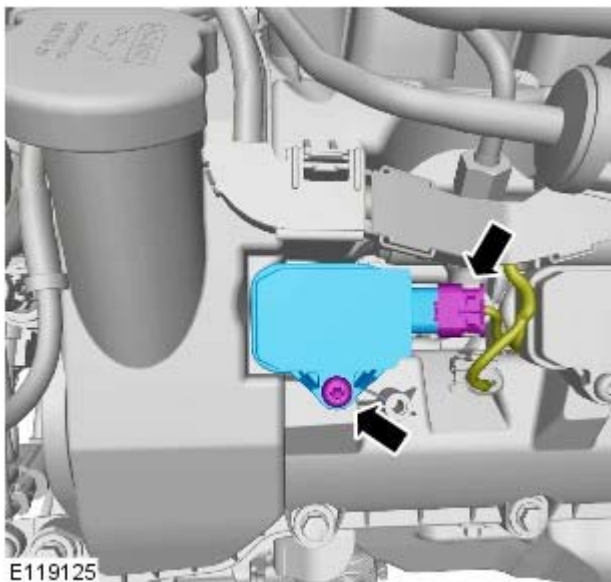
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

2.



3. Torque: 7 Nm




Installation

1. To install, reverse the removal procedure.

Engine Ignition - V8 5.0L Petrol - Spark Plugs

Removal and Installation

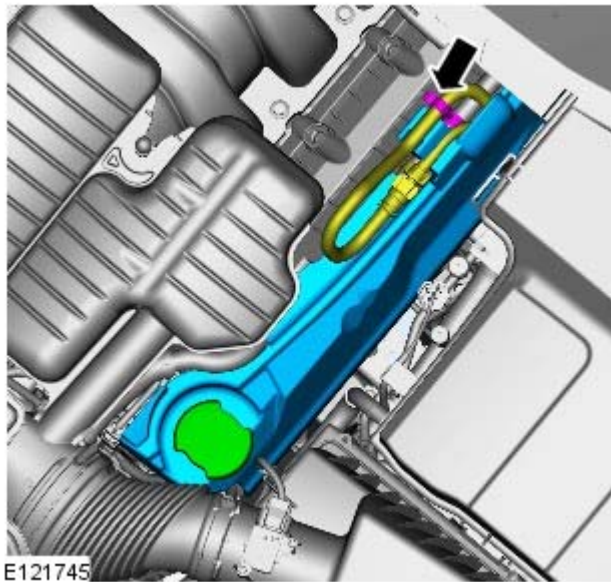
Special Tool(s)

 E115268	303-1450 Spark Plug Remover/Installer
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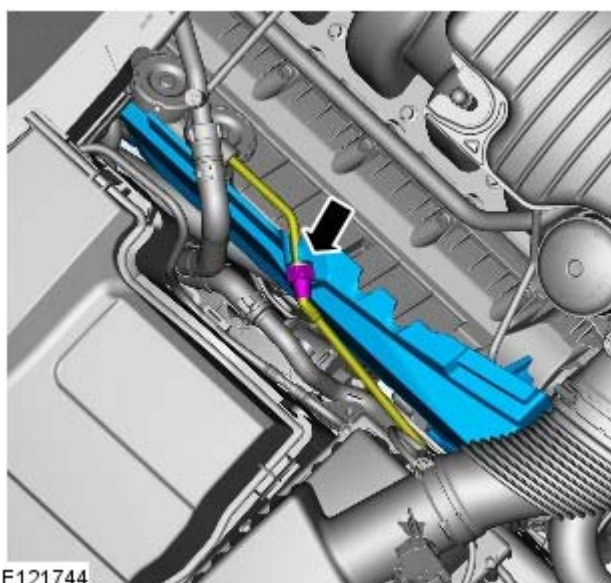
Removal

- NOTE: Removal steps in this procedure may contain installation details.

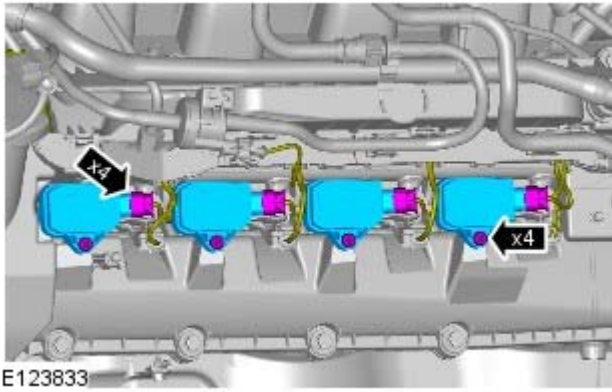
1. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornementation, Removal and Installation).



2.

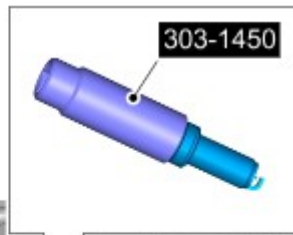


3.



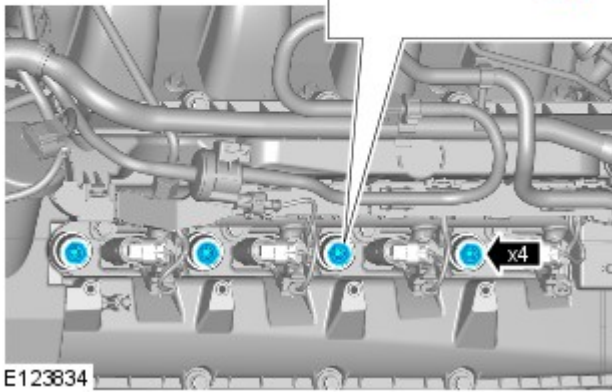
4. **4.** NOTE: Left-hand shown, right-hand similar.

Torque: 7 Nm



5. *Special Tool(s):* [303-1450](#)

Torque: 20 Nm



Installation

1. To install, reverse the removal procedure.

Glow Plug System - TDV6 2.7L Diesel -

General Specifications

Item	Description
Glow plugs - Make	Beru

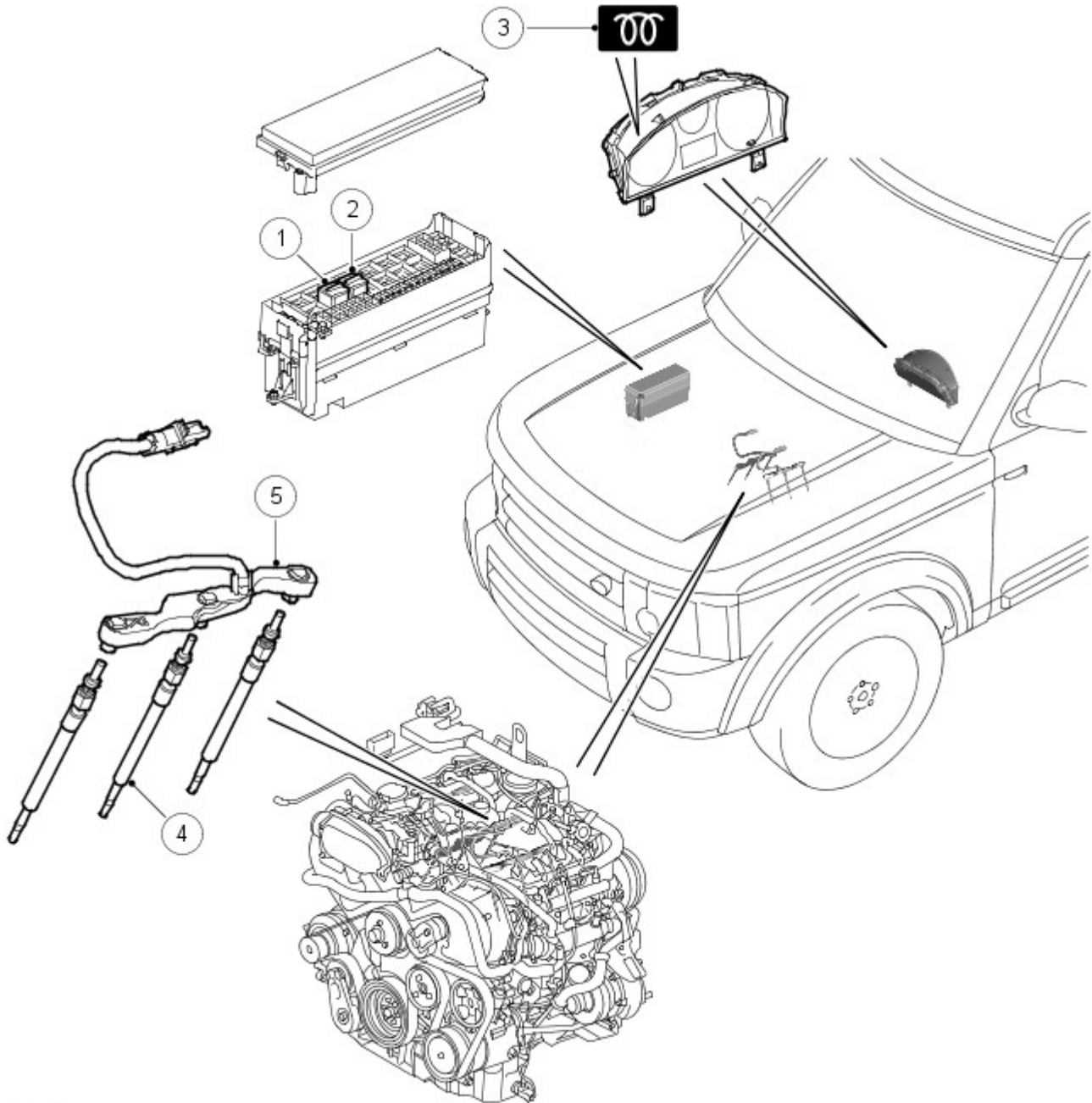
Torque Specifications

Description	Nm	lb-ft
Glow plugs	10	7

Glow Plug System - TDV6 2.7L Diesel - Glow Plug System

Description and Operation

COMPONENT LOCATIONS



E47679

Item	Part Number	Description
1	-	B (LH) bank glow plug relay
2	-	A (RH) bank glow plug relay
3	-	Glow plug indicator
4	-	Glow plug (x 6)
5	-	Glow plug harness (x 2)

GENERAL

The glow plug system has a glow plug installed in the inlet side of each cylinder. The glow plugs heat the combustion chambers before and during cranking, to aid cold starting, and after the engine starts to reduce emissions and engine noise when idling with a cold engine.

A glow plug wiring harness on each bank of glow plugs is connected to a separate relay and fusible link in the Battery Junction Box (BJB). The individual glow plugs are grounded through their fixing in the cylinder head. Operation of the glow plug relays is controlled by the Engine Control Module (ECM), which also controls the illumination of the glow plug indicator in the instrument cluster.

Each glow plug is a tubular heating element which contains a spiral filament encased in magnesium oxide powder. At the tip of the tubular heating element is the heater coil. Behind the heater coil, and connected in series, is a control coil. The

control coil regulates the current to the heater coil to ensure that it does not overheat.

SYSTEM OPERATION

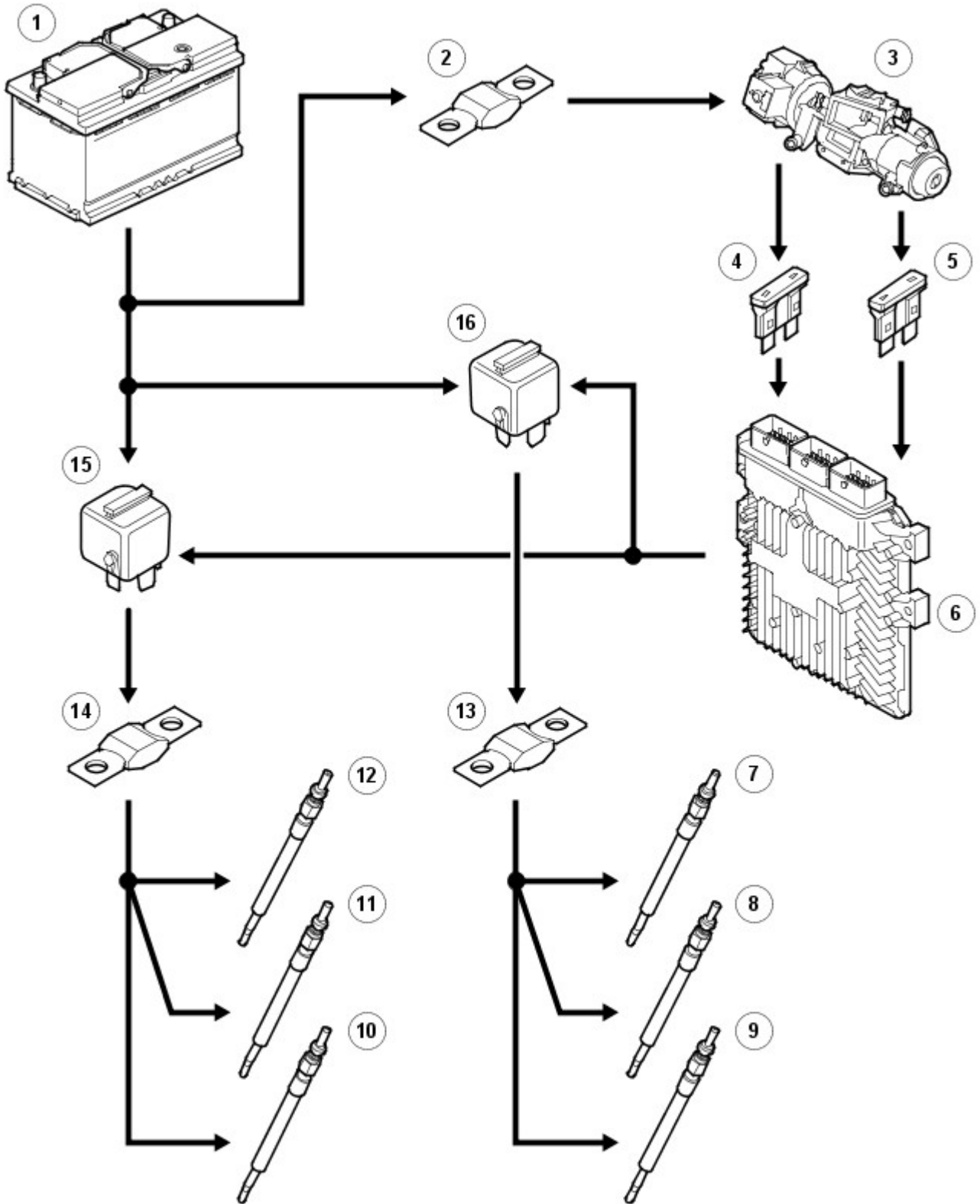
There are three phases of glow plug heating: Pre heating, crank heating and post heating. The ECM determines the heating times from the Engine Coolant Temperature (ECT). The lower the ECT, the longer the heating times.

When the ignition switch is turned to position II, the ECM calculates any required heating times and, if heating is required, energizes the glow plug relays in the BJB. When pre heating is required, the ECM also sends a message to the instrument cluster, on the high speed CAN bus, to request illumination of the glow plug indicator. The glow plug indicator remains illuminated for the duration of the pre heating phase, or until the ignition switch is turned to the crank position, whichever occurs first. If required, the ECM keeps the glow plug relays energized during cranking and for the duration of any post heating phase.

The ECM monitors the drive circuit of the glow plug relays for plausibility of operation, continuity, and short and open circuits. If a fault is detected, the ECM stores a related fault code and permanently illuminates the glow plug indicator while the ignition switch is in position II.

GLOW PLUG SYSTEM CONTROL DIAGRAM

- NOTE: A = Hardwired Connections



A →

E47680

Item	Part Number	Description
1	-	Battery
2	-	Fusible link 11E, BJB
3	-	Ignition switch
4	-	Fuse 25P, Central Junction Box (CJB) (ignition)
5	-	Fuse 60P, CJB (crank)
6	-	ECM
7	-	Glow plug 6
8	-	Glow plug 5
9	-	Glow plug 4
10	-	Glow plug 1
11	-	Glow plug 2

12	-	Glow plug 3
13	-	Fusible link 4E, BJB
14	-	Fusible link 1E, BJB
15	-	A (RH) bank glow plug relay
16	-	B (LH) bank glow plug relay

Glow Plug System - TDV6 2.7L Diesel - Glow Plug System

Diagnosis and Testing

Principles of Operation

For a detailed description of the glow plug system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Glow Plug System](#) (303-07C Glow Plug System - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of electrical damage.

Visual Inspection

Electrical
<ul style="list-style-type: none"> ● Glow plug lamp ● Fuses ● Glow plug relays ● Engine management control relay ● Wiring harness(es) ● Electrical connector(s) ● Glow plug(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor starting (extreme weather conditions)	<ul style="list-style-type: none"> ● Glow plugs inoperative/inefficient ● Fuel temperature too low 	Check the glow plug harnesses at the glow plugs and at the connection to the main harness. Refer to the electrical guides. Check for glow plug DTCs. The fuel system recycles fuel until operating temperature is reached to reduce this possibility.
High cold-engine emissions	<ul style="list-style-type: none"> ● After-glow phase inoperative 	Check the glow plug harnesses at the glow plugs and at the connection to the main harness. Refer to the electrical guides. Check for glow plug DTCs. After-glow is designed to function at engine temperatures below 50 degrees C (122 degrees F), and below 2,500 rpm.
High cold-engine noise, vibration or harshness	<ul style="list-style-type: none"> ● After-glow phase inoperative 	Check the glow plug harnesses at the glow plugs and at the connection to the main harness. Refer to the electrical guides. Check for glow plug DTCs. After-glow is designed to function at engine temperatures below 50 degrees C (122 degrees F), and below 2,500 rpm.

DTC Index

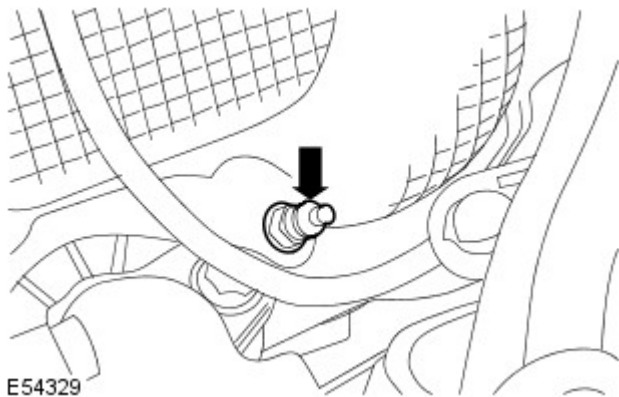
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Glow Plug System - TDV6 2.7L Diesel - Glow Plugs

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the crankcase vent oil separator.
For additional information, refer to: Crankcase Vent Oil Separator (303-08, Removal and Installation).
3. Remove the glow plugs.



E54329

Installation

1. To install, reverse the removal procedure.
 - Tighten the glow plugs to 10 Nm (7 lb.ft).

Glow Plug System - TDV6 2.7L Diesel - Glow Plug Module

Removal and Installation

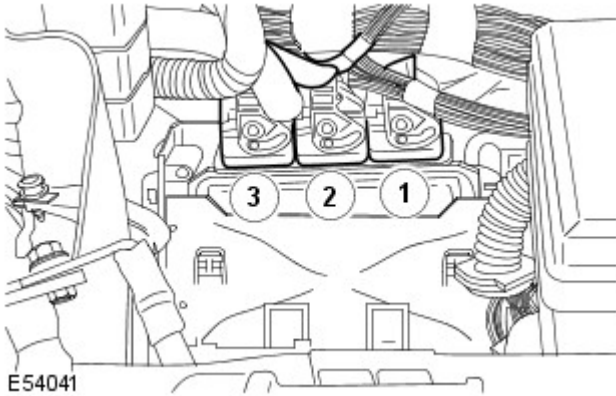
Removal

- NOTE: The glow plug module is an integral part of the engine control module and cannot be replaced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the four-wheel drive (4WD) control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
3. NOTE: Right hand drive shown, for Left hand drive reverse the sequence.

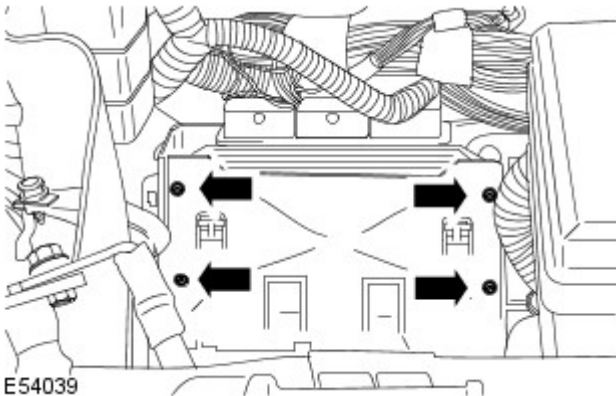
Disconnect the three glow plug module electrical connectors in the sequence shown.

- Position the three engine harness electrical connectors aside for access.



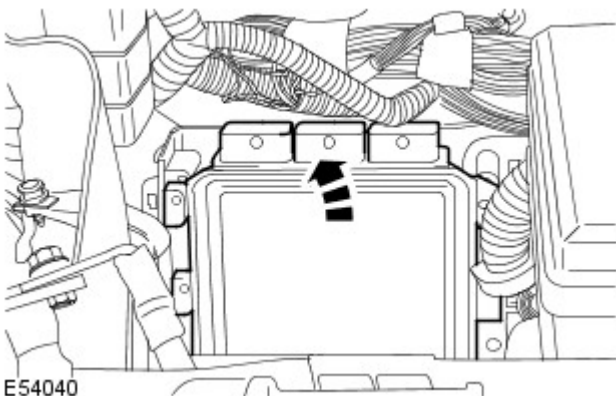
4. Remove the glow plug module securing plate.

- Remove the four retaining bolts.



5. Remove the glow plug module.

- Remove the glow plug module top cover.



Installation

1. Install the glow plug module.
 - Install the glow plug module top cover.

2. Install the glow plug module securing plate.
 - Install the four retaining bolts.
3. Connect the three glow plug module electrical connectors.
4. Install the 4WD control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
6. Connect T4 to calibrate a new ECM.

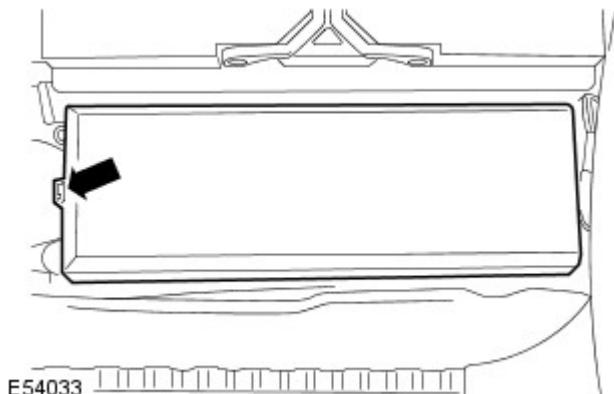
Glow Plug System - TDV6 2.7L Diesel - Glow Plug Relay

Removal and Installation

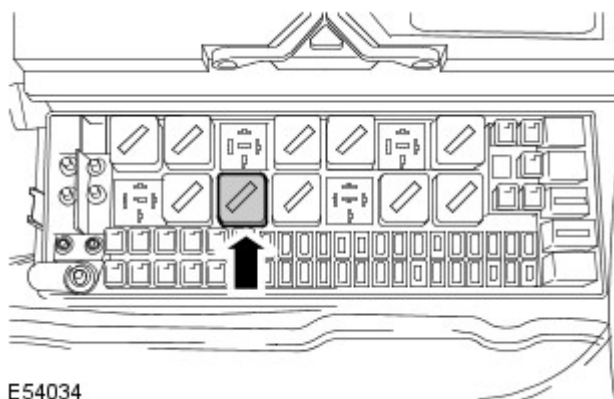
Removal

• NOTE: This procedure shows the removal and installation of the right hand bank and left hand bank glow plug relays. The glow plug relays are available individually.

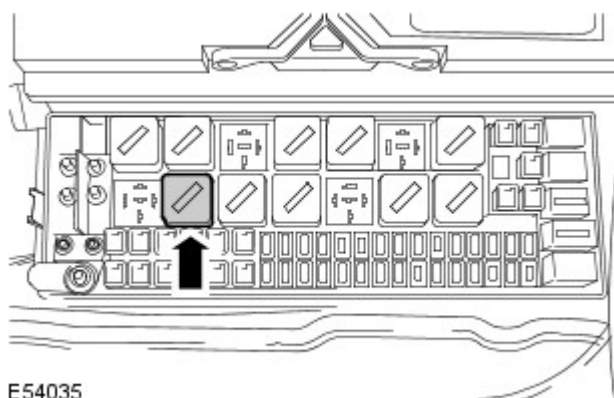
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the battery junction box (BJB) lid.
 - Release the BJB latch.



3. Remove the RH bank glow plug relay.



4. Remove the LH bank glow plug relay.



Installation

1. To install, reverse the removal procedure.

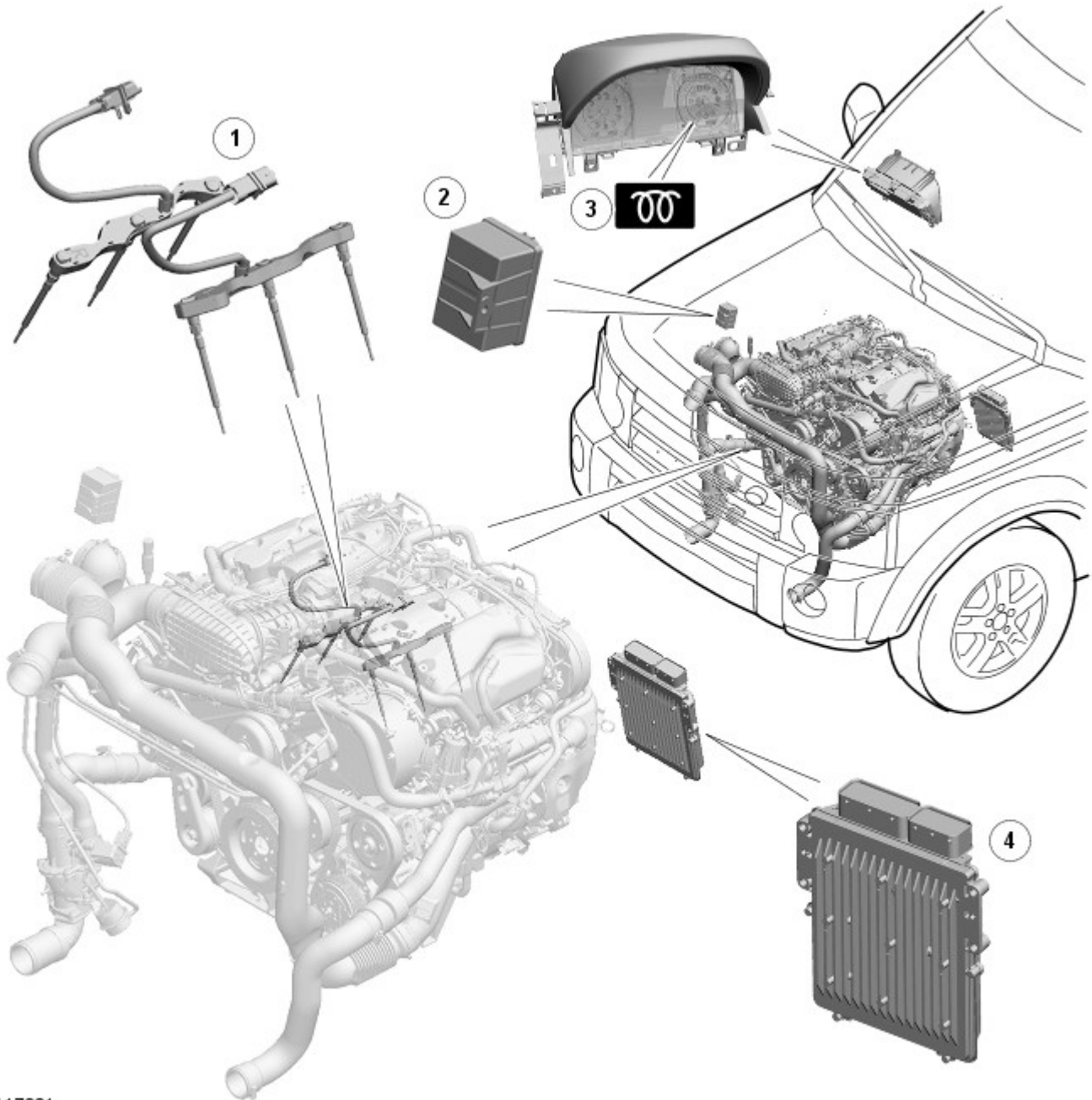
Glow Plug System - TDV6 3.0L Diesel -

Description	Nm	lb-ft	lb-in
Glow plug	10	-	89

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System - Component

Location

Description and Operation



E117321

ItemDescription

1	Glow plugs
2	Glow plug module
3	Glow plug warning lamp
4	ECM (engine control module)

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System - Overview

Description and Operation

OVERVIEW

The glow plug system includes a glow plug installed in the inlet side of each cylinder and a glow plug module. The glow plugs heat the combustion chambers before and during cranking, to aid cold starting, and after the engine starts to reduce emissions and engine noise when idling with a cold engine.

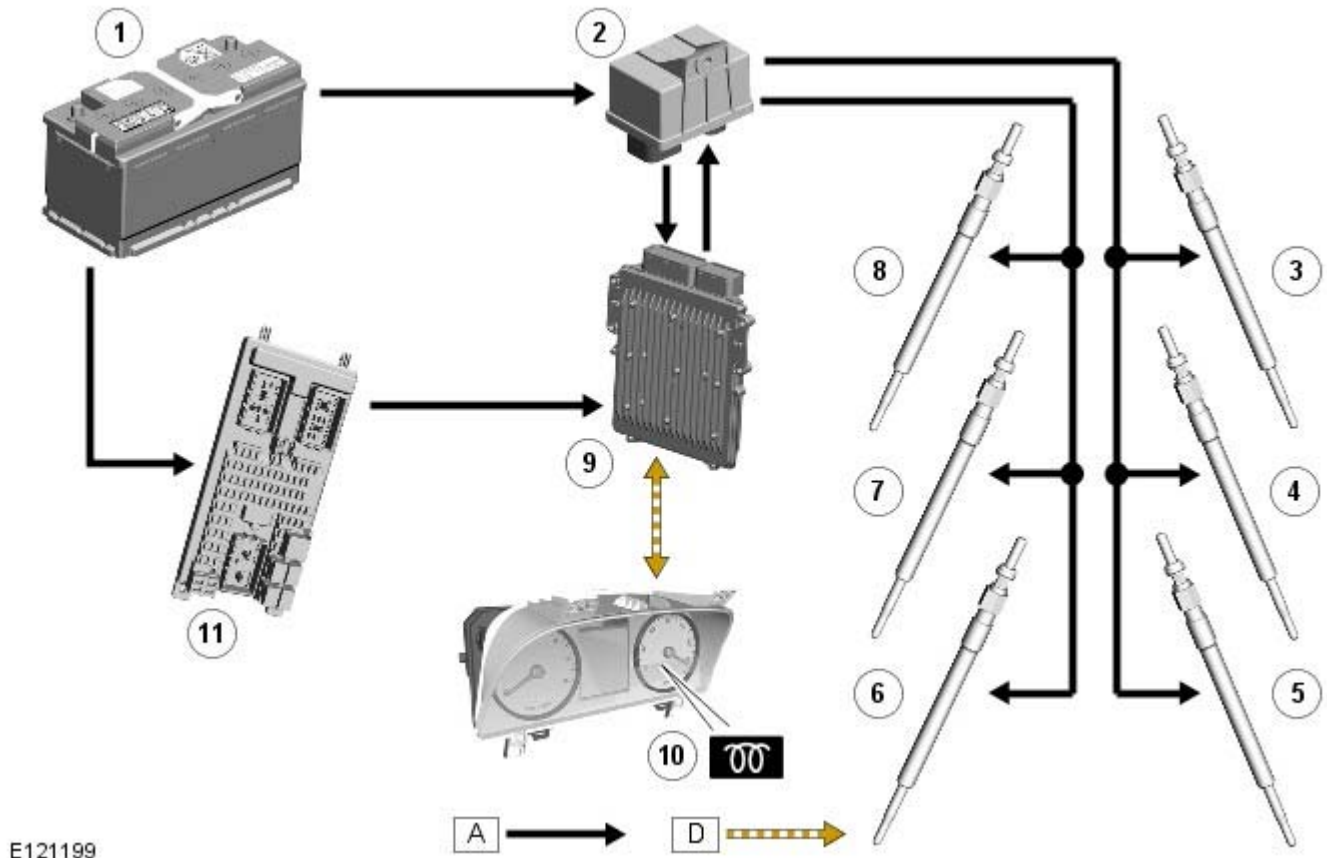
The glow plugs are connected for each bank by a common harness which is connected into the main engine harness. The harness for each bank connects into a connector block which attaches to each of the glow plugs for that bank. The glow plugs are connected directly to the glow plug module which is controlled by glow plug software contained within the [ECM \(engine control module\)](#).

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System - System Operation and Component Description

Description and Operation

Control Diagram

• NOTE: **A** = Hardwired; **D** = High Speed CAN (controller area network)



E121199

ItemDescription

1	Battery
2	Glow plug module
3	Glow plug
4	Glow plug
5	Glow plug
6	Glow plug
7	Glow plug
8	Glow plug
9	ECM (engine control module)
10	Instrument cluster (glow plug warning indicator)
11	CJB (central junction box)

System Operation

System Operation

There are three phases of glow plug heating:

- Pre heating
- Crank heating
- Post heating

The **ECM** determines the heating times from the **ECT (engine coolant temperature)**. The lower the engine coolant temperature, the longer the heating times.

When the ignition is switched to power mode 9, the **ECM** calculates any required heating times and, if heating is required, energizes the glow plug relays in the **CJB**. When pre heating is required, the **ECM** also sends a message to the instrument cluster, on the high speed **CAN**, to request illumination of the glow plug indicator. The glow plug indicator remains illuminated for the duration of the pre heating phase, or until the ignition is switched to crank, whichever occurs first. If required, the **ECM** keeps the glow plug relays energized during cranking and for the duration of any post heating phase.

The [ECM](#) monitors the drive circuit of the glow plug relay for plausibility of operation, continuity, and short and open circuits. If a fault is detected, the [ECM](#) stores a related fault code.

Pre Heating

Pre-heat is the length of time the glow plugs operate prior to engine cranking. The [ECM](#) controls the pre-heat time based on [ECT](#) sensor output and barometric pressure. If the [ECT](#) sensor fails, the [ECM](#) will use a predefined temperature as a default value. The pre-heat duration is extended if the coolant temperature is low.

The [ECM](#) receives the corresponding temperature signal from the [ECT](#) sensor.

The preheating period is dependent on the temperature signal (low temperature = longer preheating period).

The driver is informed that preheating is in operation by the glow plug indicator light in the instrument cluster coming on. The preheating times become longer as the coolant temperature falls.

The [BARO \(barometric pressure\)](#) also has an influence on activation and deactivation of the glow plugs in the event of large altitude differences.

Crank Heating

Crank heating is carried out at every start where the coolant temperature is below the predefined threshold of 20°C. Crank heating begins if the engine speed exceeds 80 rpm for longer than 50ms, or the starter is active for longer than 4 sec. If the coolant temperature sensor is defective, a default temperature of 0°C is used.

Post Heating

Post heat is the length of time the glow plugs operate after the engine starts. The [ECM](#) controls the post heating time based on [ECT](#) sensor output. The post heat phase reduces engine noise, improves idle quality and reduces hydrocarbon emissions.

Preheating is followed by the post heating phase once the engine has started. The post heating phase depends upon how the vehicle is driven.

In addition to [ECT](#), [BARO](#) and engine speed, the injected fuel quantity is significant in this context. For example, if the injected fuel quantity is less than 70 mg per piston stroke and the coolant temperature is below -20°C, post heating is performed.

Component Description

Glow Plug

The ceramic sheathed element glow plugs are made from a heat-resistant, electrically conductive ceramic material. The ceramic sheathed-element glow plugs outer layer is heated directly and is self regulating. The self regulation allows the resistance of the sheathed element to automatically increase as the heat increases preventing the glow plug from overheating. In addition, during the heating process and under the control of the glow plug relay, the glow plugs can be operated above their nominal voltages. This permits heat-up speeds of 1000°C per second. The sheathed-element glow plugs reach a maximum glow temperature of 1300°C and can hold a temperature of 1150°C for several minutes after the first-start glow or at intervening times.

Each cylinder bank has a separate harness connecting the three glow plugs. The harness connects into the engine wiring harness and each harness has a connector block which attaches to each of the glow plugs for that bank.

The glow plug module receives a battery voltage feed via a 250A fusible and a 60A fuse in the engine compartment fusebox. Operation of the glow plug module is controlled by the [ECM](#), which also controls the illumination of the glow plug indicator in the instrument cluster.

The system has been designed as a low-voltage glow system. At 7 volts, the nominal voltage of the sheathed-element glow plugs is significantly lower than the 12 volts of the main electrical circuit. The electronic glow plug module matches the voltage to the sheathed-element glow plugs and controls their glow temperature precisely to the specific requirements of the engine. This produces the optimum glow temperature even when the main circuit voltage is interrupted during engine starting. The lower power consumption of the ceramic glow plugs and their time-staggered activation reduce to a minimum the peak load on the main circuit during the cold start and immediate post-start periods.

In the event of glow plug failure, the engine may be difficult to start and excessive smoke emissions may be observed after starting.

Glow Plug System - TDV6 3.0L Diesel - Glow Plug System

Diagnosis and Testing

Principles of Operation

For a detailed description of the glow plug system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-07D Glow Plug System - TDV6 3.0L Diesel)

[Glow Plug System](#) (Description and Operation),
[Glow Plug System](#) (Description and Operation),
[Glow Plug System](#) (Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of electrical damage.

Visual Inspection

Electrical
<ul style="list-style-type: none"> ● Glow plug lamp ● Fuses ● Glow plug relays ● Engine management control relay ● Wiring harness(es) ● Electrical connector(s) ● Glow plug(s) ● Engine Control Module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor starting (extreme weather conditions)	<ul style="list-style-type: none"> ● Glow plugs inoperative/inefficient ● Fuel temperature too low 	Check the glow plug harnesses at the glow plugs and at the connection to the main harness. Refer to the electrical guides. Check for glow plug DTCs. The fuel system recycles fuel until operating temperature is reached to reduce this possibility.
High cold-engine emissions	<ul style="list-style-type: none"> ● After-glow phase inoperative 	Check the glow plug harnesses at the glow plugs and at the connection to the main harness. Refer to the electrical guides. Check for glow plug DTCs. After-glow is designed to function at engine temperatures below 50 degrees C (122 degrees F), and below 2,500 rpm.
High cold-engine noise, vibration or harshness	<ul style="list-style-type: none"> ● After-glow phase inoperative 	Check the glow plug harnesses at the glow plugs and at the connection to the main harness. Refer to the electrical guides. Check for glow plug DTCs. After-glow is designed to function at engine temperatures below 50 degrees C (122 degrees F), and below 2,500 rpm.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation).

Glow Plug System - TDV6 3.0L Diesel - Glow Plugs

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

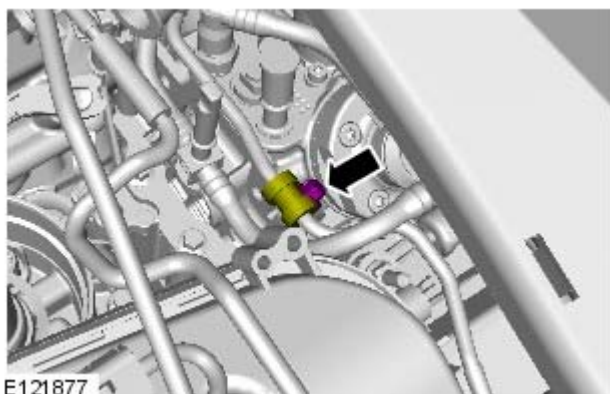
Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

2. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).

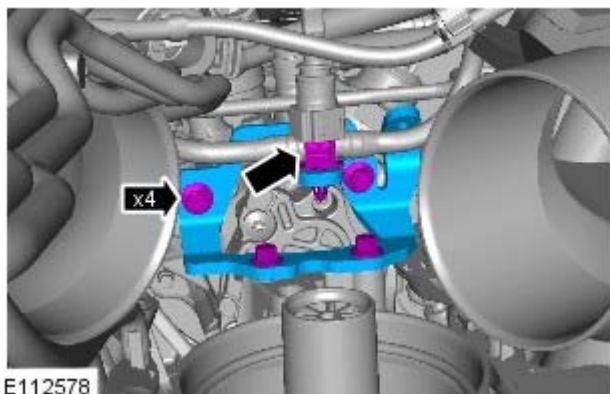
3. Refer to: [Crankcase Vent Oil Separator](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

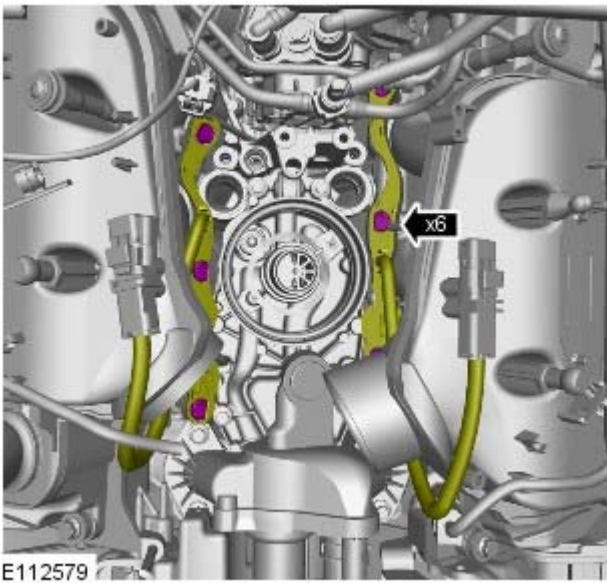
4. Refer to: [Oil Filter Element](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

5.

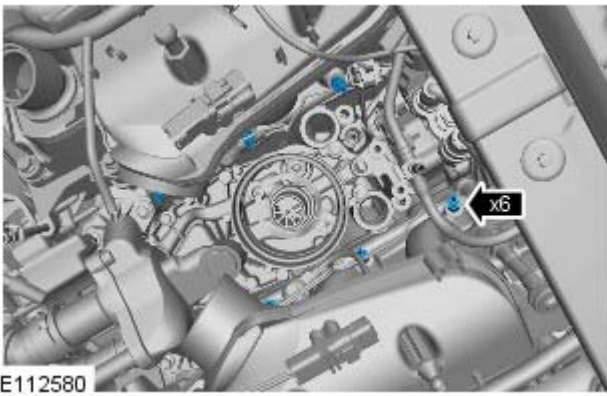


6.



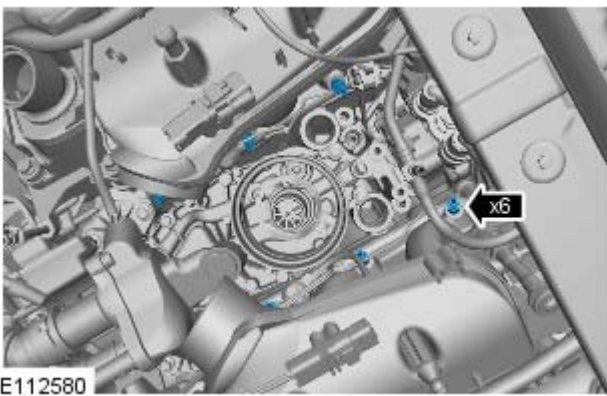


7.  CAUTION: Take extra care not to damage the component.







- 8.

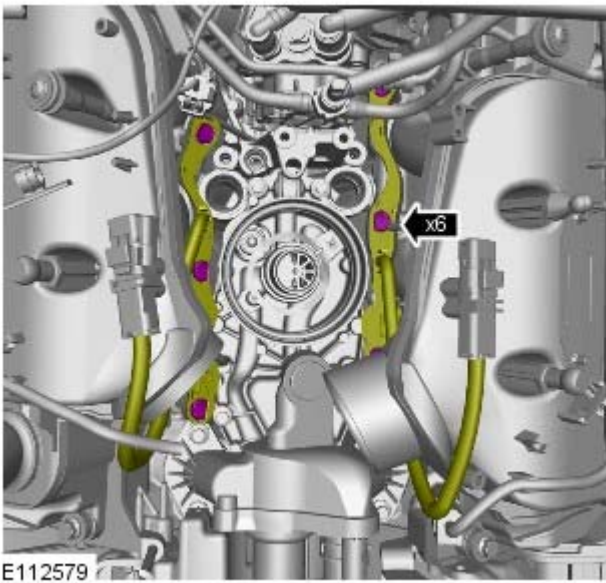
Installation



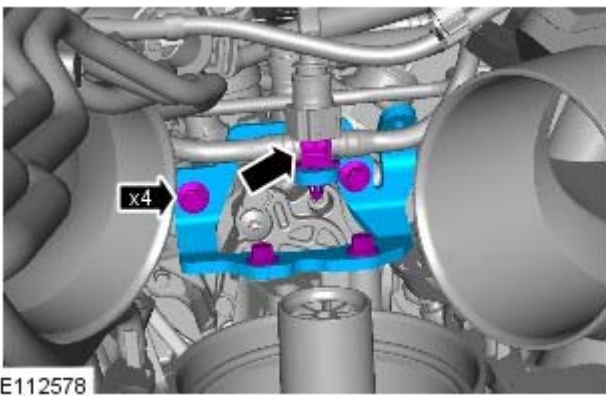
1. 1. CAUTIONS:

-  Take extra care when handling the component.
-  Fixings must be started by hand to avoid damaging threads.
-  If accidentally dropped or knocked install a new module.
-  Make sure the engine is cold before this procedure is carried out. Failure to follow this instruction may result in damage to the vehicle.

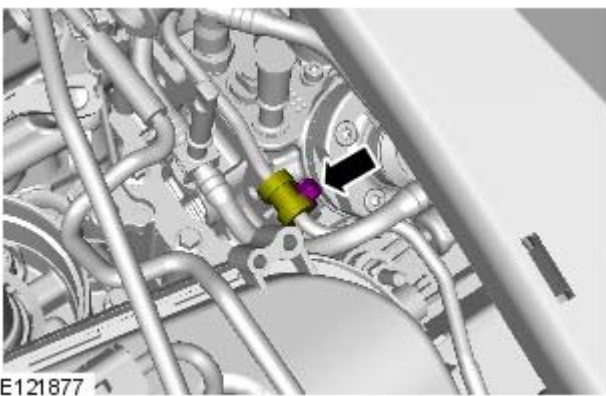
Torque: 10 Nm



2.  CAUTION: Take extra care not to damage the component.



3. Torque: 10 Nm



4. Torque: 10 Nm

5. Refer to: [Oil Filter Element](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).
6. Refer to: [Crankcase Vent Oil Separator](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
7. Refer to: [Intake Air Shutoff Throttle](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Removal and Installation).
8. Connect the battery ground cable.

Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables,

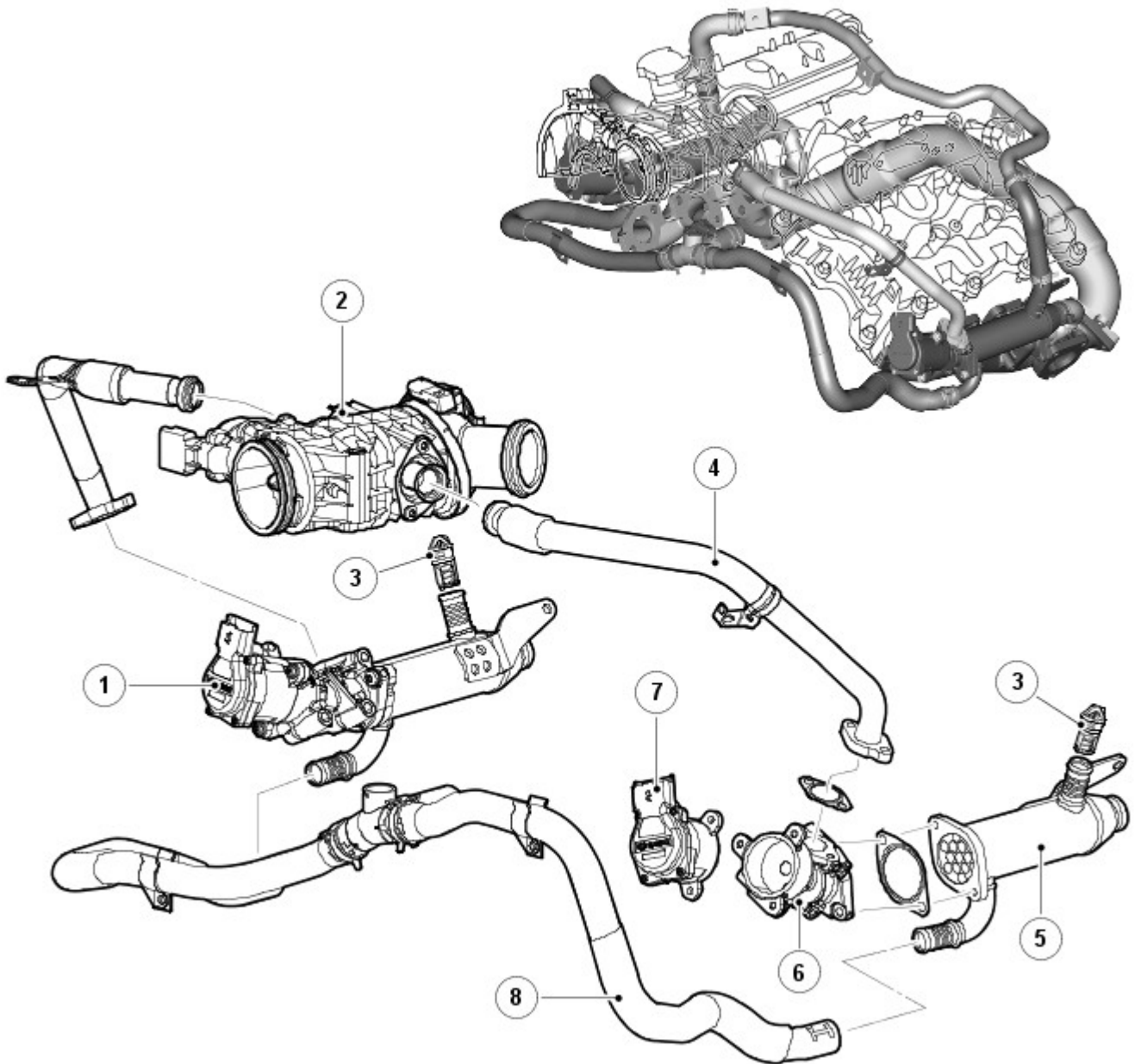
Specifications).

Engine Emission Control - TDV6 2.7L Diesel -**Torque Specifications**

Description	Nm	lb-ft
EGR valve outlet tube bolts	10	7
Wiring harness Torx screw	5	4
EGR valve inlet tube bolts	10	7
EGR valve bolts	10	7
Fuel line retaining bracket bolt	10	7
EGR valve support bracket bolts	10	7
Oil level indicator tube bolt	10	7
Oil filter element	25	18
EGR cooler cross-over pipe securing bolt	13	10
Upper suspension arm and brake line heat shield nuts and bolts	10	7
EGR valve to cooler retaining Torx screws	10	7

Engine Emission Control - TDV6 2.7L Diesel - Engine Emission Control

Description and Operation



E48444

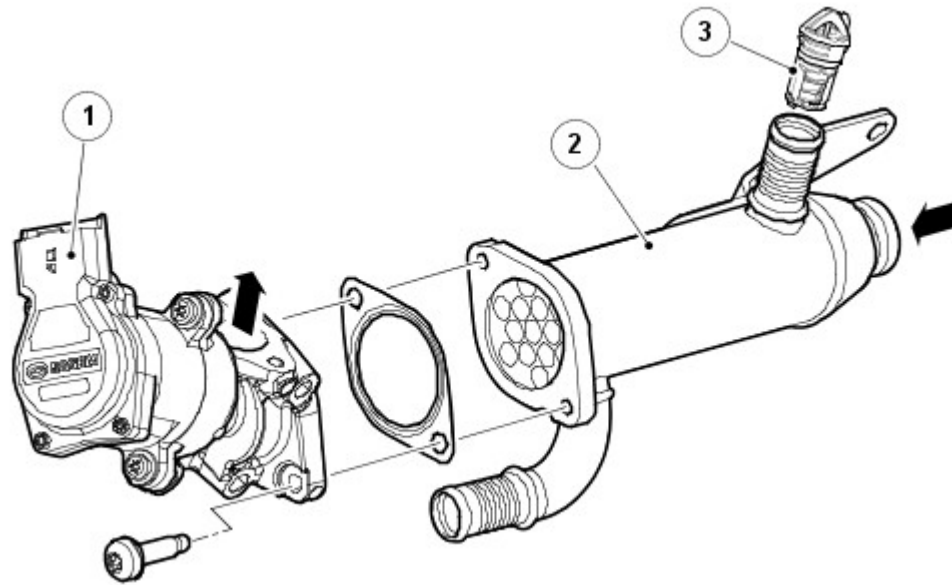
Item	Part Number	Description
1	-	EGR modulator/ cooler assembly
2	-	Electric throttle
3	-	EGR thermostat (from 2007MY)
4	-	EGR to electric throttle tube
5	-	EGR cooler
6	-	EGR modulator valve
7	-	EGR modulator solenoid valve
8	-	EGR coolant hoses

EGR SYSTEM

The EGR system comprises:

- EGR modulator x 2
- EGR cooler x 2
- Associated connecting pipes

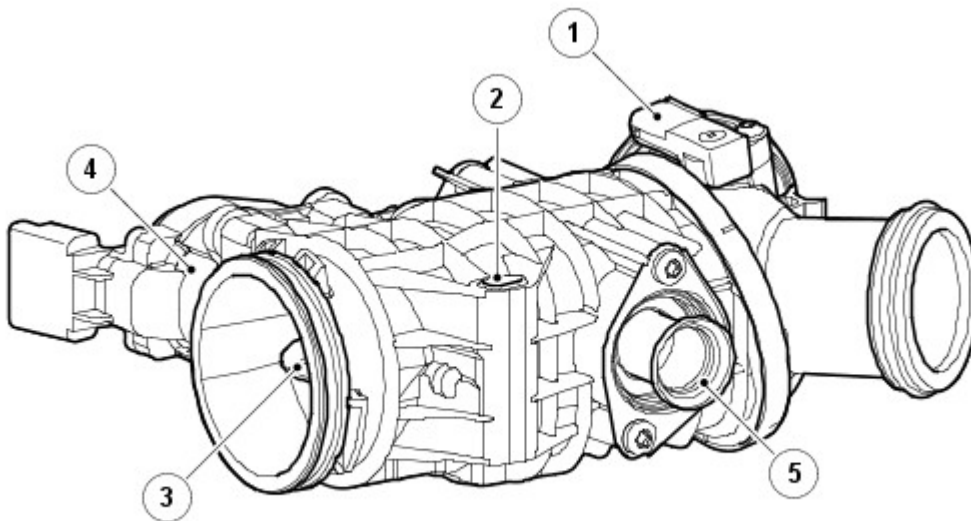
EGR Cooler and Modulator



E48446

Item	Part Number	Description
1	-	EGR modulator
2	-	EGR cooler
3	-	EGR thermostat (from 2007MY)

Electric Throttle Body



E48447

Item	Part Number	Description
1	-	Inlet air temperature sensor
2	-	Electric throttle body
3	-	Electric throttle flap
4	-	Electric throttle control motor
5	-	Gas inlet port

The EGR modulator and cooler are a combined unit.

The combined EGR modulator and cooler is located under each cylinder bank, between the exhaust manifold and the cylinder head. The cooler side of the EGR is connected to the vehicle cooling system, via hoses. The inlet exhaust side is connected directly into the exhaust manifolds on each side. The exhaust gas passes through the cooler and is expelled via the actuator and a metal pipe into the throttle housing. The EGR modulator is a solenoid operated valve which is controlled by the ECM. The ECM uses the EGR modulator to control the amount of exhaust gas being recirculated in order to reduce exhaust emissions and combustion noise. The EGR is enabled when the engine is at normal operating temperature and under cruising conditions.

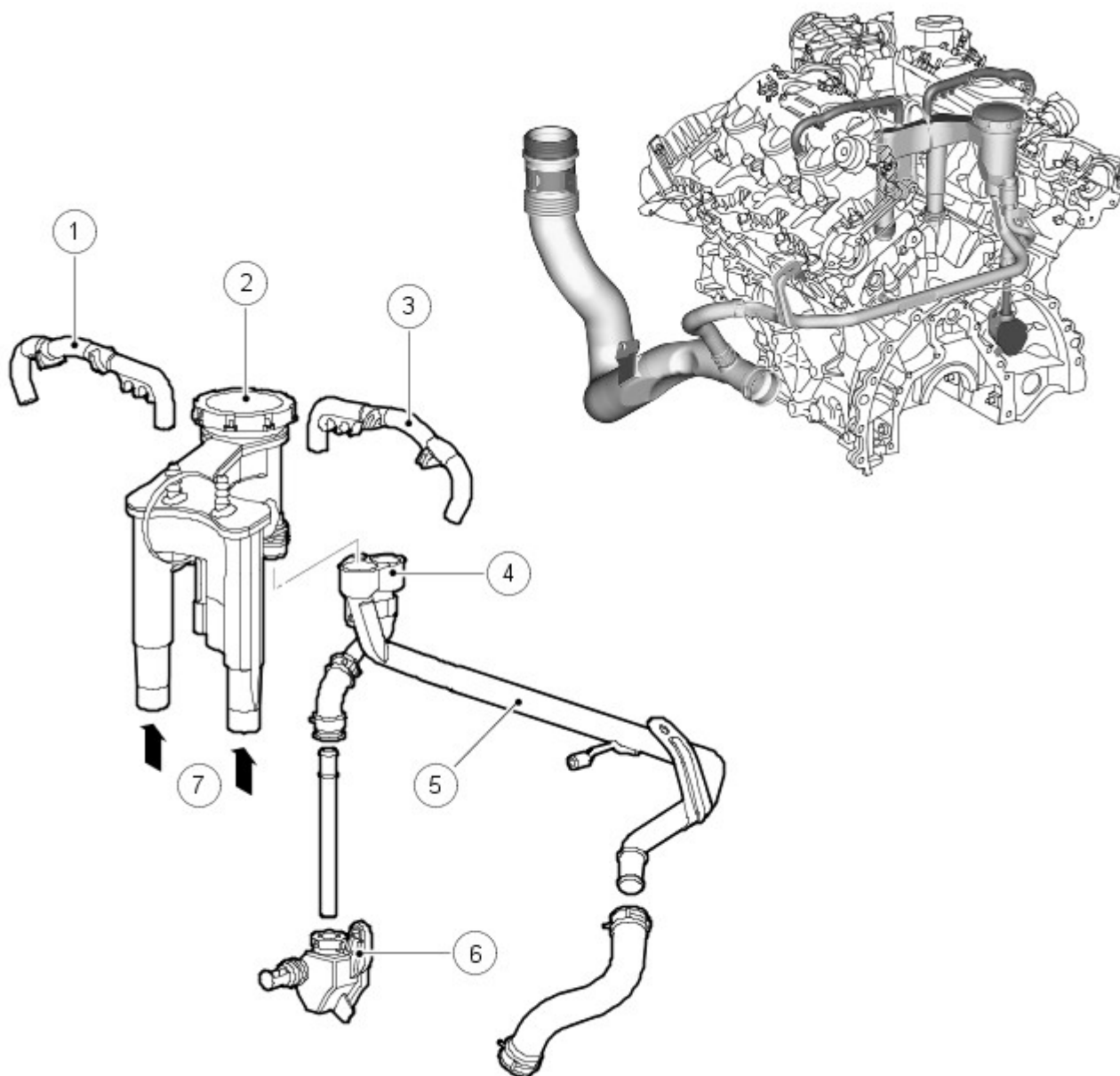
On vehicles from 2007MY, a flow regulating, wax thermostat is fitted to the coolant outlet of the EGR cooler. The purpose of the thermostat is to promote faster engine warm-up, improve cabin heater performance and assist the emissions to comply with the requirements of EU4 regulations. The thermostat is closed when cold, starts to open at 75°C (167°F) and is fully open at normal operating temperatures. The thermostat has a small bleed hole which allows a small amount of leakage when cold.

The EGR modulator receives a 12V supply from the main relay. The ground for the solenoid is via the ECM and is controlled using a PWM signal. The PWM duty signal of the solenoid ground is varied to determine the precise amount of exhaust gas delivered to the cylinders.

The modulators are operated through their full range at each engine start-up, to clear any carbon deposits that may have built up whilst the engine was running

In the event of a failure of the EGR modulator, the EGR function will become inoperative. The ECM can monitor the EGR modulator solenoid for short circuits and store fault codes in the event of failure. The modulator can also be activated for testing using a Land Rover approved diagnostic system.

CRANKCASE VENTILATION



E48445

Item	Part Number	Description
1	-	Breather tube
2	-	Oil separator
3	-	Breather tube
4	-	Crankcase oil return connection
5	-	Oil return tube
6	-	Crankcase oil return valve
7	-	Breather flow

The crankcase ventilation system on the TdV6 ensures that all gasses emitted from the crankcase during engine running are separated from any oil particles.

Crankcase gasses are drawn into the oil separator unit from the crankcase and the cylinder head covers (both banks) where the gas and oil are separated. The gas is returned to the inlet side of the air induction system prior to the turbo charger. The oil is drained down to the sump via an oil return valve locate at the rear of the cylinder block.

Engine Emission Control - TDV6 2.7L Diesel - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Emission Control](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine breather system ● Oil separator ● Exhaust gas recirculation pipes/hoses (check for cracks) ● EGR valve(s) ● EGR cooler(s) ● Vacuum system 	<ul style="list-style-type: none"> ● Fuse(s) ● Wiring harness ● Loose or corroded electrical connector(s) ● Intake air shut off throttle ● Exhaust gas recirculation (EGR) valve(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start	<ul style="list-style-type: none"> ● Exhaust gas recirculation (EGR) valve stuck open 	Check the Exhaust gas recirculation (EGR) valve.
Poor/Erratic idle		
Lack of power when accelerating		
Engine stops/stalls	<ul style="list-style-type: none"> ● Exhaust gas recirculation (EGR) valve stuck open ● Breather system disconnected/restricted/blocked 	Check the Exhaust gas recirculation (EGR) valve. Check the engine breather system. Check the oil separator. Check for Exhaust gas recirculation (EGR) DTCs.
Excessive fuel consumption	<ul style="list-style-type: none"> ● Exhaust gas recirculation (EGR) valve stuck open ● Exhaust gas recirculation (EGR) not operating ● Breather system restricted/blocked 	
Excessive black smoke		
Excessive emissions		
Excessive blow-by	<ul style="list-style-type: none"> ● Breather system restricted/blocked 	Check the engine breather hoses. Check the oil separator.
Engine oil leaks	<ul style="list-style-type: none"> ● Breather system restricted/blocked 	Check the engine breather hoses. Check the oil separator.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Engine Emission Control - TDV6 2.7L Diesel - Crankcase Vent Oil Separator

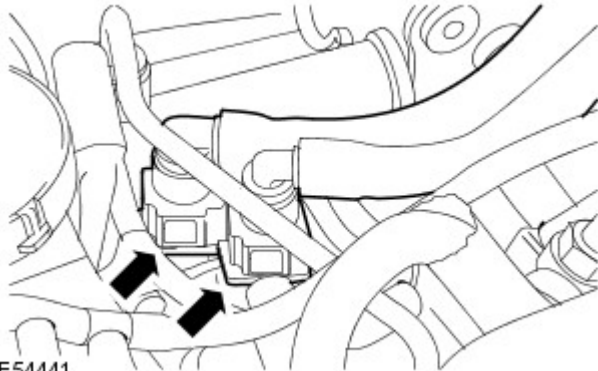
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Disconnect the low-pressure fuel lines.

- Install blanking caps to the exposed ports.



E54441

3. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

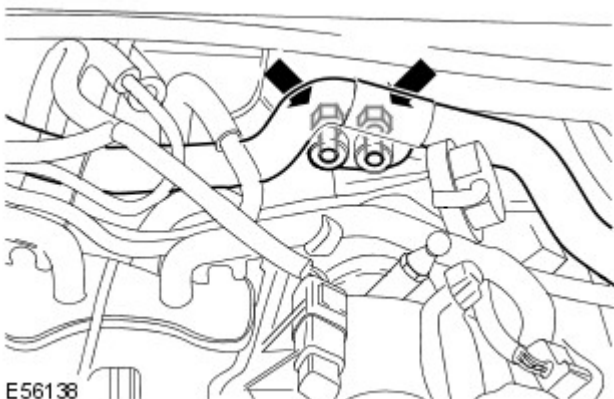
- Clamp the EGR coolant hoses to minimize coolant loss.



E53903

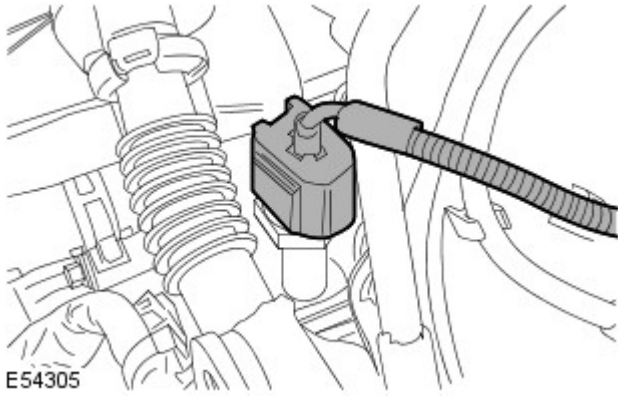
4. Remove the EGR coolant cross-over pipe.

- Remove the two retaining bolts.



E56138

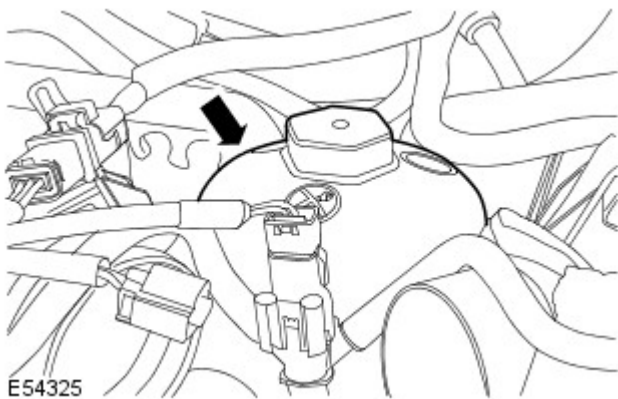
5. Disconnect the engine oil pressure (EOP) sensor electrical connector.



6.  CAUTION: The O-ring seal is to be reused unless damaged.

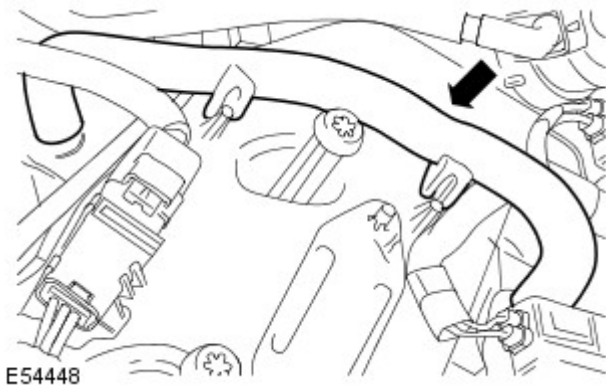
Using the special tool, remove the oil filter element.

- Loosen the element cover 4 complete turns to allow engine oil to drain from the filter cover.
- Remove element cover.
- Clean the immediate area.

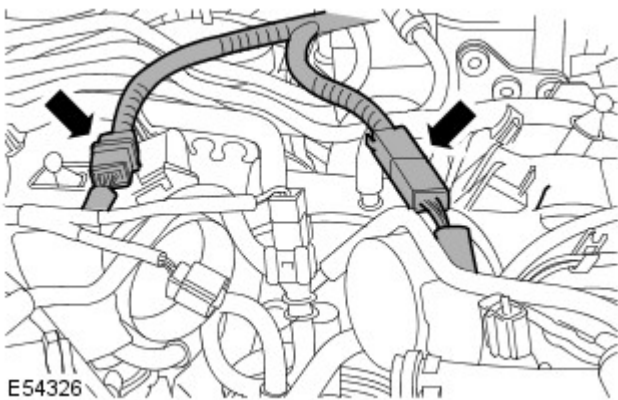


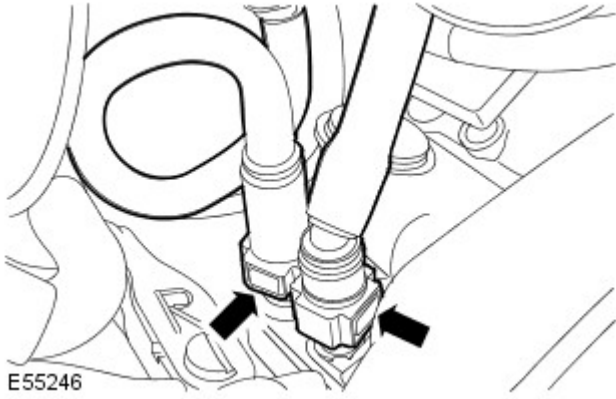
7. NOTE: Left-hand shown, right-hand similar.

Remove the breather pipes.




8. Disconnect the glow plug electrical connectors.





9. Disconnect the low-pressure fuel lines.

- Install blanking caps to the exposed ports.

10.  **CAUTION:** Make sure that the high-pressure fuel supply line remains in contact with the fuel pump and fuel injection diverter rail until both unions have been detached and cleaned. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

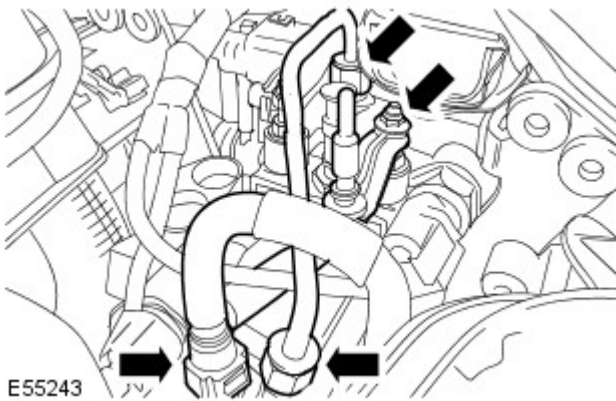
- **NOTE:** Crankcase vent oil separator shown removed for clarity.

Remove and discard the high-pressure fuel supply line.

- Install blanking caps to the exposed ports.

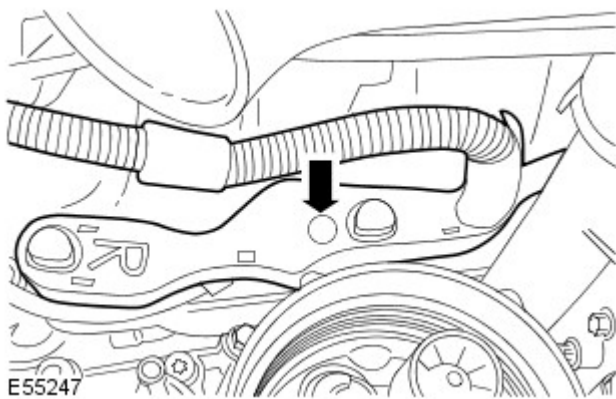
11. Remove the low-pressure fuel line.

- Disconnect the low-pressure fuel line.
- Release the low-pressure fuel line.
- Install blanking caps to the exposed ports.

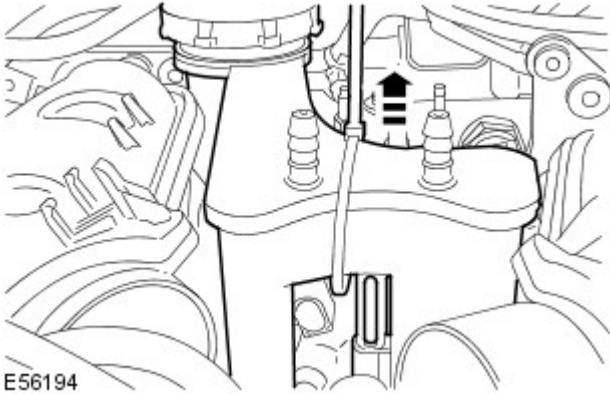


12. **NOTE:** Right-hand shown, left-hand similar.

Remove the glow plug wires.

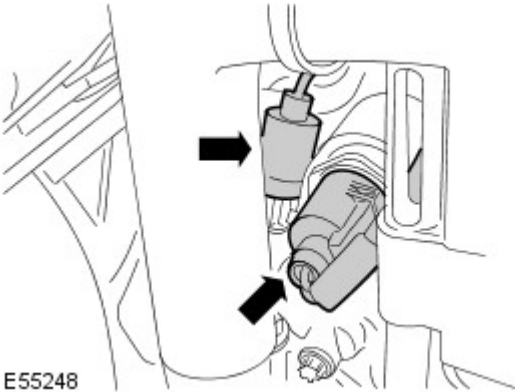


13. Reposition the crankcase vent oil separator.



E56194

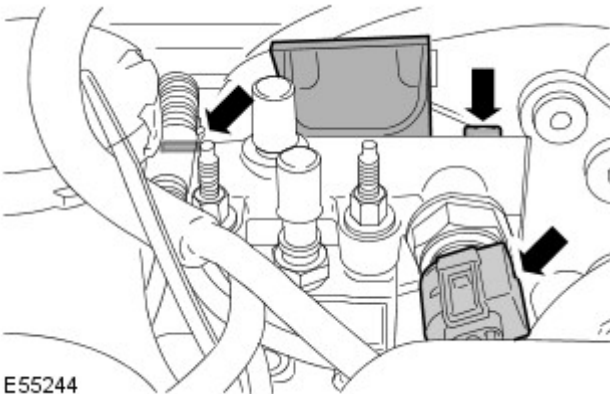
14. Disconnect the fuel injection pump electrical connectors.



E55248

15. Disconnect the fuel rail pressure (FRP) sensor electrical connector.

- Release the fuel charging wiring harness.

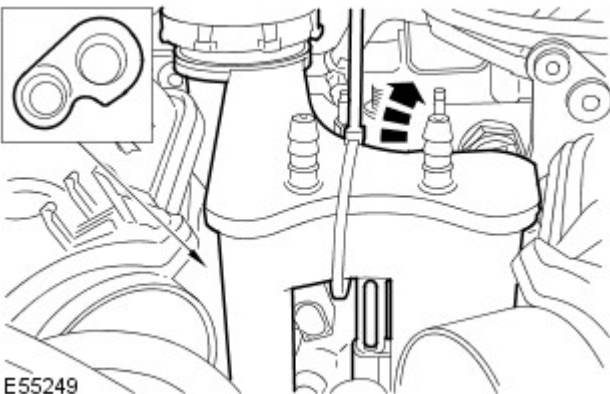


E55244

16.  CAUTION: The O-ring seals are to be reused unless damaged.

- NOTE: Remove the crankcase vent oil separator drain tube seal prior to the removal of the crankcase vent oil separator.
- NOTE: Using a suitable adhesive tape, protect the oil cooler.

Remove the crankcase vent oil separator.



E55249

Installation

1.  CAUTION: The O-ring seals are to be reused unless damaged.

Position the crankcase vent oil separator, but do not fully install at this stage.

- Clean the immediate area.

2. Connect the FRP sensor electrical connector.

- Attach the fuel charging wiring harness.

3. Install the crankcase vent oil separator.

4. Connect the fuel injection pump electrical connectors.

5. Install the glow plug wires.

6. Install the low-pressure fuel line.

- Remove the blanking caps from the ports.
- Connect the low-pressure fuel line.
- Attach the low-pressure fuel line.

7. Install the new high-pressure fuel supply line.

- Remove the blanking caps from the ports.
- Install the new high-pressure fuel supply line, but do not tighten unions at this stage.
- Stage 1: Tighten the high-pressure fuel supply line union at the fuel pump to 15 Nm (11 lb.ft).
- Stage 2: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 15 Nm (11 lb.ft).
- Stage 3: Tighten the high-pressure fuel supply line union at the fuel pump to 30 Nm (22 lb.ft).
- Stage 4: Tighten the high-pressure fuel supply line union at the fuel injection diverter rail to 30 Nm (22 lb.ft).

8. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

9. Connect the glow plug electrical connectors.

10. Install the breather pipes.

11.  **CAUTION:** The O-ring seal is to be reused unless damaged.

Install the oil filter element.

- Clean the components.
- Tighten the oil filter element cover to 25 Nm (18 lb.ft).

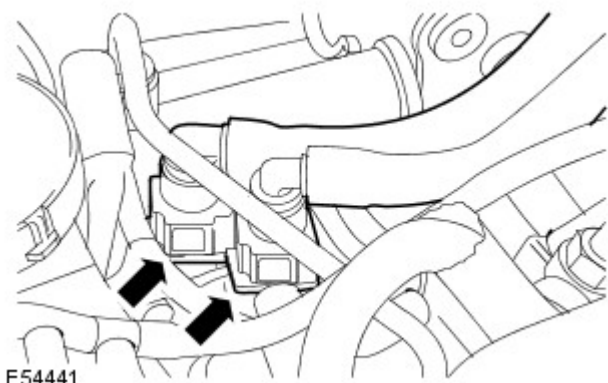
12. Connect the EOP sensor electrical connector.

13. Install the EGR coolant cross-over pipe.

- Install the two retaining bolts.
- Tighten to 13 Nm (10 lb.ft).

14. Connect both EGR coolant cross-over pipe hoses.

- Remove the EGR coolant hose clamps.



E54441

15. Connect the low-pressure fuel lines.

- Remove the blanking caps from the ports.

16. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

17. Check and top-up the engine oil.

18. Check and top-up the coolant.

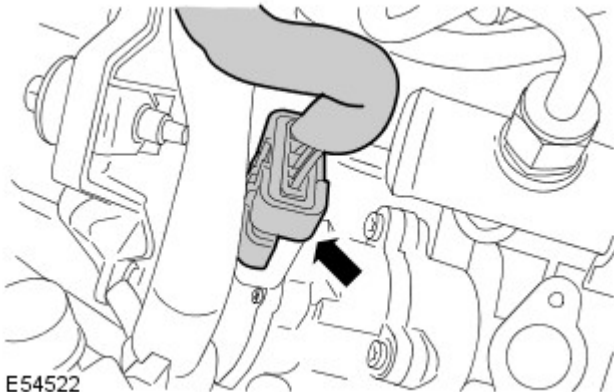
19. Bleed the fuel system.

Engine Emission Control - TDV6 2.7L Diesel - Exhaust Gas Recirculation (EGR) Valve LH Vehicles Without: Diesel Particulate Filter (DPF)

Removal and Installation

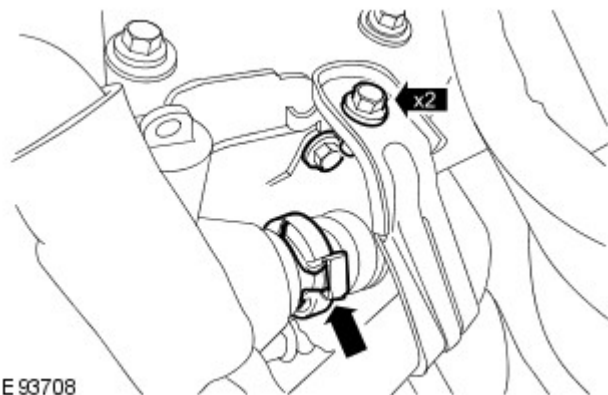
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Remove the LH exhaust gas recirculation (EGR) outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
4. Disconnect the LH EGR valve electrical connector.



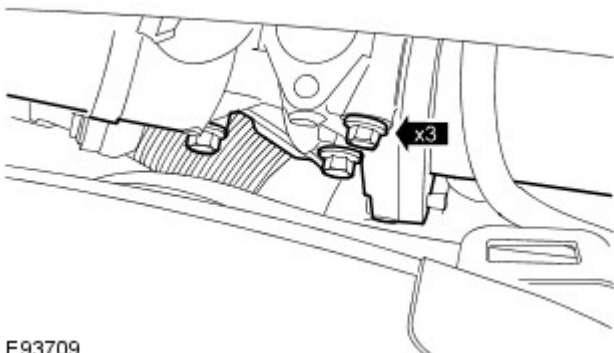
5. Release the LH EGR cooler.

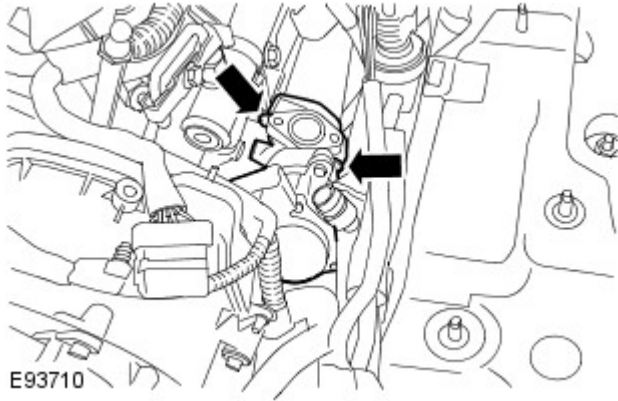
- Remove and discard the clip.
- Loosen the 2 bolts.



6. Release the LH EGR valve from the cylinder head.

- Remove the 3 bolts.





7. Remove the LH EGR valve.

- Remove the 2 bolts.
- Remove and discard the gasket.

Installation

1. Install the LH EGR valve.

- Clean the component mating faces.
- Install a new gasket.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. NOTE: Do not tighten at this stage.

Install the LH EGR valve bolts.

3. NOTE: Install a new clip.

Secure the LH EGR cooler.

1. Secure the clip.
2. Tighten the bolts to 10 Nm (7 lb.ft).

4. Secure the LH EGR valve.

- Tighten the bolts to 10 Nm (7 lb.ft).

5. Connect the LH EGR valve electrical connector.

6. Install the LH EGR valve outlet tube.

For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

7. Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

8. Connect the battery ground cable.

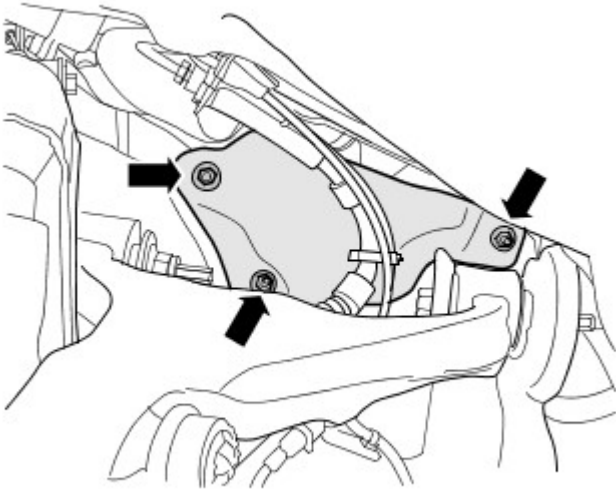
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Emission Control - TDV6 2.7L Diesel - Exhaust Gas Recirculation (EGR) Valve LH Vehicles With: Diesel Particulate Filter (DPF)

Removal and Installation

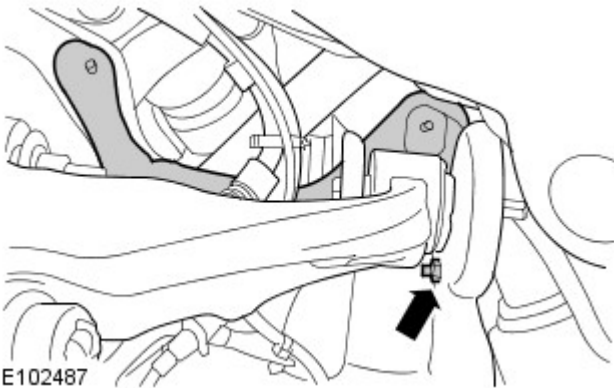
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Raise and support the vehicle.
4. Remove the exhaust heat shield.
 - Access through the LH wheel arch.
 - Remove the 3 nuts.



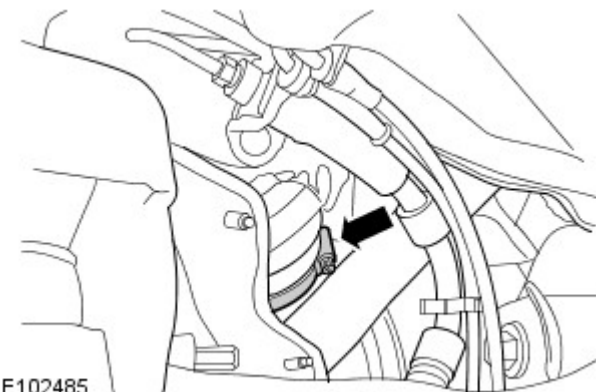
E102486

5. Remove the exhaust heat shield.
 - Access through the LH wheel arch.
 - Remove the bolt.



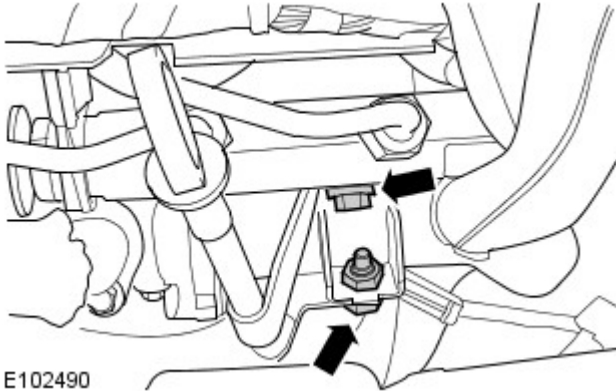
E102487

6. **NOTE:** Do not fully release the turbocharger outlet hose.
Release the turbocharger hose lower clip.



E102485

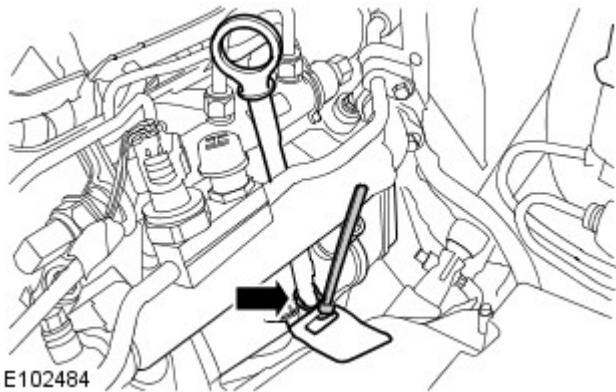
7. Lower the vehicle.
8. Remove the LH exhaust gas recirculation (EGR) outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
9. Release the oil level indicator tube.



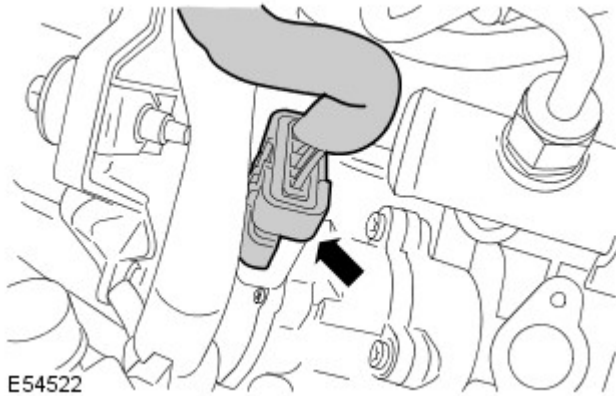
10. **NOTE:** Make sure that the turbocharger outlet pipe is free to be repositioned and allow the oil level indicator tube to be repositioned against the vehicle body.

Reposition the oil level indicator tube.

- Using a suitable tie strap, reposition and secure the oil level indicator tube to the vehicle body.

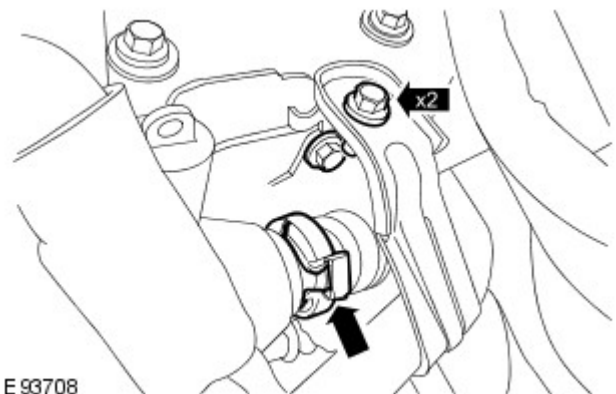


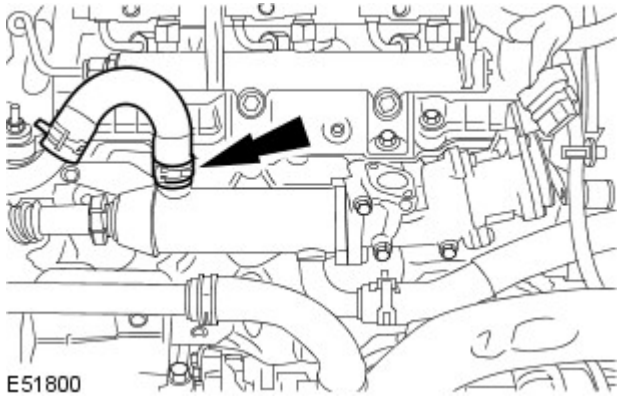
11. Disconnect the LH EGR valve electrical connector.



12. Release the LH EGR cooler.

- Remove and discard the clip.
- Loosen the 2 bolts.





13. NOTE: RH illustration shown, LH is similar.

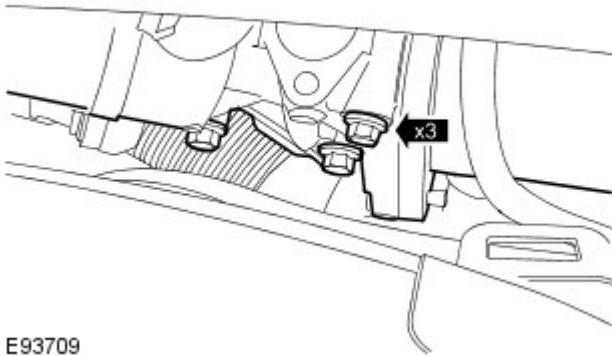
Disconnect LH EGR cooler rear coolant hose.

- Clamp the hoses to minimize coolant loss.
- Release the clip.

14. NOTE: The EGR valve front bolt cannot be removed with the EGR valve in its original orientation. The EGR valve must be removed before the front bolt can be removed.

Release the LH EGR valve from the cylinder head.

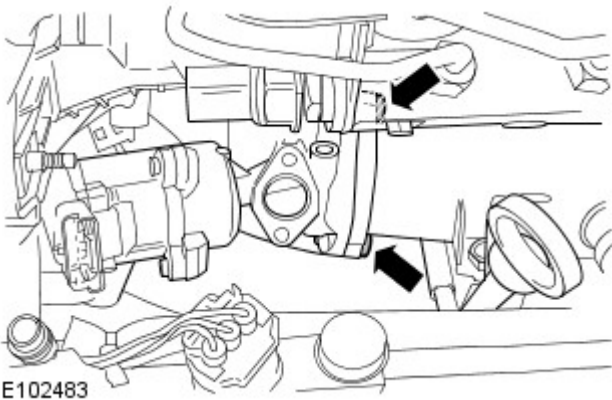
- Remove the 3 bolts.



15. NOTE: Reposition the EGR valve and EGR valve cooler assembly to gain access to the Torx bolts.

Remove the LH EGR valve.

- Remove the 2 bolts.
- Remove and discard the gasket.



Installation

1. NOTE: The EGR valve front bolt must be fitted to the EGR valve before the EGR valve is installed.

• **NOTE:** Reposition the EGR valve and EGR valve cooler assembly to gain access to the Torx bolts.

Install the LH EGR valve.

- Clean the component mating faces.
- Install a new gasket.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. NOTE: Do not tighten at this stage.

Install the LH EGR valve bolts.

3. NOTE: Install a new clip.

4: Secure the LH EGR valve.

Secure the LH EGR cooler.

- Tighten the bolts to 10 Nm (7 lb.ft).
 1. Secure the clip.
- 5.** Connect the LH EGR valve electrical connector.
 2. Tighten the bolts to 10 Nm (7 lb.ft).


6. Connect the coolant outlet hose to the LH EGR valve.
 - Position and secure the clip.
 - Remove the coolant hose clamps.
7. Secure the oil level indicator and tube.
 - Reposition the turbocharger outlet pipe.
 - Cut the cable tie.
 - Tighten the 2 bolts to 10 Nm (7 ib.ft).
8. Install the LH EGR valve outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
9. Raise the vehicle.
10. Secure the turbocharger outlet hose.
 - Secure the clip.
11. Install the heat shields.
12. Lower the vehicle.
13. Install the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
14. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
15. Check and top-up the coolant.

Engine Emission Control - TDV6 2.7L Diesel - Exhaust Gas Recirculation (EGR) Valve RH Vehicles With: Diesel Particulate Filter (DPF)

Removal and Installation

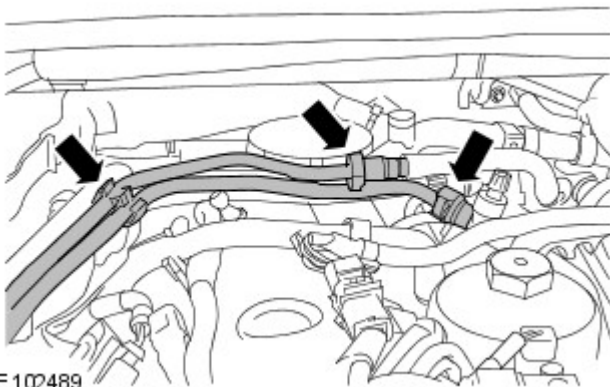
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

3.  WARNING: This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

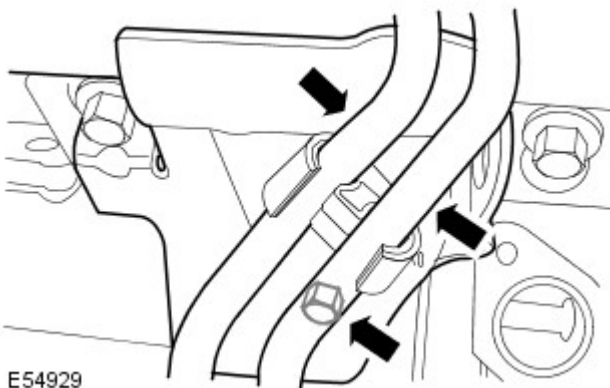
Disconnect the 2 fuel pipes.

- Release the 2 fuel pipe clips.



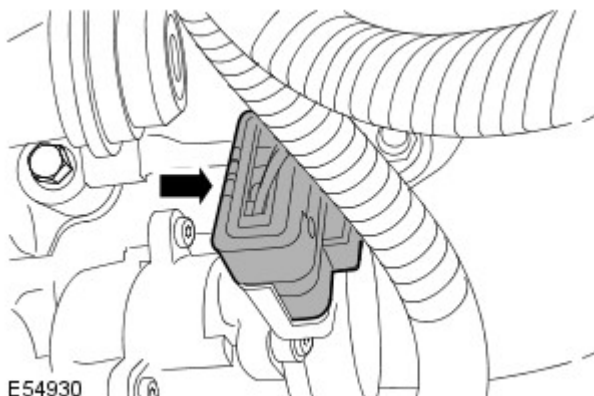
4. Remove the fuel line support bracket.

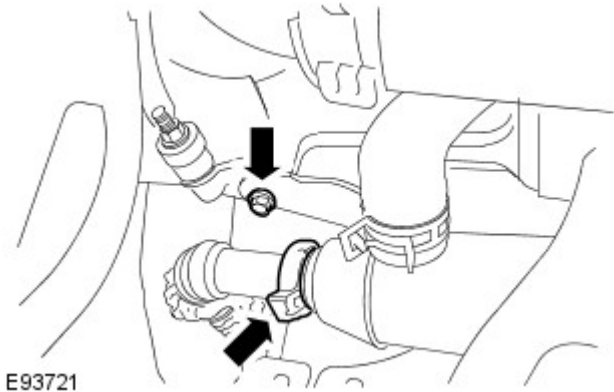
- Release the fuel pipe from the clips.
- Remove the bolt.



5. Remove the RH exhaust gas recirculation (EGR) valve outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

6. Disconnect the RH EGR valve electrical connector.

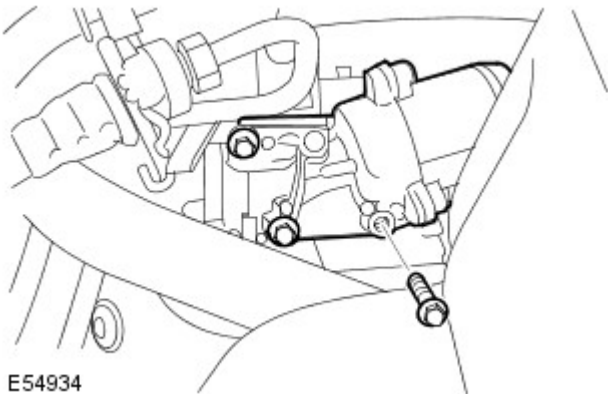




E93721

7. Release the RH EGR cooler.

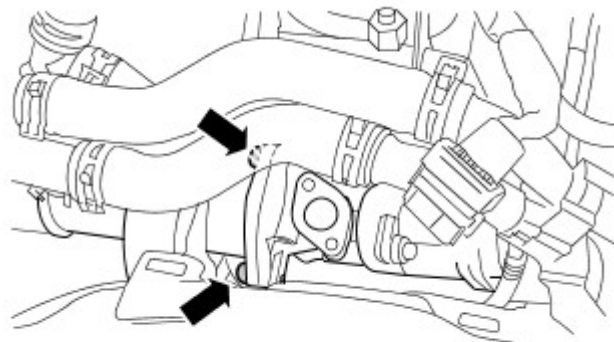
- Remove and discard the clip.
- Loosen the bolt.



E54934

8. Release the RH EGR valve from the cylinder head.

- Remove the 3 bolts.



E102488

9. NOTE: Reposition the EGR valve and EGR valve cooler assembly to gain access to the Torx bolts.

Remove the RH EGR valve.

- Remove the 2 bolts.
- Remove and discard the gasket.

Installation

1. NOTE: Reposition the EGR valve and EGR valve cooler assembly to gain access to the Torx bolts.

Install the RH EGR valve.

- Clean the component mating faces.
- Install a new gasket.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. NOTE: Do not tighten at this stage.

Install the RH EGR valve bolts.

3. NOTE: Install a new clip.

Secure the RH EGR cooler.

1. Secure the clip.
2. Tighten the bolt to 10 Nm (7 lb.ft).

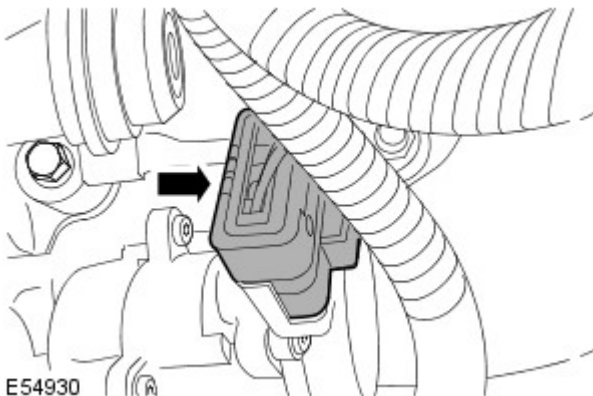
4. Secure the RH EGR valve.
 - Tighten the bolts to 10 Nm (7 lb.ft).
5. Connect the RH EGR valve electrical connector.
6. Install the RH EGR valve outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
7. Install the fuel line support bracket.
8. Connect and secure the low-pressure fuel lines.
9. Install the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
10. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Emission Control - TDV6 2.7L Diesel - Exhaust Gas Recirculation (EGR) Valve RH Vehicles Without: Diesel Particulate Filter (DPF)

Removal and Installation

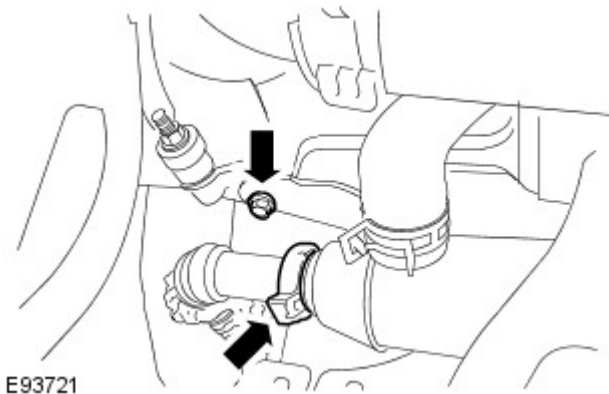
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Remove the RH exhaust gas recirculation (EGR) valve outlet tube.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
4. Disconnect the RH EGR valve electrical connector.



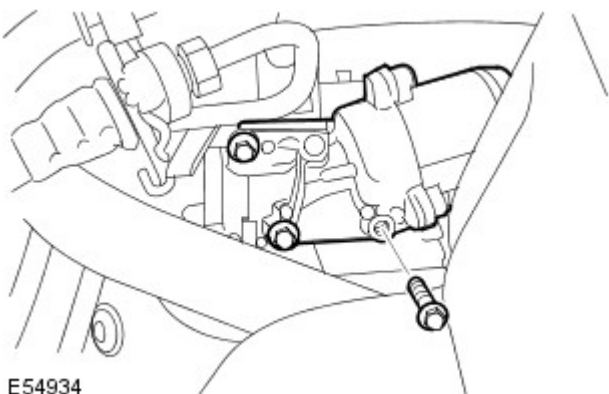
5. Release the RH EGR cooler.

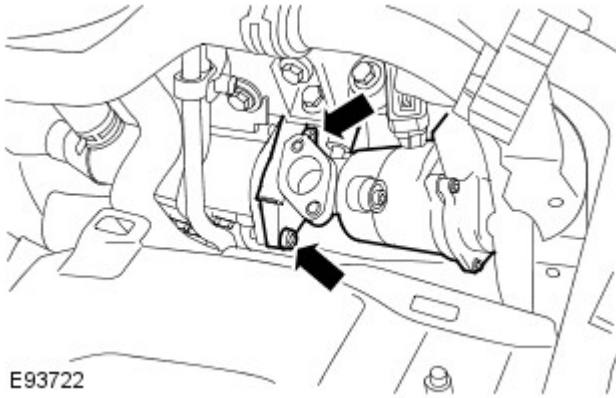
- Remove and discard the clip.
- Loosen the bolt.



6. Release the RH EGR valve from the cylinder head.

- Remove the 3 bolts.





7. Remove the RH EGR valve.

- Remove the 2 bolts.
- Remove and discard the gasket.

Installation

1. Install the RH EGR valve.

- Clean the component mating faces.
- Install a new gasket.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. NOTE: Do not tighten at this stage.

Install the RH EGR valve bolts.

3. NOTE: Install a new clip.

Secure the RH EGR cooler.

1. Secure the clip.
2. Tighten the bolt to 10 Nm (7 lb.ft).

4. Secure the RH EGR valve.

- Tighten the bolts to 10 Nm (7 lb.ft).

5. Connect the RH EGR valve electrical connector.

6. Install the RH EGR valve outlet tube.

For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

7. Install the auxiliary battery tray.

For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

8. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Emission Control - TDV6 2.7L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube

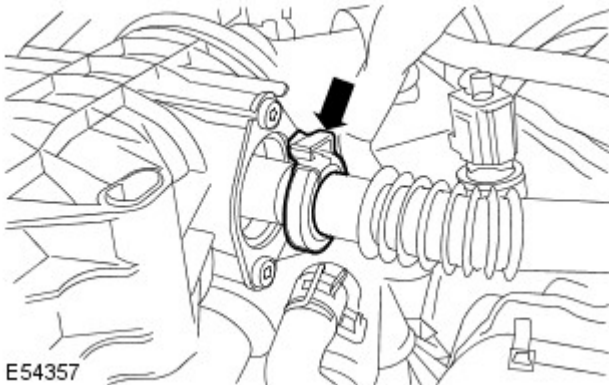
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. **NOTE:** Left-hand shown, right-hand similar.

Release the EGR valve outlet tube.

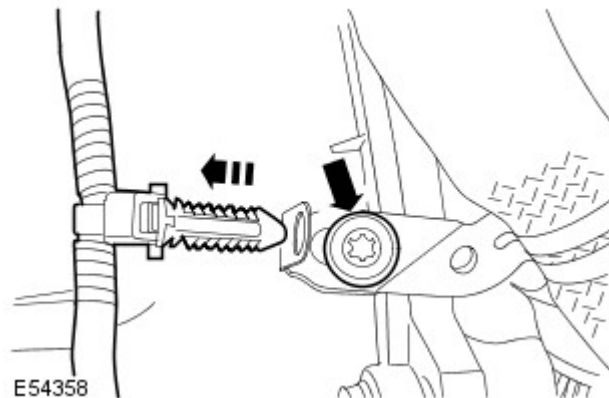
- Release the clip.



4. **NOTE:** Left-hand shown, right-hand similar.

Release the EGR valve outlet tube.

- Disconnect the engine wiring harness.
- Remove the Torx screw.

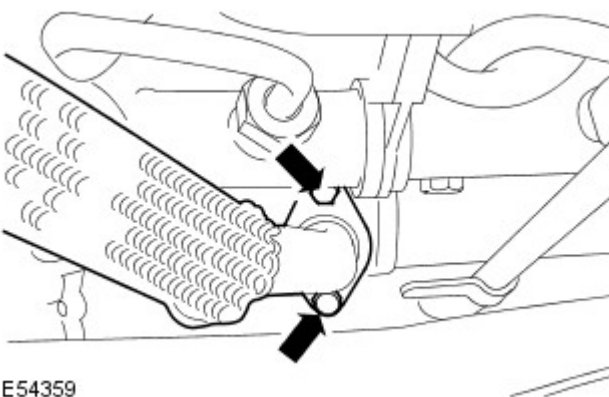


5. **NOTE:** Left-hand shown, right-hand similar.

- **NOTE:** Discard the gasket.
- **NOTE:** Discard the retaining clip.

Remove the EGR valve outlet tube.

- Remove the two bolts.



Installation

1. **NOTE:** Install a new retaining clip.
- **NOTE:** Install a new gasket.
- **NOTE:** Do not fully close the retaining clip at this stage.

Loosely install the EGR valve outlet tube.

- Install the two EGR valve outlet tube retaining bolts, but do not fully tighten at this stage.
2. Fully close the EGR valve outlet tube retaining clip.
 3. Tighten the EGR valve outlet tube retaining bolts to 10 Nm (7 lb.ft).
 4. Secure the engine wiring harness.
 - Install the Torx screw and tighten to 5 Nm (4 lb.ft).
 - Secure the engine wiring harness to the bracket with the clip.
 5. Install the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
 6. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

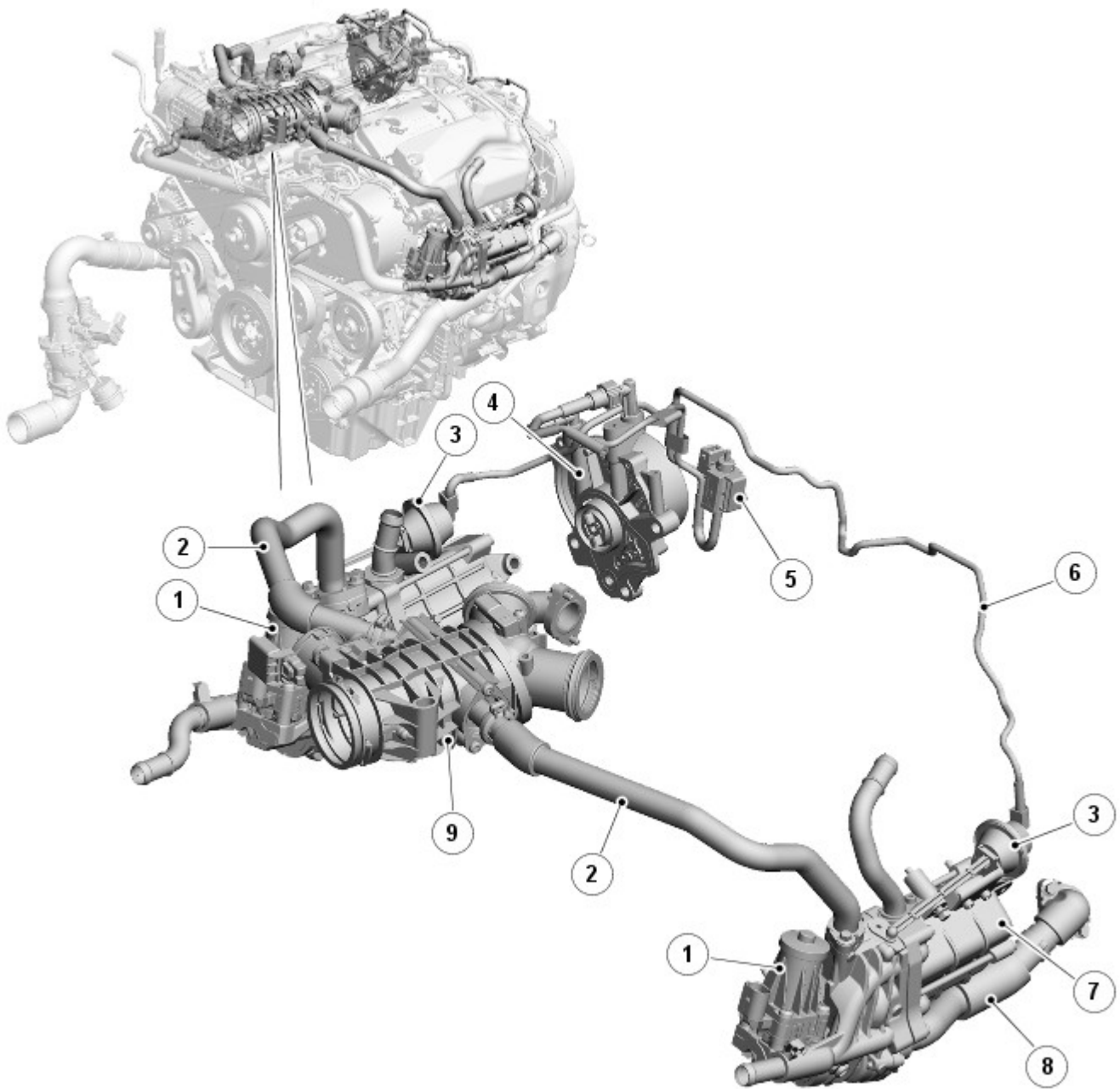
Engine Emission Control - TDV6 3.0L Diesel -

Description	Nm	lb-ft	lb-in
Exhaust gas recirculation (EGR) valve to cylinder head retaining bolts	10	7	89
EGR valve to EGR cooler retaining bolts	10	7	89
EGR valve tube to exhaust manifold retaining bolts	10	7	89
EGR valve cooler mounting bracket retaining bolt	10	7	89
EGR valve outlet tube to EGR valve retaining bolts	10	7	89
EGR valve outlet tube to timing cover retaining bolt	5	4	35

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control - Component Location

Description and Operation

EGR (exhaust gas recirculation) Component Location

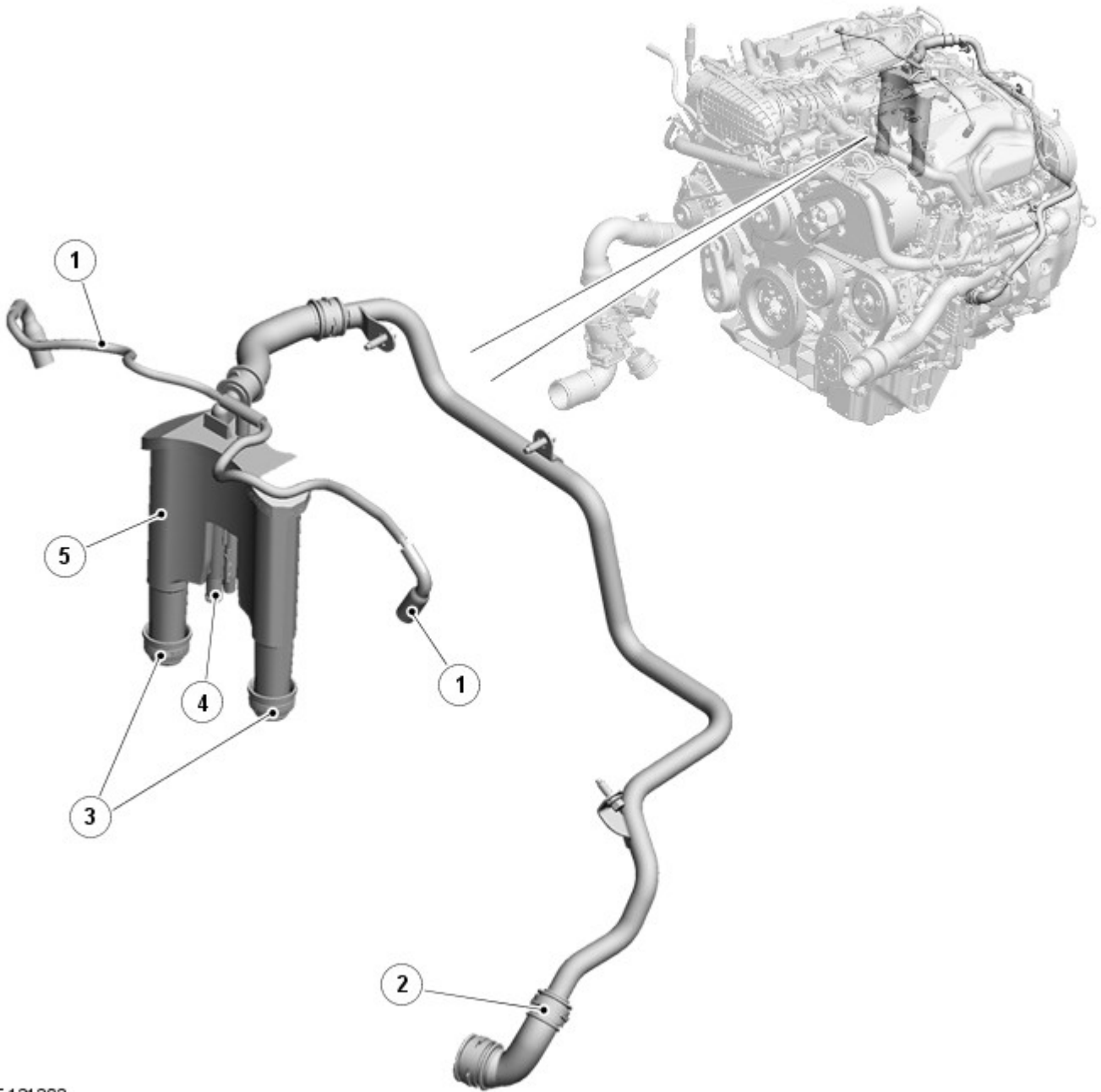


E121201

ItemDescription

1	EGR valve motor
2	EGR outlet pipe
3	By-pass valve vacuum actuator
4	Vacuum pump
5	Solenoid valve
6	Vacuum pipe (2 off)
7	EGR cooler
8	EGR inlet pipe from exhaust manifold
9	Throttle intake manifold

Crankcase Ventilation Component Location



E121202

ItemDescription

1	Cylinder ventilation scavenger hose (2 off)
2	Crankcase gas to air intake hose
3	Crankcase breather cylinder block connections
4	Oil drain to oil filter housing
5	Crankcase breather and oil separator

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control -

Overview

Description and Operation

OVERVIEW

Exhaust Gas Recirculation (EGR) System

The [EGR \(exhaust gas recirculation\)](#) system is used to control the amount of exhaust gas being recirculated in order to reduce exhaust emissions and combustion noise. [EGR](#) is enabled when the engine is at normal operating temperature and under cruising conditions.

Crankcase Ventilation System

The crankcase ventilation system ensures that all gasses emitted from the crankcase when the engine is running are separated from any oil particles and recirculated via the clean air induction system.

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control - System Operation and Component Description

Description and Operation

System Operation

EXHAUST GAS RECIRCULATION (EGR) SYSTEM OPERATION

If small volumes of fuel are injected into a combustion chamber full of pure air, the effect is to create a very lean mixture. This burns at a high temperature, which in turn causes the excess oxygen in the mixture to combine with the naturally occurring nitrogen in the air to create nitrogen oxides (NOx), a noxious class of pollutants associated with acid rain. This is a particular problem for diesel engines at low to medium loads (as the engine has no throttle, the cylinder is replenished with a full charge of 'air' at every induction stroke). Exhaust gas is blended into the intake air charge to create the cylinder charge. As the exhaust gas effectively contains no oxygen, it prevents the formation of a very lean mixture, so lowering combustion temperatures and minimizing the formation of NOx.

At low engine speeds and loads, over 50 percent of the cylinder charge can be made up of recycled exhaust gas. This is routed directly from the exhaust manifold and passes through a gas-water heat exchanger before being supplied to the inlet manifold. The volume of exhaust gas added to the intake charge is regulated by an electronically controlled [EGR \(exhaust gas recirculation\)](#) valve, actuated according to precise engine speed and load by the engine management system.

CRANKCASE VENTILATION SYSTEM OPERATION

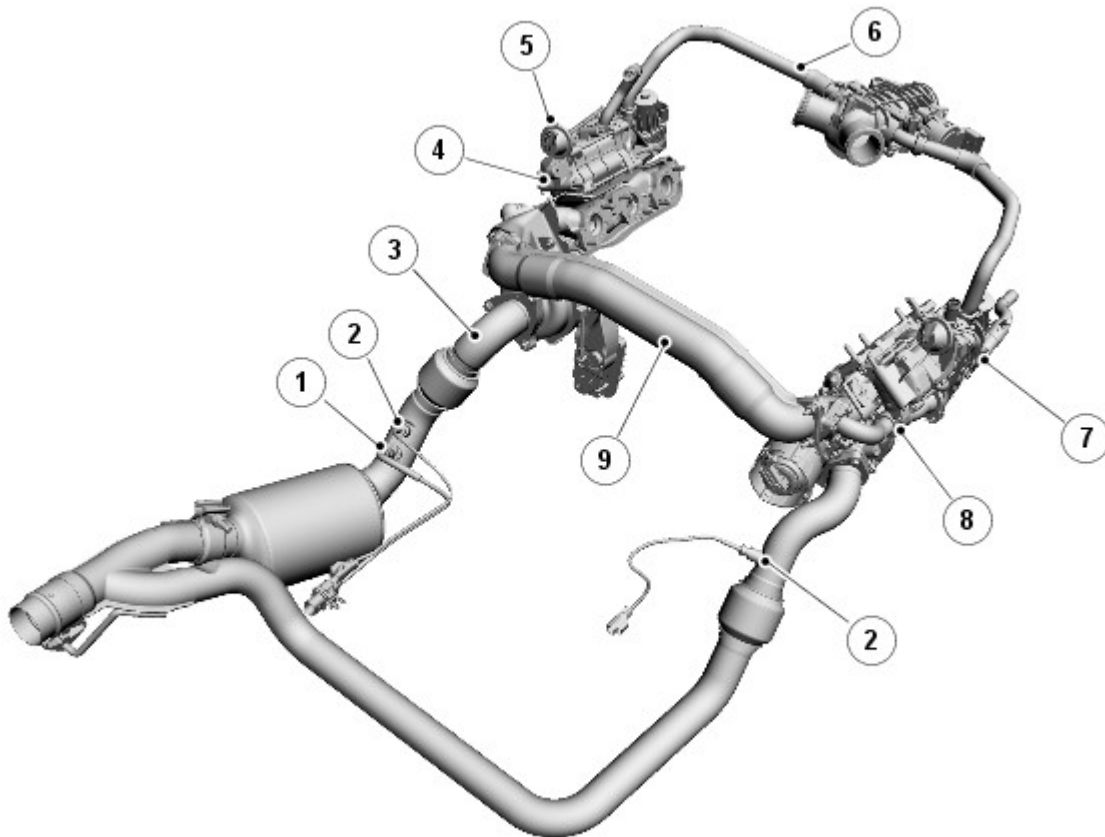
Crankcase gasses are drawn into the oil separator unit from the crankcase and the cylinder head covers (both banks) by a vacuum created by a connection into the air induction system.

The crankcase gasses are circulated around the oil separator where the gas and oil are separated. The gas is returned to the inlet side of the air induction system prior to the primary turbocharger. The collected oil is drained down to the sump via the oil cooler and filter housing on the cylinder block.

Component Description

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

EGR System Control Components



E121203

ItemDescription

1	Oxygen sensor
2	Exhaust gas temperature sensorLH (left-hand)
3	Exhaust pipe
4	EGR cooler
5	
6	
7	
8	
9	

By-pass valve vacuum actuator	
6	EGR outlet pipe
7	EGR cooler and valve housing
8	EGR inlet pipe
9	Exhaust system cross-over pipe

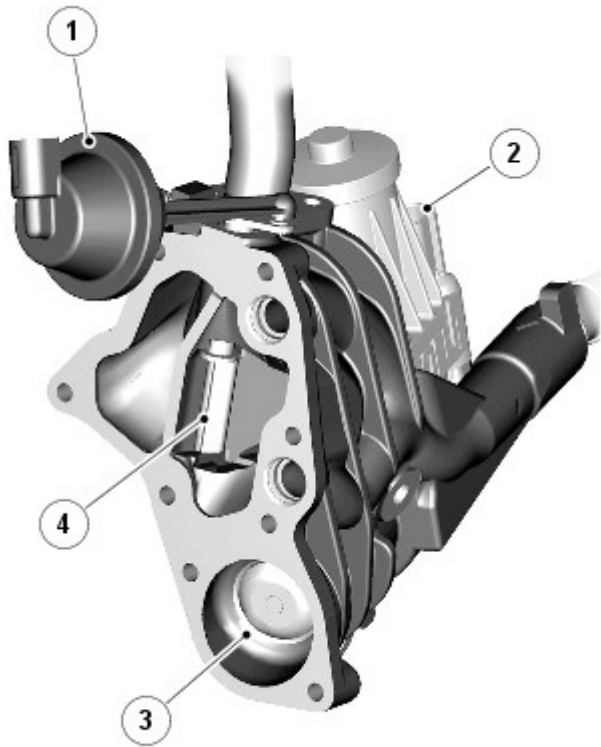
The EGR system comprises an EGR cooler and housing assembly which is bolted to the cylinder head, above the exhaust manifold. Each EGR assembly comprises an EGR cooler, a by-pass housing, a by-pass valve motor and a by-pass valve vacuum actuator.

A pipe is connected to the exhaust manifold and directs exhaust gasses into the by-pass housing. A second pipe from the by-pass housing connects to the throttle intake manifold and passes the cooled exhaust gasses into the intake manifold to mix with the clean air entering the engine from the air filter.

The EGR cooler is attached to the by-pass housing with a gasket and 5 screws. The by-pass housing has an engine coolant connection which allows coolant to flow from the engine oil cooler into the by-pass housing. Engine coolant flows from the by-pass housing into a water jacket within the cooler which in cools the exhaust gasses by heat transfer within the cooler. The engine coolant flows from the cooler through an outlet pipe and is passed back into the cooling system via the heater core.

The by-pass housing contains the EGR valve motor, the EGR valve and the by-pass valve.

By-pass Housing Components



E107585

Item	Description
1	By-pass valve vacuum actuator
2	EGR valve motor
3	EGR valve
4	By-pass valve

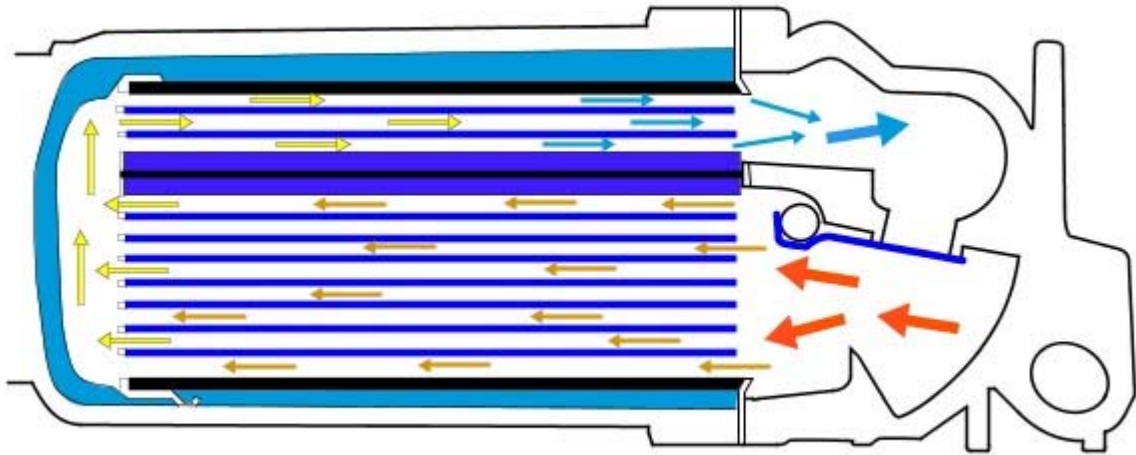
By-Pass Valve

The by-pass valve is a vacuum operated valve which directs the flow of exhaust gasses either through the EGR cooler or by-passes the cooler and directs the gasses directly to the intake manifold.

A vacuum actuator is located on a bracket attached to each EGR cooler. The actuator receives a vacuum which is produced by the vacuum pump located at the rear of the engine. The vacuum actuator is connected to the by-pass valve within the by-pass housing by a connecting rod.

The vacuum supply to the actuator is controlled by the ECM (engine control module). When by-pass control is required, the ECM energizes a vacuum solenoid valve which applies vacuum to the vacuum actuators. The vacuum causes the actuators to move the connecting rods in a linear direction. The linear movement of the rod is transferred to rotary movement of the by-pass valve within the by-pass housing.

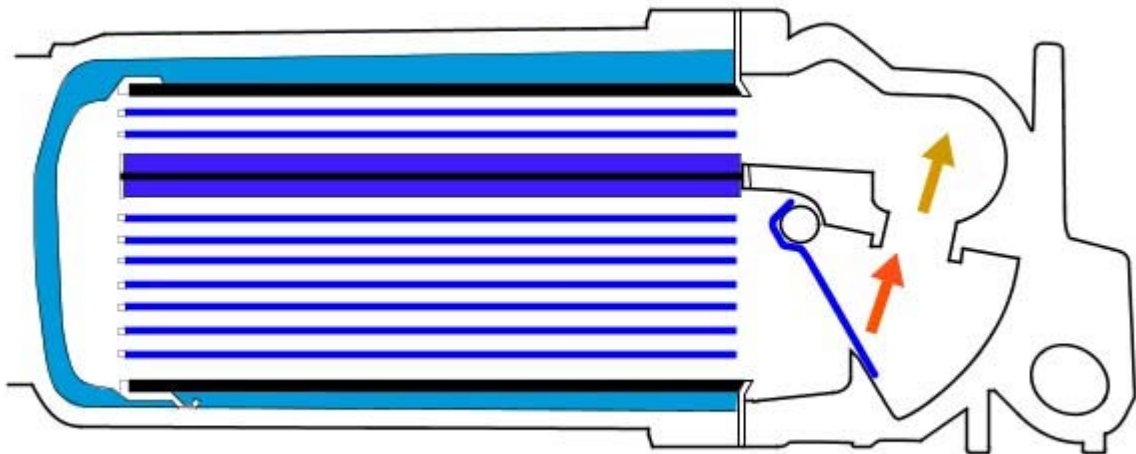
By-Pass Valve Closed



E112407

When the by-pass valve is closed, exhaust gasses are directed through the cooler before being passed to the intake manifold.

By-Pass Valve Open



E112408

When the by-pass valve is open, exhaust gasses are passed directly through the by-pass housing into the intake manifold with no cooling applied to the gasses.

EGR Valve

The [EGR](#) valve motor is located on the by-pass housing. A 5 pin connector provides the power, ground and [ECM](#) signal and feedback connections for the motor.

The motor is secured to the by-pass housing with 4 torx screws. A pinion gear on the motor spindle drives a geared rack which is connected to the [EGR](#) valve in the by-pass housing.

The motor is controlled by the [ECM](#) which provides power supply to operate the motor as required. A 5 Volt feedback signal is passed to the [ECM](#) which is used to establish motor position for precise control.

CRANKCASE VENTILATION

The crankcase ventilation system comprises an oil breather and separator. The breather receives crankcase directly from the crankcase and also from the cylinder heads.

The breather is connected to the top of the cylinder block with two seals. Two scavenge pipes located on the top of the breather are connected to the cylinder head covers. A breather pipe is connected from the top of the breather to the clean air intake hose at a point prior to the primary turbocharger.

Clean air being drawn into the engine when it is running creates a vacuum in the breather pipe. This vacuum in turn creates a vacuum in the oil breather and separator which draws gasses from the crankcase and cylinder heads into the breather. These gasses are circulated around the breather, allowing oil particles to be separated from the gas. The gasses are drawn into the breather pipe and are mixed with the clean air being drawn into the turbocharger.

The oil particles separated from the gasses accumulate in the oil separator and drain through a third connection at the bottom of the oil breather and separator, through a connection on the oil cooler housing to the oil pan.

Engine Emission Control - TDV6 3.0L Diesel - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-08B Engine Emission Control - TDV6 3.0L Diesel)

[Engine Emission Control](#) (Description and Operation),
[Engine Emission Control](#) (Description and Operation),
[Engine Emission Control](#) (Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine breather system ● Oil separator ● Exhaust gas recirculation pipes/hoses (check for cracks) ● EGR valve(s) ● EGR cooler(s) ● Vacuum system 	<ul style="list-style-type: none"> ● Fuse(s) ● Wiring harness ● Loose or corroded electrical connector(s) ● Intake air shut off throttle ● Exhaust gas recirculation (EGR) valve(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start	<ul style="list-style-type: none"> ● Exhaust gas recirculation (EGR) valve stuck open 	Check the Exhaust gas recirculation (EGR) valve.
Poor/Erratic idle		
Lack of power when accelerating		
Engine stops/stalls	<ul style="list-style-type: none"> ● Exhaust gas recirculation (EGR) valve stuck open ● Breather system disconnected/restricted/blocked 	Check the Exhaust gas recirculation (EGR) valve. Check the engine breather system. Check the oil separator. Check for Exhaust gas recirculation (EGR) DTCs.
Excessive fuel consumption		
Excessive black smoke		
Excessive emissions		
Excessive blow-by	<ul style="list-style-type: none"> ● Breather system restricted/blocked 	Check the engine breather hoses. Check the oil separator.
Engine oil leaks	<ul style="list-style-type: none"> ● Breather system restricted/blocked 	Check the engine breather hoses. Check the oil separator.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation).

Engine Emission Control - TDV6 3.0L Diesel - Crankcase Vent Oil Separator

Removal and Installation

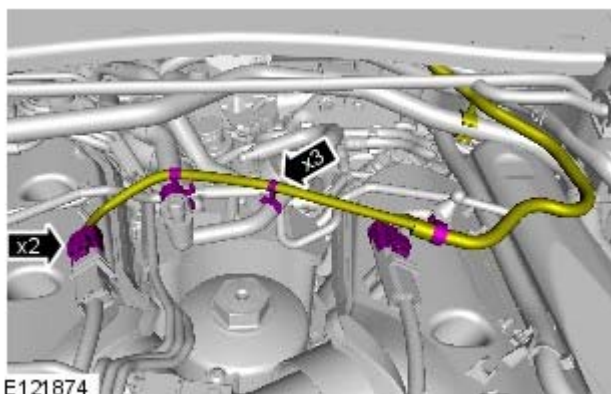
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

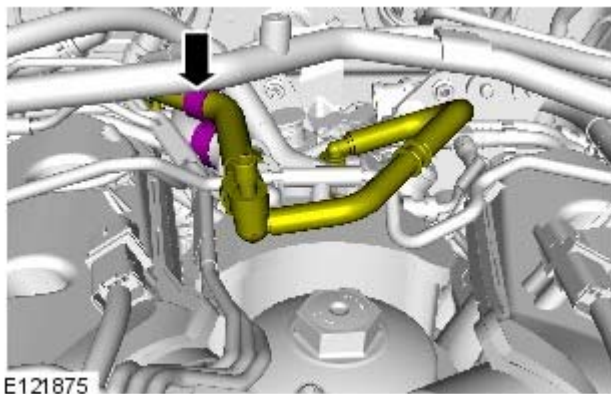
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

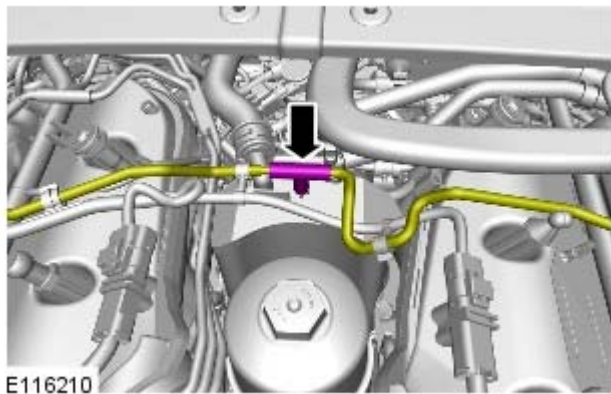
2. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



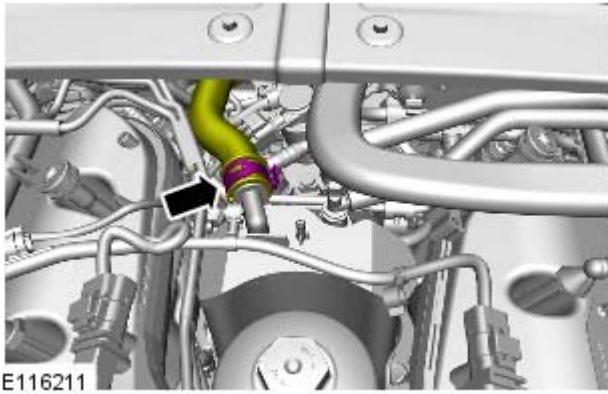
3.



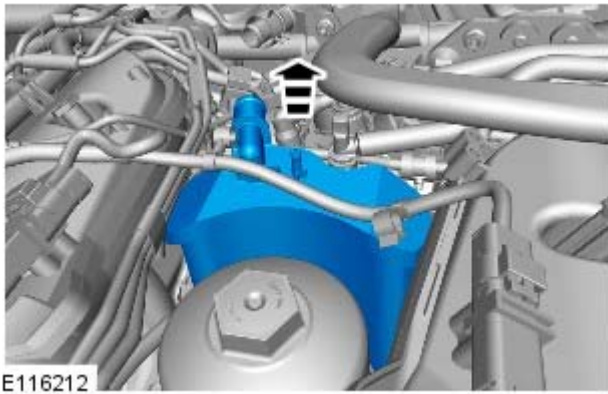
4.



5.



6.



7. **7. CAUTIONS:**



Make sure that all openings are sealed.



Lubricate the O-ring seals with clean engine oil.

Installation

1. To install, reverse the removal procedure.

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve LH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

All vehicles

1. Disconnect the battery ground cable.

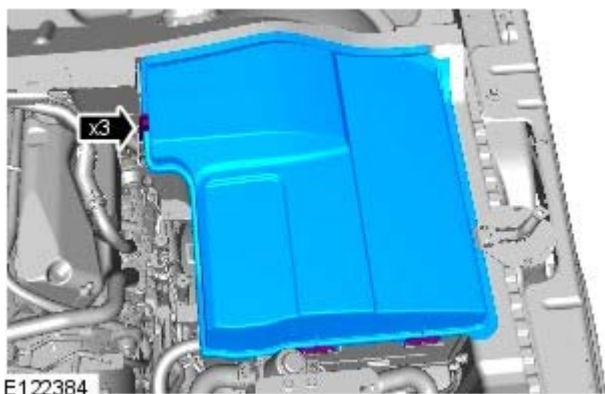
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

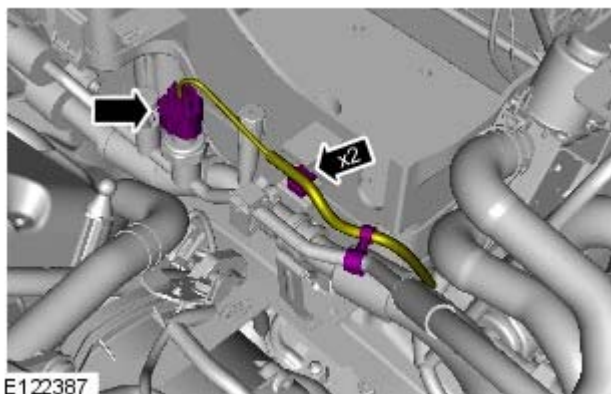
3. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

4. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

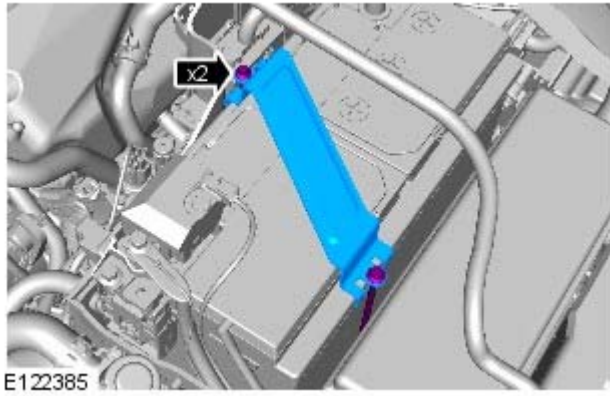
5.



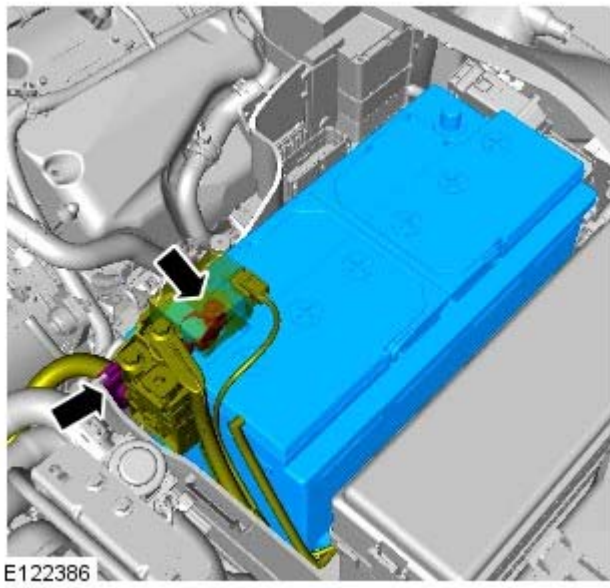
6.



Right-hand drive vehicles

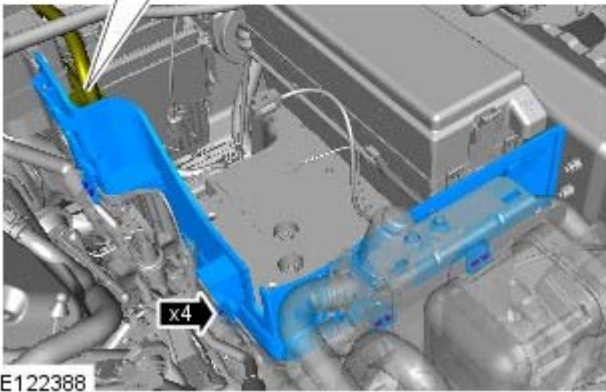
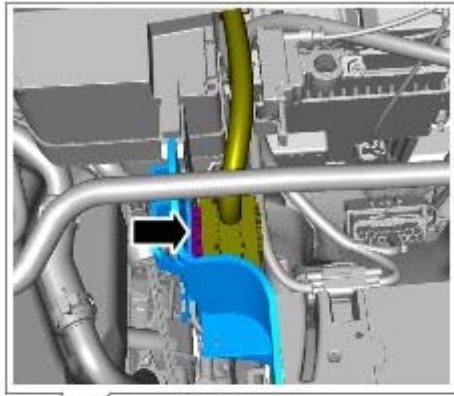


7. Torque: 10 Nm



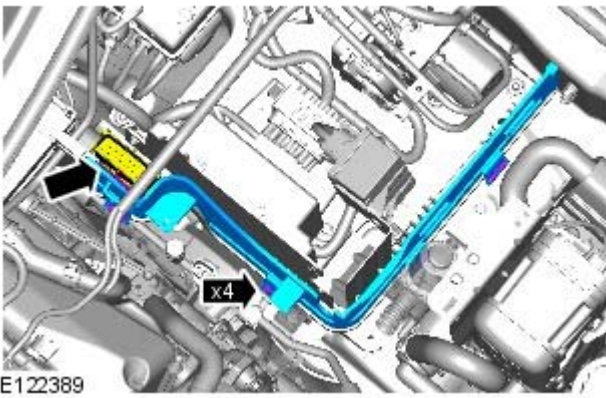
8. Torque: 10 Nm

9.

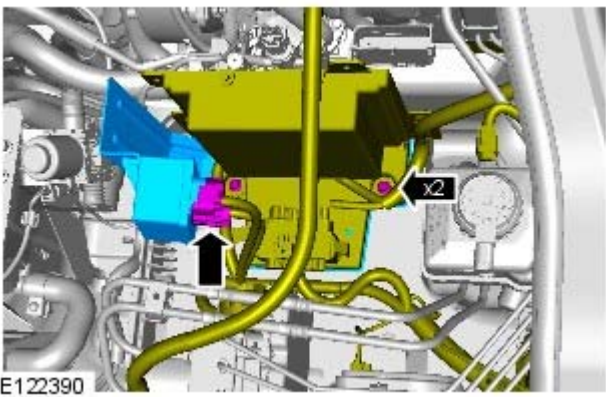


Left-hand drive vehicles

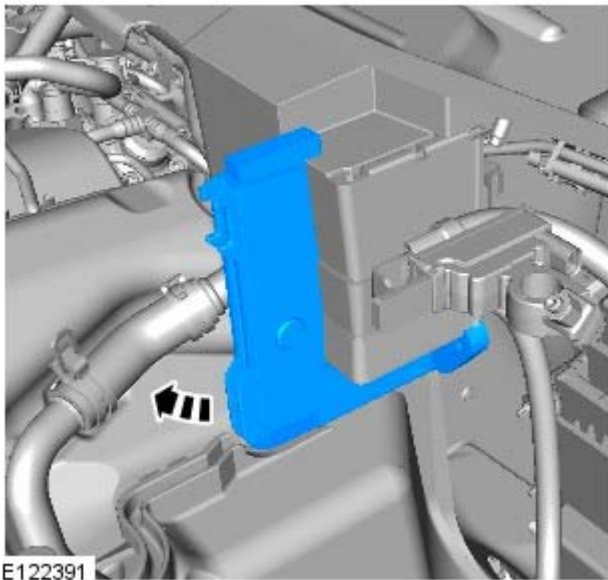
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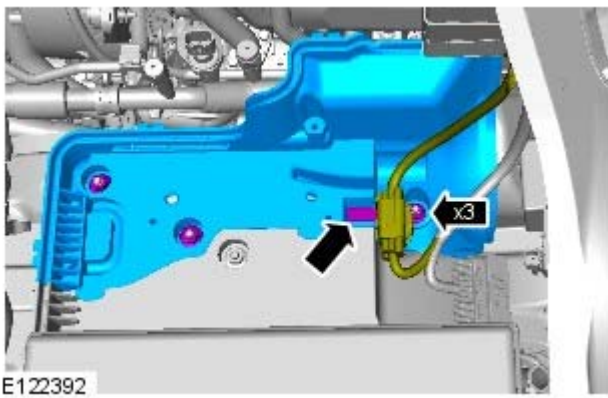
11.



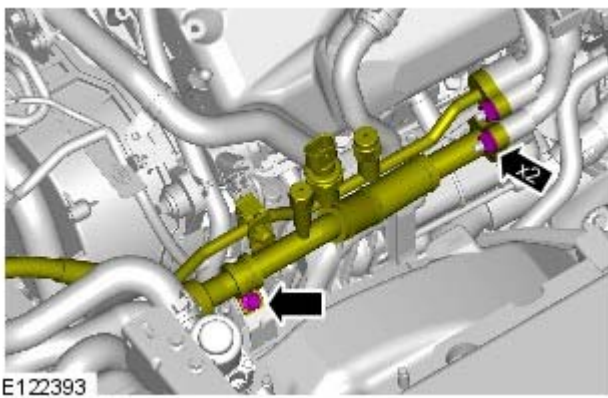
All vehicles



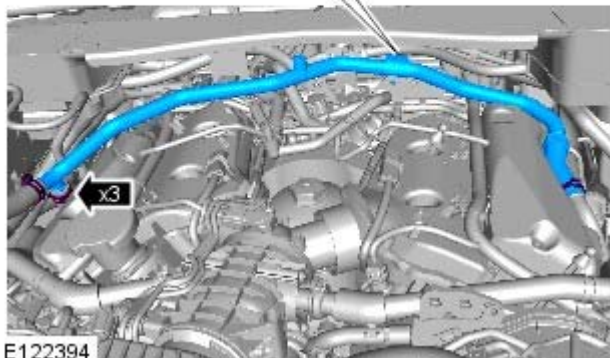
12.



13. *Torque:* 12 Nm



14. **⚠ CAUTION:** Make sure that all openings are sealed. Use new blanking caps.
• NOTE: Install new O-ring seals.
Torque: 10 Nm

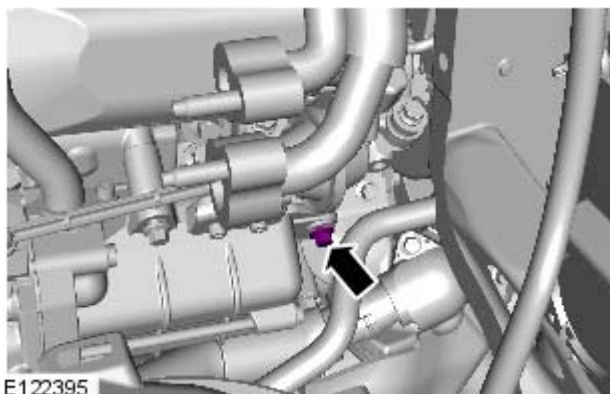


E122394

15. **15.**  CAUTION: Make sure that all openings are sealed.

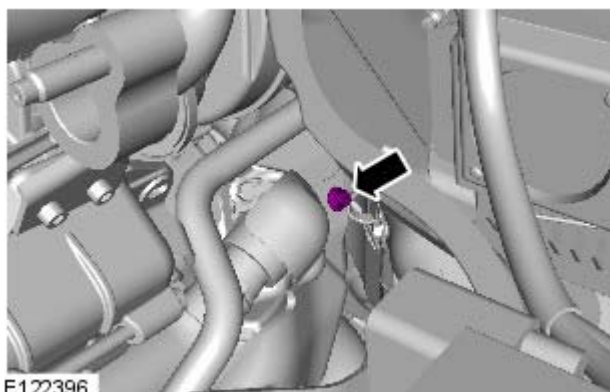
Torque: 10 Nm

16. Refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube LH](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).




E122395

17. *Torque:* 10 Nm



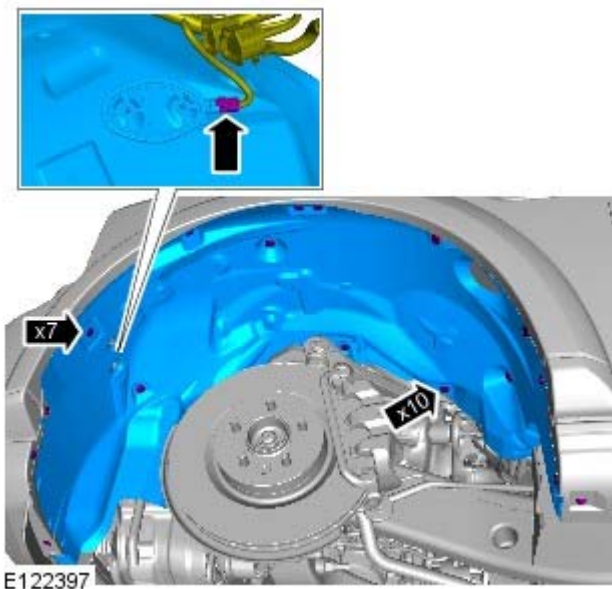
E122396

18. *Torque:* 9 Nm

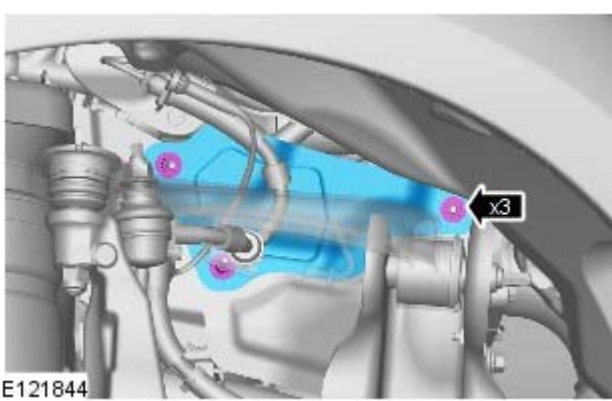
19. **19.**  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

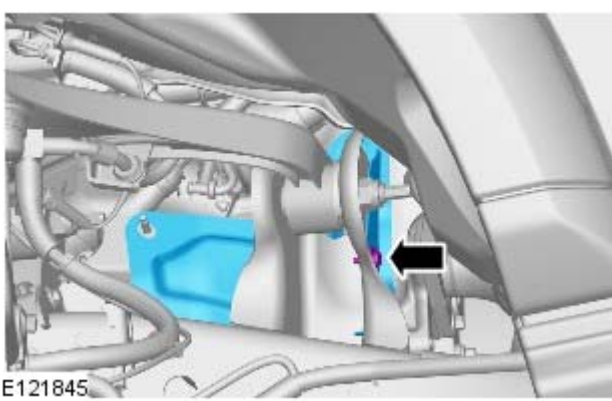
20. Remove the LH front wheel and tire.



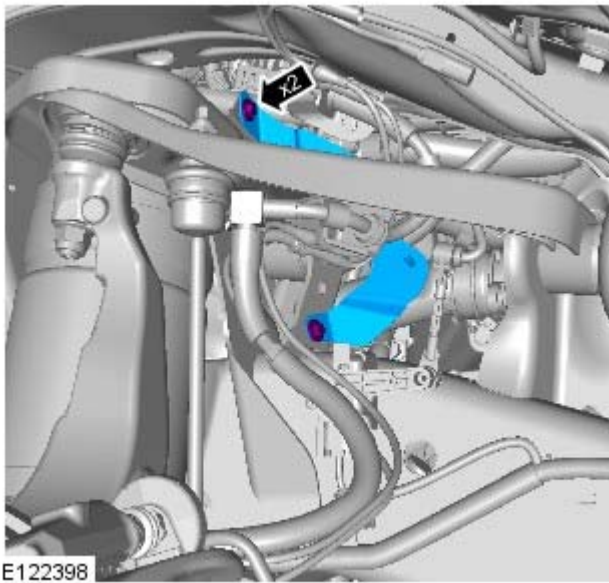
21.



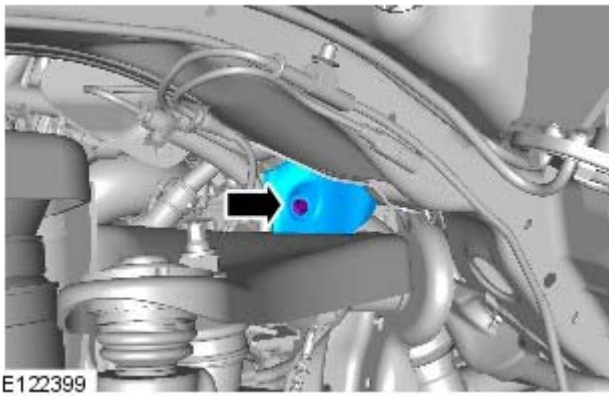
22. Torque: 9 Nm



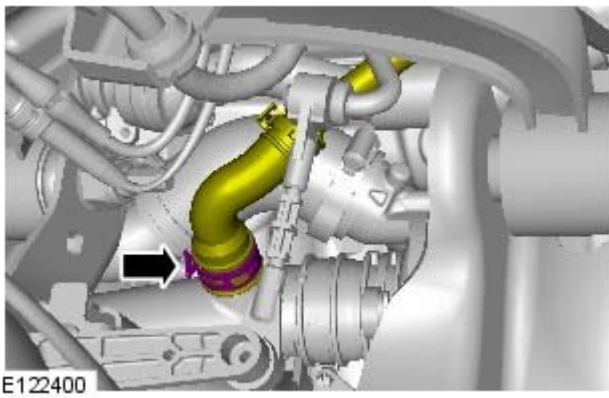
23. Torque: 9 Nm



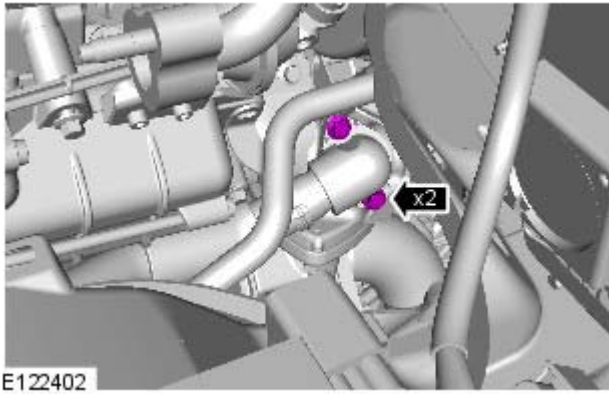
24. Torque: 9 Nm



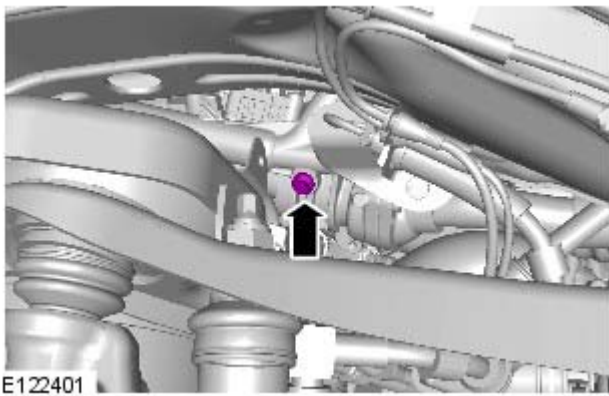
25. Torque: 9 Nm



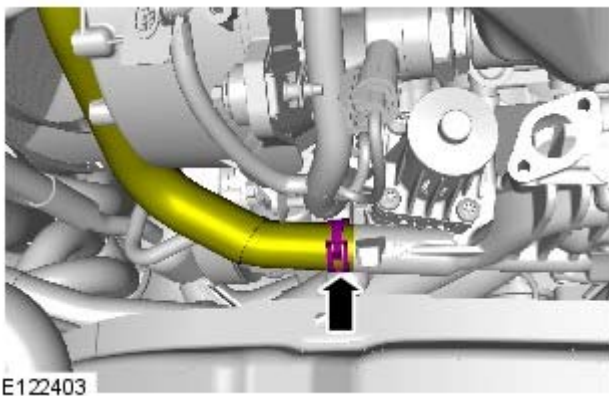
26. **26.**  CAUTION: Make sure that all openings are sealed.



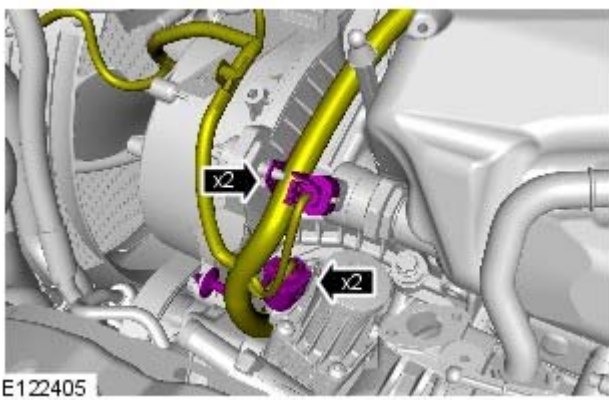
27. Torque: 10 Nm



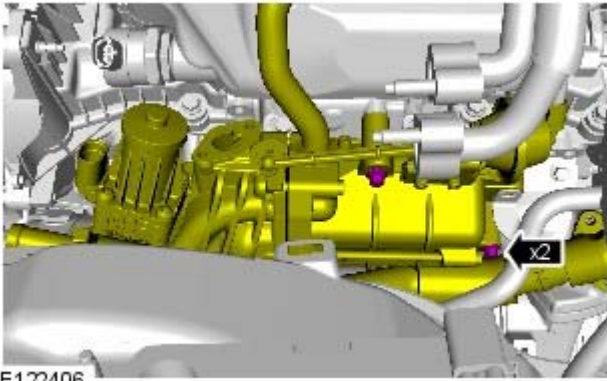
28. Torque: 10 Nm



29.  CAUTION: Make sure that all openings are sealed.

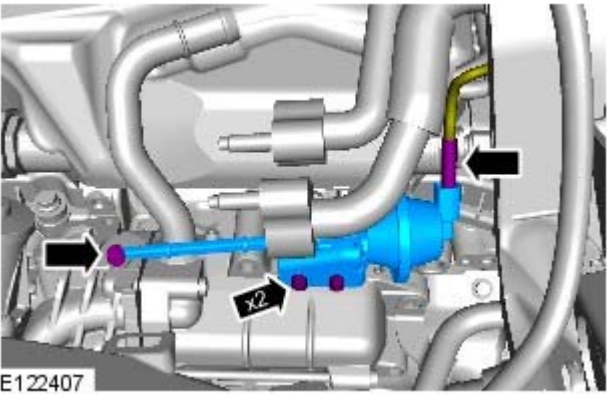


30.



31. **31.**  CAUTION: Make sure that all openings are sealed.

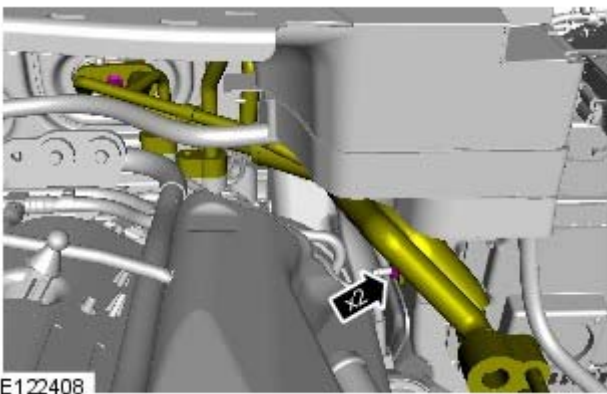
Torque: 10 Nm



32. **32.**  CAUTION: Take extra care not to damage the component.

• NOTE: An audible click is heard when the ball joint is fully latched.

Torque: 8 Nm

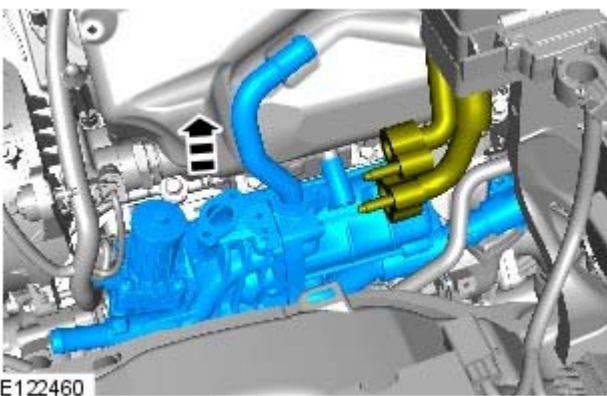


33. **33.** CAUTIONS:

 Install new o-ring seals

 Make sure that all openings are sealed. Use new blanking caps.

Torque: 6 Nm



- 34.

Installation

1. To install, reverse the removal procedure.

2. If a new unit is installed, configure using the approved diagnostic tool.

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve RH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

All vehicles

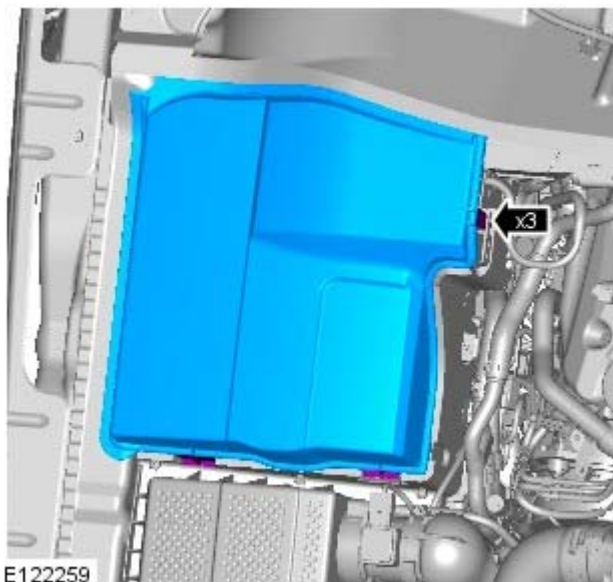
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

3. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

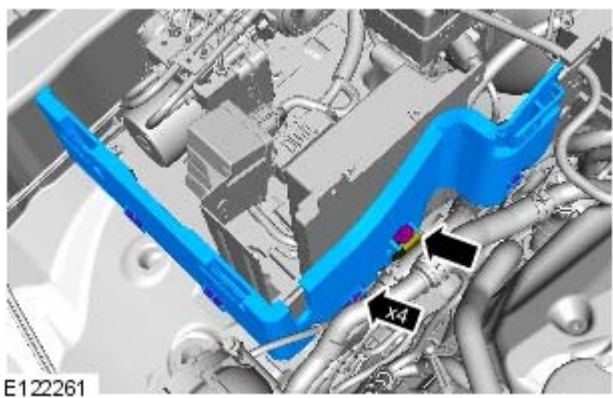
4.

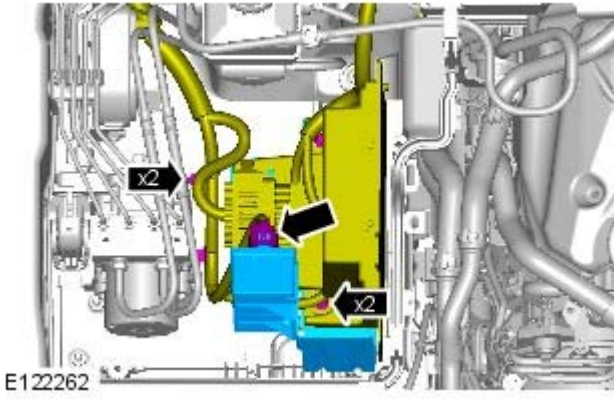


5. Refer to: [Air Cleaner](#) (303-12B Intake Air Distribution and Filtering - TDV6 3.0L Diesel, Removal and Installation).

Right-hand drive vehicles

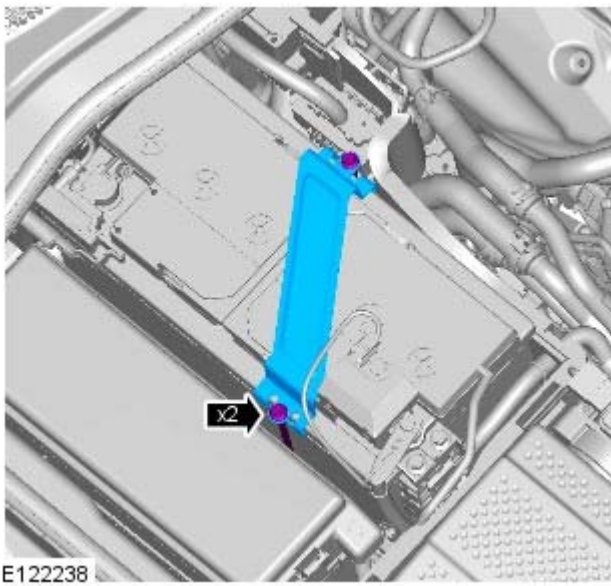
6.



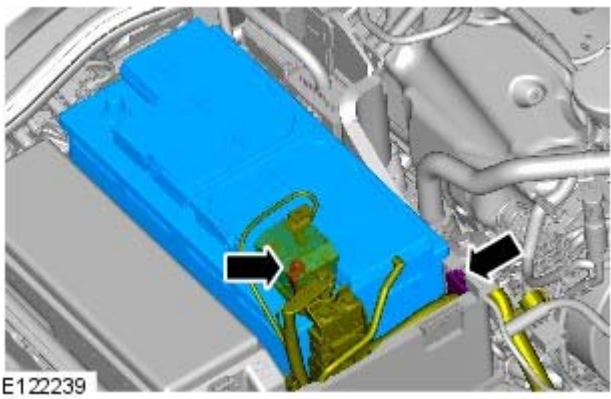


7. Torque: 10 Nm

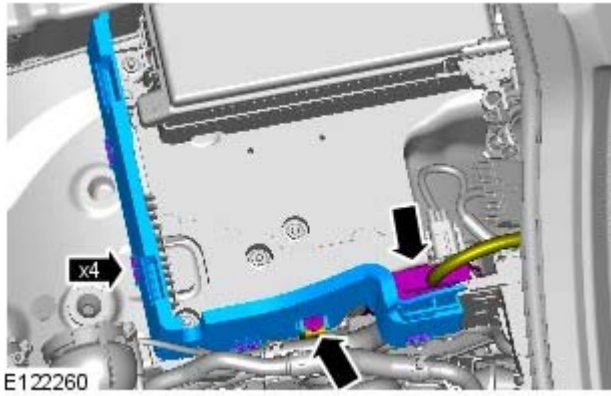
Left-hand drive vehicles



8. Torque: 10 Nm

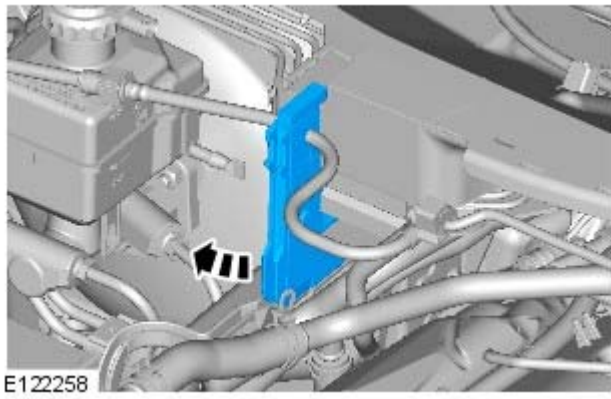


9. Torque: 10 Nm

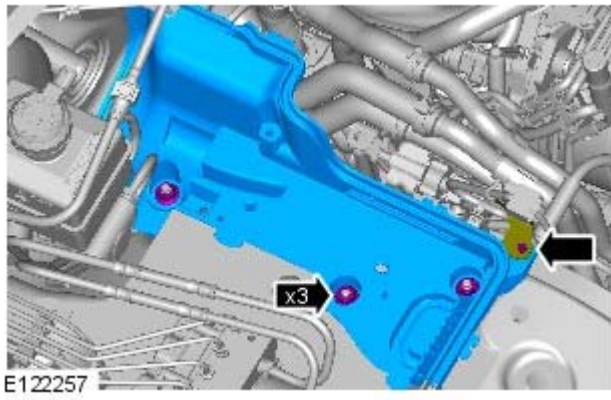


10.

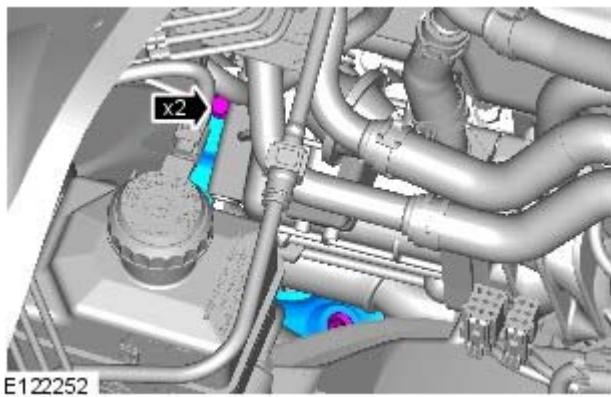
All vehicles



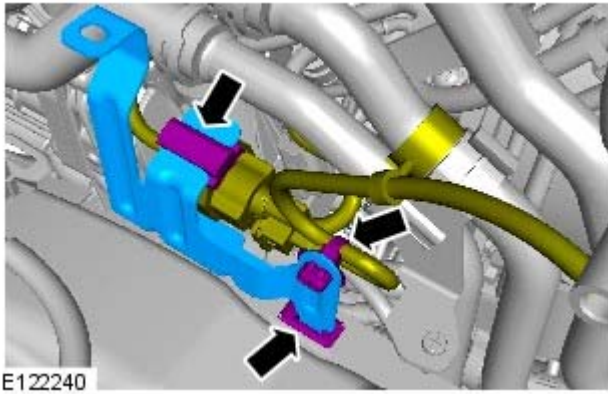
11.



12. Torque: 12 Nm

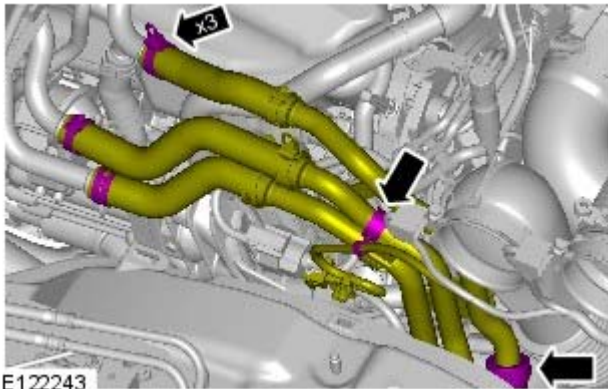


13. Torque: 9 Nm





E122240

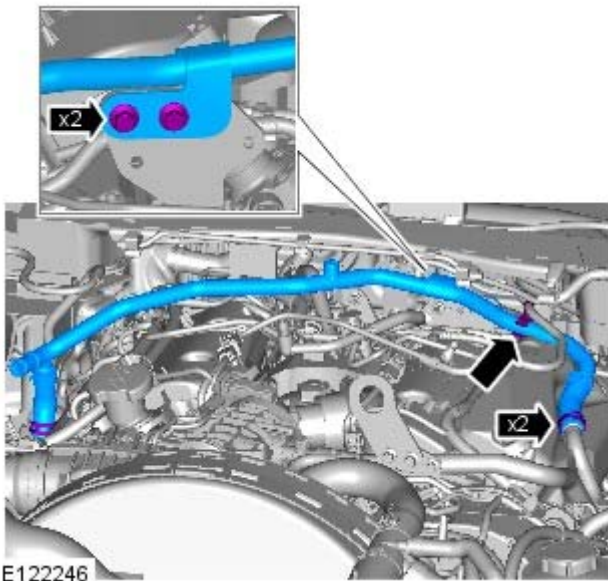
14.



E122243

15. **15. CAUTIONS:**

-  Be prepared to collect escaping fluids.
-  Make sure that all openings are sealed.



E122246

16.  **16. CAUTION:** Make sure that all openings are sealed.

Torque: 10 Nm

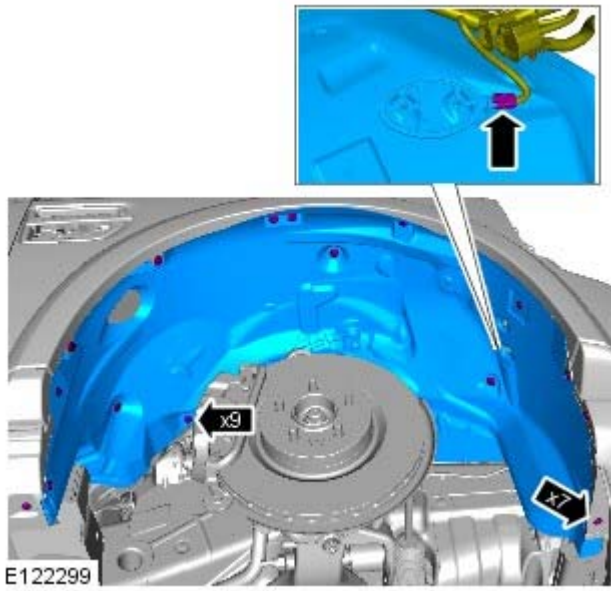
17. Refer to: [Exhaust Gas Recirculation \(EGR\) Valve Outlet Tube RH](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

18.  **18. WARNING:** Make sure to support the vehicle with axle stands.

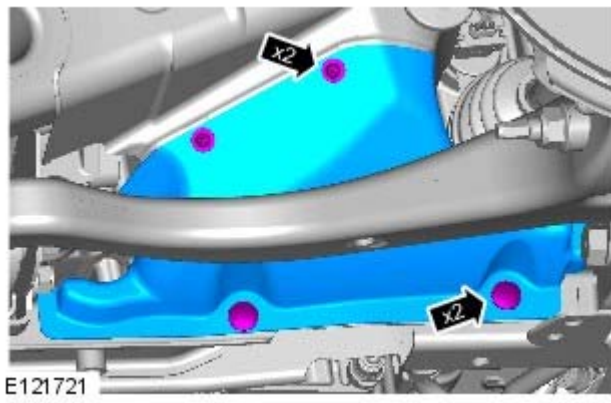
Raise and support the vehicle.

19. Remove the RH front wheel and tire.

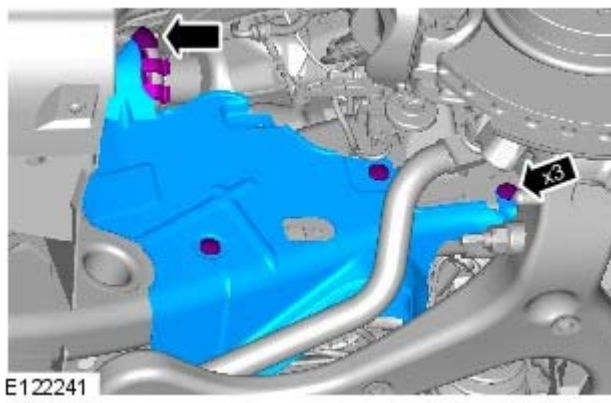
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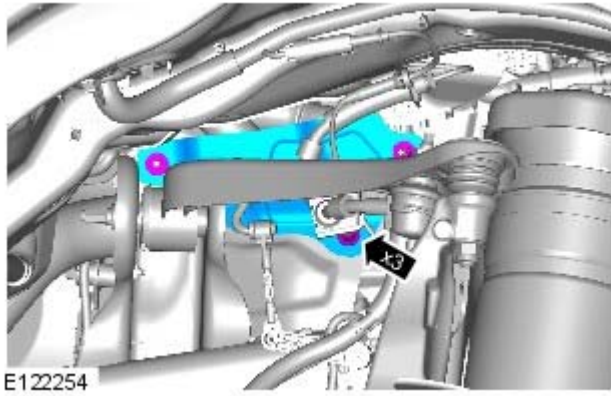


21.

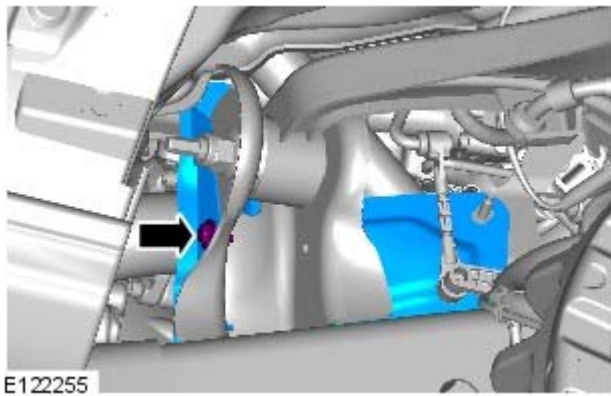


22.

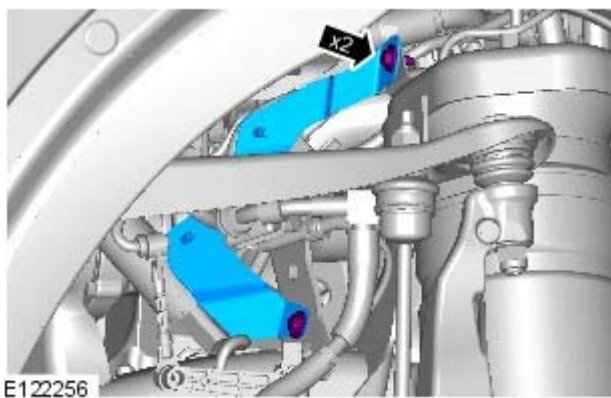




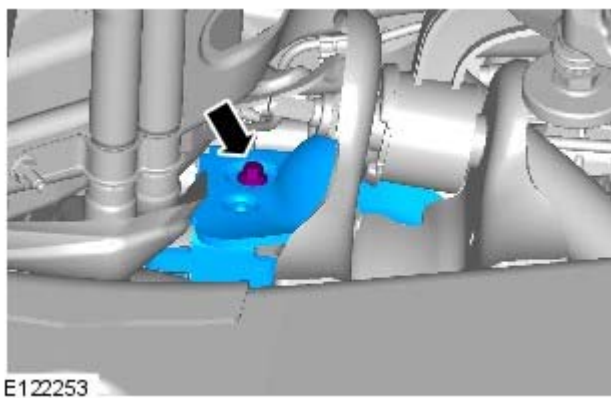
23. Torque: 9 Nm



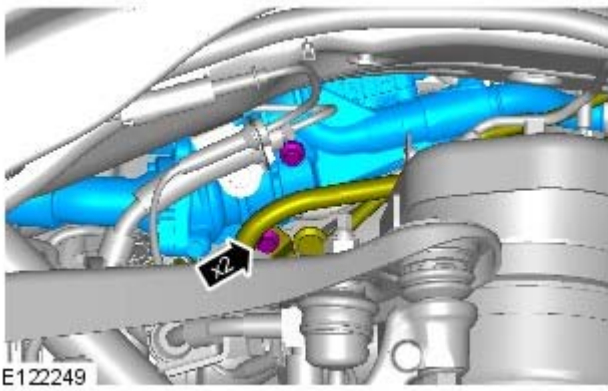
24. Torque: 9 Nm



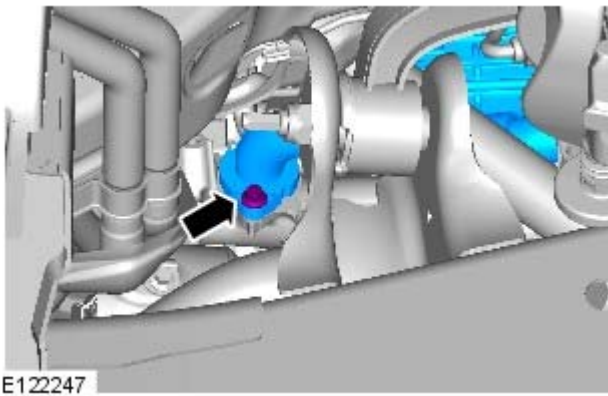
25. Torque: 9 Nm



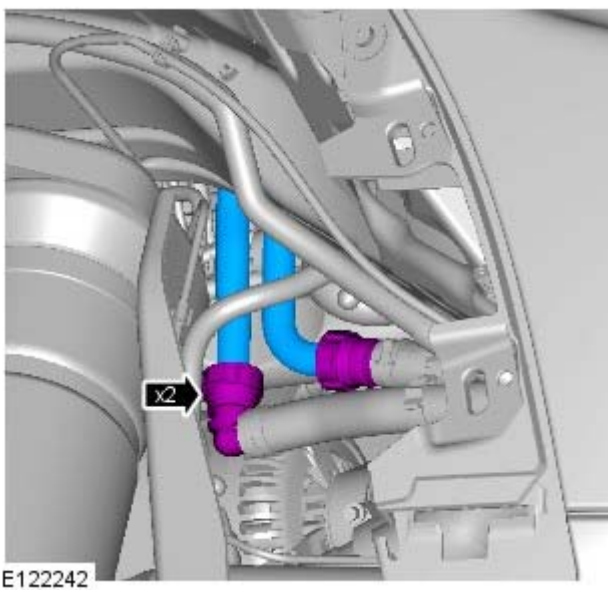
26. Torque: 9 Nm





27. Torque: 10 Nm

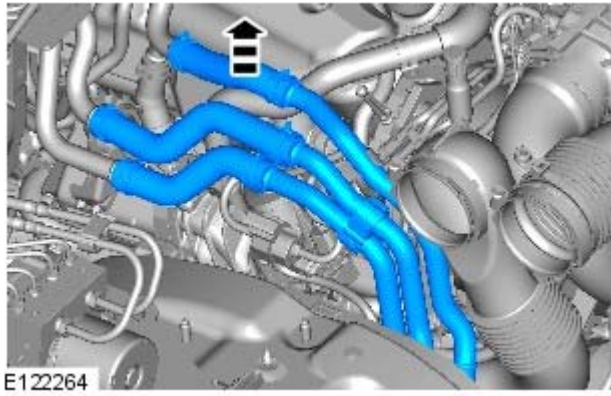


28. Torque: 10 Nm

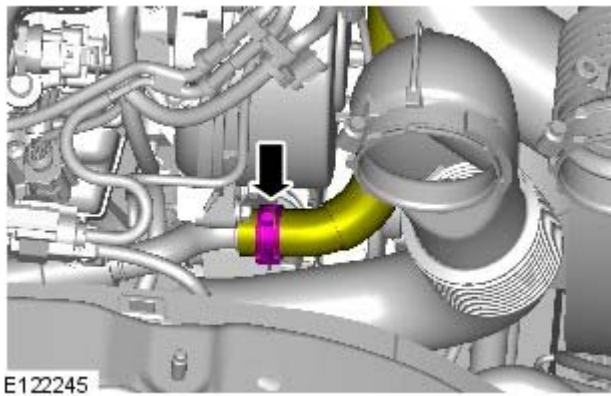


29. **29. CAUTIONS:**

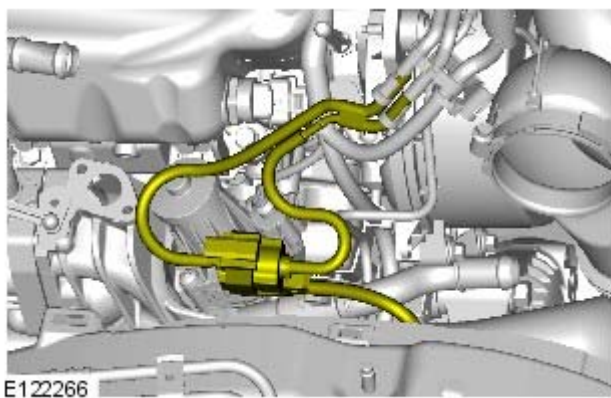
-  Be prepared to collect escaping fluids.
-  Make sure that all openings are sealed.



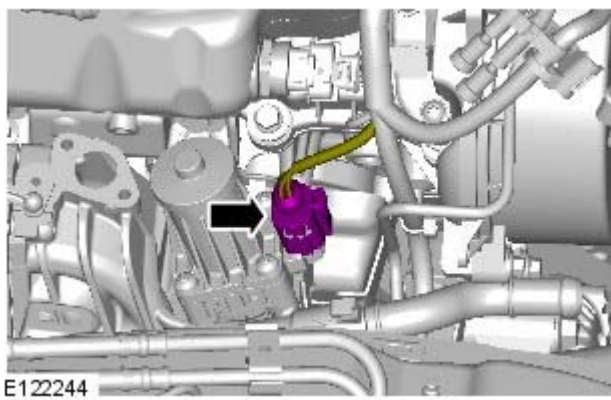
30.



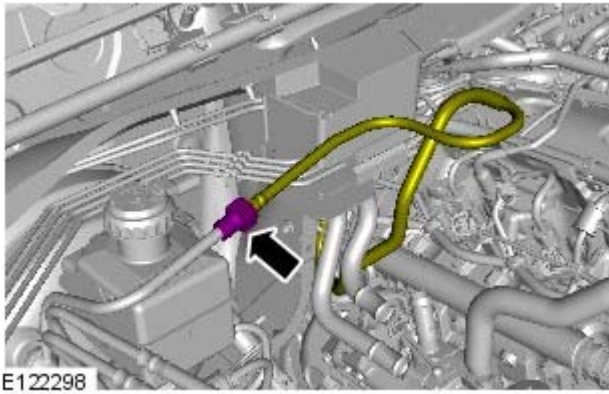
31. **31.**  CAUTION: Make sure that all openings are sealed.



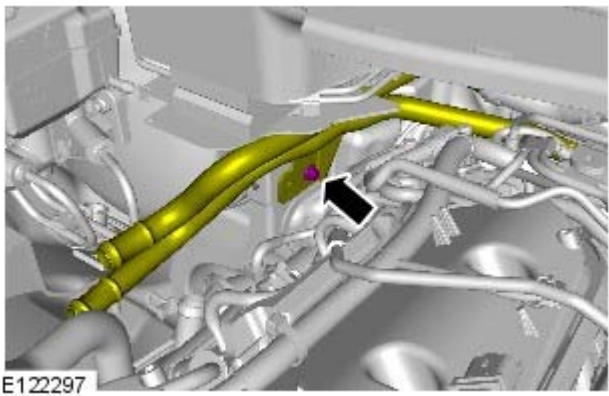
32.



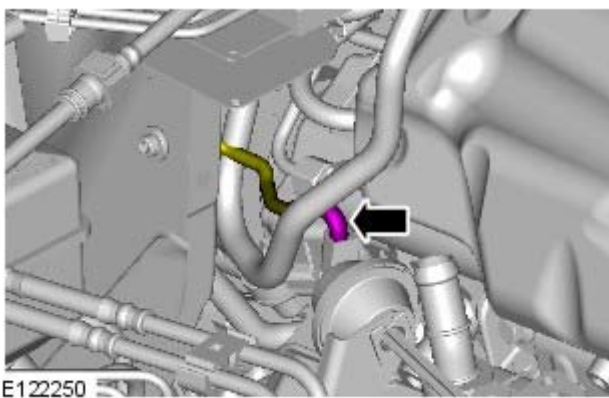
33.



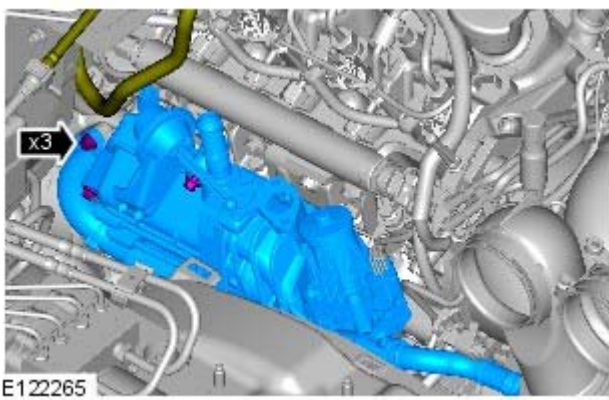
34. **34.**  CAUTION: Make sure that all openings are sealed.



35. *Torque:* 10 Nm



- 36.



37. **37.**  CAUTION: Make sure that all openings are sealed.

- NOTE: Install a new gasket.

Torque: 10 Nm

Installation

1. To install, reverse the removal procedure.

-
2. If a new unit is installed, configure using the approved diagnostic tool.

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube LH

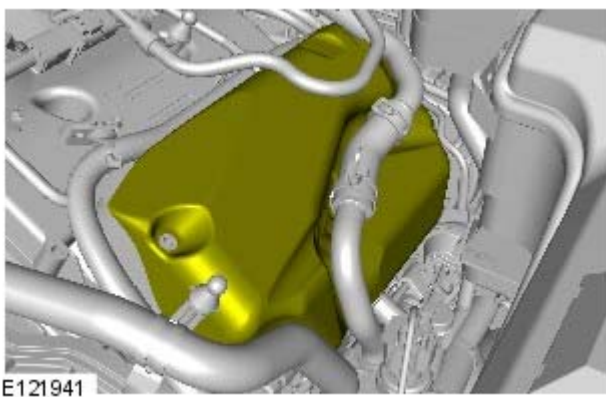
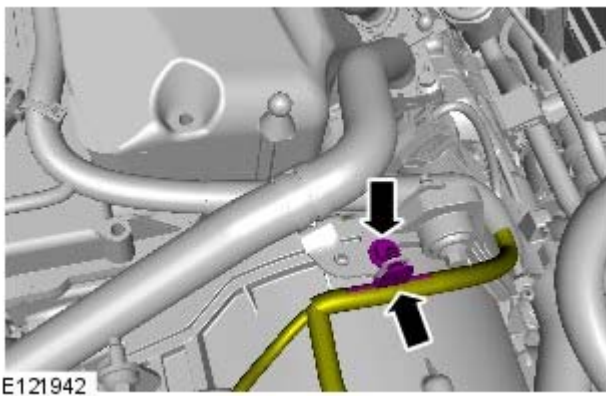
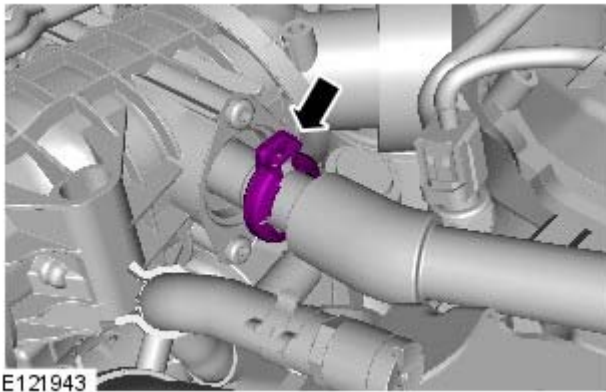
Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

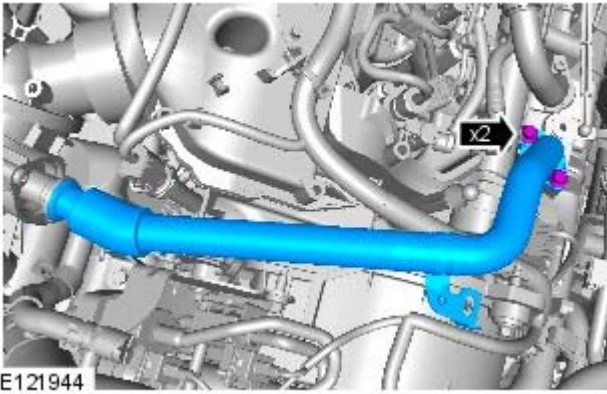
1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).


2. NOTE: Discard the retaining clips.



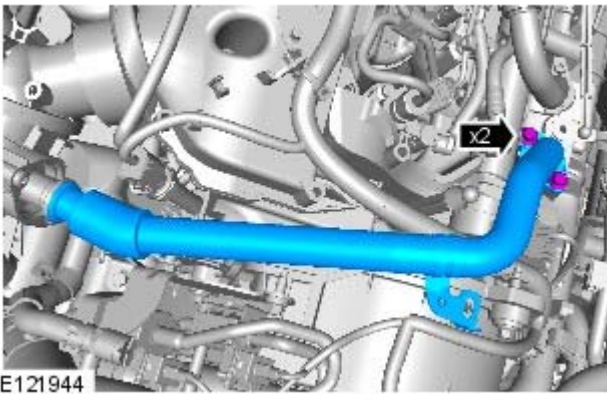
- 3.


- 4.

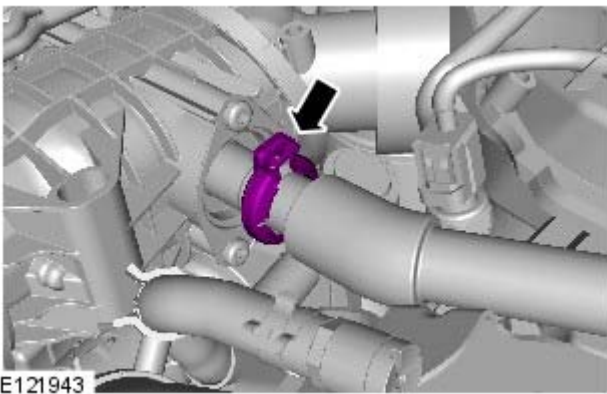


5.  CAUTION: Make sure that all openings are sealed.
 - NOTE: Discard the gasket.

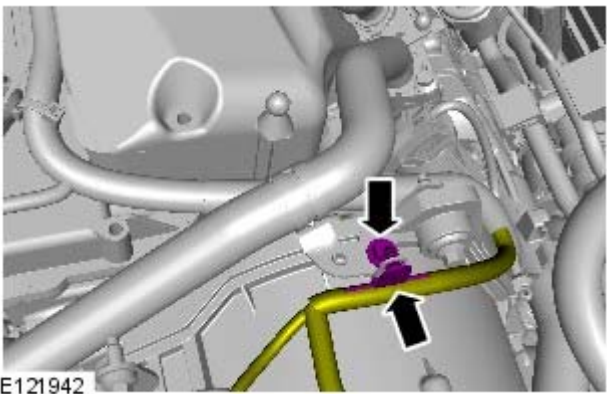
Installation



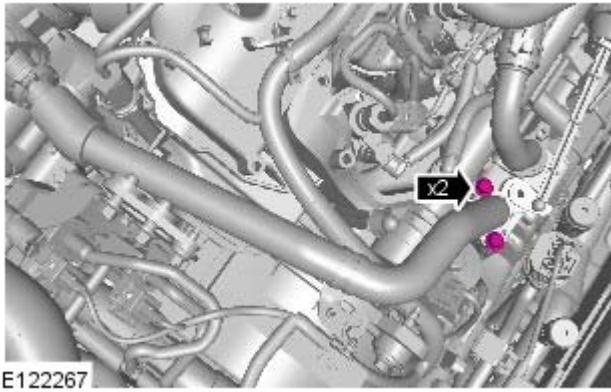
1.  CAUTION: Only tighten the bolts finger-tight at this stage.
 - NOTE: Install a new gasket.



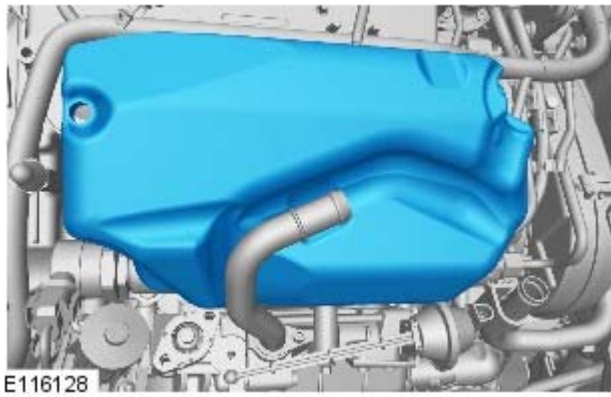
2.  CAUTION: Install a new clamp. Close the clamp to the first audible click by hand. Making sure that the clamp is in a central position to the joint, close to the second audible click using a suitable tool.



3. Torque: 5 Nm



4. Torque: 10 Nm



5.

6. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Engine Emission Control - TDV6 3.0L Diesel - Exhaust Gas Recirculation (EGR) Valve Outlet Tube RH

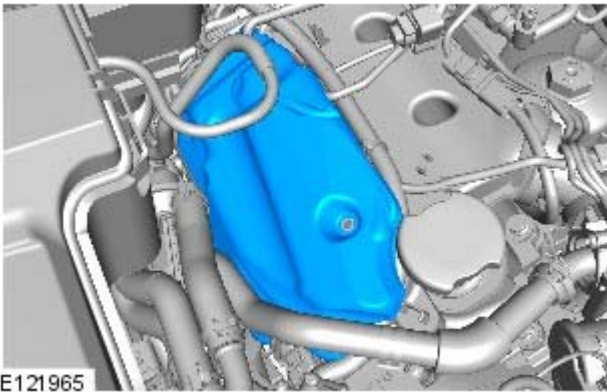
Removal and Installation

Removal

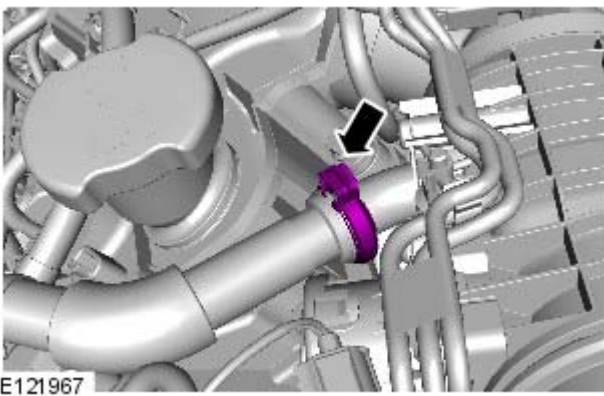
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

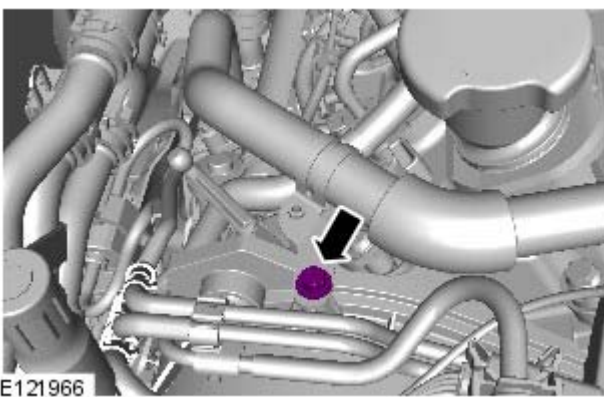
2.

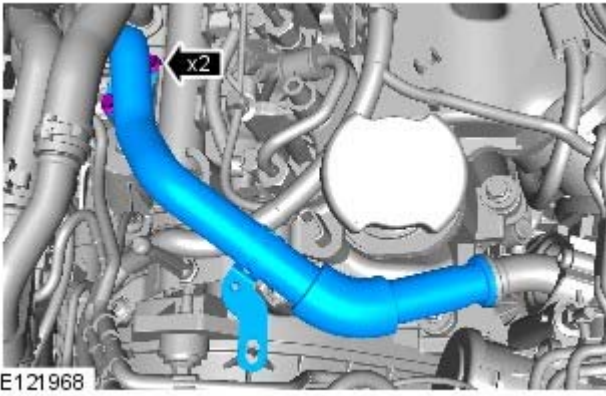



3. **3.** NOTE: Discard the retaining clips.



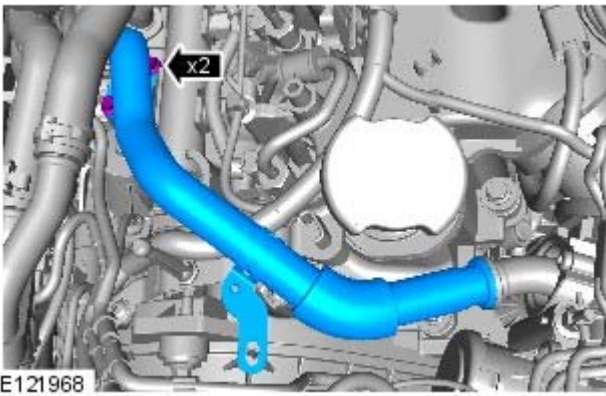
4.




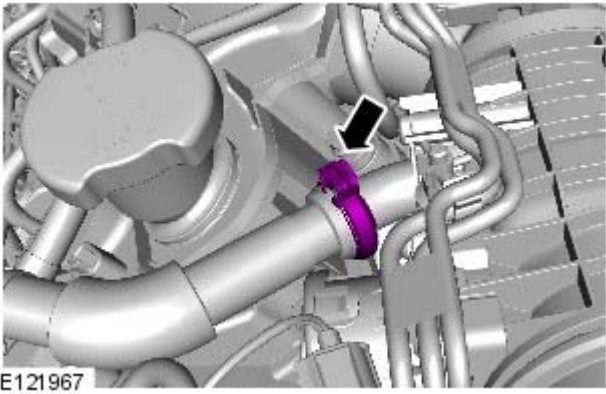


5.  CAUTION: Make sure that all openings are sealed.
 - NOTE: Discard the gasket.

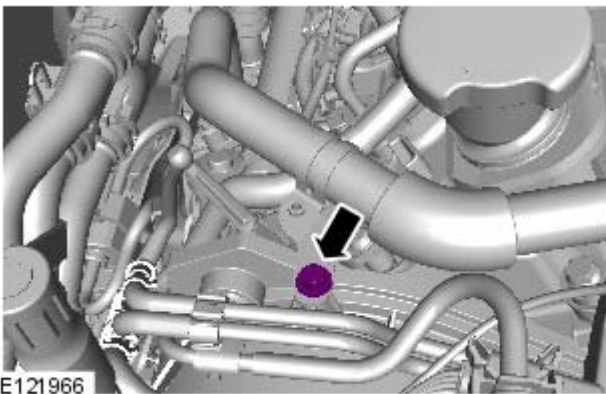
Installation



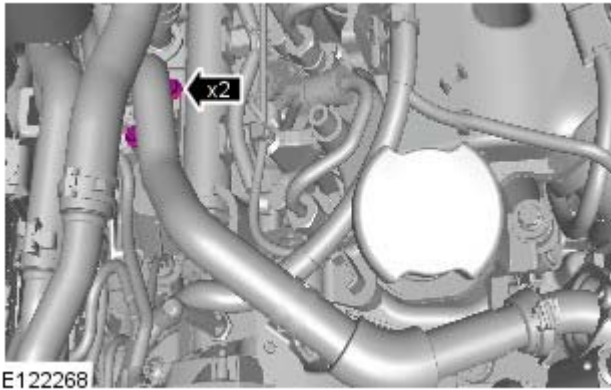
1.  CAUTION: Only tighten the bolts finger-tight at this stage.
 - NOTE: Install a new gasket.



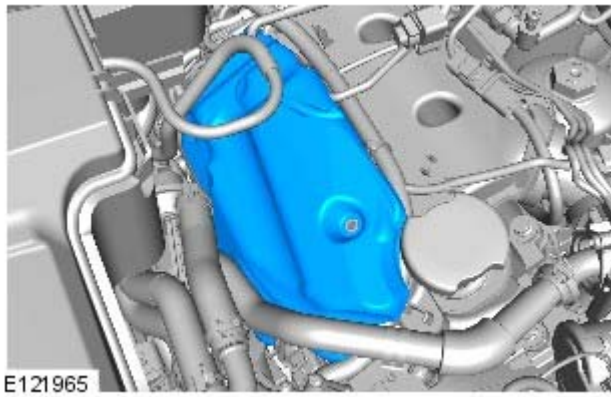
2.  CAUTION: Install a new clamp. Close the clamp to the first audible click by hand. Making sure that the clamp is in a central position to the joint, close to the second audible click using a suitable tool.



3. Torque: 5 Nm



4. Torque: 10 Nm



5.

6. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

Engine Emission Control - V6 4.0L Petrol -

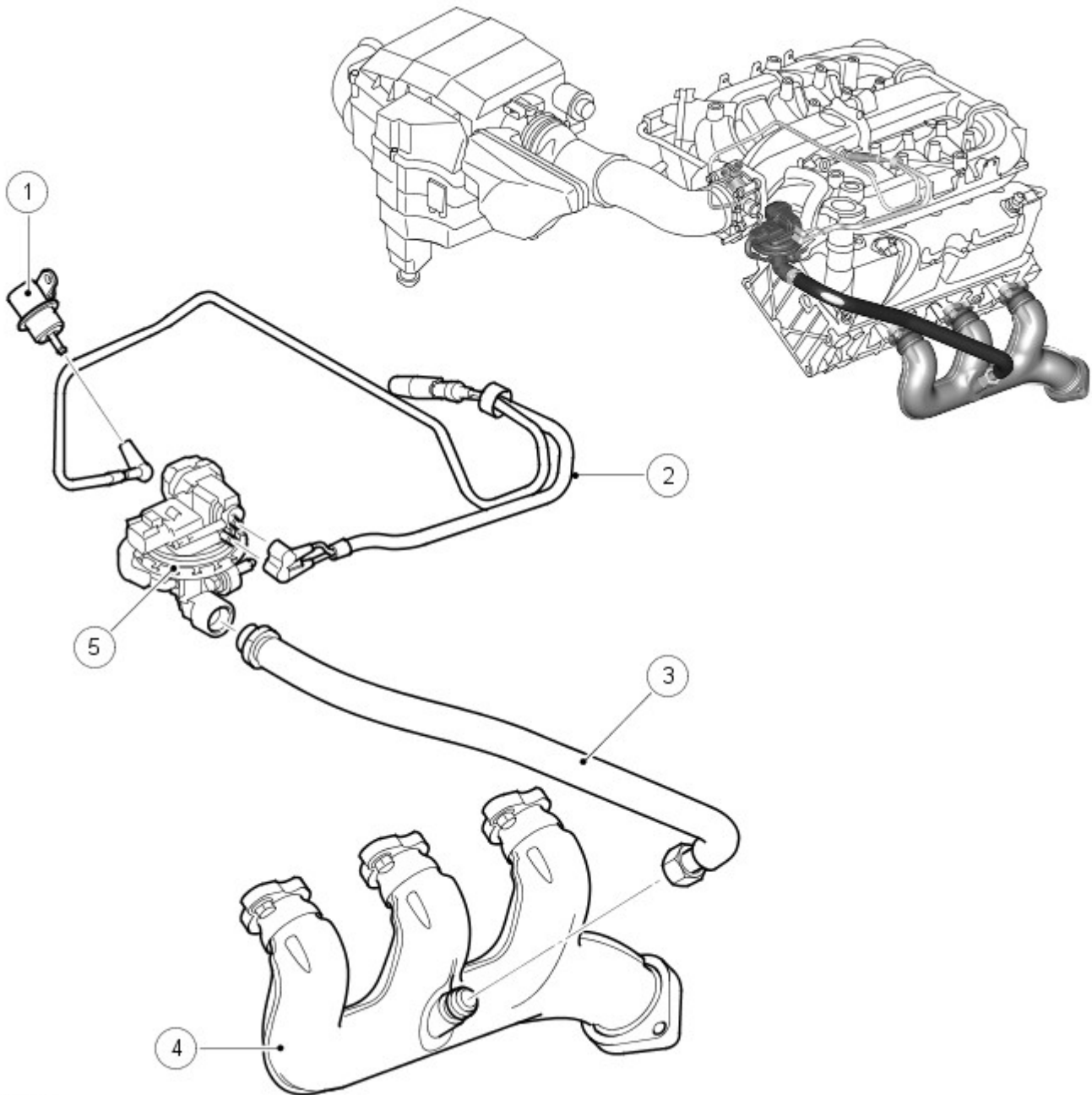
Torque Specifications

Description	Nm	lb-ft
Exhaust gas recirculation (EGR) modulator valve bolts	25	18
Exhaust gas recirculation (EGR) feed pipe to EGR valve union nut	25	18

Engine Emission Control - V6 4.0L Petrol - Engine Emission Control

Description and Operation

Exhaust Gas Recirculation Component Location



E48510

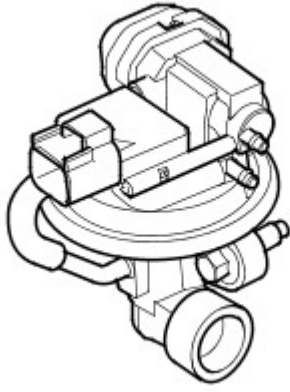
Item	Part Number	Description
1	-	Fuel rail damper
2	-	Vacuum control hoses
3	-	Exhaust manifold to Exhaust Gas Recirculation (EGR) hose
4	-	Exhaust manifold
5	-	ESM valve

Engine emissions on the V6 petrol engine are controlled by the Engine Control Module (ECM). The engine emission control system comprises:

- EGR system
- Crankcase emission system

EGR SYSTEM

ESM Valve



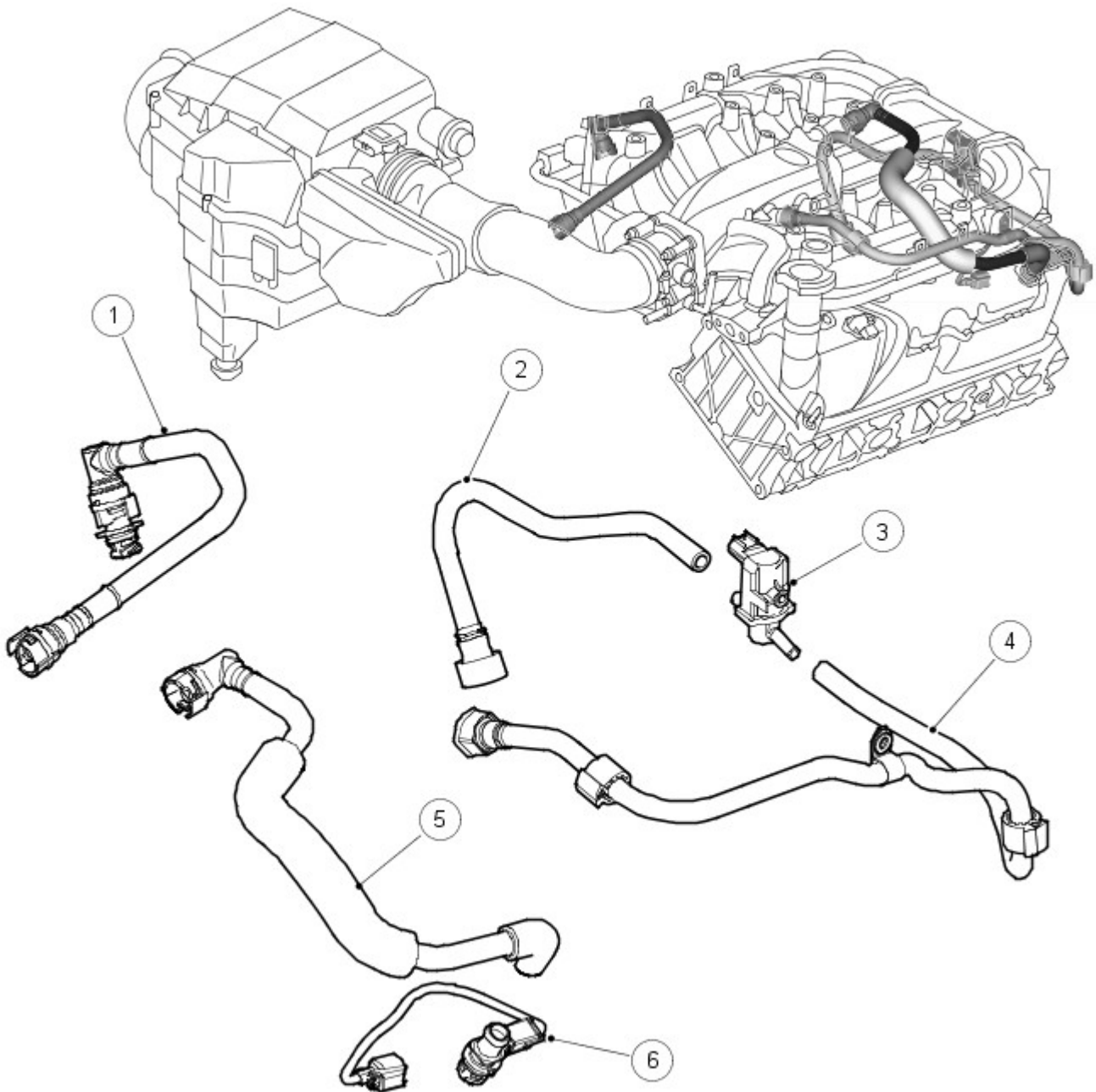
E48511

The EGR System Module (ESM) valve is located on the intake manifold with a pipe connecting the exhaust manifold to the valve. Connection between the sensor and the harness is via a six-way connector. The ESM valve is electrically controlled by a Pulse Width Modulated (PWM) signal. The ESM valve allows burned exhaust gas to be recirculated back into the engine. Since exhaust gas has much less oxygen than air, it is basically inert. The exhaust gas takes the place of air in the cylinder and reduces combustion temperature. As the combustion temperature is reduced, so are the oxides of nitrogen (NOx) emissions.

The ESM valve has an integrated Differential Pressure Feedback-Electronic/Manifold Absolute Pressure (DPFE/MAP) sensor. This pressure transducer monitors the pressure differential on either side of an orifice in the ESM system flow path and then transmits that information to the ECM. The pressure drop measured across this orifice is used to estimate the flow rate of recirculated exhaust gas. An Electronic Vacuum Regulator (EVR) is used to control the vacuum signal to the ESM valve based on the electrical signal from the ECM. The ECM monitors the ESM level based on the feedback from the DPFE/MAP sensor, which creates a closed loop system.

CRANKCASE VENTILATION SYSTEM

Crankcase Ventilation System Component Location



E48512

Item	Part Number	Description
1	-	Crankcase Ventilation (CCV) Hose and cam lock connector
2	-	Engine to evaporative emissions control tube
3	-	Evaporative emissions control valve
4	-	Crankcase Ventilation (CCV) hose
5	-	Positive Crankcase Ventilation(PCV) hose and PCV valve
6	-	PCV jump lead with integral thermistor

Positive Crankcase Ventilation (PCV) Valve



E48513

The crankcase ventilation system comprises:

- Positive Crankcase Ventilation (PCV) valve
- Positive Crankcase Ventilation (PCV) hose
- Crankcase Ventilation (CCV) hose

The PCV is an electrically heated control valve that allows the gas from left hand cylinder head to flow into the air intake. The PCV valve is electrically heated to allow it to remain operational in cold climates. The PCV heater power is fed from the fuel pump relay, therefore heating is always active while the engine is running. The current supplied is internally regulated by the PCV.

Engine Emission Control - V6 4.0L Petrol - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Emission Control](#) (303-08C Engine Emission Control - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Exhaust gas recirculation system ● Breather hoses ● Positive crankcase ventilation valve ● Fuel level ● Fuel contamination/grade/quality ● Throttle body 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors ● Exhaust Gas Recirculation (EGR) valve ● Engine Control Module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start cold	<ul style="list-style-type: none"> ● Battery ● Crankshaft Position (CKP) sensor ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel system ● Evaporative emissions purge valve 	For battery information, CKP sensor, fuel system and purge valve tests, refer to relevant workshop manual section. Check the EGR valve.
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Engine Control Module (ECM) relay ● MAF sensor ● Ignition system ● Air filter restricted ● Air leakage ● Fuel lines 	Check the engine breather hoses, PCV, etc. Check the Engine Control Module (ECM) relay operation. For MAF sensor, ignition system tests, air intake and fuel line information, refer to relevant workshop manual section.
Poor throttle response	<ul style="list-style-type: none"> ● APP sensor malfunction ● TP sensors ● ECT sensor ● MAF sensor ● Transmission malfunction ● Traction control event ● Air leakage ● Breather system disconnected/restricted 	For APP, TP, ECT, MAF sensor tests, intake system checks and transmission information, refer to relevant workshop manual section. Check the breather system hoses, PCV, etc.

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Engine Emission Control - V6 4.0L Petrol - Exhaust Gas Recirculation (EGR) Modulator Valve

Removal and Installation

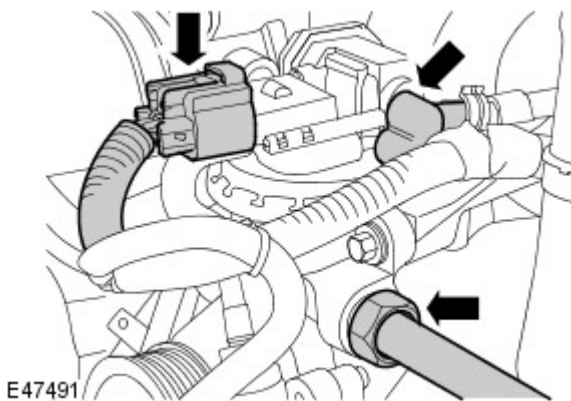
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the EGR valve electrical connector.
4. Disconnect the EGR valve vacuum hose.

5.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the EGR valve feed pipe.

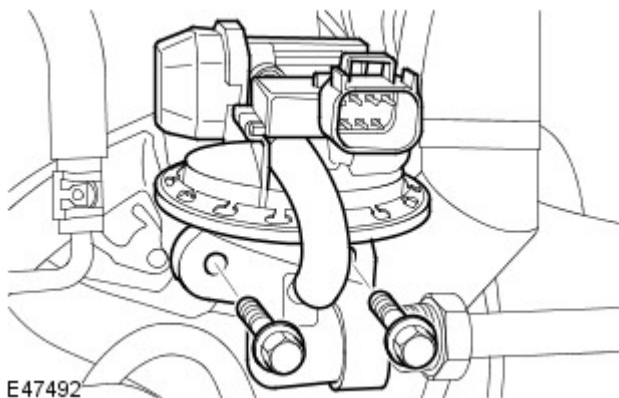
- Loosen the EGR union nut and release the pipe.



E47491

6. Remove the EGR valve.

- Remove the 2 bolts.
- Collect and discard the gasket.



E47492

Installation

1. Install the EGR valve.
 - Clean the component mating faces.
 - Install a new gasket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
2. Connect the feed pipe to the EGR valve.
 - Tighten the union to 25 Nm (18 lb.ft).
3. Connect the vacuum hose to the EGR valve.
4. Connect the EGR valve electrical connector.
5. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
6. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00

Battery and Charging System - General Information, Specifications).

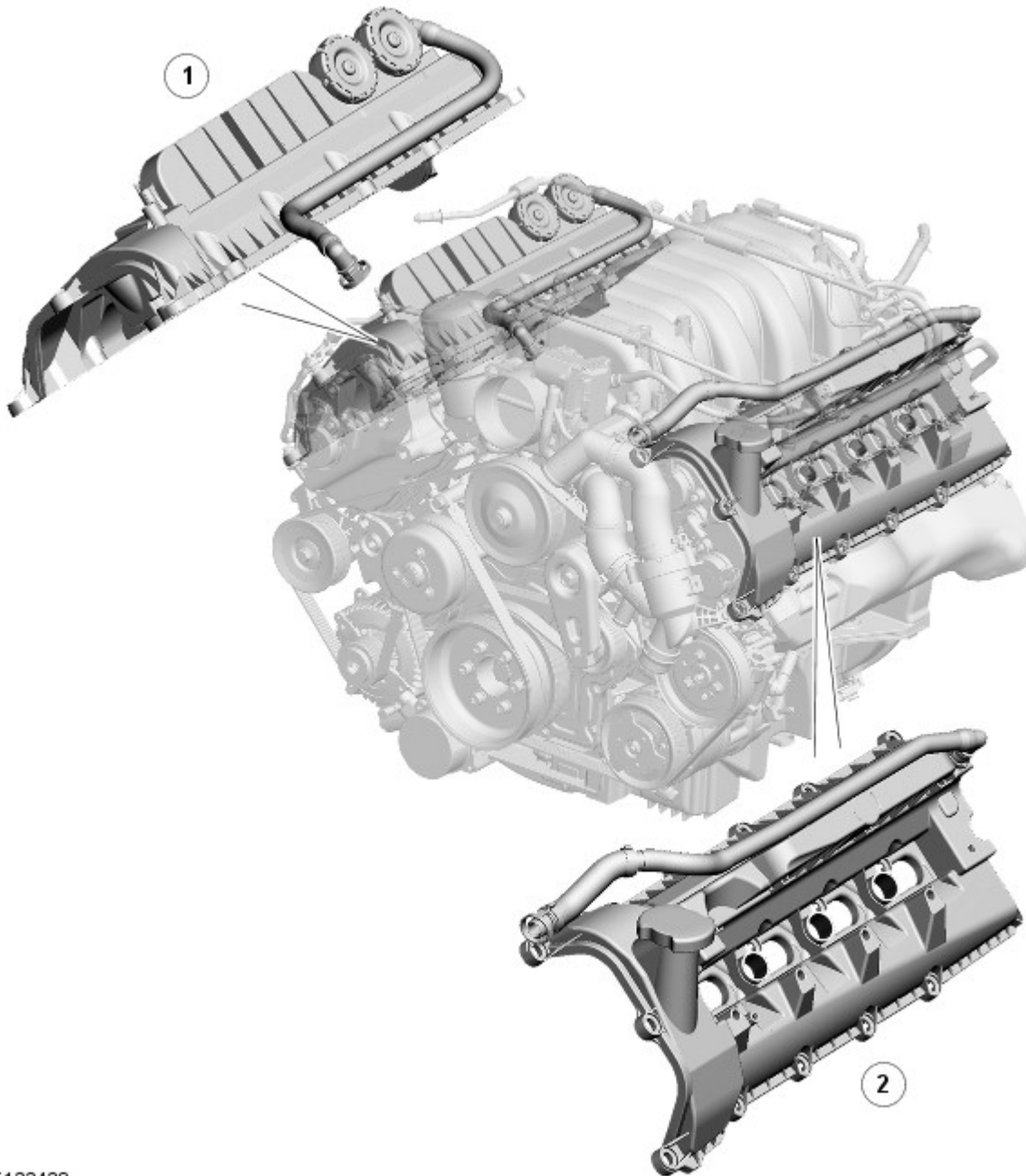
7. NOTE: For NAS vehicles only.

If required, carry out a long drive cycle.
For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Engine Emission Control - V8 5.0L Petrol - Engine Emission Control

Description and Operation

COMPONENT LOCATION



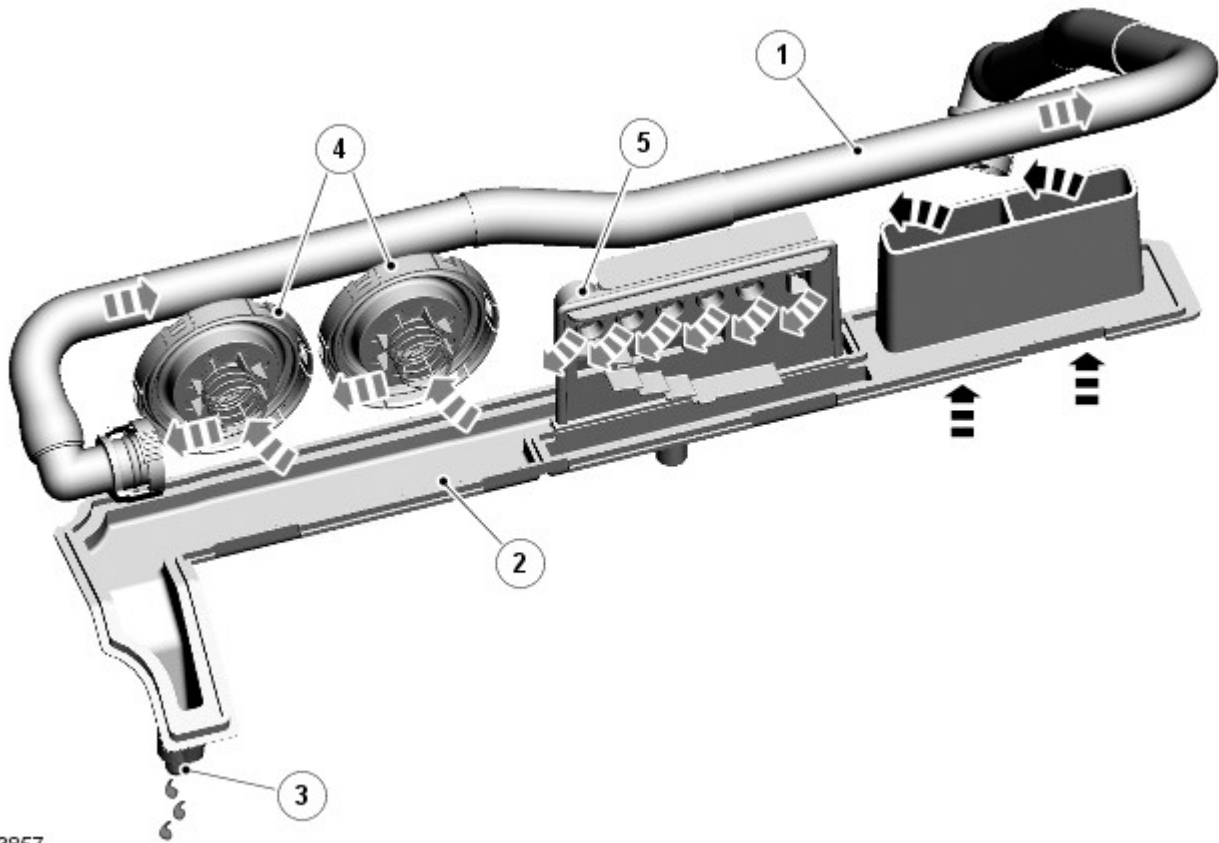
E122438

Item	Part Number	Description
1	-	Part load breather
2	-	Full load breather

INTRODUCTION

The engine emission control system reduces the level of hydrocarbon emissions released to atmosphere from the engine. The engine emission control system consists of a **PCV (positive crankcase ventilation)** system with part and full load breathers. Piston blow-by gases are drawn through the breathers into the engine air intake and added to the air charge. The resultant depression in the engine sump, front covers and cylinder head covers reduces the load on the joint seals in those areas.

PART LOAD BREATHER



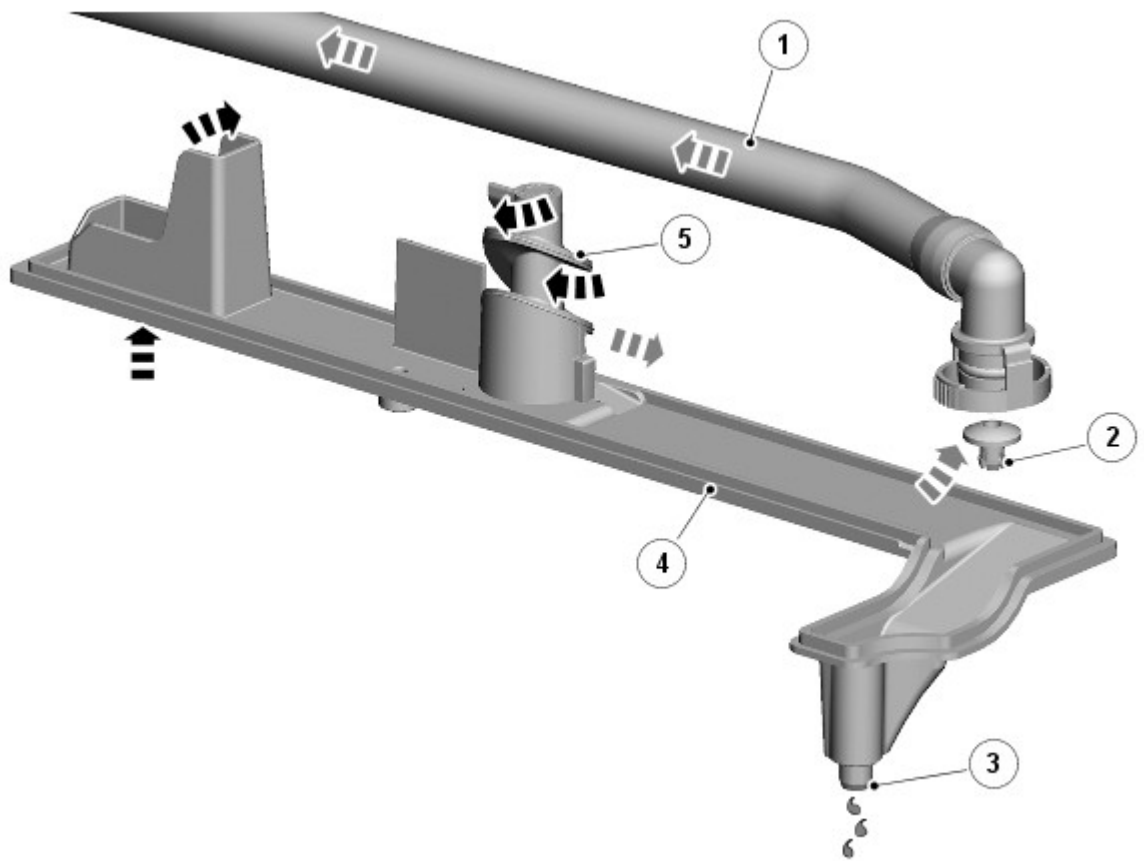
E113857

Item	Part Number	Description
1	-	Flexible hose
2	-	Baffle plate
3	-	Oil drain
4	-	PCV (positive crankcase ventilation) valve
5	-	Oil separator

The part load breather consists of an oil separator, two [PCV](#) valves and a flexible hose. The oil separator and the [PCV](#) valves are installed in the top of the [RH \(right-hand\)](#) cylinder head cover. The flexible hose connects the [RH](#) cylinder head cover to the inlet of the intake manifold.

The oil separator is installed in a channel in the top of the cylinder head cover. A baffle plate, which incorporates a gas inlet and an oil drain, is installed over the channel. The two [PCV](#) valves are installed on the outside of the cylinder head cover and connected in parallel in the gas outlet from the channel to the flexible hose. The [PCV](#) valves prevent reverse flow into the cylinder head cover when there is minimal depression in the intake manifold.

FULL LOAD BREATHER



E113867

Item	Part Number	Description
1	-	Flexible hose
2	-	Two-way valve
3	-	Oil drain
4	-	Baffle plate
5	-	Oil separator

The full load breather consists of an oil separator, a two-way valve and a flexible hose. The oil separator and the two-way valve are installed in the top of the **LH (left-hand)** cylinder head cover. The flexible hose connects the **LH** cylinder head cover to the **LH** air duct of the intake air distribution and filtering system.

The oil separator is installed in a channel in the top of the cylinder head cover. A baffle plate, which incorporates a gas inlet and an oil drain, is installed over the channel. The two-way valve is installed in the gas outlet from the channel. The two-way valve prevents reverse flow into the cylinder head cover when there is minimal depression in the air duct.

Engine Emission Control - V8 5.0L Petrol - Engine Emission Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the engine emission control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Engine Emission Control](#) (303-08D Engine Emission Control - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Exhaust gas recirculation system ● Breather hoses ● Positive crankcase ventilation valve ● Fuel level ● Fuel contamination/grade/quality ● Throttle body 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors ● Exhaust Gas Recirculation (EGR) valve ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Difficult to start cold	<ul style="list-style-type: none"> ● Battery ● Crankshaft Position (CKP) sensor ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel system ● Evaporative emissions purge valve 	For battery information, CKP sensor, fuel system and purge valve tests, refer to relevant workshop manual section. Check the EGR valve.
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Engine Control Module (ECM) relay ● MAF sensor ● Ignition system ● Air filter restricted ● Air leakage ● Fuel lines 	Check the engine breather hoses, PCV, etc. Check the Engine Control Module (ECM) relay operation. For MAF sensor, ignition system tests, air intake and fuel line information, refer to relevant workshop manual section.
Poor throttle response	<ul style="list-style-type: none"> ● APP sensor malfunction ● TP sensors ● ECT sensor ● MAF sensor ● Transmission malfunction ● Traction control event ● Air leakage ● Breather system disconnected/restricted 	For APP, TP, ECT, MAF sensor tests, intake system checks and transmission information, refer to relevant workshop manual section. Check the breather system hoses, PCV, etc.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - V8 5.0L Petrol, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index \(100-00, Description and Operation\)](#).

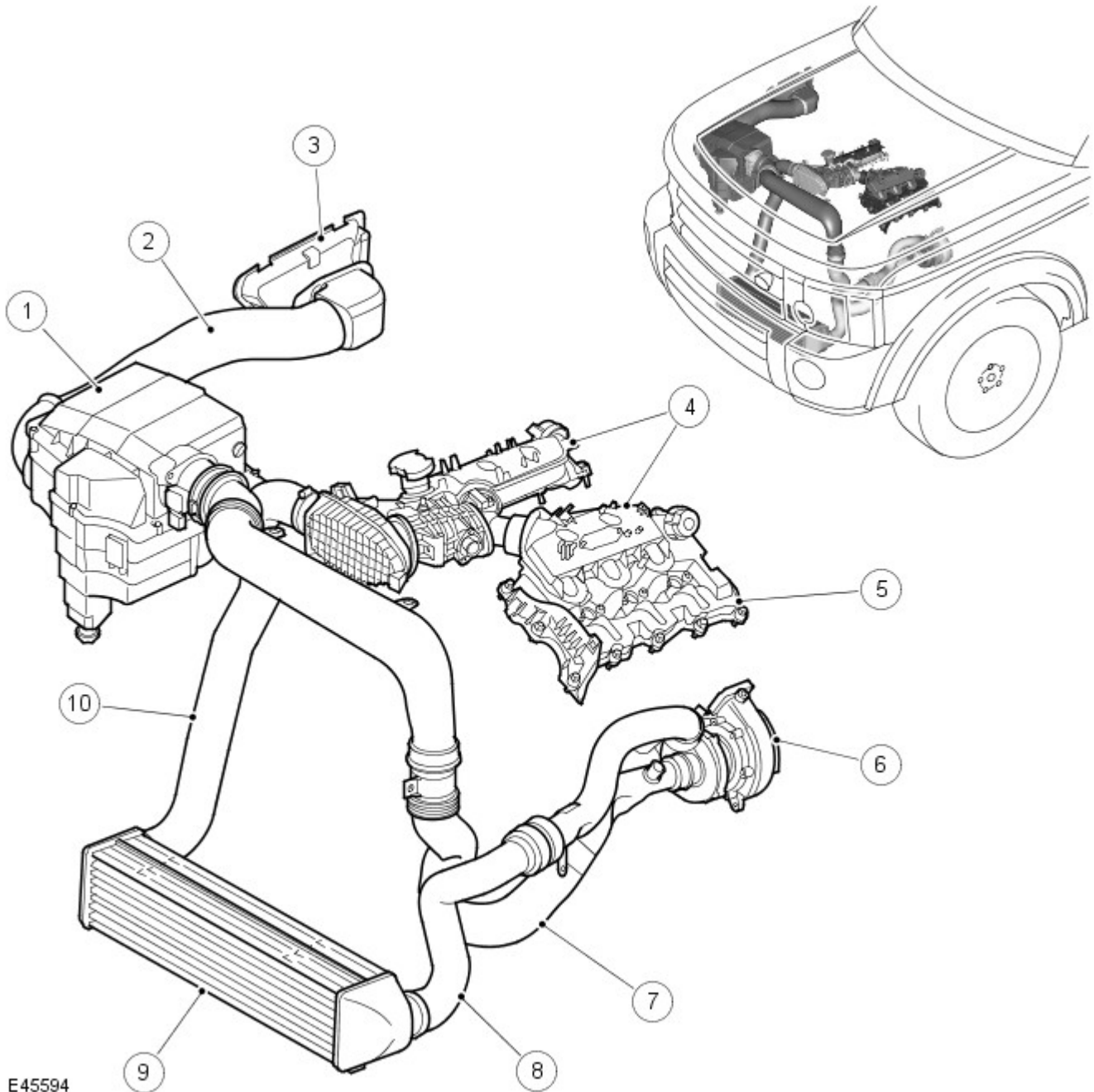
Intake Air Distribution and Filtering - TDV6 2.7L Diesel -**General Specification**

Item	Specification
Air cleaner	Mann and Hummel fitted with replaceable paper element, air flow meter and optional service indicator
Air flow meter:	
Make	Denso
Location	Air intake duct
Service indicator - Optional:	
Type	Transparent body giving visual indication of filter element condition
Location	In the filter housing adjacent to the air intake duct

Intake Air Distribution and Filtering - TDV6 2.7L Diesel - Intake Air Distribution and Filtering

Description and Operation

Intake Air Distribution



E45594

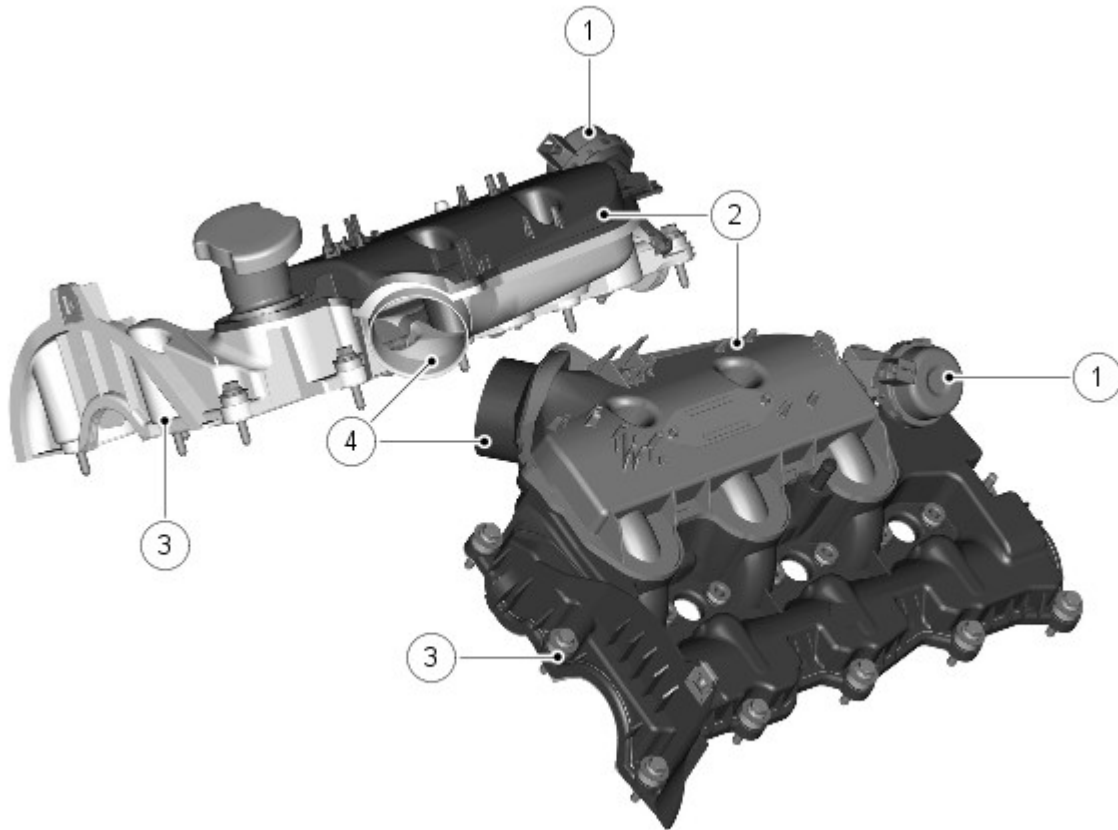
Item	Part Number	Description
1	-	Air filter box
2	-	Porous duct
3	-	Air intake duct
4	-	Air intake manifolds
5	-	Camshaft cover
6	-	Turbo charger
7	-	Air filter to turbo pipe
8	-	Turbo to charge air cooler pipe
9	-	Charge air cooler
10	-	Charge air cooler to intake manifold pipe
11	-	Filter minder (optional fit for dusty climates)

The 2.7 Liter Diesel air intake and distribution system comprises:

- Wing mounted intake duct
- A filter minder sensor
- Camshaft cover mounted intake manifolds (x2)
- Charge air cooler

- Turbo charger

Air is drawn in from the vehicle exterior via the wing mounted intake duct, along a porous duct inside the wing to the air filter box intake. Once the air has passed through the air filter it is drawn along a duct to the turbo charger. From the turbo charger the air is forced through the charge air cooler up to the electric throttle assembly and then to the inlet manifold assembly.



E45595

Item	Part Number	Description
1	-	Port deactivation control valves (not used)
2	-	Air intake manifolds
3	-	Cylinder head covers
4	-	Air intake ducts

Intake Air Distribution and Filtering - TDV6 2.7L Diesel - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Intake Air Distribution and Filtering](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Hoses and ducts condition and installation ● Air cleaner element condition and installation ● Restricted air intake ● Vacuum hoses condition and installation ● Pipework to turbocharger condition and installation ● Turbocharger condition and installation ● Charge air coolers 	<ul style="list-style-type: none"> ● Fuse(s) ● Wiring harness ● Loose or corroded electrical connector(s) ● Mass Air Flow (MAF) sensor ● Air Charge Temperature (ACT) sensor ● Manifold absolute pressure (MAP) sensor ● Intake Air Temperature (IAT) sensor ● Intake air shut-off throttle solenoid

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting	<ul style="list-style-type: none"> ● Restricted/Blocked air intake ● Restricted/Blocked air cleaner element 	Clear the restriction. Replace the air cleaner element as necessary.
Poor performance	<ul style="list-style-type: none"> ● Turbocharger fault ● Throttle body fault ● Intercooler hoses 	Check the turbocharger. Check the intake air shutoff throttle function (make sure the throttle body returns to the open position). Check the intercooler hoses.
Excessive intake noise	<ul style="list-style-type: none"> ● Intake air leak after the turbocharger ● Intake pipe disconnected/damaged after the air cleaner ● Air cleaner assembly incorrectly assembled/damaged 	Check the joint between the air intake elbow and the intake air shutoff throttle. Check the joints between the throttle body outlets and the intake manifolds. Check the charge air cooler seals. Check the intake system and hoses for correct installation/damage.

DTC Index

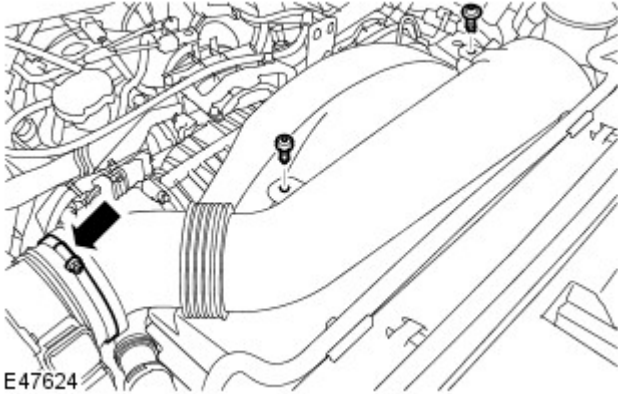
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Intake Air Distribution and Filtering - TDV6 2.7L Diesel - Air Cleaner

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

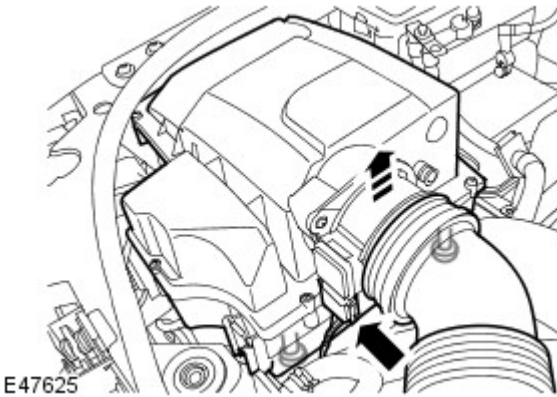


2. **CAUTION:** When removing the air cleaner outlet pipe, make sure the rubber seal, on the LH side lower air pipe, does not become dislodged. Make sure the seal is properly seated onto the lower pipe.

Remove the air cleaner outlet pipe.

- Remove the 2 screws.
- Loosen the clip.

3. Remove the air cleaner assembly.

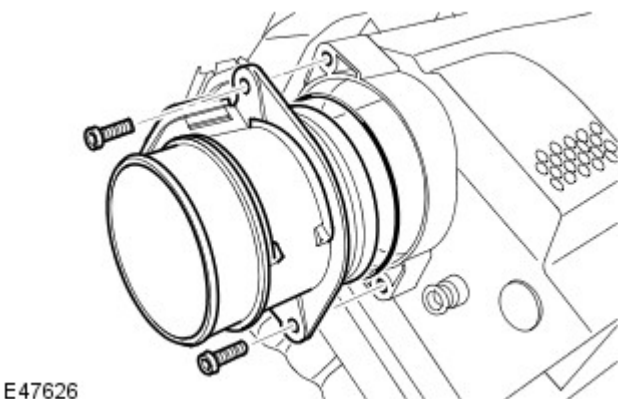


- Disconnect the electrical connector.
- Release the air cleaner from the 2 grommets.

4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the manifold absolute pressure (MAP) sensor.

- Remove the 2 Torx screws.
- Remove the O-ring seal.



Installation

1. **CAUTION:** When installing the air cleaner outlet pipe, make sure it is correctly seated onto the lower air pipe, so that an air-tight seal is made.

- **NOTE:** When installing the air cleaner, make sure the locating pegs fit securely into the grommets.

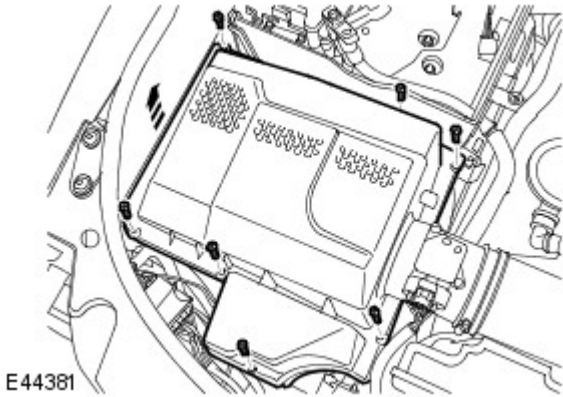
To install, reverse the removal procedure.

Intake Air Distribution and Filtering - TDV6 2.7L Diesel - Air Cleaner Element

Removal and Installation

Removal

1. Release the air cleaner housing cover.
 - Remove the 7 screws.
2. Remove the air cleaner element.




Installation

1. To install, reverse the removal procedure.
 - Clean the base of the air cleaner.
 - Check that the drain valve is clear.

Intake Air Distribution and Filtering - TDV6 2.7L Diesel - Charge Air Cooler

Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove the radiator.
For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
4. Remove the charge air cooler.
 - Remove the 2 retaining pins.



E49355

Installation

1. Install the charge air cooler.
 - Install the 2 retaining pins.
2. Install the radiator.
For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Intake Air Distribution and Filtering - TDV6 3.0L Diesel -

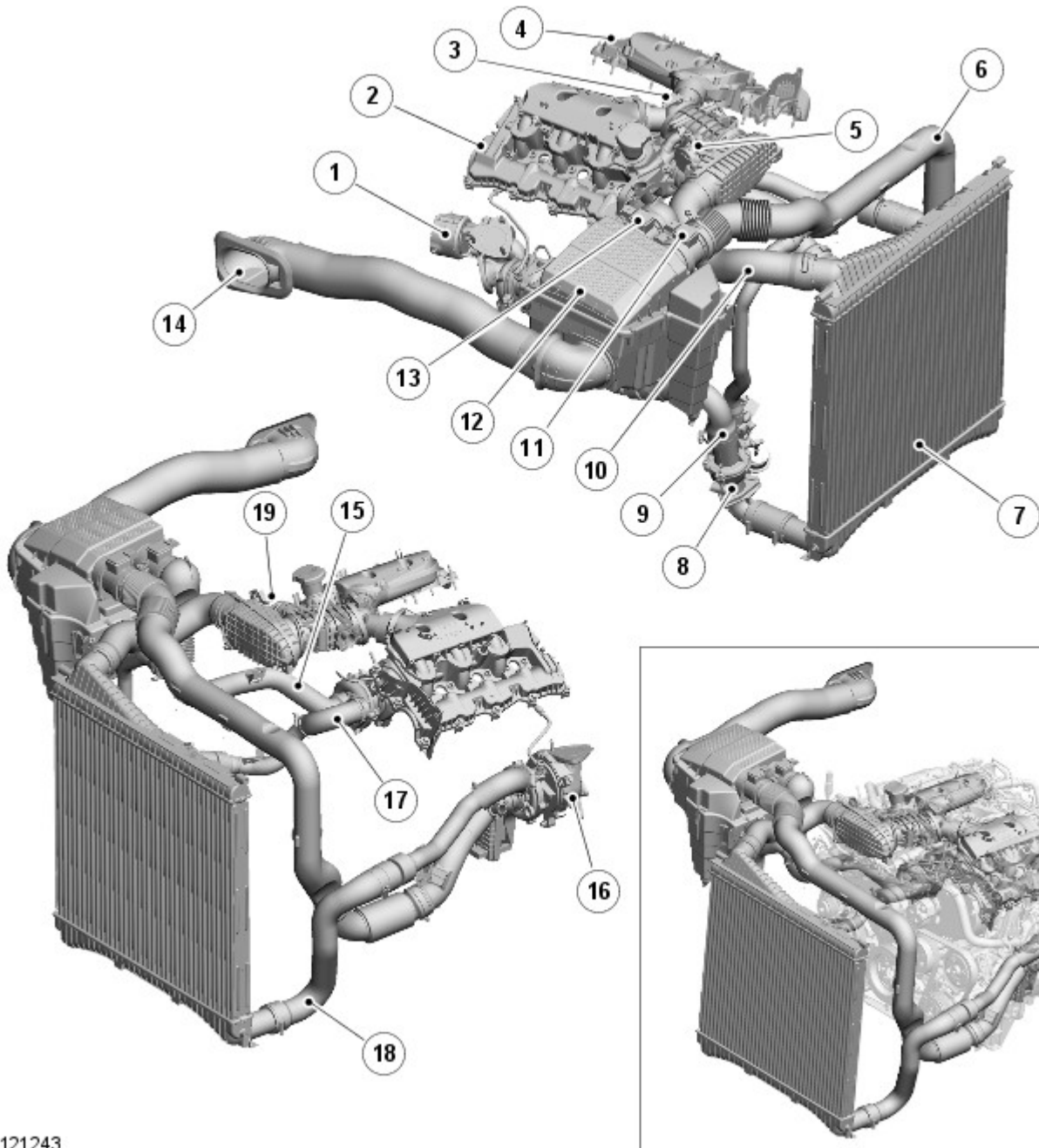
Torque Specification

Description	Nm	lb-ft	lb-in
Air cleaner outlet pipe circlip	3.5	-	31
Charge air cooler to radiator bolts	15	11	-

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering - Component Location

Description and Operation

Component Location



E121243

ItemDescription

1	Secondary turbocharger
2	RH (right-hand) intake manifold
3	Charge air MAPT (manifold absolute pressure and temperature) sensor
4	LH (left-hand) intake manifold
5	Intake manifold throttle actuator
6	Intake air to primary turbocharger pipe
7	Charge air cooler
8	Compressor shut-off and recirculation valve assembly
9	Pipe - Compressed air from secondary turbocharger to charge air cooler
10	Charge air cooler to throttle intake manifold pipe
11	MAF (mass air flow) / IAT (intake air temperature) sensor (primary turbocharger)
12	Air cleaner housing

MAF sensor (secondary turbocharger)
14 Air intake
15 Intake air to secondary turbocharger pipe
16 Primary turbocharger
17 Pipe - Compressed air from secondary turbocharger to charge air cooler
18 Pipe - Compressed air from primary turbocharger to charge air cooler
19 Charge air temperature sensor

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering - Overview

Description and Operation

Authoring Template

OVERVIEW

The intake air distribution and filtering system comprises:

- Two MAF (mass air flow) / IAT (intake air temperature) sensor
- Charge air temperature sensors
- Air cleaner and housing
- Charge air cooler
- Primary and secondary turbochargers.

The system cleans, cools and compresses the intake air. The turbochargers compress the air which is then cooled in the charge air cooler before being mixed with the injected fuel in the cylinder producing a high energy combustion increasing engine performance.

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering - System Operation and Component Description

Description and Operation

System Operation

OPERATION

Air is drawn into the air intake system via the air intake vent located on the front [RH \(right-hand\)](#) fender of the vehicle. The air passes into the air cleaner housing and passes through the air cleaner. The air cleaner is a pleated, paper type filter which removes dust, pollen etc. from the intake air.

The filtered clean air passes from the air cleaner housing to the turbocharger inlet valve assembly. Depending on engine load and operating conditions, the intake air can be passed to only the primary turbocharger or to both the primary and secondary turbochargers.

Exhaust gasses leaving the exhaust manifolds are used to drive a turbine in the turbocharger which in turn drives a compressor. The rotational speed of the compressor is directly related to the speed of the exhaust gasses leaving the engine. Increased exhaust gas emission drives the turbine, and subsequently the compressor, faster, further compressing the intake air delivered to the engine.

The compression of the air by the turbocharger increases the air pressure. The intake air is passed into the charge air cooler which reduces the air temperature as it passes through the cooler. This in turn increases the volumetric efficiency by increasing intake air charge density. The cooled and compressed air is mixed with the injected fuel in the cylinder producing a high energy combustion increasing engine performance.

Component Description

DESCRIPTION

Air Cleaner and Housing

The air cleaner housing is located in the front [RH](#) side of the engine compartment. The housing has a water drain. Two [NVH \(noise, vibration and harshness\)](#) mounting grommets secure the air cleaner housing.

The air cleaner element is a pleated paper type element with a rubber seal around its perimeter. The seal locates in a groove in the housing and prevents air by-passing the element. The housing upper lid can be removed by removing 4 screws to release the lid.

Charge Air Cooler

The charge air cooler is located at the front of the engine compartment, between the [A/C \(air conditioning\)](#) condenser and the engine cooling radiator.

Turbochargers are designed to force more air mass into the engine intake manifold and combustion chambers. This compression process by the turbocharger produces heat which can reduce the performance gains of turbocharging due to reduced density of the intake air and an increase the cylinder combustion temperature. To counteract this, the charge air cooler is used to reduce the intake air temperature which increases the density of the air allowing more air molecules to be delivered to the combustion chamber.

The cooler is a cross flow type cooler and has inlet and outlet connections. The bottom [LH \(left-hand\)](#) and [RH](#) connections are the inlets for the compressed air delivered from the turbocharger compressors. The top [RH](#) connection is the outlet for the cooled compressed air to be delivered to the throttle intake manifold.

The charge air cooler is an air-to-air type cooler. Heated air from the turbochargers is passed through tubes in the cooler. Ambient air passing over the tubes cools the intake air as it passes through the cooler.

Air Intake Components

The air intake components comprise 3 main components; airbox, intake ducting and a throttle intake manifold.

Airbox

The airbox allows for the connection of the cooled intake air from the charge air cooler to the throttle intake manifold. The air cleaner housing houses a [MAF \(mass air flow\)](#) sensor incorporating a temperature sensor which measures the air entering the turbochargers and passes this information to the [ECM \(engine control module\)](#).

Refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

There are two ducts from the airbox, one ducts air to the primary turbocharger and the other to the secondary turbocharger. Boost pressure is applied via the secondary ducting to the secondary turbocharger to maintain the correct lubrication during driving conditions where the secondary turbocharger is inactive.

Refer to: [Turbocharger](#) (303-04D Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Description and Operation).

Throttle Intake Manifold

The throttle intake manifold is located between the 2 intake manifolds and the airbox. The manifold splits the air entering the engine between the 2 intake manifolds.

The throttle intake manifold houses a [DC \(direct current\)](#) electric throttle actuator which controls a flap in the body of the manifold. The flap is controlled by the [ECM](#) and is constantly adjusted in response to driver inputs via the throttle pedal to precisely control the amount of air allowed into the intake manifolds.

Refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Pipe connections on either side of the throttle intake manifold allow for the attachment of the exhaust gas outlet pipes from the [EGR \(exhaust gas recirculation\)](#) valves. The ends of the [EGR](#) pipes are specially designed to mix the recirculated exhaust gas with the intake air and provide an even distribution to each side of the engine.

Refer to: [Engine Emission Control](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Description and Operation).

A boost pressure sensor is located on the top of the manifold where the air flow splits for the 2 intake manifolds. The pressure sensor measures the pressure of the intake air as delivered from the one or both of the turbochargers and passes this information to the [ECM](#) for turbocharger control.

Refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation).

Intake Manifolds

The intake manifolds are an integral part of the cylinder head covers. Each intake manifold is connected to the throttle intake manifold via a push fit, sealed connection. The intake manifolds direct intake air to the inlet valves for each combustion chamber.

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-12B Intake Air Distribution and Filtering - TDV6 3.0L Diesel)

[Intake Air Distribution and Filtering](#) (Description and Operation),
[Intake Air Distribution and Filtering](#) (Description and Operation),
[Intake Air Distribution and Filtering](#) (Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Hoses and ducts condition and installation ● Air cleaner element condition and installation ● Restricted air intake ● Vacuum hoses condition and installation ● Pipework to turbocharger condition and installation ● Turbocharger condition and installation ● Charge air coolers 	<ul style="list-style-type: none"> ● Fuse(s) ● Wiring harness ● Loose or corroded electrical connector(s) ● Mass Air Flow (MAF) sensor ● Air Charge Temperature (ACT) sensor ● Manifold absolute pressure (MAP) sensor ● Intake Air Temperature (IAT) sensor ● Intake air shut-off throttle solenoid

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting	<ul style="list-style-type: none"> ● Restricted/Blocked air intake ● Restricted/Blocked air cleaner element 	Clear the restriction. Replace the air cleaner element as necessary.
Poor performance	<ul style="list-style-type: none"> ● Turbocharger fault ● Throttle body fault ● Intercooler hoses 	Check the turbocharger. Check the intake air shutoff throttle function (make sure the throttle body returns to the open position). Check the intercooler hoses.
Excessive intake noise	<ul style="list-style-type: none"> ● Intake air leak after the turbocharger ● Intake pipe disconnected/damaged after the air cleaner ● Air cleaner assembly incorrectly assembled/damaged 	Check the joint between the air intake elbow and the intake air shutoff throttle. Check the joints between the throttle body outlets and the intake manifolds. Check the charge air cooler seals. Check the intake system and hoses for correct installation/damage.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation).

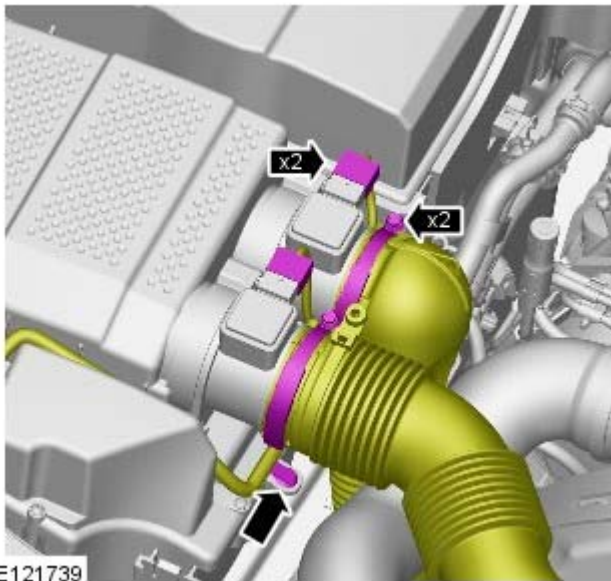
Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Air Cleaner

Removal and Installation

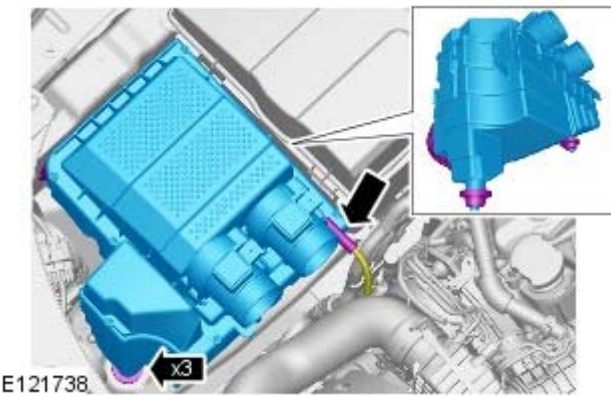
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.

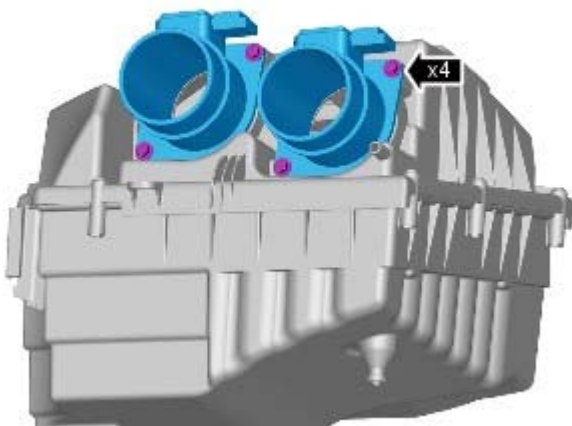


2.

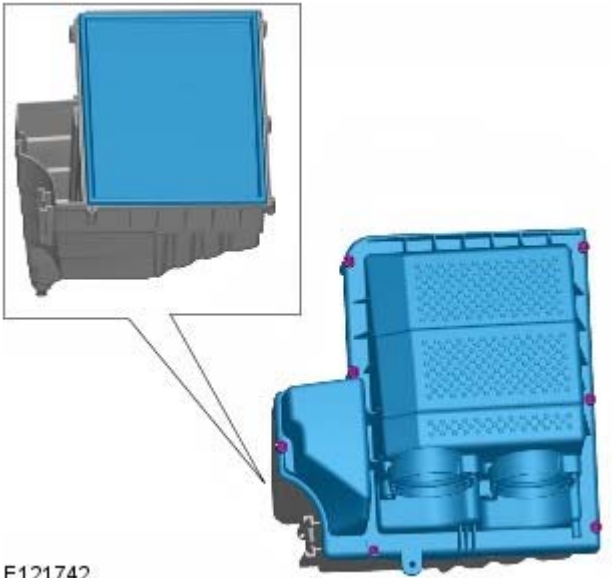


3. **3.** NOTE: Do not disassemble further if the component is removed for access only.

- NOTE: Remove and discard the O-ring seals.



4.



E121742

Installation

1. To install, reverse the removal procedure.

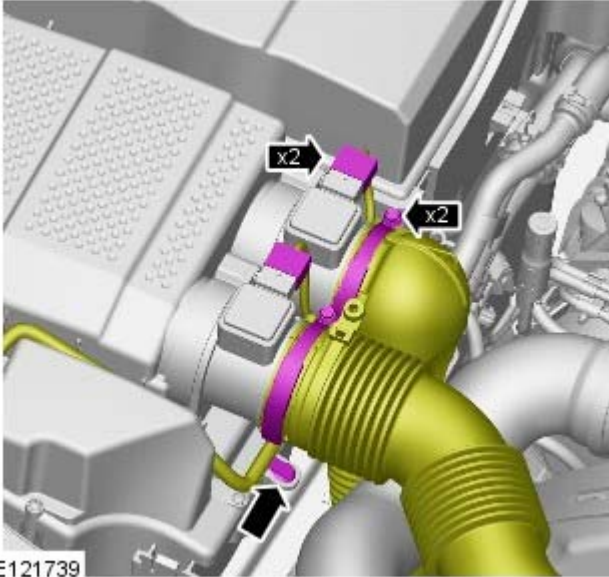
Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Air Cleaner Element

Removal and Installation

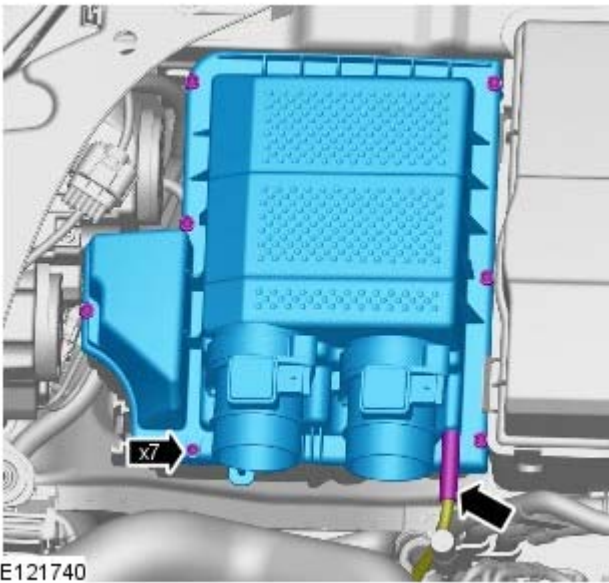
Removal

- NOTE: Removal steps in this procedure may contain installation details.

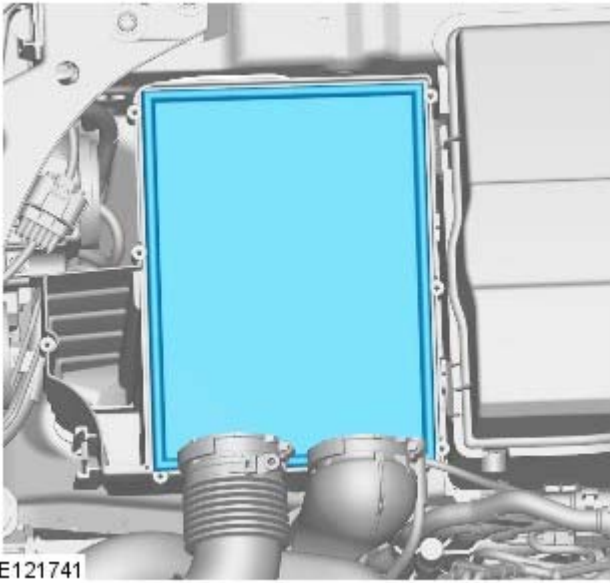
1.



2.



3.



Installation

1. To install, reverse the removal procedure.

Intake Air Distribution and Filtering - TDV6 3.0L Diesel - Charge Air Cooler

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Radiator](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).

Installation

1. Refer to: [Radiator](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).

Intake Air Distribution and Filtering - V6 4.0L Petrol -

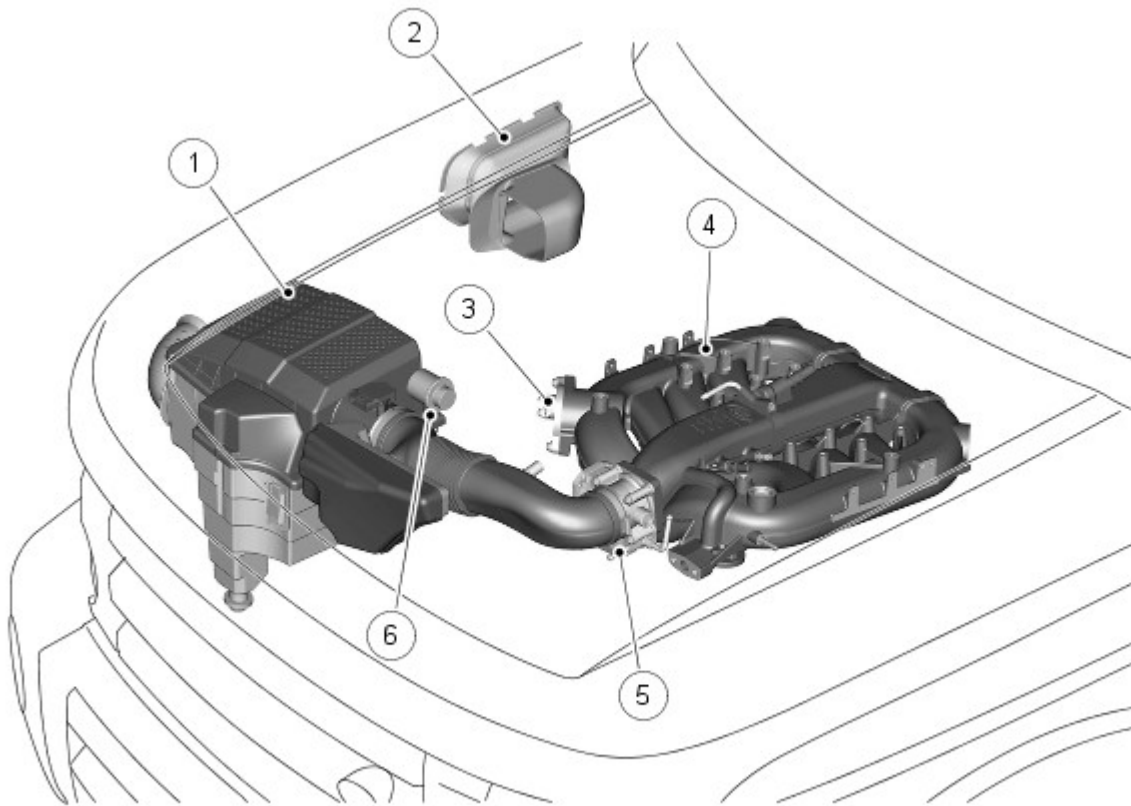
General Specification

Item	Specification
Air cleaner	Mann and Hummel fitted with replaceable paper element, air flow meter and optional service indicator
Air flow meter:	
Make	Denso
Location	Air intake duct
Service indicator - Optional:	
Type	Transparent body giving visual indication of filter element condition
Location	In the filter housing adjacent to the clean air duct

Intake Air Distribution and Filtering - V6 4.0L Petrol - Intake Air Distribution and Filtering

Description and Operation

4 Liter V6 Petrol Intake Air Distribution and Filtering Component Location



E45603

Item	Part Number	Description
1	-	Air filter box
2	-	Air intake
3	-	Intake manifold tuning valve (IMTV)
4	-	Intake manifold
5	-	Electronic throttle
6	-	Filter minder (optional fit)

The 4.0 Liter V6 engine air intake and distribution system comprises:

- Air filter box
- Air intake
- Intake manifold
- Electronic throttle

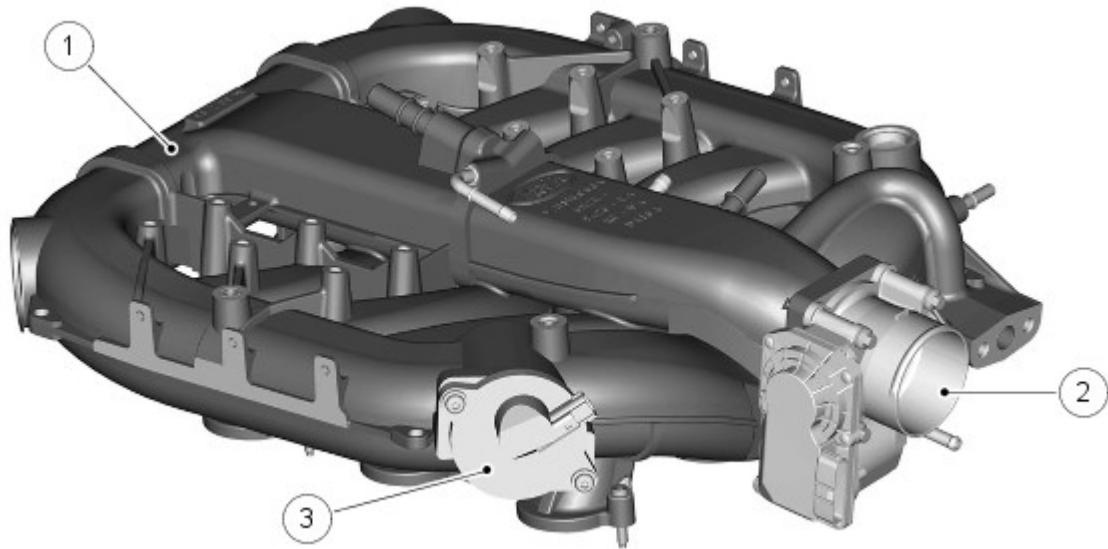
AIR FILTER BOX

The air filter box is located in the front of the engine bay on the inside of the RH front wing. Air is drawn from the air intake in the wing through the wing cavity and into the air filter box.

After the air filter box there is a resonator located after the Mass Air flow/ Intake Air Temperature (MAF/IAT) sensor.

INTAKE MANIFOLD

Air Intake Manifold



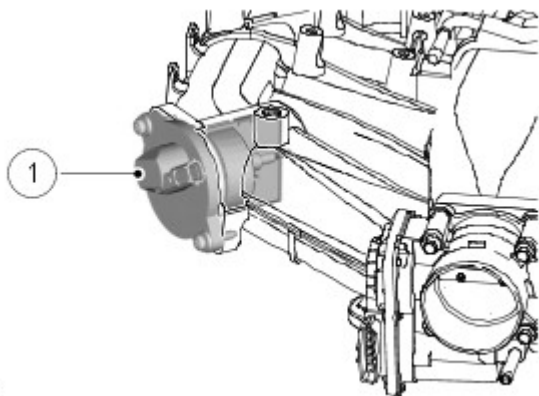
E45604

Item	Part Number	Description
1	-	Intake manifold
2	-	Electronic throttle
3	-	Inlet manifold tuning (IMTV)

The intake manifold is located on top of the engine between the two cylinder banks. The manifold is manufactured from an aluminium alloy. The intake manifold comprises a central chamber with six tracts leading to the inlet ports on the cylinder heads.

INTAKE MANIFOLD TUNING VALVE (IMTV)

Intake Manifold Tuning Valve



E45605

Item	Part Number	Description
1	-	Intake Manifold Tuning Valve (IMTV)

Intake Manifold Tuning Valve

The Intake Manifold Tuning Valve (IMTV) is located at the front right hand side of the air intake manifold. The IMTV is controlled by a PWM signal from the ECM

For additional information, refer to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

. The IMTV moves a plate within the inlet manifold to allow or block sonic pulses between the split manifold halves. This, in effect, extends the inlet runners and optimises for better low rpm torque.

Intake Air Distribution and Filtering - V6 4.0L Petrol - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Hoses and ducts (damage/connections) ● Air cleaner element (contaminated/blocked) ● Restricted air intake ● Supercharger ● Supercharger (cooling fan) drive belt ● Supercharger seals and gaskets ● Charge air coolers (damage/connection) 	<ul style="list-style-type: none"> ● Mass Air Flow (MAF) sensor ● Manifold Absolute Pressure (MAP) sensor ● Manifold Absolute Pressure/Temperature (MAPT) sensor ● Throttle body ● Harness (security/damage) ● Connections (security/damage)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting/poor performance	<ul style="list-style-type: none"> ● Restricted/Blocked air intake ● Restricted/Blocked air cleaner element 	Clear the restriction. Replace the air cleaner element as necessary. Refer to the relevant workshop manual section.
Excessive intake noise	<ul style="list-style-type: none"> ● Intake pipe disconnected/damaged after the air cleaner ● Air cleaner assembly incorrectly assembled/damaged 	Check the intake system and hoses for correct installation/damage. Refer to the relevant workshop manual section.
Lack of boost	<ul style="list-style-type: none"> ● Supercharger drive belt broken/slipping ● Supercharger fault ● Supercharger air intake fault ● Major air leakage (after the supercharger) 	Check the supercharger and drive belt. Check the charge air coolers. Refer to the relevant workshop manual section.
Noise	<ul style="list-style-type: none"> ● Supercharger drive belt slipping ● Supercharger fault ● Major air leakage (after the supercharger) 	Check the supercharger and drive belt. Remove the supercharger drive belt and recheck for noise. Turn the supercharger by hand and check for excessive resistance. Check for excessive play at the supercharger pulley. Check the charge air coolers. Refer to the relevant workshop manual section.

DTC Index

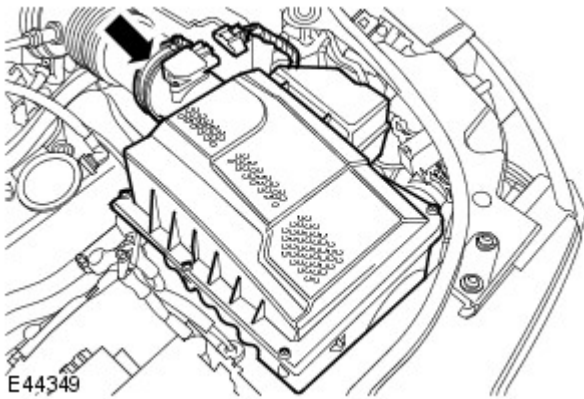
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Engine Control Module \(PCM\) 4.0L V6](#) (100-00 General Information, Description and Operation).

Intake Air Distribution and Filtering - V6 4.0L Petrol - Air Cleaner

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Release the air cleaner intake pipe.
 - Loosen the clip.
3. Disconnect the mass air flow (MAF) sensor electrical connector.



4. Remove the air cleaner assembly.

Installation

1. **NOTE:** When installing the air cleaner, make sure the locating pegs fit securely into the grommets.

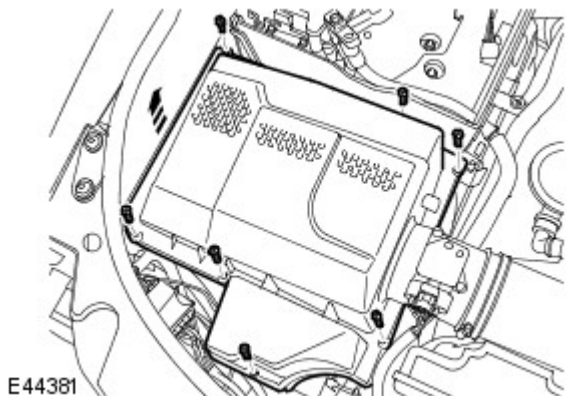
To install, reverse the removal procedure.

Intake Air Distribution and Filtering - V6 4.0L Petrol - Air Cleaner Element

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air cleaner housing cover.
 - Remove the 7 screws.
3. Remove the air cleaner element.



Installation

1. Clean the base of the air cleaner.
2. To install, reverse the removal procedure.

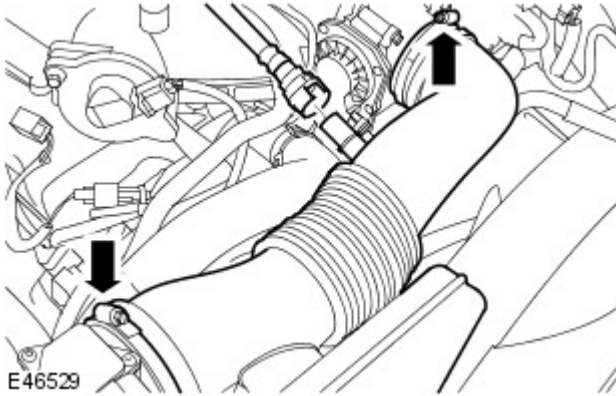
Intake Air Distribution and Filtering - V6 4.0L Petrol - Intake Air Resonator

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the air cleaner outlet pipe and intake air resonator.

- Release the 2 clips.
- Disconnect the breather hose.



Installation

1. To install, reverse the removal procedure.

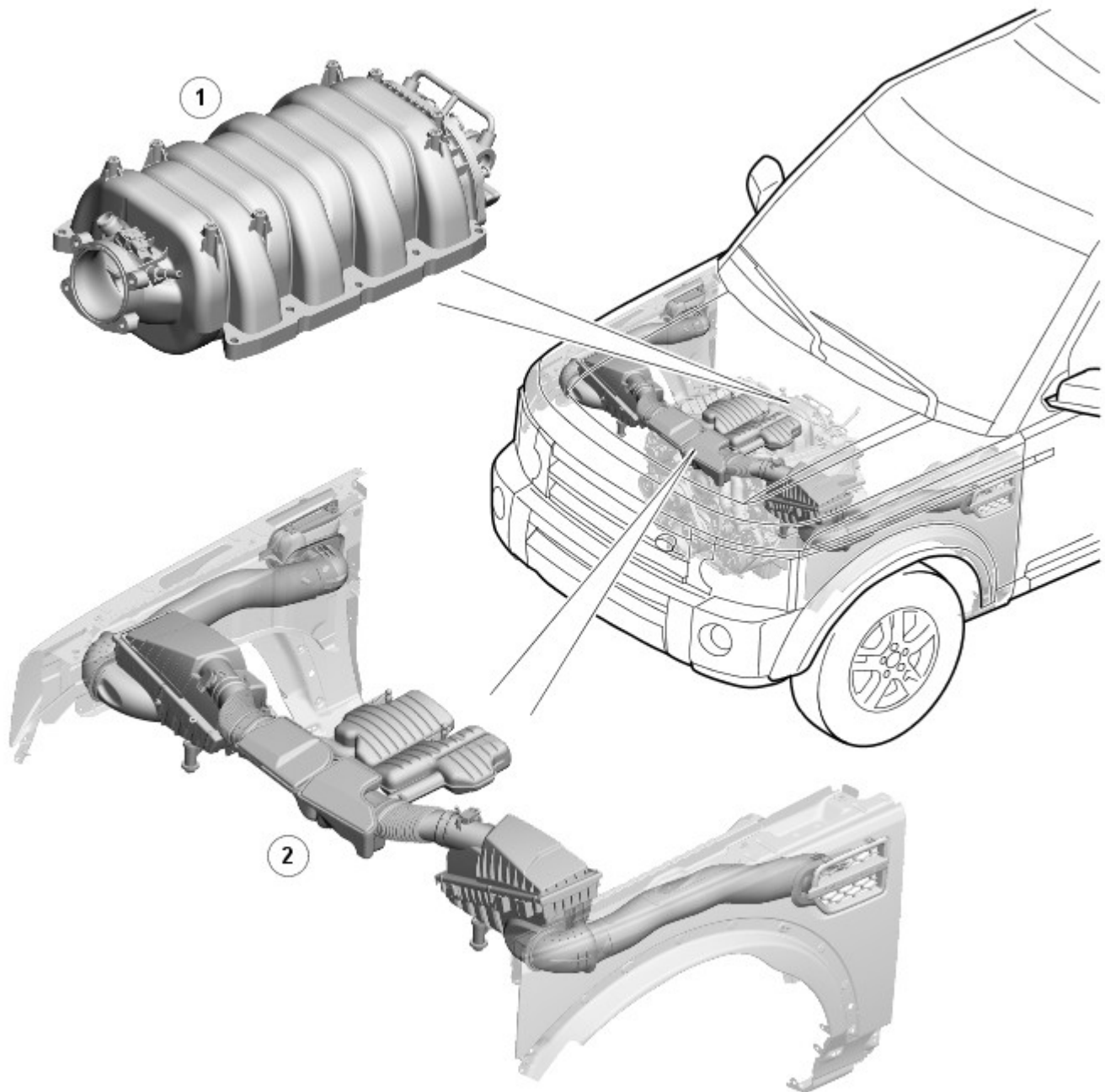
Intake Air Distribution and Filtering - V8 5.0L Petrol -

Description	Nm	lb-ft	lb-in
Air Cleaner Outlet Pipe T-Connector clip	3.5	-	31
Air Cleaner Outlet clips	3.5	-	31
Throttle body retaining studs	17	13	-
Intake manifold retaining bolts	25	18	-
Manifold absolute pressure (MAP) sensor	5	-	44

Intake Air Distribution and Filtering - V8 5.0L Petrol - Intake Air Distribution and Filtering

Description and Operation

COMPONENT LOCATION



E123715

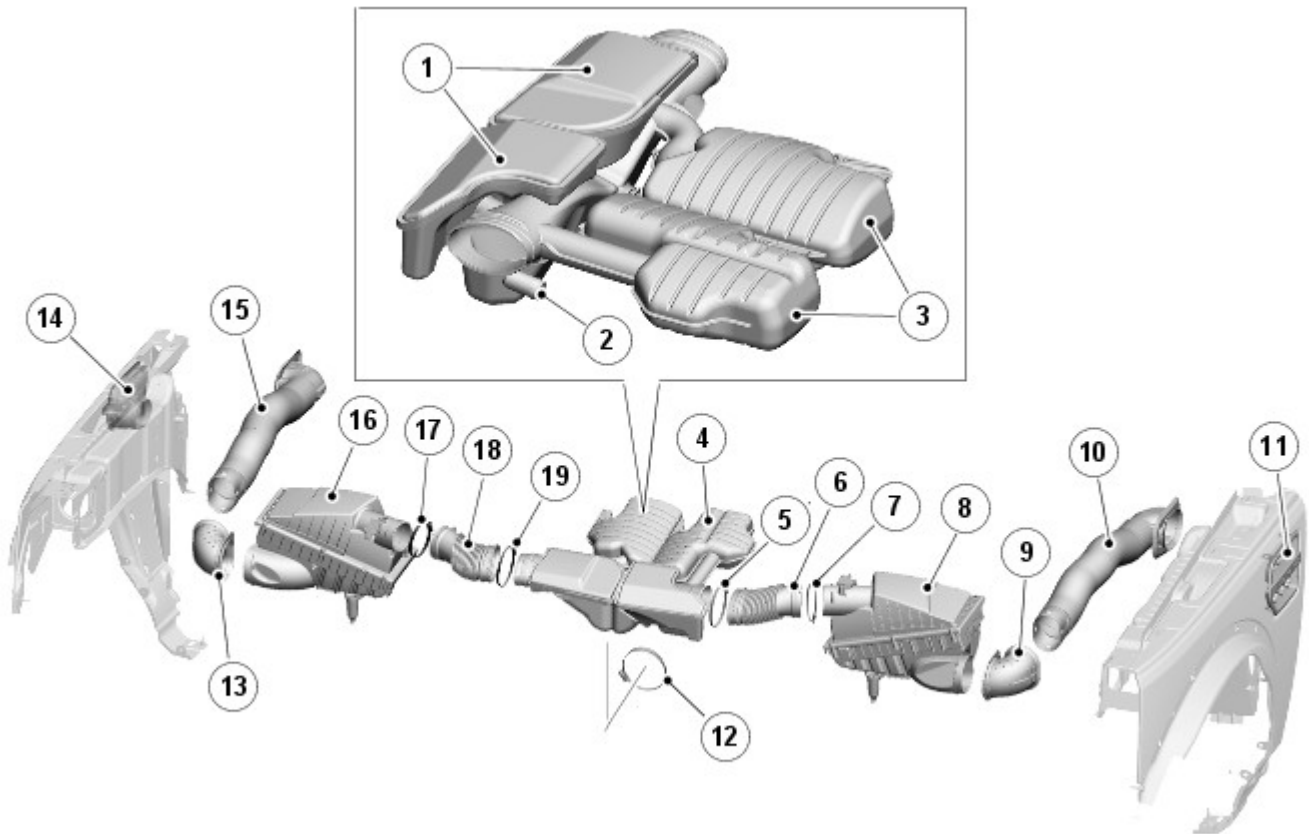
Item	Part Number	Description
1	-	Intake manifold
2	-	Air intakes, air cleaners and air ducts

INTRODUCTION

The intake air distribution and cleaning system comprises:

- Dual air intakes, air cleaners and air ducts.
- An intake manifold.

AIR INTAKES, AIR CLEANERS AND AIR DUCTS



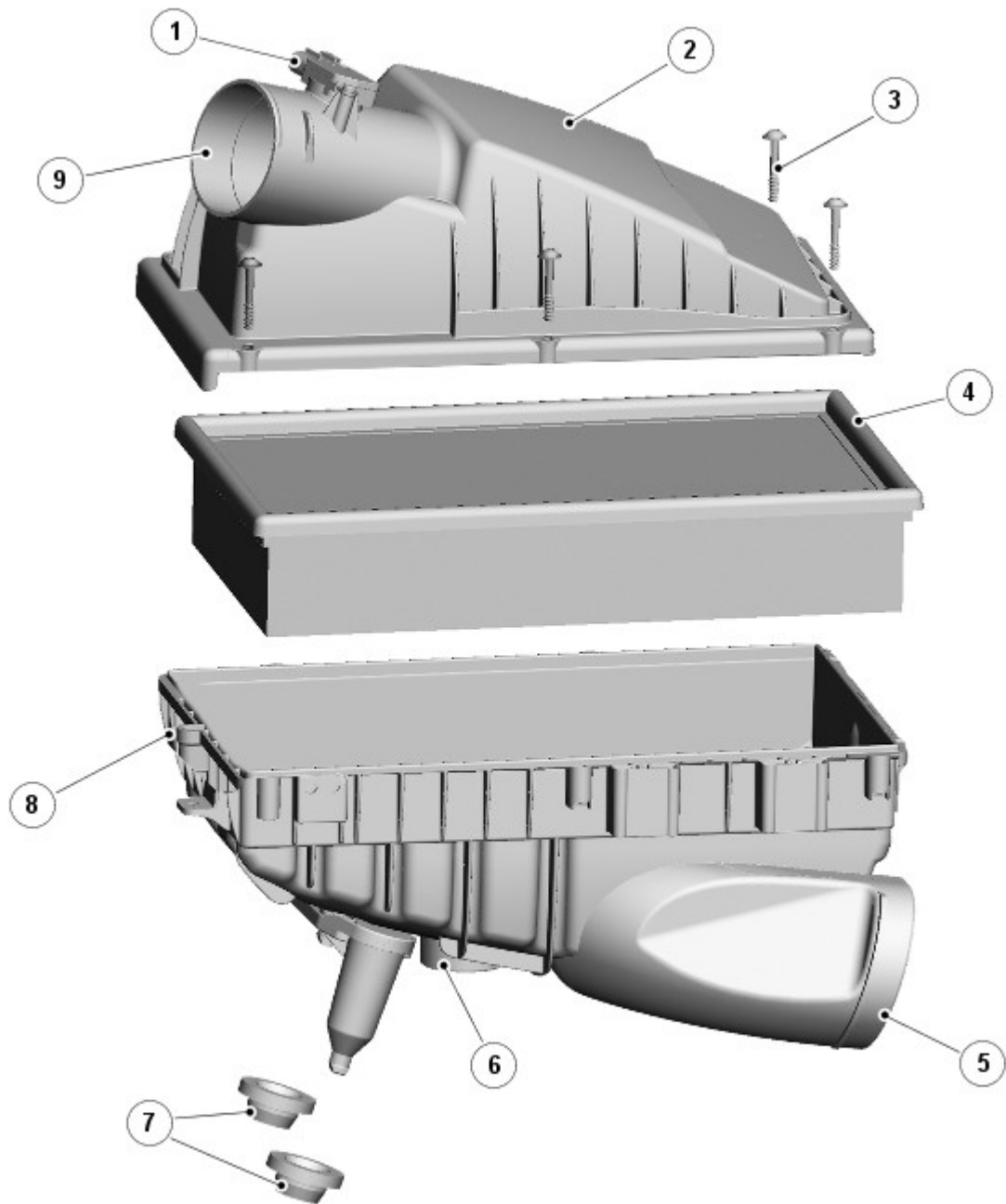
E123716

Item	Part Number	Description
1	-	Resonators
2	-	Full load breather connector stub
3	-	Resonators
4	-	Clean air duct
5	-	Hose clamp
6	-	LH (left hand) clean air convolute
7	-	Hose clamp
8	-	LH air cleaner
9	-	LH dirty air duct
10	-	LH air intake hose
11	-	LH air intake
12	-	Hose clamp
13	-	RH (right hand) dirty air duct
14	-	RH air intake
15	-	RH air intake hose
16	-	RH air cleaner
17	-	Hose clamp
18	-	RH clean air convolute
19	-	Hose clamp

Air is supplied to the air cleaners through the air intakes, air intake hoses and dirty air ducts in the fenders.

The air cleaners are located in the engine compartment, forward of the suspension housings. Two isolators locate each air cleaner on the related front side member. Each air cleaner consists of an air cleaner element installed in a tray and enclosed with a cover secured by six screws. Air inlet and outlet connections are incorporated into the tray and cover respectively. The bottom of the tray incorporates a drain valve to prevent the accumulation of water in the air cleaner. The air outlet connection incorporates a **MAFT (mass air flow and temperature)** sensor.

Air Cleaner



E121098

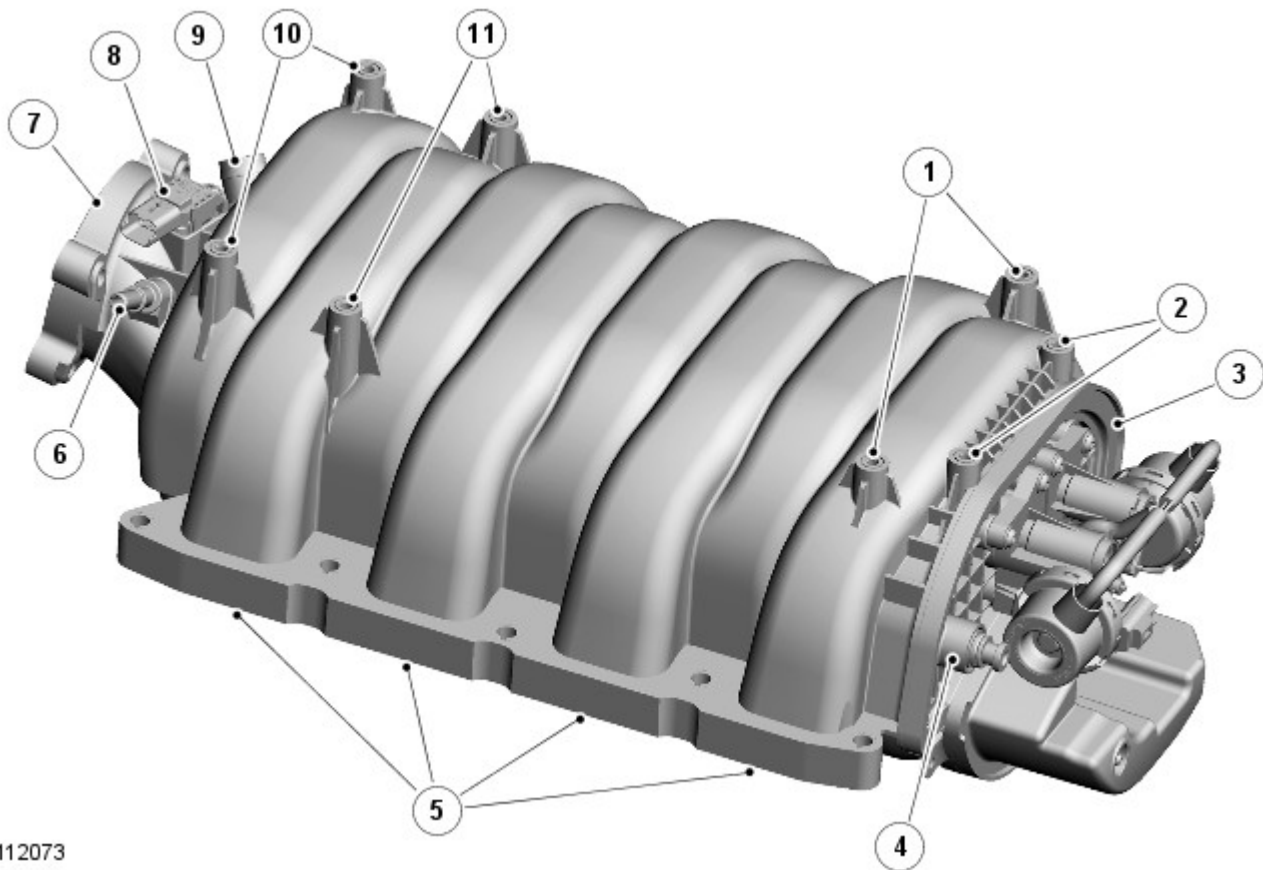
Item	Part Number	Description
1	-	MAFT sensor
2	-	Cover
3	-	Screw (6 off)
4	-	Air cleaner element
5	-	Inlet connection
6	-	Drain valve
7	-	Isolators
8	-	Tray
9	-	Outlet connection

The clean air convolutes and the clean air duct direct the air from the air cleaners into the electric throttle. Hose clamps connect the clean air convolutes and the clean air duct together, and to the air cleaners and the electric throttle.

The clean air duct also incorporates the following:

- Resonators, to reduce air induction noise.
- A connector stub for the engine full load breather pipe.

INTAKE MANIFOLD



E112073

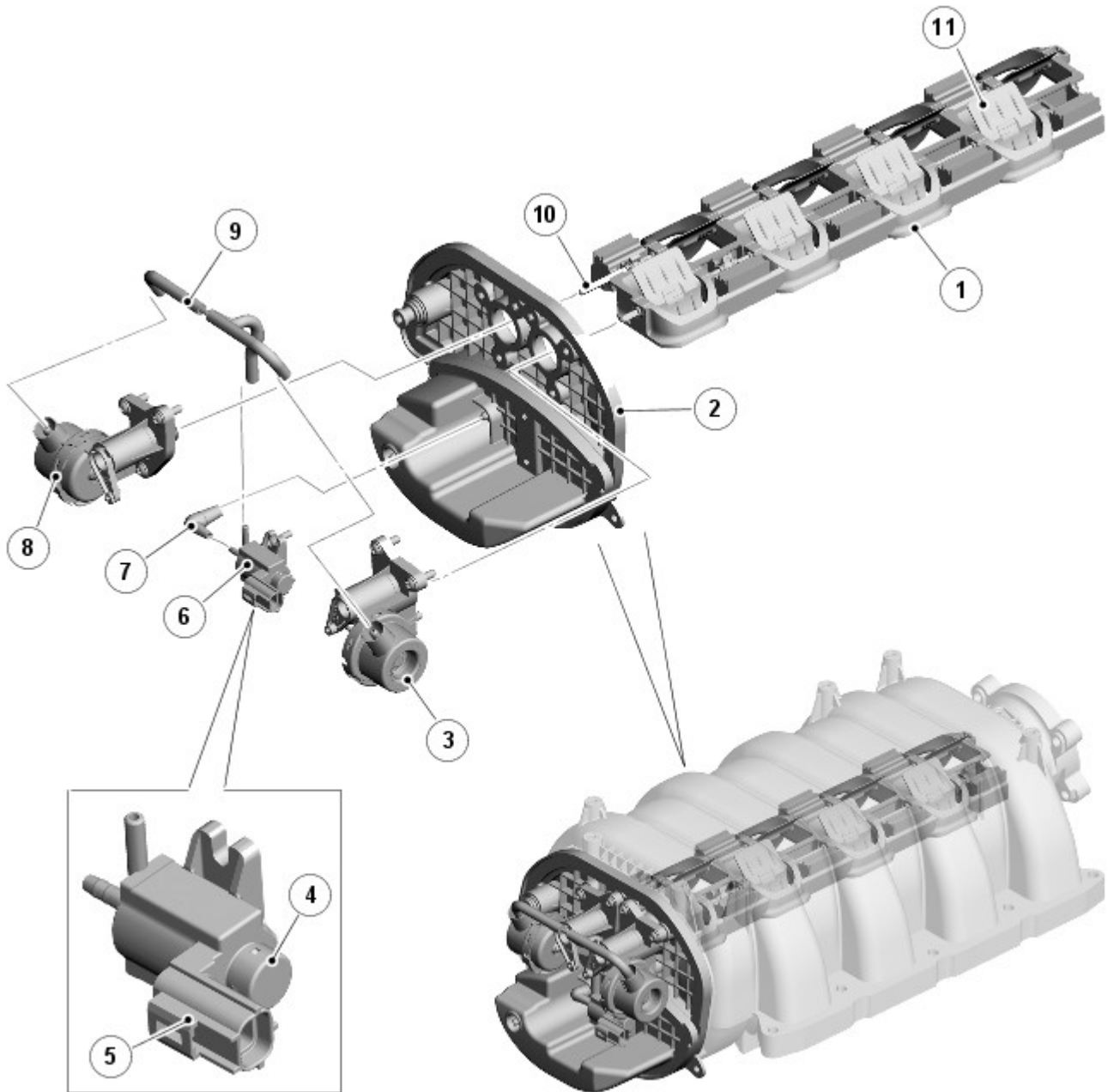
Item	Part Number	Description
1	-	Engine cover rear attachment points
2	-	Engine harness shield attachment points
3	-	Cover plate
4	-	Brake booster vacuum connection
5	-	Outlet ports
6	-	Evaporative emissions connection
7	-	Inlet port
8	-	MAP (manifold absolute pressure) sensor
9	-	Part load breather connection
10	-	Fuel crossover tube attachment points
11	-	Engine cover front attachment points

The intake manifold is installed between the cylinder heads and directs air from the electric throttle to the individual cylinders. The inlet port connects to a central chamber in the intake manifold. Eight separate tracts connect the central chamber to the outlet ports. A cover plate seals the rear of the intake manifold.

The intake manifold incorporates:

- A stub pipe for connection of the part load breather.
- A stub pipe for connection of the evaporative emissions system.
- A MAP (manifold absolute pressure) sensor.
- A vacuum connection for the brake booster.
- Threaded inserts to provide attachment points for the electric throttle, fuel crossover tube, engine cover and an engine harness shield.
- Compression limiters in the cylinder head attachment points.
- Seals in the inlet and outlet ports.
- A VIS (variable intake system).

Variable Intake System



E112074

Item	Part Number	Description
1	-	Cassette
2	-	Cover plate
3	-	RH pneumatic actuator
4	-	Vent cap
5	-	Electrical connector
6	-	Tuning valve
7	-	Vacuum connector
8	-	LH pneumatic actuator
9	-	Vacuum hoses
10	-	Drive shaft
11	-	Flap valve

The VIS changes the length of the tracts in the intake manifold to improve the air flow to the cylinders, which improves the engine power and torque.

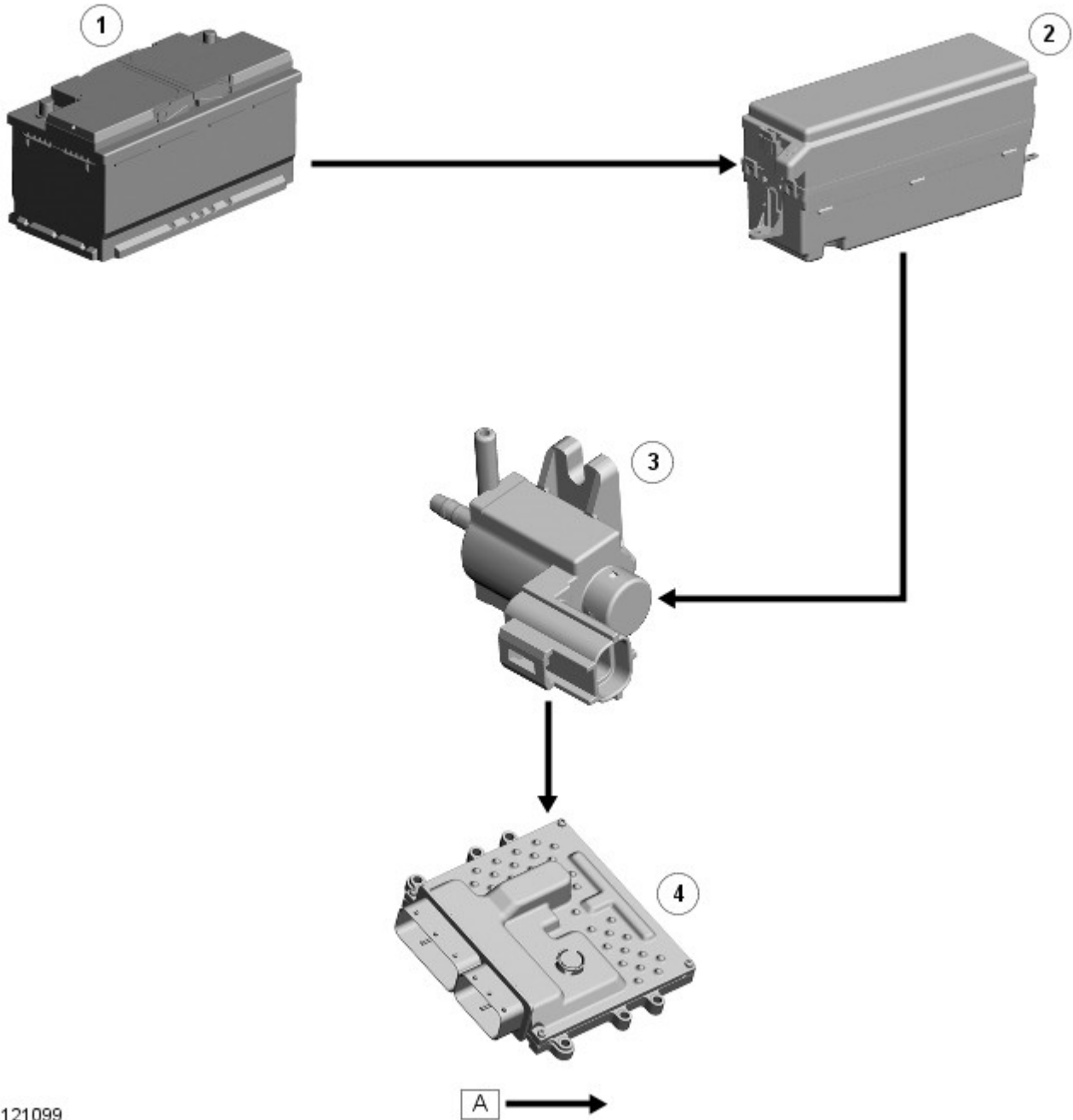
A cassette in the intake manifold contains eight flap valves, each located in an opening part-way along one of the tracts. Two drive shafts connect the flap valves together in two groups of four. Each drive shaft is connected to a pneumatic actuator installed on the cover plate of the intake manifold.

A tuning valve, also installed on the cover plate, controls the application of vacuum pressure to the pneumatic actuators. The tuning valve is a normally-closed solenoid-operated valve installed in the vacuum line between the cover plate and the pneumatic actuators. A vent cap on the tuning valve allows atmospheric pressure into the vacuum line to the pneumatic actuators when the tuning valve is closed.

The [ECM \(engine control module\)](#) controls the operation of the tuning valve.

CONTROL DIAGRAM (VARIABLE INTAKE SYSTEM)

• NOTE: A = Hardwired



E121099

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (ECM relay)
3	-	Tuning valve
4	-	ECM

OPERATION

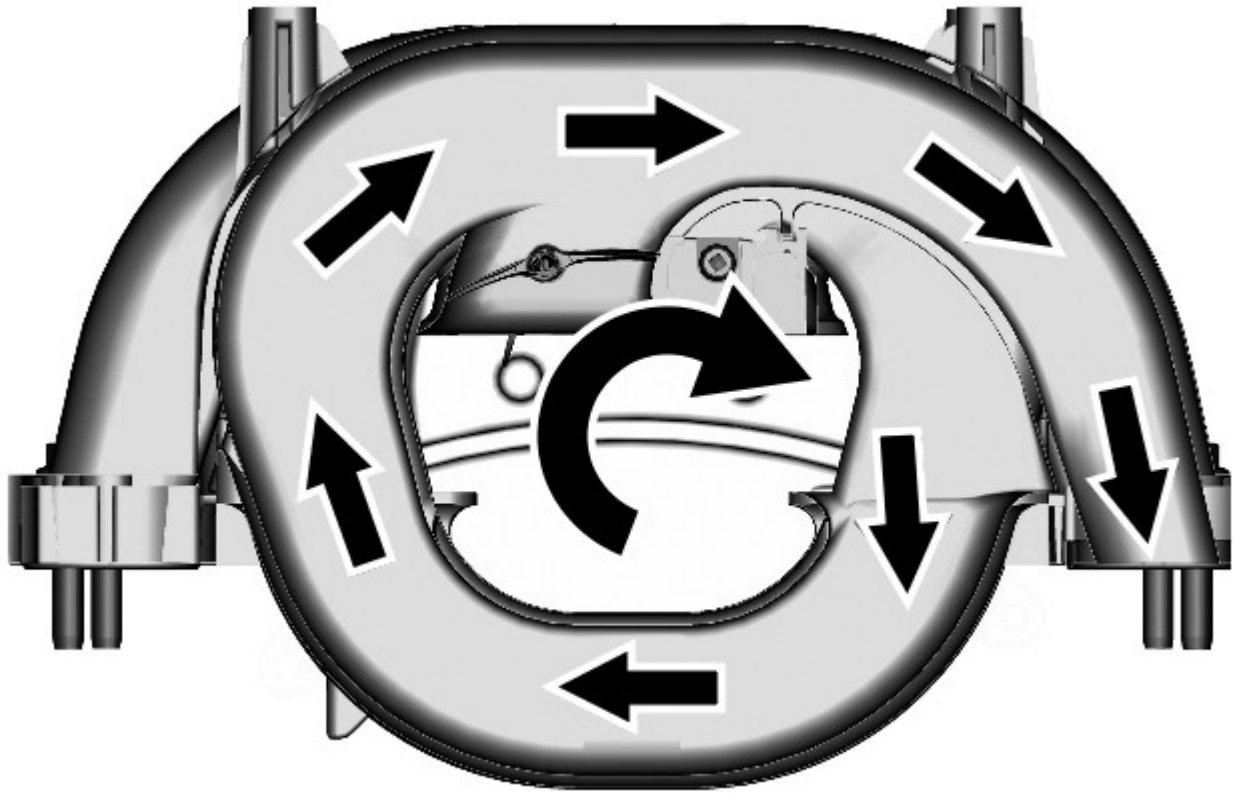
Variable Intake System

The flap valves can be set to one of two positions, to produce short or long intake tracts in the intake manifold. Long intake tracts are produced with the flap valves closed. Short intake tracts are produced with the flap valves open. The flap valves are closed at engine speeds up to 4700 rev/min and open at engine speeds of 4700 rev/min and above, with a hysteresis of 50 rev/min.

The tuning valve receives a power feed from the EMS relay in the **EJB (engine junction box)**, and is connected to ground through the **ECM**. To close the flap valves, the **ECM** connects the tuning valve to ground. The energized tuning valve blanks off the atmospheric vent and opens the vacuum line between the cover plate and the pneumatic actuators. The depression in the intake manifold is sensed at the pneumatic actuators, which turn the drive shafts and move the flap valves to the closed position.

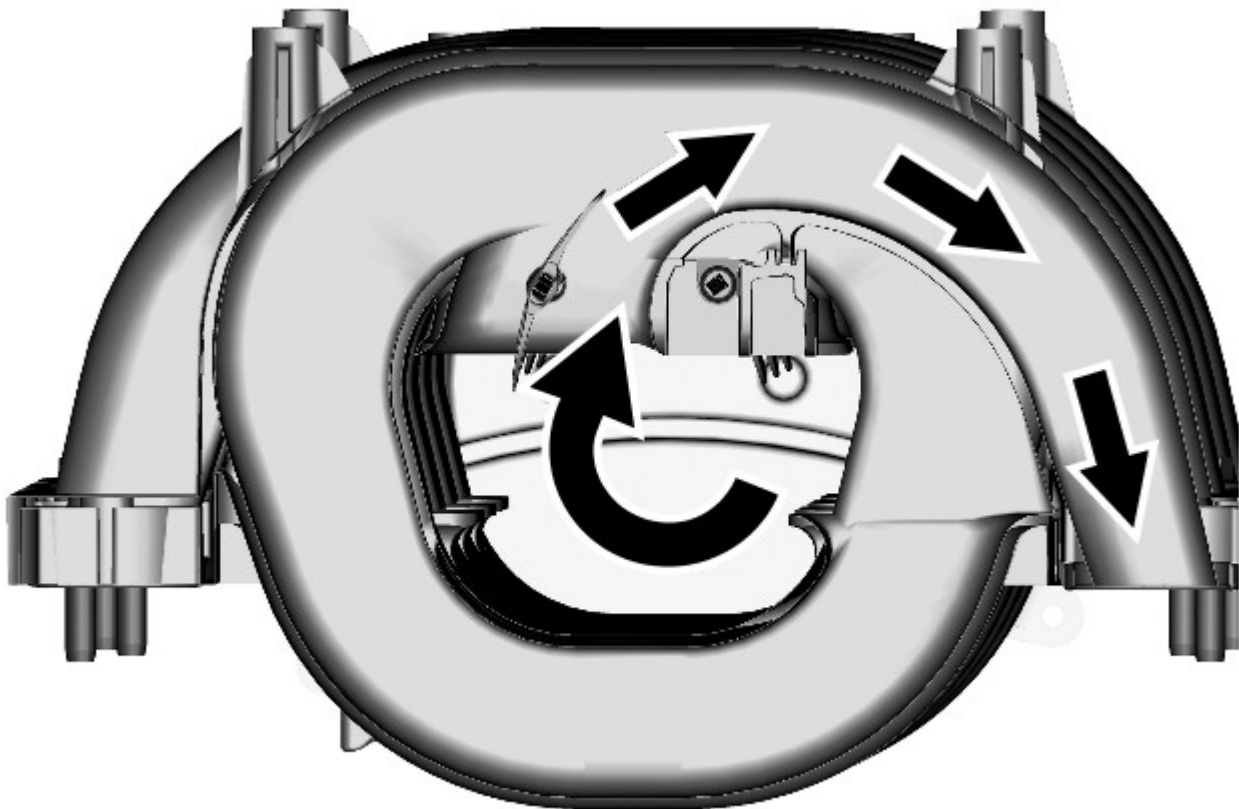
To open the flap valves, the **ECM** disconnects the ground connection and the tuning valve is de-energized closed. Atmospheric pressure is sensed at the pneumatic actuators through the vent cap on the intake manifold tuning valve and the flap valves move to the open position.

Flap Valves Closed



E 106750

Flap Valves Open



E106751

Intake Air Distribution and Filtering - V8 5.0L Petrol - Intake Air Distribution and Filtering

Diagnosis and Testing

Principles of Operation

For a detailed description of the intake air distribution and filtering system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Intake Air Distribution and Filtering](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Hoses and ducts (damage/connections) ● Air cleaner element (contaminated/blocked) ● Restricted air intake ● Supercharger ● Supercharger (cooling fan) drive belt ● Supercharger seals and gaskets ● Charge air coolers (damage/connection) 	<ul style="list-style-type: none"> ● Mass Air Flow (MAF) sensor ● Manifold Absolute Pressure (MAP) sensor ● Manifold Absolute Pressure/Temperature (MAPT) sensor ● Throttle body ● Harness (security/damage) ● Connections (security/damage)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Vehicle does not start/hard starting/poor performance	<ul style="list-style-type: none"> ● Restricted/Blocked air intake ● Restricted/Blocked air cleaner element 	Clear the restriction. Replace the air cleaner element as necessary. Refer to the relevant workshop manual section.
Excessive intake noise	<ul style="list-style-type: none"> ● Intake pipe disconnected/damaged after the air cleaner ● Air cleaner assembly incorrectly assembled/damaged 	Check the intake system and hoses for correct installation/damage. Refer to the relevant workshop manual section.
Lack of boost	<ul style="list-style-type: none"> ● Supercharger drive belt broken/slipping ● Supercharger fault ● Supercharger air intake fault ● Major air leakage (after the supercharger) 	Check the supercharger and drive belt. Check the charge air coolers. Refer to the relevant workshop manual section.
Noise	<ul style="list-style-type: none"> ● Supercharger drive belt slipping ● Supercharger fault ● Major air leakage (after the supercharger) 	Check the supercharger and drive belt. Remove the supercharger drive belt and recheck for noise. Turn the supercharger by hand and check for excessive resistance. Check for excessive play at the supercharger pulley. Check the charge air coolers. Refer to the relevant workshop manual section.

DTC Index

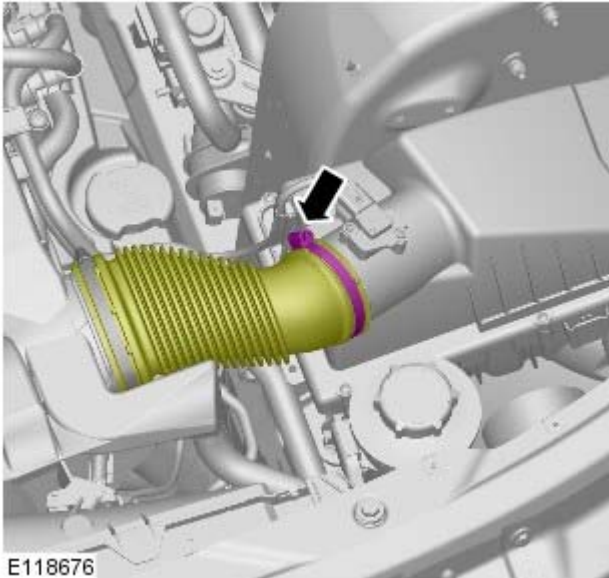
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - V8 5.0L Petrol, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Element

Removal and Installation

Removal

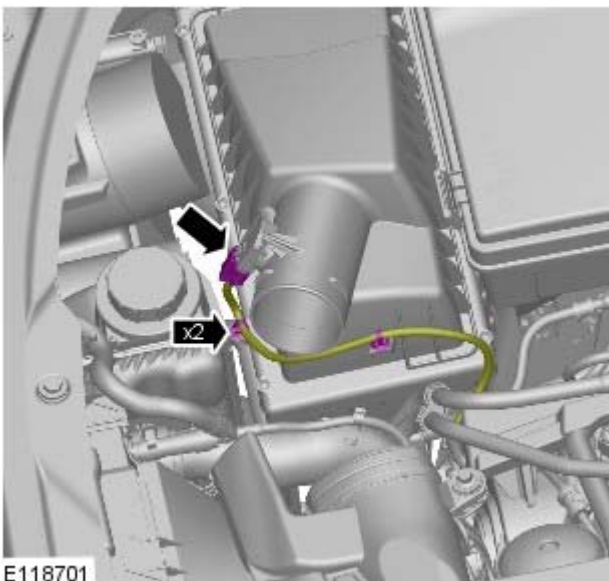
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Air cleaner elements must be renewed in pairs.



1. **1.** NOTE: Left-hand shown, right-hand similar.

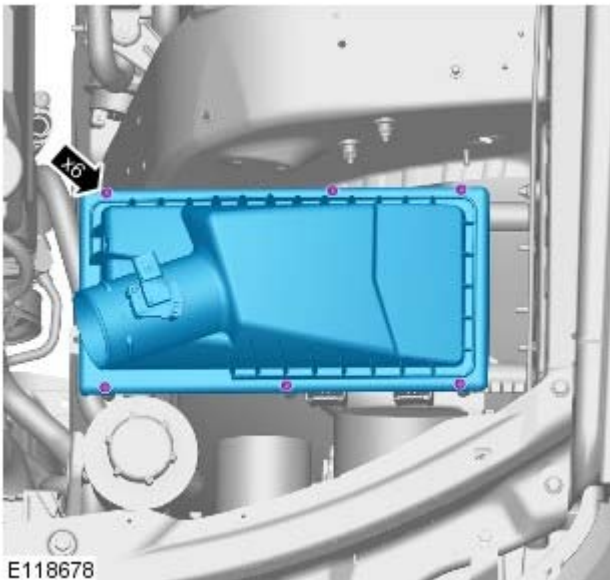
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 3.5 Nm

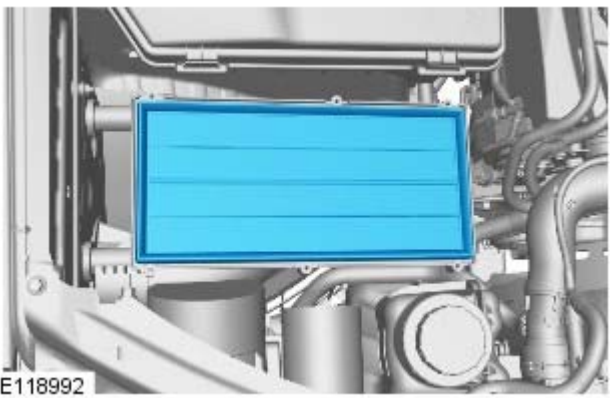


2. **2.** NOTE: Left-hand shown, right-hand similar.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



3. **3.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
 - NOTE: Left-hand shown, right-hand similar.



4. **4.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
 - NOTE: Right-hand shown, left-hand similar.
 - Repeat the above procedure for the other side.

Installation

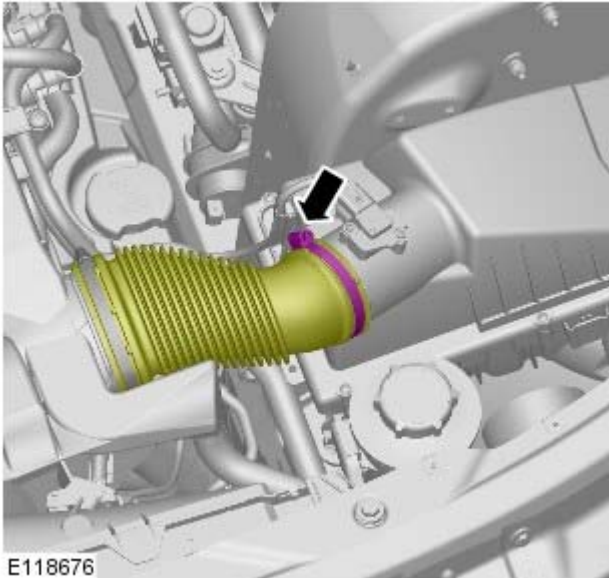
1. To install reverse the removal procedure.

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner LH

Removal and Installation

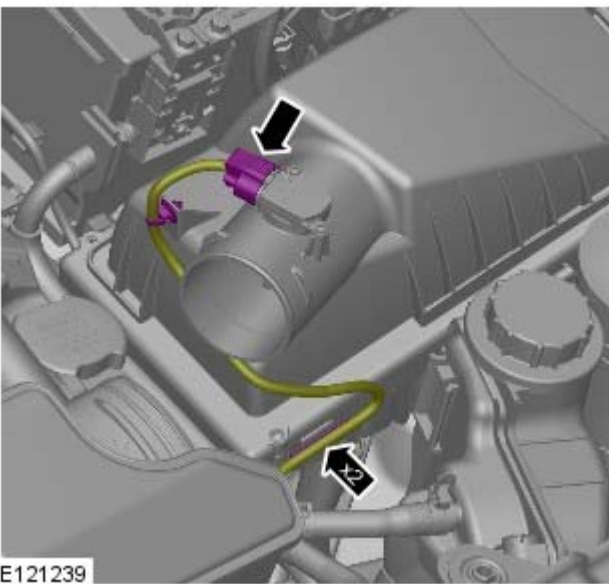
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: The ignition must be switched off.

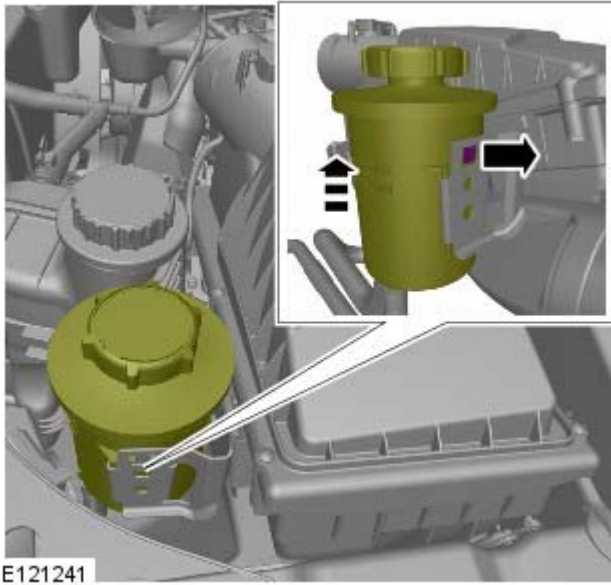


1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

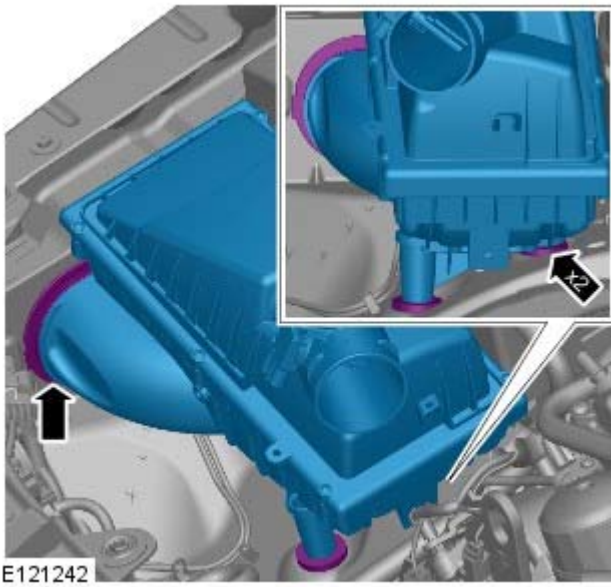
Torque: 3.5 Nm



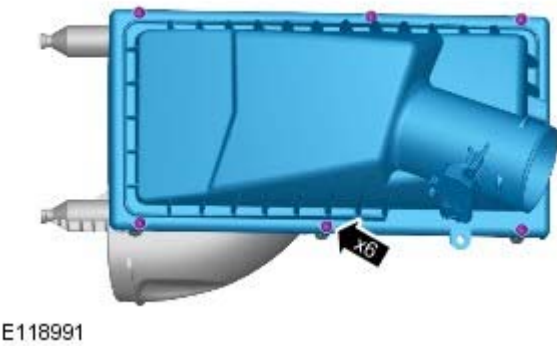
- 2.



3.



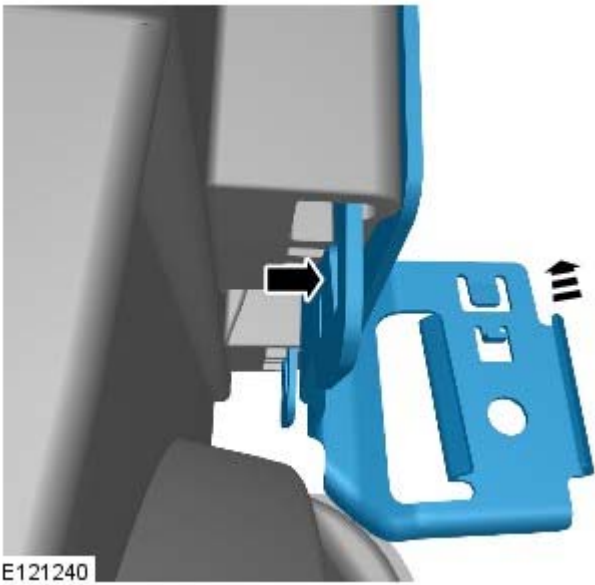
4. **4.** NOTE: Right-hand shown, left-hand similar.



5. **5.** NOTE: Do not disassemble further if the component is removed for access only.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

6.



7.



E121597

Installation

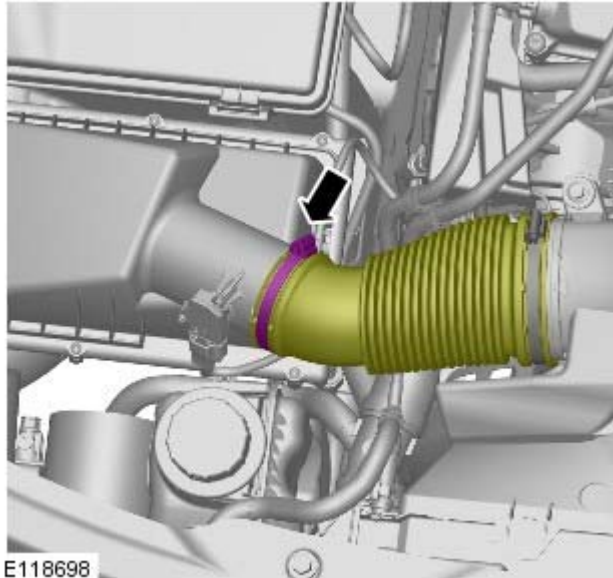
1. To install reverse the removal procedure.

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner RH

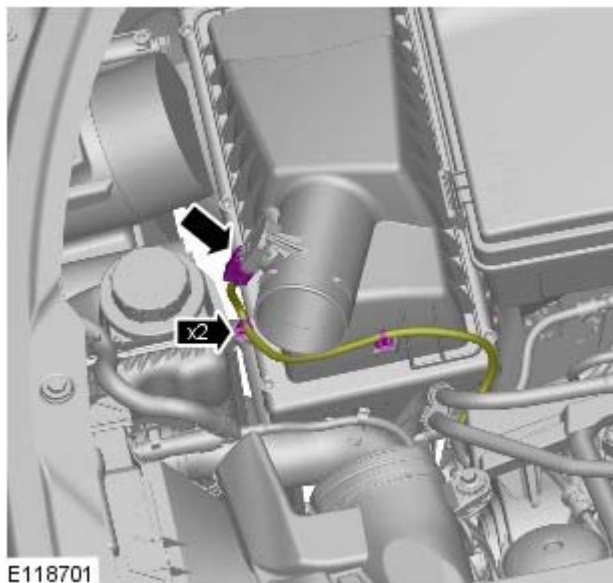
Removal and Installation

Removal

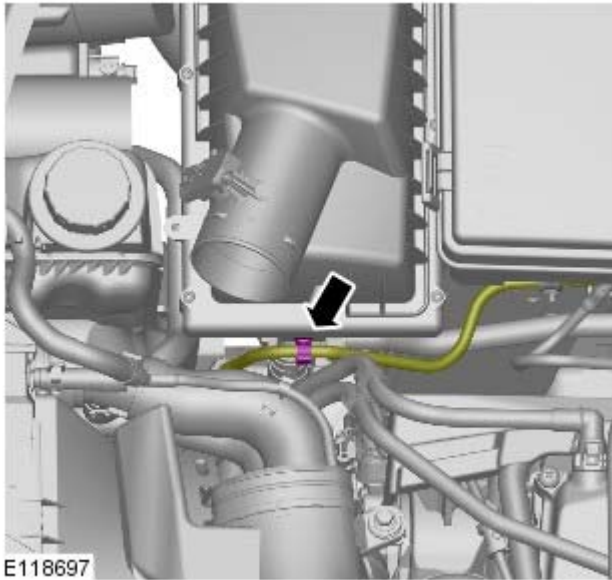
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



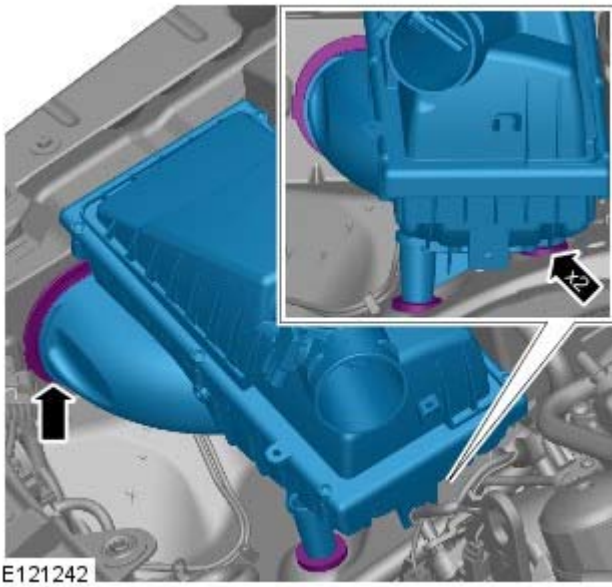
1. Torque: 3.5 Nm



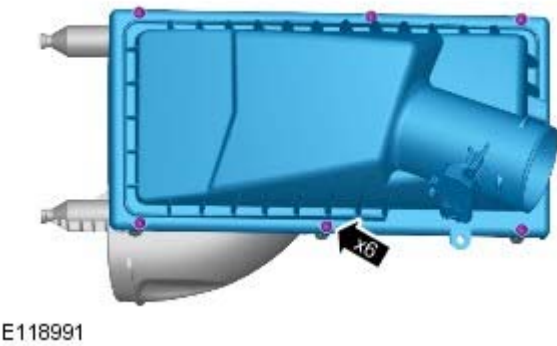
2.



3.



4.



5. **5. NOTE:** Do not disassemble further if the component is removed for access only.

6.



E121597

Installation

1. To install reverse the removal procedure.

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Outlet

Pipe LH

Removal and Installation

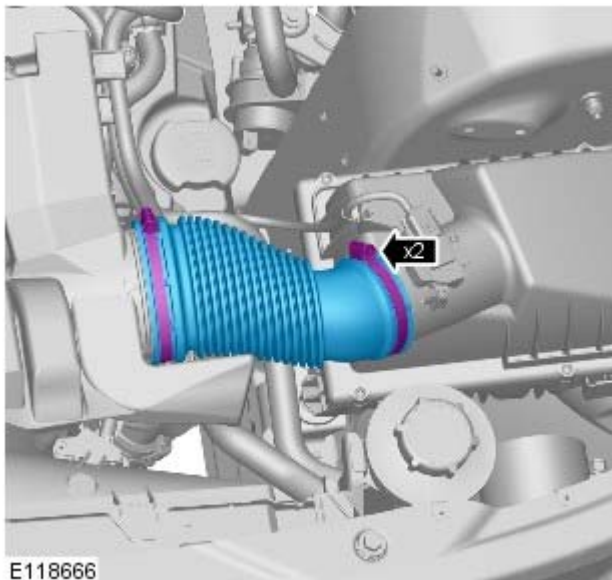
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. **2.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 3.5 Nm



Installation

1. To install reverse the removal procedure.

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Outlet

Pipe RH

Removal and Installation

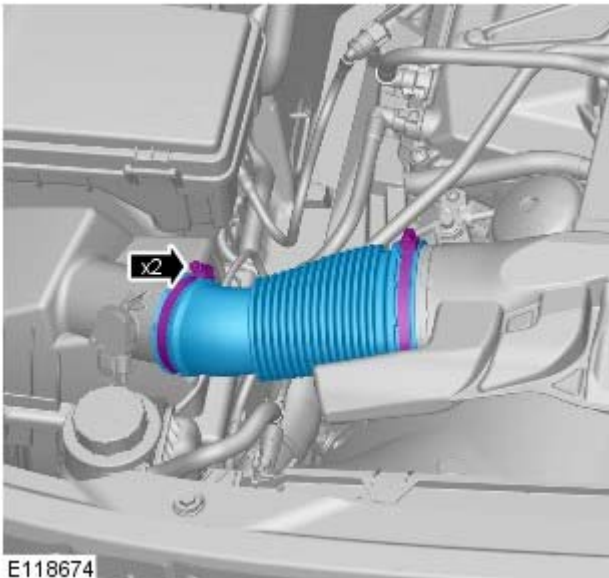
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. **2.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 3.5 Nm



Installation

1. To install reverse the removal procedure.

Intake Air Distribution and Filtering - V8 5.0L Petrol - Air Cleaner Outlet

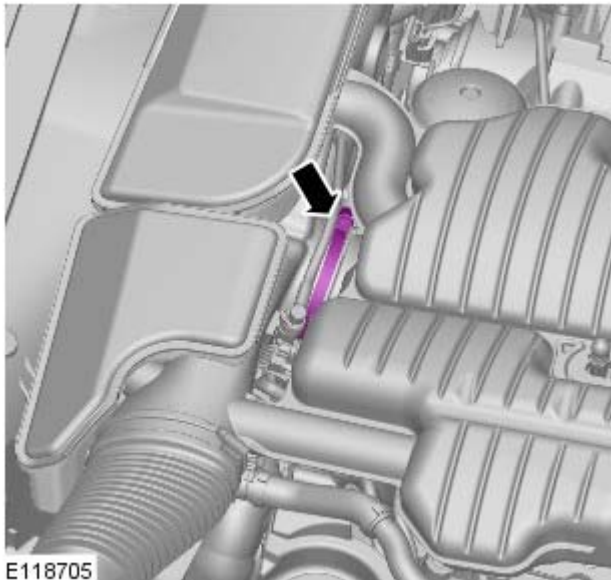
Pipe T-Connector

Removal and Installation

Removal

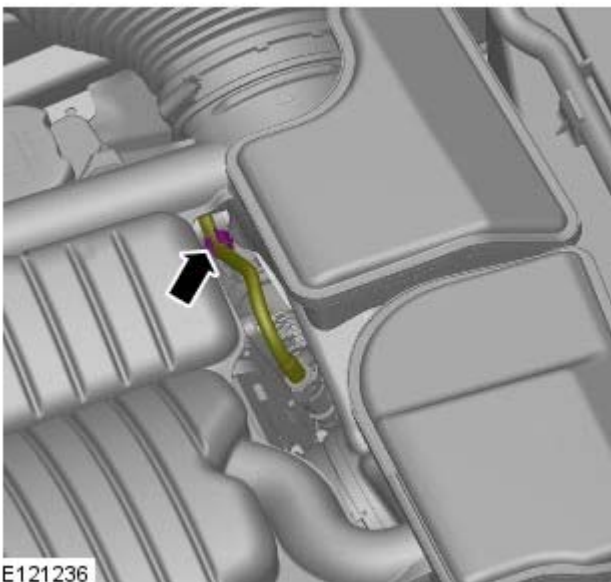
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

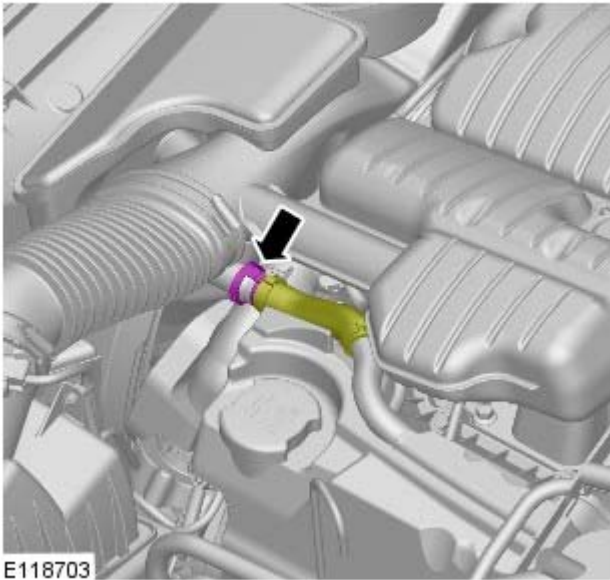


2. **2.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

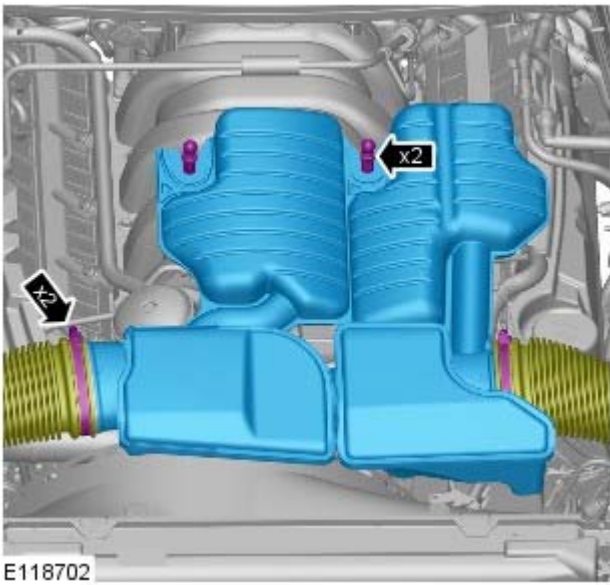
Torque: 3.5 Nm



- 3.



4. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



5. *Torque:* 3.5 Nm

Installation

1. To install reverse the removal procedure.

Evaporative Emissions - V6 4.0L Petrol -

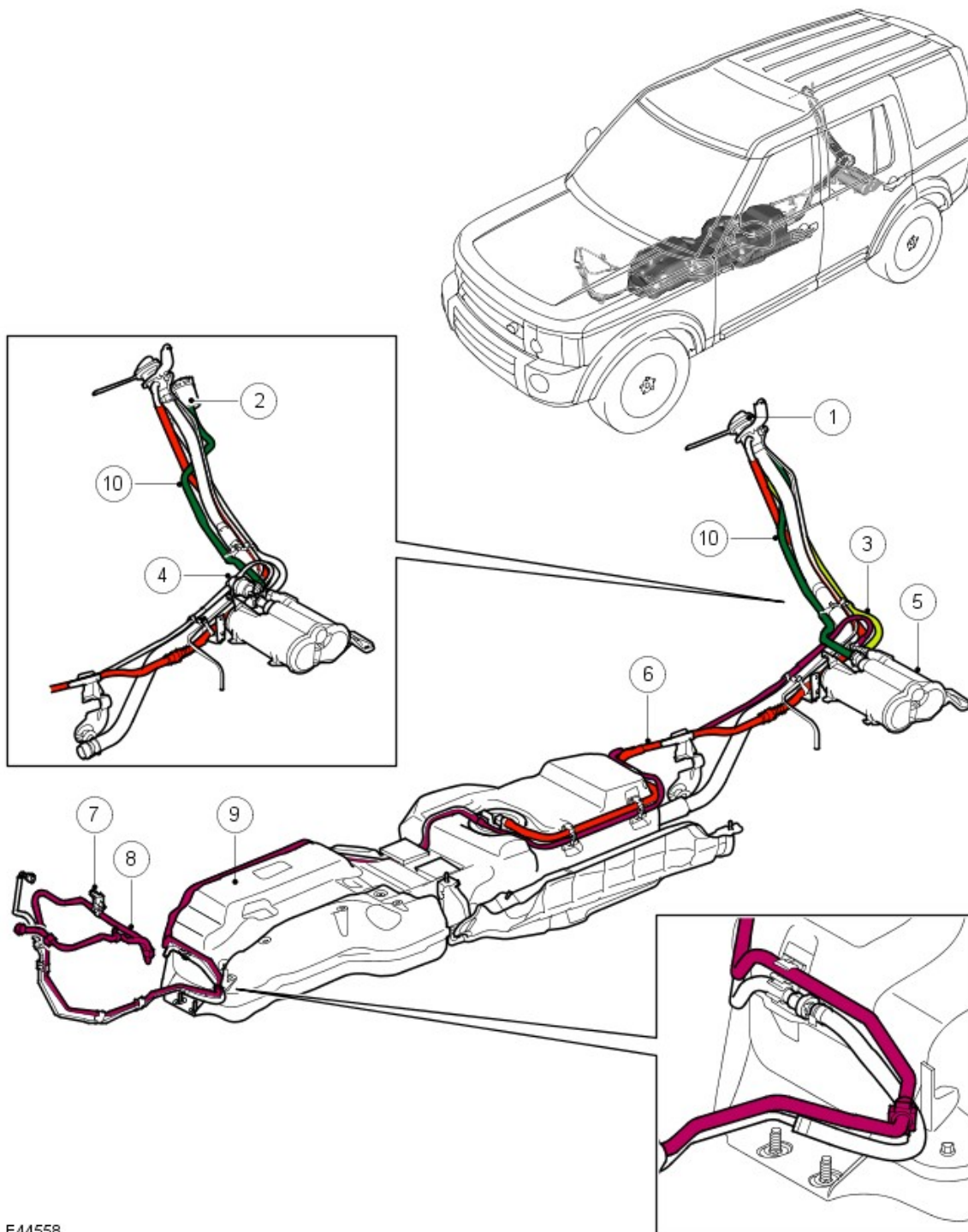
Torque Specifications

Description	Nm	lb-ft
Evaporative emissions canister bolts	23	17

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emissions

Description and Operation

4.0L V6 Evaporative Emissions Component Layout



E44558

Item	Part Number	Description
1	-	Fuel filler head
2	-	DMTL pump filter (NAS only)
3	-	Fuel tank vent hose to canister
4	-	DMTL pump (NAS only)
5	-	Charcoal canister
6	-	Fuel tank breather hose from tank
7	-	Purge valve
8	-	Purge hose
9	-	Fuel tank
10	-	Charcoal canister vent hose (All except NAS) or DMTL pump vent hose (NAS)

GENERAL

The 4.0L V6 Evaporative emission (EVAP) control system reduces the level of hydrocarbons released into the atmosphere by fuel vapor venting from the fuel tank. The system comprises a charcoal canister, purge valve and interconnecting vent pipes and hoses. The vent pipes are connected to the system components using quick release connectors.

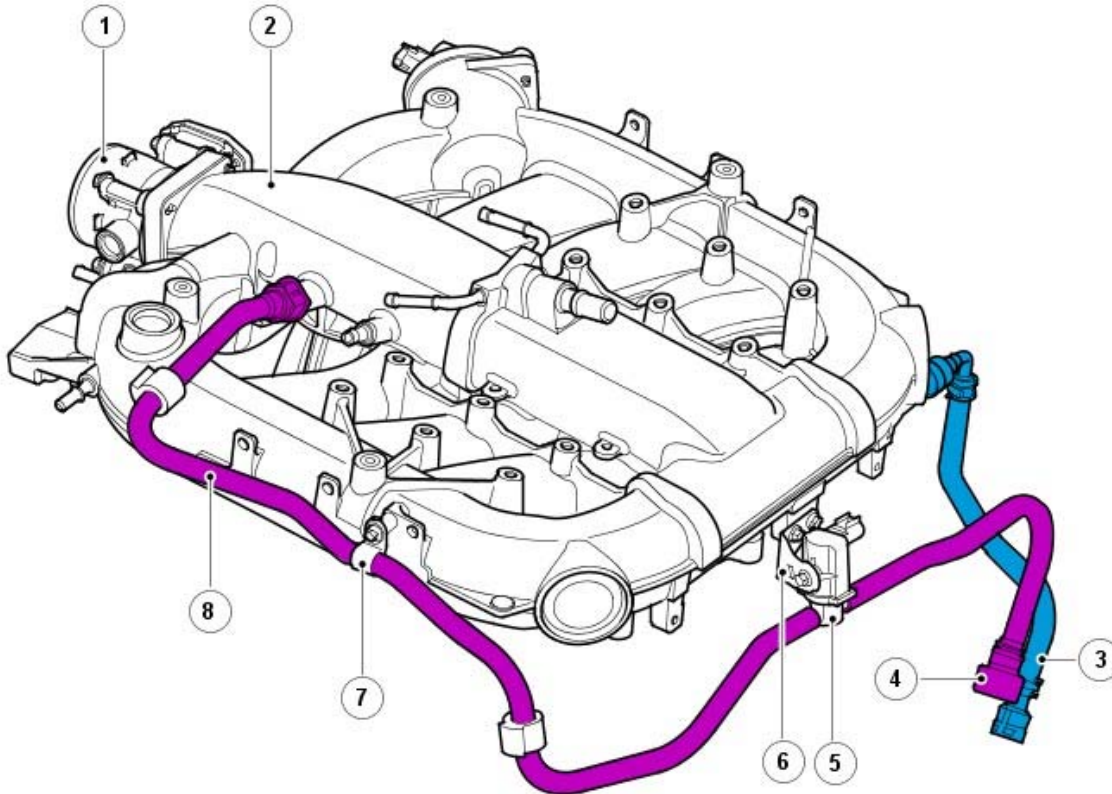
Fuel vapor is generated by the fuel in the tank and the amount of vapor produced increases as the fuel heats up. Fuel vapor can flow freely to the charcoal canister via the tank venting system. The venting system consists of roll over valves and a liquid vapor separator mounted internally in the tank and then externally via a breather line. The breather line allows the fuel vapor to flow to the charcoal canister via a 'Y' piece mounted on the filler head.

On NAS vehicles the vapor generated during refueling flows without restriction to the charcoal canister.

On all vehicles except NAS, the vapor is restricted in its path to the charcoal canister but can flow freely during the refueling operation to atmosphere, via the filler opening.

The vapor passes into the charcoal canister where it is absorbed and stored by the charcoal. Because there is a limit to the amount of vapor the canister can contain, the fuel vapor is purged from the canister when the engine is running and burned in the engine.

PURGE VALVE AND HOSES



E44559

Item	Part Number	Description
1	-	Electric throttle
2	-	Air intake manifold
3	-	Fuel feed jump hose (Ref. only)
4	-	Purge hose
5	-	Purge valve
6	-	Bracket
7	-	Hose clamp
8	-	Manifold to purge valve hose

The purge valve and purge hose are located on the air intake manifold, which is attached to the top of the engine and covered by the engine acoustic cover.

The purge hose is connected, at the right hand rear of the engine, from the purge valve with a quick release coupling to the purge line which runs parallel with the fuel feed line along the top of the fuel tank to the charcoal canister.

The purge hose is connected to the purge valve on the air intake manifold and is routed, via a hose clamp, to a connection on the manifold. The hose is connected to the air intake manifold with a quick release connector.

The purge valve is located on a bracket at the rear of the air intake manifold and secured with a single bolt. The purge valve is a solenoid operated valve which is closed when de-energised. The valve is controlled by the Engine Control Module (ECM) and is cycled when engine operating conditions are correct to allow purging of the charcoal canister.

The purge valve is Pulse Width Modulated (PWM) at 10Hz by the ECM. At this high frequency the pulses of purge gas flowing into the inlet manifold are almost a continuous flow. The valve operates between 5% and 100% duty or mark space ratio (% open time).

The ECM waits until the engine is running above 40°C (104°F) coolant with closed loop fuel operational. Under these conditions the engine

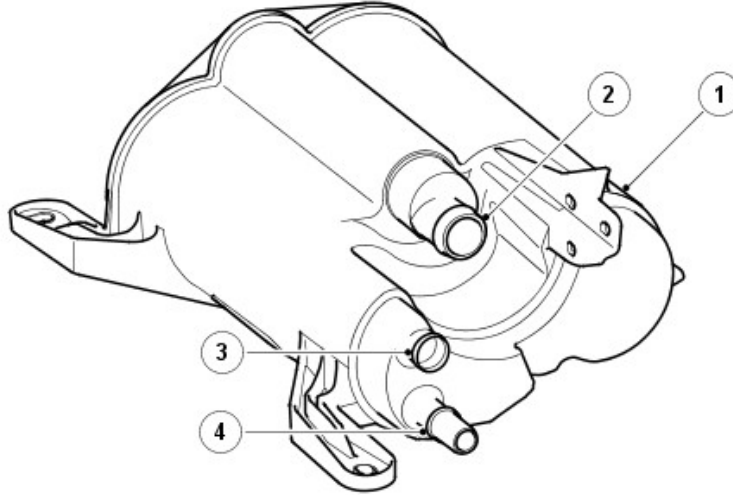
should be running smoothly with no warm up enrichment. The purge valve duty (and flow) is initially ramped slowly because the vapor concentration is unknown (a sudden increase in purge could cause the engine to flood). The concentration is then determined from the amount of adjustment that the closed loop fuelling is required to make to achieve the target Air Fuel Ratio (AFR). Once the concentration has been determined, the purge flow can be increased rapidly and the injected fuel can be proactively adjusted to compensate for the know purge vapor and the target AFR control is maintained.

When the purging process is active, fresh air is drawn into the charcoal canister via the DMTL pump atmospheric vent connection and its filter on NAS vehicles and via the vent hose connection and the spider trap on non NAS vehicles.

On NAS vehicles the system does not include a pressure test point. Pressure testing of the purge valve hose is achieved by disconnecting the purge valve joint on the underside of the vehicle, forward of the fuel tank and connecting a special tool to allow the system to be pressure tested. The test performs a pressure test on the purge hose connection forward of the fuel tank back to the charcoal canister. The special tool is then connected to the purge hose connection forward of the fuel tank to perform a pressure test on the purge hose to the purge valve.

CHARCOAL CANISTER

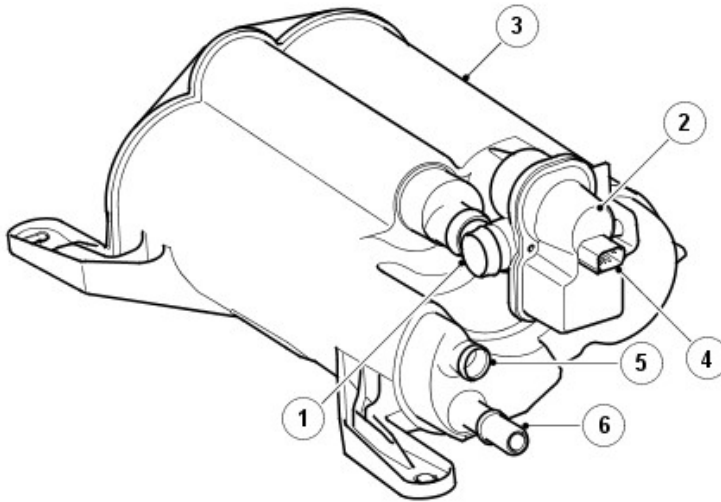
Charcoal Canister - All except NAS



E44560

Item	Part Number	Description
1	-	Charcoal canister
2	-	Charcoal canister atmospheric vent connection
3	-	Purge hose connection
4	-	Charcoal canister tank vent connection

Charcoal Canister - NAS



E44561

Item	Part Number	Description
1	-	Charcoal atmospheric vent connection (via DMTL pump)
2	-	DMTL pump
3	-	Charcoal canister
4	-	Electrical connector
5	-	Purge hose connection
6	-	Charcoal canister vent hose connection

The charcoal canister is located in a central position, forward of the spare wheel. It is attached at the rear with two bolts which screw into the spare wheel carrier. At the front, the canister has two lugs which locate in the parking brake module support bracket.

The canister on ROW vehicles has a capacity of 1400 cc (85.4 in³).

The canister on NAS vehicles has a capacity of 3000 cc (183 in³).

The canister has three ports which allow for the attachment of the atmospheric vent hose, the purge hose and the tank vent hose. On NAS vehicles the atmospheric vent hose connection allows for the attachment of the DMTL pump.

The canister contains a bed of activated charcoal or carbon. The charcoal is produced using special manufacturing techniques to treat the charcoal with oxygen. The oxygen treatment opens up millions of pores between the carbon atoms resulting in a highly porous charcoal with a

very large effective surface area which is capable of absorbing large quantities of fuel vapor. Once treated the charcoal is known as 'activated' carbon or charcoal. The charcoal canister on NAS vehicles uses a higher grade charcoal to meet the requirements of LEV2 emission regulations.

DIAGNOSTIC MONITORING OF TANK LEAKAGE (DMTL) - NAS ONLY

The DMTL system is a legislative requirement for NAS vehicles. The DMTL system periodically checks the EVAP system and the fuel tank for leaks when the ignition is switched off.

The DMTL system comprises the previously described components of the EVAP system with the following additional components: a DMTL pump and a DMTL filter.

The DMTL pump is connected to the atmospheric vent of the charcoal canister and incorporates an electric air pump, a Positive Temperature Co-efficient (PTC) heating element, a normally open valve and a reference orifice. The DMTL pump is only operated when the ignition is switched off and is controlled by the ECM. The ECM also monitors the electric air pump operation and the normally open valve for faults.

The DMTL filter protects the pump from dust being drawn into the system when the pump is being operated. The filter is located on the fuel filler head and is connected to the DMTL pump by a hose.

DMTL Operation

To check the fuel tank and the EVAP system for leaks, the ECM operates the DMTL pump and monitors the current draw. Initially, the ECM establishes a reference current by pumping air through the reference orifice and back to atmosphere. Once the reference current is determined, the ECM closes the normally open valve which seals the EVAP system. The purge valve remains de-energised and is therefore closed. The output from the air pump is diverted from the reference orifice and into the EVAP system.

When the normally open valve is closed, the load on the air pump falls to zero. Providing there are no leaks, the air pump will begin to pressurise the EVAP system and the load and current draw in the pump increases. By monitoring the rate and level of the current increase, the ECM can determine if there is a leak in the EVAP system.

During normal vehicle operation, the ECM energises the heating element in the pump to prevent condensation formation and possible incorrect current readings.

Leaks are classified as:

- Minor - equivalent to a hole diameter of 0.5 to 1.0 mm (0.02 to 0.04 in)
- Major - equivalent to hole diameter of 1.0 mm (0.04 in) or greater.

The ECM performs a check for major leaks each time the ignition is switched off, providing the following conditions are met:

- The vehicle speed is zero
- The engine speed is zero
- The pressure altitude (70kPa (10.15 lbf/in²) derived from engine load calculations) is below 3047 m (10,000 feet)
- The ambient temperature is between 0 and 40°C (32 and 104°F)
- The charcoal canister load factor is 2 or less (where the load factor is a measure, between -1 and +30, of the fuel vapor stored in the charcoal canister. Where -1 is 0% fuel vapor, 0 is stoichiometric fuel vapor level and +30 is 100% saturated with fuel vapor.
- The fuel tank level is valid and between 15 and 85% of nominal capacity
- The engine running time during the previous cycle was more than 10 minutes
- The battery voltage is between 10 and 15 volts
- The last engine off time was more than 180 minutes
- No errors are detected with the EVAP components, the ambient air temperature and the fuel level
- High range must be selected on the transfer box.

• NOTE: A leak test can be performed using T4. This overrides the above conditions and is useful for checking correct system and component operation.

The ECM performs a check for minor leaks after every 14th major leak check or after refuelling is detected.

When the leak check is complete, the ECM stops the DMTL pump and opens (de-energises) the normally open valve.

If the fuel filler cap is opened or refuelling is detected during the leak check, by a sudden drop in the current draw or a rise in the fuel level, the ECM aborts the leak check.

If a leak is detected during the check, the ECM stores an appropriate fault code in its memory. If a leak is detected on two consecutive checks, the ECM illuminates the Malfunction Indicator Lamp (MIL) in the instrument cluster on the next drive cycle.

The duration of a leak check can be between 40 and 270 seconds depending on the results and fuel tank level.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emissions

Diagnosis and Testing

Principles of Operation

For a detailed description of the evaporative emission system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Evaporative Emissions (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel filler cap and seal ● Fuel filler neck ● DMTL fresh air filter (restriction, etc) ● Fuel tank (leaks, damage, etc) ● Fuel lines and joints, etc ● Carbon canister ● Purge valve ● Diagnostic module fuel tank leak (DMTL) pump module 	<ul style="list-style-type: none"> ● Fuses ● Connectors ● Harness ● Purge valve ● Diagnostic module fuel tank leak (DMTL) pump

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.
5. 5. Where K-Line, Vacutec or other proprietary smoke test equipment is available, it should be utilized to assist with Evaporative Emissions System leak diagnosis.

Symptom Chart

Symptom	Possible Causes	Action
Difficulty in filling fuel tank	<ul style="list-style-type: none"> ● Restriction in the vapour line between the fuel tank and the carbon canister outlet/atmospheric port 	Check for restrictions/damage, etc (see visual inspection)
Fuel smell	<ul style="list-style-type: none"> ● System leak ● Purge valve inoperative 	Check for leaks, check the purge valve operation
'Check Fuel Filler Cap' displayed on Message Center	<ul style="list-style-type: none"> ● Fuel filler cap missing/not tightened after refuelling 	Check the fuel filler cap and seal

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Evaporative Leak OBD Fault Rectification Guide

Determine Which DTC Has Been Stored

Using the manufacturer approved diagnostic system, choose **diagnostic session**, then choose the following symptom paths : **Powertrain/engine system/fuel vapour and odor**, **Powertrain/engine system/fuel tank**, **Electrical/instruments /warning lamps/engine malfunction lamp/lamp illuminated**, **Powertrain/engine system/engine performance/fuel consumption high**

• **NOTE:** This guide covers DTCs that relate to evaporative leak monitoring, as listed in the table below

DTC	Description
P0442-00	DMTL small leak
P0447-00	DMTL COV electrical low (open)
P0448-00	DMTL COV electrical high
P0455-00	DMTL rough leak
P2401-00	DMTL pump electrical low (open)
P2402-00	DMTL pump electrical high
P2404-2F	DMTL noise fault
P2404-29	DMTL reference leak

DTC	Description
P2405-00	DMTL reference current low
P2406-00	DMTL reference current high
P2450-00	DMTL COV stuck open
P2451-00	DMTL COV stuck closed
P240B-00	DMTL heater electrical low (open)
P240C-00	DMTL heater electrical high

Attempt To Replicate The Fault Using The "Fuel Leak Check" Forced Test

1. Record any DTCs that has been logged
 2. Using the manufacturer approved diagnostic system, in the **Recommendations** tab run the **Fuel Leak Check** forced test
 3. For the test to run the fuel level must be between 15% and 85%
 4. During this procedure the engine must be off
 5. The possible responses from the test and the associated DTCs are listed below
 6. If again no fault is found it could suggest that the failure mode is a borderline condition (refer to section 3) or that it was caused by incorrect fitment of the fuel cap or the fuel filler neck is at fault therefore it is important not disturb the fuel cap
 7. Disconnect purge pipe from the purge valve, observe the condition of connection (the seating and condition of the "O" ring) and then reconnect. Using the manufacturer approved diagnostic system, run **Purge Valve Self Test** (to clean the purge valve) then run the **Fuel Leak Check**
 8. If the test failed, a smoke test is required to determine the cause of the leak
- NOTE: P240B & P240C are not included in the **Fuel Leak Check** forced test (these monitors run at every ignition on and complete within 30 seconds)

Response Description	ID	Equivalent DTC
Function running: Reference leak measurement	1	
Function running: Rough leak measurement	2	
Function running: Small leak measurement	3	
Function running: 2nd ref leak measurement	4	
Function running: COV Cleaning	5	
Function aborted due to conditions: Vbatt conditions not correct (too high/ low)	11	
Function aborted due to conditions: Variation Ref. I (reference current) too high	12	P2404-29
Function aborted due to conditions: DMTL electrical fault	13	P0447, P0448
Function aborted due to conditions: Maximum diagnostic time exceeded	14	
Function aborted due to conditions: Crash detected	15	
Function aborted due to conditions: Refuel detected	20	
Function aborted due to conditions: Filler cap opened	21	
Function aborted due to conditions: Engine start	23	
Function aborted due to conditions: Noisy current measurement	24	P2404-2F
Function aborted due to conditions: Ambient temp outside range	26	
Function aborted due to conditions: Ambient pressure outside range	27	
Function aborted due to conditions: Other conditions	29	
Function complete - Tight system, fault free	30	
Function complete - Fine leak detected	31	P0442
Function complete - Rough leak detected	32	P0455
Function complete - Module error	33	P2401, P2402, P2450, P2451, P2405, P2406, P2404-29
Function complete - Medium leak detected	34	P0442, P0455

Read The "Ranking values" To Determine How Far Away The Result Is From The Failure Threshold

9. When the **Fuel Leak Check** forced test has completed the test results (known as ranking values) will be displayed
10. These should be compared against the limits shown in the table below
11. If the test result is borderline then there is a risk that a failure will occur at a later date (during customer usage of the vehicle)
12. To avoid this the vehicle should be carefully checked for any small leaks

Ranking Value	Normal Result For Tight System	Leak Failure Condition
Rough Leak (40 thou+)	0 > = 50	>= 128
Small Leak (20 thou+)	0 > = 60	>= 128

TRACE THE ROOT CAUSE OF THE FAULT

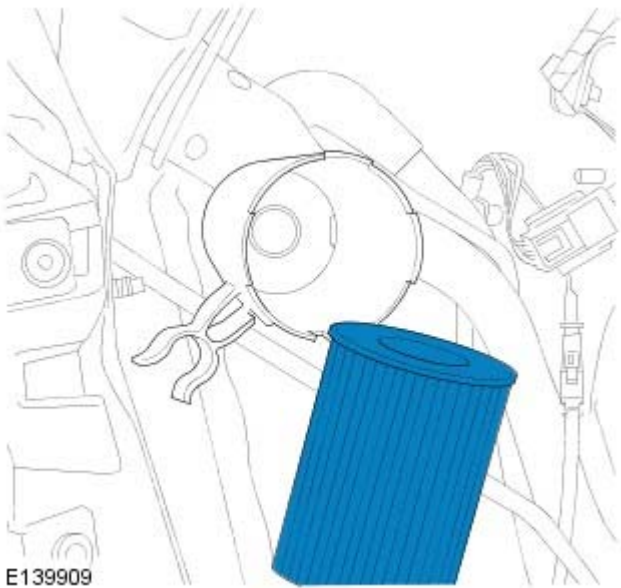
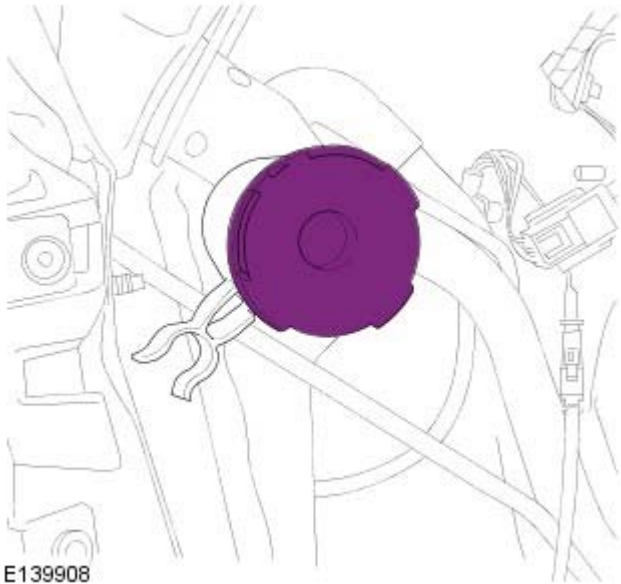
The list below provides some suggested actions to help trace the root cause of the fault

Each action should be followed up with a **Fuel Leak Check** forced test (and ranking value check) in order to determine if any improvement has been made

DTC	Fault Description	Fault Rectification Actions after smoke test
-----	-------------------	--

DTC	Fault Description	Fault Rectification Actions after smoke test
P0442-00	DMTL small leak	<ul style="list-style-type: none"> ● 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filler neck protrudes) ● 2. Run engine at idle; Using the manufacturer approved diagnostic system, run Purge Valve Self Test (to clean the purge valve) ● 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition ● 4. Check all fuel system connections are correctly installed and secure ● 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage ● 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe ● 7. Carry out a smoke test ● 8. Replace the DMTL module
P0447-00	DMTL COV electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits tightly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P0448-00	DMTL COV electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module
P0455-00	DMTL rough leak	<ul style="list-style-type: none"> ● 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filler neck protrudes) ● 2. Run engine at idle; Using the manufacturer approved diagnostic system, run "Purge Valve Self Test" (to help clean the purge valve) ● 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition (surprisingly, this is a potential leakage path!) ● 4. Check all fuel system connections are correctly installed and secure ● 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage ● 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe ● 7. Carry out a smoke test ● 8. Replace DMTL module
P2401-00	DMTL pump electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits correctly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P2402-00	DMTL pump electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module
P2404-2F	DMTL noise fault	<ul style="list-style-type: none"> ● Replace DMTL module
P2404-29	DMTL reference leak	<ul style="list-style-type: none"> ● Replace DMTL module
P2405-00	DMTL reference current low	<ul style="list-style-type: none"> ● Replace DMTL module
P2406-00	DMTL reference current high	<ul style="list-style-type: none"> ● 1. Check for any blockages in the DMTL ventilation pipe & filter ● 2. Replace DMTL module
P2450-00	DMTL COV stuck open	<ul style="list-style-type: none"> ● Replace DMTL module
P2451-00	DMTL COV stuck close	<ul style="list-style-type: none"> ● Replace DMTL module
P240B-00	DMTL heater electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits tightly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P240C-00	DMTL heater electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module

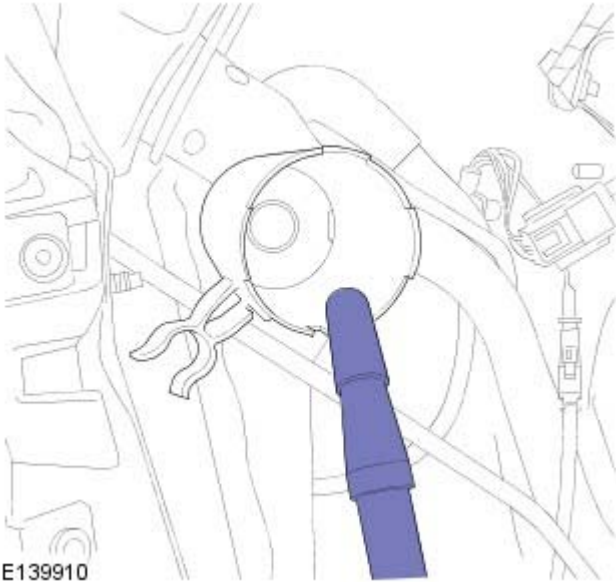
Pre and 10MY Denso/Bosch PCM Systems



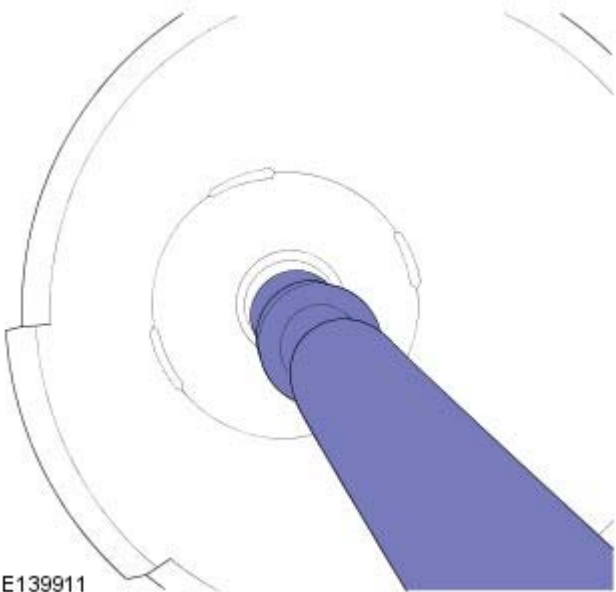
CAUTION: The Maximum pressure of the EVAP system is 0.07 bar **do not exceed**

• **NOTE:** Apart from the purge valve connection, it is recommended to smoke test the EVAP system without disturbing any joints associated with the system, this will determine the leak more accurately and quickly

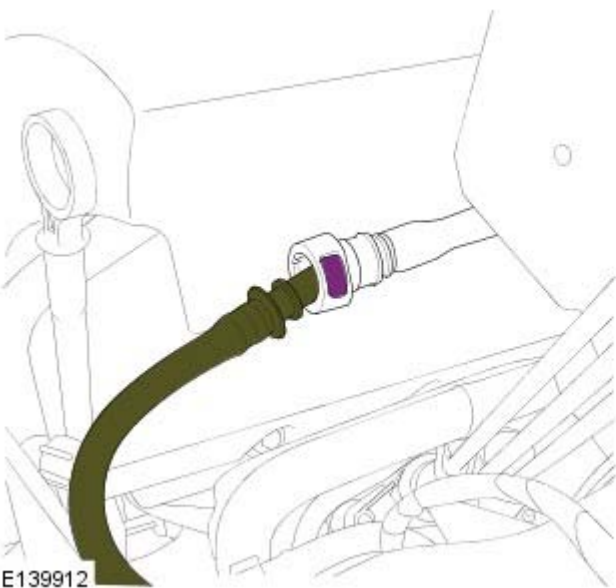
- 1. Remove rear wheel arch liner to access fuel filler neck
- 2. On the fuel filler neck the DMTL filter will be visible as shown in picture. Unclip filter housing from fuel filler neck to gain better access to DMTL filter
- 3. Remove carefully the top of filter to expose filter and remove
- 4. Attach rubber adapter to tip of smoke machine nozzle to ensure tight seal to filter housing. Disconnect the purge pipe from purge valve; this will be an escape point for the smoke to exit
- 5. Allow tester to complete self-test and green READY light to turn ON 2. For best Tester performance; completely unwind Tester's supply hose
- 6. Press **Smoke** on control panel to fill EVAP system with smoke vapour. The control panel **Smoke** light will light indicating smoke production. The smoke setting is on a 15 minute timer. Pressing the **Smoke** button again turns Tester off. It is normal for the flow meter ball, while in the smoke mode, not to be as steady as when it is in the **Test** mode. Note: The pressure gauge is active only after smoke cycle is complete
- 7. Continue introducing smoke into the EVAP System until the flow meter's ball stops descending and this assures the system test pressure is met and smoke will appear from the purge pipe, then close off purge pipe with special tool (Test Adapter Hose/EVAP Port 310-142)



E139910



E139911



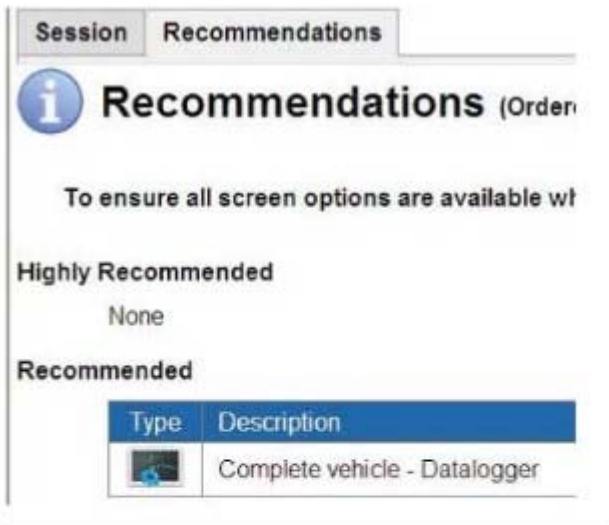
E139912



CAUTION: On some vehicles, the DMTL filter can not be removed, in these instances fill the system through the purge valve and smoke will appear from the filter

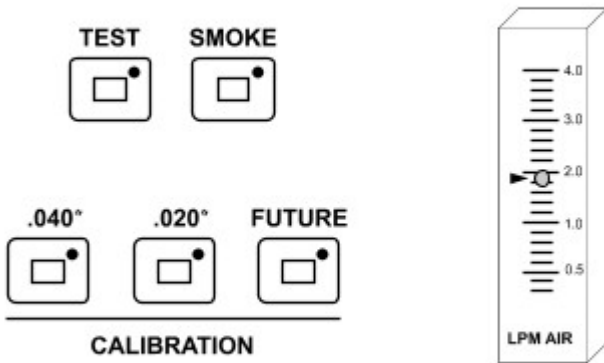
Pre 10MY Vehicles

On pre 10MY DMTL systems, Using the manufacturer approved diagnostic system, select **Measurement application** session then select the **Recommendations** tab which will give you access to **Datalogger**. Then select **Engine systems** then select the **Output state control** data-logger signal **Engine output 1 – diagnostic module – tank leakage -change over valve active** which will close the system. Then select **Engine output 1 – diagnostic module – tank leakage – pump active** this will pressurize the EVAP system



- Engine output 1 - engine management system warning lamp.
- Engine output 1 - malfunction indicator warning lamp.
- Engine output 1 - diagnostics module - tank leakage - test complete.
- Engine output 1 - diagnostics module - tank leakage - heater active.
- Engine output 1 - diagnostics module - tank leakage - pump active.
- Engine output 1 - diagnostics module - tank leakage - changeover valve active.
- Engine output 2 - heated exhaust gas oxygen heater active - bank 2.

E139916



E139913

10MY vehicles

On 10MY vehicles a smoke test application is available so therefore only smoke fill the system and then run the application

- 8. Follow the EVAP system path with the halogen light provided and looks for the smoke exiting the leak(s) or use the UV light provided and look for the dye deposited at the exact location of the leak(s)
- 9. Repair the leak(s) and perform the **Fuel Leak Check** application again or smoke test to verify repair, as well as to make sure there are no additional leaks in the EVAP system

The UltraTraceUV® smoke solution's dye feature is especially helpful when the leak is in an area that is not readily visible, as on the top of the fuel tank or behind a panel. Once you gain access to the area of the leak, wear the yellow UV glasses and shine the UV light provided to identify the exact location of the leak(s). Smoke exiting a very small leak is even easier to see with lower pressure. If you encounter smoke leaking out of an area but find it difficult to pinpoint exactly where the source of the leak is; try reducing the pressure in the system being tested by turning the Tester OFF and allow the pressure to dissipate. The longer a particular leak is allowed to leak, the more fluorescent dye material will be deposited

at that leak. With some vapour system leaks, the leak may only present itself under vacuum and not under pressure. If equipment permits, test the system in both states. Purge valve faults [P0441, P0444, P0458 and P0459] should all inhibit DMTL leak test and therefore need to be resolved prior to any DMTL issues. For this reason, when smoke testing the vapour system, it should be sufficient to enter the system at the connection up stream of the purge valve. If no leak is found then testing the remainder of the system up to the purge valve is recommended

• **NOTE:** It may be possible to search for small leaks using a gas analyzer and looking for HC (hydro carbon) spikes. This should enable leaks to be detected in areas of the vapor system that our out of sight of the technician. The solenoid should be deactivated after five minutes to prevent potential damage. Check that connector and individual terminals are sealed correctly

Phase-One – (quantifying the leak)



E139914

- 1. Connect the tester supply hose to vehicle EVAP system. > Refer to appropriate vehicle application
- 2. Determine if the vehicle's EVAP system you are testing is governed by a .020" (0.5 mm) or .040" (1 mm) acceptable leak standard. Press the appropriate calibration standard on the tester's control panel and observe the position of the flow meter ball. > This function automatically turns off in 10 seconds
- 3. Position the flow meter's pointer flag so that it aligns with the measurement observed in step 2 above. > This sets PASS / FAIL mark
- 4. Close vehicle's EVAP Vent Solenoid. > Refer to appropriate vehicle application
- 5. Press TEST on control panel and fill EVAP system. > This introduces 5-minutes of nitrogen gas
- 6. Look for flow meter ball to stop descending indicating that the vehicle system is full. > Fill time 1-4 minutes depending on system volume
- 7. Compare flow meter ball reading to pointer flag. > ABOVE flag = FAIL (go to Phase-Two). > BELOW flag = PASS (test complete)

Testing With Pressure and Vacuum Decay

In addition to quantifying the leak with the Phase-One flow test, the Tester allows you the flexibility of testing the vehicle's EVAP system by using either **Pressure Decay** or **Vacuum Decay** methods. Below are instructions for performing both decay tests

Pressure-Decay Test

• **NOTE:** The Pressure Decay test is best performed immediately after the Phase-one flow test, since the system has already built up pressure

At the completion of the Phase-one flow test, the EVAP system is fully pressurized, since the Phase-one test uses pressure to perform its flow test. Testing pressure decay with the Vacutec® 522B-J/LR is very simple. All you need to do is the following:

- 1. Allow tester to complete self-test and green **READY** light to turn ON
- 2. Connect Tester supply hose to vehicle EVAP system
- 3. Close vehicle's EVAP Vent solenoid > Refer to appropriate vehicle application
- 4. Press **VACUUM** switch on the tester control panel
 - NOTE: The vacuum switch is on a 30-second timer, which should be sufficient time to draw the appropriate vacuum from the EVAP system. Press **VACUUM** switch again if additional time is required
- 5. After vacuum timer turns off, observe the vacuum gauge for any decay (loss of vacuum) indicating a leak in the EVAP system




E139915


- NOTE: Disconnect the Tester from the vehicle after the Vacuum Decay Test. The fuel pressure in the vehicle's fuel tank is constantly changing due to the vehicle's fuel volatility and that could cause the Tester's pressure gauge to exceed its maximum reading limits

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission System Leak Test

General Procedures

Special Tool(s)	
 <p>310-142</p> <p>E67117</p>	EVAP tool 310-142


• NOTE: The following procedure allows a fuel leak, indicated by the Malfunction Indicator Lamp (MIL), to be accurately located. The test must only be carried out once it has been established that there are no obvious faults with any of the fuel system components.

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Position the vehicle on a lift.

- Check the components in the fuel and EVAP system for obvious damage. Make sure all the connections are secure.
- Connect T4 to the vehicle.
 - Run the DMTL test.
 - Follow the on-screen prompts and force the DMTL to close.

4. WARNINGS:

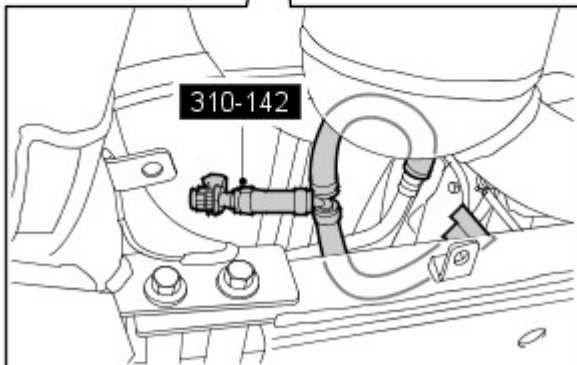
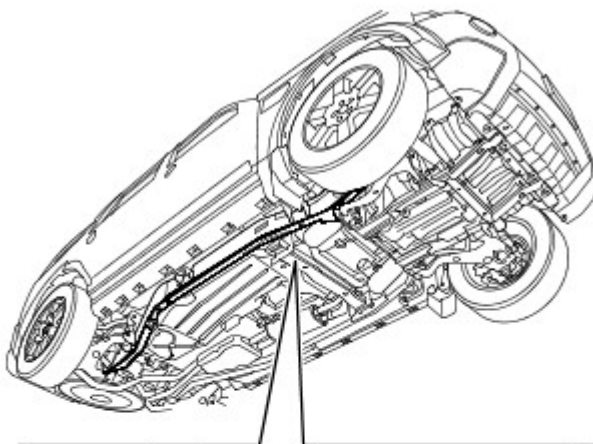
 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.


 **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Install the special tool to the purge line.

- Release the clip and disconnect the purge line.
- Clean the component mating faces.
- Connect the special tool.



E67118

-  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the purge line at the emission canister line.


- Release the clip.
6. Carry out the procedures in order, from the instruction sheet supplied with the EVAPS diagnostic testing station 310-115 (LRA-19-004) or (LRA-19-005A).
 7. When a leak is detected, replace the component as necessary and repeat the test to validate the repair.
 8. Connect the purge line to the emission canister line.
 - Clean the component mating faces.
 - Secure with the clip.
 9. Disconnect the special tool from the purge line.
 - Clean the component mating faces.
 - Connect the purge line.
 10. Disconnect T4 from the vehicle.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission Canister

Removal and Installation

Removal

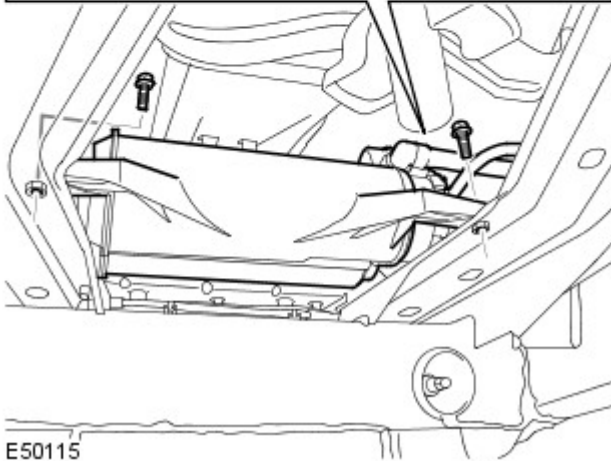
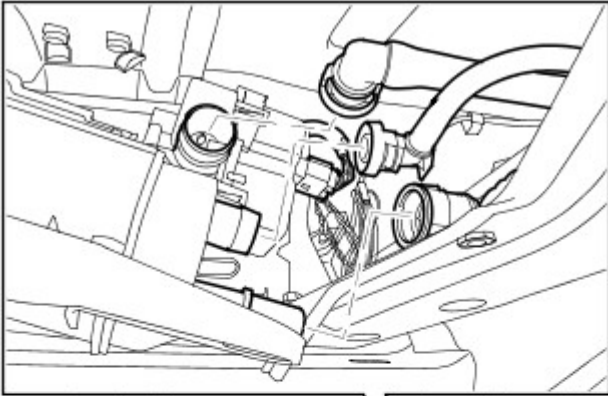
1. Remove the spare wheel and tire.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the evaporative emissions canister.

- Remove the 2 bolts.
- Disconnect the 3 lines.
- Disconnect the electrical connector.



E50115

4. **NOTE:** Do not disassemble further if the component is removed for access only.

NAS vehicles: Remove the fuel tank leakage detection module.

- Remove the 3 screws.



E50116

Installation

1. NAS vehicles: Install the fuel tank leakage detection module.

- Install the screws.

2. Install the evaporative emissions canister.

- Connect the electrical connector.
- Connect the lines.

- Tighten the bolts to 23 Nm (17 lb.ft).

3. Install the spare wheel and tire.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission Canister

Purge Valve


Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold casting.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. **NOTE:** Note the fitted position.

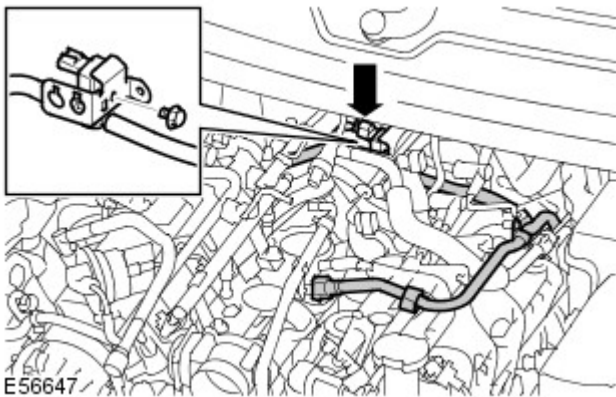
Release the purge valve from the mounting bracket.

- Remove the bolt.

4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the purge valve.

- Disconnect the 2 hoses.
- Disconnect the electrical connector.



E56647

Installation

1. Connect the purge valve.
 - Connect the hoses.
 - Connect and secure the electrical connector.

2. **NOTE:** Align to the position noted on removal.

Install the purge valve, align the peg and tighten the bolt to 6 Nm (4 lb.ft).


3. Install the intake manifold casting.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Evaporative Emissions - V6 4.0L Petrol - Fuel Tank Leakage Monitoring Pump

Removal and Installation

Removal

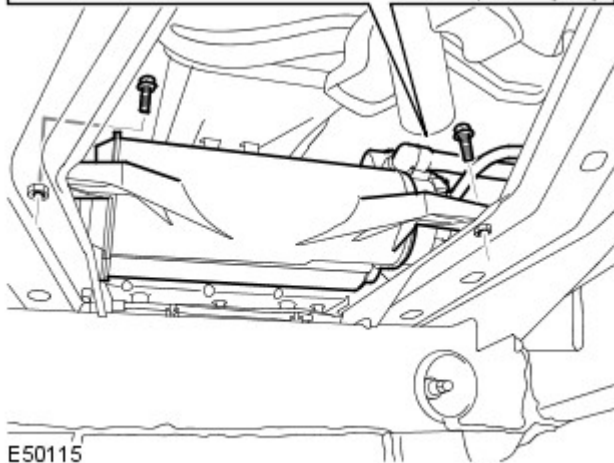
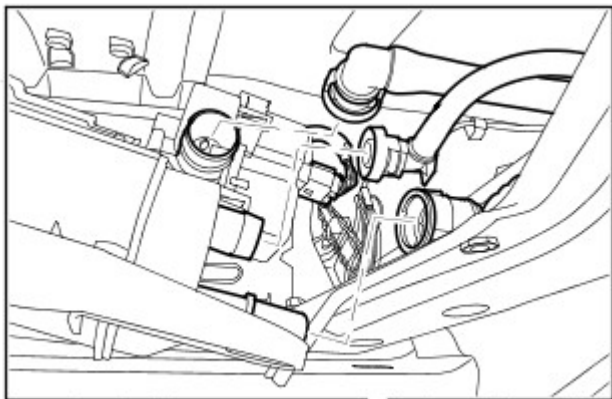
1. Remove the spare wheel and tire.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the evaporative emissions canister.

- Remove the 2 bolts.
- Disconnect the 3 lines.
- Disconnect the electrical connector.



E50115

4. Remove the fuel tank leakage detection module.

- Remove the 3 screws.



E50116

Installation

1. Install the fuel tank leakage detection module.

- Install the screws.

2. Install the evaporative emissions canister.

- Connect the electrical connector.

- Connect the lines.
- Tighten the bolts to 23 Nm (17 lb.ft).

3. Install the spare wheel and tire.


Evaporative Emissions - V6 4.0L Petrol - Fuel Tank Leakage Monitoring

Pump Filter

Removal and Installation

Removal

1. Remove the spare wheel and tire.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Position the vehicle on a lift.

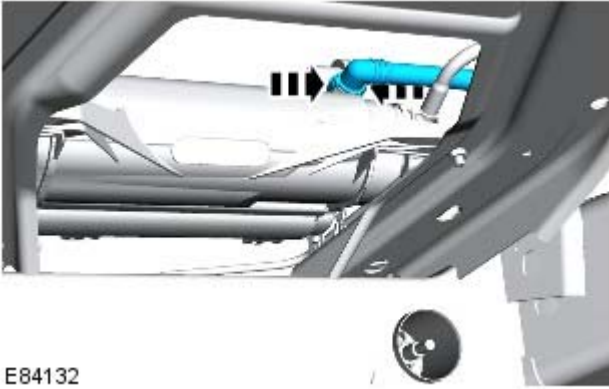
3. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

4. Remove the RH rear wheel and tire.

5. Remove the fender moulding.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

6. Release the fuel leak detection filter.

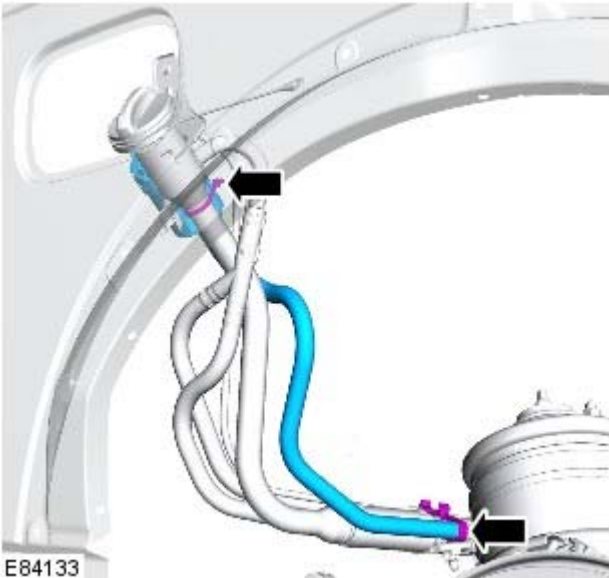
- Disconnect the breather hose from the fuel leak detection pump.



E84132

7. Remove the fuel leak detection filter and breather hose assembly.

- Release the breather hose from the clip.
- Remove and discard the cable tie.



E84133

Installation

1. Install the fuel leak detection filter and breather hose assembly.

- Secure with a cable tie.
- Secure the breather hose in the clip.

2. Attach the fuel leak detection filter breather hose to the

pump.

3. Install the fender moulding.

For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

4. Install the RH rear wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

5. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

6. Install the spare wheel and tire.

Evaporative Emissions - V6 4.0L Petrol - Evaporative Emission Canister Ventilation Filter

Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

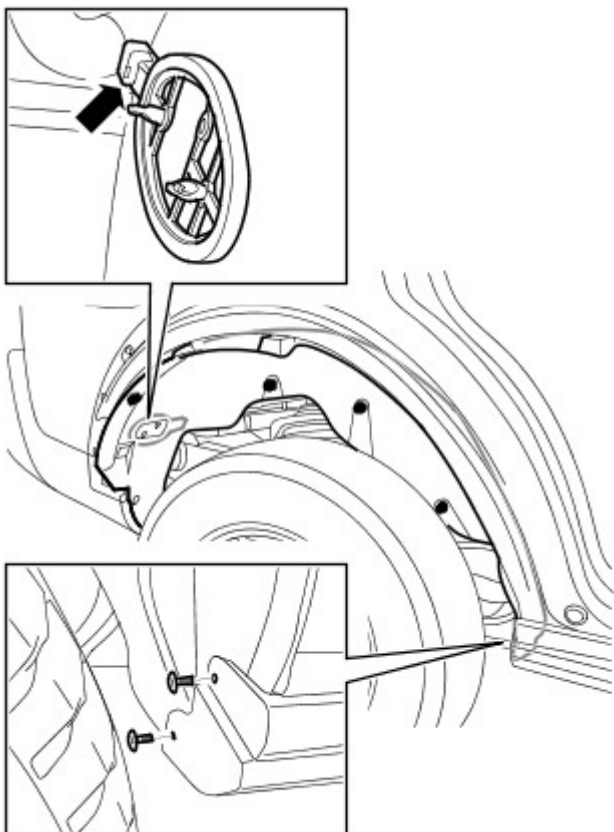
Raise and support the vehicle.

2. Remove the RH rear wheel and tire.
3. Remove the RH rear quarter panel moulding.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

4. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Remove the RH rear fender splash shield.

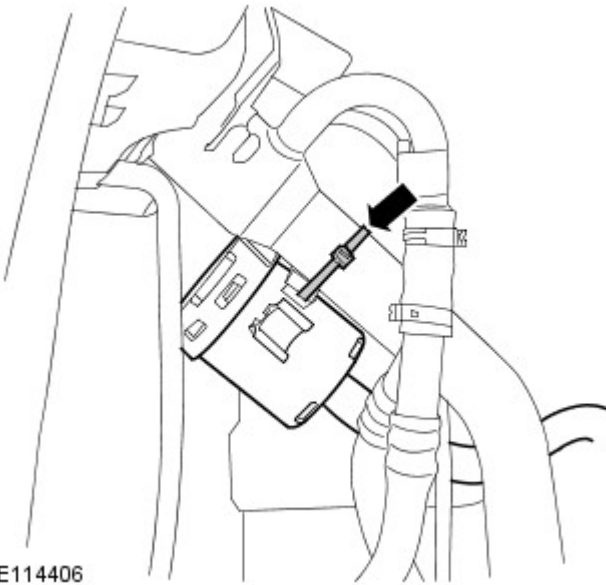
- Remove the 2 screws.
- Remove the 6 retainers.
- Disconnect the electrical connector.



E48478

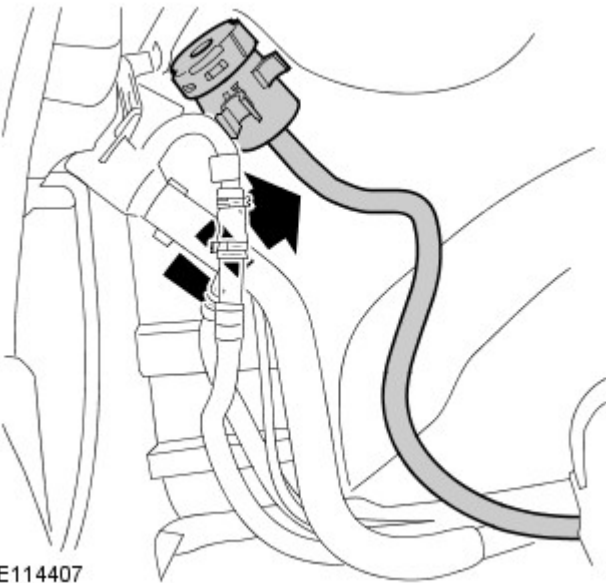
5. Release the evaporative emission canister ventilation filter from the fuel filler pipe.

- Cut the cable tie.



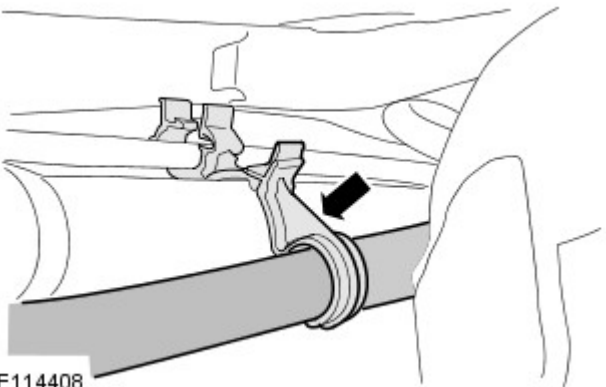
E114406

6. Position the evaporative emission canister ventilation filter to one side.



E114407

7. Release the evaporative emission ventilation filter from the clip.

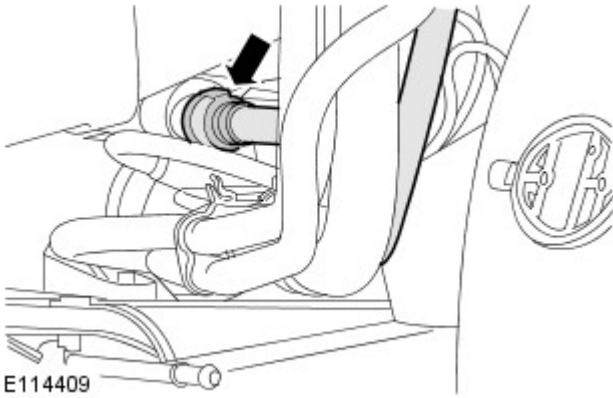


E114408

8. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the evaporative emission canister ventilation filter.

- Release the evaporative emission canister ventilation filter from the evaporative emission canister.



Installation

1. To install reverse the removal procedure.

Evaporative Emissions - V8 5.0L Petrol -

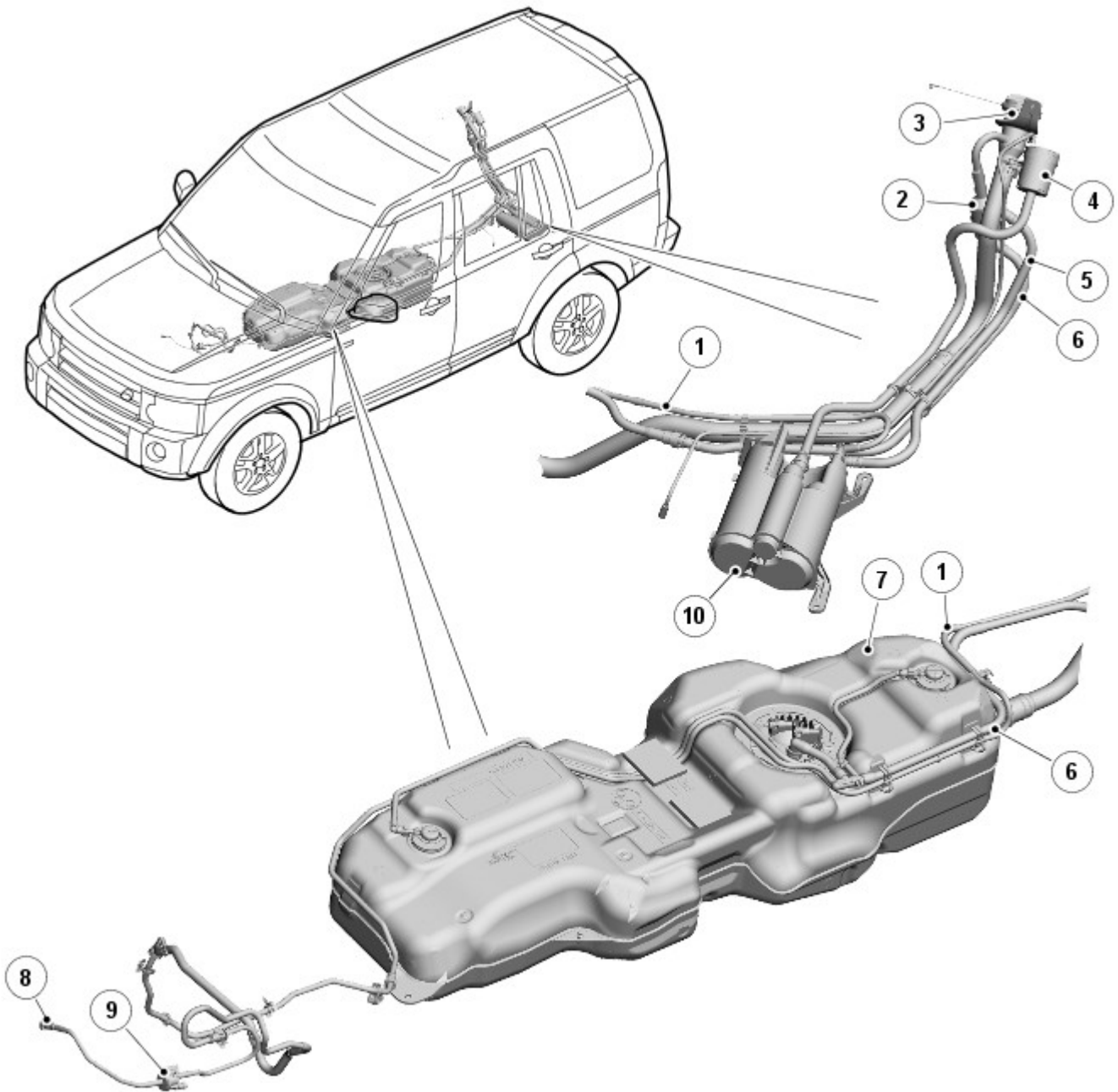
Torque Specifications

Description	Nm	lb-ft	lb-in
Evaporative emission canister retaining bolts	19	14	-

Evaporative Emissions - V8 5.0L Petrol - Evaporative Emissions

Description and Operation

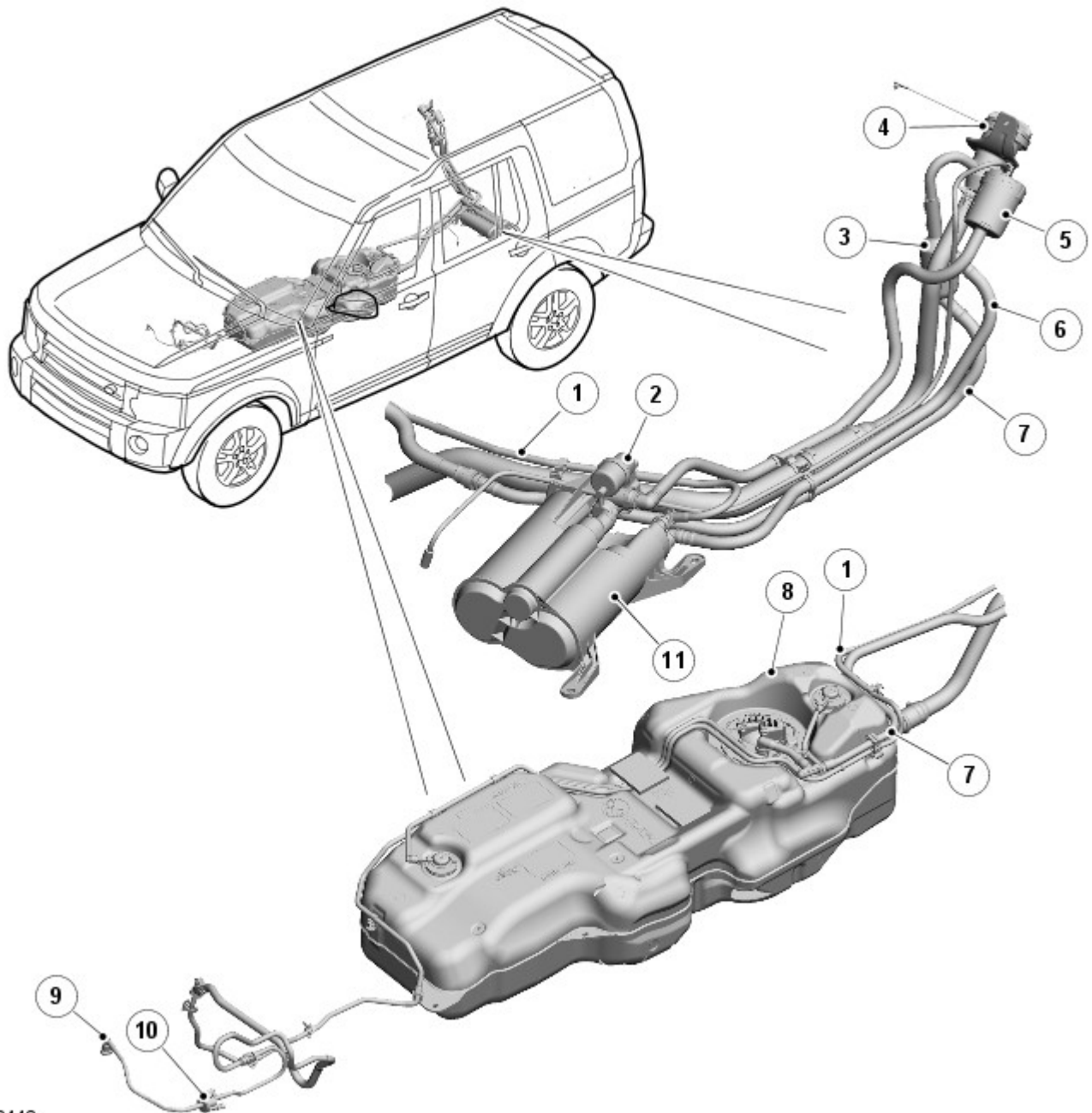
COMPONENT LOCATION - ALL EXCEPT NAS



E122441

Item	Part Number	Description
1	-	Charcoal canister to purge valve pipe
2	-	Vapor separator
3	-	Fuel filler pipe and cap
4	-	Atmospheric vent filter
5	-	Vapor separator to charcoal canister pipe
6	-	Fuel tank to vapor separator pipe
7	-	Fuel tank
8	-	Purge line connector to intake manifold
9	-	Purge valve
10	-	Charcoal canister

COMPONENT LOCATION - NAS



E122442

Item	Part Number	Description
1	-	Charcoal canister to purge valve pipe
2	-	DMTL (diagnostic module tank leakage) pump
3	-	Vapor separator
4	-	Fuel filler pipe and cap
5	-	Atmospheric vent filter
6	-	Vapor separator to charcoal canister pipe
7	-	Fuel tank to vapor separator pipe
8	-	Fuel tank
9	-	Purge line connector to supercharger
10	-	Purge valve
11	-	Charcoal canister

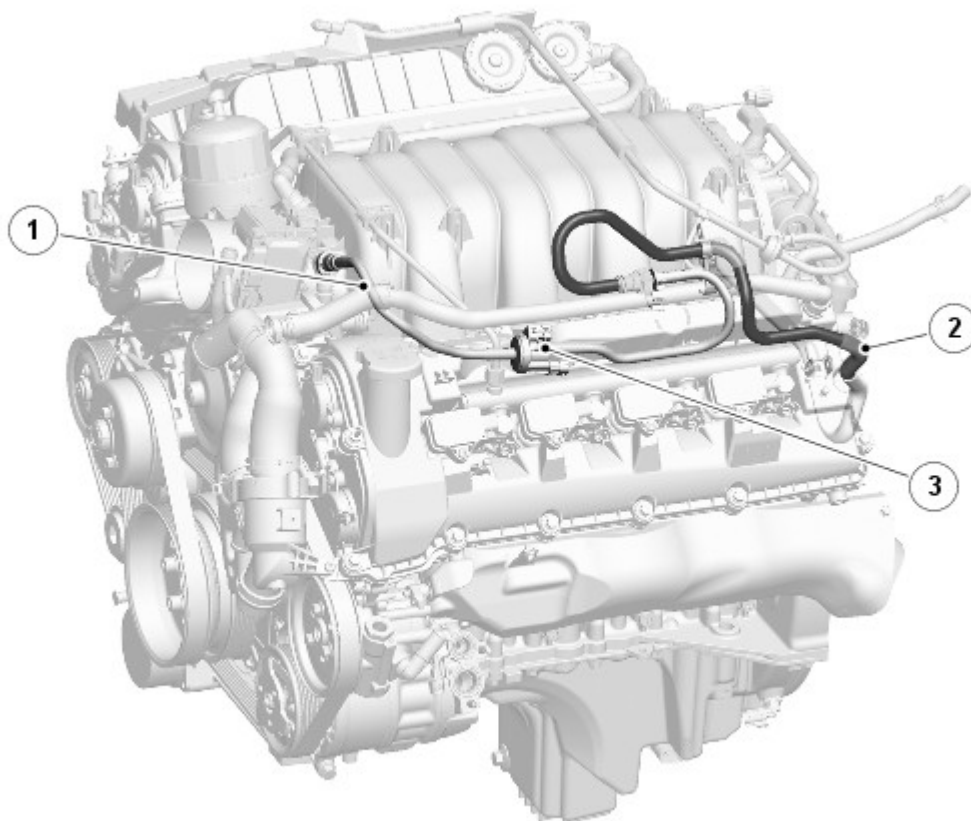
INTRODUCTION

The **EVAP (evaporative emission)** control system reduces the level of hydrocarbons released into the atmosphere by fuel vapor venting from the fuel tank. The system comprises a charcoal canister, purge valve and interconnecting vent pipes. The vent pipes are connected to the system components using quick release connectors.

Fuel vapor is generated by the fuel in the tank and the amount of vapor produced increases as the fuel heats up. Fuel vapor flows to the charcoal canister through the tank vent pipes, via a liquid/vapor separator.

The vapor from the liquid/vapor separator is absorbed and stored by the charcoal canister. Because there is a limit to the amount of vapor the canister can contain, the fuel vapor is purged from the canister when the engine is running and burned in the engine during the combustion cycle.

PURGE VALVE AND PIPES



E122118

Item	Part Number	Description
1	-	Pipe to engine
2	-	Pipe from charcoal canister
3	-	Purge valve

The purge valve is installed on a bracket attached to the **LH (left-hand)** cylinder head cover. The pipe to the engine from the purge valve is connected to the intake manifold (naturally aspirated vehicles), or **SC (supercharger)** front cover (**SC** vehicles), with a quick release connector. The pipe to the charcoal canister from the purge valve is installed between the **LH** cylinder head cover and ignition coil cover. From the rear of the **LH** cylinder head, the pipe then goes across the back of the engine, along the **RH (right-hand)** side of the transmission, along the fuel tank and rearwards of the tank to the charcoal canister.

The purge valve is a solenoid operated valve, which is closed when de-energized. The valve is controlled by the **ECM (engine control module)** and is operated when engine operating conditions are suitable for purging of the charcoal canister.

The purge valve is controlled by a **PWM (pulse width modulation)** signal at 10 Hz from the **ECM**. At this frequency, the pulses of purge gas flow into the engine in an almost continuous flow. The valve operates between 0% and 99% duty or mark space ratio (% open time).

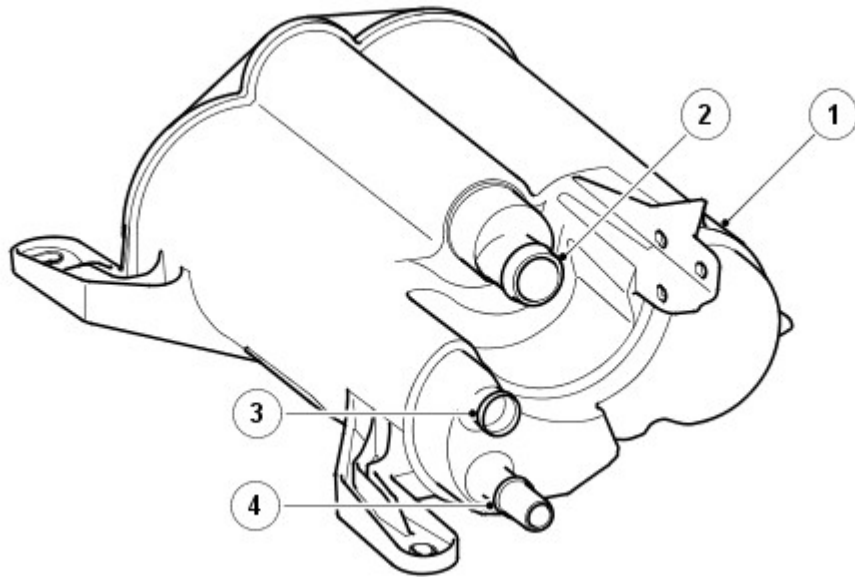
The atmospheric pressure at the air intake vent of the system is higher than the inlet manifold pressure under all throttled engine running conditions. It is this pressure differential across the system that causes the air to flow through the air intake of the purge system and in to the engine. The operation of the supercharger does not affect the purging process.

The **ECM** waits until the engine is running with a coolant temperature of 55 °C (131 °F) or above and closed loop fuel operational before the purging process is activated. Under these conditions the engine should be running smoothly with no warm up enrichment. The purge valve duty (and flow) is initially ramped slowly because the vapor concentration is unknown (a sudden increase in purge could cause the engine to stall or loss of AFR (air fuel ratio) control to occur). The concentration is then determined from the amount of adjustment that the closed loop fueling is required to make to achieve the target AFR. Once the concentration has been determined, the purge flow can be increased and the injected fuel can be proactively adjusted to compensate for the known purge vapor and the target AFR control is maintained.

When the purging process is active, fresh air is drawn into the charcoal canister via the atmospheric vent filter and, on NAS vehicles, the DMTL pump.

CHARCOAL CANISTER

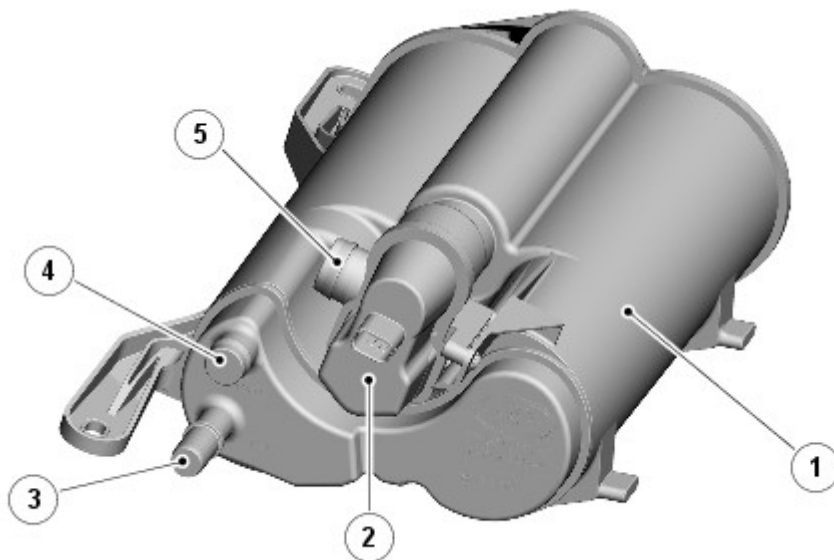
Charcoal Canister - All Except NAS



E44560

Item	Part Number	Description
1	-	Charcoal canister
2	-	Atmospheric vent pipe connection
3	-	Fuel tank vent pipe connection
4	-	Purge valve pipe connection

Charcoal Canister - NAS



E122119

Item	Part Number	Description
1	-	Charcoal canister
2	-	DMTL pump
3	-	Purge valve pipe connection
4	-	Fuel tank vent pipe connection
5	-	Atmospheric vent pipe connection

The charcoal canister is located in a central position, forward of the spare wheel. It is attached at the rear with two bolts which screw into the spare wheel carrier. At the front, the canister has two lugs which locate in the [EPB \(electronic parking brake\)](#) module support bracket.

The canister on all except NAS vehicles has a capacity of 1400 cc (85.4 in³).

The canister on NAS vehicles has a capacity of 3000 cc (183 in³).

The canister has three connections for attachment of the pipes from the atmospheric vent, the purge valve and the tank vent. On NAS vehicles, the DMTL pump is installed between the atmospheric vent connection and the atmospheric vent pipe.

The canister contains a bed of activated charcoal or carbon. The charcoal is produced using special manufacturing techniques to treat the charcoal with oxygen. The oxygen treatment opens up millions of pores between the carbon atoms resulting in a highly porous charcoal with a very large effective surface area which is capable of absorbing large quantities of fuel vapor. Once treated the charcoal is known as 'activated' carbon or charcoal. The charcoal canister on NAS vehicles uses a higher grade charcoal to meet the stricter emissions regulations.

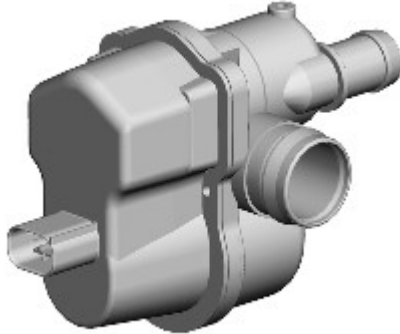
A filter on the atmospheric vent prevents dust being drawn into the system. The filter is located by the fuel filler cap.

DIAGNOSTIC MODULE TANK LEAKAGE - NAS ONLY

The DMTL system is a legislative requirement for NAS vehicles. The DMTL system periodically checks the [EVAP](#) system and the fuel tank for leaks when the ignition is switched off.

The DMTL system comprises the previously described components of the [EVAP](#) system and a DMTL pump.

DMTL Pump



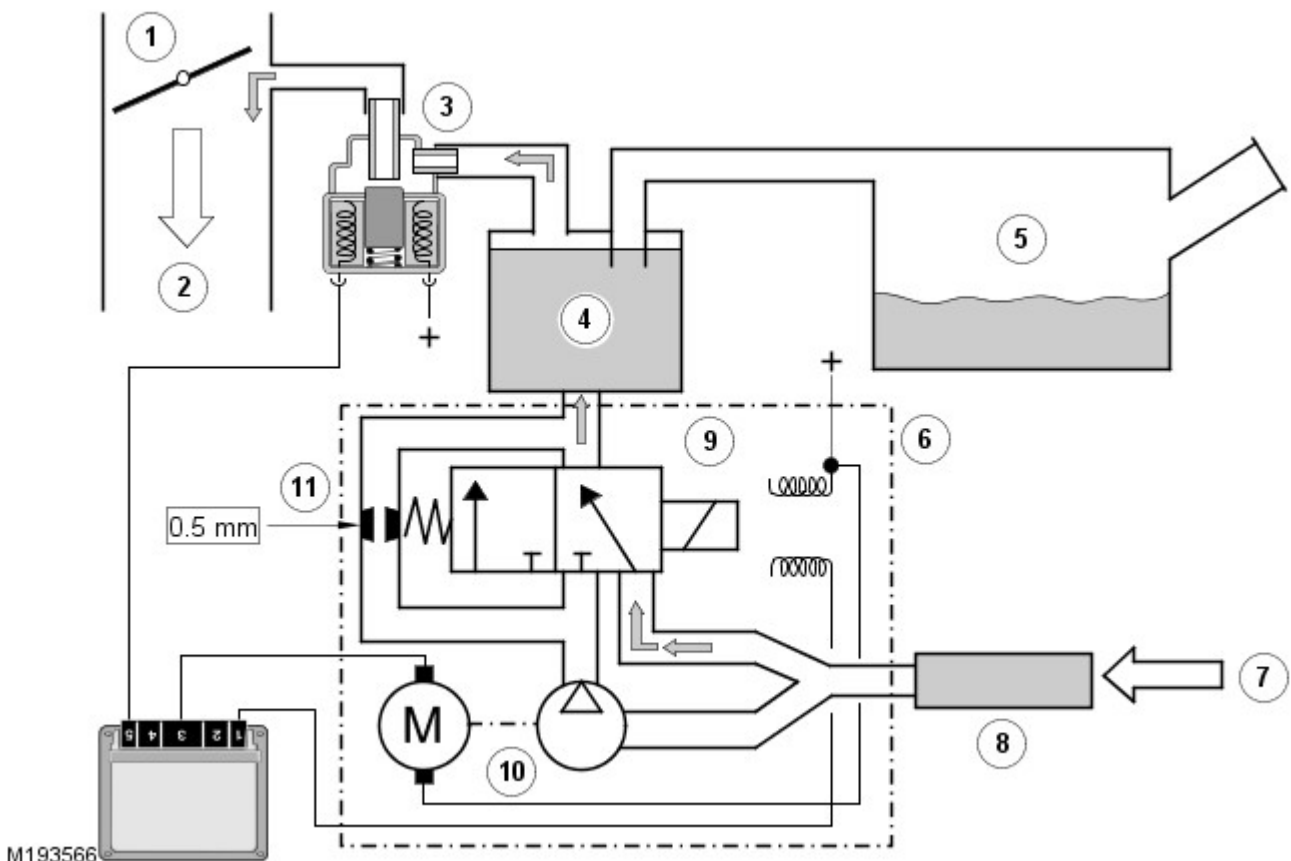
E122120

The DMTL pump is connected to the atmospheric vent of the charcoal canister and incorporates an electric air pump, a [PTC \(positive temperature coefficient\)](#) heating element, a normally open change-over valve and a reference orifice. The DMTL pump is only operated when the ignition is off and is controlled by the [ECM](#). The [ECM](#) also monitors the electric air pump operation and the change-over valve for faults.

DMTL Operation

To check the fuel tank and the [EVAP](#) system for leaks, the [ECM](#) operates the DMTL pump and monitors the current draw. Initially, the [ECM](#) establishes a reference current by pumping air through the reference orifice and back to atmosphere. Once the reference current is determined, the [ECM](#) closes the change-over valve, which seals the [EVAP](#) system. The purge valve remains de-energized and is therefore closed. The output from the air pump is diverted from the reference orifice and into the [EVAP](#) system.

DMTL System Inactive



M193566

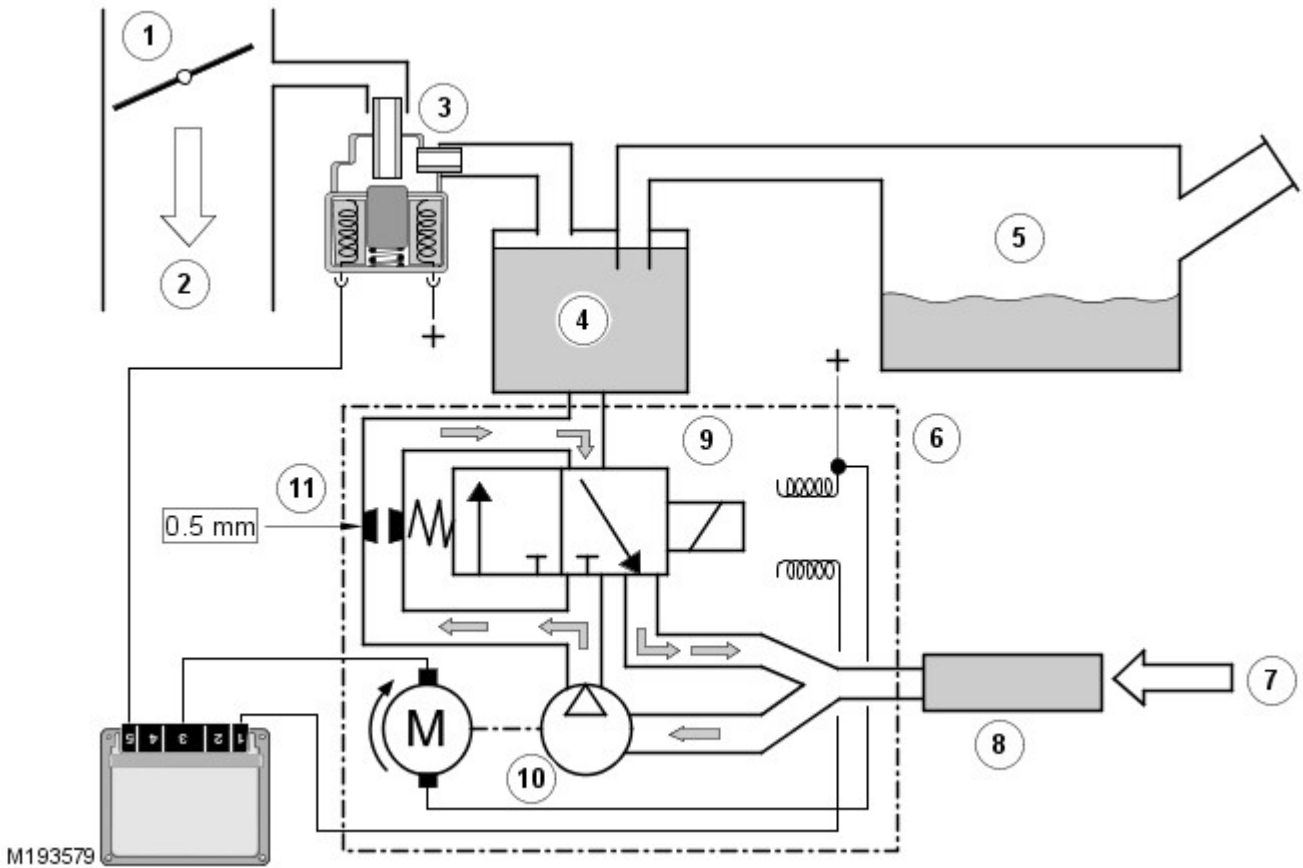
Item	Part Number	Description
1	-	Throttle plate

2	-	Air flow to engine
3	-	Purge valve
4	-	Charcoal canister
5	-	Fuel tank
6	-	DMTL pump assembly
7	-	Air intake
8	-	Air filter
9	-	Change-over valve
10	-	Pump
11	-	Reference orifice

In its inactive state, the DMTL pump motor and the change-over valve solenoid are not energized. When the [ECM](#) energizes the purge valve, filtered fresh air enters the evaporative system through the open change-over valve of the DMTL pump. The filtered air enters the system compensating for engine vacuum drawing on the hydrocarbon vapors stored in the charcoal canister.

DMTL System Active

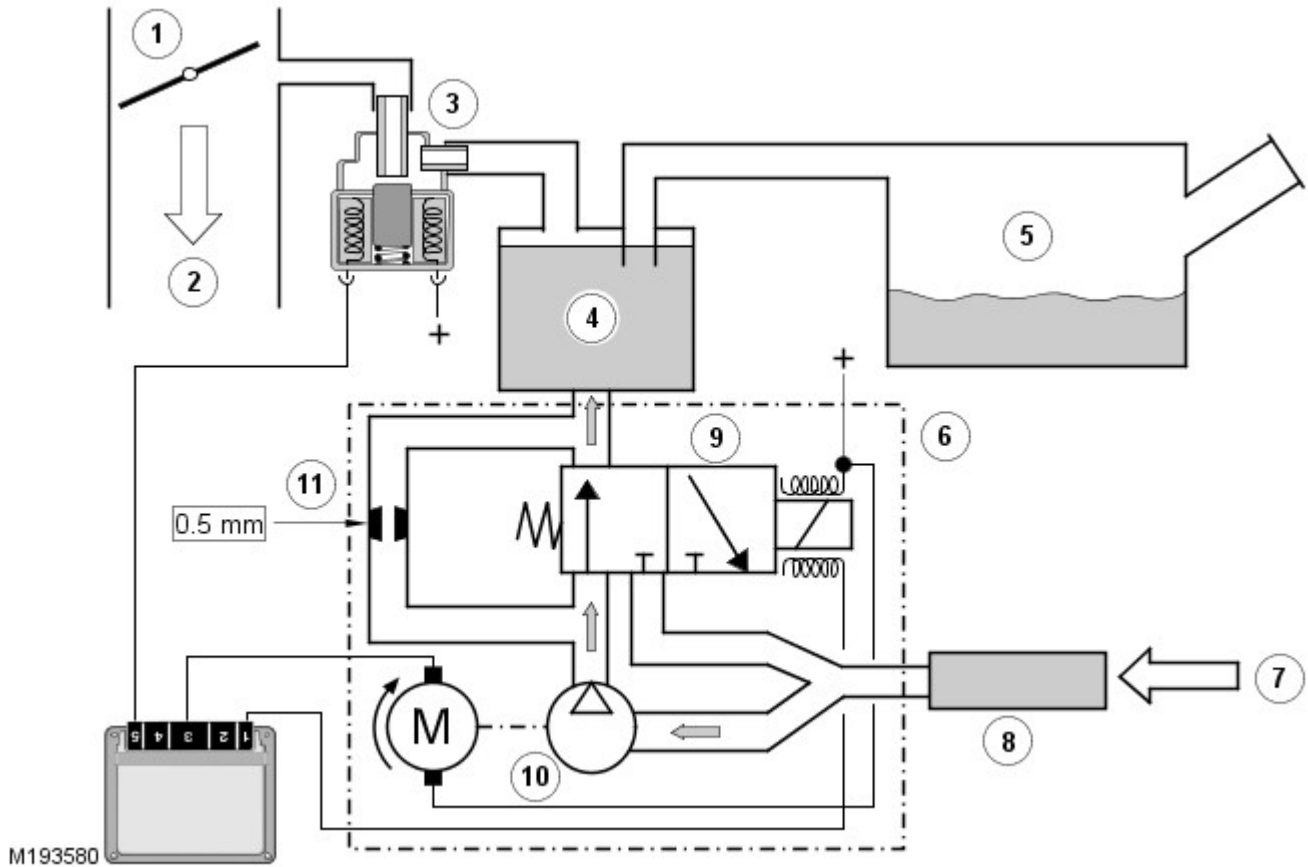
Phase 1 - Reference Measurement



Item	Part Number	Description
1	-	Throttle plate
2	-	Air flow to engine
3	-	Purge valve
4	-	Charcoal canister
5	-	Fuel tank
6	-	DMTL pump assembly
7	-	Air intake
8	-	Air filter
9	-	Change-over valve
10	-	Pump
11	-	Reference orifice

When the [ECM](#) activates the DMTL system, it first activates only the DMTL pump motor. This pumps air through a 0.5 mm (0.02 in) reference orifice, which causes the electric motor to draw a specific amperage value. This value equates to the size of the reference orifice.

Phase 2 - Leak Detection



Item	Part Number	Description
1	-	Throttle plate
2	-	Air flow to engine
3	-	Purge valve
4	-	Charcoal canister
5	-	Fuel tank
6	-	DMTL pump assembly
7	-	Air intake
8	-	Air filter
9	-	Change-over valve
10	-	Pump
11	-	Reference orifice

When the change-over valve solenoid is energized, the valve closes, sealing the [EVAP](#) system from atmosphere. Providing there are no leaks, the air pump will begin to pressurize the [EVAP](#) system and the load and current draw on the pump increases. By monitoring the rate and level of the current increase, the [ECM](#) can determine if there is a leak in the [EVAP](#) system.

During normal vehicle operation, the [ECM](#) energizes the heating element in the pump to prevent condensation formation and possible incorrect current readings.

Leaks are classified as:

- Minor - equivalent to a hole diameter of 0.5 to 1.0 mm (0.02 to 0.04 in)
- Major - equivalent to hole diameter of 1.0 mm (0.04 in) or greater.

The [ECM](#) performs a check for major leaks each time the ignition is switched off, providing the following conditions are met:

- The vehicle speed is zero
- The engine speed is zero
- The atmospheric pressure is above 70 kPa (10.15 lbf/in²), i.e. the altitude is less than approximately 3047 m (10000 feet)
- The ambient temperature is between 0 and 40 °C (32 and 104 °F)
- The charcoal canister vapor concentration factor is 5 or less (where 0 is no fuel vapor, 1 is stoichiometric fuel vapor and greater than 1 is rich fuel vapor)
- The fuel tank level is valid and between 15 and 85% of nominal capacity
- The engine running time during the previous cycle was more than 10 minutes
- The battery voltage is between 10 and 15 volts
- The last engine off time was more than 180 minutes
- No errors are detected with the [EVAP](#) components, the ambient air temperature and the fuel level
- High range is selected on the transfer box.

• **NOTE:** A leak test can be performed using the Land Rover approved diagnostic equipment. This overrides the above conditions and is useful for checking correct system and component operation.

The [ECM](#) performs a check for minor leaks after every 2nd major leak check.

When the leak check is complete, the [ECM](#) stops the DMTL pump and opens (de-energizes) the change-over valve.

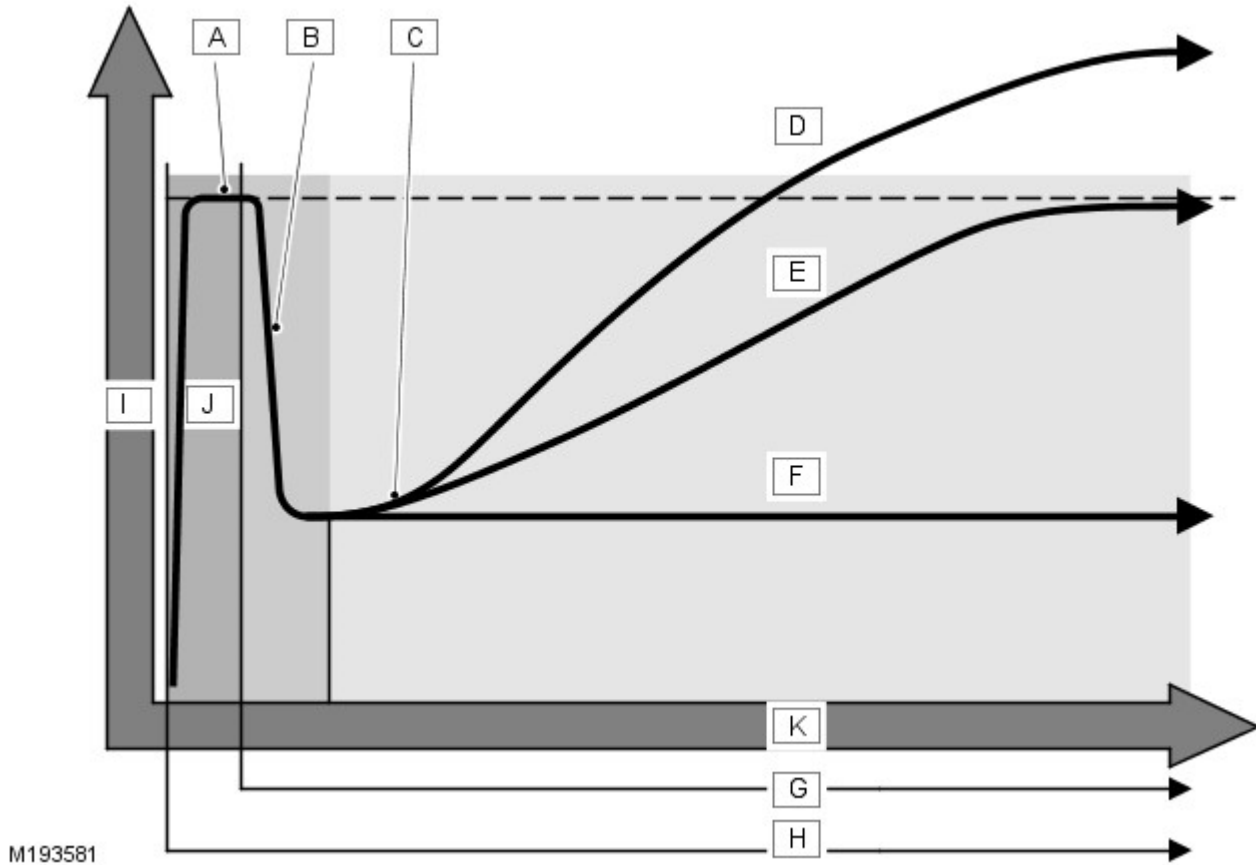
If the fuel filler cap is opened or refueling is detected during the leak check, by a sudden drop in the current draw or a rise in the fuel level, the [ECM](#) aborts the leak check.

If a leak is detected during the check, the [ECM](#) stores an appropriate fault code in its memory. If a leak is detected on two consecutive checks, the [ECM](#) illuminates the [MIL \(malfunction indicator lamp\)](#) in the instrument cluster on the next drive cycle.

The duration of a leak check can be between 60 and 900 seconds depending on the test results (developed tank pressure amperage within a specific time period) and fuel tank level.

The following chart depicts the logic used to determine fuel system leaks:

Test Results



M193581

Item	Part Number	Description
A	-	Current stabilizes
B	-	Current drops
C	-	Current rises
D	-	No leak detected
E	-	0.5 mm leak
F	-	Leak >1.0 mm
G	-	Change-over valve energized
H	-	Pump motor energized
I	-	Motor current pressure
J	-	Reference measurement 0.5 mm
K	-	Time duration

Evaporative Emissions - V8 5.0L Petrol - Evaporative Emissions

Diagnosis and Testing

Principles of Operation

For a detailed description of the evaporative emission system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Evaporative Emissions (303-13 Evaporative Emissions - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel filler cap and seal ● Fuel filler neck ● DMTL fresh air filter (restriction, etc) ● Fuel tank (leaks, damage, etc) ● Fuel lines and joints, etc ● Carbon canister ● Purge valve ● Diagnostic module fuel tank leak (DMTL) pump module 	<ul style="list-style-type: none"> ● Fuses ● Connectors ● Harness ● Purge valve ● Diagnostic module fuel tank leak (DMTL) pump

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.
5. 5. Where K-Line, Vacutec or other proprietary smoke test equipment is available, it should be utilized to assist with Evaporative Emissions System leak diagnosis.

Symptom Chart

Symptom	Possible Causes	Action
Difficulty in filling fuel tank	<ul style="list-style-type: none"> ● Restriction in the vapour line between the fuel tank and the carbon canister outlet/atmospheric port 	Check for restrictions/damage, etc (see visual inspection)
Fuel smell	<ul style="list-style-type: none"> ● System leak ● Purge valve inoperative 	Check for leaks, check the purge valve operation
'Check Fuel Filler Cap' displayed on Message Center	<ul style="list-style-type: none"> ● Fuel filler cap missing/not tightened after refuelling 	Check the fuel filler cap and seal

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Evaporative Leak OBD Fault Rectification Guide

Determine Which DTC Has Been Stored

Using the manufacturer approved diagnostic system, choose **diagnostic session**, then choose the following symptom paths : **Powertrain/engine system/fuel vapour and odor**, **Powertrain/engine system/fuel tank**, **Electrical/instruments /warning lamps/engine malfunction lamp/lamp illuminated**, **Powertrain/engine system/engine performance/fuel consumption high**

• **NOTE:** This guide covers DTCs that relate to evaporative leak monitoring, as listed in the table below

DTC	Description
P0442-00	DMTL small leak
P0447-00	DMTL COV electrical low (open)
P0448-00	DMTL COV electrical high
P0455-00	DMTL rough leak
P2401-00	DMTL pump electrical low (open)
P2402-00	DMTL pump electrical high
P2404-2F	DMTL noise fault
P2404-29	DMTL reference leak

DTC	Description
P2405-00	DMTL reference current low
P2406-00	DMTL reference current high
P2450-00	DMTL COV stuck open
P2451-00	DMTL COV stuck closed
P240B-00	DMTL heater electrical low (open)
P240C-00	DMTL heater electrical high

Attempt To Replicate The Fault Using The "Fuel Leak Check" Forced Test

1. Record any DTCs that has been logged
 2. Using the manufacturer approved diagnostic system, in the **Recommendations** tab run the **Fuel Leak Check** forced test
 3. For the test to run the fuel level must be between 15% and 85%
 4. During this procedure the engine must be off
 5. The possible responses from the test and the associated DTCs are listed below
 6. If again no fault is found it could suggest that the failure mode is a borderline condition (refer to section 3) or that it was caused by incorrect fitment of the fuel cap or the fuel filler neck is at fault therefore it is important not disturb the fuel cap
 7. Disconnect purge pipe from the purge valve, observe the condition of connection (the seating and condition of the "O" ring) and then reconnect. Using the manufacturer approved diagnostic system, run **Purge Valve Self Test** (to clean the purge valve) then run the **Fuel Leak Check**
 8. If the test failed, a smoke test is required to determine the cause of the leak
- NOTE: P240B & P240C are not included in the **Fuel Leak Check** forced test (these monitors run at every ignition on and complete within 30 seconds)

Response Description	ID	Equivalent DTC
Function running: Reference leak measurement	1	
Function running: Rough leak measurement	2	
Function running: Small leak measurement	3	
Function running: 2nd ref leak measurement	4	
Function running: COV Cleaning	5	
Function aborted due to conditions: Vbatt conditions not correct (too high/ low)	11	
Function aborted due to conditions: Variation Ref. I (reference current) too high	12	P2404-29
Function aborted due to conditions: DMTL electrical fault	13	P0447, P0448
Function aborted due to conditions: Maximum diagnostic time exceeded	14	
Function aborted due to conditions: Crash detected	15	
Function aborted due to conditions: Refuel detected	20	
Function aborted due to conditions: Filler cap opened	21	
Function aborted due to conditions: Engine start	23	
Function aborted due to conditions: Noisy current measurement	24	P2404-2F
Function aborted due to conditions: Ambient temp outside range	26	
Function aborted due to conditions: Ambient pressure outside range	27	
Function aborted due to conditions: Other conditions	29	
Function complete - Tight system, fault free	30	
Function complete - Fine leak detected	31	P0442
Function complete - Rough leak detected	32	P0455
Function complete - Module error	33	P2401, P2402, P2450, P2451, P2405, P2406, P2404-29
Function complete - Medium leak detected	34	P0442, P0455

Read The "Ranking values" To Determine How Far Away The Result Is From The Failure Threshold

9. When the **Fuel Leak Check** forced test has completed the test results (known as ranking values) will be displayed
10. These should be compared against the limits shown in the table below
11. If the test result is borderline then there is a risk that a failure will occur at a later date (during customer usage of the vehicle)
12. To avoid this the vehicle should be carefully checked for any small leaks

Ranking Value	Normal Result For Tight System	Leak Failure Condition
Rough Leak (40 thou+)	0 > = 50	>= 128
Small Leak (20 thou+)	0 > = 60	>= 128

TRACE THE ROOT CAUSE OF THE FAULT

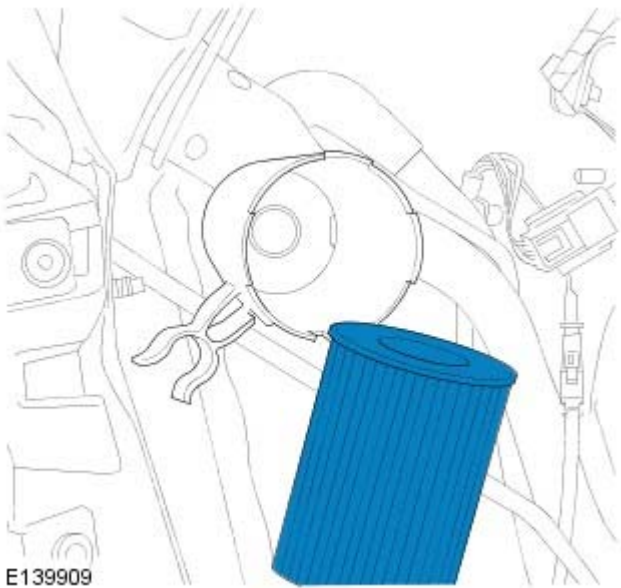
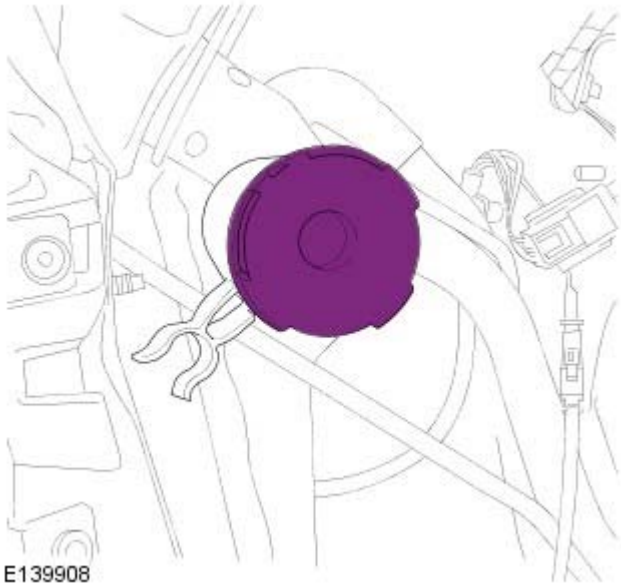
The list below provides some suggested actions to help trace the root cause of the fault

Each action should be followed up with a **Fuel Leak Check** forced test (and ranking value check) in order to determine if any improvement has been made

DTC	Fault Description	Fault Rectification Actions after smoke test
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DTC	Fault Description	Fault Rectification Actions after smoke test
P0442-00	DMTL small leak	<ul style="list-style-type: none"> ● 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filler neck protrudes) ● 2. Run engine at idle; Using the manufacturer approved diagnostic system, run Purge Valve Self Test (to clean the purge valve) ● 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition ● 4. Check all fuel system connections are correctly installed and secure ● 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage ● 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe ● 7. Carry out a smoke test ● 8. Replace the DMTL module
P0447-00	DMTL COV electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits tightly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P0448-00	DMTL COV electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module
P0455-00	DMTL rough leak	<ul style="list-style-type: none"> ● 1. Inspect / refit filler cap after smoke test (inspect filler neck for correct fitment to pocket so that filler neck protrudes) ● 2. Run engine at idle; Using the manufacturer approved diagnostic system, run "Purge Valve Self Test" (to help clean the purge valve) ● 3. Check that the DMTL module wiring connector has been installed correctly and that the seals around the connector body and individual wires are in good condition (surprisingly, this is a potential leakage path!) ● 4. Check all fuel system connections are correctly installed and secure ● 5. Visually inspect purge canister, purge pipes, fuel tank and filler neck for any obvious damage ● 6. Try isolating the purge valve by fitting a blanking plug to the purge pipe ● 7. Carry out a smoke test ● 8. Replace DMTL module
P2401-00	DMTL pump electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits correctly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P2402-00	DMTL pump electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module
P2404-2F	DMTL noise fault	<ul style="list-style-type: none"> ● Replace DMTL module
P2404-29	DMTL reference leak	<ul style="list-style-type: none"> ● Replace DMTL module
P2405-00	DMTL reference current low	<ul style="list-style-type: none"> ● Replace DMTL module
P2406-00	DMTL reference current high	<ul style="list-style-type: none"> ● 1. Check for any blockages in the DMTL ventilation pipe & filter ● 2. Replace DMTL module
P2450-00	DMTL COV stuck open	<ul style="list-style-type: none"> ● Replace DMTL module
P2451-00	DMTL COV stuck close	<ul style="list-style-type: none"> ● Replace DMTL module
P240B-00	DMTL heater electrical low (open)	<ul style="list-style-type: none"> ● 1. Check fuse ● 2. Check that fuse fits tightly into the fuse holder ● 3. Check that the DMTL module wiring connector has been fitted correctly ● 4. Check wiring harness continuity between DMTL module and ECU connectors ● 5. Replace DMTL module
P240C-00	DMTL heater electrical high	<ul style="list-style-type: none"> ● 1. Check wiring ● 2. Replace DMTL module

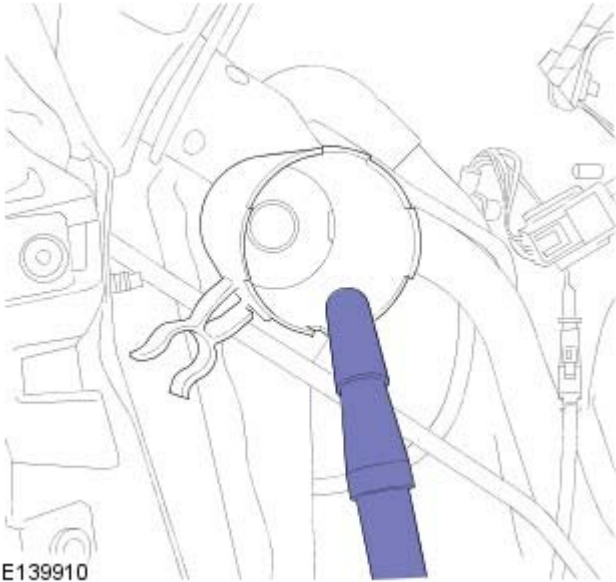
Pre and 10MY Denso/Bosch PCM Systems



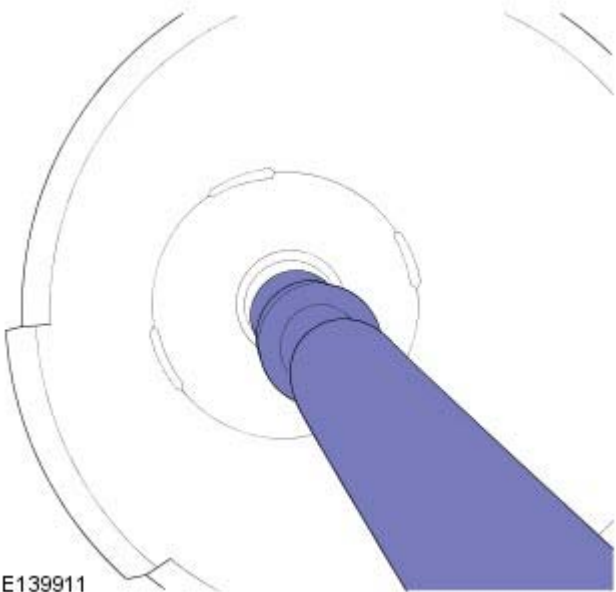
CAUTION: The Maximum pressure of the EVAP system is 0.07 bar **do not exceed**

• **NOTE:** Apart from the purge valve connection, it is recommended to smoke test the EVAP system without disturbing any joints associated with the system, this will determine the leak more accurately and quickly

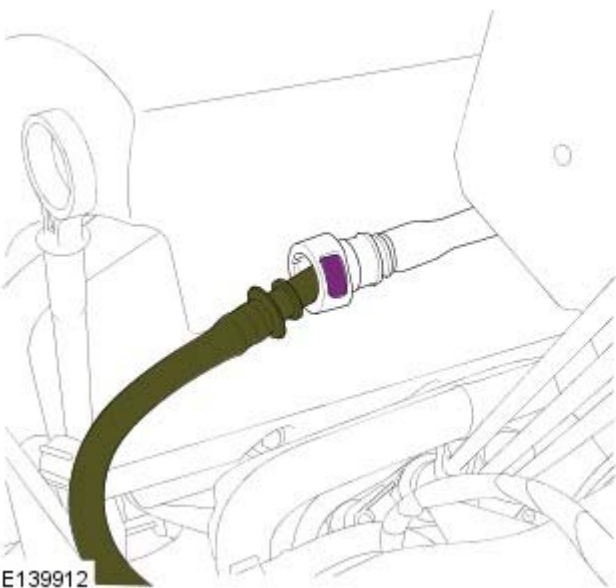
- 1. Remove rear wheel arch liner to access fuel filler neck
- 2. On the fuel filler neck the DMTL filter will be visible as shown in picture. Unclip filter housing from fuel filler neck to gain better access to DMTL filter
- 3. Remove carefully the top of filter to expose filter and remove
- 4. Attach rubber adapter to tip of smoke machine nozzle to ensure tight seal to filter housing. Disconnect the purge pipe from purge valve; this will be an escape point for the smoke to exit
- 5. Allow tester to complete self-test and green READY light to turn ON 2. For best Tester performance; completely unwind Tester's supply hose
- 6. Press **Smoke** on control panel to fill EVAP system with smoke vapour. The control panel **Smoke** light will light indicating smoke production. The smoke setting is on a 15 minute timer. Pressing the **Smoke** button again turns Tester off. It is normal for the flow meter ball, while in the smoke mode, not to be as steady as when it is in the **Test** mode. Note: The pressure gauge is active only after smoke cycle is complete
- 7. Continue introducing smoke into the EVAP System until the flow meter's ball stops descending and this assures the system test pressure is met and smoke will appear from the purge pipe, then close off purge pipe with special tool (Test Adapter Hose/EVAP Port 310-142)



E139910



E139911



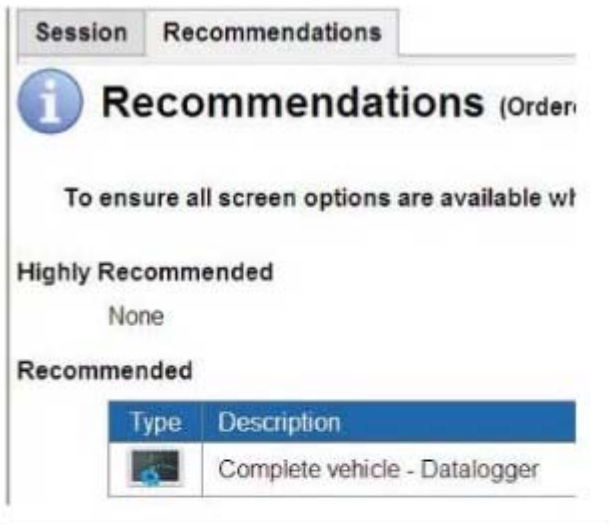
E139912



CAUTION: On some vehicles, the DMTL filter can not be removed, in these instances fill the system through the purge valve and smoke will appear from the filter

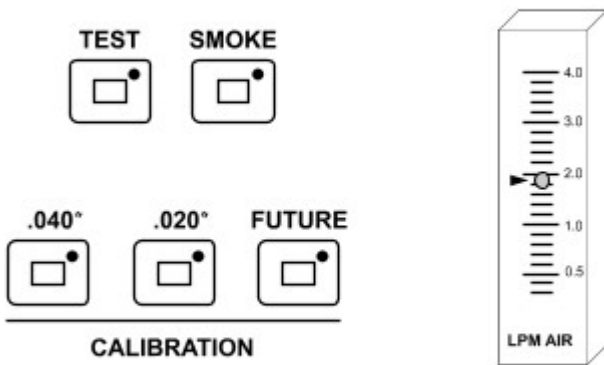
Pre 10MY Vehicles

On pre 10MY DMTL systems, Using the manufacturer approved diagnostic system, select **Measurement application** session then select the **Recommendations** tab which will give you access to **Datalogger**. Then select **Engine systems** then select the **Output state control** data-logger signal **Engine output 1 – diagnostic module – tank leakage -change over valve active** which will close the system. Then select **Engine output 1 – diagnostic module – tank leakage – pump active** this will pressurize the EVAP system



- Engine output 1 - engine management system warning lamp.
- Engine output 1 - malfunction indicator warning lamp.
- Engine output 1 - diagnostics module - tank leakage - test complete.
- Engine output 1 - diagnostics module - tank leakage - heater active.
- Engine output 1 - diagnostics module - tank leakage - pump active.
- Engine output 1 - diagnostics module - tank leakage - changeover valve active.
- Engine output 2 - heated exhaust gas oxygen heater active - bank 2.

E139916



E139913

10MY vehicles

On 10MY vehicles a smoke test application is available so therefore only smoke fill the system and then run the application

- 8. Follow the EVAP system path with the halogen light provided and looks for the smoke exiting the leak(s) or use the UV light provided and look for the dye deposited at the exact location of the leak(s)
- 9. Repair the leak(s) and perform the **Fuel Leak Check** application again or smoke test to verify repair, as well as to make sure there are no additional leaks in the EVAP system

The UltraTraceUV® smoke solution's dye feature is especially helpful when the leak is in an area that is not readily visible, as on the top of the fuel tank or behind a panel. Once you gain access to the area of the leak, wear the yellow UV glasses and shine the UV light provided to identify the exact location of the leak(s). Smoke exiting a very small leak is even easier to see with lower pressure. If you encounter smoke leaking out of an area but find it difficult to pinpoint exactly where the source of the leak is; try reducing the pressure in the system being tested by turning the Tester OFF and allow the pressure to dissipate. The longer a particular leak is allowed to leak, the more fluorescent dye material will be deposited

at that leak. With some vapour system leaks, the leak may only present itself under vacuum and not under pressure. If equipment permits, test the system in both states. Purge valve faults [P0441, P0444, P0458 and P0459] should all inhibit DMTL leak test and therefore need to be resolved prior to any DMTL issues. For this reason, when smoke testing the vapour system, it should be sufficient to enter the system at the connection up stream of the purge valve. If no leak is found then testing the remainder of the system up to the purge valve is recommended

• **NOTE:** It may be possible to search for small leaks using a gas analyzer and looking for HC (hydro carbon) spikes. This should enable leaks to be detected in areas of the vapor system that our out of sight of the technician. The solenoid should be deactivated after five minutes to prevent potential damage. Check that connector and individual terminals are sealed correctly

Phase-One – (quantifying the leak)



E139914

- 1. Connect the tester supply hose to vehicle EVAP system. > Refer to appropriate vehicle application
- 2. Determine if the vehicle's EVAP system you are testing is governed by a .020" (0.5 mm) or .040" (1 mm) acceptable leak standard. Press the appropriate calibration standard on the tester's control panel and observe the position of the flow meter ball. > This function automatically turns off in 10 seconds
- 3. Position the flow meter's pointer flag so that it aligns with the measurement observed in step 2 above. > This sets PASS / FAIL mark
- 4. Close vehicle's EVAP Vent Solenoid. > Refer to appropriate vehicle application
- 5. Press TEST on control panel and fill EVAP system. > This introduces 5-minutes of nitrogen gas
- 6. Look for flow meter ball to stop descending indicating that the vehicle system is full. > Fill time 1-4 minutes depending on system volume
- 7. Compare flow meter ball reading to pointer flag. > ABOVE flag = FAIL (go to Phase-Two). > BELOW flag = PASS (test complete)

Testing With Pressure and Vacuum Decay

In addition to quantifying the leak with the Phase-One flow test, the Tester allows you the flexibility of testing the vehicle's EVAP system by using either **Pressure Decay** or **Vacuum Decay** methods. Below are instructions for performing both decay tests

Pressure-Decay Test

• **NOTE:** The Pressure Decay test is best performed immediately after the Phase-one flow test, since the system has already built up pressure

At the completion of the Phase-one flow test, the EVAP system is fully pressurized, since the Phase-one test uses pressure to perform its flow test. Testing pressure decay with the Vacutec® 522B-J/LR is very simple. All you need to do is the following:

- 1. Allow tester to complete self-test and green **READY** light to turn ON
- 2. Connect Tester supply hose to vehicle EVAP system
- 3. Close vehicle's EVAP Vent solenoid > Refer to appropriate vehicle application
- 4. Press **VACUUM** switch on the tester control panel
 - NOTE: The vacuum switch is on a 30-second timer, which should be sufficient time to draw the appropriate vacuum from the EVAP system. Press VACUUM switch again if additional time is required
- 5. After vacuum timer turns off, observe the vacuum gauge for any decay (loss of vacuum) indicating a leak in the EVAP system



E139915


- NOTE: Disconnect the Tester from the vehicle after the Vacuum Decay Test. The fuel pressure in the vehicle's fuel tank is constantly changing due to the vehicle's fuel volatility and that could cause the Tester's pressure gauge to exceed its maximum reading limits

Evaporative Emissions - V8 5.0L Petrol - Evaporative Emission Canister

Removal and Installation

Removal

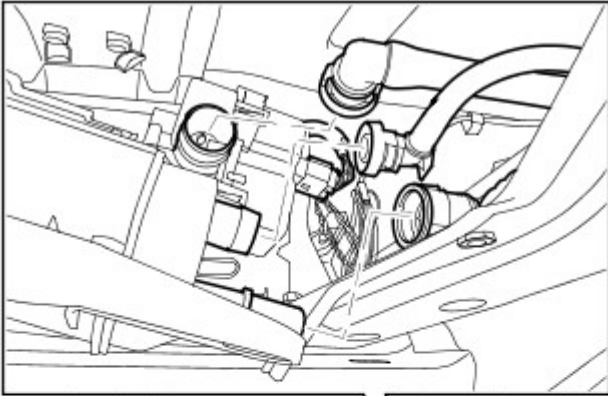
1. Remove the spare wheel and tire.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the evaporative emissions canister.

- Remove the 2 bolts.
- Disconnect the 3 lines.
- Disconnect the electrical connector.



E50115

4. **NOTE:** Do not disassemble further if the component is removed for access only.

NAS vehicles: Remove the fuel tank leakage detection module.

- Remove the 3 screws.



E50116

Installation

1. NAS vehicles: Install the fuel tank leakage detection module.

- Install the screws.

2. Install the evaporative emissions canister.

- Connect the electrical connector.
- Connect the lines.

- Tighten the bolts to 23 Nm (17 lb.ft).

3. Install the spare wheel and tire.

Evaporative Emissions - V8 5.0L Petrol - Evaporative Emission Canister

Purge Valve

Removal and Installation

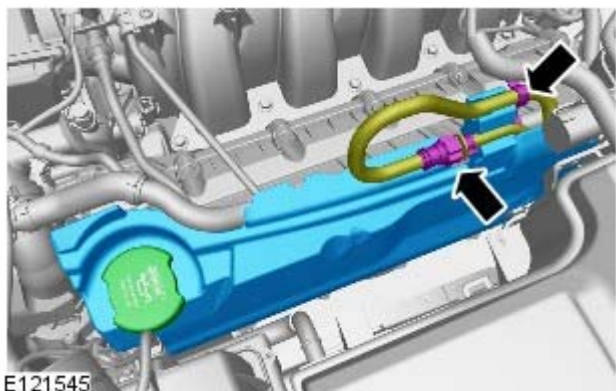
Removal

• NOTE: Removal steps in this procedure may contain installation details.

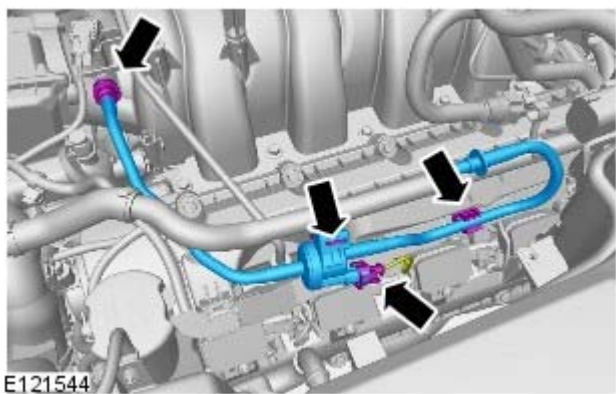
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).



3.



4.

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 2.7L Diesel -

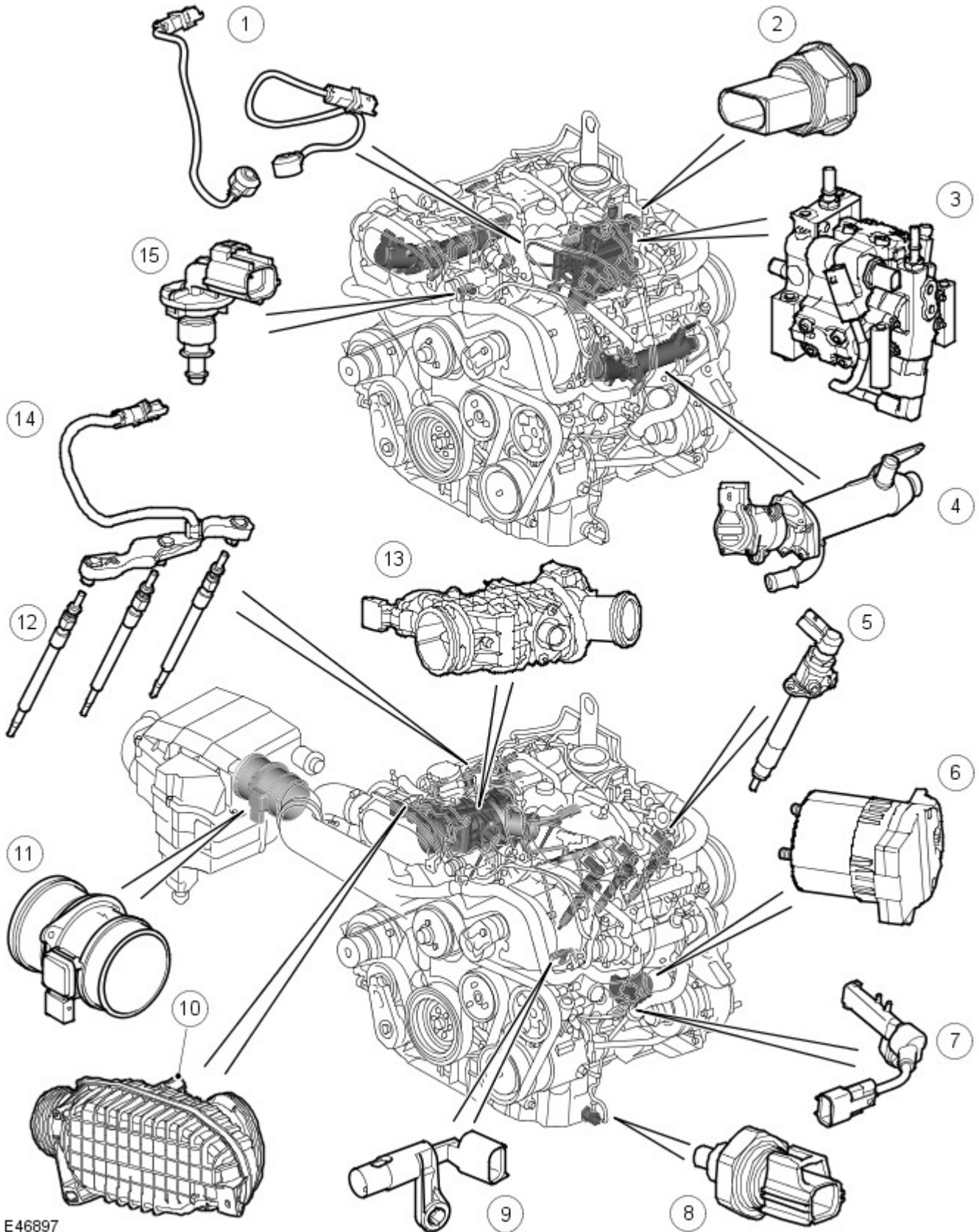
Torque Specifications

Description	Nm	lb-ft
Camshaft position (CMP) sensor retaining bolt	10	7
Crankshaft position (CKP) sensor retaining bolt	5	4
Engine oil pressure (EOP) sensor	15	11
Knock sensor (KS) LH retaining bolt	20	15
KS RH retaining bolt	20	15
Manifold absolute pressure (MAP) sensor	3	2
Mass air flow (MAF) sensor retaining screws	2	1
Oil temperature sensor	10	7
Fuel injection diverter rail studs	23	17
High pressure fuel supply line to fuel pump and diverter rail:		
Stage 1 - Union to fuel pump	15	11
Stage 2 - Union to diverter rail	15	11
Stage 3 - Union to fuel pump	30	22
Stage 4 - Union to diverter rail	30	22
RH and LH High pressure fuel supply lines to fuel injection supply manifold and diverter rail:		
Stage 1 - Union to fuel injection supply manifold	15	11
Stage 2 - Union to diverter rail	15	11
Stage 3 - Union to fuel injection supply manifold	30	22
Stage 4 - Union to diverter rail	30	22
High pressure fuel supply line retaining bolts	10	7
EGR coolant cross-over pipe retaining bolts	13	10
ECM retaining bolts	1.5	1.1

Electronic Engine Controls - TDV6 2.7L Diesel - Electronic Engine Controls

Description and Operation

TDV6 ENGINE MANAGEMENT COMPONENT LOCATION - SHEET 1 of 2

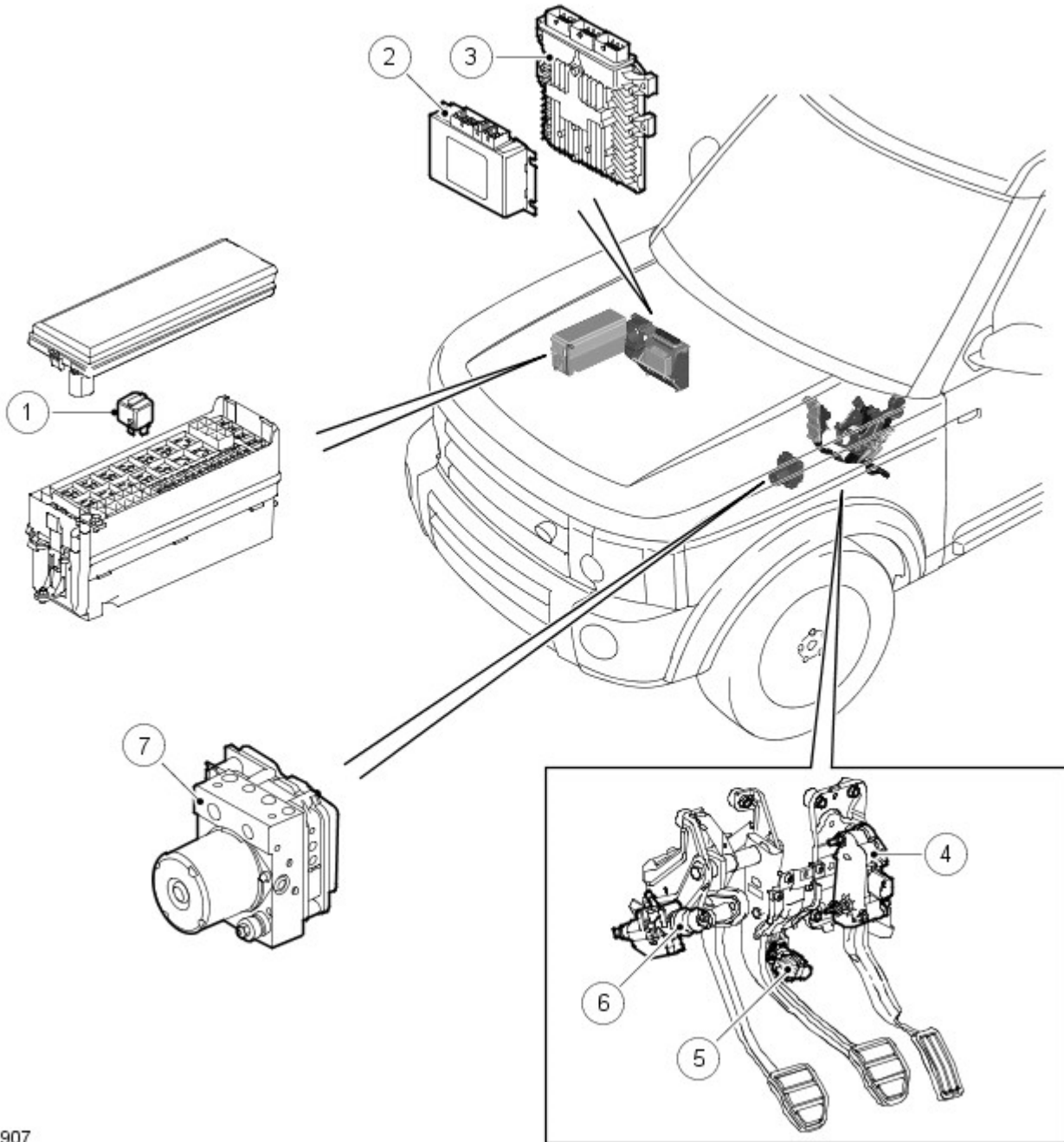


E46897

Item	Part Number	Description
1	-	Knock sensors
2		Fuel rail pressure sensor
3		High pressure fuel pump
4		exhaust gas recirculation (EGR) Valve/cooler

5		Injector
6		Turbo boost pressure control
7		crankshaft position (CKP) sensor
8		Oil temperature sensor
9		camshaft position (CMP) sensor
10		mass air flow (MAF)/intake air temperature (IAT) sensor
11	-	Air charge temperature sensor
12		Glow plugs
13		Electronic throttle incorporating manifold absolute pressure (MAP) sensor
14		Glow plug wiring harness
15		engine coolant temperature (ECT) sensor

TDV6 ENGINE MANAGEMENT COMPONENT LOCATION - SHEET 2 of 2

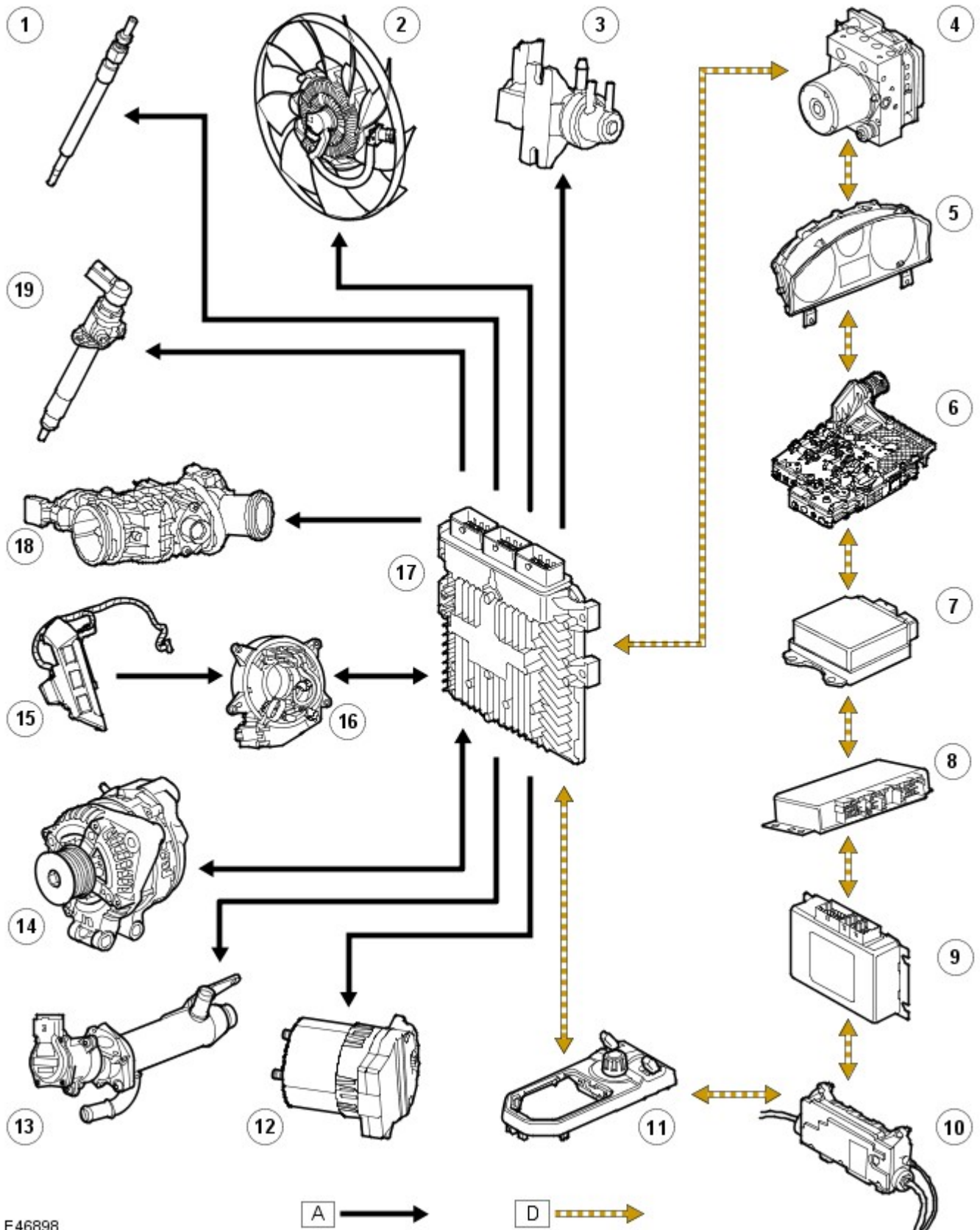


E46907

Item	Part Number	Description
1		Main relay
2		Transfer box control module
3		engine control module (ECM)
4		accelerator pedal position (APP) sensor
5		Stop lamp switch
6		Clutch switch
7		anti-lock brake system (ABS) Control module

TDV6 ENGINE MANAGEMENT CONTROL DIAGRAM - SHEET 1 of 2

• NOTE: **A** = Hardwired; **D** = controller area network (CAN)



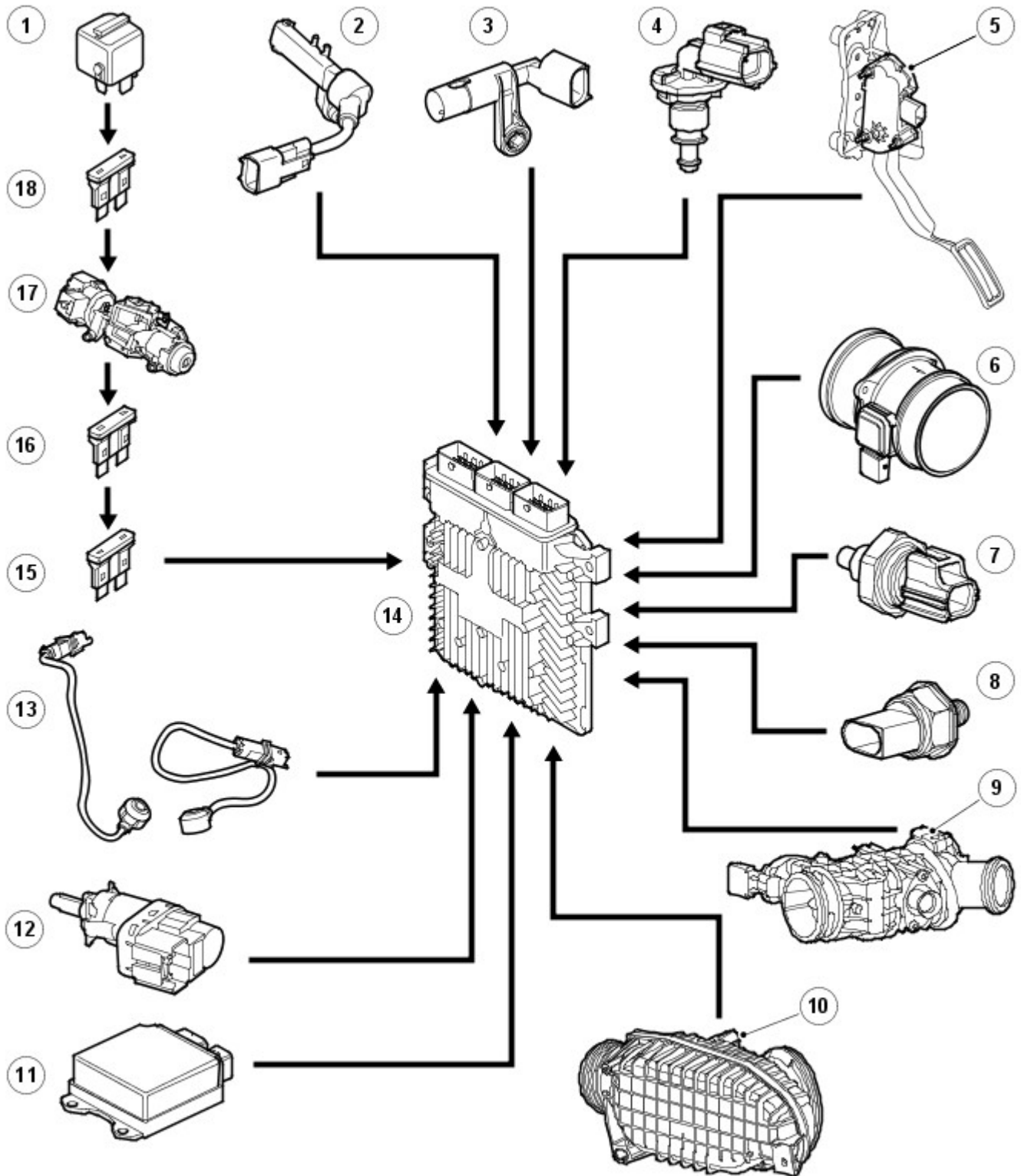
E46898

Item	Part Number	Description
1	-	Glow plugs
2	-	E-box cooling fan
3		Port de-activation vacuum actuator
4		ABS control module
5		Instrument cluster
6		transmission control module (TCM)
7		restraints control module (RCM)
8		Transfer box control module
9		Differential control module

10	Electric park brake control module
11	Terrain Response™ control module
12	Turbo boost pressure controller
13	EGR valve/cooler
14	Generator
15	Steering wheel mounted speed control switches
16	Clock spring
17	ECM
18	Electric throttle valve
19	Injectors

TDV6 ENGINE MANAGEMENT CONTROL DIAGRAM - SHEET 2 of 2

- NOTE: **A** = Hardwired



E46908

A →

Item	Part Number	Description
1		Main relay
2		CKP sensor
3		CMP sensor
4		ECT sensor
5		APP sensor
6		MAF/IAT sensor
7		Engine oil temperature sensor
8		Fuel rail temperature sensor
9		Boost pressure sensor
10	-	Boost air temperature sensor
11		RCM

12	Stop lamp switch
13	Knock sensors
14	ECM
15	Fuse 60P
16	Fuse 25P
17	Ignition switch
18	Fuse 11E

OVERVIEW

The TDV6 engine has an Electronic Diesel Control (EDC) engine management system supplied by Siemens. The system is controlled by an ECM and is able to monitor, adapt and precisely control the fuel injection. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

The ECM controls fuel delivery to all six cylinders via a Common Rail (CR) injection system. The CR system uses a fuel rail to accumulate highly pressurized fuel and feed the six, electronically controlled injectors. The fuel rail is located in close proximity to the injectors, which assists in maintaining full system pressure at each injector at all times.

The ECM uses the drive by wire principle for acceleration control. There are no control cables or physical connections between the accelerator pedal and the engine. Accelerator pedal demand is communicated to the ECM by two potentiometers located in a throttle position sensor. The ECM uses the two signals to determine the position, rate of movement and direction of movement of the pedal. The ECM then uses this data, along with other engine information from other sensors, to achieve the optimum engine response.

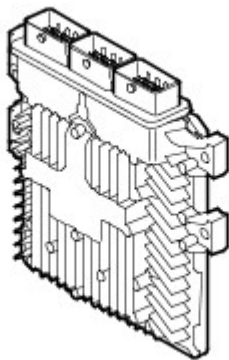
The ECM processes information from the following input sources:

- CKP sensor
- CMP sensor
- Manifold air temperature and pressure
- Coolant temperature
- Oil temperature
- Inlet air flow and temperature
- Fuel rail temperature
- Knock sensors (one per cylinder bank).

The ECM outputs controlling signals to the following sensors and actuator:

- Fuel injectors
- Cooling fan solenoid
- Electronic Throttle
- Electronic vane controlled turbo
- Port deactivation
- Fuel pressure control valve
- Fuel volume control valve
- E-box fan
- Engine mounts
- Electronic EGR
- Glow plugs.

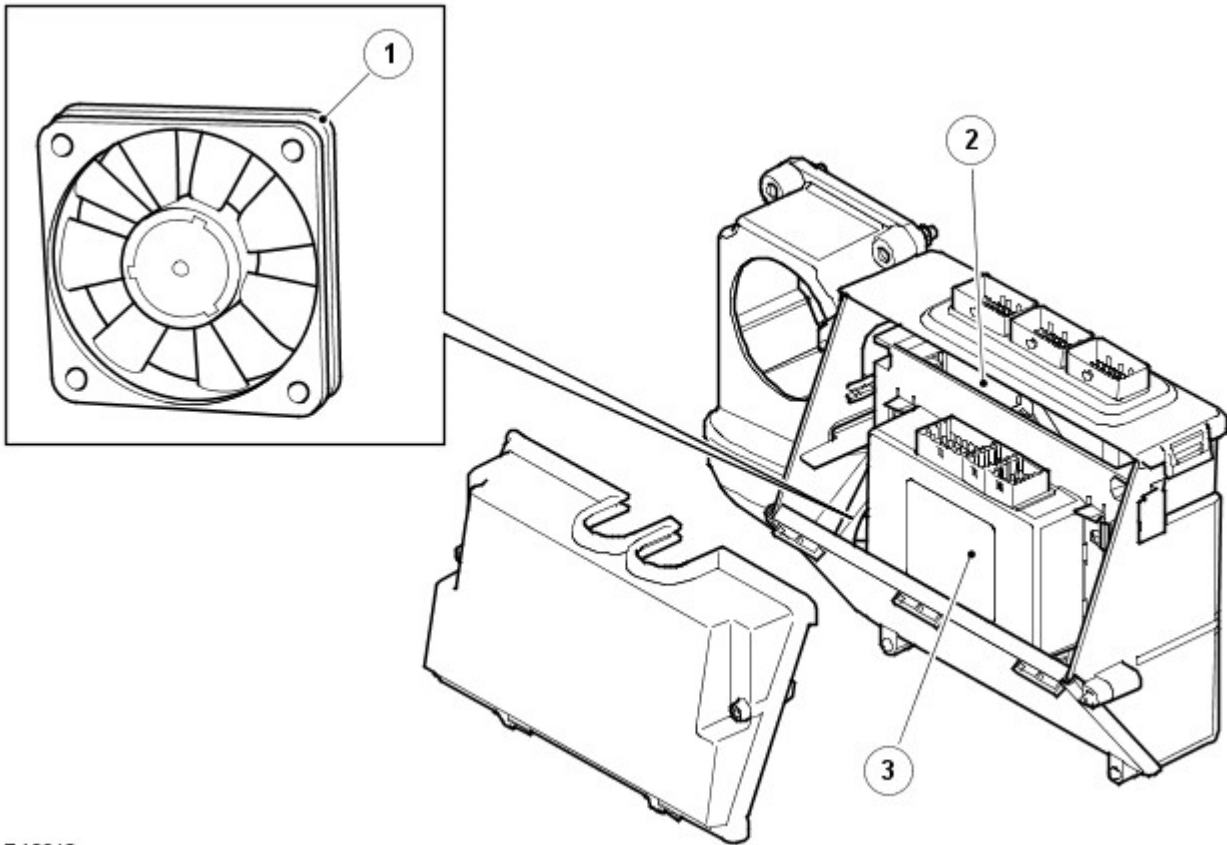
ENGINE CONTROL MODULE (ECM)



E46899

The ECM is located in the E-Box in the plenum area on the RH side of the engine compartment attached to the bulkhead.

E Box



E46913

Item	Part Number	Description
1		E box fan
2		ECM
3		Transfer box control module

Inputs

The ECM has the following inputs:

- Engine Coolant Temperature
- Clutch Switch (via electric park brake control module)
- Stop lamp switch (via ABS control module on CAN)
- Manifold Absolute Pressure
- Throttle Pedal Position 1
- Throttle Pedal Position 2
- Electronic throttle Position
- Viscous Fan Speed
- Engine speed and position sensor (crankshaft sensor)
- Camshaft position sensor
- Engine Oil Temperature
- Speed Control Switches (resistive ladders)
- Vehicle Speed (via CAN bus)
- Generator Monitor
- Restraints Control Module
- Manifold Absolute Pressure and Inlet Air Temperature

Outputs

The ECM outputs to the following:

- Throttle Actuator
- Fuel injectors (6)
- EGR Valves
- Engine Cooling Fan
- Fuel pump relay
- Starter Relay
- Air conditioning condenser fan module
- EMS Main Relay
- Viscous Fan Control
- Generator Control

The ECM connected to the vehicle harnesses via three connectors. The ECM contains data processors and memory microchips. The output signals to the actuators are in the form of ground paths provided by driver circuits within the ECM. The ECM driver circuits produce heat during normal operation and dissipate this heat via the casing. The fan in the E-box assists with the cooling process by maintaining a constant temperature with the E-box. The fan is controlled by a thermostatic switch located in the E-box. The E-box has pipe connections to the vehicle interior and receives additional cooled air via the A/C system. Some sensors receive a regulated voltage supplied by the ECM. This avoids incorrect signals caused by voltage drop during cranking.

The ECM performs self diagnostic routines and stores fault codes in its memory. These fault codes and diagnostics can be accessed using a Land Rover approved diagnostic system. If the ECM is to be replaced, the new ECM is supplied 'blank' and must be configured to the vehicle using a Land Rover approved diagnostic system. A 'flash' Electronic Erasable Programmable Read Only Memory (EEPROM) allows the ECM to be externally configured, using a Land Rover approved diagnostic system, with market specific or new tune information up to 14 times. If a fifteenth update is required the ECM must be replaced. The current engine tune data can be accessed and read using a Land Rover approved diagnostic system.

When a new ECM is fitted, it must also be synchronized to the immobilization control module using a Land Rover approved diagnostic system. ECM's cannot be 'swapped' between vehicles.

The ECM is connected to the engine sensors which allow it to monitor the engine operating conditions. The ECM processes these signals and decides the actions necessary to maintain optimum engine performance in terms of driveability, fuel efficiency and exhaust emissions. The memory of the ECM is programmed with instructions for how to control the engine, this known as the strategy. The memory also contains data in the form of maps which the ECM uses as a basis for fueling and emission control. By comparing the information from the sensors to the data in the maps, the ECM is able to calculate the various output requirements. The ECM contains an adaptive strategy which updates the system when components vary due to production tolerances or ageing.

The ECM receives a vehicle speed signal on a CAN bus connection from the ABS Control Module. Vehicle speed is an important input to the ECM strategies. The ABS control module derives the speed signal from the ABS wheel speed sensors. The frequency of this signal changes according to road speed. The ECM uses this signal to determine the following:

- How much to reduce engine torque during gear changes.
- When to permit speed control operation.
- To control the operation of the speed control system.
- Implementation of the idle strategy when the vehicle is stationary.

ECM Harness Connector C0872 Pin details

Pin No	Description	Input/Output
A1	Serial to immobilization control module	Output
A2	Serial from immobilization control module	Input
A3	CAN Low	Input/Output
A4	CAN High	Input/Output
B1	Starter motor enable	Output
B2	APP sensor ground	-
B3	Radiator outlet temperature sensor ground	-
B4	Speed control	Input
C1	APP 1 Sensor ground	-
C2	APP sensor 2 reference voltage	Output
C3	ECT sensor 2	Output
C4	Speed control	Input
D1	APP 1 signal	Input
D2	APP 2 Sensor ground	-
D3	Voltage 2	Input
D4	Not used	-
E1	APP sensor 1 reference voltage	Output
E2	Water in fuel sensor	Input
E3	Stop switch 1	Input
E4	Inertia switch	Input
F1	Intake air temperature sensor	Input
F2	Not used	-
F3	Engine cranking signal	Input
F4	Mass air flow sensor	Input
G1	Fuel pump power monitor	Input
G2	Stop light switch	Input
G3	Not used	-
G4	Not used	-
H1	Not used	-
H2	Not used	-
H3	Not used	-
H4	Not used	-
J1	Not used	-
J2	E box fan	Output
J3	Main relay	Output
J4	Fuel pump relay	Output
K1	Not used	-
K2	Electric cooling fan control	Output
K3	Ignition switch sense	Input
K4	Keep alive power supply	Input
L1	Battery voltage	Input
L2	Battery voltage	Input
L3	Battery voltage	Input
L4	Ground	-
M1	Ground	-
M2	Ground	-
M3	Ground	-
M4	Ground	-

ECM Harness Connector C0411 Pin details

Pin No	Description	Input/Output
A1	Engine oil temperature sensor	Input
A2	Not used	-
A3	Not used	-
A4	Not used	-
B1	Spare analogue input	Input
B2	Spare analogue input	Output
B3	CAN loop Low	Input/Output
B4	CAN loop High	Input/Output
C1	Not used	Input
C2	Sensor ground	
C3	Not used	
C4	Knock sensor B -	Input
D1	Fuel rail pressure sensor signal	Input
D2	Fuel rail pressure sensor	Output
D3	Knock sensor B +	Output
D4	Knock sensor A-	Input
E1	Throttle valve position sensor	Input
E2	Fuel rail pressure sensor ground	-
E3	Glow plug power monitor bank A	Input
E4	Knock sensor bank A+	Input
F1	Electric throttle voltage	Output
F2	Electric throttle ground	-
F3	Glow plug monitor bank B	Input
F4	Spare pulse width modulation (PWM) output	Output
G1	Active engine mount control 1	Output
G2	Active engine mount control 2	Output
G3	Glow plug relay control	Output
G4	Not used	-
H1	Alternator command	Output
H2	Not used	-
H3	Not used	-
H4	Not used	-
J1	Not used	-
J2	E box fan	
J3	Main relay	Output
J4	Fuel volume control valve	Output
K1	Oil temperature sensor ground	-
K2	Viscous cooling fan control	Output
K3	Fuel pressure control valve	Input
K4	Inlet port deactivation actuator	Output
L1	Injector 1 command	Output
L2	Injector 1 common	-
L3	Injector 3 common	-
L4		Output
M1	Injector 3 command	Output
M2	Injector 5 command	Output
M3	Injector 5 common	-
M4	Ground 7	-

ECM Harness Connector C2518 Pin details

Pin No	Description	Input/Output
A1	Spare analogue input	-
A2	EGR valve position sensor bank B	Input
A3	EGR valve position sensor bank A	Input/Output
A4	Not used	Input/Output
B1	Air charge temperature sensor	Input
B2	Fuel temperature sensor	Input
B3	Not used	-
B4	Not used	-
C1	Manifold absolute pressure sensor	Input
C2	Engine coolant temperature sensor	-
C3	Analogue voltage 1	Input
C4	VGT bank A	Input
D1	Manifold absolute pressure sensor supply	Output
D2	Sensor ground M	Output
D3	Not used	
D4	Not used	
E1	Engine cooling fan monitor	Input
E2	Not used	-
E3	Not used	-
E4	Not used	-
F1	Crankshaft position sensor	Input
F2	Generator load monitor signal	Input
F3	Not used	-
F4	Not used	-
G1	Crankshaft position sensor supply	Output

Pin No	Description	Input/Output
G2	Crankshaft position sensor ground	-
G3	Variable geometry turbine actuator ground	-
G4	Camshaft sensor signal	Input
H1	EGR bank A +	Output
H2	EGR bank A -	-
H3	Camshaft position sensor ground	-
H4	Camshaft position sensor supply	Output
J1	EGR bank B+	Output
J2	VGT Bank A+	Output
J3	Not used	Output
J4	Throttle valve actuator +	Output
K1	EGR Bank B-	-
K2	VGT -	-
K3	Not used	Input
K4	Throttle valve actuator -	-
L1	Not used	-
L2	Injector 2 common	-
L3	Injector 0 common	-
L4	Injector 4 common	-
M1	Power ground	-
M2	Injector 2 command	Output
M3	Injector 0 command	Output
M4	Injector 4 command	Output

IMMOBILIZATION

The IMMOBILIZATION control module receives information from related systems on the vehicle and passes a coded signal to the ECM to allow starting if all starting parameters have been met. The information is decoded by the ECM which will allow the engine to run if the information is correct.

The information is on a rolling code system and both the immobilization control module and the ECM will require synchronisation if either component is renewed.

The ECM also protects the starter motor from inadvertent operation. The IMMOBILIZATION control module receives an engine speed signal from the ECM via the instrument cluster. When the engine speed exceeds a predetermined value, the immobilization control module prevents operation of the starter motor via an integral starter disable relay. For additional information, refer to: Anti-Theft - Passive (419-01B Anti-Theft - Passive, Description and Operation).

CAMSHAFT POSITION SENSOR (CMP)



E46902

The CMP is located on the front face of the left hand cylinder head. The sensor tip protrudes through the face to pick up on the reluctor behind the camshaft pulley. The CMP is a Hall effect type sensor

The ECM uses the CMP sensor signal to determine if the piston in No. 1 cylinder is at injection TDC or exhaust TDC. Once this has been established, the ECM can then operate the correct injector to inject fuel into the cylinder when the piston is at injection TDC.

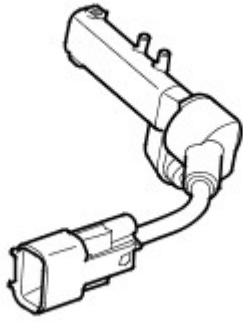
The CMP sensor is a Hall effect sensor which used by the ECM at engine start-up to synchronize the ECM with the CKP sensor signal. The ECM does this by using the CMP sensor signal to identify number one cylinder to ensure the correct injector timing. Once the ECM has established the injector timing, the CMP sensor signal is no longer used.

The CMP sensor receives a 5V supply from the ECM. Two further connections to the ECM provide ground and signal output.

If a fault occurs, an error is registered in the ECM. Two types of failure can occur; camshaft signal frequency too high or total failure of the camshaft signal. The error recorded by the ECM can also relate to a total failure of the crankshaft signal or crankshaft signal dynamically implausible. Both components should be checked to determine the cause of the fault.

If a fault occurs with the CMP sensor when the engine is running, the engine will continue to run but the ECM will deactivate boost pressure control. Once the engine is switched off, the engine will crank but will not restart while the fault is present.

CRANKSHAFT POSITION SENSOR (CKP)



E46903

The CKP sensor is located at the rear of the engine block on the left hand side. The sensor tip is aligned with a magnetic trigger which is attached to the crankshaft. The reluctor is a press fit on the end of the crankshaft. The trigger wheel must be carefully aligned to the crankshaft to ensure correct timing. The sensor produces a square wave signal, the frequency of which is proportional to engine speed.

The ECM monitors the CKP sensor signal and can detect engine over-speed. The ECM counteracts engine over-speed by gradually fading out speed synchronized functions. The CKP is a Hall effect sensor. The sensor measures the magnetic field variation induced by the magnetized trigger wheel.

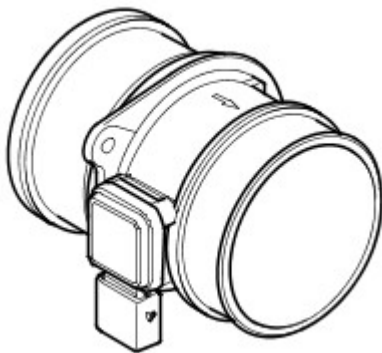
The trigger wheel has two missing teeth representing 6° of crankshaft rotation. The two missing teeth provide a reference point for the angular position of the crankshaft.

When the space with the two missing teeth pass the sensor tip, a gap in the signal is produced which the ECM uses to determine the crankshaft position. The air gap between the sensor tip and the ring is important to ensure correct signals are output to the ECM. The recommended air gap between the CKP and the trigger wheel is 0.4 mm- 1.5 mm.

The ECM uses the signal from the CKP sensor for the following functions:

- Synchronisation.
- Determine fuel injection timing.
- Enable the fuel pump relay circuit (after the priming period).
- Produce an engine speed signal which is broadcast on the CAN bus for use by other systems.

MASS AIR FLOW/INTAKE AIR TEMPERATURE (MAF/IAT) SENSOR



E46904

The MAF/IAT sensor is located on the inlet air duct directly after the air filter box. The sensor combines the two functions of a MAF sensor and an IAT sensor in one unit. The sensor is housed in a plastic molding which is connected between the intake manifold and the air intake pipe.

The MAF sensor works on the hot film principle. Two sensing elements are contained within a film. One element is maintained at ambient (air intake) temperature, e.g. 25°Celsius (77°F). The other element is heated to 200°Celsius (392°F) above the ambient temperature, e.g. 225°Celsius (437°F). Intake air entering the engine passes through the MAF sensor and has a cooling effect on the film. The ECM monitors the current required to maintain the 200°Celsius (392°F) differential between the two elements and uses the differential to provide a precise, non-linear, signal which equates to the volume of air being drawn into the engine.

The MAF sensor output is a digital signal proportional to the mass of the incoming air. The ECM uses this data, in conjunction with signals from other sensors and information from stored fueling maps, to determine the precise fuel quantity to be injected into the cylinders. The signal is also used as a feedback signal for the EGR system.

The IAT sensor incorporates a negative temperature coefficient (NTC) thermistor in a voltage divider circuit. The NTC thermistor works on the principle of decreasing resistance in the sensor as the temperature of the intake air increases. As the thermistor allows more current to pass to ground, the voltage sensed by the ECM decreases. The change in voltage is proportional to the temperature change of the intake air. Using the voltage output from the IAT sensor, the ECM can correct the fueling map for intake air temperature. The correction is an important requirement because hot air contains less oxygen than cold air for any given volume.

The MAF sensor receives a 12V supply from the battery junction box (BJB) and a ground connection via the ECM. Two further connections to the ECM provide a MAF signal and IAT signal.

The IAT sensor receives a 5V reference voltage from the ECM and shares a ground with the MAF sensor. The signal output from the IAT sensor is calculated by the ECM by monitoring changes in the supplied reference voltage to the IAT sensor voltage divider circuit.

The ECM checks the calculated air mass against the engine speed. If the calculated air mass is not plausible, the ECM uses a default air mass figure which is derived from the average engine speed compared to a stored characteristic map. The air mass value will be corrected using values for boost pressure, atmospheric pressure and air temperature.

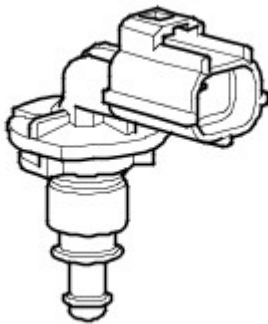
If the MAF sensor fails the ECM implements the default strategy based on engine speed. In the event of a MAF sensor signal failure, any of the following symptoms may be observed:

- Difficult starting
- Engine stalls after starting
- Delayed engine response
- Emission control inoperative
- Idle speed control inoperative
- Reduced engine performance.

If the IAT sensor fails the ECM uses a default intake air temperature of -5°Celsius (23°F). In the event of an IAT sensor failure, any of the following symptoms may be observed:

- Over fueling, resulting black smoke emitting from the exhaust.
- Idle speed control inoperative.

ENGINE COOLANT TEMPERATURE SENSOR



E46905

The engine coolant temperature sensor is located in the top hose at the coolant manifold junction. The ECT sensor provides the ECM and the instrument cluster with engine coolant temperature status.

The ECM uses the temperature information for the following functions:

- Fueling calculations
- Limit engine operation if engine coolant temperature becomes too high
- Cooling fan operation
- Glow plug activation time.

The instrument cluster uses the temperature information for temperature gauge operation. The engine coolant temperature signal is also transmitted on the CAN bus by the instrument cluster for use by other systems.

The ECMECT sensor circuit consists of an internal voltage divider circuit which incorporates an NTC thermistor. As the coolant temperature rises the resistance through the sensor decreases and vice versa. The output from the sensor is the change in voltage as the thermistor allows more current to pass to earth relative to the temperature of the coolant.

The ECM compares the signal voltage to stored values and adjusts fuel delivery to ensure optimum driveability at all times. The engine will require more fuel when it is cold to overcome fuel condensing on the cold metal surfaces inside the combustion chamber. To achieve a richer air/fuel ratio, the ECM extends the injector opening time. As the engine warms up the air/fuel ratio is leaned off.

The input to the sensor is a 5V reference voltage supplied from the voltage divider circuit within the ECM. The ground from the sensor is also connected to the ECM which measures the returned current and calculates a resistance figure for the sensor which relates to the coolant temperature.

The following table shows engine coolant temperature values and the corresponding sensor resistance and voltage values.

Coolant Temperature Sensor Response

Temperature (Degrees Celsius)	Resistance (Kohms)	Voltage (Volts)
-40	925	4.54
-30	496	4.46
-20	277	4.34
-10	160	4.15
0	96	3.88
10	59	3.52
20	37	3.09
30	24	2.62
40	16	2.15
50	11	1.72

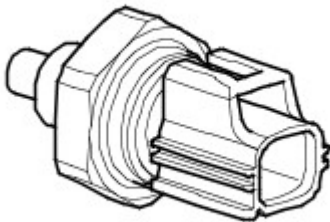
Temperature (Degrees Celsius)	Resistance (Kohms)	Voltage (Volts)
60	7.5	1.34
70	5.6	1.04
80	3.8	0.79
90	2.9	0.64
100	2.08	0.49
110	1.56	0.38
120	1.19	0.29
130	0.918	0.22
140	0.673	0.17
150	0.563	0.14

If the ECT sensor fails, the following symptoms may be observed:

- Difficult cold start.
- Difficult hot start.
- Engine performance compromised.
- Temperature gauge inoperative or inaccurate reading.

In the event of ECT sensor signal failure, the ECM applies a default value of 80°Celsius (176°F) coolant temperature for fueling purposes. The ECM will also permanently operate the cooling fan at all times when the ignition is switched on, to protect the engine from overheating.

ENGINE OIL TEMPERATURE SENSOR



E46906

The oil temperature sensor is located in the engine sump. The temperature sensor is a NTC type which operates in the -30 Degrees Celsius to +150 Degrees Celsius temperature range.

Oil Temperature Sensor Response

Temperature Degrees Celsius	Resistance Ohms
60	620
90	255
120	117
150	60

FUEL RAIL TEMPERATURE SENSOR

The fuel rail temperature sensor is located on the LP return line.

The sensor is an NTC sensor which is connected to the ECM by two wires. The ECM fuel temperature sensor circuit consists of an internal voltage divider circuit which incorporates an NTC thermistor. As the fuel temperature rises the resistance through the sensor decreases. The output from the sensor is the change in voltage as the thermistor allows more current to pass to earth relative to the temperature of the fuel.

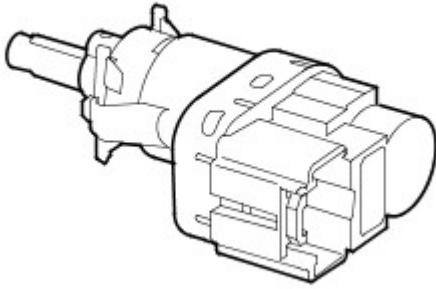
The ECM monitors the fuel temperature constantly. If the fuel temperature exceeds 85°Celsius (185°F), the ECM invokes an engine 'derate' strategy. This reduces the amount of fuel delivered to the injectors in order to allow the fuel to cool. When this occurs, the driver may notice a loss of performance.

Further fuel cooling is available by a bi-metallic valve diverting fuel through the fuel cooler when the fuel reaches a predetermined temperature. In hot climate markets, an electrically operated cooling fan is positioned in the air intake ducting to the fuel cooler. This is controlled by a thermostatic switch, which switches the fan on and off when the fuel reaches a predetermined temperature.

The wires to the fuel sensor are monitored by the ECM for short and open circuit. The ECM also monitors the 5V supply. If a failure occurs a fault is recorded in the ECM memory and the ECM uses a default fuel pressure value.

If the ECM registers an 'out of range' deviation between the pressure signal from the sensor and the pre-programmed 'set point' a fault is stored in the ECM memory. Depending on the extent of the deviation, the ECM will reduce the injection quantity, stop the engine immediately or prevent further engine starting.

BRAKE LAMP SWITCH



E46910

The brake lamp switch is located on the brake box and is operated by the brake pedal. The switch has a normally open circuit switch which closes the circuit when the driver has applied the brakes. The switch is connected directly to the ECM and the ECM also receives a brake lamp signal on the CAN bus from the ABS module.

The ECM uses the brake signal for the following:

- To limit fueling during braking
- To inhibit/cancel Speed control if the brakes are applied.

In the event of a brake switch failure, the following symptoms may be observed:

- Speed control inactive
- Increased fuel consumption.

GLOW PLUGS



E46912

Three glow plugs are located in each of the cylinder heads, on the inlet side. The glow plugs and the glow plug relay are a vital part of the engine starting strategy. The glow plugs heat the air inside the cylinder during cold starts to assist combustion. The use of glow plugs helps reduce the amount of additional fuel required on start-up, and consequently reduces the emission of black smoke. The use of glow plugs also reduces the amount of injection advance required, which reduces engine noise, particularly when idling with a cold engine.

There are three phases of glow plug activity:

- Pre-heat
- During crank
- Post heat.

The main part of the glow plug is a tubular heating element which protrudes into the combustion chamber of the engine. The heating element contains a spiral filament encased in magnesium oxide powder. At the tip of the tubular heating element is the heater coil. Behind the heater coil, and connected in series, is a control coil. The control coil regulates the heater coil to ensure that it does not overheat.

Pre-heat is the length of time the glow plugs operate prior to engine cranking. The ECM controls the pre-heat time based on ECT sensor output and battery voltage. If the ECT sensor fails, the ECM will use the IAT sensor value as a default value. The pre-heat duration is extended if the coolant temperature is low and the battery is not fully charged.

Post heat is the length of time the glow plugs operate after the engine starts. The ECM controls the post heating time based on ECT sensor output. The post heat phase reduces engine noise, improves idle quality and reduces hydrocarbon emissions.

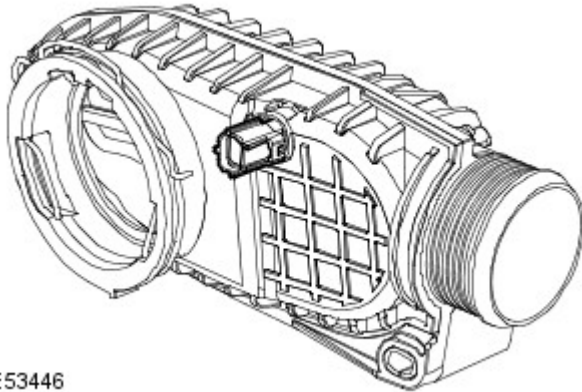
When the ignition is switched on to position II, the glow plug warning lamp illuminates and the instrument cluster displays 'PREHEATING' in the message center. The glow-lamp is activated separately from the glow-plugs, so is not illuminated during or after start. The plugs can still be ON when the lamp is off in these two phases.

In the event of glow plug failure, the engine may be difficult to start and excessive smoke emissions may be observed after starting.

The glow plug warning lamp also serves a second function within the EDC system. If a major EDC system fault occurs, the

glow plug warning lamp will be illuminated permanently and a message generated in the instrument cluster. The driver must seek attention to the engine management system at a Land Rover dealer as soon as possible.

INTAKE AIR TEMPERATURE (BOOST AIR TEMPERATURE) SENSOR



E53446

The IAT is located in the rear of the intake chamber immediately preceding the electric throttle. The sensor is used to measure the intake air temperature from the turbo in order to calculate the required amount of fueling.

BOOST PRESSURE CONTROL

The Boost Pressure (BP) sensor is located post turbo after the electric throttle valve. The sensor provides a voltage signal to the ECM relative to the intake manifold pressure. The BP sensor has a three pin connector which is connected to the ECM and provides a 5V reference supply from the ECM, a signal input to the ECM and a ground for the sensor.

The BP sensor uses diaphragm transducer to measure pressure. The ECM uses the BP sensor signal for the following functions:

- Maintain manifold boost pressure.
- Reduce exhaust smoke emissions when driving at high altitude.
- Control of the EGR system.
- Control of the vacuum control module.

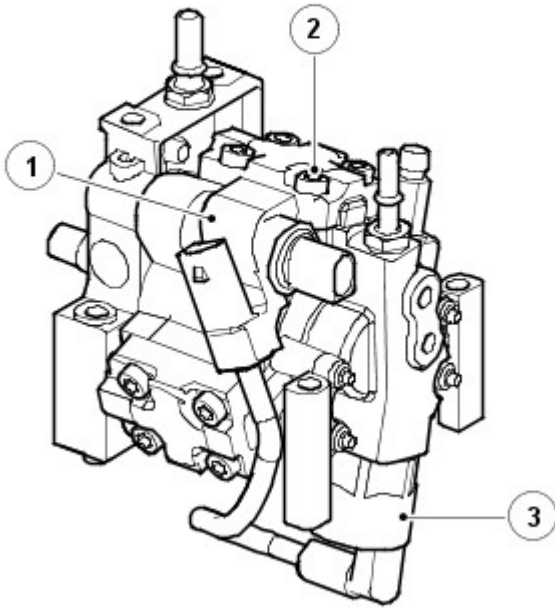
If the BP sensor fails, the ECM uses a default pressure of 1013 mbar (14 lbf/in²). In the event of a BP sensor failure, the following symptoms may be observed:

- Altitude compensation inoperative (black smoke emitted from the exhaust).
- Active boost control inoperative.

Boost control is achieved by the use of a direct drive electric actuator. The actuator is attached to the side of the turbo unit and is connected with the control mechanism via a linkage. The electric actuator works on the torque motor principle and has integrated control module.

The electric actuator moves the control vanes through an 60 degree stroke and has the capability to learn its own maximum stroke positions. The electric actuator is controlled via PWM signals from the ECM. For additional information, refer to: Turbocharger (303-04D Fuel Charging and Controls - Turbocharger - 2.7L Diesel, Description and Operation).

FUEL RAIL PRESSURE CONTROL VALVE



E46984

Item	Part Number	Description
1	-	Fuel volume control valve
2	-	High pressure fuel pump
3	-	Fuel rail pressure control valve

The fuel rail pressure control valve is incorporated into the high pressure fuel pump. The control valve regulates the fuel pressure within the fuel rail and is controlled by the ECM. The control valve is a PWM controlled solenoid valve.

When the solenoid is de-energized, an internal spring holds an internal valve closed. At fuel pressure of 100 bar (1450 lbf/in²) or higher, the force of the spring is overcome, opening the valve and allowing fuel pressure to decay into the fuel return pipe. When the pressure in the fuel rail decays to approximately 100 bar (1450 lbf/in²) or less, the spring force overcomes the fuel pressure and closes the valve. When the ECM energizes the solenoid, the valve is closed allowing the fuel pressure to build. The pressure in the fuel rail in this condition can reach approximately 1300 bar (18854 lbf/in²).

The ECM controls the fuel rail pressure by operating the control valve solenoid using a PWM signal. By varying the duty cycle of the PWM signal, the ECM can accurately control the fuel rail pressure and hence the pressure delivered to the injectors according to engine load. This is achieved by the control valve allowing a greater or lesser volume of fuel to pass from the high pressure side of the pump to the un-pressurized fuel return line, regulating the pressure on the high pressure side.

The fuel rail pressure control valve receives a PWM signal from the ECM of between 0 and 12V. The ECM controls the operation of the control valve using the following information to determine the required fuel pressure:

- Fuel rail pressure
- Engine load
- Accelerator pedal position
- Engine temperature
- Engine speed.

In the event of a total failure of the fuel rail pressure control valve, the engine will not start.

In the event of a partial failure of the fuel rail pressure control valve, the ECM will activate the solenoid with the minimum duty cycle which results in the injection quantity being limited.

FUEL VOLUME CONTROL VALVE

The fuel rail volume control valve is incorporated into the high pressure fuel pump. The VCV spills unwanted fuel back to the tank (or LP system) or forwards it to the PCV. This avoids unused fuel being pressurized by the HP stage of the pump, only to be spilt back to LP by the PCV wasting energy and heating the fuel.

INJECTORS

There are six electronic fuel injectors (one for each cylinder) located in a central position between the four valves of each cylinder. The ECM divides the injectors into two banks of three with cylinders 1 to 3 being designated bank A and cylinders 4 to 6 designated bank B, with injector numbers 1 and 4 at the front of the engine. Although the injectors are numbered 1-6 the firing order determined by the ECM software is numbered 0-5.

Injector/Cylinder Numbering

Injector	Cylinder No
0	1
1	4
2	2
3	5
4	3
5	6

Each injector is supplied with pressurized fuel from the fuel rail and delivers finely atomized fuel directly into the combustion chambers. Each injector is individually controlled by the ECM which operates each injector in the firing order and controls the injector opening period via PWM signals. Each injector receives a 12V supply from the ECM and, using programmed injection/timing maps and sensor signals, determines the precise pilot and main injector timing for each cylinder. If battery voltage falls to between 6 and 9V, fuel injector operation is restricted, affecting emissions, engine speed range and idle speed. In the event of a failure of a fuel injector, the following symptoms may be observed:

- Engine misfire
- Idle irregular
- Reduced engine performance
- Reduced fuel economy
- Difficult starting
- Increased smoke emissions.

The ECM monitors the wires for each injector for short circuit and open circuit, each injector and the transient current within the ECM. If a defect is found, an error is registered in the ECM for the injector in question.

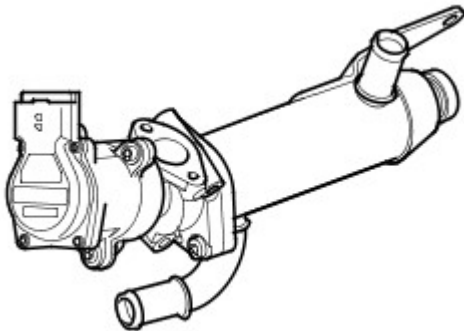
For additional information, refer to: Fuel Charging and Controls (303-04C Fuel Charging and Controls - 2.7L Diesel, Description and Operation).

EGR SYSTEM

The EGR system comprises:

- EGR modulator x 2
- EGR cooler x 2
- Associated connecting pipes

EGR



E46914

The EGR modulator and cooler are a combined unit.

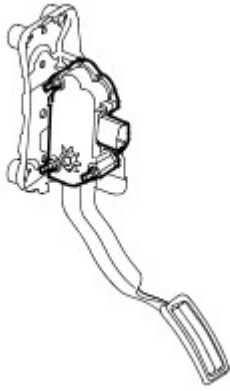
The combined EGR modulator and cooler is located under each cylinder bank, between the exhaust manifold and the cylinder head. The cooler side of the EGR is connected to the vehicle cooling system, via hoses. The inlet exhaust side is connected directly into the exhaust manifolds on each side. The exhaust gas passes through the cooler and is expelled via the actuator and a metal pipe into the throttle housing. The EGR modulator is a solenoid operated valve which is controlled by the ECM. The ECM uses the EGR modulator to control the amount of exhaust gas being re-circulated in order to reduce exhaust emissions and combustion noise. The EGR is enabled when the engine is at normal operating temperature and under cruising conditions.

The EGR modulator receives a 12V supply from the ECM and is controlled using a PWM signal. The PWM duty signal of the solenoid ground is varied to determine the precise amount of exhaust gas delivered to the cylinders.

The modulators are operated through their full range at each engine shut down, to clear any carbon deposits that may have built up whilst the engine was running

In the event of a failure of the EGR modulator, the EGR function will become inoperative. The ECM can monitor the EGR modulator solenoid for short circuits and store fault codes in the event of failure. The modulator can also be activated for testing using a Land Rover approved diagnostic system.

ACCELERATOR PEDAL POSITION (APP) SENSOR



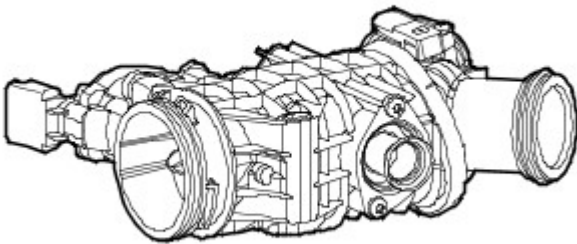
E46901

The APP sensor is incorporated into the pedal assembly. The sensor is a twin track rotary potentiometer type.

The APP sensor is located in plastic housing which is integral with the throttle pedal. The housing is injection molded and provides location for the APP sensor. The sensor is mounted externally on the housing and is secured with two Torx screws. The external body of the sensor has a six pin connector which accepts a connector on the vehicle wiring harness.

The sensor has a spigot which protrudes into the housing and provides the pivot point for the pedal mechanism. The spigot has a slot which allows for a pin, which is attached to the sensor potentiometers, to rotate through approximately 90°, which relates to pedal movement. The pedal is connected via a link to a drum, which engages with the sensor pin, changing the linear movement of the pedal into rotary movement of the drum. The drum has two steel cables attached to it. The cables are secured to two tension springs which are secured in the opposite end of the housing. The springs provide 'feel' on the pedal movement and require an effort from the driver similar to that of a cable controlled throttle. A detente mechanism is located at the forward end of the housing and is operated by a ball located on the drum. At near maximum throttle pedal movement, the ball contacts the detente mechanism. A spring in the mechanism is compressed and gives the driver the feeling of depressing a 'kickdown' switch when full pedal travel is achieved.

ELECTRONIC THROTTLE



E46900

The electric throttle body is located in the inlet tract prior to where the inlet splits to divert air flow into the two separate air intake manifolds. The electric throttle controls the volume of air allowed into the inlet manifold by means of a DC motor which controls a flap in the body of the throttle. This is done in response to inputs from the engine management system.

Just after the throttle flap the tubes from the EGR valves/coolers are joined into the assembly.

DIESEL PARTICULATE FILTER (DPF) CONTROL - VEHICLES FROM 2008MY

Vehicles from 2008MY are fitted with a Diesel Particulate Filter (DPF) which collects the particulate matter produced during the combustion process and reduces the particulates entering the atmosphere.

The DPF is located in the exhaust system, downstream of the catalytic converter. A major feature of the DPF is its ability for regeneration. Regeneration is the burning of particulates trapped by the filter to prevent obstruction to the free flow of exhaust gasses. The regeneration process is controlled by the ECM and takes place at calculated intervals and is not noticeable by the driver of the vehicle.

For details of the DPF and the regeneration processes refer to the relevant exhaust system section. For additional information, refer to: Exhaust System (309-00C, Description and Operation).

Regeneration is most important, since an overfilled filter can damage the engine through excessive exhaust back pressure and can itself be damaged or destroyed.

The exhaust gas and DPF temperatures are controlled by the DPF software located in the ECM. The DPF software monitors the load status of the DPF based on driving style, distance travelled and signals from a differential pressure sensor and temperature sensors located before and after the DPF in the exhaust system. When the particulate loading of the DPF reaches predetermined levels, the DPF is actively regenerated by adjusting, in conjunction with the ECM, various engine control functions such as:

- fuel injection

- intake air throttle
- EGR
- turbocharger boost pressure control.

The regeneration process is possible because of the flexibility of the common-rail fuel injection engine which provides precise control of fuel flow, fuel pressure and injection timing which are essential requirements to promote the efficient regeneration process.

The ECM contains the DPF software which controls and monitors the DPF and the regeneration process. The software is broken down into three separate modules; a DPF supervisor module, a DPF fuel management module and a DPF air management module, which interact with each other to provide precise DPF control.

These three modules are controlled by a fourth software module known as the DPF co-ordinator module. The co-ordinator module manages the operation of the other modules when an active regeneration is requested. The DPF supervisor module is a sub-system of the DPF co-ordinator module.

DPF Co-Ordinator Module

The DPF co-ordinator module reacts to a regeneration request from the supervisor module by initiating and controlling the following DPF regeneration requests:

- EGR cut-off
- Turbocharger boost pressure control
- Engine load increase
- Control of air pressure and temperature in the intake manifold
- Fuel injection control.

When the supervisor module issues a regeneration request, the co-ordinator module requests EGR cut-off and a regeneration specific turbocharger boost pressure control. It then waits for a feedback signal from the EGR system confirming that the EGR valve is closed.

• **NOTE: The EGR valve is open at idle to allow reduced NO_x. EGR is not used during part load due to intake manifold contamination.**

When the EGR valve is closed, the co-ordinator module initiates requests to increase engine load by controlling the intake air temperature and pressure.

Once confirmation is received that intake conditions are controlled or a calibration time has expired, the co-ordinator module then changes to a state awaiting an accelerator pedal release manoeuvre from the driver. If this occurs or a calibration time has expired, the co-ordinator module generates a request to control fuel injections to increase exhaust gas temperature.

DPF Fuel Management Module

The DPF fuel management module controls the following functions:

- Timing and quantity of the four split injections per stroke (pilot, main and two post injections).
- Injection pressure and the transition between the three different calibration levels of injection.

The above functions are dependant on the condition of the catalytic converter and the DPF.

The controlled injection determines the required injection level in addition to measuring the activity of the catalytic converter and the DPF. The fuel management calculates the quantity and timing for the four split injections, for each of the three calibration levels for injection pressure, and also manages the transition between the levels.

The two post injections are required to separate the functionality of increasing in-cylinder gas temperatures and the production of hydrocarbons. The first post injection is used to generate the higher in-cylinder gas temperature while simultaneously retaining the same engine torque output produced during normal (non-regeneration) engine operation. The second post injection is used to generate hydrocarbons by allowing unburnt fuel into the catalytic converter without producing increased engine torque.

DPF Air Management Module

The DPF air management module controls the following functions:

- EGR control
- Turbocharger boost pressure control
- Intake air temperature and pressure control.

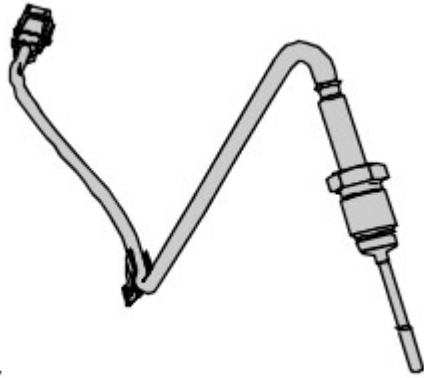
During active regeneration, the EGR operation is disabled and the closed-loop activation of the turbocharger boost controller is calculated. The air management module controls the air in the intake manifold to a predetermined level of pressure and temperature. This control is required to achieve the correct in-cylinder conditions for stable and robust combustion of the post injected fuel.

Restricting the air intake during DPF regeneration has the following functions:

- Increase in engine load
- Slower combustion
- Reduction in the mass of air taken in
- A reduction in the speed of the exhaust gases and therefore an increase in the time for which the gases are in the catalytic converter.

The module controls the intake air temperature by actuating the EGR throttle and by adjustment of the turbocharger boost pressure control.

DPF Temperature Sensors



E48497

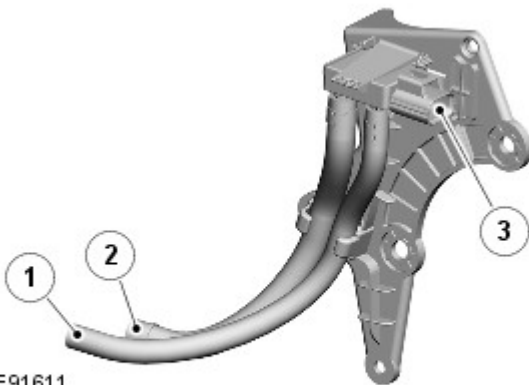
Three temperature sensors are used in the DPF system. One is located in the turbocharger outlet elbow, the second sensor is after the catalytic converter and the third sensor is located after the DPF.

The sensors measure the temperature of exhaust gas exiting the turbocharger, before it passes through the DPF and after it has passed through the DPF and provides the information required by the ECM to calculate the DPF temperature. The information is used, in conjunction with other data, to estimate the amount of accumulated particulate and to control the DPF temperature.

The sensors are Negative Temperature Co-efficient (NTC) type resistors, which measure the temperature of the exhaust gases. The resistance, and subsequently the voltage at the sensor, will decrease as the exhaust gas temperature increases.

In the event of a fault in a temperature sensor, the ECM uses a substitute value of 350°C (1202°F).

Differential Pressure Sensor



E91611

Item	Part Number	Description
1	-	Low pressure connection
2	-	High pressure connection
3	-	Electrical connector

The differential pressure sensor is located on the rear of the transfer box, adjacent to the DPF.

The differential pressure sensor is used by the DPF software to monitor the condition of the DPF. Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the DPF. The pipes allow the sensor to measure the inlet and outlet pressures of the DPF.

As the amount of particulates trapped by the DPF increases, the pressure at the inlet side of the DPF increases in comparison to the DPF outlet. The DPF software uses this comparison, in conjunction with other data, to calculate the accumulated amount of trapped particulates.

By measuring the pressure difference between the DPF inlet and outlet air flow and the DPF temperature, the DPF software can determine if the DPF is becoming blocked and requires regeneration.

A DPF is recognized as overloaded if the differential pressure under certain operating conditions exceeds the overload limit calculated by the ECM. The DPF software may start regeneration attempts but be unable to complete them. These attempts are counted by the ECM and, if the maximum number of regeneration attempts is reached, a fault entry is recorded in the ECM at the next ignition on cycle.

The DPF software performs the following checks using the DPF differential pressure sensor:

- Plausibility check
- Diesel particulate filter efficiency
- Diesel particulate filter overloaded
- Diesel particulate filter clogged
- Monitoring of the maximum regeneration attempts in the lower load range.

TERRAIN RESPONSE™

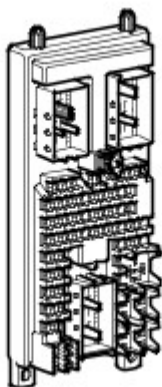
Terrain Response system allows the driver to select a program which will provide the optimum settings for traction and performance for prevailing terrain conditions.

As part of Terrain Response there will be different throttle pedal progression maps associated with different Terrain Response modes. The two extremes are likely to be a sand map (quick build up of torque with pedal travel) and grass/gravel/snow (very cautious build up of torque).

The TdV6 implementation of throttle progression is based on a fixed blend time. The torque will blend from that on one map to that on the new map (for the same pedal position) over a fixed time. This means blending will always take the same amount of time but when the torque change is small the torque increase over time will be small, whilst if the torque change is greater then the torque increase over time will be steeper. The resulting acceleration of the vehicle will depend on the torque difference between the two maps as well as on the gear and range selected. The worst case blending that could ever occur has been calibrated to match the blend rate for petrol derivatives as closely as possible, so as to give a transparent behavior to customers.

For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).

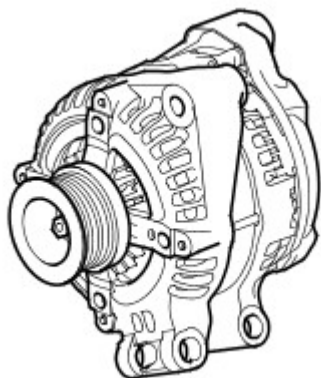
CENTRAL JUNCTION BOX



E47607

The central junction box (CJB) initiates the power up and power down routines within the ECM. When the ignition is turned on 12V is applied to the Ignition Sense input. The ECM then starts its power up routines and turns on the ECM main relay; the main power to the ECM and it's associated system components. When the ignition is turned OFF the ECM will maintain its powered up state for up to 20 seconds while it initiates its power down routine and on completion will turn off the ECM main relay.

GENERATOR



E47591

The generator has a multifunction voltage regulator for use in a 14V charging system with 6÷12 zener diode bridge rectifiers.

The ECM monitors the load on the electrical system via PWM signal and adjusts the generator output to match the required load. The ECM also monitors the battery temperature to determine the generator regulator set point. This characteristic is necessary to protect the battery; at low temperatures battery charge acceptance is very poor so the voltage needs to be high to maximize any rechargeability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing of the battery with consequent water loss.

For additional information, refer to: Generator (414-02C Generator and Regulator - 2.7L Diesel, Description and Operation).

The generator has a smart charge capability that will reduce the electrical load on the generator reducing torque requirements, this is implemented to utilize the engine torque for other purposes. This is achieved by monitoring three signals to the ECM:

- Generator sense (A sense), measures the battery voltage at the CJB.
- Generator communication (Alt Com) communicates desired generator voltage set point from ECM to generator.
- Generator monitor (Alt Mon) communicates the extent of generator current draw to ECM. This signal also transmits faults to the ECM which will then sends a message to the instrument cluster on the CAN bus to illuminate the charge warning lamp.

Electronic Engine Controls - TDV6 2.7L Diesel - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Fuel leaks ● Accessory drive belt ● Sensor installation/condition ● Viscous fan and solenoid 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● 5 volt sensor supply ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> ● Inertia fuel shutoff switch ● Low/Contaminated fuel ● Air leakage ● Low-pressure fuel system fault ● Fuel pump module (lift pump) fault ● Blocked fuel filter ● Fuel volume regulator blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel pump fault ● Crankshaft position (CKP) sensor 	Check that the inertia switch has not tripped. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.
Difficult to start	<ul style="list-style-type: none"> ● Glow plug system fault (very cold conditions) ● Low/Contaminated fuel ● Air leakage ● Fuel pump module (lift pump) fault ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.

Symptom	Possible Causes	Action
Rough idle	<ul style="list-style-type: none"> ● Intake air system fault ● Low/Contaminated fuel ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Lack of power when accelerating	<ul style="list-style-type: none"> ● Intake air system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust gas recirculation (EGR) valve(s) fault ● Turbocharger actuator fault 	Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary. Check for DTCs indicating a fuel pressure fault. Check the EGR system. Check turbocharger actuator.
Engine stops/stalls	<ul style="list-style-type: none"> ● Air leakage ● Low/Contaminated fuel ● Low-pressure fuel system fault ● High pressure fuel leak ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Engine judders	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Air ingress ● Low-pressure fuel system fault ● Fuel metering valve blocked/contaminated ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● High pressure fuel leak ● Fuel pump fault 	Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	<ul style="list-style-type: none"> ● Low-pressure fuel system fault ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel temperature sensor leak ● High pressure fuel leak ● Injector(s) fault ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the EGR system.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Electronic Engine Controls - TDV6 2.7L Diesel - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.
2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

Position the DTI gauge on a suitable mounting block, as illustrated.



3. With the aid of another technician, gently press the brake pedal until the stoplamps illuminate.
4. NOTE: The specification is that the stoplamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

Note the measurement of the brake pedal travel from rest position until the stoplamps illuminated.

Adjust

1. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Remove the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Only use light finger pressure when installing the stoplamp switch. Failure to follow this instruction may result in an incorrectly adjusted stoplamp switch.

Install the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

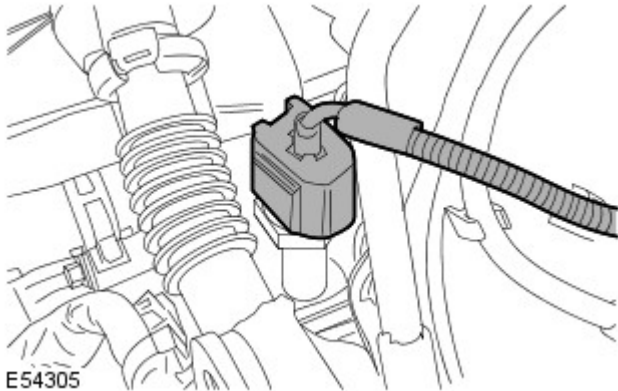
3. Check the adjustment of the stoplamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Electronic Engine Controls - TDV6 2.7L Diesel - Engine Oil Pressure (EOP) Sensor

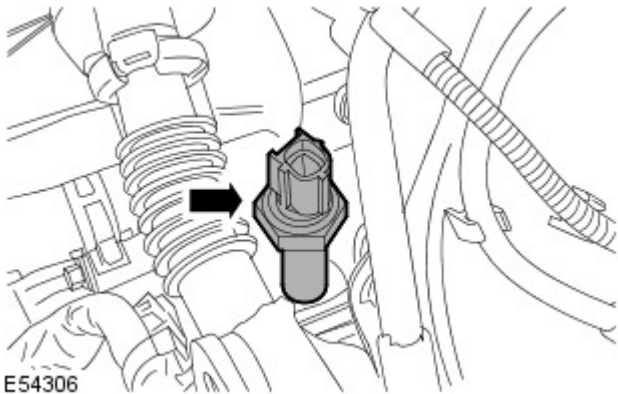
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Oramentation, Removal and Installation).
3. Disconnect the engine oil pressure (EOP) sensor electrical connector.



4. Remove the EOP sensor.



Installation


1. To install, reverse the removal procedure.
 - Tighten the EOP sensor to 15 Nm (11 lb.ft).
2. Check and top-up the engine oil.

Electronic Engine Controls - TDV6 2.7L Diesel - Oil Temperature Sensor

Removal and Installation

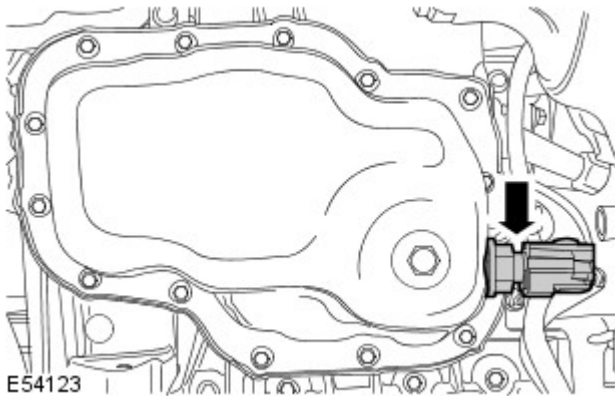
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the engine oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures).

3.  CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the oil temperature sensor.

- Disconnect the engine oil temperature sensor electrical connector.
- Position a container to collect the oil spillage.
- Remove and discard the O-ring seal.



Installation

1. **NOTE:** Lubricate new seals with clean engine oil.

Install the oil temperature sensor.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the oil temperature sensor to 20 Nm (15 lb.ft).
- Connect the engine oil temperature sensor electrical connector.

2. Fill the engine with oil.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - TDV6 2.7L Diesel - Engine Control Module (ECM)

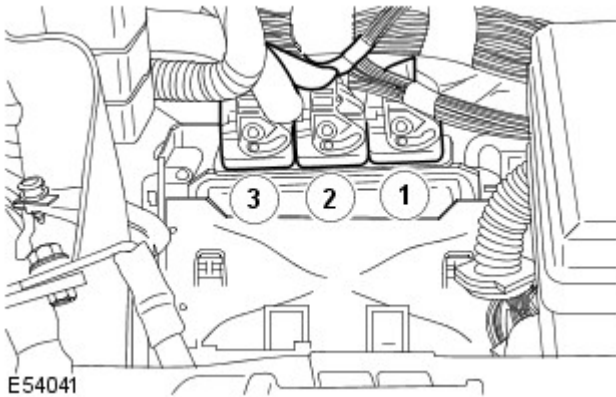
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
3. **NOTE:** Right hand drive shown, for Left hand drive reverse the sequence.

Disconnect the three engine harness electrical connectors in the order shown.

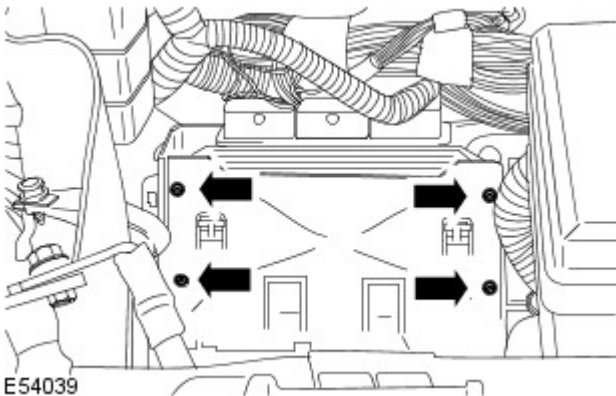
- Position the three engine harness electrical connectors aside for access.



E54041

4. Remove the ECM securing plate.

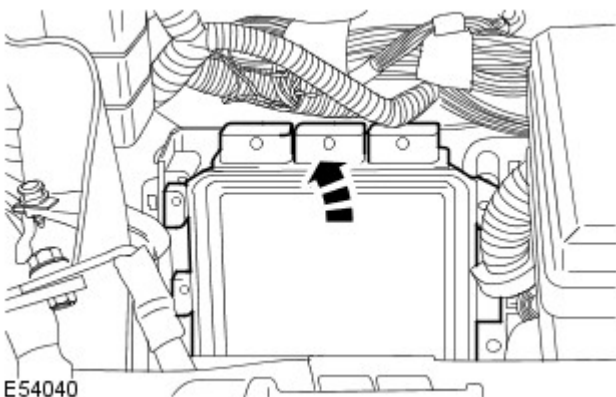
- Remove the four ECM securing bolts



E54039

5. Remove the ECM.

- Remove the ECM top cover.



E54040

Installation

1. Install the ECM.
 - Install the ECM top cover.
2. Install the ECM securing plate.

- Install and tighten the four securing bolts.
3. Connect the three engine harness electrical connectors.
 4. Install the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
 5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 6. **NOTE: Vehicles with DPF (Diesel Particulate Filter) installed only.**

Renew the engine oil and filter.
For additional information, refer to: [Engine Oil Draining and Filling](#) (303-01A Engine - TDV6 2.7L Diesel, General Procedures).
 7. Connect T4 to calibrate a new ECM.

Electronic Engine Controls - TDV6 2.7L Diesel - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

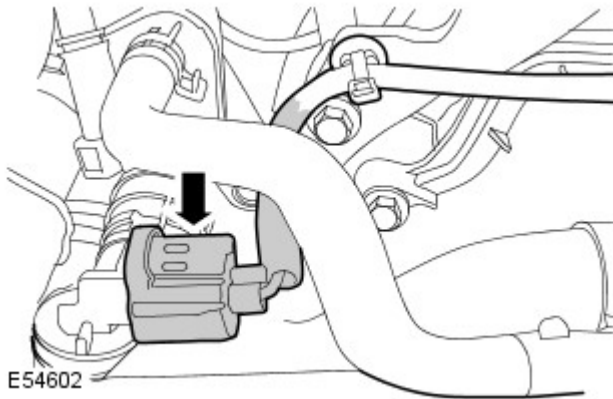


WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the engine coolant temperature sensor while the system is hot.



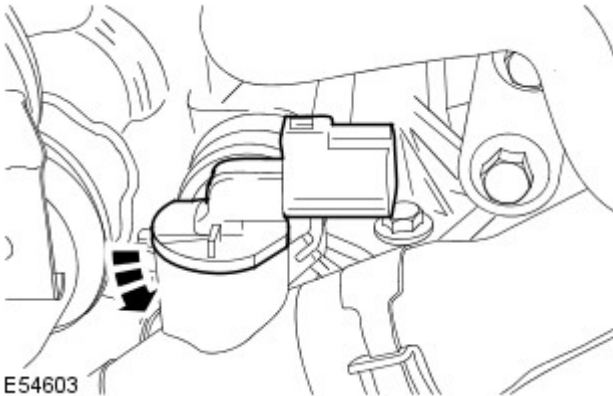
CAUTION: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the ECT sensor electrical connector.



4. Remove the ECT sensor.

- Lift the tang and rotate the ECT sensor anti-clockwise.
- Remove and discard the O-ring seal.



Installation

1. Install the ECT sensor.
 - Clean the component mating faces.
 - Install a new O-ring seal.
2. Connect the ECT sensor electrical connector.
3. Check and top-up the coolant.
 - Clean any remaining coolant from around the hoses and pipes.
4. Install the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

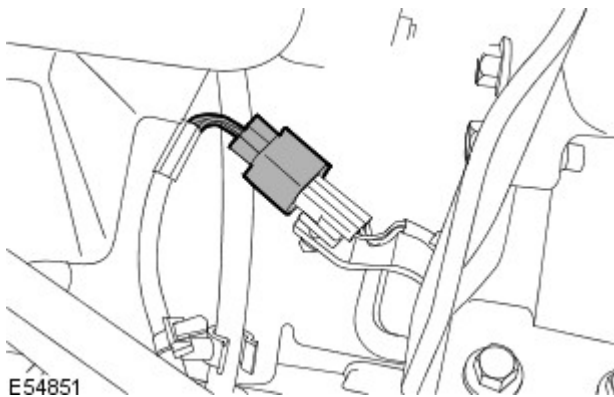
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - TDV6 2.7L Diesel - Crankshaft Position (CKP) Sensor

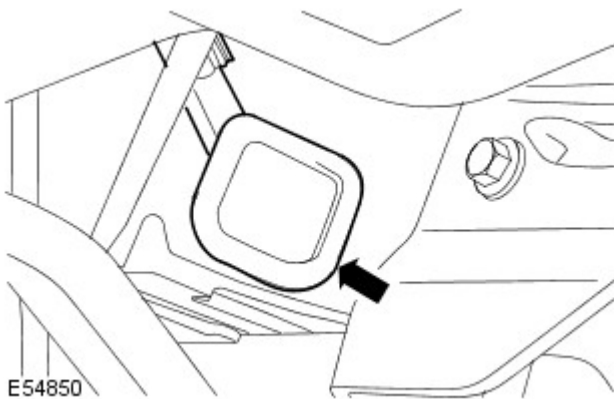
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the turbocharger.
For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).
3. Disconnect the CKP sensor electrical connector.



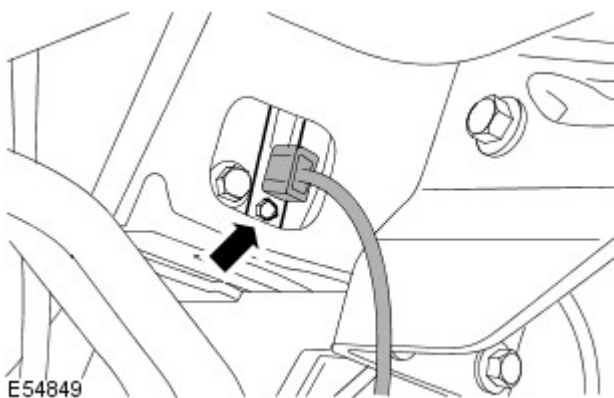
4. Remove the CKP sensor blanking cover.



5. **NOTE:** The CKP sensor retaining bolt should not be removed from the CKP sensor.

Remove the CKP sensor.

- Fully loosen the CKP sensor retaining bolt.



Installation


1.  **CAUTION:** Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

To install, reverse the removal procedure.

- Tighten the CKP sensor bolt to 5 Nm (4 lb.ft)


Electronic Engine Controls - TDV6 2.7L Diesel - Crankshaft Position (CKP) Sensor Ring

Removal and Installation

Special Tool(s)	
	Installer -Crankshaft Position (CKP) Sensor Ring 303-1130

Removal

- NOTE: The CKP sensor ring must always be discarded and replaced when removed.

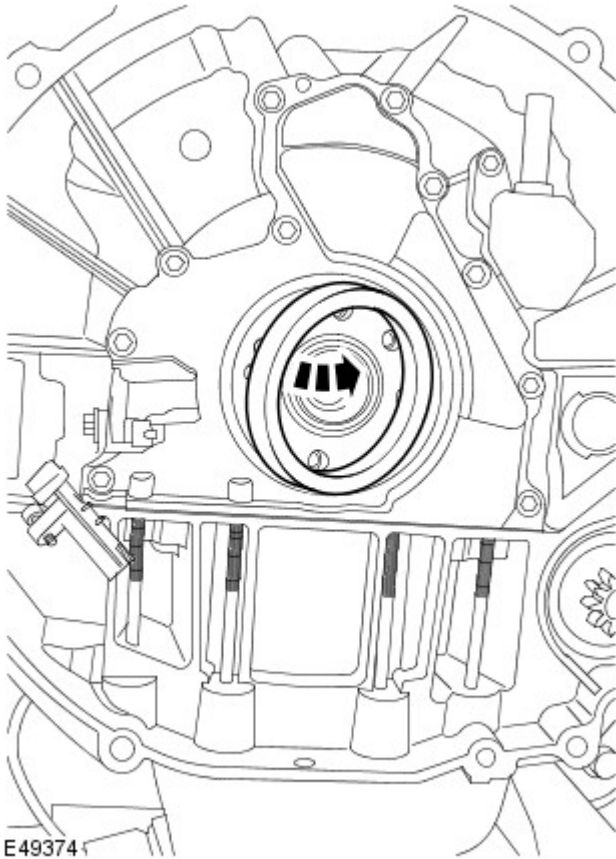
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Raise and support the vehicle.

2. Manual models: Remove the flywheel.
For additional information, refer to: [Flywheel](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
3. Automatic models: Remove the flexplate.
For additional information, refer to: [Flexplate](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).
4. Release the CKP sensor.

- Release the Allen screw.





5.  CAUTION: Care must be taken to avoid damage to the crankshaft.

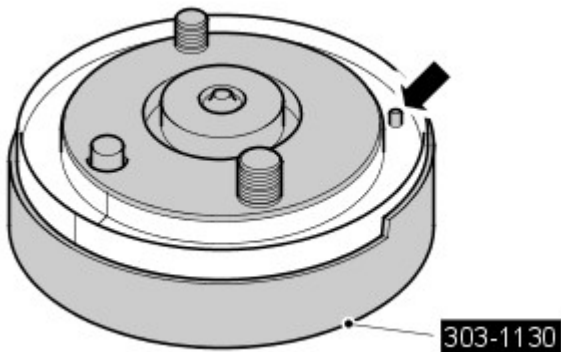
Remove the CKP sensor ring.

- Carefully remove the CKP sensor ring.

Installation

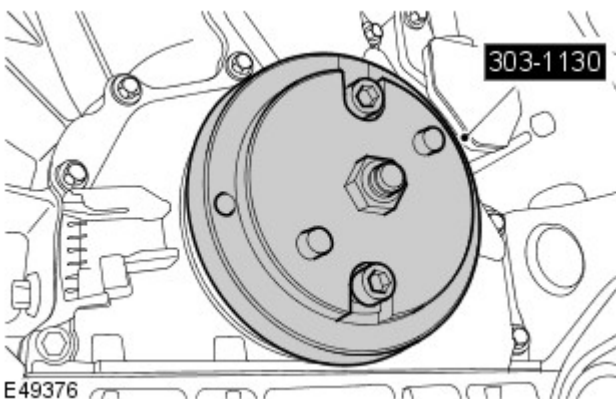
1. Install the new CKP sensor ring to the special tool.

- Wind the special tool nut back to the end of the thread.
- Engage the CKP sensor ring to the locating pin.



2. Install the CKP sensor ring to the crankshaft.

- Clean the component mating faces.
- Align the dowel and install the special tool to the crankshaft.
- Tighten the 2 Allen screws.
- Tighten the special tool nut, to install the CKP sensor ring to the crankshaft.
- Remove the special tool.



3. Install the CKP sensor. For additional information, refer to: [Flywheel](#) (303-01A Engine - TDV6 2.7L Diesel, In-Vehicle Repair).

- Tighten the Allen screw to 6 Nm (4 lb.ft).

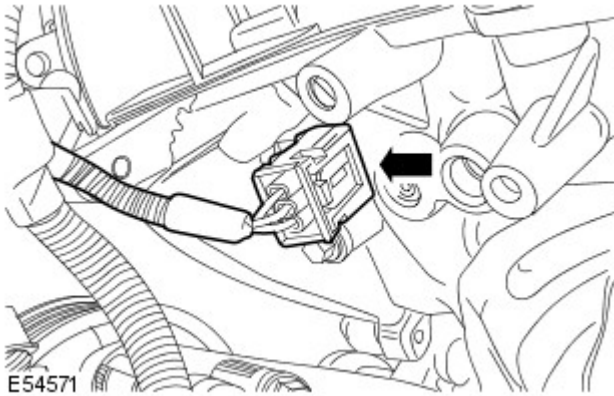
5. Automatic models: Remove the flexplate.
For additional information, refer to: [Flexplate](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

Electronic Engine Controls - TDV6 2.7L Diesel - Camshaft Position (CMP) Sensor

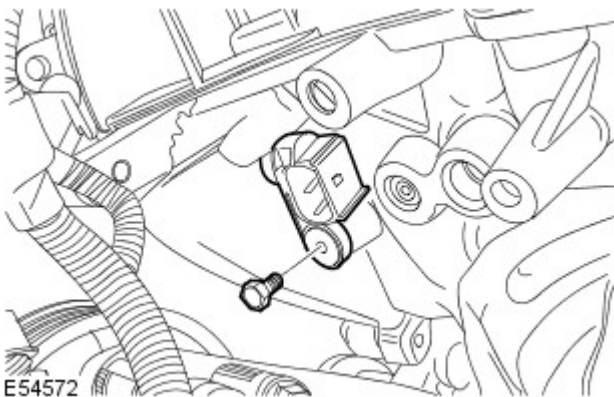
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH exhaust gas recirculation (EGR) valve.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve LH - Vehicles Without Diesel Particulate Filter \(DPF\)](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
3. Disconnect the CMP sensor electrical connector.



4. Remove and discard the CMP sensor.
 - Remove the CMP sensor retaining bolt.

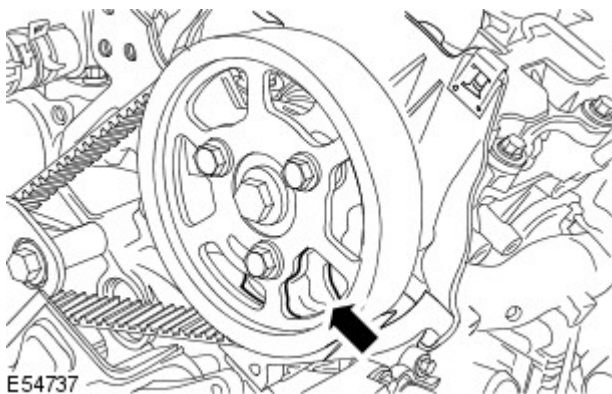


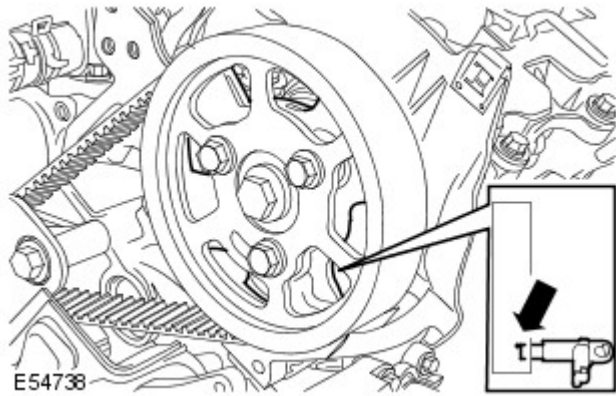
Installation

1. **NOTE:** Only turn the engine in the normal direction of rotation.

Turn the engine until one of the three webs on the back of the camshaft pulley is visible through the CMP sensor housing.

- Timing belt cover shown removed for clarity.
- Use a mirror, to view the webs on the camshaft pulley through the CMP sensor locating hole.





2.  CAUTION: The Camshaft position (CMP) sensor tip must rest on one of the three webs on the back of the camshaft pulley. Incorrect installation may result in the CMP sensor being damaged.

Install a new CMP sensor

3. Install the retaining bolt.

- Tighten the bolt to 10 Nm (7 lb.ft).

4. Connect the CMP sensor electrical connector.

5. Install the LH EGR valve.

For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve LH - Vehicles Without Diesel Particulate Filter \(DPF\)](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

6. Connect the battery ground cable.

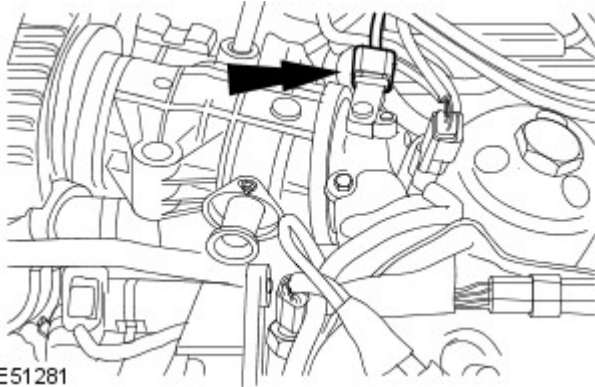
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - TDV6 2.7L Diesel - Manifold Absolute Pressure (MAP) Sensor

Removal and Installation

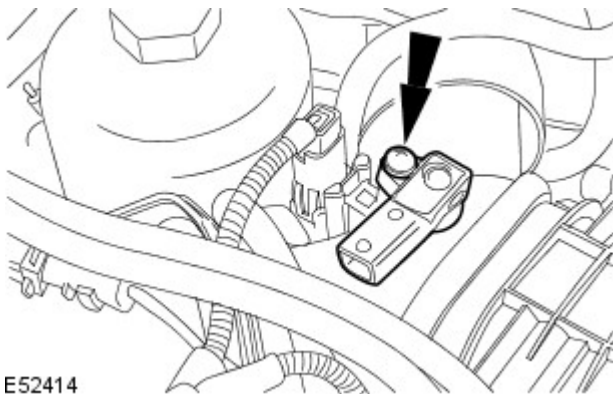
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the MAP sensor electrical connector.



E51281

4. Remove the MAP sensor.
 - Remove the Torx screw.
 - Remove the O-ring seal.



E52414

Installation

1. To install, reverse the removal procedure.
 - Tighten the Torx screw to 3 Nm (2 lb.ft).

Electronic Engine Controls - TDV6 2.7L Diesel - Fuel Temperature Sensor

Removal and Installation

Removal

• WARNINGS:



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.



Do not carry out any repairs to the fuel system with the engine running. The fuel pressure within the system can be as high as 1650 bar (23,931 lb-sq-in). Failure to follow this instruction may result in personal injury.

• CAUTIONS:



Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

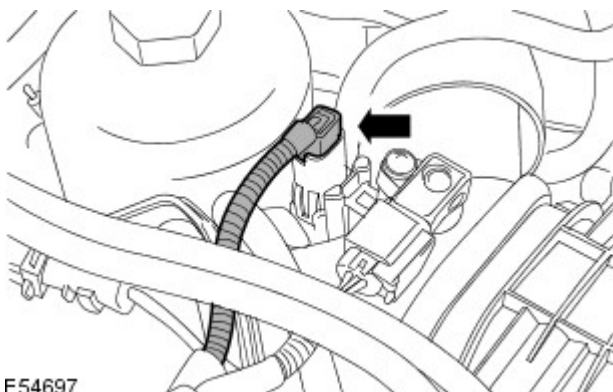


Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.



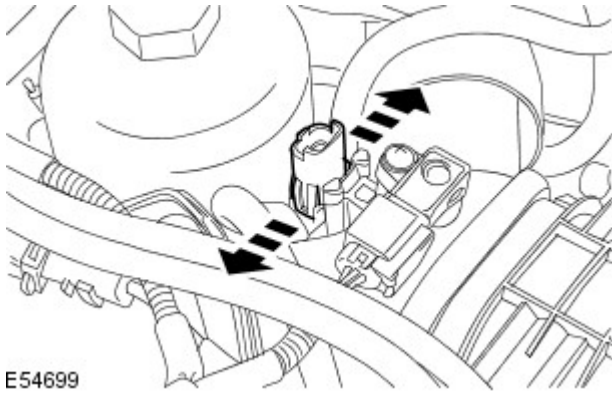
Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Disconnect the fuel temperature sensor electrical connector.




E54697

4. Release the fuel temperature sensor locking tangs.

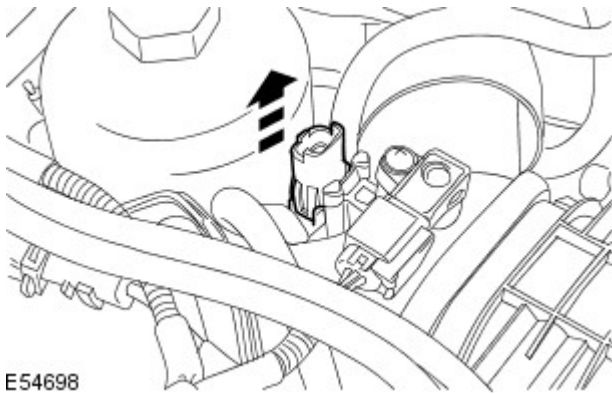


E54699

5.  CAUTION: Always plug any open connections to prevent contamination.

Remove the fuel temperature sensor from the fuel return line.

- Position an absorbent cloth to collect fluid spillage.
- Discard the O-ring seal.
- Clean the seal contact area.
- Install a clean blanking plug to the fuel return line.



E54698

Installation

1. To install, reverse the removal procedure.

- Clean the immediate area.

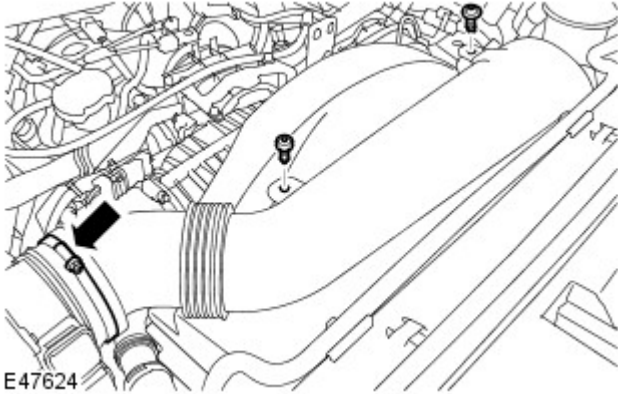
Electronic Engine Controls - TDV6 2.7L Diesel - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Release the air outlet pipe.

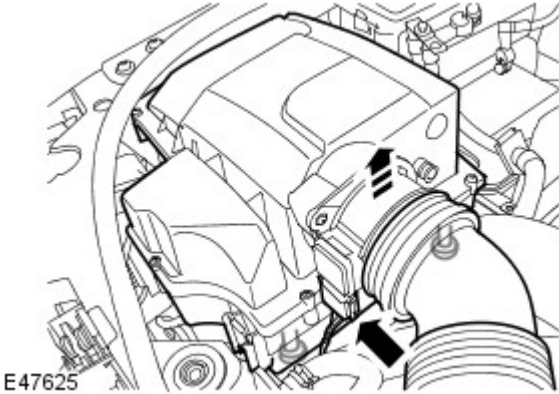
- Remove the 2 screws.
- Loosen the clip.



E47624

3. Remove the RH air cleaner assembly.

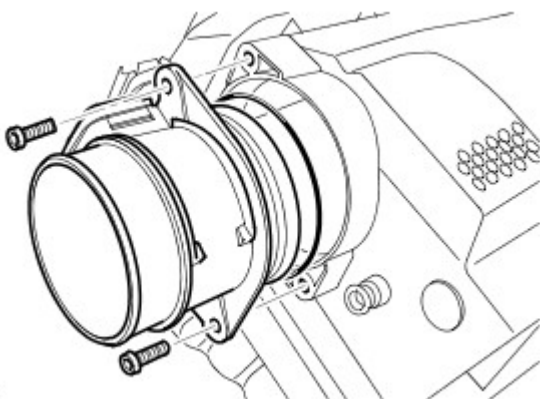
- Disconnect the electrical connector.
- Release the air cleaner from the 2 grommets.



E47625

4. Remove the MAF sensor.

- Remove the 2 Torx screws.
- Remove the O-ring seal.



E47626

Installation

1. **NOTE:** When installing the air cleaner, make sure the locating pegs fit securely into the grommets.

To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 2.7L Diesel - Fuel Rail Pressure (FRP) Sensor

Removal and Installation

Removal



CAUTION: The FRP sensor must not be removed from the fuel diverter rail.

• **NOTE:** If a new fuel rail pressure sensor is to be installed, a new FRP sensor and fuel diverter rail must be installed as an assembly.

1. Remove the fuel diverter rail.
For additional information, refer to: [Fuel Diverter Rail](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

Installation

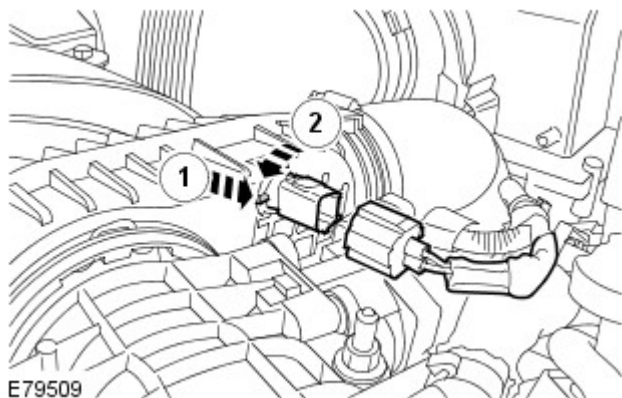
1. Install the fuel diverter rail.
For additional information, refer to: [Fuel Diverter Rail](#) (303-04A Fuel Charging and Controls - TDV6 2.7L Diesel, Removal and Installation).

Electronic Engine Controls - TDV6 2.7L Diesel - Intake Air Temperature (IAT) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the intake air temperature (IAT) sensor.
 - Disconnect the electrical connector.



Installation

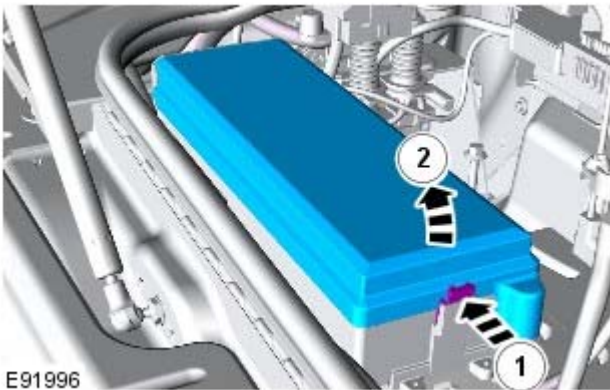
1. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 2.7L Diesel - Engine Control Module (ECM) Cooling Fan

Removal and Installation

Removal

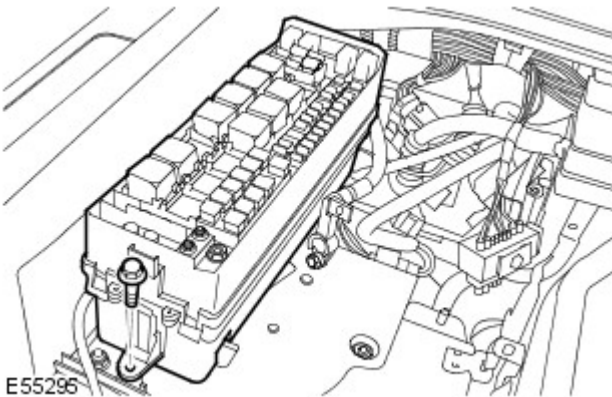
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Remove the engine control module (ECM).
For additional information, refer to: [Engine Control Module \(ECM\)](#) (303-14, Removal and Installation).
4. Remove the battery junction box (BJB) cover.
 - Release the clip.



E91996

- Release the clip.

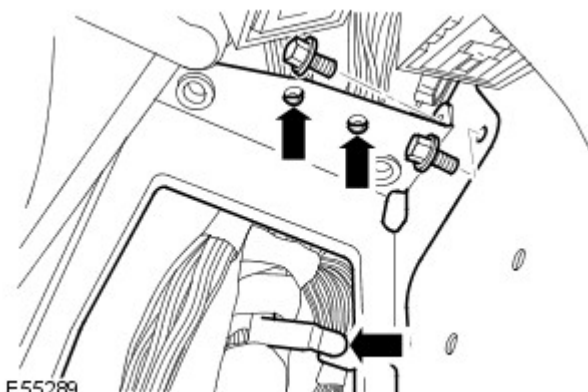
5. Release the BJB from the bracket.
 - Remove the bolt.



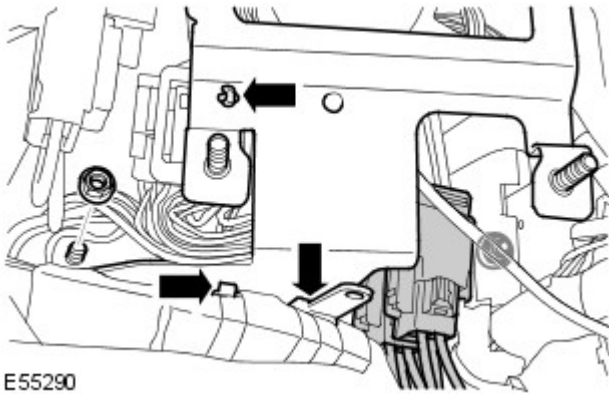
E55296

6. Remove the central junction box (CJB).
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

7. Release the CJB bracket.
 - Release the 3 upper wiring harness clips.
 - Remove the 2 bolts.

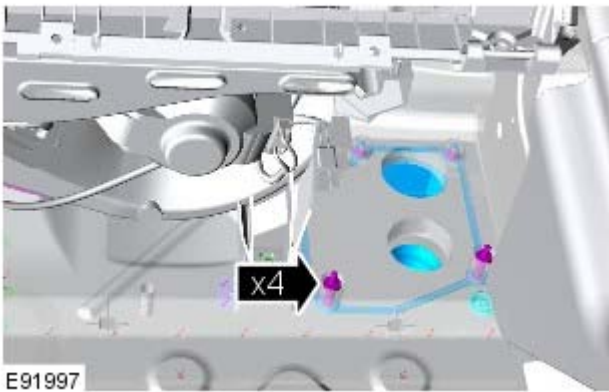


E55289



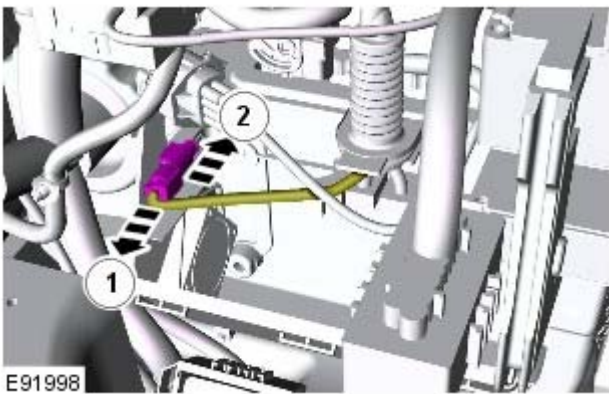
8. Remove the CJB bracket.

- Disconnect the 2 electrical connectors.
- Release the 3 lower wiring harness clips.
- Remove the 2 nuts.



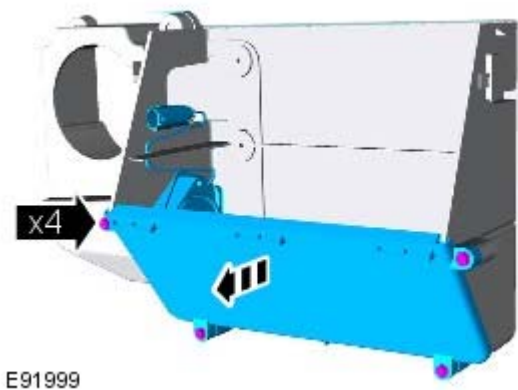
9. Release the ECM housing.

- Release the insulation for access to the nuts.
- Remove the 2 nuts and 2 bolts.



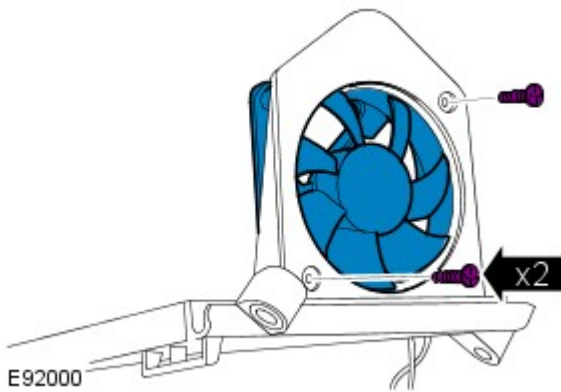
10.  CAUTION: Note of the routing of the wiring harnesses.

Release and disconnect the ECM cooling fan electrical connector.



11. Remove the ECM housing lower panel.

- Remove the 4 screws.




12.  **CAUTION:** Note the fitted position of the component prior to removal.

Remove the cooling fan.

- Remove the 2 screws.

Installation

1.  **CAUTION:** Make sure that these components are installed to the noted removal position.


Install the cooling fan.

- Install the 2 screws.

2.  **CAUTION:** Make sure the seal is installed correctly.

Install the ECM housing lower panel.

- Install the 4 screws.

3.  **CAUTION:** Make sure that the wiring harnesses are correctly routed.

Connect and secure the cooling fan electrical connector.

4.  **CAUTION:** Make sure that the seal is correctly located.

Secure the ECM housing.

- Tighten the bolts and nuts to 10 Nm (7 lb.ft).

5. Install the CJB bracket.

- Tighten the nuts to 10 Nm (7 lb.ft).
- Secure the clips.
- Connect the electrical connectors.
- Tighten the bolts to 25 Nm (18 lb.ft).

6. Install the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

7. Secure the BJB to the bracket.

- Tighten the bolt to 6 Nm (4 lb.ft).

8. Install the BJB cover.

- Secure the clip.

9. Install the engine ECM.

For additional information, refer to: Engine Control Module (ECM) (303-14, Removal and Installation).

10. Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

11. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - TDV6 2.7L Diesel - Exhaust Gas Temperature Sensor

Removal and Installation

Removal



WARNING: Observe due care when working near a hot exhaust system.

• **NOTE:** Pre-catalytic converter exhaust gas temperature sensor shown, post catalytic converter and post diesel particulate filter (DPF) sensors similar.

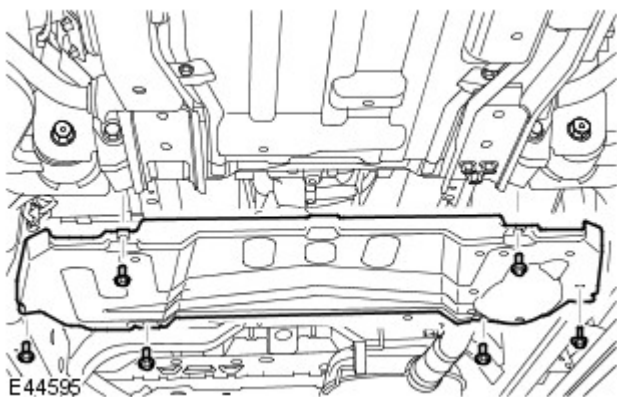


1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission undershield.

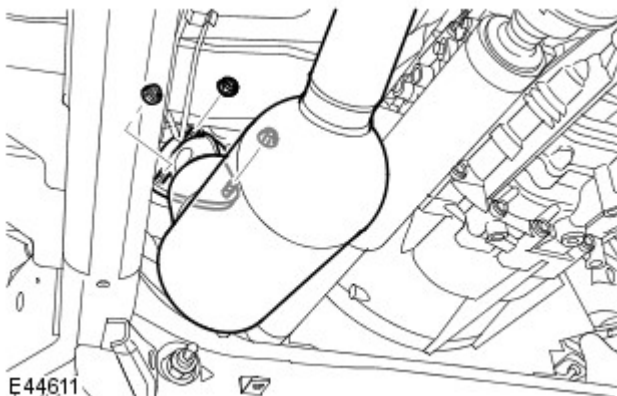
- Remove the 6 bolts.



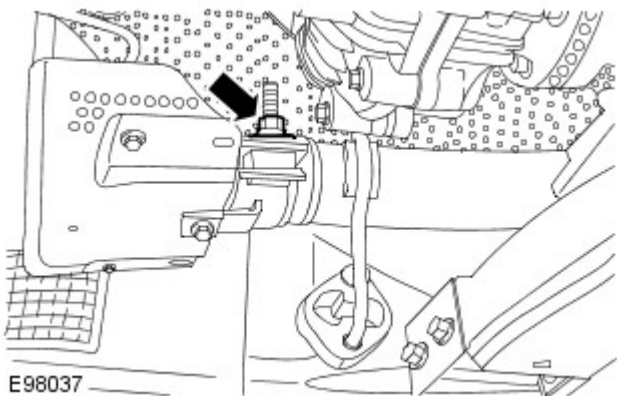
3. NOTE: Discard the gasket.

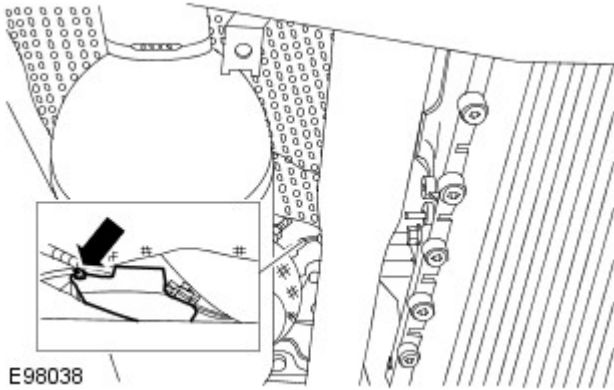
Release the catalytic converter.

- Remove and discard the 3 nuts.



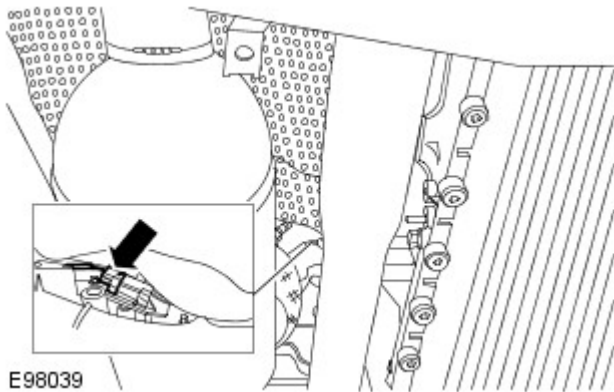
4. Loosen the catalytic converter to diesel particulate filter (DPF) clamp.



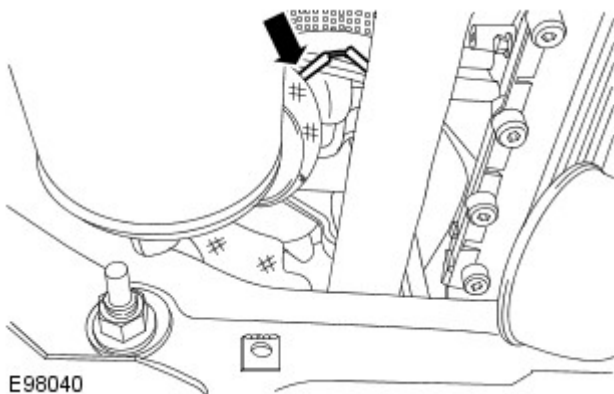


5. Remove the exhaust gas temperature sensor electrical connector heat shield.

- Remove the bolt.



6. Disconnect the exhaust gas temperature sensor electrical connector.



7. Remove the exhaust gas temperature sensor.

- Reposition the catalytic converter.

Installation

1. Install the exhaust gas temperature sensor.

- Tighten to 35 Nm (26 lb.ft).

2. Connect the exhaust gas temperature sensor electrical connector.

3. Install the exhaust gas temperature sensor connector heat shield.

- Tighten the bolt to 10 Nm (7 lb.ft).

4. **NOTE:** Install a new gasket.

Secure the LH catalytic converter.

- Tighten the nuts to 48 Nm (35 lb.ft).

5. Tighten the catalytic converter to DPF retaining clamp.

- Tighten the nut to 48 Nm (35 lb.ft).

6. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).

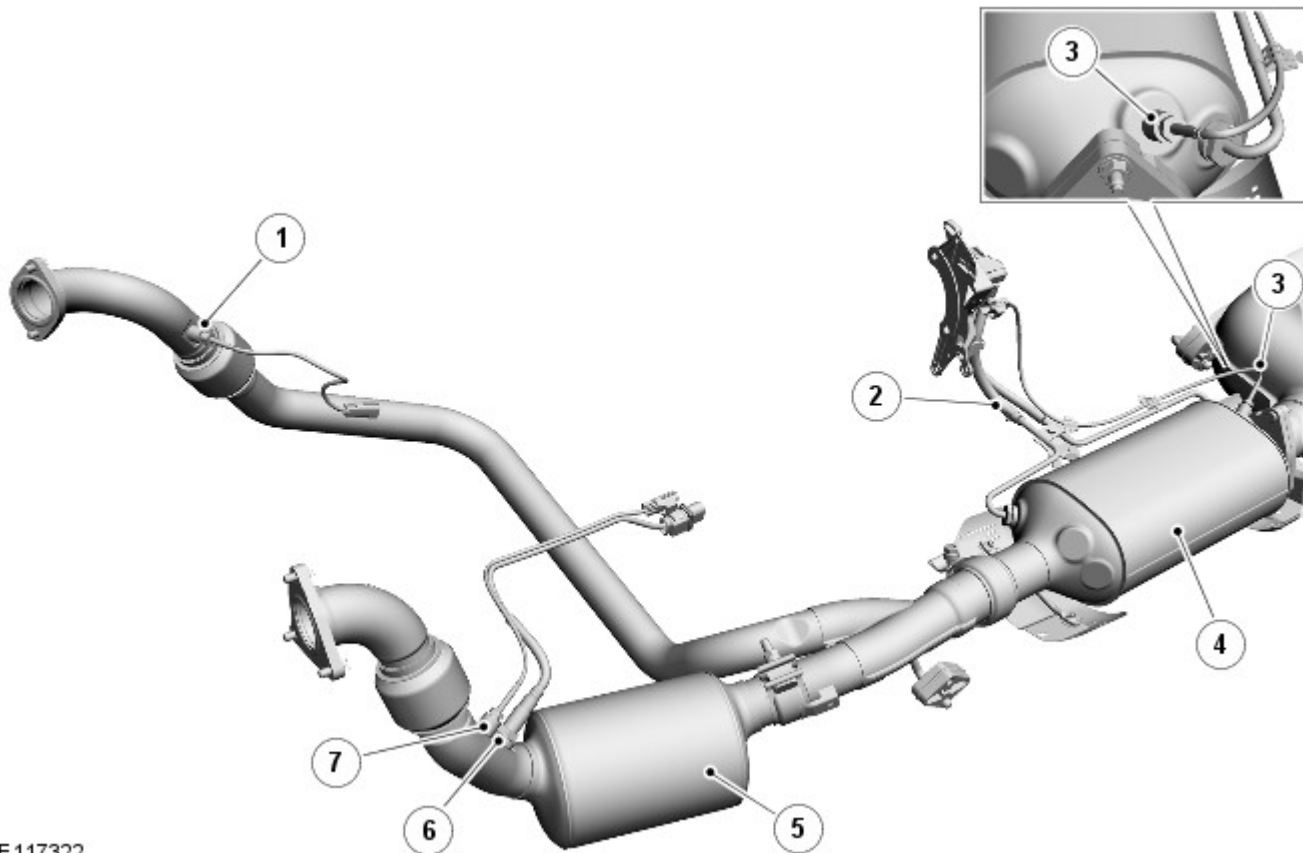
Electronic Engine Controls - TDV6 3.0L Diesel -**Torque Specification**

Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	5	-	44
Engine control module (ECM) retaining bolts	7	-	62
Engine control module (ECM) retaining nuts	7	-	62
Engine oil pressure (EOP) sensor	14	11	-
Engine oil level sensor retaining bolts	10	7	-
Mass air flow (MAF) sensor	2	-	18
Manifold absolute pressure (MAP) sensor	3	-	27
Exhaust gas temperature sensor RH	35	26	-
Pre catalytic converter temperature sensor	35	26	-
Post catalytic converter temperature sensor	35	26	-
Pre diesel particulate filter (DPF) exhaust gas temperature sensor	35	26	-
Post DPF exhaust gas temperature sensor	35	26	-
Heated oxygen sensor (HO2S)	48	35	-

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls - Component Location

Description and Operation

Component Location - Sheet 1 of 3

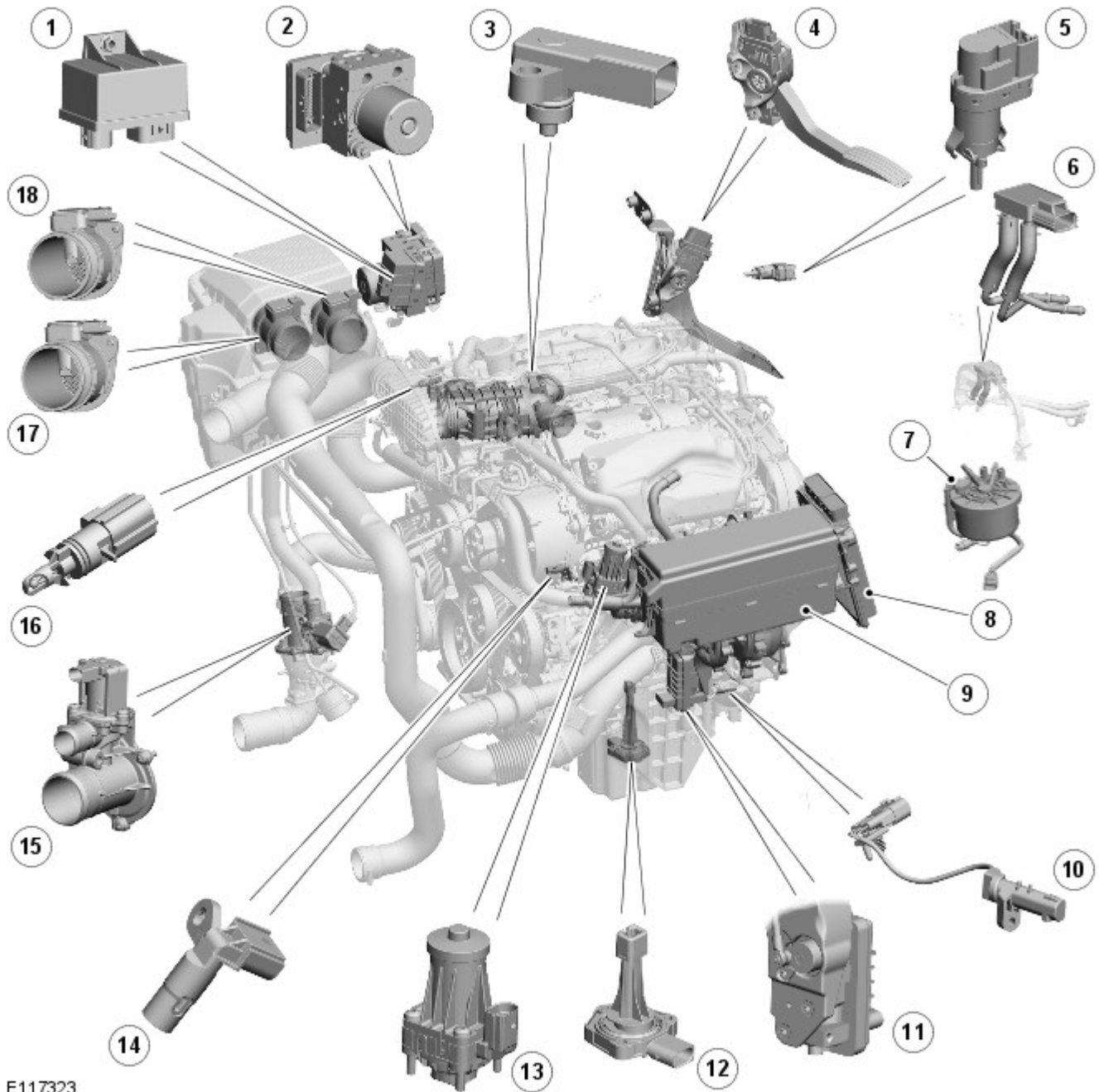


E117322

ItemDescription

1	Exhaust gas temperature sensor
2	DPF (diesel particulate filter) pressure pipes (connected to differential pressure sensor located on top of transmission)
3	DPF temperature sensors
4	DPF
5	Catalyst (RH (right-hand) bank)
6	HO2S (heated oxygen sensor)
7	Pre-catalyst temperature sensor

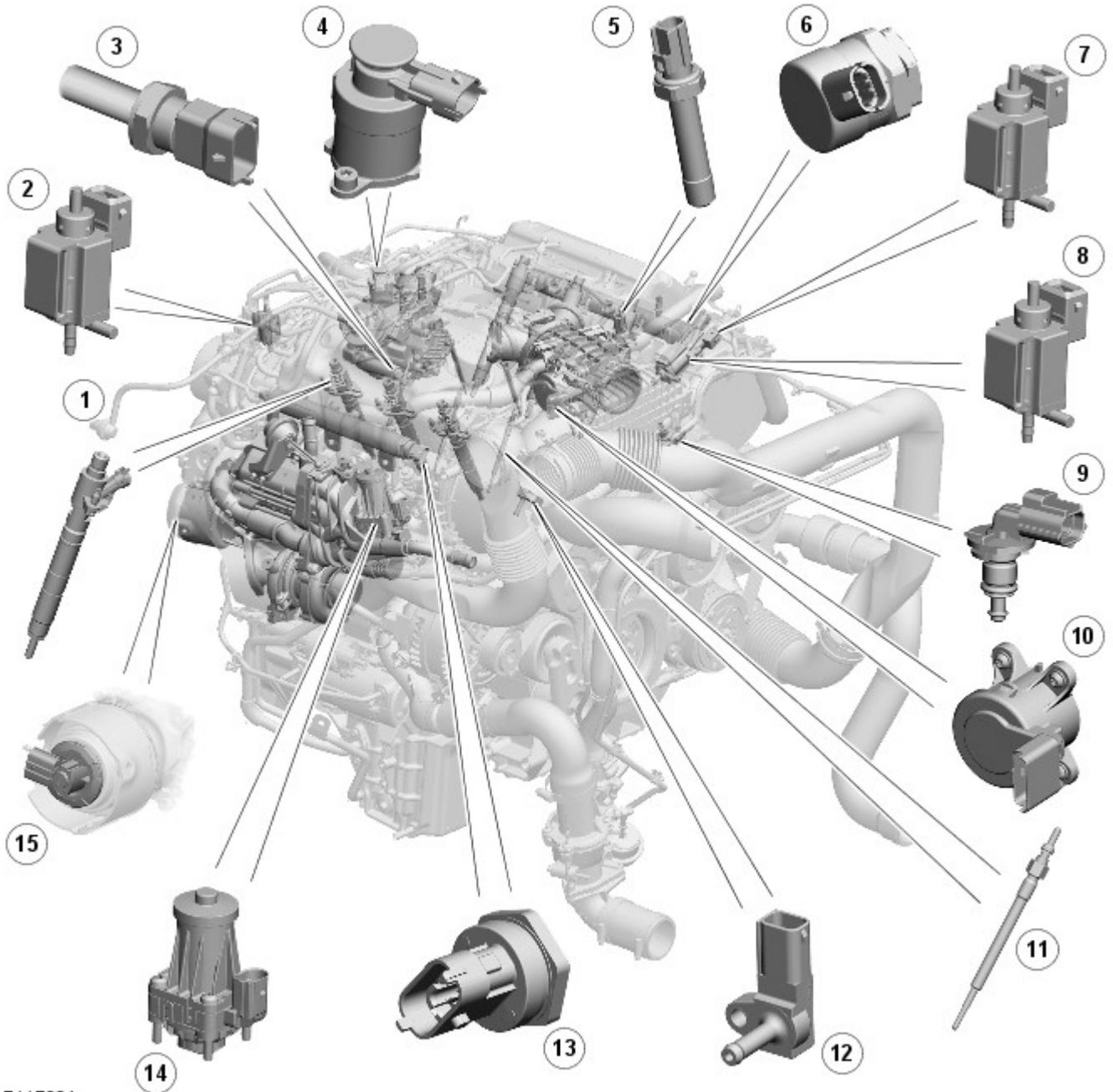
Component Location - Sheet 2 of 3



E117323

ItemDescription

1	Glow plug module
2	ABS (anti-lock brake system) module
3	MAP (manifold absolute pressure) sensor
4	APP (accelerator pedal position) sensor
5	Brake lamp/brake test switch
6	Differential pressure sensor
7	Water-in-fuel sensor
8	ECM (engine control module)
9	EJB (engine junction box)
10	CKP (crankshaft position) sensor
11	Primary turbocharger control module
12	Engine oil level/temperature sensor
13	LH (left-hand)EGR (exhaust gas recirculation) valve
14	CMP (camshaft position) sensor
15	Secondary turbocharger compressor recirculation valve
16	Charge air temperature sensor
17	MAF (mass air flow) / IAT (intake air temperature) sensor (primary turbocharger)
18	



E117324

ItemDescription

1	Fuel injector (6 off)
2	EGR cooler bypass vacuum solenoid valve
3	High pressure fuel pump inlet temperature sensor
4	High pressure fuel pump volume control valve
5	Engine oil pressure sensor
6	Fuel pressure control valve
7	Secondary turbocharger compressor shut-off solenoid valve
8	Secondary turbocharger turbine shut-off solenoid valve
9	ECT (engine coolant temperature) sensor
10	Throttle actuator
11	Glow plug (6 off)
12	Secondary turbocharger boost pressure sensor
13	Fuel pressure sensor
14	RHEGR valve
15	Secondary turbocharger turbine shut-off valve and position sensor

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls - Overview

Description and Operation

OVERVIEW

The 3.0L V6 diesel engine has an [ECM \(engine control module\)](#) controlled engine management system. Multiple sensor inputs and precision control of actuators are used by the [ECM](#) to achieve optimum performance during all driving conditions.

The [ECM](#) receives and processes information from the following input sources:

- Oil level sensor
- Secondary turbocharger shut-off sensor
- Secondary turbocharger boost pressure sensor
- Generator
- Differential pressure sensor
- [CMP \(camshaft position\)](#) sensor
- [CKP \(crankshaft position\)](#) sensor
- Fuel rail pressure sensor
- Fuel temperature sensor
- Air charge temperature sensor
- [ECT \(engine coolant temperature\)](#) sensor
- [TP \(throttle position\)](#) sensor
- [MAF \(mass air flow\)](#) sensor
- [MAF/IAT \(intake air temperature\)](#) sensor
- [MAP \(manifold absolute pressure\)](#) sensor
- [EGR \(exhaust gas recirculation\)](#) sensors
- [HO2S \(heated oxygen sensor\)](#)
- Catalyst and Diesel Particulate Filter (DPF) temperature sensors
- Brake lamp switch

The [ECM](#) outputs controlling signals to the following sensors and actuators:

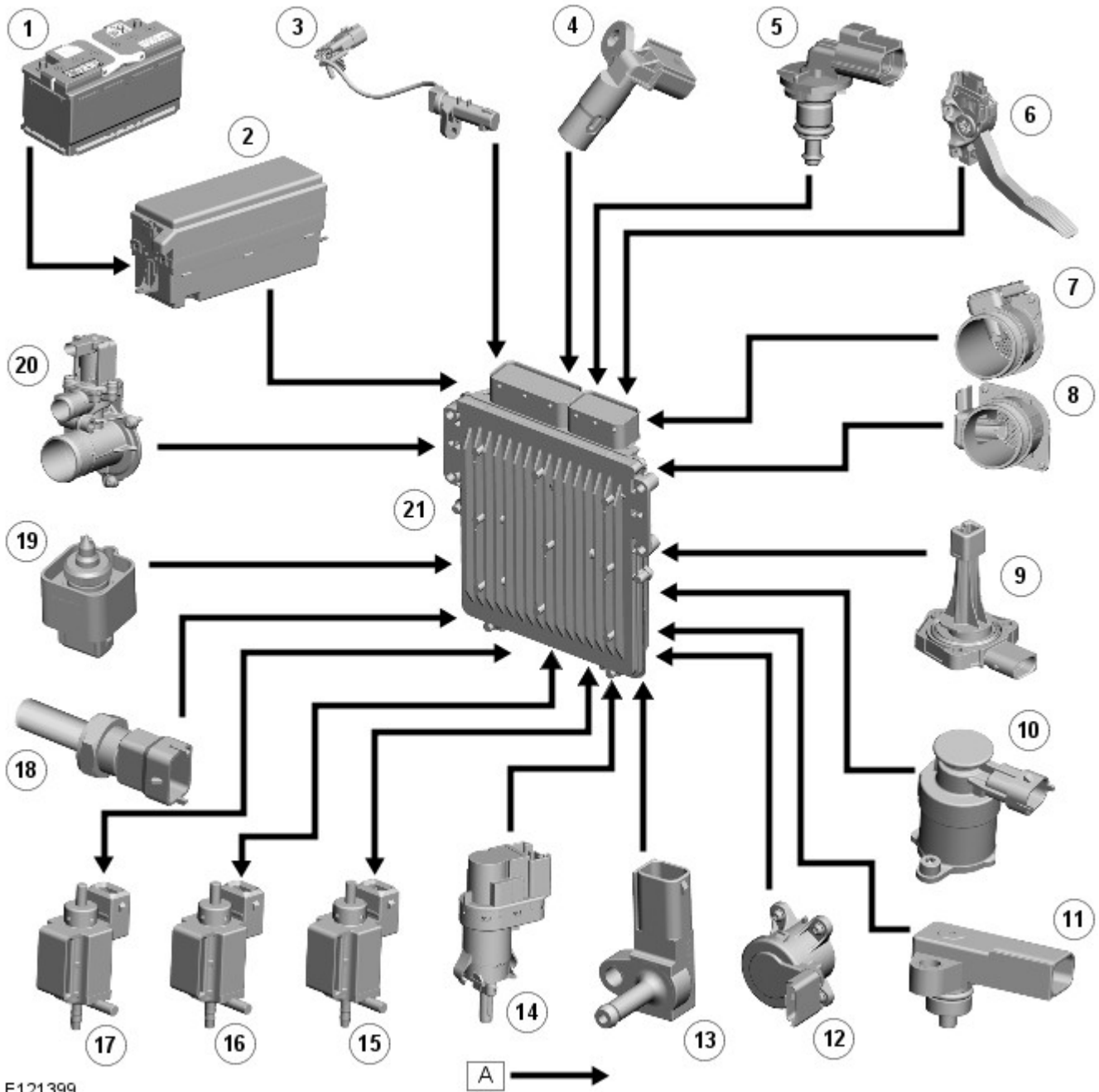
- [A/C \(air conditioning\)](#) compressor clutch solenoid
- [A/C](#) compressor clutch
- Fuel injectors
- Glow plug relay
- Fuel pressure control valve
- Fuel volume control valve
- Fan control module
- Vacuum control valves (EGR cooler by-pass, secondary turbocharger compressor shut-off, secondary turbocharger turbine shut-off)
- [ABS \(anti-lock brake system\)](#) module
- [TCM \(transmission control module\)](#)
- Instrument cluster
- [RCM \(restraints control module\)](#)
- Primary turbocharger control module
- [EGR](#) recirculation valves
- Alternator
- Throttle actuator
- Secondary turbocharger compressor recirculation valve

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls - System Operation and Component Description

Description and Operation

Control Diagram

3.0L V6 Diesel Control Diagram - Sheet 1 of 2



E121399

ItemDescription

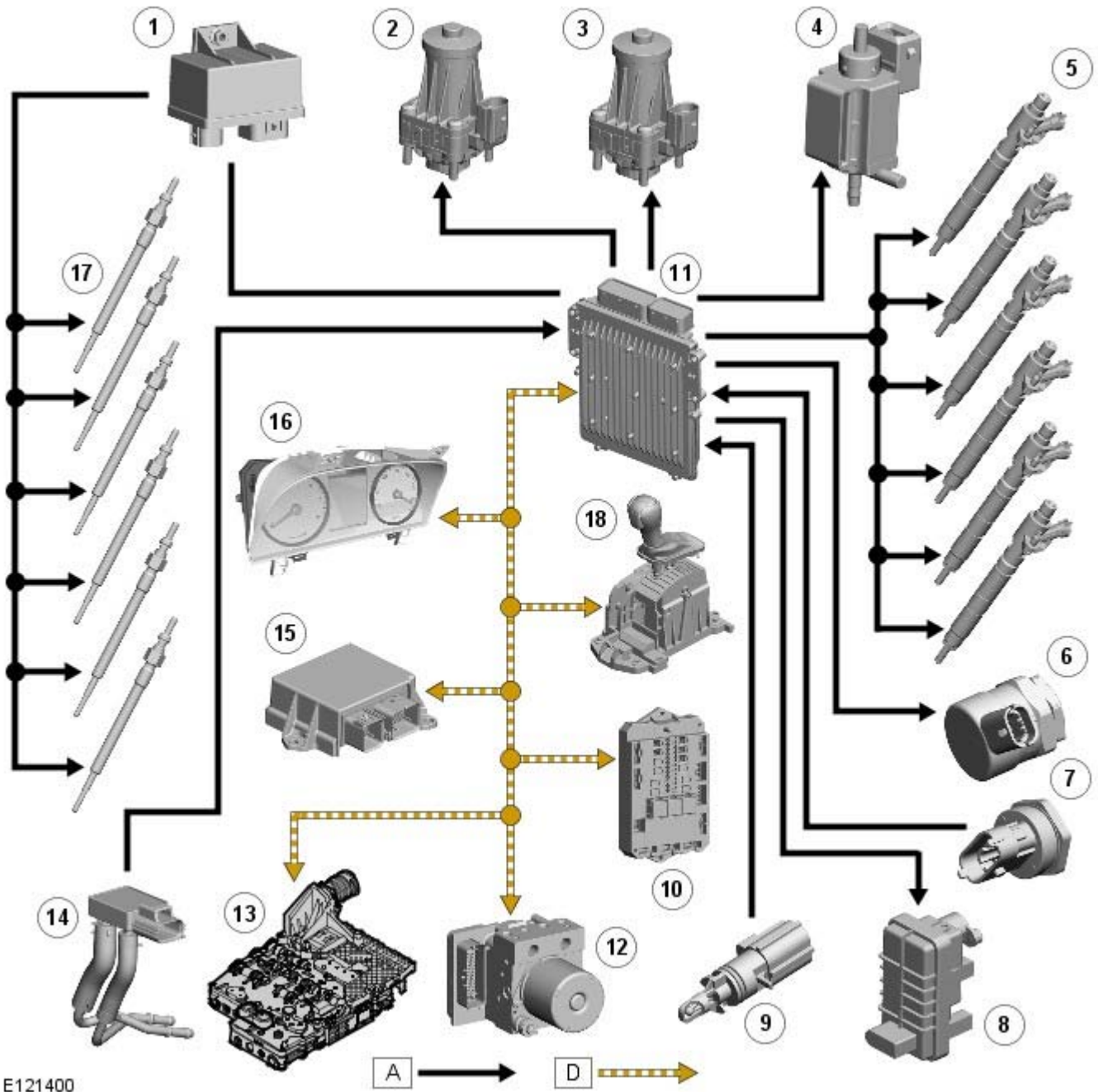
NOTE:A = Hardwired

1	Battery
2	EJB (engine junction box)
3	CKP (crankshaft position) sensor
4	CMP (camshaft position) sensor
5	ECT (engine coolant temperature) sensor
6	APP (accelerator pedal position) sensor
7	MAF (mass air flow)/IAT (intake air temperature) sensor
8	MAF sensor
9	Engine oil level/temperature sensor
10	High pressure fuel pump volume control valve

MAP (manifold absolute pressure) sensor

12	Throttle actuator
13	Secondary turbocharger boost pressure sensor
14	Brake lamp/brake test switch
15	EGR (exhaust gas recirculation) solenoid valve
16	Secondary turbocharger turbine shut-off solenoid valve
17	Secondary turbine compressor shut-off solenoid valve
18	High pressure fuel pump inlet temperature sensor
19	Water in fuel sensor
20	Secondary turbocharger recirculation valve
21	ECM (engine control module)

3.0L V6 Diesel Control Diagram - Sheet 2 of 2



E121400

ItemDescription

NOTE: A = Hardwired; D = High Speed CAN (controller area network)

1	Glow plug relay
2	LH (left-hand) EGR recirculation valve
3	RH (right-hand) EGR recirculation valve
4	EGR cooler bypass vacuum solenoid valve
5	Fuel injector (6 off)

Fuel pressure control valve
7 Fuel pressure sensor
8 Primary turbocharger control module
9 Charge air temperature sensor
10 CJB (central junction box)
11 ECM
12 ABS (anti-lock brake system) module
13 TCM (transmission control module)
14 Differential pressure sensor
15 RCM (restraints control module)
16 Instrument cluster
17 Glow plug (6 off)
18 Transmission selector

System Operation

OPERATION

The 3.0L V6 diesel engine management system is controlled by an [ECM](#) and is able to monitor, adapt and precisely control the fuel injection. The [ECM](#) uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

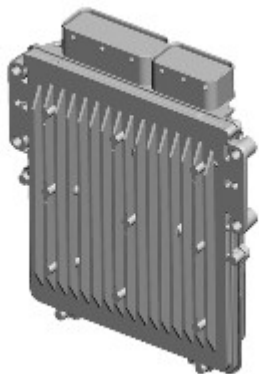
The [ECM](#) controls fuel delivery to all six cylinders via a common rail injection system. The common rail system uses a fuel rail to accumulate highly pressurized fuel and feed the six, electronically controlled injectors. The fuel rail is located in close proximity to the injectors, which assists in maintaining full system pressure at each injector at all times.

The [ECM](#) uses the drive by wire principle for acceleration control. There are no control cables or physical connections between the accelerator pedal and the engine. Accelerator pedal demand is communicated to the [ECM](#) by two potentiometers located in an [APP](#) sensor. The [ECM](#) uses the two signals to determine the position, rate of movement and direction of movement of the pedal. The [ECM](#) then uses this data, along with other engine information from other sensors, to achieve the optimum engine response.

Component Description

DESCRIPTION

Engine Control Module (ECM)



E123673

The [ECM](#) is located on a bracket on the passenger side of the engine compartment bulkhead.

The [ECM](#) connected to the vehicle harnesses via 2 connectors. The [ECM](#) contains data processors and memory microchips. The output signals to the actuators are in the form of ground paths provided by driver circuits within the [ECM](#). The [ECM](#) driver circuits produce heat during normal operation and dissipate this heat via the casing. Some sensors receive a regulated voltage supplied by the [ECM](#). This avoids incorrect signals caused by voltage drop during cranking.

The [ECM](#) performs self diagnostic routines and stores fault codes in its memory. These fault codes and diagnostics can be accessed using Land Rover approved diagnostic equipment. If the [ECM](#) is to be replaced, the new [ECM](#) is supplied 'blank' and must be configured to the vehicle using Land Rover approved diagnostic equipment. A 'flash' [EEPROM \(electrically erasable programmable read only memory\)](#) allows the [ECM](#) to be externally configured, using Land Rover approved diagnostic equipment, with market specific or new tune information. The current engine tune data can be accessed and read using Land Rover approved diagnostic equipment.

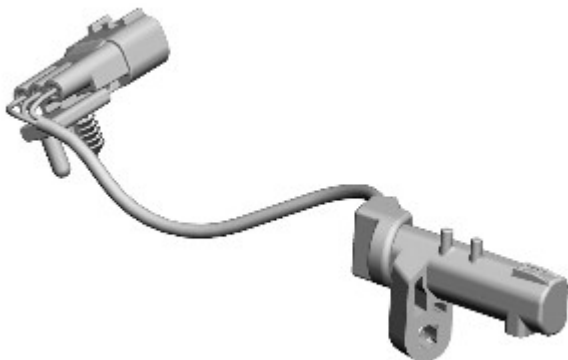
When a new [ECM](#) is fitted, it must also be synchronized to other system control modules using Land Rover approved diagnostic equipment. [ECM](#)'s cannot be 'swapped' between vehicles as they must be 'matched' with security information to other system modules.

The [ECM](#) is connected to the engine sensors which allow it to monitor the engine operating conditions. The [ECM](#) processes these signals and decides the actions necessary to maintain optimum engine performance in terms of drive ability, fuel efficiency and exhaust emissions. The memory of the [ECM](#) is programmed with instructions for how to control the engine. The memory also contains data in the form of maps which the [ECM](#) uses as a basis for fueling and emission control. By

comparing the information from the sensors to the data in the maps, the [ECM](#) is able to calculate the various output requirements. The [ECM](#) contains an adaptive strategy which updates the system when components vary due to production tolerances or ageing.

The [ECM](#) is connected to other system control modules and receives data from these modules on the high speed [CAN](#) bus to enable precise engine control under all vehicle operating conditions.

Crankshaft Position (CKP) Sensor



E116415

The [CKP](#) sensor is located at the rear of the engine block on the [LH](#) side. The sensor lead passes through a cover in an aperture on the side of the engine block. The sensor is secured to a bracket on a plate which locates the rear crankshaft oil seal. The sensor tip is aligned with a magnetic trigger reluctor wheel which is attached to the end of the crankshaft. The trigger wheel is a press fit on the end of the crankshaft. The trigger wheel must be carefully aligned to the crankshaft to ensure correct timing. The sensor produces a square wave signal, the frequency of which is proportional to engine speed.

The [ECM](#) monitors the [CKP](#) sensor signal and can detect engine over-speed. The [ECM](#) counteracts engine over-speed by gradually fading out speed synchronized functions. The [CKP](#) is a Hall effect sensor. The sensor measures the magnetic field variation induced by the magnetized trigger wheel.

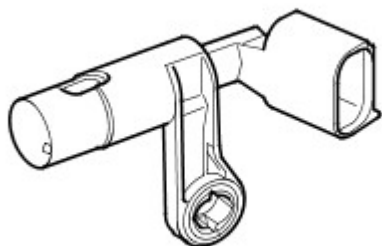
The trigger wheel has a 60 minus 2 tooth pattern. The missing teeth represent 12 degrees of crankshaft rotation and provide a reference point for the angular position of the crankshaft at 21 degrees [BTDC](#) (before top dead center) on cylinder 1.

When the space with the two missing teeth pass the sensor tip, a gap in the signal is produced which the [ECM](#) uses to determine the crankshaft position. The air gap between the sensor tip and the ring is important to ensure correct signals are output to the [ECM](#). The recommended air gap between the [CKP](#) and the trigger wheel is 0.4 mm- 1.5 mm.

The [ECM](#) uses the signal from the [CKP](#) sensor for the following functions:

- Synchronization
- Determine fuel injection timing
- Produce an engine speed signal which is broadcast on the high speed [CAN](#) bus for use by other systems.

Camshaft Position (CMP) Sensor



E46902

The [CMP](#) is located on the front face of the [LH](#) cylinder head. The sensor tip protrudes through an aperture in the front face of the cylinder head to pick up on a reluctor behind the camshaft pulley. The [CMP](#) sensor is a Hall effect type sensor.

The [ECM](#) uses the [CMP](#) sensor signal to determine if the piston in No. 1 cylinder is at injection [TDC](#) (top dead center) or exhaust [TDC](#). Once this has been established, the [ECM](#) can then operate the correct injector to inject fuel into the cylinder when the piston is at injection [TDC](#).

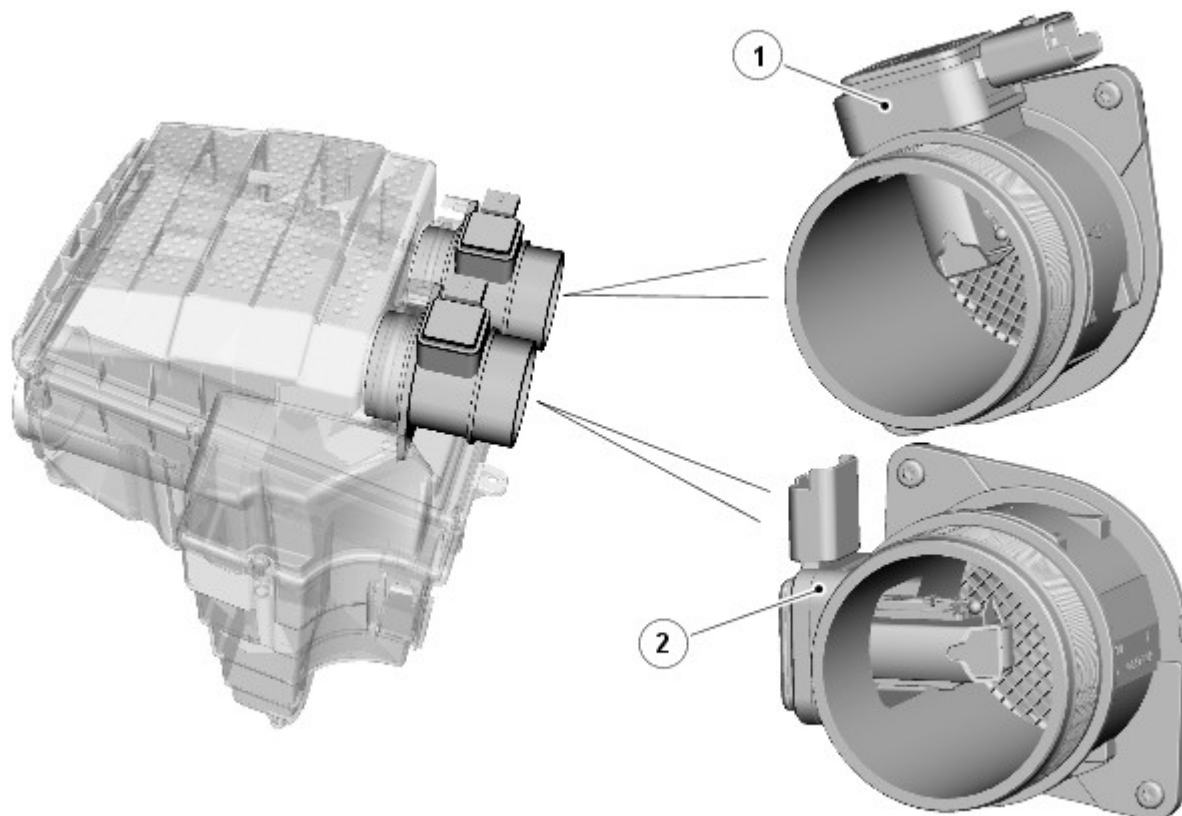
The [CMP](#) sensor is a Hall effect sensor which used by the [ECM](#) at engine start-up to synchronize the [ECM](#) with the [CKP](#) sensor signal. The [ECM](#) does this by using the [CMP](#) sensor signal to identify number one cylinder to ensure the correct injector timing. Once the [ECM](#) has established the injector timing, the [CMP](#) sensor signal is no longer used.

The [CMP](#) sensor receives a 5V supply from the [ECM](#). Two further connections to the [ECM](#) provide ground and signal output.

If a fault occurs, an error is registered in the [ECM](#). Two types of failure can occur; no [CMP](#) sensor signal or a synchronization error of the [CMP](#) and [CKP](#) sensors. The error recorded by the [ECM](#) can also relate to a total failure of the crankshaft signal or crankshaft signal dynamically implausible. Both components should be checked to determine the cause of the fault.

If a fault occurs with the [CMP](#) sensor when the engine is running, the engine will continue to run but the [ECM](#) will deactivate boost pressure control. Once the engine is switched off, the engine will crank but will not restart while the fault is present.

Mass Air Flow (MAF) and Inlet Air Temperature (IAT) Sensors



E123727

ItemDescription

1	MAF sensor
2	MAF/IAT sensor

The [MAF/IAT](#) sensors are located on the inlet air duct directly after the air filter box. Two sensors are fitted; the front sensor, located prior to the intake air to primary turbocharger pipe, is a combined [MAF/IAT](#) sensor (4-wire). The rear sensor, located prior to the intake air to secondary turbocharger pipe, is a [MAF](#) sensor (3-wire) only.

The [MAF](#) sensors work on the hot film principle. Each sensor has 2 sensing elements which are contained within a film. One element is maintained at ambient (air intake) temperature, e.g. 25°Celsius (77°F). The other element is heated to 200°Celsius (392°F) above the ambient temperature, e.g. 225°Celsius (437°F). Intake air entering the engine passes through the [MAF](#) sensors and has a cooling effect on the film. The [ECM](#) monitors the current required to maintain the 200°Celsius (392°F) differential between the two elements and uses the differential to provide a precise, non-linear, signal which equates to the volume of air being drawn into the engine.

The [MAF](#) sensor output is a digital signal proportional to the mass of the incoming air. The [ECM](#) uses this data, in conjunction with signals from other sensors and information from stored fueling maps, to determine the precise fuel quantity to be injected into the cylinders. The signal is also used as a feedback signal for the [EGR](#) system.

The [IAT](#) sensor in the front sensor incorporates a [NTC \(negative temperature coefficient\)](#) thermistor in a voltage divider circuit. The [NTC](#) thermistor works on the principle of decreasing resistance in the sensor as the temperature of the intake air increases. As the thermistor allows more current to pass to ground, the voltage sensed by the [ECM](#) decreases. The change in voltage is proportional to the temperature change of the intake air. Using the voltage output from the [IAT](#) sensor, the [ECM](#) can correct the fueling map for intake air temperature. The correction is an important requirement because hot air contains less oxygen than cold air for any given volume.

The [MAF](#) sensor receives a 12V supply from the [BJB \(battery junction box\)](#) and a ground connection via the [ECM](#). Two further connections to the [ECM](#) provide a [MAF](#) signal and [IAT](#) signal.

The [IAT](#) sensor receives a 3.3V reference voltage from the [ECM](#) and shares a ground with the [MAF](#) sensor. The signal output from the [IAT](#) sensor is calculated by the [ECM](#) by monitoring changes in the supplied reference voltage to the [IAT](#) sensor voltage divider circuit.

The [ECM](#) checks the calculated air mass against the engine speed. If the calculated air mass is not plausible, the [ECM](#) uses a default air mass figure which is derived from the average engine speed compared to a stored characteristic map. The air mass value will be corrected using values for boost pressure, atmospheric pressure and air temperature.

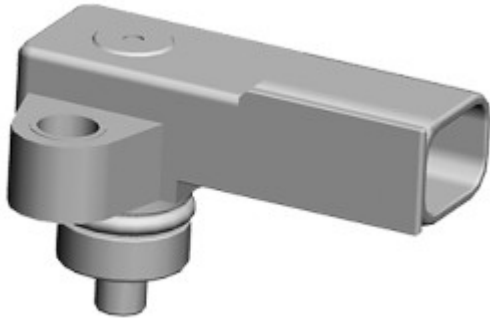
If one of the [MAF](#) sensors fails the [ECM](#) implements the default strategy based on engine speed. In the event of a [MAF](#) sensor signal failure, the following symptoms may be observed:

- [EGR](#) system off
- Delayed engine response
- Reduced engine performance.

If the [IAT](#) sensor fails the [ECM](#) uses a default intake air temperature of 40°Celsius (104°F). In the event of an [IAT](#) sensor failure, the following symptom may be observed:

- Under fueling, resulting in reduced engine performance.

Manifold Absolute Pressure (MAP) Sensor



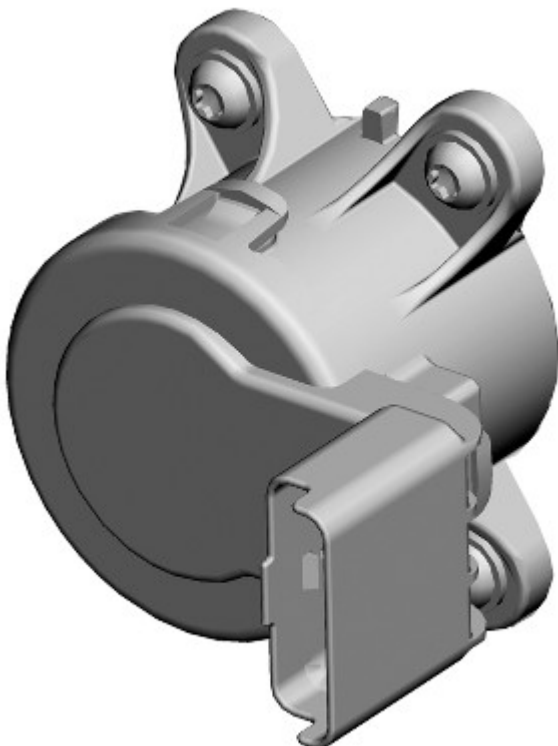
E123688

The [MAP](#) sensor is located on top of the throttle intake manifold. The [MAP](#) sensor measures the absolute pressure in the intake manifold. The sensor is a semi-conductor type sensor which responds to pressure acting on a membrane within the sensor, altering the output voltage. The sensor receives a 5V reference voltage and a ground from the [ECM](#) and returns a signal of between 0.5 - 4.5V to the [ECM](#). A low pressure returns a low voltage signal to the [ECM](#) and a high pressure returns a high voltage.

The [MAP](#) sensor detects quick pressure changes in the intake manifold after the electric throttle. The signal is used in conjunction with the [MAF](#) sensor signal to calculate the injection period.

The [ECM](#) monitors the engine [MAP](#) sensor for faults and can store fault related codes. These can be retrieved using Land Rover approved diagnostic equipment. If the sensor fails, the [ECM](#) uses the [MAF/IAT](#) sensor signal value as a substitute.

Electronic Throttle Actuator

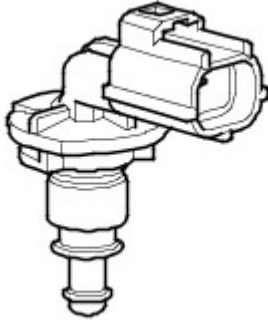


E116417

The electronic throttle actuator is located on the side of the throttle intake manifold.

The electronic throttle actuator controls the volume of air allowed into the inlet manifolds by means of a [DC \(direct current\)](#) motor which controls a flap in the body of the throttle. The actuator is controlled by the [ECM](#) which operates the actuator in response to driver inputs from the [APP](#) sensor and other engine related sensors to provide the correct air flow to the intake manifolds.

Engine Coolant Temperature (ECT) Sensor



E46905

The [ECT](#) sensor is located in the [LHEGR](#) cooler coolant inlet pipe, at the front of the engine. The [ECT](#) sensor provides the [ECM](#) and the instrument cluster with engine coolant temperature status.

The [ECM](#) uses the temperature information for the following functions:

- Fueling calculations
- Limit engine operation if engine coolant temperature becomes too high
- Cooling fan operation
- Glow plug activation time.

The instrument cluster uses the temperature information for generation of engine temperature messages. The engine coolant temperature signal is also transmitted on the medium speed [CAN](#) bus by the instrument cluster for use by other systems.

The [ECT](#) sensor circuit consists of an internal voltage divider circuit which incorporates an [NTC](#) thermistor. As the coolant temperature rises the resistance through the sensor decreases and vice versa. The output from the sensor is the change in voltage as the thermistor allows more current to pass to ground relative to the temperature of the coolant.

The [ECM](#) compares the signal voltage to stored values and adjusts fuel delivery to ensure optimum drive ability at all times. The engine will require more fuel when it is cold to overcome fuel condensing on the cold metal surfaces inside the combustion chamber. To achieve a richer air/fuel ratio, the [ECM](#) extends the injector opening time. As the engine warms up the air/fuel ratio is leaned off.

The input to the sensor is a 3.3V reference voltage supplied from the voltage divider circuit within the [ECM](#). The ground from the sensor is also connected to the [ECM](#) which measures the returned current and calculates a resistance figure for the sensor which relates to the coolant temperature.

If the [ECT](#) sensor fails, the following symptoms may be observed:

- Difficult cold start
- Difficult hot start
- Engine performance compromised
- Temperature gauge inoperative or inaccurate reading.

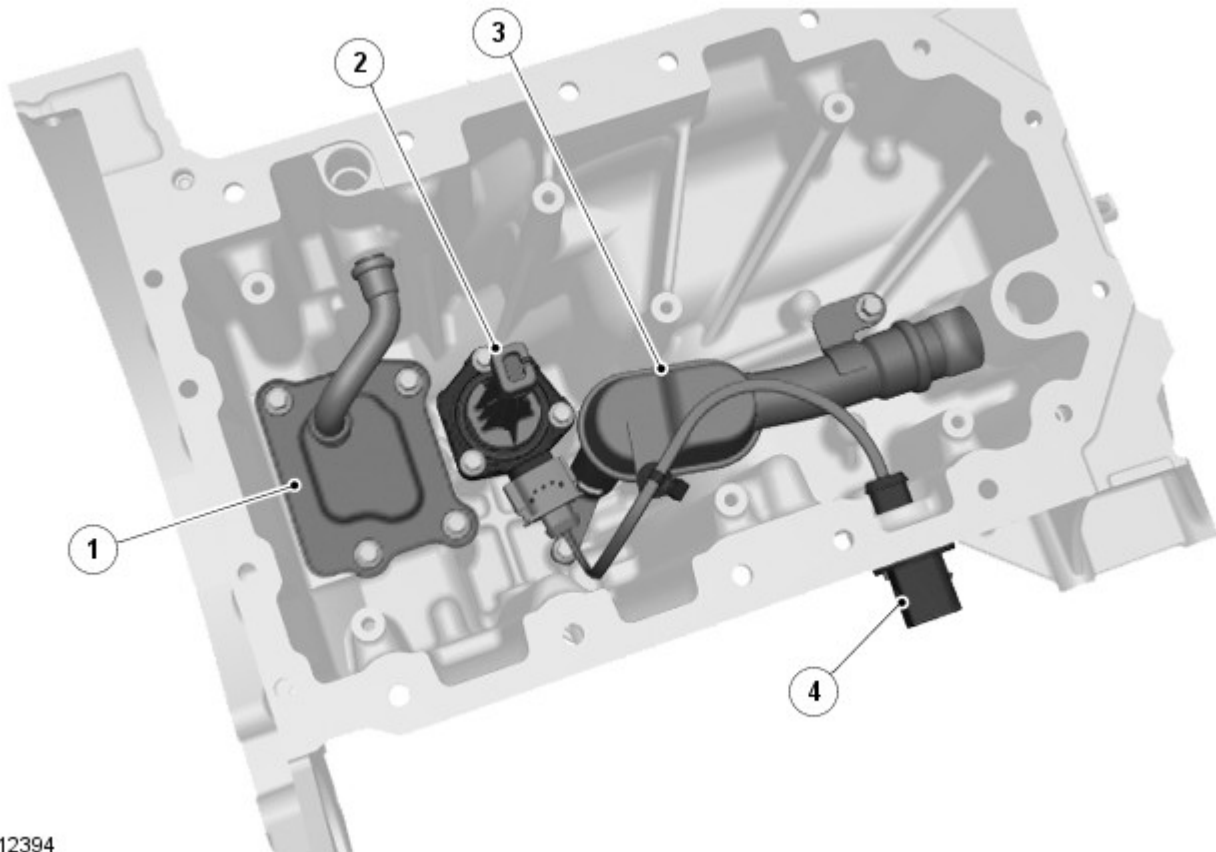
In the event of [ECT](#) sensor signal failure, the [ECM](#) applies a default value of 80°Celsius (176°F) coolant temperature for fueling purposes. The [ECM](#) will also permanently operate the cooling fan at all times when the ignition is switched on, to protect the engine from overheating.

The table that follows shows [ECT](#) sensor values and the corresponding sensor resistance and voltage values.

Temperature (Degrees Celsius)	Resistance (KOhms)	Voltage (Volts)
- 40	925	3.23
- 30	496	3.16
- 20	277	3.06
- 10	160	2.91
-0	96	2.70
10	59	2.42
20	37	2.09
30	24	1.75
40	16	1.41
50	11	1.11
60	7.55	0.86
70	5.34	0.66
80	3.84	0.50
90	2.80	0.38
100	2.08	0.29
110	1.56	0.22
120	1.19	0.17
130	0.918	0.14

Temperature (Degrees Celsius)	Resistance (KOhms)	Voltage (Volts)
140	0.715	0.11
150	0.563	0.08

Engine Oil Level and Oil Temperature Sensor



E112394

ItemDescription

1	Oil scavenge reservoir
2	Engine oil level and temperature sensor
3	Oil pick-up pipe
4	Engine oil level and temperature sensor electrical connector

The 3.0L V6 diesel engine is not fitted with a conventional dipstick. The dipstick is replaced with an ultrasonic oil level and temperature sensor which is located with 3 bolts on the inside of the oil pan.

The sensor uses ultrasonic pulses to determine the oil level in the oil pan. The level sensor sends an ultrasonic pulse vertically upward and measures the time taken for the pulse to be reflected back to the sensor from the upper surface of the oil. A second reference pulse is also transmitted across a reference distance. The time periods of the first and second pulses are compared and the sensor calculates the oil height in the oil pan. The sensor then converts the results into a [PWM \(pulse width modulation\)](#) signal to the [ECM](#) which converts the frequency of the signal into an oil level height.

The sensor uses an [NTC](#) type sensor to determine the oil temperature. The sensor measures the oil temperature and converts the sensor signal into a [PWM](#) signal to the [ECM](#) which converts the frequency of the signal into an oil temperature.

If the oil level is incorrect or a system fault occurs, a warning message is displayed in the instrument cluster message center. The messages that follow can be displayed in the message center:

Warning	System Status
ENGINE OIL LOW (Amber warning triangle displayed)	The oil is at the minimum level for safe operation. Top-up with 2 liters (3.5 pints) of oil.
ENGINE OIL HIGH (Amber warning triangle displayed)	This warning is displayed when the engine is started, if the oil is above the maximum level for safe operation. Stop the vehicle as soon as safety permits and seek qualified assistance to have the engine oil drained, before driving the vehicle.
ENGINE OIL CRITICALLY LOW (Red warning triangle displayed)	The oil is below the minimum level for safe operation. Stop the vehicle as soon as safety permits and top-up with 2.5 liters (4.4 pints) of oil. Wait for 10 minutes, re-check the oil level reading and top-up again if necessary.
ENGINE OIL LEVEL MONITOR SYSTEM FAULT (Amber warning triangle displayed)	A fault with the oil level monitoring system is indicated. Seek qualified assistance as soon as possible.

Oil Level Check

Check the oil level weekly, when the engine is hot and with the vehicle resting on level ground.

• **NOTE:** Switch off the engine and let the vehicle stand for ten minutes to allow the oil drain back to the oil pan. Do not start the engine.

The oil level can be viewed in the message centre when the ignition is on (power mode 6), the engine stopped and the transmission in Park (P).

- **NOTE:** The system will not give a reading until the oil level has stabilized.

E124193

An indication of the oil level is displayed on the gauge. Messages to the right of the gauge give advice of any action that may need to be taken.

If the oil level is within the required operating range, the message '**Level OK**' will be displayed. Do not add any additional oil to the engine.

If the oil level is below the required operating range, a message advising how much oil to add will be displayed. Add the recommended quantity of oil then re-check the level.

If '**Overfilled**' is displayed, seek qualified assistance immediately. Do not drive the vehicle as this will cause serious damage to the engine.

Engine Oil Top-Up

- **CAUTIONS:**



Failure to use oil that meets the required specification, could cause excessive engine wear, a build-up of sludge and deposits and increase pollution. It could also lead to engine failure and invalidation of vehicle warranty.



Overfilling with oil could result in severe engine damage.

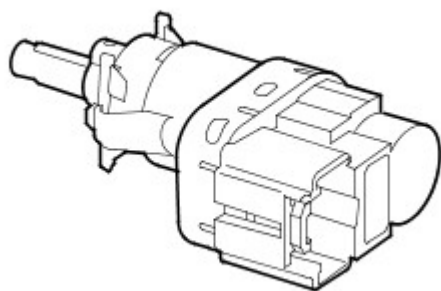
Use the procedure that follows to replenish the engine oil level:

- With the ignition on, but the engine not running, unscrew the oil filler cap.
 - Add the appropriate quantity of oil (as indicated by the message center oil level display). Wait 10 minutes to allow the oil level stabilize and re-check the level. Clean up any oil spilled during topping up
 - Once the correct level is achieved, refit the filler cap and hand-tighten securely until one click is heard.
- **NOTE:** The approximate quantity of oil required to raise the level from the minimum level of safe operation to the maximum, is 2.0 liters (3.5 pints).
 - **NOTE:** The ignition must be left on during the top-up, so that the electronic dipstick can register and display the new oil level. This enables an accurate level re-check.

Live Reading/Average Reset

A procedure is available to allow the technician to access the actual engine oil level, rather than the average engine oil level which is available to the driver. An additional procedure is also available to reset the average engine oil level. Refer to Engine - 3.0L Diesel - General Procedures - Engine Oil Draining and Filling 303-01B.

Brake Lamp/Brake Test Switch



E46910

The brake lamp/brake test switch is located on the pedal box and is operated by the brake pedal. The 2 pole switch has a normally open circuit switch connected to battery voltage which closes the circuit when the driver has depressed the brake pedal and a normally closed circuit which is connected to ground when the driver depresses the brake pedal. The switch contacts are connected directly to the [ECM](#) and the [ECM](#) also receives a brake pressure signal on the high speed [CAN](#) bus from the [ABS](#) module.

The [ECM](#) uses the brake signal for the following:

- To limit fueling during braking
- To inhibit/cancel Speed control if the brakes are applied.

In the event of a brake switch failure, the following symptoms may be observed:

- Speed control inactive
- Increased fuel consumption.

Fuel Pressure Control Valve



E116419

The fuel pressure control valve is incorporated into the forward end of the common fuel rail for the [LH](#) cylinder bank. The control valve regulates the fuel pressure within the fuel rails and is controlled by the [ECM](#). The control valve is a [PWM](#) controlled solenoid valve.

When the solenoid is de-energized, an internal spring holds an internal valve closed. At fuel pressure of 100 bar (1450 lbf/in²) or higher, the force of the spring is overcome, opening the valve and allowing fuel pressure to decay into the fuel return pipe. When the pressure in the fuel rail decays to approximately 100 bar (1450 lbf/in²) or less, the spring force overcomes the fuel pressure and closes the valve. When the [ECM](#) energizes the solenoid, the valve is closed allowing the fuel pressure to build. The pressure in the fuel rail in this condition can reach approximately 2000 bar (29000 lbf/in²).

The [ECM](#) constantly monitors the fuel pressure and activates the fuel pressure control valve accordingly to control the fuel rail pressure within the required parameters. Relieved fuel from the fuel rails is directed through the fuel rail leak-off pipe to the fuel filter return circuit.

The [ECM](#) controls the fuel rail pressure by operating the control valve solenoid using a [PWM](#) signal. By varying the duty cycle of the [PWM](#) signal, the [ECM](#) can accurately control the fuel rail pressure and hence the pressure delivered to the injectors according to engine load. This is achieved by the control valve allowing a greater or lesser volume of fuel to pass from the high pressure side of the pump to the un-pressurized fuel return line, regulating the pressure on the high pressure side.

The fuel pressure control valve receives a [PWM](#) signal from the [ECM](#) of between 0 and 12V. The [ECM](#) controls the operation of the control valve using the following information to determine the required fuel pressure:

- Fuel rail pressure
- Engine load
- [APP](#) sensor position
- Engine coolant temperature
- Engine speed.

In the event of a total failure of the fuel pressure control valve, the engine will not start. In the event of a partial failure of the fuel pressure control valve, the [ECM](#) will activate the solenoid with the minimum duty cycle which results in the injection quantity being limited.

Fuel Pressure Sensor



E116418

The fuel pressure sensor is located in the forward end of the common fuel rail for the [RH](#) cylinder bank. The sensor is screwed into a threaded port in the end of the fuel rail.

The fuel pressure sensor is a piezo-resistive type sensor containing an actuating diaphragm. Deflection of the diaphragm provides a proportional signal (output) voltage to the [ECM](#), dependant on the fuel pressure within the fuel rails.

Accelerator Pedal Position (APP) Sensor



E116420

The [APP](#) sensor allows the [ECM](#) to determine the driver requests for vehicle speed, acceleration and deceleration. The [ECM](#) uses this information to determine the torque demand from the engine via injection control.

The [APP](#) sensor is installed on the pedal box and secured to a bracket with 3 screws.

The [APP](#) sensor is incorporated into the pedal box assembly. The [APP](#) sensor is a twin track rotary potentiometer type sensor which is integral with the throttle pedal housing.

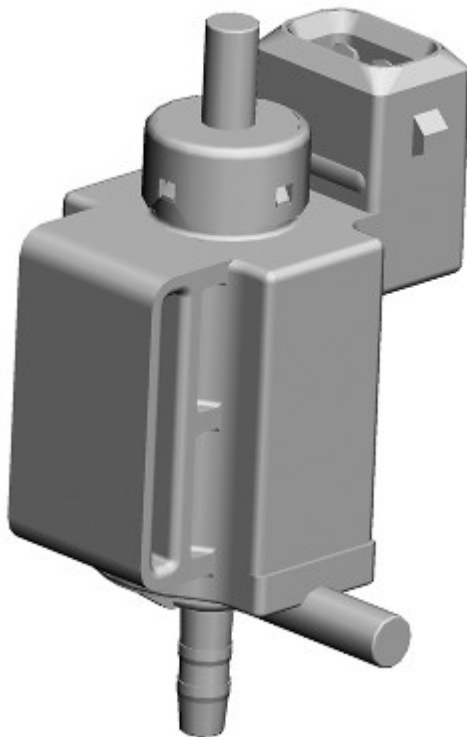
A six pin electrical connector provides the interface with the vehicle harness. The accelerator pedal is connected to a spindle on the [RH](#) side of the [APP](#) sensor. The [APP](#) sensor receives two separate electrical supplies and generates two different outputs.

Both tracks are analogue output signals connected to the [ECM](#). Both signals contain the same positional information, but the secondary track has half the voltage output of the primary track.

If there is a fault with the primary track, the secondary track is used and the vehicle/engine response to pedal demand will be sluggish. If both analogue signals have a fault, the engine adopts a constant high speed of 1300 rpm to allow the vehicle to move. Torque application and reduction of engine speed back to normal idle speed can be subsequently controlled via brake lamp/brake test switch operation.

The [ECM](#) constantly checks the range and plausibility of the two signals and stored a fault code if it detects a fault.

EGR Cooler Bypass Vacuum Solenoid Valve



E116421

The [EGR](#) cooler bypass solenoid valve is located on a bracket at the rear of the engine, adjacent to the vacuum pump.

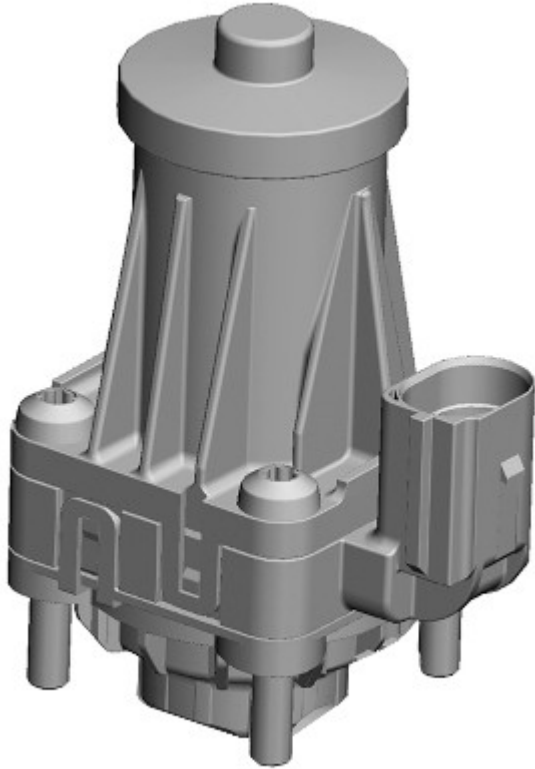
The solenoid valve has a vacuum pipe connection to the vacuum pump which provides the vacuum when the engine is running. Two outlets from the solenoid valve each connect to an [EGR](#) bypass vacuum actuator.

When the [EGR](#) cooler bypass solenoid valve is energized, vacuum created by the vacuum pump is applied to each [EGR](#)

bypass vacuum actuator and exhaust gasses by-pass the [EGR](#) cooler. The default position is for exhaust gas cooling. The actuators move under the influence of the vacuum and move a valve within the [EGR](#) cooler to divert the exhaust gasses straight through the cooler. This system is used when the engine management system determines that exhaust gas cooling is not required.

The [EGR](#) cooler bypass solenoid valve receives a 12 volt supply from the [EJB](#). The [ECM](#) controls the operation of the solenoid valve by controlling the ground path for the solenoid.

Exhaust Gas Recirculation (EGR) Valve Motor



E116422

The [EGR](#) valve motors each receive a 12 volt supply and ground from the [ECM](#).

The 12 volt power supply from the [ECM](#) operates the [EGR](#) valve motor. Three further wires connect the [EGR](#) valve to the [ECM](#) a 5 volt reference voltage, a ground and a position signal feedback.

The valve is used to direct a calculated proportion of exhaust gas back into the combustion chamber.

Engine Oil Pressure Sensor

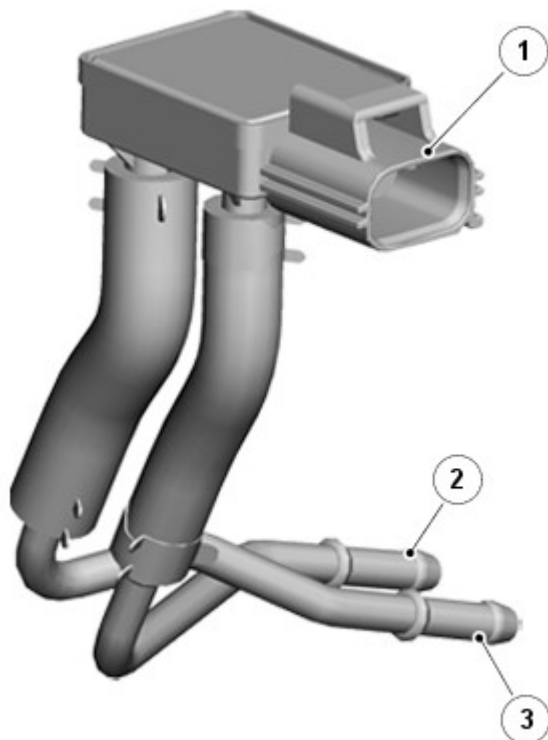


E116423

The engine oil pressure sensor is located in a threaded port in the [LH](#) cylinder head. The sensor is connected directly to the instrument cluster.

The sensor is not connected to the [ECM](#) but is supplied with a reference voltage from the instrument cluster. The sensor ground is through the sensor body and the engine. When the oil pressure falls to below a predetermined threshold, the sensor internal switch contacts close, completing a circuit from the instrument cluster. This circuit is sensed by the instrument cluster which displays an appropriate warning message and warning lamp to alert the driver.

Differential Pressure Sensor



E123690

ItemDescription

1	Electrical connector
2	Low pressure connection
3	High pressure connection

The differential pressure sensor is located on the rear of the transfer box, adjacent to the [DPF \(diesel particulate filter\)](#).

The differential pressure sensor is used by the [DPF](#) software to monitor the condition of the [DPF](#). Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the [DPF](#). The pipes allow the sensor to measure the inlet and outlet pressures of the [DPF](#).

As the amount of particulates trapped by the [DPF](#) increases, the pressure at the inlet side of the [DPF](#) increases in comparison to the [DPF](#) outlet. The [DPF](#) software uses this comparison, in conduction with other data, to calculate the accumulated amount of trapped particulates.

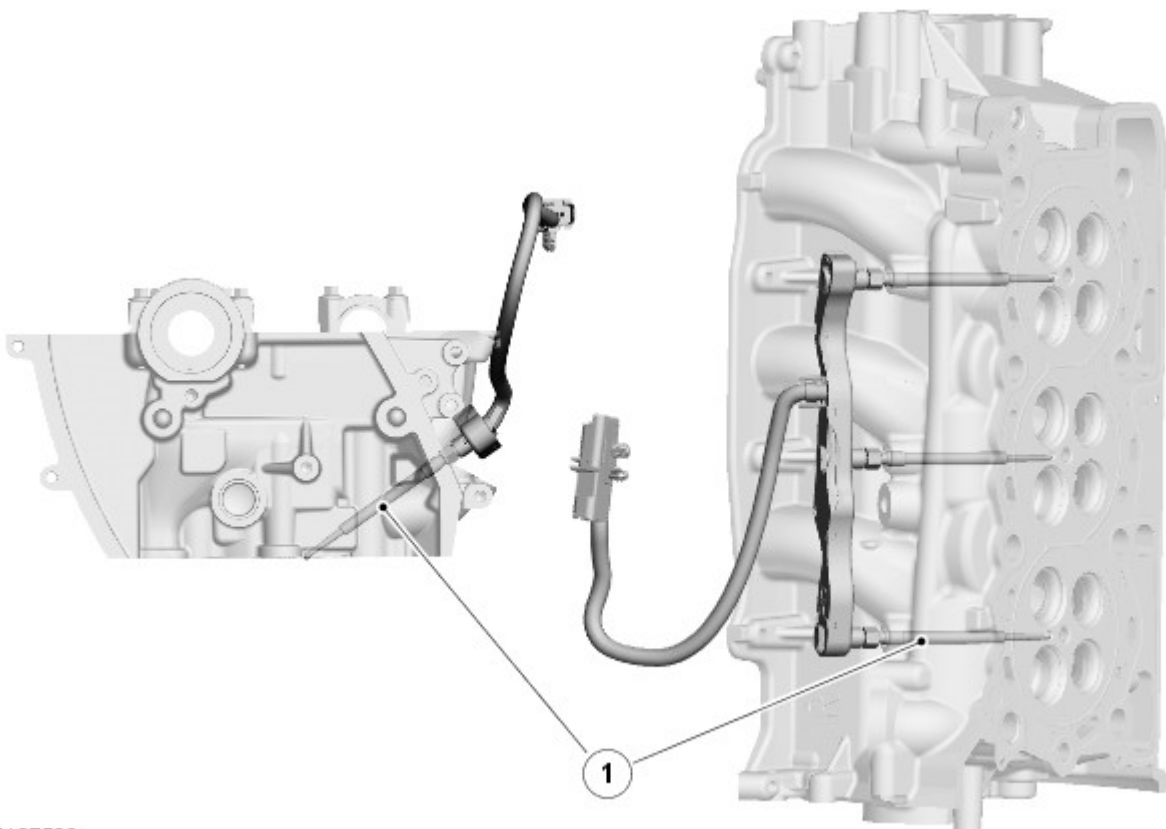
By measuring the pressure difference between the [DPF](#) inlet and outlet air flow the [DPF](#) software can determine if the [DPF](#) is becoming blocked and requires regeneration.

A [DPF](#) is recognized as overloaded if the differential pressure under certain operating conditions exceeds the overload limit calculated by the [ECM](#). The [DPF](#) software may start regeneration attempts but be unable to complete them. These attempts are counted by the [ECM](#) and, if the maximum number of regeneration attempts is reached, a fault entry is recorded in the [ECM](#) at the next ignition on cycle.

The [DPF](#) software performs the following checks using the [DPF](#) differential pressure sensor:

- Sensor plausibility check
- [DPF](#) efficiency
- [DPF](#) overloaded
- [DPF](#) clogged
- Circuit range checks (max. and min.)
- [DPF](#) hose lines (dropped, crossed and blocked)
- [DPF](#) dislodged/damaged
- Monitoring of the maximum regeneration attempts in the lower load range

Glow Plugs



E107586

ItemDescription

1	Glow plug
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Three glow plugs are located in each of the cylinder heads, on the inlet side. The glow plugs and the glow plug module are a vital part of the engine starting strategy. The glow plugs heat the air inside the cylinder during cold starts to assist combustion. The use of glow plugs helps reduce the amount of additional fuel required on start-up, and consequently reduces the emission of black smoke. The use of glow plugs also reduces the amount of injection advance required, which reduces engine noise, particularly when idling with a cold engine.

There are three phases of glow plug activity:

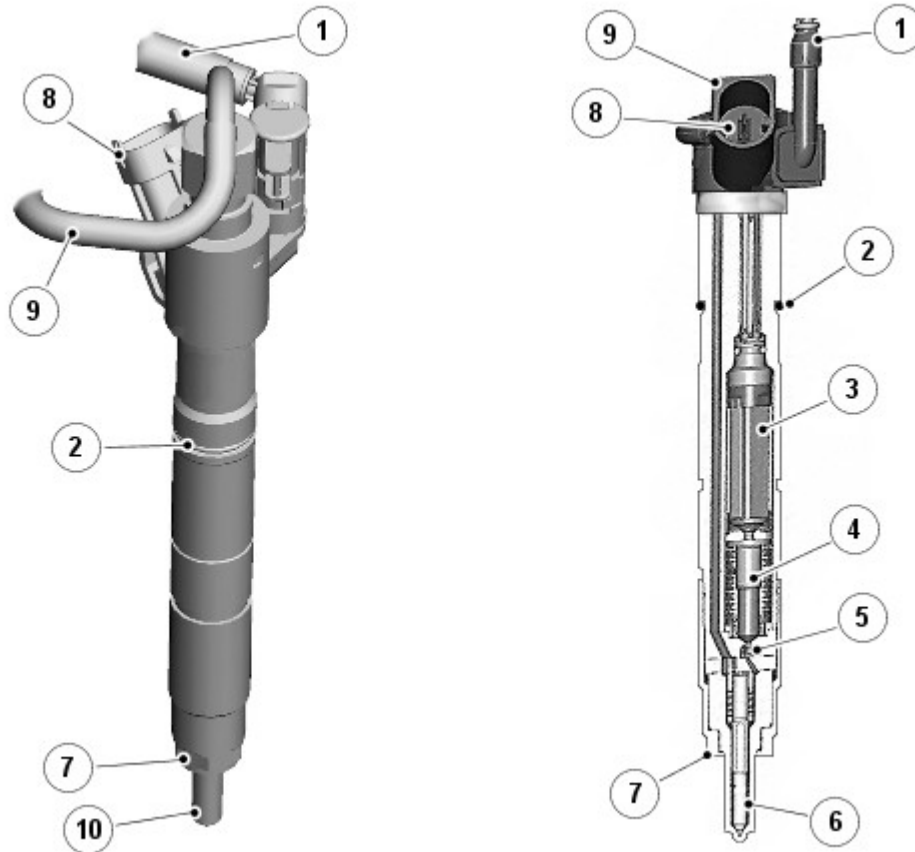
- Pre-heat

- During crank
- Post heat.

The ceramic sheathed element glow plugs are made from a heat-resistant, electrically conductive ceramic material. The ceramic sheathed-element glow plugs outer layer is heated directly and is self regulating. The self regulation allows the resistance of the sheathed element to automatically increase as the heat increases preventing the glow plug from overheating. In addition, during the heating process and under the control of the glow plug module, the glow plugs can be operated above their nominal voltages. This permits heat-up speeds of 1000°C per second. The sheathed-element glow plugs reach a maximum glow temperature of 1300°C and can hold a temperature of 1150°C for several minutes after the first-start glow or at intervening times.

The glow plugs are controlled by the [ECM](#) using the glow plug module and external sensor values to control the glow plug operation via internal software.

Fuel Injectors



E 115475

ItemDescription

1	Fuel return
2	O-ring seal
3	Piezo stack actuator
4	Hydraulic coupler
5	Control valve
6	Nozzle body
7	Copper sealing washer
8	Electrical connector
9	High pressure feed
10	Nozzle

Six fuel injectors are used in the fuel system. A piezo actuator in each injector is electronically controlled by the [ECM](#) to operate the injector in response to engine speed and load conditions.

Each injector is calibrated to the [ECM](#) and applicable the cylinder to which it is fitted. Therefore, if an injector is removed it must be refitted to the cylinder from which it was removed. If a new injector is fitted, a calibration routine using a Land Rover approved diagnostic equipment must be performed to calibrate the injector unique code to the [ECM](#).

The operating voltage of the injector is between 110 and 163 volts depending on engine speed and load and care must be taken when working in the vicinity of the injectors. The voltage increases linearly with the injector operating pressure from 200 to 2000 bar.

Each injector has an electrical resistance value of between 150 - 250 kOhms.

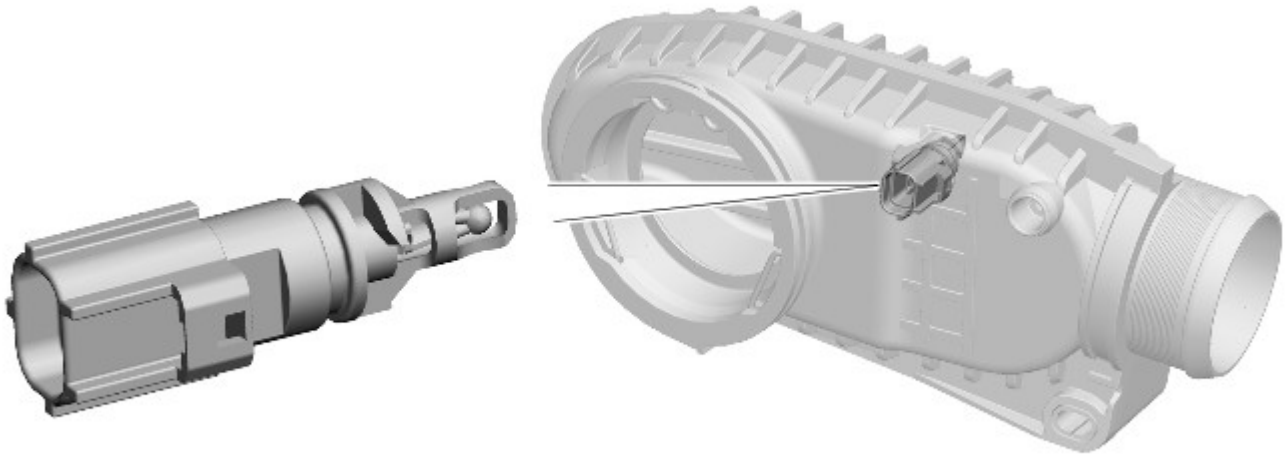


CAUTION: Each injector operation is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from the injector. Never disconnect the wiring connection when the engine is running. The injector can remain open

causing engine damage.

Refer to: [Fuel Charging and Controls](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).

Charge Air Temperature Sensor



E116759

The charge air temperature sensor is located in the rear of the intake chamber immediately preceding the throttle intake manifold. The sensor is used to measure the intake air temperature from the turbochargers in order to calculate the required amount of fueling.

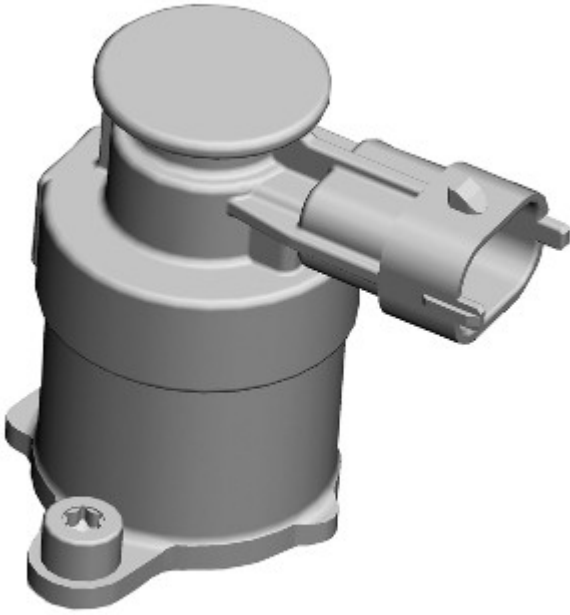
The charge air temperature sensor incorporates a [NTC](#) thermistor in a voltage divider circuit. The [NTC](#) thermistor works on the principle of decreasing resistance in the sensor as the temperature of the charge air increases. As the thermistor allows more current to pass to ground, the voltage sensed by the [ECM](#) decreases. The change in voltage is proportional to the temperature change of the charge air. Using the voltage output from the charge air temperature sensor, the [ECM](#) can correct the fueling map for charge air temperature. The correction is an important requirement because hot air contains less oxygen than cold air for any given volume.

The charge air temperature sensor receives a 3.3V reference voltage from the [ECM](#). The signal output from the charge air temperature sensor is calculated by the [ECM](#) by monitoring changes in the supplied reference voltage to the charge air temperature sensor voltage divider circuit.

If the charge air temperature sensor fails the [ECM](#) uses a default charge air temperature of -5°C (23°F). In the event of a charge air temperature sensor failure, any of the following symptoms may be observed:

- Over fueling, resulting black smoke emitting from the exhaust
- Idle speed control inoperative.

High Pressure Fuel Pump Volume Control Valve



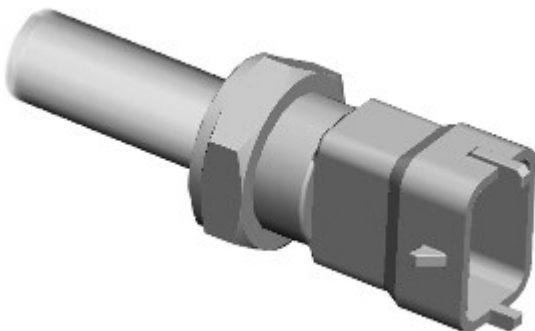
E116761

The high pressure fuel pump volume control valve is mounted on the high pressure pump, and located in the feed port between the high-pressure pump elements and the internal transfer pump. The high pressure fuel pump volume control valve is a variable position solenoid-operated valve that is controlled by the [ECM](#).

The high pressure fuel pump volume control valve is controlled by a [PWM](#) signal from the [ECM](#) to allow a defined amount of 'leak off' from the high pressure fuel pump. The leak off fuel provides cooling and lubrication for the high-pressure pump internal components. The fuel is returned through a leak off pipe to the fuel filter, where it cools and is returned into the fuel filter via the low pressure return line.

The high pressure fuel pump volume control valve determines the amount of fuel that is delivered from the internal transfer pump to the high pressure pumping elements. When there is no signal to the high pressure fuel pump volume control valve, the valve is closed and there is no fuel delivery. The [ECM](#) applies a varying [PWM](#) signal of between 0 to 100% to control the required fuel volume.

High Pressure Fuel Pump Inlet Temperature Sensor



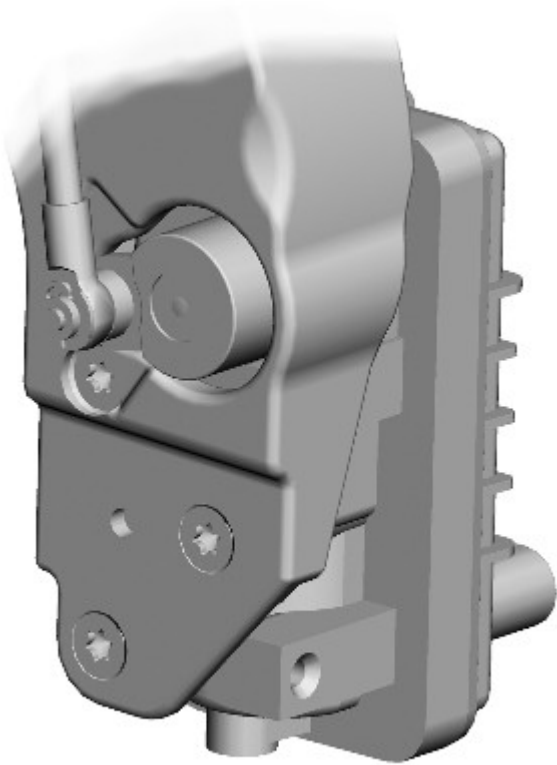
E116762

The high pressure fuel pump inlet temperature sensor is located on the rear of the high pressure fuel pump. It measures the fuel temperature in the low-pressure side of the high pressure fuel pump.

The [ECM](#) continually monitors this signal to determine the fuel temperature to prevent overheating of the fuel system. The [ECM](#) will also make fine adjustments to fuel injection quantity to adjust for fuel temperature.

The inlet temperature sensor is an [NTC](#) thermistor. As the fuel temperature rises the resistance through the sensor decreases and visa versa. The [ECM](#) measures the change in voltage as the thermistor allows more current to pass to ground relative to the fuel temperature.

Primary Turbocharger Control Module



E116424

The primary turbocharger control module is attached to a bracket which is an extension of the turbocharger body.

The primary turbocharger control module comprises a stepper motor which electronically controls the primary turbocharger variable vanes by moving an actuating lever. When the stepper motor drive shaft turns, a position signal is created. The [ECM](#) receives the position signal to determine the angular position of the vanes.

The stepper motor is connected to an output shaft. The output shaft has a connecting rod attached eccentrically which converts the rotary motion of the shaft into linear motion of the connecting rod. The opposite end of the connecting rod is attached to an actuating lever. The actuating lever moves with the connecting rod and adjusts the variable vanes mechanically.

The [ECM](#) provides the stepper motor with a power and ground for stepper motor operation and also a reference voltage, ground and position signal connections for variable vane position control.

Secondary Turbocharger Boost Pressure Sensor



E116425

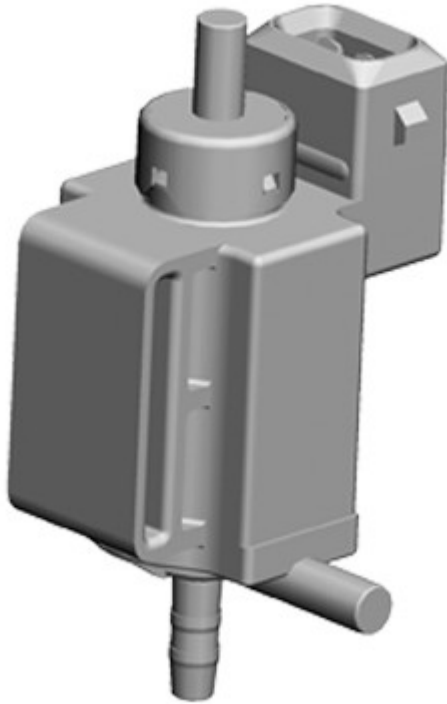
The secondary turbocharger boost pressure sensor is located on the steering pump mounting bracket on the [RH](#) side of the engine. The sensor is connected via a hose to the charge air outlet pipe from the secondary turbocharger compressor.

The sensor provides a voltage signal to the [ECM](#) relative to the output charge air pressure from the secondary turbocharger. The boost pressure sensor has a 3 pin connector which is connected to the [ECM](#) and provides a 5V reference supply from the [ECM](#), a signal input to the [ECM](#) and a ground for the sensor.

The boost pressure sensor uses a diaphragm transducer to measure pressure. The [ECM](#) uses the boost pressure sensor signal for the following functions:

- Maintain manifold boost pressure
- Reduce exhaust smoke emissions when driving at high altitude
- Control of the [EGR](#) system
- To help smooth control of the mono to bi and bi to mono turbo transitions
- To aid the air path diagnostics.

Secondary Turbocharger Turbine Shut-off Solenoid Valve



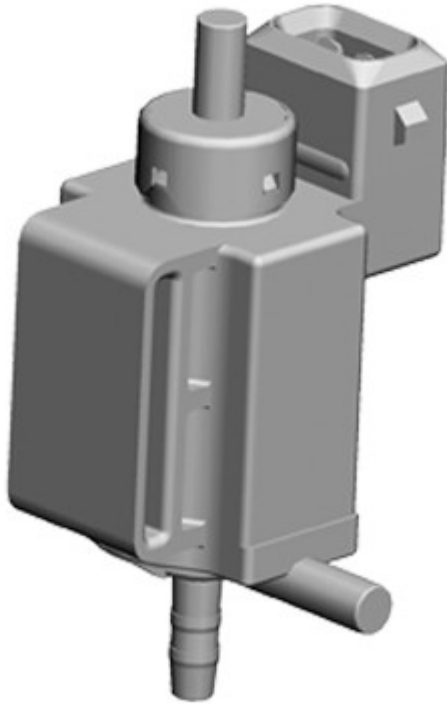
E123687

The secondary turbocharger turbine shut-off solenoid valve is located on a bracket at the front of the engine, above the [LH](#) front cylinder cover assembly. The bracket is shared with the secondary turbocharger compressor shut-off solenoid valve. The secondary turbocharger turbine shut-off solenoid valve is the innermost of the two solenoid valves.

The secondary turbocharger turbine shut-off solenoid valve receives a vacuum supply from the vacuum pump. The valve is connected by a pipe to the turbine shut-off valve vacuum actuator which is located on the rear of the secondary turbocharger. A position sensor is attached to the turbine shut-off valve vacuum actuator to inform the [ECM](#) of the turbine shut-off position.

Operation of the valve vacuum actuator is controlled by a [PWM](#) signal from the [ECM](#) and the secondary turbocharger turbine shut-off solenoid valve. When the shut-off solenoid is energized by the [ECM](#) a 4.5V [PWM](#) current is applied to operate the solenoid, vacuum is then applied to the shut-off valve vacuum actuator. The valve is opened allowing the secondary turbocharger turbine to be driven by the exhaust gasses for as long as the valve is open. When the valve is to be closed the [ECM](#) applies a 0.5V [PWM](#) current to the solenoid.

Secondary Turbocharger Compressor Shut-off Solenoid Valve



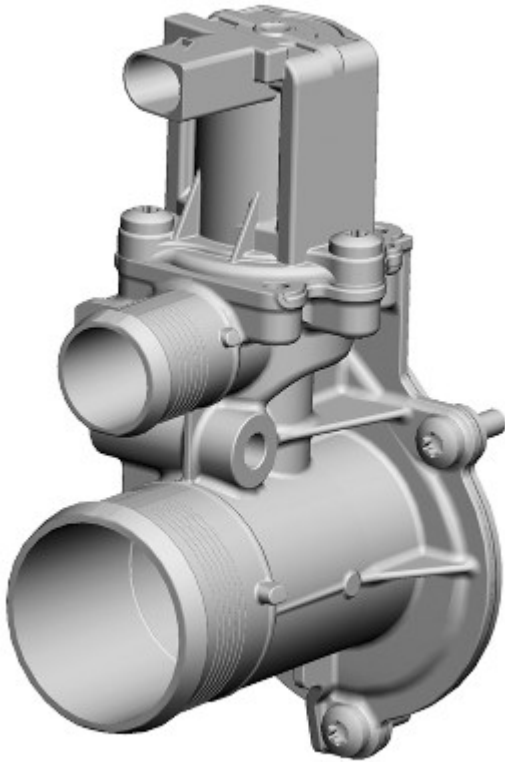
E123687

The secondary turbocharger compressor shut-off solenoid valve is located on a bracket at the front of the engine, above the [LH](#) front cylinder cover assembly. The bracket is shared with the secondary turbocharger turbine shut-off solenoid valve. The secondary turbocharger compressor shut-off solenoid valve is the outermost of the two solenoid valves.

The secondary turbocharger compressor shut-off solenoid valve receives a vacuum supply from the vacuum pump. The valve is connected by a pipe to the compressor shut-off vacuum actuator located on the charge air intake manifold tube. When the vacuum is applied to the vacuum actuator, the actuator operates to open the shut-off valve allowing charge air to flow into the air intake pipe.

Operation of the secondary turbocharger compressor shut-off solenoid valve is controlled by a [PWM](#) signal from the [ECM](#); 0% is off and 100% is on (solenoid activated). The solenoid valve is opened when bi-turbocharger operation is required allowing compressed charge air from the secondary turbocharger compressor to enter the air intake system.

Secondary Turbocharger Compressor Recirculation Valve



E116426

The secondary turbocharger compressor recirculation valve motor is located on the compressor recirculation valve housing, adjacent to the compressor shut-off valve. The solenoid valve is attached to the compressor recirculation valve with 3 screws.

The secondary turbocharger compressor recirculation valve motor is controlled by the [ECM](#). The valve is used during operation of the secondary turbocharger. When the [ECM](#) is switching to bi-turbocharger operation, the valve motor is operated which opens the recirculation path to the primary turbocharger. This allows the secondary turbocharger to increase its speed. When the secondary turbocharger has reached its optimum operating speed the recirculation valve motor is operated, closing the recirculation path to the primary turbocharger.

Secondary Turbocharger Turbine Shut-off Valve and Position Sensor



E116760

The secondary turbocharger turbine shut-off valve and position sensor is located on the turbine vacuum shut-off valve. The sensor has three connections to the [ECM](#); a 5V reference voltage, a ground and a signal return.

The sensor is connected to the turbine shut-off vacuum actuator and senses when the actuator has operated. The sensor returns a 0 - 5V analogue position signal to the [ECM](#) to confirm that the vacuum actuator has operated.

Water-in-fuel Sensor



E123689

The fuel filter element has a water sensor located in its base. The sensor is screwed into a threaded hole in the base of the element. When the filter is replaced at service, the sensor can be unscrewed from the element and installed in the new element. The sensor has an electrical connector located at the side of the element which can be disconnected to assist element removal.

The water-in-fuel sensor is connected to the [ECM](#). When the water in the element reaches 64 cm³ (3.9 in³) the [ECM](#) issues a high speed [CAN](#) bus message to the instrument cluster to display a 'WATER IN FUEL' message in the message center.

Electronic Engine Controls - TDV6 3.0L Diesel - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: (303-14B Electronic Engine Controls - TDV6 3.0L Diesel)

[Electronic Engine Controls](#) (Description and Operation),
[Electronic Engine Controls](#) (Description and Operation),
[Electronic Engine Controls](#) (Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Fuel leaks ● Accessory drive belt ● Sensor installation/condition ● Viscous fan and solenoid 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● 5 volt sensor supply ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> ● Inertia fuel shutoff switch ● Low/Contaminated fuel ● Air leakage ● Low-pressure fuel system fault ● Fuel pump module (lift pump) fault ● Blocked fuel filter ● Fuel volume regulator blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel pump fault ● Crankshaft position (CKP) sensor 	Check that the inertia switch has not tripped. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.
Difficult to start	<ul style="list-style-type: none"> ● Glow plug system fault (very cold conditions) ● Low/Contaminated fuel ● Air leakage ● Fuel pump module (lift pump) fault ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) 	Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.

Symptom	Possible Causes	Action
	valve(s) fault	
Rough idle	<ul style="list-style-type: none"> ● Intake air system fault ● Low/Contaminated fuel ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Lack of power when accelerating	<ul style="list-style-type: none"> ● Intake air system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust gas recirculation (EGR) valve(s) fault ● Turbocharger actuator fault 	Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary. Check for DTCs indicating a fuel pressure fault. Check the EGR system. Check turbocharger actuator.
Engine stops/stalls	<ul style="list-style-type: none"> ● Air leakage ● Low/Contaminated fuel ● Low-pressure fuel system fault ● High pressure fuel leak ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Engine judders	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Air ingress ● Low-pressure fuel system fault ● Fuel metering valve blocked/contaminated ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● High pressure fuel leak ● Fuel pump fault 	Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	<ul style="list-style-type: none"> ● Low-pressure fuel system fault ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel temperature sensor leak ● High pressure fuel leak ● Injector(s) fault ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the EGR system.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module (PCM) 3.0L TdV6 (100-00, Description and Operation).

Electronic Engine Controls - TDV6 3.0L Diesel - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.
2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

Position the DTI gauge on a suitable mounting block, as illustrated.



E135356

3. With the aid of another technician, gently press the brake pedal until the stoplamps illuminate.
4. NOTE: The specification is that the stoplamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

Note the measurement of the brake pedal travel from rest position until the stoplamps illuminated.

Adjust

1. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Remove the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Only use light finger pressure when installing the stoplamp switch. Failure to follow this instruction may result in an incorrectly adjusted stoplamp switch.

Install the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

3. Check the adjustment of the stoplamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Electronic Engine Controls - TDV6 3.0L Diesel - Camshaft Position (CMP) Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

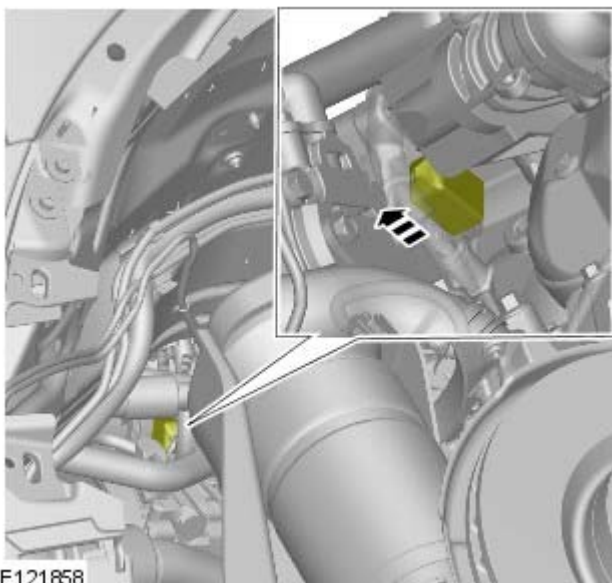
2. Refer to: [Cooling Fan](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

3. Remove the LH front wheel and tire.

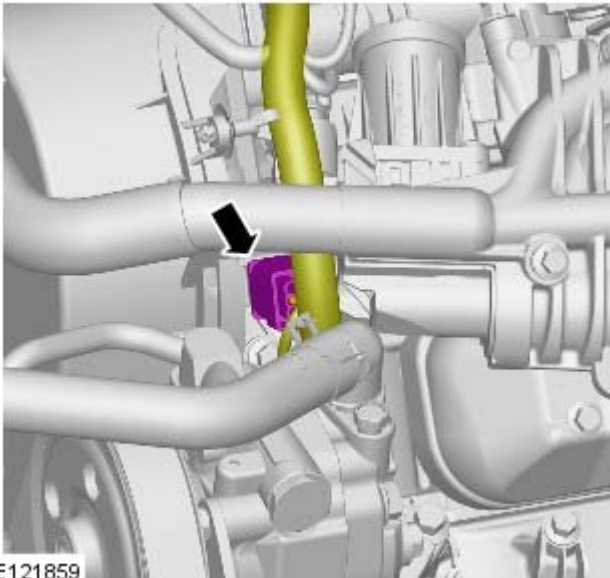
Torque: 140 Nm

4. Refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

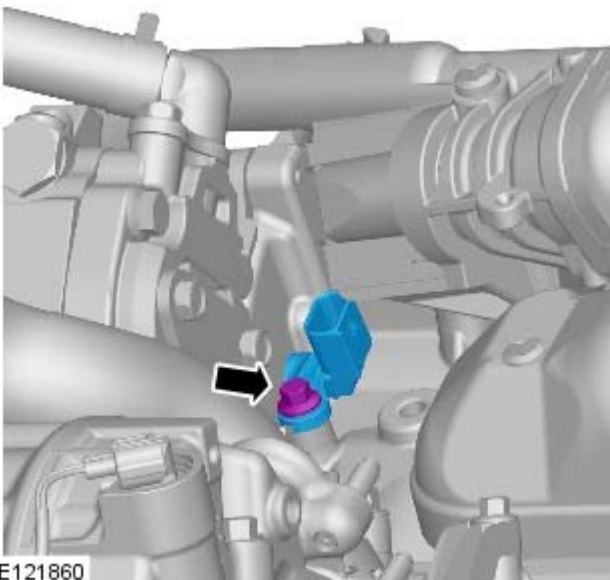
- 5.



E121858

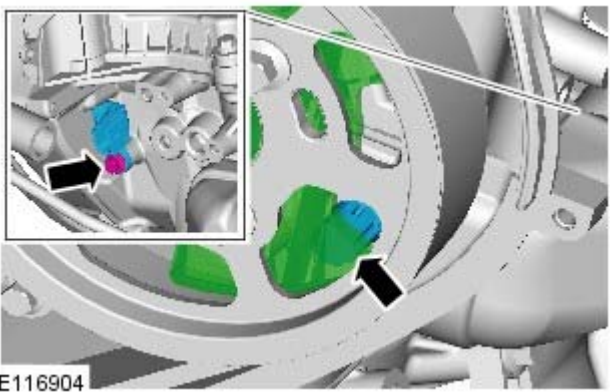


6.





7.

Installation



1. CAUTIONS:

 Make sure that the mating faces are clean and free of foreign material.

 The Camshaft position (CMP) sensor tip must rest on one of the three webs on the back of the camshaft pulley. Incorrect installation may result in the CMP sensor being damaged.

- NOTE: Only turn the engine in the normal direction of rotation.

- NOTE: Timing belt left hand cover shown removed for clarity.

Turn the engine until one of the three webs on the back of the camshaft pulley is visible through the CMP sensor housing.

Torque: 10 Nm


2. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Crankshaft Position (CKP) Sensor

Removal and Installation

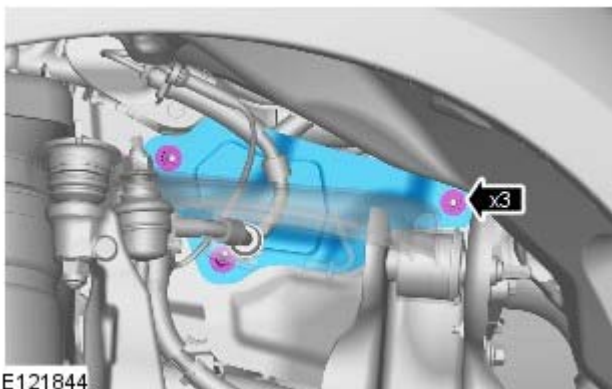
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Remove the left-hand front wheel and tire.

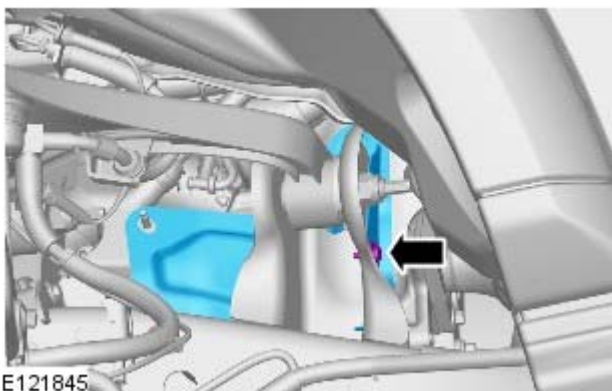
Torque: 140 Nm
3. Refer to: [Engine Oil Vacuum Draining and Filling](#) (303-01B Engine - TDV6 3.0L Diesel, General Procedures).
4. Refer to: [Suspension Height Sensor](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

5. *Torque: 9 Nm*

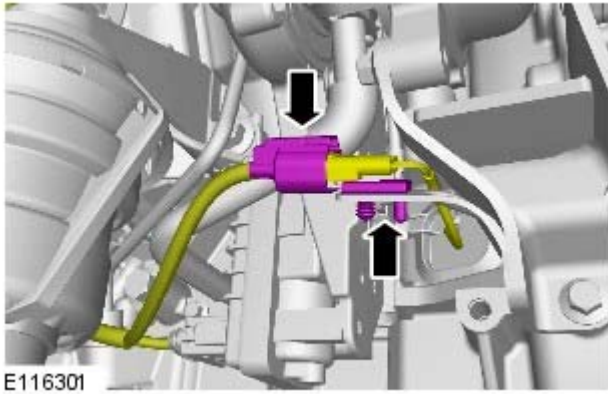


E121844

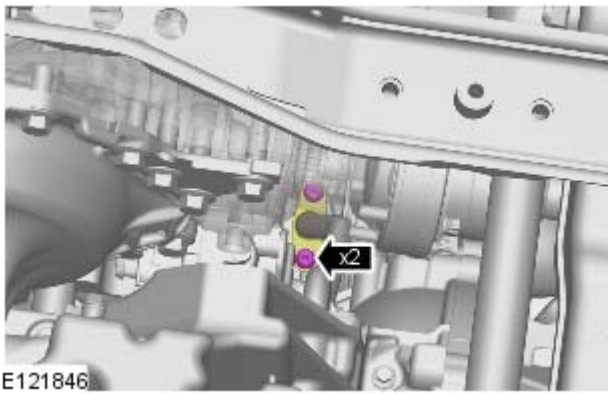
6. *Torque: 9 Nm*



E121845

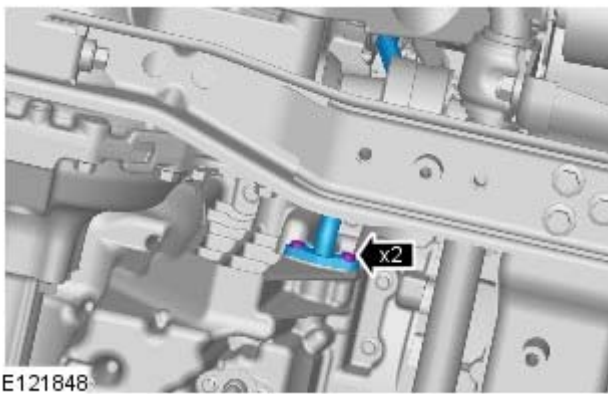


7. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



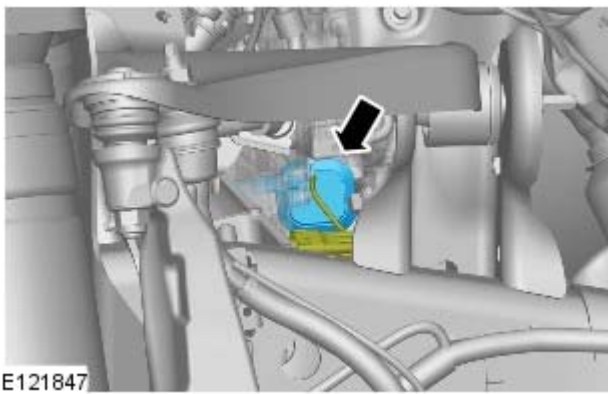
8. **NOTE:** Remove and discard the gasket.

Torque: 10 Nm

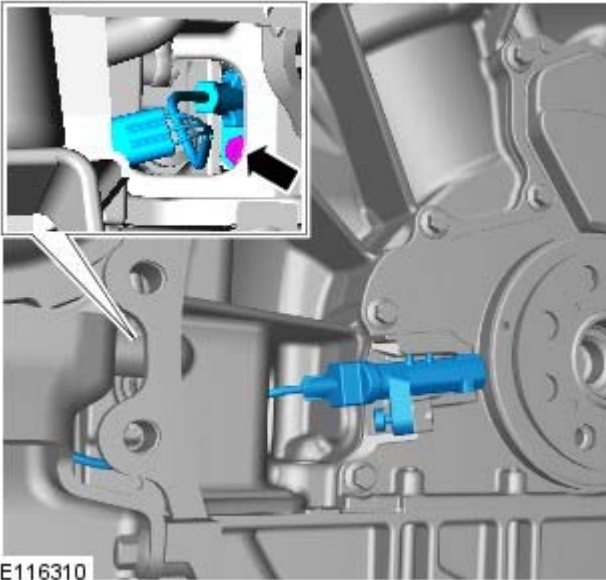



9. **NOTE:** Remove and discard the gasket.

Torque: 10 Nm



- 10.



11.  CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

- NOTE: Engine shown removed for clarity.

- NOTE: The CKP sensor retaining bolt should not be removed from the CKP sensor.

Torque: 5 Nm

Installation

1.  CAUTION: Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Crankshaft Position (CKP) Sensor Ring

Sensor Ring

Removal and Installation

Special Tool(s)

	<p>303-1130 Installer - Crankshaft Position (CKP) Sensor Ring</p>
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Removal

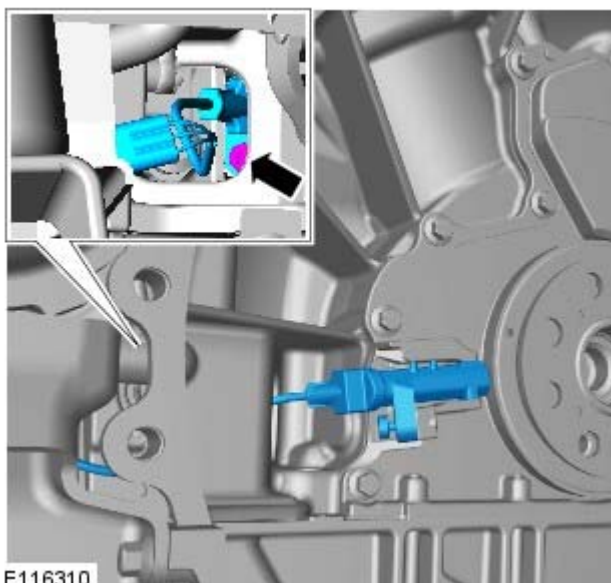
1. Disconnect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

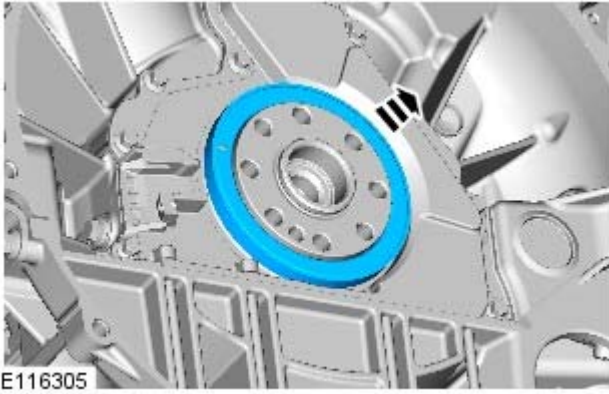
Raise and support the vehicle.

3. Refer to: [Flexplate](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).



4.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

• **NOTE:** The CKP sensor retaining bolt should not be removed from the CKP sensor.




5.

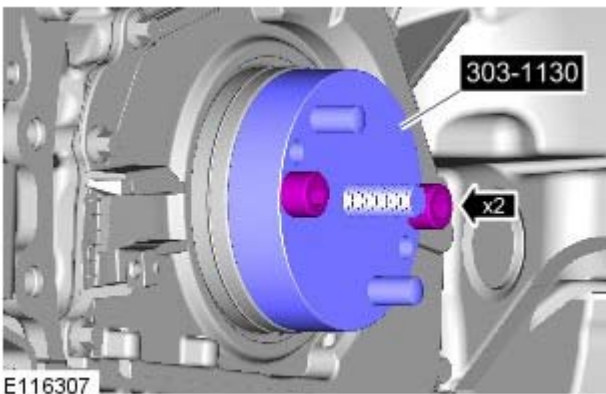
Installation



E116306

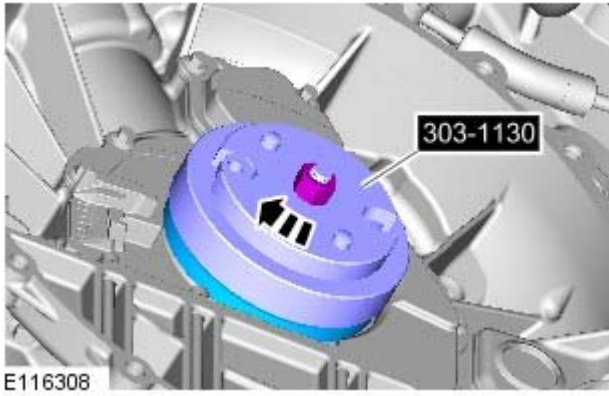
1.  **CAUTION:** Make sure that the CKP sensor ring is aligned correctly with the special tool pip and that both mating surfaces are fully seated.

- *Special Tool(s):* [303-1130](#)

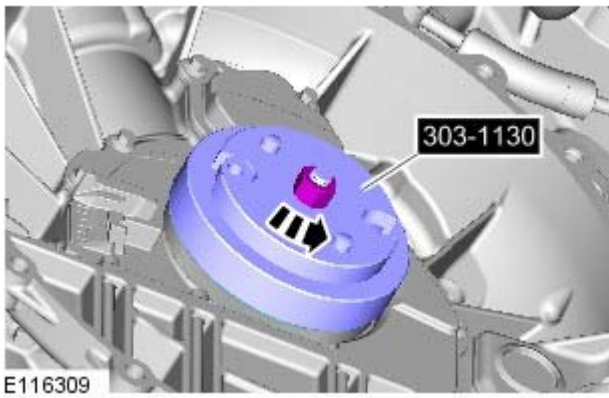


2. Install the special tool.

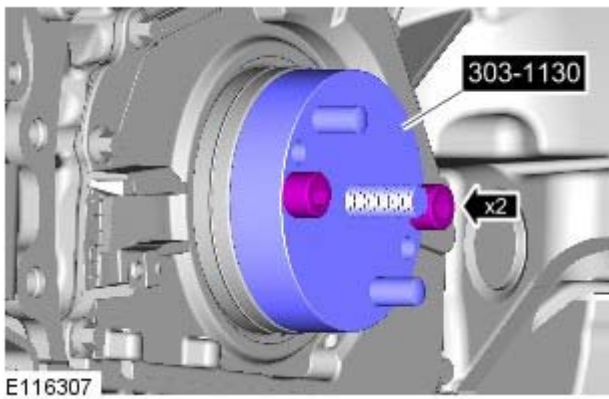
Special Tool(s): [303-1130](#)



3.

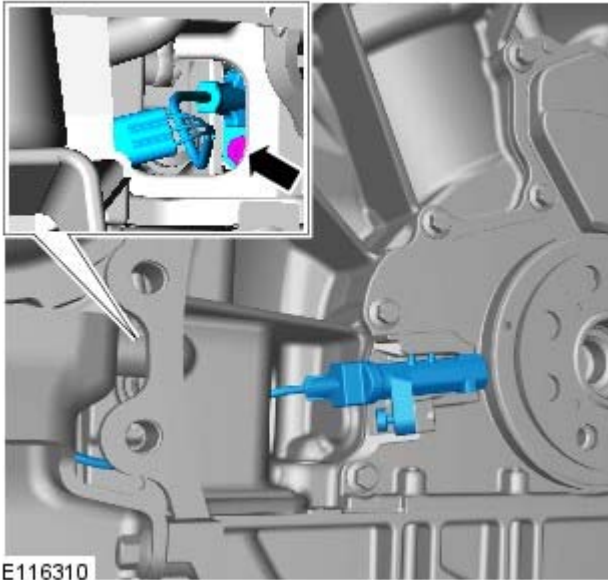


4.




5. Remove the special tool.


Special Tool(s): [303-1130](#)



6. **6. CAUTIONS:**

 Install the CKP sensor correctly into the housing. Failure to follow this instruction may result in damage to the CKP sensor.

 Make sure that the mating faces are clean and free of foreign material.

 Make sure that the component is clean, free of foreign material and lubricant.

- *Torque:* 5 Nm

7. Refer to: [Flexplate](#) (303-01B Engine - TDV6 3.0L Diesel, Removal and Installation).

8. Connect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - TDV6 3.0L Diesel - Diesel Particulate Filter (DPF) Differential Pressure Sensor

Removal and Installation

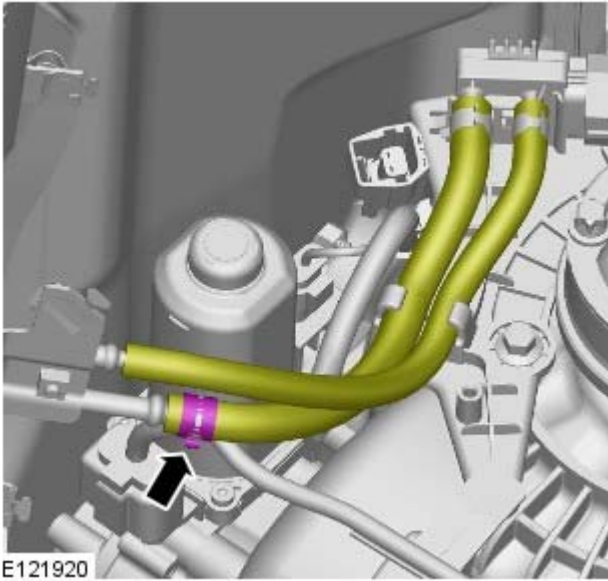
Removal

- NOTE: Removal steps in this procedure may contain installation details.

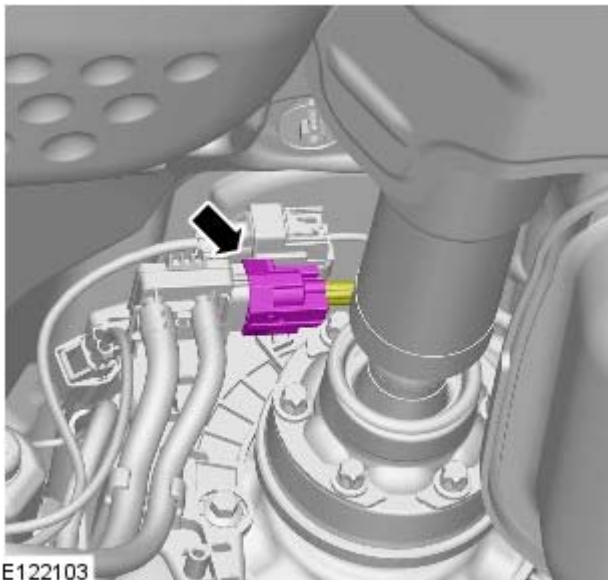
1.  **WARNING:** Make sure to support the vehicle with axle stands.

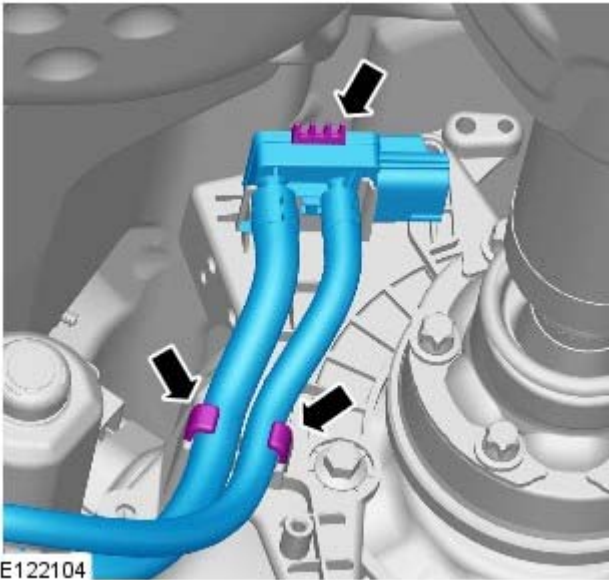
Raise and support the vehicle.

2.



3.





E122104

4.



E114350

5.

Installation

1. To install, reverse the removal procedure.
2. **NOTE:** This step is only necessary when installing a new component.
 1. Using the diagnostic tool, clear diagnostic trouble codes (DTCs) from the engine control module (ECM).
 2. Using the data logger, check the engine oil temperature.
 3. Make sure the selector lever is in the 'P' position.
 4. Start and run the engine.
 5. Make sure that the engine oil is at a minimum temperature of 50 degrees C.
 6. Allow the engine to idle for 2 minutes and 30 seconds.
 7. Make sure that the engine cooling fan is not running.
 8. Turn off the ignition.
 9. Wait for 30 seconds.
 10. Repeat steps 4 to 9, a further 5 times.
 11. Disconnect the Jaguar approved diagnostic system.

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Coolant Temperature (ECT) Sensor

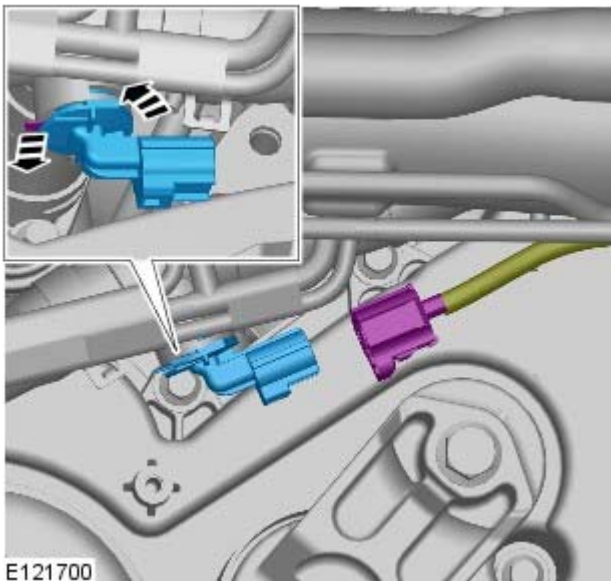
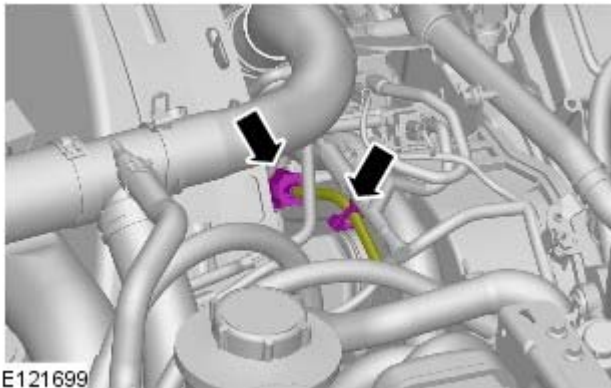
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



3. **3. CAUTIONS:**



Be prepared to collect escaping fluids.



The seal is to be reused unless damaged.



Make sure that the mating faces are clean and free of foreign material.

- NOTE: Release the locking tang to remove the ECT sensor.

Installation

1. **1. NOTE:** Make sure that all the component mating faces are clean.

To install, reverse the removal procedure.

2. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank.

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Control Module (ECM)

Removal and Installation

Removal

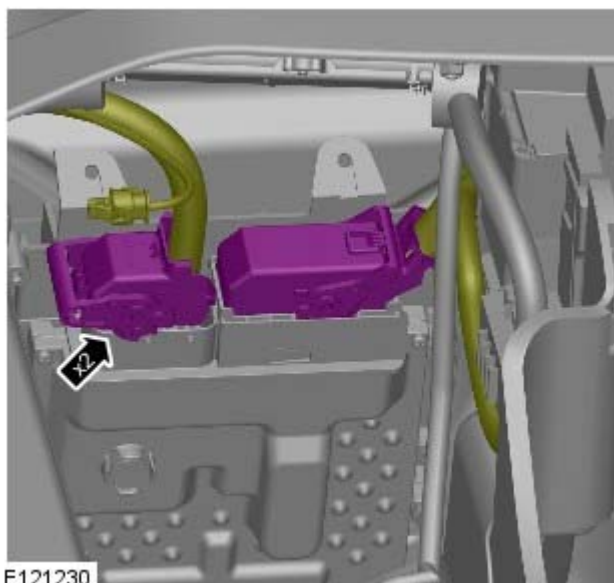
- NOTE: Removal steps in this procedure may contain installation details.


All vehicles

1. Remove the battery.

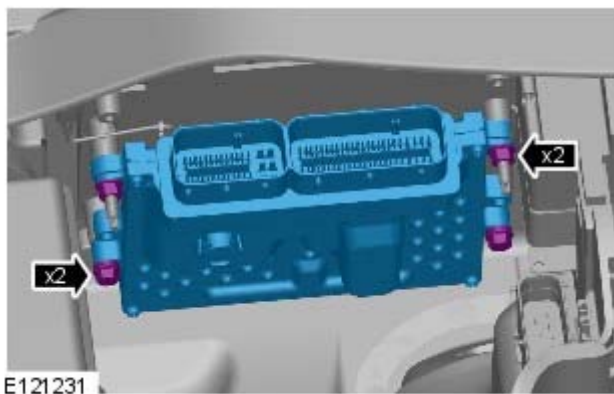
Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

Left-hand drive vehicles



2.  CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

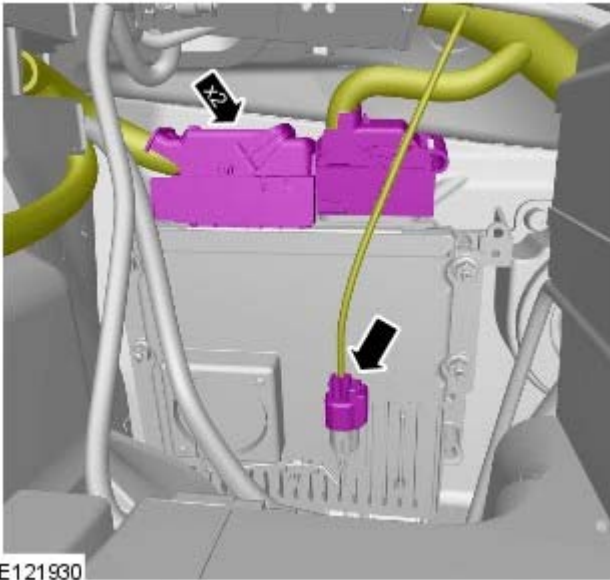
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.




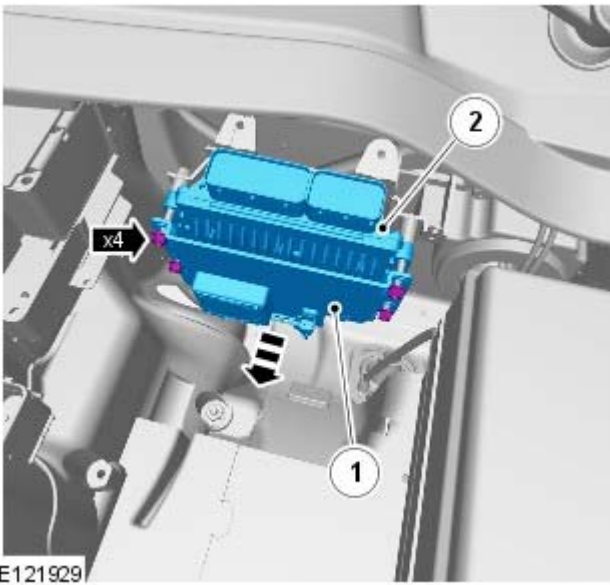
3. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 7 Nm

Right-hand drive vehicles



4.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.



5. *Torque: 7 Nm*

Installation

1. To install, reverse the removal procedure.
2. New units must be configured using the Programmable Module Routine in the diagnostic tool.

Electronic Engine Controls - TDV6 3.0L Diesel - Engine Oil Level Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

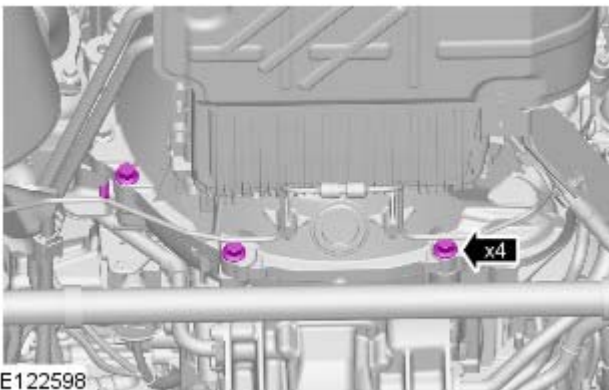
Raise and support the vehicle.

3. Refer to: [Engine Oil Draining and Filling](#) (303-01B Engine - TDV6 3.0L Diesel, General Procedures).

4. Refer to: [Front Drive Axle and Differential](#) (205-03 Front Drive Axle/Differential, Description and Operation).

5. Refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).

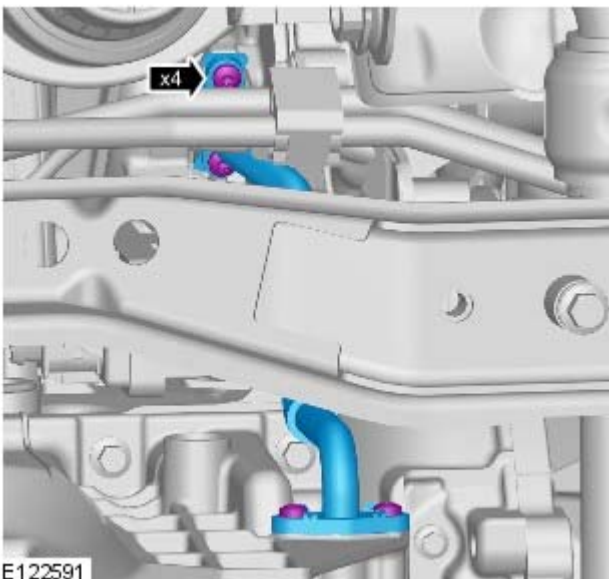
6. *Torque:*
M10 40 Nm
M8 24 Nm



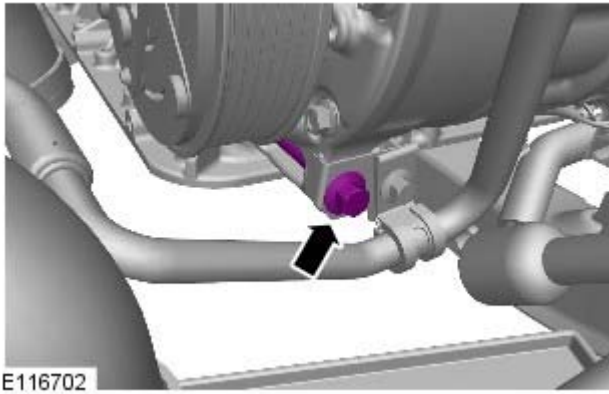
E122598

7.  **CAUTION:** Make sure that the gaskets are correctly located.

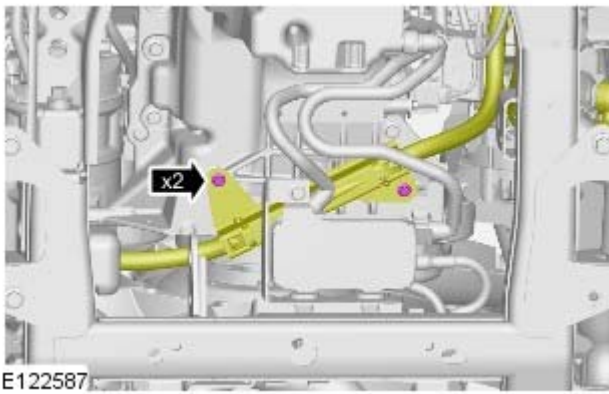
Torque: 10 Nm



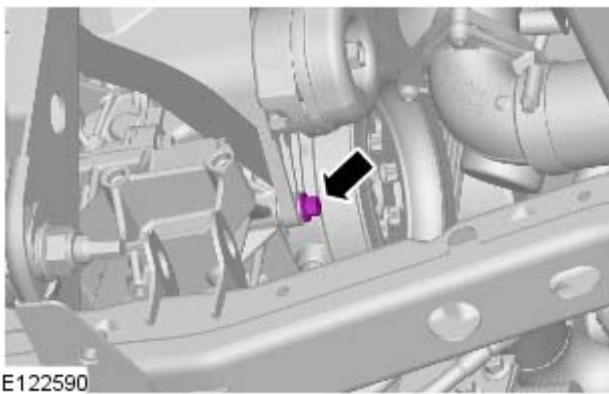
E122591



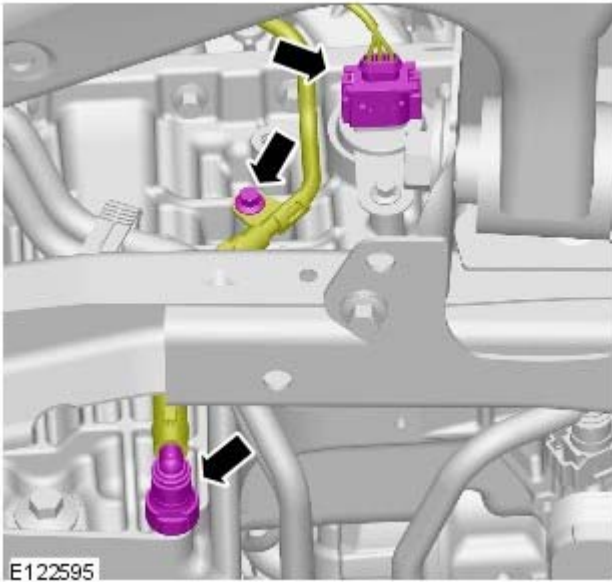
8. Torque: 25 Nm



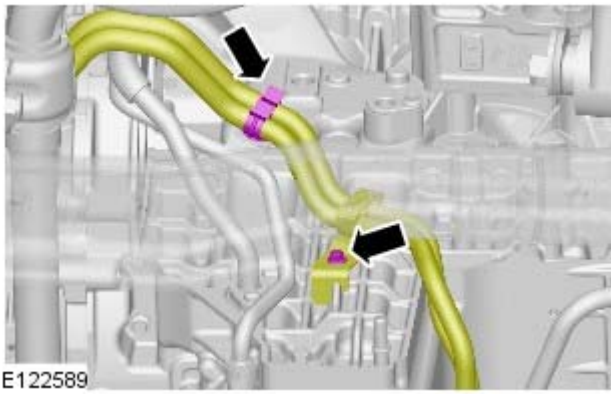
9. Torque: 10 Nm



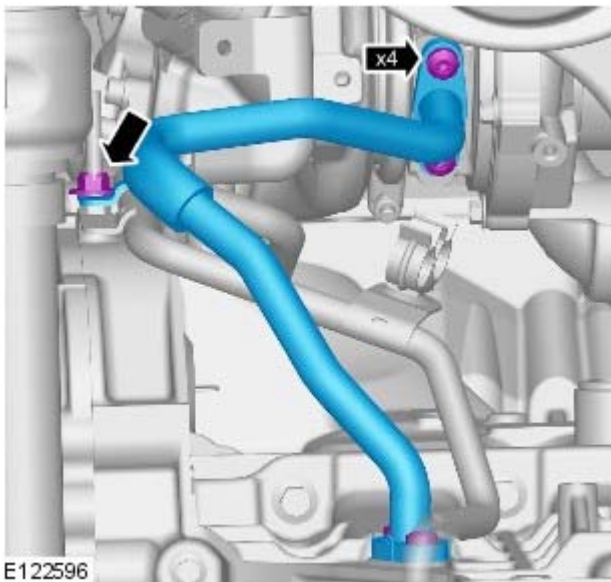
10. Torque: 24 Nm



11. *Torque:* 10 Nm

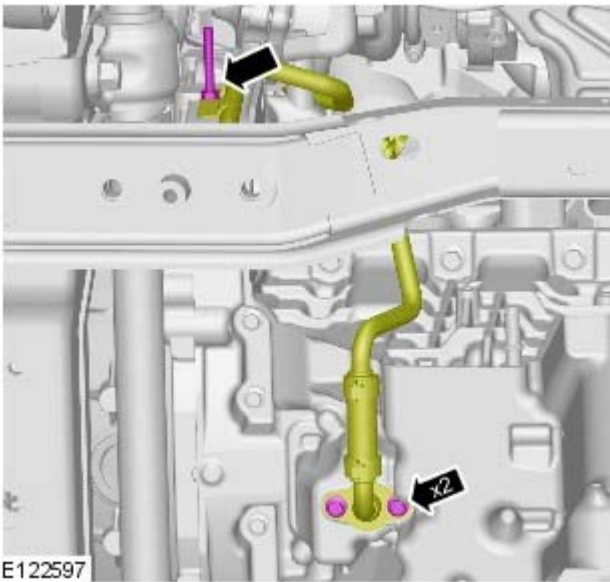


12. *Torque:* 10 Nm



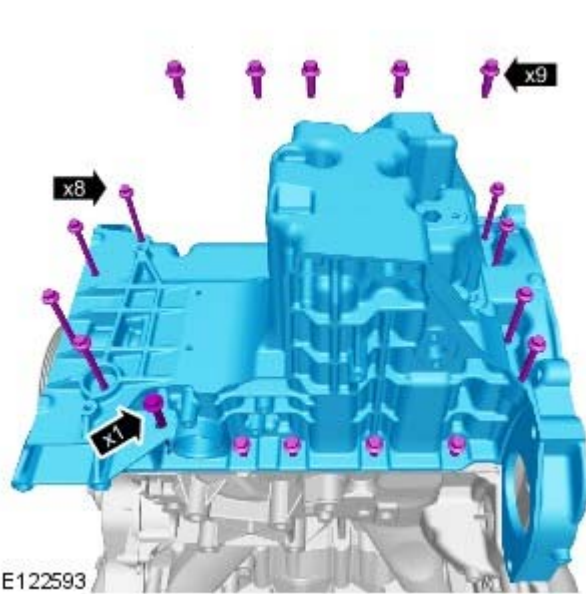
13. **⚠ CAUTION:** Make sure that the gaskets are correctly located.


Torque: 10 Nm



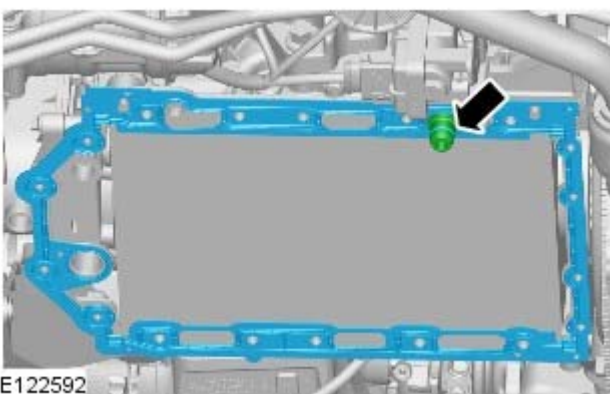
14. **14.** NOTE: Remove and discard the gasket.

Torque: 10 Nm

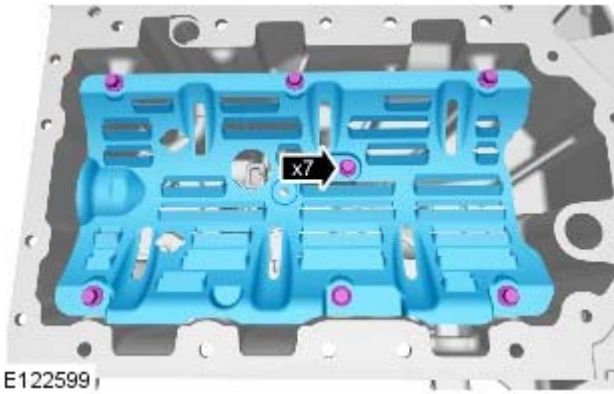


15. **15.**  CAUTION: Note the position of the bolts, prior to removal.

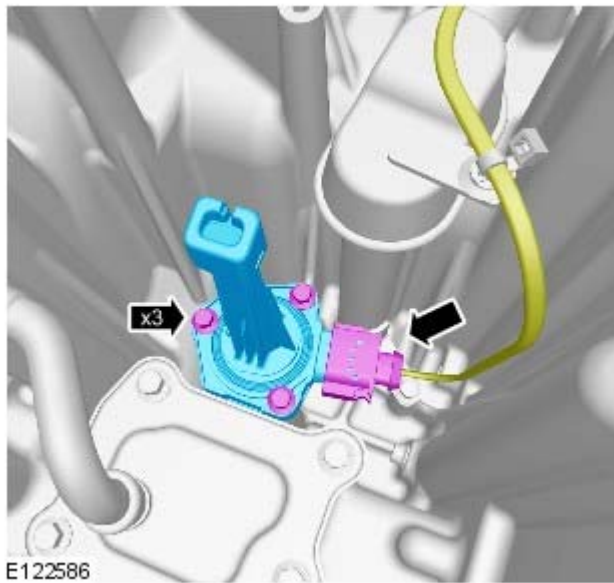
Torque:
M8 23 Nm
M6 10 Nm



16. **16.**  CAUTION: Remove and discard the O-ring seal.

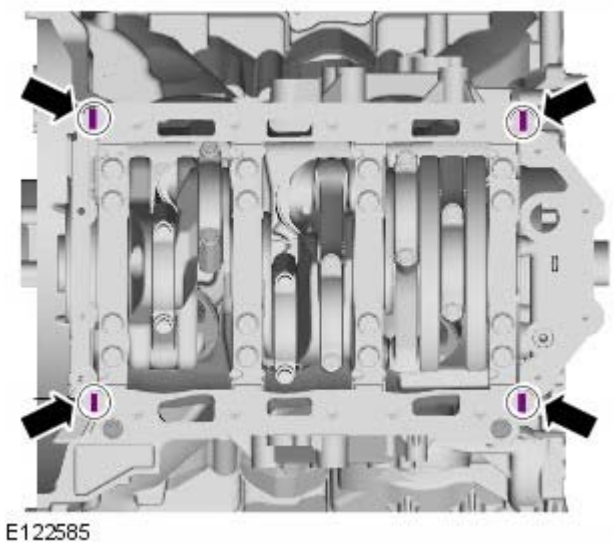


17. Torque: 10 Nm





18. Torque: 10 Nm

Installation



1. CAUTIONS:

 Make sure that the mating faces are clean and free of corrosion and foreign material.

 Installation of the oil pan and tightening must be carried out within 7 minutes of applying the sealant.

Apply an 8 mm bead of sealant to the cylinder block in the areas shown.

2. To install, reverse the removal procedure.

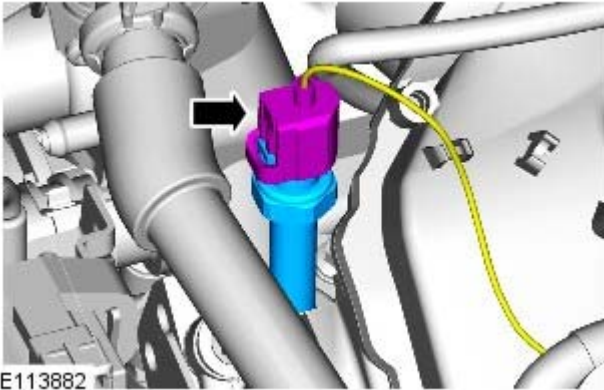
Electronic Engine Controls - TDV6 3.0L Diesel - Engine Oil Pressure (EOP) Sensor


Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



2.  CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

- Torque: 14 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Exhaust Gas Temperature Sensor RH

Removal and Installation


Removal

- NOTE: Removal steps in this procedure may contain installation details.

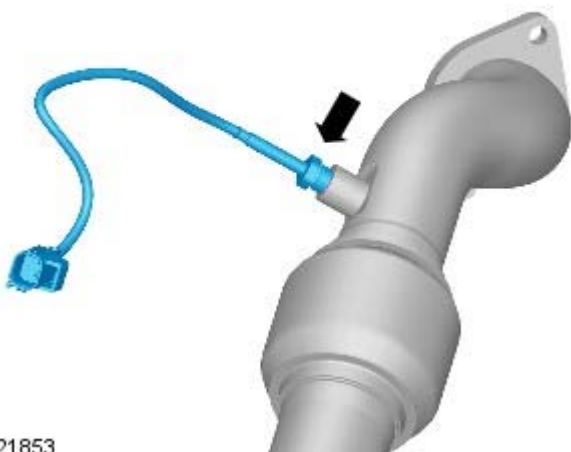
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 35 Nm



E121853

Installation

1.  **CAUTION:** If accidentally dropped or knocked install a new sensor.

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.


To install, reverse the removal procedure.

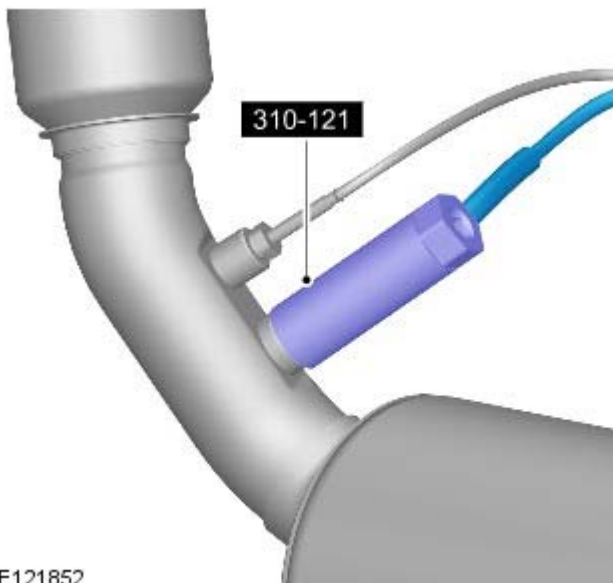
Electronic Engine Controls - TDV6 3.0L Diesel - Heated Oxygen Sensor (HO2S)

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Catalytic Converter](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).



E121852

3.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 48 Nm

Installation

1. **CAUTIONS:**



If accidentally dropped or knocked install a new sensor.



Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

- NOTE: Make sure the anti-seize compound does not contact the HO2S tip.

To install, reverse the removal procedure.

2. If a new unit is installed, configure using the approved diagnostic tool.

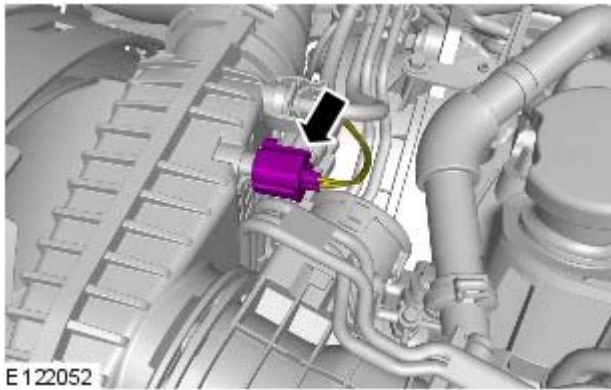
Electronic Engine Controls - TDV6 3.0L Diesel - Intake Air Temperature (IAT) Sensor

Removal and Installation

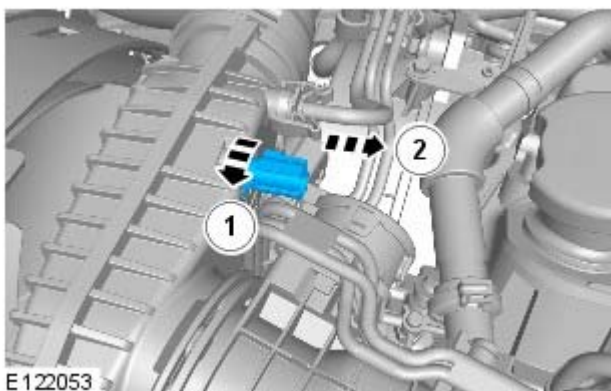
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



2.



3.

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Manifold Absolute Pressure (MAP) Sensor

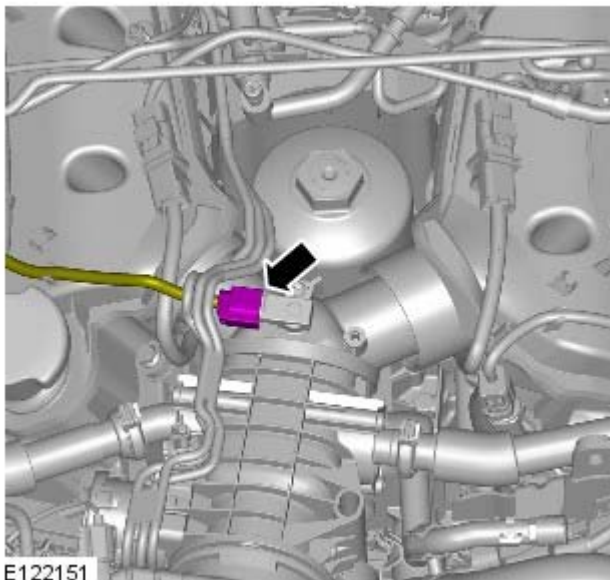
Removal and Installation

Removal

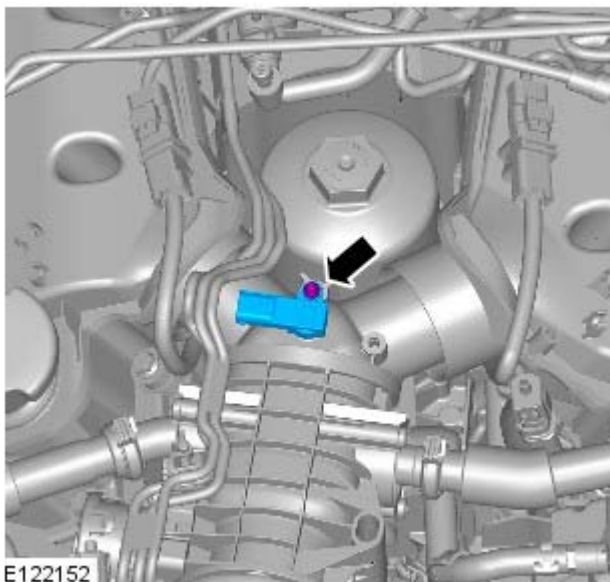
- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2.



3. Torque: 3 Nm



Installation

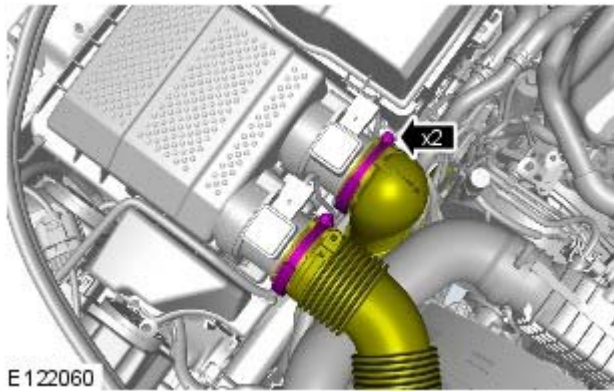
1. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Mass Air Flow (MAF) Sensor

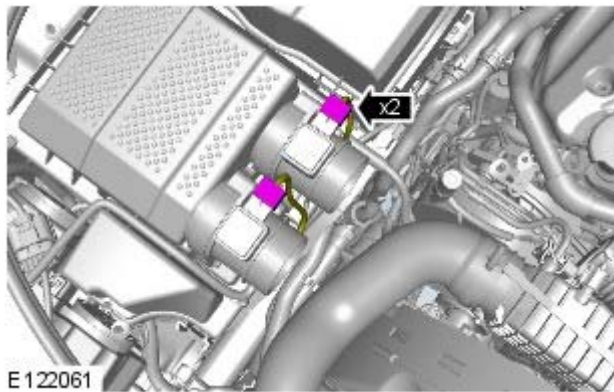
Removal and Installation

Removal

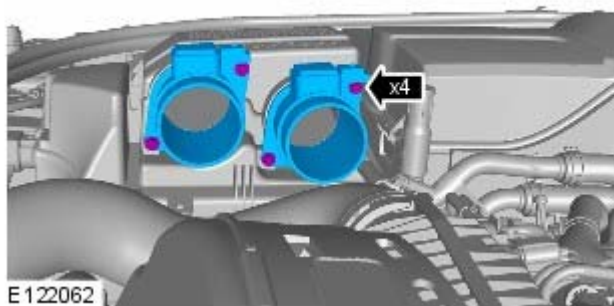
- NOTE: Removal steps in this procedure may contain installation details.



1. Torque: 3.5 Nm



- 2.



3. Torque: 2 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Oil Temperature Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. The oil temperature sensor is an integrated part of the engine oil level sensor.

Refer to: [Engine Oil Level Sensor](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Post Catalytic Converter Temperature Sensor

Removal and Installation


Removal

- NOTE: Removal steps in this procedure may contain installation details.

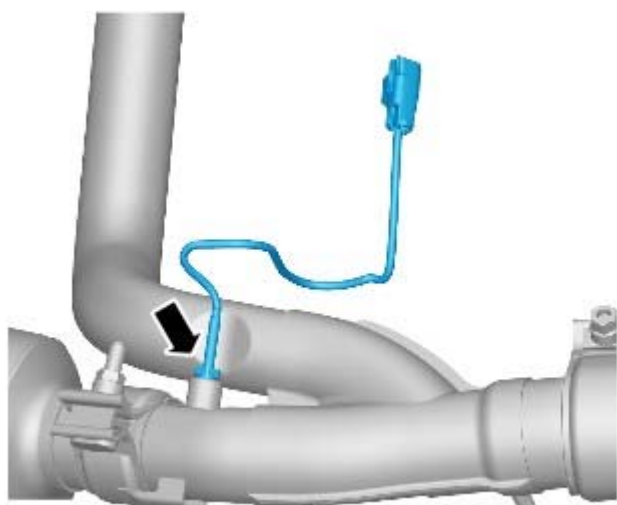
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 35 Nm



E121854

Installation

1.  **CAUTION:** If accidentally dropped or knocked install a new sensor.

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.


To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Post DPF Exhaust Gas Temperature Sensor

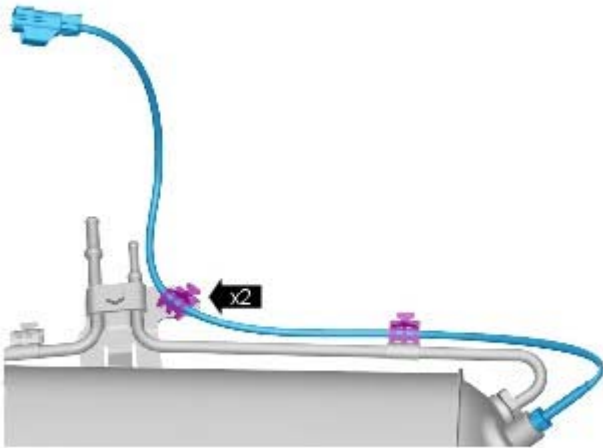
Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.


1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
3.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 35 Nm



E121856

Installation

1.  **CAUTION:** If accidentally dropped or knocked install a new sensor.
• NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.
To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Pre Catalytic Converter Temperature Sensor

Removal and Installation


Removal

- NOTE: Removal steps in this procedure may contain installation details.

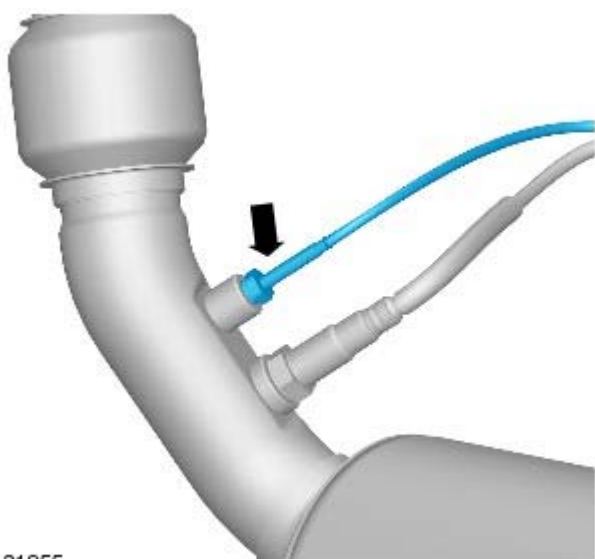
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

3.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 35 Nm



E121855

Installation

1.  **CAUTION:** If accidentally dropped or knocked install a new sensor.

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.



To install, reverse the removal procedure.

Electronic Engine Controls - TDV6 3.0L Diesel - Pre DPF Exhaust Gas Temperature Sensor

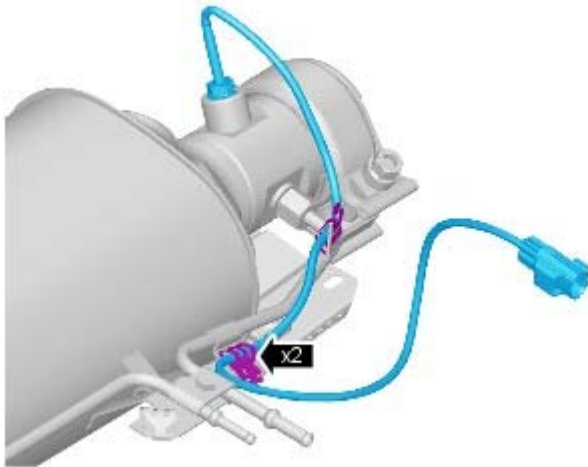
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.


1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
3.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 35 Nm



E121857

Installation

1.  **CAUTION:** If accidentally dropped or knocked install a new sensor.
 - NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.To install, reverse the removal procedure.

Electronic Engine Controls - V6 4.0L Petrol -

Lubricants

Item	Land Rover Part No.
* HO2s removal	STC 50545
HO2s threads	Apply suitable high temperature anti-seize compound to threads of sensor

* **Apply to area around sensor threads prior to attempting to remove sensor**

Engine Management System

Item	Description
Engine management system:	
Make	Siemens
Type	PAG EMS - Generation 1

Torque Specifications

Description	Nm	lb-ft
Intake manifold tuning (IMT) valve bolts	10	7
+ Heated oxygen sensor (HO2S)	45	33
* RH catalytic converter to exhaust manifold bolts	22	16
* LH catalytic converter to exhaust manifold bolts	22	16
LH catalyst monitor sensor	45	33
Heat shield bolts	10	7
Mass air flow (MAF) sensor Torx screws	2	1.5
** Camshaft position (CMP) sensor bolt	6	4
Engine coolant temperature (ECT) sensor	18	13
Throttle body bolts	10	7
Crankshaft position (CKP) sensor Torx screw	8	6
Knock sensor (KS) bolt	20	15

+ **Apply anti-seize lubricant to threads of sensor - See Lubricants**

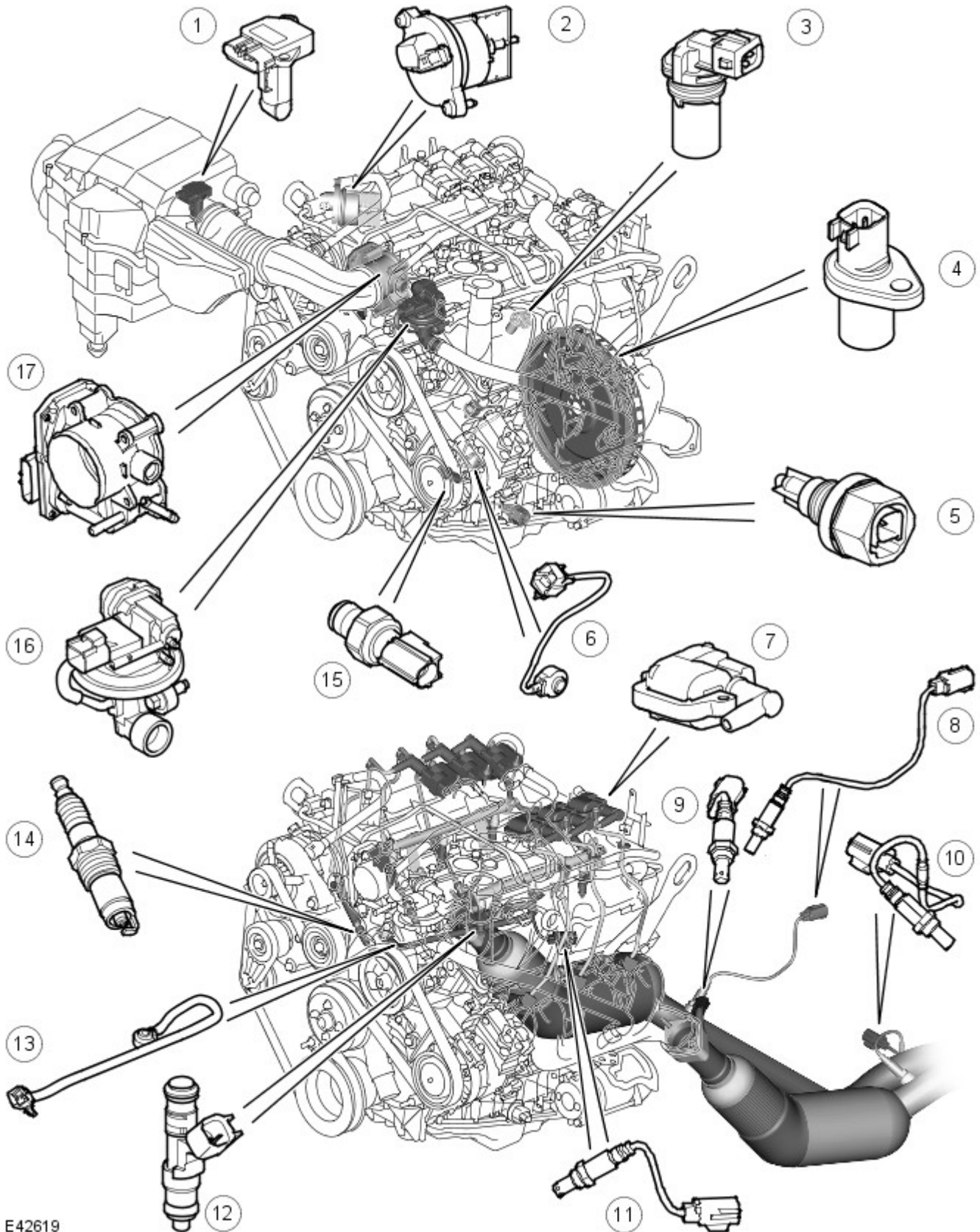
* **New bolts must be fitted**

** **Apply clean engine oil to a new CMP sensor O-ring seal.**

Electronic Engine Controls - V6 4.0L Petrol - Electronic Engine Controls

Description and Operation

4.0 Liter Electronic Engine Controls Component Location Sheet 1 of 2

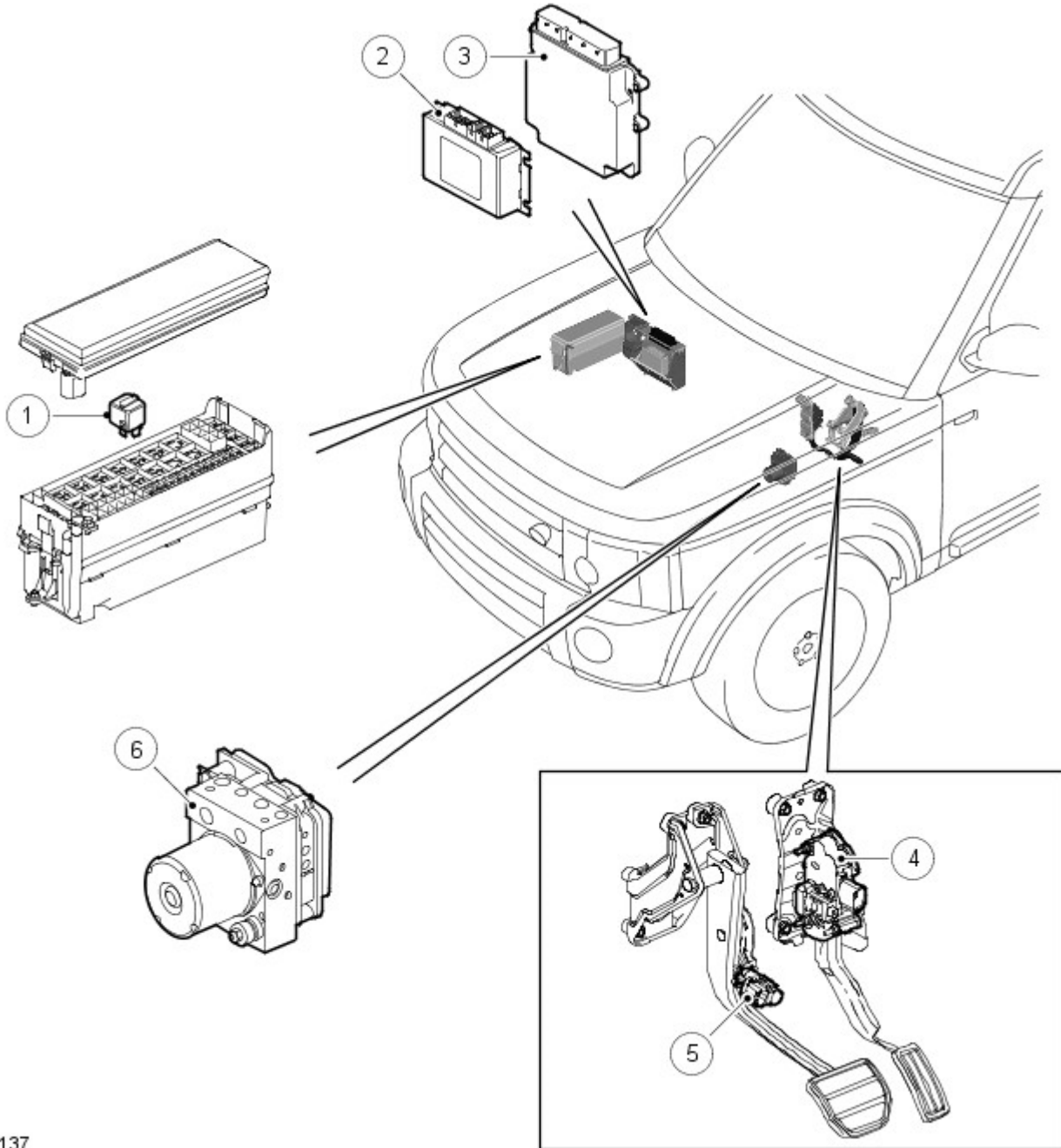


E42619

Item	Part Number	Description
1	-	mass air flow (MAF)/intake air temperature (IAT)
2	-	intake manifold tuning (IMT) valve
3	-	camshaft position (CMP)
4	-	crankshaft position (CKP)

5	-	Engine oil temperature sensor
6	-	Knock sensor
7	-	Ignition coils
8	-	Heated Exhaust Gas Oxygen sensor (HEGO)
9	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO)
10	-	Heated Exhaust Gas Oxygen sensor (HEGO)
11	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO)
12	-	Injectors
13	-	Knock sensor
14	-	Spark plugs
15	-	engine oil pressure (EOP) sensor
16	-	exhaust gas recirculation (EGR) valve and pressure differential sensor
17	-	Electric throttle

4.0 Liter Electronic Engine Controls Component Location Sheet 2 of 2

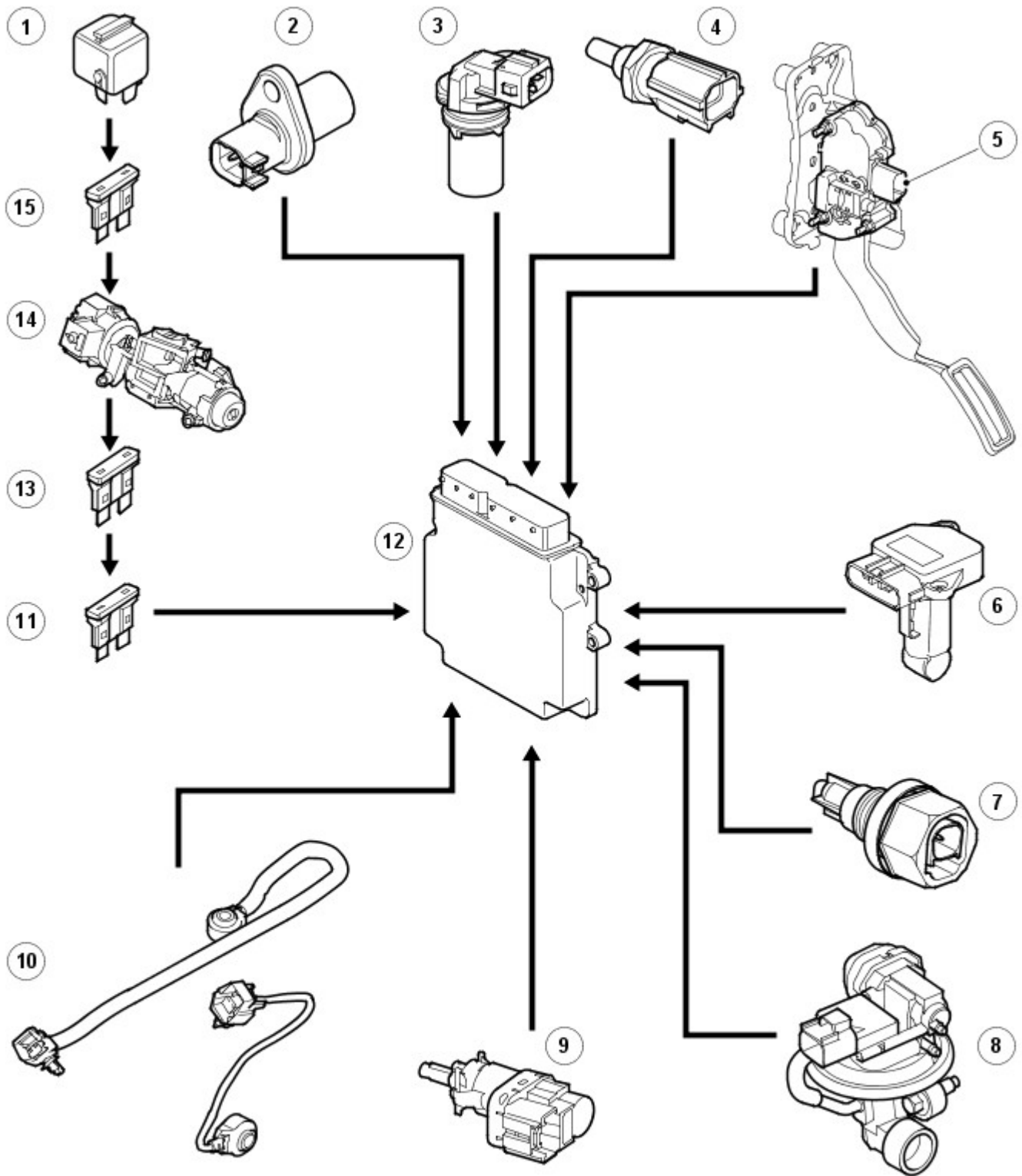


E50137

Item	Part Number	Description
1	-	Main relay
3	-	Transfer box control module
2	-	engine control module (ECM)
4	-	Brake lamp switch
5	-	Clutch switch
6	-	anti-lock brake system (ABS) control module

4.0L EMS Control Diagram Sheet 1 of 2

• NOTE: A= Hardwired



E50136

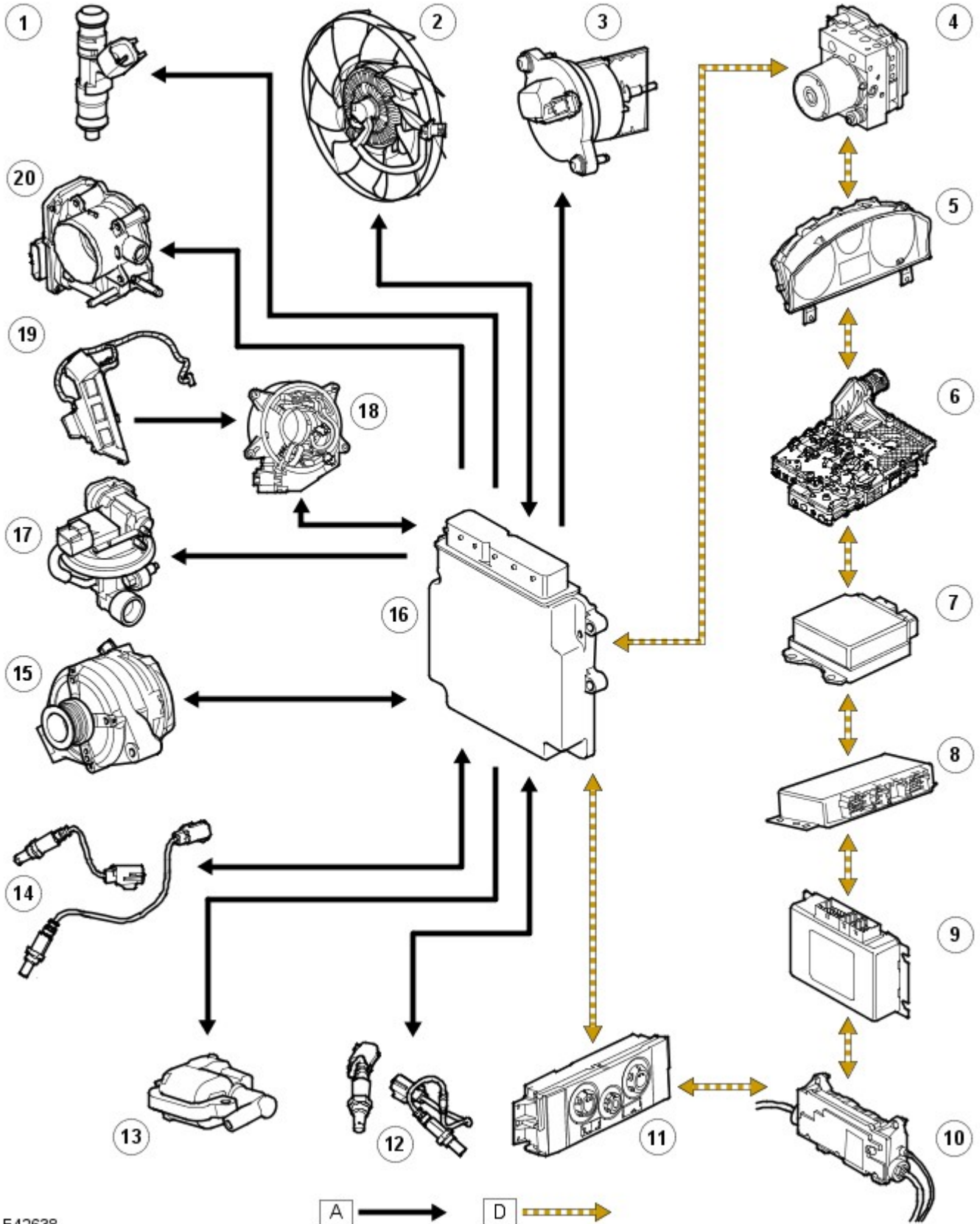
A →

Item	Part Number	Description
1	-	Main relay
2	-	CKP
3	-	CMP
4	-	engine coolant temperature (ECT) sensor
5	-	accelerator pedal position (APP)
6	-	MAF
7	-	Engine oil temperature sensor
8	-	manifold absolute pressure (MAP)
9	-	Brake light switch
10	-	Knock sensor
11	-	Fuse No 25P

12	-	ECM
13	-	Fuse 60P
14	-	Ignition switch
15	-	Fuseable link 11E

4.0L EMS Control Diagram Sheet 2 of 2

• NOTE: A= Hardwired D= controller area network (CAN) Bus



E42638

Item	Part Number	Description
1	-	Injectors
2	-	Engine cooling fan

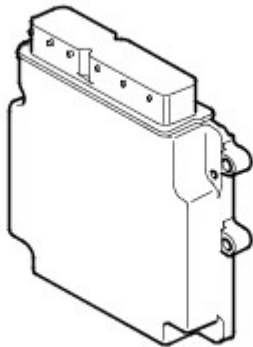
3	-	IMT valve
4	-	ABS control module
5	-	Instrument cluster
6	-	transmission control module (TCM)
7	-	restraints control module (RCM)
8	-	Differential control module
9	-	Transfer box control module
10	-	Electric park brake control module
11	-	automatic temperature control (ATC) module
12	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO) and Heated Exhaust Gas Oxygen sensor (HEGO)
13	-	Ignition coils
14	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO) and Heated Exhaust Gas Oxygen sensor (HEGO)
15	-	Generator
16	-	ECM
17	-	EGR valve/differential pressure sensor
18	-	Clock spring
19	-	Speed control switches
20	-	Electric throttle body

GENERAL

The V6 4.0 Liter engine is controlled by an ECM manufactured by DENSO. The Engine Management System (EMS) controls the following:

- Engine fueling
- Ignition timing
- Closed loop fueling
- Knock control
- Idle speed control
- Emission control
- On board diagnostic
- Interface with the immobilization system
- Speed control

ENGINE CONTROL MODULE (ECM)



E42610

The ECM is located in the E-Box in the plenum area on the passenger side of the engine compartment attached to the bulkhead.

Inputs

The ECM has the following inputs:

- Central Junction Box
- Engine Coolant Temperature
- Brake Switch
- Manifold Absolute Pressure
- Accelerator Pedal Position 1
- Accelerator Pedal Position 2
- Throttle Position 1
- Throttle Position 2
- Engine cooling fan Speed
- Engine speed and position sensor (crankshaft sensor)
- Camshaft position sensor
- Engine Oil Temperature
- IAT sensor (integrated into MAF)
- MAF
- Knock sensors (2)
- Speed Control Switches (resistive ladders)
- Oxygen sensors (4)
- Vehicle Speed (via CAN)
- EGR Differential Pressure

- EGRMAP
- Generator Monitor

Outputs

The ECM outputs to the following:

- Throttle Actuator
- Ignition coils (6)
- Oxygen sensor heaters (4)
- Fuel injectors (6)
- EGR Valve
- IMT valve
- Purge Valve
- Fuel pump relay
- Starter Relay
- Air conditioning condenser fan module (CAN)
- EMS Main Relay
- Viscous Fan Control
- Generator Control

The ECM controls the engine fueling by providing sequential fuel injection to all cylinders. Ignition is controlled by a direct ignition system, provided by six plug top coils. The ECM is able to detect and correct for ignition knock on each cylinder and adjust the ignition timing for each cylinder to achieve optimum performance.

The ECM uses a torque-based strategy to generate the torque required by the driver and other vehicle ECU's. The EMS uses various sensors to determine the torque required from the engine. These include:

- Mass Air Flow meter
- Accelerator Pedal Position sensor
- Engine temperatures
- Oxygen sensors

The EMS processes these signals and decides how much torque to generate. Torque is then generated by using various actuators to supply air, fuel and spark to the engine (electronic throttle, injectors, coils, etc.)The EMS also interfaces with other vehicle ECU's, via CAN, to obtain additional information, these include

- ABS control module
- TCM
- Transfer box control module

Pin No	Description	Input/Output
1	CAN	Input/Output
2	CAN	Input/Output
3	Generator monitor	Input
4	UHEGO Bank A ground	-
5	UHEGO Bank B ground	-
6	Crank sensor -	Input
7	Cam sensor ground	-
8	Not used	-
9	Not used	-
10	Sensor ground 3	-
11	Sensor ground 4	-
12	Sensor ground 5	-
13	Not used	-
14	Spare ground	-
15	Sensor ground 6	-
16	Not used	-
17	Not used	-
18	MAF ground	-
19	Knock sensor bank A ground	-
20	Knock sensor bank B ground	-
21	Not used	-
22	Not used	-
23	Oil temperature sensor	Input
24	Sensor power 6	Output
25	LIN A	Output
26	UHEGO B +	Input
27	UHEGO B -	-
28	UHEGO A +	+
29	UHEGO A -	-
30	Crank sensor +	Input
31	Not used	-
32	Not used	-
33	Not used	-
34	CMP signal bank A	Input
35	Not used	-
36	Not used	-
37	Not used	-
38	Differential pressure sensor	Input
39	Not used	-

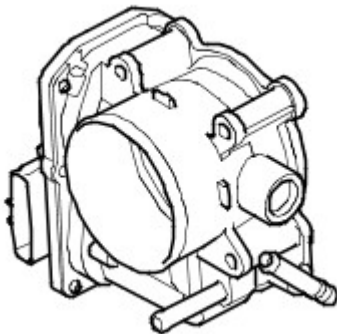
Pin No	Description	Input/Output
40	Fuel pressure sensor	Input
41	Not used	-
42	Knock sensor A +	Input
43	Knock sensor B +	Input
44	Not used	-
45	Not used	-
46	Fuel temperature sensor	Input
47	Sensor power 5	Output
48	Sensor power 4	Output
49	Not used	-
50	Not used	-
51	Not used	-
52	Not used	-
53	Not used	-
54	Not used	-
55	Not used	-
56	Ignition coil cylinder 3 B	Output
57	Ignition coil cylinder 3 A	Output
58	Ignition coil cylinder 2 B	Output
59	Ignition coil cylinder 2 A	Output
60	Ignition coil cylinder 1 B	Output
61	Ignition coil cylinder 1 A	Output
62	Ignition coil ground bank A	-
63	Viscous fan monitor	Input
64	Ignition coil ground bank B	-
65	Throttle position sensor 1	-I
66	Air temperature sensor	Input
67	Throttle position sensor 2	Input
68	Coolant temperature sensor	Input
69	MAP	Input
70	MAF	Input
71	Not used	-
72	Sensor power 3	Output
73	Not used	-
74	Throttle valve open direction -	Output
75	Throttle valve open direction +	Output
76	UHEGO Heater bank A	Output
77	UHEGO Heater bank B	Output
78	Injector cylinder 1 B	Output
79	Injector cylinder 1 B	Output
80	Injector cylinder 2 A	Output
81	Injector cylinder 2 B	Output
82	Injector cylinder 3 A	Output
83	Injector cylinder 3 B	Output
84	Inlet manifold tuning valve 1	Output
85	Not used	-
86	Not used	Output
87	Not used	Output
88	Not used	Output
89	Not used	-
90	EGR	Input
91	Not used	-
92	Purge valve	Output
93	Viscous fan request	Output
94	Not used	-
95	Fuel pump relay	Output
96	Alternator control	Output

ECM Connector C0635 Pin Out Table

Pin No	Description	Input/Output
1	Signal ground 1	-
2	Power ground 1	-
3	Power ground 2	-
4	ECM power	Input
5	Power ground 3	-
6	APP sensor ground 1	-
7	APP sensor ground 2	-
8	Not used	-
9	Not used	-
10	Not used	-
11	Not used	-
12	Park/Neutral signal	Input
13	Not used	-
14	Not used	-
15	Not used	-
16	EMS relay	Output

Pin No	Description	Input/Output
17	Crank request	Output
18	CAN +	Output
19	APP sensor 2 power	Output
20	Fuel pump control	Output
21	Not used	-
22	Not used	-
23	Not used	-
24	APP sensor 1 signal	Output
25		
26	Brake light switch	Input
27	Not used	-
28	Not used	-
29	Not used	-
30	Ignition switch	Input
31	CAN +	Input
32	APP sensor 1 power	Output
33	DMTL	Output
34	Not used	-
35	Speed switch -	Output

ELECTRONIC THROTTLE



E42611

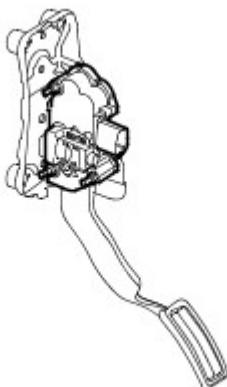
The V6 engine torque is regulated via an electronic throttle body which is located on the intake manifold in the engine compartment. An APP determines the driver demand to control throttle opening. This value is input into the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body. Sensors in the throttle body are used to determine the position of the throttle plate and the rate of change in its angle. A software strategy within the ECM enables the throttle position to be calibrated each ignition cycle. When the ignition is turned 'ON', the ECM opens and closes the throttle fully, thus performing a self-diagnostic and calibration. The throttle body is connected to the ECM via a pair of twisted wires to avoid electrical interference.

For additional information, refer to: [Acceleration Control](#) (310-02B Acceleration Control - V6 4.0L Petrol, Description and Operation).

C0175 Electronic Throttle Pin Out Table

Pin No	Description	Input/Output
1	Signal 1	Output
2	5 volt supply	Input
3	Signal 2	Output
4	Ground	-
5	Actuator +	Input
6	Actuator -	-

ACCELERATOR PEDAL POSITION SENSOR (APP)



E42612

The APP is used in conjunction with the electronic throttle body to provide a drive-by-wire system. The sensor is a resistive

type. Sensors in the accelerator pedal are used to determine the driver's request for vehicle speed, acceleration and deceleration. This value is input into the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body.

The APP sensor signals are checked for range, and for plausibility. Two separate reference voltages are supplied to the pedal. If one sensor fails, the other can be used as a 'limp – home' input.

The wires that connect the ground and signal from both potentiometers to the EMS are twisted together into two pairs, avoiding having to use a screen wire.

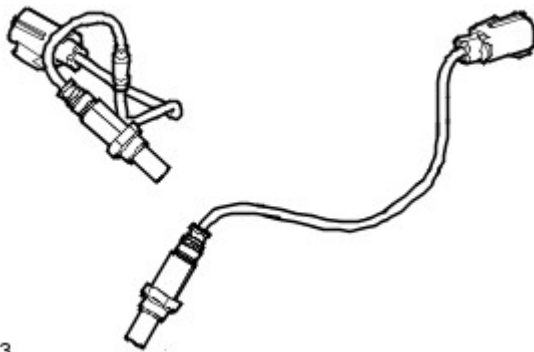
If signal failure occurs, the ECM enters limp home mode. The APP Sensor is located at the accelerator pedal .

C0787 APP Sensor Connector Pin Out Table

Pin No	Description	Input/Output
1	Sensor 2 ground	-
2	Sensor 1 demand	Output
3	Sensor 1 ground	-
4	Not used	-
5	Sensor 2 demand	Output
6	Supply 2 5 volt	Input
7	Supply 1 5 volt	Input
8	Not used	-

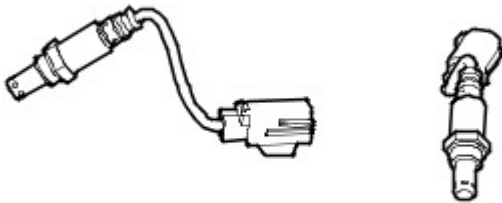
OXYGEN SENSORS

Oxygen Sensor-Upstream



E42613

Oxygen Sensor-Downstream



E42614

There are four oxygen sensors located in the exhaust system. Two upstream (UHEGO) before the catalytic converter and two down stream (HEGO) after the catalytic converter. The sensors monitor the level of oxygen in the exhaust gases and is used to control the fuel/air mixture. Positioning a sensor in the stream of exhaust gasses from each bank enables the ECM to control the fueling on each bank independently of the other, allowing much closer control of the air/fuel ratio and catalyst conversion efficiency.

The Oxygen Sensor needs to operate at high temperatures in order to function correctly. To achieve the high temperatures required, the sensors are fitted with heater elements that are controlled by a pulse width modulation (PWM) signal from the ECM. The heater elements are operated immediately following engine start and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperatures. A non-functioning heater delays the sensor's readiness for closed loop control and influences emissions. The PWM duty cycle is carefully controlled to prevent thermal shock to cold sensors.

UHEGO (Universal Heated Exhaust Gas Oxygen) sensors also known as Linear or "Wide Band" sensors produces a constant voltage, with a variable current that is proportional to the oxygen content. This allows closed loop fueling control to a target lambda, i.e. during engine warm up (after the sensor has reached operating temperature and is ready for operation). This improves emission control.

The HEGO sensor uses Zirconium technology that produces an output voltage dependant upon the ratio of exhaust gas

oxygen to the ambient oxygen. The device contains a Galvanic cell surrounded by a gas permeable ceramic, the voltage of which depends upon the level of O₂ diffusing through. Nominal output voltage of the device for $I = 1$ is 300 to 500m volts. As the fuel mixture becomes richer ($I < 1$) the voltage tends towards 900m volts and as it becomes leaner ($I > 1$) the voltage tends towards 0 volts. Maximum tip temperature is 1,000 Degrees Celsius for a maximum of 100 hours.

Sensors age with mileage, increasing their response time to switch from rich to lean and lean to rich. This increase in response time influences the ECM closed loop control and leads to progressively increased emissions. Measuring the period of rich to lean and lean to rich switching monitors the response rate of the upstream sensors.

Diagnosis of electrical faults is continually monitored in both the upstream and downstream sensors. This is achieved by checking the signal against maximum and minimum threshold, for open and short circuit conditions.

Oxygen sensors must be treated with the utmost care before and during the fitting process. The sensors have ceramic material within them that can easily crack if dropped/banged or over-torqued. The sensors must be torqued to the required figure, (40-50Nm), with a calibrated torque wrench. Care should be taken not to contaminate the sensor tip when anti-seize compound is used on the thread.

Failure Modes

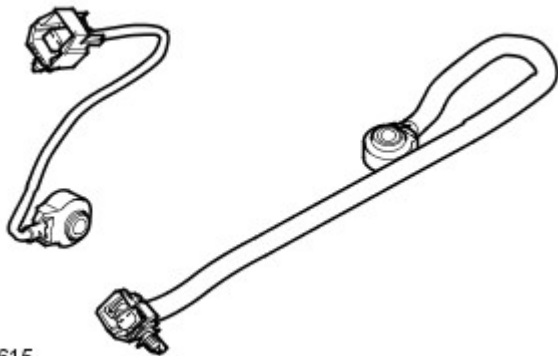
- Mechanical fitting & integrity of the sensor.
- Sensor open circuit/disconnected.
- Short circuit to vehicle supply or ground.
- Lambda ratio outside operating band.
- Crossed sensors Bank A & B.
- Contamination from leaded fuel or other sources.
- Change in sensor characteristic.
- Harness damage.
- Air leak into exhaust system.

Failure Symptoms

- Default to Open Loop fueling for the particular cylinder bank
- High CO reading.
- Strong smell of H₂S (rotten eggs) till default condition.
- Excess emissions.

It is possible to fit front and rear sensors in their opposite location. However the harness connections are of different gender and color to ensure that the sensors cannot be incorrectly connected. In addition to this the upstream sensors have two holes in the sensor tip, whereas the down stream sensors have four holes in the sensor tip for the gas to pass through.

KNOCK SENSORS



The ECM uses active knock control, which serves to prevent engine damaging pre-ignition or detonation under all operating conditions enabling the engine to operate without additional safety margins. For the ECM to be able to determine the point at which a cylinder is pre-detonating, 2 piezo-ceramic sensors are mounted on the engine block. Each sensor monitors engine knock by converting the engine block noise into a suitable electrical signal, which is then transmitted back to the ECM via a twisted pair cable. The signal is then processed within the ECM to identify the data that characterizes knocking.

This information is compared to known signal profiles to determine whether knock is present. If so, the closed loop control system then retards the ignition on that cylinder, for a number of cycles, after which it gradually moves back towards its original setting.

Failure Symptoms

The following describes the failure symptoms of the knock sensors:

- Knock control disabled and a default "safe ignition map" are used.
- Possible rough running and reduced engine performance.

One sensor is located in the center of the engine valley and the other is located on the front RH side of the cylinder block.

CRANKSHAFT SPEED AND POSITION SENSOR



E42616

The CKP is located on the top of the transmission bell housing just to the left of the center line with the sensor tip adjacent to the flywheel rim. The sensor is a variable reluctance type with a resistance of 1100 Ohms +/- 150 Ohms.

The sensor produces the signal which enables the ECM to determine the angle of the crankshaft, and the engine RPM. From this, the point of ignition, fuel injection, etc. is calculated. If the signal wires are reversed a 3° advance in timing will occur, as the ECM uses the falling edge of the signal waveform as its reference/timing point for each tooth.

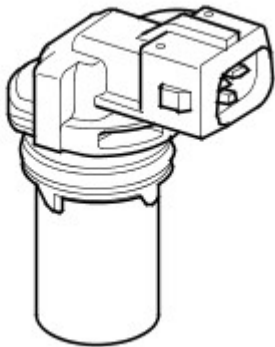
The sensor picks up its signal from a reluctor ring machined into the diameter of the drive plate. The reluctor ring has 36 teeth at 10° intervals and 3° wide. One of the teeth is removed to provide a reference mark which is 60 degrees BTDC No.1 cylinder.

The sensor operates by generating an output voltage caused by the change in magnetic field that occurs as the teeth pass in front of the sensor. The output voltage varies with the speed of the teeth passing the sensor. The higher the engine speed, the higher the output voltage.

The ECM transmits the engine speed over the CAN bus.

If the CKP sensor fails while the engine is running the engine will stall, misfire or run poorly and a relevant fault code will be stored. If the engine is not running when a fault occurs then the engine will not start.

CMP SENSOR

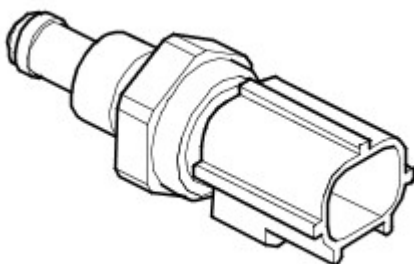


E42617

The CMP is a variable reluctance type sensor located at the front of the engine in the valve cover above number 4 cylinder.

The CMP sensor produces one pulse for every two engine revolutions. The sensor picks up on a reluctor on the LH camshaft.

ECT SENSOR



E42618

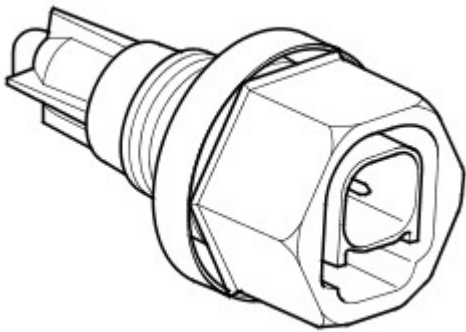
The ECT sensor is a negative temperature coefficient (NTC) type sensor. As coolant temperature rises the resistance of the

sensor falls.

The sensor is located at the front of the engine behind and below the throttle body.

Should the sensor fail the ECM use the oil temperature sensor signal as a backup coolant temperature signal.

ENGINE OIL TEMPERATURE SENSOR

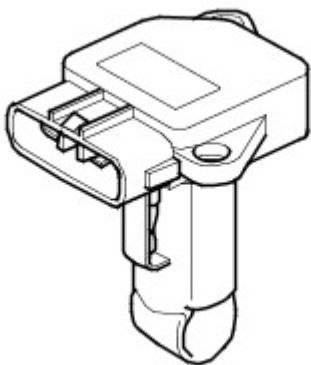


E42632

Oil temperature is monitored through a sensor mounted in the engine sump.

The sensor operates in the range -40 TO 150 degrees Celsius.

MAF/IAT) SENSOR



E42634

The MAF and IAT sensor is located in the air duct between the air filter and throttle body.

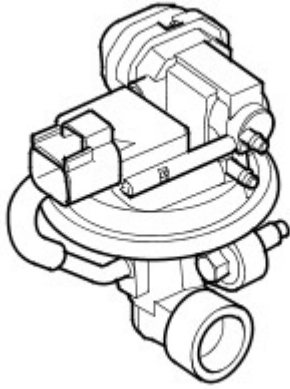
The air mass flow is determined by the cooling effect of inlet air passing over a "hot film" element contained within the device. The higher the air flow the greater the cooling effect and the lower the electrical resistance of the element. The signal from the device is then calculated by the ECM to determine the mass air flow into the engine.

The measured air mass flow is used in determining the fuel quantity to be injected in order to maintain the stoichiometric air/fuel mixture required for correct operation of the engine and exhaust catalysts. Should the device fail there is a software backup strategy that will be evoked once a fault has been diagnosed.

The IAT sensor is integrated into the Mass Air Flow meter. It is a temperature dependent resistor (thermistor), i.e. the resistance of the sensor varies with temperature. This thermistor is a NTC type element meaning that the sensor resistance decreases as the sensor temperature increases. The sensor forms part of a voltage divider chain with an additional resistor in the ECM. The voltage from this network changes as the sensor resistance changes, thus relating the air temperature to the voltage measured by the ECM.

The fixed default value for air temperature is 35°C

MAP SENSOR



E48511

The MAP sensor provides a voltage proportional to the absolute pressure in the intake manifold.

This signal allows the load on the engine to be calculated and used within the internal calculations of the ECM.

The sensor is located in the EGR valve at the front LH side of the engine.

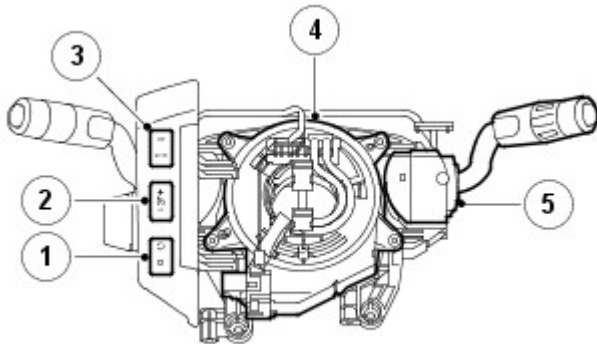
DIFFERENTIAL PRESSURE FEEDBACK-ELECTRONIC/MANIFOLD ABSOLUTE PRESSURE SENSOR (DPFE/MAP)

This pressure transducer monitors the pressure differential on either side of an orifice in the EGR system flow path and transmits that information to the ECM. The pressure drop measured across this orifice is used to estimate the flow rate of recirculated exhaust gas. An Electronic Vacuum Regulator (EVR) is used to control the vacuum signal to the EGR valve based on the electrical signal from the ECM. The ECM monitors the EGR level based on the feedback from the DPFE/MAP transducer, which creates a closed loop system.

EXHAUST GAS RECIRCULATION VALVE (EGR)

The EGR Valve is a PWM controlled valve that allows burned exhaust gas to be recirculated back into the engine. Since exhaust gas has much less oxygen than air, it is basically inert. It takes the place of air in the cylinder and reduces combustion temperature. As the combustion temperature is reduced, so are the oxides of nitrogen (NOx) emissions.

SPEED CONTROL



E47030

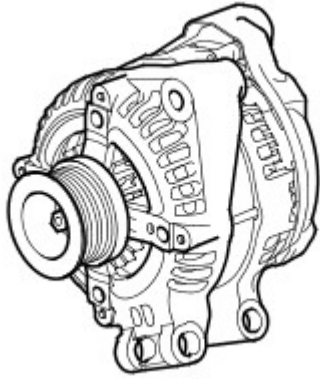
Item	Part Number	Description
1	-	Suspend/resume switch
2	-	Resume/Accelerate/Decelerate (+/-) Switches
3	-	Active speed control time gap switches (for future release)
4	-	Clock spring
5	-	Wiper control column switch

The V6 ECM incorporates a speed control function. The EMS uses a set of resistive ladders to interface with the driver speed control requirements. The speed control is operated from the steering wheel mounted switches. There are three illuminated rocker switches on a resistive ladder.

For additional information, refer to: [Speed Control](#) (310-03C Speed Control - V6 4.0L Petrol, Description and Operation).

The speed control does not have a master switch, it is enabled by pressing the set switch.

GENERATOR



E47591

The Generator has a multi function voltage regulator for use in a 14V charging system with 6÷12 zener diode bridge rectifiers.

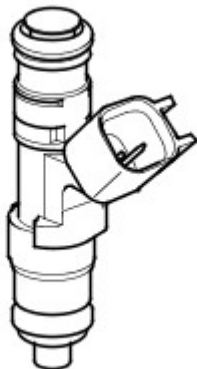
The ECM monitors the load on the electrical system via PWM signal and adjusts the generator output to match the required load. The ECM also monitors the battery temperature to determine the generator regulator set point. This characteristic is necessary to protect the battery; at low temperatures battery charge acceptance is very poor so the voltage needs to be high to maximize any recharge ability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing of the battery with consequent water loss.

For additional information, refer to: Generator (414-02A Generator and Regulator - 4.0L, Description and Operation).

The Generator has a smart charge capability that will reduce the electrical load on the Generator reducing torque requirements, this is implemented to utilize the engine torque for other purposes. This is achieved by monitoring three signals to the ECM:

- Generator sense (A sense), measures the battery voltage at the central junction box (CJB).
- Generator communication (Alt Com) communicates desired Generator voltage set point from ECM to Generator.
- Generator monitor (Alt Mon) communicates the extent of Generator current draw to ECM. This signal also transmits faults to the ECM which will then sends a message to the instrument pack on the CAN bus to illuminate the charge warning lamp.

FUEL INJECTORS



E42640

The ECM controls six fuel injectors located on the cylinder head. The injectors are fed from a common fuel rail as part of a 'returnless' fuel system.

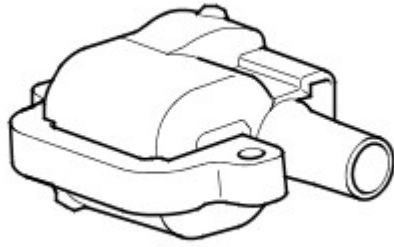
Fuel rail pressure is constant at 4.5 bar (59 psi) and is regulated by a regulator that is integral to the fuel pump module. The ECM monitors the output power stages of the injector drivers for electrical faults. The injector has a default resistance of 14.5 Ohms at 20 Degrees Celsius.

For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - 4.0L, Description and Operation).

SPARK PLUGS

It is essential that only factory-approved spark plugs be used in service. DO NOT attempt to use 'equivalent' spark plugs. Use of unapproved spark plugs may cause the misfire detection system to malfunction, and the ECM to store misfire faults.

IGNITION COILS



E42644

The Land Rover V6 engine is fitted with ignition coils that are driven directly by the ECM. The coils are mounted on top of the inlet manifold and are connected to the spark plugs by High Tension (HT) leads. The positive supply to the coil is fed from fuse 19 in the battery junction box (BJB). Each coil contains a power stage to trigger the primary current. The ECM sends a signal to each of the coils power stage to trigger the power stage switching. Each bank has a feedback signal that is connected to each power stage. If the coil power stage fails the feedback signal is not sent, causing the ECM to store a fault code.

FUEL PUMP RELAY

The V6 engine has a return less fuel system. The system pressure is maintained at a constant 4.5 bar , with no reference to intake manifold pressure. The fuel is supplied to the injectors from a fuel pump located within the fuel tank. The electrical supply to this fuel pump is controlled by the ECM via the fuel pump relay, in the event of a vehicle impact the ECM will receive a crash signal from the restraints control module and will cut the power supply to the fuel pump relay. The fuel system is pressurized as soon as the ECM is powered up, the pump is then switched off until engine start has been achieved.

The fuel pump relay is located in the CJB. The Fuel pump is contained within the fuel tank.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01C Fuel Tank and Lines - V6 4.0L Petrol, Description and Operation).

VISCOUS FAN CONTROL

The ECM controls an electronically controlled viscous coupled fan to provide engine cooling. The ECM supplies the fan with a PWM signal that controls the amount of slippage of the fan, thus providing the correct amount of cooling fan speed and airflow. The EMS uses a Hall Effect sensor to determine the fan speed.

STARTER RELAY

The starter relay is supplied with power from fuseable link 19 in the Battery Junction Box.

The ECM controls the starter relay by supplying a 12 volt signal to the relay coil when the ignition is in crank position. This relies on the transmission gear position being either P or N.

CONDENSER FAN CONTROL

The ECM receives CAN messages from the ATC control module for idle speed adjustment and for cooling fan.

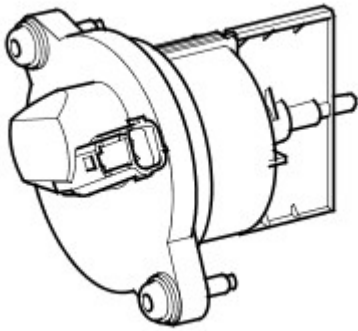
AirConCoolingRequest

This signal defines the level of cooling (from engine cooling fan(s)) required by the ATC system. Calibration within the EMS determines the fan speed required, and which fans will be used, at each requested level.

AirConIdleSpeedRequest

This signal defines whether or not an increase in the engine idle speed is required by the ATC system. The amount of idle speed increase is defined in the EMS calibration.

IMT valve



E42646

The IMT valve moves a plate within the inlet manifold to allow or block sonic pulses between the split manifold halves. This, in effect, extends the inlet tracts for better low rpm torque. The IMT valve is a two position valve and is either fully open or fully closed.

For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

ECM ADAPTIONS

The ECM has the ability to adapt the values it uses to control certain outputs. This capability ensures the EMS can meet emissions legislation and improve the refinement of the engine throughout its operating range.

The components which have adaptions associated with them are:

- The APP sensor
- The HO2S
- The MAF/IAT sensor
- The CKP sensor
- Electric throttle body.

UHEGO/HEGO and MAF/IAT Sensor

There are several adaptive maps associated with the fueling strategy. Within the fueling strategy the ECM calculates short-term adaptions and long term adaptions. The ECM will monitor the deterioration of the HO2S over a period of time. It will also monitor the current correction associated with the sensors.

The ECM will store a fault code in circumstances where an adaption is forced to exceed its operating parameters. At the same time, the ECM will record the engine speed, engine load and intake air temperature.

CKP Sensor

The characteristics of the signal supplied by the CKP sensor are learned by the ECM. This enables the ECM to set an adaption and support the engine misfire detection function. Due to the small variation between different flywheels and different CKP sensors, the adaption must be reset if either component is renewed, or removed and refitted. It is also necessary to reset the flywheel adaption if the ECM is renewed or replaced. The ECM supports four flywheel adaptions for the CKP sensor. Each adaption relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

Adaptions	Engine Speed, rev/min
1	1800 - 3000
2	3001 - 3800
3	3801 - 4600
4	4601 - 5400

Misfire Detection

Legislation requires that the ECM must be able to detect the presence of an engine misfire. It must be able to detect misfires at two separate levels. The first level is a misfire that could lead to the vehicle emissions exceeding 1.5 times the Federal Test Procedure (FTP) requirements for the engine. The second level is a misfire that may cause catalyst damage.

The ECM monitors the number of misfire occurrences within two engine speed ranges. If the ECM detects more than a predetermined number of misfire occurrences within either of these two ranges, over two consecutive journeys, the ECM will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, the ECM monitors the number of misfire occurrences that happen in a 'window' of 200 engine revolutions. The misfire occurrences are assigned a weighting according to their likely impact on the catalysts. If the number of misfires exceeds a certain value, the ECM stores catalyst-damaging fault codes, along with the engine speed, engine load and engine coolant temperature.

The signal from the crankshaft position sensor indicates how fast the poles on the flywheel are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The ECM can detect variations in flywheel speed by monitoring the sine wave signal supplied by the crankshaft position sensor.

By assessing this signal, the ECM can detect the presence of an engine misfire. At this time, the ECM will assess the amount of variation in the signal received from the crankshaft position sensor and assigns a roughness value to it. This roughness value can be viewed within the real time monitoring feature, using T4. The ECM will evaluate the signal against a number of factors and will decide whether to count the occurrence or ignore it. The ECM can assign a roughness and misfire signal for each cylinder, (i.e. identify which cylinder is misfiring).

T4 Diagnostics

The ECM stores faults as diagnostic trouble code (DTC), referred to as 'P' codes. The 'P' codes are defined by on-board diagnostic (OBD) legislation and, together with their associated environmental and freeze frame data, can be read using a third party scan tool or T4. T4 can also read real time data from each sensor, the adaptive values currently being employed and the current fueling, ignition and idle settings.

P Code No	Component/Signal	Fault Description
P0011	CMP/CKP/VVT	Bank A CMP/CKP Position error high , VVT retard position high
P0012	CMP/CKP/VVT	Bank A CMP/CKP Position error low, VVT retard position low
P0021	CMP/CKP/VVT	Bank B CMP/CKP Position error, VVT retard position high
P0022	CMP/CKP/VVT	Bank B CMP/CKP Position error low , VVT retard position low
P0026	VVT	Bank A circuit malfunction range high/low
P0028	VVT	Bank B circuit malfunction range high/low
P0031	UHEGO	Bank A heater control circuit low
P0032	UHEGO	Bank A heater control circuit high
P0051	UHEGO	Bank B heater control circuit low
P0052	UHEGO	Bank B heater control circuit high
P0069	HAC	Sensor circuit/range performance
P0071	Ambient air temperature sensor	Range performance
P0072	Ambient air temperature sensor	Circuit low input
P0073	Ambient air temperature sensor	Circuit high input
P0075	VVT	Bank A open circuit
P0076	VVT	Bank A short to ground
P0077	VVT	Bank A short to battery
P0081	VVT	Bank B open circuit
P0082	VVT	Bank B short to ground
P0083	VVT	Bank B short to battery
P0087	Fuel pressure system	Low fault
P0088	Fuel pressure system	High fault
P0089	Fuel pressure system	Noise fault
P0093	Fuel pressure system	Large leak
P0096	IAT	Sensor range performance
P0101	AFM	Circuit range performance
P102	AFM	Circuit low input
P103	AFM	Circuit high input
P0106	MAP	Sensor range performance
P0107	MAP	Circuit low input
P0108	MAP	Circuit high input
P0111	IAT	Stuck high/low at engine start, stuck high
P0112	IAT	Sensor 1 circuit low input
P0113	IAT	Sensor 1 circuit high input
P0116	ECT	Implausible signal
P0117	ECT	Circuit low input
P0118	ECT	Circuit high input
P0121	Throttle circuit 1 and 2	Range/performance
P0122	Throttle circuit 1	Low input
P0123	Throttle circuit 1	High input
P0125	ECT	Insufficient coolant temperature for closed loop control
P0128	Thermostat monitor	Low coolant temperature – thermostat stuck open
P0131	UHEGO	Bank A short circuit to ground
P0132	UHEGO	Bank A Short circuit to battery
P0133	UHEGO	Bank A slow response
P0136	HEGO	Bank A adaptations
P0137	HEGO	Bank A short circuit to ground
P0138	HEGO	Bank A short circuit to battery
P0139	HEGO	Bank A slow response
P0140	HEGO	Bank A no activity
P0141	HEGO	Bank A heater control circuit malfunction
P0150-1A	HEGO	Bank A element impedance low
P0151	UHEGO	Bank B short circuit to ground
P0152	UHEGO	Bank B short circuit to battery
P0153	UHEGO	Bank B slow response
P0154-00	UHEGO	Bank B slow activation
P0156	HEGO	Bank B adaptations
P0157	HEGO	Bank B short circuit to ground
P0158	HEGO	Bank B short circuit to battery
P0159	HEGO	Bank B slow response
P0160	HEGO	Bank B no activity
P0161	HEGO	Bank B heater control circuit malfunction
P00171	lambda control	Bank A too lean
P0172	lambda control	Bank A too rich
P0174	lambda control	Bank B too lean
P0175	lambda control	Bank B too rich
P0181	Fuel rail temperature sensor	Temperature signal implausible
P0182	Fuel rail temperature sensor	Circuit low input
P0183	Fuel rail temperature sensor	Circuit high input

P Code No	Component/Signal	Fault Description
P0191	Fuel rail pressure sensor	Range/performance
P0192	Fuel Rail Pressure Sensor	Low Input
P0193	Fuel Rail Pressure Sensor	High Input
P0196	Oil temperature sensor	Range/performance
P0197	Oil temperature sensor	Low input
P0198	Oil temperature sensor	High input
P0201	Injector Circuit	Malfunction - Cylinder 1
P0202	Injector Circuit	Malfunction - Cylinder 2
P0203	Injector Circuit	Malfunction - Cylinder 3
P0204	Injector Circuit	Malfunction - Cylinder 4
P0205	Injector Circuit	Malfunction - Cylinder 5
P0206	Injector Circuit	Malfunction - Cylinder 6
P0207	Injector Circuit	Malfunction - Cylinder 7
P0208	Injector Circuit	Malfunction - Cylinder 8
P0222	APP sensor 2	Low input
P0223	APP sensor 2	High input
P0227	APP sensor 1	Low input
P0228	APP sensor 1	High input
P0229	APP sensor	Intermittent fault
P0297	Active speed control	Vehicle over speed condition
P0300	Misfire	Random/multiple cylinder misfire
P0301	Misfire	Cylinder 1
P0302	Misfire	Cylinder 2
P0303	Misfire	Cylinder 3
P0304	Misfire	Cylinder 4
P0305	Misfire	Cylinder 5
P0306	Misfire	Cylinder 6
P0307	Misfire	Cylinder 7
P0308	Misfire	Cylinder 8
P0313	Misfire	Misfire under low fuel condition
P0316	Misfire	Misfire detected in first 1000 revs
P0326	Knock sensor	Sensor 1 high/low performance error
P0327	Knock sensor	Bank A sensor low input fault
P0328	Knock sensor	Bank A high input fault
P0331	Knock sensor	Sensor 2 high/low performance error
P0332	Knock sensor	Bank B sensor low input fault
P0333	Knock sensor	Bank A high input fault
P0335	Crank sensor	Sensor circuit malfunction during crank/running
P0336	Crank sensor	Range/performance fault
P0340	Intake CMP sensor bank A	Fault during cranking/running
P0341	Intake CMP sensor bank A	Range/performance fault
P0345	Intake CMP sensor bank B	Fault during cranking/running
P0346	Intake CMP sensor bank B	Range/performance fault
P0351	Ignition coil	Circuit malfunction cylinder 1
P0352	Ignition coil	Circuit malfunction cylinder 2
P0353	Ignition coil	Circuit malfunction cylinder 3
P0354	Ignition coil	Circuit malfunction cylinder 4
P0355	Ignition coil	Circuit malfunction cylinder 5
P0356	Ignition coil	Circuit malfunction cylinder 6
P0357	Ignition coil	Circuit malfunction cylinder 7
P0358	Ignition coil	Circuit malfunction cylinder 8
P0365	Exhaust CMP sensor bank A	Fault during cranking/running
P0366	Exhaust CMP sensor bank A	Range/performance fault
P0390	Exhaust CMP sensor bank B	Fault during cranking/running
P0391	Exhaust CMP sensor bank B	Range/performance fault
P0401	EGR system	Insufficient flow detected
P0403	EGR system	Valve circuit high/low input
P0405	Differential pressure sensor	Short to ground
P0406	Differential pressure sensor	Short to battery
P0409	Differential pressure sensor	Range performance
P0420	Catalyst system bank A	Efficiency below threshold
P0430	Catalyst system bank	Efficiency below threshold
P0441	Purge valve	Range performance
P0442	DMTL	Medium leak detected
P0447	DMTL	Short to ground
P0448	DMTL	Short to battery
P0455	DMTL	Large leak detected
P0456	DMTL	Small leak detected
P0458	Purge valve	Short to ground
P0459	Purge valve	Short to battery
P0461	Fuel level sensor	Range/performance fault
P0480	Radiator fan module	Control circuit malfunction
P0493	Viscous fan	Speed Out of range
P0501	Vehicle speed	Range/performance malfunction
P0504	Brake switch	Circuit malfunction

P Code No	Component/Signal	Fault Description
P0506	Idle Control System	RPM Lower Than Expected
P0507	Idle Control System	RPM higher Than Expected
P0512	Crank request circuit	High/low input
P0513	Security key	Key invalid
P0532	Air conditioning refrigerant pressure sensor	Low input
P0533	Air conditioning refrigerant pressure sensor	High input
P0560	Battery back up	Malfunction
P0562	Sensor power supply	Low input
P0563	Sensor power supply	High input
P0566	Speed control cancel switch	ON fault
P0567	Speed control resume switch	ON fault
P0568	Speed control	Low/high input
P0569	Decelerate/set/inch switch	ON fault
P0570	Accelerate/set/inch switch	On fault
P0574	Speed control	Speed monitoring
P0576	Speed control	Low input
P0577	Speed control	High input
P0604	ECM self test	RAM error
P0605	ECM self test	ROM error
P0606	ECM self test	Processor error
P0616	Starter relay	Low input
P0617	Starter relay	High input
P0627	Primary fuel pump	no commands received
P0628	Fuel pump	Electrical low
P0629	Fuel pump	Electrical high
P0633	Security	No ID in ECM
P0634	ECM temperature	Internal temperature too high
P0646	Air conditioning clutch relay	Low input
P0647	Air conditioning clutch relay	High input
P0661	Manifold valve output drive 1	Open circuit or short circuit to ground
P0662	Manifold valve output drive 1	Short circuit to battery
P0664	Manifold valve output drive 2	Open circuit or short circuit to ground
P0665	Manifold valve output drive 2	Short circuit to battery
P0668	ECM temperature sensor	Short to ground
P0669	ECM temperature sensor	Short to battery
P0687	EMS control relay	Relay malfunction
P0831	Clutch switch circuit A	Low input
P0832	Clutch switch circuit A	High input
P0834	Clutch switch circuit B	Low input
P0835	Clutch switch circuit B	High input
P0851	Park/Neutral Switch	Input Circuit Low
P0852	Park/Neutral Switch	Input Circuit High
P1136	E Box fan	Fan malfunction
P1146	Generator command line	Low input/communication error
P1155	HEGO Heater bank A	
P1160	UHEGO Bank A	Slow activation
P1197	UHEGO Bank A	Slow activation/open shorted
P1198	UHEGO Bank B	Slow activation/open shorted
P1233	Secondary fuel pump	Output circuit open
P1234	Primary fuel pump	No commands received
P1236	Primary fuel pump	Pump not working when requested
P1244	Alternator command line	High input
P1260	Security limited start	Theft attempt
P1339	Secondary fuel pump	Driver circuit output low/high
P1367	Ignition coil bank A	
P1368	Ignition coil bank A	
P1452	DMTL	Reference current too low
P1453	DMTL	Reference current too high
P1482	DMTL heater control circuit	Low
P1483	DMTL heater control circuit	High
P1582	Flight recorder	Data stored
P1624	Security ID	ID transfer process failed
P1629	Generator	FR line failure
P1632	Generator	Charge system failure
P1646	UHEGO sensor bank A	Slow activation/control module open shorted
P1647	UHEGO sensor bank B	Slow activation/control module open shorted
P1670	E Box fan	Malfunction low
P1671	E Box fan	Malfunction high
P1697	Speed control	Shorter/Longer switch ON fault
P1700	Low gear ratio	plausibility check
P2066	Secondary fuel pump	Range check
P2070	Manifold valve output drive 1	Performance check stuck open/closed
P2071	Manifold valve output drive 2	Performance check stuck open/closed
P2101	Electric throttle	Range performance
P2103	Electric throttle	Throttle duty at 100% continuously

P Code No	Component/Signal	Fault Description
P2105	Electric throttle	malfunction indicator lamp (MIL) request dual fuel cut off
P2106	Intended reduced availability	Re-configuration failure
P2118	Electric throttle system	Over current detection by hardware
P2119	Electric throttle	Throttle stuck open
P2122	APP sensor	Circuit 2 low input
P2123	App sensor	Circuit 2 high input
P2228	HAC sensor	Circuit low
P2229	HAC sensor	Circuit high
P2299	Accelerator pedal	Brake override
P2401	DMTL Pump	Ground short
P2402	DMTL Pump	Battery short
P2404	DMTL Pump	Noise/reference leak fault
P2450	DMTL	COV stuck open
P2451	DMTL	COV stuck closed
P2503	Charging system	Voltage low
P2504	Charging system	Voltage high
P2601	Water pump	Performance fault
P2610	Engine off timer	Timer malfunction
P2632	Secondary fuel pump driver circuit	Output circuit open
P2633	Secondary fuel pump driver circuit	Output low
P2634	Secondary fuel pump driver circuit	High input
P6365	Primary fuel pump	Pump not working when requested
P2636	Secondary fuel pump	Low flow/performance

CENTRAL JUNCTION BOX

The Central Junction box is used to initiate the power up and power down routines within the ECM. When the ignition is turned on, 12V is applied to the Ignition Sense input to pin 30 of connector C0635. The ECM then starts its power up routines and turns on the ECM main relay.

When the ignition is turned OFF the ECM will maintain its powered up state for several seconds (this may be up to 20 minutes in extreme cases when cooling fans are required) while it initiates its power down routine and on completion will turn off the ECM main relay.

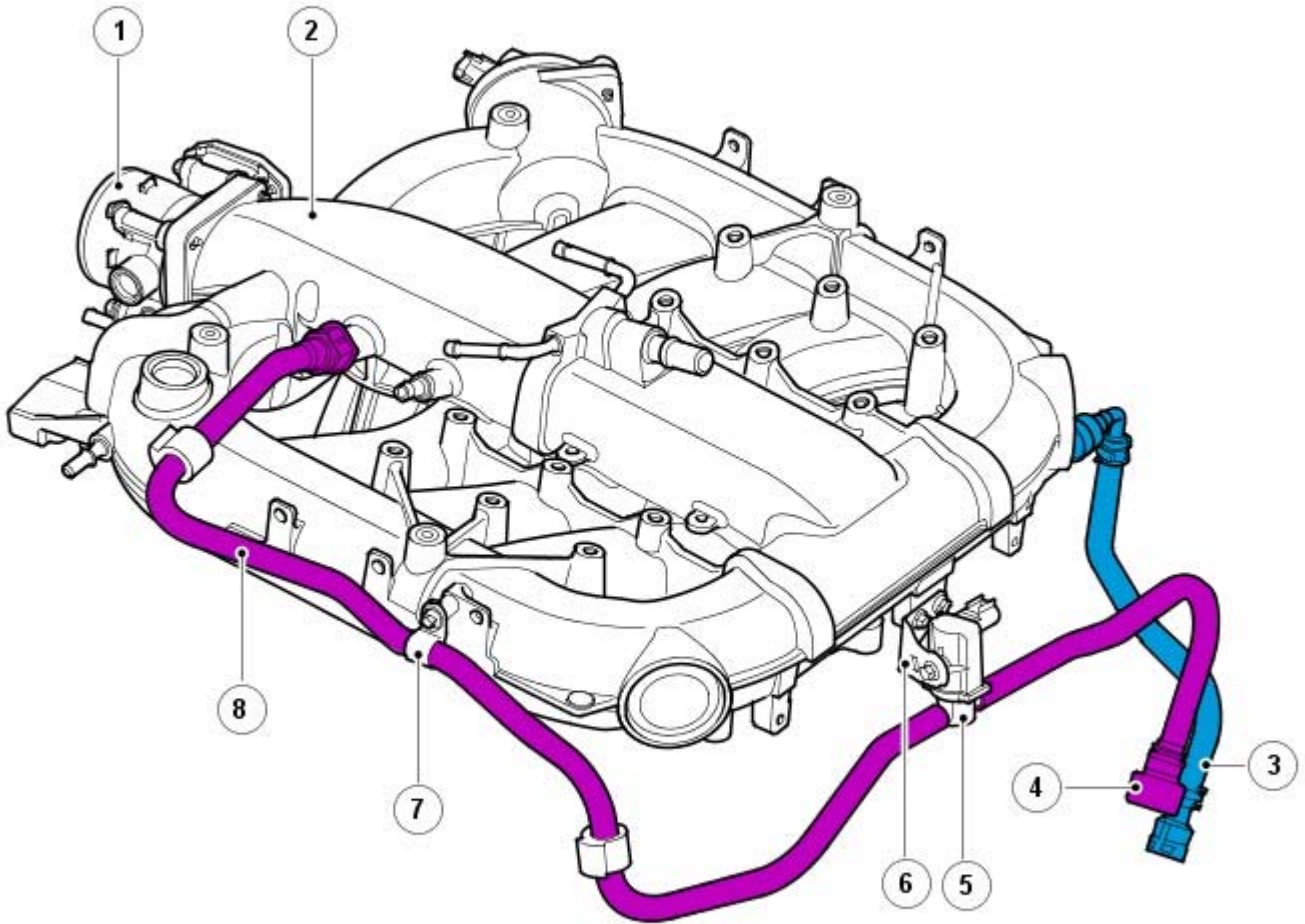
POWER SUPPLIES

The ECM requires a permanent battery level voltage supply and a switched battery level voltage supply. The switched voltage supply is controlled by the ECM via a relay based on the condition of the Central Junction Box input (key position 2).

At key "OFF", the ECM will maintain the switched supply active until internal self checks have been completed. The Main Supply fuse is located in the engine compartment fuse box.

PURGE VALVE

Purge Valve and Hoses



E44559

Item	Part Number	Description
1	-	Electric throttle
2	-	Air intake manifold
3	-	Fuel feed jump hose
4	-	Purge hose connector
5	-	Purge valve
6	-	Purge valve bracket
7	-	Hose clamp
8	-	Manifold to purge valve hose

To meet increasing legislation in fuel evaporative loss the Evaporative Emissions Loss Control System has been introduced to minimize the evaporative loss of fuel vapor from the fuel system to the atmosphere. This is achieved by venting the fuel system through a vapor trap (charcoal canister). The charcoal acts like a sponge and stores the vapor until the canister is purged under the control of the ECM.

The charcoal canister is connected with the inlet manifold, after the throttle body, via a purge valve. This valve is opened and closed according to a PWM signal from the ECM. The canister is purged by drawing clean air through the charcoal, which carries the hydrocarbons into the engine where they are burnt. To maintain drivability and emission control purging must be closely controlled as a 1% concentration of fuel vapor from the canister in the air intake may shift the air/fuel ratio by as much as 20%. Purging must be carried out at regular intervals, to regenerate the charcoal, as its storage capacity is limited, and is cycled with the Fueling Adaption, as both cannot be active at the same time.

The ECM alters the PWM signal to the purge valve to control the rate of purging of the canister. The purging of the canister is done in a controlled manner in order to maintain the correct Stoichiometric air/fuel mixture for the engine. It also ensures the canister itself is purged frequently enough to prevent fuel saturation of the charcoal leading to an excessive build up of fuel vapor (and hence vapor pressure) in the system which could increase the likelihood of vapor leaks. For additional information, refer to: [Evaporative Emissions](#) (303-13A Evaporative Emissions - V6 4.0L Petrol, Description and Operation).

Electronic Engine Controls - V6 4.0L Petrol - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Fuel leaks ● Accessory drive belt ● Sensor installation/condition ● Viscous fan and solenoid ● Air cleaner condition 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● 5 volt sensor supply ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot engine off, after engine has reached operating temperature	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to the relevant Diagnostic Trouble Code (DTC) Index (PCM) 4.0L V6 (100-00 General Information, Description and Operation).

Electronic Engine Controls - V6 4.0L Petrol - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.
2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

Position the DTI gauge on a suitable mounting block, as illustrated.



E135356

3. With the aid of another technician, gently press the brake pedal until the stoplamps illuminate.
4. NOTE: The specification is that the stoplamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

Note the measurement of the brake pedal travel from rest position until the stoplamps illuminated.

Adjust

1. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Remove the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Only use light finger pressure when installing the stoplamp switch. Failure to follow this instruction may result in an incorrectly adjusted stoplamp switch.


Install the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

3. Check the adjustment of the stoplamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Electronic Engine Controls - V6 4.0L Petrol - Engine Oil Pressure (EOP) Sensor

Removal and Installation

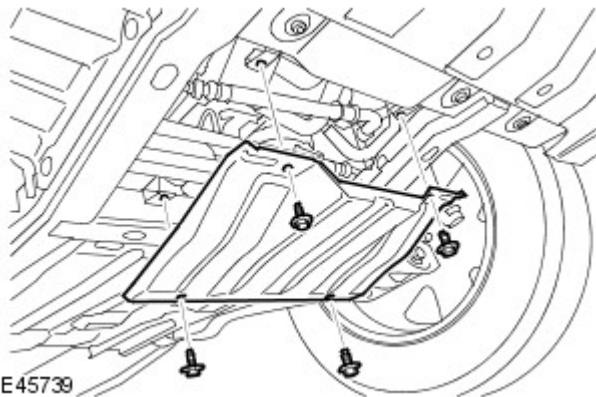
Removal

1. Raise and support the vehicle.
2.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Remove the radiator access panel.

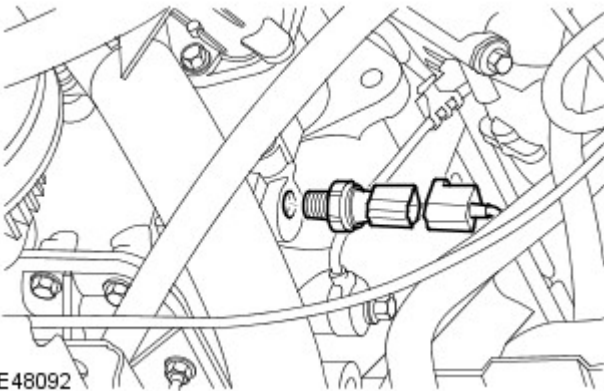
- Remove the 4 bolts.



E45739

4. Remove the EOP sensor.

- Disconnect the electrical connector.
- Position a container to collect the fluid.



E48092


Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the oil pressure sensor to 13 Nm (10 lb.ft).
2. Check and top-up the engine oil.

Electronic Engine Controls - V6 4.0L Petrol - Oil Temperature Sensor


Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the oil temperature sensor.

- Disconnect the electrical connector.
- Position a container to collect spillage.
- Remove and discard the O-ring seal.

Installation

1. **NOTE:** Lubricate new seals with clean engine oil.

Install the oil temperature sensor.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the oil temperature sensor to 20 Nm (15 lb.ft).
 - Connect the electrical connector.
2. Install the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Check and top-up the engine oil.

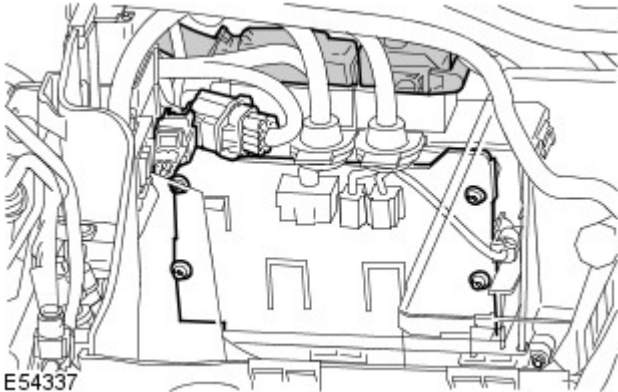
Electronic Engine Controls - V6 4.0L Petrol - Engine Control Module (ECM)

Removal and Installation

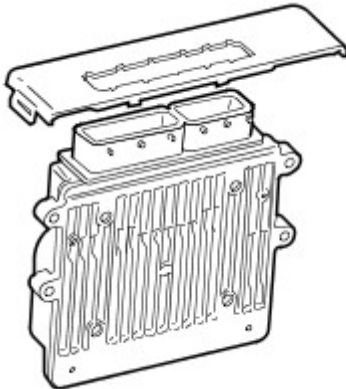
Removal

• **NOTE:** If the ECM is to be replaced, the T4 must be connected prior to battery disconnection and on-screen instructions must be followed.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
3. Remove the ECM cover.
 - Disconnect 2 electrical connectors for access.
 - Disconnect the 2 ECM electrical connectors.
 - Remove the 4 Torx screws.



4. Remove the ECM.
 - Remove the ECM top cover.



Installation

1. Install the ECM.
 - Install the ECM cover and secure with Torx screws.
 - Install the ECM upper cover.
2. Connect the ECM electrical connectors.
3. Connect the 2 electrical connectors disconnected for access.
4. Install the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
6. Connect T4 to calibrate a new ECM.

Electronic Engine Controls - V6 4.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the throttle body gasket.
For additional information, refer to: [Throttle Body Gasket](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).
3. Remove the ECT sensor.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the electrical connector.
- Remove and discard the O-ring seal.



Installation

1. To install, reverse the removal procedure.
 - Clean the components.
 - Tighten the ECT sensor to 18 Nm (13 lb.ft).
 - Top-up the coolant.


Electronic Engine Controls - V6 4.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal


- NOTE: The CKP sensor is located on the LH side of the torque converter housing.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

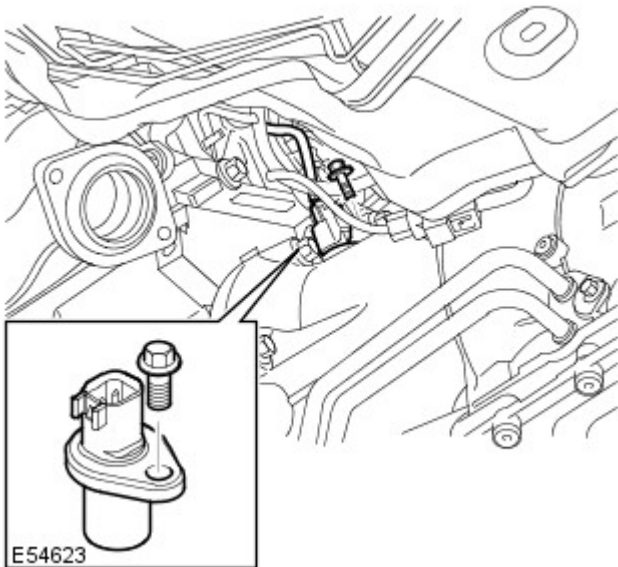
Raise and support the vehicle.

3. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

4.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the CKP sensor.

- Disconnect the electrical connector.
- Remove the bolt.



Installation

1. To install, reverse the removal procedure.

- Clean the component mating faces.
- Tighten the Torx screw to 8 Nm (6 lb.ft).

2. Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V6 4.0L Petrol - Throttle Position (TP) Sensor


Removal and Installation

Removal

- NOTE: The TP sensor is part of the throttle body and cannot be serviced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the air intake resonator.
For additional information, refer to: Resonator (303-12, Removal and Installation).
4. Disconnect the TP sensor electrical connector.



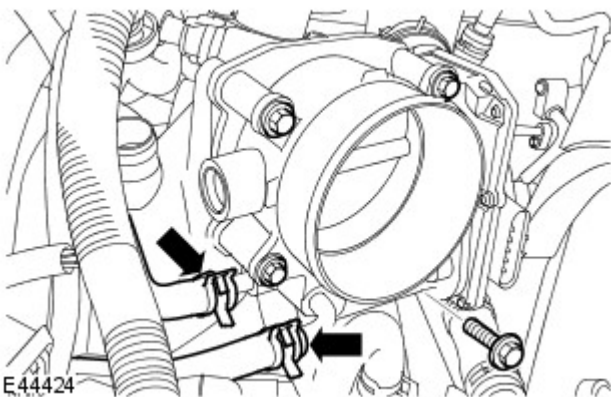
5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Disconnect the coolant hoses from the throttle body.

- Clamp the throttle body coolant hoses to minimize coolant loss.
- Release the throttle body hose clips

6. Remove the throttle body.

- Remove the 4 bolts.
- Remove and discard the throttle body gasket.



Installation

1. Install the throttle body.
 - Clean the component mating faces.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
2. Connect the coolant hoses to the throttle body.

- Secure the throttle body hoses clips.
 - Remove the hose clamps from the throttle body hoses.
3. Install the TP sensor electrical connector.
 4. Install the air intake resonator.
For additional information, refer to: Resonator (303-12, Removal and Installation).
 5. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 6. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 7. Check and top-up the coolant.
 8. Use T4 to re-calibrate a new TP sensor.

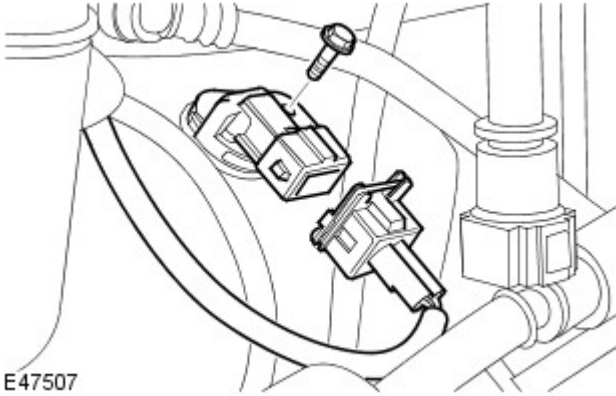
Electronic Engine Controls - V6 4.0L Petrol - Camshaft Position (CMP)

Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the CMP sensor.
 - Disconnect the electrical connector.
 - Remove the bolt.



Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 1. Lubricate a new O-ring seal with clean engine oil.
 - Tighten the bolt to 6 Nm (4 lb.ft)

Electronic Engine Controls - V6 4.0L Petrol - Knock Sensor (KS) LH

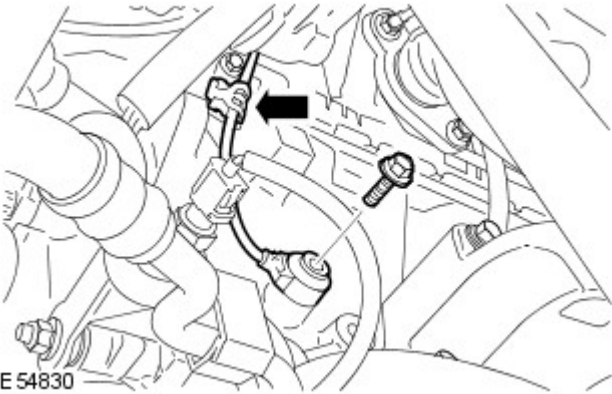
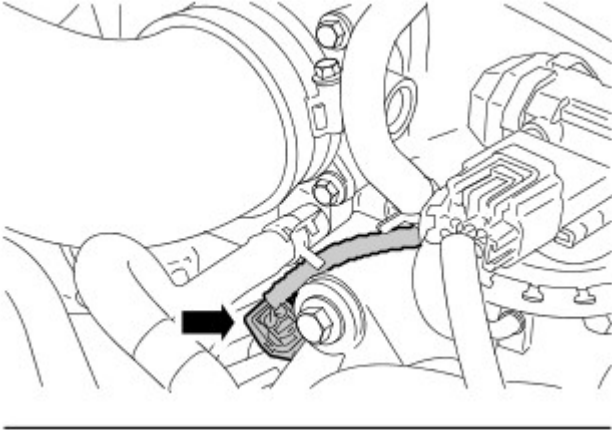
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the KS.

- Disconnect the electrical connector.
- Release the knock sensor electrical connector retaining clips.
- Remove the bolt.



Installation

1. To install, reverse the removal procedure.

- Clean the component mating faces.
- Tighten the bolt to 20 Nm (15 lb.ft).

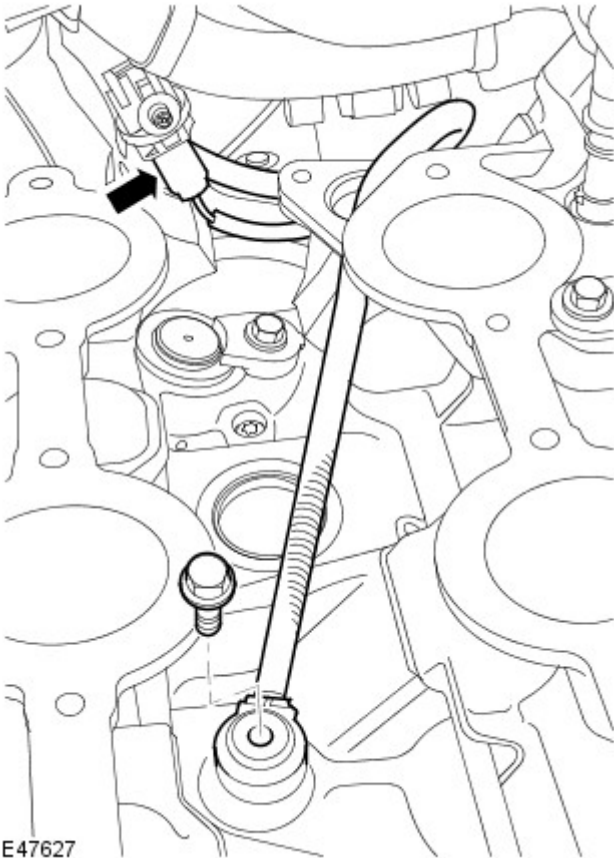
Electronic Engine Controls - V6 4.0L Petrol - Knock Sensor (KS) RH

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the KS.

- Disconnect the electrical connector.
- Release the RH KS electrical connector retaining clip.
- Remove the bolt.




Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the bolt to 20 Nm (15 lb.ft).


Electronic Engine Controls - V6 4.0L Petrol - Heated Oxygen Sensor (HO2S)

LH

Removal and Installation

Special Tool(s)	
 <p>310-121</p> <p>E53465</p>	<p>Wrench, HO2S</p> <p>310-121 (LRT-19-014)</p>

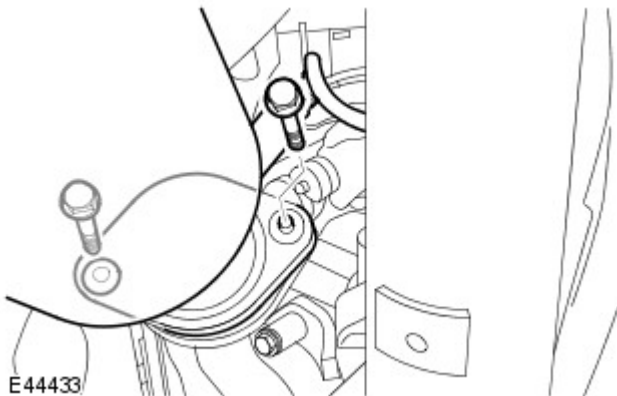
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

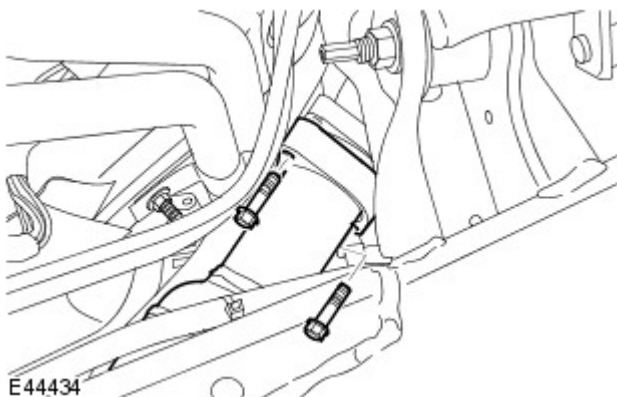
- Disconnect the LH catalytic converter from the exhaust manifold.

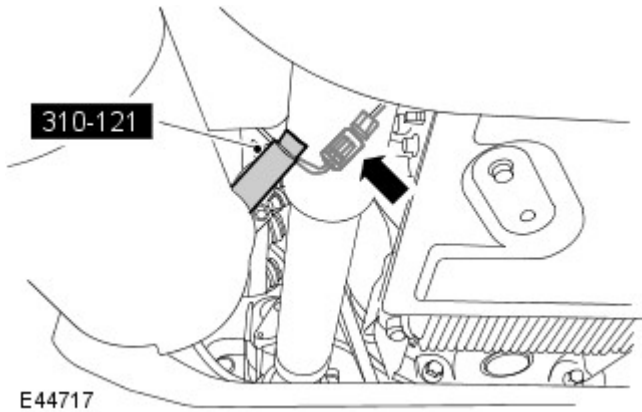
- Remove and discard the 2 bolts.



- Disconnect the RH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.





4. Using the special tool, remove the HO2S.

- Release the wiring harness.
- Disconnect the electrical connector.

Installation

1. CAUTIONS:

 Make sure the anti-seize compound does not contact the HO2S tip.


 Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Using the special tool, install the HO2S.

- Clean the components.
- Apply an anti-seize compound to the thread of the sensor.
- Tighten the HO2S to 45 Nm (33 lb.ft).
- Connect the electrical connector.
- Attach the wiring harness.

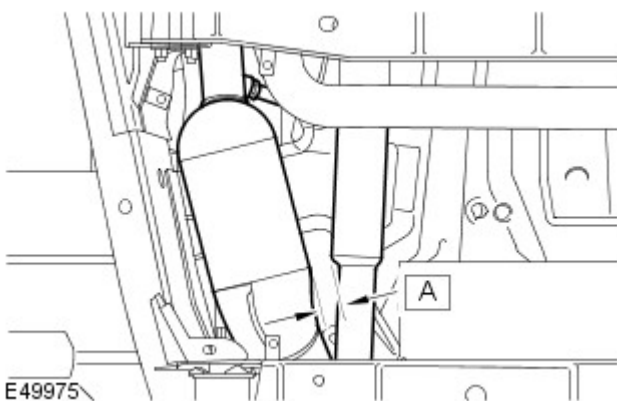
2. Position the RH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

3.  CAUTION: Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).



4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

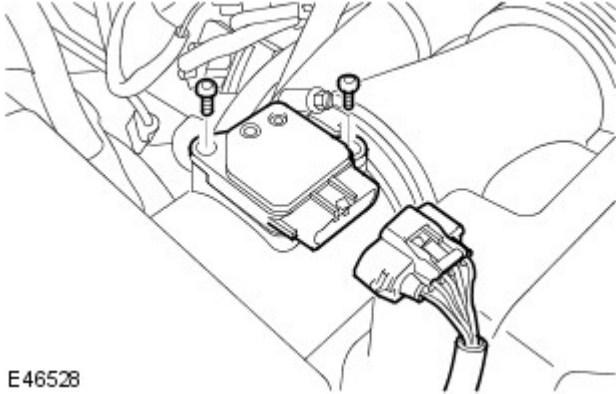
Electronic Engine Controls - V6 4.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the MAF sensor.

- Remove the 2 Torx screws.
- Disconnect the electrical connector.



E46528

Installation

1. To install, reverse the removal procedure.

- Tighten Torx screws to 2 Nm (1.5 lb.ft).

2. NOTE: [Federal market vehicles only](#).

If required, carry out a short drive cycle.

For additional information, refer to: [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#) (303-14D Electronic Engine Controls - V8 5.0L Petrol, General Procedures).

3. NOTE: [Non federal market vehicles only](#).

Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V6 4.0L Petrol - Intake Manifold Tuning (IMT) Valve

Removal and Installation

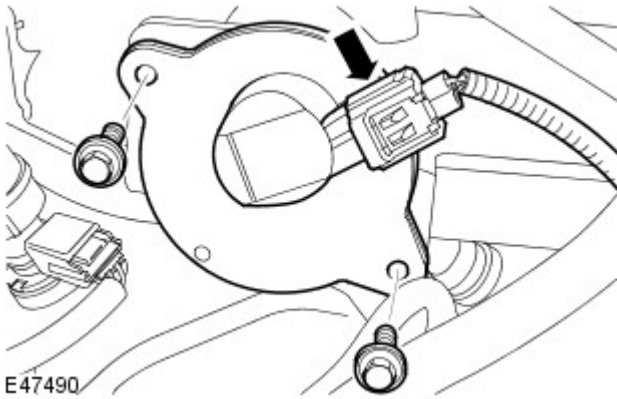
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. ⚠ CAUTION: Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the intake manifold tuning valve.

- Disconnect the electrical connector.
- Remove the 2 bolts.
- Discard the O-ring seal.




Installation


1. Install the intake manifold tuning valve.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Connect the electrical connector.
3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - V6 4.0L Petrol - Catalyst Monitor Sensor LH

Removal and Installation

Special Tool(s)	
 <p>310-121</p> <p>E53465</p>	Wrench, HO2S
	310-121 (LRT-19-014)

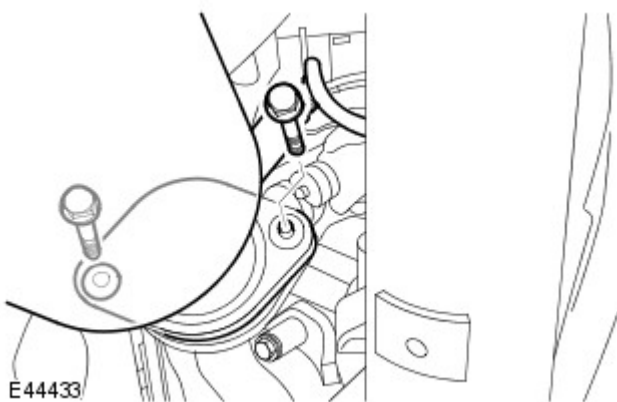
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

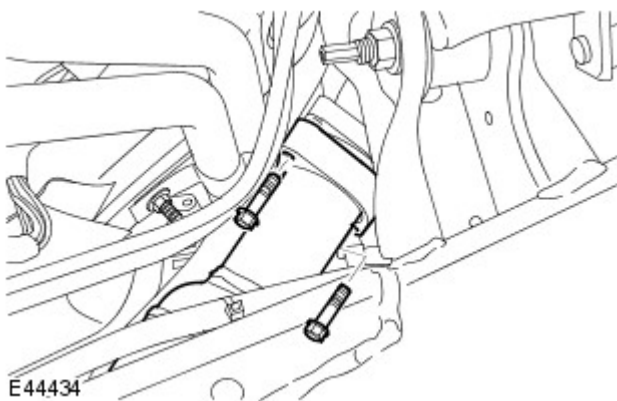
- Disconnect the LH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.



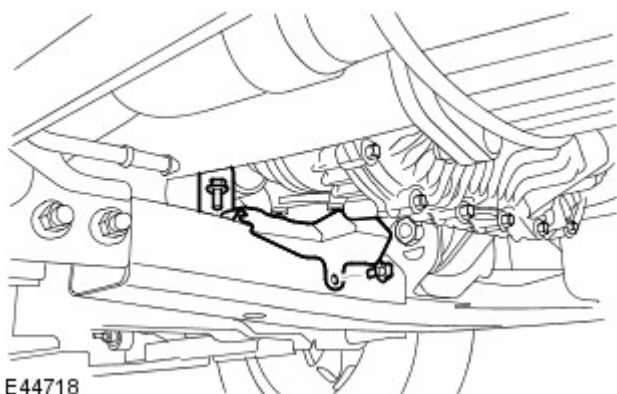
- Disconnect the RH catalytic converter from the exhaust manifold.

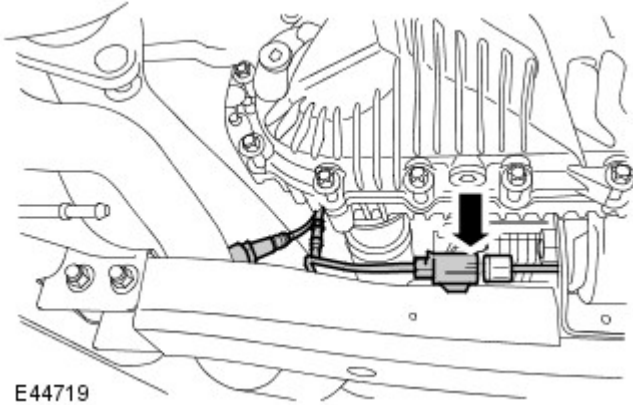
- Remove and discard the 2 bolts.



- Remove the catalyst monitor sensor electrical connector heat shield.

- Remove the 2 bolts.





5. Using the special tool, remove the catalyst monitor sensor.


- Release the wiring harness.
- Disconnect the electrical connector.

E44719

Installation

1. CAUTIONS:

 Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.

 Make sure the catalyst monitor sensor wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Using the special tool, install the catalyst monitor sensor.


- Clean the components.
- Apply an anti-seize compound to the thread of the sensor.
- Tighten the catalyst monitor sensor to 45 Nm (33 lb.ft).
- Connect the electrical connector.
- Attach the wiring harness.

2. Install the heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

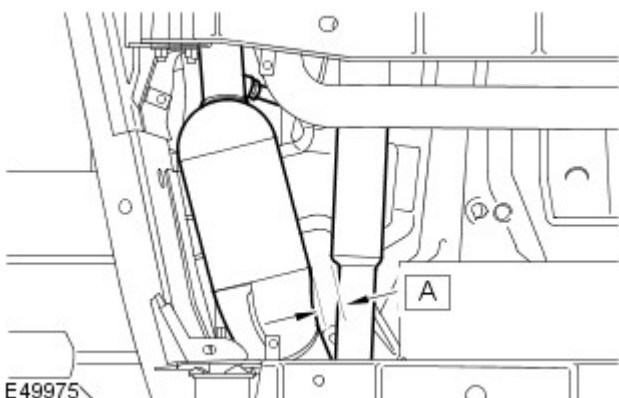
3. Position the RH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

4.  CAUTION: Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).



E49975

5. NOTE: For NAS vehicles only.

If required, carry out a long drive cycle.
For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

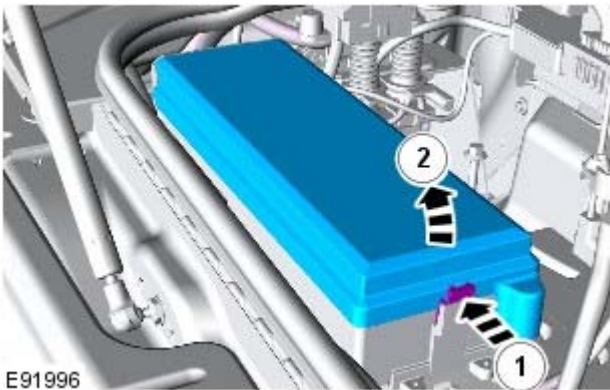
Electronic Engine Controls - V6 4.0L Petrol - Engine Control Module (ECM)

Cooling Fan

Removal and Installation

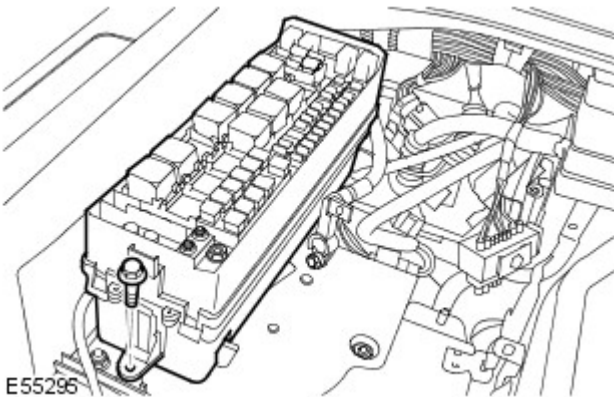
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Remove the engine control module (ECM).
For additional information, refer to: [Engine Control Module \(ECM\)](#) (303-14, Removal and Installation).
4. Remove the battery junction box (BJB) cover.
 - Release the clip.



E91996

5. Release the BJB from the bracket.
 - Remove the bolt.



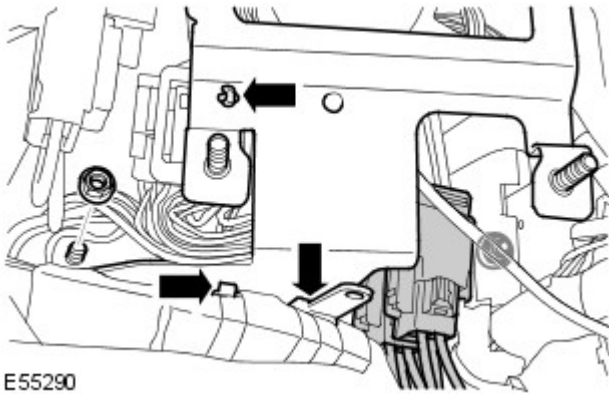
E55296

6. Remove the central junction box (CJB).
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

7. Release the CJB bracket.
 - Release the 3 upper wiring harness clips.
 - Remove the 2 bolts.

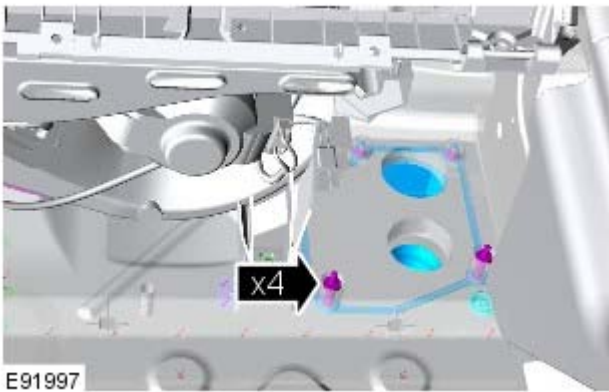


E55289



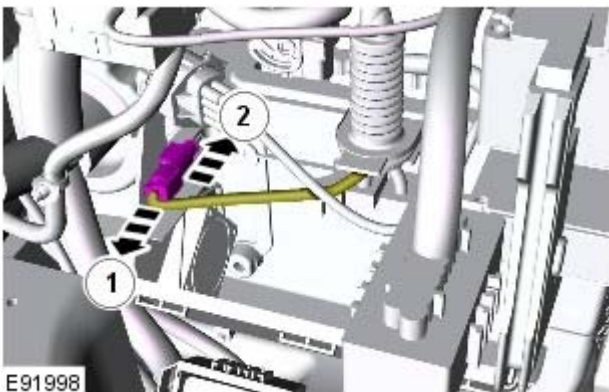
8. Remove the CJB bracket.

- Disconnect the 2 electrical connectors.
- Release the 3 lower wiring harness clips.
- Remove the 2 nuts.



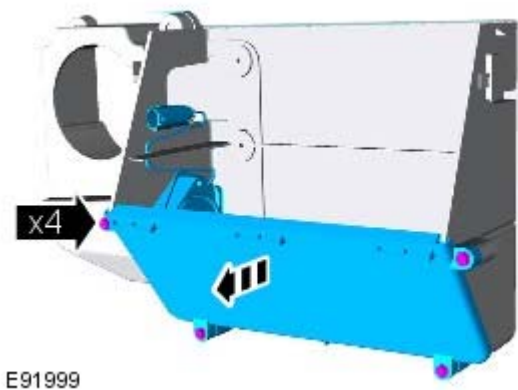
9. Release the ECM housing.

- Release the insulation for access to the nuts.
- Remove the 2 nuts and 2 bolts.



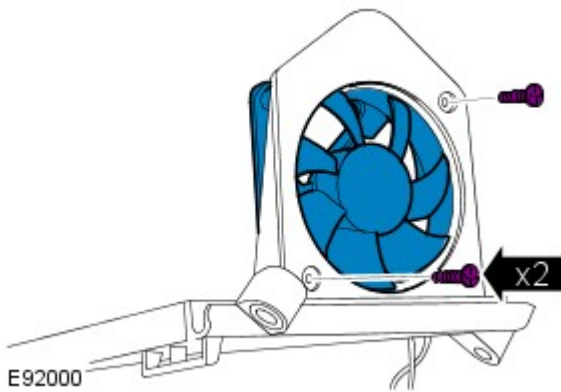
10.  CAUTION: Note of the routing of the wiring harnesses.

Release and disconnect the ECM cooling fan electrical connector.



11. Remove the ECM housing lower panel.

- Remove the 4 screws.




12.  **CAUTION:** Note the fitted position of the component prior to removal.

Remove the cooling fan.

- Remove the 2 screws.

Installation

1.  **CAUTION:** Make sure that these components are installed to the noted removal position.


Install the cooling fan.

- Install the 2 screws.

2.  **CAUTION:** Make sure the seal is installed correctly.

Install the ECM housing lower panel.

- Install the 4 screws.

3.  **CAUTION:** Make sure that the wiring harnesses are correctly routed.

Connect and secure the cooling fan electrical connector.

4.  **CAUTION:** Make sure that the seal is correctly located.

Secure the ECM housing.

- Tighten the bolts and nuts to 10 Nm (7 lb.ft).

5. Install the CJB bracket.

- Tighten the nuts to 10 Nm (7 lb.ft).
- Secure the clips.
- Connect the electrical connectors.
- Tighten the bolts to 25 Nm (18 lb.ft).

6. Install the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

7. Secure the BJB to the bracket.

- Tighten the bolt to 6 Nm (4 lb.ft).

8. Install the BJB cover.

- Secure the clip.

9. Install the engine ECM.

For additional information, refer to: Engine Control Module (ECM) (303-14, Removal and Installation).

10. Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

11. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

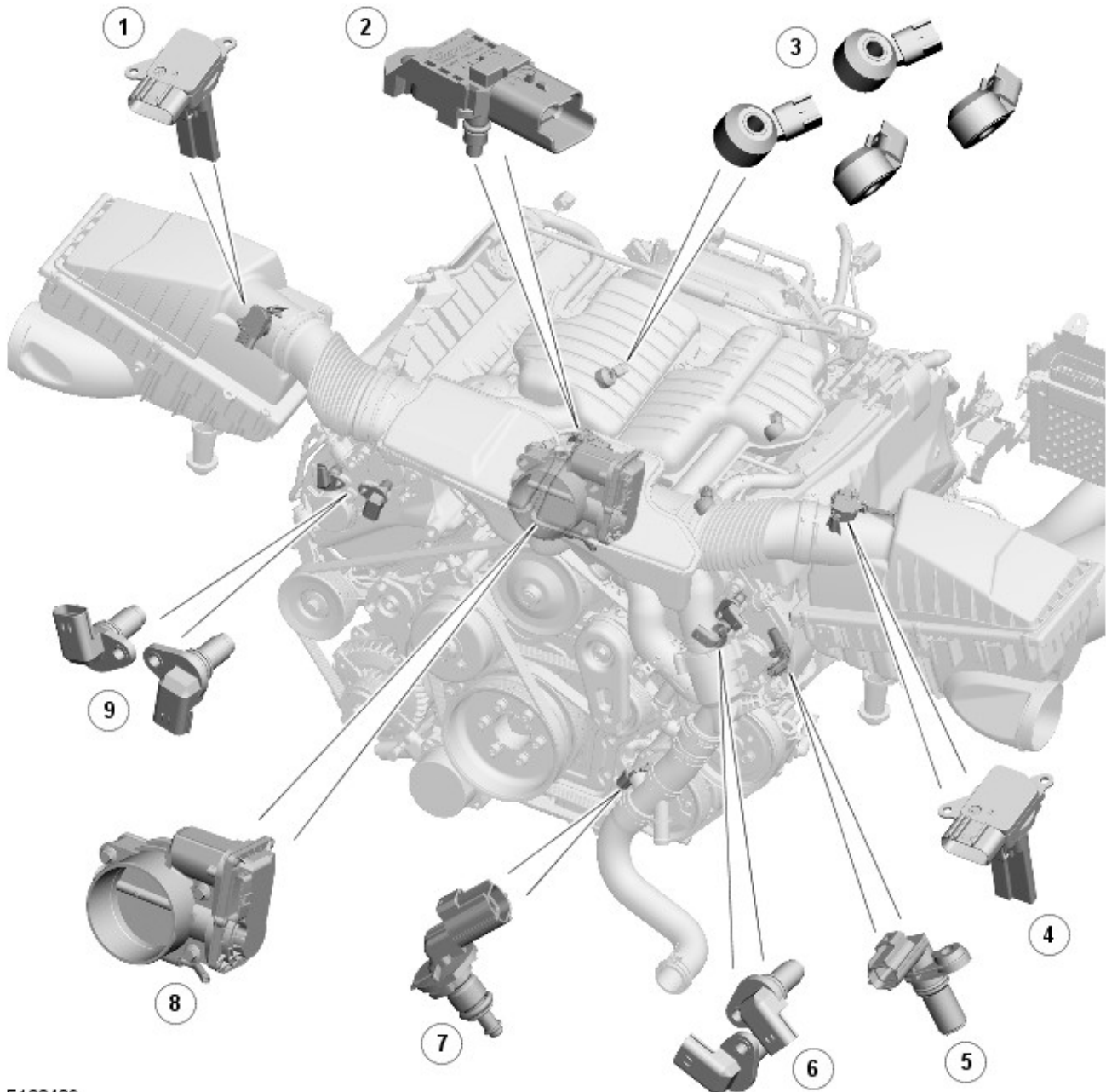
Electronic Engine Controls - V8 5.0L Petrol -**Torque Specifications**

Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor(s) retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Heated oxygen sensor(s) (HO2S)	48	35	-
Catalyst monitor sensor(s)	48	35	-
Knock sensor(s) (KS) retaining bolt	20	15	-
Fuel rail pressure (FRP) sensor	32	24	-
Manifold absolute pressure and temperature (MAPT) sensor	5	-	44
Engine oil level sensor retaining bolts	12	8	-
Variable valve timing (VVT) oil control solenoid(s) retaining bolts	10	7	-
Engine control module (ECM) retaining bolts	7	-	62
Engine control module (ECM) retaining nuts	7	-	62
Mass air flow (MAF) sensor retaining bolts	1.2	-	10.6

Electronic Engine Controls - V8 5.0L Petrol - Electronic Engine Controls

Description and Operation

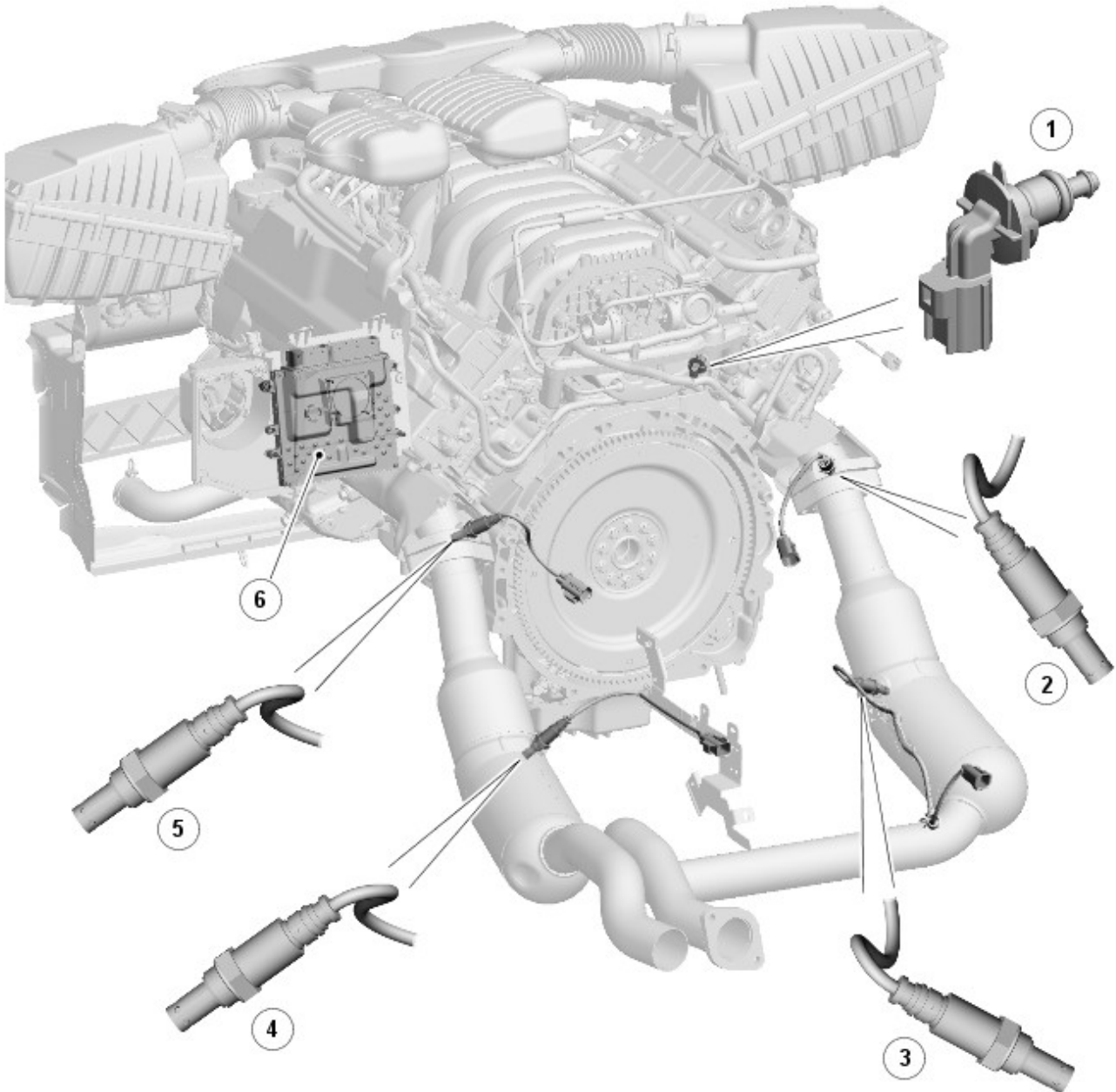
COMPONENT LOCATION - SHEET 1 OF 3



E122439

Item	Part Number	Description
1	-	MAFT (mass air flow and temperature) sensor
2	-	MAP (manifold absolute pressure) sensor
3	-	Knock sensors
4	-	MAFT sensor
5	-	CKP (crankshaft position) sensor
6	-	CMP (camshaft position) sensors
7	-	ECT (engine coolant temperature) sensor (ECT 2)
8	-	Electronic throttle
9	-	CMP sensors

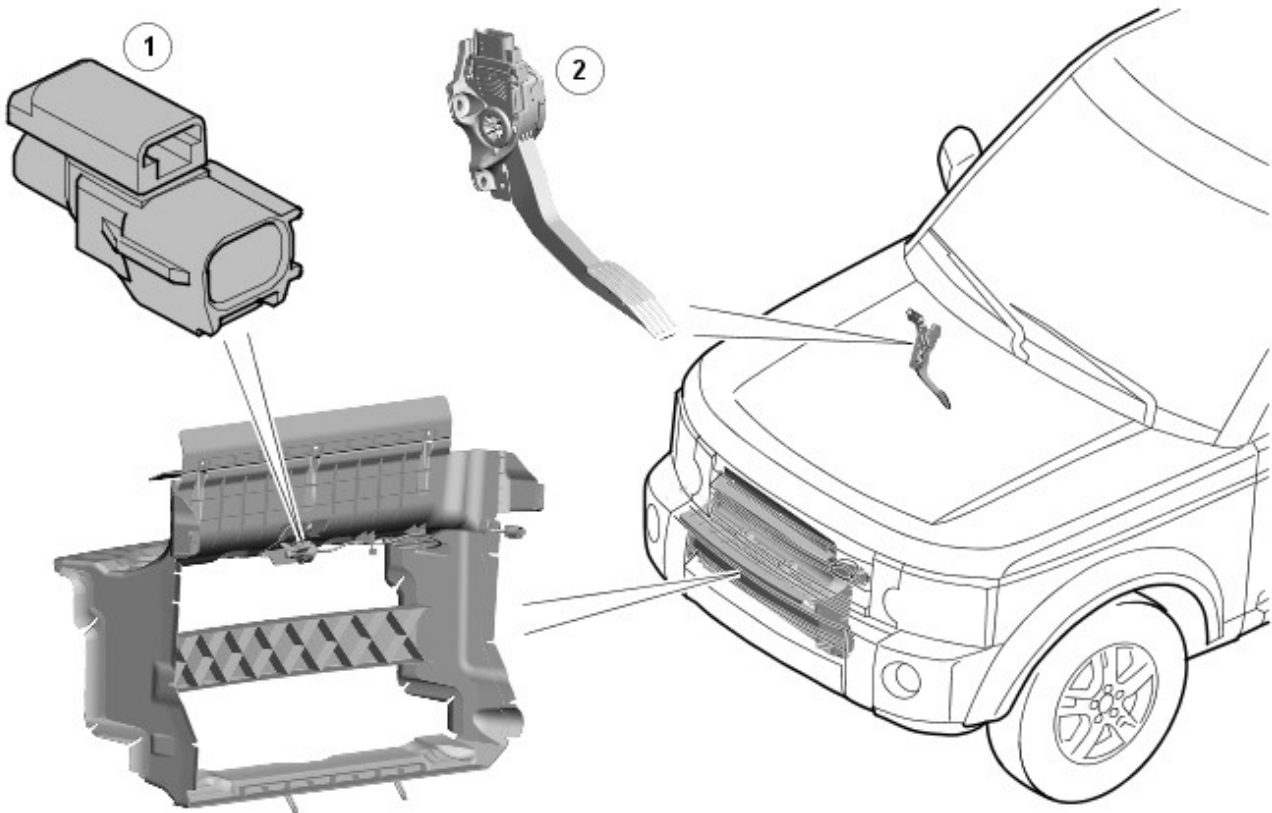
COMPONENT LOCATION - SHEET 2 OF 3



E121379

Item	Part Number	Description
1	-	ECT sensor (ECT 1)
2	-	Upstream HO2S (heated oxygen sensor)
3	-	Downstream HO2S
4	-	Downstream HO2S
5	-	Upstream HO2S
6	-	ECM (engine control module)

COMPONENT LOCATION - SHEET 3 OF 3



E122440

Item	Part Number	Description
1	-	AAT (ambient air temperature) sensor
2	-	APP (accelerator pedal position) sensor

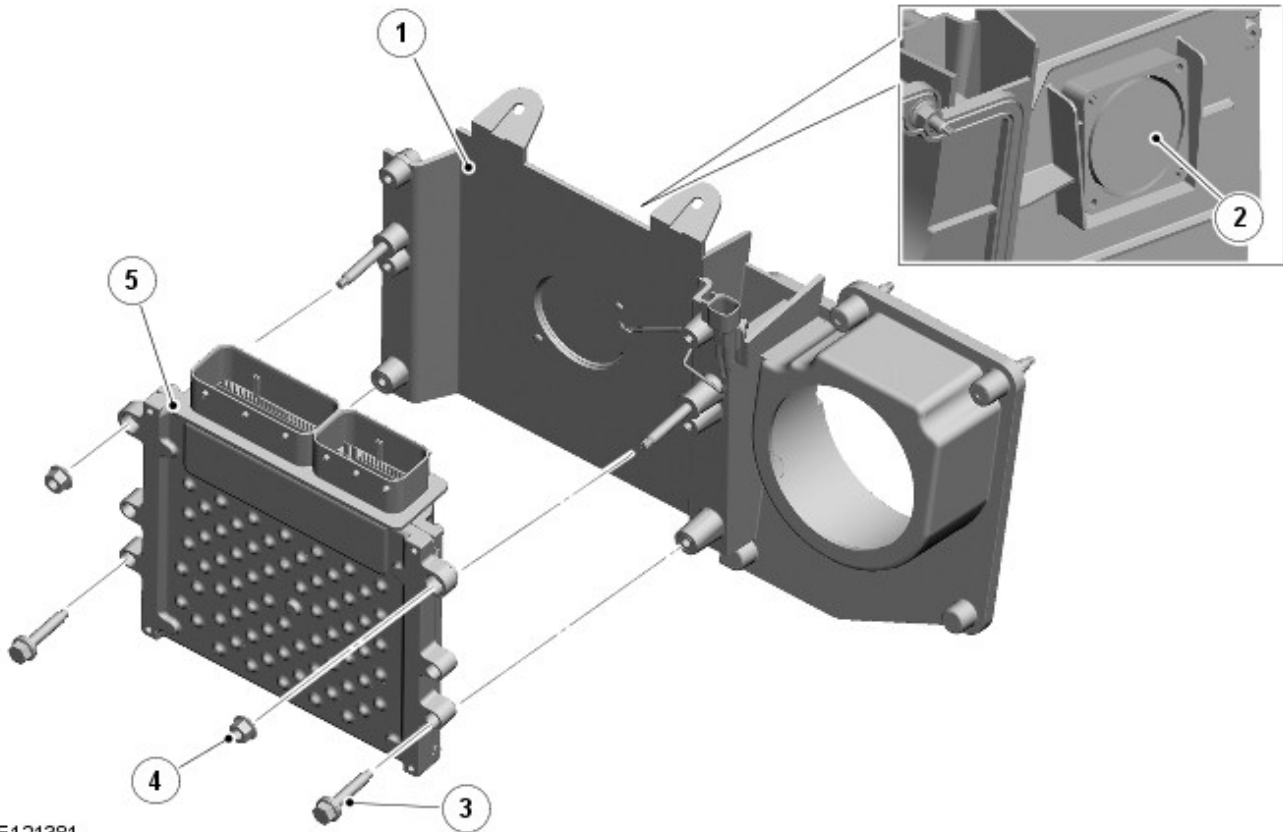
INTRODUCTION

The [EEC \(electronic engine control\)](#) system operates the engine to generate the output demanded by the accelerator pedal and loads imposed by other systems. The [EEC](#) system has an [ECM \(engine control module\)](#) that uses a torque-based strategy to evaluate inputs from sensors and other systems, then produces outputs to engine actuators to produce the required torque.

The [EEC](#) system controls the following:

- Charge air
- Fueling
- Ignition timing
- Valve timing
- Cylinder knock
- Idle speed
- Engine cooling fan
- Evaporative emissions
- On-board diagnostics
- Immobilization system interface
- Speed control.

ENGINE CONTROL MODULE



E121381

Item	Part Number	Description
1	-	ECM and cooling fan mounting bracket
2	-	Cooling fan
3	-	Screw (2 off)
4	-	Nut (2 off)
5	-	ECM

The [ECM](#) is installed in the passenger side protective box in the engine compartment, on a bracket attached to the engine bulkhead. The bracket also contains an electric cooling fan. The [ECM](#), which has an internal temperature sensor, controls the operation of the cooling fan. While the ignition is on, the cooling fan receives a power supply from the [ECM](#) relay in the [EJB](#) ([engine junction box](#)). When cooling is required, the [ECM](#) connects the cooling fan to ground.

The [ECM](#) has the capability of adapting its fuel and ignition control outputs in response to several sensor inputs.

The [ECM](#) receives inputs from the following:

- [CKP \(crankshaft position\)](#) sensor.
- [CMP \(camshaft position\)](#) sensors (4 off).
- [ECT \(engine coolant temperature\)](#) sensors (2 off).
- Knock sensors (4 off).
- [MAP \(manifold absolute pressure\)](#) sensor.
- [MAFT \(mass air flow and temperature\)](#) sensors (2 off).
- Throttle position sensor.
- Heated oxygen sensors (4 off).
- [APP \(accelerator pedal position\)](#) sensor.
- Ambient air temperature sensor.
- [FRP \(fuel rail pressure\)](#) sensor.
- For additional information, refer to: [Fuel Charging and Controls](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Description and Operation).
- Engine cooling fan.
- For additional information, refer to: [Engine Cooling](#) (303-03D Engine Cooling - V8 5.0L Petrol, Description and Operation).
- Stoplamp switch.
- For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).
- Speed control cancel/suspend switch.
- For additional information, refer to: [Speed Control](#) (310-03D Speed Control - V8 5.0L Petrol, Description and Operation).
- Oil level and temperature sensor.
- For additional information, refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Description and Operation).
- Fuel LP (low pressure) sensor.
- For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).
- Fuel pump driver module.
- For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).

The [ECM](#) provides outputs to the following:

- Electronic throttle.

- Main relay.
- Heaters elements of the heated oxygen sensors (4 off).
- Fuel injectors (8 off).
For additional information, refer to: [Fuel Charging and Controls](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Description and Operation).
- Ignition coils (8 off).
For additional information, refer to: [Engine Ignition](#) (303-07B Engine Ignition - V8 5.0L Petrol, Description and Operation).
- VCT (variable camshaft timing) solenoids (4 off).
For additional information, refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Description and Operation).
- Camshaft profile switching solenoids (2 off).
For additional information, refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Description and Operation).
- Variable intake system tuning valve.
For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Description and Operation).
- EVAP (evaporative emission) canister purge valve.
For additional information, refer to: [Evaporative Emissions](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Description and Operation).
- Engine starter relay. For additional information, refer to: Starting System (303-06D, Description and Operation).
- Engine cooling fan.
For additional information, refer to: [Engine Cooling](#) (303-03D Engine Cooling - V8 5.0L Petrol, Description and Operation).
- Generator. For additional information, refer to: Generator and Regulator (414-02D, Description and Operation).
- HP fuel pumps.
For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).
- Fuel pump driver module.
For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).
- DMTL (diagnostic module - tank leakage) (NAS only).
For additional information, refer to: [Evaporative Emissions](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Description and Operation).

CRANKSHAFT POSITION SENSOR



E116086

The [CKP](#) sensor is an inductive sensor that allows the [ECM](#) to determine the angular position of the crankshaft and the engine speed.

The [CKP](#) sensor is installed in the rear left side of the sump body, in line with the engine drive plate. The sensor is secured with a single screw and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

The head of the [CKP](#) sensor faces a reluctor ring pressed into the outer circumference of the engine drive plate. The reluctor ring has a 60 minus 2 tooth pattern. There are 58 teeth at 6° intervals, with two teeth removed to provide a reference point with a centerline that is 21° [BTDC \(before top dead center\)](#) on cylinder 1 of bank A.

If the [CKP](#) sensor fails, the [ECM](#):

- Uses signals from the [CMP](#) sensors to determine the angular position of the crankshaft and the engine speed
- Adopts a limp home mode where engine speed is limited to a maximum of 3000 rev/min.

With a failed [CKP](#) sensor, engine starts will require a long crank time while the [ECM](#) determines the angular position of the crankshaft.

CAMSHAFT POSITION SENSORS



E116087

The [CMP](#) sensors are MRE (magneto resistive element) sensors that allow the [ECM](#) to determine the angular position of the camshafts. MRE sensors produce a digital output which allows the [ECM](#) to detect speeds down to zero.

The four [CMP](#) sensors are installed in the front upper timing covers, one for each camshaft.

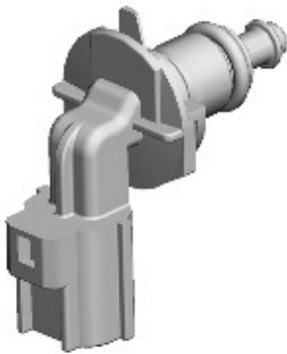
Each [CMP](#) sensor is secured with a single screw and sealed with an O-ring. On each [CMP](#) sensor, a three pin electrical connector provides the interface with the engine harness.

The head of each [CMP](#) sensor faces a sensor wheel attached to the front of the related [VCT](#) unit.

If an exhaust [CMP](#) sensor fails, the [ECM](#) disables the [VCT](#) of both exhaust camshafts.

If an intake [CMP](#) sensor fails, the [ECM](#) disables the [VCT](#) of both intake camshafts. This can result in the engine being slow, or failing, to start.

ENGINE COOLANT TEMPERATURE SENSORS



E108397

The [ECT](#) sensors are [NTC \(negative temperature coefficient\)](#) thermistors that allow the [ECM](#) to monitor the engine coolant temperature.

There are two identical [ECT](#) sensors installed, which are identified as ECT 1 and ECT 2. Each sensor is secured with a twist-lock and latch mechanism, and is sealed with an O-ring. A two pin electrical connector provides the interface between the sensor and the engine harness.

ECT 1

ECT 1 is installed in the heater manifold, at the rear of the [RH \(right-hand\)](#) cylinder head. The input from this sensor is used in calibration tables and by other systems.

If there is an ECT 1 fault, the [ECM](#) adopts an estimated coolant temperature. On the second consecutive trip with an ECT 1 fault, the [ECM](#) illuminates the [MIL \(malfunction indicator lamp\)](#).

ECT 2

ECT 2 is installed in the lower hose connector which attaches to the bottom of the thermostat. The input from this sensor is used for [OBD \(on-board diagnostic\)](#) 2 diagnostics and, in conjunction with the input from ECT 1, to confirm that the thermostat is functional.

If there is an ECT 2 fault, the [ECM](#) illuminates the [MIL](#) on the second consecutive trip.

KNOCK SENSORS



E108400

The knock sensors are piezo-ceramic sensors that allow the [ECM](#) to employ active knock control and prevent engine damage from pre-ignition or detonation.

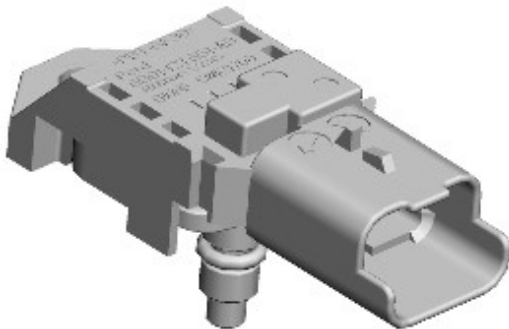
Two knock sensors are installed on the inboard side of each cylinder head, one mid-way between cylinders 1 and 2, and one mid-way between cylinders 3 and 4. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the engine harness.

The [ECM](#) compares the signals from the knock sensors with mapped values stored in memory to determine when detonation occurs on individual cylinders. When detonation is detected, the [ECM](#) retards the ignition timing on that cylinder for a number of engine cycles, then gradually returns it to the original setting.

The [ECM](#) cancels closed loop control of the ignition system if the signal received from a knock sensor becomes implausible. In these circumstances the [ECM](#) defaults to base mapping for the ignition timing. This ensures the engine will not become damaged if low quality fuel is used. The [MIL](#) will not illuminate, although the driver may notice that the engine 'pinks' in some driving conditions and displays a drop in performance and smoothness.

The ECM calculates the default value if one sensor fails on each bank of cylinders.

MANIFOLD ABSOLUTE PRESSURE SENSOR



E108402

The [MAP](#) sensor allows the [ECM](#) to calculate the load on the engine, which is used in the calculation of fuel injection time.

The [MAP](#) sensor is installed in the air inlet of the intake manifold. The sensor is secured with a single screw and sealed with an O-ring. A three pin electrical connector provides the interface with the engine harness.

If the [MAP](#) sensor fails, the [ECM](#) adopts a default value of 1 bar (14.5 lbf/in.²).

With a failed [MAP](#) sensor, the engine will suffer from poor starting, rough running and poor driveability.

MASS AIR FLOW AND TEMPERATURE SENSORS



E116091

The [MAFT](#) sensors allow the [ECM](#) to measure the mass flow and the temperature of the air flow into the engine. The mass air flow is measured with a hot film element in the sensor. The temperature of the air flow is measured with a [NTC](#) thermistor in the sensor. The mass air flow is used to determine the fuel quantity to be injected in order to maintain the target air/fuel mixture required for correct operation of the engine and the catalytic converters.

There are two [MAFT](#) sensors installed, one in each air cleaner outlet duct. Each [MAFT](#) sensor is secured with two screws and sealed with an O-ring. On each [MAFT](#) sensor, a five pin electrical connector provides the interface with the engine harness.

If the hot film element signal fails the [ECM](#) invokes a software backup strategy to calculate the mass air flow from other inputs. Closed loop fuel control, closed loop idle speed control and evaporative emissions control are discontinued. The engine will suffer from poor starting, poor throttle response and, if the failure occurs while driving, the engine speed may dip and surging may occur before recovering.

If the [NTC](#) thermistor signal fails the [ECM](#) adopts a default value of 25 °C (77 °F) for the intake air temperature.

THROTTLE POSITION SENSORS

The [TP](#) (throttle position) sensors allow the [ECM](#) to determine the position and angular rate of change of the throttle blade.

There are two [TP](#) sensors located in the electronic throttle. See below for details of the electronic throttle.

If a [TP](#) sensor fails, the [ECM](#):

- Adopts a limp home mode where engine speed is limited to a maximum of approximately 2000 rev/min
- Discontinues evaporative emissions control
- Discontinues closed loop control of engine idle speed.

With a failed [TP](#) sensor, the engine will suffer from poor running and throttle response.

HEATED OXYGEN SENSORS



E119261

The heated oxygen sensors allow the [ECM](#) to measure the oxygen content of the exhaust gases, for closed loop control of the fuel:air mixture and for catalytic converter monitoring.

An upstream heated oxygen sensor is installed in the outlet of each exhaust manifold, which enables independent control of the fuel:air mixture for each cylinder bank. A downstream heated oxygen sensor is installed in each catalytic converter, which enables the performance of the catalytic converters to be optimized and monitored.

Oxygen sensors need to operate at high temperatures in order to function correctly. To achieve the high temperatures required, the sensors are fitted with heater elements that are controlled by a [PWM](#) (pulse width modulation) signal from the [ECM](#). The heater elements are operated after each engine start, once it has been calculated that there is no moisture in the exhaust (between 0 and 2 minutes delay), and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature. The [PWM](#) duty cycle is carefully controlled to prevent thermal shock to cold sensors. A non-functioning heater delays the sensor's readiness for closed loop control and increases emissions.

The upstream heated oxygen sensors produce a constant voltage, with a variable current that is proportional to the lambda ratio. The downstream heated oxygen sensors produce an output voltage dependant on the ratio of the exhaust gas oxygen to the ambient oxygen.

The heated oxygen sensors age with mileage, increasing their response time to switch from rich to lean and lean to rich. This increase in response time influences the [ECM](#) closed loop control and leads to progressively increased emissions. Measuring the period of rich to lean and lean to rich switching monitors the response rate of the upstream sensors.

Diagnosis of electrical faults is continually monitored in both the upstream and downstream sensors. This is achieved by checking the signal against maximum and minimum threshold, for open and short circuit conditions.

If a heated oxygen sensor fails:

- The [ECM](#) defaults to open loop fueling for the related cylinder bank
- The CO (carbon monoxide) and emissions content of the exhaust gases may increase
- The exhaust may smell of rotten eggs (hydrogen sulphide).

With a failed heated oxygen sensor, the engine will suffer from reduced refinement and performance.

ACCELERATOR PEDAL POSITION SENSOR



E118973

The [APP](#) sensor allows the [ECM](#) to determine the driver requests for vehicle speed, acceleration and deceleration. The [ECM](#) uses this information, together with information from the [ABS \(anti-lock brake system\)](#) module and the [TCM \(transmission control module\)](#), to determine the setting of the electronic throttle.

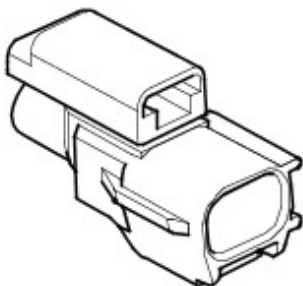
Three screws attach the [APP](#) sensor and integrated accelerator pedal to a bracket on the lower dash panel. A six pin electrical connector provides the interface with the vehicle harness.

The [APP](#) sensor is a twin track potentiometer. Each track receives an independent power supply from the [ECM](#) and returns an independent analog signal to the [ECM](#). Both signals contain the same positional information, but the signal from track 2 is half the voltage of the signal from track 1 at all positions.

If both signals have a fault, the [ECM](#) adopts a limp home mode, which limits the engine speed to 2000 rev/min maximum.

The [ECM](#) constantly checks the range and plausibility of the two signals and stores a fault code if it detects a fault.

AMBIENT AIR TEMPERATURE SENSOR



E43580

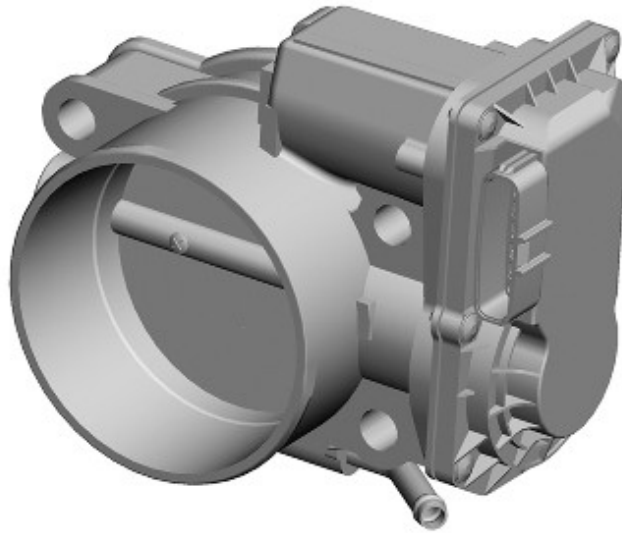
The AAT (ambient air temperature) sensor is a [NTC](#) thermistor that allows the [ECM](#) to monitor the temperature of the air around the vehicle. The [ECM](#) uses the AAT input for a number of functions, including engine cooling fan control. The [ECM](#) also transmits the ambient temperature on the high speed [CAN \(controller area network\)](#) bus for use by other control modules.

The AAT sensor is installed on a bracket in the front bumper ducting, on the vehicle centerline.

The [ECM](#) supplies the sensor with a 5 V reference voltage and a ground, and translates the return signal voltage into a temperature.

If there is a fault with the AAT sensor, the [ECM](#) calculates the AAT from the temperature inputs of the [MAFT](#) sensors. If the AAT sensor and the temperature inputs of the [MAFT](#) sensors are all faulty, the [ECM](#) adopts a default ambient temperature of 25 °C (77 °F).

ELECTRONIC THROTTLE



E116090

The [ECM](#) uses the electronic throttle to help regulate engine torque.

The electronic throttle is attached to the intake manifold.

For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Description and Operation).

The throttle plate is operated by an electric DC (direct current) motor integrated into the throttle body. The [ECM](#) uses a [PWM](#) signal to control the DC motor. The [ECM](#) compares the [APP](#) sensor inputs against an electronic request or value to determine the required position of the throttle plate. The [ECM](#) and electronic throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electronic throttle for accurate cruise control
- Perform all dynamic stability control engine interventions
- Monitor and carry out maximum engine speed and road speed cut outs
- Provide different engine maps for the ride and handling optimization system.

A software strategy within the [ECM](#) calibrates the position of the throttle plate at the beginning of each ignition cycle. When the ignition is turned on, the [ECM](#) performs a self test and calibration routine by fully closing the throttle plate and then opening it again. This tests the default position springs and allows the [ECM](#) to learn the fully closed position.

ECM RELAY

The [ECM](#) relay is used to initiate the power up and power down routines within the [ECM](#). The [ECM](#) relay is installed in the [EJB](#).

When the ignition is turned on, battery voltage is applied to the ignition sense input. The [ECM](#) then starts its power up routines and energizes the [ECM](#) relay.

When the ignition is turned off, the [ECM](#) maintains its powered up state while it conducts the power down routines. This can be for:

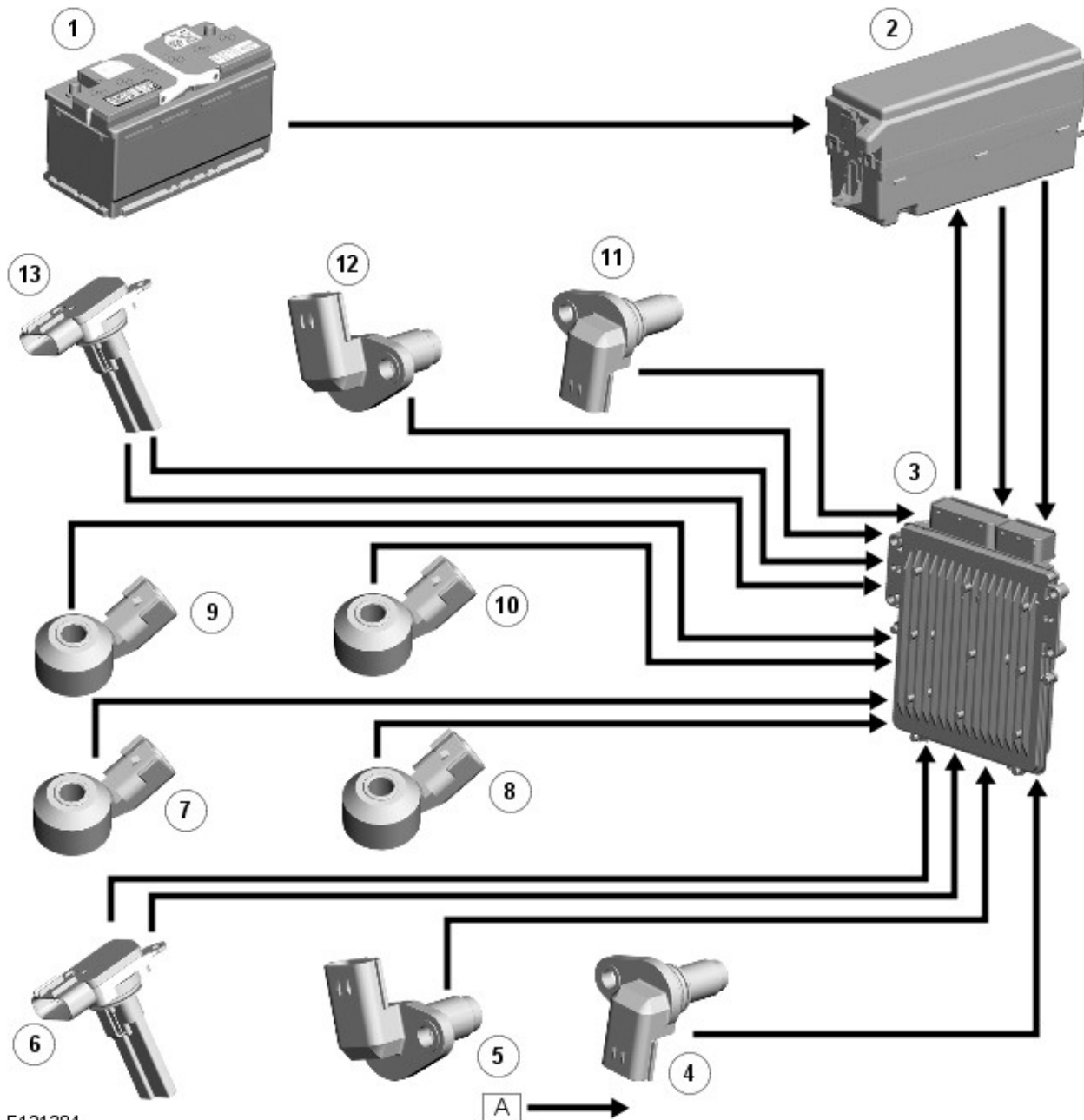
- Up to 20 minutes in extreme cases, when the DMTL system is running (NAS markets) or the [TCM](#) is 'kept awake' because of a 'not in park' condition
- Up to 5 minutes when cooling fans are required.

On completion of the power down routines the [ECM](#) de-energizes the [ECM](#) relay.

CONTROL DIAGRAM

Sheet 1 of 2

- NOTE: A = Hardwired.

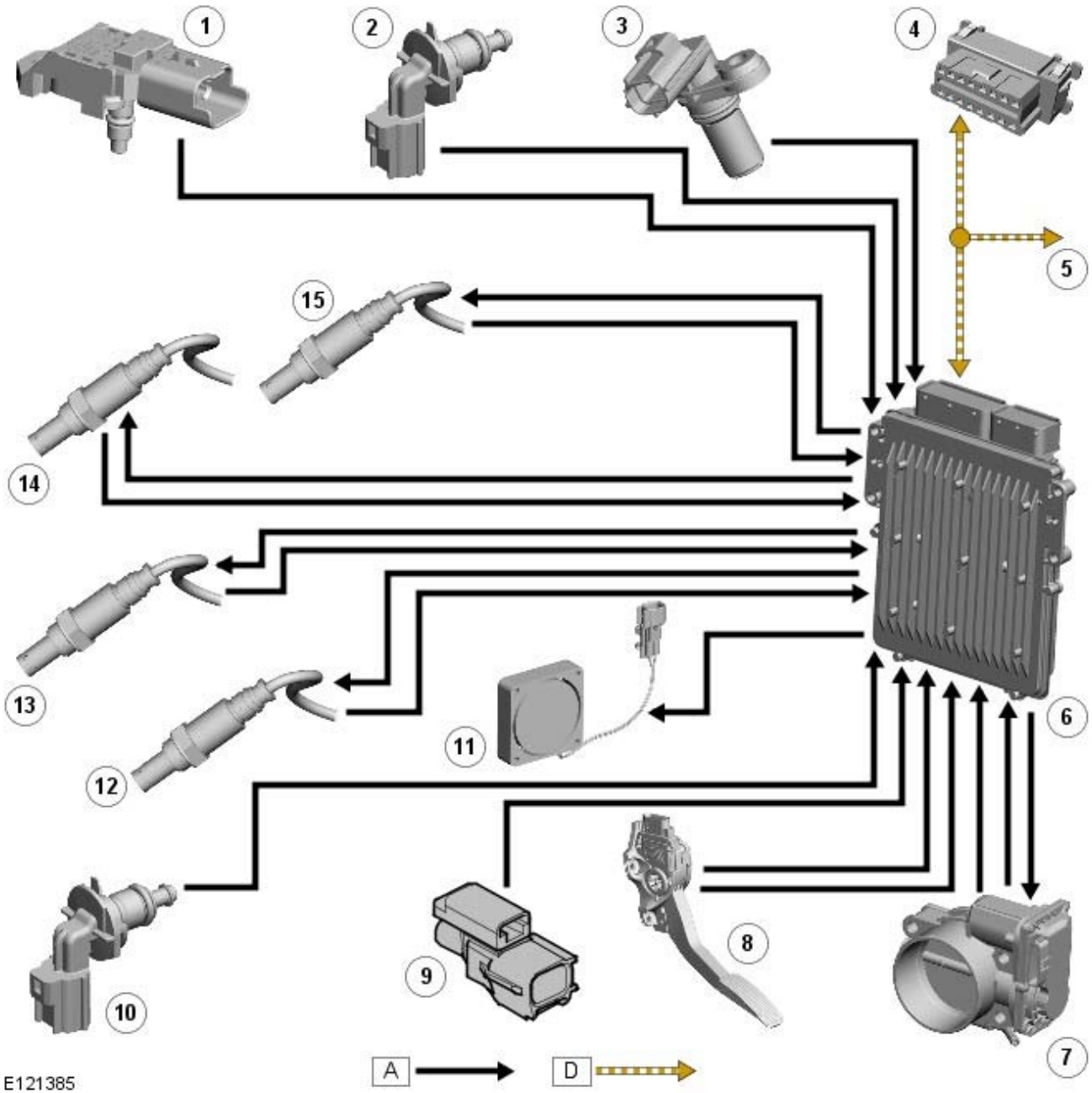


E121384

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	ECM
4	-	LH (left hand) intake CMP sensor
5	-	LH exhaust CMP sensor
6	-	LH MAFT sensor
7	-	LH front knock sensor
8	-	LH rear knock sensor
9	-	RH (right hand) front knock sensor
10	-	RH rear knock sensor
11	-	RH intake CMP sensor
12	-	RH exhaust CMP sensor
13	-	RH MAFT sensor

Sheet 2 of 2

• NOTE: A = Hardwired; D = High speed CAN bus.



E121385

Item	Part Number	Description
1	-	MAP sensor
2	-	ECT sensor (ECT 2)
3	-	CKP sensor
4	-	Diagnostic socket
5	-	To other system control modules
6	-	ECM
7	-	Electronic throttle
8	-	APP sensor
9	-	AAT sensor
10	-	ECT sensor (ECT 1)
11	-	ECM cooling fan
12	-	LH upstream HO2S
13	-	LH downstream HO2S
14	-	RH downstream HO2S
15	-	RH upstream HO2S

OPERATION

ECM Adaptions

The [ECM](#) has the ability to adapt the input values it uses to control certain outputs. This capability maintains engine refinement and ensures the engine emissions remain within the legislated limits. The components which have adaptions associated with them are:

- The [APP](#) sensor
- The heated oxygen sensors

- The [MAFT](#) sensors
- The [CKP](#) sensor
- Electronic throttle
- Knock sensors.

Oxygen and MAFT Sensors

There are several adaptive maps associated with the fueling strategy. Within the fueling strategy the [ECM](#) calculates short-term adaptations and long term adaptations. The [ECM](#) will monitor the deterioration of the heated oxygen sensors over a period of time. It will also monitor the current correction associated with the sensors.

The [ECM](#) will store a fault code in circumstances where an adaptation is forced to exceed its operating parameters. At the same time, the [ECM](#) will record the engine speed, engine load and intake air temperature.

Crankshaft Position Sensor

The characteristics of the signal supplied by the [CKP](#) sensor are learned by the [ECM](#). This enables the [ECM](#) to set an adaptation and support the engine misfire detection function. Due to the small variation between different drive plates and different [CKP](#) sensors, the adaptation must be reset if either component is renewed, or removed and refitted. It is also necessary to reset the drive plate adaptation if the [ECM](#) is renewed or replaced. The [ECM](#) supports four drive plate adaptations for the [CKP](#) sensor. Each adaptation relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

Adaption	Engine Speed, rev/min
1	1800 - 3000
2	3001 - 3800
3	3801 - 4600
4	4601 - 5400

Misfire Detection

Legislation requires that the [ECM](#) must be able to detect the presence of an engine misfire. It must be able to detect misfires at two separate levels. The first level is an amount of misfire that could lead to the legislated emissions limit being exceeded by a given amount. The second level is a misfire rate that causes degradation in catalytic converter efficiency.

The [ECM](#) monitors the number of misfire occurrences within two engine revolution ranges. If the [ECM](#) determines a misfire failure within either of these two ranges, over two consecutive journeys, it will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, if the second level of misfire occurs, on any trip, the [ECM](#) flashes the [MIL](#) while the fault is occurring.

The signal from the [CKP](#) sensor indicates how fast the poles on the drive plate are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The [ECM](#) can detect variations in drive plate speed by monitoring the sine wave signal supplied by the crankshaft position sensor. By assessing this signal, the [ECM](#) can detect the presence of an engine misfire. The [ECM](#) will evaluate the signal against a number of factors and will decide whether to record the occurrence or ignore it. The [ECM](#) can assign a misfire judgement to an individual cylinder, which can be viewed on Land Rover approved diagnostic equipment.

Diagnostics

The [ECM](#) stores each fault as a [DTC \(diagnostic trouble code\)](#). The [DTC](#) and associated environmental and freeze frame data can be read using Land Rover approved diagnostic equipment, which can also read real time data from each sensor, the adaptation values currently being employed and the current fueling, ignition and idle speed settings.

Electronic Engine Controls - V8 5.0L Petrol - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Electronic Engine Controls](#) (303-14D Electronic Engine Controls - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Engine oil level ● Cooling system coolant level ● Fuel level ● Fuel contamination/grade/quality ● Fuel leaks ● Accessory drive belt ● Sensor installation/condition ● Viscous fan and solenoid ● Air cleaner condition 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● 5 volt sensor supply ● Sensor(s) ● Engine Control Module (ECM) ● Transmission Control Module (TCM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot engine off, after engine has reached operating temperature	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to the relevant Diagnostic Trouble Code (DTC) Index for [V8 5.0L Petrol, DTC Index](#) and [Electronic Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Electronic Engine Controls - V8 5.0L Petrol - Powertrain Control Module (PCM) Long Drive Cycle Self-Test

General Procedures



WARNING: Where possible, all road tests should be on well surfaced and dry roads. Always comply with speed limits and local traffic regulations.

• **NOTE:** This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

• **NOTE:** The vehicle must exceed 50mph (80 km/h) during the road test.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Disconnect the diagnostic equipment from the vehicle.
5. **NOTE:** Make sure cruise control is not engaged.

Make sure the engine temperature is above 60 °C (140 °F).

Carry out a road test and perform the following operations.

1. Accelerate to 55 mph (88 km/h) in 5th gear and cruise for 2 minutes with the engine speed at or above 1800rpm.
 2. Lift off the throttle and allow the vehicle to decelerate until the engine speed is less than 1000 rpm.
 3. Stop the vehicle.
 4. Release brake, allow the vehicle to move with no throttle for 1 minute.
 5. Road test is now complete.
6. Connect the diagnostic equipment to the vehicle.
 7. **NOTE:** If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.
 8. Disconnect the diagnostic equipment from the vehicle.

Electronic Engine Controls - V8 5.0L Petrol - Powertrain Control Module (PCM) Short Drive Cycle Self-Test

General Procedures

• NOTE: This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Start the engine.
 - Allow the engine to idle for 30 seconds.
 - Raise the engine speed to 1500 rpm and hold for 3 minutes until a temperature of 70°C (158 °F) is achieved.
 - Allow the engine to idle for 30 seconds.
 - Switch off the engine.

5. NOTE: If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.

6. Disconnect the diagnostic equipment from the vehicle.

Electronic Engine Controls - V8 5.0L Petrol - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.
2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.



Position the DTI gauge on a suitable mounting block, as illustrated.

3. With the aid of another technician, gently press the brake pedal until the stoplamps illuminate.
4. NOTE: The specification is that the stoplamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

Note the measurement of the brake pedal travel from rest position until the stoplamps illuminated.

Adjust

1. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Remove the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Only use light finger pressure when installing the stoplamp switch. Failure to follow this instruction may result in an incorrectly adjusted stoplamp switch.

Install the stoplamp switch.
For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

3. Check the adjustment of the stoplamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.


Electronic Engine Controls - V8 5.0L Petrol - Camshaft Position (CMP)

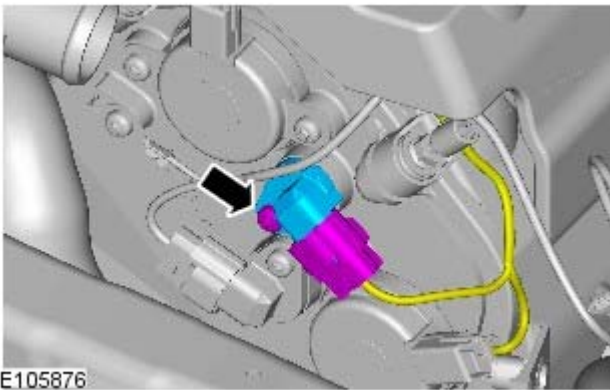
Sensor LH

Removal and Installation

Removal



- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).



3.
 - Torque: 10 Nm

Installation

1. **CAUTIONS:**
 -  Make sure that the mating faces are clean and free of foreign material.
 -  Make sure that the sensor tip is clean and free of foreign material.
- NOTE: Lubricate the O-ring seal with clean engine oil.
- To install, reverse the removal procedure.


Electronic Engine Controls - V8 5.0L Petrol - Camshaft Position (CMP)

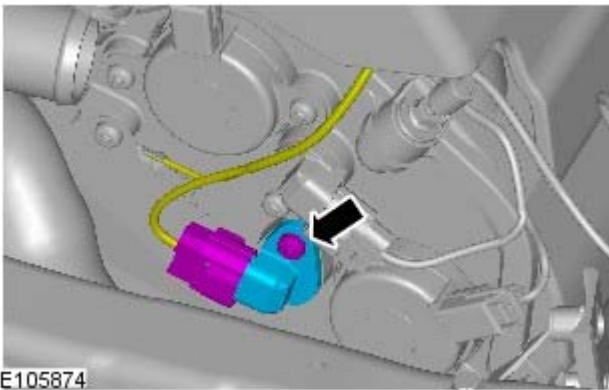
Sensor RH

Removal and Installation

Removal



- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).



3.
 - Torque: 10 Nm

Installation

1. **CAUTIONS:**
 -  Make sure that the mating faces are clean and free of foreign material.
 -  Make sure that the sensor tip is clean and free of foreign material.
- NOTE: Lubricate the O-ring seal with clean engine oil.
- To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Catalyst Monitor Sensor LH

Removal and Installation

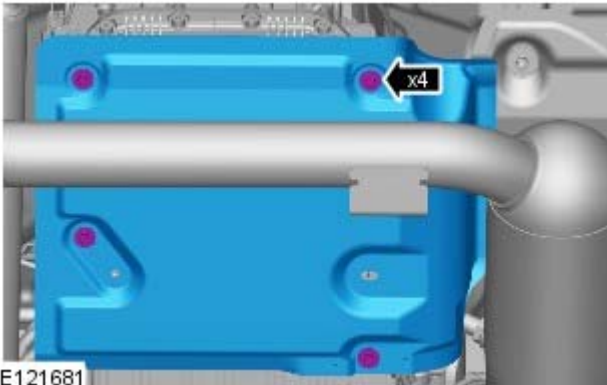
Removal

- NOTE: Removal steps in this procedure may contain installation details.

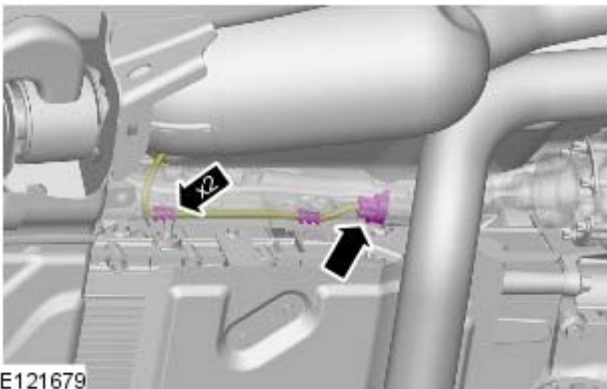
1.  **WARNING:** Make sure to support the vehicle with axle stands.


Raise and support the vehicle.

2. Torque: 10 Nm

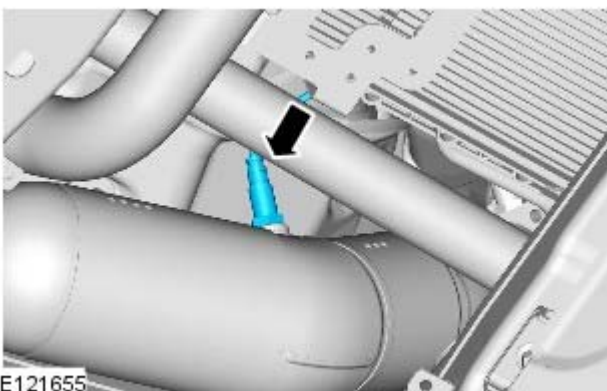


- 3.



4.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 48 Nm



Installation

1. **CAUTIONS:**



If accidentally dropped or knocked install a new sensor.



Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.
- NOTE: Make sure the anti-seize compound does not contact the HO2S tip.

To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Catalyst Monitor Sensor RH

Removal and Installation

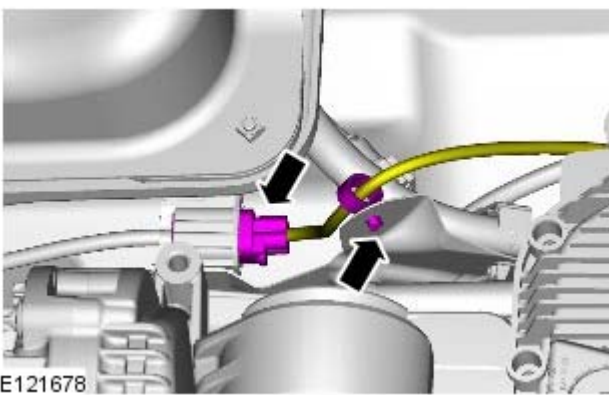
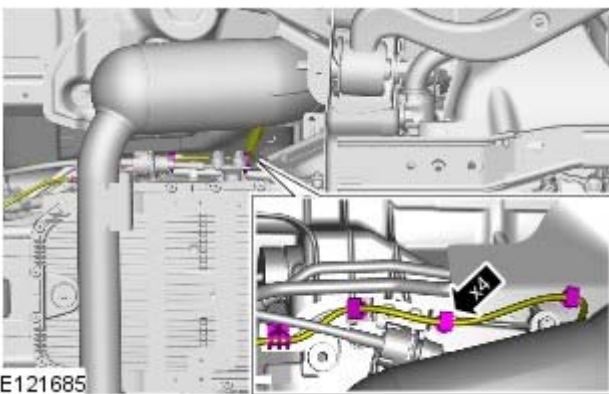
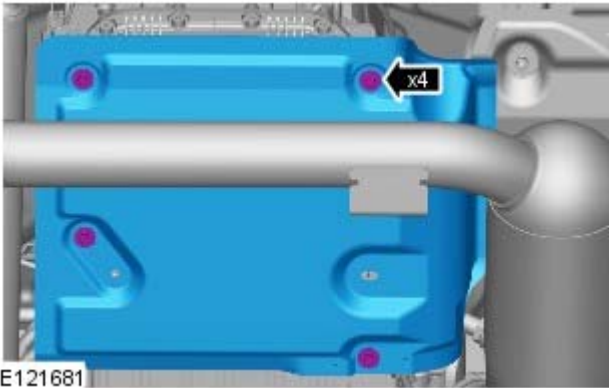
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

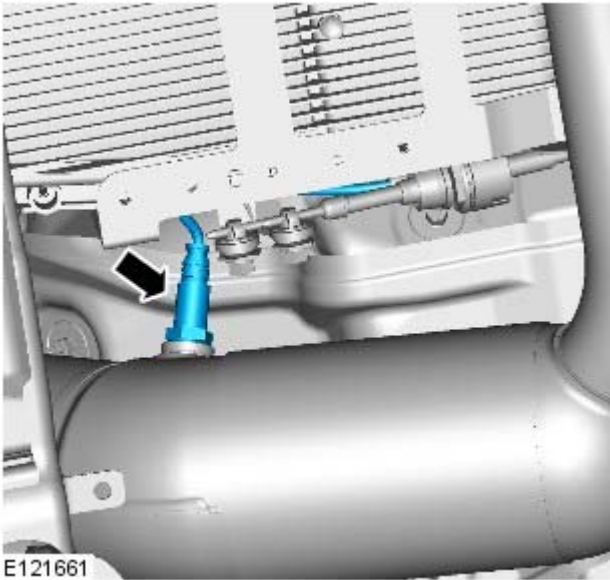
Raise and support the vehicle.


2. Torque: 10 Nm



- 3.

- 4.



5.  CAUTION: Make sure that the mating faces are clean and free of foreign material.

Torque: 48 Nm

Installation

1. 1. CAUTIONS:

 Make sure the anti-seize compound does not contact the HO2S tip.

 If accidentally dropped or knocked install a new sensor.

 Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

• NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

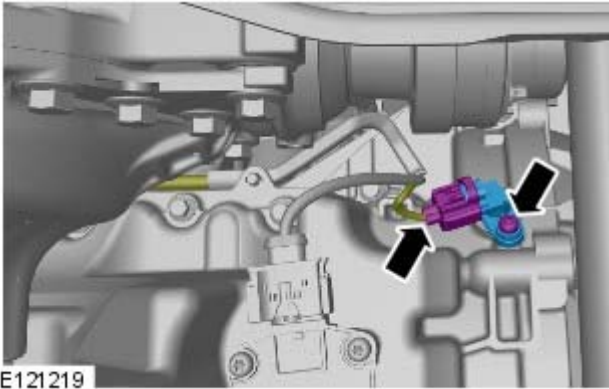
1. Disconnect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



4.  CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Torque: 10 Nm

Installation

1. 1. CAUTIONS:



Make sure that the mating faces are clean and free of foreign material.



Make sure that the component is clean, free of foreign material and lubricant.

To install, reverse the removal procedure.

2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V8 5.0L Petrol - Engine Control Module (ECM)

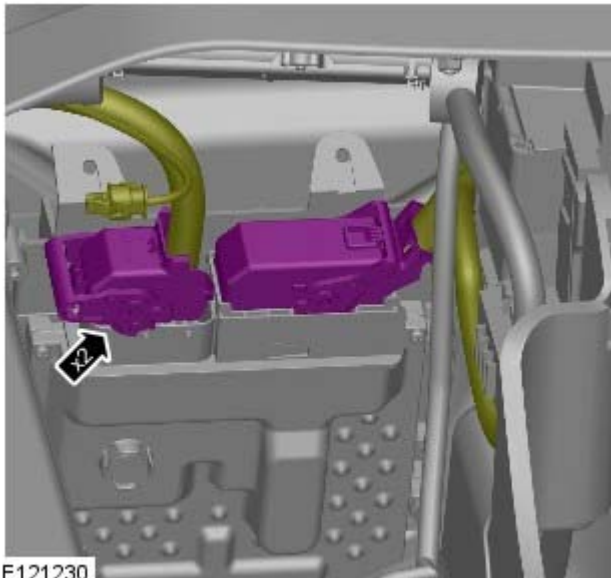
Removal and Installation


Removal

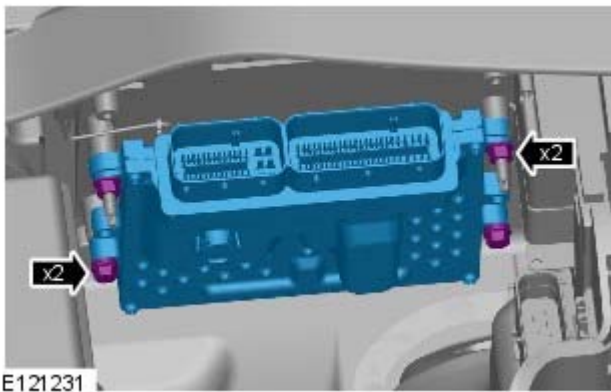
- NOTE: Removal steps in this procedure may contain installation details.

1. Remove the battery.

Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).



2.  CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.



3. Torque: 7 Nm

Installation


1. To install, reverse the removal procedure.

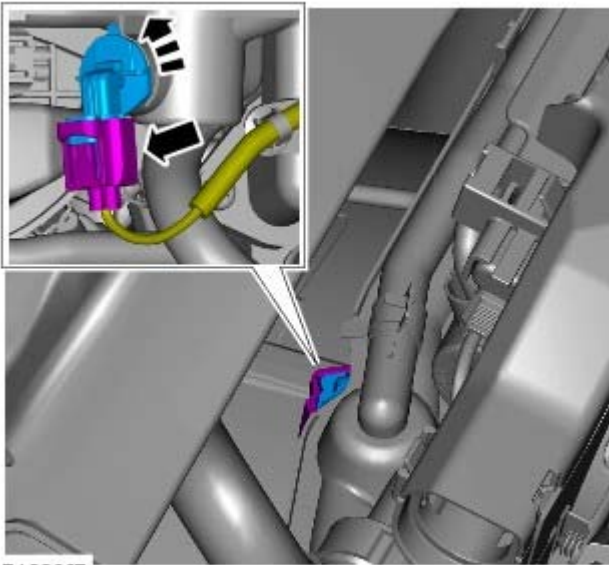
Electronic Engine Controls - V8 5.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Disconnect the battery ground cable.
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).



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5. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Engine Oil Level Sensor

Removal and Installation

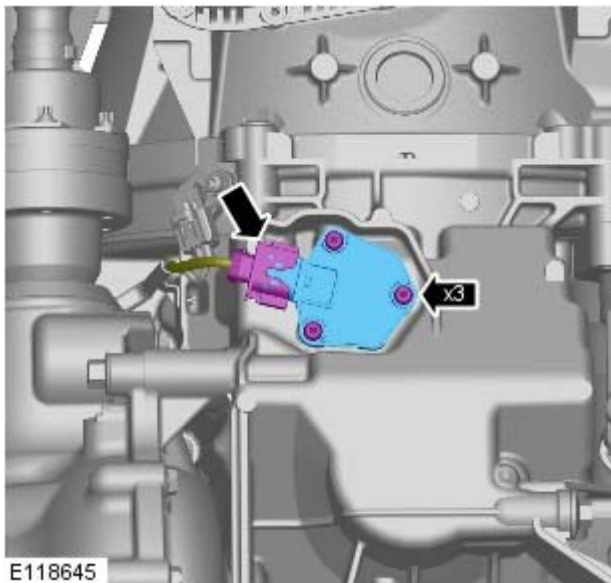
Removal

- NOTE: Removal steps in this procedure may contain installation details.


1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).



3. **3. CAUTIONS:**

 Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

 Remove and discard the O-ring seal.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 12 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Front Knock Sensor (KS) LH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

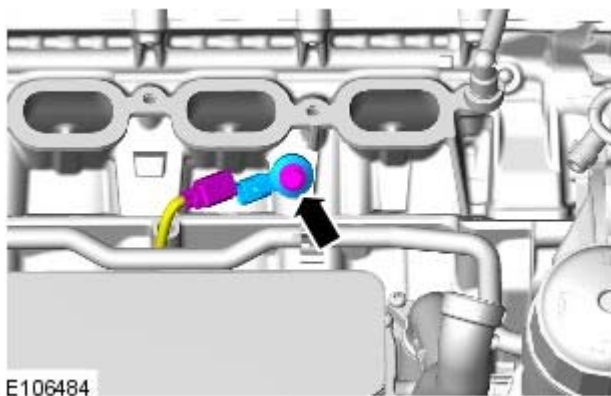
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).

4. Torque: 20 Nm



Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Front Knock Sensor (KS) RH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

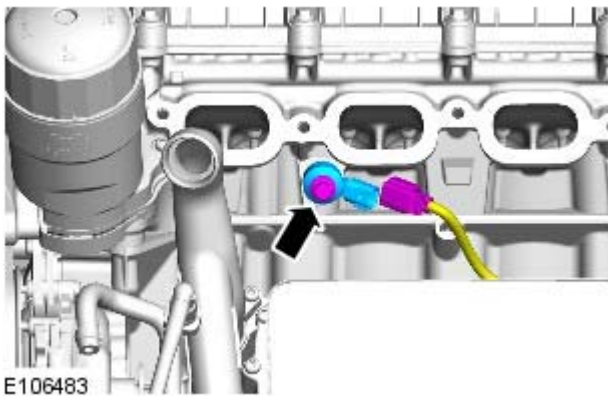
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



4. Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Fuel Rail Pressure (FRP)

Sensor

Removal and Installation

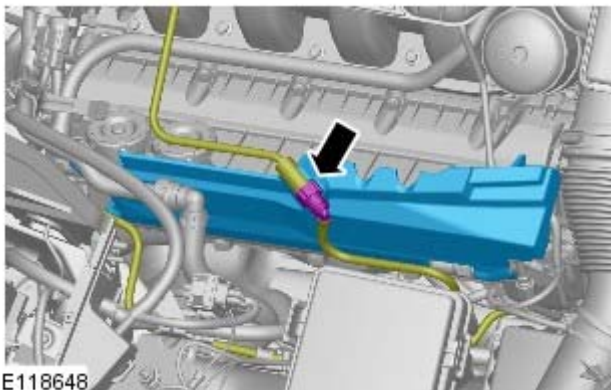
Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Refer to: [Fuel System Pressure Release - V8 5.0L Petrol](#) (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: [Fuel Injection Component Cleaning](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).
5. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



7. CAUTIONS:



Be prepared to collect escaping fluids.



Make sure that all openings are sealed. Use new blanking caps.

- Torque: 32 Nm

Installation

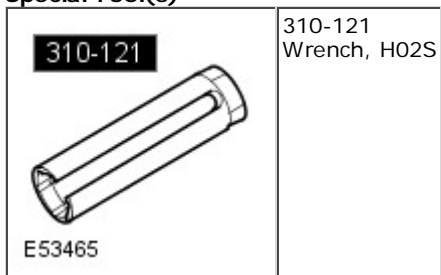
1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Heated Oxygen Sensor (HO2S)

LH


Removal and Installation

Special Tool(s)

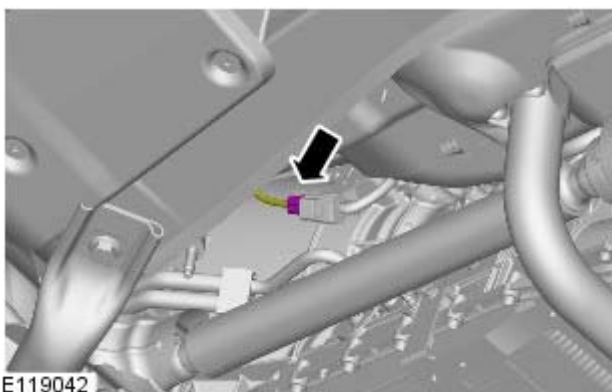
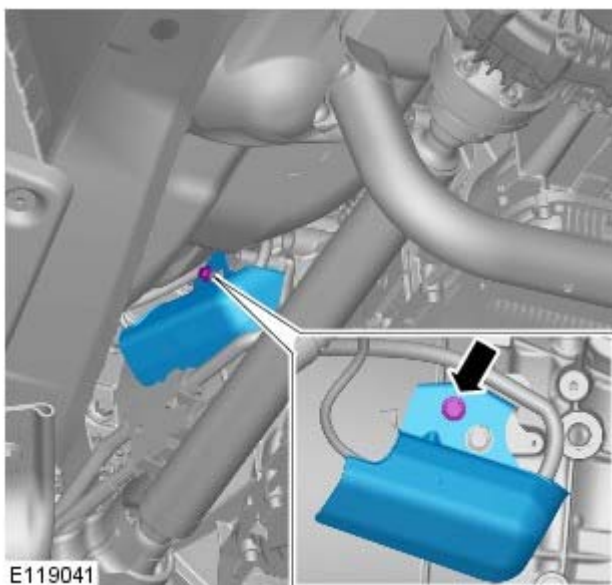


Removal

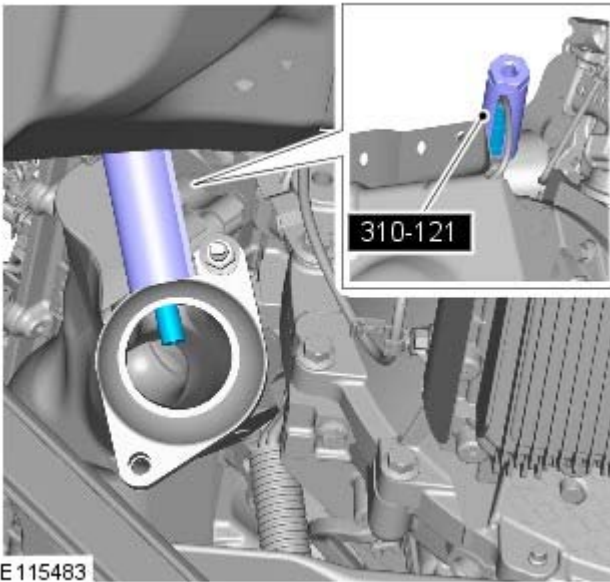
• NOTE: Removal steps in this procedure may contain installation details.


1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

3. *Torque: 11 Nm*



4.



5.  CAUTION: Make sure that the mating faces are clean and free of foreign material.

Special Tool(s): [310-121](#)
Torque: [48 Nm](#)

Installation

1. CAUTIONS:

 Make sure the anti-seize compound does not contact the HO2S tip.

 If accidentally dropped or knocked install a new sensor.

 Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

• NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

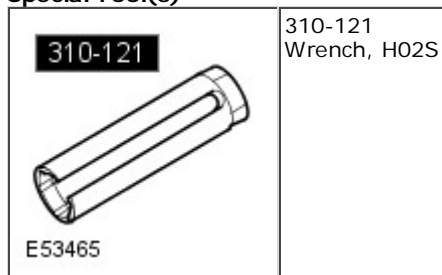
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V8 5.0L Petrol - Heated Oxygen Sensor (HO2S)

RH

Removal and Installation

Special Tool(s)



Removal

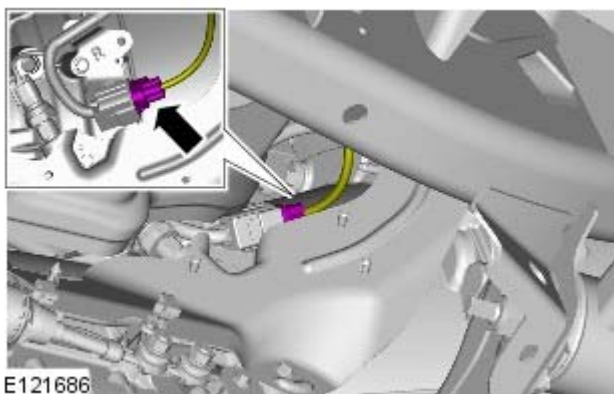
• NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

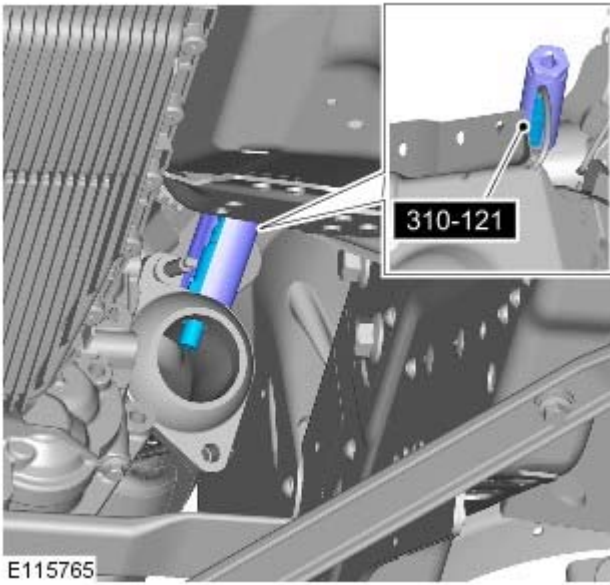
Raise and support the vehicle.


2. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

3. Torque: 9 Nm



- 4.



5.  CAUTION: Make sure that the mating faces are clean and free of foreign material.

Special Tool(s): [310-121](#)
Torque: [48 Nm](#)

Installation

1. CAUTIONS:

 Make sure the anti-seize compound does not contact the HO2S tip.

 If accidentally dropped or knocked install a new sensor.

 Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

• NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Manifold Absolute Pressure (MAP) Sensor

Removal and Installation

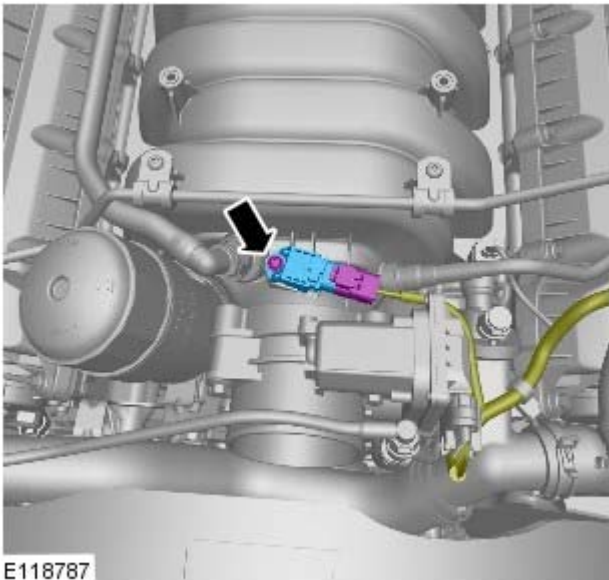
Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

2. **2.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

• Torque: 5 Nm



Installation

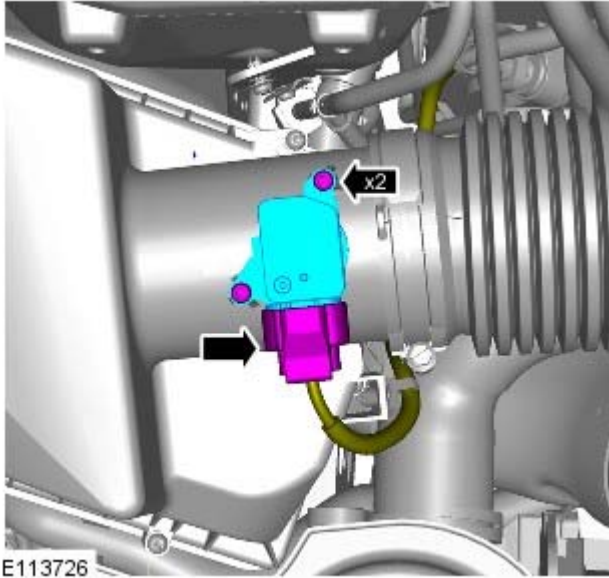
1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.



1. NOTE: Right-hand shown, left-hand similar.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 1.2 Nm

Installation

1. To install reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V8 5.0L Petrol - Rear Knock Sensor (KS) LH

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

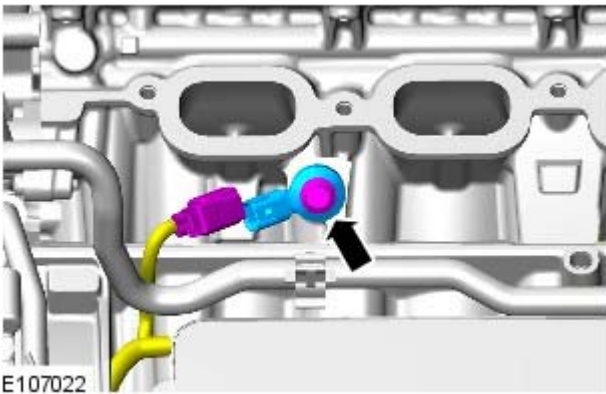
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



4. Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Rear Knock Sensor (KS) RH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

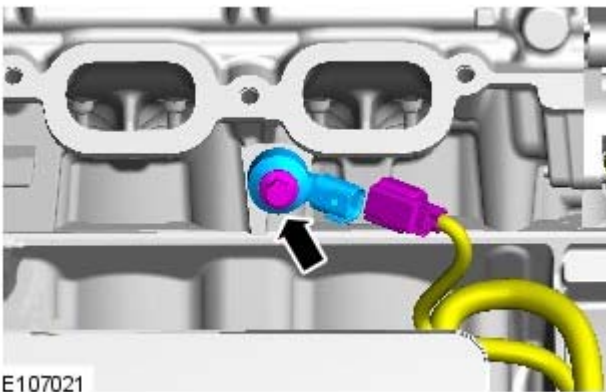
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



4. Torque: 20 Nm

Installation


1. To install, reverse the removal procedure.

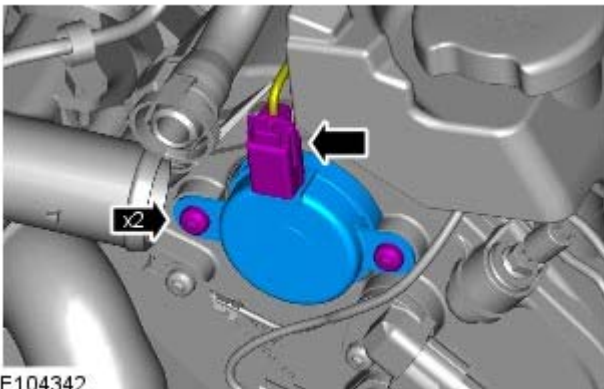
Electronic Engine Controls - V8 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid LH

Removal and Installation

Removal

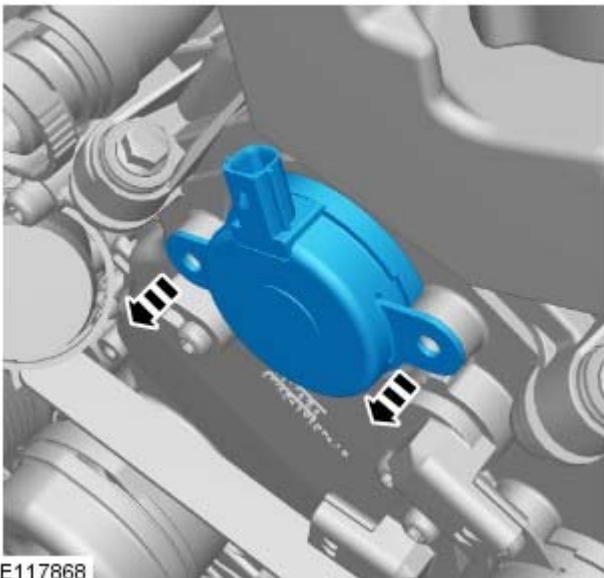
- NOTE: Removal steps in this procedure may contain installation details.


1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).




3. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 10 Nm



4.  **CAUTION:** Evenly and progressively, remove the VVT units from each side.
• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Installation

1.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.
• NOTE: Lubricate the O-ring seal with clean engine oil.
To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid RH

Removal and Installation

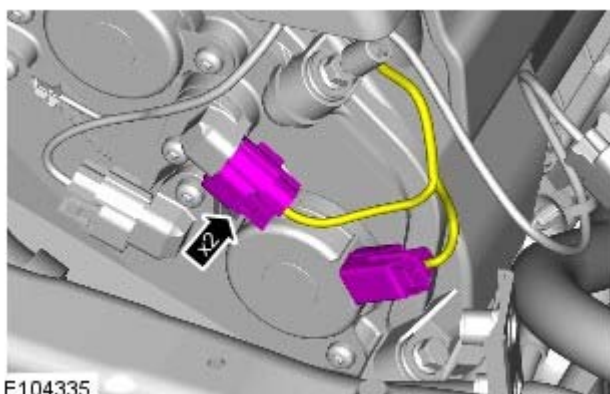
Removal

- NOTE: Removal steps in this procedure may contain installation details.

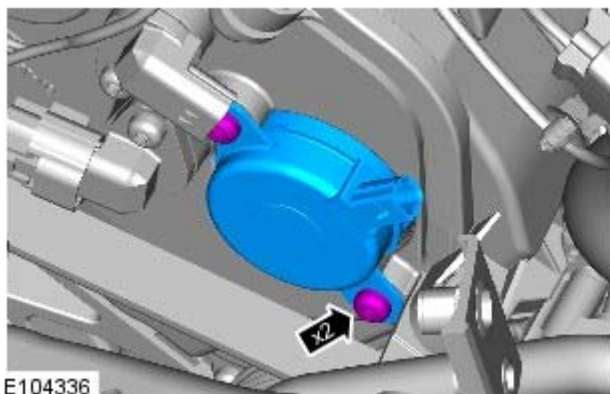
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

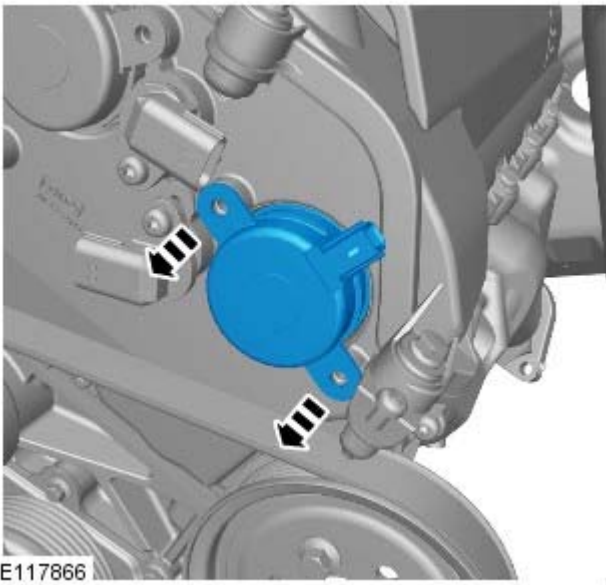



3. **3.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.




4. **4.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 10 Nm



5.  CAUTION: Evenly and progressively, remove the VVT units from each side.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Installation

1.  CAUTION: Make sure that the mating faces are clean and free of foreign material.

- NOTE: Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.

Automatic Transmission/Transaxle - TDV6 2.7L Diesel -

Item	Specification
* Recommended lubricant	Shell M13754
+ Torque converter nose	Molybdenum disulphide grease to specification FB180

• **CAUTIONS:**

* Do not use any lubricant other than that specified.



+ Do not over lubricate.

Capacity

Item	Capacity
+ Initial dry fill	9.5 litres (16.7 pints) (10.0 US qts)

**CAUTION:** + A final oil level check/drain down/top-up must be carried out when the unit has been installed.**General Specification**

Item	Specification
Automatic transmission	ZF 6HP26
Speeds	6 Forward, 1 Reverse
Gear ratios:	
First	4.17:1
Second	2.340:1
Third	1.521:1
Fourth	1.143:1
Fifth	0.867:1
Sixth	0.691:1
Reverse	3.403:1
Torque converter	Sachs W255 2GWK with turbine torsional damper and slip controlled, dual friction faced lock-up clutch
Transmission control module:	
Location	Located in gearbox casing
Type	1904

Torque Specifications

Description	Nm	lb-ft
Main control valve body Torx screws	8	6
Transmission heat shield bolts	10	7
Transmission heat shield bracket bolts	10	7
Selector cable bracket nut	12	9
Selector cable bracket bolts	10	7
Wiring harness bracket Torx bolt	10	7
Fluid pan Torx screws	8	6
Engine RH support nut	90	66
Transmission support insulator bolts	60	44
Selector shaft nut	12	9
Selector cable bracket bolts	10	7
Flexplate to torque converter bolts	45	33
Transmission bolts	45	33
Transmission breather pipe clip bolt	25	18
Transmission fluid lines clip bolt	10	7
Radiator access panel bolts	10	7
Exhaust cross-over pipe center support bracket bolts	25	18
Exhaust cross-over pipe LH/RH support bracket bolts	25	18
Turbocharger support bracket nut and bolts	22	16
Transmission fluid drain plug	9	6.5
Transmission fluid filler/level plug	35	26
transmission heat shield bolts	10	7
Transmission under shield bolts	10	7
Transfer case retaining bolts	45	33
* Exhaust crossover pipe retaining nuts	22	16
Exhaust manifold heat shield retaining bolts	10	7

*** New nuts must be installed**

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Automatic Transmission

Description and Operation

For additional information, refer to: [Automatic Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Description and Operation).

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Automatic Transmission

Diagnosis and Testing

Principle of Operation

For detailed description of the automatic transmission system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Automatic Transmission](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification

This section is intended to provide a means for the technician to diagnose transmission component faults, rather than replacing the entire unit.

However, there are a number of situations where the replacement of the unit is the only practical solution, and this section will cover the diagnosis necessary to gather the information required for transmission replacement to be authorized by the warranty prior approval program (WPAP) where it applies, as well as covering the diagnostic trouble codes (DTCs) stored by the control module.

The basic checks of the transmission (fluid condition and level, etc) should be carried out first, and this will mean using the approved diagnostic system or other equipment with data logging facility to monitor temperatures, etc.

For information on the operation of the transmission, refer to the relevant workshop manual section.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fluid condition ● Fluid level ● Fluid leaks ● Fluid cooler ● External linkages ● Gear selector lever 	<ul style="list-style-type: none"> ● Fuses ● Wiring harnesses ● Electrical connector(s) ● Transmission control module (TCM) ● Engine control module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** Use the approved diagnostic system or a scan tool to retrieve any DTCs before moving onto the DTC index.
 - Because the DTCs are stored in more than one module, a complete vehicle read is recommended
 - Make sure that all DTCs are cleared following rectification.

Preliminary Inspection

1. **1.** As much information as possible should be obtained from the owner/driver about the fault in order to assist with the diagnosis. Time spent on this will reduce the necessity for extensive road testing and possible missed diagnosis.
 - The information required for WPAP is still useful as an aid to diagnosis, even where the system is not in operation

Required information for WPAP (where applicable)

- The nature of the fault (loss of drive, slip, judder, gear shift quality, noise, etc)
 - The frequency with which the fault occurs
 - The conditions under which the fault occurs, including temperature (coolant and ambient), selected gear, road speed, engine speed, and any specific conditions
 - Check and rectify non-transmission related DTCs before continuing with transmission diagnosis
2. **2.** Record the vehicle details, including:
 - Service history
 - The transmission serial number
 - The transmission software level
 3. **3.** Visually inspect the transmission for fluid leaks, damage, etc.
 4. **4.** Check the transmission fluid condition.

• **NOTE:** Fluid condition is a good indicator of the transmission internal condition. If the fluid is burnt and/or contaminated, this would usually mean the internal damage to the transmission is at such a level that unit replacement is the best option. Compare the fluid drained from the transmission with fresh fluid for color and odor.

5. **5.** Check the transmission fluid level. Refer to the relevant workshop manual section.

• **NOTE:** This is crucial to the operation of the transmission, and the procedure must be closely followed to avoid inaccurate diagnosis, with the resultant possible rejection of a warranty claim.

6. **6.** Check the engine idle speed and throttle sensor using the approved diagnostic system or a scan tool.
7. **7.** Check the transmission selector cable adjustment. Refer to the relevant workshop manual section.
8. **8.** Check the transmission range sensor adjustment.

- A comprehensive procedure for transmission range sensor setting is accessible through the approved diagnostic system.

If any faults are found and rectified in the above sequence, clear any DTCs and test the vehicle for normal operation.

If a failure condition is found indicating the need to renew the transmission assembly, the request must go through the warranty prior approval program (where applicable) before work is begun.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transmission Control Module \(TCM\) - Bosch](#) (100-00 General Information, Description and Operation).

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Transmission Fluid Drain and Refill

General Procedures

• WARNINGS:



Observe due care when draining transmission fluid as the fluid can be very hot.



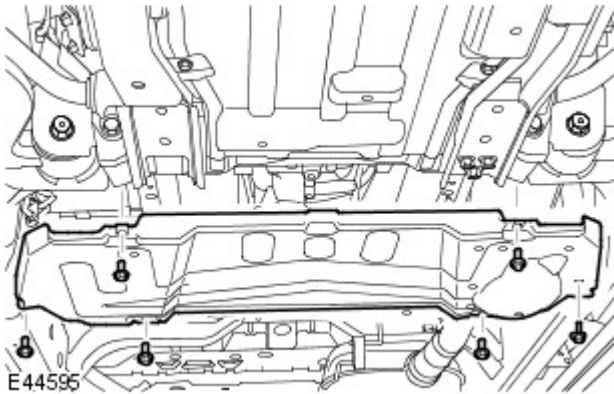
Observe due care when working near a hot exhaust system.

All vehicles

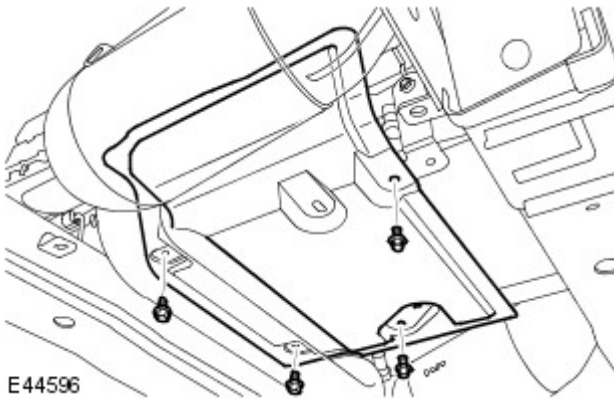
- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the transmission undershield.
 - Remove the 6 bolts.

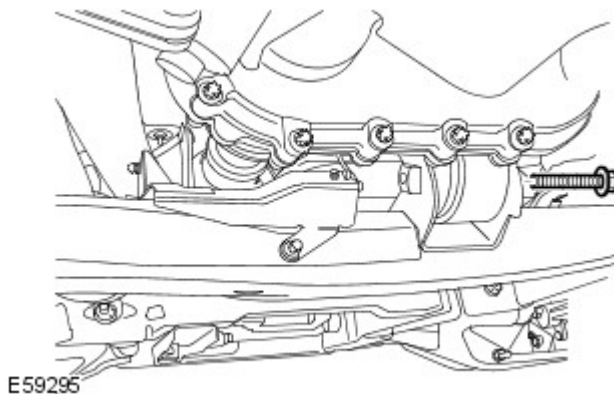


- If installed, remove the transmission heat shield.
 - Remove the 4 bolts.



Vehicles with 4.0L engine

- Remove the transmission support insulator through-bolt.
 - Raise the transmission to gain access to the fluid drain plug.



All vehicles

5. Clean the area around the transmission fluid drain and filler plugs.
6. Place a container under the transmission.



7. WARNINGS:



Observe due care when draining transmission fluid as the fluid can be very hot.



Observe due care when working near a hot exhaust system.

Remove the transmission fluid filler/level plug.

- Remove and discard the sealing washer.



8. Remove the transmission fluid drain plug.

- Remove and discard the sealing washer.
- Allow the fluid to drain.

9. Install the transmission fluid drain plug and tighten to 9 Nm (7 lb.ft).

- Install a new sealing washer.

Vehicles with 4.0L engine

10. Install the transmission support insulator through-bolt and tighten to 175 Nm (129 lb.ft).

- Lower the transmission.

All vehicles

11. Add 3.5 to 4 litres of the correct transmission fluid, or until a small thread of fluid runs from the filler/level hole.

12. Check and top-up the transmission fluid level.

For additional information, refer to: [Transmission Fluid Level Check](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Transmission Fluid Level Check

General Procedures

• WARNINGS:



Observe due care when draining transmission fluid as the fluid can be very hot.



Observe due care when working near a hot exhaust system.



CAUTION: The gearbox fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

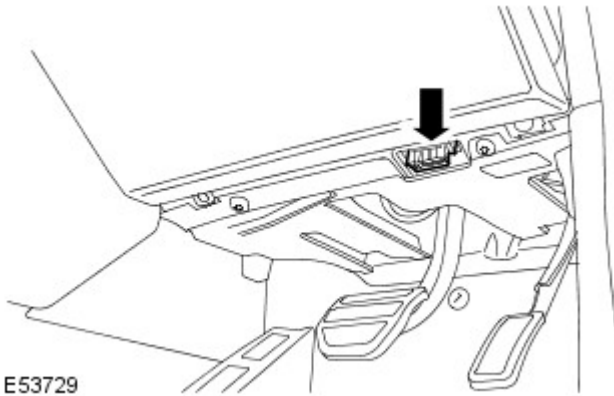
1. The following steps must be observed before starting the transmission fluid level check and top-up.

- The vehicle must be on a horizontal ramp.
- The parking brake must be applied.
- The wheels must be chocked.



CAUTION: Make sure the transmission fluid temperature is below 30 degrees before starting the fluid level check.

Using the approved Land Rover diagnostic equipment, monitor the transmission fluid temperature.



E53729

3. Start the engine. Move the selector lever from 'P' through all gear positions, pausing in each gear position for 2-3 seconds and return to the 'P' position.

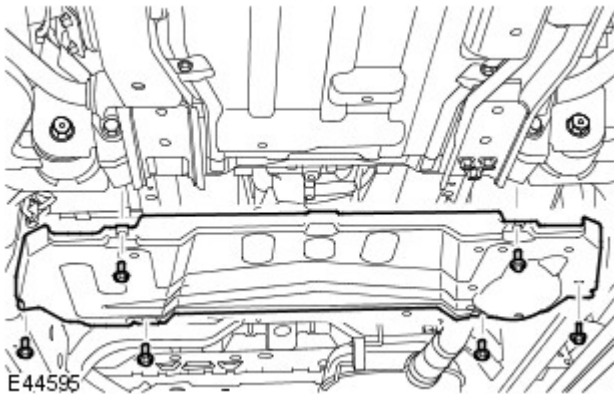


WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

5. Remove the transmission undershield.

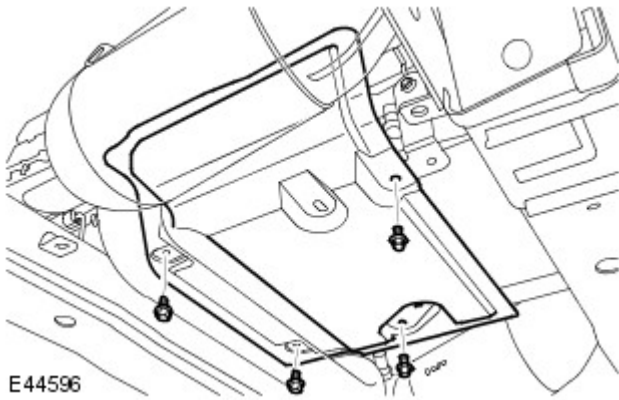
- Remove the 6 bolts.



E44595

6. If installed, remove the transmission heat shield.

- Remove the 4 bolts.




7. Place a container under the transmission.

8. WARNINGS:

 Observe due care when draining transmission fluid as the fluid can be very hot.

 Observe due care when working near a hot exhaust system.

 CAUTION: The gearbox fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

Remove the transmission fluid filler/level plug.

- Clean the area around the filler/level plug.
- Remove and discard the sealing washer.

9. If no fluid loss is apparent when the filler/level plug is removed, with the engine at idle, continue to fill the transmission until a small thread of oil runs from oil filler/level hole.

10. Install the transmission fluid filler/level plug and tighten to 35 Nm (26 lb.ft).

- Install a new sealing washer.
- Remove the container.

11. If installed, install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

12. Install the transmission undershield.




- Tighten the bolts to 10 Nm (7 lb.ft).

13. Disconnect the approved Land Rover diagnostic equipment from the vehicle.




Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Selector Shaft Seal

In-vehicle Repair

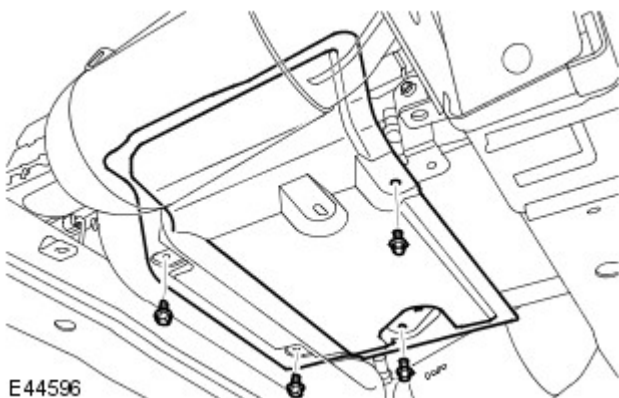
Special Tool(s)	
 <p>307-509-1</p> <p>E50766</p>	<p>ZF Automatic transmission selector shaft seal remover</p> <p>307-509-1 (LRT-44-033/1)</p>
 <p>307-509-2</p> <p>E50767</p>	<p>ZF Automatic transmission selector shaft seal remover</p> <p>307-509-2 (LRT-44-033/2)</p>
 <p>307-509-3</p> <p>E50768</p>	<p>ZF Automatic transmission selector shaft seal installer</p> <p>307-509-3 (LRT-44-033/3)</p>

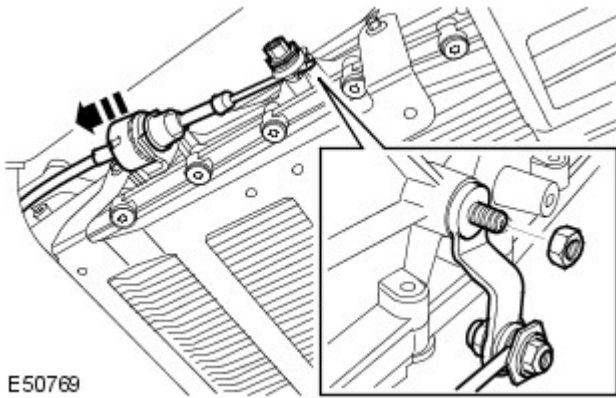
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- LH selector shaft seal only: Remove the exhaust system. For additional information, refer to: [Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation) / [Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).
- Remove the transmission heat shield.
 - Remove the 4 bolts.

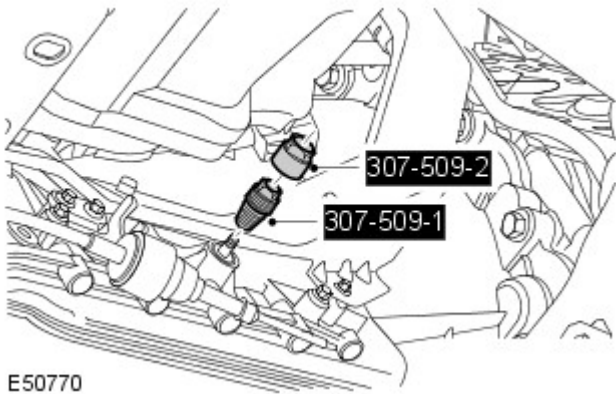





E50769

4. Release the selector cable and lever.

- Remove the nut.
- Compress the latch and release the cable.



E50770

5.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

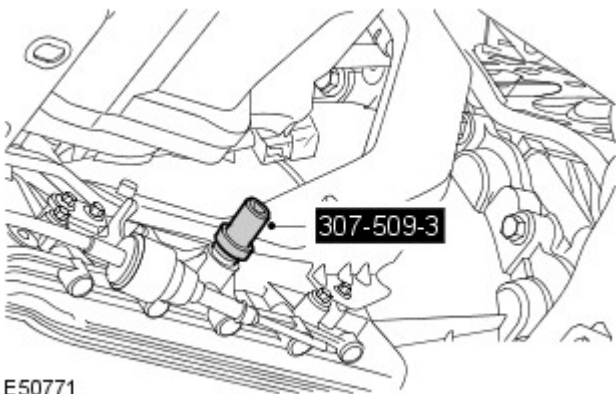
Remove the selector shaft seal.

- Install 307-509-1 to the seal.
- Install 307-509-2 to 307-509-1 and extract the seal.

Installation

1. **NOTE:** Clean the components.

Using 307-509-3, install the selector shaft seal.



E50771

2. Install the selector cable and bracket.

- Secure with the clip.
- Tighten the nut to 12 Nm (9 lb.ft).


3. Install the transmission heat shield.

- Install the bolts.

4. LH selector shaft seal only: Install the exhaust system.
For additional information, refer to: [Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation) / [Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).


Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Transmission Control Module (TCM)

In-vehicle Repair

Special Tool(s)	
 <p>307-492</p> <p>E48903</p>	Seal extractor 307-492 (LRT-44-005)

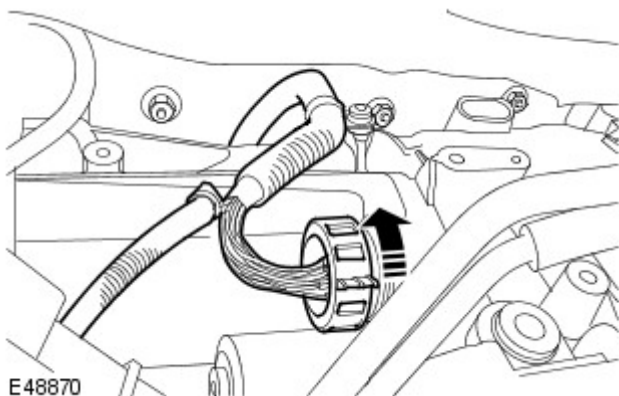
Removal

- NOTE: The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

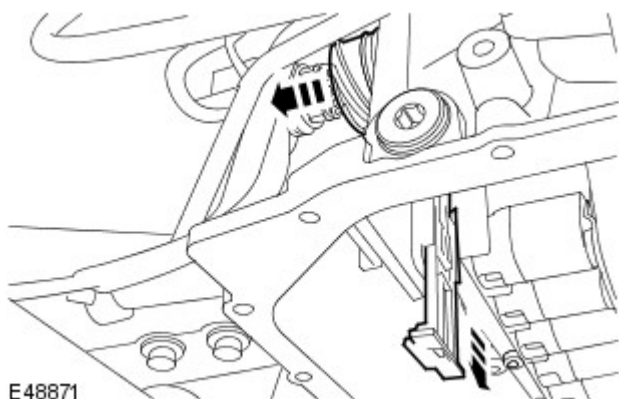
Raise and support the vehicle.

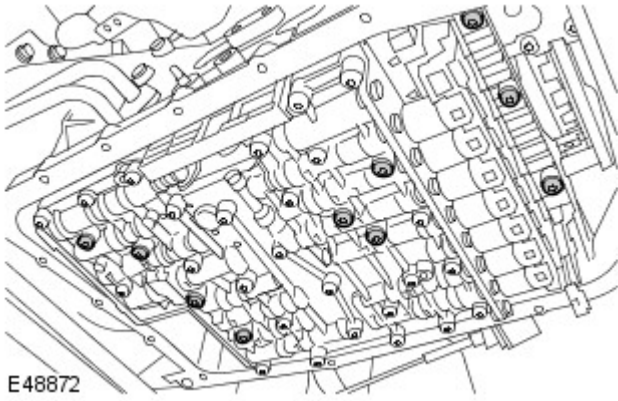
- Remove the fluid pan.
For additional information, refer to: [Fluid Pan, Gasket and Filter](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, In-vehicle Repair).
- Disconnect the electrical connector.



- Remove and discard the electrical connector sleeve.

- Release the retainer.



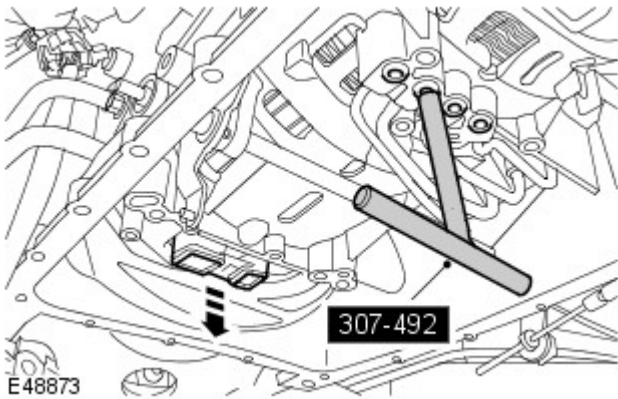


5. Remove the valve body.

- Position a container to collect spillage.
- Remove the 10 Torx screws.

6. Using the special tool, remove the 4 seals.

7. Remove the seal block.



Installation

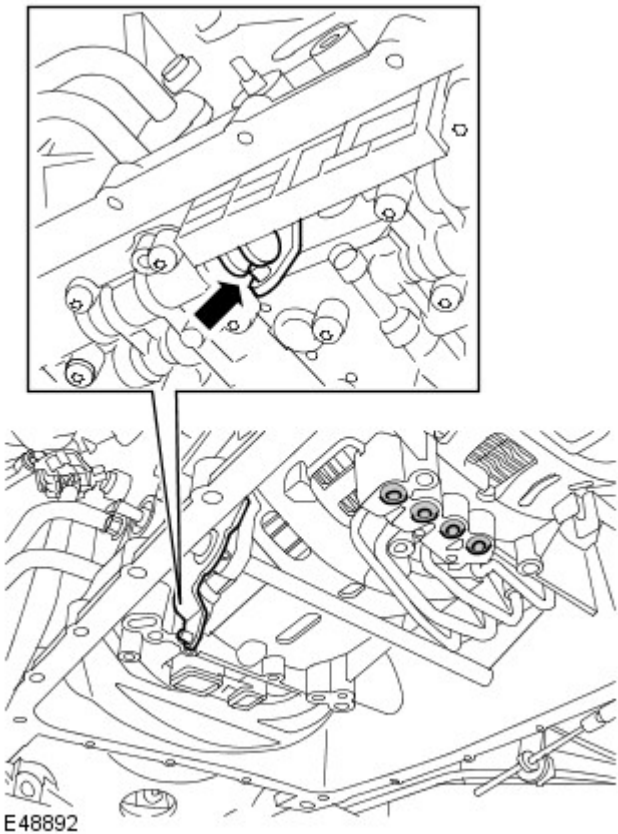
1. CAUTIONS:

 Make sure that when fully fitted, all seals protrude by the same amount.

 Engage the selector lever with the groove in the piston rod.

Install the valve body.

- Clean the component mating faces.
- Install new seals.
- Install a new seal block.
- Tighten the Torx screws to 8 Nm (6 lb.ft).



2. Install a new electrical connector sleeve.

- Secure with retainer.

3. Connect the electrical connector.



4. Install the fluid pan.

For additional information, refer to: [Fluid Pan, Gasket and Filter](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, In-vehicle Repair).


5. Using T4, calibrate a new TCM.

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Output Shaft Seal

In-vehicle Repair


Special Tool(s)	
 <p>303-903 E50940</p>	<p>Oil seal remover 303-903 (LRT-12-092)</p>
 <p>307-520 E52536</p>	<p>Oil seal installer 307-520</p>

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

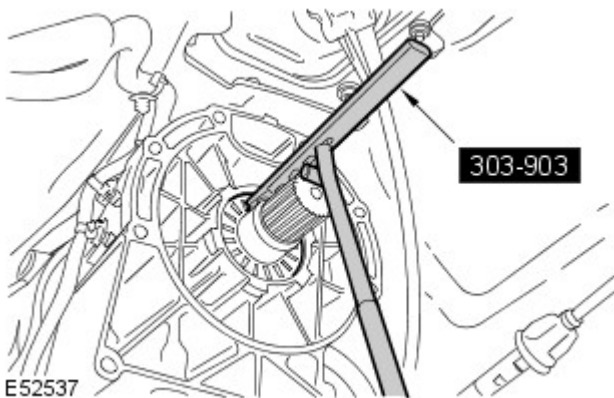
Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

-  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.

Remove the transmission output shaft oil seal.

- Use the special tool.

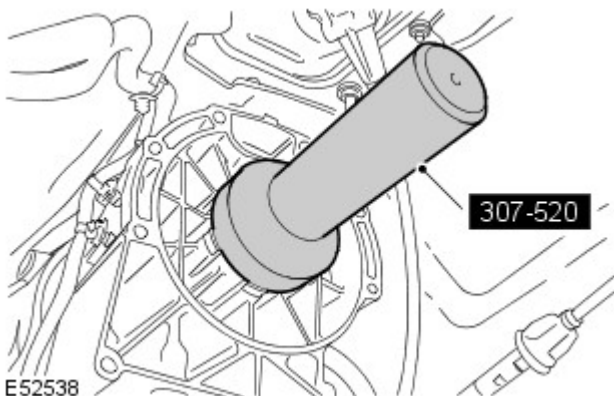


Installation

-  **CAUTION:** Oil seals must be fitted dry.

Install a new transmission output shaft oil seal.

- Clean the seal register.
- Use the special tool.



- Install the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L](#)

[Diesel](#) (308-07B Transfer Case, Removal).


3. Check and top-up the transmission fluid level.
For additional information, refer to: [Transmission Fluid Level Check](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Fluid Pan, Gasket and Filter

In-vehicle Repair

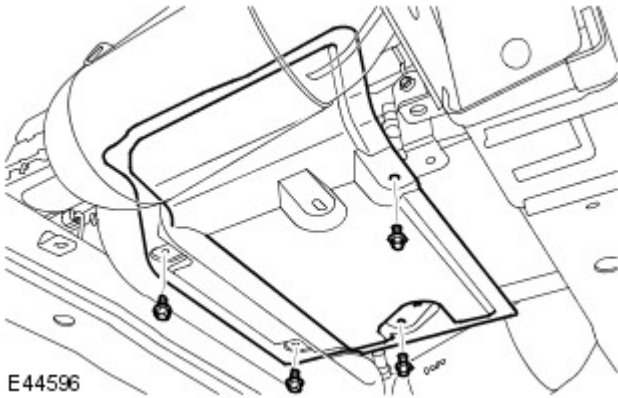
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

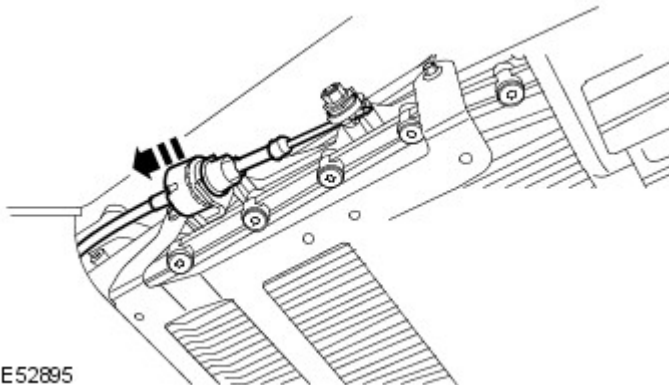
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

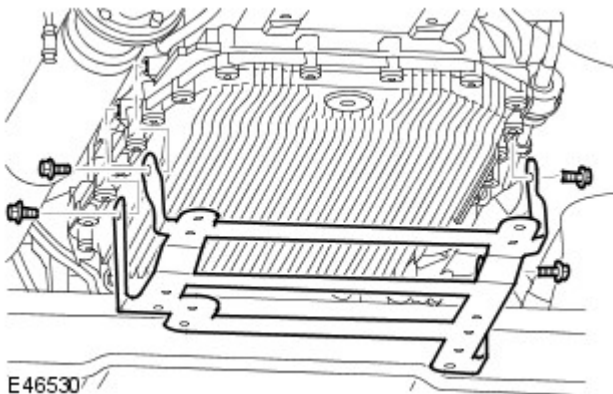
3. Remove the transmission heat shield.
 - Remove the four retaining bolts.



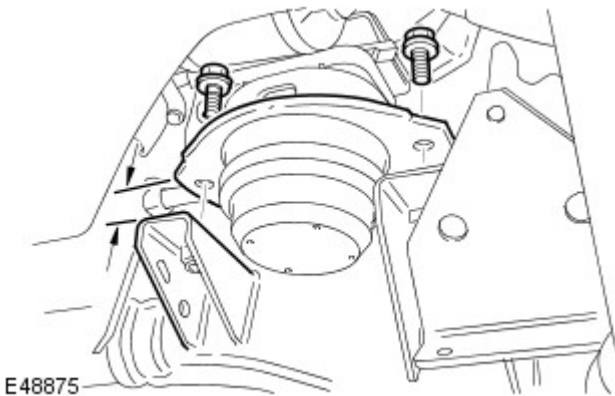
4. Release the selector cable from its abutment bracket.




5. Remove the transmission heat shield bracket.
 - Remove the four retaining bolts.



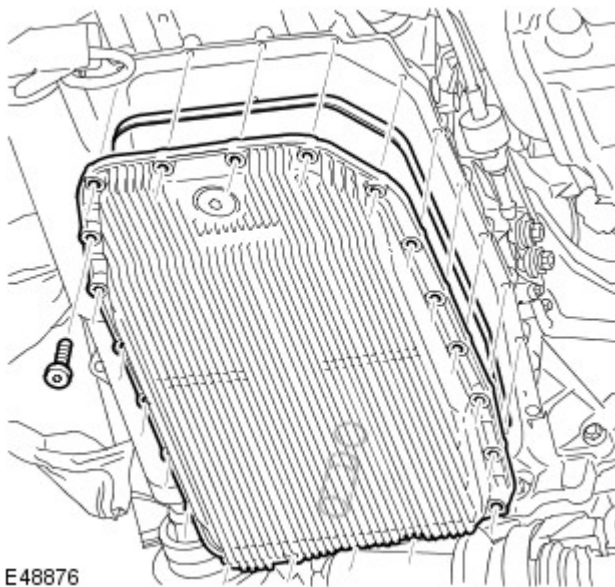
6. Drain the transmission fluid.
For additional information, refer to: [Transmission Fluid Drain and Refill](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).



7.  CAUTION: Protect the engine during this operation.

Raise the RH side of the engine by approximately 35 mm (1.38 in).

- Use a transmission jack.
- Remove and discard the two retaining bolts.



8. Remove the fluid pan, gasket and filter.

- Position a container to collect the fluid spillage.
- Remove the 21 Torx screws.
- Remove and if necessary, discard the seal.
- Discard the O-ring seal.


Installation

1. Install the fluid pan, gasket and filter.
 - Clean the components mating faces.
 - Install a new O-ring seal.
 - Tighten the Torx screws to 8 Nm (6 lb.ft).
2. Lower the RH side of the engine.
 - Remove the transmission jack.
 - Install new engine mounting retaining bolts and tighten to 45 Nm (33 lb.ft).
3. Install the transmission heat shield bracket.
 - Install the four retaining bolts and tighten to 10 Nm (7 lb.ft).
4. Install the selector cable to its abutment bracket.
5. Install the transmission heat shield.
 - Install the four retaining bolts and tighten to 10 Nm (7 lb.ft).
6. Connect the battery ground cable.
 For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
7. Refill the transmission with fluid.
 For additional information, refer to: [Transmission Fluid Drain and Refill](#) (307-01A Automatic Transmission/Transaxle - TDV6

2.7L Diesel, General Procedures).

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Main Control Valve Body

In-vehicle Repair

Special Tool(s)	
	Seal extractor
	307-492(LRT-44-005)

Removal

- NOTE: The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

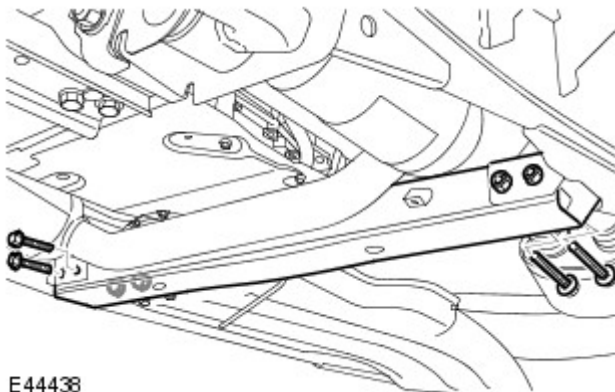
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Drain the transmission fluid.
For additional information, refer to: [Transmission Fluid Drain and Refill](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

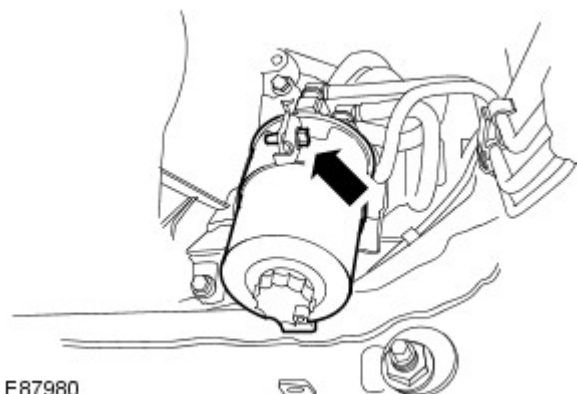
4. Remove the transmission support crossmember.

- Support the transmission on a jack.
- Remove the transmission mounting securing bolt.
- Remove the 4 bolts.
- Remove the transmission support insulator through-bolt.



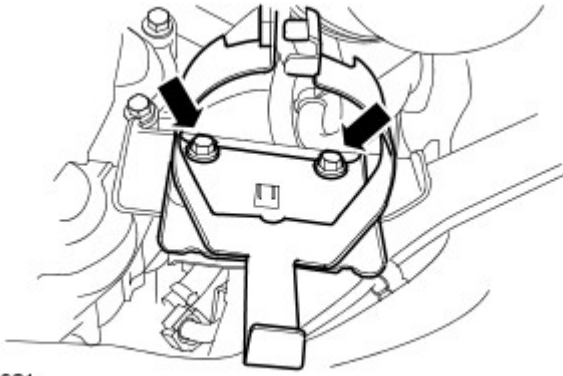
5. Release the fuel filter from its bracket.

- Tie aside.



6. Release the support bracket.

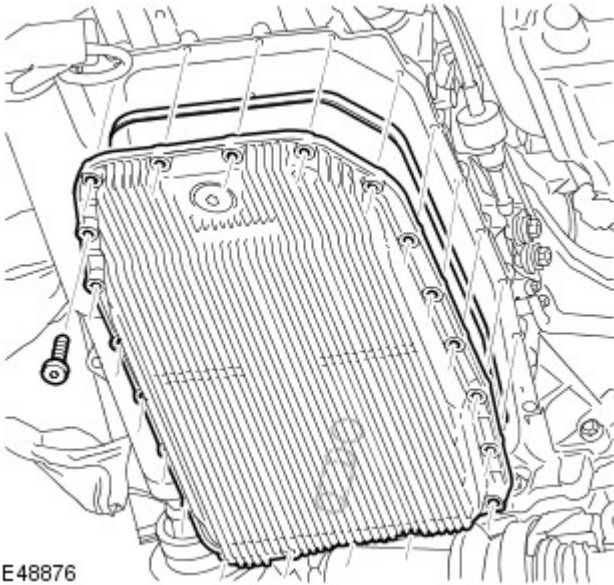
- Remove the bolt closest to the engine.
- Release but do not remove the second bolt.



E87981

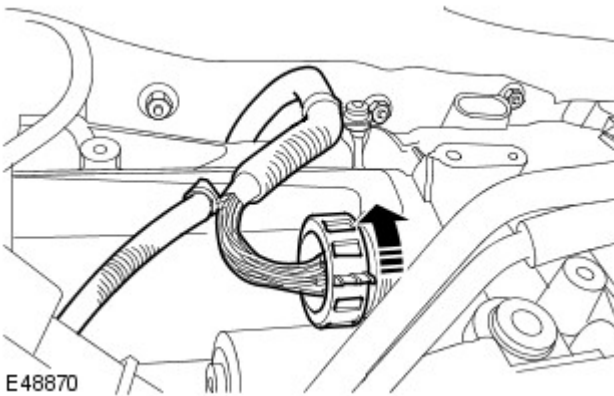
7. Release the oil pan.

- Position a container to collect the oil spillage.
- Remove the 21 Torx screws.

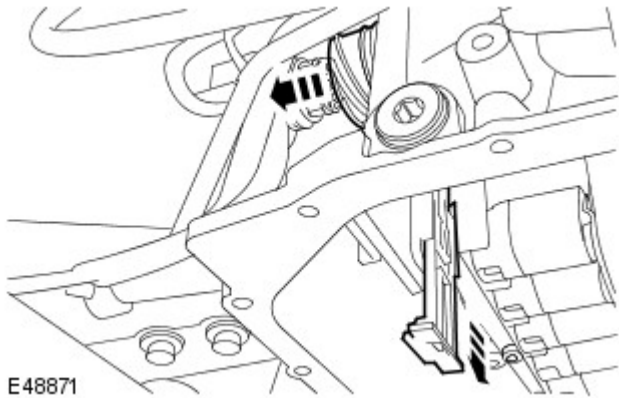


E48876

8. Release and disconnect the electrical connector.



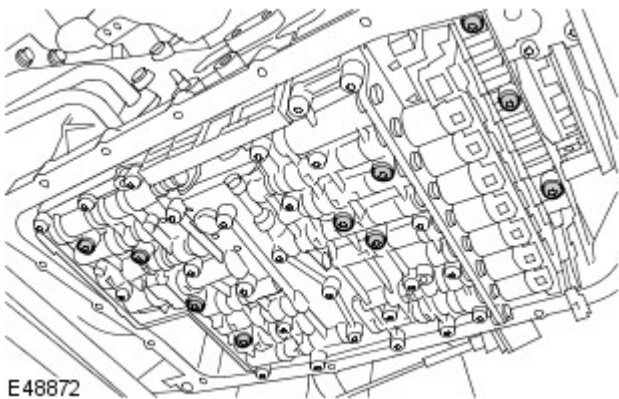
E48870



E48871

9. Remove and discard the electrical connector sleeve.

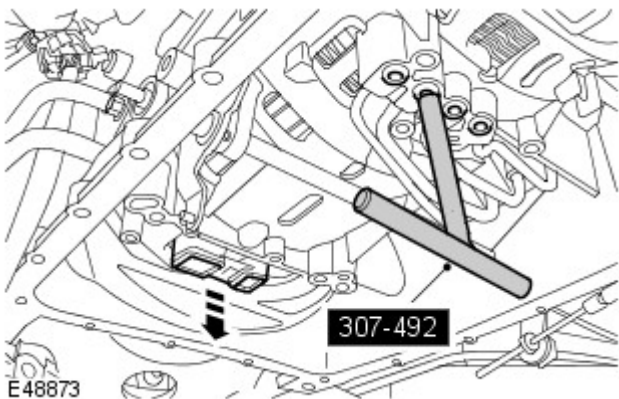
- Release the retainer.



E48872

10. Remove the valve block and oil pan.

- Remove the 7 Torx bolts.
- Discard the O-ring seal.

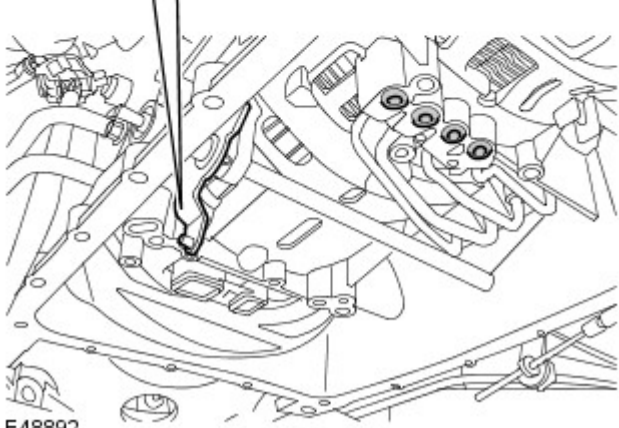
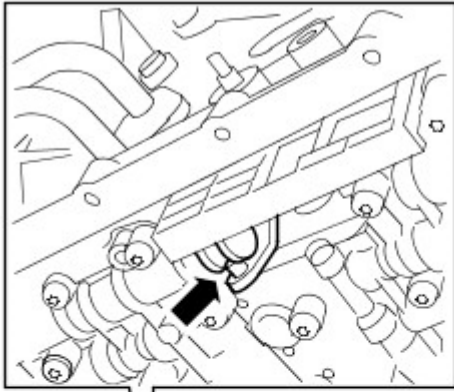


E48873

11. Using the special tool, remove the 4 seals.

12. Remove the seal block.

Installation



E48892

1. CAUTIONS:



Make sure that when fully fitted, all seals protrude by the same amount.



Engage the selector lever with the groove in the piston rod.

Install the valve block and oil pan.

- Clean the component mating faces.
- Install new seals.
- Install a new seal block.
- Tighten the Torx screws to 8 Nm (6 lb.ft).

2. Install a new electrical connector sleeve.

- Secure with retainer.

3. Connect the electrical connector.

4. Secure the oil pan.

- Tighten the Torx screws to 8 Nm (6 lb.ft).

5. Install the fuel filter support bracket.

6. Install the fuel filter.

7. Install the transmission support crossmember.

- Install the transmission support insulator through-bolt and tighten to 175 Nm (129 lb.ft).
- Install the 4 bolts.
- Tighten the nuts and bolts to 90 Nm (66 lb.ft).
- Remove the transmission jack.

8. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

9. Fill the transmission with fluid.


For additional information, refer to: [Transmission Fluid Drain and Refill](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

10. Using the Land Rover approved diagnostic equipment, calibrate the control valve body.

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Transmission Support Insulator

In-vehicle Repair

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

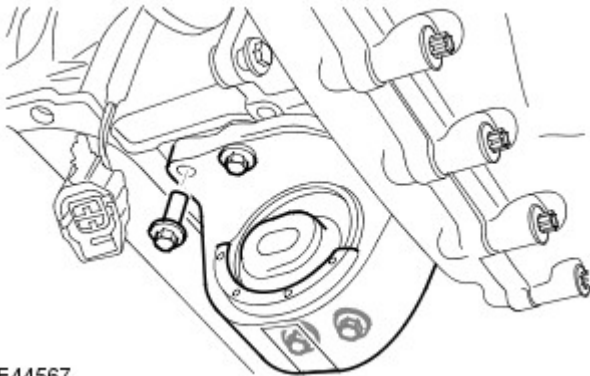
Raise and support the vehicle.

2. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

3. **NOTE:** 4.4L illustration shown, 4.0L and 2.7L Diesel are similar.

Remove the transmission support insulator.

- Remove the 4 bolts.



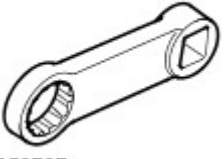
E44567

Installation


1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the bolts to 60 Nm (44 lb.ft).

Automatic Transmission/Transaxle - TDV6 2.7L Diesel - Transmission

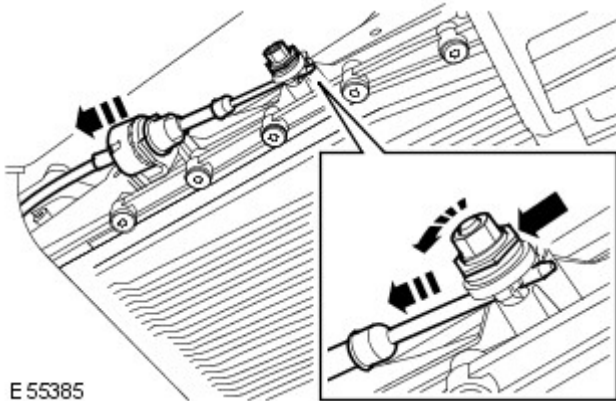
Removal and Installation

Special Tool(s)	
 <p>303-1069</p> <p>E53727</p>	<p>Wrench adaptor</p> <p>303-1069</p>

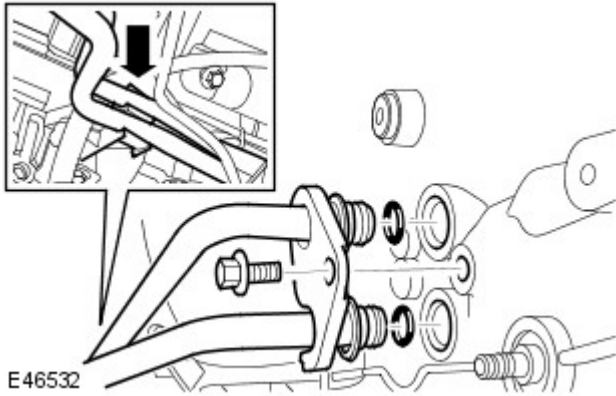
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the front driveshaft.
For additional information, refer to: [Front Driveshaft - TDV6 2.7L Diesel](#) (205-01 Driveshaft, Removal and Installation).
4. Remove the exhaust system.
For additional information, refer to: [Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation) / [Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).
5. Remove the rear driveshaft.
For additional information, refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).
6. Remove the starter motor.
For additional information, refer to: [Starter Motor](#) (303-06A Starting System - TDV6 2.7L Diesel, Removal and Installation).
7. Release the selector cable.
 - Using an additional wrench, restrain the clamping bush and loosen the locknut.
 - Compress the latch and release the cable.



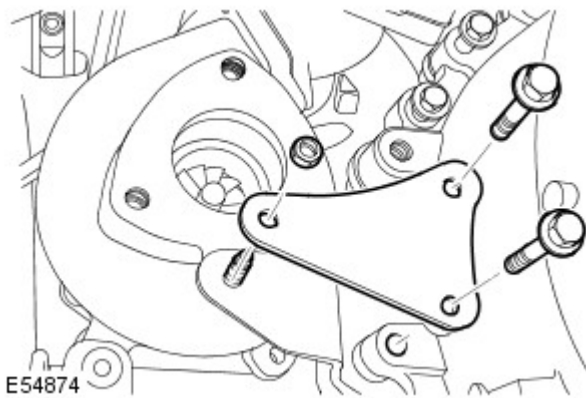
E 55385



8.  **CAUTION:** Always plug any open connections to prevent contamination.

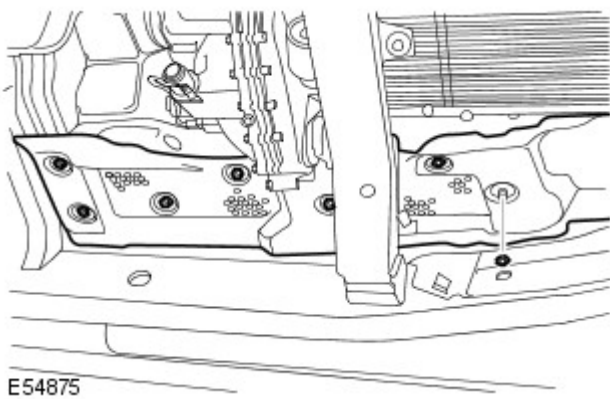
Disconnect the transmission fluid lines.

- Remove the bolt.
- Release the clip.
- Remove and discard the 2 O-ring seals.



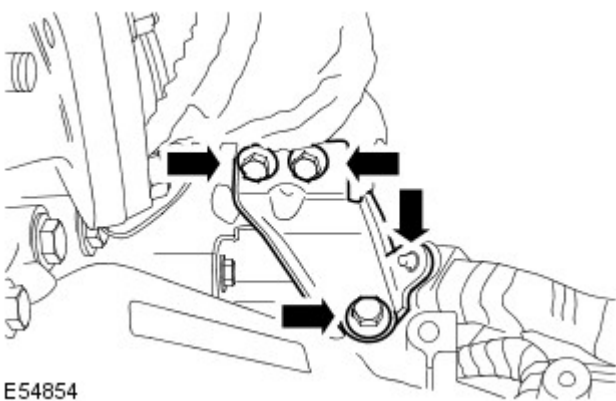
9. Remove the turbocharger support bracket.

- Remove the nut and 2 bolts.



10. Remove the exhaust heat shield.

- Remove the 7 nuts.

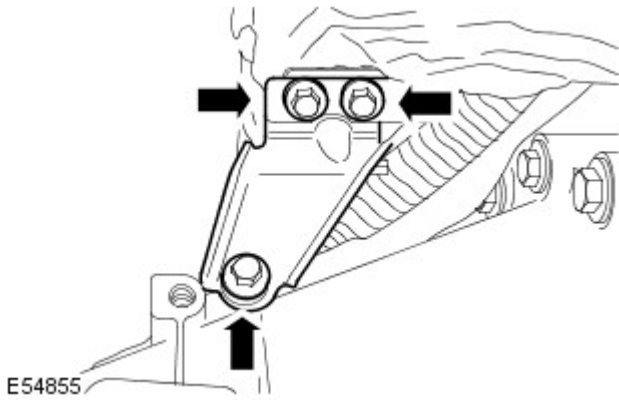


11. Remove the exhaust cross-over pipe LH support bracket.

- Remove the 3 bolts.
- Release the transmission wiring harness.

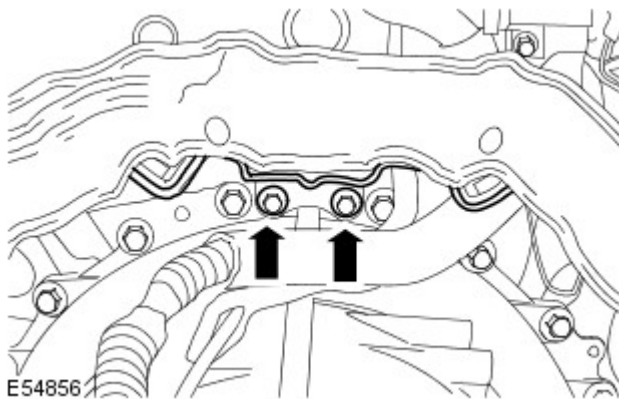
12. Remove the exhaust cross-over pipe RH support bracket.

- Remove the 3 bolts.



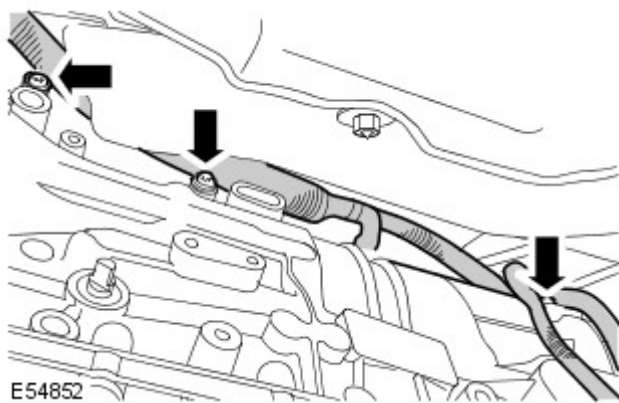
13. Remove the exhaust cross-over pipe center support bracket.

- Remove the 2 bolts.



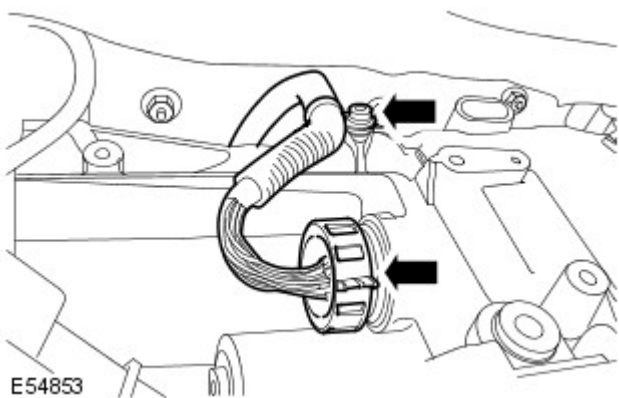
14. Release the wiring harness from the LH side of the transmission.

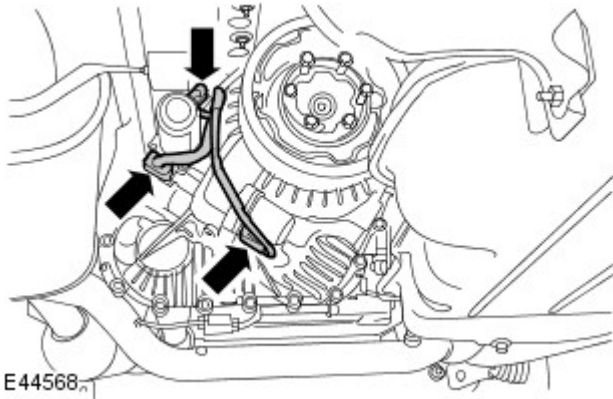
- Remove the 2 bolts.
- Release the clip.



15. Release the wiring harness from the RH side of the transmission.

- Remove the bolt.
- Disconnect the electrical connector.

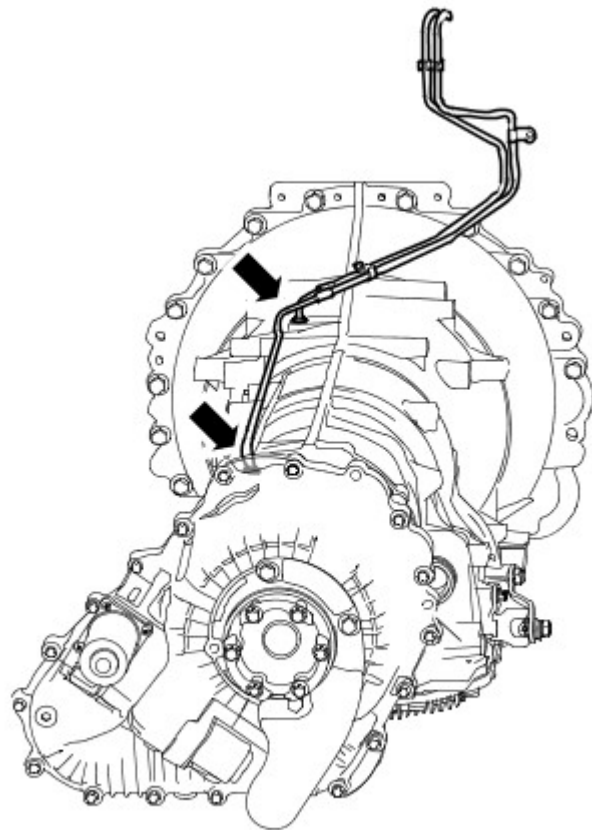




E44568

16. Disconnect the transfer case electrical connectors.

- Disconnect the 3 electrical connectors.



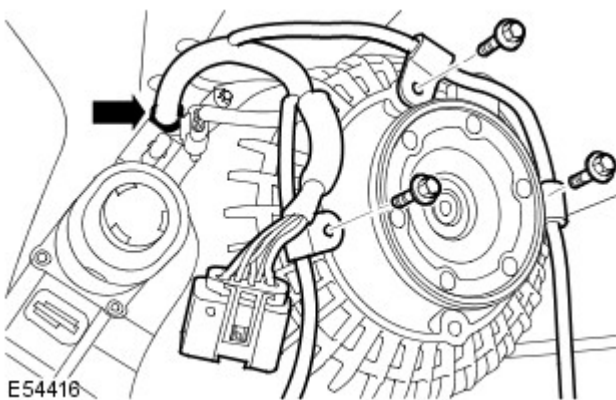
E56515

17.  CAUTION: Always plug any open connections to prevent contamination.

- NOTE: Transmission shown removed for clarity.

Disconnect the breather line.

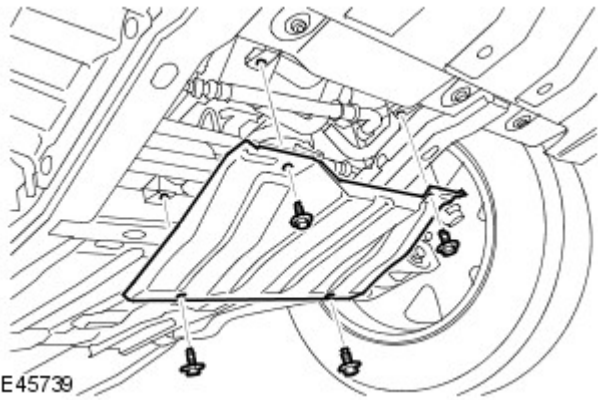
- Depress the locking ring.



E54416

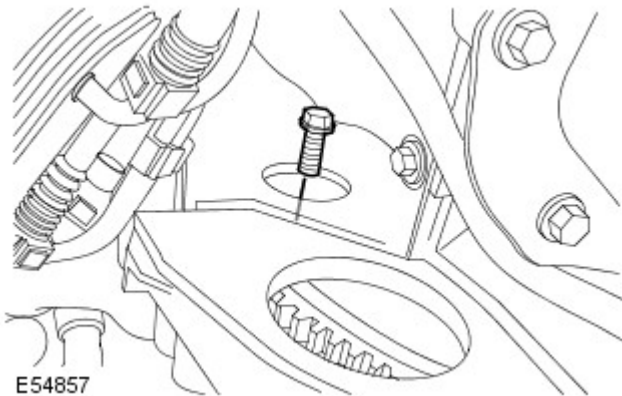
18. Release the wiring harness from the transfer case.

- Remove the 3 bolts.
- Release the clip.



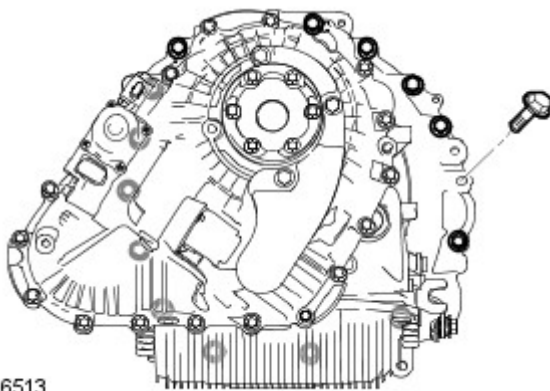
19. Remove the radiator access panel.

- Remove the 4 bolts.



20. Release the flexplate.

- Remove the access plug.
- Rotate the crankshaft in a clockwise direction to access the retaining bolts.
- Remove the 4 bolts.



21. Using a transmission jack, support the transmission.

22. WARNINGS:



Secure the transmission to the transmission jack.



Support the engine. The engine will move forward when the transmission is removed.



CAUTION: Make sure the torque converter remains connected to the transmission.

- NOTE: Transmission shown removed for clarity.

With assistance, remove the transmission.

- Remove the 15 transmission bolts.

23. Using a suitable tool, retain the torque converter.

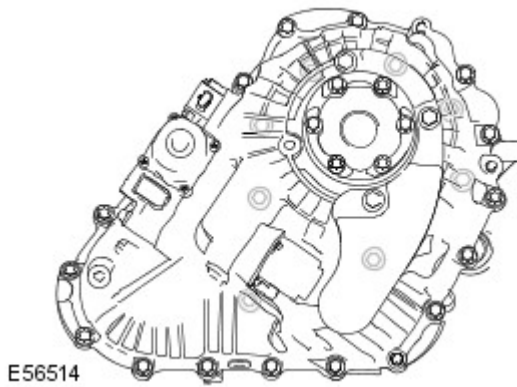
24. NOTE: Do not disassemble further if the component is removed for access only.

Remove the transmission from the transmission jack.

25. Drain the transmission fluid.

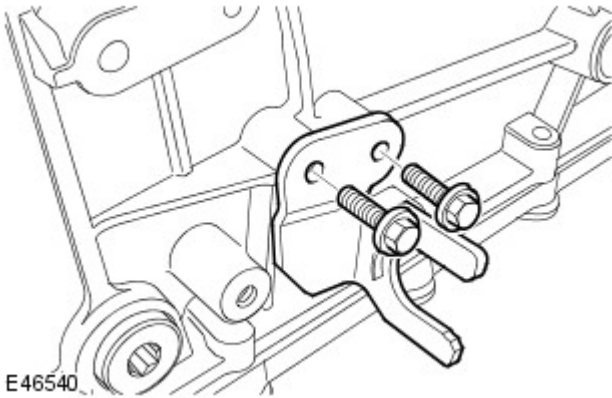
26. With assistance, remove the transfer case.

- Remove the 8 bolts.
- Remove and discard the O-ring seal.



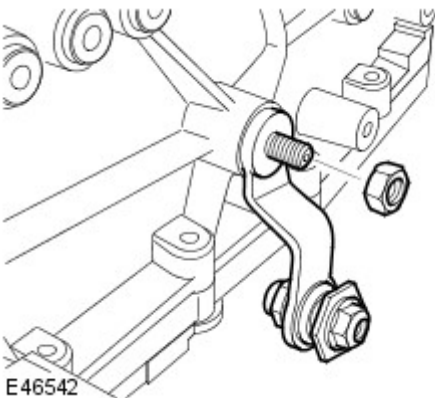
27. Remove the selector cable bracket.

- Remove the bolts.



28. Remove the selector lever.

- Remove the nut.

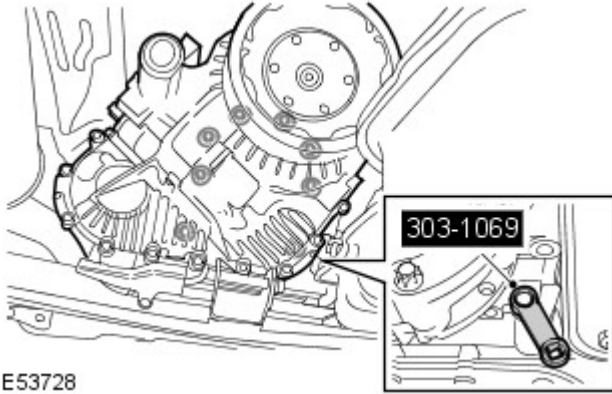


29. Release the fuel filter housing and support bracket.

Installation



CAUTION: If the automatic transmission fluid is very dirty or it contains metallic particles, then along with a new transmission, install a new automatic transmission fluid cooler and lines.



E53728

1. NOTE: Clean the component mating faces.

• NOTE: Install a new O-ring seal.

With assistance, install the transfer case.

- Lubricate input shaft splines with 'Weicon TL7391' grease.
- Install the 8 bolts.
- Using the special tool, tighten the bolts to 45 Nm (33 lb.ft).

2. Secure the selector lever.

- Tighten the nut to 12 Nm (9 lb.ft).

3. Attach the selector cable bracket.

- Install the 2 bolts and tighten to 10 Nm (7 lb.ft).

4. Secure the wiring harness to the transmission.

- Repeat the above procedure for the other side.
- Tighten the bolt to 10 Nm (7 lb.ft).

5. Using a suitable tool, retain the torque converter.

6. Position the transmission to the transmission jack.

7. Remove the torque converter retainer.

8. NOTE: Apply grease of the correct specification to the torque converter spigot.

• NOTE: Clean the component mating faces.

With assistance, install the transmission.

- Tighten the 15 bolts to 45 Nm (33 lb.ft).

9. Connect the breather line.

10. Secure the wiring harness to the transmission.

- Connect the electrical connector.
- Tighten the screws.
- Secure the wiring harness to the transmission.

11. NOTE: Clean the component mating faces.

• NOTE: Install the new O-ring seals.

Attach the transmission fluid lines.

- Secure the transmission fluid lines to the clip.
- Tighten the bolt to 10 Nm (7 lb.ft).

12. Attach the flexplate to the torque converter.

- Rotate the crankshaft to access the bolts.
- Install the access plug.
- Tighten the 4 bolts to 45 Nm (33 lb.ft).

13. Install the starter motor.

For additional information, refer to: [Starter Motor](#) (303-06A Starting System - TDV6 2.7L Diesel, Removal and Installation).

14. Install the radiator access panel.

- Install the 4 bolts and tighten to 10 Nm (7 lb.ft).

15. Install the exhaust manifold crossover pipe center support

bracket.

- Loosely install the 2 bolts.

16. Install the exhaust manifold crossover pipe RH support bracket.

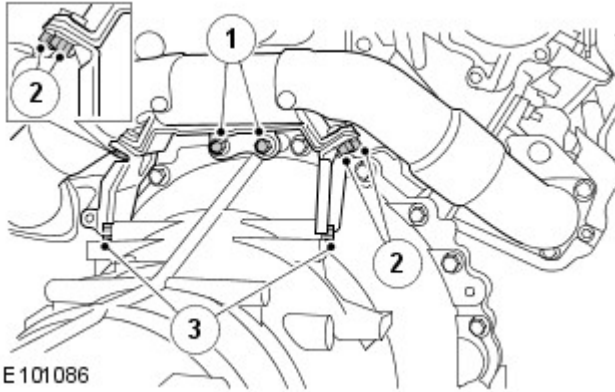
- Loosely install the 3 bolts.

17. Install the exhaust manifold crossover pipe LH support bracket.

- Loosely install the 3 bolts.

18. Tighten the exhaust manifold crossover pipe mounting bracket bolts in the following sequence.

- Tighten the 2 bolts marked 1 to 10 Nm (7 lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 2 bolts marked 3 to 10 Nm (7lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 4 bolts marked 2 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts marked 1 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts marked 3 to 25 Nm (18 lb. ft).
- Attach the wiring harness.



19. Install the exhaust heat shield.

20. Install the turbocharger support bracket.

- Tighten the nut and 2 bolts to 22 Nm (16 lb.ft).

21. Install the rear driveshaft.

For additional information, refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).

22. Install the front driveshaft.

For additional information, refer to: [Front Driveshaft - TDV6 2.7L Diesel](#) (205-01 Driveshaft, Removal and Installation).

23. Install the exhaust system.

For additional information, refer to: [Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation) / [Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).

24. NOTE: Do not fully tighten the locking nut at this stage.

Connect the selector cable to the transmission.

- Engage the inner cable with the lever clamping bush.
- Install the selector cable to its abutment bracket.

25. Adjust the selector cable.

For additional information, refer to: [Selector Lever Cable Adjustment](#) (307-05B Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol, General Procedures).

26. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

27. Check and top-up the transfer case fluid level.

28. Check and top-up the transmission fluid level.

For additional information, refer to: [Transmission Fluid Level Check](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, General Procedures).

29. Lower the vehicle.

Automatic Transmission/Transaxle - V6 4.0L Petrol -

Lubricants

Item	Specification
* Recommended lubricant	ATF Shell M13754
+ Torque converter nose	Molybdenum disulphide grease to specification FB180

• CAUTIONS:



* Do not use any lubricant other than that specified.



+ Do not over lubricate.

Capacity

Item	Capacity
+ Initial dry fill	9.5 litres (16.7 pints) (10.0 US qts)



CAUTION: + A final oil level check/top-up must be carried out when the unit has been installed.

General Specification

Item	Specification
Automatic transmission	ZF 6HP26
Speeds	6 Forward, 1 Reverse
Gear ratios:	
First	4.17:1
Second	2.340:1
Third	1.521:1
Fourth	1.143:1
Fifth	0.867:1
Sixth	0.691:1
Reverse	3.403:1
Torque converter	Sachs W260 2GWK with slip controlled, dual friction faced lock-up clutch
Transmission control module:	
Location	Located in gearbox casing
Type	1904

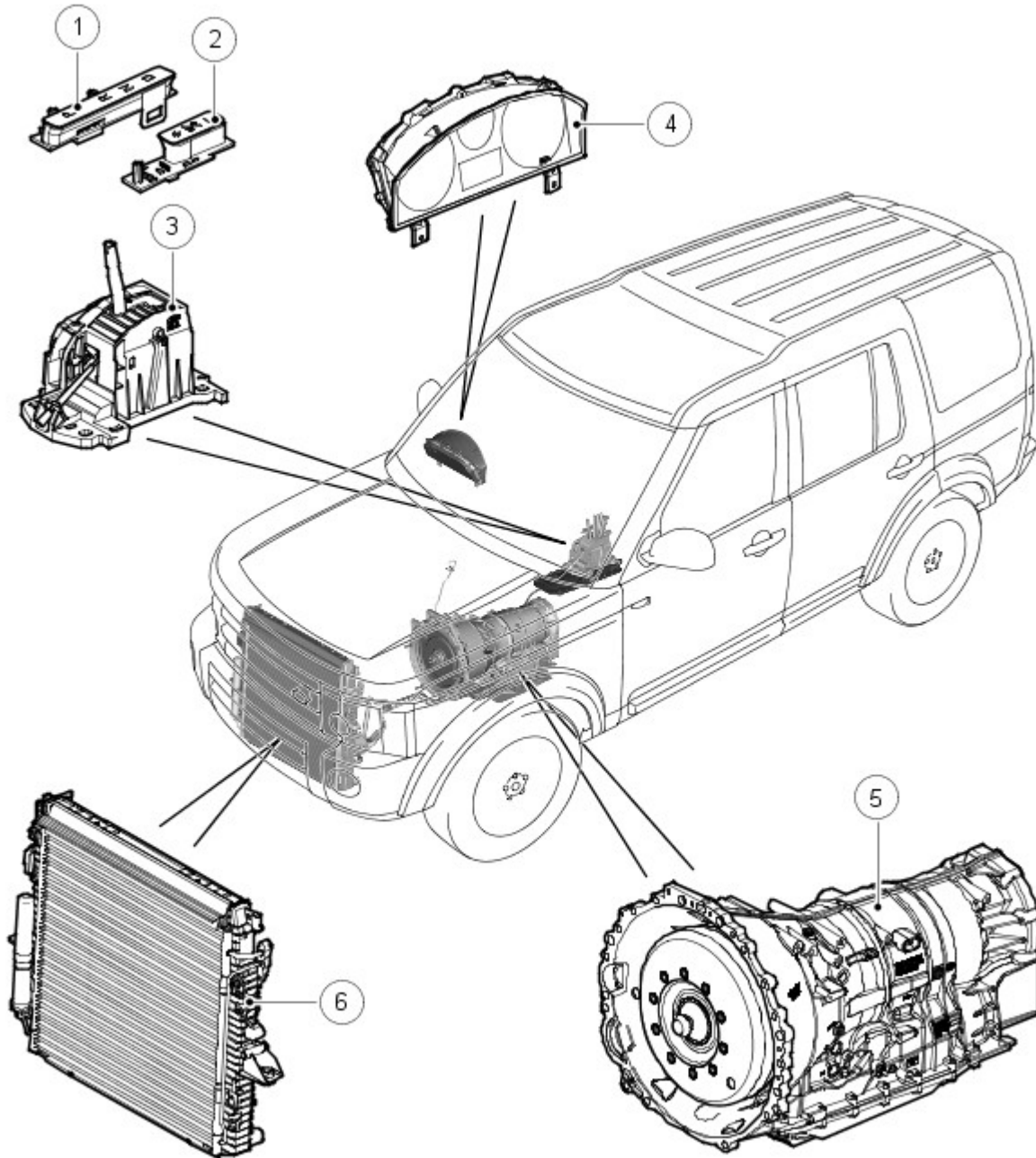
Torque Specifications

Description	Nm	lb-ft
Transmission heat shield bolts	10	7
Transmission heat shield bracket bolts	10	7
Fuel pipe heat shield bracket bolts	10	7
Selector cable bracket nut	12	9
Transmission control module Torx screws	8	6
Main control valve body Torx screws	8	6
Fluid pan Torx screws	8	6
Engine RH support nut	90	66
Transmission support insulator bolts	60	44
Selector shaft nut	12	9
Selector cable bracket bolts	10	7
Flexplate to torque converter bolts	45	33
Transmission bolts	45	33
Transmission breather pipe clip bolt	25	18
Transmission fluid lines clip bolt	10	7

Automatic Transmission/Transaxle - V6 4.0L Petrol - Automatic Transmission

Description and Operation

ZF 6HP26 Automatic Transmission Component Location



E42389

Item	Part Number	Description
1	-	PRND LCD display
2	-	M/S LCD display
3	-	Selector lever assembly
4	-	Instrument cluster
5	-	Automatic transmission
6	-	Transmission fluid cooler

GENERAL

The ZF 6HP26 transmission is an electronically controlled, six speed unit. The transmission is manufactured by ZF Transmissions GmbH in Saarbrücken, Germany. This transmission represents the latest in automatic transmission technology and incorporates new features to enhance the transmission functionality:

- The hydraulic and electronic control elements of the transmission are now incorporated in a single unit located inside the transmission and is known as 'Mechatronic'
- Another new strategy is Adaptive Shift Strategy (ASIS). ASIS represents the continuous adaptation of shift changes to suit the driving style of the driver which can vary from sporting to economical. Further details of the ASIS

function are contained in the 'Driving Modes' section.

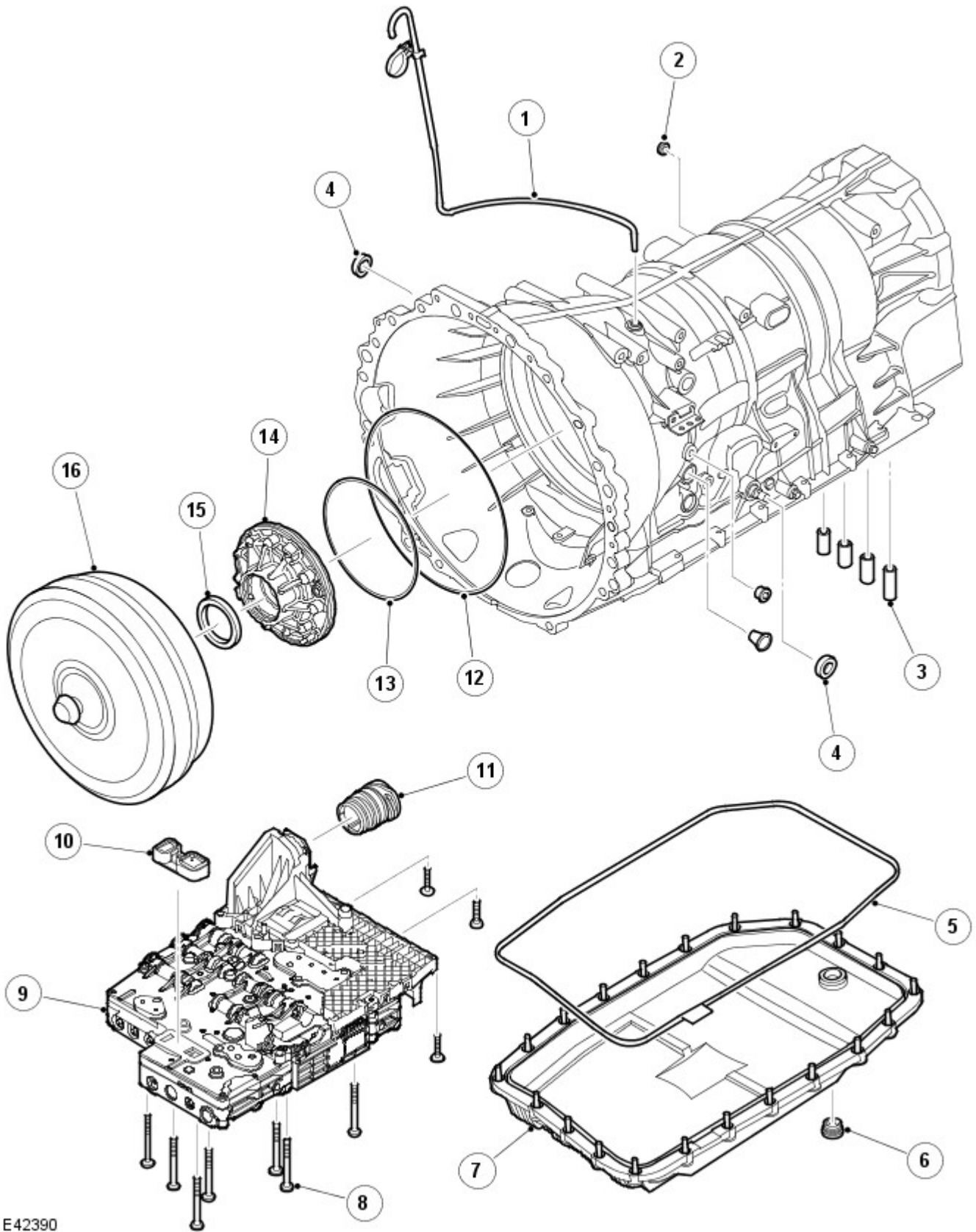
The transmission is controlled by an Transmission Control Module (TCM) which contains software to provide operation as a semi-automatic 'CommandShift™' transmission. The TCM allows the transmission to be operated as a conventional automatic unit by selecting P, R, N, D on the selector lever. Movement of the selector lever across the gate to the 'M/S' position puts the transmission into electronic 'Sport' mode. Further movement of the lever in a lateral direction to the + or – position puts the transmission into electronic manual 'CommandShift™' mode.

The 6HP26 transmission has the following features:

- Designed to be maintenance free
- Transmission fluid is 'fill for life'
- The torque converter features a controlled slip feature with electronically regulated control of lock-up, creating a smooth transition to the fully locked condition
- Shift programs controlled by the TCM
- Connected to the ECM via the High Speed CAN for communications
- Default mode if major faults occur
- Diagnostics available from the TCM via the CAN.

ZF 6HP26 Automatic Transmission – Exploded View

- NOTE: The transmission shown is exploded to the extent of the serviceable items



E42390

Item	Part Number	Description
1	-	Breather tube
2	-	Plug
3	-	Seal sleeves
4	-	Seal - Selector shaft (2 off)
5	-	Gasket
6	-	Drain plug
7	-	Fluid pan
8	-	Torx screws
9	-	Mechatronic valve block
10	-	Element seal
11	-	Electrical connector – guide sleeve

12	-	O-ring
13	-	O-ring
14	-	Pump housing (not a serviceable component)
15	-	Input shaft seal
16	-	Torque converter

The gearbox comprises the main casing which houses all of the transmission components. The main case also incorporates an integral bell housing.

A fluid pan is bolted to the lower face of the main case and is secured with bolts. The fluid pan is sealed to the main case with a gasket. Removal of the fluid pan allows access to the Mechatronic valve block. The fluid pan has a magnet located around the drain plug which collects any metallic particles present in the transmission fluid.

A fluid filter is located inside the fluid pan. If the transmission fluid becomes contaminated or after any service work, the fluid pan with integral filter must be replaced.



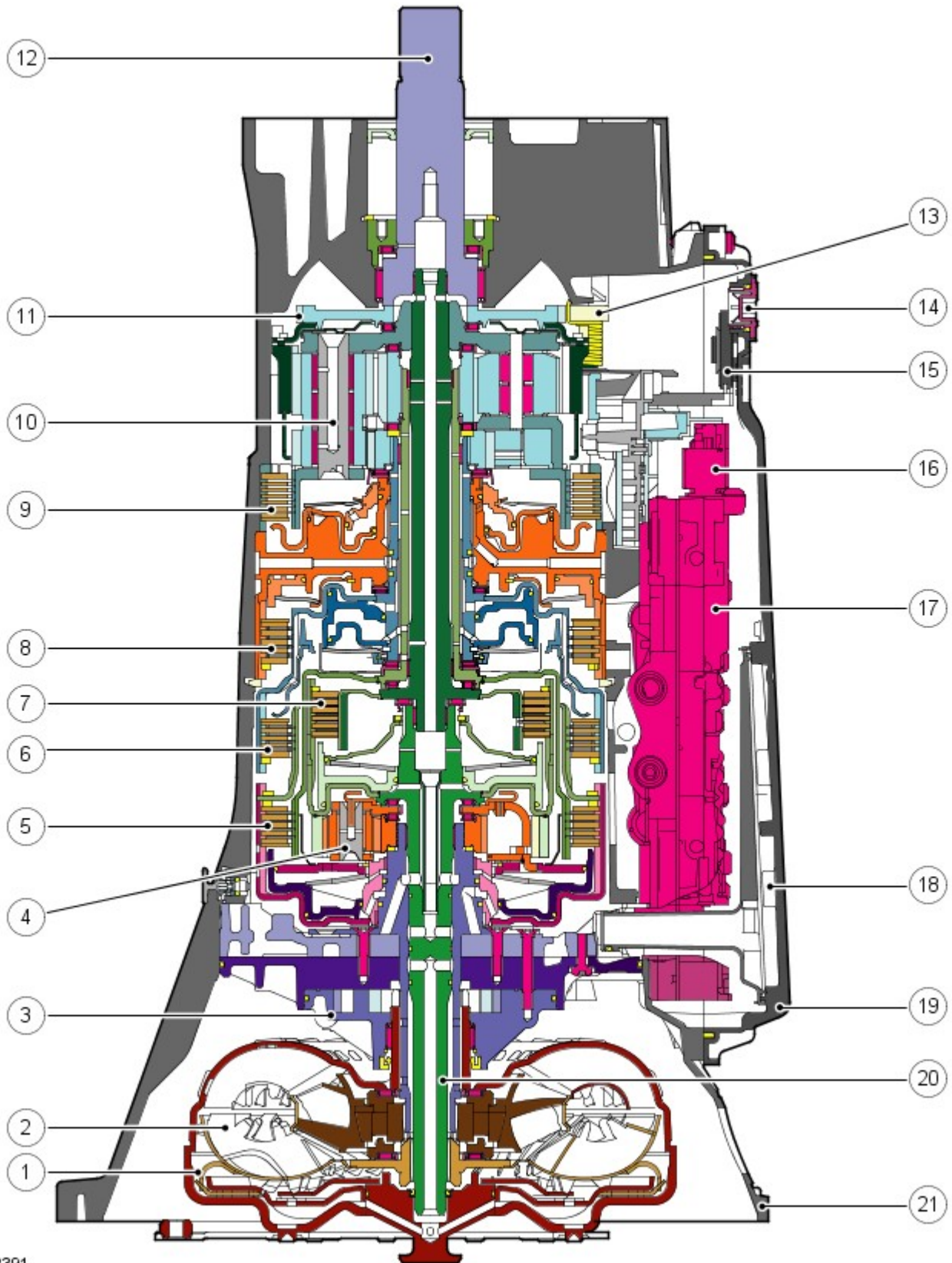
CAUTION: Take care when removing the fluid pan and/or replacing the Mechatronic valve block that neither the fluid pan gasket or the mating face on the transmission casing is damaged or leakage may occur. Do not use metal tools to prise the fluid pan from the transmission casing. Take care when positioning a new mechatronic unit to ensure it does not contact the casing face.

The integral bell housing provides protection for the torque converter assembly and also provides the attachment for the gearbox to the engine cylinder block. The torque converter is a non-serviceable assembly which also contains the lock-up clutch mechanism. The torque converter drives a crescent type pump via drive tangs. The fluid pump is located in the main case, behind the torque converter.

The main case contains the following major components:

- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the TCM
- Three rotating multiplate drive clutches
- Two fixed multiplate brake clutches
- A single planetary gear train and a double planetary gear train.

ZF 6HP26 Automatic Transmission – Sectional View



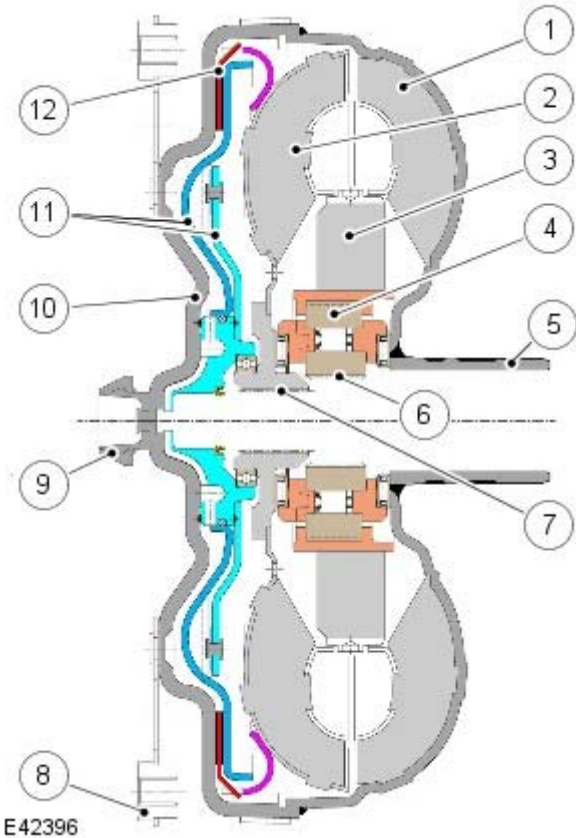
E42391

Item	Part Number	Description
1	-	Torque converter lock-up clutch
2	-	Torque converter
3	-	Fluid pump
4	-	Single planetary gearset
5	-	Clutch A
6	-	Clutch B
7	-	Clutch E
8	-	Brake C
9	-	Brake D
10	-	Double planetary gearset
11	-	Park lock gear

12	-	Output shaft
13	-	Park lock pawl
14	-	Drain plug
15	-	Magnet
16	-	Pressure regulator
17	-	Mechatronic valve block
18	-	Fluid filter
19	-	Fluid pan
20	-	Input shaft
21	-	Transmission casing

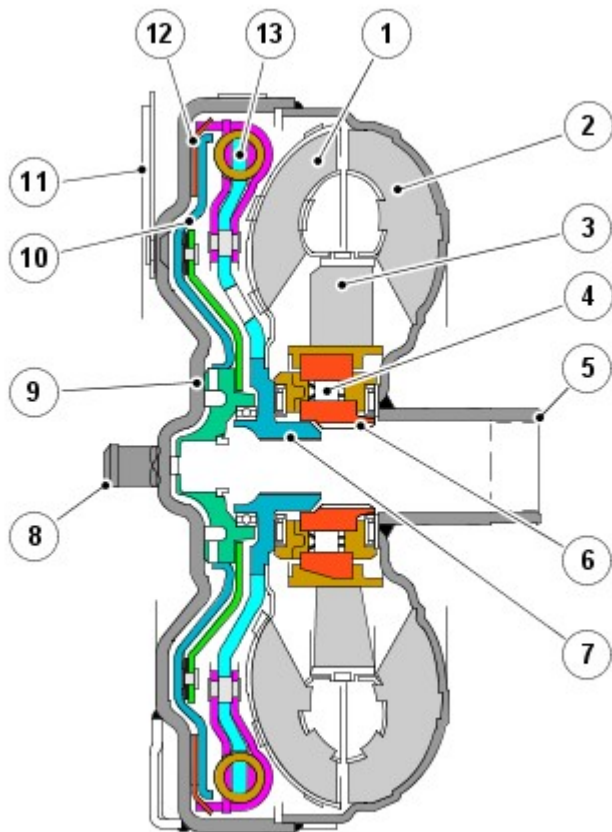
TORQUE CONVERTER

Torque Converter Components - 4.0L V6 and 4.4L V8 Models



Item	Part Number	Description
1	-	Impeller
2	-	Turbine
3	-	Stator
4	-	Freewheel
5	-	Torque converter hub
6	-	Stator shaft
7	-	Turbine shaft
8	-	Drive plate
9	-	Journal - Drive plate location
10	-	Torque converter cover
11	-	Lock-up clutch piston
12	-	Lock-up clutch plate

Torque Converter Components - TdV6 Models



E42740

Item	Part Number	Description
1	-	Turbine
2	-	Impeller
3	-	Stator
4	-	Freewheel
5	-	Torque converter hub
6	-	Stator shaft
7	-	Turbine shaft
8	-	Journal - Drive plate location
9	-	Torque converter cover
10	-	Lock-up clutch piston
11	-	Drive plate
12	-	Lock-up clutch plate
13	-	Torsional vibration damper

The torque converter is the coupling element between the engine and the gearbox and is located in the transmission housing, on the engine side of the transmission. The driven power from the engine crankshaft is transmitted hydraulically and mechanically through the torque converter to the transmission. The torque converter is connected to the engine by a drive plate.

The torque converter comprises an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The two components are welded together to form a sealed, fluid filled housing. With the impeller welded to the converter housing cover, the impeller is therefore driven at engine crankshaft speed.

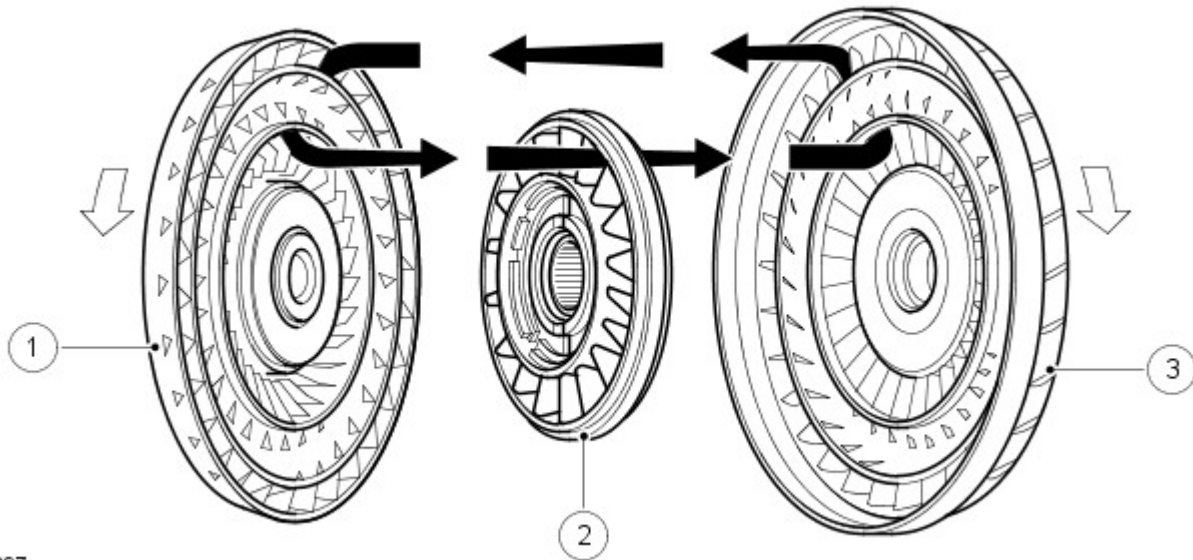
The converter housing cover has threaded bosses which provide for attachment of the engine drive plate which is connected to the engine crankshaft. The threaded bosses also provide for location of special tools which are required to remove the torque converter from the bell housing.

The torque converter used on TdV6 models is similar in construction to the torque converter on petrol models but contains a torsional vibration damper. The damper smooths the output from the engine and prevents unwanted vibration from being passed to the transmission.

Impeller

Fluid Flow

- NOTE: Typical torque converter shown



E42397

Item	Part Number	Description
1	-	Turbine
2	-	Stator
3	-	Impeller

When the engine is running the rotating impeller acts as a centrifugal pump, picking up fluid at its centre and discharging it at high velocity through the blades on its outer rim. The design and shape of the blades and the curve of the impeller body cause the fluid to rotate in a clockwise direction as it leaves the impeller. This rotation improves the efficiency of the fluid as it contacts the outer row of blades on the turbine.

The centrifugal force of the fluid leaving the blades of the impeller is passed to the curved inner surface of the turbine via the tip of the blades. The velocity and clockwise rotation of the fluid causes the turbine to rotate.

Turbine

The turbine is similar in design to the impeller with a continuous row of blades. Fluid from the impeller enters the turbine through the tip of the blades and is directed around the curved body of the turbine to the root of the blades. The curved surface redirects the fluid back in the opposite direction to which it entered the turbine, effectively increasing the turning force applied to the turbine from the impeller. This principle is known as torque multiplication.

When engine speed increases, turbine speed also increases. The fluid leaving the inner row of the turbine blades is rotated in an anti-clockwise direction due to the curve of the turbine and the shape of the blades. The fluid is now flowing in the opposite direction to the engine rotation and therefore the impeller. If the fluid was allowed to hit the impeller in this condition, it would have the effect of applying a brake to the impeller, eliminating the torque multiplication effect. To prevent this, the stator is located between the impeller and the turbine.

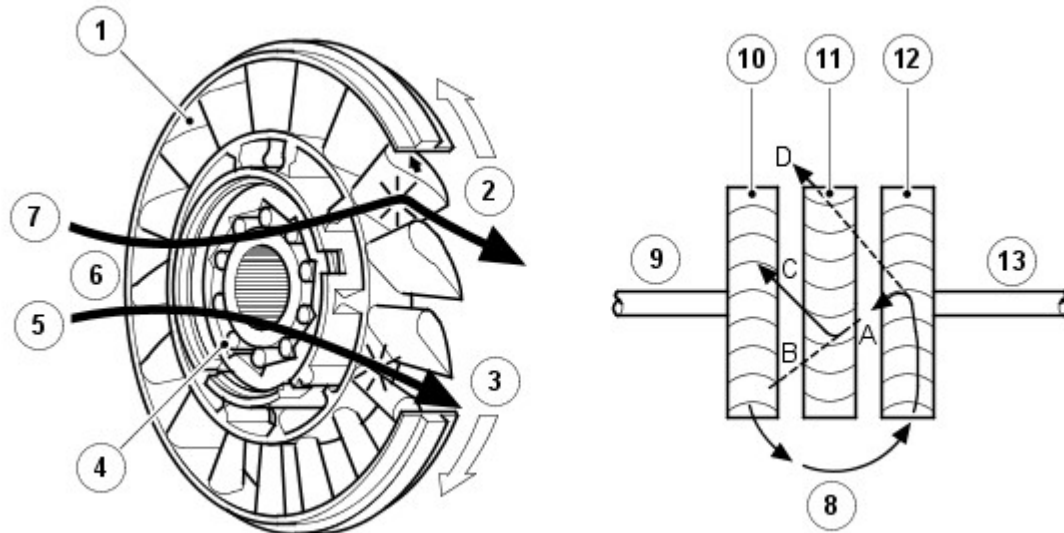
Stator

The stator is located on the splined transmission input shaft via a freewheel clutch. The stator comprises a number of blades which are aligned in an opposite direction to those of the impeller and turbine. The main function of the stator is to redirect the returning fluid from the turbine, changing its direction to that of the impeller.

The redirected fluid from the stator is directed at the inner row of blades of the impeller, assisting the engine in turning the impeller. This sequence increases the force of the fluid emitted from the impeller and thereby increases the torque multiplication effect of the torque converter.

Stator Functions

- NOTE: Typical stator shown



E 42398

Item	Part Number	Description
1	-	Blades
2	-	Stator held – fluid flow redirected
3	-	Stator rotates freely
4	-	Roller
5	-	Converter at coupling speed
6	-	Fluid flow from turbine
7	-	Converter multiplying
8	-	Fluid flow from impeller
9	-	Drive from engine
10	-	Impeller
11	-	Stator
12	-	Turbine
13	-	Output to transmission

Refer to the 'Stator Functions' illustration

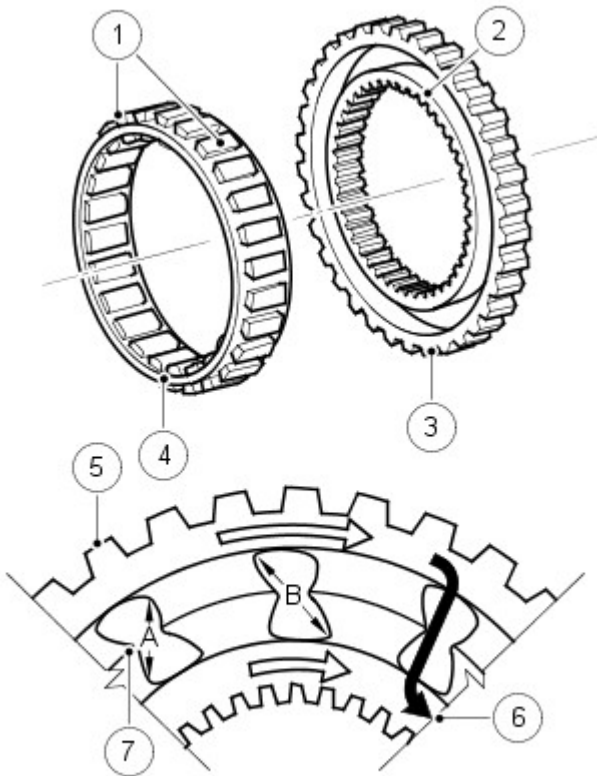
Fluid emitted from the impeller acts on the turbine. If the turbine is rotating at a slower speed than the fluid from the impeller, the fluid will be deflected by the turbine blades in the path 'A'. The fluid is directed at and deflected by the stator blades from path 'B' to path 'C'. This ensures that the fluid is directed back to the pump in the optimum direction. In this condition the sprag clutch is engaged and the force of the fluid on the stator blades assists the engine in rotating the impeller

As the rotational speed of the engine and therefore the turbine increases, the direction of the fluid leaving the turbine changes to path 'D'. The fluid is now directed from the turbine to the opposite side of the stator blades, rotating the stator in the opposite direction. To prevent the stator from resisting the smooth flow of the fluid from the turbine, the sprag clutch releases, allowing the stator to rotate freely on its shaft.

When the stator becomes inactive, the torque converter no longer multiplies the engine torque. When the torque converter reaches this operational condition it ceases to multiply the engine torque and acts solely as a fluid coupling, with the impeller and the turbine rotating at approximately the same speed.

The stator uses a sprag type, one way, freewheel clutch. When the stator is rotated in a clockwise direction the sprags twist and are wedged between the inner and outer races. In this condition the sprags transfer the rotation of the outer race to the inner race which rotates at the same speed.

One Way Free Wheel Clutch – Typical



E 42712

Item	Part Number	Description
1	-	Sprags
2	-	Inner race
3	-	Outer race
4	-	Sprag and cage assembly
5	-	Sprag outer race
6	-	Sprag inner race
7	-	Retaining ring

The free wheel clutch can perform three functions; hold the stator stationary, drive the stator and free wheel allowing the stator to rotate without a drive output. The free wheel clutch used in the 6HP26 transmission is of the sprag type and comprises an inner and outer race and a sprag and cage assembly. The inner and outer races are pressed into their related components with which they rotate. The sprag and cage assembly is located between the inner and outer races.

The sprags are located in a cage which is a spring which holds the sprags in the 'wedge' direction and maintains them in contact with the inner and outer races.

Referring to the illustration, the sprags are designed so that the dimension 'B' is larger than the distance between the inner and outer race bearing surfaces. When the outer race rotates in a clockwise direction, the sprags twist and the edges across the dimension 'B' wedge between the races, providing a positive drive through each sprag to the inner race. The dimension 'A' is smaller than the distance between the inner and outer race bearing surfaces. When the outer race rotates in an anti-clockwise direction, the dimension 'A' is too small to allow the sprags to wedge between the races, allowing the outer race to rotate freely.

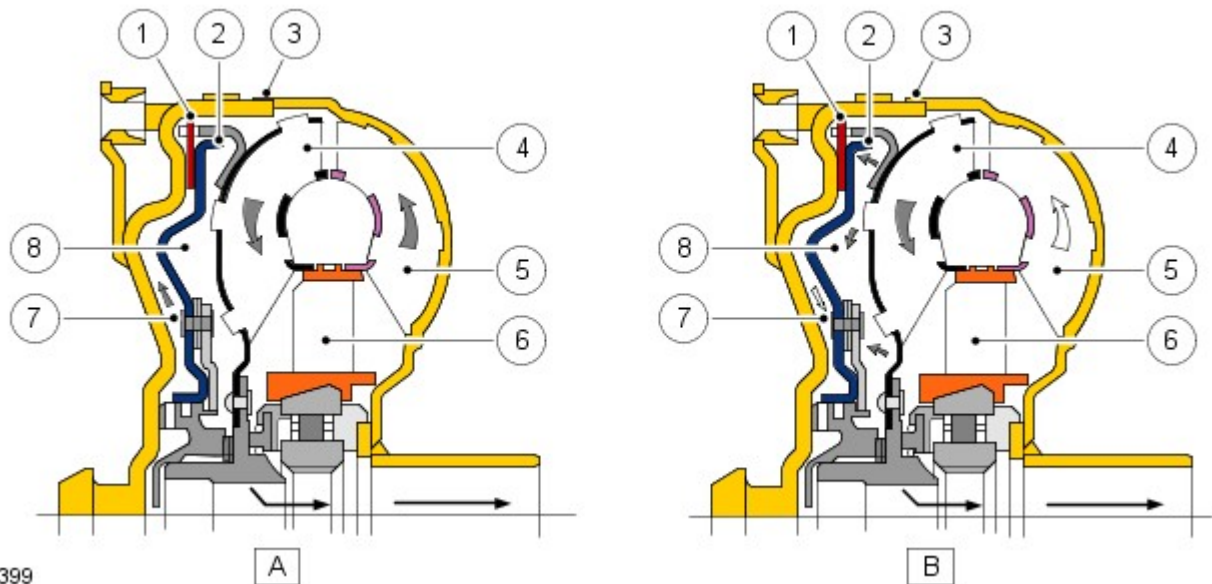
On the illustration shown, when the outer race is rotated in a clockwise direction, the sprags twist and are 'wedged' between the inner and outer races. The sprags then transfer the rotation of the outer race to the inner race, which rotates at the same speed.

Lock-Up Clutch Mechanism

The Torque Converter Clutch (TCC) is hydraulically controlled by an electronic pressure regulating solenoid (EPRS6) which is controlled by the TCM. This allows the torque converter to have three states of operation as follows:

- Fully engaged
- Controlled slip variable engagement
- Fully disengaged

The TCC is controlled by two hydraulic spool valves located in the valve block. These valves are actuated by pilot pressure supplied via a solenoid valve which is also located in the valve block. The solenoid valve is operated by PWM signals from the TCM to give full, partial or no lock-up of the torque converter.



E 42399

Item	Part Number	Description
A	-	Unlocked condition
B	-	Locked condition
1	-	Clutch plate
2	-	Clutch piston
3	-	Torque converter body
4	-	Turbine
5	-	Impeller
6	-	Stator
7	-	Piston chamber
8	-	Turbine chamber

The lock-up clutch is a hydro-mechanical device which eliminates torque converter slip, improving fuel consumption. The engagement and disengagement is controlled by the TCM to allow a certain amount of controlled 'slip'. This allows a small difference in the rotational speeds of the impeller and the turbine which results in improved shift quality. The lock-up clutch comprises a piston and a clutch friction plate.

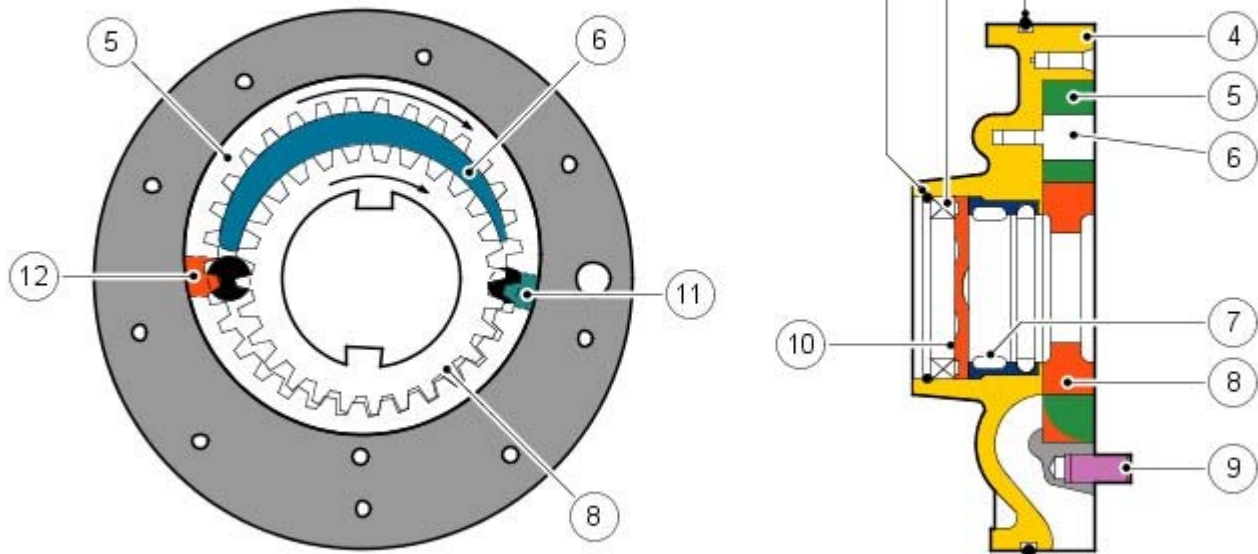
In the unlocked condition, the oil pressure supplied to the piston chamber and the turbine chamber is equal. Pressurised fluid flows through a drilling in the turbine shaft and through the piston chamber to the turbine chamber. In this condition the clutch plate is held away from the torque converter body and torque converter slip is permitted.

In the locked condition, the TCC spool valves are actuated by the electronic pressure regulating solenoid (EPRS6). The fluid flow in the unlocked condition is reversed and the piston chamber is vented. Pressurised fluid is directed into the turbine chamber and is applied to the clutch piston. The piston moves with the pressure and pushes the clutch plate against the torque converter body. As the pressure increases, the friction between the clutch plate and the body increases, finally resulting in full lock-up of the clutch plate with the body. In this condition there is direct mechanical drive from the engine crankshaft to the transmission planetary gear train.

FLUID PUMP

The fluid pump is an integral part of the transmission. The fluid pump is used to supply hydraulic pressure for the operation of the control valves and clutches and also to pass the fluid through the transmission cooler.

The 6HP26 fluid pump is a crescent type pump and is located between the intermediate plate and the torque converter. The pump has a delivery rate of 16cm³ per revolution.



E42400

Item	Part Number	Description
1	-	Securing ring
2	-	Shaft oil seal
3	-	O-ring seal
4	-	Pump housing
5	-	Ring gear
6	-	Crescent spacer
7	-	Roller bearing
8	-	Impeller
9	-	Centring pin
10	-	Spring washer
11	-	Outlet port (high pressure)
12	-	Inlet port (low pressure)

The pump comprises a housing, a crescent spacer, an impeller and a ring gear. The housing has inlet and outlet ports to direct flow and is located in the intermediate plate by a centring pin. The pump action is achieved by the impeller, ring gear and crescent spacer.

The crescent spacer is fixed in its position by a pin and is located between the ring gear and the impeller. The impeller is driven by drive from the torque converter which is located on a needle roller bearing in the pump housing. The impeller teeth mesh with those of the ring gear. When the impeller is rotated, the motion is transferred to the ring gear which rotates in the same direction.

The rotational motion of the ring gear and the impeller collects fluid from the intake port in the spaces between the teeth. When the teeth reach the crescent spacer, the oil is trapped in the spaces between the teeth and is carried with the rotation of the gears. The spacer tapers near the outlet port. This reduces the space between the gear teeth causing a build up of fluid pressure as the oil reaches the outlet port. When the teeth pass the end of the spacer the pressurised fluid is passed to the outlet port.

The fluid emerging from the outlet port is passed through the fluid pressure control valve. At high operating speeds the pressure control valve maintains the output pressure to the gearbox at a predetermined maximum level. Excess fluid is relieved from the pressure control valve and is directed, via the main pressure valve in the valve block, back to the pump inlet port. This provides a pressurised feed to the pump inlet which prevents cavitation and reduces pump noise.

MECHATRONIC VALVE BLOCK

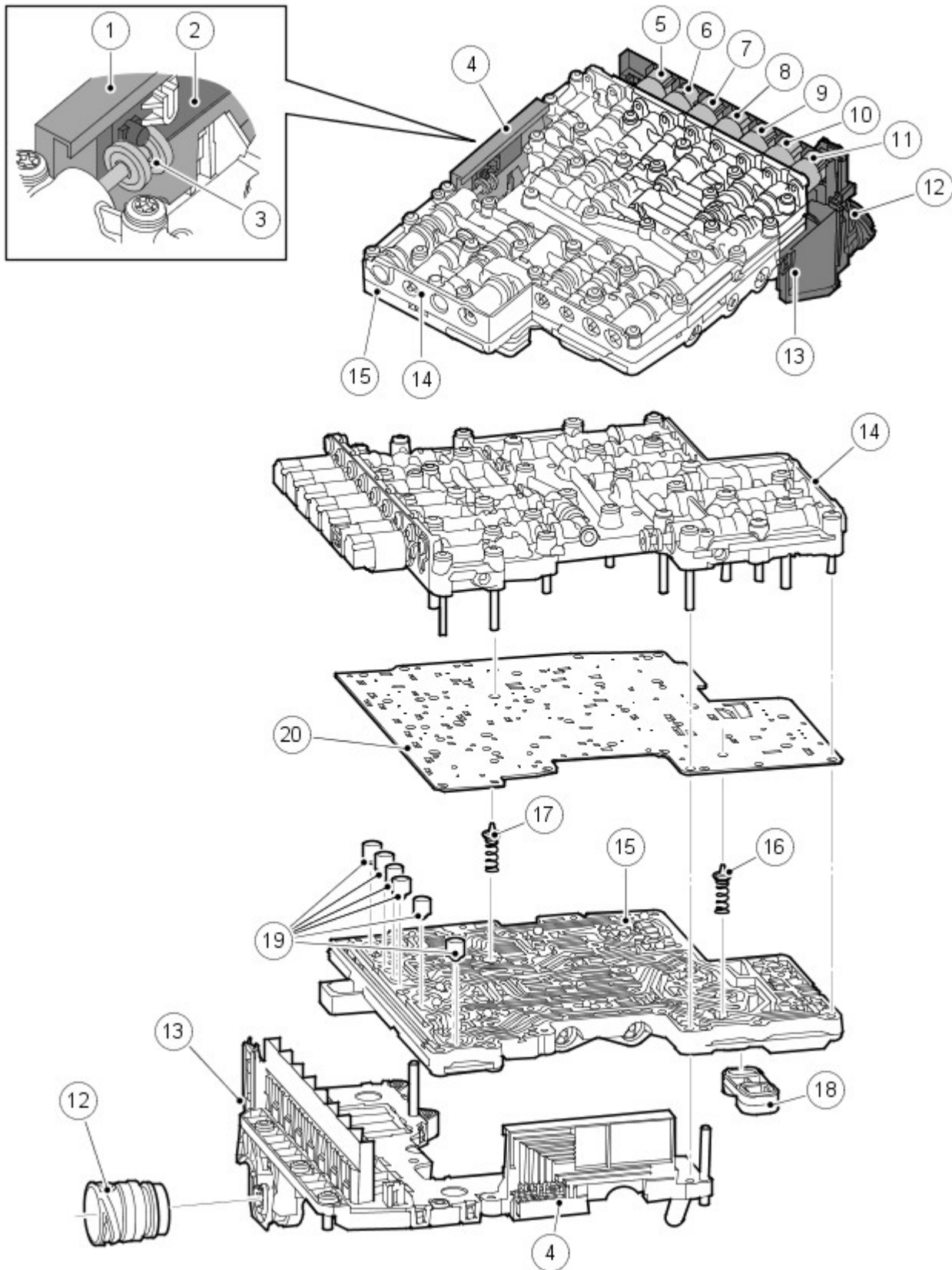
The Mechatronic valve block is located in the bottom of the transmission and is covered by the fluid pan. The valve block houses the TCM, electrical actuators, speed sensors and control valves which provide all electro-hydraulic control for all transmission functions. The Mechatronic valve block comprises the following components:

- TCM
- Six pressure regulator solenoids
- One shift control solenoid
- One damper
- Twenty one hydraulic spool valves
- Manually operated selector valve
- Temperature sensor

- Turbine speed sensor
- Output shaft speed sensor.

A radio interference suppressor is located on a bracket on the right hand side of the transmission, forward of the selector shaft lever. The suppressor is connected into the transmission wiring harness and prevents solenoid operating noise affecting the audio system.

ZF 6HP26 Automatic Transmission – Mechatronic Valve Block

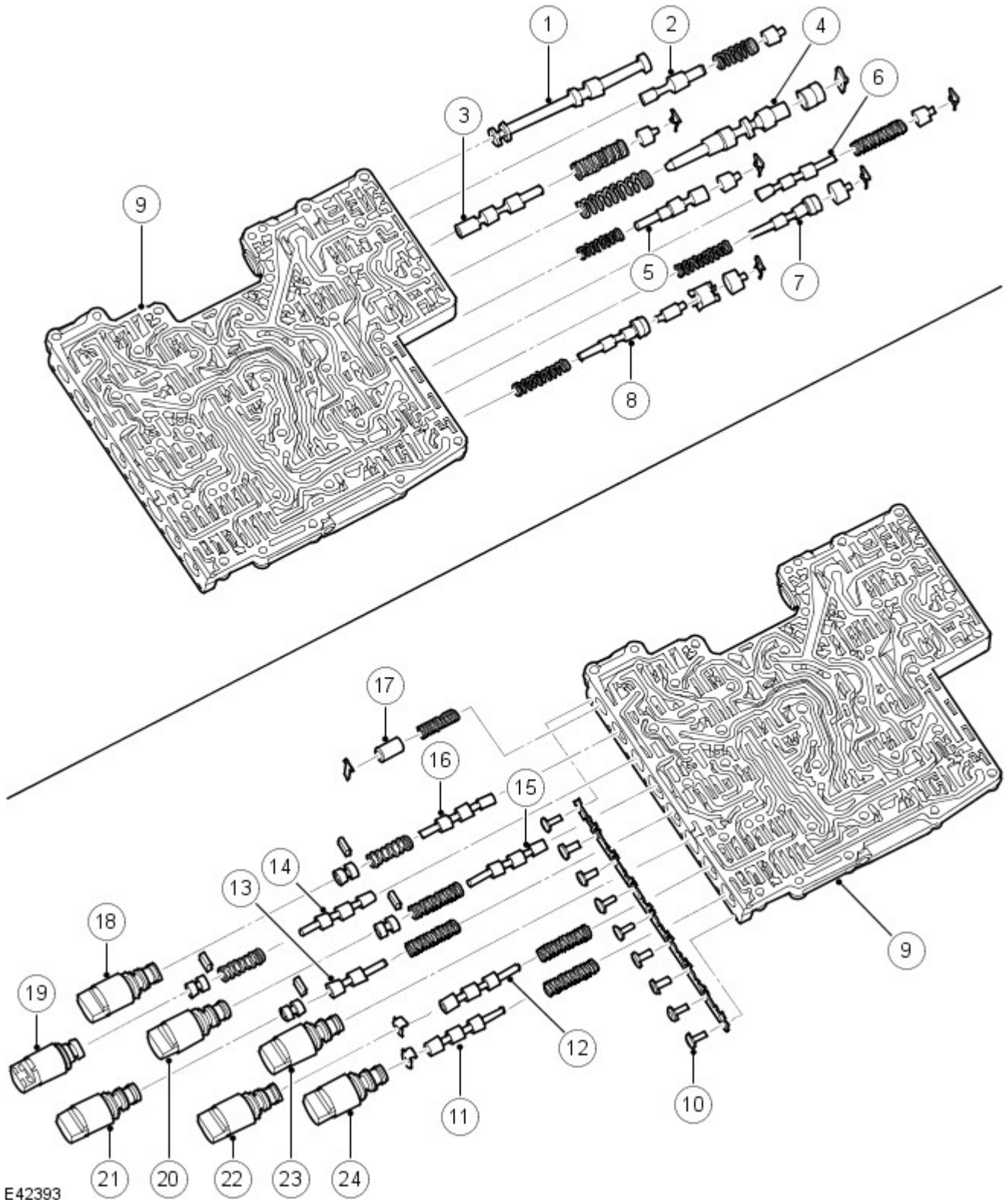


E42392

Item	Part Number	Description
1	-	Position switch
2	-	Sliding block
3	-	Selector spool valve

4	-	Position switch assembly
5	-	Electronic Pressure Regulator Solenoid (EPRS) 6
6	-	Solenoid Valve 1
7	-	EPRS 4
8	-	EPRS 5
9	-	EPRS 3
10	-	EPRS 2
11	-	EPRS 1
12	-	Electrical connector
13	-	Transmission Control Module (TCM)
14	-	Valve housing
15	-	Valve plate
16	-	Torque converter retaining valve
17	-	Clutch return valve
18	-	Element seal
19	-	Pressure regulator dampers
20	-	Intermediate plate

ZF 6HP26 Automatic Transmission – Valve Housing Components

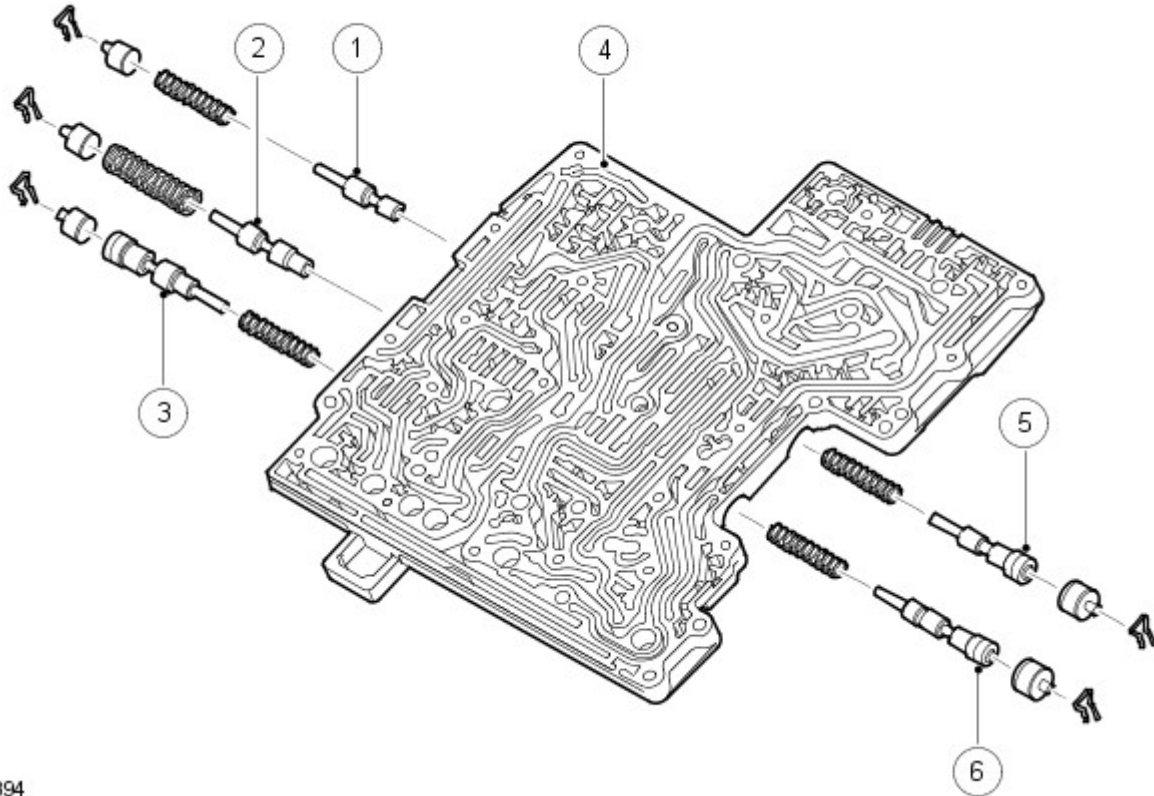


E42393

Item	Part Number	Description
1	-	Selector spool valve
2	-	Lubricating valve
3	-	Torque converter pressure valve
4	-	System pressure valve
5	-	Torque converter clutch valve
6	-	Retaining valve – Clutch E
7	-	Clutch valve E
8	-	Clutch valve A
9	-	Valve housing
10	-	Bolts
11	-	Retaining valve – Clutch A

12	-	Retaining valve – Clutch B
13	-	Pressure reducing valve
14	-	Shift valve 1
15	-	Retaining valve – Brake D
16	-	Shift valve 2
17	-	Damper
18	-	Electronic Pressure Regulator Solenoid (EPRS) 6
19	-	Solenoid valve 1
20	-	EPRS 4
21	-	EPRS 5
22	-	EPRS 2
23	-	EPRS 3
24	-	EPRS 1

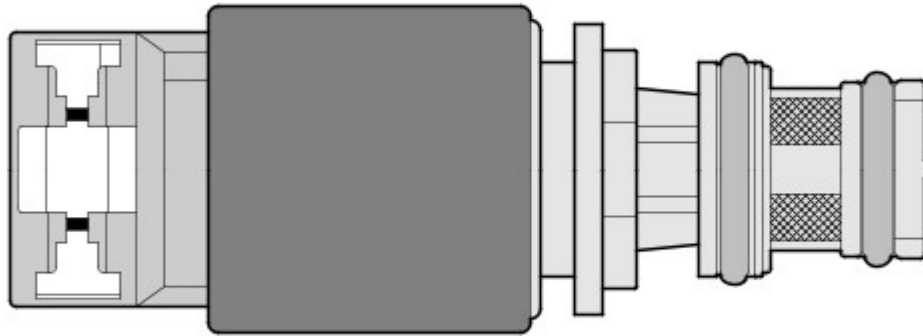
ZF 6HP26 Automatic Transmission – Valve Plate Components



E42394

Item	Part Number	Description
1	-	Retaining valve – Brake D2
2	-	Clutch valve – Brake D2
3	-	Clutch valve B
4	-	Valve plate
5	-	Clutch valve – Brake D1
6	-	Clutch valve – Brake C

Electronic Pressure Regulator Solenoids (EPRS)



E42713

Six Electronic Pressure Regulator Solenoids (EPRS) are located in the valve block. The solenoids are controlled by Pulse width Modulation (PWM) signals from the TCM. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

The following table shows EPRS and their associated functions:

EPRS	Function
1	Clutch A
2	Clutch B
3	Clutch C
4	Brake clutches D and E
5	System pressure control
6	Torque converter lock-up control

Solenoids EPRS 1, 3 and 6 supply a lower control pressure as the signal amperage increases and can be identified by a black connector cap. The TCM operates the solenoids using PWM signals. The TCM monitors engine load and clutch slip and varies the solenoid duty cycle accordingly. The solenoids have a 12V operating voltage and a pressure range of 0 - 4.6 bar (0 - 67 lbf.in²).

Solenoids EPRS 2, 4 and 5 supply a higher control pressure as the signal amperage increases and can be identified by a green connector cap. The solenoids are normally open, regulating flow solenoid valves. The TCM operates the solenoids using a PWM earth proportional to the required increasing or decreasing clutch pressures. The solenoids have a 12V operating voltage and a pressure range of 4.6 - 0 bar (67 - 0 lbf.in²).

The resistance of the coil winding for the EPRS solenoids is 5.05 ohms at 20°C (68°F).

Control Solenoid



E42714

A shift control Solenoid Valve (SV) is located in the valve block. The solenoid is controlled by the TCM and converts electrical signals into hydraulic control signals to control clutch application.

The shift control solenoid is an open/closed, on/off solenoid which is controlled by the TCM switching the solenoid to earth. The TCM also supplies power to the solenoid. The TCM energises the solenoid in a programmed sequence for clutch application for gear ratio changes and shift control.

The resistance of the solenoid coil winding for solenoid is between 26 to 30.4 ohms at 20°C (68°F).

Sensors

Speed Sensors

The turbine speed sensor and the output shaft speed sensor are Hall effect type sensors located in the Mechatronic valve block and are not serviceable items. The TCM monitors the signals from each sensor to determine the input (turbine) speed and the output shaft speed.

The turbine speed is monitored by the TCM to calculate the slip of the torque converter clutch and internal clutch slip. This signal allows the TCM to accurately control the slip timing during shifts and adjust clutch application or release pressure for overlap shift control.

The output shaft speed is monitored by the TCM and compared to engine speed signals received on the CAN bus from the ECM. Using a comparison of the two signals the TCM calculates the transmission slip ratio for plausibility and maintains adaptive pressure control.

Temperature Sensor

The temperature sensor is also located in the Mechatronic valve block. The TCM uses the temperature sensor signals to determine the temperature of the transmission fluid. These signals are used by the TCM to control the transmission operation to promote faster warm-up in cold conditions or to assist with fluid cooling by controlling the transmission operation when high fluid temperatures are experienced. If the sensor fails, the TCM will use a default value and a fault code will be stored in the TCM.

Damper

There is one damper located in the valve housing. The damper is used to regulate and dampen the regulated pressure supplied via EPRS 5. The damper is load dependent through modulation of the damper against return spring pressure.

The damper comprises a piston, a housing bore and a spring. The piston is subject to the pressure applied by the spring. The bore has a connecting port to the function to which it applies. Fluid pressure applied to the applicable component (i.e. a clutch) is also subjected to the full area of the piston, which moves against the opposing force applied by the spring. The movement of the piston creates an action similar to a shock absorber, momentarily delaying the build up of pressure in the circuit. This results in a more gradual application of clutches improving shift quality.

Spool Valves

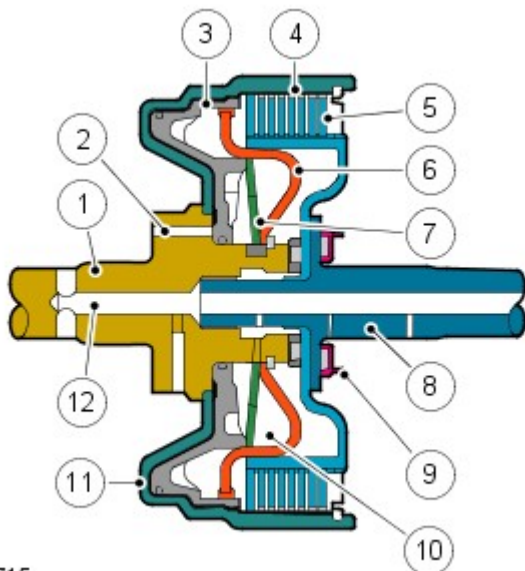
The valve block contains twenty one spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

Each spool valve is located in its spool bore and held in a default (unpressurised) position by a spring. The spool bore has a number of ports which allow fluid to flow to other valves and clutches to enable transmission operation. Each spool has a piston which is waisted to allow fluid to be diverted into the applicable ports when the valve is operated.

When fluid pressure moves a spool, one or more ports in the spool bore are covered or uncovered. Fluid is prevented from flowing or is allowed to flow around the applicable waisted area of the spool and into another uncovered port. The fluid is either passed through galleries to actuate another spool, operate a clutch or is returned to the fluid pan.

DRIVE CLUTCHES

Multiplate Drive or Brake Clutch – Typical



E42715

Item	Part Number	Description
1	-	Input shaft
2	-	Main pressure supply port
3	-	Piston
4	-	Cylinder – External plate carrier
5	-	Clutch plate assembly
6	-	Baffle plate
7	-	Diaphragm spring
8	-	Output shaft
9	-	Bearing

10	-	Dynamic pressure equalisation chamber
11	-	Piston chamber
12	-	Lubrication channel

There are three drive clutches and two brake clutches used in the 6HP26 transmission. Each clutch comprises one or more friction plates dependent on the output controlled. A typical clutch consists of a number of steel outer plates and inner plates with friction material bonded to each face.

The clutch plates are held apart mechanically by a diaphragm spring and hydraulically by dynamic pressure. The pressure is derived from a lubrication channel which supplies fluid to the bearings etc. The fluid is passed via a drilling in the output shaft into the chamber between the baffle plate and the piston. To prevent inadvertent clutch application due to pressure build up produced by centrifugal force, the fluid in the dynamic pressure equalisation chamber overcomes any pressure in the piston chamber and holds the piston off the clutch plate assembly.

When clutch application is required, main pressure from the fluid pump is applied to the piston chamber from the supply port. This main pressure overcomes the low pressure fluid present in the dynamic pressure equalisation chamber. The piston moves, against the pressure applied by the diaphragm spring, and compresses the clutch plate assembly. When the main pressure falls, the diaphragm spring pushes the piston away from the clutch plate assembly, disengaging the clutch.

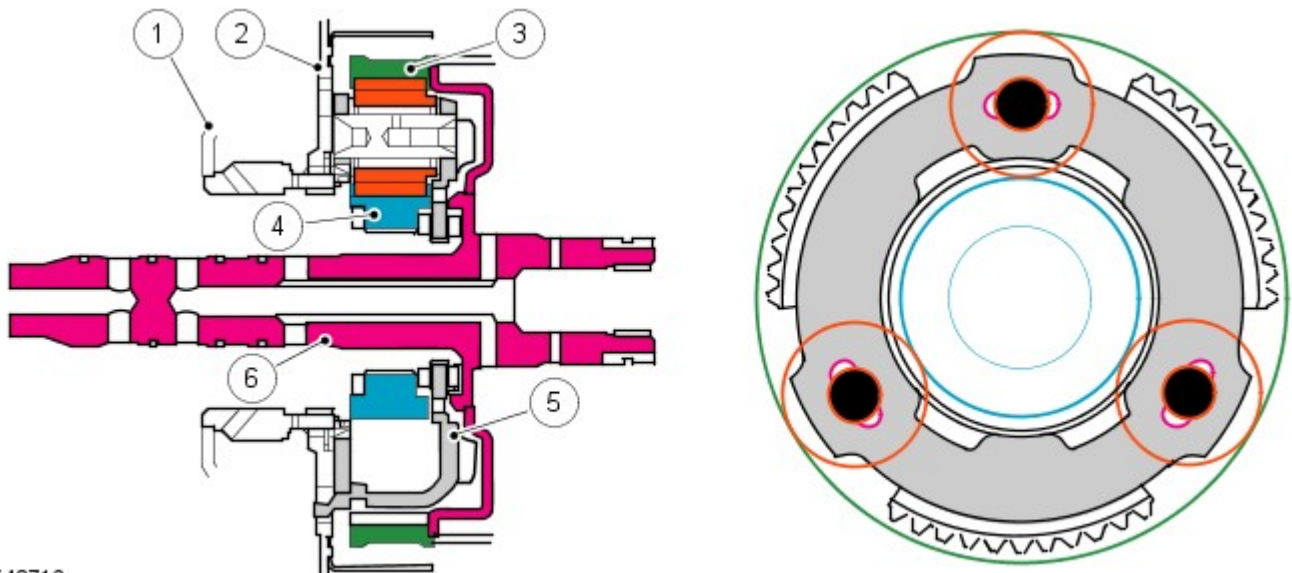
PLANETARY GEAR TRAINS

The planetary gear trains used on the 6HP26 transmission comprise a single web planetary gear train and a double web planetary gear train. These gear trains are known as Lepelletier type gear trains and together produce the six forward gears and the one reverse gear.

Single Web Planetary Gear Train

The single web planetary gear train comprises:

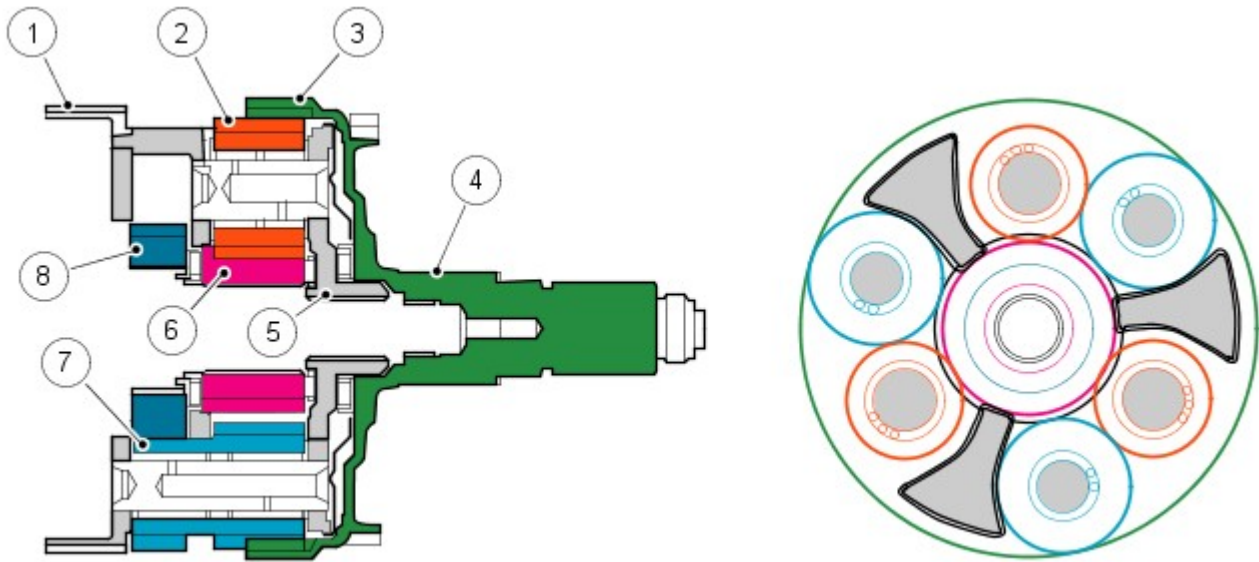
- One sunwheel
- Three planetary gears
- One planetary gear carrier
- One ring gear or annulus



E42716

Item	Part Number	Description
1	-	Cylinder
2	-	Baffle plate
3	-	Ring gear
4	-	Planetary gear carrier
5	-	Planetary gear spider
6	-	Torque converter input shaft

Double Web Planetary Gear Train



E42717

Item	Part Number	Description
1	-	Planetary gear spider
2	-	Planetary gears (short)
3	-	Ring gear
4	-	Output shaft
5	-	Planetary gear
6	-	Sunwheel
7	-	Double planetary gears (long)
8	-	Sunwheel

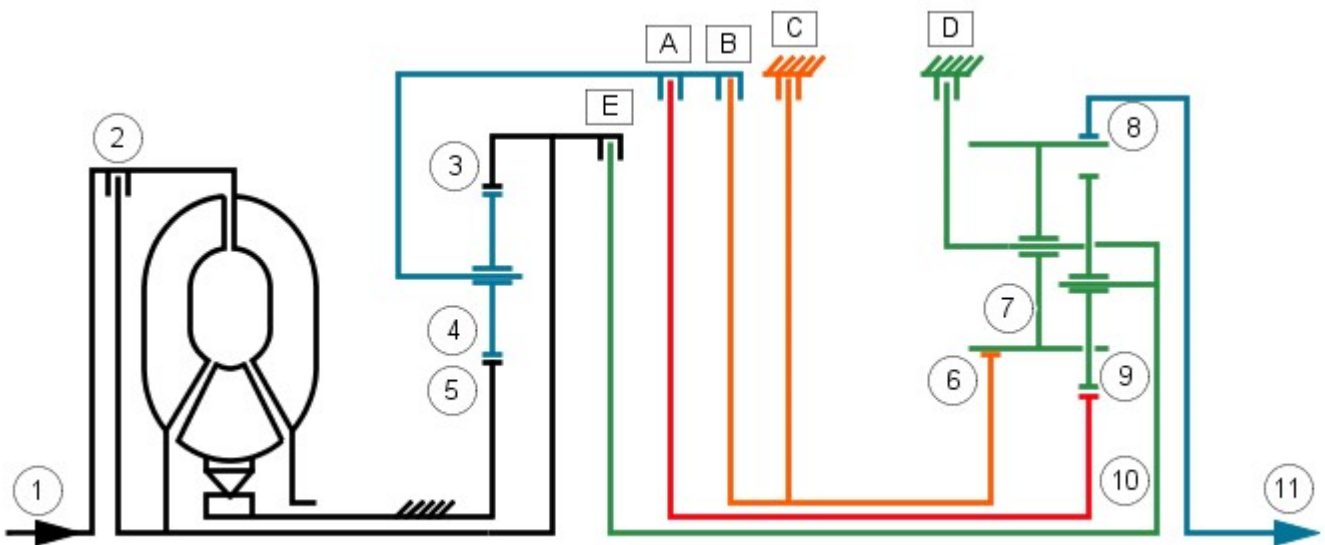
The double planetary gear train comprises:

- Two sunwheels
- Three short planetary gears
- Three long planetary gears
- One planetary gear carrier
- One ring gear or annulus

POWER FLOWS

Operation of the transmission is controlled by the TCM which electrically activates various solenoids to control the transmission gear selection. The sequence of solenoid activation is based on programmed information in the module memory and physical transmission operating conditions such as vehicle speed, throttle position, engine load and selector lever position.

Powerflow Schematic



E42718

Item	Part Number	Description
1	-	Torque input from engine
2	-	Torque converter lock-up clutch
3	-	Single web planetary gear carrier

4	-	Single web planetary gears
5	-	Single web sunwheel 1
6	-	Double web sunwheel 2
7	-	Double web planetary gears - Long
8	-	Double web planetary gear carrier
9	-	Double web planetary gears - Short
10	-	Double web sunwheel 3
11	-	Torque output from transmission
A	-	Multiplate clutch
B	-	Multiplate clutch
C	-	Multiplate brake
D	-	Multiplate brake
E	-	Multiplate clutch

Engine torque is transferred, via operation of single or combinations of clutches to the two planetary gear trains. Both gear trains are controlled by reactionary inputs from brake clutches to produce the six forward gears and one reverse gear. The ratios are as follows:

Gear	1st	2nd	3rd	4th	5th	6th	Reverse
Ratio	4.171	2.340	1.521	1.143	0.867	0.691	3.403

The following table shows which solenoids are activated to produce the required torque output from the transmission.

Gear Selector Lever Position	Shift Control Solenoid Valve	Electronic Pressure Regulator Solenoids (EPRS)					
		1	2	3	4	5	6
P					ON	-ON-	
R				ON		ON	-ON-
N						ON	-ON-
D 1			ON			ON	-ON-
D 2			ON		ON		-ON-
D 3			ON	ON			-ON-
D 4	ON		ON			ON	-ON-
D 5	ON			ON		ON	-ON-
D 6	ON				ON	ON	-ON-

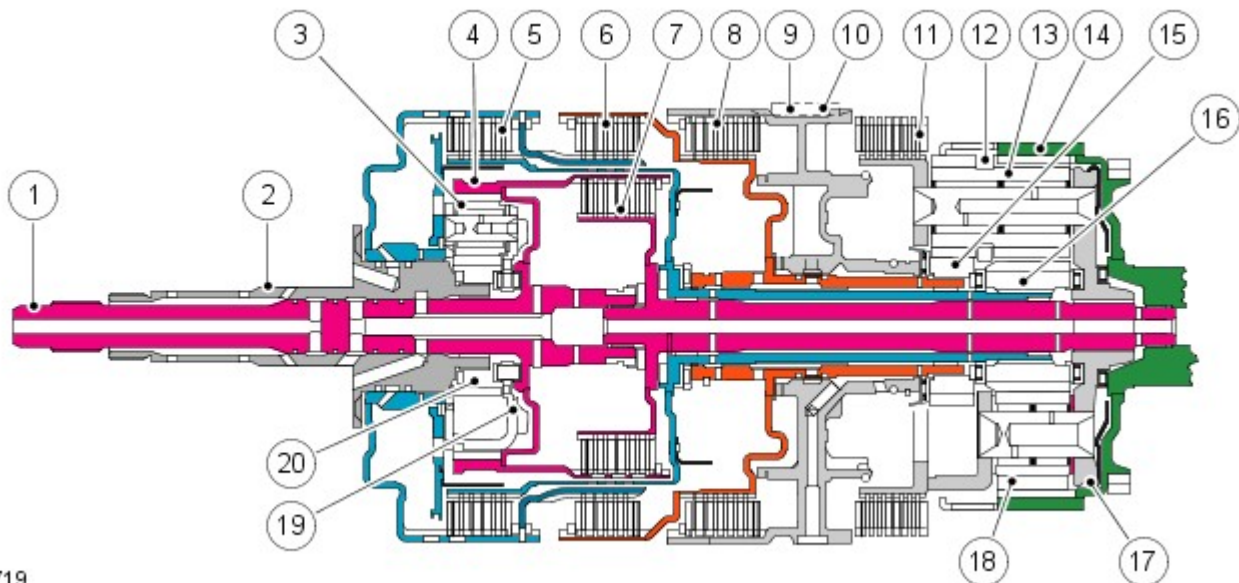
ON = Active (pressure build up)
OFF = Inactive
-ON- = Inactive (pressure drain)

The following table shows which clutches are operating for selected gear ratios to produce the required torque output from the transmission.

Gear Selector Lever Position	Shift Control Solenoid Valve	Clutch				Brake	
		A	B	E	WK	C	D
P							X
R			X				X
N							X
D 1		X		X			X
D 2		X		X		X	
D 3		X	X	X			
D 4	ON	X		X	X		
D 5	ON		X	X	X		
D 6	ON			X	X	X	

X = clutch applied

Shift Elements



E42719

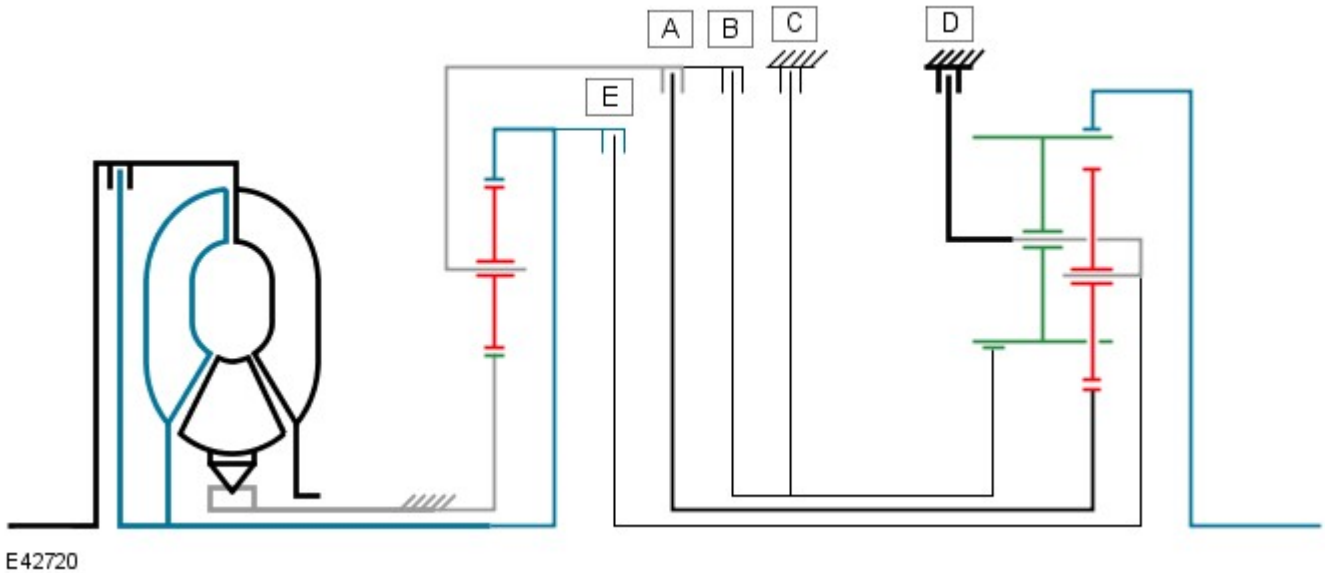
Item	Part Number	Description
1	-	Turbine shaft

2	-	Stator shaft
3	-	Single web planetary gear train
4	-	Ring gear 1
5	-	Clutch A
6	-	Clutch B
7	-	Clutch E
8	-	Brake clutch C
9	-	Fixed connection to transmission housing
10	-	Shaft key
11	-	Brake clutch D
12	-	Double web planetary gear train
13	-	Planetary gears - Long
14	-	Ring gear 2
15	-	Sunwheel 2
16	-	Sunwheel 3
17	-	Double web planetary gear carrier
18	-	Planetary gears - short
19	-	Single web planetary gear carrier
20	-	Sunwheel 1

The shift elements are three rotating multiplate clutches (A, B and E) and two fixed multiplate brakes © and D). All shifts from 1st to 6th gears are power-on overlapping shifts. Overlapping shifts can be described as one of the clutches continuing to transmit drive at a lower main pressure until the next required clutch is able to accept the input torque.

The shift elements, clutches and brakes are actuated hydraulically. Fluid pressure is applied to the required clutch and/or brake, pressing the plates together and allowing drive to be transmitted through the plates. The purpose of the shift elements is to perform power-on shifts with no interruption to traction and smooth transition between gear ratios.

Power Flow 1st Gear



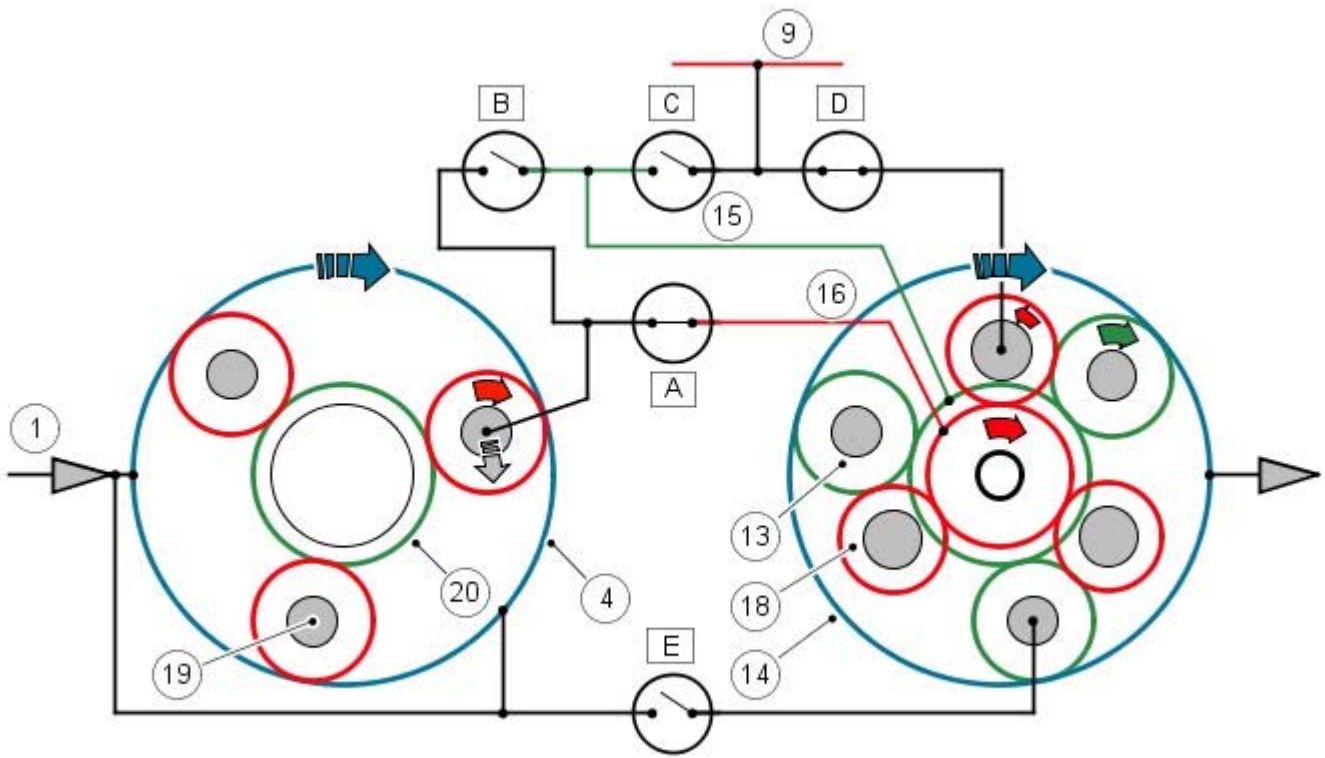
The gear selector lever and the manual selector valve spool are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

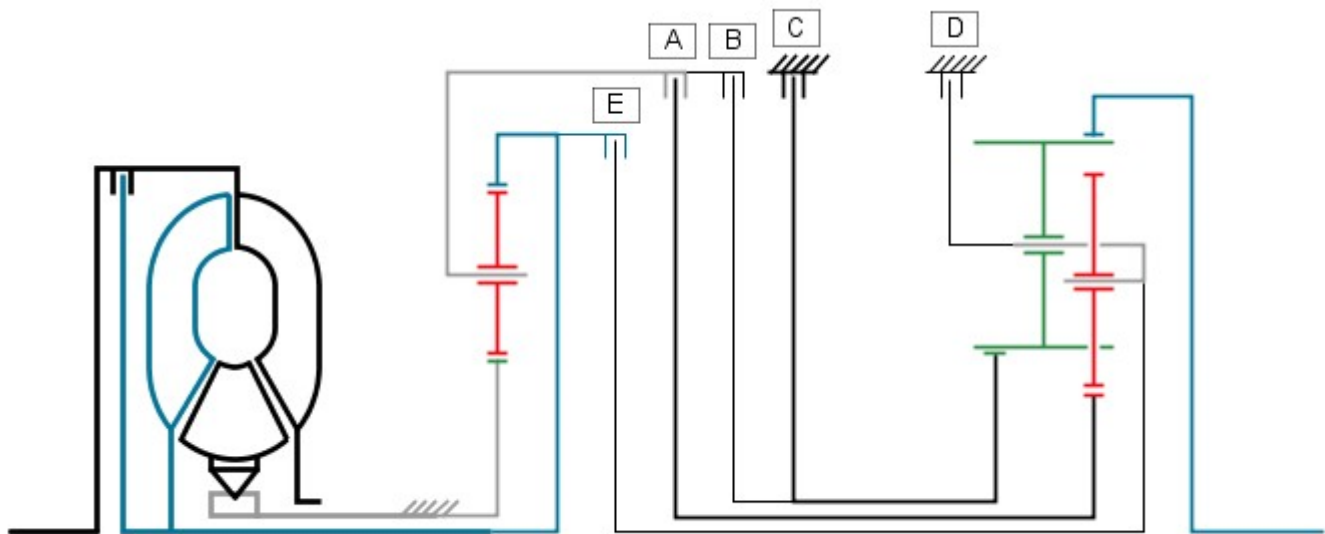
The double web planetary gear train is locked against the transmission housing by brake 'D'. This allows ring gear 2 (output shaft) to be driven in the same direction as the engine via the long planetary gears.

• NOTE: Refer to 'Shift Elements' illustration for key



E42721

Power Flow 2nd Gear



E42722

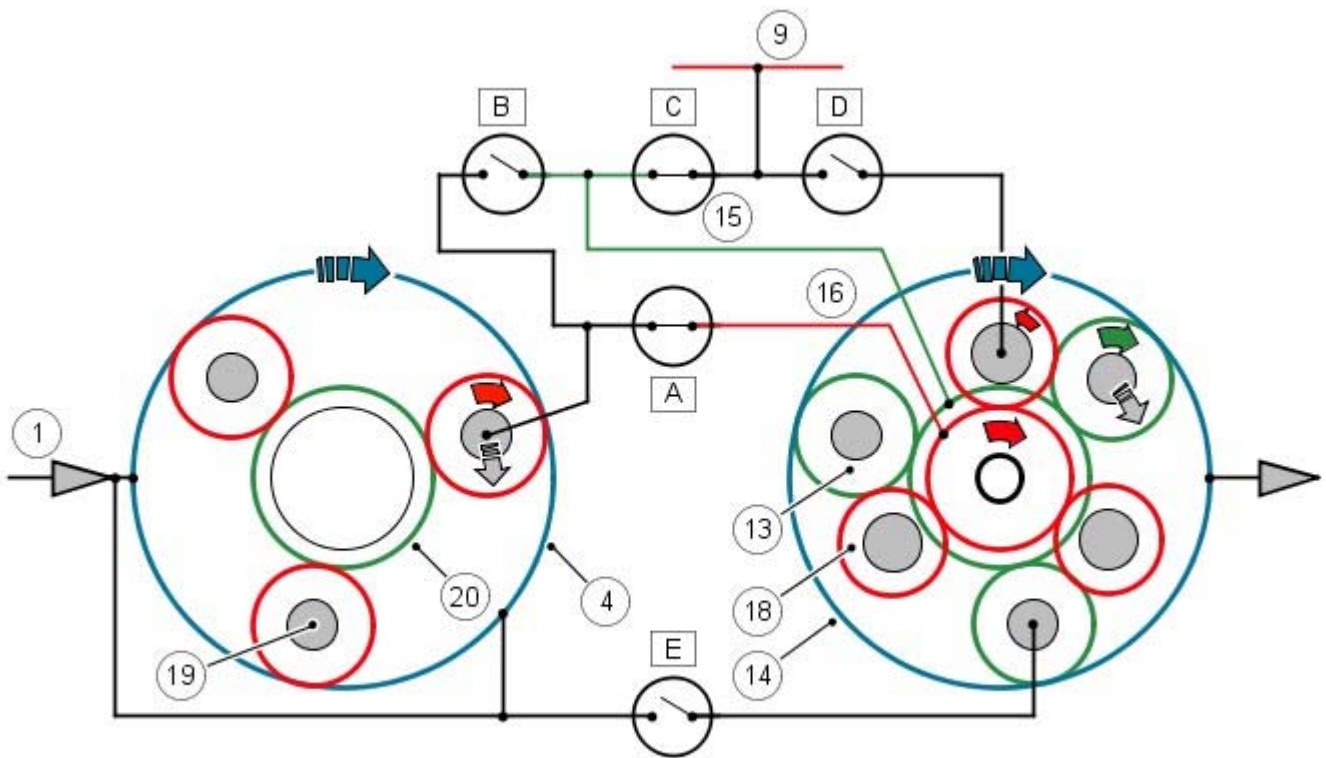
The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

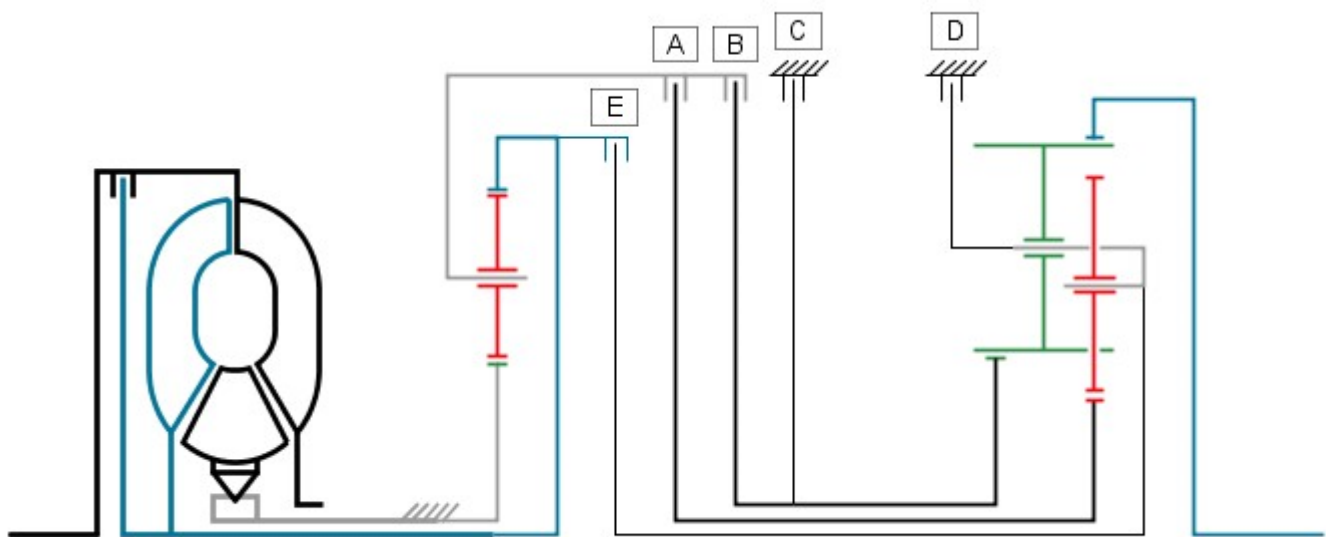
Sunwheel 2 is locked to the transmission housing by brake clutch 'C'. The long planetary gears, which are also meshed with the short planetary gears, roll around the fixed sunwheel 2 and transmit drive to the double web planetary gear train carrier and ring gear 2 in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42723

Power Flow 3rd Gear



E 42724

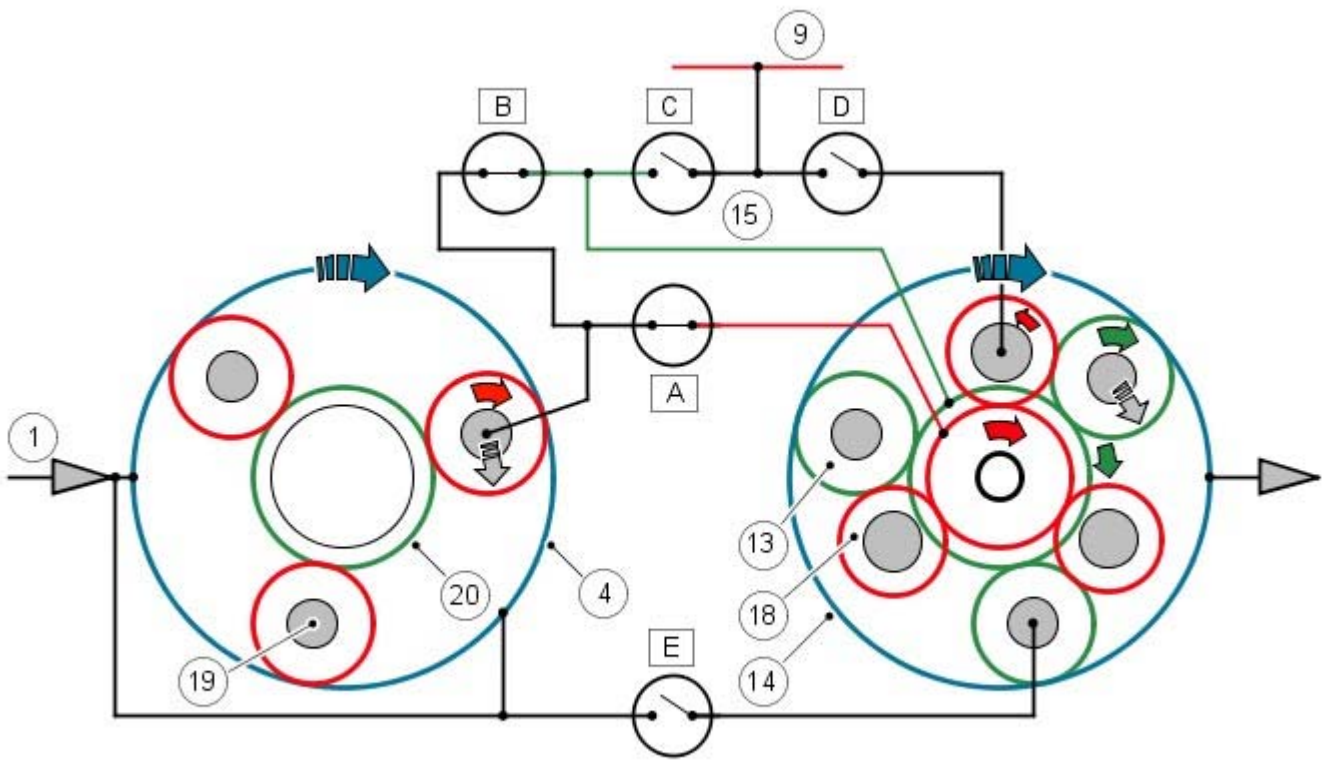
The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

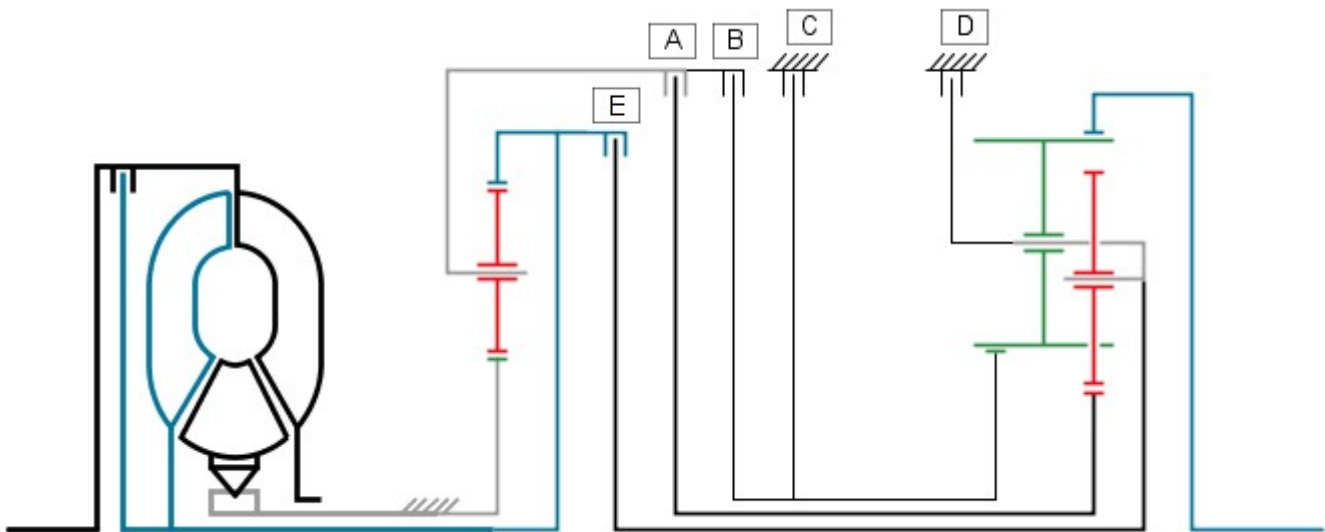
Sunwheel 2 is driven via clutch 'B' which is engaged. The long planetary gears, which are also meshed with the short planetary gears, cannot roll around the fixed sunwheel 2 and transmit drive to the locked double web planetary gear train carrier in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42725

Power Flow 4th Gear



E42726

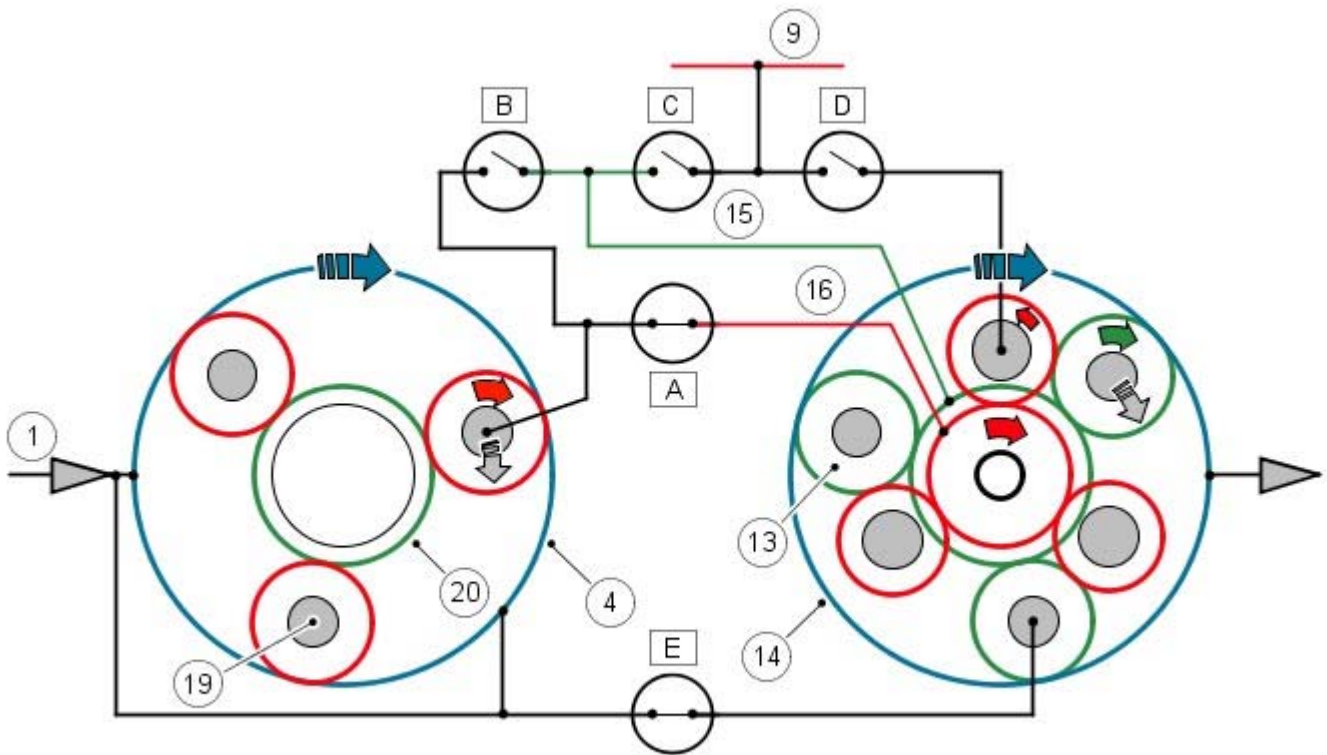
The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

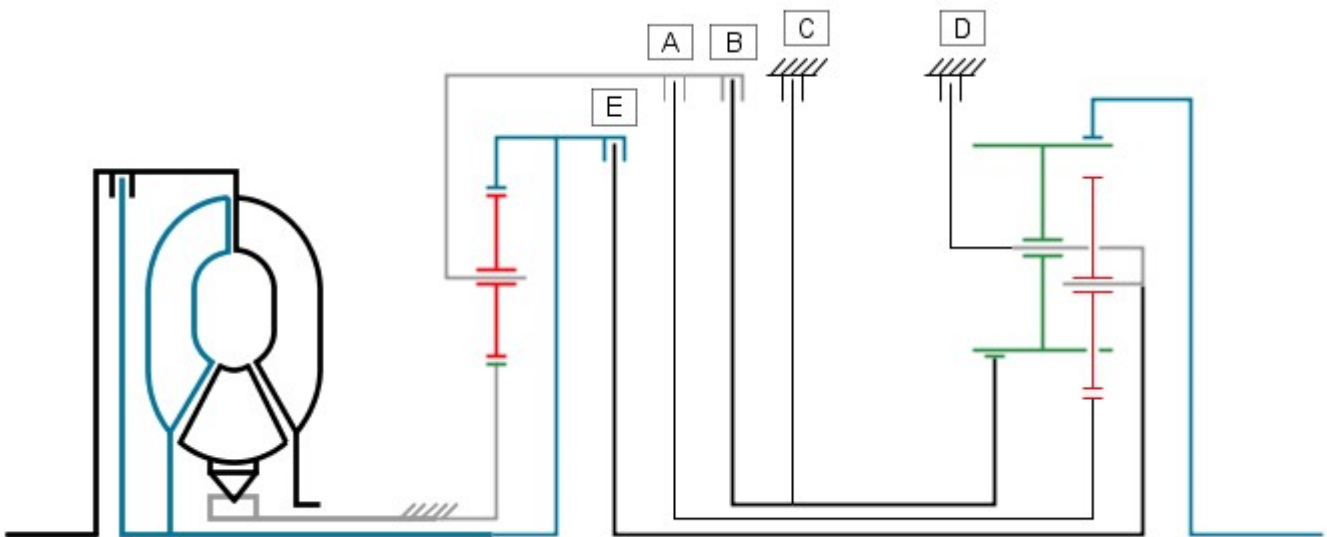
The double web planetary gear carrier is driven via clutch 'E' which is engaged. The long planetary gears, which are also meshed with the short planetary gears, and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42727

Power Flow 5th Gear



E42728

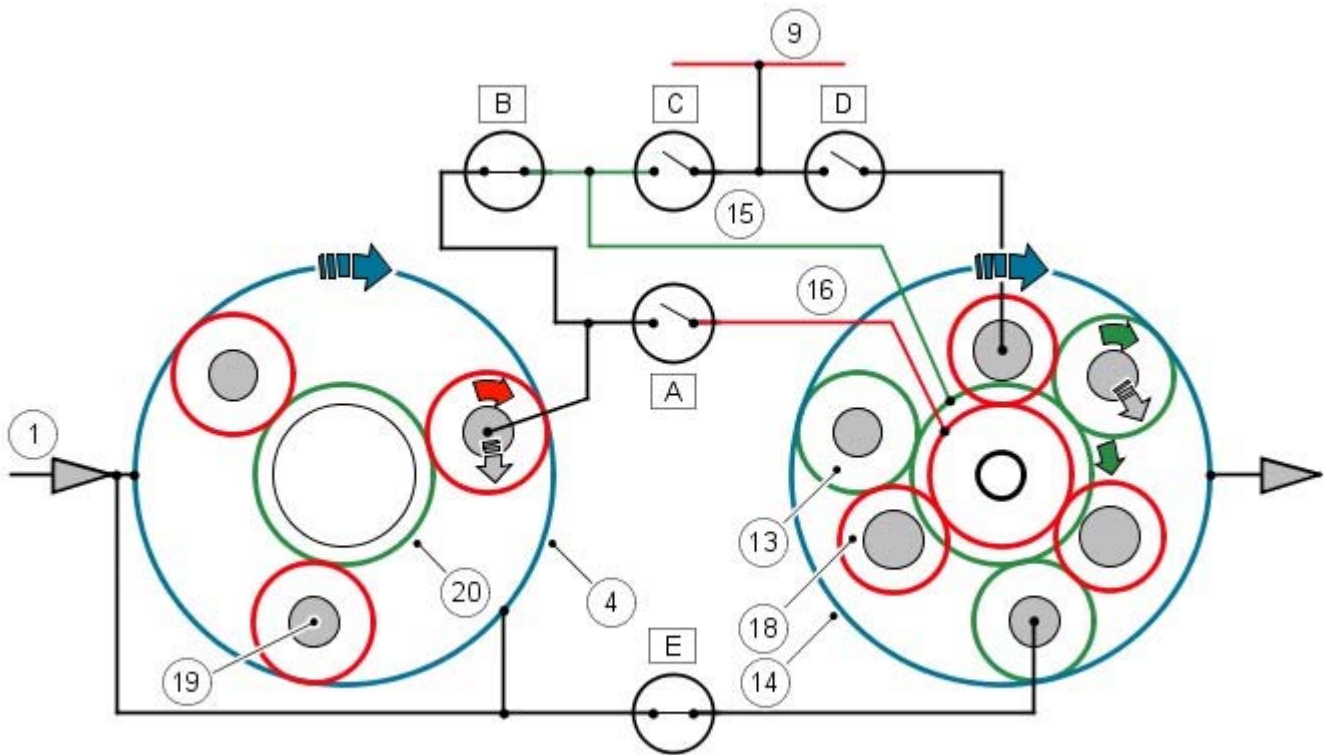
The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

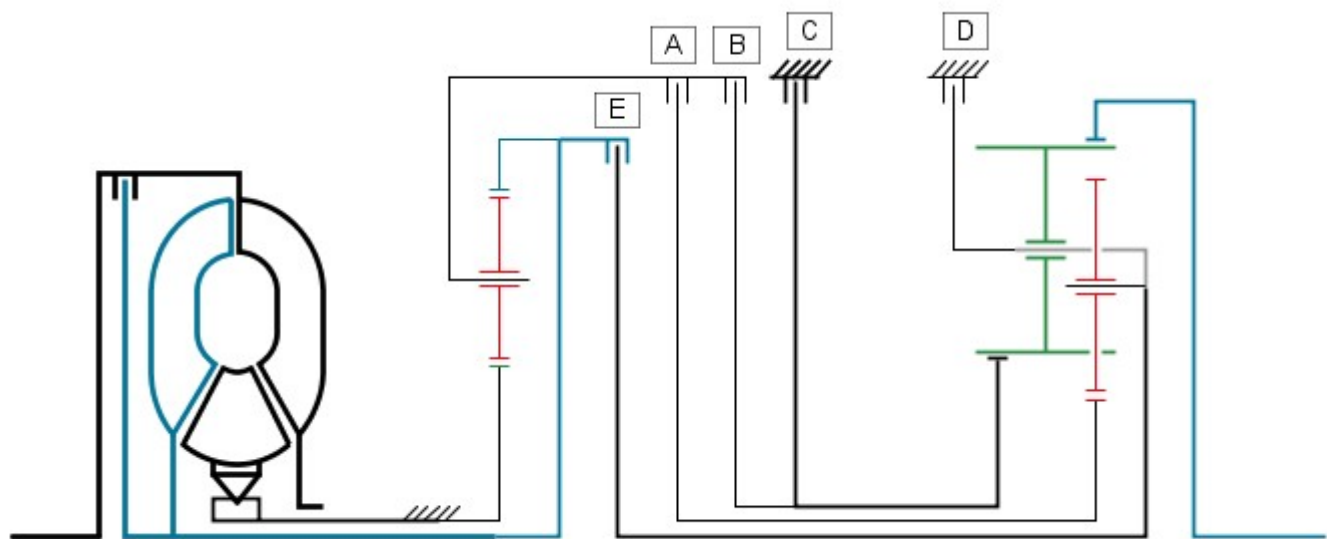
The long planetary gears, which are also meshed with the short planetary gears, and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42729

Power Flow 6th Gear



E42730

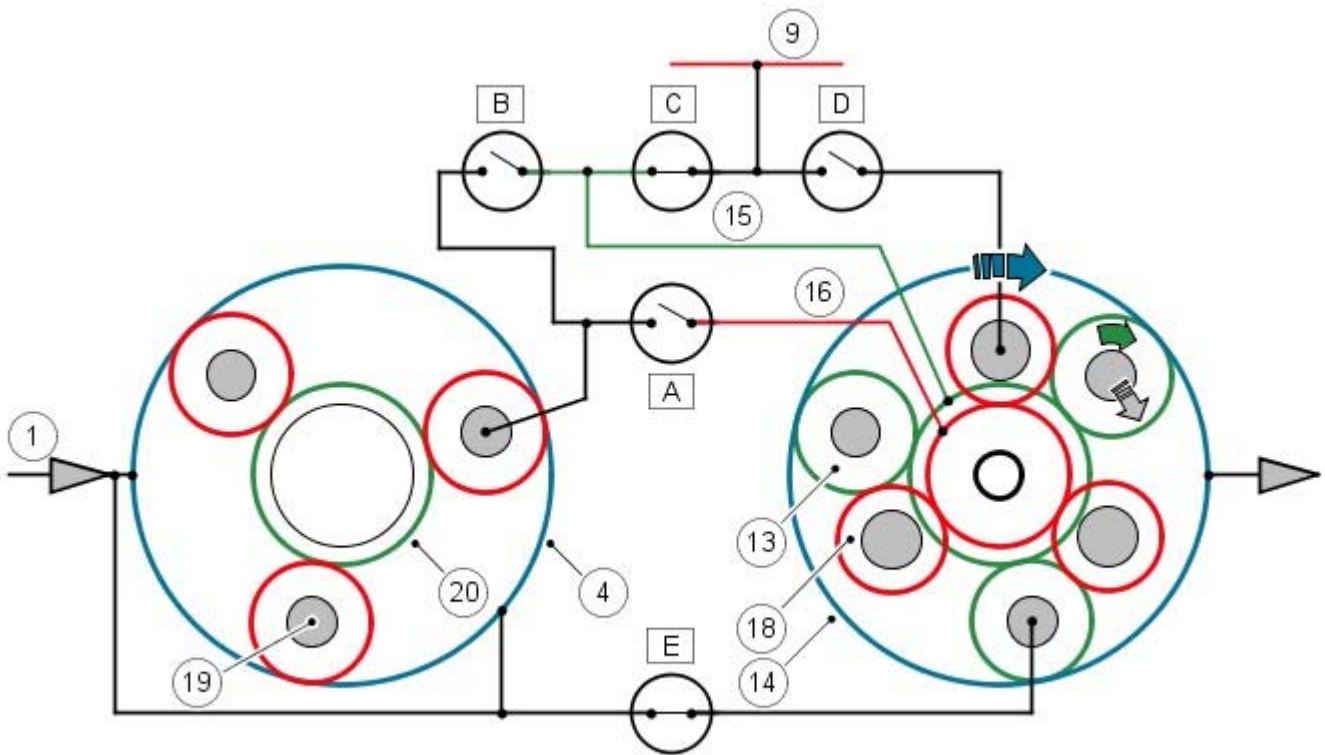
The gear selector lever and the manual selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Clutches 'A' and 'B' are released, removing the effect of the single web planetary gear train.

Clutch brake 'C' is applied which locks sunwheel 2 to the transmission housing.

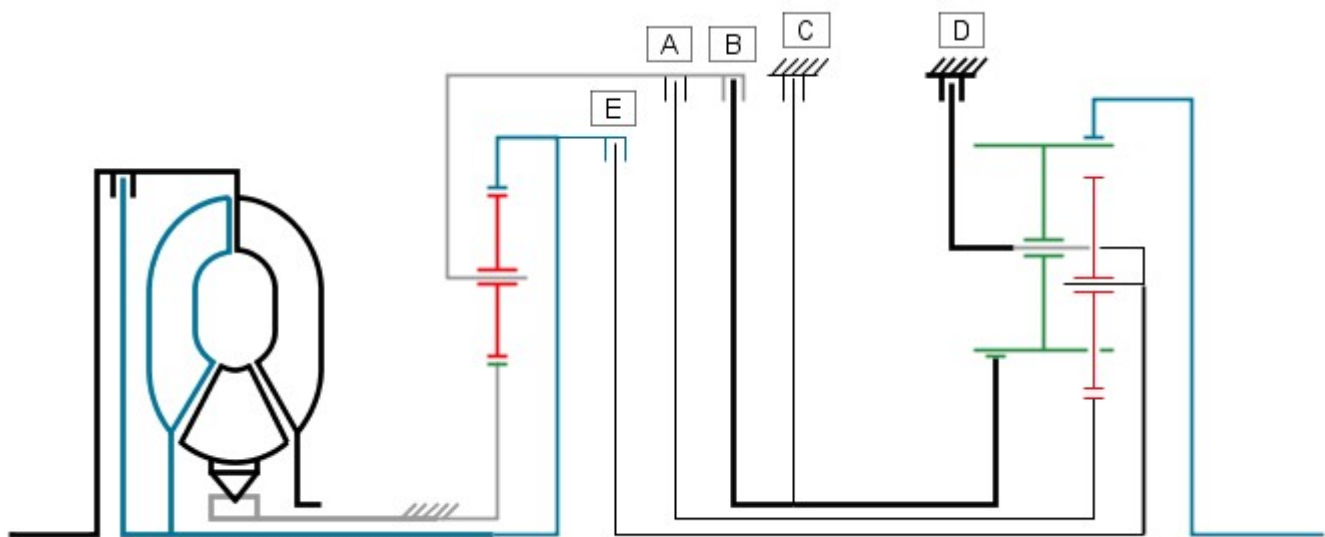
Clutch 'E' is engaged and drives the double web planetary gear carrier. This causes the long planetary gears to rotate around the fixed sunwheel 2 and transmit drive to ring gear 2 which is driven in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42731

Power Flow Reverse Gear



E42732

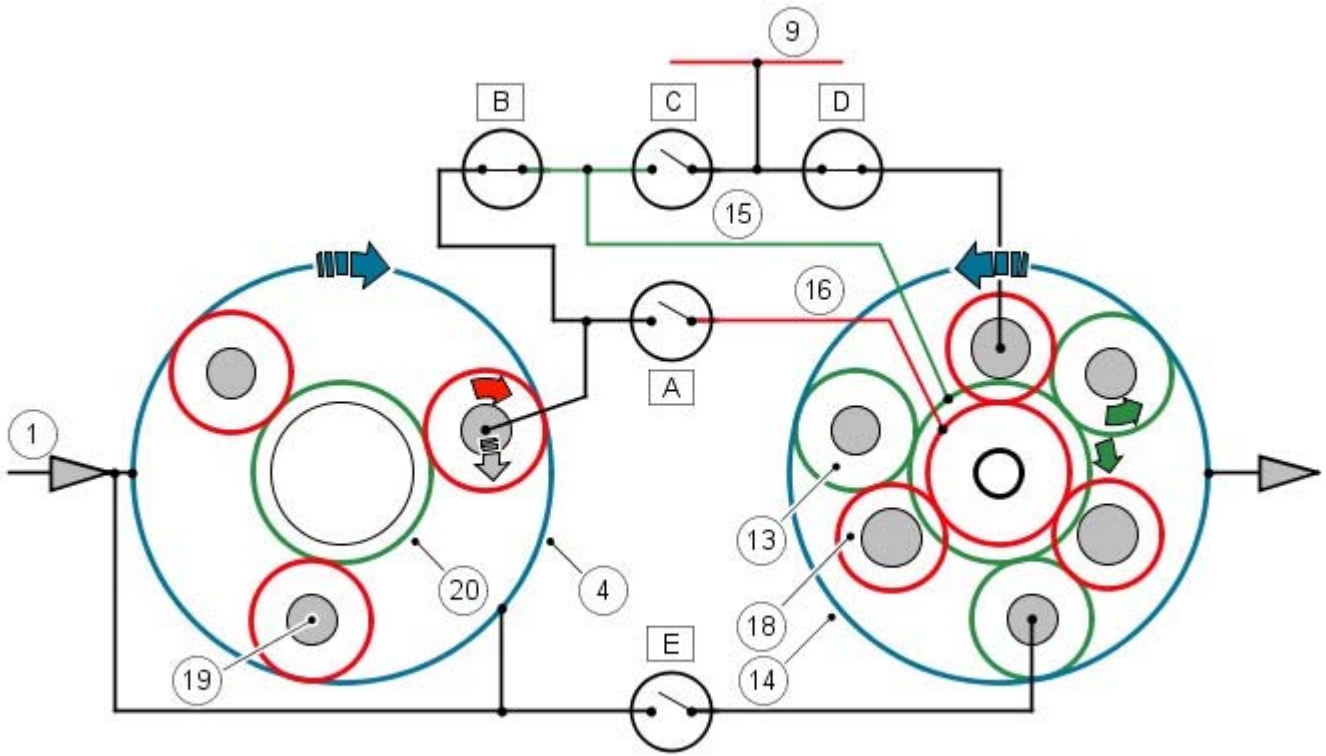
The gear selector lever and the manual selector spool valve are in the 'R' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears of the single web planetary gear train which rotate around the fixed sunwheel 1. This transmits the drive to the single web planetary gear carrier, the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

With clutch 'B' applied, sunwheel 2 in the double web planetary gear train is driven and meshes with the long planetary gears.

The double web planetary gear carrier is locked to the transmission housing by brake clutch 'D'. This allows ring gear 2 to be driven in the opposite direction to engine rotation by the long planetary gears.

• NOTE: Refer to 'Shift Elements' illustration for key



E42733

SELECTOR POSITION SWITCH

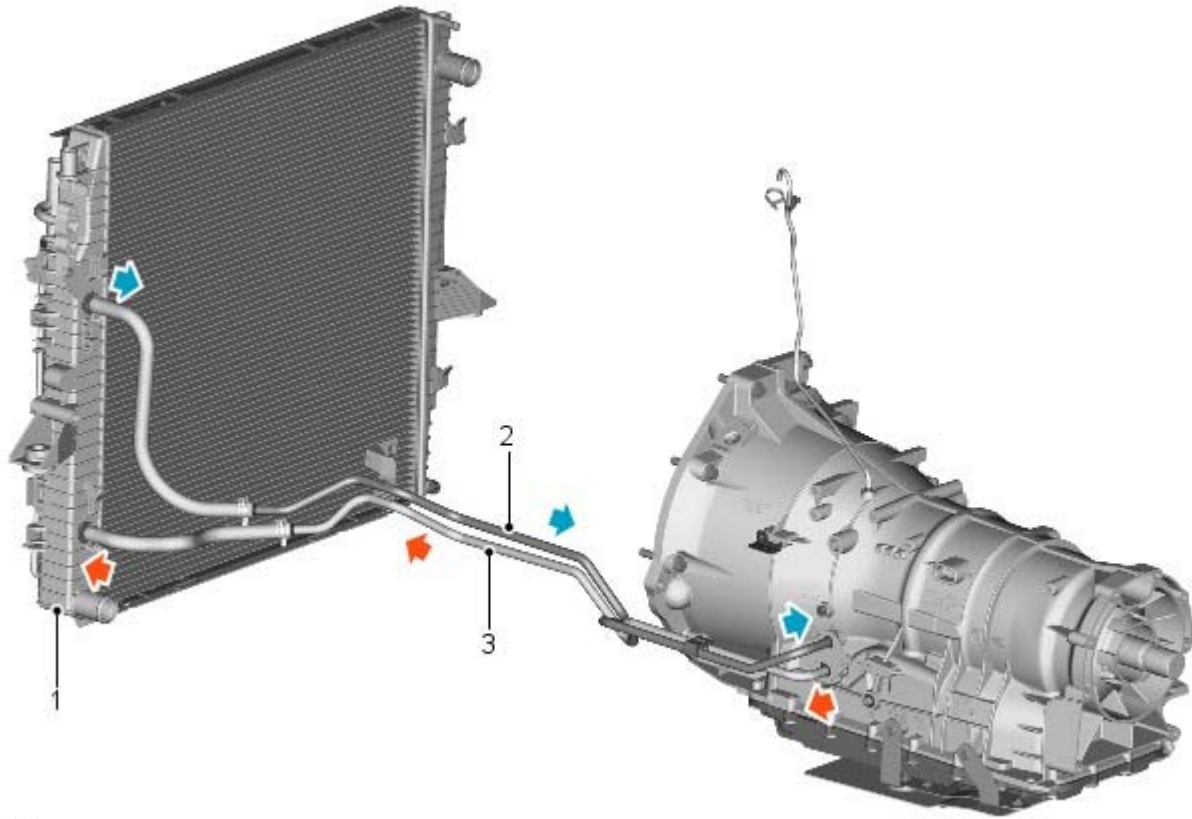
The Mechatronic valve block contains a position switch which is mechanically connected to the selector spool valve. The selector spool valve is connected by a selector shaft to the selector lever via a 'Bowden' selector cable.

The signals from the position switch are used by the TCM to determine the P, R, N or D selection made by the driver.

FLUID COOLING

The transmission fluid cooler is an integral part of the engine cooling radiator. The transmission is connected to the fluid cooler via flexible hoses and metal pipes.

- NOTE: 4.0L V6 Petrol shown, 4.4L V8 and TdV6 similar



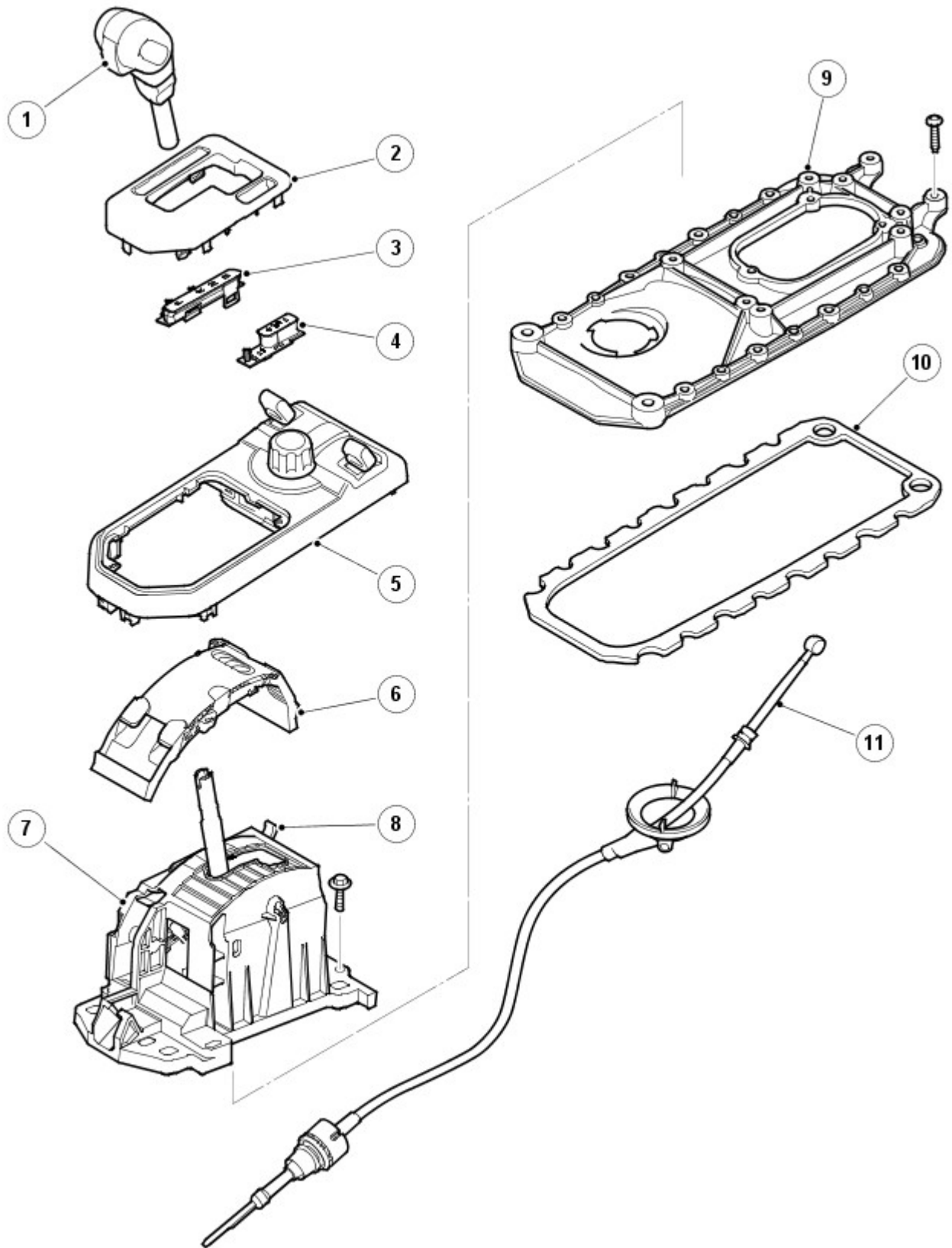
E42898

Item	Part Number	Description
1	-	Transmission cooler
2	-	Return pipe (To transmission)
3	-	Feed pipe (From transmission)

The transmission cooler is integrated into the left hand end tank of the engine cooling radiator. The transmission fluid is cooled by the temperature differential between the transmission fluid and the engine coolant and also by airflow over cooling fins on the end tank.

Fluid is supplied from the transmission fluid pump into the lower connection of the cooler. After passing through the cooler, the fluid passes out of the upper connection and is returned to transmission fluid pan.

GEAR SELECTOR LEVER ASSEMBLY



E42734

Item	Part Number	Description
1	-	Selector lever
2	-	Finisher
3	-	PRND display
4	-	M/S display
5	-	Switch pack and finisher
6	-	Shutter
7	-	Selector assembly
8	-	Interlock emergency release lever
9	-	Mounting plate
10	-	Seal

11	-	Selector cable
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The gear selector lever assembly is located in a central position on the transmission tunnel, between the front driver and passenger seats and is secured to the transmission tunnel closure plate. The selector lever comprises a moulded plastic housing which provides for the location of the selector components.

The lever is connected to a crosspiece which allows for the selection of P, R, N, D in a forward or backward direction and selection between automatic and manual/sport mode in a left/right transverse direction.

When manual/sport mode is selected the lever can be moved in a forward or backward direction to select + or - for manual (CommandShift™) operation. If left in Sport mode all gear changes are performed automatically.

If Manual (CommandShift™) mode is selected, all gear changes are based on inputs received by the TCM from the manual +/- hall effect sensors located on the PCB.

The selector lever mechanism houses the following components:

- Electronic Printed Circuit Board (PCB)
- Shift Interlock solenoid
- Park and Neutral locking levers.

There are four selector lever positions and two additional positions for manual/sport operation:

- P (Park) - Prevents the vehicle from moving by locking the transmission
- R (Reverse) - Select only when the vehicle is stationary and the engine is at idle
- N (Neutral) - No torque transmitted to drive wheels
- D (Drive) - This position uses all six forward gears in high and low ranges
- M/S (Sport Mode) - This position uses all forward gears in 'D' but will upshift at higher engine speeds to improve acceleration
- + and - (Manual 'CommandShift™' mode) - Movement of the selector lever in the +/- positions, when the lever is in the M/S position, will operate the transmission in manual (CommandShift™) mode allowing the driver to manually select all six forward gears

The selector lever position is displayed to the driver on the selector position LED display and in the instrument cluster. In 'CommandShift™' mode, if a gear is selected but the TCM logic prevents selection of that gear, the requested gear will be initially displayed. The TCM will engage the next allowed gear and then display that gear.

Sport/Manual +/- CommandShift™ Switch

The PCB contains the hall effect sensors to activate the sport/manual mode and also the sensors which provide the +/- signals. When the selector lever is moved to the manual/sport position, the lower magnet located in the selector lever is moved within proximity of the M/S hall effect sensor on the PCB. This provides the momentary signal which is received by the TCM, which in turn initiates sport mode.

When the lever is moved to the + or - position, the magnet is moved within proximity of one of the hall effect sensors positioned either side of the M/S hall effect sensor. When an input from either the + or - sensors is received, manual CommandShift™ mode will be initiated. In this position a spring will move the selector lever back to the centre position when released. To leave the CommandShift™ mode, return the lever to the 'D' position.

Selector Position LED Display

The P, R, N, D LED display is located on the right hand side of the selector lever and the M/S (MANUAL/SPORT) +/- LED display is located on the left hand side of the selector lever. Each LED display is connected via a separate harness to the selector lever position switch. When the lever is moved to the required position, the switch contact for that position is made and the LED is illuminated.

P, R, N, D Position Switch

The P, R, N, D position switch is located within the Mechatronic valve block in the transmission. The switch is operated by movement of the selector lever to the P, R, N or D positions via the Bowden cable which is connected between the selector lever and the transmission selector shaft.

The switch is electrically connected to the TCM which outputs a common power supply to each of the four switch contacts. This power supply is also used by the two speed sensors and the fluid temperature sensor. Each of the four switch contacts have a separate feed input to the TCM which can detect which selector lever position has been selected.

Shift Interlock Solenoid

The shift interlock solenoid is located on the side of the selector lever assembly. The solenoid operates two locking levers which engage in the lower lever and lock it in the Park (P) and Neutral (N) positions. When the ignition is on or the engine is running, the solenoid is de-energised and prevents the lever from moving.

When energised, by the depression of the footbrake, the solenoid is energised and the selector lever may be moved from the P position. If the selector lever is left in the N position for more than 800m/s the solenoid will be energised and the selector lever will become locked in the N position. To move the selector lever from the N position in this condition the footbrake must be applied. This prevents the selector lever from being moved to the 'D' or 'R' position unintentionally and the application of the brakes also prevents the vehicle 'creeping' when the gear is engaged.

Movement of the selector lever from the 'P' or 'N' positions is also prevented if the TCM senses the engine speed is above 2500 rev/min, even if the brake pedal is depressed.

In the event of an electrical failure of the vehicle or failure of the interlock solenoid or its associated wiring, it is possible to move the selector lever from the Park 'P' position by removing the coin tray on left hand drive vehicles or the trim panel behind the park brake switch on right hand drive vehicles and lifting the white coloured tab on the rear of the selector lever assembly. Whilst holding the tab in this position move the selector lever from the 'P' position.

The selector lever will also be locked in the N position during the transfer box changing range from high to low or vice

versa.

Selector Cable

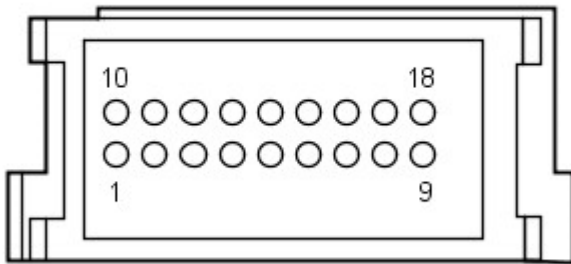
A selector cable is used as a mechanical connection between the selector lever and the transmission. The cable is a Bowden type cable which is connected to the selector lever. Movement of the lever in the P, R, N or D positions moves the cable. Movement of the cable is prevented when the selector lever is in the Manual/Sport position.

The cable is passed through a sealing grommet in the floorpan and is attached to a bracket on the transmission. The inner cable is connected to a lever which is positively attached to the transmission selector shaft.

Movement of the selector lever in the P, R, N or D positions moves the inner cable which in turn moves the lever. The lever transforms the linear movement of the cable into rotary movement of the selector shaft. The rotation of the shaft moves the position switch located within the Mechatronic valve block and also moves the manual spool valve to the applicable position.

Inputs and Outputs

Connector C2658

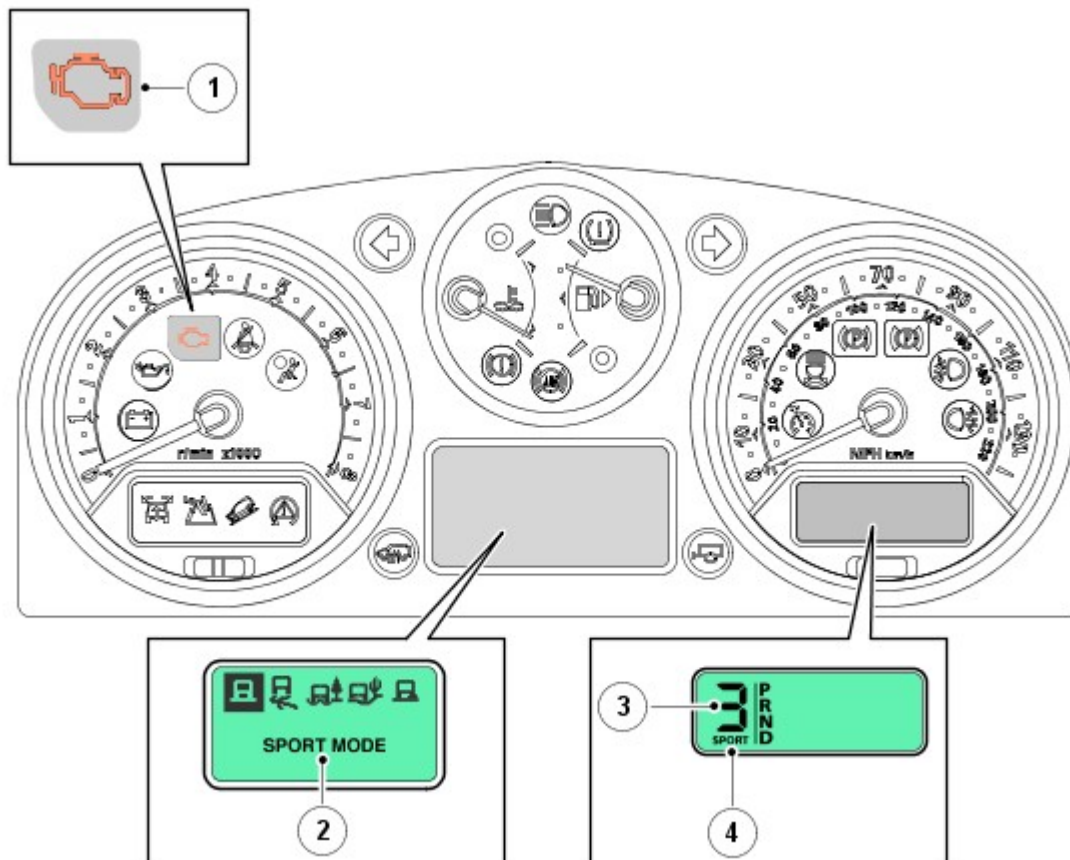


E42931

The following table shows the connector pin details for the connector on the selector lever assembly.

Pin No.	Description	Input/Output
1	Ground	-
2	Park lock confirmation	Input
3	Ground	-
4	Sport/Manual switch	Output
5	CommandShift™ + (up shift)	Output
6	CommandShift™ - (down shift)	Output
7	Ignition position II supply 12V	Input
8	Permanent power supply 12V	Input
9	Shift Interlock solenoid +	Input
10	Shift Interlock solenoid -	Input
11	Selector indicator PARK LED	Output
12	Selector indicator REVERSE LED	Output
13	Selector indicator NEUTRAL LED	Output
14	Selector indicator DRIVE LED	Output
15	Selector indicator SPORT/MANUAL LED	Output
16	Selector indicator backlight	Output - PWM
17 - 18	Not used	-

INSTRUMENT CLUSTER



E42905

Item	Part Number	Description
1	-	Malfunction Indicator Lamp (MIL)
2	-	Message centre
3	-	Selector lever position indicator
4	-	Mode display

The instrument cluster is connected to the TCM via the high speed CAN bus. Transmission status is transmitted by the TCM and displayed to the driver in one of two displays in the instrument cluster. For additional information, refer to: Instrument Cluster (413-01, Description and Operation).

Malfunction Indicator Lamp (MIL)

The MIL is located in the tachometer in the instrument cluster. Transmission related faults which may affect the vehicle emissions output will illuminate the MIL.

The MIL is illuminated by the ECM on receipt of a relevant fault message from the TCM on the high speed CAN. The nature of the fault can be diagnosed using T4 which reads the fault codes stored in the TCM memory.

Transmission Status Display

The transmission status display is located in a Liquid Crystal Display (LCD) within the speedometer housing. The LCD shows the selector lever position and the selected transmission mode. When the selector lever is in the manual CommandShift™ position, the selector lever position display will show the selected gear ratio.

The following table shows the displays and their descriptions.

Symbol	Description
P	Park selected
R	Reverse selected
N	Neutral selected
D	Drive selected
1	1st gear selected (Manual CommandShift™ mode)
2	2nd gear selected (Manual CommandShift™ mode)
3	3rd gear selected (Manual CommandShift™ mode)
4	4th gear selected (Manual CommandShift™ mode)
5	5th gear selected (Manual CommandShift™ mode)
6	6th gear selected (Manual CommandShift™ mode)

Message Centre Display

The message centre is located in the lower centre of the instrument cluster. The message centre is a LCD to relay vehicle status and operating information to the driver. The message centre can display messages relating to a number of the vehicle systems. The following list shows the possible transmission related messages:

- TRANSMISSION FAULT LIMITED GEARS AVAILABLE
- TRANSMISSION FAULT AND OVERHEAT
- TRANSMISSION FAULT

- TRANSMISSION OVERHEAT

TRANSMISSION CONTROL MODULE (TCM)

The TCM is an integral part of the Mechatronic valve block which is located at the bottom of the transmission, behind the fluid pan. The TCM is the main controlling component of the transmission.

The TCM processes signals from the transmission speed and temperature sensors, engine control module and other vehicle systems. From the received signal inputs and pre-programmed data, the module calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

The TCM outputs signals to control the shift control solenoid valve and the Electronic Pressure Regulator Solenoids (EPRS) to control the hydraulic operation of the transmission.

The ECM supplies the engine management data on the high speed CAN bus system. The TCM requires engine data to efficiently control the transmission operation, for example; flywheel torque, engine speed, accelerator pedal angle, engine temperature etc.

The steering angle sensor and the ABS module also supply data to the TCM on the high speed CAN bus system. The TCM uses data from these systems to suspend gear changes when the vehicle is cornering and/or the ABS module is controlling braking or traction control.

The selector lever is connected to the automatic transmission and the position switch in the transmission by a Bowden cable. Movement of the selector lever moves the position switch via the Bowden cable and the switch position informs the TCM of the selected position. The sport/manual +/- CommandShift switch passes manual/sport selections to the TCM. An additional switch provides a selector lever in park position signal. Once the selector lever position is confirmed, the TCM outputs appropriate information which is received by the instrument cluster to display the gear selection information in the message centre.

The Mechatronic valve block also contains the speed and temperature sensors. These are integral with the Mechatronic valve block and cannot be serviced individually. The speed sensors measure the transmission input and output speeds and pass signals to the TCM. The fluid temperature sensor is also located in the valve block and measures the fluid temperature of the transmission fluid in the fluid pan.

The TCM is connected to the starter relay coil. When the selector lever is in PARK or NEUTRAL, the module provides a ground for the coil allowing the starter relay to be energised and allow starter motor operation. If the selector lever is in any other position, the module will not provide the ground preventing starter motor operation.

Inputs and Outputs

Connector C0193



E42922

The following table shows the connector pin details for the connector on the transmission.

Pin No.	Description	Input/Output
1	Manual/sport shift programme selection	Input
2	CAN low	Input/Output
3	Diagnostic ISO9141 K Line bus	Input/Output
4	CommandShift™ - (downshift)	Input
5	CommandShift™ + (upshift)	Input
6	CAN high	Input/Output
7	Shiftlock power supply	Output
8	Not used	-
9	Ignition position II supply 12V	Input
10	Park/Neutral signal (starter inhibit)	Input
11	Shiftlock ground	Output
12	Selector lever in park position confirmation signal	Input
13	Ground 1	-
14	Permanent power supply 12V	Input
15	Not used	-
16	Ground 2	-

DIAGNOSTICS

The diagnostic socket is located in the lower instrument panel closing panel, on the driver's side, below the steering

column.

The diagnostic socket allows the exchange of information between the various modules on the bus systems and T4 or a diagnostic tool using ISO14229 protocol. The information is communicated to the socket via the high speed CAN bus from the TCM. This allows the retrieval of diagnostic information and programming of certain functions using T4 or a suitable diagnostic tool.

The TCM uses a P code strategy which stores industry standard Diagnostic Trouble Codes (DTC) relating to faults.

P Code	Component/Signal	Fault Description
P012100	Kickdown	Signal not plausible
P021900	Stall speed/engine overspeed	Signal not plausible
P050000	Wheel speeds plausible signal	General fault type
P050100	Wheels speeds plausible signal	Signal not plausible
P056100	Power supply (battery)	General fault type
P056200	Power supply (battery)	Signal voltage too low
P056300	Power supply (battery)	Signal voltage too high
P060100	EPROM/FLASH Checksum	Signal not plausible
P060300	Battery buffered RAM	Signal not plausible
P060500	EPROM/FLASH Checksum after software verification	Signal not plausible
P061300	Watchdog locking mechanism	General fault type Signal not plausible Short circuit to power supply Short circuit to ground Circuit break Short circuit to ground or power break Signal voltage too high Signal voltage too low Function specific, see monitoring function
P061300	Micro controller components	General fault type No change in signal Function specific, see monitoring function
P062F00	EEPROM communication	General fault type
P064100	Sensor supply voltage	Signal voltage too high or too low
P065700	Power supply pressure regulators and solenoids	Signal not plausible Circuit break
P065800	Power supply pressure regulators and solenoids	Short circuit to ground
P065900	Power supply pressure regulators and solenoids	Short circuit to power supply
P066800	Micro processor chip temperature sensor	Signal voltage too low
P066900	Micro processor chip temperature sensor	Signal voltage too high
P070000	Combination of impossible substitute functions	General fault type Signal not plausible Signal voltage too high
P070500	Selector position switch	Signal not plausible
P071000	Transmission oil temperature	Circuit break
P071100	Transmission oil temperature	General fault type Signal voltage too high
P071200	Transmission oil temperature	Short circuit to ground
P071300	Transmission oil temperature	Short circuit to power supply
P071600	Transmission turbine speed sensor	Short circuit to ground or power break Signal voltage too high Signal voltage too low
P071700	Transmission turbine speed sensor	Short circuit to power supply
P072000	Transmission output shaft speed sensor	Short circuit to power supply Short circuit to ground or power break
P072100	Transmission output shaft speed sensor	Signal voltage too high Signal not plausible
P072100	Falling gradient on output speed	Signal not plausible
P072900	Gear ratio - 6th gear	Signal not plausible
P073000	Gear ratio symptom	Signal not plausible
P073100	Gear ratio - 1st gear	Signal not plausible
P073200	Gear ratio - 2nd gear	Signal not plausible
P073300	Gear ratio - 3rd gear	Signal not plausible
P073400	Gear ratio - 4th gear	Signal not plausible
P073500	Gear ratio - 5th gear	Signal not plausible
P073600	Gear ratio - reverse gear	Signal not plausible General fault type
P074000	EPRS 6	Circuit break
P074100	Torque converter clutch permanently open	General fault type
P074800	EPRS 1	Signal voltage too high or too low
P075100	Shift control solenoid valve	Short circuit to power or ground Circuit break
P075200	Shift control solenoid valve	short circuit to ground
P075300	Shift control solenoid valve	Short circuit to power supply
P077800	EPRS 2	Signal voltage too high or too low
P078000	Gear load symptom	Signal voltage too high No change in signal

P Code	Component/Signal	Fault Description
P078100	Gear load during shift 1st to 2nd	Signal voltage too high No change in signal
P078100	Gear load during shift 2nd to 1st	Signal voltage too high No change in signal
P078200	Gear load during shift 2nd to 3rd	Signal voltage too high No change in signal
P078200	Gear load during shift 3rd to 2nd	Signal voltage too high No change in signal
P078300	Gear load during shift 3rd to 4th	Signal voltage too high No change in signal
P078300	Gear load during shift 4th to 3rd	Signal voltage too high No change in signal
P078400	Gear load during shift 4th to 5th	Signal voltage too high No change in signal
P078400	Gear load during shift 5th to 4th	Signal voltage too high No change in signal
P079800	EPRS 3	Signal voltage too high or too low
P081C00	Lever locking mechanism	General fault type Signal not plausible
P082600	Manual/Sport switch module	Signal not plausible
P082900	Gear load during shift 4th to 5th	Signal voltage too high
P082900	Gear load during shift 5th to 6th	No change in signal
P082900	Gear load during shift 6th to 5th	No change in signal
P085000	Park/Neutral signal plausibility	Signal not plausible
P089700	Oil temperature monitoring	General fault type
P093800	Transmission oil temperature (cross-check against processor chip temperature)	Signal not plausible
P096000	EPRS 1	Short circuit to ground or power break Circuit break
P096200	EPRS 1	Short circuit to ground
P096300	EPRS 1	Short circuit to power supply
P096400	EPRS 2	Short circuit to ground or power break Circuit break
P096600	EPRS 2	Short circuit to ground
P096700	EPRS 2	Short circuit to power supply
P096800	EPRS 3	Short circuit to ground or power break Circuit break
P097000	EPRS 3	Short circuit to ground
P097100	EPRS 3	Short circuit to power supply
P178300	Hot shutdown	General fault type
P182500	Shift interlock solenoid	Short circuit to ground Short circuit to power supply Circuit break
P271600	EPRS 4	Signal voltage too high or too low
P271800	EPRS 4	Short circuit to ground or power break Circuit break
P272000	EPRS 4	Short circuit to ground
P272100	EPRS 4	Short circuit to power supply
P272500	EPRS 5	Signal voltage too high or too low
P272700	EPRS 5	Short circuit to ground or power break Circuit break
P272900	EPRS 5	Short circuit to ground
P273000	EPRS 5	Short circuit to power supply
P275900	EPRS 6	Signal voltage too high
P276100	EPRS 6	Short circuit to ground or power break
P276200	EPRS 6	Signal voltage too small
P276300	EPRS 6	Short circuit to power supply
P276400	EPRS 6	Short circuit to ground

CONTROLLER AREA NETWORK (CAN)

The high speed CAN broadcast bus network is used to connect the powertrain modules. The CAN bus is connected between the following electronic units:

High Speed CAN Bus

- TCM
- Instrument cluster
- Air suspension module
- Steering angle sensor
- Rear differential module
- Centre console switch pack
- Electric park brake module
- Restraints control module
- Engine Control Module (ECM)
- ABS control module
- Adaptive front lighting control module
- Transfer box control module
- Adaptive cruise control module

- Diagnostic socket.

The CAN bus allows a fast exchange of data between modules. The CAN bus comprises two wires which are identified as CAN high (H) and CAN low (L). The two wires are coloured yellow/black (H) and yellow/brown (L) and are twisted together to minimise electromagnetic interference (noise) produced by the CAN bus messages. For additional information, refer to: Communications Network (418-00, Description and Operation).

In the event of CAN bus failure, the following symptoms may be observed:

- Transmission operates in default mode
- Torque converter lock-up clutch control is disabled
- Gear position indication in instrument cluster message centre inoperative (this will also occur with any transmission fault).

DRIVING MODES

There are a number of different driving modes of operation. Some can be selected by the driver and some are automatically initiated by the TCM during driving:

- Normal mode
- Sport mode
- Manual (CommandShift™) mode
- Adaptive Shift Strategy (ASIS)
- Hill Descent Control (HDC) mode
- Cruise mode
- Hill mode
- Default (Limp home) mode
- Reverse lock-out mode
- Cooling strategy.
- Curve recognition mode
- Fast off recognition

Normal Mode

Normal mode is automatically selected by the TCM on power up. In this mode all automatic and adaptive modes are active. Normal mode uses gear shift and lock-up maps to allow for vehicle operation which offers fuel consumption and emissions or driveability depending on the driving style. If the transmission is operated in sport or manual mode and the selector lever is moved to the 'D' position, normal mode is automatically resumed.

Sport Mode

The sport mode operates in high range only and provides enhanced acceleration and responsiveness. In sport mode the TCM uses shift maps which allow the transmission to downshift more readily, hold gears for longer at higher engine speeds, and limits the transmission to the first five gears (6th gear is not used).

Sport mode is selected by moving the selector lever to the left into the 'M/S' position. When the sport mode is first selected, 'SPORT' is displayed in the message centre for 6 seconds and, if 6th gear is currently engaged, the TCM downshifts to 5th.

Manual (CommandShift™) Mode

Manual mode allows the transmission to operate as a semi-automatic 'CommandShift™' unit. The driver can change up and down the six forward gears with the freedom of a manual transmission.

Shift maps are provided for manual mode to protect the engine at high engine speeds. The TCM will automatically change up to a higher gear ratio to prevent engine overspeed and change down to a lower gear ratio to avoid engine labouring and stalling.

When kickdown is requested the TCM downshifts at least 2 gears.

When the vehicle is stationary, to drive off the driver can select 1st, 2nd or 3rd gear in low and high range. Any other gear selection will be rejected by the TCM.

When driving off, upshifts can be pre-selected by making + selections with the selector lever for the number of upshifts required. The TCM then automatically performs a corresponding number of upshifts when the appropriate shift points are reached. So, for example, when starting off in 1st gear, if three + selections are made in quick succession, the TCM will automatically change up through the box to 4th gear as the vehicle accelerates, without any further selections being made.

In manual mode a low gear can be selected to provide engine braking for descending a slope without HDC or continuous use of the brake pedal. The driver can prepare for the end of the descent by moving the selector lever to D. The TCM will maintain the low gear and only revert to automatic shift control when the throttle is opened and vehicle speed increases.

Adaptive Shift Strategy (ASIS)

The ASIS system is a new feature on automatic transmissions. With the TCM linked via the CAN bus to other vehicle systems, signals are received which can allow the TCM to calculate the way in which the vehicle is being driven. The type of signals include the following:

- Longitudinal and lateral acceleration
- Engine speed
- Engine torque
- Oil temperature
- Accelerator pedal position
- Wheel speed.

Using these signals, additional transmission control can be obtained. The TCM can calculate when the vehicle is cornering, all wheels are gripping, the driver is braking or if the driver is accelerating. This is the conventional 'Adaptive' transmission control. ASIS uses this system but adds the continuous adaptation of the gear changes to the individual driving style of the driver.

HDC Mode

The HDC mode assists the ABS module in controlling the downhill speed of the vehicle. When HDC is selected on, the ABS module selects the most appropriate gear for the descent, to maximise engine braking.

Cruise Mode

When speed control is activated, the TCM receives a cruise active message on the CAN bus. The TCM activates a speed control map which prevents locking and unlocking of the torque converter clutch and minimises up and down shifts.

Hill Mode

Hill mode is initiated by the TCM when the engine torque, via ECM signals on the CAN bus, exceeds the theoretical load curve for normal operation. The TCM monitors this signal to determine when the vehicle is travelling up or down a steep gradient.

In hill mode the TCM adopts one of four shift maps, three uphill and one downhill. The shift map chosen depends on the severity of the slope as determined from the engine signals and the appropriate gear is selected to assist with the ascent or descent.

Hill mode can also be initiated when the vehicle is at very high altitudes or ambient temperatures, and also when the vehicle is towing.

Default (Limp Home) Mode

If a transmission fault is detected by the TCM, the TCM adopts a limp home mode strategy. 'TRANS. FAILSAFE' is displayed in the message centre and, if the fault has an effect on engine emissions, the MIL will also be illuminated.

In default mode, P, R and N functions operate normally (if the fault allows these selections) and the TCM locks the transmission in 3rd or 5th gear to allow the driver to take the vehicle to the nearest dealer. The torque converter lock-up clutch is disabled and reverse lock-out will not function.

If the vehicle is stopped and subsequently restarted in the default mode condition, the TCM operates normally until the fault which caused the condition is detected again.

When limp home mode is active, the gear position indicator will show one of the following letters which defines the fault type:

- 'F' - transmission is operating in limp home mode
- 'H' - transmission has reached overheat threshold temperature and transmission is operating in limp home mode
- 'E' - CAN bus is off and transmission is operating in limp home mode.

If electrical power is lost and the transmission is operating in mechanical limp home mode, the selector lever will not be locked in the 'N' position by the shift interlock solenoid. The lever will be locked in the 'P' position and can only be released by using the interlock emergency release lever or by correcting the electrical fault.

Reverse Lock-Out Mode

When the vehicle is travelling forwards, selecting reverse could cause transmission damage. To protect against this, reverse gear is prohibited if the vehicle is travelling forwards at a road speed above 5 mph (8 km/h).

Cooling Strategy

The purpose of the cooling strategy is to reduce engine and transmission temperatures during high load conditions, when towing a trailer for example. Under these conditions the engine and transmission may generate excessive heat.

If the transmission fluid temperature increases to 125°C (257°F) or higher, the TCM employs the cooling strategy. The message 'TRANSMISSION OVERHEAT' is displayed in the message center.

The strategy uses a specific shift and torque converter lock-up clutch map. This map allows torque converter clutch lock-up and gear shifts to operate outside of their normal operation. This will reduce the engine speed and/or slip in the torque converter, therefore reducing heat generated by the engine and the transmission.

If the transmission fluid temperature increases to 137°C (278°F) or higher, the transmission will use the default (limp home mode). 'H' is displayed in the gear position indicator. If the temperature exceeds 140°C (284°F), CAN bus transmission is disabled and 'E' is displayed in the gear position indicator.

The cooling strategy is cancelled when the transmission fluid temperature decreases to less than 120°C (248°F) or below.

Curve Recognition

Curve recognition is activated when high levels of lateral acceleration and/or steering angle are detected via the ABS module and steering angle sensor signals on the CAN bus. When this condition is detected, the TCM prevents the transmission from changing to a higher gear to assist with cornering. When the vehicle completes its manoeuvre, the transmission will shift to the correct ratio.

Fast Off Recognition

Fast off recognition is activated when the TCM detects that the driver has backed off the accelerator pedal quickly in a 'change of mind' manoeuvre. This is detected by monitoring for a high level of negative pedal angle from the engine

control module signal on the CAN bus. If this condition is detected, the TCM holds the current gear ratio to allow the driver to complete his original action without the need for a downshift. The mode remains active for a predetermined time period or if the driving style remains passive.

Terrain Response™ Mode

If the vehicle has the Terrain Response system fitted, the following additional modes are available. For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).

Grass/Gravel/Snow

When the driver selects the Terrain Response grass/gravel/snow special program with the transfer box in either high or low range, the TCM uses a specific set of shift and torque converter maps to optimise the delivery of torque to the wheels and to minimise wheel slip in these terrains. To assist with the vehicle moving from a standstill, the TCM automatically selects 2nd gear in high range and 3rd gear in low range. This special program is fully integrated with hill mode to enhance vehicle control during ascents and descents.

Mud/Ruts

When the driver selects the Terrain Response mud/ruts special program with the transfer box in either high or low range, the TCM uses a specific set of shift and torque converter maps to optimise vehicle traction in this terrain.

Sand

When the driver selects the Terrain Response sand special program with the transfer box in either high or low range, the TCM uses a specific set of shift and torque converter maps to optimise the tractive performance in sand by holding onto gears longer and downshifting more readily. This mode is fully integrated with the hill mode to further enhance performance during ascents.

Rock Crawl

When the driver selects the Terrain Response rock crawl special program, which is only available with the transfer box in low range, the TCM uses a specific shift map which maximises torque delivery at slow speeds associated with this type of terrain.

TRANSMISSION FAULT STATUS

If the TCM detects a fault with the transmission system, it will enter a default mode to prevent further damage to the transmission and allow the vehicle to be driven.

When a fault is detected a CAN message is sent from the TCM and is received by the instrument cluster. The instrument cluster illuminates the MIL and displays 'TRANS. FAILSAFE' in the message centre.

Some transmission faults may not illuminate the MIL or display a fault message, but the driver may notice a reduction in shift quality.

ENGINE SPEED AND TORQUE MONITORING

The ECM constantly supplies the TCM with information on engine speed and torque through messages on the CAN bus. The TCM uses this information to calculate the correct and appropriate timing of shift changes.

If the messages are not received by the ECM, the TCM will implement a back-up strategy to protect the transmission from damage and allow the vehicle to be driven.

In the event of an engine speed or torque signal failure, the transmission will adopt the electrical limp home mode with the transmission operating in a fixed gear.

TOWING FOR RECOVERY

The following procedure must be used to ensure that the vehicle is towed in a safe condition and damage to the vehicle transmission systems is prevented.

- Secure the towing attachment from the recovery vehicle to the towing eye of the vehicle to be recovered.
- Make sure that the hand brake is on. Turn the ignition key to the ignition position II.
- Apply the footbrake and move the automatic transmission selector lever to the neutral position. If electrical power is not available, use the manual interlock release tab on the selector lever to move the lever to the neutral position.
- Make sure that the ignition is in the auxiliary position I or, if the stop lamps and turn signal indicators are required, in the ignition position II.
- Make sure that the hand brake is released before the vehicle is towed.
- The vehicle can only be towed for a maximum of 31 miles (50 km) at a maximum speed of 30 mph (50 km/h). Towing the vehicle for longer distances and/or faster speeds will damage the transmission.

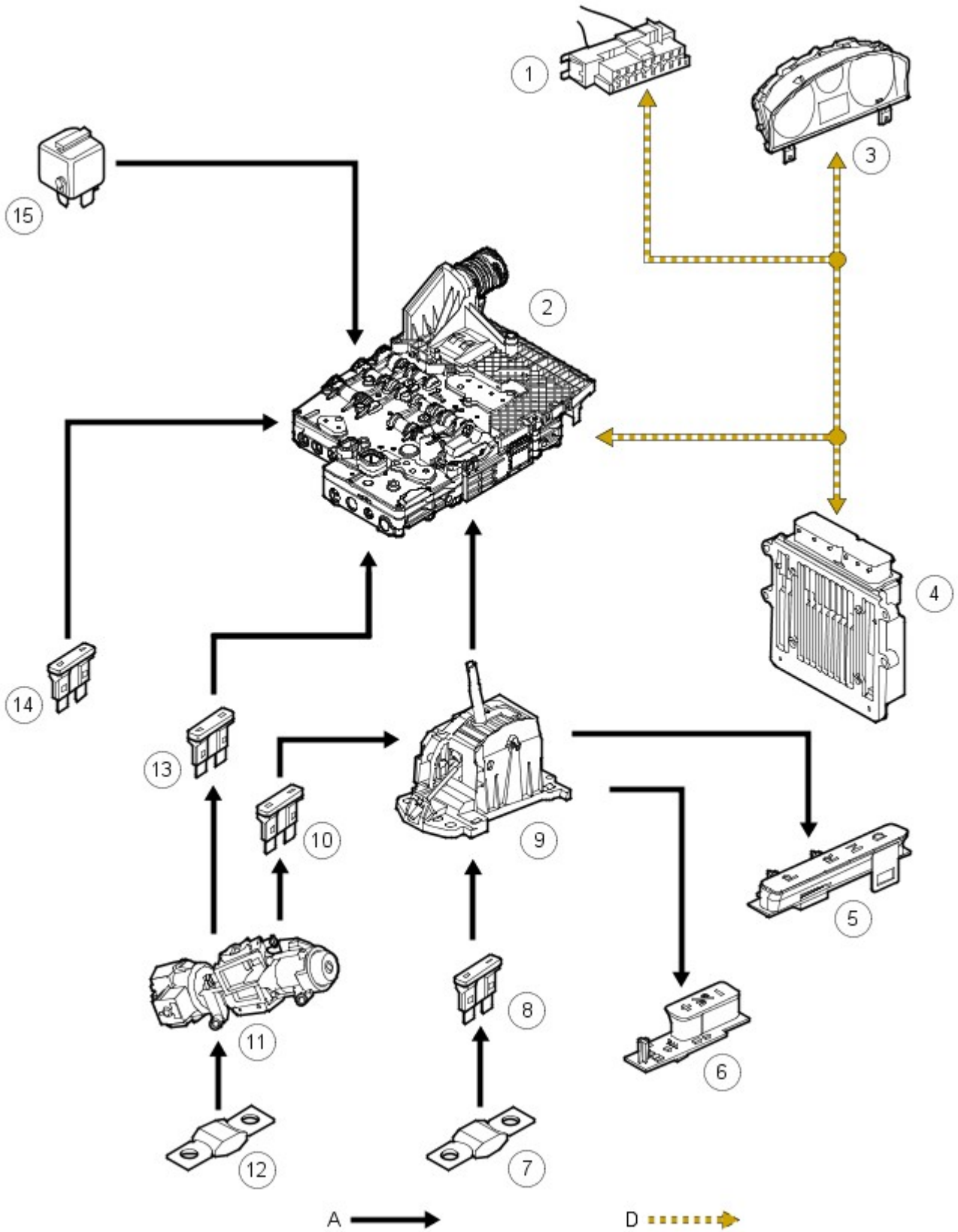


WARNING: Do not remove the key or move the ignition switch to position 'O' when the vehicle is being towed. The steering lock will be engaged preventing the steering from being turned.

With the engine not running, the brake booster and power steering pump will be inoperative. Care must be taken to ensure the vehicle is manoeuvred and driven accordingly.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **D**= High Speed CAN Bus



E42395

Item	Part Number	Description
1	-	Diagnostic socket
2	-	Mechatronic Valve (including TCM, sensors and solenoids)
3	-	Instrument cluster
4	-	Engine Control Module (ECM)
5	-	Selector indicator
6	-	Selector indicator
7	-	Fusible link 7E (50A)
8	-	Fuse 43P (5A)
9	-	Selector lever assembly
10	-	Fuse 33P (5A)
11	-	Ignition switch

12	-	Fusible link 10E (30A)
13	-	Fuse 27P (5A) – Ignition feed
14	-	Fuse 4E (10A) – Permanent feed
15	-	Starter relay

Automatic Transmission/Transaxle - V6 4.0L Petrol - Automatic Transmission

Diagnosis and Testing

Principle of Operation

For detailed description of the automatic transmission system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Automatic Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Description and Operation).

Inspection and Verification

This section is intended to provide a means for the technician to diagnose transmission component faults, rather than replacing the entire unit.

However, there are a number of situations where the replacement of the unit is the only practical solution, and this section will cover the diagnosis necessary to gather the information required for transmission replacement to be authorized by the warranty prior approval program (WPAP) where it applies, as well as covering the diagnostic trouble codes (DTCs) stored by the control module.

The basic checks of the transmission (fluid condition and level, etc) should be carried out first, and this will mean using the approved diagnostic system or other equipment with data logging facility to monitor temperatures, etc.

For information on the operation of the transmission, refer to the relevant workshop manual section.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fluid condition ● Fluid level ● Fluid leaks ● Fluid cooler ● External linkages ● Gear selector lever 	<ul style="list-style-type: none"> ● Fuses ● Wiring harnesses ● Electrical connector(s) ● Transmission control module (TCM) ● Engine control module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** Use the approved diagnostic system or a scan tool to retrieve any DTCs before moving onto the DTC index.
 - Because the DTCs are stored in more than one module, a complete vehicle read is recommended
 - Make sure that all DTCs are cleared following rectification.

Preliminary Inspection

1. **1.** As much information as possible should be obtained from the owner/driver about the fault in order to assist with the diagnosis. Time spent on this will reduce the necessity for extensive road testing and possible missed diagnosis.
 - The information required for WPAP is still useful as an aid to diagnosis, even where the system is not in operation

Required information for WPAP (where applicable)

- The nature of the fault (loss of drive, slip, judder, gear shift quality, noise, etc)
 - The frequency with which the fault occurs
 - The conditions under which the fault occurs, including temperature (coolant and ambient), selected gear, road speed, engine speed, and any specific conditions
 - Check and rectify non-transmission related DTCs before continuing with transmission diagnosis
2. **2.** Record the vehicle details, including:
 - Service history
 - The transmission serial number
 - The transmission software level
 3. **3.** Visually inspect the transmission for fluid leaks, damage, etc.
 4. **4.** Check the transmission fluid condition.

• **NOTE:** Fluid condition is a good indicator of the transmission internal condition. If the fluid is burnt and/or contaminated, this would usually mean the internal damage to the transmission is at such a level that unit replacement is the best option. Compare the fluid drained from the transmission with fresh fluid for color and odor.

5. **5.** Check the transmission fluid level. Refer to the relevant workshop manual section.

• **NOTE:** This is crucial to the operation of the transmission, and the procedure must be closely followed to avoid inaccurate diagnosis, with the resultant possible rejection of a warranty claim.

6. **6.** Check the engine idle speed and throttle sensor using the approved diagnostic system or a scan tool.
7. **7.** Check the transmission selector cable adjustment. Refer to the relevant workshop manual section.
8. **8.** Check the transmission range sensor adjustment.

- A comprehensive procedure for transmission range sensor setting is accessible through the approved diagnostic system.

If any faults are found and rectified in the above sequence, clear any DTCs and test the vehicle for normal operation.

If a failure condition is found indicating the need to renew the transmission assembly, the request must go through the warranty prior approval program (where applicable) before work is begun.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transmission Control Module \(TCM\) - Bosch](#) (100-00 General Information, Description and Operation).

Automatic Transmission/Transaxle - V6 4.0L Petrol - Transmission Fluid Drain and Refill

General Procedures

• **WARNINGS:**



Observe due care when draining transmission fluid as the fluid can be very hot.



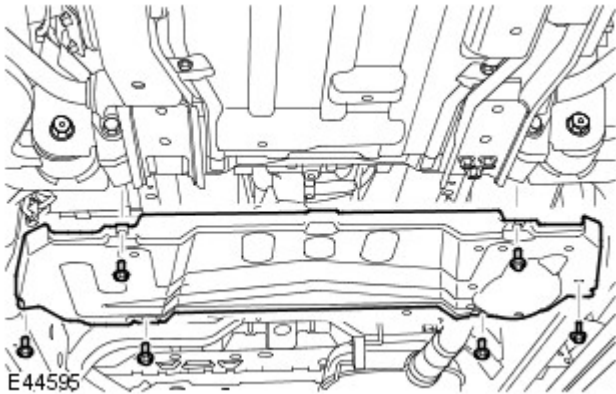
Observe due care when working near a hot exhaust system.

All vehicles

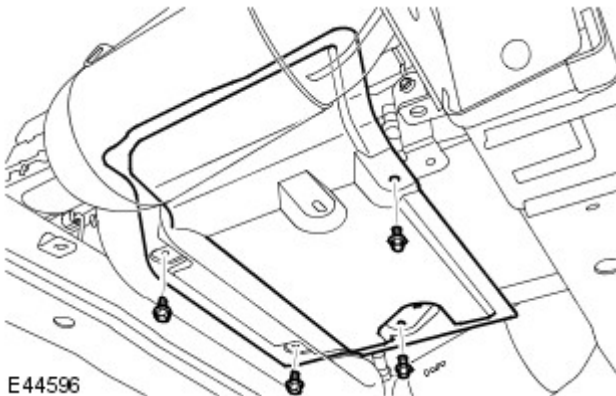
- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the transmission undershield.
 - Remove the 6 bolts.

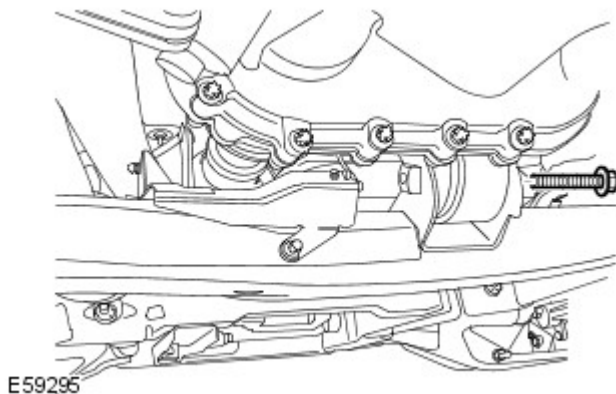


- If installed, remove the transmission heat shield.
 - Remove the 4 bolts.



Vehicles with 4.0L engine

- Remove the transmission support insulator through-bolt.
 - Raise the transmission to gain access to the fluid drain plug.



All vehicles

5. Clean the area around the transmission fluid drain and filler plugs.
6. Place a container under the transmission.



7. WARNINGS:



Observe due care when draining transmission fluid as the fluid can be very hot.



Observe due care when working near a hot exhaust system.

Remove the transmission fluid filler/level plug.

- Remove and discard the sealing washer.



8. Remove the transmission fluid drain plug.

- Remove and discard the sealing washer.
- Allow the fluid to drain.

9. Install the transmission fluid drain plug and tighten to 9 Nm (7 lb.ft).

- Install a new sealing washer.

Vehicles with 4.0L engine

10. Install the transmission support insulator through-bolt and tighten to 175 Nm (129 lb.ft).

- Lower the transmission.

All vehicles

11. Add 3.5 to 4 litres of the correct transmission fluid, or until a small thread of fluid runs from the filler/level hole.

12. Check and top-up the transmission fluid level.

For additional information, refer to: [Transmission Fluid Level Check](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Automatic Transmission/Transaxle - V6 4.0L Petrol - Transmission Fluid Level Check

General Procedures

• **WARNINGS:**



Observe due care when draining transmission fluid as the fluid can be very hot.



Observe due care when working near a hot exhaust system.



CAUTION: The gearbox fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

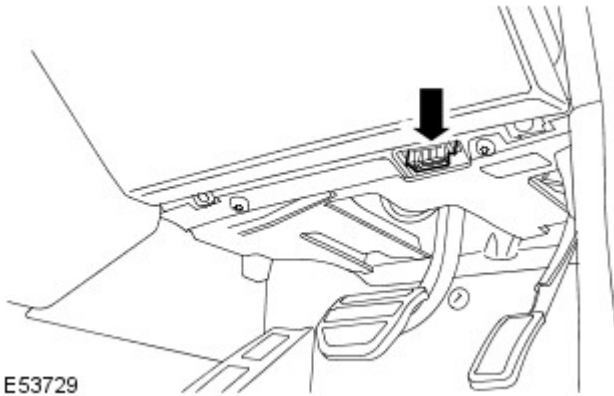
1. The following steps must be observed before starting the transmission fluid level check and top-up.

- The vehicle must be on a horizontal ramp.
- The parking brake must be applied.
- The wheels must be chocked.



CAUTION: Make sure the transmission fluid temperature is below 30 degrees before starting the fluid level check.

Using the approved Land Rover diagnostic equipment, monitor the transmission fluid temperature.



E53729

3. Start the engine. Move the selector lever from 'P' through all gear positions, pausing in each gear position for 2-3 seconds and return to the 'P' position.

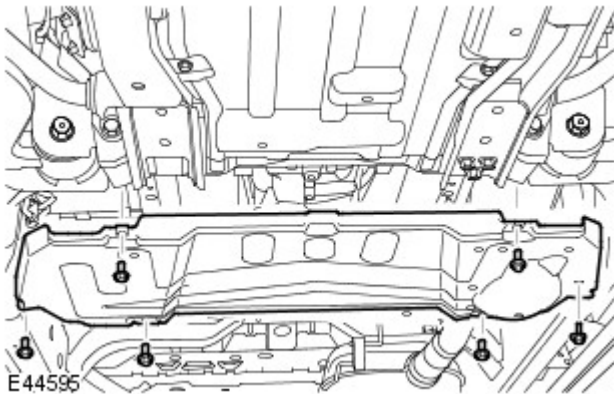


WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

5. Remove the transmission undershield.

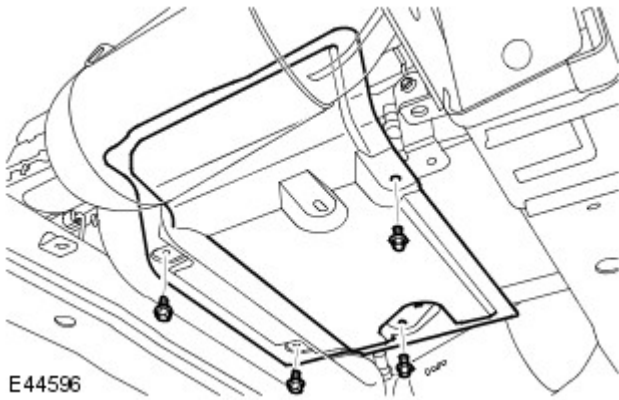
- Remove the 6 bolts.



E44595

6. If installed, remove the transmission heat shield.

- Remove the 4 bolts.




7. Place a container under the transmission.

8. WARNINGS:

 Observe due care when draining transmission fluid as the fluid can be very hot.

 Observe due care when working near a hot exhaust system.

 CAUTION: The gearbox fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

Remove the transmission fluid filler/level plug.

- Clean the area around the filler/level plug.
- Remove and discard the sealing washer.

9. If no fluid loss is apparent when the filler/level plug is removed, with the engine at idle, continue to fill the transmission until a small thread of oil runs from oil filler/level hole.

10. Install the transmission fluid filler/level plug and tighten to 35 Nm (26 lb.ft).

- Install a new sealing washer.
- Remove the container.

11. If installed, install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

12. Install the transmission undershield.




- Tighten the bolts to 10 Nm (7 lb.ft).

13. Disconnect the approved Land Rover diagnostic equipment from the vehicle.




Automatic Transmission/Transaxle - V6 4.0L Petrol - Selector Shaft Seal

In-vehicle Repair

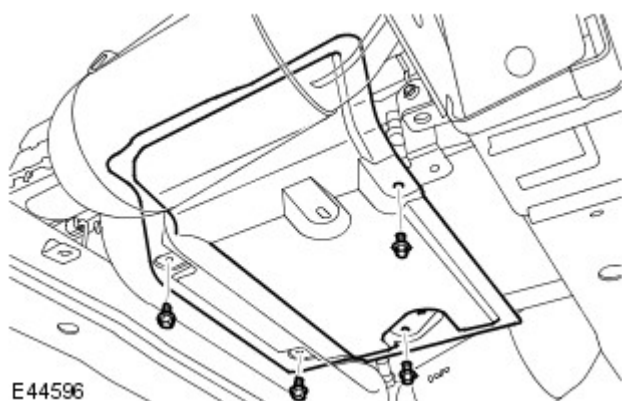
Special Tool(s)	
 <p>307-509-1</p> <p>E50766</p>	<p>ZF Automatic transmission selector shaft seal remover</p> <p>307-509-1 (LRT-44-033/1)</p>
 <p>307-509-2</p> <p>E50767</p>	<p>ZF Automatic transmission selector shaft seal remover</p> <p>307-509-2 (LRT-44-033/2)</p>
 <p>307-509-3</p> <p>E50768</p>	<p>ZF Automatic transmission selector shaft seal installer</p> <p>307-509-3 (LRT-44-033/3)</p>

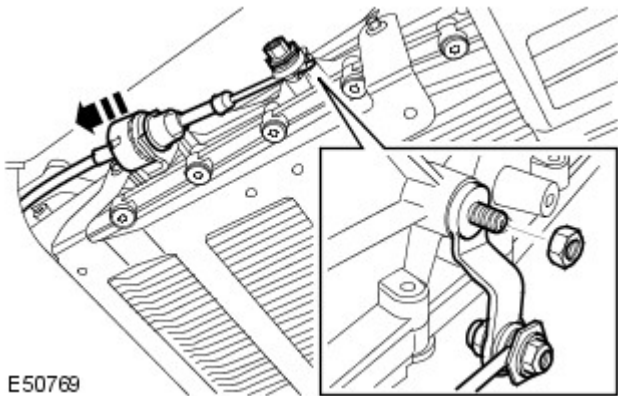
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- LH selector shaft seal only: Remove the exhaust system. For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
- Remove the transmission heat shield.
 - Remove the 4 bolts.

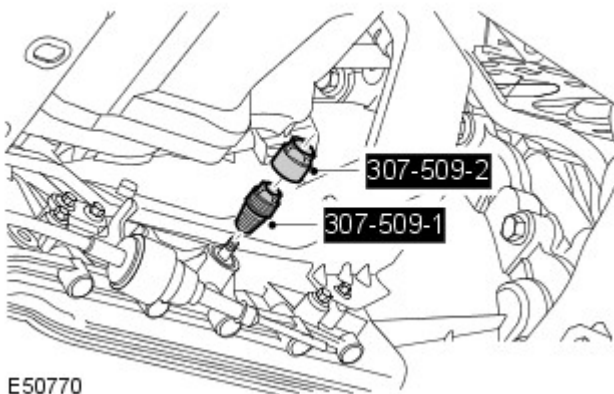





E50769

4. Release the selector cable and lever.

- Remove the nut.
- Compress the latch and release the cable.



E50770

5.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

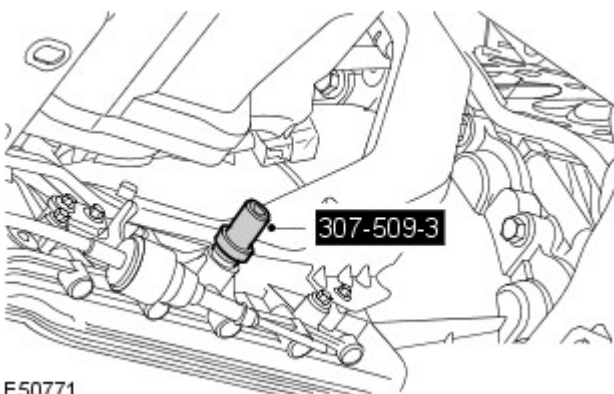
Remove the selector shaft seal.

- Install 307-509-1 to the seal.
- Install 307-509-2 to 307-509-1 and extract the seal.

Installation

1. Using 307-509-3, install the selector shaft seal.

- Clean the components.



E50771

2. Install the selector cable and bracket.

- Secure with the clip.
- Tighten the nut to 12 Nm (9 lb.ft).


3. Install the transmission heat shield.

- Install the bolts.

4. LH selector shaft seal only: Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).


Automatic Transmission/Transaxle - V6 4.0L Petrol - Transmission Control Module (TCM)

In-vehicle Repair

Special Tool(s)	
 <p>E48903</p>	ZF Automatic transmission valve block seals remover 307-492 (LRT-44-005)

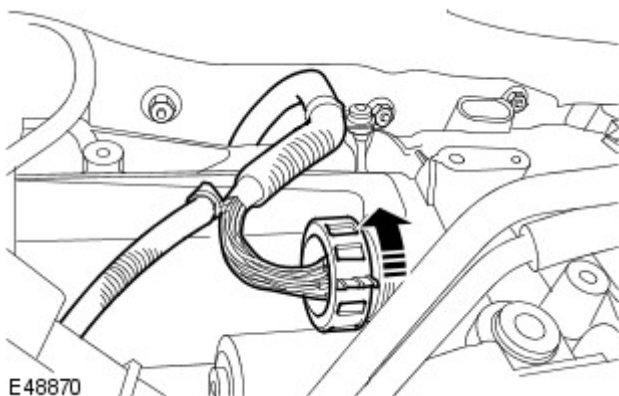
Removal

- NOTE: The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

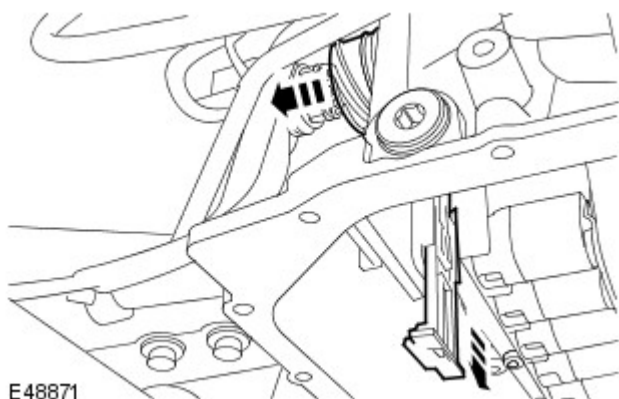
Raise and support the vehicle.

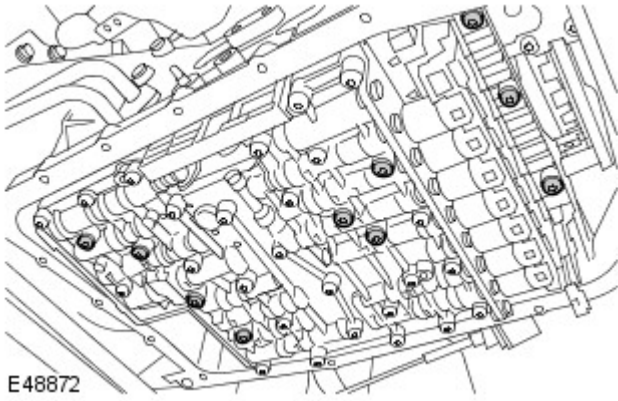
2. Remove the fluid pan.
For additional information, refer to: [Fluid Pan, Gasket and Filter](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, In-vehicle Repair).
3. Disconnect the electrical connector.



4. Remove and discard the electrical connector sleeve.

- Release the retainer.

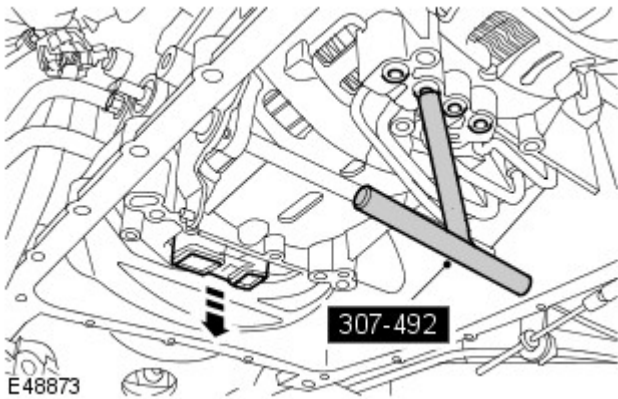




5. Remove the valve body.

- Position a container to collect spillage.
- Remove the 10 Torx screws.

6. Using the special tool, remove the 4 seals.
7. Remove the seal block.



Installation

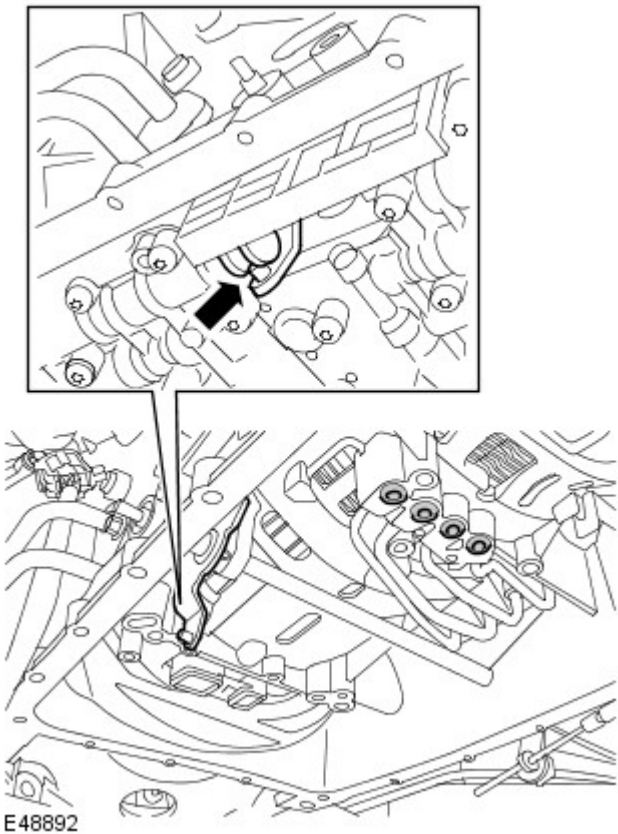
1. CAUTIONS:

 Make sure that when fully fitted, all seals protrude by the same amount.

 Engage the selector lever with the groove in the piston rod.

Install the valve body.

- Clean the component mating faces.
- Install new seals.
- Install a new seal block.
- Tighten the Torx screws to 8 Nm (6 lb.ft).



2. Install a new electrical connector sleeve.

- Secure with retainer.

3. Connect the electrical connector.



4. Install the fluid pan.

For additional information, refer to: [Fluid Pan, Gasket and Filter](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, In-vehicle Repair).


5. Calibrate a new main control valve body using T4.

Automatic Transmission/Transaxle - V6 4.0L Petrol - Output Shaft Seal

In-vehicle Repair


Special Tool(s)	
 <p>303-903 E50940</p>	<p>Oil seal remover 303-903 (LRT-12-092)</p>
 <p>307-520 E52536</p>	<p>Oil seal installer 307-520</p>

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

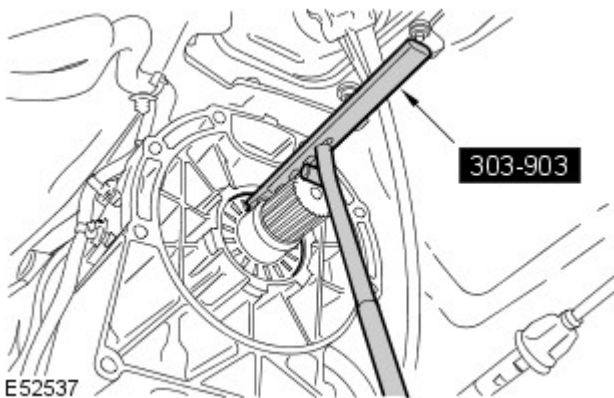
Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - V6 4.0L Petrol](#) (308-07B Transfer Case, Removal).

-  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.

Remove the transmission output shaft oil seal.

- Use the special tool.

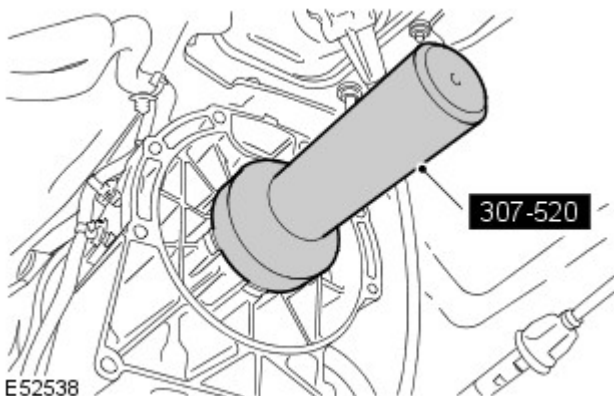


Installation

-  **CAUTION:** Oil seals must be fitted dry.

Install a new transmission output shaft oil seal.

- Clean the seal register.
- Use the special tool.



- Install the transfer case.
For additional information, refer to: [Transfer Case - V6 4.0L](#)

[Petrol](#) (308-07B Transfer Case, Removal).


3. Check and top-up the transmission fluid level.
For additional information, refer to: [Transmission Fluid Level Check](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Automatic Transmission/Transaxle - V6 4.0L Petrol - Fluid Pan, Gasket and Filter

In-vehicle Repair

Removal

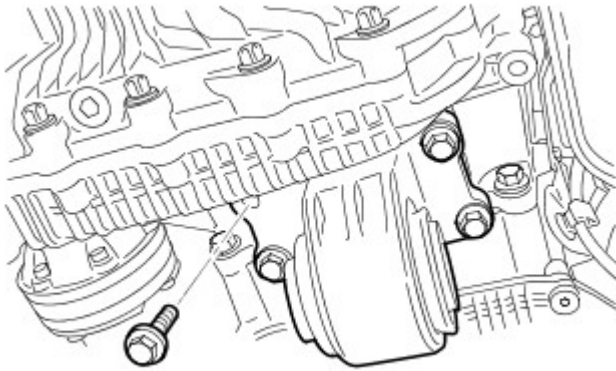
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
5. Remove the transmission support insulator.

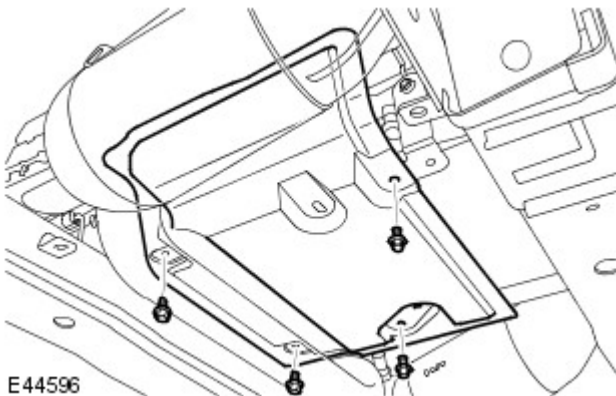
- Remove the 4 bolts.



E54739

6. Remove the transmission heat shield.

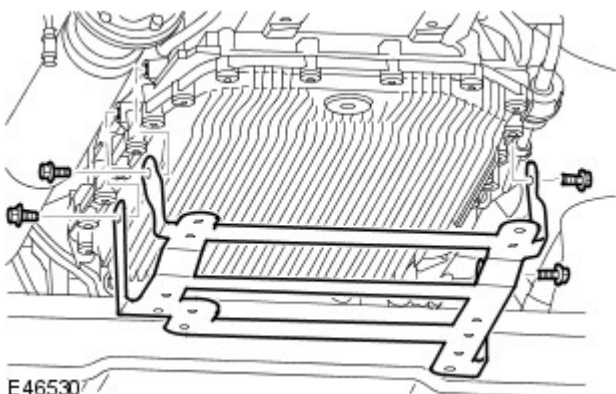
- Remove the 4 bolts.



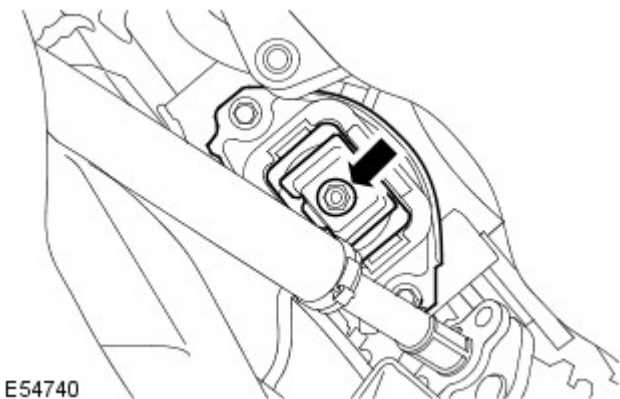
E44596

7. Release the selector cable from its abutment bracket.
8. Drain the transmission.
9. Remove the transmission heat shield bracket.
For additional information, refer to: [Transmission Fluid Drain and Refill](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).


- Remove the 4 bolts.



E46530

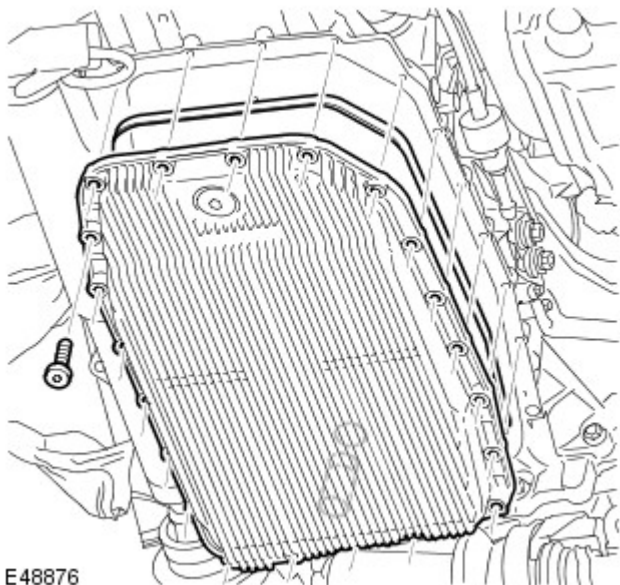


E54740

10.  **CAUTION:** Protect the engine during this operation.

Raise the RH side of the engine by approximately 15 mm.

- Remove the nut.
- Use a transmission jack.



E48876

11. Remove the fluid pan.

- Position a container to collect the fluid spillage.
- Remove the 21 Torx screws.
- Remove and if necessary, discard the seal.
- Discard the O-ring seal.

Installation


1. Install the fluid pan.
 - Clean the components.
 - Install the seal.
 - Install a new O-ring seal.
 - Tighten the Torx screws to 8 Nm (6 lb.ft).
2. Lower the RH side of the engine.
 - Remove the engine support.
 - Tighten the nut to 90 Nm (66 lb.ft).
3. Install the transmission heat shield bracket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
 - Install the selector cable to its abutment bracket.
4. Install the selector cable to its abutment bracket.
5. Install the transmission heat shield.
 - Tighten the bolts to 10 Nm (7 lb.ft).
6. Install the transmission support insulator.
 - Clean the component mating faces.
 - Tighten the bolts to 60 Nm (44 lb.ft).

- 7.** Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
- 8.** Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
- 9.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- 10.** Refill the transmission with fluid.
For additional information, refer to: [Transmission Fluid Drain and Refill](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Automatic Transmission/Transaxle - V6 4.0L Petrol - Main Control Valve


Body

In-vehicle Repair

Special Tool(s)	
 <p>E48903</p>	ZF Automatic transmission valve block seals remover 307-492 (LRT-44-005)

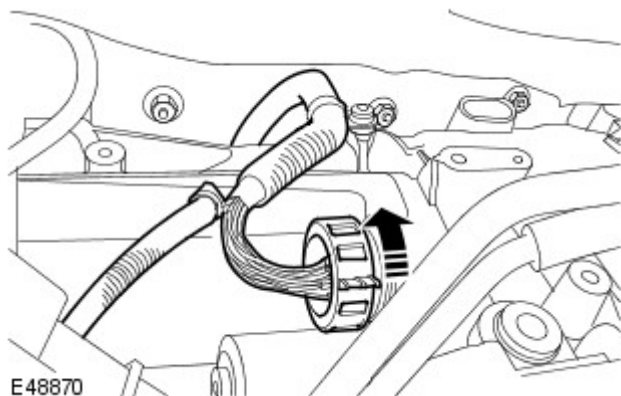
Removal

- NOTE: The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

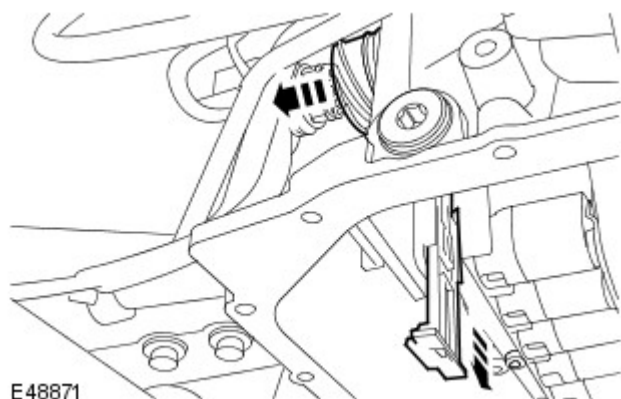
Raise and support the vehicle.

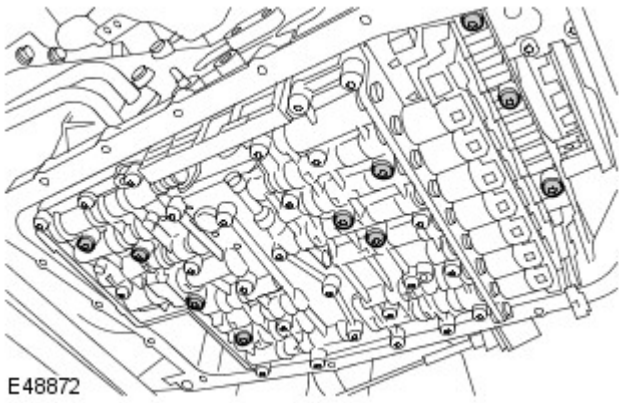
- Remove the fluid pan.
For additional information, refer to: [Fluid Pan, Gasket and Filter](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, In-vehicle Repair).
- Disconnect the electrical connector.



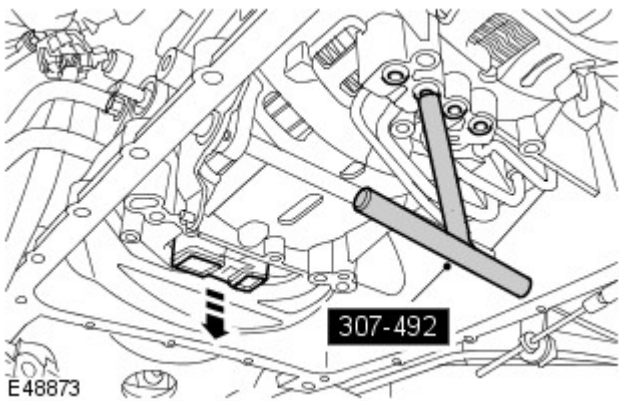
- Remove and discard the electrical connector sleeve.

- Release the retainer.

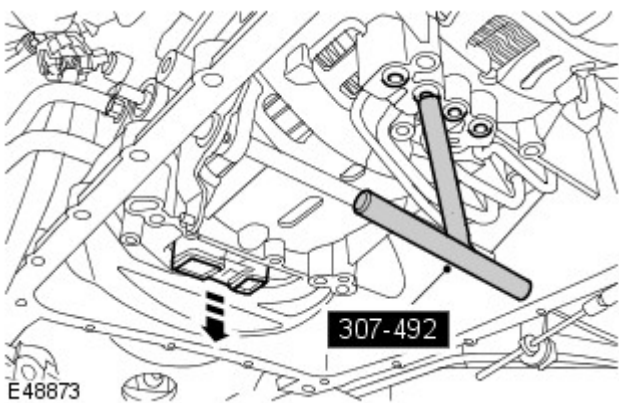




5. Remove the valve body.
 - Position a container to collect spillage.
 - Remove the 10 Torx screws.

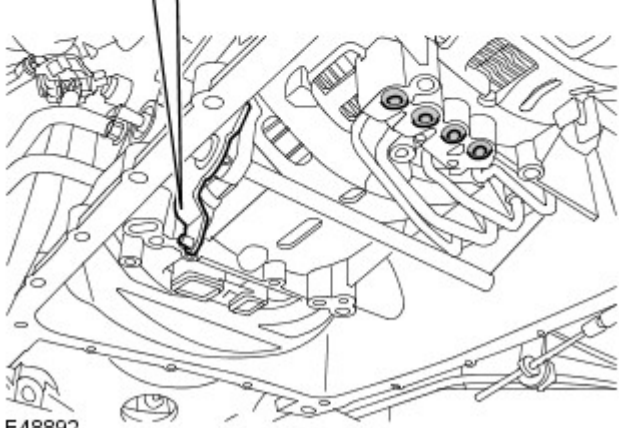
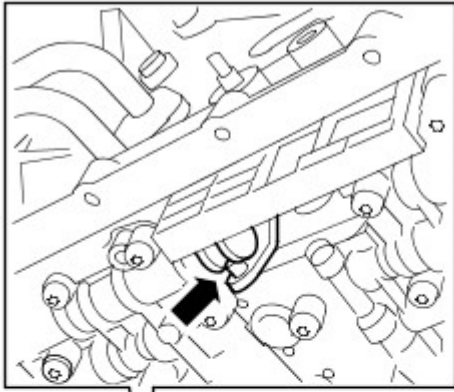


6. Using the special tool, remove the 4 seals.



7. Remove the seal block.

Installation



E48892

1. CAUTIONS:



Make sure that when fully fitted, all seals protrude by the same amount.



Engage the selector lever with the groove in the piston rod.

Install the valve body.

- Clean the component mating faces.
- Install new seals.
- Install a new seal block.
- Tighten the Torx screws to 8 Nm (6 lb.ft).

2. Install a new electrical connector sleeve.

- Secure with retainer.

3. Connect the electrical connector.

4. Install the fluid pan.


For additional information, refer to: [Fluid Pan, Gasket and Filter](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, In-vehicle Repair).

5. Calibrate a new main control valve body using T4.

Automatic Transmission/Transaxle - V6 4.0L Petrol - Transmission Support Insulator

In-vehicle Repair

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

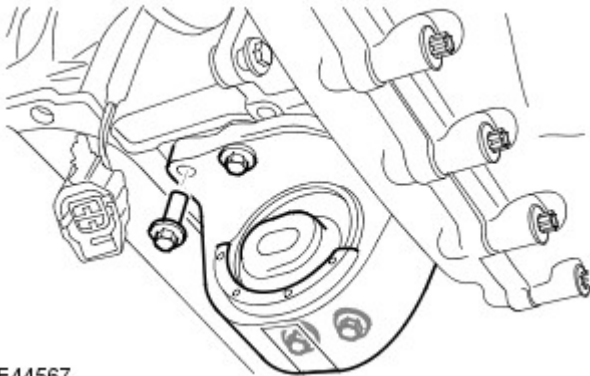
Raise and support the vehicle.

2. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

3. **NOTE:** 4.4L illustration shown, 4.0L and 2.7L Diesel are similar.

Remove the transmission support insulator.

- Remove the 4 bolts.




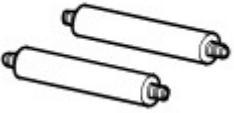
E44567

Installation


1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the bolts to 60 Nm (44 lb.ft).

Automatic Transmission/Transaxle - V6 4.0L Petrol - Transmission

Removal and Installation

Special Tool(s)	
 <p>308-246</p> <p>E46737</p>	<p>Torque converter seal installer 308-246</p>
 <p>307-497</p> <p>E46738</p>	<p>Torque converter support handles 307-497 (LRT-44-010)</p>

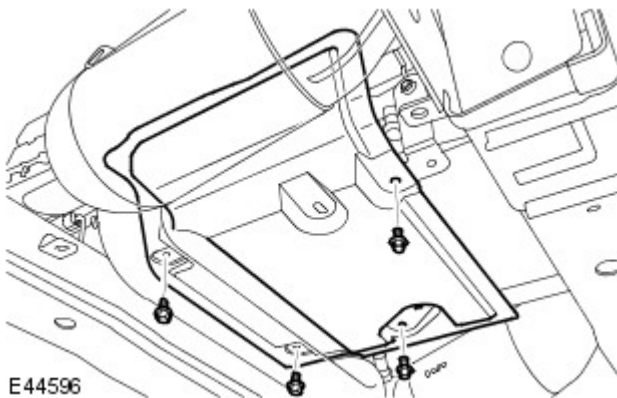
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

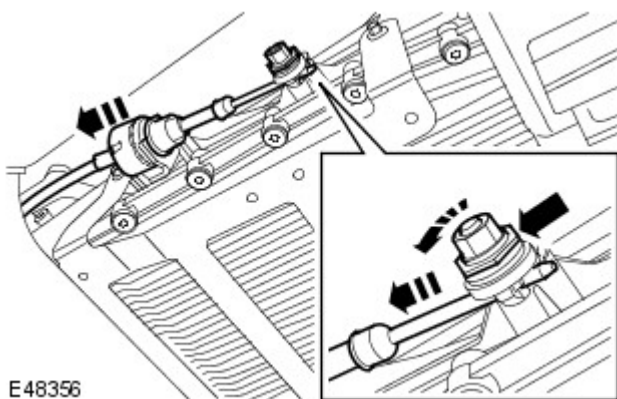
- Remove the transfer case.
For additional information, refer to: [Transfer Case - V6 4.0L Petrol](#) (308-07B Transfer Case, Removal).
- Remove the transmission heat shield.

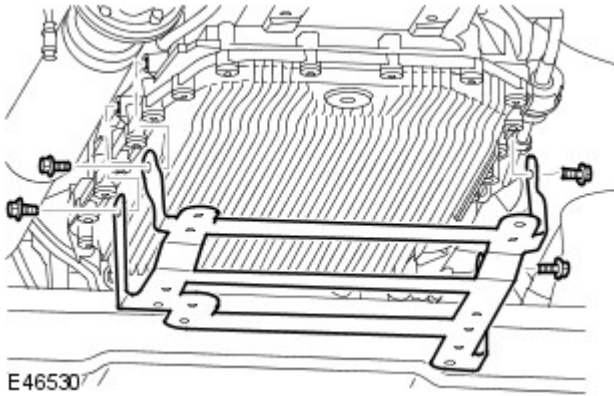
- Remove the 4 bolts.



- Release the selector cable.

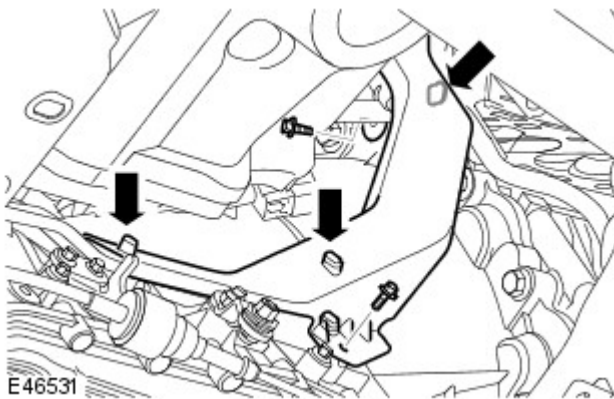
- Using an additional wrench, restrain the clamping bush and loosen the locknut.
- Compress the latch and release the cable.





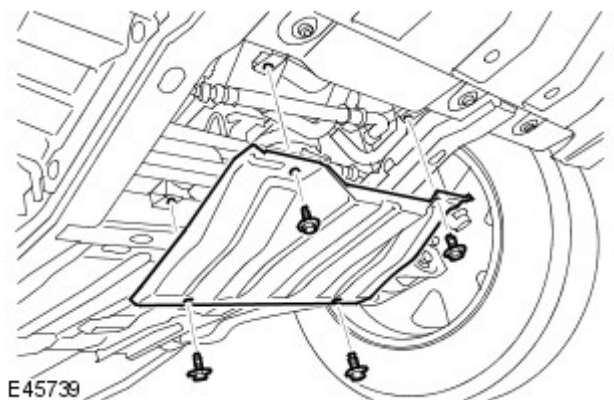
5. Remove the transmission heat shield bracket.

- Remove the 4 bolts.



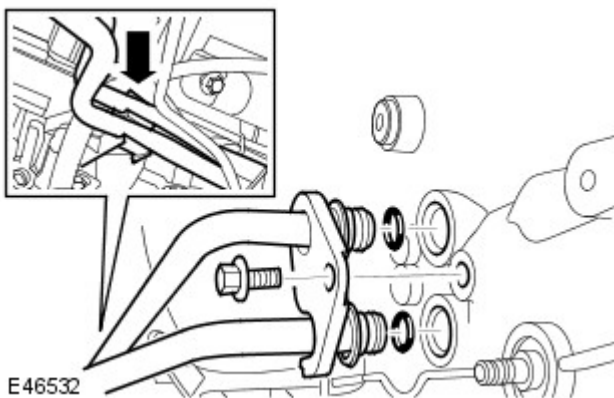
6. Remove the fuel pipe heat shield.

- Remove the 2 bolts.
- Release the fuel pipes from the 3 clips.



7. Remove the radiator access panel.

- Remove the 4 bolts.



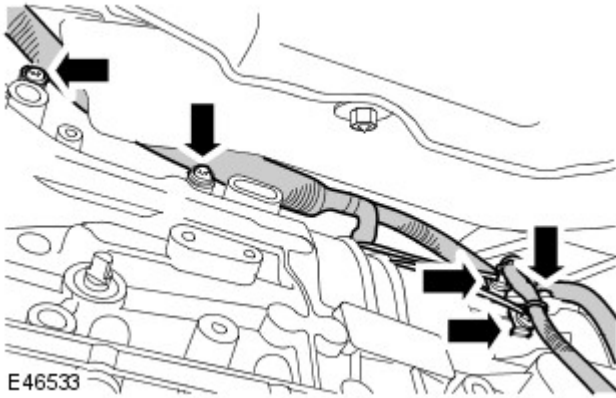
8. **⚠ CAUTION:** Always plug any open connections to prevent contamination.

Release the transmission fluid lines.

- Remove the bolt.
- Release the clip.
- Remove and discard both O-ring seals.

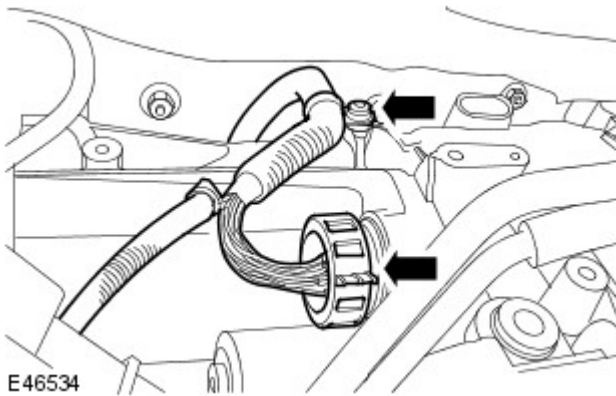
9. Release the wiring harness from the LH side of the transmission.

- Remove the 3 Torx screws.
- Release the 2 clips.



10. Release the wiring harness from the RH side of the transmission.

- Remove the Torx screw.
- Disconnect the electrical connector.



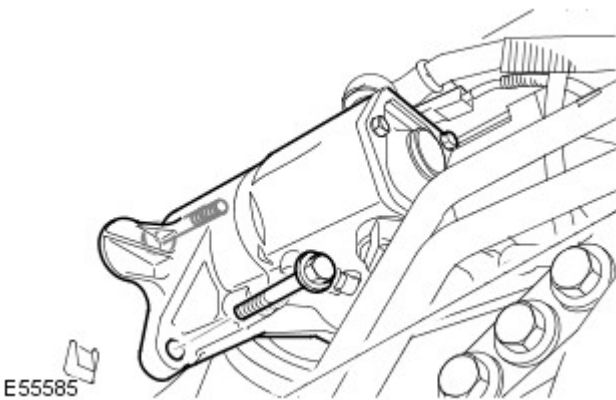
11. Release the transmission breather line clip.

- Remove the bolt.



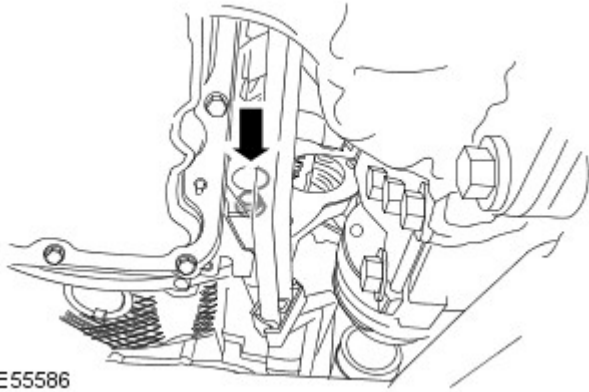
12. Release the starter motor.

- Remove the 2 bolts.
- Tie the starter motor aside.



13. Release the flexplate.

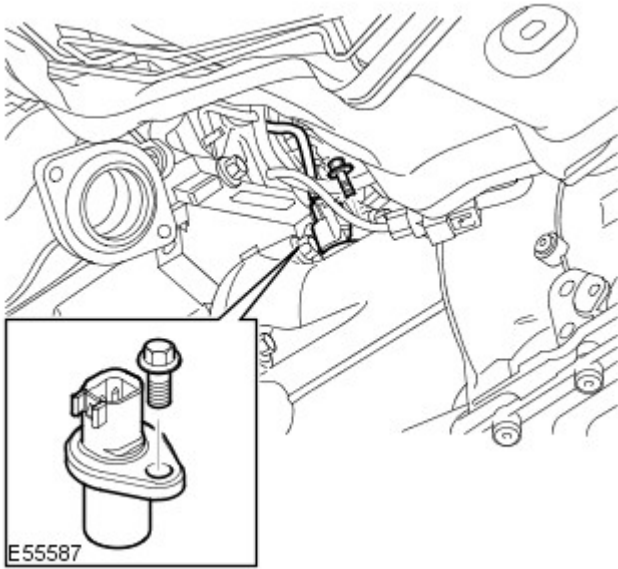
- Rotate the crankshaft to access the bolts.
- Remove the 4 bolts.



E55586

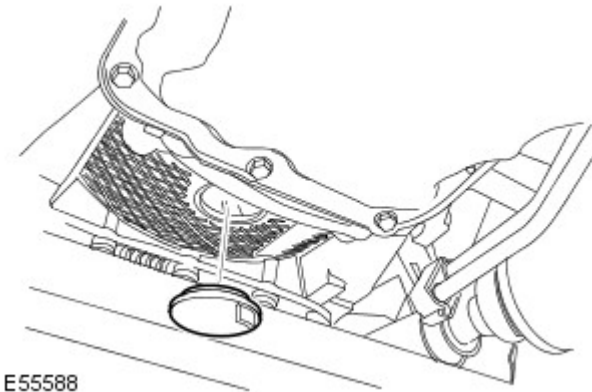
14. Remove the crankshaft position (CKP) sensor.

- Disconnect the electrical connector.
- Remove the bolt.

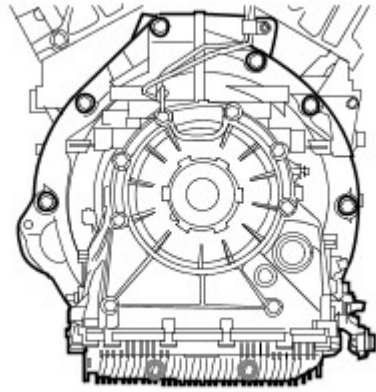


E55587

15. Remove the access hole plug.






E55588



E55589

16. WARNINGS:

-  Support the engine. The engine will fall forward when the transmission is removed.
-  Secure the transmission to the transmission jack.
-  Make sure the torque converter remains with the transmission.

With assistance, remove the transmission.

- Using a transmission jack, support the transmission.
- Remove the 8 bolts.

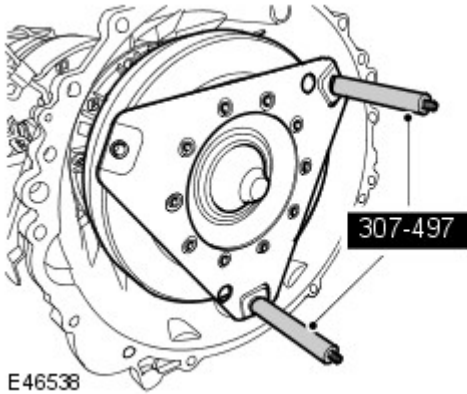
17. Install the torque converter retainer.

18. NOTE: Do not disassemble further if the component is removed for access only.

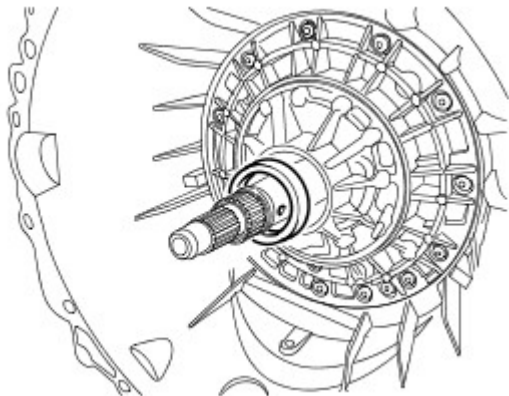
Remove the transmission from the transmission jack.

19. Remove the torque converter retainer.

20. Using the special tools, remove the torque converter.

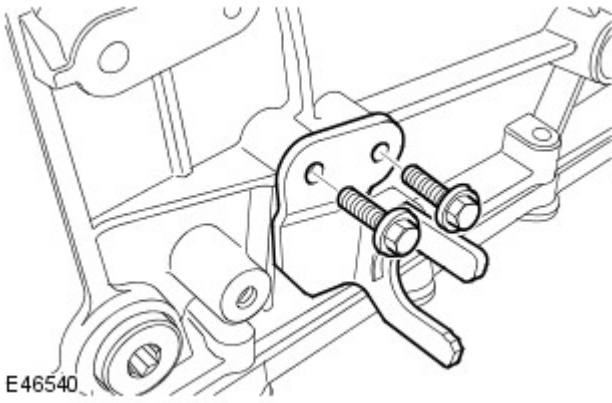


E46538



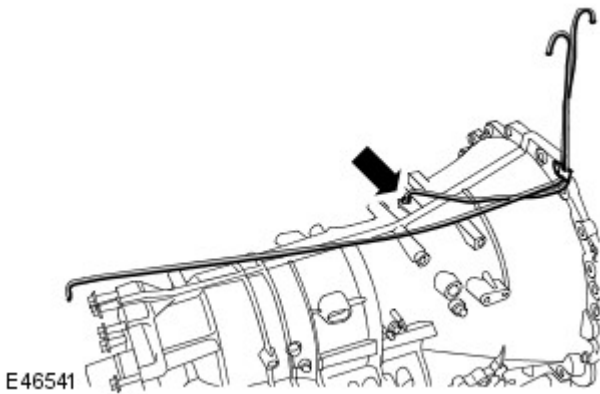
E48465

21. Carefully remove and discard the torque converter fluid seal.



22. Remove the selector cable bracket.

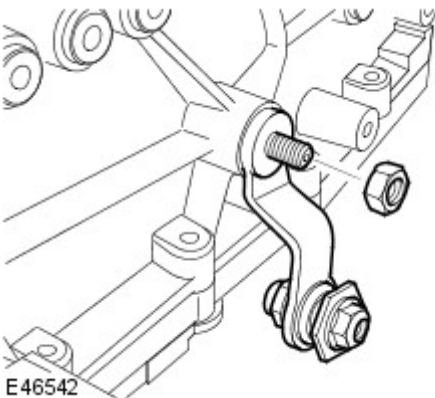
- Remove the 2 bolts.



23.  **CAUTION:** Always plug any open connections to prevent contamination.

Remove the transmission breather lines.

- Depress the locking ring.



24. Remove the selector lever.

- Remove the nut.

Installation

 **CAUTION:** If the automatic transmission fluid is very dirty or it contains metallic particles, then along with a new transmission, install a new automatic transmission fluid cooler and lines.

1. Attach the selector lever.

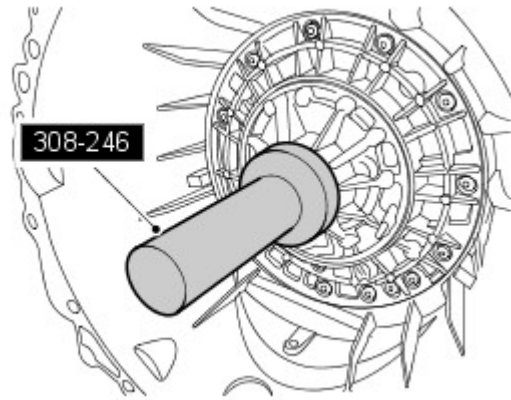
- Tighten the nut to 12 Nm (9 lb.ft).

2. Attach the transmission breather lines.

- Secure with the clip.

3. Attach the selector cable bracket.

- Tighten the bolts to 10 Nm (7 lb.ft).



E46739

4. Using the special tool, install a new torque converter oil seal.

- Clean the seal register.

5.  **CAUTION:** Make sure the torque converter is fully located into the oil pump drive.

Install the torque converter.

- Clean the seal contact area.
- Remove the special tools.

6. Install the torque converter retainer.

7.  **WARNING:** Secure the transmission to the transmission jack.

Position the transmission to the transmission jack.

8. Remove the torque converter retainer.

9.  **CAUTION:** Apply grease of the correct specification to the torque converter spigot.

With assistance, install the transmission.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).

10. Attach the flexplate to the torque converter.

- Rotate the crankshaft to access the bolts.
- Tighten the bolts to 45 Nm (33 lb.ft).

11. Attach the transmission breather pipe clip.

- Tighten the bolt to 25 Nm (18 lb.ft).

12. Attach the wiring harness.

- Tighten the Torx screws.
- Connect the electrical connector.

13. Attach the transmission fluid lines.

- Clean the components.
- Install the new O-ring seals.
- Secure with the clip.
- Tighten the bolt to 10 Nm (7 lb.ft).

14. Install the fuel pipe heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Secure with the clips.

15. Install the transmission heat shield bracket.

16. Attach the selector cable.

17. Tighten the transmission case bolts to 10 Nm (7 lb.ft).

For additional information, refer to: [Transfer Case - V6 4.0L Petrol](#) (308-07B Transfer Case, Removal).

18. Adjust the selector cable.

For additional information, refer to: [Selector Lever Cable Adjustment](#) (307-05B Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol, General Procedures).

19. Check and top-up the transmission fluid level.

For additional information, refer to: [Transmission Fluid Level Check](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, General Procedures).

20. Install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

21. NOTE: For NAS vehicles only.

If fitting new or exchange components, carry out long drive cycle.

For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Automatic Transmission/Transaxle - V6 4.0L Petrol/TDV6 2.7L Diesel - Diagnostics

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission/transaxle system and operation, refer to the relevant Description and Operation sections in the workshop manual.

Fluid Level and Condition Check



CAUTION: The vehicle should not be driven if the fluid level is low as internal failure can result.

• **NOTE:** The transmission fluid temperature must not be allowed to exceed 50°C (122°F) whilst checking level. Should the temperature rise above this figure, abort the check and allow the transmission fluid to cool to below 30°C (86°F).

This vehicle is not equipped with a fluid level indicator. An incorrect level may affect the transmission operation and could result in transmission damage. To correctly check and add fluid to the transmission. Refer to the relevant section in the workshop manual.

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission damage. If an overfill condition is identified, with the engine at idle ensure the fluid temperature is within the specified range and allow the excess fluid to drain until a small thread of fluid runs from the filler/level plug hole.

Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, or damage. This could also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid



CAUTION: The use of any other type of transmission fluid other than that specified can result in transmission damage.

If fluid needs to be added, add fluid in 0.50 liter increments through the fill hole opening. Do not overfill the fluid. For fluid type, refer to the Specification section in the workshop manual.

Fluid Condition Check

1. **1.** Check the fluid level.
2. **2.** Observe the color and the odor of the fluid. The color under normal circumstances should be like honey, not dark brown or black.
3. **3.** Allow the fluid to drip onto a facial tissue and examine the stain.
4. **4.** If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.

NOTE: In the event of a transmission unit replacement for internal failure, the oil cooler and pipes must also be replaced.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical	Electrical	Hydraulic
<ul style="list-style-type: none"> ● Damaged/stuck shift mechanism ● Damaged automatic transmission casing 	<ul style="list-style-type: none"> ● Blown fuse(s) ● Damaged, loose or corroded connectors ● Wiring harness 	<ul style="list-style-type: none"> ● Fluid level too high/low ● Poor condition of fluid ● Fluid leak

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.


DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transmission Control Module \(TCM\) - Bosch](#) (100-00 General Information, Description and Operation).

Automatic Transmission/Transaxle - V6 4.0L Petrol/TDV6 2.7L Diesel - Input Shaft Seal

Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

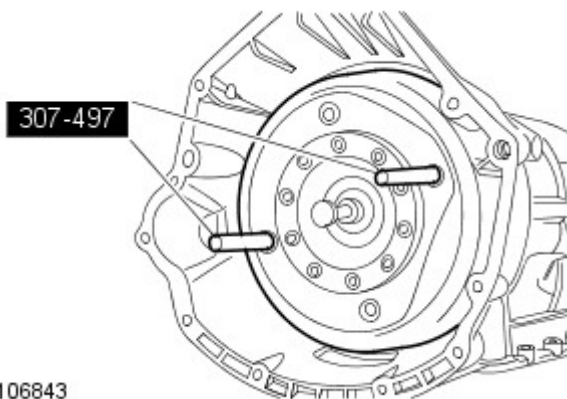
Raise and support the vehicle.

2. Remove the transmission assembly.


Refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).

Refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).

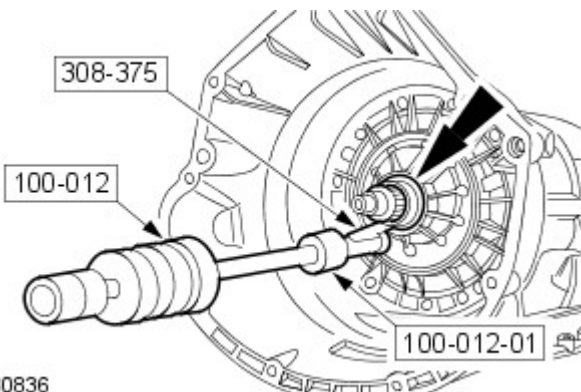
Refer to: [Transmission](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Removal and Installation).




E106843

3.  **WARNING:** Do not let the torque converter drop out of the transmission. Failure to follow this instruction may result in personal injury.

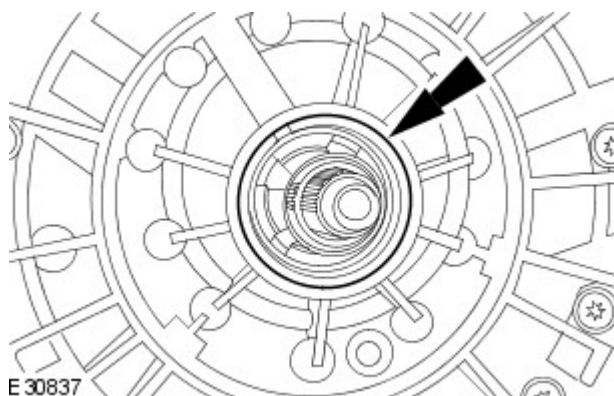
Using the special tools, remove the torque converter. Drain any remaining fluid into a suitable container.



E30836

4.  **WARNING:** Make sure the transmission housing seal face is not damaged when removing the torque converter seal. Failure to follow this instruction may result in damage to the vehicle.

Using the special tools, remove the input shaft seal.

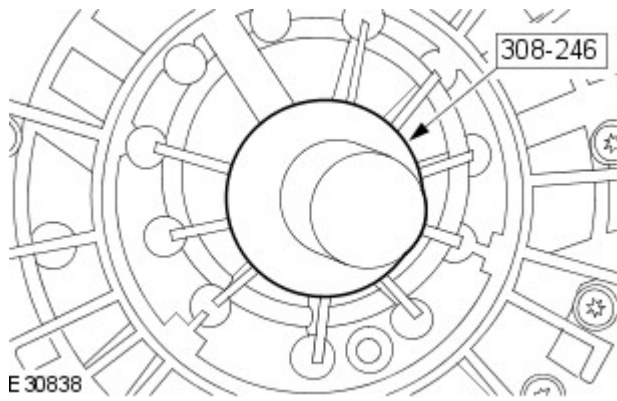


E 30837

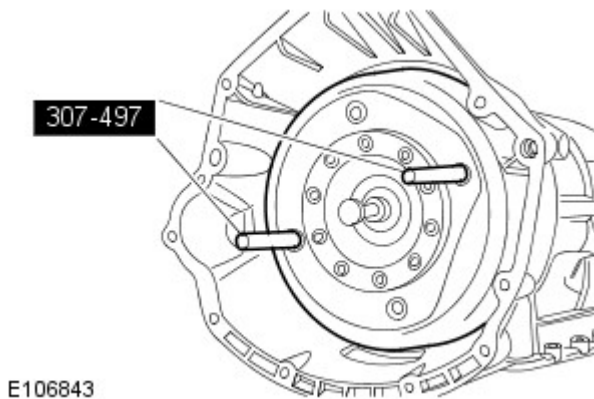
5. **NOTE:** Using a suitable metal surface cleaner meeting Jaguar specification, clean the seal face on the housing before fitting the new seal.


Clean and inspect the transmission housing seal face.

Installation



1. Using the special tool, install a new input shaft seal.



2.  **WARNING:** Do not let the torque converter drop out of the transmission. Failure to follow this instruction may result in personal injury.

- **NOTE:** The torque converter hub must engage fully in the oil pump drive gear.

Using the special tools, install the torque converter. Remove the special tools.

3. Install the transmission assembly.

Refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).
Refer to: [Transmission](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, Removal and Installation).
Refer to: [Transmission](#) (307-01A Automatic Transmission/Transaxle - TDV6 2.7L Diesel, Removal and Installation).

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel -

Maintenance



CAUTION: Use only Shell M1375.4 Automatic transmission fluid. Use of any other fluids may result in a transmission malfunction or failure.

Description	Intervals
Normal maintenance	Filled for life.
Severe duty maintenance	Change the fluid at 48,000 km (30,000 miles) intervals.

Capacities

	Liters
Transmission	9.9

Lubricants, Fluids, Sealers and Adhesives

Description	Specification
Transmission fluid	Shell M1375.4
Sealant	WSS-M4G323-A6
Metal surface cleaner	WSW-M5B392-A
High temperature grease	Molecote FB180

Torque Specifications

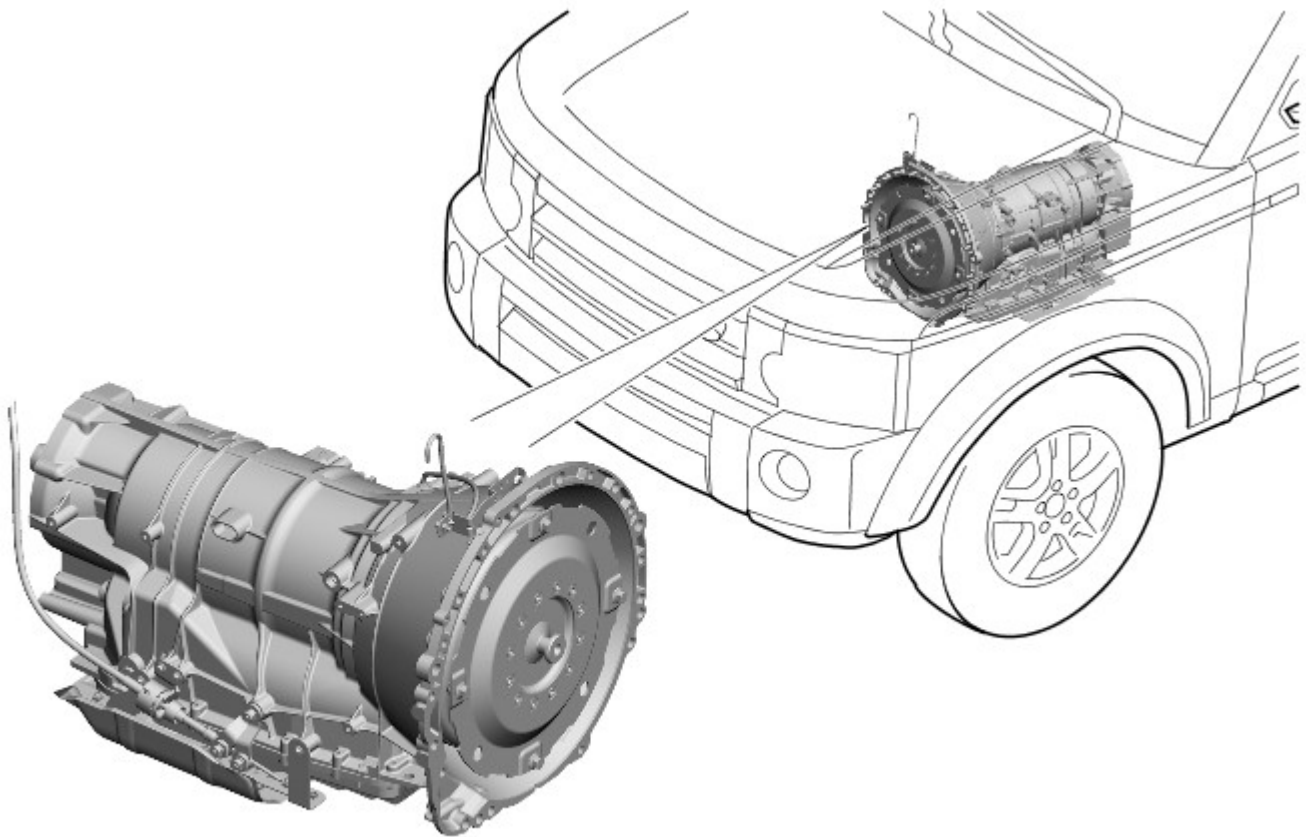
- NOTE: A = refer to the procedure for correct torque sequence

Description	Nm	lb-ft	lb-in
Transmission retaining bolts	48	35	-
Transmission mount retaining bolts	60	44	-
Transmission fluid fill plug	A	A	A
Transmission control module (TCM) and main control valve body retaining bolts	8	-	53
Torque converter retaining bolts	62	46	-
Transmission fluid cooler tube retaining bolt	22	16	-
Transmission fluid drain plug	8	-	53
Transmission fluid pan, gasket and filter retaining bolts	8	-	53

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Description

Description and Operation

COMPONENT LOCATION



E122443

INTRODUCTION

The ZF 6HP28 transmission is an electronically controlled, hydraulically operated, six speed automatic unit. The hydraulic and electronic control elements of the transmission, including the [TCM \(transmission control module\)](#), are incorporated in a single unit located inside the transmission and is known as 'Mechatronic'.

3.0L diesel models use an updated derivative of the ZF 6HP28 transmission used in the 5.0L naturally aspirated models.

The ZF 6HP28 transmission has the following features:

- Designed to be maintenance free
- Transmission fluid is 'fill for life'
- The torque converter features a controlled slip feature with electronically regulated control of lock-up, creating a smooth transition to the fully locked condition
- Shift programs controlled by the [TCM](#)
- ASIS (adaptive shift strategy), to provide continuous adaptation of shift changes to suit the driving style of the driver, which can vary from sporting to economical
- Connected to the [ECM \(engine control module\)](#) via the high speed [CAN \(controller area network\)](#) bus for communications
- Default mode if major faults occur
- Diagnostics available from the [TCM](#) via the high speed [CAN](#) bus.

The transmission selections are made using the selector lever in the floor console and two paddle switches on the steering wheel.

For additional information, refer to: [External Controls](#) (307-05C Automatic Transmission/Transaxle External Controls - V8 5.0L Petrol/TDV6 3.0L Diesel, Description and Operation).

TRANSMISSION

The transmission comprises the main casing which houses all of the transmission components. The main casing also incorporates an integral bell housing.

A fluid pan is attached to the lower face of the main casing and is secured with bolts. The fluid pan is sealed to the main casing with a gasket. Removal of the fluid pan allows access to the Mechatronic valve block. The fluid pan has a magnet located around the drain plug which collects any metallic particles present in the transmission fluid.

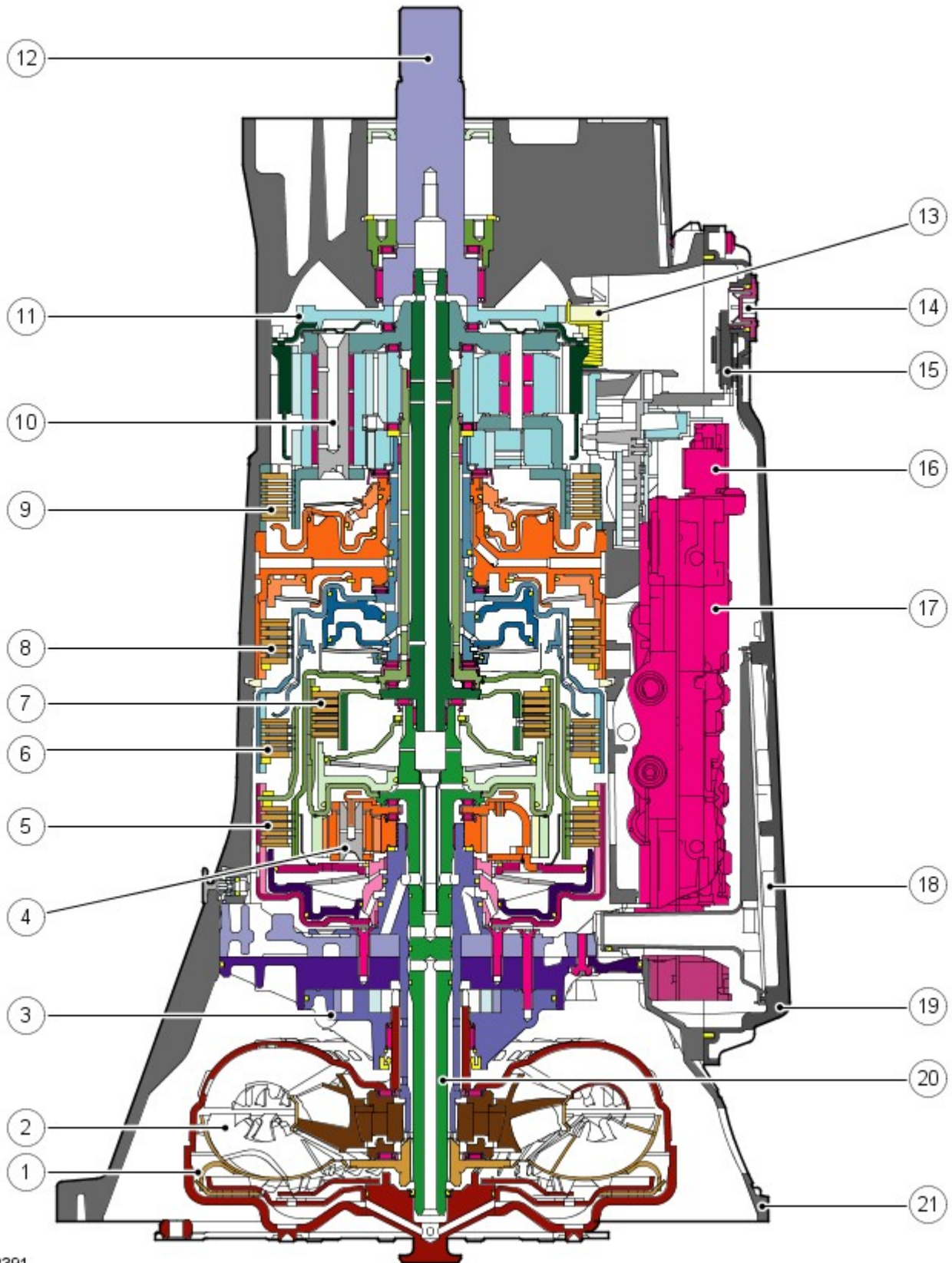
A fluid filter is located inside the fluid pan. If the transmission fluid becomes contaminated or after any service work, the fluid pan with integral filter must be replaced.

On the [RH \(right-hand\)](#) side of the transmission, a gear change lever is installed on the end of a selector shaft. The selector shaft operates a selector spool valve and a selector switch in the transmission. A selector cable, connected between the gear change lever and the selector lever in the floor console, controls the position of the selector shaft.

The integral bell housing provides protection for the torque converter assembly and also provides the attachment for the gearbox to the engine. The torque converter is a non-serviceable assembly which also contains the lock-up clutch mechanism. The torque converter drives a crescent type pump via drive tangs. The fluid pump is located in the main casing, behind the torque converter.

The main casing contains the following major components:

- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the [TCM](#)
- Three rotating multiplate drive clutches
- Two fixed multiplate brake clutches
- A single planetary gear train and a double planetary gear train.

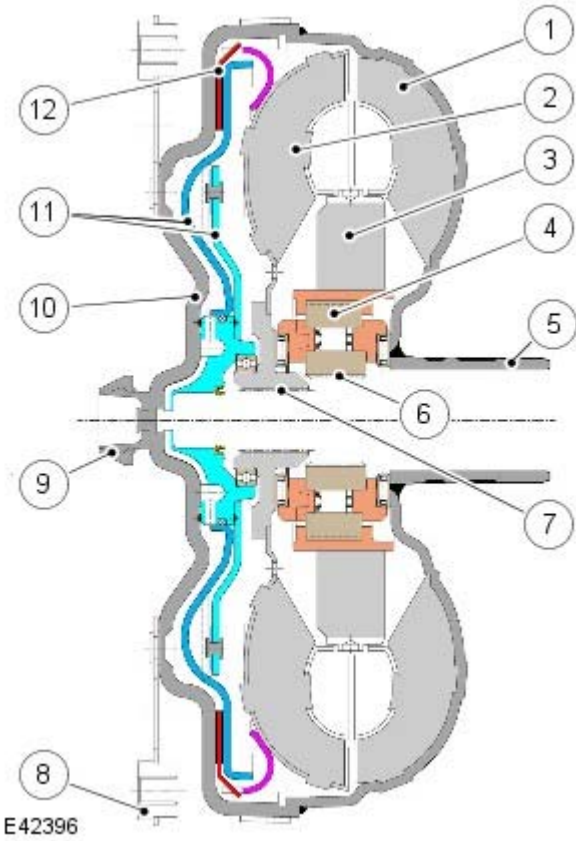


E42391

Item	Part Number	Description
1	-	Torque converter lock-up clutch
2	-	Torque converter
3	-	Fluid pump
4	-	Single planetary gearset
5	-	Clutch A
6	-	Clutch B
7	-	Clutch E
8	-	Brake C
9	-	Brake D
10	-	Double planetary gearset
11	-	Park lock gear

12	-	Output shaft
13	-	Park lock pawl
14	-	Drain plug
15	-	Magnet
16	-	Pressure regulator
17	-	Mechatronic valve block
18	-	Fluid filter
19	-	Fluid pan
20	-	Input shaft
21	-	Transmission casing

TORQUE CONVERTER



Item	Part Number	Description
1	-	Impeller
2	-	Turbine
3	-	Stator
4	-	Freewheel clutch
5	-	Torque converter hub
6	-	Stator shaft
7	-	Turbine shaft
8	-	Drive plate
9	-	Journal - Drive plate/crankshaft location
10	-	Torque converter cover
11	-	Lock-up clutch piston
12	-	Lock-up clutch plate

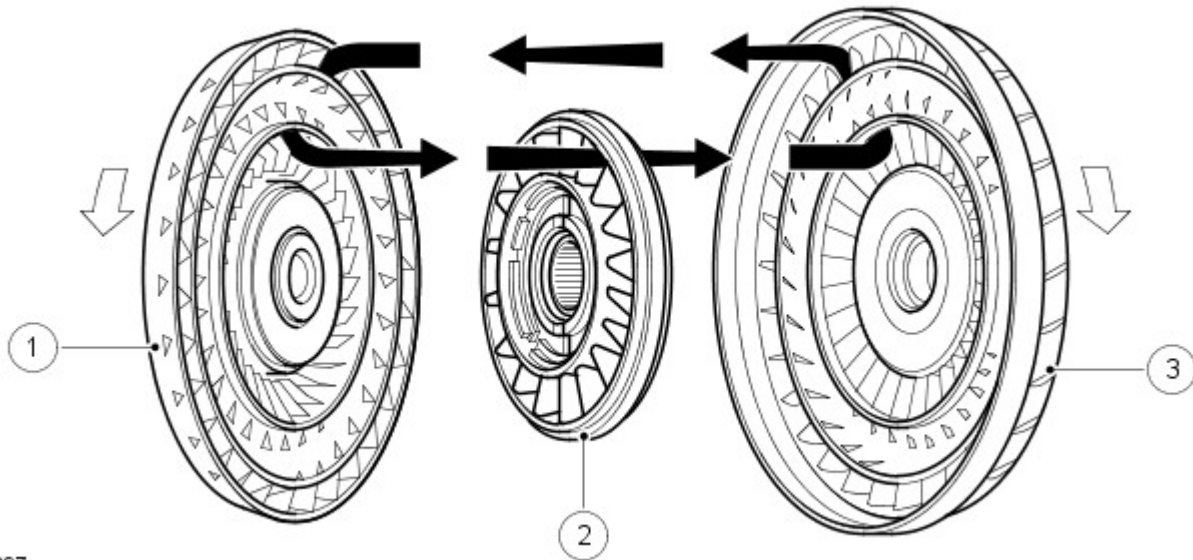
The torque converter is the coupling element between the engine and the transmission and is located in the bell housing, on the engine side of the transmission. The driven power from the engine crankshaft is transmitted hydraulically and mechanically through the torque converter to the transmission. The torque converter is connected to the engine by a drive plate attached to the rear of the crankshaft.

The torque converter comprises an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The two components are welded together to form a sealed, fluid filled housing. With the impeller welded to the converter housing cover, the impeller is therefore driven at engine crankshaft speed.

The converter housing cover has four threaded bosses, which provide for attachment of the engine drive plate. The threaded bosses also provide for location of special tools which are required to remove the torque converter from the bell housing.

Impeller

Fluid Flow



E42397

Item	Part Number	Description
1	-	Turbine
2	-	Stator
3	-	Impeller

When the engine is running the rotating impeller acts as a centrifugal pump, picking up fluid at its center and discharging it at high velocity through the blades on its outer rim. The design and shape of the blades and the curve of the impeller body cause the fluid to rotate in a clockwise direction as it leaves the impeller. This rotation improves the efficiency of the fluid as it contacts the outer row of blades on the turbine.

The centrifugal force of the fluid leaving the blades of the impeller is passed to the curved inner surface of the turbine via the tip of the blades. The velocity and clockwise rotation of the fluid causes the turbine to rotate.

Turbine

The turbine is similar in design to the impeller with a continuous row of blades. Fluid from the impeller enters the turbine through the tip of the blades and is directed around the curved body of the turbine to the root of the blades. The curved surface redirects the fluid back in the opposite direction to which it entered the turbine, effectively increasing the turning force applied to the turbine from the impeller. This principle is known as torque multiplication.

When engine speed increases, turbine speed also increases. The fluid leaving the inner row of the turbine blades is rotated in a counter-clockwise direction due to the curve of the turbine and the shape of the blades. The fluid is now flowing in the opposite direction to the engine rotation and therefore the impeller. If the fluid was allowed to hit the impeller in this condition, it would have the effect of applying a brake to the impeller, eliminating the torque multiplication effect. To prevent this, the stator is located between the impeller and the turbine.

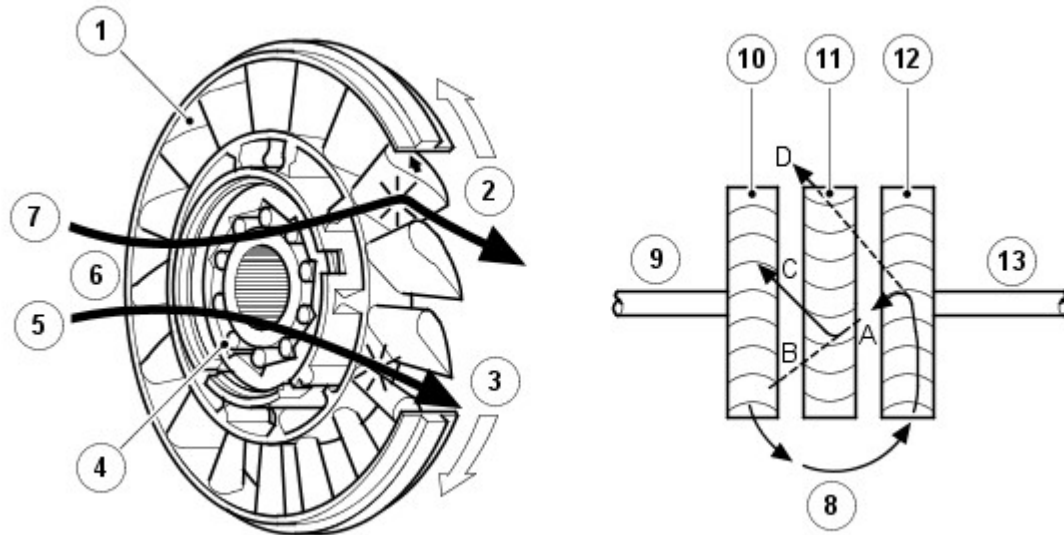
Stator

The stator is located on the splined transmission input shaft via a freewheel clutch. The stator comprises a number of blades which are aligned in an opposite direction to those of the impeller and turbine. The main function of the stator is to redirect the returning fluid from the turbine, changing its direction to that of the impeller.

The redirected fluid from the stator is directed at the inner row of blades of the impeller, assisting the engine in turning the impeller. This sequence increases the force of the fluid emitted from the impeller and thereby increases the torque multiplication effect of the torque converter.

Stator Functions

- NOTE: The following illustration shows a typical stator



E 42398

Item	Part Number	Description
1	-	Blades
2	-	Stator held – fluid flow redirected
3	-	Stator rotates freely
4	-	Roller
5	-	Converter at coupling speed
6	-	Fluid flow from turbine
7	-	Converter multiplying
8	-	Fluid flow from impeller
9	-	Drive from engine
10	-	Impeller
11	-	Stator
12	-	Turbine
13	-	Output to transmission

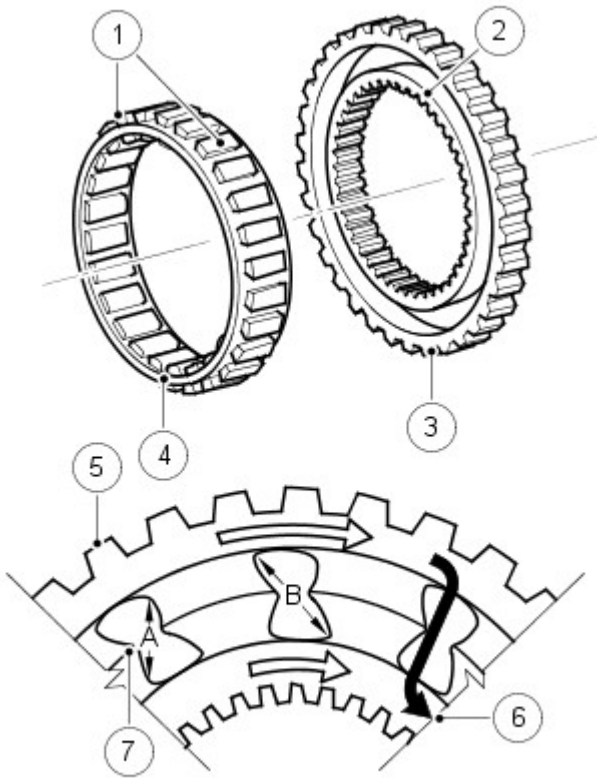
Fluid emitted from the impeller acts on the turbine. If the turbine is rotating at a slower speed than the fluid from the impeller, the fluid will be deflected by the turbine blades in the path 'A'. The fluid is directed at and deflected by the stator blades from path 'B' to path 'C'. This ensures that the fluid is directed back to the pump in the optimum direction. In this condition the sprag clutch is engaged and the force of the fluid on the stator blades assists the engine in rotating the impeller.

As the rotational speed of the engine and therefore the turbine increases, the direction of the fluid leaving the turbine changes to path 'D'. The fluid is now directed from the turbine to the opposite side of the stator blades, rotating the stator in the opposite direction. To prevent the stator from resisting the smooth flow of the fluid from the turbine, the sprag clutch releases, allowing the stator to rotate freely on its shaft.

When the stator becomes inactive, the torque converter no longer multiplies the engine torque. When the torque converter reaches this operational condition it ceases to multiply the engine torque and acts solely as a fluid coupling, with the impeller and the turbine rotating at approximately the same speed.

The stator uses a sprag type, one way, freewheel clutch. When the stator is rotated in a clockwise direction the sprags twist and are wedged between the inner and outer races. In this condition the sprags transfer the rotation of the outer race to the inner race which rotates at the same speed.

One Way Free Wheel Clutch – Typical



E 42712

Item	Part Number	Description
1	-	Sprags
2	-	Inner race
3	-	Outer race
4	-	Sprag and cage assembly
5	-	Sprag outer race
6	-	Sprag inner race
7	-	Retaining ring

The free wheel clutch can perform three functions; hold the stator stationary, drive the stator and free wheel allowing the stator to rotate without a drive output. The free wheel clutch used in the ZF 6HP28 transmission is of the sprag type and comprises an inner and outer race and a sprag and cage assembly. The inner and outer races are pressed into their related components with which they rotate. The sprag and cage assembly is located between the inner and outer races.

The sprags are located in a cage which is a spring which holds the sprags in the 'wedge' direction and maintains them in contact with the inner and outer races.

Referring to the illustration, the sprags are designed so that the dimension 'B' is larger than the distance between the inner and outer race bearing surfaces. When the outer race rotates in a clockwise direction, the sprags twist and the edges across the dimension 'B' wedge between the races, providing a positive drive through each sprag to the inner race. The dimension 'A' is smaller than the distance between the inner and outer race bearing surfaces. When the outer race rotates in an anti-clockwise direction, the dimension 'A' is too small to allow the sprags to wedge between the races, allowing the outer race to rotate freely.

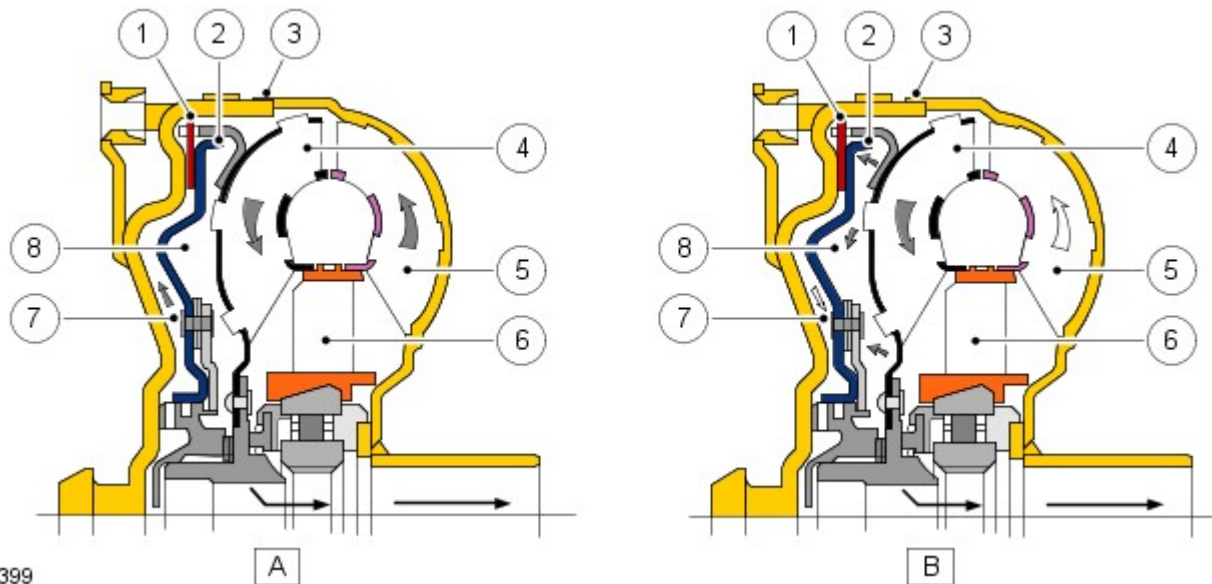
On the illustration shown, when the outer race is rotated in a clockwise direction, the sprags twist and are 'wedged' between the inner and outer races. The sprags then transfer the rotation of the outer race to the inner race, which rotates at the same speed.

Lock-Up Clutch Mechanism

The [TCC \(torque converter clutch\)](#) is hydraulically controlled by an EPRS (electronic pressure regulating solenoid), which is controlled by the [TCM](#). This allows the torque converter to have three states of operation as follows:

- Fully engaged
- Controlled slip variable engagement
- Fully disengaged.

The [TCC](#) is controlled by two hydraulic spool valves located in the valve block. These valves are actuated by pilot pressure supplied via a solenoid valve which is also located in the valve block. The solenoid valve is operated by [PWM \(pulse width modulation\)](#) signals from the [TCM](#) to give full, partial or no lock-up of the torque converter.



E 42399

Item	Part Number	Description
A	-	Unlocked condition
B	-	Locked condition
1	-	Clutch plate
2	-	Clutch piston
3	-	Torque converter body
4	-	Turbine
5	-	Impeller
6	-	Stator
7	-	Piston chamber
8	-	Turbine chamber

The lock-up clutch is a hydro-mechanical device which eliminates torque converter slip, improving fuel consumption. The engagement and disengagement is controlled by the [TCM](#) to allow a certain amount of controlled 'slip'. This allows a small difference in the rotational speeds of the impeller and the turbine which results in improved shift quality. The lock-up clutch comprises a piston and a clutch friction plate.

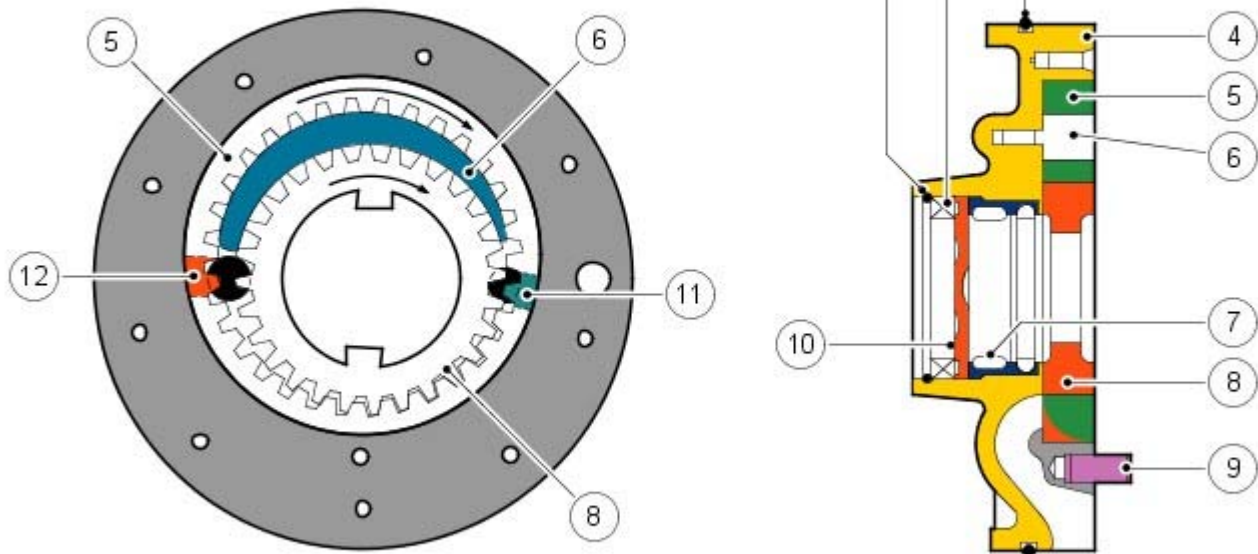
In the unlocked condition, the oil pressure supplied to the piston chamber and the turbine chamber is equal. Pressurized fluid flows through a drilling in the turbine shaft and through the piston chamber to the turbine chamber. In this condition the clutch plate is held away from the torque converter body and torque converter slip is permitted.

In the locked condition, the [TCC](#) spool valves are actuated by the EPRS. The fluid flow in the unlocked condition is reversed and the piston chamber is vented. Pressurized fluid is directed into the turbine chamber and is applied to the clutch piston. The piston moves with the pressure and pushes the clutch plate against the torque converter body. As the pressure increases, the friction between the clutch plate and the body increases, finally resulting in full lock-up of the clutch plate with the body. In this condition there is direct mechanical drive from the engine crankshaft to the transmission planetary gear train.

FLUID PUMP

The fluid pump is an integral part of the transmission. The fluid pump is used to supply hydraulic pressure for the operation of the control valves and clutches, to pass the fluid through the transmission cooler and to lubricate the gears and shafts.

The ZF 6HP28 fluid pump is a crescent type pump and is located between the intermediate plate and the torque converter. The pump has a delivery rate of 16 cm³ per revolution.



E42400

Item	Part Number	Description
1	-	Securing ring
2	-	Shaft oil seal
3	-	O-ring seal
4	-	Pump housing
5	-	Ring gear
6	-	Crescent spacer
7	-	Roller bearing
8	-	Impeller
9	-	Centering pin
10	-	Spring washer
11	-	Outlet port (high pressure)
12	-	Inlet port (low pressure)

The pump comprises a housing, a crescent spacer, an impeller and a ring gear. The housing has inlet and outlet ports to direct flow and is located in the intermediate plate by a centering pin. The pump action is achieved by the impeller, ring gear and crescent spacer.

The crescent spacer is fixed in its position by a pin and is located between the ring gear and the impeller. The impeller is driven by drive from the torque converter hub which is located on a needle roller bearing in the pump housing. The impeller teeth mesh with those of the ring gear. When the impeller is rotated, the motion is transferred to the ring gear which rotates in the same direction.

The rotational motion of the ring gear and the impeller collects fluid from the intake port in the spaces between the teeth. When the teeth reach the crescent spacer, the oil is trapped in the spaces between the teeth and is carried with the rotation of the gears. The spacer tapers near the outlet port. This reduces the space between the gear teeth causing a build up of fluid pressure as the oil reaches the outlet port. When the teeth pass the end of the spacer the pressurized fluid is released into the outlet port.

The fluid emerging from the outlet port is passed through the fluid pressure control valve. At high operating speeds the pressure control valve maintains the output pressure to the gearbox at a predetermined maximum level. Excess fluid is relieved from the pressure control valve and is directed, via the main pressure valve in the valve block, back to the pump inlet port. This provides a pressurized feed to the pump inlet which prevents cavitation and reduces pump noise.

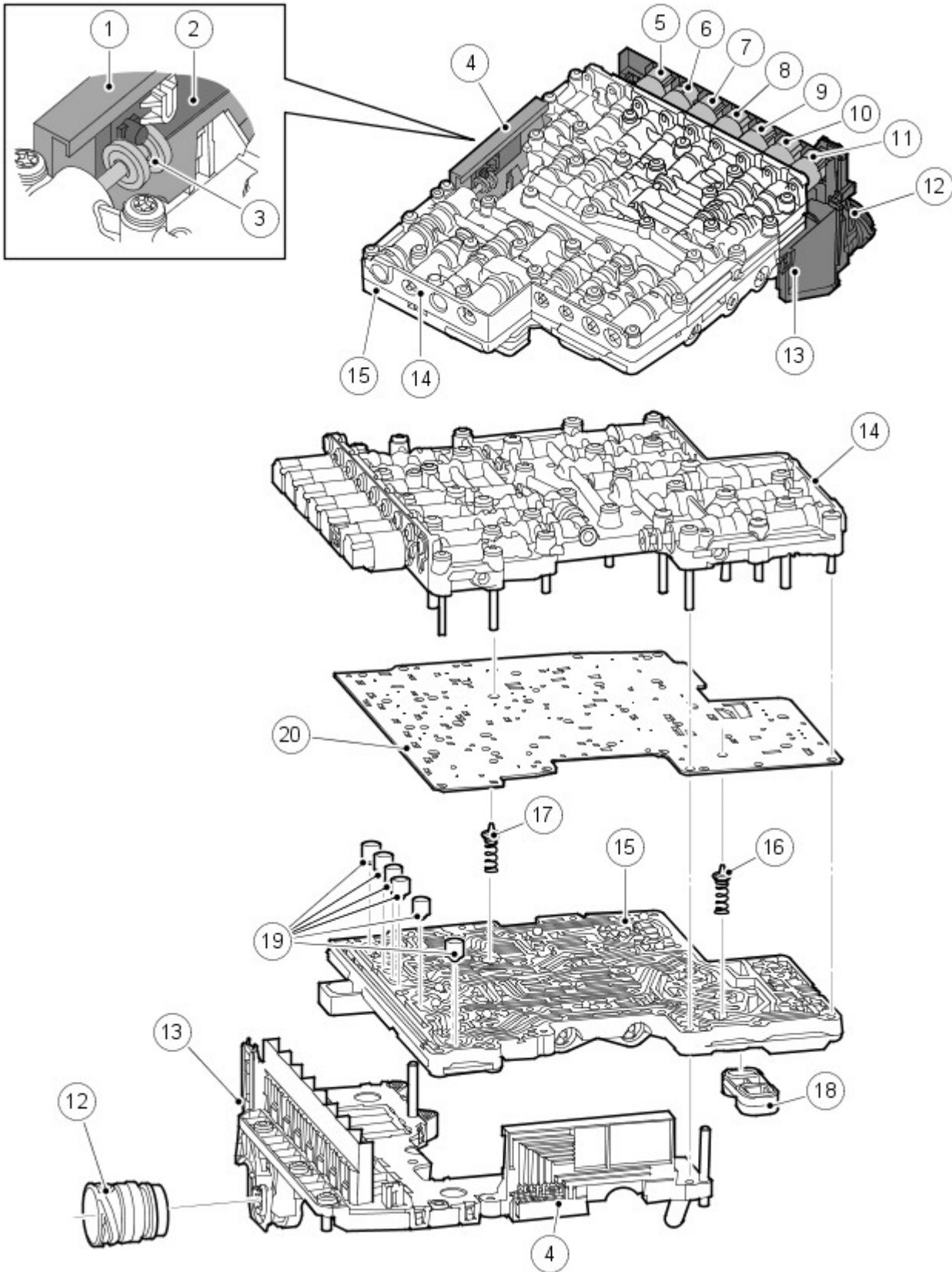
MECHATRONIC VALVE BLOCK

The Mechatronic valve block is located in the bottom of the transmission and is covered by the fluid pan. The valve block houses the [TCM](#), electrical actuators, speed sensors and control valves which provide all electro-hydraulic control for all transmission functions. The Mechatronic valve block comprises the following components:

- [TCM](#)
- Six pressure regulator solenoids
- One shift control solenoid
- One damper
- Twenty one hydraulic spool valves
- Manually operated selector valve
- Temperature sensor

- Turbine speed sensor
- Output shaft speed sensor.

Mechatronic Valve Block

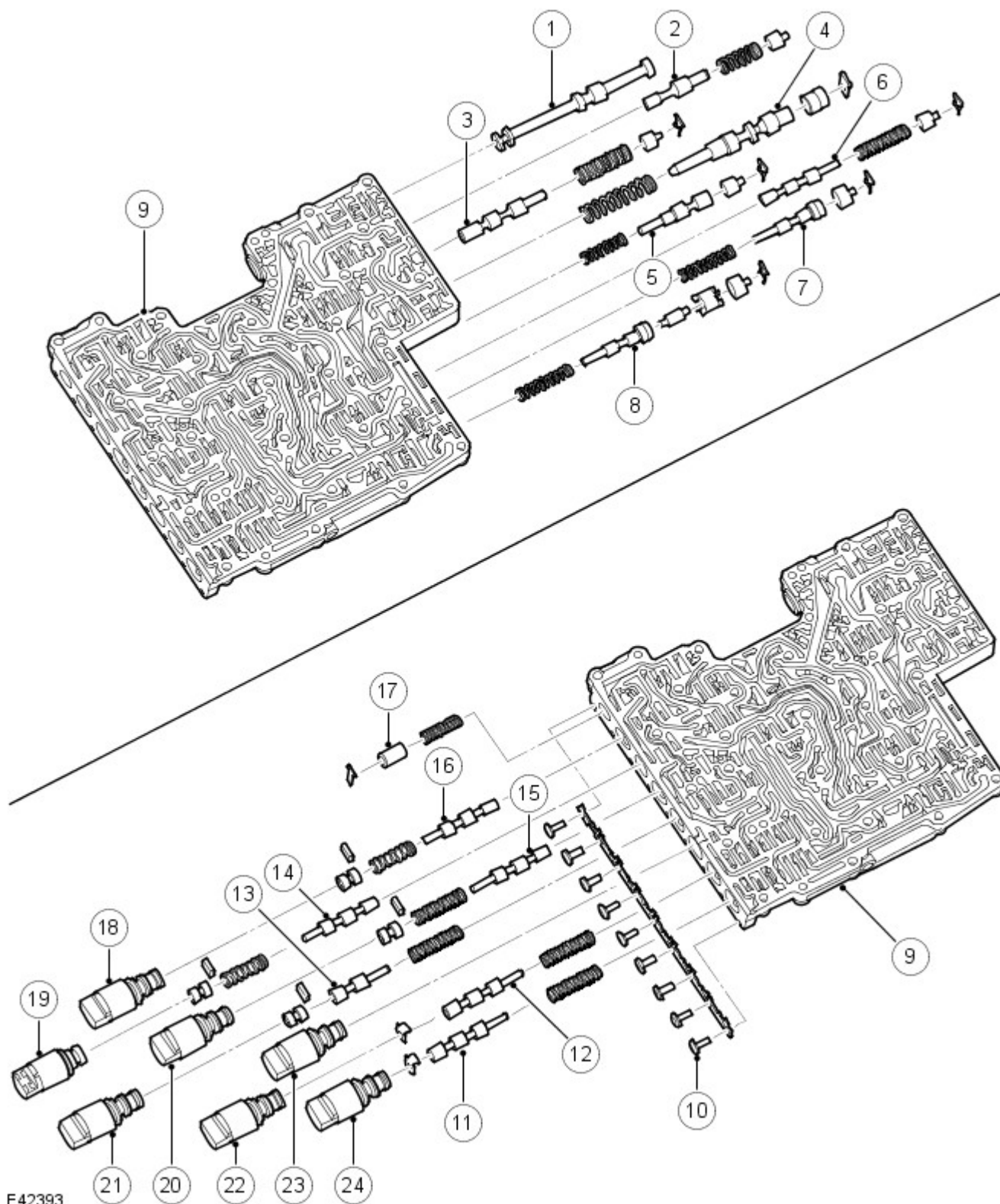


E42392

Item	Part Number	Description
1	-	Position switch
2	-	Sliding block
3	-	Selector spool valve
4	-	Position switch assembly
5	-	EPRS 6
6	-	Solenoid Valve 1
7	-	EPRS 4

8	-	EPRS 5
9	-	EPRS 3
10	-	EPRS 2
11	-	EPRS 1
12	-	Electrical connector
13	-	TCM
14	-	Valve housing
15	-	Valve plate
16	-	Torque converter retaining valve
17	-	Clutch return valve
18	-	Element seal
19	-	Pressure regulator dampers
20	-	Intermediate plate

Valve Housing Components

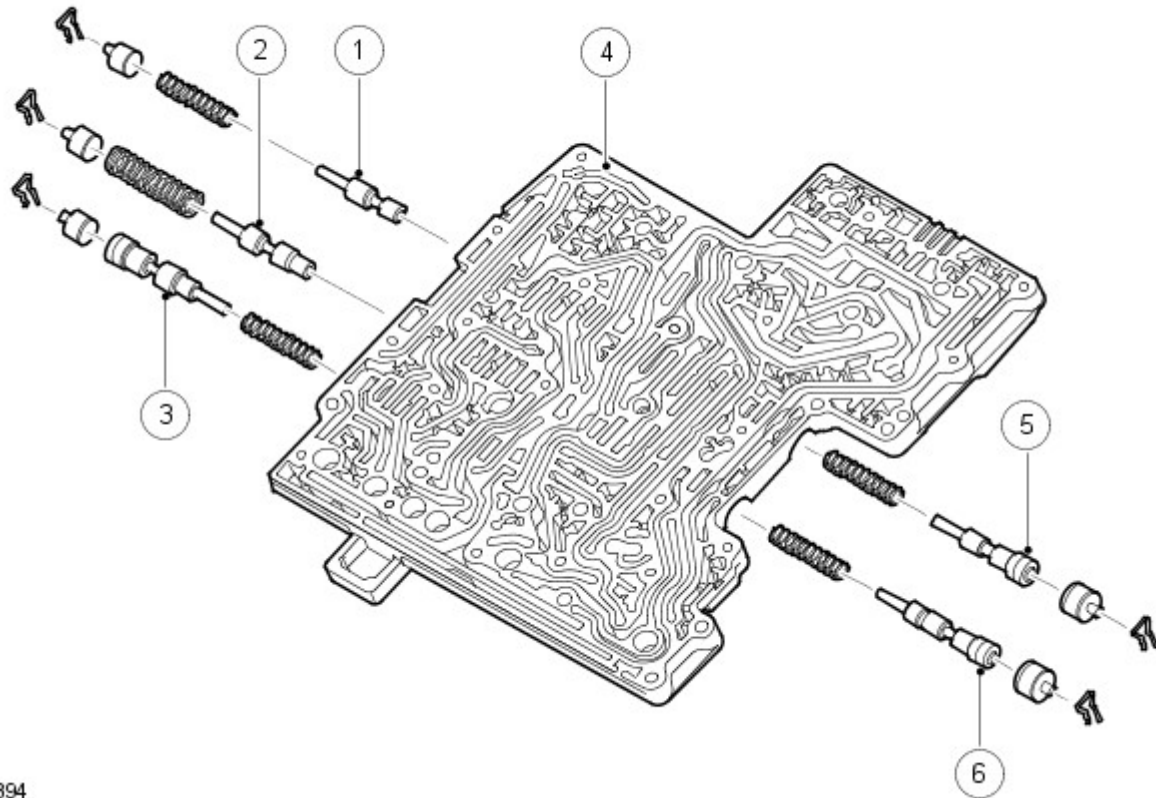


E42393

Item	Part Number	Description
1	-	Selector spool valve
2	-	Lubricating valve
3	-	Torque converter pressure valve
4	-	System pressure valve
5	-	Torque converter clutch valve
6	-	Retaining valve – Clutch E
7	-	Clutch valve E
8	-	Clutch valve A
9	-	Valve housing
10	-	Bolts
11	-	Retaining valve – Clutch A

12	-	Retaining valve – Clutch B
13	-	Pressure reducing valve
14	-	Shift valve 1
15	-	Retaining valve – Brake D
16	-	Shift valve 2
17	-	Damper
18	-	EPRS 6
19	-	Solenoid valve 1
20	-	EPRS 4
21	-	EPRS 5
22	-	EPRS 2
23	-	EPRS 3
24	-	EPRS 1

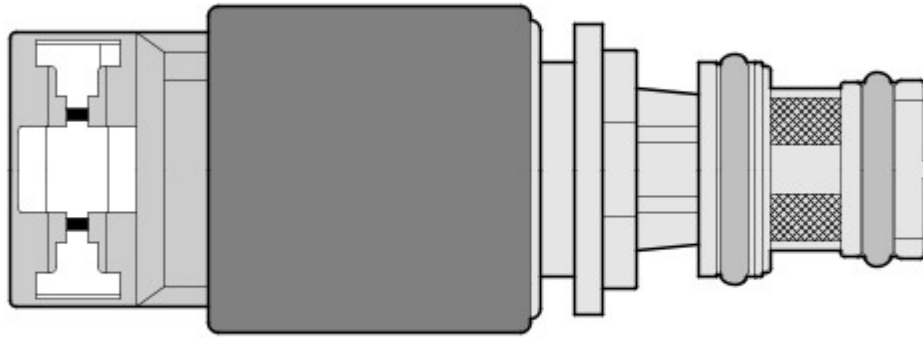
Valve Plate Components



E42394

Item	Part Number	Description
1	-	Retaining valve – Brake D2
2	-	Clutch valve – Brake D2
3	-	Clutch valve B
4	-	Valve plate
5	-	Clutch valve – Brake D1
6	-	Clutch valve – Brake C

Electronic Pressure Regulator Solenoids



E42713

Six EPRS are located in the valve block. The solenoids are controlled by [PWM](#) signals from the [TCM](#). The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

The following table shows EPRS and their associated functions:

EPRS	Function
1	Clutch A
2	Clutch B
3	Clutch C
4	Brake clutches D and E
5	System pressure control
6	Torque converter lock-up control

Solenoids EPRS 1, 3 and 6 supply a lower control pressure as the signal amperage increases and can be identified by a black connector cap. The [TCM](#) operates the solenoids using PWM signals. The TCM monitors engine load and clutch slip and varies the solenoid duty cycle accordingly. The solenoids have a 12 V operating voltage and a pressure range of 0 - 4.6 bar (0 - 67 lbf.in²).

Solenoids EPRS 2, 4 and 5 supply a higher control pressure as the signal amperage increases and can be identified by a green connector cap. The solenoids are normally open, regulating flow solenoid valves. The operates the solenoids using a [PWM](#) earth proportional to the required increasing or decreasing clutch pressures. The solenoids have a 12 V operating voltage and a pressure range of 4.6 - 0 bar (67 - 0 lbf.in²).

The resistance of the solenoid coil winding for solenoid is between 26 to 30.4 ohms at 20 °C (68 °F).

Control Solenoid



E42714

A shift control SV (solenoid valve) is located in the valve block. The solenoid is controlled by the [TCM](#) and converts electrical signals into hydraulic control signals to control clutch application.

The shift control solenoid is an open/closed, on/off solenoid which is controlled by the [TCM](#) switching the solenoid to earth. The [TCM](#) also supplies power to the solenoid. The [TCM](#) energizes the solenoid in a programmed sequence for clutch application for gear ratio changes and shift control.

The resistance of the solenoid coil winding for solenoid is between 26 to 30.4 ohms at 20 °C (68 °F).

Sensors

Speed Sensors

The turbine speed sensor and the output shaft speed sensor are Hall effect type sensors located in the Mechatronic valve block and are not serviceable items. The [TCM](#) monitors the signals from each sensor to determine the input (turbine) speed and the output shaft speed.

The turbine speed is monitored by the [TCM](#) to calculate the slip of the torque converter clutch and internal clutch slip. This signal allows the [TCM](#) to accurately control the slip timing during shifts and adjust clutch application or release pressure for overlap shift control.

The output shaft speed is monitored by the [TCM](#) and compared to engine speed signals received on the [CAN](#) bus from the [ECM](#). Using a comparison of the two signals the [TCM](#) calculates the transmission slip ratio for plausibility and maintains adaptive pressure control.

Temperature Sensor

The temperature sensor is also located in the Mechatronic valve block. The [TCM](#) uses the temperature sensor signals to determine the temperature of the transmission fluid. These signals are used by the [TCM](#) to control the transmission operation to promote faster warm-up in cold conditions or to assist with fluid cooling by controlling the transmission operation when high fluid temperatures are experienced. If the sensor fails, the [TCM](#) will use a default value and a fault code will be stored in the [TCM](#).

Damper

There is 1 damper located in the valve housing. The damper is used to regulate and dampen the regulated pressure supplied via EPRS 5. The damper is load dependent through modulation of the damper against return spring pressure.

The damper comprises a piston, a housing bore and a spring. The piston is subject to the pressure applied by the spring. The bore has a connecting port to the function to which it applies. Fluid pressure applied to the applicable component (i.e. a clutch) is also subjected to the full area of the piston, which moves against the opposing force applied by the spring. The movement of the piston creates an action similar to a shock absorber, momentarily delaying the build up of pressure in the circuit. This results in a more gradual application of clutches improving shift quality.

Spool Valves

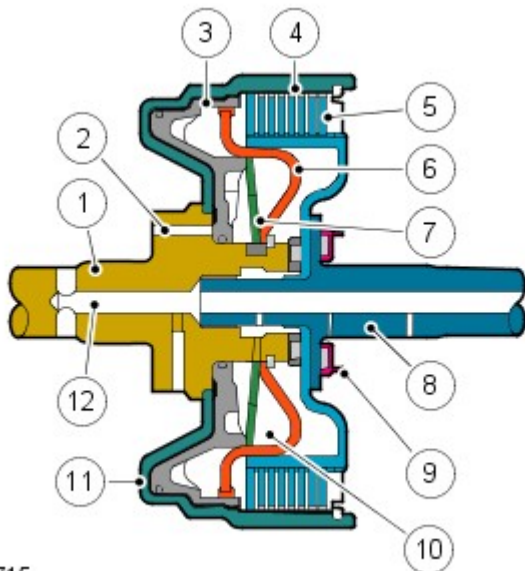
The valve block contains 21 spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

Each spool valve is located in its spool bore and held in a default (unpressurized) position by a spring. The spool bore has a number of ports which allow fluid to flow to other valves and clutches to enable transmission operation. Each spool has a piston which is waisted to allow fluid to be diverted into the applicable ports when the valve is operated.

When fluid pressure moves a spool, 1 or more ports in the spool bore are covered or uncovered. Fluid is prevented from flowing or is allowed to flow around the applicable waisted area of the spool and into another uncovered port. The fluid is either passed through galleries to actuate another spool, operate a clutch or is returned to the fluid pan.

DRIVE CLUTCHES

Multiplate Drive or Brake Clutch – Typical



E42715

Item	Part Number	Description
1	-	Input shaft
2	-	Main pressure supply port
3	-	Piston
4	-	Cylinder – external plate carrier
5	-	Clutch plate assembly
6	-	Baffle plate
7	-	Diaphragm spring
8	-	Output shaft
9	-	Bearing

10	-	Dynamic pressure equalization chamber
11	-	Piston chamber
12	-	Lubrication channel

There are three drive clutches and two brake clutches used in the ZF 6HP28 transmission. Each clutch comprises one or more friction plates dependent on the output controlled. A typical clutch consists of a number of steel outer plates and inner plates with friction material bonded to each face.

On 3.0L diesel models, the updated transmission includes additional clutch plates to enable the transmission to manage the additional power output from these engines.

The clutch plates are held apart mechanically by a diaphragm spring and hydraulically by dynamic pressure. The pressure is derived from a lubrication channel which supplies fluid to the bearings etc. The fluid is passed via a drilling in the output shaft into the chamber between the baffle plate and the piston. To prevent inadvertent clutch application due to pressure build up produced by centrifugal force, the fluid in the dynamic pressure equalization chamber overcomes any pressure in the piston chamber and holds the piston off the clutch plate assembly.

When clutch application is required, main pressure from the fluid pump is applied to the piston chamber from the supply port. This main pressure overcomes the low pressure fluid present in the dynamic pressure equalization chamber. The piston moves, against the pressure applied by the diaphragm spring, and compresses the clutch plate assembly. When the main pressure falls, the diaphragm spring pushes the piston away from the clutch plate assembly, disengaging the clutch.

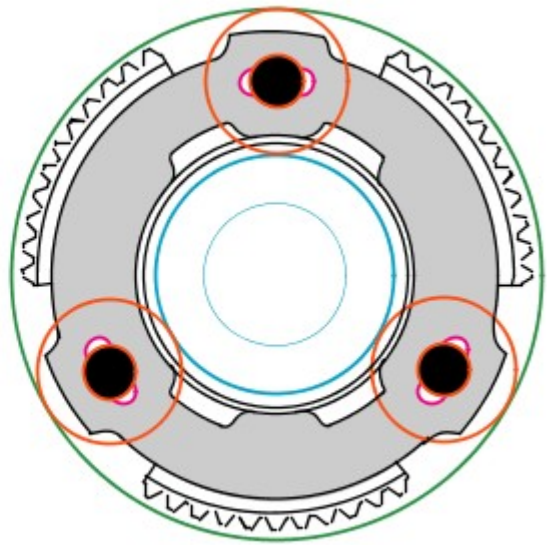
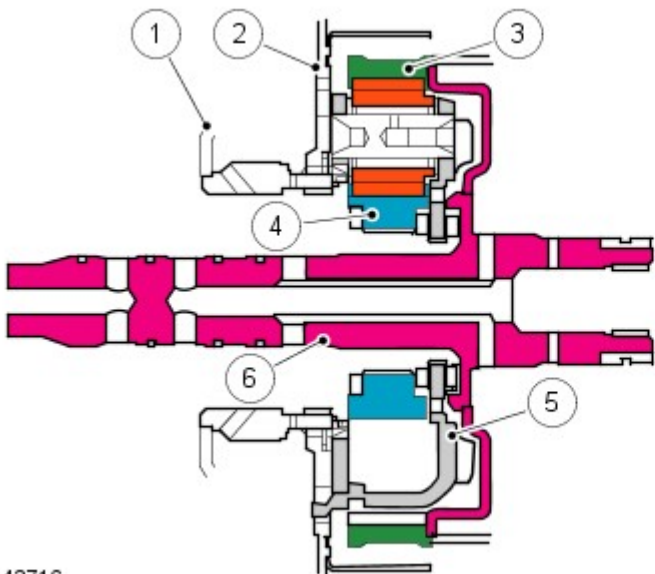
PLANETARY GEAR TRAINS

The planetary gear trains used on the ZF 6HP28 transmission comprise a single web planetary gear train and a double web planetary gear train. These gear trains are known as Lepelletier type gear trains and together produce the six forward gears and the one reverse gear.

Single Web Planetary Gear Train

The single web planetary gear train comprises:

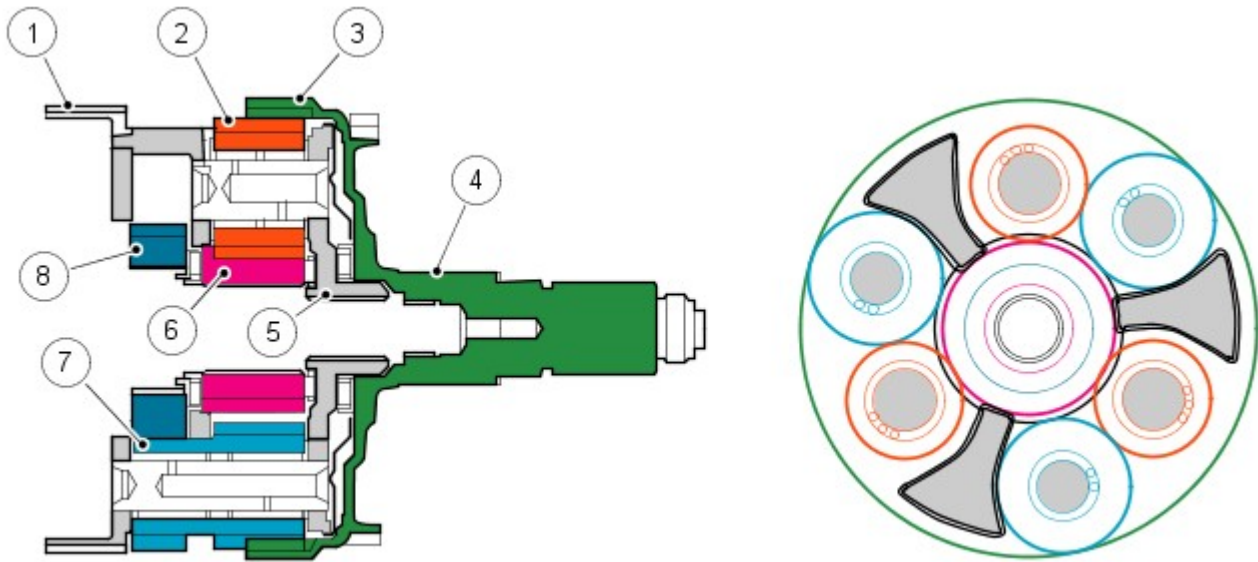
- Sunwheel
- Four planetary gears
- Planetary gear carrier (spider)
- Ring gear or annulus.



E42716

Item	Part Number	Description
1	-	Cylinder
2	-	Baffle plate
3	-	Ring gear
4	-	Sun gear
5	-	Planetary gear spider
6	-	Torque converter input shaft

Torque Converter Input Shaft



E42717

Item	Part Number	Description
1	-	Planetary gear spider
2	-	Planetary gears (short)
3	-	Ring gear
4	-	Output shaft
5	-	Planetary gear carrier
6	-	Sunwheel
7	-	Double planetary gears (long)
8	-	Sunwheel

The double planetary gear train comprises:

- Two sunwheels
- Three short planetary gears
- Three long planetary gears
- Planetary gear carrier
- Ring gear or annulus

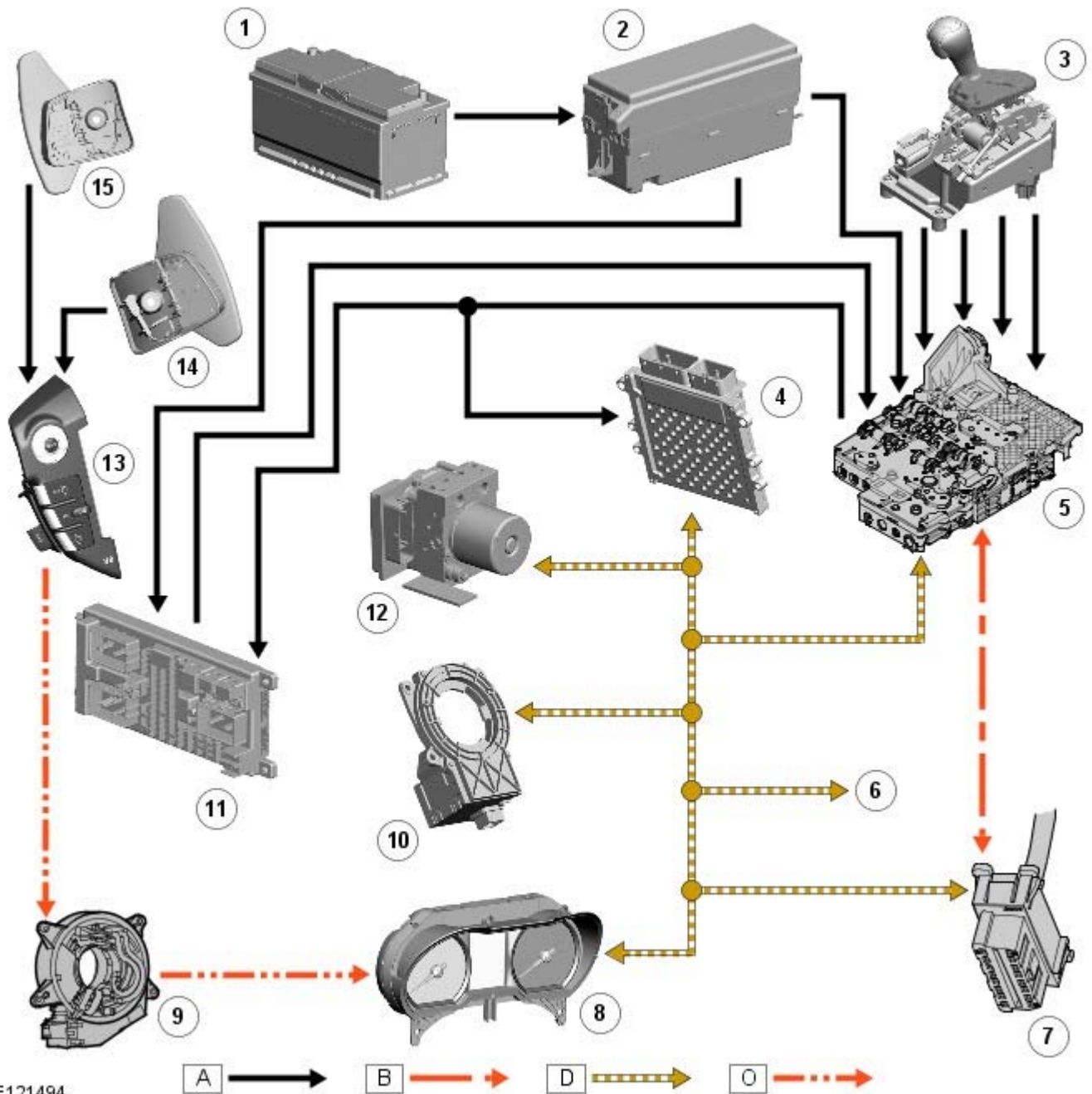
TRANSMISSION CONTROL MODULE

The [TCM](#) is an integral part of the Mechatronic valve block which is located at the bottom of the transmission, within the fluid pan. The [TCM](#) is the main controlling component of the transmission.

The [TCM](#) processes signals from the transmission speed and temperature sensors, [ECM](#) and other vehicle systems. From the received signal inputs and pre-programmed data, the module calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

CONTROL DIAGRAM

- NOTE: A = Hardwired; B = K bus; D = High speed [CAN](#) bus O = LIN (local interconnect network) bus.



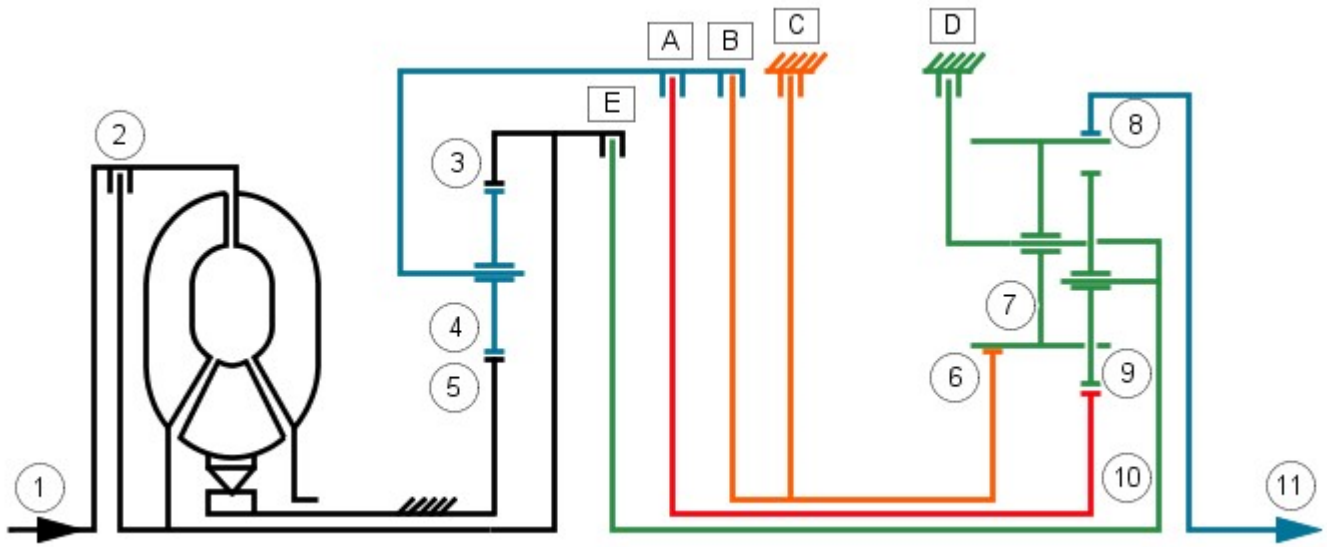
E121494

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	Selector lever
4	-	ECM (engine control module)
5	-	TCM
6	-	To other systems
7	-	Diagnostic socket
8	-	Instrument cluster
9	-	Clockspring
10	-	Steering angle sensor
11	-	CJB (central junction box)
12	-	ABS module
13	-	Steering wheel LH switchpack
14	-	Upshift paddle switch
15	-	Downshift paddle switch

OPERATION

Power Flows

Operation of the transmission is controlled by the [TCM](#), which electrically activates various solenoids to control the transmission gear selection. The sequence of solenoid activation is based on programmed information in the [TCM](#) memory and physical transmission operating conditions such as vehicle speed, throttle position, engine load and selector lever position.



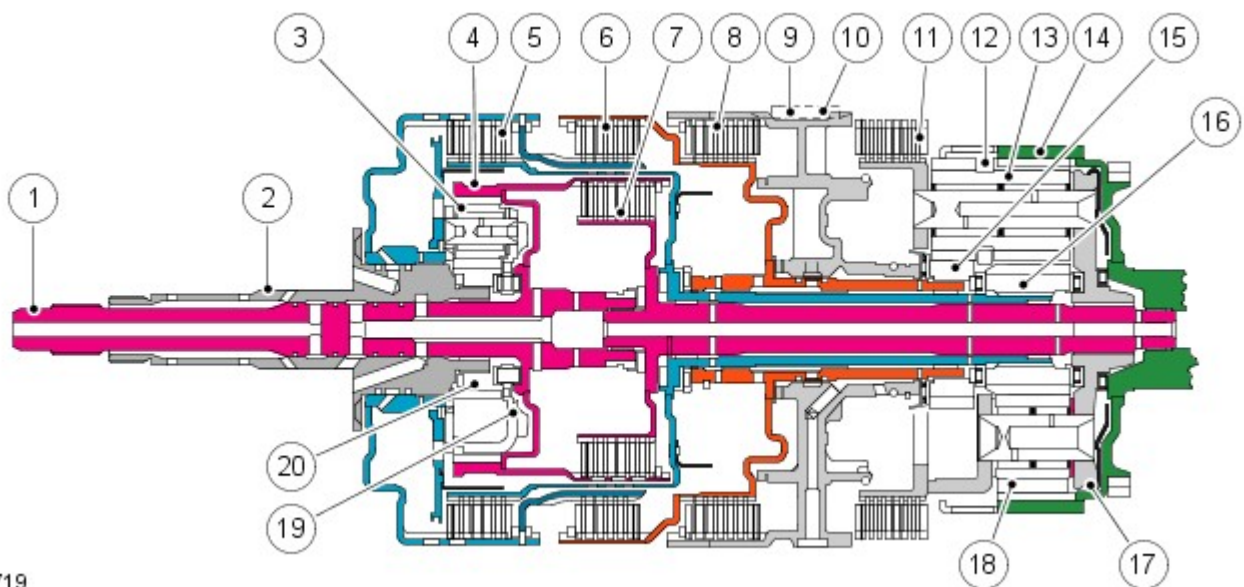
E42718

Item	Part Number	Description
1	-	Torque input from engine
2	-	Torque converter lock-up clutch
3	-	Single web planetary gear carrier
4	-	Single web planetary gears
5	-	Single web sunwheel 1
6	-	Double web sunwheel 2
7	-	Double web planetary gears - long
8	-	Double web planetary gear carrier
9	-	Double web planetary gears - short
10	-	Double web sunwheel 3
11	-	Torque output from transmission
A	-	Multiplate clutch
B	-	Multiplate clutch
C	-	Multiplate brake
D	-	Multiplate brake
E	-	Multiplate clutch

Engine torque is transferred, via operation of single or combinations of clutches to the 2 planetary gear trains. Both gear trains are controlled by reactionary inputs from brake clutches to produce the 6 forward gears and 1 reverse gear. The ratios are as follows:

Gear	1st	2nd	3rd	4th	5th	6th	Reverse
Ratio	4.171	2.340	1.521	1.143	0.867	0.691	3.403

Shift Elements



E42719

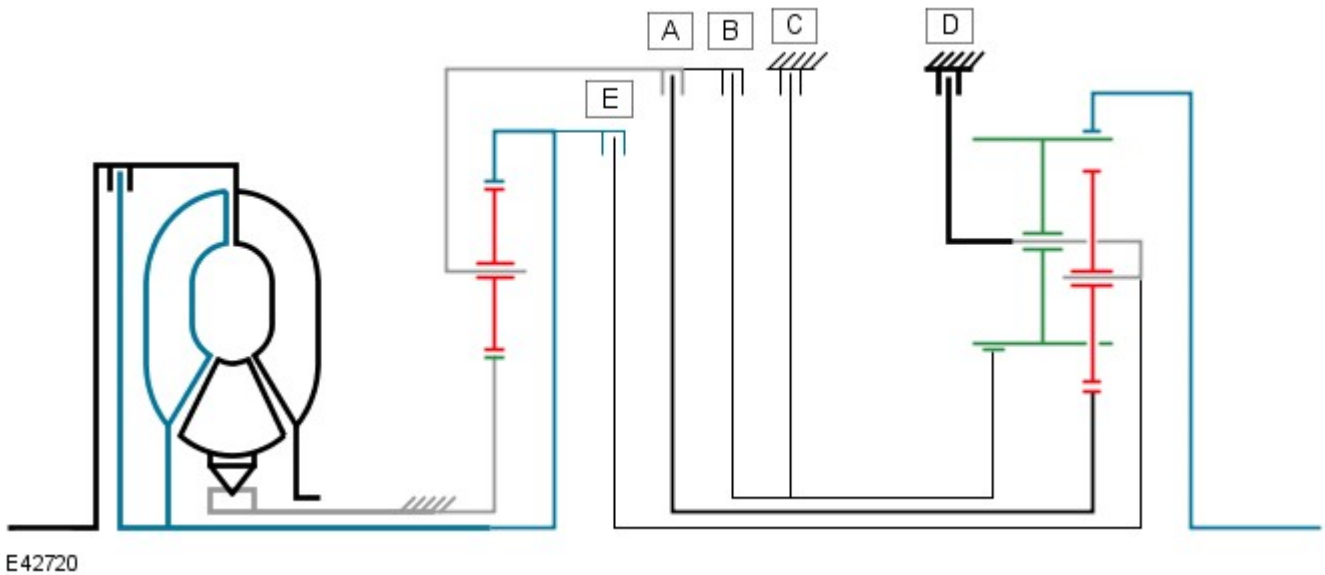
Item	Part Number	Description
1	-	Turbine shaft
2	-	Stator shaft
3	-	Single web planetary gear train

4	-	Ring gear 1
5	-	Clutch A
6	-	Clutch B
7	-	Clutch E
8	-	Brake clutch C
9	-	Fixed connection to transmission housing
10	-	Shaft key
11	-	Brake clutch D
12	-	Double web planetary gear train
13	-	Planetary gears - long
14	-	Ring gear 2
15	-	Sunwheel 2
16	-	Sunwheel 3
17	-	Double web planetary gear carrier
18	-	Planetary gears - short
19	-	Single web planetary gear carrier
20	-	Sunwheel 1

The shift elements are three rotating multiplate clutches (A, B and E) and two fixed multiplate brakes (C and D). All shifts from 1st to 6th gears are power-on overlapping shifts. Overlapping shifts can be described as one of the clutches continuing to transmit drive at a lower main pressure until the next required clutch is able to accept the input torque.

The shift elements, clutches and brakes are actuated hydraulically. Fluid pressure is applied to the required clutch and/or brake, pressing the plates together and allowing drive to be transmitted through the plates. The purpose of the shift elements is to perform power-on shifts with no interruption to traction and smooth transition between gear ratios.

Power Flow 1st Gear



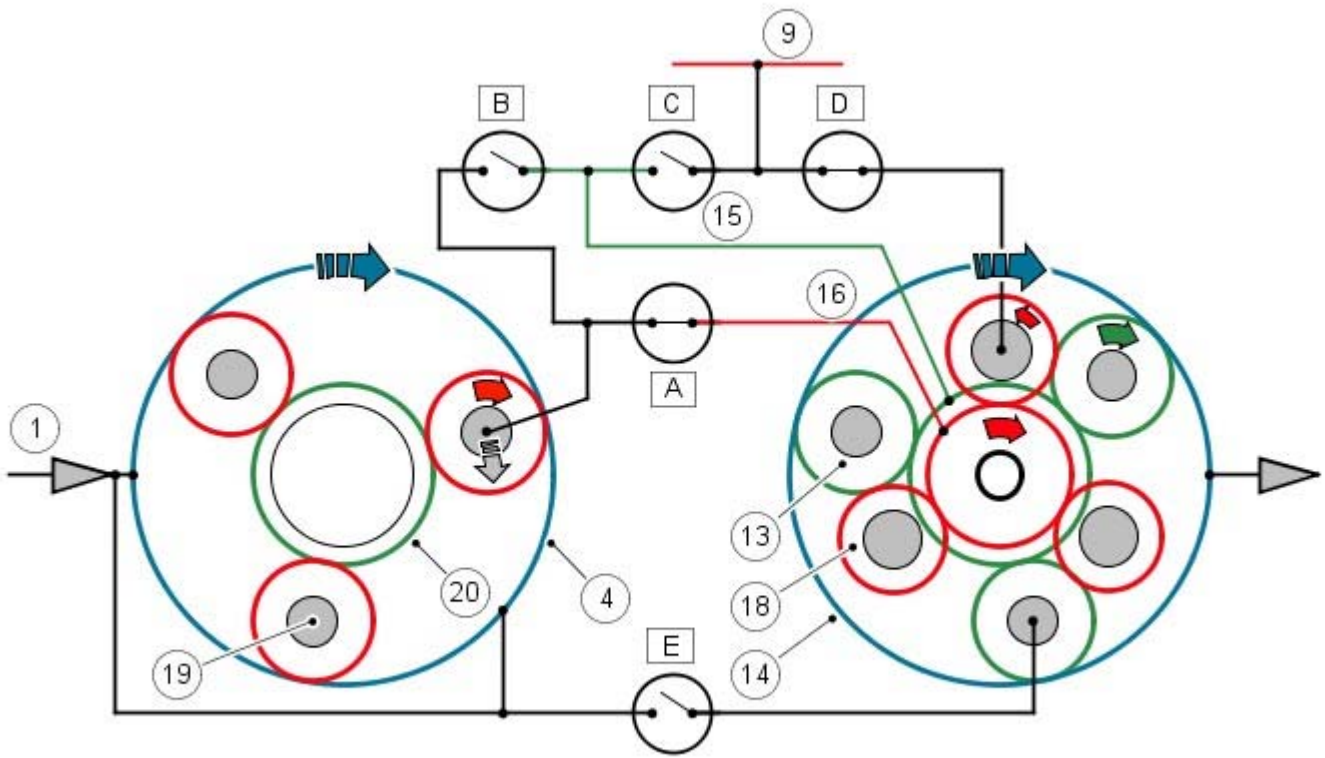
The selector lever and the selector valve spool are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

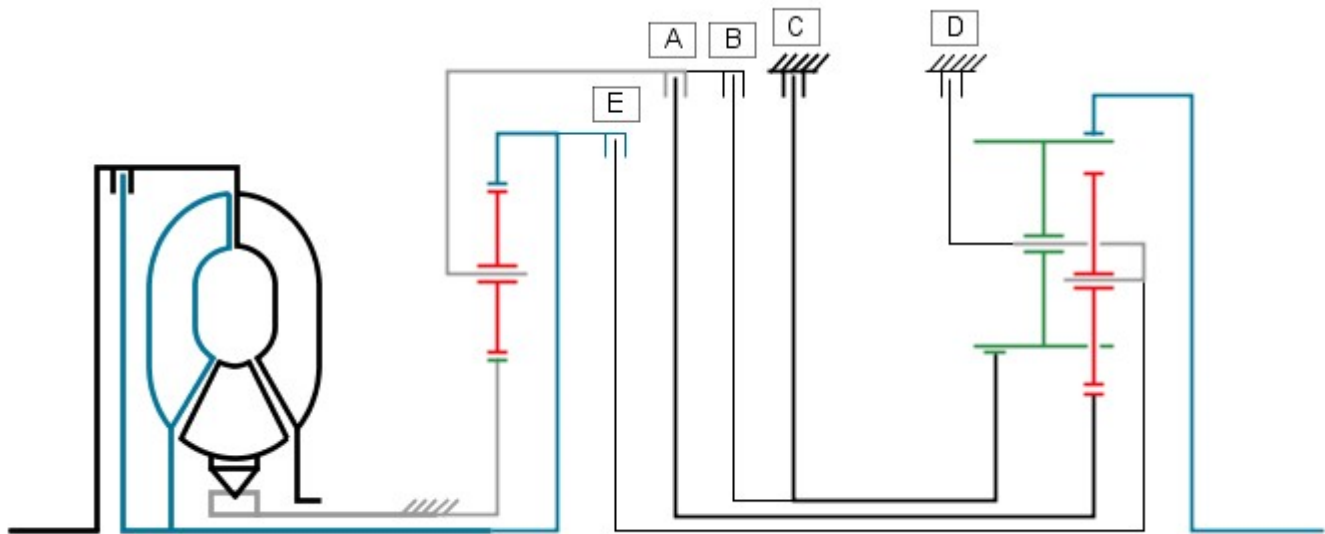
The double web planetary gear train is locked against the transmission housing by brake 'D'. This allows ring gear 2 (output shaft) to be driven in the same direction as the engine via the long planetary gears.

• NOTE: Refer to 'Shift Elements' illustration for key



E42721

Power Flow 2nd Gear



E42722

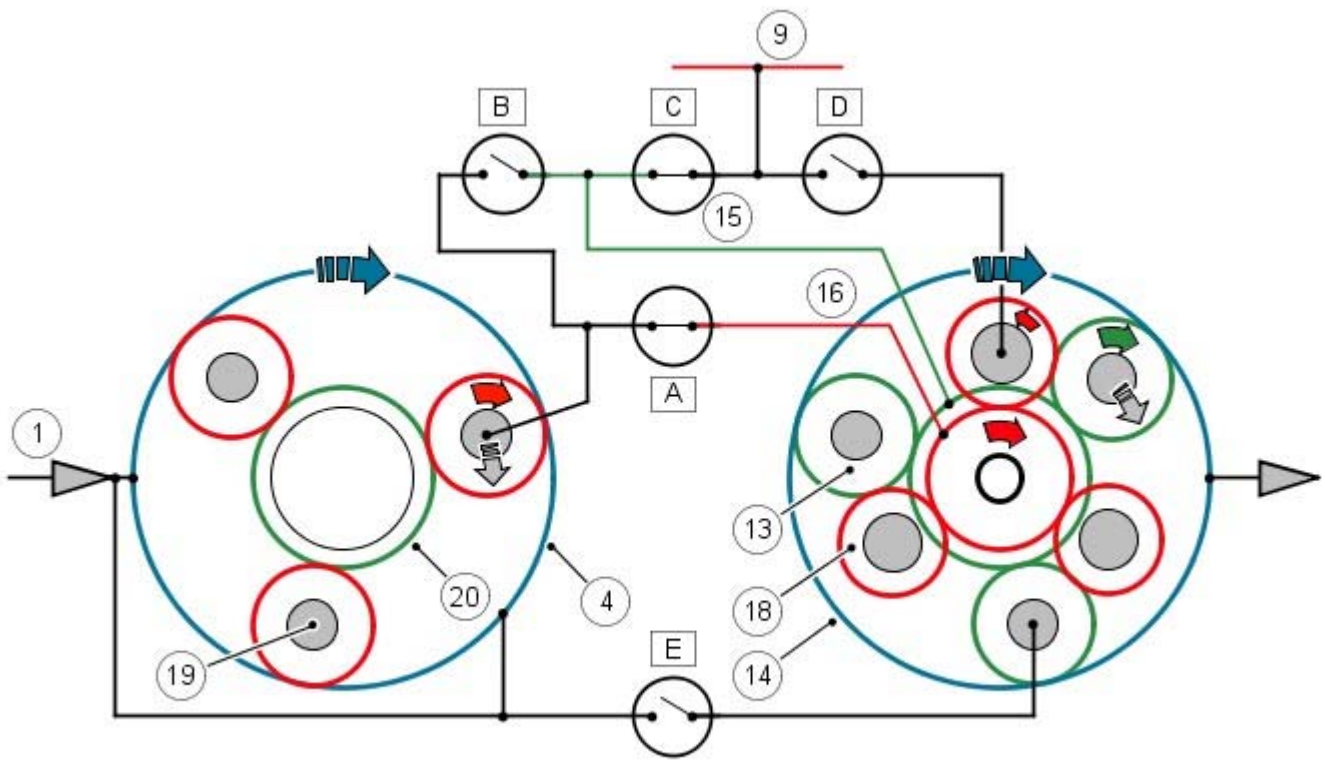
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

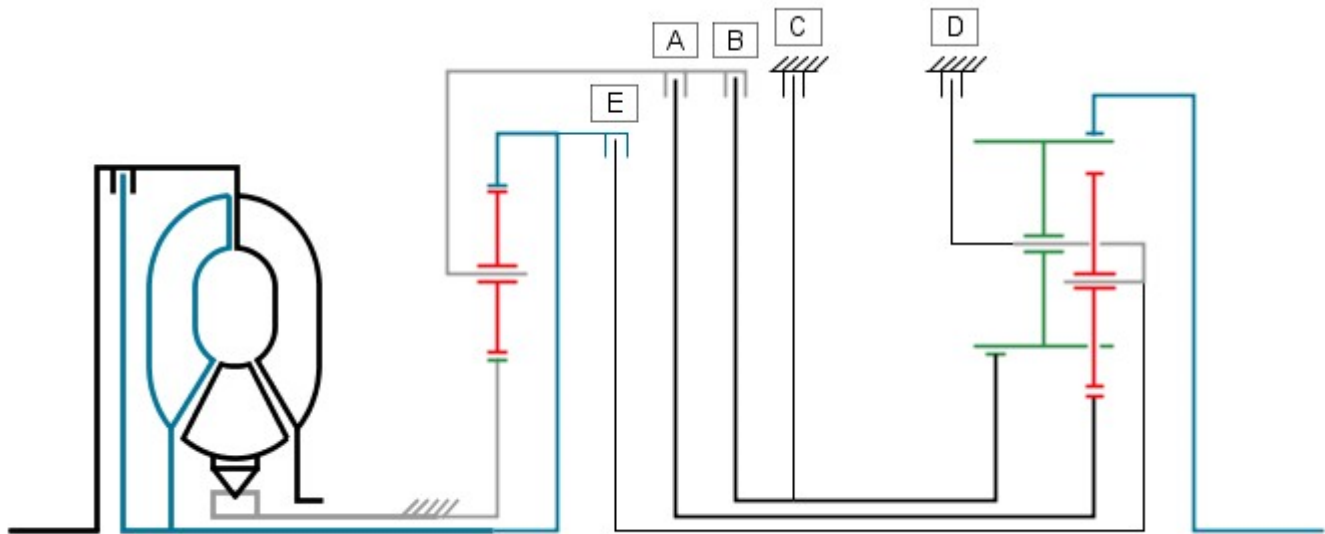
Sunwheel 2 is locked to the transmission housing by brake clutch 'C'. The long planetary gears, which are also meshed with the short planetary gears, roll around the fixed sunwheel 2 and transmit drive to the double web planetary gear train carrier and ring gear 2 in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42723

Power Flow 3rd Gear



E 42724

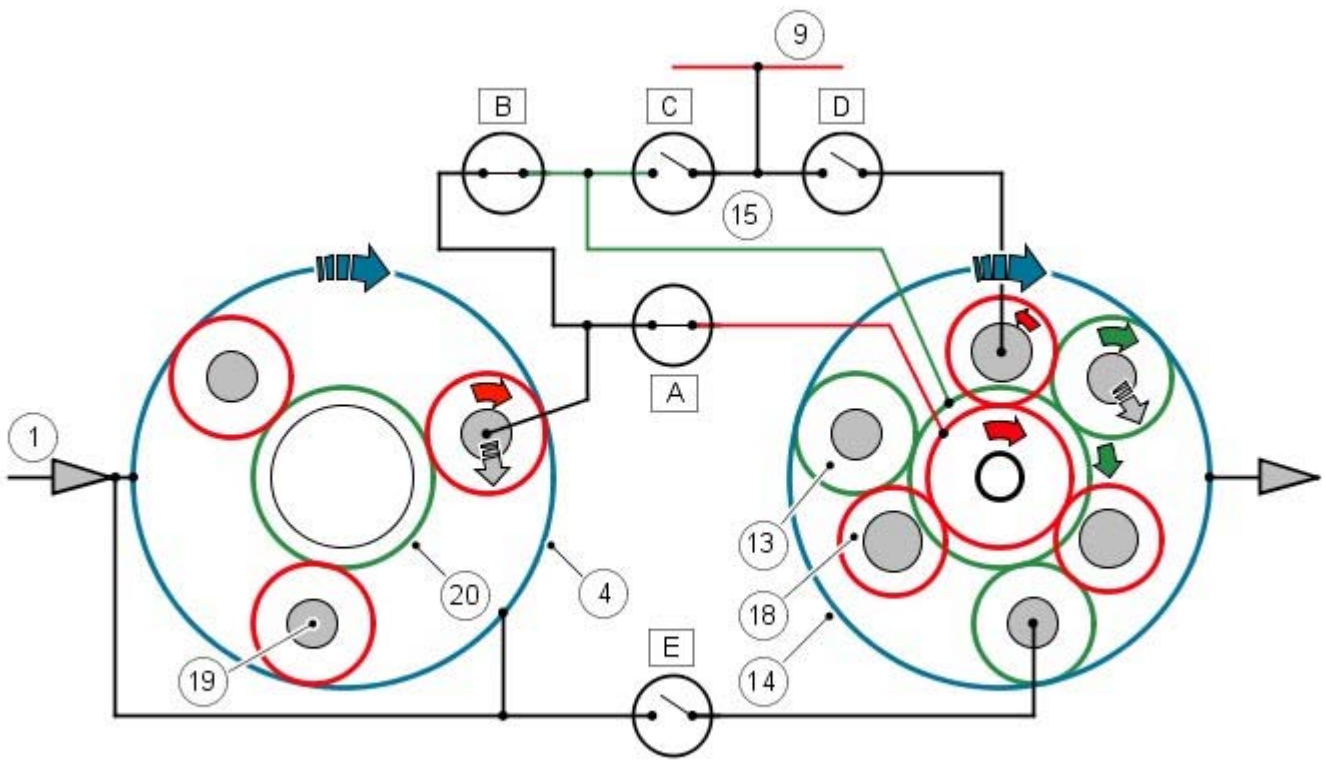
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to the ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

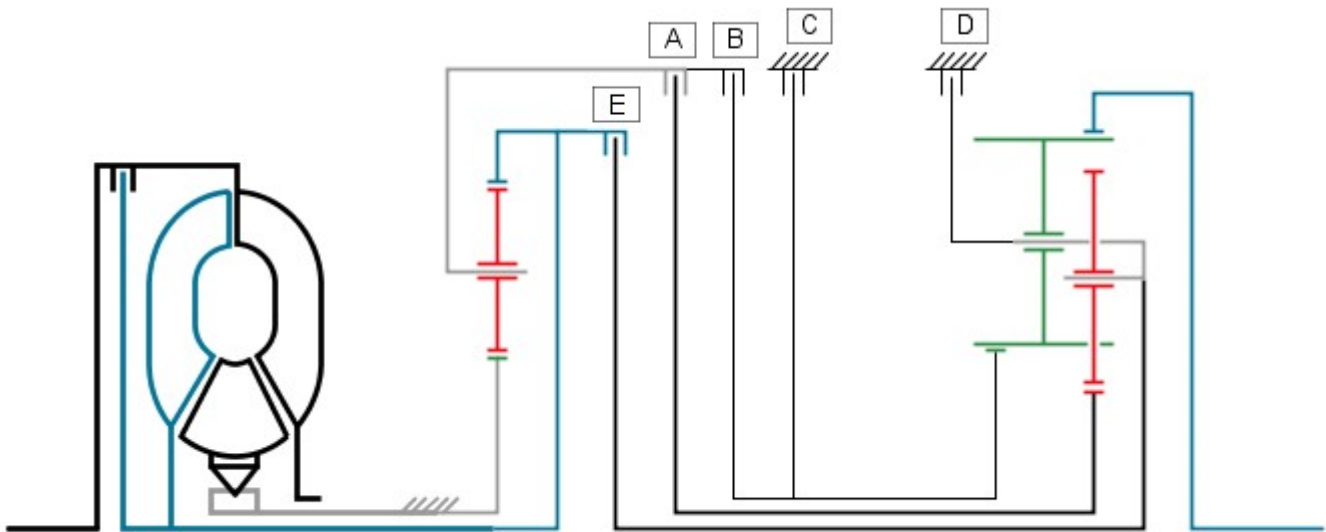
Sunwheel 2 is driven via clutch 'B' which is engaged. The long planetary gears, which are also meshed with the short planetary gears, cannot roll around the fixed sunwheel 2 and therefore transmit drive to the locked double web planetary gear train carrier in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42725

Power Flow 4th Gear



E42726

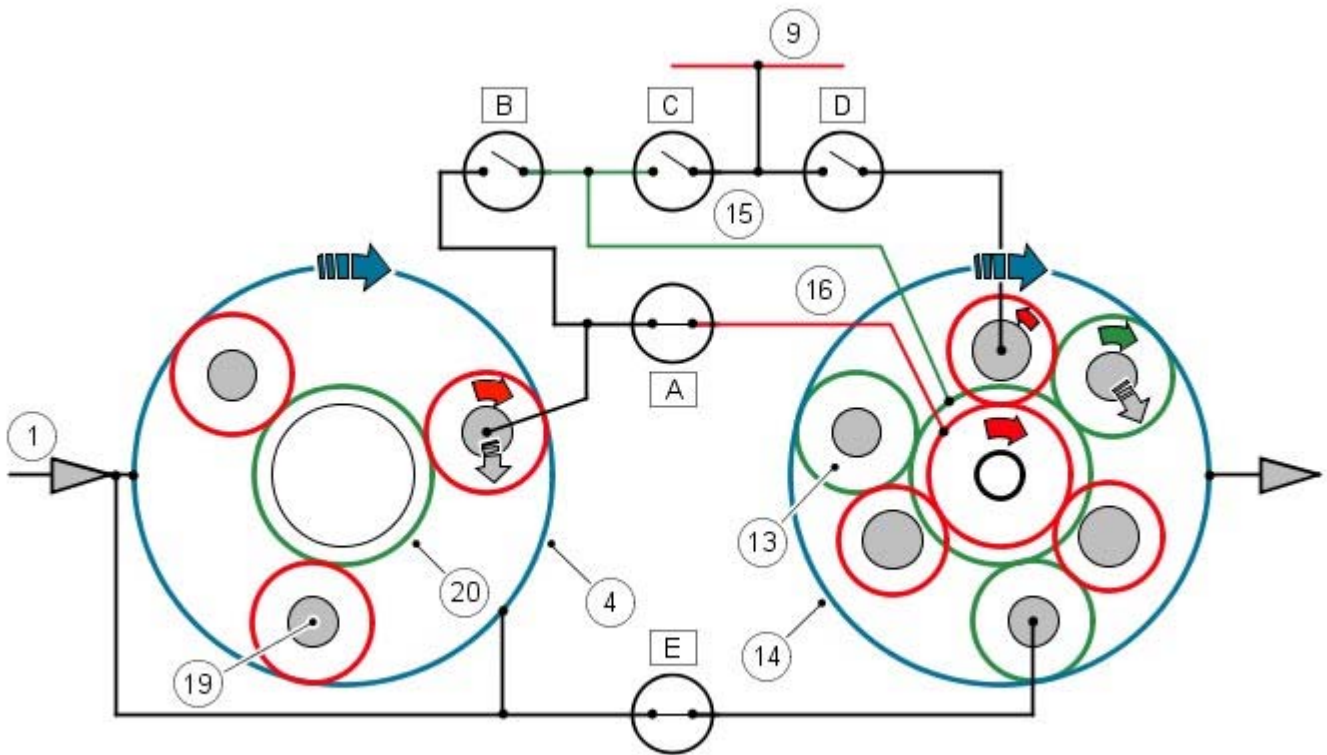
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

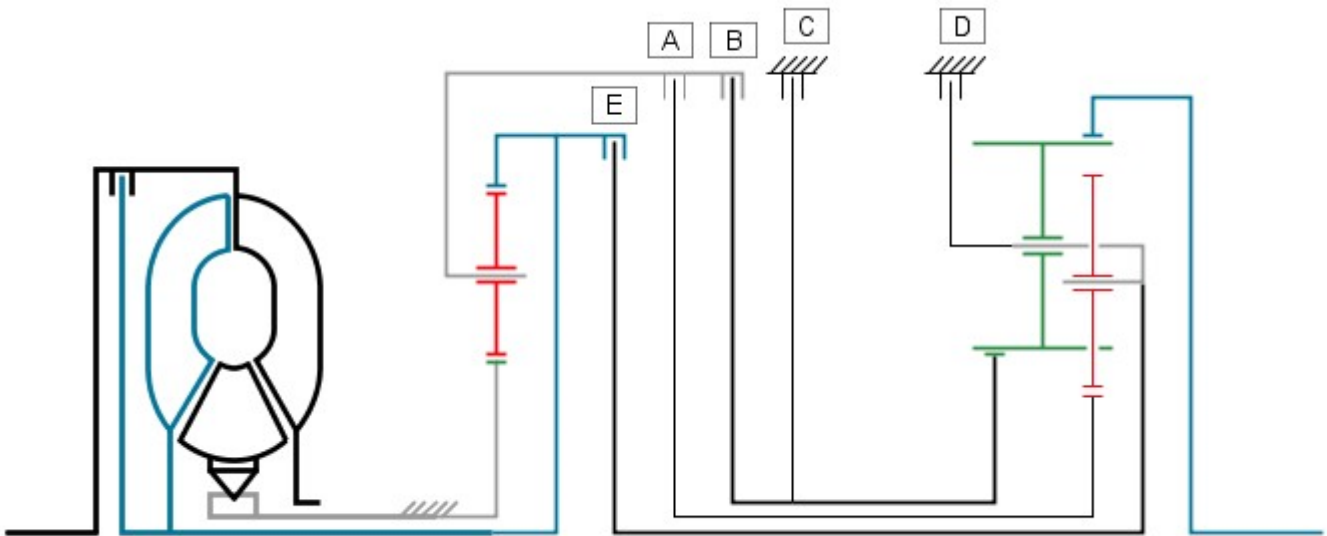
The double web planetary gear carrier is driven via clutch 'E' which is engaged. The long planetary gears, which are also meshed with the short planetary gears and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42727

Power Flow 5th Gear



E42728

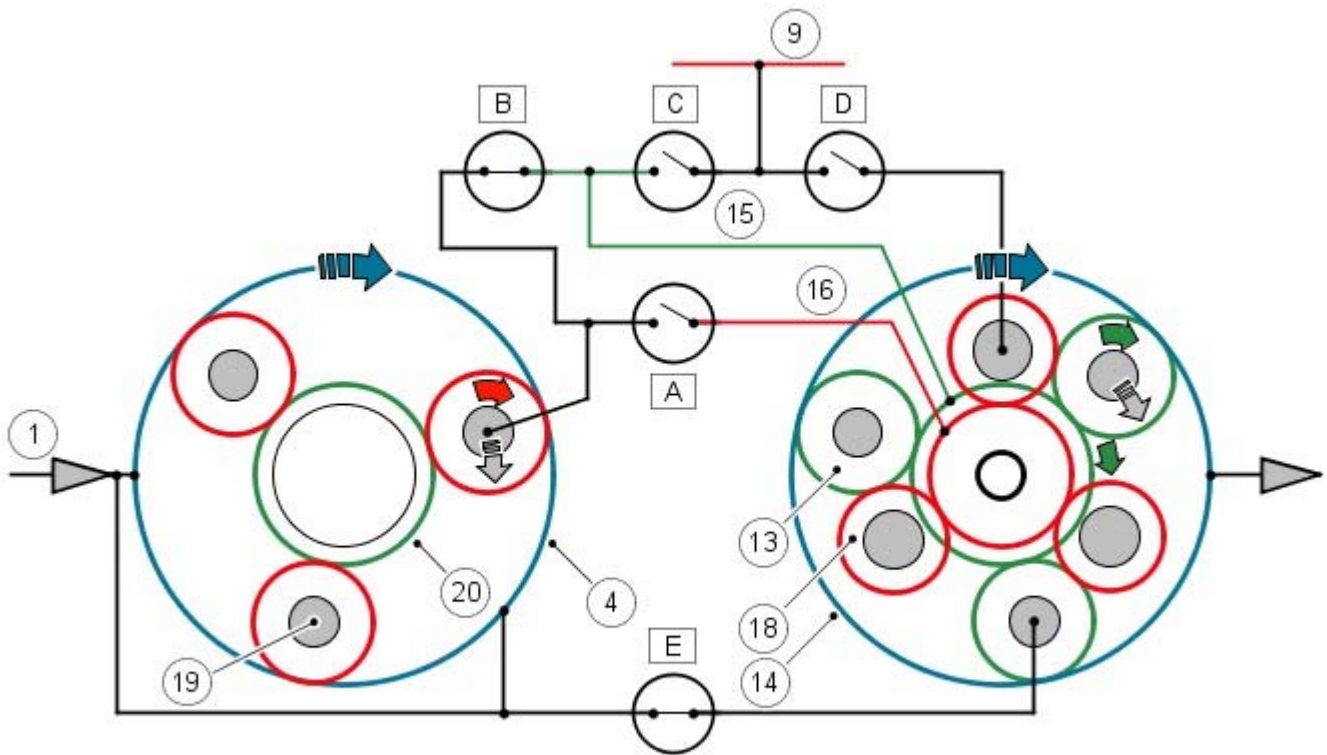
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears which rotate around sunwheel 1. This drives the planetary gear carrier 1 and also the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

When clutch 'A' is engaged, sunwheel 3 in the double web planetary gear train is driven and meshes with the short planetary gears.

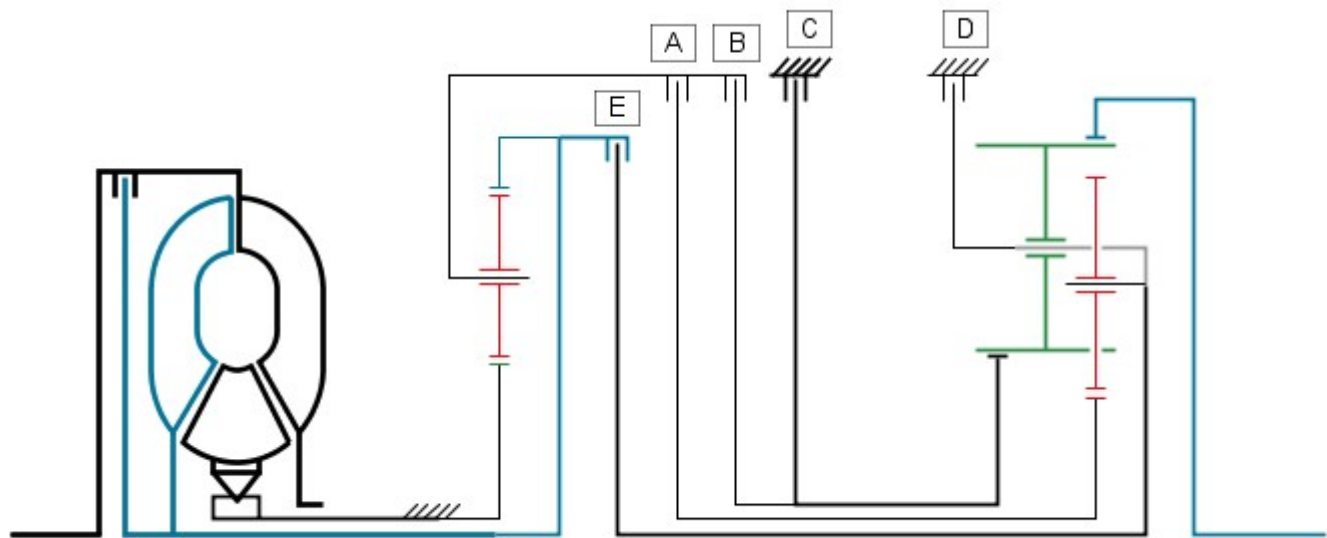
The long planetary gears, which are also meshed with the short planetary gears and the double web planetary gear carrier, drive ring gear 2 in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42729

Power Flow 6th Gear



E42730

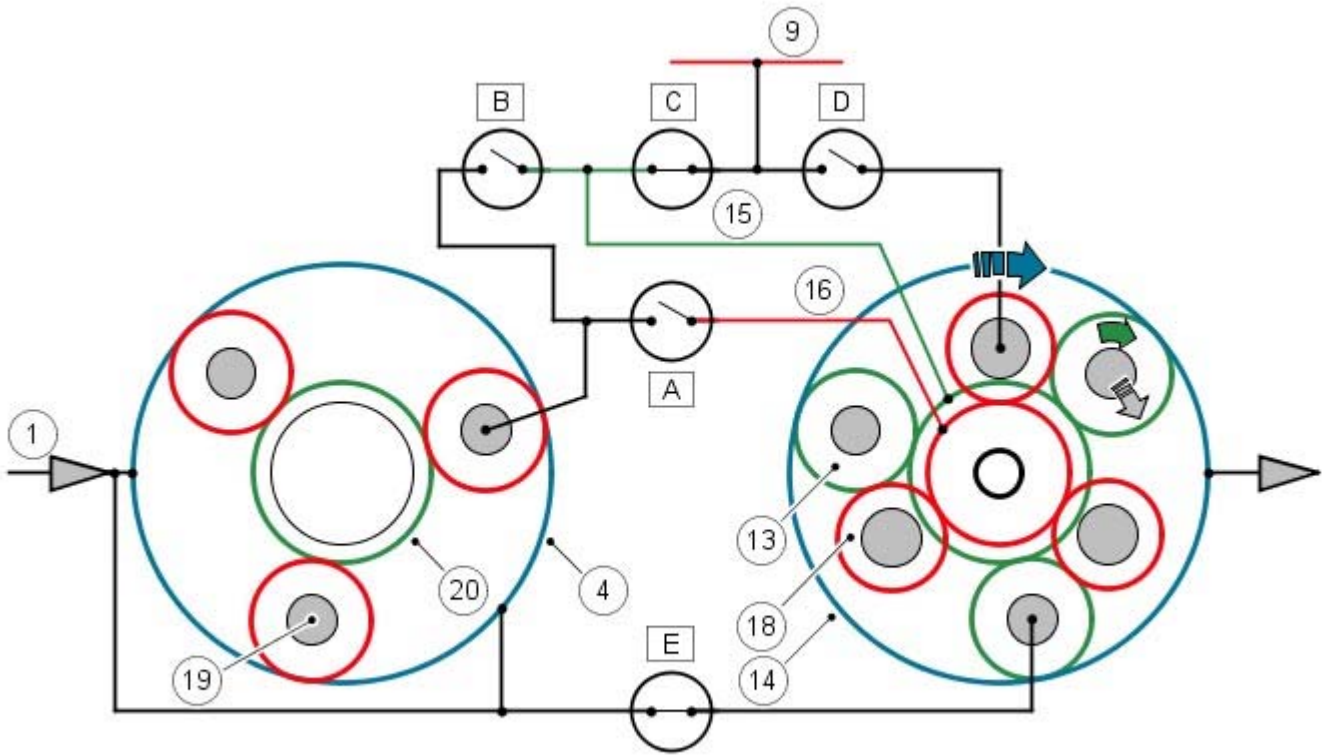
The selector lever and the selector spool valve are in the 'D' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Clutches 'A' and 'B' are released, removing the effect of the single web planetary gear train.

Clutch brake 'C' is applied which locks sunwheel 2 to the transmission housing.

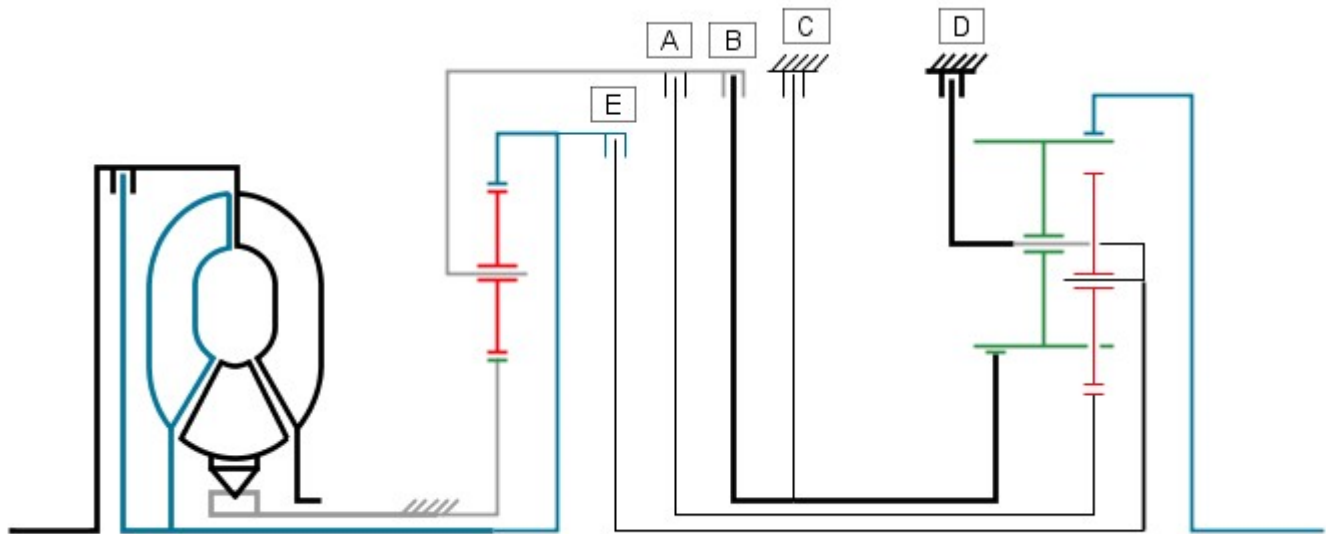
Clutch 'E' is engaged and drives the double web planetary gear carrier. This causes the long planetary gears to rotate around the fixed sunwheel 2 and transmit drive to ring gear 2 which is driven in the direction of engine rotation.

• NOTE: Refer to 'Shift Elements' illustration for key



E42731

Power Flow Reverse Gear



E42732

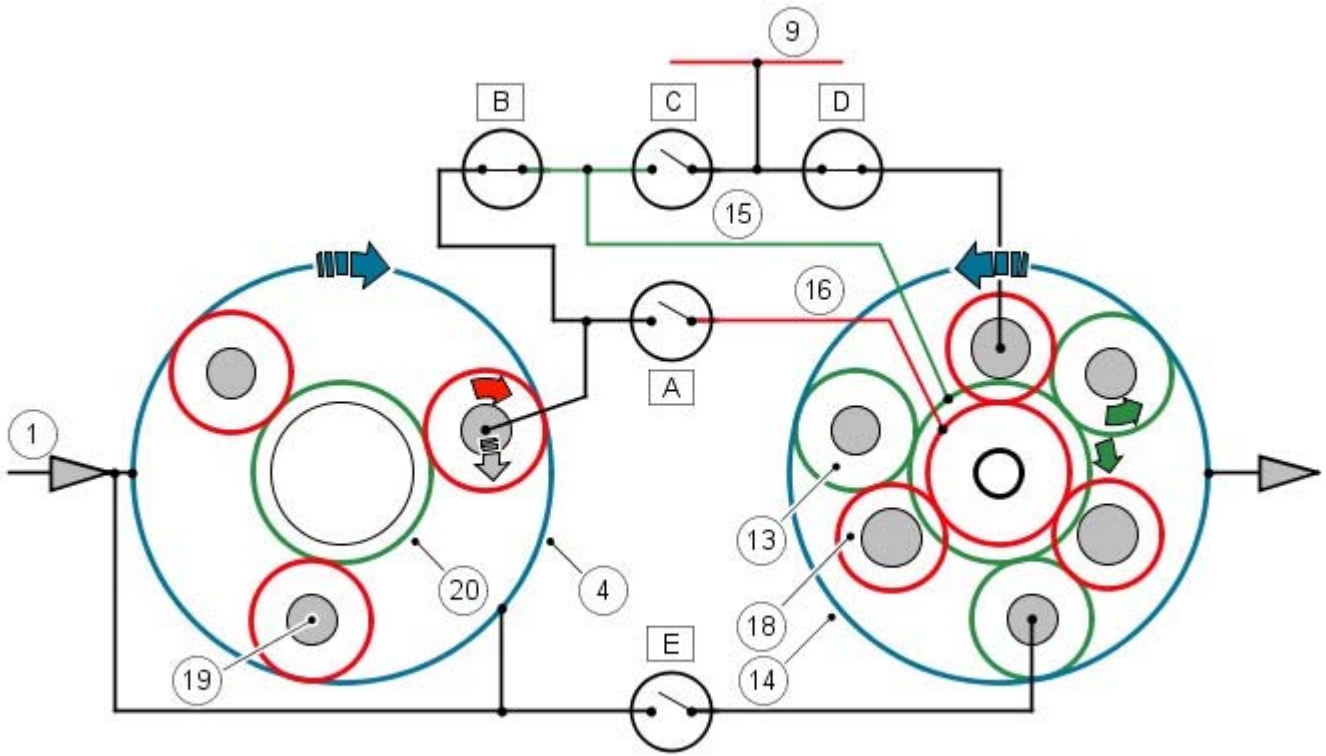
The selector lever and the selector spool valve are in the 'R' position. Engine torque is transmitted from the torque converter turbine shaft to ring gear 1 of the single web planetary gear train and the outer plate carrier of clutch 'E'.

Ring gear 1 drives the planetary gears of the single web planetary gear train which rotate around the fixed sunwheel 1. This transmits the drive to the single web planetary gear carrier, the outer plate carrier of clutch 'A' and the inner plate carrier of clutch 'B'.

With clutch 'B' applied, sunwheel 2 in the double web planetary gear train is driven and meshes with the long planetary gears.

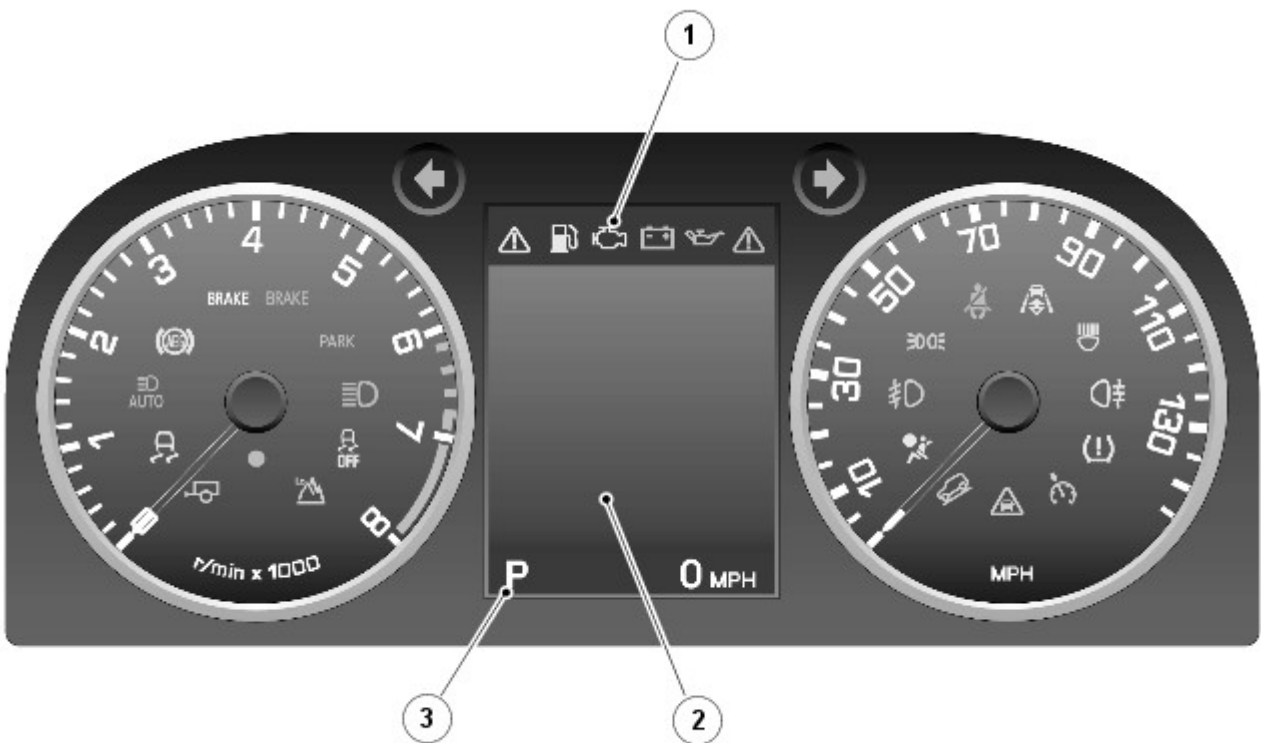
The double web planetary gear carrier is locked to the transmission housing C by brake clutch 'D'. This allows ring gear 2 to be driven in the opposite direction to engine rotation by the long planetary gears.

• NOTE: Refer to 'Shift Elements' illustration for key



E42733

Instrument Cluster



E121495

Item	Part Number	Description
1	-	MIL (malfunction indicator lamp)
2	-	Message center
3	-	Transmission status display

The instrument cluster is connected to the [TCM](#) via the high speed [CAN](#) bus. Transmission status is transmitted by the [TCM](#) and displayed to the driver in one of two displays in the instrument cluster. For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

Malfunction Indicator Lamp

The [MIL \(malfunction indicator lamp\)](#) is located in the tachometer of the instrument cluster. Transmission related faults which may affect the vehicle emissions will illuminate the [MIL](#).

The [MIL](#) is illuminated by the [ECM](#) on receipt of a relevant fault message from the [TCM](#) on the high speed [CAN](#). The nature of the fault can be diagnosed using Land Rover approved diagnostic equipment which reads the fault codes stored in the [TCM](#) memory.

Transmission Status Display

The transmission status display is located in the tachometer of the instrument cluster. The display shows the selector lever position or the selected gear when in manual and sport modes.

The following table shows the displays and their descriptions.

Symbol	Description
P	Park selected
R	Reverse selected
N	Neutral selected
D	Drive selected
s*	Sport mode selected (* = current gear)
1	1st gear selected (manual CommandShift mode)
2	2nd gear selected (manual CommandShift mode)
3	3rd gear selected (manual CommandShift mode)
4	4th gear selected (manual CommandShift mode)
5	5th gear selected (manual CommandShift mode)
6	6th gear selected (manual CommandShift mode)

Message Center

The message center is located in the center of the instrument cluster. The message center is a [LCD \(liquid crystal display\)](#) that relays vehicle status and operating information to the driver and can display messages relating to a number of vehicle systems. If a transmission fault occurs, the message GEARBOX FAULT is displayed in the message center.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Transmission Control Module

The [TCM](#) outputs signals to control the shift control solenoid valve and the EPRS to control the hydraulic operation of the transmission.

The [TCM](#) processes signals from the transmission speed and temperature sensors, the selector lever, the [ECM](#) and other vehicle systems. From the received signal inputs and pre-programmed data, the [TCM](#) calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

The [ECM](#) supplies the engine management data over the high speed [CAN](#) bus. The [TCM](#) requires engine data to efficiently control the transmission operation, for example; flywheel torque, engine speed, accelerator pedal angle, engine temperature. The steering angle sensor and the [ABS \(anti-lock brake system\)](#) module also supply data to the [TCM](#) on the high speed [CAN](#) bus. The [TCM](#) uses data from these systems to suspend gear changes when the vehicle is cornering and/or the [ABS](#) module is controlling braking or traction control.

Using the signal inputs and the memorized data, the [TCM](#) control program computes the correct gear and torque converter lock-up clutch setting and the optimum pressure settings for gear shift and lock-up clutch control. Special output-side modules (power output stages, current regulator circuits), allow the [TCM](#) to control the solenoid valves and pressure regulators and consequently precisely control the hydraulics of the automatic transmission. In addition, the amount and duration of engine interventions are supplied to the engine management by way of the [CAN](#) bus.

The [TCM](#) determines the position of the selector lever using signals from:

- The selector switch in the transmission.
- The park lock and M/S (manual/sport) 'CommandShift' switches on the selector lever.

When the driver operates the steering wheel paddle switches the selections are sensed by the [TCM](#), which then operates in the manual CommandShift mode. If the selector lever is in D, the CommandShift mode is temporary and will cancel after a time period or can be cancelled by pressing and holding the + paddle for approximately 2 seconds. If the selector lever is in the M/S position, the CommandShift mode is permanent and can only be cancelled by pressing and holding the + paddle for approximately 2 seconds or by moving the selector lever to the D position.

The [TCM](#) transmits the position of the selector lever and the selected gear on the high speed [CAN](#) bus. This information is shown in the gear selector display in the instrument cluster.

Engine Stall

If the vehicle stalls it will coast down in gear, with the transmission providing drive to the engine. A restart can be attempted at this point and the engine may start and the driver can continue.

If the coast down speed reduces such that the speed of the engine is less than 600 rev/min, the transmission will go to neutral, D illumination will flash in the instrument cluster. The driver needs to select neutral or park and then press the brake pedal to restart the engine.

If the start/stop button is pressed when driving, the message ENGINE STOP BUTTON PRESSED is displayed in the message center but there will be no change to the ignition state. If the driver requires to switch off the engine, the start/stop button must be pressed for a second time. The engine will be stopped and will be back driven by the transmission as the vehicle coasts down.

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Diagnostics

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission/transaxle system and operation, refer to the relevant Description and Operation sections in the workshop manual.

Fluid Level and Condition Check



CAUTION: The vehicle should not be driven if the fluid level is low as internal failure can result.

• **NOTE:** The transmission fluid temperature must not be allowed to exceed 50°C (122°F) whilst checking level. Should the temperature rise above this figure, abort the check and allow the transmission fluid to cool to below 30°C (86°F).

This vehicle is not equipped with a fluid level indicator. An incorrect level may affect the transmission operation and could result in transmission damage. To correctly check and add fluid to the transmission. Refer to the relevant section in the workshop manual.

High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission damage. If an overfill condition is identified, with the engine at idle ensure the fluid temperature is within the specified range and allow the excess fluid to drain until a small thread of fluid runs from the filler/level plug hole.

Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, or damage. This could also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid



CAUTION: The use of any other type of transmission fluid other than that specified can result in transmission damage.

If fluid needs to be added, add fluid in 0.50 liter increments through the fill hole opening. Do not overfill the fluid. For fluid type, refer to the Specification section in the workshop manual.

Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor of the fluid. The color under normal circumstances should be like honey, not dark brown or black.
3. Allow the fluid to drip onto a facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.

NOTE: In the event of a transmission unit replacement for internal failure, the oil cooler and pipes must also be replaced.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

1. Verify the customer concern.
2. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical	Electrical	Hydraulic
<ul style="list-style-type: none"> ● Damaged/stuck shift mechanism ● Damaged automatic transmission casing 	<ul style="list-style-type: none"> ● Blown fuse(s) ● Damaged, loose or corroded connectors ● Wiring harness 	<ul style="list-style-type: none"> ● Fluid level too high/low ● Poor condition of fluid ● Fluid leak

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

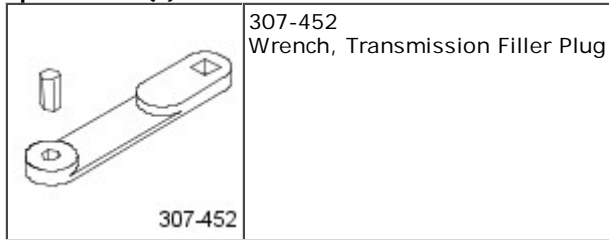
DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transmission Control Module \(TCM\) - Siemens](#) (100-00 General Information, Description and Operation).

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Fluid Level Check

General Procedures

Special Tool(s)



Check

• WARNINGS:




Observe due care when draining, as the fluid can be very hot.



Observe due care when working near a hot exhaust system.

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1.
 - The following steps must be observed before starting the transmission fluid level check.
 - The vehicle must be on a horizontal ramp.
 - The parking brake must be applied.
 - The engine must be running for 2 minutes with the transmission control switch (TCS) in the "P" position.

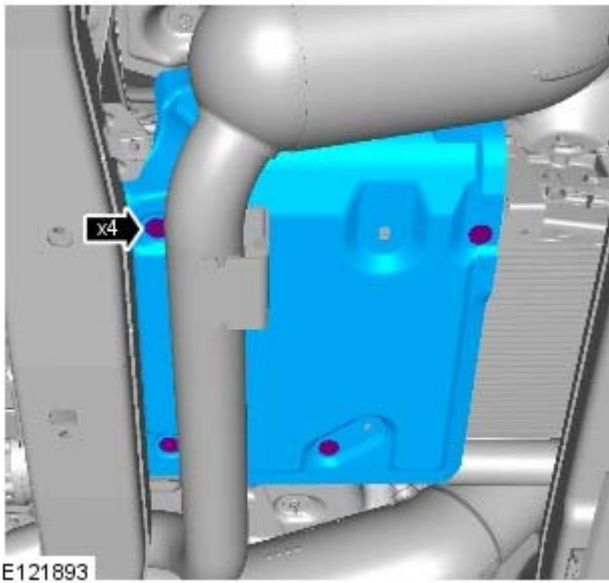
2.  **CAUTION:** Make sure that the transmission fluid temperature is below 30 degrees before starting the fluid level check.

Connect the diagnostic tool to the vehicle.

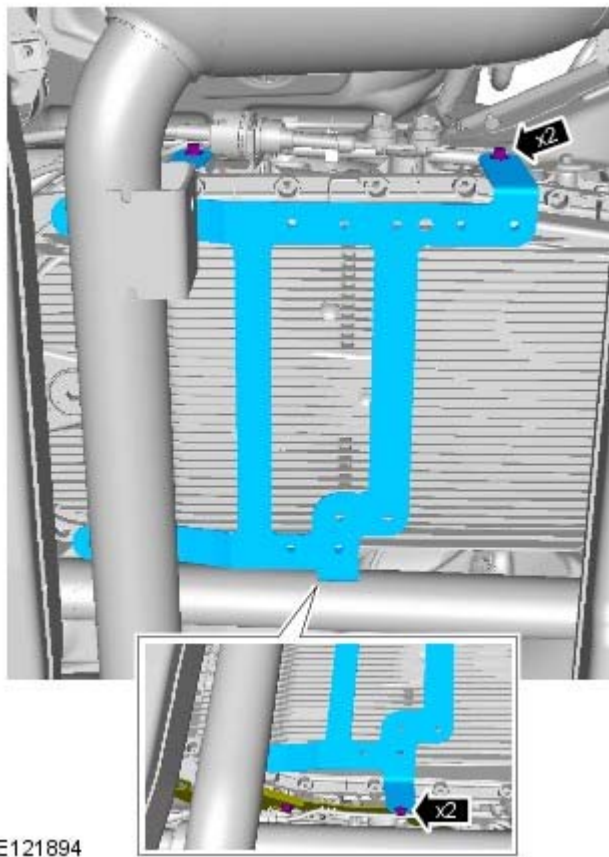
3.
 - Start the engine.
 - Apply, and hold, the footbrake.
 - Move the selector lever from 'P' through all gear positions, pausing in each gear position for 2-3 seconds and return to the 'P' position.

4.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

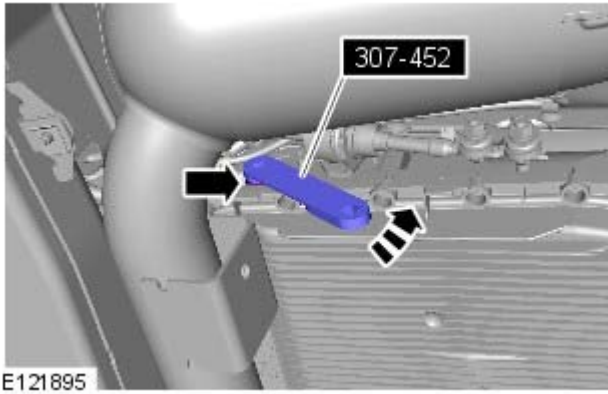


5. Torque: 9 Nm





6. Torque: 9 Nm

7. Place a suitable container under the transmission fluid fill plug.




8. **8. WARNINGS:**

 Observe due care when draining, as the fluid can be very hot.

 Observe due care when working near a hot exhaust system.

• **CAUTIONS:**

 The transmission fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.

 Discard the seal.

- *Special Tool(s):* [307-452](#)
- Clean the area around the transmission fluid level plug.

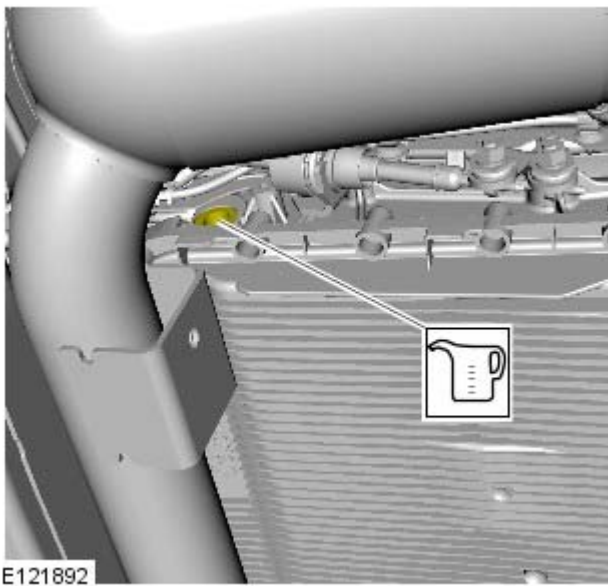
Adjustment

• **WARNINGS:**

 Observe due care when draining, as the fluid can be very hot.

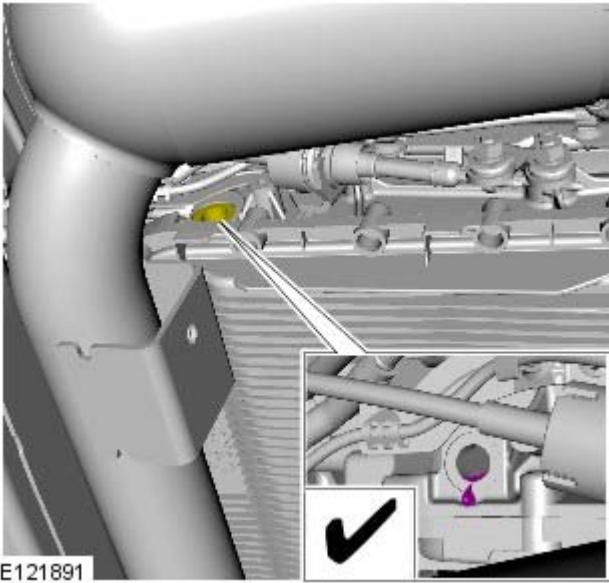
 Observe due care when working near a hot exhaust system.

• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



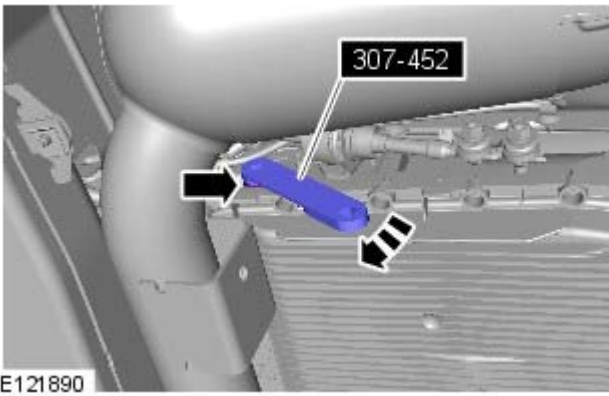
1. **9. NOTE:** Use transmission fluid meeting Land Rover specification.

If the transmission fluid does not come out of the transmission fluid fill plug hole the transmission fluid level is insufficient. If this is the case add the transmission fluid in 0.5 liter units into the transmission fluid fill plug hole until fluid comes out.



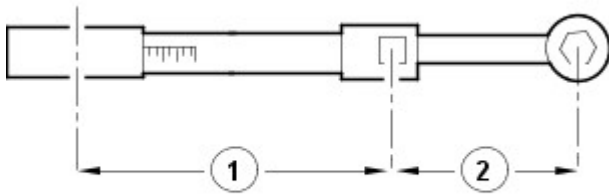
2. **10.** NOTE: Make sure the transmission fluid temperature does not exceed 50 °C (122 °F). If the transmission fluid temperature does exceed 50 °C (122 °F) stop the transmission fluid level check and allow the transmission fluid to cool until the temperature is below 30 °C (86 °F).

Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.




3. **11.** NOTE: Install a new sealing washer.

Using the special tool, install the new transmission fluid fill plug.



E37107

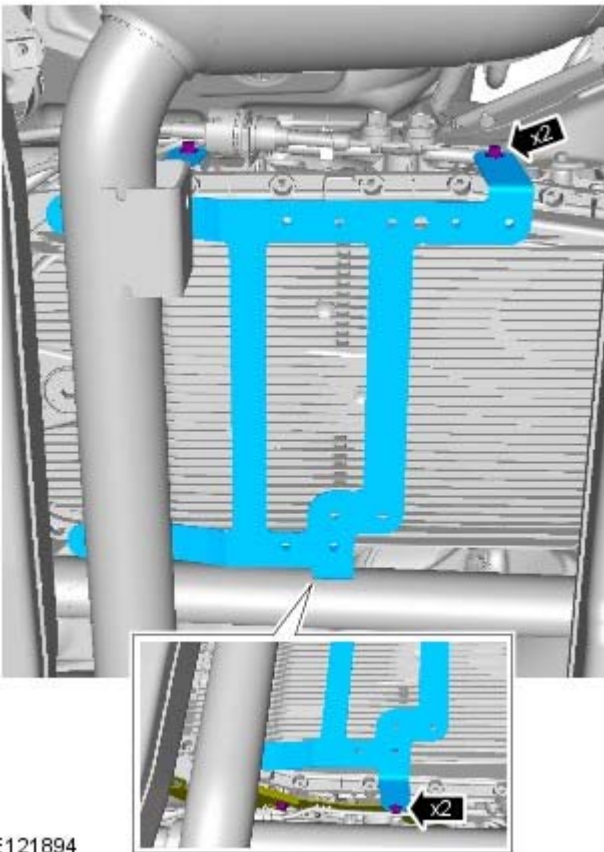
4. **12.**  CAUTION: Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.

- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (2) to the effective length of the torque wrench (1).
- Step 3. Divide the total of step 1 by the total of step 2.
- Step 4. Set the torque wrench to the figure arrived at in step 3.
- Tighten the transmission fluid fill plug to the torque given by the calculation.

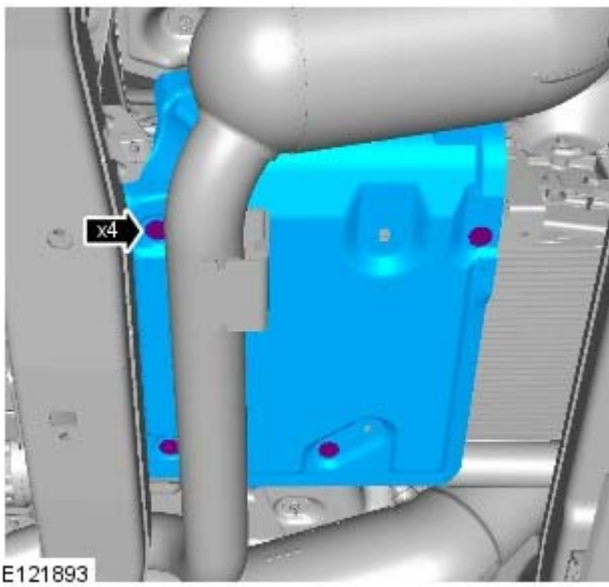
5. Remove the special tool.

6. Remove the container.

7. Torque: 9 Nm



8. Torque: 9 Nm



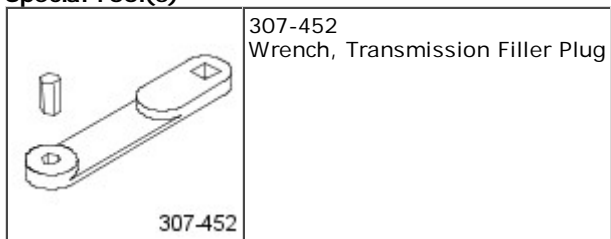
9. Lower the vehicle.

10. Disconnect the diagnostic tool from the vehicle.

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Fluid Drain and Refill

General Procedures

Special Tool(s)



Drain

- WARNINGS:

 Observe due care when draining, as the fluid can be very hot.

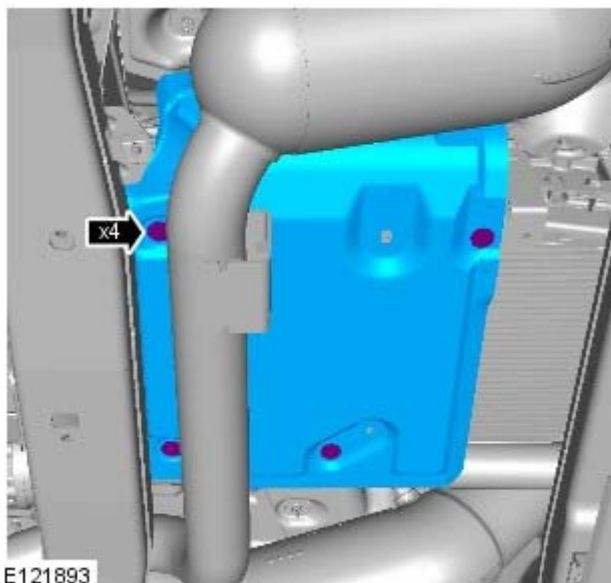
 Observe due care when working near a hot exhaust system.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

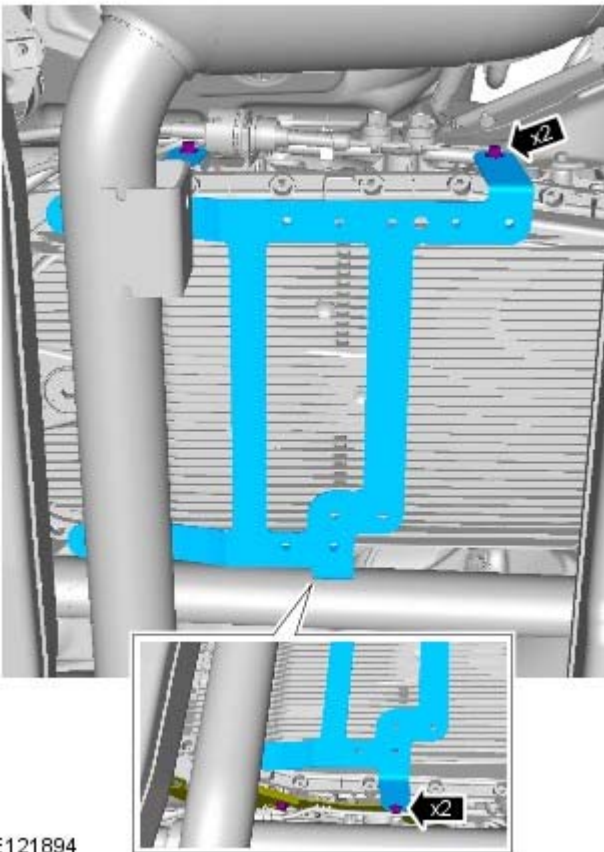
1.  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. *Torque: 9 Nm*

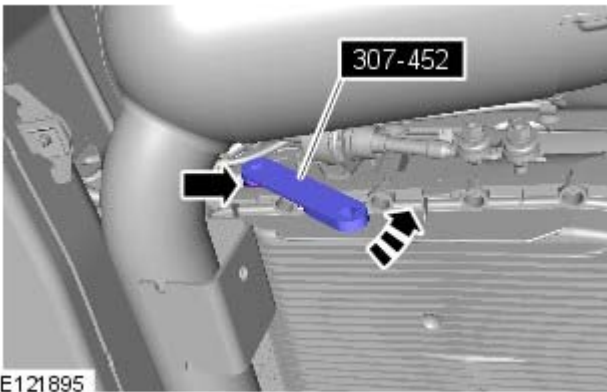


3. Torque: 9 Nm



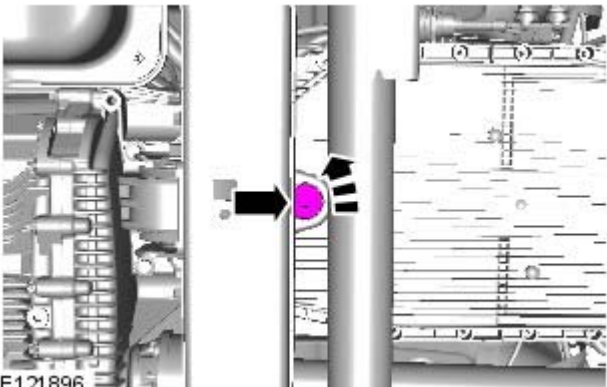
E121894

4. Place a container under the transmission.



E121895

5. Special Tool(s): [307-452](#)

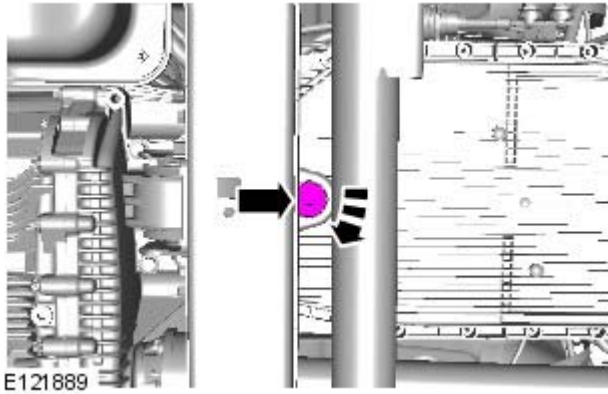


E121896

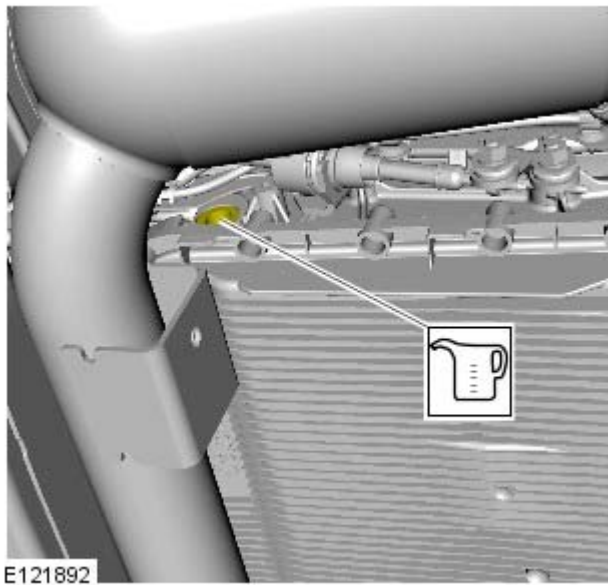
6.

- Allow the fluid to drain.
- Discard the component.

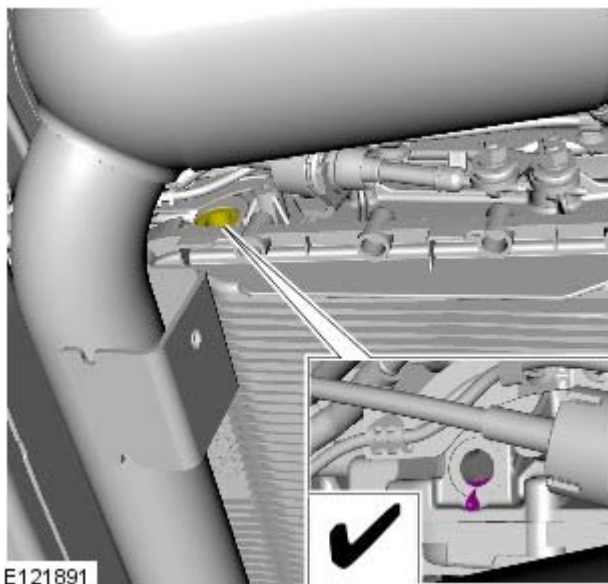
Filling



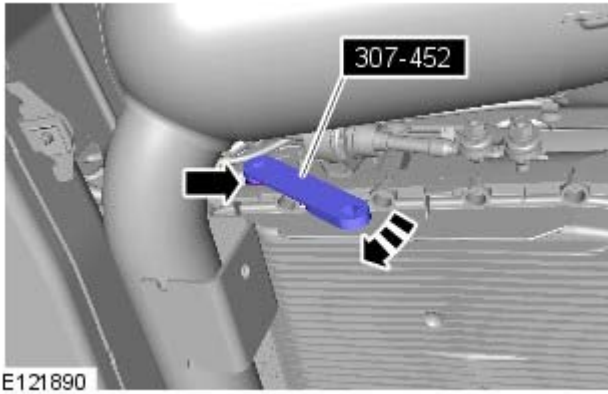
1. Torque: 8 Nm



- 2.
- Refill the transmission with fluid.
 - Use transmission fluid meeting Land Rover specification.

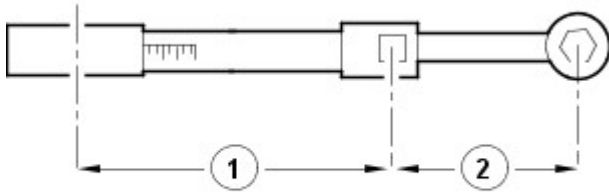


3. Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.



4. **4. NOTE:** Install a new sealing washer.

- Loosely install the transmission fluid fill plug.



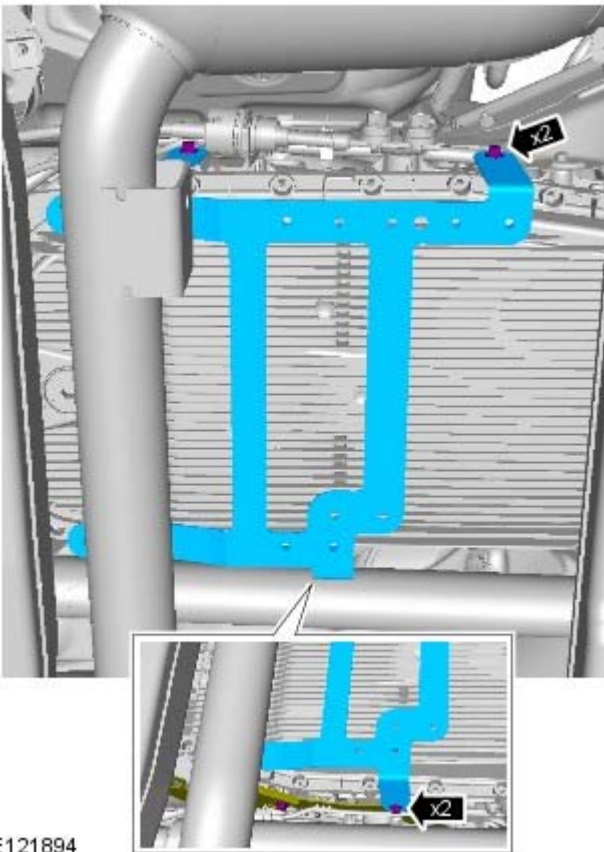
5. **5. ⚠ CAUTION:** Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.

- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (2) to the effective length of the torque wrench (1).
- Step 3. Divide the total of step 1 by the total of step 2.
- Step 4. Set the torque wrench to the figure arrived at in step 3.
- Tighten the transmission fluid fill plug to the torque given by the calculation.

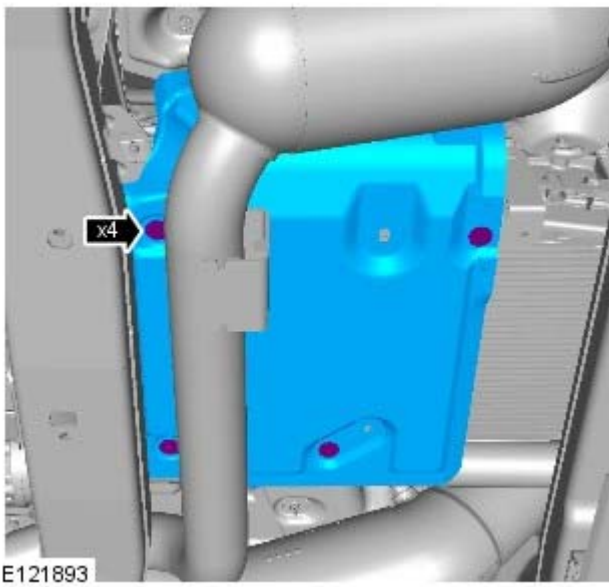
6. Carry out a transmission fluid level check.

Refer to: [Transmission Fluid Level Check](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).

7. Torque: 9 Nm



8. Torque: 9 Nm


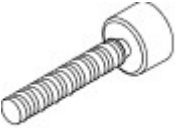

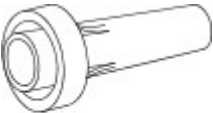



9. Lower the vehicle.

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Input Shaft Seal

Removal and Installation

Special Tool(s)

 <p>100-012</p> <p>E54135</p>	<p>100-012 Slide Hammer</p>
 <p>100-012-01</p>	<p>100-012-01 Slide Hammer Adaptor</p>
 <p>307-613</p> <p>E84067</p>	<p>307-613 Holding Pins, Torque Converter</p>
 <p>308246</p>	<p>308-246 Front Seal Installer</p>
 <p>308-375</p>	<p>308-375 Seal Remover Input and Output</p>

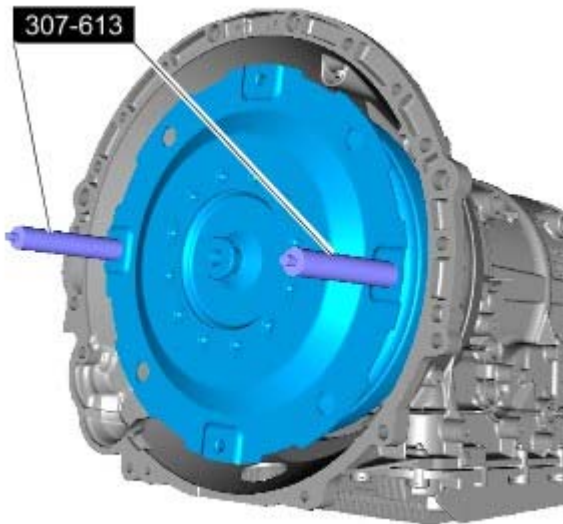
Removal

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Transmission - TDV6 3.0L Diesel](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal). Refer to: [Transmission - V8 5.0L Petrol](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal).

3. *Special Tool(s):* [307-613](#)



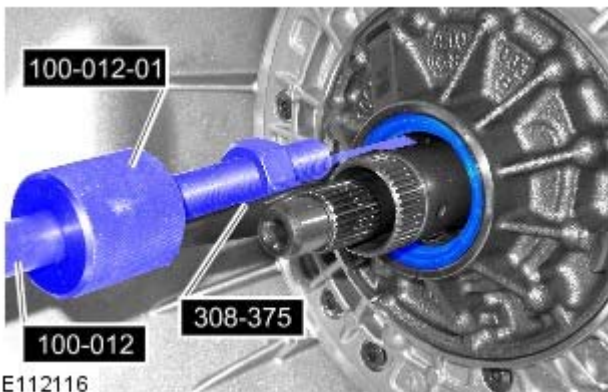
E112115

4. **4. CAUTIONS:**

 Take extra care not to damage the edges of the component.

 Discard the seal.

Special Tool(s): [100-012](#), [100-012-01](#), [308-375](#)



E112116

Installation



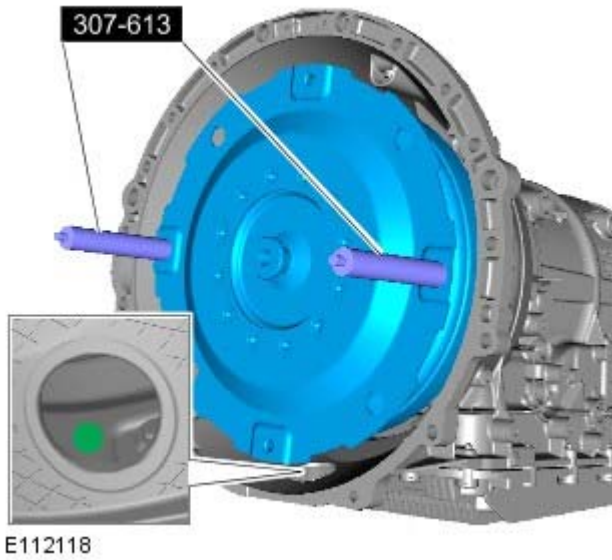
E112117

1. **1.**  **CAUTION:** Install a new seal.

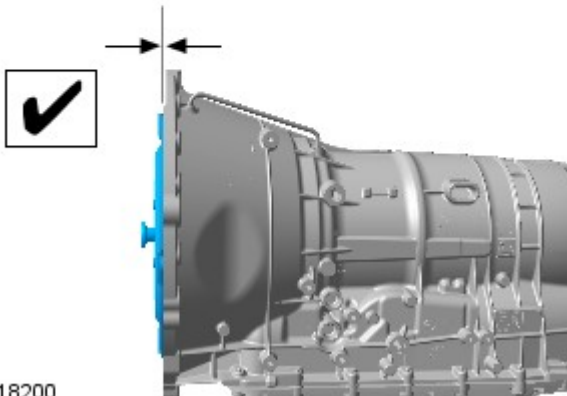
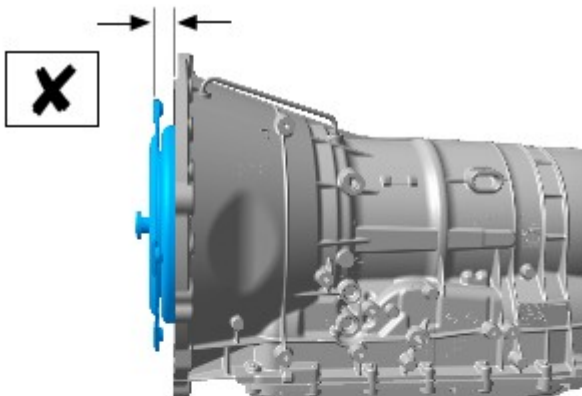
Special Tool(s): [308-246](#)

2. **NOTE:** Make sure that the alignment mark is visible through the inspection hole as illustrated.

Special Tool(s): [307-613](#)



3. **CAUTION:** Make sure the torque converter is fully located into the oil pump drive.


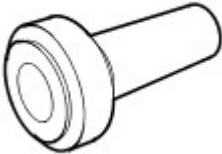


4. Refer to: [Transmission - V8 5.0L Petrol](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Installation).
Refer to: [Transmission - TDV6 3.0L Diesel](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Installation).

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Extension Housing Seal

Removal and Installation

Special Tool(s)

 <p>303-903 E50940</p>	<p>303-903 Remover, Input Shaft Seal</p>
 <p>307-520 E52536</p>	<p>307-520 Installer, Output Shaft Seal</p>

Removal

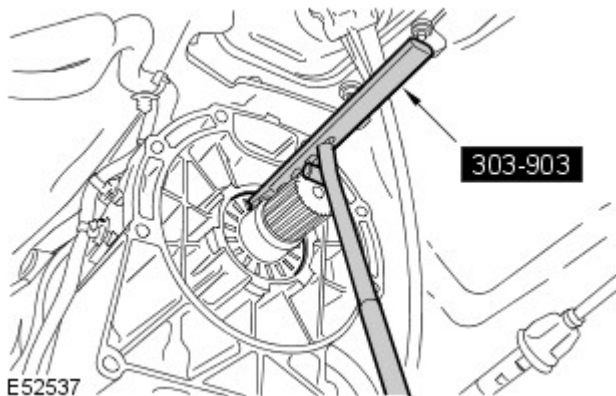
1.  **WARNING:** Make sure to support the vehicle with axle stands.


Raise and support the vehicle.

2. Remove the transfer case.

Refer to: [Transfer Case - V8 5.0L Petrol](#) (308-07B Transfer Case, Removal).

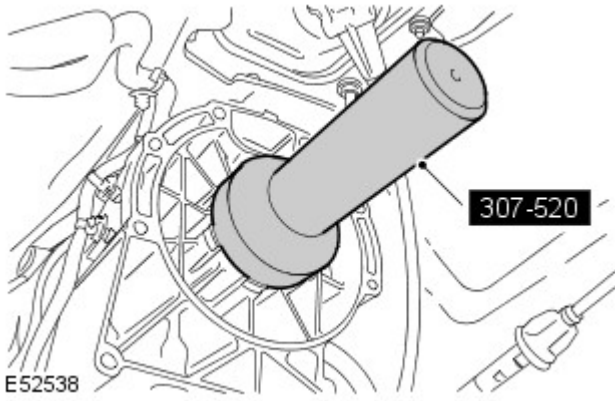
Refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).



3.  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.

- Remove the transmission output shaft oil seal.
- Use the special tool.
- *Special Tool(s):* [303-903](#)

Installation



1. **1. CAUTIONS:**



Oil seals must be fitted dry.



Make sure that the mating faces are clean and free of foreign material.

- Install a new transmission output shaft oil seal.
- Clean the seal register.
- Use the special tool.
- *Special Tool(s):* [307-520](#)

2. Install the transfer case.

Refer to: [Transfer Case - V8 5.0L Petrol](#) (308-07B Transfer Case, Removal).

Refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

3. Check and top-up the transmission fluid level.

Refer to: [Transmission Fluid Level Check](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Control Module (TCM) and Main Control Valve Body

Removal and Installation

Removal

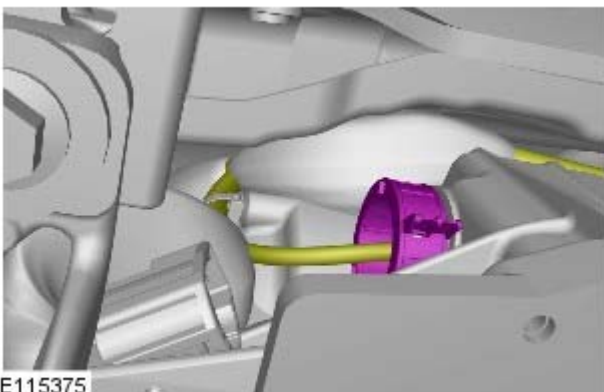
- NOTE: The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

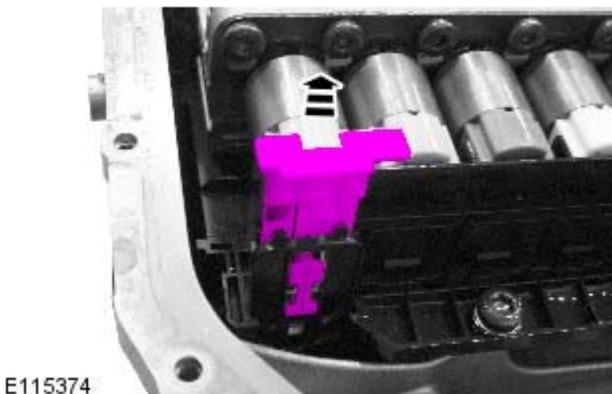
Raise and support the vehicle.

2. Refer to: [Transmission Fluid Pan, Gasket and Filter](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal and Installation).

3.

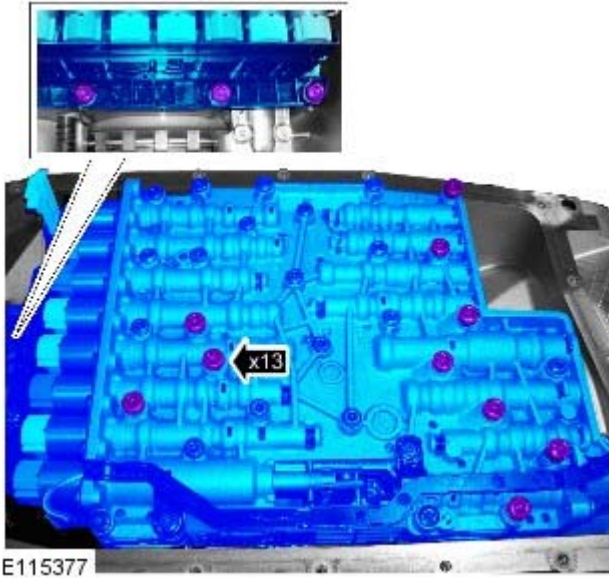



4.

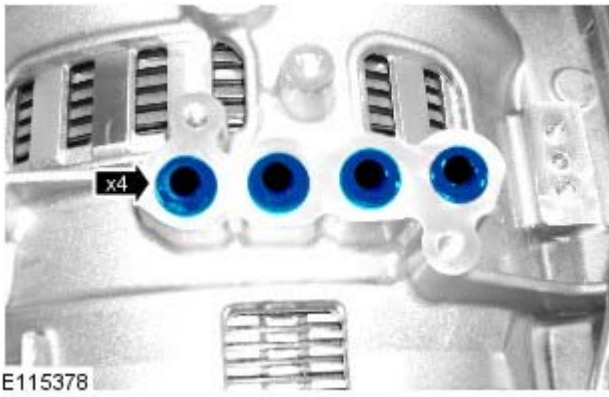


5.  **CAUTION:** Discard the component.





6.  CAUTION: Be prepared to collect escaping fluids.
- NOTE: Note the position of the manual park brake release.



7.





8.

Installation




1. 1. CAUTIONS:


 Make sure that when fully fitted, all seals protrude by the same amount.

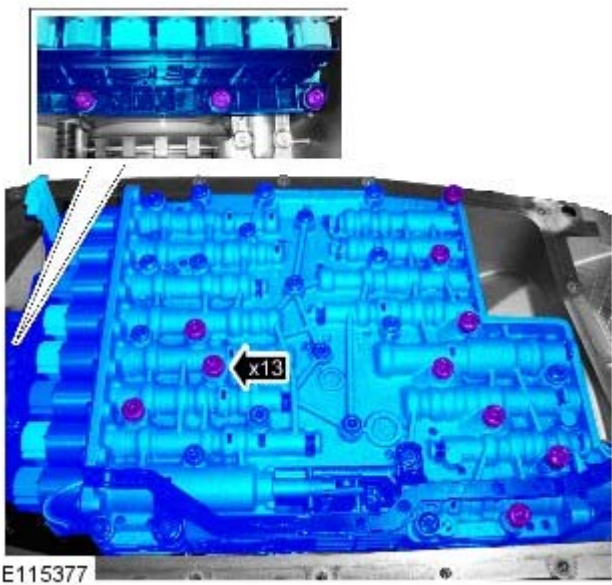
-  Install the new seals.
- Install a new seal block.



2. 2. CAUTIONS:

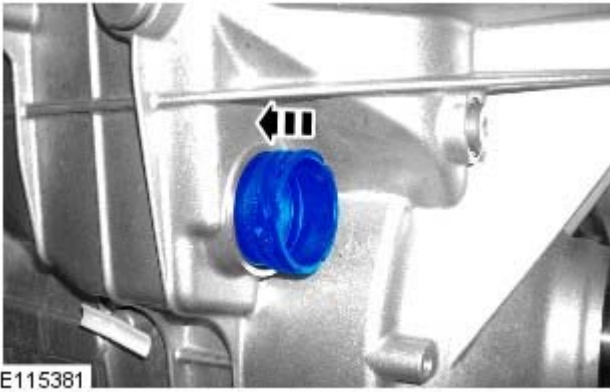
 Install the new seals.

 Make sure that when fully fitted, all seals protrude by the same amount.

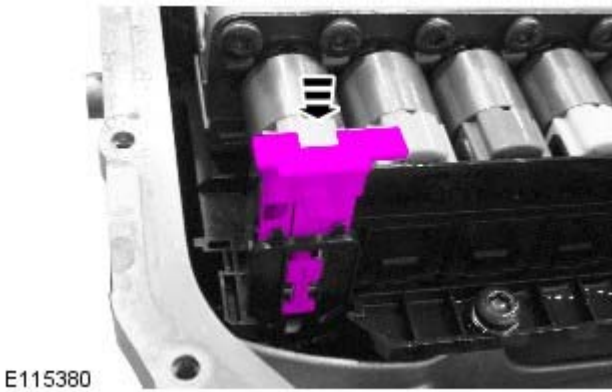


3. 3.  CAUTION: Make sure the manual park release is correctly engaged.

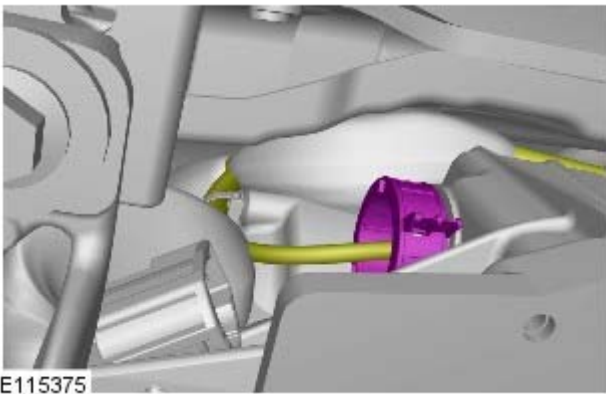
Torque: 8 Nm



4.  CAUTION: Make sure that a new component is installed.



- 5.



- 6.

7. Refer to: [Transmission Fluid Pan, Gasket and Filter](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal and Installation).


8. If a new component has been installed, configure using Jaguar approved diagnostic equipment.

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Fluid Pan, Gasket and Filter

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

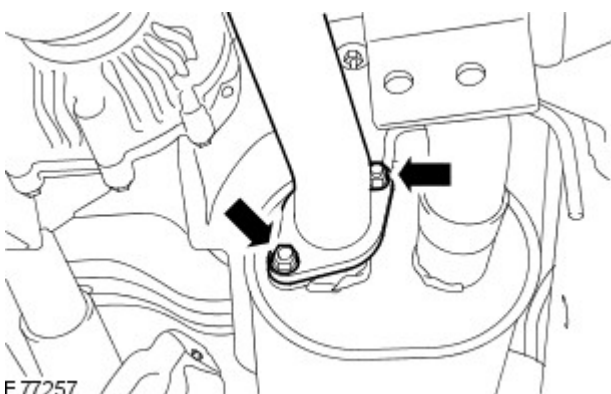
1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Transmission Fluid Drain and Refill](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).
3. Refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).



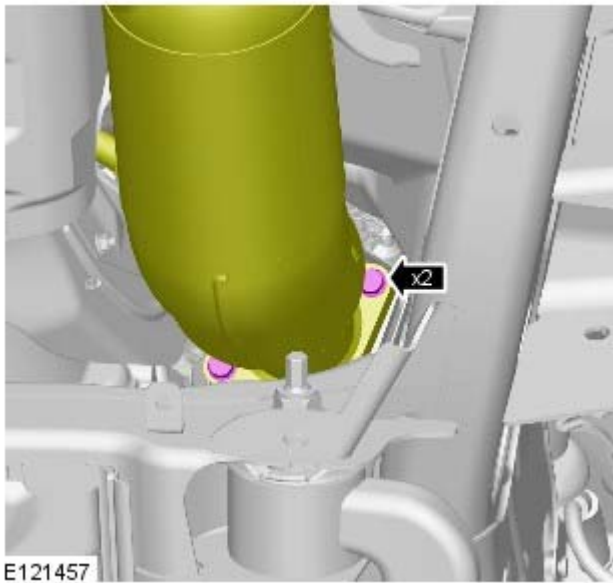
4.



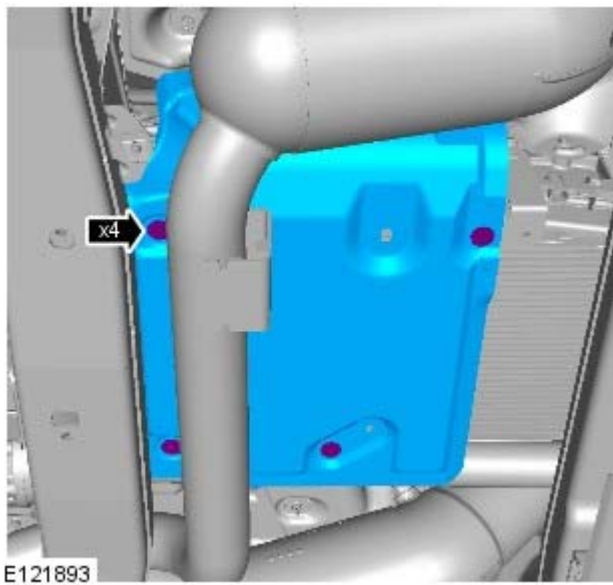
5.



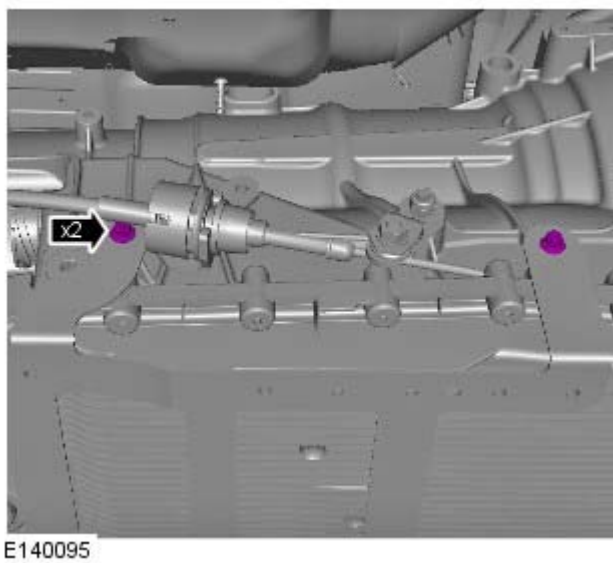
6.



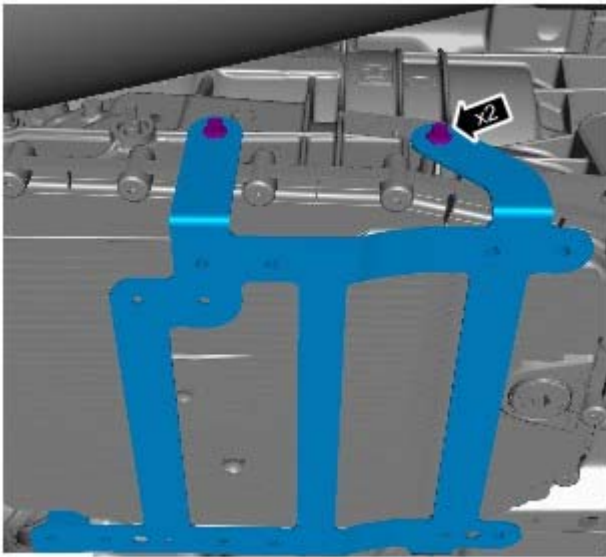
7. **7.** NOTE: Install a new gasket.



8.

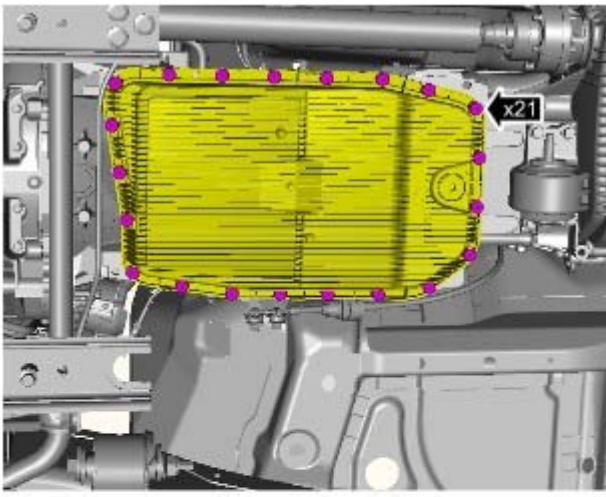


9.



E140096

10.

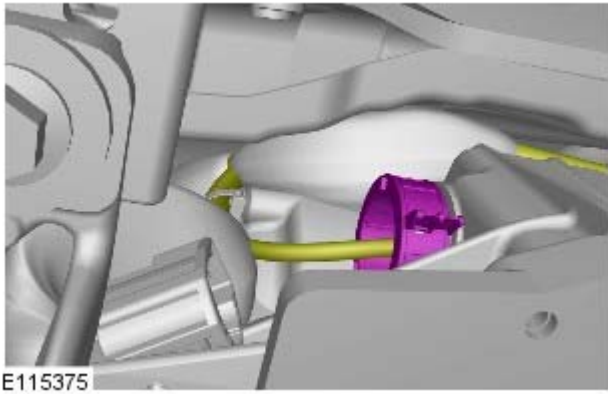


E 141086

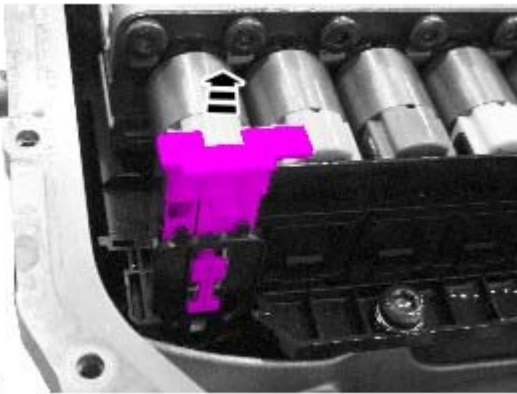
11.  CAUTION: Be prepared to collect escaping fluids.

- NOTE: The component cannot be removed at this stage.

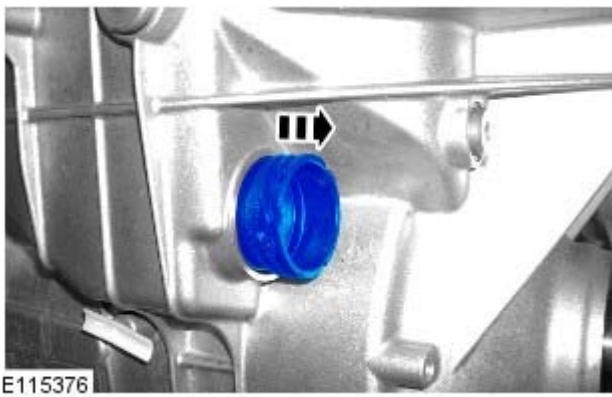
Detach the transmission fluid pan from the transmission.



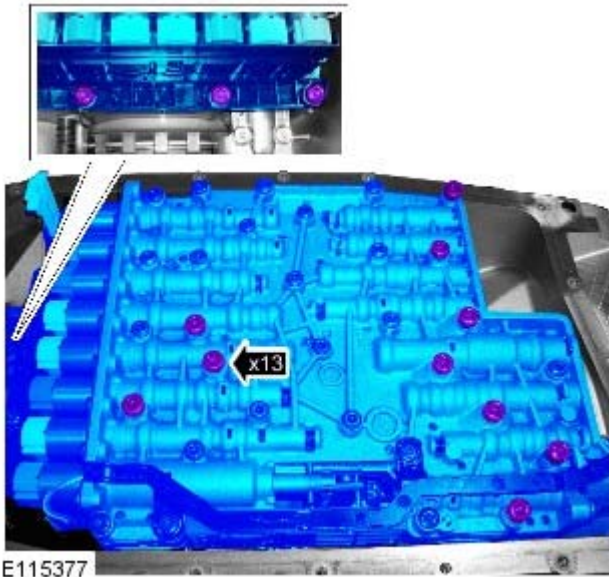
12.




13.



14. **14.**  CAUTION: Discard the component.



15. **15.**  **CAUTION:** Be prepared to collect escaping fluids.
- **NOTE:** Note the position of the manual park brake release.
 - **NOTE:** Transmission fluid pan shown removed for clarity.

Remove the transmission control module and the transmission fluid pan.



16.



17.


18. Remove the transmission fluid pan and the transmission control module.


19. Remove and discard the gasket.

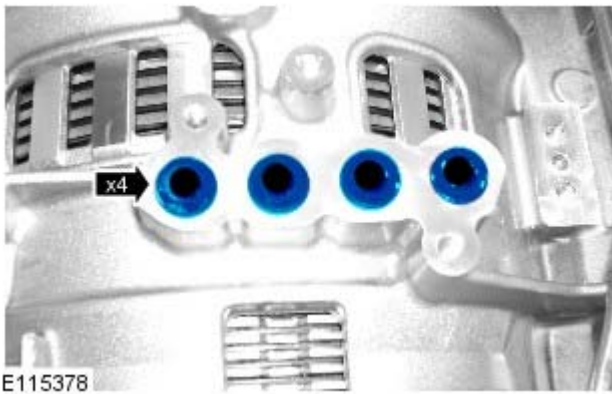
Installation




1. 1. CAUTIONS:


 Make sure that when fully fitted, all seals protrude by the same amount.

-  Install the new seals.
- Install a new seal block.



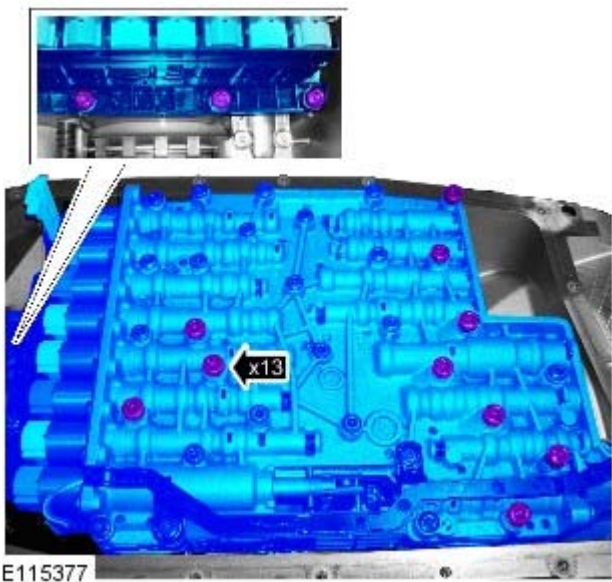
2. 2. CAUTIONS:

 Install the new seals.

 Make sure that when fully fitted, all seals protrude by the same amount.

3. Install the new gasket.

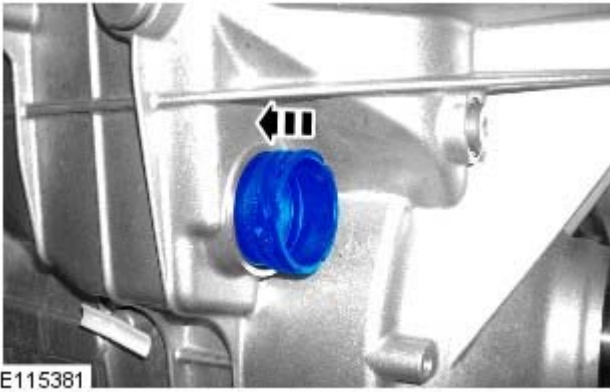
4. Install the transmission fluid pan and the transmission control module.



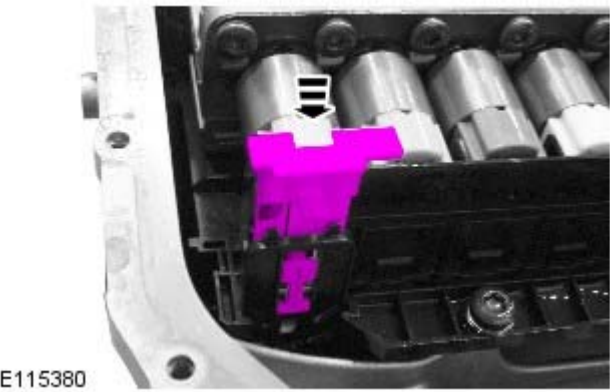
5.  CAUTION: Make sure the manual park release is correctly engaged.

- NOTE: Transmission fluid pan shown removed for clarity.

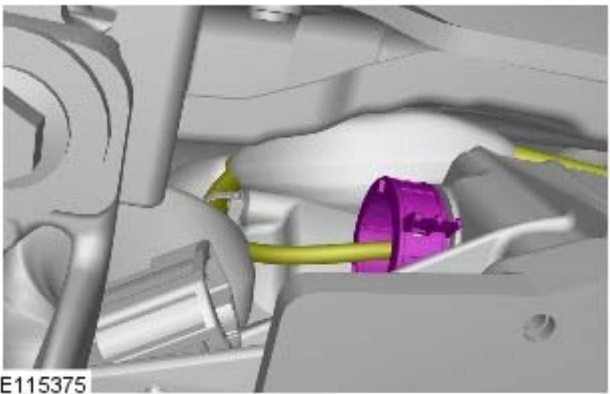
Tighten to 8 Nm.



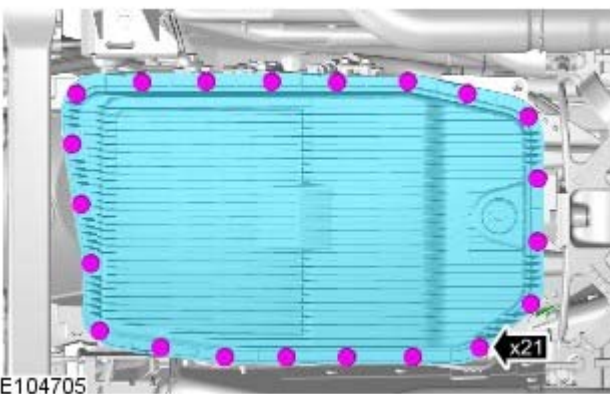
6.  CAUTION: Make sure that a new component is installed.



- 7.

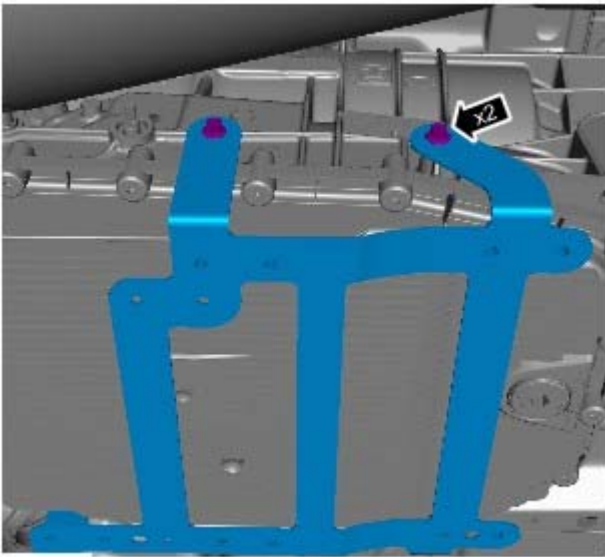


- 8.



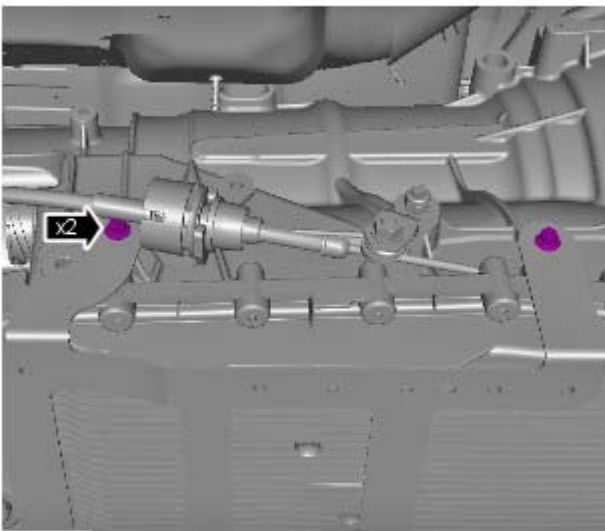
9. Tighten to 8 Nm.

10.



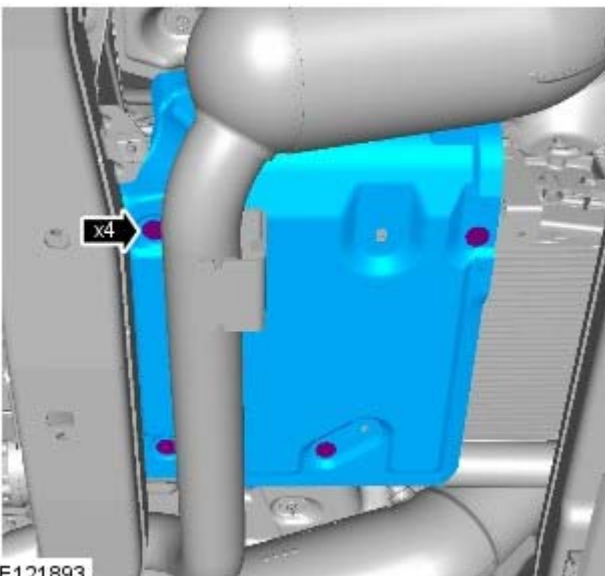
E140096

11.

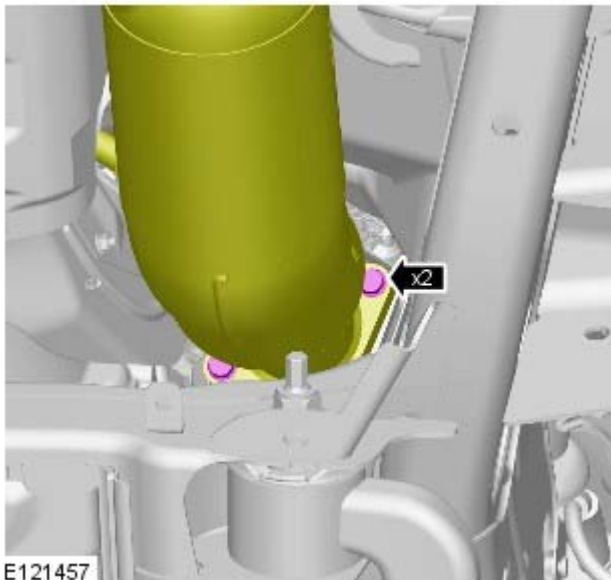


E140095

12.

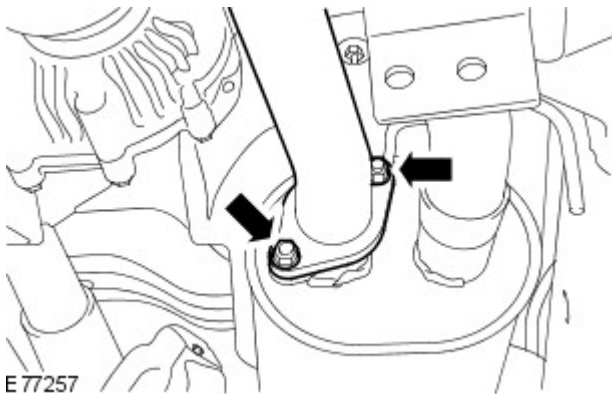


E121893



13. **13.** NOTE: Install a new gasket.

Tighten to 22 Nm.



14. Tighten to 22 Nm.



15.



17. Refer to: ¹⁶[Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

18. Refer to: [Transmission Fluid Drain and Refill](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).

19. Lower the vehicle.

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Support Insulator

Removal and Installation

Removal

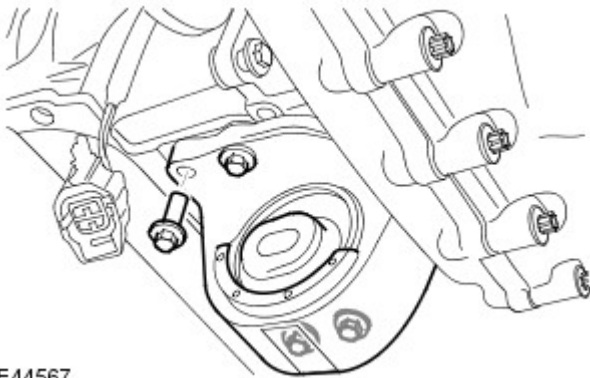
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

3. Remove the transmission support insulator.

- Remove the 4 bolts.



E44567

Installation

1. To install, reverse the removal procedure.

- Clean the component mating faces.
- Tighten the bolts to 60 Nm (44 lb.ft).

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission V8 5.0L Petrol

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the transmission removed for clarity.
- NOTE: Some illustrations may show the engine removed for clarity.

1. Remove the battery.

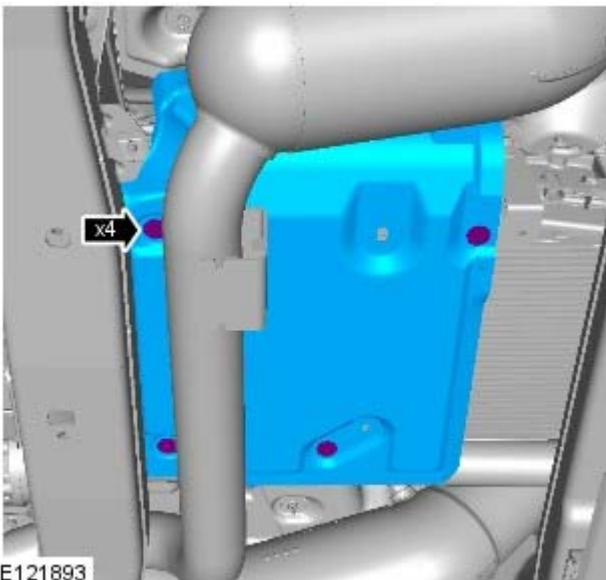
Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

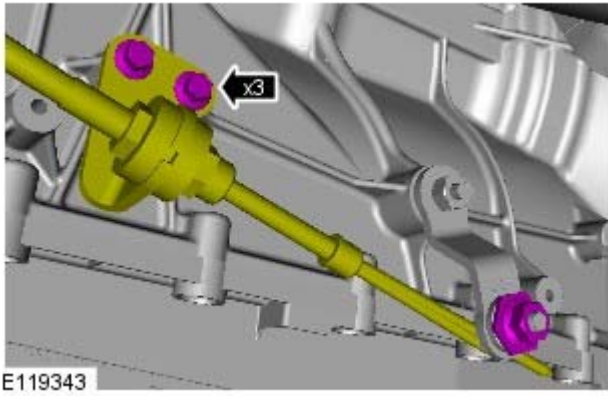
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).
4. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).
5. Refer to: [Front Driveshaft - V8 5.0L Petrol](#) (205-01 Driveshaft, Removal and Installation).
6. Refer to: [Axle Assembly](#) (205-03 Front Drive Axle/Differential, Removal and Installation).

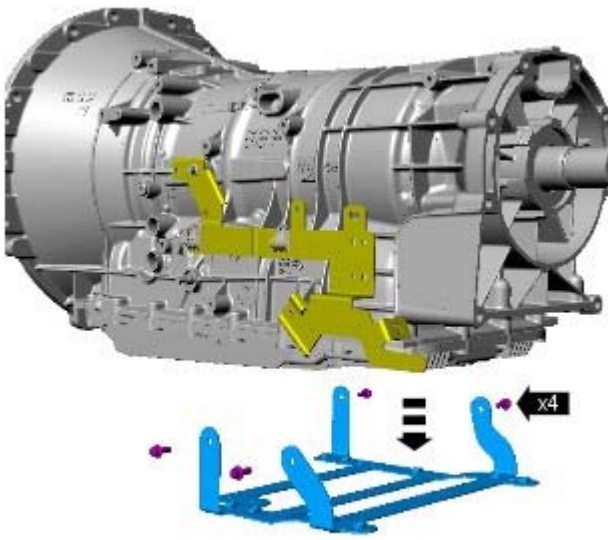
- 7.





E119343

8.



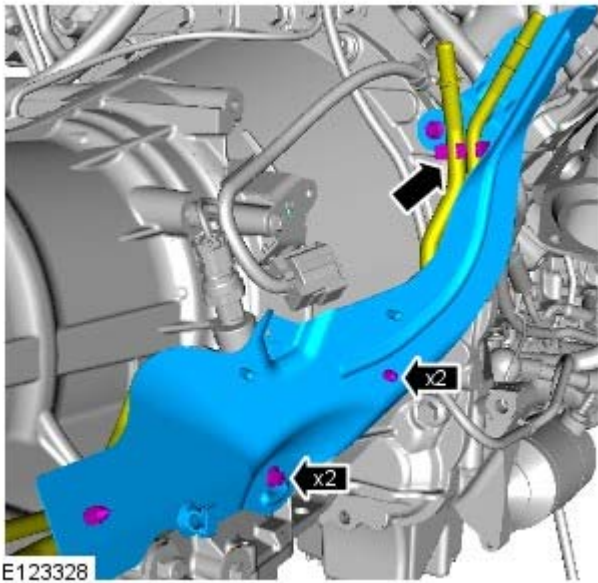
E123334

9.

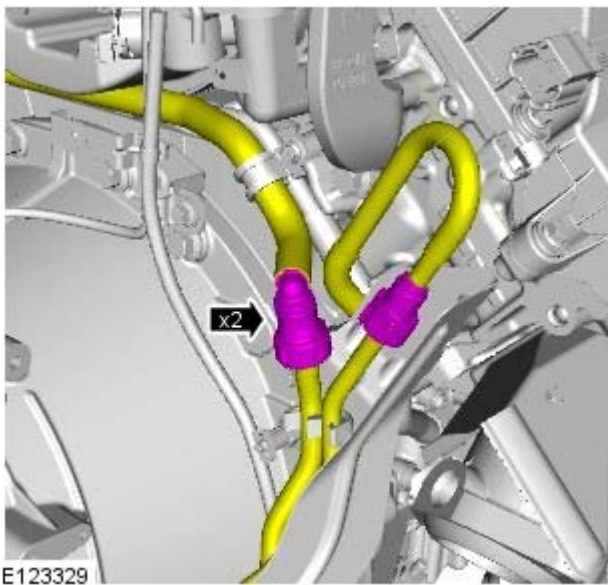



E121680

10.

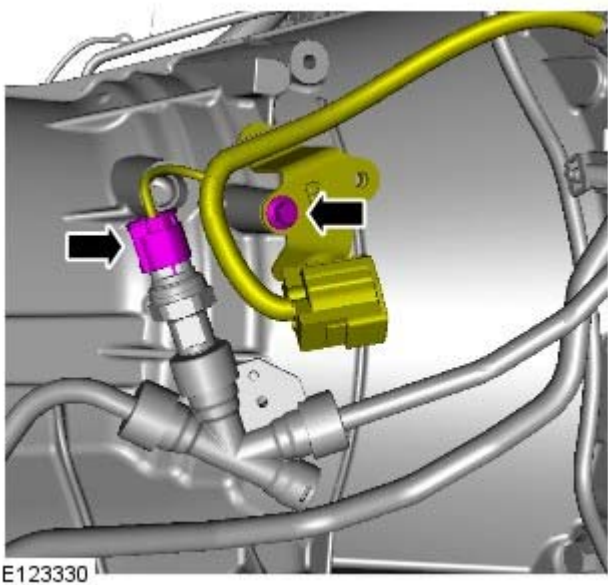


11.



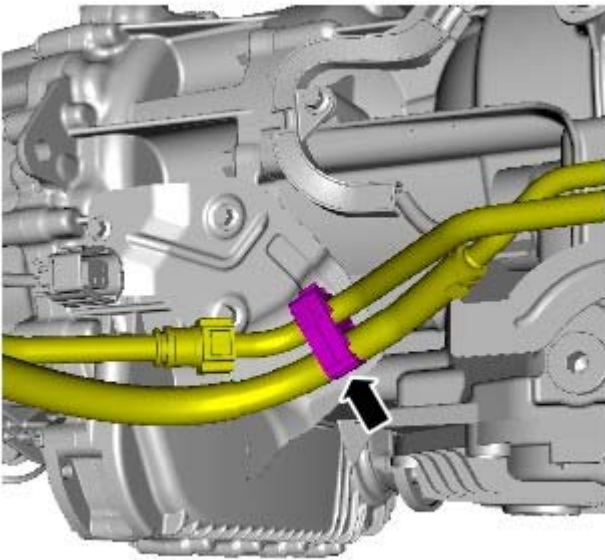
12.  **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 **CAUTION:** Be prepared to collect escaping fluids.



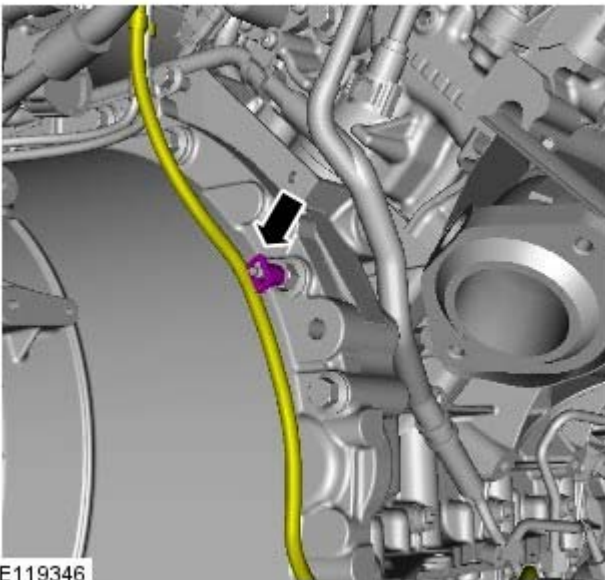
13.

14.



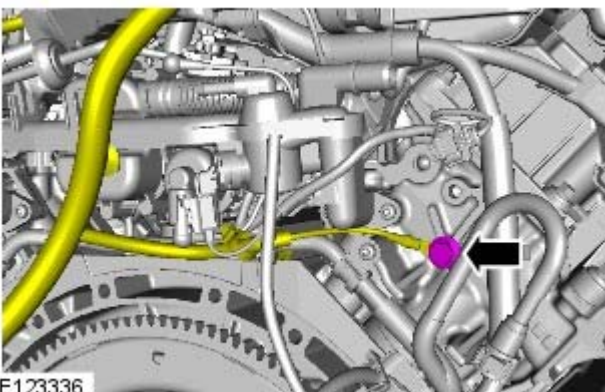
E123332

15.

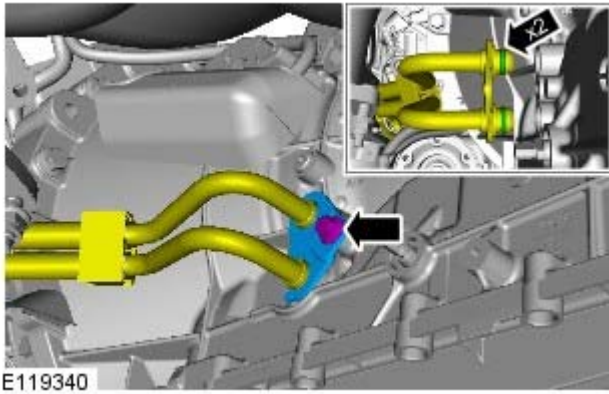


E119346


16.



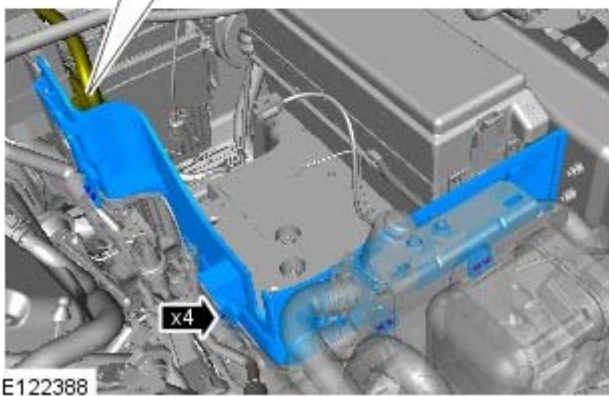
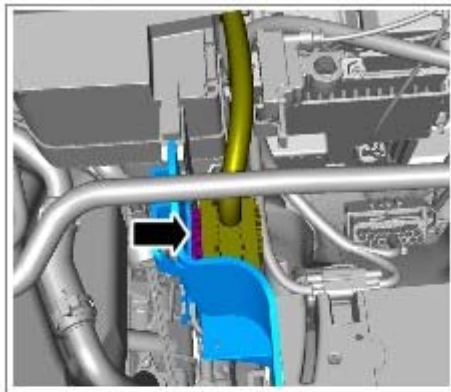
E123336



17. **17.**  **WARNING:** Be prepared to collect escaping fluids.

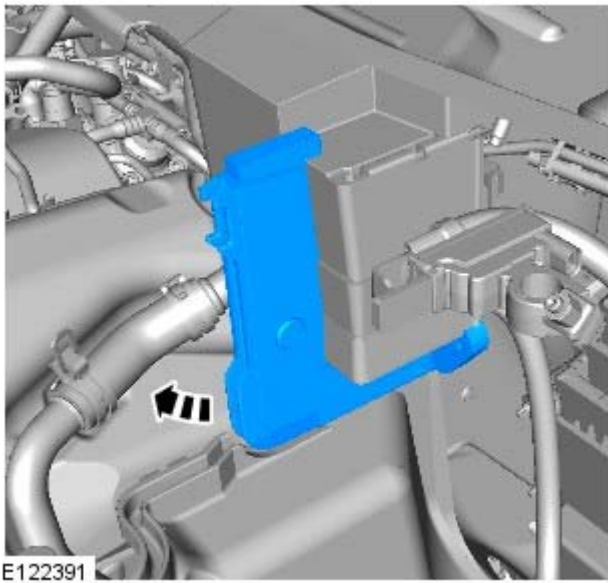
 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

- Remove and discard the 2 O-ring seals.

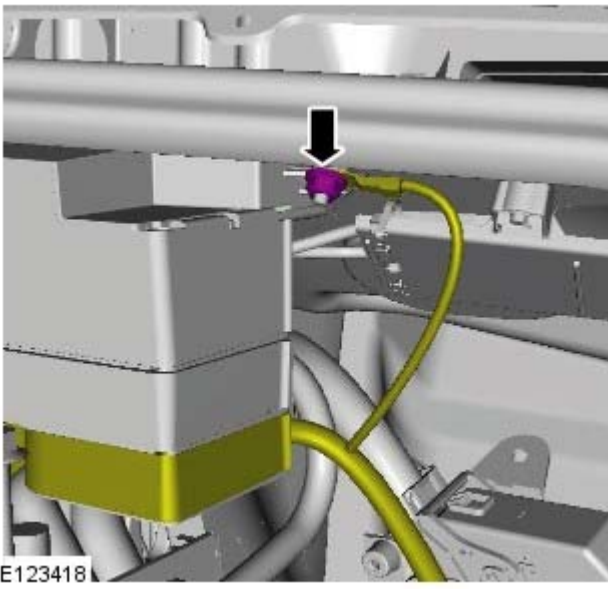


18. **18.** **NOTE:** RHD illustration shown, LHD is similar.

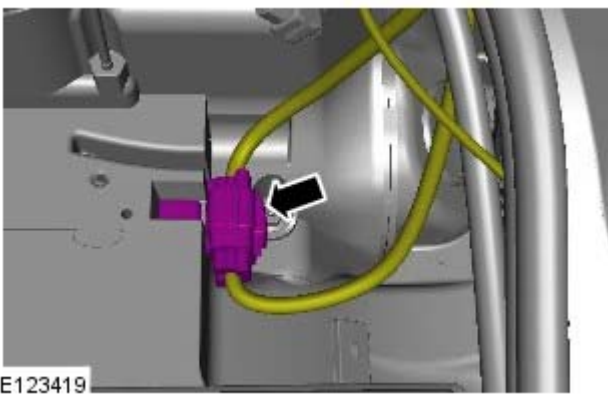
19.

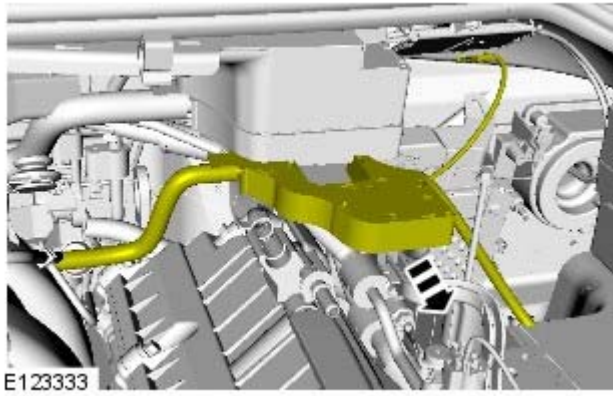


20.

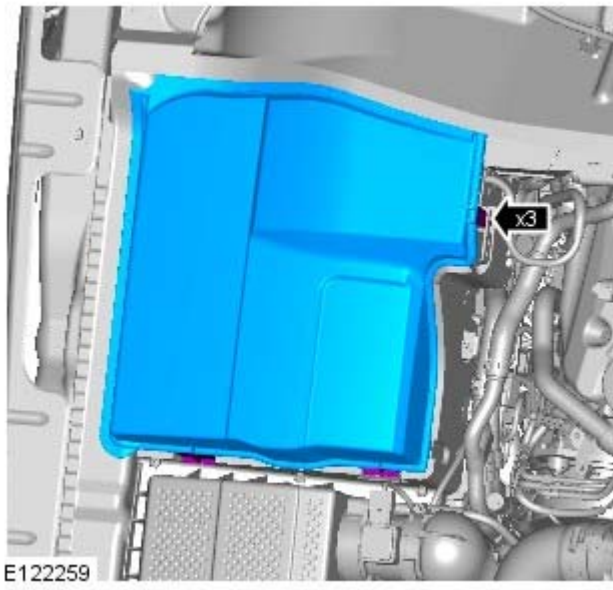


21.

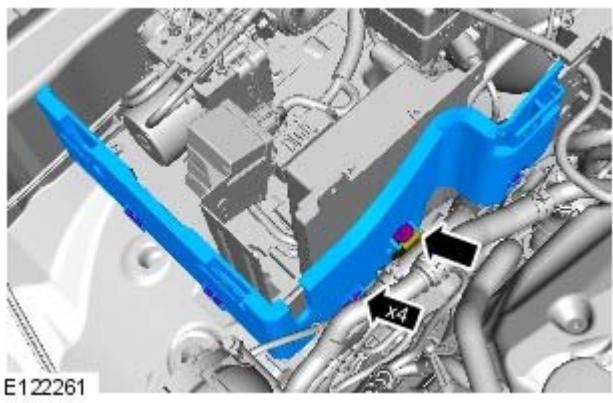




22.

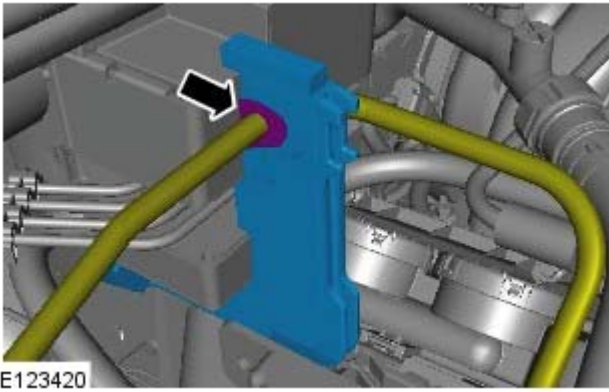


23.

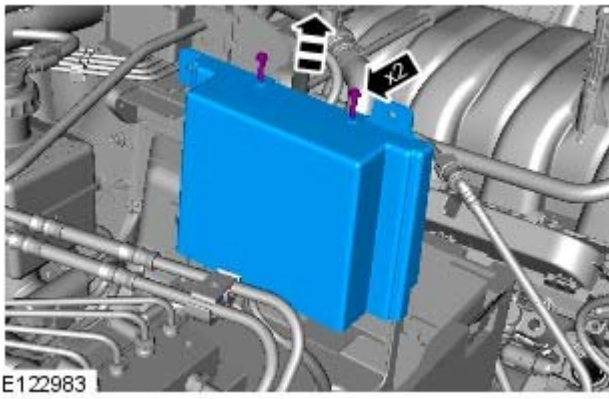


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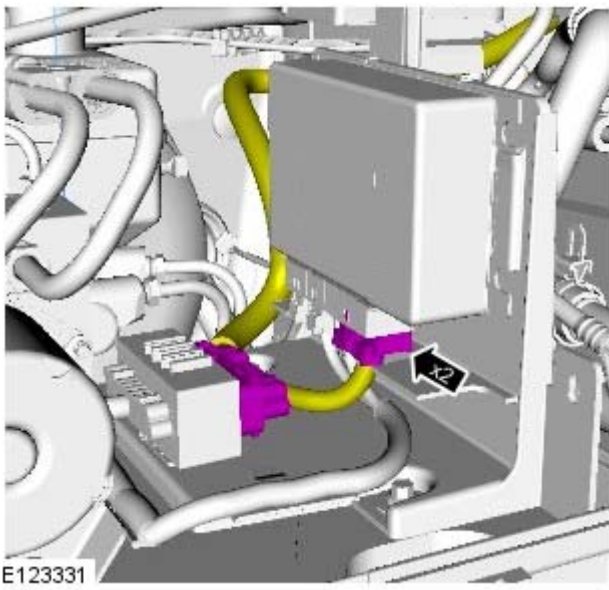
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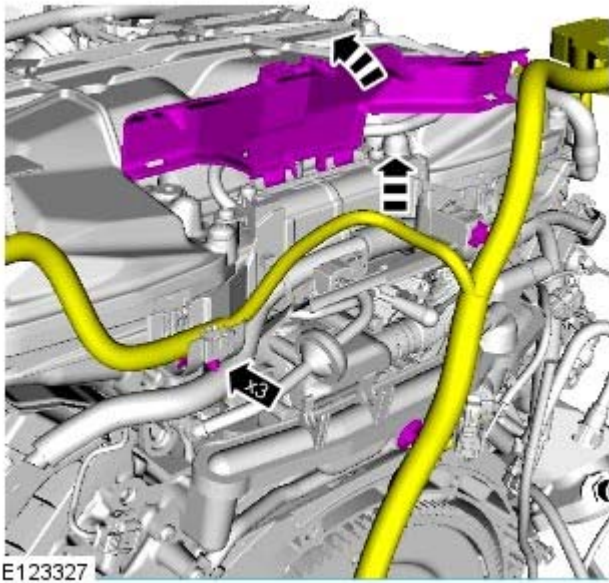


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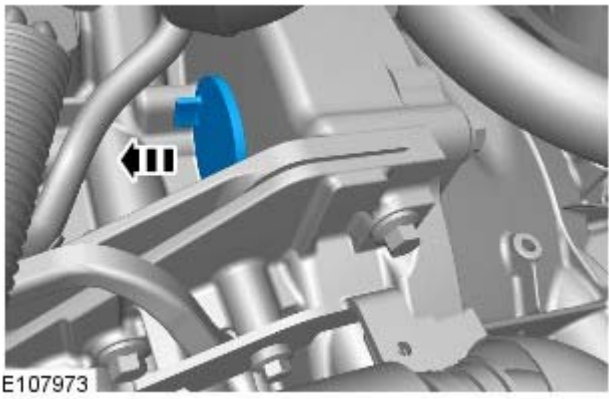


27.

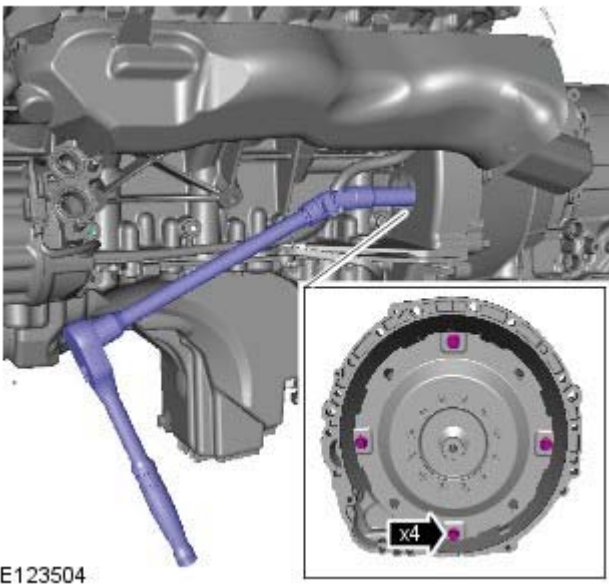





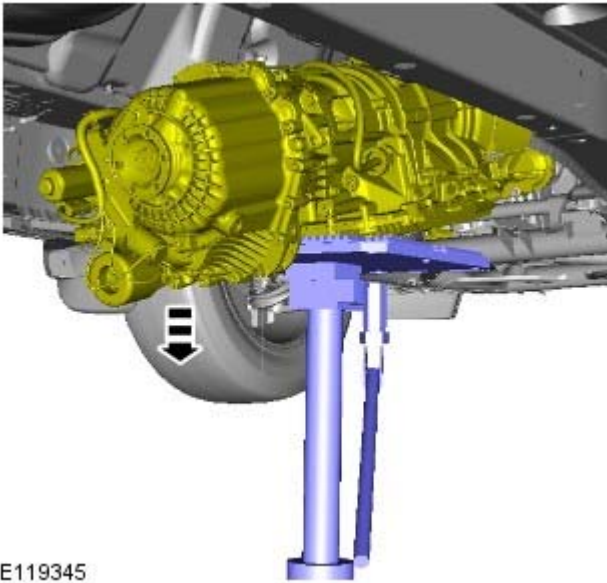
28.




29.



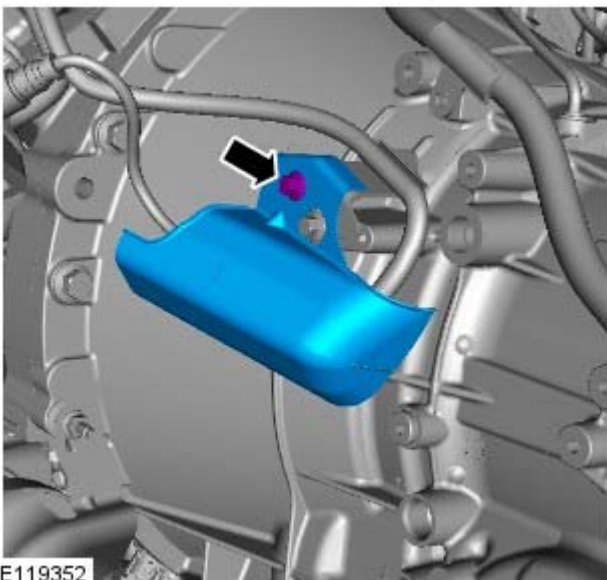
30. **30.**  CAUTION: Only rotate the crankshaft clockwise.
- Make sure that the alignment mark is visible through the inspection hole on removal of the last torque converter bolt.



E119345

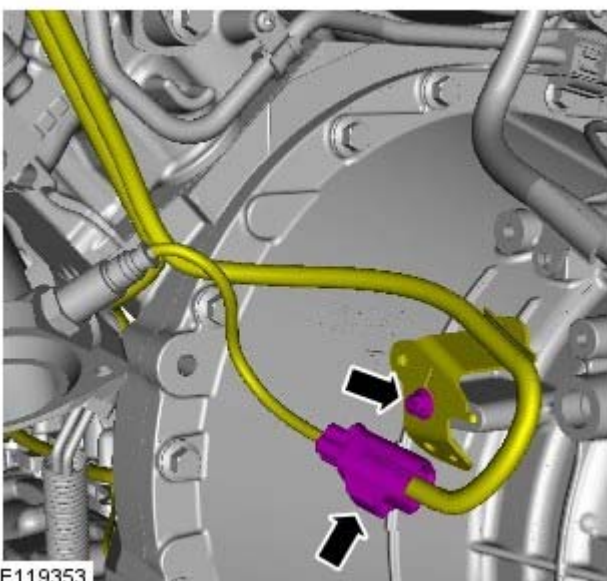
31. **31.**  **WARNING:** Make sure that the transmission is secured with suitable retaining straps.

Lower the rear of the transmission for access.



E119352

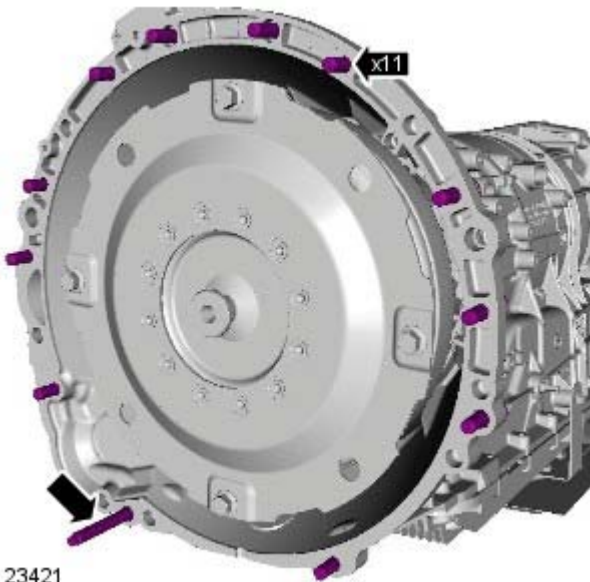
- 32.



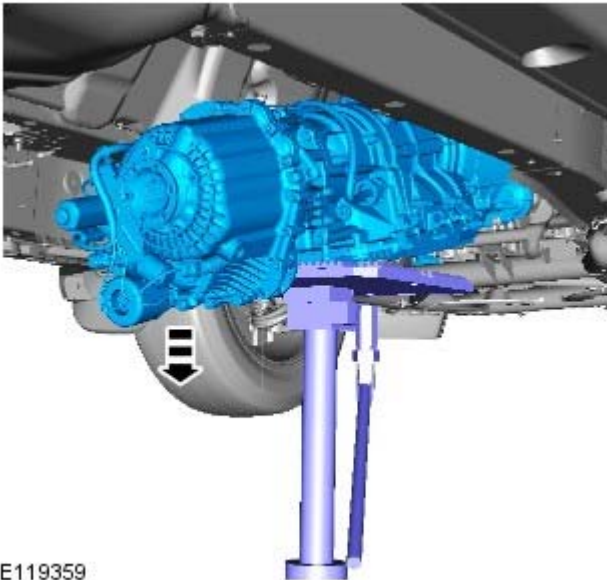
E119353

- 33.


34.



E123421



E119359

35. **35.**  **CAUTION:** Make sure that the torque converter remains in the transmission.


• **NOTE:** This step requires the aid of another technician.

- Using a suitable hydraulic jack, support the transmission.
- Do not disassemble further if removed for access only
- Install the torque converter retainer.


Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - TransmissionTDV6 3.0L Diesel

Removal

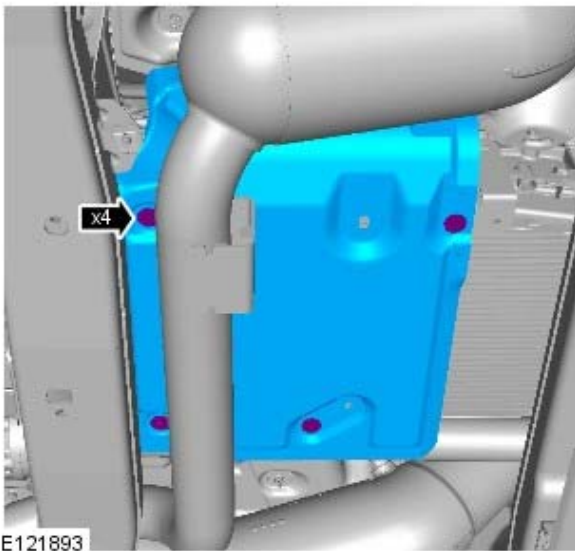
Special Tool(s)

 <p>303-1069 E53727</p>	303-1069 Adaptor, Wrench
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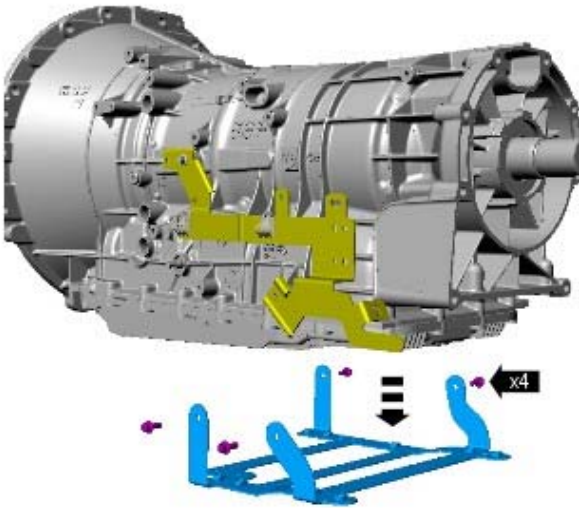
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the transmission removed for clarity.
- NOTE: Some illustrations may show the engine removed for clarity.

1.
 - Disconnect the battery ground cable.
 - Refer to: Specifications (414-00, Specifications).
2.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.

3.



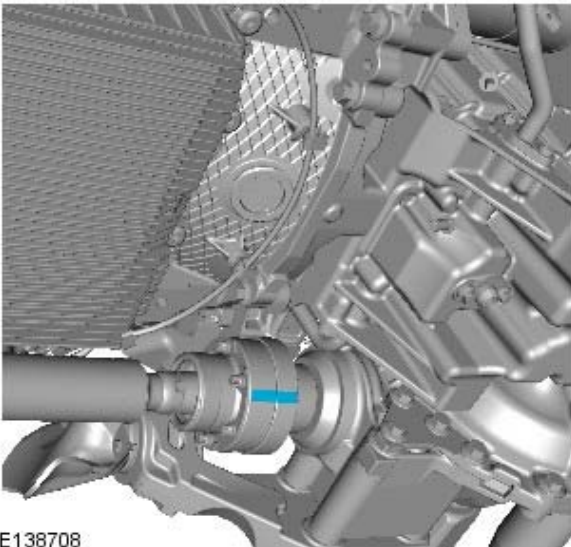
4.




E123334

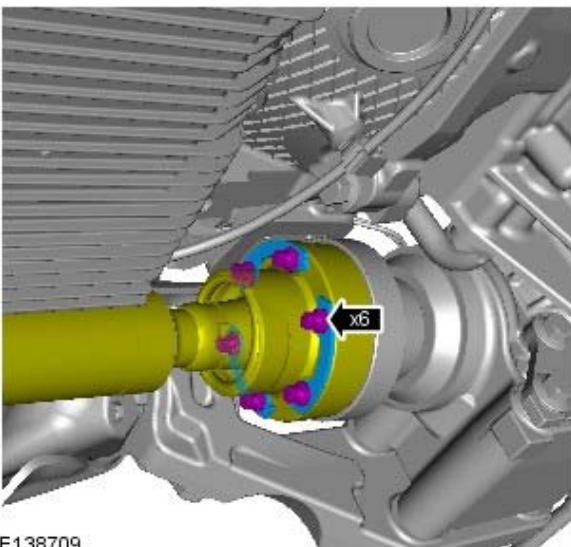
5. Refer to: [Catalytic Converter](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
6. Refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).

7.



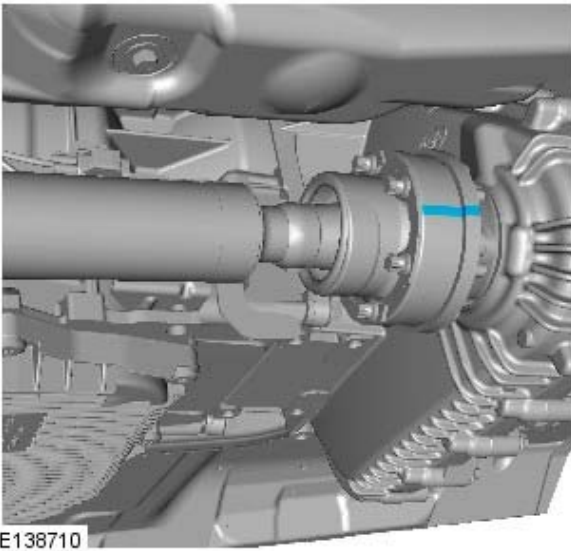
E138708

8.  **CAUTION:** Discard the bolts.
Using a suitable tie strap, secure the driveshaft.



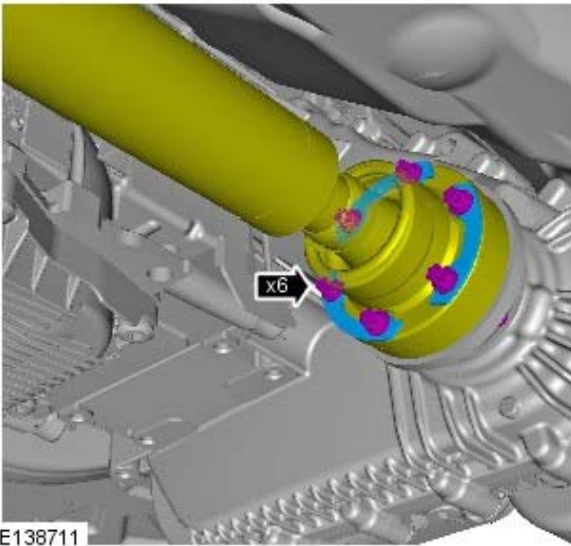
E138709

9.



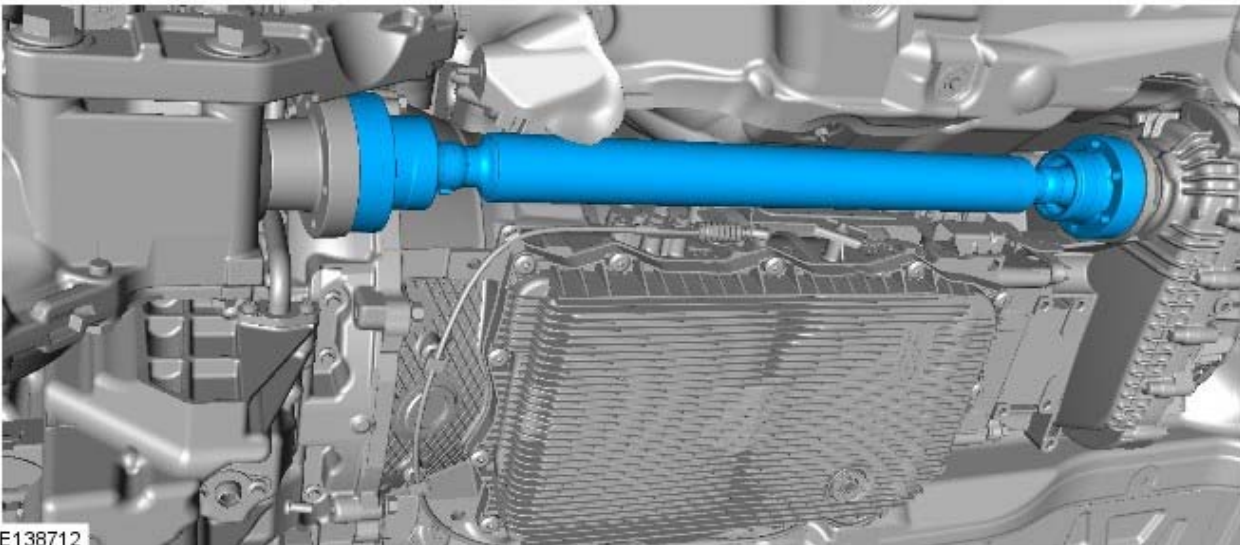
E138710

10.  CAUTION: Discard the bolts.

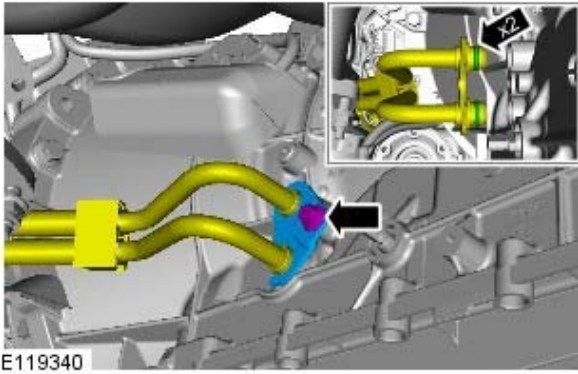



E138711

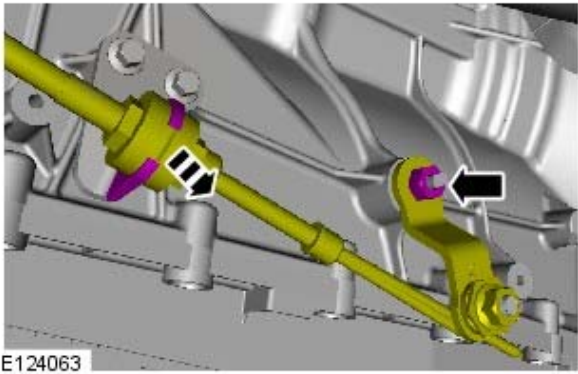
11.



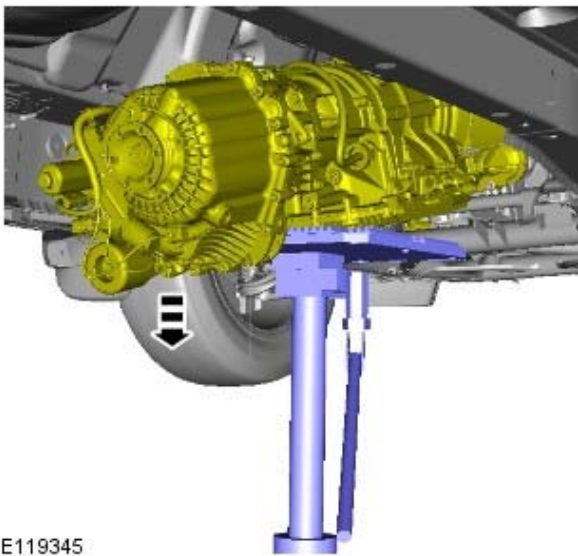
E138712




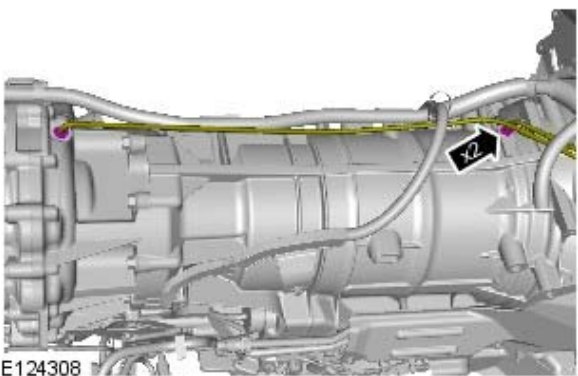
12. **12.**  **WARNING:** Be prepared to collect escaping fluids.
- **NOTE:** Make sure that all openings are sealed. Use new blanking caps.
- Remove and discard the O-ring seals.



13.

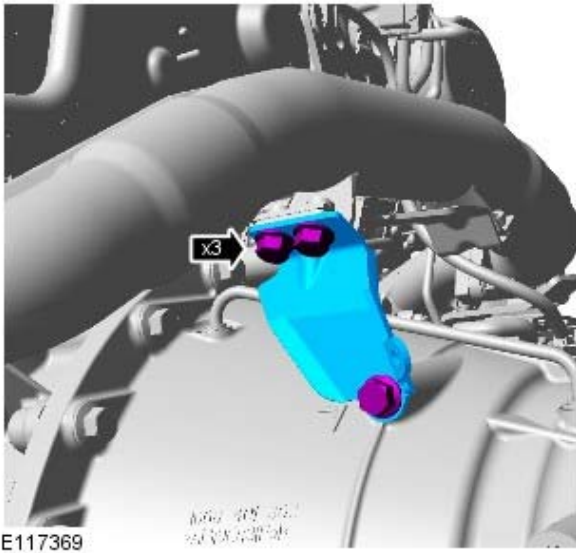


14. **14.**  **WARNING:** Make sure that the transmission is secured with suitable retaining straps.
- Lower the rear of the transmission for access.

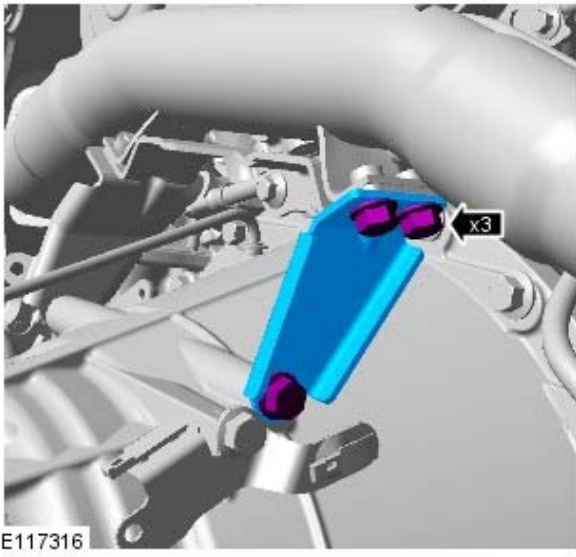


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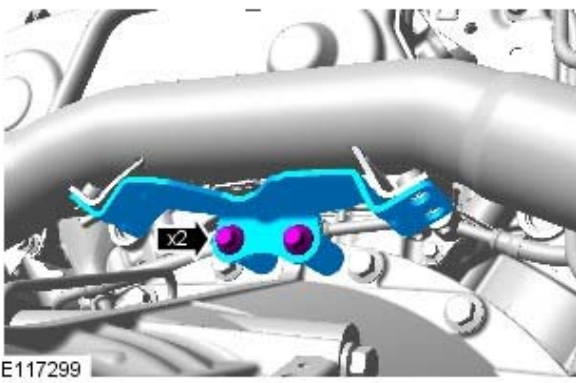
16.



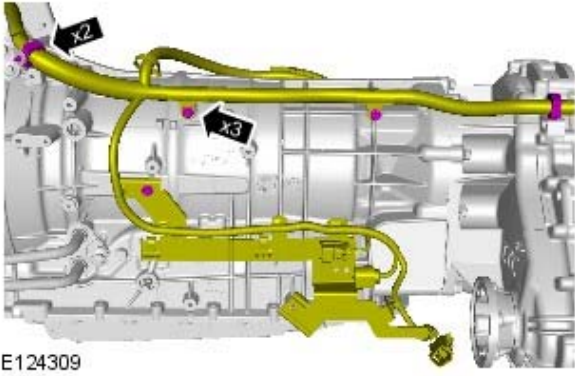
17.



18.

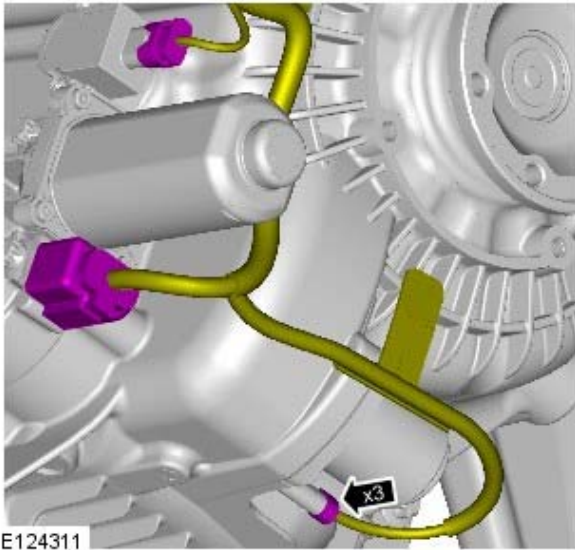


19.



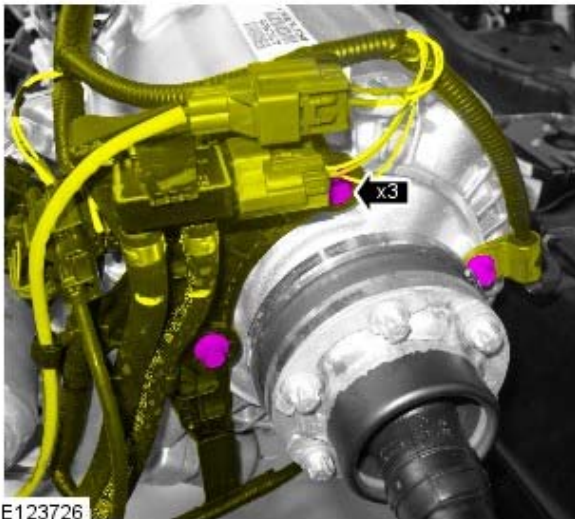
E124309

20.



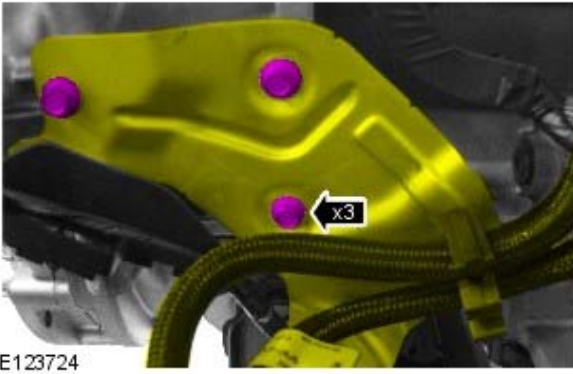
E124311

21.



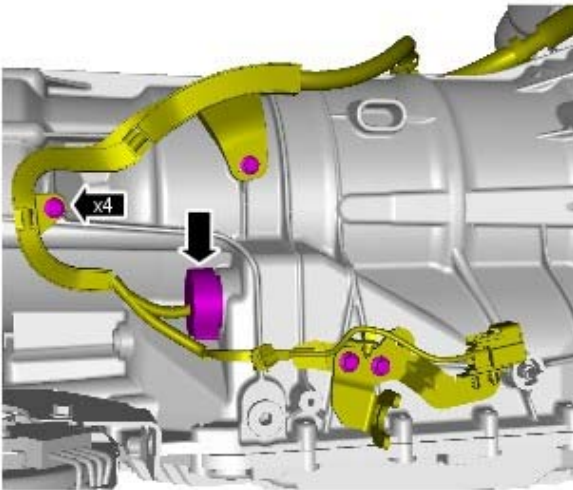
E123726

22.



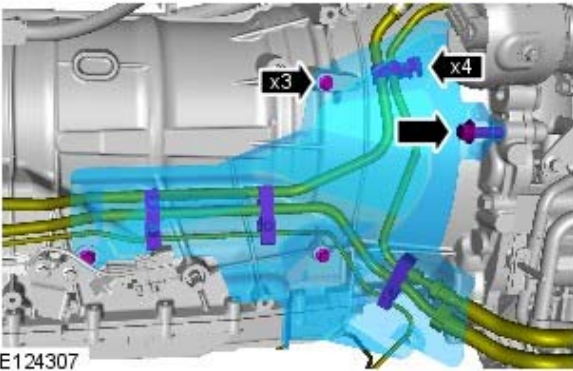
E123724

23.

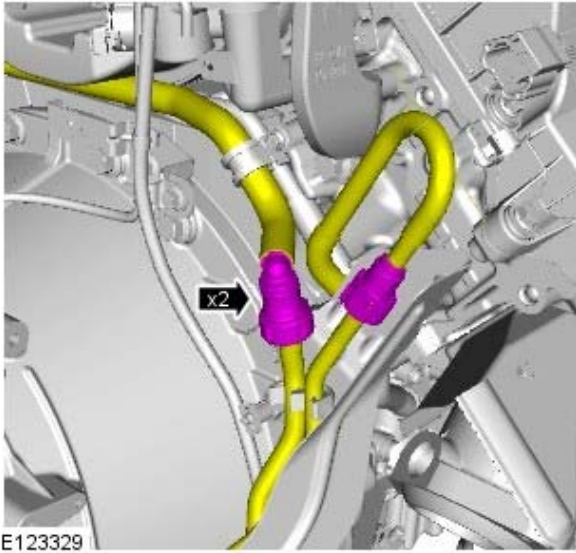


E124310

24.



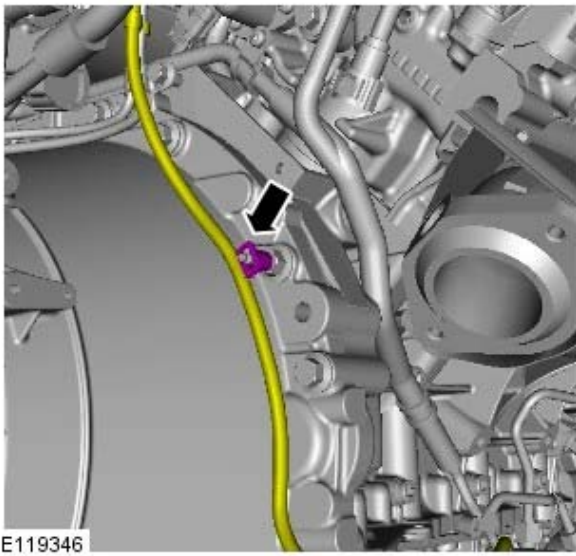
E124307



25. **⚠️ WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

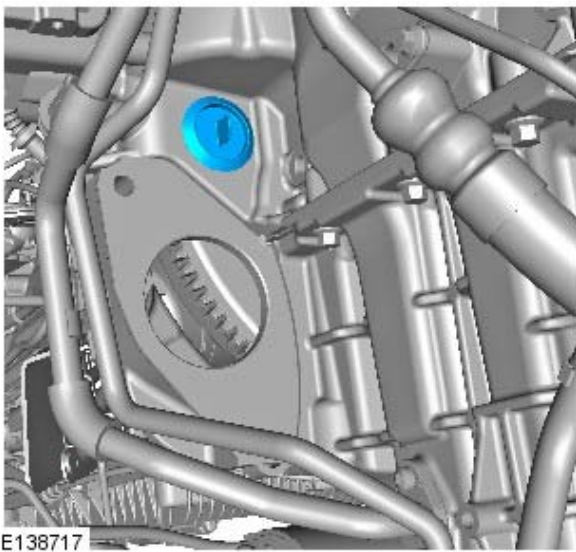
⚠️ CAUTION: Be prepared to collect escaping fluids.

- **NOTE:** Make sure that all openings are sealed. Use new blanking caps.



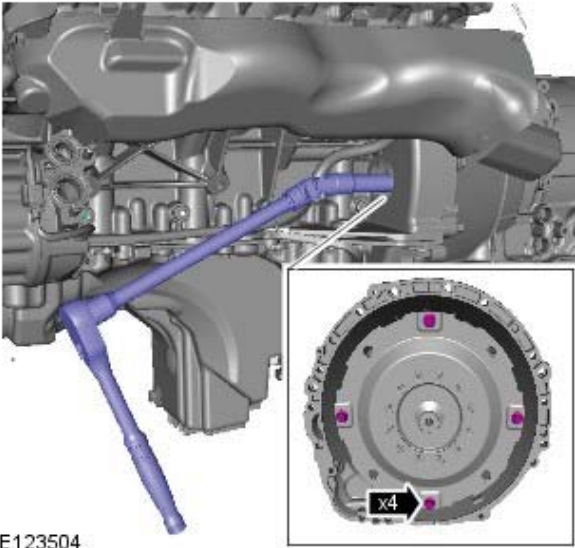
26.

27. Refer to: Starter Motor (303-06, Removal and Installation).



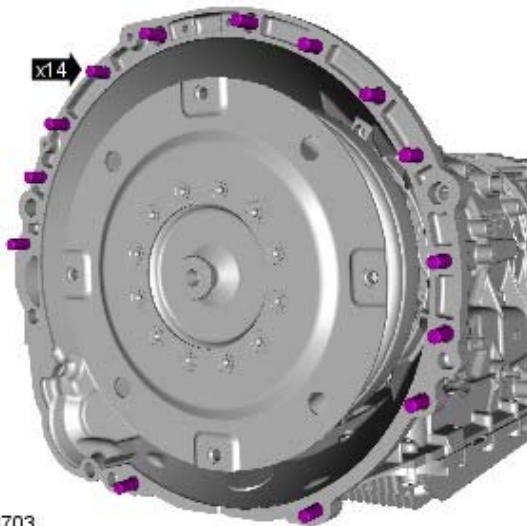
28.

29.



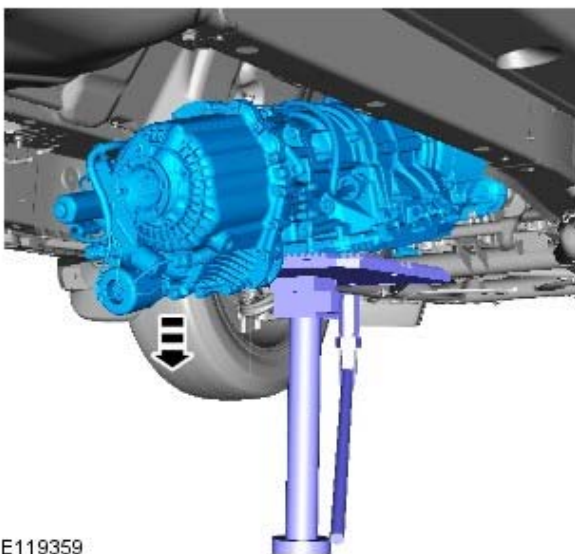
E123504

30.

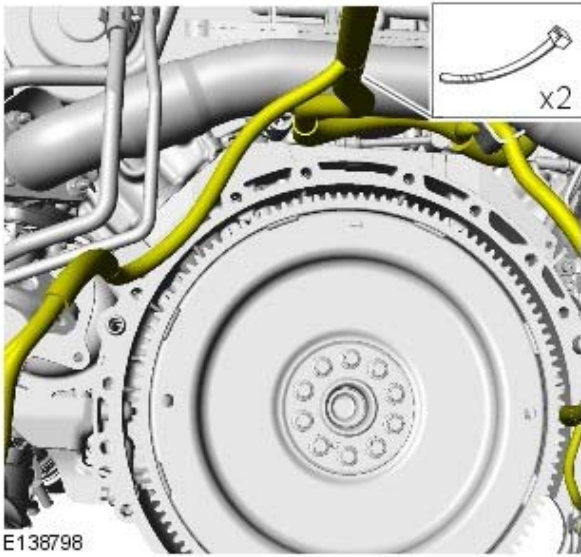


E138703

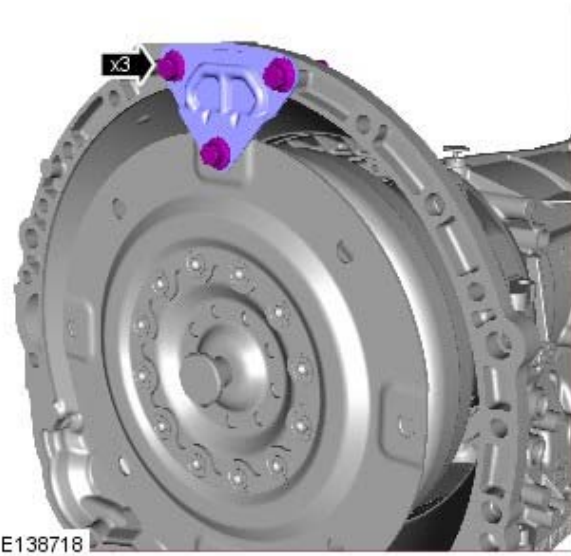
31. **31.**  CAUTION: WARNING: Make sure that the transmission is secured with suitable retaining straps.




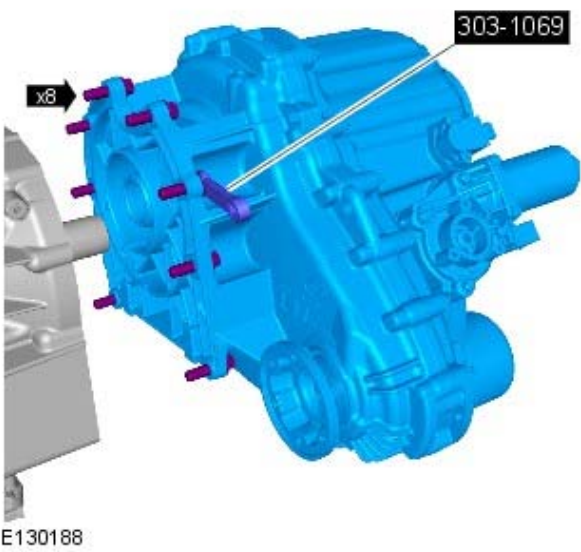
E119359



32. Carefully tie the harness aside.

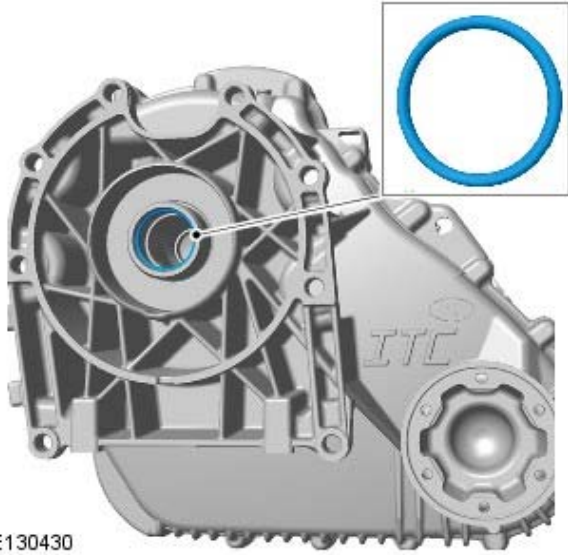


33. **33.**  CAUTION: Make sure that the torque converter remains in the transmission.




34. **34.** NOTE: Do not disassemble further if the component is removed for access only.

Special Tool(s): [303-1069](#)



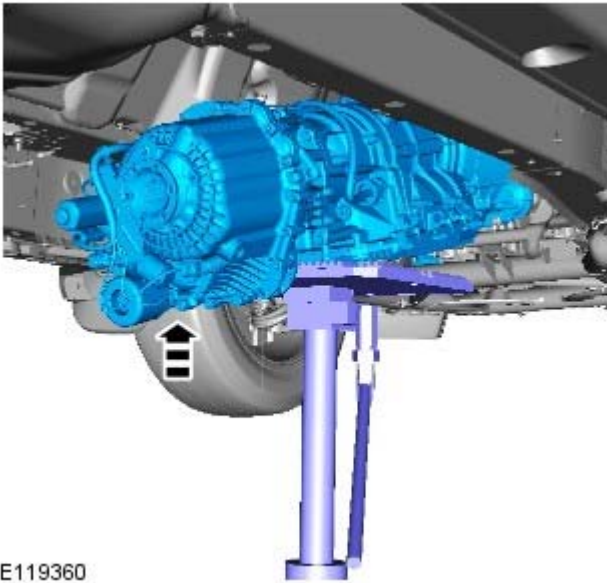
E130430

35. **35.**  **CAUTION:** Inspect the seal, replace if damaged
- **NOTE:** Remove and discard the O-ring seal.

Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission V8 5.0L Petrol


Installation

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the transmission removed for clarity.
- NOTE: Some illustrations may show the engine removed for clarity.



E119360

1. 1. CAUTIONS:

 Apply grease of the correct specification to the torque converter spigot.

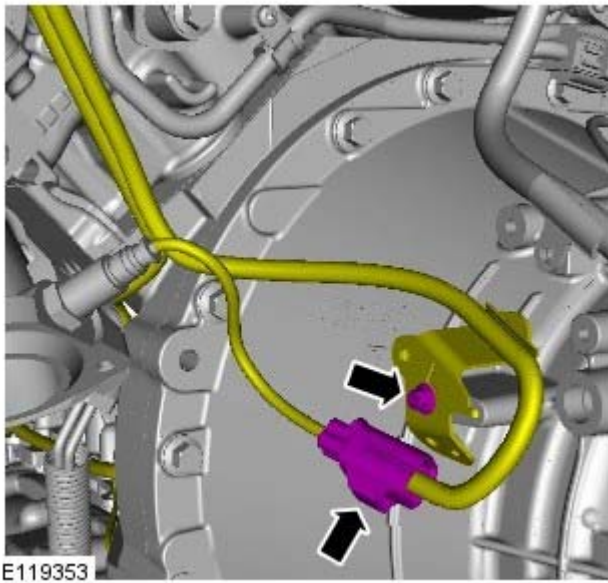
 Make sure the torque converter remains connected to the transmission.

With assistance, install the transmission.

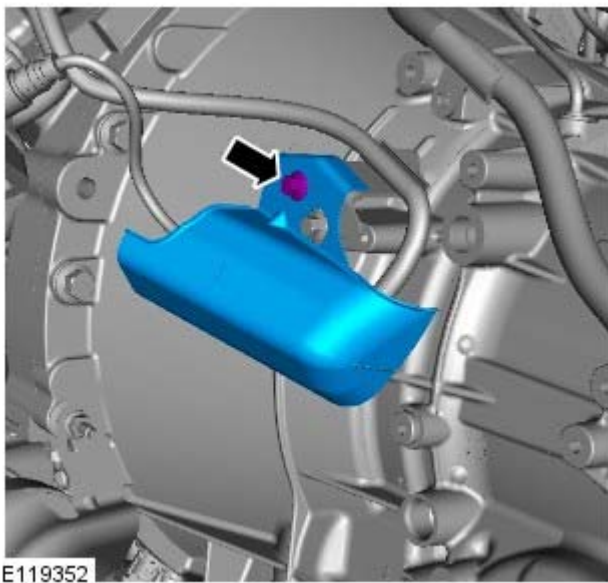


E123421

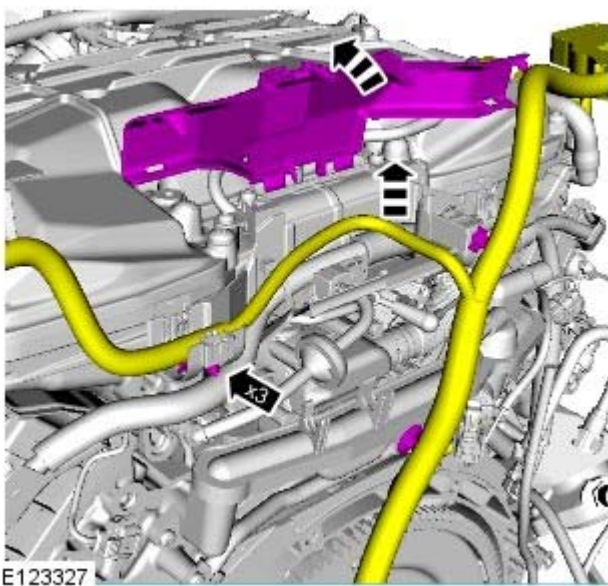
2. Torque: 40 Nm



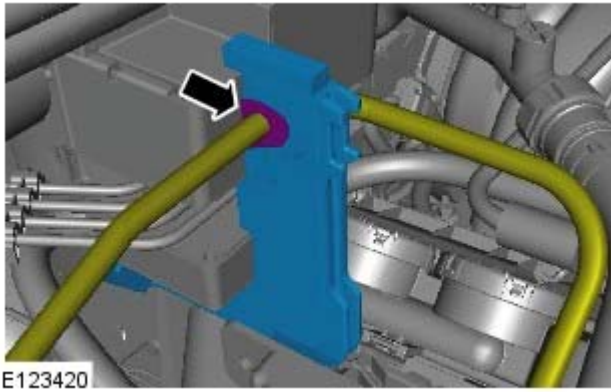
3. Torque: 10 Nm



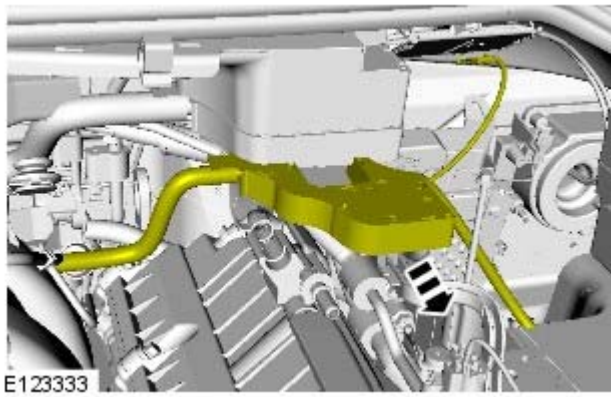
4. Torque: 10 Nm



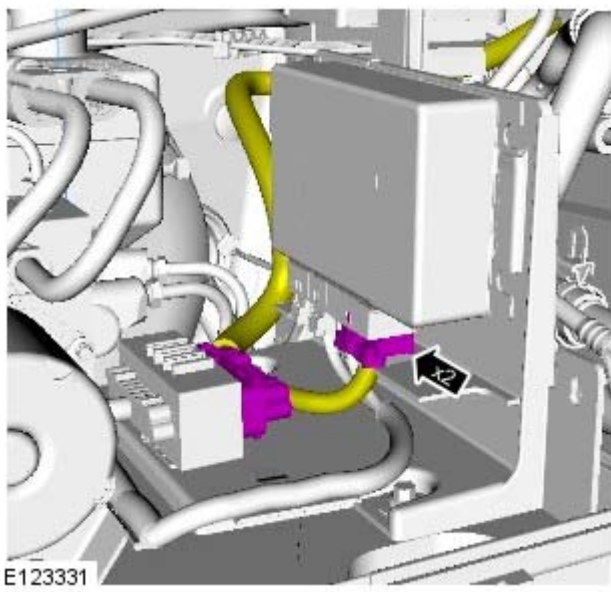
5.



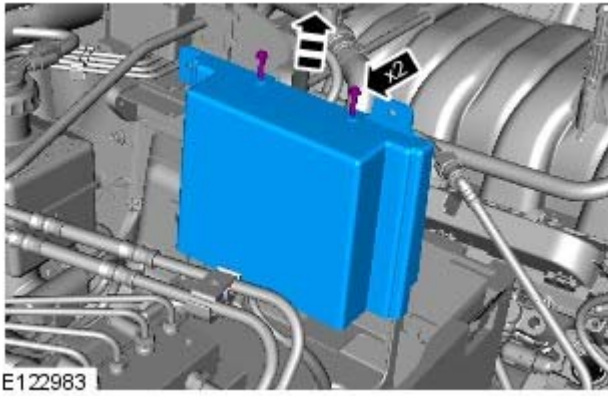
6.



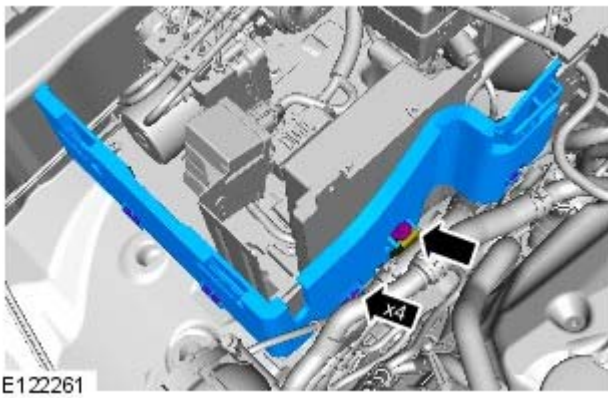
7.



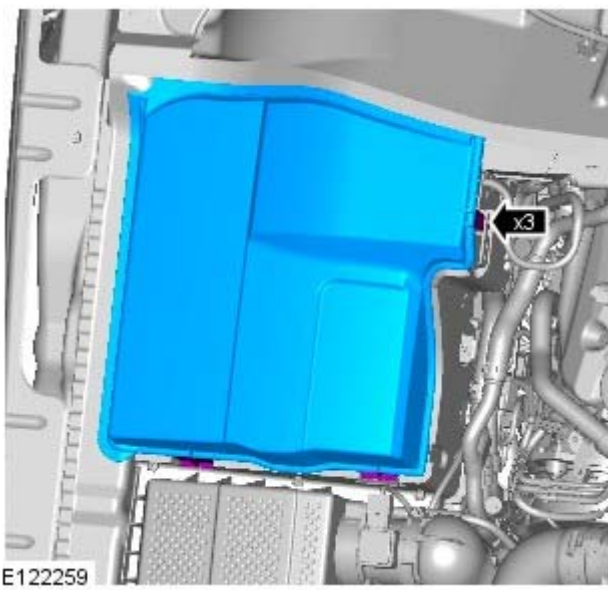
8.



9. Torque: 3 Nm

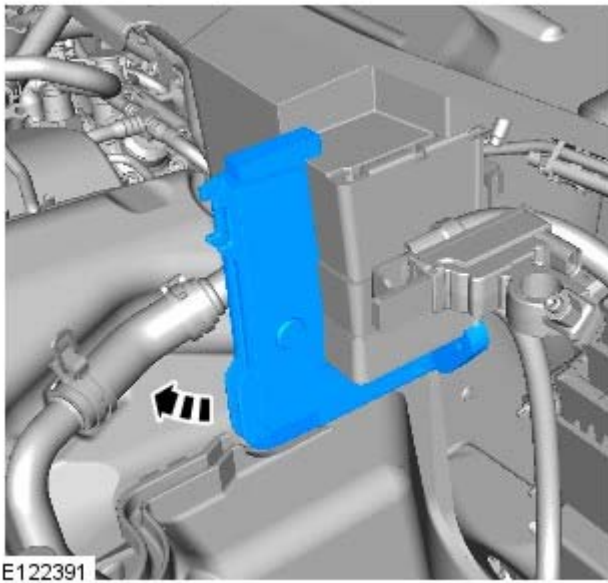


10. Torque: 9 Nm

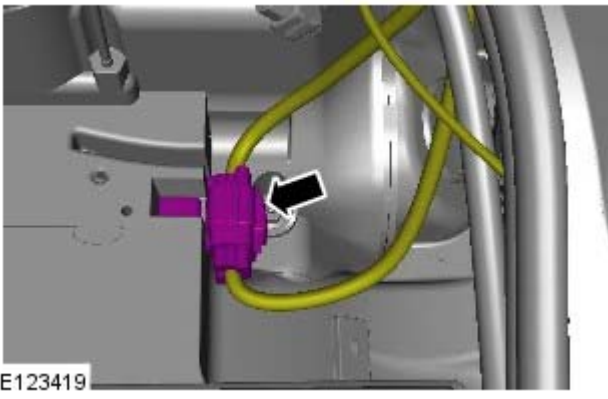


11. **11.** NOTE: RHD illustration shown, LHD is similar.

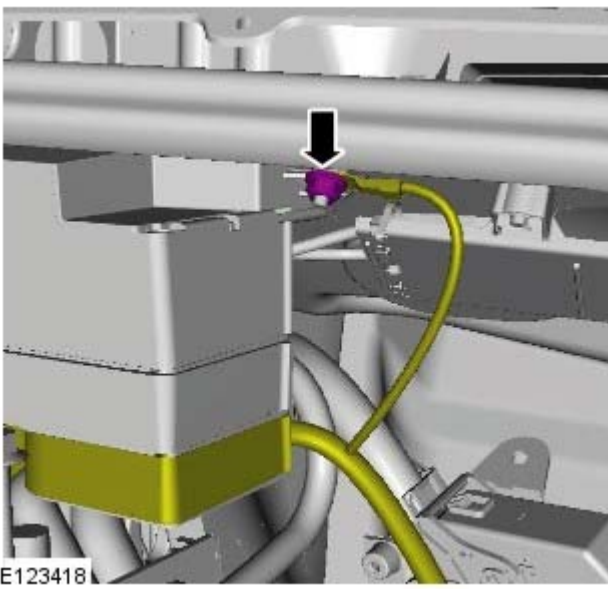
12.



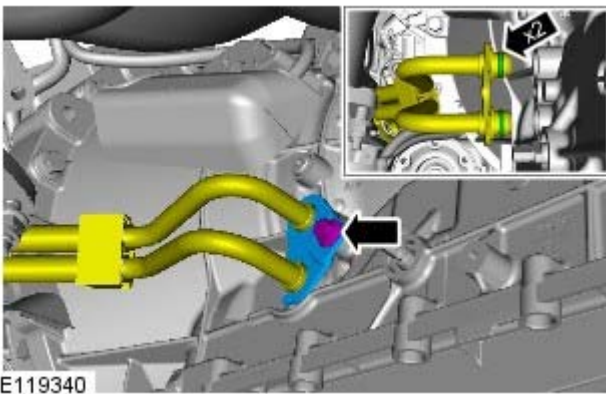
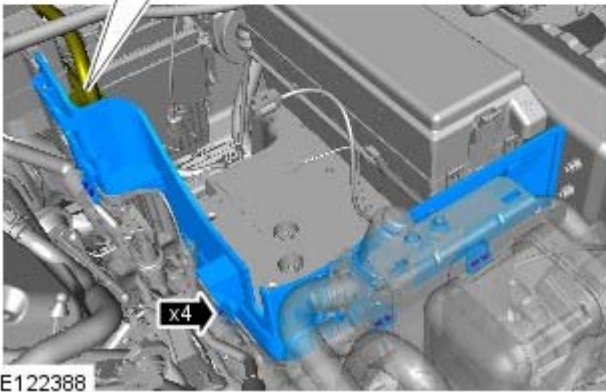
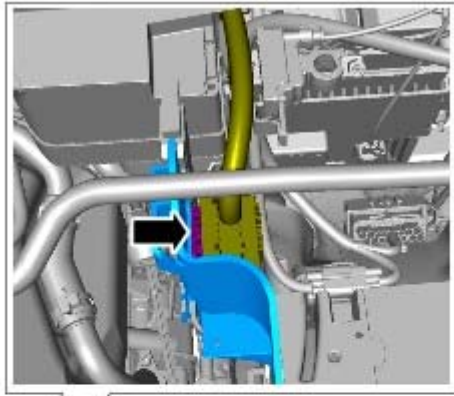
13.



14. *Torque: 9 Nm*

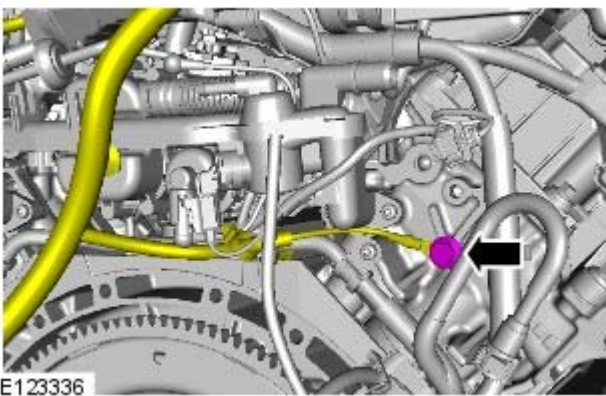


15. **15.** NOTE: RHD illustration shown, LHD is similar.

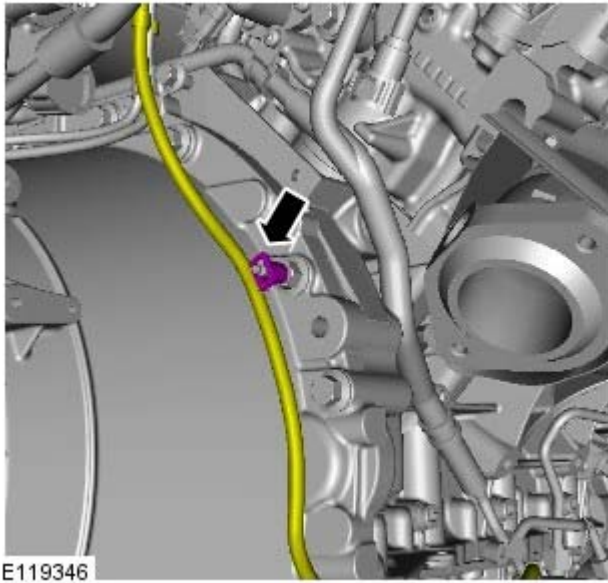


16. **16.**  **WARNING:** Be prepared to collect escaping fluids.

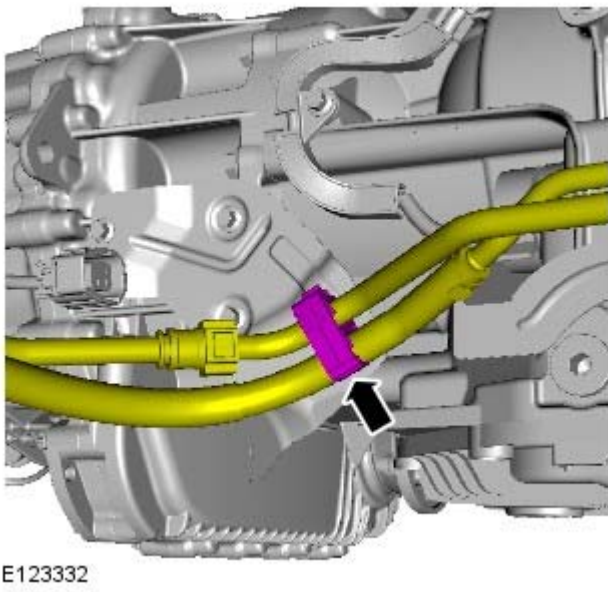
- Install new O-ring seals.
- *Torque:* 12 Nm



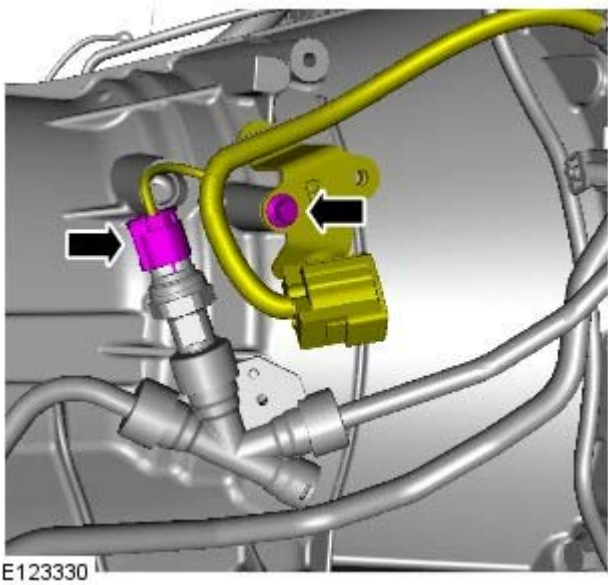
17.



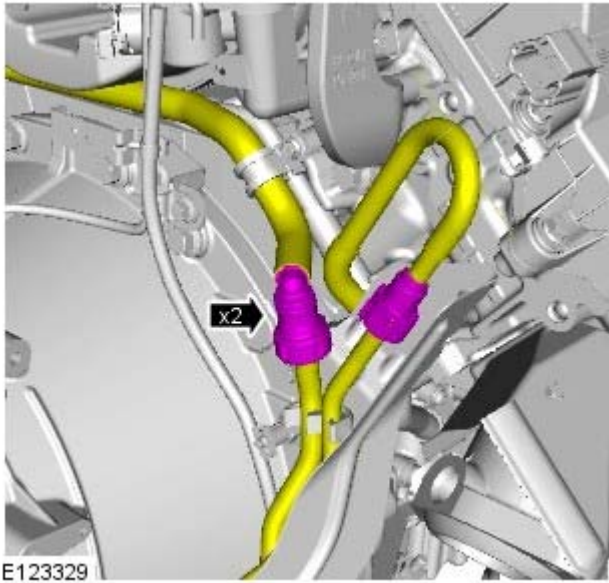
18.



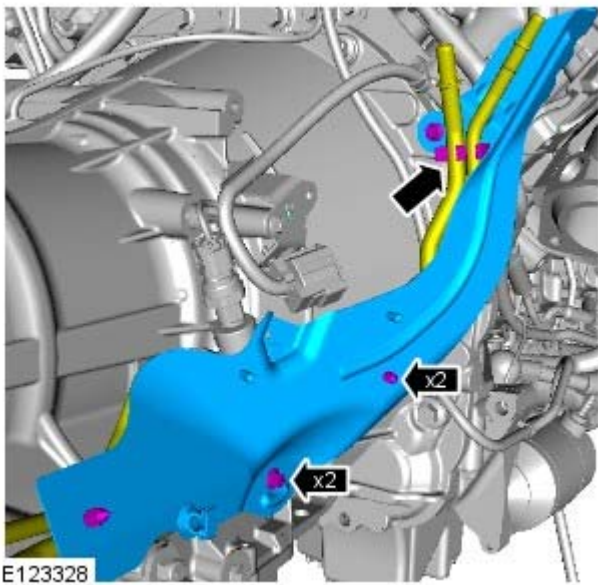
19.



20. Torque: 10 Nm



21. **⚠** **WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

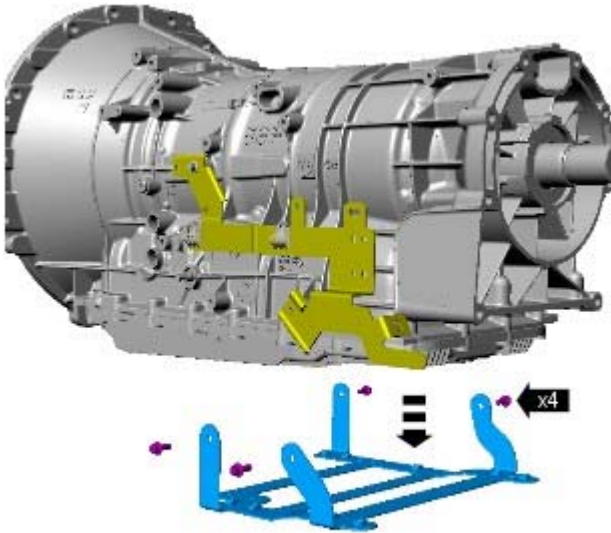


22. *Torque:* 10 Nm



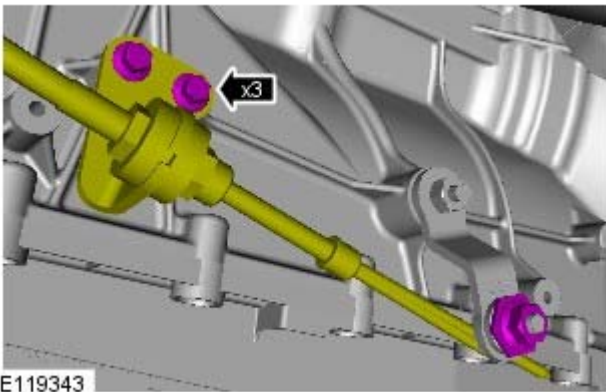
23. *Torque:* 10 Nm

24. Torque: 9 Nm



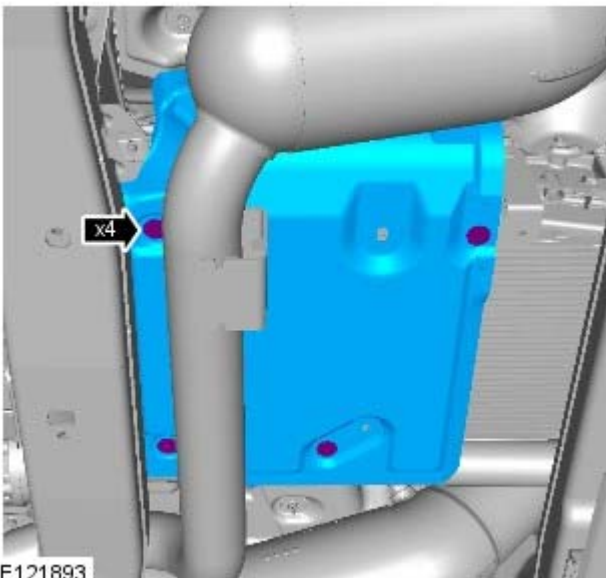
E123334

25. Torque:
M6 Bolt 10 Nm
M6 Nut 12 Nm

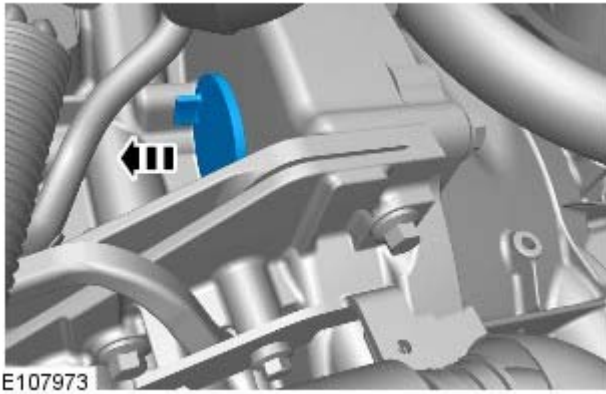


E119343

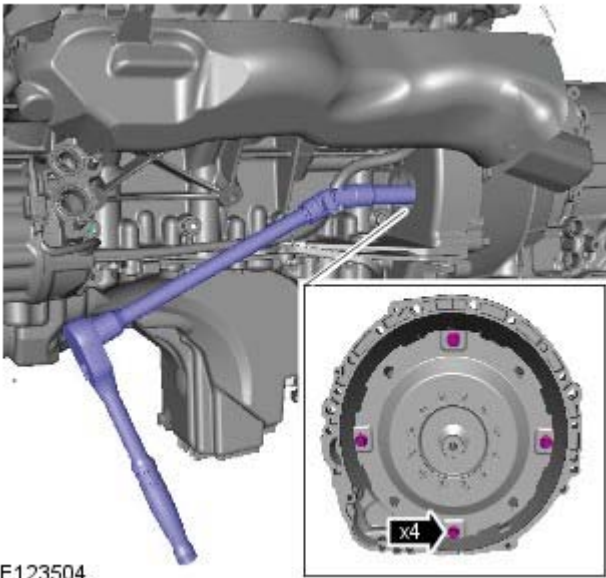
26. Torque: 8 Nm



E121893



27.



28. **28.**  **CAUTION:** Only rotate the crankshaft clockwise.

Make sure that the alignment mark is visible through the inspection hole on install of the first torque converter bolt.


Torque: 63 Nm

29. Refer to: [Front Driveshaft - V8 5.0L Petrol](#) (205-01 Driveshaft, Removal and Installation).

30. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

31. Refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).

32. Refer to: [Axle Assembly](#) (205-03 Front Drive Axle/Differential, Removal and Installation).

33. **33.**  **WARNING:** Make sure to support the vehicle with axle stands.

Lower the vehicle.

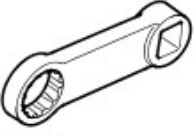
34. Install the battery.

Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

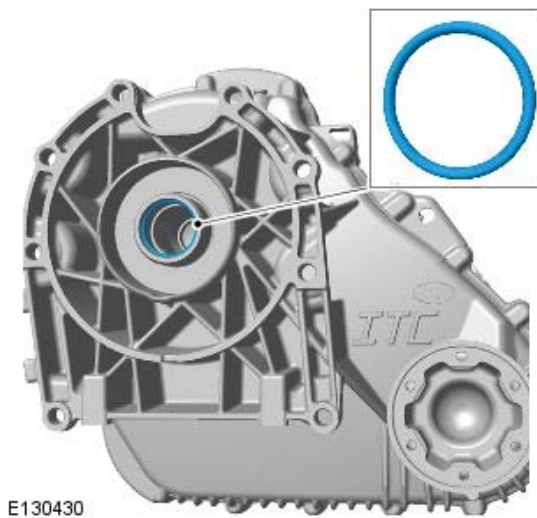
Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel - TransmissionTDV6 3.0L Diesel

Installation

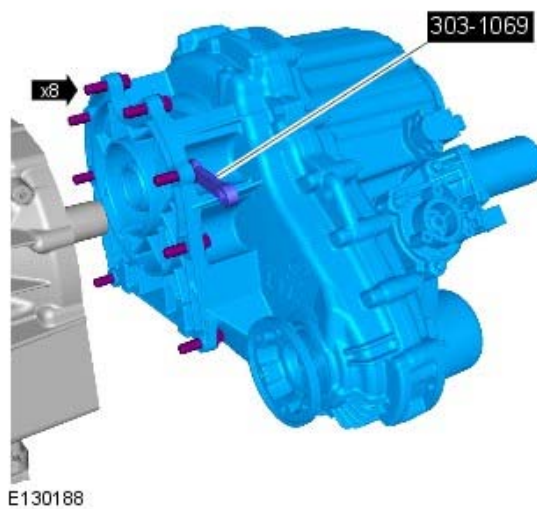
Special Tool(s)

 <p>303-1069 E53727</p>	<p>303-1069 Adaptor, Wrench</p>
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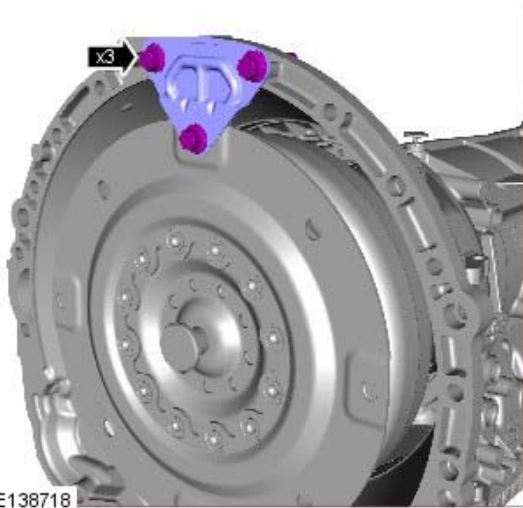
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the transmission removed for clarity.
- NOTE: Some illustrations may show the engine removed for clarity.




1. NOTE: This step is only required if previously removed.
 - NOTE: Install a new O-ring seal.

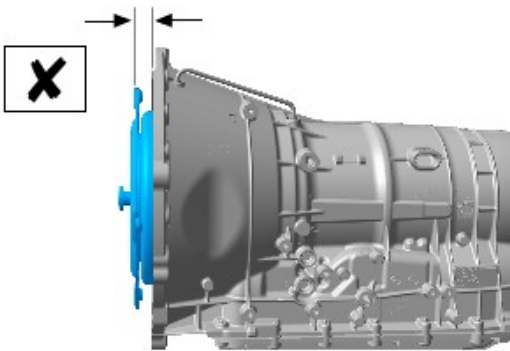


2. NOTE: This step is only required if previously removed.
 - Clean the component mating faces.
 - Lubricate input shaft splines with 'Weicon TL7391' grease.
 - *Special Tool(s)*: [303-1069](#)
 - *Torque*: 45 Nm

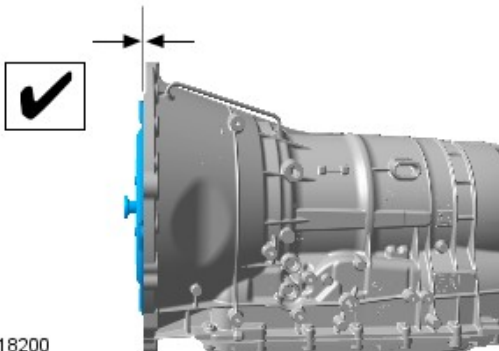


E138718

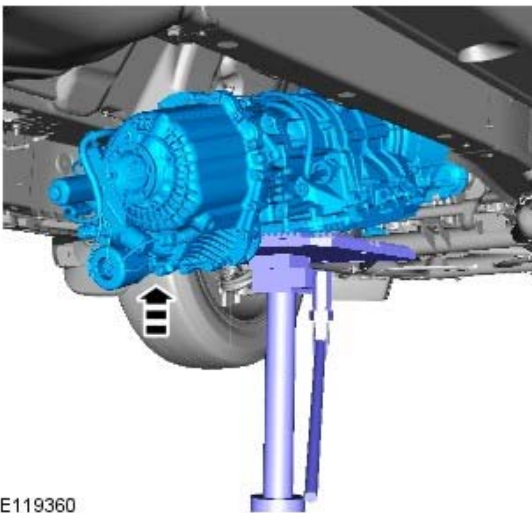
3.  CAUTION: Make sure that the torque converter remains in the transmission.



4.  CAUTION: Make sure the torque converter is fully located into the oil pump drive.



E118200

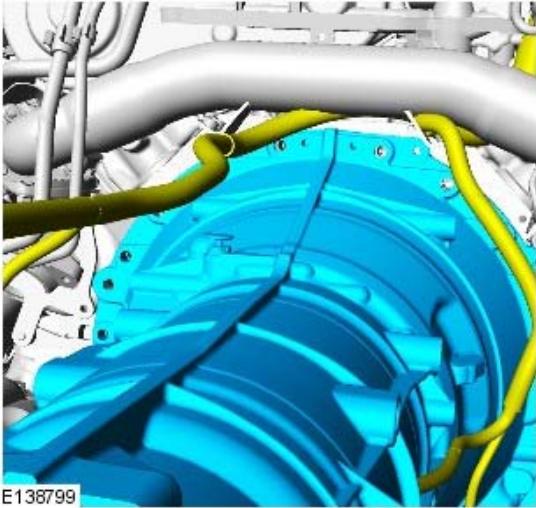


E119360


5. CAUTIONS:

 Apply grease of the correct specification to the torque converter spigot.

 Make sure that the torque converter remains in the transmission.

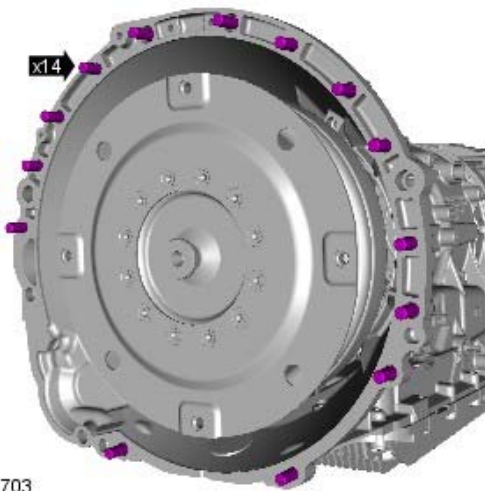


E138799

6.  CAUTION: Care must be taken to avoid damaging the transmission wiring harness.

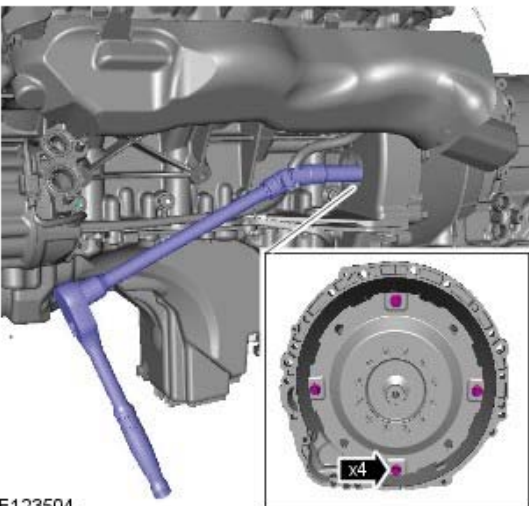
Cut the cable ties securing the harness.

7. Torque: 40 Nm



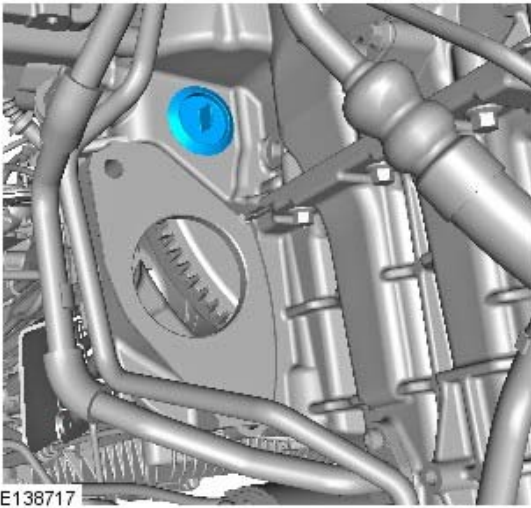
E138703

8. Torque: 63 Nm



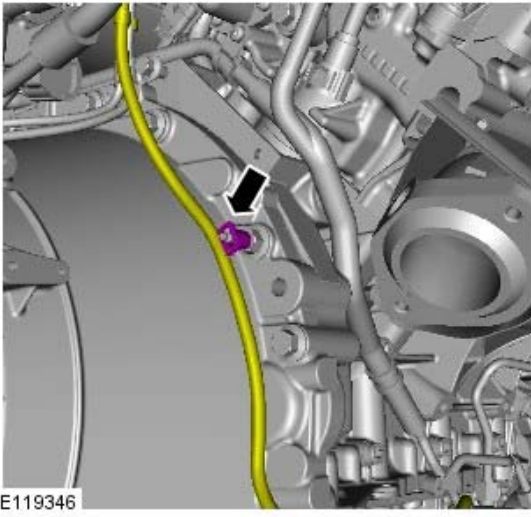
E123504

9.

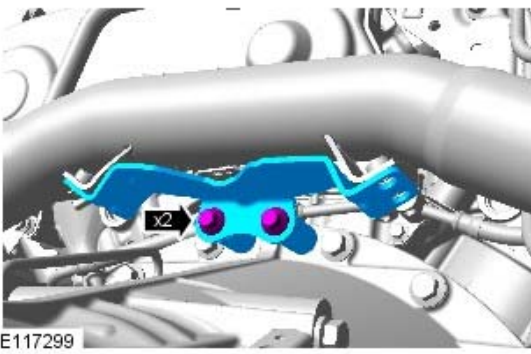


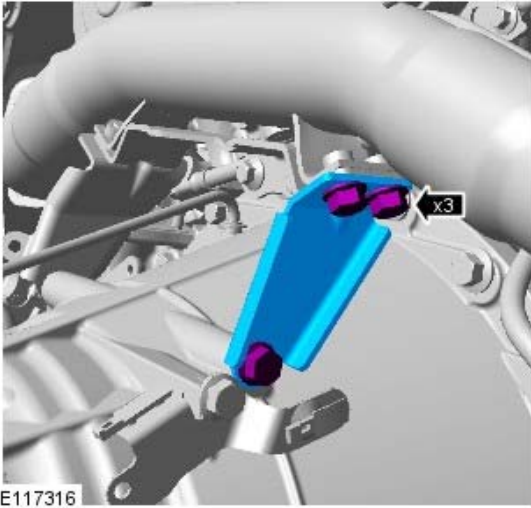
10. Refer to: Starter Motor (303-06, Removal and Installation).

11.

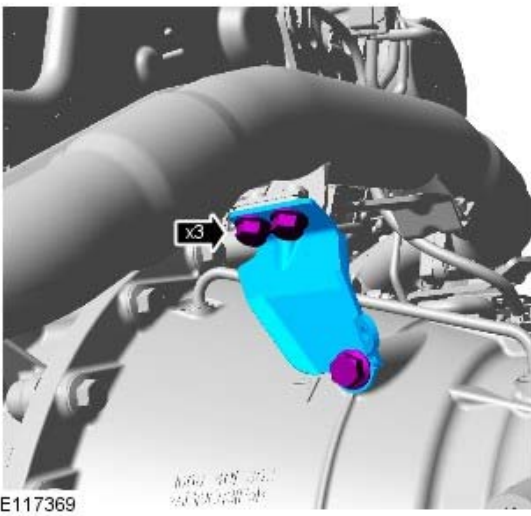


12. *Torque: 23 Nm*

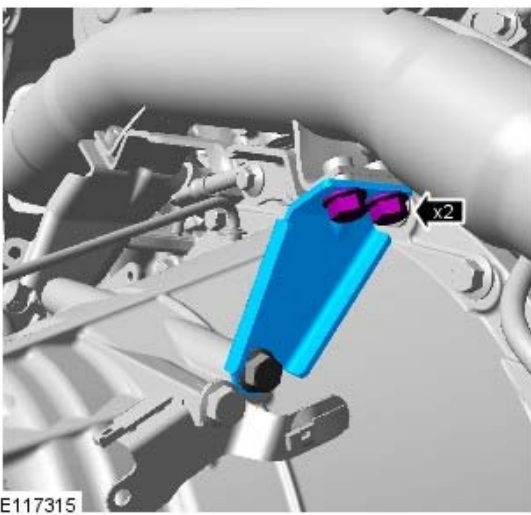




13. **13.** ⚠ CAUTION: Only tighten the bolts finger-tight at this stage.

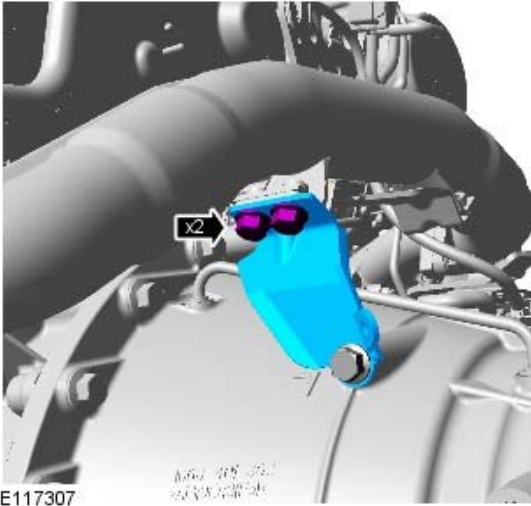


14. **14.** ⚠ CAUTION: Only tighten the bolts finger-tight at this stage.

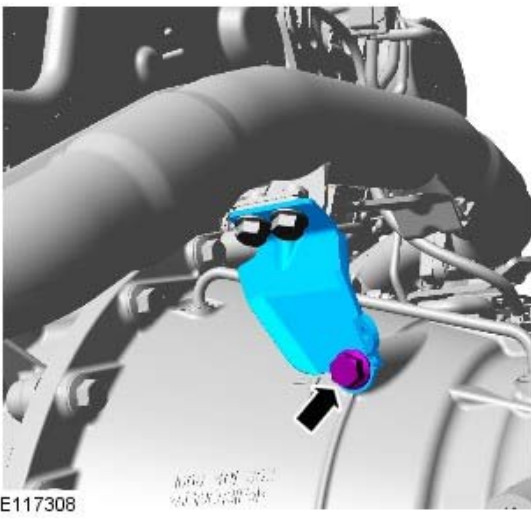


15. Torque: 23 Nm

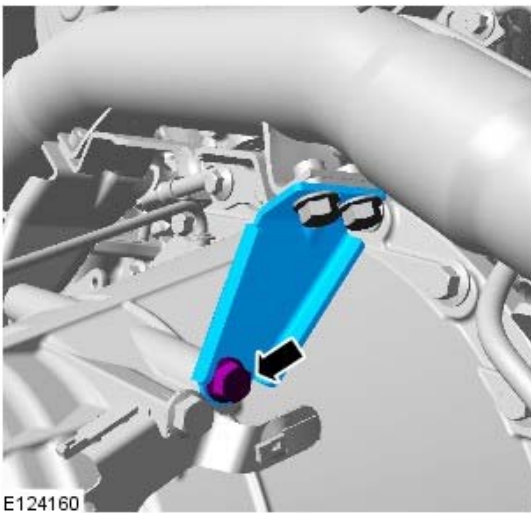
16. Torque: 23 Nm



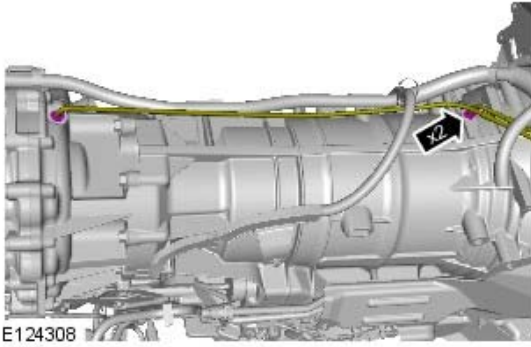
17. Torque: 23 Nm



18. Torque: 23 Nm

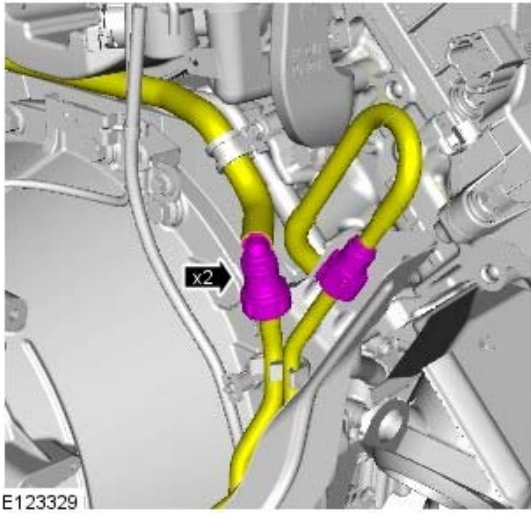


19.

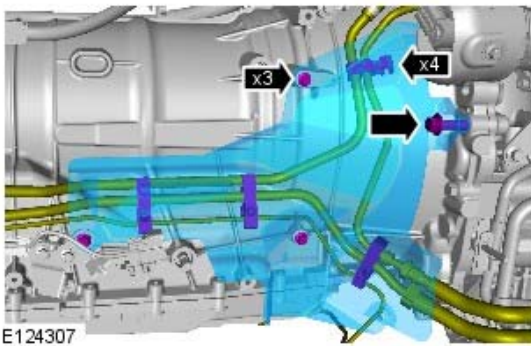


20. **⚠️ WARNING:** Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

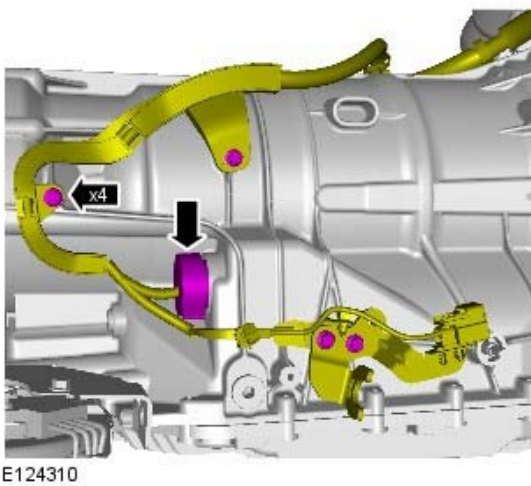
⚠️ CAUTION: Be prepared to collect escaping fluids.



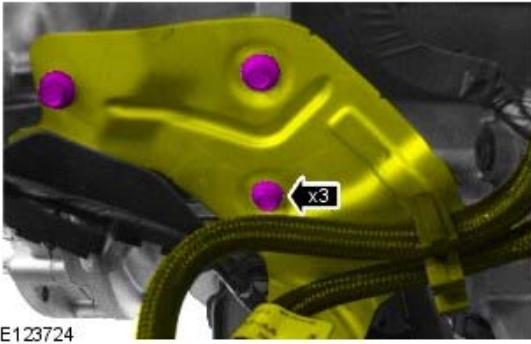
21. *Torque:*
M6 9 Nm
M10 40 Nm



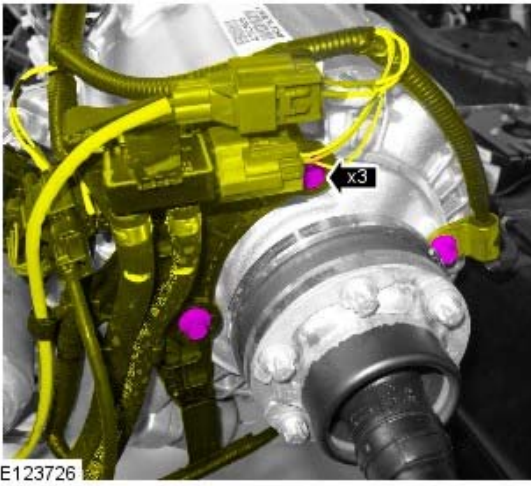
22. *Torque:* 9 Nm



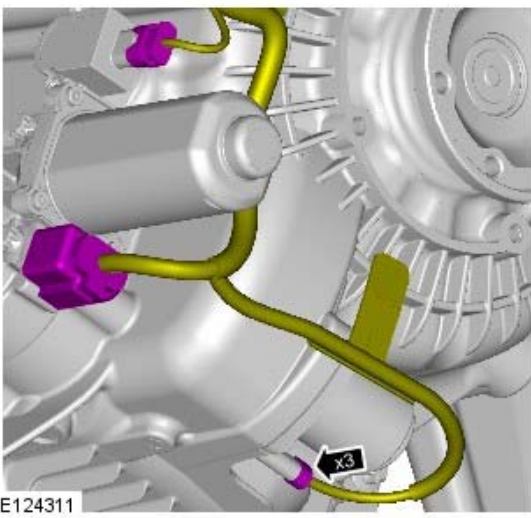
23. Torque: 9 Nm



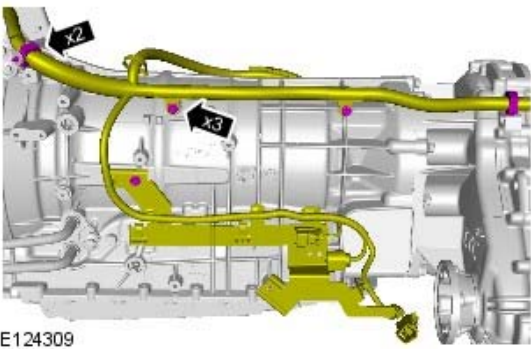
24. Torque: 9 Nm



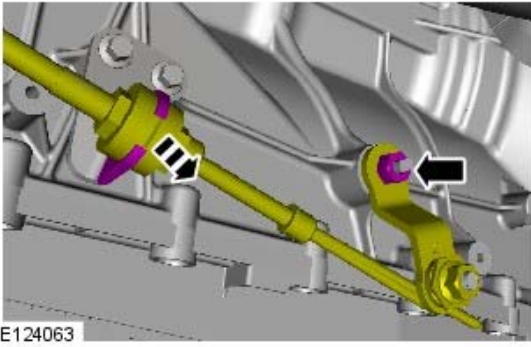
25.



26. Torque: 9 Nm

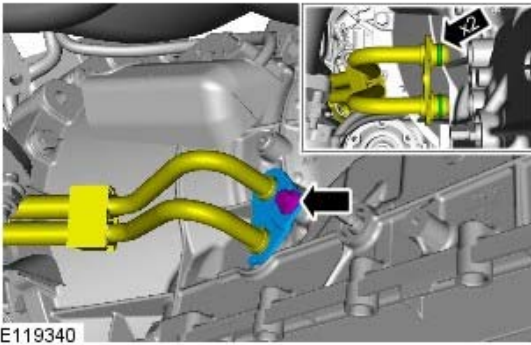


27. Torque: 12 Nm

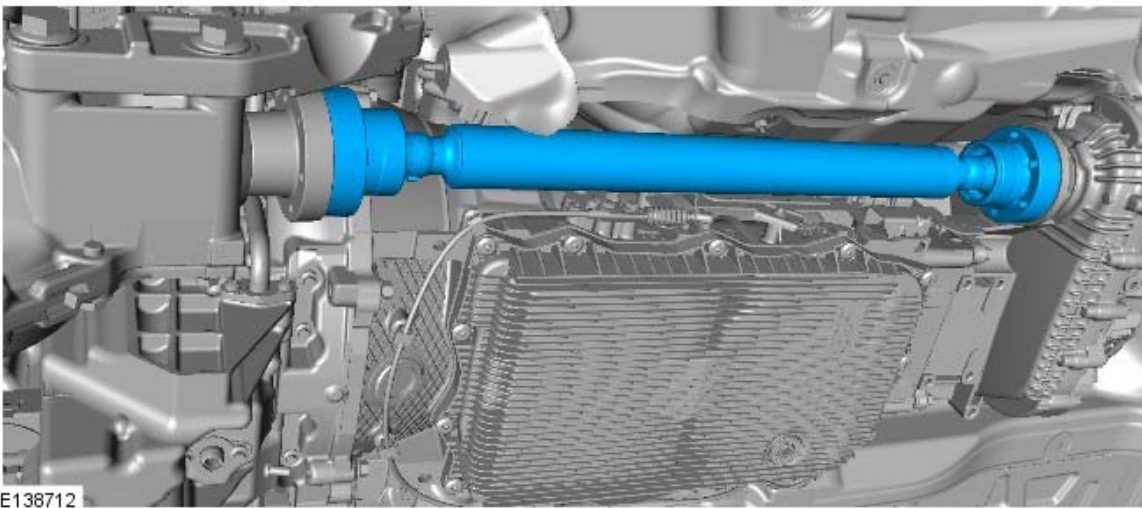


28. **28.** NOTE: Install new O-ring seals.

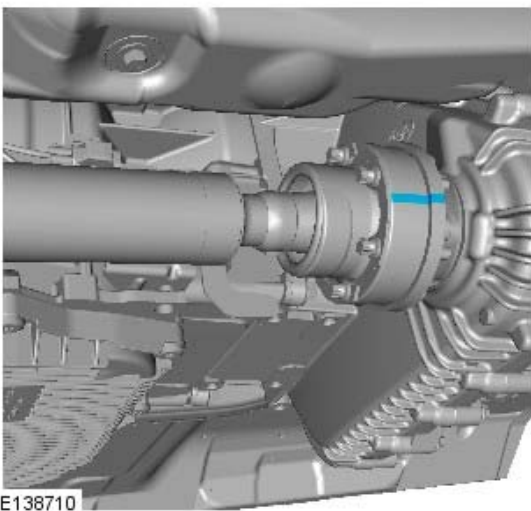
Torque: 12 Nm

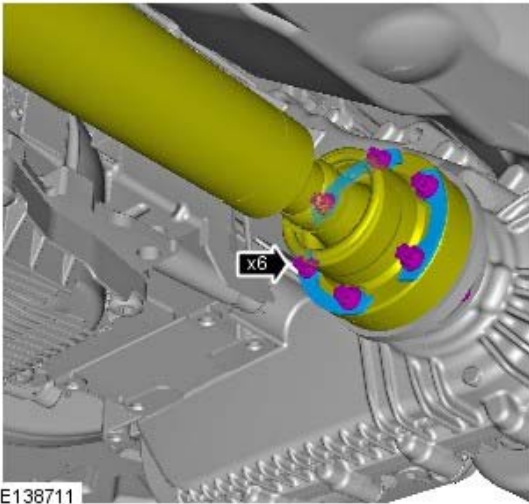


29. Using a suitable tie strap, secure the driveshaft.



30. **30.** NOTE: Make sure that the component aligns with the installation mark noted in the removal step.

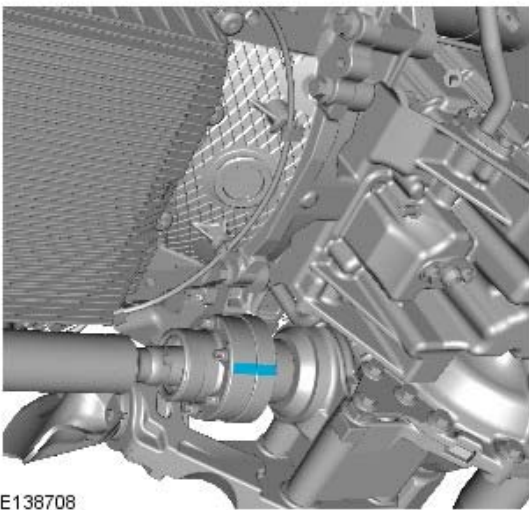




E138711

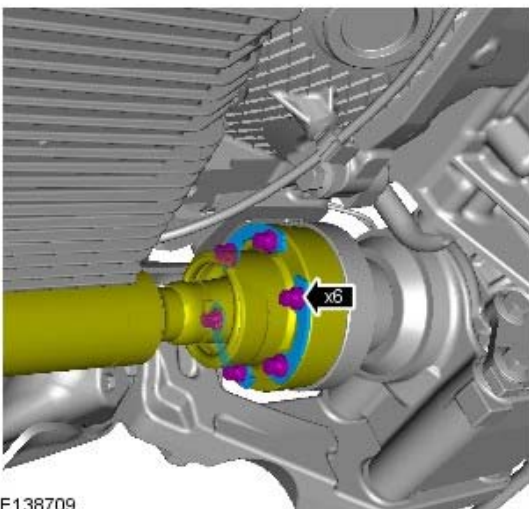
31. **31.**  CAUTION: Make sure that new bolts are installed.

Torque:
 Stage 1: 45 Nm
 Stage 2: 90°




E138708

32. **32.** NOTE: Make sure that the component aligns with the installation mark noted in the removal step.



E138709

33. **33.**  CAUTION: Make sure that new bolts are installed.

Torque:
 Stage 1: 45 Nm
 Stage 2: 90°

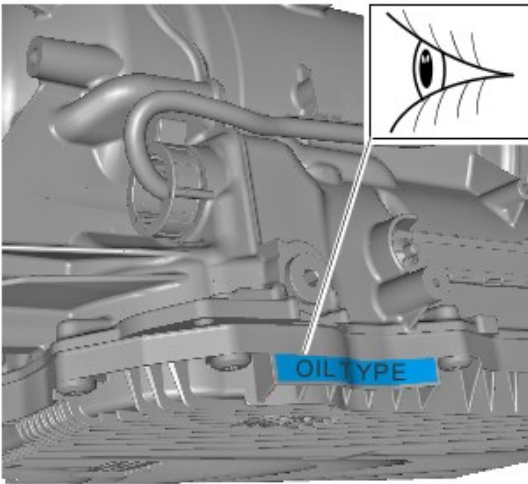
34. Refer to: [Catalytic Converter](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

- 35.
- Remove the securing straps.
 - Remove the jack supporting the transmission.

36. Refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).

37.

- Connect the battery ground cable.
- Refer to: Specifications (414-00, Specifications).



E138154

38. **38. CAUTIONS:**



Make sure the correct specification of oil is used.



Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.

• **NOTE:** Install a new fluid level filler plug.

- Carry out a transmission fluid level check.
- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (2) to the effective length of the torque wrench (1).
- Step 3. Divide the total of step 1 by the total of step 2.
- Step 4. Set the torque wrench to the figure arrived at in step 3.
- Tighten the transmission fluid fill plug to the torque given by the calculation.

Transmission/Transaxle Cooling - TDV6 2.7L Diesel - Transmission Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission cooling system, refer to the relevant Description and Operation sections in the workshop manual.

Inspection and Verification

1. **1.** Verify the customer concern by operating the system.
2. **2.** Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Feed and return tubes ● Connections to the automatic transmission and the automatic transmission fluid cooler ● Automatic transmission fluid level

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Condition	Possible Causes	Action
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid cooler	Flush out the automatic transmission fluid cooler with new automatic transmission fluid. If the flushing is unsuccessful, install a new transmission fluid cooler. REFER to: Transmission Fluid Cooler (307-02A Transmission/Transaxle Cooling - TDV6 2.7L Diesel, Removal and Installation).
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid tubes	Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid. If the flushing is unsuccessful install new automatic transmission fluid cooler tubes.
Loss of automatic transmission fluid	Connections to the automatic transmission and the automatic transmission fluid cooler	Check the integrity of the tubes, connections and seals. Check the torque of the tube fixings.
Loss of automatic transmission fluid	Leak at oil cooler	Check the integrity of tubes, connections and seals. Check the torque of the tube fixings.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transmission Control Module \(TCM\) - Bosch](#) (100-00 General Information, Description and Operation).

Transmission/Transaxle Cooling - TDV6 2.7L Diesel - Transmission Fluid Cooler

Removal and Installation

Removal

- NOTE: The transmission fluid cooler is part of the radiator assembly and cannot be serviced separately.

1. Remove the radiator.

For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

Installation

1. Install the radiator.

For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

Transmission/Transaxle Cooling - TDV6 2.7L Diesel - Transmission Fluid

Cooler Tubes

Removal and Installation

Removal

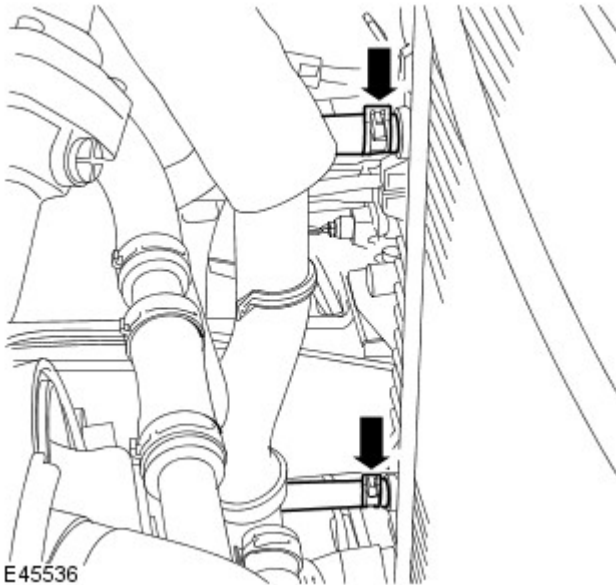
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

3. ⚠ CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- NOTE: Some fluid spillage is inevitable during this operation.
- NOTE: Fan shroud shown removed for clarity.

Disconnect the 2 transmission fluid cooler coolant hoses.

- Position a container to collect the fluid spillage.
- Release the 2 clips.



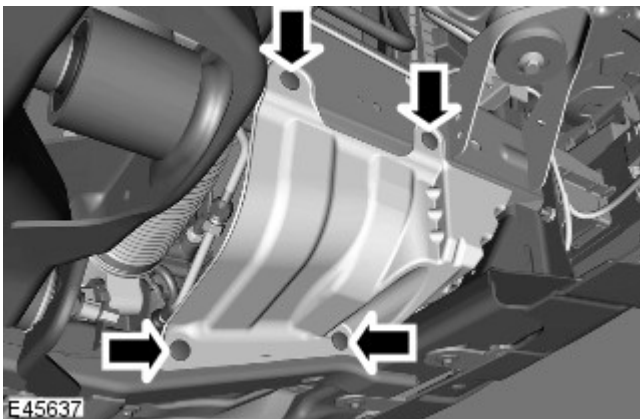
E45536

4. ⚠ WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

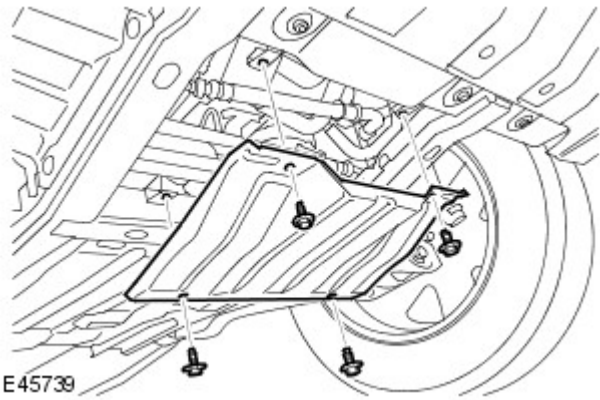
Raise and support the vehicle.

5. Remove the front LH splash shield.

- Remove the 4 clips.



E45637



6. Remove the radiator access panel.

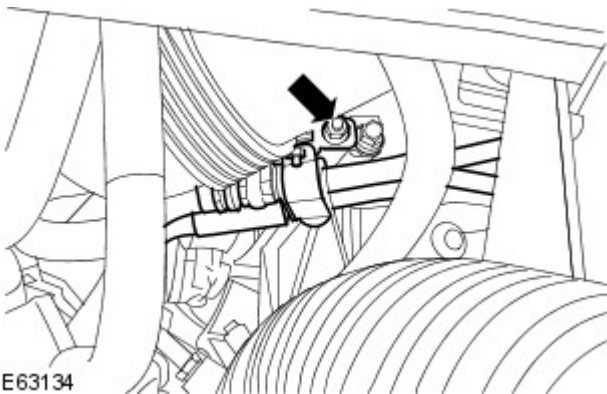
- Remove the 4 bolts.


7. Remove the front driveshaft.

For additional information, refer to: [Front Driveshaft - TDV6 2.7L Diesel](#) (205-01 Driveshaft, Removal and Installation).

8. Release the transmission fluid cooler hoses bracket.

- Remove the bolt.

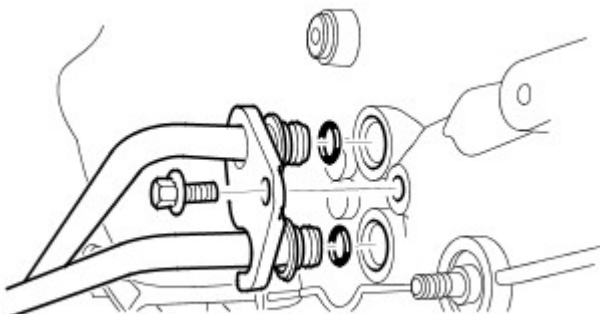


9.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** Some fluid spillage is inevitable during this operation.

Remove the transmission fluid cooler hoses.

- Position a container to collect spillage.
- Remove the bolt.



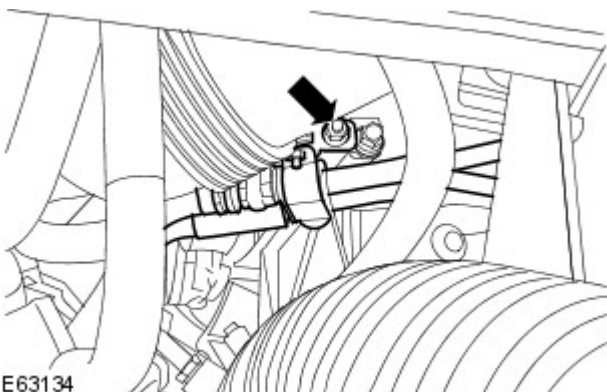
10. Remove and discard both O-ring seals.

Installation

1. To install, reverse the removal procedure.

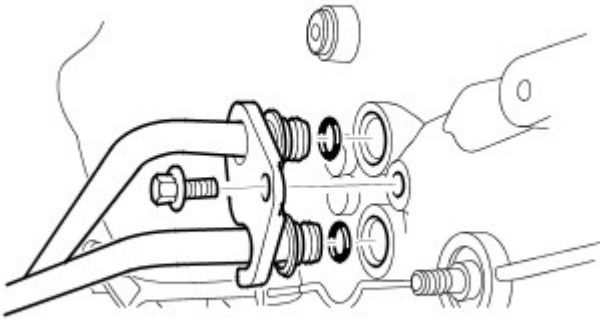
2. Install the transmission fluid cooler hoses.

- Tighten the bolt to 10 Nm.



3. Connect the transmission fluid cooler hoses.

- Tighten the bolt to 10 Nm.



E60442

4. Check and top-up the transmission fluid level.
For additional information, refer to: [Transmission Fluid Level Check](#) (307-01B Automatic Transmission/Transaxle - V6 4.0L Petrol, General Procedures).

Transmission/Transaxle Cooling - V6 4.0L Petrol - Transmission Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission cooling system, refer to the relevant Description and Operation sections in the workshop manual.

Inspection and Verification

1. **1.** Verify the customer concern by operating the system.
2. **2.** Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Feed and return tubes ● Connections to the automatic transmission and the automatic transmission fluid cooler ● Automatic transmission fluid level

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Condition	Possible Causes	Action
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid cooler	Flush out the automatic transmission fluid cooler with new automatic transmission fluid. If the flushing is unsuccessful, install a new transmission fluid cooler. REFER to: Transmission Fluid Cooler (307-02A Transmission/Transaxle Cooling - TDV6 2.7L Diesel, Removal and Installation).
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid tubes	Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid. If the flushing is unsuccessful install new automatic transmission fluid cooler tubes.
Loss of automatic transmission fluid	Connections to the automatic transmission and the automatic transmission fluid cooler	Check the integrity of the tubes, connections and seals. Check the torque of the tube fixings.
Loss of automatic transmission fluid	Leak at oil cooler	Check the integrity of tubes, connections and seals. Check the torque of the tube fixings.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transmission Control Module \(TCM\) - Bosch](#) (100-00 General Information, Description and Operation).

Transmission/Transaxle Cooling - V6 4.0L Petrol - Transmission Fluid Cooler

Removal and Installation

Removal

- NOTE: The transmission fluid cooler is part of the radiator assembly and cannot be serviced separately.

1. Remove the radiator.

For additional information, refer to: [Radiator](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).

Installation

1. Install the radiator.

For additional information, refer to: [Radiator](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).

Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel -

Lubricants

• CAUTIONS:



Do not use any lubricant other than that specified.



Do not over lubricate.

Item	Specification
Transmission fluid	ATF Shell M 1375.4 Land Rover Part No. TYK500050

Capacity

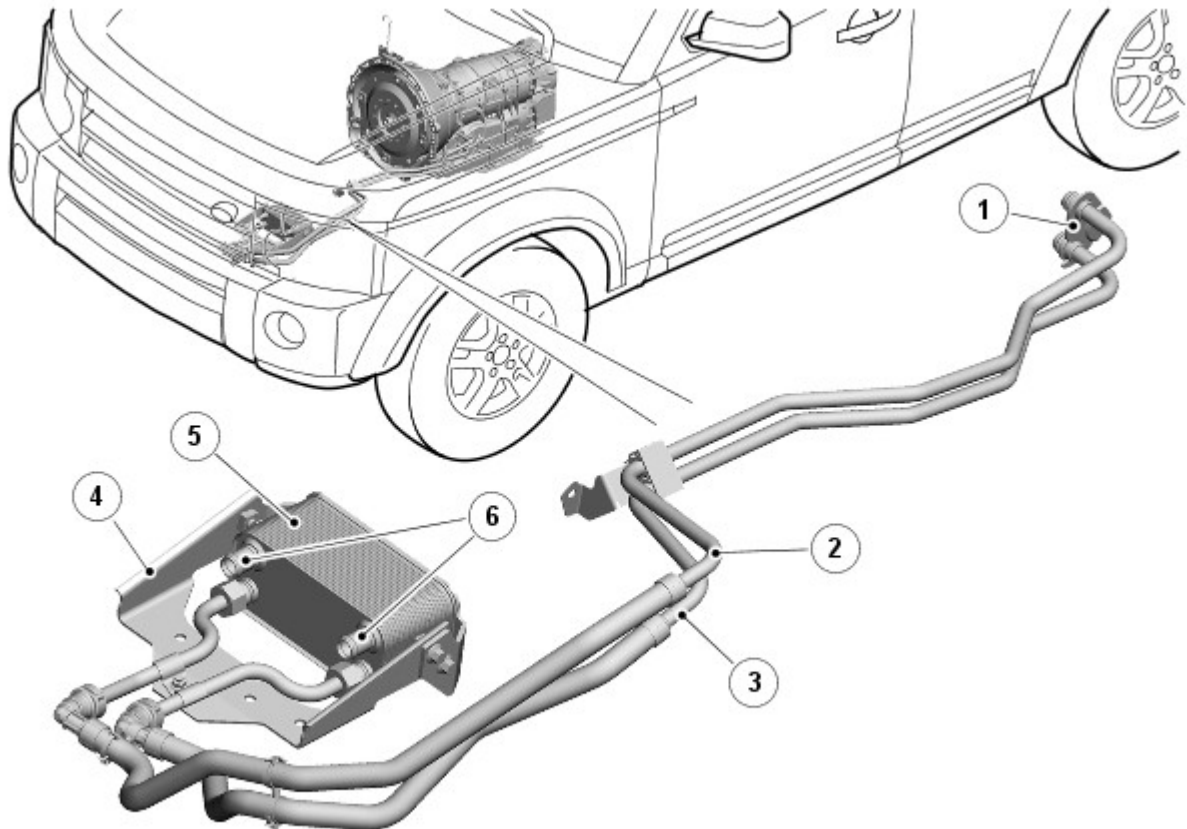
Item	Capacity
Initial dry fill	9.5 Litres (16.7 pints) (10.0 US quarts)

Torque Specification

Description	Nm	lb-ft	lb-in
Transmission fluid cooler tube to transmission housing bolt	23	17	-
Transmission fluid cooler tube bracket retaining bolt - vehicles with Engine 5.0L	10	7	-
Transmission fluid cooler tube bracket retaining nut - vehicles with Engine 3.0D	11	8	-
Transmission fluid cooler retaining bolts	25	18	-
Transmission fluid cooler tube line union to cooler	16	12	-

Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Cooling

Description and Operation



E122434

Item	Part Number	Description
1	-	Latch-plate
2	-	Return hose and pipe (to transmission)
3	-	Feed hose and pipe (from transmission)
4	-	Mounting bracket
5	-	Transmission fluid cooler
6	-	Engine coolant hose connections

INTRODUCTION

Transmission cooling is provided by a transmission fluid cooler, which transfers heat from the transmission to the engine cooling system. The transmission fluid cooler is installed in the engine compartment, on a mounting bracket attached to the crossmember of the secondary loadpath frame.

Two hose and pipe assemblies connect the transmission fluid cooler to the automatic transmission. Two engine coolant hose connections are incorporated into the transmission fluid cooler for the supply and return of coolant from the engine cooling system.

For additional information, refer to: [Engine Cooling](#) (303-03D Engine Cooling - V8 5.0L Petrol, Description and Operation).

Fluid from the pump in the automatic transmission flows through the feed hose and pipe to the transmission fluid cooler. The fluid then flows through the transmission fluid cooler, and the return hose and pipe, to the sump of the automatic transmission.

Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the automatic transmission cooling system, refer to the relevant Description and Operation sections in the workshop manual.

Inspection and Verification

1. 1. Verify the customer concern by operating the system.
2. 2. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Feed and return tubes ● Connections to the automatic transmission and the automatic transmission fluid cooler ● Automatic transmission fluid level

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Condition	Possible Causes	Action
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid cooler	Flush out the automatic transmission fluid cooler with new automatic transmission fluid. If the flushing is unsuccessful, install a new transmission fluid cooler. REFER to: Transmission Fluid Cooler (307-02A Transmission/Transaxle Cooling - TDV6 2.7L Diesel, Removal and Installation).
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid tubes	Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid. If the flushing is unsuccessful install new automatic transmission fluid cooler tubes.
Loss of automatic transmission fluid	Connections to the automatic transmission and the automatic transmission fluid cooler	Check the integrity of the tubes, connections and seals. Check the torque of the tube fixings.
Loss of automatic transmission fluid	Leak at oil cooler	Check the integrity of tubes, connections and seals. Check the torque of the tube fixings.

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transmission Control Module \(TCM\) - Siemens](#) (100-00 General Information, Description and Operation).

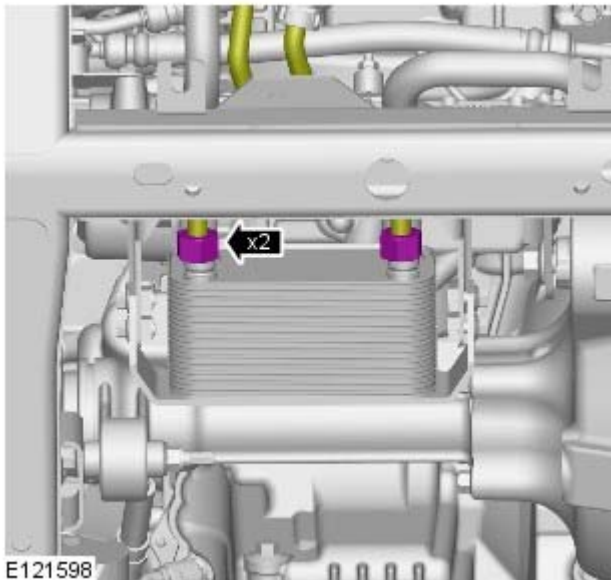
Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Fluid Cooler V8 5.0L Petrol


Removal and Installation


Removal

- NOTE: Removal steps in this procedure may contain installation details.

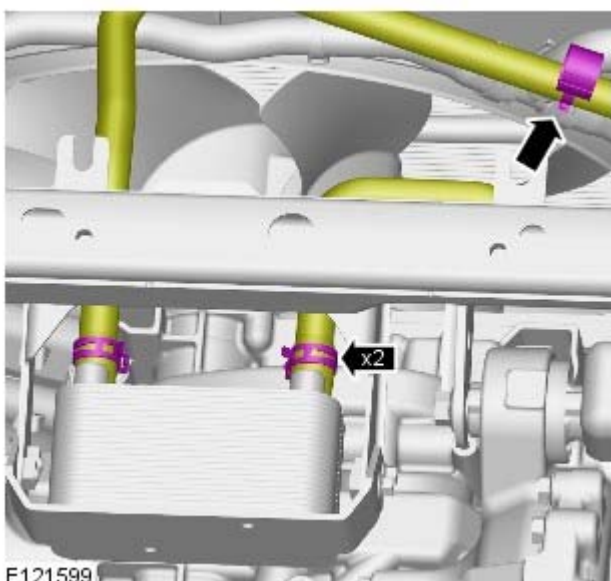
1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
3. Refer to: [Transmission Fluid Level Check](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).




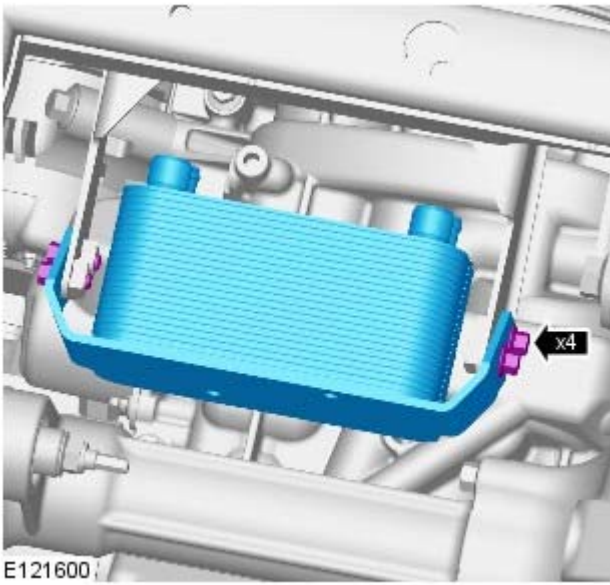
4.  **WARNING:** Be prepared to collect escaping fluids.

 **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

Torque: 16 Nm



5.  **WARNING:** Be prepared to collect escaping fluids.



6. Torque: 25 Nm

Installation


1. To install, reverse the removal procedure.

Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Fluid CoolerTDV6 3.0L Diesel

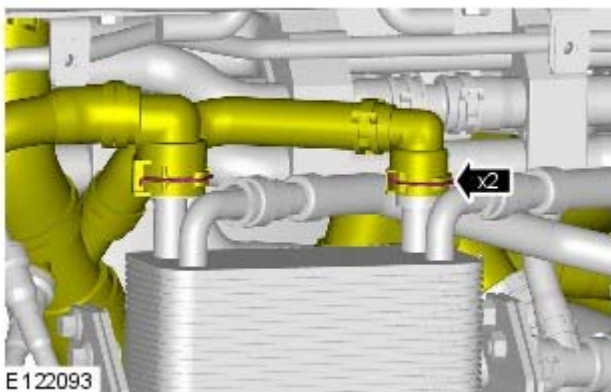
Removal and Installation


Removal

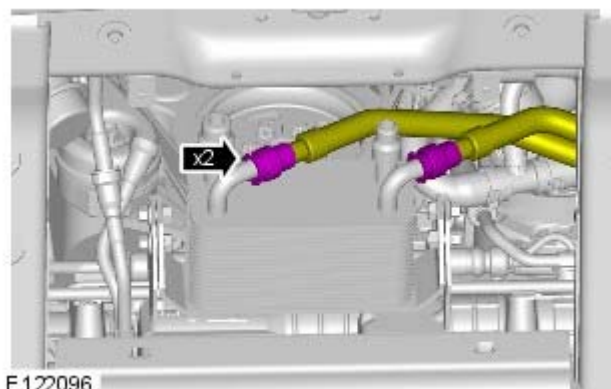
• NOTE: Removal steps in this procedure may contain installation details.


1.  **WARNING:** Make sure to support the vehicle with axle stands.


Raise and support the vehicle.
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
3. Refer to: [Transmission Fluid Level Check](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, General Procedures).

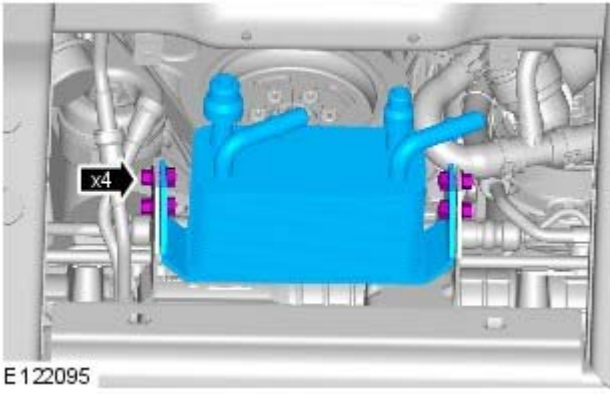


4.  **WARNING:** Be prepared to collect escaping fluids.



5.  **WARNING:** Be prepared to collect escaping fluids.

 **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.



6. *Torque:* 23 Nm

Installation

1. To install, reverse the removal procedure.

Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Fluid Cooler Tubes V8 5.0L Petrol

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

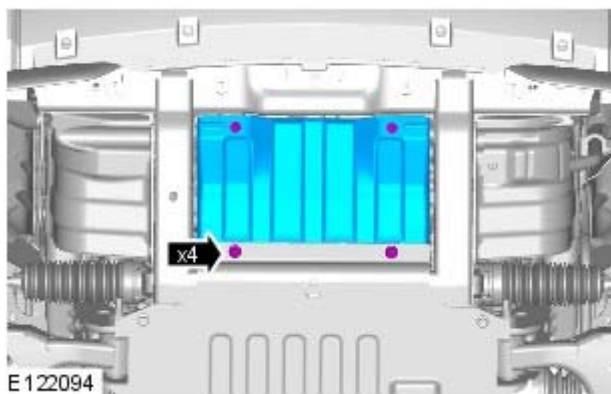
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

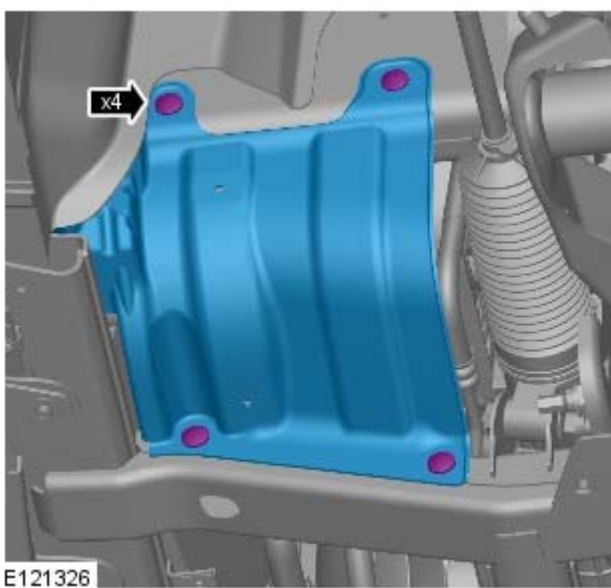
2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

3. Remove the LH front road wheel.

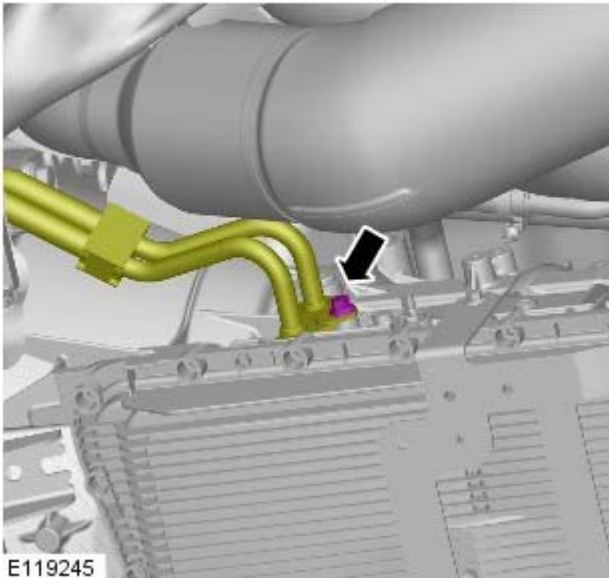
Torque: 140 Nm



4. *Torque: 10 Nm*



- 5.

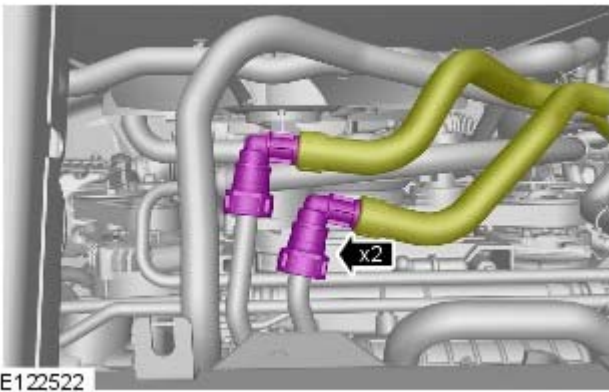


6.  **WARNING:** Be prepared to collect escaping fluids.


 **CAUTION:** Always plug any open connections to prevent contamination.

• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

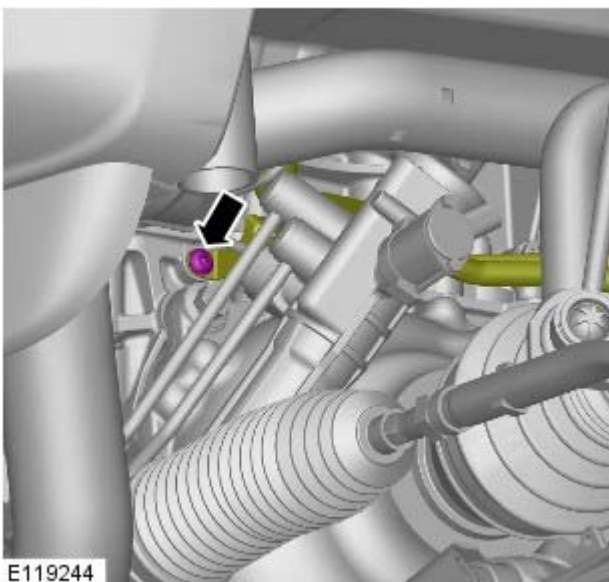
Torque: 23 Nm



7.  **WARNING:** Be prepared to collect escaping fluids.

 **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

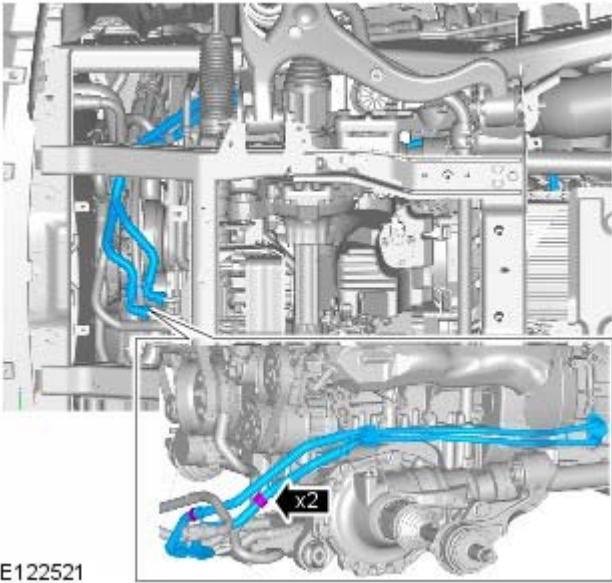
Torque: 16 Nm



8. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 10 Nm

9.



E122521

Installation

1. To install, reverse the removal procedure.

Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel - Transmission Fluid Cooler Tubes TDV6 3.0L Diesel

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

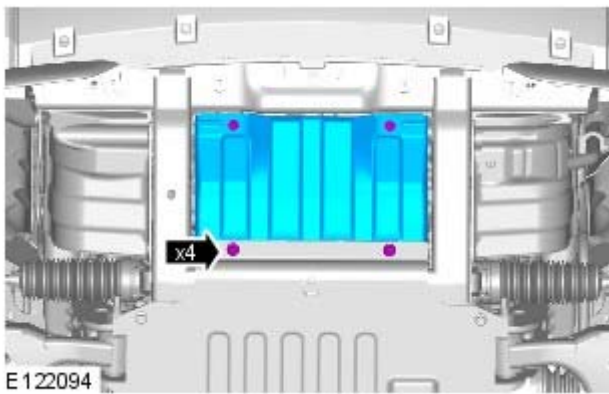
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

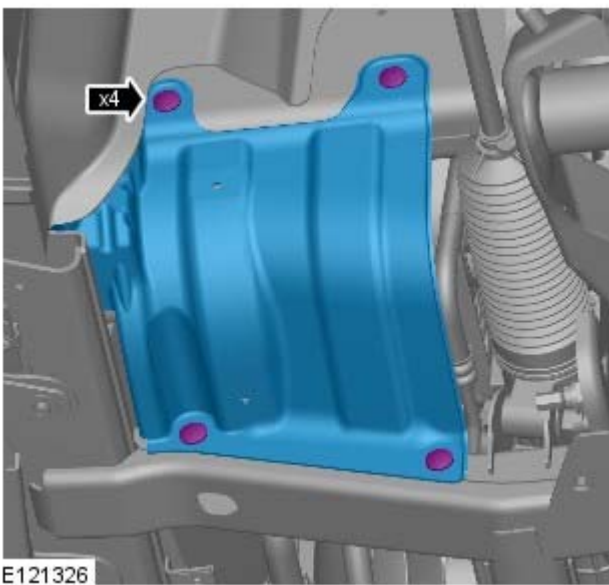
2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

3. Remove the LH front road wheel.

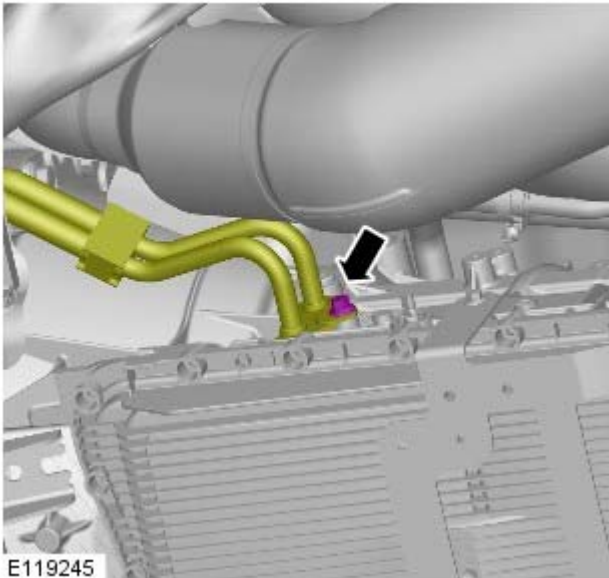
Torque: 140 Nm




4. *Torque:* 10 Nm



- 5.

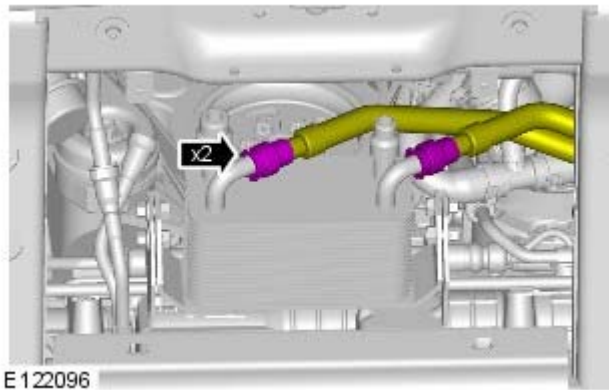



6.  **WARNING:** Be prepared to collect escaping fluids.


 **CAUTION:** Always plug any open connections to prevent contamination.

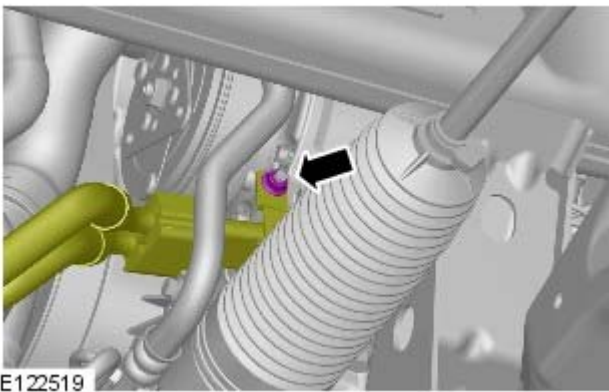
• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 23 Nm

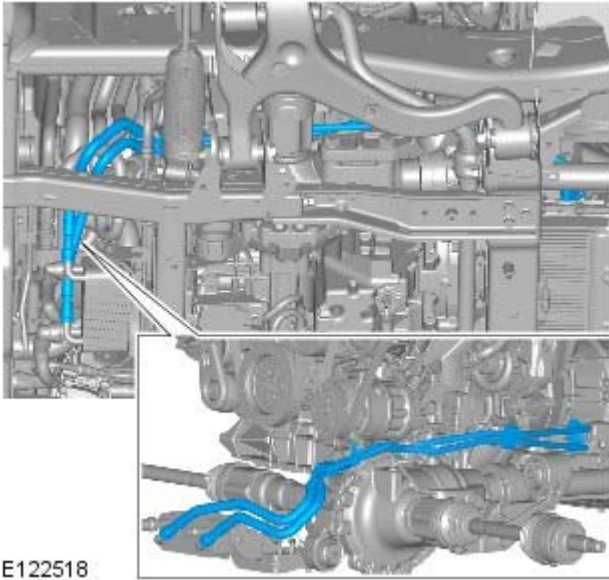


7.  **WARNING:** Be prepared to collect escaping fluids.

 **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.



8. *Torque:* 11 Nm



9.  **WARNING:** Be prepared to collect escaping fluids.

Installation

1. To install, reverse the removal procedure.

Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel -

Item	Specification
Type	Cable operated from shift mechanism to bellcrank on side of gearbox with manual release from Park 'P' position in the event of electrical failure

Torque Specifications

Description	Nm	lb-ft
Selector lever locknut	14	10
Transmission heat shield bolts	10	7
Transmission undershield bolts	10	7
Transmission selector nuts	8*	6

*Before VIN257100, discard old fixings and tighten new fixings to the torque value given.

Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel - External Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the automatic transmission/transaxle external controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check for correct gear selector lever cable adjustment. REFER to: Selector Lever Cable Adjustment (307-05A Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel, General Procedures). ● Visibly worn or damaged components ● Loose or missing fasteners 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors


3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.


Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel - Selector Lever Cable Adjustment

General Procedures

1.  **WARNING:** The hand brake and foot brake **MUST BE** applied.

Check for correct cable adjustment.

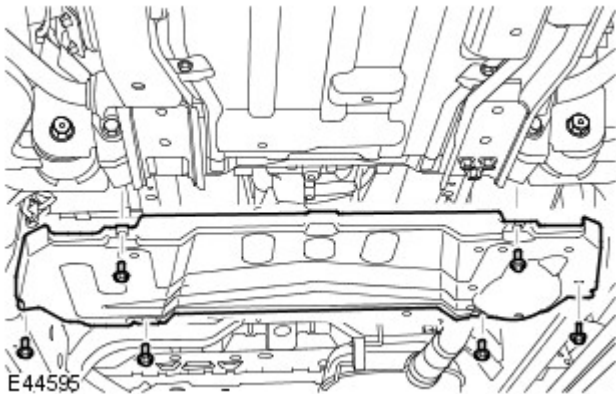
- Move the selector lever from 'P' position, check engagement in each position and return to 'P'.
- Check that the engine will start in 'P' and 'N' positions and that the engine start is inhibited when drive positions are selected.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

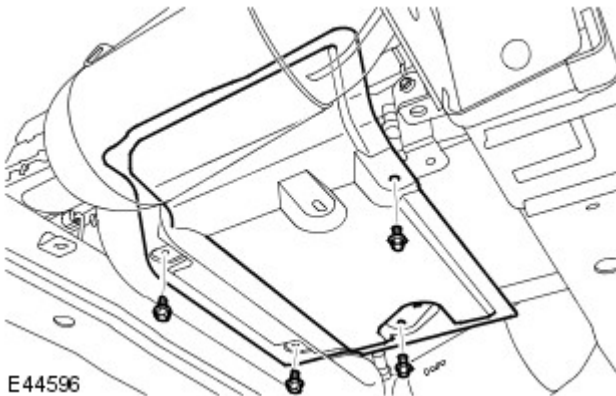
3. Remove the transmission undershield.

- Remove the 6 bolts.



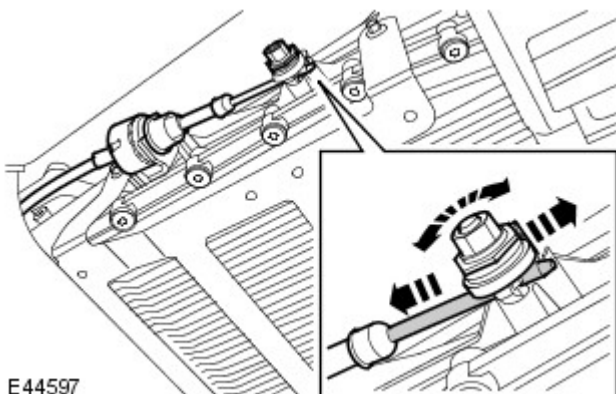
4. If installed, remove the transmission heat shield.

- Remove the 4 bolts.



5. Adjust the selector cable.

- Using an additional wrench, restrain the clamping bush and loosen the locknut.
- Move the selector lever on the gearbox fully forward and release it. The lever will return to the 'P' position.
- Make sure the selector lever is in the 'P' position.
- Push the cable inner rearward then release it.
- Tighten the locknut to 14 Nm (10 lb.ft).



6.  **WARNING:** The hand brake and foot brake **MUST BE** applied.

Check for correct cable adjustment.

- Move the selector lever from 'P' position, check engagement in each position and return to 'P'.
- Check that the engine will start in 'P' and 'N' positions and that the engine start is inhibited when drive positions are selected.

7. If installed, install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).


8. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).

Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel - Selector Lever Assembly

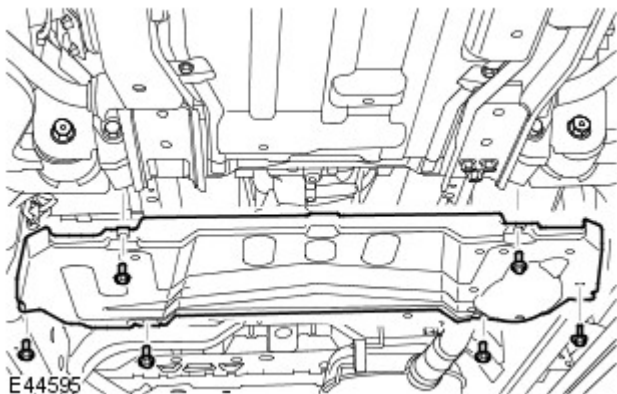
Removal and Installation

Removal

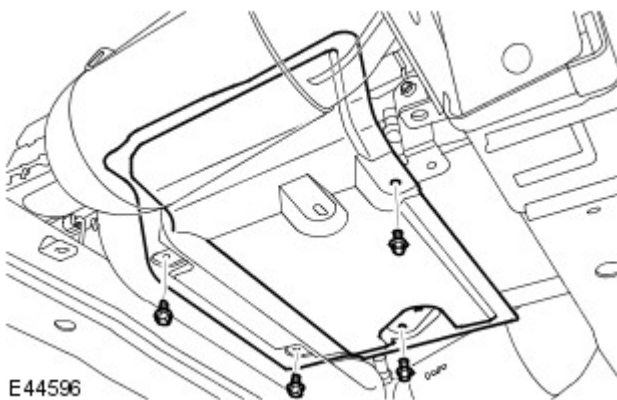
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

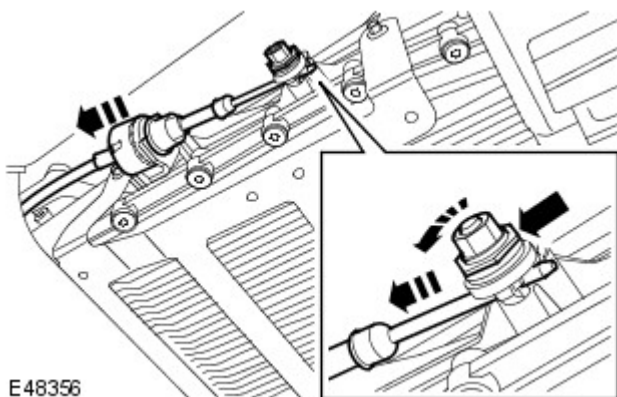
- If installed, remove the transmission undershield.
 - Remove the 6 bolts.



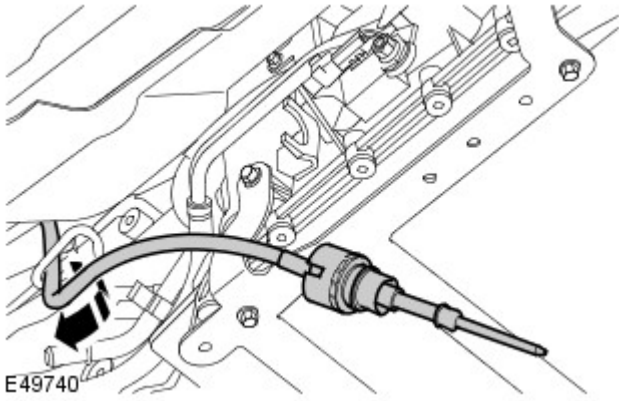
- Remove the transmission heat shield.
 - Remove the 4 bolts.



- Release the selector cable.
 - Using an additional wrench, restrain the clamping bush and loosen the locknut.
 - Compress the latch and release the cable.



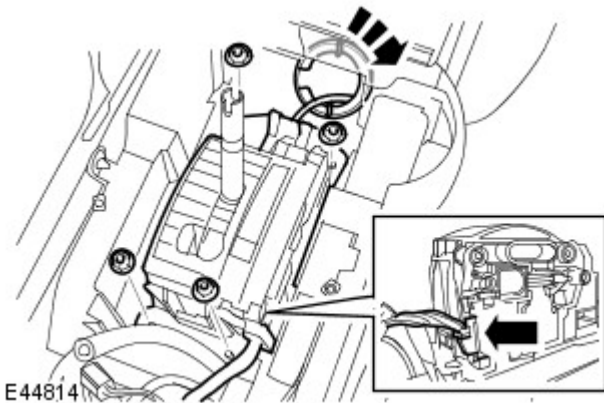
5. Release the selector cable from its guide bracket.



6. Remove the floor console upper trim panel.

7. Remove the transmission selector lever.

- Remove the 3 nuts.
- Disconnect the electrical connector.
- Release the selector cable from the body.



Installation

1. Install the transmission selector lever.

- Secure the cable to the floor.
- Connect the electrical connector.
- Tighten the nuts to 8 Nm (6 lb.ft). Before VIN257100, discard old fixings.

2. **NOTE:** Do not tighten the locking nut at this stage.

Connect the selector cable to the transmission.

- Engage the inner cable with the lever clamping bush.
- Connect the selector cable to its abutment bracket.

3. Position the selector cable to its guide bracket.

4. Install the floor console upper trim panel.

5. Adjust the selector cable.

6. Install the transmission heat shield.

- Tighten the bolts to 10 Nm (8 lb.ft).

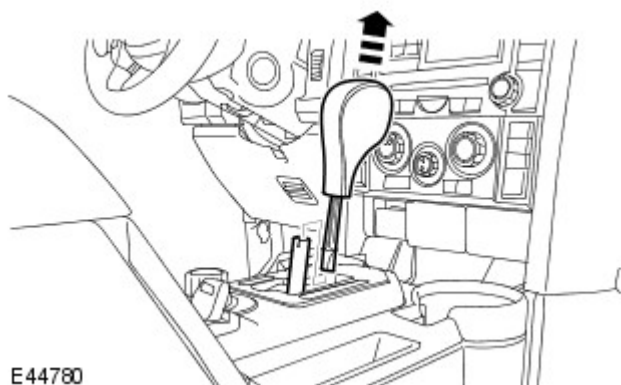
7. If installed, install the transmission undershield.

- Tighten the bolts to 10 Nm (8 lb.ft).

Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel - Selector Lever Knob

Removal and Installation

Removal



1.  **WARNING:** The gear lever knob will be released suddenly, keep face clear during removal.

Remove the selector lever knob.

- Pull the knob upwards.

Installation

1.  **CAUTION:** Only fit the selector knob when the selector lever is in the 'P' position.


Install the selector lever knob.

- Engage the locating tang of the knob with the slot in the selector lever.
- Push the knob fully onto the selector lever.

Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel - Selector Lever Cable

Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission selector lever.
For additional information, refer to: Shift Selector (307-01, In-vehicle Repair).
3. Remove the selector lever cable.
 - Remove the clip.
 - Release the cable.



E44788

Installation

1. Install the selector lever cable.
 - Clean the components.
 - Secure the cable.
 - Install the clip.
2. Install the transmission selector lever.
For additional information, refer to: Shift Selector (307-01, In-vehicle Repair).

Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel - Selector Lever Gate Finish Panel

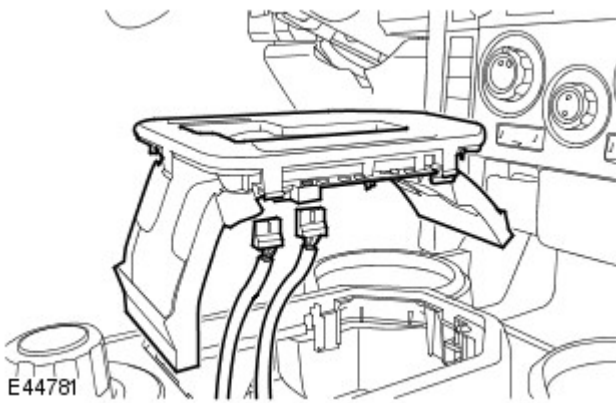
Removal and Installation

Removal

1. Remove the selector lever knob.
For additional information, refer to: [Selector Lever Knob](#) (307-05A Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel, Removal and Installation).

2. Remove the selector lever gate finish panel.

- Carefully release the gate finish panel.
- Disconnect the 2 electrical connectors.



Installation

1. Install the selector lever gate finish panel.

- Connect the electrical connectors.

2. Install the selector lever knob.

For additional information, refer to: [Selector Lever Knob](#) (307-05A Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel, Removal and Installation).

Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol -

Item	Specification
Type	Cable operated from shift mechanism to bellcrank on side of gearbox with manual release from Park 'P' position in the event of electrical failure

Torque Specifications

Description	Nm	lb-ft
Transmission heat shield bolts	10	7
Transmission undershield bolts	10	7
Transmission selector nuts	10	7
Transmission selector cable locknut	14	10

Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol - External Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the automatic transmission/transaxle external controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check for correct gear selector lever cable adjustment. REFER to: Selector Lever Cable Adjustment (307-05A Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel, General Procedures). ● Visibly worn or damaged components ● Loose or missing fasteners 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.


Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol - Selector Lever Cable Adjustment

General Procedures

1.  **WARNING:** The hand brake and foot brake **MUST BE** applied.

Check for correct cable adjustment.

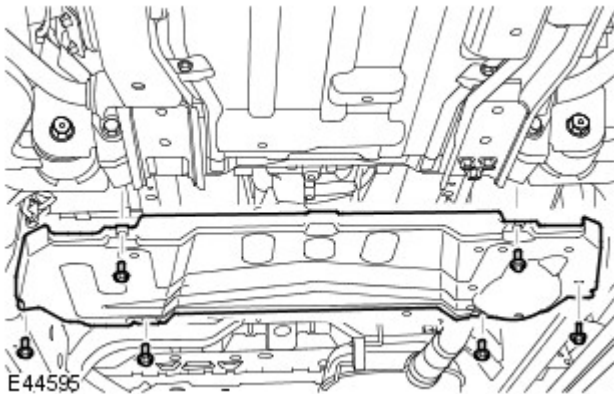
- Move the selector lever from 'P' position, check engagement in each position and return to 'P'.
- Check that the engine will start in 'P' and 'N' positions and that the engine start is inhibited when drive positions are selected.

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

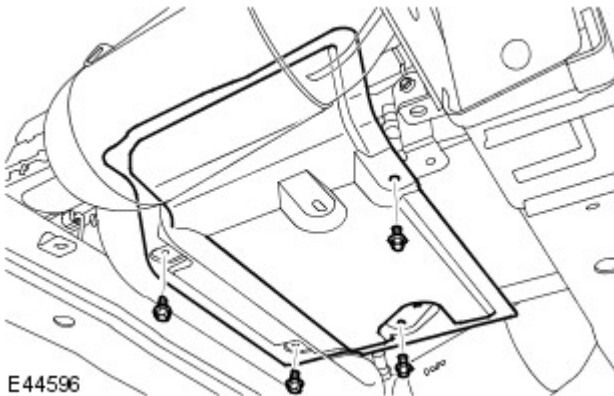
3. Remove the transmission undershield.

- Remove the 6 bolts.



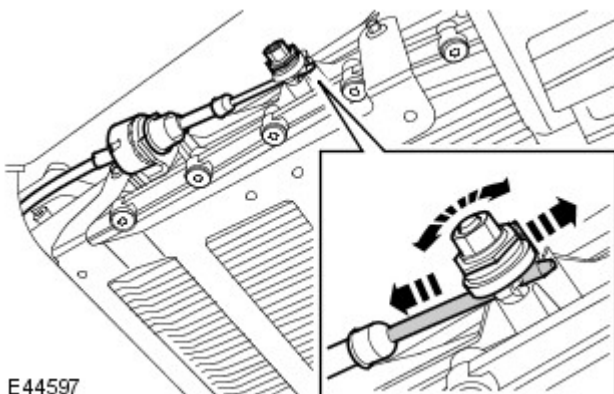
4. If installed, remove the transmission heat shield.

- Remove the 4 bolts.



5. Adjust the selector cable.

- Using an additional wrench, restrain the clamping bush and loosen the locknut.
- Move the selector lever on the gearbox fully forward and release it. The lever will return to the 'P' position.
- Make sure the selector lever is in the 'P' position.
- Push the cable inner rearward then release it.
- Tighten the locknut to 14 Nm (10 lb.ft).



6.  **WARNING:** The hand brake and foot brake **MUST BE** applied.

Check for correct cable adjustment.

- Move the selector lever from 'P' position, check engagement in each position and return to 'P'.
- Check that the engine will start in 'P' and 'N' positions and that the engine start is inhibited when drive positions are selected.

7. If installed, install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).


8. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).

Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol - Selector Lever Assembly

Removal and Installation

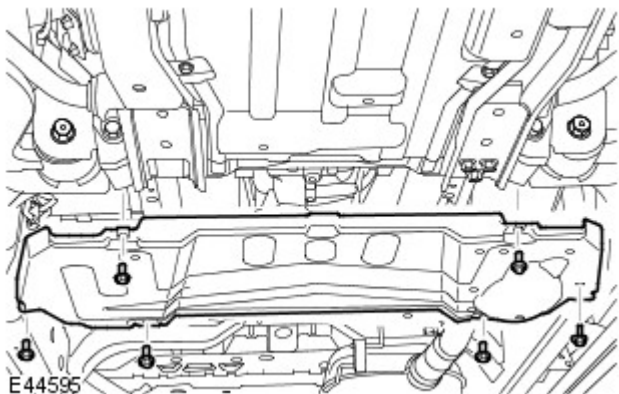
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

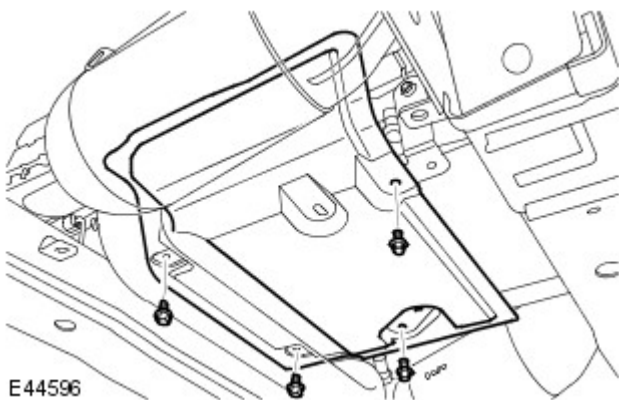
2. If installed, remove the transmission undershield.

- Remove the 6 bolts.



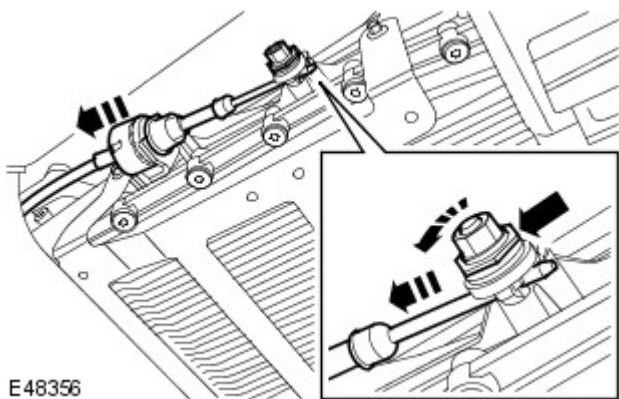
3. Remove the transmission heat shield.

- Remove the 4 bolts.

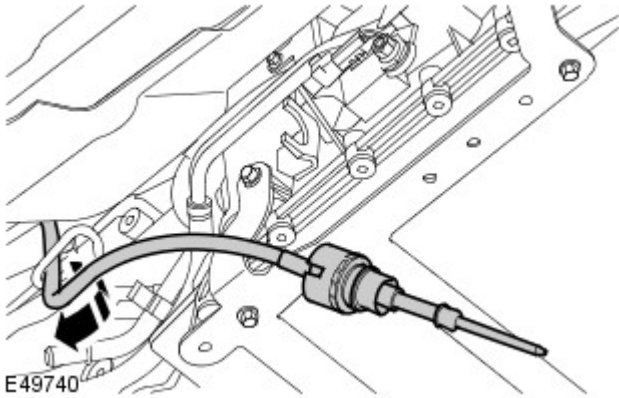


4. Release the selector cable.

- Using an additional wrench, restrain the clamping bush and loosen the locknut.
- Compress the latch and release the cable.



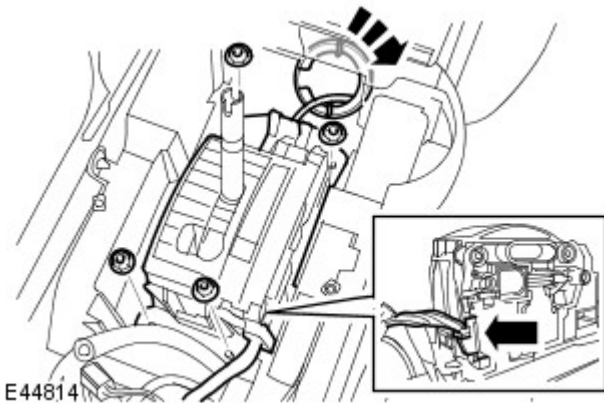
5. Release the selector cable from its guide bracket.



6. Remove the floor console upper trim panel.

7. Remove the transmission selector lever.

- Remove the 3 nuts.
- Disconnect the electrical connector.
- Release the selector cable from the body.



Installation

1. Install the transmission selector lever.

- Secure the cable to the floor.
- Connect the electrical connector.
- Tighten the nuts to 8 Nm (6 lb.ft). Before VIN257100, discard old fixings.

2. **NOTE:** Do not tighten the locking nut at this stage.

Connect the selector cable to the transmission.

- Engage the inner cable with the lever clamping bush.
- Connect the selector cable to its abutment bracket.

3. Position the selector cable to its guide bracket.

4. Install the floor console upper trim panel.

5. Adjust the selector cable.

6. Install the transmission heat shield.

- Tighten the bolts to 10 Nm (8 lb.ft).

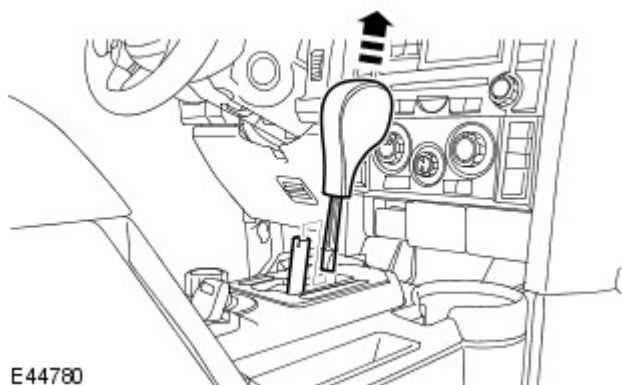
7. If installed, install the transmission undershield.

- Tighten the bolts to 10 Nm (8 lb.ft).

Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol - Selector Lever Knob

Removal and Installation

Removal



E44780

1.  **WARNING:** The gear lever knob will be released suddenly, keep face clear during removal.

Remove the selector lever knob.

- Pull the knob upwards.

Installation

1.  **CAUTION:** Only fit the selector knob when the selector lever is in the 'P' position.


Install the selector lever knob.

- Engage the locating tang of the knob with the slot in the selector lever.
- Push the knob fully onto the selector lever.

Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol - Selector Lever Cable

Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission selector lever.
For additional information, refer to: Shift Selector (307-01, In-vehicle Repair).
3. Remove the selector lever cable.
 - Remove the clip.
 - Release the cable.



E44788

Installation

1. Install the selector lever cable.
 - Clean the components.
 - Secure the cable.
 - Install the clip.
2. Install the transmission selector lever.
For additional information, refer to: Shift Selector (307-01, In-vehicle Repair).

Automatic Transmission/Transaxle External Controls - V6 4.0L Petrol - Selector Lever Gate Finish Panel

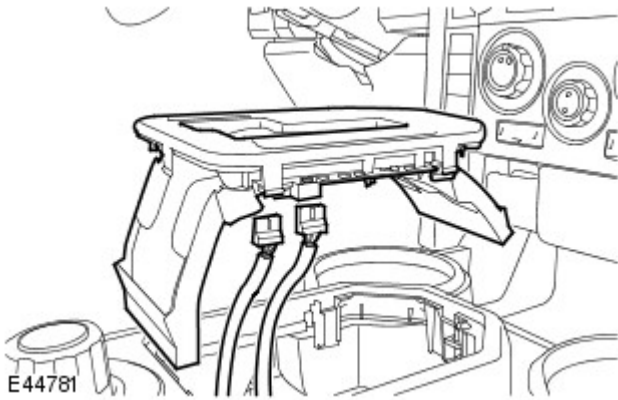
Removal and Installation

Removal

1. Remove the selector lever knob.
For additional information, refer to: [Selector Lever Knob](#) (307-05A Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel, Removal and Installation).

2. Remove the selector lever gate finish panel.

- Carefully release the gate finish panel.
- Disconnect the 2 electrical connectors.



Installation

1. Install the selector lever gate finish panel.

- Connect the electrical connectors.

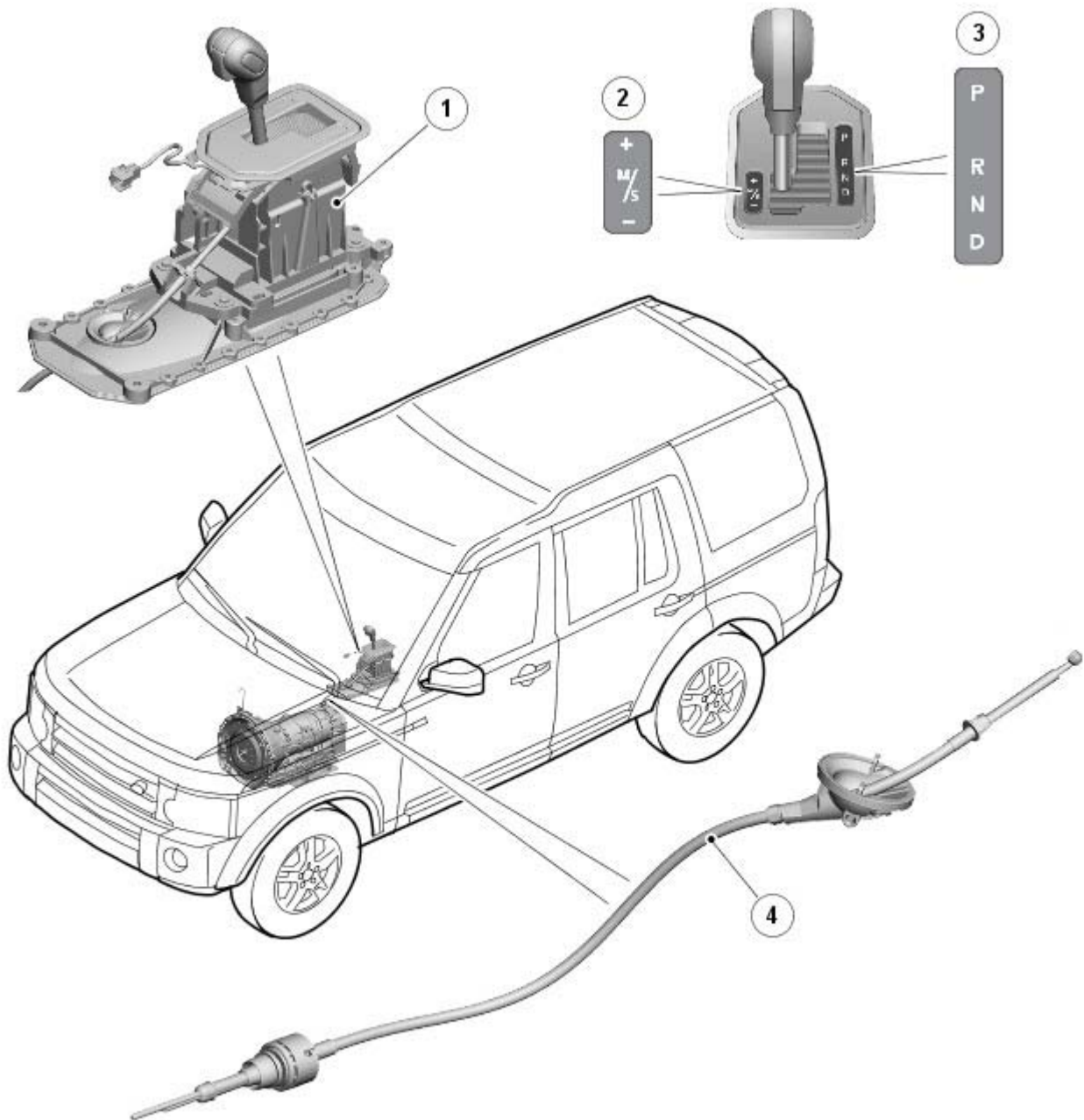
2. Install the selector lever knob.

For additional information, refer to: [Selector Lever Knob](#) (307-05A Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel, Removal and Installation).

Automatic Transmission/Transaxle External Controls - V8 5.0L Petrol/TDV6 3.0L Diesel - External Controls

Description and Operation

COMPONENT LOCATION



E122602

Item	Part Number	Description
1	-	Selector lever assembly
2	-	M/S (manual/sport) display
3	-	Selector lever position display
4	-	Selector cable

INTRODUCTION

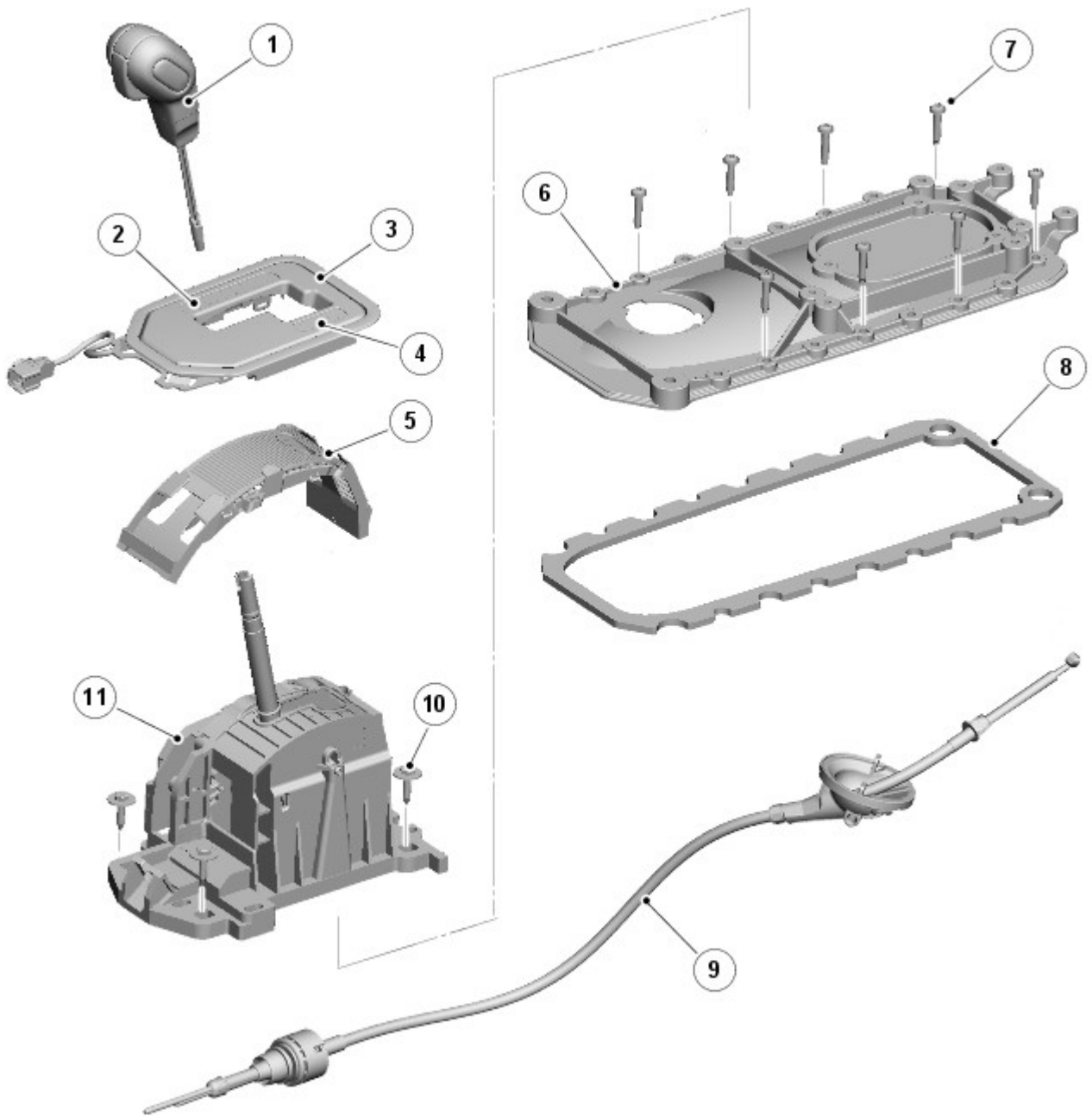
The external controls for the transmission consist of a selector lever assembly and a selector cable.

The selector cable transmits the position of the selector lever to the transmission.

The selector lever position is displayed on the selector lever position display and the M/S (manual/sport) display. The selector lever position and current forward gear are also displayed in the instrument cluster.

For additional information, refer to: [Transmission Description](#) (307-01D Automatic Transmission/Transaxle - V8 5.0L Petrol/TDV6 3.0L Diesel, Description and Operation).

SELECTOR LEVER ASSEMBLY



E123732

Item	Part Number	Description
1	-	Selector lever
2	-	Selector lever position display
3	-	Console panel and bezel
4	-	M/S display
5	-	Shutter
6	-	Mounting plate
7	-	Screw (8 off)
8	-	Seal
9	-	Selector cable
10	-	Screw and washer (4 off)
11	-	Interlock emergency release lever and selector assembly

The selector lever assembly is located in the floor console and is secured to the transmission tunnel closure plate. The selector lever assembly comprises a moulded plastic housing which provides for the location of the selector components.

The lever is connected to a crosspiece which allows for the selection of P, R, N, D in a forward and backward direction and selection between D and M/S in a left/right direction.

When M/S (sport) mode is selected the lever can be moved in a forward or backward direction to select + or - for manual (CommandShift®) operation. If left in sport mode, all gear changes are performed automatically.

If manual (CommandShift®) mode is selected, all gear changes are based on inputs received by the [TCM \(transmission control module\)](#) from manual +/- Hall effect sensors located in the selector lever assembly.

The selector lever assembly houses the following components:

- PCB (printed circuit board)
- Shift Interlock solenoid
- Park and Neutral locking levers.

The selector lever positions are as follows:

- P (park) : no torque transmitted to the drive wheels and prevents the vehicle from moving by locking the transmission
- R (reverse) : selects reverse gear - only to be selected when the vehicle is stationary and the engine is at idle
- N (neutral) : no torque transmitted to the drive wheels - allows the vehicle to roll, so ensure the [EPB \(electronic parking brake\)](#) is applied before leaving the vehicle in this state
- D (drive) : this position uses all six forward gears in automatic operation
- M/S : this position engages the sport mode, which uses all six forward gears as in D, but will upshift at higher engine speeds improving acceleration
- + and - : initiates upshifts and downshifts respectively, allowing the transmission to be used as a sequential manual transmission (CommandShift® mode) with six forward gears.

The selector lever position is displayed to the driver on the selector lever position display, M/S display and in the instrument cluster.

Manual/Sport and +/- CommandShift® Sensors

The PCB in the selector lever assembly contains Hall effect sensors to activate the M/S mode and provide the +/- signals.

When the selector lever is moved to the M/S position, the lower magnet located in the selector lever is moved close to the M/S Hall effect sensor on the PCB. This provides a signal for the [TCM](#), which initiates sport mode.

When the selector lever is moved to the + or - position, the magnet is moved close to one of the Hall effect sensors positioned either side of the M/S Hall effect sensor. When an input from either the + or - sensor is received, manual CommandShift® mode is initiated by the [TCM](#). A spring moves the selector lever back to the center position when released. When the selector lever is moved back to the D position, the [TCM](#) returns to normal automatic operation.

Selector Lever Position and Manual/Sport Displays

The displays are incorporated into the console panel on the selector lever assembly. The selector lever position display is located on the [RH \(right-hand\)](#) side of the selector lever and the M/S display is located on the [LH \(left-hand\)](#) side of the selector lever. The two displays are connected to the PCB of the selector lever assembly. An [LED \(light emitting diode\)](#) is installed under the P, R, N and D of the selector lever position display and the M/S of the M/S display. The position of the selector lever is sensed by the PCB, which illuminates the related [LED](#) in the displays.

P, R, N, D Position Switch

The P, R, N, D position switch is located within the Mechatronic valve block in the transmission. The switch is operated by movement of the selector lever to the P, R, N or D positions via the selector cable, which is connected between the selector lever and the transmission selector shaft.

The switch is electrically connected to the [TCM](#), which outputs a common power supply to each of the four switch contacts. This power supply is also used by the two speed sensors and the fluid temperature sensor in the transmission. Each of the four switch contacts have a separate output to the [TCM](#), which enables the [TCM](#) to detect the position of the selector lever.

Shift Interlock Solenoid

The shift interlock solenoid is located on the side of the selector lever assembly. The solenoid is connected to two locking levers, which engage with the base of the selector lever and lock it in the P and N positions when the solenoid is de-energized. Operation of the solenoid is controlled by the [TCM](#).

When the ignition is on and the brake pedal is pressed, the [TCM](#) energizes the solenoid and the selector lever can be moved from the P or N position. This prevents the selector lever from being moved to the D or R position unintentionally, and the application of the brakes prevents the vehicle 'creeping' when the transmission engages gear.

Movement of the selector lever from the P or N positions is prevented if the [TCM](#) senses the engine speed is above 2500 rev/min, even if the brake pedal is pressed.

The selector lever is locked in the N position during the transfer box changing range from high to low or vice versa.

If there is a vehicle electrical failure, or failure of the interlock solenoid or associated wiring, it is possible to move the selector lever from the P position by removing the selector lever, and the switch pack and finisher, and lifting the white tab on the rear of the selector lever assembly. While holding the tab in this position, the selector lever can be moved from the P position.

SELECTOR CABLE

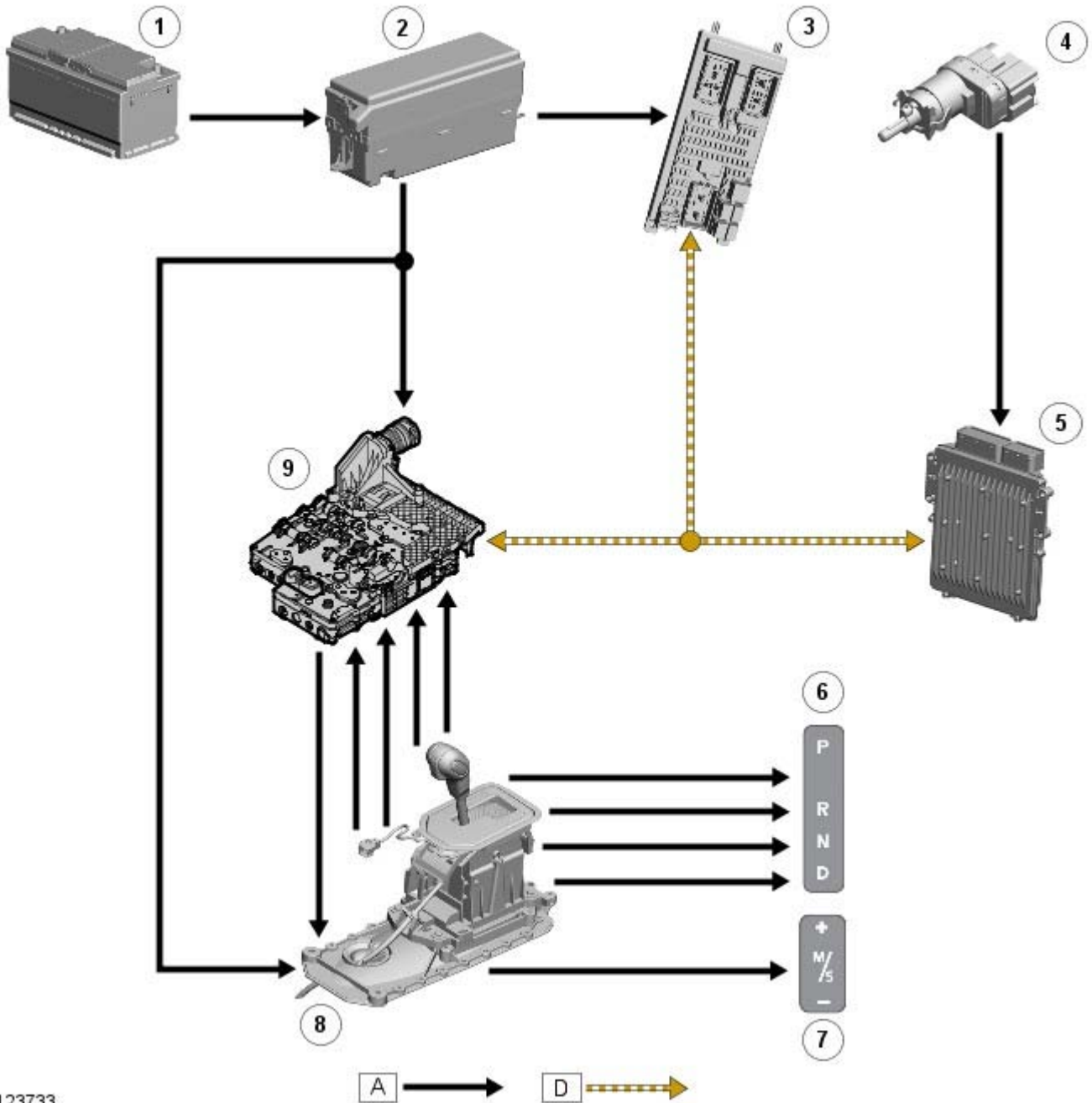
The selector cable is used as a mechanical connection between the selector lever and the transmission. The cable is a Bowden cable. Movement of the selector lever between the P, R, N and D positions moves the cable. Movement of the cable is prevented when the selector lever is in the M/S position.

A seal is installed on the cable where it passes through the mounting plate. The outer cable is attached to a bracket on the transmission. The inner cable is connected to a lever attached to the transmission selector shaft.

Movement of the selector lever between the P, R, N and D positions moves the inner cable, which moves the lever. The lever transforms the linear movement of the cable into rotary movement of the selector shaft, which operates the P, R, N, D position switch and a spool valve in the Mechatronic valve block.

CONTROL DIAGRAM

• NOTE: A = Hardwired; D = High speed CAN (controller area network) bus.



E123733

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box) (50 A megafuse)
3	-	CJB (central junction box) (ignition relay)
4	-	Stoplamp switch
5	-	ECM (engine control module)
6	-	Selector lever position display
7	-	M/S display
8	-	Selector lever assembly
9	-	TCM/Mechatronic valve block

Automatic Transmission/Transaxle External Controls - V8 5.0L Petrol/TDV6

3.0L Diesel - External Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the automatic transmission/transaxle external controls system and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check for correct gear selector lever cable adjustment. REFER to: Selector Lever Cable Adjustment (307-05A Automatic Transmission/Transaxle External Controls - TDV6 2.7L Diesel, General Procedures). ● Visibly worn or damaged components ● Loose or missing fasteners 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Manual Transmission/Transaxle and Clutch - General Information -**Torque Specifications**

Description	NM	lb-ft
Clutch bleed screw	10	7
Transmission heat shield bolts	10	7

Manual Transmission/Transaxle and Clutch - General Information - Clutch System Bleeding

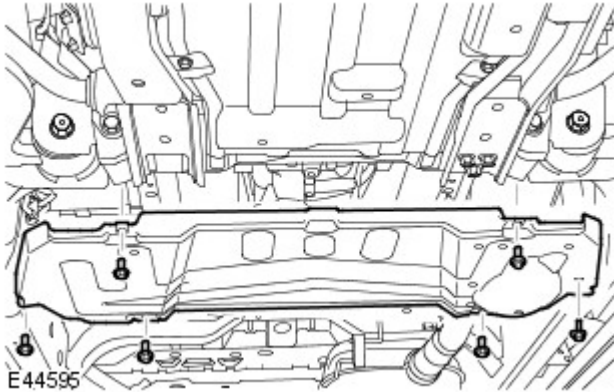
General Procedures

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission undershield.

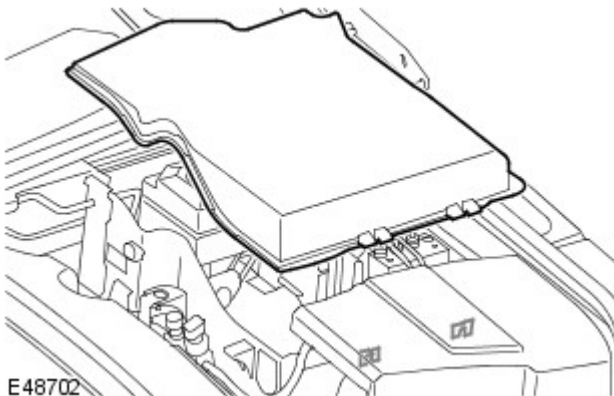
- Remove the 6 bolts.





3. Check that all the clutch line connections are tight and that there are no signs of leaks.

4. Remove the brake master cylinder cover.

- Release the 3 clips.



5.  **WARNING:** Do not allow dirt or foreign liquids to enter the reservoir. Use only new Shell DOT 4 ESL brake fluid from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

 **CAUTION:** Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.


Fill the brake fluid reservoir.

- Remove the filler cap.

6. Attach the bleed tube to the clutch bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.




7. Loosen the bleed screw by one-half turn.

8.  CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

• NOTE: It may be necessary to physically return the pedal to the start position.

Depress the clutch pedal steadily through its full stroke and return to the rest position. Repeat the procedure until a flow of clean, air-free fluid is being pumped into the bleed jar.

9.  CAUTION: Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

With the clutch pedal fully depressed, tighten the bleed screw to 10 Nm (7 lb.ft).

10. Fill the brake fluid reservoir.

- Install the filler cap.

11. Operate the clutch pedal and check for leaks.

12. Install the cover.

13. Install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

Clutch - TDV6 2.7L Diesel -**Hydraulic fluid**

Item	Specification
* Recommended hydraulic fluid	SHELL DONAX YB DOT4 ESL FLUID



CAUTION: * If the above fluid is not available, use a low viscosity DOT 4 brake fluid meeting ISO 4925 Class 6 and Land Rover LRES22BF03 requirements.

General Specifications

Item	Specification
Type	Diaphragm spring, hydraulically operated self-adjusting clutch with lead free friction facings coupled to a dual mass flywheel
Drive plate diameter	258 mm (10.15 in)
Pressure plate diameter	258 mm (10.15 in)
Clutch plate friction material	Raybestos 5088
Clutch plate thickness - Measured from outer face of plate to rivet:	
Drive plate - New	3.2 mm (0.125 in)
Service limit	0.2 mm (0.007 in)
Pressure plate - New	3.2 mm (0.125 in)
Service limit	0.2 mm (0.007 in)
Master cylinder	Integral with brake master cylinder
Slave cylinder	Incorporates quick release hydraulic pipe coupling and bleed valve

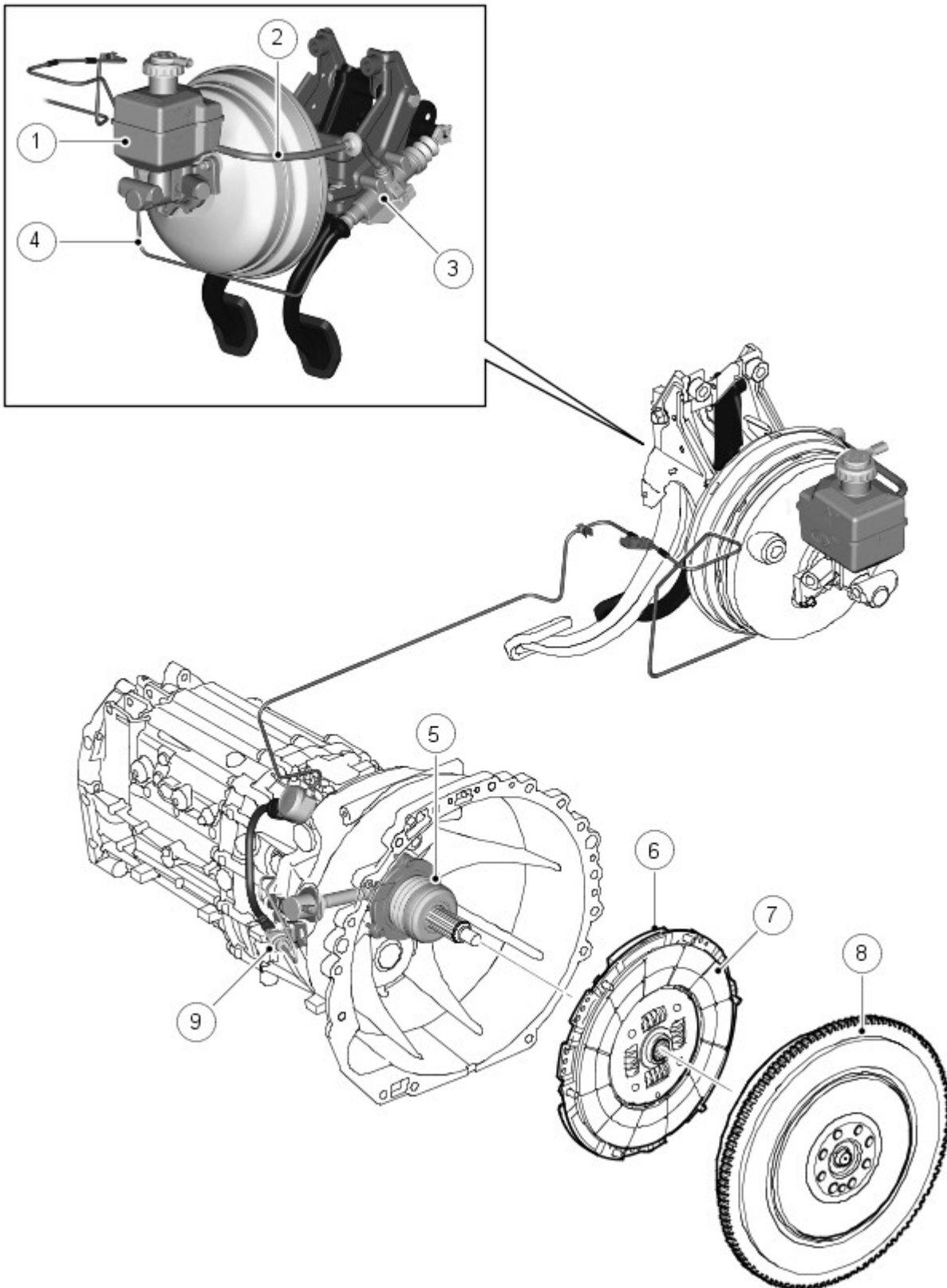
Torque Specifications

Description	Nm	lb-ft
* Clutch cover to flywheel bolts	25	18

* **Tighten bolts progressively by diagonal selection**

Clutch - TDV6 2.7L Diesel - Clutch

Description and Operation



E50627

Item	Part Number	Description
1	-	Common brake/clutch fluid reservoir
2	-	Low pressure pipe
3	-	Clutch master cylinder
4	-	High pressure pipe
5	-	Concentric slave cylinder
6	-	Clutch cover assembly

7	-	Drive plate
8	-	Dual mass flywheel
9	-	Concentric slave cylinder outlet

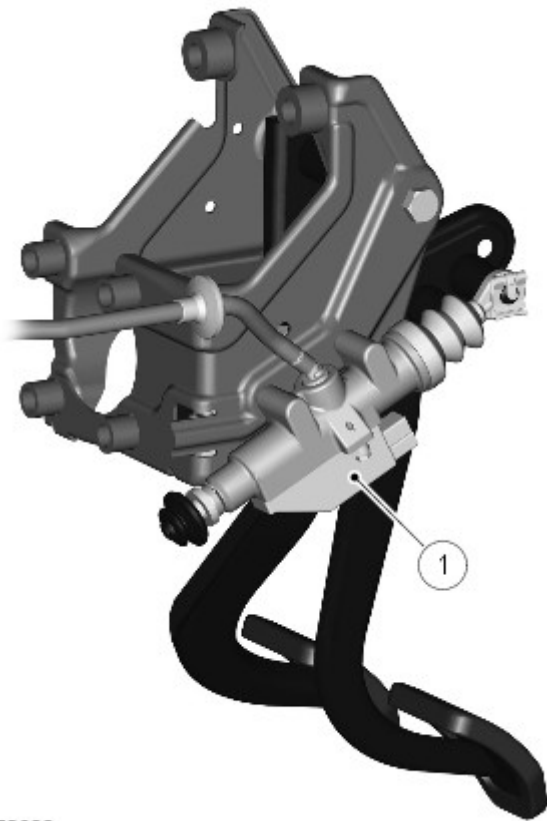
GENERAL

The clutch system is based on the established principle of a single driven plate and diaphragm spring clutch cover assembly hydraulically actuated from the clutch pedal. Depressing the clutch pedal transfers hydraulic fluid through the master cylinder, pipework, and slave cylinder ultimately actuating the clutch fingers to release the clutch and thus disengage drive from the crankshaft. When your foot is off the pedal, the spring pushes the pressure plate against the clutch disc, which in turn presses against the flywheel, this locks the engine to the transmission input shaft, causing them to rotate at the same speed.

The clutch system is of conventional design comprising the following major components:

- Clutch master cylinder
- Clutch pressure pipes
- Release bearing/slave cylinder
- Clutch Cover assembly
- Clutch driven plate
- Dual mass flywheel

CLUTCH MASTER CYLINDER



E50628

Item	Part Number	Description
1	-	Clutch master cylinder

The clutch master cylinder is attached directly to the pedal box assembly, located in the driver's footwell.

The cylinder contains a piston assembly, with a push rod connected to the clutch pedal and spring. When the clutch pedal is depressed, it pushes on the piston, via a linkage. Pressure builds in the cylinder and lines as the clutch pedal is depressed further.

The cylinder has two hydraulic connections:

- A low pressure feed pipe (providing fluid supply from the brake fluid reservoir)
- A high pressure pipe

The cylinder also contains a linear transducer type sensor, which provides signals to various vehicle systems, for example, the electric park brake, engine calibration and the slip control system.

For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

The pedal travel is constrained by an 'up-stop', and a 'down-stop' contained within the master cylinder.

LOW-PRESSURE PIPE

The low-pressure pipe is a plastic pipe running between the master cylinder and the common brake fluid reservoir. The pipes function is to ensure the hydraulic system remains full. The pipes connections are of the push type and are located at each end.

HIGH-PRESSURE PIPES

The high-pressure pipes run from the clutch master cylinder to a point adjacent to the gearbox clutch housing, on the RH side of vehicle. The assembly consists a steel tubing and a flexible pipe. The flexible pipe is used to absorb movement between the metal tube, which is fixed to the vehicle body, and the transmission.

A vibration absorber is fitted in the pipe. The absorber is located at the front end of the transmission tunnel on RH side of vehicle and is fixed to a bracket on the body.

All high-pressure connections are of the 'quickfit' design utilising a 'U' shaped spring clip for retention.

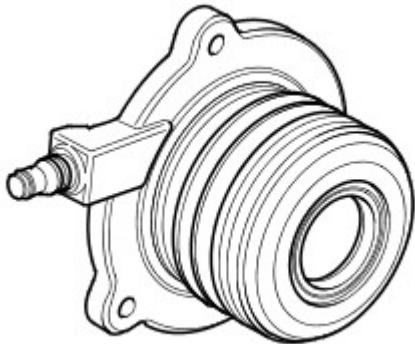
CONCENTRIC SLAVE CYLINDER OUTLET ASSEMBLY



E50629

The concentric slave cylinder outlet assembly connects the external pipes with the release system contained within the clutch housing. A securing bracket locates the assembly in the correct orientation and a seal is provided between the assembly and the clutch housing. The bleed screw is also located at this point.

CONCENTRIC SLAVE CYLINDER



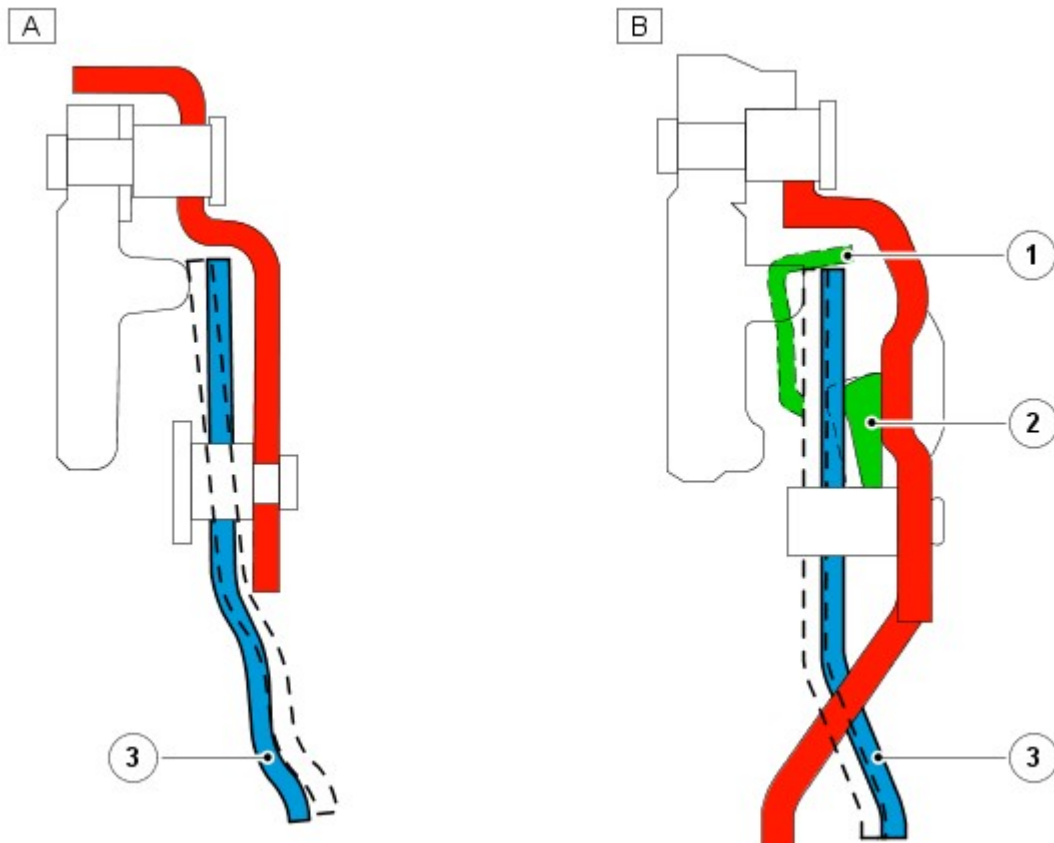
E50630

The concentric slave cylinder assembly contains the release bearing and the hydraulic slave cylinder. The assembly is attached to the front end of the transmission via 3 bolts. These bolts are asymmetrically positioned to ensure correct angular location of the slave cylinder, which is also spigot-mounted for positional fit. In its free condition the slave cylinder is fully extended, but it positions itself automatically as the clutch housing is fitted to the engine. The assembly requires no setting or adjustment.

CLUTCH COVER ASSEMBLY

The clutch cover assembly is known as a self-adjusting clutch with a nominal diameter of 260mm.

Self Adjusting Clutch



E50631

Item	Part Number	Description
A	-	Conventional clutch
B	-	Self adjusting clutch
1	-	Sensor spring
2	-	Adjuster ring
3	-	Diaphragm spring

The self-adjusting clutch contains a mechanism, which improves operation and driver comfort by enabling a more consistent pedal load as the friction faces wear, unlike conventional types of clutch which exhibit increasing pedal load with wear.

With a conventional clutch, facing wear causes the angle of the actuating diaphragm spring to change as the pressure plate moves axially towards the engine, requiring a greater force to operate the clutch (diaphragm actuating force varies with diaphragm angle). The self-adjusting clutch reduces this problem by allowing the diaphragm spring to follow the axial movement of the pressure plate thus maintaining the diaphragm spring at the same angle throughout the life of the clutch. As well as maintaining a more consistent pedal load, the clamp force on the pressure plate also remains constant with wear.

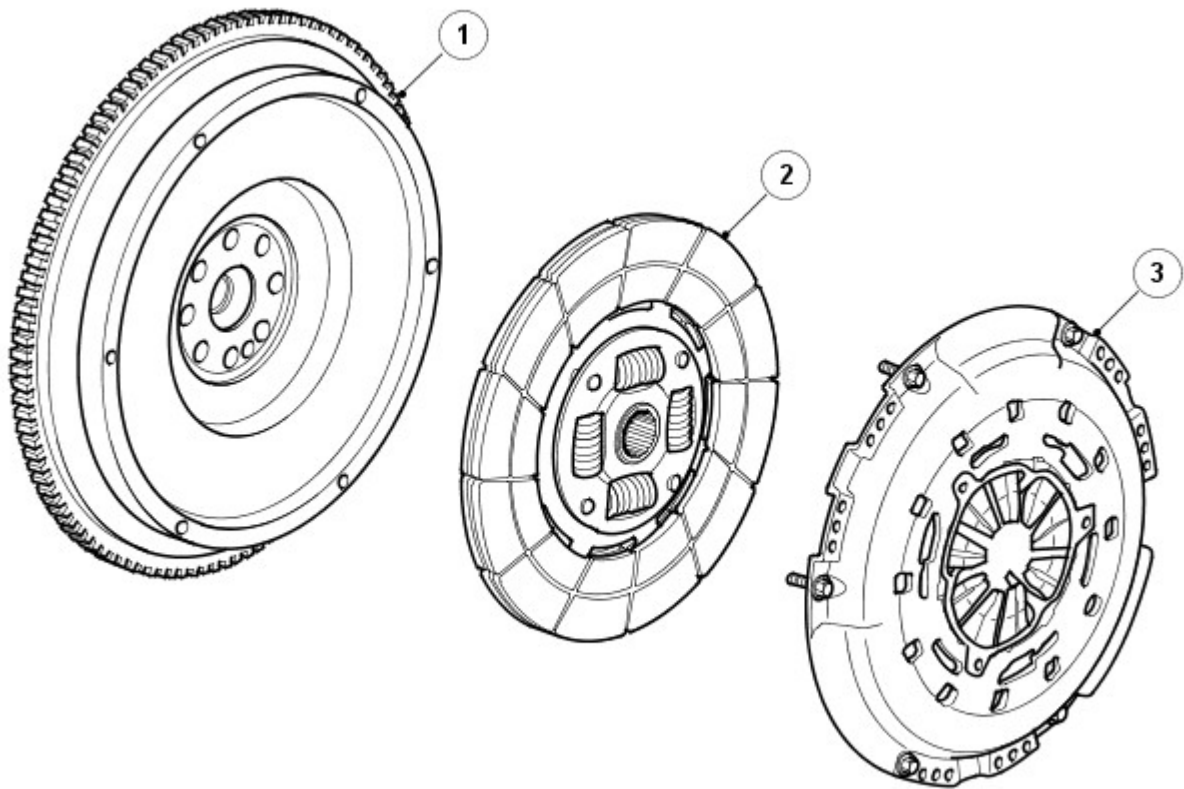
The diaphragm spring is not fixed at its rotation point like the conventional system but pivots between a sensor spring and an adjuster ring. The sensor spring provides a counter force, which is just sufficient to retain the diaphragm spring axially against the cover via the adjuster ring and during normal actuation of the clutch. As the linings wear, the tendency of the diaphragm angle to change causes an increase in the actuation force required to operate the clutch. When this increased effort exceeds the counter force of the sensor spring, the diaphragm spring moves axially towards the pressure plate until the original angle is restored. At this point the actuation force required drops to the level of the opposing sensor spring force, restoring equilibrium with the diaphragm spring at its new location.

During the axial movement of the diaphragm spring, the adjuster ring takes up the increased distance between the spring and cover. This ring contains raised segments, each having a ramp profile, which fits into a corresponding shape in the clutch cover. When the diaphragm spring moves axially for wear compensation, three pre-loaded coil springs in the clutch cover cause the adjuster ring to rotate, moving up the ramps and taking up the extra distance between the diaphragm spring and clutch cover.

• NOTE: During operation, the adjuster ring rotates in a clockwise direction, as viewed from the transmission. If, for any reason, a worn driven plate is replaced in service but the clutch cover assembly is to be reused, the adjuster ring must be rotated back to its pre-loaded position. This operation requires the use of a press to release load on the clutch whilst the adjuster ring is repositioned and is not recommended as a service action. However, it is recommended that a complete clutch cover assembly and driven plate are used together in any service repair.

• NOTE: If, for any reason, the clutch cover and driven plate are removed and the driven plate is found to be capable of further use, then the original cover/driven plate can be re-installed without the need for any adjustment.

CLUTCH DRIVE PLATE

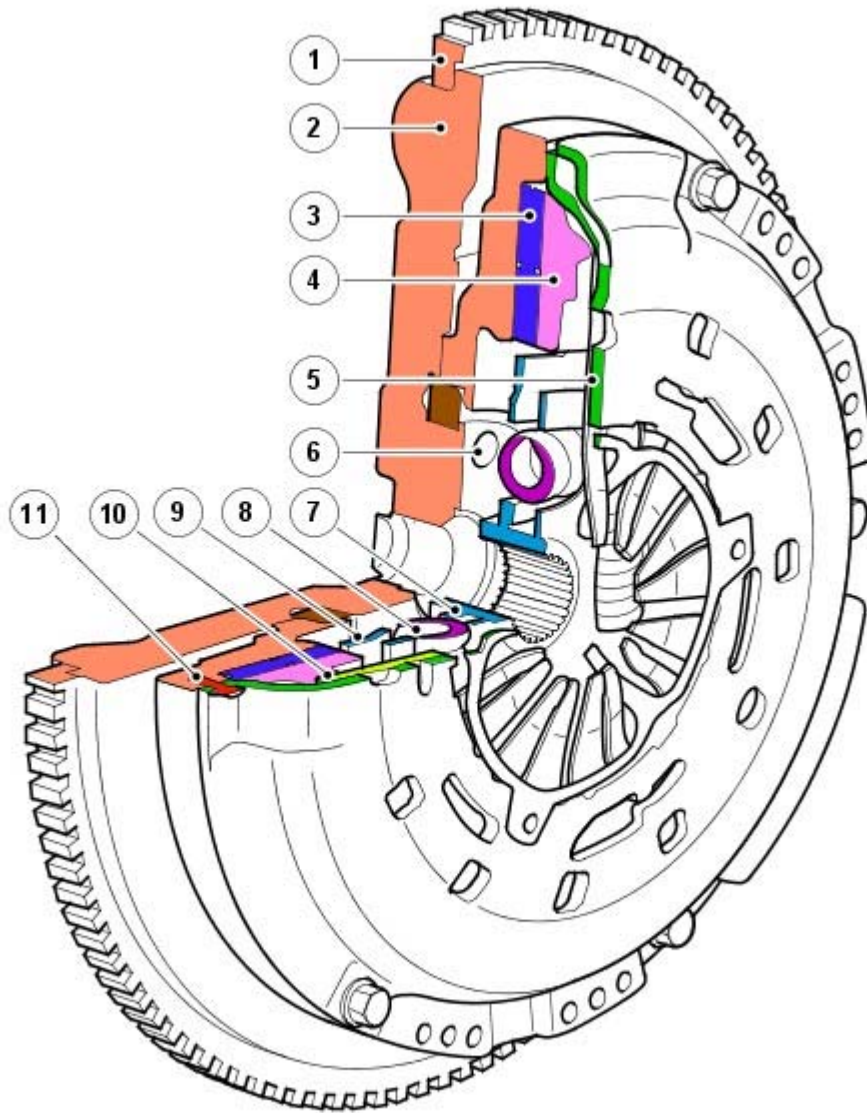


E47715

Item	Part Number	Description
1	-	Dual mass flywheel
2	-	Drive plate
3	-	Pressure plate

The clutch driven plate is of conventional design with a splined hub for locating the gearbox input spline. Lubricant is not required on this interface. The friction material, which is lead and asbestos free, is connected to the hub by a spring pack, which reduces torsional inputs into the transmission.

DUAL MASS FLYWHEEL



E47716

Item	Part Number	Description
1	-	Ring gear
2	-	Primary flywheel
3	-	Inner drive plate
4	-	Spring housing
5	-	Cover
6	-	Mounting hole
7	-	Splined hub
8	-	Damper springs
9	-	Inner drive plate
10	-	Spring housing
11	-	Secondary flywheel

As the name implies, this assembly consists of two main assemblies; the primary side, which is secured to the crankshaft with eight fixing's, and the secondary side to which the clutch cover assembly is secured.

The primary side carries the starter ring gear, and a roller bearing into which the long gearbox input shaft is supported.

The secondary side provides the surface to which the clutch friction material contacts, and is fitted with three dowels and 6 fixing holes, which are used to secure the clutch cover to the flywheel.

It is recommended that new crankshaft fixing's are used when removing or replacing a flywheel.

The secondary side is supported by the primary side on a bearing and radial springs.


The freedom of rotational movement between the primary and secondary masses acts as a damper, reducing torsional vibration levels between the crankshaft and the transmission.

Clutch - TDV6 2.7L Diesel - Pilot Bearing

Removal and Installation

Special Tool(s)	
 <p>303-1096</p> <p>E48531</p>	Pilot (spigot) bearing installer/clutch alignment
	303-1096

Removal

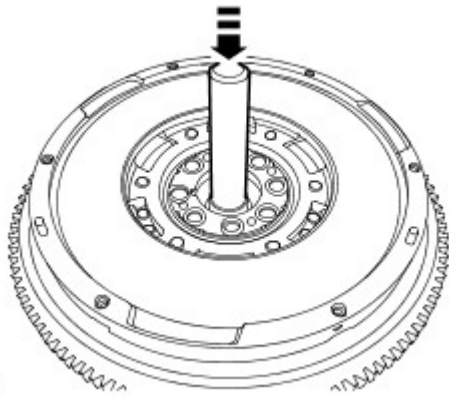
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the flywheel.
For additional information, refer to: [Flywheel](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

- Remove the pilot bearing.

- With the flywheel supported, use a drift.

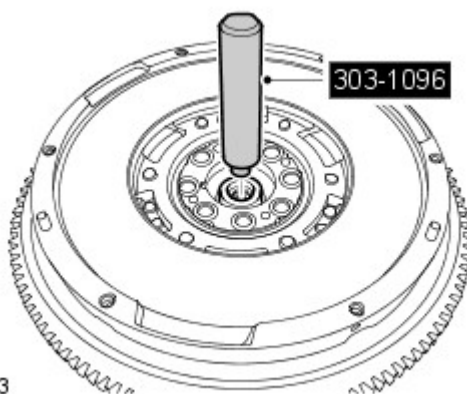


E48532

Installation

- Using the special tool, install the pilot bearing.

- Clean the component mating faces.




E48533


- Install the flywheel.
For additional information, refer to: [Flywheel](#) (303-01A Engine - TDV6 2.7L Diesel, In-vehicle Repair).

Clutch - TDV6 2.7L Diesel - Clutch Disc and Pressure Plate

Removal and Installation


Special Tool(s)	
 <p>303-1096</p> <p>E48531</p>	Pilot (spigot) bearing installer/clutch alignment
	303-1096

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

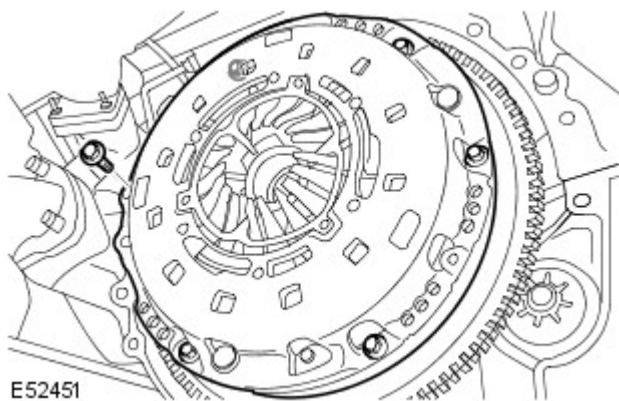
- Remove the transmission.
For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).

-  **CAUTION:** Working in a diagonal sequence, progressively loosen the bolts.

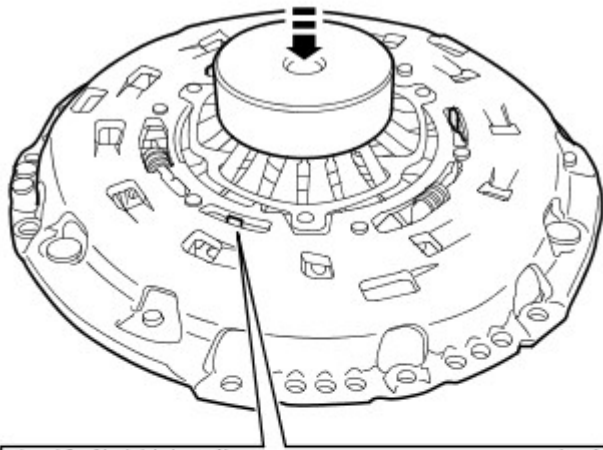
- NOTE:** Restrain the flywheel.

Remove the pressure plate and clutch disc.

- Remove the 6 bolts.

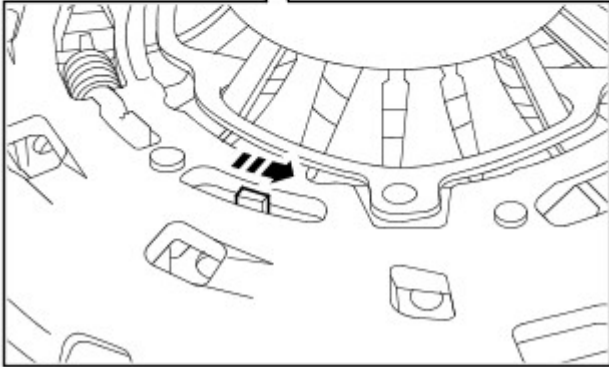


Installation



1. NOTE: The clutch cover is self adjusting. It is recommended that a clutch disc and clutch cover is replaced as an assembly. If a used clutch cover is assembled with a new clutch disc, the clutch cover adjustment must be reset prior to assembly. With the clutch cover supported under its outside edge, press down evenly on the diaphragm fingers as shown, until the clutch cover adjustment ring can be rotated fully counterclockwise. With the adjustment ring held in this position, release the pressure on the diaphragm fingers. The adjustment ring will be held in this position until self adjustment on the application of the clutch pedal.


Check, and if necessary, reset the clutch pressure plate.



E54194

2. CAUTIONS:

 Examine the flywheel for signs of scoring or overheating. Renew if worn or damaged.

 Examine the clutch release bearing for signs of wear or damage. Renew if necessary.

 Examine the spigot bearing for signs of wear or damage. Renew if necessary.

Clean the component mating faces.

3. CAUTIONS:

 Install the clutch disc with 'TRANSMISSION SIDE' marking against the clutch cover.

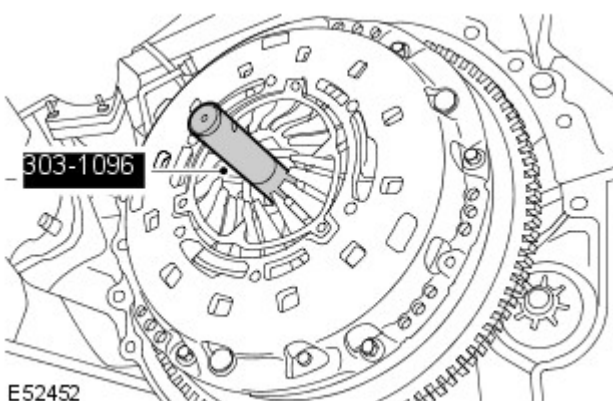
 Use the special tool to align the components.

 Working in a diagonal sequence, progressively tighten the bolts.

• NOTE: Restrain the flywheel.

Install the clutch disc and pressure plate.

- Tighten the bolts to 25 Nm (18 lb.ft).



E52452

4. Install the transmission.

For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).

Clutch Controls - TDV6 2.7L Diesel -**Torque Specifications**

Description	Nm	lb-ft
Clutch pedal nut	45	33
Clutch slave cylinder bolts	10	7
Clutch bleed screw	10	7
Slave cylinder fluid pipe clamp bolt	10	7
Master cylinder bolts	10	7
Clutch pedal assembly nuts	25	18
Brake pedal bracket Torx bolt	10	7
Clutch master cylinder nuts	10	7
Transmission heat shield	10	7

Clutch Controls - TDV6 2.7L Diesel - Clutch Controls

Description and Operation

For additional information, refer to: [Clutch](#) (308-01 Clutch - TDV6 2.7L Diesel, Description and Operation).

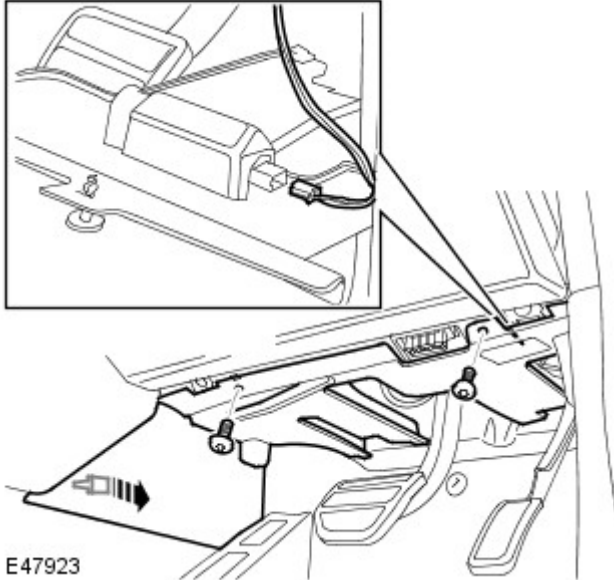
Clutch Controls - TDV6 2.7L Diesel - Clutch Master Cylinder

Removal and Installation

Removal



CAUTION: Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.



E47923

1. Remove the driver side closing trim panel.

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.

2. Release the clutch master cylinder clevis pin.

- Remove the clip.

3. Remove clutch pedal spring assister.

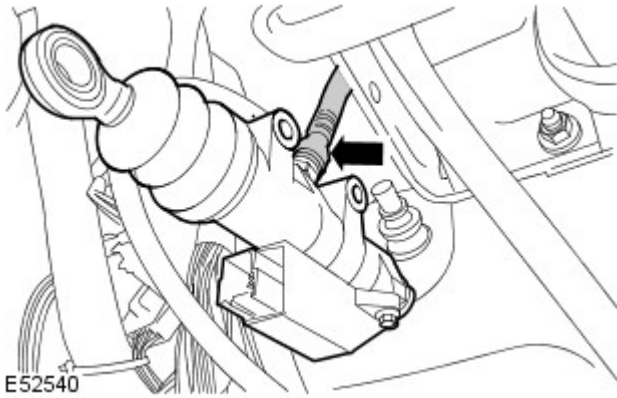
4. **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Release the clutch master cylinder.

- Position a container to collect the fluid.
- Disconnect the electrical connector.
- Remove the 2 bolts.
- Remove the clip.



E52539



5. Remove the clutch master cylinder.

- Disconnect the fluid supply line and discard the O-ring seal.

Installation

1. Install the clutch master cylinder.

- Using a new seal, connect the fluid supply line.
- Install the clip.
- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect the electrical connector.
- Remove the container.

2. Install the clutch pedal spring assister.

3. Secure the clevis pin.

- Fit the clip.

4. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

5. Raise and support the vehicle.

6. Bleed the clutch system.

For additional information, refer to: [Clutch System Bleeding](#) (308-00 Manual Transmission/Transaxle and Clutch - General Information, General Procedures).

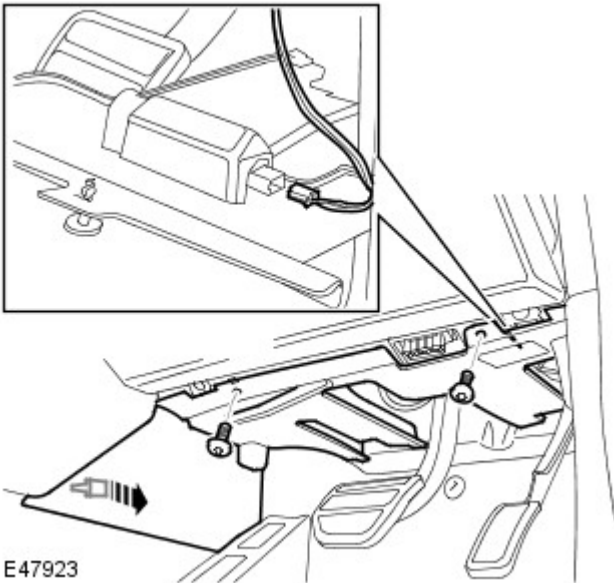
Clutch Controls - TDV6 2.7L Diesel - Clutch Pedal

Removal and Installation

Removal

1. Remove the brake booster.
For additional information, refer to: Brake Booster (206-07, Removal and Installation).
2. Remove the headlamp switch.
For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).
3. Remove the driver side closing trim panel.

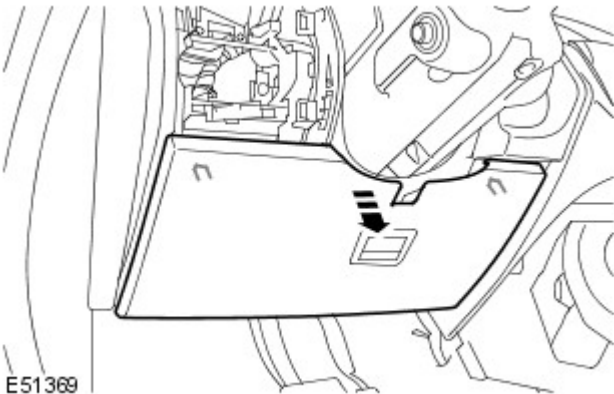
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47923

4. Remove the instrument panel access panel.

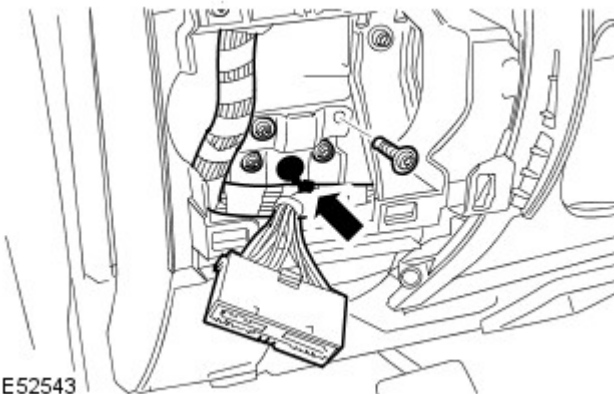
- Release the 2 clips.



E51369

5. Remove the brake pedal bracket.

- Release the wiring harness clip.
- Remove the 4 Torx bolts.



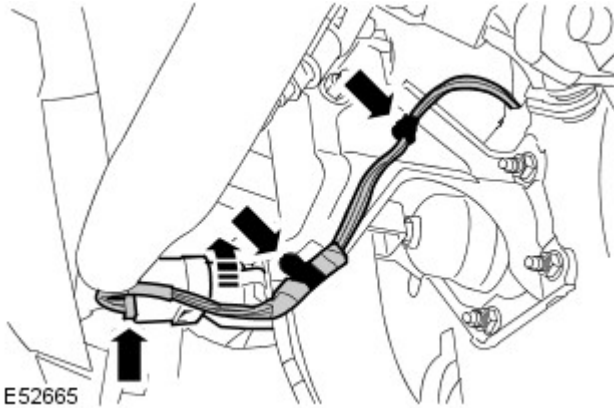
E52543

6. Release the stoplamp wiring harness.

- Disconnect the electrical connector.

- Release the 2 clips.

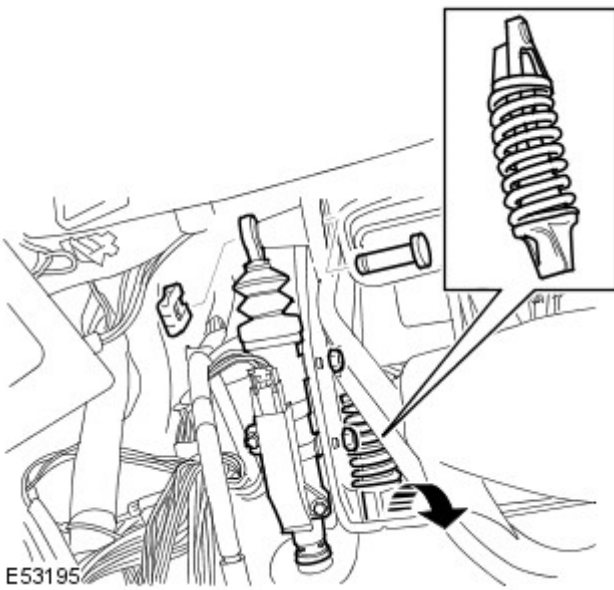
7. Remove the stoplamp switch.



8. Remove clutch pedal spring assister.

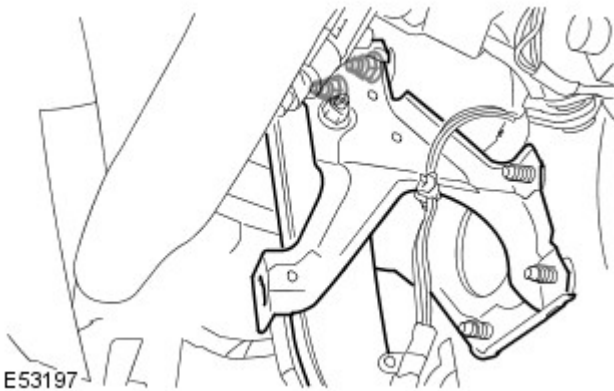
9. Release the clutch master cylinder.

- Release the clutch master cylinder clevis pin.
- Remove the 2 nuts.



10. Remove the pedal assembly.

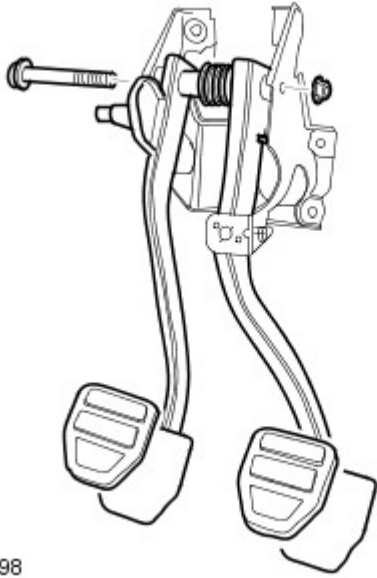
- Remove the 2 nuts.



11. NOTE: Do not disassemble further if the component is removed for access only.

Remove the brake pedal pad.

12. Remove the clutch pedal pad.

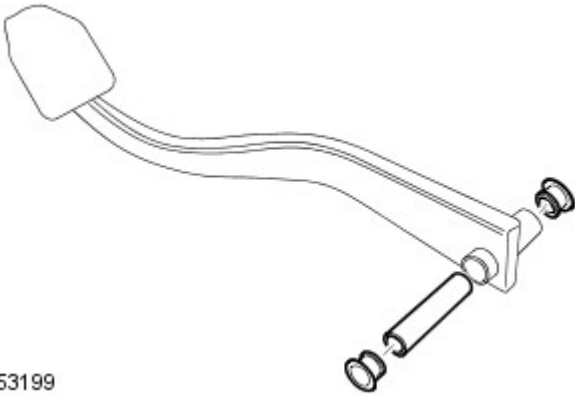


E53198

13. Remove the pedals.

- Carefully release the spring tension.
- Remove the bolt and discard the nut.

14. Remove the 3 pedal bushings.



E53199

Installation

1. Install the bushing.
 - Clean the component mating faces.
 - Lubricate the components.
2. Install the pedals.
 - Install the return spring.
 - Tighten the nut and bolt to 45 Nm (33 lb.ft).
3. Install the clutch pedal pad.
4. Install the brake pedal pad.
5. Install the stoplamp switch.
6. Install the pedal assembly.
 - Tighten the nuts to 25 Nm (18 lb.ft).
7. Install the clutch master cylinder.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 - Install the clevis pin.
8. Install the clutch pedal spring assister.
9. Secure the wiring harness.
 - Secure the clips.
 - Connect the electrical connector.

10. Install the brake pedal bracket.

- Tighten the Torx bolt to 10 Nm (7 lb.ft).
- Secure the wiring harness.

11. Install the instrument panel access panel.

- Secure with the clips.

12. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

13. Install the headlamp switch.

For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).

14. Install the brake booster.


For additional information, refer to: Brake Booster (206-07, Removal and Installation).

Clutch Controls - TDV6 2.7L Diesel - Clutch Slave Cylinder

Removal and Installation

Removal

- NOTE: The clutch release bearing is included with the slave cylinder assembly.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

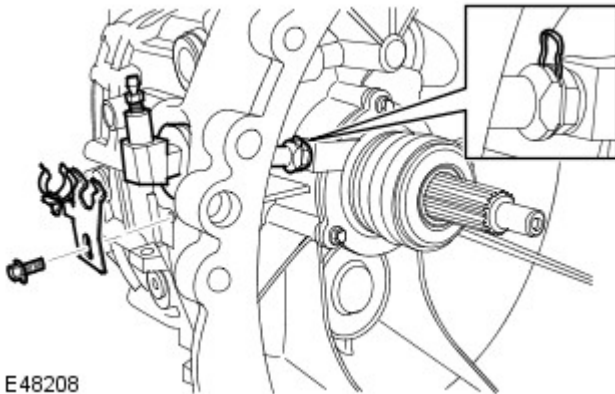
2. Remove the transmission.
For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).

3.  **CAUTION:** Always plug any open connections to prevent contamination.

- NOTE: Position cloth to collect fluid spillage.

Remove the fluid pipe.

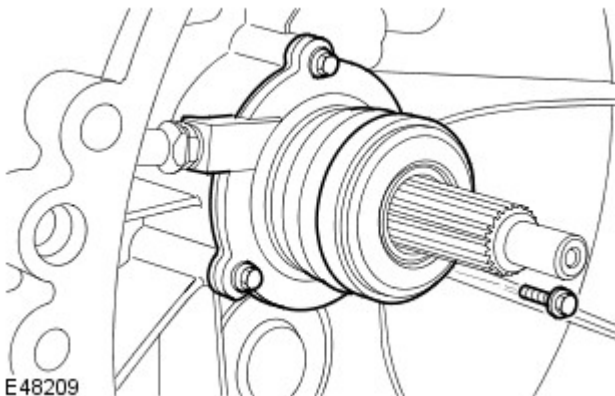
- Remove the clip.
- Remove the bolt.
- Remove the clamp.
- Remove and discard the O-ring seal.



E48208

4. Remove the clutch slave cylinder and release bearing assembly.

- Remove the 3 bolts.



E48209

Installation

1. Install the clutch slave cylinder and release bearing assembly.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. Install the fluid pipe.

- Clean the component mating faces.
- Install a new O-ring seal.
- Install the clip.
- Install the clamp.
- Tighten the bolt to 10 Nm (7 lb.ft).

3. Install the transmission.

For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).

Manual Transmission/Transaxle - TDV6 2.7L Diesel -

Sealers

Item	Land Rover Part No.
Adaptor shaft Allen bolt	STC 50553

Lubricant

Item	Specification
* Recommended lubricant	Burmah/Castrol MTF BOT 338



CAUTION: * Do not use any lubricant other than that specified.

Capacity

Unit	Capacity
Capacity - Wet and dry fill	1.6 litres (2.8 pints) (1.5 US quarts)

General Specifications

Item	Specification
Gearbox make/type	ZF S6-53 fitted with gear position and speed sensors
Gears	6 forward, 1 reverse - all synchromesh
Synchromesh:	
Triple	First gear
Dual	Second, third, fourth and reverse gears
Single	Fifth and sixth gears
Torque - Maximum	472 Nm (347 lbf ft)
Gear ratios:	
First	5.080:1
Second	2.804:1
Third	1.783:1
Fourth	1.260:1
Fifth	1.000:1
Sixth	0.835:1
Reverse	4.725:1
Gear position sensor	Mounted on the gearbox and connected to transfer box ECU
Speed sensor	Mounted at the rear of the gearbox casing and connects to the transfer box ECU to enable range changes on the move function

Torque Specifications

Description	Nm	lb-ft
* Transmission fluid drain plug	35	26
* Transmission fluid filler plug	35	26
Transmission undershield bolts	10	7
Output shaft speed sensor Torx screw	10	7
+ Gear position sensor Torx screws	10	7
+ Adaptor shaft Allen bolt	68	50
Transmission bolts	40	30
Gearbox breather line support bracket bolts	10	7
Turbocharger support bracket:		
M8 bolt	25	18
Nut	25	18
M10 bolts	40	30
Exhaust cross-over pipe center support bracket bolts	25	18
Exhaust cross-over pipe LH/RH supprt bracket bolts	25	18

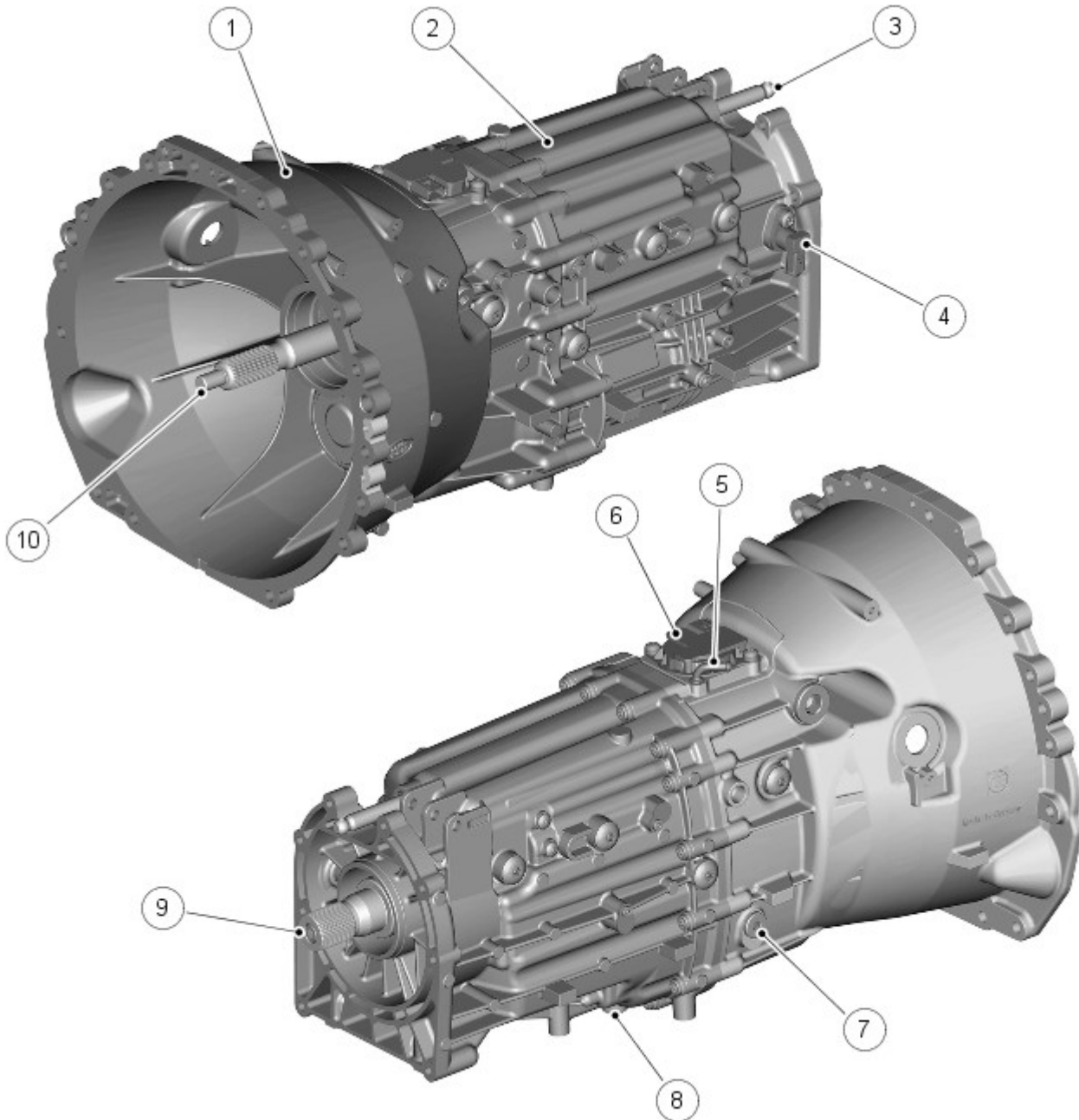
* **New drain/filler plugs must be fitted**

+ **Apply sealant, Part No. STC 50553 to threads of bolt/Torx screws**

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Manual Transmission

Description and Operation

External View



E47702

Item	Part Number	Description
1	-	Front housing
2	-	Rear housing
3	-	Gear selector shaft
4	-	Speed sensor
5	-	Breather
6	-	Gear position sensor
7	-	Oil filler plug
8	-	Oil drain plug
9	-	Output shaft
10	-	Input shaft

GENERAL

The ZF S6-53 all synchromesh transmission has six forward gears and a reverse. It is mounted longitudinally and has a maximum torque capacity of 472Nm. The aluminium die-cast front housing is bolted to the front of the transmission and the DD295 transfer box is mounted at the rear.

The sixth gear has been set up as an economic overdrive to ensure comfortable travel at higher vehicle speeds. Optimum

gear steps ensure highly fuel-efficient utilisation of the engine torque.

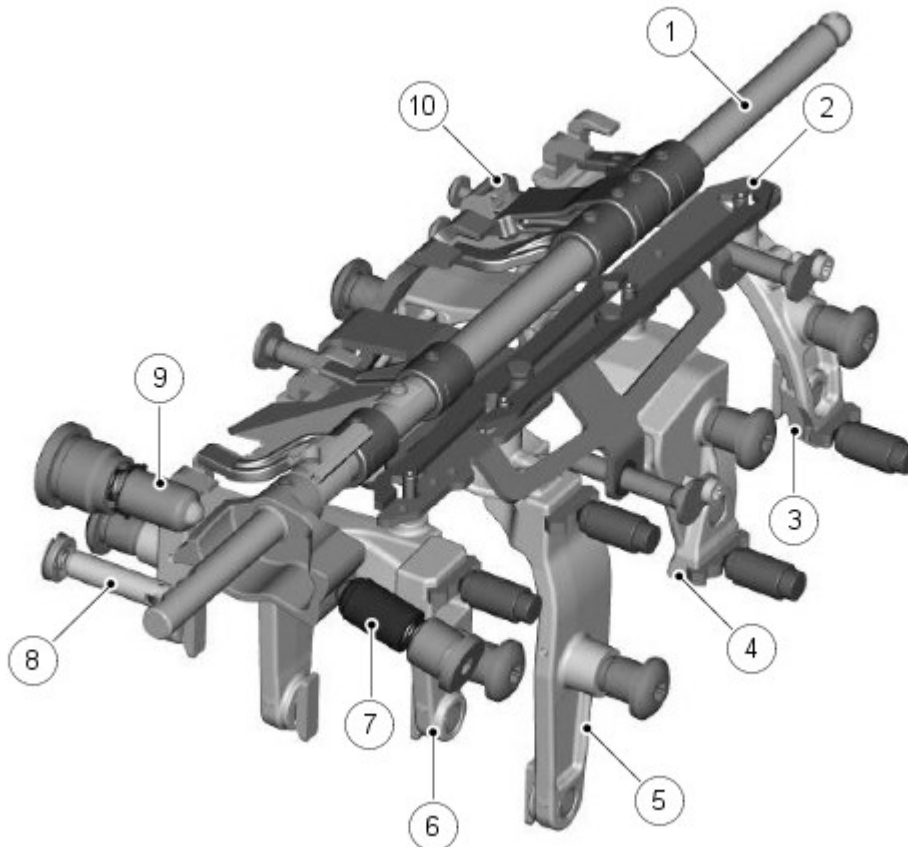
The idler gears of the 1st, 2nd, 6th and reverse gears are located on the main shaft, while the 3rd and 4th gears are located on the layshaft. The mating gears are solidly attached to the opposite shaft. Changing direction, via the reverse gear, is achieved with the assistance of an intermediate gear situated between the layshaft and main shaft. The layshaft and main shaft are hollow to reduce weight.

The transmission is a fill for life unit and no level check is required at service unless a leak is present.

Technical Data

Input Torque	Ratios							Weight including oil	Oil fill, from dry	Oil grade
	1st	2nd	3rd	4th	5th	6th	Rev.			
472Nm	5,08	2,80	1,78	1,26	1,00	0,84	4,61	57kg	1.6L	Castrol BOT 338

INTERNAL SHIFTING SYSTEM

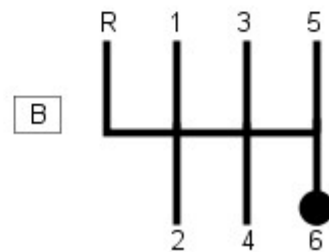
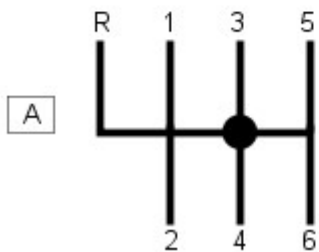
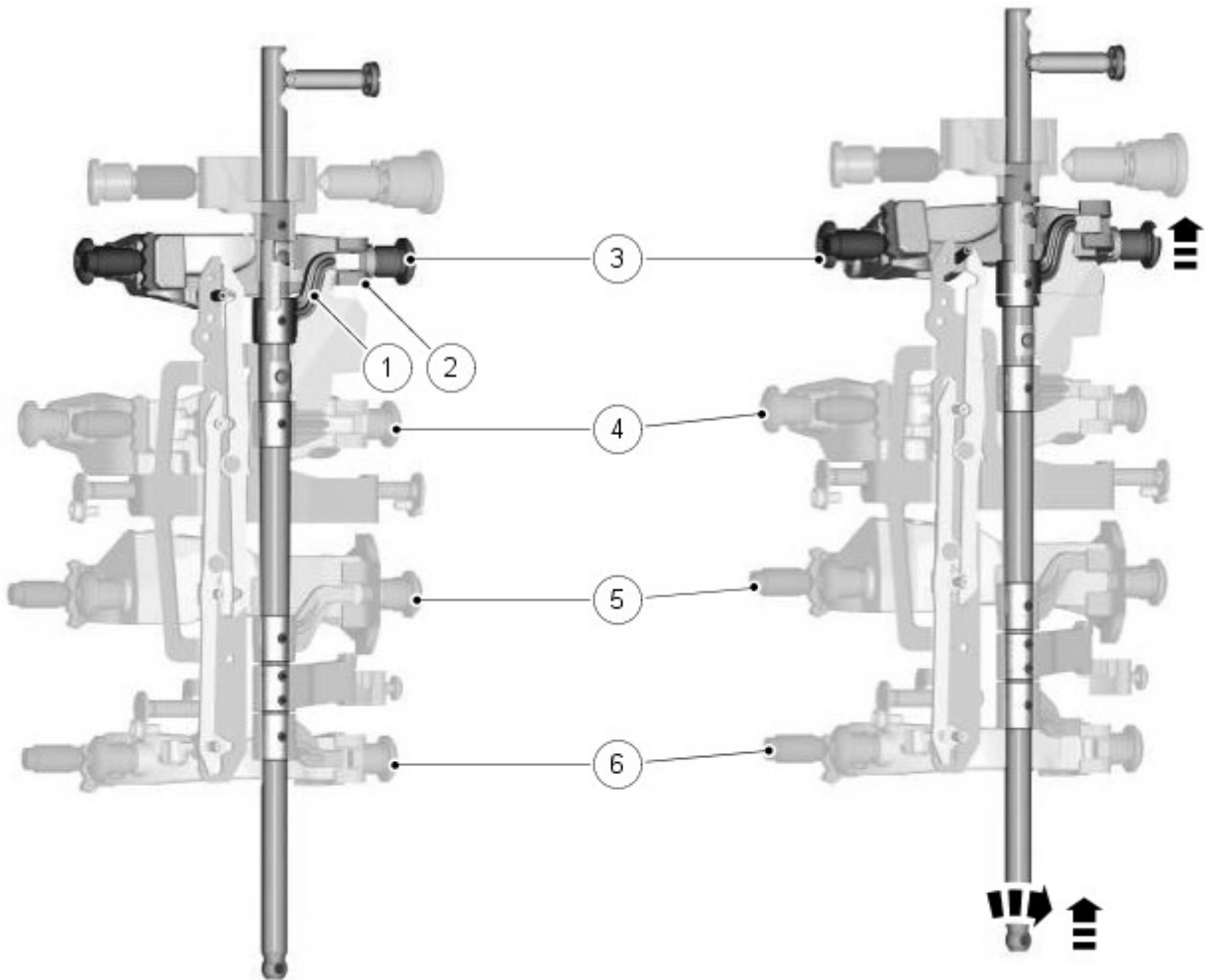


E47703

Item	Part Number	Description
1	-	Gear selector shaft
2	-	Locking bracket (interlock)
3	-	Swing fork reverse gear
4	-	Swing fork 1st/2nd speed
5	-	Swing fork 3rd/4th speed
6	-	Swing fork 5th/6th speed
7	-	X-gate bias load detent, forward gears
8	-	Central detent
9	-	X-gate bias load detent, reverse gear
10	-	Gate

In contrast to a traditional manual transmission where there are typically three forks, fixed to and controlled by three shafts, that are engaged by the shift lever, the ZF S6-53 transmission utilises a single central gear selector shaft and aluminium die-cast swing forks to generate the axial motion needed in the sliding sleeve for changing gears. This reduces friction in the internal shifting system.

The central gear selector shaft transfers the selection and shifting motion to the transmission. The gear shift fingers, located at different angles on the central control shaft, mesh with one of the swing fork engaging pieces.



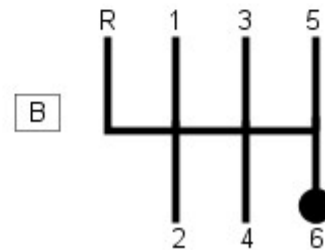
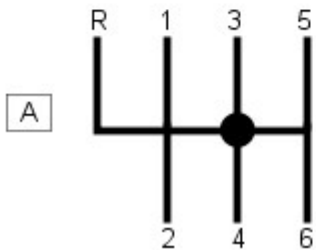
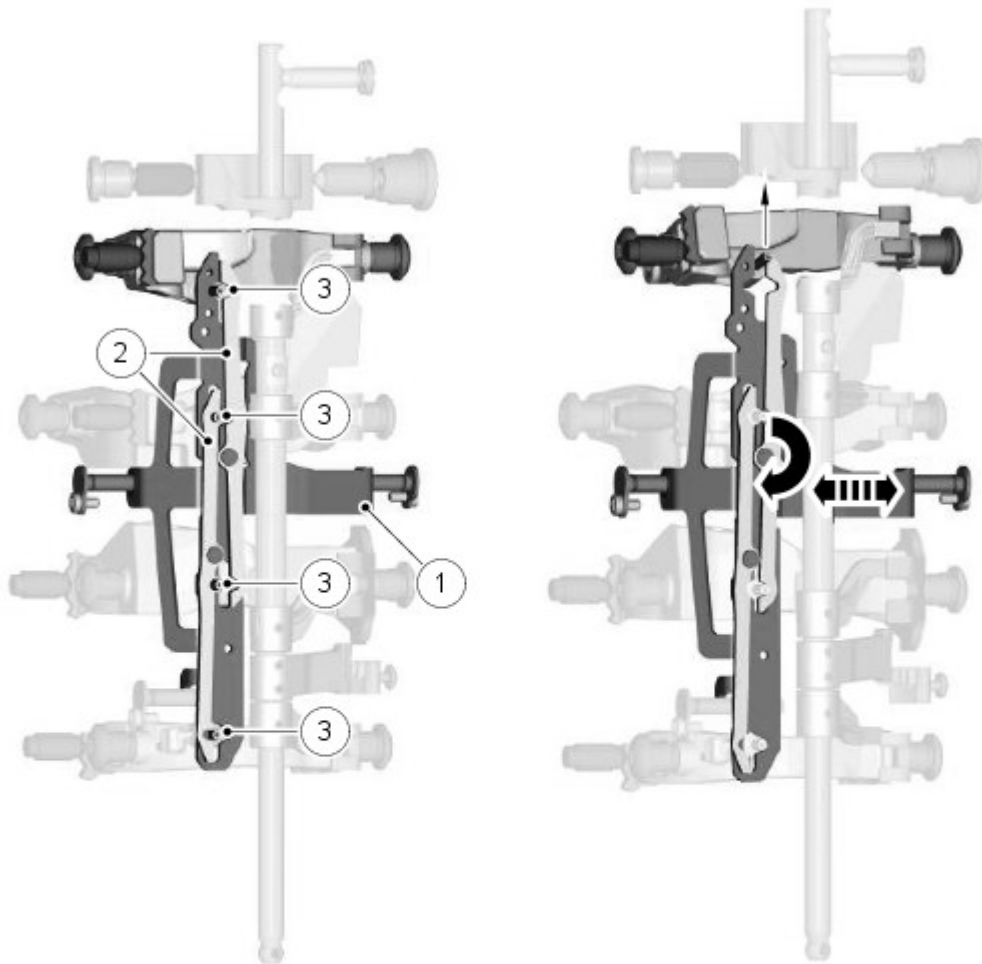
E47704

Item	Part Number	Description
A	-	Neutral position
B	-	6th gear position
1	-	Gear shift fingers
2	-	Swing fork engaging pieces
3	-	Swing fork 5th/6th
4	-	Swing fork 3rd/4th
5	-	Swing fork 1st/2nd
6	-	Swing fork reverse

The axial displacement of the central gear selector shaft leads to a tilting motion of the swing fork above the corresponding engaging piece. This tilting motion of the swing fork is forwarded, via two sliding pads, as an axial motion to the sliding sleeve guided by the synchroniser body. The sliding sleeve is moved from the neutral position towards the free-wheeling gear and, once synchronisation is complete, connects the free-wheeling gear to the main and/or layshafts.

INTERLOCK

The interlock prevents the simultaneous engagement of several gears.



E47705

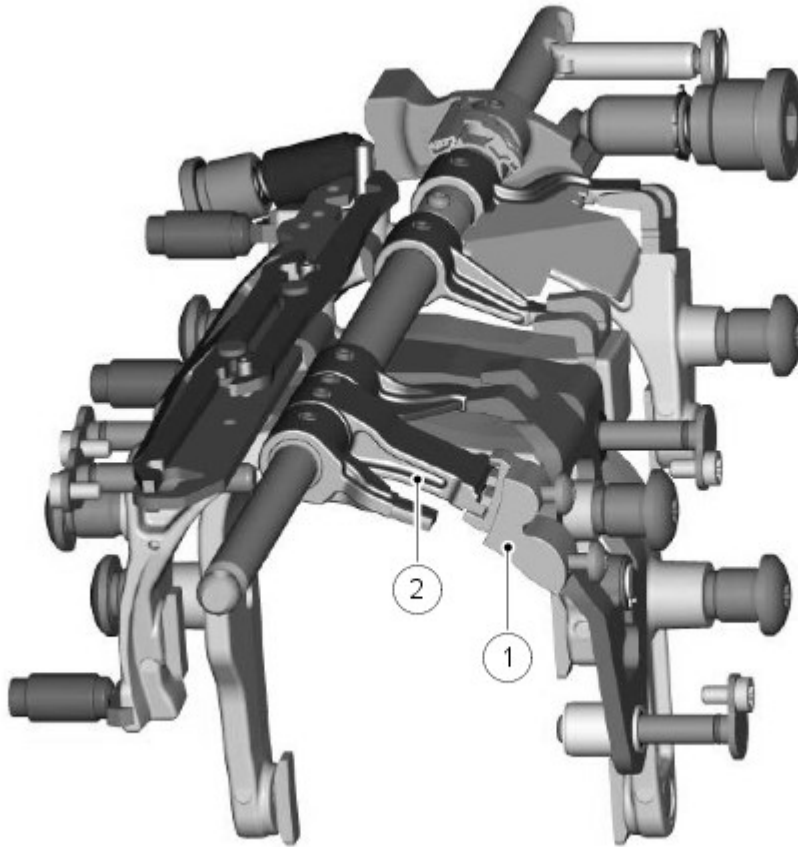
Item	Part Number	Description
A	-	Neutral position
B	-	6th gear position
1	-	Locking bracket
2	-	Locking lever
3	-	Locking pins

Two locking levers, attached to a locking bracket, control the interlock. The locking system works passively, i.e. the locking mechanism is actuated through the swing fork motion itself. The swing forks are therefore designed with locking pins.

During gear engagement, the locking levers are turned by the locking pins on the swing forks in the direction of the selected gear and the locking bracket is shifted axially. The shifted swing fork remains moveable and all other swing forks are fixed in place by their respective locking pins and the recesses at the locking levers and/or locking bracket.

GATE

An exact H-shifting pattern is used through the gear change shaft guide in the gate.



E47706

Item	Part Number	Description
1	-	Gate guide
2	-	Finger

A finger attached to the gear change shaft ensures alignment of the corresponding guide groove in the gate, depending upon the selected shift gate. In the engaged gear, the gate limits the side-to-side freeplay at the shift lever.

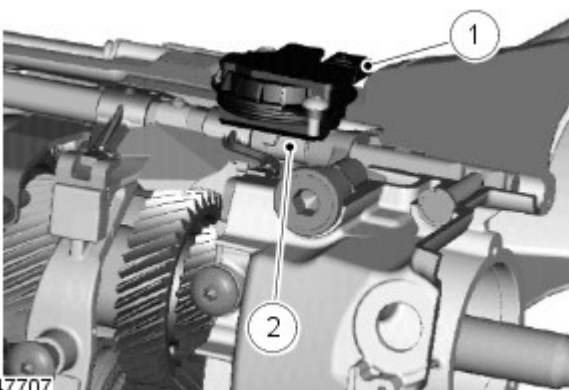
SYNCHRONISATION

The purpose of a synchromesh is to allow the collar and the gear to make frictional contact before the dogteeth make contact. This lets the collar and the gear synchronize their speeds before the teeth need to engage. The cone/s on the gear fits into the cone-shaped area in the collar, and friction between the cone and the collar synchronize the collar and the gear. The outer portion of the collar then slides so that the dogteeth can engage the gear.

Fast and easy shift engagement of the transmission is achieved by single, double and triple cone synchroniser mechanisms.

Gear	Synchro
1st	Triple
2nd	Dual
3rd	Dual
4th	Dual
5th	Single
6th	Single
Reverse	Dual

GEAR POSITION SENSOR



E47707

Item	Part Number	Description
1	-	Sensor body
2	-	Magnet assembly

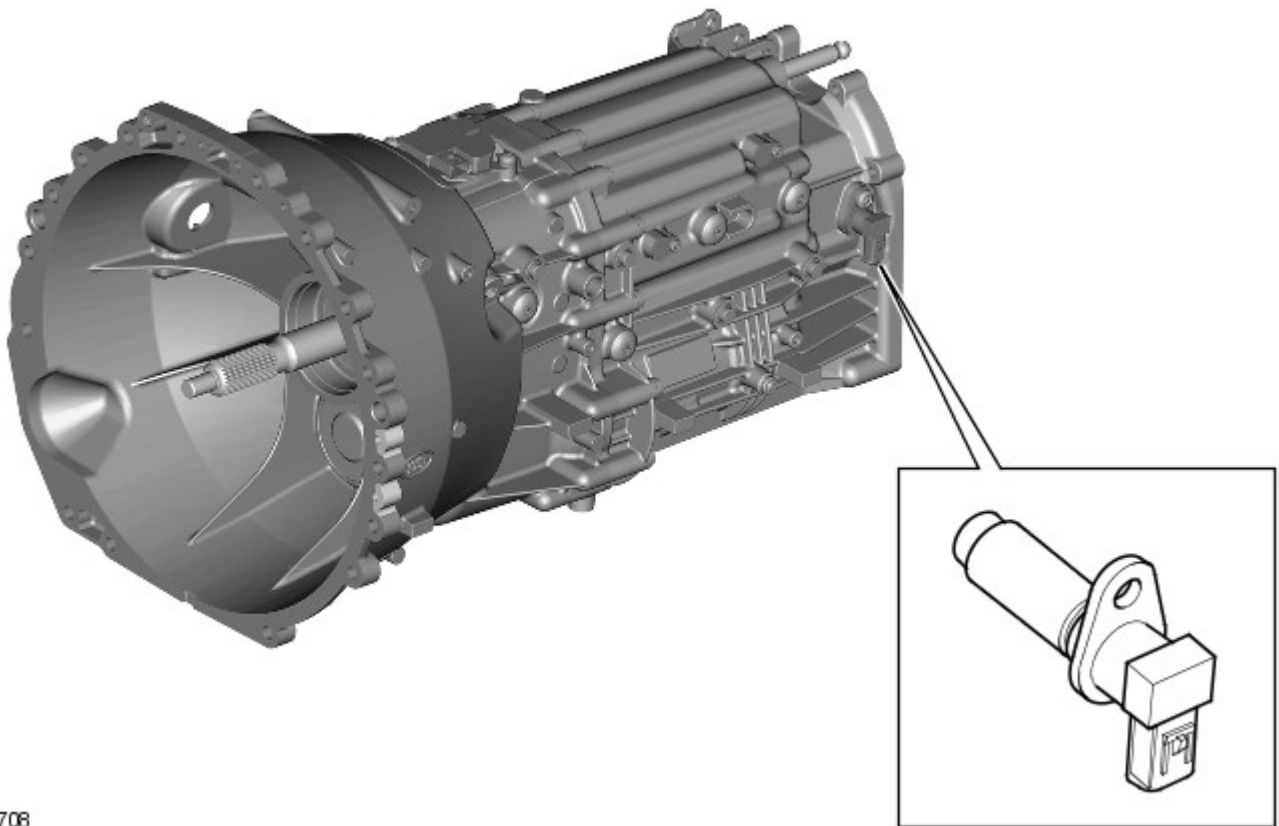
A gear position sensor, located on top of the front housing, is used to enable the transfer box to determine which gear the transmission is in. This information is used for both instrumentation and range change functions.

The transfer box control module receives a gear position signal and publishes the status on the CAN bus. The selected gear is shown in the information display of the instrument cluster. The transfer box also uses the status message to check the vehicle is in neutral before attempting a range change.

The gear position sensor is a Permanent Linear Contact less Displacement (PLCD) type sensor. It uses the 'X' axis as the left and right position of the lever and the 'Y' axis as the forward and backward position. The sensor gives a voltage in 'X' and 'Y' directions, which is used to deduce the gear position.

The PLCD sensor uses the electromagnetic induction principle, which has a primary winding around a soft magnetic core. On each end of the core is a second short coil winding and when a permanent magnet is in the vicinity of the sensor, the core is interrupted at that point and two separate transformers are created. Each transformer generates an induced voltage in the secondary coils. The induced voltage of 0 to 5 V in turn provides proportional feedback to the transfer box control module relative to the position of the magnet assembly.

SPEED SENSOR



E47708

Item	Part Number	Description
1	-	Speed sensor

The transfer box is designed to allow range changes when the vehicle is moving, providing the transmission speed complies with the preset thresholds determined by the transfer box control module.

For additional information, refer to: [Four-Wheel Drive Systems](#) (308-07A Four-Wheel Drive Systems, Description and Operation).

The transmission speed sensor is a Hall effect sensor and is located at the rear of the transmission. The sensor measures the speed of the transmission output shaft from a single tooth reluctor on the output shaft.

Hall effect sensors require a supply current, which allows the sensor to detect zero movement. Hall sensors use the principle of a voltage, which is generated across a semiconductor carrying an electric current. The voltage is generated when the transmission output shaft reluctor is exposed to magnetic flux.

When the semiconductor is exposed to a magnetic flux, the electron flow through the semiconductor is deflected creating a potential difference across the semiconductor. This difference in voltage is called the Hall effect. It is this voltage that the transfer box control module uses to establish the speed of the transmission output shaft.

When the reluctor is near the sensor, the sensor produces a low voltage output. When the reluctor is away from the sensor, the sensor produces a high output voltage (battery voltage).

The sensor connector has three wires; one is used for sensor earth, one is supply current, from the transfer box control module, and the other is the signal output to the transfer box control module.

SERVICE


The ZF S6-53 manual transmission is a black box unit. Therefore the repairs permitted are limited to:

- Oil drain plug
- Oil filler plug
- Layshaft sealing cap
- Input shaft seal
- Gear position sensor and magnet assembly
- Selector shaft seal
- Speed sensor
- Output shaft and output shaft seal.

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Transmission Draining and Filling

General Procedures

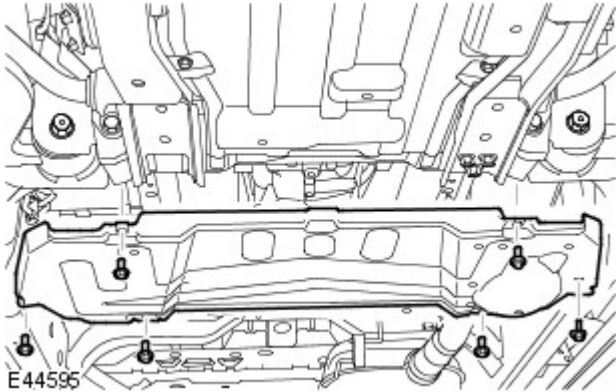
 **CAUTION:** The fluid filler plug is not a fluid level plug.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. If installed, remove the transmission undershield.

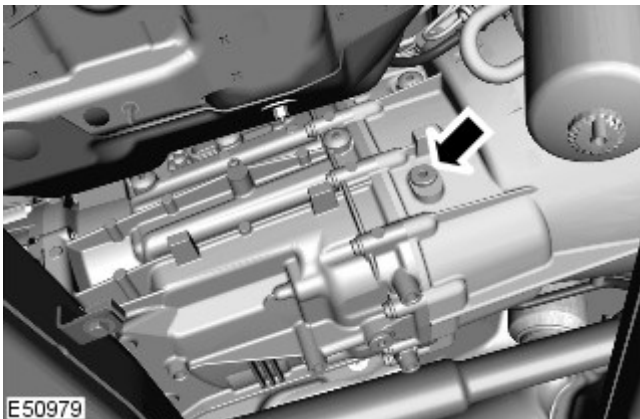
- Remove the 6 bolts.



3. Clean the area around the transmission fluid drain and filler plugs.

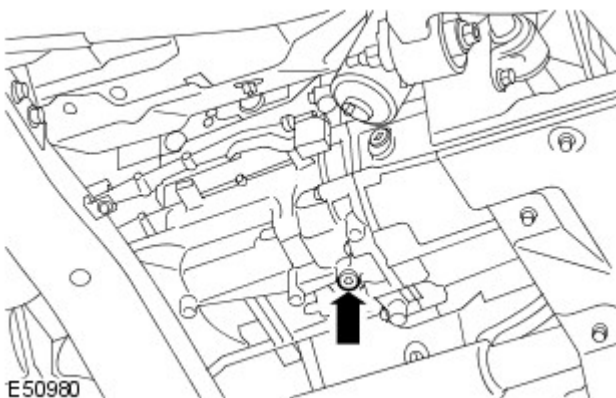
4. Place a container under the transmission.

5. Remove the transmission fluid filler plug.



6. Remove the transmission fluid drain plug.

- Drain the transmission.



7. Install a new transmission fluid drain plug and tighten it to 35 Nm (26 lb.ft).

8.  **CAUTION:** The fluid filler plug is not a fluid level plug.

Fill transmission with 1.6 litres of the correct transmission fluid.


For additional information, refer to: [Specifications](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Specifications).

9. Install a new transmission fluid filler plug and tighten it to 35 Nm (26 lb.ft).
 - Remove the container.
10. If installed, install the transmission undershield.
 - Tighten the bolts to 10 Nm (7 lb.ft).

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Output Shaft Speed (OSS) Sensor

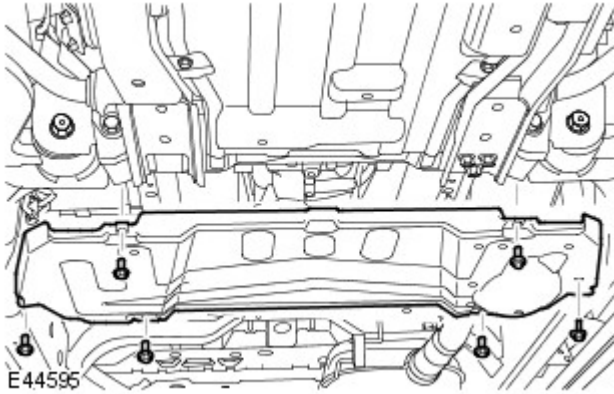
In-vehicle Repair

Removal

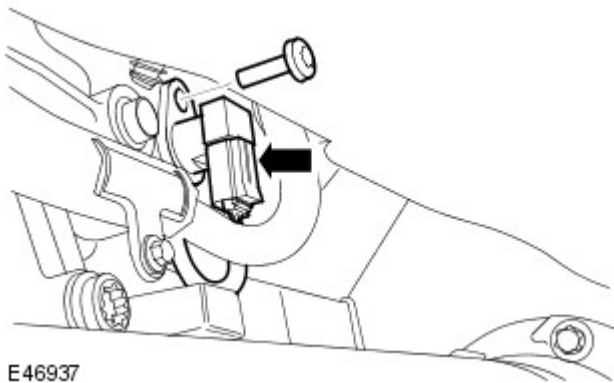
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- If installed, remove the transmission undershield.
 - Remove the 6 bolts.



- Remove the OSS sensor.
 - Disconnect the electrical connector.
 - Remove the Torx screw.

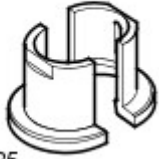



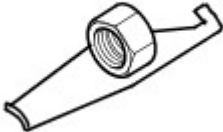




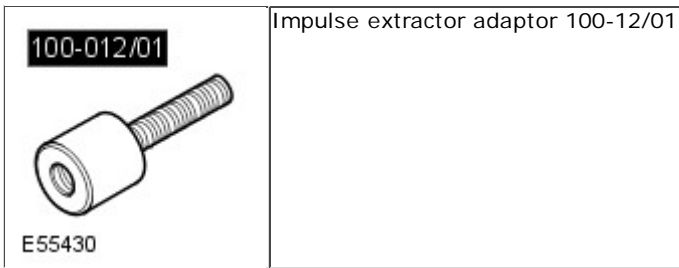
Installation

- Install the OSS sensor.
 - Clean the component mating faces.
 - Tighten the Torx screw to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
- If installed, install the transmission undershield.
 - Tighten the bolts to 10 Nm (7 lb.ft).


Manual Transmission/Transaxle - TDV6 2.7L Diesel - Output Shaft Seal

In-vehicle Repair

Special Tool(s)	
<p>205-817/01</p>  <p>E55425</p>	<p>Adaptor shaft holding/extractor split 205-817/01</p>
<p>205-817/02</p>  <p>E55426</p>	<p>Adaptor shaft holding/extractor ring 205-817/02</p>
<p>205-817/03</p>  <p>E55427</p>	<p>Adaptor shaft holding/extractor bolt 205-817/03</p>
<p>100-005A</p>  <p>E49451</p>	<p>General purpose puller 100-005A (LRT-99-500A)</p>
<p>308-375</p>  <p>E55428</p>	<p>Seal extractor 308-375</p>
<p>100-012</p>  <p>E54135</p>	<p>Impulse extractor 100-012 (LRT-99-004)</p>
<p>205-818</p>  <p>E55429</p>	<p>Seal installer 205-818</p>



Removal

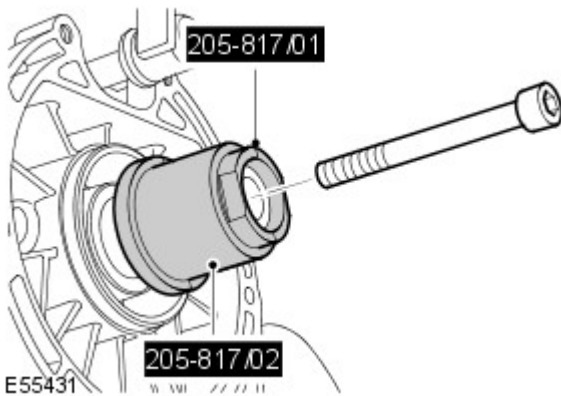
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

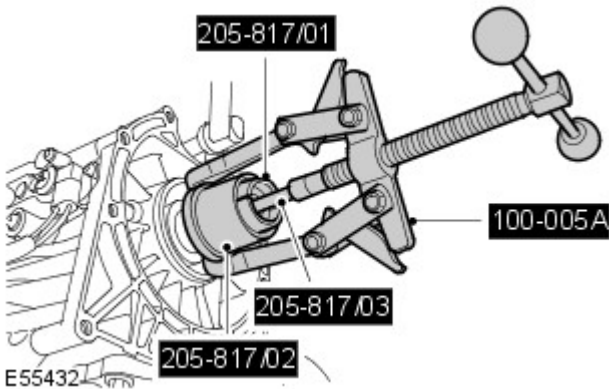
- Remove the Allen bolt retaining the adaptor shaft.

- Use the special tool to hold the adaptor shaft.



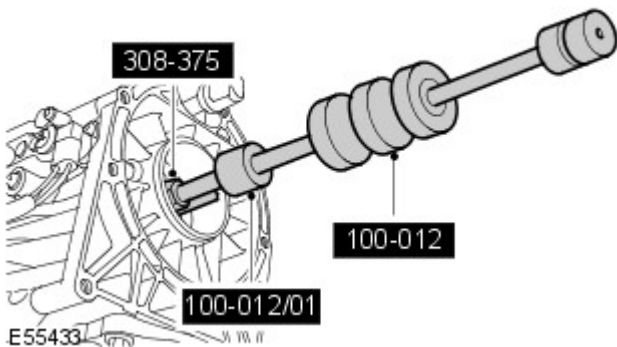
- Remove the adaptor shaft.

- Use the special tools.

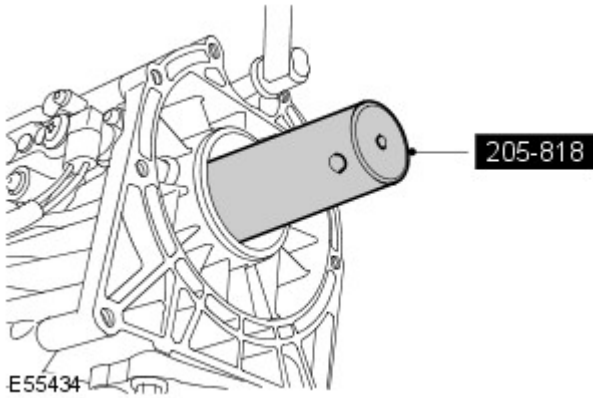


- Remove the output shaft seal.

- Use the special tool.



Installation



1.  CAUTION: Oil seals must be fitted dry.

Install a new output shaft seal.

- Clean the component mating faces.
- Use the special tool.

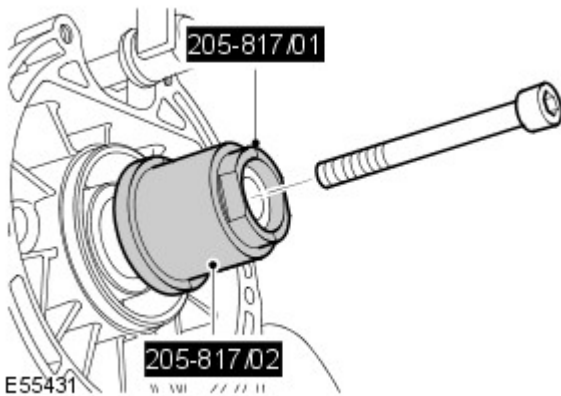
2.  WARNING: Wear protective gloves.

Install the adaptor shaft.

- Clean the component mating faces.
- Heat the adaptor shaft evenly to 120 degrees Centigrade before fitting the adaptor shaft to the splines.

3. Install the Allen bolt.

- Use the special tool to hold the adaptor shaft.
- Apply sealant to the Allen bolt thread.
- Tighten the Allen bolt to 68 Nm (50 lb.ft).



4. Install the transfer case.


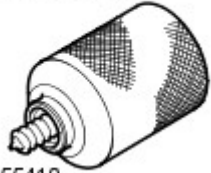


For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

5. Drain and refill the transmission.


For additional information, refer to: [Transmission Draining and Filling](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Countershaft Seal

In-vehicle Repair

Special Tool(s)	
 <p>308-617</p> <p>E55409</p>	Seal extractor drill 308-617
 <p>308-615</p> <p>E55410</p>	Seal extractor 308-615
 <p>100-012</p> <p>E54135</p>	Impulse extractor 100-012 (LRT-99-004)
 <p>308-620</p> <p>E55411</p>	Seal installer 308-620

Removal

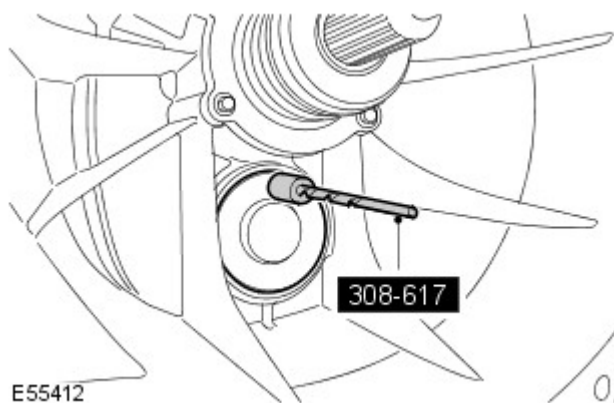
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the transmission.
For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).

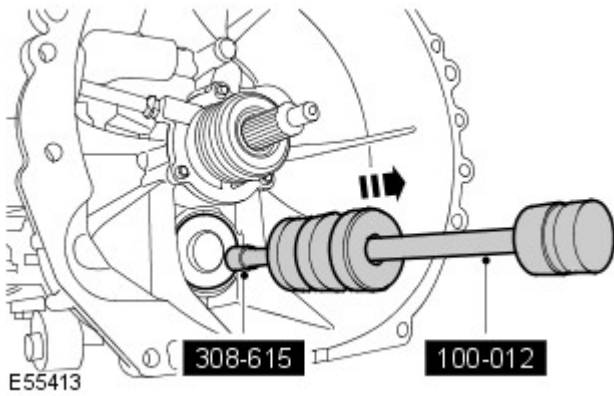
-  **CAUTION:** Use a drill stop. Do not drill deeper than 5 mm.

Using the special tool, drill a 3 mm hole in the seal as shown.



4. Remove the countershaft seal.

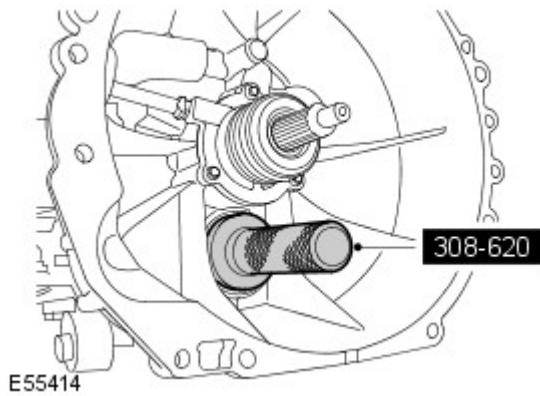
- Install the extractor.



Installation

1. Install the countershaft seal.

- Clean the component mating faces.
- Use the special tool.



2. Install the transmission.




For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).

3. Drain and refill the transmission.


For additional information, refer to: [Transmission Draining and Filling](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Input Shaft Seal

In-vehicle Repair

Special Tool(s)	
 <p>308-615 E55410</p>	Seal extractor 308-615
 <p>100-012 E54135</p>	Impulse extractor 100-012 (LRT-99-004)
 <p>308-618 E55405</p>	Seal installer 308-618

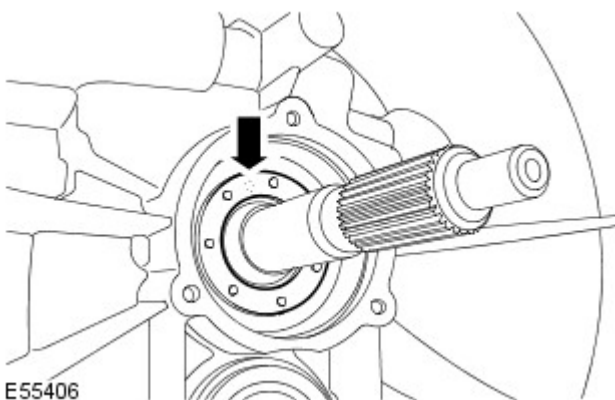
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

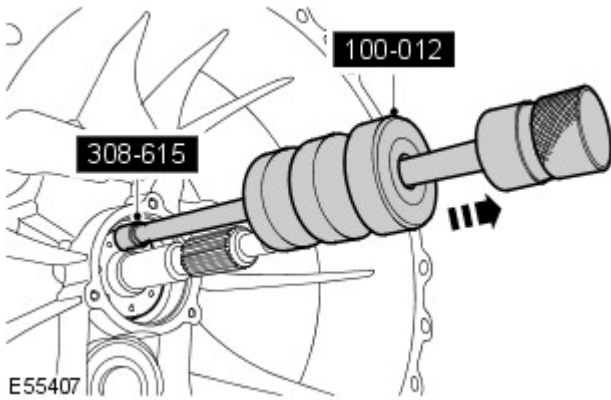
- Remove the clutch slave cylinder and release bearing assembly.
For additional information, refer to: [Clutch Slave Cylinder](#) (308-02 Clutch Controls - TDV6 2.7L Diesel, Removal and Installation).
- NOTE:** The screw holes are located through the rubber membrane.

Locate the hole for the extraction tool screw.



4. Remove the input shaft seal.

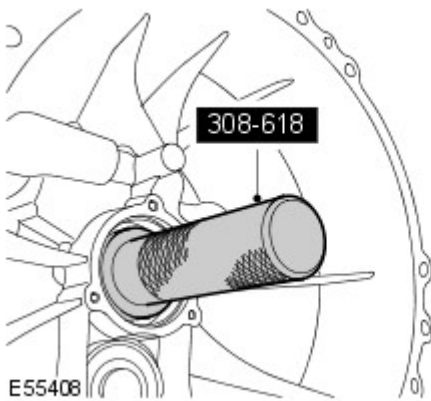
- Install the special tool.



Installation

1. Install the input shaft seal.


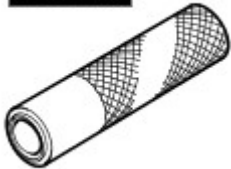
- Clean the component mating faces.
- Use the special tool.




2. Install the clutch slave cylinder and release bearing assembly.
For additional information, refer to: [Clutch Slave Cylinder](#) (308-02 Clutch Controls - TDV6 2.7L Diesel, Removal and Installation).
3. Drain and refill the transmission.
For additional information, refer to: [Transmission Draining and Filling](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Gearshift Control Shaft Seal

In-vehicle Repair

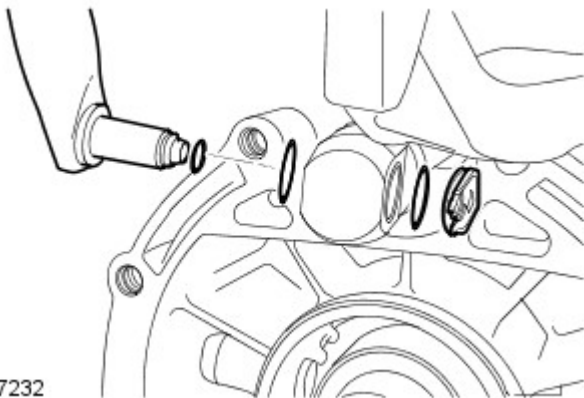
Special Tool(s)	
 <p>308-621</p> <p>E55400</p>	Seal extractor 308-621
 <p>308-622</p> <p>E55401</p>	Seal installer 308-622

Removal

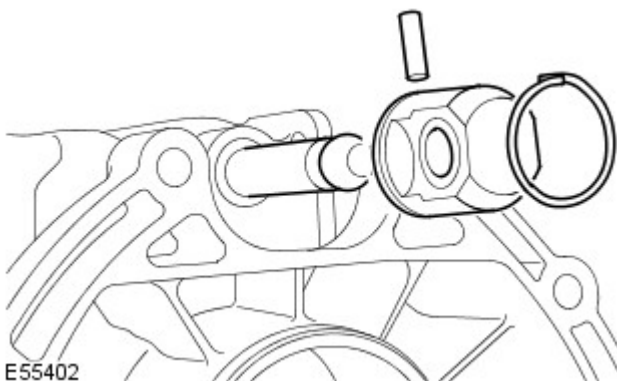
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).
- Release the gearshift rod.
 - Remove the clip.
 - Remove and discard both O-ring seals.

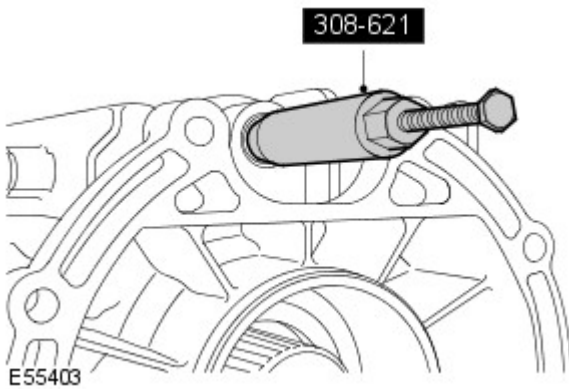


- Remove the selector rod coupling.
 - Release the clip.
 - Remove the link pin.



5. Remove the gearshift control shaft seal.

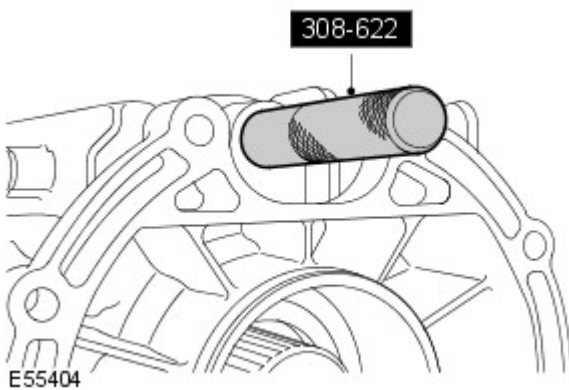
- Use the special tool.



Installation

1. Install the gearshift control shaft seal.

- Clean the component mating faces.
- Use the special tool.



2. Install the selector rod coupling.

- Install the link pin.
- Secure with the clip.

3. Install the gearshift rod.

- Clean the components.
- Lubricate the components.
- Install new O-ring seals.
- Install the clip.

4. Install the transfer case.

For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).


5. Drain and refill the transmission.

For additional information, refer to: [Transmission Draining and Filling](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, General Procedures).

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Gear Position Sensor

In-vehicle Repair

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the transmission.
For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).



4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the gear position sensor.

- Remove the 2 Torx screws.
- Remove and discard the O-ring seal.

Installation

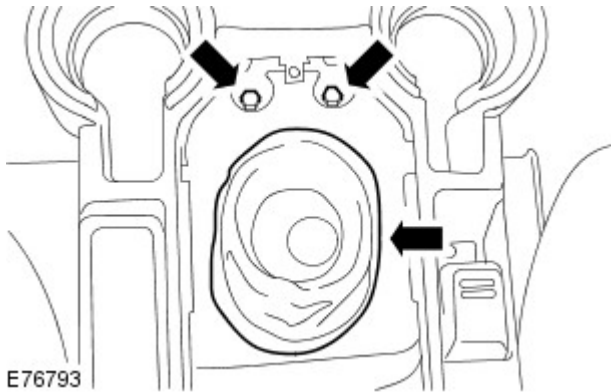
1. Install the gear position sensor.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Apply sealant to the Torx screw thread.
 - Tighten the Torx screws to 10 Nm (7 lb.ft).
2. Install the transmission.
For additional information, refer to: [Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Removal).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Transmission


Removal

Removal

1. Position the vehicle on a lift.
2. Disconnect the battery ground cable.
For additional information, refer to: Battery Charging (414-00, General Procedures).
3. Remove the ride and handling optimization switch.
For additional information, refer to: Ride and Handling Optimization Switch (204-06, Removal and Installation).
4. Release the gearshift mounting bracket.
 - Remove the 2 gearshift mounting bracket bolts.
 - Release the gearshift lever gaiter.

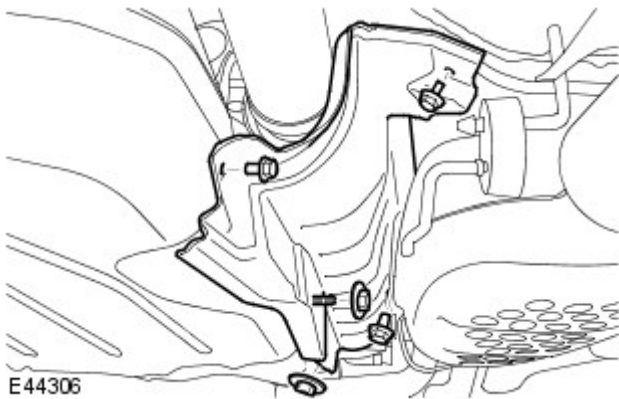


E76793

5.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

6. Remove the fuel tank heat shield.
 - Remove the 3 bolts and 2 nuts.



E44306

7. CAUTIONS:

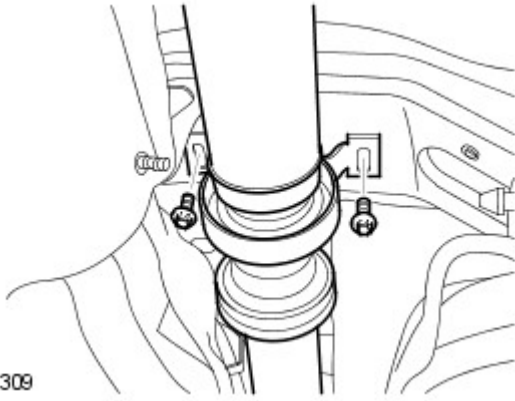
 Mark the position of the driveshaft flange in relation to the drive pinion flange.

 To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers.

8. Remove the 2 driveshaft center bearing mount bolts.



9.  CAUTION: To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Using a suitable tie strap, reposition and secure the driveshaft to the exhaust system.

10. Remove the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

11. Remove the front driveshaft.

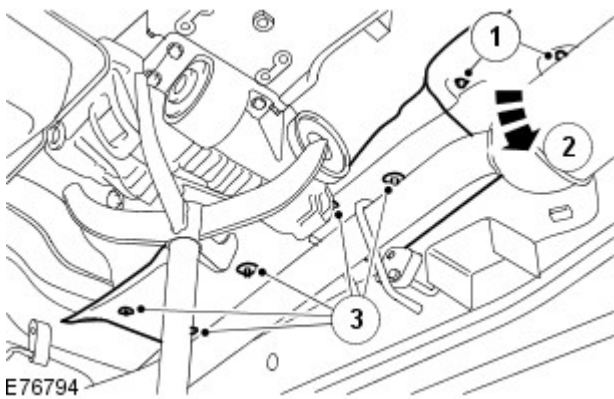
For additional information, refer to: [Front Driveshaft - TDV6 3.0L Diesel](#) (205-01 Driveshaft, Removal and Installation).

12. Remove the exhaust heat shield.

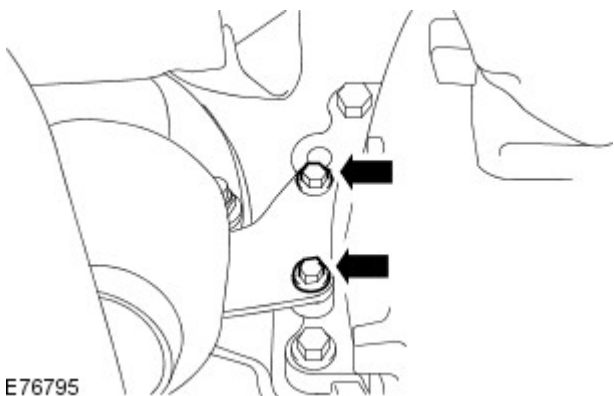
1. Remove the 2 exhaust heat shield front nuts.

2. Release the bulkhead heat shield.

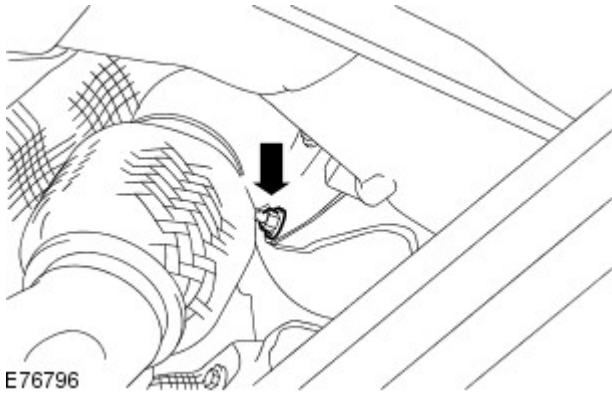
3. Remove the 5 remaining exhaust heat shield nuts.



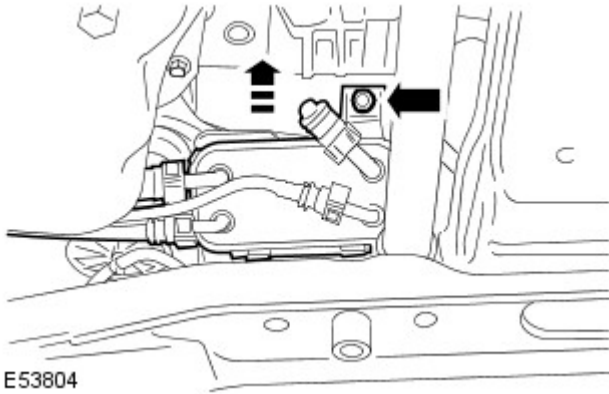
13. Remove the 2 turbocharger support bracket bolts.



14. Loosen the turbocharger support bracket nut and reposition the turbocharger support bracket.

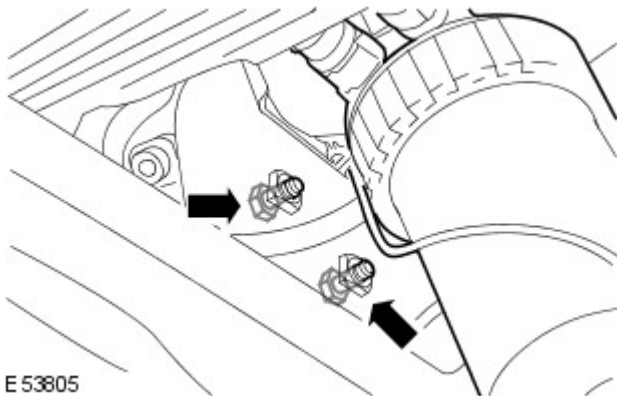


15. Release and reposition the fuel cooler.



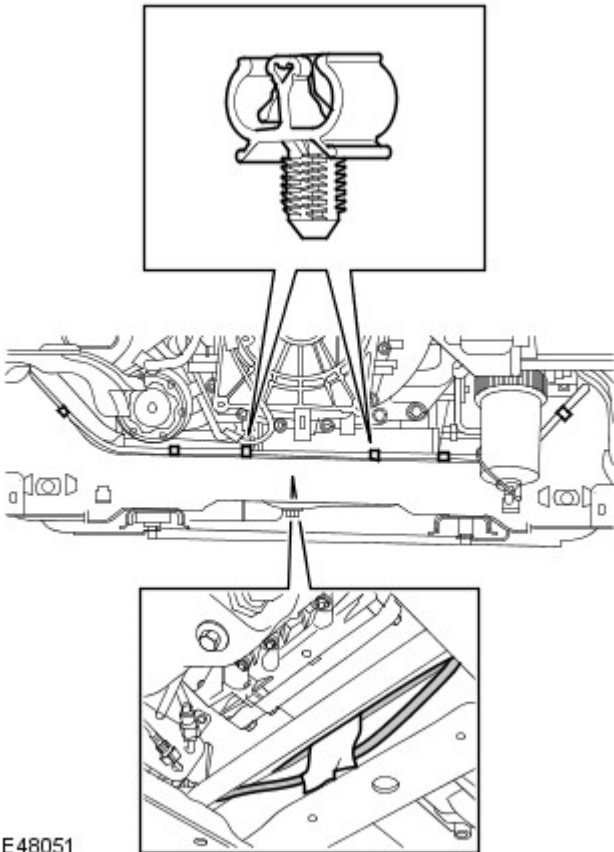
16. Release the fuel filter housing and support bracket.

- Remove the 2 bolts.



17. Secure the vacuum hose to the forward edge of the chassis cross member.

- Release from the 6 clips.
- Secure with adhesive tape.
- Remove the 2 clips.



E48051

18. CAUTIONS:



An approved hose clamp must be used.



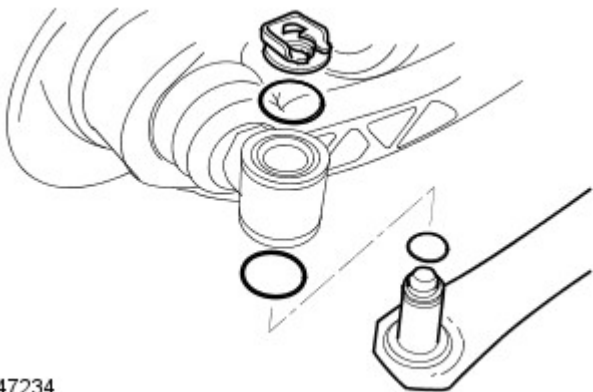
Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the clutch fluid hose.

- Remove the clip.
- Clamp the hose.
- Remove and discard the O-ring seal.

19. Release the gearshift rod.

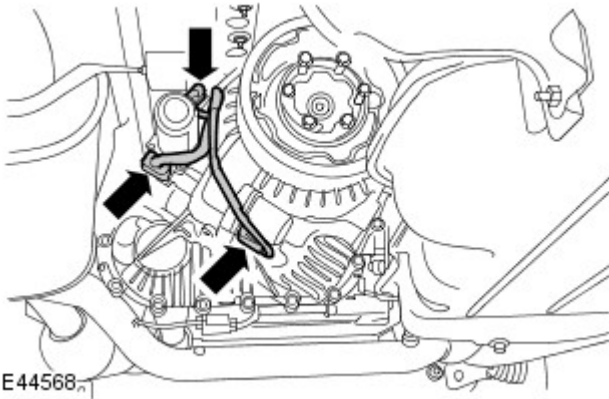
- Remove the clip.
- Remove and discard the O-ring seals.



E47234

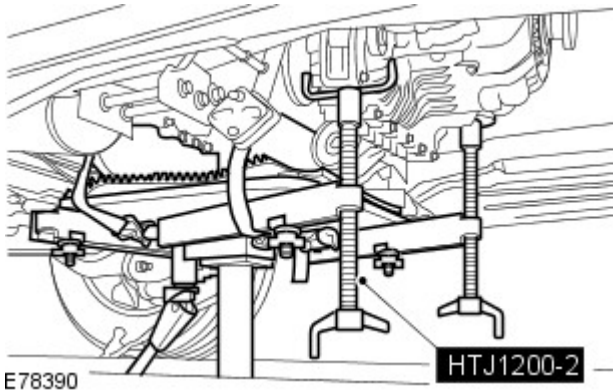
20. Release the wiring harness from the transfer case.

1. Disconnect the transfer case 3 electrical connectors.
2. Remove the wiring harness bolt.
3. Release the wiring harness from the clip.



21. Position the special tool to the transmission.

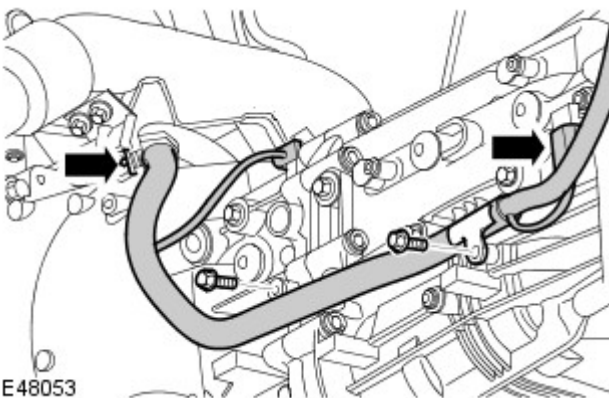
- Secure the transmission to the special tool.



22. Lower the rear of the transmission for access.

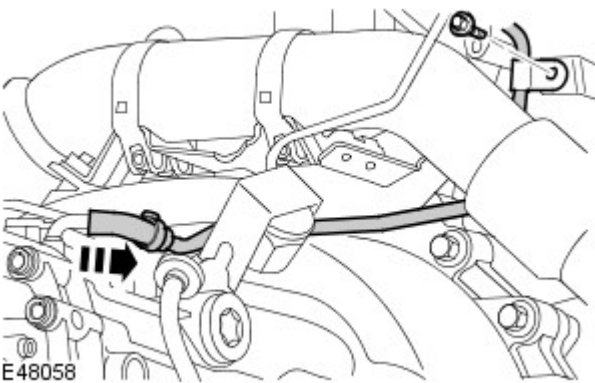
23. Release the wiring harness from the transmission.

- Disconnect the 2 electrical connectors.
- Remove the 2 bolts.
- Release the wiring harness from the clip.



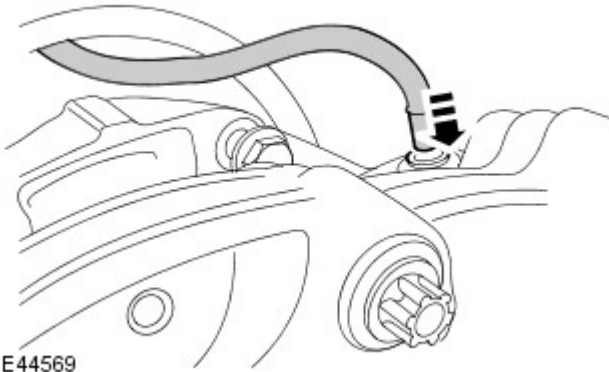
24.  CAUTION: Always plug any open connections to prevent contamination.

Disconnect the gearbox breather line.



25.  CAUTION: Always plug any open connections to prevent contamination.

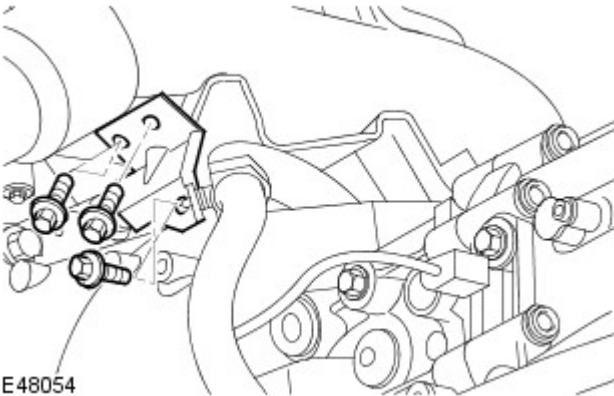
Disconnect the transfer case breather line.



E44569

26. Remove the exhaust cross-over pipe LH support bracket.

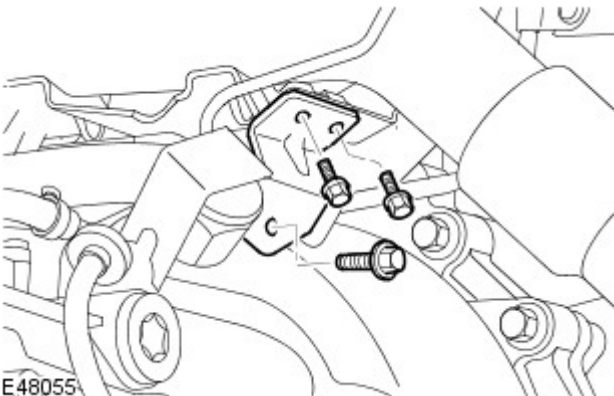
- Remove the 3 bolts.



E48054

27. Remove the exhaust cross-over pipe RH support bracket.

- Remove the 3 bolts.

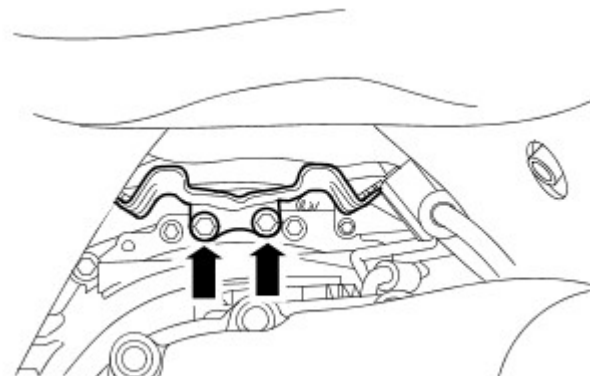


E48055

28. Reposition the wiring harness to allow access to exhaust cross-over pipe center support bracket.

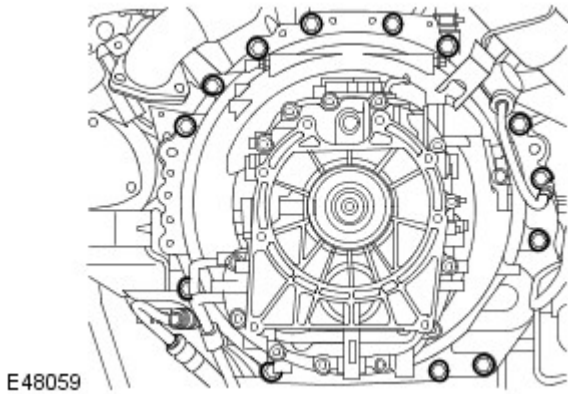
29. Remove the exhaust cross-over pipe center support bracket.


- Remove the 2 bolts.



E48056

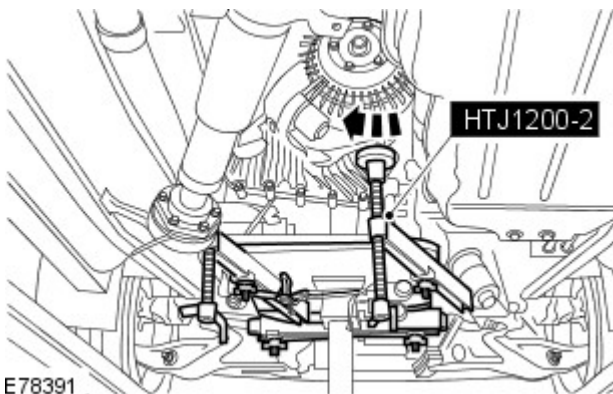
30. Remove the 14 transmission bolts.



31.  CAUTION: Make sure the transmission remains level.

Release the transmission from the engine and move the transmission 40mm (1.57 inches) rearwards.

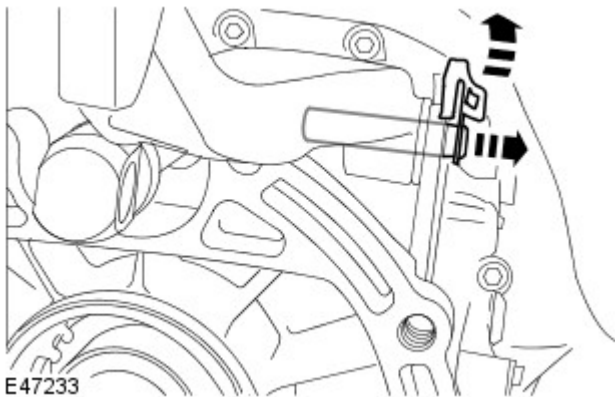
32. Using the transmission jack, rotate the transmission to gain access to the gearshift mechanism.




33. NOTE: Transfer case shown removed for clarity.

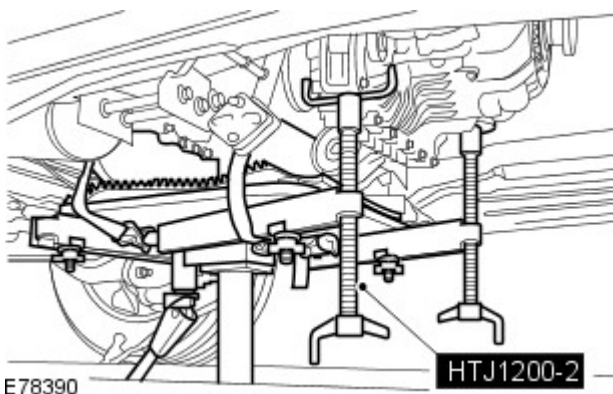
Release the gearshift mechanism from the transmission.

- Release the clip.
- Release the pin.



34.  CAUTION: Make sure the transmission remains level.

With assistance, remove the transmission.



35. Remove the transmission from the transmission jack.

Manual Transmission/Transaxle - TDV6 2.7L Diesel - Transmission

Installation

Installation

1. Position the transmission to the transmission jack.

2. CAUTIONS:



Make sure the transmission remains level.



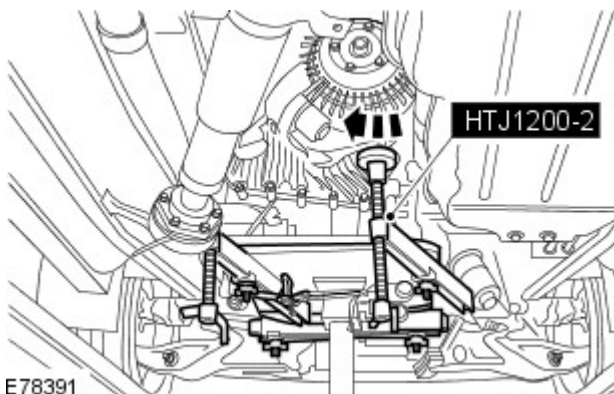
Make sure the clutch assembly is not damaged as the transmission is installed.

• NOTE: Do not install the transmission fully to the engine, a 40mm (1.57 inches) gap must be maintained.

With assistance, install the transmission.

- Clean the component mating faces.

3. Using the transmission jack, rotate the transmission to gain access to the gearshift mechanism.

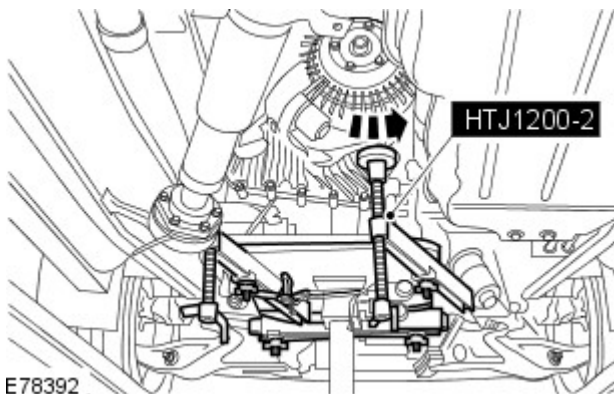


E78391

4. Attach the gearshift mechanism to the transmission.

5. CAUTION: Make sure the clutch assembly is not damaged as the transmission is installed.

Align the transmission to the engine and install the transmission.



E78392

6. NOTE: Transfer case shown removed for clarity.

Install the 14 transmission bolts.

- Tighten the bolts to 40 Nm (30 lb.ft).

7. Install the exhaust manifold crossover pipe center support bracket.

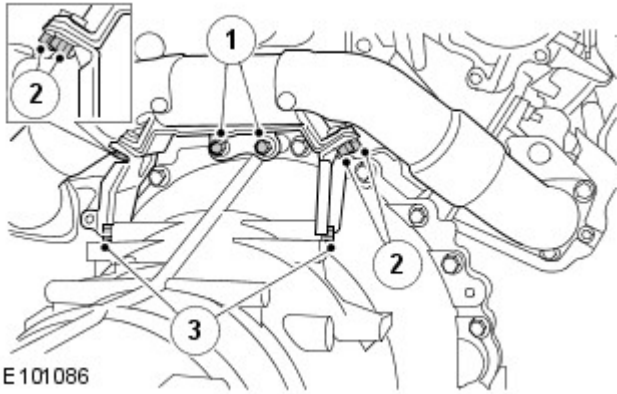
- Loosely install the 2 bolts.

8. Install the exhaust manifold crossover pipe RH support bracket.

- Loosely install the 3 bolts.

9. Install the exhaust manifold crossover pipe LH support bracket.

- Loosely install the 3 bolts.



10. Tighten the exhaust manifold crossover pipe mounting bracket bolts in the following sequence.

- Tighten the 2 bolts marked 1 to 10 Nm (7 lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 2 bolts marked 3 to 10 Nm (7lb.ft).
- Loosen the 2 bolts by 90 degrees.
- Tighten the 4 bolts marked 2 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts marked 1 to 25 Nm (18 lb. ft).
- Tighten the 2 bolts marked 3 to 25 Nm (18 lb. ft).
- Attach the wiring harness.

11. Reposition the wiring harness to the transmission.

12. Connect the transmission and transfer case breather lines.

13. Secure the wiring harness to the transmission.

- Attach the wiring harness to the clip.
- Connect the electrical connectors.
- Install and tighten the 2 bolts.

14. Raise the transmission jack.

15. Secure the wiring harness to the transfer case.

- Tighten the bolt to 25 Nm (18 lb.ft).
- Attach the wiring harness to the clip.

16. Connect the transfer case electrical connectors.

17. Attach the gearshift rod.

- Clean the components.
- Lubricate the components.
- Install new O-ring seals.
- Install the clip.

18. Connect the clutch fluid hose.

- Clean the components.
- Install a new O-ring seal.
- Install the clip.
- Remove the hose clamp.

19. Install the vacuum hose to the clips.

- Remove the adhesive tape.
- Install the retaining clips.

20. Attach the fuel filter support bracket.

- Install the 2 bolts and tighten to 10 Nm (7 lb.ft).

21. Attach the fuel cooler.

- Install the bolt and tighten to 10 Nm (7 lb.ft).


22. Install the 2 turbocharger support bracket bolts.

- Tighten the bolts to 25 Nm (18 lb.ft).

23. Tighten the turbocharger support bracket nut.

- Tighten the nut to 25 Nm (18 lb.ft).

24. Install the exhaust heat shield.

25. Bleed the clutch system.
26. Install the front driveshaft.
For additional information, refer to: [Front Driveshaft - TDV6 2.7L Diesel](#) (205-01 Driveshaft, Removal and Installation).
27. Remove the transmission jack.
28. Install the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
29.  **CAUTION:** To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Attach the driveshaft to the transfer case drive flange.
 - Remove the securing strap.
 - Tighten the Torx bolts to 55 Nm (40 lb.ft).
30. Install the driveshaft center bearing mount bolts.
 - Align the center bearing mount.
 - Tighten the 2 driveshaft center bearing bolts to 30 Nm (22 lb.ft).
31. Install the fuel tank heat shield.
 - Tighten the bolts to 6 Nm (4 lb.ft).
 - Tighten the nuts to 3 Nm (2 lb.ft).
32. Lower the vehicle.
33. Attach the gearshift lever gaiter.
34. Install the 2 gearshift mechanism mounting bracket bolts.
 - Tighten the bolts to 25 Nm (18 lb.ft).
35. Install the ride and handling optimization switch.
For additional information, refer to: Ride and Handling Optimization Switch (204-06 Ride and Handling Optimization, Removal and Installation).
36. Connect the battery ground cable.

Manual Transmission/Transaxle External Controls - TDV6 2.7L Diesel -**Lubricant**

Item	Specification
* Gearshift linkage grease	Land Rover Part Number UYL 500010 (Kluebersynth LI 44-22)



CAUTION: * Do not use any grease other than that specified

General Specifications

Item	Specification
Gearshift linkage type	Rod shifter enabling selection of six forward gears and one reverse gear with 'knock over' selection of reverse

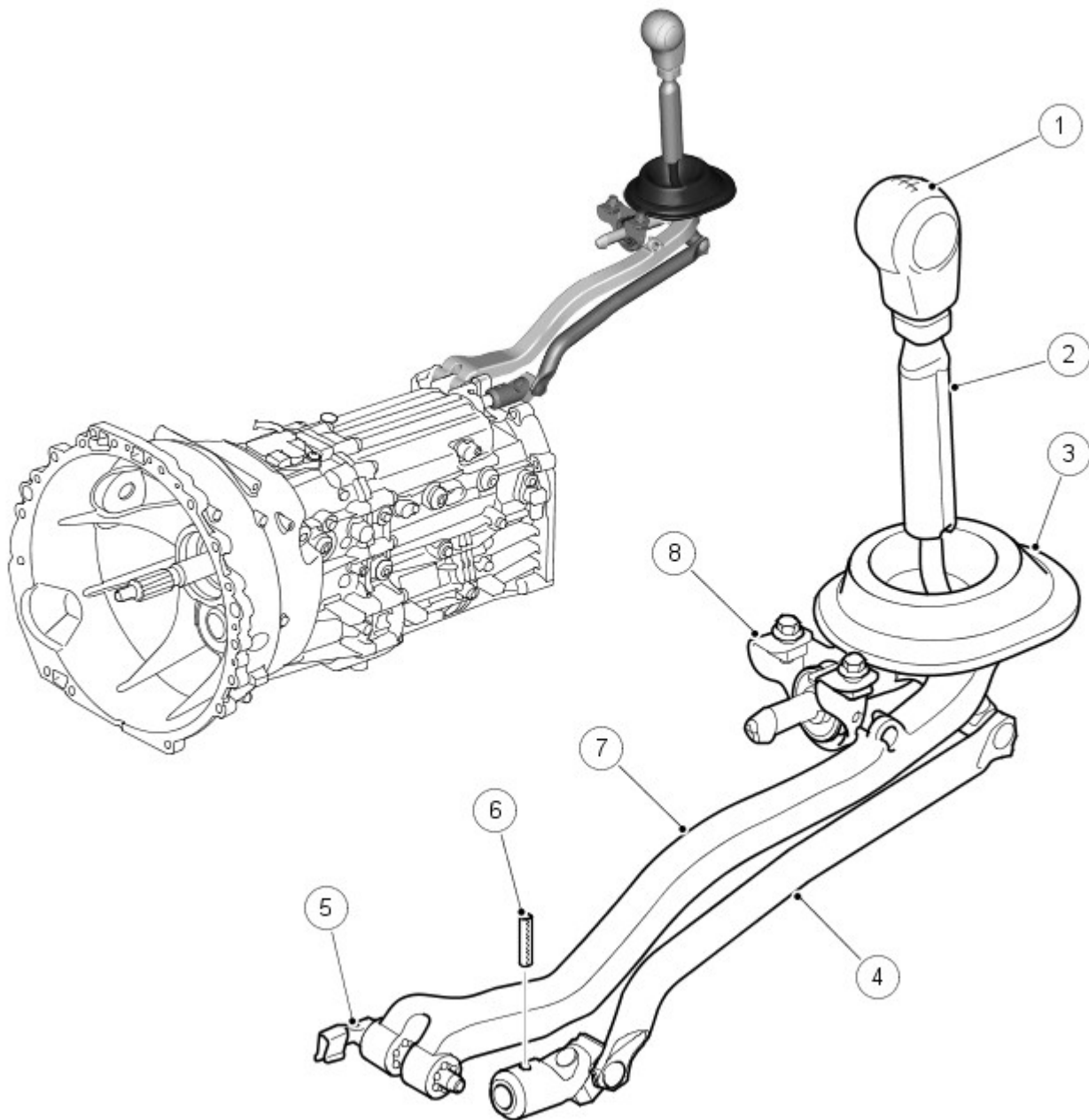
Torque Specifications

Description	Nm	lb-ft
Gearshift mechanism mounting bracket bolts	25	18

Manual Transmission/Transaxle External Controls - TDV6 2.7L Diesel - External Controls

Description and Operation

Gear Change Mechanism

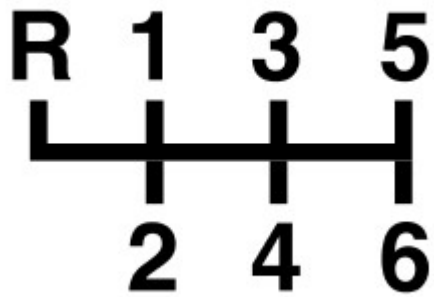


E47713

Item	Part Number	Description
1	-	Gear knob
2	-	Gear lever
3	-	Gaiter
4	-	Shift rod
5	-	Clevis pin
6	-	Roll pin
7	-	Steady rod
8	-	Floater bracket

The gear change assembly is bolted to the transmission tunnel via a floater bracket. A pin and retainer connects the shift rod to the transmissions selector shaft. A steady rod is fitted between the gear change mechanism and the rear of the transmission casing. The rod is held in place by means of a clevis pin for added strength and rigidity.

The gear lever incorporates a vibration attenuator to reduce any Noise Vibration and Harshness (NVH) generated by the powertrain components.




E47714

Bias springs within the transmission provide a positive return of the gear lever to the neutral position with selection of 1st/2nd, 5th/6th and reverse gears being against bias spring pressure. Spring-loaded detents on the selector rod and x-gate butterfly within the transmission, provide positive gear and neutral selection.

Manual Transmission/Transaxle External Controls - TDV6 2.7L Diesel - Gearshift Lever

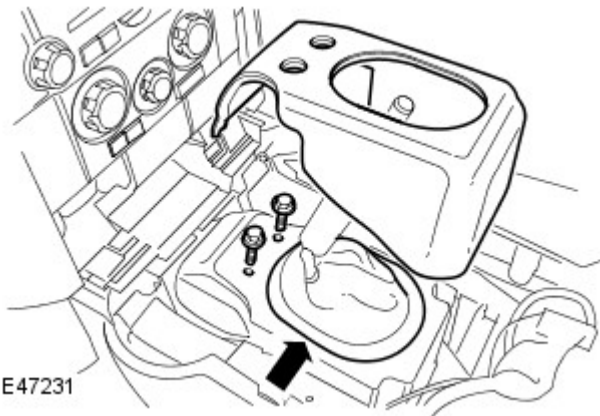
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

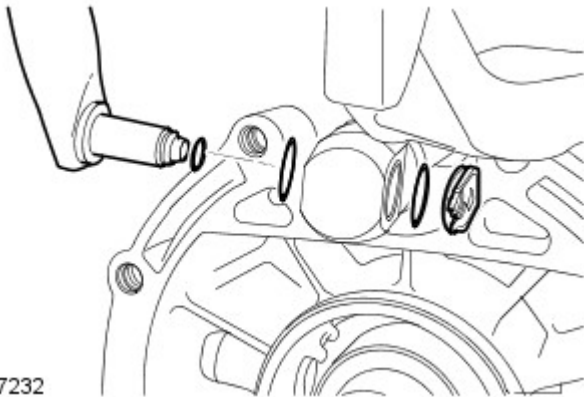
Raise and support the vehicle.

2. Remove the floor console upper trim panel.
For additional information, refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 2.7L Diesel](#) (308-07B Transfer Case, Removal).
4. Release the gearshift mounting bracket.
 - Remove the acoustic pad.
 - Release the gaiter.
 - Remove the 2 bolts.



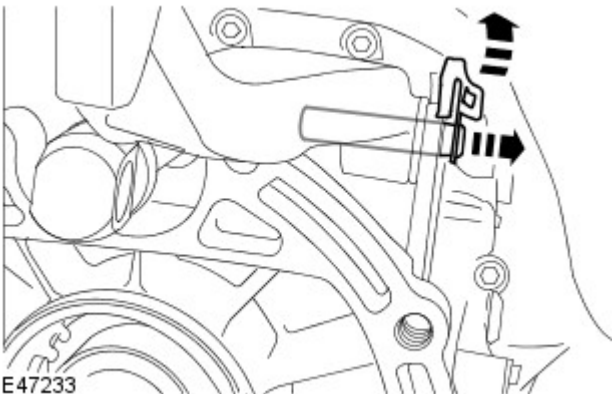
E47231

5. Release the gearshift rod.
 - Remove the clip.
 - Remove and discard the O-ring seals.



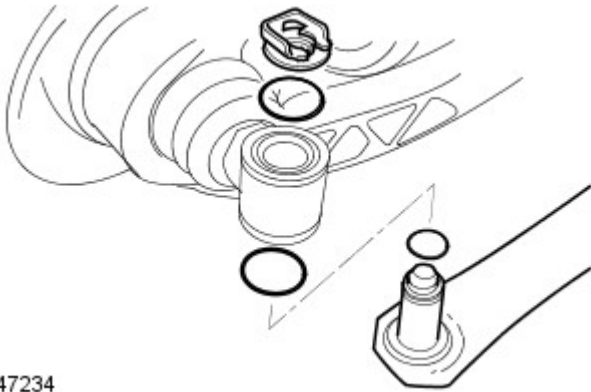
E47232

6. Remove the gearshift mechanism.
 - Release the clip.
 - Remove and discard the pin.



E47233

7. NOTE: Do not disassemble further if the component is removed for access only.



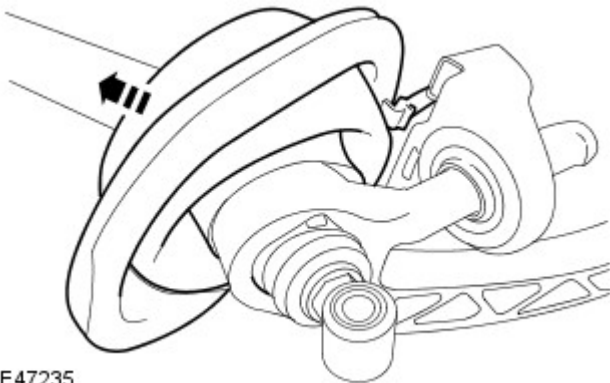
E47234

Remove the gearshift rod.

- Remove and discard the clip.
- Remove and discard the O-ring seals.

8. Remove the gaiter.

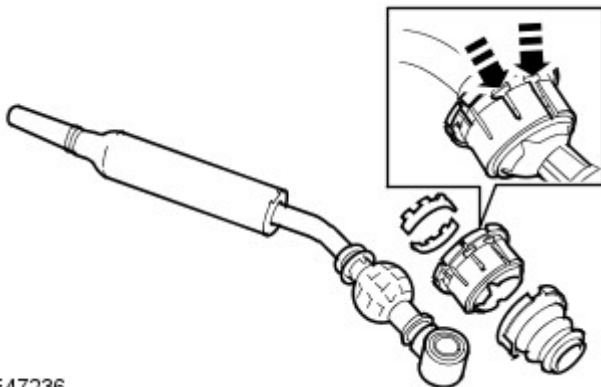
- Release the gaiter from the gearshift lever ball socket.



E47235

9. Remove the gearshift lever.

- Release the gearshift lever ball socket from the steady rod.



E47236

10. Remove the gearshift lever ball socket.

- Remove the dust seal.
- Remove the 2 clips.

Installation

1. Install the gearshift lever ball socket.

- Clean the components.
- Lubricate the components.
- Install the 2 clips.
- Install the dust seal.

2. Install the gearshift lever.

- Secure the gearshift lever ball socket.

3. Install the gearshift lever gaiter.

- Install the gaiter to the gearshift lever and ball socket.
4. Install the gearshift rod to the lever.
 - Clean the components.
 - Lubricate the components.
 - Install new O-ring seals.
 - Install the new clip.
 5. Install the gearshift mechanism.
 - Clean the components.
 - Lubricate the components.
 - Install the new pin.
 - Secure the clip.
 6. Install the gearshift rod.
 - Clean the components.
 - Lubricate the components.
 - Install new O-ring seals.
 - Install the clip.
 7. Install the gearshift mechanism mounting bracket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
 - Install the gearshift lever gaiter.
 - Install the acoustic pad.
 8. Install the transfer case.
For additional information, refer to: [Transfer Case - TDV6 2.7L Diesel](#) (308-07B Transfer Case, Removal).
 9. Install the floor console upper trim panel.
For additional information, refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

Four-Wheel Drive Systems -

Torque Specifications

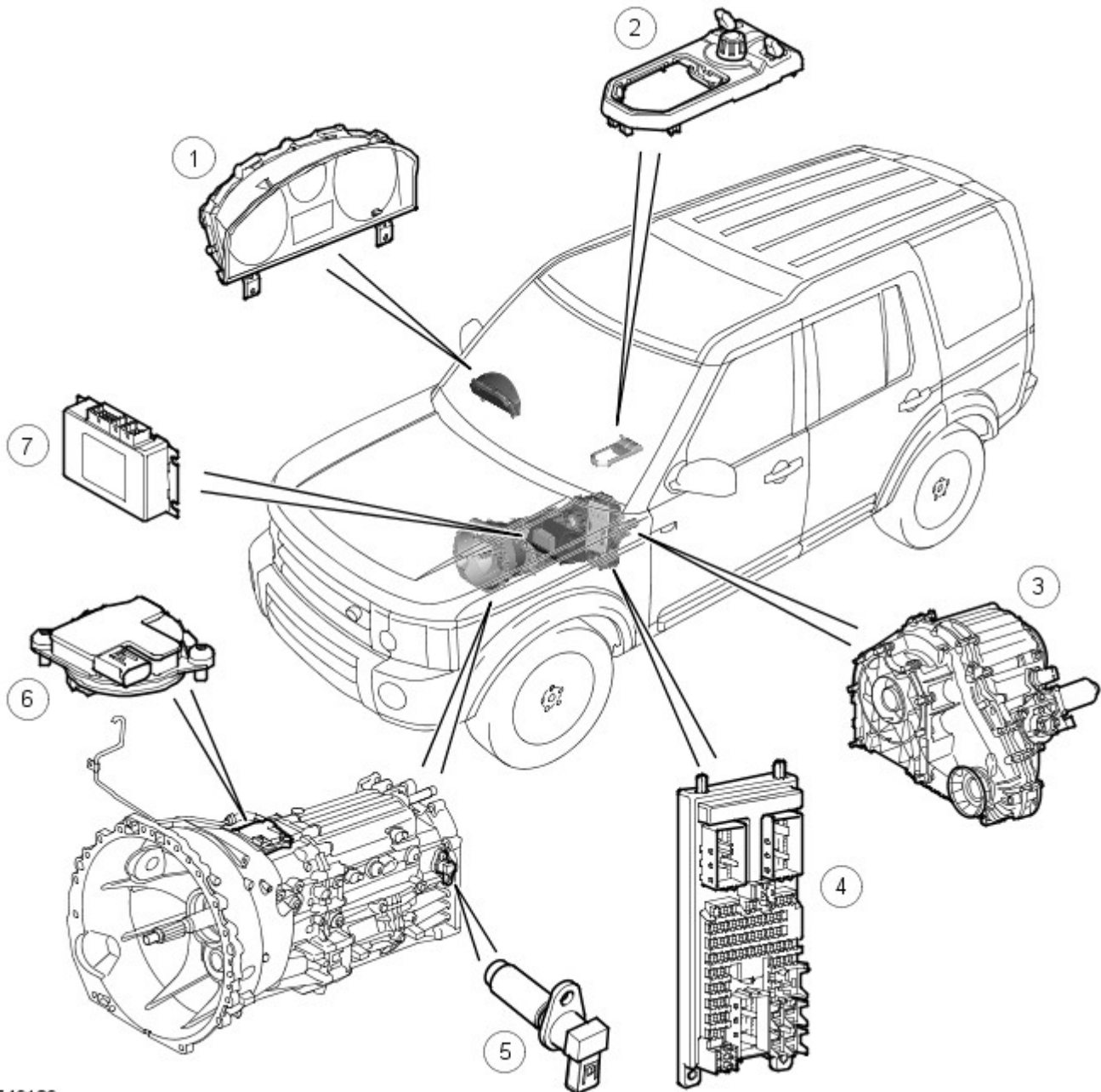
- NOTE: * New bolts must be fitted.

Description	Nm	lb-ft
* Transfer case shift motor Torx bolts	25	18
* Transfer case clutch control solenoid Torx bolts	10	7
* High/Low range sensor Torx bolts	10	7

Four-Wheel Drive Systems - Four-Wheel Drive Systems

Description and Operation

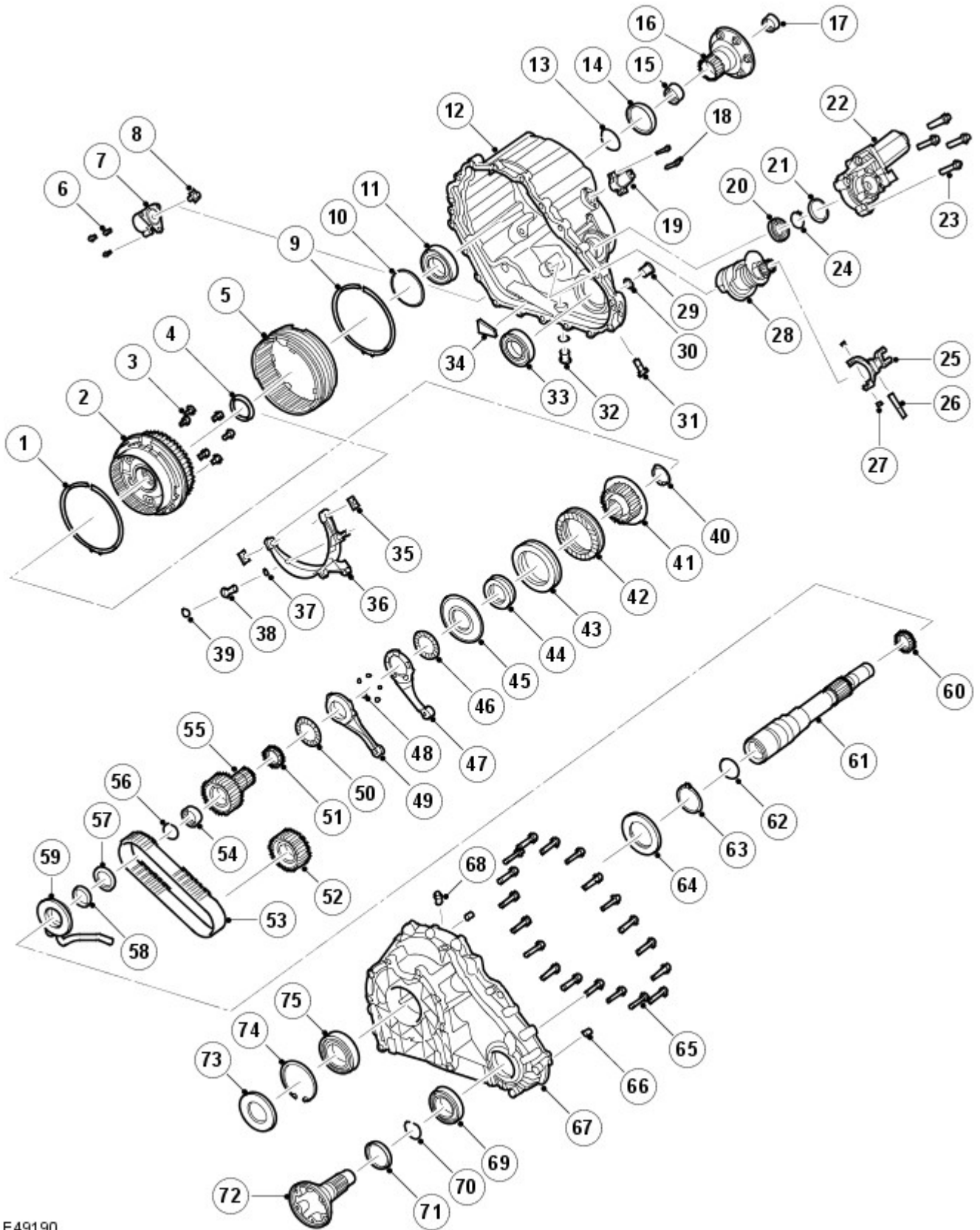
Transfer Box Component Location



E49189

Item	Part Number	Description
1	-	Instrument cluster
2	-	Range change selection switch
3	-	Transfer box
4	-	Central junction box (CJB)
5	-	Manual transmission output shaft speed sensor
6	-	Gear position sensor (manual transmission only)
7	-	Transfer box control module

Transfer Box Exploded View



E49190

Item	Part Number	Description
1	-	Synchronisation spring
2	-	Differential assembly
3	-	Bolt, 6 off
4	-	Spacer ring
5	-	Shifting sleeve
6	-	Bolt, 3 off
7	-	Solenoid
8	-	Shifting element
9	-	Synchronisation spring
10	-	Circlip
11	-	Ball bearing

12	-	Rear housing
13	-	Circlip
14	-	Seal ring
15	-	Needle roller bearing
16	-	Rear output flange
17	-	Needle roller bearing
18	-	Bolt, 2 off
19	-	Selector fork position sensor
20	-	Bearing
21	-	Circlip
22	-	Transfer box motor assembly
23	-	Bolt, 4 off
24	-	Circlip
25	-	Shifting fork
26	-	Fork pin
27	-	Sliding block
28	-	Actuator assembly
29	-	Fill plug
30	-	Seal ring
31	-	Ball retention
32	-	Drain plug
33	-	Seal ring
34	-	Particle collector magnet
35	-	Sliding block
36	-	High/low shifting fork
37	-	O-ring
38	-	High/low fork pin
39	-	Circlip
40	-	Circlip
41	-	Clutch hub
42	-	Clutch friction plate, 10 off
43	-	Clutch steel plate, 10 off
44	-	Disc spring, 6 off
45	-	Clutch piston
46	-	Axial needle roller bearing
47	-	Transfer box motor lever assembly
48	-	Ball, 5 off
49	-	Transfer box motor lever assembly
50	-	Axial needle roller bearing
51	-	Needle roller bearing
52	-	Front output sprocket
53	-	Chain
54	-	Needle roller bearing
55	-	Sprocket
56	-	Circlip
57	-	Thrust washer
58	-	Spacer ring
59	-	Oil pump assembly
60	-	Needle roller bearing
61	-	Input shaft
62	-	O-ring
63	-	Circlip
64	-	Disc spring, 2 off
65	-	Bolt, 19 off
66	-	Dowel pin (2 off)
67	-	Front housing
68	-	Breather cartridge
69	-	Bearing
70	-	Circlip
71	-	Seal ring
72	-	Front output flange
73	-	Seal ring
74	-	Circlip
75	-	Bearing

GENERAL

The DD295 transfer box is a full time, permanent four-wheel-drive unit, with 50/50 torque distribution to the front and rear driveshafts. The unit is manufactured by Magna Steyr Powertrain in Graz, Austria and supports the following features:

- Permanent four-wheel-drive with a bevel gear centre differential, providing a 50:50 torque split
- Selectable high and low range for optimum on-road and off-road performance
- Two-speed, fully synchronized 'shift-on-the-move' system allows the driver to change the range without having to stop the vehicle
- Electronically controlled multi-plate clutch providing a centre differential lock and torque biasing function to give improved traction performance and vehicle dynamic stability.

A strategy, to electronically control the centre differential multi plate clutch assembly, has been developed to provide:

- a pre-loading function, increasing locking torque with increased driving torque
- a slip controller to increase locking torque under off-road conditions and decrease locking torque for optimum comfort, e.g. parking.

The unit is located under the vehicle and is mounted on the cross-member, behind the transmission. The unit is identical for all engine derivatives.

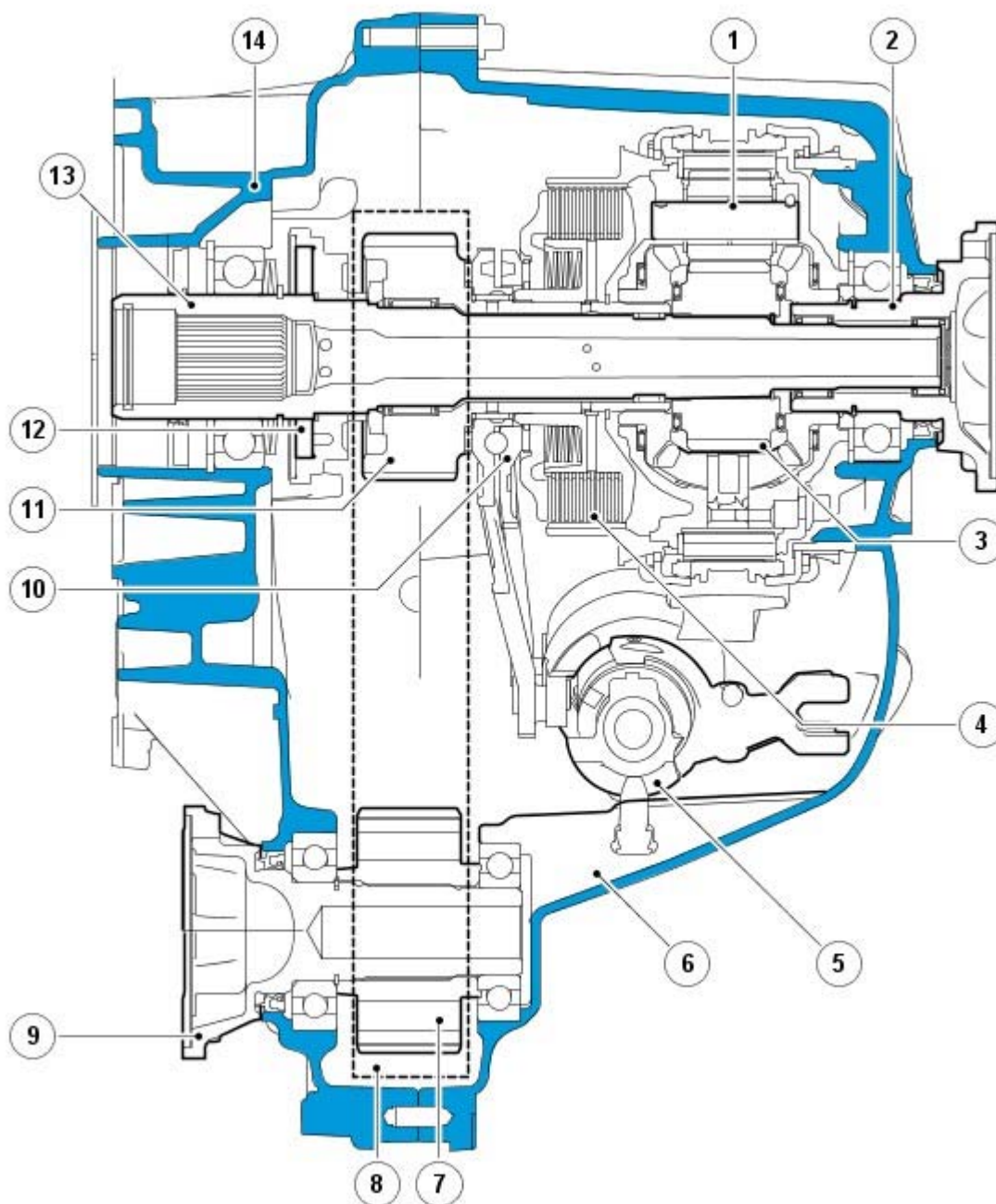
The transfer box receives a torque input from the transmission output shaft, which is passed through the unit to two outputs for the front and rear drive shafts.

The input torque is equally distributed via a bevel gear type differential. In order to provide an optimal torque distribution to each wheel in all driving conditions, the unit is equipped with an electronically controlled locking and torque-biasing device. This device detects wheel slip via various vehicle system inputs to the transfer box control module and locks the differential accordingly. The locking torque is applied through a multi-plate clutch assembly.

A planetary gear set, located in the differential assembly, allows the driver to select high or low range whilst driving, this is known as 'shift on the move'. When in low range, the planetary gear set provides a ratio of 2.93:1, which gives the vehicle an extremely low crawl speed for off road driving and trailer towing. High range is a direct drive from the transmission output shaft and provides a 1:1 ratio.

Both the centre differential locking and biasing and the 'shift on the move' features are actuated via a DC transfer box motor, which is controlled by the transfer box control module, via a Pulse Width Modulation (PWM) signal.

Transfer Box - Sectional View

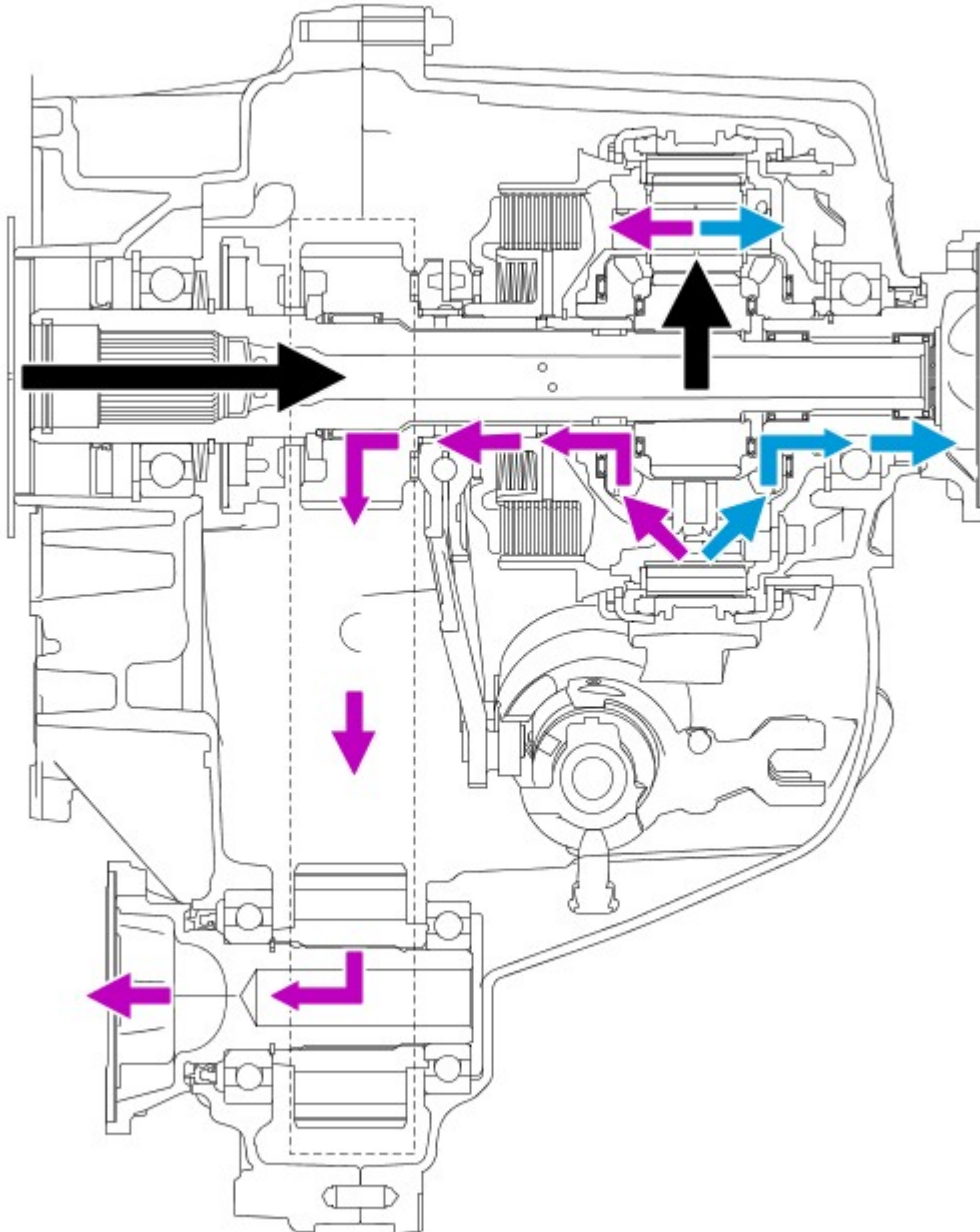


E49191

Item	Part Number	Description
1	-	Planetary gear set
2	-	Rear output flange

3	-	Centre differential assembly
4	-	Multi-plate clutch
5	-	Transfer box motor module
6	-	Rear housing assembly
7	-	Front output sprocket
8	-	Chain drive
9	-	Front output flange
10	-	Transfer box motor levers
11	-	Sprocket
12	-	Oil pump assembly
13	-	Input shaft
14	-	Front housing assembly

Transfer Box Power Flow



E49192

The input torque, from the transmission, is transferred to the input shaft of the transfer box and then onto the planetary sun gear and planetary pinion gears. The planetary pinion gears are held in place by the planet pinion shafts, which are connected to the differential carrier, and drive the differential pinion gears. The torque is then distributed to both the front and rear carriers, which are connected to the outputs of the transfer box. The rear carrier is connected directly to the rear output flange; the front carrier is connected to the sprocket and therefore to the chain drive, which provides the front output flange rotation.

TRANSFER BOX CASINGS

The front and rear casing assemblies are manufactured from cast aluminium.

Front Casing Assembly

The front casing assembly provides the location for the input shaft bearing and the front output flange bearing. It is also equipped with threaded holes to mount the chassis mounting bush, two lifting eyes and a breather cartridge for the transfer box breather pipe. The breather pipe allows an equalisation between atmospheric and internal transfer box pressure.

Rear Casing Assembly

The rear casing assembly provides the location for the rear output flange bearing, the transfer box motor and the oil fill and drain plug. Fins are cast into the rear casing assembly to improve the heat dissipation. The unit number is also stamped into the rear housing.

OIL PUMP

An oil pump assembly is located in the front casing to provide lubrication for the bearings and rotary components through cross-drillings in the input shaft. A flat-sectioned coupling on the input shaft drives the rotor of the pump; the stator is fixed to the front housing assembly. A tube is attached to the pump, which leads into a calm suction area at the bottom of the two casing assemblies. The collector magnet in the suction area of the pump collects any metallic debris.

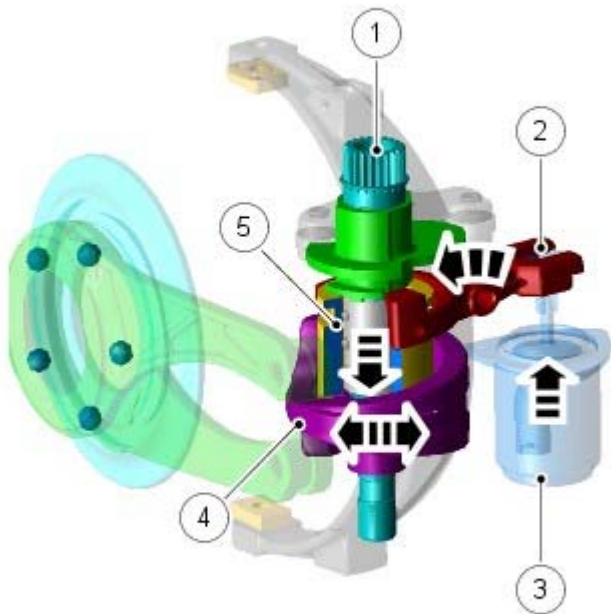
CHAIN DRIVE

The chain-drive transfers drive from the centre differential to the front output flange. A 3/8" pitch chain connects the sprocket on the transfer box input shaft with the sprocket on the front output flange. As both sprockets have the same number of teeth, the rotational speed of both sprockets is identical.

TRANSFER BOX MOTOR

One motor operates both the high/low range change and the differential locking and torque-biasing device (multi-plate clutch). The motor solenoid switches between the two functions, while the motor provides the rotational movement for both operations.

Transfer Box Motor Position For Clutch Control Mode



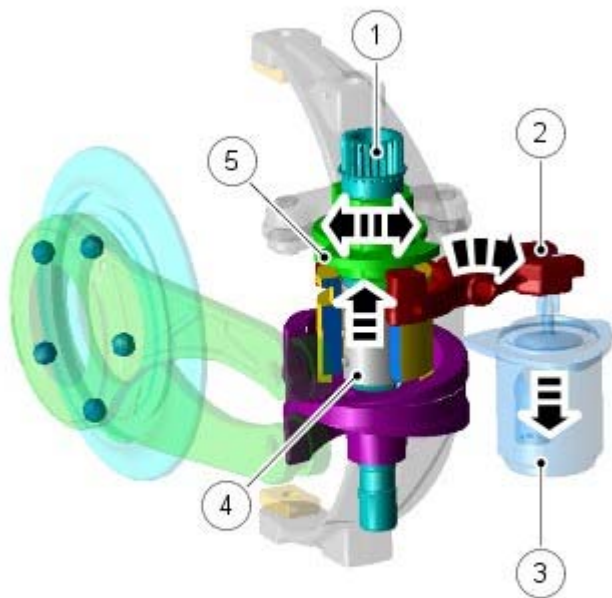
E49193

Item	Part Number	Description
1	-	Motor shaft
2	-	Solenoid shift fork
3	-	Solenoid
4	-	Clutch control disc
5	-	Shifting sleeve

To actuate the multi-plate clutch, the transfer box control module energizes the solenoid (3). The solenoid pin pivots the solenoid shift fork (2), which engages the shifting sleeve (5) into the dogteeth on the clutch control disc (4). The rotational movement of the motor shaft (1) is then linked to the clutch control disc via the shifting sleeve.

This is the normal operating mode of the transfer box. In this position, the range change function is disengaged and mechanically locked.

Transfer Box Motor Position For High/Low Range Mode



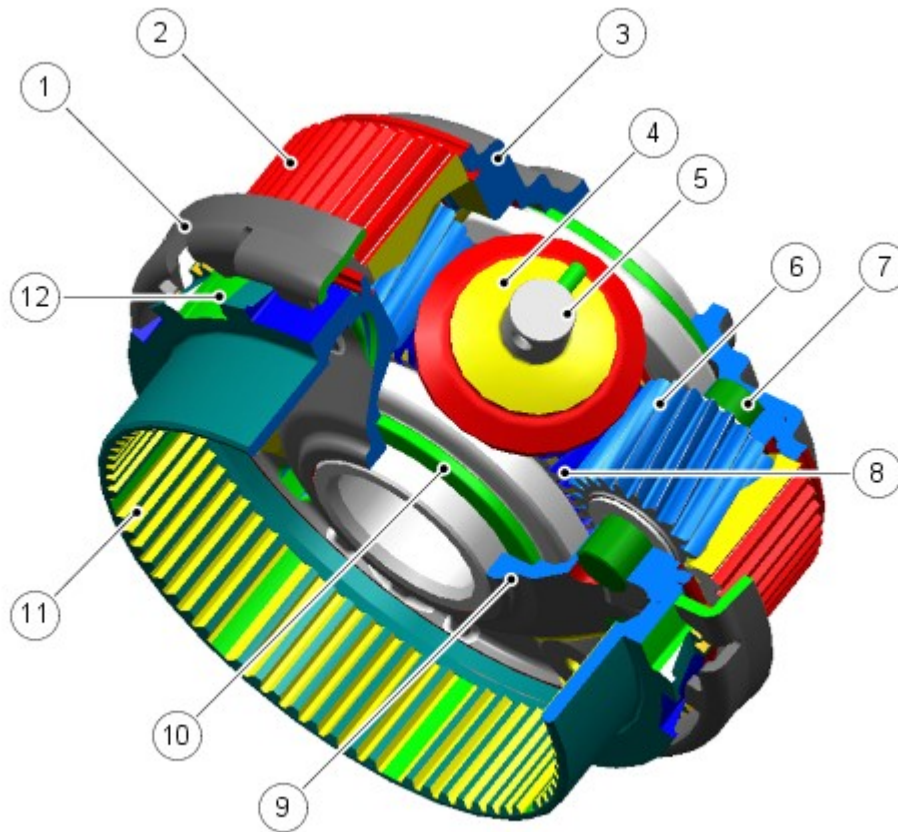
E49194

Item	Part Number	Description
1	-	Motor shaft
2	-	Solenoid shift fork
3	-	Solenoid
4	-	Shifting sleeve
5	-	Actuation cam

To actuate the high/low range change, the transfer box control module de-energizes the solenoid (3). A spring in the solenoid retracts the solenoid pin and rotates the solenoid shift fork (2). This engages the shifting sleeve (4) to the dogteeth on the high/low actuation cam (5). The rotational movement of the motor shaft (1) is then linked to the cam.

In this position, the multi-plate clutch is open, the differential cannot be locked and torque cannot be biased. Once the range change is complete the system returns to clutch control mode. In the event of an electrical failure, the motor will default to this position.

CENTRE DIFFERENTIAL ASSEMBLY



E49195

Item	Part Number	Description
1	-	Synchronisation cup and spring
2	-	Planetary ring gear
3	-	Differential carrier
4	-	Pinion gears
5	-	Pinion gear shafts
6	-	Planetary pinion gears
7	-	Planetary pinion gear shafts
8	-	Planetary sun gear
9	-	Differential cover
10	-	Differential side gears
11	-	Multi-plate clutch basket
12	-	Dogteeth

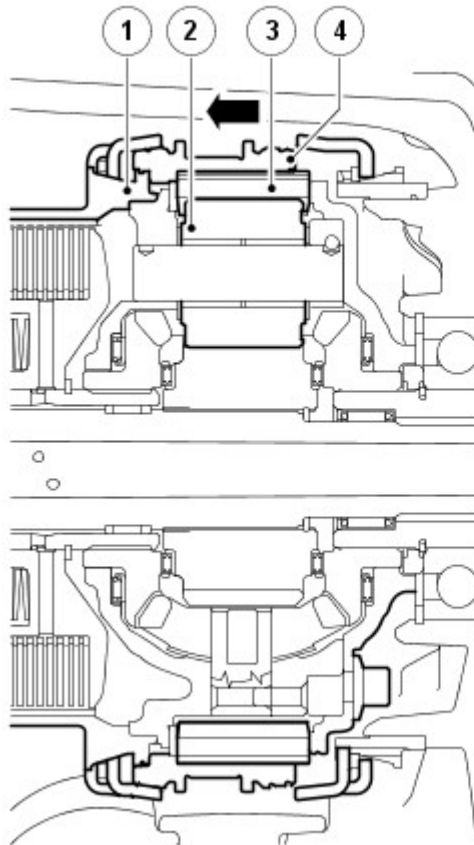
The centre differential assembly is the primary feature of the transfer box. Torque is transmitted through the centre differential carrier and distributed to the differential gears and the front and rear output flanges. The planetary gear set, for the high/low range change function, is also an integral part of the centre differential assembly.

The assembly comprises 3 differential pinion gears (4) and shafts (5), which are equally spaced within the centre differential carrier (3). The differential shafts have a rigid connection to the differential carrier. Located between the pinion gears are 3 planetary pinion gears (6) and shafts (7). The planetary sun gear (8) and two differential side gears (10) are located in the centre line of the carrier.

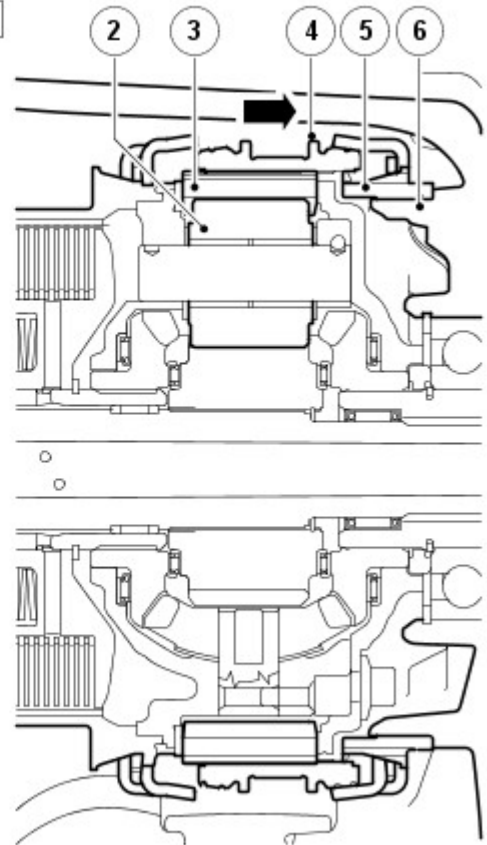
The planetary ring gear (2) is supported in both directions by the differential casing and the differential cover (9). The planetary ring gear is connected to a shifting sleeve, which is engaged in either high or low range.

The multi-plate clutch basket (11), which is welded to the differential casing, supports the friction plates, the dogteeth (12) for high range engagement and the synchronisation cup and spring (1) for the 'shift-on-the-move' function.

A



B



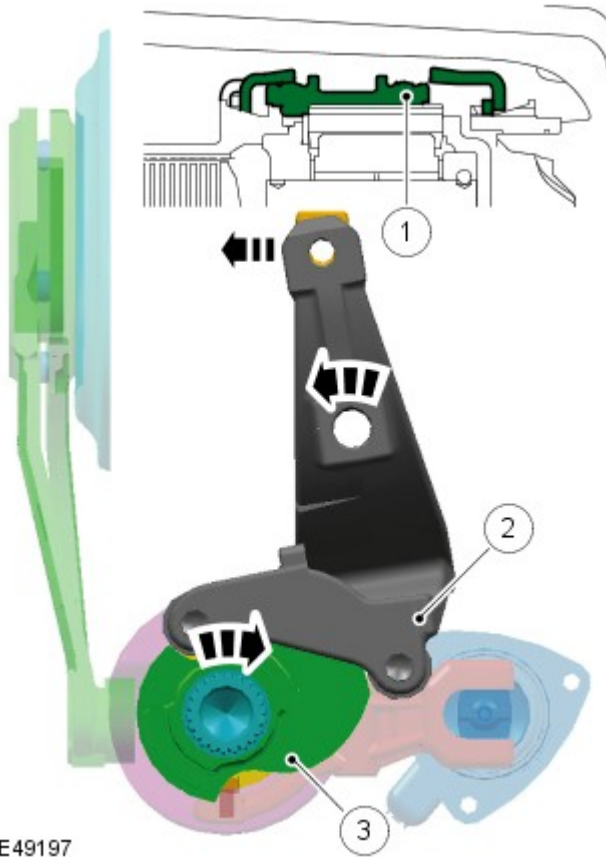
E49196

Item	Part Number	Description
A	-	High range position
B	-	Low range position
1	-	Dogteeth
2	-	Planetary pinion gears
3	-	Planetary ring gear
4	-	Shifting sleeve
5	-	Low range dogteeth
6	-	Rear carrier assembly

When high range is engaged, the shifting sleeve (4) connects to the differential carrier via dogteeth (1). The planetary ring gear (3), via the shifting sleeve, and the planetary pinion gears (5), via the planetary shafts, are also attached to the differential carrier. The planetary gear set rotates as one unit and therefore turns the differential side gear with a 1:1 ratio.

In low range the motor moves the shifting sleeve (4) in the direction of the low range dogteeth (5). The low range dogteeth, with the synchronisation cup and spring, are fixed to the rear carrier assembly (6). When the shifting sleeve is engaged with the low range dogteeth, the planetary ring gear (3), via the shifting sleeve, is stationary and the planetary pinion gears (2), via the planetary bolts, turn the differential side gears with 2.93: 1 ratio.

High range actuation sequence

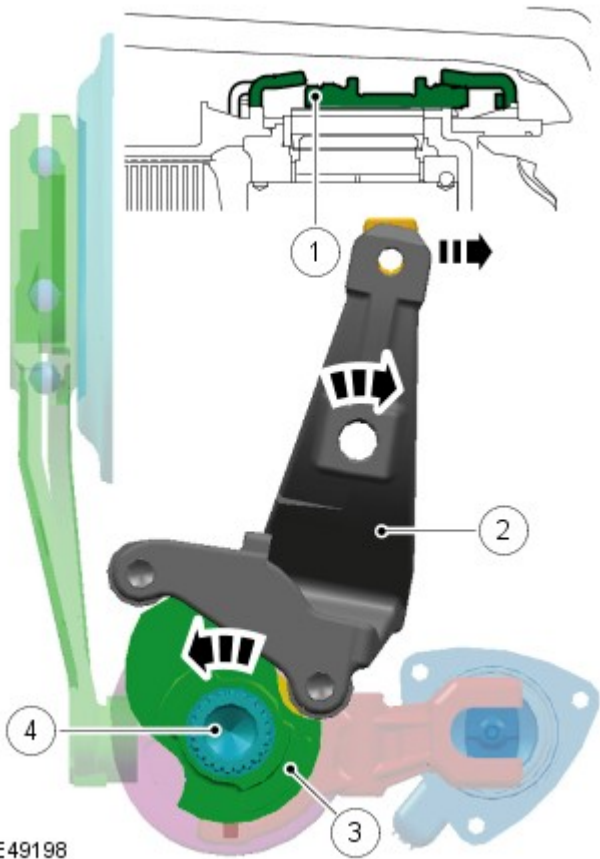


E49197

Item	Part Number	Description
1	-	Shifting sleeve
2	-	High/low shifting fork
3	-	Shifting cam

The rotational movement of the motor shaft turns the shifting cam (3) to high range position. The shifting cam then moves the shifting sleeve (1), via the high/low shifting fork (2), into the high range position. After the synchronisation sequence, the planetary ring gear is connected to the high range dogteeth, via the shifting sleeve, on the differential carrier. In this position, the input speed equals the output speed, which equates to a high range ratio of 1:1.

Low range actuation sequence

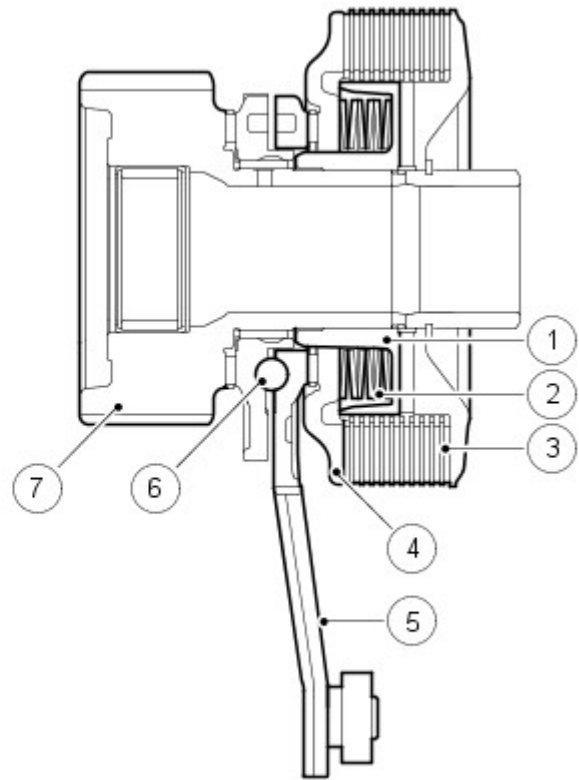


E49198

Item	Part Number	Description
1	-	Shifting sleeve
2	-	High/low shifting fork
3	-	Shifting cam
4	-	Motor shaft

The rotational movement of the motor shaft (4) turns the shifting cam (3) into low range position. The shifting cam then moves the shifting sleeve (1) of the centre differential assembly via the high/low shifting fork (2) into low range position. After the synchronisation sequence, the planetary ring gear is connected to the low range dogteeth, via the shifting sleeve, on the rear carrier assembly. The output speed is then reduced to a ratio of 2.93:1.

MULTI-PLATE CLUTCH ASSEMBLY



E49199

Item	Part Number	Description
1	-	Clutch hub
2	-	Cup springs
3	-	Clutch plates
4	-	Clutch piston
5	-	Motor levers
6	-	Ball ramp mechanism
7	-	Sprocket

The multi-plate clutch assembly for both centre and rear differentials act in a similar way. The aim of the multi-plate clutch assembly is to prevent excessive differential slip and therefore maximise the traction performance of the vehicle. This is fundamentally different from the 'braked' traction control, which can only counter act differential slip when it occurs.

A certain amount of differential slip is required to allow the vehicle to turn corners and to remain stable under control of the Anti-lock Braking System (ABS). The transfer box control module monitors the driver's demands through primary vehicle controls and automatically sets the slip torque at the differentials. The system is completely automatic and does not require any special driver input.

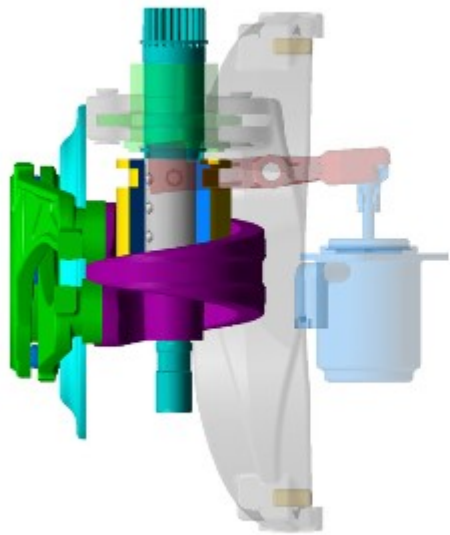
The multi-plate clutch assembly actively controls the torque flow through the centre differential and optimises the torque distribution in the driveline. The clutch assembly biases the torque from the transmission to the axle and wheels with the higher grip and prevents the wheels with the lower grip from spinning.

The multi-plate clutch assembly comprises the sprocket (7), which is connected to the front differential side gear, the motor levers (5) with the ball ramp mechanism (6), the clutch hub (1) as support for the clutch plates (3), the clutch piston (4) to generate friction between the clutch plates, and a pack of cup springs (2) to return the clutch piston into its original position.

One set of friction plates are connected to the clutch hub; the other set of friction plates are connected to the multi-plate clutch basket, which is welded to the centre differential housing.

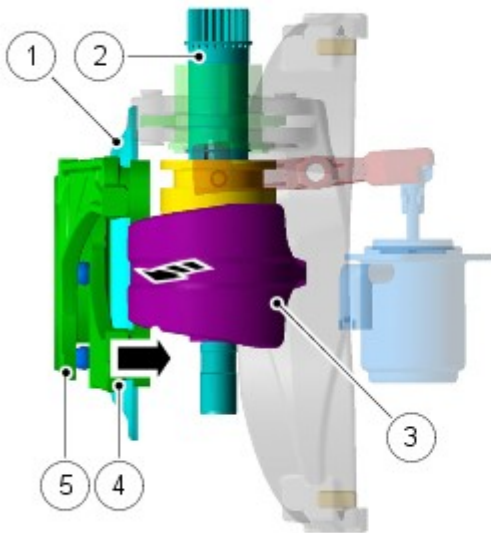
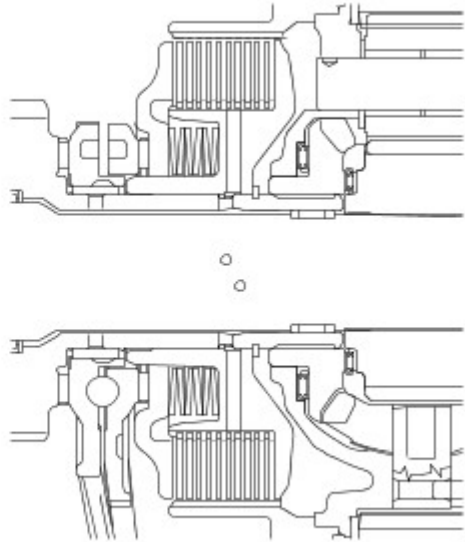
Multi-plate Clutch Actuation

Transfer box motor levers in initial position, multi-plate clutch open condition

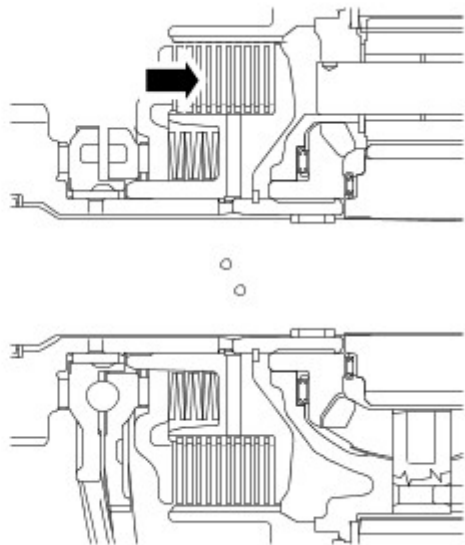


E49200

Transfer box motor in end position, multi-plate clutch closed condition



E49201

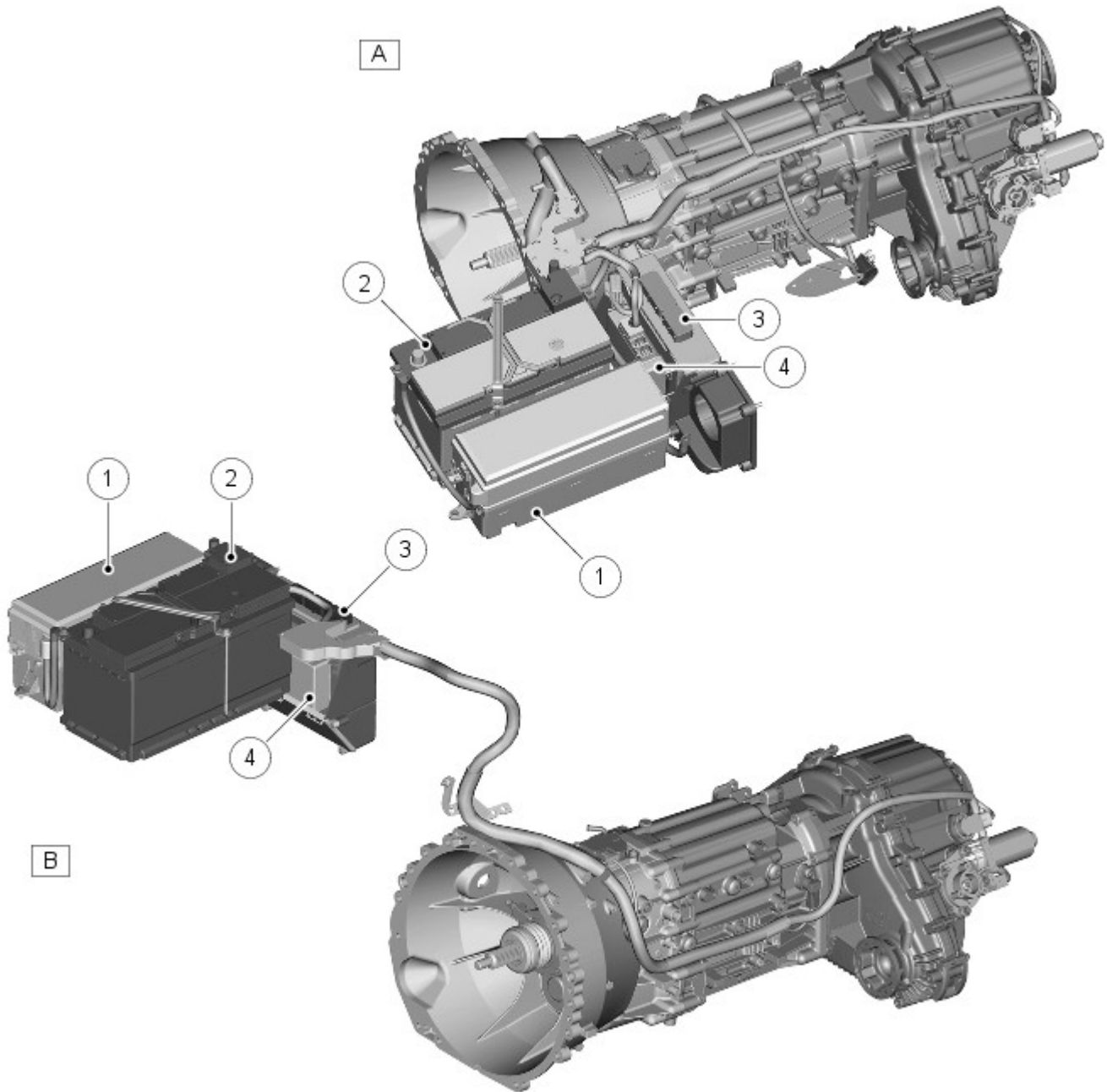


Item	Part Number	Description
1	-	Clutch piston
2	-	Motor shaft
3	-	Clutch control disc
4	-	Motor levers
5	-	Ramp mechanism balls

By turning the clutch control disc (3), via the motor shaft (2), the motor levers (4) are rotated relative to each other. This relative movement acts on 5 balls (5) in a ramp mechanism between the two levers and give a defined axial movement. The movement forces the clutch piston (1) to induce friction between the plates supported by the clutch hub and the plates supported by the clutch basket on the differential carrier. This frictional force inhibits the differential rotation; the differential carrier and front differential side gear are locked together.

TRANSFER BOX CONTROL MODULE

The transfer box control module controls the high/low 'shift-on-the-move' actuation and the multi-plate clutch actuation. The control module is located in the E-box, next to the Engine Control Module (ECM), behind the battery in the engine compartment. The position of the control module changes with LH and RH drive vehicles.



E49202

Item	Part Number	Description
A	-	RH drive
B	-	LH drive
1	-	Battery Junction Box (BJB)
2	-	Battery
3	-	Engine Control Module (ECM)
4	-	Transfer box control module

The control module is connected to the Controller Area Network (CAN) bus and controls the transfer box operation using CAN messages from other control modules on the network.

The control module memorises the position of the transfer box motor when the ignition is switched off.

The transfer box control module uses the same actuator to control both range change function and application of centre differential locking torque. The module uses position feed back from the actuator to provide smooth range changing capability and graduated application of locking torque appropriate for the current driving conditions. Range change can be carried out while moving providing the transmission is in neutral and the vehicle is below the speed necessary for the requested range change.

The control module uses three connectors for all inputs and outputs. It receives a permanent power supply via a 30A fusible link located in the Battery Junction Box (BJB), and an ignition supply via fuse 24 in the Central Junction Box (CJB).

The control module uses a series of programmed shift maps to control the synchronisation speed and ensure that a maximum shift time of approximately one second is achieved.

If the control module is replaced, T4 must be connected to the vehicle and the transfer box control module self-calibration procedure must be performed. This procedure must also be performed if the transfer box motor assembly is replaced.

Default/Limp-home Strategy

If a fault occurs with the transfer box, the transfer box control module or one of the required input signals i.e. road speed signal, the control module records an error code and will respond appropriately to provide the highest level of system capability under the specific fault conditions. The following fault states are possible:

Fault state	System response	Driver warning
No reduction in capability	Diagnostic Trouble Code (DTC) will be recorded but no effect on performance	Non
Clutch control not possible. Temporary over temperature condition	The tractive capability of the vehicle, off road, is reduced.	Driveline over temperature warning lamp or "CENTRE DIFF OVER TEMP REDUCE SPEED" on message centre
Clutch control not possible. Permanent fault	The tractive capability of the vehicle, off road, is reduced.	Driveline fault warning lamp or "CENTRE DIFF FAULT TRACTION REDUCED" on message centre
Range change not possible	The system inhibits the driver from making a range change	Driveline fault warning lamp or "TRANSMISSION RANGE CHANGE NOT AVAILABLE" on message centre
Stuck in Transfer box neutral	The transfer box is stuck between high and low range resulting in no drive to wheels	Flash low range indicator plus "APPLY HANDBRAKE (PARK BRAKE in USA and Canada)". The message will only display at times when it is deemed safe or necessary. It will not display during normal driving for example.

If a driveline over temperature condition has occurred, after the driveline has been allowed to cool, clutch control will be re-enabled and the warnings will disappear. There is no need to seek service assistance following an over temperature event.

If clutch control or Range change is not possible due to a permanent fault the driver must seek service assistance at the earliest opportunity.

If the system suffers a fault, which causes the transfer box to fail in neutral, the control module is designed to continue attempting to engage the requested range or return to its original range for a fixed number of attempts. If this has not been successful and the low range lamp is still flashing the driver should bring the vehicle to a halt and attempt the range change again while stationary. If this does not work after a number of attempts, key off for 30 seconds, restart engine and request range change again while stationary. The driver must seek service assistance at the earliest opportunity.

Transfer Box Control Module Pin Out Details

Connector 1-C1319

Pin No.	Description	Input/output
1	Not used	-
2	Not used	-
3	CAN bus low	Data (input and output)
4	Range change selection switch - High	Input
5	Range change selection switch - Low	Input
6	CAN bus high	Data (input and output)
7	Key interlock solenoid	Output
8	LED-high	Output
9	LED-low	Output

Connector 2-C1854

Pin No.	Description	Input/output
1	CAN bus low	Data (input and output)
2	Not used	-
3	Ignition power supply	Input
4	CAN bus high	Data (input and output)
5	Ground	-
6	Permanent battery power supply	Input

Connector 3-C1855

Pin No.	Description	Input/output
1	Hall sensor signal-A (directional)	Input
2	Hall sensor ground	-
3	Hall sensors supply	Output
4	Not used	-
5	Temperature sensor	Input
6	Hall sensor signal-B (speed)	Input
7	Selector position ground	-
8	5V position sensor supply	Output
9	Selector mode solenoid ground	-
10	Selector position sensor signal	Input
11	Transmission position sensor X axis signal	Input
12	Selector mode solenoid power supply	Output
13	Transmission position sensor Y axis signal	Input
14	Manual transmission output shaft speed sensor supply	Output
15	Motor supply/ground	Input/output
16	Manual transmission output shaft speed signal	Input
17	Manual transmission output shaft speed sensor ground	-
18	Motor supply/ground	Input/output

TRANSFER BOX CONTROL MODULE INPUTS

The transfer box control module receives the following inputs:

- Range change selection switch

- High/low position sensor
- Transfer box actuator motor temperature
- Transfer box actuator motor position sensor
- CAN bus messages
- Gear position sensor (manual transmission only)
- Transmission output shaft speed sensor (manual transmission only).

CAN Bus Messages

The CAN bus is a high speed broadcast network connected between various vehicle control modules. The CAN network carries an extensive list of messages between the different control modules enabling more sophisticated control with reduced complexity. Data on the network is packaged for efficient communication and prioritised according to the urgency and importance of the Messages. The bus comprises two wires, which are twisted together to minimise electromagnetic interference (noise) produced by the CAN messages.

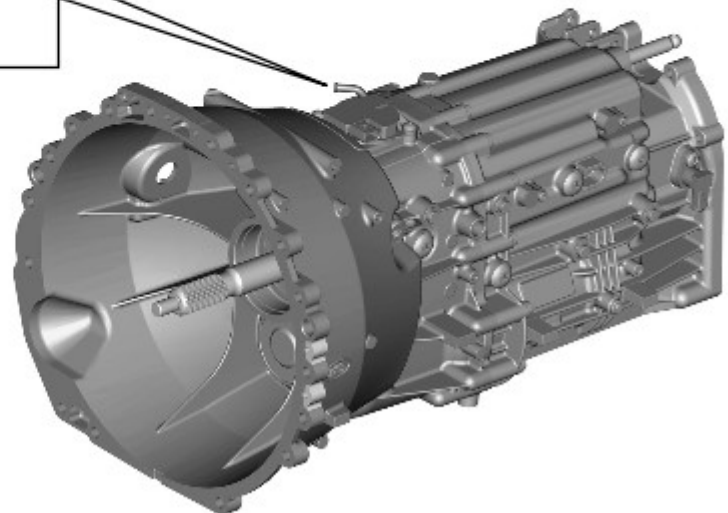
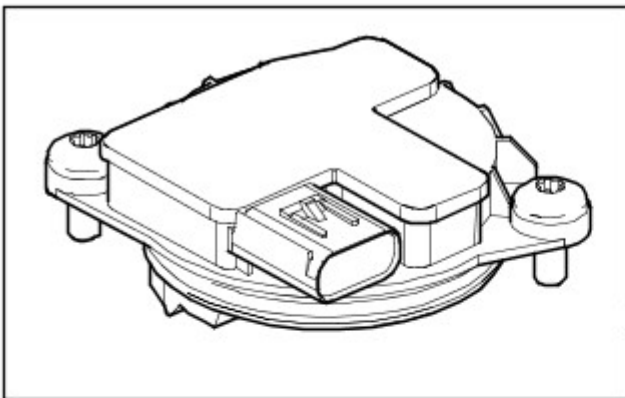
For additional information, refer to: Communications Network (418-00, Description and Operation).

The transfer box control module is connected on the CAN bus and controls transfer box operation using CAN messages from other control units on the network. Wheel speed, vehicle acceleration, engine torque and speed, gear information, from the automatic transmission, temperature information, car configuration, axle ratios and Terrain Response™ mode inputs, are some of the main signals received by the control module.

In the event of a CAN bus failure the following symptoms may be observed:

- Shift from high to low or low to high inoperative
- Instrument cluster low range warning lamp inoperative
- warning messages or lamps displayed in instrument cluster.

Gear Position Sensor (Manual Transmission Only)



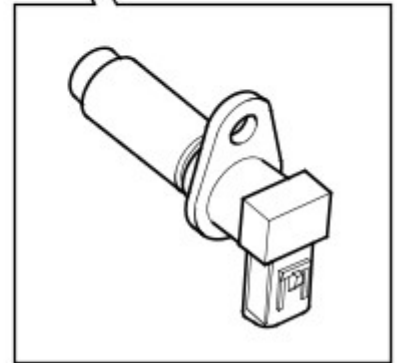
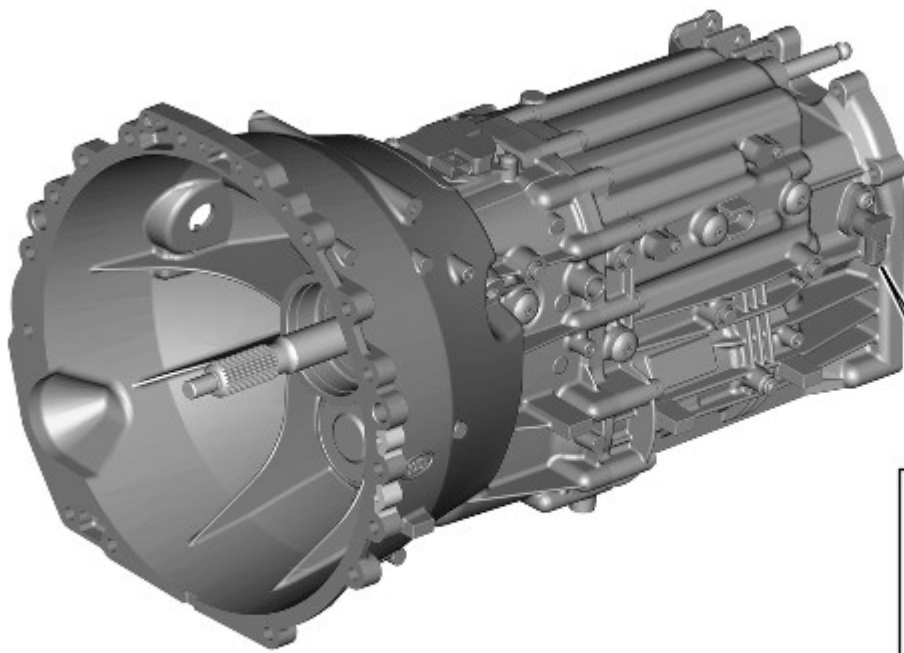
E49203

The transfer box control module uses positional information from the manual gear position sensor to determine which gear the transmission is in. This information is broadcast on the CAN bus for display on the instrument cluster and for use by other vehicle systems. Vehicles fitted with automatic transmission use a similar message broadcast by the Transmission Control Module (TCM). Vehicles fitted with manual transmission have a learning function, which compares the positional information from the sensor with the gear ratio calculated from the ratio of engine speed to transmission output shaft speed. The transmission learning is carried out at end of manufacture. If a new transmission is fitted during the life of the vehicle the learning algorithm needs to learn the characteristics of the new transmission.

The instrument cluster displays the selected gear as determined by the transfer box. The transfer box also uses this to check the vehicle is in neutral before attempting a range change.

For additional information, refer to: [Manual Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Description and Operation).

Manual Transmission Output Shaft Speed Sensor



E49204

The output shaft speed sensor is located at the rear of the transmission and measures the speed of the transmission output shaft.

The transfer box is designed to allow range changes when the vehicle is moving, providing the transmission speed complies with the preset thresholds determined by the control module. The control module calculates the optimised synchronization timing through the speed of the transmission output shaft and the wheel speed of the vehicle. For additional information, refer to: [Manual Transmission](#) (308-03 Manual Transmission/Transaxle - TDV6 2.7L Diesel, Description and Operation).

Range Change Selection Switch



E49205

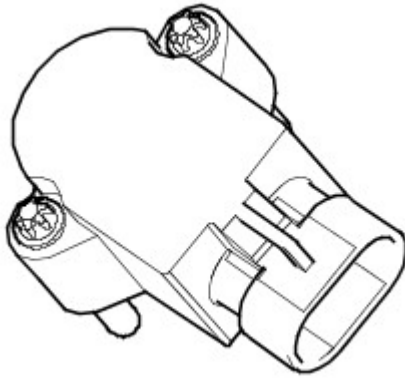
The range change selection switch is located behind the main transmission selection lever, in the centre console. The switch is a 3-position momentary action centre sprung device. The driver pushes the lever forward to select high range and back to select low range.

The switch comprises a housing, which provides the location for a sliding contact. When the switch is moved to the high or low position, it completes a momentary connection to 12V with one of two micro-switches located at each end of the range change selection switch. These micro-switches correspond to the high or low range positions.

The transfer box control module receives this momentary signal and selects the requested range.

In this position, a spring will move the selector lever to the centre position when released.

High/Low Position Sensor



E49209

The high/low position sensor converts the pivotal movement of the high/low fork into a PWM signal on the input. The PWM signal of the position sensor differs between high range and low range. The control module checks this signal and informs the driver, via the instrument cluster and the range change selection switch LED's, if a range change is in progress or has been completed.

The high/low position sensor is connected to the transfer box control module via a three-pin connector.

TRANSFER BOX CONTROL MODULE OUTPUTS

The transfer box control module sends the following outputs:

- CAN bus messages
- Key interlock solenoid
- High/low range change LED
- Transfer box motor
- Solenoid.

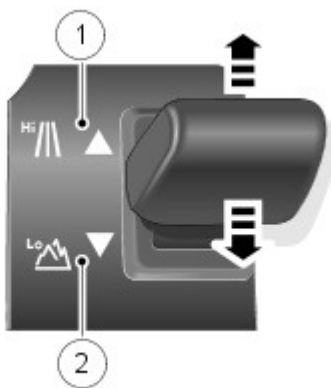
CAN Bus Messages

The control module also sends messages via the CAN bus to tell other control modules on the network, the status of the transfer box. The high/low status, clutch torque and default mode status are some of the main signals sent out by the transfer box control module.

Key Interlock Solenoid

The transfer box control module is able to send a signal to the key interlock solenoid. This signal locks the key in the ignition barrel to prevent it from being removed if the automatic transmission is not in the 'Park' position.

High/Low Range Change LED



E49206

Item	Part Number	Description
1	-	High range LED
2	-	Low range LED

The control module is responsible for illuminating the 2 'high/low' range change LED's adjacent to the range change lever. One LED indicates high range and the other indicates low range.

One LED will be on continuously when in the corresponding range.

When changing range, the current range LED will remain on until the new range status has been achieved.

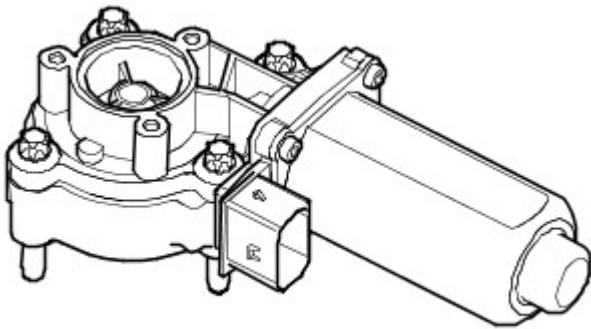
The new range LED will start flashing only when the range change has commenced (i.e. speed and neutral conditions have been met). The new range LED will be illuminated continuously at the same instant that the current range (now the old range) LED turns off.

The flash rate is 2 Hz with a 50% duty cycle.

The LED's have 2 levels of intensity, high when the vehicle lights are switch off and low when they are switched on.

If both lights are flashing at 0.5 Hz, this would indicate a transfer box fault or that the transfer box is in undefined range and may require calibration.

Transfer Box Motor



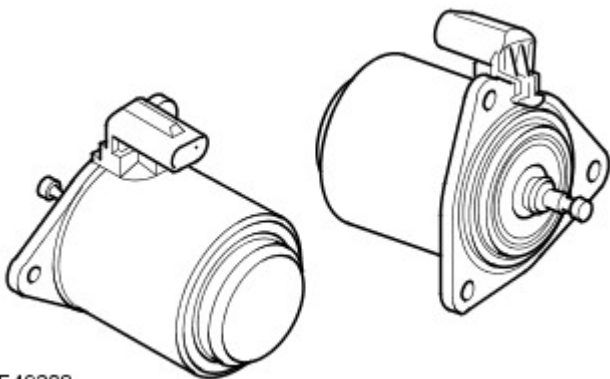
E49207

The transfer box motor provides the necessary movement to perform the high/low range change and the multi-plate clutch actuation. The motor is located on the rear casing assembly and secured with four bolts.

The motor is a PWM controlled, DC motor with an integrated worm gear reduction drive. It is connected to the transfer box control module with an eight-pin connector; the power supply of the motor is maintained through two large diameter cables on the motor connector. An internal position sensor checks the rotational movement of the motor.

There is an temperature sensor located within the motor housing.

Solenoid



E49208

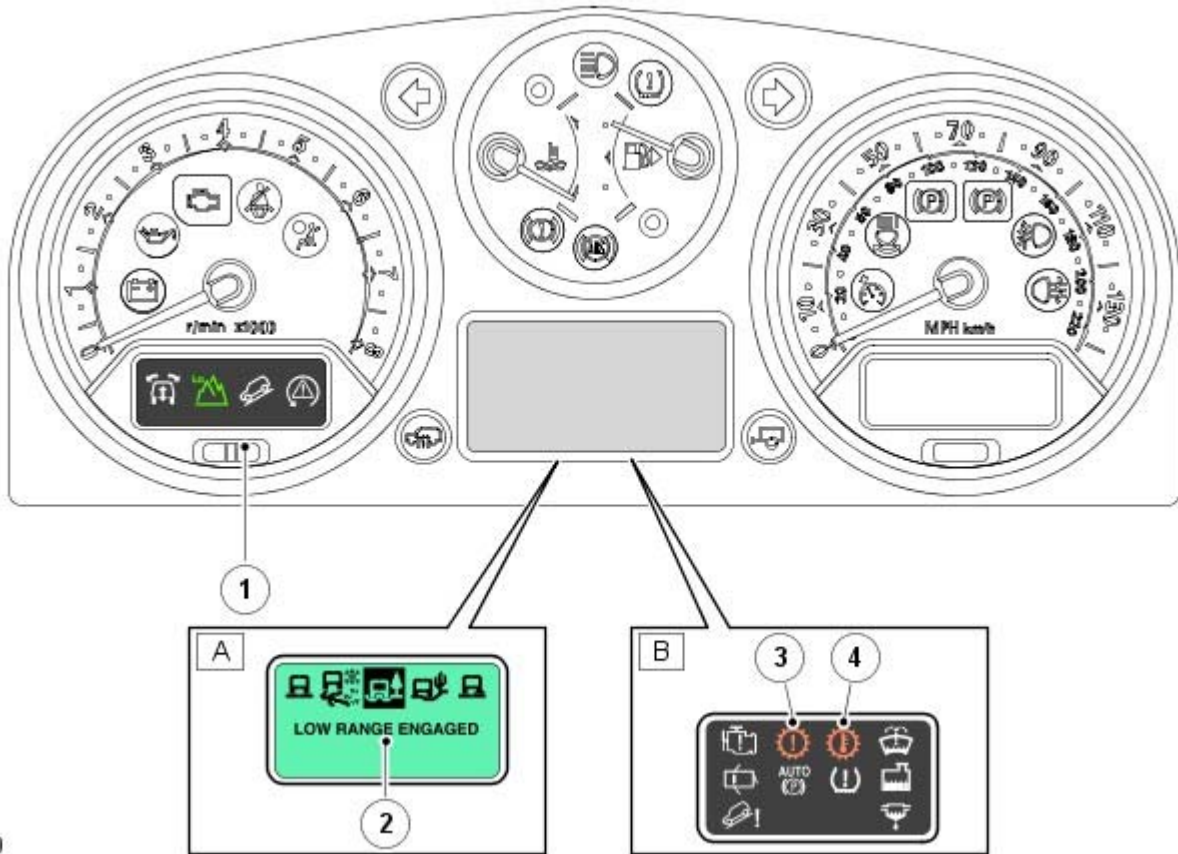
The solenoid switches the power flow on the actuation system between high/low range change mode and clutch control mode. When the solenoid is energized, the solenoid pin deploys and activates the clutch control mode. When the solenoid is de-energized, the internal spring rejects the solenoid pin and activates the high/low range change mode.

- **NOTE:** In order to replace the solenoid in service, the solenoid must be energized using the diagnostic tool.

The solenoid is connected to the transfer box control module with a two-pin connector.

Status Indication

Instrument Cluster



E49210

Item	Part Number	Description
A	-	High-line instrument cluster
B	-	Low-line instrument cluster
1	-	Low-range status indicator
2	-	Message centre text (high-line only)
3	-	Driveline fault lamp
4	-	Driveline over temperature

On vehicles fitted with the high line instrument cluster there will be one low range status indicator. This indicator will take the form of a mountain symbol and has the following logic:

- Lamp on = low range
- Lamp off = high range
- Lamp flashing = range change in progress/range undefined/range fault.

There will also be a message displayed in the message centre, on vehicles with high-line instrument cluster, which will inform the driver of any faults with the transfer box.

The following table shows the messages that can be displayed in the message centre of a high-line instrument cluster relating to the transfer box:

Message	Description	Chime
'LOW RANGE ENGAGED'	Transfer case has engaged low range after a range change request	Single
'HIGH RANGE ENGAGED'	Transfer case has engaged high range after a range change request	Single
'SPEED TOO HIGH FOR RANGE CHANGE'	Range change request when vehicle speed too high	Single
'SELECT NEUTRAL FOR RANGE CHANGE'	Range change request when lever not in neutral	Single
'APPLY HANDBRAKE' (PARK BRAKE in USA and Canada)	This alerts the driver that the automatic transmission park lock function is inoperative due to transfer box out of high or low range. Transfer box control module has stopped transmitting on the CAN bus during a range change or while in neutral mode and as a result the automatic transmission park lock function is inoperative	One per second for three seconds
'TRANSMISSION RANGE CHANGE NOT AVAILABLE'	Transfer box has detected a fault inhibiting a new range change. Control unit has shut down due to thermal overload	Single
'CENTRE DIFF OVER TEMP REDUCE SPEED'	Centre differential temperature is approaching the over heated threshold	Single
'CENTRE DIFF FAULT – TRACTION REDUCED'	Centre differential has failed - operating as an open differential	Single
'CENTRE DIFF FAULT – TRACTION REDUCED'	Transfer box control module has stopped transmitting on the CAN bus and defaults to open centre differential	Single

The transfer box control module receives a gear position signal from the manual transmission gear position sensor and publishes the status on the CAN bus. This is displayed in the odometer display, similar to how the automatic transmission displays gear information.

Odometer Display	Description
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Odometer Display	Description
N	Transmission is in neutral
1	Transmission is in first gear
2	Transmission is in second gear
3	Transmission is in third gear
4	Transmission is in fourth gear
5	Transmission is in fifth gear
6	Transmission is in sixth gear
R	Transmission is in reverse gear (Japan only)
Blank display	Transmission is between neutral and a gear
E	Transmission gear position sensor has a fault

On vehicles fitted with the low line instrument cluster, in place of the message centre there will be a status lamp, which has the following logic:

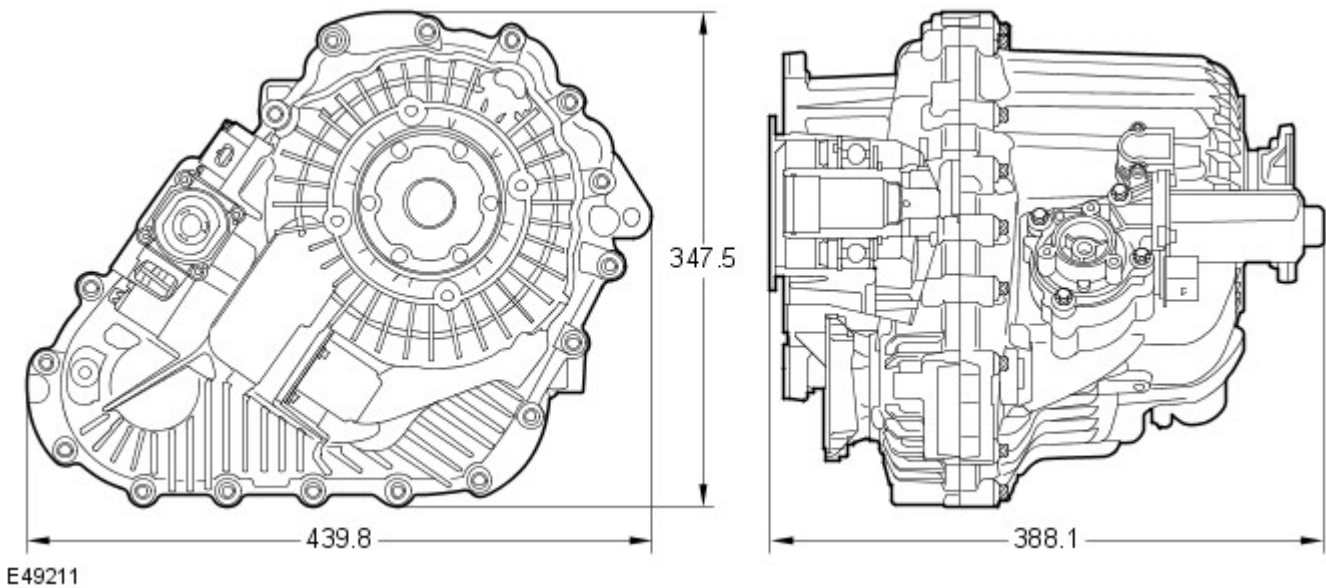
- Amber - Over temperature
- Red - Failure, stop vehicle

The following table shows the faults that could possibly illuminate the transfer box status lamp on vehicles fitted with the low-line instrument cluster:

Indication	Description
OFF	Transfer box is operating at normal working temperature
YELLOW WARNING LAMP ON	Transfer box temperature is approaching the over heated threshold
YELLOW WARNING LAMP ON	Transfer box has detected a fault, which affects the range change function (current range is still maintained) or the centre differential has failed to open.
RED WARNING LAMP ON	Transfer box has detected a fault which renders the transmission park lock function inoperative due to out of range condition, OR centre differential has failed with a non-zero locking torque
YELLOW WARNING LAMP ON	Transfer box control module has stopped transmitting on the CAN bus and defaults to open centre differential
RED WARNING LAMP ON	Transfer box control module has stopped transmitting on the CAN bus during a range change or while in neutral mode and as a result the automatic transmission park lock function is inoperative

SERVICE

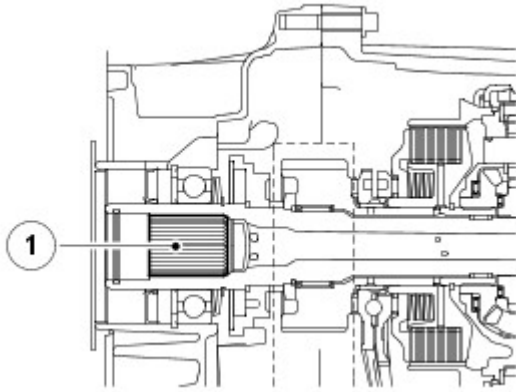
Basic Dimensions (Millimetres)



The transfer box weighs 40.30 kg without oil and 41.55 kg with oil. The unit requires 1500 ml \pm 2% of oil from empty.

The oil used in the transfer box is Shell TF 0753, which has been specially developed by Magna Steyr and Shell. The oil contains unique additives, which enhance the transfer box operation. No other oil must be used in the transfer box.

There is a unique type of grease, Weicon anti-seize montagepaste grau TL 7391, that needs to be applied the units input shaft spline when installing or reinstalling the transfer box.



E49212

Item	Part Number	Description
1	-	Input shaft spline

DIAGNOSTICS

The transfer box control module can store fault codes, which can be retrieved using T4 or a diagnostic tool using KW2000* protocol.

The information is communicated via a diagnostic socket.

The diagnostic socket allows the exchange of information between the various control modules on the bus systems and T4 or another suitable diagnostic tool. The information is communicated to the socket via the CAN bus. This allows the retrieval of diagnostic information and programming of certain functions using T4 or another suitable diagnostic tool.

The transfer box control module uses Diagnostic Trouble Codes (DTC), which relate to transfer box electrical faults.

Clutch and Range Change Mechanism Calibration

In order for the range change mechanism to function correctly, the transfer box control module must be calibrated to the mechanical dimensions of the transfer box that it is connected to.

This procedure will need to be followed if one of the following occurs:

- The switch is changed
- The transfer box control module is changed
- The transfer box or range position sensor is changed
- Vehicle or transfer box control module fault has caused the transfer box to revert to an undefined range.

Calibration can be carried out using T4.

Manual Transmission Gear Learning Procedure

The transfer box control module contains an adaption that enables it to recognize which gear the driver has selected. The adaption has to be reset, by performing the gear learning procedure, if one of the following occurs:

- The transfer box control module is reprogrammed or replaced
- The manual transmission is replaced
- The gear position sensor is replaced

During the gear learning procedure the vehicle must be driven smoothly in all gears, with the clutch fully released in each gear, in a single drive cycle. The procedure can be performed with the transfer box in either high or low range.

Gear Learning Procedure

- If the gear learning procedure is to be performed because the manual transmission or the gear position sensor has been replaced, use T4 to set the gear adaption status to 0 in the transfer box control module.
- Start the vehicle.
- Drive in reverse gear and fully remove your foot from the clutch, drive in reverse with your foot off the clutch for 3 seconds and ensure that R is displayed in the instrument cluster.
- Drive in 1st gear and, when gear position 1 is displayed in the instrument cluster, change to the next gear. Continue driving, and changing up to the next gear once the current gear is displayed in the instrument cluster, until gear 6 is displayed in the instrument cluster, then stop the vehicle.
- Stop the engine, remove the ignition key and wait for a minimum of 60 seconds (for the transfer box control module to power down).
- Insert the ignition key and turn the ignition switch to position II (ignition).
- Select each gear in turn. If the appropriate gear position is displayed in the instrument cluster as soon as each gear is selected, the gear learning procedure has been successful. If the gear position is not displayed in the instrument cluster, the gear learning procedure has failed and must be repeated.
 - NOTE: T4 can also be used to check if the gear learning procedure has been successful.

SYSTEM OPERATION

The selection of high/low range is achieved by using a switch located behind the main transmission selection lever in the centre console. A range change can only be performed when the transmission selector lever is in neutral (position 'N' for vehicles with automatic transmission). The accelerator pedal must not be depressed when a range change is in progress.

If high or low range is requested and the transmission selector lever is in a position other than neutral, or 'N' or 'P' on a

vehicle with an automatic transmission, the instrument cluster message centre, if fitted, will display 'SELECT NEUTRAL FOR RANGE CHANGE'.

• **NOTE:** On vehicles with an automatic transmission, if the transmission selector lever is in the 'P' position, the range change will not take place and the 'SELECT NEUTRAL FOR RANGE CHANGE' message will not be displayed in the message centre.

When low range is selected, the low range 'mountain' symbol will flash when the range change is taking place and then remain illuminated when the range change is complete. The instrument cluster message centre, if fitted, will display 'LOW RANGE' for approximately 3 seconds followed by a chime from the instrument cluster to confirm that the range change has been completed. On vehicles with automatic transmission, only 'D' and 'Manual mode' are available, the 'Sport mode' selection is not available.

When high range is selected, the low range 'mountain' symbol will flash when the range change is taking place and then extinguish when the range change is complete. The instrument cluster message centre, if fitted, will display 'HIGH RANGE' for approximately 3 seconds followed by a chime from the instrument cluster to confirm that the range change has been completed.

The design of the transfer box allows range changes when the vehicle is moving, within set limitations as follows:

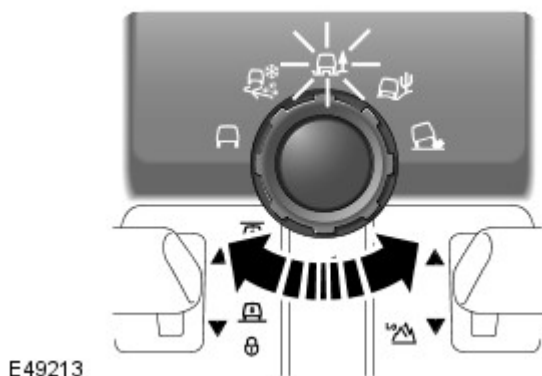
- High to Low – at speeds not exceeding 25 mph (40 km/h) for vehicles with automatic transmission, and 12 mph (20 km/h) for vehicles with manual transmission
- Low to High – at speeds not exceeding 37 mph (60 km/h).

If the vehicle speed is higher than the parameters given, the instrument cluster message centre, if fitted, will display 'SLOW DOWN'. When the correct speed range is reached, the message will be deleted and the range change will commence.

The transfer box control module interprets a road speed of less than 2 mph (3 km/h) as a static shift (vehicle not moving). In this instance, on vehicles with automatic transmission, the driver must use the shift lock procedure of operating the brake pedal to allow the selector lever to be moved from 'N' to 'D' after the range change has been performed.

High range should be used for all normal road driving and also for off-road driving across dry, level terrain. Low range should only be required where low speed manoeuvring is necessary, such as reversing a trailer, negotiating steep slippery surfaces or boulder-strewn terrain. Low range should also be used for extreme off-road conditions where progress in high range cannot be maintained. Low range should never be used for normal road driving.

Terrain Response™



The Terrain Response™ system allows the driver to select a program, which will provide the optimum settings for traction and performance for the prevailing terrain conditions.

The system is controlled by a rotary control located on the centre console. The rotary control allows the selection of one of the following five programs:

- Special programs off (general driving conditions)
- Grass/Gravel/Snow
- Mud/Ruts
- Sand
- Rock crawl.

The Terrain Response™ system uses a combination of vehicle subsystems to achieve the required vehicle characteristics for the terrain selected. The following subsystems form the Terrain Response™ system:

- Engine management system
- Automatic transmission (if fitted)
- Transfer box
- Rear locking differential (if fitted)
- Brake system
- Air suspension.

Each subsystem control module provides a feedback for the selected program so that the Terrain Response™ control module can check that all systems are controlling the system correctly. For additional information, refer to: Ride and Handling Optimization (204-06, Description and Operation).

HIGH RANGE OPERATION

In high range, the torque input from the transmission is passed to the transfer box input shaft. The position of the

synchroniser sleeve couples the shaft directly to the differential housing. The differential splits the torque between the two side gears. One side gear is connected by splines and passes the torque to the rear output flange. The second side gear is connected to the chain drive sprocket and passes the torque, via the chain, to the front output flange.

LOW RANGE OPERATION

In low range, the torque input from the transmission is passed to the transfer box input shaft. The synchroniser sleeve is moved and connects the planetary carrier to the differential housing. The torque from the transmission is now directed through the sun gear of the epicyclic gearset and, via the pinion gears and pinion gear shafts, into the planetary carrier. The annulus gear of the epicyclic gearset is secured inside the casing and generates the low range ratio of 2.93:1. The torque is then passed, via the synchroniser sleeve, to the differential housing where it is split between the two side gears. One side gear is connected by splines and passes the torque to the rear output flange. The second side gear is connected to the chain drive sprocket and passes the torque, via the chain, to the front output flange.

HIGH/LOW RANGE GEARS WITH SHIFT-ON-THE-MOVE

The driver is able to change between high and low range gears while the vehicle is moving, or if the vehicle is stationary.

Pushing the range change lever makes a range change requests. This lever is located on the centre console behind and to one side of the main transmission lever.

The driver requests a high to low range change by pushing the range change lever towards the rear of the vehicle and, conversely, a low to high request by pushing the lever towards the front of the vehicle. The range change lever is centre sprung and therefore does not latch in the forward or rear positions.

The driver is informed of the range status via a green lamp (mountain symbol) in the instrument cluster and LED's next to the range change lever. The lamp will not be illuminated in high range, illuminated in low range and flashing during a range change. There are two LED's on the range change lever one for high and one for low. During a range change the new range LED will flash.

The vehicle will remain in the selected range unless the driver requests a change, i.e. it will not automatically revert to high range following a key off/key on sequence.

RANGE CHANGE PROCEDURE (AUTOMATIC VEHICLES ONLY)

Neutral must be selected on the main transmission before requesting a range change and then select the appropriate gear following completion of the range change. During the range change the main transmission will be locked in neutral.

If neutral is not selected when a range change is requested then the request is denied and the driver will be advised to select neutral via the instrument cluster message centre (if fitted).

The range change process can take up to one second to complete following a request being accepted.

There is a limit set on the maximum speed at which a range change can be achieved. The maximum speed for a high to low range change is 25 mph (40 km/h) for vehicles with automatic transmission, and 12 mph (20 km/h) for vehicles with manual transmission. The maximum speed for a low to high range change is 37 mph (60 km/h). If the vehicle speed is over the limit when a range change is selected then the request is denied and the instrument cluster message centre (if fitted) will display a 'SLOW DOWN' message.

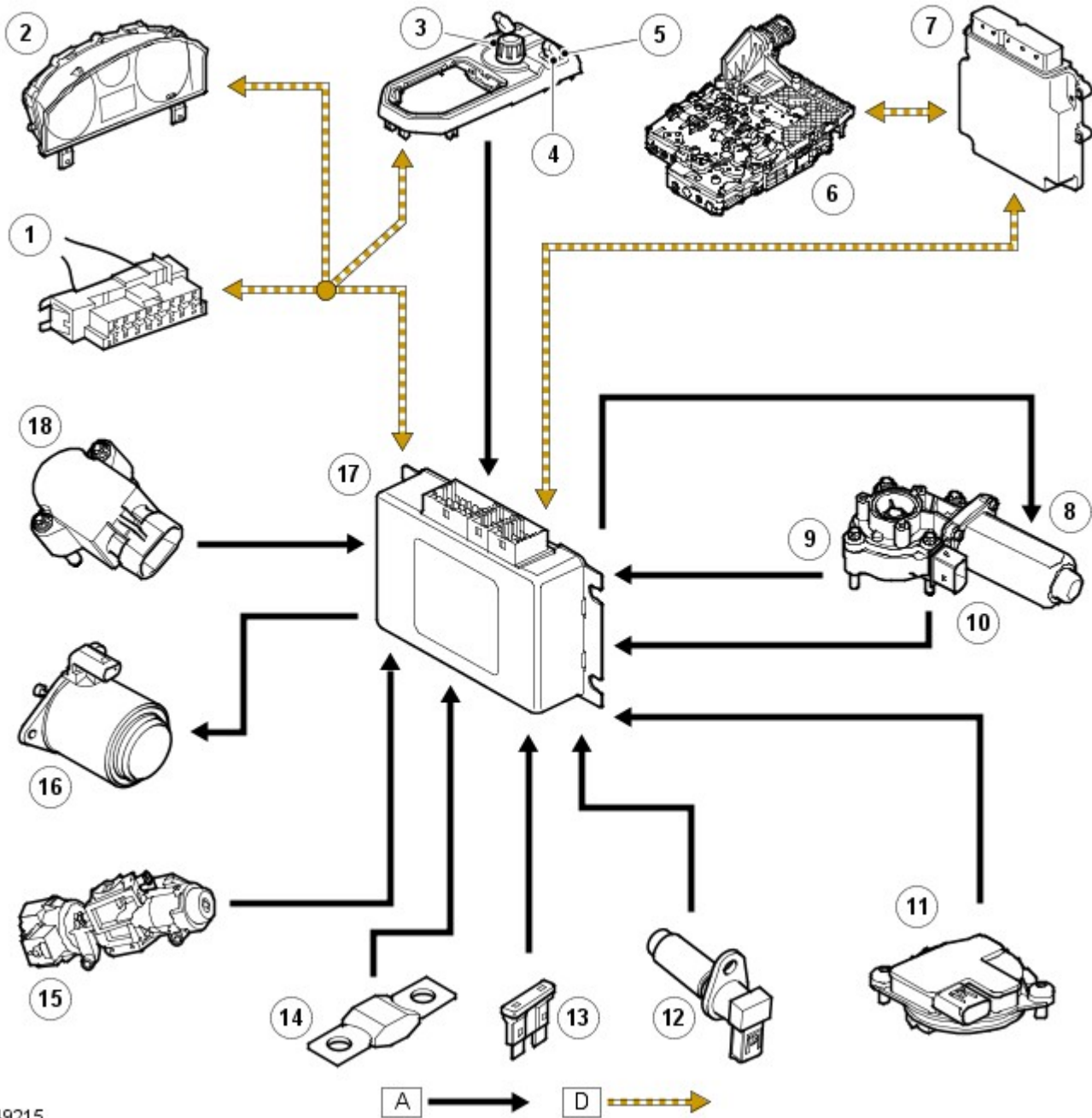
RANGE CHANGE PROCEDURE (MANUAL VEHICLES ONLY)

Neutral must be selected on the main transmission before requesting a range change and then select the appropriate gear following completion of the range change. During the range change the driver must not attempt to move the main transmission out of neutral. If the lever is moved out of neutral then the range change will stop and will be completed only when the driver re-selects neutral on the main transmission. This must be done to prevent damage to the transfer box mechanism.

The speed limit for shift-on-the-move for the manual vehicle is set lower than for the auto, at around 12 mph (20 km/h) for high to low and 37 mph (60 km/h) for low to high. The lower limits are set so that, if the driver tries to select too lower gear following a range change, no damage is caused to the vehicle.

TRANSFER BOX CONTROL DIAGRAM

- NOTE: A = Hardwired; D = CAN bus



E49215

Item	Part Number	Description
1	-	Diagnostic socket
2	-	Instrument cluster
3	-	Terrain response™
4	-	High/Low range selection switch
5	-	High/Low range LED
6	-	Transmission Control Module (TCM)
7	-	Engine Control Module (ECM)
8	-	Transfer box motor
9	-	Temperature sensor
10	-	Hall sensors (speed and direction)
11	-	Manual transmission gear position sensor
12	-	Output shaft speed sensor
13	-	Fuse 24 ignition feed
14	-	Fusible link permanent battery feed
15	-	Ignition switch
16	-	Solenoid
17	-	Transfer box control module
18	-	High/low position sensor

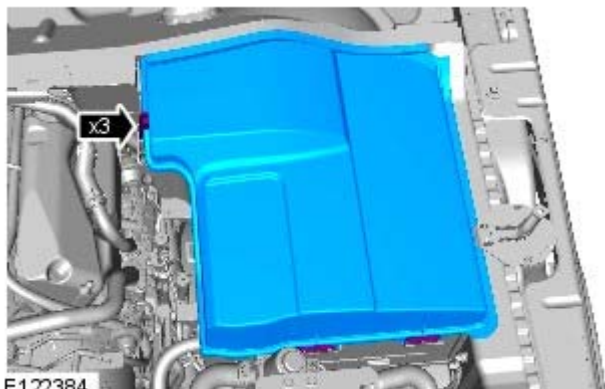
Four-Wheel Drive Systems - Four-Wheel Drive (4WD) Control Module

Removal and Installation

Removal

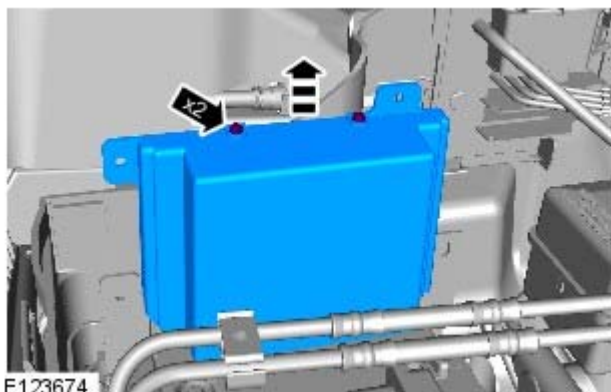
• NOTE: LHD illustration shown, RHD is similar.

1. Remove drivers side plenum box lid.



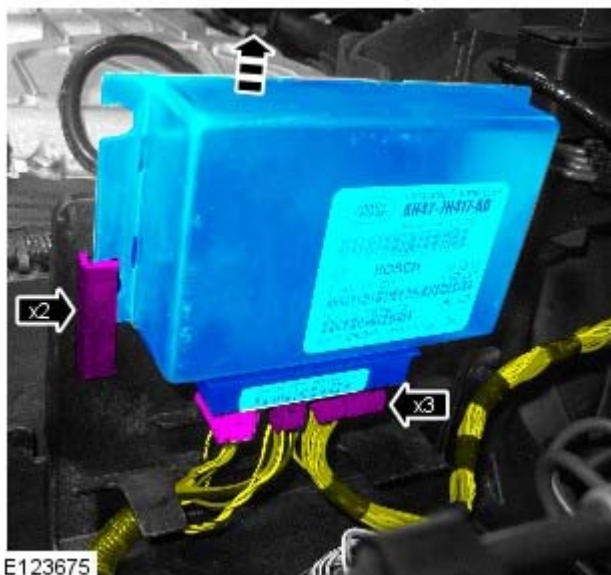
2. Remove the four-wheel drive control module cover.

• Remove the 2 bolts.



3. Release and remove the four-wheel drive control module.

• Disconnect the 3 electrical connectors.



Installation

1. To install, reverse the removal procedure.
2. Using the diagnostic tool, configure the new units using the Programmable Module Installation Routine.

Four-Wheel Drive Systems - Transfer Case Shift Motor

Removal and Installation


Removal

-  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

- Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

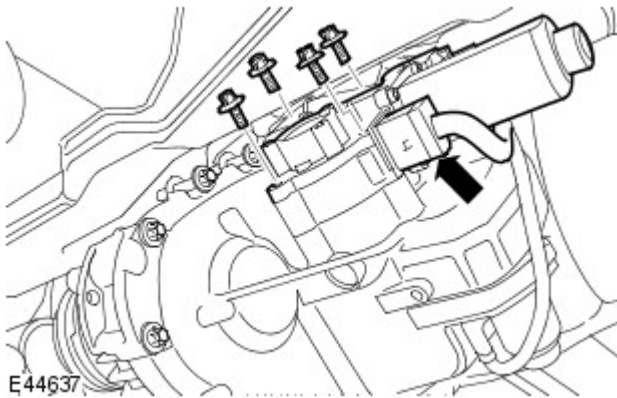
3. CAUTIONS:

 To avoid damage to the joints or gaiters, do not allow the transmission to hang on the driveshafts.


 Discard the bolts.

Remove the shift motor.

- Lower the rear of the transmission for access.
- Disconnect the electrical connector.
- Remove the 4 Torx bolts.



Installation

-  **CAUTION:** Make sure that new bolts are installed.

Install the shift motor.

- Clean the components.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- Connect the electrical connector.

- Install the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
- Calibrate a new transfer case shift motor using the diagnostic tool.

Four-Wheel Drive Systems - Transfer Case Clutch Solenoid

Removal and Installation

Removal

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. CAUTIONS:



Connect the diagnostic tool, prior to removal of the solenoid.

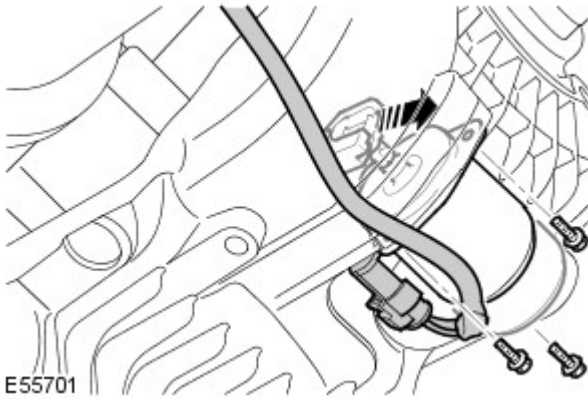


Discard the bolts.


- **NOTE:** Some fluid spillage is inevitable during this operation.

Remove the transfer case clutch solenoid.

- Position a container to collect the fluid spillage.
- Remove the 3 Torx screws.
- Use the diagnostic tool to energise the solenoid.
- Detach from the selector lever.
- Disconnect the electrical connector.



Installation

1.  **WARNING:** The transfer case clutch solenoid must be energised prior to installation to the selector lever. Failure to follow this instruction may result in damage to the transfer case.

• CAUTIONS:



Make sure the seal is installed correctly.



Make sure that new bolts are installed.

Install the transfer case clutch solenoid.

- Clean the components.
- Connect the electrical connector.
- Use the diagnostic tool to energise the solenoid.
- Install to the selector lever.
- Tighten the Torx screws to 10 Nm (7 lb.ft).

2. Check and top-up the transfer case fluid level.

3. Using the diagnostic tool, calibrate the new transfer case control solenoid.

Four-Wheel Drive Systems - High/Low Range Sensor

Removal and Installation


Removal

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

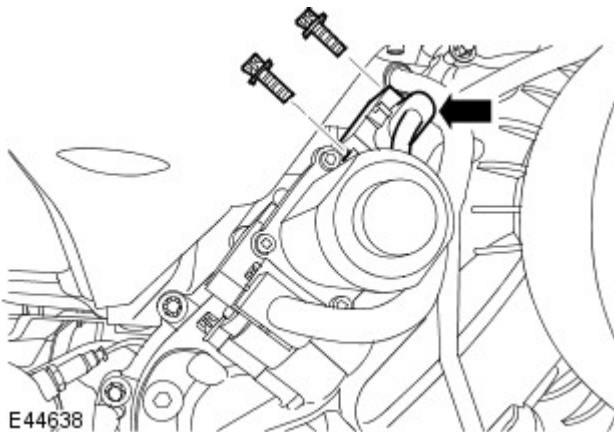
3. CAUTIONS:

 To avoid damage to the joints or gaiters, do not allow the transmission to hang on the driveshafts.


 Discard the bolts.

Remove the high/low range sensor.

- Lower the rear of the transmission for access.
- Disconnect the electrical connector.
- Remove the 2 Torx bolts.



Installation

1.  **CAUTION:** Make sure that new bolts are installed.

To install, reverse the removal procedure.

- Clean the components.
- Install the high/low range sensor.
- Tighten the Torx bolts to 10 Nm (7 lb.ft).

2. Install the crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation) / [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
3. Using the diagnostic tool, calibrate a new high/low range sensor.

Transfer Case -

Sealers and Lubricants

Item	Specification
* Recommended oil	Shell TF 0753
Capacity - Wet and dry fill	1.5 litres, (2.6 pints) (1.5 US quarts)
Input shaft splines grease	Weicon TL7391
Sealant	STC 50550 or Loctite 5900

* **CAUTION:** Do not use any lubricant other than that specified

General Specification

Item	Specification
Make	Magna Steyr
Model	DD295
Type	Two speed, permanent four wheel drive transfer box having synchronised shift on the move facility with an actively controlled wet clutch and 50/50 torque split across the centre differential
Clutch type	Wet, multi-plate
Maximum torque capacity	2500 Nm (1842.5 lb.ft)
Ratios:	
<ul style="list-style-type: none"> ● High ● Low 	<ul style="list-style-type: none"> ● 1:1 ● 2.93:1
Maximum shift speeds, Manual Gearbox:	
<ul style="list-style-type: none"> ● High to low ratio ● Low to high ratio 	<ul style="list-style-type: none"> ● 20 kph (12.4 mph) ● 60 kph (37.2 mph)
Maximum shift speeds, Automatic Transmission:	
<ul style="list-style-type: none"> ● High to low ratio ● Low to high ratio 	<ul style="list-style-type: none"> ● 40 kph (24.8 mph) ● 60 kph (37.2 mph)

Torque Specifications

• NOTE: ** New 'Patchlock' Torx bolts must be fitted.

Description	Nm	lb-ft
Transfer case fluid drain plug	22	16
Transfer case fluid level/filler plug	22	16
Fuel tank heat shield nuts/bolts	10	7
** Rear drive shaft M12 Torx screws	150	111
Rear drive shaft M10 Torx screws	73	54
** Front driveshaft Torx screws		
Stage 1	45	33
Stage 2	Further 90°	Further 90°
Drive shaft centre bearing bolts	30	22
Transmission support insulator	60	44
Wiring harness securing bolts	10	7
Fuel line support bracket bolts	10	7
Transfer case retaining bolts	45	33
Earth cable bolt (2010 Model Year onwards)	15	11

Transfer Case - Transfer Case

Description and Operation

For additional information, refer to: [Four-Wheel Drive Systems](#) (308-07A Four-Wheel Drive Systems, Description and Operation).

Transfer Case - Transfer Case

Diagnosis and Testing

Principle of Operation

For a detailed description of the transfer case system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Transfer Case](#) (308-07B Transfer Case, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Transfer case ● Oil leaks ● Driveshafts ● Halfshafts ● Constant velocity (CV) joints 	<ul style="list-style-type: none"> ● Fuse(s) ● Wiring harness/electrical connectors ● Controller area network (CAN) circuits ● Instrument cluster ● Range change selection switch ● Transfer case control module

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Message	Possible Causes	Action
Loss of drive due to transfer case stuck in neutral and transmission park lock function is inoperative	'PARK LOCK FAILURE APPLY HANDBRAKE'	<ul style="list-style-type: none"> ● Transfer case control module CAN bus - off bus during range change ● Transfer case changeover solenoid fault ● Transfer case motor fault ● Transfer case internal obstruction 	Check for Transfer Case Control Module DTCs and refer to the relevant DTC Index
Loss of drive	-	<ul style="list-style-type: none"> ● Half shaft failure ● Driveshaft failure ● Front or rear axle: differential failure ● Transfer case center differential failure 	Check the condition of the driveshafts, half shafts and CV joints, differential
Range change inhibited	'TRANSMISSION RANGE CHANGE INOPERATIVE'	<ul style="list-style-type: none"> ● Transfer case control module has shut down due to thermal overload ● Transfer case internal obstruction ● Transfer case changeover solenoid fault ● Transfer case motor fault ● Transfer case control module failure 	Check for Transfer Case Control Module DTCs and refer to the relevant DTC Index
Off road traction reduced	'TRANSMISSION OVER HEAT SLOW DOWN'	<ul style="list-style-type: none"> ● Center differential temperature is approaching the over heated threshold 	Check for over-temperature DTCs
	'TRANSMISSION FAULT – TRACTION REDUCED'	<ul style="list-style-type: none"> ● Center differential has failed - operating as an open differential ● Transfer case control module has stopped transmitting on the CAN bus and defaults to open center differential 	Check for lost communication and bus off DTCs


DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Transfer Case Control Module \(TCCM\)](#) (100-00 General Information, Description and Operation).

Transfer Case - Transfer Case Draining and Filling

General Procedures

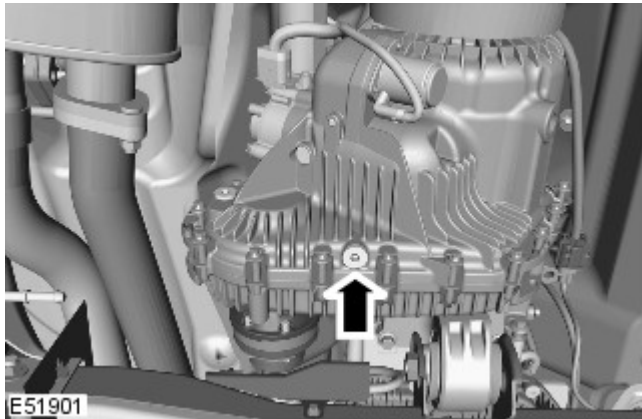
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Position a container to collect the fluid.

- Remove the fluid drain plug.

- Clean the immediate area.
- Remove and discard the sealing washer.



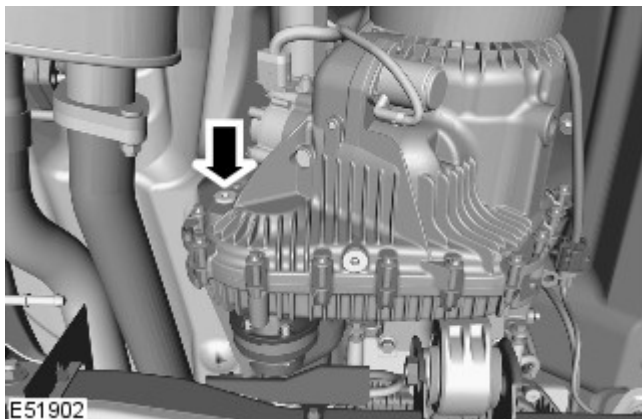
- Allow the fluid to drain.

- Install the drain plug and tighten it to 22 Nm (16 lb.ft).

- Clean the component mating faces.
- Install a new sealing washer.

- Remove the fluid filler/level plug.

- Clean the immediate area.
- Remove and discard the sealing washer.



- Refill transfer case with the recommended fluid, until the fluid is level with bottom of filler/level plug hole.



For additional information, refer to: [Specifications](#) (308-07B Transfer Case, Specifications).

- Install the fluid filler/level plug and tighten to 22 Nm (16 lb.ft).


- Clean the component mating faces.
- Install a new sealing washer.

Transfer Case - Transfer Case Input Shaft Seal V6 4.0L Petrol

In-vehicle Repair


Special Tool(s)	
 <p>303-903 E50940</p>	<p>Oil seal remover 303-903 (LRT-12-092)</p>
 <p>308-598 E50941</p>	<p>Oil seal installer 308-598</p>

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

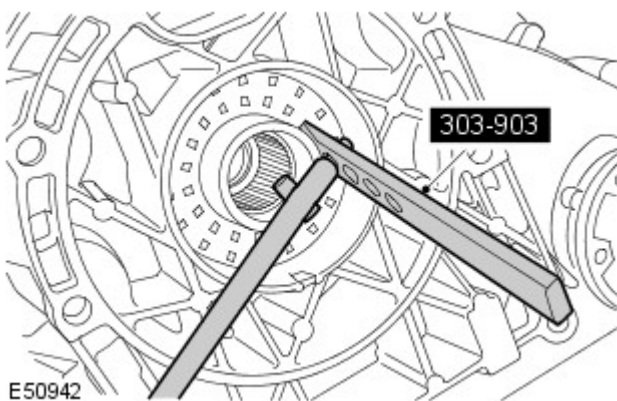
Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - V6 4.0L Petrol](#) (308-07B Transfer Case, Removal).

-  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.

Carefully remove and discard the oil seal.

- Use the special tool.

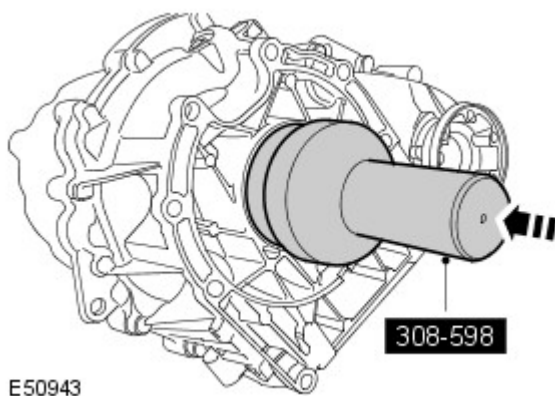


Installation

-  **CAUTION:** Oil seals must be fitted dry.

Install a new seal.

- Clean the seal register.
- Use the special tool.





- Install the transfer case.
For additional information, refer to: [Transfer Case - V6 4.0L](#)


[Petrol](#) (308-07B Transfer Case, Removal).

Transfer Case - Transfer Case Input Shaft Seal V8 5.0L Petrol

In-vehicle Repair


Special Tool(s)	
 <p>303-903</p> <p>E50940</p>	<p>Oil seal remover 303-903(LRT-12-092)</p>
 <p>308-598</p> <p>E50941</p>	<p>Oil seal installer 308-598</p>

Removal

-  **WARNING:** Make sure to support the vehicle with axle stands.

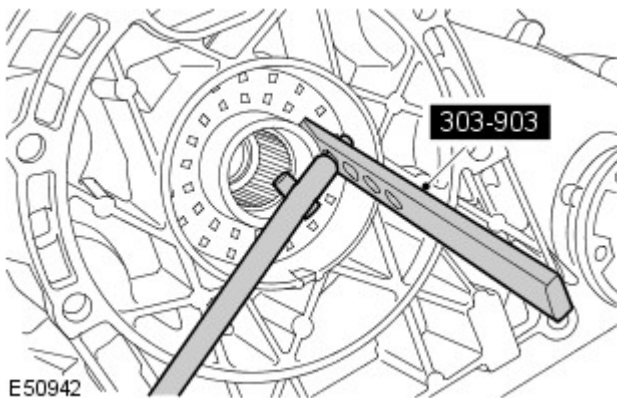
Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - V8 5.0L Petrol](#) (308-07B Transfer Case, Removal).

-  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.

Carefully remove and discard the oil seal.

- Use the special tool.

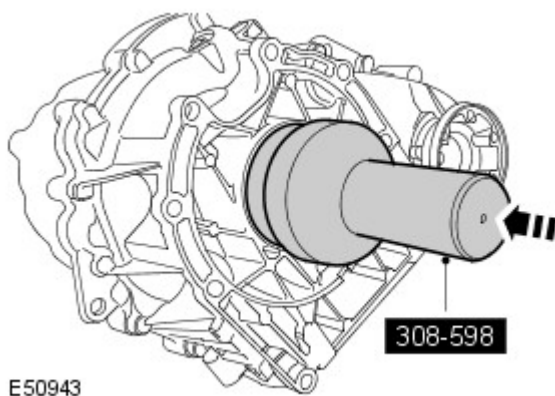


Installation

-  **CAUTION:** Oil seals must be fitted dry.

Install a new seal.

- Clean the seal register.
- Use the special tool.





- Install the transfer case.
For additional information, refer to: [Transfer Case - V8 5.0L](#)


[Petrol](#) (308-07B Transfer Case, Removal).

Transfer Case - Transfer Case Input Shaft Seal TDV6 2.7L Diesel

In-vehicle Repair


Special Tool(s)	
 <p>308-598</p> <p>E50941</p>	<p>Oil seal installer</p> <p>308-598</p>
 <p>303-903</p> <p>E50940</p>	<p>Oil seal remover</p> <p>303-903 (LRT-12-092)</p>

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

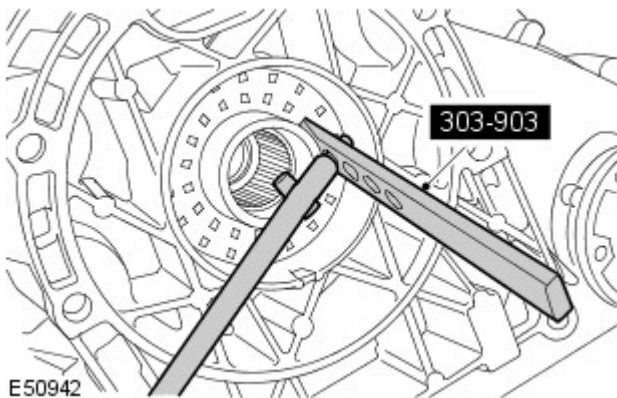
Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

-  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.

Carefully remove and discard the oil seal.

- Use the special tool.

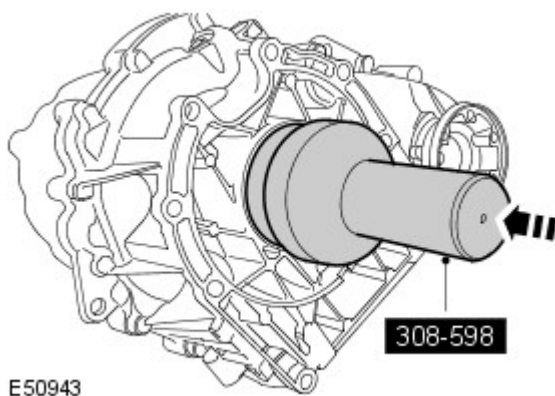


Installation

-  **CAUTION:** Oil seals must be fitted dry.

Install a new seal.

- Clean the seal register.
- Use the special tool.





- Install the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L](#)

[Diesel](#) (308-07B Transfer Case, Removal).

Transfer Case - Transfer Case Input Shaft Seal TDV6 3.0L Diesel

In-vehicle Repair


Special Tool(s)	
 <p>303-903 E50940</p>	<p>Oil seal remover 303-903(LRT-12-092)</p>
 <p>308-598 E50941</p>	<p>Oil seal installer 308-598</p>

Removal

-  **WARNING:** Make sure to support the vehicle with axle stands.

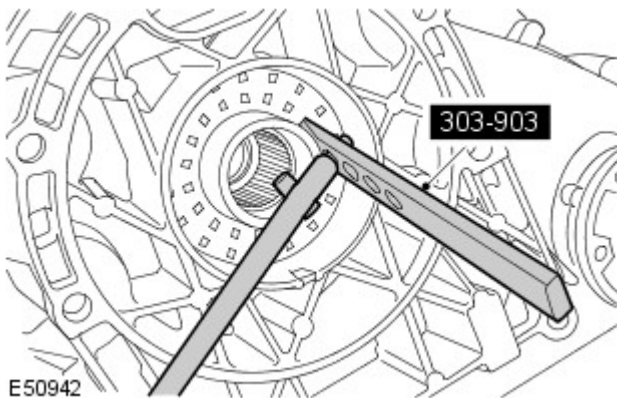
Raise and support the vehicle.

- Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

-  **CAUTION:** Care must be taken to avoid damage to the seal register and running surface.

Carefully remove and discard the oil seal.

- Use the special tool.

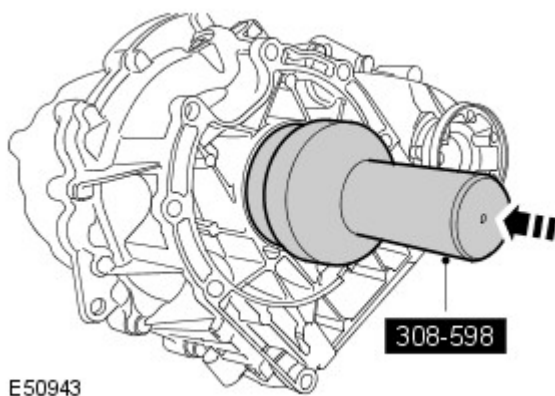


Installation

-  **CAUTION:** Oil seals must be fitted dry.

Install a new seal.

- Clean the seal register.
- Use the special tool.


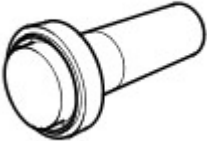



- Install the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L](#)


[Diesel](#) (308-07B Transfer Case, Removal).

Transfer Case - Transfer Case Front Output Shaft Seal V6 4.0L Petrol

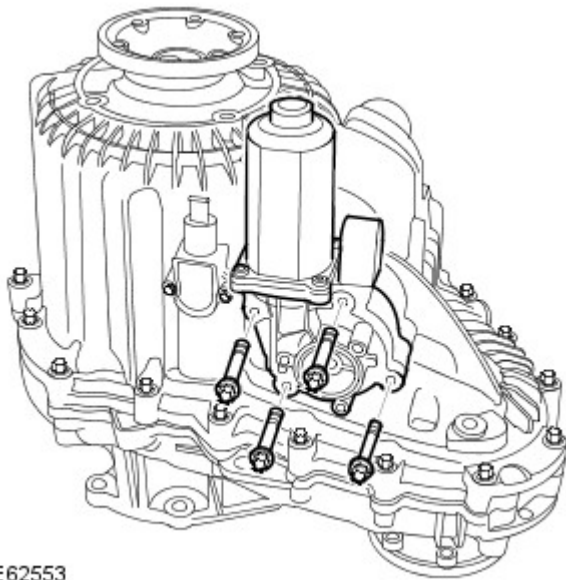
In-vehicle Repair

Special Tool(s)	
<p>307-486</p>  <p>E62808</p>	<p>Installer (LRT-41-019)</p> <p>307-486</p>
<p>308-636</p>  <p>E55702</p>	<p>Installer</p> <p>308-636</p>
<p>205-818</p>  <p>E55429</p>	<p>Installer</p> <p>205-818</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - V6 4.0L Petrol](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

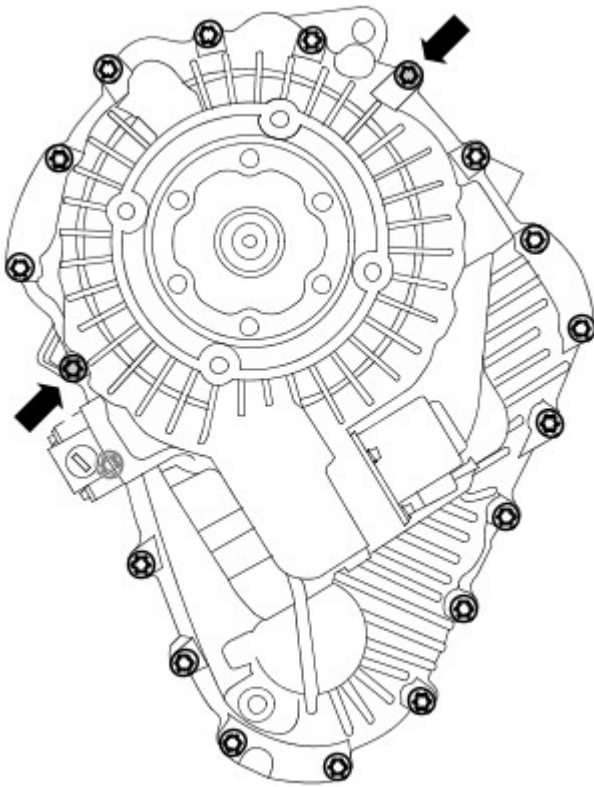


E62553

6.  **WARNING:** Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.



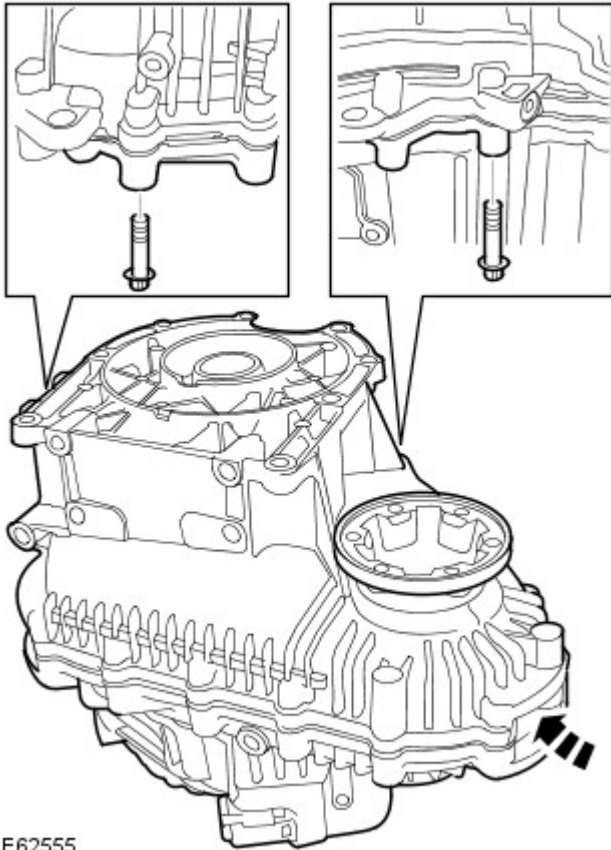
E62554

7.  **WARNING:** Eye protection must be worn.

Remove 17 Torx bolts securing the transfer casings.


- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.

8. With assistance, release the transfer case and secure with the rear face of the transfer case facing down on a flat surface.



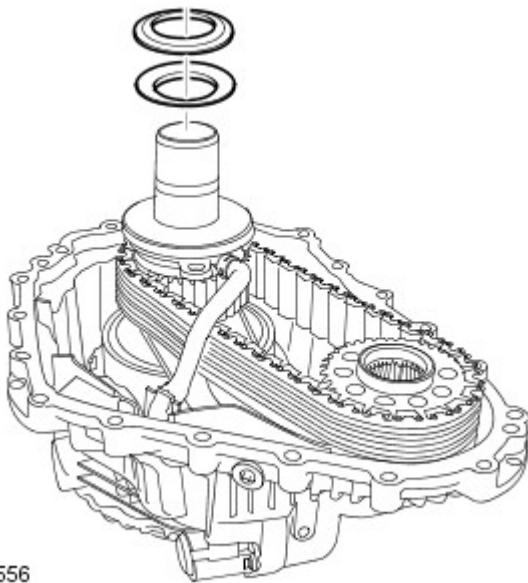
E62555

9.  **WARNING:** Eye protection must be worn.

 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the front half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.



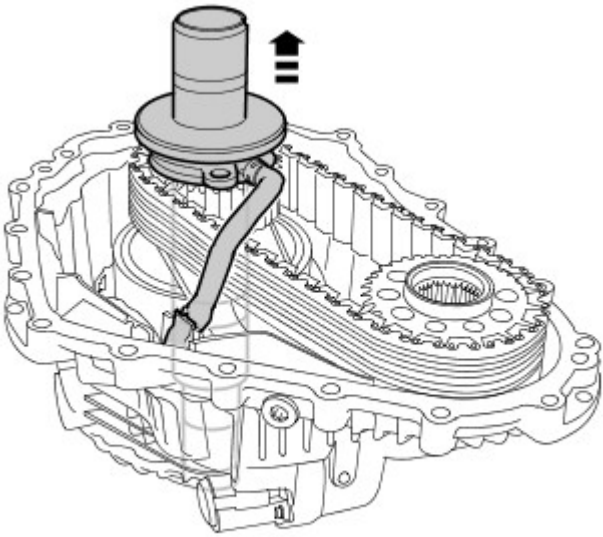
E62556

10.  **CAUTION:** Note the fitted position of the special washers.

Remove the 2 special washers.

11. Remove the input shaft and oil pump assembly.

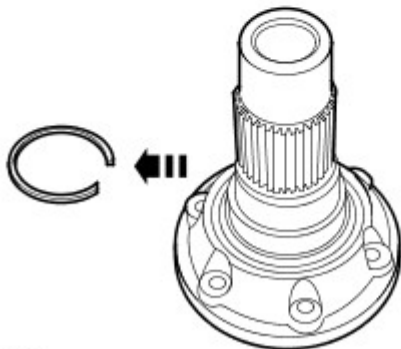
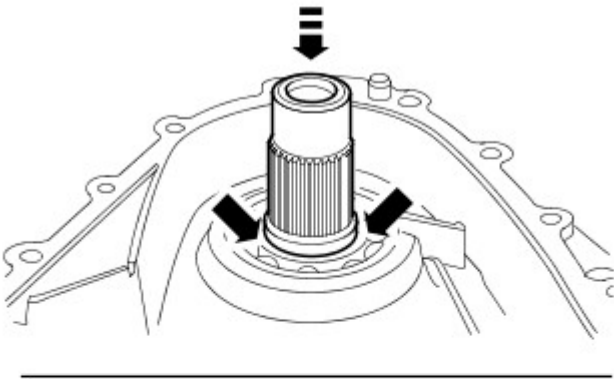
- Release the fluid pump pickup line.



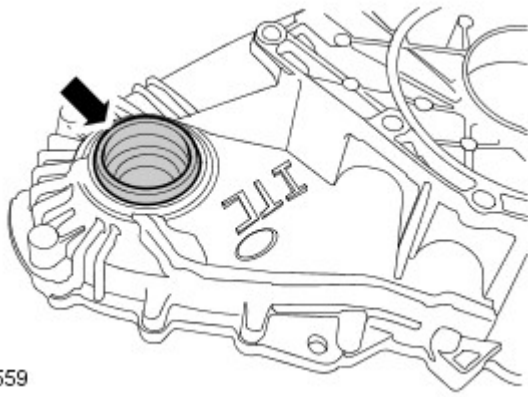
E62557

12. Remove the front output flange.


- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



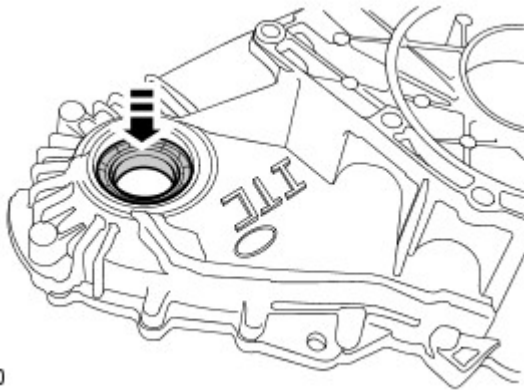
E62558



E62559

13.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

Remove the output flange seal.



E62560

14. Remove the output flange bearing.

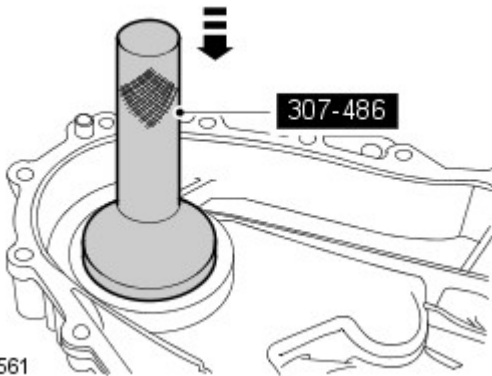
Installation

1. Remove the sealant from the transfer case mating faces.
2. Clean the magnetic filter.

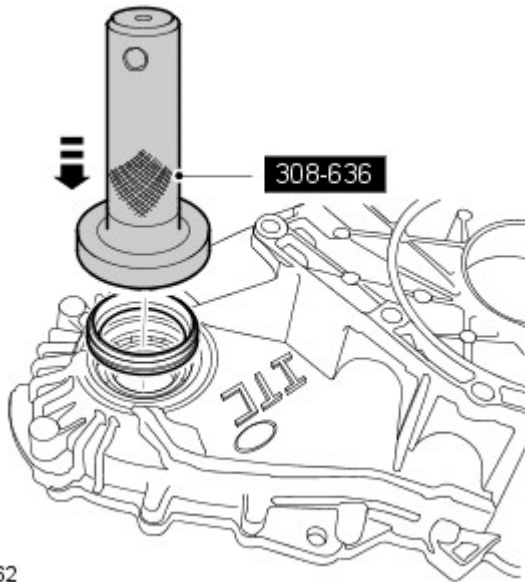
3.  CAUTION: The chamfer on the bearing inner track must face the seal.

Using the special tool, install the output flange bearing.

- Clean the components mating faces.



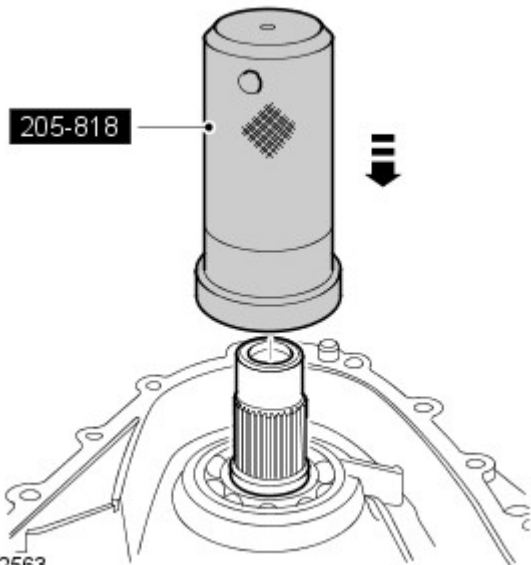
E62561



E62562

4. Using the special tool, install a new oil seal.


- Clean the component mating faces.
- Grease the new seal.



E62563

5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

6.  CAUTION: Make sure the washers are installed correctly.

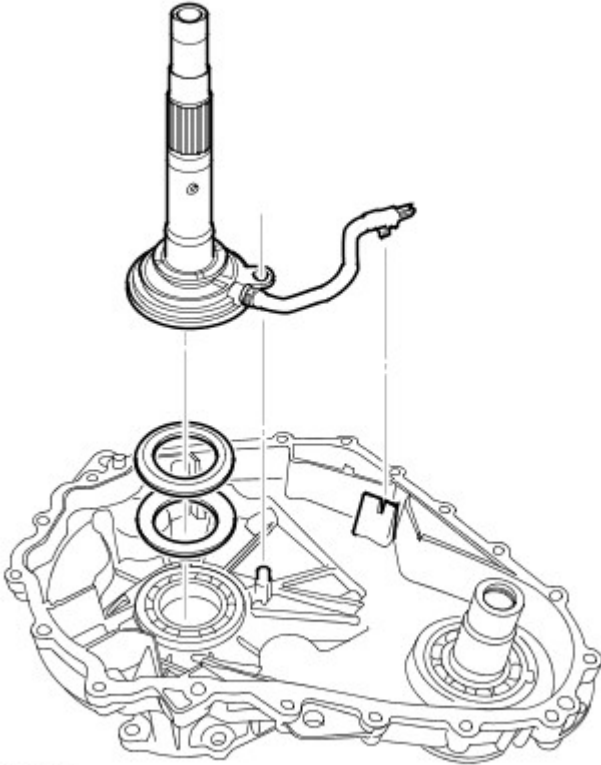
Install the 2 special washers.

- Clean the components.

7.  CAUTION: Make sure the oil pump is installed over its location peg.

Install the input shaft and oil pump assembly.

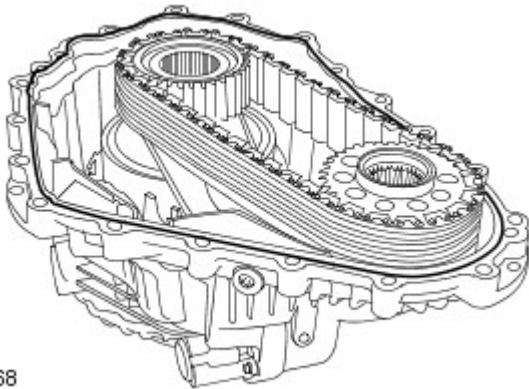
- Clean the components.
- Secure the fluid pickup line.



E62564

8. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

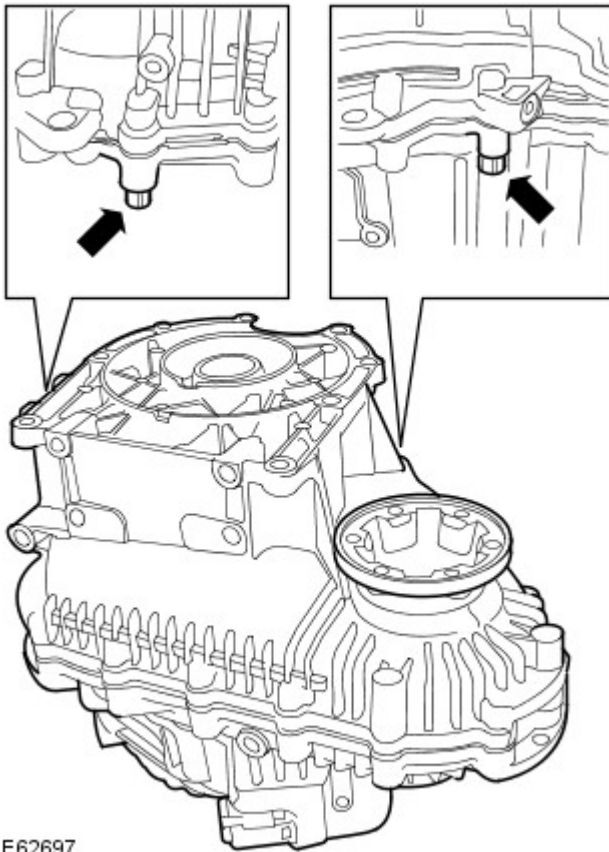
- Clean the component mating faces.
- Clean the dowels and dowel holes.



E62568

9. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



E62697

10. With assistance, release the transfer case and secure with its transmission mating face down on a flat surface.

11. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

12. Install the shift motor.

- Clean the components.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).

13. With assistance, release the transfer case.

- Remove the 2 bolts.

14. Install the transfer case.

For additional information, refer to: [Transfer Case - V6 4.0L Petrol](#) (308-07B Transfer Case, Removal).

15. Refill the transfer case with the recommended fluid.


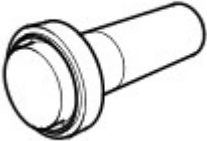

For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).

16. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer Case Front Output Shaft Seal V8 5.0L Petrol

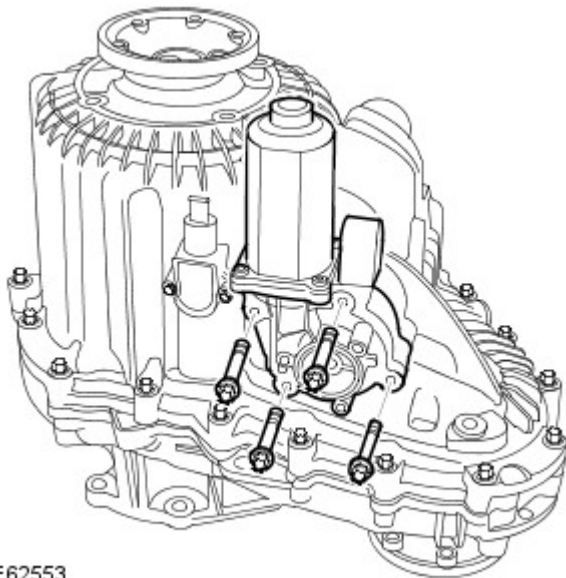
In-vehicle Repair

Special Tool(s)	
<p>307-486</p>  <p>E62808</p>	<p>Installer 307-486(LRT-41-019)</p>
<p>308-636</p>  <p>E55702</p>	<p>Installer 308-636</p>
<p>205-818</p>  <p>E55429</p>	<p>Installer 205-818</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - V8 5.0L Petrol](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

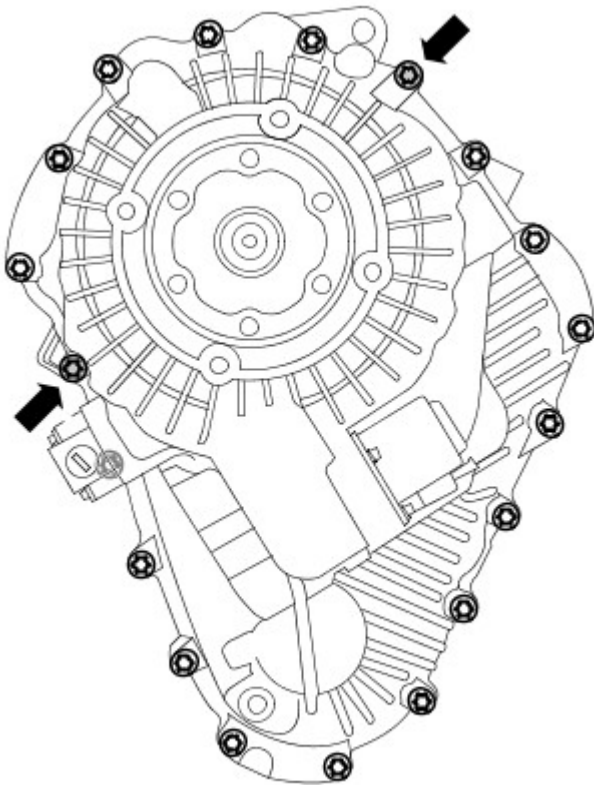


E62553

6.  **WARNING:** Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.



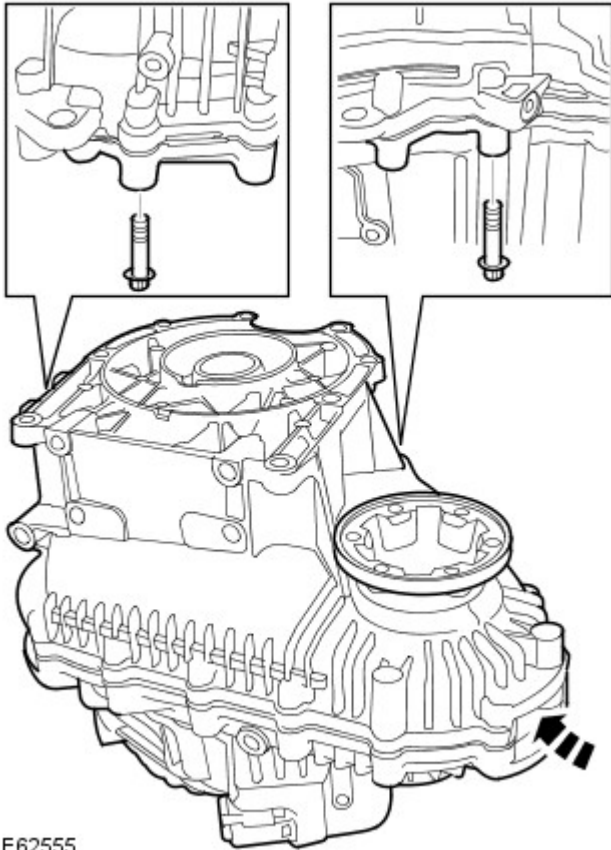
E62554

7.  **WARNING:** Eye protection must be worn.

Remove 17 Torx bolts securing the transfer casings.


- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.

8. With assistance, release the transfer case and secure with the rear face of the transfer case facing down on a flat surface.



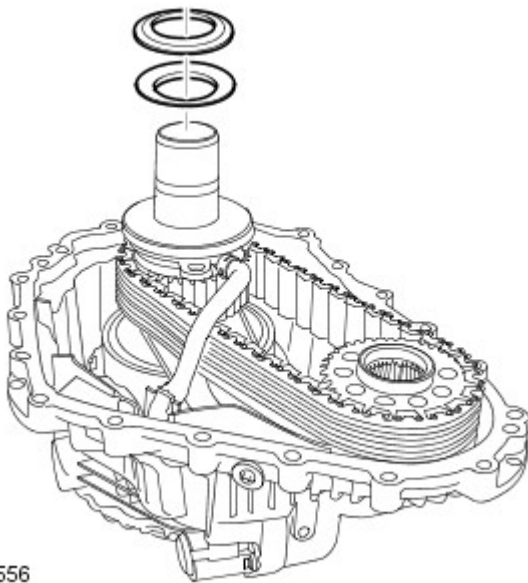
E62555

9.  **WARNING:** Eye protection must be worn.

 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the front half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.



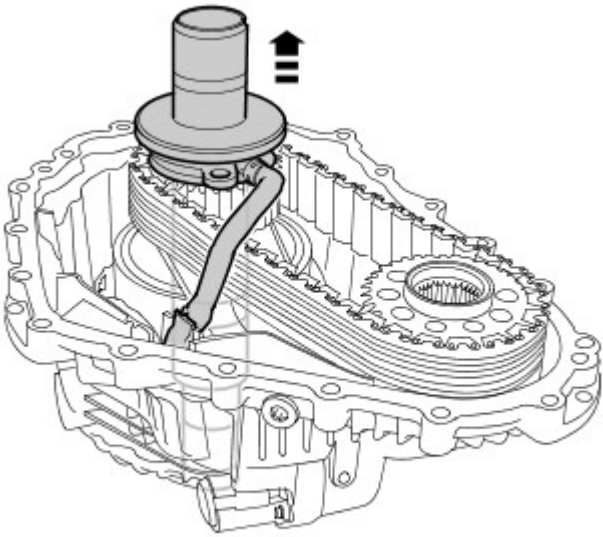
E62556

10.  **CAUTION:** Note the fitted position of the special washers.

Remove the 2 special washers.

11. Remove the input shaft and oil pump assembly.

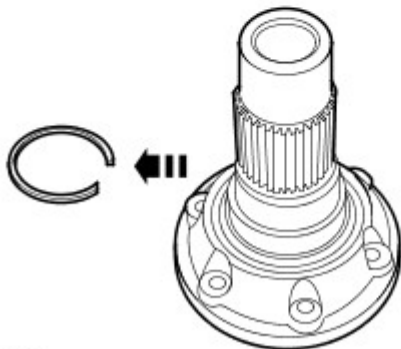
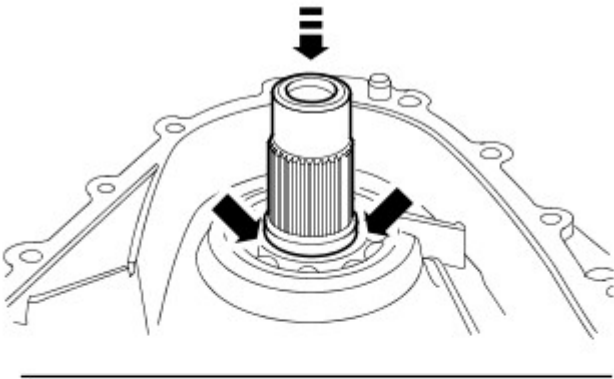
- Release the fluid pump pickup line.



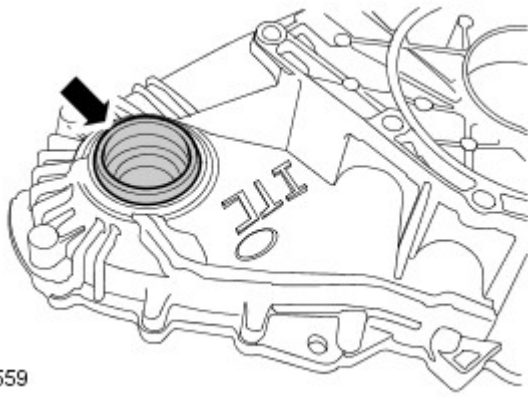
E62557

12. Remove the front output flange.


- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



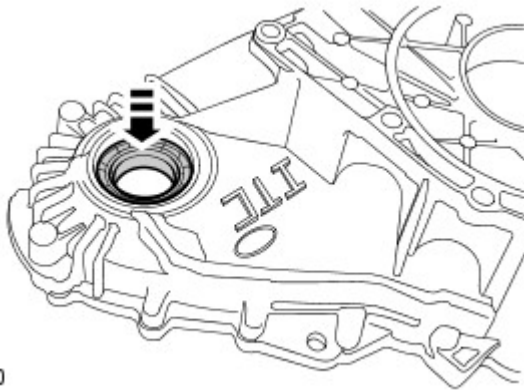
E62558



E62559

13.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

Remove the output flange seal.



E62560

14. Remove the output flange bearing.

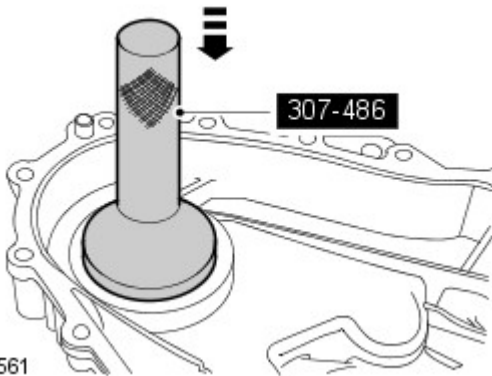
Installation

1. Remove the sealant from the transfer case mating faces.
2. Clean the magnetic filter.

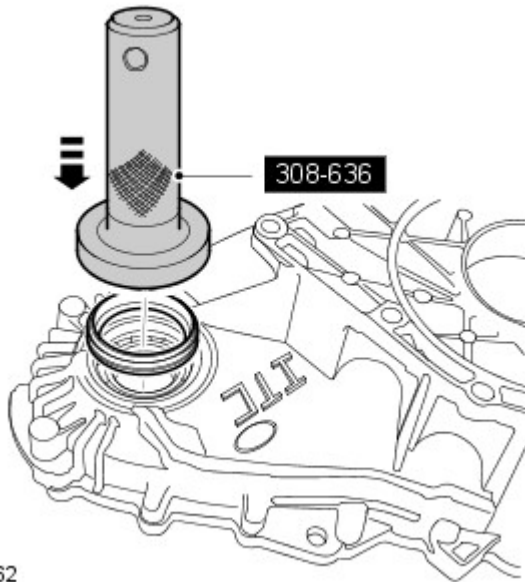
3.  CAUTION: The chamfer on the bearing inner track must face the seal.

Using the special tool, install the output flange bearing.

- Clean the components mating faces.



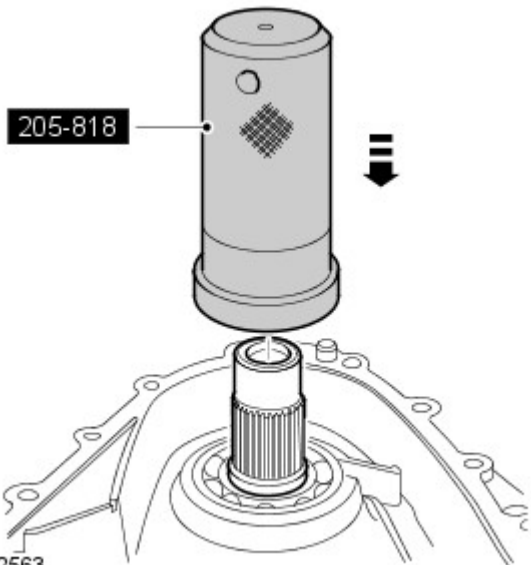
E62561



E62562

4. Using the special tool, install a new oil seal.


- Clean the component mating faces.
- Grease the new seal.



E62563

5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

6.  CAUTION: Make sure the washers are installed correctly.

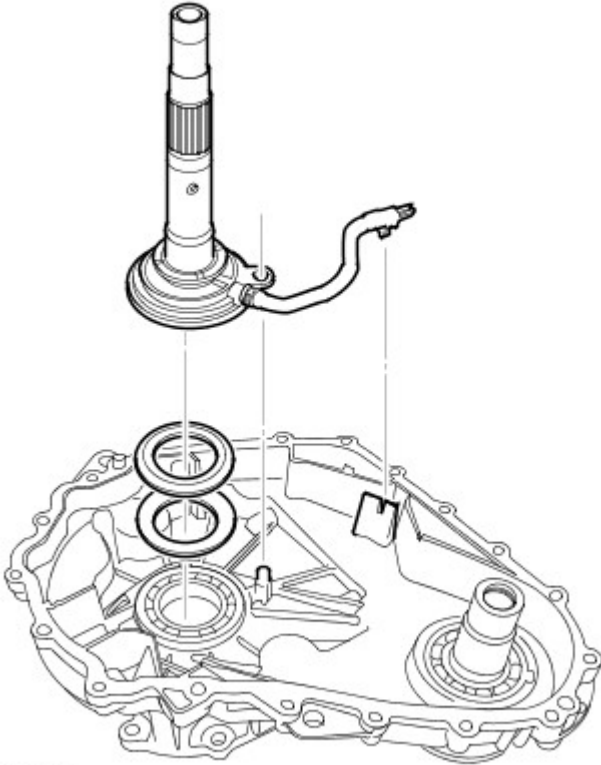
Install the 2 special washers.

- Clean the components.

7.  CAUTION: Make sure the oil pump is installed over its location peg.

Install the input shaft and oil pump assembly.

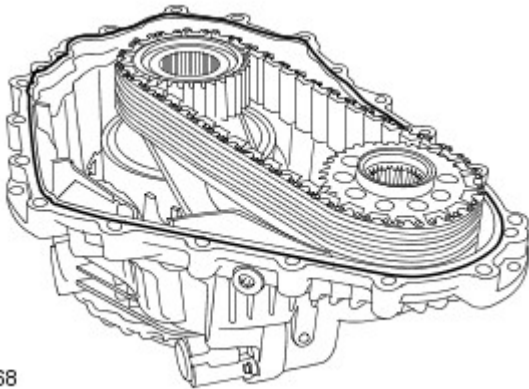
- Clean the components.
- Secure the fluid pickup line.



E62564

8. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

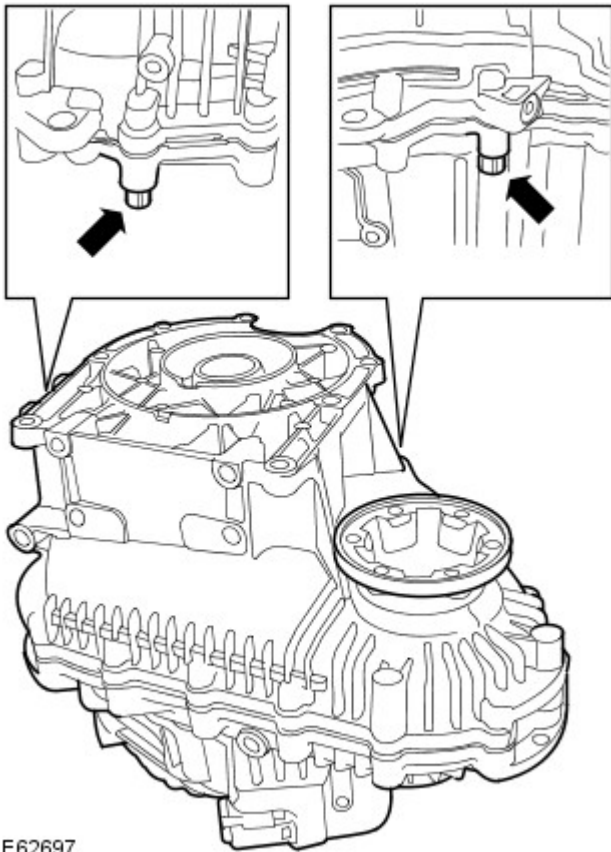
- Clean the component mating faces.
- Clean the dowels and dowel holes.



E62568

9. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



10. With assistance, release the transfer case and secure with its transmission mating face down on a flat surface.

11. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

12. Install the shift motor.

- Clean the components.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).

13. With assistance, release the transfer case.

- Remove the 2 bolts.

14. Install the transfer case.

For additional information, refer to: [Transfer Case - V8 5.0L Petrol](#) (308-07B Transfer Case, Removal).

15. Refill the transfer case with the recommended fluid.


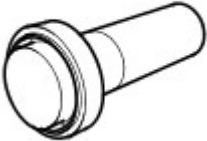

For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).

16. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer Case Front Output Shaft SealTDV6 2.7L Diesel

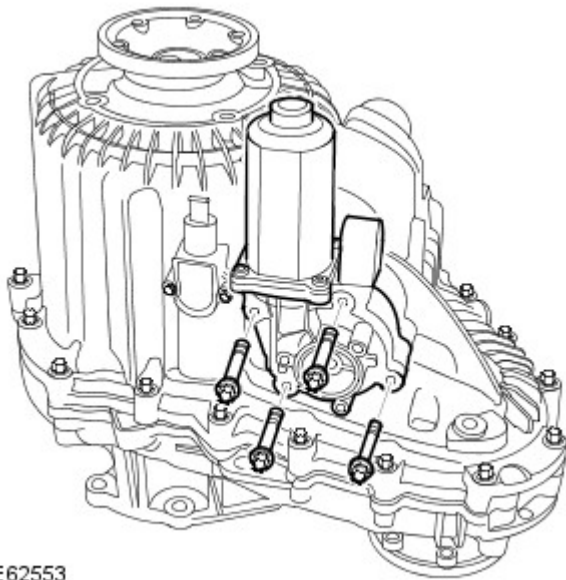
In-vehicle Repair

Special Tool(s)	
 <p>307-486 E62808</p>	Installer (LRT-41-019) 307-486
 <p>308-636 E55702</p>	Installer 308-636
 <p>205-818 E55429</p>	Installer 205-818

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

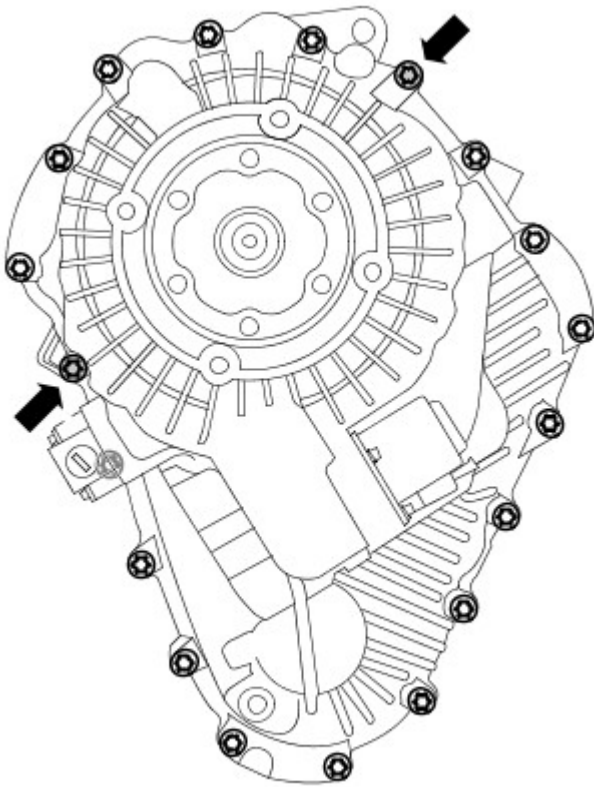


E62553

6.  **WARNING:** Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.



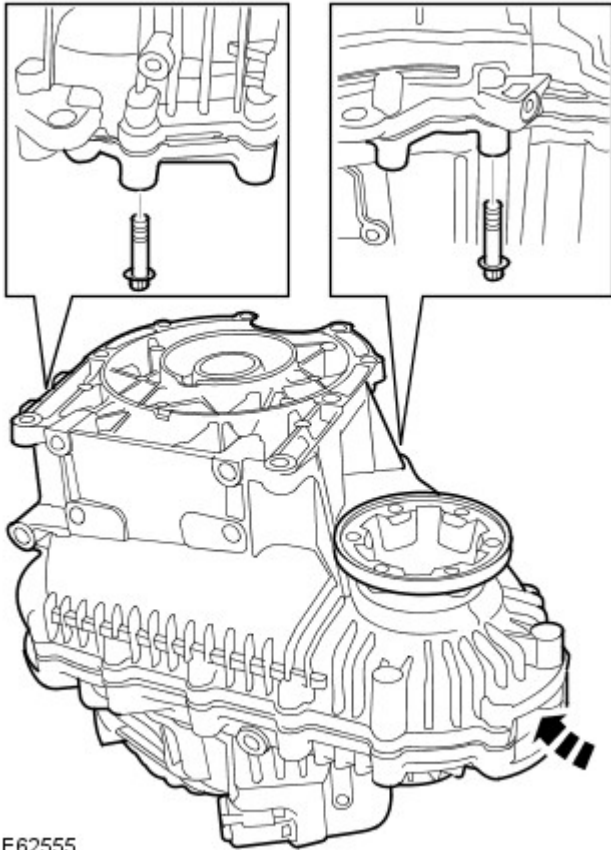
E62554

7.  **WARNING:** Eye protection must be worn.

Remove 17 Torx bolts securing the transfer casings.


- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.

8. With assistance, release the transfer case and secure with the rear face of the transfer case facing down on a flat surface.



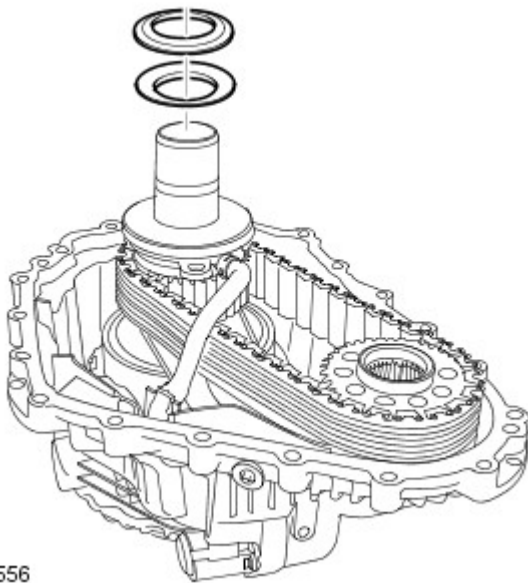
E62555

9.  **WARNING:** Eye protection must be worn.

 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the front half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.



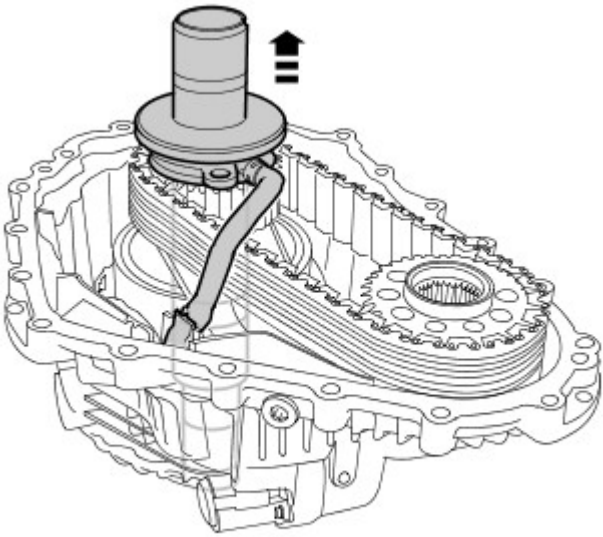
E62556

10.  **CAUTION:** Note the fitted position of the special washers.

Remove the 2 special washers.

11. Remove the input shaft and oil pump assembly.

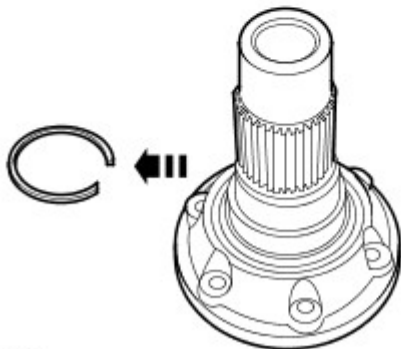
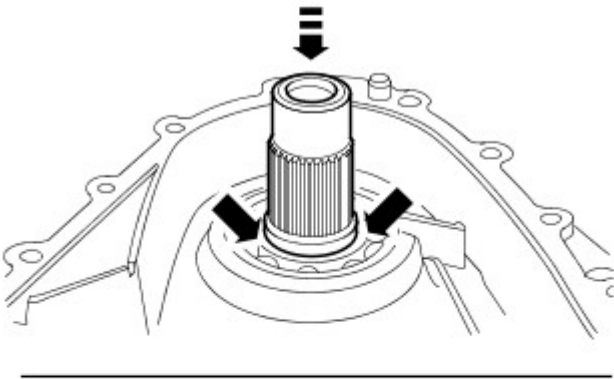
- Release the fluid pump pickup line.



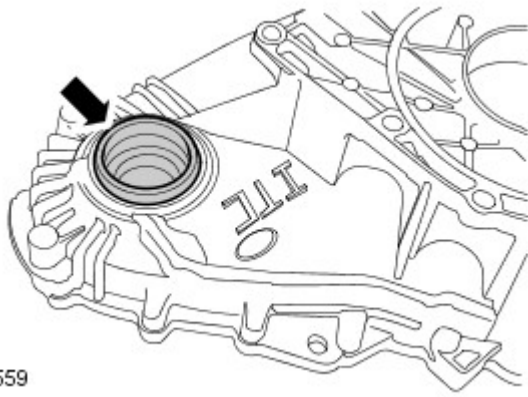
E62557

12. Remove the front output flange.


- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



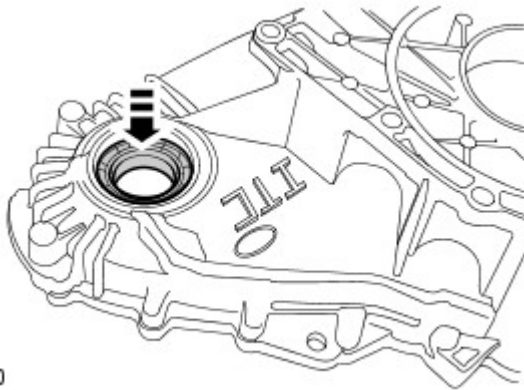
E62558



E62559

13.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

Remove the output flange seal.



E62560

14. Remove the output flange bearing.

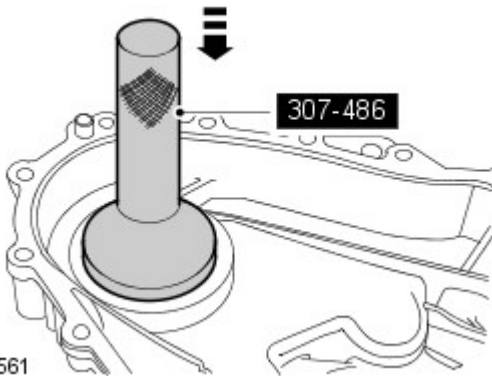
Installation

1. Remove the sealant from the transfer case mating faces.
2. Clean the magnetic filter.

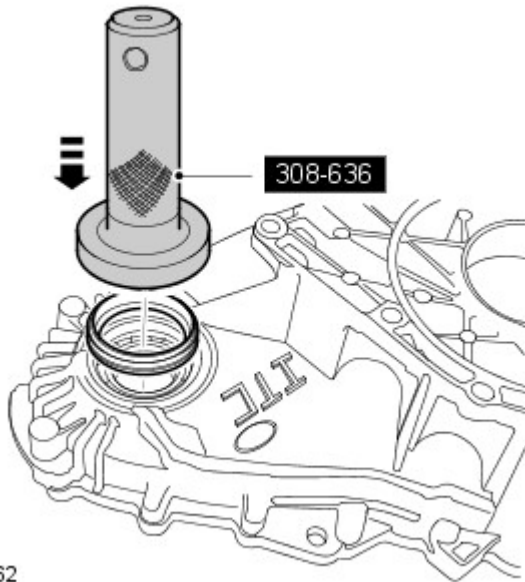
3.  CAUTION: The chamfer on the bearing inner track must face the seal.

Using the special tool, install the output flange bearing.

- Clean the components mating faces.



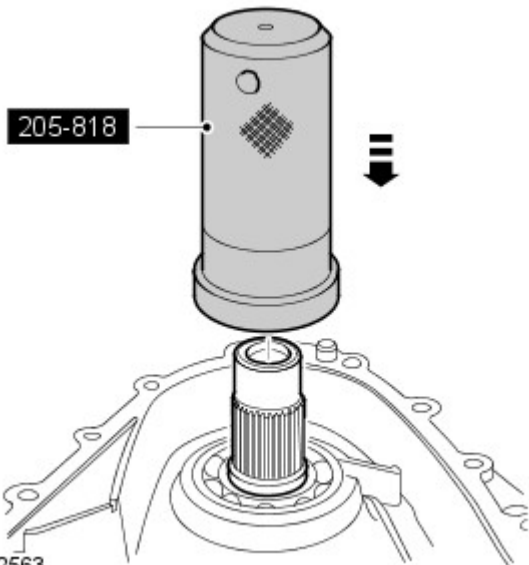
E62561



E62562

4. Using the special tool, install a new oil seal.

- Clean the component mating faces.
- Grease the new seal.



E62563

5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

6.  CAUTION: Make sure the washers are installed correctly.

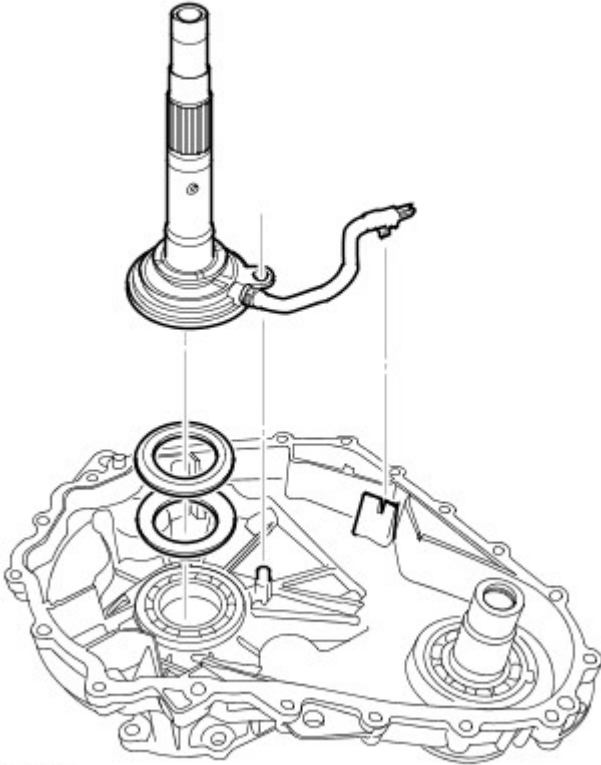
Install the 2 special washers.

- Clean the components.

7.  CAUTION: Make sure the oil pump is installed over its location peg.

Install the input shaft and oil pump assembly.

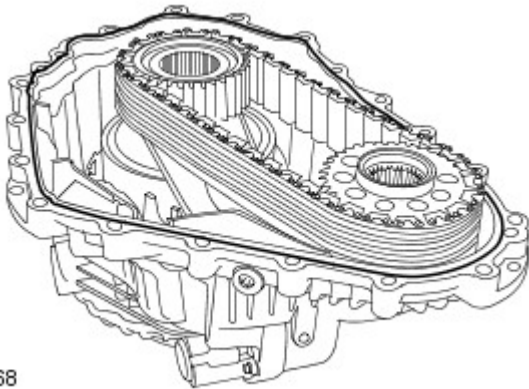
- Clean the components.
- Secure the fluid pickup line.



E62564

8. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

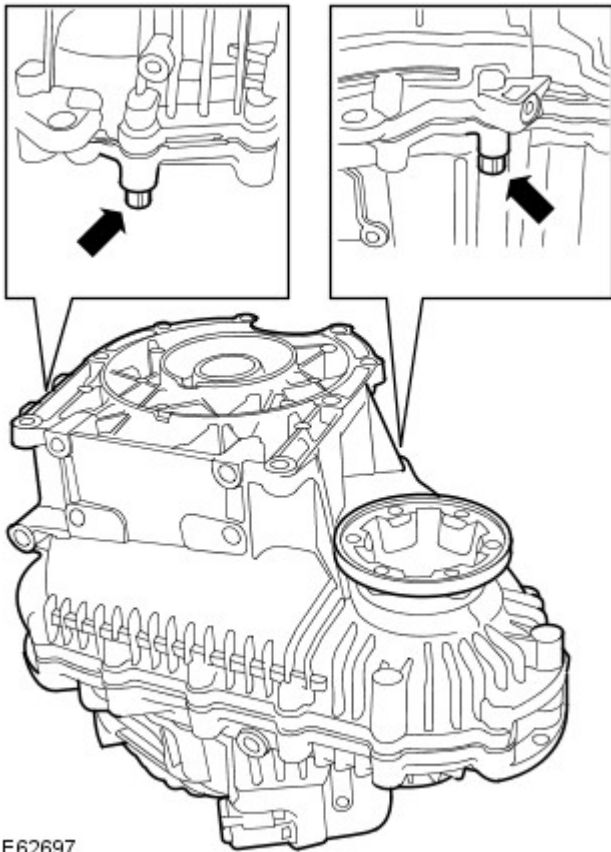
- Clean the component mating faces.
- Clean the dowels and dowel holes.



E62568

9. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



E62697

10. With assistance, release the transfer case and secure with its transmission mating face down on a flat surface.

11. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

12. Install the shift motor.

- Clean the components.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).

13. With assistance, release the transfer case.

- Remove the 2 bolts.

14. Install the transfer case.

For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

15. Refill the transfer case with the recommended fluid.


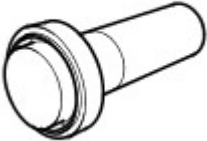

For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).

16. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer Case Front Output Shaft SealTDV6 3.0L Diesel

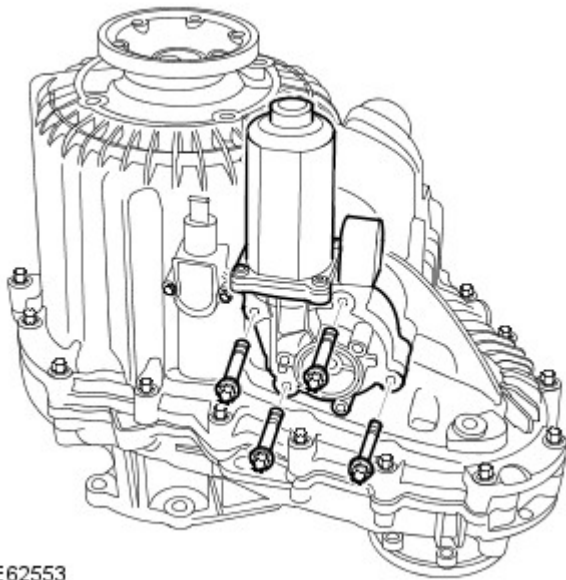
In-vehicle Repair

Special Tool(s)	
 <p>307-486 E62808</p>	<p>Installer 307-486(LRT-41-019)</p>
 <p>308-636 E55702</p>	<p>Installer 308-636</p>
 <p>205-818 E55429</p>	<p>Installer 205-818</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

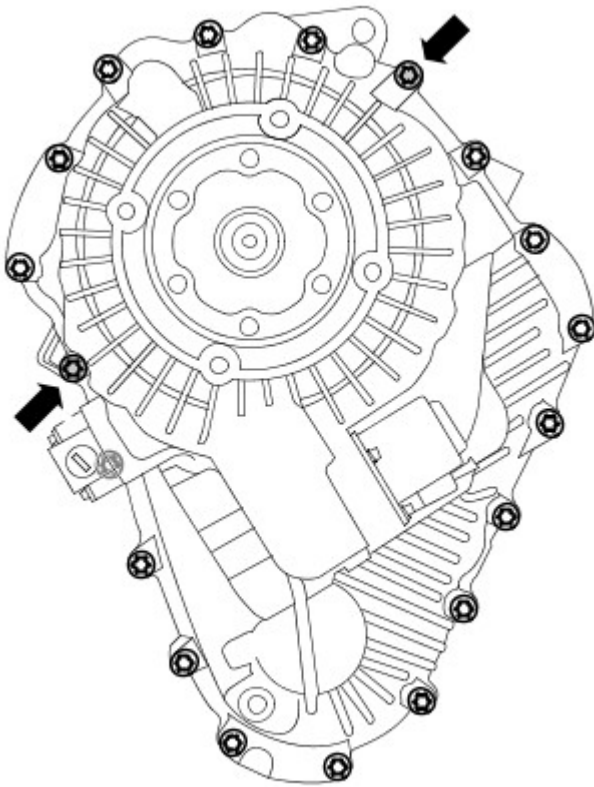


E62553

6.  **WARNING:** Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.



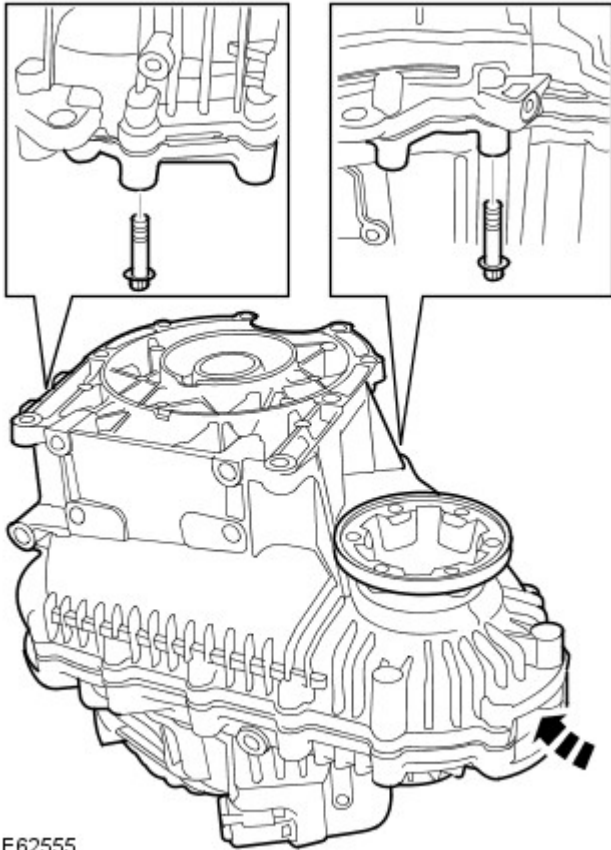
E62554

7.  **WARNING:** Eye protection must be worn.

Remove 17 Torx bolts securing the transfer casings.

- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.

8. With assistance, release the transfer case and secure with the rear face of the transfer case facing down on a flat surface.



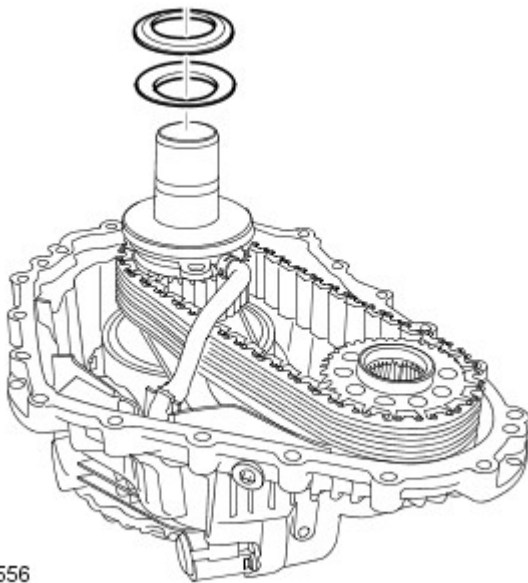
E62555

9.  **WARNING:** Eye protection must be worn.

 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the front half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.



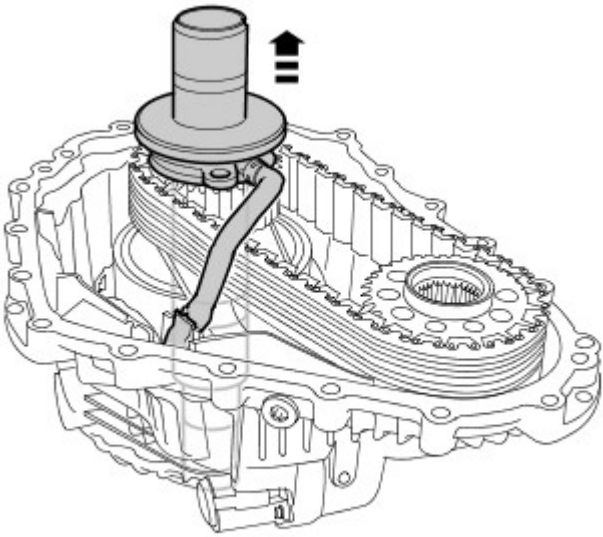
E62556

10.  **CAUTION:** Note the fitted position of the special washers.

Remove the 2 special washers.

11. Remove the input shaft and oil pump assembly.

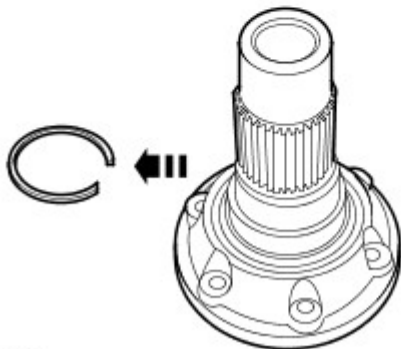
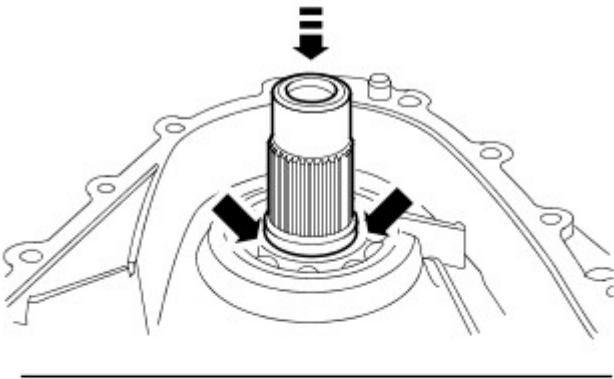
- Release the fluid pump pickup line.



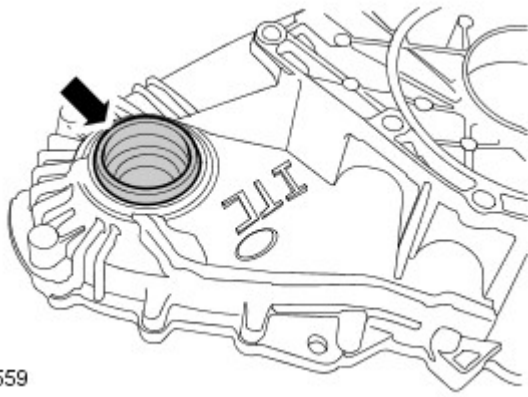
E62557

12. Remove the front output flange.


- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



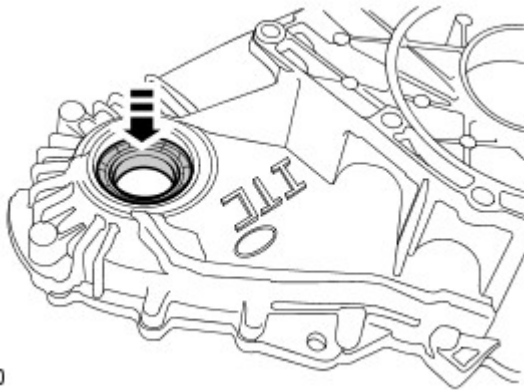
E62558



E62559

13.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

Remove the output flange seal.



E62560

14. Remove the output flange bearing.

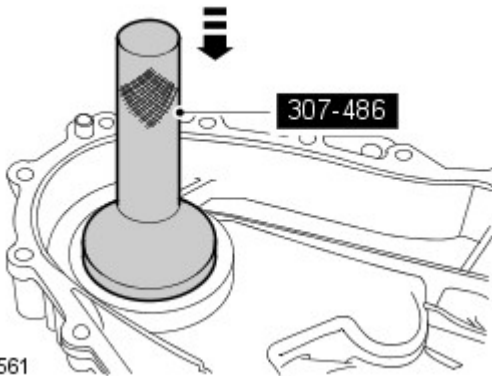
Installation

1. Remove the sealant from the transfer case mating faces.
2. Clean the magnetic filter.

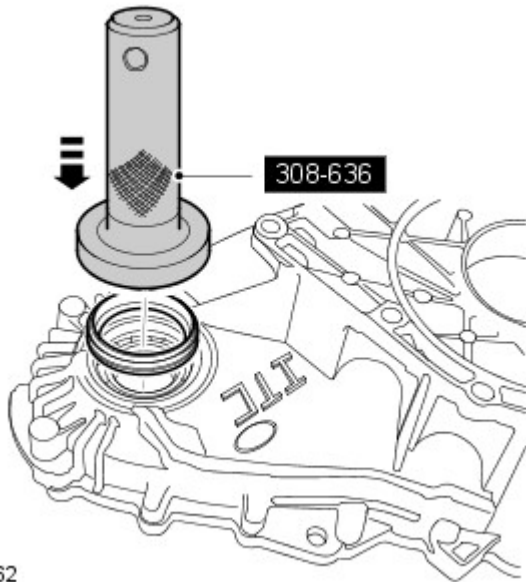
3.  CAUTION: The chamfer on the bearing inner track must face the seal.

Using the special tool, install the output flange bearing.

- Clean the components mating faces.



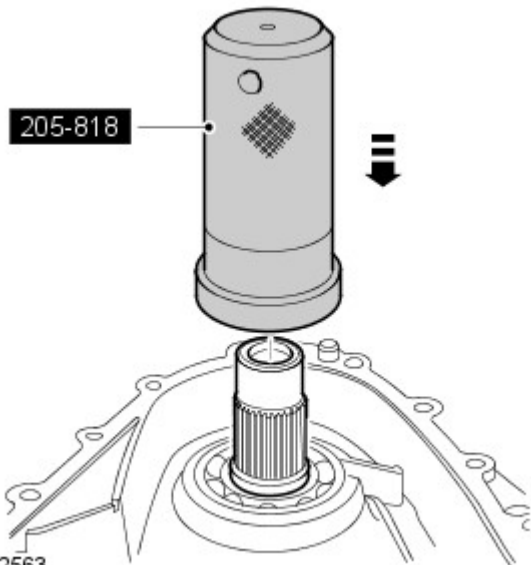
E62561



E62562

4. Using the special tool, install a new oil seal.


- Clean the component mating faces.
- Grease the new seal.



E62563

5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

6.  CAUTION: Make sure the washers are installed correctly.

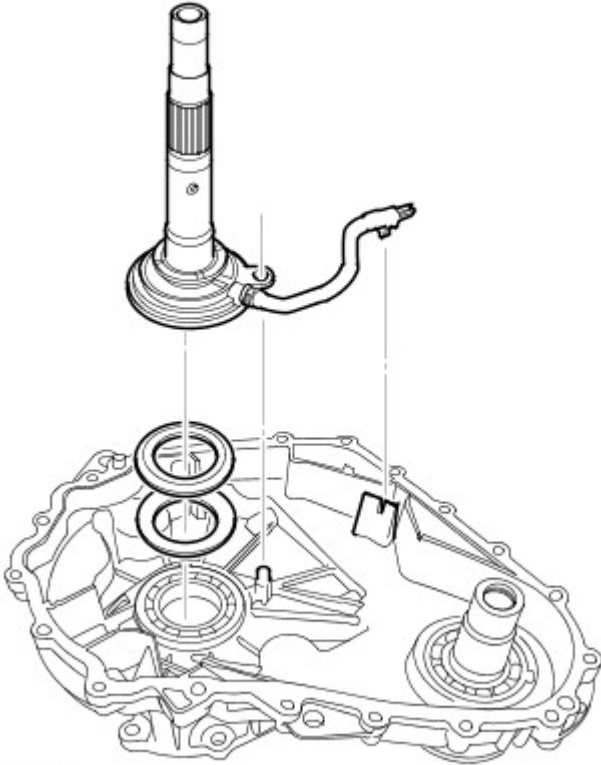
Install the 2 special washers.

- Clean the components.

7.  CAUTION: Make sure the oil pump is installed over its location peg.

Install the input shaft and oil pump assembly.

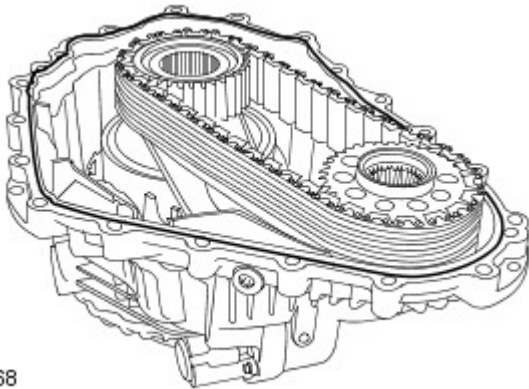
- Clean the components.
- Secure the fluid pickup line.



E62564

8. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

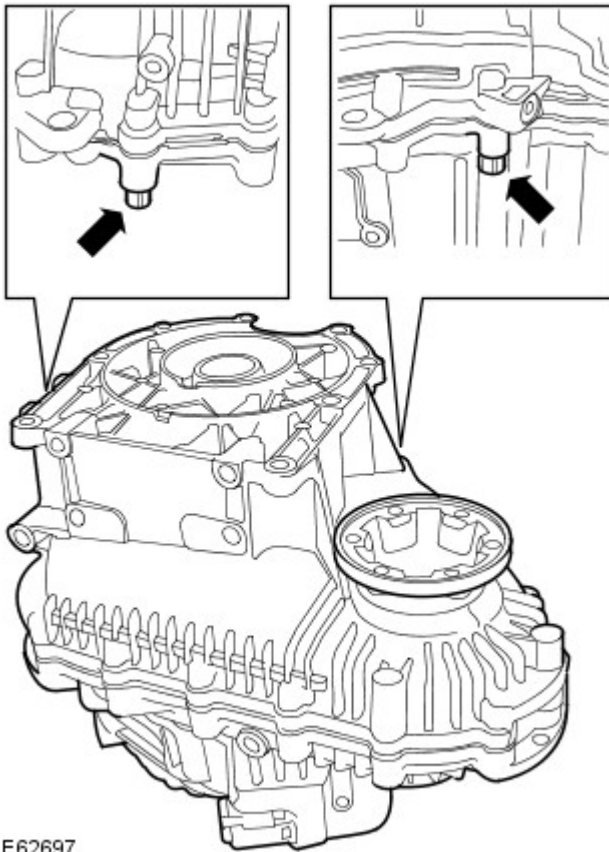
- Clean the component mating faces.
- Clean the dowels and dowel holes.



E62568

9. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



E62697

10. With assistance, release the transfer case and secure with its transmission mating face down on a flat surface.

11. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

12. Install the shift motor.

- Clean the components.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).

13. With assistance, release the transfer case.

- Remove the 2 bolts.

14. Install the transfer case.

For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).

15. Refill the transfer case with the recommended fluid.


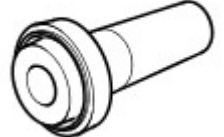

For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).

16. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer Case Rear Output Shaft Seal V6 4.0L Petrol

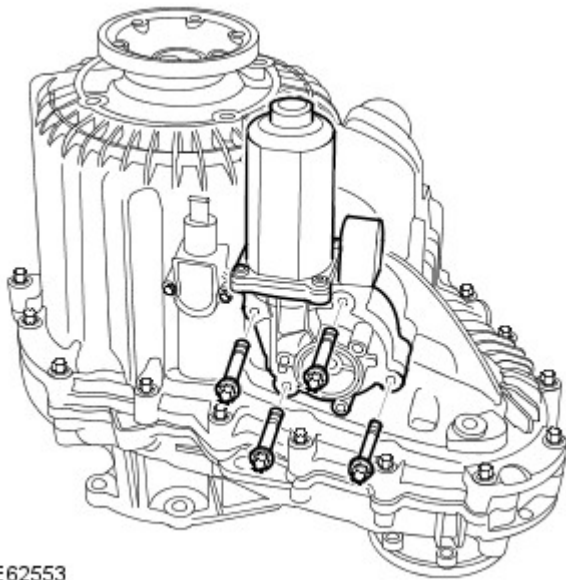
In-vehicle Repair

Special Tool(s)	
 <p>205-726 E63175</p>	Remover/installer (LRT-54-015) 205-726
 <p>308-637 E55697</p>	Seal installer 308-637
 <p>204-525-1 E49576</p>	Installer 204-525/1

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - V6 4.0L Petrol](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

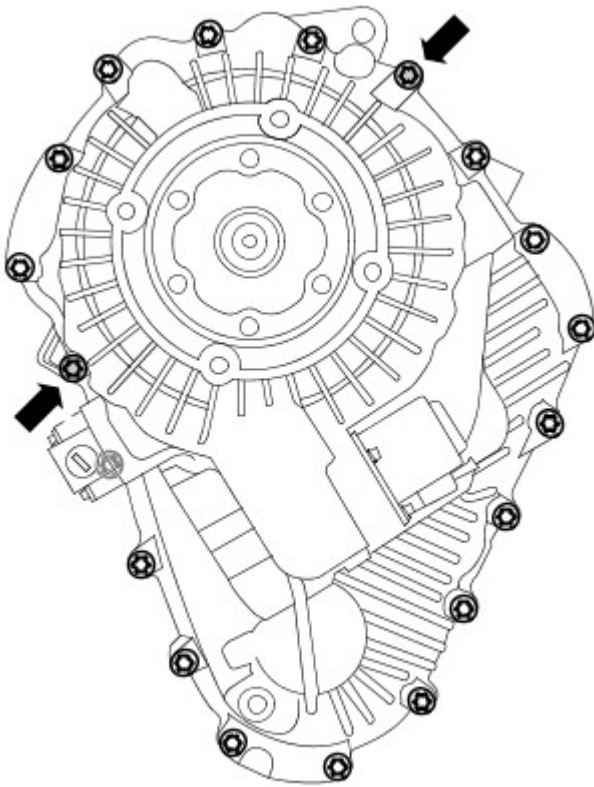


E62553

6.  WARNING: Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.

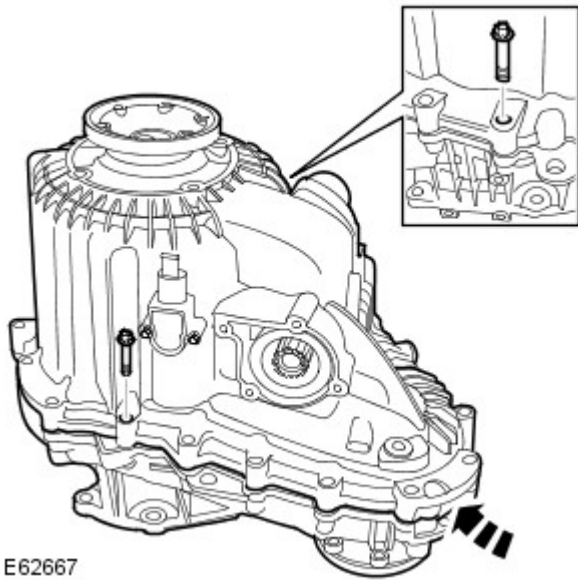


E62554

7.  WARNING: Eye protection must be worn.

Remove 17 Torx bolts securing the transfer casings.

- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.



E62667

8.  **WARNING:** Eye protection must be worn.

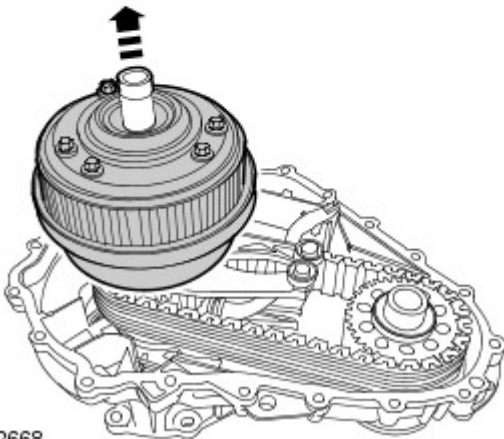
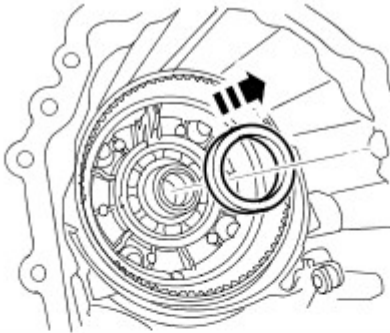
 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the rear half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.

9. Remove the differential module.

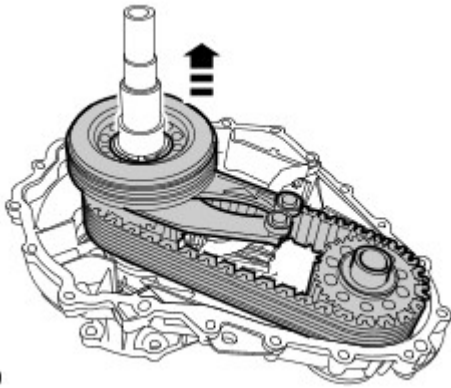
- Remove the spacer.



E62668

10. NOTE: Remove as an assembly.

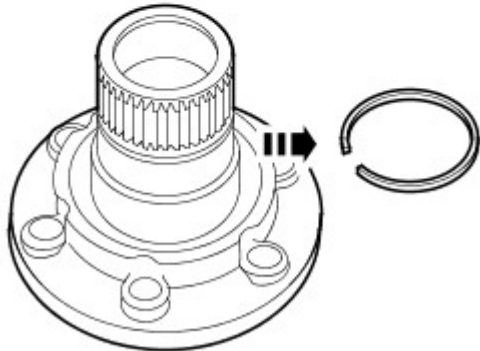
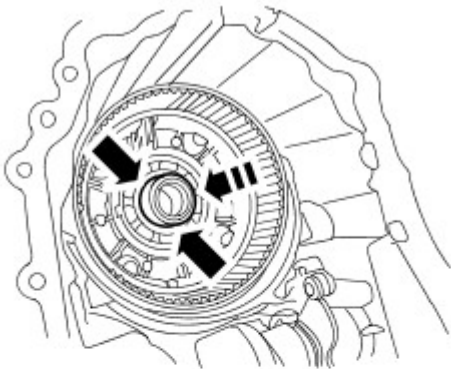
Remove the clutch, chain and sprocket.




E62669

11. Remove the rear output flange.

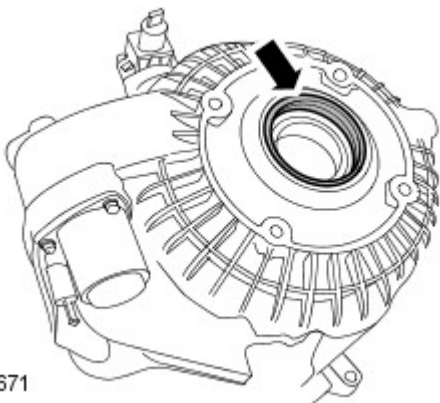
- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



E62670

12.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

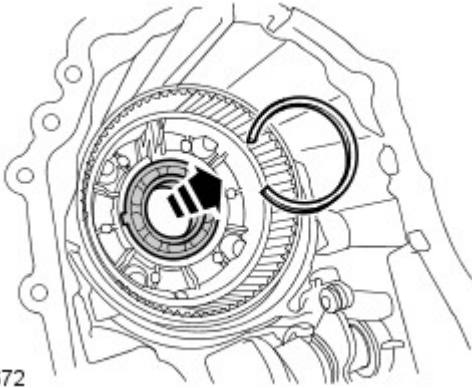
Remove the output flange seal.



E62671

13. Remove the output flange bearing.

- Remove the circlip.



14. Release the front half of the transfer case from the flat surface.

- Remove the 2 bolts.

Installation

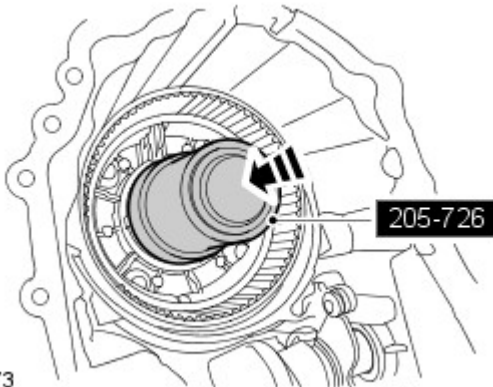
1. Remove the sealant from the transfer case mating faces.

2. Clean the magnetic filter.

3.  **CAUTION:** The chamfer on the bearing inner track must face the seal.

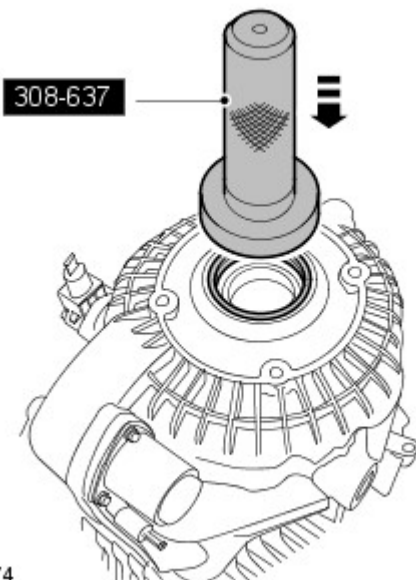
Using the special tool, install the output flange bearing.

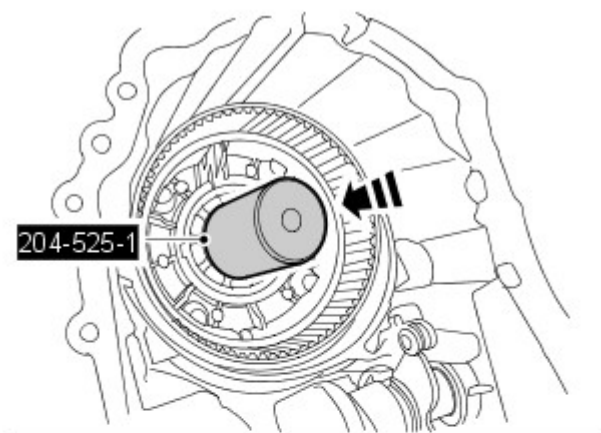
- Clean the components mating faces.
- Install the circlip.



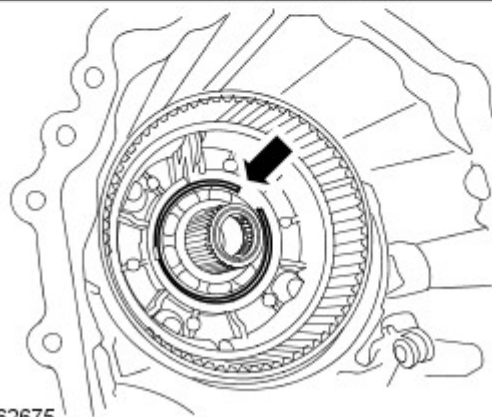
4. Using the special tool, install a new oil seal.

- Clean the component mating faces.
- Grease the new seal.






E62675



5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

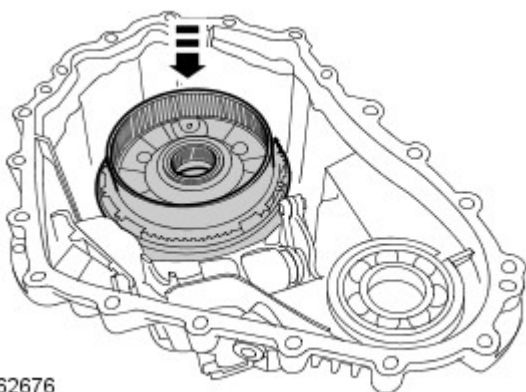
- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

6. Secure the rear half of the transfer case with its rear face down on a flat surface.

7. NOTE: Rotate the differential to engage the splines.

Install the differential module.

- Clean the components.
- Install the spacer.



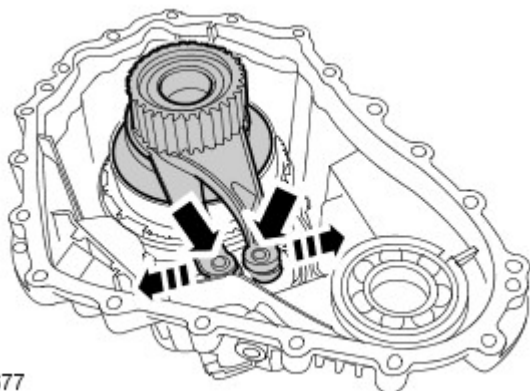
E62676

8. NOTE: Rotate the assembly to engage the clutch plates.

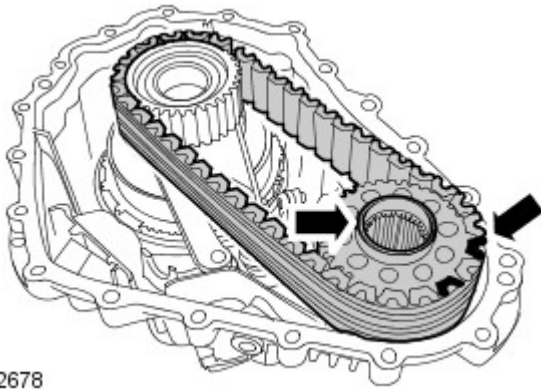
• NOTE: Use circlip pliers to open the actuator levers.

Install the clutch.

- Clean the components.
- Engage the actuator levers.



E62677



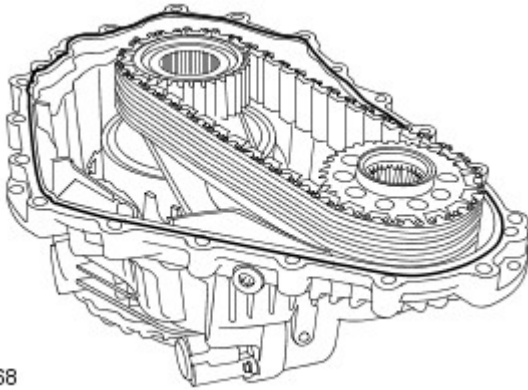
E62678

9.  CAUTION: The dark links in the chain face up as shown.

• NOTE: The relieved splined inner diameter of the sprocket must face up as shown.

Install the chain and sprocket.

- Clean the components.



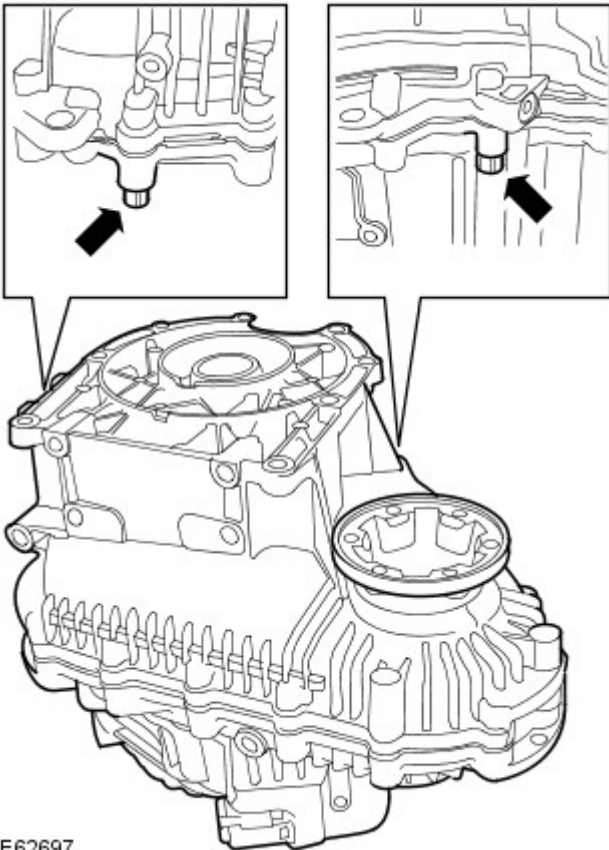
E62568

10. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

- Clean the component mating faces.
- Clean the dowels and dowel holes.

11. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



E62697

12. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

13. Install the shift motor.

14. Install the transfer case from the flat


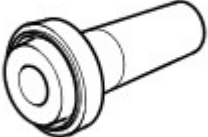

For additional information, refer to: [Transfer Case - V6 4.0L Petrol \(308-07B Transfer Case, Removal\)](#).

- Remove the 2 bolts.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).


- 16.** Refill the transfer case with the recommended fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
- 17.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer Case Rear Output Shaft Seal V8 5.0L Petrol

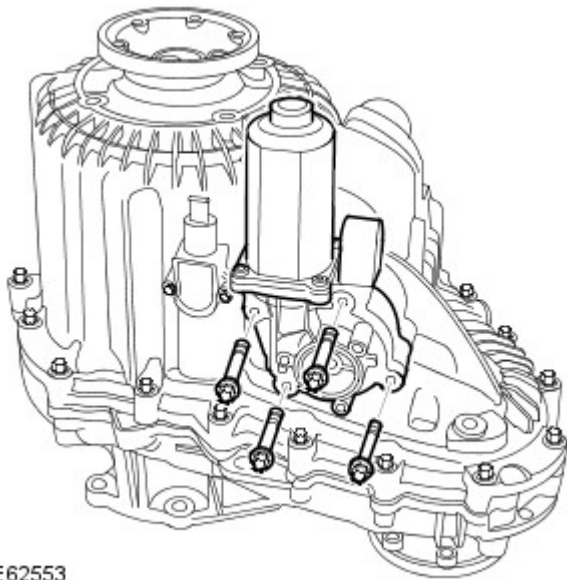
In-vehicle Repair

Special Tool(s)	
 <p>205-726 E63175</p>	Remover/installer 205-726(LRT-54-015)
 <p>308-637 E55697</p>	Seal installer 308-637
 <p>204-525-1 E49576</p>	Installer 204-525/1

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - V8 5.0L Petrol](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

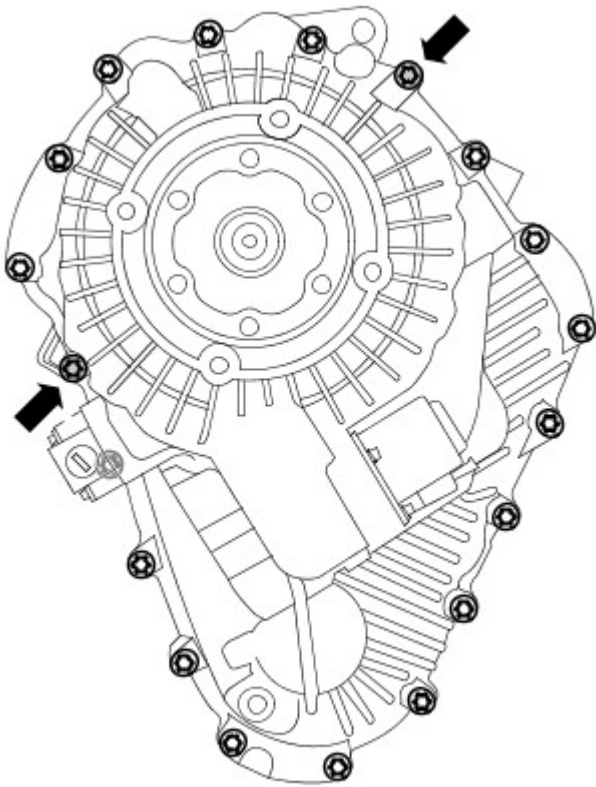


E62553

6.  **WARNING:** Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.

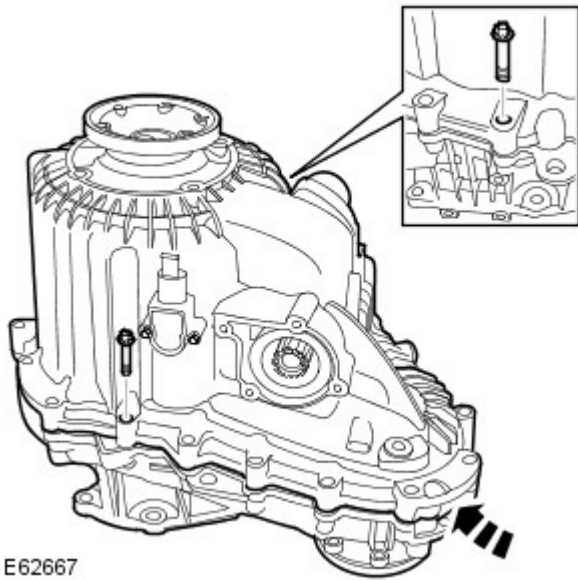


E62554

7.  **WARNING:** Eye protection must be worn.

Remove 17 Torx bolts securing the transfer casings.

- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.



E62667

8.  **WARNING:** Eye protection must be worn.

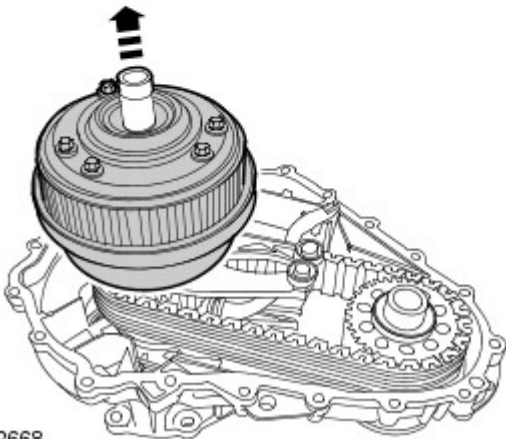
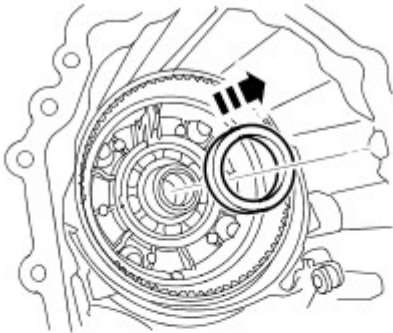
 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the rear half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.

9. Remove the differential module.

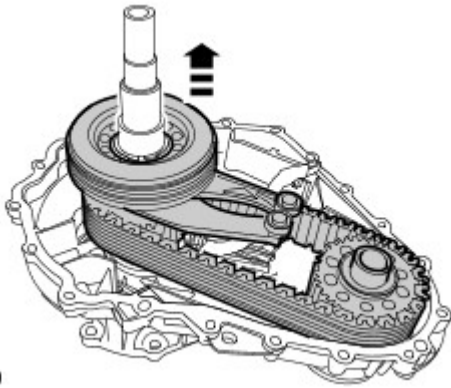
- Remove the spacer.



E62668

10. NOTE: Remove as an assembly.

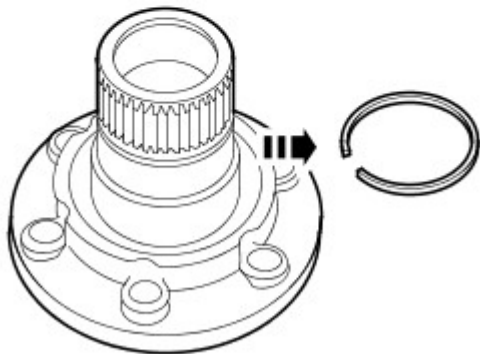
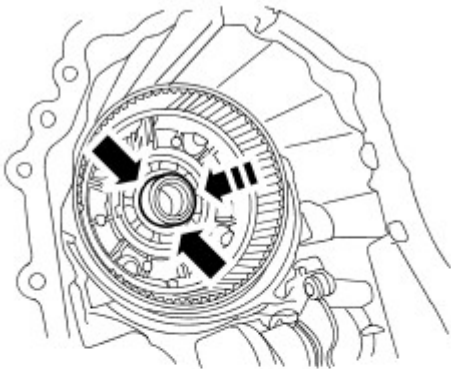
Remove the clutch, chain and sprocket.




E62669

11. Remove the rear output flange.

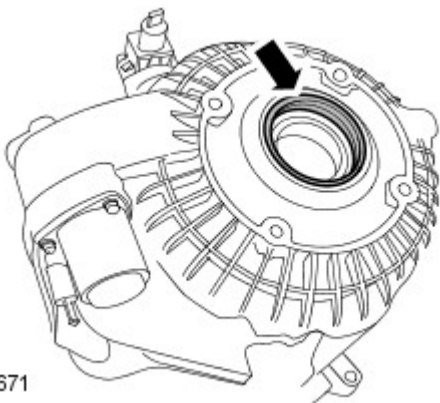
- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



E62670

12.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

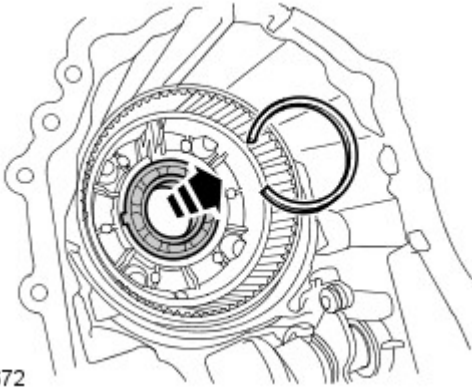
Remove the output flange seal.



E62671

13. Remove the output flange bearing.

- Remove the circlip.



E62672

14. Release the front half of the transfer case from the flat surface.

- Remove the 2 bolts.

Installation

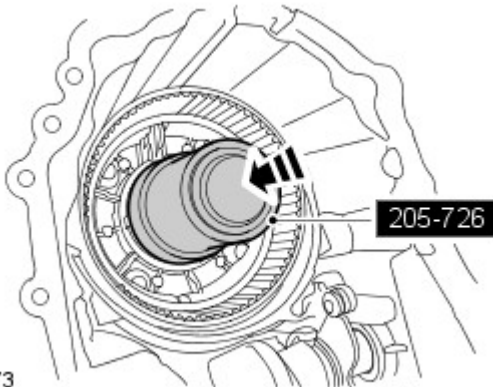
1. Remove the sealant from the transfer case mating faces.

2. Clean the magnetic filter.

3.  **CAUTION:** The chamfer on the bearing inner track must face the seal.

Using the special tool, install the output flange bearing.

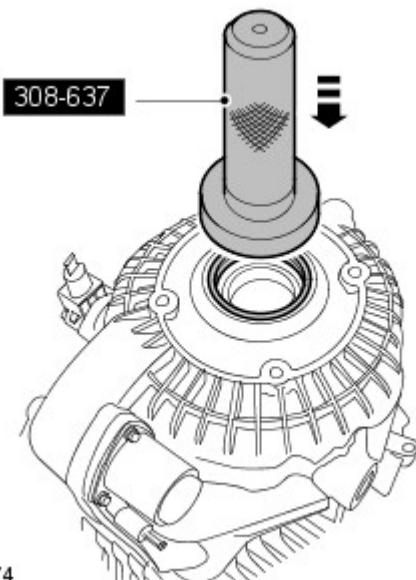
- Clean the components mating faces.
- Install the circlip.



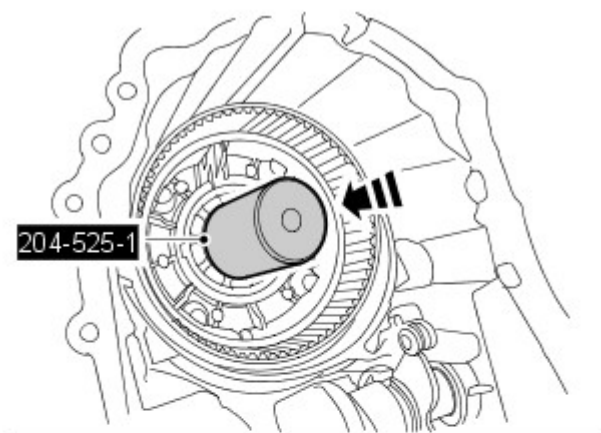
E62673

4. Using the special tool, install a new oil seal.

- Clean the component mating faces.
- Grease the new seal.





E62674



E62675

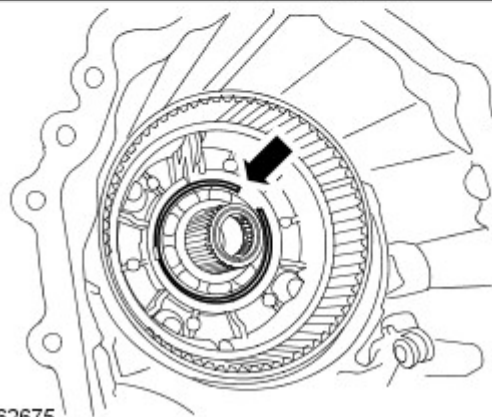
5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

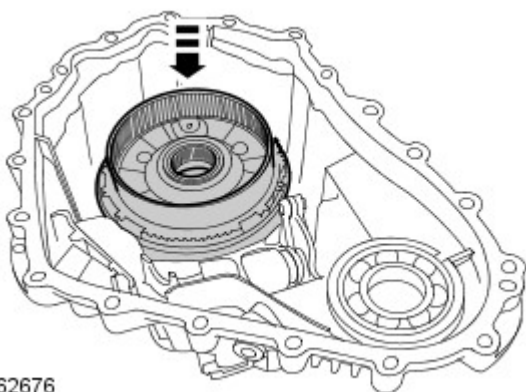


6. Secure the rear half of the transfer case with its rear face down on a flat surface.

7. NOTE: Rotate the differential to engage the splines.

Install the differential module.

- Clean the components.
- Install the spacer.



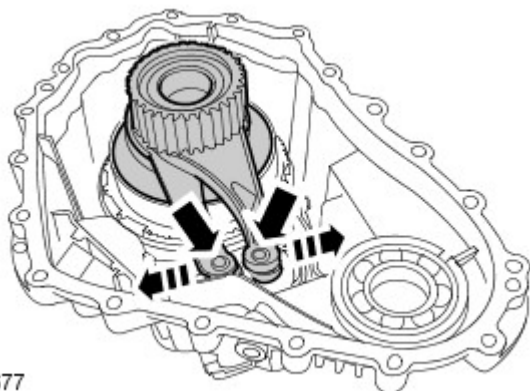
E62676

8. NOTE: Rotate the assembly to engage the clutch plates.

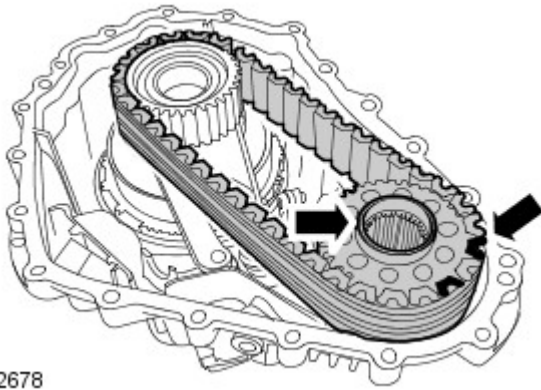
• NOTE: Use circlip pliers to open the actuator levers.

Install the clutch.

- Clean the components.
- Engage the actuator levers.



E62677



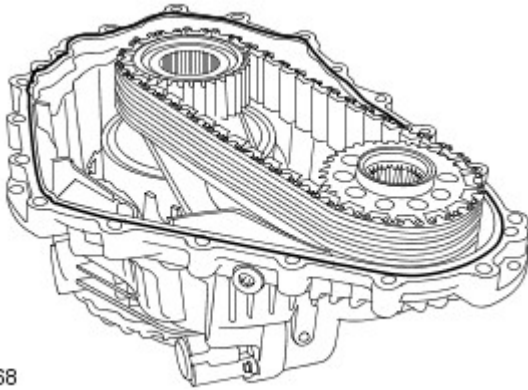
E62678

9.  CAUTION: The dark links in the chain face up as shown.

• NOTE: The relieved splined inner diameter of the sprocket must face up as shown.

Install the chain and sprocket.

- Clean the components.



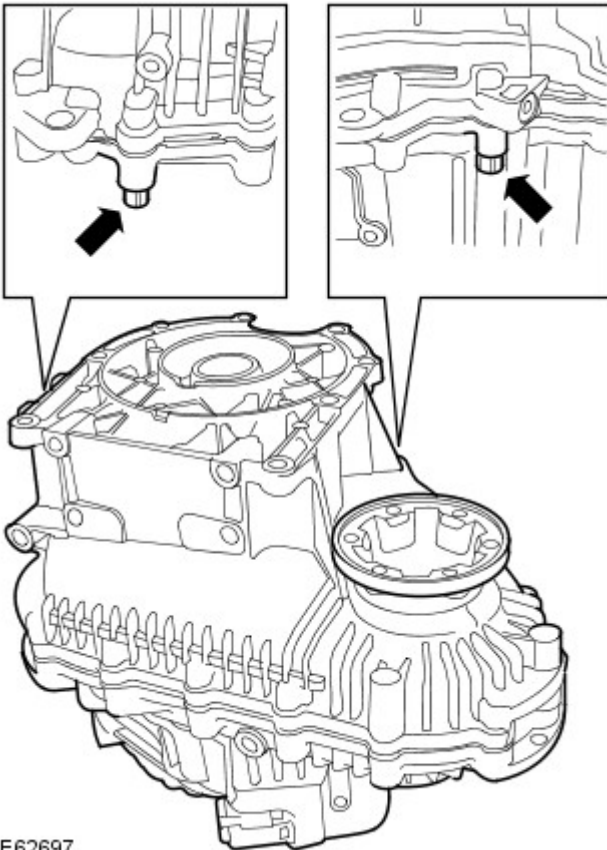
E62568

10. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

- Clean the component mating faces.
- Clean the dowels and dowel holes.

11. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



E62697

12. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

13. Install the shift motor.


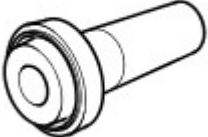

14. Install the transfer case from the flat surface of the component. For additional information, refer to: [Transfer Case - V8 5.0L Petrol \(308-07B Transfer Case, Removal\)](#).

- Remove the 2 bolts.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).


- 16.** Refill the transfer case with the recommended fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
- 17.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer Case Rear Output Shaft SealTDV6 2.7L Diesel

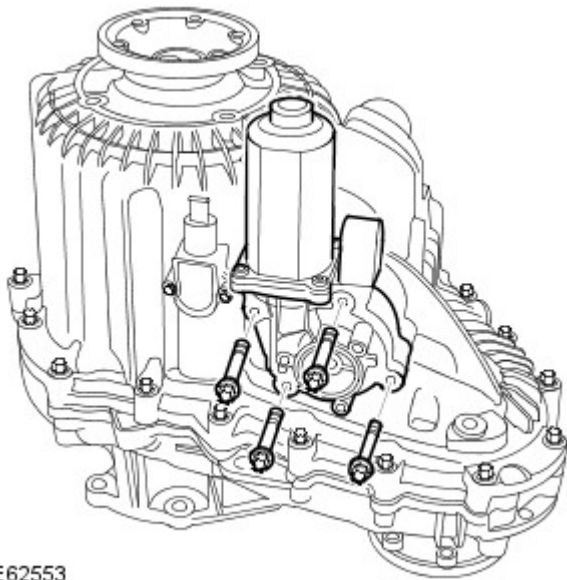
In-vehicle Repair

Special Tool(s)	
 <p>205-726 E63175</p>	Remover/installer (LRT-54-015) 205-726
 <p>308-637 E55697</p>	Seal installer 308-637
 <p>204-525-1 E49576</p>	Installer 204-525/1

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

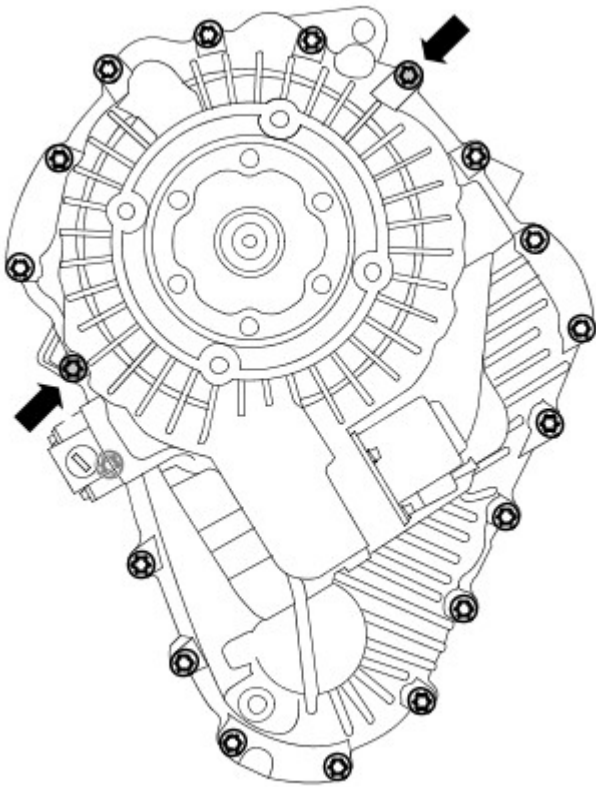


E62553

6.  **WARNING:** Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.

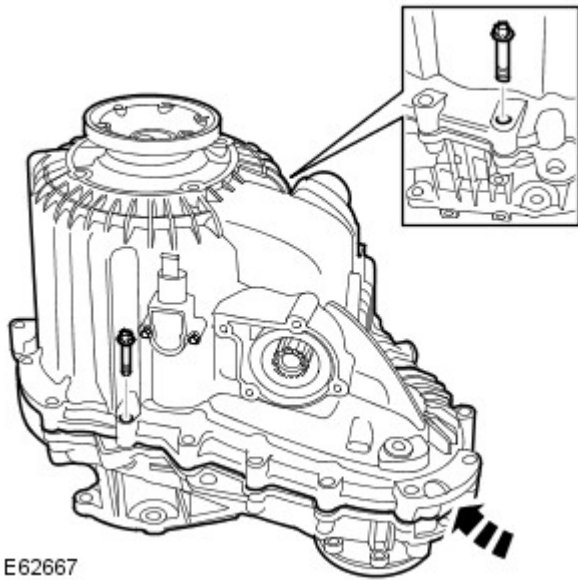


E62554

7.  **WARNING:** Eye protection must be worn.


Remove 17 Torx bolts securing the transfer casings.

- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.



E62667

8.  **WARNING:** Eye protection must be worn.

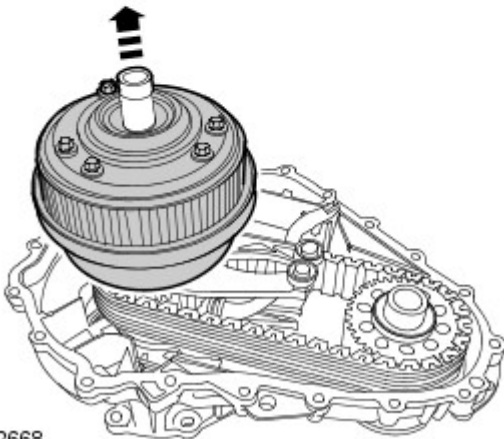
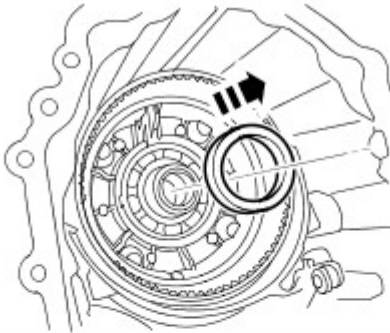
 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the rear half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.

9. Remove the differential module.

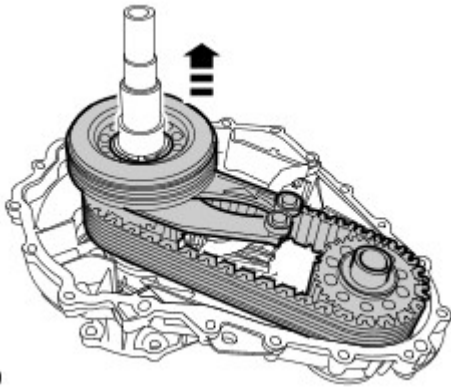
- Remove the spacer.



E62668

10. NOTE: Remove as an assembly.

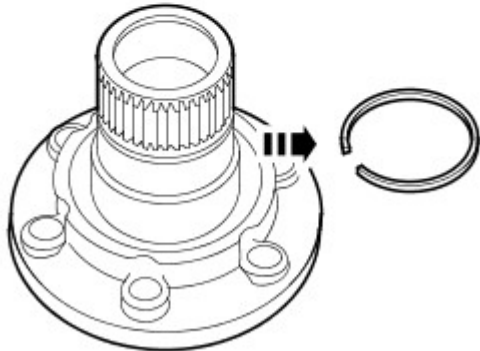
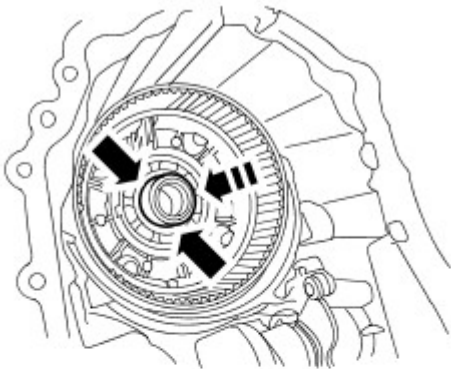
Remove the clutch, chain and sprocket.




E62669

11. Remove the rear output flange.

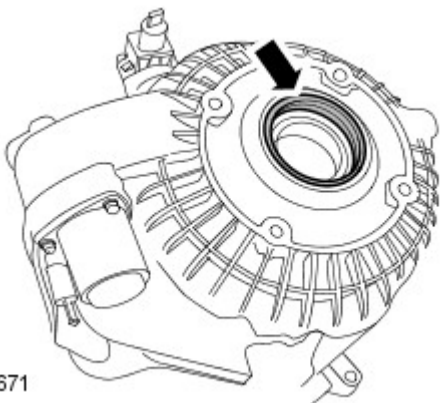
- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



E62670

12.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

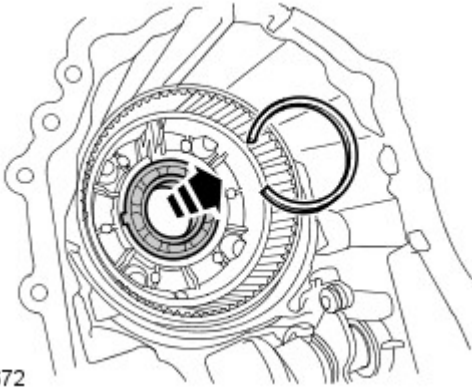
Remove the output flange seal.



E62671

13. Remove the output flange bearing.

- Remove the circlip.



E62672

14. Release the front half of the transfer case from the flat surface.

- Remove the 2 bolts.

Installation

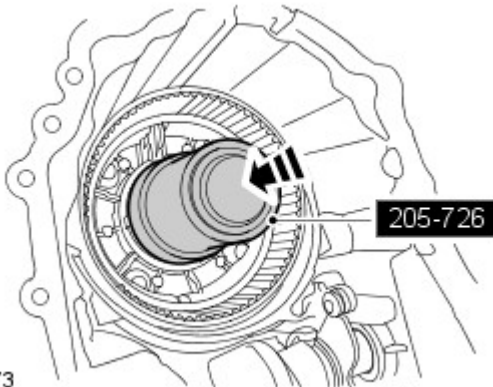
1. Remove the sealant from the transfer case mating faces.

2. Clean the magnetic filter.

3.  **CAUTION:** The chamfer on the bearing inner track must face the seal.

Using the special tool, install the output flange bearing.

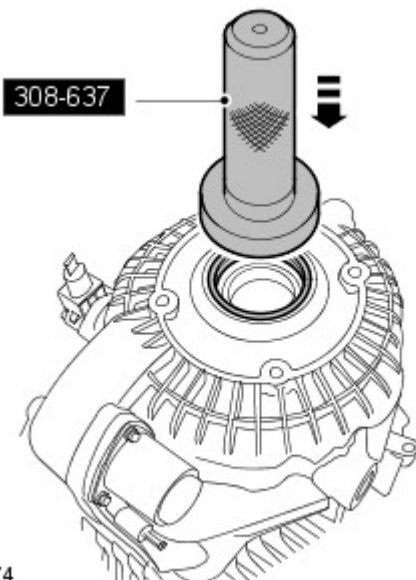
- Clean the components mating faces.
- Install the circlip.



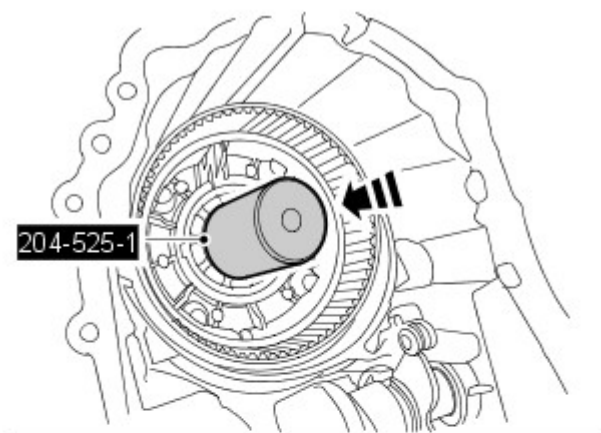
E62673

4. Using the special tool, install a new oil seal.

- Clean the component mating faces.
- Grease the new seal.





E62674



E62675

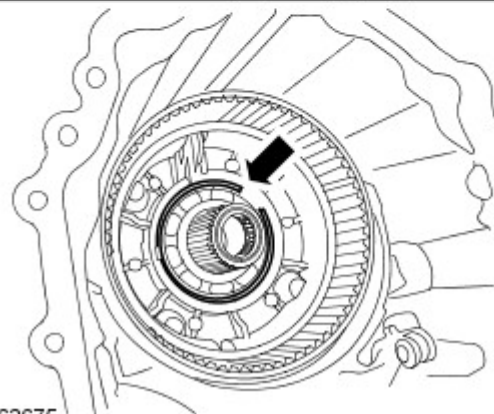
5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

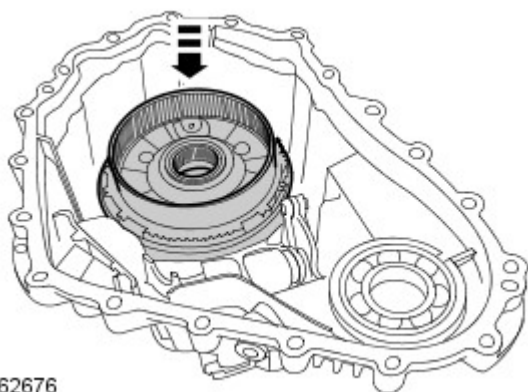


6. Secure the rear half of the transfer case with its rear face down on a flat surface.

7. NOTE: Rotate the differential to engage the splines.

Install the differential module.

- Clean the components.
- Install the spacer.



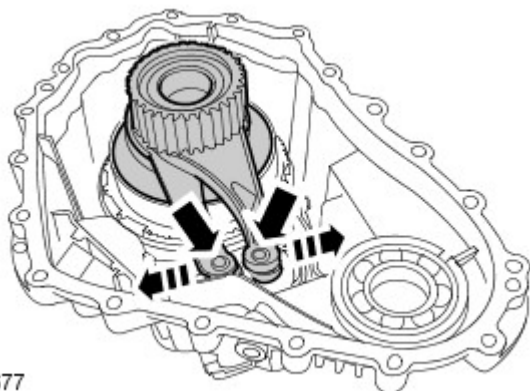
E62676

8. NOTE: Rotate the assembly to engage the clutch plates.

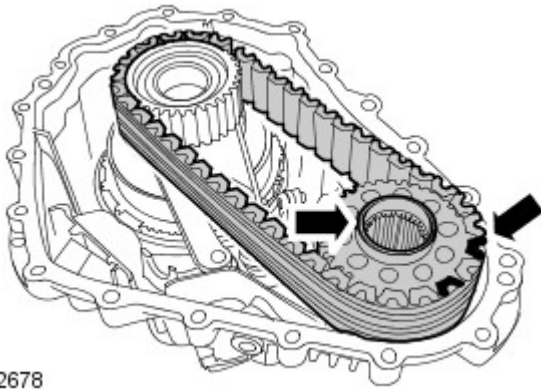
• NOTE: Use circlip pliers to open the actuator levers.

Install the clutch.

- Clean the components.
- Engage the actuator levers.



E62677



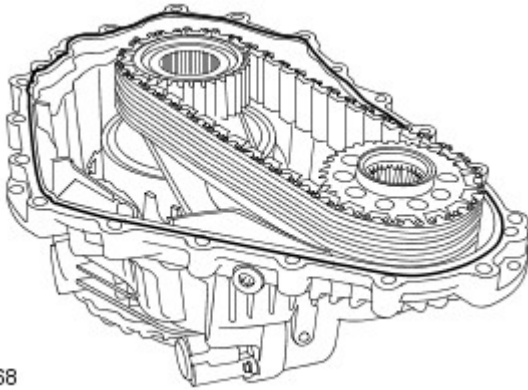
E62678

9.  CAUTION: The dark links in the chain face up as shown.

• NOTE: The relieved splined inner diameter of the sprocket must face up as shown.

Install the chain and sprocket.

- Clean the components.



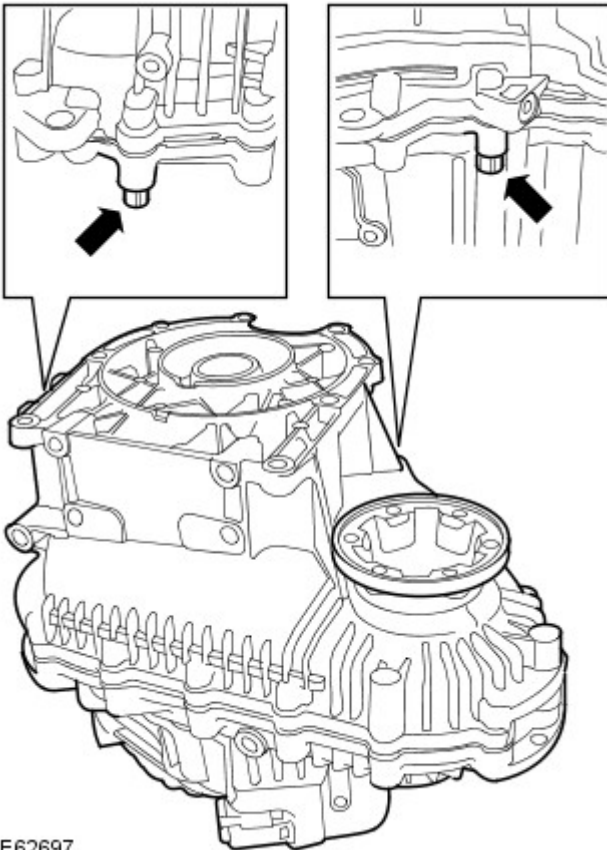
E62568

10. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

- Clean the component mating faces.
- Clean the dowels and dowel holes.

11. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



E62697

12. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

13. Install the shift motor.

14. Install the transfer case from the flat




For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel \(308-07B Transfer Case, Removal\)](#).

- Remove the 2 bolts.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).


- 16.** Refill the transfer case with the recommended fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
- 17.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer Case Rear Output Shaft Seal TDV6 3.0L Diesel

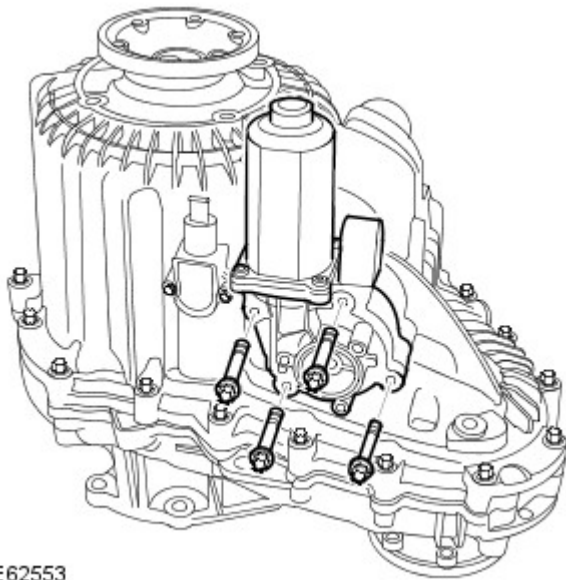
In-vehicle Repair

Special Tool(s)	
 <p>205-726 E63175</p>	Remover/installer 205-726(LRT-54-015)
 <p>308-637 E55697</p>	Seal installer 308-637
 <p>204-525-1 E49576</p>	Installer 204-525/1

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Drain the transfer case fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
4. Remove the transfer case.
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel](#) (308-07B Transfer Case, Removal).
5. With assistance, secure the transfer case with its transmission mating face down on a flat surface.
 - Secure with 2 bolts.

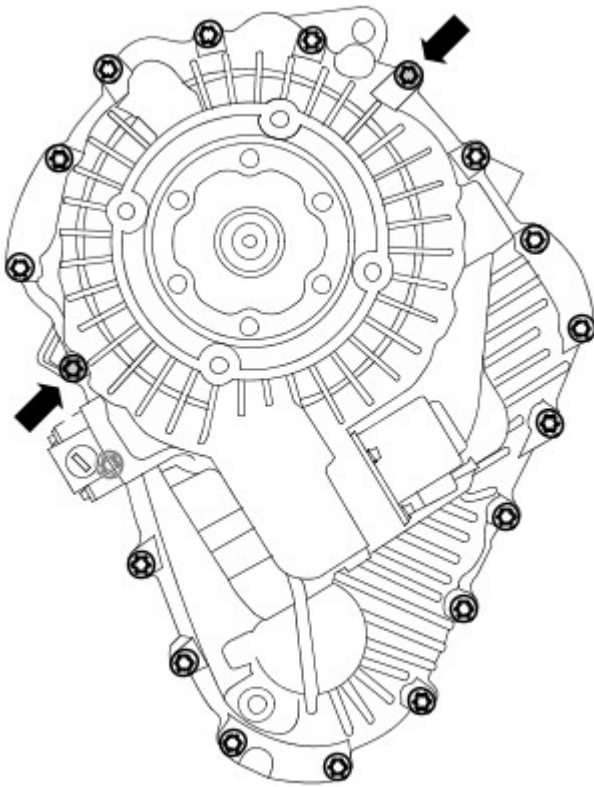


E62553

6.  WARNING: Eye protection must be worn.

Remove the shift motor.

- Remove the 4 bolts.
- Remove any debris from the bolt holes.

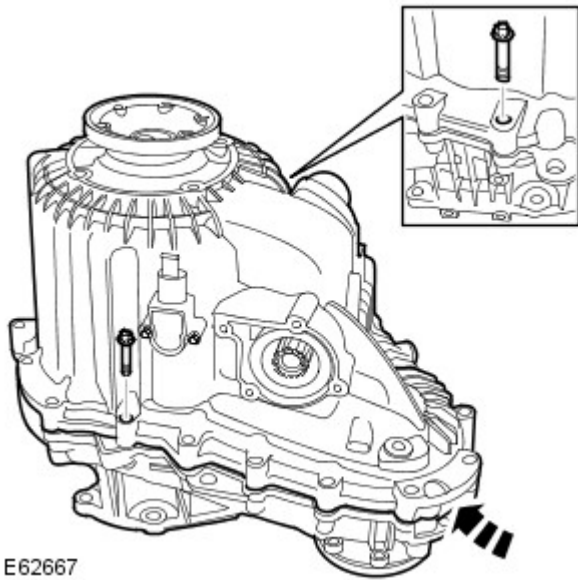


E62554

7.  WARNING: Eye protection must be worn.

Remove 17 Torx bolts securing the transfer casings.

- The two bolts indicated remain fully tightened.
- Remove any debris from the bolt holes.



E62667

8.  **WARNING:** Eye protection must be worn.

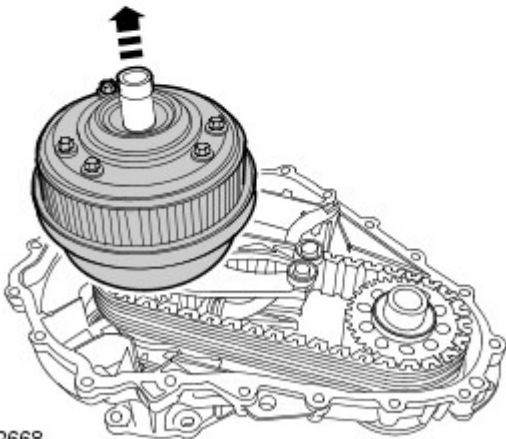
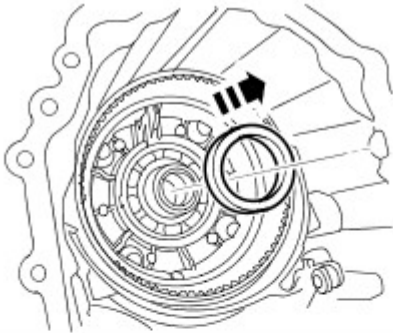
 **CAUTION:** Care must be taken to avoid damage to the mating surfaces.

Remove the rear half of the transfer case.

- Remove the remaining 2 Torx bolts.
- Remove any debris from the bolt holes.
- Use a soft faced mallet.

9. Remove the differential module.

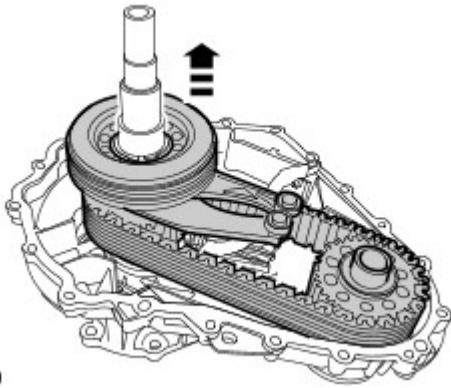
- Remove the spacer.



E62668

10. NOTE: Remove as an assembly.

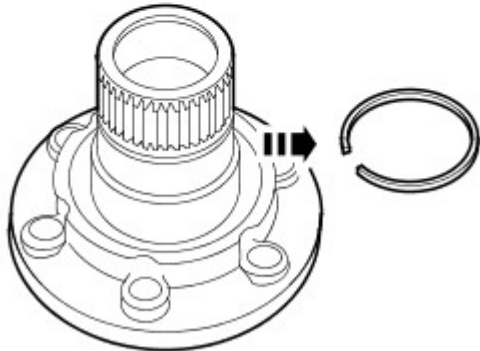
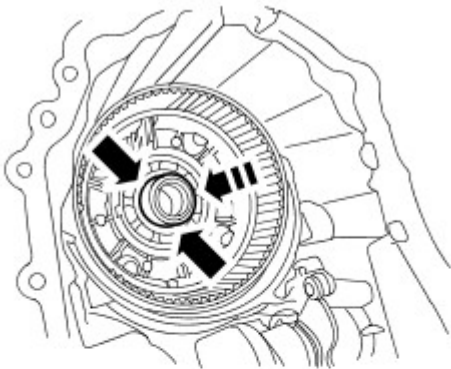
Remove the clutch, chain and sprocket.




E62669

11. Remove the rear output flange.

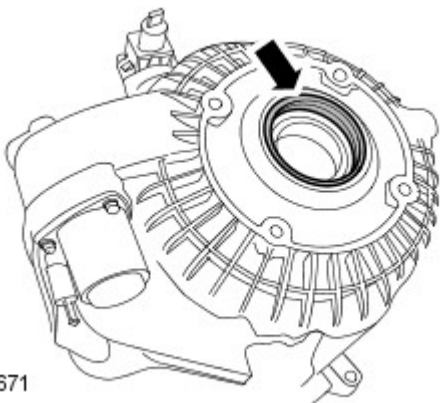
- Compress the snap ring.
- Press the flange through the bearing.
- Remove and discard the snap ring.



E62670

12.  CAUTION: Care must be taken to avoid damage to the seal register and running surface.

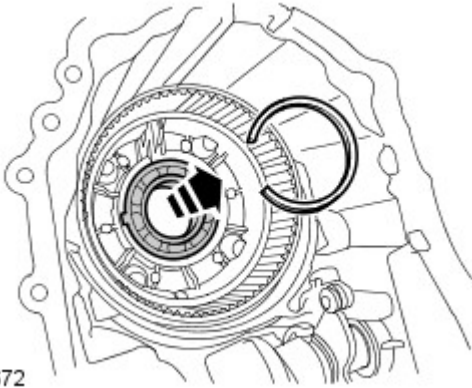
Remove the output flange seal.



E62671

13. Remove the output flange bearing.

- Remove the circlip.



E62672

14. Release the front half of the transfer case from the flat surface.

- Remove the 2 bolts.

Installation

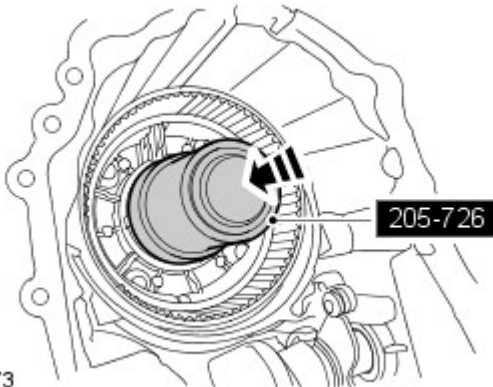
1. Remove the sealant from the transfer case mating faces.

2. Clean the magnetic filter.

3.  **CAUTION:** The chamfer on the bearing inner track must face the seal.

Using the special tool, install the output flange bearing.

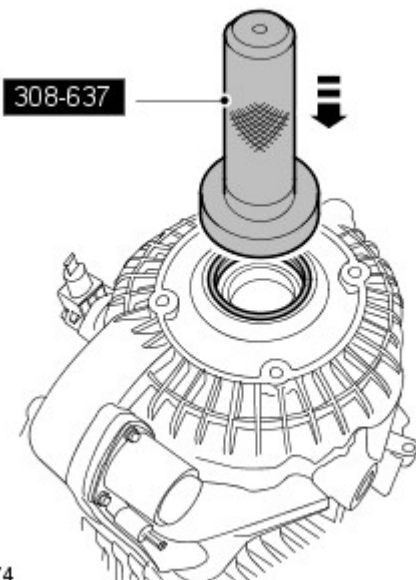
- Clean the components mating faces.
- Install the circlip.



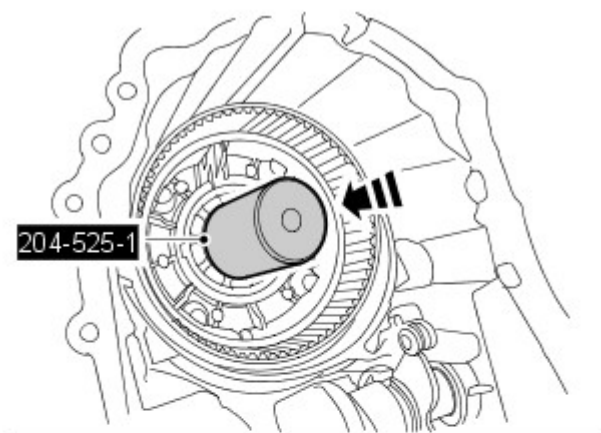
E62673

4. Using the special tool, install a new oil seal.

- Clean the component mating faces.
- Grease the new seal.





E62674



E62675

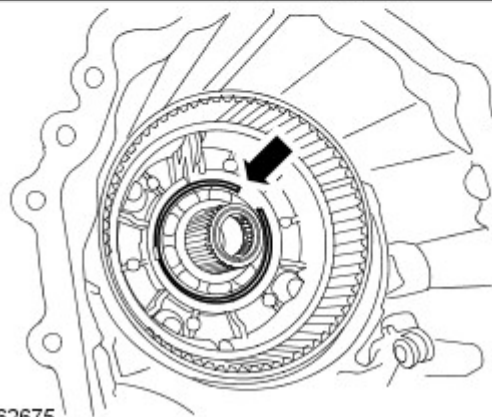
5. CAUTIONS:

 Centralise the snap ring in the snap ring groove before installing the output flange.

 Extreme care is necessary to make sure the snap ring enters the bearing squarely.

Using the special tool and with assistance, install the drive flange.

- Clean the component mating faces.
- Install a new snap ring.
- Make sure the snap ring is fully engaged and retains the drive flange.

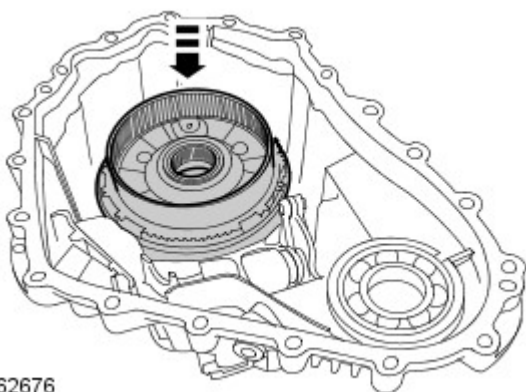


6. Secure the rear half of the transfer case with its rear face down on a flat surface.

7. NOTE: Rotate the differential to engage the splines.

Install the differential module.

- Clean the components.
- Install the spacer.



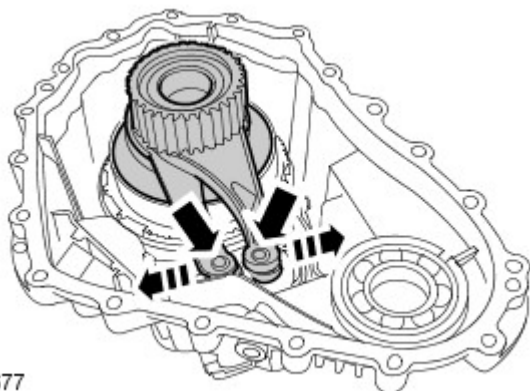
E62676

8. NOTE: Rotate the assembly to engage the clutch plates.

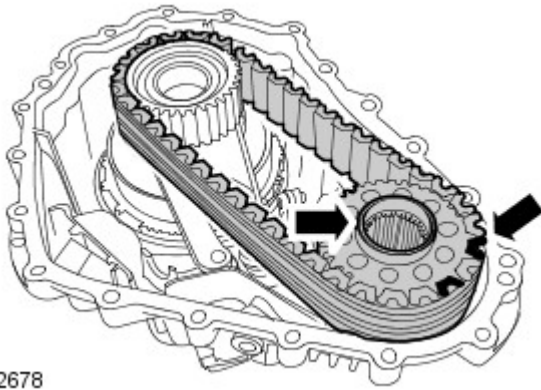
• **NOTE:** Use circlip pliers to open the actuator levers.

Install the clutch.

- Clean the components.
- Engage the actuator levers.



E62677



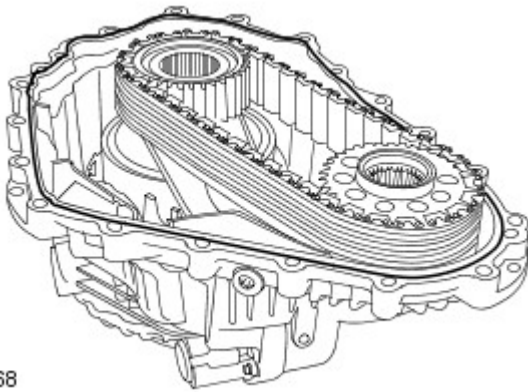
E62678

9.  CAUTION: The dark links in the chain face up as shown.

• NOTE: The relieved splined inner diameter of the sprocket must face up as shown.

Install the chain and sprocket.

- Clean the components.



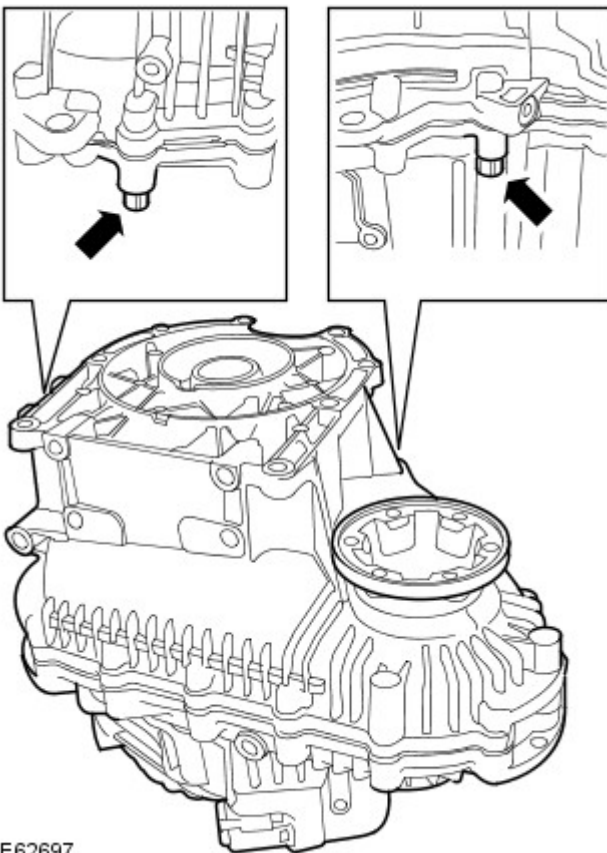
E62568

10. Apply a 2 mm bead of sealant to one surface of the transfer case mating face, as shown.

- Clean the component mating faces.
- Clean the dowels and dowel holes.

11. Install the front half of the transfer case.

- Evenly tighten the 2 Torx bolts shown to 35 Nm (26 lb.ft).



E62697

12. Tighten the remaining Torx bolts to 35 Nm (26 lb.ft).

13. Install the shift motor.

14. Install the transfer case from the flat

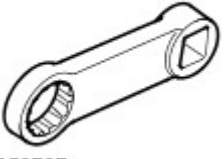
For additional information, refer to: [Transfer Case - TDV6 3.0L Diesel \(308-07B Transfer Case, Removal\)](#).

- Remove the 2 bolts
- Tighten the Torx bolts to 25 Nm (18 lb.ft).

- 16.** Refill the transfer case with the recommended fluid.
For additional information, refer to: [Transfer Case Draining and Filling](#) (308-07B Transfer Case, General Procedures).
- 17.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Transfer Case - Transfer CaseTDV6 2.7L Diesel


Removal

Special Tool(s)	
 <p>303-1069</p> <p>E53727</p>	<p>Wrench adaptor</p> <p>303-1069</p>

Removal

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Raise and support the vehicle.

Vehicles with diesel particulate filter (DPF)

3. Remove the diesel particulate filter (DPF). For additional information, refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).

All vehicles

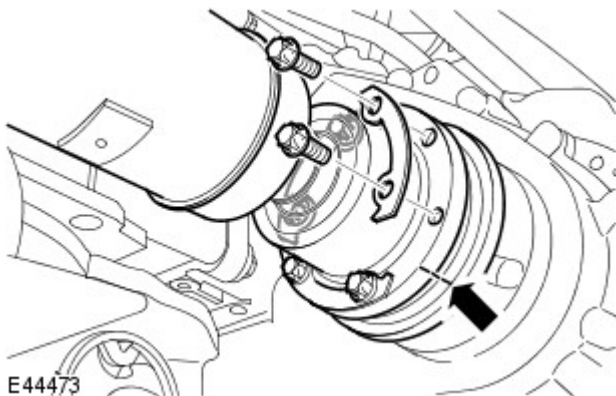
4. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).


5.  **CAUTION:** To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

- **NOTE:** Mark the position of the driveshaft on the transmission flange.

Release the front driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.
- Using a suitable tie strap, reposition and secure the driveshaft to the exhaust system.

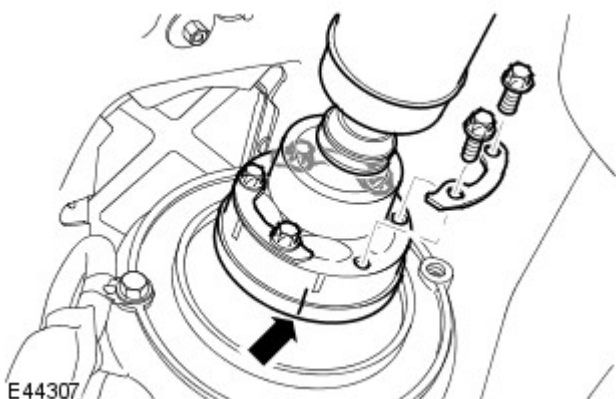


6.  **CAUTION:** To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

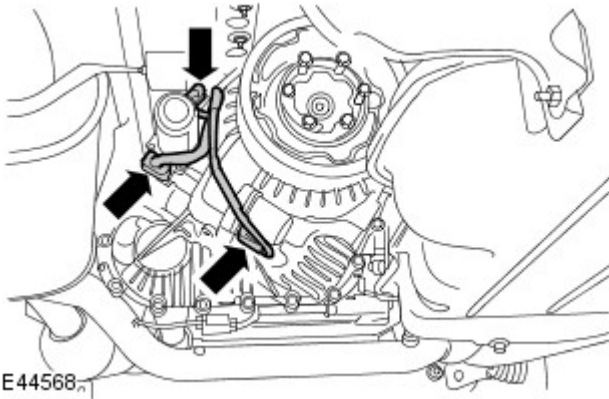
- **NOTE:** Mark the position of the driveshaft on the transmission flange.

Release the rear driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers.
- Using a suitable tie strap, secure the driveshaft.

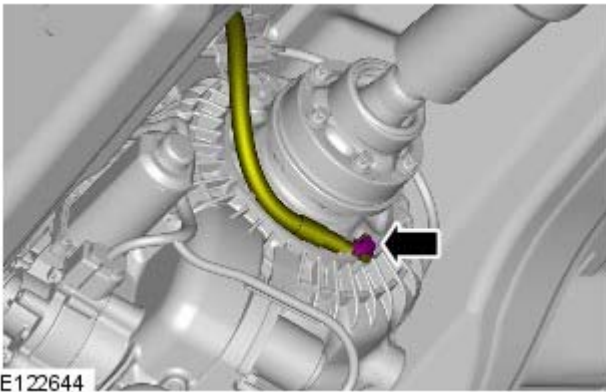


7. Disconnect the transfer case 3 electrical connectors.



8. Remove the ground cable from the transfer box.

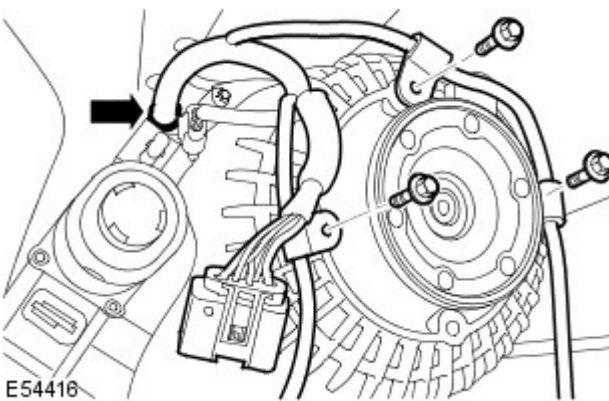
- Remove the bolt.



9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

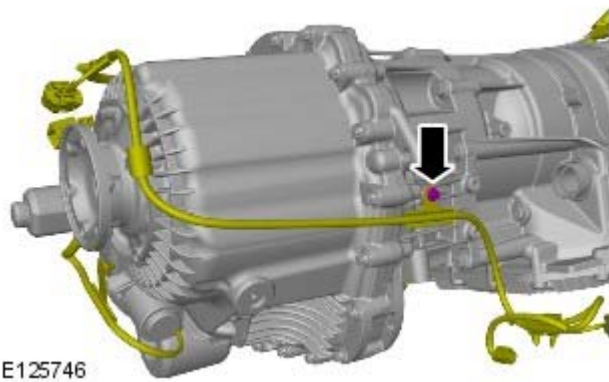
Release the wiring harness from the transfer case.

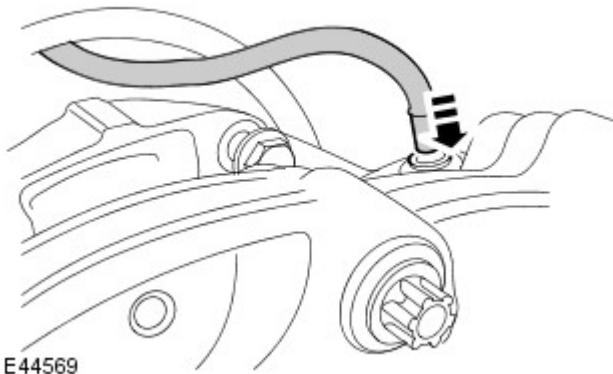
- Release the clip.
- Remove the 3 bolts.



10. Release the wiring harness from the transfer case.

- Remove the bolt.





11.  **CAUTION:** Always plug any open connections to prevent contamination.

Disconnect the breather line.

- Depress the locking ring.

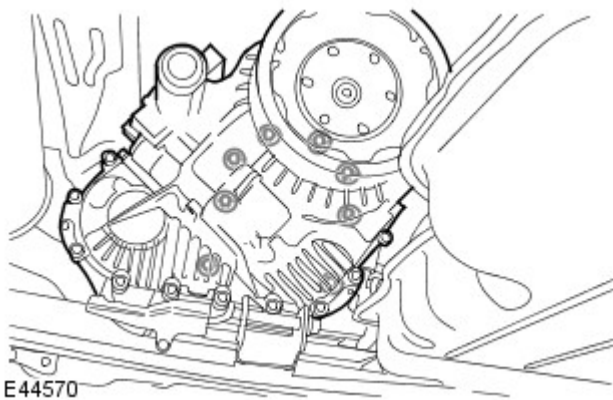
12.  **WARNING:** Secure the component to the transmission jack.

Using a transmission jack, support the transfer case.

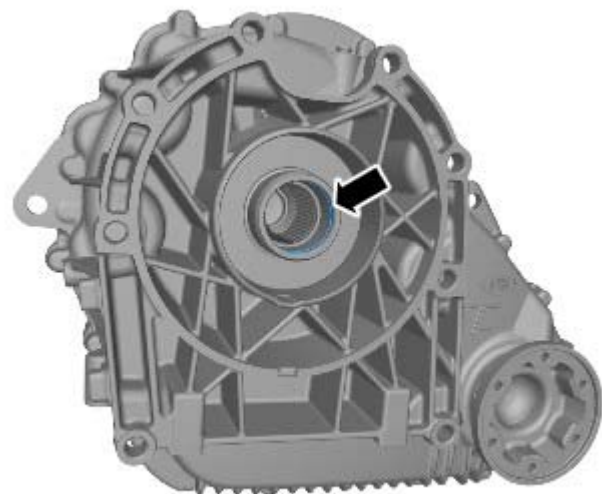
13.  **CAUTION:** Take extra care not to damage the wiring harnesses.

With assistance, remove the transfer case.

- Remove the 8 bolts.




14. Remove and discard the O-ring seal.



Transfer Case - Transfer CaseTDV6 3.0L Diesel

Removal


Special Tool(s)	
 <p>303-1069</p> <p>E53727</p>	<p>Wrench adaptor</p> <p>303-1069</p>

Removal

All vehicles

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

Vehicles with diesel particulate filter (DPF)

3. Remove the diesel particulate filter (DPF).
For additional information, refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

All vehicles

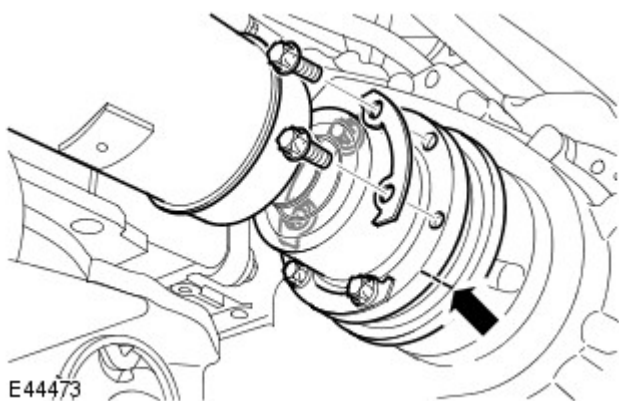
4. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

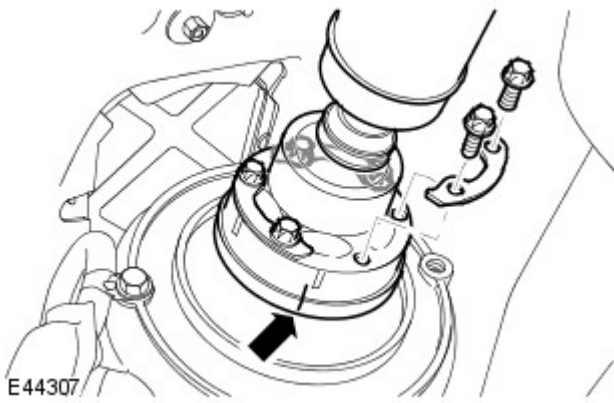
5.  **CAUTION:** To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.


- NOTE: Mark the position of the driveshaft on the transmission flange.

Release the front driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.
- Using a suitable tie strap, secure the driveshaft.



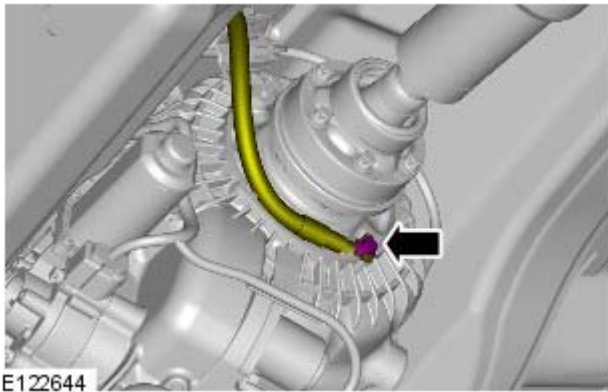


6.  **CAUTION:** To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

• **NOTE:** Mark the position of the driveshaft on the transmission flange.

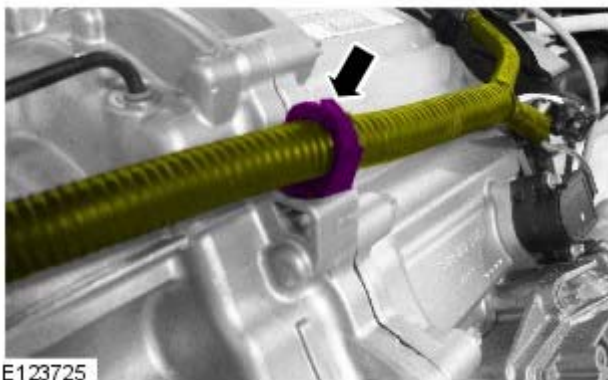
Release the rear driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers.
- Using a suitable tie strap, secure the driveshaft.

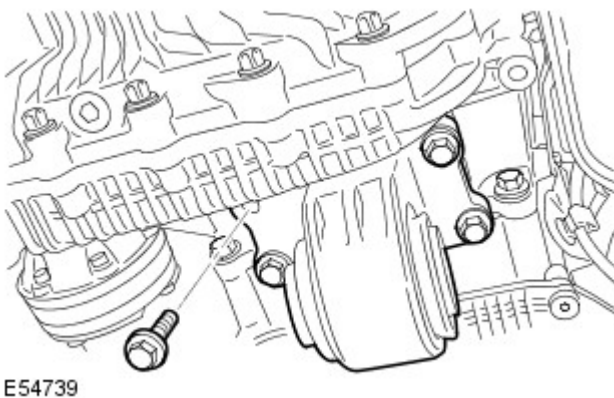


7. Remove the ground cable from the transfer box.

- Remove the bolt.



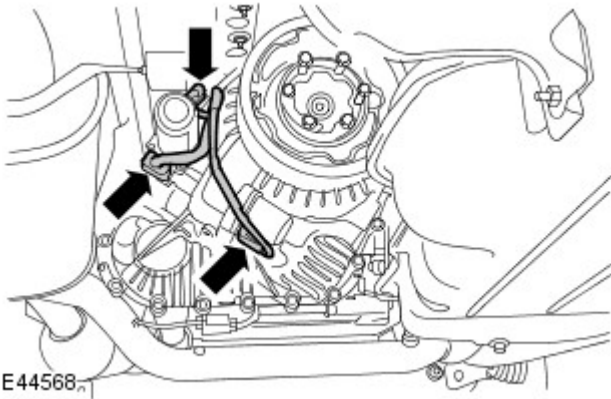
8. Release the transmission wiring harness retaining clip.



9. Remove the transmission support insulator.

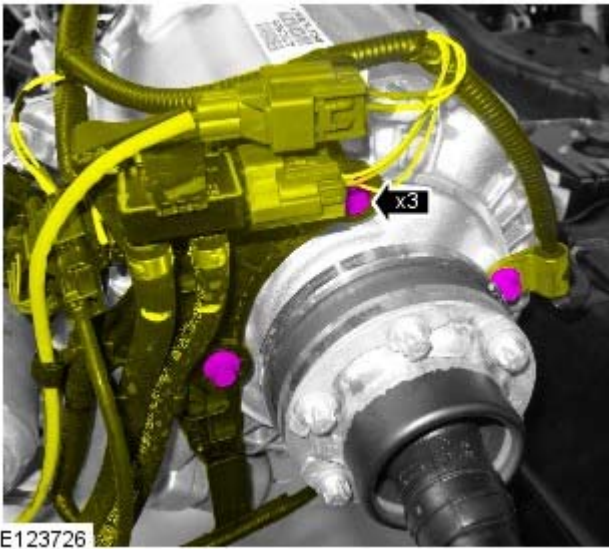
- Remove the 4 bolts.

10. Disconnect the transfer case 3 electrical connectors.



11. Release the wiring harness from the transfer case.

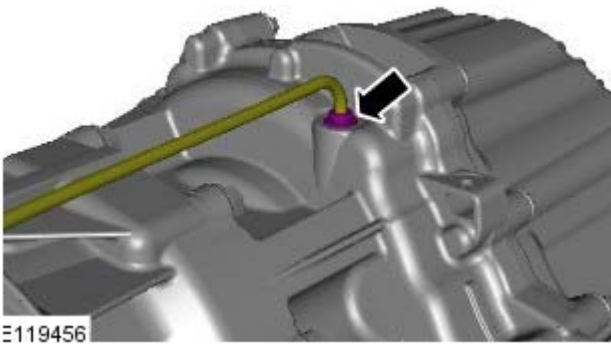
- Remove the 3 bolts.



12.  CAUTION: Always plug any open connections to prevent contamination.

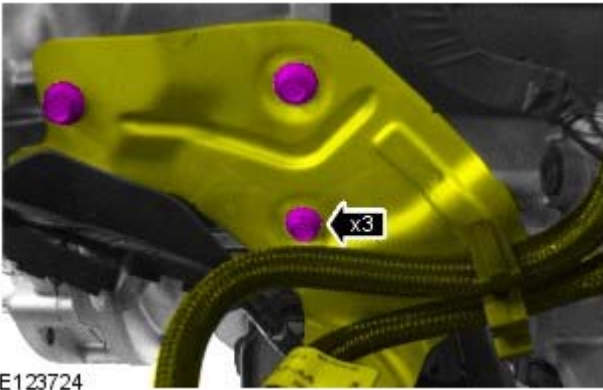
Disconnect the breather line.

- Depress the locking ring.



13. Release the fuel line support bracket.

- Remove the 3 bolts.



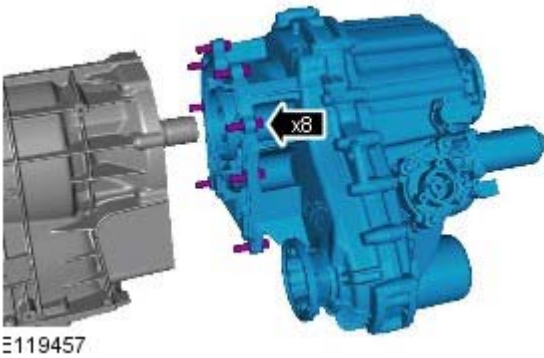
14. Support the transmission on a jack.

15.  **WARNING:** Secure the component to the transmission jack.

Using a transmission jack, support the transfer case.

16. With assistance, remove the transfer case.


- Remove the 8 bolts.
- Move the fuel hose support bracket aside.
- Remove the O-ring seal.



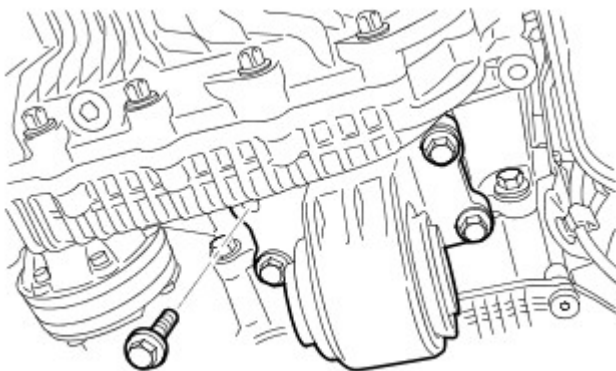
Transfer Case - Transfer Case V6 4.0L Petrol

Removal

Removal

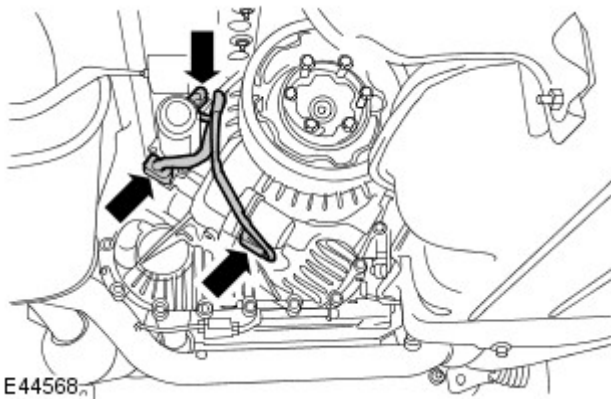
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the front driveshaft.
For additional information, refer to: [Front Driveshaft - V6 4.0L Petrol](#) (205-01 Driveshaft, Removal and Installation).
4. Remove the rear driveshaft.
For additional information, refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).
5. Remove the transmission support insulator.
 - Remove the 4 bolts.



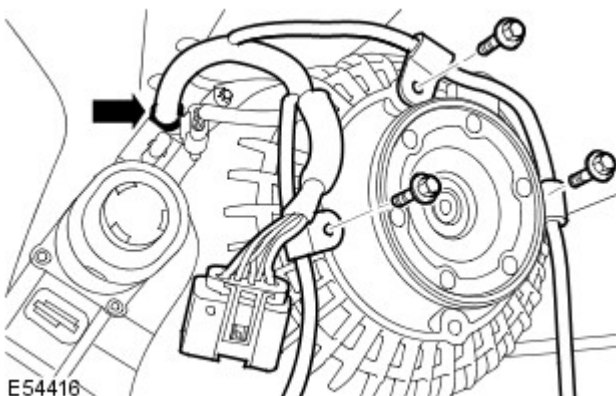
E54739

6. Disconnect the transfer case 3 electrical connections.

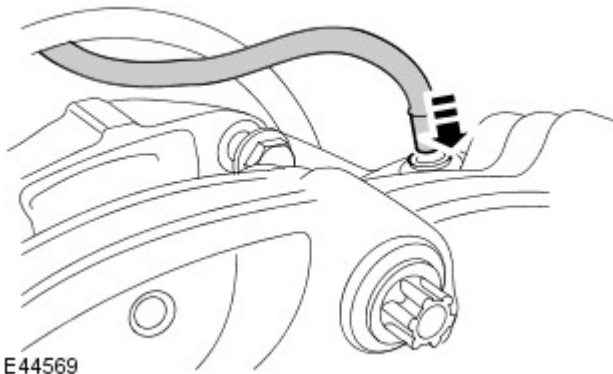


E44568

7. Release the wiring harness from the transfer case.
 - Remove the 3 bolts.
 - Release the clip.



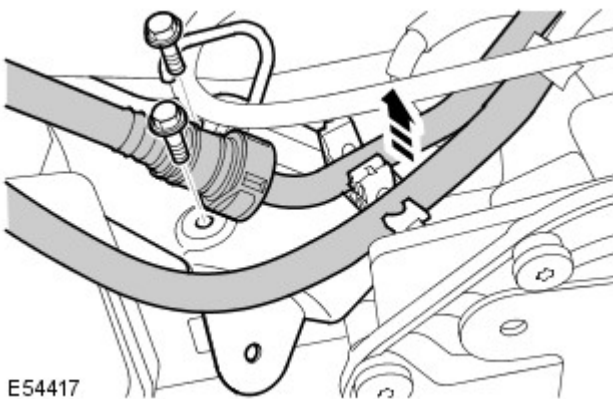
E54416



8.  **CAUTION:** Always plug any open connections to prevent contamination.

Disconnect the breather line.

- Depress the locking ring.



9. Release the fuel line support bracket.

- Release the fuel lines.
- Remove the 2 bolts.

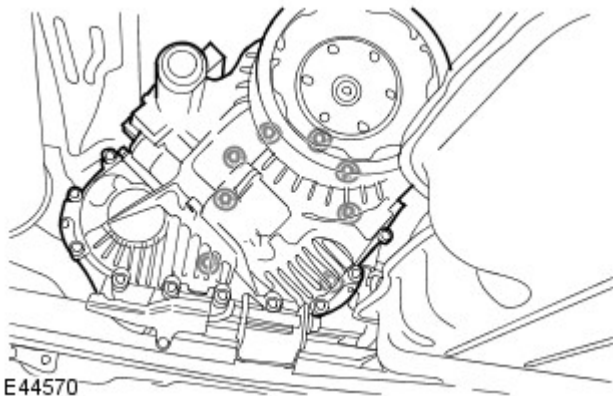
10. Support the transmission on a jack.

11.  **WARNING:** Secure the component to the transmission jack.

Using a transmission jack, support the transfer case.


12. With assistance, remove the transfer case.

- Remove the 8 bolts.
- Move the fuel hose support bracket aside.
- Remove the O-ring seal.




Transfer Case - Transfer Case V8 5.0L Petrol

Removal

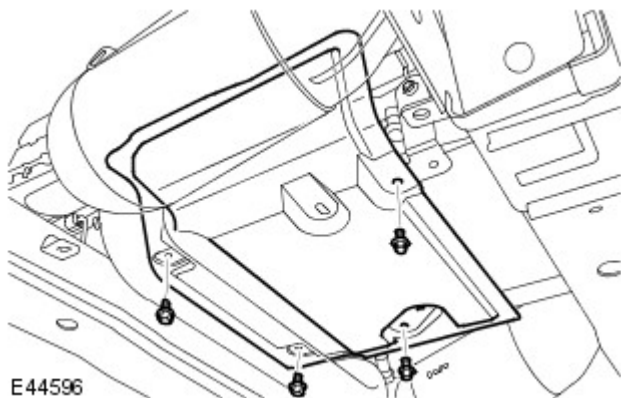
Special Tool(s)	
 <p>303-1069</p> <p>E53727</p>	<p>Wrench adaptor</p> <p>303-1069</p>

Removal

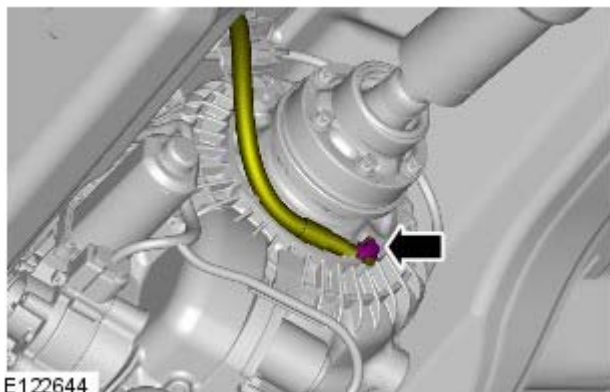
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

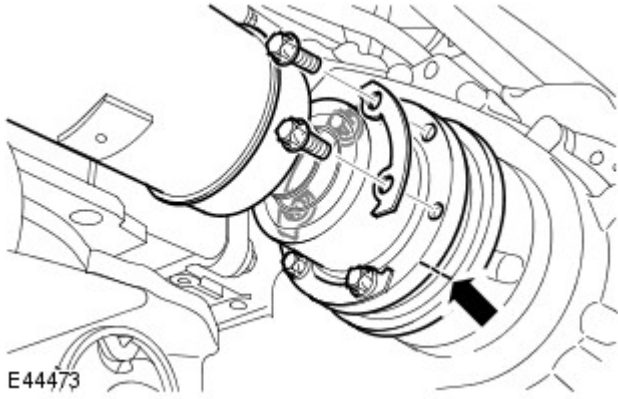
3. Remove the transmission heat shield.
 - Remove the 4 bolts.



4. Remove the ground cable from the transfer box.
 - Remove the bolt.



5. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).



E44473

6. CAUTIONS:

 Mark the position of the driveshaft flange in relation to the drive pinion flange.

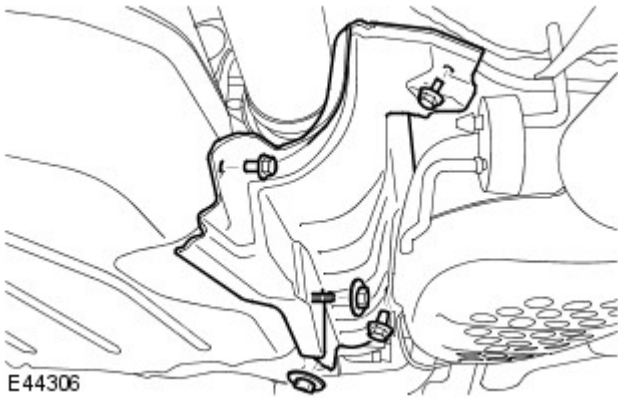
 To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the front driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers, discard the bolts.
- Using a suitable tie strap, reposition and secure the driveshaft to the exhaust system.

7. Remove the fuel tank heat shield.

- Remove the 3 bolts and 2 nuts.



E44306

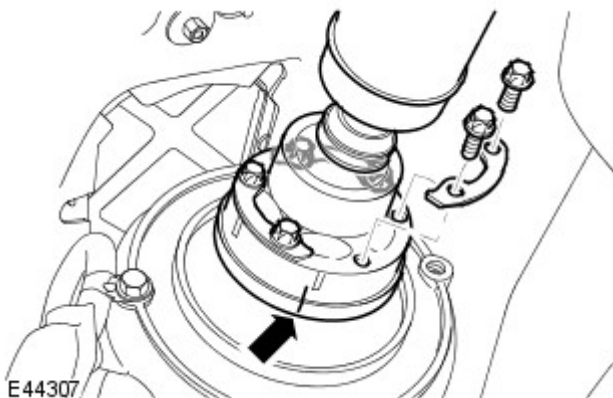
8. CAUTIONS:

 Mark the position of the driveshaft flange in relation to the drive pinion flange.


 To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

Release the rear driveshaft from the transfer case drive flange.

- Remove the 6 Torx bolts and washers.

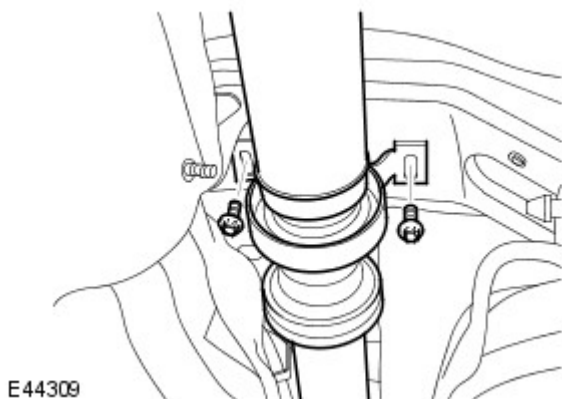


E44307

9.  CAUTION: To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

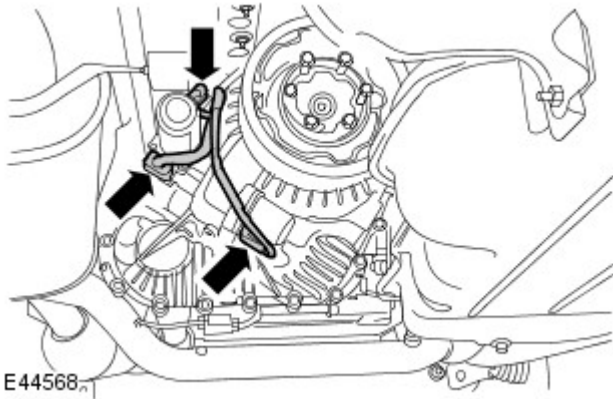
Release the driveshaft center bearing mount.

- Remove the 2 driveshaft center bearing mount bolts.
- Using suitable securing strap, reposition and support the driveshaft.



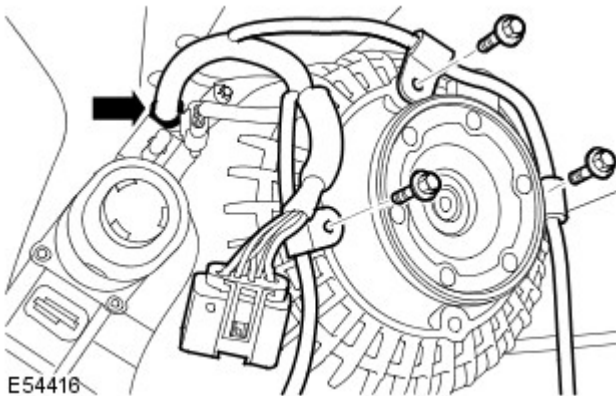
E44309

10. Disconnect the transfer case 3 electrical connectors.



11. Release the wiring harness from the transfer case.

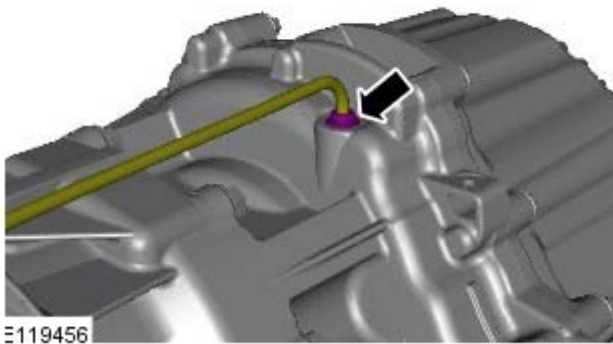
- Remove the 3 bolts.
- Release the clip.



12.  CAUTION: Always plug any open connections to prevent contamination.

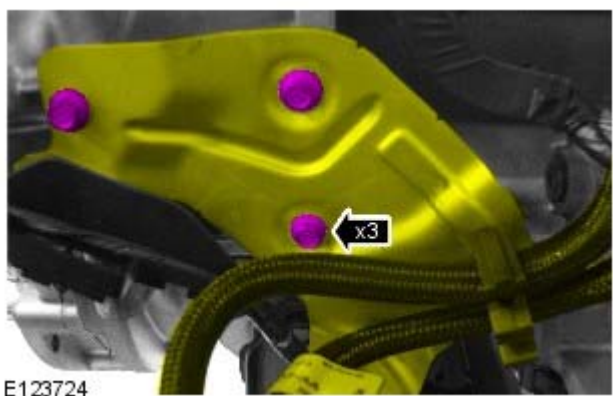
Disconnect the breather line.

- Depress the locking ring.



13. Release the fuel line support bracket.

- Remove the 3 bolts.



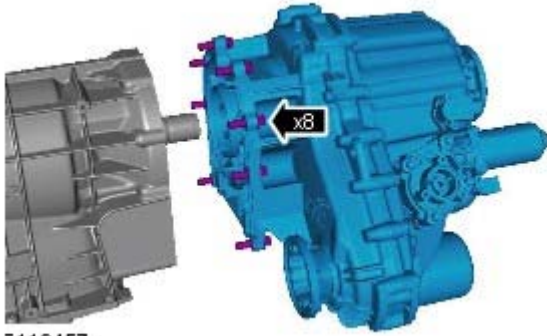
14. Support the transmission on a jack.

15.  WARNING: Secure the component to the transmission jack.

Using a transmission jack, support the transfer case.

16. With assistance, remove the transfer case.


- Remove the 8 bolts.
- Move the fuel hose support bracket aside.
- Remove the O-ring seal.



E119457

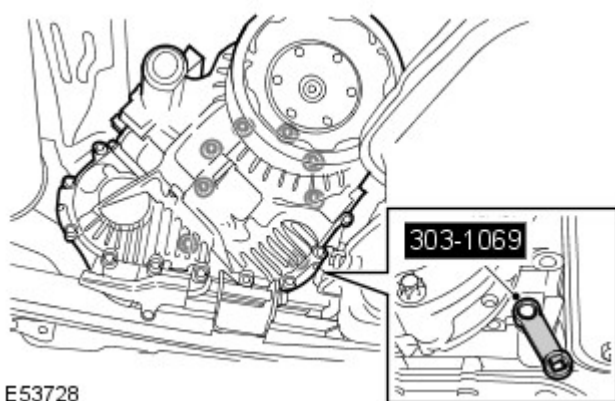
Transfer Case - Transfer CaseTDV6 2.7L Diesel

Installation

Special Tool(s)	
 <p>303-1069</p> <p>E53727</p>	<p>Wrench adaptor 303-1069</p>

Installation

All vehicles



- CAUTION:** Take extra care not to damage the wiring harnesses.

With assistance, install the transfer case.

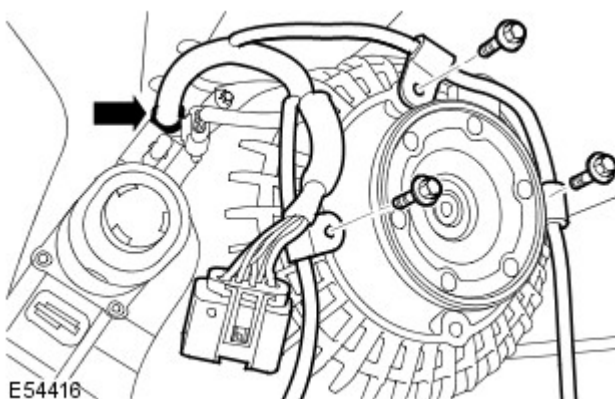
- Clean the component mating faces.
- Lubricate input shaft splines with 'Welcon TL7391' grease.
- Install the O-ring seal.
- Using the special tool, tighten the bolts to 45 Nm (33 lb.ft).

- Connect the breather line.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

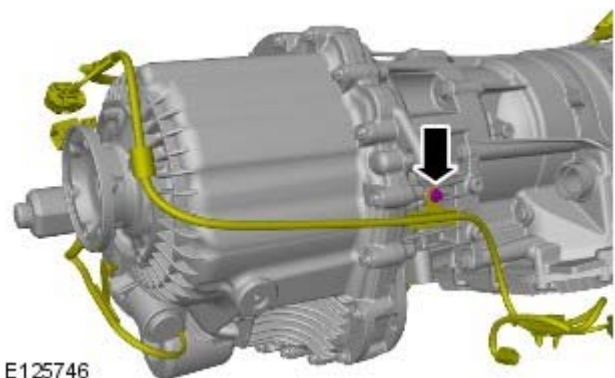
Secure the wiring harness to the transfer case.

- Tighten the bolts to 25 Nm (18 lb.ft).
- Secure the clip.



- Secure the wiring harness to the transfer case.

- Tighten bolt to 10Nm (7 lb.ft)



- Connect the electrical connectors.

6. Install the ground cable to the transfer box.
 - Tighten the bolt to 15Nm (11 lb.ft).
7. Secure the rear driveshaft to the transfer case drive flange.
 - Install the washers.
 - Tighten the Torx bolts to 55 Nm (40 lb.ft).
8. Secure the front driveshaft to the transfer case drive flange.
 - Install the washers.
 - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
 - Stage 2: Tighten the bolts a further 90 degrees.
9. Install the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V6 4.0L Petrol/TDV6 2.7L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Vehicles with diesel particulate filter (DPF)

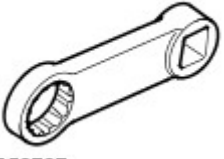
10. Install the diesel particulate filter (DPF). For additional information, refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).

All vehicles

11. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
12. Check and top-up the transfer case fluid level.
13. Using the diagnostic tool, re-calibrate the transfer case.

Transfer Case - Transfer CaseTDV6 3.0L Diesel

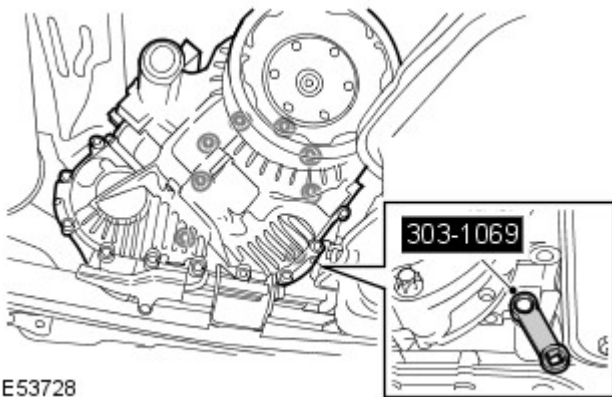
Installation

Special Tool(s)	
 <p>303-1069</p> <p>E53727</p>	<p>Wrench adaptor 303-1069</p>

Installation

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

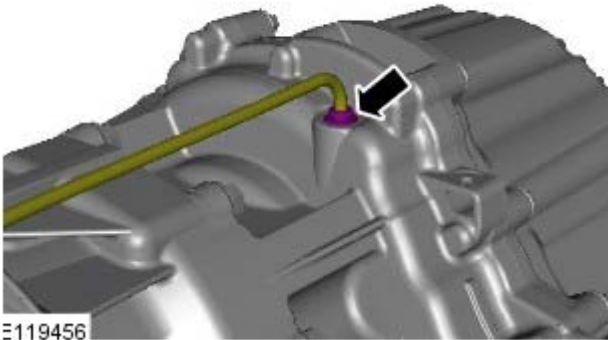
All vehicles



1. With assistance, install the transfer case.

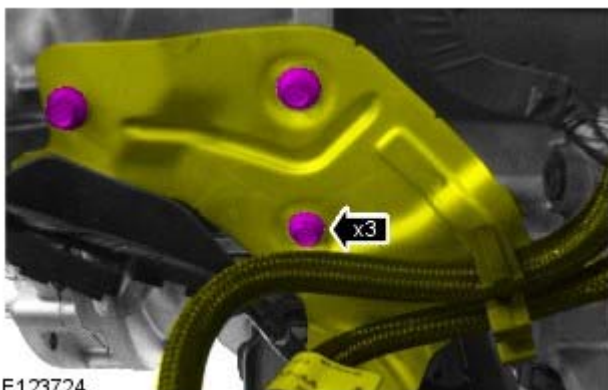
- Clean the component mating faces.
- Lubricate input shaft splines with 'Weicon TL7391' grease.
- Install the O-ring seal.
- Align the fuel hose support bracket.
- Using the special tool, tighten the bolts to 45 Nm (33 lb.ft).

2. Connect the breather line.

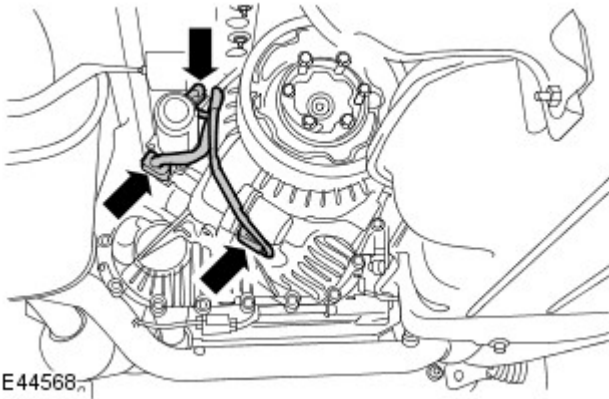


3. Secure the fuel line support bracket.

- Tighten the bolts to 10 Nm (7 lb.ft).

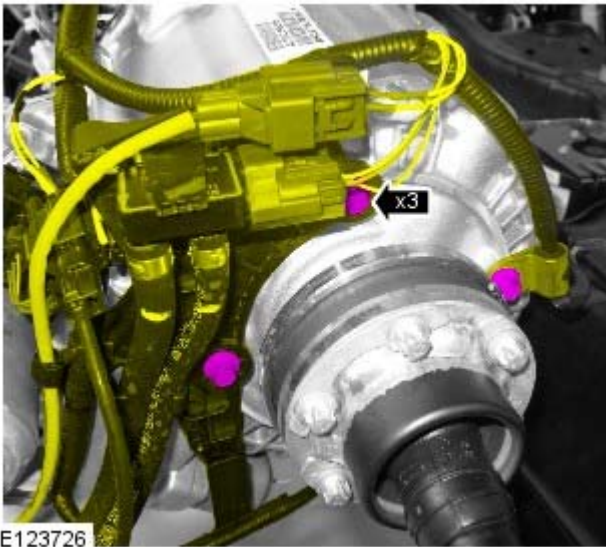


4. Connect the electrical connectors.



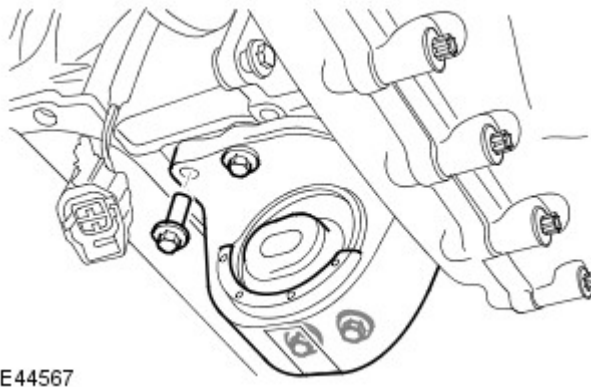
5. Secure the wiring harness to the transfer case.

- Tighten the bolts to 25 Nm (18 lb.ft).

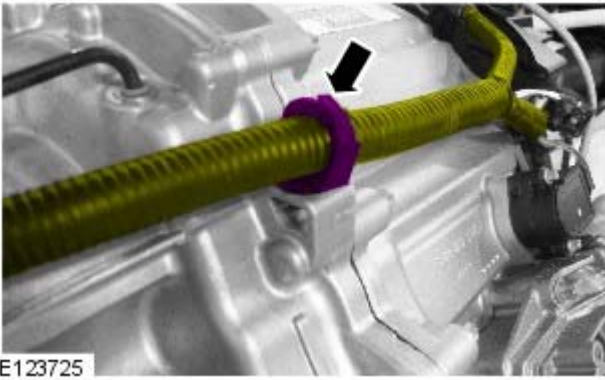


6. Install the transmission support insulator.

- Clean the component mating faces.
- Tighten the bolts to 60 Nm (44 lb.ft).



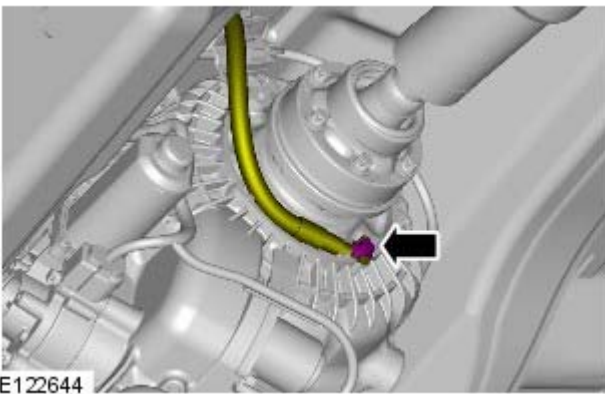
7. Secure the transmission wiring harness.



8. Secure the rear driveshaft to the transfer case drive flange.
 - Install the washers.
 - Tighten the Torx bolts to 55 Nm (40 lb.ft).
9. Secure the front driveshaft to the transfer case drive flange.
 - Install the washers.
 - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
 - Stage 2: Tighten the bolts a further 90 degrees.

10. Install the ground cable to the transfer box.

- Tighten the bolt to 15Nm (11 lb.ft).



11. Install the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Vehicles with diesel particulate filter (DPF)

12. Install the DPF.
For additional information, refer to: [Diesel Particulate Filter \(DPF\)](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

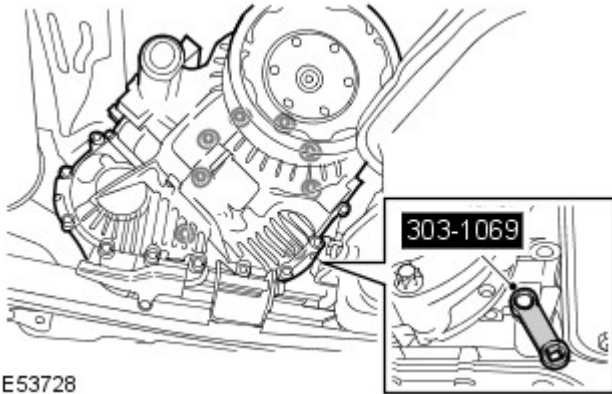
All vehicles

13. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
14. Check and top-up the transfer case fluid level.
15. Using the diagnostic tool, re-calibrate the transfer case.

Transfer Case - Transfer CaseV6 4.0L Petrol

Installation

Installation

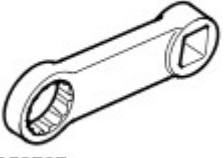


E53728

1. With assistance, install the transfer case.
 - Clean the component mating faces.
 - Lubricate input shaft splines with 'Weicon TL7391' grease.
 - Install the O-ring seal.
 - Align the fuel hose support bracket.
 - Using the special tool, tighten the bolts to 45 Nm (33 lb.ft).
2. Connect the breather line.
3. Position the fuel line support bracket.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Secure the fuel lines.
 - Position the selector cable to its guide bracket.
4. Connect the electrical connectors.
5. Secure the wiring harness to the transfer case.
 - Secure with the clip.
 - Tighten the bolts to 25 Nm (18 lb.ft).
6. Install the transmission support insulator.
 - Clean the component mating faces.
 - Tighten the bolts to 60 Nm (44 lb.ft).
7. Install the rear driveshaft.
For additional information, refer to: [Rear Driveshaft](#) (205-01 Driveshaft, Removal and Installation).
8. Install the front driveshaft.
For additional information, refer to: [Front Driveshaft - V6 4.0L Petrol](#) (205-01 Driveshaft, Removal and Installation).
9. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
10. Use T4 to re-calibrate a new transfer case.

Transfer Case - Transfer CaseV8 5.0L Petrol

Installation

Special Tool(s)	
 <p>303-1069</p> <p>E53727</p>	<p>Wrench adaptor</p> <p>303-1069</p>

Installation

1. With assistance, install the transfer case.
 - Clean the component mating faces.
 - Lubricate input shaft splines with 'Weicon TL7391' grease.
 - Install the O-ring seal.
 - Using the special tool, tighten the bolts to 45 Nm (33 lb.ft).
2. Connect the breather line.
3. Position the fuel line support bracket.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Secure the fuel lines.
4. Connect the electrical connectors.
5. Secure the wiring harness to the transfer case.
 - Secure with the clip.
 - Tighten the bolts to 25 Nm (18 lb.ft).
6. Secure the front driveshaft to the transfer case drive flange.
 - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
 - Stage 2: Tighten the bolts a further 90 degrees.
7. Secure the rear driveshaft to the transfer case drive flange.
 - Clean the component mating faces.
 - Tighten the Torx bolts to 55 Nm (40 lb.ft).

8. CAUTIONS:



Align the driveshaft center bearing mount by moving the floating front section of the shaft backward or forwards until the bolt holes in the mount align with the holes in the chassis.



Make sure the center bearing mount is not under tension.

Install the driveshaft center bearing mount bolts.

- Align the center bearing mount.
 - Tighten the driveshaft center bearing retaining bolts to 30 Nm (22 lb.ft).
9. Install the fuel tank heat shield.
 - Tighten the bolts to 6 Nm (4 lb.ft).
 - Tighten the nuts to 3 Nm (2 lb.ft).
 10. Install the ground cable to the transfer box.

- Tighten the bolt to 15Nm (11 lb.ft).

11. Install the transmission heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

12. Install the transmission crossmember.

For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

13. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

14. Check and top-up the transfer case fluid level.

15. Using the diagnostic tool, re-calibrate the transfer case.

Exhaust System - TDV6 2.7L Diesel -

General Specifications

Item	Specification
Exhaust manifolds	Cast with cross over pipe from right to left hand manifold exiting into single turbocharger
Exhaust system	Single, stainless steel downpipe with twin stainless steel intermediate and tail pipes and stainless steel mufflers
Catalytic converter - type/location	Near coupled cascade - located in the down pipe

Torque Specifications

Description	Nm	lb-ft
Catalytic converter clamp without diesel particulate filter (DPF)	55	40
Catalytic converter clamp with DPF	48	35
Catalytic converter to muffler nuts	48	35
DPF to muffler nuts	48	35
* Catalytic converter to exhaust manifold nuts	48	35
Service clamp	48	35
Differential pressure sensor pipe unions	35	26
** Exhaust gas temperature sensors	35	26
DPF heat shield bolts	10	7

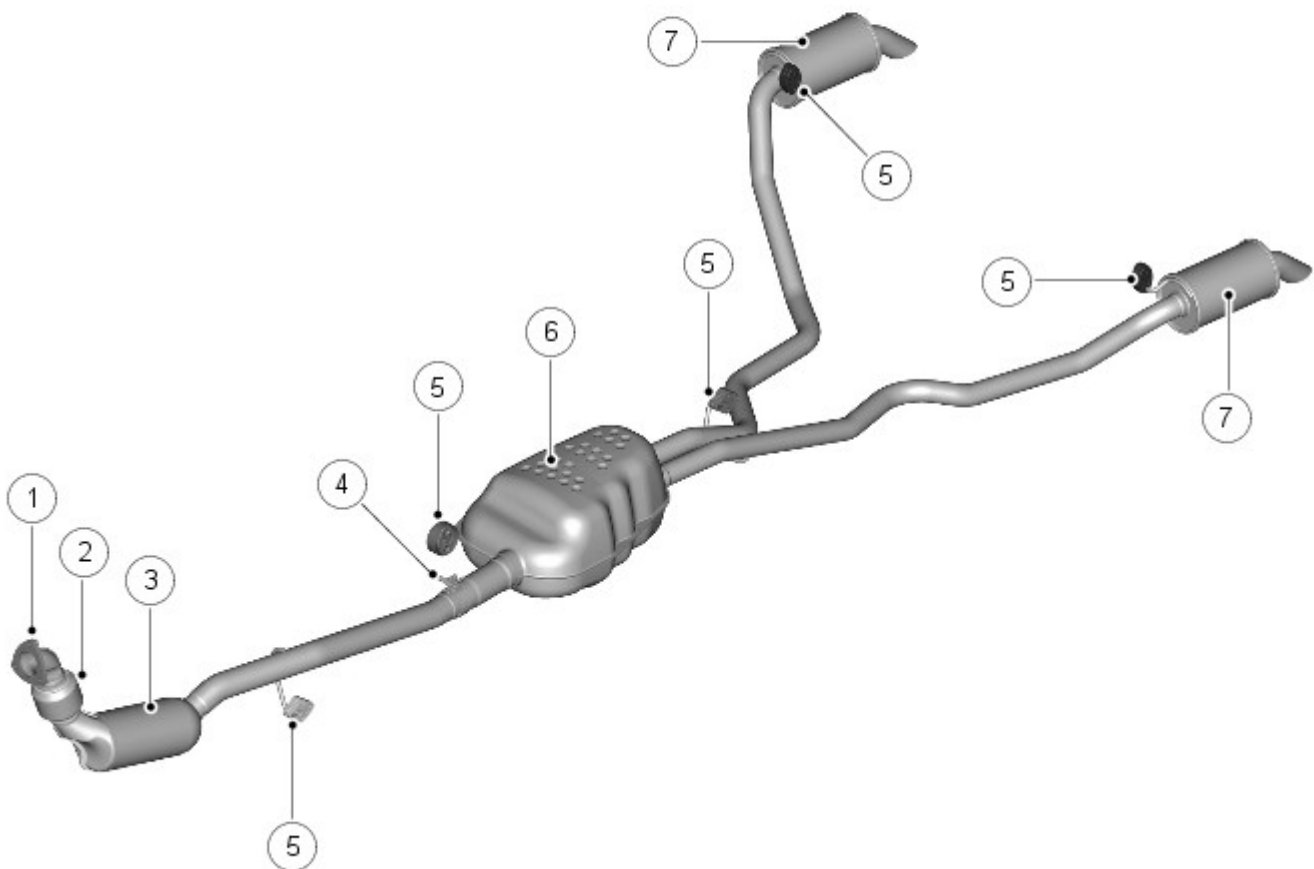
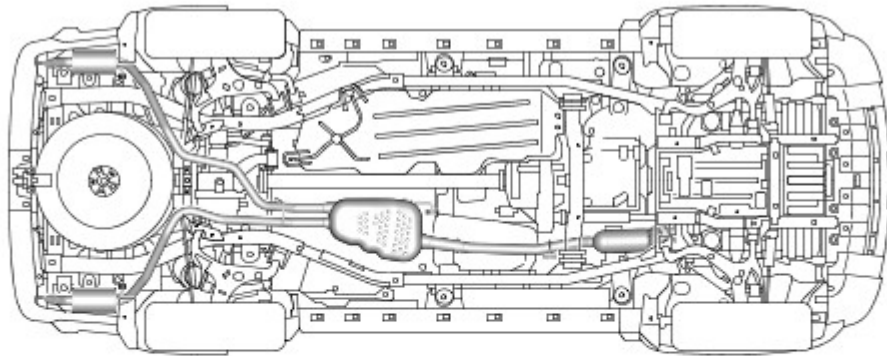
* **New nuts must be installed**

* **Apply suitable high temperature resistant anti-seize compound**

Exhaust System - TDV6 2.7L Diesel - Exhaust System

Description and Operation

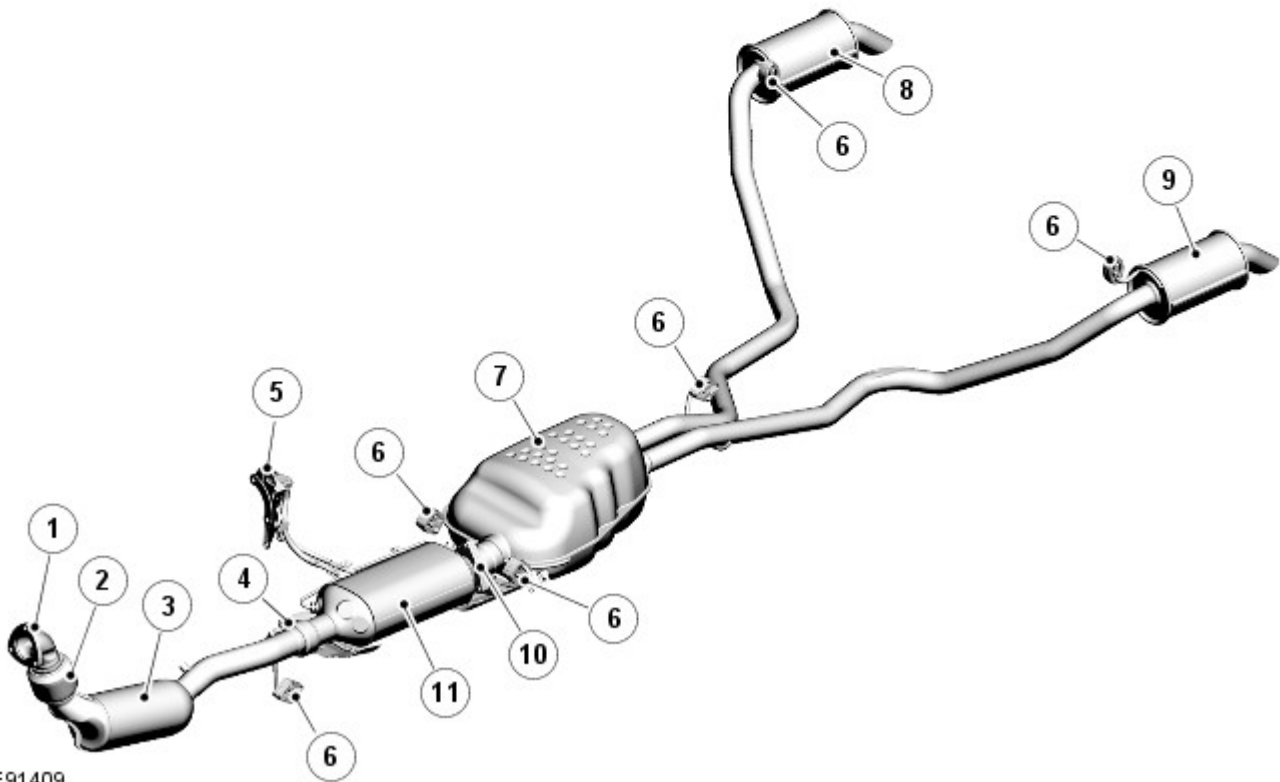
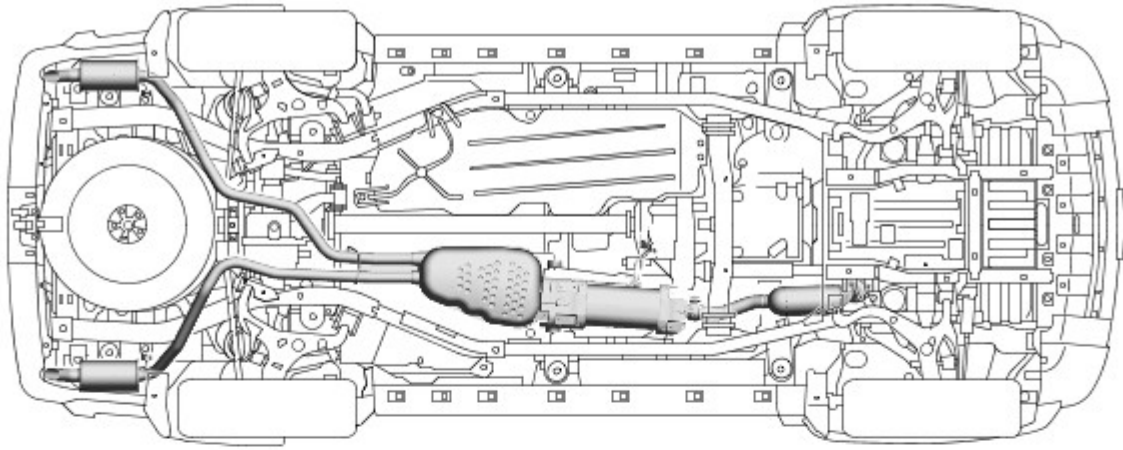
TDV6 EXHAUST SYSTEM COMPONENT LOCATION - WITHOUT DIESEL PARTICULATE FILTER



E43726

Item	Part Number	Description
1	-	Inlet flange
2	-	Flexible de-coupler
3	-	Catalytic converter
4	-	Clamp
5	-	Mounting rubber (5 off)
6	-	Silencer - Centre
7	-	Silencer - Rear

TDV6 EXHAUST SYSTEM COMPONENT LOCATION - WITH OPTIONAL DIESEL PARTICULATE FILTER - FROM 2008 MY (WHERE FITTED)



E91409

Item	Part Number	Description
1	-	Inlet flange
2	-	Flexible de-coupler
3	-	Catalytic converter
4	-	Clamp
5	-	Differential pressure sensor
6	-	Mounting rubber (6 off)
7	-	Silencer - Centre
8	-	Silencer - Rear Left Hand (LH)
9	-	Silencer - Rear Right Hand (RH)
10	-	Flange joint and gasket
11	-	DPF

OVERVIEW

The TdV6 exhaust system is fabricated from stainless steel and is supplied as two separate assemblies; a front section incorporating a catalytic converter and a rear section incorporating a centre silencer and two rear silencers.

The system is attached to the underside of the body with five mounting rubbers which are located on mild steel hanger bars that are welded to the system. The mounting rubbers locate on corresponding hangers which are welded to the underside of the vehicle body.

The system has service repair items available. Indentations in the rear section between the center and the rear silencers show the cut points for the service replacement rear silencers or front section. When a service repair section is used, the joint is connected using a sleeve and two clamps to connect the pipes at the cut points.

On vehicles from 2008MY, an optional Diesel Particulate Filter (DPF) is available. The non-DPF exhaust system is also

available on vehicles from 2008MY as the DPF is not required to comply with EU4 emission regulations.

• **CAUTIONS:**



The use of bio-fuels can seriously contaminate and destroy the coatings used on the catalytic converter. The DPF and the catalytic converter can become irreversibly contaminated if non-specified oils or fuels are used. This will result in the vehicle being unable to regenerate the DPF, becoming non-compliant with tailpipe emission regulations and replacement of the catalytic converter and DPF will be required.



If the vehicle is waded in deep water and the engine is stopped with the tailpipes submerged, the water, which can enter the system, can also contaminate both the DPF and the catalytic converter. This again can result in catalytic converter damage and damaging the ability for the DPF to regenerate therefore requiring both components to be replaced.

FRONT SECTION

The front section has a welded flange with three holes which provide for the attachment to three studs on the turbocharger. The flange is sealed with a metal gasket. This is secured to the turbocharger studs with three nuts.

The flange is welded to a fabricated elbow which in turn is welded to the de-coupler. Fabricated pressings are welded between the de-coupler and the body of the catalytic converter. The converter outlet pipe is a 60 mm (2.2 in) diameter tube, with a 2.0 mm (0.079 in) wall thickness, which is welded to the converter body. The outlet pipe has hanger bar which provides for the location of a mounting rubber.

Vehicles without DPF

The rear of the outlet pipe from the catalytic converter locates into the rear section. When the front section is inserted into the flared end, a clamp is used to compress and secure the joint.

Vehicles with Optional DPF - From 2008MY

The rear outlet pipe from the catalytic converter has a flared end which slides onto the DPF inlet pipe and is secured with a clamp. The outlet pipe of the DPF has a triangular shaped flange which mates with a similar flange on the rear section of the exhaust. The 2 flanges are sealed with a metal gasket and are secured using 3 locknuts screwed onto captive studs located in the DPF flange.

REAR SECTION

Vehicles without DPF

On vehicles without DPF, the rear section has a short 70 mm (2.75 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which provides location for the front section as previously mentioned. The tube is welded to the centre silencer assembly.

Vehicles with Optional DPF - From 2008MY

On vehicles from 2008MY fitted with the optional DPF, the rear section has a short 70 mm (2.75 in) with a triangular flange which mates with a similar flange on the front section as previously mentioned.

All Vehicles

The centre silencer comprises two pressed stainless steel shells which are welded together to give a capacity of 25.2 liters (1537 in³). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gases pass through the silencer. Hanger bars are welded to the front right hand side and left hand side of the silencer and provide for the location of mounting rubbers.

The silencer has two 50 mm (2.0 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which are curved to pass around the rear suspension components.

Each outlet pipe terminates in a welded joint with the rear silencers. The outlet pipes have a hanger bar which provides for the location of a mounting rubber.

A hanger bar is welded to the front face of each rear silencer and provides for the location of a mounting rubber. The silencer is a circular fabrication with a baffle tube which is surrounded with glass fiber to provide further noise suppression. Each silencer has a capacity of 2.7 liters (165 in³).

The silencers each have an outlet pipe which is 55 mm (2.16 in) diameter, with a wall thickness of 1.2 mm (0.05 in). Each outlet pipe is curved downwards to direct exhaust gasses away from the rear of the vehicle.

CATALYTIC CONVERTER

The engine management system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient use of fuel and to minimise the exhaust emissions.

To further reduce the carbon monoxide and hydrocarbons content of the exhaust gases, a catalytic converter (Diesel Oxidation Catalyst) is integrated into the front pipe of the exhaust system. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called 'washcoat'. The washcoat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the washcoat is a coating containing platinum on vehicles without a DPF or platinum and palladium on vehicles with a DPF, which are the active constituents for converting harmful emissions into inert by-products. The platinum and palladium adds oxygen to the carbon monoxide and the hydrocarbons in the exhaust gases, to convert them into carbon dioxide and water.

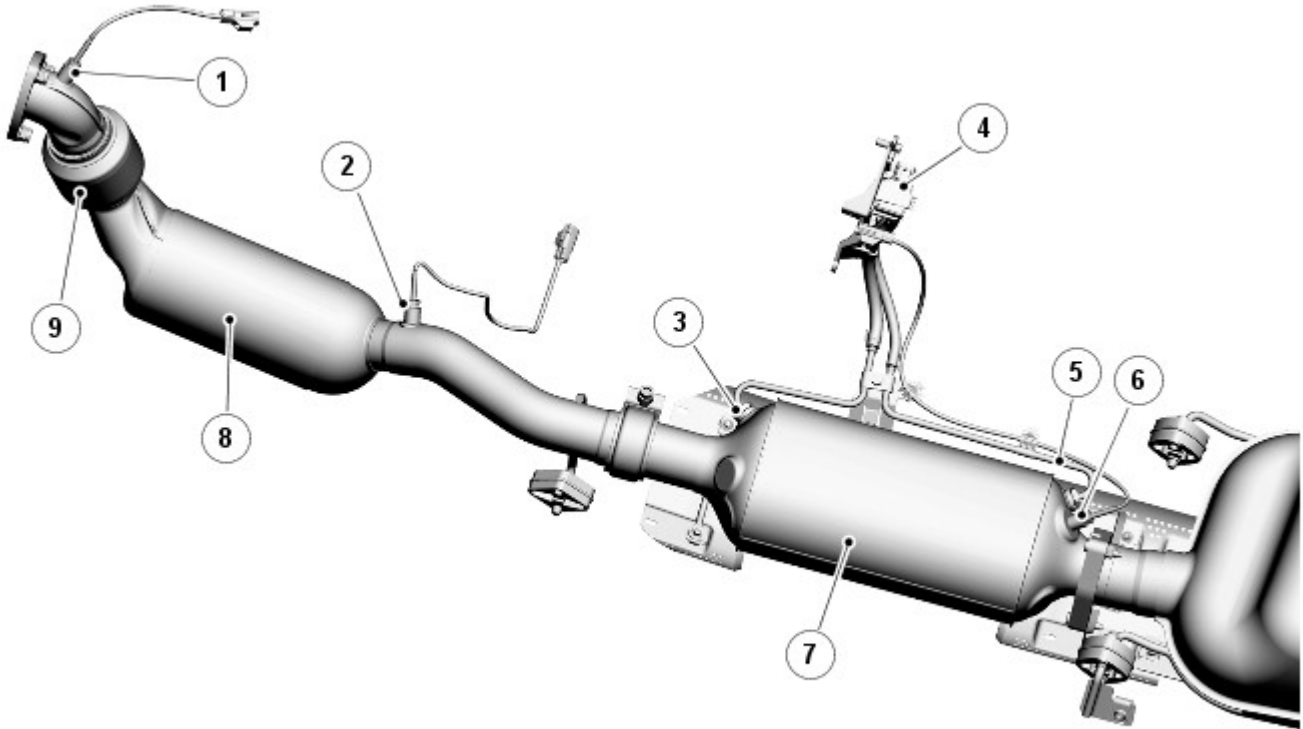
DIESEL PARTICULATE FILTER (DPF) - VEHICLES FROM 2008MY (WHERE FITTED)

On vehicles from 2008MY, an optional Diesel Particulate Filter (DPF) is available.

• NOTE: The non-DPF exhaust system is also available on vehicles from 2008MY.

The DPF system reduces diesel particulate emissions to negligible levels.

DPF System Components



E91610

Item	Part Number	Description
1	-	Exhaust gas temperature sensor (pre catalyst)
2	-	Exhaust gas temperature sensor (post catalyst)
3	-	High pressure sensor pipe
4	-	Differential pressure sensor
5	-	Low pressure sensor pipe
6	-	Exhaust gas temperature sensor (Post DPF)
7	-	Diesel particulate filter
8	-	Catalytic converter

The particulate emissions are the black fumes emitted from the diesel engine under certain load conditions. The emissions are a complex mixture of solid and liquid components with the majority of the particulates being carbon microspheres on which hydrocarbons from the engine's fuel and lubricant condense.

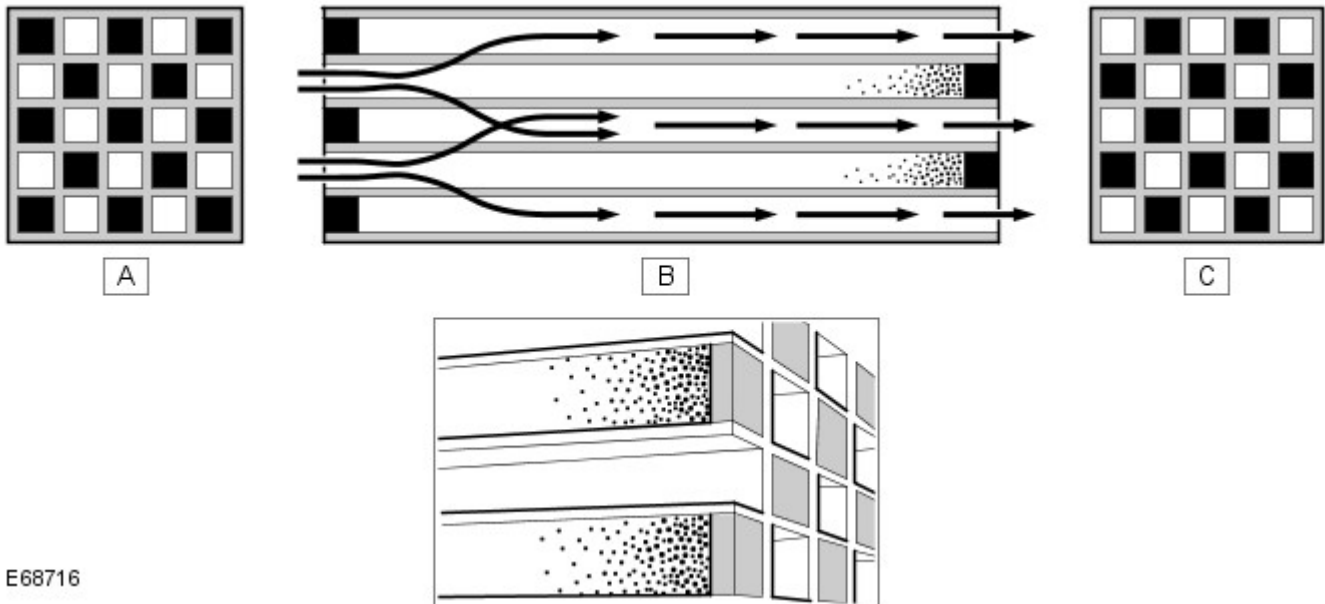
The DPF system comprises the following components:

- Diesel particulate filter
- DPF control software incorporated into the Engine Control Module (ECM)
- Differential pressure sensor.

Diesel Particulate Filter

The DPF is located in the exhaust system, downstream of the catalytic converter. A major feature of the DPF is its ability for regeneration. Regeneration is the burning of particulates trapped by the filter to prevent obstruction to the free flow of exhaust gasses. The regeneration process takes place at calculated intervals and is not noticeable by the driver of the vehicle.

Regeneration is most important, since an overfilled filter can damage the engine through excessive exhaust back pressure and can itself be damaged or destroyed. The material trapped in the filter is in the most part carbon particles with some absorbed hydrocarbons.



E68716

Item	Part Number	Description
A	-	Front face showing alternate closed cells
B	-	Side view showing exhaust gas flow through the filter and particulate build up
C	-	Rear face showing alternate closed cells

The DPF uses a filter technology based on a filter with a catalytic coating. The DPF is made from silicon carbide housed in a steel container and has excellent thermal shock resistance and thermal conductivity properties. The DPF is designed for the engine's operating requirements to maintain the optimum back pressure requirements.

The porous surface of the filter consists of a number of small parallel channels positioned in the longitudinal direction of the exhaust system. Adjacent channels in the filter are alternately plugged at the end. This design forces the exhaust gasses to flow through the porous filter walls, which act as the filter medium. Particulate matter which are too big to pass through the porous surface are collected and stored in the channels.

The collected particulate matter, if not removed, can create an obstruction to exhaust gas flow. The particles are removed by a regeneration process which oxidizes the particles.

DPF regeneration is controlled by the temperature of the exhaust gasses and the DPF. The DPF includes a wash coat to the filter surface which comprises platinum and other active components and is similar to the catalytic converter. At certain exhaust gas and DPF temperatures the wash coat promotes combustion of the particles in addition to oxidizing carbon monoxide and hydrocarbon emissions.

The exhaust gas and DPF temperatures are controlled by the DPF software located in the ECM. The DPF software monitors the load status of the DPF based on driving style, distance travelled and signals from the differential pressure sensor and temperature sensors. When the particulate loading of the DPF reaches predetermined levels, the DPF is actively regenerated by adjusting, in conjunction with the ECM, various engine control functions such as:

- fuel injection
- intake air throttle
- exhaust gas recirculation
- turbocharger boost pressure control.

The regeneration process is possible because of the flexibility of the common-rail fuel injection engine which provides precise control of fuel flow, fuel pressure and injection timing which are essential requirements to promote the efficient regeneration process.

Two processes are used to regenerate the DPF; passive and active.

Passive Regeneration

Passive regeneration requires no special engine management intervention and occurs during normal engine operation. The passive regeneration involves a slow conversion of the particulate matter deposited in the DPF into carbon dioxide. This process is active when the DPF temperature reaches 250°C (482°F) and is a continuous process when the vehicle is being driven at higher engine loads and speeds.

During passive regeneration, only a portion of the particulate matter is converted into carbon dioxide. This is due to the chemical reaction process which is only effective within the normal operating temperature range of 250°C to 500°C (482°F to 932°F).

Above this temperature range the conversion efficiency of the particulates into carbon dioxide increases as the DPF temperature is raised. These temperatures can only be achieved using the active regeneration process.

Active Regeneration

Active regeneration starts when the particulate loading of the DPF reaches a threshold as monitored or determined by the DPF control software. The threshold calculation is based on driving style, distance travelled and back pressure signals from the differential pressure sensor.

Active regeneration generally occurs every 450 miles (725 km) although this is highly dependant on how the vehicle is driven. For example, if the vehicle is driven at low loads in urban traffic regularly, active regeneration will occur more

often. This is due to the rapid build-up of particulates in the DPF than if the vehicle is driven at high speeds when passive regeneration will have occurred.

The DPF software incorporates a mileage trigger which is used as back-up for active regeneration. If active regeneration has not been initiated by a back pressure signal from the differential pressure sensor, regeneration is requested based on distance travelled.

Active regeneration of the DPF is commenced when the temperature of the DPF is increased to the combustion temperature of the particles. The DPF temperature is raised by increasing the exhaust gas temperature. This is achieved by introducing post-injection of fuel after the pilot and main fuel injections have occurred.

This is determined by the DPF software monitoring the signals from the two DPF temperature sensors to establish the temperature of the DPF. Depending on the DPF temperature, the DPF software requests the ECM to perform either one or two post-injections of fuel:

- The first post-injection of fuel retards combustion inside the cylinder which increases the temperature of the exhaust gas.
- The second post-injection of fuel is injected late in the power stroke cycle. The fuel partly combusts in the cylinder, but some unburnt fuel also passes into the exhaust where it creates an exothermic event within the catalytic converter, further increasing the temperature of the DPF.

The active regeneration process takes approximately 20 minutes to complete. The first phase increases the DPF temperature to 500°C (932°F). The second phase further increases the DPF temperature to 600°C (1112°F) which is the optimum temperature for particle combustion. This temperature is then maintained for 15-20 minutes to ensure complete incineration of the particles within the DPF. The incineration process converts the carbon particles to carbon dioxide and water.

The active regeneration temperature of the DPF is closely monitored by the DPF software to maintain a target temperature of 600°C (1112°F) at the DPF inlet. The temperature control ensures that the temperatures do not exceed the operational limits of the turbocharger and the catalytic converter. The turbocharger inlet temperature must not exceed 830°C (1526°F) and the catalytic converter brick temperature must not exceed 800°C (1472°F) and the exit temperature must remain below 750°C (1382°F).

During the active regeneration process the following ECM controlled events occur:

- The turbocharger is maintained in the fully open position. This minimizes heat transmission from the exhaust gas to the turbocharger and reduces the rate of exhaust gas flow allowing optimum heating of the DPF. If the driver demands an increase in engine torque, the turbocharger will respond by closing the vanes as necessary.
- The throttle is closed as this assists in increasing the exhaust gas temperature and reduces the rate of exhaust gas flow which has the effect of reducing the time for the DPF to reach the optimum temperature.
- The Exhaust Gas Recirculation (EGR) valve is closed. The use of EGR decreases the exhaust gas temperature and therefore prevents the optimum DPF temperature being achieved.

If, due to vehicle usage and/or driving style, the active regeneration process cannot take place or is unable to regenerate the DPF, the dealer can force regenerate the DPF. This is achieved by either driving the vehicle until the engine is at its normal operating temperature and then driving for a further 20 minutes at speeds of not less than 30 mph (48 km/h) or by connecting a Land Rover approved diagnostic system to the vehicle which will guide the technician through an automated regeneration procedure to clean the DPF.

Diesel Particulate Filter Control

The DPF requires constant monitoring to ensure that it is operating at its optimum efficiency and does not become blocked. The ECM contains DPF software which controls the monitoring and operation of the DPF system and also monitors other vehicle data to determine regeneration periods and service intervals.

The DPF software can be divided into three separate control software modules; a DPF supervisor module, a DPF fuel management module and a DPF air management module.

These three modules are controlled by a fourth software module known as the DPF co-ordinator module. The co-ordinator module manages the operation of the other modules when an active regeneration is requested. The DPF supervisor module is a sub-system of the DPF co-ordinator module.

DPF Fuel Management Module

The DPF fuel management module controls the following functions:

- Timing and quantity of the four split injections per stroke (pilot, main and two post injections).
- Injection pressure and the transition between the three different calibration levels of injection.

The above functions are dependant on the condition of the catalytic converter and the DPF.

The controlled injection determines the required injection level in addition to measuring the activity of the catalytic converter and the DPF. The fuel management calculates the quantity and timing for the four split injections, for each of the three calibration levels for injection pressure, and also manages the transition between the levels.

The two post injections are required to separate the functionality of increasing in-cylinder gas temperatures and the production of hydrocarbons. The first post injection is used to generate the higher in-cylinder gas temperature while simultaneously retaining the same engine torque output produced during normal (non-regeneration) engine operation. The second post injection is used to generate hydrocarbons by allowing unburnt fuel into the catalytic converter without producing increased engine torque.

DPF Air Management Module

The DPF air management module controls the following functions:

- EGR control

- Turbocharger boost pressure control
- Intake air temperature and pressure control.

During active regeneration, the EGR operation is disabled and the closed-loop activation of the turbocharger boost controller is calculated. The air management module controls the air in the intake manifold to a predetermined level of pressure and temperature. This control is required to achieve the correct in-cylinder conditions for stable and robust combustion of the post injected fuel.

The module controls the intake air temperature by actuating the EGR throttle and by adjustment of the turbocharger boost pressure control.

DPF Co-ordinator Module

The DPF co-ordinator module reacts to a regeneration request from the supervisor module by initiating and co-ordinating the following DPF regeneration requests:

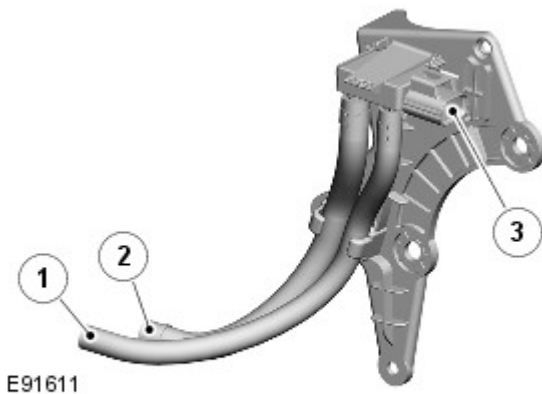
- EGR cut-off
- Turbocharger boost pressure control
- Engine load increase
- Control of air pressure and temperature in the intake manifold
- Fuel injection control.

When the supervisor module issues a regeneration request, the co-ordinator module requests EGR cut-off and a regeneration specific turbocharger boost pressure control. It then waits for a feedback signal from the EGR system confirming that the EGR valve is closed.

When the EGR valve is closed, the co-ordinator module initiates requests to increase engine load by controlling the intake air temperature and pressure.

Once confirmation is received that intake conditions are controlled or a calibration time has expired, the co-ordinator module then changes to a state awaiting an accelerator pedal release manoeuvre from the driver. If this occurs or a calibration time has expired, the co-ordinator module generates a request to control fuel injections to increase exhaust gas temperature.

Differential Pressure Sensor



Item	Part Number	Description
1	-	Low pressure connection
2	-	High pressure connection
3	-	Electrical connector

The differential pressure sensor is located on a bracket which is attached to the transfer case.

The differential pressure sensor is used by the DPF software to monitor the condition of the DPF. Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the DPF. The pipes allow the sensor to measure the inlet and outlet pressures of the DPF

As the amount of particulates trapped by the DPF increases, the pressure at the inlet side of the DPF increases in comparison to the DPF outlet. The DPF software uses this comparison, in conjunction with other data, to calculate the accumulated amount of trapped particulates.

By measuring the pressure difference between the DPF inlet and outlet and the DPF temperature, the DPF software can determine if the DPF is becoming blocked and requires regeneration.

Differential Particulate Filter Temperature Sensors

Three temperature sensors are used in the DPF system. The first is located just after the turbocharger in the catalytic converter inlet pipe, the second located in the catalytic converter outlet pipe and the third in the DPF outlet cone pipe work.

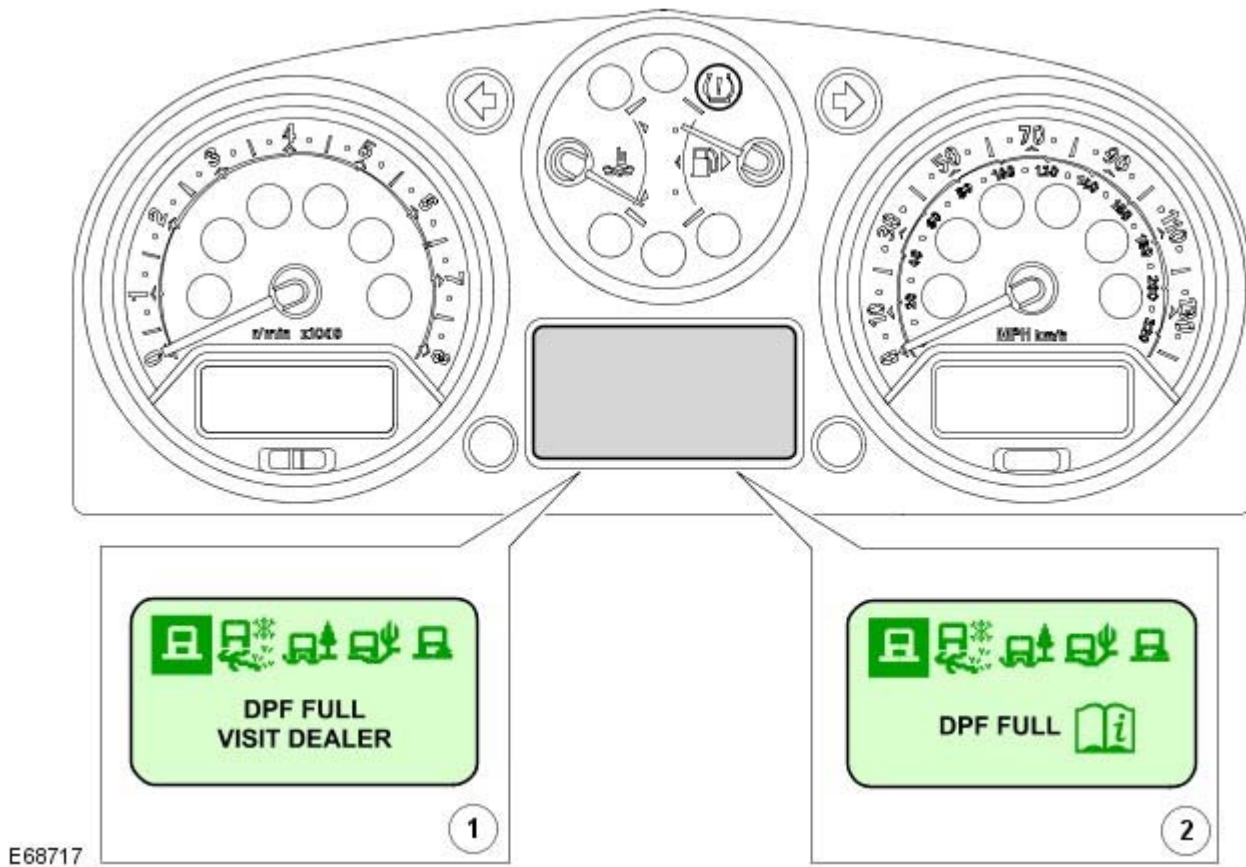
The sensors measure the temperature of exhaust gas exiting the turbocharger, after the catalyst and after it passes through the DPF to provide the information needed to calculate the DPF temperature.

The information is used, in conjunction with other data, to estimate the amount of accumulated particulates and to control

the DPF temperature.

Instrument Cluster Indications

For drivers who make regular short journeys at low speeds, it may not be possible to efficiently regenerate the DPF. In this case, the DPF software will detect a blockage of the DPF from signals from the differential pressure sensor and will alert the driver as follows.



Item	Part Number	Description
1	-	'DPF FULL VISIT DEALER' message
2	-	'DPF FULL' message

Vehicles with DPF use a high-line instrument cluster to alert the driver to the condition of the DPF via messages in the message centre.

When the DPF becomes full the driver will be alerted to this condition by a message 'DPF FULL' accompanied by a handbook symbol. As detailed in the Owners Handbook, the driver should drive the vehicle until the engine is at its normal operating temperature and then drive for a further 20 minutes at speeds of not less than 30 mph (48 km/h). Successful regeneration of the DPF is indicated to the driver by the 'DPF FULL' message no longer being displayed.

If the DPF software detects that the DPF is still blocked, the message will change to 'DPF FULL VISIT DEALER', the driver should take the vehicle to an authorized dealer to have the DPF force regenerated.

Diesel Particulate Filter Side Effects

The following section details some side effects caused by the active regeneration process.

Engine Oil Dilution

Engine oil dilution can occur due to small amounts of fuel entering the engine crankcase during the post-injection phases. This has made it necessary to introduce a calculation based on driving style to reduce oil service intervals if necessary. The driver is alerted to the oil service by a message in the instrument cluster.

The DPF software monitors the driving style, the frequency of the active regeneration and duration. Using this information a calculation can be made on the engine oil dilution. When the DPF software calculates the engine oil dilution has reached a predetermined threshold (fuel being 7% of engine oil volume) a service message is displayed in the instrument cluster.

Depending on driving style, some vehicles may require an oil service before the designated interval. If an service message is displayed, the vehicle will be required have a full service and the service interval counter will be reset.

Fuel Consumption

During the active regeneration process of the DPF, there will be an increase in fuel consumption. However, because active regeneration occurs infrequently and for limited periods of time, the overall effect on fuel consumption is approximately 2%. The additional fuel used during the active regeneration process is accounted for in the instantaneous and average fuel consumption displays in the instrument cluster.

Exhaust System - TDV6 2.7L Diesel - Exhaust System

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exhaust System](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Leaks ● Metal fatigue ● Pipes ● Catalytic converter ● Muffler(s) ● Joints ● Mountings ● Clearance around components 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noisy or leaking exhaust	<ul style="list-style-type: none"> ● Exhaust system/components 	Install new components as necessary. Refer to the relevant section of the workshop manual.
Lack of power	<ul style="list-style-type: none"> ● Air intake system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust Gas Recirculation (EGR) valve(s) fault ● Turbocharger fault 	Check the air intake system. Check for a blocked catalytic converter or muffler, install new components as necessary. Check the fuel pressure. For EGR and turbocharger tests, refer to the relevant section of the workshop manual.


DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

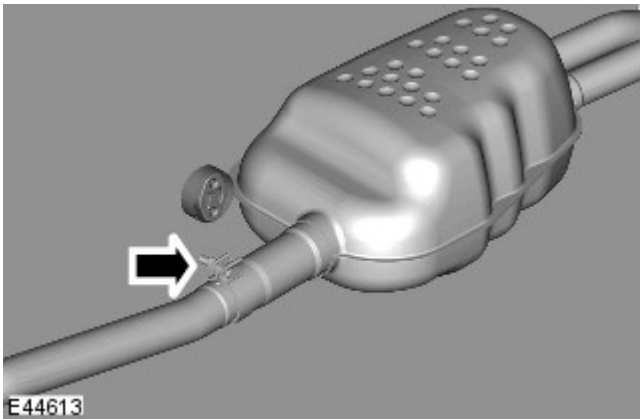
Exhaust System - TDV6 2.7L Diesel - Catalytic Converter Vehicles Without: Diesel Particulate Filter (DPF)

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the exhaust system.
For additional information, refer to: [Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).
4. Remove the catalytic converter.
 - Remove the nut and release the retaining clamp.



Installation

1. **NOTE:** Do not tighten the retaining clamp at this stage.

Position the catalytic converter to the front muffler.
 - Clean the components.
 - Install the nut.
2. Install the exhaust system.
For additional information, refer to: [Exhaust System - Vehicles Without: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).
3. Tighten the catalytic converter retaining clamp to 55 Nm (40 lb.ft).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Exhaust System - TDV6 2.7L Diesel - Catalytic Converter Vehicles With: Diesel Particulate Filter (DPF)

Removal and Installation

Removal

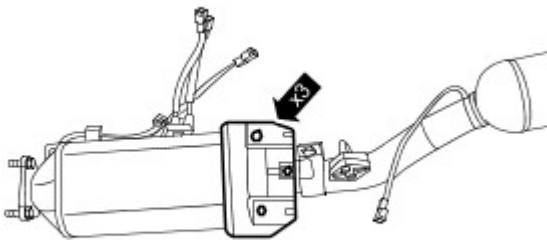


WARNING: Observe due care when working near a hot exhaust system.

- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

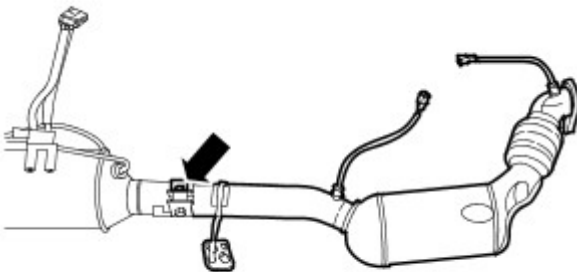
Raise and support the vehicle.

- Remove the exhaust system.
For additional information, refer to: [Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).
- Remove the diesel particulate filter (DPF) heat shield.
 - Remove the 3 bolts.



E98041

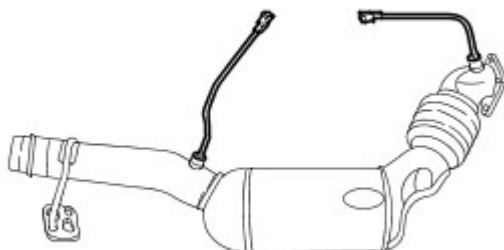
- Remove the catalytic converter.
 - Remove the nut.
 - Remove and discard the clamp.



E98042

- NOTE:** Do not disassemble further if the component is removed for access only.

Remove the catalytic converter temperature sensors.




E98043

Installation

- Install the catalytic converter temperature sensors.

- Tighten to 35 Nm (26 lb.ft).

2.  CAUTION: Make sure that the mating faces are clean and free of foreign material.

- NOTE: Do not fully tighten the clamp at this stage.

Install the catalytic converter.

- Install a new clamp.

3. Install the exhaust system.

For additional information, refer to: [Exhaust System - Vehicles With: Diesel Particulate Filter \(DPF\)](#) (309-00A Exhaust System - TDV6 2.7L Diesel, Removal and Installation).

4. Install the DPF heat shield.


- Tighten the 2 bolts to 10 Nm (7 lb.ft).

Exhaust System - TDV6 2.7L Diesel - Diesel Particulate Filter (DPF)

Removal and Installation

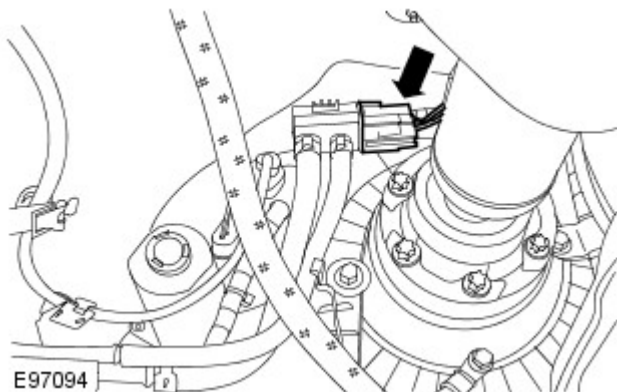
Removal

 **WARNING:** Observe due care when working near a hot exhaust system.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

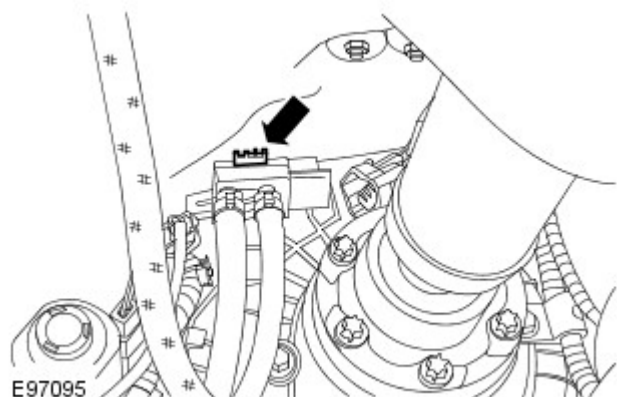
Raise and support the vehicle.

2. Disconnect the diesel particulate filter (DPF), differential pressure sensor electrical connector.

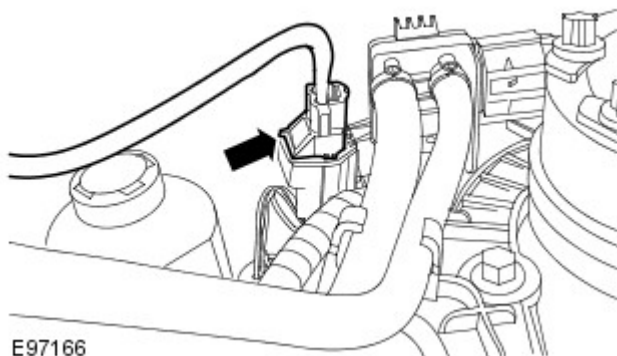



3. Release the DPF differential pressure sensor.

- Release the clip.

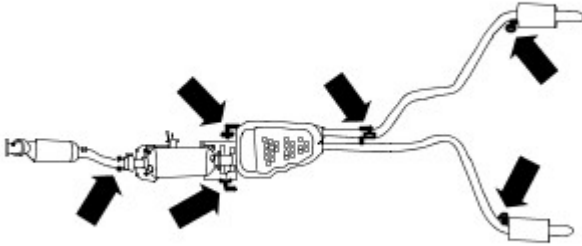


4. Disconnect the DPF exhaust gas temperature sensor electrical connector.



5.  CAUTION: Make sure that the exhaust system is supported with a suitable stand.

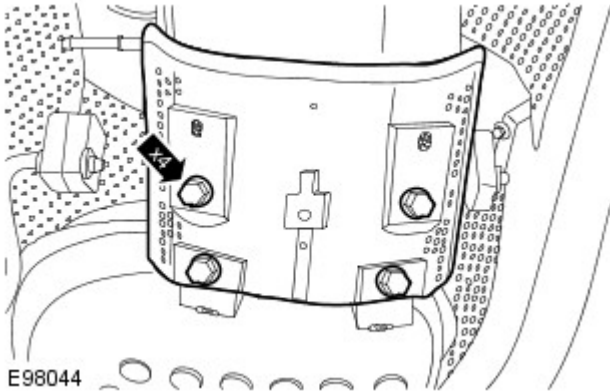
Release the 6 exhaust hangers.



E98050

6. Remove the DPF rear heat shield.

- Remove the 4 bolts.

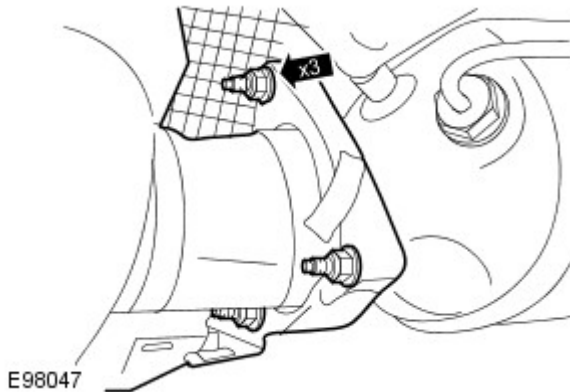


E98044

7. NOTE: Discard the gasket.

Reposition the muffler and tailpipe assembly.

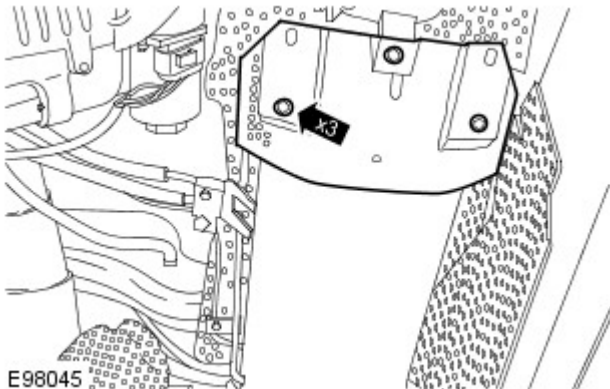
- Remove the 3 nuts.
- Remove the bracket.



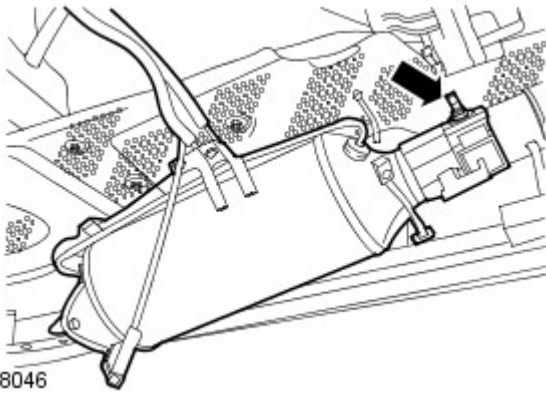
E98047

8. Remove the DPF front heat shield.

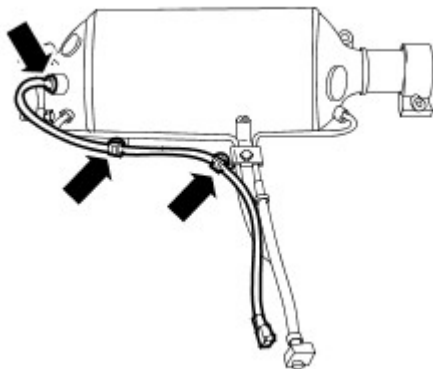
- Remove the 3 bolts.



E98045



9. Remove the DPF.
 - Remove the nut.



10. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the DPF exhaust gas temperature sensor.

- Release the wiring harness from the 2 clips.

Installation

1. Install the DPF exhaust gas temperature sensor.
 - Tighten to 35 Nm (26 lb.ft).
 - Secure the wiring harness in the clips.
2. **NOTE:** Do not fully tighten the clamp at this stage.
Install the DPF.
3. **NOTE:** Install a new gasket.
Secure the muffler and tailpipe assembly.
 - Install the bracket.
 - Tighten the nuts to 48 Nm (35 lb.ft).
 - Secure the exhaust hangers.
4. Tighten the catalytic converter to DPF clamp.
 - Tighten the nut to 48 Nm (35 lb.ft).
5. Install the DPF heat shields.
 - Tighten the bolts to 10 Nm (7 lb.ft).
6. Secure the DPF differential pressure sensor.
7. Connect the DPF differential pressure sensor electrical connector.
8. Connect the DPF exhaust gas temperature sensor electrical connector.

Exhaust System - TDV6 2.7L Diesel - Diesel Particulate Filter (DPF) Differential Pressure Sensor

Removal and Installation

Removal

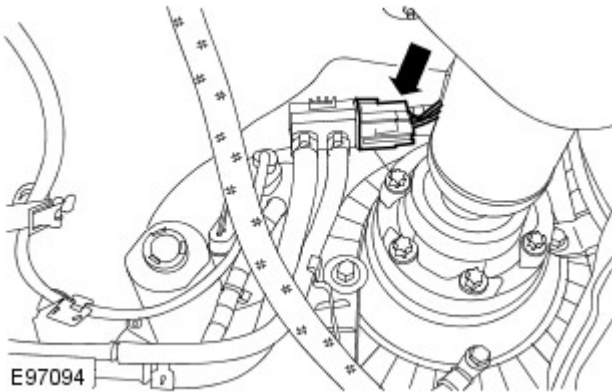


WARNING: Observe due care when working near a hot exhaust system.

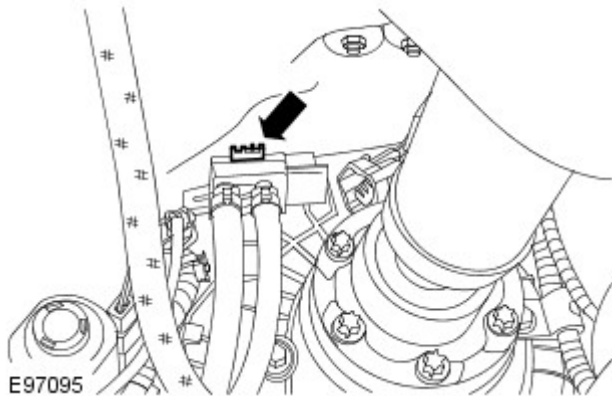
- WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Disconnect the diesel particulate filter (DPF), differential pressure sensor electrical connector.



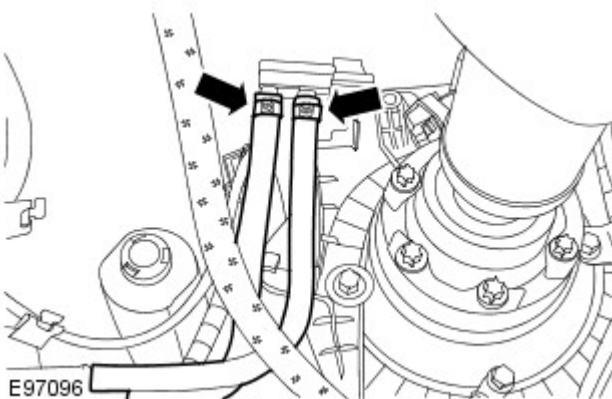
- Release the DPF differential pressure sensor.
 - Release the clip.



- CAUTION:** Make a note of the connection orientation of the high and low pressure hoses to the sensor ports. Make sure the hoses are located to the correct sensor port when installed. Failure to follow these instructions may result in damage to the vehicle.

Disconnect the high and low pressure hoses from the DPF differential pressure sensor.

- Release the 2 clips.



Installation

- Connect the high and low pressure hoses to the DPF differential pressure sensor.

- Secure the clips.

2. Secure the DPF differential pressure sensor.


- Secure with the clip.

3. Connect the DPF differential pressure sensor electrical connector.

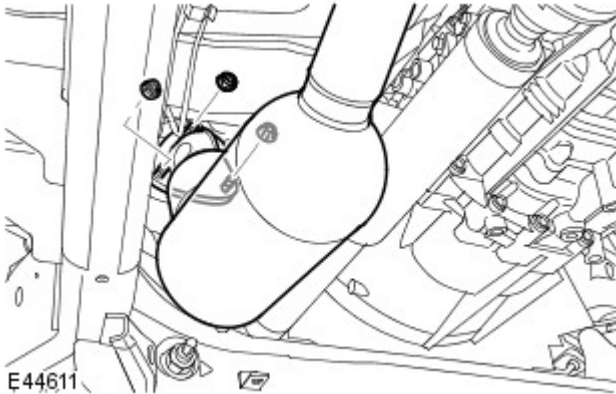
Exhaust System - TDV6 2.7L Diesel - Exhaust System Vehicles Without: Diesel Particulate Filter (DPF)

Removal and Installation

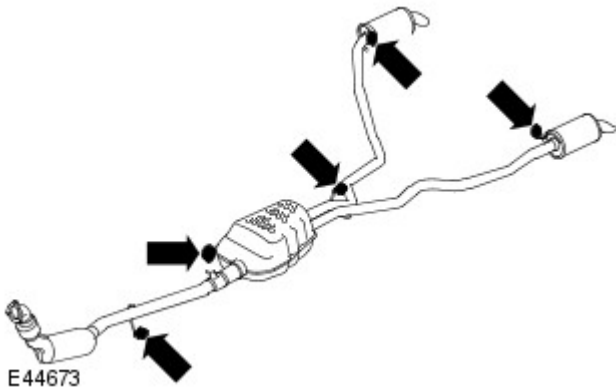
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
4. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
5. Disconnect the catalytic converter from the exhaust manifold.
 - Remove the 3 nuts.
 - Discard the gasket.



6. With assistance, remove the exhaust system.
 - Disconnect the 5 exhaust hangers.



Installation

1. With assistance, install the exhaust system.
 - Attach the exhaust hangers.
2. Position the catalytic converter to the exhaust manifold.
 - Clean the components.
 - Install a new gasket.
 - Tighten the nuts to 48 Nm (35 lb.ft).
3. Install the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body

Mounting, Removal and Installation).

4. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

5. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Exhaust System - TDV6 2.7L Diesel - Exhaust System Vehicles With: Diesel Particulate Filter (DPF)

Removal and Installation

Removal

 **WARNING:** Observe due care when working near a hot exhaust system.

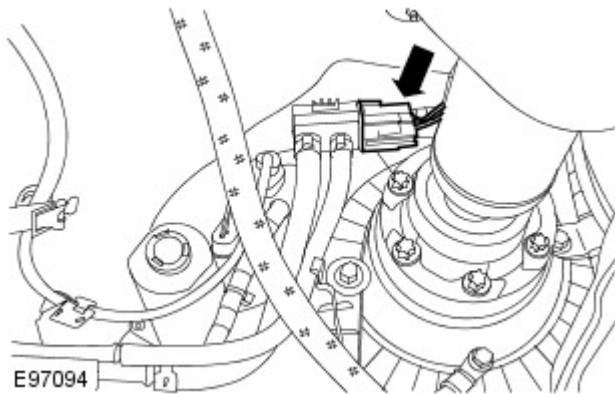
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

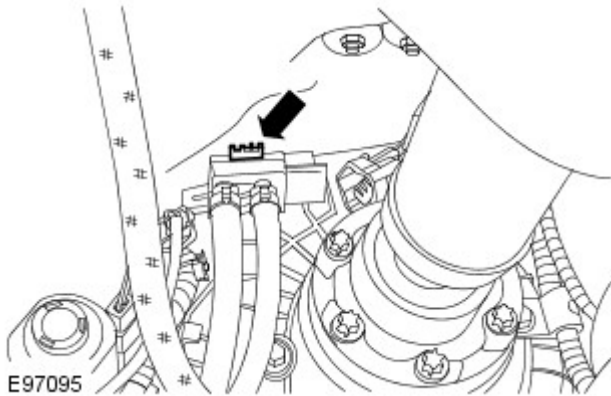
3. Disconnect the diesel particulate filter (DPF), differential pressure sensor electrical connector.

4.



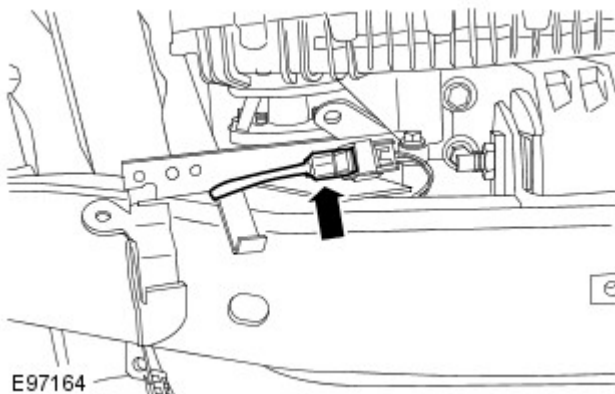
5. Release the DPF differential pressure sensor.

- Release the clip.

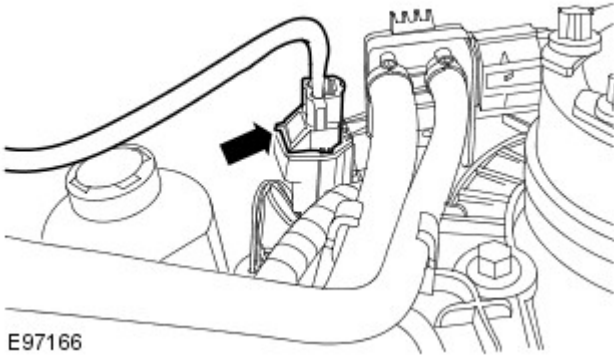


6. Disconnect the post-catalytic converter exhaust gas temperature sensor electrical connector.

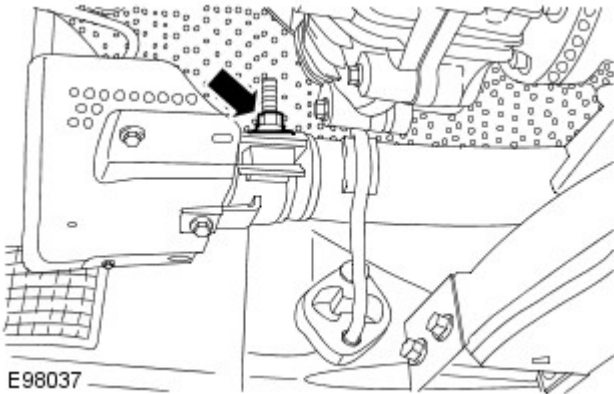
- Release the 2 clips.



7. Disconnect the DPF exhaust gas temperature sensor electrical connector.



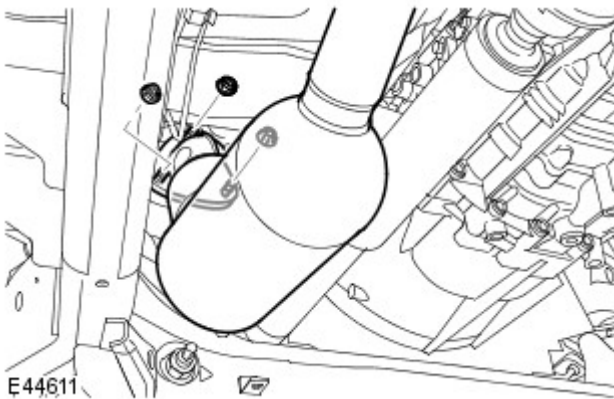
8. Loosen the catalytic converter to DPF clamp.



9. NOTE: Discard the gasket.

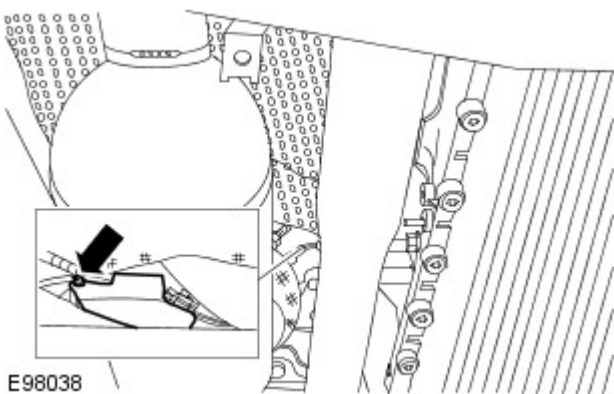
Release the catalytic converter from the turbocharger.

- Remove and discard the 3 nuts.

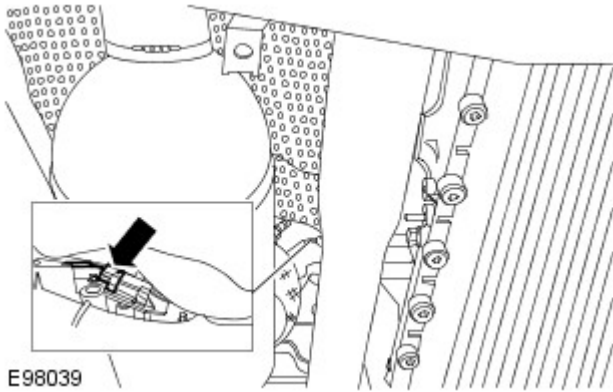


10. Remove the exhaust gas temperature sensor electrical connector heat shield.

- Remove the bolt.

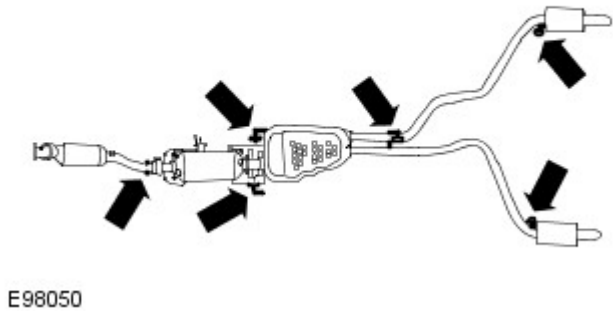


11. Disconnect the pre-catalytic converter exhaust gas temperature sensor electrical connector.



12. With assistance, remove the exhaust system.

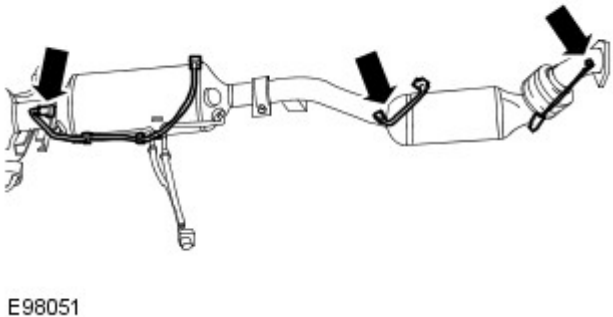
- Release the 6 exhaust hangers.



13. NOTE: Do not disassemble further if the component is removed for access only.

- NOTE: Make a note of the fitted positions of the sensors before removal.

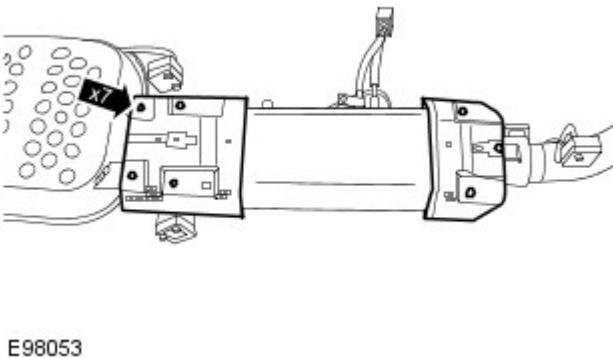
Remove the 3 exhaust gas temperature sensors.



14. Remove the 6 exhaust hangers.

15. Remove the 2 DPF heat shields.


- Remove the bolts.



Installation

1. Install the 2 DPF heat shields.

- Tighten to 10 Nm (7 lb.ft).
2. Install the exhaust hangers.
 3. Install the exhaust gas temperature sensors.
 - Tighten to 35 Nm (26 lb.ft).
 4. With assistance, install the exhaust system.
 - Secure the exhaust hangers.
 5. Connect the pre-catalytic converter exhaust gas temperature sensor electrical connector.
 6. Install the exhaust gas temperature sensor electrical connector heat shield.
 - Tighten to 10 Nm (7 lb.ft).

7.  CAUTION: Make sure that the mating faces are clean and free of corrosion and foreign material.

- NOTE: Install a new gasket.


Secure the catalytic converter to the turbocharger.

- Tighten the nuts to 48 Nm (35 lb.ft).
8. Secure the catalytic converter to DPF clamp.
 - Tighten to 48 Nm (35 lb.ft).
 9. Connect the DPF exhaust gas temperature sensor electrical connector.
 10. Connect the post-catalytic converter exhaust gas temperature sensor electrical connector.
 11. Secure the DPF differential pressure sensor.
 12. Connect the DPF differential pressure sensor electrical connector.
 13. Install the transmission crossmember.


For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Exhaust System - TDV6 2.7L Diesel - Muffler Vehicles Without: Diesel Particulate Filter (DPF)

Removal and Installation

Special Tool(s)	
 <p>100-051</p> <p>E45589</p>	<p>Pipe cutter-exhaust 100-051 (LRT-99-027)</p>

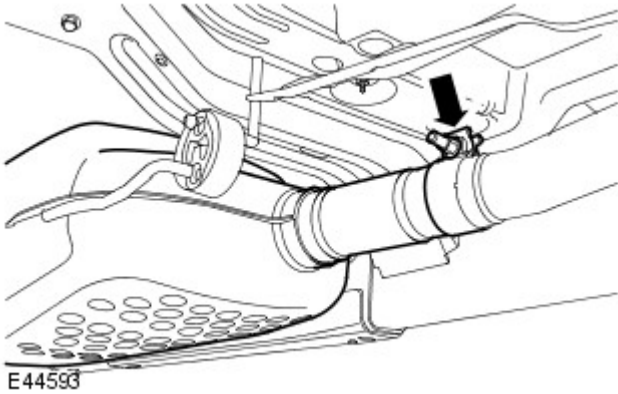
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

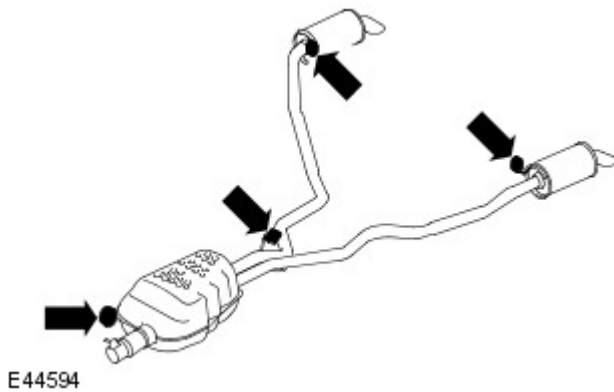
- Disconnect the catalytic converter from the muffler assembly.

- Remove the nut and release the retaining clamp.



- With assistance, remove the muffler assembly.

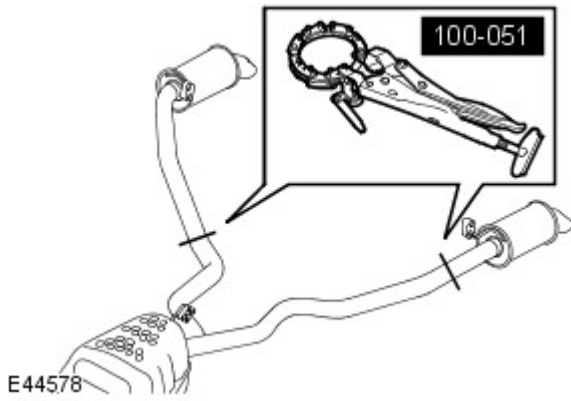
- Disconnect the 4 exhaust hangers.



- NOTE:** Do not disassemble further if the component is removed for access only.

Remove the LH tail pipe.

- Using 100-051, cut the tail pipe at the point indicated by a depression in the pipe.



5. Remove the RH tail pipe.

- Using 100-051, cut the tail pipe at the point indicated by a depression in the pipe.

Installation

1. **NOTE: Do not tighten the retaining clamp at this stage.**

Position the RH tail pipe to the muffler assembly.

- Clean the components.
- Install the retaining clamp.

2. **NOTE: Do not tighten the retaining clamp at this stage.**

Position the LH tail pipe to the muffler assembly.

- Clean the components.
- Install the retaining clamp.

3. With assistance, install the muffler assembly.

- Attach the exhaust hangers.
- Tighten the catalytic converter nuts and clamp to 48 Nm (35 lb.ft).


4. Align both tail pipes and tighten the retaining clamps to 55 Nm (40 lb.ft).

Exhaust System - TDV6 2.7L Diesel - Muffler Vehicles With: Diesel Particulate Filter (DPF)

Removal and Installation

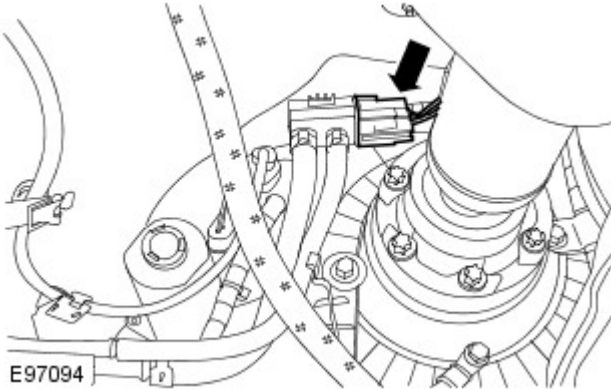
Removal

 **WARNING:** Observe due care when working near a hot exhaust system.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

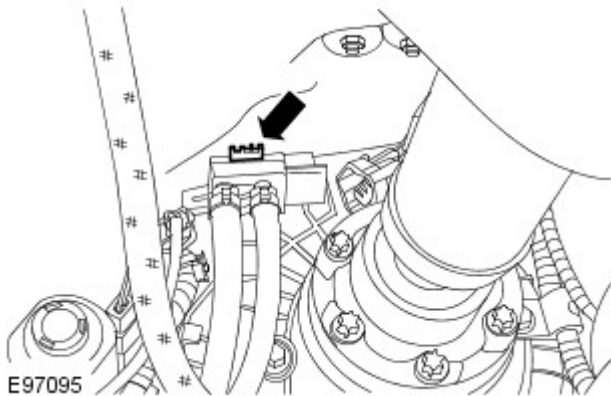
Raise and support the vehicle.

2. Disconnect the diesel particulate filter (DPF), differential pressure sensor electrical connector.

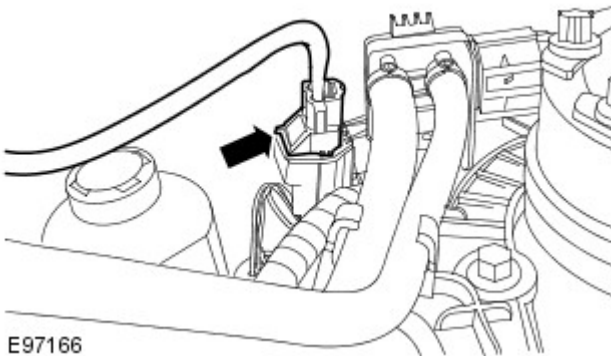



3. Release the DPF differential pressure sensor.

- Release the clip.

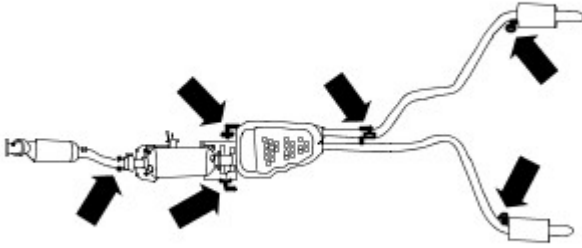


4. Disconnect the DPF exhaust gas temperature sensor electrical connector.



5.  CAUTION: Make sure that the exhaust system is supported with a suitable transmission stand.

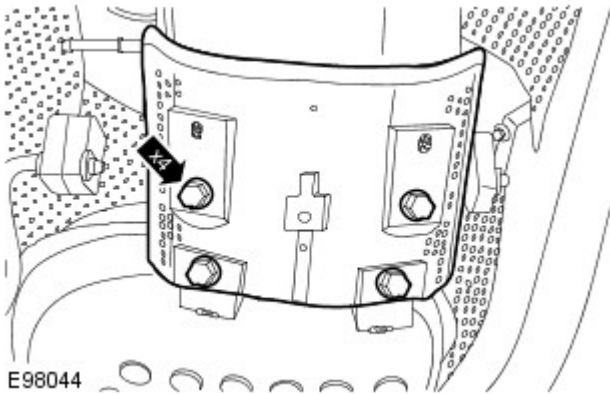
Release the 6 exhaust hangers.



E98050

6. Remove the DPF rear heat shield.

- Remove the 4 bolts.

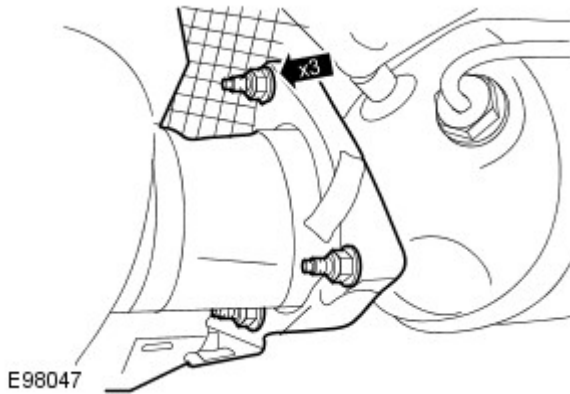


E98044

7. NOTE: Discard the gasket.

With assistance, remove the muffler and tailpipe assembly.

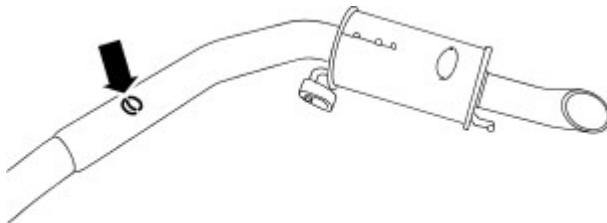
- Remove the 3 nuts.
- Remove the bracket.



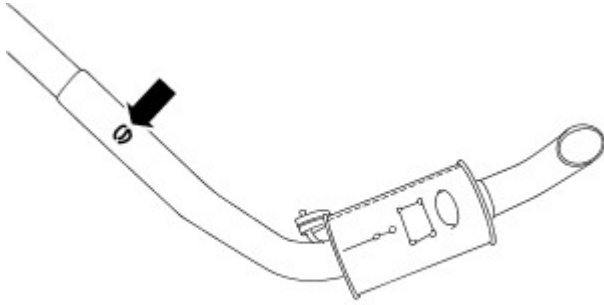
E98047

8. Remove the LH tail pipe.

- Using the special tool, cut the exhaust pipe at the marked position.



E87326



E87327

9. Remove the RH tail pipe.

- Using the special tool, cut the exhaust pipe at the marked position.

Installation

1. NOTE: Do not tighten the clamp at this stage.

Install the RH tail pipe to the muffler assembly.

- Clean the components.
- Install the clamp.

2. NOTE: Do not tighten the clamp at this stage.

Install the LH tail pipe to the muffler assembly.

- Clean the components.
- Install the clamp.

3. NOTE: Install a new gasket.

With assistance, install the muffler and tailpipe assembly.

- Install the bracket.
- Tighten the nuts to 48 Nm (35 lb.ft).
- Secure the exhaust hangers.

4. Align both of the tail pipes and tighten the clamps to 48 Nm (35 lb.ft).

5. Install the DPF rear heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).


6. Connect the DPF exhaust gas temperature sensor electrical connector.

7. Secure the DPF differential pressure sensor.


8. Connect the DPF differential pressure sensor electrical connector.

Exhaust System - TDV6 2.7L Diesel - Tailpipe

Removal and Installation

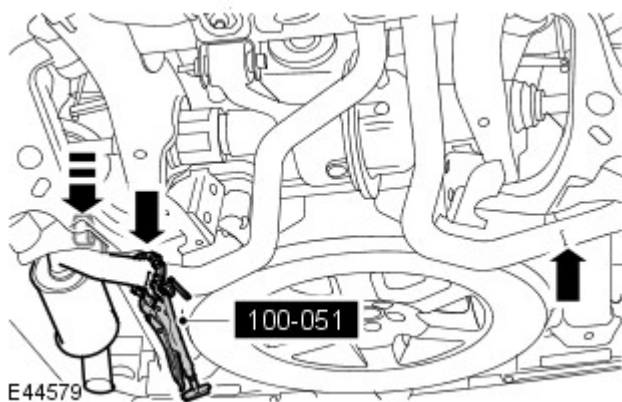
Special Tool(s)	
 E45589	Pipe cutter-exhaust
	100-051 (LRT-99-027)

Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the tail pipe.
 - Using 100-051, cut the tail pipe at the point indicated by a depression in the pipe.
 - Disconnect from the exhaust hanger.



Installation

- NOTE:** Do not tighten the retaining clamp at this stage.

Install the tail pipe.

- Clean the components.
- Install the retaining clamp.

- Align the tail pipe and tighten the retaining clamp to 55 Nm (40 lb.ft).

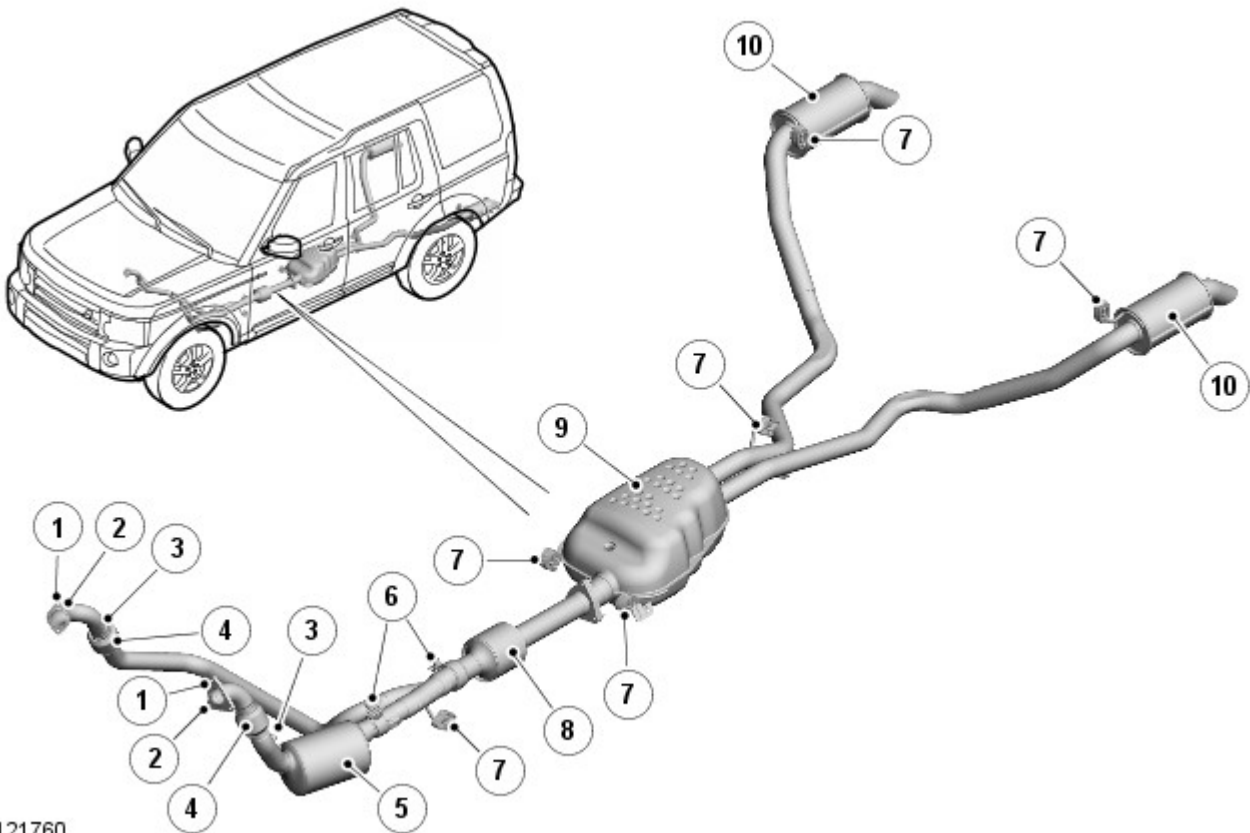
Exhaust System - TDV6 3.0L Diesel -

Description	Nm	lb-ft	lb -in
Turbocharger to catalytic converter retaining bolts	28	21	-
Catalytic converter clamp without diesel particulate filter (DPF)	48	35	-
Catalytic converter clamp with DPF	48	35	-
DPF to front muffler securing strap nuts	23	17	-
Catalytic converter temperature sensors	35	26	-
DPF temperature sensor	35	26	-
Heated oxygen sensor (HO2S)	48	35	-
DPF heat shield retaining bolts	10	7	-
Service clamp	48	35	-

Exhaust System - TDV6 3.0L Diesel - Exhaust System

Description and Operation

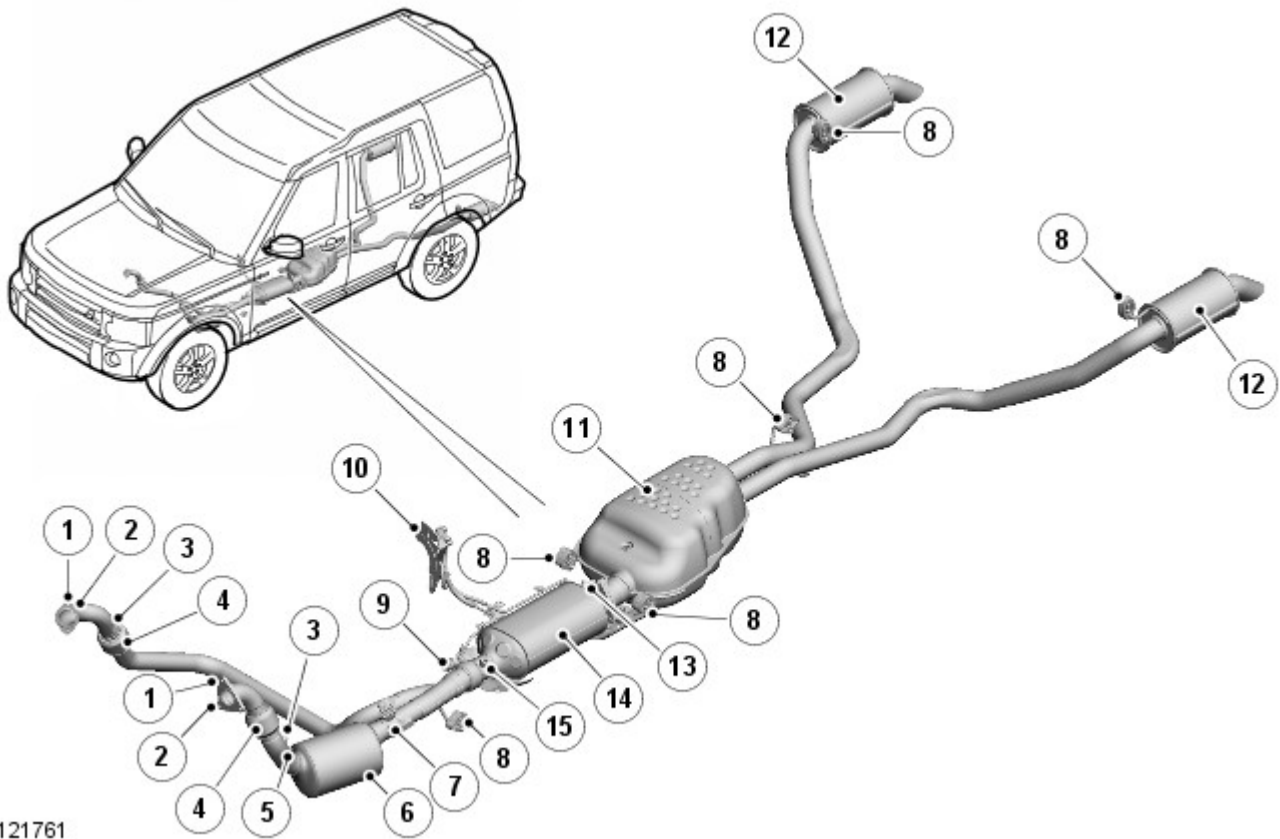
3.0L TdV6 EXHAUST SYSTEM COMPONENT LOCATION - WITHOUT DIESEL PARTICULATE FILTER



E121760

Item	Part Number	Description
1	-	Bolt (5 off)
2	-	Gasket
3	-	Flexible coupling
4	-	Heated Oxygen Sensor (HO2S) mounting boss
5	-	Catalytic converter
6	-	Clamp
7	-	Mounting rubber (6 off)
8	-	Catalytic converter
9	-	Silencer - Center
10	-	Silencer - Rear

3.0L TdV6 EXHAUST SYSTEM COMPONENT LOCATION - WITH DIESEL PARTICULATE FILTER (IF FITTED)



E121761

Item	Part Number	Description
1	-	Bolt (5 off)
2	-	Gasket
3	-	Temperature sensor mounting boss
4	-	Flexible coupling
5	-	HO2S mounting boss
6	-	Catalytic converter
7	-	Clamp
8	-	Mounting rubber (6 off)
9	-	Clamp
10	-	Differential pressure sensor
11	-	Silencer - Center
12	-	Silencer - Rear
13	-	Temperature sensor mounting boss
14	-	Diesel Particulate Filter (DPF)
15	-	Temperature sensor mounting boss

OVERVIEW

The 3.0L V6 TdV6 exhaust system is fabricated from stainless steel and is supplied as four separate assemblies; 2 front sections, one incorporating a catalytic converter, a connecting section or Diesel Particulate Filter (DPF) and a rear section incorporating a centre silencer and two rear silencers.

The system is attached to the underside of the body with 6 mounting rubbers which are located on mild steel hanger bars that are welded to the system. The mounting rubbers locate on corresponding hangers which are welded to the underside of the vehicle body.

The system has service repair items available. Indentations in the rear section between the center and the rear silencers show the cut points for the service replacement rear silencers or front section. When a service repair section is used, the joint is connected using a sleeve and two clamps to connect the pipes at the cut points.

Two variants of the exhaust system are available; a non DPF system and a system incorporating a DPF. The DPF is required to comply with EU5 emission regulations



CAUTION: The use of bio-fuels can seriously contaminate and destroy the coatings used on the catalytic converter. The DPF and the catalytic converter can become irreversibly contaminated if non-specified oils or fuels are used. This will result in the vehicle being unable to regenerate the DPF, becoming non-compliant with tailpipe emission regulations and replacement of the catalytic converter and DPF will be required.

If the vehicle is waded in deep water and the engine is stopped with the tailpipes submerged, the water, which can enter the system, can also contaminate both the DPF and the catalytic converter. This again can result in catalytic converter damage and damaging the ability for the DPF to regenerate therefore requiring both components to be replaced.

DESCRIPTION

FRONT SECTION

The front section comprises 1 catalytic converter for the LH (left-hand) bank of cylinders. The catalytic converter has a welded inlet pipe which is curved through 90 degrees. The RH (right-hand) bank also has a curved inlet pipe which connects to a pipe to the DPF (if fitted) or catalytic converter assembly (vehicles without DPF).

The outer end of each inlet pipe is fitted with a flange which mates with the turbocharger for each bank of cylinders. Three bolts in the LH flange and two bolts in the RH flange locate in threaded holes in the mating flange on the turbocharger. Each flange is sealed with a gasket. The inlet pipes are 55 mm (2.16 in) diameter and are fitted with a flexible coupling.

The base of the catalytic converter has a connection with the LH bank outlet pipe and is secured with a clamp. The outlet connection from the LH bank catalytic converter and the outlet connection from the RH bank, merge into one single pipe which then connects to the DPF (if fitted) or catalytic converter assembly (vehicles without DPF).

The DPF (if fitted) or catalytic converter assembly (vehicles without DPF) is connected at its rearward end to the center silencer with a flange connection with the rear exhaust section. Three studs in the DPF (if fitted) or catalytic converter assembly (vehicles without DPF) mate with the center silencer rear section flange and are secured with 3 nuts and sealed with a gasket.

REAR SECTION

The centre silencer comprises two pressed stainless steel shells which are welded together to give a capacity of 25.2 liters (1537 in³). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gases pass through the silencer.

Hanger bars are welded to the front right hand side and left hand side of the silencer and provide for the location of mounting rubbers. The silencer has two 60 mm (2.3 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which are curved to pass around the rear suspension components. Each outlet pipe terminates in a welded joint with the rear silencers. The outlet pipes have a hanger bar which provides for the location of a mounting rubber. A hanger bar is welded to the front face of each rear silencer and provides for the location of a mounting rubber.

The silencer is a circular fabrication with a baffle tube which is surrounded with glass fiber to provide further noise suppression. Each silencer has a capacity of 2.7 liters (165 in³). The silencers each have an outlet pipe which is 65 mm (2.55 in) diameter, with a wall thickness of 1.2 mm (0.05 in). Each outlet pipe is curved downwards to direct exhaust gasses away from the rear of the vehicle.

CATALYTIC CONVERTER

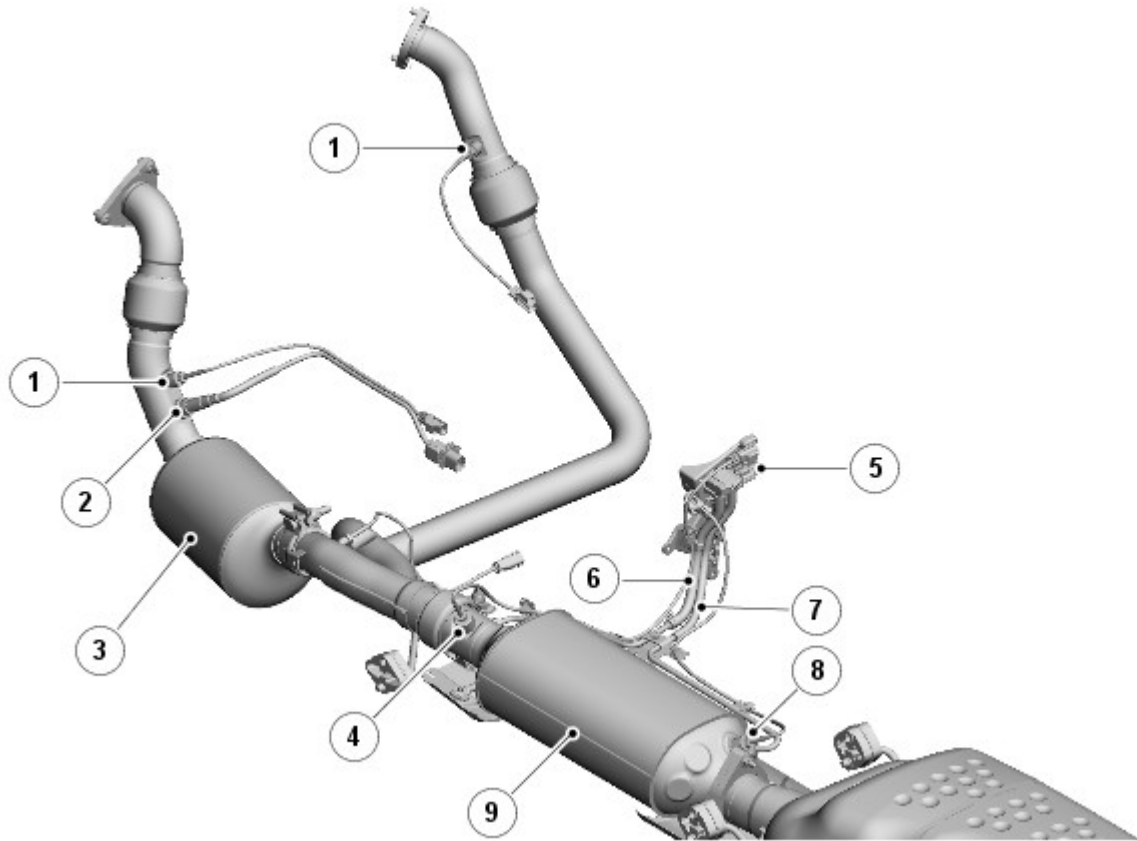
The oxidizing catalytic converter is fitted in the front section of the LH bank outlet pipe from the turbocharger, after the pre-catalyst exhaust gas temperature sensor (vehicles with DPF only) and the Heated Oxygen Sensor (HO2S).

• **NOTE:** On vehicles fitted with a DPF: The pre and post catalyst exhaust gas temperature sensors are used by the engine management system to monitor the DPF for regeneration purposes.

On vehicles without a DPF, a second smaller catalytic converter is fitted in place of the DPF to further improve emissions.

The engine management system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient use of fuel and to minimise the exhaust emissions. To further reduce the carbon monoxide and hydrocarbons content of the exhaust gases, a catalytic converter is integrated into the LH bank front pipe of the exhaust system. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called 'washcoat'. The washcoat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the washcoat is a coating containing platinum and palladium, which are the active constituents for converting harmful emissions into inert by-products. The platinum and palladium add oxygen to the carbon monoxide and the hydrocarbons in the exhaust gases, to convert them into carbon dioxide and water respectively.

DIESEL PARTICULATE FILTER (DPF)



E121762

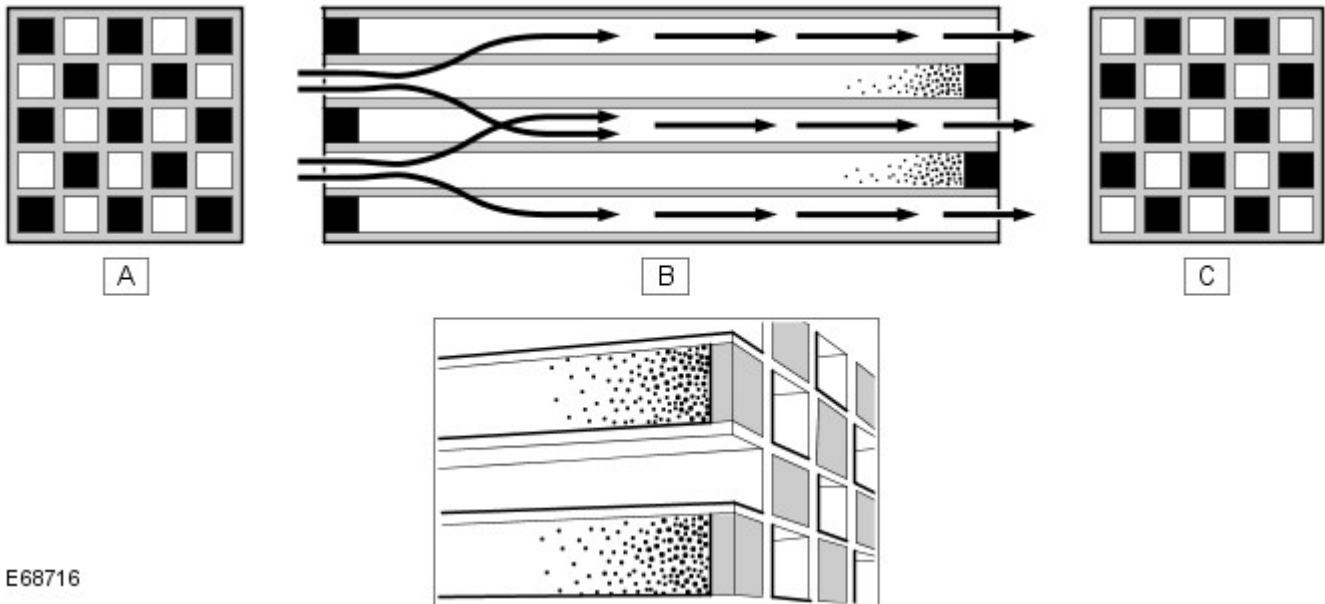
Item	Part Number	Description
1	-	Exhaust gas temperature sensor (2 off)
2	-	HO2S
3	-	Catalytic converter
4	-	Pre DPF temperature sensor
5	-	Differential pressure sensor
6	-	High pressure pipe
7	-	Low pressure pipe
8	-	Post DPF temperature sensor
9	-	DPF

The DPF system reduces diesel particulate emissions to negligible levels to meet European Stage 5 emission standards. The particulate emissions are the black fumes emitted from the diesel engine under certain load conditions. The emissions are a complex mixture of solid and liquid components with the majority of the particulates being carbon microspheres on which hydrocarbons from the engine's fuel and lubricant condense.

The DPF is located in the exhaust system, downstream of the catalytic converters. A major feature of the DPF is its ability for to trap carbon particles before they are emitted to the atmosphere and then to oxidize the carbon at an opportune time. Regeneration is the oxidation of particulates trapped by the filter. The regeneration process takes place at calculated intervals and is not noticeable by the driver of the vehicle. Regeneration is most important, since an overfilled filter can damage the engine through excessive exhaust back pressure and can itself be damaged. The material trapped in the filter is in the most part carbon particles with some absorbed hydrocarbons.

The DPF system comprises the following components:

- • Diesel particulate filter (silicone carbide ceramic)
- • DPF control software incorporated into the Engine Control Module (ECM)
- • Exhaust gas temperature sensors
- • Differential pressure sensor.



E68716

Item	Part Number	Description
A	-	A. Front face showing alternate closed cells
B	-	B. Side view showing exhaust gas flow through the filter and particulate build up
C	-	C. Rear face showing alternate closed cells

The DPF uses a technology based on a filter with a catalytic coating. The DPF is made from silicon carbide housed in a steel container and has excellent thermal shock resistance and thermal conductivity properties. The DPF is designed for the engine's operating requirements to maintain the optimum back pressure requirements.

The porous surface of the filter consists of a number of small parallel channels positioned in the longitudinal direction of the exhaust system. Adjacent channels in the filter are alternately plugged at the end. This design forces the exhaust gasses to flow through the porous walls, which act as the filter medium. Particulate matter which are too big to pass through the porous surface are collected and stored in the channels.

The collected particulate matter, if not removed, can create an obstruction to exhaust gas flow. The particles are removed by a regeneration process which oxidizes the particles.

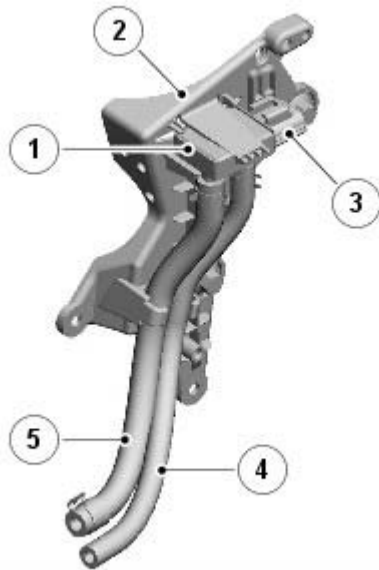
DPF regeneration is controlled by the temperature of the exhaust gasses and the DPF. The DPF includes a wash coat to the filter surface which comprises platinum and other active components and is similar to the catalytic converter. At certain exhaust gas and DPF temperatures the assembly promotes oxidation of the particles in addition to oxidizing carbon monoxide and hydrocarbon emissions.

The exhaust gas and DPF temperatures are controlled by the DPF software located in the ECM. The DPF software monitors the load status of the DPF based on driving style, distance travelled and signals from the differential pressure sensor and temperature sensors. When the particulate loading of the DPF reaches predetermined levels, the DPF is actively regenerated by adjusting, in conjunction with the ECM, various engine control functions such as:

- • fuel injection
- • intake air throttle
- • exhaust gas recirculation
- • turbocharger boost pressure control.

The regeneration process is possible because of the flexibility of the common-rail fuel injection engine which provides precise control of fuel flow, fuel pressure and injection timing which are essential requirements to promote the efficient regeneration process.

Differential Pressure Sensor



E121763

Item	Part Number	Description
1	-	Differential pressure sensor
2	-	Bracket (attached to transfer box)
3	-	Electrical connector
4	-	Low pressure pipe
5	-	High pressure pipe

The differential pressure sensor is located on a bracket which is attached to the transfer case.

The differential pressure sensor is used by the DPF software to monitor the condition of the DPF. Two pipe connections on the sensor are connected by pipes to the inlet and outlet ends of the DPF. The pipes allow the sensor to measure the inlet (high) and outlet (low) pressures of the DPF

As the amount of particulates trapped by the DPF increases, the pressure at the inlet side of the DPF increases in comparison to the DPF outlet. The DPF software uses this comparison, in conjunction with other data, to calculate the accumulated amount of trapped particulates.

By measuring the pressure difference between the DPF inlet and outlet and the DPF temperature, the DPF software can determine if the DPF is becoming blocked and requires regeneration.

Diesel Particulate Filter Temperature Sensors

Four temperature sensors are used in the DPF system. Two temperature sensors are located in the inlet pipes from each cylinder bank, just before the flexible couplings. A third is located in the inlet pipe to the DPF and the fourth sensor is located in the DPF outlet pipe to the center silencer.

The sensors measure the temperature of exhaust gas leaving the turbochargers, the temperature of the exhaust gas before it passes through the DPF and the temperature of the exhaust gas exiting the DPF. The 4 sensors provide the information needed to calculate the DPF temperature.

The information is used, in conjunction with other data, to estimate the amount of accumulated particulates and to control the DPF temperature.

Instrument Cluster Indications

For drivers who make regular short journeys at low speeds, it may not be possible to efficiently regenerate the DPF. This condition will be detected by the DPF software and will alert the driver as follows:

When the DPF becomes full the driver will be alerted to this condition by a message 'DPF FULL' accompanied by a handbook symbol. As detailed in the Owners Handbook, the driver should drive the vehicle until the engine is at its normal operating temperature and then drive for a further 20 minutes at speeds of between 45 and 70 mph (72 and 112 km/h). Successful regeneration of the DPF is indicated to the driver by the 'DPF FULL' message no longer being displayed. It should be noted that this condition is not a fault in the hardware. The message is intended to provide feedback to the driver that the current driving style may not be optimal for DPF regeneration and that high oil dilution may occur (refer to the following section 'Engine Oil Dilution').

A further DPF loading state may occur in which the DPF software detects that the DPF is still blocked, the message will change to 'DPF FULL VISIT DEALER', the driver should take the vehicle to an authorized dealer to have the DPF force regenerated. This message may imply that the DPF requires replacement - refer to service documentation for service regeneration options before replacing the DPF.

DIESEL PARTICULATE FILTER - SIDE EFFECTS

The following section details some side effects caused by the active regeneration process.

Engine Oil Dilution

Engine oil dilution can occur due to small amounts of fuel entering the engine crankcase during the post-injection phases. This has made it necessary to introduce a calculation based on driving style to reduce oil service intervals if necessary.

The driver is alerted to the oil service by a message in the instrument cluster.

The DPF software monitors the driving style, the frequency of the active regeneration and duration. Using this information a calculation can be made on the engine oil dilution. When the DPF software calculates the engine oil dilution has reached a predetermined threshold (fuel being 7% of engine oil volume) a service message is displayed in the instrument cluster.

Depending on driving style, some vehicles may require an oil service before the designated interval. If an service message is displayed, the vehicle will be required to have a full service and the service interval counter will need to be reset.

Fuel Consumption

During the active regeneration process of the DPF, there will be an increase in fuel consumption. However, because active regeneration occurs infrequently and for limited periods of time, the overall effect on fuel consumption is less than 1%. The additional fuel used during the active regeneration process is accounted for in the instantaneous (where applicable) and average fuel consumption displays in the instrument cluster.

OPERATION

Passive Regeneration

Passive regeneration requires no special engine management intervention and occurs during normal engine operation. The passive regeneration involves a slow conversion of the particulate matter deposited in the DPF into carbon dioxide. This process is active when the DPF temperature reaches 250°C (482°F) and is a continuous process when the vehicle is being driven at higher engine loads and speeds.

During passive regeneration, the oxidation rate is low. This is due to the chemical reaction process and is only effective within the normal operating temperature range of 250°C to 500°C (482°F to 932°F).

Above this temperature range the conversion efficiency of the particulates into carbon dioxide increases as the DPF temperature is raised. These temperatures can normally be achieved using the active regeneration process.

Active Regeneration

Active regeneration starts when the particulate loading of the DPF reaches a threshold as monitored or determined by the DPF control software. The threshold calculation is based on driving style, distance travelled and back pressure signals from the differential pressure sensor.

Active regeneration generally occurs every 450 miles (725 km) although this is highly dependant on how the vehicle is driven. For example, if the vehicle is driven at low loads in urban traffic regularly, active regeneration will occur more often. This is due to the rapid build-up of particulates in the DPF than if the vehicle is driven at high speeds when passive regeneration will have occurred.

The DPF software incorporates a mileage trigger which is used as back-up for active regeneration. If active regeneration has not been initiated by a back pressure signal from the differential pressure sensor, regeneration is requested based on distance traveled.

Active regeneration of the DPF is commenced when the temperature of the DPF is increased to the oxidation temperature of the particles. The DPF temperature is raised by increasing the exhaust gas temperature. This is achieved by introducing post-injection of fuel after the pilot and main fuel injections have occurred.

This is determined by the DPF software monitoring the signals from the two DPF temperature sensors to establish the temperature of the DPF. Depending on the DPF temperature, the DPF software requests the ECM to perform either one or two post-injections of fuel:

- The first post-injection of fuel retards combustion inside the cylinder which increases the temperature of the exhaust gas
- The second post-injection of fuel is injected late in the power stroke cycle. The fuel partly combusts in the cylinder, but some unburnt fuel also passes into the exhaust where it creates an exothermic event within the catalytic converter, further increasing the temperature of the DPF.

The active regeneration process takes approximately 20 minutes to complete. The first phase increases the DPF temperature to 500°C (932°F). The second phase further increases the DPF temperature to 600°C (1112°F) which is the optimum temperature for particle combustion. This temperature is then maintained for 15-20 minutes to ensure complete oxidation of the particles within the DPF. The process converts the carbon particles to carbon dioxide and water.

The active regeneration temperature of the DPF is closely monitored by the DPF software to maintain a target temperature of 600°C (1112°F) at the DPF inlet. The temperature control ensures that the temperatures do not exceed the operational limits of the turbocharger and the catalytic converter. The turbocharger inlet temperature must not exceed 830°C (1526°F) and the catalytic converter brick temperature must not exceed 800°C (1472°F) and the exit temperature must remain below 750°C (1382°F).

During the active regeneration process the following ECM controlled events occur:

- The turbocharger is adjusted to reduce boost pressure. This minimizes heat transmission from the exhaust gas to the turbocharger and reduces the rate of exhaust gas flow allowing optimum heating of the DPF. If the driver demands an increase in engine torque, the turbocharger will respond by closing the vanes as necessary
- The intake throttle is adjusted as this assists in increasing the exhaust gas temperature and reduces the rate of exhaust gas flow which has the effect of reducing the time for the DPF to reach the optimum temperature
- The Exhaust Gas Recirculation (EGR) valve is closed. The use of EGR decreases the exhaust gas temperature and therefore prevents the optimum DPF temperature being achieved.

If, due to vehicle usage and/or driving style, the active regeneration process cannot take place or is unable to regenerate the DPF, the dealer can force regenerate the DPF. This is achieved by either driving the vehicle until the engine is at its normal operating temperature and then driving for a further 20 minutes at speeds of between 45 and 70 mph (72 and 112 km/h) or by connecting a Jaguar approved diagnostic system to the vehicle which will guide the technician through an automated regeneration procedure to clean the DPF.

Diesel Particulate Filter Control

The DPF requires constant monitoring to ensure that it is operating at its optimum efficiency and does not become blocked. The ECM contains DPF software which controls the monitoring and operation of the DPF system and also monitors other vehicle data to determine regeneration periods and service intervals.

The DPF software can be divided into three separate control software modules; a DPF supervisor module, a DPF fuel management module and a DPF air management module.

These three modules are controlled by a fourth software module known as the DPF co-ordinator module. The co-ordinator module manages the operation of the other modules when an active regeneration is requested. The DPF supervisor module is a sub-system of the DPF co-ordinator module.

DPF Fuel Management Module

The DPF fuel management module controls the following functions:

- • Timing and quantity of the four split injections per stroke (pilot, main and two post injections)
- • Injection pressure and the transition between the three different calibration levels of injection.

The above functions are dependant on the condition of the catalytic converter and the DPF.

The controlled injection determines the required injection level in addition to measuring the activity of the catalytic converter and the DPF. The fuel management calculates the quantity and timing for the four split injections, for each of the three calibration levels for injection pressure, and also manages the transition between the levels.

The two post injections are required to separate the functionality of increasing in-cylinder gas temperatures and the production of hydrocarbons. The first post injection is used to generate the higher in-cylinder gas temperature while simultaneously retaining the same engine torque output produced during normal (non-regeneration) engine operation. The second post injection is used to generate hydrocarbons by allowing unburnt fuel into the catalytic converter without producing increased engine torque.

DPF Air Management Module

The DPF air management module controls the following functions:

- • EGR control
- • Turbocharger boost pressure control
- • Intake air temperature and pressure control.

During active regeneration, the EGR operation is disabled and the closed-loop activation of the turbocharger boost controller is calculated. The air management module controls the air in the intake manifold to a predetermined level of pressure and temperature. This control is required to achieve the correct in-cylinder conditions for stable and robust combustion of the post injected fuel.

The module controls the intake air temperature by actuating the EGR throttle and by adjustment of the turbocharger boost pressure control.

DPF Co-ordinator Module

The DPF co-ordinator module reacts to a regeneration request from the supervisor module by initiating and co-ordinating the following DPF regeneration requests:

- EGR cut-off
- Turbocharger boost pressure control
- Engine load increase
- Control of air pressure and temperature in the intake manifold
- Fuel injection control.

When the supervisor module issues a regeneration request, the co-ordinator module requests EGR cut-off and a regeneration specific turbocharger boost pressure control. It then waits for a feedback signal from the EGR system confirming that the EGR valve is closed.

When the EGR valve is closed, the co-ordinator module initiates requests to increase engine load by controlling the intake air temperature and pressure.

Once confirmation is received that intake conditions are controlled or a calibration time has expired, the co-ordinator module then changes to a state awaiting an accelerator pedal release manoeuvre from the driver. If this occurs or a calibration time has expired, the co-ordinator module generates a request to control fuel injections to increase exhaust gas temperature.

Exhaust System - TDV6 3.0L Diesel - Exhaust System

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual.

REFER to: Exhaust System (309-00A, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests

1. 1. Verify the customer concern
2. 2. Visually inspect for obvious signs of mechanical or electrical damage

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Leaks ● Metal fatigue ● Pipes ● Catalytic converter ● Muffler(s) ● Joints ● Mountings ● Clearance around components 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for DTCs and refer to the DTC Index

Symptom Chart

Symptom	Possible Causes	Action
Noisy or leaking exhaust	<ul style="list-style-type: none"> ● Exhaust system/components 	Install new components as necessary. Refer to the relevant section of the workshop manual
Lack of power	<ul style="list-style-type: none"> ● Air intake system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust Gas Recirculation (EGR) valve(s) fault ● Turbocharger fault 	Check the air intake system. Check for a blocked catalytic converter or muffler, install new components as necessary. Check the fuel pressure. For EGR and turbocharger tests, refer to the relevant section of the workshop manual

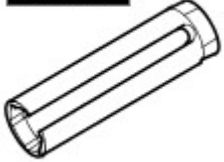
DTC Index

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - TDV6 3.0L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Exhaust System - TDV6 3.0L Diesel - Catalytic Converter


Removal and Installation

Special Tool(s)

 <p>310-121 Wrench, H02S</p> <p>E53465</p>	310-121 Wrench, H02S
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Removal

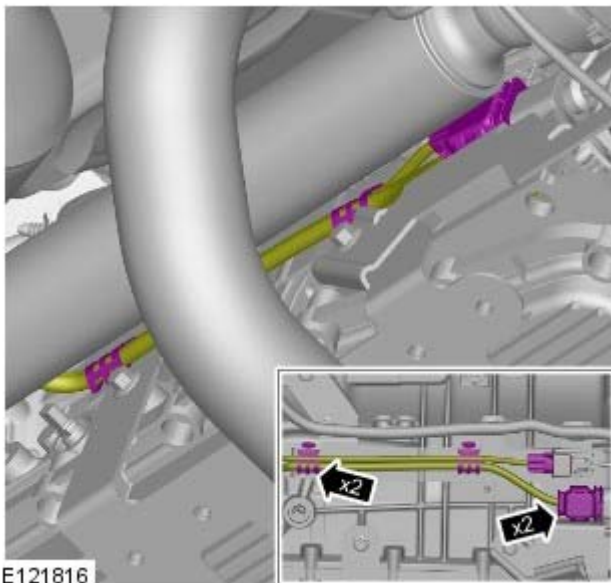
- NOTE: Removal steps in this procedure may contain installation details.

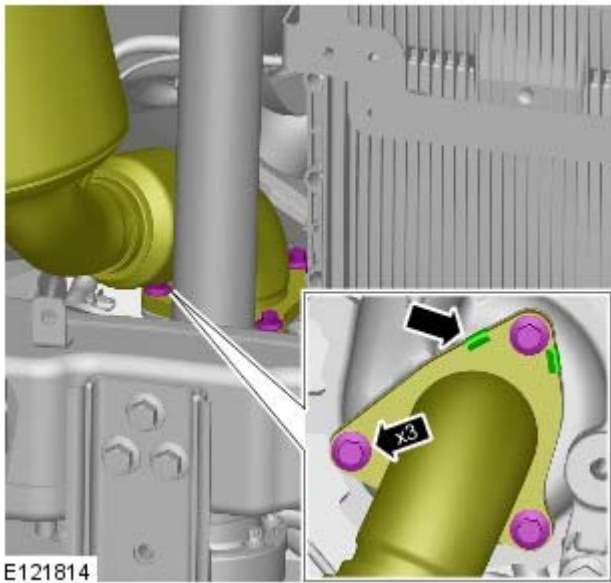
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.


Raise and support the vehicle.

2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

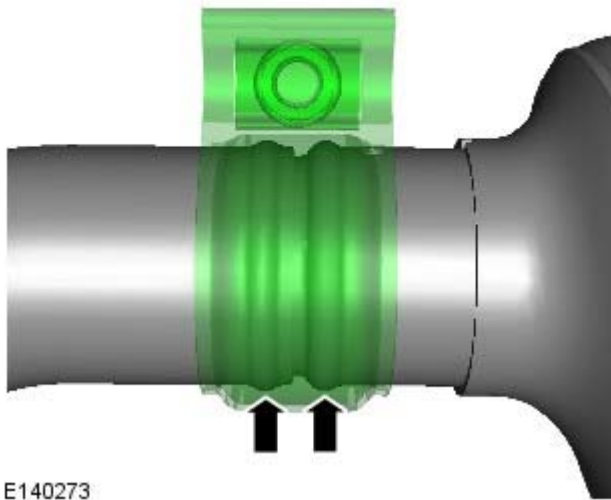
4.



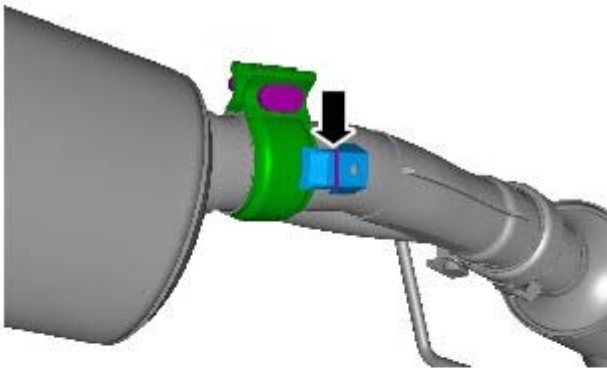


5.  CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

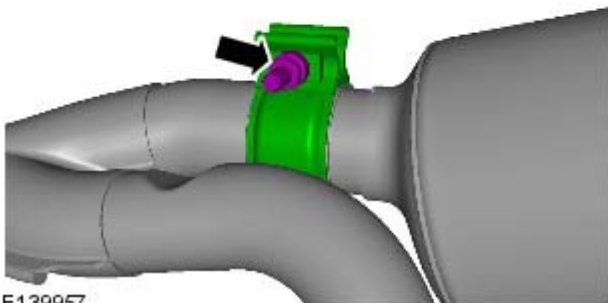
Torque: 28 Nm



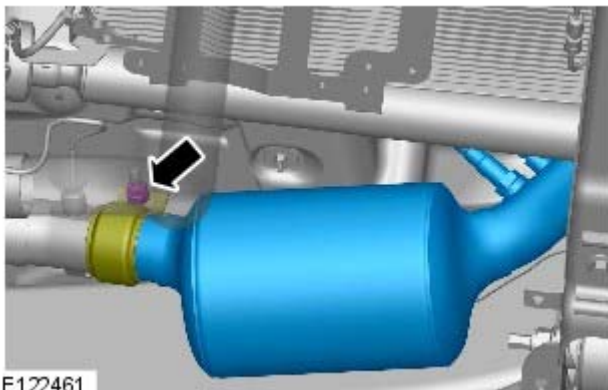
6. 6. NOTE: Note the orientation of the component prior to removal.



E139957



E122461



E122462

7.  **WARNING:** Always wear hand, eye and ear safety standard protection when grinding.

 **CAUTION:** Discard the clamp.

- **NOTE:** For vehicles with a welded exhaust clamp only.

Using suitable cutting/grinding equipment remove the clamp weld at the point illustrated.

Torque: 55 Nm

8. **8. CAUTIONS:**

 If weld is present on the clamp, grind off and install a new clamp.

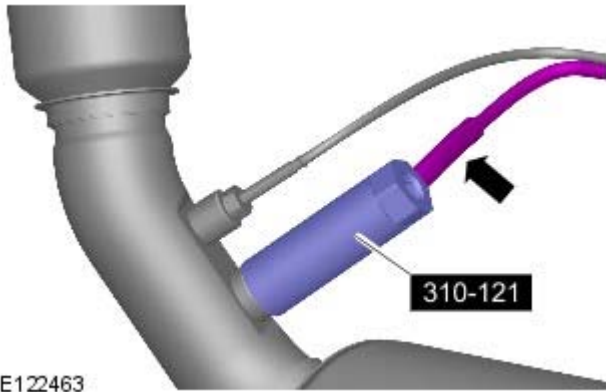
 Discard the clamp.

- **NOTE:** Note the orientation of the component prior to removal.

Torque: 55 Nm

9. **9. NOTE:** Do not disassemble further if the component is removed for access only.

Torque: 35 Nm



10. **NOTE:** Do not disassemble further if the component is removed for access only.

Special Tool(s): [310-121](#)
Torque: [48 Nm](#)

Installation

1. **CAUTIONS:**



If accidentally dropped or knocked install a new sensor.



Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

- **NOTE:** Install the retaining clamp.
- **NOTE:** Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.
- **NOTE:** If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

Exhaust System - TDV6 3.0L Diesel - Diesel Particulate Filter (DPF)

Removal and Installation

General Equipment

Transmission jack

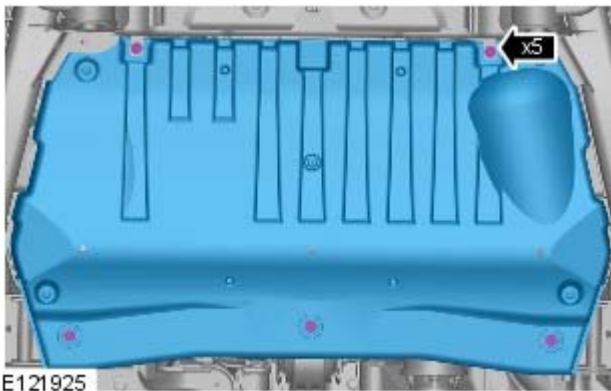
Removal

- NOTE: Removal steps in this procedure may contain installation details.

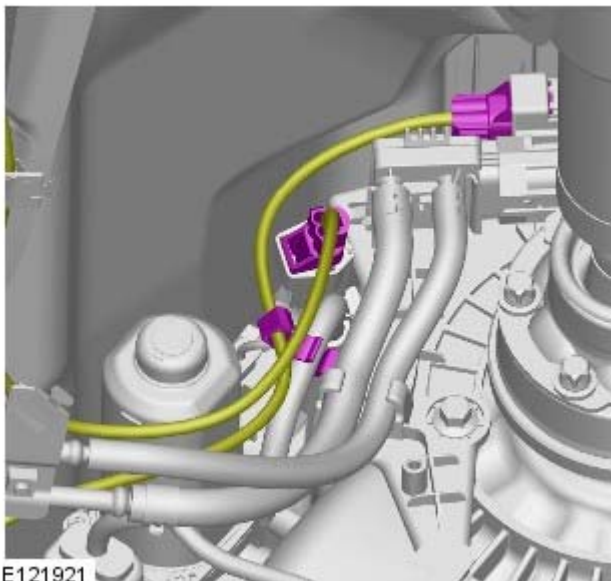
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Torque: 10 Nm

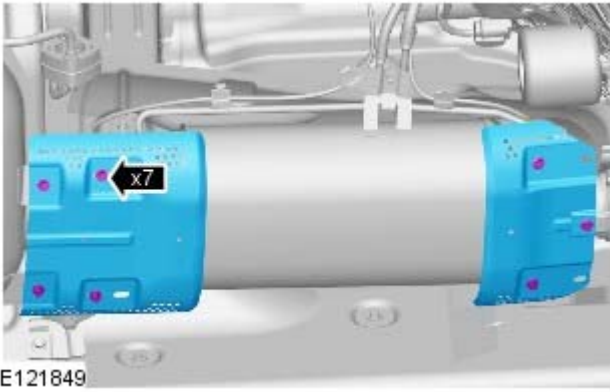


E121925

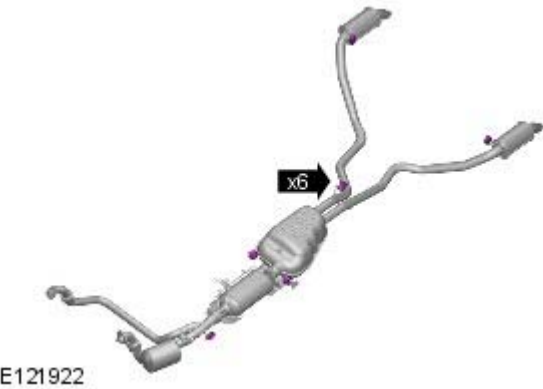



E121921

- 3.



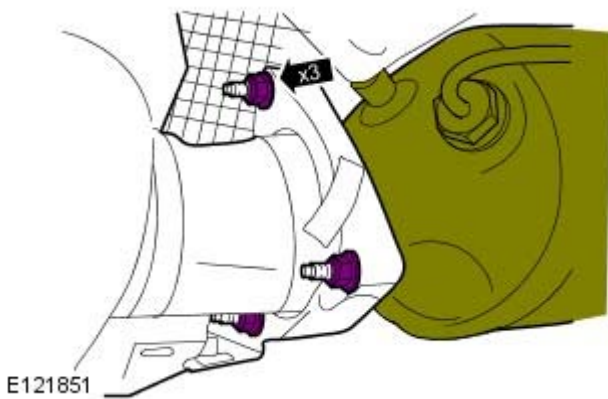
4. Torque: 10 Nm



5.  CAUTION: Make sure that the exhaust system is supported with a suitable transmission stand.

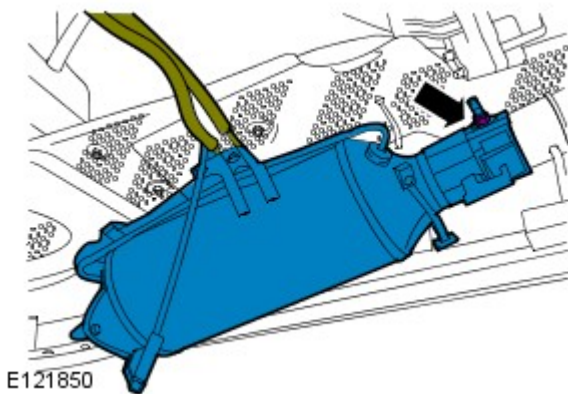
Release the 6 exhaust hangers.

General Equipment: [Transmission jack](#)



6. NOTE: Discard the gasket.

Torque: 23 Nm



7. Torque: 50 Nm

Installation

1. To install, reverse the removal procedure.

2. If a new unit is installed, configure using the approved diagnostic tool.

Exhaust System - TDV6 3.0L Diesel - Exhaust System

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

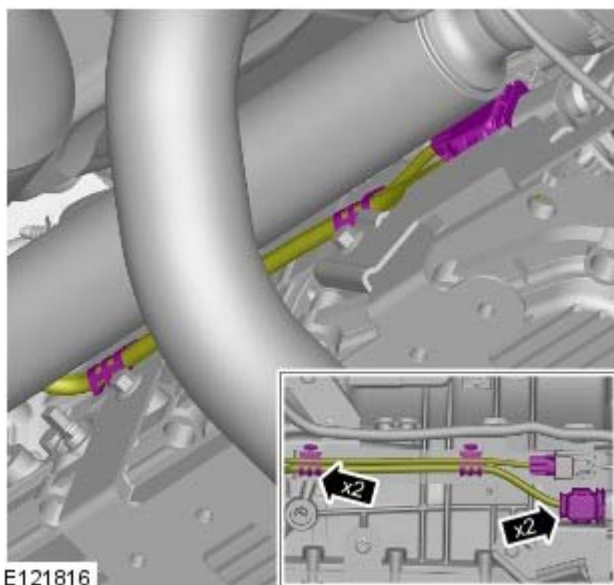
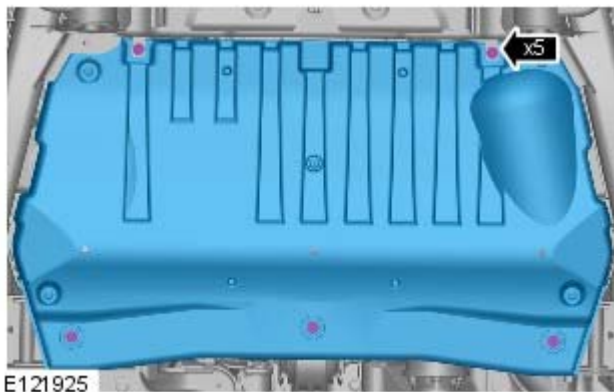
All vehicles

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

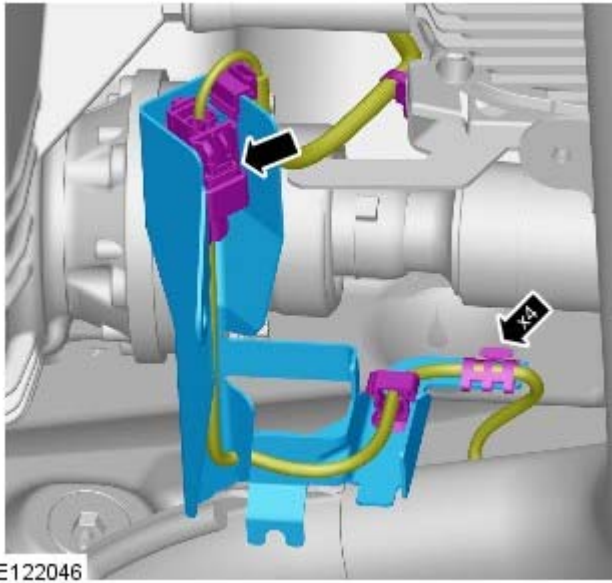
Raise and support the vehicle.

2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: [Transmission Support Crossmember - TDV6 3.0L Diesel](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

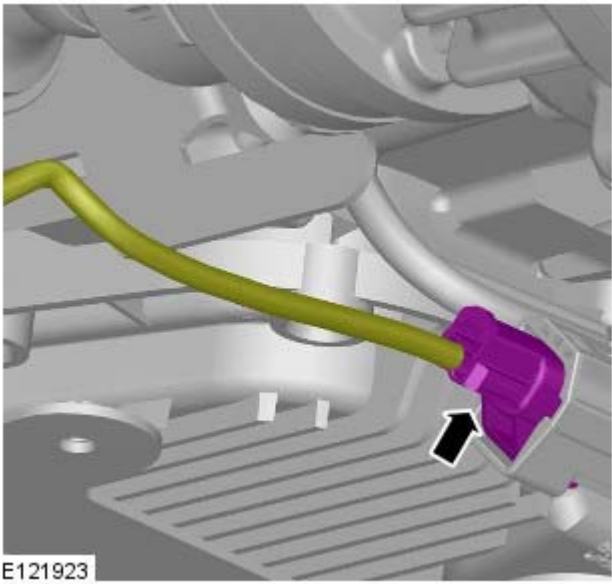
4. Torque: 10 Nm



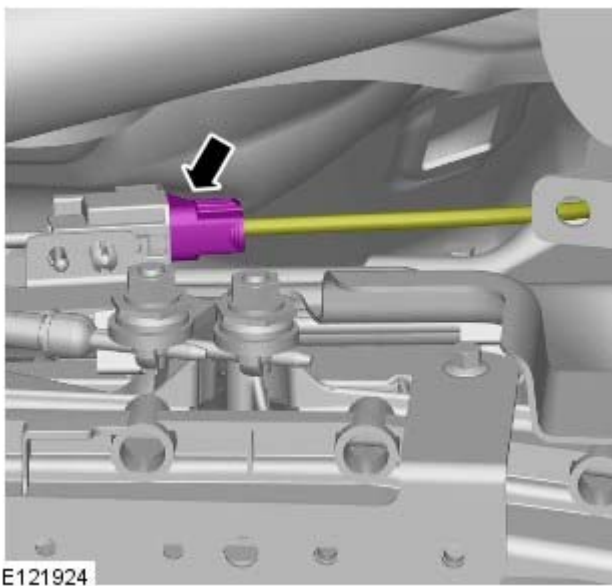
- 5.



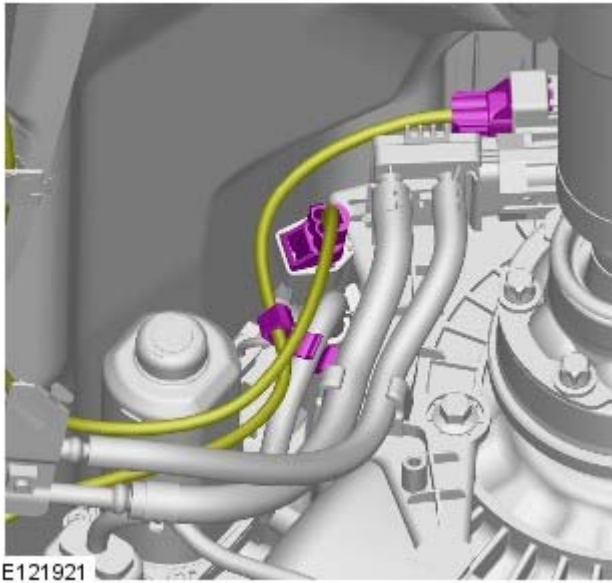
6.



7.

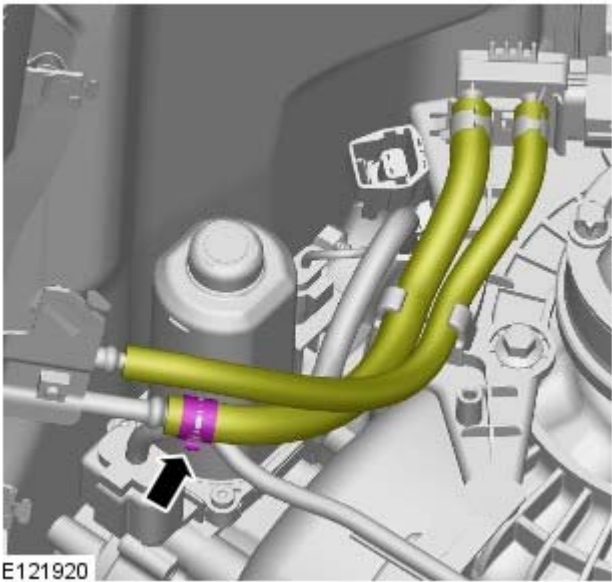


8.



E121921

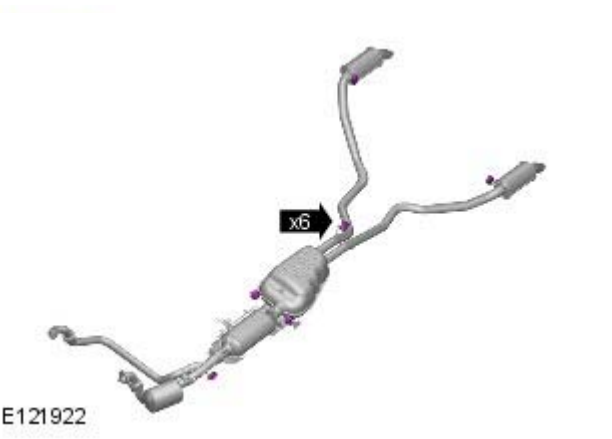
9.



E121920

10.

All vehicles



E121922

- 13. **NOTE:** Do not disassemble further if the component is for a **CAUTION:** Make sure that the exhaust system is supported with suitable retaining straps.
- 12. With assistance, remove the exhaust system.
Torque: 28 Nm

Installation



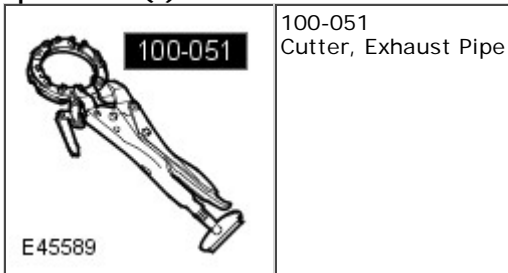
E121815

1. To install, reverse the removal procedure.

Exhaust System - TDV6 3.0L Diesel - Front Muffler

Removal and Installation

Special Tool(s)



General Equipment

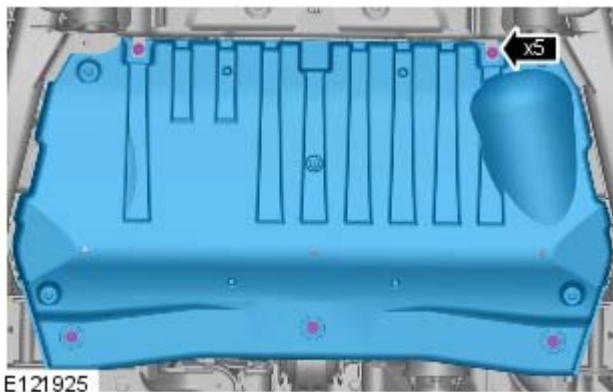
Transmission jack

Removal

All vehicles

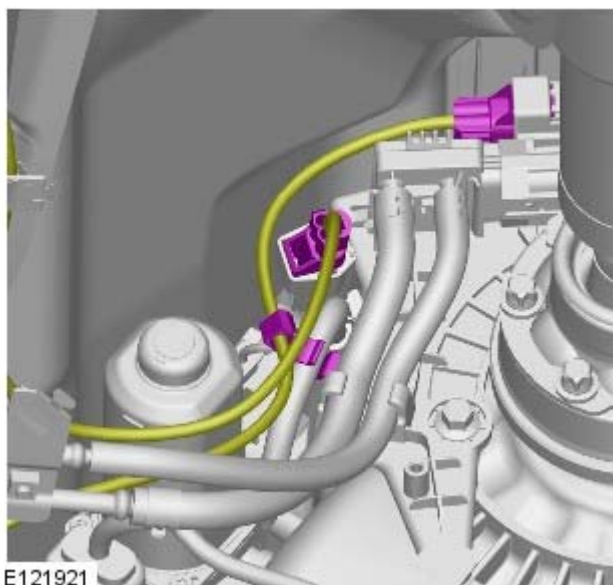
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

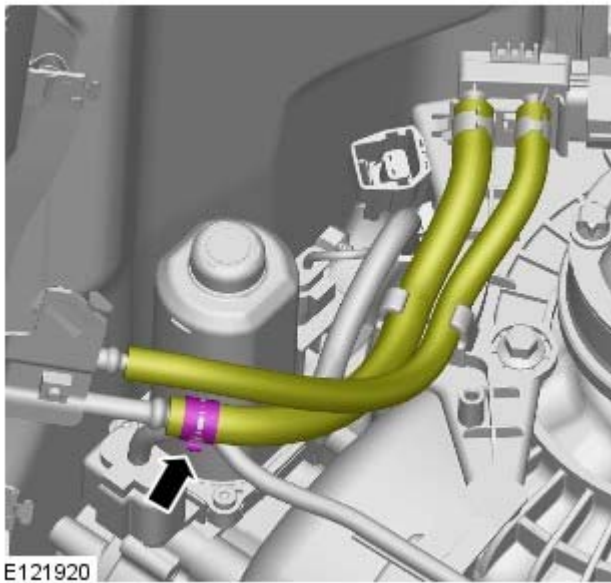


2. Remove the 6 bolts.

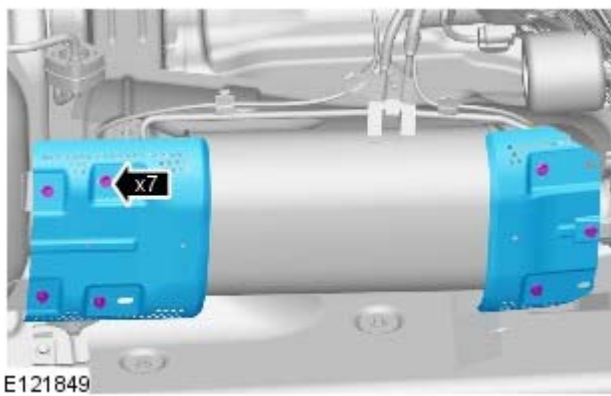
Vehicles with diesel particulate filter (DPF)



- 3.

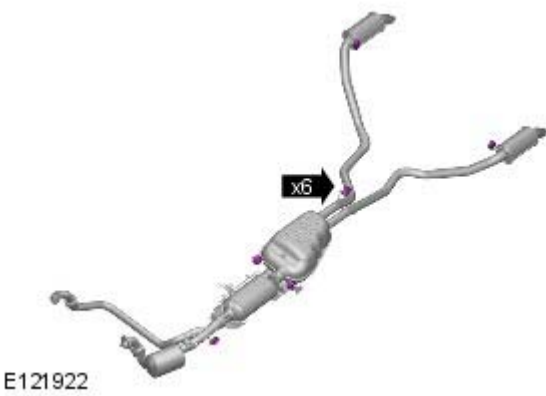



4.



5.

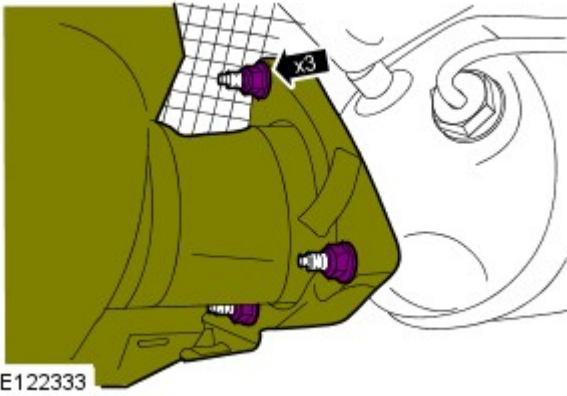
All vehicles



6.  **CAUTION:** Make sure that the exhaust system is supported with a suitable transmission stand.

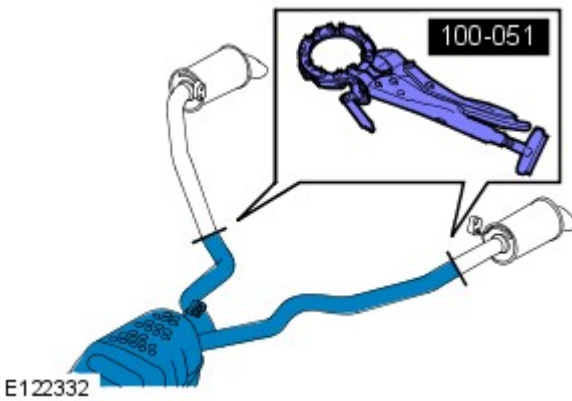
Release the 6 exhaust hangers.

General Equipment: [Transmission jack](#)



7. **7. NOTE: Discard the gasket.**

With assistance, remove the muffler and tailpipe assembly.



8. Using the special tool, cut the exhaust pipe at the marked position.

Special Tool(s): [100-051](#)

Installation

All vehicles

1. **1. NOTE: Do not tighten the retaining clamp at this stage.**
Position the RH tail pipe to the muffler assembly.
2. **2. NOTE: Do not tighten the retaining clamp at this stage.**
Position the LH tail pipe to the muffler assembly.
3. **3. NOTE: Install a new gasket.**
With assistance, install the muffler assembly.
4. Tighten the nuts to 23 Nm (17 lb.ft).
5. Align both tail pipes and tighten the retaining clamps to 55 Nm (40 lb.ft).

Vehicles with diesel particulate filter (DPF)

6. Install the heat shields.

Torque: 10 Nm
7. Install the DPF differential pressure sensor, high and low pressure pipes.
8. Connect the DPF differential pressure sensor electrical connectors.

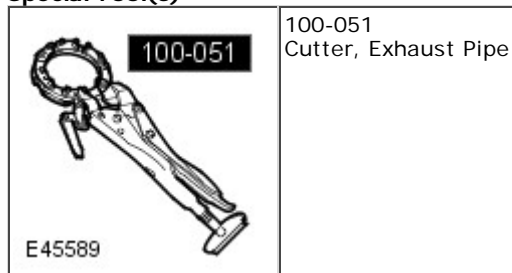
All vehicles

9. Install the transmission undershield.
10. Install the bolts and tighten to 10 Nm (7 lb.ft).

Exhaust System - TDV6 3.0L Diesel - Rear Muffler


Removal and Installation

Special Tool(s)

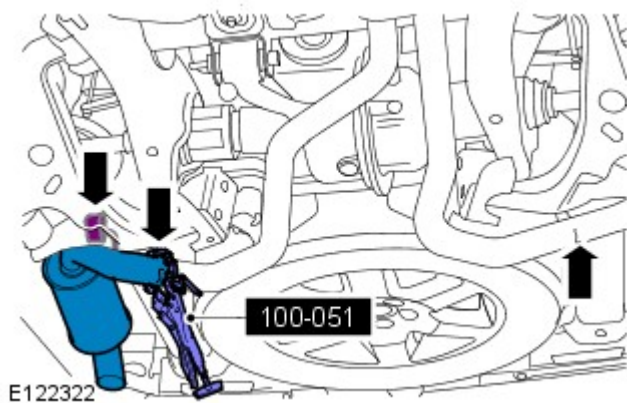


Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.



2. **NOTE:** Right-hand shown, left-hand similar.

- NOTE: Using the special tool, cut the exhaust pipe at the marked position.

Remove the tail pipe.

Special Tool(s): [100-051](#)

Installation

1. **NOTE:** Do not tighten the retaining clamp at this stage.

- NOTE: Clean the components.
- NOTE: Install the retaining clamp.

Install the tail pipe.

2. Align the tail pipe and tighten the retaining clamp to 55 Nm (40 lb.ft).

Exhaust System - V6 4.0L Petrol -

Recommended Lubricant

Item	Specification
HO2S threads	Use a high temperature resistant anti-seize compound

General Specifications

Item	Specification
Exhaust manifolds	Fabricated, air gapped with exhaust gas recirculation (EGR) tapping on left hand manifold
Exhaust system	Twin, stainless steel pipes throughout with stainless steel mufflers
Catalytic converters - type/location	Close coupled cascade - located in each down pipe with pre and post catalyst sensors in both pipes

Torque Specifications

Description	Nm	lb-ft
** HO2S	45	33
Catalytic converter retaining clamp	55	40
Catalytic converter to muffler nuts and retaining clamp	48	35
Tailpipe clamps	55	40
* Catalytic converter to exhaust manifold bolts	22	16

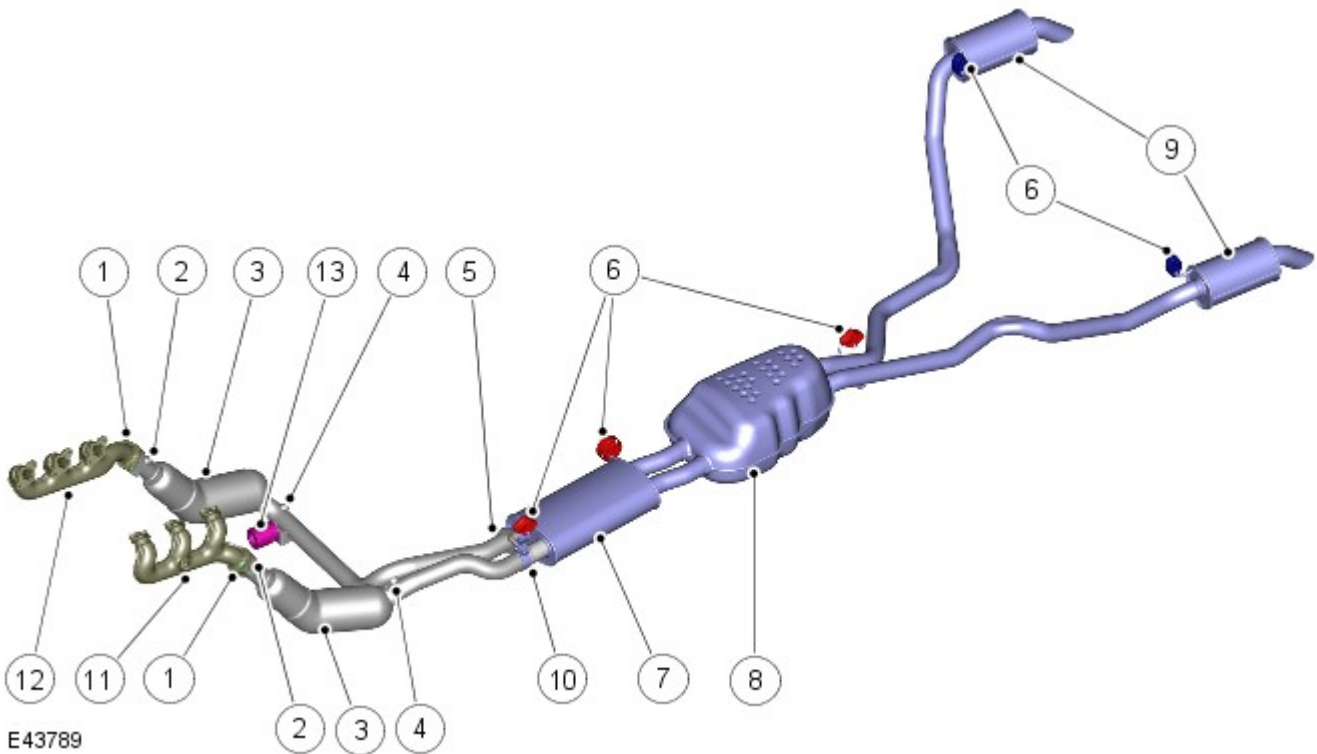
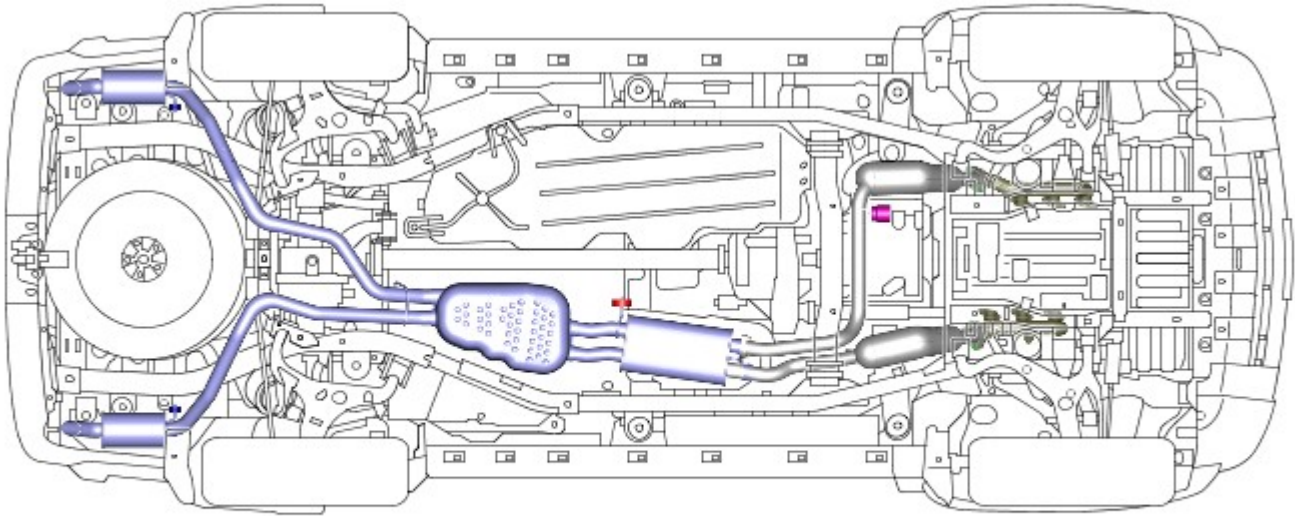
* **New bolts must be installed**

** **Apply suitable high temperature resistant anti-seize compound**

Exhaust System - V6 4.0L Petrol - Exhaust System

Description and Operation

4.0L V6 Exhaust System Component Location



E43789

Item	Part Number	Description
1	-	Flange - manifold to front section
2	-	Pre catalyst heated oxygen sensor location
3	-	Catalyst
4	-	Post catalyst heated oxygen sensor location
5	-	Flange - RH front section to rear section
6	-	Mounting rubber (5 off)
7	-	Silencer - Front
8	-	Silencer - Centre
9	-	Silencer - Rear
10	-	Clamp - LH front section to rear section
11	-	LH manifold
12	-	RH manifold
13	-	Mass damper

GENERAL

The 4.0L V6 exhaust system is fabricated from stainless steel and is supplied as three separate assemblies; a LH front section incorporating a catalytic converter, a RH front section incorporating a catalytic converter and a rear section

incorporating a front silencer (non-NAS only), a centre silencer and two rear silencers.

The system is attached to the underside of the body with five mounting rubbers which are located on mild steel hanger bars that are welded to the system. The mounting rubbers locate on corresponding hangers which are welded to the underside of the vehicle body. The system is routed mainly on the inside of the LH chassis longitudinal before splitting near the rear differential to exit at each side of the rear of the vehicle.

The system has service repair items available. Indentations in the rear section, between the center and the rear silencers, show the cut points for the service replacement rear silencers or front section. When a service repair section is used, the joint is connected using a sleeve and two clamps to connect the pipes at the cut points.

FRONT SECTION

Both front sections have a welded flange with two holes which provide for the attachment with two bolts to the LH and RH exhaust manifolds. The flange is sealed by a tapered seat in the flange and a machined cone on the manifold.

The flange is welded to a short, straight pipe, which in turn is welded to the body of the catalytic converter. The pipe has a threaded boss which is welded over a hole in the pipe to provide location for the pre catalyst heated oxygen sensor (HO2S).

On the LH front section, the converter outlet pipe is a 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is welded to the converter body. The rear of the outlet pipe is inserted into the flared end of the rear section. A clamp is used to compress and secure the joint.

On the RH front section, the converter outlet pipe is a 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is welded to the converter body. The rear of the pipe curves left, under the transmission and then curves again to run parallel to the LH pipe. The end of the pipe has a welded flange with two holes which locate on two studs on the rear section and is secured with nuts. A metal gasket is used to seal the joint between the front and rear section flanges.

Both the LH and RH converter outlet pipes have a threaded boss which is welded over a hole in the pipe to provide location for the post catalyst HO2S.

REAR SECTION

The rear section has a short 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is flared to an inside diameter of 55 mm (2.16 in) to locate the LH front section. The tube is welded to the front silencer assembly. A second short 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, has a welded flange with captive studs to provide attachment for the flange on the RH front section. This tube is also welded to the front silencer assembly.

The front silencer comprises a single skin and two end plates which are welded together which give a capacity of 6.4 litres (390.5 in³). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gases pass through the silencer. A hanger bar is welded to the front of the silencer and provides for the location of a mounting rubber.

The silencer has two short 55 mm (2.16 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which connect to the centre silencer.

The centre silencer comprises two pressed stainless steel shells which are welded together to give a capacity of 25.2 litres (1538 in³). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gasses pass through the silencer. A hanger bar is welded to the front right hand side of the silencer and provides location for a mounting rubber.

The silencer has two 55 mm (2.16 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which are curved to pass around the rear suspension components.

Each outlet pipe terminates in a welded joint with the tail silencers. The outlet pipes have a hanger bar which provides for the location of a mounting rubber.

A hanger bar is welded to the front face of each rear silencer and provides for the location of a mounting rubber. The silencer is a circular fabrication with a baffle tube which is surrounded with glass fibre to provide further noise suppression. Each silencer has a capacity of 2.7 litres (165 in³).

The silencers each have an outlet pipe which is 55 mm (2.2 in) diameter, with a wall thickness of 1.2 mm (0.05 in). Each outlet pipe is curved downwards to direct exhaust gasses away from the rear of the vehicle.

CATALYTIC CONVERTER

The engine management system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient use of fuel and to minimise the exhaust emissions.

To further reduce the carbon monoxide and hydrocarbons content of the exhaust gases, a catalytic converter is integrated into the front pipe of the exhaust system. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called 'washcoat'. The washcoat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the washcoat is a coating containing metals, which are the active constituent for converting harmful emissions into inert by-products. The metals add oxygen to the carbon monoxide and the hydrocarbons in the exhaust gases, to convert them into carbon dioxide and water respectively.

Exhaust System - V6 4.0L Petrol - Exhaust System

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Leaks ● Metal fatigue ● Pipes ● Catalytic converter ● Muffler(s) ● Joints ● Mountings ● Clearance around components 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

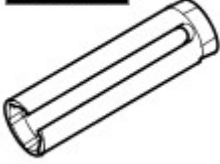
Symptom	Possible Causes	Action
Noisy or leaking exhaust	<ul style="list-style-type: none"> ● Exhaust system/components 	Install new components as necessary. Refer to the relevant section of the workshop manual.
Lack of power	<ul style="list-style-type: none"> ● Air intake system fault ● Restricted exhaust system ● Low fuel pressure 	Check the air intake system. Check for a blocked catalytic converter or muffler, install new components as necessary. Check the fuel pressure. Refer to the relevant section of the workshop manual.

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Exhaust System - V6 4.0L Petrol - Catalytic Converter LH

Removal and Installation

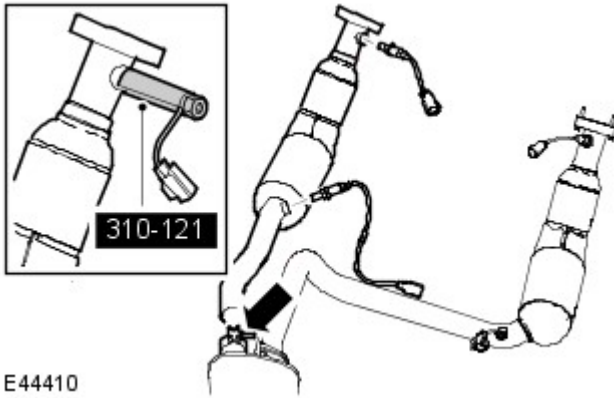
Special Tool(s)	
 <p>310-121</p> <p>E53465</p>	Wrench, HO2S
	310-121 (LRT-19-014)

Removal


1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
4. Remove the catalytic converter.
 - Remove the nut and release the retaining clamp.
5. **NOTE:** Do not disassemble further if the component is removed for access only.

Using the special tool, remove both HO2S from the catalytic converter.



Installation

1.  **CAUTION:** Make sure the anti-seize compound does not contact the HO2S tip.

Using the special tool, install the HO2S to the catalytic converter and tighten to 45 Nm (33 lb.ft).
 - Clean the components.
 - Apply an anti-seize compound to the thread of the HO2S.
2. **NOTE:** Do not tighten the retaining clamp at this stage.

Position the catalytic converter to the front muffler.
 - Clean the components.
 - Install the nut.
3. Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
4. Tighten the catalytic converter retaining clamp to 55 Nm (40

lb.ft).

5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

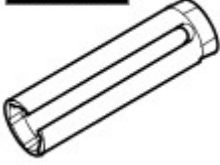
6. NOTE: For NAS vehicles only.

If required, carry out a long drive cycle.


For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Exhaust System - V6 4.0L Petrol - Catalytic Converter RH

Removal and Installation

Special Tool(s)	
 <p>310-121</p> <p>E53465</p>	<p>Wrench, HO2S</p> <p>310-121 (LRT-19-014)</p>

Removal

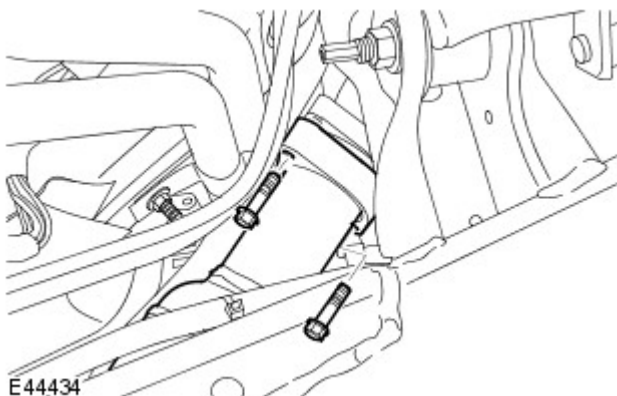
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

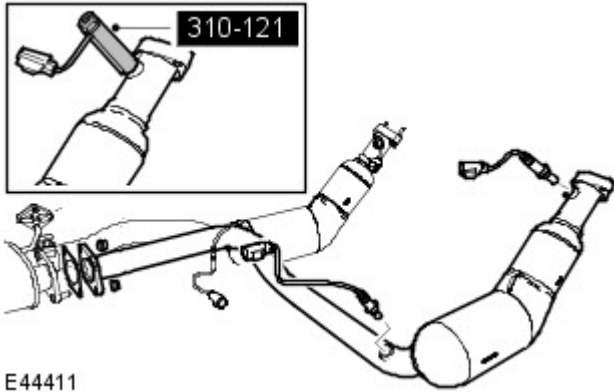
3. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
4. Release the RH rear HO2S wiring harness.
 - Disconnect the electrical connector.



5. Disconnect the catalytic converter from the exhaust manifold.
 - Remove and discard the 2 bolts.



6. Remove the catalytic converter.
 - Remove the 2 nuts.
 - Discard the gasket.



E44411

7. NOTE: Do not disassemble further if the component is removed for access only.

Using the special tool, remove both HO2S from the catalytic converter.

Installation

1. ⚠ CAUTION: Make sure the anti-seize compound does not contact the HO2S tip.

Using the special tool, install the HO2S to the catalytic converter and tighten to 45 Nm (33 lb.ft).

- Clean the components.
- Apply an anti-seize compound to the thread of the HO2S.

2. Position the catalytic converter to the front muffler.

- Clean the components.
- Install a new gasket.
- Tighten the nuts to 55 Nm (40 lb.ft).

3. Position the catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

4. Install the transmission crossmember.

For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

5. ⚠ CAUTION: Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Connect the HO2S electrical connector.

- Attach the HO2S wiring harness.

6. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

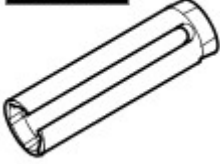
7. NOTE: For NAS vehicles only.

If required, carry out a long drive cycle.


For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

Exhaust System - V6 4.0L Petrol - Exhaust System

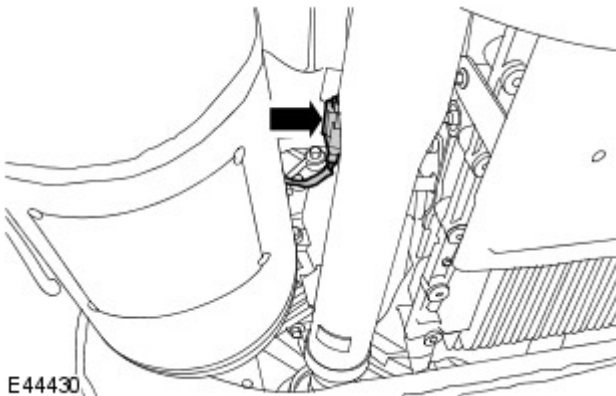
Removal and Installation

Special Tool(s)	
 <p>310-121</p> <p>E53465</p>	<p>Wrench, HO2S</p> <p>310-121 (LRT-19-014)</p>

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
4. Remove the transmission crossmember.
For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).
5. Release the LH front HO2S wiring harness.
 - Disconnect the electrical connector.



6. Release the RH front HO2S wiring harness.
 - Disconnect the electrical connector.

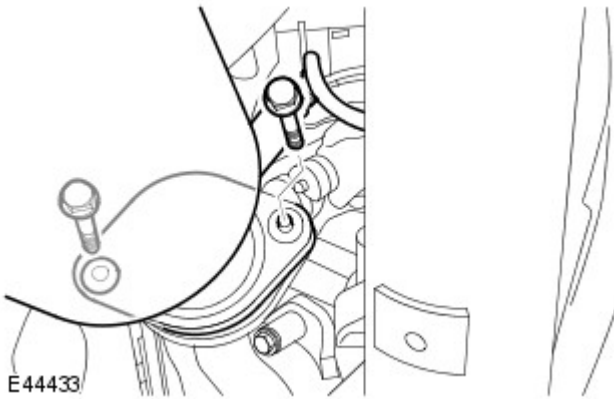


7. Release the LH rear HO2S wiring harness.
 - Disconnect the electrical connector.



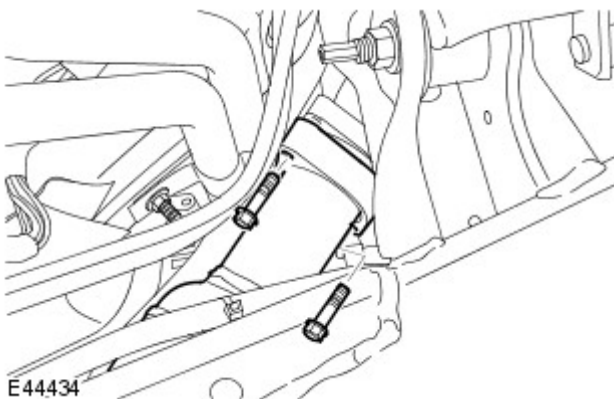
8. Release the RH rear HO2S wiring harness.

- Disconnect the electrical connector.



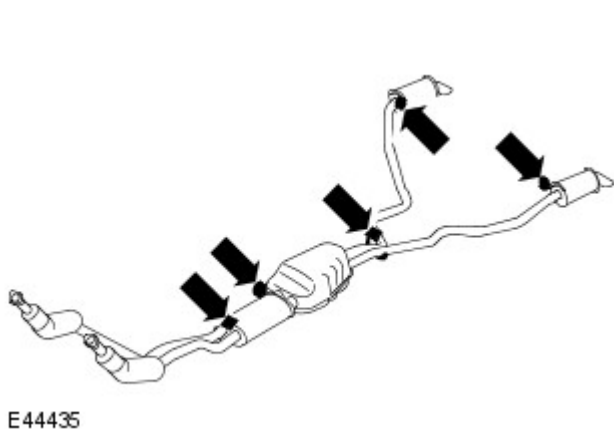
9. Disconnect the LH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.



10. Disconnect the RH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.

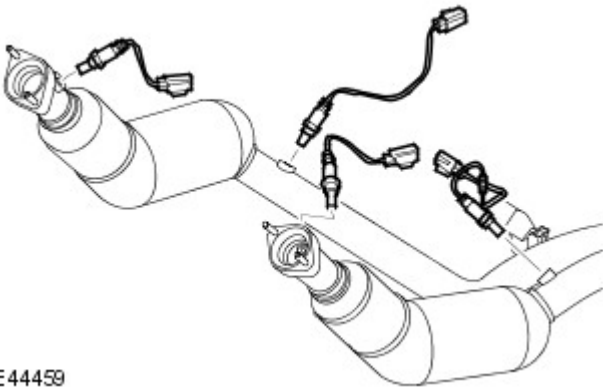


11. With assistance, remove the exhaust system.

- Disconnect the 5 exhaust hangers.

12. NOTE: Do not disassemble further if the component is removed for access only.

Using the special tool, remove the 4 HO2S from the catalytic converters.



E44459

Installation

1.  CAUTION: Make sure the anti-seize compound does not contact the HO2S tip.

Using the special tool, install the HO2S to the catalytic converters and tighten to 45 Nm (33 lb.ft).


- Clean the components.
- Apply an anti-seize compound to the thread of the HO2S.

2. With assistance, install the exhaust system.

- Attach the exhaust hangers.

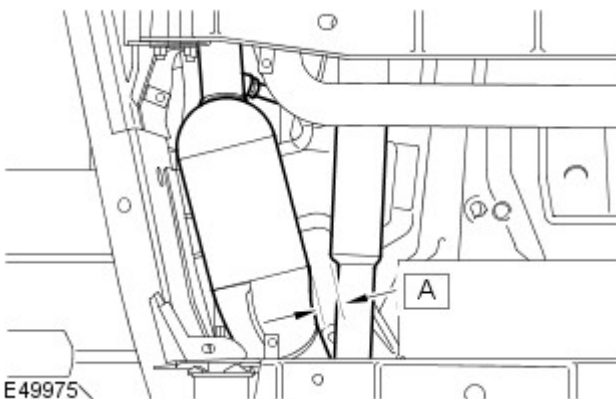
3. Position the RH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).


4.  CAUTION: Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).



E49975

5.  CAUTION: Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Connect the HO2S electrical connectors.

- Attach the HO2S wiring harnesses.

6. Install the transmission crossmember.

For additional information, refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

7. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).


8. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information,


Specifications).

Exhaust System - V6 4.0L Petrol - Muffler

Removal and Installation

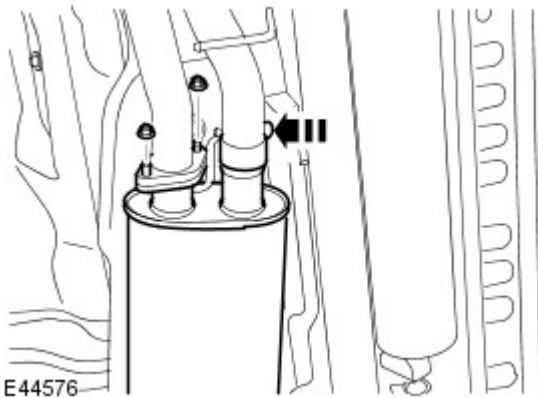
Special Tool(s)	
	Pipe cutter-exhaust
	100-051 (LRT-99-027)

Removal

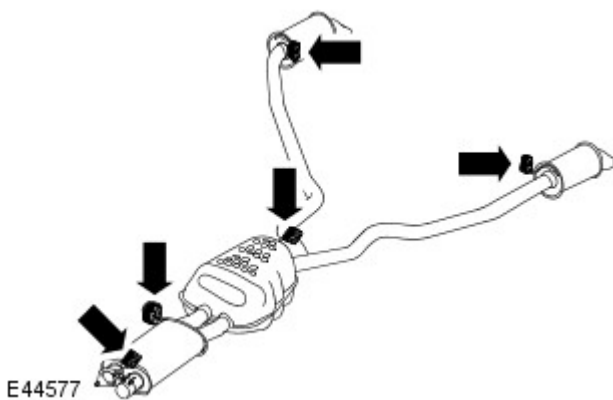
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Disconnect the RH catalytic converter from the muffler assembly.
 - Remove the 2 nuts.
 - Discard the gasket.
- Disconnect the LH catalytic converter from the muffler assembly.
 - Remove the nut and release the retaining clamp.



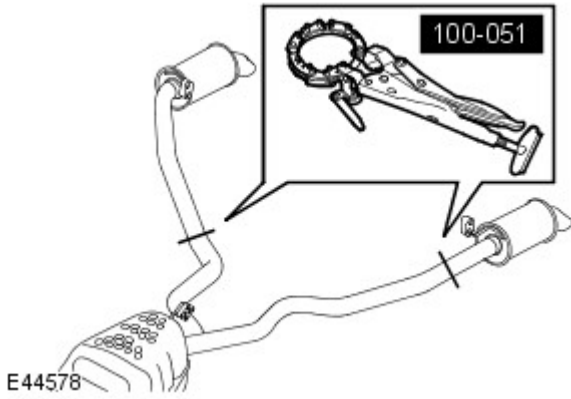
- With assistance, remove the muffler assembly.
 - Disconnect the 5 exhaust hangers.



- NOTE:** Do not disassemble further if the component is removed for access only.

Remove the LH tail pipe.

- Using 100-051, cut the tail pipe at the point indicated by a depression in the pipe.



6. Remove the RH tail pipe.

- Using 100-051, cut the tail pipe at the point indicated by a depression in the pipe.

Installation

1. NOTE: Do not tighten the retaining clamp at this stage.

Position the RH tail pipe to the muffler assembly.

- Clean the components.
- Install the retaining clamp.

2. NOTE: Do not tighten the retaining clamp at this stage.

Position the LH tail pipe to the muffler assembly.

- Clean the components.
- Install the retaining clamp.


3. With assistance, install the muffler assembly.

- Attach the exhaust hangers.
- Install a new gasket.
- Tighten the catalytic converter nuts and clamp to 48 Nm (35 lb.ft).


4. Align both tail pipes and tighten the retaining clamps to 55 Nm (40 lb.ft).

Exhaust System - V6 4.0L Petrol - Tailpipe

Removal and Installation

Special Tool(s)	
 <p>100-051</p> <p>E45589</p>	Pipe cutter-exhaust
	100-051 (LRT-99-027)

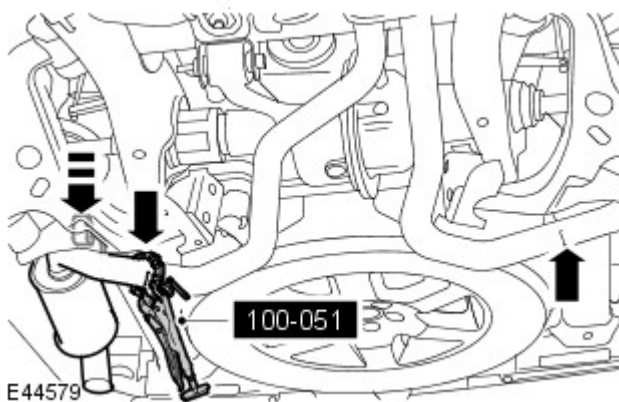
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

- Remove the tail pipe.

- Using 100-051, cut the tail pipe at the point indicated by a depression in the pipe.
- Disconnect from the exhaust hanger.



Installation

- NOTE:** Do not tighten the retaining clamp at this stage.

Install the tail pipe.

- Clean the components.
- Install the retaining clamp.

- Align the tail pipe and tighten the retaining clamp to 55 Nm (40 lb.ft).

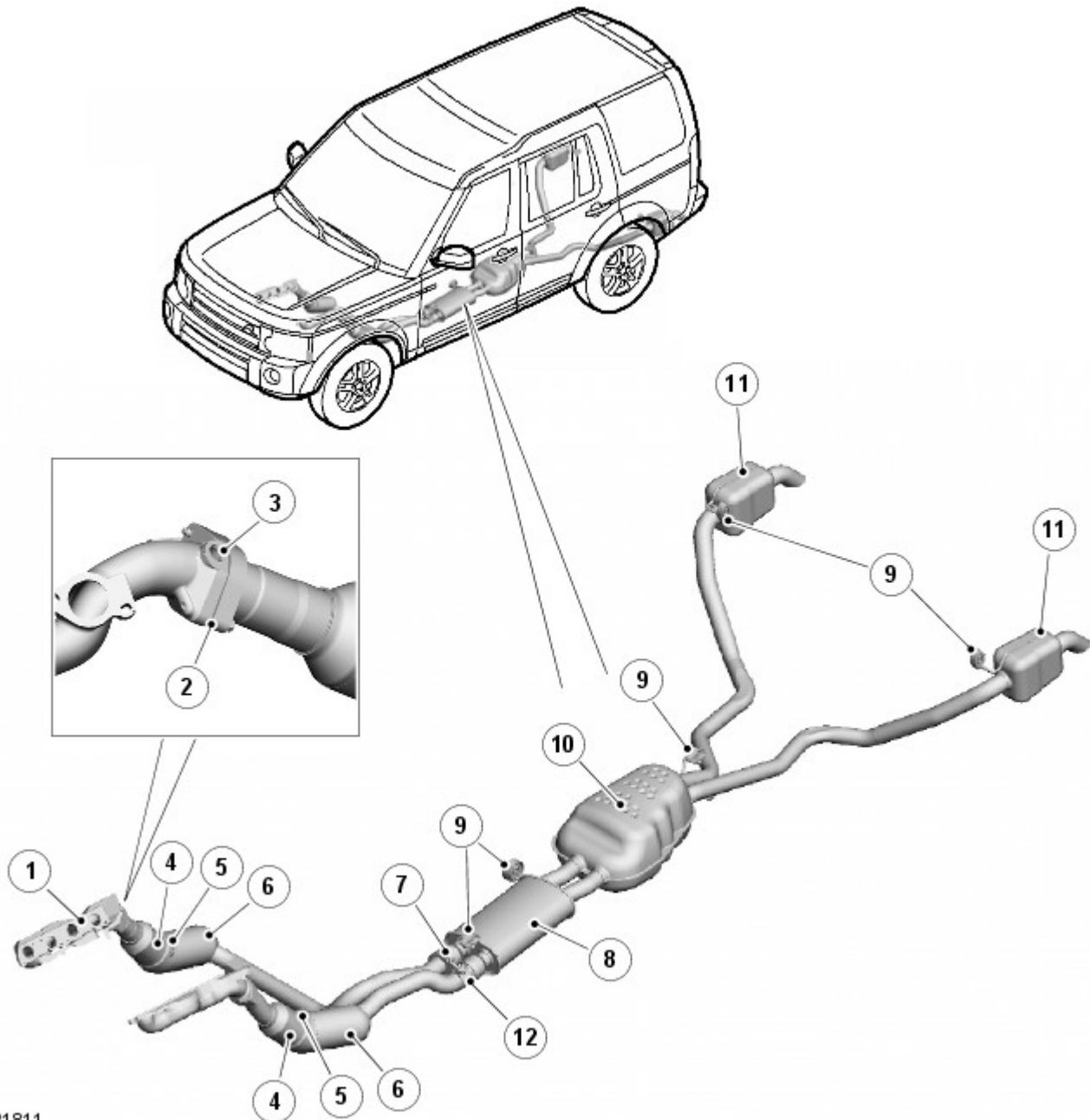
Exhaust System - V8 5.0L Petrol -**Torque Specifications**

Description	Nm	lb-ft	lb-in
Heated oxygen sensor (HO2S)	48	35	-
Catalyst monitor sensor	48	35	-
Catalytic converter retaining clamp	55	40	-
Catalytic converter retaining bolts to exhaust manifold	25	16	-
Exhaust manifold retaining bolts	18	13	-

Exhaust System - V8 5.0L Petrol - Exhaust System

Description and Operation

5.0L V8 COMPONENT LOCATION - FROM 2010MY



E121811

Item	Part Number	Description
1	-	Exhaust manifold
2	-	Flange joint - manifold to front section
3	-	Pre-catalyst Heated Oxygen Sensor (HO2S) mounting boss
4	-	Pre-catalytic converter
5	-	Post catalyst HO2S mounting boss
6	-	Main catalytic converter
7	-	Flange joint - Right Hand (RH) front section to rear section
8	-	Silencer - Front
9	-	Mounting rubber (5 off)
10	-	Silencer - Center
11	-	Silencer - Rear
12	-	Clamp joint - Left Hand (LH) front section to rear section

EXHAUST SYSTEM

The 5.0L V8 exhaust system is fabricated from stainless steel and is supplied as three separate assemblies; a Left Hand (LH) front section incorporating a catalytic converter, a Right Hand (RH) front section incorporating a catalytic converter

and a rear section incorporating a front silencer, a centre silencer and two rear silencers.

The system is attached to the underside of the body with 5 mounting rubbers which are located on mild steel hanger bars that are welded to the system. The mounting rubbers locate on corresponding hangers which are welded to the underside of the vehicle body. The system is routed mainly on the inside of the LH chassis longitudinal before splitting near the rear differential to exit at each side of the rear of the vehicle.

The system has service repair items available. Indentations in the rear section, between the center and the rear silencers, show the cut points for the service replacement rear silencers or front section. When a service repair section is used, the joint is connected using a sleeve and two clamps to connect the pipes at the cut points.

FRONT SECTION

Both front sections have a loose flange with two holes which provide for the attachment with two bolts onto the LH and RH exhaust manifolds. The flange is sealed by a tapered seat in the flange and a machined cone on the manifold.

Each flange is located on a short, straight pipe, which in turn is welded to the body of the catalytic converter. The pipe has a threaded boss which is welded over a hole to provide location for the Heated Oxygen Sensor (HO2S) in a position between the pre-catalyst and the main catalyst.

On the LH front section, the converter outlet pipe is a 60 mm (2.36 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is welded to the converter body. The rear of the outlet pipe is inserted into the flared end of the rear section. A clamp is used to compress and secure the joint.

On the RH front section, the converter outlet pipe is a 60 mm (2.36 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is welded to the converter body. The rear of the pipe curves left, under the transmission and then curves again to run parallel to the LH pipe. The end of the pipe has a welded flange with two holes which locate on two studs on the rear section and is secured with nuts. A metal gasket is used to seal the joint between the front and rear section flanges.

REAR SECTION

The rear section has a short 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, which is flared to an inside diameter of 61 mm (2.4 in) to locate the LH front section. The tube is welded to the front silencer assembly. A second short 55 mm (2.16 in) diameter tube, with a 1.5 mm (0.06 in) wall thickness, has a welded flange with captive studs to provide attachment for the flange on the RH front section. This tube is also welded to the front silencer assembly.

The front silencer comprises a double skin and two end plates which are rolled together to give a capacity of 7.0 litres (427 in³). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gases pass through the silencer. A hanger bar is welded to the front of the silencer and provides for the location of a mounting rubber.

The silencer has two short 55 mm (2.16 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which connect to the centre silencer.

The centre silencer comprises two pressed stainless steel shells which are welded together to give a capacity of 25.2 litres (1538 in³). The silencer contains baffles and perforated tubes which reduce noise as the exhaust gasses pass through the silencer. A hanger bar is welded to the front right hand side of the silencer and provides location for a mounting rubber.

The silencer has two 55 mm (2.16 in) diameter outlet pipes, with a 1.5 mm (0.06 in) wall thickness, which are curved to pass around the rear suspension components.

Each outlet pipe terminates in a welded joint with the tail silencers. The outlet pipes have a hanger bar which provides for the location of a mounting rubber.

A hanger bar is welded to the front face of each rear silencer and provides for the location of a mounting rubber. The silencer is a rectangular fabrication with a baffle tube which is surrounded with glass fibre to provide further noise suppression. Each silencer has a capacity of 4 litres (244 in³).

The silencers each have an outlet pipe which is 60 mm (2.36 in) diameter, with a wall thickness of 1.2 mm (0.05 in). Each outlet pipe is curved downwards to direct exhaust gasses away from the rear of the vehicle.

EXHAUST MANIFOLDS

The cast exhaust manifolds are unique for each cylinder bank. Spacers on the securing bolts allow the manifolds to expand and retract with changes of temperature while maintaining the clamping loads. Heat shields are integrated into the exhaust manifold gaskets. Each manifold has a threaded port near to its outlet which allows for the fitment of the pre-catalyst HO2S.

CATALYTIC CONVERTERS

The engine management system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient use of fuel and to minimise the exhaust emissions. A threaded boss is located on each manifold and a and another threaded boss is located between the starter and the main catalyst to house the pre and post catalyst oxygen sensors. The engine management system monitors the sensors and uses the information to further improve the fuelling and exhaust emissions.

To further reduce the carbon monoxide and hydrocarbons content of the exhaust gases, two catalytic converters are integrated into the front down pipe from each exhaust manifold. In the catalytic converter the exhaust gases are passed through honeycombed ceramic elements coated with a special surface treatment called 'washcoat'. The washcoat increases the surface area of the ceramic elements by a factor of approximately 7000. On top of the washcoat is a coating containing metals, which are the active constituent for converting harmful emissions into inert by-products. The metals add oxygen to the carbon monoxide and the hydrocarbons in the exhaust gases, to convert them into carbon dioxide and water respectively.

Two catalytic converters are used in each cylinder bank down pipe. A starter and main catalyst are located below the downpipe flange. The starter catalyst is monitored by two HO2S's. The main catalyst is not monitored.

Exhaust System - V8 5.0L Petrol - Exhaust System

Diagnosis and Testing

Principle of Operation

For a detailed description of the exhaust system, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Leaks ● Metal fatigue ● Pipes ● Catalytic converter ● Muffler(s) ● Joints ● Mountings ● Clearance around components 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Noisy or leaking exhaust	<ul style="list-style-type: none"> ● Exhaust system/components 	Install new components as necessary. Refer to the relevant section of the workshop manual.
Lack of power	<ul style="list-style-type: none"> ● Air intake system fault ● Restricted exhaust system ● Low fuel pressure 	Check the air intake system. Check for a blocked catalytic converter or muffler, install new components as necessary. Check the fuel pressure. Refer to the relevant section of the workshop manual.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Exhaust System - V8 5.0L Petrol - Catalytic Converter LH

Removal and Installation

Removal

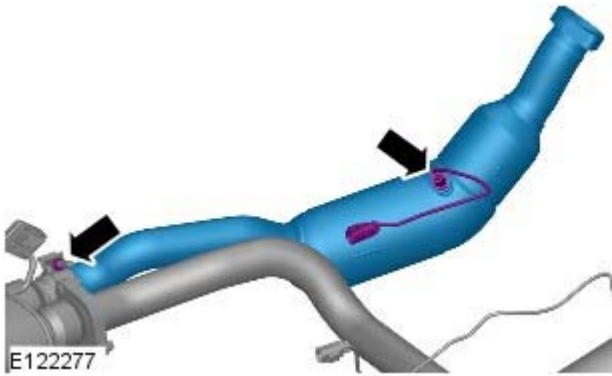
- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

3. *Torque:* 48 Nm



Installation

1. **CAUTIONS:**



Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.



If accidentally dropped or knocked install a new sensor.



Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.


To install, reverse the removal procedure.

Exhaust System - V8 5.0L Petrol - Catalytic Converter RH

Removal and Installation

Removal

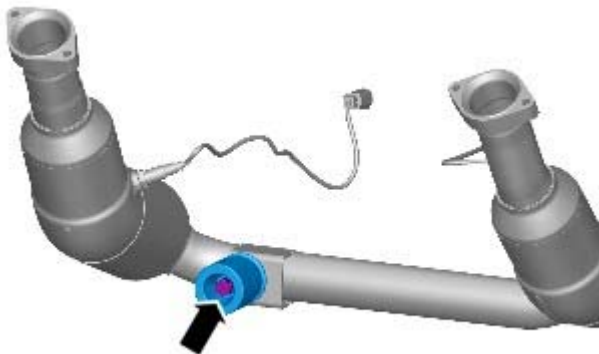
- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

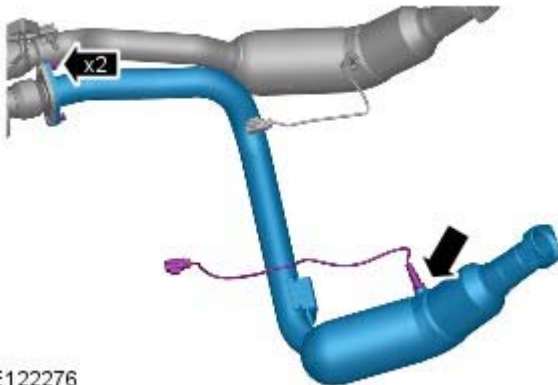
2. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

3. Torque: 22 Nm



E122319

4. Torque: 48 Nm



E122276

Installation

1. CAUTIONS:



Make sure the anti-seize compound does not contact the heated oxygen sensor (HO2S) tip.



If accidentally dropped or knocked install a new sensor.



Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.


Exhaust System - V8 5.0L Petrol - Exhaust System

Removal and Installation

General Equipment

Transmission jack

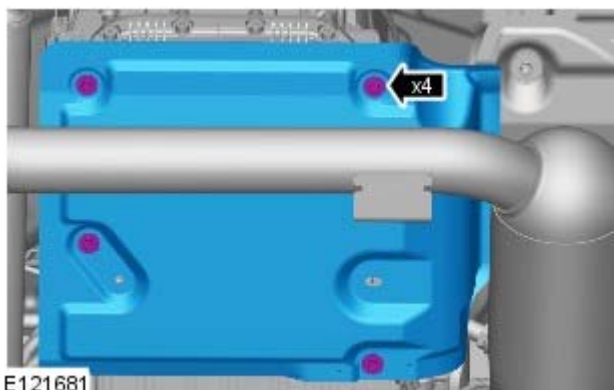
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

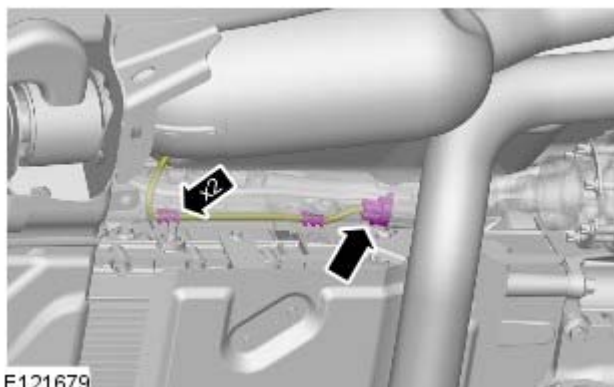
Raise and support the vehicle.

2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Refer to: [Transmission Support Crossmember - V8 5.0L Petrol](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

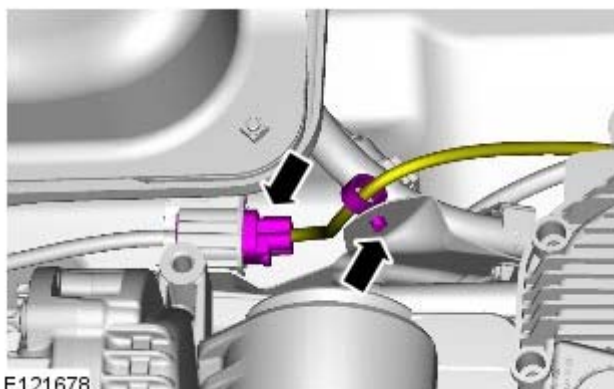
4. *Torque:* 10 Nm



E121681



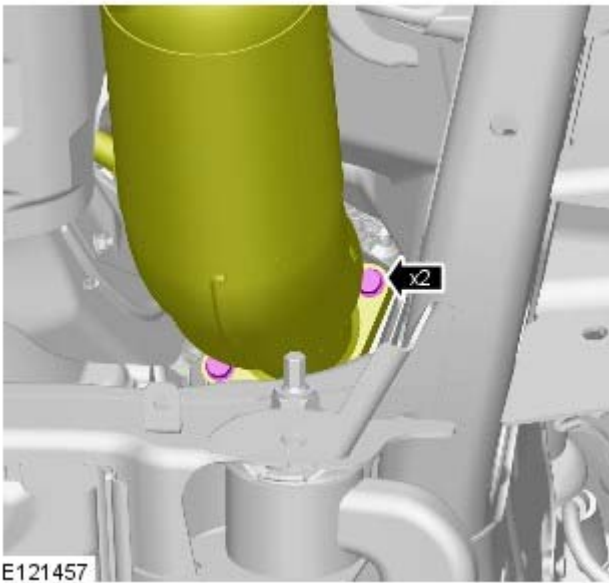
E121679



E121678

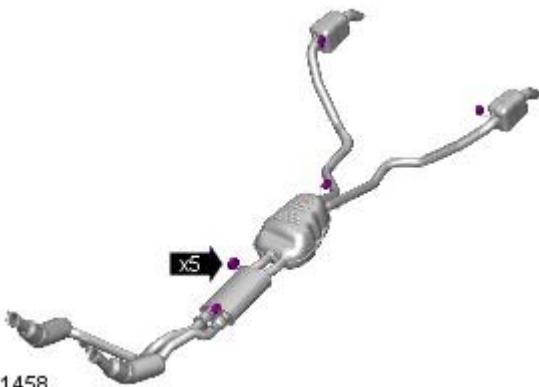
- 5.


- 6.



8. **8.** NOTE: Right-hand shown, left-hand similar.

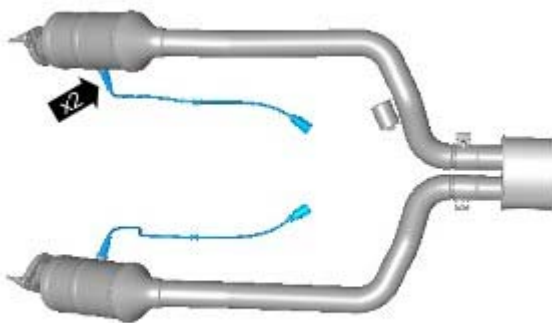
Torque: 22 Nm



9. **9.**  CAUTION: Make sure that the exhaust system is supported with suitable retaining straps.

With assistance, remove the exhaust system.

General Equipment: [Transmission jack](#)



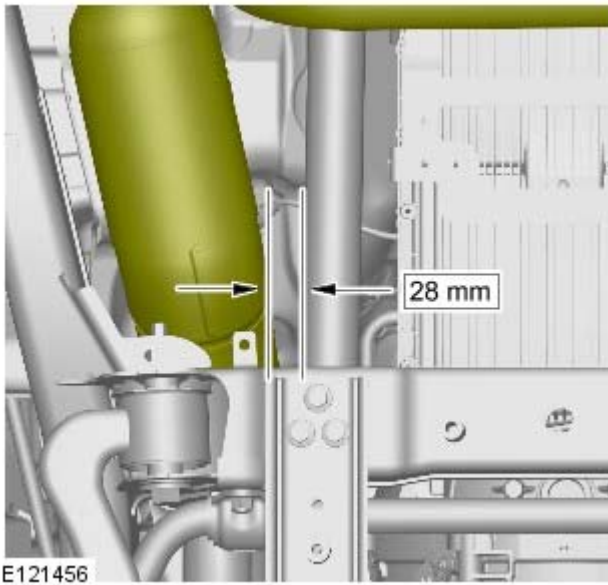
10. **10.** NOTE: Do not disassemble further if the component is removed for access only.


• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 45 Nm

Installation

1. To install, reverse the removal procedure.




2.  CAUTION: Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Exhaust System - V8 5.0L Petrol - Front Muffler

Removal and Installation

Special Tool(s)

	100-051 Cutter, Exhaust Pipe
---	---------------------------------

General Equipment

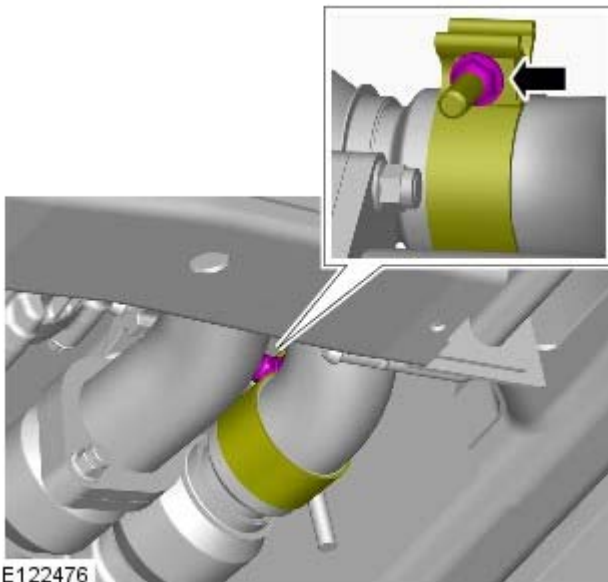
Transmission jack

Removal

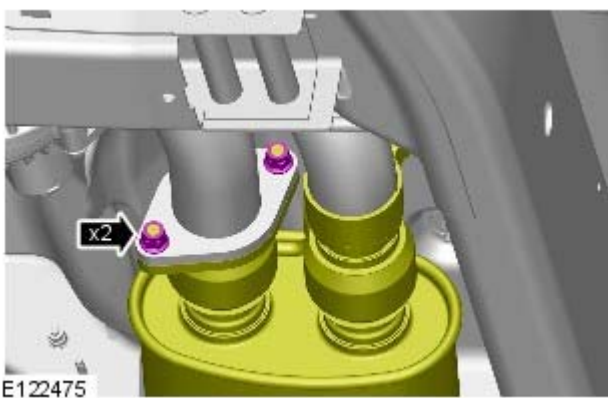
1.  **WARNING:** Make sure to support the vehicle with axle stands.

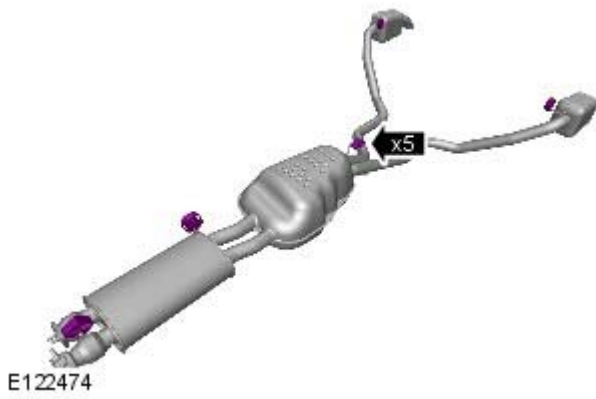
Raise and support the vehicle.

2.



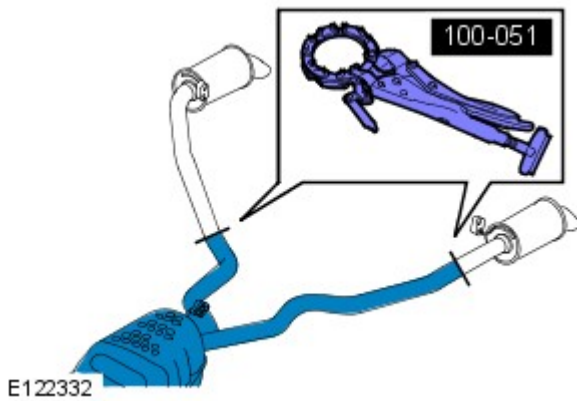
3. Discard the gasket.





4. With assistance, remove the muffler assembly.

General Equipment: [Transmission jack](#)



5. Using the special tool, cut the exhaust pipe at the marked position.

Special Tool(s): [100-051](#)

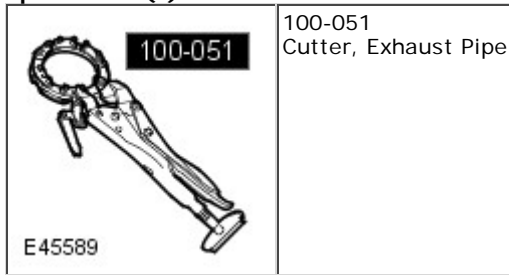
Installation

1. **1. NOTE: Do not tighten the retaining clamp at this stage.**
Position the RH tail pipe to the muffler assembly.
2. **2. NOTE: Do not tighten the retaining clamp at this stage.**
Position the LH tail pipe to the muffler assembly.
3. **3. NOTE: Install a new gasket.**
With assistance, install the muffler assembly.
4. Align both tail pipes and tighten the retaining clamps to 55 Nm (40 lb.ft).
5. Tighten the catalytic converter nuts and clamp to 48 Nm (35 lb.ft).

Exhaust System - V8 5.0L Petrol - Rear Muffler

Removal and Installation

Special Tool(s)

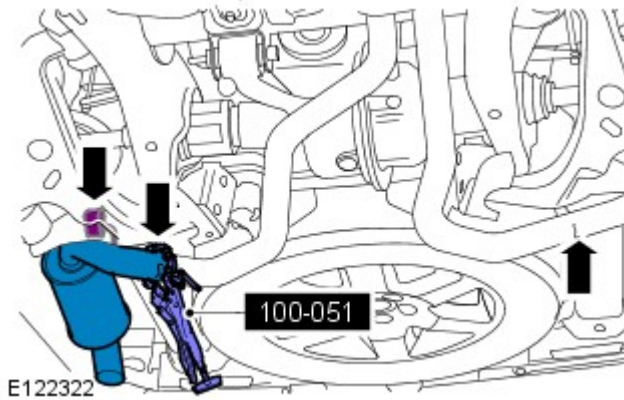


Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.



2. **2.** NOTE: Right-hand shown, left-hand similar.

- NOTE: Using the special tool, cut the exhaust pipe at the marked position.

Remove the tail pipe.

Special Tool(s): [100-051](#)

Installation

1. **1.** NOTE: Do not tighten the retaining clamp at this stage.

- NOTE: Clean the components.
- NOTE: Install the retaining clamp.


Install the tail pipe.


2. Align the tail pipe and tighten the retaining clamp to 55 Nm (40 lb.ft).


Fuel System - General Information - Diesel Filter Water Drain-Off

General Procedures

• WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.


 If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.


 Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

 The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

• CAUTIONS:

 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

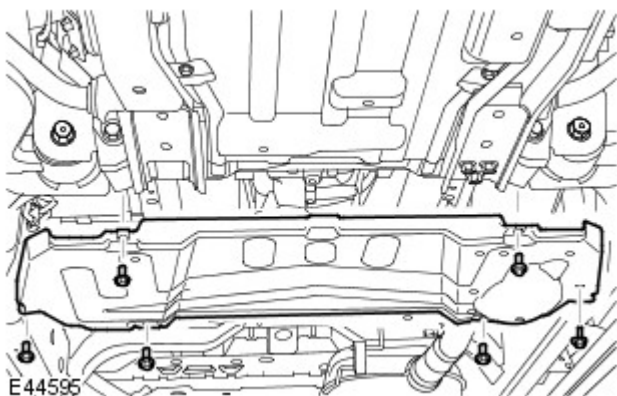
 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

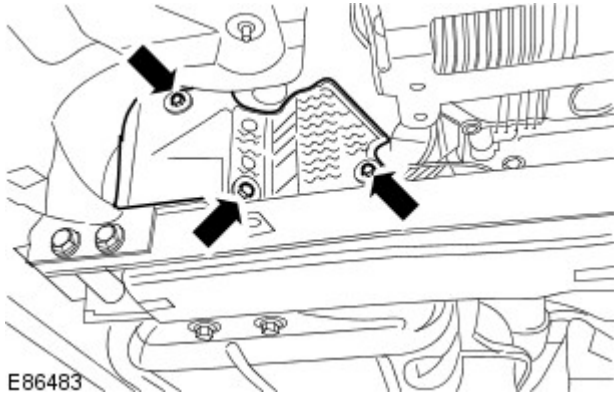
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


2. Remove the transmission undershield.

- Remove the 6 bolts.





E86483

3.  **WARNING:** Observe due care when working near a hot exhaust system.

Remove the fuel filter heat shield.

- Remove the 3 bolts.



E88183

4. Drain the fuel filter element.

- Attach a suitable drain tube to the water-in-fuel drain port.
- Loosen the water-in-fuel drain port 2 complete turns and allow the fluid to drain into a container.
- Turn the ignition to position 2 until 100ml of fluid is drained, then turn to position O.
- Remove the drain tube.

5. Tighten the water-in-fuel drain port.

6. Install the fuel filter heat shield.

- Tighten the bolts to 6 Nm (4 lb.ft).



7. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).

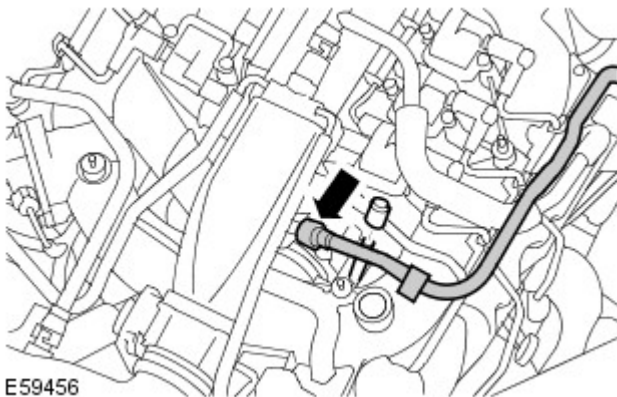
Fuel System - General Information - Fuel System Pressure Check V6 4.0L

Petrol

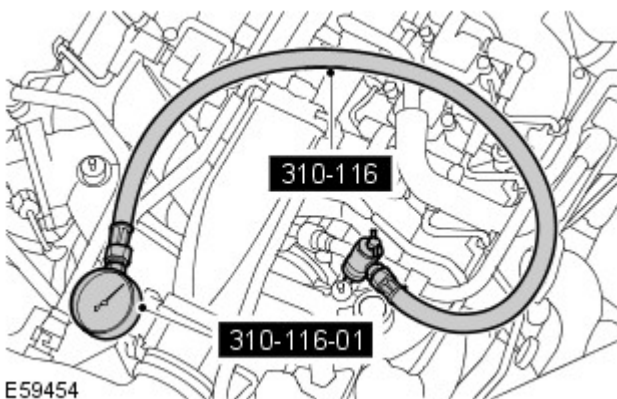
General Procedures

Special Tool(s)	
 <p>310-116-01</p> <p>E66951</p>	<p>Gauge fuel pressure</p> <p>310-116-01</p>
 <p>310-116</p> <p>E56747</p>	<p>Adapter - fuel pressure check</p> <p>310-116(LRT-19-006A)</p>

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the clip and disconnect the purge line.
4. Remove the fuel rail Schraeder valve cap.



5. Install the special tool to the fuel rail Schraeder valve.



6. Connect the purge line.

7. WARNINGS:



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



Start and run the engine.

- Open the valve on the special tool.
- Note the fuel pressure readings.

8. For fuel pressure data, refer to specifications.
For additional information, refer to: [Specifications](#) (303-01C Engine - V6 4.0L Petrol, Specifications).
9. Close the special tool valve.
10. Release the clip and disconnect the purge line.
11. Disconnect the special tool from the Schraeder valve.
12. Install the Schraeder valve cap.
13. Connect the purge line.
14. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
15. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

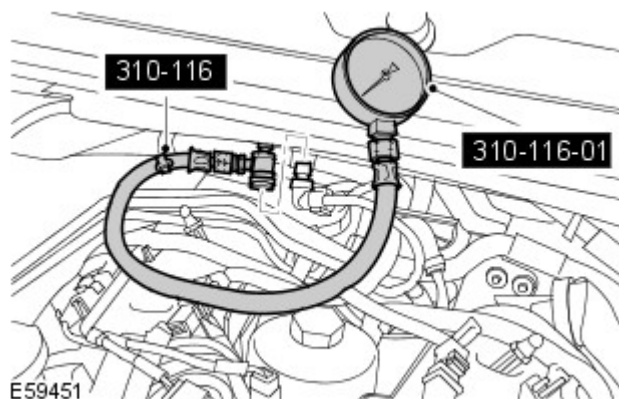
Fuel System - General Information - Fuel System Pressure Check TDV6 2.7L Diesel

General Procedures


Special Tool(s)	
 <p>310-116-01</p> <p>E66951</p>	<p>Gauge fuel pressure</p> <p>310-116-01</p>
 <p>310-116</p> <p>E56747</p>	<p>Adapter - fuel pressure check</p> <p>310-116(LRT-19-006A)</p>


• NOTE: This procedure only checks the supply pressure to the high pressure pump.


1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornementation, Removal and Installation).
3. Remove the fuel rail Schraeder valve cap.
4. Install the special tool to the fuel rail Schraeder valve.



5. WARNINGS:

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.


Start and run the engine.

- Open the valve on the special tool.









- Note the fuel pressure readings.
6. For fuel pressure data, refer to specifications.
For additional information, refer to: [Specifications](#) (303-01A Engine - TDV6 2.7L Diesel, Specifications).
 7. Close the special tool valve.
 8. Disconnect the special tool from the Schraeder valve.
 9. Install the Schraeder valve cap.
 10. Install the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 11. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel System - General Information - Low-Pressure Fuel System Bleeding



General Procedures

Special Tool(s)	
	Adaptor fuel rail pressure check 310-116 (LRT-19-006A)

• WARNINGS:

-  Wait at least 30 seconds after the engine stops before commencing any repair to the high-pressure fuel injection system. Failure to follow this instruction may result in personal injury.
-  Before any work is carried out on the fuel system, ground the vehicle to earth and maintain the ground connection until the work is complete.
-  Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.
-  After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.
-  If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.
-  If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.
-  Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.
-  This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

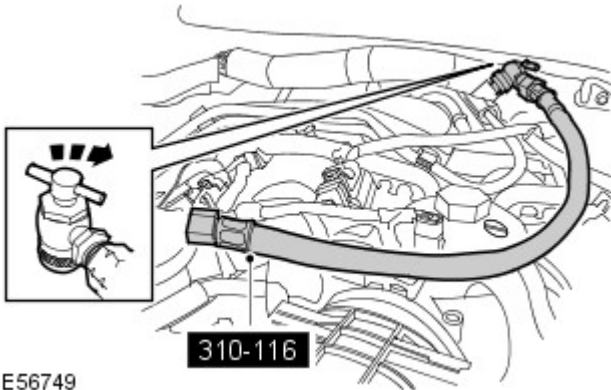
• CAUTIONS:

-  Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.
-  This procedure must be carried out before the engine is attempted to be started, following removal or replacement of any fuel system component involving fuel line intrusion. Failure to follow this instruction will result in damage to the fuel injection pump.

1. This procedure is necessary if any of the following fuel system components are removed, disconnected or replaced: Fuel tank, fuel lines, fuel filter element, fuel coolers, fuel injection pump or fuel rail pressure sensor.
2. Remove the engine cover. For additional information, refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Install the special tool to the fuel rail Schraeder valve.
 - Remove the fuel rail Schraeder valve cap.

4. Position a container to collect spillage.

- Open the valve on the special tool.



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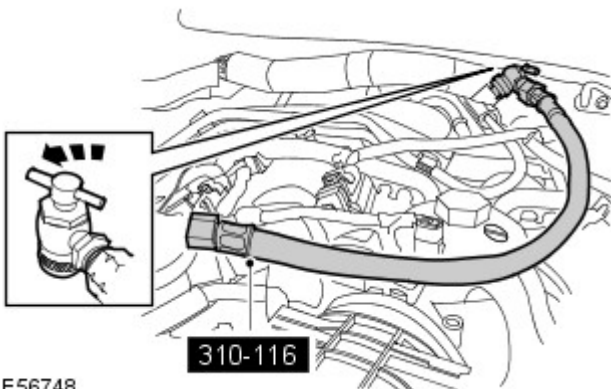
5. Turn the ignition switch to the ON position for 25 seconds. The fuel pump in the fuel tank will be audible.

6. Repeat the above procedure until clean, air free fuel is seen escaping from the special tool.

- While the pump is still running, close the valve on the special tool to prevent air entering the fuel system.


7. Remove the special tool from the Schraeder valve.

- Install the Schraeder valve protective cap.



E56748

8. Remove the container.

9.  **CAUTION:** If a new fuel injection pump is fitted, the following step must be carried out to make sure the fuel injection pump is fully primed. Failure to follow this instruction may result in damage to the vehicle.

Repeat Step 5 four times.

10. **NOTE:** The engine must be allowed to idle for two minutes to allow air in the fuel injection supply manifolds and fuel injectors to purge.

Start the engine and allow to idle.

11. Install the engine cover. For additional information, refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Fuel System - General Information - Fuel Tank Draining

General Procedures

- WARNINGS:



Place the vehicle in a well ventilated, quarantined area and arrange ' No Smoking/Petrol Fumes' signs about the vehicle.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.




CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

1. Open the fuel filler door and remove the cap.
2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Connect the fuel tank drain equipment ground cable to the vehicle.
4. Remove the fuel from the fuel tank, via the filler neck, using the fuel tank draining equipment. Follow the manufacturer's operating instructions.
5. To install, reverse the removal procedure.

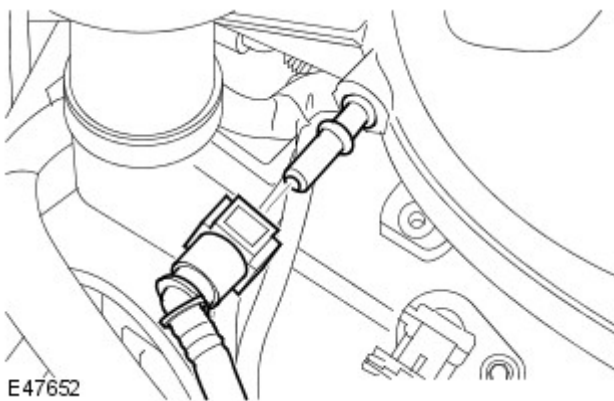
Fuel System - General Information - Fuel System Pressure Release V6 4.0L Petrol

General Procedures

Special Tool(s)	
	Adaptor fuel rail pressure check 310-116 (LRT-19-006A)

⚠ WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the clip and disconnect the purge line.



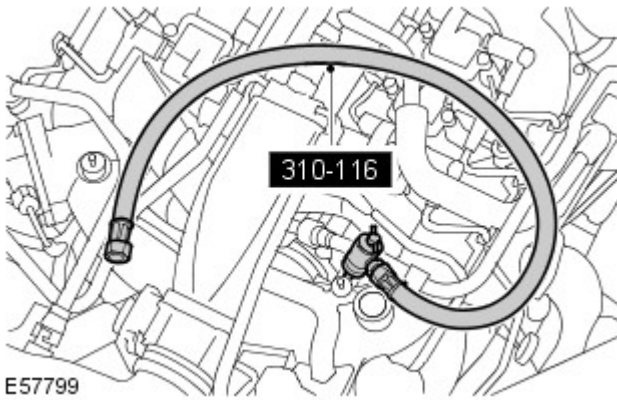
4. Remove the fuel rail Schraeder valve cap.
5. Install the special tool to the fuel rail Schraeder valve.
6. **WARNINGS:**

⚠ Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

⚠ Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

Open the valve on the special tool, release the fuel pressure and allow the fuel to drain into a container.

7. Close the special tool valve.



E57799

8. Remove the special tool from the Schraeder valve.

- Remove the container.

9. Install the Schraeder valve cap.

10. Connect the purge line.

- Clean the component mating faces.

11. Install the engine cover.

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

12. Connect the battery ground cable.


For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel System - General Information - Fuel System Pressure ReleaseV8 5.0L

Petrol

General Procedures

Draining

1.  **WARNING:**
Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Remove the fuel pump fuse.
3. Remove the fuel filler cap.
4. Start the engine and allow it to idle until the engine stalls.
5. Crank the engine for approximately five seconds to make sure that the fuel rail pressure is released.

Filling

1. **6. NOTE:** Make sure all repairs have been carried out before proceeding to the following steps.
Install the fuel pump fuse.
2. Install the fuel filler cap.
3. Read and clear stored DTC fault codes.

Fuel Tank and Lines - TDV6 2.7L Diesel -

Capacity

Fuel tank	84.0 litres (18.5 gallons) (22.19 US gallons)
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General Specification

Item	Specification
System type	Mechanical - returnless
Fuel delivery module	Located in the fuel tank
High pressure fuel pump:	
Location	Located at rear of engine between the cylinder heads, belt driven from the camshafts
Maximum operating pressure	165000 kPa (1650 bar) (23925 lb/in ²)
Advance delivery fuel pump:	
Location	Located in the fuel tank
Operating pressure	50 kPa (0.5 bar) (7.35 lb/in ²)
Maximum output @12.3 volts	70 litres/hour (15.4 gallons/hour) (18.4 US gallons/hour)
Fuel pressure regulator:	
Type/location	In-line, within fuel tank
Operating pressure	50 kPa (0.5 bar) (7.25) lb/in ²
Fuel filter	Remotely mounted on the inside of the longitudinal member - fitted with a renewable element and having a 178 cc (6 fl-oz) water separation capacity
Fuel tank sender units	Two - Front and rear - Front unit is mounted remotely within the fuel tank, rear is mounted on the body of the advance delivery fuel pump

Torque Specifications

Description	Nm	lb-ft
Fuel tank bracket bolts	10	7
Fuel pump module access flange clamp screw	4	3
Fuel tank bolts	45	33
Fuel tank heat shield, bolts	5	4
Fuel tank heat shield, nuts	3	2
Fuel filter to retaining bracket bolt	10	7
Transmission undershield bolts	10	7

Fuel Tank and Lines - TDV6 2.7L Diesel - Fuel Tank and Lines

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel tank and lines system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification

• WARNINGS:



Do **NOT** carry out any work on the fuel system with the engine running. The fuel pressure within the system can be as high as 1600 bar (23,206 lb/in²). Failure to follow this instruction may result in personal injury.



Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow this instruction may result in personal injury.



After carrying out repairs, the fuel system must be checked visually for leaks. This should be done after the engine has been run, but with the engine switched **OFF**. Failure to follow this instruction may result in personal injury.



If taken internally, **DO NOT** induce vomiting. Seek immediate medical attention. Failure to follow this instruction may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention. Failure to follow this instruction may result in personal injury.



Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention. Failure to follow this instruction may result in personal injury.

• CAUTIONS:



Before disconnecting any part of the system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into the fuel system. Failure to follow this instruction may result in damage to the vehicle.



The fuel pipes between the injectors and the rail must be discarded after each use, and new pipes installed. Failure to follow this instruction may result in damage to the vehicle.



It is essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.



Make sure that the workshop area in which the vehicle is being worked on is as clean and dust-free as possible. Areas in which work on clutches, brakes or where welding or machining are carried out are not suitable in view of the risk of contamination to the fuel system. Failure to follow this instruction may result in damage to the vehicle.



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material. Failure to follow this instruction may result in damage to the vehicle.



Make sure that any protective gloves worn are new and are of the non-powdered latex type. Failure to follow this instruction may result in damage to the vehicle.



Make sure that clean, non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh cleaning fluid prior to starting work on the vehicle. Failure to follow this instruction may result in damage to the vehicle.



Use a steel-topped work bench and cover it with clean, lint-free, non-flocking material. Failure to follow this instruction may result in damage to the vehicle.



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor

vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel level ● Contaminated fuel ● Fuel supply line(s) ● Fuel return line(s) ● High-pressure fuel supply line(s) ● Fuel tank filler pipe ● Fuel leak(s) ● Fuel tank ● Fuel filler cap ● Fuel filter ● Push connect fittings ● Fuel rail ● Fuel injection pump ● Exhaust Gas Recirculation (EGR) system 	<ul style="list-style-type: none"> ● Battery charge and condition ● Fuse(s) ● Inertia fuel shutoff (IFS) switch ● Fuel pump module relay ● Fuel pump module ● Electrical connector(s) ● Damaged or corroded wiring harness ● Fuel Volume Control Valve (FVCV) ● Fuel Pressure Control Valve (FPCV) ● Engine Control Module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> ● Inertia fuel shutoff switch ● Low/Contaminated fuel ● Air leakage ● Low-pressure fuel system fault ● Fuel pump module (lift pump) fault ● Blocked fuel filter ● Fuel volume regulator blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel pump fault ● Crankshaft position (CKP) sensor 	Check that the inertia switch has not tripped. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.
Difficult to start	<ul style="list-style-type: none"> ● Glow plug system fault (very cold conditions) ● Low/Contaminated fuel ● Air leakage ● Fuel pump module (lift pump) fault ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Rough idle	<ul style="list-style-type: none"> ● Intake air system fault ● Low/Contaminated fuel ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.

Symptom	Possible Causes	Action
	valve(s) fault	
Lack of power when accelerating	<ul style="list-style-type: none"> ● Intake air system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust gas recirculation (EGR) valve(s) fault ● Turbocharger actuator fault 	Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary. Check for DTCs indicating a fuel pressure fault. Check the EGR system. Check turbocharger actuator.
Engine stops/stalls	<ul style="list-style-type: none"> ● Air leakage ● Low/Contaminated fuel ● Low-pressure fuel system fault ● High pressure fuel leak ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Engine judders	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Air ingress ● Low-pressure fuel system fault ● Fuel metering valve blocked/contaminated ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● High pressure fuel leak ● Fuel pump fault 	Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	<ul style="list-style-type: none"> ● Low-pressure fuel system fault ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel temperature sensor leak ● High pressure fuel leak ● Injector(s) fault ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the EGR system.

Fuel Gauge Diagnosis

1. Using the manufacturer approved diagnostic system monitor, "active fuel level sensor(A)" and "passive fuel level sensor(B)" data logger signals located within the body control module subsection.

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	>3.6v	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, ● C0390-18 and C0114-1 ● If no fault is evident then check C0376-18 to C0586R-8, ● If no fault is evident with the above, remove the fuel pump module and two fuel senders from the fuel tank and check for backed out terminals and circuit faults. Refer to the warranty policy and procedures manual if a module/component is suspect

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	<3.0v	>3.6v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, C0390-2 and C0114-6, If no fault is evident then check C0376-2 to C0586R-20 If no fault is evident with the above, remove the fuel sender B (front) from the fuel tank and check for backed out terminals and circuit faults
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	<3.0v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, C0390-3 and C0114-2 If no fault is evident then check C0376-3 to C0586R-21 If no fault can be found with the above check then the active fuel sender A (rear) will need to be removed and the wiring carefully inspected
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Electric parkbrake fault (EPB)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> NOTE: Check for correct EPB operation prior to carrying out the following checks. NOTE: The EPB module is calibrated to allow fuel gauge correction for varying gradients (via CAN Bus). Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults at connectors, C2178-31, C2178-32 C2178-9, C2178-10, C2178-15 and C2178-16 Check Earth Point (LH D Post) C2570S (Discovery 4/LR4) C2570T (Range Rover Sport)
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 3.06v	0.35v	<ul style="list-style-type: none"> Check active sender A (rear) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v	0.35v to 3.06v	<ul style="list-style-type: none"> Check passive sender B (front) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	>1.0v	0.35v to 0.54v	<ul style="list-style-type: none"> Remove from the fuel tank and check all active sender A (rear) blue wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>1.0v	<ul style="list-style-type: none"> Remove from the fuel tank and check all passive sender B (front) blue circuit wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>0.55v and within 0.6v of B	>0.55v and within 0.6v of A	<ul style="list-style-type: none"> Remove fuel pump module and both senders from the fuel tank and check all black wires on the circuit for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>3.2v but <3.6v	0.35v to 0.54v	<ul style="list-style-type: none"> Active sender A (rear) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>3.2v but <3.6v	<ul style="list-style-type: none"> Passive sender B (front) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	No	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check the pressure relief valve inside fuel tank. Check Internal fuel feed pipe is connected to flange
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check terminals are correctly latched / installed to the fuel pump module

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> ● Check the bayonet fitting on the fuel pump module. Check both the active and passive fuel senders are securely located in their brackets
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel tank - out of shape / sucking in (diesel only)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> ● Incorrect filler cap installed. Install the correct fuel filler cap (applies to diesel variants only). Refer to the warranty policy and procedures manual if a module/component is suspect

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Fuel Tank and Lines - TDV6 2.7L Diesel - Fuel Pump Module

Removal and Installation

Removal

• WARNINGS:



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

• NOTE: The fuel pump module comprises of a rear fuel level sender and a fuel pressure regulator. These components cannot be serviced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the fuel tank.
For additional information, refer to: [Fuel Tank](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation).

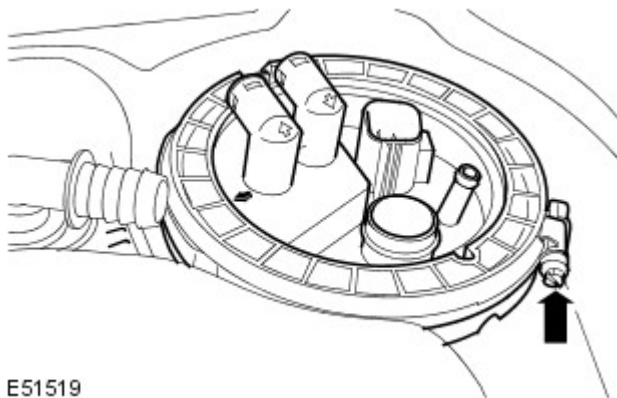


CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• NOTE: Note the fitted position.

Release the fuel pump module access flange.

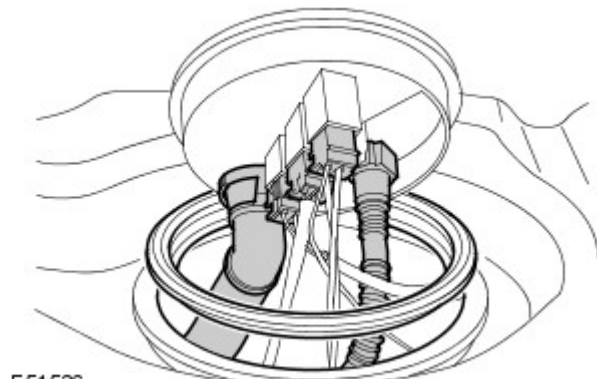
- Loosen the screw.
- Remove the clamp.



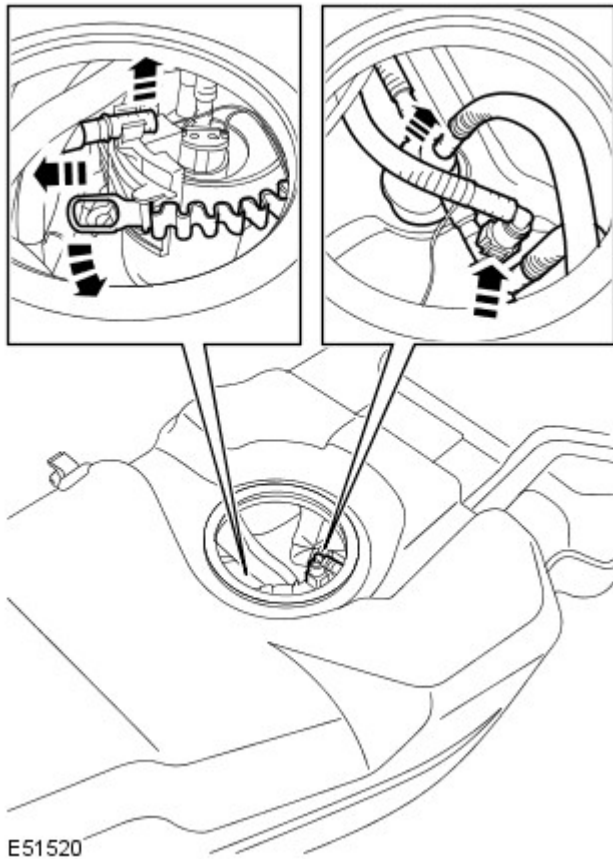
E51519

5. Remove the fuel pump module access flange.

- Disconnect the vent line.
- Disconnect the fuel supply line.
- Disconnect the 3 electrical connectors.
- Remove and discard the seal.



E51526



6. Remove the fuel pump module.

- Release the strap.
- Release the fuel pressure regulator.
- Disconnect the 2 fuel lines.

Installation

1. Install the fuel pump module.

- Connect the fuel lines.
- Secure with the strap.
- Secure the fuel pressure regulator.

2. Install the fuel pump module access flange.

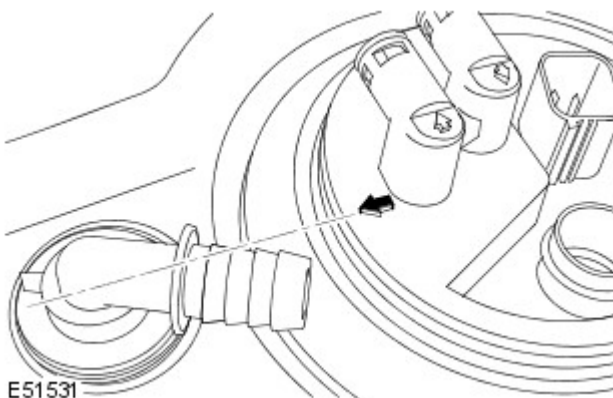
- Clean the component mating faces.
- Install a new seal.
- Connect the 3 electrical connectors.
- Connect the fuel supply line.
- Connect the vent line.

3.  **CAUTION:** Make sure the seal is correctly fitted.

- **NOTE:** Align to the position noted on removal.

Secure the fuel pump module access flange.

- Install the clamp.
- Tighten the screw to 4 Nm (3 lb.ft).



4. Install the fuel tank.

For additional information, refer to: [Fuel Tank](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation).

5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Tank and Lines - TDV6 2.7L Diesel - Fuel Tank

Removal and Installation

Removal

• WARNINGS:



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

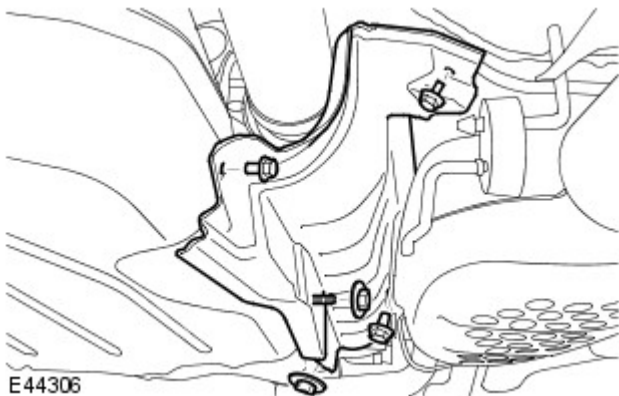
All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the fuel tank.
For additional information, refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).

3. ⚠ WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Remove the fuel tank heat shield.
 - Remove the 3 bolts and 2 nuts.

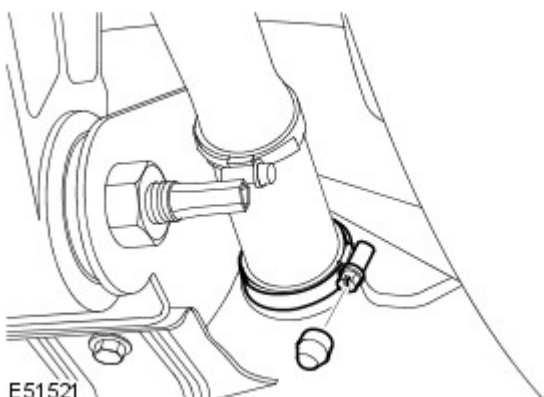


E44306

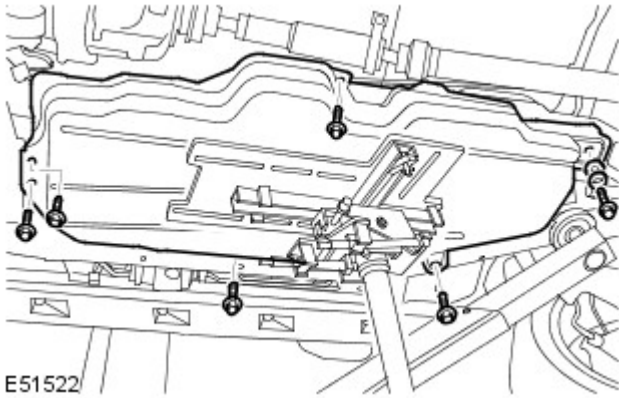
5. ⚠ CAUTION: Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the fuel filler neck from the fuel tank.

- Remove the tamper proof cover.
- Remove and discard the hose clip.



E51521



6.  **WARNING:** Secure the component to the transmission jack.

Using a transmission jack, lower the fuel tank.

- Remove the 5 bolts.

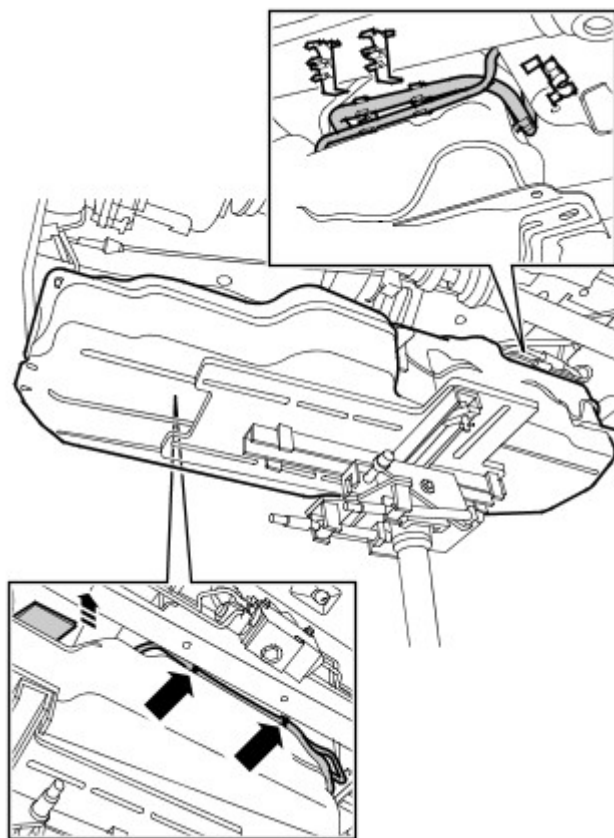
7. Release the parking brake emergency release cable.


- Release it from the 4 clips

8. **NOTE:** Note the fitted position.

Release the fuel tank vent and fuel lines.

- Remove the retainers.
- Release from the clips.
- Remove the adhesive pad.




9.  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the 2 fuel tank vent lines.

- Release the clip.


Vehicles with fuel fired heater

10.  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the fuel fired booster heater fuel line.

- Release the clip.

All vehicles

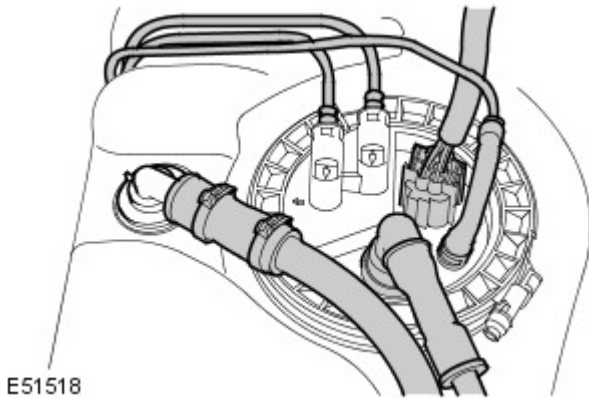
- 11.**  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the 2 fuel lines.

- Release the 2 clips.


- 12.** Disconnect the fuel pump module electrical connector.

- 13.** Remove the fuel tank.



- 14.** **NOTE:** Do not disassemble further if the component is removed for access only.

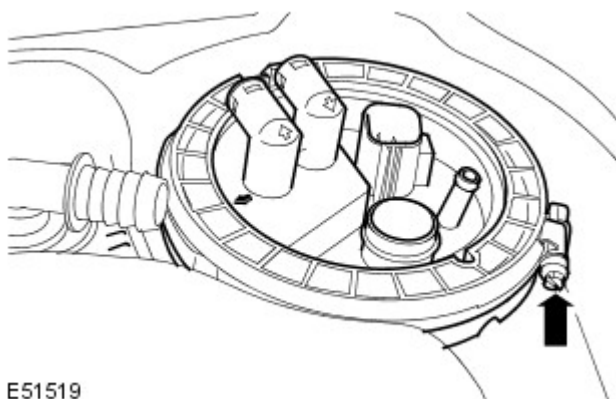
With assistance, remove the fuel tank from the transmission jack.


- 15.**  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- **NOTE:** Note the fitted position.

Release the fuel pump module access flange.

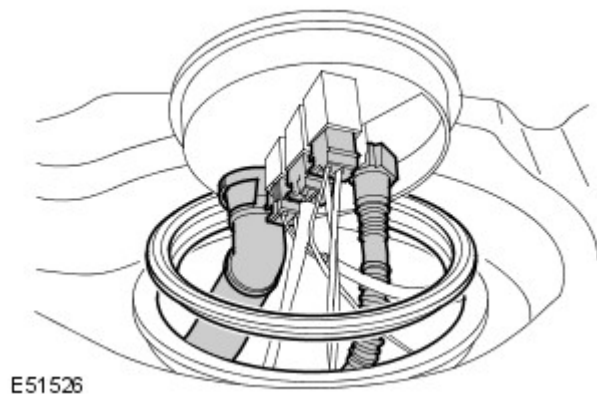
- Loosen the screw.
- Remove the clamp.

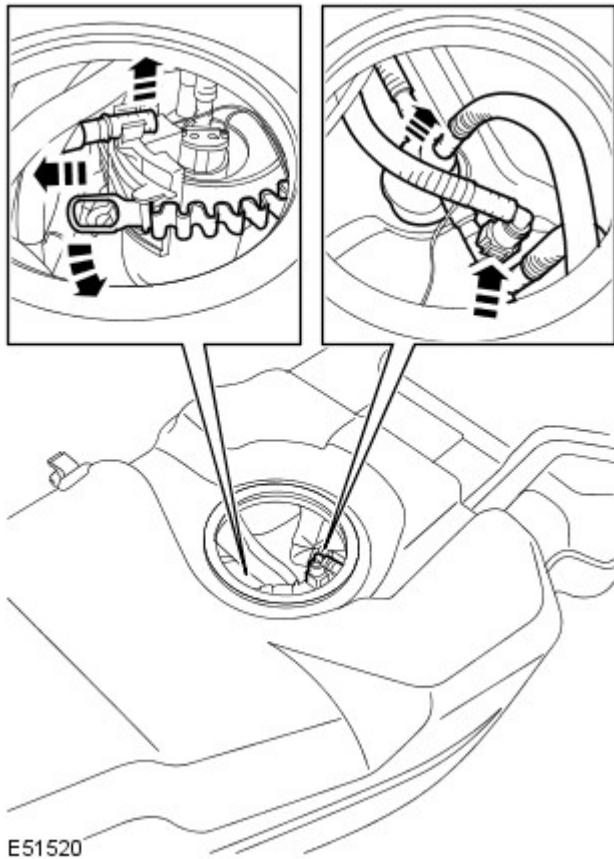


- 16.**  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the fuel pump module access flange.

- Disconnect the vent line.
- Disconnect the fuel supply line.
- Disconnect the 3 electrical connectors.
- Remove and discard the seal.

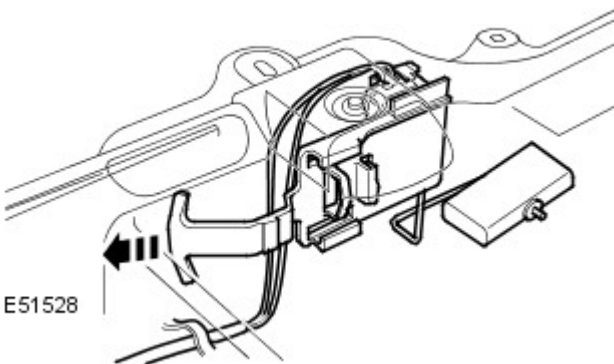




E51520

17. Remove the fuel pump module.

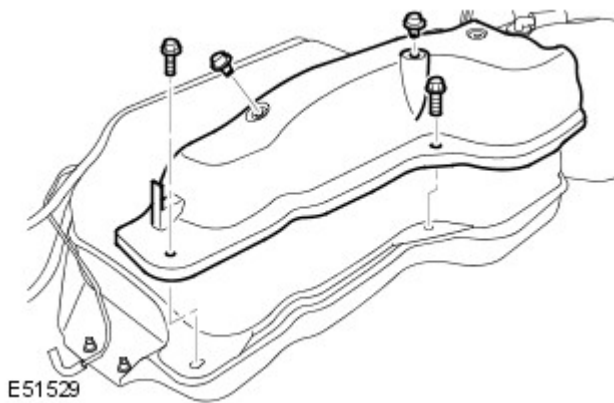
- Release the strap.
- Release the fuel pressure regulator.
- Disconnect the 2 fuel lines.



E51528

18. Remove the fuel tank front fuel level sender unit.

- Release the lead.
- Release the clip.



E51529

19. Remove the fuel tank bracket.

- Remove the 2 clips.
- Remove the 2 bolts.
- Remove the retaining plate.

Installation

All vehicles

1. Install the fuel tank bracket.

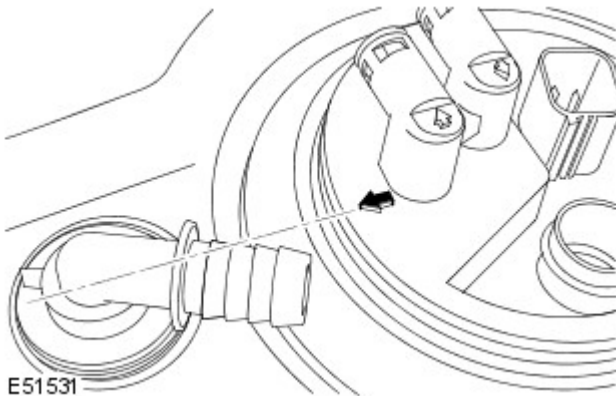
- Install the retaining plate.
 - Install the clips.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the fuel tank front fuel level sender unit.
 - Secure the clip.
 - Secure the lead.
 3. Install the fuel pump module.
 - Connect the fuel lines.
 - Secure with the strap.
 - Secure the fuel pressure regulator.
 4. Install the fuel pump module access flange.
 - Clean the component mating faces.
 - Install a new seal.
 - Connect the 3 electrical connectors.
 - Connect the fuel supply line.
 - Connect the vent line.

5.  **CAUTION:** Make sure the seal is installed correctly.

• **NOTE:** Align to the position noted on removal.

Secure the fuel pump module access flange.

- Install the clamp.
- Tighten the screw to 4 Nm (3 lb.ft).



6. With assistance, install the fuel tank to the transmission jack.
7. Position the fuel tank to the vehicle.
8. Connect the fuel lines.
 - Secure with the clip.

Vehicles with fuel fired heater

9. Connect the fuel fired booster heater fuel line.
 - Secure with the clip.

All vehicles

10. Connect the vent lines.
 - Secure with the clip.
11. Connect the electrical connector.
12. Secure the fuel and vent lines.
 - Secure in the clips.
 - Install the retainers.
 - Install the adhesive pad.
13. Secure the parking brake emergency release cable.

- Secure in the 4 clips.

14. Install the fuel tank.

- Tighten the bolts to 45 Nm (33 lb.ft).

15.  **CAUTION:** Tighten the new tamper proof clip until the hexagon shears.

Connect the fuel filler neck.

- Install a new retaining clip.

16. Install the fuel tank heat shield.

- Tighten the bolts to 5 Nm (4 lb.ft).
- Tighten the nuts to 3 Nm (2 lb.ft).

17. Refill the fuel tank.

For additional information, refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).

18. Bleed the fuel system.

For additional information, refer to: [Low-Pressure Fuel System Bleeding](#) (310-00 Fuel System - General Information, General Procedures).

Fuel Tank and Lines - TDV6 2.7L Diesel - Fuel Tank Filler Pipe

Removal and Installation

Removal

- WARNINGS:



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

- NOTE: Removal steps in this procedure may contain installation details.

1. Remove the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

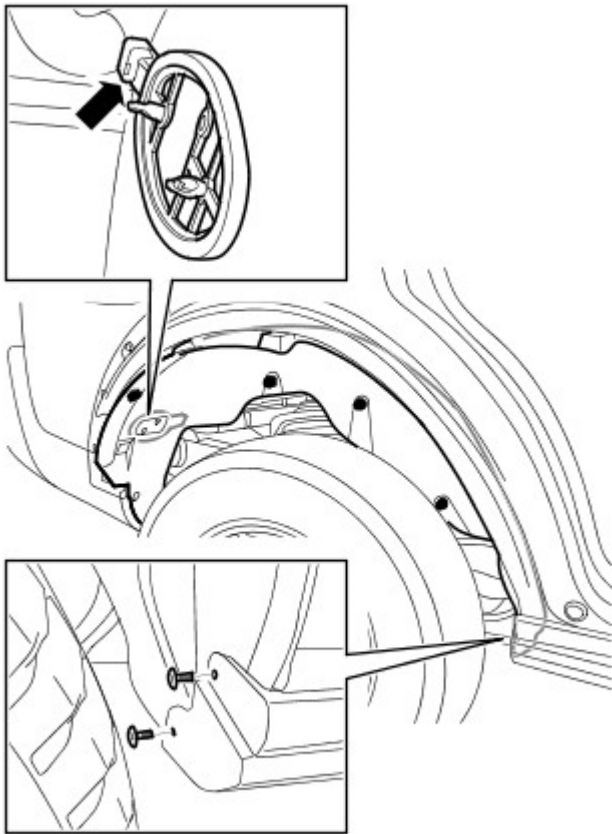
Raise and support the vehicle.

3. Refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).

4. Refer to: [Fuel Filler Door Assembly](#) (501-03 Body Closures, Removal and Installation).

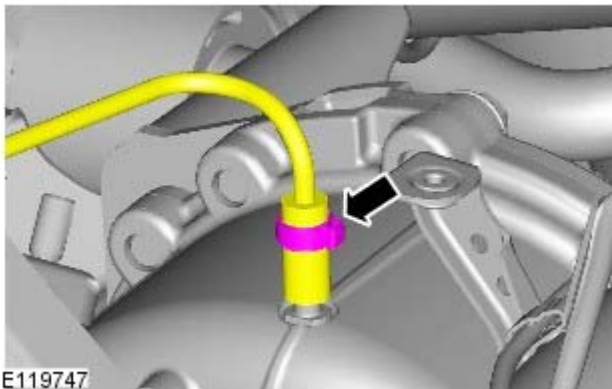
5. Remove the RH rear wheel and tire.

Torque: 140 Nm



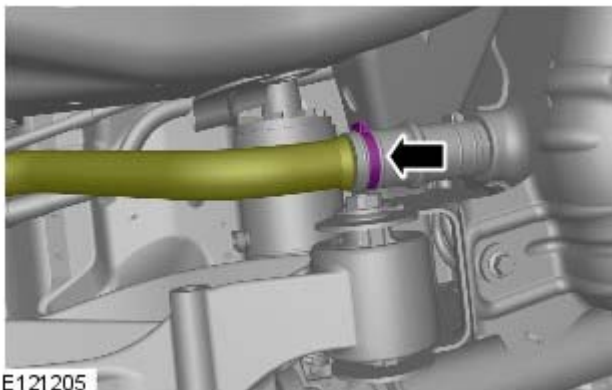
E48478

6. Remove the fender splash shield.



E119747

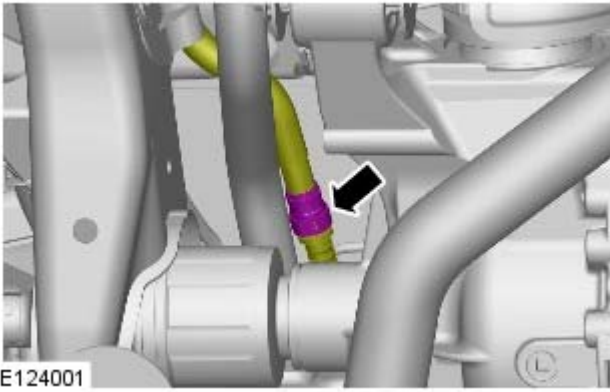
7.




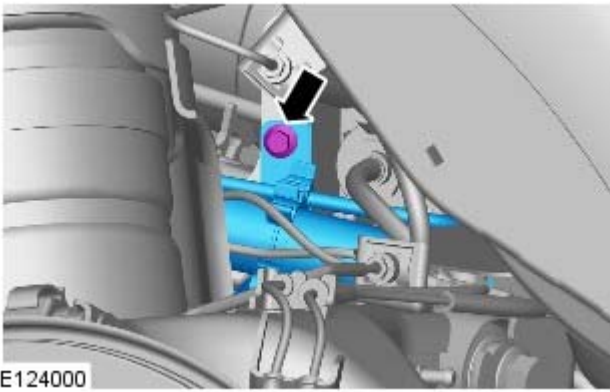
E121205

8. **8.** NOTE: Discard the retaining clip.

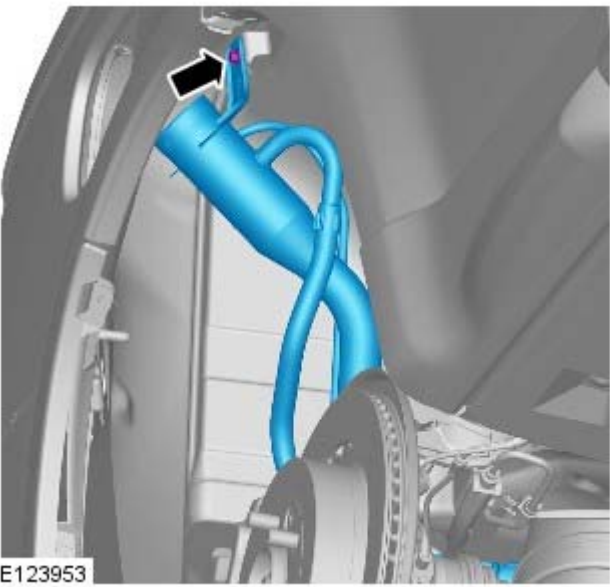
Remove the tamper proof cover from the fuel tank filler pipe hose clip.



9.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



10. Torque: 4 Nm



11. Torque: 4 Nm

Installation


1. To install, reverse the removal procedure.


Fuel Tank and Lines - TDV6 2.7L Diesel - Fuel Filter Element VIN Range: SALLA000304->END OF 06MY


Removal and Installation

Removal

• WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


 The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.


 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.


 If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.

 Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

• CAUTIONS:

 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.


 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

 Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

 Make sure the fuel lines are connected to the correct fuel line connector on the fuel filter. Failure to follow these instructions may result in damage to the engine or fuel injection system.

• NOTE: Before disconnecting the battery, make sure all text and cautions in the battery disconnect section are observed.

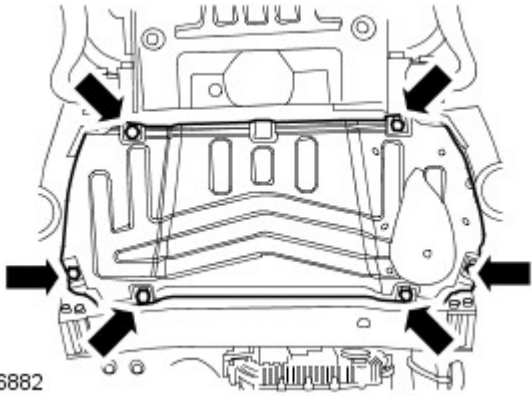
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the transmission undershield.

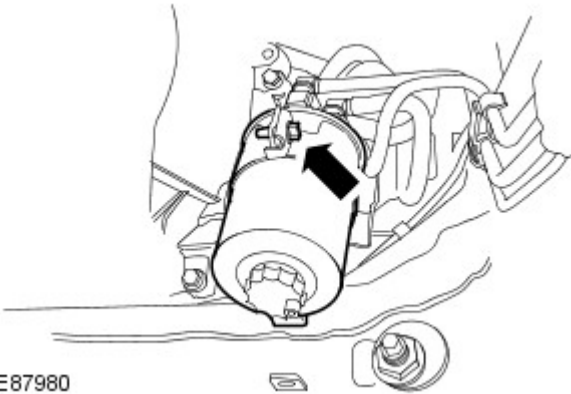
- Remove the 6 bolts.



E56882

4. Release the fuel filter from its bracket.

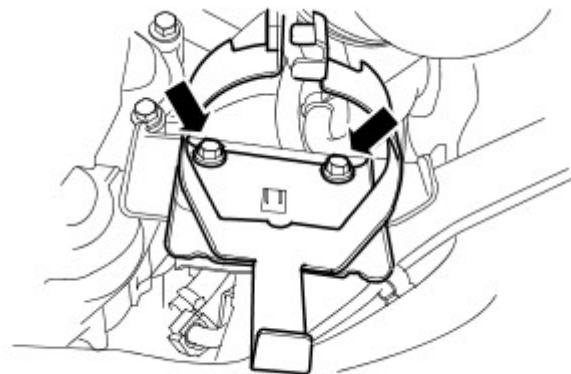
- Remove the bolt.



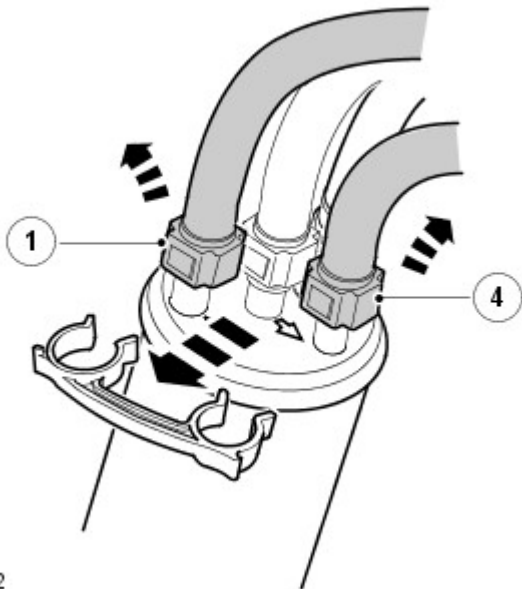
E87980

5. Remove the fuel filter bracket.


- Remove the 2 bolts.



E87981



E87982

6.  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** Note the fitted position of the fuel lines to the fuel filter connections.

Release and disconnect the fuel supply line from the tank, (yellow connector number 1) and the fuel tank vent line, (small blue connector number 4) from the fuel filter.

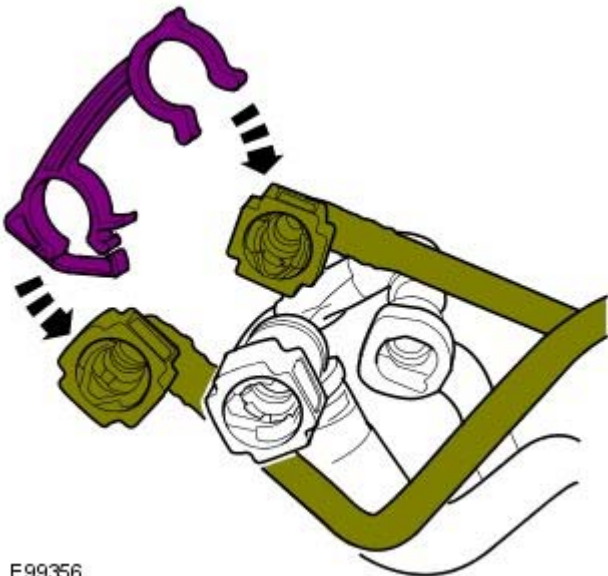
- Position a container to collect the fuel spillage.

7. Remove and discard the clip.



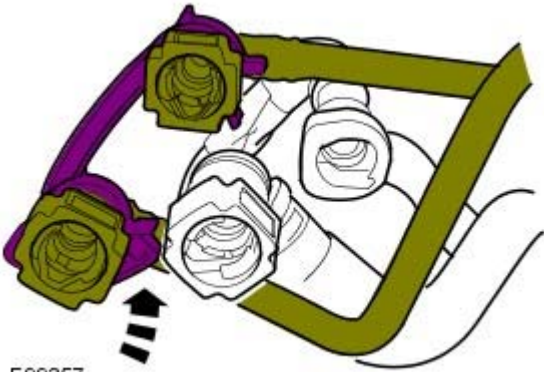
E99355

8. Install the new clip to fuel lines 1 and 4.




E99356

9. Secure the clip.



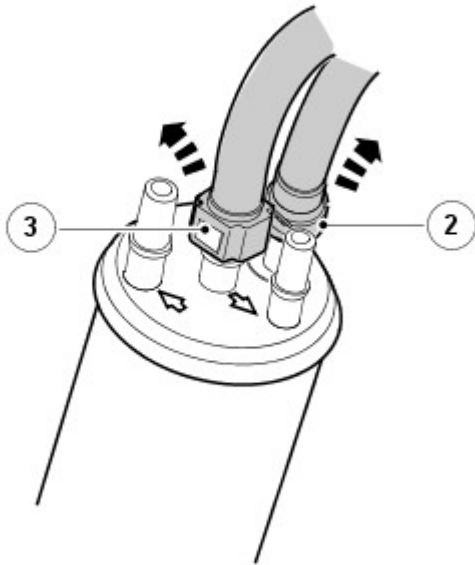
E99357

10.  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** Note the fitted position of the fuel lines to the fuel filter connections.


Remove the fuel filter.

- Release and disconnect the high-pressure fuel pump supply line. (Large blue connector number 3).
- Release and disconnect the fuel cooler return line. (White connector number 2).



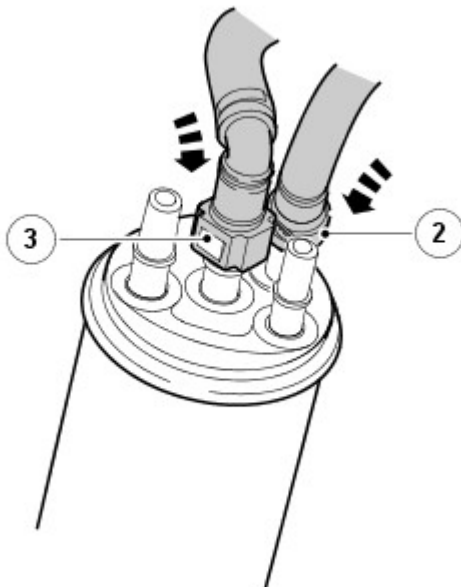
E87984

Installation

1.  **CAUTION:** Make sure that the colors of the connectors match the colors on the disc supplied with the new fuel filter.


Install the fuel filter.

- Connect the fuel cooler return line. (White connector number 2).
- Connect the high-pressure fuel pump supply line. (Large blue connector number 3).



E99538

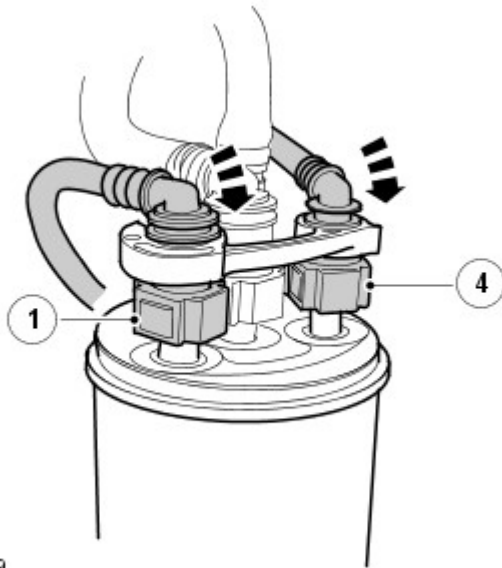
2. CAUTIONS:

 Make sure that the colors of the connectors match the colors on the disc supplied with the new fuel filter.

 Make sure that the clip is correctly fitted.

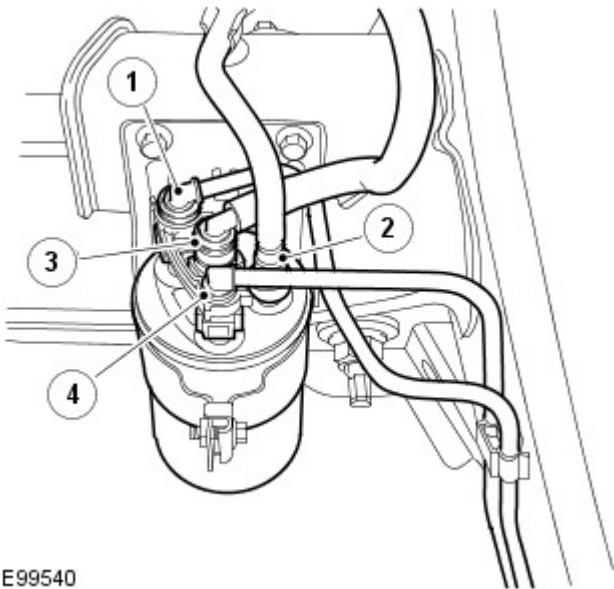
Connect the 2 remaining lines to the fuel filter.

- Connect the fuel supply line from the fuel tank. (Yellow connector number 1).
- Connect the vent line from the fuel tank. (Small blue connector number 4).



E99539

3. Correct connector and line installation shown.

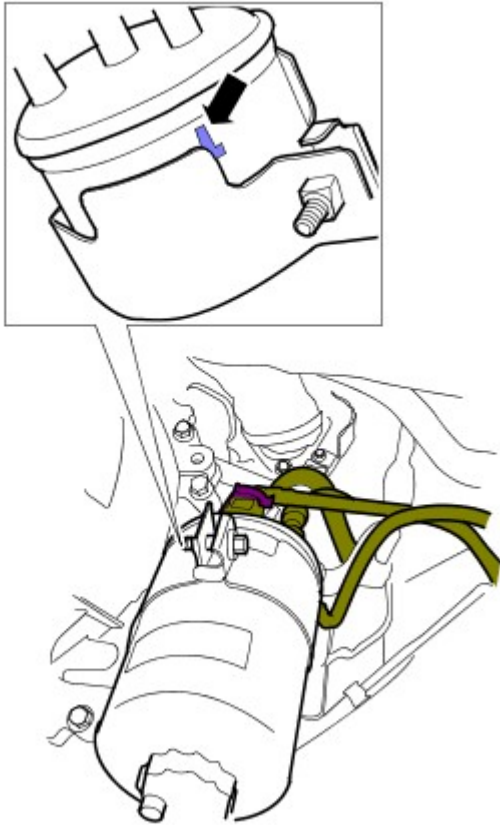


E99540

4. Install the fuel filter bracket.

- Install the 2 bolts and tighten to 10 Nm (7 lb.ft).

6



E99358

5. Secure the fuel filter in its bracket.

- Align the fuel filter to the bracket.
- Install the bolt and tighten to 10 Nm (7 lb.ft).
- Remove the container.

6. Install the transmission undershield.

- Install the 6 bolts and tighten to 10 Nm (7 lb.ft).

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

8. Bleed the fuel system.


For additional information, refer to: [Low-Pressure Fuel System Bleeding](#) (310-00 Fuel System - General Information, General Procedures).


Fuel Tank and Lines - TDV6 2.7L Diesel - Fuel Filter Element VIN Range: 07 MODEL YEAR->CURRENT


Removal and Installation

Removal

• WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.


 If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.


 Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

 The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

• CAUTIONS:

 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

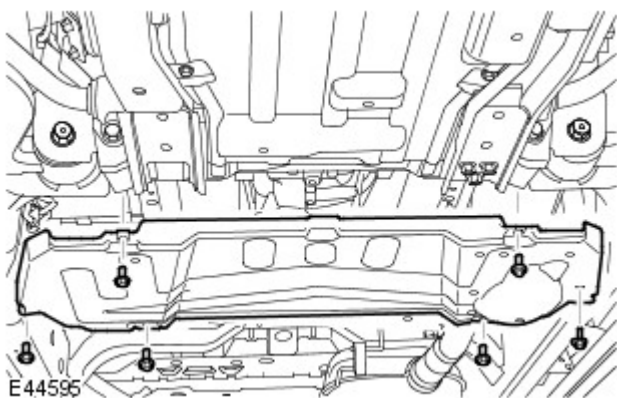
 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

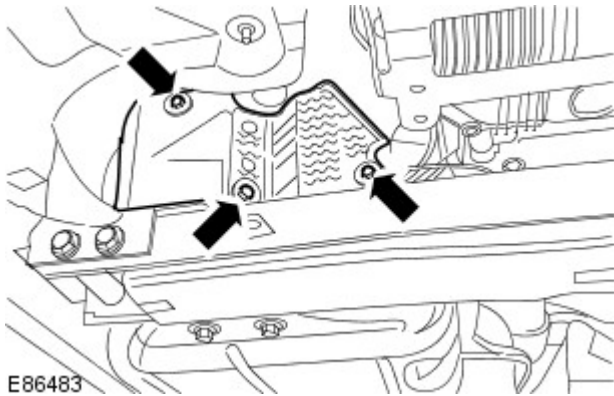
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


2. Remove the transmission undershield.

- Remove the 6 bolts.





E86483


3.  **WARNING:** Observe due care when working near a hot exhaust system.

Remove the fuel filter heat shield.

- Remove the 3 bolts.



E88183


4.  **CAUTION:** Make sure the water-in-fuel sensor remains in the aligned position.

Drain the fuel filter element.

- Position a container to collect the fluid spillage.
- Loosen the nut.
- Attach a suitable drain tube to the water-in-fuel sensor drain port.
- Remove the drain tube.
- Tighten the nut.



E86484

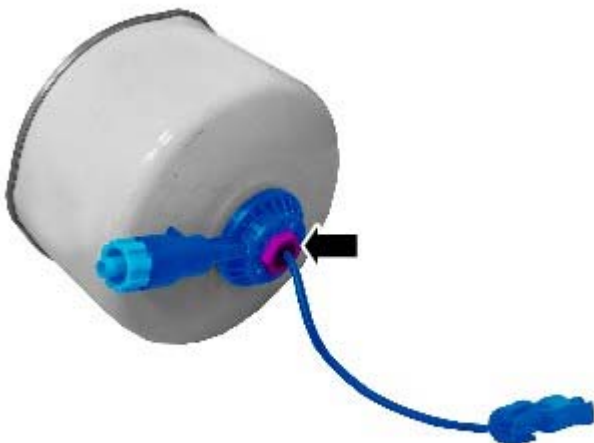
5.  **CAUTION:** Make sure that the area around the component is clean and free of foreign material.

Remove the fuel filter element.

- Disconnect the water-in-fuel sensor electrical connector.

6. Remove the water-in-fuel sensor.

- Discard the fuel filter element.



E138939

7. Remove and discard the O ring seals.



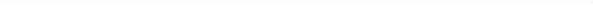
E138941

Installation

1. Install new O ring seals.




2.



E138940



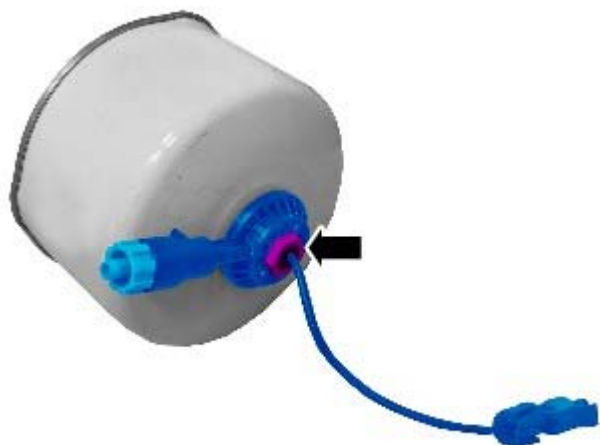
E138603

2.  CAUTION: Make sure that the mating faces are clean and free of foreign material.


• NOTE: Make sure that the water-in-fuel sensor is aligned with the drain arrow.

Install the water-in-fuel sensor.

- Remove and discard the water-in-fuel drain plug from the new fuel filter element.



E138939

3.  CAUTION: Make sure the water-in-fuel sensor remains in the aligned position.

Tighten the plastic nut to 1.6 Nm.

4. NOTE: Make sure that the fuel filter element is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

Install the fuel filter element.

1. Insert the fuel filter with the the lock symbol arrow aligned with the inlet pipe on the fuel filter housing.



5. NOTE: Make sure that the fuel filter element is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

Rotate to tighten and seal the fuel filter element.

1. When tightened correctly, the lock symbol arrow should be aligned with the arrow symbol on the fuel filter housing.

- Connect the water-in-fuel sensor electrical connector.
- Remove the container.



6. Install the fuel filter heat shield.

- Tighten the bolts to 6 Nm.

7. Install the transmission undershield.

- Tighten the bolts to 10 Nm.

8. Carry out the low-pressure fuel system bleeding.

Fuel Tank and Lines - TDV6 3.0L Diesel -**General Specifications**

Item	Specification
Fuel system	Mechanical - returnless
Fuel tank	Multi layer plastic
High pressure fuel pump	Located at rear of engine between the cylinder heads, belt driven from the camshafts
Low pressure fuel pump	Located in the fuel tank
Fuel filter	Remotely mounted on the inside of the longitudinal member - fitted with a renewable element
Fuel tank sender units	Two - Front and Rear - front sender is attached to the frame of the fuel pick up tube and the rear sender is attached to the fuel pump swirl pot
High pressure fuel pump maximum operating pressure	1650 bar - 23931.2 lbf/in ²
Low pressure fuel pump operating pressure	0.5 bar - 7.25 lbf/in ²

Capacities

	Liters
Fuel tank capacity	86.3 (total)

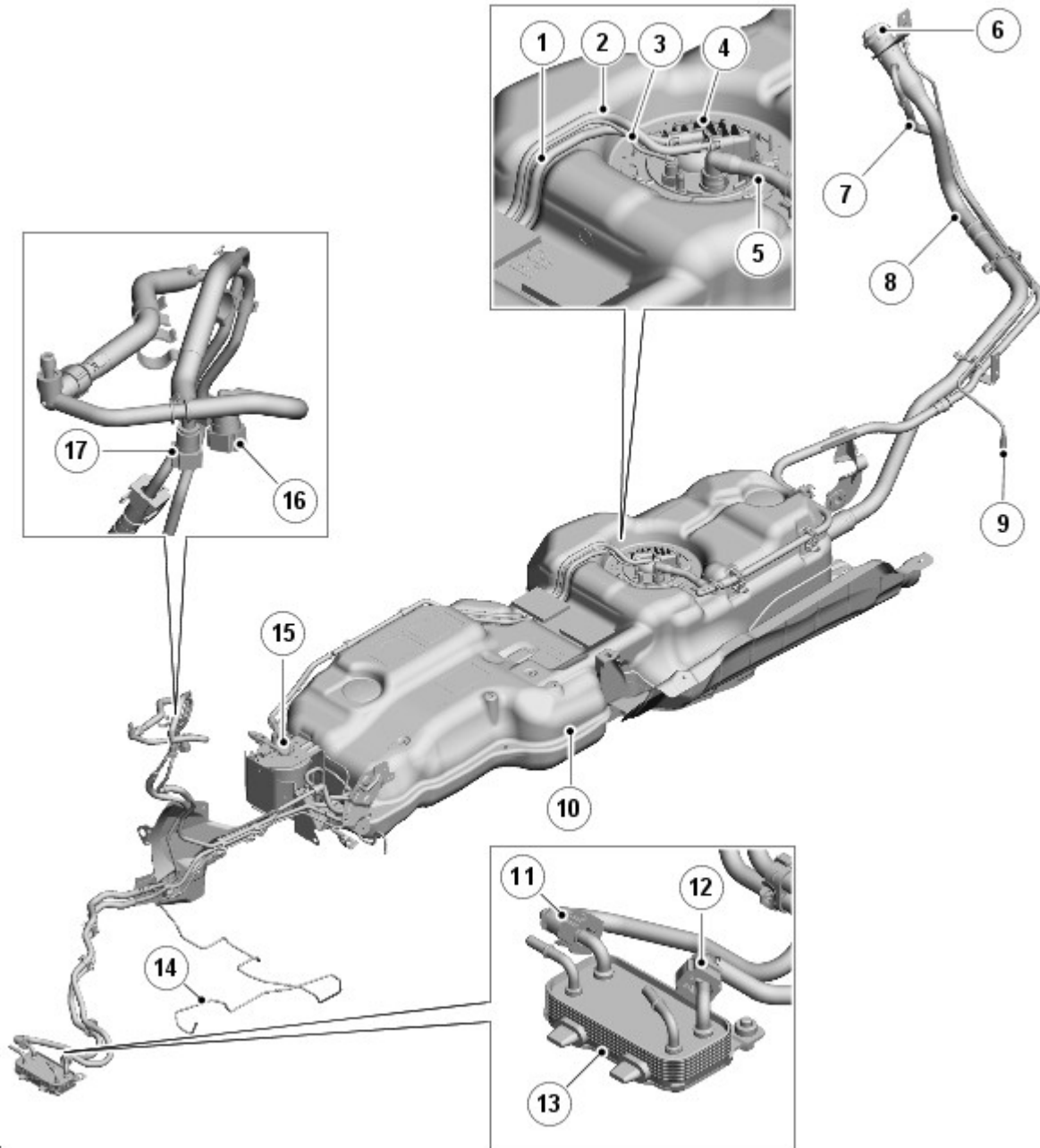
Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel tank filler pipe retaining bolt	4	-	35
Fuel tank retaining bolts	45	33	-
Fuel tank heat shield retaining bolts	6	-	53
Fuel tank heat shield retaining nuts	3	-	27
Fuel filter heat shield retaining bolts	6	-	53
Transmission undershield retaining bolts	10	7	-
Fuel cooler retaining bolt	23	17	-

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank and Lines

Description and Operation

3.0L V6 DIESEL FUEL TANK AND LINES COMPONENT LOCATION



E122445

Item	Part Number	Description
1	-	Pipe - Fuel pump to filter (fuel feed)
2	-	Pipe - Filter to pump module (fuel return)
3	-	Pipe - Fuel burning heater supply
4	-	Fuel pump module assembly
5	-	Fuel tank vent pipe
6	-	Filler cap and lanyard
7	-	Fuel tank vent pipe
8	-	Fuel filler pipe
9	-	Rear differential breather pipe (Ref only)
10	-	Cover
11	-	Pipe - Fuel cooler to filter (fuel return)
12	-	Pipe - HP pump to fuel cooler (fuel return)
13	-	Fuel cooler
14	-	Pipe - Fuel burning heater supply
15	-	Fuel filter
16	-	Pipe - HP pump to fuel cooler (fuel return)
17	-	Pipe - Filter to HP pump (fuel feed)

GENERAL

The major components of the 3.0L TdV6 fuel system comprises a fuel tank, a fuel pump module, a fuel filter, a fuel cooler, a fuel filler pipe and cap assembly and two fuel level sensors. The fuel system is a high pressure common rail system which uses an engine mounted and driven high pressure pump to deliver a uniform level of pressure to the common fuel rails which supply all 6 fuel injectors.

The fuel tank houses an internal fuel lift pump, located in the fuel pump module. The lift pump is employed to provide a low-pressure supply to the common rail high pressure fuel system.

Two fuel level sensors are installed in the front and rear of the fuel tank. The sensors are a MAGnetic Passive Position Sensor (MAPPS) which provide a variable resistance to ground for the output from the fuel gauge.

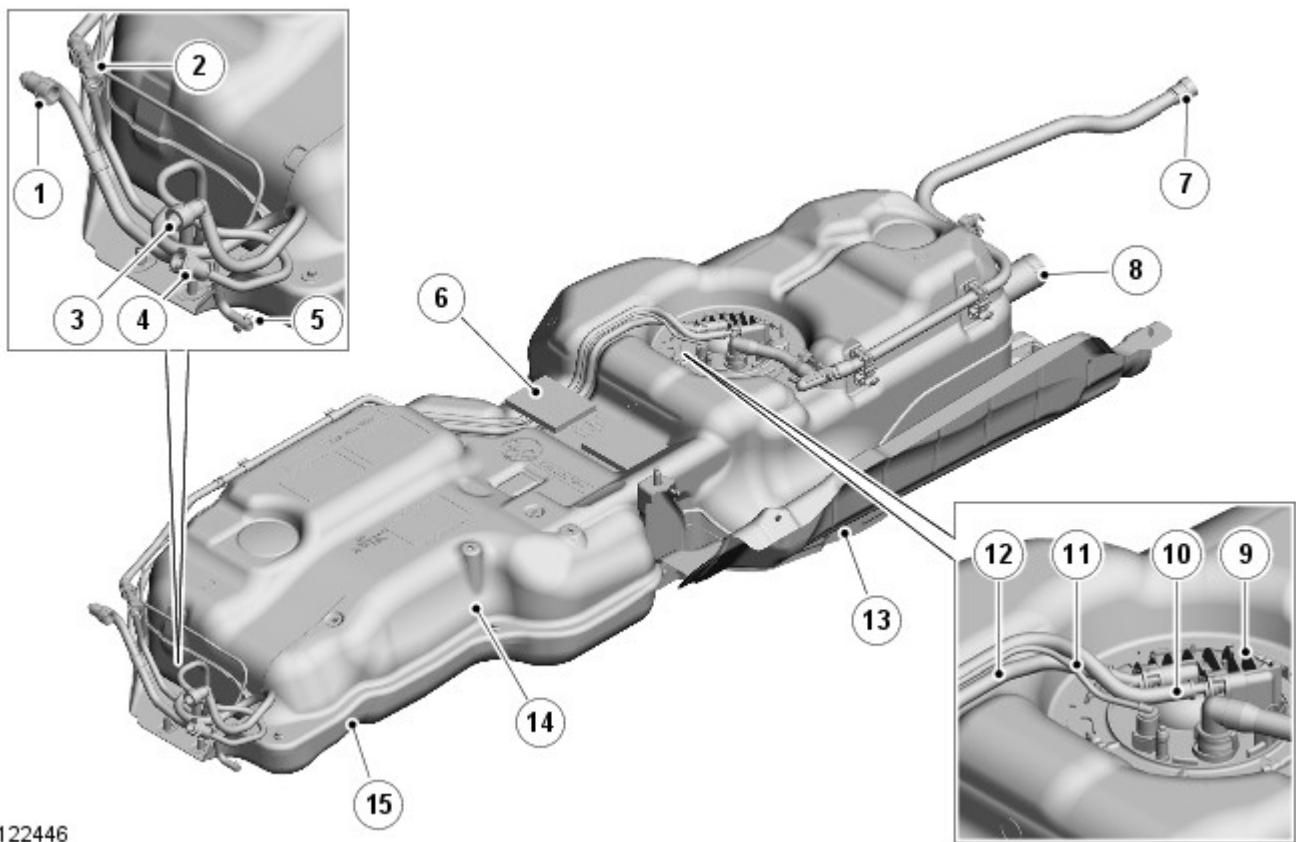
A fuel cooler is located in the low pressure side of the system in the fuel return line and is a fuel to water type cooler.

The fuel tank breather system consists of a fuel cut-off elbow. No Roll Over Valves (ROV's) are fitted.

The fuel filter is a disposable canister type and is located on a bracket at the front of the fuel tank.

DESCRIPTION

FUEL TANK ASSEMBLY



E122446

Item	Part Number	Description
1	-	Fuel return from filter to tank
2	-	Fuel supply from fuel pump to filter
3	-	Pipe - return from fuel cooler
4	-	Pipe - Fuel supply to HP pump
5	-	Pipe - Fuel burning heater supply
6	-	Pad (2 off)
7	-	Pipe - Fuel tank breather
8	-	Fuel tank filler inlet hose
9	-	Fuel pump module assembly
10	-	Pipe - Fuel return
11	-	Pipe - Fuel burning heater supply
12	-	Pipe - Fuel supply from pump
13	-	Heat shield
14	-	Cover
15	-	Cradle

The fuel tank is located on the right hand side of the vehicle, between the transmission and the right hand chassis longitudinal. The tank is located on a mounting cradle which secures the whole fuel tank assembly to the vehicle. The tank is blow moulded from HDPE (high density polyethylene) and has a useable capacity of 82.0 liters (18 gallons).

The cradle is attached to the chassis with six screws. When the cradle is attached to the chassis, the tank is positively secured via foam pads which bear against the central chassis cross beam. A protective cover is fitted to the front right

hand corner of the tank and provides additional protection.

The fuel tank is manufactured from moulded plastic which is a minimum of 3 mm thick. The tank is a sealed unit with the only internal access being via the pump module flange aperture on the top of the tank.

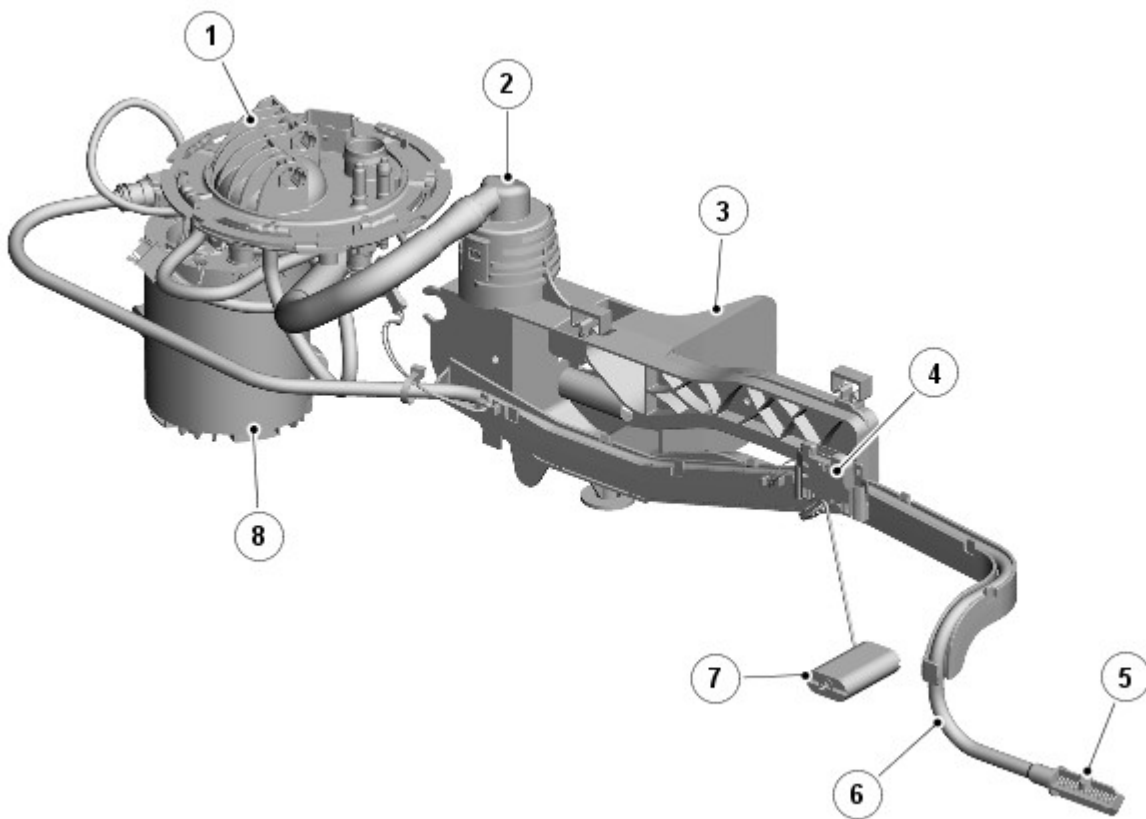
The flange is fitted with a locking ring and seal. The seal locates in a groove on the tank. The locking ring locates and clamps on the encapsulated ring that is moulded into the fuel tank. The flange has a tag which locates in the top of the tank to ensure correct orientation.

The flange has six pin internal and external connectors which provide for electrical connections for the level sensors and the fuel pump. Two quick release connectors provide for the connection of the fuel feed and return pipes and the vent pipes. The fuel return connection contains a non return valve which prevents fuel escaping from the connection in the event of a vehicle roll over and the pipe becoming detached. On vehicles with a fuel burning heater, a third connection provides the connection for the fuel feed supply to the fuel burning heater.

The fuel pump module is mounted on a bayonet lock ring which is welded inside the fuel tank. A carrier within the tank provides for the mounting of the fuel suction jet, front fuel sensor and the fuel cut-off elbow.

The fuel pump module contains a number of components. The module comprises the fuel pump, the rear fuel level sensor, the rear jet pump, the pump inlet filter and the fuel pressure regulator. Only the pump module assembly, the fuel level sensors and the flange are available as serviceable components, the individual assembly components are not available separately.

Fuel Tank Internal Components



E122447

Item	Part Number	Description
1	-	Fuel pump module assembly
2	-	Fuel cut-off elbow
3	-	Carrier
4	-	Forward fuel level sensor
5	-	Suction port filter
6	-	Suction port pipe
7	-	Level sensor float
8	-	Swirl pot

Fuel Pump Module

The low pressure fuel lift pump is located in the fuel pump module. The lift pump is employed to provide a low pressure supply at approximately 0.5 bar, to the common-rail high pressure fuel system and to allow the jet pump assemblies to maintain a full swirl pot.

The lift pump operation is controlled by the Engine Control Module (ECM), via the fuel pump relay located in the Engine Junction Box (EJB). When the ignition is switched on, the fuel pump operates for 25 seconds to build up fuel pressure. As engine cranking commences the fuel pump stops running until the engine starts. This function is employed to decrease load on the battery.

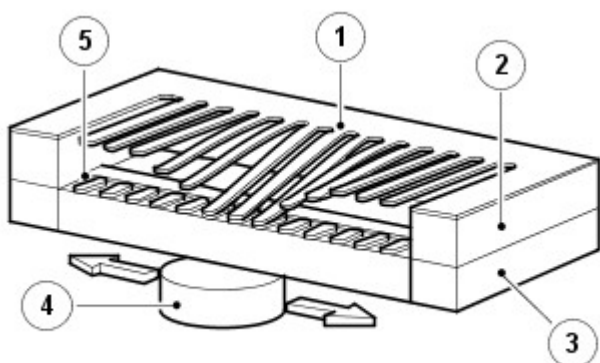
In cold conditions, 'waxing' of the fuel can occur. For this reason a coarse mesh filter is attached to the swirl pot inlet port at the bottom of the pump module.

A three way connection is located on the top of the module. Two outlets supply the jet pumps, the other outlet is the pressure feed through the pressure regulating valve to the fuel delivery line. The module incorporates a jet pump which draws fuel from the front of the tank and delivers it directly into the swirl pot.

Fuel Level Sensors

Two fuel level sensors are installed at either end of the tank. One is mounted on the fuel pump module, the other is mounted in a central position on the internal carrier within the tank. The sensors are a MAPPS (magnetic passive position sensor) which provide a variable resistance to ground for the output from the fuel gauge. The sensor is sealed from the fuel preventing contamination of the contacts, increasing reliability. The fuel level sensors are connected to an electrical connector on the underside of the fuel pump module flange.

The sensor comprises a series of 51 film resistors mounted in an arc on a ceramic surface. The resistors are wired in series with individual contacts. A soft magnetic foil with 51 flexible contacts is mounted a small distance above the film resistors. A magnet, located below the ceramic surface, is attached to the sender unit float arm. As the float arm moves, the magnet follows the same arc as the film resistors. The magnet pulls the flexible contacts onto the opposite film resistor contacts forming an electrical circuit.



E44504

Item	Part Number	Description
1	-	Magnetic foil
2	-	Spacer
3	-	Ceramic surface
4	-	Magnet
5	-	Resistance film

The film resistors are arranged in a linear arc with resistance ranging from 51.2 to 992.11 Ohms. The electrical output signal is proportional to the amount of fuel in the tank and the position of the float arm. The measured resistance is processed by the instrument cluster to implement an anti-slosh function. This monitors the signal and updates the fuel gauge pointer position at regular intervals, preventing constant pointer movement caused by fuel movement in the tank due to cornering or braking.

A warning lamp is incorporated in the instrument cluster and illuminates when the fuel level is low.

The fuel level sender signal is converted into a CAN (controller area network) message by the instrument cluster as a direct interpretation of the fuel tank contents in liters.

In the event that fuel is allowed to run too low, signals transmitted from the fuel level sensors initiate the fuel run-dry strategy. The driver will be notified before the tank is run critically low on fuel. Although this is a simulated run-dry procedure, it provides the symptoms of the vehicle running out of fuel and the driver will perceive it as such. The engine will stop when there is approximately 4 liters (0.87 gallons) of fuel remaining in the fuel tank.

Jet Pumps

The fuel system incorporates twin jet pumps which are integral with the fuel pump module. One jet pump collects fuel from the rear of the tank, and the other draws additional fuel from the front of the tank through a suction line that is mounted on the carrier. The jet pump operates on a venturi effect created by the fuel at pump output pressure passing through the jet pump.

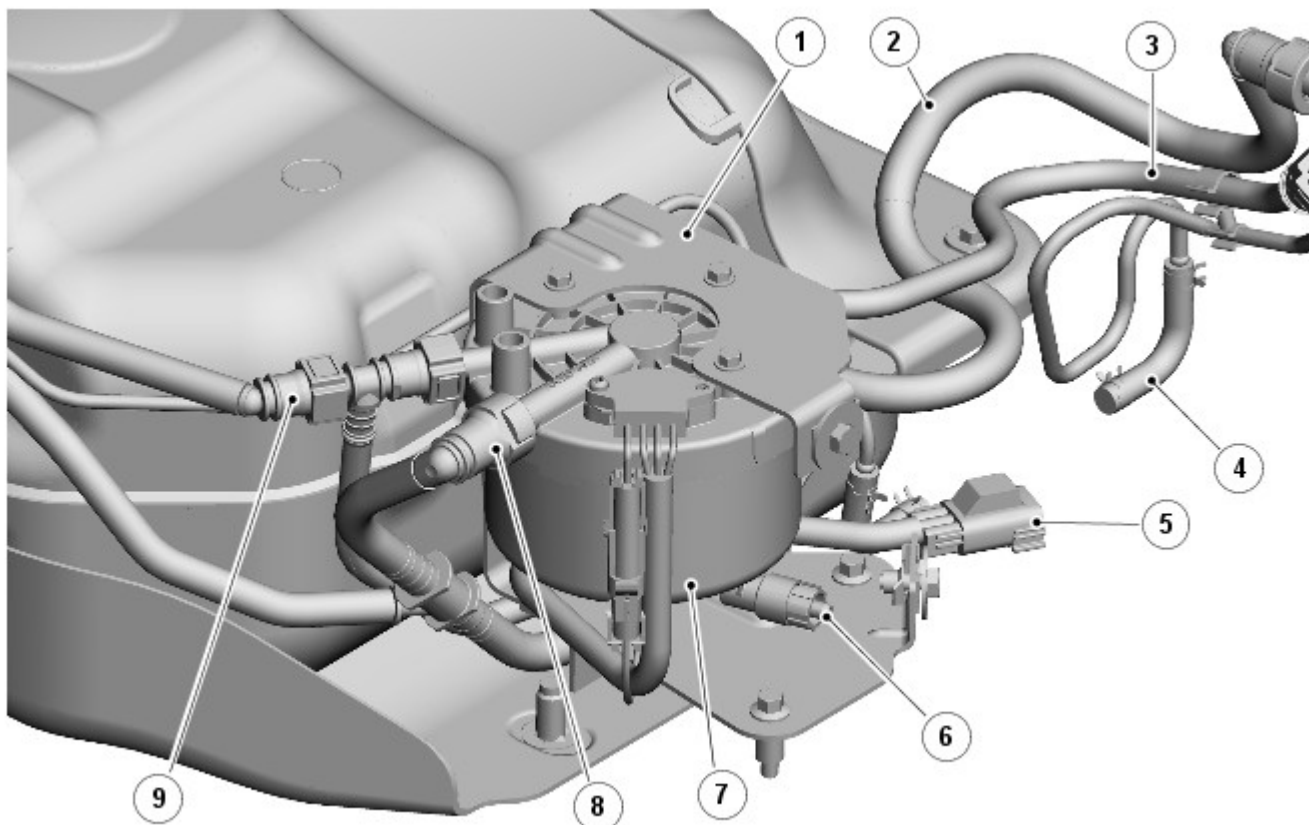
The prime function of the jet pump is to collect fuel from the front of the tank and transfer it into the fuel pump module swirl pot at the rear of the tank. The jet pump feature ensures that fuel is drained from the front of the tank before fuel run-out at the rear of the tank.

Fuel Cut-Off Elbow

The fuel cut-off elbow is located in the upper half of the tank on the carrier and is connected to the tank breather. The main purpose of the fuel cut-off elbow is to control the fill volume of the tank. During filling air, trapped inside the tank and a small amount of vapor is passed via the fuel cut-off elbow to the tank breather. The air and vapor mix then vents to atmosphere through the breather. During filling, when the tank reaches its full level, the fuel cut-off elbow closes and prevents air/vapor passing through to the tank breather. The resulting back pressure causes refueling to stop automatically.

The fuel cut-off elbow is always open when the fuel tank is below full, providing an unrestricted air/vapor outlet to the tank breather.

FUEL FILTER



E122448

Item	Part Number	Description
1	-	Mounting bracket
2	-	Pipe - Fuel return from fuel cooler
3	-	Pipe - Fuel supply to high pressure fuel pump
4	-	Pipe - Fuel supply to Fuel Burning Heater (FBH)
5	-	Electrical connector
6	-	Water drain
7	-	Fuel filter
8	-	Fuel return to tank connection
9	-	Fuel supply from tank connection

The fuel filter assembly is located in front of the fuel tank and is mounted on a bracket which is attached to the top face of the transfer box chassis cross member. The fuel filter assembly comprises a bracket, filter housing and the filtration element. The filter housing is secured to the bracket with 3 bolts. The bracket is secured to the cross member with 2 bolts which are screwed into threaded holes in the cross member.

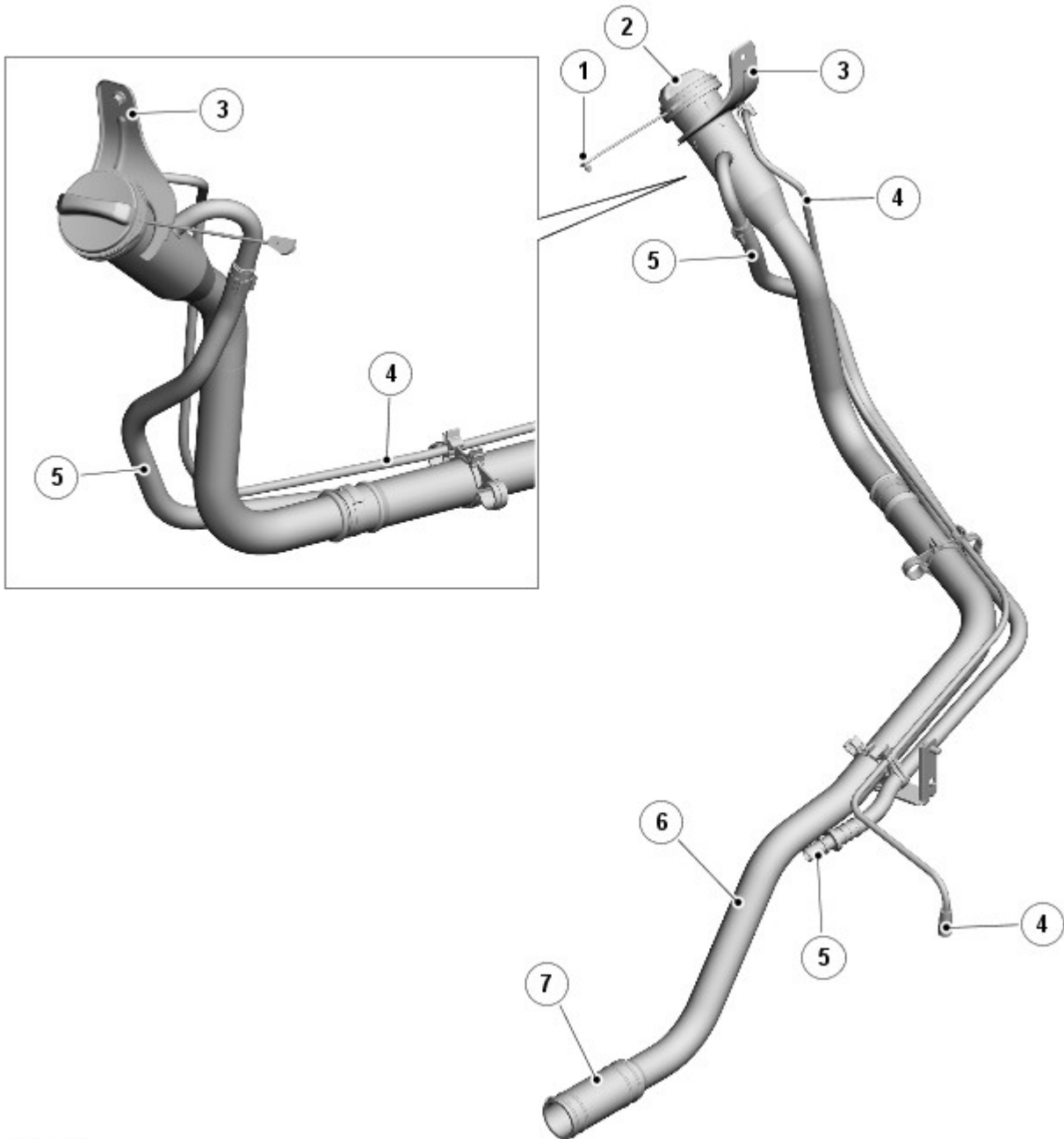
The filter housing has an inlet and outlet which allow for the attachment of hoses using quick release connectors. The filter element is located on the underside of the housing and can be removed by rotating one quarter turn to release from the housing.

The filter element has a capacity of 200 cm³ (12.2 in³). The filtration element can filter particulate matter larger than 15 microns. A water drain valve is located on the base of the filter. The filter can be purged of water by partially unscrewing the drain valve and allowing at least 84 cm³ (5.12 in³) of fuel to drain into a suitable container. The drain plug has a centre outlet which allows for the attachment of a drain hose.

The filter element also has a water sensor located in its base. The sensor is screwed into a threaded hole in the base of the element. When the filter is replaced at service, the sensor can be unscrewed from the element and installed in the new element. The sensor has an electrical connector located at the side of the element which can be disconnected to assist element removal.

The water sensor is connected to the Engine Control Module (ECM). When the water in the element reaches 64 cm³ (3.9 in³) the ECM issues a high speed Controller Area Network (CAN) bus message to the instrument cluster to display a 'WATER IN FUEL' message in the message center.

FUEL FILLER PIPE



E122449

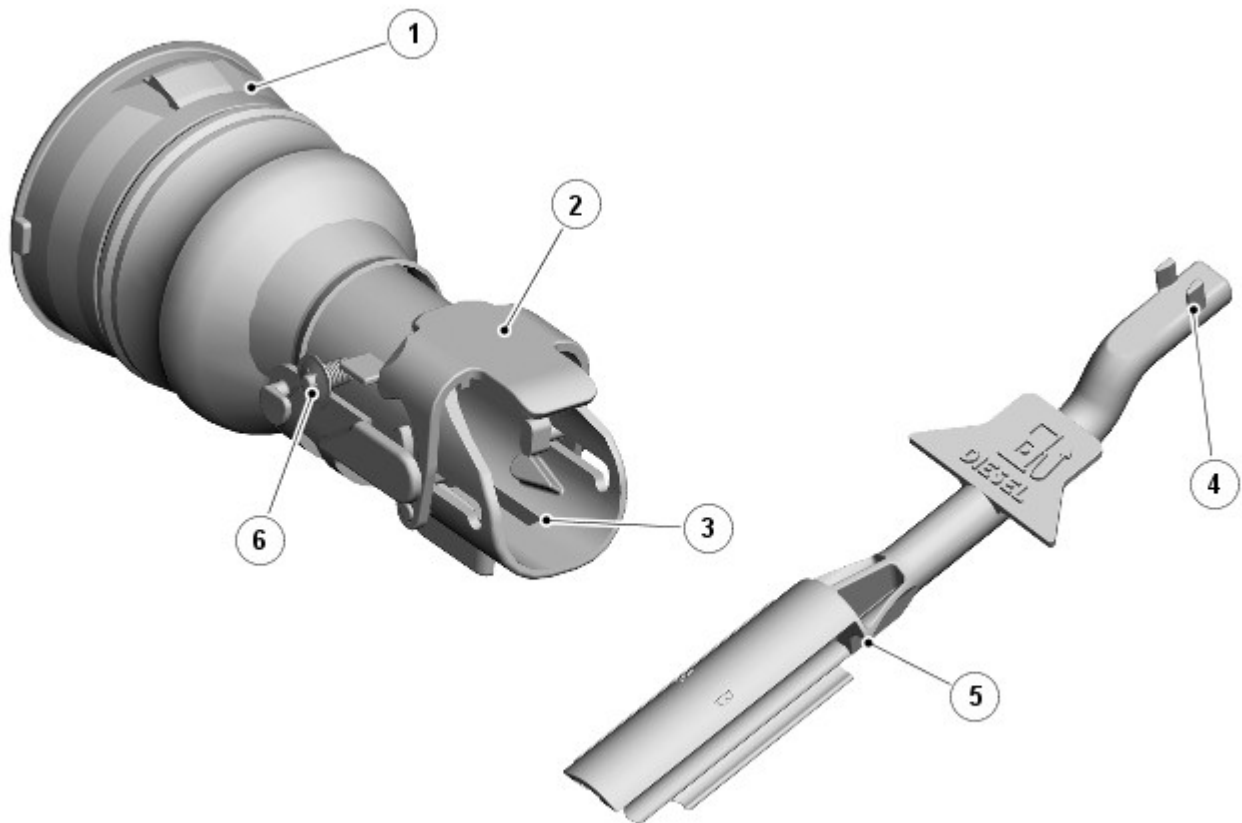
Item	Part Number	Description
1	-	Lanyard
2	-	Filler cap
3	-	Bracket
4	-	Pipe - Rear differential breather (Reference only)
5	-	Pipe - Fuel vapor vent
6	-	Fuel filler pipe
7	-	Hose - connection to fuel tank

The stainless steel filler neck has a wide bore neck specially designed to reduce diesel frothing while the fuel tank is being replenished. The filler pipe is connected at its lower end to the fuel tank by a hose which is secured to the pipe with a worm drive clamp. The opposite end of the hose is connected to the fuel tank inlet check valve and secured with another worm drive clamp.

A fuel vapor vent pipe is attached to the filler pipe and connects between the fuel level vent valve in the fuel tank and fuel filler pipe neck.

The filler head incorporates the Fuel Guard system to prevent accidental filling of the tank with petrol (gasoline).

Fuel Guard System



E117721

Item	Part Number	Description
1	-	Filler neck
2	-	Flap
3	-	Reset slots
4	-	Spigots
5	-	Reset tool
6	-	Spring

The fuel guard system comprises a mechanically operated flap which is triggered when the smaller diameter filler nozzle tube, used on petrol (gasoline) pumps, is inserted in the filler neck. The flap is actuated and blocks the sensor port on the fuel pump nozzle, causing it to automatically switch off. The flap is locked in this position by a latch mechanism.

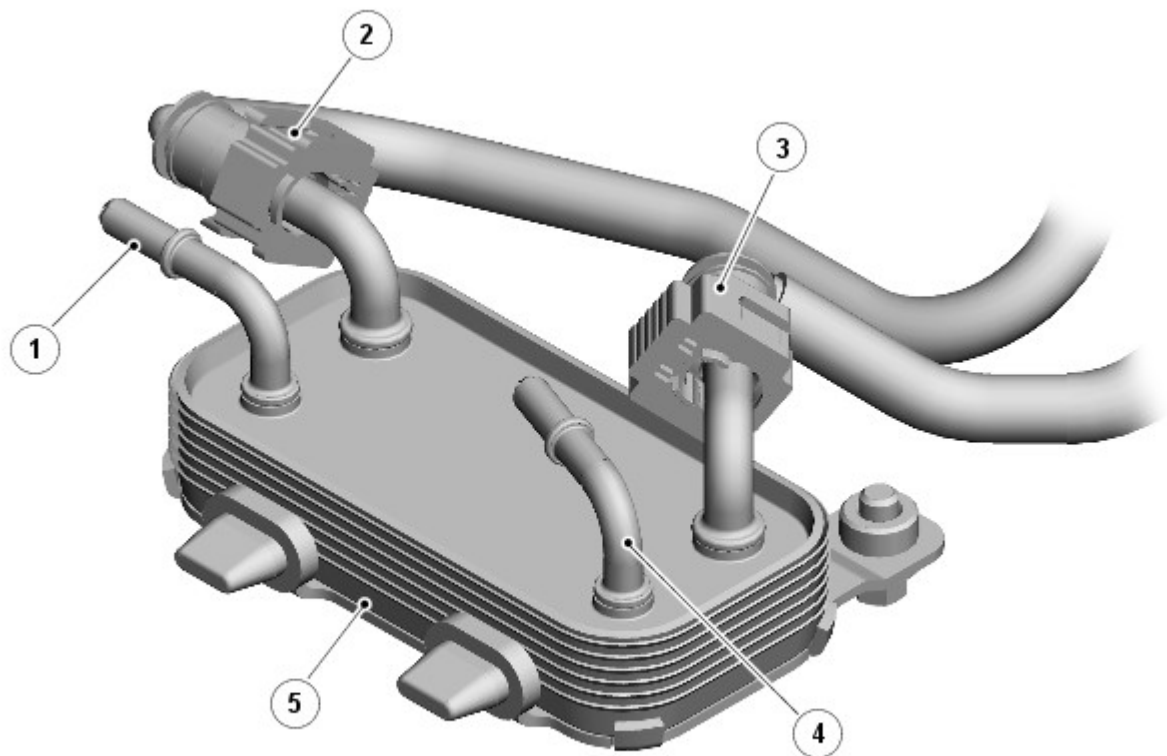
A reset tool is provided and stored in the luggage compartment. The tool is used to reset the fuel guard device if triggered and release the latch. Two spigots on the tool locate in slots in the filler neck which release a latch and the flap is opened by its own spring. The tool is located in the filler neck and once the two spigots on the tool are located in the slots it can be pulled outwards, releasing a latch and allowing the flap to be opened by its own spring pressure. The tool is stored on the battery mounting clamp.

The flap is colored yellow so that it is clearly visible when activated and has a 'Handbook' symbol on it.

A diesel fuel pump nozzle will not activate the fuel guard because the nozzle stops against two molded lugs. However, if an unleaded gasoline pump nozzle is inserted into the housing, its smaller diameter allows it to pass the two molded lugs. The nozzle strikes two pins on the inside of the filler housing which move forward. This movement rotates the shut-off flap which is then held in place when the nozzle is removed by the latch mechanism.

• NOTE: Russian markets do not use the fuel guard system and are fitted with a conventional filler neck.

FUEL COOLER



E122450

Item	Part Number	Description
1	-	Coolant outlet
2	-	Pipe - cooler to fuel filter
3	-	Pipe - HP pump to cooler
4	-	Coolant inlet
5	-	Fuel cooler

The fuel cooler uses engine coolant, direct from the lower part of the radiator, to cool fuel returning to the tank from the HP injection pump.

The fuel cooler is located on the right hand side of the chassis, at the rear of the engine, near to transmission cooler. A bracket, which is attached to the right hand chassis rail, provides for the attachment of the cooler. The bracket has two slots which accept two plastic pegs which are attached to the cooler. A bolt is inserted through a hole in the bracket and screws into a captive nut on the cooler to positively secure the cooler to the bracket.

The cooler has four quick fit connector pipes which provide for the attachment of the fuel inlet hose from the HP injection pump, the fuel outlet hose to the fuel filter, the coolant inlet hose from the radiator and the coolant outlet hose to the coolant thermostat housing. The coolant pipes can be identified by their smaller diameter.

OPERATION

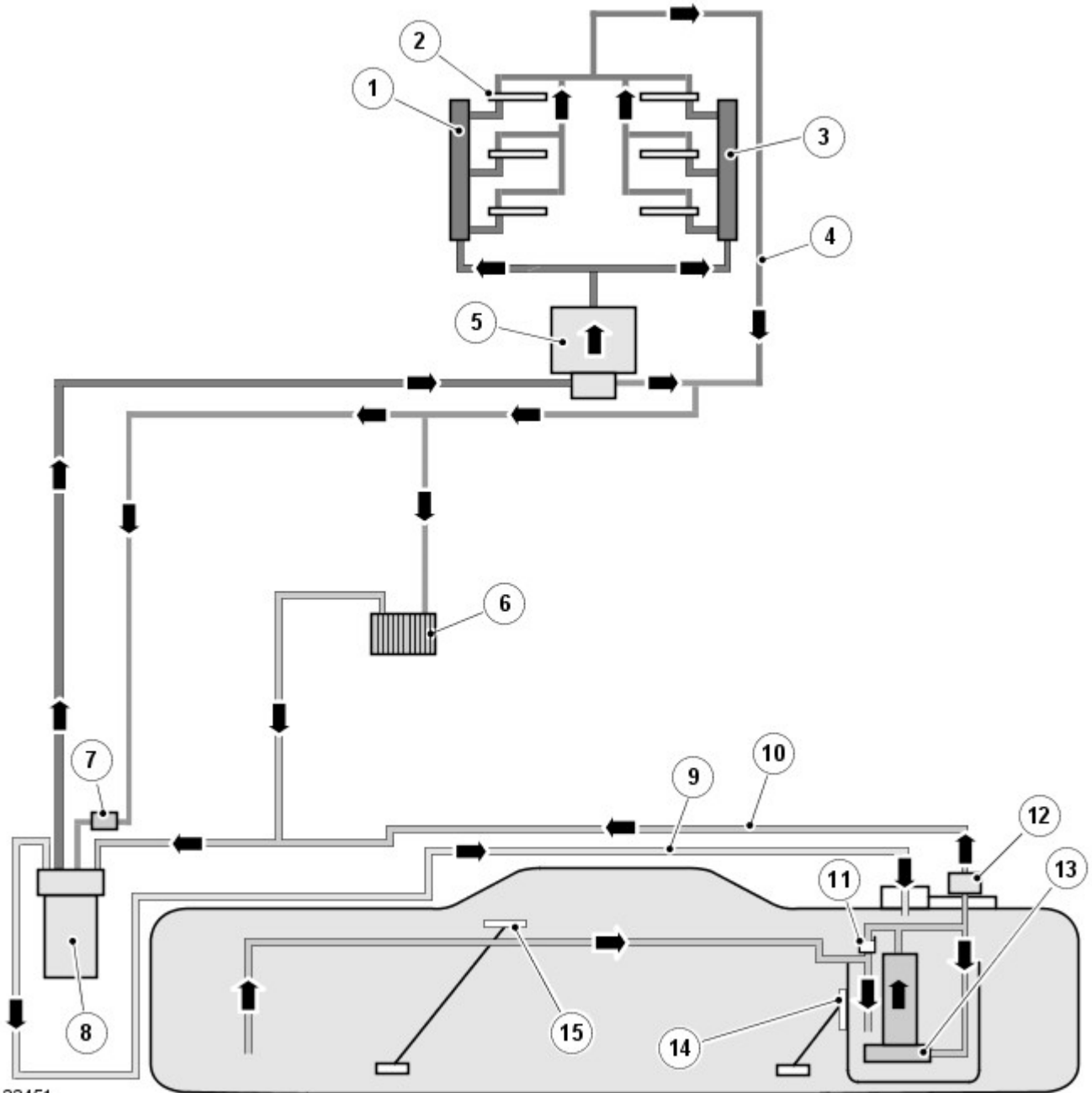
Diesel fuel is drawn from the tank by the internal electric lift pump. The fuel pressure regulator located in the fuel pump module assembly regulates the delivery pressure at approximately 0.5 bar to the transfer pump housed in the High Pressure (HP) pump. A VCV (volume control valve) governs the amount of fuel supplied to the HP pump.

The transfer and high pressure pump are driven directly by the engine. Due to the storage volume of the common rail, the injection pressure will remain practically constant over the complete duration of the injection process.

The HP pump has a return pipe circuit which is separate from the injector return pipes.

For additional information, refer to: [Fuel Charging and Controls](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation).

Fuel Delivery Schematic Diagram



E122451

Item	Part Number	Description
1	-	Left Hand (LH) common rail
2	-	Fuel injector (6 off)
3	-	Right Hand (RH) common rail
4	-	Fuel rail and injector leak-off return line
5	-	High Pressure (HP) fuel pump
6	-	Fuel cooler
7	-	Thermostatic diverter valve
8	-	Fuel filter assembly
9	-	Fuel return/air bleed pipe
10	-	Low Pressure (LP) delivery pipe
11	-	Jet pump
12	-	Pressure regulator
13	-	Fuel pump module
14	-	Fuel level sensor - Rear
15	-	Fuel level sensor - Front

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank and Lines

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel tank and lines system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

[Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation),
[Fuel Tank and Lines](#) (310-01B Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation),
[Fuel Tank and Lines](#) (310-01B Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).

Inspection and Verification

• WARNINGS:



Do **NOT** carry out any work on the fuel system with the engine running. The fuel pressure within the system can be as high as 2000 bar (29,008 lb/in²). Failure to follow this instruction may result in personal injury.



Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow this instruction may result in personal injury.



After carrying out repairs, the fuel system must be checked visually for leaks. This should be done after the engine has been run, but with the engine switched **OFF**. Failure to follow this instruction may result in personal injury.



If taken internally, **DO NOT** induce vomiting. Seek immediate medical attention. Failure to follow this instruction may result in personal injury.



If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention. Failure to follow this instruction may result in personal injury.



Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention. Failure to follow this instruction may result in personal injury.

• CAUTIONS:



Before disconnecting any part of the system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into the fuel system. Failure to follow this instruction may result in damage to the vehicle.



The fuel pipes between the injectors and the rail must be discarded after each use, and new pipes installed. Failure to follow this instruction may result in damage to the vehicle.



It is essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.



Make sure that the workshop area in which the vehicle is being worked on is as clean and dust-free as possible. Areas in which work on clutches, brakes or where welding or machining are carried out are not suitable in view of the risk of contamination to the fuel system. Failure to follow this instruction may result in damage to the vehicle.



Make sure that any protective clothing worn is clean and made from lint-free non-flocking material. Failure to follow this instruction may result in damage to the vehicle.



Make sure that any protective gloves worn are new and are of the non-powdered latex type. Failure to follow this instruction may result in damage to the vehicle.



Make sure that clean, non-plated tools are used. Clean tools using a new brush that will not lose its bristles and fresh cleaning fluid prior to starting work on the vehicle. Failure to follow this instruction may result in damage to the vehicle.



Use a steel-topped work bench and cover it with clean, lint-free, non-flocking material. Failure to follow this instruction may result in damage to the vehicle.



Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel level ● Contaminated fuel ● Fuel supply line(s) ● Fuel return line(s) ● High-pressure fuel supply line(s) ● Fuel tank filler pipe ● Fuel leak(s) ● Fuel tank ● Fuel filler cap ● Fuel filter ● Push connect fittings ● Fuel rail ● Fuel injection pump ● Exhaust Gas Recirculation (EGR) system 	<ul style="list-style-type: none"> ● Battery charge and condition ● Fuse(s) ● Inertia fuel shutoff (IFS) switch ● Fuel pump module relay ● Fuel pump module ● Electrical connector(s) ● Damaged or corroded wiring harness ● Fuel Volume Control Valve (FVCV) ● Fuel Pressure Control Valve (FPCV) ● Engine Control Module (ECM)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not start	<ul style="list-style-type: none"> ● Inertia fuel shutoff switch ● Low/Contaminated fuel ● Air leakage ● Low-pressure fuel system fault ● Fuel pump module (lift pump) fault ● Blocked fuel filter ● Fuel volume regulator blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel pump fault ● Crankshaft position (CKP) sensor 	Check that the inertia switch has not tripped. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the CKP sensor circuits. Refer to the electrical guides.
Difficult to start	<ul style="list-style-type: none"> ● Glow plug system fault (very cold conditions) ● Low/Contaminated fuel ● Air leakage ● Fuel pump module (lift pump) fault ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Rough idle	<ul style="list-style-type: none"> ● Intake air system fault ● Low/Contaminated fuel ● Low-pressure fuel system fault ● Blocked fuel filter ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.

Symptom	Possible Causes	Action
	blocked/contaminated <ul style="list-style-type: none"> ● Exhaust gas recirculation (EGR) valve(s) fault 	
Lack of power when accelerating	<ul style="list-style-type: none"> ● Intake air system fault ● Restricted exhaust system ● Low fuel pressure ● Exhaust gas recirculation (EGR) valve(s) fault ● Turbocharger actuator fault 	Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary. Check for DTCs indicating a fuel pressure fault. Check the EGR system. Check turbocharger actuator.
Engine stops/stalls	<ul style="list-style-type: none"> ● Air leakage ● Low/Contaminated fuel ● Low-pressure fuel system fault ● High pressure fuel leak ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Exhaust gas recirculation (EGR) valve fault 	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage: Check for DTCs indicating a fuel volume or pressure control valve fault. Check the EGR system.
Engine judders	<ul style="list-style-type: none"> ● Low/Contaminated fuel ● Air ingress ● Low-pressure fuel system fault ● Fuel metering valve blocked/contaminated ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● High pressure fuel leak ● Fuel pump fault 	Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	<ul style="list-style-type: none"> ● Low-pressure fuel system fault ● Fuel volume control valve blocked/contaminated ● Fuel pressure control valve blocked/contaminated ● Fuel temperature sensor leak ● High pressure fuel leak ● Injector(s) fault ● Exhaust gas recirculation (EGR) valve(s) fault 	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Check the EGR system.

Fuel Gauge Diagnosis

1. Using the manufacturer approved diagnostic system monitor, "active fuel level sensor(A)" and "passive fuel level sensor(B)" data logger signals located within the body control module subsection.

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	>3.6v	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, ● C0390-18 and C0114-1 ● If no fault is evident then check C0376-18 to C0586R-8, ● If no fault is evident with the above, remove the fuel pump module and two fuel senders from the fuel tank and check for backed out terminals and circuit faults. Refer to the warranty policy and procedures manual if a

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
					module/component is suspect
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	<3.0v	>3.6v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, <ul style="list-style-type: none"> C0390-2 and C0114-6, If no fault is evident then check C0376-2 to C0586R-20 If no fault is evident with the above, remove the fuel sender B (front) from the fuel tank and check for backed out terminals and circuit faults
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	<3.0v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, <ul style="list-style-type: none"> C0390-3 and C0114-2 If no fault is evident then check C0376-3 to C0586R-21 If no fault can be found with the above check then the active fuel sender A (rear) will need to be removed and the wiring carefully inspected
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Electric parkbrake fault (EPB)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> NOTE: Check for correct EPB operation prior to carrying out the following checks. NOTE: The EPB module is calibrated to allow fuel gauge correction for varying gradients (via CAN Bus). <ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults at connectors, <ul style="list-style-type: none"> C2178-31, C2178-32 C2178-9, C2178-10, C2178-15 and C2178-16 Check Earth Point (LH D Post) C2570S (Discovery 4/LR4) C2570T (Range Rover Sport)
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 3.06v	0.35v	<ul style="list-style-type: none"> Check active sender A (rear) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v	0.35v to 3.06v	<ul style="list-style-type: none"> Check passive sender B (front) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	>1.0v	0.35v to 0.54v	<ul style="list-style-type: none"> Remove from the fuel tank and check all active sender A (rear) blue wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>1.0v	<ul style="list-style-type: none"> Remove from the fuel tank and check all passive sender B (front) blue circuit wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>0.55v and within 0.6v of B	>0.55v and within 0.6v of A	<ul style="list-style-type: none"> Remove fuel pump module and both senders from the fuel tank and check all black wires on the circuit for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>3.2v but <3.6v	0.35v to 0.54v	<ul style="list-style-type: none"> Active sender A (rear) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>3.2v but <3.6v	<ul style="list-style-type: none"> Passive sender B (front) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	No	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check the pressure relief valve inside fuel tank. Check Internal fuel feed pipe is connected to flange

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> ● Check terminals are correctly latched / installed to the fuel pump module
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> ● Check the bayonet fitting on the fuel pump module. Check both the active and passive fuel senders are securely located in their brackets
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel tank - out of shape / sucking in (diesel only)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> ● Incorrect filler cap installed. Install the correct fuel filler cap (applies to diesel variants only). Refer to the warranty policy and procedures manual if a module/component is suspect

DTC Index


For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.


Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Cooler


Removal and Installation

Removal

- WARNINGS:

 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install new blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

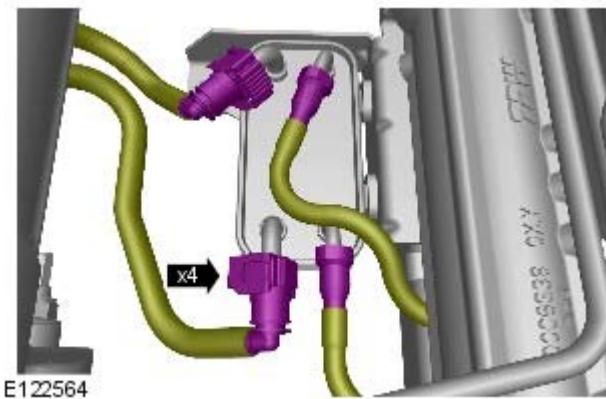
 CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

- NOTE: Removal steps in this procedure may contain installation details.

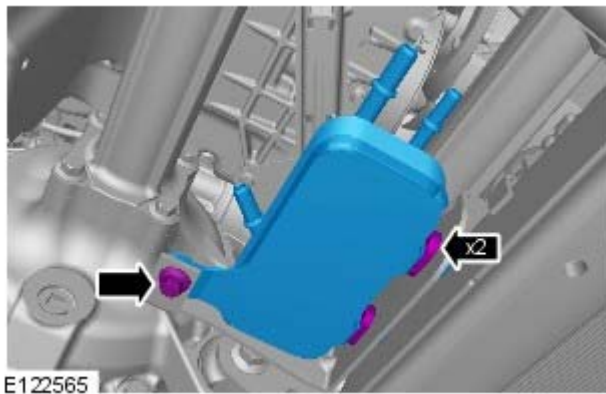
1.  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



3.  WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.



4.  CAUTION: Always plug any open connections to prevent contamination.

Torque: 23 Nm

Installation

1.  CAUTION: Remove and discard all blanking caps.


To install, reverse the removal procedure.

2. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank.

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Pump and Sender Unit

Removal and Installation

Special Tool(s)

	<p>310-123 Locking Ring, Fuel Tank</p>
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General Equipment

Transmission jack

Removal

• WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

• NOTE: Removal steps in this procedure may contain installation details.

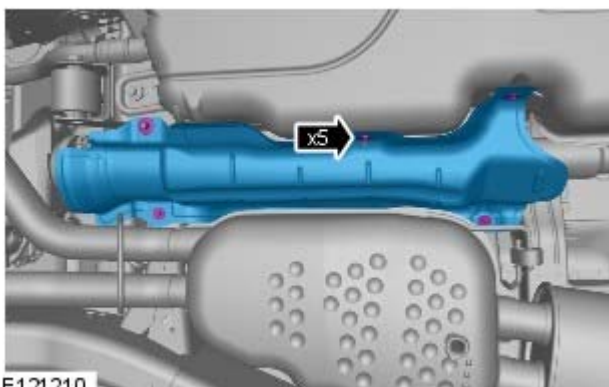
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

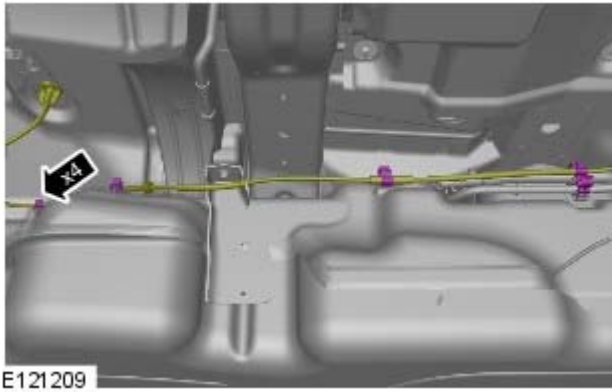
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

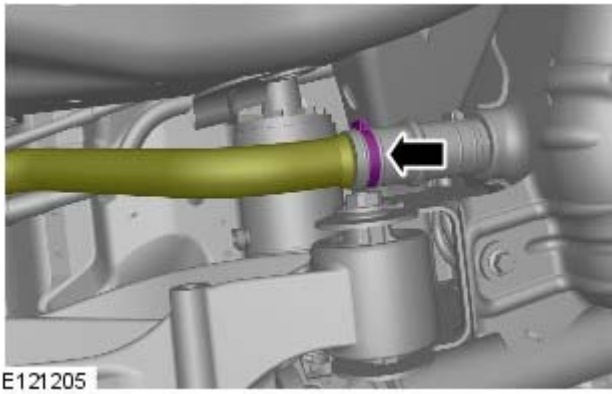
3. Refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).




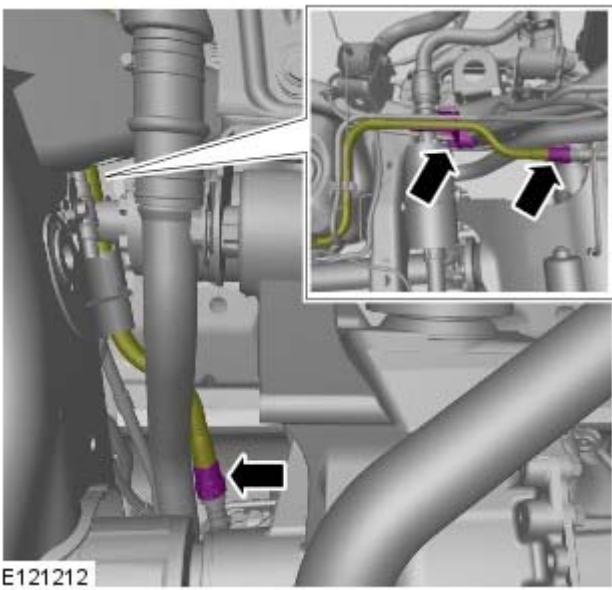
4. *Torque:*
Bolts 6 Nm
Nuts 3 Nm




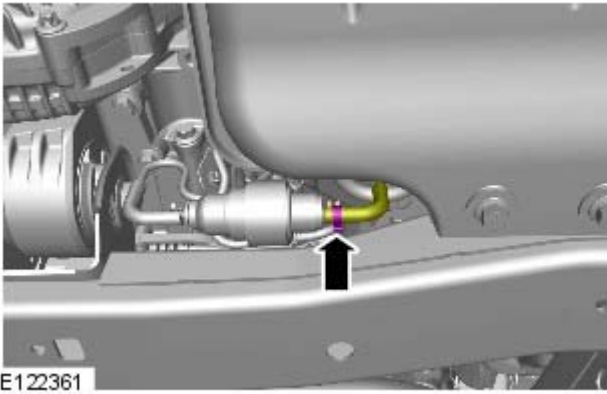
5.




6.  CAUTION: Discard the retaining clip.
Remove the tamper proof cover.

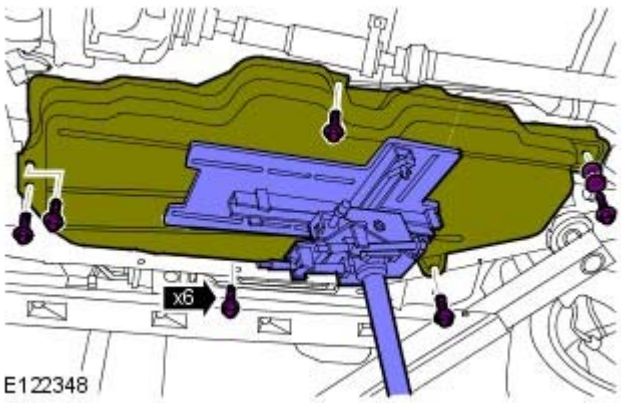


7.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



8.  **WARNING:** Be prepared to collect escaping fuel.

 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.



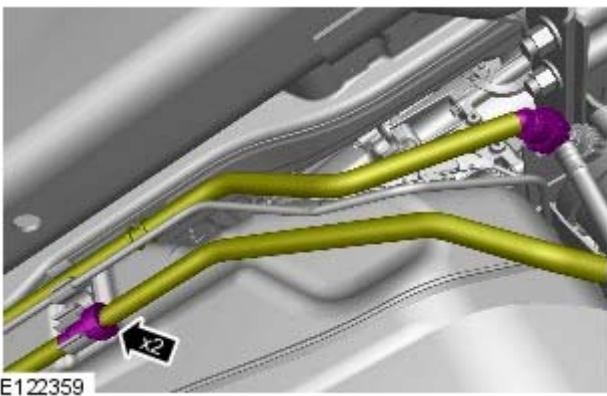
9.  **WARNING:** Secure the component to the transmission jack.


 **CAUTION:** Do not lower the fuel tank more than 250 mm.


• **NOTE:** Note the orientation of the two rear retaining bolts and washers.

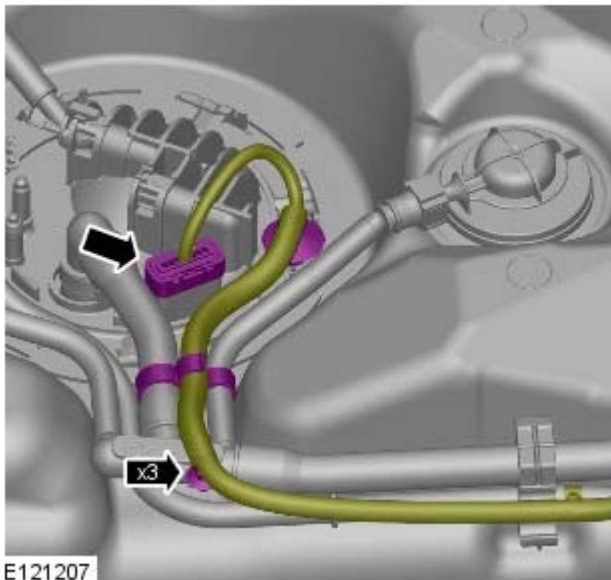
Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

General Equipment: [Transmission jack](#)
Torque: 45 Nm



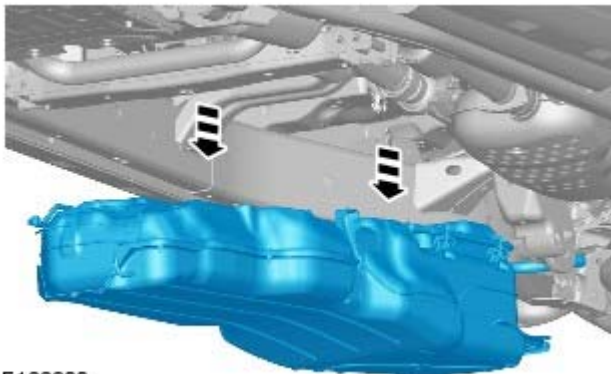
10.  **WARNING:** Be prepared to collect escaping fuel.

 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.



E121207

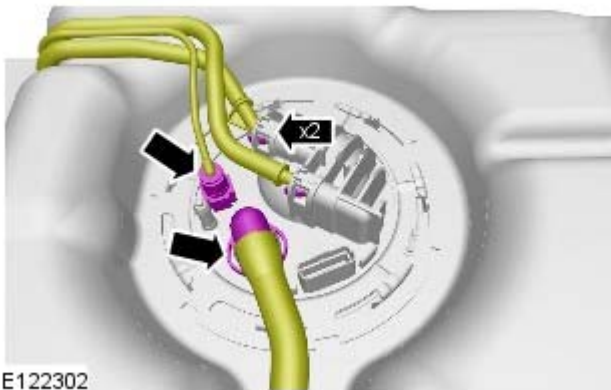
11. **11.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.




E122300

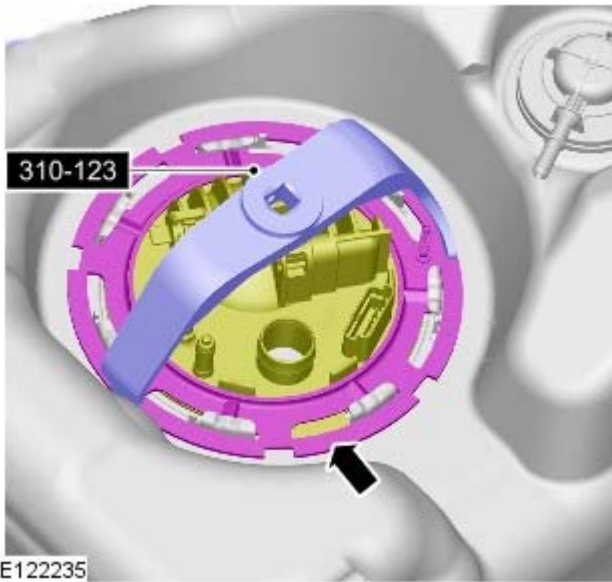
12. **12.** NOTE: Do not disassemble further if the component is removed for access only.

With assistance, remove the fuel tank.

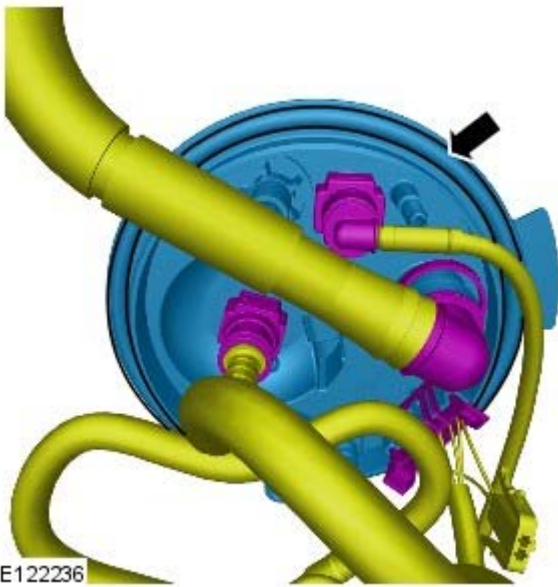


E122302

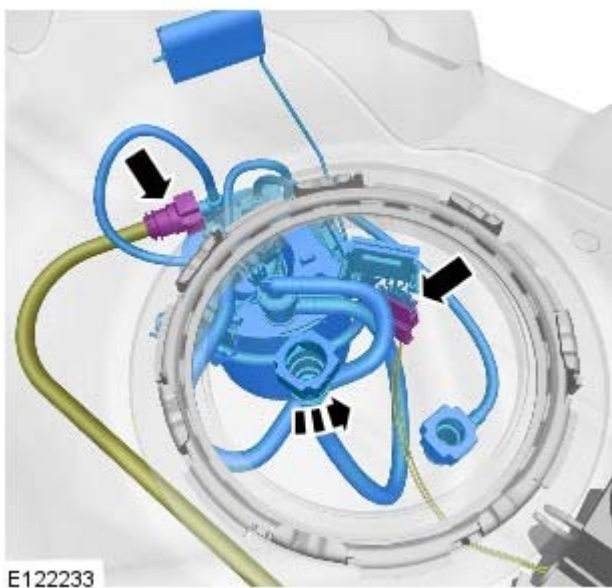
13. **13.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.




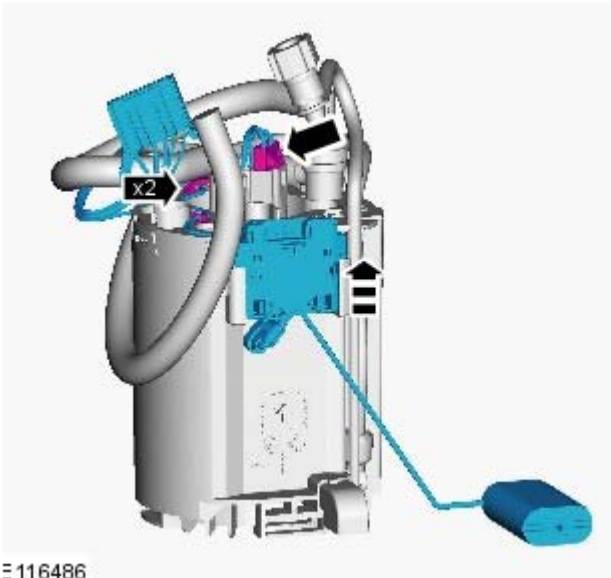
14. **14.** NOTE: Note the position of the locating tang.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- Special Tool(s): [310-123](#)




15. **15.** NOTE: Remove and discard the O-ring seal.

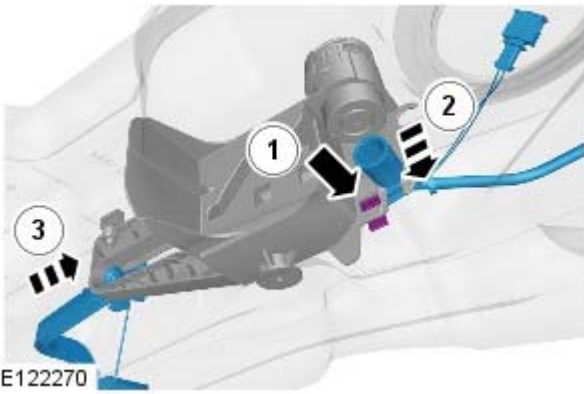


16. **16.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.




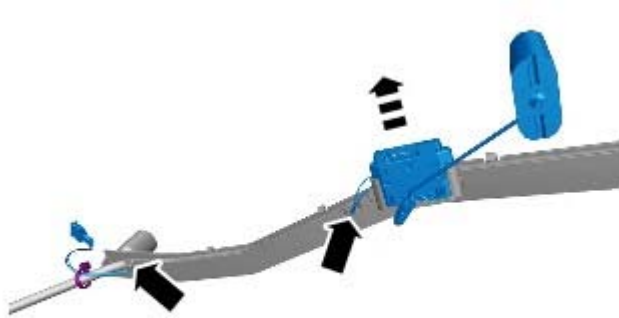
E116486

17. **17.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.
- NOTE: Do not disassemble further if the component is removed for access only.



E122270

18. **18.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.



E122269

- 19.

Installation


1. **1.** NOTE: Remove and discard all blanking caps.
- NOTE: Make sure the locating tang is installed in the position noted in the removal step.

To install, reverse the removal procedure.

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank

Removal and Installation

Special Tool(s)

	<p>310-123 Locking Ring, Fuel Tank</p>
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Removal

• WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

• NOTE: Removal steps in this procedure may contain installation details.

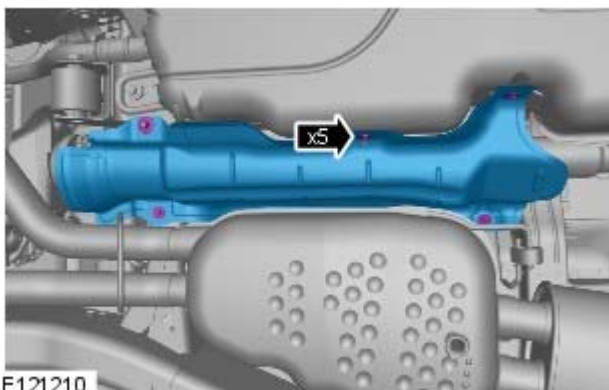
1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

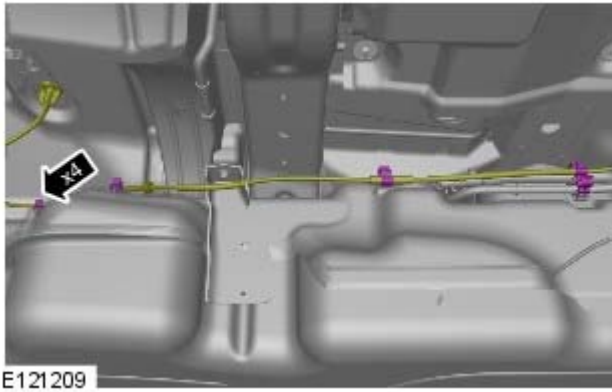
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

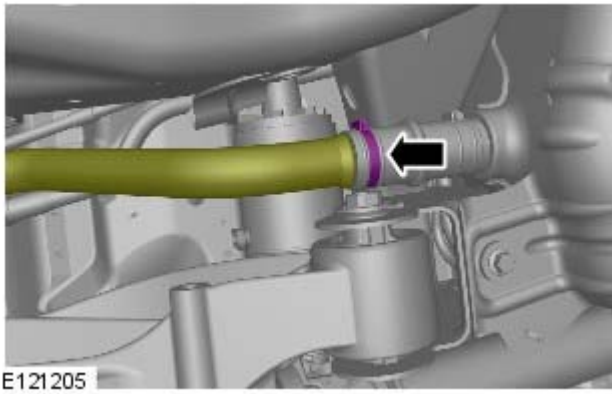
3. Refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).

4. *Torque:*
Bolts 6 Nm
Nuts 3 Nm

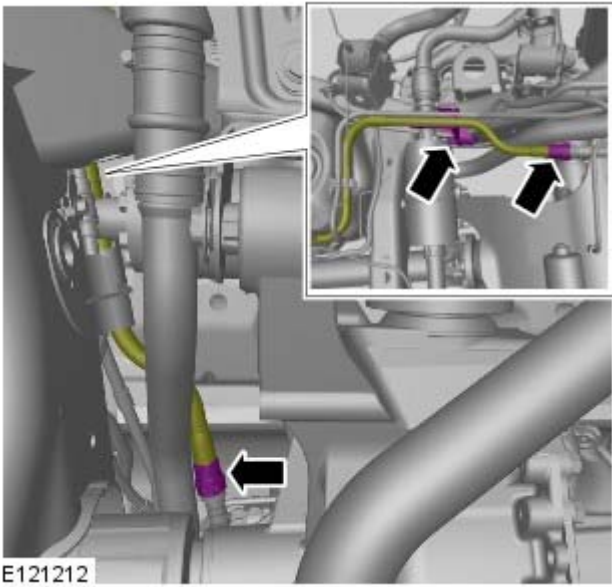




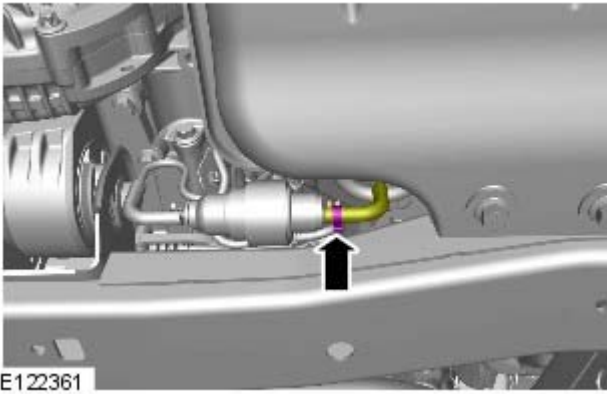
5.




6. **NOTE:** Discard the retaining clip.
Remove the tamper proof cover.

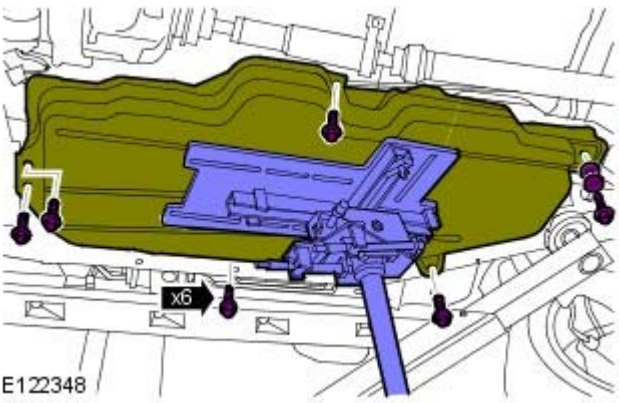


7. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.



8.  **WARNING:** Be prepared to collect escaping fuel.

 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.



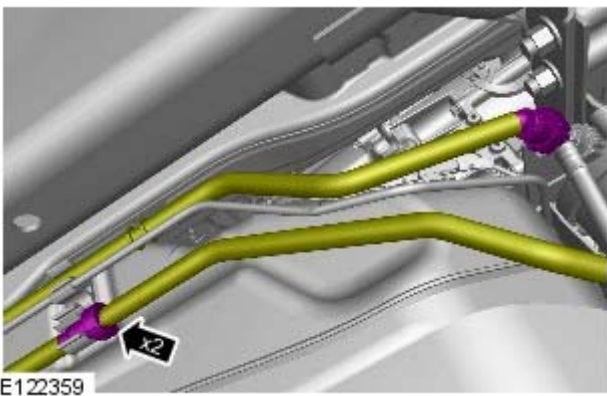
9.  **WARNING:** Secure the component to the transmission jack.


 **CAUTION:** Do not lower the fuel tank more than 250 mm (9.75 in)

• **NOTE:** Note the orientation of the two rear retaining bolts and washers.

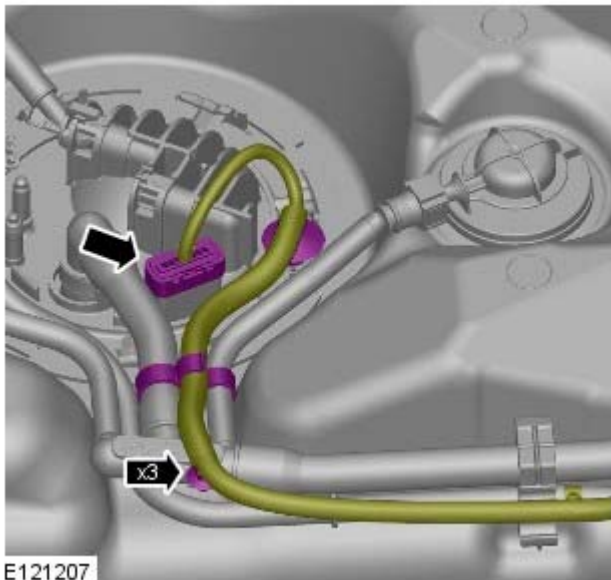
Using a transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

Torque: 45 Nm

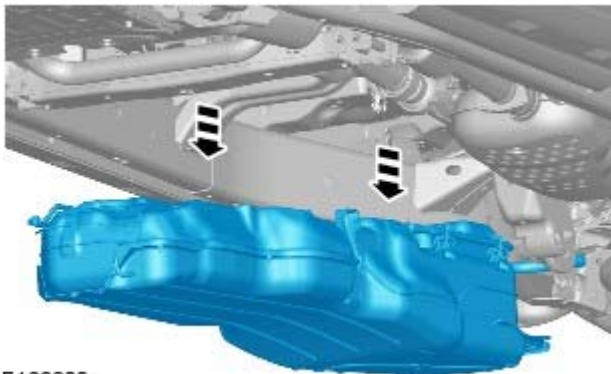


10.  **WARNING:** Be prepared to collect escaping fuel.

 **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

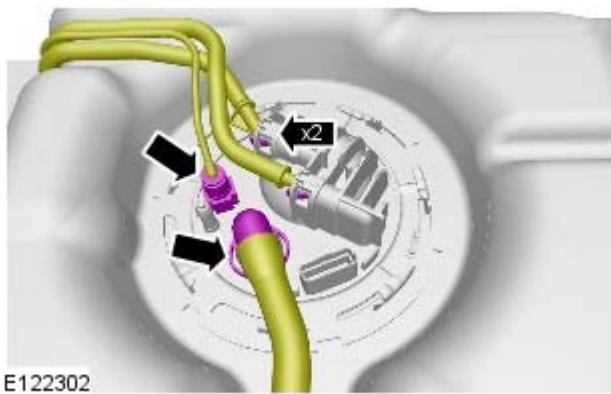



11. **11.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

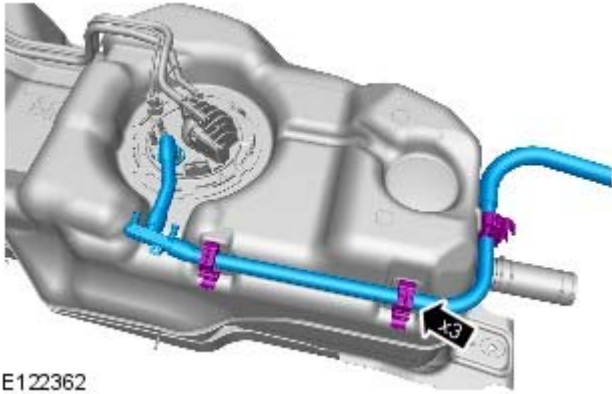


12. **12.** NOTE: Do not disassemble further if the component is removed for access only.

With assistance, remove the fuel tank.

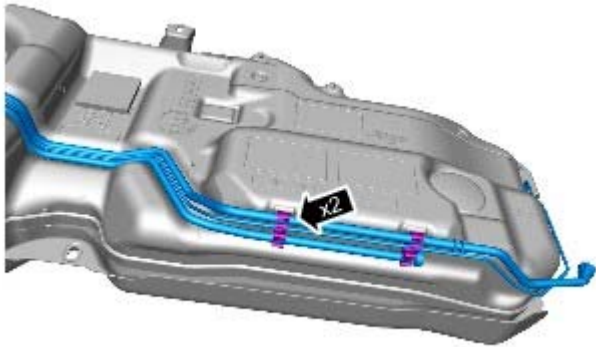


13. **13.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



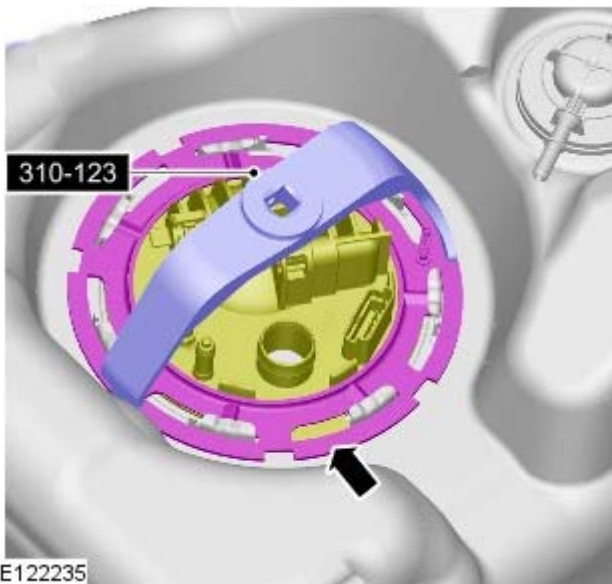
E122362

14.



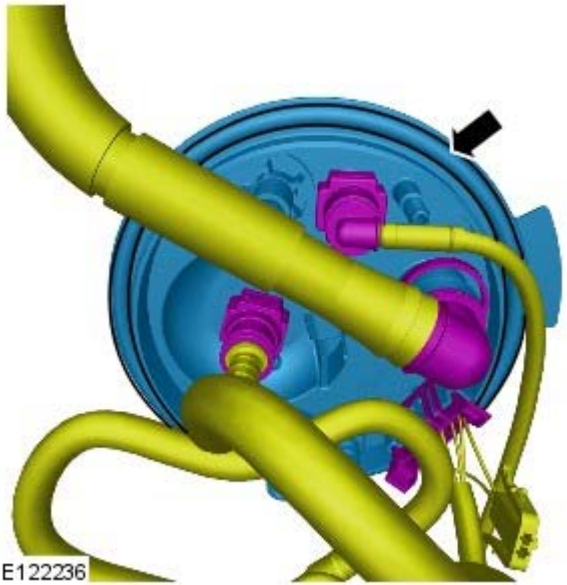
E122360

15.

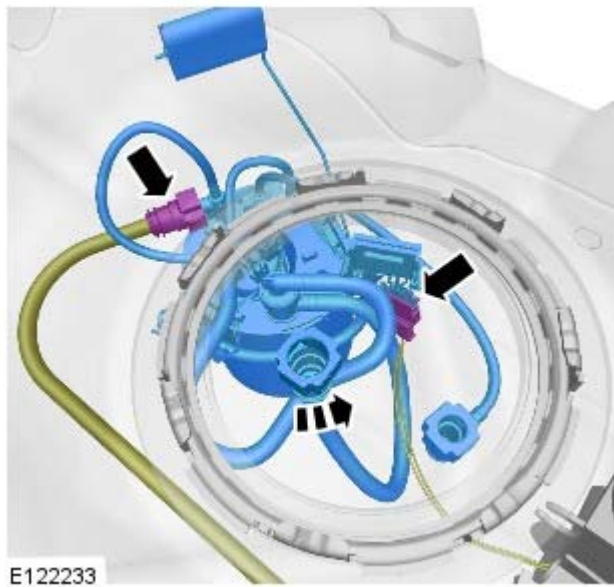



E122235

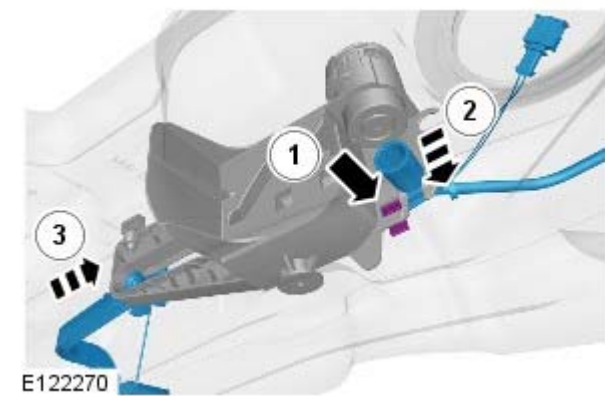
16. **16.** NOTE: Note the position of the locating tang.
Special Tool(s): [310-123](#)




17. **17.** NOTE: Remove and discard the O-ring seal.

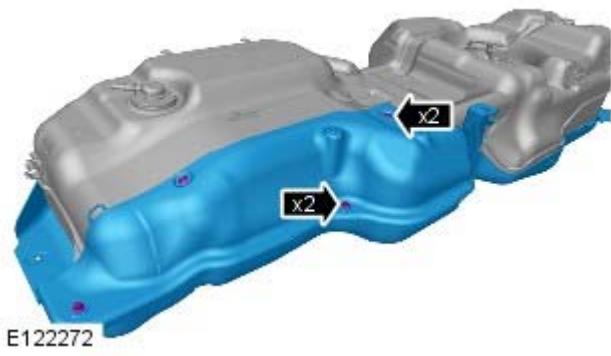


18. **18.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.



19. **19.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

20.



Installation

1. **NOTE:** Remove and discard all blanking caps.
 - **NOTE:** Make sure the locating tang is installed in the position noted in the removal step.

To install, reverse the removal procedure.

Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Tank Filler Pipe

Removal and Installation

Removal

- WARNINGS:



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

- NOTE: Removal steps in this procedure may contain installation details.

1. Remove the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

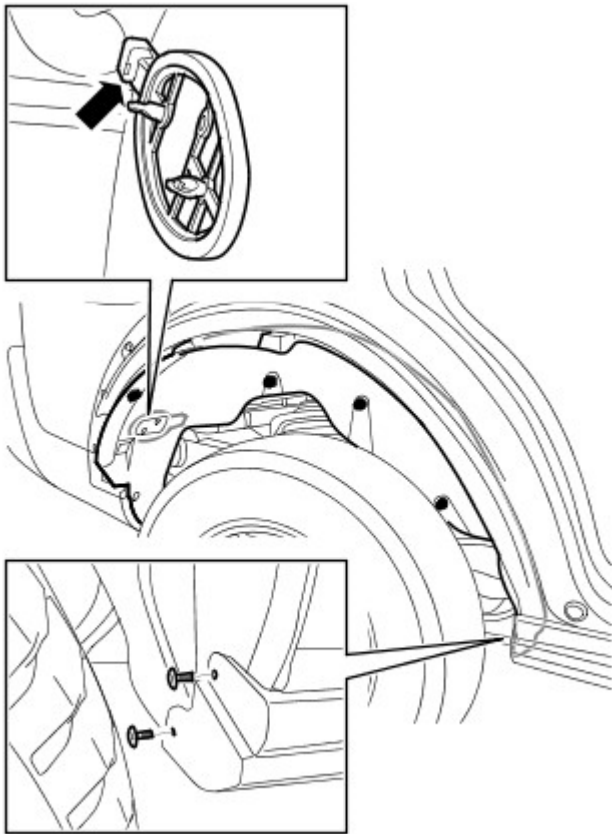
Raise and support the vehicle.

3. Refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).

4. Refer to: [Fuel Filler Door Assembly](#) (501-03 Body Closures, Removal and Installation).

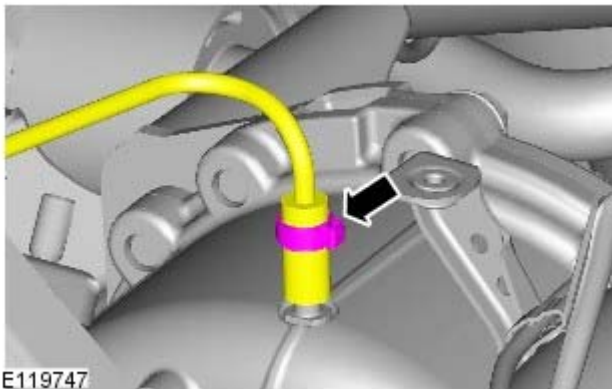
5. Remove the RH rear wheel and tire.

Torque: 140 Nm



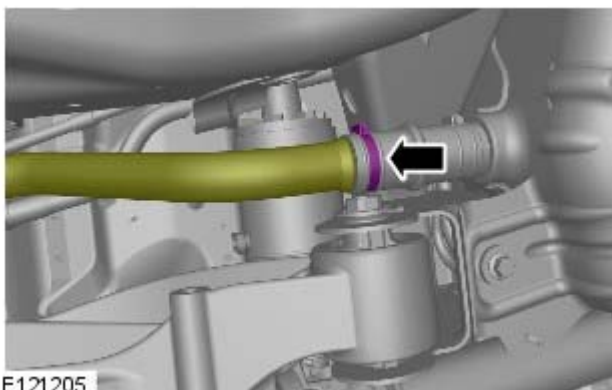
E48478

6. Remove the fender splash shield.



E119747

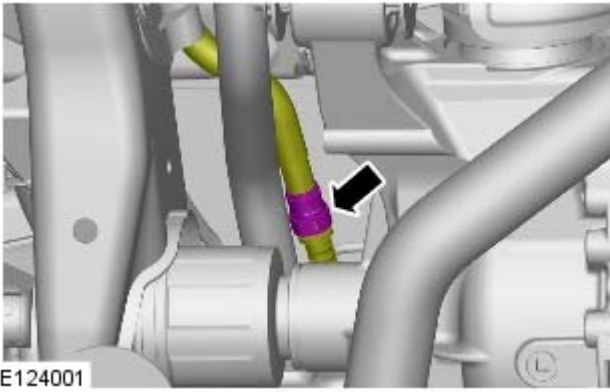
7.




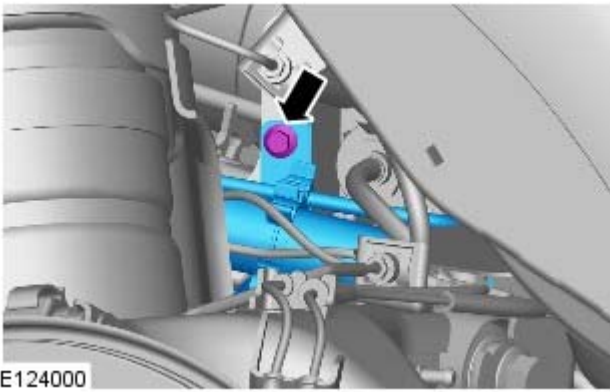
E121205

8. **8. NOTE:** Discard the retaining clip.

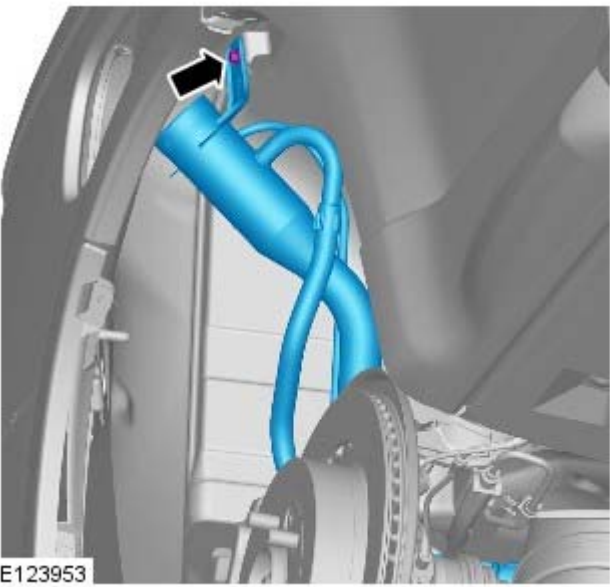
Remove the tamper proof cover from the fuel tank filler pipe hose clip.



9.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



10. Torque: 4 Nm



11. Torque: 4 Nm

Installation


1. To install, reverse the removal procedure.


Fuel Tank and Lines - TDV6 3.0L Diesel - Fuel Filter Element


Removal and Installation

Removal

• WARNINGS:

 Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.


 If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek immediate medical attention.


 If taken internally, do not induce vomiting, seek immediate medical attention. Failure to follow these instructions may result in personal injury.


 Wash hands thoroughly after fuel handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention.

 The spilling of fuel is unavoidable during this operation. Make sure that all necessary precautions are taken to prevent fire and explosion.

• CAUTIONS:

 Diesel fuel injection equipment is manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

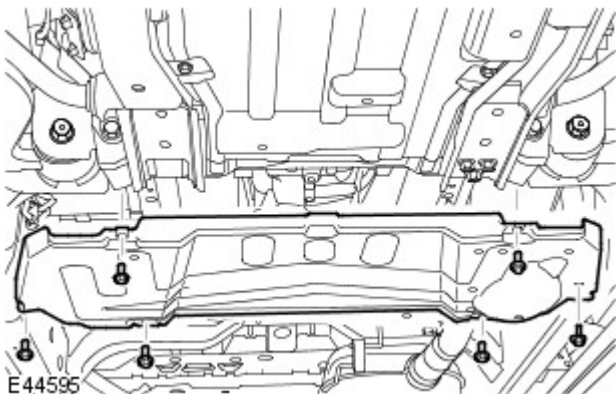
 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

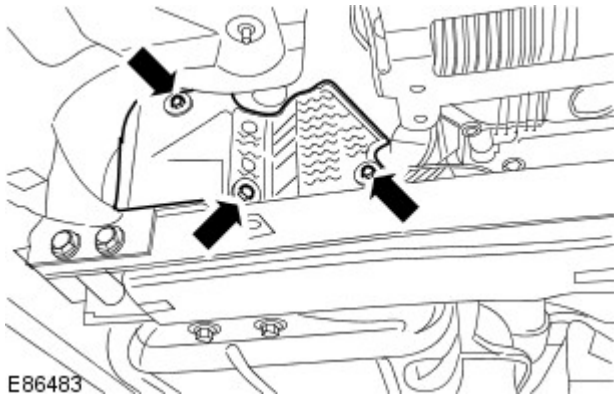
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.


2. Remove the transmission undershield.

- Remove the 6 bolts.





E86483


3.  **WARNING:** Observe due care when working near a hot exhaust system.

Remove the fuel filter heat shield.

- Remove the 3 bolts.

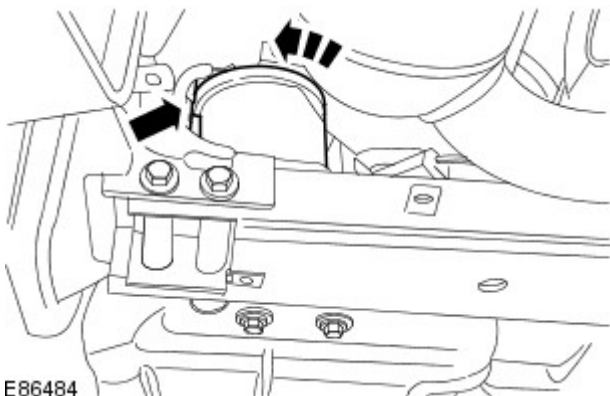


E88183


4.  **CAUTION:** Make sure the water-in-fuel sensor remains in the aligned position.

Drain the fuel filter element.

- Position a container to collect the fluid spillage.
- Loosen the nut.
- Attach a suitable drain tube to the water-in-fuel sensor drain port.
- Remove the drain tube.
- Tighten the nut.



E86484

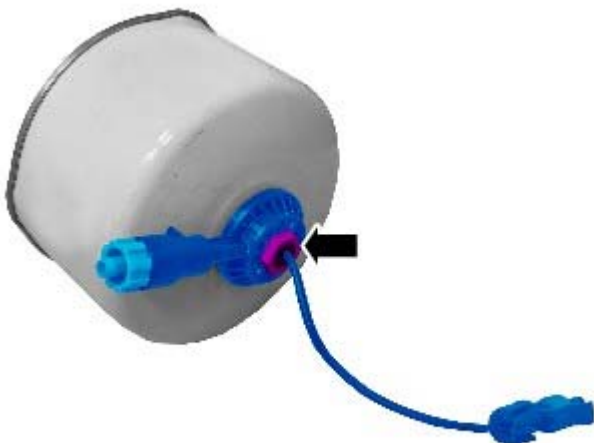
5.  **CAUTION:** Make sure that the area around the component is clean and free of foreign material.

Remove the fuel filter element.

- Disconnect the water-in-fuel sensor electrical connector.

6. Remove the water-in-fuel sensor.

- Discard the fuel filter element.



E138939

7. Remove and discard the O ring seals.



E138941

Installation


1. Install new O ring seals.



E138940



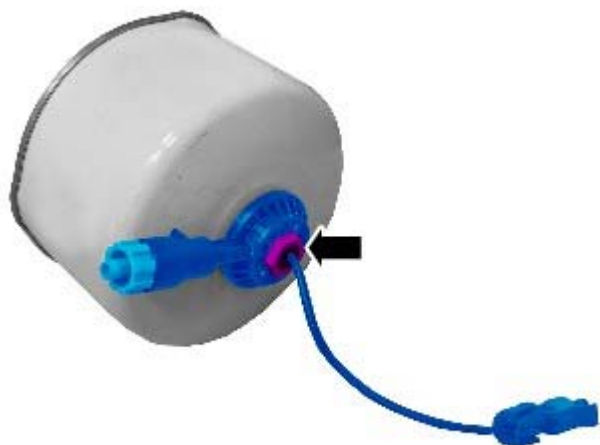
E138603

2.  CAUTION: Make sure that the mating faces are clean and free of foreign material.


• NOTE: Make sure that the water-in-fuel sensor is aligned with the drain arrow.

Install the water-in-fuel sensor.

- Remove and discard the water-in-fuel drain plug from the new fuel filter element.



E138939

3.  CAUTION: Make sure the water-in-fuel sensor remains in the aligned position.

Tighten the plastic nut to 1.6 Nm.

4. NOTE: Make sure that the fuel filter element is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

Install the fuel filter element.

1. Insert the fuel filter with the the lock symbol arrow aligned with the inlet pipe on the fuel filter housing.



5. NOTE: Make sure that the fuel filter element is correctly aligned. Failure to follow this instruction may result in damage to the vehicle.

Rotate to tighten and seal the fuel filter element.

1. When tightened correctly, the lock symbol arrow should be aligned with the arrow symbol on the fuel filter housing.

- Connect the water-in-fuel sensor electrical connector.
- Remove the container.



6. Install the fuel filter heat shield.

- Tighten the bolts to 6 Nm.

7. Install the transmission undershield.

- Tighten the bolts to 10 Nm.

8. Carry out the low-pressure fuel system bleeding.

Fuel Tank and Lines - V6 4.0L Petrol -

Capacity

Fuel tank	86.3 litres (18.9 gallons) (22.7 US gallons)
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General Specification

Item	Specification
System type	Mechanical - returnless
Fuel delivery module	Located in the fuel tank
Fuel pump:	
Type/location	Electric - submersible - located in the fuel tank
Operating pressure	450 kPa (4.5 bar) (65.25 lbf/in ²)
Maximum output @ 12.3 volts	122 litres/hour (26.8 gallons/hour) (32.2 US gallons/hour)
Fuel pressure regulator:	
Type/location	In-line, within fuel tank
Operating pressure	450 kPa (4.5 bar) (65.25 lbf/in ²)
Fuel filter	Located in the fuel delivery module - fitted with a renewable element
Fuel tank sender units	Two - Front and rear - Front unit is located remotely within the fuel tank, rear is mounted on the body of the fuel pump

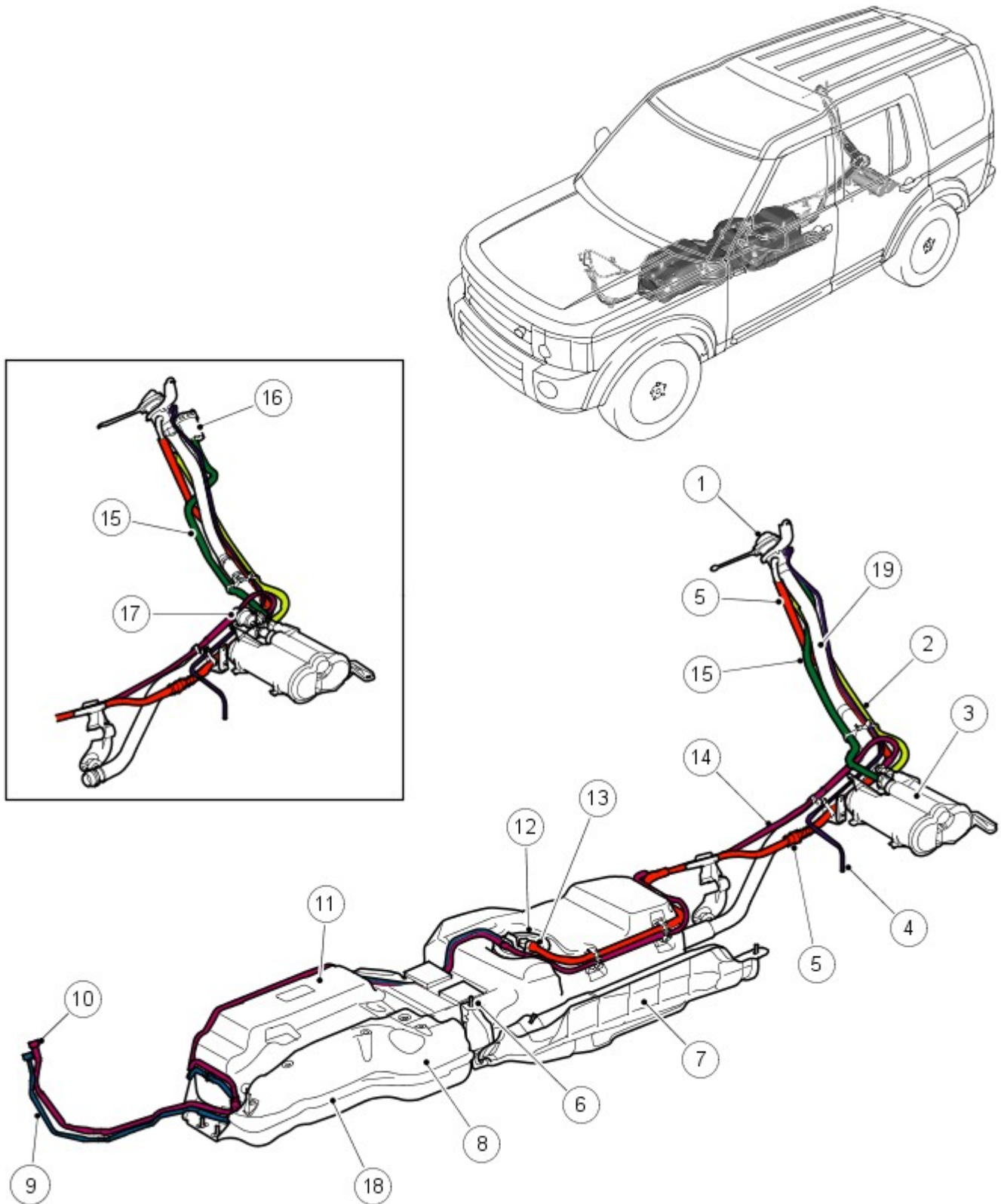
Torque Specifications

Description	Nm	lb-ft
Fuel tank bracket bolts	10	7
Fuel tank bolts	45	33
Fuel tank heat shield, bolts	5	4
Fuel tank heat shield, nuts	3	2
Fuel pump module clamp screw	4	3
Fuel tank filler pipe bolt	10	7
Road wheel nuts	140	103

Fuel Tank and Lines - V6 4.0L Petrol - Fuel Tank and Lines

Description and Operation

Fuel Delivery System Component Location



E44502

Item	Part Number	Description
1	-	Filler cap and lanyard
2	-	Breather line 'Y' piece to charcoal canister
3	-	Charcoal canister
4	-	Rear differential breather pipe

5	-	Tank breather pipe
6	-	Mounting screw (6 off)
7	-	Heat shield
8	-	Cover
9	-	Pipe - Fuel pump to engine (feed)
10	-	Charcoal canister purge line
11	-	Fuel tank
12	-	Fuel pump module assembly
13	-	Tank breather pipe connection
14	-	Pipe - purge valve to charcoal canister
15	-	Charcoal canister vent pipe
16	-	DMTL filter (NAS only)
17	-	DMTL pump (NAS only)
18	-	Cradle
19	-	Fuel filler pipe

GENERAL

The major components of the 4.0L V6 fuel system comprise a fuel tank, a fuel pump module, a fuel filler assembly and two fuel level sensors.

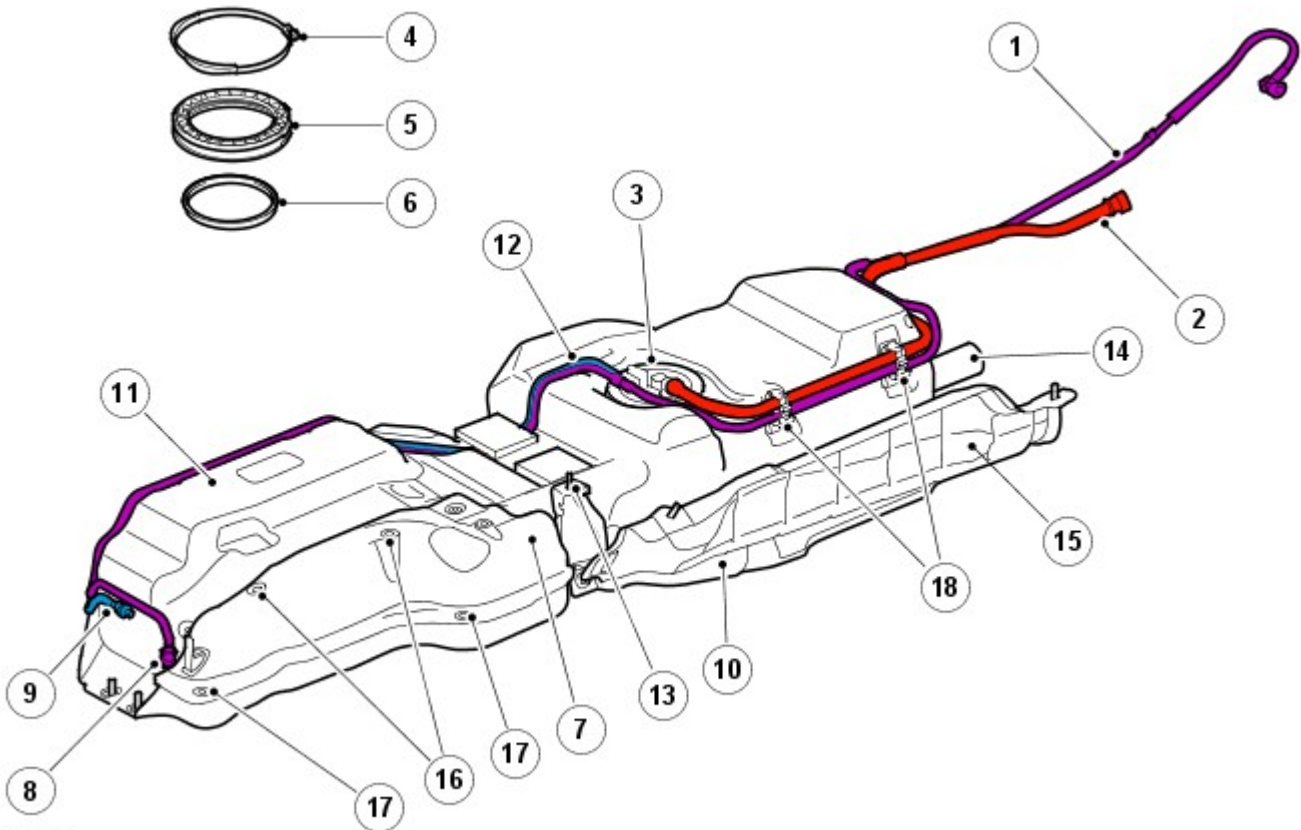
The 4.0L V6 fuel system uses a fuel pump module mounted in the fuel tank to deliver a uniform level of pressure to the fuel rails which supply fuel to all fuel injectors. The fuel rails and the injectors are described in Fuel & Charging Controls – 4.0L V6.

For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - 4.0L, Description and Operation).

Fuel system emission control is described in Engine Emission Control - 4.0L V6.

For additional information, refer to: [Engine Emission Control](#) (303-08C Engine Emission Control - V6 4.0L Petrol, Description and Operation).

FUEL TANK ASSEMBLY



E44503

Item	Part Number	Description
1	-	Pipe - purge valve to charcoal canister
2	-	Tank breather pipe
3	-	Fuel pump module flange
4	-	Pump module clamp
5	-	Pump module collar
6	-	Pump module seal
7	-	Cover
8	-	Pipe connection - purge valve
9	-	Pipe connection - fuel feed
10	-	Cradle

11	-	Fuel tank
12	-	Pipe - fuel feed
13	-	Mounting screws (6 off)
14	-	Fuel filler hose
15	-	Heat shield
16	-	Scrivet
17	-	Screw M6
18	-	Clip cover

The fuel tank is located on the right hand side of the vehicle, between the transmission and the right hand chassis longitudinal. The tank is located on a mounting cradle which secures the whole fuel tank assembly to the vehicle. The tank has a useable capacity of 86.3 litres (22.8 US gallons).

The cradle is attached to the chassis with six screws. When the cradle is attached to the chassis, the tank is positively secured via foam pads which bear against the central chassis cross beam. A protective cover is fitted to the front left hand corner of the tank and provides additional protection.

The fuel tank is manufactured from moulded plastic which is a minimum of 3 mm thick. The tank is a sealed unit with the only internal access being via the pump module flange aperture on the top of the tank.

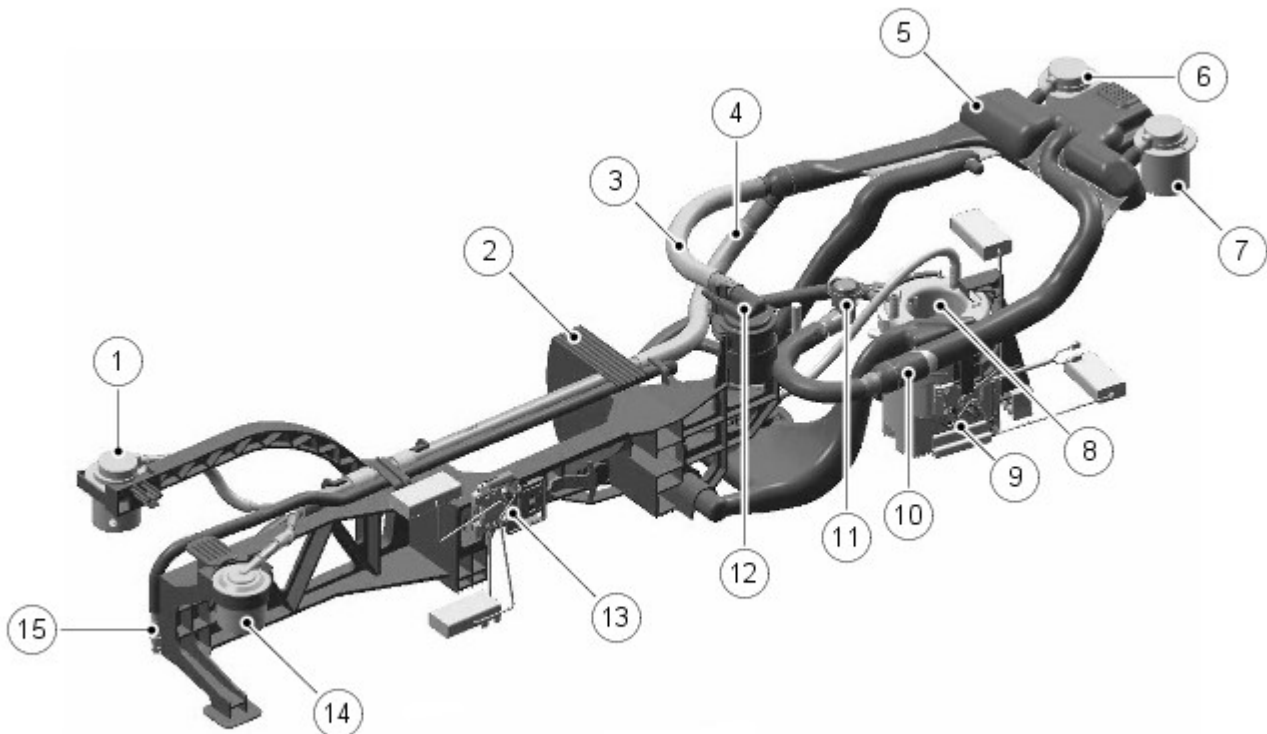
The flange assembly comprises a pump module flange which contains all external pipe and electrical connections for the tank internal components, a collar and a clamp. The flange is fitted with a seal which locates in the tank aperture. An arrow on the flange must be aligned between two moulded lines on the tank, adjacent to the pump module flange aperture, to obtain the correct orientation of the flange. The collar is located over the flange and is secured with the clamp. The flange, seal, collar and clamp arrangement meets the sealing requirements of LEV2 emissions.

The flange has a six pin external connector which provides for electrical connections for the level sensors and the fuel pump. This connector is wired to three push fit connectors on the underside of the flange. A quick release connector provides for the connection of the fuel feed pipe and breather.

A tank carrier assembly is attached inside the tank and is used to locate the internal tank components. The carrier provides location for the fuel pump module, the front level sensor, the Roll Over Valves (ROV's), the front jet pump and the Fuel Level Vent Valve (FLVV).

The fuel pump module contains a number of components. The module comprises the fuel pump, the rear fuel level sensor, the rear jet pump, the pump inlet filter, a second fine mesh filter and the fuel pressure regulator which is housed in a manifold that is mounted in the carrier. Only the pump module assembly and fuel level sensors are available as serviceable components, the individual assembly components are not available separately.

Fuel Tank Internal Components



E50099

Item	Part Number	Description
1	-	Front right hand Roll Over Valve (ROV)
2	-	Carrier assembly
3	-	Fuel Level Vent Valve (FLVV) breather corrugated tube
4	-	Front ROV corrugated tube
5	-	Liquid Vapor Separator (LVS)

6	-	Rear right hand ROV
7	-	Rear left hand ROV
8	-	Fuel pump module
9	-	Rear fuel level sensor
10	-	Tank breather tube
11	-	Connector
12	-	Fuel Level Vent Valve (FLVV)
13	-	Front fuel level sensor
14	-	Front left hand ROV
15	-	Front jet pump

The 4.0L V6 vent system is identical to the system used on the 4.4L V8 models. The vent system comprises:

- four Roll Over Valves (ROV)
- one Fuel Level Vent Valve (FLVV)
- one Liquid Vapor Separator (LVS)

The vent system is mounted on the fuel tank internal carrier which is assembled outside of the tank and inserted into the tank during the blow moulding process. None of the internal tank venting components are serviceable.

The two rear ROVs are mounted directly onto the LVS with a rubber grommet and secured with clips.

The two front ROVs are located in the front of the tank and are attached to the main beam of the carrier by a moulded clip. Both ROVs are connected to the LVS with a plastic corrugated tube.

The four ROVs vent directly into the LVS. Any liquid fuel is separated from the vapor in the LVS and drains back into the tank via the FLVV. The LVS is connected by a corrugated tube to the fuel pump module flange. This allows fuel vapor to exit the tank during venting.

The main purpose of the FLVV is to control the fill volume of the tank. During filling, vapor is passed via the FLVV to the LVS. The vapor then passes from the LVS to the fuel pump module flange vent connection via a corrugated tube. The flange vent connection is connected to the charcoal canister which stores the fuel vapor. During filling, when the tank reaches its full level, the FLVV closes and prevents fuel vapor passing through to the LVS. This causes the pressure in the tank to rise which in turn causes the pump filling nozzle to turn off.

Fuel Pump Module

The fuel pump is attached to the carrier and is located in the bottom of the swirl pot. The pump and the fuel level sensors are connected to the external electrical connector via the connectors on the underside of the fuel pump module flange.

The pump module has a rated flow of 122 litres/hour (32.2 US gallons/hour) at a voltage of 12.3V and an output pressure of 4.5 bar (65.2 lbf/in²).

The fuel pump is energised by the fuel pump relay which is located in the battery junction box. The relay is controlled by the engine control module and energises the relay at all times when the ignition switch is in ignition position II.

A pump inlet filter is attached to pump inlet port at the bottom of the pump. The filter has a 'winged' section which is located vertically at the side of the pump to ensure that a portion of the filter is off the base of the swirl pot, to prevent premature blocking of the filter. The filter has a 31 micron fine mesh filter with a surface area of 70 cm² (10.8 in²).

A second fine mesh filter is located around the top of the fuel pump. This provides additional filtration to the fuel before it is passed into the manifold and onto the fuel rail. The filter has an electrical connection which is attached to ground. The ground is required to dissipate electrostatic charges that can build up on the fine filter.

The fuel filter incorporates a non-return valve which prevents fuel returning to the pump when the engine is not running. This ensures that system pressure is maintained in the fuel feed line to the fuel rail when the engine is not running.

Fuel Level Sensors

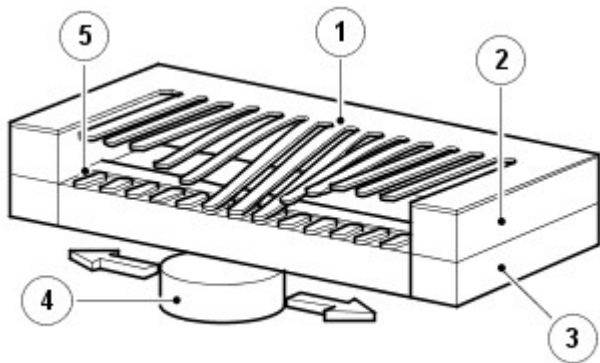
The sensor is a Magnetic Passive Position Sensor (MAPPS) which provides a variable resistance to earth for the output from the fuel gauge. The sensor is sealed from the fuel preventing contamination of the contacts, increasing reliability. The front and rear fuel level sensors are connected to the external electrical connector on the flange via the connectors on the underside of the fuel pump module flange.

The front sensor is attached to the front of the carrier and is accessible via the fuel pump flange aperture. The rear sensor is attached to the side of the swirl pot and is also accessible via the flange aperture.

- **NOTE:** When a service replacement tank is ordered the tank is supplied with the front level sensor fitted.

The sensor comprises a series of 51 film resistors mounted in an arc on a ceramic surface. The resistors are wired in series with individual contacts. A soft magnetic foil with 51 flexible contacts is mounted a small distance above the film resistors. A magnet, located below the ceramic surface, is attached to the sender unit float arm. As the float arm moves, the magnet follows the same arc as the film resistors. The magnet pulls the flexible contacts onto the opposite film resistor contacts forming an electrical circuit.

Sensor Operating Principle



E44504

Item	Part Number	Description
1	-	Magnetic foil
2	-	Spacer
3	-	Ceramic surface
4	-	Magnet
5	-	Resistance film

The film resistors are arranged in a linear arc with resistance ranging from 51.2 to 992.11 Ohms. The electrical output signal is output proportional to the amount of fuel in the tank and the position of the float arm. The measured resistance is processed by the instrument pack to implement an anti-slosh function. This monitors the signal and updates the fuel gauge pointer position at regular intervals, preventing constant pointer movement caused by fuel movement in the tank due to cornering or braking.

A warning lamp is incorporated in the instrument cluster and illuminates when the fuel level is at or below 10 litres (2.64 US gallons).

The fuel level sender signal is converted into a CAN message by the instrument pack as a direct interpretation of the fuel tank contents in litres. The ECM uses the CAN message to store additional OBD P Codes for misfire detection when the fuel level is below a predetermined capacity.

Front Fuel Level Sensor Resistance/Fuel Gauge Read out Table

• NOTE: These figures are with the vehicle on level ground. Sensor readings will differ with varying vehicle inclinations.

Sender Unit Resistance, Ohms	Nominal Gauge Reading
51	Empty
51	Low fuel level illumination
294	Half full
798	Full

Rear Fuel Level Sensor Resistance/Fuel Gauge Read out Table

• NOTE: These figures are with the vehicle on level ground. Sensor readings will differ with varying vehicle inclinations.

Sender Unit Resistance, Ohms	Nominal Gauge Reading
75.5	Empty
120	Low fuel level illumination
280	Half full
675	Full

Fuel Pressure Regulator

The fuel pressure regulator is located in the manifold inside the fuel tank. The regulator controls the fuel pressure in the feed pipe to the fuel rail by allowing some fuel to be diverted to the front jet pump.

The regulator is subject to pump output pressure and controls the pressure of the fuel delivered to the fuel rail to 4.5 bar (65.2 lbf/in²). At pressures above this figure, the regulator opens, decaying the pressure supplied to the fuel rail by allowing fuel to pass to the front jet pump. The regulator is required to maintain the fuel pressure at the optimum pressure for correct fuel injection.

Swirl Pot

The swirl pot is located at the rear of the fuel tank and provides for the attachment or location of most of the fuel pump assembly components.

The swirl pot acts as a fuel reserve, providing a constant supply of fuel to the fuel pump irrespective of fuel quantity or vehicle attitude. When the vehicle is level the swirl pot contains approximately 400 cm³ (24.4 in³) of fuel when the engine is running. The two jet pumps ensure that fuel is constantly supplied to the swirl pot to provide a sufficient fuel supply for the pump.

A one way valve is located in the base of the swirl pot. The valve allows fuel from the tank to enter the swirl pot, but prevents it from escaping.

Jet Pumps

The fuel system incorporates two jet pumps. The front jet pump is located on the carrier near the front of the fuel tank. The rear jet pump is located in the swirl pot below the fuel pump. Both jet pumps operate on a venturi effect created by fuel at pump output pressure passing through the jet pump. This draws additional fuel from the tank through ports in the jet pump body, delivering additional fuel to the swirl pot.

The front jet pump is mainly used when the vehicle is driving downhill. The jet pump is connected via a pipe from the fuel manifold and receives fuel diverted from the fuel feed pipe by the pressure regulator. The front jet pump collects fuel from the front of the tank and transfers it into the swirl pot, ensuring a constant supply of fuel to the pump. The jet pump has a jet nozzle of 2.1 mm diameter.

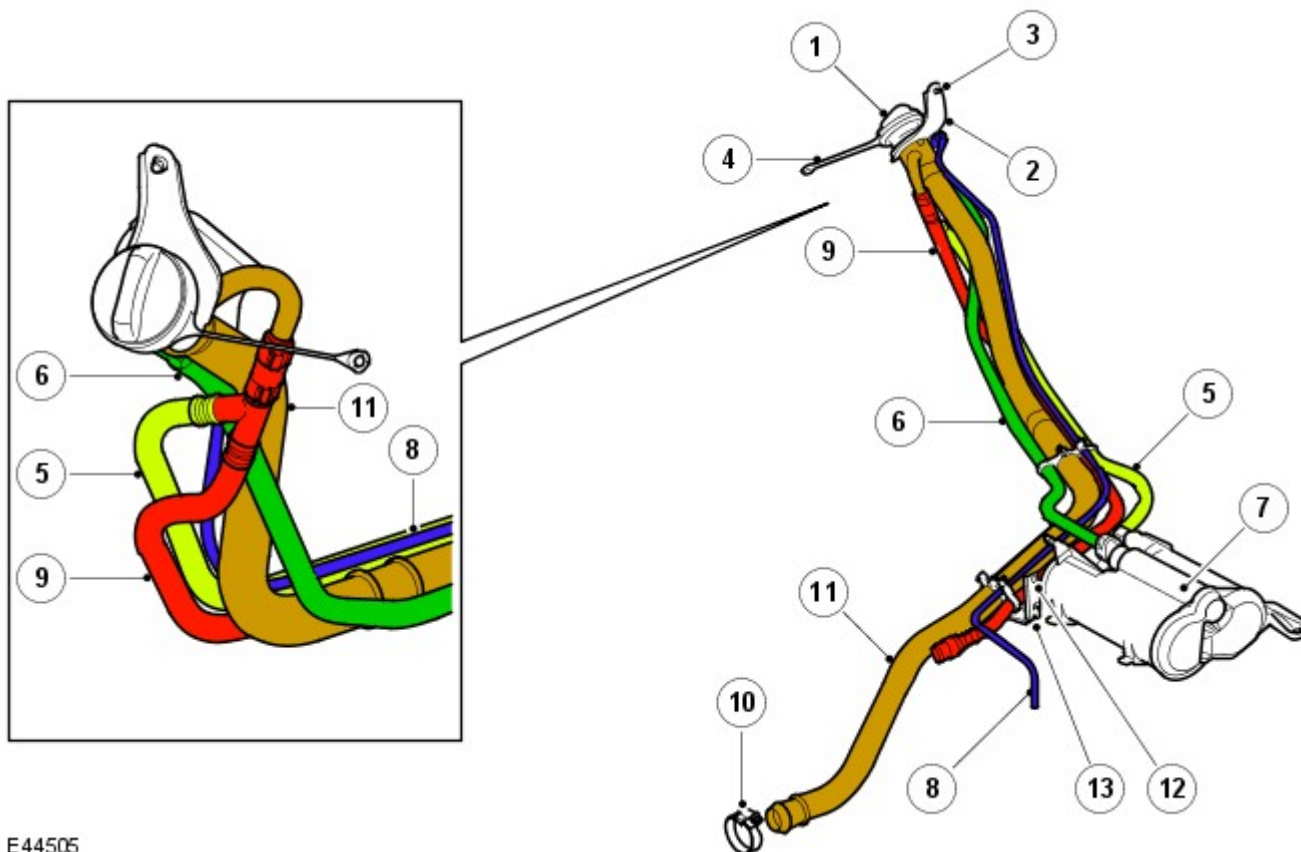
The rear jet pump operates at pump output pressure and delivers some of the fuel at pump pressure from the rear of the tank back into the swirl pot.

Roll Over Valves (ROVs)

Four ROVs are located on the carrier and are connected via pipes to a liquid vapour separator. The separator, which is also attached to the carrier, is connected via a pipe to the tank breather outlet in the pump module flange. The ROVs contain non-return valves which close in the event of the vehicle overturning, preventing liquid fuel escaping from the tank via the breather pipe.

FUEL FILLER

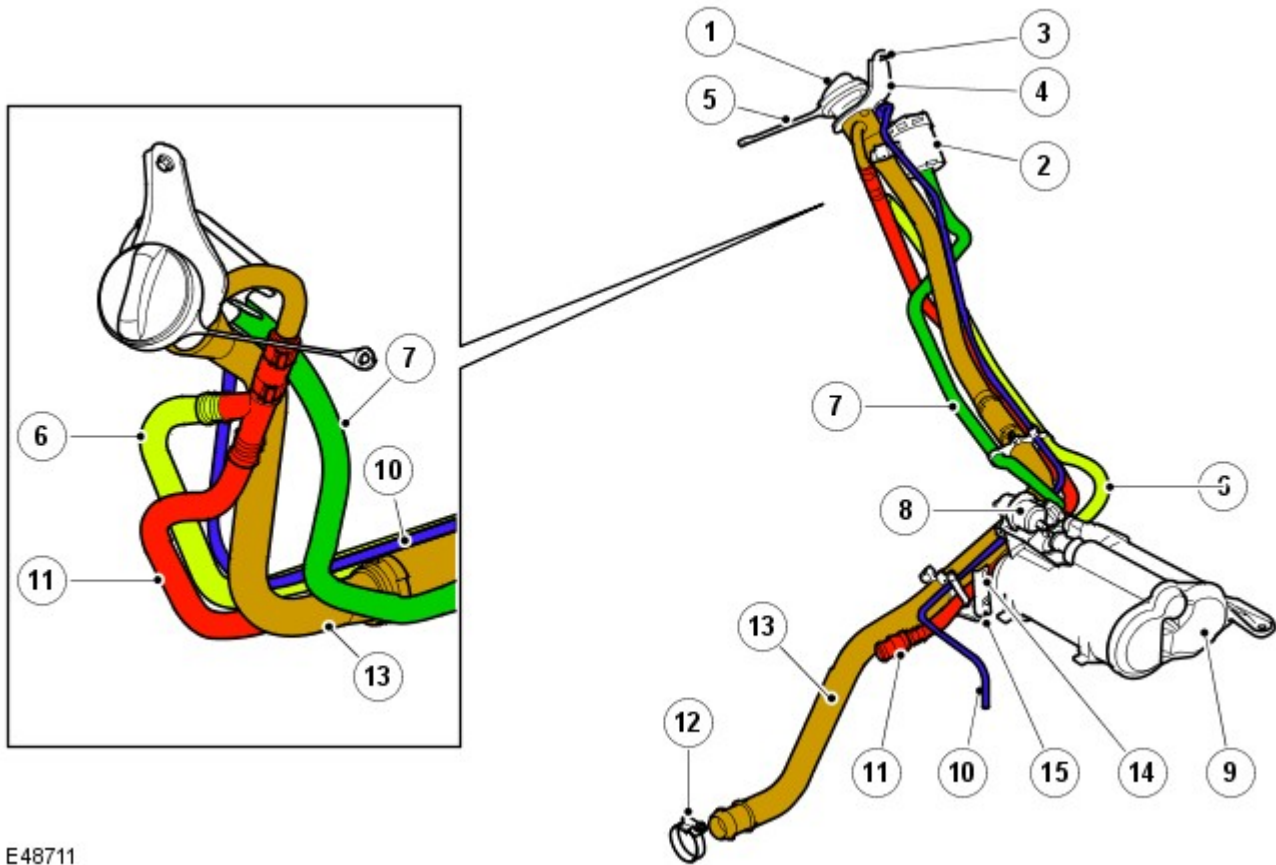
Fuel Filler - ROW



E44505

Item	Part Number	Description
1	-	Filler cap
2	-	Bracket
3	-	Screw M6
4	-	Filler cap lanyard
5	-	Charcoal canister breather hose
6	-	Charcoal canister vent hose to atmosphere
7	-	Charcoal canister (ROW)
8	-	Rear differential breather pipe
9	-	Tank breather pipe
10	-	Clamp - filler hose
11	-	Fuel filler pipe
12	-	Screw M8
13	-	Lower mounting bracket to EPB bracket

Fuel Filler - NAS



E48711

Item	Part Number	Description
1	-	Filler cap
2	-	DMTL pump filter
3	-	Screw M6
4	-	Bracket
5	-	Filler cap lanyard
6	-	Charcoal canister breather hose
7	-	DMTL pump vent hose to filter
8	-	DMTL pump
9	-	Charcoal canister (NAS)
10	-	Rear differential breather pipe
11	-	Tank breather pipe
12	-	Clamp - filler hose
13	-	Fuel filler pipe
14	-	Screw M8
15	-	Lower mounting bracket to EPB bracket

The fuel filler head is positioned at the rear of the vehicle, above the right hand rear wheel. The filler head is covered by a moulded plastic cover which is electrically locked when the vehicle is locked. The filler cap is a conventional screw in type which is secured to the vehicle with a lanyard.

• **NOTE:** The fuel filler head plastic cover does not lock on NAS vehicles.

The filler head is a stainless steel fabrication. Two brackets provide for the attachment of the filler to the vehicle body and the chassis electronic park brake bracket.

Connections on the rear of the filler head allow for the connection of the fuel tank breather pipe from the fuel tank flange, the fuel filler pipe to the tank and the charcoal canister breather pipe.

The fuel tank breather pipe has a quick release fitting and connects to the breather pipe from the fuel tank flange.

The fuel filler pipe locates in a short flexible hose attached to the tank and is secured with worm drive clamps. The canister vent pipe is routed alongside the fuel filler pipe and attaches to the canister with a quick release coupling.

A charcoal canister to atmosphere pipe is also routed alongside the fuel filler pipe and provides air ventilation for the charcoal canister. On all petrol vehicles, except NAS vehicles, the pipe is connected to the air port on the charcoal canister with a quick release coupling and connects to an insect trap at the fuel filler head. On NAS vehicles fitted with a DMTL pump, the pipe connects to the pump vent port and is also connected to a filter which is attached to the filler head.

A smaller pipe, which is not associated with the fuel system, is attached to the side of the fuel filler pipe. This pipe connects to the rear differential and provides breathing for the differential case. The pipe terminates near the fuel filler head.

Fuel Tank and Lines - V6 4.0L Petrol - Fuel Tank and Lines

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel tank and lines system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

[Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation),
[Fuel Tank and Lines](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Description and Operation),
[Fuel Tank and Lines](#) (310-01B Fuel Tank and Lines - TDV6 3.0L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel level ● Fuel leaks ● Damaged fuel lines ● Damaged push connect fittings ● Fuel contamination/grade/quality ● Throttle body ● Damaged fuel tank filler pipe cap ● Damaged fuel tank filler pipe 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors ● Harnesses ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant

Symptom	Possible Causes	Action
temperature)	<ul style="list-style-type: none"> ● Ignition system ● EGR valve stuck open 	DTC Index
Engine stalls soon after start	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● ECM relay ● Electronic engine control ● Ignition system ● Air intake system restricted ● Air leakage ● Fuel lines 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> ● Fuel pressure, fuel pump, fuel lines ● Injector leak ● Air leakage ● Electronic engine control ● Throttle motor ● Restricted accelerator pedal travel (carpet, etc) ● Ignition system ● EGR valve stuck open ● Transmission malfunction 	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls ● Ignition system 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system related DTCs and refer to the relevant DTC Index
Engine surges	<ul style="list-style-type: none"> ● Fuel pump/lines ● Electronic engine controls ● Throttle motor ● Ignition system 	Check for fuel system failures. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	<ul style="list-style-type: none"> ● Fuel pump/lines ● Air leakage ● Electronic engine controls 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls related DTCs and refer to the relevant DTC Index
No throttle response	<ul style="list-style-type: none"> ● Electronic engine controls ● Throttle motor 	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	<ul style="list-style-type: none"> ● Breather system disconnected/restricted ● Electronic engine controls ● Transmission malfunction ● Traction control event ● Air leakage 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

Fuel Gauge Diagnosis

1. Using the manufacturer approved diagnostic system monitor, "active fuel level sensor(A)" and "passive fuel level sensor(B)" data logger signals located within the body control module subsection.

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	>3.6v	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, ● C0390-18 and C0114-1 ● If no fault is evident then check C0376-18 to C0586R-8, ● If no fault is evident with the above, remove the fuel pump module and two fuel senders from the fuel tank and check for backed out terminals and circuit faults. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	<3.0v	>3.6v	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, ● C0390-2 and C0114-6, ● If no fault is evident then check C0376-2 to C0586R-20 ● If no fault is evident with the above, remove the fuel sender B (front) from the fuel tank and check for backed out terminals and circuit faults

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	<3.0v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, C0390-3 and C0114-2 If no fault is evident then check C0376-3 to C0586R-21 If no fault can be found with the above check then the active fuel sender A (rear) will need to be removed and the wiring carefully inspected
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Electric parkbrake fault (EPB)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> NOTE: Check for correct EPB operation prior to carrying out the following checks. NOTE: The EPB module is calibrated to allow fuel gauge correction for varying gradients (via CAN Bus). Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults at connectors, C2178-31, C2178-32 C2178-9, C2178-10, C2178-15 and C2178-16 Check Earth Point (LH D Post) C2570S (Discovery 4/LR4) C2570T (Range Rover Sport)
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 3.06v	0.35v	<ul style="list-style-type: none"> Check active sender A (rear) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v	0.35v to 3.06v	<ul style="list-style-type: none"> Check passive sender B (front) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	>1.0v	0.35v to 0.54v	<ul style="list-style-type: none"> Remove from the fuel tank and check all active sender A (rear) blue wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>1.0v	<ul style="list-style-type: none"> Remove from the fuel tank and check all passive sender B (front) blue circuit wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>0.55v and within 0.6v of B	>0.55v and within 0.6v of A	<ul style="list-style-type: none"> Remove fuel pump module and both senders from the fuel tank and check all black wires on the circuit for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>3.2v but <3.6v	0.35v to 0.54v	<ul style="list-style-type: none"> Active sender A (rear) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>3.2v but <3.6v	<ul style="list-style-type: none"> Passive sender B (front) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	No	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check the pressure relief valve inside fuel tank. Check Internal fuel feed pipe is connected to flange
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check terminals are correctly latched / installed to the fuel pump module
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check the bayonet fitting on the fuel pump module. Check both the active and passive fuel senders are securely located in their brackets
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel tank - out of shape / sucking in (diesel only)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Incorrect filler cap installed. Install the correct fuel filler cap (applies to diesel variants only). Refer to the warranty policy and procedures manual if a module/component is suspect

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Fuel Tank and Lines - V6 4.0L Petrol - Fuel Pump Module

Removal and Installation

Removal

• **WARNINGS:**



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

• **NOTE:** The fuel pump module comprises of a rear fuel level sender, filter and a fuel pressure regulator. These components cannot be serviced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the fuel tank.
For additional information, refer to: Fuel Tank (310-01, Removal and Installation).

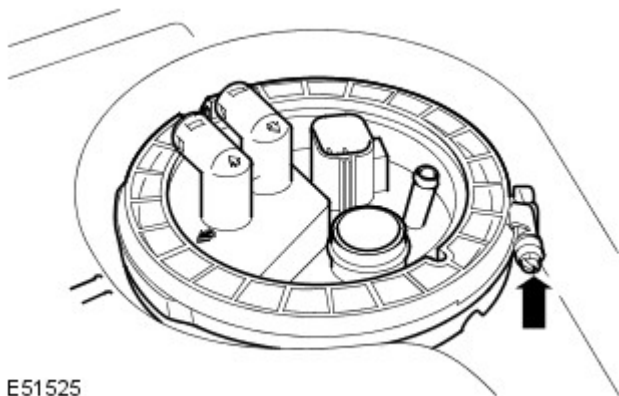


CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** Note the fitted position.

Release the fuel pump module access flange.

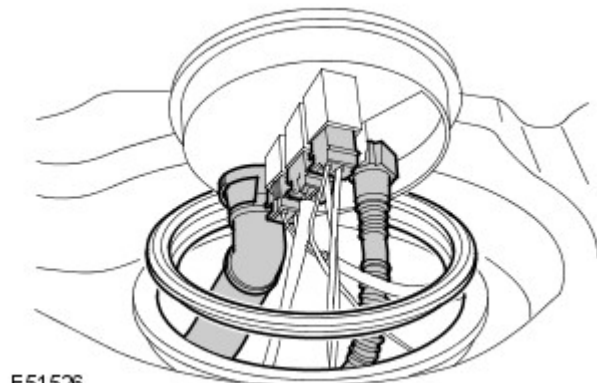
- Loosen the screw.
- Remove the clamp.



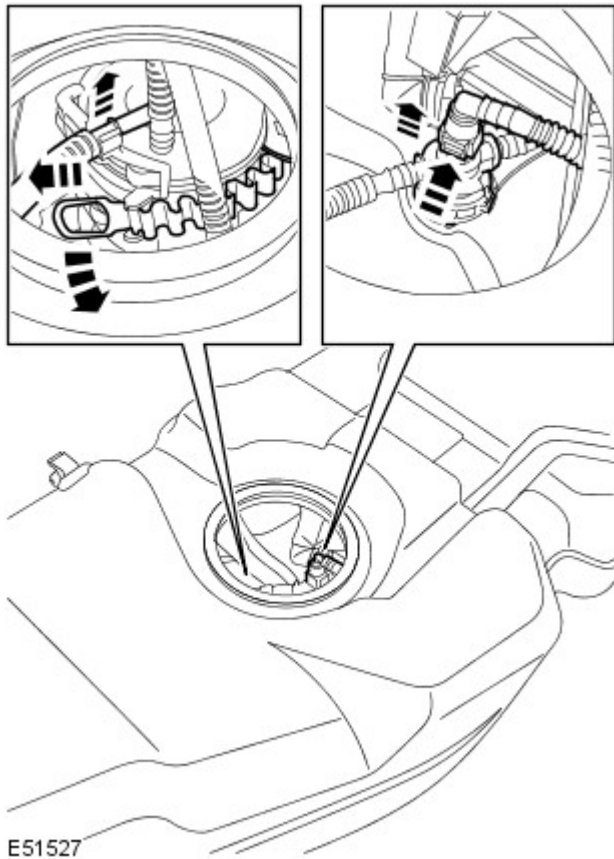
E51525

5. Remove the fuel pump module access flange.

- Disconnect the vent line.
- Disconnect the fuel supply line.
- Disconnect the 3 electrical connectors.
- Remove and discard the seal.



E51526



6. Remove the fuel pump module.
 - Release the strap.
 - Release the fuel pressure regulator.
 - Disconnect the 2 fuel lines.

Installation

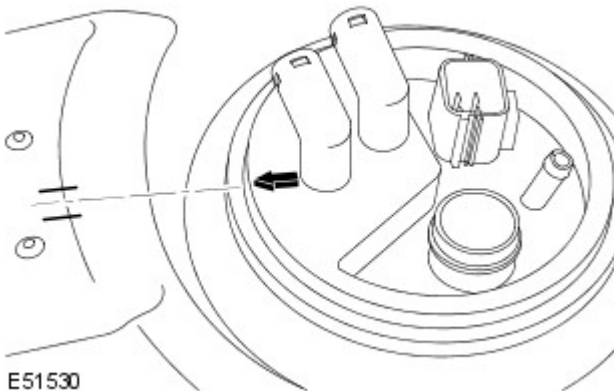
1. Install the fuel pump module.
 - Connect the fuel lines.
 - Secure with the strap.
 - Secure the fuel pressure regulator.
2. Install the fuel pump module access flange.
 - Clean the component mating faces.
 - Install a new seal.
 - Connect the 3 electrical connectors.
 - Connect the fuel supply line.
 - Connect the vent line.

3.  **CAUTION:** Make sure the seal is correctly fitted.

• **NOTE:** Align to the position noted on removal.

Secure the fuel pump module access flange.

- Install the clamp.
- Tighten the screw to 4 Nm (3 lb.ft).



4. Install the fuel tank.
For additional information, refer to: Fuel Tank (310-01, Removal and Installation).

5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Fuel Tank and Lines - V6 4.0L Petrol - Fuel Tank Filler Pipe

Removal and Installation

Removal

• **WARNINGS:**



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.




After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.

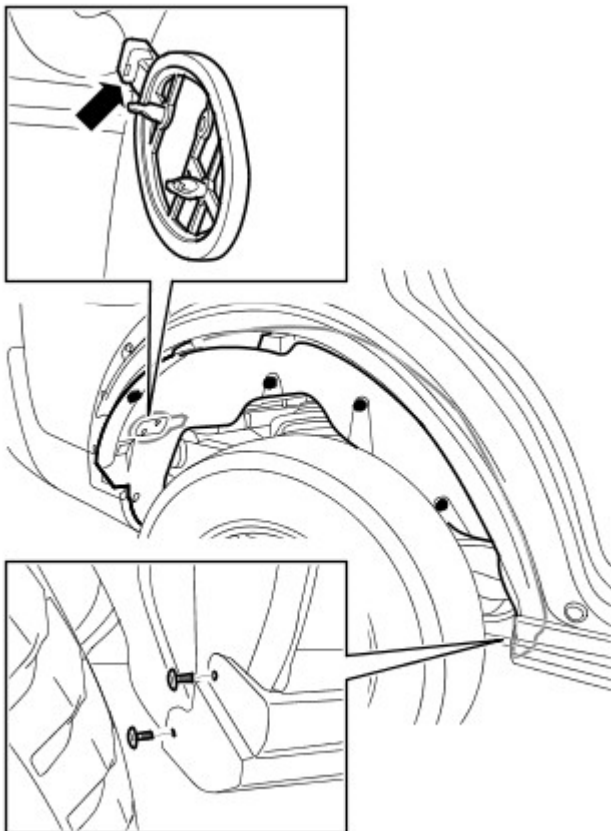


This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

• **NOTE:** Removal steps in this procedure may contain installation details.

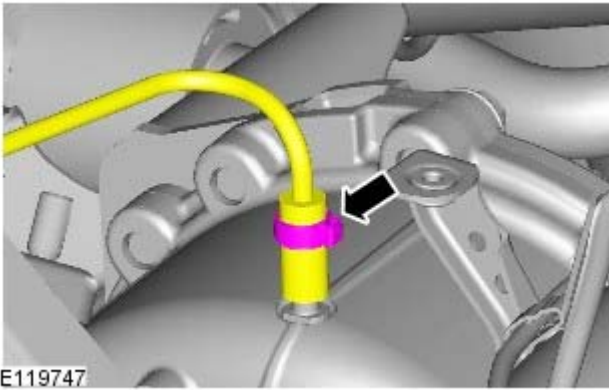
1. Remove the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.
3. For additional information, refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).
4. For additional information, refer to: [Fuel Filler Door Assembly](#) (501-03 Body Closures, Removal and Installation).
5. Remove the RH rear wheel and tire.
 - TORQUE: 140 Nm
6. Remove the fender splash shield.



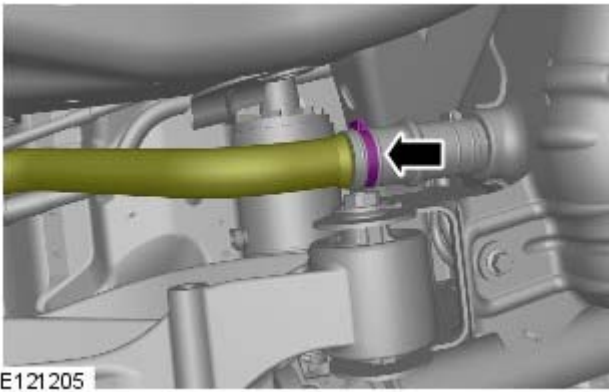
E48478

7.

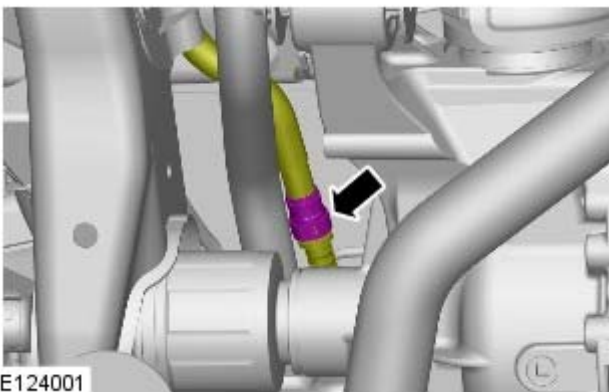


8. NOTE: Discard the retaining clip.

Remove the tamper proof cover from the fuel tank filler pipe hose clip.

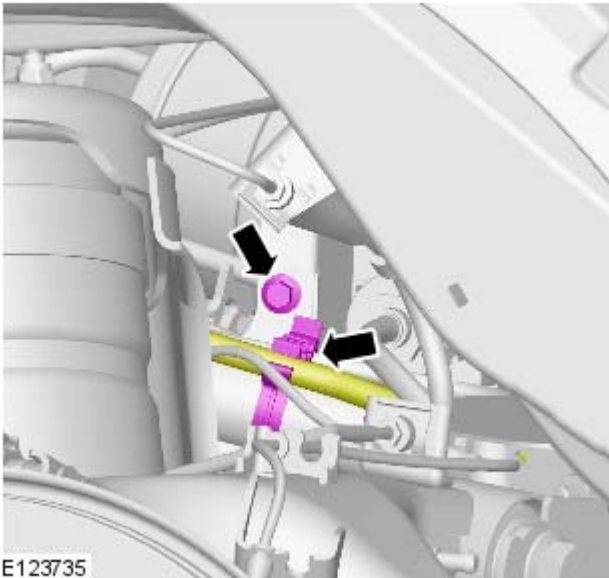


9.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

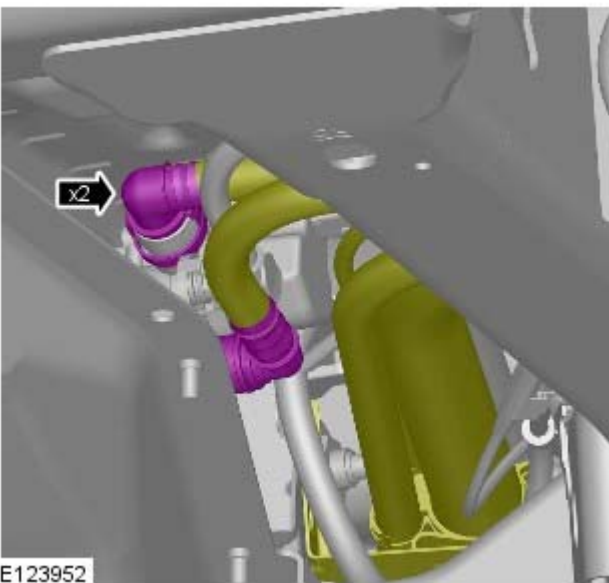


10.

- TORQUE: 4 Nm

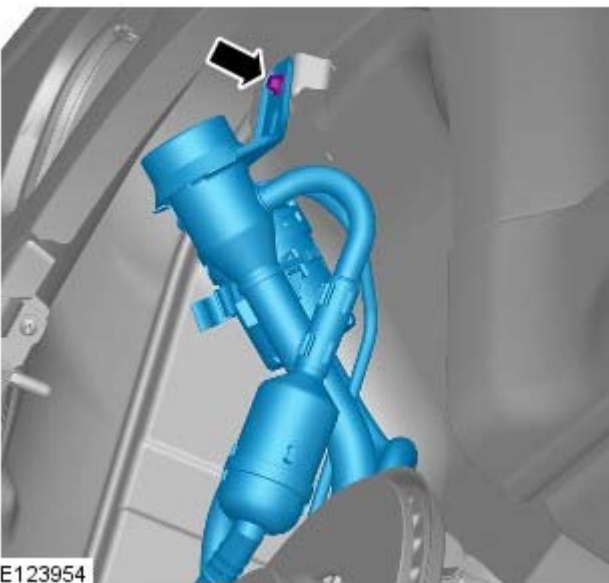


11.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



12.

- TORQUE: 4 Nm



Installation

1. To install, reverse the removal procedure.

Fuel Tank and Lines - V6 4.0L Petrol - Fuel Tank

Removal and Installation

Removal

• WARNINGS:



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.




Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

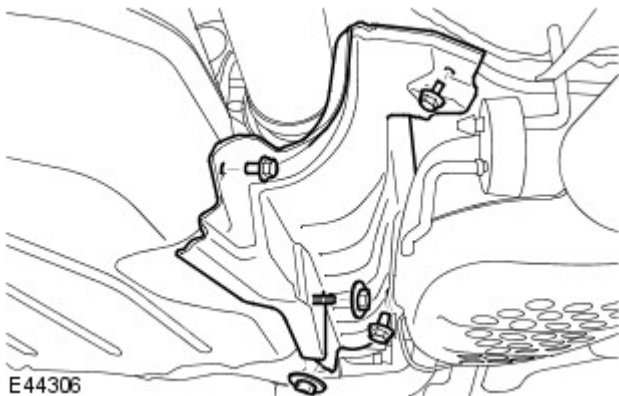



CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the fuel tank.
For additional information, refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

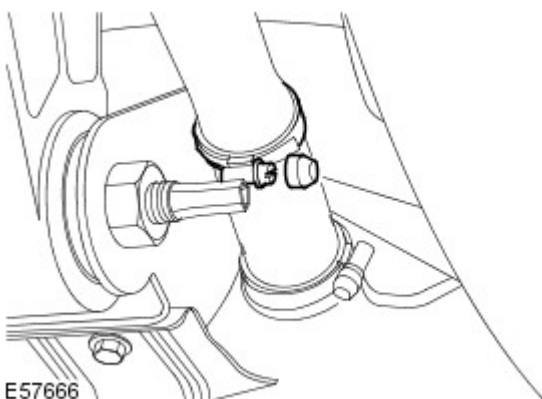
4. Remove the fuel tank heat shield.
 - Remove the 3 bolts and 2 nuts.



5.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.


Disconnect the fuel filler neck from the filler neck hose.

- Remove the tamper proof cover.
- Remove and discard the hose clip.






E57668

6.  CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the fuel supply and purge lines quick release connections at the front of the fuel tank.

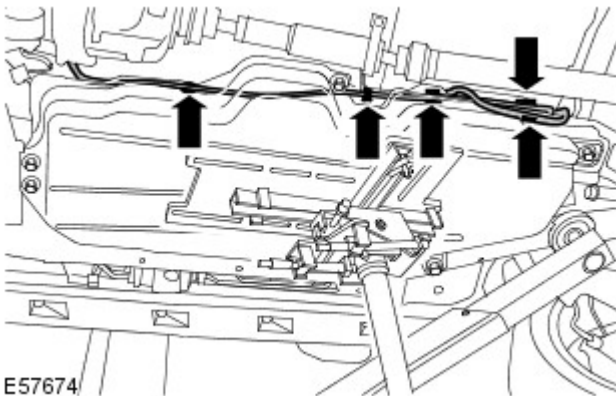


E57667

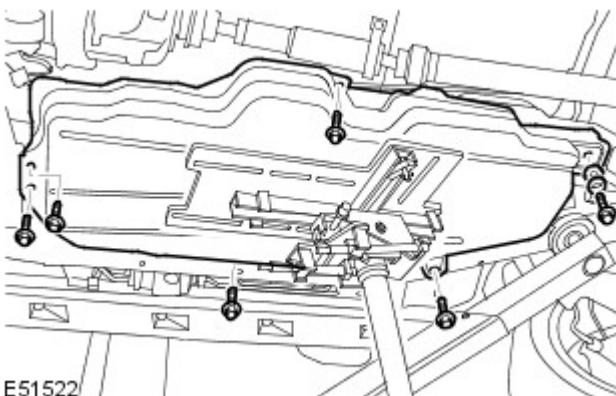
7.  CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect the fuel tank vent line.


- 8. Release the fuel tank harness.
- 9. Release the parking brake emergency release cable.
 - Release from the 4 clips.
- 10. Remove the 2 emergency release cable clips.



E57674



E51522

11.  WARNING: Secure the component to the transmission jack.

• CAUTIONS:

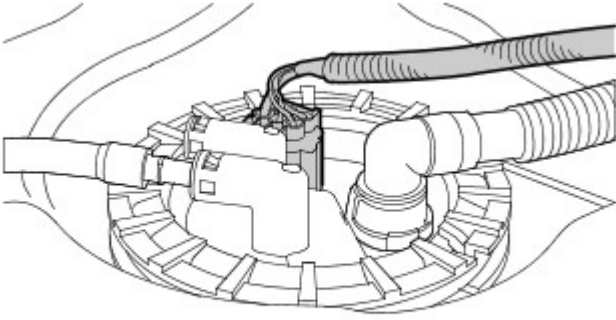
 Do not lower the fuel tank more than 250 mm (9.75 in)

 Note the rear bolt is fitted with 2 washers.

Using a transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

- Remove the 6 bolts.

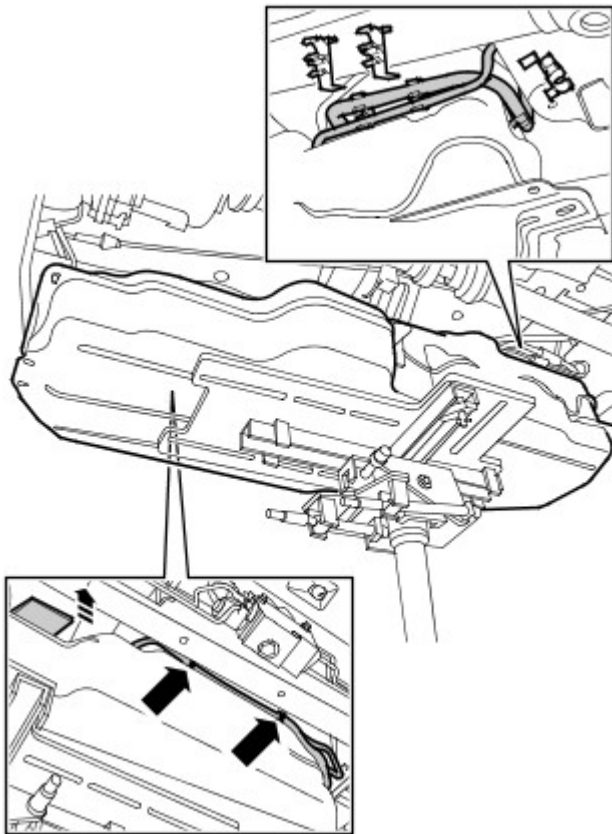
12. Disconnect the fuel pump module electrical connector.



E57673

13. Release the purge line from the top of the fuel tank.

- Remove the adhesive pad.
- Release from the 5 clips.



E51523

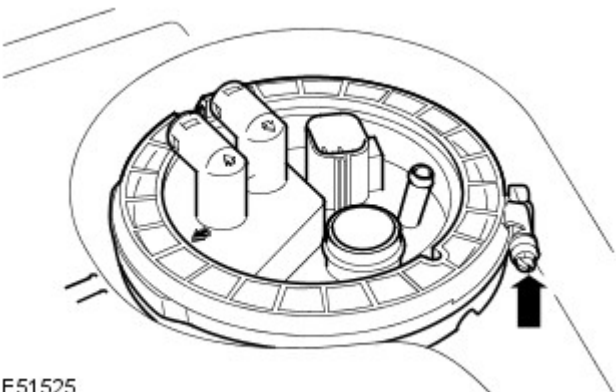
14. Remove the fuel tank.

15. NOTE: Do not disassemble further if the component is removed for access only.

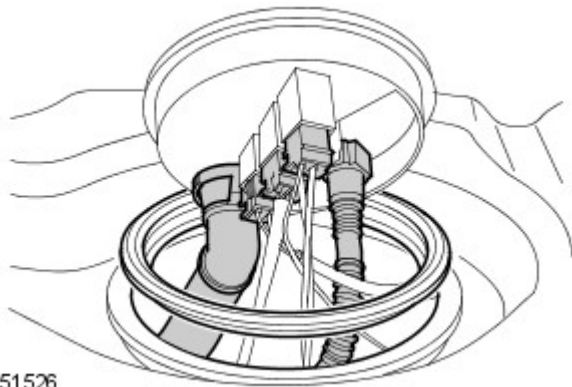
With assistance, remove the fuel tank from the transmission jack.

CAUTION: Before disconnecting or removing the component, be sure to disconnect the joint and clean the area. Plug open connectors to prevent contamination.


- Remove the fuel tank vent line.
NOTE: Note the fitted position.
- Disconnect the quick release connector.
Release the fuel pump module access frame.
- Remove from the 3 clips.
Loosen the screw.
- Remove the clamp.



E51525

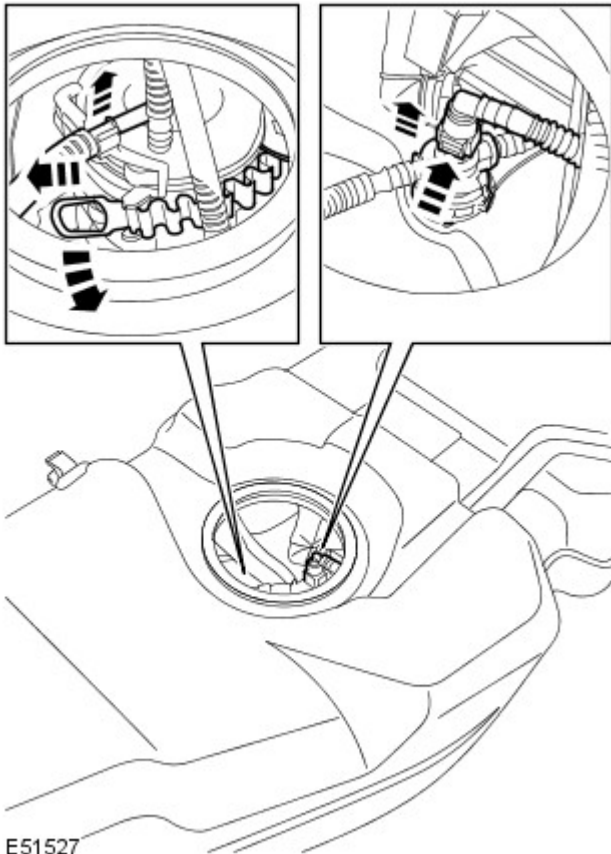


E51526

19.  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the fuel pump module access flange.

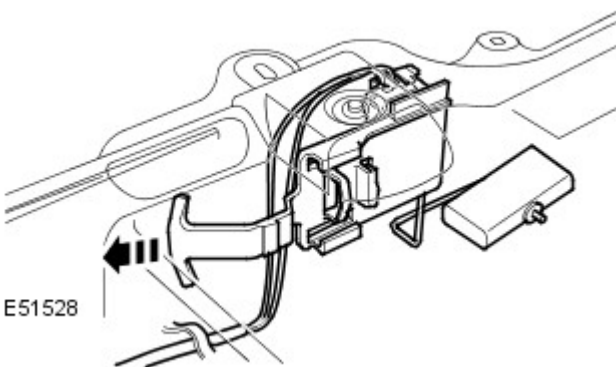
- Disconnect the vent line.
- Disconnect the fuel supply line.
- Disconnect the 3 electrical connectors.
- Remove and discard the seal.



E51527

20. Remove the fuel pump module.

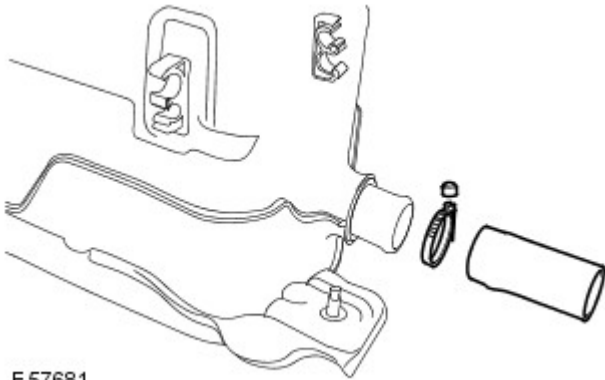
- Release the strap.
- Release the fuel pressure regulator.
- Disconnect the 2 fuel lines.




E51528

21. Remove the fuel tank front fuel level sender unit.

- Release the lead.
- Release the clip.

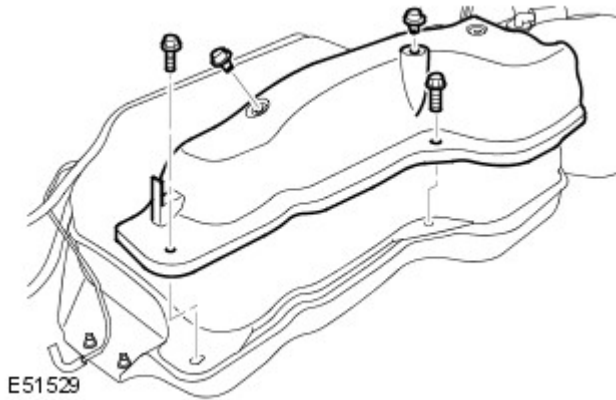


E57681

22.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the fuel filler hose.

- Remove the tamper proof cover.
- Remove and discard the hose clip.



E51529

23. Remove the fuel tank bracket.

- Remove the 2 clips.
- Remove the 2 bolts.
- Remove the retaining plate.

Installation

1. Install the fuel tank bracket.

- Install the retaining plate.
- Install the clips.
- Tighten the bolts to 3.5 Nm (2.5 lb.ft).

2.  **CAUTION:** Tighten the new tamper proof clip until the hexagon shears.

Install the fuel filler hose.

- Install a new retaining clip.

3. Install the fuel tank front fuel level sender unit.

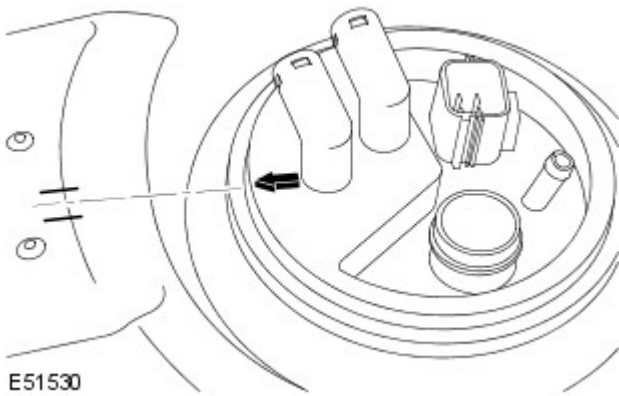
- Secure the clip.
- Secure the lead.

4. Install the fuel pump module.

- Connect the fuel lines.
- Secure with the strap.
- Secure the fuel pressure regulator.

5. Install the fuel pump module access flange.

- Clean the component mating faces.
- Install a new seal.
- Connect the 3 electrical connectors.
- Connect the fuel supply line.
- Connect the vent line.



6.  **CAUTION:** Make sure the seal is installed correctly.

Secure the fuel pump module access flange.

- Install the clamp.
- Tighten the screw to 4 Nm (3 lb.ft).

7. Install the fuel supply line.

- Connect the quick release connector.
- Secure in the 2 clips.

8. Install the vent line.

- Connect the quick release connector.
- Secure in the 3 clips.

9. With assistance, install the fuel tank to the transmission jack.

10. Position the fuel tank to the vehicle.

11. Secure the purge line to the fuel tank.

- Secure with the clips.
- Install the adhesive pad.

12. Connect the electrical connector.

13.  **CAUTION:** Note the rear bolt is fitted with 2 washers.

Install the fuel tank.

- Tighten the bolts to 45 Nm (33 lb.ft).

14. Install the 2 emergency release cable clips.

15. Secure the parking brake emergency release cable.

- Secure in the 4 clips.

16. Secure the fuel tank harness.

17. Connect the vent line.

18. Connect the fuel supply and purge lines.

19.  **CAUTION:** Tighten the new tamper proof clip until the hexagon shears.

Connect the fuel filler neck.

- Install a new retaining clip.

20. Install the fuel tank heat shield.

- Tighten the bolts to 6 Nm (4 lb.ft).
- Tighten the nuts to 3 Nm (2 lb.ft).

21. Refill the fuel tank.

For additional information, refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).

Fuel Tank and Lines - V8 5.0L Petrol -**Capacity**

Item	Liters
Fuel tank capacity	86.3 (total)

General Specifications

Item	Specifications
Fuel system	Electronic - returnless
Fuel tank	Multi layer plastic
Fuel tank sender units	Two - Front and Rear - front sender unit is attached to the frame of the fuel pick up tube and the rear sender unit is attached to the fuel pump swirl pot
Fuel filter	Located in the fuel tank - if the fuel filter becomes blocked a new pump and sender unit must be installed
Fuel pump	Dual stage electric - submersible - located in fuel tank
System pressure	4.5 bar - 65.3 lbf/in ²
Starting pressure	6.3 bar - 91.4 lbf/in ²

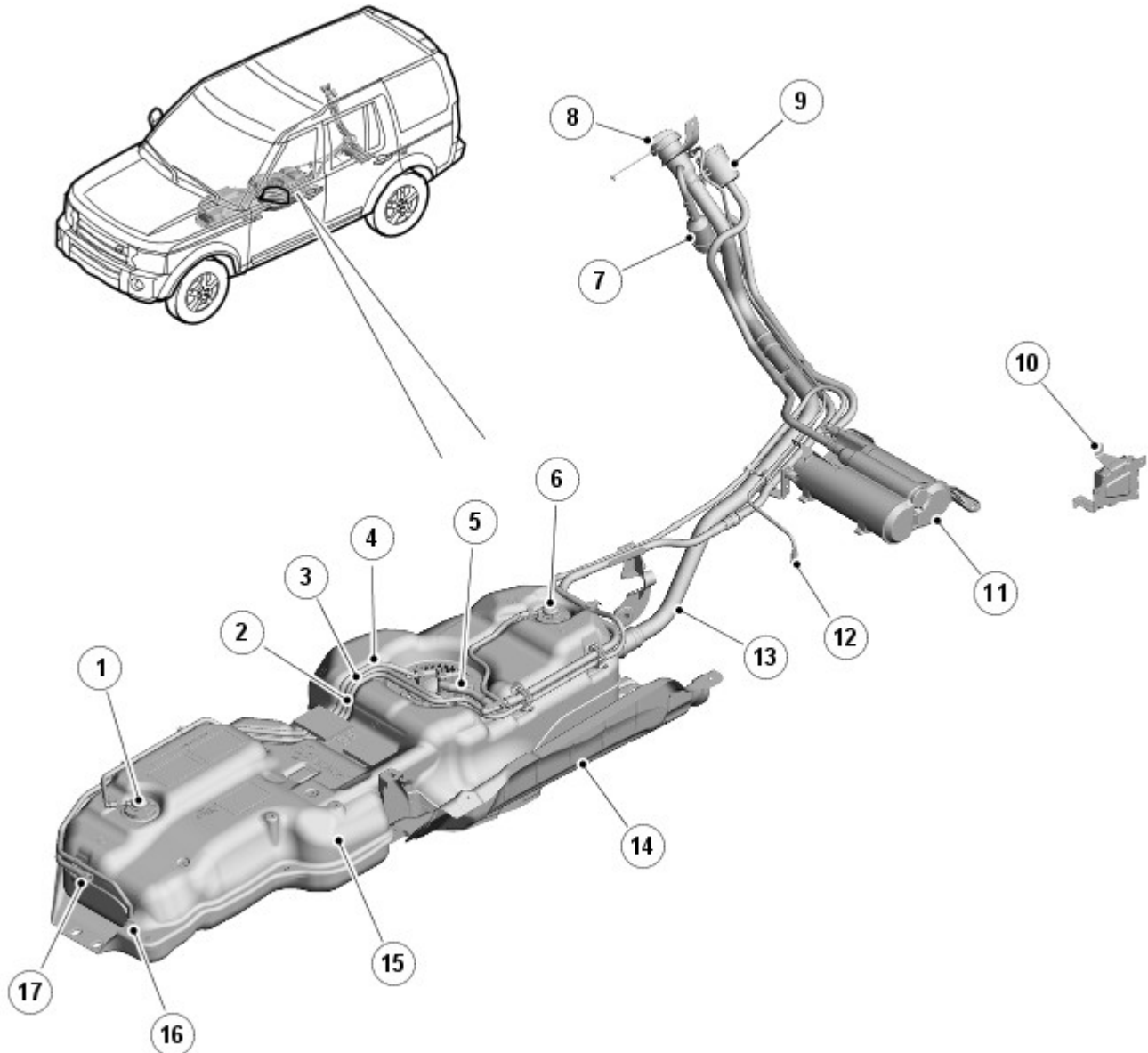
Torque Specifications

Item	Nm	lb-ft	lb-in
Fuel tank filler pipe retaining bolt	4	-	35
Fuel tank heat shield retaining bolts	6	-	53
Fuel tank heat shield retaining nuts	3	-	27
Fuel tank retaining bolts	45	33	-

Fuel Tank and Lines - V8 5.0L Petrol - Fuel Tank and Lines

Description and Operation

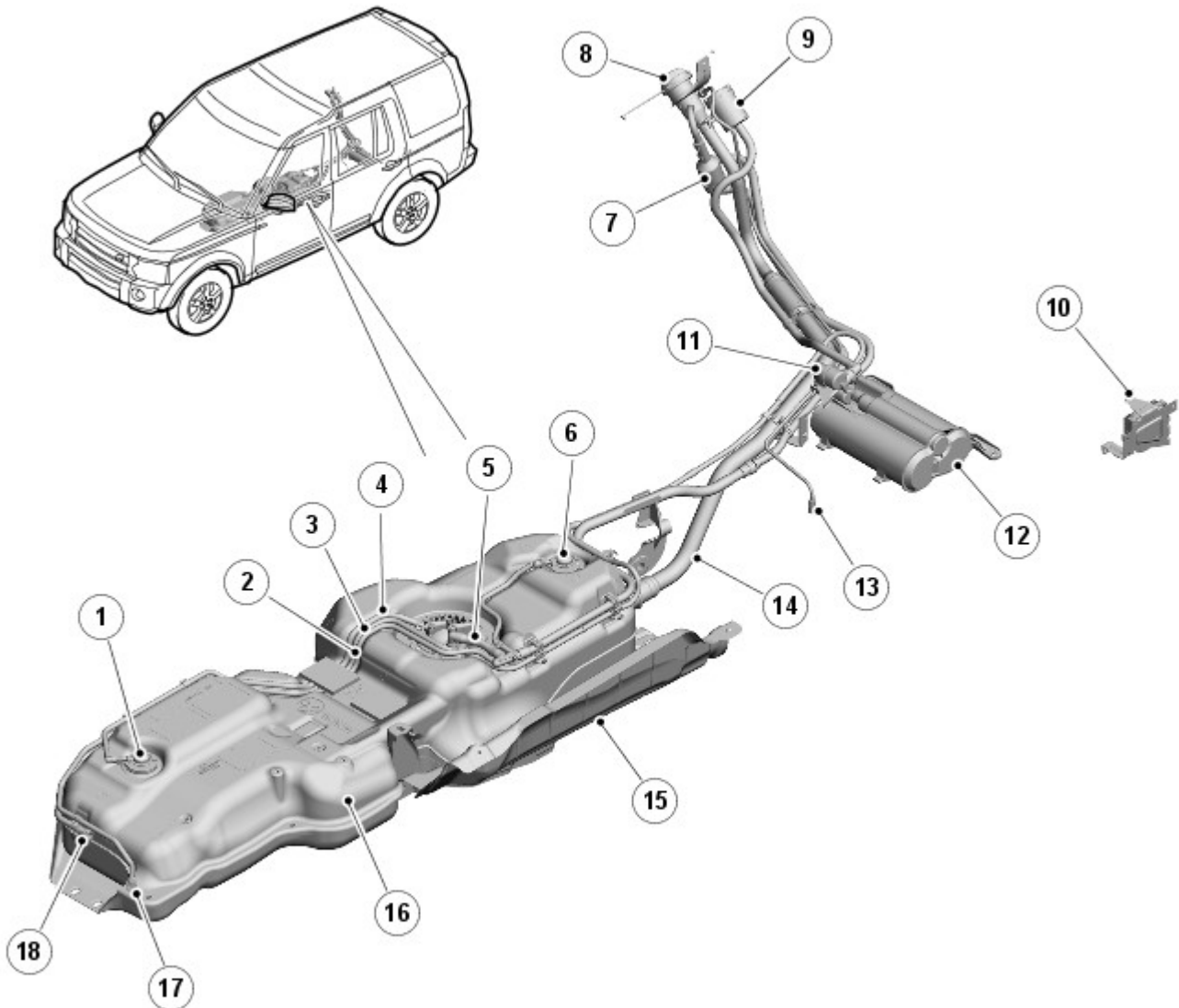
5.0L V8 FUEL TANK AND LINES COMPONENT LOCATION (All except NAS)



E122736

Item	Part Number	Description
1	-	Front Roll Over Valve (ROV)
2	-	Pipe - fuel vapor from charcoal canister to purge valve
3	-	Pipe - vent from front ROV
4	-	Pipe - fuel supply to engine mounted fuel pumps
5	-	Fuel delivery module
6	-	Rear ROV
7	-	Liquid Vapor Separator (LVS)
8	-	Fuel filler cap
9	-	Charcoal canister breather pipe
10	-	Fuel Pump Driver Module (FPDM)
11	-	Charcoal canister
12	-	Pipe - rear differential breather (Reference only)
13	-	Filler pipe
14	-	Heat shield
15	-	Cover
16	-	Pipe - charcoal canister breather connection to purge valve
17	-	Pipe - fuel supply connection to engine mounted fuel pumps

5.0L V8 FUEL TANK AND LINES COMPONENT LOCATION (NAS ONLY)



E122737

Item	Part Number	Description
1	-	Front Roll Over Valve (ROV)
2	-	Pipe - fuel vapor from charcoal canister to purge valve
3	-	Pipe - vent from front ROV
4	-	Pipe - fuel supply to engine mounted fuel pumps
5	-	Fuel delivery module
6	-	Rear ROV
7	-	Liquid Vapor Separator (LVS)
8	-	Fuel filler cap
9	-	Charcoal canister breather pipe
10	-	Fuel Pump Driver Module (FPDM)
11	-	Diagnostic Monitoring Tank Leakage (DMTL) pump
12	-	Charcoal canister
13	-	Pipe - rear differential breather (Reference only)
14	-	Filler pipe
15	-	Heat shield
16	-	Cover
17	-	Pipe - connection to purge valve
18	-	Pipe - fuel supply

GENERAL

The major components of the 5.0L V8 fuel system comprises a fuel tank, a fuel delivery module, a fuel filler assembly and

two fuel level sensors.

The 5.0L V8 fuel system uses a returnless fuel system which comprises a fuel pump mounted in the fuel tank to deliver fuel at a variable flow and pressure to the engine mounted high pressure fuel pumps which supply fuel to the fuel rails and to all the fuel injectors.

The fuel pump operation is regulated by a Fuel Pump Driver Module (FPDM) which is controlled by the engine management system. The driver module regulates the flow and pressure supplied by controlling the operation of the fuel pump using a Pulse Width Modulation (PWM) output.

The fuel rails and the injectors are described in Fuel Charging and Controls – 5.0L V8.

For additional information, refer to: [Fuel Charging and Controls](#) (303-04C Fuel Charging and Controls - TDV6 3.0L Diesel, Description and Operation) /

[Turbocharger](#) (303-04D Fuel Charging and Controls - Turbocharger - TDV6 3.0L Diesel, Description and Operation).

Fuel system emission control is described in Engine Emission Control - 5.0L V8

For additional information, refer to: [Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation) /

[Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

FUEL TANK

The fuel tank is located on the right hand side of the vehicle, between the transmission and the right hand chassis longitudinal. The tank is located on a mounting cradle which secures the whole fuel tank assembly to the vehicle. The tank is blow moulded from HDPE (high density polyethylene) and has a useable capacity of 86.0 liters (19 gallons).

The cradle is attached to the chassis with six screws. When the cradle is attached to the chassis, the tank is positively secured via foam pads which bear against the central chassis cross beam. A protective cover is fitted to the front right hand corner of the tank and provides additional protection.

The fuel tank is manufactured from moulded plastic which is a minimum of 3 mm thick. The tank is a sealed unit with the only internal access being via the pump module flange aperture on the top of the tank.

The flange is fitted with a locking ring and seal. The seal locates in a groove on the tank. The locking ring locates and clamps on the encapsulated ring that is moulded into the fuel tank. The flange has a tag which locates in the top of the tank to ensure correct orientation.

The flange has six pin internal and external connectors which provide for electrical connections for the level sensors and the fuel pump. A quick release connector provides for the connection of the fuel supply pipe.

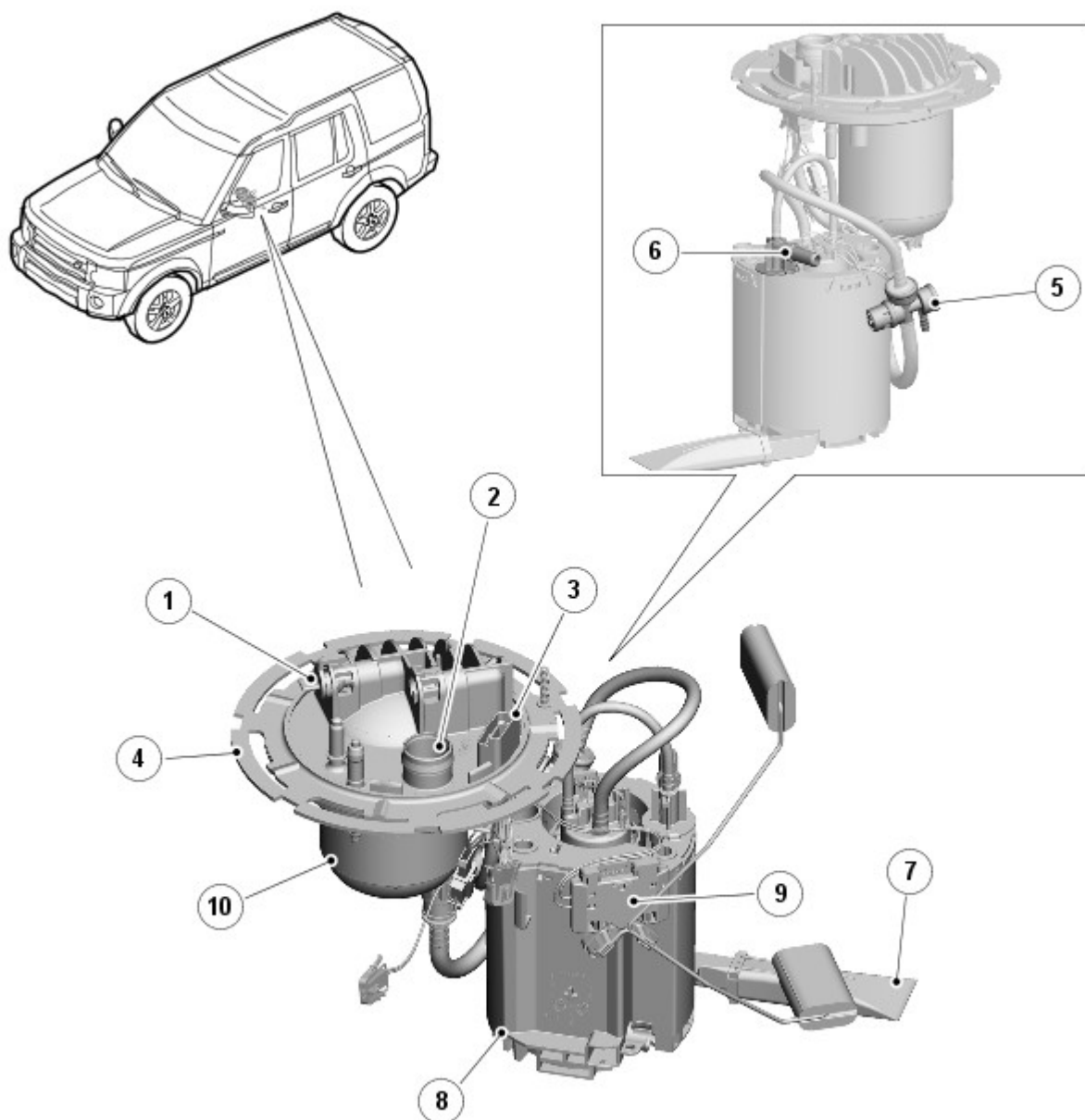
A carrier within the tank provides for the mounting of the fuel suction tube, vent valve, and the front fuel level sensor.

The fuel delivery module is mounted on a bayonet lock ring which is welded inside the fuel tank. The fuel delivery module comprises the fuel pump, jet pumps, the pump inlet filter and the fuel pressure relief valve. The rear fuel level sensor is also mounted on the side of the pump module body.

The pressure relief valve assists engine starting by retaining a pre-set fuel pressure in the fuel supply pipe and the fuel rails. The valve also limits fuel rail pressure due to temporary vapor increase in hot conditions and pressure caused by sudden load changes; a fully open to closed throttle transition, for example.

Only the pump module assembly, the fuel level sensors and the flange are available as serviceable components, the individual assembly components are not available separately.

FUEL DELIVERY MODULE



E122738

Item	Part Number	Description
1	-	Fuel supply outlet connection
2	-	Vent pipe connection
3	-	Electrical connector
4	-	Locking ring
5	-	Pressure relief valve
6	-	Suction pipe connection
7	-	Fuel pick-up filter
8	-	Fuel pump
9	-	Rear fuel level sensor
10	-	Fuel filter

The fuel delivery module is a new design for 5.0L V8 2010MY vehicles. The module is located inside the fuel tank and comprises three main components; a fuel pump, a remote fuel pick-up and a top flange assembly.

Fuel Pump

The fuel pump is a variable-speed rotary-vane type, which operates in a fuel pump module located at the rear of the fuel tank. A venturi transfer pump is also located in the rear of the tank. The fuel pump module is secured in the fuel tank with a bayonet style locking ring that is welded into the tank structure. The fuel pump module has an integral top plate for the external pipe work and electrical connectors.

The fuel pump delivers fuel at a maximum pressure of 630 kPa (6.3 bar; 91.4 lbf/in.²) to the filter bowl in the top flange.

The electric pump is located in a plastic swirl pot which collects fuel from the base of the fuel tank via a filter. The swirl pot acts as a fuel reserve, providing a constant supply of fuel to the fuel pump irrespective of fuel quantity or vehicle attitude. When the vehicle is level the swirl pot contains approximately 275 cm³ (16.8 in³) of fuel when the engine is

running. The jet pump ensures that fuel is constantly supplied to the swirl pot to provide a sufficient fuel supply for the pump. A one way valve is located in the base of the swirl pot. The valve allows fuel from the tank to enter the swirl pot, but prevents it from escaping.

The fuel level sensor for the rear of the tank is attached to the outside of the swirl pot.

The fuel pump module is a serviceable component and access to the pump is by removal of the top flange.

Remote Fuel Suction Jet and Level Sensor Assembly

The remote fuel suction jet is located in the front of the fuel tank. The fuel suction jet is attached to the internal carrier which is secured inside the fuel tank.

The fuel system incorporates 2 jet pumps. The jet pumps are integrated into the fuel pump module and draw fuel from the front and rear of the fuel tank. A suction pipe is connected to the fuel suction jet that is located in the front of the tank that allows fuel to be drawn from the front of the tank, delivering fuel into the swirl pot via the suction pipe connection on the pump body. The jet pump operates on a venturi effect created by the fuel at pump output pressure passing through the jet pump.

The fuel level sensor for the front of the fuel tank is attached to the carrier frame. The fuel suction jet and the level sensor are serviceable components and access is by removal of the flange cover on the top rear of the fuel tank.

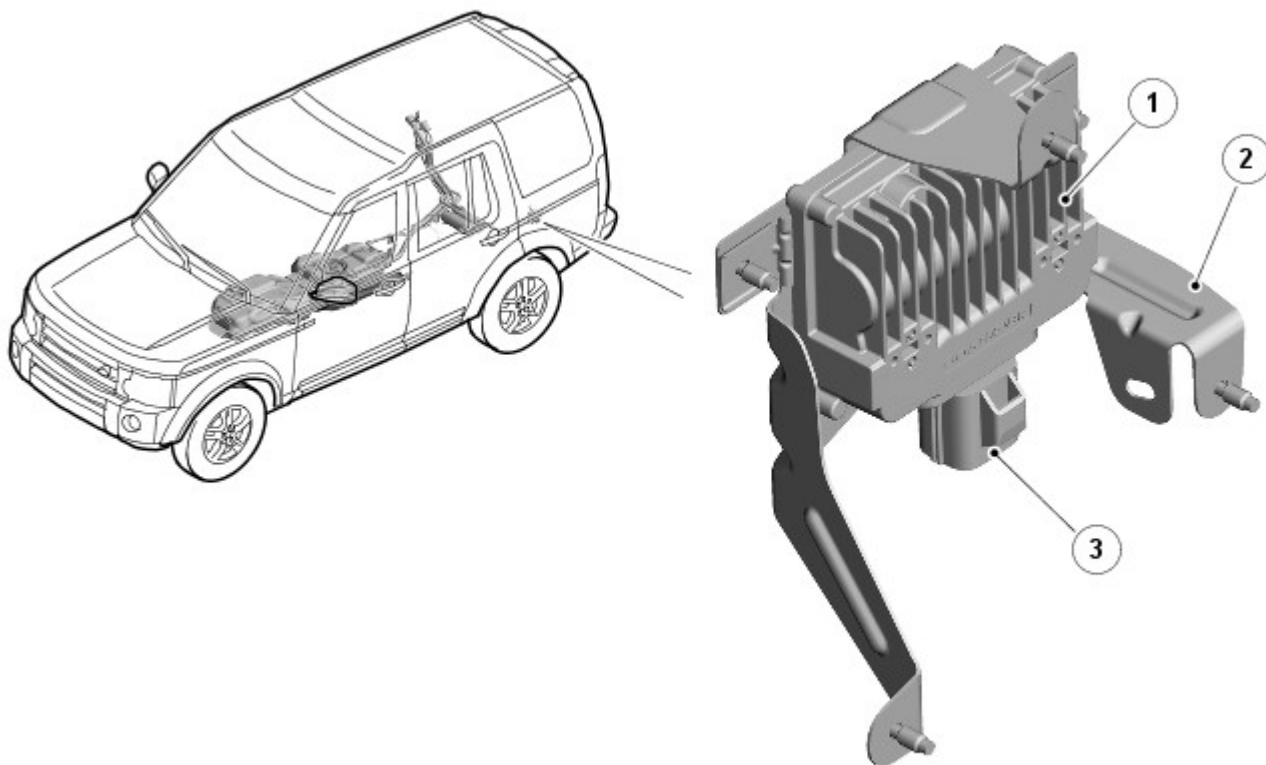
Top Flange Assembly

The top flange is located on the top of the fuel tank. The flange assembly is sealed in the tank with a with a sealing ring. A locking ring secures the flange assembly in the tank and requires a special tool for removal.

The outer surface of the flange has 1 fuel feed outlet with a quick-fit connection. The connection is for the fuel supply pressure outlet to the engine mounted fuel pumps. An electrical connector is located adjacent to the pipe connections and provides the electrical interface to the fuel pump and the level sensors. A breather connection allows the fuel tank to breathe and connects the fuel tank to the fuel filler and charcoal canister systems.

On the underside of the flange, inside the tank, is a moulded housing which contains the non-serviceable fuel filter. Fuel from the fuel pump enters the base of the housing and passes through the filter before exiting the tank to the engine mounted fuel pumps. An electrical connection on the base of the filter housing provides a ground for the filter.

FUEL PUMP DRIVER MODULE (FPDM)



E122739

Item	Part Number	Description
1	-	Fuel Pump Driver Module (FPDM)
2	-	Mounting bracket

The FPDM is located in the LH side of the luggage compartment, above the LH wheel arch, behind the trim panel. The FPDM is located on a bracket and secured with 2 bolts and nuts.

The fuel pump operation is regulated by the FPDM which is controlled by the Engine Control Module (ECM). The FPDM regulates the flow and pressure supplied by controlling the operation of the fuel pump using a PWM output.

The FPDM is powered by a supply from the fuel pump relay in the Engine Junction Box (EJB). The fuel pump relay is energized on opening the driver's door or when power mode 9 engine crank is initiated using the stop/start button. The FPDM supplies power to the fuel pump, and adjusts the power to control the speed of the fuel pump and thus the pressure and flow in the fuel delivery line.

A Pulse Width Modulation (PWM) signal from the ECM tells the FPDM the required speed for the fuel pump. The on time of the PWM signal represents half the fuel pump speed, e.g. if the PWM signal has an on time of 50%, the FPDM drives the pump at 100%.

The FPDM will only energize the fuel pump if it receives a valid PWM signal, with an on time of between 4% and 50%. To switch the fuel pump off, the ECM transmits a PWM signal with an on time of 75%.

The output pressure from the fuel pump will change with changes of engine demand and fuel temperature. The ECM monitors the input from the Low Pressure (LP) fuel sensor and the fuel rail pressure sensor and adjusts the speed of the fuel pump as necessary to maintain a nominal output pressure of 450 kPa (4.5 bar; 65.3 lbf/in.²), except during engine start-up. At engine start-up the target pressure for the fuel delivery line is 630 kPa (6.3 bar; 91.4 lbf/in.²).

If the Supplemental Restraint System (SRS) outputs a crash signal on the high speed Controller Area Network (CAN) bus, the ECM de-energizes the fuel pump relay to prevent any further fuel being pumped to the engine.

If the ECM does not detect pressure in the fuel delivery line, it stops, or refuses to start the engine and stores the appropriate Diagnostic Trouble Code (DTC).

The ECM receives a monitoring signal from the FPDM. Any DTC's produced by the FPDM are stored by the ECM.

DTC's can be retrieved from the ECM using an approved Land Rover diagnostic system. The FPDM itself cannot be interrogated by the approved Land Rover diagnostic system.

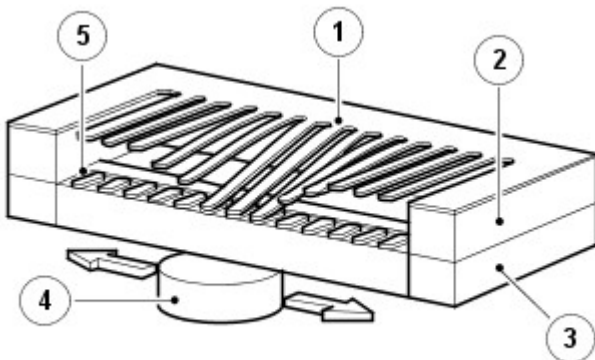
FUEL LEVEL SENSORS

Two fuel level sensors are used in the fuel tank to measure the amount of remaining fuel in the front and rear of the fuel tank. The front level sensor is attached to the internal carrier and the rear level sensor is attached to the fuel pump swirl pot. The sensors are connected to the vehicle wiring harness via a connector on the outer face of the top flange assembly.

The sensors are a MAGnetic PASSive Position Sensor (MAPPS) which provides a variable resistance to ground for the output from the fuel gauge. The sensor is sealed from the fuel preventing contamination of the contacts and increasing reliability. The front and rear fuel level sensors are connected to the external electrical connector on the flange via the connectors on the underside of the fuel pump module flange.

The sensor comprises a series of 51 film resistors mounted in an arc on a ceramic surface. The resistors are wired in series with individual contacts. A soft magnetic foil with 51 flexible contacts is mounted a small distance above the film resistors. A magnet, located below the ceramic surface, is attached to the sender unit float arm. As the float arm moves, the magnet follows the same arc as the film resistors. The magnet pulls the flexible contacts onto the opposite film resistor contacts forming an electrical circuit.

Sensor Operating Principle



E44504

Item	Part Number	Description
1	-	Magnetic foil
2	-	Spacer
3	-	Ceramic surface
4	-	Magnet
5	-	Resistance film

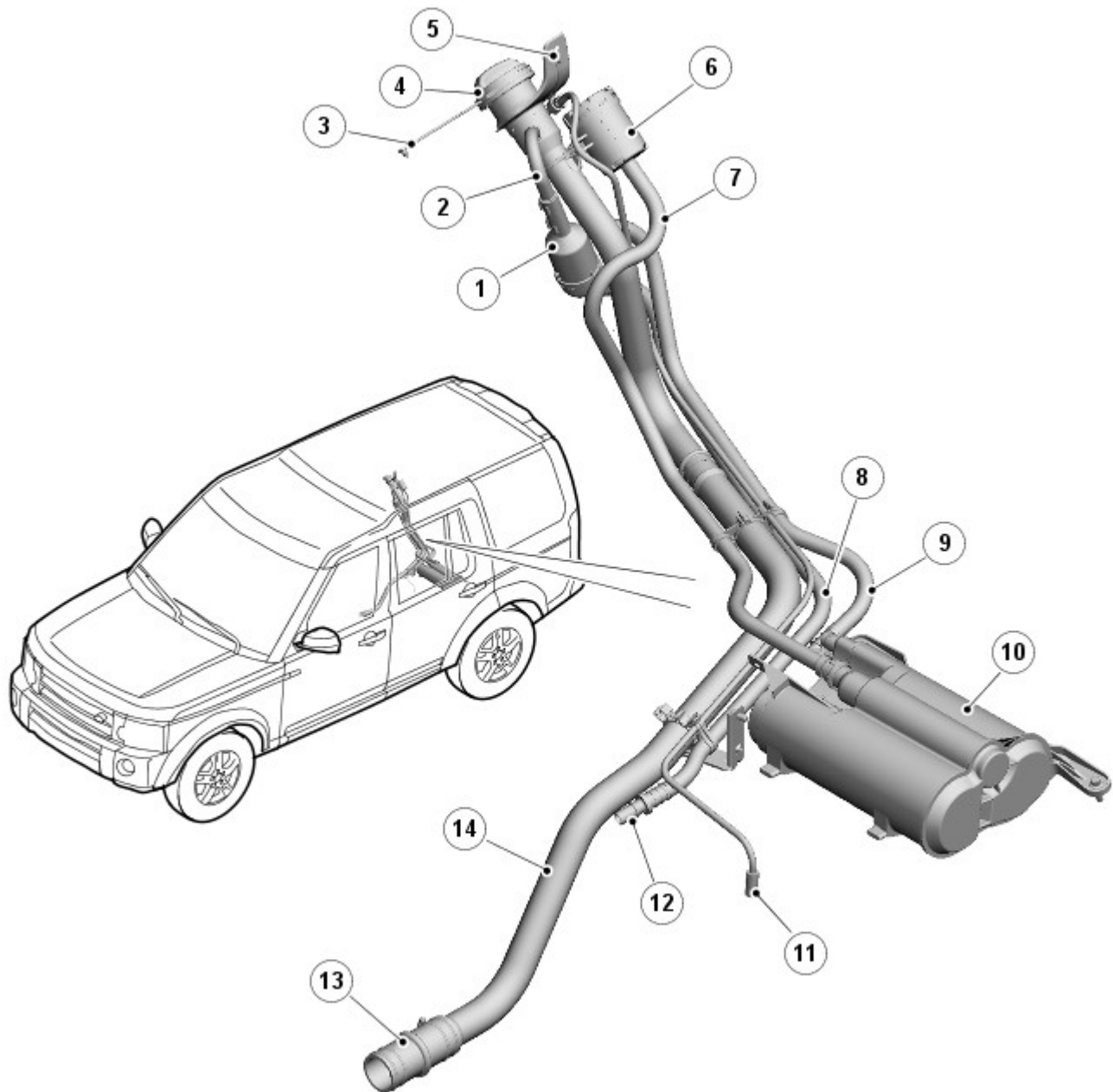
The film resistors are arranged in a linear arc with resistance ranging from 51.2 to 992.11 Ohms. The electrical output signal output is proportional to the amount of fuel in each side of the tank and the position of the float arms. The measured resistance is processed by the instrument cluster to implement an anti-slosh function. This monitors the signal and updates the fuel gauge pointer position at regular intervals, preventing constant pointer movement caused by fuel movement in the tank due to cornering or braking.

A warning indicator is incorporated in the instrument cluster and illuminates when the fuel level is at or below 10 liters (2.64 US gallons).

The fuel level sender signals are converted into a CAN bus message by the instrument cluster as a direct interpretation of the fuel tank contents in liters. The ECM uses the CAN bus message to store additional On-Board Diagnostic (OBD) P Codes for misfire detection when the fuel level is below a predetermined capacity.

FUEL FILLER PIPE AND TANK BREATHER ASSEMBLY

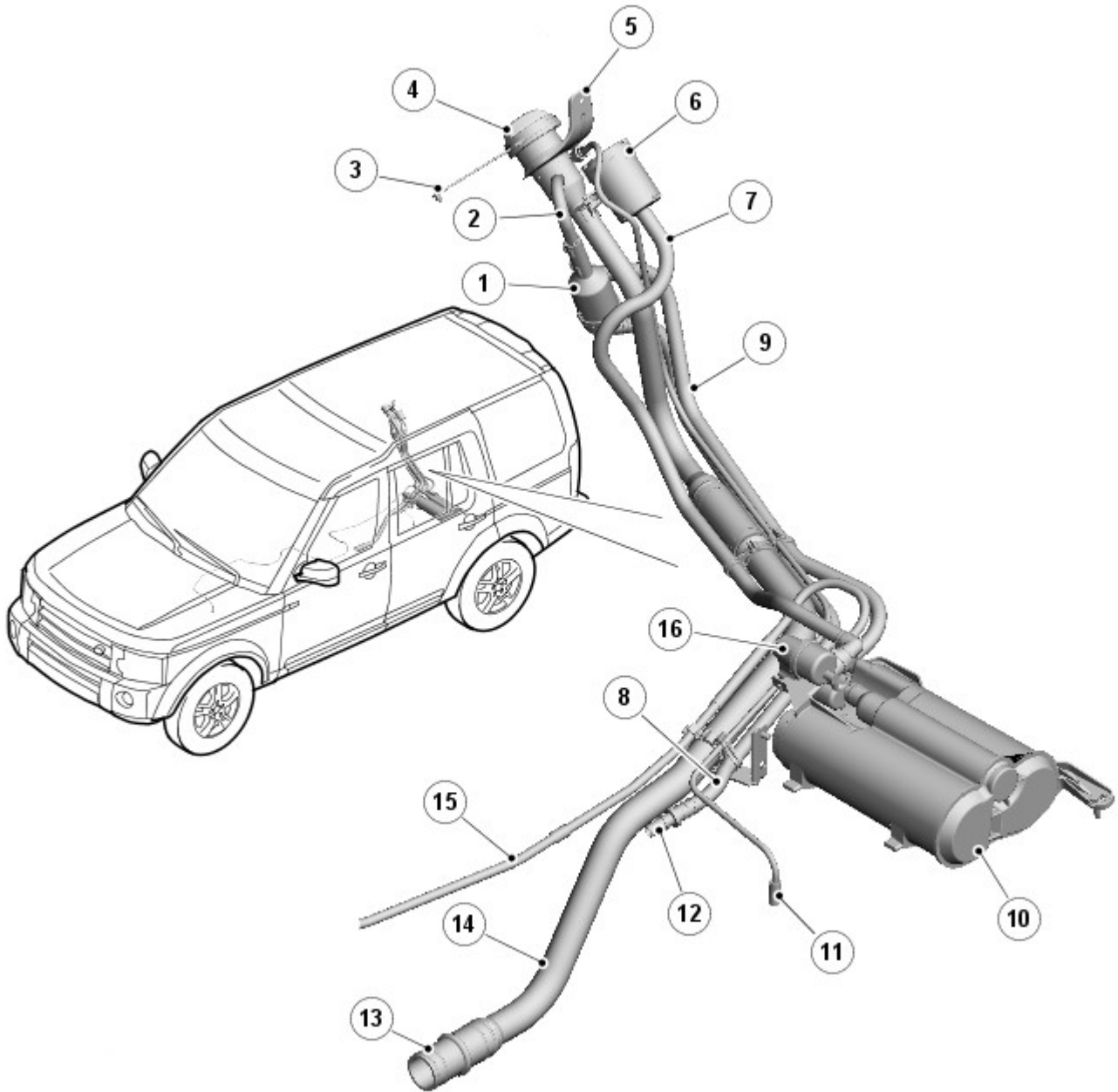
Fuel Filler Pipe Assembly (All Except NAS)



E122740

Item	Part Number	Description
1	-	Liquid Vapor Separator (LVS)
2	-	Pipe - fuel vapor vent
3	-	Filler cap lanyard
4	-	Filler cap
5	-	Bracket
6	-	Charcoal canister breather/dust filter
7	-	Pipe - breather
8	-	Pipe - fuel vapor vent
9	-	Pipe - fuel vapor to charcoal canister
10	-	Charcoal canister
11	-	Pipe - rear differential breather (Reference only)
12	-	Pipe - fuel vapor connection
13	-	Hose - fuel filler pipe to fuel tank spit back flap
14	-	Pipe - fuel filler

Fuel Filler Pipe Assembly (NAS Only)



E122741

Item	Part Number	Description
1	-	Liquid Vapor Separator (LVS)
2	-	Pipe - fuel vapor vent
3	-	Filler cap lanyard
4	-	Filler cap
5	-	Bracket
6	-	Charcoal canister breather/dust filter
7	-	Pipe - breather
8	-	Pipe - fuel vapor vent
9	-	Pipe - fuel vapor to charcoal canister
10	-	Charcoal canister
11	-	Pipe - rear differential breather (Reference only)
12	-	Pipe - fuel vapor connection
13	-	Hose - fuel filler pipe to fuel tank spit back flap
14	-	Pipe - fuel filler
15	-	Pipe - fuel vapor to purge valve (part of fuel tank assembly)
16	-	Diagnostic Tank Monitoring Leakage (DMTL) pump

The fuel filler head is positioned at the rear of the vehicle, above the right hand rear wheel. The filler head and cap is covered by a moulded plastic cover which is electrically locked when the vehicle is locked.

The filler cap is a conventional screw in type which is secured to the vehicle with a lanyard. The filler cap must be securely fitted to ensure that the tank venting system is sealed. The cap has a locking mechanism which gives an audible click when the cap is correctly tightened.

Failure to correctly secure the filler cap will result in vapor being lost from the system. On NAS Vehicles, if the cap is incorrectly secured when the engine management system operates the Diagnostic Monitoring Tank Leakage (DMTL)

system, the loss of vapor will be detected as a leak and the MIL lamp will be illuminated.

The filler head is a stainless steel fabrication. A bracket provides for the attachment of the filler head to the vehicle body.

A connection on the rear of the filler head allows for the connection of the fuel tank breather pipe from the vapor separator on ROW vehicles and from the roll over valves on NAS vehicles.

The fuel filler pipe locates in the tank and incorporates a spitback flap in the tank end of the pipe. The flap is a spring loaded cover which acts as a 1-way valve, allowing the tank to be filled but preventing fuel leaving the tank into the filler pipe.

All vehicles have a charcoal canister breather pipe which is connected from the charcoal canister and is routed alongside the fuel filler pipe to the filler head. The filler head end of this pipe is connected differently depending on market as follows:

- On ROW vehicles the breather pipe is fitted with a mesh and allows fresh air to be drawn into the charcoal canister when fuel vapor is being purged from the system.
- On NAS vehicles the breather pipe is connected to the DMTL pump. Fresh air is drawn into the pipe via a DMTL filter integral with the pump when fuel vapor is being purged from the system. When the DMTL system is active, the breather pipe is closed by the pump, sealing the system and allowing the system to be pressure checked for leakage.

For information on the charcoal canister and purging system refer to the evaporative emissions section.

For additional information, refer to: [Evaporative Emissions](#) (303-13A Evaporative Emissions - V6 4.0L Petrol, Description and Operation).

A second pipe is routed alongside the charcoal canister breather pipe. On ROW vehicles, this pipe is the fuel tank breather pipe from the vapor separator and is connected into the fuel filler pipe near to the filler head. On NAS vehicles, this pipe is smaller in diameter and also serves as the fuel tank breather pipe. The pipe is not connected to the vapor separator but allows fuel vapor from the right hand roll over valve to vent into the connection with the fuel filler pipe near to the filler head.

A pipe is routed across the top of the tank in front of the vapor separator. This pipe connects the charcoal canister to the purge valve located in the engine compartment.

FUEL LOW PRESSURE (LP) SENSOR



E112870

The fuel LP sensor supplies a pressure signal to the Engine Control Module (ECM) to enable closed loop control of the fuel pump. The fuel LP sensor is installed in a manifold in the fuel supply line. The manifold is located in the rear of the front Right Hand (RH) wheelarch, behind the splash shield.

OPERATION

The fuel pump is a variable-speed rotary-vane type, which operates in a fuel delivery module located in the fuel tank. The fuel delivery module is secured in the fuel tank with a bayonet style locking ring that is welded into the tank structure. The fuel pump module has an integral top plate for the external pipe work and electrical connectors.

Fuel level is biased towards the rear of the fuel tank by drawing fuel from the front of the tank via the jet pump, which serves to deliver a constant supply of fuel to the swirl pot. High pressure fuel from the fuel pump is directed through the jet pump's orifice, creating a low pressure area to be formed in the cross over pipe. The fuel is drawn into this low pressure area in the cross over pipe and directed into the swirl pot delivery pipe.

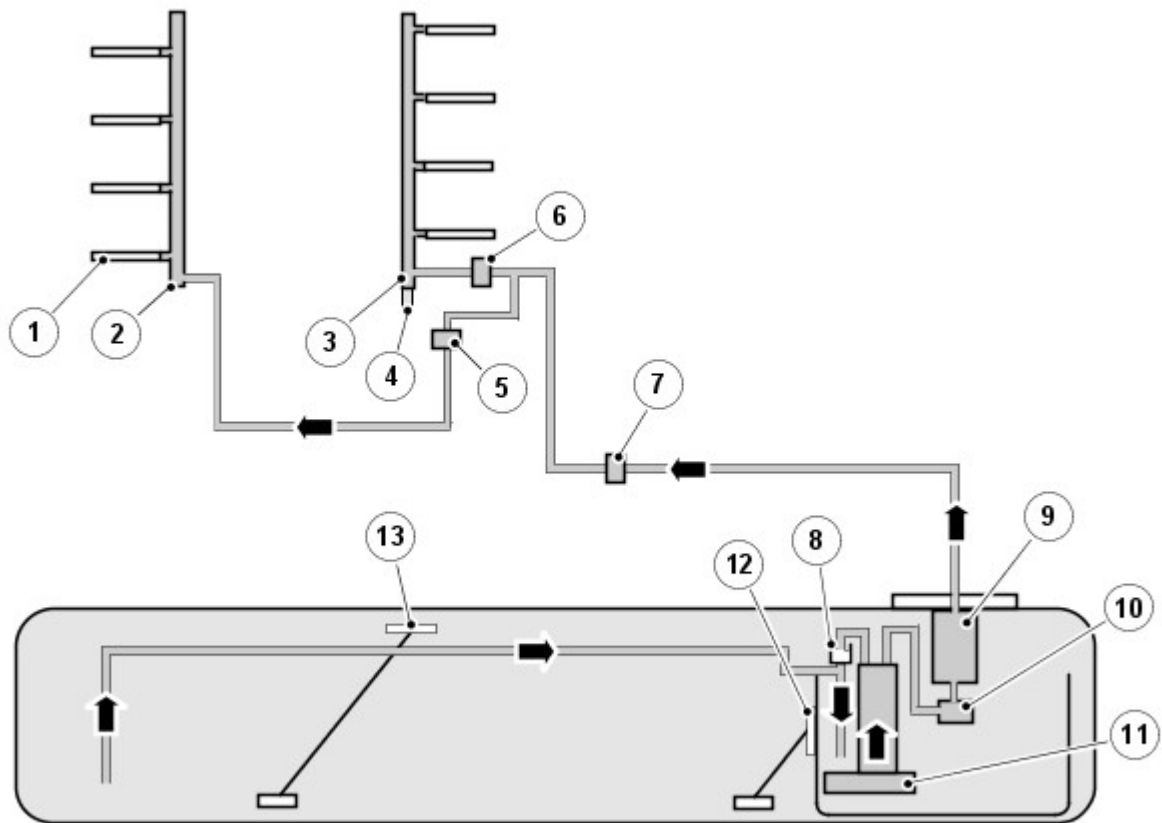
Fuel is pumped from the fuel pump to the two engine mounted HP fuel pumps via the integral filter and pressure relief valve.

The pressure relief valve assists engine starting by retaining a pre-set fuel pressure in the supply pipe and fuel rail. The pressure relief valve also limits fuel rail pressure due to temporary vapor increase in hot conditions and pressure caused by sudden load changes, for example, a fully open to closed throttle transition.

To meet emission requirements, the fuel tank and associated components are designed to minimize fuel vapor loss during refueling. This is achieved by preventing fuel vapor from the fuel tank venting directly to the atmosphere. Instead fuel vapor is directed into the charcoal canister where it is stored before being purged at intervals to the engine's intake manifold.

North American Specification (NAS) vehicles feature additional connections and pipes at the rear of the filler head and also incorporates a Diagnostic Monitoring Tank Leakage (DMTL) pump for leak detection requirements.

Fuel System Schematic Diagram



E122742

Item	Part Number	Description
1	-	Fuel injector (8 off)
2	-	Left Hand (LH) fuel rail
3	-	Right Hand (RH) fuel rail
4	-	Fuel rail pressure sensor
5	-	RH High Pressure(HP) fuel pump
6	-	LH HP fuel pump
7	-	Fuel Low Pressure (LP) sensor
8	-	Jet pump
9	-	Fuel filter
10	-	Pressure relief valve
11	-	Fuel delivery module assembly
12	-	Fuel level sensor - Rear
13	-	Fuel level sensor - Front

Fuel Tank and Lines - V8 5.0L Petrol - Fuel Tank and Lines

Diagnosis and Testing

Principle of Operation

For a detailed description of the fuel tank and lines system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel level ● Fuel leaks ● Damaged fuel lines ● Damaged push connect fittings ● Fuel contamination/grade/quality ● Throttle body ● Damaged fuel tank filler pipe cap ● Damaged fuel tank filler pipe 	<ul style="list-style-type: none"> ● Fuses ● Loose or corroded electrical connectors ● Harnesses ● Sensor(s) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	<ul style="list-style-type: none"> ● Engine breather system disconnected/restricted ● Ignition system ● Fuel system ● Electronic engine control 	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	<ul style="list-style-type: none"> ● Evaporative emissions purge valve ● Fuel pump ● Spark plugs ● HT short to ground (tracking) check rubber boots for cracks/damage ● Ignition system 	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	<ul style="list-style-type: none"> ● Engine coolant level/anti-freeze content ● Battery ● Electronic engine controls ● Exhaust Gas Recirculation (EGR) valve stuck open ● Fuel pump ● Purge valve 	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	<ul style="list-style-type: none"> ● Injector leak ● Electronic engine control ● Purge valve ● Fuel pump ● Ignition system ● EGR valve stuck open 	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

Symptom	Possible Causes	Action
Engine stalls soon after start	<ul style="list-style-type: none"> Breather system disconnected/restricted ECM relay Electronic engine control Ignition system Air intake system restricted Air leakage Fuel lines 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	<ul style="list-style-type: none"> Fuel pressure, fuel pump, fuel lines Injector leak Air leakage Electronic engine control Throttle motor Restricted accelerator pedal travel (carpet, etc) Ignition system EGR valve stuck open Transmission malfunction 	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index
Engine backfires	<ul style="list-style-type: none"> Fuel pump/lines Air leakage Electronic engine controls Ignition system Sticking variable camshaft timing (VCT) hub 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and VCT system related DTCs and refer to the relevant DTC Index
Engine surges	<ul style="list-style-type: none"> Fuel pump/lines Electronic engine controls Throttle motor Ignition system 	Check for fuel system failures. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	<ul style="list-style-type: none"> Fuel pump/lines Air leakage Electronic engine controls Sticking VCT hub 	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	<ul style="list-style-type: none"> Electronic engine controls Throttle motor 	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	<ul style="list-style-type: none"> Breather system disconnected/restricted Electronic engine controls Transmission malfunction Traction control event Air leakage 	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

Fuel Gauge Diagnosis

1. Using the manufacturer approved diagnostic system monitor, "active fuel level sensor(A)" and "passive fuel level sensor(B)" data logger signals located within the body control module subsection.

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	>3.6v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, C0390-18 and C0114-1 If no fault is evident then check C0376-18 to C0586R-8, If no fault is evident with the above, remove the fuel pump module and two fuel senders from the fuel tank and check for backed out terminals and circuit faults. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	<3.0v	>3.6v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, C0390-2 and C0114-6, If no fault is evident then check C0376-2 to C0586R-20 If no fault is evident with the above, remove the fuel sender B (front) from the fuel tank and check for backed out terminals and circuit faults

Customer Complaint	Possible Concern	Fuel Pressure	Active Fuel Level Sensor Voltage Reading A	Passive Fuel Level Sensor Voltage Reading B	Action
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Open circuit	Yes	>3.6v	<3.0v	<ul style="list-style-type: none"> Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults between, C0390-3 and C0114-2 If no fault is evident then check C0376-3 to C0586R-21 If no fault can be found with the above check then the active fuel sender A (rear) will need to be removed and the wiring carefully inspected
Fuel gauge switches on and off intermittently and / or fuel gauge indicates empty whilst there is fuel still available in the fuel tank	Electric parkbrake fault (EPB)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> NOTE: Check for correct EPB operation prior to carrying out the following checks. NOTE: The EPB module is calibrated to allow fuel gauge correction for varying gradients (via CAN Bus). Refer to the electrical circuit diagrams and check for backed out terminals and circuit faults at connectors, C2178-31, C2178-32 C2178-9, C2178-10, C2178-15 and C2178-16 Check Earth Point (LH D Post) C2570S (Discovery 4/LR4) C2570T (Range Rover Sport)
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 3.06v	0.35v	<ul style="list-style-type: none"> Check active sender A (rear) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v	0.35v to 3.06v	<ul style="list-style-type: none"> Check passive sender B (front) for potential hang up/fouling inside of the fuel tank
Fuel gauge indicating fuel present	No fuel present inside tank	No	>1.0v	0.35v to 0.54v	<ul style="list-style-type: none"> Remove from the fuel tank and check all active sender A (rear) blue wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>1.0v	<ul style="list-style-type: none"> Remove from the fuel tank and check all passive sender B (front) blue circuit wires for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>0.55v and within 0.6v of B	>0.55v and within 0.6v of A	<ul style="list-style-type: none"> Remove fuel pump module and both senders from the fuel tank and check all black wires on the circuit for backed out pin/defective wire
Fuel gauge indicating fuel present	No fuel present inside tank	No	>3.2v but <3.6v	0.35v to 0.54v	<ul style="list-style-type: none"> Active sender A (rear) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	No fuel present inside tank	No	0.35v to 0.44v	>3.2v but <3.6v	<ul style="list-style-type: none"> Passive sender B (front) internal fault. No repair possible, replace the sender. Refer to the warranty policy and procedures manual if a module/component is suspect
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	No	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check the pressure relief valve inside fuel tank. Check Internal fuel feed pipe is connected to flange
Fuel gauge indicating fuel present	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check terminals are correctly latched / installed to the fuel pump module
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel present inside the fuel tank	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Check the bayonet fitting on the fuel pump module. Check both the active and passive fuel senders are securely located in their brackets
Fuel gauge indicating fuel present but reading an incorrect fuel level	Fuel tank - out of shape / sucking in (diesel only)	Yes	0.35v to 3.06v	0.35v to 3.06v	<ul style="list-style-type: none"> Incorrect filler cap installed. Install the correct fuel filler cap (applies to diesel variants only). Refer to the warranty policy and procedures manual if a module/component is suspect

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Fuel Tank and Lines - V8 5.0L Petrol - Fuel Tank Filler Pipe

Removal and Installation

Removal

• **WARNINGS:**



The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.




After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow these instructions may result in personal injury.

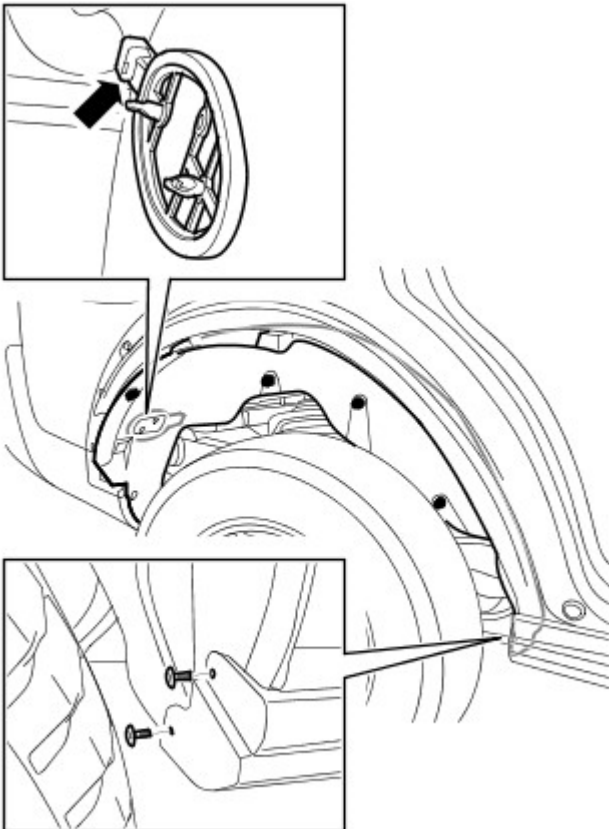


This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

• **NOTE:** Removal steps in this procedure may contain installation details.

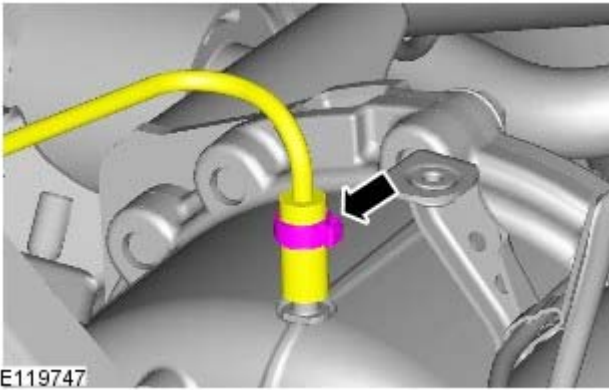
1. Remove the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.
3. For additional information, refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).
4. For additional information, refer to: [Fuel Filler Door Assembly](#) (501-03 Body Closures, Removal and Installation).
5. Remove the RH rear wheel and tire.
 - TORQUE: 140 Nm
6. Remove the fender splash shield.



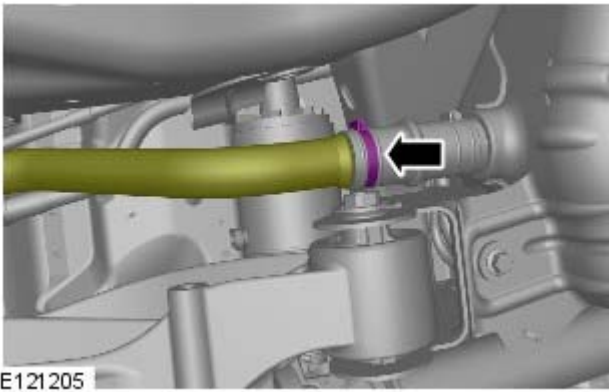
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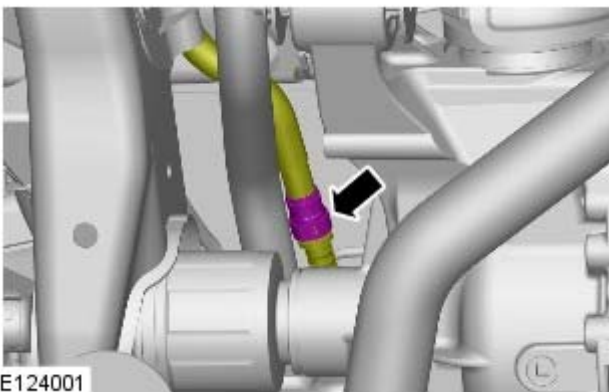


8. NOTE: Discard the retaining clip.

Remove the tamper proof cover from the fuel tank filler pipe hose clip.

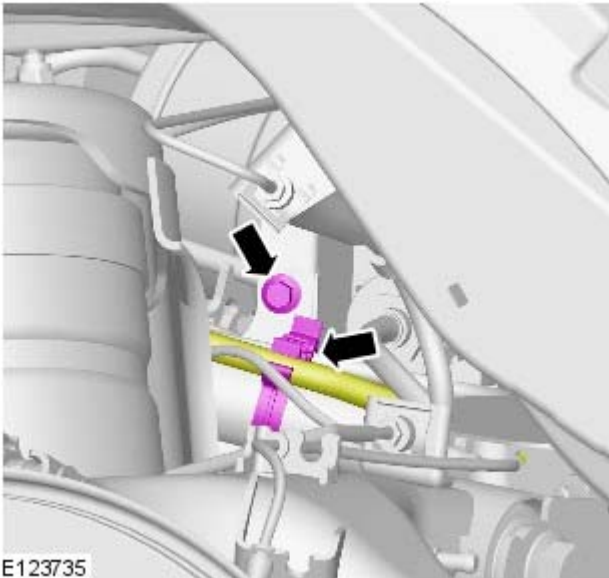


9.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

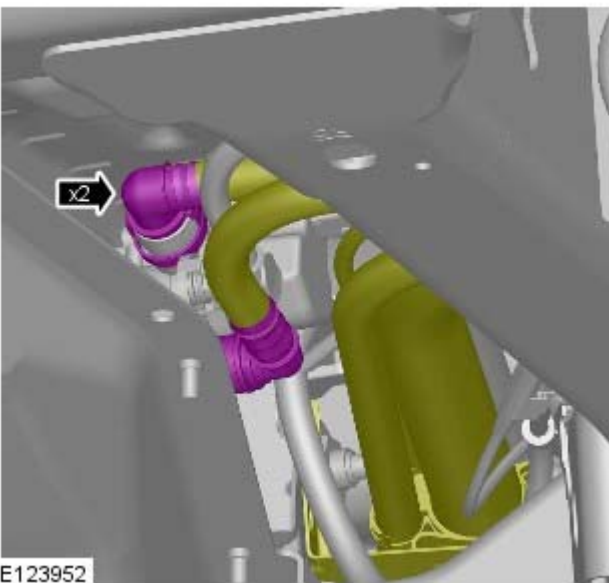


10.

- TORQUE: 4 Nm

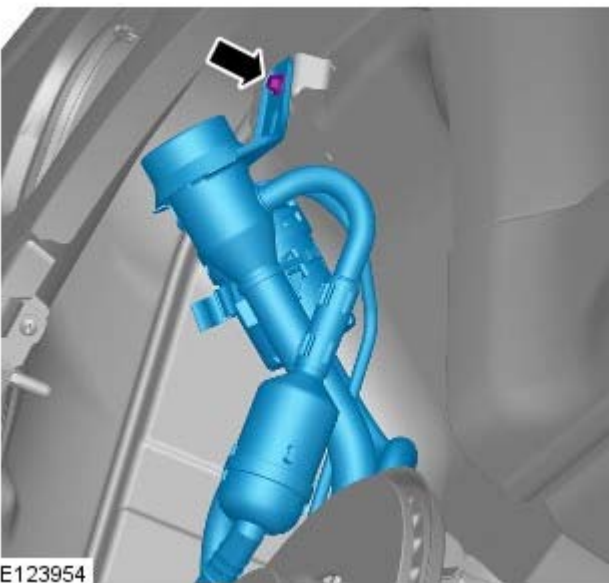


11.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



12.

- TORQUE: 4 Nm




Installation

1. To install, reverse the removal procedure.

Fuel Tank and Lines - V8 5.0L Petrol - Fuel Pump and Sender Unit

Removal and Installation

Special Tool(s)

 <p>310-123 E80148</p>	<p>310-123 Locking Ring, Fuel Tank</p>
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General Equipment

Transmission jack

Removal

• WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

• NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).

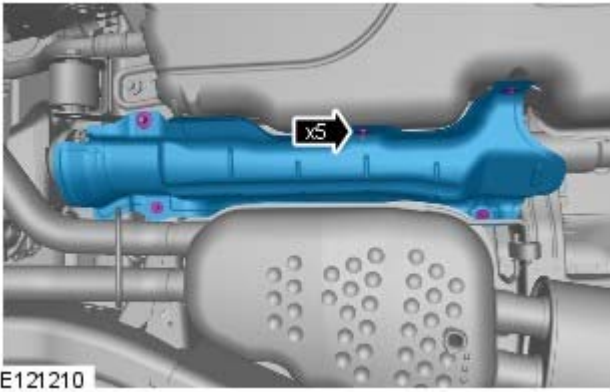
2. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

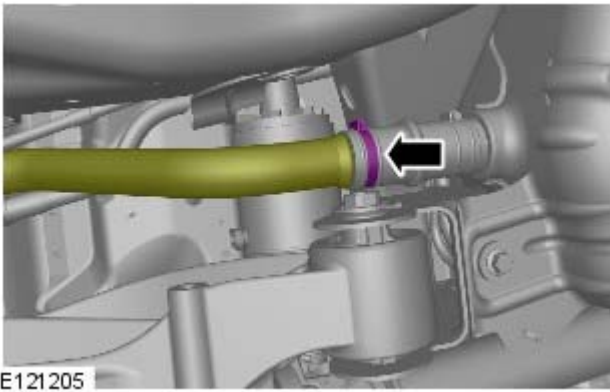
3.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

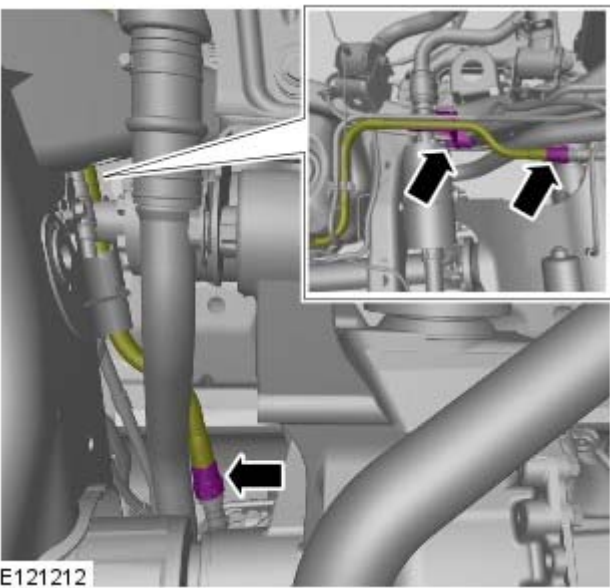
4. Refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).



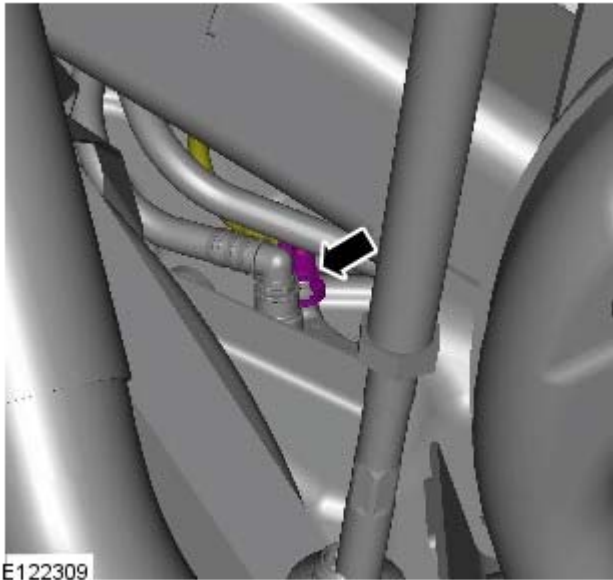
5. *Torque:*
Bolts 6 Nm
Nuts 3 Nm




6. **NOTE:** Discard the retaining clip.
Remove the tamper proof cover.

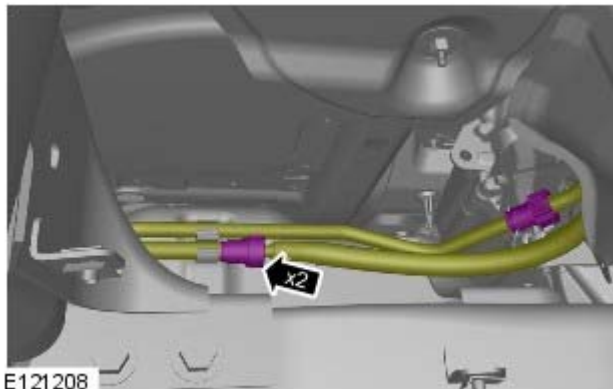


7. **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.



E122309

8.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



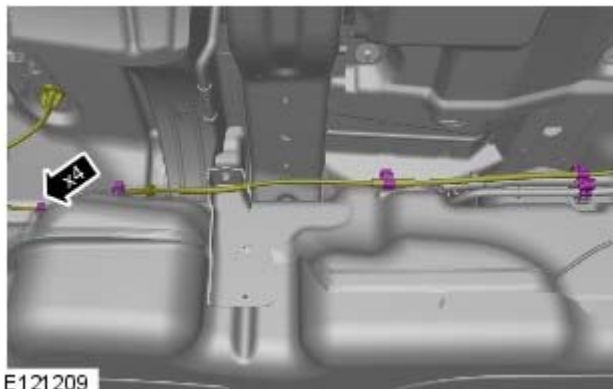
E121208

9. CAUTIONS:

 Be prepared to collect escaping fluids.

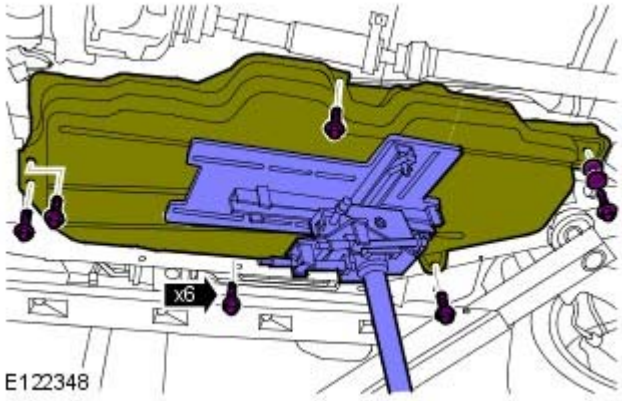
 Make sure that all openings are sealed. Use new blanking caps.

• NOTE: Transmission support heat shield shown removed for clarity.



E121209

- 10.



E122348

11. **11.**  **WARNING:** Secure the component to the transmission jack.

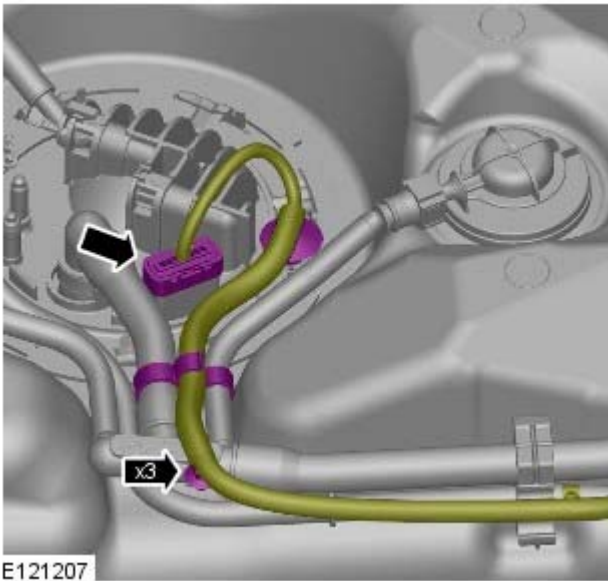
 **CAUTION:** Do not lower the fuel tank more than 250 mm.

• **NOTE:** Note the orientation of the two rear retaining bolts and washers.


Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

General Equipment: [Transmission jack](#)
Torque: 45 Nm

12.

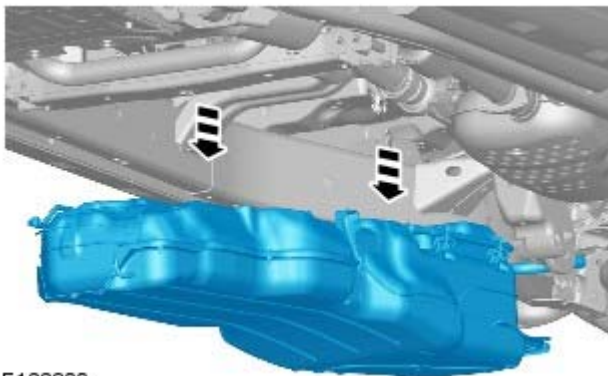


E121207

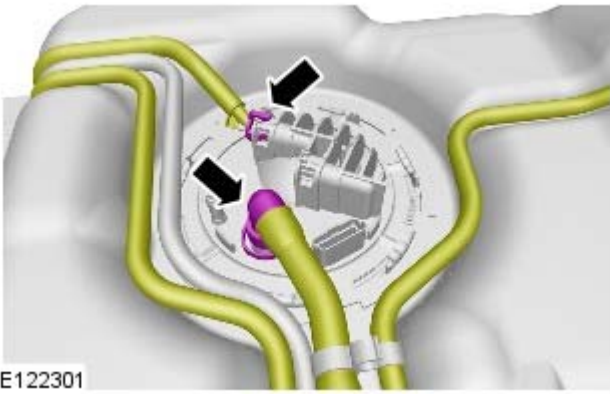
13. **13.**  **CAUTION:** Position the breather hose and vent hose through the vehicle body during the fuel tank removal operation.


• **NOTE:** Do not disassemble further if the component is removed for access only.

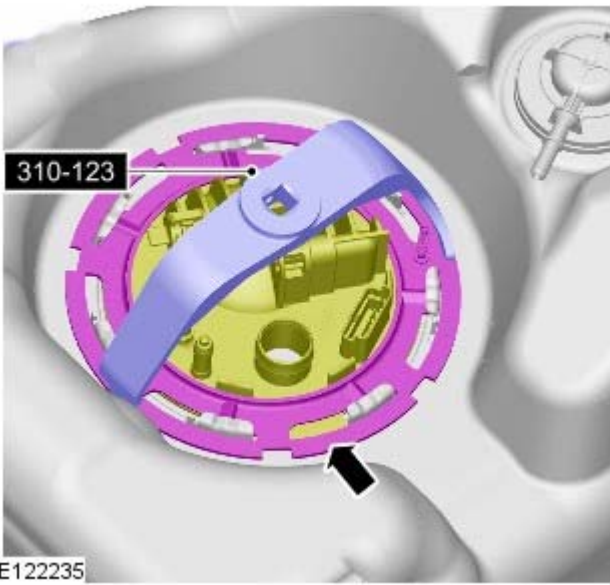
With assistance, remove the fuel tank.



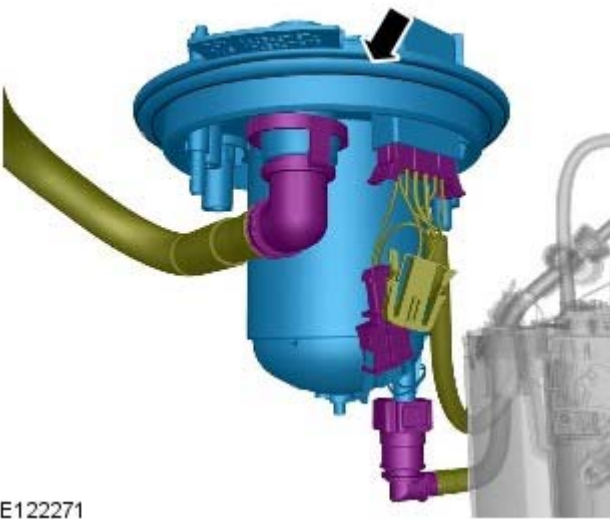
E122300




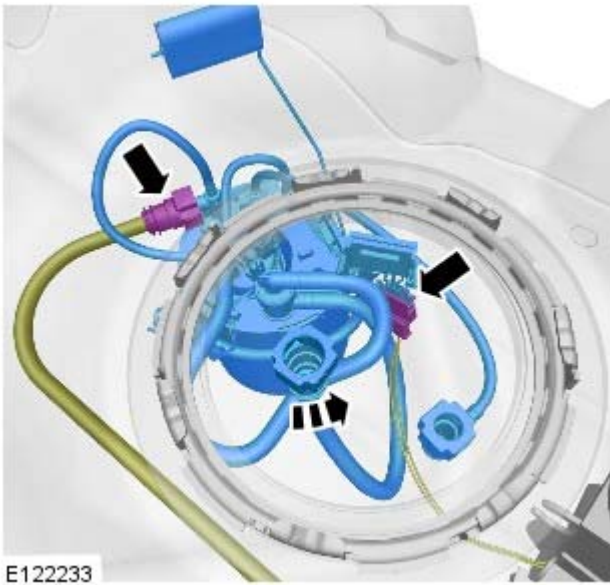
14. **14.**  CAUTION: Make sure that all openings are sealed. Use new blanking caps.




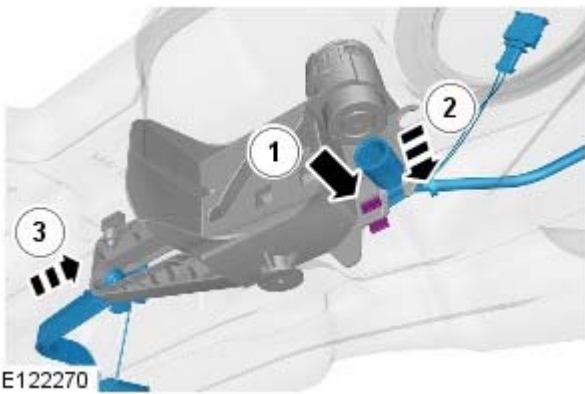
15. **15.** NOTE: Note the position of the locating tang.
- *Special Tool(s):* [310-123](#)




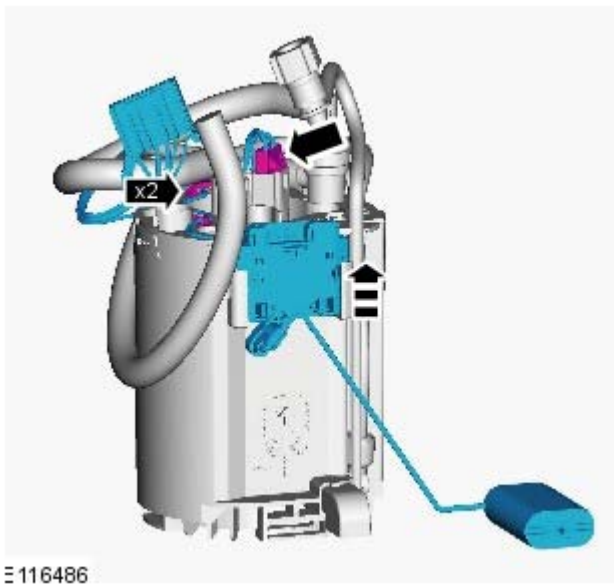
16. **16.**  CAUTION: Be prepared to collect escaping fuel.
- NOTE: Remove and discard the O-ring seal.




17. **17.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

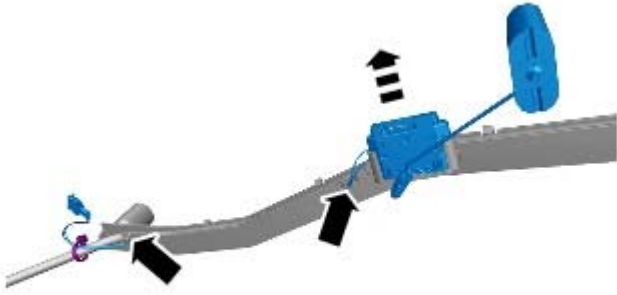


18. **18.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.



19. **19.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

20.



E122269

Installation


1. **NOTE:** Remove and discard all blanking caps.
 - **NOTE:** Make sure the locating tang is installed in the position noted in the removal step.

To install, reverse the removal procedure.

Fuel Tank and Lines - V8 5.0L Petrol - Fuel Tank

Removal and Installation

Special Tool(s)

 <p>310-123 E80148</p>	<p>310-123 Locking Ring, Fuel Tank</p>
---	--

General Equipment

Transmission jack

Removal

• WARNINGS:



After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.



After the fuel tank drain is complete always fit the sealing covers over the drain ports. Failure to do so will mean that fuel vapor can escape.



This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.



CAUTION: Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

• NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).

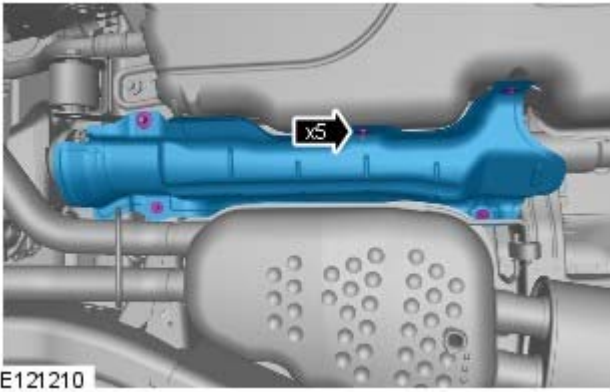
2. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

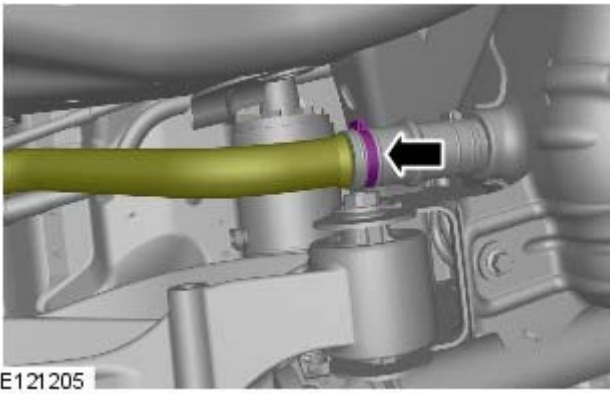
3.  **WARNING:** Make sure to support the vehicle with axle stands.


Raise and support the vehicle.

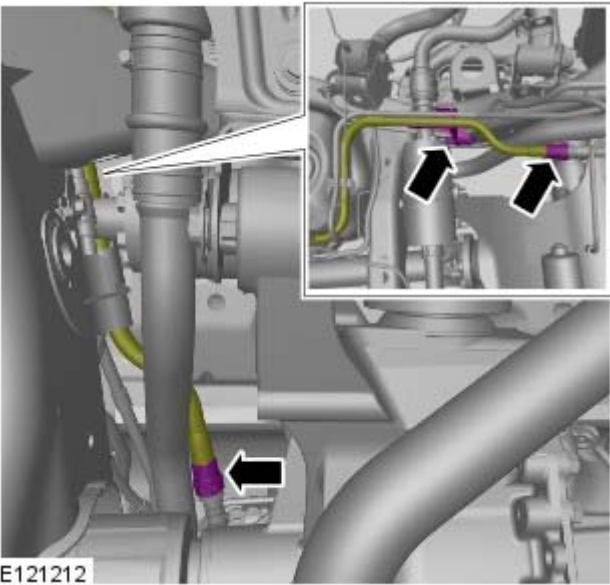
4. Refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).




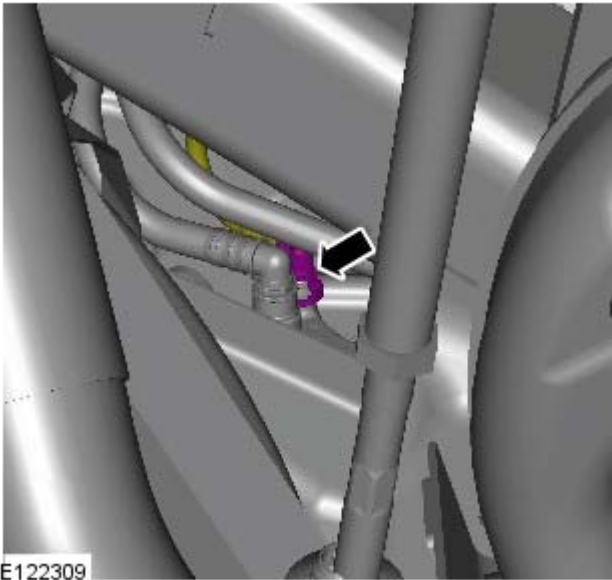
5. *Torque:*
Bolts 6 Nm
Nuts 3 Nm




6.  CAUTION: Discard the retaining clip.
Remove the tamper proof cover.

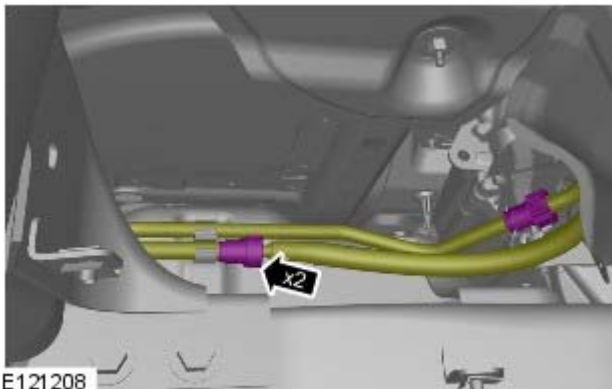


7.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



E122309

8.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



E121208

9. CAUTIONS:

 Be prepared to collect escaping fluids.

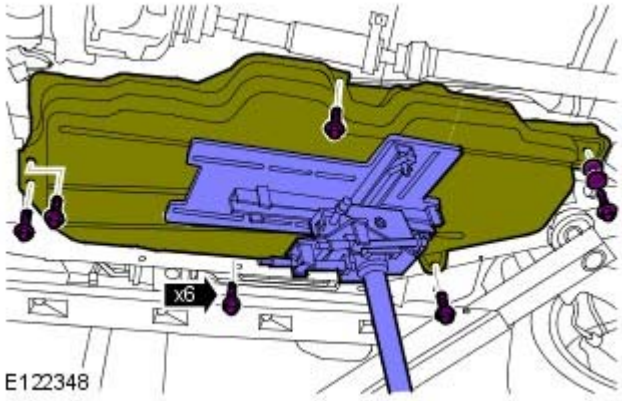
 Make sure that all openings are sealed. Use new blanking caps.

• NOTE: Transmission support heat shield shown removed for clarity.



E121209

- 10.



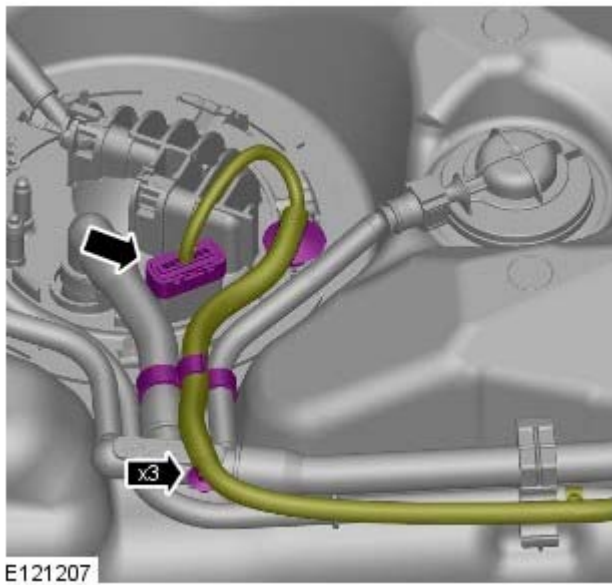
11. **11.**  **WARNING:** Secure the component to the transmission jack.

 **CAUTION:** Do not lower the fuel tank more than 250 mm.


• **NOTE:** Note the orientation of the two rear retaining bolts and washers.

Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.

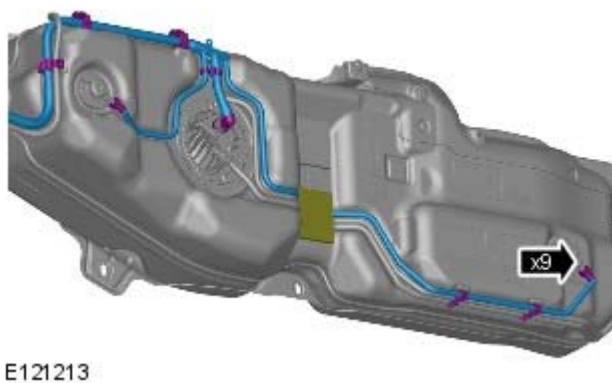
General Equipment: [Transmission jack](#)
Torque: 45 Nm



- 12.

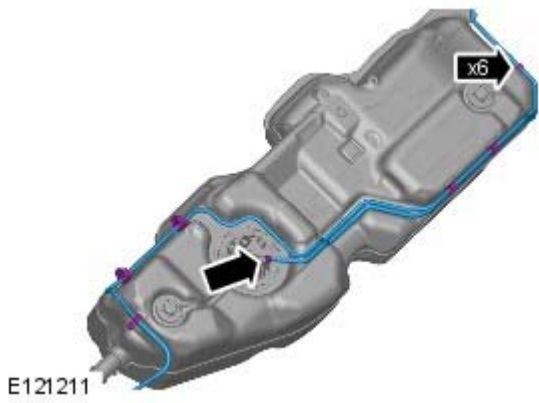
13. **13.**  **CAUTION:** Position the breather and vent hoses through the vehicle body during the fuel tank removal.
- **NOTE:** Do not disassemble further if the component is removed for access only.

With assistance, remove the fuel tank.

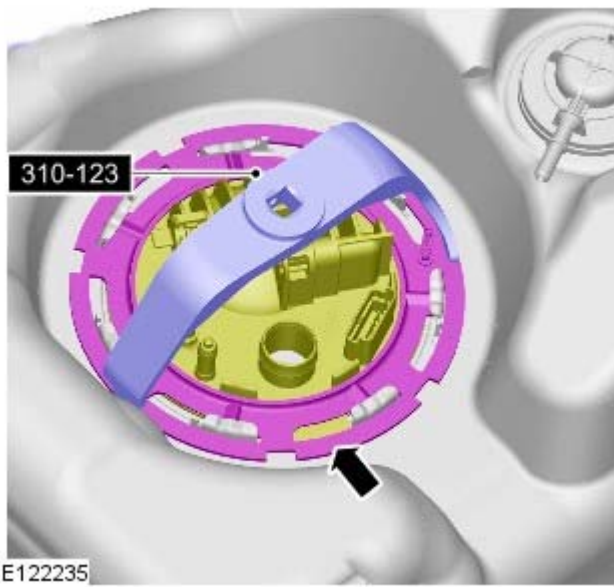


- 14.

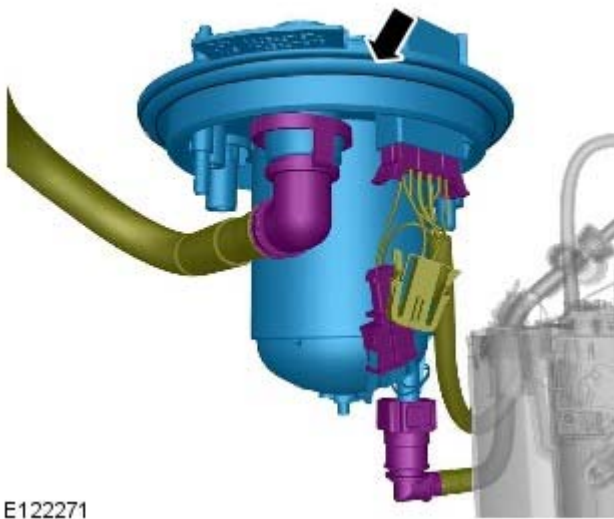
E121213




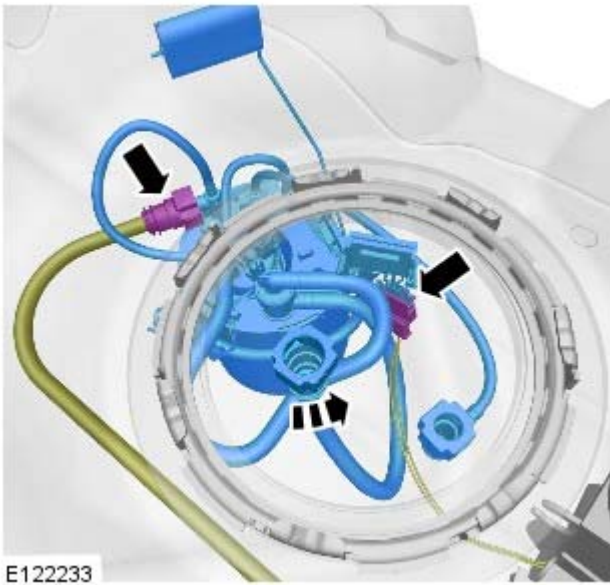
15.




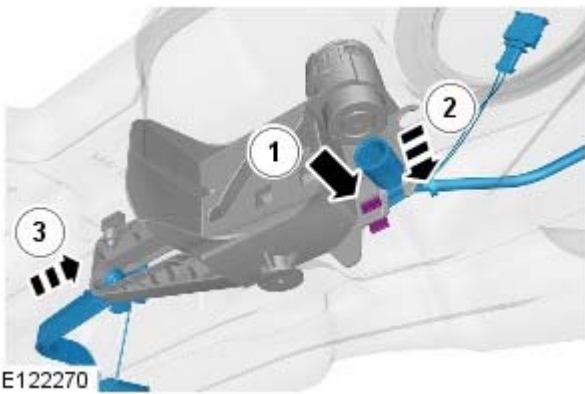
16. **16.** NOTE: Note the position of the locating tang.
Special Tool(s): [310-123](#)




17. **17.**  CAUTION: Be prepared to collect escaping fluids.
• NOTE: Remove and discard the O-ring seal.

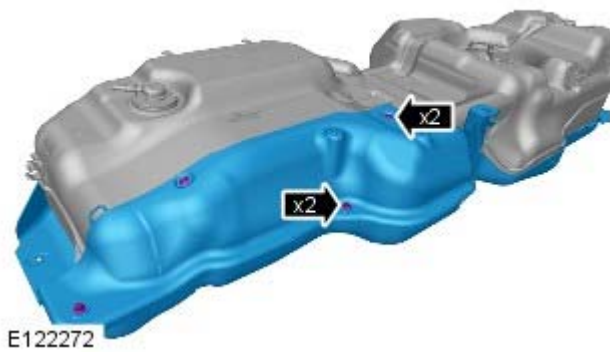


18. **18.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



19. **19.**  CAUTION: Take extra care not to damage the fuel tank level sensor float and arm.

20.



Installation

1. **1.** NOTE: Remove and discard all blanking caps.
- NOTE: Make sure the locating tang is installed in the position noted in the removal step.
- To install, reverse the removal procedure.


Fuel Tank and Lines - V8 5.0L Petrol - Fuel Filter

Removal and Installation

Removal


- WARNINGS:

 After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

 This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow these instructions may result in personal injury.

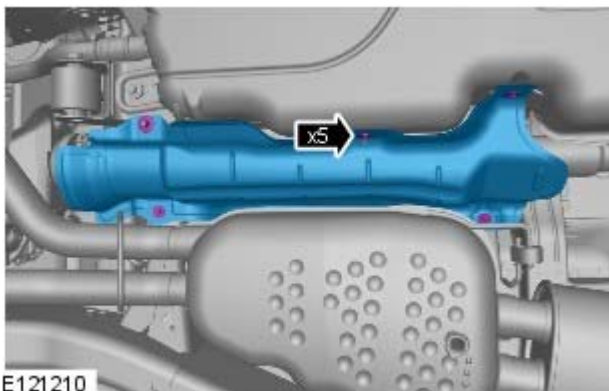
- CAUTIONS:

 Always carry out the cleaning process before carrying out any repairs to the fuel injection system components. Failure to follow this instruction may result in foreign matter ingress to the fuel injection system.

 Make sure the workshop area in which the vehicle is being worked on is as clean and as dust free as possible. Foreign matter from work on clutches, brakes or from machining or welding operations can contaminate the fuel system and may result in later malfunction.

- NOTE: Removal steps in this procedure may contain installation details.

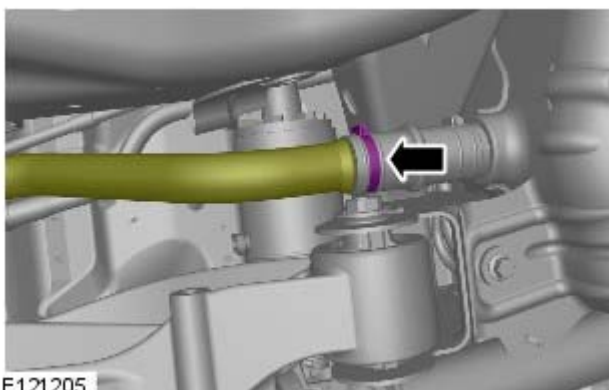
1. For additional information, refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. For additional information, refer to: [Fuel System Pressure Release - V8 5.0L Petrol](#) (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. For additional information, refer to: [Fuel Tank Draining](#) (310-00 Fuel System - General Information, General Procedures).
- 5.



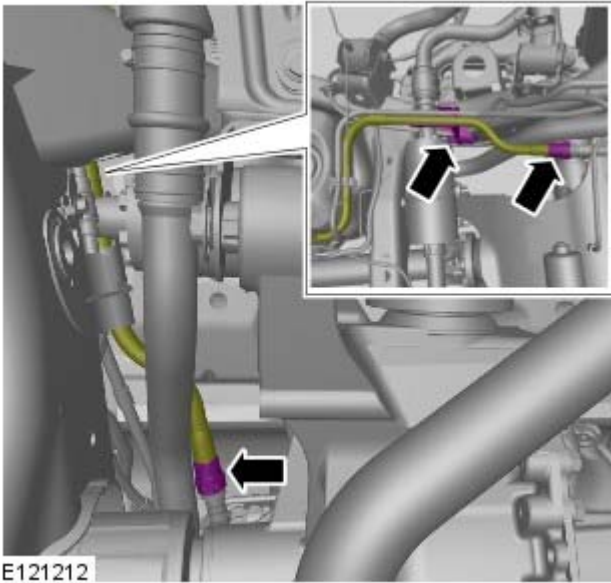
E121210


6. NOTE: Discard the retaining clip.

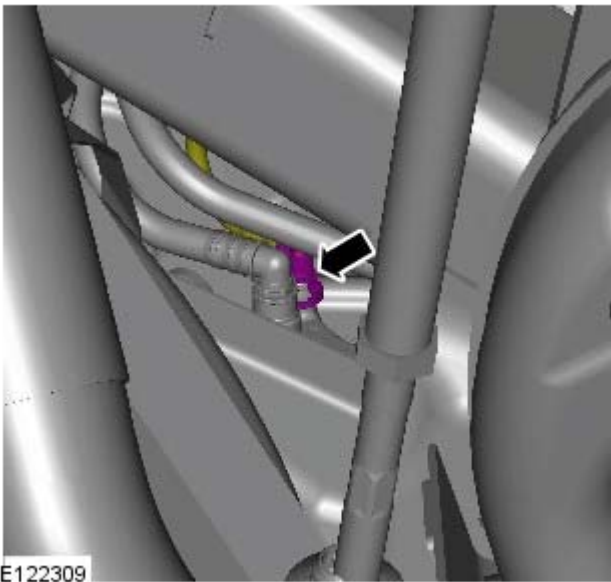
Remove the tamper proof cover.




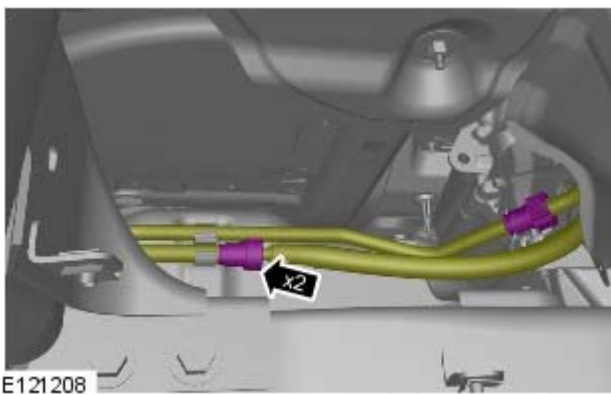
E121205



7.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



8.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



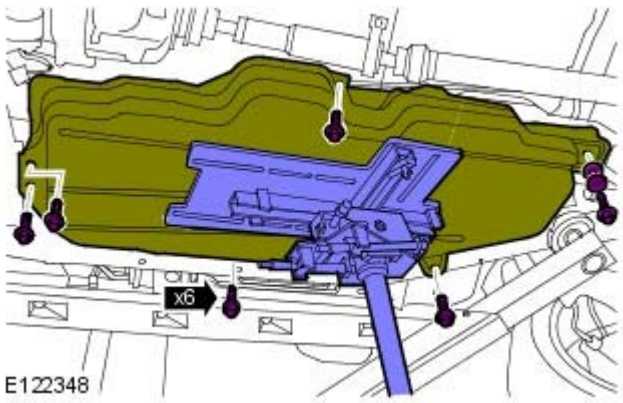
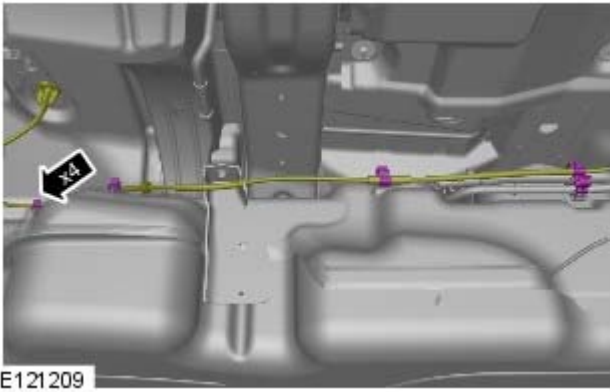
9. CAUTIONS:

 Be prepared to collect escaping fuel.

 Make sure that all openings are sealed. Use new blanking caps.

• NOTE: Transmission support heat shield shown removed for clarity.

10.



11.  **WARNING:** Secure the component to the transmission jack.

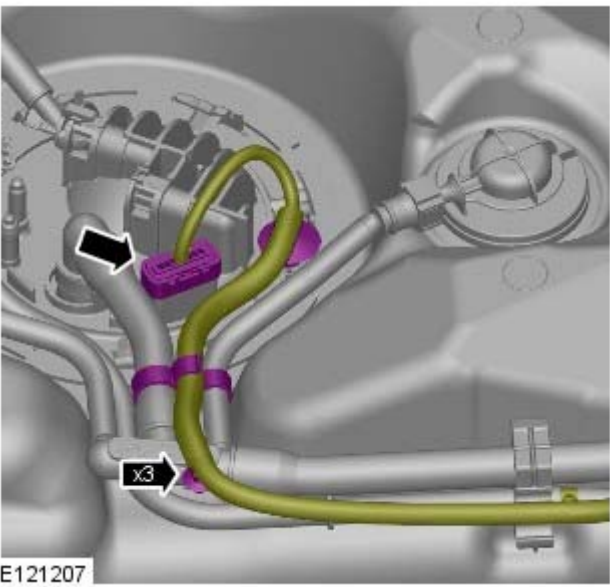
 **CAUTION:** Do not lower the fuel tank more than 250 mm.

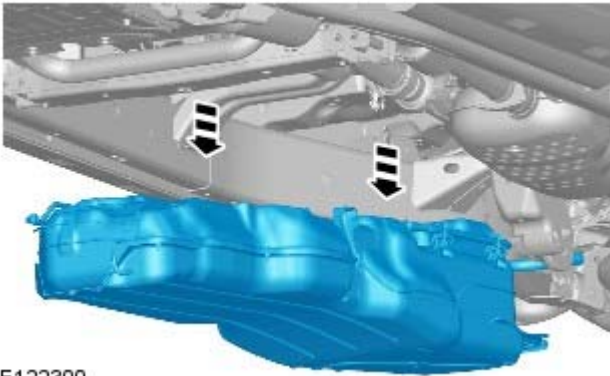
• **NOTE:** Note the orientation of the two rear retaining bolts and washers.

Using a suitable transmission jack, lower the fuel tank sufficiently only to access the top of the fuel tank.


- **TORQUE:** 45 Nm

12.



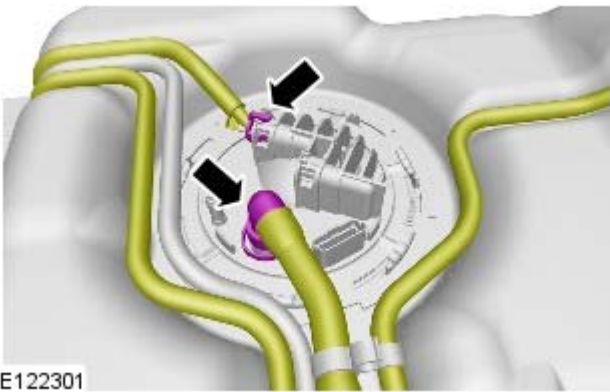


E122300


13.  CAUTION: Position the breather hose and vent hose through the vehicle body during the fuel tank removal operation.

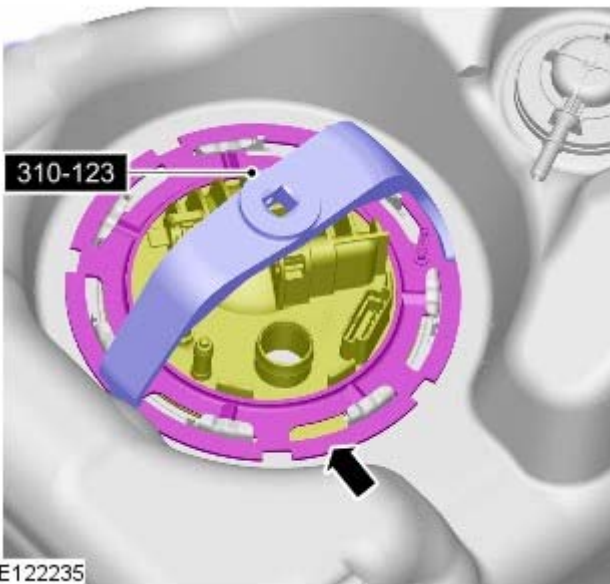
• NOTE: Do not disassemble further if the component is removed for access only.

With assistance, remove the fuel tank.



E122301

14.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

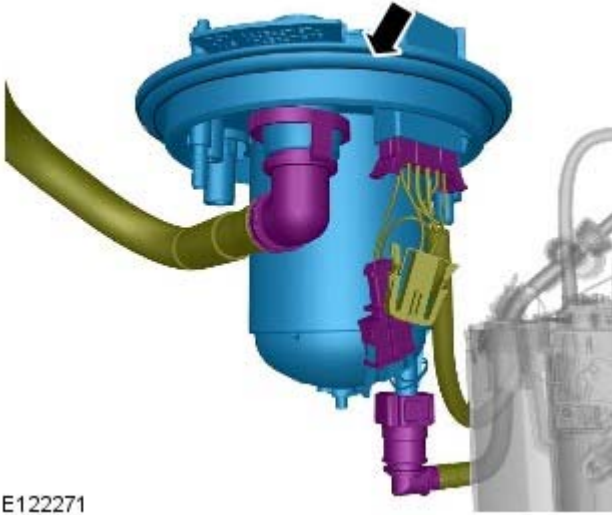


E12235

15. NOTE: Note the position of the locating tang.

16.  CAUTION: Be prepared to collect escaping fuel.

- NOTE: Remove and discard the O-ring seal.



E122271

Installation

1. To install, reverse the removal procedure.

Acceleration Control - TDV6 2.7L Diesel -**Torque Specifications**

Description	Nm	lb-ft
Accelerator pedal bracket nuts and bolts	10	7
Accelerator pedal assembly nuts	25	18

Acceleration Control - TDV6 2.7L Diesel - Acceleration Control

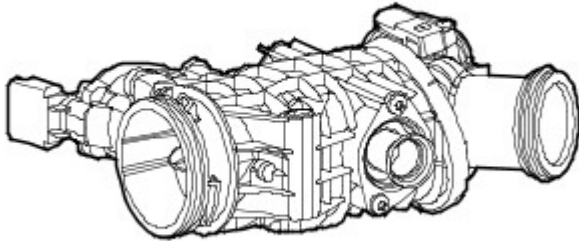
Description and Operation

Acceleration control for the diesel engine is achieved via an electronic throttle drive by wire system. The throttle is electronically connected to the ECM and the ECM then controls the fuelling for the relevant throttle demand signal from the Accelerator Pedal Position sensor (APP).

For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

ELECTRONIC THROTTLE

Electronic Throttle



E46900

The electric throttle controls the air flow into the engine. In addition to the normal engine power control function, the electric throttle allows the cruise control, idle speed control and engine speed limiting functions to be performed without the need for additional hardware.

The electric throttle consists of a throttle body which incorporates a throttle plate driven by a DC motor via reduction gears. A return spring biases the throttle plate in the closed direction.

Operation of the DC motor is controlled by the ECM, which outputs two Pulse Width Modulated (PWM) signals to an H bridge drive circuit in the motor. The ECM varies the speed and direction of the motor by varying the duty cycle of the PWM signals.

To enable closed loop control, the position of the throttle plate is supplied to the ECM by two feedback Hall effect sensors in the throttle body. The feedback sensors have a common 5 volt supply and a common ground connection from the ECM, and produce separate linear signal voltages to the ECM proportional to the position of the throttle plate. The ECM uses the signal from feedback sensor 1 as the primary signal of throttle plate position, and the signal from feedback sensor 2 for plausibility checks.

- The signal from feedback sensor 1 varies between 0.5 volt (0% throttle open) and 4.5 volts (100% throttle open)
- The signal from feedback sensor 2 varies between 4.5 volts (0% throttle open) and 0.5 volt (100% throttle open)

While the ignition is on, the ECM continuously monitors the two feedback sensors for short and open circuits and checks the feedback sensor signals, against each other and the inputs from the Accelerator Pedal Position (APP) sensor, for plausibility. If a fault is detected in the feedback sensor signals or the DC motor, the ECM:

- Stores a related fault code in memory.
- Illuminates the SERVICE ENGINE warning lamp in the instrument pack.
- Adopts a throttle limp home mode or disables throttle control, depending on the nature of the fault.

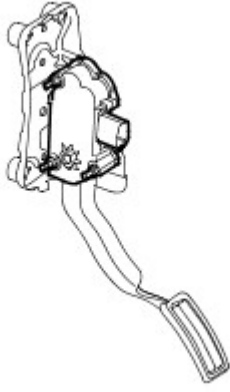
The throttle limp home mode adopted depends on the nature of the fault:

- If there is a fault with one feedback sensor, or the throttle position controller in the ECM, the ECM limits vehicle acceleration by limiting throttle plate opening.
- If there is a fault with both feedback sensors, the ECM uses fuel injection cut-off to limit engine speed to 1300 rev/min maximum.

C0272 Electronic Throttle Pinout Details

Pin No	Description	Input/ Output
1	Supply voltage	Input
2	Throttle position	Output
3	Throttle position +	Input
4	Throttle position -	Input
5	N/C	-
6	Signal ground	-

ACCELERATOR PEDAL POSITION SENSOR



E46901

The Accelerator Pedal Position Sensor (APP) is integral to the accelerator pedal assembly.

The APP sensor enables the ECM to determine the throttle position requested by the driver on the accelerator pedal.

The APP sensor is installed on the pedal box and consists of a twin track potentiometer with wipers driven by a linkage connected to the accelerator pedal. Each potentiometer track has a 5 volt supply and ground connection from the ECM, and produces a linear signal voltage to the ECM proportional to the position of the accelerator pedal. The signal voltage from track 1 of the potentiometer is approximately double that of the signal voltage from track 2.

From the sensor signals, the ECM determines driver demand as a percentage of pedal travel, where 0% is with the pedal released and 100% is with the pedal fully depressed. Driver demand is then used to calculate throttle angle, fuel quantity and ignition timing. The ECM also outputs driver demand on the CAN system, for use by the brake and gearbox control systems.

The ECM stores the signal values that correspond with closed and wide open throttle, and adapts to new values to accommodate component wear or replacement.

The signals from the APP sensor are monitored by the ECM for short and open circuits and plausibility. If a fault is detected, the ECM:

- Stores a related fault code in memory.
- Illuminates the SERVICE ENGINE warning lamp in the instrument pack.
- Inhibits the driver demand message on the CAN bus, which disables the Hill Descent Control (HDC) function of the ABS modulator and reduces the performance of the automatic gearbox (harsh gear changes and loss of kick down).
- Adopts a throttle limp home mode.

The throttle limp home mode adopted depends on the nature of the fault:

- If a fault is detected with one potentiometer track, the ECM limits vehicle acceleration by limiting throttle plate opening.
- If a fault is detected with both potentiometer tracks, the ECM uses the throttle plate to run the engine at a fixed speed of 1472 rev/min while the brake pedal is released, and idle speed (750 rev/min) while the brake pedal is pressed or if there is a brake pedal sensor fault.
- If there is a process fault in the ECM, the ECM either uses fuel injection cut-off to limit engine speed to 1300 rev/min or disables fuel injection to stop the engine.

Accelerator Pedal Position Sensor Pin Out Table

Pin No	Description	Input/Output
1	APP 1 ground	-
2	APP 1 signal	Output
3	APP 2 ground	-
4	N/C	-
5	APP2 Signal	Output
6	APPS 2 reference voltage	Input
7	APP 1 reference voltage	Input
8	N/C	-

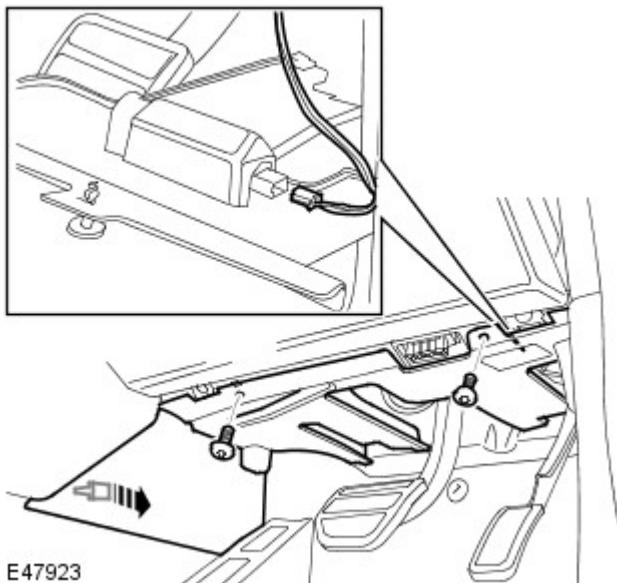
Acceleration Control - TDV6 2.7L Diesel - Accelerator Pedal

Removal and Installation

Removal

1. Remove the driver side closing trim panel.

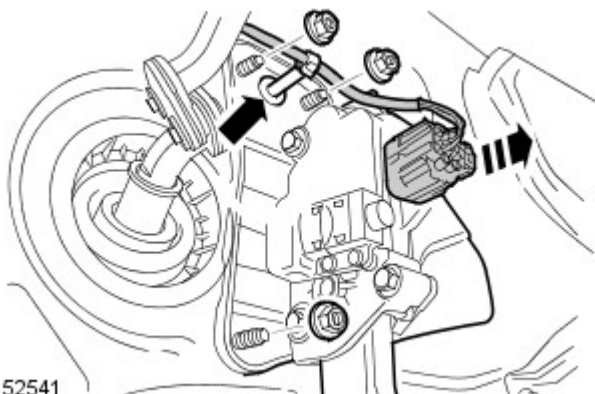
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47923

2. Remove the accelerator pedal assembly.

- Release the wiring harness.
- Remove the 3 nuts.
- Disconnect the electrical connector.

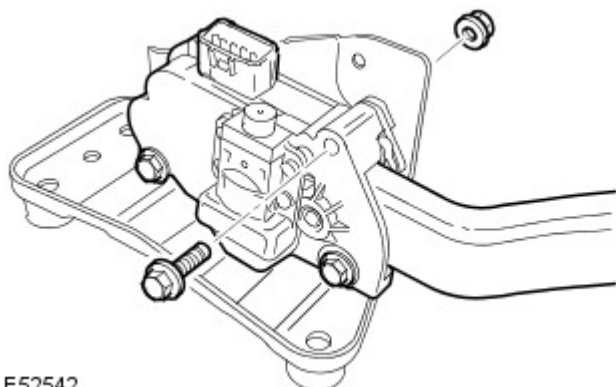


E52541

3. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the accelerator pedal bracket.

- Remove the 3 nuts and bolts.



E52542

Installation

All vehicles

1. Attach the accelerator pedal bracket.

- Tighten the nuts and bolts to 10 Nm (7 lb.ft).

2. **NOTE:** Make sure the electrical connector is securely

connected.

Install the accelerator pedal assembly.

- Connect the electrical connector.
- Tighten the nuts to 25 Nm (18 lb.ft).
- Secure the wiring harness.

3. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

Vehicles with petrol engine

4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Acceleration Control - V6 4.0L Petrol -**Torque Specifications**

Description	Nm	lb-ft
Accelerator pedal bracket nuts and bolts	10	7
Accelerator pedal assembly nuts	25	18

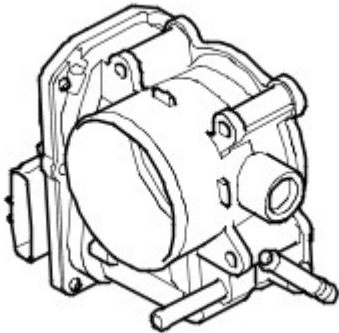
Acceleration Control - V6 4.0L Petrol - Acceleration Control

Description and Operation

Acceleration control for the 4.0 Liter petrol engine is achieved via an electronic throttle drive by wire system. The throttle is electronically connected to the ECM and the ECM then controls the fuelling for the relevant throttle demand signal from the Accelerator Pedal Position sensor (APP).

ELECTRONIC THROTTLE

Electronic Throttle Body



E42611

The electric throttle controls the air flow into the engine. In addition to the normal engine power control function, the electric throttle allows the cruise control, idle speed control and engine speed limiting functions to be performed without the need for additional hardware.

The electric throttle consists of a throttle body which incorporates a throttle plate driven by a DC motor via reduction gears. A return spring biases the throttle plate in the closed direction.

Operation of the DC motor is controlled by the ECM, which outputs two Pulse Width Modulated (PWM) signals to an H bridge drive circuit in the motor. The ECM varies the speed and direction of the motor by varying the duty cycle of the PWM signals.

To enable closed loop control, the position of the throttle plate is supplied to the ECM by two feedback Hall effect sensors in the throttle body. The feedback sensors have a common 5 volt supply and a common ground connection from the ECM, and produce separate linear signal voltages to the ECM proportional to the position of the throttle plate. The ECM uses the signal from feedback sensor 1 as the primary signal of throttle plate position, and the signal from feedback sensor 2 for plausibility checks.

- The signal from feedback sensor 1 varies between 0.5 volt (0% throttle open) and 4.5 volts (100% throttle open)
- The signal from feedback sensor 2 varies between 4.5 volts (0% throttle open) and 0.5 volt (100% throttle open)

While the ignition is on, the ECM continuously monitors the two feedback sensors for short and open circuits and checks the feedback sensor signals, against each other and the inputs from the Accelerator Pedal Position (APP) sensor, for plausibility. If a fault is detected in the feedback sensor signals or the DC motor, the ECM:

- Stores a related fault code in memory.
- Illuminates the SERVICE ENGINE warning lamp in the instrument pack.
- Adopts a throttle limp home mode or disables throttle control, depending on the nature of the fault.

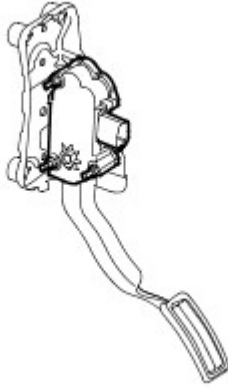
The throttle limp home mode adopted depends on the nature of the fault:

- If there is a fault with one feedback sensor, or the throttle position controller in the ECM, the ECM limits vehicle acceleration by limiting throttle plate opening.
- If there is a fault with both feedback sensors, the ECM uses fuel injection cut-off to limit engine speed to 1300 rev/min maximum.

C0175 Electronic Throttle Pinout Details

Pin No	Description	Input/ Output
1	Throttle position 1	Input
2	5 volt reference voltage	Input
3	Throttle position 2	Input
4	Sensor Ground	-
5	Throttle +	Input
6	Throttle -	Input

ACCELERATOR PEDAL POSITION SENSOR



E46901

The Accelerator Pedal Position Sensor (APP) is integral to the accelerator pedal assembly.

The APP sensor enables the ECM to determine the throttle position requested by the driver on the accelerator pedal.

The APP sensor is installed on the pedal box and consists of a twin track potentiometer with wipers driven by a linkage connected to the accelerator pedal. Each potentiometer track has a 5 volt supply and ground connection from the ECM, and produces a linear signal voltage to the ECM proportional to the position of the accelerator pedal. The signal voltage from track 1 of the potentiometer is approximately double that of the signal voltage from track 2.

From the sensor signals, the ECM determines driver demand as a percentage of pedal travel, where 0% is with the pedal released and 100% is with the pedal fully depressed. Driver demand is then used to calculate throttle angle, fuel quantity and ignition timing. The ECM also outputs driver demand on the CAN system, for use by the brake and gearbox control systems.

The ECM stores the signal values that correspond with closed and wide open throttle, and adapts to new values to accommodate component wear or replacement.

The signals from the APP sensor are monitored by the ECM for short and open circuits and plausibility. If a fault is detected, the ECM:

- Stores a related fault code in memory.
- Illuminates the SERVICE ENGINE warning lamp in the instrument pack.
- Inhibits the driver demand message on the CAN bus, which disables the Hill Descent Control (HDC) function of the ABS modulator and reduces the performance of the automatic gearbox (harsh gear changes and loss of kick down).
- Adopts a throttle limp home mode.

The throttle limp home mode adopted depends on the nature of the fault:

- If a fault is detected with one potentiometer track, the ECM limits vehicle acceleration by limiting throttle plate opening.
- If a fault is detected with both potentiometer tracks, the ECM uses the throttle plate to run the engine at a fixed speed of 1472 rev/min while the brake pedal is released, and idle speed (750 rev/min) while the brake pedal is pressed or if there is a brake pedal sensor fault.
- If there is a process fault in the ECM, the ECM either uses fuel injection cut-off to limit engine speed to 1300 rev/min or disables fuel injection to stop the engine.

C0787 Accelerator Pedal Position Sensor Pin Out Table

Pin No	Description	Input/Output
1	APPS 1 ground	-
2	APP 1 demand	Output
3	APP 2 demand	Output
4	N/C	-
5	APP 2 ground	-
6	Reference voltage 2	Input
7	Reference voltage 1	Input

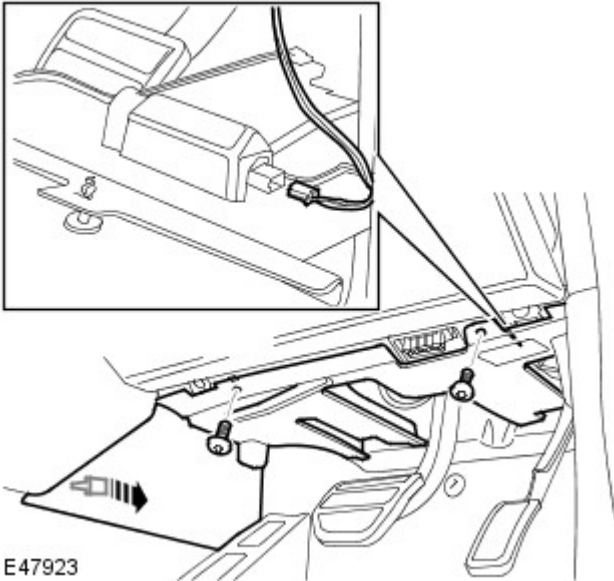
Acceleration Control - V6 4.0L Petrol - Accelerator Pedal

Removal and Installation

Removal

1. Remove the driver side closing trim panel.

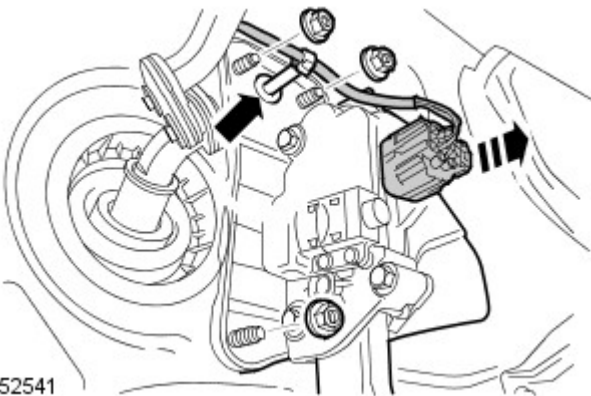
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47923

2. Remove the accelerator pedal assembly.

- Release the wiring harness.
- Remove the 3 nuts.
- Disconnect the electrical connector.

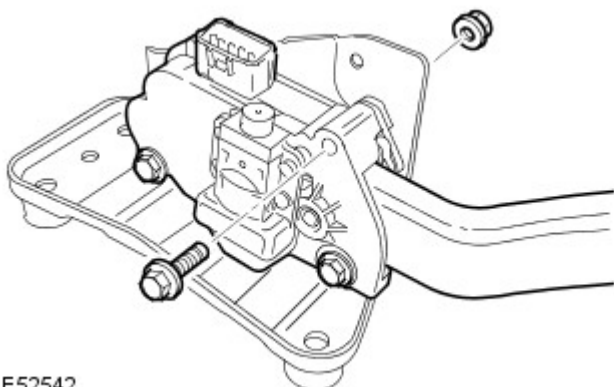


E52541

3. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the accelerator pedal bracket.

- Remove the 3 nuts and bolts.



E52542

Installation

All vehicles

1. Attach the accelerator pedal bracket.

- Tighten the nuts and bolts to 10 Nm (7 lb.ft).

2. **NOTE:** Make sure the electrical connector is securely

connected.

Install the accelerator pedal assembly.

- Connect the electrical connector.
- Tighten the nuts to 25 Nm (18 lb.ft).
- Secure the wiring harness.

3. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

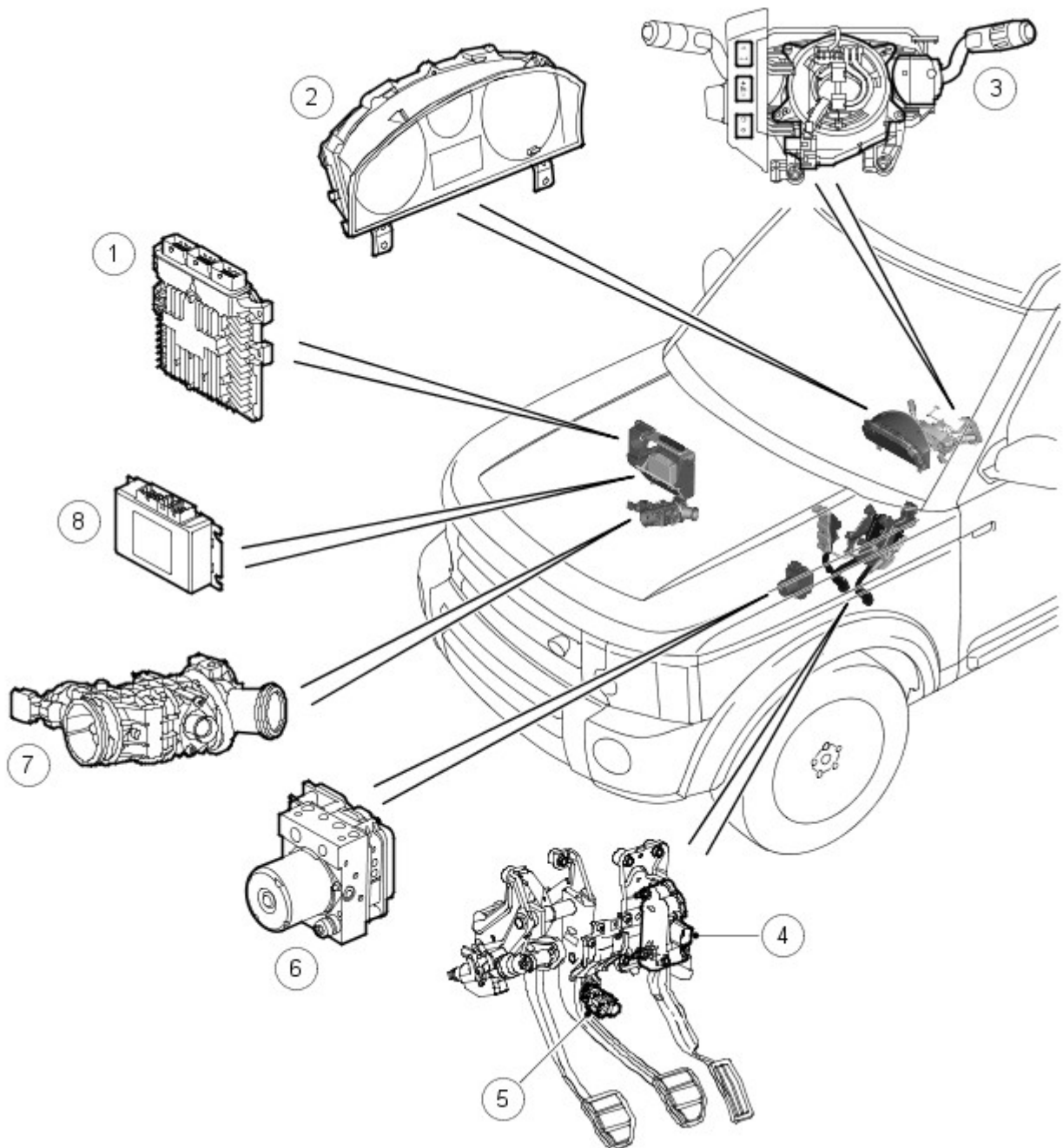
Vehicles with petrol engine

4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Speed Control - TDV6 2.7L Diesel - Speed Control

Description and Operation

Speed Control Component Location

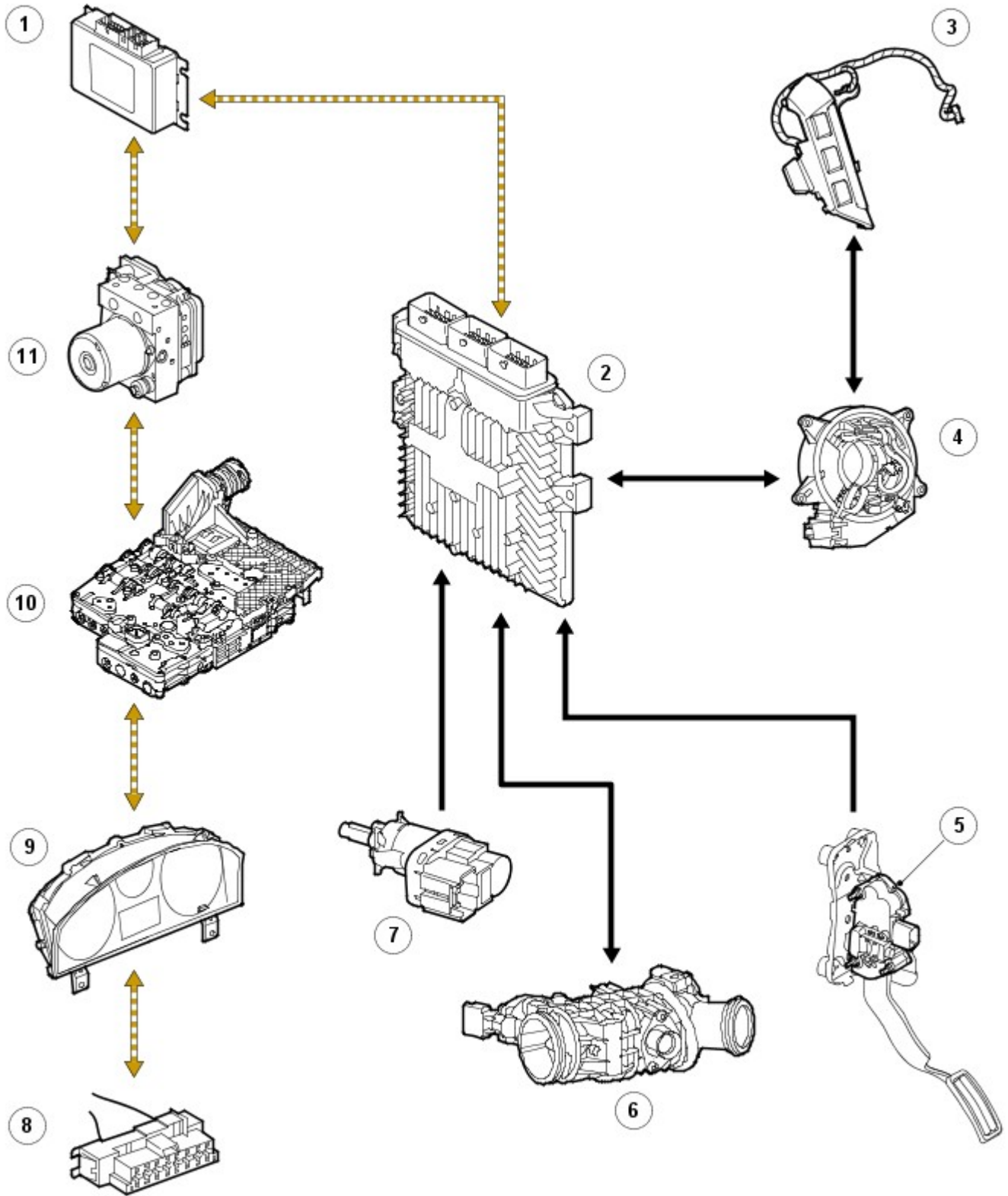


E47028

Item	Part Number	Description
1	-	engine control module (ECM)
2	-	Instrument cluster
3	-	Speed control switches
4	-	accelerator pedal position (APP)
5	-	Brake switch
6	-	anti-lock brake system (ABS) Control Module
7	-	Electric throttle
8	-	Transfer box control module

Speed Control, Control Diagram

• NOTE: A= Hardwired D= controller area network (CAN)



E62045



Item	Part Number	Description
1	-	Transfer box control module
2	-	ECM
3	-	Speed control switches
4	-	Clock spring Brake switch
5	-	APP
6	-	Electric throttle
7	-	Brake light switch
8	-	Diagnostic socket
9	-	Instrument cluster
10	-	transmission control module (TCM)
11	-	ABS Control Module

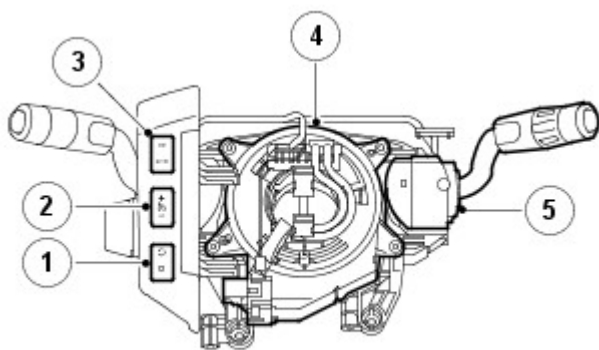
The speed control system is integrated with the engine management system and uses fueling intervention to automatically maintain a set vehicle speed. Once engaged, the system can also be used to accelerate the vehicle without using the accelerator pedal. The speed control system comprises the following components:

- Suspend/resume switch
- '+' and '-' (set/accelerate and decelerate)
- Clock spring
- Speed control warning lamp (in the instrument cluster)

The speed control system also uses inputs from the brake pedal switch, the APP sensor, the ECM and the ABS control module.

The speed control is operated by the driver using only the steering wheel switches. When speed is active, the ECM regulates the pulse width modulation (PWM) signals to the fuel injectors to adjust the fuel supply as required to maintain the set speed.

CONTROL SWITCHES



E47030

Item	Part Number	Description
1	-	Suspend/resume switch
2	-	Accelerate/decelerate (+/-) Switches
3	-	Adaptive speed control time gap switches (where fitted)
4	-	Clock spring
5	-	Wiper control column switch

The speed control switches are located on the left-hand (LH) side of the steering wheel. The switches are connected via fly leads directly to the clock spring. All of the speed control switches are non-latching momentary rocker switches. The minimum set speed for speed control is 18 mph (30 km/h). Speed control is automatically suspended if the vehicle speed falls below 15 mph (24 km/h).

The speed control switches are resistive ladder type switches. There are three switches associated with speed control, two of which are for active speed control (where specified). The switches vary the resistance of a signal voltage sent to the ECM. The switches receive a 5 volt reference supply which is varied in response to which switches are pressed.

Suspend/Resume Switch

The suspend/resume switch controls the selection of speed control. When the ignition is in position II, a press of the suspend switch will activate the suspend mode which temporarily switches off the speed control system, but retains the previously set speed in the ECM memory.

Resume Switch

The resume switch re-activates the previously set speed after the speed control has been suspended by pressing the suspend switch or by depressing the brake pedal.

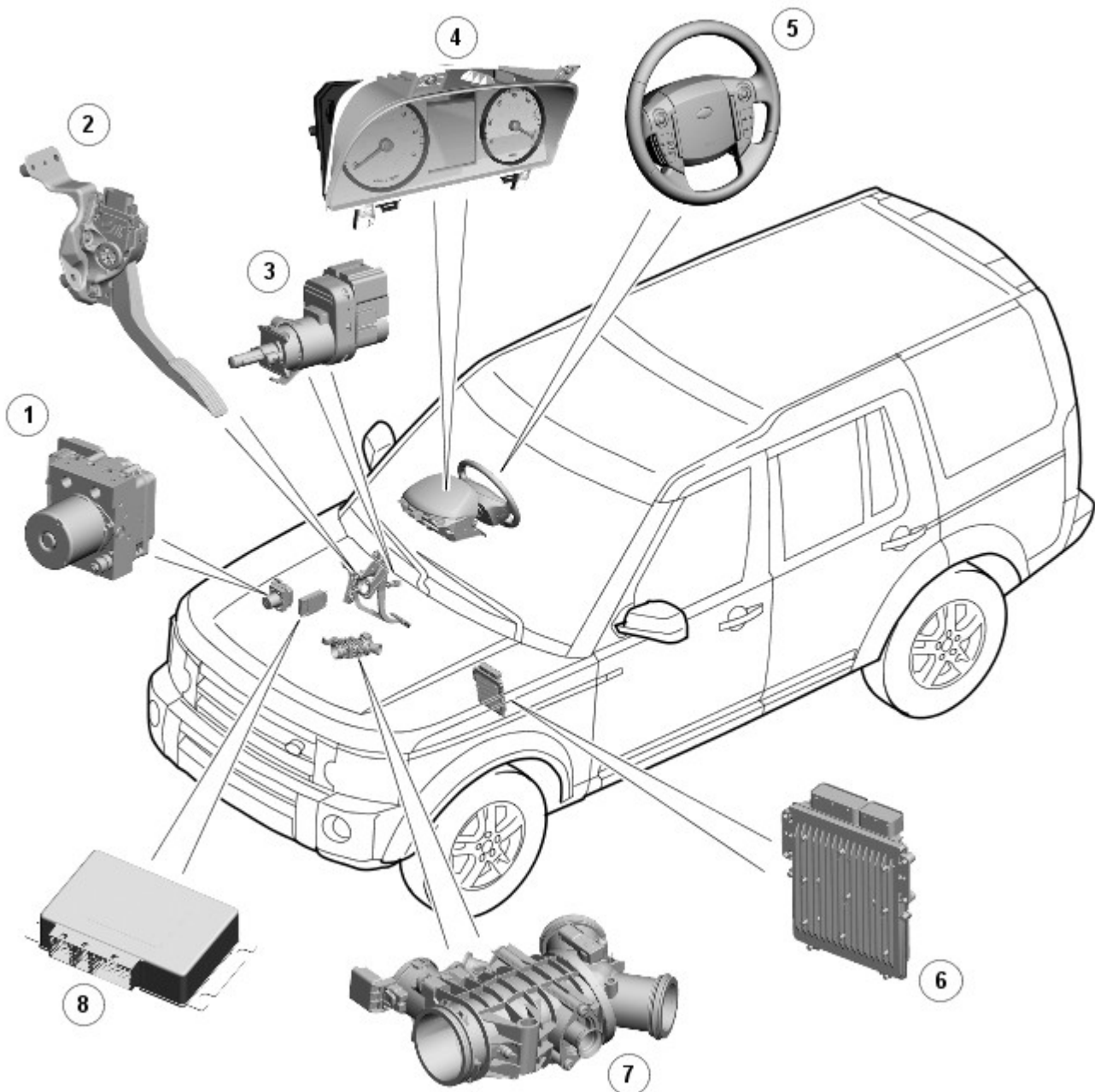
Accelerate/Decelerate (+/-) Switches

When the speed control system is active, pressing the '+' switch set the controlled speed to the current road speed of the vehicle. Subsequent momentary presses of the switch increase the set road speed by 0.6 mph (1 km/h) with each press. If the switch is pressed and held the road speed will continue to increase until the switch is released. Momentarily pressing the '-' switch, decreases the set speed by 0.6 mph (1 km/h) with each press. If the switch is pressed and held, the set speed is decreased until the switch is released.

Speed Control - TDV6 3.0L Diesel - Speed Control

Description and Operation

3.0L V6 DIESEL SPEED CONTROL COMPONENT LOCATION



E124127

Item	Part Number	Description
1	-	Anti-lock Brake System (ABS) module
2	-	Accelerator Pedal Position (APP) sensor
3	-	Brake switch
4	-	Instrument cluster
5	-	Speed control switches
6	-	Engine Control Module (ECM)
7	-	Electric throttle
8	-	Transfer box control module

GENERAL

The speed control system maintains a set speed selected by the driver until operation is suspended or cancelled by a further input from the driver and is controlled by the Engine Control Module (ECM).

The system has the following components:

- A set + switch
- A - switch

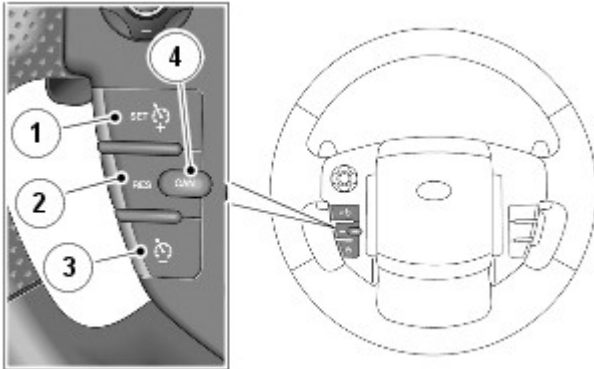
- A RESUME switch
- A CANCEL switch.

The system uses the following vehicle systems:

- The ECM
- The brake switch
- The Accelerator Pedal Position (APP) sensor.

DESCRIPTION

Speed Control Switches



E124128

Item	Part Number	Description
1	-	Set '+' increase the speed
2	-	Decrease '-' the speed
3	-	Resume set speed
4	-	Cancels without erasing memorized speed

Instrument Cluster Warning Indicator



E124129

Item	Part Number	Description
1	-	Speed control warning indicator

The speed control switches are located on the Left Hand (LH) side of the steering wheel. The switches are connected via fly leads to the clock spring. The speed control switches are resistive ladder type switches which vary the resistance of a 5 volt signal sent to them. The signal is returned along a Local Interconnect Network (LIN) bus to the instrument cluster. The instrument cluster routes the control signals to the Engine Control Module (ECM) on the high speed Controller Area Network (CAN) bus.

Speed control is engaged by pressing the set/increase switch. Once engaged the speed can be varied by the speed adjustment switches. Each press of the speed adjustment switches (+/-) will increase or decrease the set speed in steps of 1 mph (2 kph).

Accelerate/Decelerate (+/-) Switches

The Set + switch is used to activate the speed control system and set the speed control at the current vehicle speed. A speed control warning indicator will illuminate on the instrument cluster to advise the driver that the system is active. The switch can be pressed to adjust the set speed. Each single press of the switch increases the vehicle speed by 1 mph (2 km/h). If the switch is pressed and held the vehicle speed will increase and the once the switch is released the attained vehicle speed will be maintained.

The vehicle speed can be increased by using the accelerator pedal. When the accelerator pedal is released the vehicle speed will reduce to the previously set speed. When the vehicle speed is increased by use of the accelerator pedal, the message 'Cruise Override' will be displayed in the instrument cluster message center. This method can also be used to increase the vehicle set speed; once the required increase in speed is achieved, a single press of the Set + switch will maintain that speed as the new set speed.

• **NOTE:** If the accelerator pedal is pressed for more than 5 minutes, the speed control is cancelled.

The '-' switch can be used to decrease the vehicle set speed. The speed can be reduced by pressing and holding the switch until the required set speed is reached. When the switch is released the current speed will become the new set speed. A single press of the '-' switch will decrease the vehicle speed by 1 mph (2 km/h).

Cancel Switch

Speed control can be suspended temporarily or switched off by a single press of the Cancel switch. When the switch is pressed the speed control warning indicator in the instrument cluster is extinguished and the message 'Cruise Cancelled' is displayed in the message center.

Speed control can also be suspended if the brake pedal is pressed, if the transmission selector lever is moved to the neutral position or if Hill Descent Control (HDC) or Dynamic Stability Control (DSC) become active.

Once suspended, the cruise control can be resumed at the previously set speed by pressing the resume switch.

• **NOTE:** The set speed is not removed from the memory when the cancel switch is pressed. The set speed is only erased when the ignition is off.

Resume Switch

The resume speed is used to re-activate the speed control system at the previously set speed after the speed control has been cancelled or suspended.

OPERATION

Speed Control

The speed control system is integrated with the engine management system and uses fueling intervention to automatically maintain a set vehicle speed. Once engaged, the system can also be used to accelerate the vehicle without using the accelerator pedal. The speed control system comprises the following components:

- '+' and '-' (set/accelerate and decelerate) steering wheel switches
- Resume switch
- Cancel switch
- Clock spring
- Speed control warning lamp.

The speed control system also uses inputs from the brake pedal switch, the APP sensor, the ECM and the ABS module.

The speed control is operated by the driver using only the steering wheel switches. When speed control is active, the ECM regulates the Pulse Width Modulation (PWM) signals to the fuel injectors to adjust the fuel supply as required to maintain the set speed.

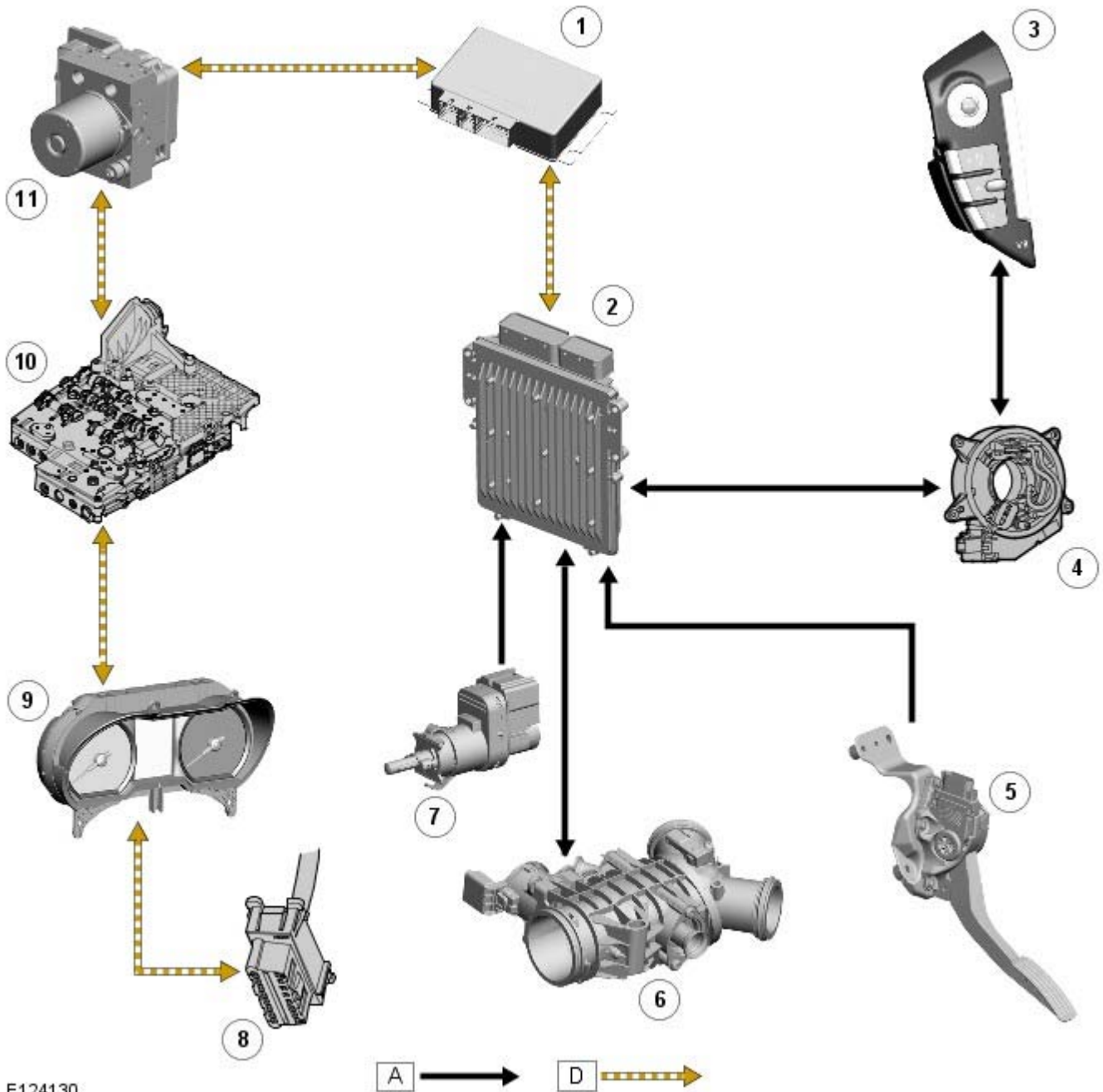
During speed control operation, the ECM controls vehicle speed by adjusting fuel injection duration and timing. When the accelerator pedal is pressed with speed control active, the ECM outputs a calculated throttle angle signal in place of the actual throttle angle signals produced by the APP sensor. The calculated throttle angle is derived from fuel demand.

The minimum set speed for speed control is 20 mph (32 km/h). Speed control is automatically suspended if the following conditions apply:

- Vehicle speed falls below 20 mph (32 km/h).
- The brake pedal is pressed
- The cancel button is pressed
- Neutral, park or reverse gear is selected
- Certain Terrain Modes are selected (i.e. Rock crawl)
- Low range gear selected
- The difference between actual speed and the set speed is too great
- When the vehicle speed reaches a maximum speed of 150 mph (240 kph)
- If the accelerator pedal is used to accelerate beyond the set speed for too long
- Stability control system intervention
- System error causes shut-off.

CONTROL DIAGRAM

• **NOTE:** A = Hardwired; D = High speed CAN Bus



E124130


Item	Part Number	Description
1	-	Transfer box control module
2	-	Engine control Module (ECM)
3	-	Left Hand (LH) steering wheel speed control switches
4	-	Clock spring
5	-	Accelerator Pedal Position (APP) sensor
6	-	Electric throttle
7	-	Brake switch
8	-	Diagnostic socket
9	-	Instrument cluster
10	-	Transmission Control Module (TCM)
11	-	Anti-lock Brake System (ABS) module


Speed Control - TDV6 3.0L Diesel - Speed Control Switch

Removal and Installation


Removal


- WARNINGS:

 To avoid accidental deployment, the restraints control module backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.


 Always wear safety glasses when working on an air bag equipped vehicle and when handling an air bag module. Failure to follow this instruction may result in personal injury.

 To minimize the possibility of premature deployment, do not use radio key code savers when working on the supplemental restraint system. Failure to follow this instruction may result in personal injury.

 To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.

 To minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure to follow these instructions may result in personal injury.

 Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.

 Painting over the driver air bag module trim cover or instrument panel could lead to deterioration of the trim cover and air bags. Do not for any reason attempt to paint discolored or damaged air bag module trim covers or instrument panel. Install a new component. Failure to follow this instruction may result in personal injury.

- NOTE: Removal steps in this procedure may contain installation details.

1. Make the air bag supplemental restraint system (SRS) safe.

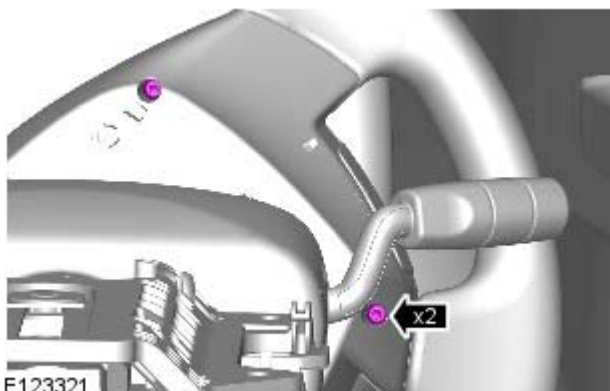
Refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Disconnect the battery ground cable.

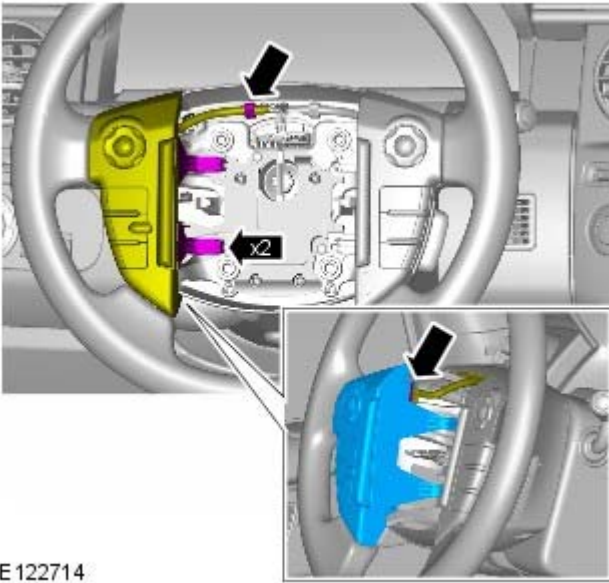
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Refer to: [Driver Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).

4. Torque: 1.5 Nm



5.



E 122714

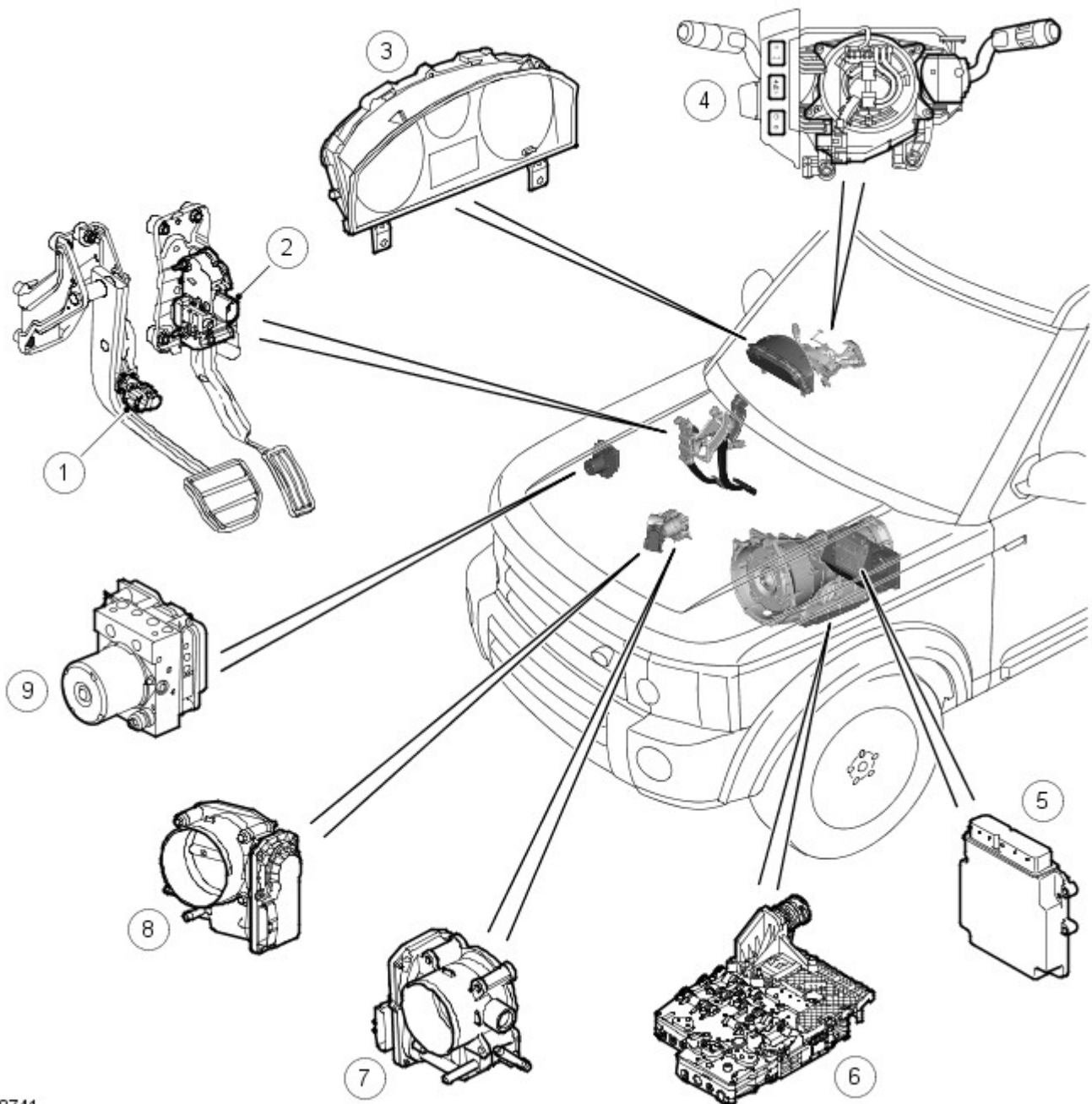
Installation

1. To install, reverse the removal procedure.

Speed Control - V6 4.0L Petrol - Speed Control

Description and Operation

Petrol Engine Speed Control Component Location

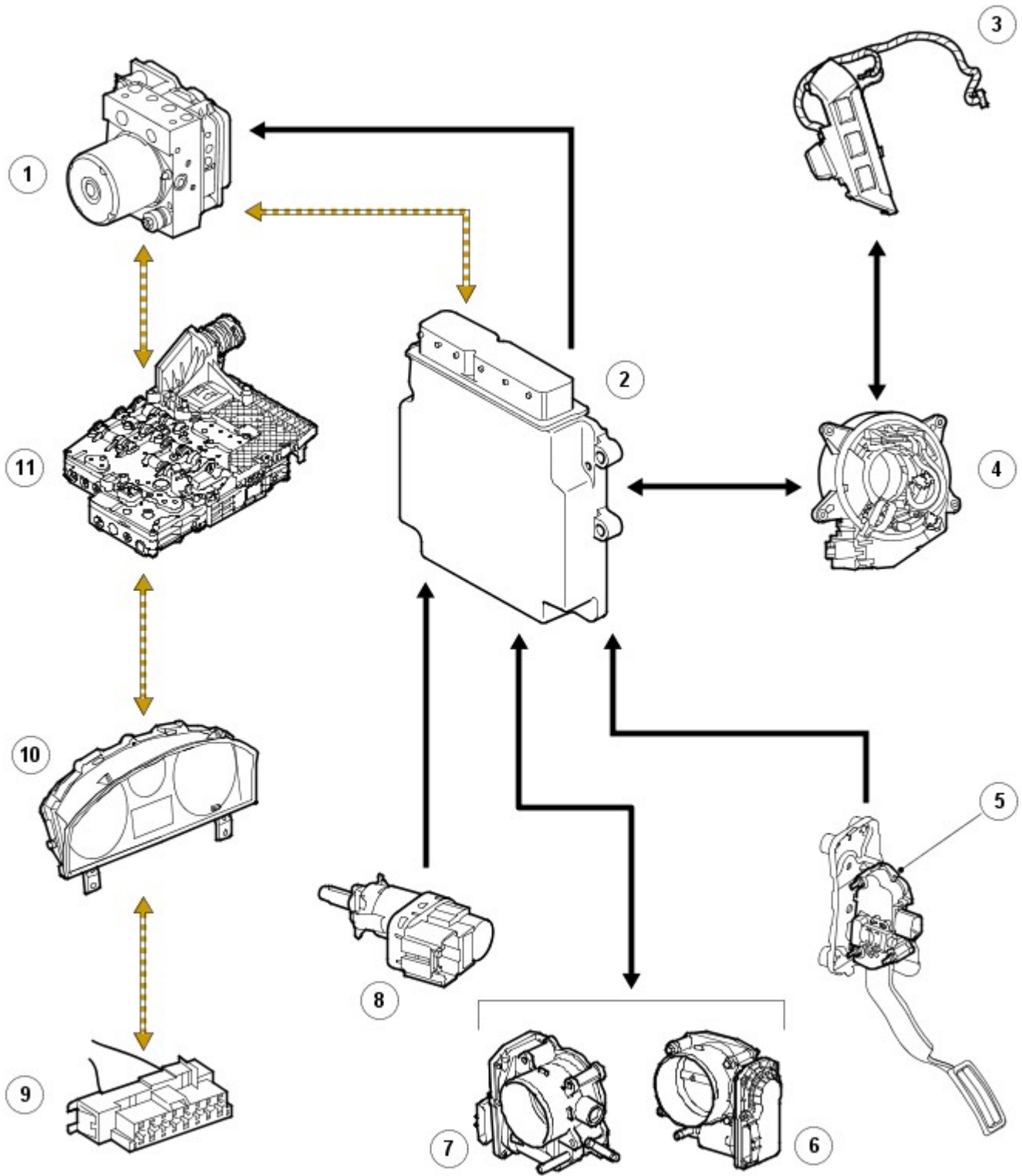


E 48741

Item	Part Number	Description
1	-	Brake switch
2	-	accelerator pedal position (APP)
3	-	Instrument cluster
4	-	Speed control switches
5	-	engine control module (ECM)
6	-	transmission control module (TCM)
7	-	Electric throttle 4.0 Liter engine
8	-	Electric throttle 4.4 Liter engine
9	-	anti-lock brake system (ABS) control module

Petrol Engine Speed Control, Control Diagram

- NOTE: A= Hardwired D= CAN



E48742



Item	Part Number	Description
1	-	ABS control module
2	-	ECM
3	-	Speed control switches
4	-	Clock spring
5	-	APP
6	-	Electric throttle 4.4 Liter
7	-	Electric throttle 4.0 Liter
8	-	Brake light switch
9	-	Diagnostic socket
10	-	Instrument cluster
11	-	TCM

SPEED CONTROL

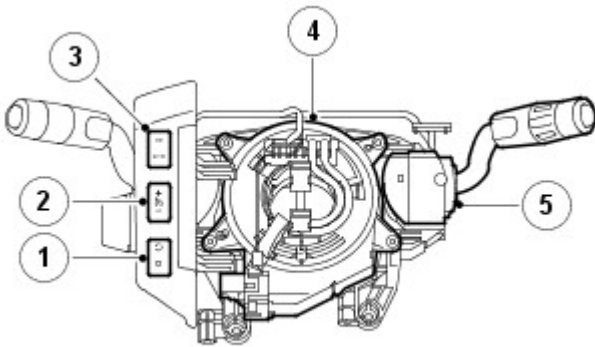
The speed control system is integrated with the engine management system and uses fuelling intervention to automatically maintain a set vehicle speed. Once engaged, the system can also be used to accelerate the vehicle without using the accelerator pedal. The speed control system comprises the following components:

- Suspend switch/Resume
- '+' and '-' (set/accelerate and decelerate)
- Resume switch
- Clock spring
- Speed control warning lamp (in the instrument cluster)

The speed control system also uses inputs from the brake pedal switch, the APP sensor, the ECM and the ABS control module.

The speed control is operated by the driver using only the steering wheel switches. When speed is active, the ECM regulates the engine torque to maintain the set speed.

CONTROL SWITCHES



E47030

Item	Part Number	Description
1	-	Suspend/Resume switch
2	-	Accelerate/Decelerate (+/-) Switches
3	-	Active cruise control time gap switches
4	-	Clock spring
5	-	Wiper control column switch

The speed control switches are located on the LH side of the steering wheel. The switches are connected via fly leads directly to the clock spring. All of the speed control switches are non-latching momentary rocker switches. The minimum set speed for speed control is 18 mph (30 km/h). Speed control is automatically suspended if the vehicle speed falls below 15 mph (24 km/h).

The speed control switches are resistive ladder type switches. There are three switches associated with speed control, two of which are for active speed control (where specified). The switches vary the resistance of a signal voltage sent to the ECM. The switches receive a 5 volt reference supply which is varied in response to which switches are pressed.

Suspend/Resume Switch

The suspend/resume switch controls the selection of speed control. When the ignition is in position II, a press of the suspend switch will activate the suspend mode which temporarily switches off the speed control system, but retains the previously set speed in the ECM memory.

Resume Switch

The resume switch re-activates the previously set speed after the speed control has been suspended by pressing the suspend switch or by depressing the brake pedal.

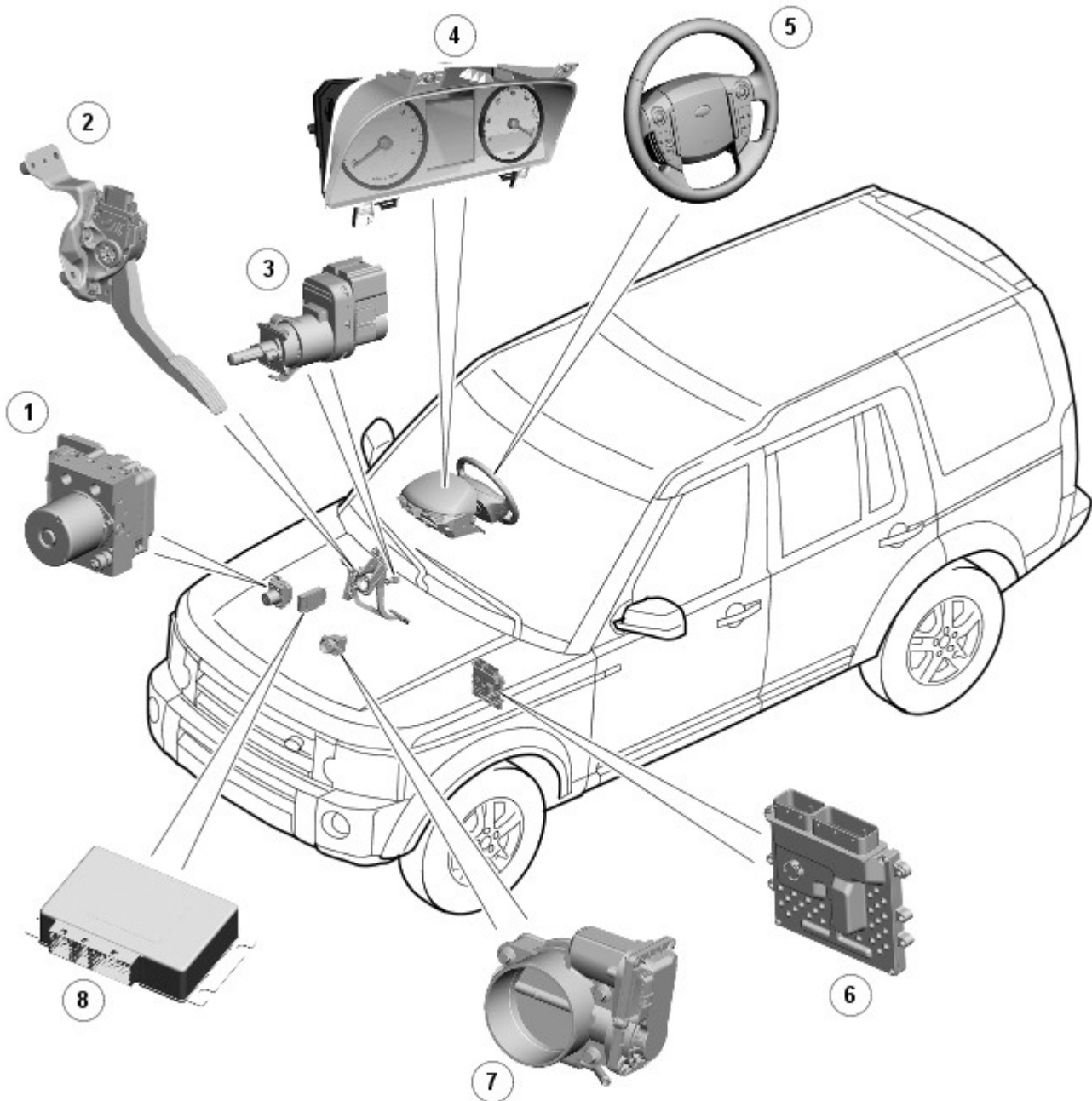
Accelerate/Decelerate (+/-) Switches

When the speed control system is active, pressing the '+' switch set the controlled speed to the current road speed of the vehicle. Subsequent momentary presses of the switch increase the set road speed by 0.6 mph (1 km/h) with each press. If the switch is pressed and held the road speed will continue to increase until the switch is released. Momentarily pressing the '-' switch, decreases the set speed by 0.6 mph (1 km/h) with each press. If the switch is pressed and held, the set speed is decreased until the switch is released.

Speed Control - V8 5.0L Petrol - Speed Control

Description and Operation

5.0L V8 PETROL SPEED CONTROL COMPONENT LOCATION



E124153

Item	Part Number	Description
1	-	Anti-lock Brake system (ABS) module
2	-	Accelerator Pedal Position (APP) sensor
3	-	Brake switch
4	-	Instrument cluster
5	-	Speed control switches
6	-	Engine Control Module (ECM)
7	-	Electric throttle
8	-	Transfer box control module

GENERAL

The speed control system maintains a set speed selected by the driver until operation is suspended or cancelled by a further input from the driver and is controlled by the Engine Control Module (ECM).

The system has the following components:

- A set + switch
- A - switch

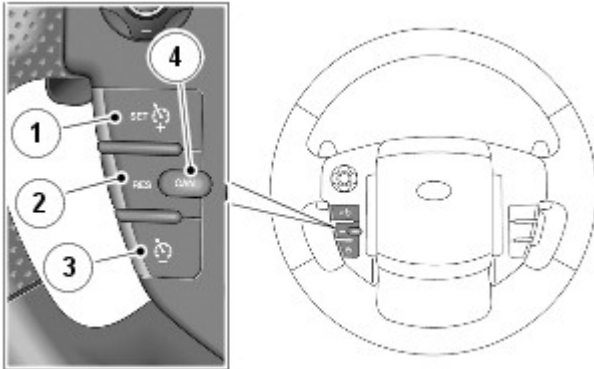
- A RESUME switch
- A CANCEL switch.

The system uses the following vehicle systems:

- The ECM
- The brake switch
- The Accelerator Pedal Position (APP) sensor.

DESCRIPTION

Speed Control Switches



E124128

Item	Part Number	Description
1	-	Set '+' increase the speed
2	-	Decrease '-' the speed
3	-	Resume set speed
4	-	Cancels without erasing memorized speed

Instrument Cluster Warning Indicator



E124129

Item	Part Number	Description
1	-	Speed control warning indicator

The speed control switches are located on the Left Hand (LH) side of the steering wheel. The switches are connected via fly leads to the clock spring. The speed control switches are resistive ladder type switches which vary the resistance of a 5 volt signal sent to them. The signal is returned along a Local Interconnect Network (LIN) bus to the instrument cluster. The instrument cluster routes the control signals to the Engine Control Module (ECM) on the high speed Controller Area Network (CAN) bus.

Speed control is engaged by pressing the set/increase switch. Once engaged the speed can be varied by the speed adjustment switches. Each press of the speed adjustment switches (+/-) will increase or decrease the set speed in steps of 1 mph (2 kph).

Accelerate/Decelerate (+/-) Switches

The Set + switch is used to activate the speed control system and set the speed control at the current vehicle speed. A speed control warning indicator will illuminate on the instrument cluster to advise the driver that the system is active. The switch can be pressed to adjust the set speed. Each single press of the switch increases the vehicle speed by 1 mph (2 km/h). If the switch is pressed and held the vehicle speed will increase and the once the switch is released the attained vehicle speed will be maintained.

The vehicle speed can be increased by using the accelerator pedal. When the accelerator pedal is released the vehicle speed will reduce to the previously set speed. When the vehicle speed is increased by use of the accelerator pedal, the message 'Cruise Override' will be displayed in the instrument cluster message center. This method can also be used to increase the vehicle set speed; once the required increase in speed is achieved, a single press of the Set + switch will maintain that speed as the new set speed.

- **NOTE: If the accelerator pedal is pressed for more than 5 minutes, the speed control is cancelled.**

The '-' switch can be used to decrease the vehicle set speed. The speed can be reduced by pressing and holding the switch until the required set speed is reached. When the switch is released the current speed will become the new set speed. A single press of the '-' switch will decrease the vehicle speed by 1 mph (2 km/h).

Cancel Switch

Speed control can be suspended temporarily or switched off by a single press of the Cancel switch. When the switch is pressed the speed control warning indicator in the instrument cluster is extinguished and the message 'Cruise Cancelled' is displayed in the message center.

Speed control can also be suspended if the brake pedal is pressed, if the transmission selector lever is moved to the neutral position or if Hill Descent Control (HDC) or Dynamic Stability Control (DSC) become active.

Once suspended, the cruise control can be resumed at the previously set speed by pressing the resume switch.

- **NOTE: The set speed is not removed from the memory when the cancel switch is pressed. The set speed is only erased when the ignition is off.**

Resume Switch

The resume speed is used to re-activate the speed control system at the previously set speed after the speed control has been cancelled or suspended.

OPERATION

Speed Control

The speed control system is integrated with the engine management system and uses fueling intervention to automatically maintain a set vehicle speed. Once engaged, the system can also be used to accelerate the vehicle without using the accelerator pedal. The speed control system comprises the following components:

- '+' and '-' (set/accelerate and decelerate) steering wheel switches
- Resume switch
- Cancel switch
- Clock spring
- Speed control warning lamp.

The speed control system also uses inputs from the brake pedal switch, the APP sensor, the ECM and the ABS module.

The speed control is operated by the driver using only the steering wheel switches. When speed control is active, the ECM regulates the Pulse Width Modulation (PWM) signals to the fuel injectors to adjust the fuel supply as required to maintain the set speed.

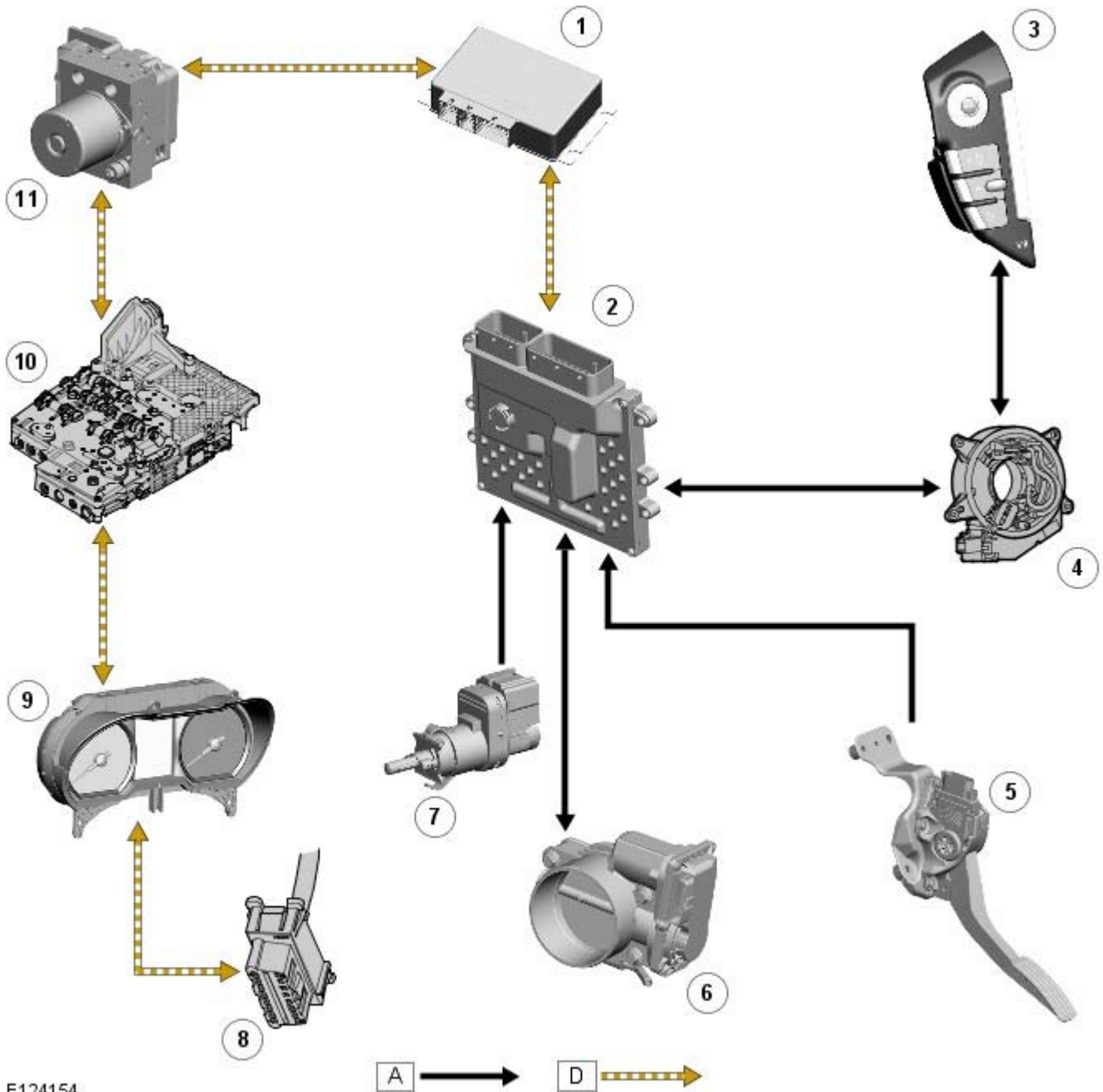
During speed control operation, the ECM controls vehicle speed by adjusting fuel injection duration and timing. When the accelerator pedal is pressed with speed control active, the ECM outputs a calculated throttle angle signal in place of the actual throttle angle signals produced by the APP sensor. The calculated throttle angle is derived from fuel demand.

The minimum set speed for speed control is 20 mph (32 km/h). Speed control is automatically suspended if the following conditions apply:

- Vehicle speed falls below 20 mph (32 km/h).
- The brake pedal is pressed
- The cancel button is pressed
- Neutral, park or reverse gear is selected
- The difference between actual speed and the set speed is too great
- When the vehicle speed reaches a maximum speed of 150 mph (240 kph)
- If the accelerator pedal is used to accelerate beyond the set speed for too long
- Stability control system intervention
- System error causes shut-off.

CONTROL DIAGRAM

- **NOTE: A = Hardwired; D = High speed CAN Bus**



E124154

Item	Part Number	Description
1	-	Transfer box control module
2	-	Engine Control Module (ECM)
3	-	Left Hand (LH) steering wheel speed control switches
4	-	Clock spring
5	-	Accelerator Pedal Position (APP) sensor
6	-	Electric throttle
7	-	Brake switch
8	-	Diagnostic socket
9	-	Instrument cluster
10	-	Transmission Control Module (TCM)
11	-	Anti-lock Brake System (ABS) module

Speed Control - V8 5.0L Petrol - Speed Control Switch

Removal and Installation

Removal

- WARNINGS:



To avoid accidental deployment, the restraints control module backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.



Always wear safety glasses when working on an air bag equipped vehicle and when handling an air bag module. Failure to follow this instruction may result in personal injury.



To minimize the possibility of premature deployment, do not use radio key code savers when working on the supplemental restraint system. Failure to follow this instruction may result in personal injury.



To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.



To minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure to follow these instructions may result in personal injury.



Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.



Painting over the driver air bag module trim cover or instrument panel could lead to deterioration of the trim cover and air bags. Do not for any reason attempt to paint discolored or damaged air bag module trim covers or instrument panel. Install a new component. Failure to follow this instruction may result in personal injury.

- NOTE: Removal steps in this procedure may contain installation details.

1. Make the air bag supplemental restraint system (SRS) safe.

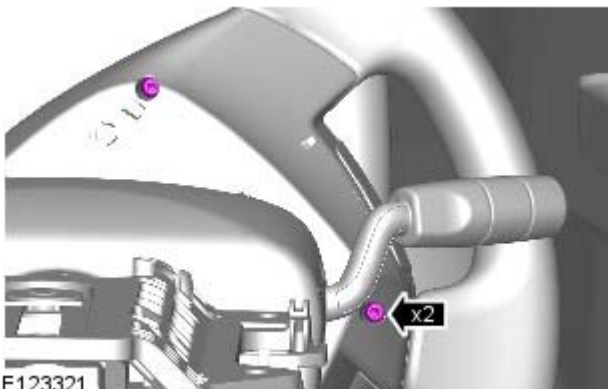
Refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Disconnect the battery ground cable.

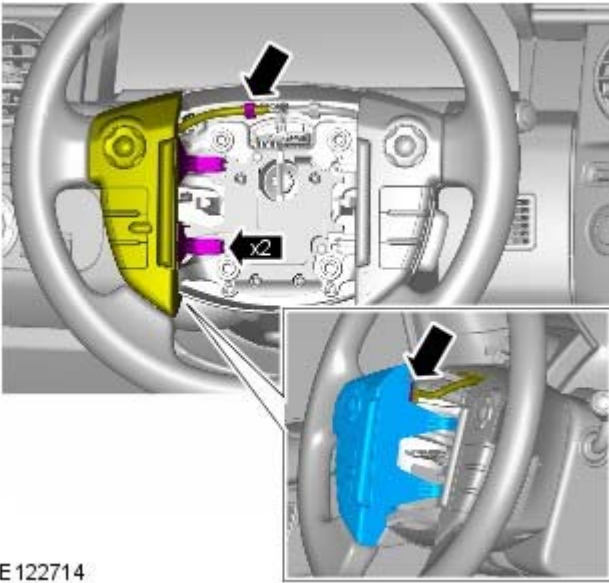
Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Refer to: [Driver Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).

4. Torque: 1.5 Nm



5.



E 122714

Installation

1. To install, reverse the removal procedure.

Climate Control System - General Information -

General Specification

Type	Description
Heating, ventilation and air conditioning unit: <ul style="list-style-type: none">● Front unit - Manual version● Front unit Automatic Temperature Control (ATC) version● Rear unit	<ul style="list-style-type: none">● Centrally mounted with offset (handed) blower unit● Dual zone with side to side temperature control● Located behind right hand rear quarter panel. Includes heater, evaporator, in-line TVX, blower motor and drain tube. Air intake is 100% recirculation.
Compressor	Clutchless, belt driven from engine with electronically controlled outputs.

Climate Control System - General Information - Climate Control System

Diagnosis and Testing

Principle of Operation

For a detailed description of the climate control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

[Air Distribution and Filtering](#) (412-01 Air Distribution and Filtering, Description and Operation),
[Heating and Ventilation](#) (412-02A Heating and Ventilation, Description and Operation),
[Auxiliary Heater](#) (412-02B Auxiliary Heating, Description and Operation),
[Air Conditioning](#) (412-03A Air Conditioning - TDV6 2.7L Diesel, Description and Operation),
 Air Conditioning (412-03 Air Conditioning - 4.0L, Description and Operation),
[Auxiliary Climate Control](#) (412-03E Auxiliary Climate Control, Description and Operation),
 Control Components (412-04 Control Components, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Coolant level ● Air vents (contaminated/blocked) ● Auxiliary drive belt condition and tension ● Air conditioning compressor 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Electrical connector(s) ● Relays ● Control module(s) ● Control panel(s) ● Air conditioning compressor

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Distribution motor self-test

The motor and flap operation can be checked using the on-board distribution motor self-test function.

The self-test can be initiated by pressing and holding the **ECON** and **RECIRC** buttons while turning the ignition switch to the **ON** position.

The control module will then compare the current motor position with the values stored in the module and will indicate an error by flashing the **ECON** LED (light emitting diode).

If there are no errors, the LED will go out and the system will function normally.

To confirm that there are no errors, turn the ignition switch to the **OFF** position, then back to the **ON** position.

Observe the operation of the **programmed defrost** LED.

If there are errors present, the **programmed defrost** LED will flash and the system will attempt to calibrate itself.

Symptom Chart

Symptom	Possible Causes	Action
No climate control function, flashing LED at start-up	<ul style="list-style-type: none"> ● The system is in calibration mode 	Check the motors and levers at the heating and ventilation assembly for damage/foreign objects jamming the movement of the flaps. For additional information on the self-calibration process, see the distribution motor self-test above
Poor or no cooling	<ul style="list-style-type: none"> ● Air conditioning function 	Carry out the checks from the visual inspection, refer to the relevant section of the workshop manual

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: (100-00 General Information)

[Diagnostic Trouble Code \(DTC\) Index - DTC: Climate Control Module \(HVAC\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Fuel Fired Booster Heater Module \(AHCM\)](#) (Description and Operation).

Climate Control System - General Information - Air Conditioning (A/C) System Recovery, Evacuation and Charging

General Procedures



WARNING: Servicing must be carried out by personnel familiar with both vehicle system and the charging and testing equipment. All operations must be carried out in a well ventilated area away from open flame and heat sources.

• **NOTE:** The receiver drier need only be changed under the following circumstances: There is dirt in the refrigerant circuit (eg. compressor seizure); the system is leaking and refrigerant has been lost to atmosphere; refrigerant circuit has been open more than 24 hours due to repair.



1. Refrigerant recovery: Remove the dust covers from the high and low pressure connections.

2. Connect the high and low pressure lines to the appropriate connections.
3. Open the valves on the connections.
4. Turn the valves on the station to the correct positions.
5. Turn the process switch to the correct position.
6. Turn the main switch to 'ON'.



7. WARNING: Refrigerant must always be recycled before re-use to ensure that the purity of the refrigerants high enough for safe use in the air conditioning system. Recycling should always be carried out with equipment which is design certified by Underwriter Laboratory Inc. for compliance with SEA J1991. Other equipment may not recycle refrigerant to the required level of purity. R143a Refrigerant Recover Recycling Recharging station must not be used with any other type of refrigerant. Refrigerant R134a from domestic and commercial sources must not be used in motor vehicles air conditioning systems.

Allow the system to recover the refrigerant from the system.

8. Close the valves on the refrigerant station.
9. Turn the main switch 'OFF'.
10. Close the valves on the connections.
11. Disconnect the high and low pressure connections.
12. Install the dust covers to the connectors.
13. Open the tap at the rear of the station to drain the refrigerant oil.
14. Measure and record the quantity of refrigerant oil recovered from the system.
15. Close the tap at the rear of the station.
16. **Evacuation:** Remove the dust covers from the high and low pressure connections.
17. Connect the high and low pressure lines to the appropriate connections.
18. Open the valves on the connections.
19. Turn the valves on the station to the correct positions.
20. Turn the process switch to the correct position.
21. Turn the main switch to 'ON'.
22. Allow the station to evacuate the A/C system.

23.  CAUTION: The system must be evacuated immediately before recharging commences. Delay between evacuation and recharging is not permitted

Recharging: Close the valves on the refrigerant station.

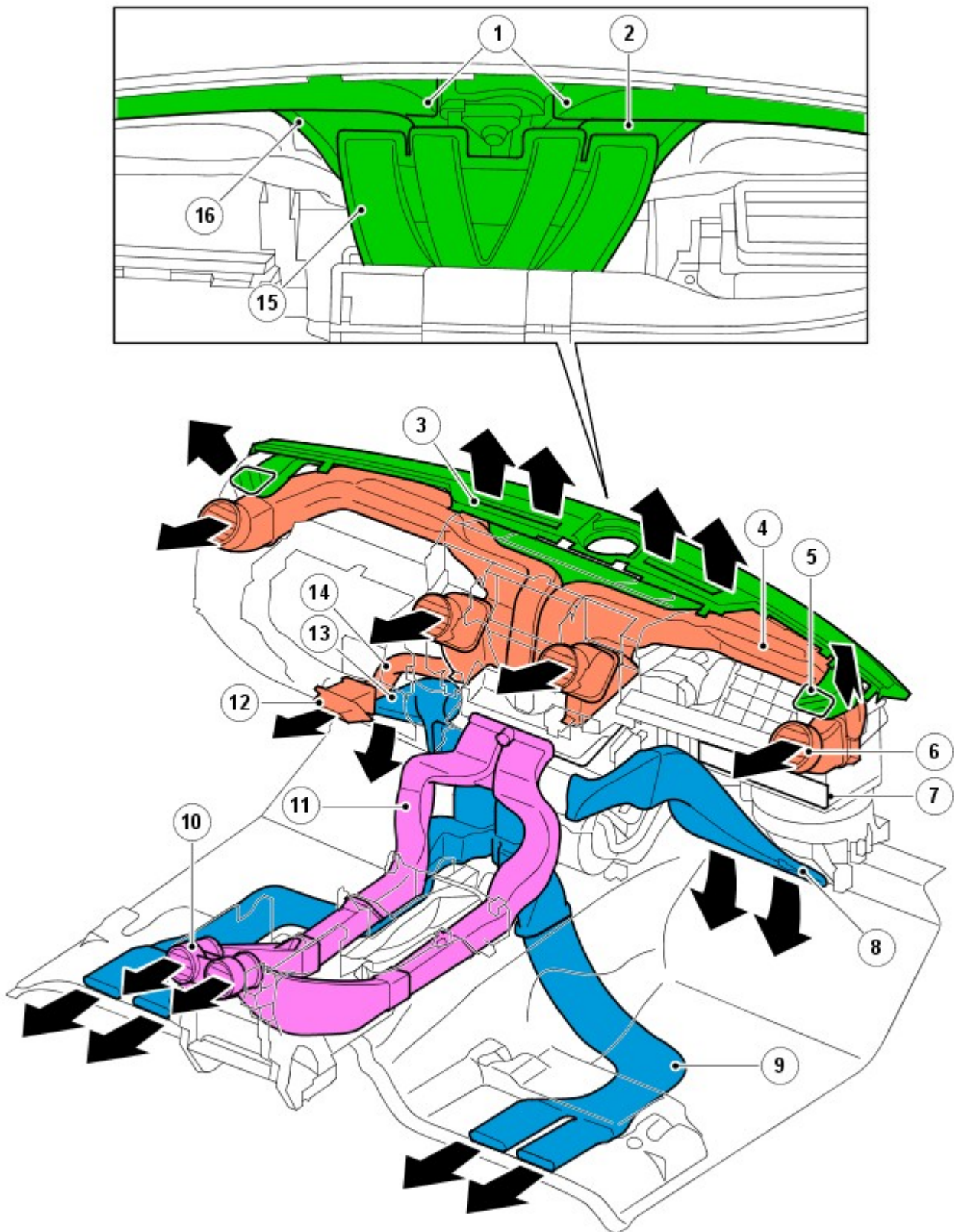
24. Close the valve on the oil charger.
25. Disconnect the yellow line from the refrigerant station.
26. Remove the cover from the oil charger.
27. Pour the correct quantity of refrigerant oil into the oil charger.
28. Install the cover to the oil charger.
29. Connect the yellow line to the refrigerant station.
30. Open the valve on the oil charger.
31. Move the pointer on the refrigerant gauge to mark the position of the refrigerant drop.
32. Slowly open the correct valve on the refrigerant to allow the vacuum to pull the refrigerant into the system.
33. Close the valve on the refrigerant station when the correct amount of refrigerant has been drawn into the air conditioning system.
34. Turn the main switch 'OFF'.
35. Close the valves on the connections.
36. Disconnect the high and low pressure connections.

Air Distribution and Filtering - Air Distribution and Filtering

Description and Operation

COMPONENT LOCATIONS

• NOTE: LHD installation shown, RHD similar



E47041

Item	Part Number	Description
1	-	Side window ducts
2	-	Windshield duct
3	-	Windshield vent

4	-	Instrument panel register duct
5	-	Side window vent
6	-	Instrument panel register
7	-	Cabin air filter
8	-	Front passenger footwell duct
9	-	Second row footwell duct
10	-	Second row register
11	-	Second row register duct
12	-	Driver lap register
13	-	Driver footwell duct
14	-	Driver lap register duct
15	-	Heater outlet manifold
16	-	Windshield duct

GENERAL

The air distribution and filtering system controls the distribution and quality of air supplied to the vehicle interior. The system consists of:

- Air ducts.
- Air registers and vents.
- A cabin air filter.

AIR DUCTS

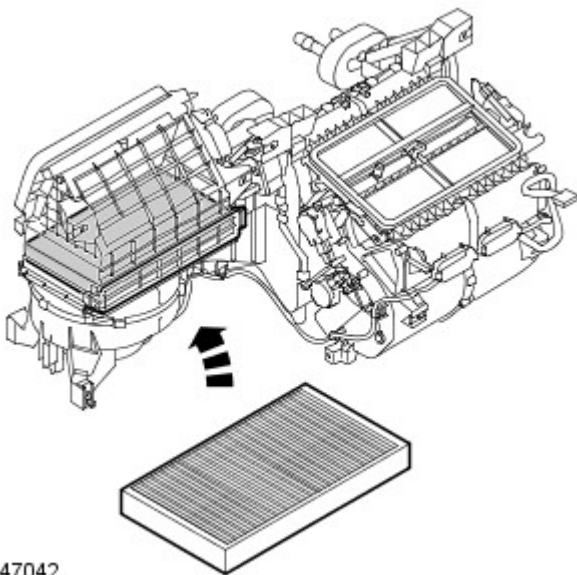
The air ducts distribute the air from the heater to the various registers and air vents around the vehicle interior. The air ducts for the instrument panel registers, the driver lap register and the second row registers are connected to the heater outlet manifold on top of the heater. The air ducts for the front and second row footwells are connected direct to outlet ports on the heater. The air ducts for the windshield vents and the side window vents form part of the structure of the instrument panel.

AIR REGISTERS AND VENTS

The air registers allow occupants to control the flow and direction of air from the air ducts. The driver lap register has moveable vanes to regulate the flow and direction of the air. The instrument panel and second row registers each have a thumbwheel to regulate flow, and moveable vanes to control direction.

The air vents are fixed outlets either integrated into the end of the air duct or installed in the trim panel connected to the air duct.

CABIN AIR FILTER



E47042

The cabin air filter is installed in the air inlet duct and is either a pollen filter or a pollen and odor filter. The pollen filter removes particulates, and the pollen and odor filter removes particulates and unpleasant odors, from the fresh and recirculated air entering the blower.

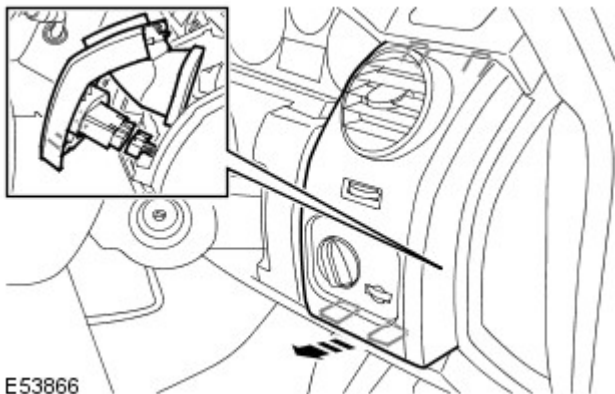
Air Distribution and Filtering - Driver Side Register Trim Panel

Removal and Installation

Removal

1. Remove the driver side register trim panel.

- Release the 2 clips.
- Disconnect the electrical connector.

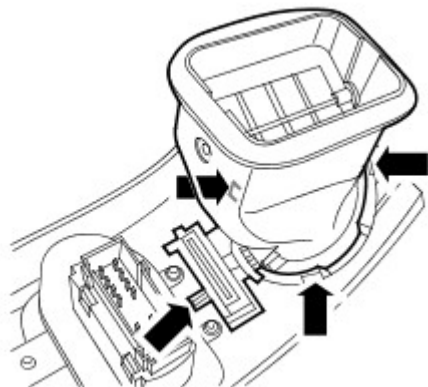


E53866

2. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the register.

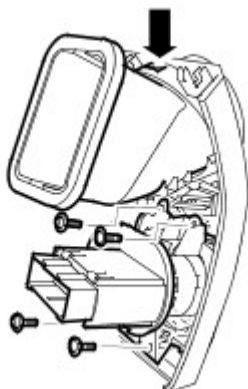
- Release the 4 clips.



E53867

3. Remove the headlamp switch.

- Remove the 4 Torx screws.



E49996

Installation

1. Install the headlamp switch.

- Tighten the Torx screws.

2. Install the register.

- Secure with the clips.

3. Install the driver side register trim panel.

- Connect the electrical connector.
- Secure with the clips.

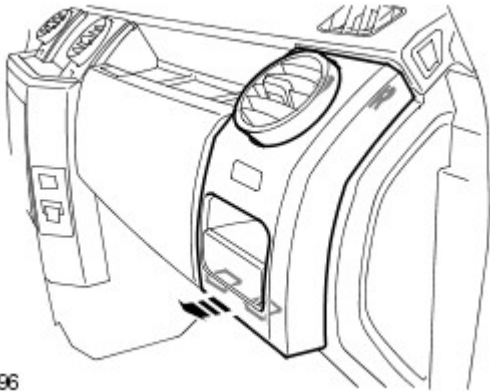
Air Distribution and Filtering - Passenger Side Register Trim Panel

Removal and Installation

Removal

1. Remove the passenger side register trim panel.

- Release the 2 clips.

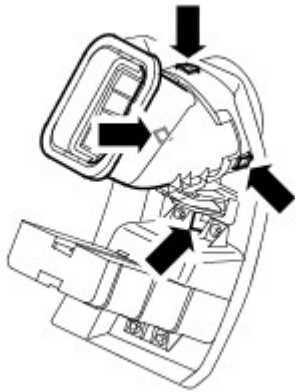


E49996

2. NOTE: Do not disassemble further if the component is removed for access only.

Remove the register.

- Release the 4 clips.



E53870

3. Remove the cup holder.

- Remove the 4 Torx screws.



E49997

Installation

1. Install the cup holder.

- Tighten the Torx screws.

2. Install the register.

- Secure with the clips.

3. Install the passenger side register trim panel.

- Secure with the clips.

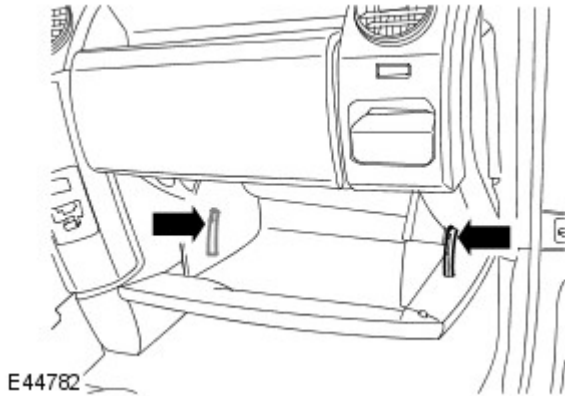
Air Distribution and Filtering - Pollen Filter

Removal and Installation

Removal

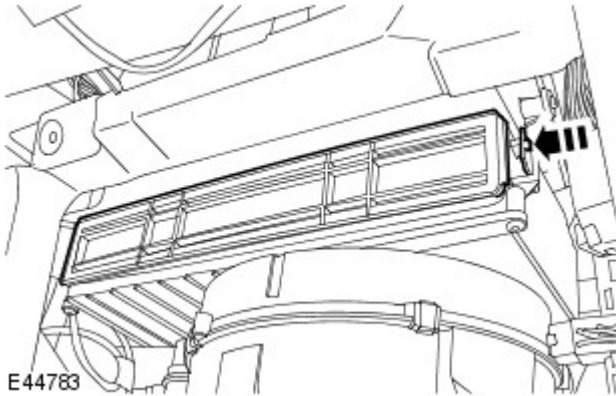
1. Open the glove compartment to the service condition.

- Release the glove compartment latch stops.



E44782

2. Remove the pollen filter housing cover.



E44783

3. Remove the pollen filter.

Installation

1. To install, reverse the removal procedure.

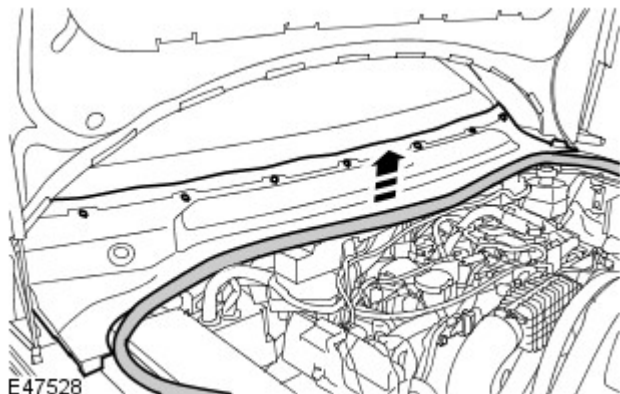
- Clean the component mating faces.

Air Distribution and Filtering - Plenum Chamber

Removal and Installation

Removal

1. Remove the A-pillar mouldings.
For additional information, refer to: [A-Pillar Moulding LH](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
2. Remove the windshield wiper arms.
For additional information, refer to: [Front Wiper Pivot Arm](#) (501-16 Wipers and Washers, Removal and Installation).
3. Release the hood seal from the plenum chamber.

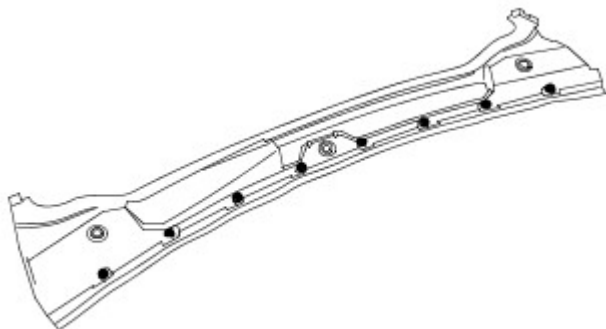


4. Remove the plenum chamber panel.

- Release the 8 clips.

5. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the clips from the plenum chamber panel.



Installation

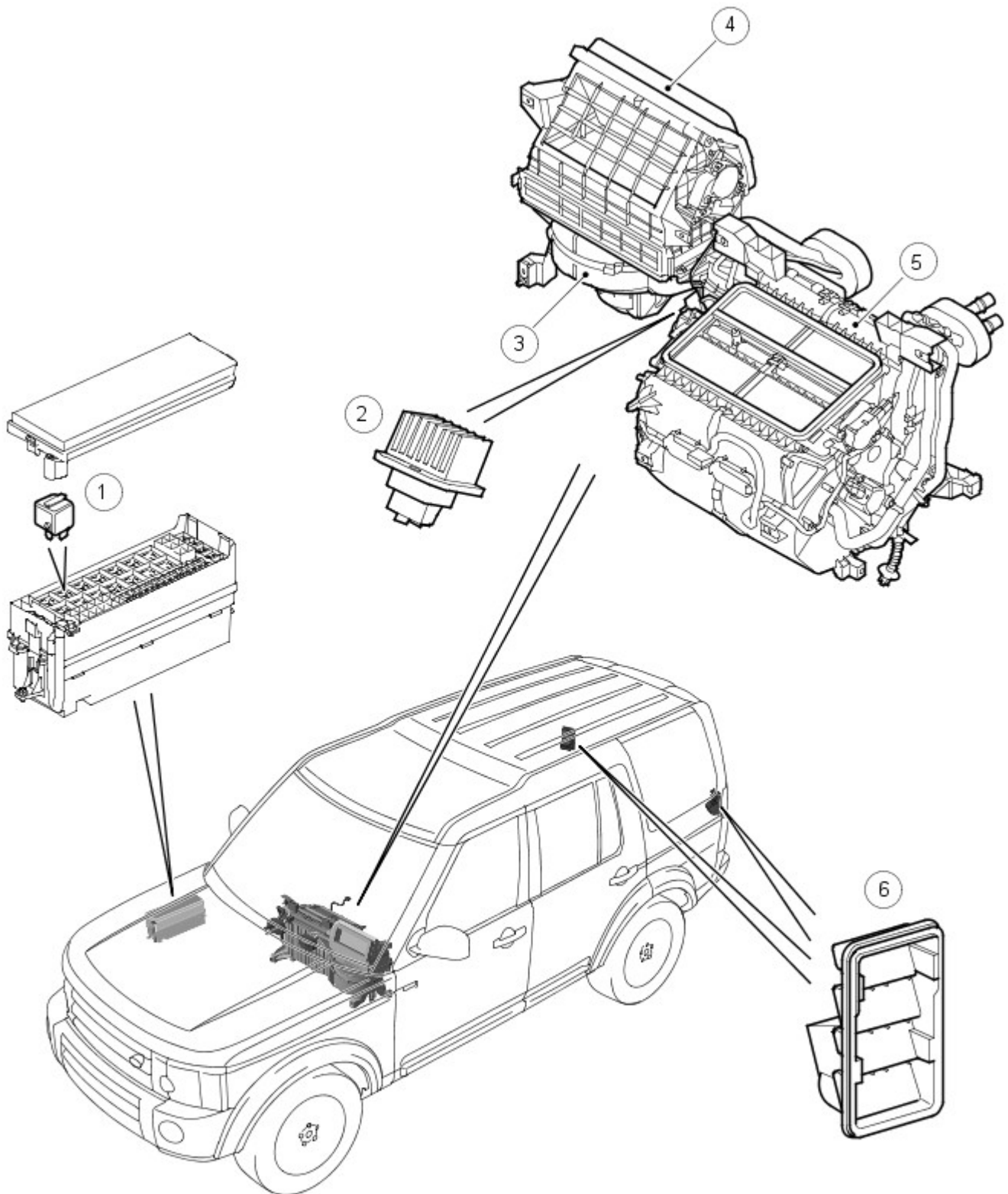
1. To install, reverse the removal procedure.

Heating and Ventilation - Heating and Ventilation

Description and Operation

COMPONENT LOCATIONS

- NOTE: right-hand drive (RHD) installation shown, left-hand drive (LHD) similar



E47348

Item	Part Number	Description
1	-	Blower relay
2	-	Blower control module
3	-	Blower

4	-	Air inlet duct
5	-	Heater
6	-	Ventilation outlets

GENERAL

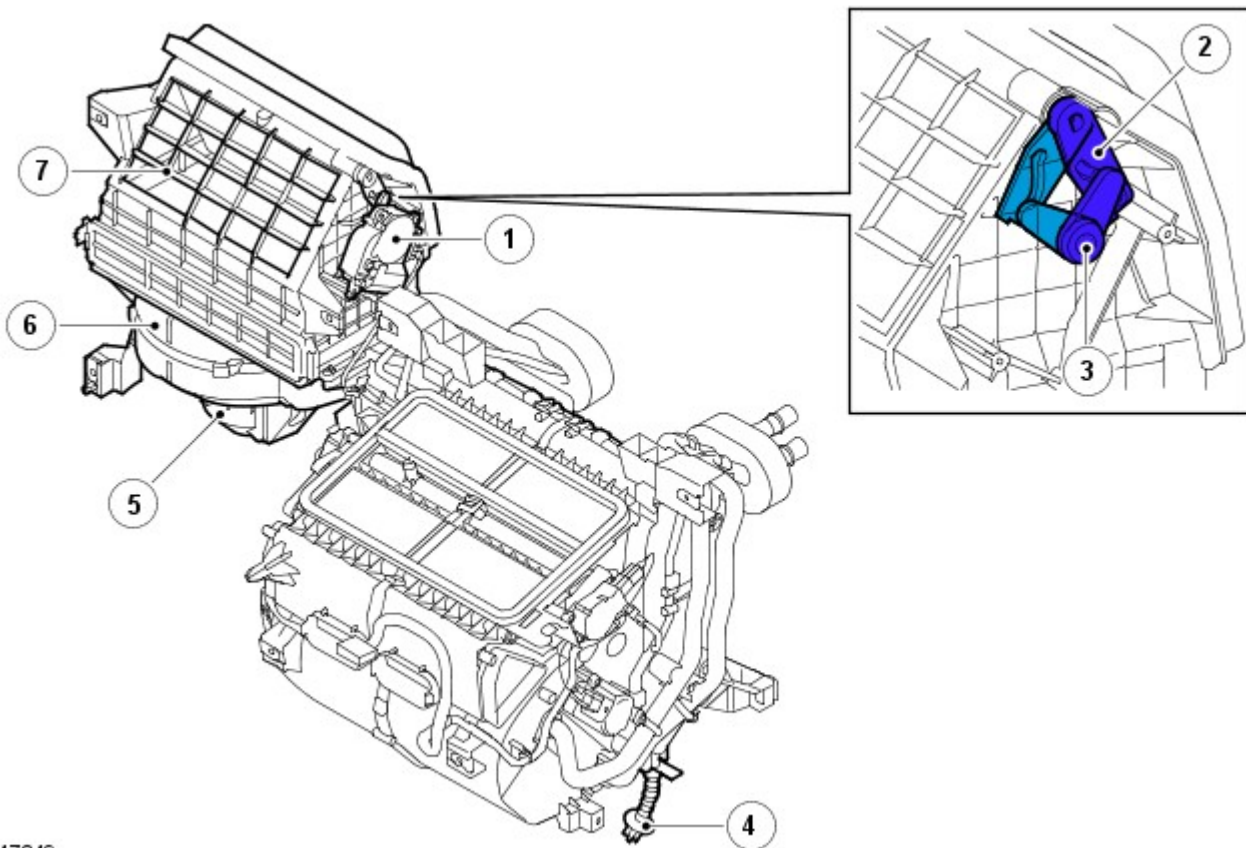
The heating and ventilation system controls the temperature and flow of air supplied to the vehicle interior. The system consists of:

- An air inlet duct.
- A blower.
- A blower control module.
- A blower relay.
- A heater.
- Two ventilation outlets.

Fresh or recirculated air flows into the heater assembly from the inlet duct. The blower, and ram effect when the vehicle is moving, forces the air through the heater assembly. Air from the cabin exhausts through the ventilation outlets.

AIR INLET DUCT

- NOTE: RHD version shown, LHD mirror image



E47349

Item	Part Number	Description
1	-	Recirculation door motor
2	-	Recirculation door arm
3	-	Recirculation motor arm
4	-	Evaporator drain tube
5	-	Blower
6	-	Air inlet duct
7	-	Recirculation air inlet

The air inlet duct is installed behind the instrument panel, on the front passenger side, and connected between the plenum chamber below the windshield and the heater.

The plenum chamber is formed by the upper and lower cowl and a plenum molding. Grilles in the plenum molding allow fresh air into the plenum chamber. From the plenum chamber, the air passes through a water separator and into the fresh air inlet of the air inlet duct.

The air inlet duct incorporates a grille to provide the inlet for recirculated air from the vehicle interior. The air inlet duct also accommodates:

- The cabin air filter.
For additional information, refer to: [Air Distribution and Filtering](#) (412-01 Air Distribution and Filtering, Description and Operation).
- The blower.
- The blower control module.

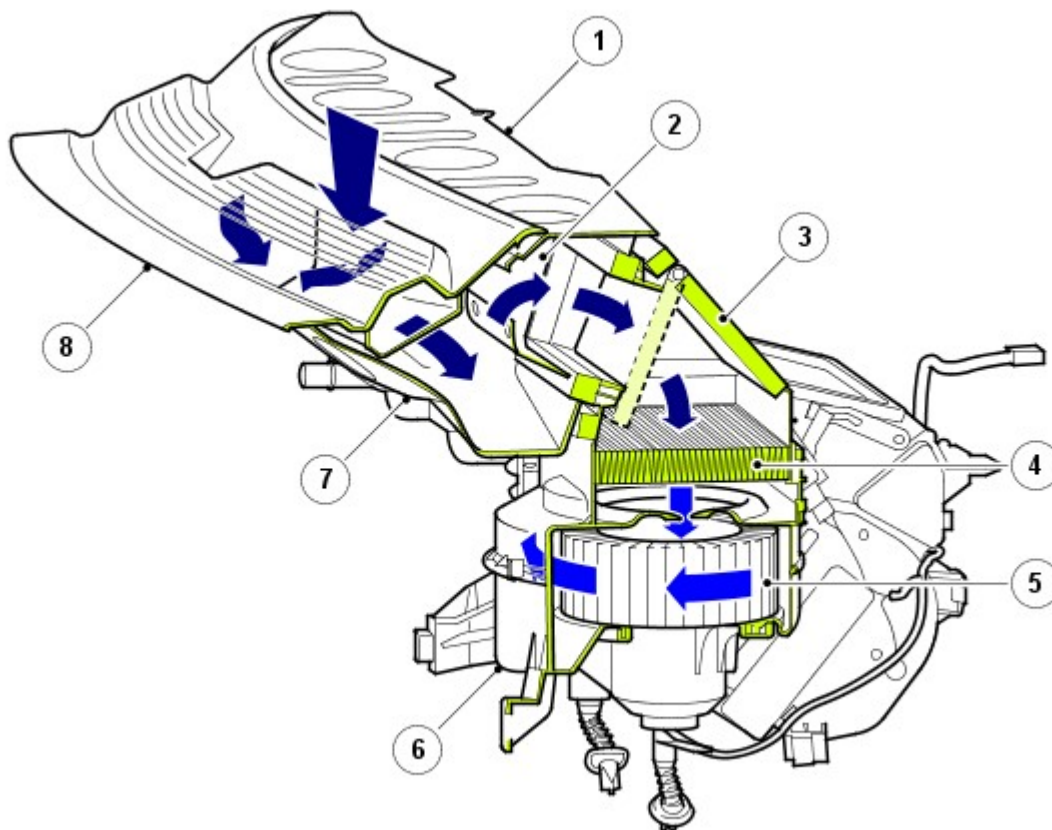
The outlet from the air inlet duct forms the rear wall of the heater, enclosing the evaporator and incorporating the two evaporator drain outlets. Drain tubes connect the evaporator drain outlets to the transmission tunnel, to direct the water that condenses on the evaporator overboard.

A recirculation door is installed between the fresh and recirculated air inlets, to control the source of incoming air. A lever on the recirculation door is driven by the recirculation door motor. Operation of the recirculation door motor is automatically controlled by the automatic temperature control (ATC) module and manually controlled by a switch on the ATC module control panel.

For additional information, refer to: Control Components (412-04 Control Components, Description and Operation).

Fresh or recirculated air enters the air inlet duct and passes through the cabin air filter to the hub of the blower. From the blower, the air flows to the outlet of the air inlet duct and into the heater. The blower, and ram effect from the forward motion of the vehicle, forces the air through the air inlet duct.

Air Flow Through Air Inlet Duct



E47350

Item	Part Number	Description
1	-	Upper cowl
2	-	Water separator
3	-	Recirculation door
4	-	Cabin air filter
5	-	Blower
6	-	Air inlet duct casing
7	-	Lower cowl
8	-	Plenum molding

BLOWER

The blower is installed in the air inlet duct, below the cabin air filter, and consists of an open hub, centrifugal fan powered by an electric motor. Operation of the blower is controlled by the ATC module, using the blower relay in the battery junction box (BJB) and the blower control module. The blower control module is installed in the air inlet duct downstream of the blower, where any heat generated during operation is dissipated by the air flow. A wiring harness on the air inlet duct connects the recirculation door motor, blower and blower control module to the vehicle wiring.

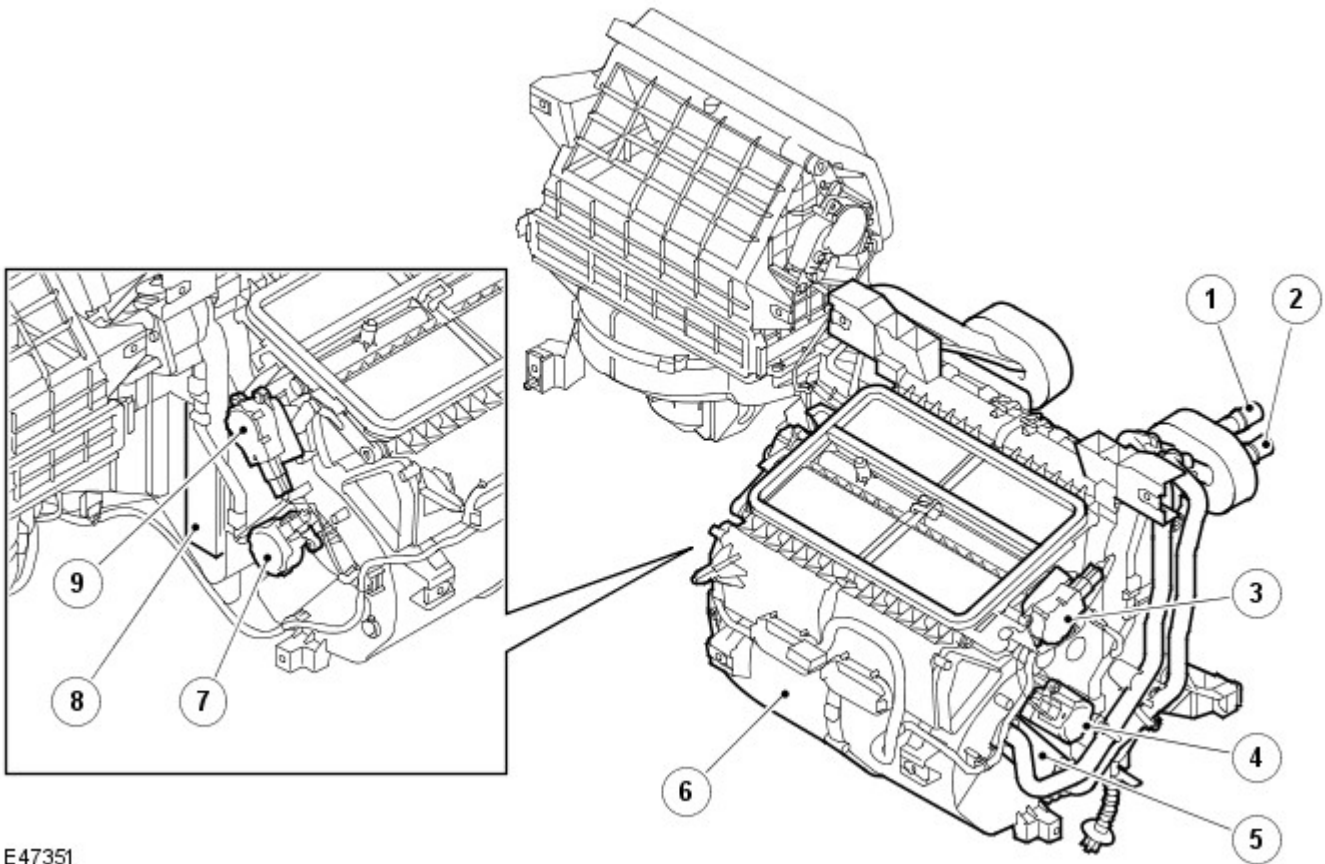
When the blower is required, the ATC module energizes the coil of the blower relay. The energized blower relay supplies battery power to the blower motor, which is connected to ground through the blower control module. The speed of the blower is controlled by the blower control module, which regulates the blower motor voltage in response to a pulse width modulation (PWM) signal from the ATC module. To vary the blower motor voltage the ATC module varies the duty cycle of the PWM signal.

When the blower is in the automatic mode the ATC module determines the blower speed required from the comfort algorithms. When the blower is in the manual mode, the ATC module operates the blower at one of seven fixed speeds as selected on the control panel.

For additional information, refer to: Control Components (412-04 Control Components, Description and Operation).

HEATER

• NOTE: RHD unit shown, LHD units similar



E47351

Item	Part Number	Description
1	-	Coolant outlet pipe
2	-	Coolant inlet pipe
3	-	Windshield distribution door motor
4	-	right-hand (RH) temperature blend motor
5	-	Heater core
6	-	Heater casing
7	-	left-hand (LH) temperature blend motor (automatic system only)
8	-	Evaporator
9	-	Face and feet distribution door motor

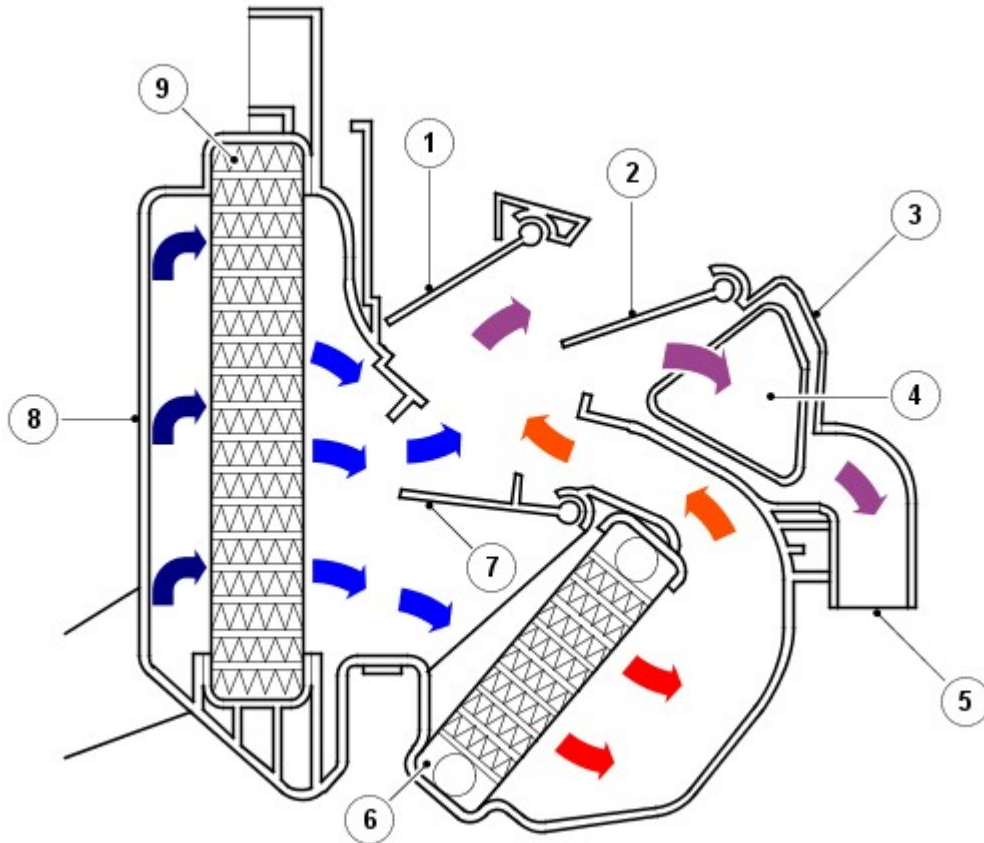
The heater controls the temperature of the air supplied to the distribution ducts, as directed by the ATC module. The heater is installed on the vehicle center-line, between the instrument panel and the engine bulkhead. The heater consists of a casing, formed from a series of plastic molding, which contains an evaporator, heater core and control doors. Internal passages integrated into the casing guide the air through the casing and separate it into two flows, one for the LH outlets and one for the RH outlets.

When the air conditioning (A/C) system is operating, the evaporator cools the air entering the heater.

The heater core provides the heat source to warm the air being supplied to the distribution ducts. The heater core is an aluminum two pass, fin and tube heat exchanger, installed across the width of the heater housing. Two aluminum tubes attached to the heater core extend through the engine bulkhead to connect with the engine cooling system. When the engine is running, coolant is constantly circulated through the heater matrix by the coolant pump. On vehicles with a FFBH (fuel fired booster heater), when the FFBH is active the coolant flow is assisted by an electric circulation pump. For additional information, refer to: [Auxiliary Heater](#) (412-02B Auxiliary Heating, Description and Operation).

Two temperature blend doors, one LH and one RH, regulate the flow of air through the heater core to control the temperature of the air leaving the heater. On the automatic system, the two temperature blend doors operate independently to allow different temperatures to be set for the LH and RH outlets. On the manual system, the temperature blend doors are coupled together and produce a common temperature for the LH and RH outlets.

Air Flow Through Heater



E47352

Item	Part Number	Description
1	-	Windshield distribution door
2	-	Face and feet distribution door
3	-	Heater casing
4	-	Front footwell outlet
5	-	Rear footwell outlet
6	-	Heater core
7	-	Temperature blend door
8	-	Air inlet duct casing
9	-	Evaporator

Stepper Motors

On the automatic system, separate stepper motors operate the RH and the LH side temperature blend doors. On the manual system, a single stepper motor operates both the RH and the LH temperature blend doors.

The distribution doors in the heater are also operated by stepper motors. One for the windshield distribution door and one for the face and feet distribution door.

If a stepper motor is to be replaced, ensure it is replaced with the correct replacement part. Although similar in appearance, each of the stepper motors is different and faults will occur if an incorrect motor is fitted.

Operation of the distribution and temperature blend door stepper motors is controlled by the ATC module, which is connected to the stepper motors by a LIN (local interconnect network) bus.

All of the stepper motors contain microprocessors, which store positional information. To enable the ATC module to move the stepper motors correctly it requires the following information:

- The travel range, end to end, of each motor.
- Where each motor is on its range.

Approximately 2 minutes after the vehicle ignition is switched off, the climate control system powers down. At this point, the ATC module stores the position of each stepper motor in its memory. Each of the stepper motors also stores its own position in its memory. When the Ignition is next switched on, all of the stepper motors send positional information to the ATC module via the LIN bus. This information is compared with the positional information stored within the ATC module memory.

In normal circumstances, the information sent by the stepper motors matches that held in the ATC module memory. In this instance, the ATC module recognizes there are no problems with the system and starts normally. If however, there are differences, the ATC module carries out a calibration routine.

The stepper motor calibration routine will normally take about 15 seconds to complete, but can take up to approximately 2 minutes in certain circumstances. During this period:

- The programmed de-frost light emitting diode (LED) on the ATC module panel will flash.
- All other climate control operations will be suspended.

The programmed de-frost LED will stop flashing after 2 minutes, regardless of whether the exercise was successful or not

so it is important to check that calibration has been carried out successfully. To do this:

- Switch the ignition off.
- Switch the ignition back on.
- Check for a flashing programmed de-frost LED.

If calibration has been successful, the programmed de-frost LED will not flash and the system will return to normal operation. If flashing does occur, more investigation will be required .

Automatic Calibration: The ATC module will automatically initiate a calibration routine every 175 hours of vehicle life. This occurs approximately 1 minute after the ignition has been switched off once 175 hours is reached. In this instance, the programmed de-frost LED will not blink.

Forced Calibration: The ATC module can be manually forced to carry out a calibration routine on the stepper motors. This can be carried out by holding down the ECON and recirculation buttons on the ATC module panel while simultaneously switching the ignition on. The ATC module will now carry out a calibration routine on the stepper motors, but will flash the ECON LED rather than the programmed de-frost LED.

Stepper Motor Diagnostics

Fault diagnosis on the heater stepper motors falls into two main groups:

- Electrical fault: A diagnostic trouble code (DTC) will be raised and logged in the ATC module memory.
- Mechanical fault: The programmed de-frost LED will blink to indicate the ATC module is attempting to carry out a calibration routine.

A calibration routine will be initiated by the ATC module if any of the following occur:

- One or more of the stepper motors is replaced.
- The ATC module is replaced.
- A foreign object enters the system and causes a stepper motor to stall.

Stepper motor related DTCs are stored in the ATC module memory and can be retrieved using T4. For additional information, refer to: [Climate Control System](#) (412-00 Climate Control System - General Information, Diagnosis and Testing).

VENTILATION OUTLETS

The ventilation outlets promote the free flow of air through the passenger compartment. The outlets are installed in the LH and RH rear quarter body panels, behind the tail lamps.

Each ventilation outlet consists of a grille covered by soft rubber flaps and is effectively a non-return valve. The flaps open and close automatically depending on the differential between cabin and outside air pressures.

Heating and Ventilation - Heating and Ventilation

Diagnosis and Testing

Principles of Operation

For a detailed description of the heating and ventilation system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Heating and Ventilation](#) (412-02A Heating and Ventilation, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Front End Accessory Drive (FEAD) belt ● Refrigerant ● Heater control flaps ● Ducting ● Cabin air filter ● Coolant level ● Compressor ● Cooling fan 	<ul style="list-style-type: none"> ● Fuses ● Electrical harnesses ● Harness connectors ● Blower motor ● Cooling fan ● Actuators

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Climate Control Module \(HVAC\)](#) (100-00 General Information, Description and Operation).

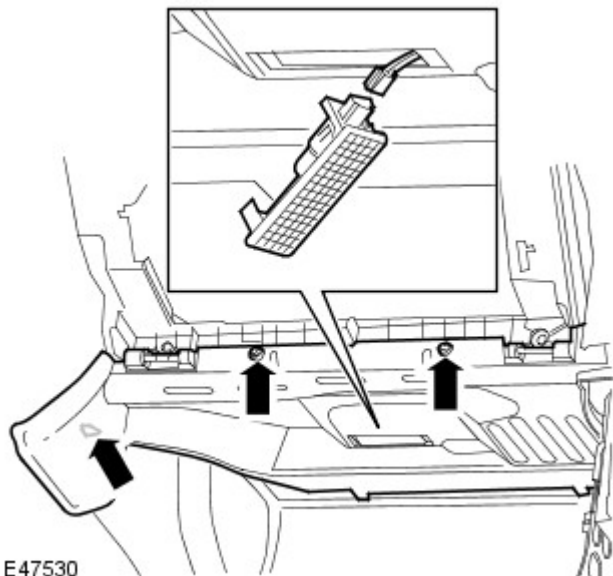
Heating and Ventilation - Blower Motor

Removal and Installation

Removal

1. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).
2. Remove the passenger side closing trim panel.

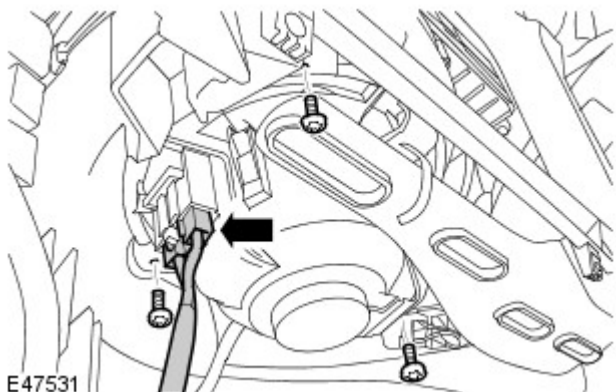
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47530

3. Position the footwell duct aside for access.


- Release the clip.



E47531

4. Remove the blower motor.
 - Disconnect the electrical connector.
 - Remove the 3 screws.

Installation

1.  **CAUTION:** Fixings must be started by hand to avoid damaging threads.

Install the blower motor.

- Tighten the screws.
- Connect the electrical connector.

2. Secure the footwell duct.

- Install the clip.

3. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

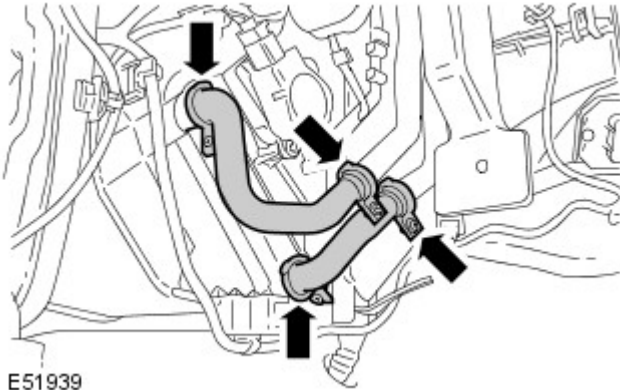
4. Install the glove compartment.
For additional information, refer to: [Glove Compartment](#)
(501-12 Instrument Panel and Console, Removal and Installation).

Heating and Ventilation - Heater CoreLHD AWD

Removal and Installation

Removal

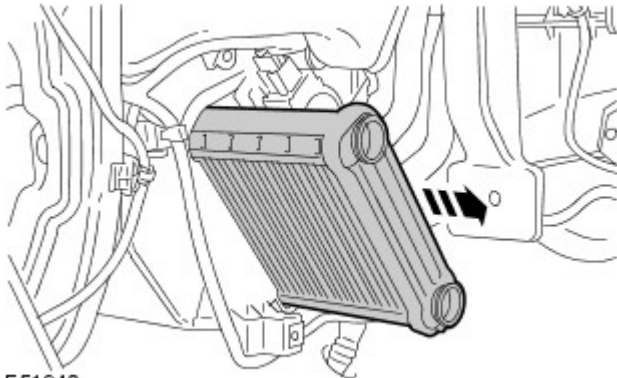
1. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
2. Remove the instrument panel passenger side reinforcement.
For additional information, refer to: [Instrument Panel Passenger Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the heater core upper and lower pipes.



E51939

- Position a container to collect the fluid.
- Loosen the 4 screws and remove the clips.
- Remove and discard the 4 O-ring seals.

4. Remove the heater core.



E51940

Installation

1. Install the heater core.
2. Install the heater core upper and lower pipes.
 - Clean the components.
 - Install the new O-ring seals.
 - Install the clips and tighten the screws.
 - Remove the container.
3. Install the instrument panel passenger side reinforcement.
For additional information, refer to: [Instrument Panel Passenger Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

Heating and Ventilation - Heater CoreRHD AWD

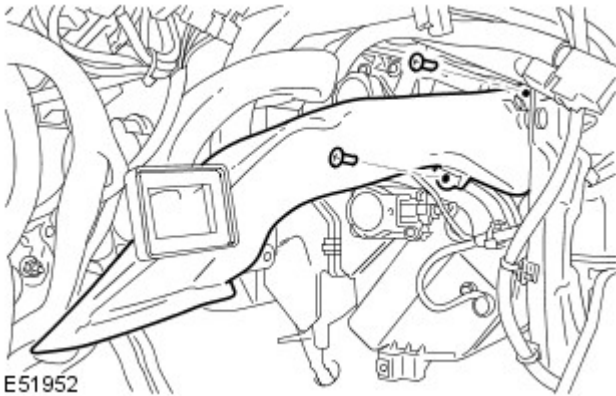
Removal and Installation

Removal

1. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
2. Remove the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. **NOTE:** LHD illustration shown, RHD is similar.

Remove the driver side footwell duct.

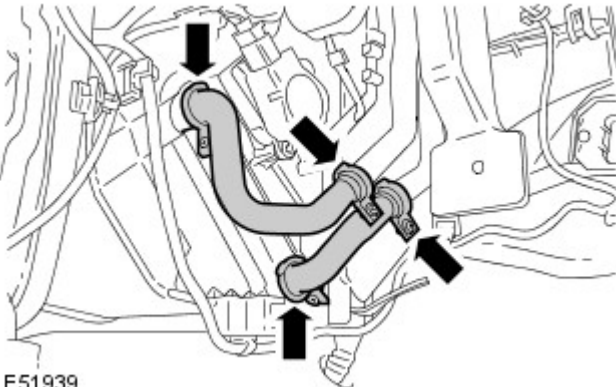
- Remove the 2 Torx screws.



E51952

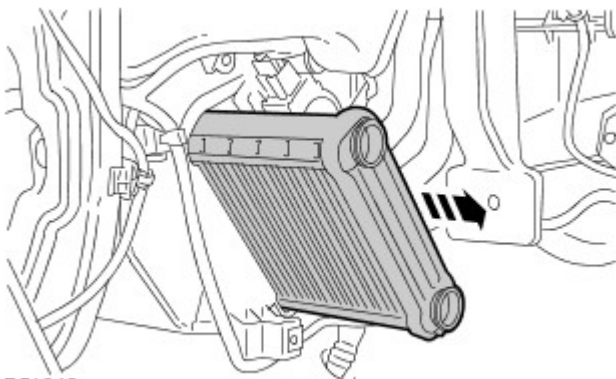
4. Remove the heater core upper and lower pipes.

- Position a container to collect the fluid.
- Loosen the 4 screws and remove the clips.
- Remove and discard the 4 O-ring seals.



E51939

5. Remove the heater core.



E51940

Installation

1. Install the heater core.
2. Install the heater core upper and lower pipes.
 - Clean the components.
 - Install the new O-ring seals.

- Install the clips and tighten the screws.
 - Remove the container.
3. Install the driver side footwell duct.
- Tighten the screws.
4. Install the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
5. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

Auxiliary Heating -

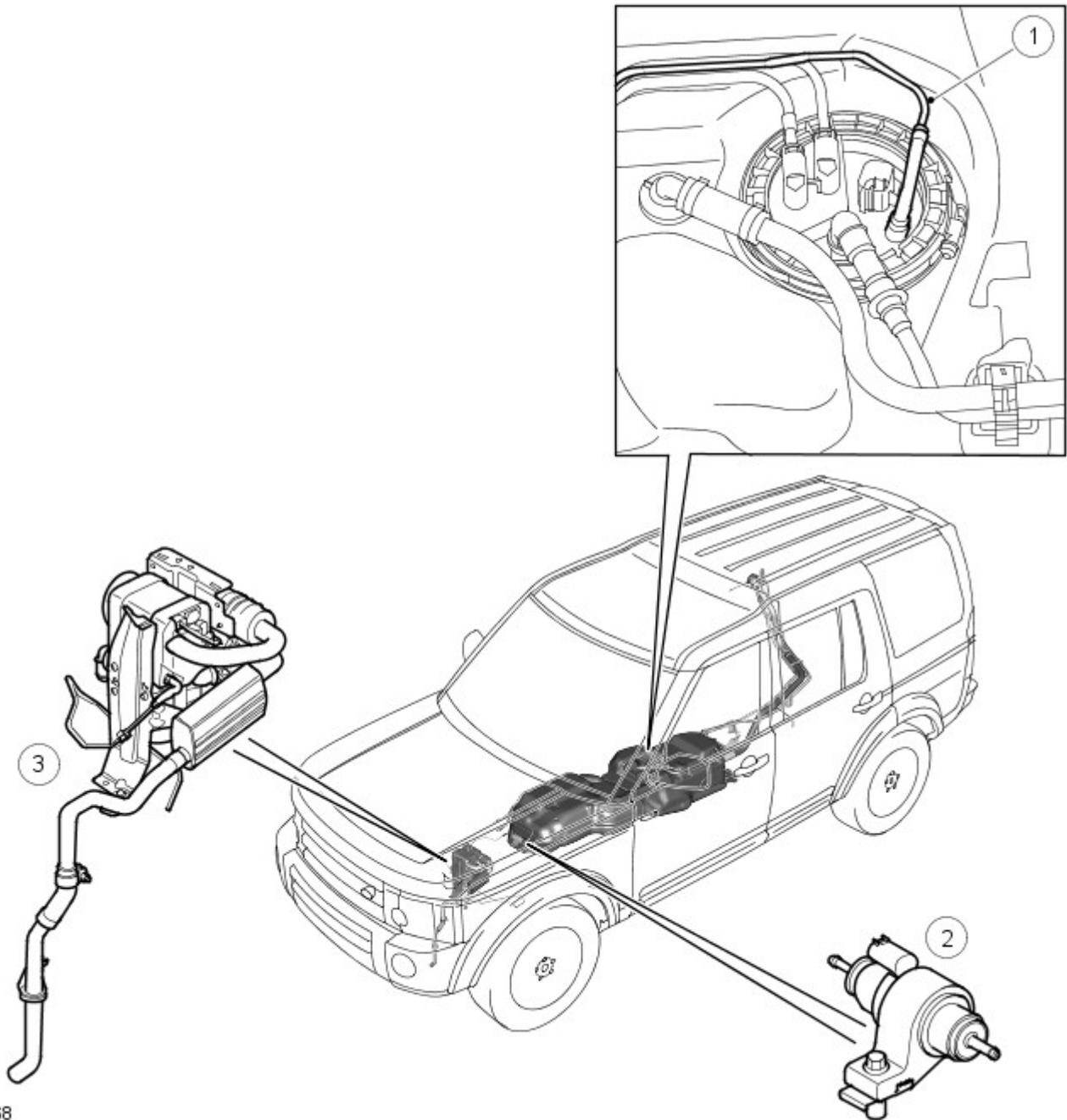
Torque Specifications

Description	Nm	lb-ft
Fuel fired booster heater exhaust bracket bolt	10	7
Fuel fired booster heater	10	7

Auxiliary Heating - Auxiliary Heater

Description and Operation

COMPONENT LOCATIONS



E43568

Item	Part Number	Description
1	-	Fuel line connection with fuel tank
2	-	Auxiliary fuel pump
3	-	FFBH (fuel fired booster heater)

GENERAL

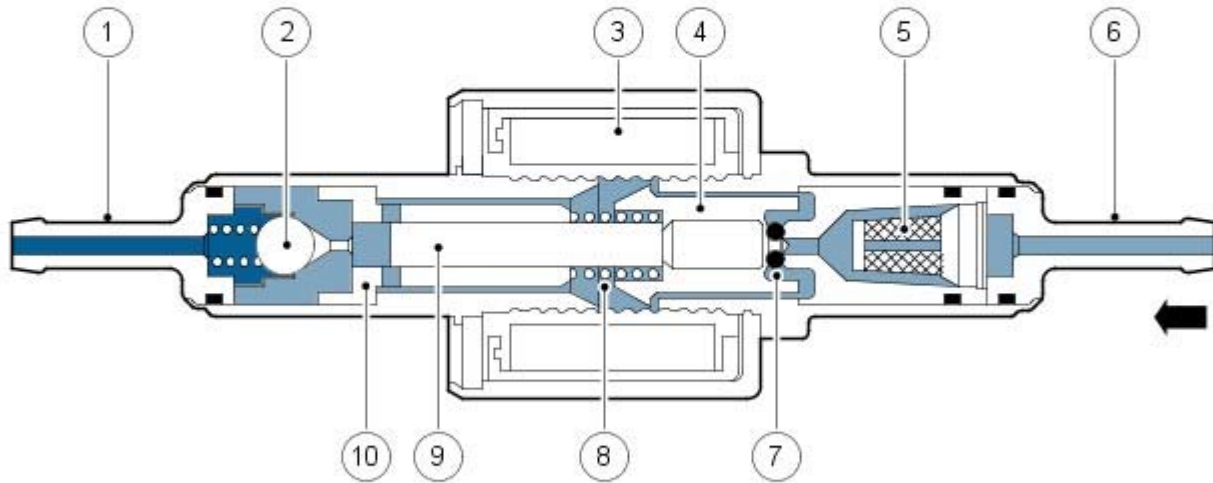
Auxiliary heating is provided by a FFBH, which boosts the temperature of the coolant supplied to the heater from the engine. Fuel for the FFBH is taken from the vehicle fuel tank, through a fuel line attached to the fuel pump module. An auxiliary fuel pump supplies the fuel at low pressure to the FFBH. In the FFBH, the fuel is burned and the resultant heat output is used to heat the engine coolant.

Operation of the FFBH is enabled and disabled by the automatic temperature control (ATC) module.

AUXILIARY FUEL PUMP

The auxiliary fuel pump regulates the fuel supply to the FFBH. The pump is installed in a rubber mounting attached to the chassis, below the right-hand (RH) front seat. The pump is a self-priming, solenoid operated plunger pump, controlled by a pulse width modulation (PWM) signal from the control module in the FFBH. When the pump is de-energized, it provides a positive shut-off of the fuel supply.

Sectioned View of Auxiliary Fuel Pump



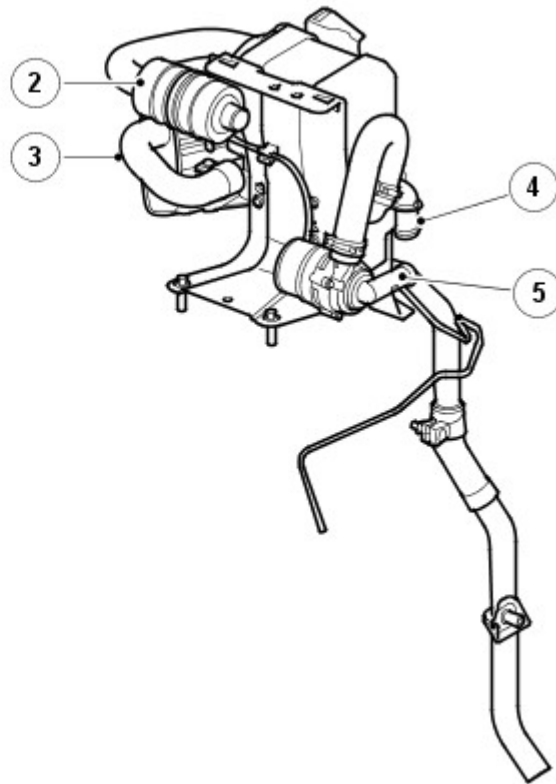
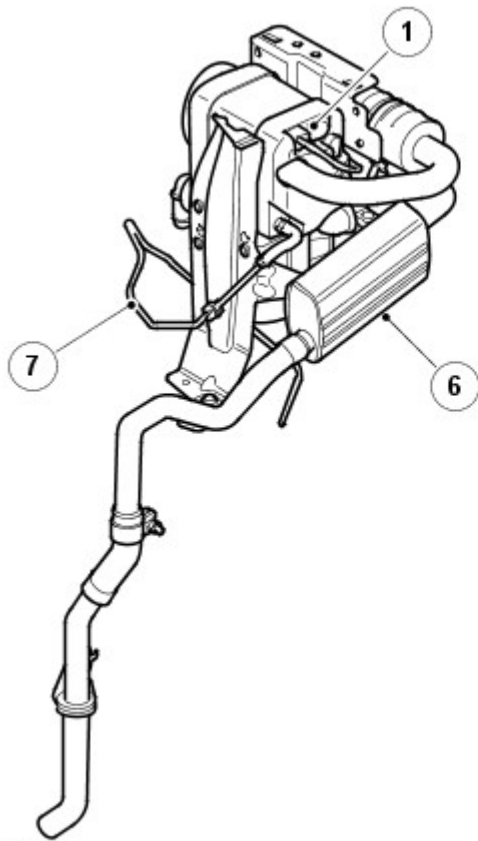
E43569

Item	Part Number	Description
1	-	Fuel line connector
2	-	Non return valve
3	-	Solenoid coil
4	-	Plunger
5	-	Filter insert
6	-	Fuel line connector
7	-	O-ring seal
8	-	Spring
9	-	Piston
10	-	Bush

The solenoid coil of the auxiliary fuel pump is installed around a housing which contains a plunger and piston. The piston locates in a bush, and a spring is installed on the piston between the bush and the plunger. A filter insert and a fuel line connector are installed in the inlet end of the housing. A non return valve and a fuel line connector are installed in the fuel outlet end of the housing.

While the solenoid coil is de-energized, the spring holds the piston and plunger in the closed position at the inlet end of the housing. An O-ring seal on the plunger provides a fuel tight seal between the plunger and the filter insert, preventing any flow through the pump. When the solenoid coil is energized, the piston and plunger move towards the outlet end of the housing, until the plunger contacts the bush; fuel is then drawn in through the inlet connection and filter. The initial movement of the piston also closes transverse drillings in the bush and isolates the pumping chamber at the outlet end of the housing. Subsequent movement of the piston then forces fuel from the pumping chamber through the non return valve and into the line to the FFBH. When the solenoid de-energizes, the spring moves the piston and plunger back towards the closed position. As the piston and plunger move towards the closed position, fuel flows past the plunger and through the annular gaps and transverse holes in the bush to replenish the pumping chamber.

FFBH



E43570

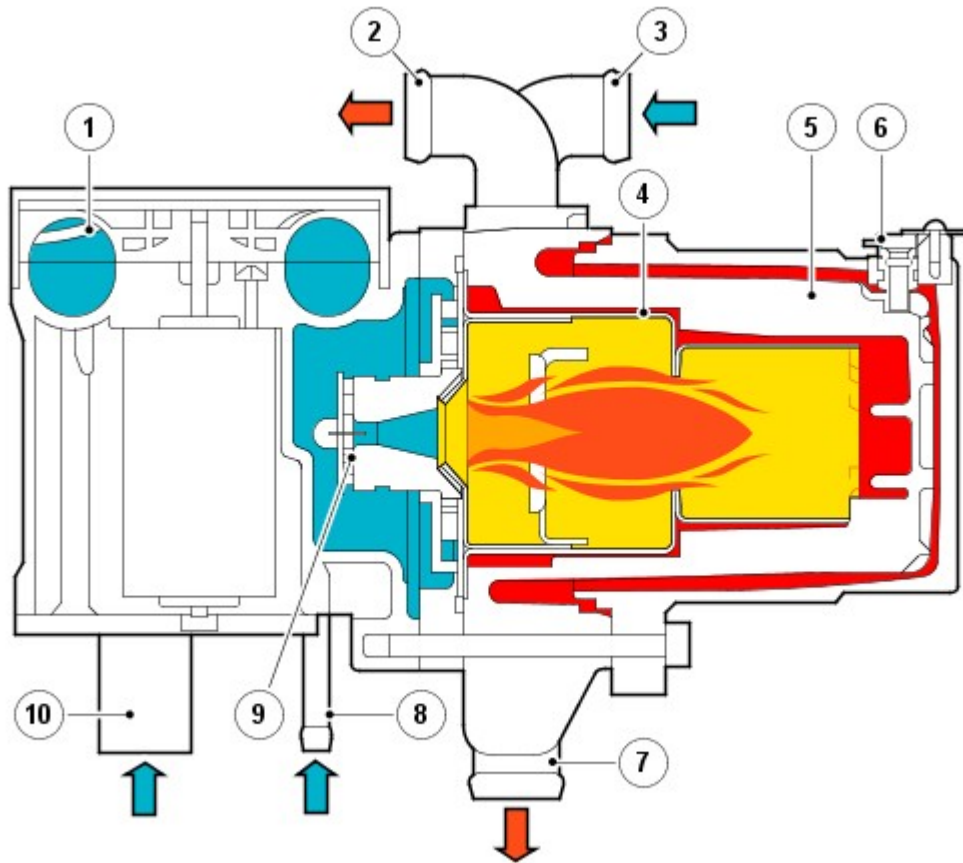
Item	Part Number	Description
1	-	Electrical connectors
2	-	Air inlet muffler
3	-	Exhaust pipe
4	-	Coolant outlet connection
5	-	Coolant inlet connection
6	-	Exhaust muffler
7	-	Fuel supply line

The FFBH is installed in the front left corner of the engine compartment. It is connected in series with the coolant supply to the heater assembly. Two electrical connectors on the FFBH connect it to the vehicle wiring.

The FFBH unit consists of:

- A circulation pump.
- A combustion air fan.
- A burner housing.
- A heat exchanger.
- An air inlet hose and muffler.
- An exhaust pipe and muffler.
- A control module.

Sectioned View of FFBH



E43571

Item	Part Number	Description
1	-	Combustion air fan
2	-	Coolant outlet
3	-	Coolant inlet
4	-	Burner insert
5	-	Heat exchanger
6	-	Temperature sensor
7	-	Exhaust
8	-	Fuel inlet
9	-	Evaporator
10	-	Air inlet

Remote Handset

Remote Handset Pairing

Each remote handset must be 'paired' to the receiver to enable communications. Each handset has a unique identification number which is stored by the receiver. The receiver can store up to 3 handset identification numbers. If a fourth handset is paired to the receiver, the receiver will replace the first paired handset number with that for the fourth handset in the receiver memory. Subsequently, the first paired handset will no longer be paired and will not be recognized by the receiver.

The following procedure details the pairing process:

• **NOTE:** The pairing process relies on the FFBH receiver having the power supply removed and then the power supply re-instated. The fuse method is the easiest method but it can also be achieved by battery disconnection or removal of the harness connector from the receiver unit.

- Remove minifuse F2 5A (telestart fuse) from the [BJB \(battery junction box\)](#)
- Wait for a minimum of 5 seconds
- Replace fuse to position F2 5A in the [BJB](#)
- Within 5 seconds of replacing the fuse (and restoring the receiver power supply), press and hold the remote handset OFF button
- Confirmation of successful pairing is displayed by the remote handset [LED \(light emitting diode\)](#) illuminating in a red color for 2 seconds.

Circulation Pump

The circulation pump is installed at the coolant inlet to the FFBH to assist the coolant flow through the FFBH and the vehicle heater core. The circulation pump runs continuously while the FFBH is in standby or active operating modes. While the FFBH is inactive, coolant flow is reliant on the engine coolant pump. Operation of the circulation pump is controlled by a power feed direct from the control module.

Combustion Air Fan

The combustion air fan regulates the flow of air into the FFBH to support combustion of the fuel supplied by the auxiliary fuel pump and to purge and cool the FFBH.

Burner Housing

The burner housing contains the burner insert and also incorporates connections for the exhaust pipe, the coolant inlet from the circulation pump and the coolant outlet to the vehicle heater core.

The burner insert incorporates the fuel combustion chamber, an evaporator and a glow pin and flame sensor. Fuel from the auxiliary fuel pump is supplied to a venturi, where it evaporates and enters the combustion chamber to mix with air from the combustion air fan. The glow pin and flame sensor provides the ignition source of the fuel:air mixture and, once combustion is established, monitors the flame.

Heat Exchanger

The heat exchanger transfers heat generated by combustion to the coolant. Two sensors are installed in the heat exchanger casing to provide the control module with inputs of coolant temperature. The control module uses the temperature inputs to control system operation.

Air Inlet Hose and Muffler

A canister type muffler is included in the air inlet supply line. The muffler reduces the noise caused by induction roar.

Exhaust Pipe and Muffler

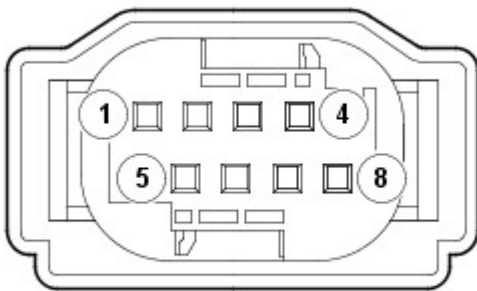
The exhaust pipe and muffler directs exhaust combustion gases to atmosphere below the front left corner of the engine. Exhaust vapor may be visible when the FFBH is running, depending on atmospheric conditions.

Control Module

The control module controls and monitors operation of the FFBH system. An internal flow of air from the combustion air fan ventilates the control module to prevent it overheating.

The control module communicates with other systems on the vehicle over the medium speed Controller Area Network (CAN) bus.

FFBH Control Module Harness Connector C0925

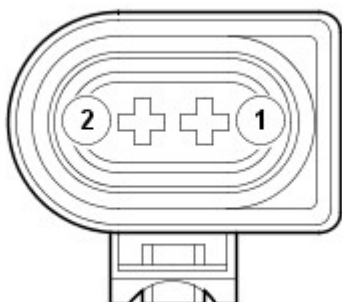


E50045

FFBH Control Module Harness Connector C0925 Pin Details

Pin No.	Description	Input/Output
1	Not used	-
2 and 3	Not used	-
4	Medium speed controller area network (CAN) bus low	Input/Output
5	Auxiliary fuel pump power feed	Output
6	Not used	-
7	Medium speed CAN bus high	Input/Output
8	Not used	-

FFBH Control Module Harness Connector C0926



E50046

FFBH Control Module Harness Connector C0926 Pin Details

Pin No.	Description	Input/Output
1	Permanent battery power supply	Input
2	Ground	Output

Operation of the FFBH is controlled by a status message from the ATC module to the control module. A similar status message, from the control module to the ATC module, advises the ATC module of the current operating status of the FFBH.

While the engine is running, if the ambient air temperature is less than 9 °C (48 °F) and the engine coolant temperature (ECT) is less than 75 °C (167 °F) the ATC module changes the status message from 'heater off' to 'supplemental heat'. The control module then changes the status message it sends the ATC module to 'supplemental heat' and starts the FFBH. The control module will not start the FFBH, or will discontinue operation, if any of the following occur:

- The control module is in the error lockout mode (see Diagnostics, below).
- A crash message is received from the restraints control module (RCM). For additional information, refer to: Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) (descop 501-20B).
- A low fuel level message is received from the instrument cluster. For additional information, refer to: Information and Message Center (descop 413-08).
- The engine is not running, or stops running for approximately 4 seconds. The time delay is included for stall protection.

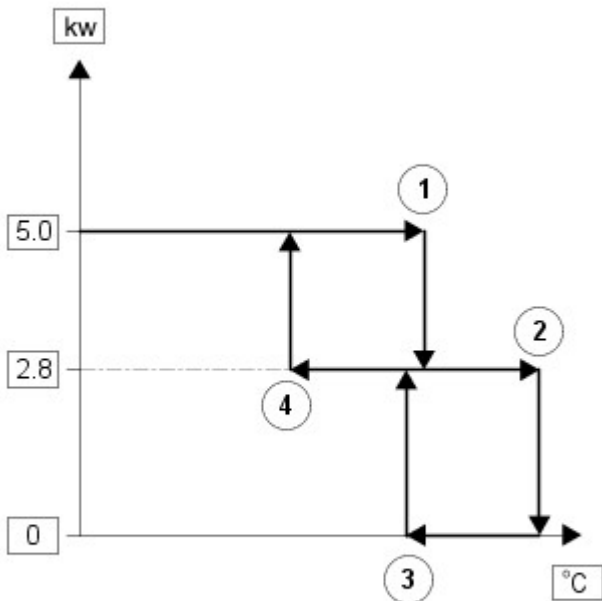
If the control module does not start the FFBH, or discontinues operation, the status message to the ATC module remains at, or changes to, 'heater off'. If the ambient air temperature increases to 9 °C (48 °F), or the ECT increases to 75 °C (167 °F), the ATC module cancels supplementary heating, by changing the status message to the control module back to 'heater off'. The control module then cancels FFBH operation and changes the status message to the ATC module to 'heater off'.

The FFBH is controlled at one of two heat output levels, 2.8 kW at part load combustion and 5 kW at full load combustion. The control module transmits the amount of fuel used by the FFBH to the instrument cluster, and the FFBH coolant temperature to the ATC module.

Start Sequence: At the beginning of a start sequence, the control module energizes the glow pin function of the glow pin and flame sensor, to pre heat the combustion chamber, starts the combustion air fan at slow speed and energizes the coolant circulation pump. After approximately 30 seconds, the control module energizes the auxiliary fuel pump at the starting sequence speed. The fuel delivered by the auxiliary fuel pump evaporates in the combustion chamber, mixes with air from the combustion air fan and is ignited by the glow pin and flame sensor. The control module then progressively increases the speed of the auxiliary fuel pump and the combustion air fan. Once combustion is established the control module switches the glow pin and flame sensor from the glow pin function to the flame sensing function to monitor combustion. From the beginning of the start sequence to stable combustion at full load takes approximately 150 seconds.

Coolant Temperature Control: While the FFBH is running, the control module cycles the FFBH between full load combustion, part load combustion and a control idle phase of operation, depending on the temperature of the coolant in the heat exchanger.

Switching Point Diagram



E56856

Switching Point		Temperature, °C (°F)
Figure Item No.	Description	
1	Full load to part load	87 (188)
2	Part load to control idle	90 (194)

Switching Point		Temperature, °C (°F)
Figure Item No.	Description	
3	Control idle to part load	79 (174)
4	Part load to full load	76 (168)

After the start sequence, the control module maintains full load combustion until the coolant temperature reaches switching point temperature 1. At this temperature, the control module decreases the speed of the auxiliary fuel pump and the combustion air fan to half speed, to produce part load combustion. The control module maintains part load combustion while the coolant temperature remains between switching point temperatures 2 and 4. At part load combustion the temperature of the coolant will increase or decrease depending on the amount of heat required to heat the vehicle interior. If the coolant temperature decreases to switching point temperature 4, the control module increases the speed of the auxiliary fuel pump and the combustion air fan to full speed, to return to full load combustion. If the coolant temperature increases to switching point temperature 2, the control module enters a control idle phase of operation.

On entering the control idle phase, the control module immediately switches the auxiliary fuel pump off, to stop combustion, and starts a timer for the combustion air fan. After a 2 minute cool down period, the control module switches the combustion air fan off and then remains in the control idle phase while the coolant temperature remains above switching point temperature 3. If the coolant temperature decreases to switching point temperature 3, the control module initiates a start to part load combustion. A start to part load combustion takes approximately 90 seconds.

In order to limit the build up of carbon deposits on the glow pin and flame sensor, the control module also enters the control idle phase if continuous combustion time exceeds 72 minutes (at part load, full load or a combination of both). After the cool down period, if the coolant is still in the temperature range that requires additional heat, the control module restarts the FFBH.

Shutdown: To stop the FFBH, the control module de-energizes the auxiliary fuel pump to stop combustion, but continues operation of the combustion air fan and the circulation pump for a time, to cool down the FFBH. The cool down time is 100 seconds if the FFBH was operating at part load combustion and 175 seconds if the FFBH was operating at full load combustion.

Diagnostics

The control module monitors the FFBH system for faults. Any faults detected are stored in a volatile memory in the control module, which can be interrogated by T4 via the medium speed CAN bus. A maximum of three faults and associated freeze frame data can be stored at any one time. If a further fault is detected, the oldest fault is overwritten by the new fault.

The control module also incorporates an error lockout mode of operation that inhibits operation to prevent serious faults from causing further damage to the system. In the error lockout mode, the control module immediately stops the auxiliary fuel pump, and stops the combustion air fan and circulation pump after a cool down time of approximately 2 minutes. Error lockout occurs for start sequence failures, combustion flameouts, heat exchanger casing overheat and if battery voltage is out of limits. The error lockout mode can be cleared using T4, or by disconnecting the battery power supply (connector C0926) for a minimum of 10 seconds.

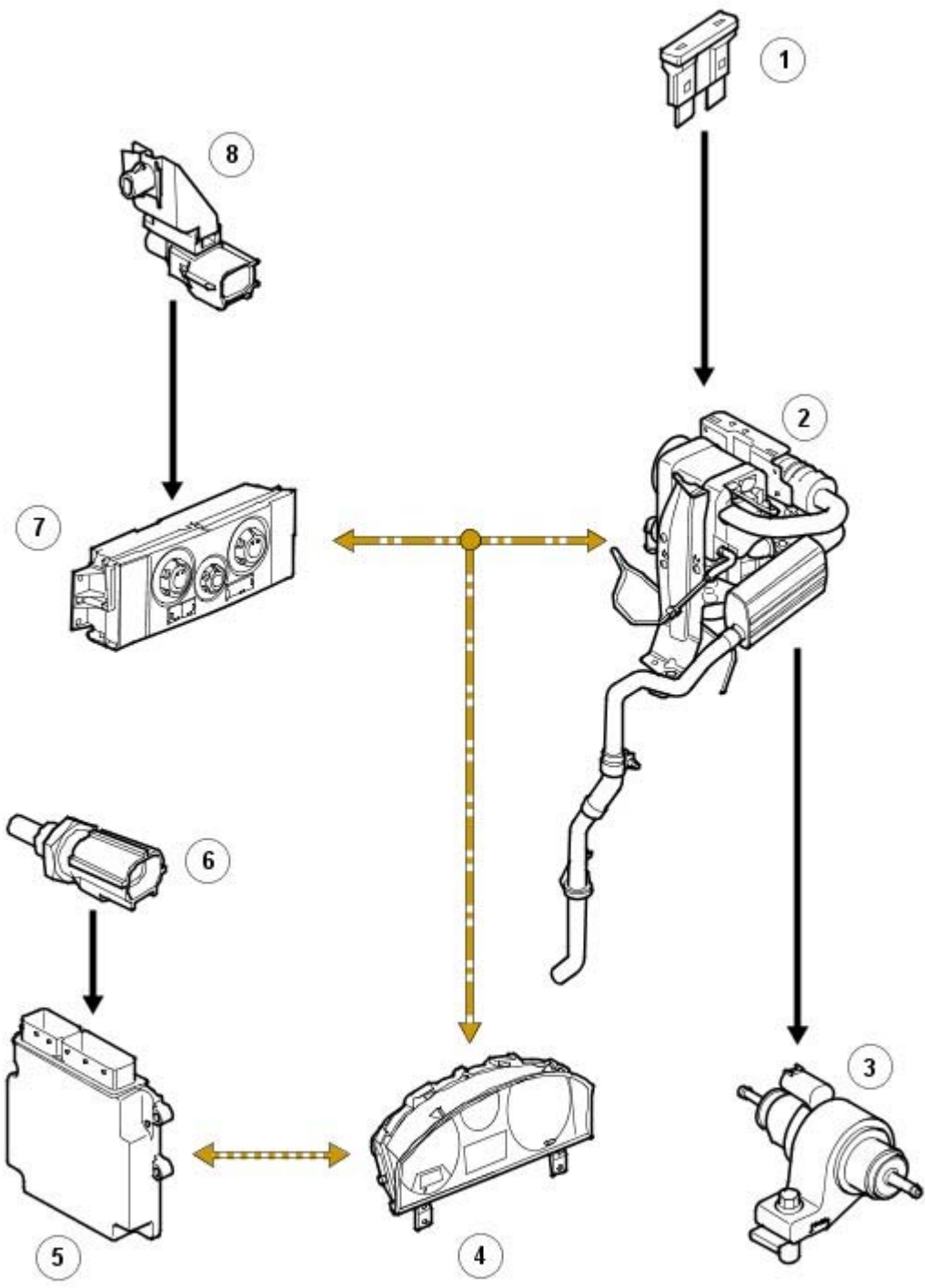
Start Failure and Flameout: If a start sequence fails to establish combustion, or a flameout occurs after combustion is established, the control module immediately initiates another start sequence. The start failure or flameout is also recorded by an event timer in the control module. The event timer is increased by one after each start failure or flameout, and decreased by one if a subsequent start is successful. If the event timer increases to three (over any number of drive cycles), the control module enters the error lockout mode.

Heat Exchanger Casing Overheat: To protect the system from excessive temperatures, the control module enters the error lockout mode if the heat exchanger coolant temperature exceeds 125 °C (257 °F).

Battery Voltage Limits: 10.25 - 15.5 volts.

CONTROL DIAGRAM

• NOTE: A = Hardwired connections; D = High speed CAN bus; F = RF transmission; N = Medium speed CAN bus; P = MOST bus



E43575



Item	Part Number	Description
1	-	Fuse 28E, battery junction box (BJB)
2	-	FFBH
3	-	Auxiliary fuel pump
4	-	Instrument cluster
5	-	engine control module (ECM)
6	-	ECT sensor
7	-	ATC module
8	-	Ambient air temperature sensor

Auxiliary Heating - Fuel Fired Booster Heater

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel fired booster heater system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Auxiliary Heater](#) (412-02B Auxiliary Heating, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Fuel fired heater assembly <ul style="list-style-type: none"> - Coolant inlet/outlet - Exhaust - Fuel inlet - Air inlet ● Auxiliary fuel pump and lines ● Auxiliary coolant pump 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Electrical connector(s) ● Control module(s)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Fuel Fired Booster Heater Module \(AHCM\)](#) (100-00 General Information, Description and Operation).

Auxiliary Heating - Auxiliary Heater Remote Transmitter Programming

General Procedures

Activation

- NOTE: A second or third hand held transmitter can be programmed using this method.

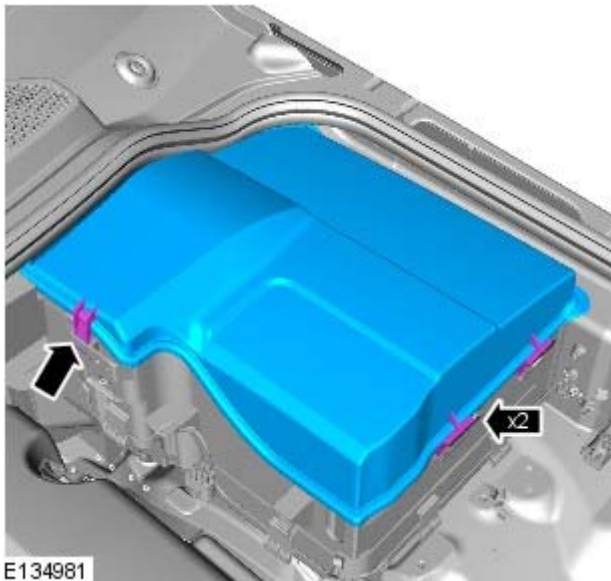


E135001

1. NOTE: Use a coin or similar implement to remove and install the battery cover.

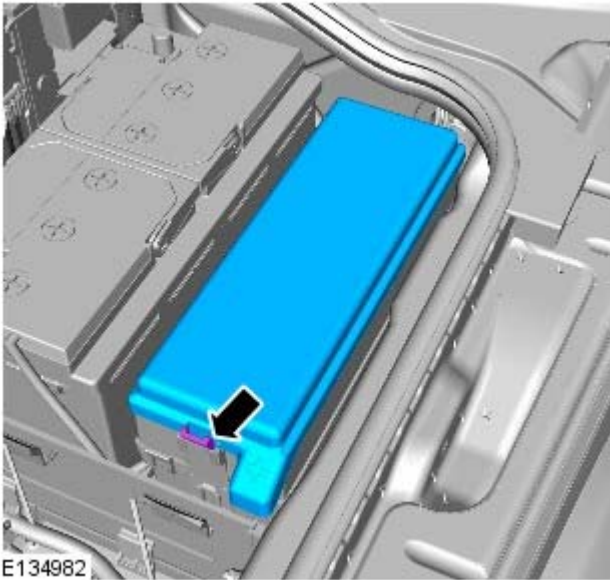
- NOTE: Make sure that correct battery polarity is maintained.

Remove and install the transmitter battery.

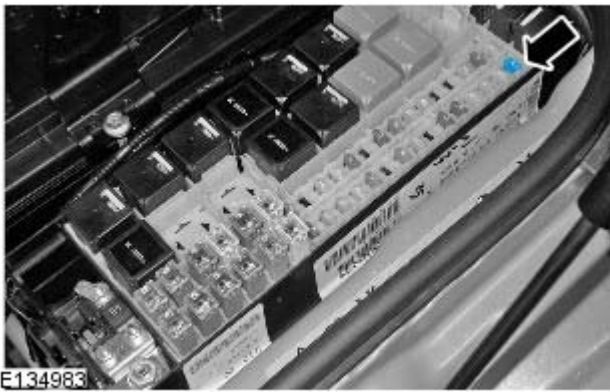


E134981

- 2.



3.



4. Remove fuse 2 (5 Amp) from the battery junction box (BJB).



5. **5. NOTE:** This completes the programming procedure.

Install fuse 2 (5 Amp), and within 5 seconds press the OFF button on the transmitter for at least 1 second.

6. To confirm whether the programming procedure has completed correctly, push the off button. If a continuous red light is displayed on the transmitter, the programming procedure was successful. If a flashing red light is displayed, the procedure was unsuccessful, or the transmitter is not in range. In this case, make sure the transmitter is within the recommended range and repeat the above procedure from step 4.

Auxiliary Heating - Fuel Fired Booster Heater TDV6 2.7L Diesel

Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. NOTE: Wheel shown removed for clarity.

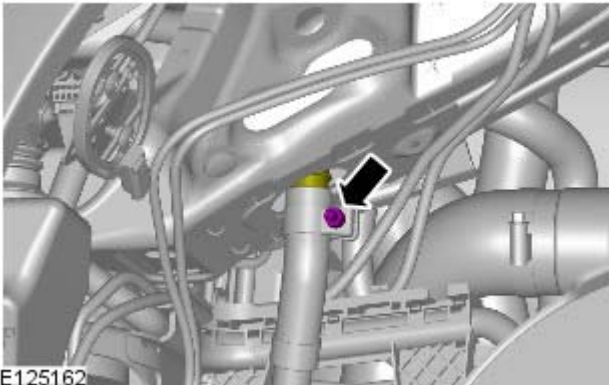
Carefully release the wheel arch liner, to allow access to the fuel fired burner heater (FFBH) exhaust clamp retaining bolt.




E131518

4. NOTE: Components removed for clarity.

Release the exhaust clamp.

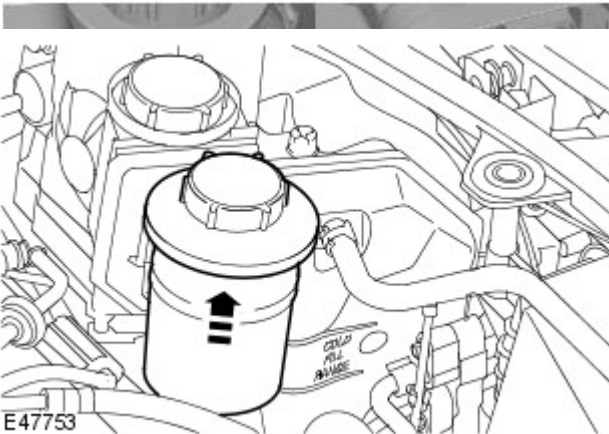


E125162

6. Lower the vehicle.
5.  **CAUTION:** Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.
7. Release the power steering fluid reservoir.

Disconnect the fuel fired booster heater fuel line.

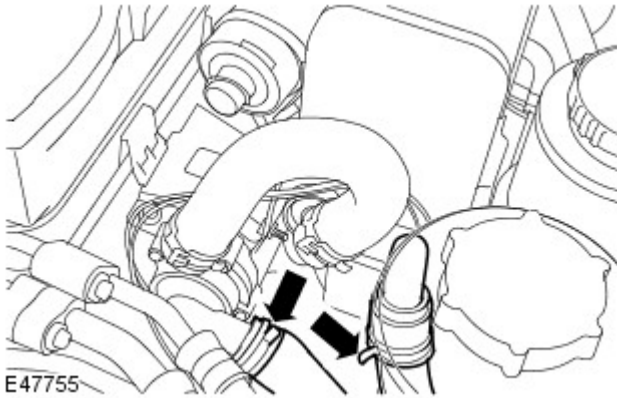
- Release the clip.



E47753

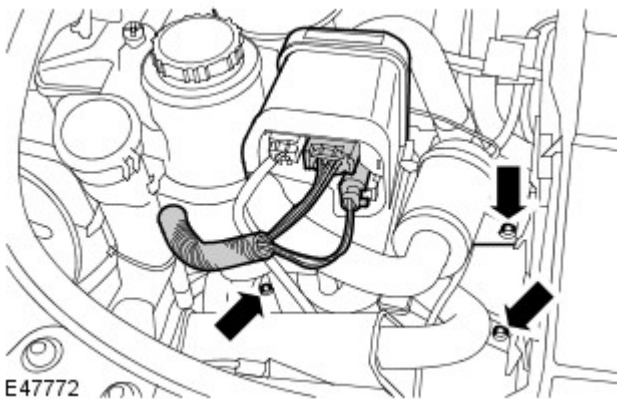


E125164



8. Disconnect the fuel fired booster heater inlet and outlet coolant hoses.

- Clamp the hoses to minimise coolant loss.
- Release the 2 clips.



9. Remove the fuel fired booster heater.

- Disconnect the 2 electrical connectors.
- Remove the 3 bolts.
- Release the fuel pipe from the clip.

Installation

1. Install the fuel fired booster heater.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect the electrical connectors.
- Secure the fuel pipe in the clip.

2. Connect the fuel fired booster heater coolant hoses.

- Secure with the clips.
- Remove the clamps.

3. Connect the fuel fired booster heater fuel hose.

- Secure with the clip.

4. Raise the vehicle.

5. Tighten the exhaust clamp.

- Tighten to 10 Nm (7 lb.ft).

6. Secure the wheel arch liner.

- Install the two retaining screws.
- Install the clip.

7. Lower the vehicle.

8. Install the power steering fluid reservoir.

9. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

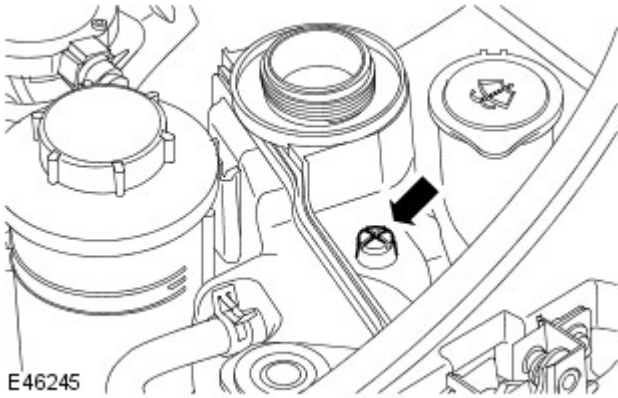
10. Connect exhaust extraction hoses to the tail pipes.

11. Remove the engine cover.

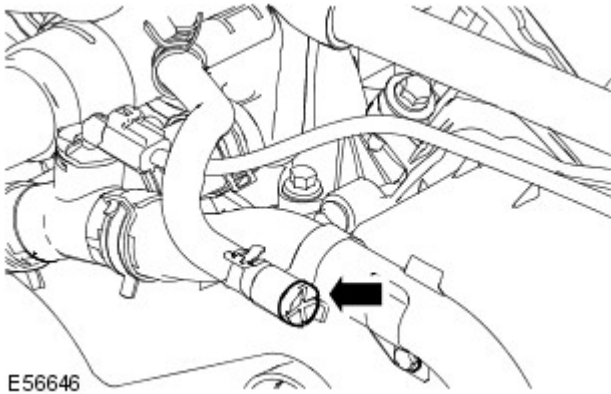
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and

Installation).

12. Loosen the coolant expansion tank bleed screw.



13. Loosen the cylinder head bleed hose bleed screw.




14. Refill the cooling system.

15. Tighten the bleed screws to 14 Nm (10 lb.ft).

16. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

17. NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top up the expansion tank to 30mm above the maximum level.

Install the coolant expansion tank cap.

18.  **WARNING:** Release the cooling system pressure by slowly turning the expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

Start and run the engine.

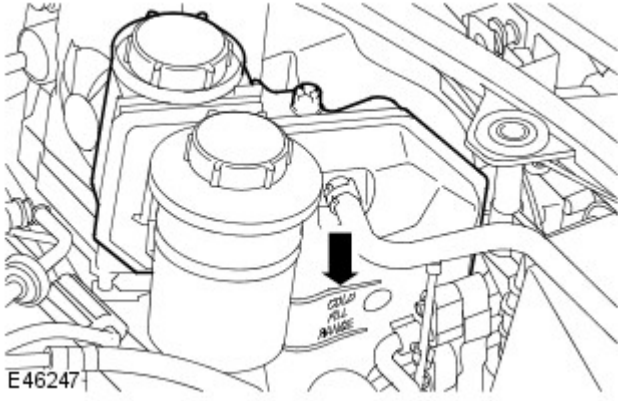
- Hold the engine speed at 3,000 RPM for one minute.
- Return the engine to idle for five minutes.
- Hold the engine speed at 3,000 RPM for one minute.
- Run the engine until the thermostat opens.
- Remove coolant expansion tank cap, allow float to settle and top-up coolant if required. Install cap.

19. Switch the engine off and allow to cool.

20. Install the engine cover.

For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

21. Check and top-up the coolant if required.



E46247

Auxiliary Heating - Fuel Fired Booster Heater TDV6 3.0L Diesel

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. **NOTE:** Wheel shown removed for clarity.

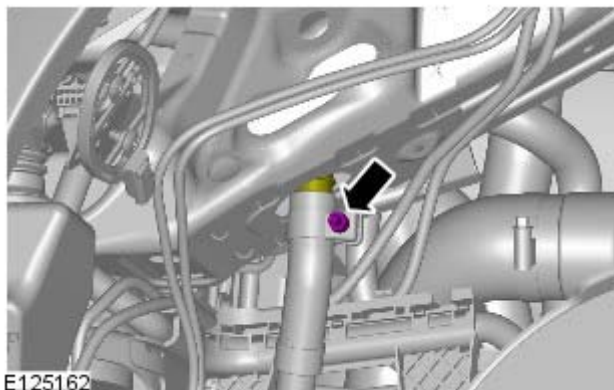
- Carefully release the wheel arch liner, to allow access to the fuel fired burner heater (FFBH) exhaust clamp retaining bolt.



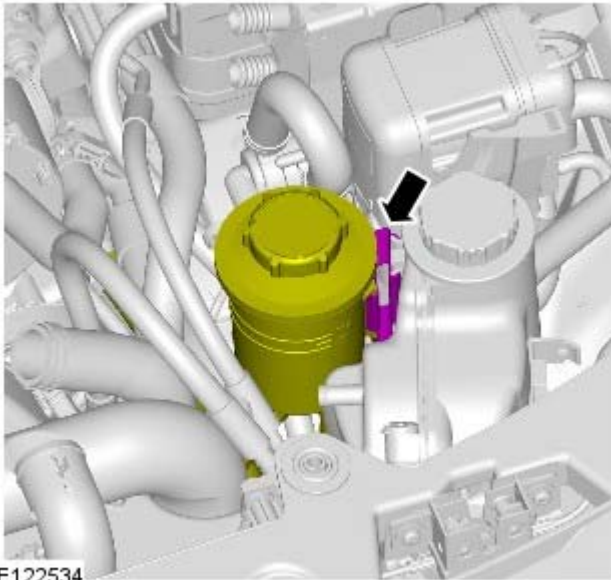
E131518

4.
 - NOTE: Components removed for clarity.

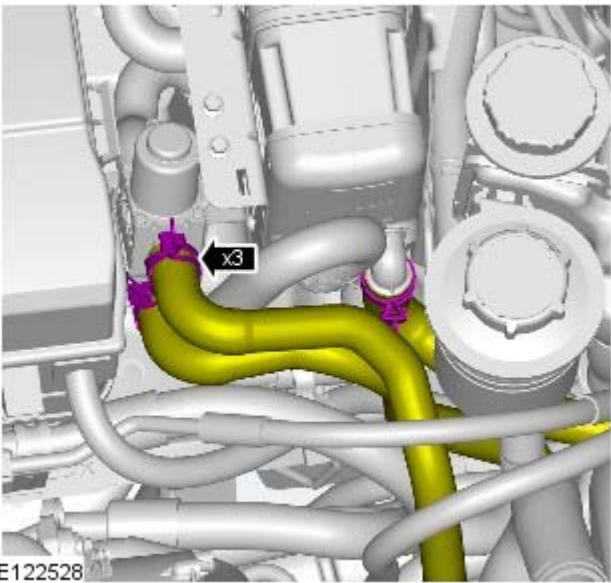
Torque: 10 Nm



E125162

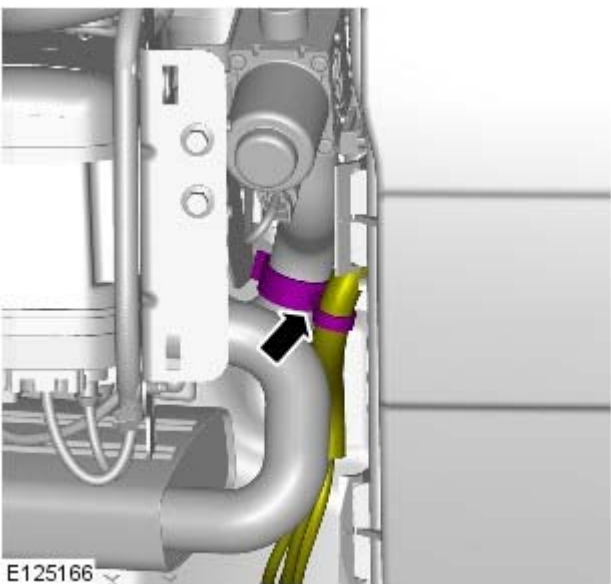


5.

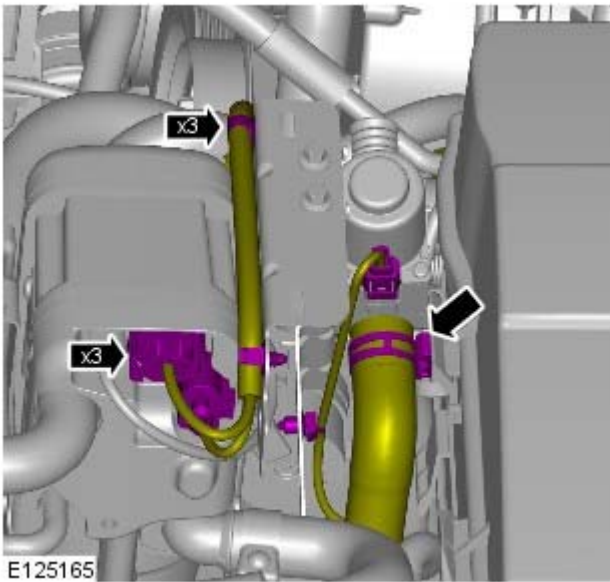


6.  CAUTION: Be prepared to collect escaping coolant.

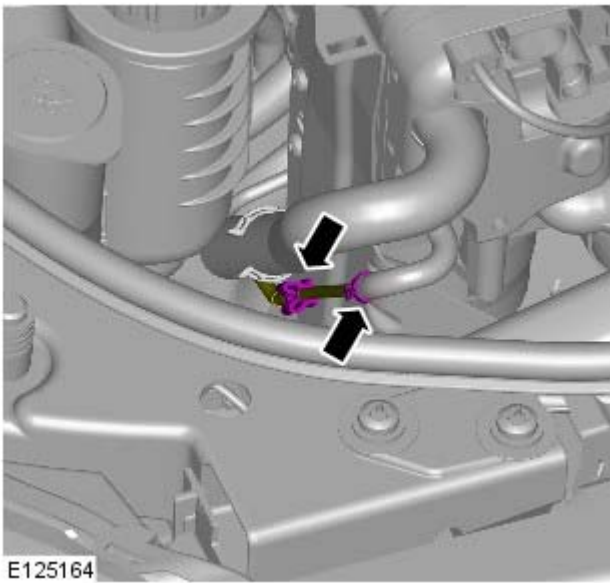
- Clamp the hoses to minimize coolant loss.




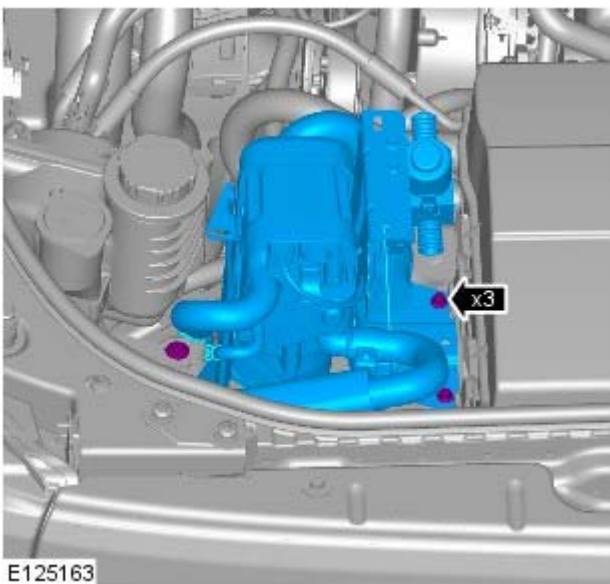
7.



8.



9.  CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



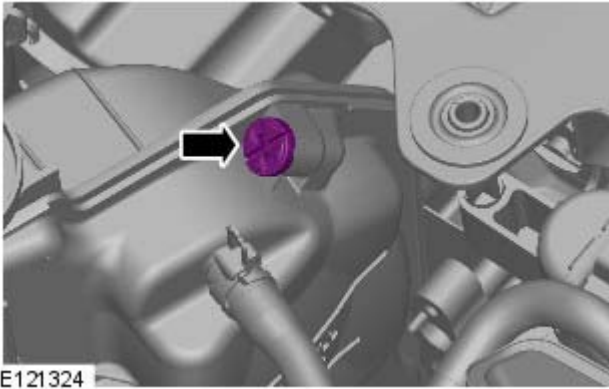
10. Torque: 10 Nm

Installation

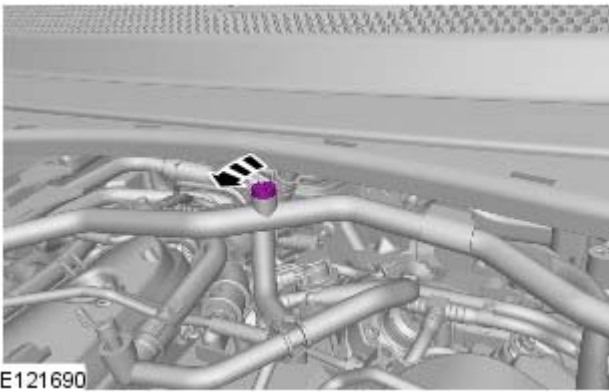
1. To install, reverse the removal procedure.

2. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

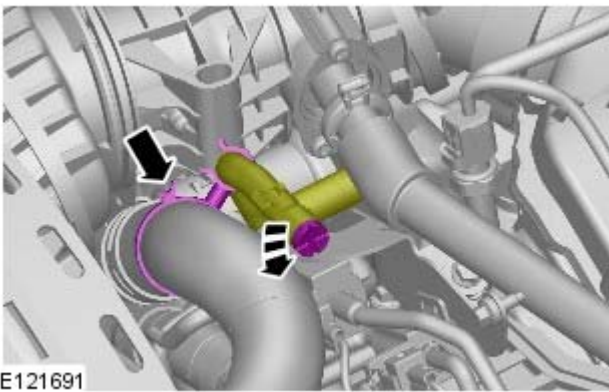
3.

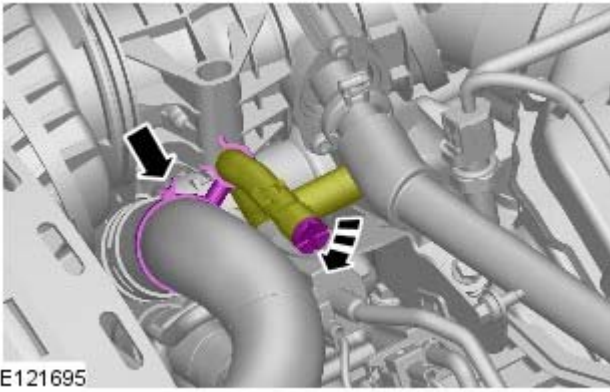


4.



5.



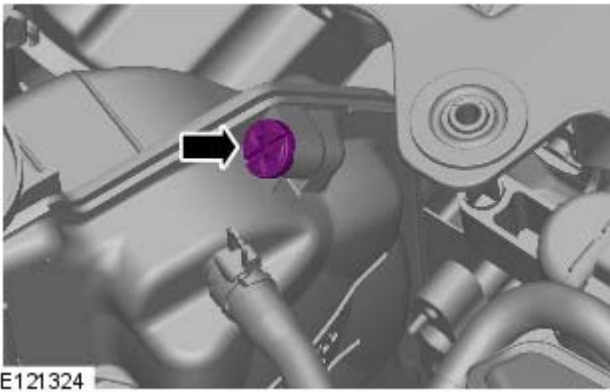


6. **6. CAUTIONS:**

 Anti-freeze concentration must be maintained at 50%.

 Be prepared to collect escaping coolant.

Fill the coolant expansion tank until coolant appears through the bleed ports.



7. **7.  CAUTION: Be prepared to collect escaping coolant.**

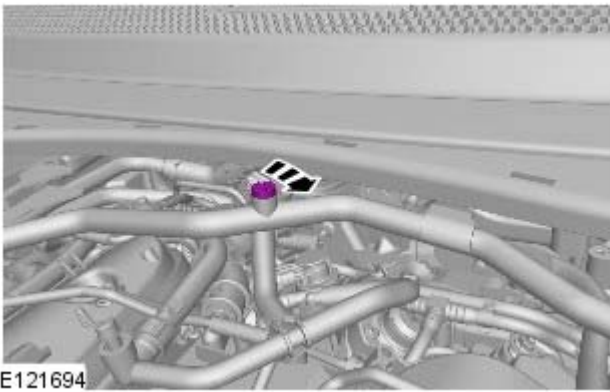
Fill the coolant expansion tank until coolant appears through the bleed ports.

8.

- Set the heater controls to maximum.

9.

- Start the engine and continue to fill the coolant until the maximum level is reached.



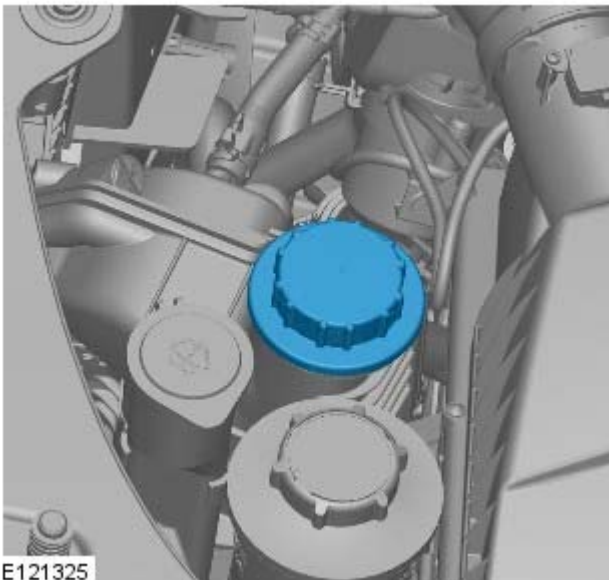
10. **10.  CAUTION: Be prepared to collect escaping coolant.**


Fill the coolant expansion tank until coolant appears through the bleed ports.

11. Increase engine speed to 2500rpm and cycle between this and idle.

12.

- Continue to top-up with coolant with the engine at idle.



13.  **CAUTION:** Correct installation of the Coolant expansion tank cap can be obtained by tightening the cap until an audible click is heard.


14. Allow the engine to idle, until hot air is emitted at the face registers.
15. Once the front heater is warm, check if the rear heater is warm (if equipped). If no heat is felt, increase the engine speed to 3000 rpm for 30 seconds and return to idle.

16.  **CAUTION:** Switch off the engine and allow the coolant temperature to go cold.

17. Visually check the engine and cooling system for signs of coolant leakage.

18.  **WARNING:** When releasing the cooling system pressure, cover the coolant expansion tank cap with a thick cloth.

• **CAUTIONS:**

 Since injury such as scalding could be caused by escaping steam or coolant, make sure the vehicle cooling system is cool prior to carrying out this procedure

 Make sure the coolant level remains above the "COLD FILL RANGE" lower level mark.

• **NOTE:** When the cooling system is warm, the coolant will be approximately 10mm above the upper level mark on the expansion tank with the cap removed.

Check and top-up the coolant if required.


19. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

Auxiliary Heating - Fuel Fired Booster Heater Glow Plug And Burner

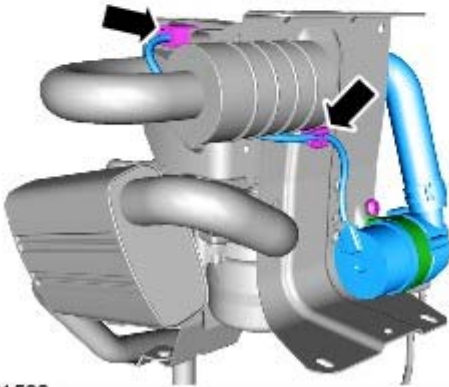
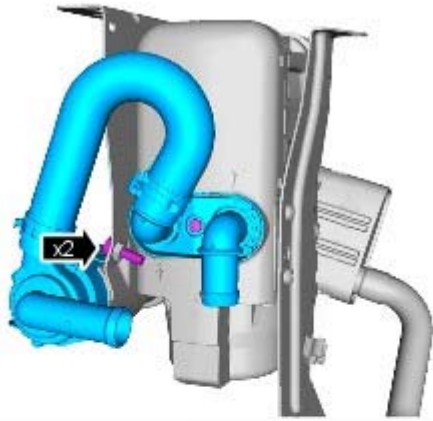
Assembly TDV6 2.7L Diesel

Removal and Installation

Removal

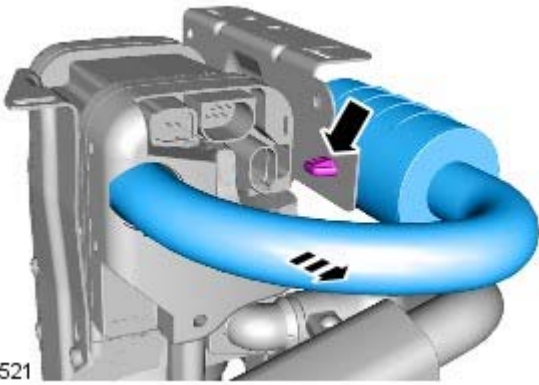
- NOTE: Removal steps in this procedure may contain installation details.
 - NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 2.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
 3. Refer to: [Fuel Fired Booster Heater - TDV6 2.7L Diesel](#) (412-02B Auxiliary Heating, Removal and Installation).

4. 7.5 Nm



E131520

5.



E131521

6. 10 Nm



E131522

7. 10 Nm



E131523

8.



E131524



E131525

9.



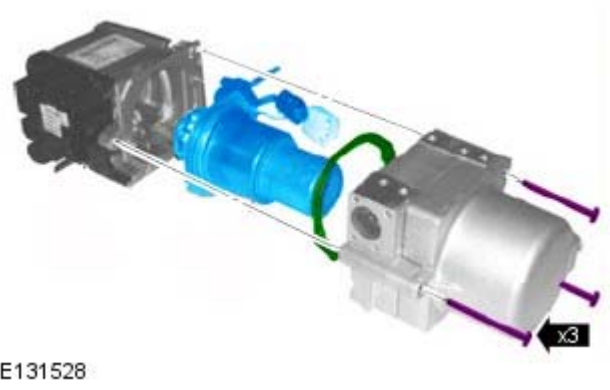
E131526

10.



E131527

11.



E131528

12. 7 Nm

Installation

1. To install, reverse the removal procedure.

2. Refer to: [Fuel Fired Booster Heater - TDV6 2.7L Diesel](#) (412-02B Auxiliary Heating, Removal and Installation).

Auxiliary Heating - Fuel Fired Booster Heater Glow Plug And Burner

AssemblyTDV6 3.0L Diesel

Removal and Installation

Removal

1. Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

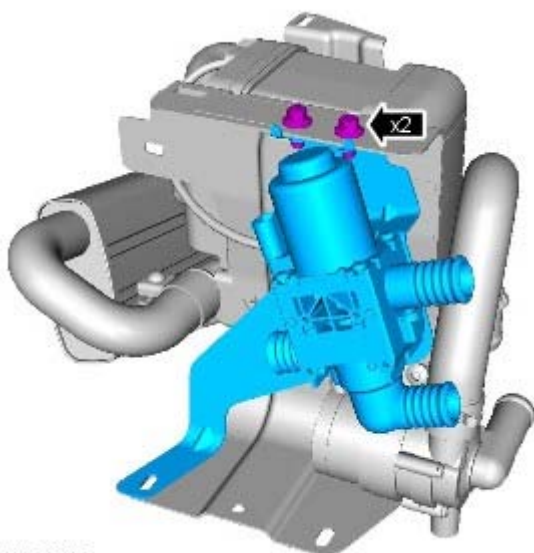
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Fuel Fired Booster Heater - TDV6 3.0L Diesel](#) (412-02B Auxiliary Heating, Removal and Installation).

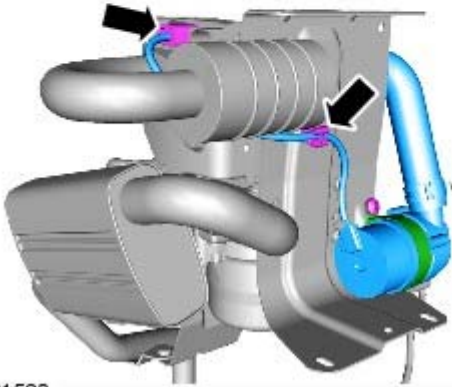
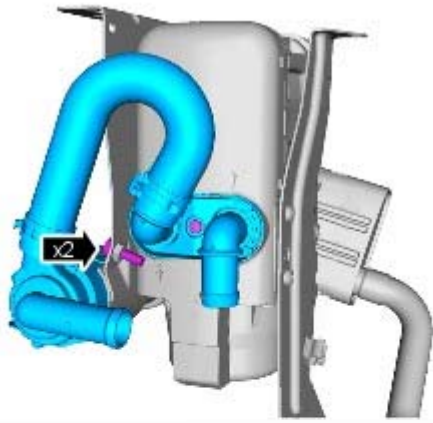
4. **4. NOTE:** Where installed.

10 Nm



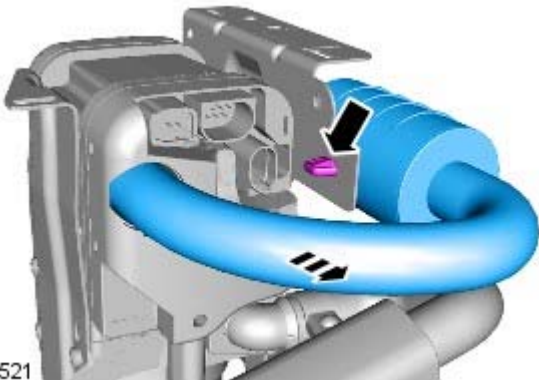
E131519

5. 7.5 Nm



E131520

6.



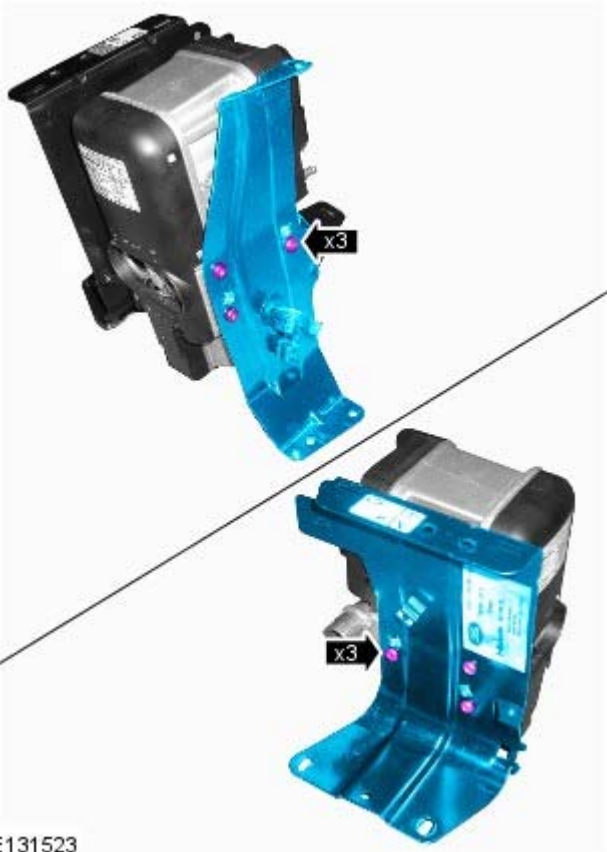
E131521

7. 10 Nm



E131522

8. 10 Nm



E131523

9.



E131524

10.



E131525

11.

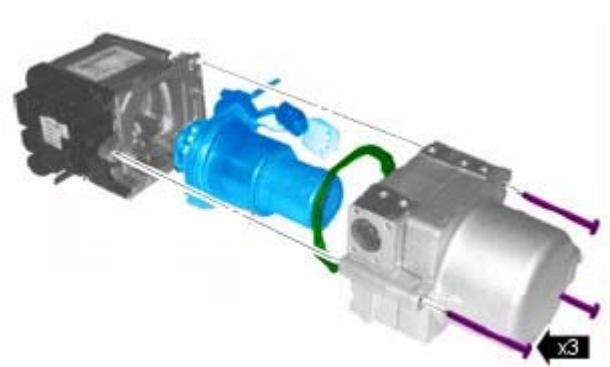


E131526



E131527

12.



E131528

13. 7 Nm

Installation

1. To install, reverse the removal procedure.
2. Refer to: [Fuel Fired Booster Heater - TDV6 3.0L Diesel](#) (412-02B Auxiliary Heating, Removal and Installation).

Air Conditioning - TDV6 2.7L Diesel -**Lubricant**

Item	Specification
Compressor oil	Denso ND-8 PAG oil
Total system capacity:	
Front	130 cm ³ (4.5 fluid ounces)
Rear	170 cm ³ (5.9 fluid ounces)
Additional amount of oil to be added to system if a component is replaced:	
Condenser	40 cm ³ (1.4 fluid ounces)
Evaporator - Front or rear	40 cm ³ (1.4 fluid ounces)
Pipe or hose	10 cm ³ (0.35 fluid ounces)

System Refrigerant Specification/Capacity

Item	Specification
Refrigerant type	R134A
Total system capacity:	
2.7 litre - Front system only fitted	550 grammes (10.25 ounces)
2.7 litre - Front and rear systems fitted	810 grammes (28.35 ounces)
4.0 and 4.4 litre - Front system only fitted	600 grammes (21.16 ounces)
4.0 and 4.4 litre - Front and rear systems fitted	900 grammes (31.83 ounces)

General Specification

Item	Description
Compressor:	
Make	Denso
Type	7SEU17
Sensor locations:	
Ambient temperature sensor	At the front of the vehicle
Smog sensor	At the front of the vehicle adjacent to the ambient temperature sensor
ICS/humidity sensor	On the instrument panel adjacent to the steering column
Solar sensor	On the vehicle centre line on top of the instrument panel
Pressure transducer	In A/C line - LH side of engine compartment

Torque Specifications

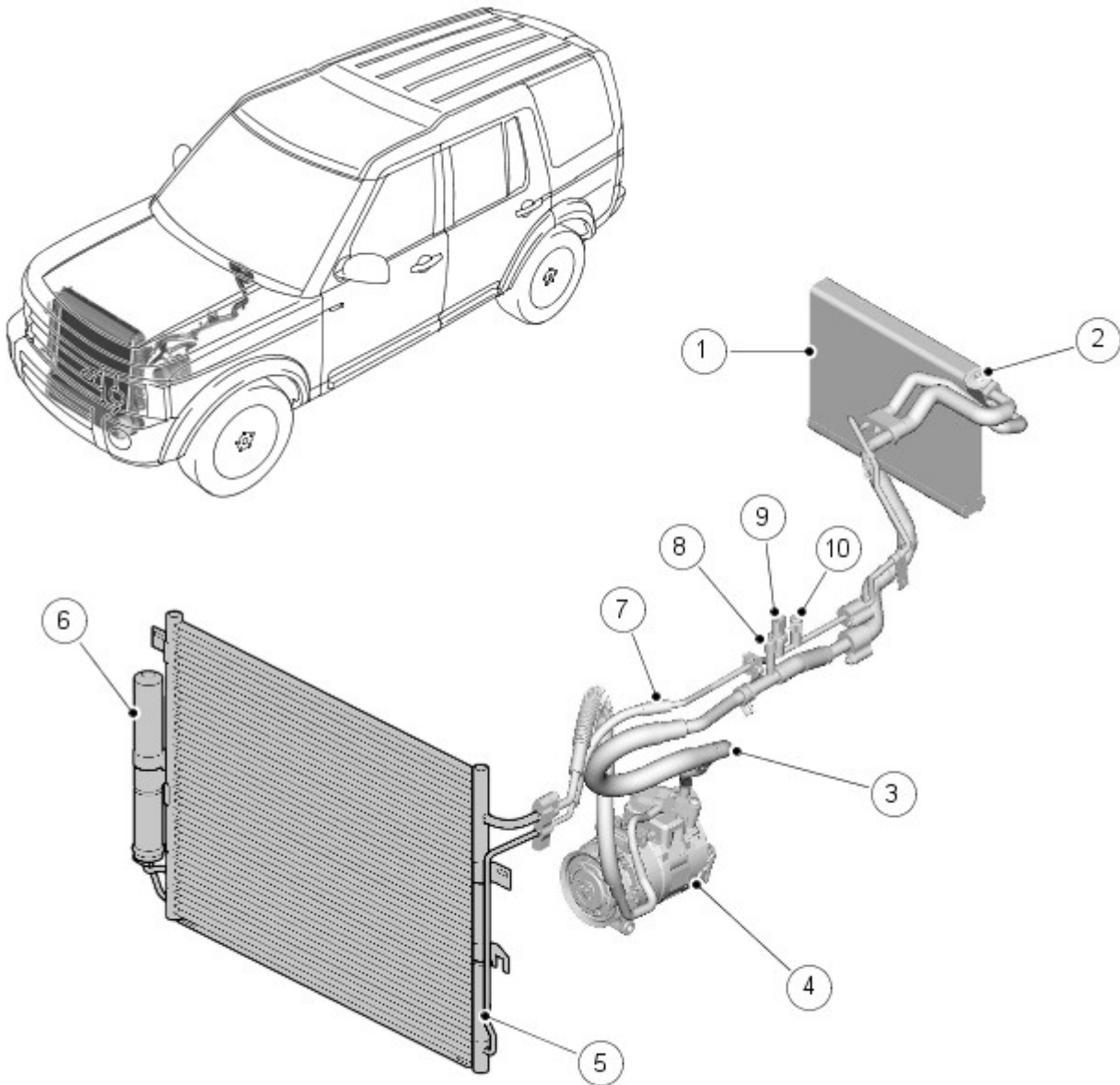
Description	Nm	lb-ft
Compressor mounting bolts	25	18
Receiver/drier mounting bolts	10	7
Refrigerant line bolts	10	7
Condenser core bolts - Not 2.7 litre	10	7
Radiator bolts	25	18
A/C pipe bolts	25	18
Coolant expansion tank bolts	10	7
Heater housing to bulkhead Torx bolts	6	4
Adaptor panel nuts	6	4
Air conditioning lines to bulkhead bolt	6	4
Air conditioning lines to body nut	6	4
Instrument panel Torx bolts	25	18
Instrument panel carrier to bulkhead Torx bolt	25	18
* Steering column intermediate shaft nut	22	16
Ground cables to passenger side lower A-pillar nuts	10	7
Ground cables to driver side lower A-pillar nuts	10	7
Pressure transducer	10	7

* New nut must be fitted

Air Conditioning - TDV6 2.7L Diesel - Air Conditioning

Description and Operation

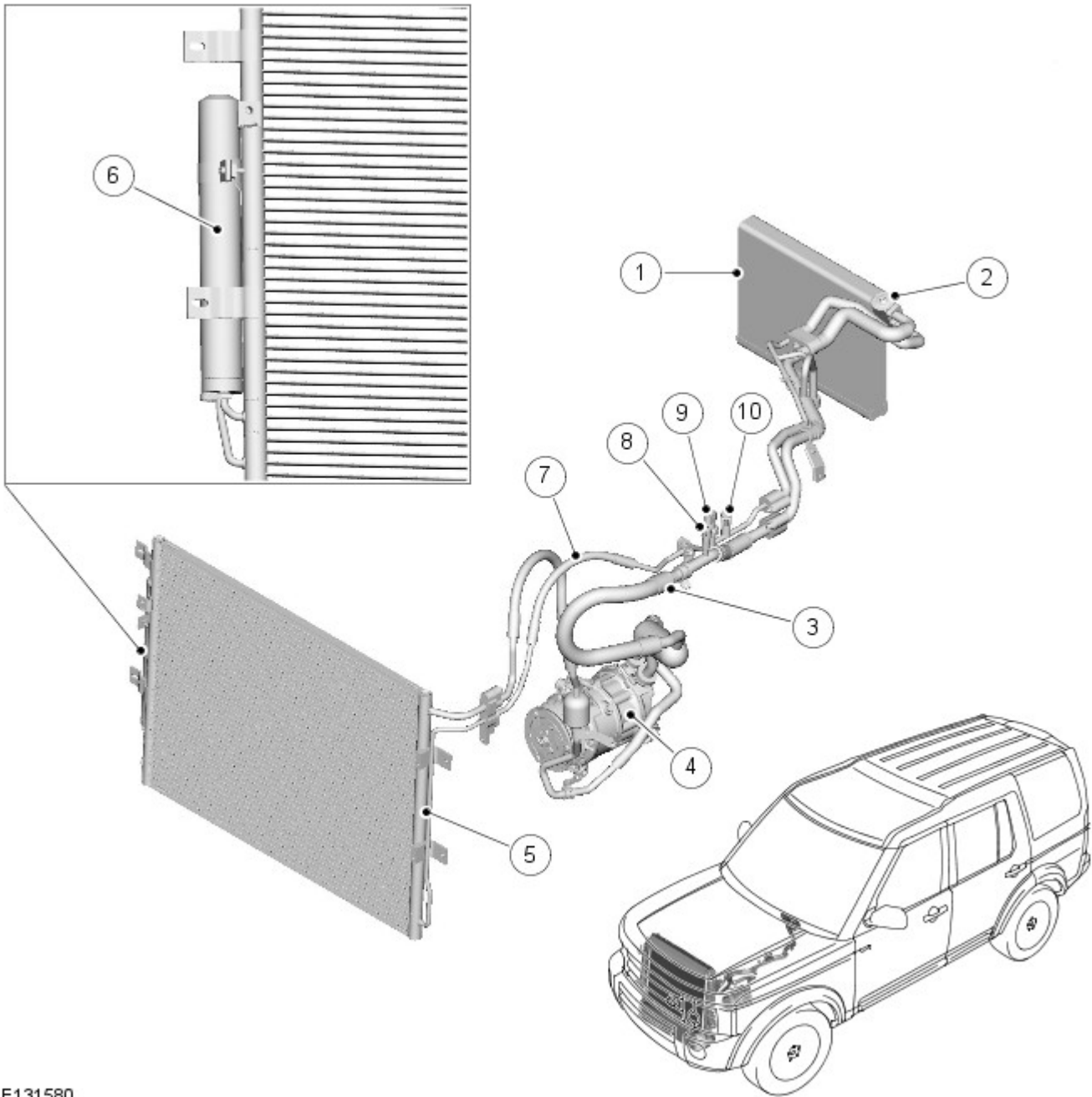
COMPONENT LOCATION 2.7L TdV6



E131578

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	air conditioning (A/C) compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

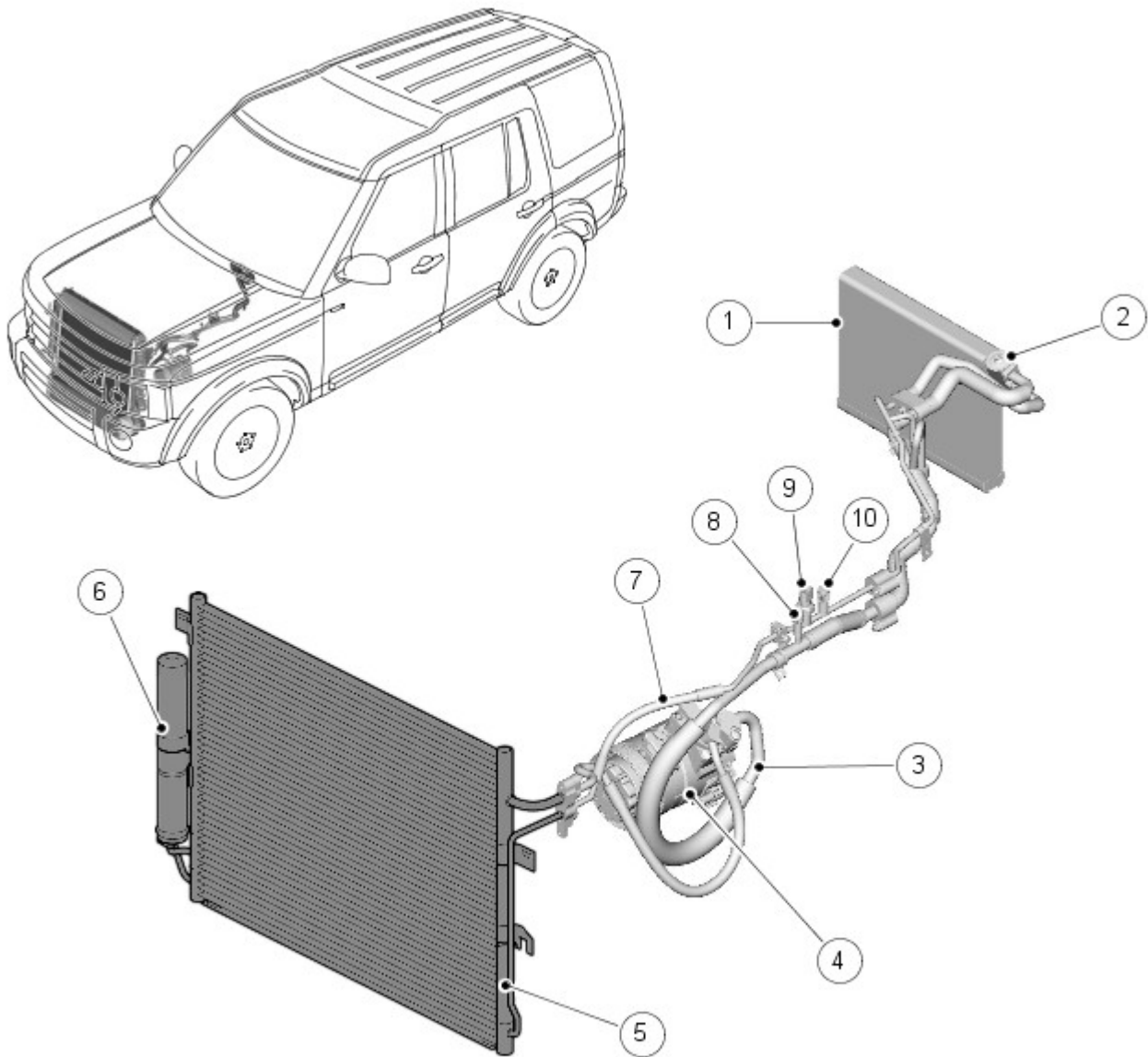
COMPONENT LOCATION 3.0L TdV6



E131580

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

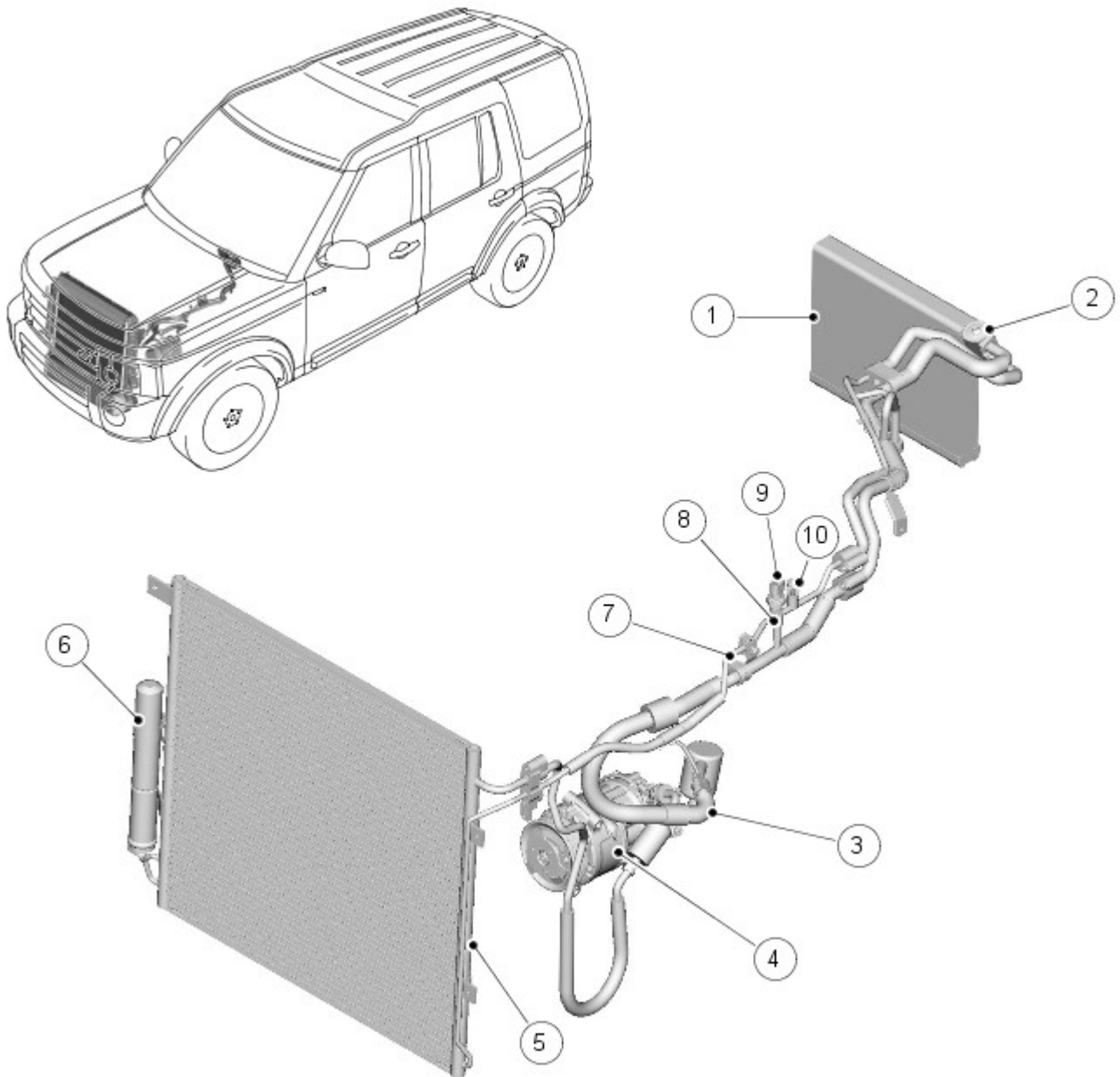
COMPONENT LOCATION 4.0L NA V6



E131582

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

COMPONENT LOCATION 5.0L NA V8



E131583

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

GENERAL

The A/C system transfers heat from the vehicle interior to the outside atmosphere to provide the heater assembly with dehumidified cool air. The system consists of:

- A compressor.
- A condenser.
- A receiver drier.
- A thermostatic expansion valve.
- An evaporator.
- Low and high pressure refrigerant lines.

The system is a sealed, closed loop, filled with a charge weight of R134a refrigerant as the heat transfer medium. Oil is added to the refrigerant to lubricate the internal components of the compressor.

Operation of the air conditioning system is controlled by the automatic temperature control (ATC) module. The A/C compressor circulates the refrigerant around the system by compressing low pressure, low temperature vapor from the evaporator and discharging the resultant high pressure, high temperature vapor to the condenser.

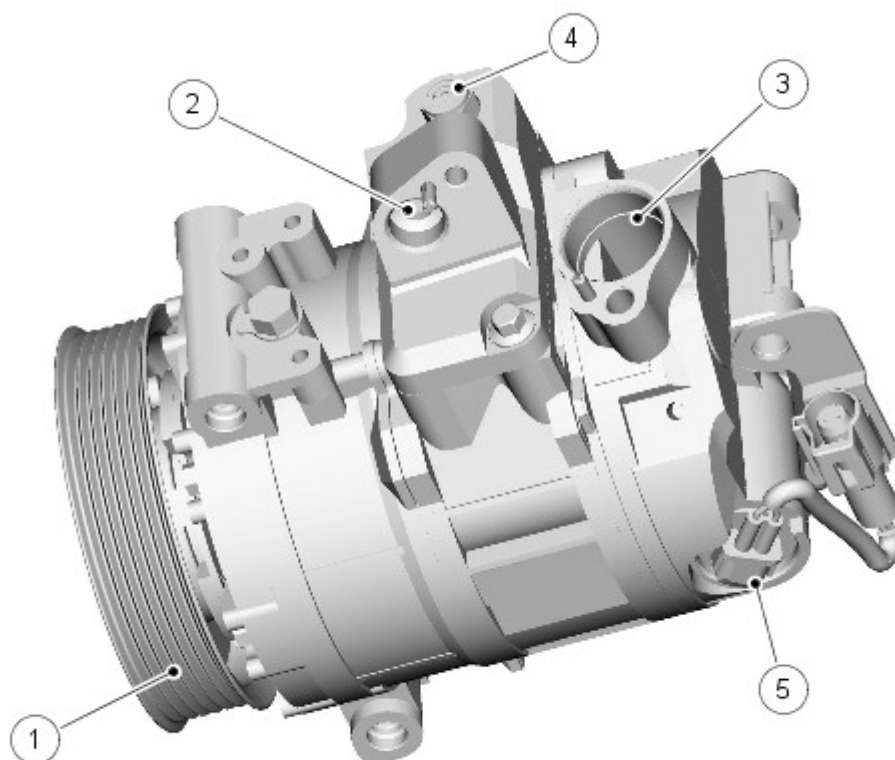
The A/C compressor is a variable displacement unit which is driven by the engine accessory drive belt. On 2.7L/4.0L and 5.0L vehicles, the [A/C \(air conditioning\)](#) compressor is permanently driven directly from the pulley. On 3.0L diesel vehicles the [A/C](#) compressor is driven via an electro-magnetic clutch.

To protect the refrigerant system from excessive pressure, a pressure relief valve is installed in the outlet side of the A/C compressor. The pressure relief valve vents excess pressure into the engine compartment.

For additional information, refer to: Control Components (412-04, Description and Operation).

A/C COMPRESSOR

2.7L TdV6



E131577

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

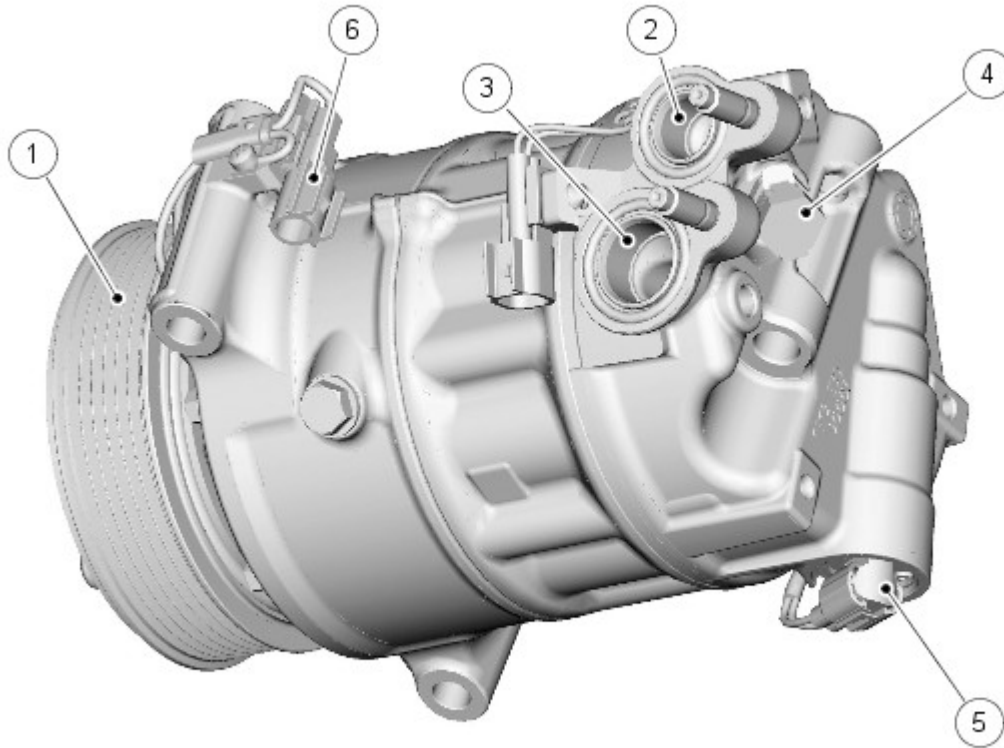
The [A/C](#) compressor fitted to 2.7L TdV6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC \(automatic temperature control\)](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (436 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

3.0L TdV6



E131579

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector
6	-	electromagnetic clutch connector

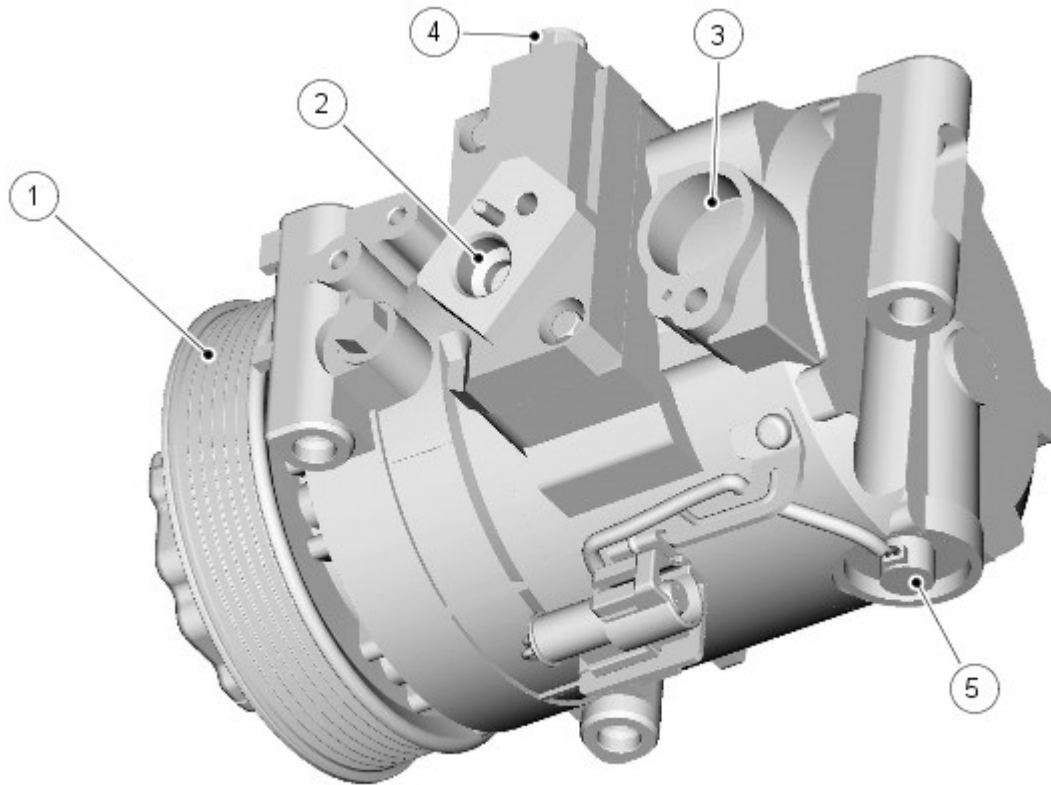
The [A/C](#) compressor fitted to 3.0L TdV6 diesel vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley and an electromagnetic clutch. Operation of the clutch is controlled by a power feed from the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The clutch of the [A/C](#) compressor incorporates a thermal cut-off fuse, which disconnects the power feed from the [ATC](#) module if the temperature increases to 182 ± 5 °C (360 ± 9 °F).

4.0L NA V6



E131581

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

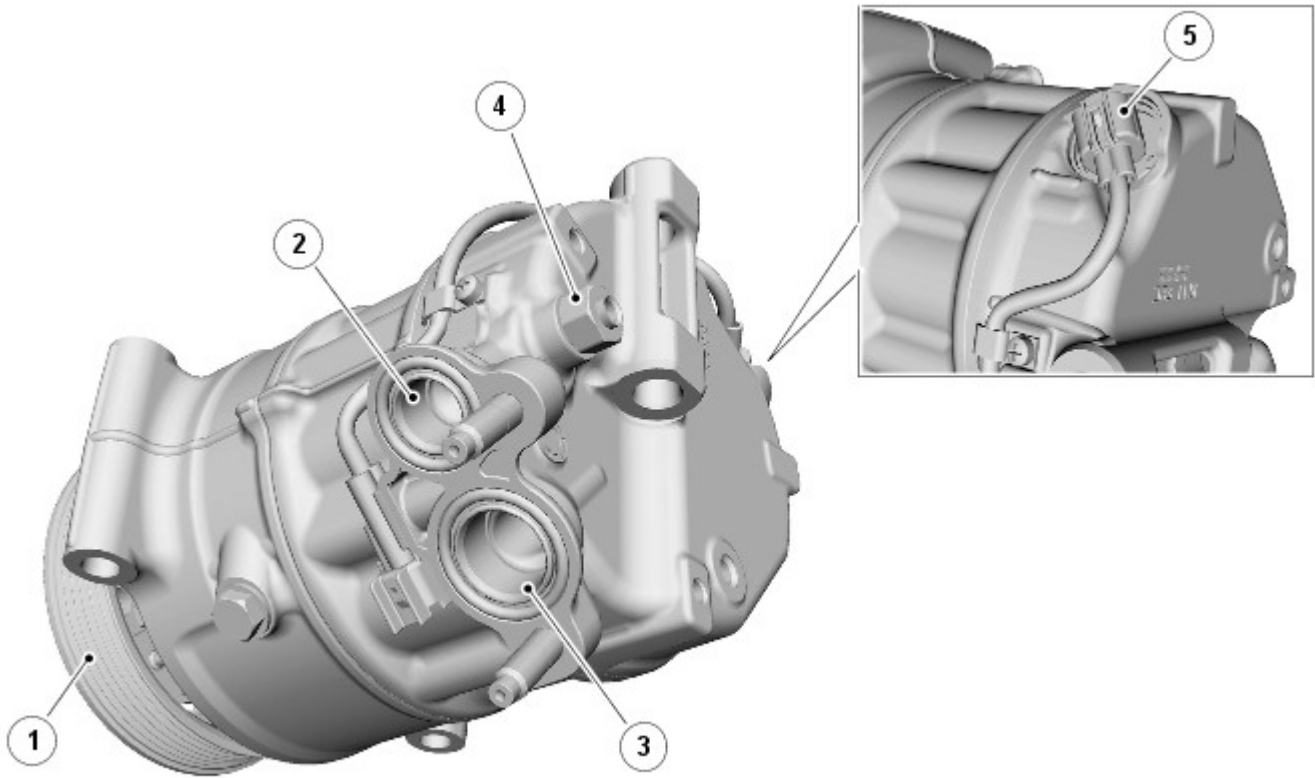
The [A/C](#) compressor fitted to 4.0L NA V6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (437 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

5.0L NA V8



E131337

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

The [A/C](#) compressor fitted to 5.0L V8 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

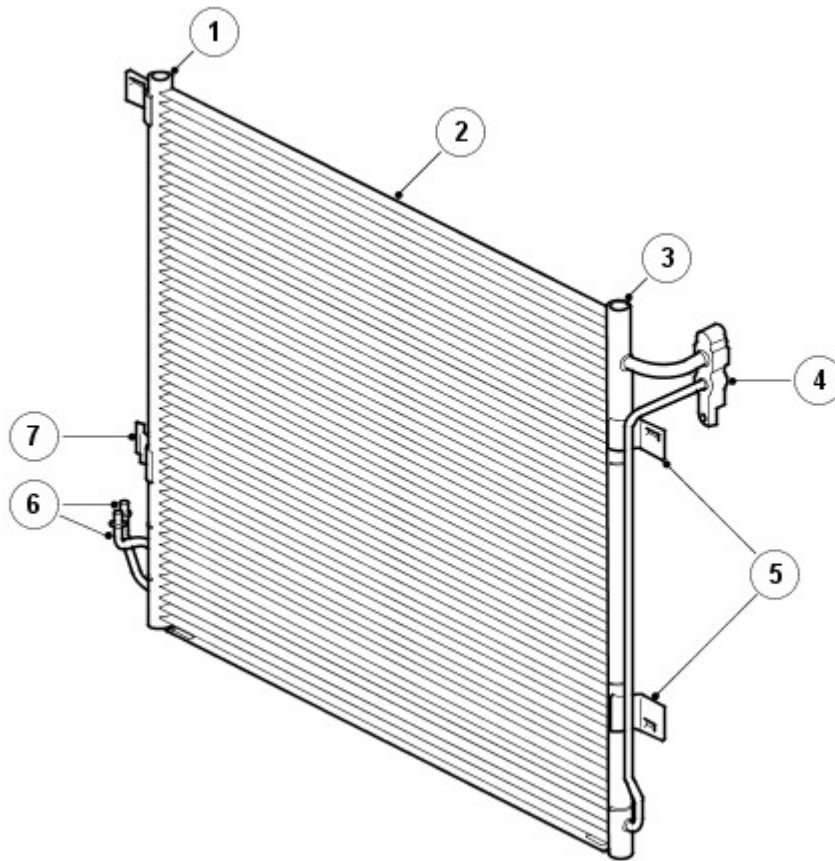
The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

CONDENSER

- NOTE: 5.0L NA V8 version shown other installations similar



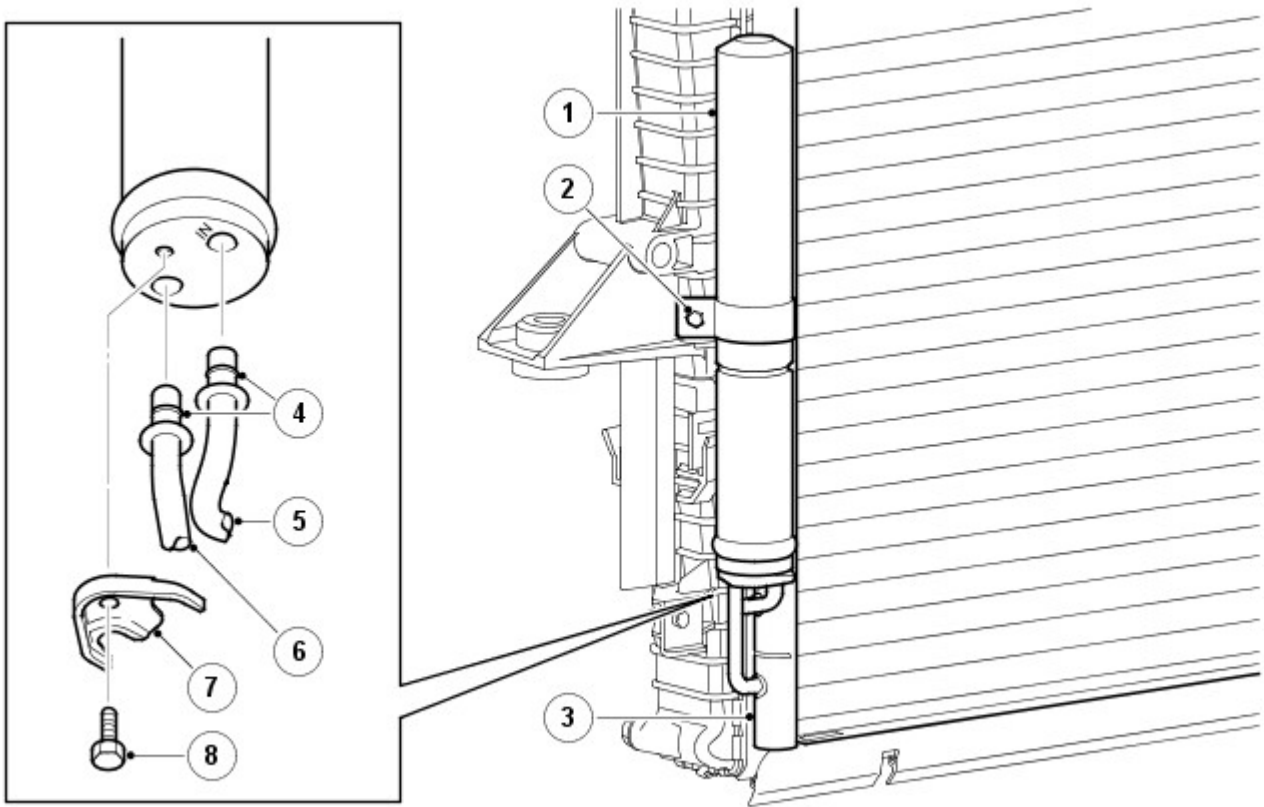
E46920

Item	Part Number	Description
1	-	right-hand (RH) end tank
2	-	Condenser core
3	-	left-hand (LH) end tank
4	-	High pressure line connector block
5	-	Condenser attachment brackets
6	-	Receiver drier pipes
7	-	Receiver drier attachment bracket

The condenser transfers heat from the refrigerant to the surrounding air to convert the high pressure vapor from the compressor into a liquid. The condenser is installed immediately in front of the radiator. Two brackets on each end tank of the condenser attach the condenser to clips on the end tanks of the radiator.

The condenser is classified as a sub-cooling condenser and consists of a fin and tube heat exchanger core installed between two end tanks. Divisions in the end tanks separate the heat exchanger into a four pass upper (condenser) section and a two pass lower (sub-cooler) section. A connector block on the left end tank of the condenser provides connections for the high pressure lines from the A/C compressor and the evaporator. Two pipes at the bottom of the right end tank of the condenser provide connections for the receiver drier.

RECEIVER DRIER



E46921

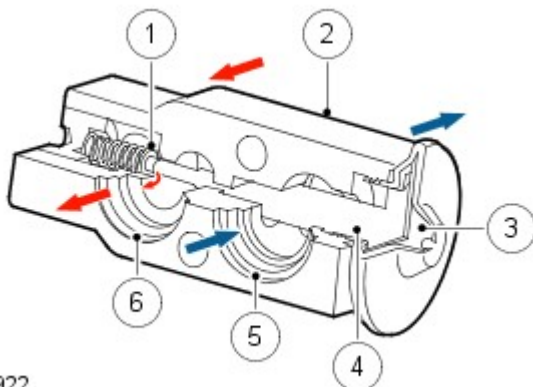
Item	Part Number	Description
1	-	Receiver drier
2	-	Clamp
3	-	Condenser RH end tank
4	-	O-ring seals
5	-	Inlet pipe
6	-	Outlet pipe
7	-	Collar
8	-	Bolt

The receiver drier removes solid impurities and moisture from the refrigerant, and provides a reservoir for liquid refrigerant to accommodate changes of heat load at the evaporator.

The receiver drier is attached to the two stub pipes on the right end tank of the condenser. A collar, located on lands on the stub pipes and secured with a bolt, attaches the stub pipes to the receiver drier. A clamp secures the body of the receiver drier to a bracket welded to the right end tank of the condenser. The inlet and outlet ports of the receiver drier are the same size, so care must be taken to install the receiver drier the correct way round on the stub pipes; to assist with installation, the inlet port is identified with the word IN etched into the receiver drier.

Refrigerant entering the receiver drier passes through a filter and a desiccant pack, then collects in the base of the unit before flowing through the outlet stub pipe back to the condenser. The desiccant and the filter are non-serviceable; the complete unit must be replaced when a change of desiccant is required.

THERMOSTATIC EXPANSION VALVE



E46922

Item	Part Number	Description
1	-	Metering valve
2	-	Housing

3	-	Diaphragm
4	-	Temperature sensitive tube
5	-	Outlet passage from evaporator
6	-	Inlet passage to evaporator

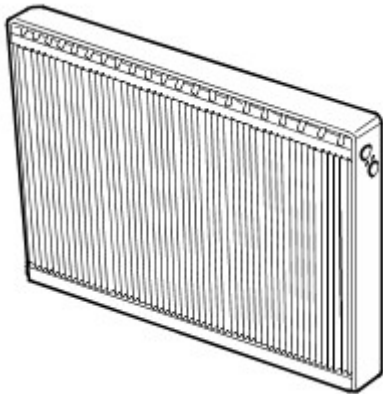
The thermostatic expansion valve meters the flow of refrigerant into the evaporator, to match the refrigerant flow with the heat load of the air passing through the evaporator.

The thermostatic expansion valve is a block type valve located behind the heater assembly, and attached to the inlet and outlet ports of the evaporator. The thermostatic expansion valve consists of an aluminum housing containing inlet and outlet passages. A ball and spring metering valve is installed in the inlet passage and a temperature sensor is installed in the outlet passage. The temperature sensor consists of a temperature sensitive tube connected to a diaphragm. The bottom end of the temperature sensitive tube acts on the ball of the metering valve. Pressure on top of the diaphragm is controlled by evaporator outlet temperature conducted through the temperature sensitive tube. The bottom of the diaphragm senses evaporator outlet pressure.

Liquid refrigerant flows through the metering valve into the evaporator. The restriction across the metering valve reduces the pressure and temperature of the refrigerant. The restriction also changes the liquid stream of refrigerant into a fine spray, to improve the evaporation process. As the refrigerant passes through the evaporator, it absorbs heat from the air flowing through the evaporator. The increase in temperature causes the refrigerant to vaporize and increase in pressure.

The temperature and pressure of the refrigerant leaving the evaporator act on the diaphragm and temperature sensitive tube, which regulate the metering valve opening and so control the volume of refrigerant flowing through the evaporator. The warmer the air flowing through the evaporator, the more heat available to evaporate refrigerant and thus the greater the volume of refrigerant allowed through the metering valve.

EVAPORATOR



E46923

The evaporator is installed in the heater assembly between the blower and the heater matrix, to absorb heat from the exterior or recirculated air. Low pressure, low temperature refrigerant changes from liquid to vapor in the evaporator, absorbing large quantities of heat as it changes state.

Most of the moisture in the air passing through the evaporator condenses into water, which drains out of the heater and through the floorpan, to the underside of the vehicle, through two drain tubes.

REFRIGERANT LINES

To maintain similar flow velocities around the system, the diameter of the refrigerant lines varies to suit the two pressure/temperature regimes. The larger diameters are installed in the low pressure/temperature regime and the smaller diameters are installed in the high pressure/temperature regime.

Low and high pressure charging connections are incorporated into the refrigerant lines for system servicing. Where auxiliary A/C is installed, connections for the auxiliary refrigerant lines are incorporated near the engine bulkhead.

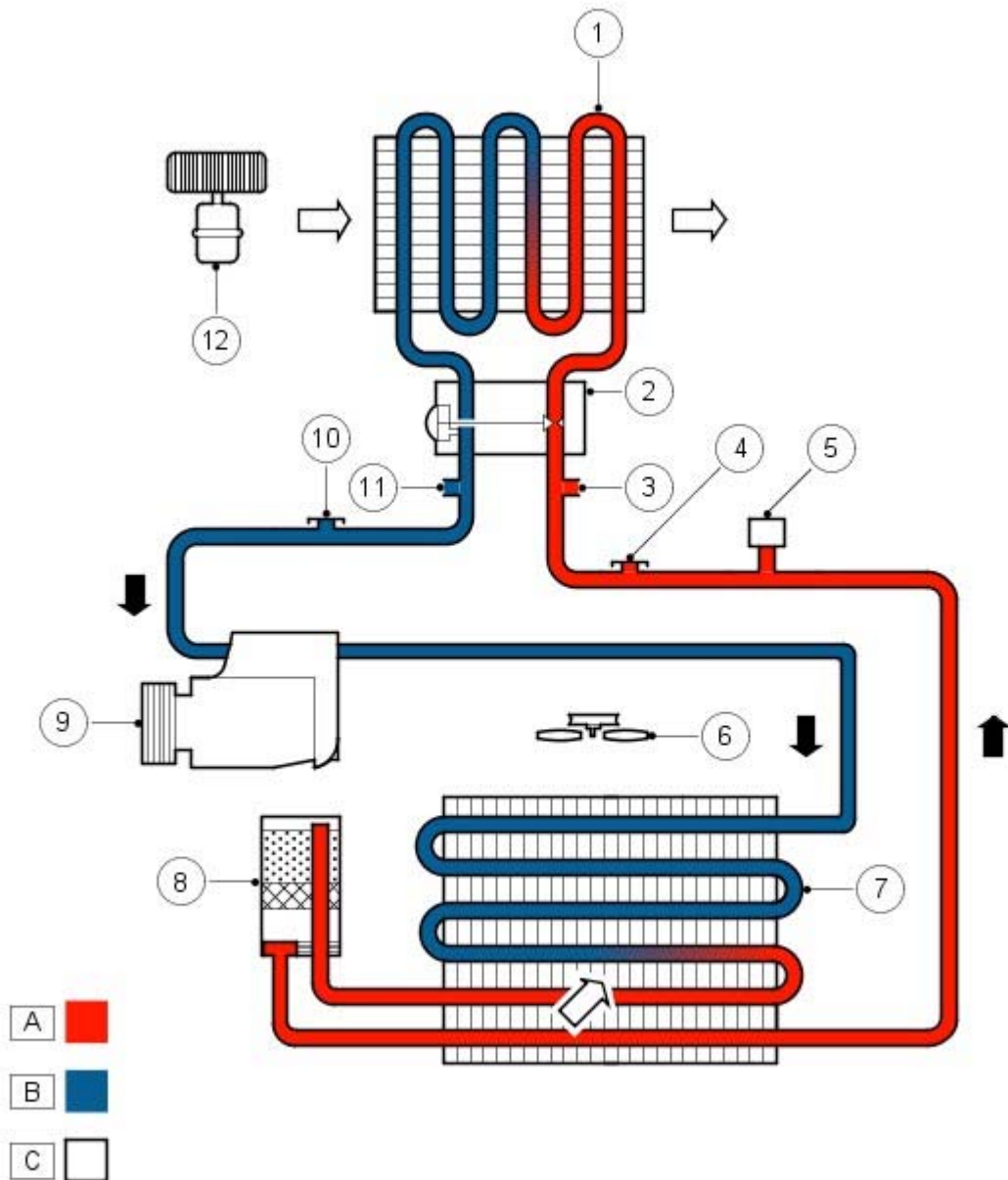
Under normal operating conditions, the smaller diameter pipes (A/C compressor discharge, liquid refrigerant) are hot to the touch and the larger diameter pipes (A/C compressor suction, gaseous refrigerant) are cold to the touch.

SYSTEM OPERATION

To accomplish the transfer of heat, the refrigerant is circulated around the system, where it passes through two pressure/temperature regimes. In each of the pressure/temperature regimes, the refrigerant changes state, during which process maximum heat absorption or release occurs. The low pressure/temperature regime is from the thermostatic expansion valve, through the evaporator to the compressor; the refrigerant decreases in pressure and temperature at the thermostatic expansion valve, then changes state from liquid to vapor in the evaporator, to absorb heat. The high pressure/temperature regime is from the compressor, through the condenser and receiver drier to the thermostatic expansion valve; the refrigerant increases in pressure and temperature as it passes through the compressor, then releases heat and changes state from vapor to liquid in the condenser.

A/C SYSTEM SCHEMATIC

- NOTE: A = Refrigerant liquid; B = Refrigerant vapor; C = Air flow



E46924

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	High pressure connection with auxiliary climate control (where fitted)
4	-	High pressure servicing connection
5	-	Refrigerant pressure sensor
6	-	Cooling fan
7	-	Condenser
8	-	Receiver drier
9	-	A/C compressor
10	-	Low pressure servicing connection
11	-	Low pressure connection with auxiliary climate control (where fitted)
12	-	Blower

Air Conditioning - TDV6 2.7L Diesel - Air Conditioning

Diagnosis and Testing

Principle of Operation

For a detailed description of the air conditioning system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Air Conditioning](#) (412-03A Air Conditioning - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Auxiliary drive belt condition and tension ● Compressor condition and installation ● Condenser condition and installation/blockage ● Air conditioning hoses and pipes ● Receiver/drier condition and installation ● Cooling fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Electrical connector(s) ● Relays ● Sensors ● Control panel(s) ● Air conditioning compressor

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor or no cooling	<ul style="list-style-type: none"> ● Drive belt fault ● Compressor fault ● Distribution motor/flap fault ● Refrigerant leak ● In-vehicle temperature sensor fault ● Refrigerant pressure sensor fault 	Check the drive belt condition and tension (see visual inspection). Check the compressor operation (observe the compressor as the engine is idling with the air conditioning switched on. If the compressor runs erratically or does not run. Carry out the distribution motor self test. Refer to the relevant workshop manual section. Check for sensor DTCs. Refer to the DTC index. Check the refrigerant system using your charging station.
Noise	<ul style="list-style-type: none"> ● Drive belt fault ● Compressor fault ● Compressor pulley fouling ● Refrigerant overcharged 	Confirm the air conditioning as the source of the noise by listening for the noise with the air conditioning switched off. Refer to the relevant workshop manual section. Check the refrigerant system using your charging station.
Water entry into cabin	<ul style="list-style-type: none"> ● Heater matrix leak ● Blocked evaporator drain tubes 	Check for coolant loss. Pressure test the cooling system as necessary. Check and clear the evaporator drain tubes as necessary.


DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Climate Control Module \(HVAC\)](#) (100-00 General Information, Description and Operation).

Air Conditioning - TDV6 2.7L Diesel - Air Conditioning (A/C) Compressor

Removal and Installation

Removal

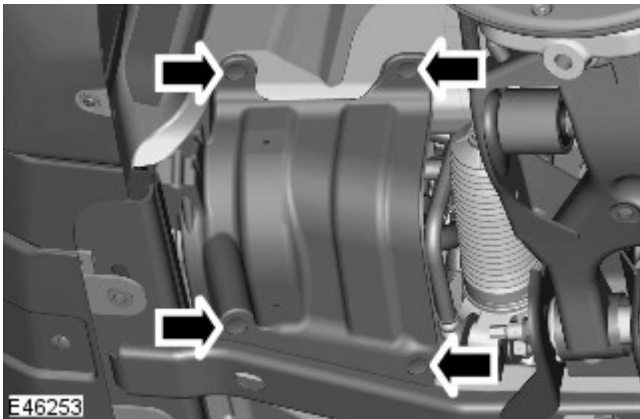
-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

For additional information, refer to: [Jacking](#) (100-02 Jacking and Lifting, Description and Operation).

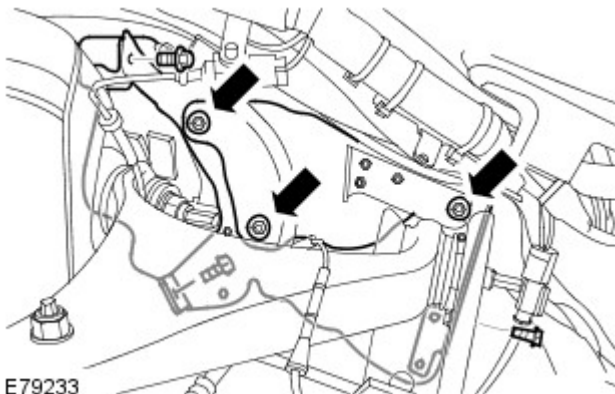
- Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
- Recover the air conditioning (A/C) refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
- Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
- Remove the LH front wheel and tire.
- Remove the front LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
- Remove the fender splash shield lower trim panel.

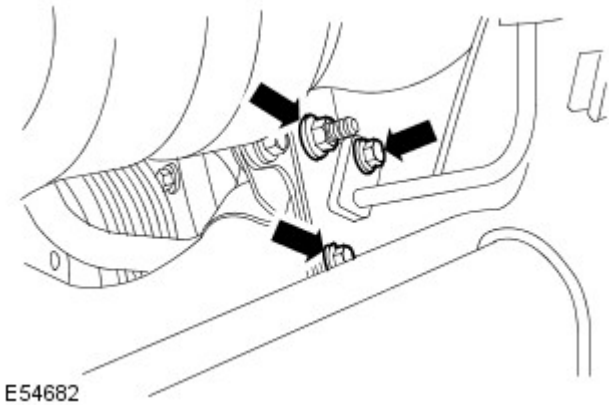
- Remove the 4 clips.



- Remove the upper arm and brake line heat shields for access.

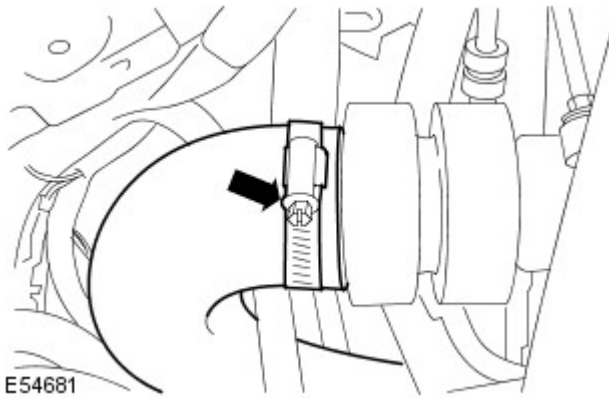
- Remove the 3 nuts.
- Remove the 3 bolts.





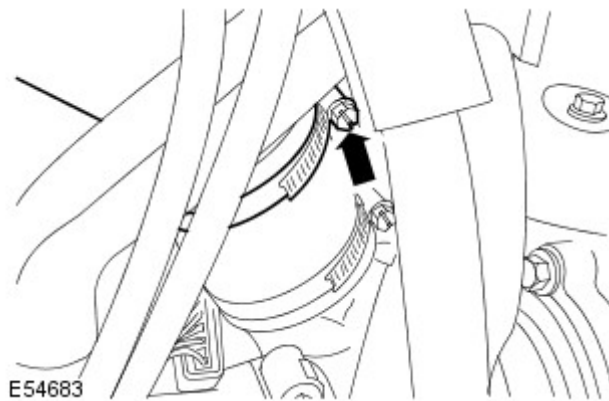
11. Release the charge air cooler inlet pipe.

- Remove the two retaining bolts.
- Remove the retaining nut.



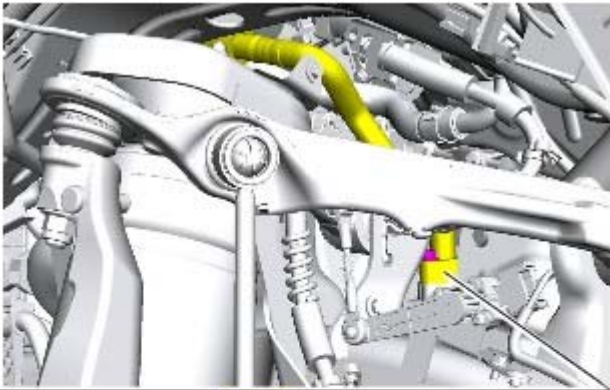
12. Disconnect the charge air cooler inlet hose.

- Loosen the clip.



13. Disconnect the charge air cooler inlet hose.

- Loosen the clip.



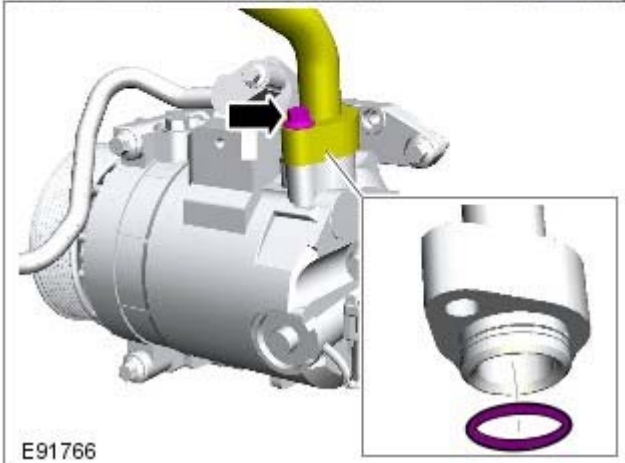
14. CAUTIONS:

 Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

 Care must be taken to avoid damage to the mating surfaces.

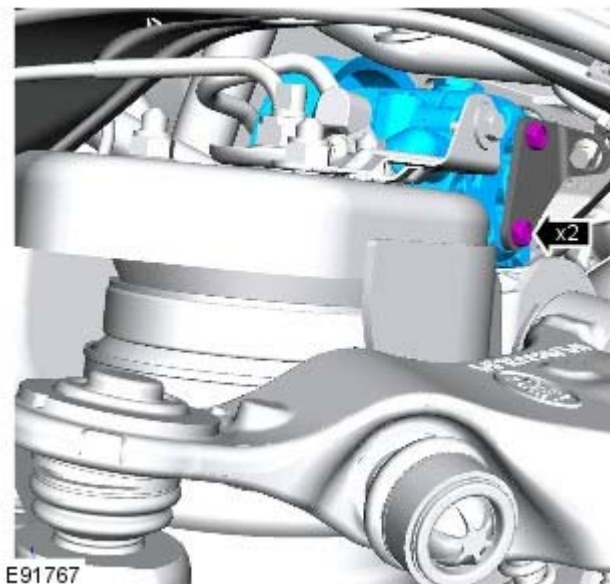
Release the A/C low-pressure pipe from the compressor.

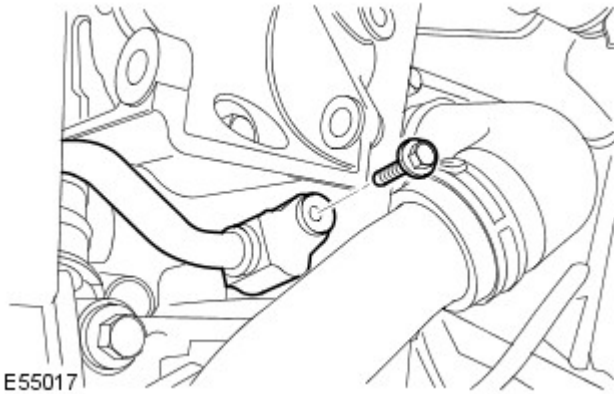
- Remove and discard the O-ring seal.
- Using a suitable tie strap, secure the A/C low-pressure pipe aside.



15. Release the power steering pump support bracket.

- Reposition the charge air cooler inlet pipe to gain access to the power steering pump retaining bolts.
- Remove the 2 bolts.





16. CAUTIONS:

 Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

 Care must be taken to avoid damage to the mating surfaces.

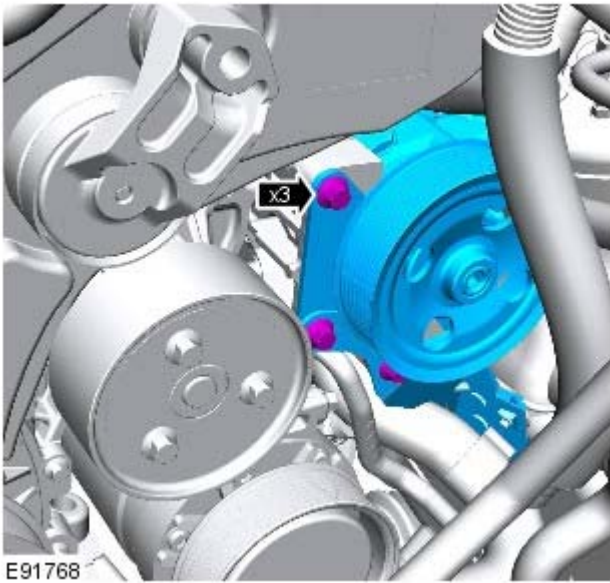
Disconnect the A/C compressor high-pressure pipe.

- Remove the LH retaining bolt.
- Remove and discard the O-ring seal.

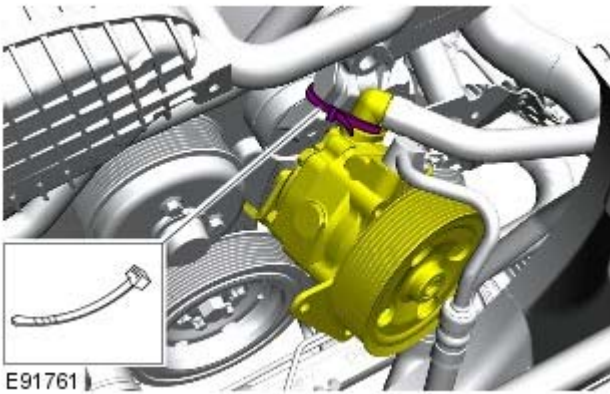
17. Reposition the A/C compressor high-pressure pipe.

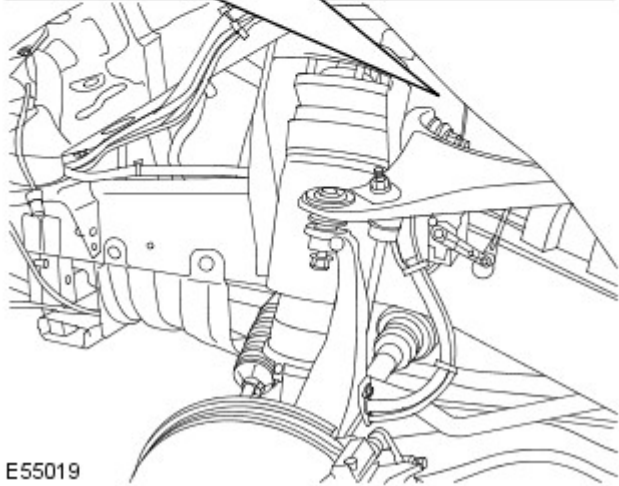
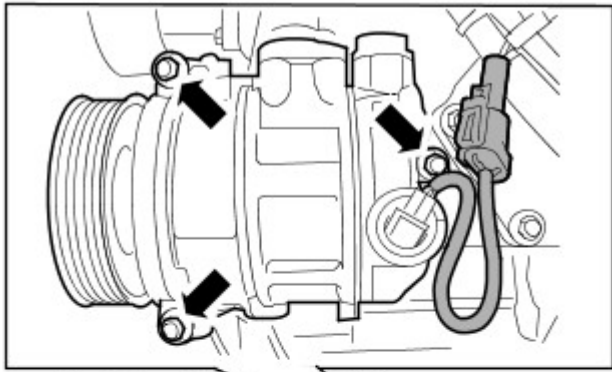
18. Release the power steering pump.

- Collect the support bracket.



19. Using a suitable tie strap, secure the power steering pump.





E55019

20. Remove the A/C compressor.

- Disconnect the A/C compressor electrical connector.
- Remove the three retaining bolts.

Installation

- 1.**  **CAUTION:** Lubricate the new seals with clean refrigerant oil.

Install the A/C compressor.

- Install the three retaining bolts.
 - Tighten the bolts to 23 Nm (17 lb.ft).
 - Connect the A/C compressor electrical connector.
- 2. Secure the power steering pump.**
- Remove and discard the tie strap.
 - Install the support bracket.
- 3. Reposition the A/C compressor high-pressure pipe.**
- 4. Connect the A/C compressor high-pressure pipe.**
- Remove the blanking caps from the ports.
 - Install a new O-ring seal.
 - Tighten the retaining bolt to 9 Nm (7 lb.ft).
- 5. Install the power steering pump rear bolts.**
- Reposition the charge air cooler inlet pipe to gain access to the power steering pump retaining bolts.
 - Tighten the bolts to 22 Nm (16 lb.ft).
- 6. Connect the A/C compressor low-pressure pipe.**
- Remove the blanking caps from the ports.
 - Install a new O-ring seal.
 - Tighten the retaining bolt to 9 Nm (7 lb.ft).

7. Connect the charge air cooler inlet hose.
 - Tighten the clips.
8. Secure the charge air cooler inlet pipe.
 - Install the two retaining bolts.
 - Install the retaining nut.
 - Tighten to 10 Nm (7 lb.ft).
9. Install the upper arm and brake line heat shields.
 - Install the 3 bolts.
 - Install the 3 nuts.
10. Install the fender splash shield lower trim panel.
 - Install the 4 clips.
11. Install the front LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
12. Install the wheel and tire.
 - Tighten nuts to 140 Nm (103 lb.ft).
13. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
14. Install the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
15. Recharge the A/C system
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
16. Install the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
17. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Air Conditioning - TDV6 2.7L Diesel - Air Conditioning (A/C) Pressure Transducer

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Recover the A/C refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

3. CAUTIONS:



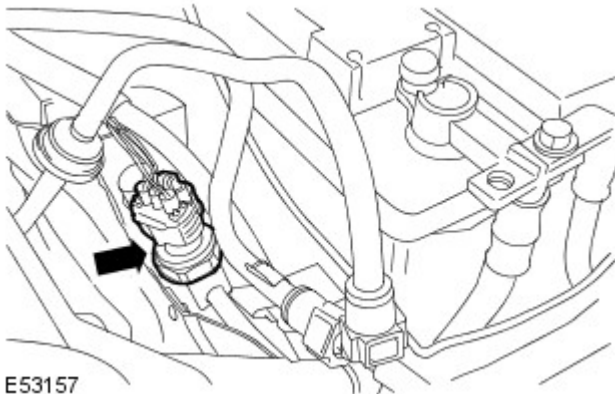
Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



To prevent damage to components, use an additional wrench when loosening or tightening unions.

Remove the A/C pressure transducer.

- Disconnect the electrical connector.
- Remove and discard the seal.



E53157

Installation


1. Install the A/C pressure transducer.
 - Clean the component mating faces.
 - Install a new seal.
 - Tighten the transducer to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Air Conditioning - TDV6 2.7L Diesel - Condenser Core

Removal and Installation

Removal

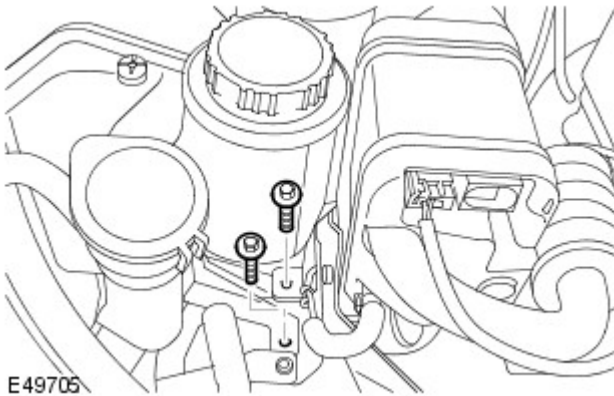
• NOTE: The receiver drier need only be changed under the following circumstances: There is dirt in the refrigerant circuit (eg. compressor seizure). The system is leaking and refrigerant has been lost to atmosphere. Refrigerant circuit has been open more than 24 hours due to repair.

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Recover the A/C refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
4. Remove the cooling fan lower shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
5. Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
6. Release the coolant expansion tank.

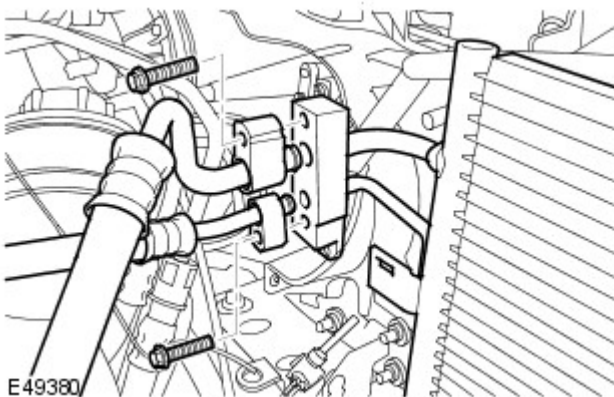
- Remove the 2 bolts.



7.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Disconnect the A/C condenser refrigerant lines.

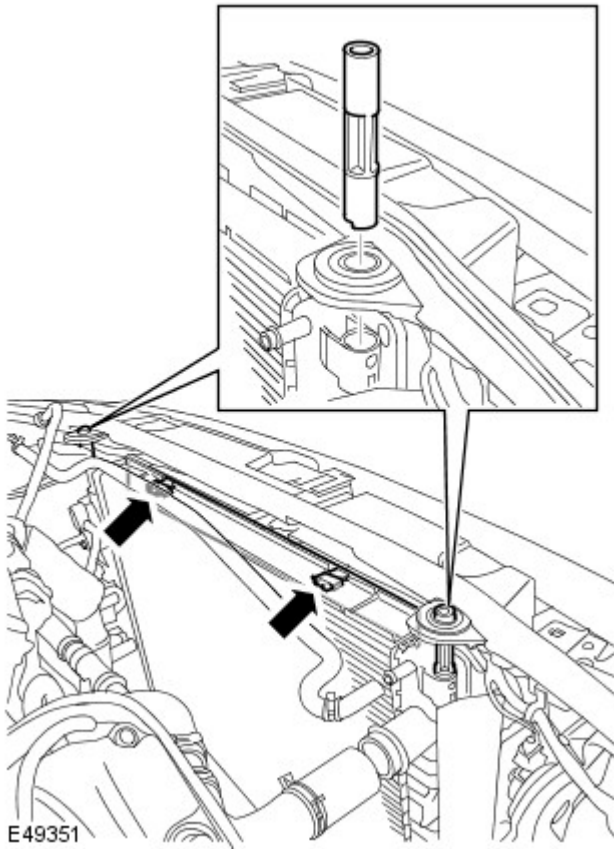
- Remove the 2 bolts.
- Discard the O-ring seals.



8. Remove the radiator securing pegs.

9. Remove the radiator upper deflector.

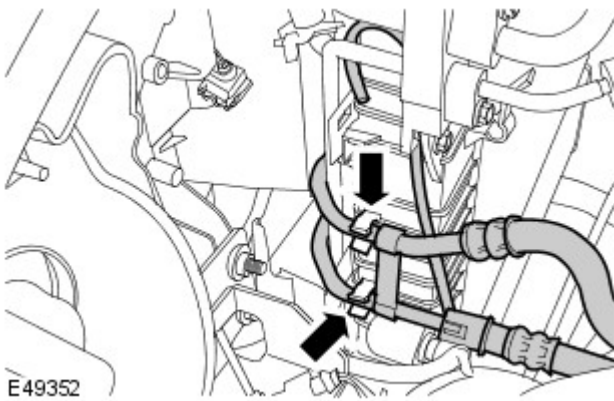
- Release the 2 clips.



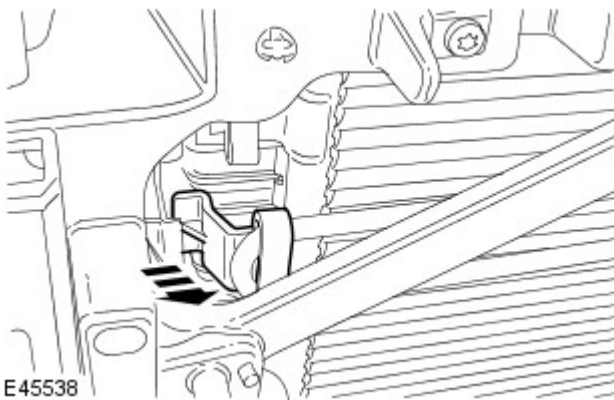
10. Release the power steering fluid cooler.

- Release it from 3 clips.

11. Release the front differential breather line.



12. Remove the power steering fluid cooler line clip.

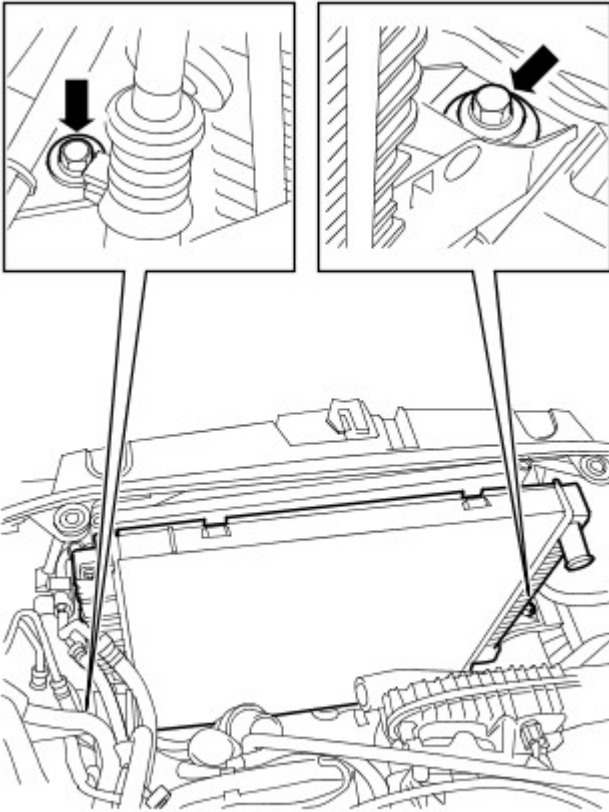


13. Tie the engine air intake duct towards the engine.

14. Tie the fuel fired booster heater coolant lines towards the engine.

15. Move the radiator towards the engine.

- Remove the 2 bolts.
- Lift it clear of its mountings.
- Tie the radiator towards the engine.



E49354

16. Remove the A/C condenser.

- Remove the bolt.
- Release it from the 4 clips

Installation

1. Install the A/C condenser.

2. Position the radiator.

- Lift the radiator onto its mountings.
- Tighten the bolts to 25 Nm (18 lb.ft).

3. Position the front differential breather line.

4. Install the power steering fluid cooler line clip.

5. Secure the power steering fluid cooler line.

- Secure in the 3 clips.

6. Install the radiator upper deflector.

7. Install the radiator securing pegs.

8. Secure the coolant expansion tank.

- Tighten the 2 bolts to 10 Nm (7 lb.ft).

9. Connect the A/C condenser refrigerant lines.

- Clean the component mating faces.
- Install new O-ring seals.
- Tighten the bolts to 25 Nm (18 lb.ft).

10. Install the radiator grille.

For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

11. Install the cooling fan lower shroud.

For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).


12. Fill the A/C system.

For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

Air Conditioning - TDV6 2.7L Diesel - Evaporator Core

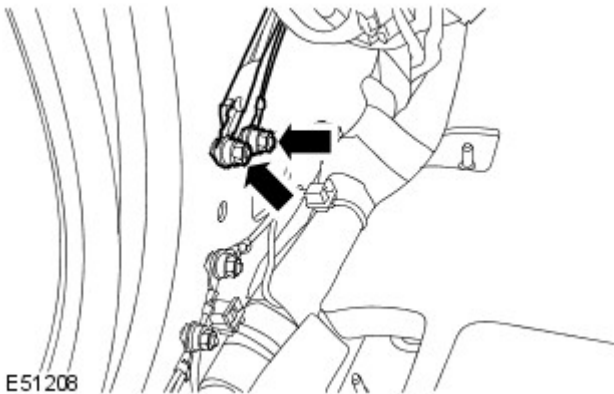
Removal and Installation

Removal

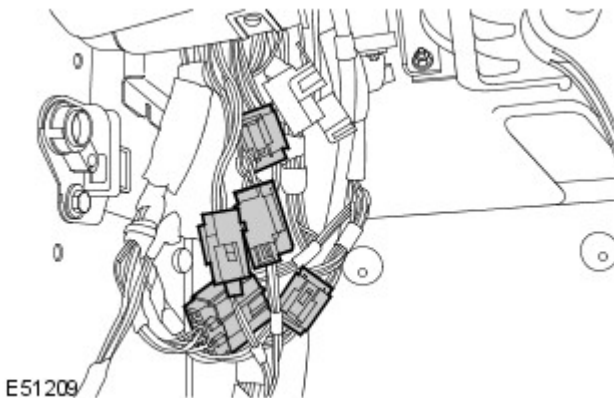
1. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

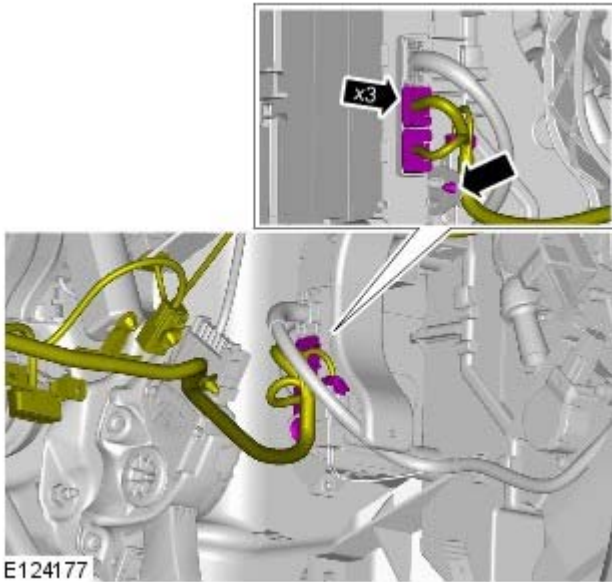
4. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
5. Remove the driver side front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
6. Remove the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
7. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
8. Release the 3 ground cables from the driver side lower A-pillar.
 - Remove the 2 nuts.



9. Disconnect the 5 electrical connectors from the driver side lower A-pillar.

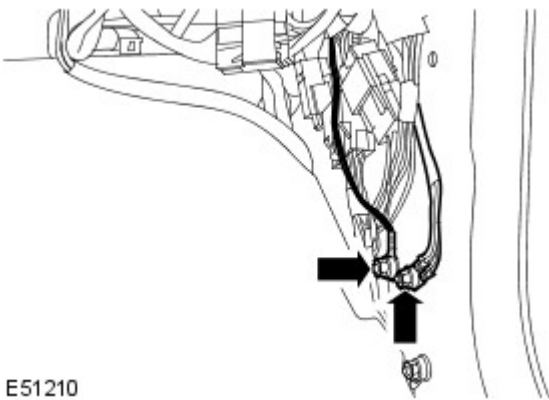


10. Disconnect the 3 electrical connectors.



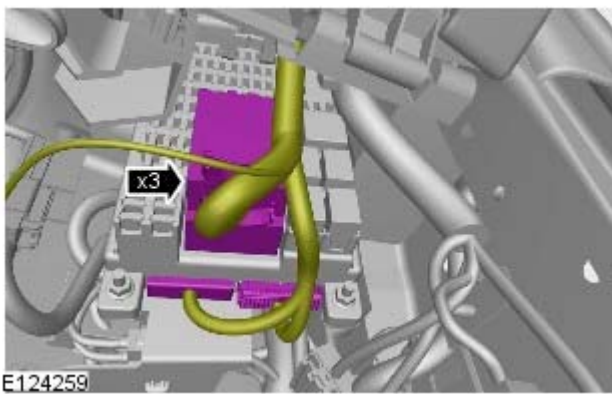
11. Release the 3 ground cables from the passenger side lower A-pillar.

- Remove the 2 nuts.



12. Disconnect the 5 electrical connectors from the passenger side lower A-pillar.

13. Disconnect the central junction box (CJB) three electrical connectors.



14. Disconnect 2 electrical connectors from the instrument panel center reinforcement.

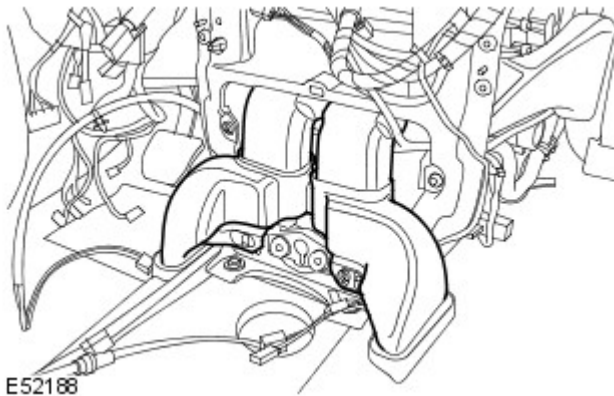


15.  **CAUTION:** Cover fiber optic cable connectors to minimize dust ingress and avoid bending the cables in a radius of less than 30 mm.

If installed, disconnect the instrument panel center reinforcement fibre optic cables.

- Disconnect the electrical connector.

16. Remove the heater housing center ducts.



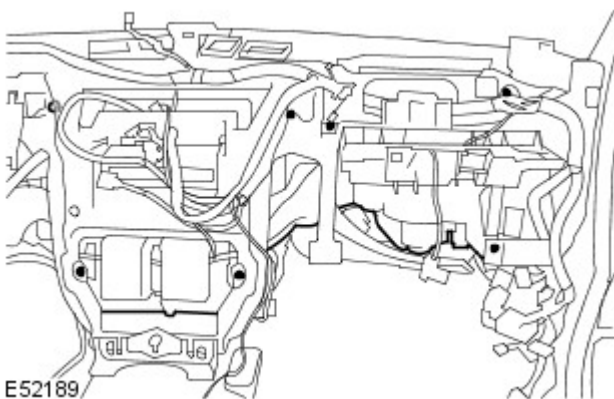
17. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.



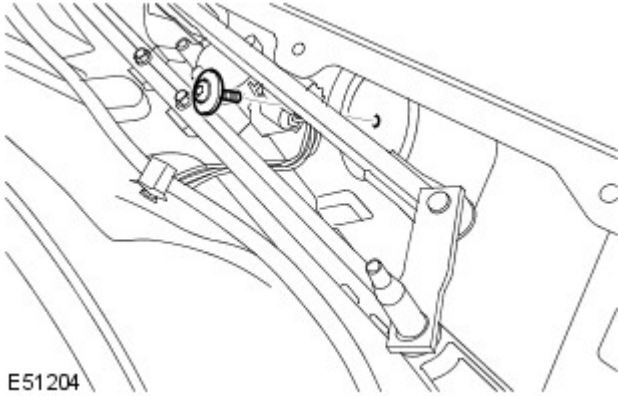
18. Release the heater housing from the instrument panel carrier.

- Remove the 7 Torx screws.



19. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

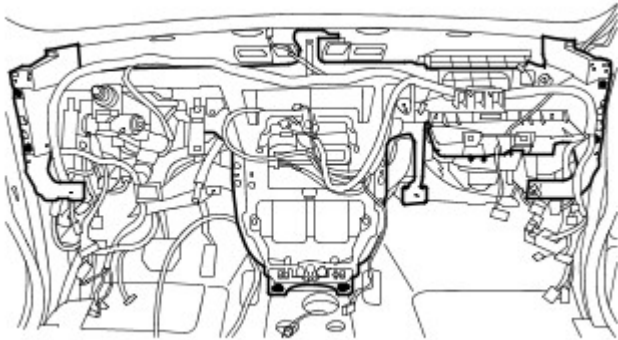
20. Remove the instrument panel carrier to bulkhead Torx bolt.




E51204

21. With assistance, remove the instrument panel.

- Remove the 6 Torx bolts.

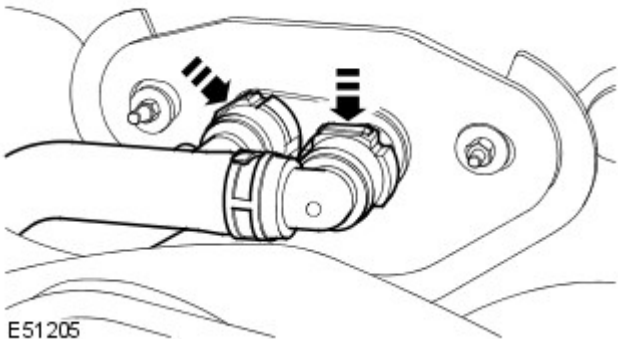


E52190

22.  CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect 2 heater hoses from the bulkhead.

- Release the 2 clips.

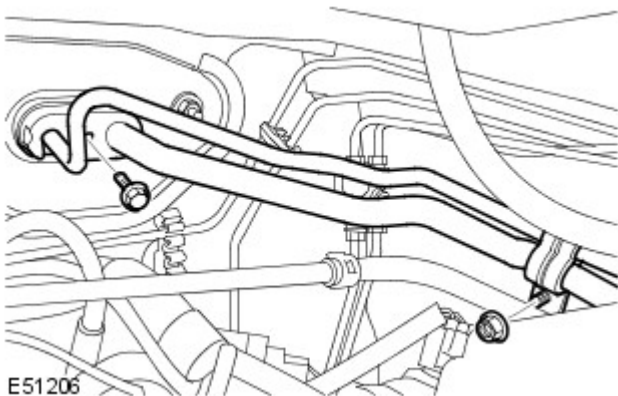


E51205

23.  CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Release the 2 A/C refrigerant lines.

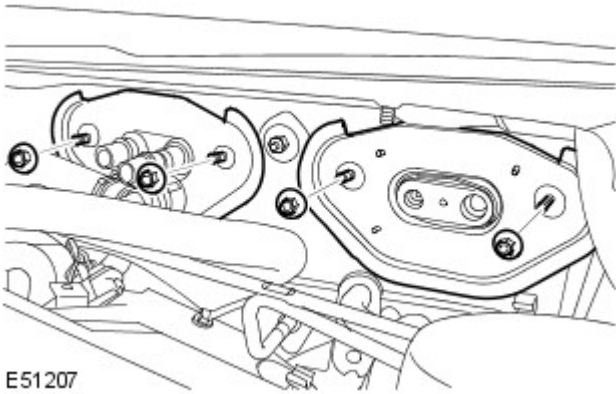
- Remove the nut and bolt.
- Remove and discard the O-ring seals.



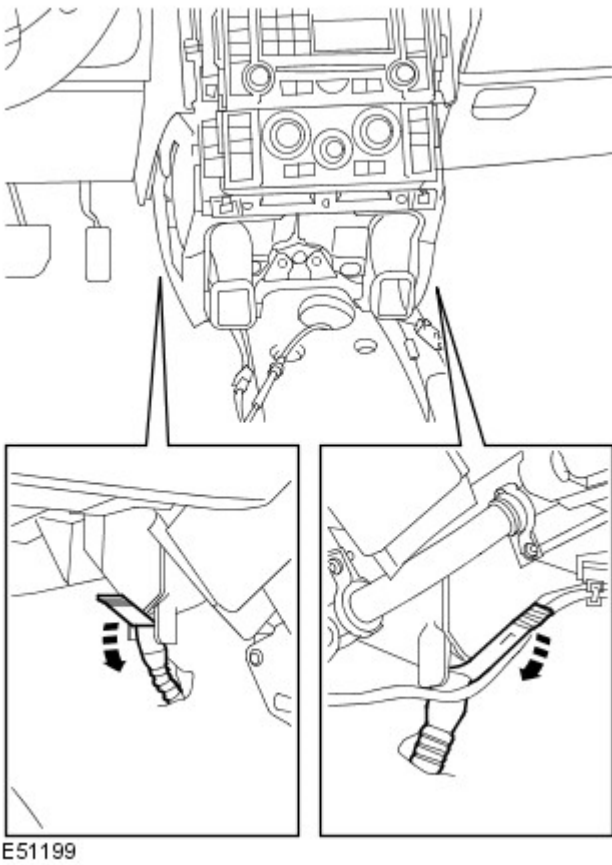
E51206

24. Remove the 2 adapter panels.

- Remove the 4 nuts.

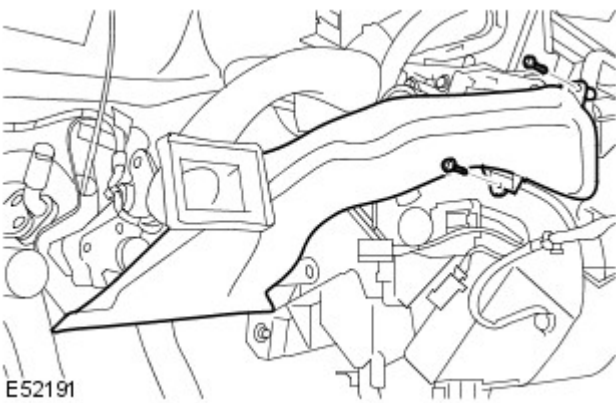


25. Disconnect 2 drain tubes from the heater housing.



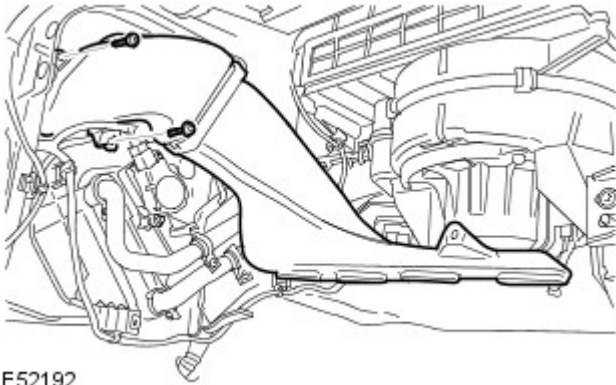
26. Remove the driver side footwell duct.

- Remove the 2 Torx screws.



27. Remove the passenger side footwell duct.

- Remove the 2 Torx screws.



E52192

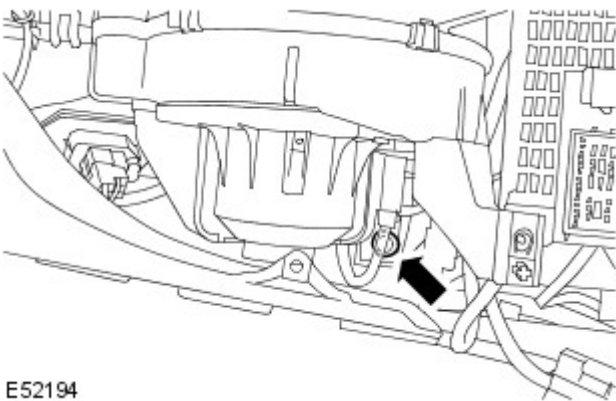
28. Driver side: Remove the heater housing to bulkhead Torx bolt.



E52193

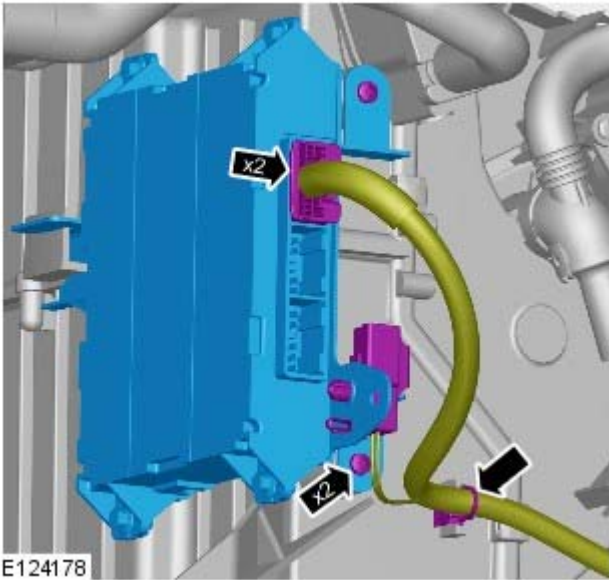
29. Passenger side: Remove the heater housing to bulkhead Torx bolt.

- With assistance, remove the heater and evaporator core housing.

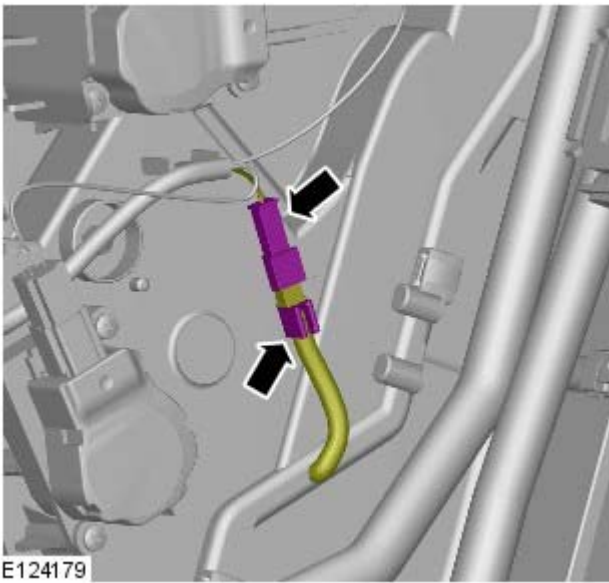


E52194

30. Remove the A/C control module.



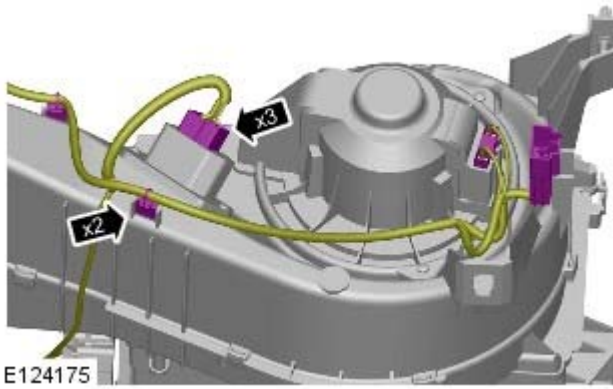
31. Disconnect the evaporator core temperature sensor electrical connector.



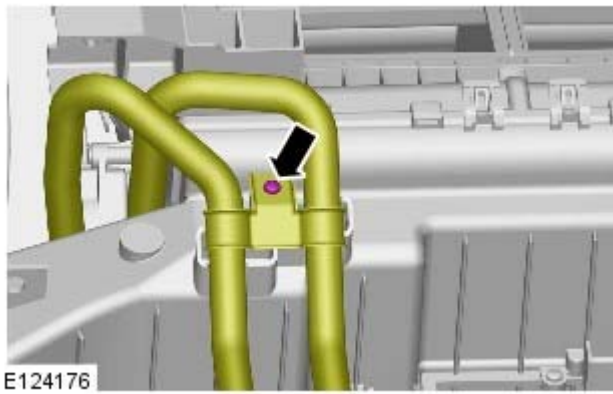
32. Disconnect the electrical connector.



33. Detach the wiring harness.

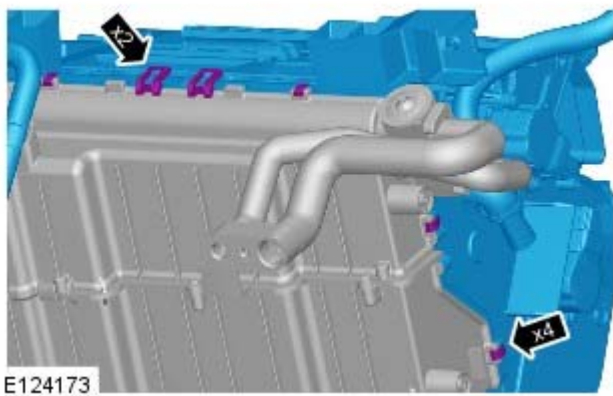
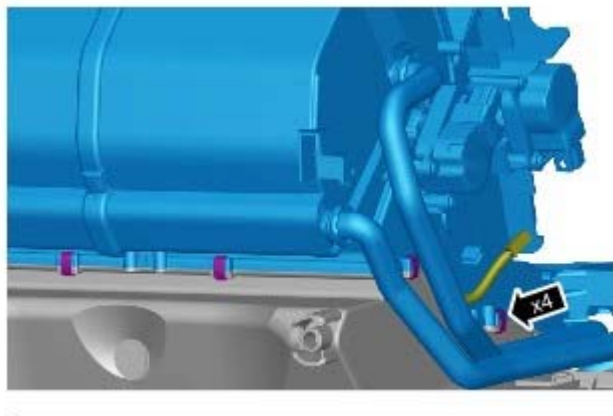


34. Remove the bolt from the support bracket.

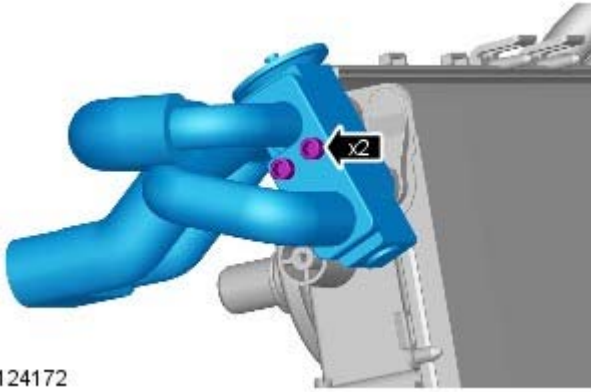


35. Remove the heater and evaporator core housing.

- Remove the 8 clips.
- Carefully release the 2 clips.



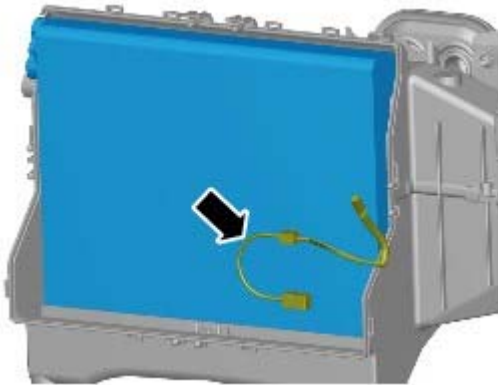
36. Remove the thermostatic expansion valve.



E124172

37. Remove the evaporator core.

- Release the temperature sensor.



E124171

Installation

1. Install the evaporator core.
 - Secure the temperature sensor.
2. Secure the heater core housing.
 - Install the clips.
3. Install the thermostatic expansion valve.
 - Tighten the bolts to 3.5 Nm (2.5 lb.ft).
4. Install the wiring harness.
5. Install and tighten the bolt.
6. Connect the temperature sensor electrical connector.
7. Install the CC module.
 - Tighten the bolts.
8. Passenger side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
 - With assistance, install the heater and evaporator core housing.
9. Driver side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
10. Install the footwell ducts.
 - Tighten the Torx screws.
11. Connect the drain tubes to the heater housing.
12. Install the adapter panels.
 - Tighten the nuts to 6 Nm (4 lb.ft).
13. Secure the A/C refrigerant lines.

- Clean the components.
 - Install new O-ring seals.
 - Tighten the bolt to 5 Nm (4 lb.ft).
 - Tighten the nut to 6 Nm.
- 14.** Connect the bulkhead heater hoses.
- 15.** With assistance, install the instrument panel.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- 16.** Install the instrument panel carrier to bulkhead Torx bolt and tighten to 25 Nm (18 lb.ft).
- 17.** Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
- 18.** Secure the heater housing.
- Tighten the screws.
- 19.** Connect the steering column intermediate shaft.
- Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).
- 20.** Install the heater housing center ducts.
- 21.** Connect the instrument panel center reinforcement fibre optic cables.
- 22.** Connect the instrument panel center reinforcement electrical connectors.
- 23.** Connect the CJB electrical connectors.
- 24.** Connect the electrical connectors to the passenger side lower A-pillar.
- 25.** Connect the ground cables to the passenger side lower A-pillar.
- Tighten the nuts to 10 Nm (7 lb.ft).
- 26.** Connect the electrical connectors to the driver side lower A-pillar.
- 27.** Connect the ground cables to the driver side lower A-pillar.
- Tighten the nuts to 10 Nm (7 lb.ft).
- 28.** Connect the 3 electrical connectors.
- 29.** Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
- 30.** Install the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
- 31.** Install the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
- 32.** Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
- 33.** Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
- 34.** Install the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Air Conditioning - TDV6 2.7L Diesel - Thermostatic Expansion Valve

Removal and Installation

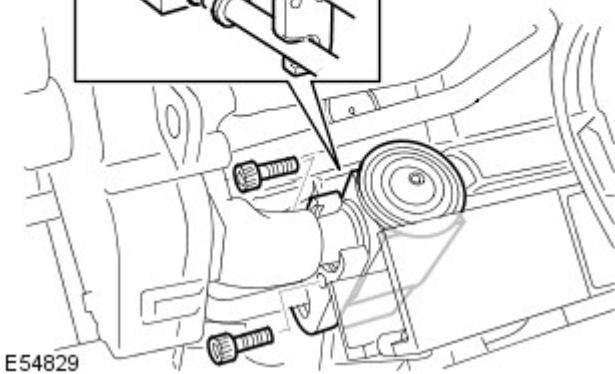
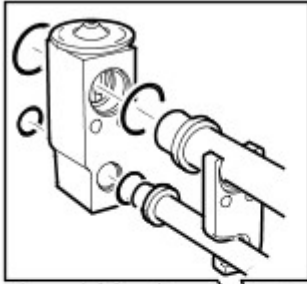
Removal

1. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
2. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

3.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Remove the thermostatic expansion valve.

- Remove the cover.
- Remove the 2 Allen bolts.
- Remove and discard the 4 O-ring seals.



E54829

Installation

1. Install the thermostatic expansion valve.
 - Clean the components.
 - Install the new O-ring seals.
 - Tighten the Allen bolts to 5 Nm (4 lb.ft).
 - Install the cover.
2. Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

Air Conditioning - TDV6 2.7L Diesel - Air Conditioning (A/C) Compressor

Pulley

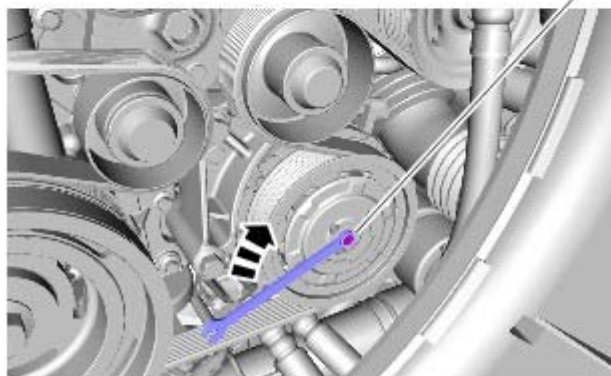
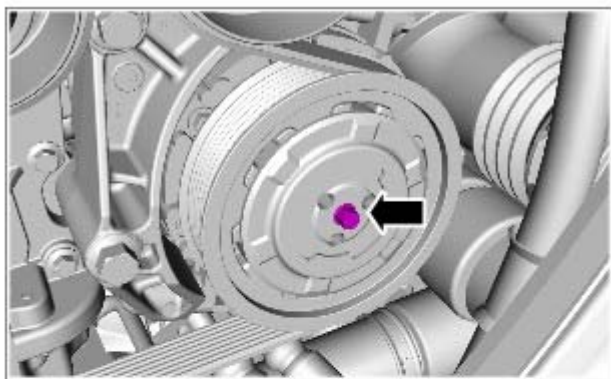
Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Components removed for clarity.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the cooling fan.
For additional information, refer to: [Cooling Fan](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
3. Using a suitable tool, release the hub locking stud.

- Rotate the fixing clockwise to release the hub.
- If required, use a suitable tool to prevent the hub from rotating.



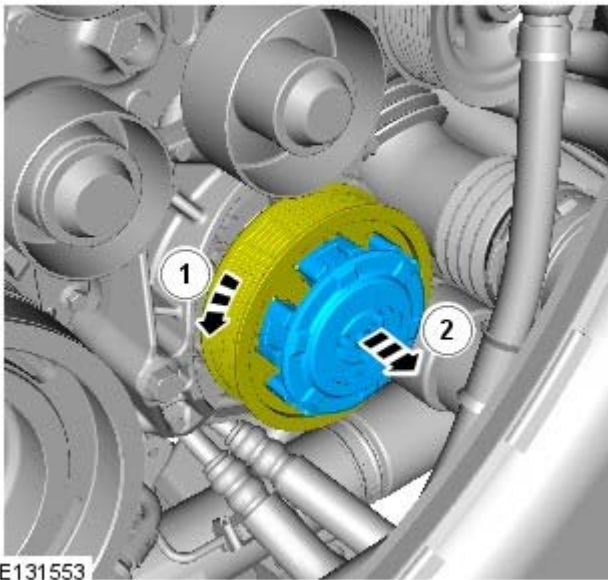
E131552

4. NOTE: Using a 3/8 square drive wrench, rotate the tensioner counter clockwise.

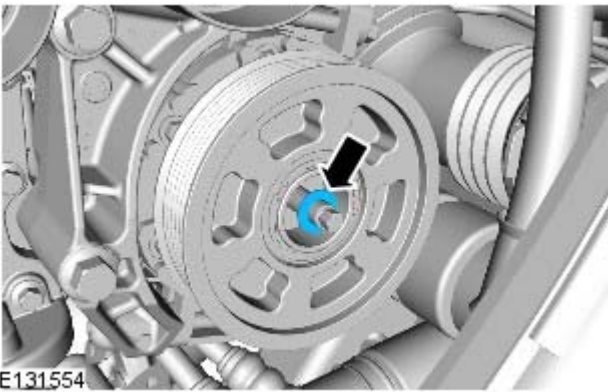
Release the accessory drive belt from the A/C compressor pulley.

5. Remove and discard the hub assembly.

- Rotate the pulley counter-clockwise, until the hub is released from the pulley.
- Discard the rubber dampers.

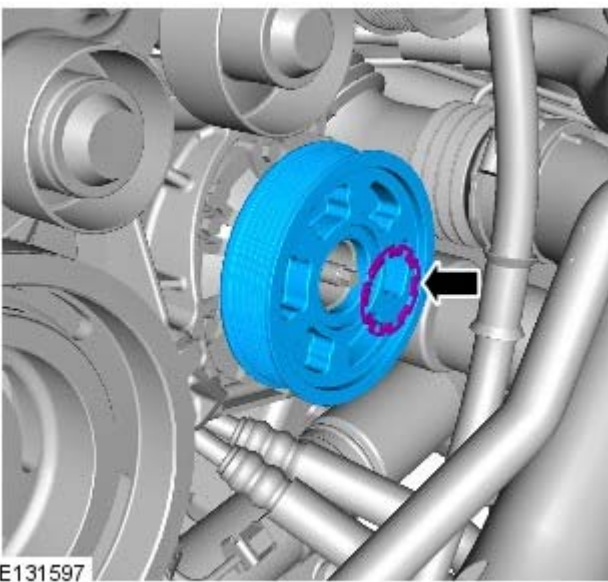


6. Remove and discard the spacer.

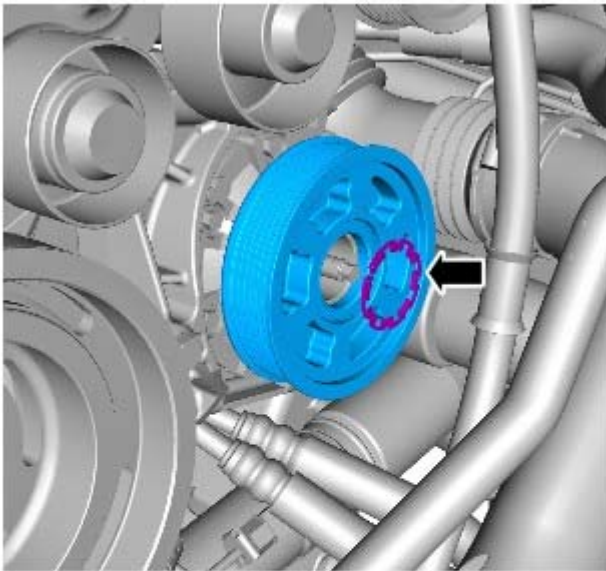


7. Remove and discard the drive pulley.

- Remove and discard the circlip.
- Clean the compressor mating surface.



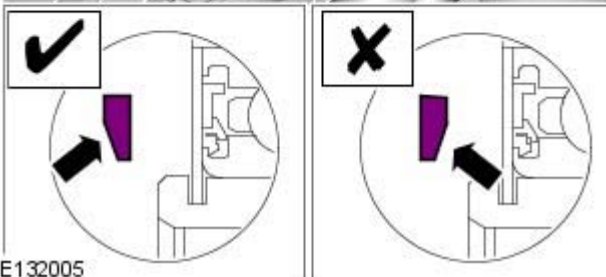
Installation



1.  CAUTION: Make sure the circlip is fitted in the correct orientation.

Install the drive pulley.

- Install the circlip.



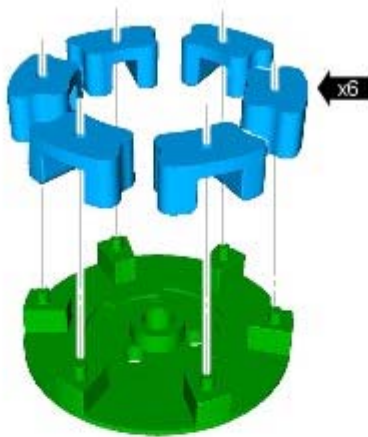
E132005

2. Install the spacer.

- Make sure the spacer is fully seated.

3. Install the 6 rubber dampers to the hub assembly.

- Make sure the dampers are installed in the correct orientation.



E131556

4. NOTE: Apply a suitable water based lubricant to the rubber dampers and to the mating surfaces on pulley.

Install the hub assembly.

- Push the hub assembly onto the pulley, and rotate clockwise to screw it onto the compressor shaft.

5. NOTE: Tighten counterclockwise.

Using a suitable tool, tighten the hub locking stud.

- Prevent the pulley rotating by hand.
- Tighten to 3.5 Nm (2.6 lb.ft)

6. Install the auxiliary drive belt.

7. Install the cooling fan.

For additional information, refer to: [Cooling Fan](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

8. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Air Conditioning - TDV6 3.0L Diesel -**Lubricant**

Item	Specification
Air conditioning (A/C) compressor oil type	Sanden SP-10 PAG oil
A/C compressor oil - vehicles fitted with 2 zone	110 cm ³
A/C compressor oil - vehicles fitted with 4 zone	160 cm ³

Refrigerant

Item	Specification
Refrigerant type	R134A
Refrigerant - vehicles fitted with 2 zone - vehicles with 3.0 diesel	600 grammes
Refrigerant - vehicles fitted with 2 zone - vehicles with 5.0L	650 grammes
Refrigerant - vehicles fitted with 4 zone	900 grammes

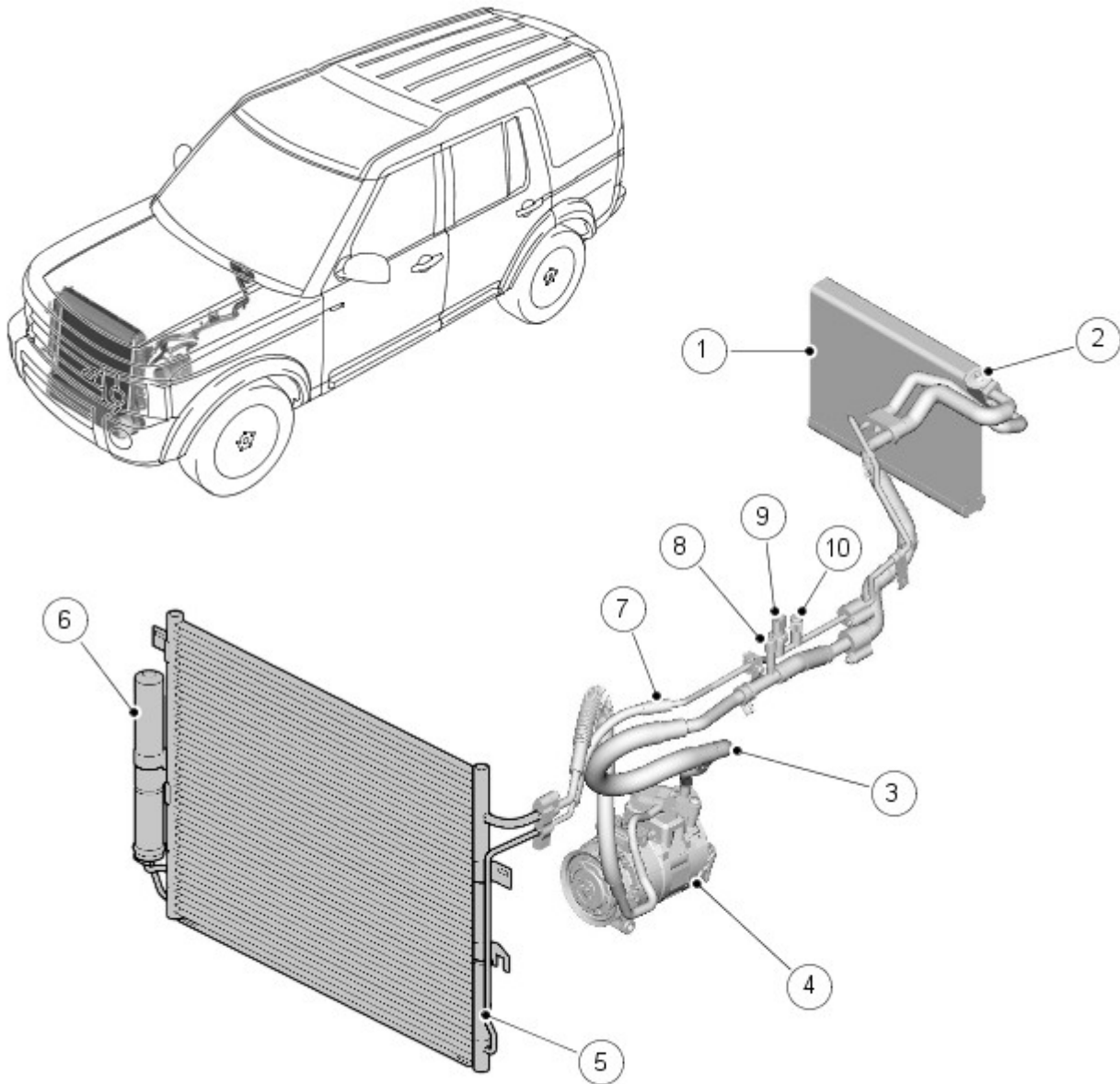
Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	-
A/C discharge line to compressor bolt	18	13	-
A/C suction line to compressor bolt	18	13	-
A/C suction line bracket bolts	6	-	53
A/C discharge line to condenser bolt	6	-	53
A/C liquid line to condenser bolt	6	-	53
A/C condenser manifold to radiator bolt	10	7	-
Condenser to radiator bolt - vehicles with 5.0L	10	7	-
Condenser to radiator bolt - vehicles with 3.0 diesel	5	-	44
Evaporator line to evaporator core bolt	6	-	53
Evaporator line bracket nut	6	-	53
A/C liquid line to front evaporator line bolt - vehicles fitted with 4 zone	18	13	-
A/C suction line to front evaporator line bolt - vehicles fitted with 4 zone	18	13	-
A/C lines to rear evaporator bolts - vehicles fitted with 4 zone	9	-	80
A/C pressure transducer	10	7	-
Thermostatic expansion valve (TXV) to refrigerant line clamp bolts	5	-	44

Air Conditioning - TDV6 3.0L Diesel - Air Conditioning

Description and Operation

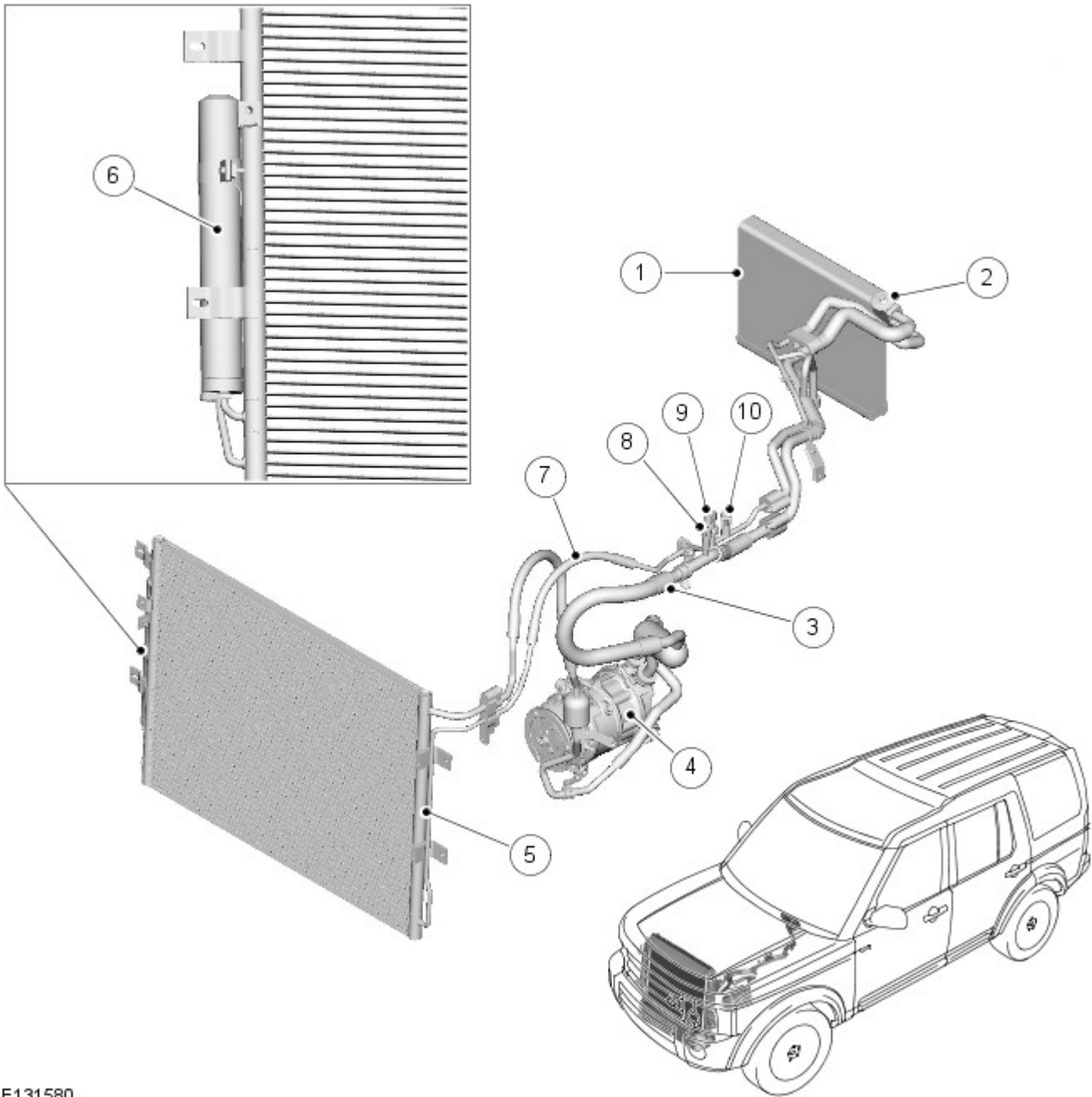
COMPONENT LOCATION 2.7L TdV6



E131578

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	air conditioning (A/C) compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

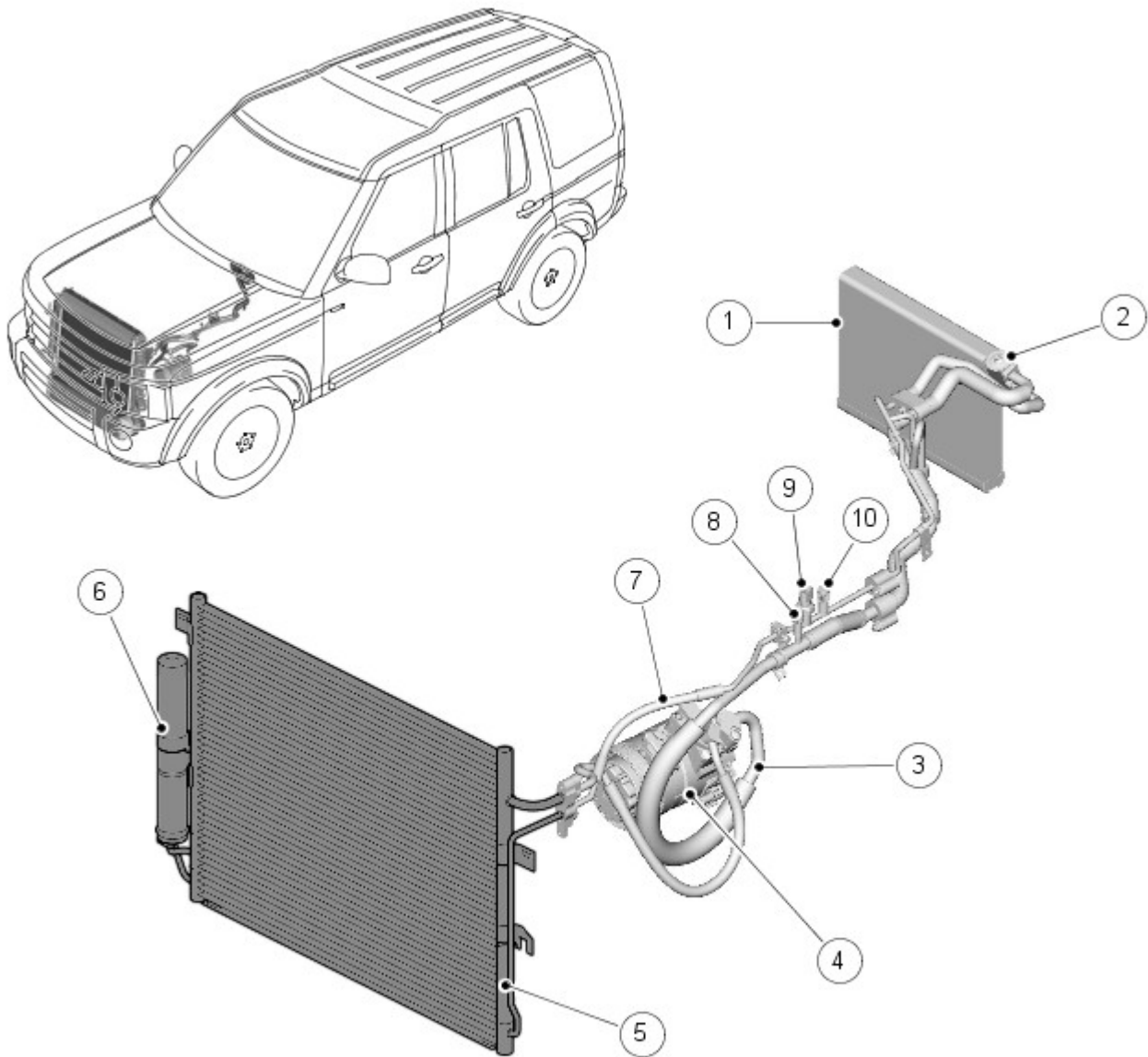
COMPONENT LOCATION 3.0L TdV6



E131580

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

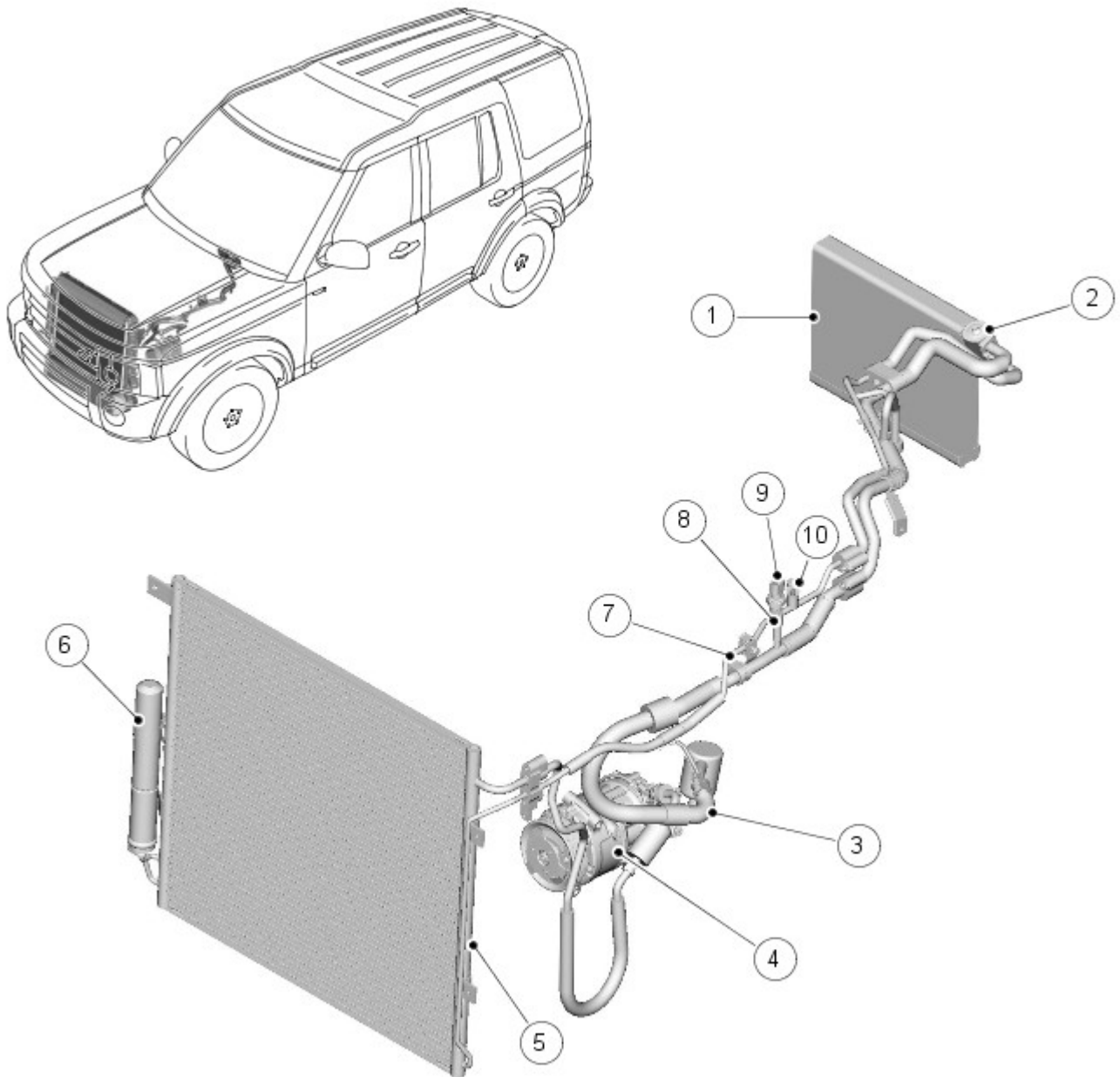
COMPONENT LOCATION 4.0L NA V6



E131582

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

COMPONENT LOCATION 5.0L NA V8



E131583

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

GENERAL

The A/C system transfers heat from the vehicle interior to the outside atmosphere to provide the heater assembly with dehumidified cool air. The system consists of:

- A compressor.
- A condenser.
- A receiver drier.
- A thermostatic expansion valve.
- An evaporator.
- Low and high pressure refrigerant lines.

The system is a sealed, closed loop, filled with a charge weight of R134a refrigerant as the heat transfer medium. Oil is added to the refrigerant to lubricate the internal components of the compressor.

Operation of the air conditioning system is controlled by the automatic temperature control (ATC) module. The A/C compressor circulates the refrigerant around the system by compressing low pressure, low temperature vapor from the evaporator and discharging the resultant high pressure, high temperature vapor to the condenser.

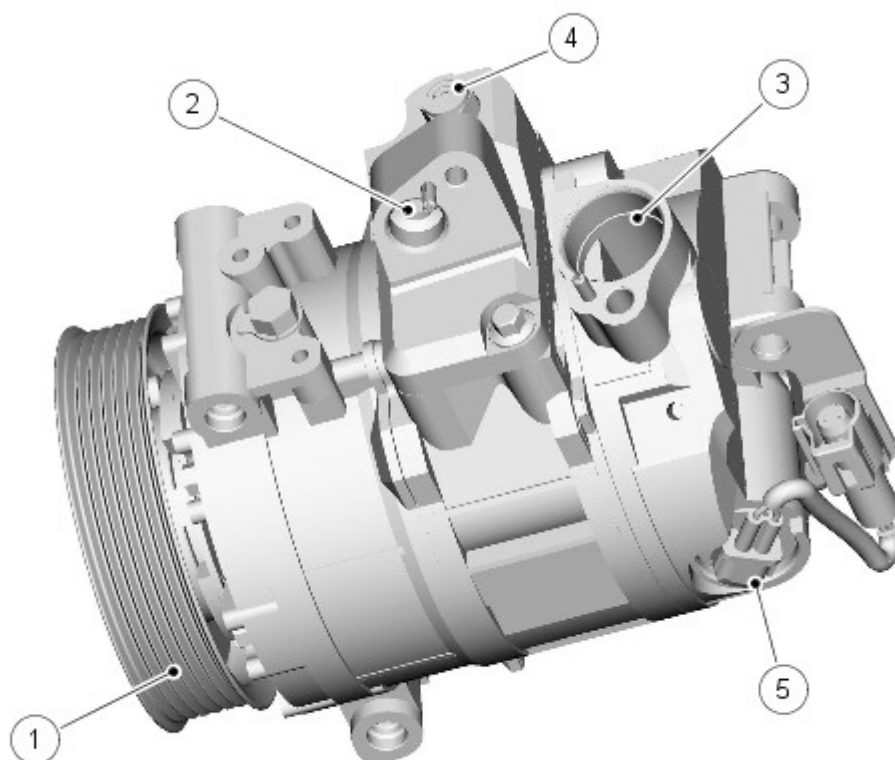
The A/C compressor is a variable displacement unit which is driven by the engine accessory drive belt. On 2.7L/4.0L and 5.0L vehicles, the [A/C \(air conditioning\)](#) compressor is permanently driven directly from the pulley. On 3.0L diesel vehicles the [A/C](#) compressor is driven via an electro-magnetic clutch.

To protect the refrigerant system from excessive pressure, a pressure relief valve is installed in the outlet side of the A/C compressor. The pressure relief valve vents excess pressure into the engine compartment.

For additional information, refer to: Control Components (412-04, Description and Operation).

A/C COMPRESSOR

2.7L TdV6



E131577

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

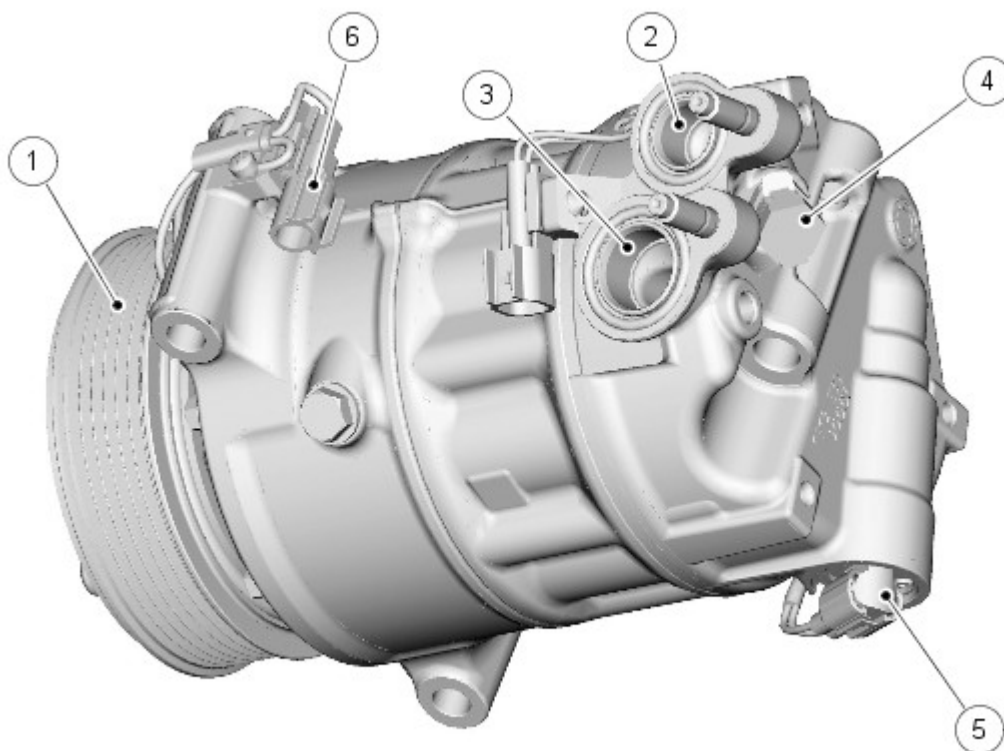
The [A/C](#) compressor fitted to 2.7L TdV6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC \(automatic temperature control\)](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (436 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

3.0L TdV6



E131579

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector
6	-	electromagnetic clutch connector

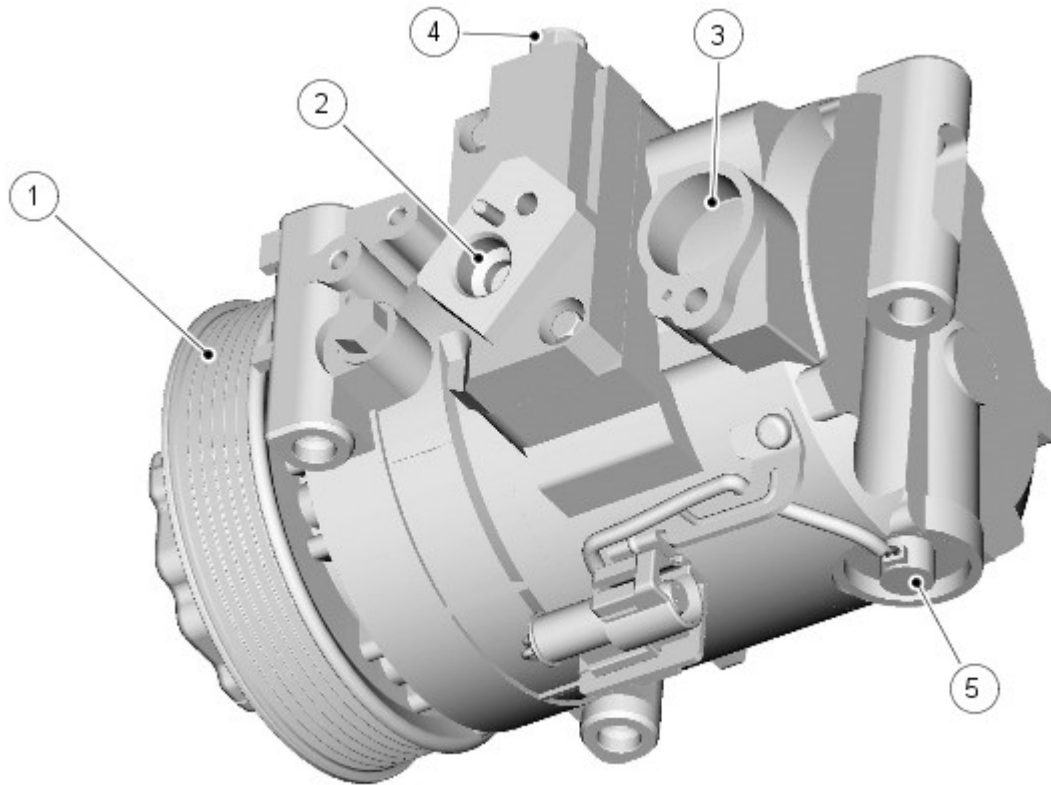
The [A/C](#) compressor fitted to 3.0L TdV6 diesel vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley and an electromagnetic clutch. Operation of the clutch is controlled by a power feed from the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The clutch of the [A/C](#) compressor incorporates a thermal cut-off fuse, which disconnects the power feed from the [ATC](#) module if the temperature increases to 182 ± 5 °C (360 ± 9 °F).

4.0L NA V6



E131581

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

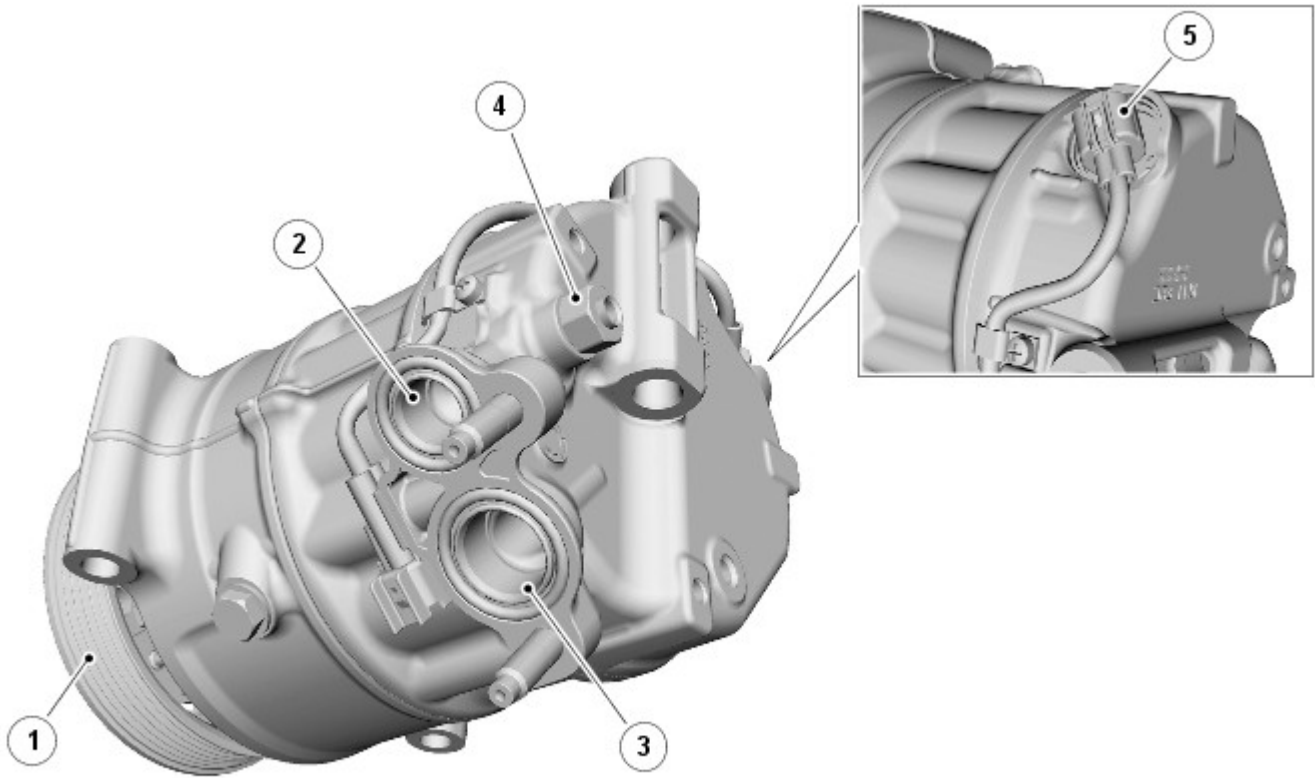
The [A/C](#) compressor fitted to 4.0L NA V6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (437 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

5.0L NA V8



E131337

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

The [A/C](#) compressor fitted to 5.0L V8 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

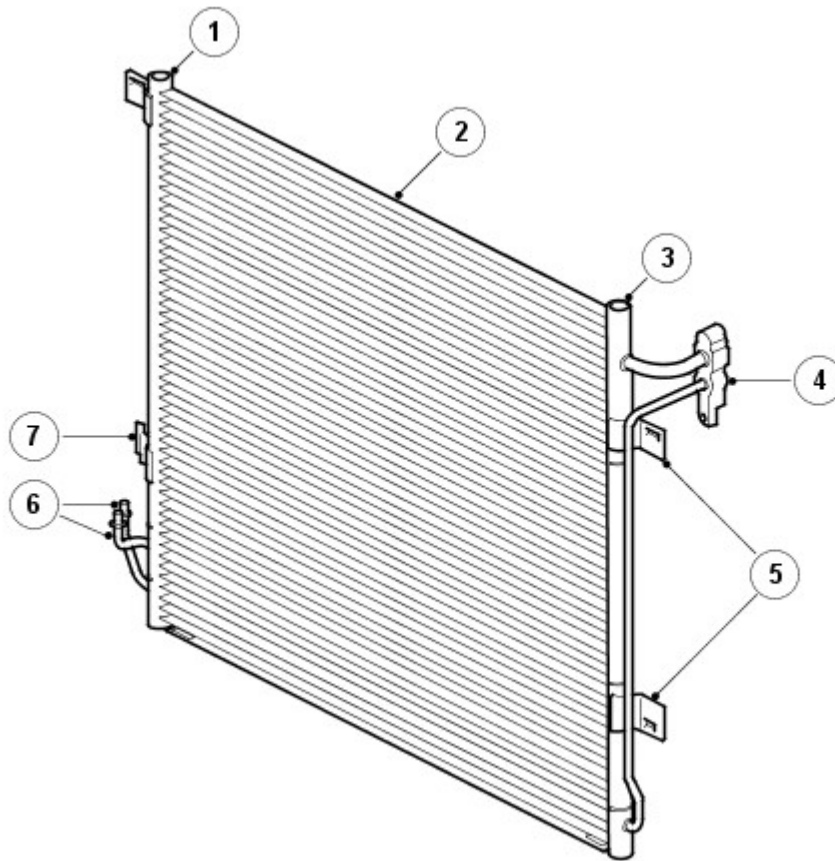
The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

CONDENSER

- NOTE: 5.0L NA V8 version shown other installations similar



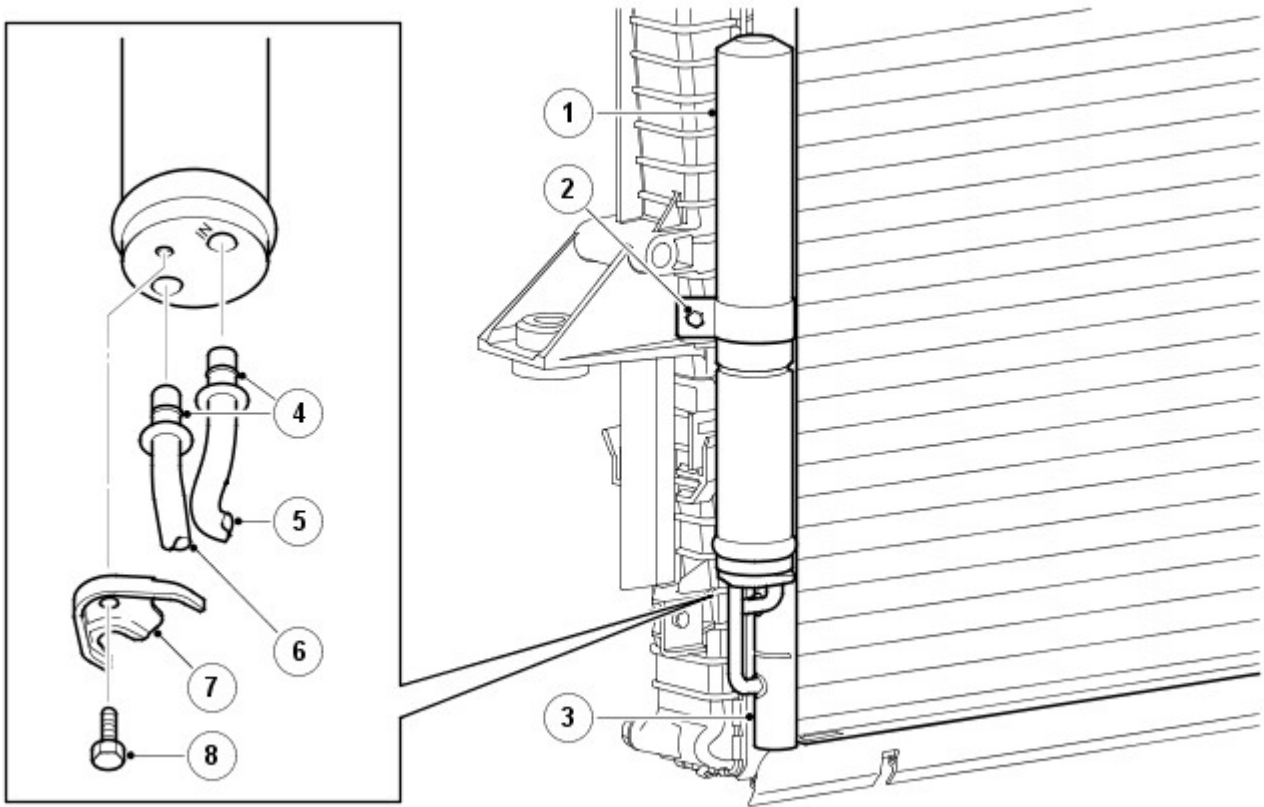
E46920

Item	Part Number	Description
1	-	right-hand (RH) end tank
2	-	Condenser core
3	-	left-hand (LH) end tank
4	-	High pressure line connector block
5	-	Condenser attachment brackets
6	-	Receiver drier pipes
7	-	Receiver drier attachment bracket

The condenser transfers heat from the refrigerant to the surrounding air to convert the high pressure vapor from the compressor into a liquid. The condenser is installed immediately in front of the radiator. Two brackets on each end tank of the condenser attach the condenser to clips on the end tanks of the radiator.

The condenser is classified as a sub-cooling condenser and consists of a fin and tube heat exchanger core installed between two end tanks. Divisions in the end tanks separate the heat exchanger into a four pass upper (condenser) section and a two pass lower (sub-cooler) section. A connector block on the left end tank of the condenser provides connections for the high pressure lines from the A/C compressor and the evaporator. Two pipes at the bottom of the right end tank of the condenser provide connections for the receiver drier.

RECEIVER DRIER



E46921

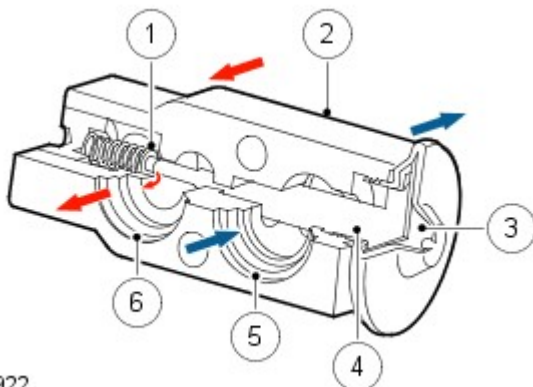
Item	Part Number	Description
1	-	Receiver drier
2	-	Clamp
3	-	Condenser RH end tank
4	-	O-ring seals
5	-	Inlet pipe
6	-	Outlet pipe
7	-	Collar
8	-	Bolt

The receiver drier removes solid impurities and moisture from the refrigerant, and provides a reservoir for liquid refrigerant to accommodate changes of heat load at the evaporator.

The receiver drier is attached to the two stub pipes on the right end tank of the condenser. A collar, located on lands on the stub pipes and secured with a bolt, attaches the stub pipes to the receiver drier. A clamp secures the body of the receiver drier to a bracket welded to the right end tank of the condenser. The inlet and outlet ports of the receiver drier are the same size, so care must be taken to install the receiver drier the correct way round on the stub pipes; to assist with installation, the inlet port is identified with the word IN etched into the receiver drier.

Refrigerant entering the receiver drier passes through a filter and a desiccant pack, then collects in the base of the unit before flowing through the outlet stub pipe back to the condenser. The desiccant and the filter are non-serviceable; the complete unit must be replaced when a change of desiccant is required.

THERMOSTATIC EXPANSION VALVE



E46922

Item	Part Number	Description
1	-	Metering valve
2	-	Housing

3	-	Diaphragm
4	-	Temperature sensitive tube
5	-	Outlet passage from evaporator
6	-	Inlet passage to evaporator

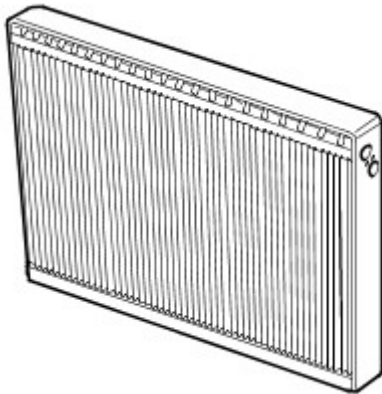
The thermostatic expansion valve meters the flow of refrigerant into the evaporator, to match the refrigerant flow with the heat load of the air passing through the evaporator.

The thermostatic expansion valve is a block type valve located behind the heater assembly, and attached to the inlet and outlet ports of the evaporator. The thermostatic expansion valve consists of an aluminum housing containing inlet and outlet passages. A ball and spring metering valve is installed in the inlet passage and a temperature sensor is installed in the outlet passage. The temperature sensor consists of a temperature sensitive tube connected to a diaphragm. The bottom end of the temperature sensitive tube acts on the ball of the metering valve. Pressure on top of the diaphragm is controlled by evaporator outlet temperature conducted through the temperature sensitive tube. The bottom of the diaphragm senses evaporator outlet pressure.

Liquid refrigerant flows through the metering valve into the evaporator. The restriction across the metering valve reduces the pressure and temperature of the refrigerant. The restriction also changes the liquid stream of refrigerant into a fine spray, to improve the evaporation process. As the refrigerant passes through the evaporator, it absorbs heat from the air flowing through the evaporator. The increase in temperature causes the refrigerant to vaporize and increase in pressure.

The temperature and pressure of the refrigerant leaving the evaporator act on the diaphragm and temperature sensitive tube, which regulate the metering valve opening and so control the volume of refrigerant flowing through the evaporator. The warmer the air flowing through the evaporator, the more heat available to evaporate refrigerant and thus the greater the volume of refrigerant allowed through the metering valve.

EVAPORATOR



E46923

The evaporator is installed in the heater assembly between the blower and the heater matrix, to absorb heat from the exterior or recirculated air. Low pressure, low temperature refrigerant changes from liquid to vapor in the evaporator, absorbing large quantities of heat as it changes state.

Most of the moisture in the air passing through the evaporator condenses into water, which drains out of the heater and through the floorpan, to the underside of the vehicle, through two drain tubes.

REFRIGERANT LINES

To maintain similar flow velocities around the system, the diameter of the refrigerant lines varies to suit the two pressure/temperature regimes. The larger diameters are installed in the low pressure/temperature regime and the smaller diameters are installed in the high pressure/temperature regime.

Low and high pressure charging connections are incorporated into the refrigerant lines for system servicing. Where auxiliary A/C is installed, connections for the auxiliary refrigerant lines are incorporated near the engine bulkhead.

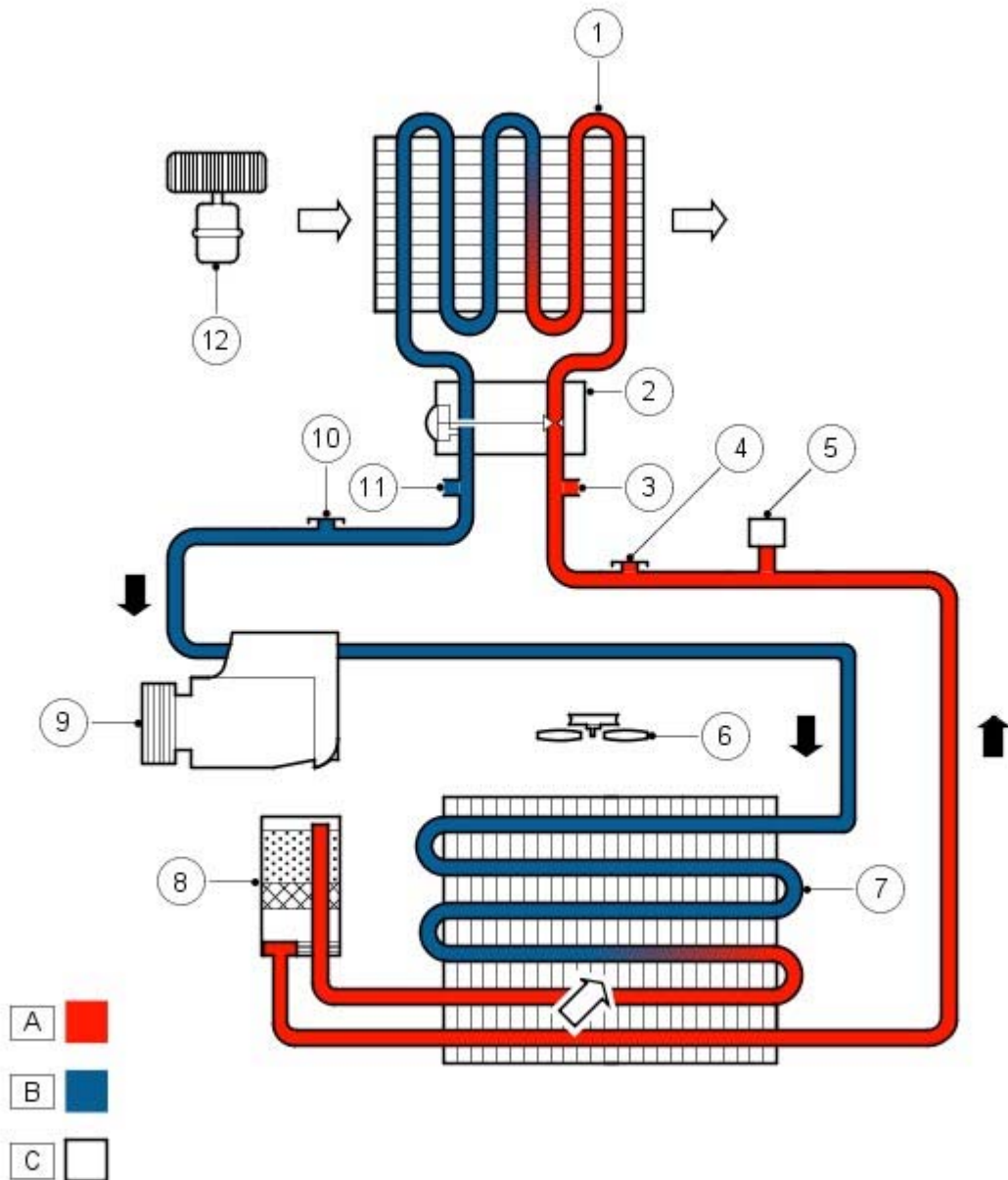
Under normal operating conditions, the smaller diameter pipes (A/C compressor discharge, liquid refrigerant) are hot to the touch and the larger diameter pipes (A/C compressor suction, gaseous refrigerant) are cold to the touch.

SYSTEM OPERATION

To accomplish the transfer of heat, the refrigerant is circulated around the system, where it passes through two pressure/temperature regimes. In each of the pressure/temperature regimes, the refrigerant changes state, during which process maximum heat absorption or release occurs. The low pressure/temperature regime is from the thermostatic expansion valve, through the evaporator to the compressor; the refrigerant decreases in pressure and temperature at the thermostatic expansion valve, then changes state from liquid to vapor in the evaporator, to absorb heat. The high pressure/temperature regime is from the compressor, through the condenser and receiver drier to the thermostatic expansion valve; the refrigerant increases in pressure and temperature as it passes through the compressor, then releases heat and changes state from vapor to liquid in the condenser.

A/C SYSTEM SCHEMATIC

- NOTE: A = Refrigerant liquid; B = Refrigerant vapor; C = Air flow



E46924

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	High pressure connection with auxiliary climate control (where fitted)
4	-	High pressure servicing connection
5	-	Refrigerant pressure sensor
6	-	Cooling fan
7	-	Condenser
8	-	Receiver drier
9	-	A/C compressor
10	-	Low pressure servicing connection
11	-	Low pressure connection with auxiliary climate control (where fitted)
12	-	Blower

Air Conditioning - TDV6 3.0L Diesel - Air Conditioning

Diagnosis and Testing

For additional information.


REFER to: [Climate Control System](#) (412-00 Climate Control System - General Information, Diagnosis and Testing).

Air Conditioning - TDV6 3.0L Diesel - Air Conditioning (A/C) Compressor

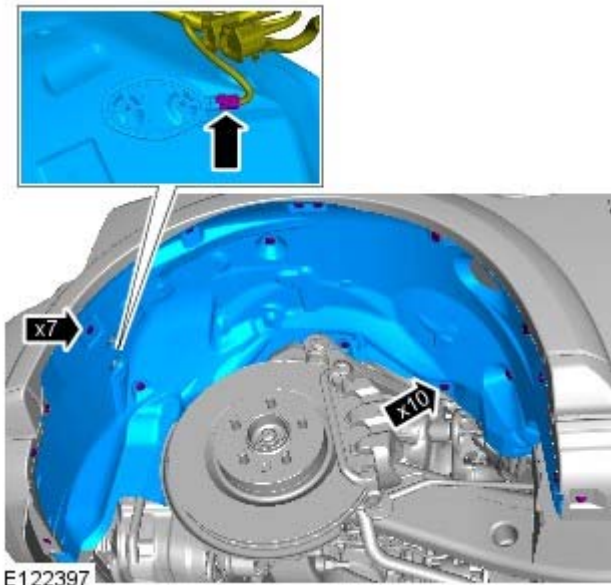
Removal and Installation

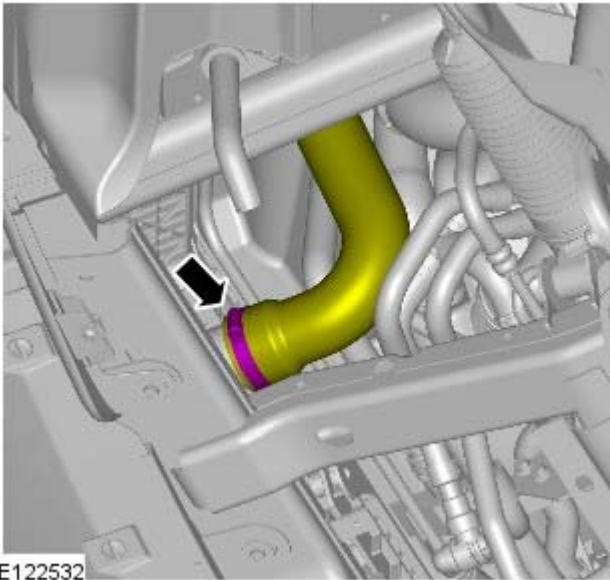
Removal

• NOTE: Removal steps in this procedure may contain installation details.


1.  **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
3. Refer to: [Accessory Drive Belt](#) (303-05B Accessory Drive - TDV6 3.0L Diesel, Removal and Installation).
4. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
5. Refer to: [Transmission Fluid Cooler Tubes - TDV6 3.0L Diesel](#) (307-02C Transmission/Transaxle Cooling - V8 5.0L Petrol/TDV6 3.0L Diesel, Removal and Installation).

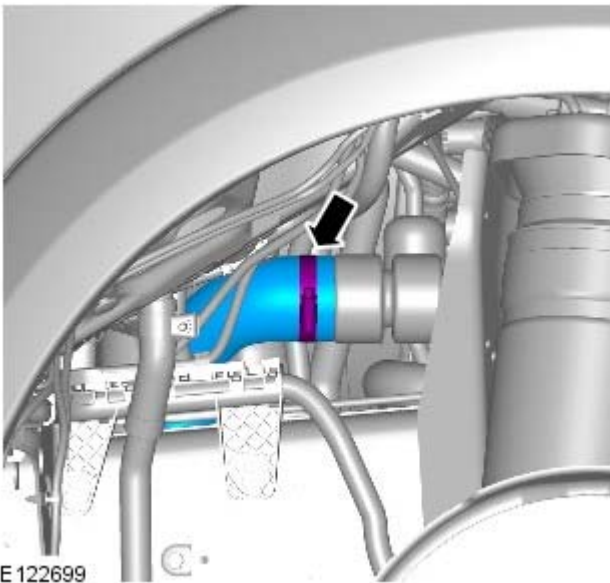
6.





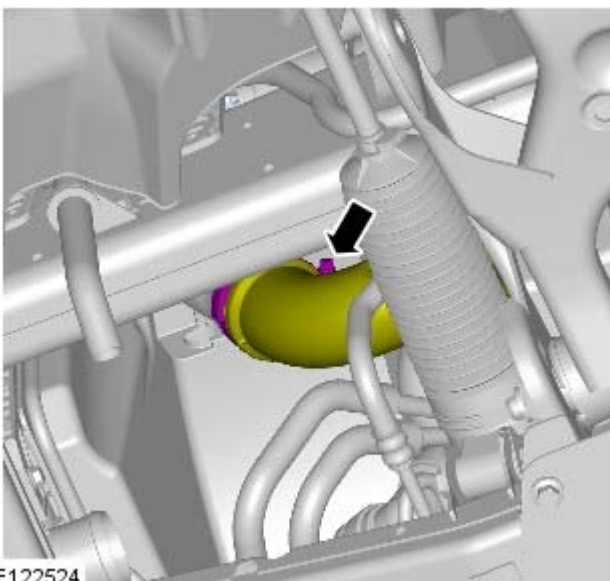
E122532

7.  CAUTION: Be prepared to collect escaping coolant.



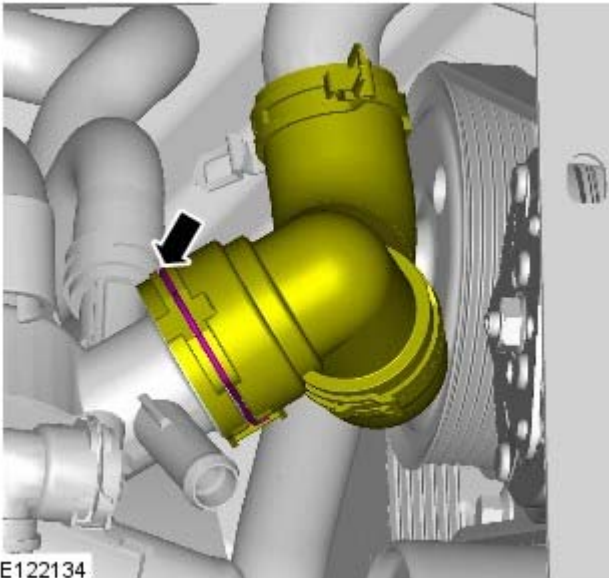
E122699

- 8.




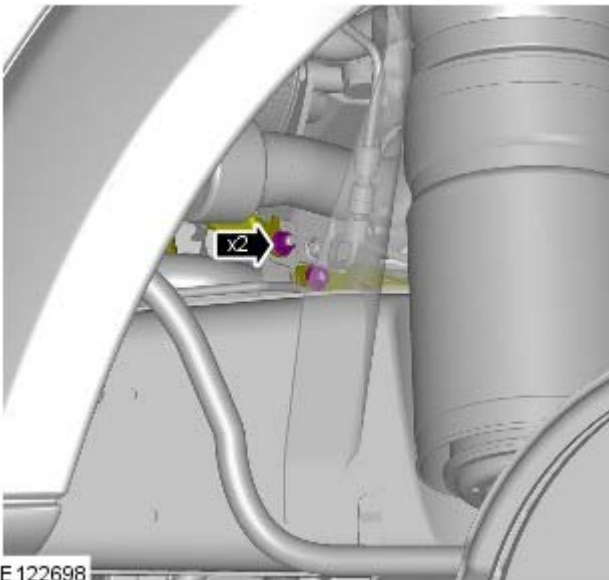
E122524

- 9.



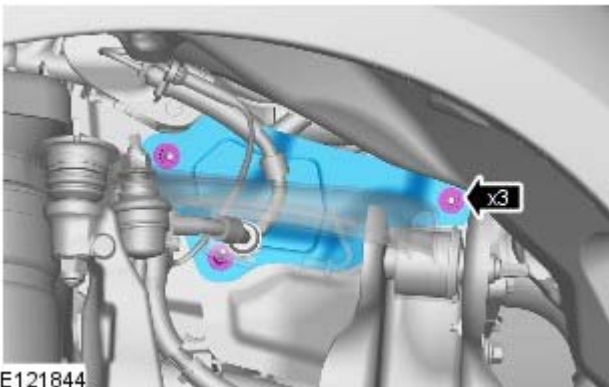
E122134

10. **10.**  **CAUTION:** Be prepared to collect escaping coolant.
- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



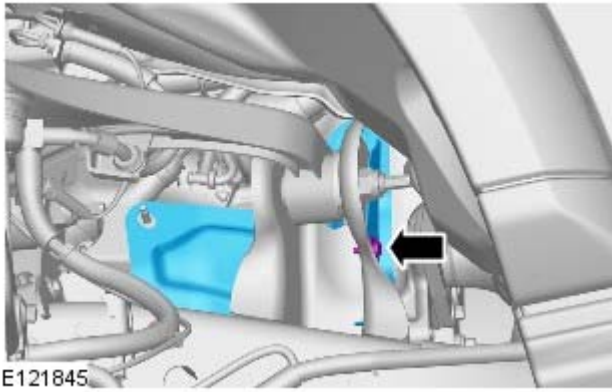
E 122698

11. *Torque: 6 Nm*

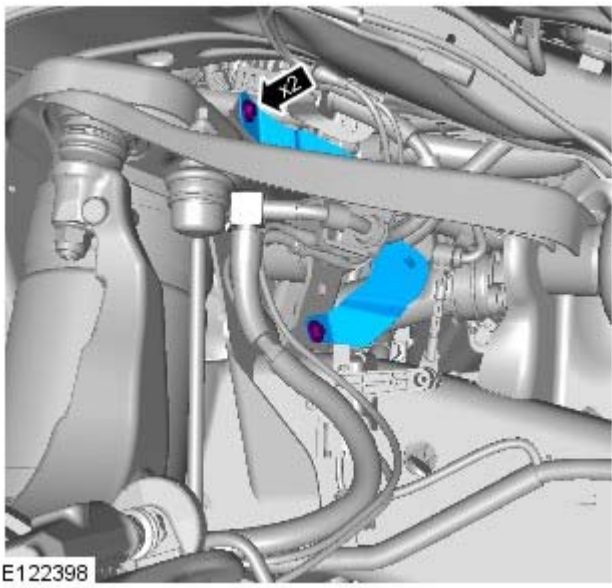


E121844

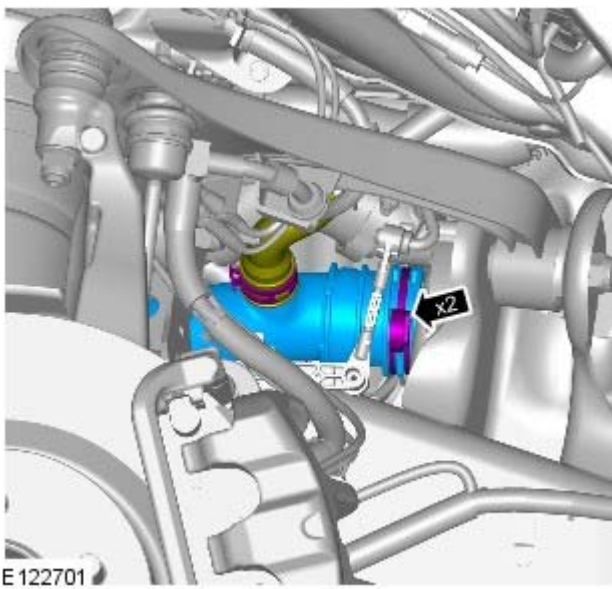
12. *Torque: 9 Nm*



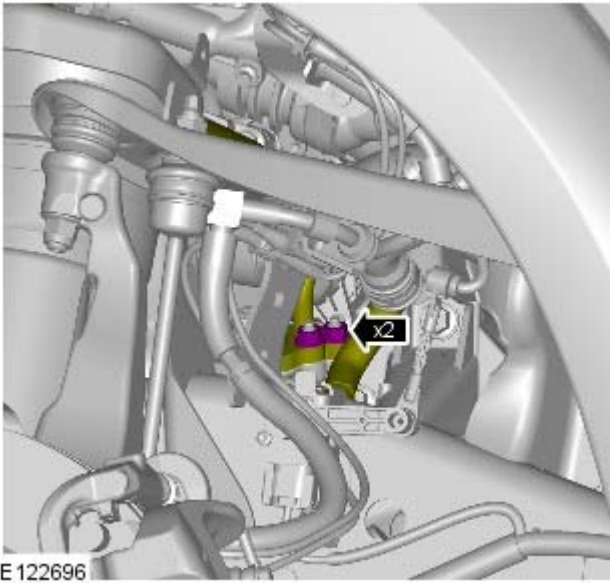
13. Torque: 9 Nm



14. Torque: 9 Nm



15.



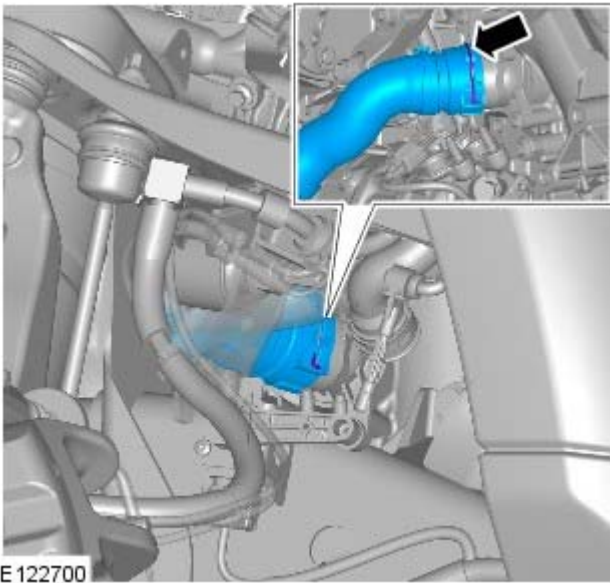
E 122696

16. **16. CAUTIONS:**

 Make sure that all openings are sealed. Use new blanking caps.

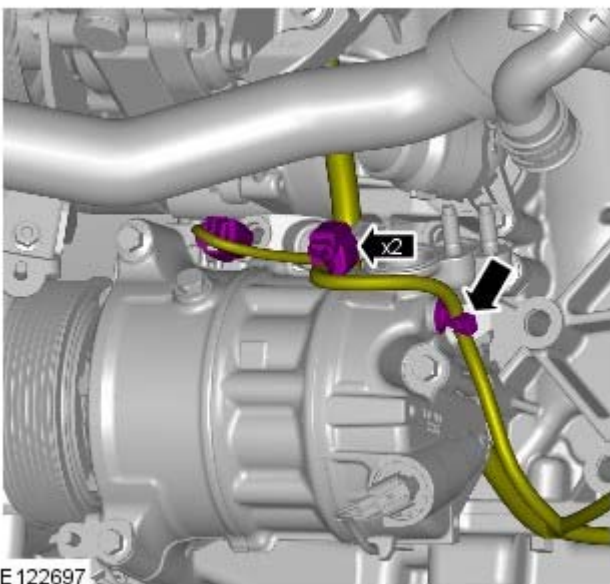
 A new O-ring seal is to be installed.

Torque: 18 Nm



E 122700

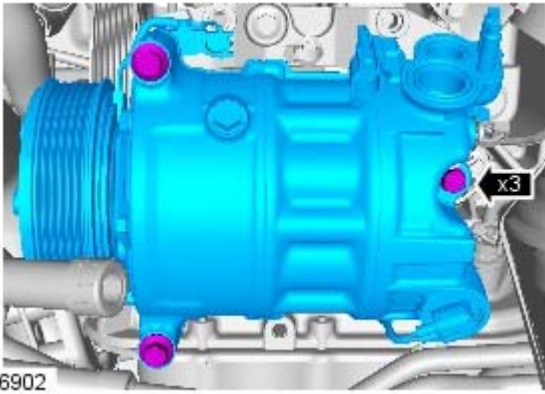
17.  **CAUTION:** Be prepared to collect escaping coolant.



E 122697

18.

19. Torque: 25 Nm



E116902

Installation

1. To install, reverse the removal procedure.

Air Conditioning - TDV6 3.0L Diesel - Air Conditioning (A/C) Pressure Transducer

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Recover the A/C refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

3. CAUTIONS:



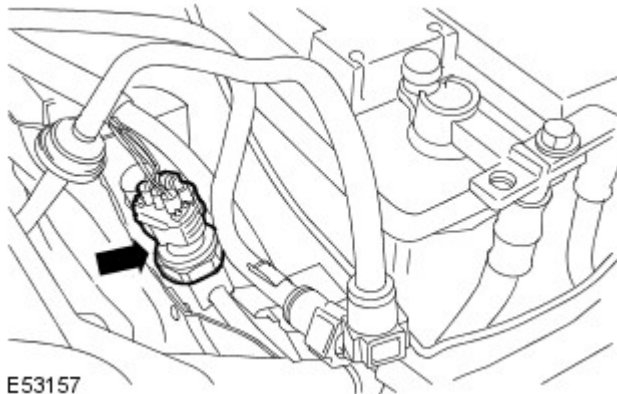
Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



To prevent damage to components, use an additional wrench when loosening or tightening unions.

Remove the A/C pressure transducer.

- Disconnect the electrical connector.
- Remove and discard the seal.



E53157

Installation

1. Install the A/C pressure transducer.
 - Clean the component mating faces.
 - Install a new seal.
 - Tighten the transducer to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

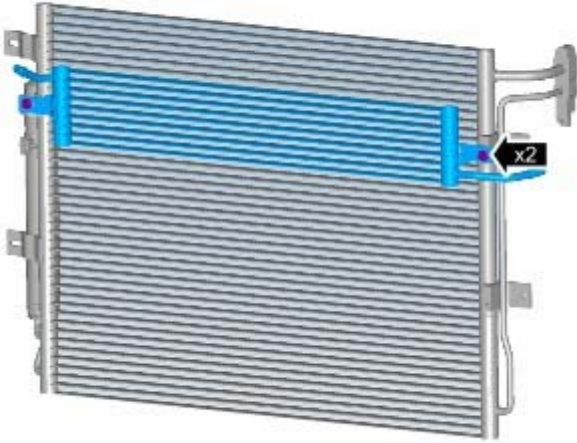
Air Conditioning - TDV6 3.0L Diesel - Condenser Core

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. For additional information, refer to: [Radiator](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).
2. TORQUE: 5 Nm



E122605


Installation

1. To install, reverse the removal procedure.

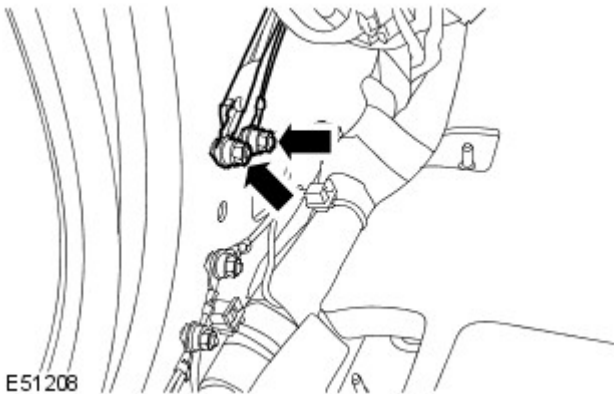
Air Conditioning - TDV6 3.0L Diesel - Evaporator Core

Removal and Installation

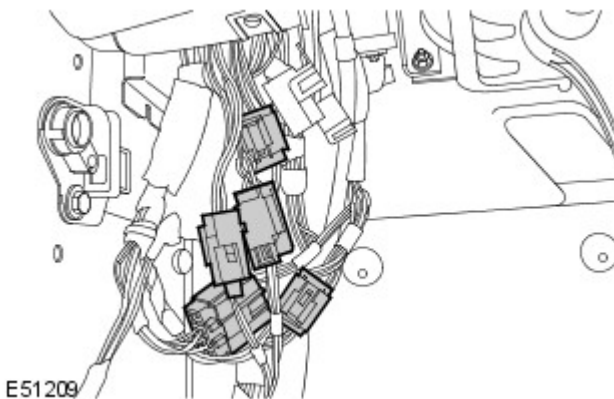
Removal

1. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

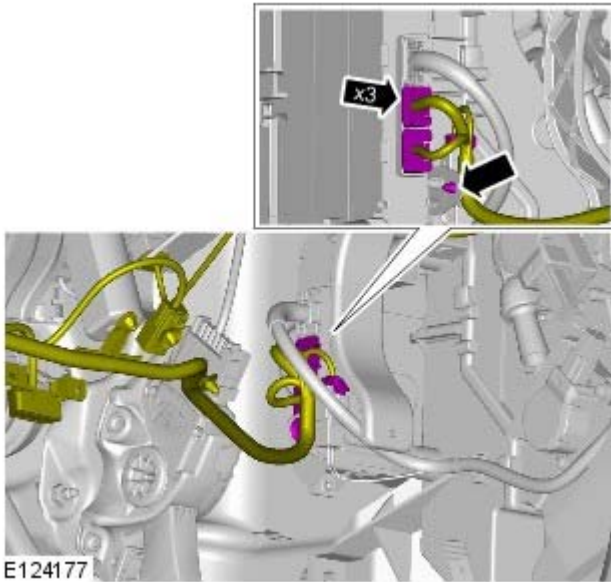
Raise and support the vehicle.
3. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).
4. Remove the driver side front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
5. Remove the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
6. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
7. Release the 3 ground cables from the driver side lower A-pillar.
 - Remove the 2 nuts.



8. Disconnect the 5 electrical connectors from the driver side lower A-pillar.

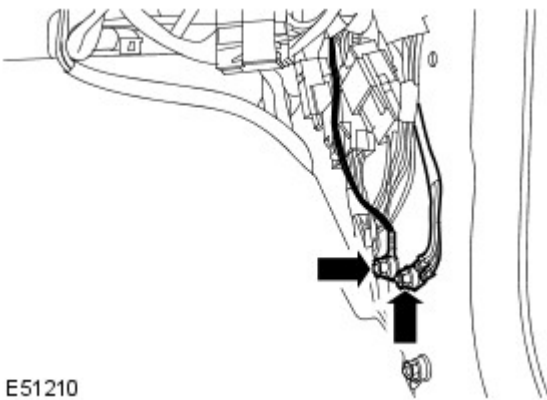


9. Disconnect the 3 electrical connectors.



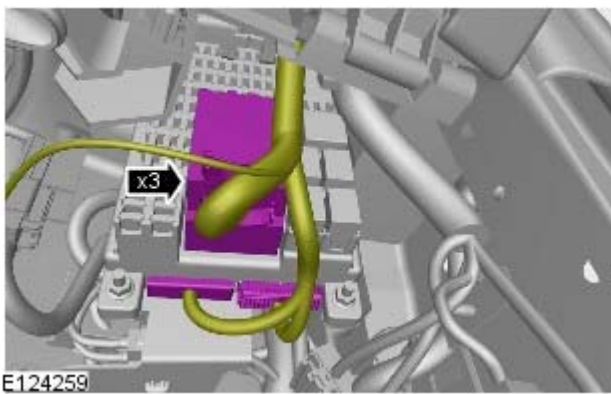
10. Release the 3 ground cables from the passenger side lower A-pillar.

- Remove the 2 nuts.



11. Disconnect the 5 electrical connectors from the passenger side lower A-pillar.

12. Disconnect the central junction box (CJB) three electrical connectors.



13. Disconnect 2 electrical connectors from the instrument panel center reinforcement.

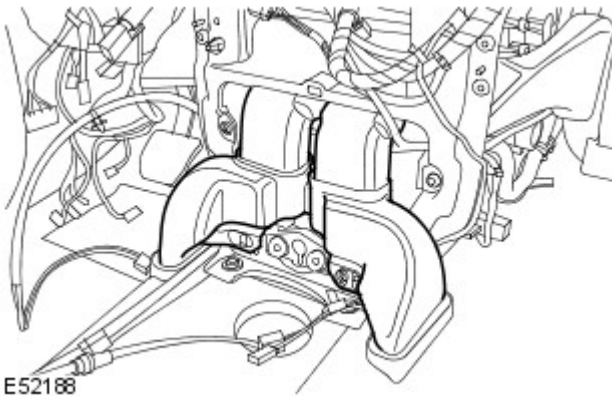


14.  **CAUTION:** Cover fiber optic cable connectors to minimize dust ingress and avoid bending the cables in a radius of less than 30 mm.

If installed, disconnect the instrument panel center reinforcement fibre optic cables.

- Disconnect the electrical connector.

15. Remove the heater housing center ducts.



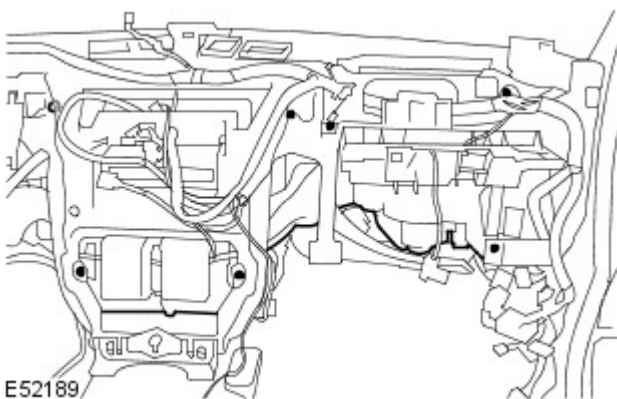
16. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.



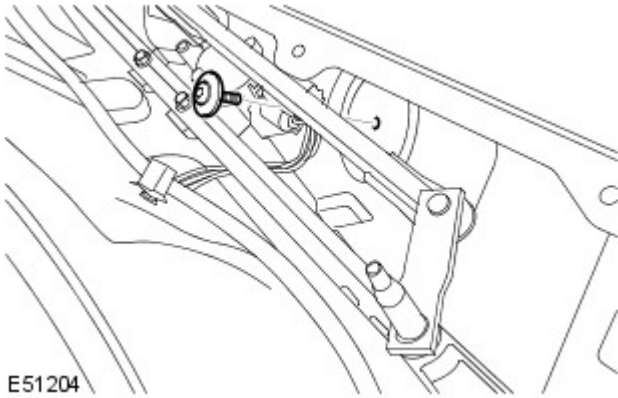
17. Release the heater housing from the instrument panel carrier.

- Remove the 7 Torx screws.



18. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

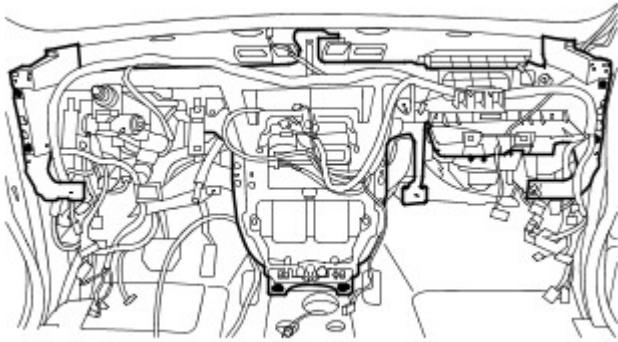
19. Remove the instrument panel carrier to bulkhead Torx bolt.



E51204

20. With assistance, remove the instrument panel.

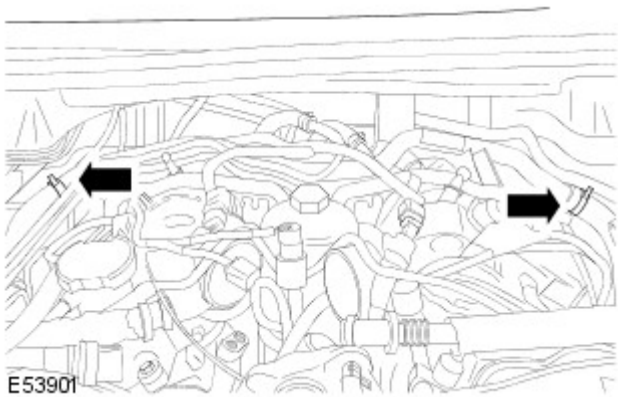
- Remove the 6 Torx bolts.



E52190

21. Disconnect both exhaust gas recirculation (EGR) coolant cross-over pipe hoses.

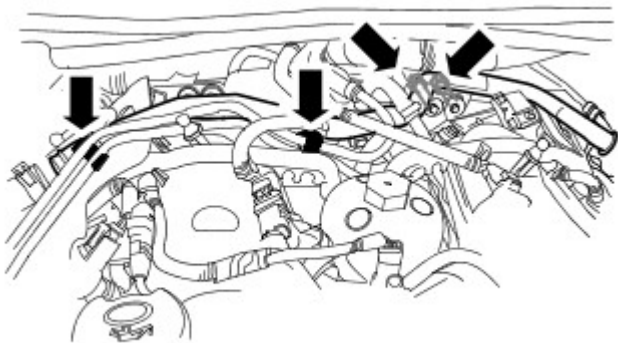
- Release the 2 clips.




E53901

22. Remove the EGR coolant cross-over pipe.

- Remove the 2 bolts.
- Release the 2 clips.

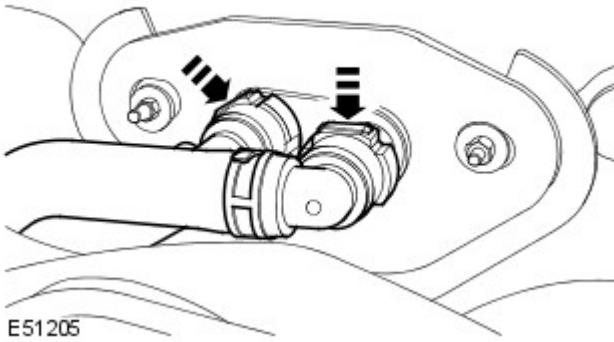


E55561

23.  CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect 2 heater hoses from the bulkhead.

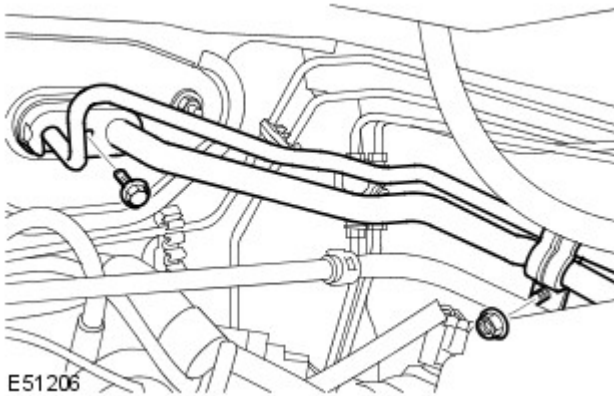
- Release the 2 clips.



24.  CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

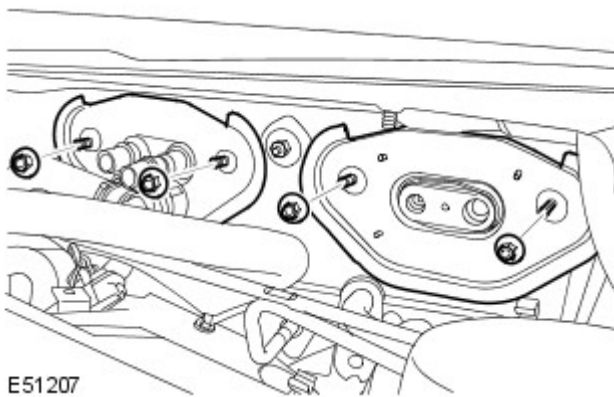
Release the 2 A/C refrigerant lines.

- Remove the nut and bolt.
- Remove and discard the O-ring seals.

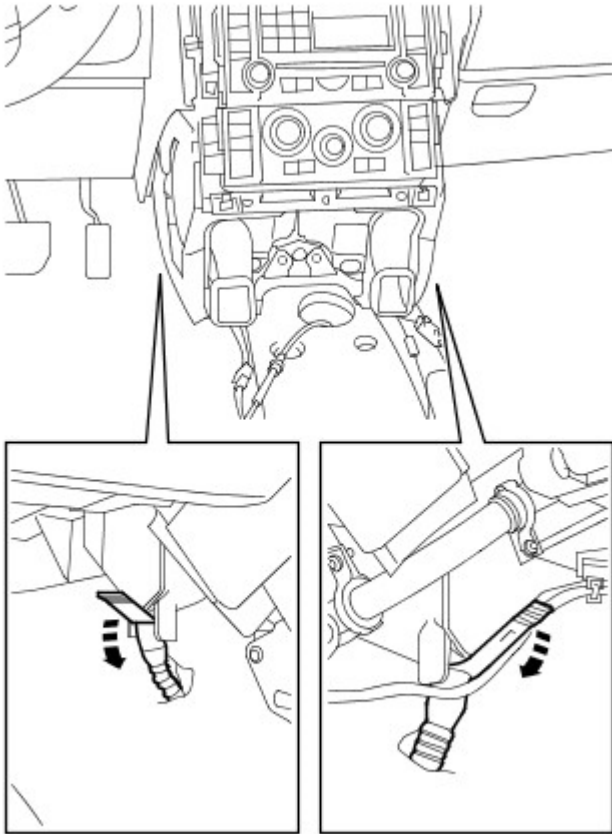


25. Remove the 2 adapter panels.

- Remove the 4 nuts.



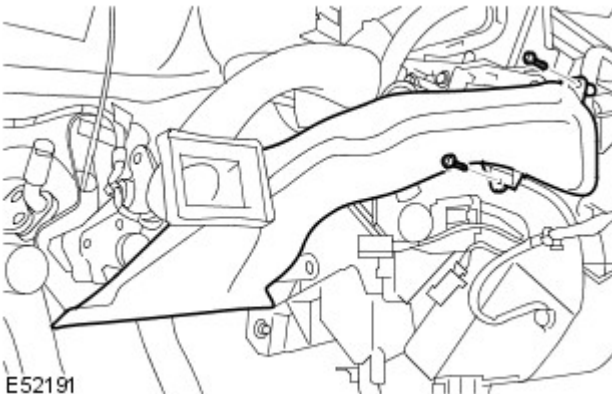
26. Disconnect 2 drain tubes from the heater housing.



E51199

27. Remove the driver side footwell duct.

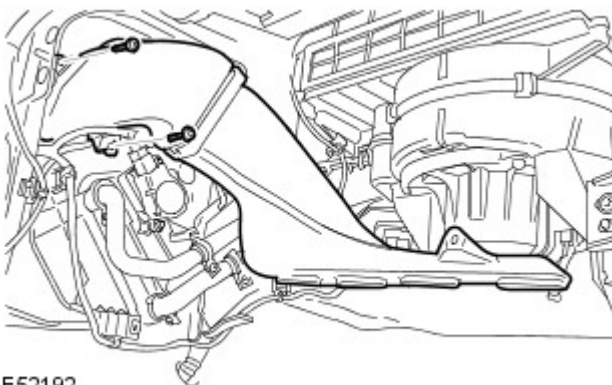
- Remove the 2 Torx screws.



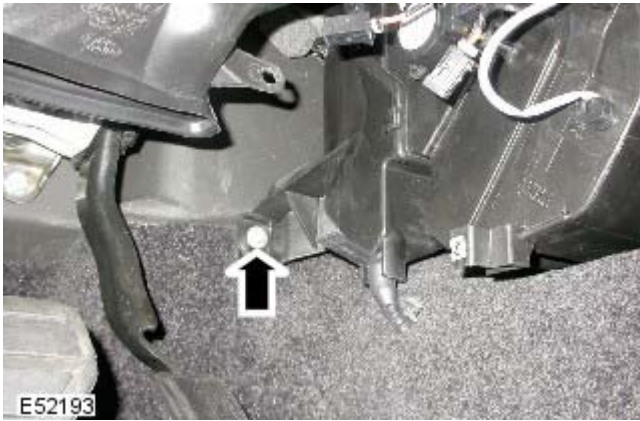
E52191

28. Remove the passenger side footwell duct.

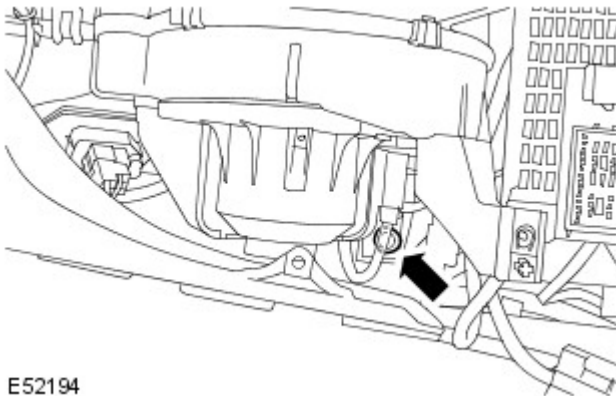
- Remove the 2 Torx screws.



E52192

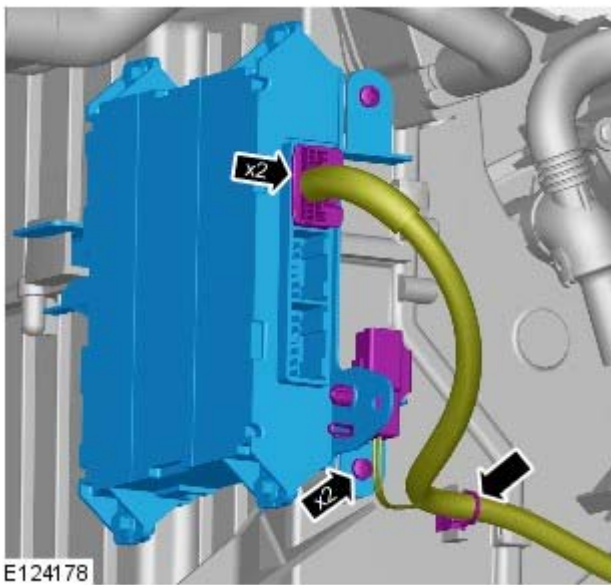


29. Driver side: Remove the heater housing to bulkhead Torx bolt.



30. Passenger side: Remove the heater housing to bulkhead Torx bolt.

- With assistance, remove the heater and evaporator core housing.



31. Remove the A/C control module.

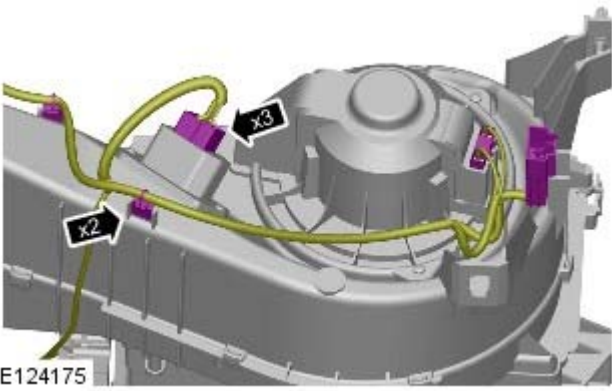
32. Disconnect the evaporator core temperature sensor electrical connector.



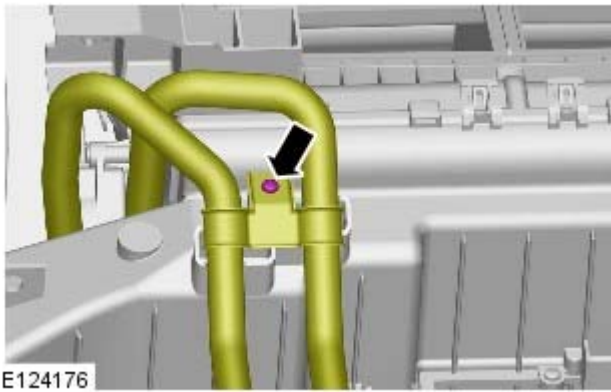
33. Disconnect the electrical connector.



34. Detach the wiring harness.

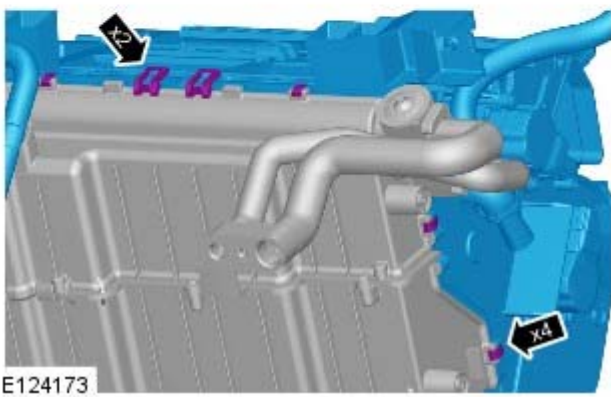


35. Remove the bolt from the support bracket.

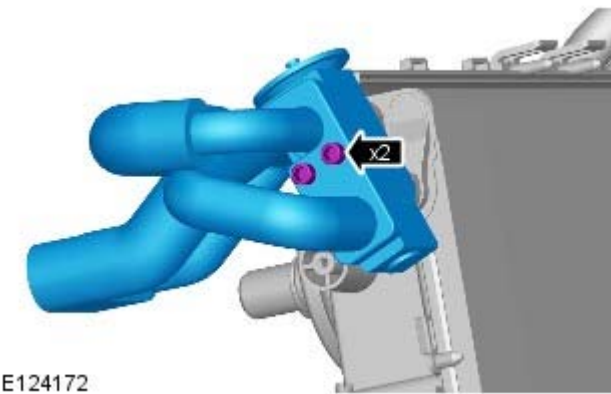


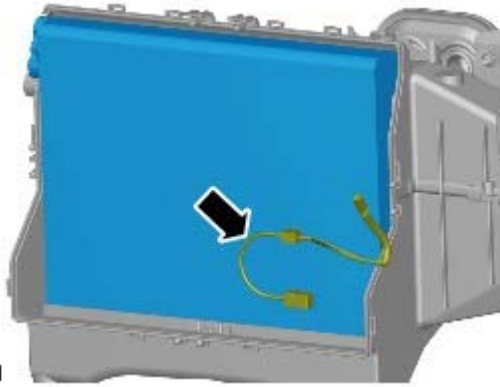
36. Remove the heater and evaporator core housing.

- Remove the 8 clips.
- Carefully release the 2 clips.



37. Remove the thermostatic expansion valve.





E124171

38. Remove the evaporator core.

- Release the temperature sensor.

Installation

1. Install the evaporator core.
 - Secure the temperature sensor.
2. Secure the heater core housing.
 - Install the clips.
3. Install the thermostatic expansion valve.
 - Tighten the bolts to 3.5 Nm (2.5 lb.ft).
4. Install the wiring harness.
5. Install and tighten the bolt.
6. Connect the temperature sensor electrical connector.
7. Install the CC module.
 - Tighten the bolts.
8. Passenger side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
 - With assistance, install the heater and evaporator core housing.
9. Driver side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
10. Install the footwell ducts.
 - Tighten the Torx screws.
11. Connect the drain tubes to the heater housing.
12. Install the adapter panels.
 - Tighten the nuts to 6 Nm (4 lb.ft).
13. Secure the A/C refrigerant lines.
 - Clean the components.
 - Install new O-ring seals.
 - Tighten the bolt to 5 Nm (4 lb.ft).
 - Tighten the nut to 6 Nm.
14. Connect the bulkhead heater hoses.
15. Install the EGR coolant cross-over pipe.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Secure the clips.
 - Connect the hoses and secure with the clips.
16. With assistance, install the instrument panel.

- Tighten the Torx bolts to 25 Nm (18 lb.ft).
17. Install the instrument panel carrier to bulkhead Torx bolt and tighten to 25 Nm (18 lb.ft).
 18. Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
 19. Secure the heater housing.
 - Tighten the screws.
 20. Connect the steering column intermediate shaft.
 - Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).
 21. Install the heater housing center ducts.
 22. Connect the instrument panel center reinforcement fibre optic cables.
 23. Connect the instrument panel center reinforcement electrical connectors.
 24. Connect the CJB electrical connectors.
 25. Connect the electrical connectors to the passenger side lower A-pillar.
 26. Connect the ground cables to the passenger side lower A-pillar.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 27. Connect the electrical connectors to the driver side lower A-pillar.
 28. Connect the ground cables to the driver side lower A-pillar.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 29. Connect the 3 electrical connectors.
 30. Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
 31. Install the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
 32. Install the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
 33. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
 34. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures).

Air Conditioning - TDV6 3.0L Diesel - Thermostatic Expansion Valve

Removal and Installation

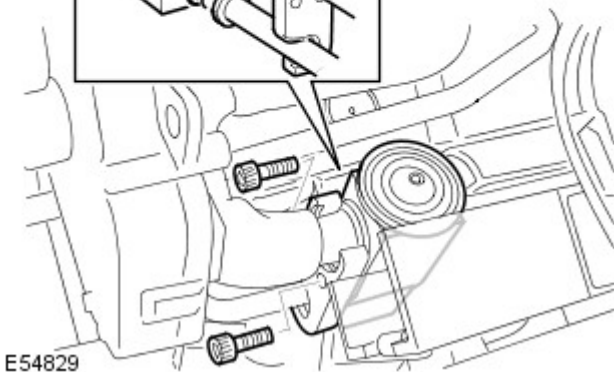
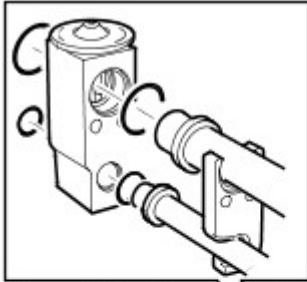
Removal

1. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
2. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

3.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Remove the thermostatic expansion valve.

- Remove the cover.
- Remove the 2 Allen bolts.
- Remove and discard the 4 O-ring seals.



E54829

Installation

1. Install the thermostatic expansion valve.
 - Clean the components.
 - Install the new O-ring seals.
 - Tighten the Allen bolts to 5 Nm (4 lb.ft).
 - Install the cover.
2. Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

Air Conditioning - V6 4.0L Petrol -

Lubricant

Item	Specification
Compressor oil	Denso ND-8 PAG oil
Total system capacity:	
Front	130 cm ³ (4.5 fluid ounces)
Rear	170 cm ³ (5.9 fluid ounces)
Additional amount of oil to be added to system if a component is replaced:	
Condenser	40 cm ³ (1.4 fluid ounces)
Evaporator - Front or rear	40 cm ³ (1.4 fluid ounces)
Pipe or hose	10 cm ³ (0.35 fluid ounces)

System Refrigerant Specification/Capacity

Item	Specification
Refrigerant type	R134A
Total system capacity:	
2.7 litre - Front system only fitted	550 grammes (10.25 ounces)
2.7 litre - Front and rear systems fitted	810 grammes (28.35 ounces)
4.0 and 4.4 litre - Front system only fitted	600 grammes (21.16 ounces)
4.0 and 4.4 litre - Front and rear systems fitted	900 grammes (31.83 ounces)

General Specification

Item	Description
Compressor:	
Make	Denso
Type	7SEU17
Sensor locations:	
Ambient temperature sensor	At the front of the vehicle
Smog sensor	At the front of the vehicle adjacent to the ambient temperature sensor
ICS/humidity sensor	On the instrument panel adjacent to the steering column
Solar sensor	On the vehicle centre line on top of the instrument panel
Pressure transducer	In A/C line - LH side of engine compartment

Torque Specifications

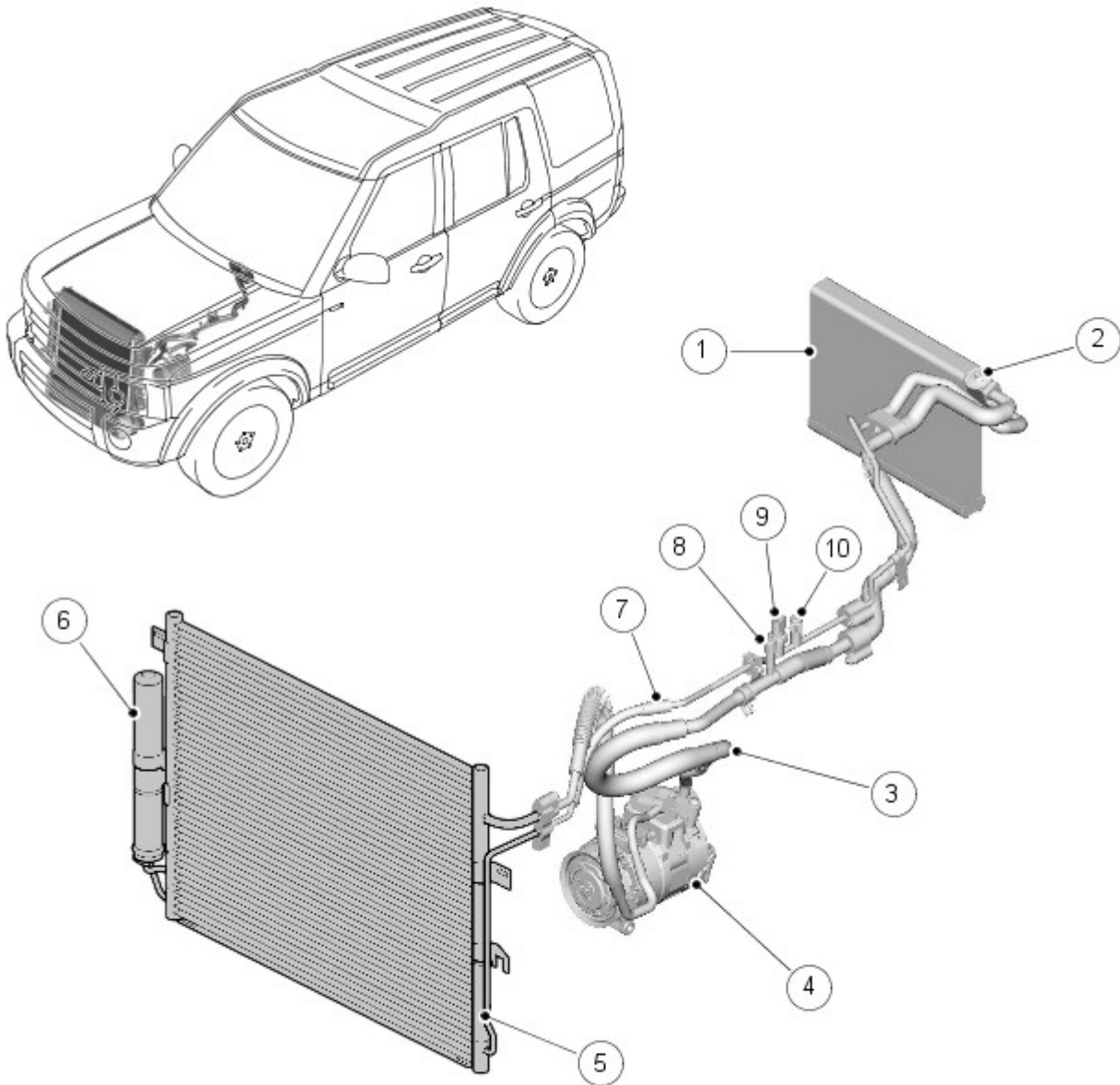
Description	Nm	lb-ft
Compressor mounting bolts	25	18
Receiver/drier mounting bolts	10	7
Refrigerant line bolts	10	7
Condenser core bolts - Not 2.7 litre	10	7
Radiator bolts	25	18
A/C pipe bolts	25	18
Coolant expansion tank bolts	10	7
Heater housing to bulkhead Torx bolts	6	4
Adaptor panel nuts	6	4
Air conditioning lines to bulkhead bolt	6	4
Air conditioning lines to body nut	6	4
Instrument panel Torx bolts	25	18
Instrument panel carrier to bulkhead Torx bolt	25	18
* Steering column intermediate shaft nut	22	16
Ground cables to passenger side lower A-pillar nuts	10	7
Ground cables to driver side lower A-pillar nuts	10	7
Pressure transducer	10	7

* New nut must be fitted

Air Conditioning - V6 4.0L Petrol - Air Conditioning

Description and Operation

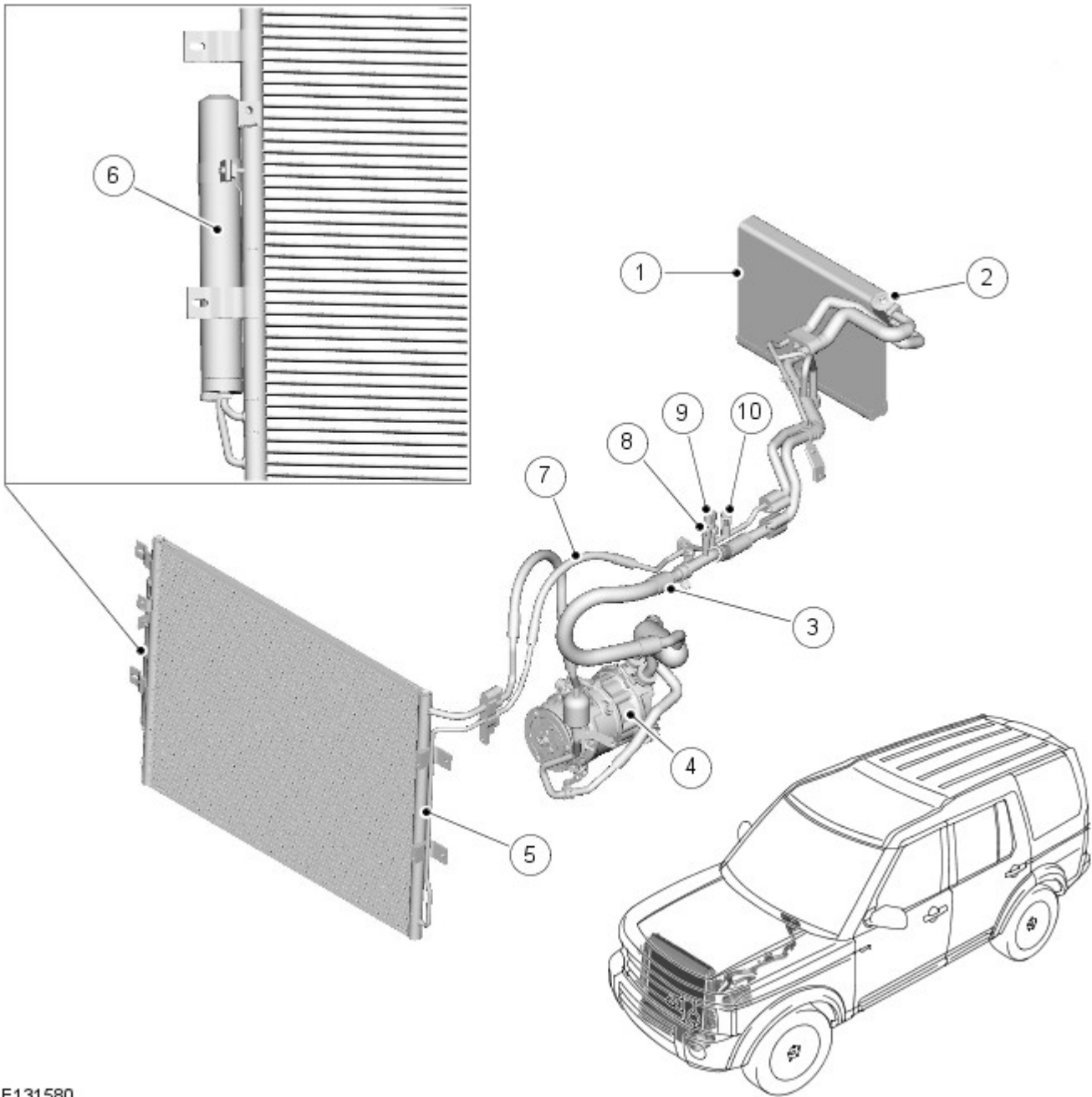
COMPONENT LOCATION 2.7L TdV6



E131578

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	air conditioning (A/C) compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

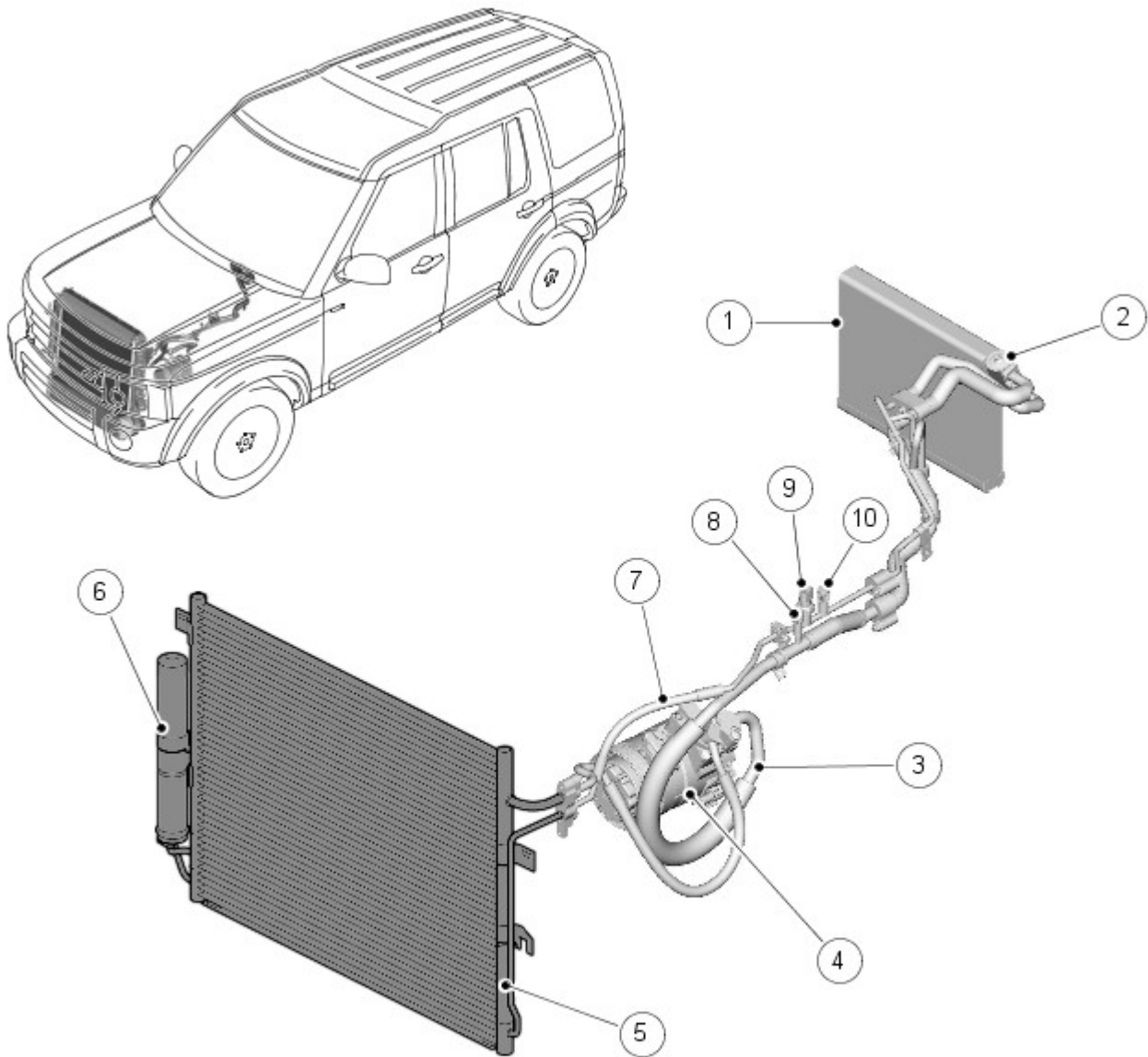
COMPONENT LOCATION 3.0L TdV6



E131580

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

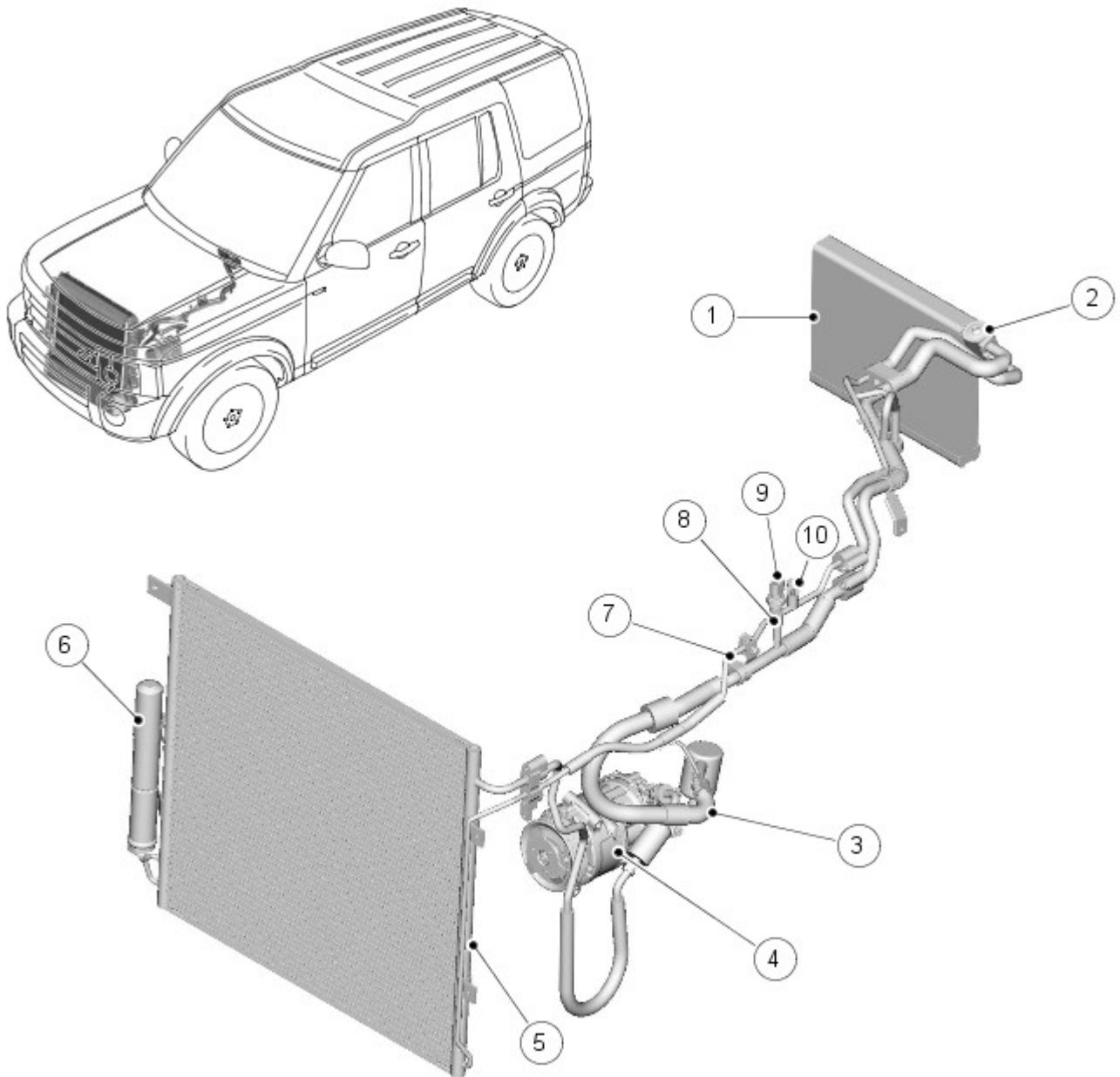
COMPONENT LOCATION 4.0L NA V6



E131582

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

COMPONENT LOCATION 5.0L NA V8



E131583

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

GENERAL

The A/C system transfers heat from the vehicle interior to the outside atmosphere to provide the heater assembly with dehumidified cool air. The system consists of:

- A compressor.
- A condenser.
- A receiver drier.
- A thermostatic expansion valve.
- An evaporator.
- Low and high pressure refrigerant lines.

The system is a sealed, closed loop, filled with a charge weight of R134a refrigerant as the heat transfer medium. Oil is added to the refrigerant to lubricate the internal components of the compressor.

Operation of the air conditioning system is controlled by the automatic temperature control (ATC) module. The A/C compressor circulates the refrigerant around the system by compressing low pressure, low temperature vapor from the evaporator and discharging the resultant high pressure, high temperature vapor to the condenser.

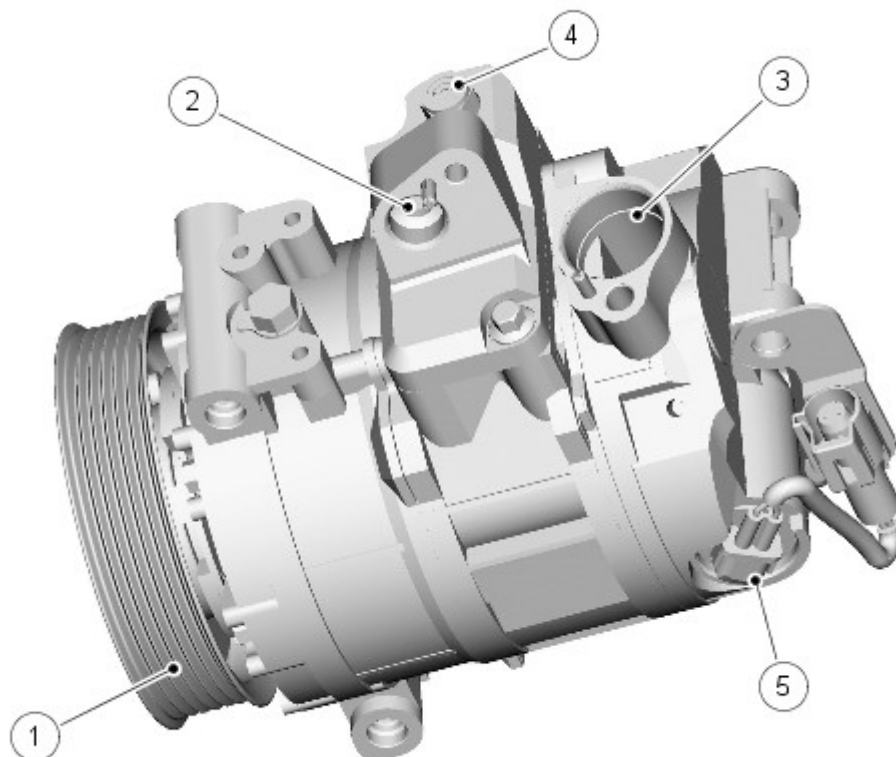
The A/C compressor is a variable displacement unit which is driven by the engine accessory drive belt. On 2.7L/4.0L and 5.0L vehicles, the [A/C \(air conditioning\)](#) compressor is permanently driven directly from the pulley. On 3.0L diesel vehicles the [A/C](#) compressor is driven via an electro-magnetic clutch.

To protect the refrigerant system from excessive pressure, a pressure relief valve is installed in the outlet side of the A/C compressor. The pressure relief valve vents excess pressure into the engine compartment.

For additional information, refer to: Control Components (412-04, Description and Operation).

A/C COMPRESSOR

2.7L TdV6



E131577

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

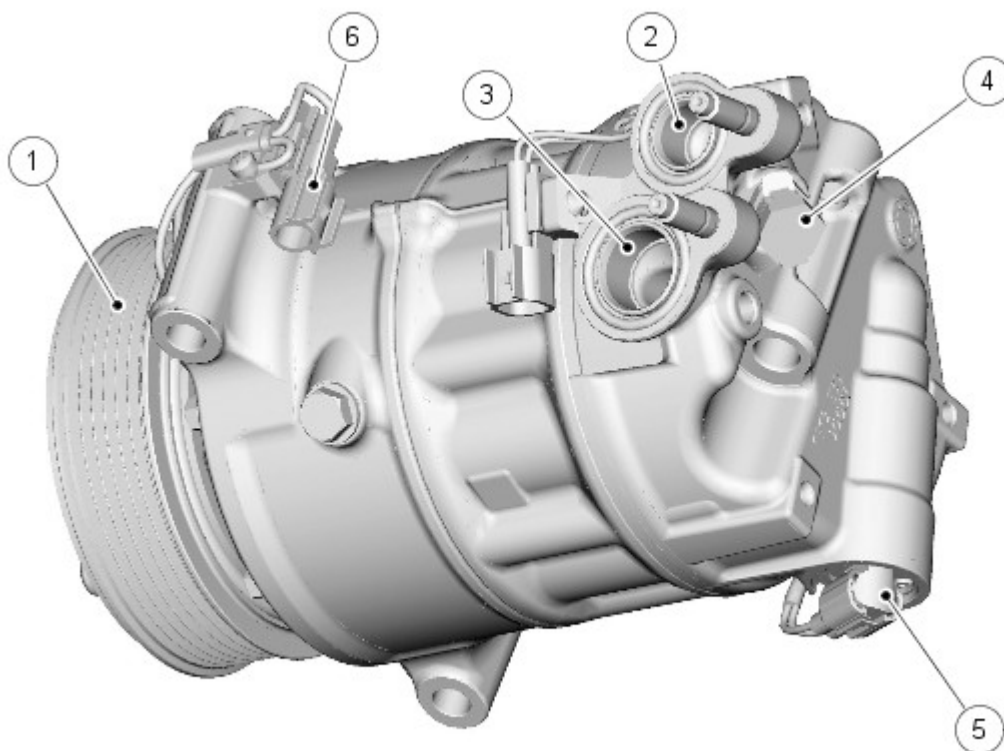
The [A/C](#) compressor fitted to 2.7L TdV6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC \(automatic temperature control\)](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (436 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

3.0L TdV6



E131579

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector
6	-	electromagnetic clutch connector

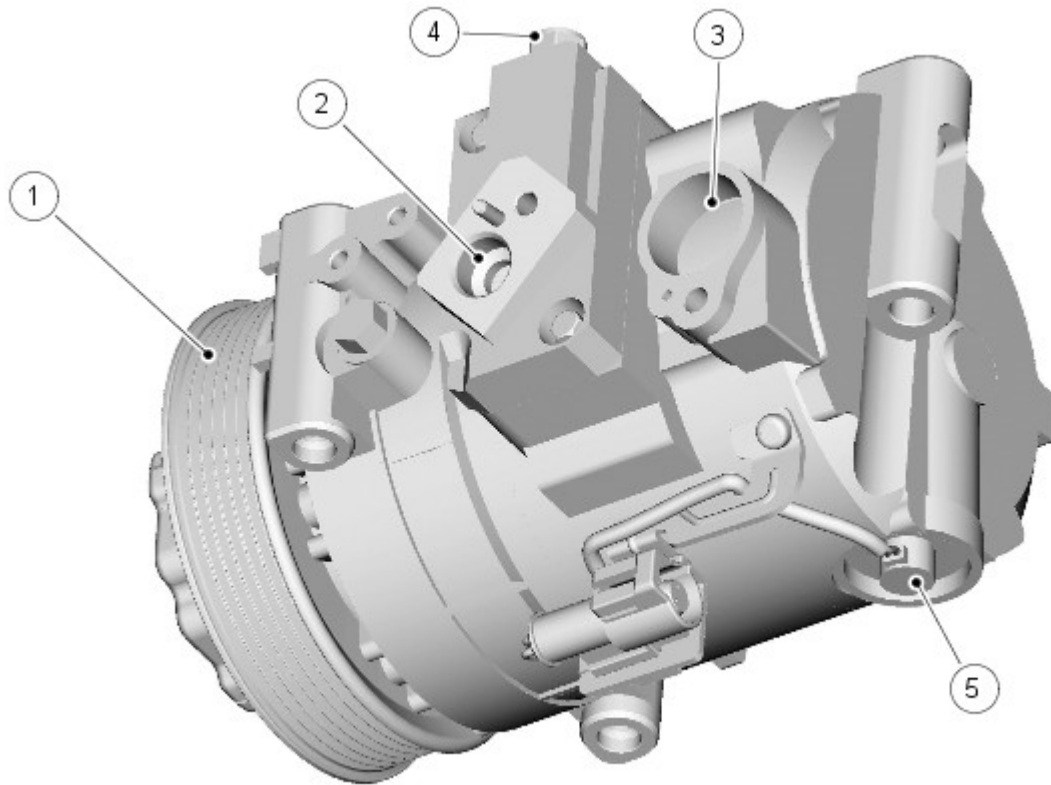
The [A/C](#) compressor fitted to 3.0L TdV6 diesel vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley and an electromagnetic clutch. Operation of the clutch is controlled by a power feed from the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The clutch of the [A/C](#) compressor incorporates a thermal cut-off fuse, which disconnects the power feed from the [ATC](#) module if the temperature increases to 182 ± 5 °C (360 ± 9 °F).

4.0L NA V6



E131581

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

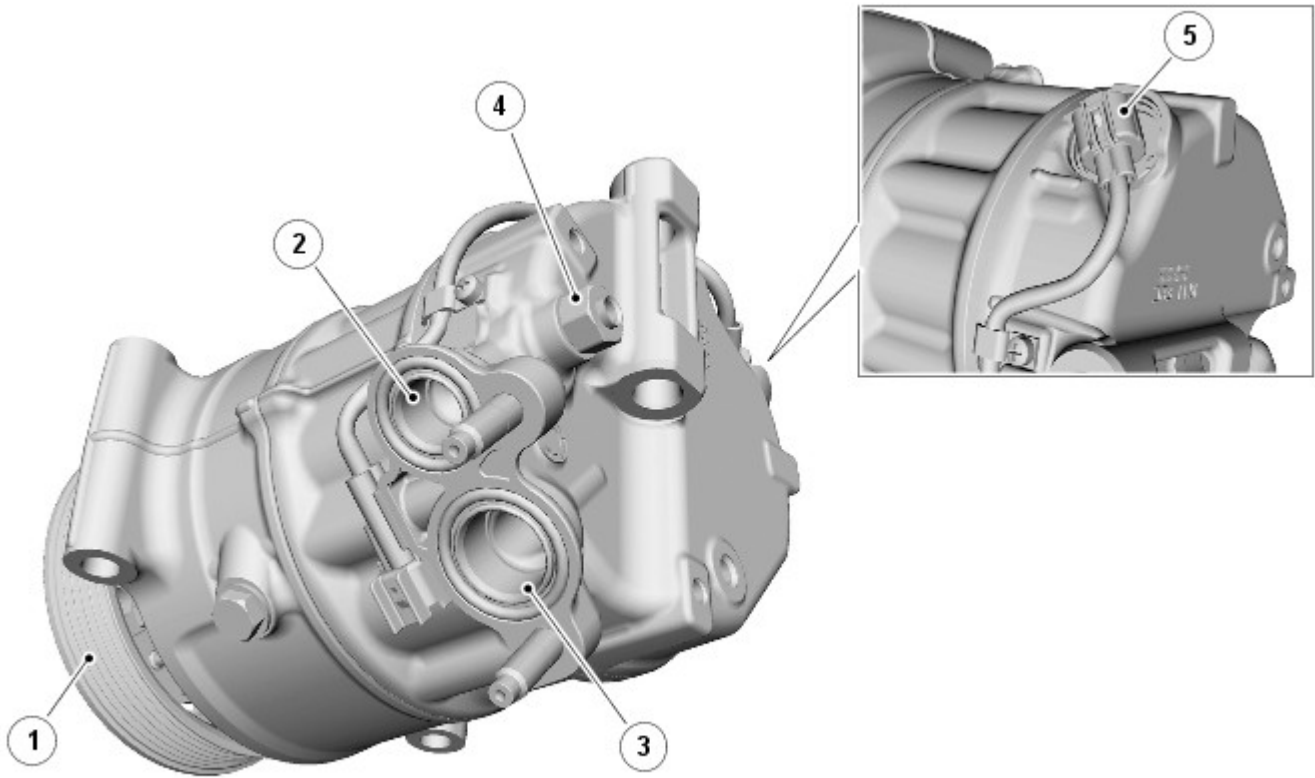
The [A/C](#) compressor fitted to 4.0L NA V6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (437 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

5.0L NA V8



E131337

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

The [A/C](#) compressor fitted to 5.0L V8 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

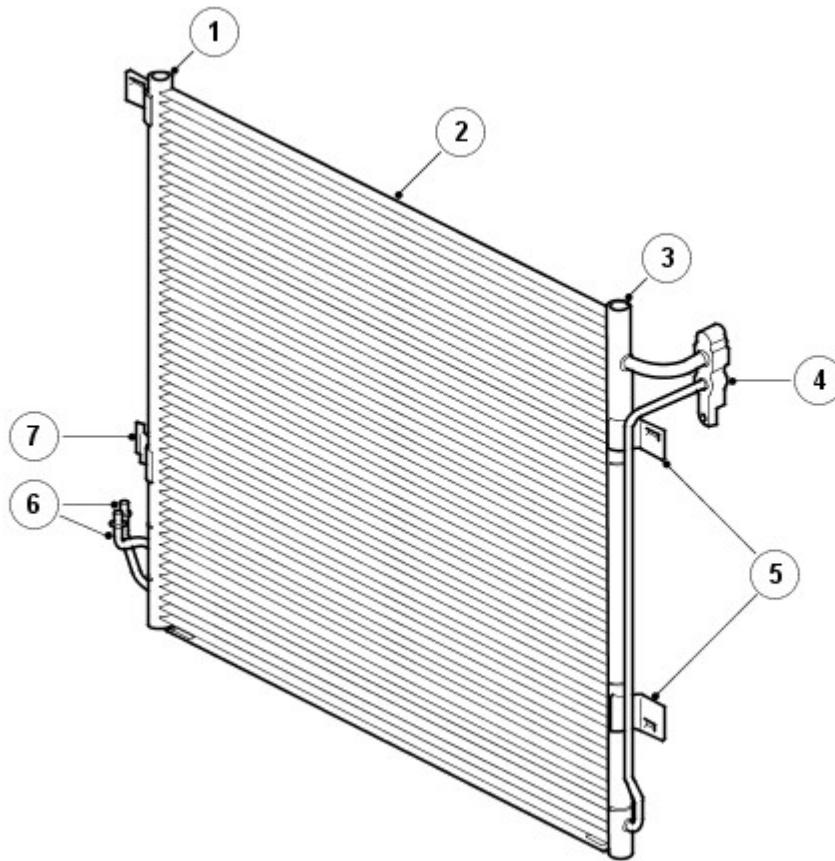
The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

CONDENSER

- NOTE: 5.0L NA V8 version shown other installations similar



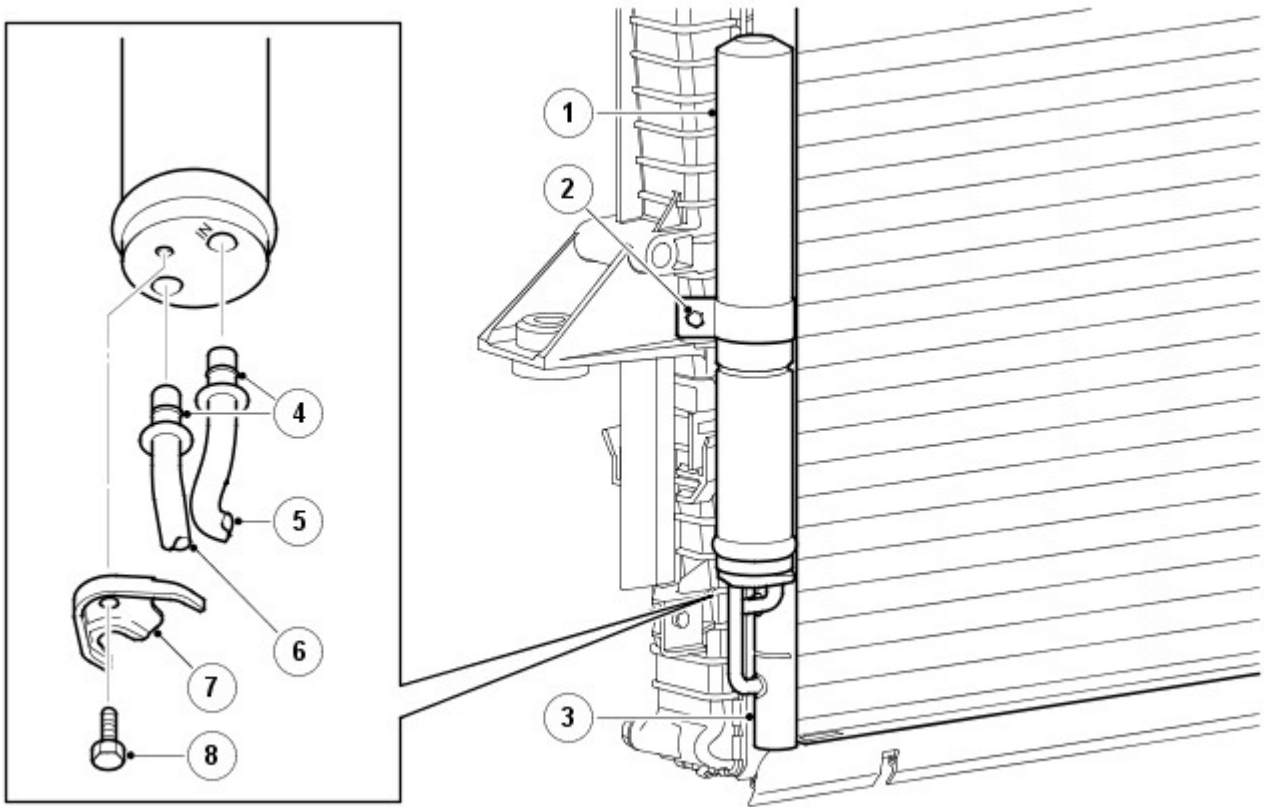
E46920

Item	Part Number	Description
1	-	right-hand (RH) end tank
2	-	Condenser core
3	-	left-hand (LH) end tank
4	-	High pressure line connector block
5	-	Condenser attachment brackets
6	-	Receiver drier pipes
7	-	Receiver drier attachment bracket

The condenser transfers heat from the refrigerant to the surrounding air to convert the high pressure vapor from the compressor into a liquid. The condenser is installed immediately in front of the radiator. Two brackets on each end tank of the condenser attach the condenser to clips on the end tanks of the radiator.

The condenser is classified as a sub-cooling condenser and consists of a fin and tube heat exchanger core installed between two end tanks. Divisions in the end tanks separate the heat exchanger into a four pass upper (condenser) section and a two pass lower (sub-cooler) section. A connector block on the left end tank of the condenser provides connections for the high pressure lines from the A/C compressor and the evaporator. Two pipes at the bottom of the right end tank of the condenser provide connections for the receiver drier.

RECEIVER DRIER



E46921

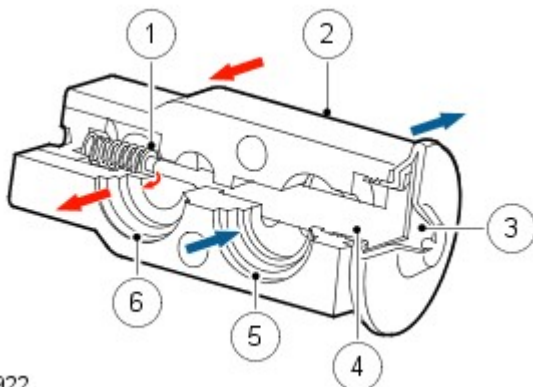
Item	Part Number	Description
1	-	Receiver drier
2	-	Clamp
3	-	Condenser RH end tank
4	-	O-ring seals
5	-	Inlet pipe
6	-	Outlet pipe
7	-	Collar
8	-	Bolt

The receiver drier removes solid impurities and moisture from the refrigerant, and provides a reservoir for liquid refrigerant to accommodate changes of heat load at the evaporator.

The receiver drier is attached to the two stub pipes on the right end tank of the condenser. A collar, located on lands on the stub pipes and secured with a bolt, attaches the stub pipes to the receiver drier. A clamp secures the body of the receiver drier to a bracket welded to the right end tank of the condenser. The inlet and outlet ports of the receiver drier are the same size, so care must be taken to install the receiver drier the correct way round on the stub pipes; to assist with installation, the inlet port is identified with the word IN etched into the receiver drier.

Refrigerant entering the receiver drier passes through a filter and a desiccant pack, then collects in the base of the unit before flowing through the outlet stub pipe back to the condenser. The desiccant and the filter are non-serviceable; the complete unit must be replaced when a change of desiccant is required.

THERMOSTATIC EXPANSION VALVE



E46922

Item	Part Number	Description
1	-	Metering valve
2	-	Housing

3	-	Diaphragm
4	-	Temperature sensitive tube
5	-	Outlet passage from evaporator
6	-	Inlet passage to evaporator

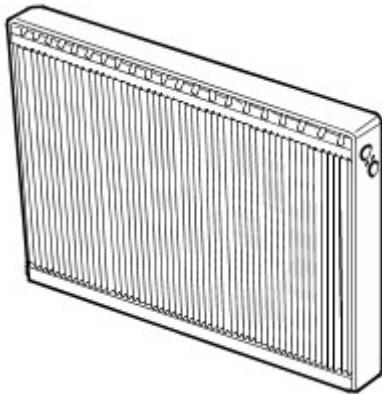
The thermostatic expansion valve meters the flow of refrigerant into the evaporator, to match the refrigerant flow with the heat load of the air passing through the evaporator.

The thermostatic expansion valve is a block type valve located behind the heater assembly, and attached to the inlet and outlet ports of the evaporator. The thermostatic expansion valve consists of an aluminum housing containing inlet and outlet passages. A ball and spring metering valve is installed in the inlet passage and a temperature sensor is installed in the outlet passage. The temperature sensor consists of a temperature sensitive tube connected to a diaphragm. The bottom end of the temperature sensitive tube acts on the ball of the metering valve. Pressure on top of the diaphragm is controlled by evaporator outlet temperature conducted through the temperature sensitive tube. The bottom of the diaphragm senses evaporator outlet pressure.

Liquid refrigerant flows through the metering valve into the evaporator. The restriction across the metering valve reduces the pressure and temperature of the refrigerant. The restriction also changes the liquid stream of refrigerant into a fine spray, to improve the evaporation process. As the refrigerant passes through the evaporator, it absorbs heat from the air flowing through the evaporator. The increase in temperature causes the refrigerant to vaporize and increase in pressure.

The temperature and pressure of the refrigerant leaving the evaporator act on the diaphragm and temperature sensitive tube, which regulate the metering valve opening and so control the volume of refrigerant flowing through the evaporator. The warmer the air flowing through the evaporator, the more heat available to evaporate refrigerant and thus the greater the volume of refrigerant allowed through the metering valve.

EVAPORATOR



E46923

The evaporator is installed in the heater assembly between the blower and the heater matrix, to absorb heat from the exterior or recirculated air. Low pressure, low temperature refrigerant changes from liquid to vapor in the evaporator, absorbing large quantities of heat as it changes state.

Most of the moisture in the air passing through the evaporator condenses into water, which drains out of the heater and through the floorpan, to the underside of the vehicle, through two drain tubes.

REFRIGERANT LINES

To maintain similar flow velocities around the system, the diameter of the refrigerant lines varies to suit the two pressure/temperature regimes. The larger diameters are installed in the low pressure/temperature regime and the smaller diameters are installed in the high pressure/temperature regime.

Low and high pressure charging connections are incorporated into the refrigerant lines for system servicing. Where auxiliary A/C is installed, connections for the auxiliary refrigerant lines are incorporated near the engine bulkhead.

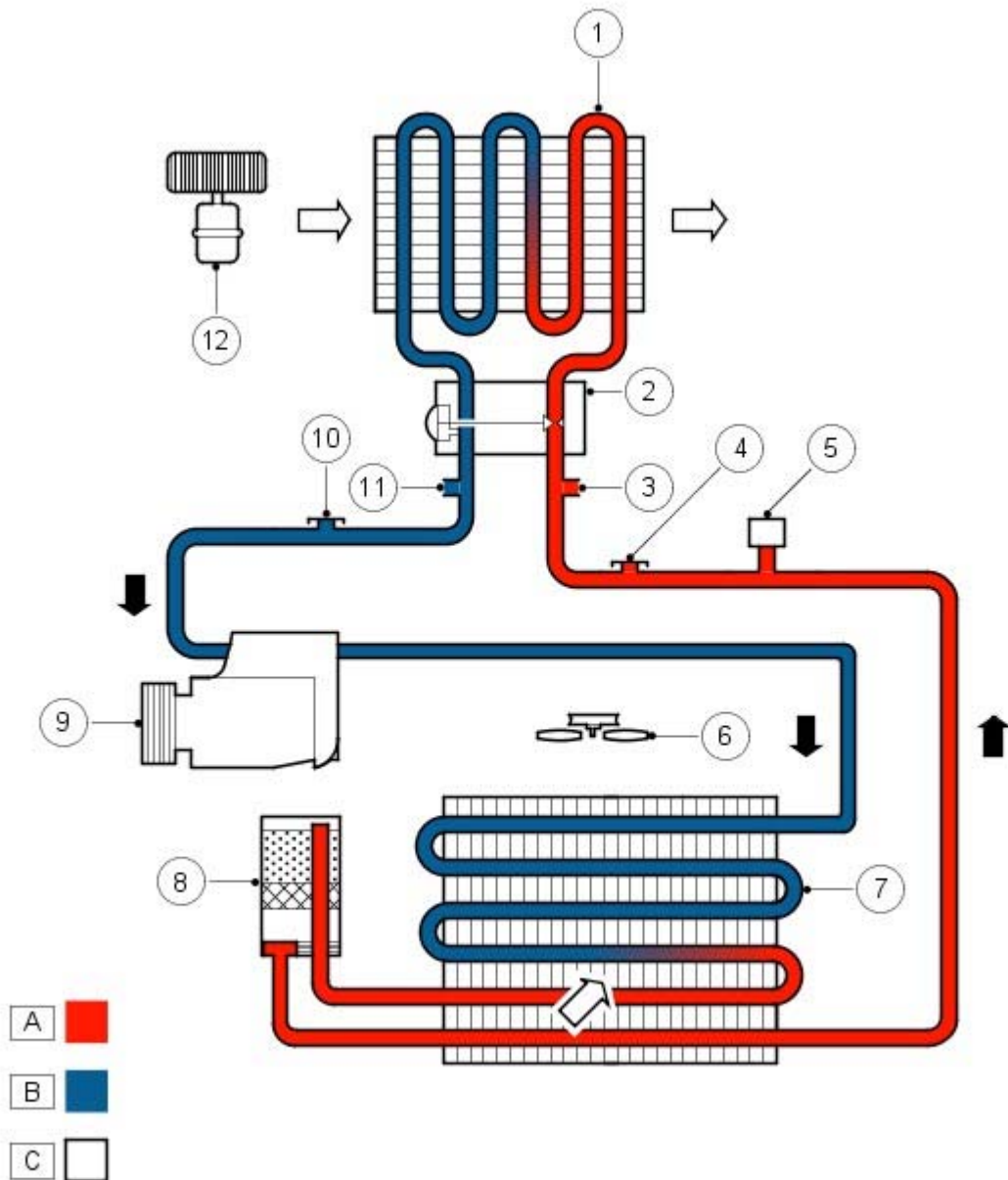
Under normal operating conditions, the smaller diameter pipes (A/C compressor discharge, liquid refrigerant) are hot to the touch and the larger diameter pipes (A/C compressor suction, gaseous refrigerant) are cold to the touch.

SYSTEM OPERATION

To accomplish the transfer of heat, the refrigerant is circulated around the system, where it passes through two pressure/temperature regimes. In each of the pressure/temperature regimes, the refrigerant changes state, during which process maximum heat absorption or release occurs. The low pressure/temperature regime is from the thermostatic expansion valve, through the evaporator to the compressor; the refrigerant decreases in pressure and temperature at the thermostatic expansion valve, then changes state from liquid to vapor in the evaporator, to absorb heat. The high pressure/temperature regime is from the compressor, through the condenser and receiver drier to the thermostatic expansion valve; the refrigerant increases in pressure and temperature as it passes through the compressor, then releases heat and changes state from vapor to liquid in the condenser.

A/C SYSTEM SCHEMATIC

- NOTE: A = Refrigerant liquid; B = Refrigerant vapor; C = Air flow



E46924

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	High pressure connection with auxiliary climate control (where fitted)
4	-	High pressure servicing connection
5	-	Refrigerant pressure sensor
6	-	Cooling fan
7	-	Condenser
8	-	Receiver drier
9	-	A/C compressor
10	-	Low pressure servicing connection
11	-	Low pressure connection with auxiliary climate control (where fitted)
12	-	Blower

Air Conditioning - V6 4.0L Petrol - Air Conditioning

Diagnosis and Testing

Principle of Operation

For a detailed description of the air conditioning system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Air Conditioning (412-03 Air Conditioning - 4.0L, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Auxiliary drive belt condition and tension ● Compressor condition and installation ● Condenser condition and installation/blockage ● Air conditioning hoses and pipes ● Receiver/drier condition and installation ● Cooling fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Electrical connector(s) ● Relays ● Sensors ● Control panel(s) ● Air conditioning compressor

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor or no cooling	<ul style="list-style-type: none"> ● Drive belt fault ● Compressor fault ● Distribution motor/flap fault ● Refrigerant leak ● In-vehicle temperature sensor fault ● Refrigerant pressure sensor fault 	Check the drive belt condition and tension (see visual inspection). Check the compressor operation (observe the compressor as the engine is idling with the air conditioning switched on. If the compressor runs erratically or does not run. Carry out the distribution motor self test. Refer to the relevant workshop manual section. Check for sensor DTCs. Refer to the DTC index. Check the refrigerant system using your charging station.
Noise	<ul style="list-style-type: none"> ● Drive belt fault ● Compressor fault ● Compressor pulley fouling ● Refrigerant overcharged 	Confirm the air conditioning as the source of the noise by listening for the noise with the air conditioning switched off. Refer to the relevant workshop manual section. Check the refrigerant system using your charging station.
Water entry into cabin	<ul style="list-style-type: none"> ● Heater matrix leak ● Blocked evaporator drain tubes 	Check for coolant loss. Pressure test the cooling system as necessary. Check and clear the evaporator drain tubes as necessary.


DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Climate Control Module \(HVAC\)](#) (100-00 General Information, Description and Operation).

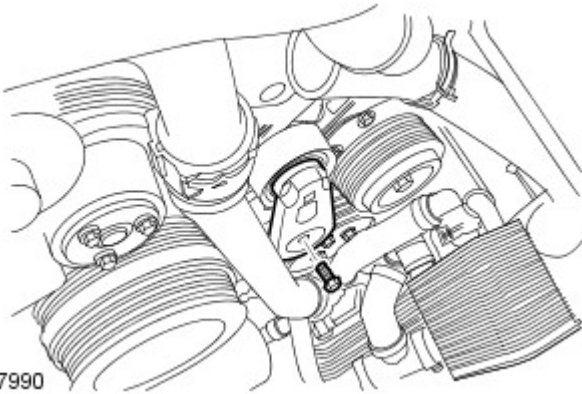
Air Conditioning - V6 4.0L Petrol - Air Conditioning (A/C) Compressor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.
3. Recover the A/C refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
4. Remove the accessory drive belt.
For additional information, refer to: Accessory Drive Belt (303-05, Removal and Installation).
5. Remove the accessory drive belt tensioner.
 - Remove the bolt.



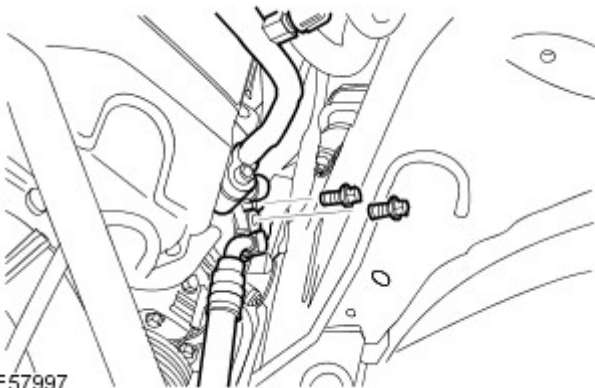
E57990

6. Remove the oil level indicator and tube.
For additional information, refer to: Oil Level Indicator and Tube (303-01, In-vehicle Repair).
7. Remove the LH front wheel.

8.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

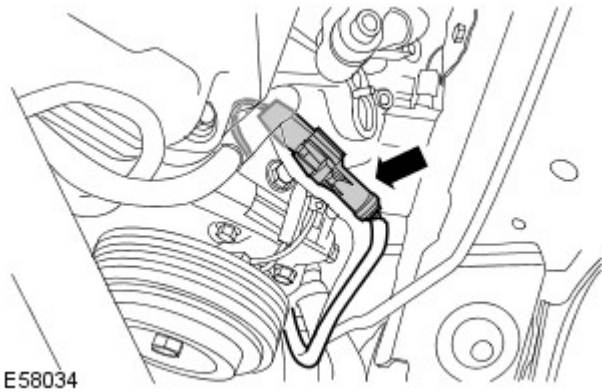
Disconnect the refrigerant lines from the A/C compressor.

- Remove the 2 bolts.
- Remove and discard the 2 O-ring seals.



E57997

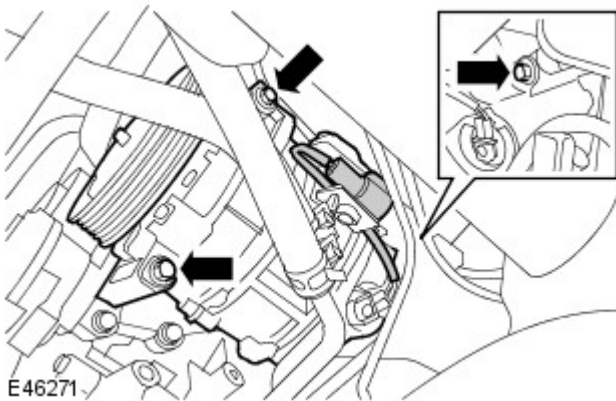
9. Disconnect the A/C clutch electrical connector.



10. NOTE: 1 A/C compressor bolt will remain captive until the mounting bracket is removed.

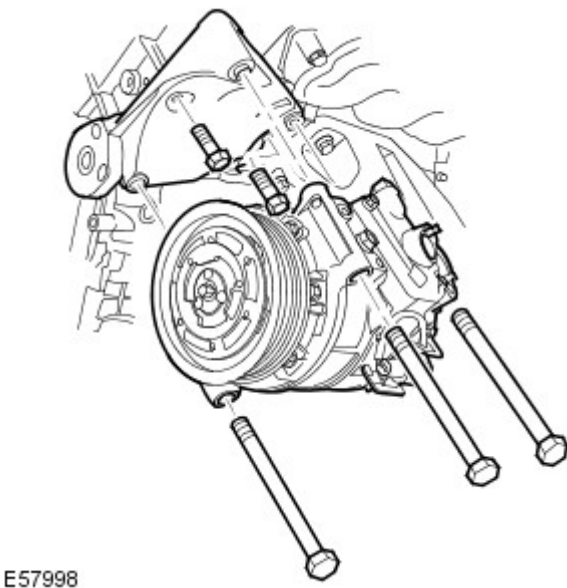
Release the A/C compressor.

- Remove the 3 bolts.



11. Remove the A/C compressor mounting bracket.

- Remove the 2 bolts.



12. Remove the A/C compressor.

Installation

1. Position the A/C compressor to the engine.

- If a new compressor is being installed, the required amount of refrigerant oil must be drained from it.

2. Install the A/C compressor mounting bracket.

- Tighten the bolts to 25 Nm (18 lb.ft).

3. Secure the A/C compressor.

- Tighten the bolts to 25 Nm (18 lb.ft).

4. Connect the A/C clutch electrical connector.

5.  **CAUTION:** Lubricate the new seals with clean refrigerant oil.

Connect the refrigerant lines.

- Clean the component mating faces.
- Install the new O-ring seals.
- Tighten the bolts to 10 Nm (7 lb.ft).

6. Install the front wheel.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

7. Lower the vehicle.

8. Install the oil level indicator and tube.

For additional information, refer to: Oil Level Indicator and Tube (303-01, In-vehicle Repair).

9. Install the accessory drive belt tensioner.

- Tighten the bolt to 40 Nm (30 lb.ft).

10. Install the accessory drive belt.

For additional information, refer to: Accessory Drive Belt (303-05, Removal and Installation).

11. Fill the A/C system.

For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

12. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

Air Conditioning - V6 4.0L Petrol - Air Conditioning (A/C) Pressure Transducer

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Recover the A/C refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

3. CAUTIONS:



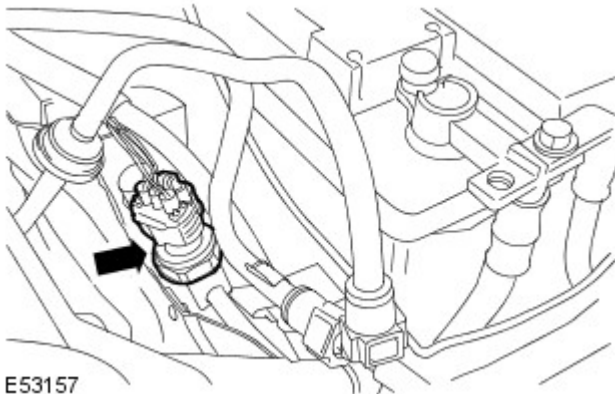
Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



To prevent damage to components, use an additional wrench when loosening or tightening unions.

Remove the A/C pressure transducer.

- Disconnect the electrical connector.
- Remove and discard the seal.



E53157

Installation

1. Install the A/C pressure transducer.
 - Clean the component mating faces.
 - Install a new seal.
 - Tighten the transducer to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Air Conditioning - V6 4.0L Petrol - Air Conditioning (A/C) Compressor

Pulley

Removal and Installation

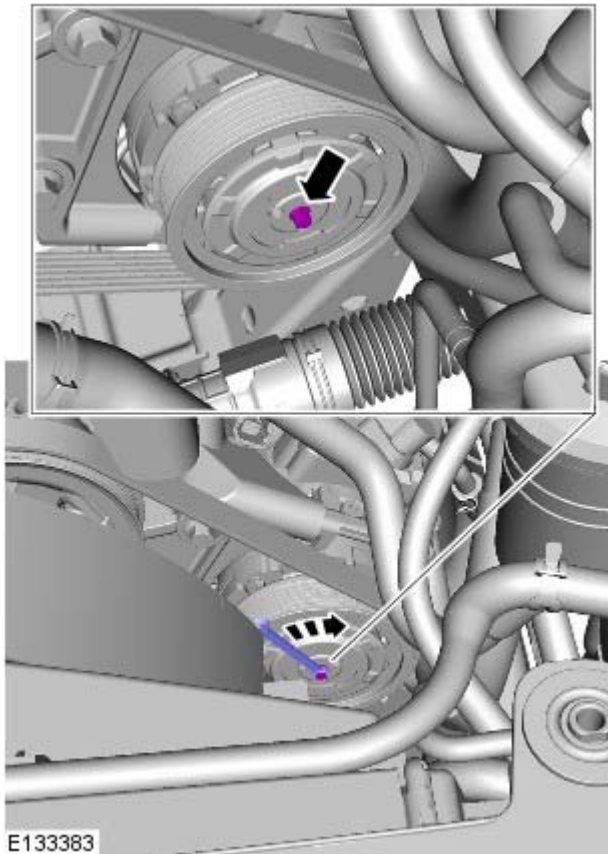
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Components removed for clarity.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Using a suitable tool, release the hub locking stud.

- Rotate the fixing clockwise to release the hub.
- If required, use a suitable tool to prevent the hub from rotating.



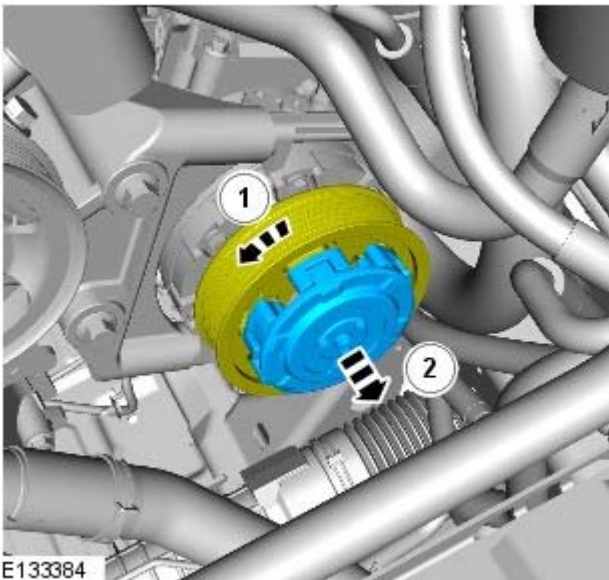
3. NOTE: This step requires the aid of another technician.

- NOTE: Using a 3/8 square drive wrench, rotate the tensioner counter clockwise.

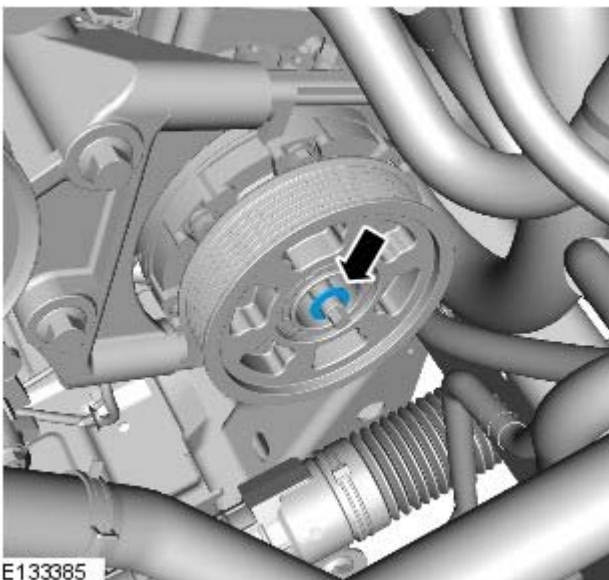
Release the accessory drive belt from the A/C compressor pulley.

4. Remove and discard the hub assembly.

- Rotate the pulley counter-clockwise, until the hub is released from the pulley.
- Discard the rubber dampers.

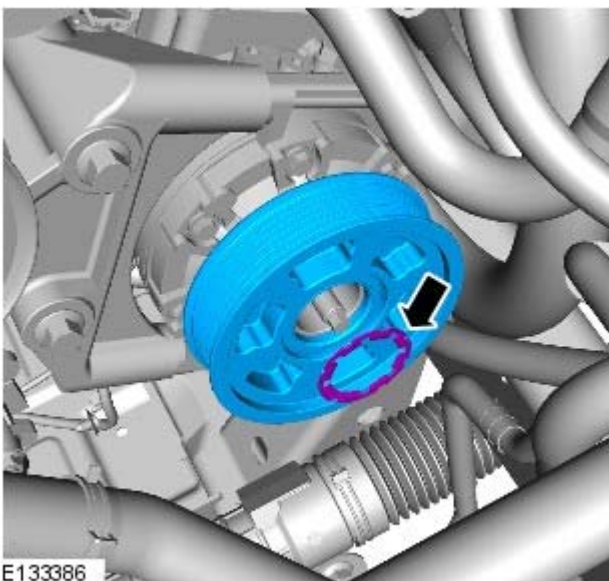


5. Remove and discard the spacer.

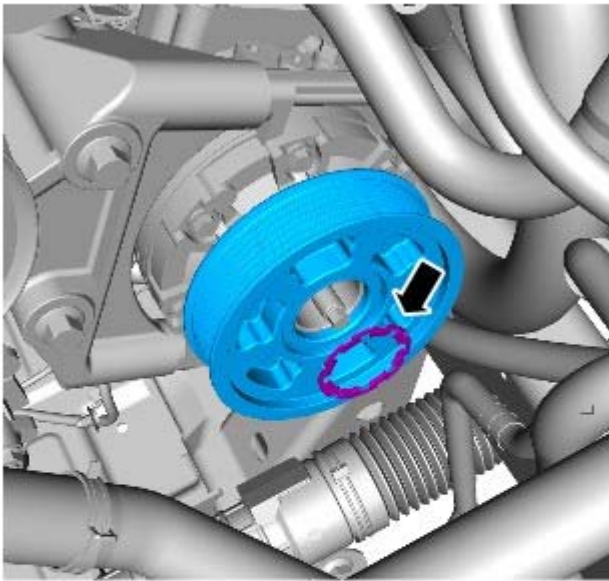



6. Remove and discard the drive pulley.

- Remove and discard the circlip.
- Clean the compressor mating surface.



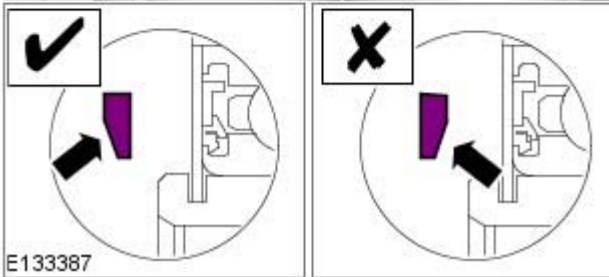
Installation



1.  **CAUTION:** Make sure the circlip is fitted in the correct orientation.

Install the drive pulley.

- Install the circlip.

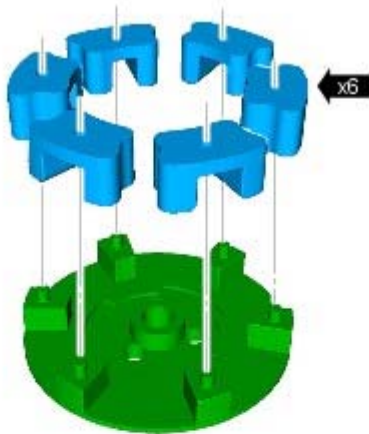


2. Install the spacer.

- Make sure the spacer is fully seated.

3. Install the 6 rubber dampers to the hub assembly.

- Make sure the dampers are installed in the correct orientation.



E131556

4. NOTE: Apply a suitable water based lubricant to the rubber dampers and to the mating surfaces on pulley.

Install the hub assembly.

- Push the hub assembly onto the pulley, and rotate clockwise to screw it onto the compressor shaft.

5. NOTE: Tighten counterclockwise.

Using a suitable tool, tighten the hub locking stud.

- Prevent the pulley rotating by hand.
- Tighten to 3.5 Nm (2.6 lb.ft)

6. Install the auxiliary drive belt.

7. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Air Conditioning - V6 4.0L Petrol - Condenser Core

Removal and Installation

Removal

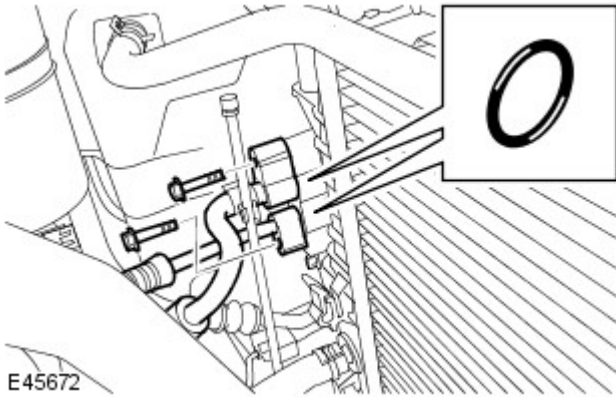
• **NOTE:** The receiver drier need only be changed under the following circumstances: There is dirt in the refrigerant circuit (eg. compressor seizure). The system is leaking and refrigerant has been lost to atmosphere. Refrigerant circuit has been open more than 24 hours due to repair.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Recover the A/C refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

3.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Disconnect the A/C pipes.

- Remove the 2 bolts.
- Discard the O-ring seals.
- Install blanking caps to the exposed ports.



E45672

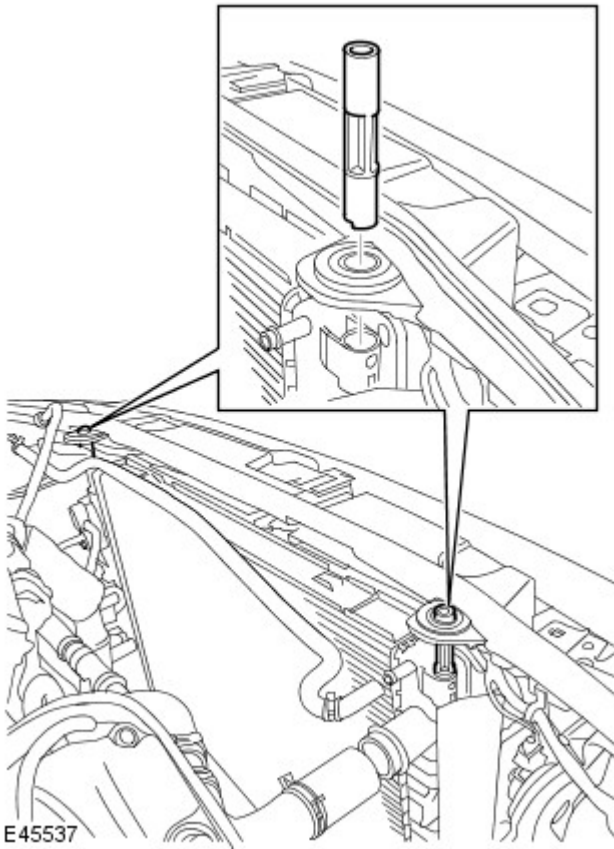
4. Remove the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
5. Remove the lower fan shroud.
 - Release it from the 4 clips
 - Release the coolant hose.



E45533

6. Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

7. Remove the radiator securing pegs.



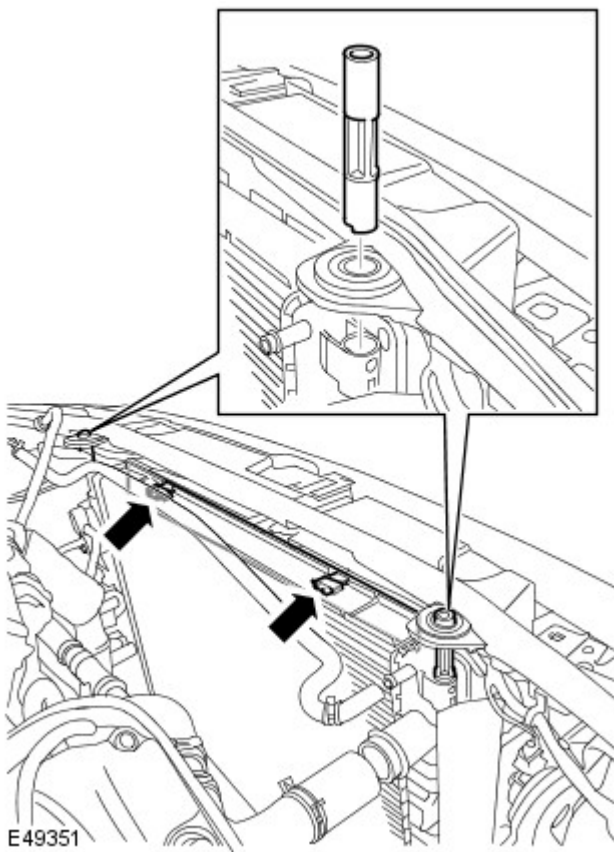
8. Remove the radiator air deflector.

- Release the 2 clips.

9. NOTE: Always protect the cooling pack elements to prevent accidental damage.

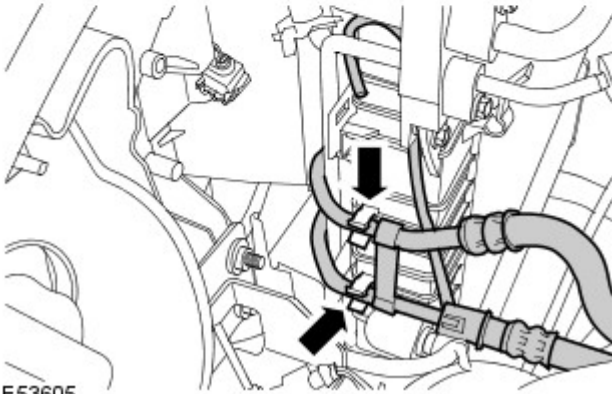
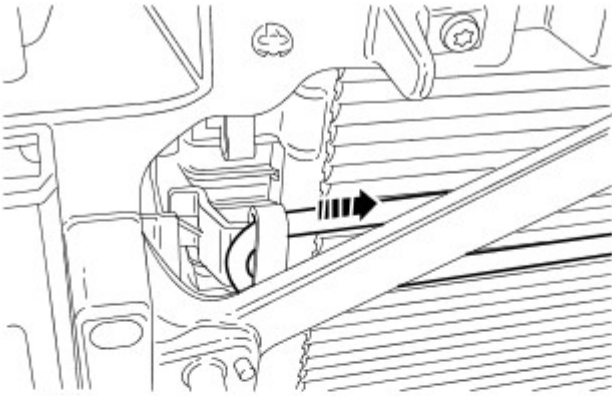
Release the radiator for access.

- Remove the 2 bolts.



10. Remove the power steering fluid cooler.

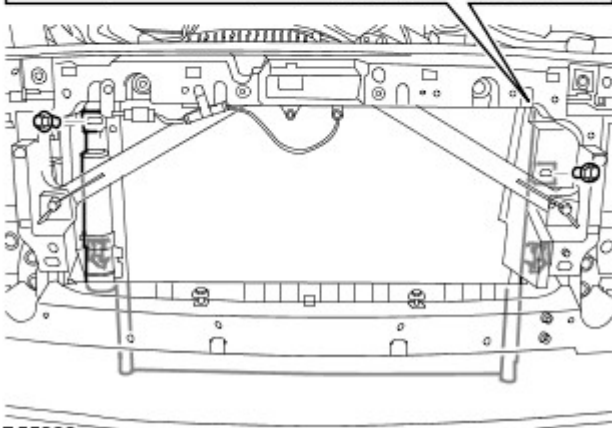
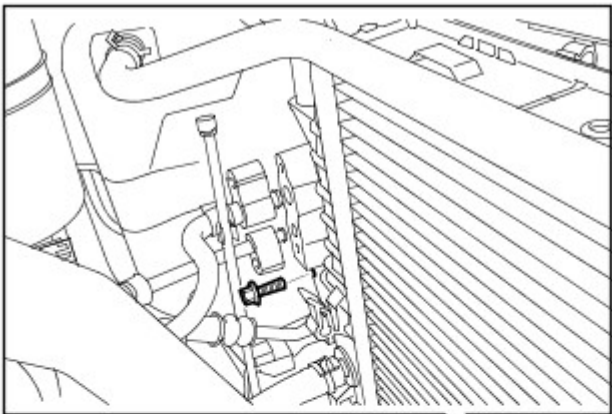
- Release the 3 clips.



E53605

11. Remove the condenser core.

- Remove the 2 screws.
- Remove the bolt.



E55033

Installation

1. Install the condenser core.

- Secure in the clips.

- Tighten the screws.
 - Install the bolt and tighten to 10 Nm (7 lb.ft).
2. Install the power steering fluid cooler.
 - Secure the clips.
 3. Install the reflector air deflector.
 4. Install the radiator.
 - Tighten the bolts to 25 Nm (18 lb.ft).

5.  **CAUTION:** Lubricate the new seals with clean refrigerant oil.


Connect the A/C pipes.

- Remove the blanking caps from the ports.
 - Install new O-ring seals.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
6. Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
 7. Install the radiator securing pegs.
 8. Install the lower fan shroud.
 - Position the locating pegs.
 - Secure in the clips.
 - Secure the hose to the fan cowl.
 9. Install the viscous fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
 10. Fill the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
 11. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Air Conditioning - V6 4.0L Petrol - Evaporator Core

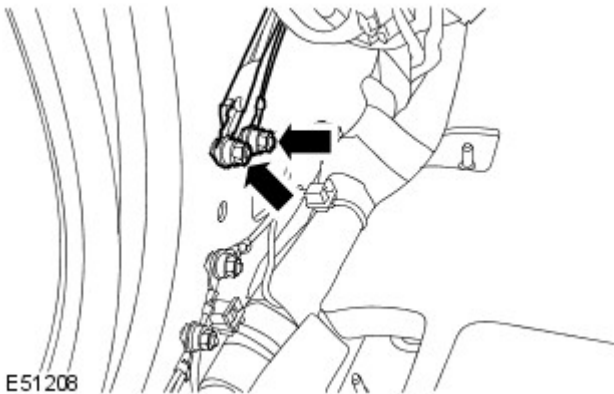
Removal and Installation

Removal

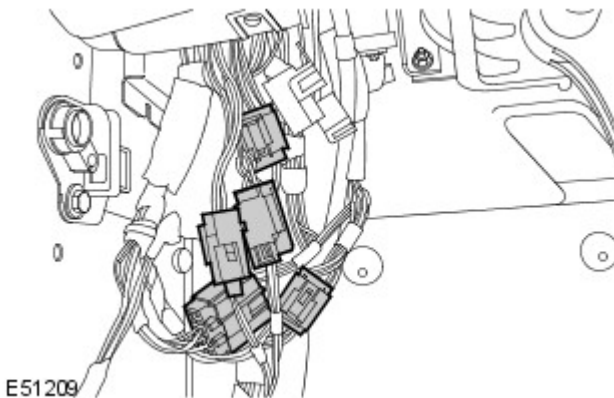
1. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

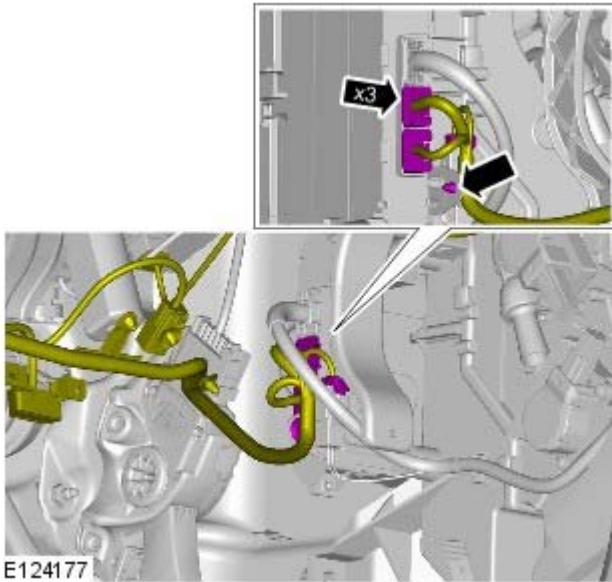
4. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
5. Remove the driver side front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
6. Remove the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
7. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
8. Release the 3 ground cables from the driver side lower A-pillar.
 - Remove the 2 nuts.



9. Disconnect the 5 electrical connectors from the driver side lower A-pillar.

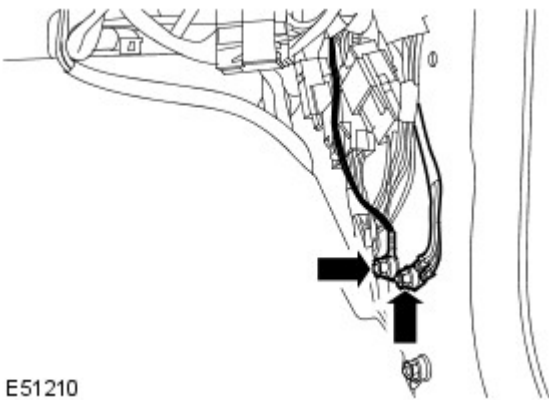


10. Disconnect the 3 electrical connectors.



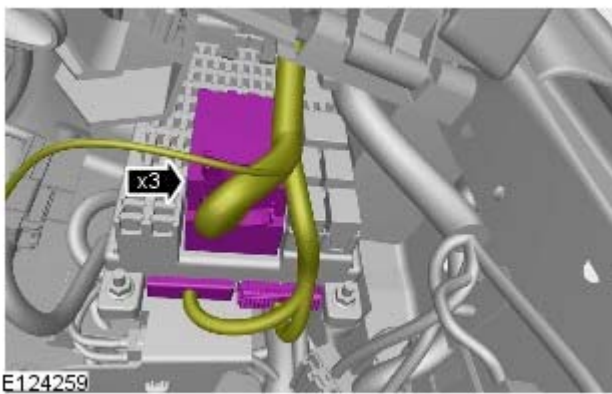
11. Release the 3 ground cables from the passenger side lower A-pillar.

- Remove the 2 nuts.




12. Disconnect the 5 electrical connectors from the passenger side lower A-pillar.

13. Disconnect the central junction box (CJB) three electrical connectors.



14. Disconnect 2 electrical connectors from the instrument panel center reinforcement.

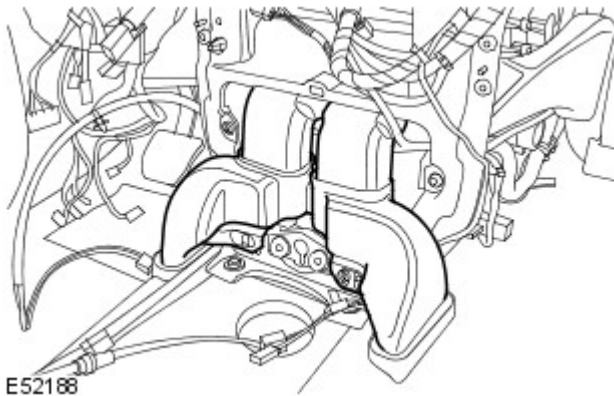


15.  **CAUTION:** Cover fiber optic cable connectors to minimize dust ingress and avoid bending the cables in a radius of less than 30 mm.

If installed, disconnect the instrument panel center reinforcement fibre optic cables.

- Disconnect the electrical connector.

16. Remove the heater housing center ducts.



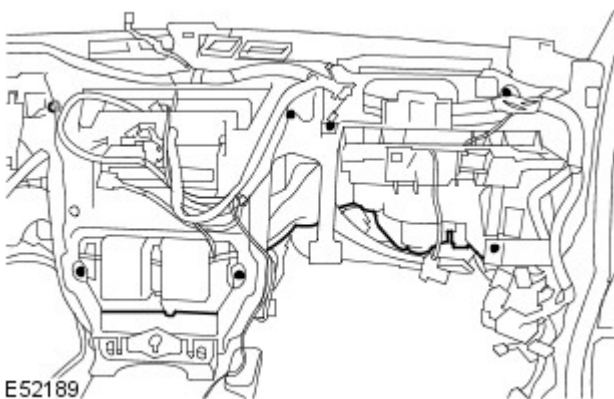
17. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.



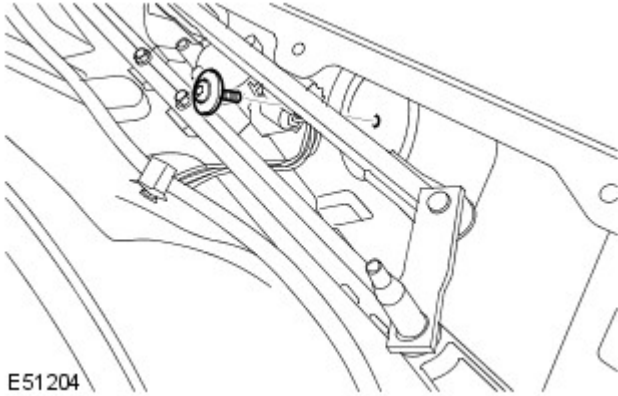
18. Release the heater housing from the instrument panel carrier.

- Remove the 7 Torx screws.



19. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

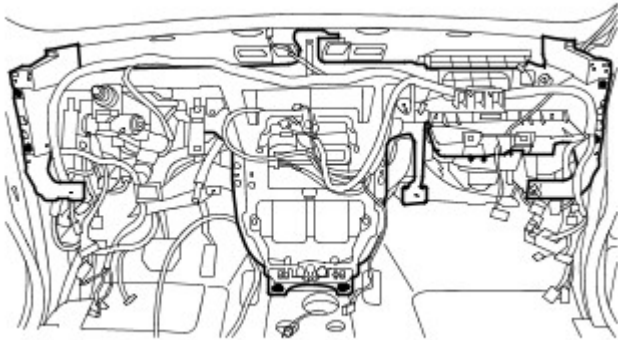
20. Remove the instrument panel carrier to bulkhead Torx bolt.




E51204

21. With assistance, remove the instrument panel.

- Remove the 6 Torx bolts.

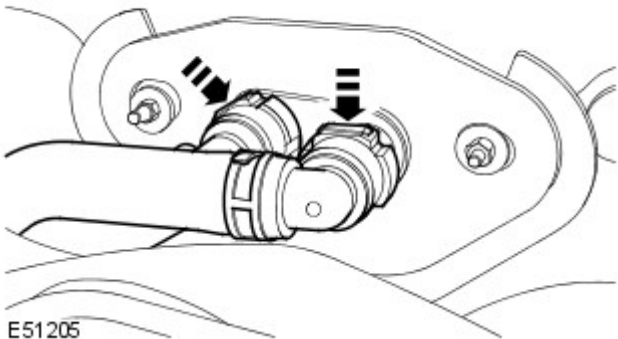


E52190

22.  CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect 2 heater hoses from the bulkhead.

- Release the 2 clips.

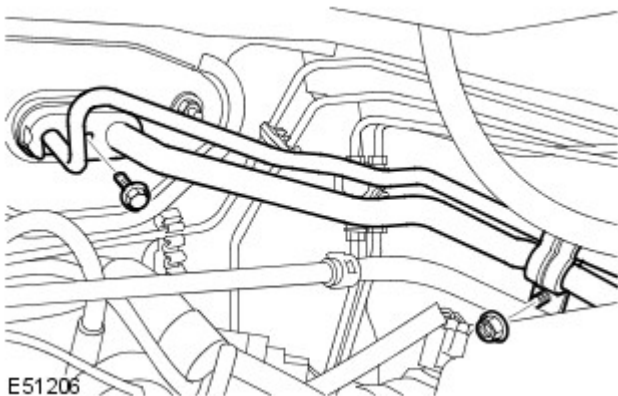


E51205

23.  CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Release the 2 A/C refrigerant lines.

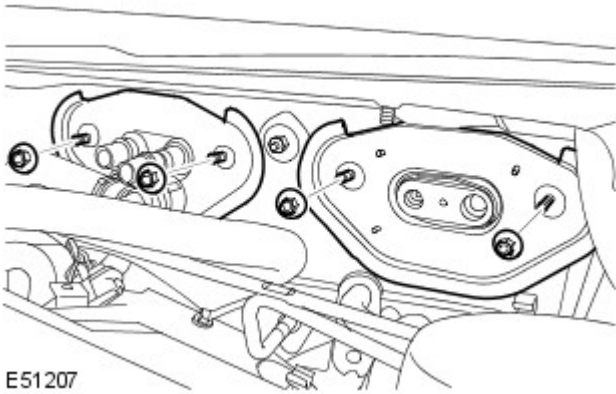
- Remove the nut and bolt.
- Remove and discard the O-ring seals.



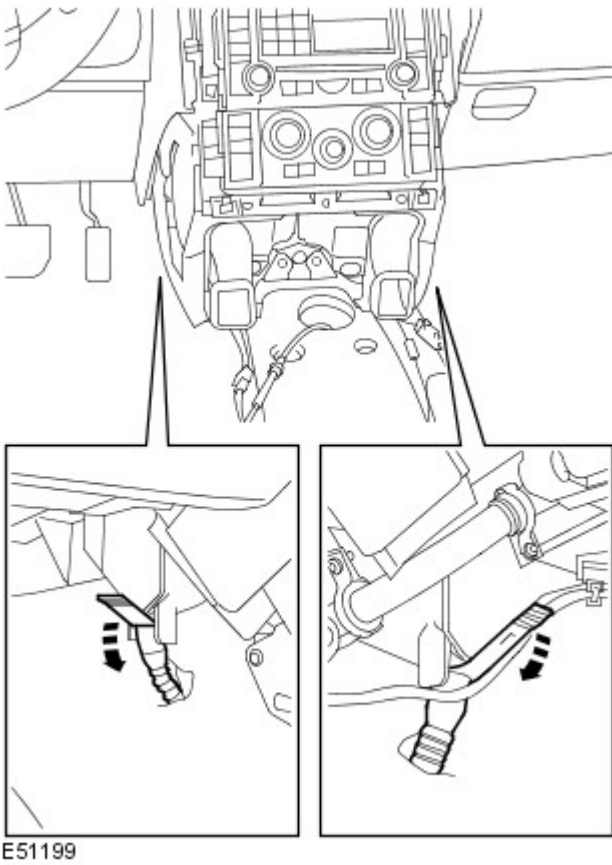
E51206

24. Remove the 2 adapter panels.

- Remove the 4 nuts.

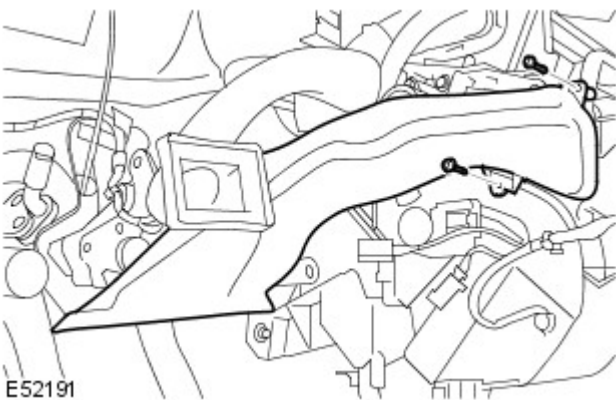


25. Disconnect 2 drain tubes from the heater housing.



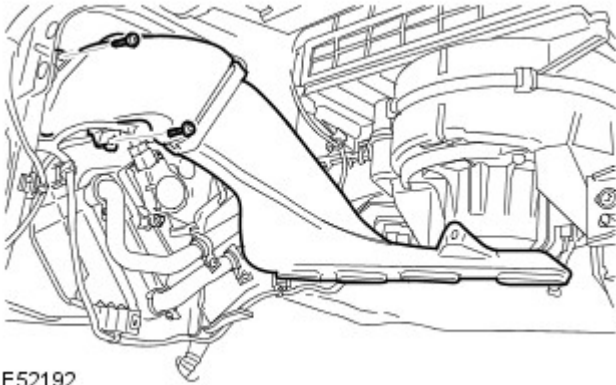
26. Remove the driver side footwell duct.

- Remove the 2 Torx screws.



27. Remove the passenger side footwell duct.

- Remove the 2 Torx screws.



E52192

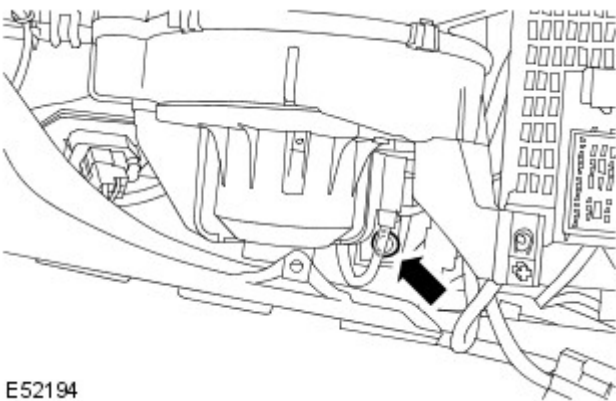
28. Driver side: Remove the heater housing to bulkhead Torx bolt.



E52193

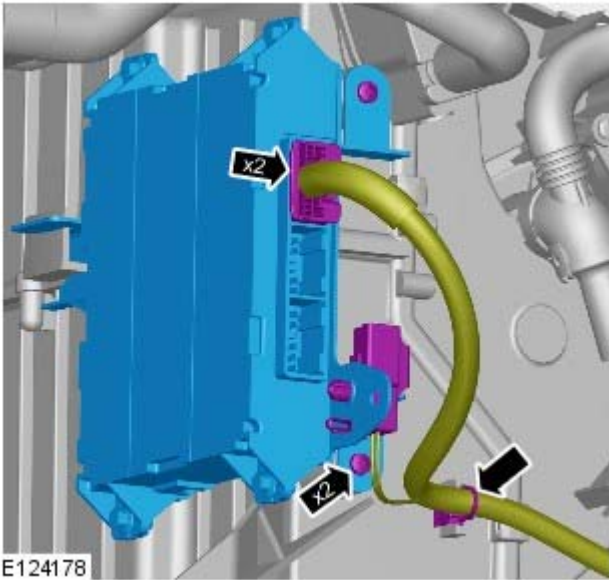
29. Passenger side: Remove the heater housing to bulkhead Torx bolt.

- With assistance, remove the heater and evaporator core housing.

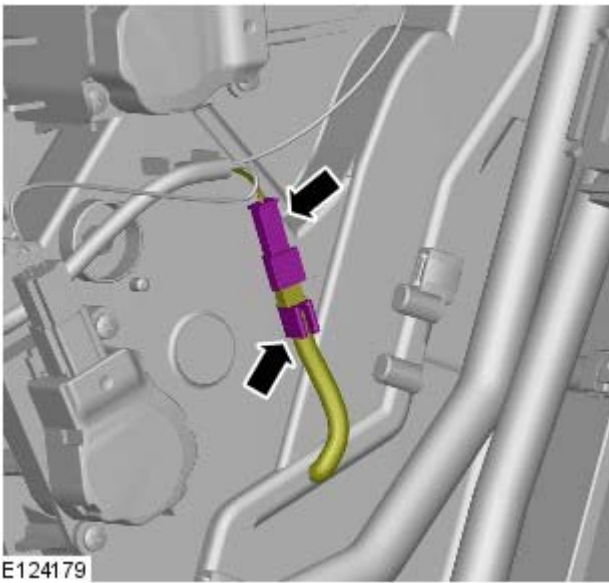


E52194

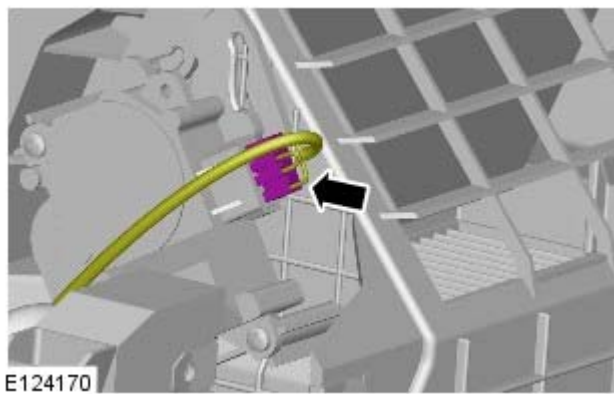
30. Remove the A/C control module.



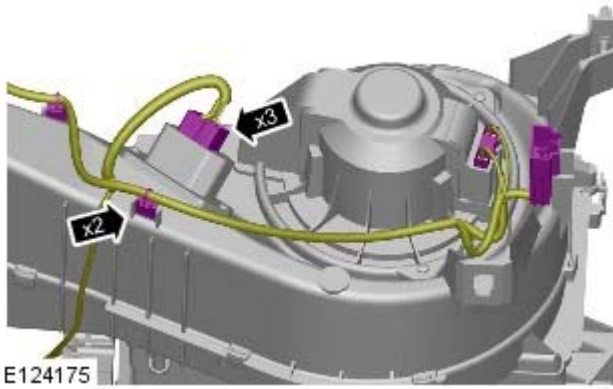
31. Disconnect the evaporator core temperature sensor electrical connector.



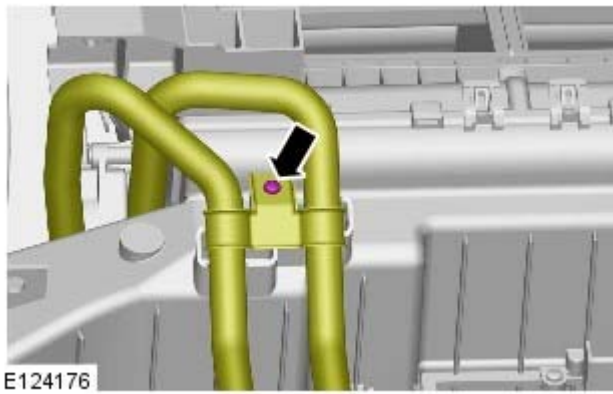
32. Disconnect the electrical connector.



33. Detach the wiring harness.

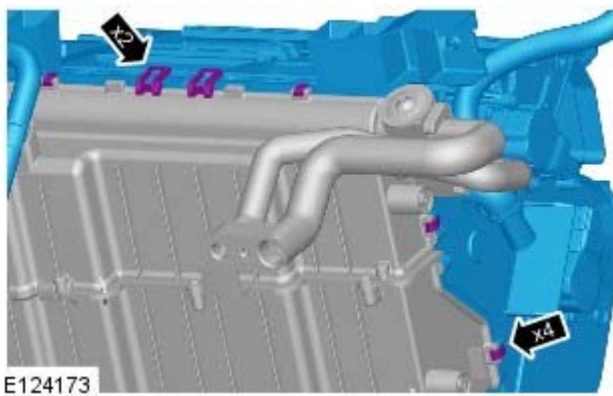
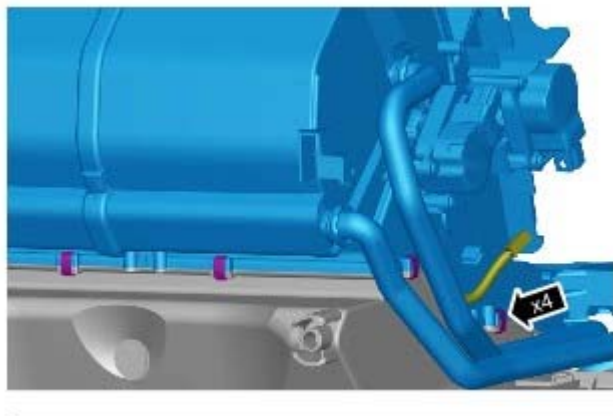


34. Remove the bolt from the support bracket.

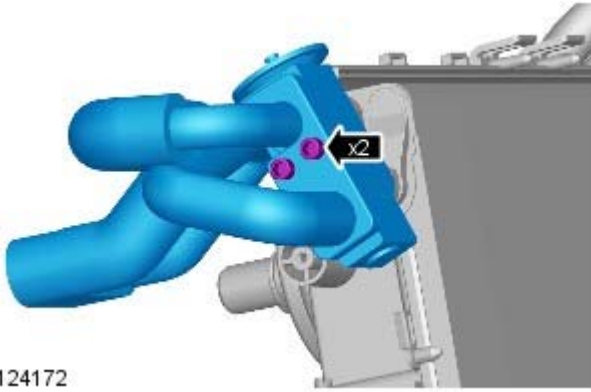


35. Remove the heater and evaporator core housing.

- Remove the 8 clips.
- Carefully release the 2 clips.



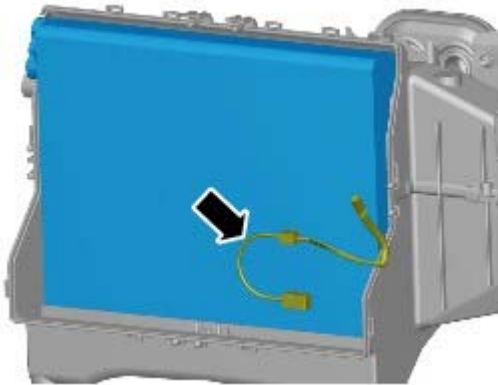
36. Remove the thermostatic expansion valve.



E124172

37. Remove the evaporator core.

- Release the temperature sensor.



E124171

Installation

1. Install the evaporator core.
 - Secure the temperature sensor.
2. Secure the heater core housing.
 - Install the clips.
3. Install the thermostatic expansion valve.
 - Tighten the bolts to 3.5 Nm (2.5 lb.ft).
4. Install the wiring harness.
5. Install and tighten the bolt.
6. Connect the temperature sensor electrical connector.
7. Install the CC module.
 - Tighten the bolts.
8. Passenger side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
 - With assistance, install the heater and evaporator core housing.
9. Driver side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
10. Install the footwell ducts.
 - Tighten the Torx screws.
11. Connect the drain tubes to the heater housing.
12. Install the adapter panels.
 - Tighten the nuts to 6 Nm (4 lb.ft).
13. Secure the A/C refrigerant lines.

- Clean the components.
 - Install new O-ring seals.
 - Tighten the bolt to 5 Nm (4 lb.ft).
 - Tighten the nut to 6 Nm.
- 14.** Connect the bulkhead heater hoses.
- 15.** With assistance, install the instrument panel.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- 16.** Install the instrument panel carrier to bulkhead Torx bolt and tighten to 25 Nm (18 lb.ft).
- 17.** Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
- 18.** Secure the heater housing.
- Tighten the screws.
- 19.** Connect the steering column intermediate shaft.
- Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).
- 20.** Install the heater housing center ducts.
- 21.** Connect the instrument panel center reinforcement fibre optic cables.
- 22.** Connect the instrument panel center reinforcement electrical connectors.
- 23.** Connect the CJB electrical connectors.
- 24.** Connect the electrical connectors to the passenger side lower A-pillar.
- 25.** Connect the ground cables to the passenger side lower A-pillar.
- Tighten the nuts to 10 Nm (7 lb.ft).
- 26.** Connect the electrical connectors to the driver side lower A-pillar.
- 27.** Connect the ground cables to the driver side lower A-pillar.
- Tighten the nuts to 10 Nm (7 lb.ft).
- 28.** Connect the 3 electrical connectors.
- 29.** Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
- 30.** Install the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
- 31.** Install the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
- 32.** Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
- 33.** Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures).
- 34.** Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Air Conditioning - V6 4.0L Petrol - Thermostatic Expansion Valve

Removal and Installation

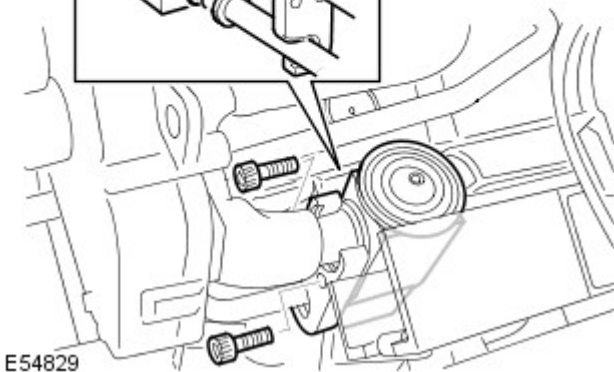
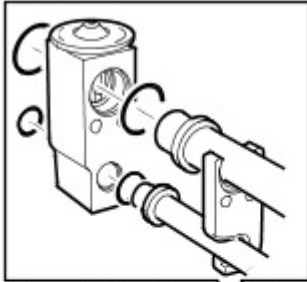
Removal

1. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
2. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

3.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Remove the thermostatic expansion valve.

- Remove the cover.
- Remove the 2 Allen bolts.
- Remove and discard the 4 O-ring seals.



E54829

Installation

1. Install the thermostatic expansion valve.
 - Clean the components.
 - Install the new O-ring seals.
 - Tighten the Allen bolts to 5 Nm (4 lb.ft).
 - Install the cover.
2. Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

Air Conditioning - V8 5.0L Petrol -**Lubricant**

Item	Specification
Air conditioning (A/C) compressor oil type	Sanden SP-10 PAG oil
A/C compressor oil - vehicles fitted with 2 zone	110 cm ³
A/C compressor oil - vehicles fitted with 4 zone	160 cm ³

Refrigerant

Item	Specification
Refrigerant type	R134A
Refrigerant - vehicles fitted with 2 zone - vehicles with 3.0 diesel	600 grammes
Refrigerant - vehicles fitted with 2 zone - vehicles with 5.0L	650 grammes
Refrigerant - vehicles fitted with 4 zone	900 grammes

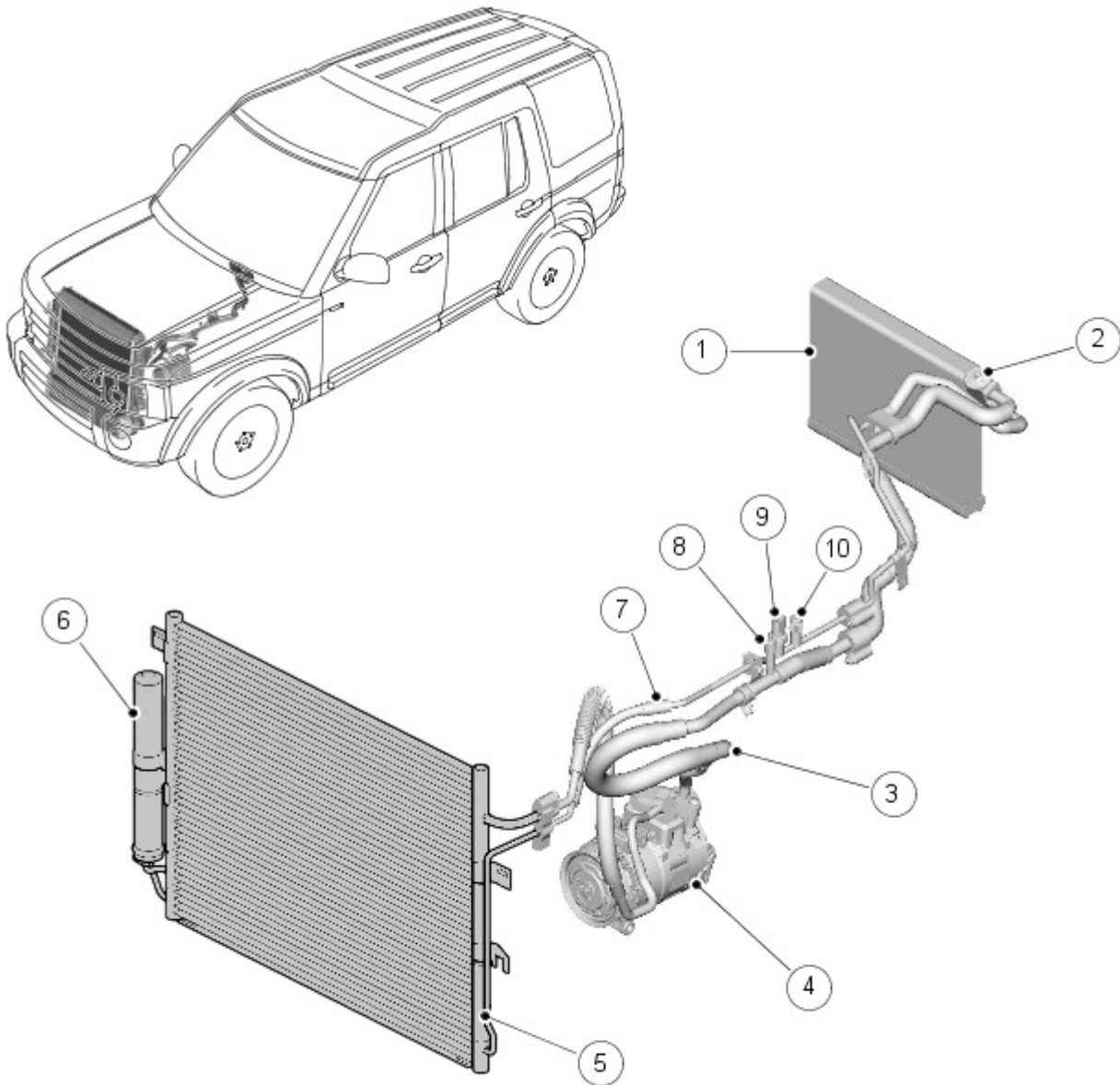
Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	-
A/C discharge line to compressor bolt	18	13	-
A/C suction line to compressor bolt	18	13	-
A/C suction line bracket bolts	6	-	53
A/C discharge line to condenser bolt	6	-	53
A/C liquid line to condenser bolt	6	-	53
A/C condenser manifold to radiator bolt	10	7	-
Condenser to radiator bolt - vehicles with 5.0L	10	7	-
Condenser to radiator bolt - vehicles with 3.0 diesel	5	-	44
Evaporator line to evaporator core bolt	6	-	53
Evaporator line bracket nut	6	-	53
A/C liquid line to front evaporator line bolt - vehicles fitted with 4 zone	18	13	-
A/C suction line to front evaporator line bolt - vehicles fitted with 4 zone	18	13	-
A/C lines to rear evaporator bolts - vehicles fitted with 4 zone	9	-	80
A/C pressure transducer	10	7	-
Thermostatic expansion valve (TXV) to refrigerant line clamp bolts	5	-	44

Air Conditioning - V8 5.0L Petrol - Air Conditioning

Description and Operation

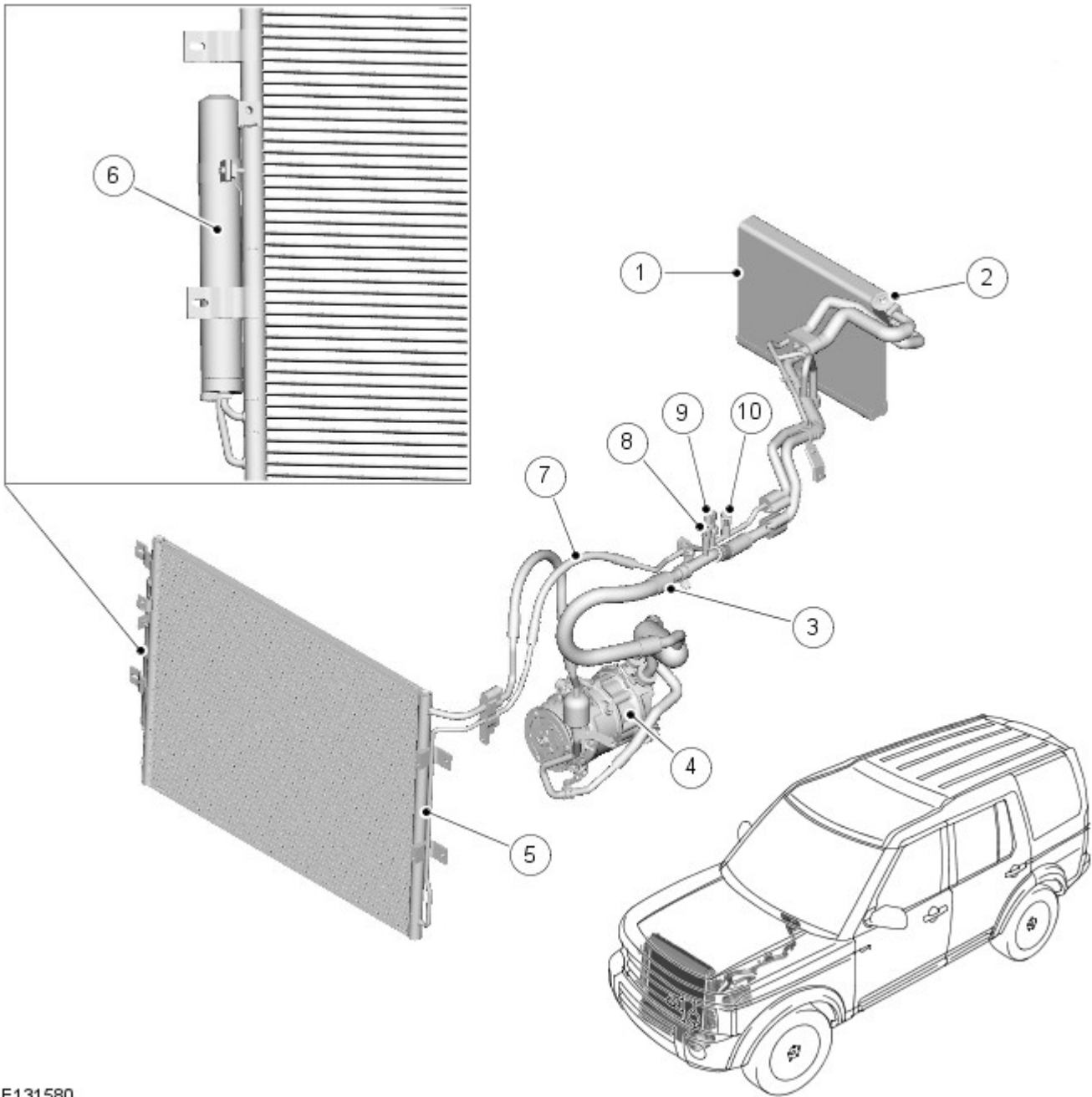
COMPONENT LOCATION 2.7L TdV6



E131578

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	air conditioning (A/C) compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

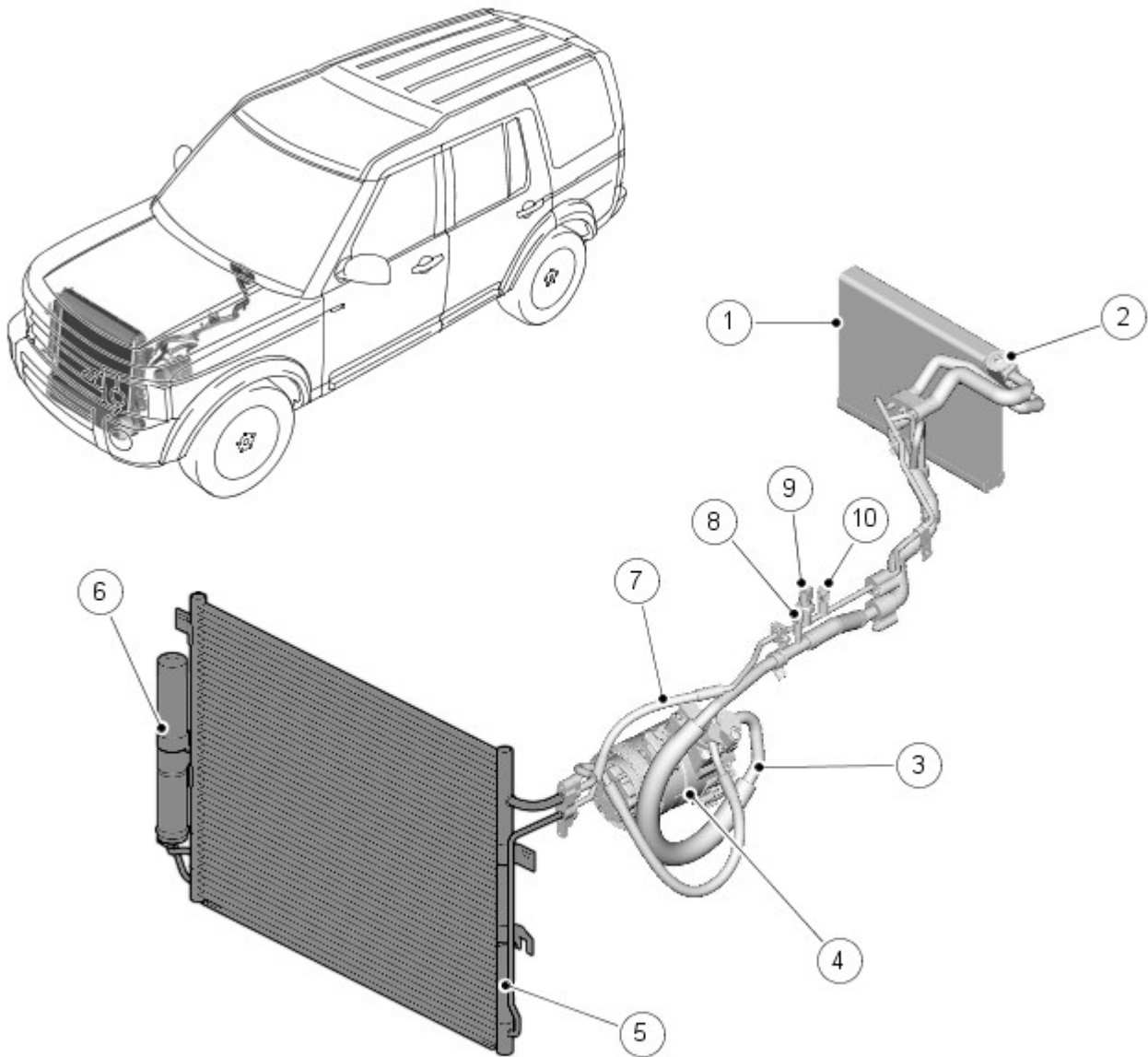
COMPONENT LOCATION 3.0L TdV6



E131580

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

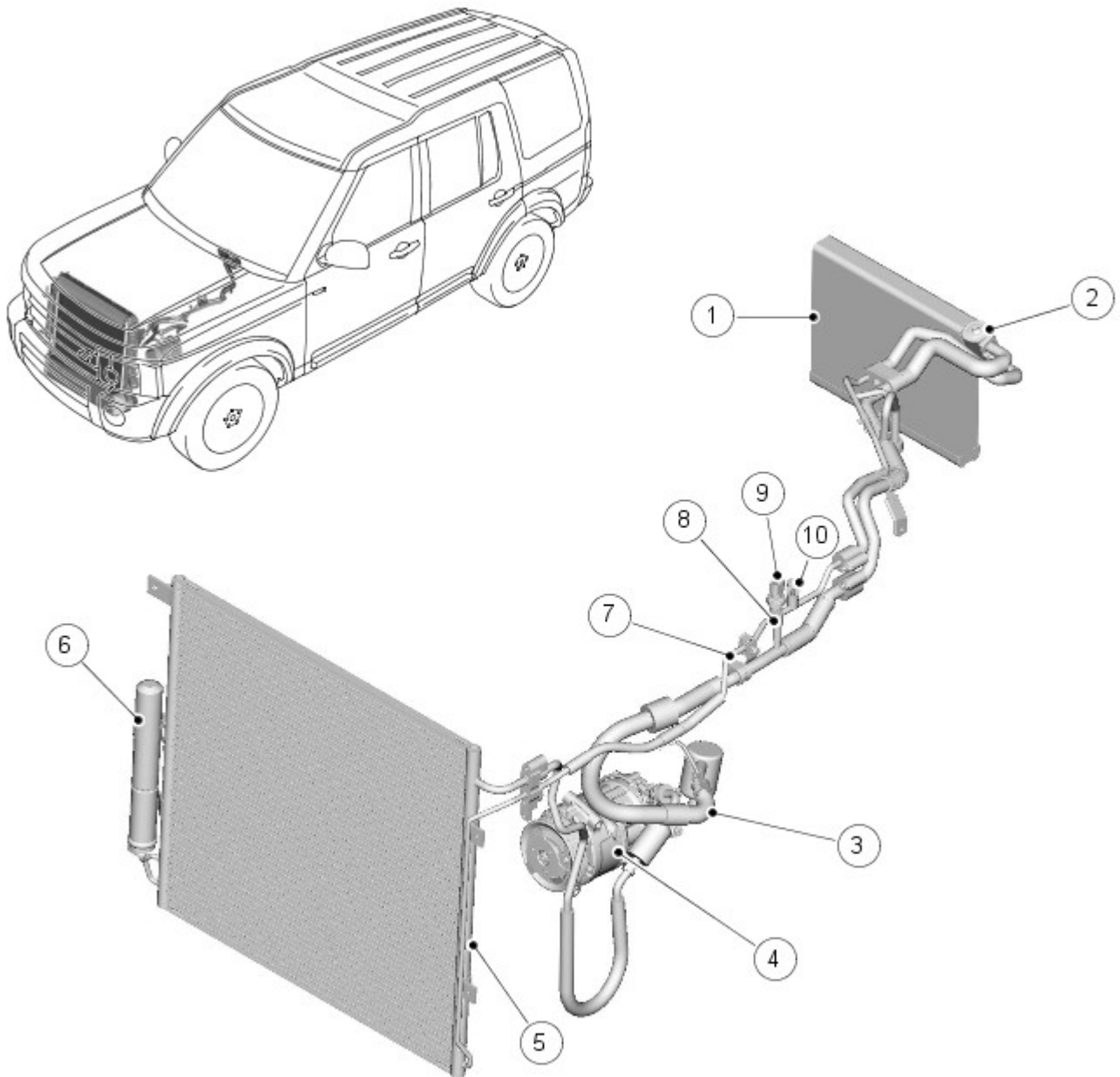
COMPONENT LOCATION 4.0L NA V6



E131582

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

COMPONENT LOCATION 5.0L NA V8



E131583

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	Low pressure line
4	-	A/C compressor
5	-	Condenser
6	-	Receiver drier
7	-	High pressure line
8	-	Low pressure servicing connection
9	-	Refrigerant pressure sensor (reference)
10	-	High pressure servicing connection

GENERAL

The A/C system transfers heat from the vehicle interior to the outside atmosphere to provide the heater assembly with dehumidified cool air. The system consists of:

- A compressor.
- A condenser.
- A receiver drier.
- A thermostatic expansion valve.
- An evaporator.
- Low and high pressure refrigerant lines.

The system is a sealed, closed loop, filled with a charge weight of R134a refrigerant as the heat transfer medium. Oil is added to the refrigerant to lubricate the internal components of the compressor.

Operation of the air conditioning system is controlled by the automatic temperature control (ATC) module. The A/C compressor circulates the refrigerant around the system by compressing low pressure, low temperature vapor from the evaporator and discharging the resultant high pressure, high temperature vapor to the condenser.

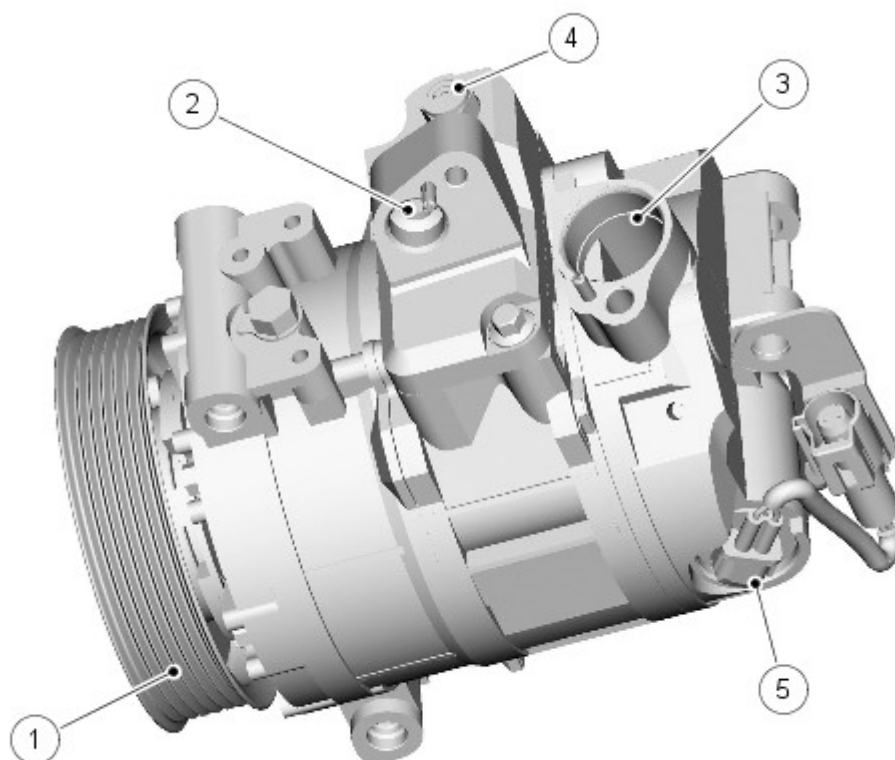
The A/C compressor is a variable displacement unit which is driven by the engine accessory drive belt. On 2.7L/4.0L and 5.0L vehicles, the [A/C \(air conditioning\)](#) compressor is permanently driven directly from the pulley. On 3.0L diesel vehicles the [A/C](#) compressor is driven via an electro-magnetic clutch.

To protect the refrigerant system from excessive pressure, a pressure relief valve is installed in the outlet side of the A/C compressor. The pressure relief valve vents excess pressure into the engine compartment.

For additional information, refer to: Control Components (412-04, Description and Operation).

A/C COMPRESSOR

2.7L TdV6



E131577

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

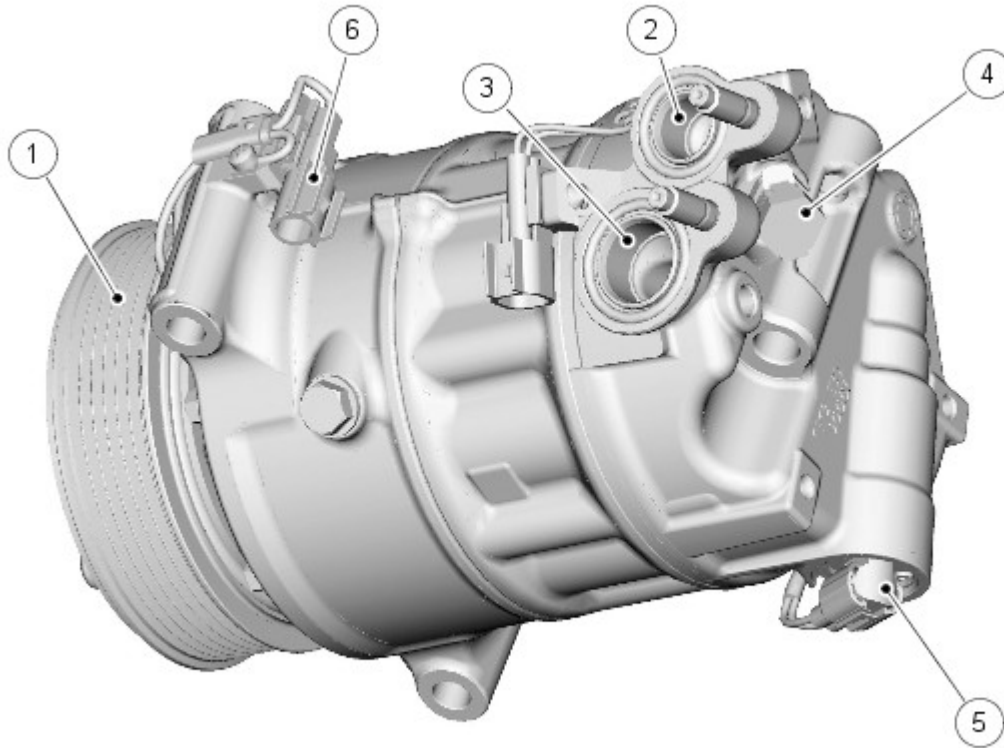
The [A/C](#) compressor fitted to 2.7L TdV6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC \(automatic temperature control\)](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (436 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

3.0L TdV6



E131579

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector
6	-	electromagnetic clutch connector

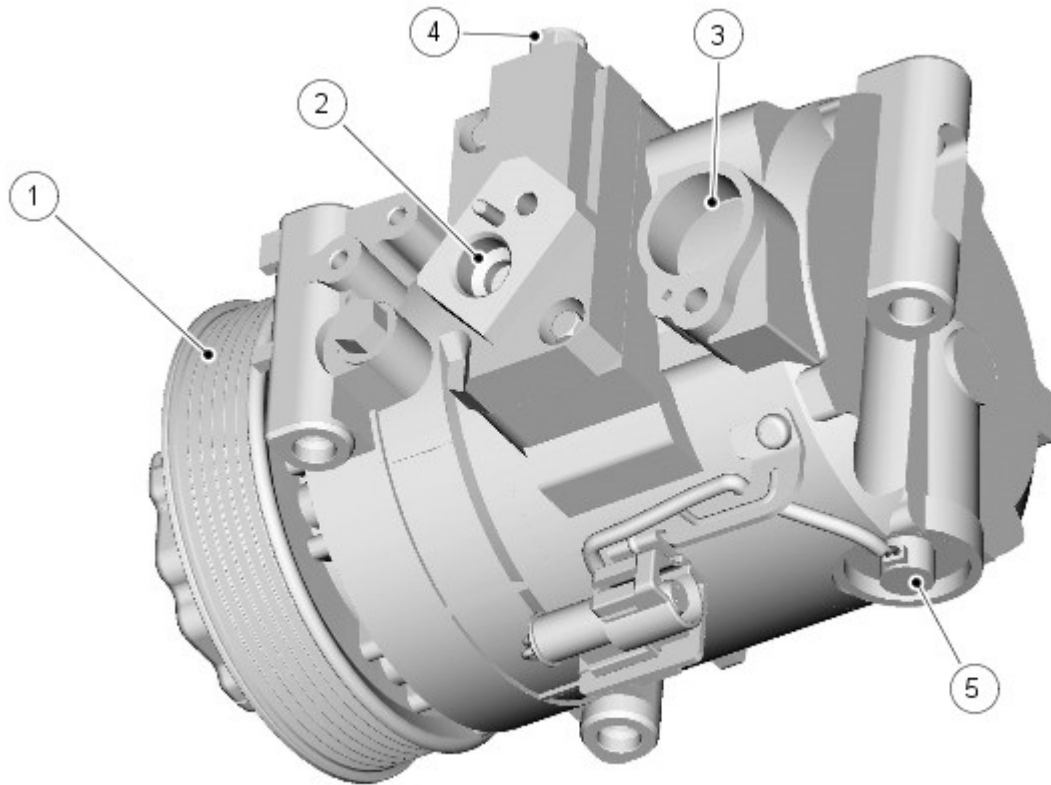
The [A/C](#) compressor fitted to 3.0L TdV6 diesel vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley and an electromagnetic clutch. Operation of the clutch is controlled by a power feed from the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The clutch of the [A/C](#) compressor incorporates a thermal cut-off fuse, which disconnects the power feed from the [ATC](#) module if the temperature increases to 182 ± 5 °C (360 ± 9 °F).

4.0L NA V6



E131581

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

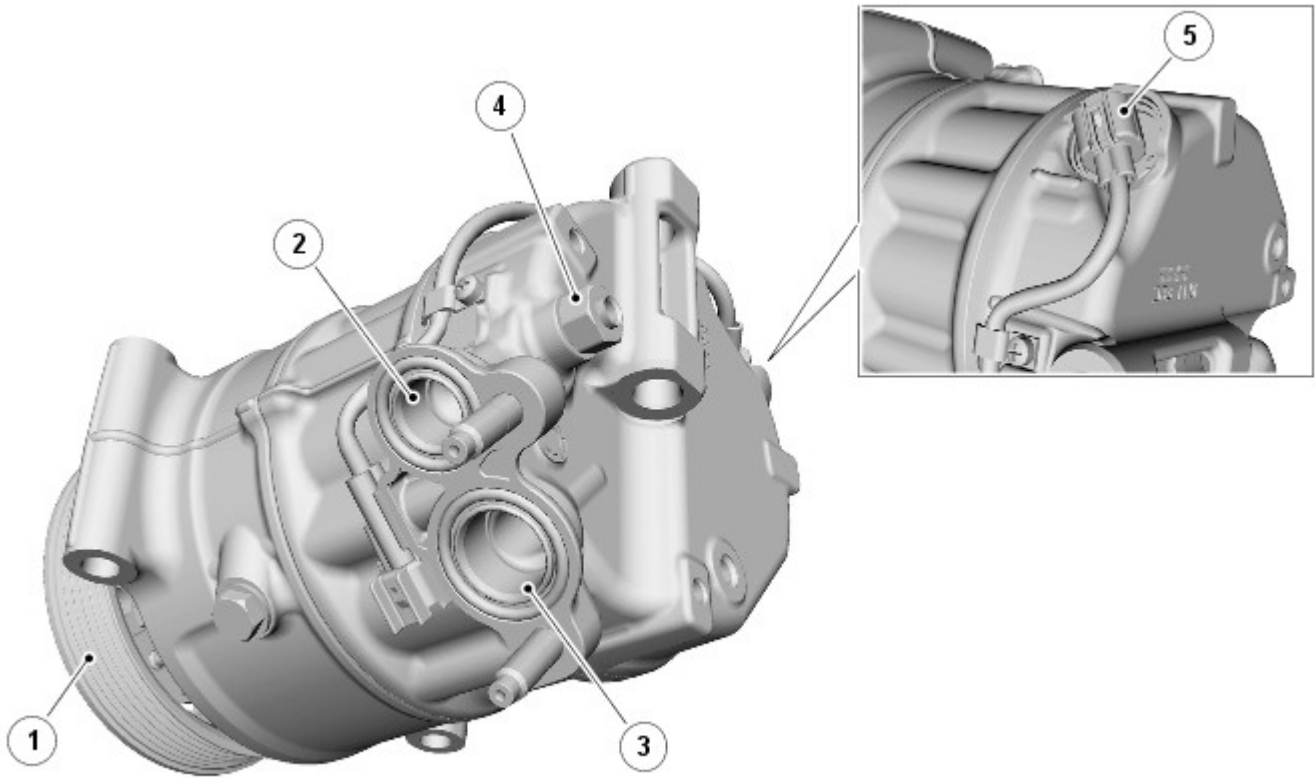
The [A/C](#) compressor fitted to 4.0L NA V6 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 171 cm³/rev (10.43 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.3 MPa (508 to 623 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.01 MPa (437 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

5.0L NA V8



E131337

Item	Part Number	Description
1	-	Pulley
2	-	Outlet port
3	-	Inlet port
4	-	Pressure relief valve
5	-	Electronic control valve connector

The [A/C](#) compressor fitted to 5.0L V8 petrol vehicles is a variable displacement unit. The secondary accessory drive belt, driven by the engine crankshaft, drives the [A/C](#) compressor via a pulley. Operation of the compressor is controlled by an electronic control valve working in conjunction with the [ATC](#) module.

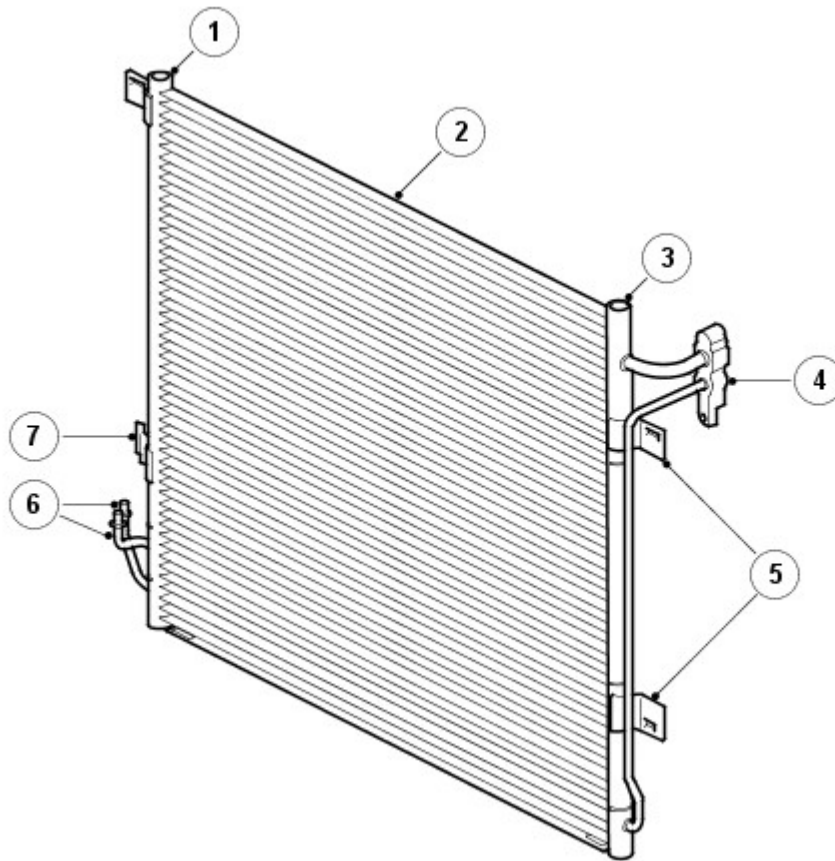
The [A/C](#) compressor is a 7 cylinder swash plate unit with a minimum displacement of 1.6 cm³/rev (0.10 in³/rev) and maximum displacement of 163 cm³/rev (9.95 in³/rev). The [ATC](#) module automatically adjusts the displacement of the [A/C](#) compressor between the minimum and maximum values, to match the thermal load of the evaporator. By matching refrigerant flow and the thermal load of the evaporator, the [ATC](#) module maintains cabin comfort whilst also considering fuel economy.

To protect the refrigerant system from unacceptably high pressure, a pressure relief valve is installed in the outlet side of the [A/C](#) compressor. The pressure relief valve is set to open at 3.5 to 4.1 MPa (508 to 595 lbf/in²) and vents excess pressure into the engine compartment. The pressure relief valve closes again when the pressure decreases to 3.1 MPa (449 lbf/in²).

The pulley of the [A/C](#) compressor incorporates a mechanical torque limiter, which disconnects the drive plate from the compressor shaft if torque increases to a level that indicates imminent compressor seizure.

CONDENSER

- NOTE: 5.0L NA V8 version shown other installations similar



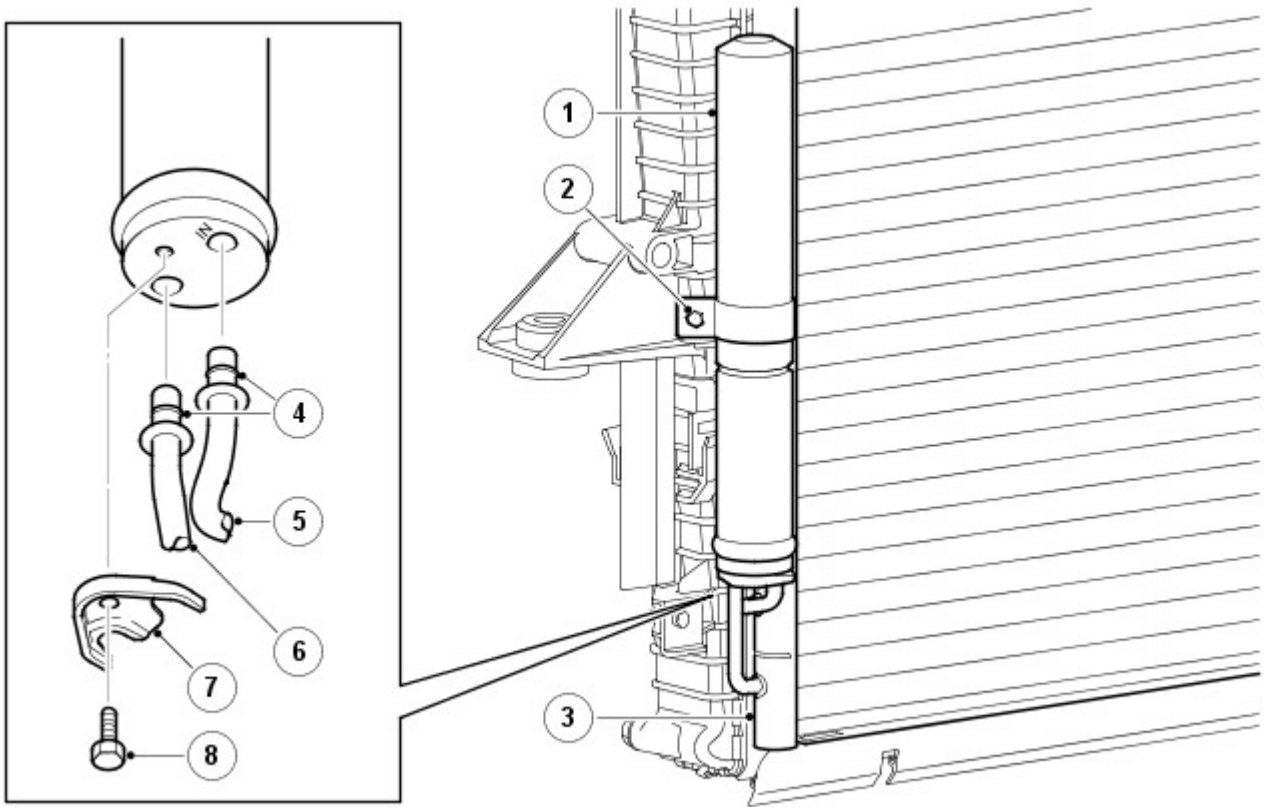
E46920

Item	Part Number	Description
1	-	right-hand (RH) end tank
2	-	Condenser core
3	-	left-hand (LH) end tank
4	-	High pressure line connector block
5	-	Condenser attachment brackets
6	-	Receiver drier pipes
7	-	Receiver drier attachment bracket

The condenser transfers heat from the refrigerant to the surrounding air to convert the high pressure vapor from the compressor into a liquid. The condenser is installed immediately in front of the radiator. Two brackets on each end tank of the condenser attach the condenser to clips on the end tanks of the radiator.

The condenser is classified as a sub-cooling condenser and consists of a fin and tube heat exchanger core installed between two end tanks. Divisions in the end tanks separate the heat exchanger into a four pass upper (condenser) section and a two pass lower (sub-cooler) section. A connector block on the left end tank of the condenser provides connections for the high pressure lines from the A/C compressor and the evaporator. Two pipes at the bottom of the right end tank of the condenser provide connections for the receiver drier.

RECEIVER DRIER



E46921

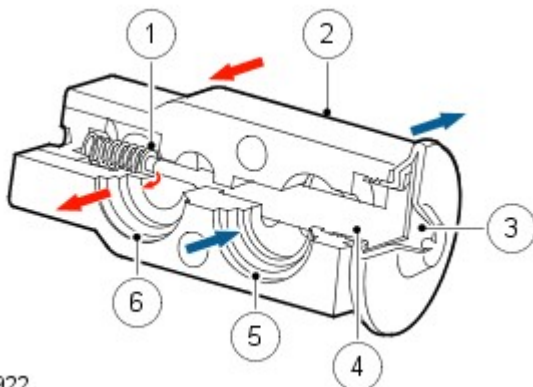
Item	Part Number	Description
1	-	Receiver drier
2	-	Clamp
3	-	Condenser RH end tank
4	-	O-ring seals
5	-	Inlet pipe
6	-	Outlet pipe
7	-	Collar
8	-	Bolt

The receiver drier removes solid impurities and moisture from the refrigerant, and provides a reservoir for liquid refrigerant to accommodate changes of heat load at the evaporator.

The receiver drier is attached to the two stub pipes on the right end tank of the condenser. A collar, located on lands on the stub pipes and secured with a bolt, attaches the stub pipes to the receiver drier. A clamp secures the body of the receiver drier to a bracket welded to the right end tank of the condenser. The inlet and outlet ports of the receiver drier are the same size, so care must be taken to install the receiver drier the correct way round on the stub pipes; to assist with installation, the inlet port is identified with the word IN etched into the receiver drier.

Refrigerant entering the receiver drier passes through a filter and a desiccant pack, then collects in the base of the unit before flowing through the outlet stub pipe back to the condenser. The desiccant and the filter are non-serviceable; the complete unit must be replaced when a change of desiccant is required.

THERMOSTATIC EXPANSION VALVE



E46922

Item	Part Number	Description
1	-	Metering valve
2	-	Housing

3	-	Diaphragm
4	-	Temperature sensitive tube
5	-	Outlet passage from evaporator
6	-	Inlet passage to evaporator

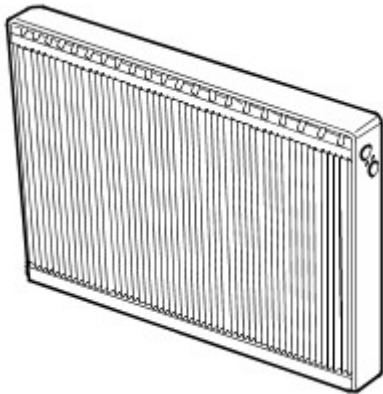
The thermostatic expansion valve meters the flow of refrigerant into the evaporator, to match the refrigerant flow with the heat load of the air passing through the evaporator.

The thermostatic expansion valve is a block type valve located behind the heater assembly, and attached to the inlet and outlet ports of the evaporator. The thermostatic expansion valve consists of an aluminum housing containing inlet and outlet passages. A ball and spring metering valve is installed in the inlet passage and a temperature sensor is installed in the outlet passage. The temperature sensor consists of a temperature sensitive tube connected to a diaphragm. The bottom end of the temperature sensitive tube acts on the ball of the metering valve. Pressure on top of the diaphragm is controlled by evaporator outlet temperature conducted through the temperature sensitive tube. The bottom of the diaphragm senses evaporator outlet pressure.

Liquid refrigerant flows through the metering valve into the evaporator. The restriction across the metering valve reduces the pressure and temperature of the refrigerant. The restriction also changes the liquid stream of refrigerant into a fine spray, to improve the evaporation process. As the refrigerant passes through the evaporator, it absorbs heat from the air flowing through the evaporator. The increase in temperature causes the refrigerant to vaporize and increase in pressure.

The temperature and pressure of the refrigerant leaving the evaporator act on the diaphragm and temperature sensitive tube, which regulate the metering valve opening and so control the volume of refrigerant flowing through the evaporator. The warmer the air flowing through the evaporator, the more heat available to evaporate refrigerant and thus the greater the volume of refrigerant allowed through the metering valve.

EVAPORATOR



E46923

The evaporator is installed in the heater assembly between the blower and the heater matrix, to absorb heat from the exterior or recirculated air. Low pressure, low temperature refrigerant changes from liquid to vapor in the evaporator, absorbing large quantities of heat as it changes state.

Most of the moisture in the air passing through the evaporator condenses into water, which drains out of the heater and through the floorpan, to the underside of the vehicle, through two drain tubes.

REFRIGERANT LINES

To maintain similar flow velocities around the system, the diameter of the refrigerant lines varies to suit the two pressure/temperature regimes. The larger diameters are installed in the low pressure/temperature regime and the smaller diameters are installed in the high pressure/temperature regime.

Low and high pressure charging connections are incorporated into the refrigerant lines for system servicing. Where auxiliary A/C is installed, connections for the auxiliary refrigerant lines are incorporated near the engine bulkhead.

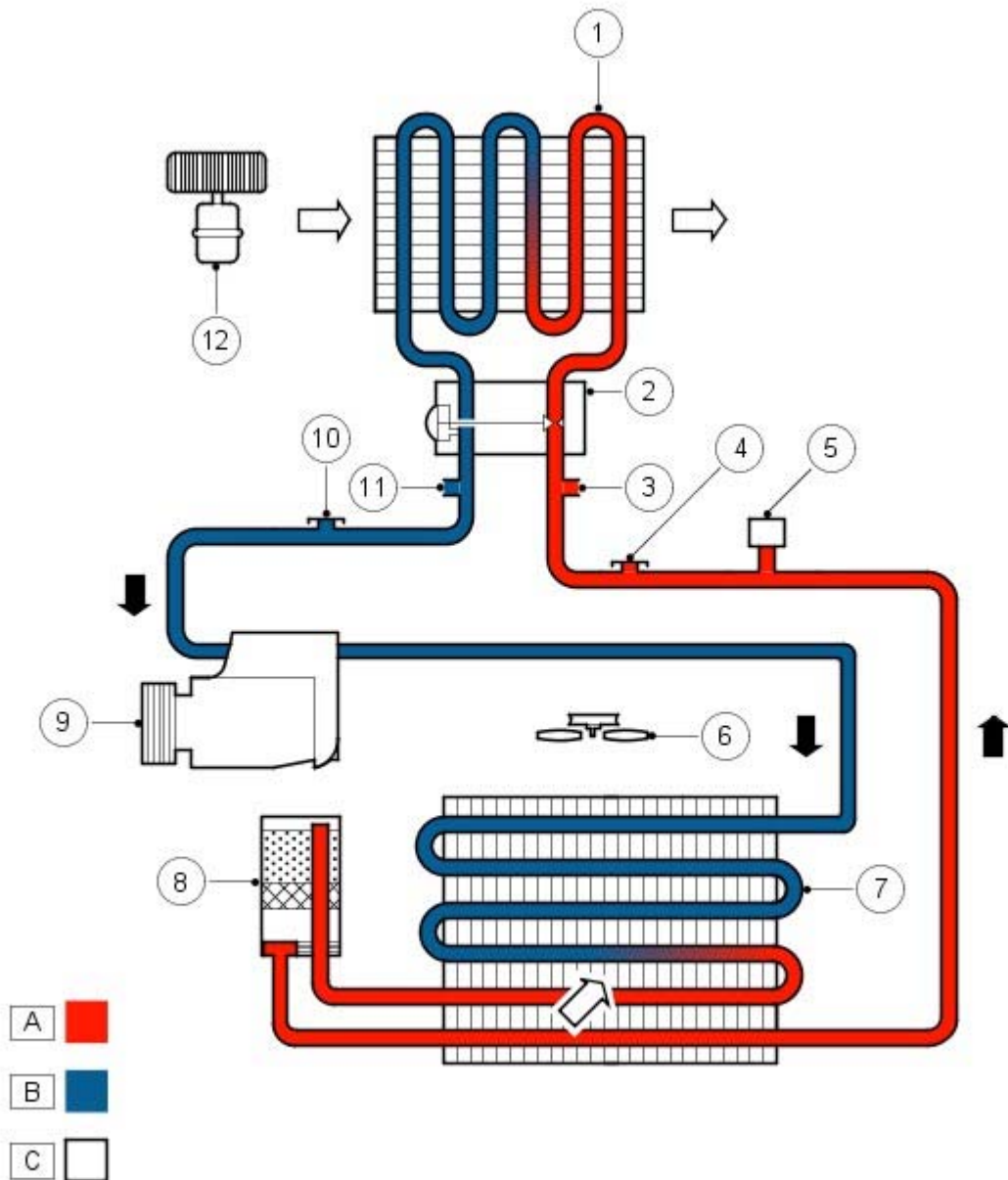
Under normal operating conditions, the smaller diameter pipes (A/C compressor discharge, liquid refrigerant) are hot to the touch and the larger diameter pipes (A/C compressor suction, gaseous refrigerant) are cold to the touch.

SYSTEM OPERATION

To accomplish the transfer of heat, the refrigerant is circulated around the system, where it passes through two pressure/temperature regimes. In each of the pressure/temperature regimes, the refrigerant changes state, during which process maximum heat absorption or release occurs. The low pressure/temperature regime is from the thermostatic expansion valve, through the evaporator to the compressor; the refrigerant decreases in pressure and temperature at the thermostatic expansion valve, then changes state from liquid to vapor in the evaporator, to absorb heat. The high pressure/temperature regime is from the compressor, through the condenser and receiver drier to the thermostatic expansion valve; the refrigerant increases in pressure and temperature as it passes through the compressor, then releases heat and changes state from vapor to liquid in the condenser.

A/C SYSTEM SCHEMATIC

- NOTE: A = Refrigerant liquid; B = Refrigerant vapor; C = Air flow



E46924

Item	Part Number	Description
1	-	Evaporator
2	-	Thermostatic expansion valve
3	-	High pressure connection with auxiliary climate control (where fitted)
4	-	High pressure servicing connection
5	-	Refrigerant pressure sensor
6	-	Cooling fan
7	-	Condenser
8	-	Receiver drier
9	-	A/C compressor
10	-	Low pressure servicing connection
11	-	Low pressure connection with auxiliary climate control (where fitted)
12	-	Blower

Air Conditioning - V8 5.0L Petrol - Air Conditioning

Diagnosis and Testing

For additional information.


REFER to: [Climate Control System](#) (412-00 Climate Control System - General Information, Diagnosis and Testing).

Air Conditioning - V8 5.0L Petrol - Air Conditioning (A/C) Compressor

Removal and Installation

Removal

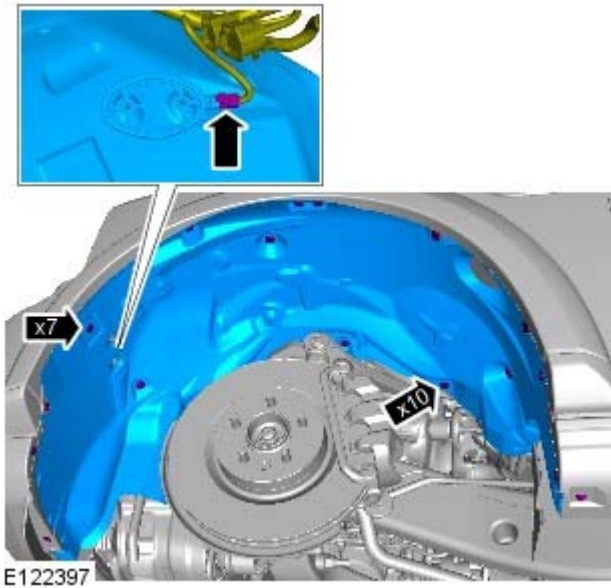
• NOTE: Removal steps in this procedure may contain installation details.

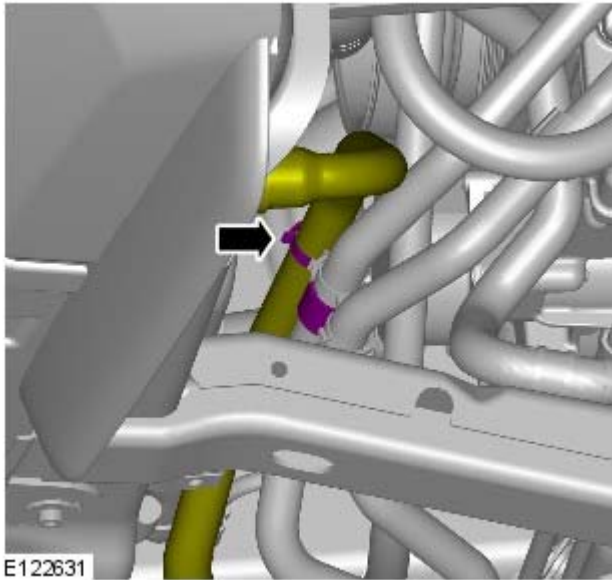
1.  **WARNING:** Make sure to support the vehicle with axle stands.


Raise and support the vehicle.
2. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
3. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
4. Refer to: [Accessory Drive Belt](#) (303-05D Accessory Drive - V8 5.0L Petrol, Removal and Installation).
5. Remove the LH front road wheel.

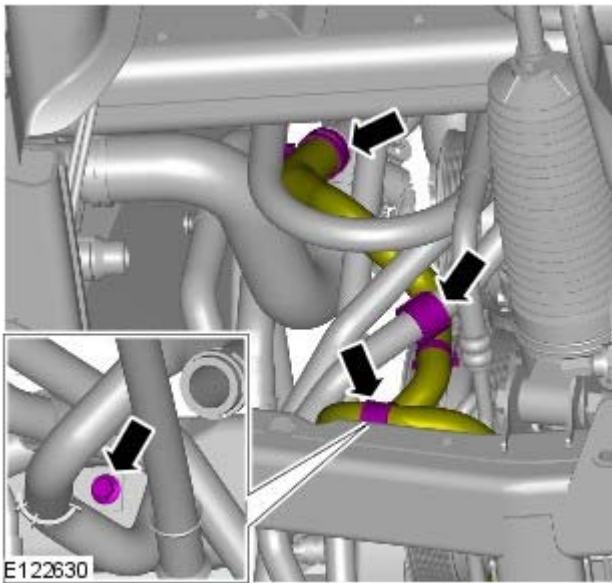
Torque: 140 Nm

6.



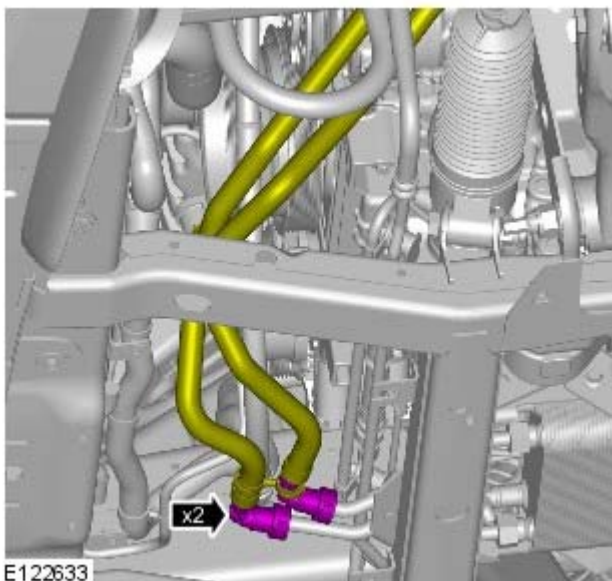



7.  CAUTION: Be prepared to collect escaping coolant.

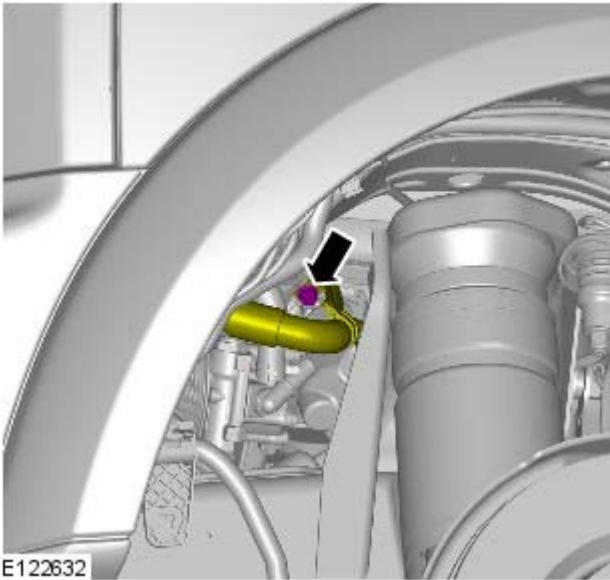


8.  CAUTION: Be prepared to collect escaping coolant.

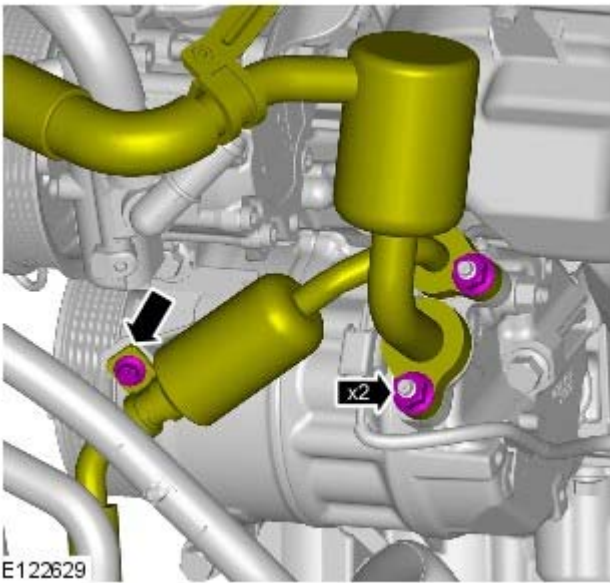
Torque: 10 Nm



9.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.



10. Torque: 18 Nm

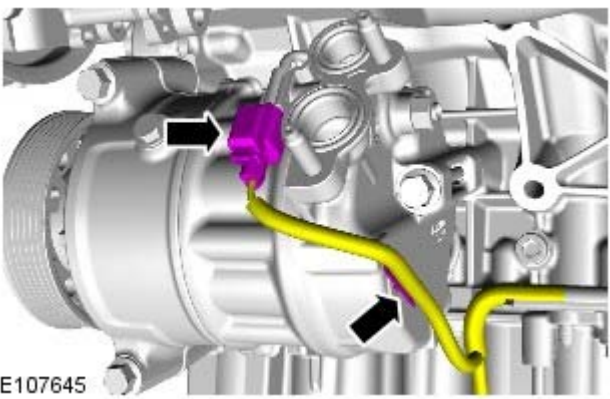


11. **11. CAUTIONS:**

 Make sure that all openings are sealed. Use new blanking caps.

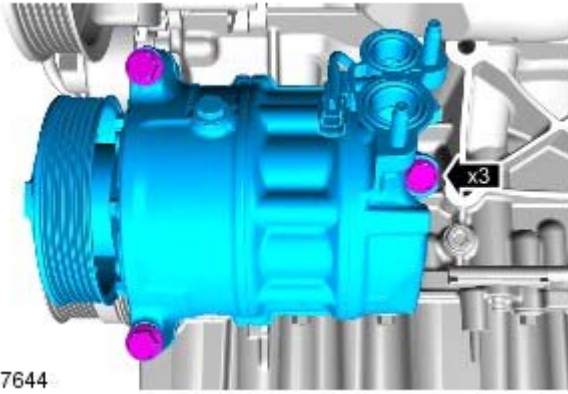
 A new O-ring seal is to be installed.

Torque:
M8 18 Nm
M6 6 Nm



12.

13. Torque: 25 Nm



E107644

Installation

1. To install, reverse the removal procedure.

Air Conditioning - V8 5.0L Petrol - Condenser Core

Removal and Installation

Removal

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

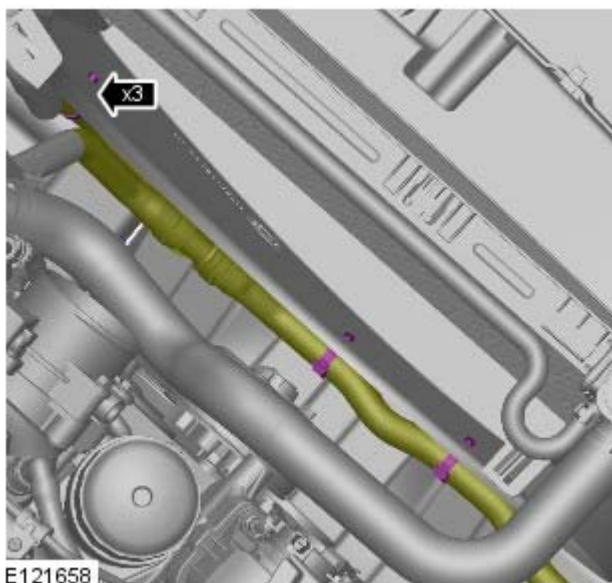
3. Refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

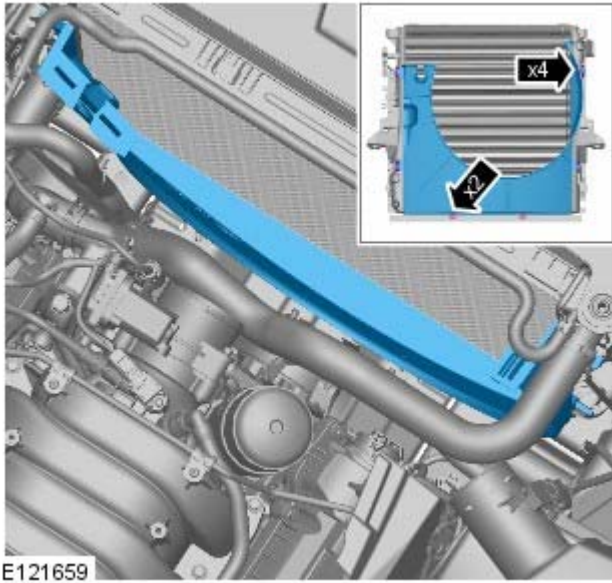
4. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

5. Refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

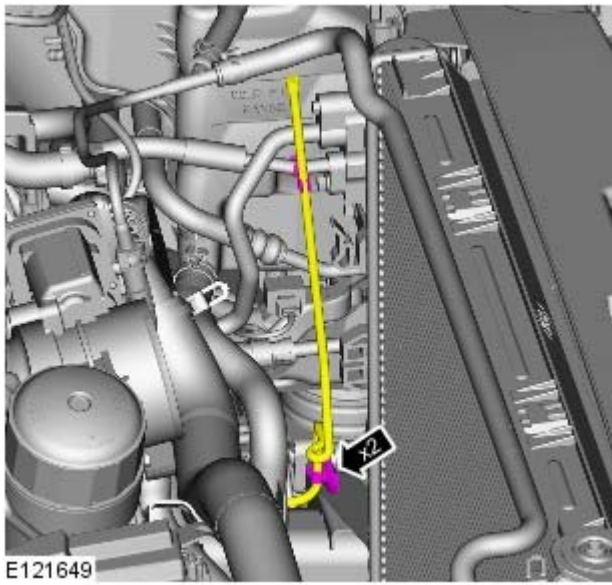
6. Refer to: [Cooling Fan](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

7.

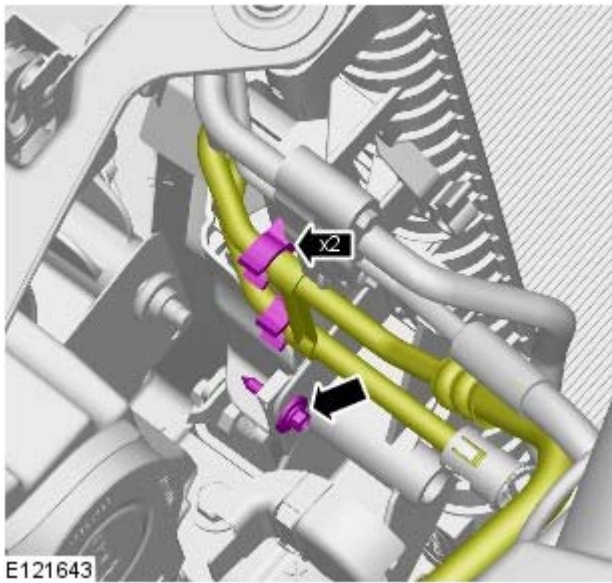




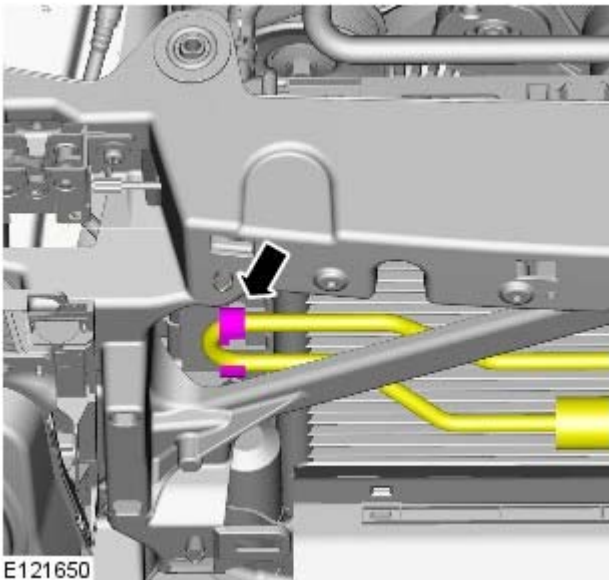
8.




9.

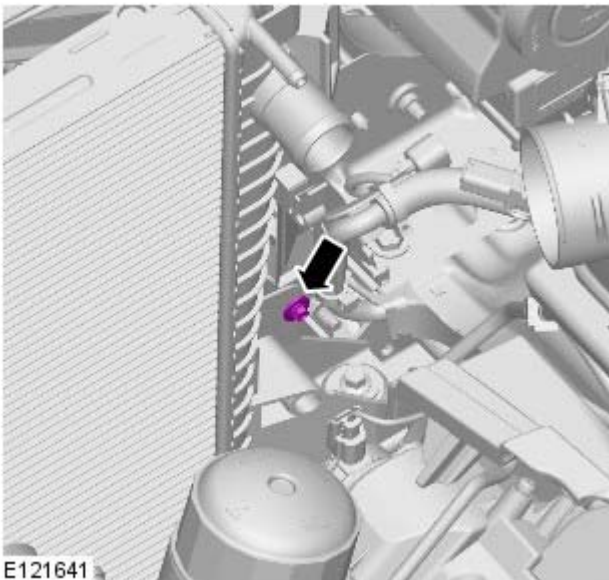


10.



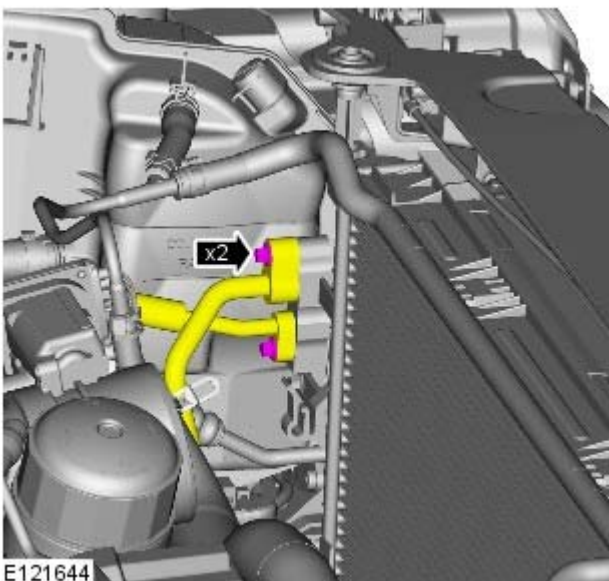
E121650

11. **11.**  CAUTION: Always plug any open connections to prevent contamination.




E121641

- 12.

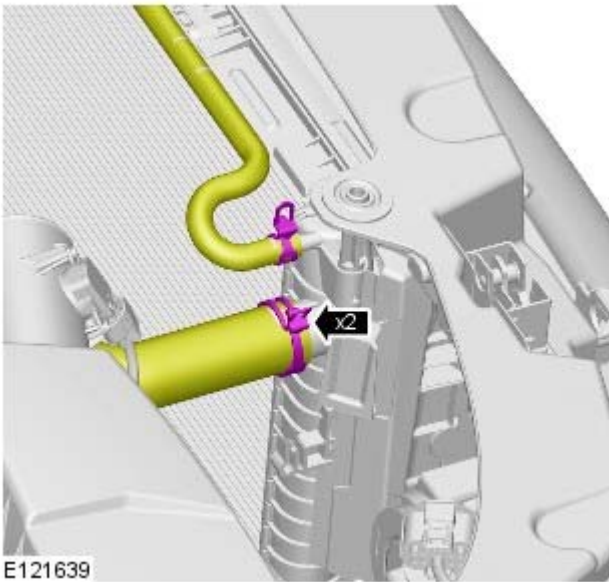


E121644

13. **13.**  CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

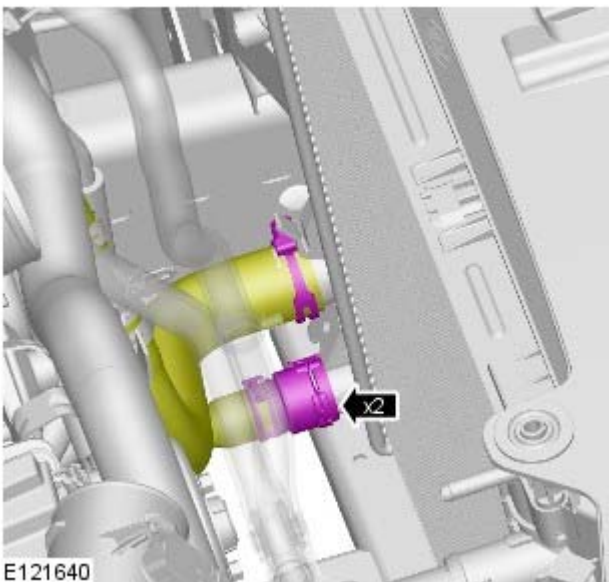
Torque: 10 Nm

14.



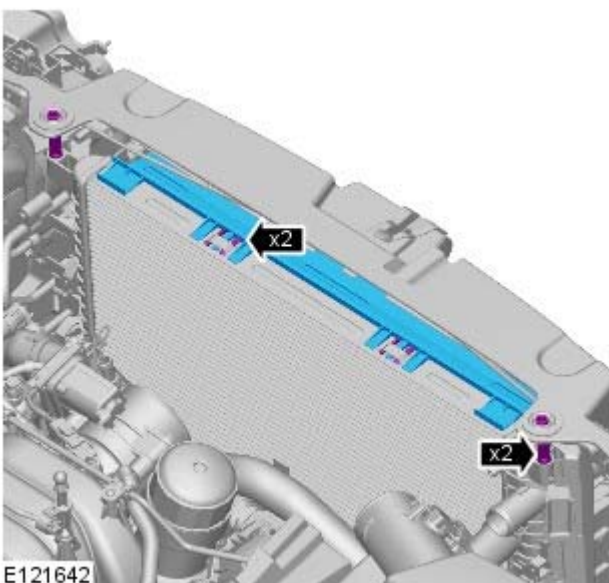
E121639

15.

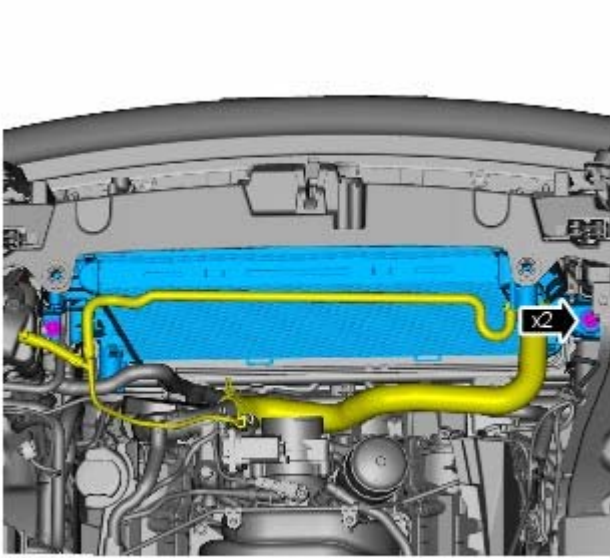


E121640

16.



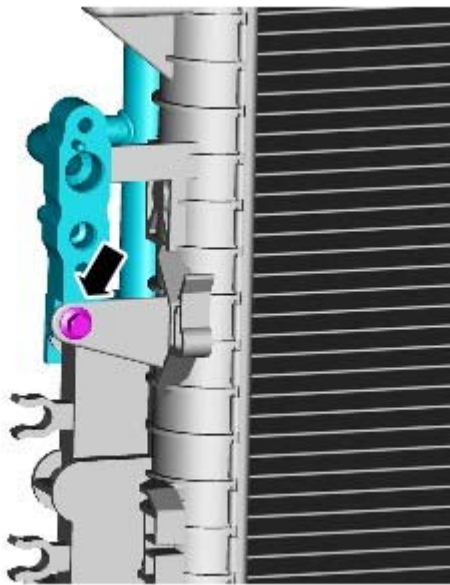
E121642



E121645

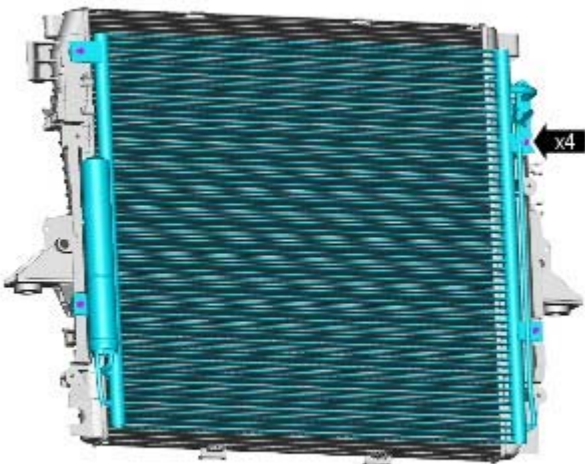
17. **17.**  CAUTION: Always protect the cooling pack elements to prevent accidental damage.

Torque: 25 Nm



E121637

18. *Torque: 10 Nm*



E121636

19. *Torque: 10 Nm*

Installation

1. To install, reverse the removal procedure.

Air Conditioning - V8 5.0L Petrol - Condenser Fan

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

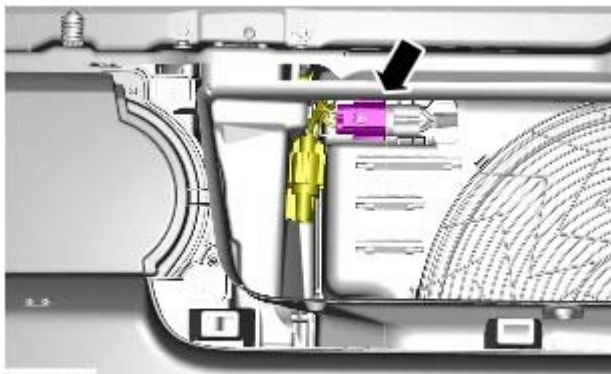
1. Disconnect the battery ground cable.

Refer to: Specifications (414-00, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

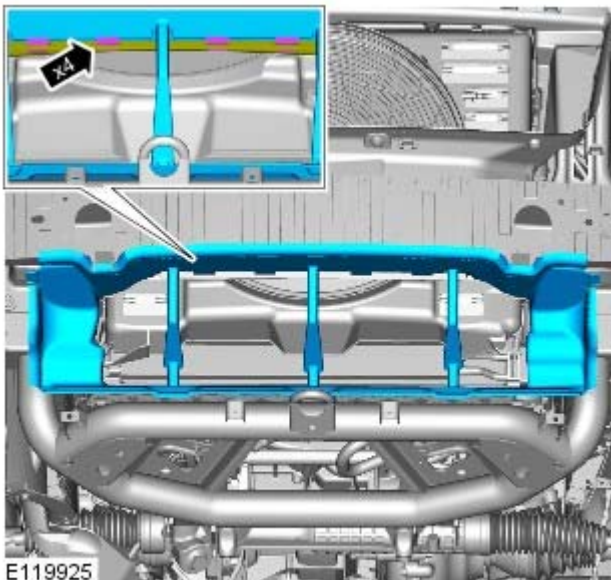
Raise and support the vehicle.

3. Refer to: Hood Latch Panel (501-02, Removal and Installation).



E119172

- 4.



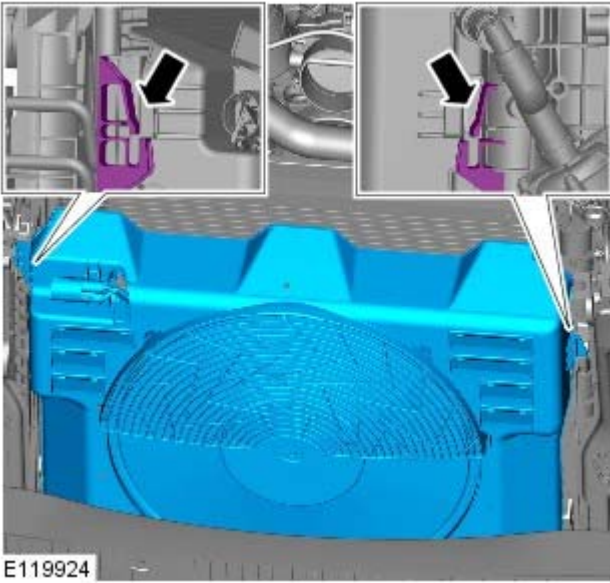
E119925

- 5.



E119923

6.



E119924

7.


Installation

1. To install reverse the removal procedure.

Air Conditioning - V8 5.0L Petrol - Evaporator Core

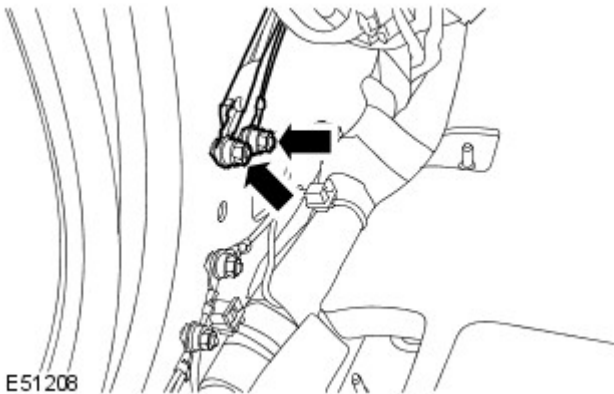
Removal and Installation

Removal

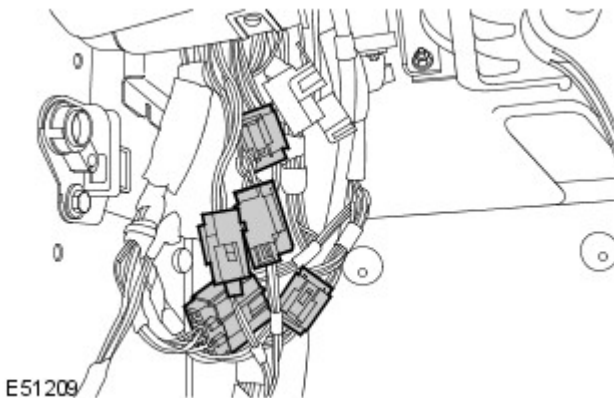
1. Remove the engine cover.
For additional information, refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

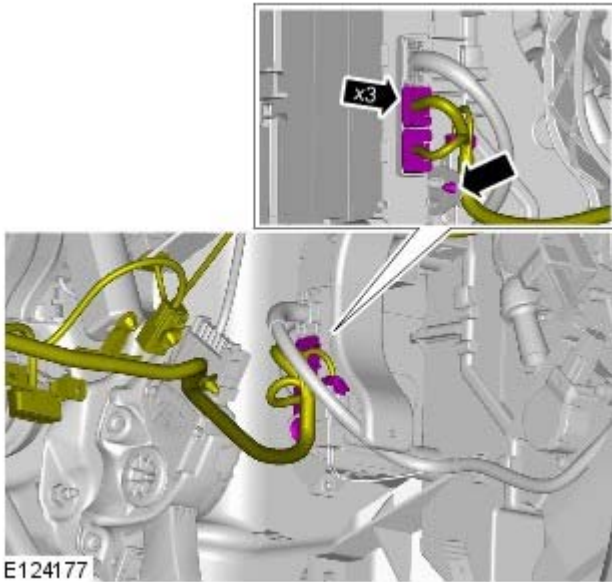
4. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
5. Remove the driver side front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
6. Remove the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
7. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
8. Release the 3 ground cables from the driver side lower A-pillar.
 - Remove the 2 nuts.



9. Disconnect the 5 electrical connectors from the driver side lower A-pillar.

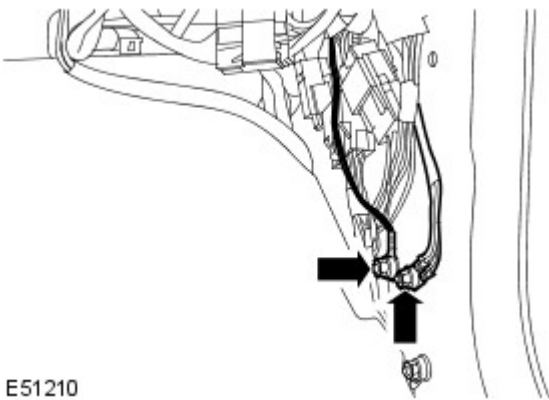


10. Disconnect the 3 electrical connectors.



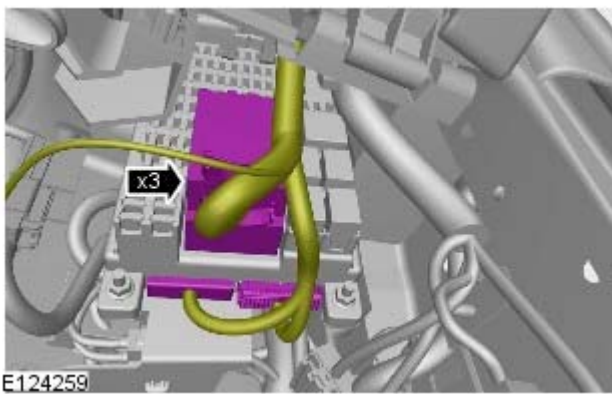
11. Release the 3 ground cables from the passenger side lower A-pillar.

- Remove the 2 nuts.



12. Disconnect the 5 electrical connectors from the passenger side lower A-pillar.

13. Disconnect the central junction box (CJB) three electrical connectors.



14. Disconnect 2 electrical connectors from the instrument panel center reinforcement.

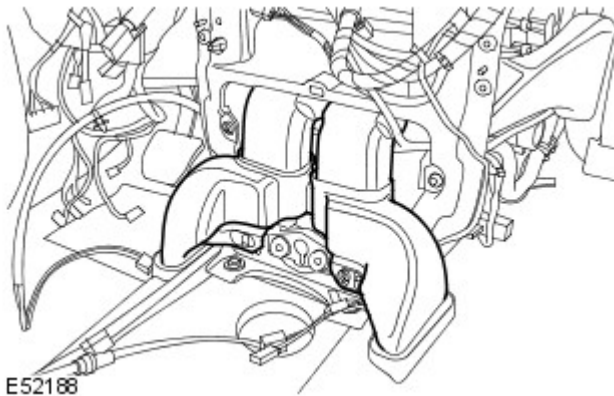


15.  **CAUTION:** Cover fiber optic cable connectors to minimize dust ingress and avoid bending the cables in a radius of less than 30 mm.

If installed, disconnect the instrument panel center reinforcement fibre optic cables.

- Disconnect the electrical connector.

16. Remove the heater housing center ducts.



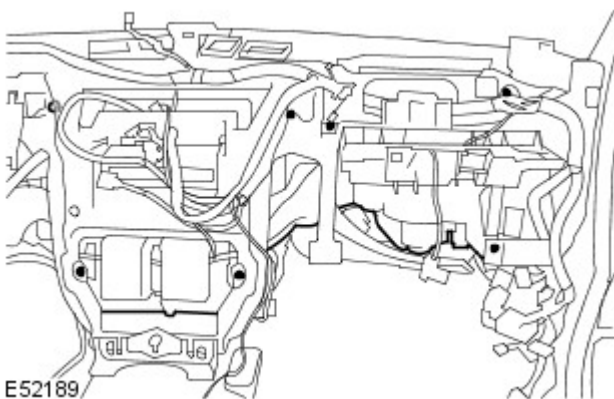
17. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.



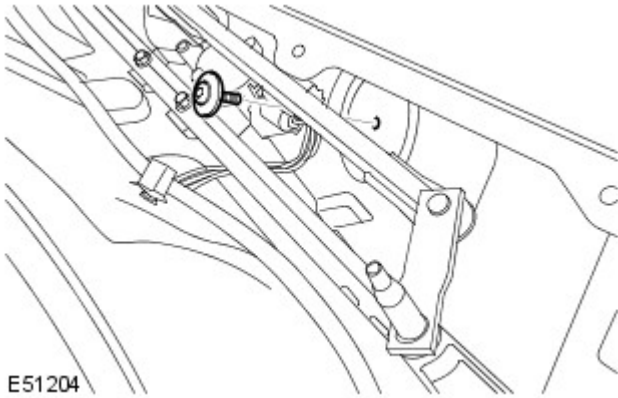
18. Release the heater housing from the instrument panel carrier.

- Remove the 7 Torx screws.



19. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

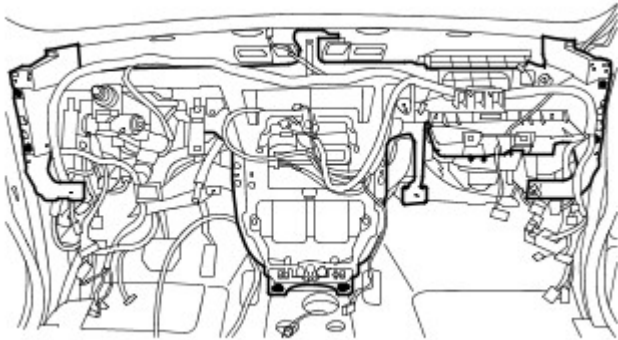
20. Remove the instrument panel carrier to bulkhead Torx bolt.




E51204

21. With assistance, remove the instrument panel.

- Remove the 6 Torx bolts.

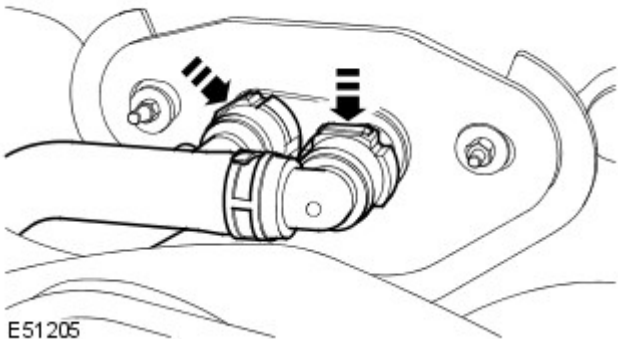


E52190

22.  CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Disconnect 2 heater hoses from the bulkhead.

- Release the 2 clips.

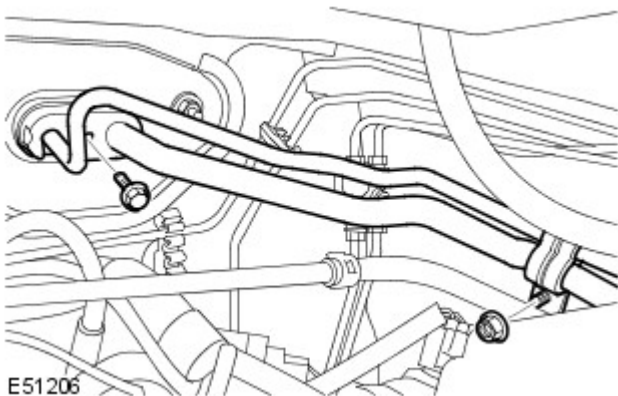


E51205

23.  CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Release the 2 A/C refrigerant lines.

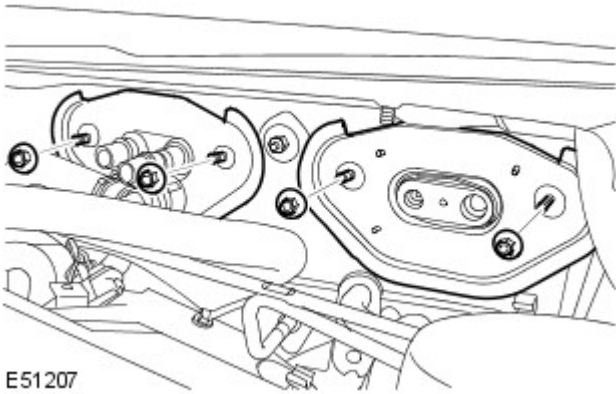
- Remove the nut and bolt.
- Remove and discard the O-ring seals.



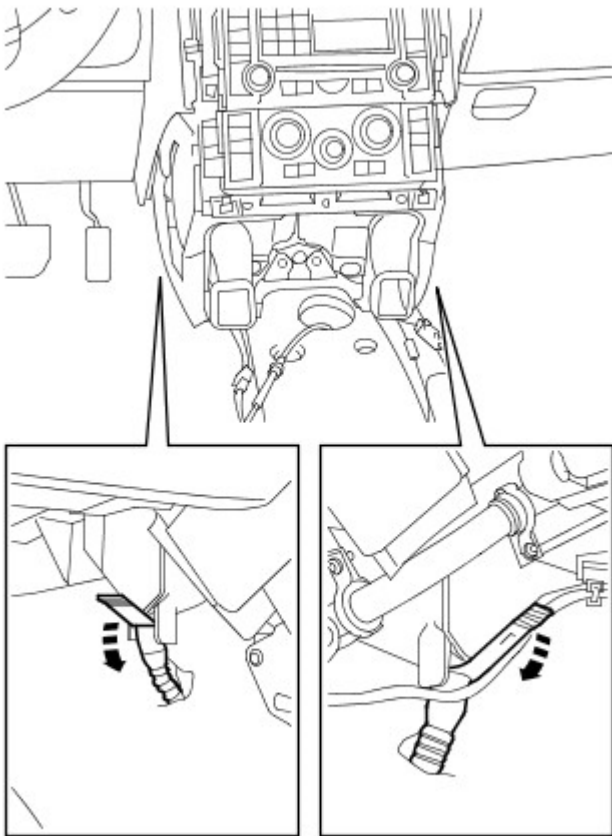
E51206

24. Remove the 2 adapter panels.

- Remove the 4 nuts.

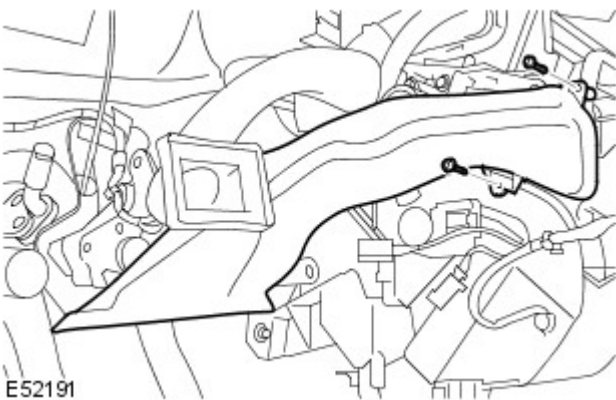


25. Disconnect 2 drain tubes from the heater housing.



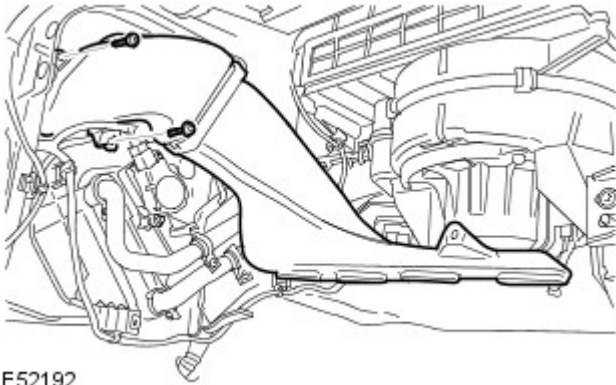
26. Remove the driver side footwell duct.

- Remove the 2 Torx screws.



27. Remove the passenger side footwell duct.

- Remove the 2 Torx screws.

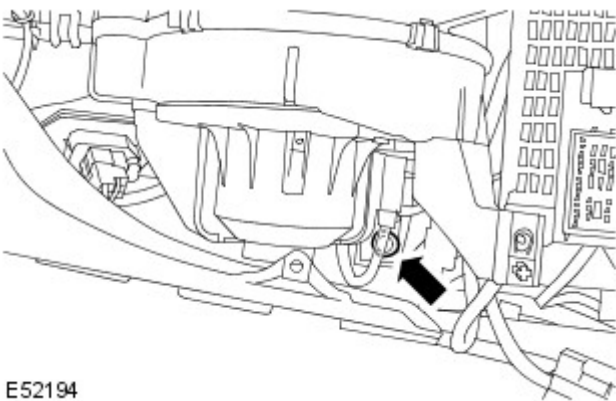


28. Driver side: Remove the heater housing to bulkhead Torx bolt.

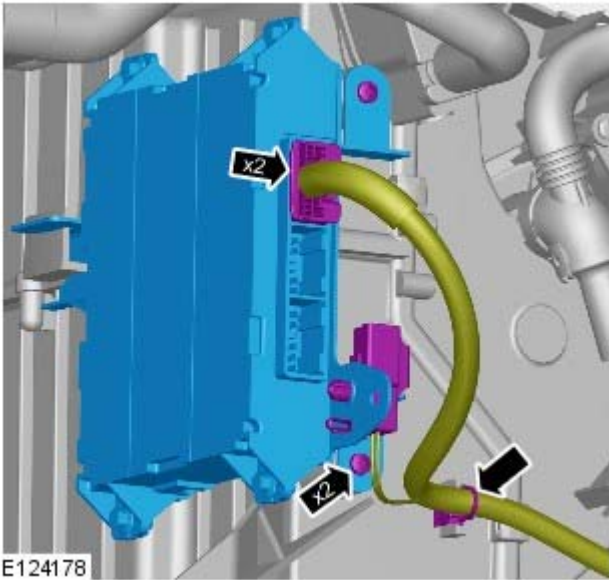


29. Passenger side: Remove the heater housing to bulkhead Torx bolt.

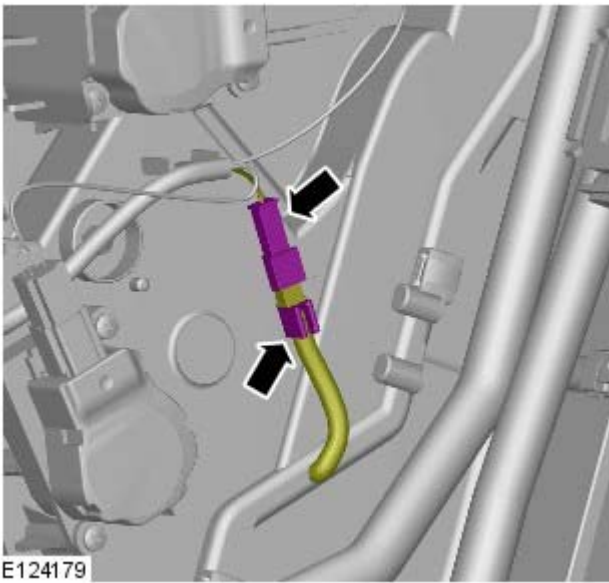
- With assistance, remove the heater and evaporator core housing.



30. Remove the A/C control module.



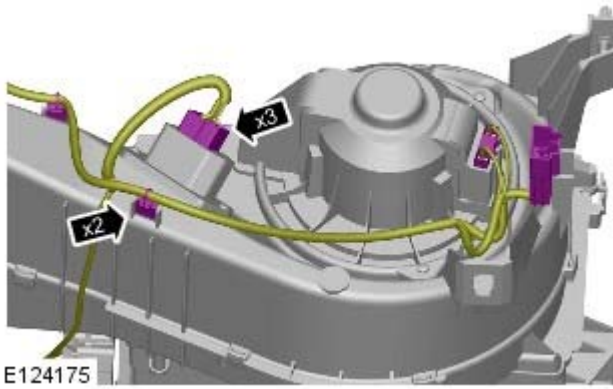
31. Disconnect the evaporator core temperature sensor electrical connector.



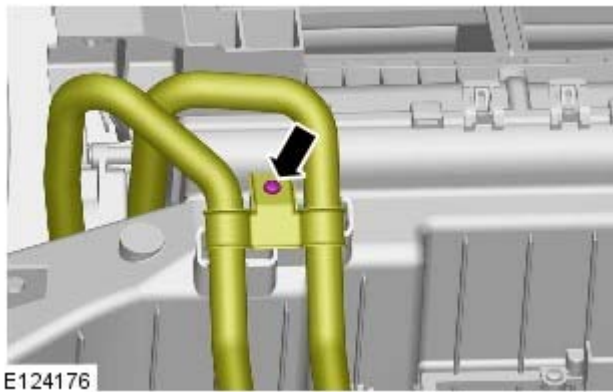
32. Disconnect the electrical connector.



33. Detach the wiring harness.

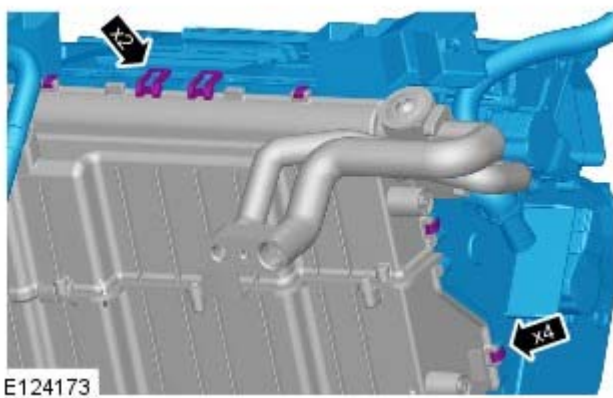
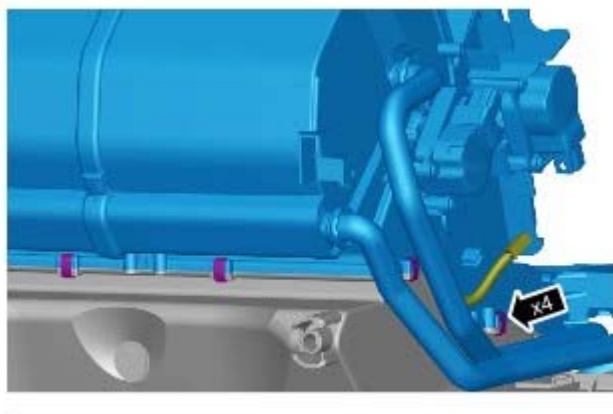


34. Remove the bolt from the support bracket.

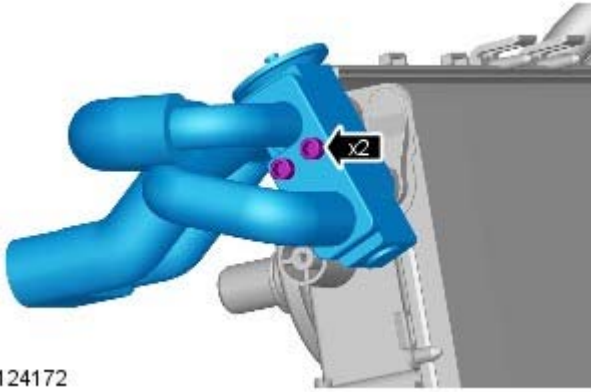


35. Remove the heater and evaporator core housing.

- Remove the 8 clips.
- Carefully release the 2 clips.



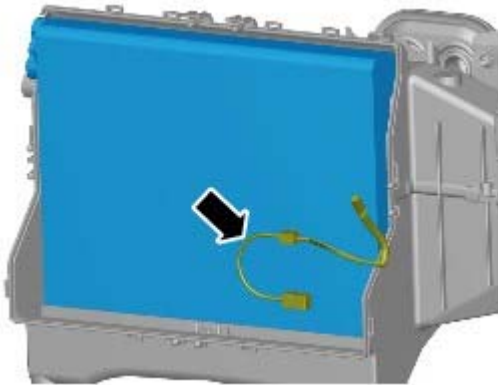
36. Remove the thermostatic expansion valve.



E124172

37. Remove the evaporator core.

- Release the temperature sensor.



E124171

Installation

1. Install the evaporator core.
 - Secure the temperature sensor.
2. Secure the heater core housing.
 - Install the clips.
3. Install the thermostatic expansion valve.
 - Tighten the bolts to 3.5 Nm (2.5 lb.ft).
4. Install the wiring harness.
5. Install and tighten the bolt.
6. Connect the temperature sensor electrical connector.
7. Install the CC module.
 - Tighten the bolts.
8. Passenger side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
 - With assistance, install the heater and evaporator core housing.
9. Driver side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).
10. Install the footwell ducts.
 - Tighten the Torx screws.
11. Connect the drain tubes to the heater housing.
12. Install the adapter panels.
 - Tighten the nuts to 6 Nm (4 lb.ft).
13. Secure the A/C refrigerant lines.

- Clean the components.
 - Install new O-ring seals.
 - Tighten the bolt to 5 Nm (4 lb.ft).
 - Tighten the nut to 6 Nm.
- 14.** Connect the bulkhead heater hoses.
- 15.** With assistance, install the instrument panel.
- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- 16.** Install the instrument panel carrier to bulkhead Torx bolt and tighten to 25 Nm (18 lb.ft).
- 17.** Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
- 18.** Secure the heater housing.
- Tighten the screws.
- 19.** Connect the steering column intermediate shaft.
- Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).
- 20.** Install the heater housing center ducts.
- 21.** Connect the instrument panel center reinforcement fibre optic cables.
- 22.** Connect the instrument panel center reinforcement electrical connectors.
- 23.** Connect the CJB electrical connectors.
- 24.** Connect the electrical connectors to the passenger side lower A-pillar.
- 25.** Connect the ground cables to the passenger side lower A-pillar.
- Tighten the nuts to 10 Nm (7 lb.ft).
- 26.** Connect the electrical connectors to the driver side lower A-pillar.
- 27.** Connect the ground cables to the driver side lower A-pillar.
- Tighten the nuts to 10 Nm (7 lb.ft).
- 28.** Connect the 3 electrical connectors.
- 29.** Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
- 30.** Install the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
- 31.** Install the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
- 32.** Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
- 33.** Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
- 34.** Install the engine cover.
For additional information, refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Air Conditioning - V8 5.0L Petrol - Thermostatic Expansion Valve

Removal and Installation

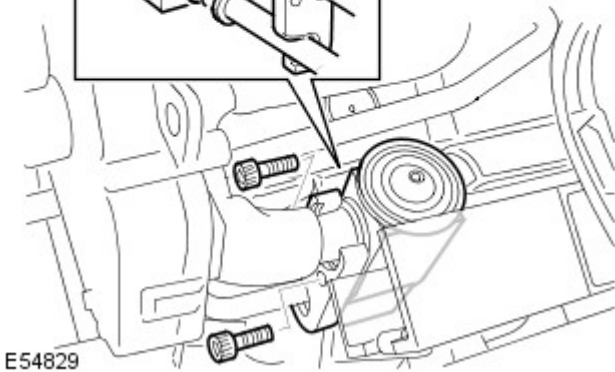
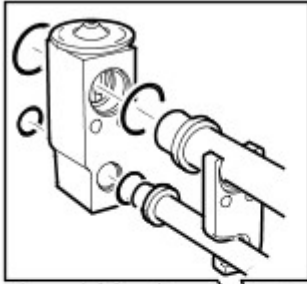
Removal

1. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
2. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

3.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

Remove the thermostatic expansion valve.

- Remove the cover.
- Remove the 2 Allen bolts.
- Remove and discard the 4 O-ring seals.



E54829

Installation

1. Install the thermostatic expansion valve.
 - Clean the components.
 - Install the new O-ring seals.
 - Tighten the Allen bolts to 5 Nm (4 lb.ft).
 - Install the cover.
2. Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

Air Conditioning - V8 5.0L Petrol - Air Conditioning (A/C) Pressure Transducer

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Recover the A/C refrigerant.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

3. CAUTIONS:



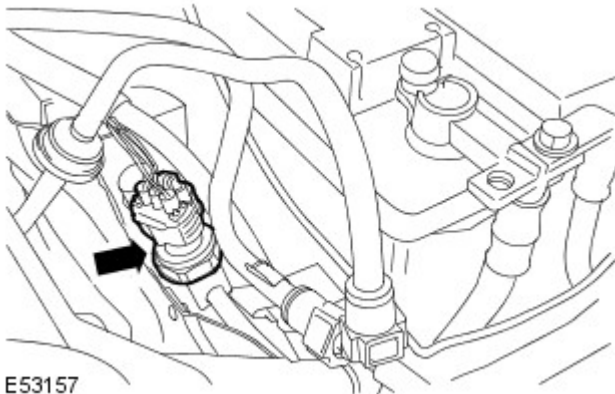
Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



To prevent damage to components, use an additional wrench when loosening or tightening unions.

Remove the A/C pressure transducer.

- Disconnect the electrical connector.
- Remove and discard the seal.



E53157

Installation

1. Install the A/C pressure transducer.
 - Clean the component mating faces.
 - Install a new seal.
 - Tighten the transducer to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Recharge the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Auxiliary Climate Control -

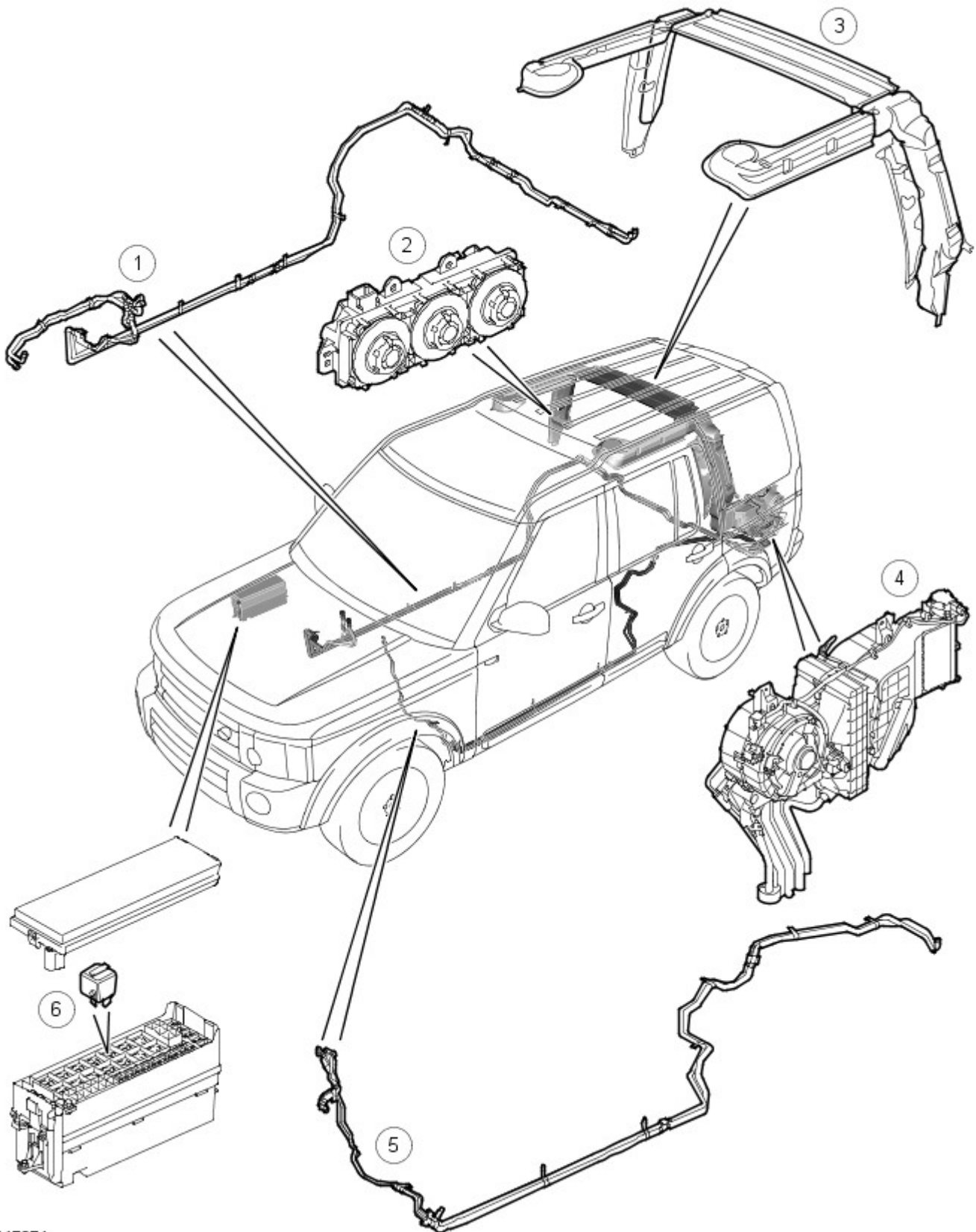
Torque Specifications

Description	Nm	lb-ft
TVX assembly bolts	10	7
Auxiliary climate control assembly bolts	10	7
Auxiliary climate control sealing plate bolts	10	7
A/C pipe bolts	10	7
TVX assembly bolts	10	7

Auxiliary Climate Control - Auxiliary Climate Control

Description and Operation

COMPONENT LOCATIONS



E47874

Item	Part Number	Description
1	-	Heater lines
2	-	ACCM (auxiliary climate control module)
3	-	Air distribution ducts
4	-	Auxiliary climate control assembly

5	-	Refrigerant lines
6	-	Rear blower relay

GENERAL

The auxiliary climate control system provides additional air conditioning for the second and third row seat occupants. The auxiliary climate control system consists of:

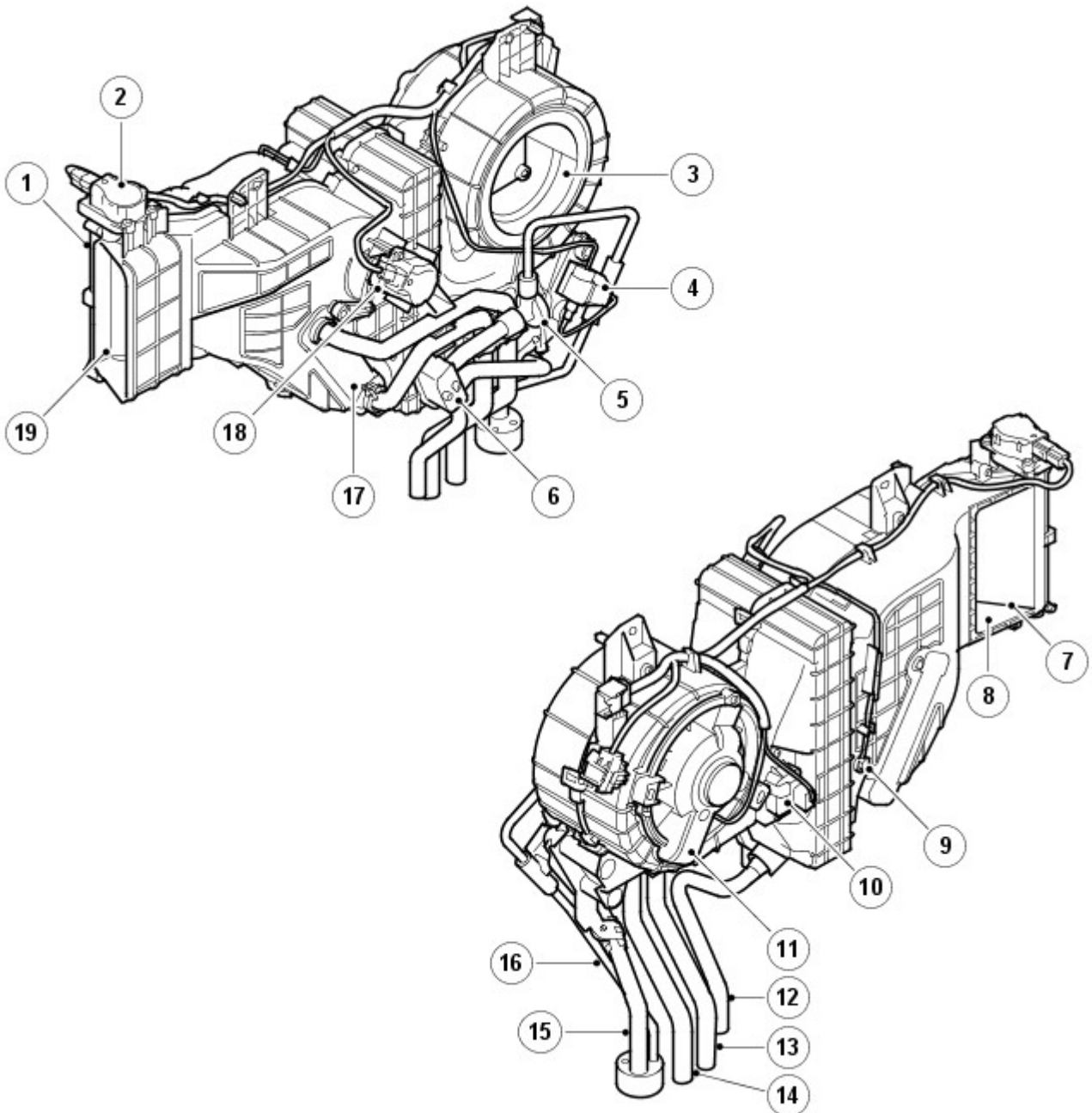
- An auxiliary climate control assembly.
- A refrigerant circuit.
- A heating circuit.
- A distribution system.
- An ACCM.

The automatic temperature control (ATC) module, of the main air conditioning system, is also used in the control of the auxiliary climate control system.

For additional information, refer to: Control Components (412-04 Control Components, Description and Operation).

Cabin air is recirculated through the auxiliary climate control assembly, where the air is temperature regulated and then directed through the distribution system to registers in the roof, on the C pillars and on the left side of the loadspace. The volume, temperature and distribution of the air from the auxiliary climate control assembly can be manually controlled by the ACCM or automatically controlled by the ATC module.

AUXILIARY CLIMATE CONTROL ASSEMBLY



E47875

Item	Part Number	Description
1	-	Casing

2	-	Distribution door motor
3	-	Blower inlet
4	-	Solenoid valve
5	-	Thermostatic expansion valve
6	-	Evaporator connector block
7	-	Distribution door
8	-	Footwell outlet
9	-	Evaporator temperature sensor
10	-	Blower control module
11	-	Blower
12	-	Evaporator drain tube
13	-	Heater core inlet pipe
14	-	Heater core outlet pipe
15	-	Evaporator outlet pipe
16	-	Evaporator inlet pipe
17	-	Heater core
18	-	Temperature blend door motor
19	-	Face level outlet

The auxiliary climate control assembly is a reheat unit, which cools the air to a constant value then reheats it as necessary to produce the required temperature. The assembly is installed on the left side of the loadspace, behind the rear quarter panel. A grille in the rear quarter panel allows air to flow from the loadspace into the auxiliary climate control assembly.

The auxiliary climate control assembly consists of a casing, formed from a series of plastic molding, which contains:

- A blower
- A blower control module
- An evaporator
- A heater core
- A temperature blend door
- A distribution door
- An evaporator temperature sensor.

Refrigerant and coolant lines from the engine compartment are connected to pipes from the evaporator and the heater core immediately below the loadspace floor. Where the pipes, and the evaporator drain tube, pass through the loadspace floor, the aperture is sealed by a seal plate.

Internal passages, integrated into the casing of the auxiliary climate control assembly, guide the air from the blower through the evaporator and heater core to the distribution outlets.

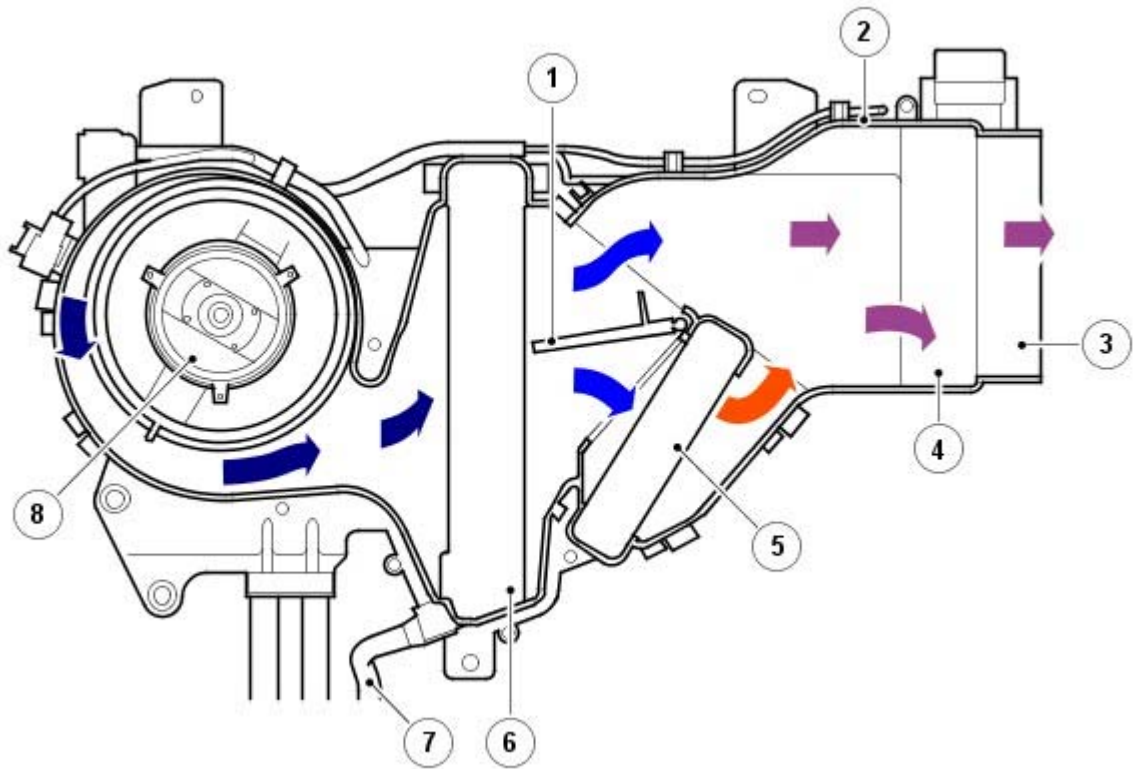
The temperature blend door regulates the flow of air through the heater core to control the temperature of the air leaving the auxiliary climate control assembly. A stepper motor installed on the rear of the casing operates the temperature blend door.

The distribution door regulates the flow of air through the face level outlet and the foot level outlet. A stepper motor installed on the top of the casing operates the distribution door.

The temperature blend stepper motor and the distribution stepper motor are both connected to a Local Interconnect (LIN) bus, which also connects the ACCM with the ATC module. Each stepper motor incorporates a microprocessor which operates the motor in response to LIN bus messages from the ACCM. The stepper motors are powered by a feed from the ATC module, and share a ground connection with the rear blower control module.

The ACCM determines the positions of the distribution and temperature blend doors by using either their closed or open position as a datum and memorizing the steps that it drives the individual stepper motors. Each time the ACCM is activated by the ATC module, it checks the memorized position of the stepper motors against fixed values for the current distribution and temperature settings on the control panel. If there is an error, the ACCM calibrates the applicable stepper motor, to re-establish the datums, by driving them fully closed or open before re-setting them to their nominal selected position. A calibration run can also be invoked using T4.

Air Flow Through Auxiliary Climate Control Assembly

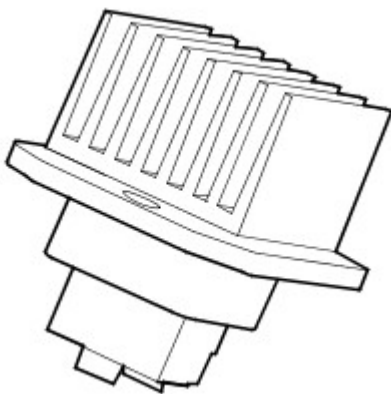


E47876

Item	Part Number	Description
1	-	Temperature blend door
2	-	Auxiliary climate control assembly casing
3	-	Face level outlet
4	-	Distribution door
5	-	Heater core
6	-	Evaporator
7	-	Evaporator drain tube
8	-	Blower

The blower is in the air inlet of the auxiliary climate control assembly, and consists of an open hub, centrifugal fan powered by an electric motor. Operation of the blower is controlled by the ACCM, using the rear blower relay in the battery junction box (BJB) and the blower control module. The blower control module is installed in the auxiliary climate control assembly downstream of the blower, where any heat generated during operation is dissipated by the air flow. A wiring harness on the auxiliary climate control assembly connects the blend door motor, distribution door motor, blower and blower control module to the vehicle wiring.

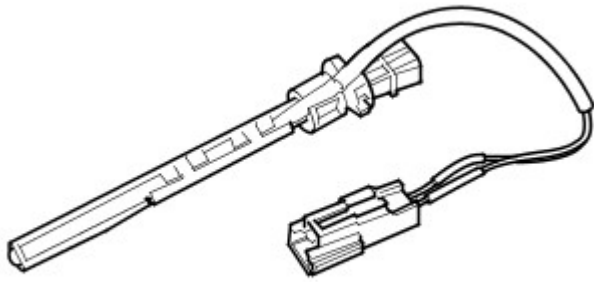
Blower Control Module



E47886

When the blower is required, the ACCM energizes the coil of the rear blower relay. The energized rear blower relay supplies battery power to the blower motor, which is connected to ground through the blower control module. The speed of the blower is controlled by the blower control module, which regulates the blower motor voltage in response to a pulse width modulation (PWM) signal from the ACCM. To vary the blower motor voltage the ACCM varies the duty cycle of the signal.

Evaporator Temperature Sensor



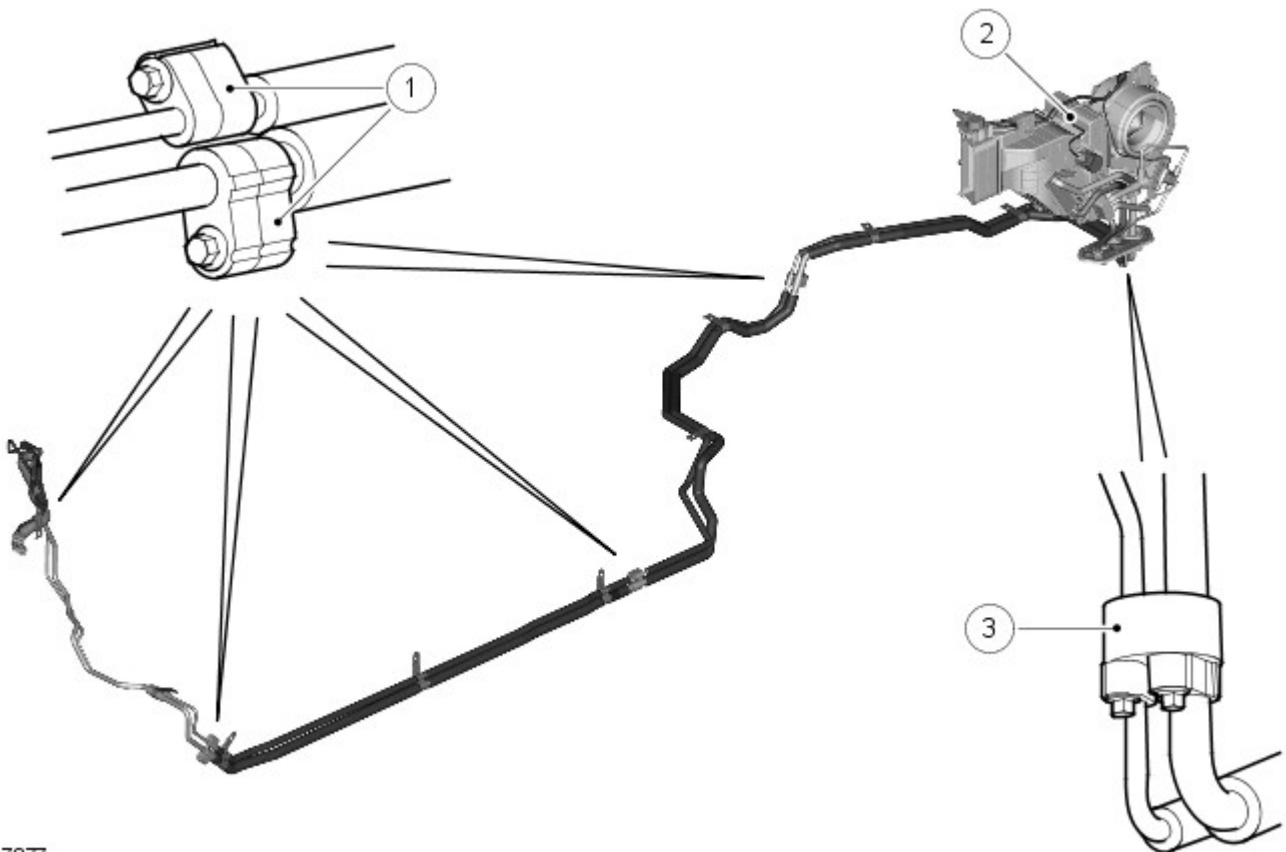
E47884

The evaporator temperature sensor is a negative temperature coefficient (NTC) thermistor installed in the auxiliary climate control assembly on the downstream side of the evaporator. The evaporator temperature sensor supplies a temperature signal to the ACCM.

REFRIGERANT CIRCUIT

Two refrigerant lines, low pressure and high pressure, connect the evaporator in the auxiliary climate control assembly to the front air conditioning (A/C) refrigerant system. On the auxiliary climate control assembly, a solenoid valve and a thermostatic expansion valve control the flow of refrigerant through the evaporator.

Refrigerant Lines

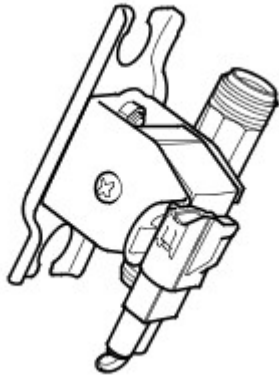


E47877

Item	Part Number	Description
1	-	In-line connections
2	-	Auxiliary climate control assembly
3	-	Connections to auxiliary climate control assembly

The refrigerant lines are routed around the left rear wheel arch and along the left-hand (LH) underside of the vehicle, and connected to the front A/C refrigerant system at the rear of the engine compartment. The refrigerant lines consist of sections of aluminum alloy pipes. All except the front section of the pipes are insulated with foam rubber sleeving.

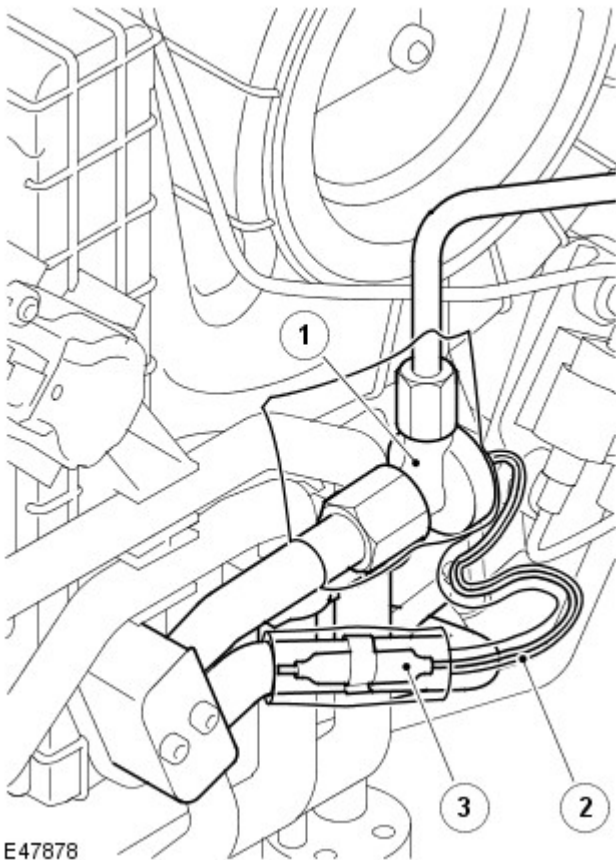
Solenoid Valve



E47885

The solenoid valve allows the auxiliary climate control assembly to be isolated from the front A/C refrigerant system. Operation of the solenoid valve is controlled by the ACCM switching a ground.

Thermostatic Expansion Valve



E47878

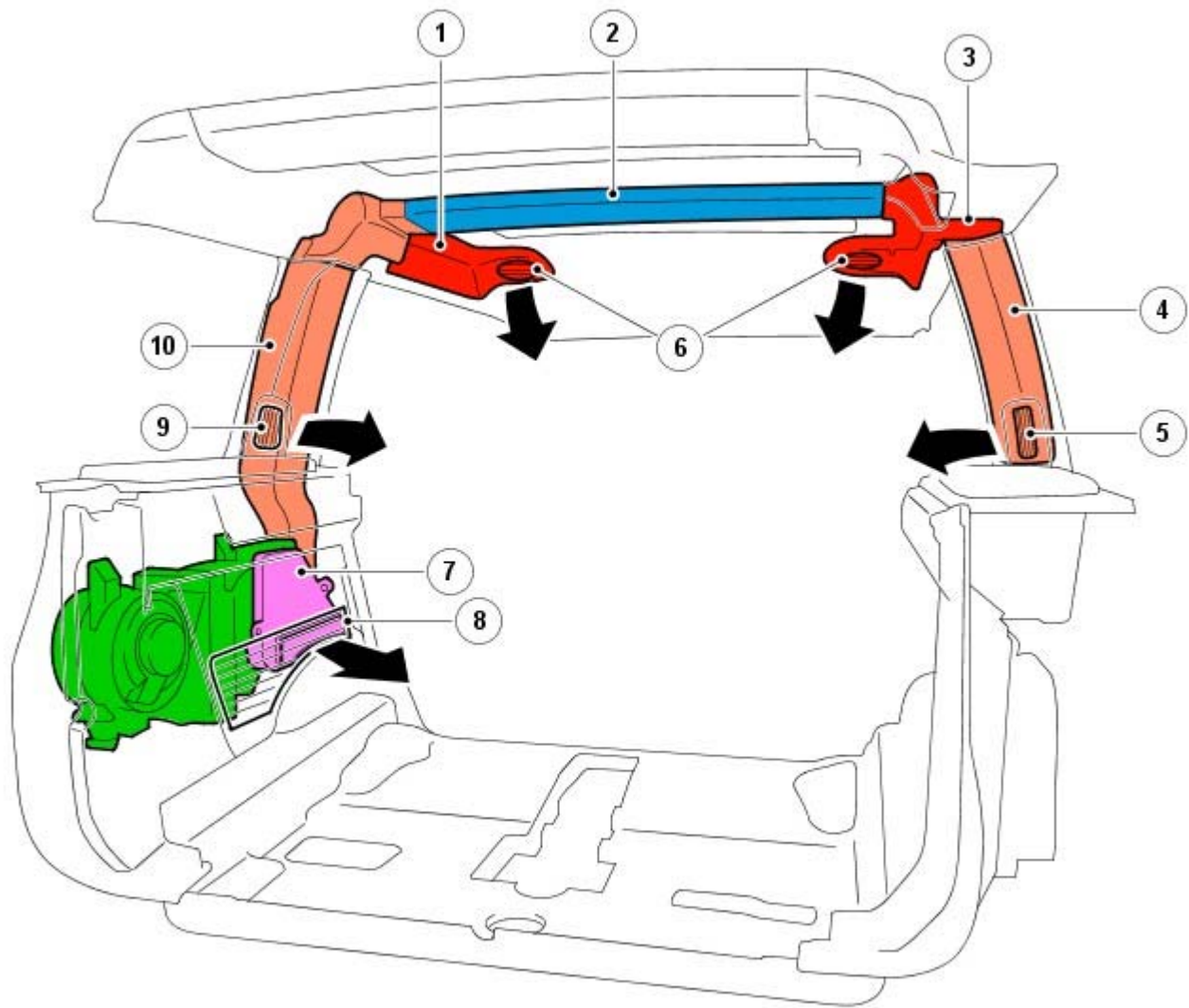
Item	Part Number	Description
1	-	Thermostatic expansion valve
2	-	Capillary tube
3	-	Temperature bulb

The thermostatic expansion valve meters the flow of refrigerant into the evaporator, to match the heat load of the air passing through the auxiliary climate control assembly.

The thermostatic expansion valve is installed in the inlet line to the evaporator. Liquid refrigerant flows through the valve to the evaporator. The restriction across the valve reduces the pressure and temperature of the refrigerant and changes it to a fine spray, which improves the evaporation process. Valve opening is controlled by the pressure in a capillary tube containing a temperature sensitive fluid. One end of the capillary tube is connected to a diaphragm housing on the thermostatic expansion valve, the other end of the capillary tube is sealed and attached to the refrigerant outlet line of the evaporator. As the temperature of the refrigerant leaving the evaporator changes, a corresponding change of capillary tube pressure and valve opening are produced. The warmer the refrigerant leaving the evaporator becomes, the greater the volume of refrigerant allowed through the valve.

Evaporator

The evaporator is installed in the auxiliary climate control assembly between the blower and the heater matrix, to absorb heat from the recirculated air. Low pressure, low temperature refrigerant changes from liquid to vapor in the evaporator, absorbing large quantities of heat as it changes state. Most of the moisture in the air passing through the evaporator condenses into water, which drains out of the auxiliary climate control assembly through the evaporator drain tube.



E47880

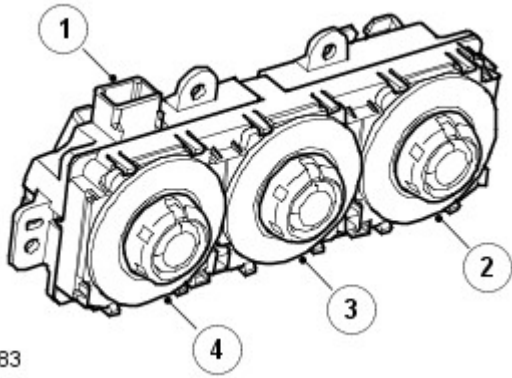
Item	Part Number	Description
1	-	Second row left face level air duct
2	-	Cross-car air duct
3	-	Second row right face level air duct
4	-	Right C pillar air duct
5	-	Third row right face level register
6	-	Second row face level registers
7	-	Third row foot level air duct
8	-	Third row foot level registers
9	-	Third row left face level register
10	-	Left C pillar air duct

The distribution system consists of a network of air ducts that supply air from the outlets of the auxiliary climate control assembly to registers installed in:

- The headliner, to the left and right of the second row interior lamp, to provide face level ventilation for second row seat occupants
- The left and right C pillar finishers, to provide face level ventilation for third row seat occupants
- The loadspace left side molding, to provide foot level ventilation for third row passengers.

The registers can all be adjusted to control the direction and volume of the air flow.

ACCM



E47883

Item	Part Number	Description
1	-	Electrical connector
2	-	Blower switch
3	-	Distribution switch
4	-	Temperature switch

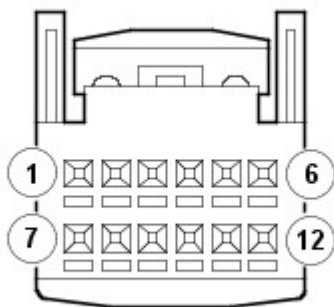
The ACCM allows manual adjustment of the output from the auxiliary climate control assembly. The ACCM is installed in the headliner immediately behind the row 2 interior lamp. An integral control panel contains separate rotary switches for temperature, distribution and blower speed. When the ACCM is in manual mode, amber light emitting diode (LED)s in the switch surrounds illuminate to indicate the current settings of the system and function symbols in the switch surrounds are illuminated when the side lamps or headlamps are on.

The ACCM is disabled when the auxiliary climate control switch on the ATC module is selected off. When the auxiliary climate control switch is selected to automatic or manual, the ACCM is enabled by the connection of a power feed from the ATC module. The same power feed also supplies the stepper motors in the auxiliary climate control assembly.

When it is enabled, the ACCM operates as a slave unit to the ATC module. The ACCM sends status signals on the LIN (local interconnect network) bus to the ATC module, which replies with command signals of the required temperature, distribution and blower settings. The ACCM then outputs the necessary drive signals to the auxiliary climate control assembly:

- In the automatic mode, the command signals are derived from the comfort strategy in the ATC module. The temperature setting is calculated from the mean of the two temperature settings on the ATC module.
- In the manual mode, the command signals reflect the temperature, distribution and blower speed set by the switches on the ACCM control panel. Temperature control by the auxiliary climate control system may be compromised if the temperature settings on the ATC module are set to maximum hot or cold.

ACCM Harness Connector C0695



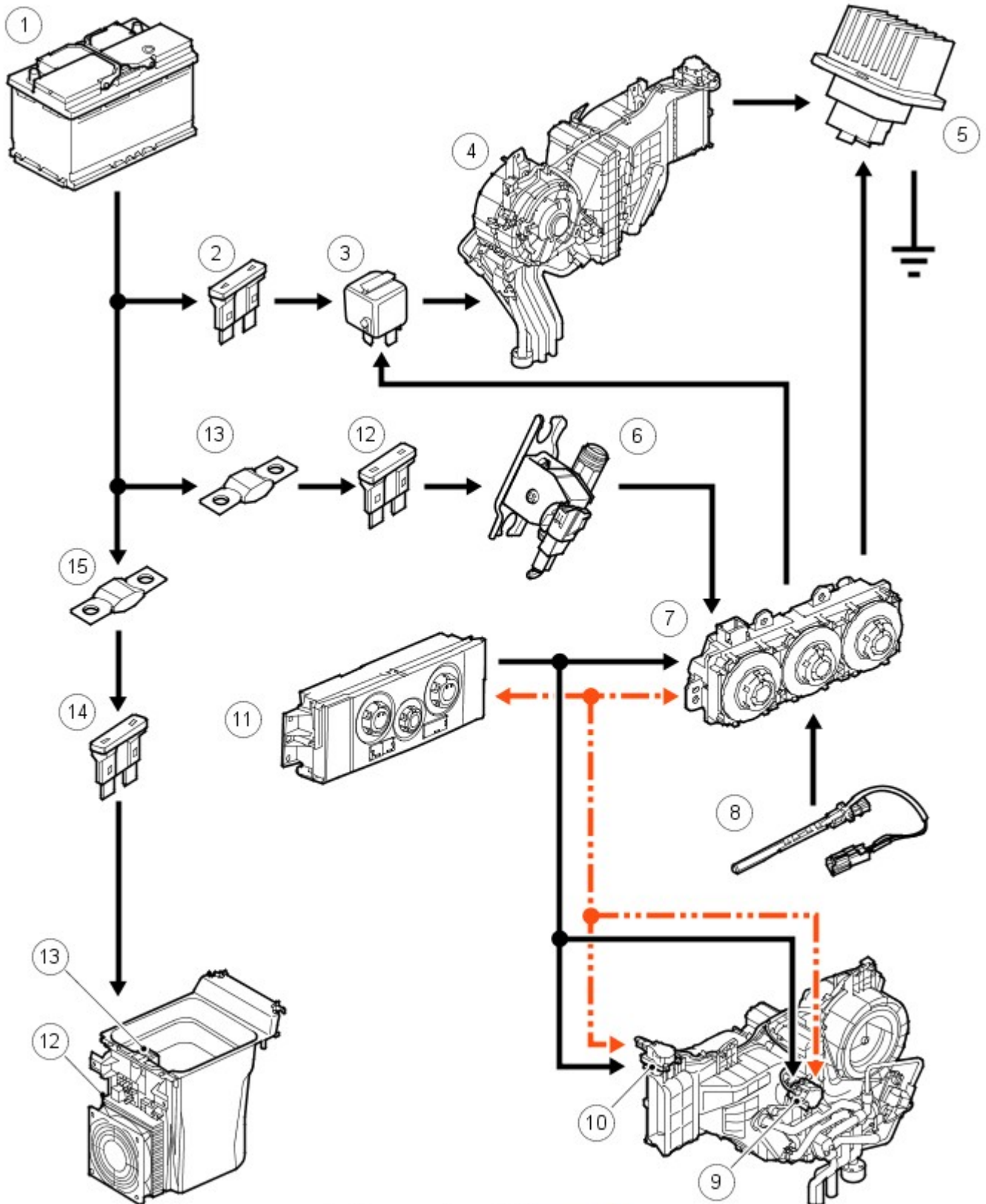
E47930

ACCM Harness Connector C0695 Pin Details

Pin No.	Description	Input/Output
1	Power supply from ATC module	Input
2	LIN bus	Input/Output
3	Ground	Output
4	Rear blower module power drive	Output
5	Blower motor voltage sense	Input
6	Cabin temperature sensor signal	Input
7 and 8	Not used	-
9	Sensor ground	Output
10	Rear blower relay coil drive	Output
11	Solenoid valve drive	Output
12	Evaporator temperature sensor signal	Input

CONTROL DIAGRAM

- NOTE: A = Hardwired connection; O = LIN bus



E47887



Item	Part Number	Description
1	-	Battery
2	-	Fuse 22B, central junction box (CJB)
3	-	Rear blower relay
4	-	Rear blower
5	-	Rear blower control module
6	-	Solenoid valve
7	-	ACCM
8	-	Evaporator temperature sensor
9	-	Temperature blend door motor
10	-	Distribution door motor
11	-	ATC module

12	-	Fuse 51P, CJB
13	-	Fusible link, 17E, BJB

Auxiliary Climate Control - Auxiliary Climate Control

Diagnosis and Testing

Principle of Operation

For a detailed description of the auxiliary climate control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Auxiliary Climate Control](#) (412-03E Auxiliary Climate Control, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Auxiliary drive belt condition and tension ● Compressor condition and installation ● Condenser condition and installation/blockage ● Air conditioning hoses and pipes ● Receiver/drier condition and installation ● Cooling fan 	<ul style="list-style-type: none"> ● Fuses ● Harnesses ● Electrical connector(s) ● Relays ● Sensors ● Control panel(s) ● Air conditioning compressor

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor or no cooling	<ul style="list-style-type: none"> ● Drive belt fault ● Compressor fault ● Distribution motor/flap fault ● Refrigerant leak ● In-vehicle temperature sensor fault ● Refrigerant pressure sensor fault 	Check the drive belt condition and tension (see visual inspection). Check the compressor operation (observe the compressor as the engine is idling with the air conditioning switched on. If the compressor runs erratically or does not run. Carry out the distribution motor self test. Refer to the relevant workshop manual section. Check for sensor DTCs. Refer to the DTC index. Check the refrigerant system using your charging station.
Noise	<ul style="list-style-type: none"> ● Drive belt fault ● Compressor fault ● Compressor pulley fouling ● Refrigerant overcharged 	Confirm the air conditioning as the source of the noise by listening for the noise with the air conditioning switched off. Refer to the relevant workshop manual section. Check the refrigerant system using your charging station.
Water entry into cabin	<ul style="list-style-type: none"> ● Heater matrix leak ● Blocked evaporator drain tubes 	Check for coolant loss. Pressure test the cooling system as necessary. Check and clear the evaporator drain tubes as necessary.

DTC Index

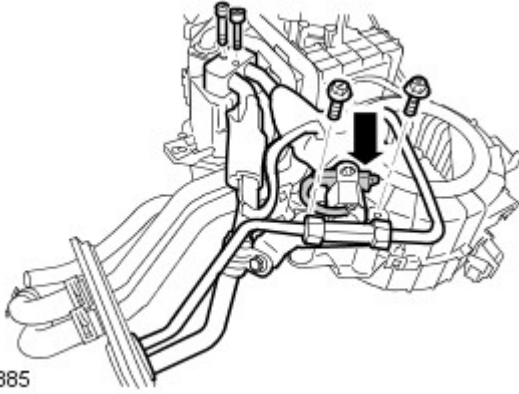
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Climate Control Module \(HVAC\)](#) (100-00 General Information, Description and Operation).

Auxiliary Climate Control - Thermostatic Expansion Valve


Removal and Installation

Removal

 **WARNING:** Eye protection must be worn.



1. Remove the climate control assembly.
For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).

 **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** The receiver drier need only be changed under the following circumstances: There is dirt in the refrigerant circuit (eg. compressor seizure). The system is leaking and refrigerant has been lost to atmosphere. Refrigerant circuit has been open more than 24 hours due to repair.

Remove the TXV assembly.

- Disconnect the electrical connector.
- Remove the 2 bolts.
- Remove the 2 screws.
- Discard the O-ring seals.

Installation

1. Install the TXV assembly.
 - Install new O-ring seals.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
 - Tighten the screws.
2. Install the climate control assembly.
For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).


Auxiliary Climate Control - Heater Core

Removal and Installation

Removal

 **WARNING:** Eye protection must be worn.

1. Remove the climate control assembly.
For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).

 **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** The receiver drier need only be changed under the following circumstances: There is dirt in the refrigerant circuit (eg. compressor seizure). The system is leaking and refrigerant has been lost to atmosphere. Refrigerant circuit has been open more than 24 hours due to repair.

Remove the TXV assembly.

- Disconnect the electrical connector.
- Remove the 2 bolts.
- Remove the 2 screws.
- Discard the O-ring seals.

 **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

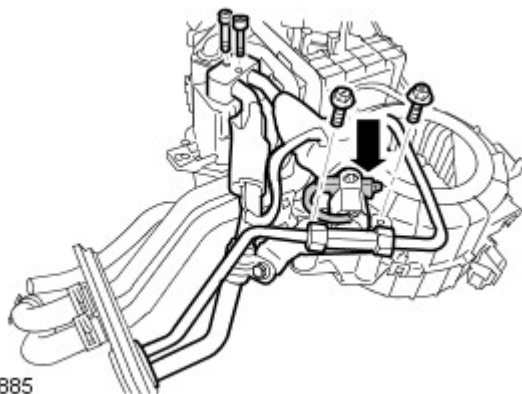
Remove the heater core.

- Carefully release the clips.

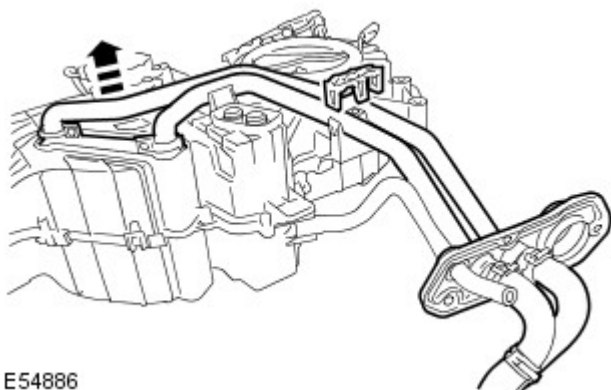
4. NOTE: Do not disassemble further if the component is removed for access only.

Remove the heater core, inlet and outlet pipes.

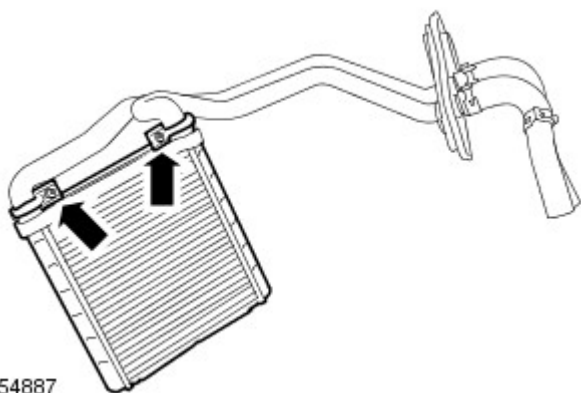
- Release the 2 clips.
- Discard the O-ring seals.



E54885



E54886



E54887

Installation

1. Connect the heater core inlet and outlet pipes.
 - Install the new O-ring seals.
 - Position and secure in the clips.

2. Install the heater core.

- Install the heater core.
- Secure in the 2 clips.

3. Install the TXV assembly.

- Install new O-ring seals.
- Install the bolts and tighten to 10 Nm (7 lb.ft).
- Tighten the screws.

4. Install the climate control assembly.

For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).


Auxiliary Climate Control - Evaporator Core

Removal and Installation

Removal

 **WARNING:** Eye protection must be worn.


1. Remove the climate control assembly.
For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).

 **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** The receiver drier need only be changed under the following circumstances: There is dirt in the refrigerant circuit (eg. compressor seizure). The system is leaking and refrigerant has been lost to atmosphere. Refrigerant circuit has been open more than 24 hours due to repair.

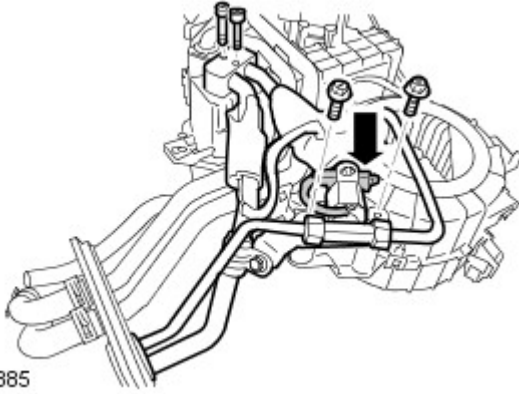
Remove the TXV assembly.

- Remove the 2 bolts.
- Remove the 2 screws.
- Discard the O-ring seals.
- Disconnect the electrical connector.

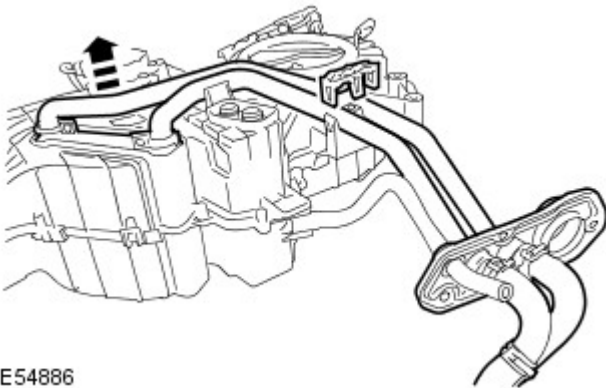
 **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Remove the heater core.

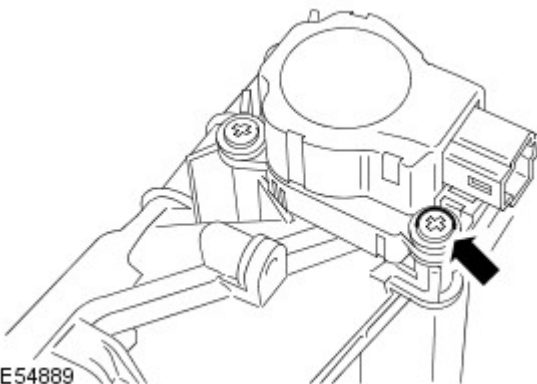
- Carefully release the clips.



E54885

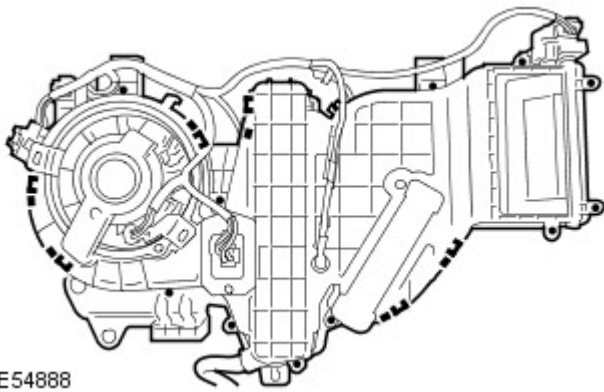


E54886



E54889

4. Remove 1 screw from the air distribution servo.

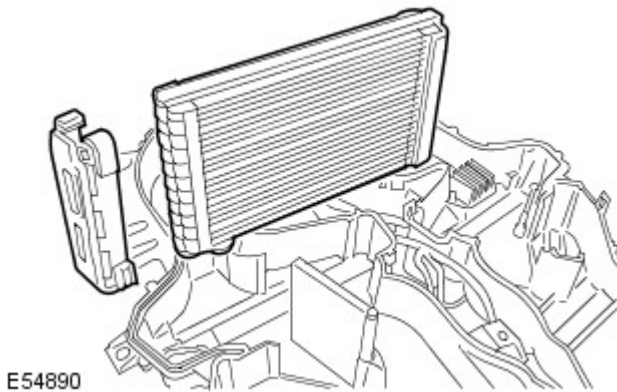


5. Separate the climate control unit.

- Remove the 11 screws.
- Remove the 6 clips.
- Release the 7 clips.

6. Remove the evaporator core.

- Remove the evaporator end trim.



Installation

1. Install the evaporator core.

- Install the evaporator end trim

2. Assemble the climate control unit.

- Secure the clips.
- Install the screws.
- Install the clips.

3. Install the distribution motor.

- Tighten the screw.

4. Install the heater core.

- Install the heater core.
- Secure in the 2 clips.

5. Install the TXV assembly.

- Install new O-ring seals.
- Install the bolts and tighten to 10 Nm (7 lb.ft).
- Tighten the screws.

6. Install the climate control assembly.

For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).

Auxiliary Climate Control - Auxiliary Climate Control Assembly

Removal and Installation

Removal

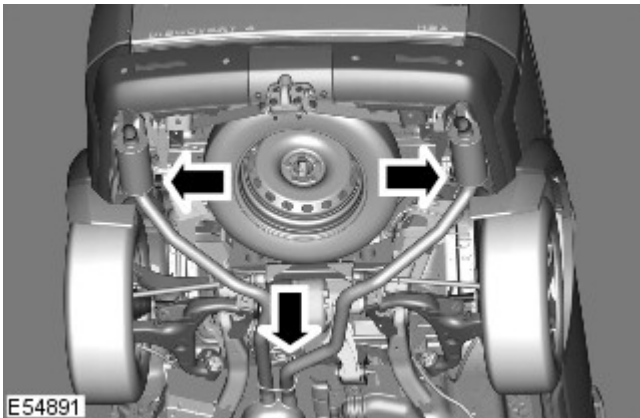
⚠ WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH C-pillar lower trim panel
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Evacuate the A/C system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

⚠ WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

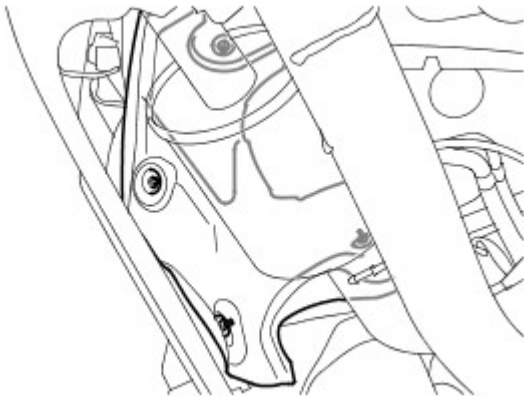
Raise and support the vehicle.

5. Support the exhaust system. Release the center, left and right rear mountings.



6. Remove the exhaust heat shield.

- Remove the 4 nuts.



7. Remove the spare wheel and tire.
8. Clamp the relevant hose, to minimise coolant loss.

⚠ CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

• **NOTE:** The receiver drier need only be changed under the following circumstances: There is dirt in the refrigerant circuit (eg. compressor seizure). The system is leaking and refrigerant has been lost to atmosphere. Refrigerant circuit has been open more than 24 hours due to repair.

Disconnect the A/C pipes.

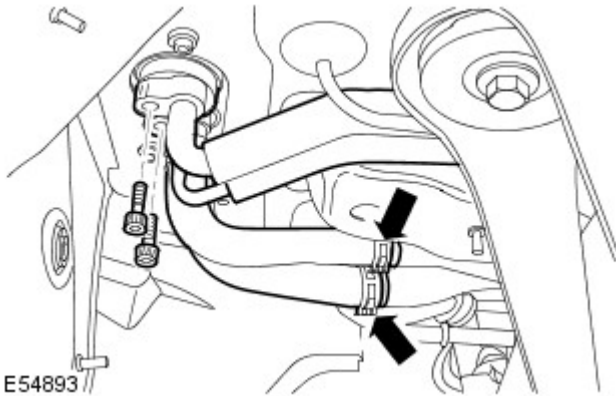
- Remove the 2 bolts.
- Discard the O-ring seals.

10.  **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

• **NOTE:** Some fluid spillage is inevitable during this operation.

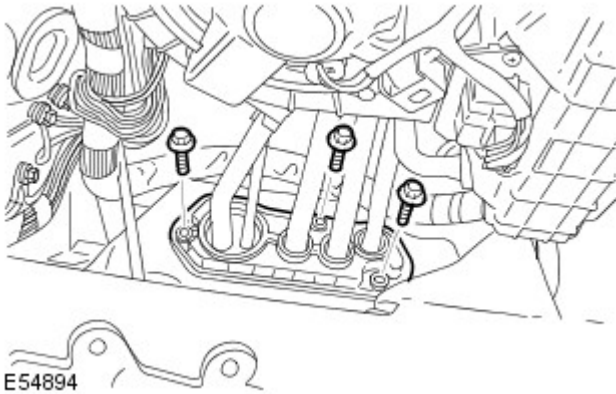
Disconnect the 2 coolant hoses.

- Position a container to collect the fluid.
- Release the 2 clips.



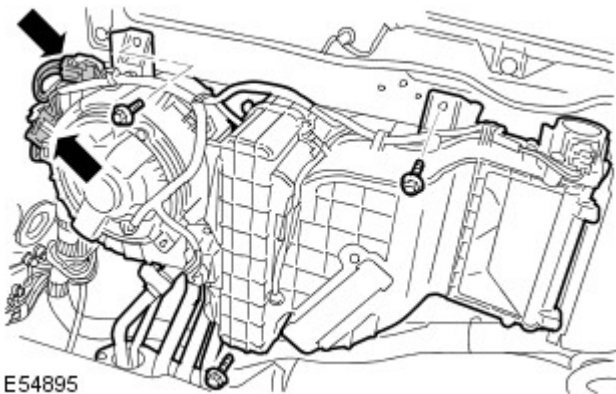
11. Release the sealing plate.

- Remove the 3 bolts.



12. Remove the climate control assembly.

- Disconnect the 2 electrical connectors.
- Remove the 3 bolts.



Installation

1. Install the climate control assembly.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect and secure the electrical connectors.

2. Install the sealing plate.

- Tighten the bolts to 10 Nm (7 lb.ft).

3. Connect and secure the coolant hoses.

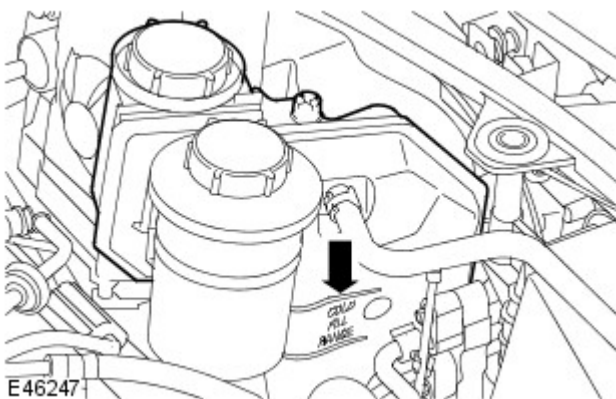
- Secure the clips.
- Remove the hose clamps.

4. Connect the A/C pipes.
 - Clean the component mating faces.
 - Install the O-ring seals.
 - Tighten the 2 bolts to 10 Nm (7 lb.ft).
 5. Install the heat shield.
 - Tighten the 4 nuts.
 6. Secure the exhaust mountings.
 7. Fill the A/C system.

For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).
 8. Install the C-pillar lower trim panel.

For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 9. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 10. Install the spare wheel and tire.
 - Stow the tool kit.
 11. Connect the exhaust extraction hoses to the tail pipes.
 12. Remove the coolant expansion tank cap.
 - Top-up the coolant.
 13. Start and run the engine.
 - Hold the engine speed at 2,500 RPM for 30 seconds.
 - Return the engine to idle for 30 seconds.
 - Repeat the above procedure a further four times.
 14. **NOTE:** When the coolant bleed is complete and prior to installing the expansion tank cap, top up the expansion tank 30mm above the maximum level.
- Install the coolant expansion tank cap.
15. Run the engine until the thermostat opens.
 16. Switch the engine off and allow to cool.
 17. Check and top-up the coolant if required.



Auxiliary Climate Control - Auxiliary Blower Motor

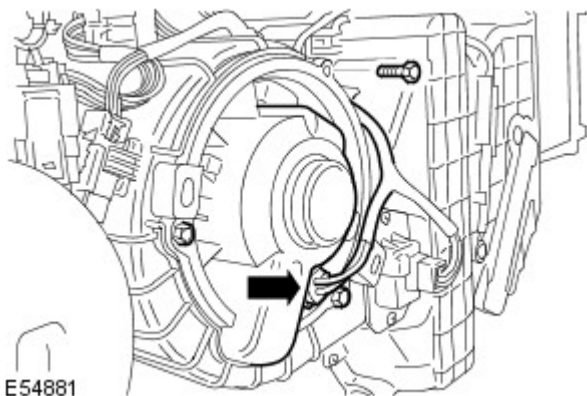
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH C-pillar lower trim panel
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. **NOTE: Note the fitted position.**

Remove the blower motor.

- Disconnect the electrical connector.
- Remove the 3 screws.



Installation

1. Install the blower motor.
 - Tighten the screws.
 - Connect and secure the electrical connector.
2. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Auxiliary Climate Control - Auxiliary Temperature Blend Door Actuator

Removal and Installation

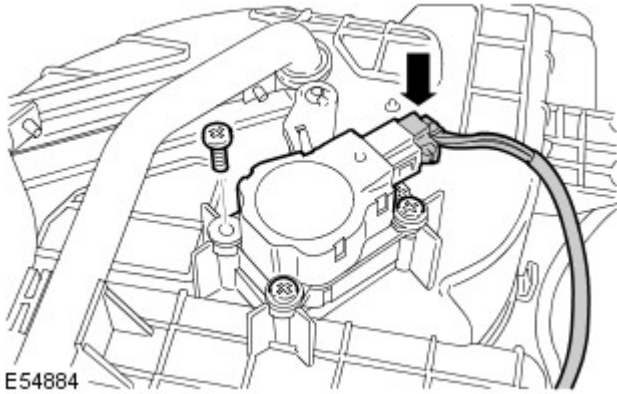
Removal

 **WARNING:** Eye protection must be worn.

1. Remove the climate control assembly.
For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).
2. **NOTE:** Note the fitted position.

Remove the blend door motor.

- Disconnect the electrical connector.
- Remove the 3 screws.



Installation

1. **NOTE:** Align to the position noted on removal.

Install the blend motor.

- Tighten the screws.
- Connect and secure the electrical connector.

2. Install the climate control assembly.
For additional information, refer to: [Auxiliary Climate Control Assembly](#) (412-03E Auxiliary Climate Control, Removal and Installation).

Auxiliary Climate Control - Auxiliary Blend Door Actuator

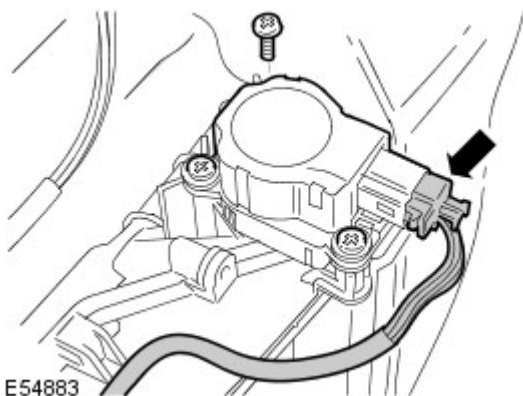
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH C-pillar lower trim panel
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. **NOTE:** Note the fitted position.

Remove the air distribution motor.

- Disconnect the electrical connector.
- Remove the 3 screws.



Installation

1. **NOTE:** Align to the position noted on removal.

Install the distribution motor.

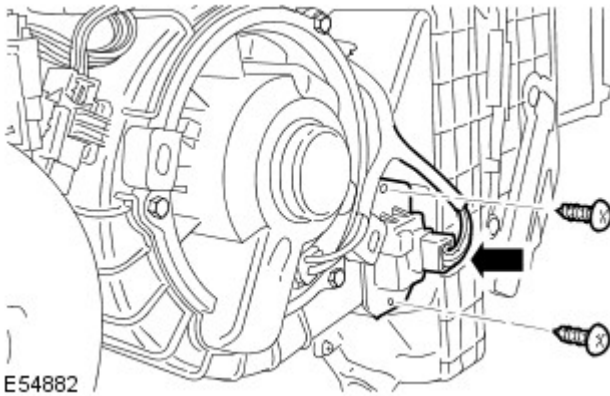
- Tighten the screws.
 - Connect and secure the electrical connector.
2. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Auxiliary Climate Control - Auxiliary Blower Motor Control Module

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH C-pillar lower trim panel
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. **NOTE:** Note the fitted position.



Remove the blower motor resistor.

- Disconnect the electrical connector.
- Remove the 2 screws.

Installation

1. **NOTE:** Align to the position noted on removal.

Install the resistor.

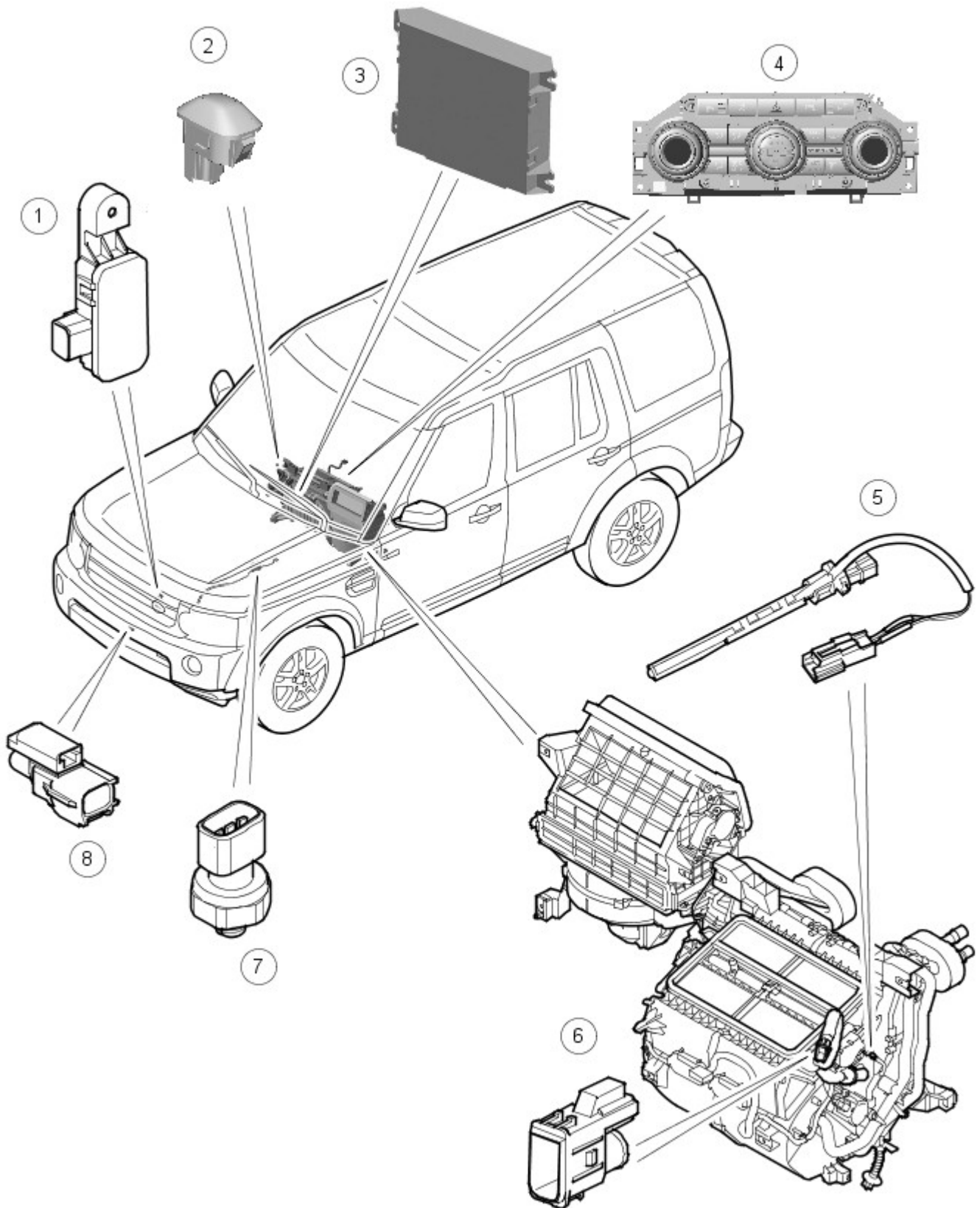
- Tighten the screws.
 - Connect and secure the electrical connector.
2. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Control Components - Control Components

Description and Operation

COMPONENT LOCATIONS

• NOTE: right-hand drive (RHD) installation shown; left-hand drive (LHD) installation similar



E 132921

Item	Part	Description
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	Number	
1	-	Pollution sensor (Japan only)
2	-	Sunlight sensor
3	-	automatic temperature control (ATC) module
4	-	Center instrument panel switch pack
5	-	Evaporator temperature sensor
6	-	In-vehicle temperature sensor (all except Japan), or in-vehicle temperature and humidity sensor (Japan only)
7	-	Refrigerant pressure sensor
8	-	Ambient air temperature sensor

GENERAL

The control system operates the air conditioning (A/C) system and the heating and ventilation system to control the temperature, volume and distribution of air from the heater.

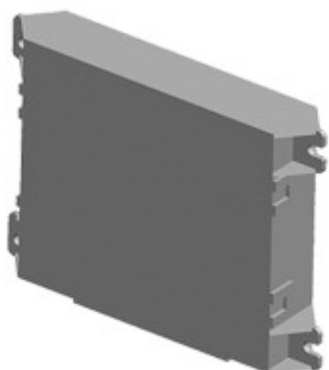
The system is a dual zone system that automatically adjusts the temperature, volume and distribution of the air from the heater to maintain the individual temperature levels selected for the left-hand (LH) and right-hand (RH) sides of the passenger compartment. The system also has manual overrides for the intake air source, blower speed and air distribution. The system includes:

- An ATC module.
- Center instrument panel switch pack
- An ambient temperature sensor.
- A refrigerant pressure sensor.
- An evaporator temperature sensor.
- An in-vehicle temperature sensor.
- A sunlight sensor.

Vehicles in the Japan market also incorporate:

- A pollution sensor.
- A humidity sensor.

ATC MODULE



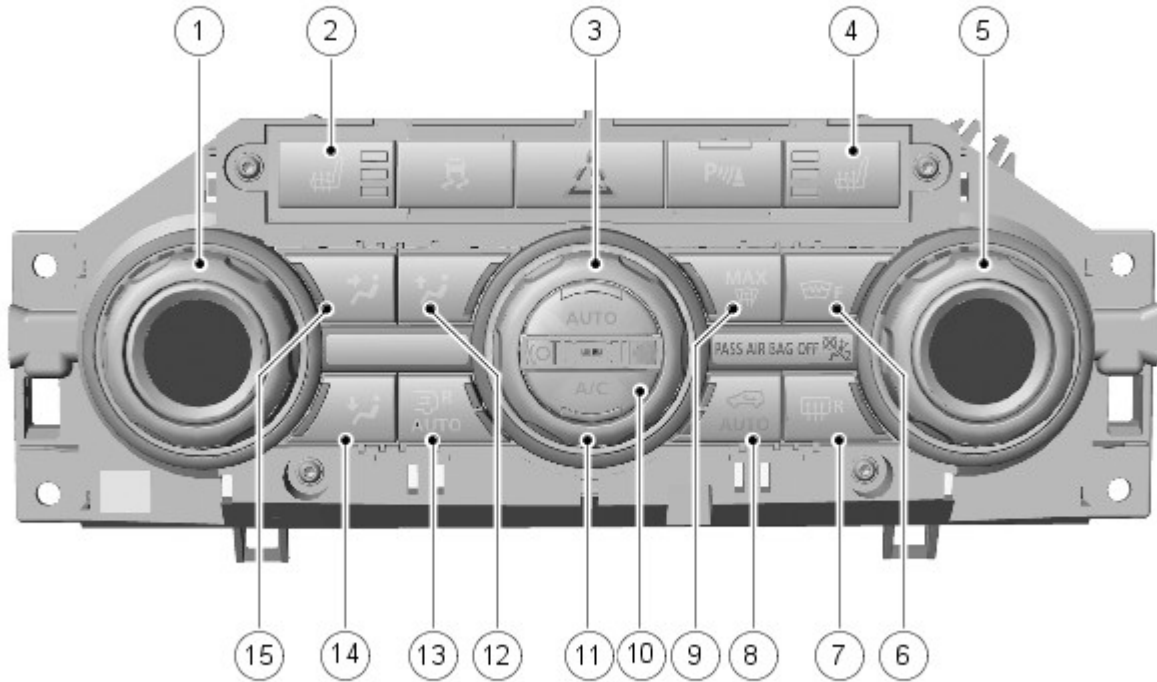
E128058

The [ATC \(automatic temperature control\)](#) module is mounted on the outboard end of the air inlet duct, behind the front passenger side of the instrument panel.

The ATC module processes inputs from the center instrument panel switch pack, system sensors and the medium speed controller area network (CAN) bus, then outputs the appropriate control signals to the A/C system and the heating and ventilation system. In addition to controlling the A/C system and the heating and ventilation system, the ATC module also controls the following:

- The front seat heaters.
For additional information, refer to: [Seats \(501-10, Description and Operation\)](#).
- The rear window heater.
For additional information, refer to: [Glass, Frames and Mechanisms \(501-11 Glass, Frames and Mechanisms, Description and Operation\)](#).
- The windshield heater.
For additional information, refer to: [Glass, Frames and Mechanisms \(501-11 Glass, Frames and Mechanisms, Description and Operation\)](#).
- The windshield washer jets and exterior mirror heaters.
For additional information, refer to: [Rear View Mirrors \(501-09 Rear View Mirrors, Description and Operation\)](#).

CENTER INSTRUMENT PANEL SWITCH PACK



E132922

Item	Part Number	Description
1	-	LH temperature switch
2	-	LH front seat heater switch
3	-	Automatic mode switch
4	-	RH front seat heater switch
5	-	RH temperature switch
6	-	Heated windshield switch
7	-	Heated rear window switch
8	-	Defrost program switch
9	-	Air recirculation switch
10	-	A/C (air conditioning) control switch
11	-	Blower control switch
12	-	Windshield and side window distribution switch
13	-	Rear environment
14	-	Footwell distribution switch
15	-	Face distribution switch

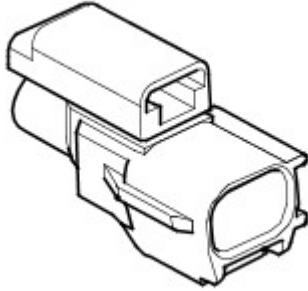
The switches on the **Center instrument panel switch pack** have the following functions:

- **LH and RH Temperature Switches:** Adjusts the nominal temperature settings of the LH and RH sides of the passenger compartment. The switch can rotate through 270°, between full cold and full hot. The switch surrounds are graduated in 2° increments between 16 and 28 °C. Minor detents define 1 °C steps over the range of the switch. Amber light emitting diode (LED)s in the switch surround illuminate to indicate the temperature setting. When maximum cold is selected, the ATC module also automatically sets the air source to recirculated air, blower speed to maximum and distribution to face. When maximum hot is selected, the ATC module also automatically sets the air source to fresh air, blower speed to maximum and distribution to footwell.
- **LH and RH Seat Heater Switches:** Activates the heater elements in the seat cushion and seat back at one of two heat levels. The first press of the switch energizes the heater elements at the higher heat setting and illuminates two LEDs in the switch. A second press of the switch sets the heater elements to the lower heat setting and extinguishes one of the LEDs. A further press of the switch de-energizes the heater elements and extinguishes the second LED. The seat heaters remain on until selected off or the engine is turned off.
- **Blower Switch:** For manual adjustment of blower speed. The switch can rotate through 240°, from off to maximum speed. Eight primary detents define the off position and seven blower speeds. Minor detents define small steps between the primary detents. When blower speed is manually adjusted, amber LEDs in the switch surround illuminate to indicate the selected blower speed. The LEDs remain off when blower speed is under automatic control.
- **Automatic Mode Switch:** Activates the automatic modes for the A/C system, blower speed and distribution. Separate amber LEDs in the automatic mode switch illuminate to show when the blower and the distribution are in automatic mode. Manually selecting the blower speed or a distribution switch extinguishes the related LED.
- **A/C control switch:** Controls activation of the [A/C](#) compressor. Allows the [A/C](#) compressor to be selected off for economy operation. A [LED \(light emitting diode\)](#) switch is illuminated when the [A/C](#) compressor is selected on.
- **Defrost program switch:** Activates a program that automatically selects: inlet air to fresh air; distribution to screen only; blower to speed 5; rear screen heater on; windshield heater on (where fitted), A/C system to automatic mode. An amber LED in the switch is illuminated while the defrost program is active.
- **Heated windshield switch:** Energizes the windshield heater for a set time period, until the switch is pressed again or until the engine stops, whichever occurs first. An amber LED in the switch is illuminated while the heater is on.
- **Heated rear window switch:** Enabled only with the engine running. Pressing the switch energizes the rear window

heater for a set time period, until the switch is pressed again or until the engine stops, whichever occurs first. An amber LED in the switch is illuminated while the heater is on.

- **Air recirculation switch:** For selection of fresh or recirculated air. On models without pollution sensing, an amber LED in the switch is illuminated when recirculated air is selected. On models with pollution sensing, the recirculation switch incorporates two amber LED. The first press of the switch sets the recirculation flaps to automatic mode and illuminates one LED. A second press of the switch manually selects recirculated air and illuminates the second LED. A further press of the switch manually selects fresh air and extinguishes the two LEDs.
- **Distribution Switches (Windshield, Face and Footwell):** For manual selection of air distribution in any combination of windshield, face and footwell outlets. Each switch has a LED which illuminates when the related distribution mode is selected.

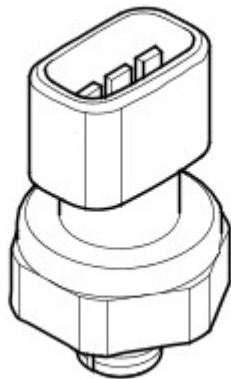
AMBIENT AIR TEMPERATURE SENSOR



E43580

The ambient air temperature sensor is a negative temperature coefficient (NTC) thermistor that provides the ATC module with an input of external air temperature. The sensor is attached to a bracket on the rear of the bumper beam, on the vehicle center-line.

REFRIGERANT PRESSURE SENSOR



E43581

The refrigerant pressure sensor provides the ATC module with a pressure input from the high pressure side of the refrigerant system. The refrigerant pressure sensor is located in the refrigerant line between the condenser and the thermostatic expansion valve.

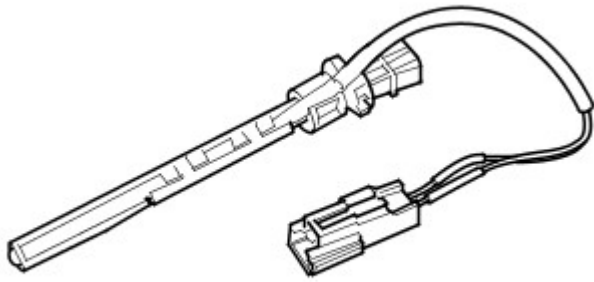
The ATC module supplies a 5 V reference voltage to the refrigerant pressure sensor and receives a return signal voltage, between 0 and 5 V, related to system pressure.

The ATC module uses the signal from the refrigerant pressure sensor to protect the refrigerant system from extremes of pressure and to calculate A/C compressor load on the engine. The ATC module also transmits the A/C compressor load value to the engine control module (ECM), via the medium speed CAN bus, instrument cluster and high speed CAN bus, for use in controlling the speed of the engine cooling fan.

To protect the system from extremes of pressure, the ATC module sets the A/C compressor to the minimum flow position if the pressure:

- Decreases to 1.9 ± 0.2 bar (27.5 ± 3 lbf/in²); the ATC module loads the A/C compressor again when the pressure increases to 2.8 ± 0.2 bar (40.5 ± 3 lbf/in²).
- Increases to 33 ± 1 bar (479 ± 14.5 lbf/in²); the ATC module loads the A/C compressor again when the pressure decreases to 23.5 ± 1 bar (341 ± 14.5 lbf/in²).

EVAPORATOR TEMPERATURE SENSOR

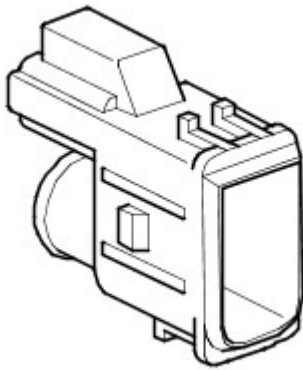


E43582

The evaporator temperature sensor is a NTC thermistor that provides the ATC module with a temperature signal from the downstream side of the evaporator. The evaporator temperature sensor is installed in the right side of the heater assembly casing.

The ATC module uses the input from the evaporator temperature sensor to control the load of the A/C compressor and thus, the operating temperature of the evaporator.

IN-VEHICLE TEMPERATURE SENSOR



E43583

The in-vehicle temperature sensor is a NTC thermistor installed behind a grill in the instrument panel, on the inboard side of the steering column. The sensor is connected to a tube, the other end of which is connected to a venturi on the side casing of the heater. An air bleed from the heater, through the venturi, induces a flow of air down the tube, which draws cabin air through the grill and over the sensor.

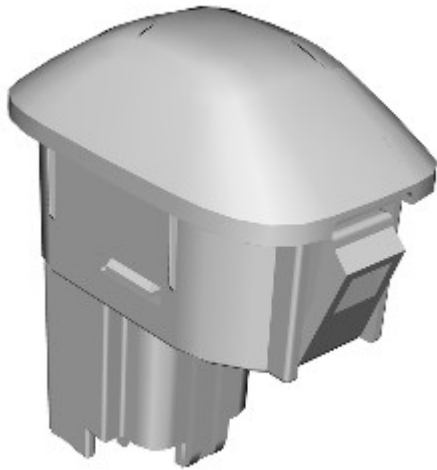
HUMIDITY SENSOR (WHERE FITTED)

The humidity sensor is a capacitive device integrated into the in-vehicle temperature sensor (see above).

The humidity sensor element is constructed from film capacitors on different substrates. The dielectric is a polymer which absorbs or releases water proportional to the relative humidity of the air being drawn through the sensor, and thus changes the capacitance of the capacitor. For protection, the sensor element is contained in a nylon mesh cover.

The humidity sensor and the in-vehicle temperature sensor are connected to a PCB (printed circuit board) inside the sensor housing. The PCB is powered by a 5V feed from the ATC module. Separate signals of temperature and relative humidity are transmitted from the PCB to the ATC module.

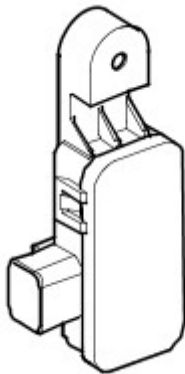
SUNLIGHT SENSOR



E132923

The sunlight sensor consists of two photoelectric cells that provide the ATC module with inputs of light intensity, one as sensed coming from the left of the vehicle and one as sensed coming from the right. The inputs are a measure of the solar heating effect on vehicle occupants, and are used by the ATC module to adjust blower speed, temperature and distribution to improve comfort. The sensor is installed in the center of the instrument panel upper surface and is powered by a 5V feed from the ATC module.

POLLUTION SENSOR (WHERE FITTED)



E43588

The pollution sensor allows the ATC module to monitor the ambient air for the level of hydrocarbons and oxidized gases such as nitrous oxides, sulphur oxides and carbon monoxide. The sensor is attached to a bracket on the front-end carrier, at the top left corner of the condenser.

The pollution sensor is powered by a battery voltage feed from the ATC module, and returns separate signals of hydrocarbon and oxidized gases.

If there is a fault with the pollution sensor, the ATC module disables the automatic operation of the recirculation door.

SYSTEM OPERATION

A/C Compressor Control

The variable displacement A/C compressor is permanently driven by the engine. The flow of refrigerant through the A/C compressor, and the resultant system pressure and evaporator operating temperature, is regulated by the refrigerant solenoid valve. Operation of the refrigerant solenoid valve is controlled by the ATC module using a 400 Hz pulse width modulation (PWM) signal. The duty cycle of the PWM signal is calculated using the following parameters:

- A/C compressor torque.
- A/C compressor torque maximum.
- A/C cooling status.
- A/C demand.
- A/C refrigerant pressure.
- Ambient air temperature.
- Blower speed.
- Engine cranking status.
- Evaporator temperature.
- Transmission gear status.

When A/C is selected, the ATC module maintains the evaporator at an operating temperature that varies with the in-vehicle cooling requirement. The ATC module increases the evaporator operating temperature, by reducing the refrigerant flow, as the requirement for air cooling decreases, and vice versa. During an increase of evaporator operating

temperature, to avoid compromising the dehumidification function, the ATC module controls the rate of temperature increase, which keeps the cabin humidity at a comfortable level.

When the economy mode is selected, the PWM signal holds the refrigerant solenoid valve in the minimum flow position, effectively switching off the A/C function.

The ATC module incorporates limits for the operating pressure of the refrigerant system. When the system approaches the high pressure limit, the duty cycle of the PWM signal is progressively reduced until the system pressure decreases. When the system pressure falls below the low pressure limit, the duty cycle of the PWM signal is held at its lowest setting, so that the A/C compressor is maintained at the minimum stroke, to avoid depletion of lubricant from the A/C compressor. The protection algorithm is calculated at a high rate, to enable early detection of the rapid pressure changes possible if a system fault develops.

A/C Compressor Torque

The ATC module uses refrigerant pressure, evaporator temperature and engine speed to calculate the torque being used to drive the A/C compressor. The calculated value is broadcast on the medium speed CAN bus for the ECM, which uses the calculated value for idle speed control and fueling control. The ATC module also compares the calculated value with a maximum A/C compressor torque value received from the ECM over the medium speed CAN bus. If the calculated value exceeds the maximum value, the ATC module signals the refrigerant solenoid valve to reduce the refrigerant flow and so reduce the torque being used to drive the A/C compressor. By reducing the maximum A/C compressor torque value, the ECM is able to reduce the load on the engine when it needs to maintain vehicle performance or cooling system integrity.

Idle Speed Control

In order to maintain A/C cooling performance, the ATC module requests an increase in engine idle speed if the evaporator temperature starts to rise while the refrigerant solenoid valve is already set to the maximum flow rate. The increase in engine idle speed is requested in three stages, using a medium speed CAN bus message to the ECM. For additional information, refer to:

[Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation),
[Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation),
[Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

The need for a change in idle speed is determined as follows:

- If the evaporator temperature increases by 3 °C (5.4 °F), or to 6 °C (10.8 °F) above the target operating temperature, over a 10 seconds period, the first stage of idle speed increase is requested.
- When the first stage of idle speed increase is set, if the evaporator temperature increases by 3 °C (5.4 °F), or increases to 12 °C (21.6 °F) above the target operating temperature, over a 9 seconds period, the second stage of idle speed increase is requested.
- When the second stage of idle speed increase is set, if the evaporator temperature increases by 3 °C (5.4 °F), or increases to 15 °C (27 °F) above the target operating temperature, over a 10 seconds period, the third stage of idle speed increase is requested.
- When an idle speed increase is set, if the evaporator temperature decreases by 3 °C (5.4 °F) over a 10 seconds period, the next stage down of idle speed increase is requested.

Electrical Load Management

The ATC module manages the vehicle electrical loads to:

- Maintain the vehicle battery in a healthy state of charge.
- Ensure adequate power is available for defrost demisting during engine warm-up.
- Ensure adequate power is available for A/C during extended periods with the engine at idle speed.
- To maintain system voltage within acceptable limits.
- To provide adequate power to meet customer expectations.

Electrical load management is achieved by increasing the engine idle speed and controlling the electrical load of systems that do not affect the driveability or safety of the vehicle.

During the engine warm-up period, the ATC module manages the electrical load to make sure that the battery voltage is maintained above a pre-determined level. The battery voltage level that is maintained and the duration of the start period varies with ambient air temperature and engine coolant temperature (ECT). After the engine warm-up period, the ATC module manages the electrical load to make sure that the requested electrical load does not exceed the generator output.

The duration of the engine warm-up period depends on the ambient air temperature and the ECT, as detailed in the following table:

Engine Warm-up Times

Ambient Air Temperature, °C (°F)	ECT, °C (°F)			
	<10 (<50)	>10 to <30 (>50 to <86)	>30 to <60 (>86 to <140)	>60 (>140)
	Warm-up Period, Minutes			
>10 (>50)	15	15	15	15
>5 to <10 (>41 to <50)	15	15	15	15
>0 to <5 (>32 to <41)	10	15	15	15
>-10 to <0 (>14 to <32)	10	10	15	15
<-10 (<14)	5	5	10	15

The ATC module calculates the electrical load from the battery voltage and generator output voltage, and compares the result against the maximum load available from the generator. The calculation is averaged across the first 20 seconds after the engine starts, and subsequently averaged every 60 seconds. When the engine is turned off, the ATC module stores the status of the electrical load management for 20 seconds. If the engine is re-started within the 20 seconds, the ATC module resumes electrical load management using the stored status. If the engine is re-started after the 20 seconds, the timers are reset and the ATC module re-calculates the status.

If the electrical load is more than the maximum load available, the ATC module requests an increase of engine idle speed

using the medium speed CAN bus message to the ECM. If an electrical load imbalance remains after an increase in engine idle speed, or if the electrical load is more than the capacity of the charging system, the ATC module reduces the electrical load by reducing the power of some vehicle systems or inhibiting their operation. The number of systems controlled depends on the electrical load reduction required. The systems controlled and the order in which their power is reduced or they are inhibited are contained in three priority tables. The table used depends on the ambient air temperature, battery temperature and ECT:

- The cold start table is used when the ambient air temperature is less than 5 °C (41 °F) and the ECT is less than 30 °C (86 °F).
- The hot start table is used when the ambient air temperature is 5 °C (41 °F) or more and the ECT is less than 30 °C (86 °F).
- The continuous table is used when battery temperature is more than 5 °C (41 °F) and the ECT is more than 50 °C (122 °F).
- If none of the above conditions are met, the ATC module adopts the last used table.

Cold Start Electrical Load Management

Priority		System
Power Reduction	Inhibited	
1	-	Air suspension
2	-	Front seat heaters
3	-	Entertainment system
-	4	Front seat heaters
5	-	Rear window heater
6	-	Windshield washer jet and exterior mirror heaters
-	7	Windshield washer jet and exterior mirror heaters
8	-	Windshield heater
9	-	Climate control blower
-	10	Rear window heater
-	11	Windshield heater

Hot Start Electrical Load Management

Priority		System
Power Reduction	Inhibited	
-	1	Front seat heaters; windshield washer jet and exterior mirror heaters
2	-	Windshield heater
3	-	Rear window heater
4	-	Air suspension
5	-	Entertainment system
-	6	Windshield heater
-	7	Rear window heater

Continuous Electrical Load Management

Priority		System
Power Reduction	Inhibited	
-	1	Front seat heaters
2	-	Windshield heater
3	-	Rear window heater
4	-	Air suspension
5	-	Entertainment system

Engine idle speed changes, and electrical load changes of systems not under direct control of the ATC module (air suspension and entertainment), are initiated using the appropriate medium speed CAN bus message. When partial operation is requested:

- The air suspension system still performs height changes but reduces air compressor operation by not replenishing the reservoir.
- The entertainment system restricts the maximum volume level and reduces the output frequency bandwidth.

Cooling Fan Control

The ATC module determines the amount of condenser cooling required from the refrigerant pressure, since there is a direct relationship between the temperature and pressure of the refrigerant. The cooling requirement is transmitted to the ECM in a medium speed CAN bus message. The ECM controls the condenser cooling using the cooling fan. For additional information, refer to:

[Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation),
[Electronic Engine Controls](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, Description and Operation),
[Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Air Temperature Control

Air from the evaporator enters the heater assembly, where temperature blend doors direct a proportion of the air through the heater core to produce the required discharge air temperature. The two temperature blend doors operate independently to enable independent temperature selection for the left and right sides of the vehicle interior. The temperature blend doors are operated by stepper motors. The stepper motors are controlled by the ATC module.

The ATC module calculates the stepper motor position required to achieve the selected temperature and compares it against the current position, which is stored in memory. If there is any difference, the ATC module signals the stepper motor to adopt the new position.

Air temperature is controlled automatically unless maximum heating or maximum cooling is selected. The required air temperature may be adjusted between 16 °C (61 °F) and 28 °C (82 °F) using the air temperature control switches. The control algorithms then attempt to maintain the desired set temperature.

Turning the temperature switches fully counterclockwise gives maximum available cooling. Turning the temperature switches fully clockwise gives maximum available heating. When maximum cooling or maximum heating is selected, the comfort algorithm adopts an appropriate strategy for the air distribution, blower speed,

A/C and air source functions, except where a function is under manual control.

The temperature control of one zone can be compromised by the other zone being set to maximum heating or maximum cooling. True maximum heating or maximum cooling can only be obtained with both controls set to the same maximum state.

When the economy mode is selected, the automatic temperature control function still operates, but with no cooling capability the minimum discharge temperature achievable will be ambient air temperature plus any heat pick up in the air intake path.

Air Distribution Control

When the A/C is in the automatic mode, the ATC module automatically controls air distribution according to a comfort strategy. Automatic control is overridden when one of the manual modes is selected. Air distribution remains manually controlled until the automatic mode is selected again. The distribution doors are operated by two stepper motors, which are controlled by the ATC module.

Blower Control

When A/C is selected or the blower speed is manually selected, the ATC module energizes the coil of the blower relay in the battery junction box (BJB). The energized blower relay supplies battery power to the blower motor, which is grounded through the blower control module. The speed of the blower is controlled by a PWM signal from the ATC module to the blower control module. The blower control module regulates the blower motor voltage in relation to the PWM signal.

When the blower is in the automatic mode the ATC module determines the blower speed required from the comfort algorithms. When the blower is in the manual mode, the ATC module operates the blower at one of seven fixed speeds as selected on the center instrument panel switch pack.

Maximum Defrost

The maximum defrost function automatically provides the maximum defrosting of the vehicle. When the maximum defrost function is selected, the ATC module configures the control system as follows:

- Automatic mode off.
- Air inlet to fresh air, manual control.
- Selected temperature unchanged, automatic control.
- Air distribution set to screen mode, manual control.
- Blower speed set to speed 5, manual control.
- Rear screen heater and windshield heater (if applicable) selected on.
- A/C mode in automatic.

The maximum defrost function is cancelled by one of the following:

- Selecting any distribution switch. The system response will be identical to the normal manual distribution control operation.
- Selecting the automatic switch. This will restore the system to fully automatic operation.
- Selecting the maximum defrost switch again. This returns the system to the state in use immediately before the maximum defrost function was first selected.
- Turning the engine off.

The blower speed can be adjusted manually without terminating the maximum defrost function.

Intake Air Control

The source of intake air is automatically controlled unless overridden by manual selection of recirculation. Under automatic control the ATC module determines the required position of the recirculation door from the comfort strategy and the input from the pollution sensor (if fitted). The recirculation door is operated by an electric motor, which is controlled by hardwired analogue signals from the ATC module. A potentiometer in the motor supplies the ATC module with a position feedback signal for closed loop control.

Provided the intake air has not been manually selected to recirculation, the ATC module adjusts the recirculation door to reduce the ram effect produced by the forward motion of the vehicle.

When the ignition switch is turned off, the ATC module evaluates the ambient air temperature. If the ambient air temperature is less than a pre-determined value, the intake air source is set to recirculation, to prevent the ingress of damp air while the vehicle is parked.

When the vehicle is in the transportation mode, the ATC module sets the intake door to recirculation every time the engine is turned off, regardless of the ambient air temperature.

Pollution Sensing

With a pollution sensor fitted to the vehicle, the ATC module controls the intake air source to reduce contamination of the intake air by external pollutants. This function is fully automatic, but can be overridden by manual selection of the intake air source.

Humidity Sensing

With a humidity sensor fitted, the ATC module controls the moisture content of the air in the vehicle. This is achieved by raising the evaporator temperature to increase the humidity of the air entering the vehicle, and reducing the evaporator temperature to reduce the humidity of the air entering the vehicle.

Front Seat Heaters

The front seat heaters are enabled when Power mode 6 engaged, and operate at one of two temperature settings. With the first press of a front seat heater switch the ATC module adopts the higher temperature setting, supplies a power feed to the related front seat heater elements and illuminates two amber LEDs in the switch. At the second press of the switch the ATC module adopts the lower temperature setting and extinguishes one of the LEDs. At the third press of the switch the ATC module de-energizes the heater elements and extinguishes the second LED. The seat heaters remain on until selected off or the engine is turned off.

The ATC module receives an input from a temperature sensor in each front seat, and regulates the power feed of the heater elements to control the seat temperature at the appropriate temperature setting between 35 and 45 °C (95 and 113 °F). The actual temperature settings vary with the type of seat covering, to allow for the different heat conduction properties of the different materials.

When the front seat heaters are activated at the higher temperature setting, the ATC module automatically resets them to the lower temperature after a time delay. The length of the time delay depends on the in-vehicle temperature.

Temperature Reset Time Delay

In-vehicle Temperature, °C (°F)	<-15 (5)	-15 to -10 (5 to 14)	-10 to 0 (14 to 32)	0 to 15 (32 to 59)	15 to 25 (59 to 77)	>25 (77)
Time Delay, minutes	Remains at higher temperature until manually de-selected	20	15	10	5	3

To protect the heater elements, the ATC module disables front seat heating if battery voltage exceeds 16.5 ± 0.3 V for more than 5 seconds. Front seat heating is re-enabled when battery voltage decreases to 16.2 ± 0.3 V.

The ATC module monitors the power feeds to the heater elements and disables the applicable front seat heating if a short or open circuit is detected. The ATC module also disables seat heating if the seat temperature rises significantly above the target temperature setting.

The plausibility of the temperature sensor inputs is also monitored by the ATC module. When seat heating is selected, if one of the temperature sensor inputs is within 5 °C (9 °F) below the target temperature, the ATC module monitors the sensor input for a temperature increase and checks that it is between the minimum and maximum working temperatures. If a temperature sensor input is at the high end of the working range, while the ambient air temperature and the engine temperature are within 10 °C (18 °F) of each other, the ATC module disables front seat heating until the input decreases below the target temperature setting. The ATC module interprets a temperature sensor input value of -45 °C (-49 °F) or below as an open circuit, and temperature sensor input value of 100 °C (212 °F) or more as a short circuit.

Rear Window Heater

The ATC module controls operation of the rear window heater using medium speed CAN messages to operate the rear window heater relay in the central junction box (CJB). The control module in the CJB interprets the CAN messages and switches the ground connection of the relay coil to operate the rear window heater. While the rear window heater relay is energized, a battery power feed is connected to the rear window heater elements. Rear window heater operation is only enabled when the engine is running.

The ATC module operates the rear window heater in heating cycles of varying power and time. The heating cycle used depends on the ambient air temperature and whether it is the initial or subsequent operation during the current Power mode cycle.

When the rear window heater switch is pressed, the ATC module illuminates an LED in the switch and initiates the appropriate heating cycle. The LED remains illuminated until the rear window heater is selected off, the heating cycle is completed or the engine stops. If the engine stalls or turned off, rear window heating resumes if the engine is re-started within 20 seconds.

On the initial selection of rear window heating, the ATC module uses a short or long defrost phase at full power, followed by a low power phase. The defrost phase used depends on the ambient temperature. During the low power phase, the rear window heater relay is cycled off for 80 seconds and on for 40 seconds.

On subsequent operations, during the same Power mode cycle, the ATC module operates the rear window heater at full power for a fixed time period.

Rear Window Heating Phases

Phase	Time, minutes
Short defrost (-5°C (23°F) and above)	10
Long defrost (less than -5°C (23°F))	15
Low power	20
Subsequent operation	10

Windshield Heater

The ATC module controls operation of the windshield heater using the windshield heater relay in the BJB. The ATC module switches the ground connection of the relay coil to operate the windshield heater. While the windshield heater relay is energized, a battery power feed is connected to each of the two windshield heater elements. Windshield heater operation is only enabled when the engine is running.

The ATC module operates the windshield heater in heating cycles of varying power and time. The heating cycle used depends on the ambient air temperature and whether it is the initial or subsequent operation during the current Power mode cycle.

When the windshield heater switch is pressed, the ATC module illuminates a LED in the switch and initiates the appropriate heating cycle. The LED remains illuminated until the windshield heater is selected off, the heating cycle is completed or the engine stops. If the engine stalls or turned off, windshield heating resumes if the engine is re-started within 20 seconds.

On the initial selection of the windshield heater, the ATC module uses a short or long defrost phase at full power, followed by a low power phase. The defrost phase used depends on the ambient temperature. During the low power phase, the

windshield heater relay is cycled off for 80 seconds and on for 40 seconds.

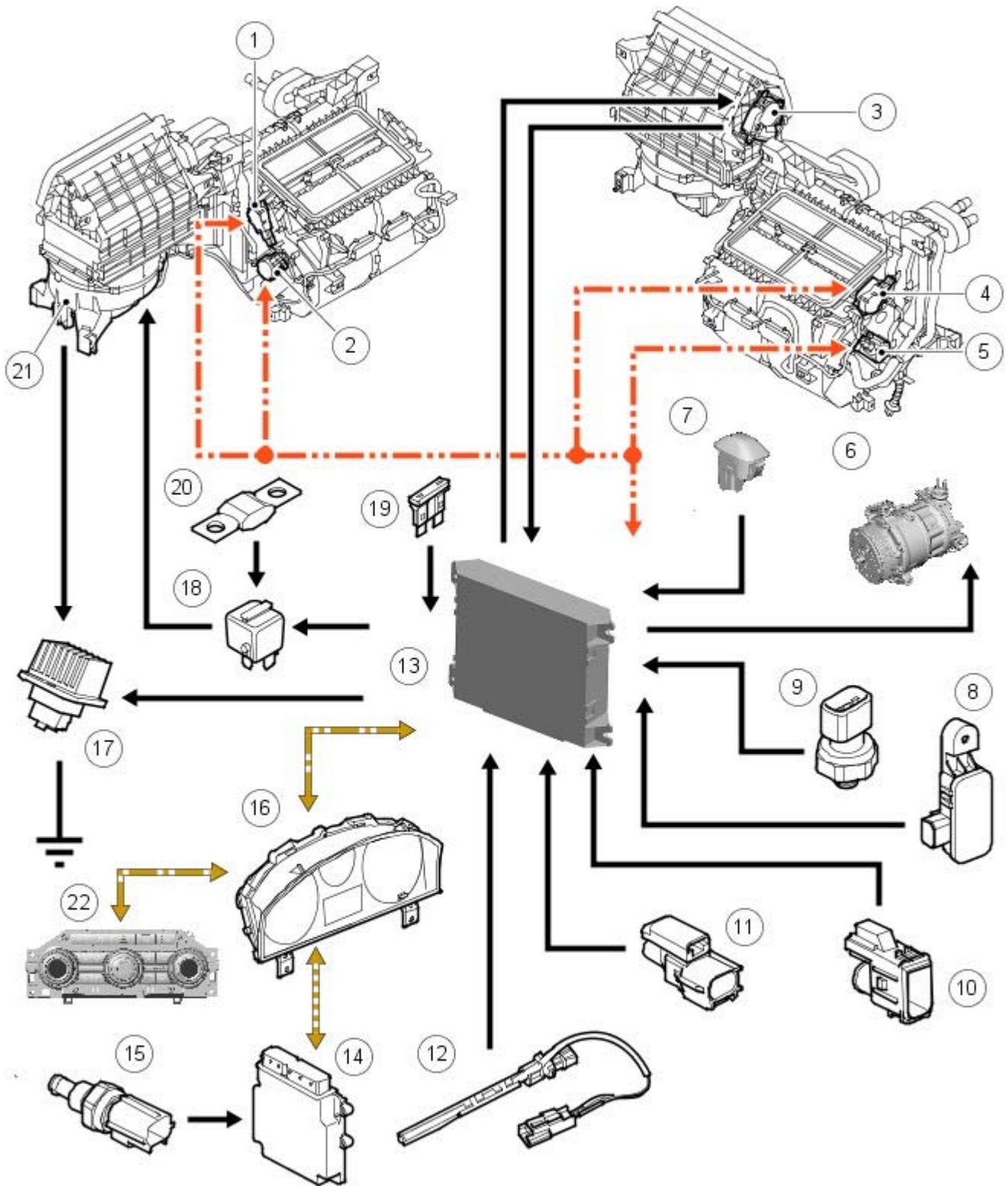
On subsequent operations, during the same Power mode cycle, the ATC module operates the windshield heater at full power for a fixed time period.

Windshield Heating Phases

Phase	Time, minutes
Short defrost (-5 °C (23 °F) and above)	3
Long defrost (less than -5 °C (23 °F))	5
Low power	10
Subsequent operation	3

CONTROL DIAGRAM

- NOTE: **A** = Hardwired connections; **D** = High speed CAN bus; **N** = Medium speed CAN bus



E 132924

Item	Part Number	Description
1	-	Face and feet distribution motor
2	-	LH temperature blend motor
3	-	Recirculation motor
4	-	Windshield distribution motor
5	-	RH temperature blend motor
6	-	A/C compressor solenoid valve
7	-	Sunlight sensor

8	-	Pollution sensor
9	-	Refrigerant pressure sensor
10	-	In-vehicle temperature sensor (all except Japan) or in-vehicle temperature and humidity sensor (Japan only)
11	-	Ambient air temperature sensor
12	-	Evaporator temperature sensor
13	-	ATC module
14	-	ECM
15	-	ECT sensor
16	-	Instrument cluster
17	-	Blower control module
18	-	BJB (battery junction box)
19	-	CJB
20	-	Blower
21	-	Center instrument panel switch pack

Control Components - Control Components

Diagnosis and Testing

Principle of Operation

For a detailed description of the climate control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Control Components (412-04 Control Components, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Front End Accessory Drive (FEAD) belt ● Refrigerant ● Heater control flaps ● Ducting ● Cabin air filter ● Coolant level ● Compressor ● Cooling fan 	<ul style="list-style-type: none"> ● Fuses ● Electrical harnesses ● Harness connectors ● Blower motor ● Cooling fan ● Actuators

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Climate Control Module \(HVAC\)](#) (100-00 General Information, Description and Operation).

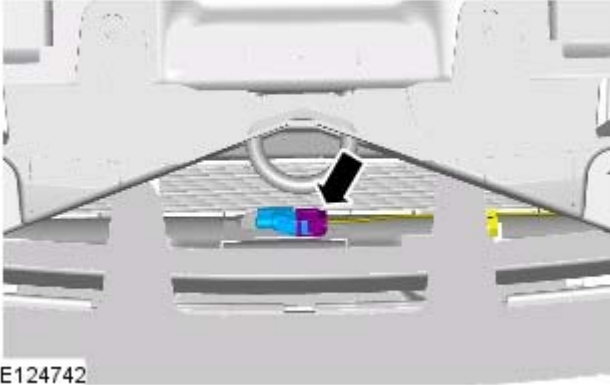
Control Components - Ambient Air Temperature Sensor

Removal and Installation

Removal

1. Remove the front spoiler.
For additional information, refer to: [Front Bumper Lower Cover](#) (501-19 Bumpers, Removal and Installation).
2. Remove the ambient air temperature sensor.

- Disconnect the electrical connector.
- Release the clip.



Installation

1. To install, reverse the removal procedure.

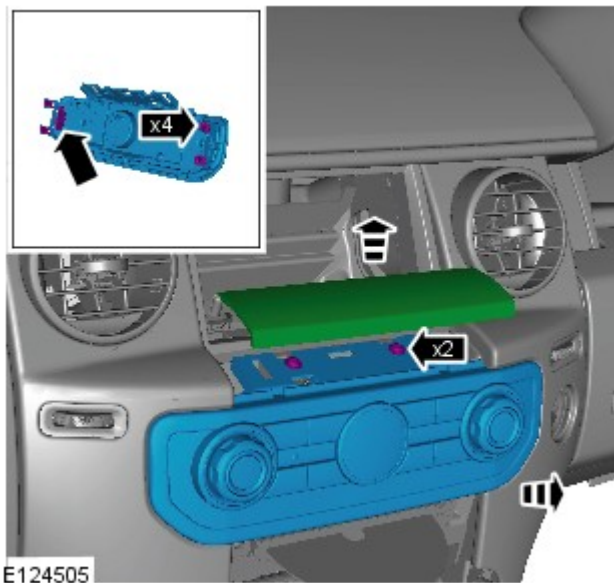
Control Components - Climate Control Assembly

Removal and Installation

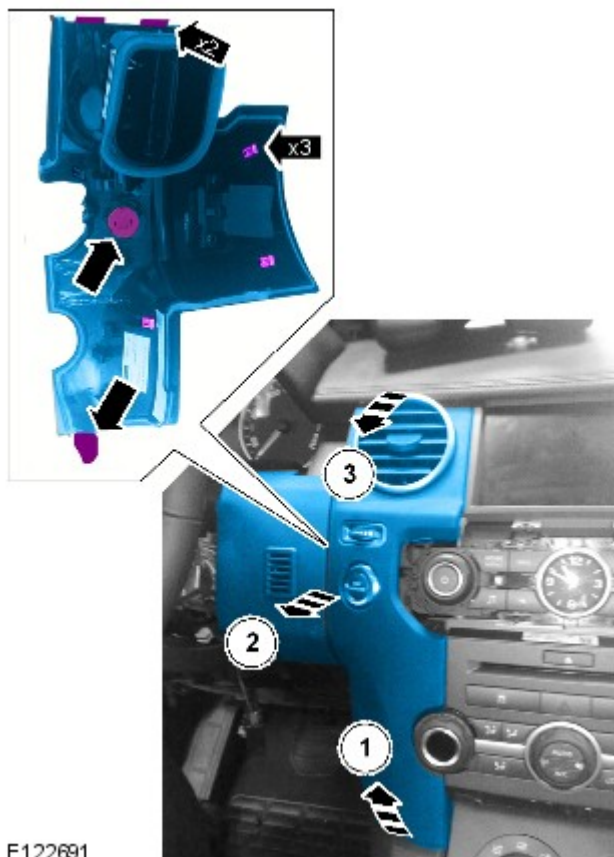
Removal


- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**
- NOTE: Make sure that the gear selector lever is in position N before removing any components.

1. Refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

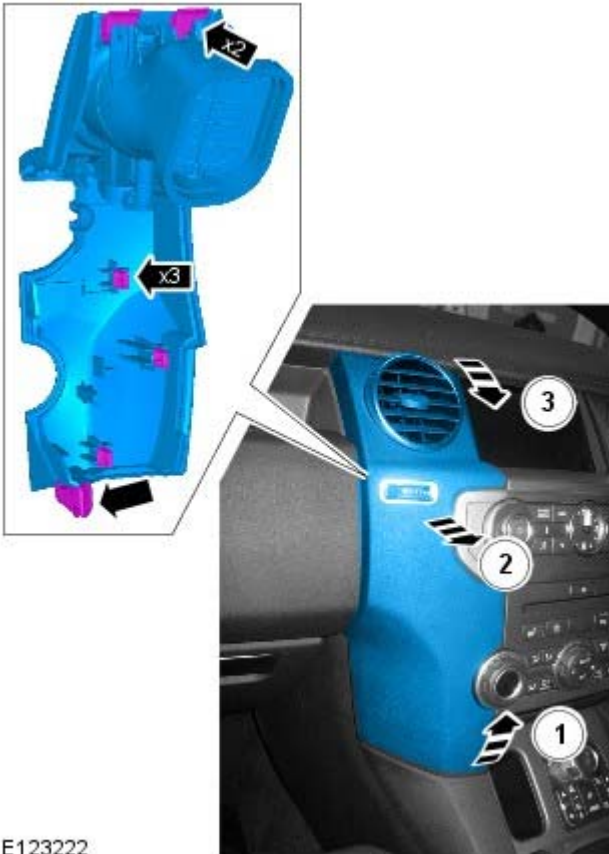


2. Torque: 2.5 Nm




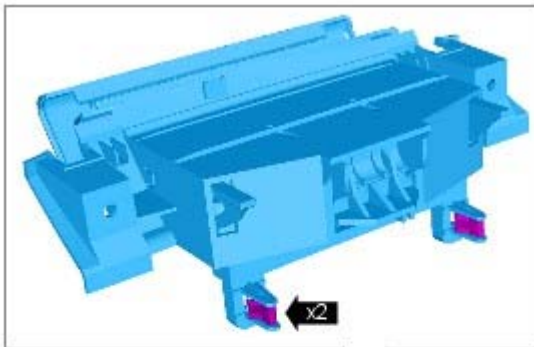
3.  CAUTION: When installing the lower locating tang of the trim panel, make sure the floor console is not damaged. If necessary protect the surrounding areas using masking tape.

- NOTE: LHD illustration shown, RHD is similar.
- NOTE: Remove in the sequence shown.
- NOTE: To install, reverse the removal sequence.



E123222

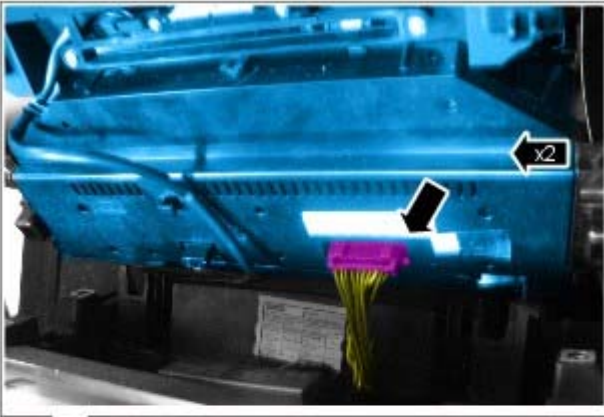
4.  CAUTION: When installing the lower locating tang of the trim panel, make sure the floor console is not damaged. If necessary protect the surrounding areas using masking tape.
 - NOTE: Remove in the sequence shown.
 - NOTE: To install, reverse the removal sequence.



E123298

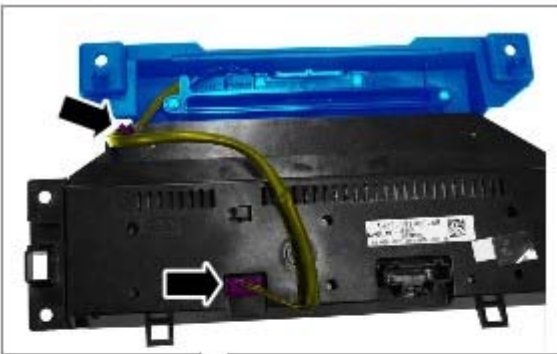
5. *Torque: 2.5 Nm*

6. Torque: 2.5 Nm



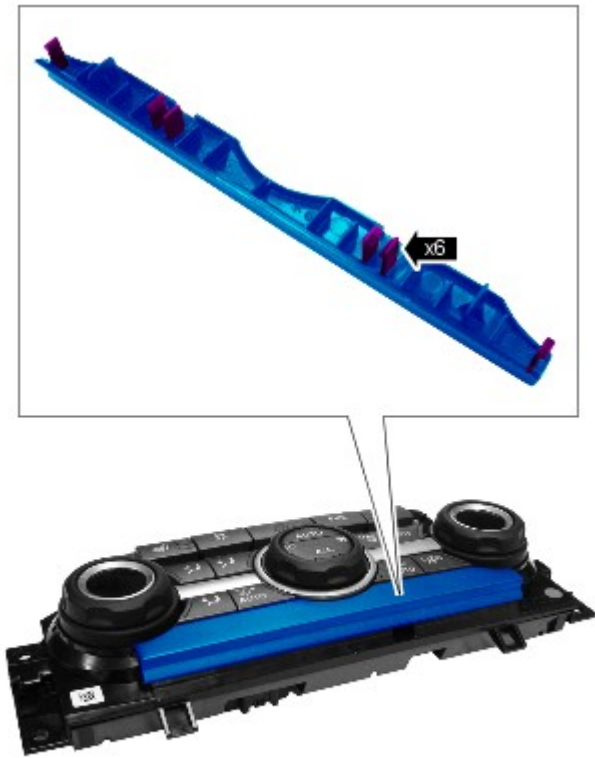
E123220

7.



E125464

8.



E125465

Installation

1. **NOTE:** Make sure that all the clips are correctly installed.
To install, reverse the removal procedure.

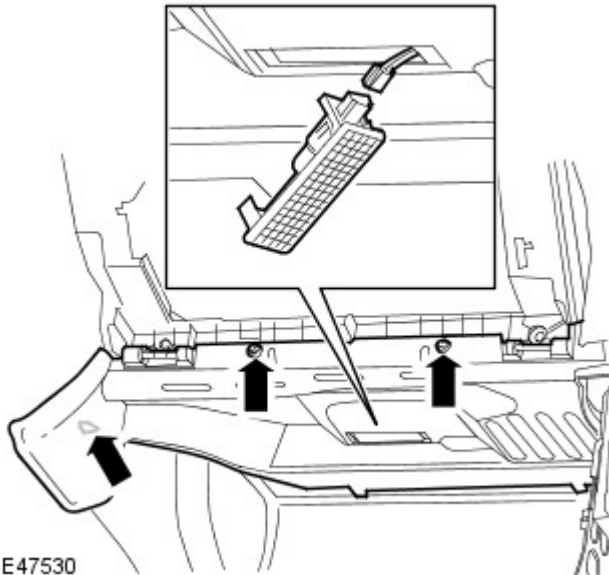
Control Components - Defrost Vent/Register Blend Door Actuator LHD AWD

Removal and Installation

Removal

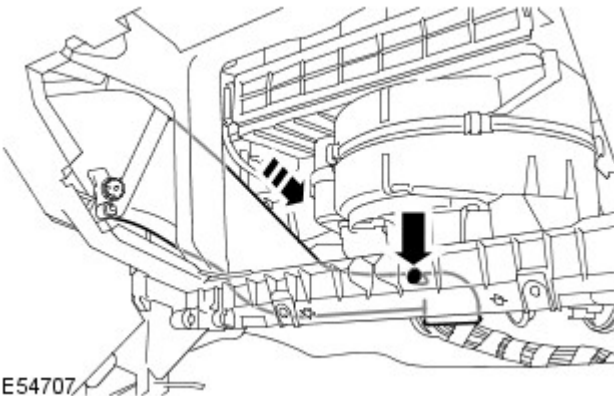
1. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).

2. Remove the passenger side closing trim panel.
 - Release the clip.
 - Remove the 2 screws.
 - Disconnect the electrical connector.



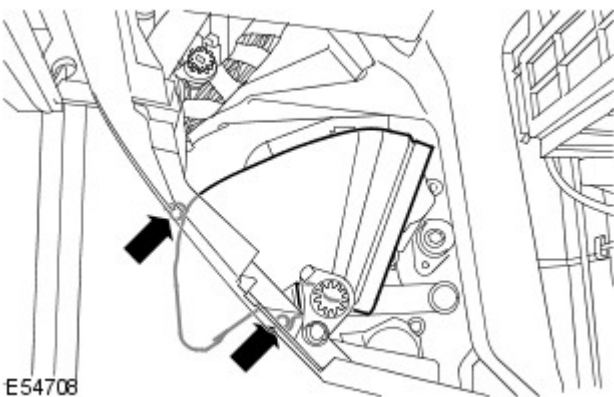
E47530

3. Remove the passenger side footwell duct.
 - Remove the clip.

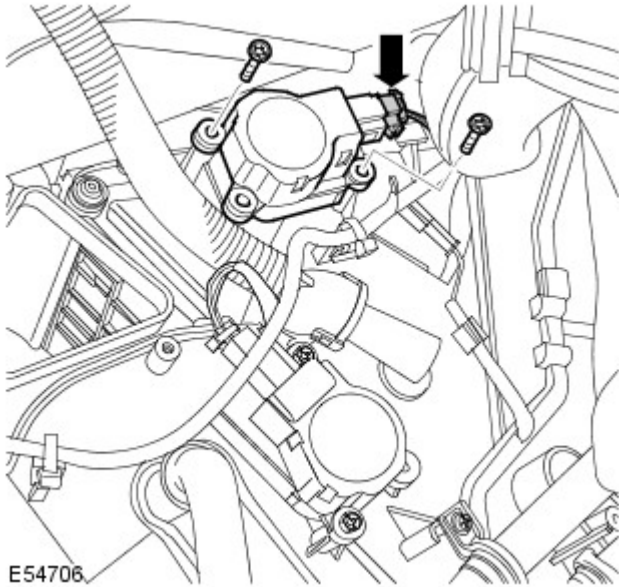


E54707

4. Remove the passenger side footwell duct elbow.
 - Remove the 2 Torx screws.



E54708



5. Remove the defrost vent/register blend door actuator.

- Disconnect the electrical connector.
- Remove the 2 screws.

Installation

1. Install the defrost vent/register blend door actuator.

- Tighten the screws to 1 Nm.
- Connect the electrical connector.

2. Install the passenger side footwell duct elbow.

- Tighten the screws.

3. Install the passenger side footwell duct.

- Install the clip.

4. Install the passenger side closing trim panel.

- Install the interior lamp.
- Connect the electrical connector.
- Secure the clip.

5. Install the glove compartment.

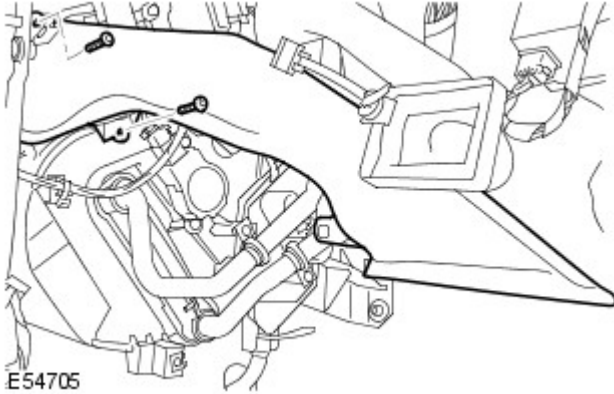
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).

Control Components - Defrost Vent/Register Blend Door Actuator RHD AWD

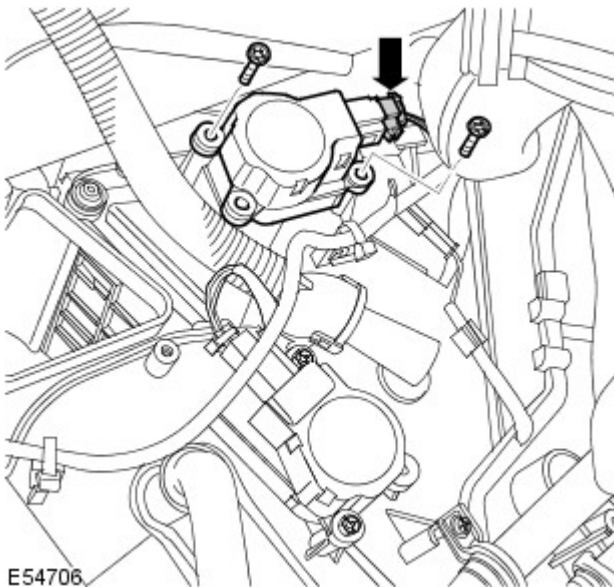
Removal and Installation

Removal

1. Remove the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
2. Remove the driver side footwell duct.
 - Remove the 2 Torx screws.



3. Remove the defrost door actuator.
 - Disconnect the electrical connector.
 - Remove the 2 screws.



Installation

1. Install the defrost door actuator.
 - Tighten the screws.
 - Connect the electrical connector.
2. Install the driver side footwell duct.
 - Tighten the screws.
3. Install the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

Control Components - Driver Side Temperature Blend Door ActuatorLHD

AWD

Removal and Installation

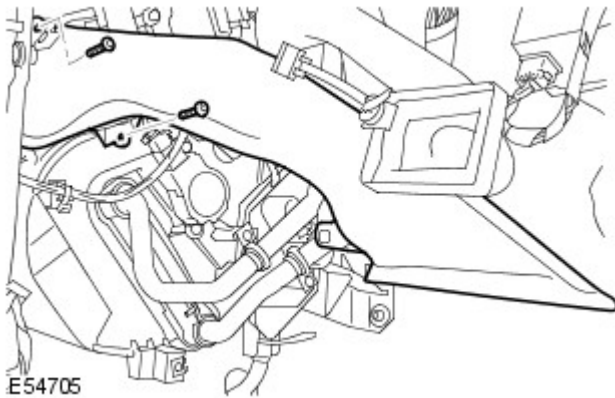
Removal

1. Remove the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

2. NOTE: RHD illustration shown, LHD is similar.

Remove the driver side footwell duct.

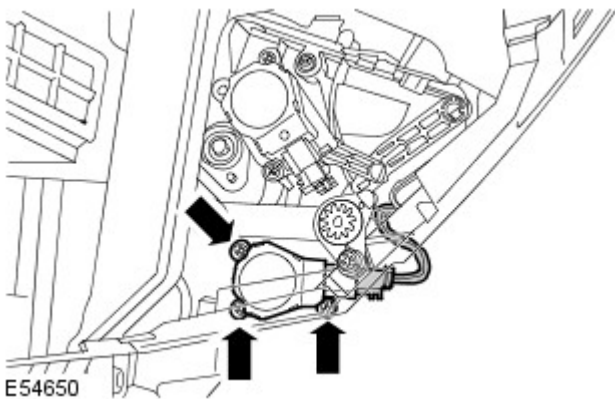
- Remove the 2 Torx screws.



3. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the temperature blend door actuator.

- Disconnect the electrical connector.
- Remove the 3 screws.



Installation

1. Install the temperature blend door actuator.
 - Tighten the screws to 1 Nm.
 - Connect the electrical connector.
2. Install the driver side footwell duct.
 - Tighten the screws.
3. Install the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

Control Components - Driver Side Temperature Blend Door ActuatorRHD

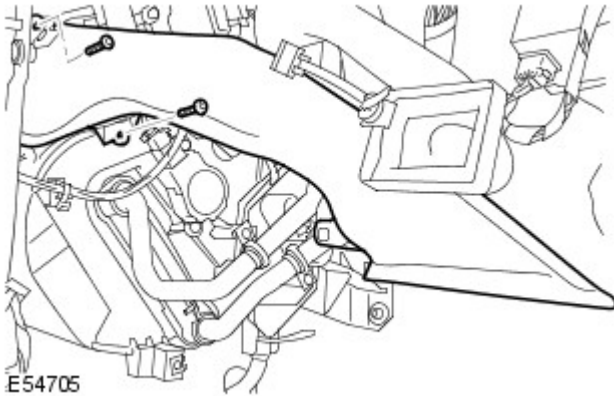
AWD

Removal and Installation

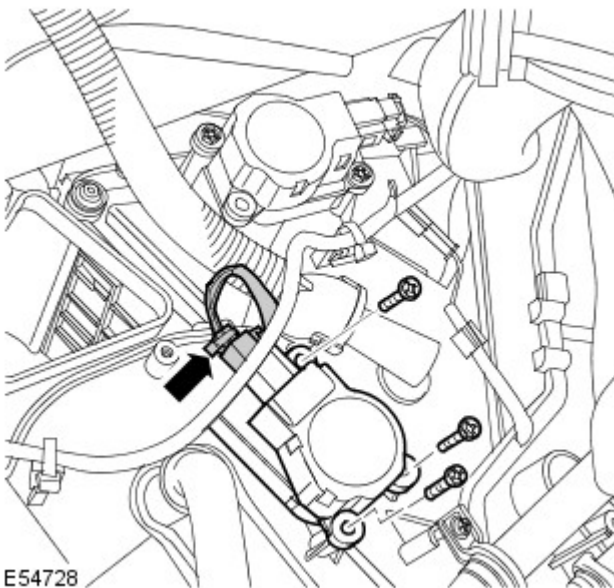
Removal

1. Remove the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

2. Remove the driver side footwell duct.
 - Remove the 2 Torx screws.



3. Remove the temperature blend door actuator.
 - Disconnect the electrical connector.
 - Remove the 2 screws.



Installation

1. Install the temperature blend door actuator.
 - Tighten the screws.
 - Connect the electrical connector.

2. Install the driver side footwell duct.
 - Tighten the screws.

3. Install the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

Control Components - Instrument Panel Blend Door Actuator LHD AWD

Removal and Installation

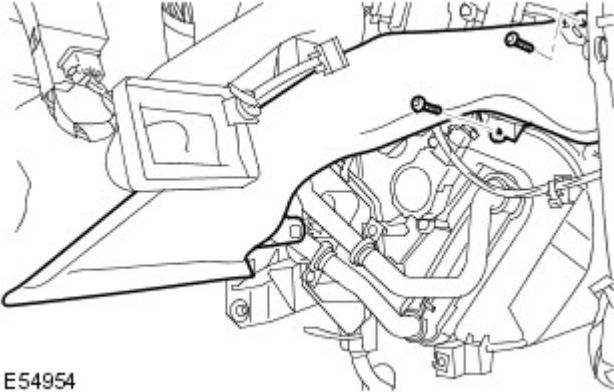
Removal

1. Remove the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the driver side footwell duct.

- Remove the 2 Torx screws.

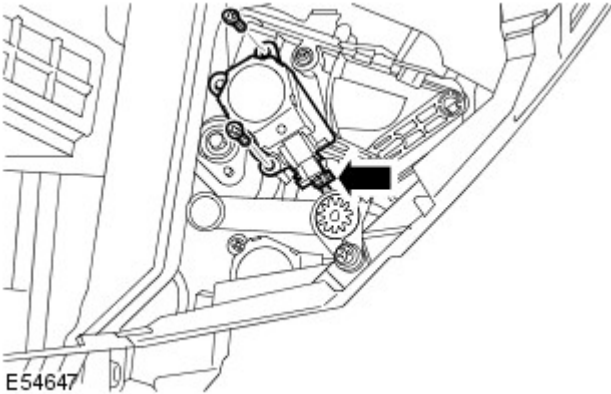


E54954

3. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the instrument panel blend door actuator.

- Disconnect the electrical connector.
- Remove the 2 screws.



E54647

Installation

1. Install the instrument panel blend door actuator.
 - Tighten the screws to 1 Nm.
 - Connect the electrical connector.
2. Install the driver side footwell duct.
 - Tighten the screws.
3. Install the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

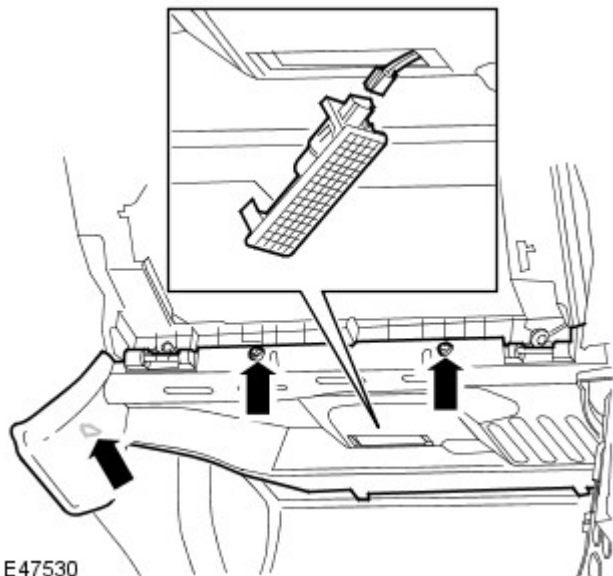
Control Components - Instrument Panel Blend Door Actuator RHD AWD

Removal and Installation

Removal

1. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).
2. Remove the passenger side closing trim panel.

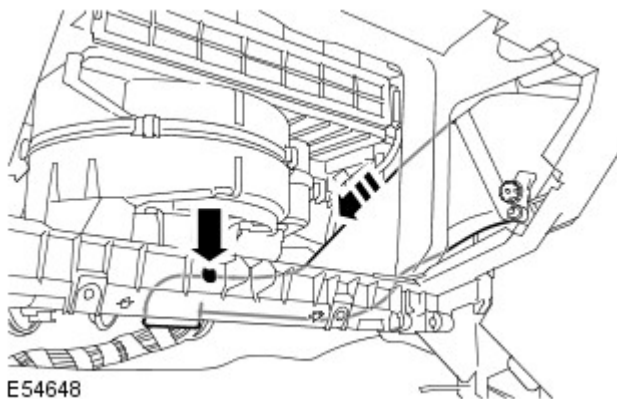
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47530

3. Remove the passenger side footwell duct.

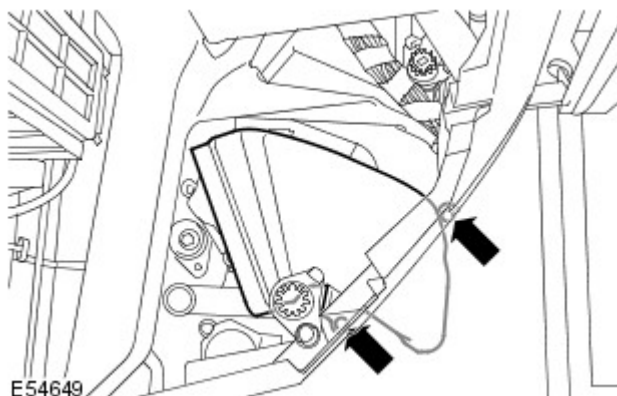
- Remove the clip.



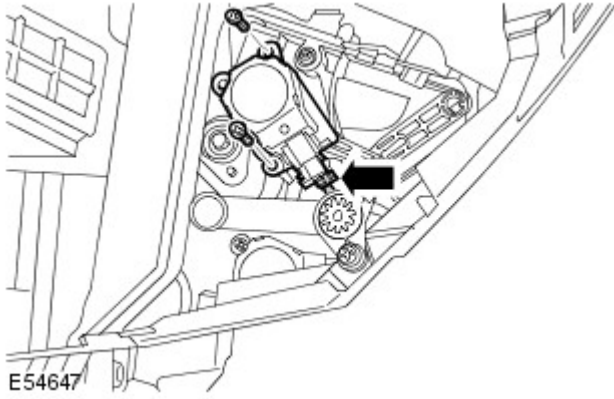
E54648

4. Remove the passenger side footwell duct elbow.

- Remove the 2 Torx screws.



E54649



5. Remove the instrument panel blend door actuator.

- Disconnect the electrical connector.
- Remove the 2 screws.

Installation

1. Install the instrument panel blend door actuator.

- Tighten the screws.
- Connect the electrical connector.

2. Install the passenger side footwell duct elbow.

- Tighten the screws.

3. Install the passenger side footwell duct.

- Install the clip.

4. Install the passenger side closing trim panel.

- Install the interior lamp.
- Connect the electrical connector.
- Secure the clip.

5. Install the glove compartment.

For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).

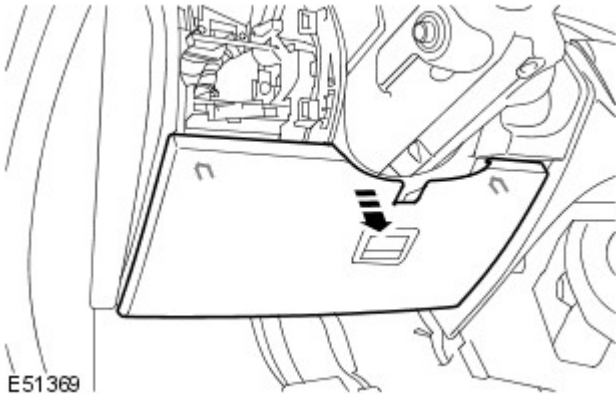
Control Components - In-Vehicle Temperature Sensor

Removal and Installation

Removal

1. Fully extend the steering column for access.
2. Remove the instrument panel access panel.

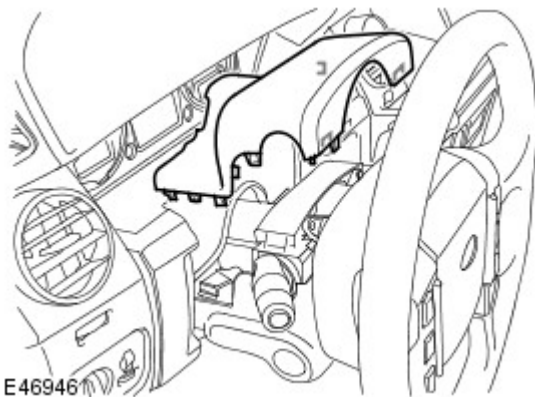
- Release the 2 clips.



E51369

3. Remove the steering column upper shroud.

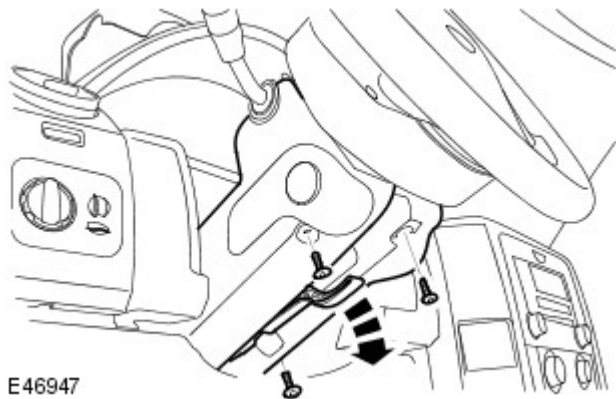
- Release the 6 clips.



E46946

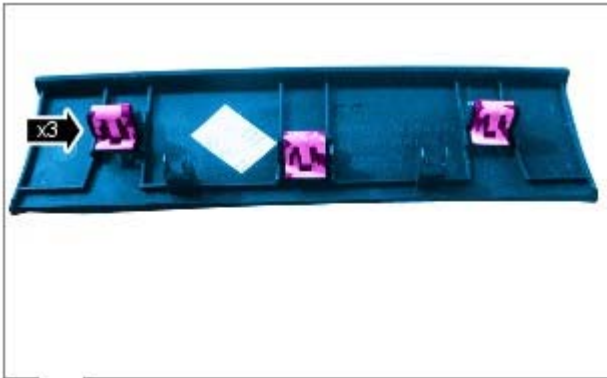
4. Remove the steering column lower shroud.

- Remove the 3 Torx screws.
- Release the steering column adjustment lever.



E46947

5. Remove the center console upper finisher trim.



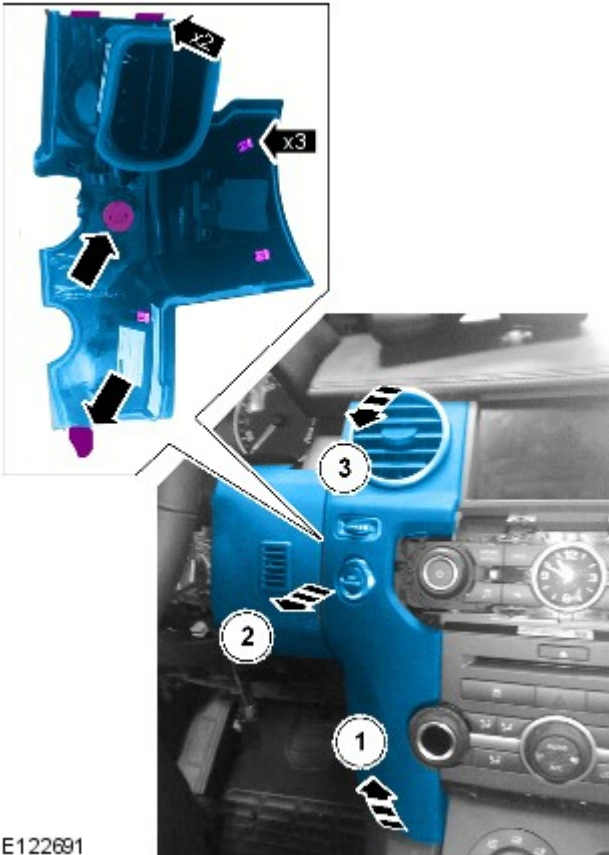
E123215

6. Remove the audio unit bezel.



E123217

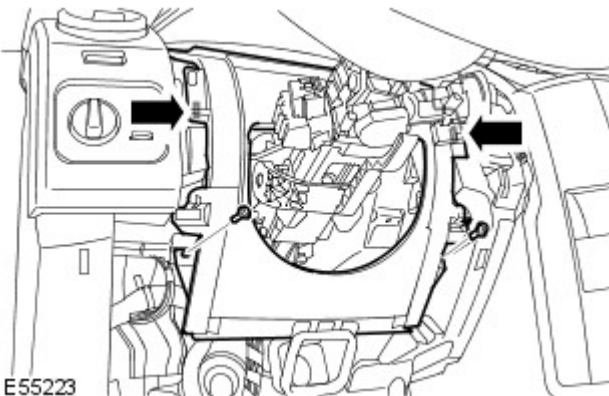
7. Remove the instrument panel centre finisher.



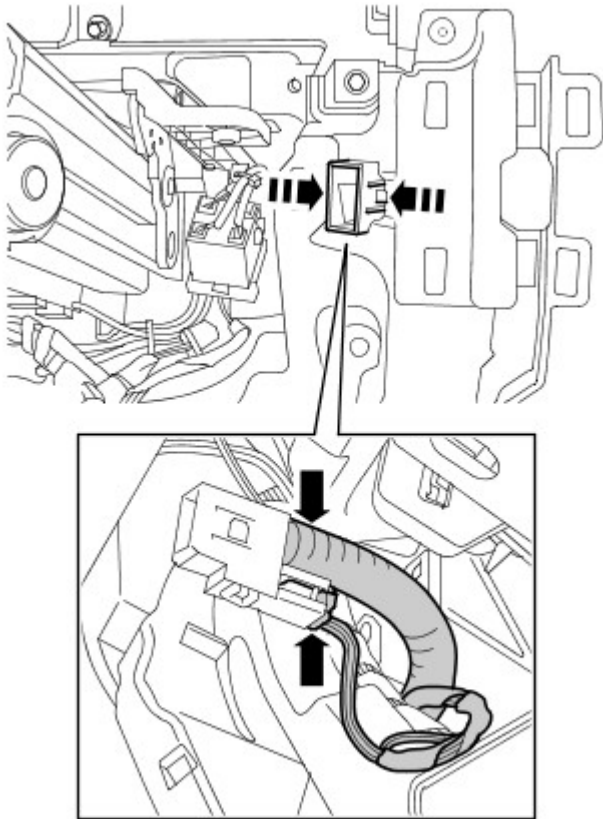
E122691

8. Release the steering column gaiter panel.

- Remove the 2 Torx screws.
- Release the 2 clips.



E55223



E55224

9. Remove the in-vehicle temperature sensor.

- Release the 2 clips.
- Disconnect the electrical connector.
- Disconnect the hose.

Installation

1. Install the in-vehicle temperature sensor.
 - Connect the hose.
 - Connect the electrical connector.
 - Secure the clips.
2. Install the steering column gaiter panel.
 - Secure with the clips.
 - Tighten the Torx screws.
3. Install the instrument panel centre finisher.
4. Install the audio unit bezel.
5. Install the center console upper finisher trim.
6. Install the steering column shrouds.
7. Install the instrument panel access panel.

Control Components - Passenger Side Temperature Blend Door ActuatorLHD AWD

Removal and Installation

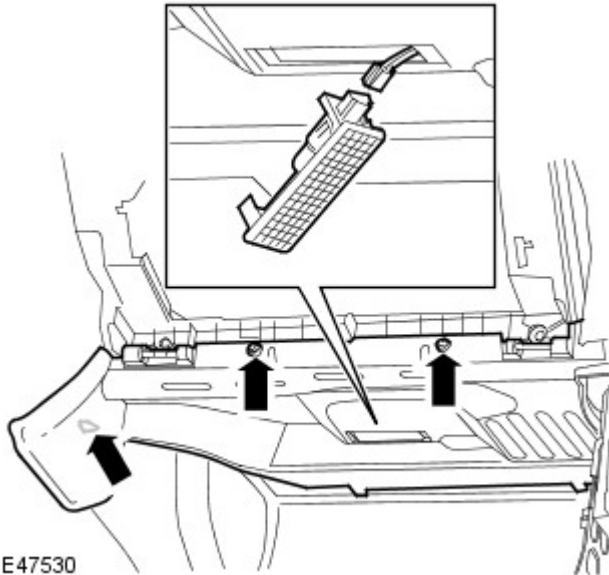
Removal

1. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).

2. NOTE: RHD illustration shown, LHD is similar.

Remove the passenger side closing trim panel.

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.

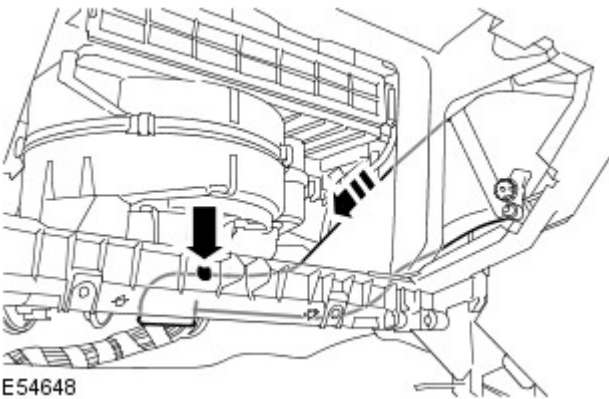


E47530

3. NOTE: RHD illustration shown, LHD is similar.

Remove the passenger side footwell duct.

- Remove the clip.

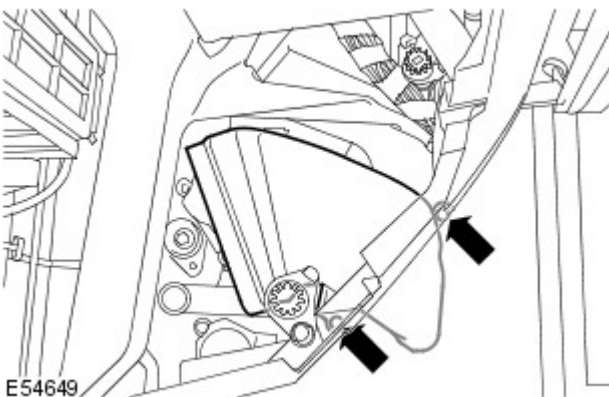


E54648

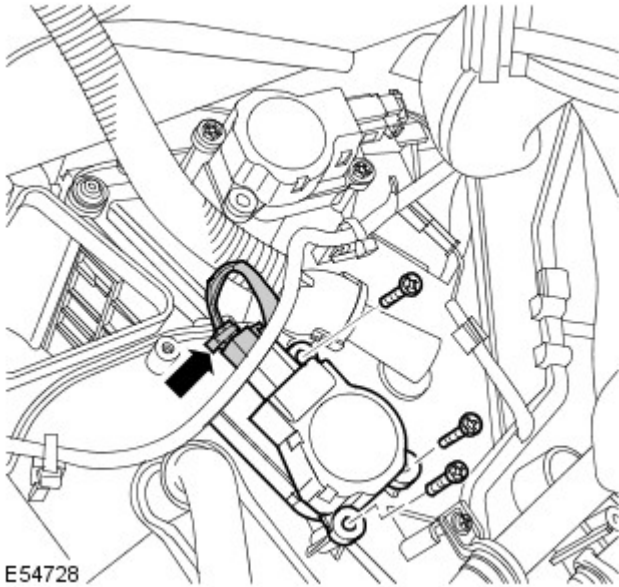
4. NOTE: RHD illustration shown, LHD is similar.

Remove the passenger side footwell duct elbow.

- Remove the 2 Torx screws.



E54649



5. Remove the temperature blend door actuator.

- Disconnect the electrical connector.
- Remove the 3 screws.

Installation

1. Install the temperature blend door actuator.

- Tighten the screws to 1 Nm.
- Connect the electrical connector.

2. Install the passenger side footwell duct elbow.

- Tighten the screws.

3. Install the passenger side footwell duct.

- Install the clip.

4. Install the passenger side closing trim panel.

- Connect the electrical connector.
- Tighten the screws.
- Secure the clip.

5. Install the glove compartment.

For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).

Control Components - Passenger Side Temperature Blend Door

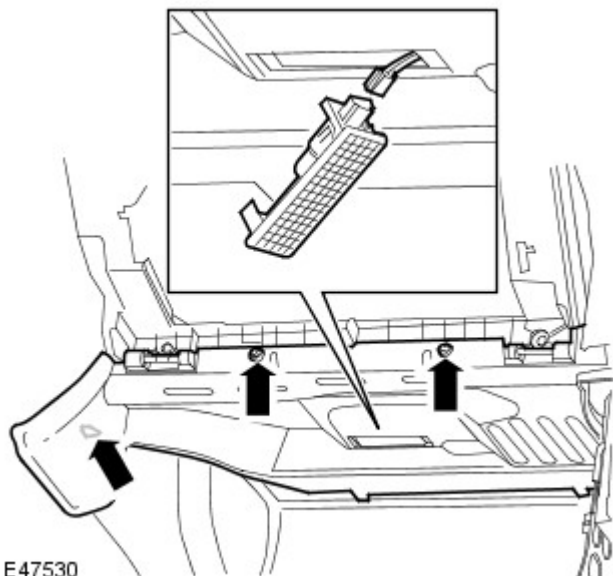
ActuatorRHD AWD

Removal and Installation

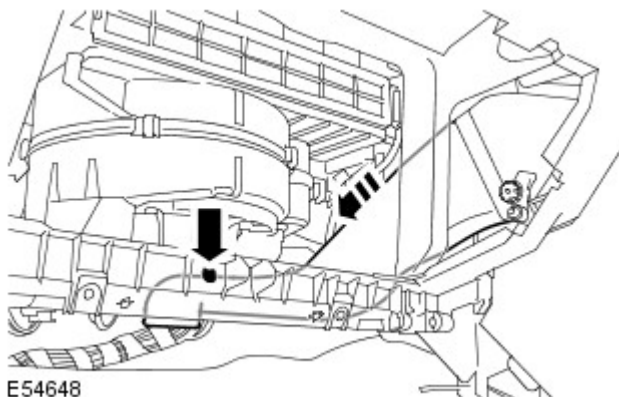
Removal

1. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).

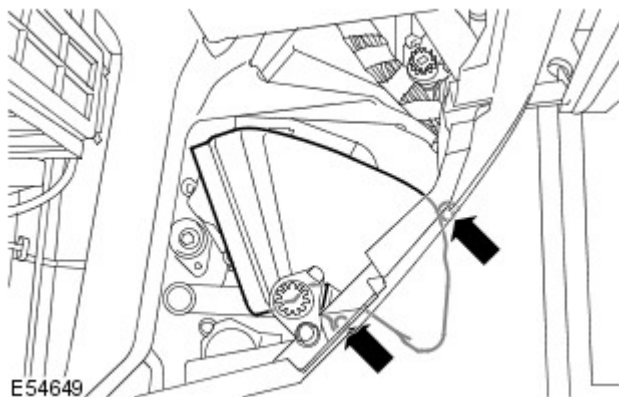
2. Remove the passenger side closing trim panel.
 - Release the clip.
 - Remove the 2 screws.
 - Disconnect the electrical connector.

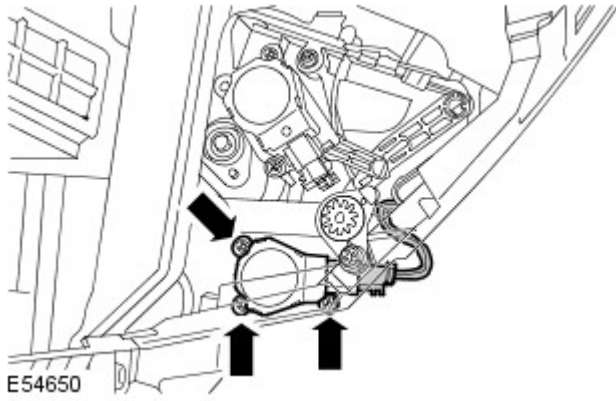


3. Remove the passenger side footwell duct.
 - Remove the clip.



4. Remove the passenger side footwell duct elbow.
 - Remove the 2 Torx screws.





5. Remove the temperature blend door actuator.

- Disconnect the electrical connector.
- Remove the 3 screws.

Installation

1. Install the temperature blend door actuator.
 - Tighten the screws.
 - Connect the electrical connector.
2. Install the passenger side footwell duct elbow.
 - Tighten the screws.
3. Install the passenger side footwell duct.
 - Install the clip.
4. Install the passenger side closing trim panel.
 - Install the interior lamp.
 - Connect the electrical connector.
 - Secure the clip.
5. Install the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).

Control Components - Recirculation Blend Door Actuator LHD AWD

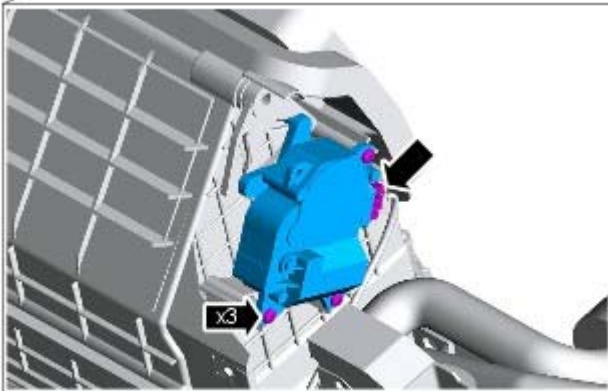
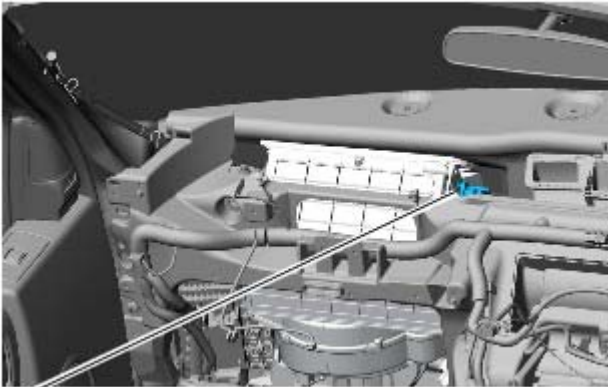
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. **NOTE:** RHD illustration shown, LHD is similar.

Remove the recirculation blend door actuator.

- Disconnect the electrical connector.
- Remove the 3 screws.



E91604

Installation

1. Install the recirculation blend door actuator.
 - Align the control arm to the recirculation blend door.
 - Install the 3 screws.
 - Connect the electrical connector.
2. Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

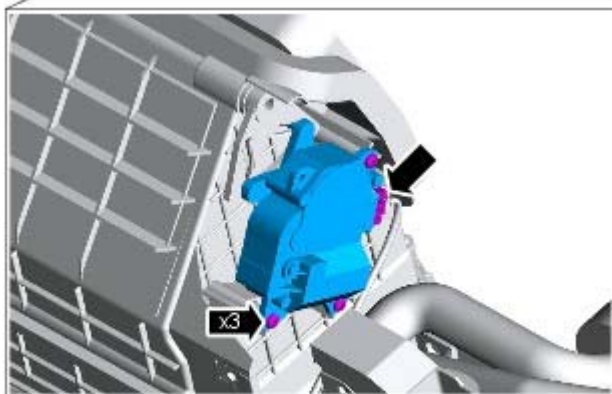
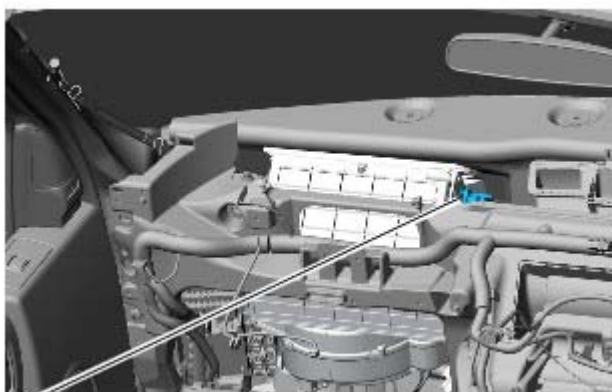
Control Components - Recirculation Blend Door Actuator RHD AWD

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Remove the recirculation blend door actuator.

- Disconnect the electrical connector.
- Remove the 3 screws.



E91604

Installation

1. Install the recirculation blend door actuator.
 - Align the control arm to the recirculation blend door.
 - Install the 3 screws.
 - Connect the electrical connector.
2. Install the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

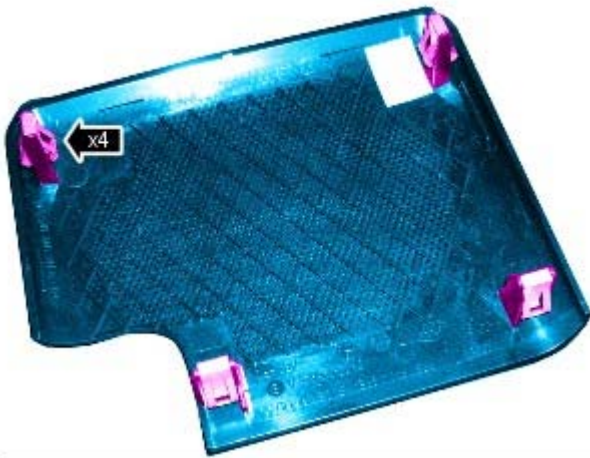
Control Components - Sunload Sensor

Removal and Installation

Removal

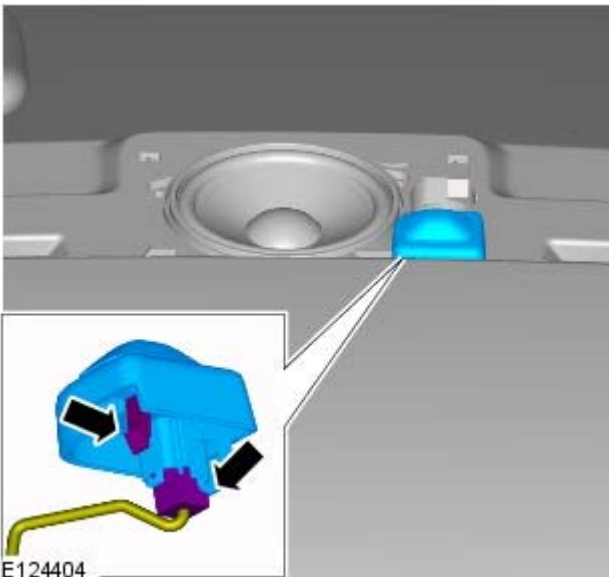
- NOTE: Removal steps in this procedure may contain installation details.

1.



E124403

2.



E124404

3.



E124405

Installation

1. To install, reverse the removal procedure.

Instrument Cluster -

Description	Nm	lb-ft
Steering column switch assembly	3	2

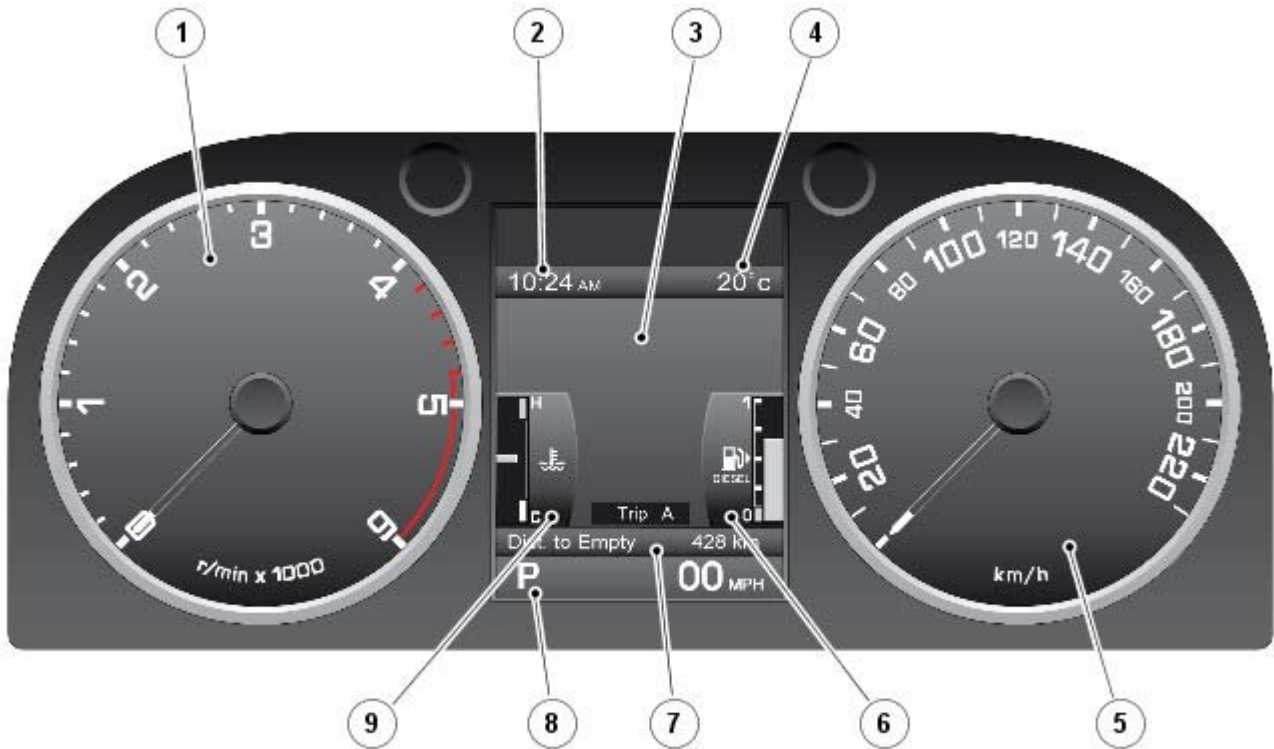
Instrument Cluster - Instrument Cluster

Description and Operation

OVERVIEW

A new instrument cluster is introduced where in addition to the larger speedometer and tachometer gauges the cluster also incorporates a Thin Film Transistor (TFT) 5" high-definition display unit.

Instrument cluster overview



E123742

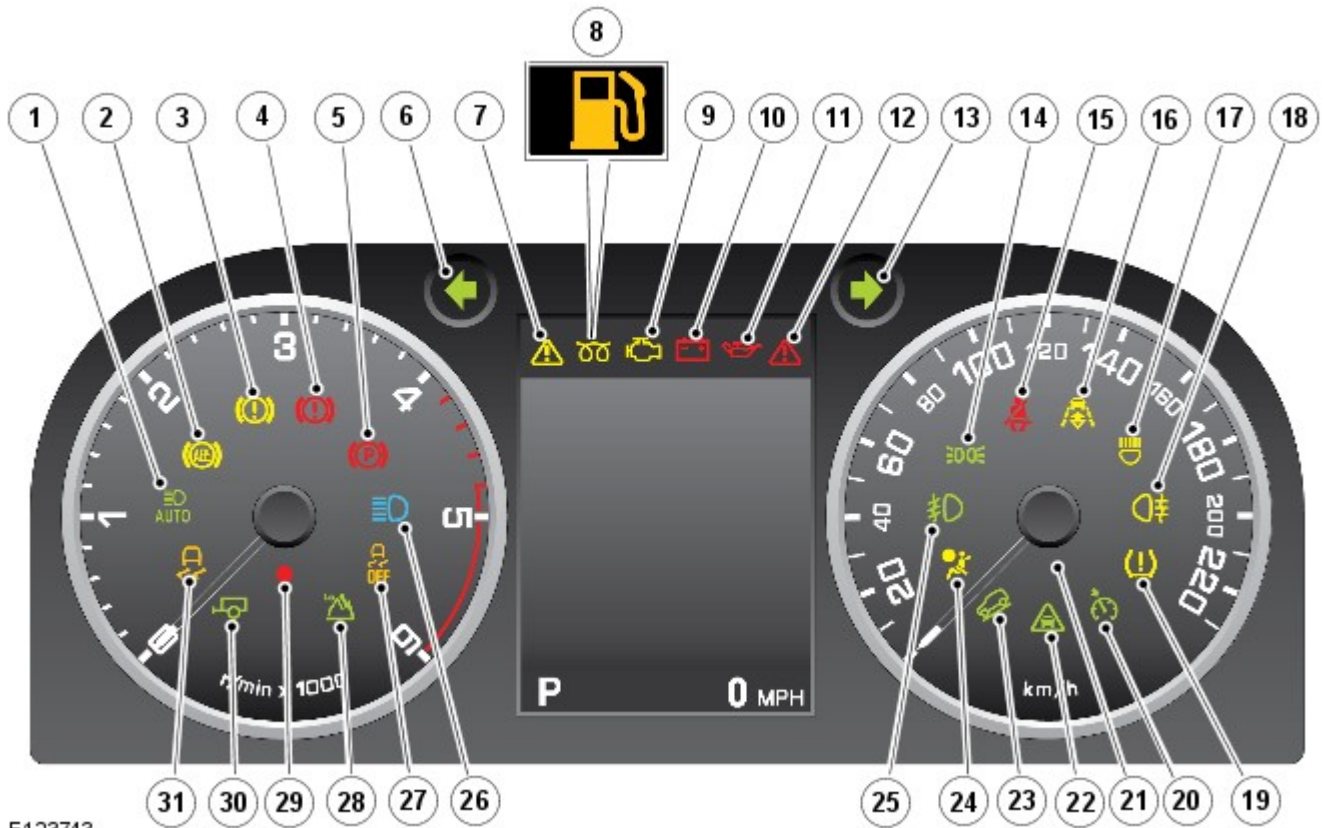
Item	Part Number	Description
1	-	Tachometer
2	-	Clock
3	-	Message center
4	-	External temperature
5	-	Speedometer
6	-	Fuel gauge
7	-	Total distance odometer and trip recorder
8	-	Gear selector position display
9	-	Temperature gauge

The TFT display incorporates a 'Message Center' that communicates vehicle information and status data to the driver. Menus displayed in the message center allow access to a number of vehicle functions through the guidance of the message center menus. The driver operates the message center using the 'menu control' located on the right-hand-side of the steering wheel. Refer to the 'Information and Message Center' section for further information.

The instrument cluster features a number of warning indicators, where in addition to those located within the speedometer and tachometer gauges, another six indicators are positioned within the TFT unit above the message center.

DESCRIPTION

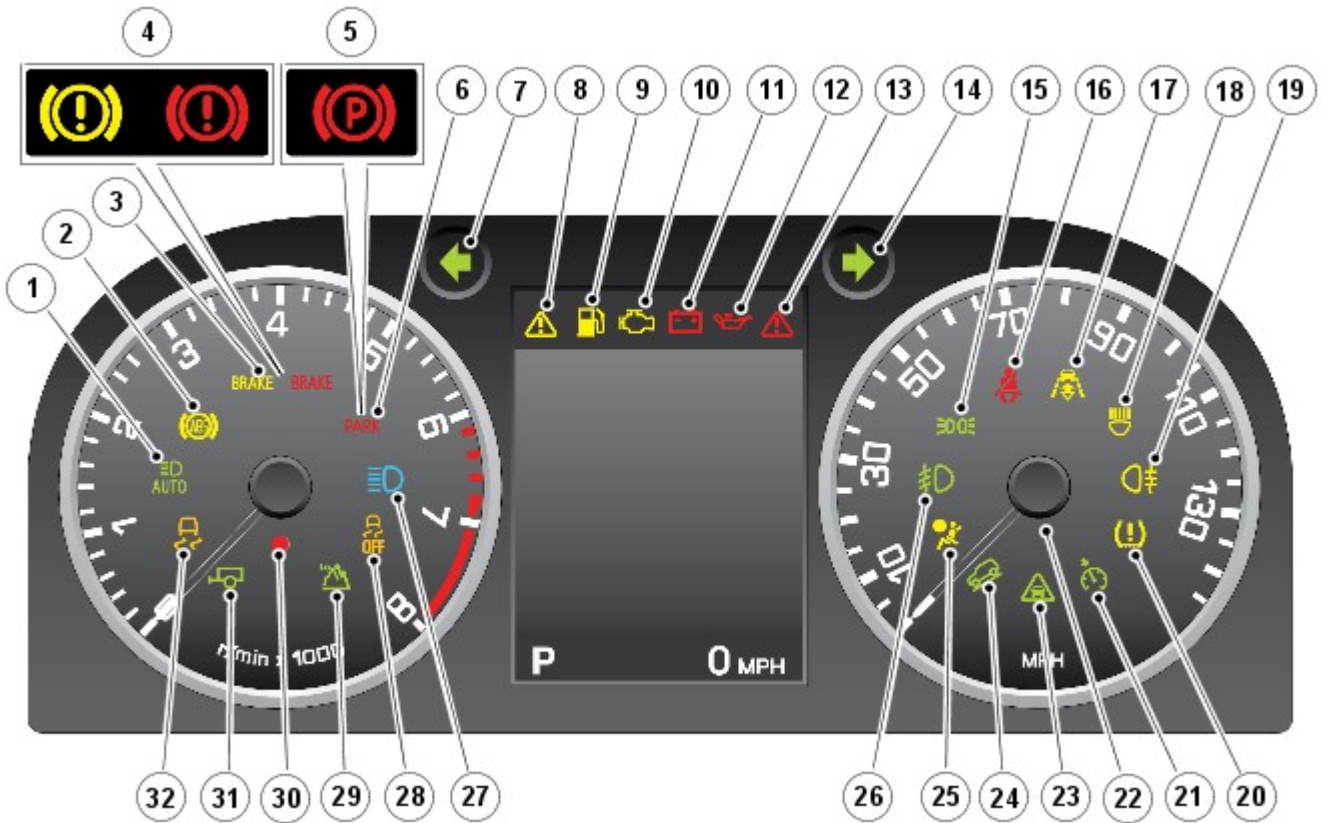
Warning Indicators – ROW Diesel Shown



E123743

Item	Part Number	Description
1	-	Automatic high beam active warning - green
2	-	Anti-lock Brake System (ABS) warning - amber
3	-	Brake system warning - amber
4	-	Brake system warning - red
5	-	Park brake system warning - red
6	-	Left-hand turn signal indicator - green
7	-	Warning/information - amber
8	-	Glow plug warning / Low fuel warning (dual function indicator) - amber
9	-	Check engine MIL warning - amber
10	-	Charge indicator - red
11	-	Oil pressure warning - red
12	-	Critical warning - red
13	-	Right-hand turn signal indicator - green
14	-	Side lamps - green
15	-	Seat belt warning - red
16	-	Adaptive Speed Control active - amber
17	-	Adaptive Front lighting System (AFS) warning - amber
18	-	Rear fog lamps active - amber
19	-	Tire pressure monitoring warning - amber
20	-	Speed control active - green
21	-	Ambient light sensor (reference only)
22	-	Forward alert active - green
23	-	Hill Descent Control (HDC) active - green
24	-	Airbag warning secondary - amber
25	-	Front fog lamps active - green
26	-	High beam warning - blue
27	-	Dynamic Stability Control (DSC) off warning - amber
28	-	Low range selected - green
29	-	Security Light Emitting Diode (LED) - red
30	-	Trailer warning - green
31	-	Dynamic Stability Control (DSC) active warning - amber

Warning Indicators – NAS Gasoline Shown



E123745

Item	Part Number	Description
1	-	Automatic high beam active warning - green
2	-	Anti-lock Brake System (ABS) warning - amber
3	-	Brake system warning USA only – amber/red
4	-	Brake system warning Canada only - amber/red
5	-	Park brake system warning Canada only - red
6	-	Park brake system warning USA only – red
7	-	Left-hand turn signal indicator - green
8	-	Warning/information - amber
9	-	Glow plug warning / Low fuel warning (dual function indicator) – amber
10	-	Check engine MIL warning - amber
11	-	Charge indicator - red
12	-	Oil pressure warning - red
13	-	Critical warning - red
14	-	Right-hand turn signal indicator - green
15	-	Side lamps - green
16	-	Seat belt warning - red
17	-	Adaptive Speed Control active - amber
18	-	Adaptive Front lighting System (AFS) warning - amber
19	-	Rear fog lamps active - amber
20	-	Tire pressure monitoring warning - amber
21	-	Speed control active - green
22	-	Ambient light sensor (reference only)
23	-	Forward alert active - green
24	-	Hill Descent Control (HDC) active - green
25	-	Airbag warning secondary - amber
26	-	Front fog lamps active - green
27	-	High beam warning - blue
28	-	Dynamic Stability Control (DSC) off warning - amber
29	-	Low range selected - green
30	-	Security Light Emitting Diode (LED) - red
31	-	Trailer warning - green
32	-	Dynamic Stability Control (DSC) active warning - amber

Stepper motors are used to actuate the mechanical speedometer and tachometer gauges to provide a smooth and progressive response.

The warning indicators above the message center are functioned using Thin Film Transistor (TFT) technology. LEDs are used to illuminate the warning indicators in the speedometer and tachometer gauges and provide backlight illumination of the instrument cluster.

A single ambient light sensor is used to measure cabin lighting and adjust the backlight brightness of the instrument cluster accordingly. The instrument cluster also incorporates an anti-glare coating.

When the vehicle is locked the TFT unit goes off. When the vehicle is unlocked, a welcome screen is displayed featuring a

Land Rover logo and an image of the vehicle, together with the current date and odometer information.

The coolant temperature and fuel quantity gauges are the default display when the stop/start button is pressed. These can be overwritten by different permutations of screens which are available to cover numerous vehicle functions through a menu selection. Refer to the 'Information and Message Center' section for further information.

Thin Film Transistor Display Unit



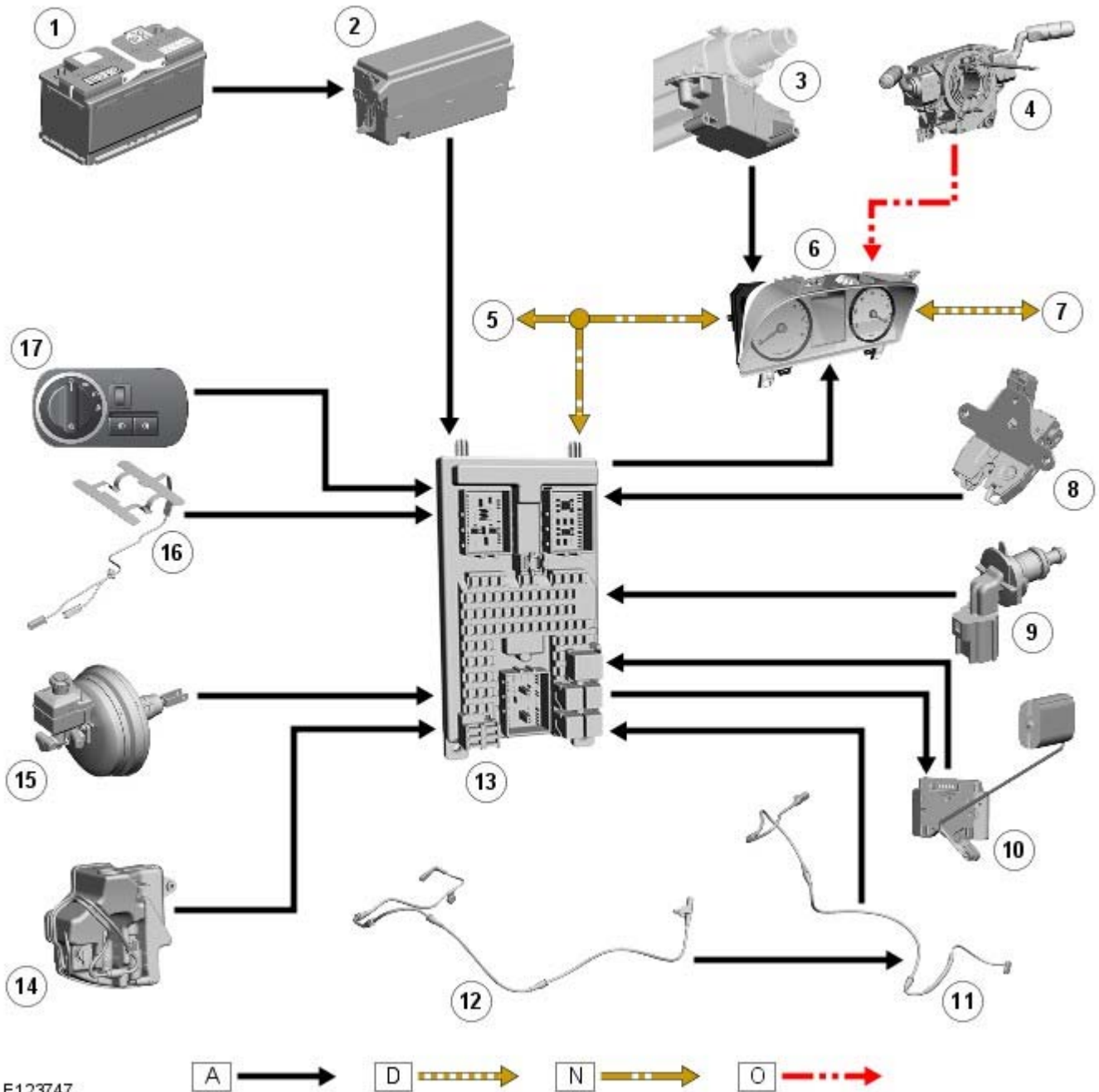
E123746

Item	Part Number	Description
1	-	Warning Indicators – this area cannot be overwritten by other information
2	-	Message Center – this area can be overwritten by other information
3	-	Gear Selection and Digital Speedometer Display - this area cannot be overwritten by other information

OPERATION

Control Diagram

- NOTE: **A** = Hardwired; **D** = High Speed CAN; **N** = Medium Speed CAN; **O** = LIN Bus;



E123747

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box (BJB)
3	-	Steering-column-lock module
4	-	Clockspring
5	-	Medium-speed CAN bus connection to other vehicle systems
6	-	Instrument cluster
7	-	High-speed CAN bus connection to other vehicle systems
8	-	Tailgate ajar switch
9	-	Engine coolant level sensor
10	-	Fuel level sensor
11	-	Front brake-pad wear sensor
12	-	Rear brake-pad wear sensor
13	-	Central Junction Box (CJB)
14	-	Washer fluid level sensor
15	-	Brake fluid level sensor
16	-	Safety belt – occupant detection pressure sensor
17	-	Exterior light control switch

The instrument cluster receives a permanent fused supply from the Battery Junction Box (BJB).

The cluster is connected to other vehicle systems and control modules via the:

- medium speed CAN bus,
- high speed CAN bus and
- LIN bus connections

However, some vehicle sensors are hardwired directly to the instrument cluster.

The steering lock control module is connected to a hardwired connection to the instrument cluster. Security information from other control modules is passed via the network buses and when the conditions are correct the instrument cluster instructs the steering lock control module to unlock the steering column.

The clockspring is connected to the instrument cluster on a LIN bus connection. The LIN bus passes driver selections made on the steering wheel mounted switches to the instrument cluster for processing and transmission to other control modules.

Instrument Cluster - Instrument Cluster

Diagnosis and Testing

Principles of Operation

For a detailed description of the instrument cluster system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of damage.

Visual Inspection

Electrical
<ul style="list-style-type: none"> ● Battery ● Fuses ● Wiring harness ● Damaged, loose or corroded connectors ● Controller Area Network (CAN) circuits ● Instrument Cluster (IPC) ● Central Junction Box (CJB) ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Instrument Cluster \(IPC\)](#) (100-00 General Information, Description and Operation).

Instrument Cluster - Instrument Cluster

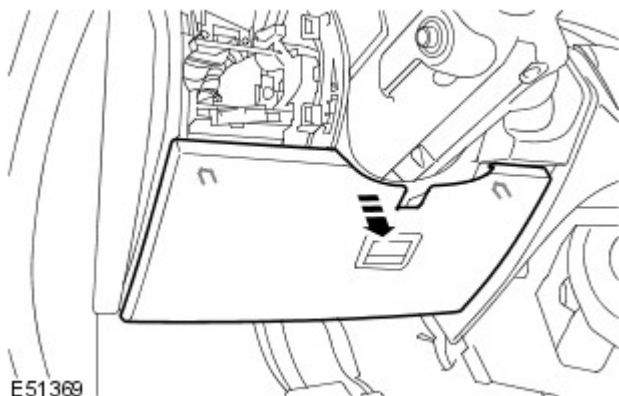
Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Fully extend the steering column for access.
2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).
3. Remove the steering wheel.
For additional information, refer to: [Steering Wheel](#) (211-04 Steering Column, Removal and Installation).
4. Remove the driver side register trim panel.
For additional information, refer to: [Driver Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).
5. Remove the instrument panel access panel.

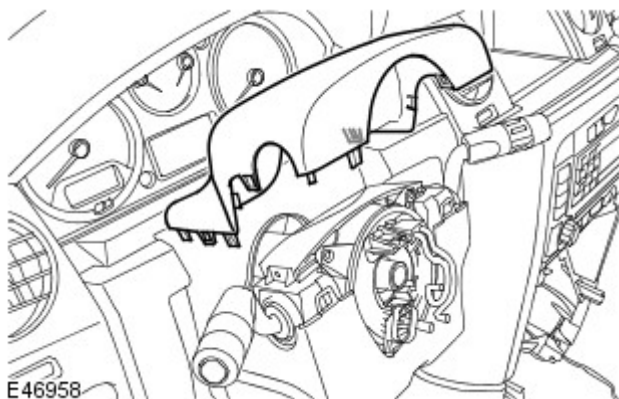
- Release the 2 clips.



E51369

6. Remove the steering column upper shroud.

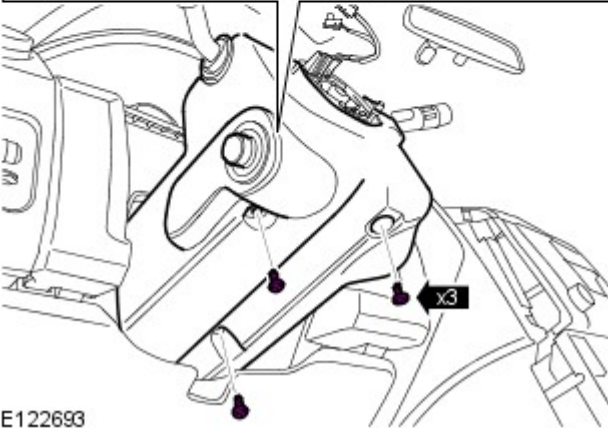
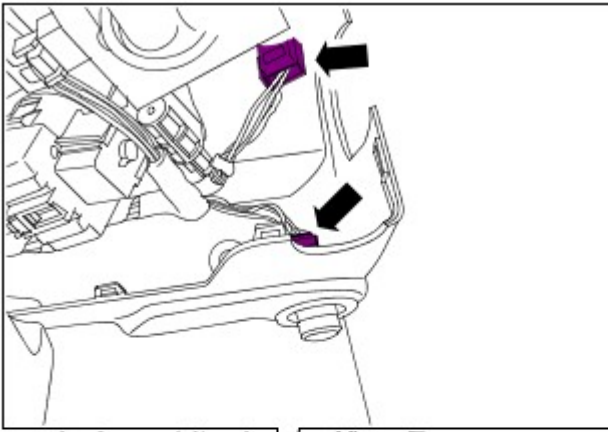
- Release the 4 clips.



E46958

7. Remove the steering column lower shroud.

- Remove the 3 Torx screws.
- Disconnect the electrical connectors.



E122693

8. Remove the audio unit control trim panel.

- Remove the 2 retaining screws.

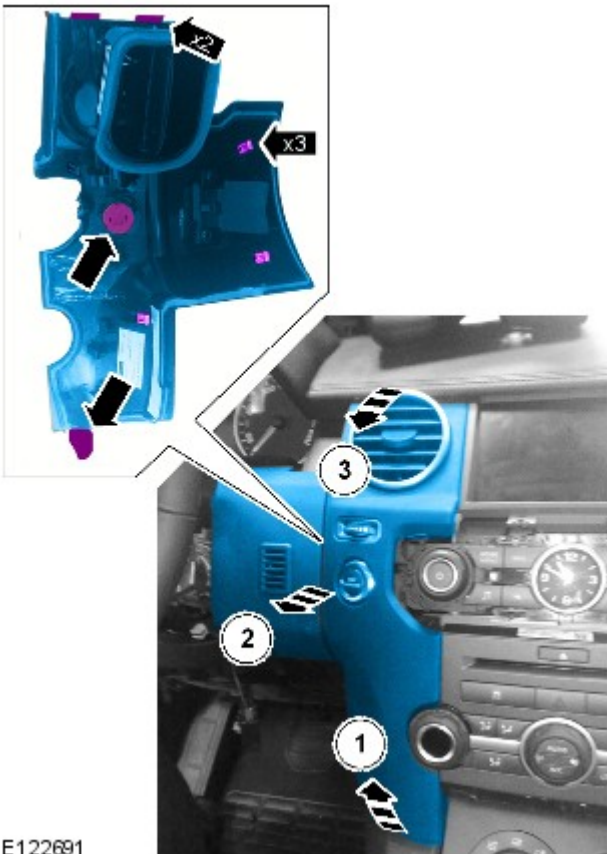


E122690

9. NOTE: Remove in the sequence shown.

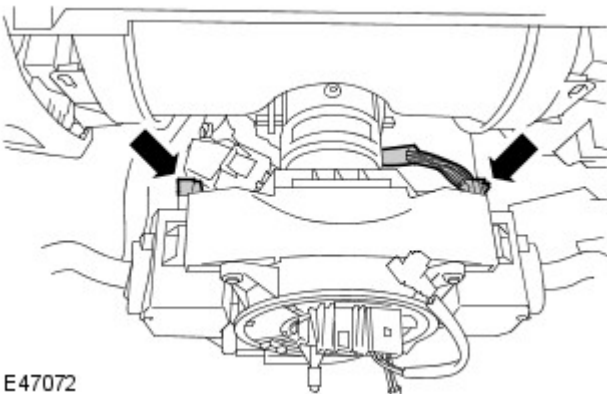
Remove the steering column side trim panel.

- Release the clips.
- Disconnect the electrical connector.



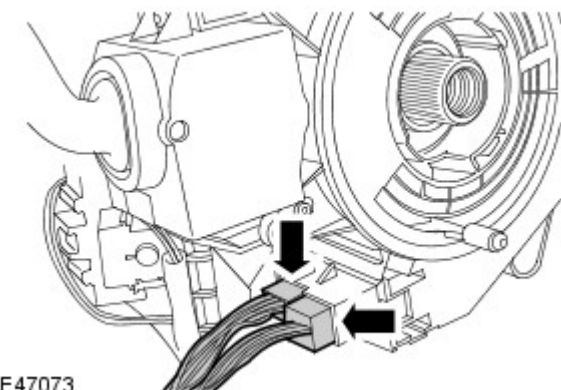
E122691

10. Disconnect the 2 electrical connectors from the steering column multifunction switches.



E47072

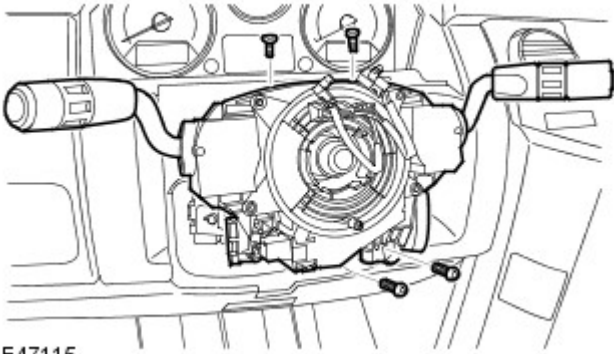
11. Disconnect the 2 electrical connectors from the clockspring.



E47073

12. Remove the steering column switch assembly.

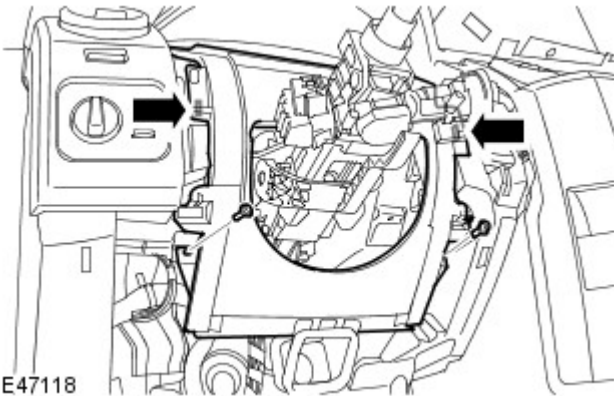
- Remove the 4 Torx bolts.



E47115

13. Remove the steering column gaiter panel.

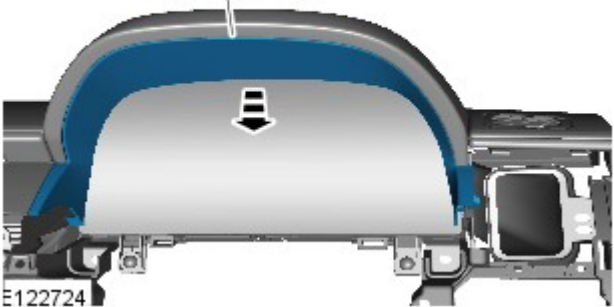
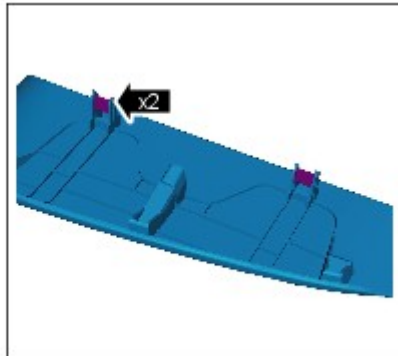
- Remove the 2 Torx screws.
- Release the 2 clips.



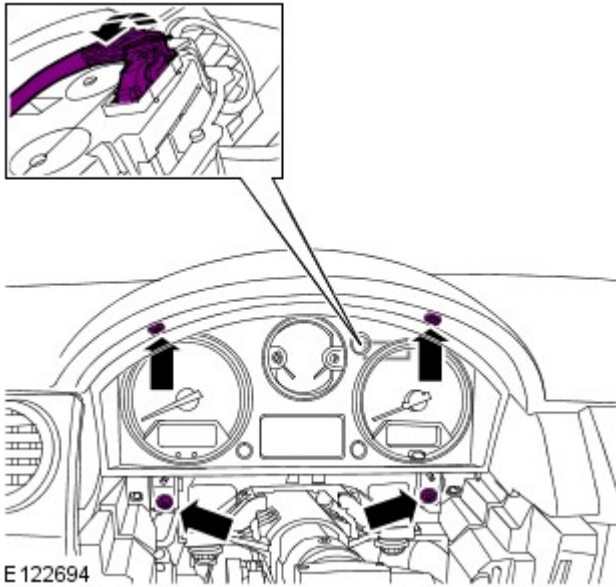
E47118

14. Remove the instrument cluster trim panel.

- Release the 2 clips.




E122724



15. Remove the instrument cluster.

- Remove the 2 Torx screws.
- Remove the 2 retaining screws.
- Disconnect the electrical connector.

Installation

1. Install the instrument cluster.
 - Connect the electrical connector.
 - Tighten the screws.
 2. Install the instrument cluster trim panel.
 - Secure the 2 clips.
 3. Install the steering column gaiter panel.
 - Secure with the clips.
 - Tighten the Torx screws.
 4. Install the steering column switch assembly.
 - Tighten the Torx bolts to 3 Nm (2 lb.ft).
 5. Connect the clockspring and multifunction switch electrical connectors.
 6.  **CAUTION:** When installing the lower locating tang of the trim panel, make sure the floor console is not damaged. If necessary protect the surrounding areas using masking tape.
 - **NOTE:** To install, reverse the removal sequence.
 - **NOTE:** Make sure that all the clips are correctly installed.
- Install the steering column side trim panel.
- Connect the electrical connector.
 - Secure with the clip.
7. Install the audio unit control trim panel.
 - Install the 2 retaining screws.
 8. Install the steering column shrouds.
 - Tighten the Torx screws.
 9. Install the instrument panel access panel.
 - Secure with the clips.
 10. Install the driver side register trim panel.
 For additional information, refer to: [Driver Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and

Installation).

11. Install the steering wheel.

For additional information, refer to: [Steering Wheel](#) (211-04 Steering Column, Removal and Installation).

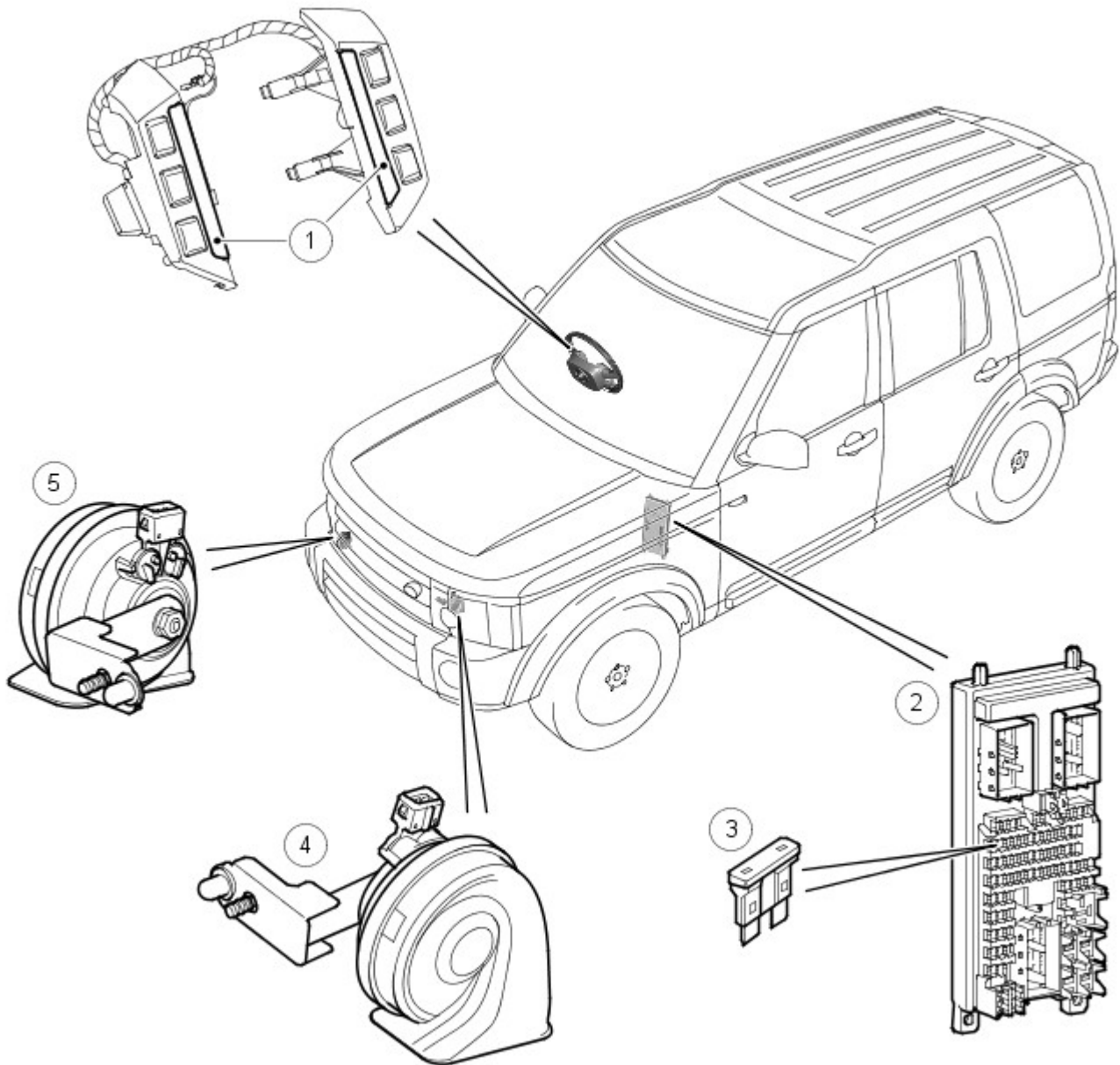
12. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-01 Battery, Mounting and Cables, Specifications).

13. Using the diagnostic tool, configure the instrument cluster.

Horn - Horn

Description and Operation



E49450

Item	Part Number	Description
1	-	Steering wheel horn switches
2	-	Central Junction Box (CJB)
3	-	Fuse 12
4	-	Horn - Low tone
5	-	Horn - High tone

GENERAL

Two horns are fitted to the vehicle; a high tone and a low tone. The horns are mounted on brackets, which are attached to the front end carrier assembly, on each side of the radiator.

The horns are operated by pressing one of the two horn switches, located on each side of the driver airbag, on the steering wheel.

The horns are also used by the vehicle alarm system. When the alarm system requires the horns to operate, the Central Junction Box (CJB) provides a ground to the horn relay solenoid, closing the relay contact which in turn supplies battery voltage to operate the horns.

For additional information, refer to: [Anti-Theft - Active](#) (419-01A Anti-Theft - Active, Description and Operation).

The horn circuit is permanently connected to battery voltage and therefore the horns can be operated at any time, irrespective of ignition switch position.

The horns are controlled by a relay which is an integral part of the CJB. The relay contact and solenoid is connected to the vehicle battery via a fusible link (Link 17) in the battery junction box and a fuse (F12) in the CJB. The horn switches, when pressed, complete a ground to the relay which energises the solenoid. The energised solenoid closes the relay contact and battery voltage is supplied to each of the horns. When the horn switch is released, the ground for the solenoid is broken, the solenoid is de-energised and the relay contact opens, cutting the voltage supply to the horns.

Horn - Horn

Diagnosis and Testing

Principles of Operation

For a detailed description of the horn system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Horn](#) (413-06 Horn, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Horn(s) condition and installation 	<ul style="list-style-type: none"> ● Battery condition and state of charge ● Fuses ● Relay ● Electrical connections ● Horn switches ● Clock spring ● Central Junction Box (CJB) ● Battery Junction Box (BJB)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Horn/s operate with a muffled tone	<ul style="list-style-type: none"> ● Low battery voltage ● Horn circuit fault ● Horn switch fault ● Horn/s faulty 	Check the battery condition and state of charge. Check the horn circuit. Check for DTCs indicating a horn circuit fault
Horn/s inoperative		

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

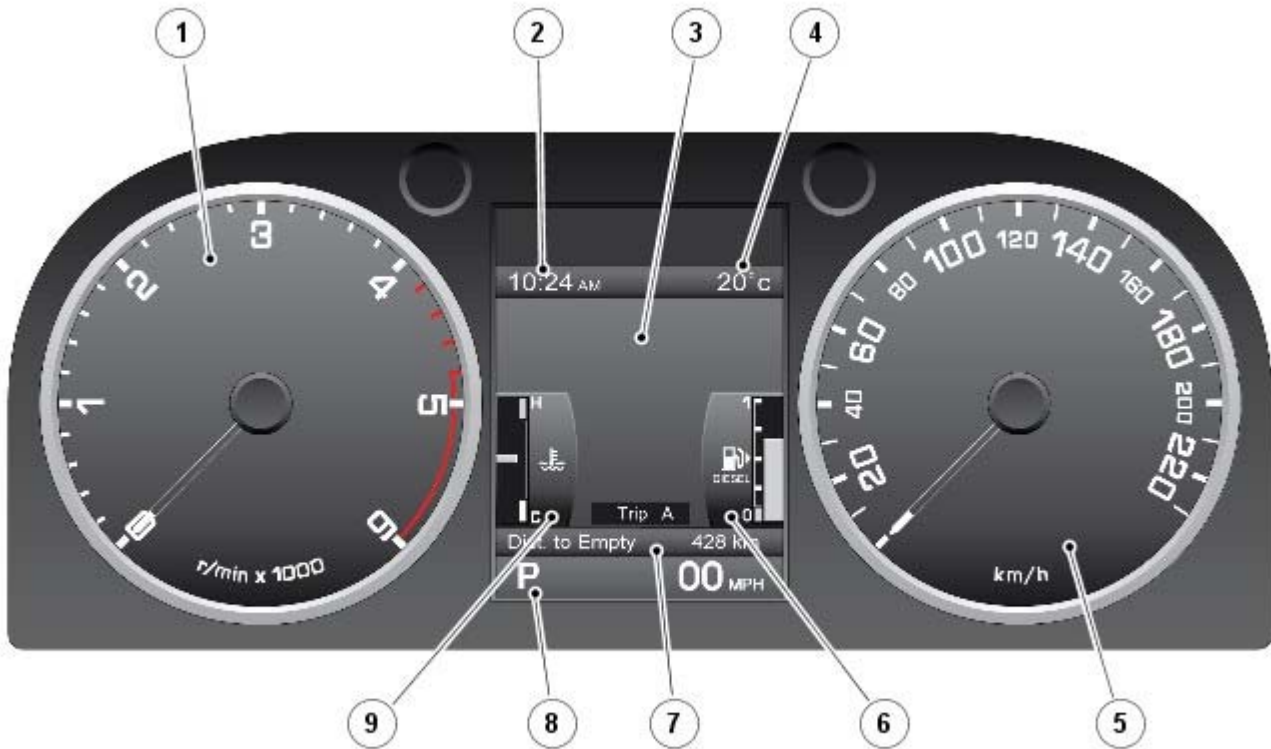
Information and Message Center - Information and Message Center

Description and Operation

OVERVIEW

A new instrument cluster is introduced where in addition to the larger speedometer and tachometer gauges the cluster also incorporates a TFT (Thin Film Transistor) 5" high-definition display unit.

Instrument Cluster Overview



E123742

Item	Part Number	Description
1	-	Tachometer
2	-	Clock
3	-	Message center
4	-	External temperature
5	-	Speedometer
6	-	Fuel gauge
7	-	Total distance odometer and trip recorder
8	-	Gear selector position display
9	-	Engine temperature gauge

The TFT display incorporates a 'Message Center' that communicates vehicle information and status data to the driver. Menus displayed in the message center allow access to a number of vehicle functions through the guidance of the message center menus. The driver operates the message center using the 'menu control' located on the right-hand-side of the steering wheel.

The instrument cluster also features a number of warning indicators, where in addition to those located within the speedometer and tachometer gauges, another six indicators are positioned within the TFT unit above the message center. Refer to the 'Instrument Cluster' section for further information.

The TFT display unit comprises three distinct areas, as shown below:

Thin Film Transistor Display Unit



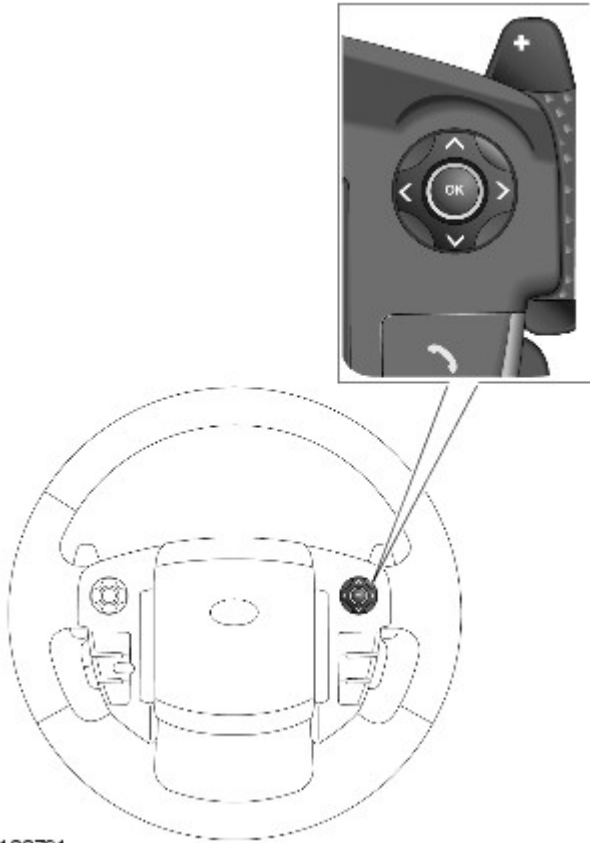
E123746

Item	Part Number	Description
1	-	Warning Indicators – this area is fixed and cannot be overwritten
2	-	Message Center – this area can be overwritten by other information
3	-	Gear Selection and Digital Speedometer Display - this area is fixed and cannot be overwritten

MESSAGE CENTER

The coolant temperature and fuel quantity gauges are the default display in the message center when the stop/start button is pressed. These can be overwritten through the guidance of message center menus, to obtain different permutations of screens which are available to communicate vehicle information and status data to the driver.

Menu Control



E123791

The driver operates the message center using the 'menu control' located on the right-hand-side of the steering wheel. A preference menu is available which allows the driver to personalize certain features and functions in the message center.

Messages displayed in the message center are mainly generated by the instrument cluster which monitors system status via the medium-speed and high-speed [CAN \(controller area network\)](#) bus systems. Other system control modules are also capable of generating messages to communicate system status. Some messages are accompanied by a chime, which is requested by the control module generating the message and functioned by the instrument cluster via the integral sounder.

The driver can view system status messages which are current in the instrument cluster [RAM \(random access memory\)](#), by pressing and releasing the menu control to display current messages in priority order; refer to 'Warning Messages'.

Vehicle Information and Settings Menu

Menu selections are made using the menu control to highlight the required menu option. Once the required option is highlighted that option can be selected by pressing the 'OK' button. The screen will then display a sub-menu, or activate the selected item where applicable.

Vehicle Information and Settings Menu



E123790

Scroll arrows to the left of the menu indicate that there are further menu items either above or below the currently viewed menu items. If the arrow is displayed brightly there are additional menu items available. If the arrows appear dim, there are no additional items. For example, the engine oil level display by can be accessed by selecting 'Service Manual' and then selecting 'Oil Level Display'.

Engine Oil Level Display



E124084

To close the main menu, press the left button on the menu control. To close sub-menus press and hold the left button on the menu control.

The menu will close automatically if:

- no action is taken with the main menu within 10 seconds
- action is taken with the main menu and it is then left for 4 minutes

If a further action is taken within the four minutes period, the timer will reset and a further four minutes will have to elapse before the menu closes automatically.

The following table contains an overview of the information and settings menu and option displays:

Close Menu	-	Close the vehicle settings and information menu.
Show Warnings	-	Display all active warning messages.
Vehicle Set-up	Forward Alert	Enable/disable the forward alert feature of the adaptive cruise control system.
	Speed Warning	Enable/disable over speed warning and set the monitored speed.
	High Beam Assist	Enable/disable the operation of the automatic headlamp high beam feature. Configure system for driving on the alternate side of road. Note: Headlamps still need to be manually adjusted.
	Alarm Sensors	This setting allows you to temporarily disable the vehicle's interior space protection and tilt sensor the next time the vehicle is locked with Smart Key. This setting is automatically enabled when the vehicle is unlocked with the Smart Key.
	Reverse-dip Mirror	Enable/disable automatic dipping of exterior mirrors when reverse gear is selected.
	Drive-away Locking	Enable/disable automatic locking off the doors when the vehicle speed exceeds 8 km/h (5 mph).
	2-Stage Unlocking	Enable/disable the single-point entry door unlocking feature.
	Headlamp Delay	Enable/disable the headlamp delay feature. Configure the amount of time the headlamps will remain on: 30, 60, 120 or 240 seconds.
	TPM Load Setting	Change the monitored tire pressures for the vehicle loading conditions: <ul style="list-style-type: none"> ● Heavy Load ● Light Load
Trip Computer	Trip A	Enable/disable display of Trip A readings.
	Trip B	Enable/disable display of Trip B readings.
	Trip Auto	Enable/disable display of Trip Auto readings.
	Units	Select the units to be displayed by the trip computer: <ul style="list-style-type: none"> ● Miles, MPH, MPG ● Miles, MPH, MPL ● Km, km/h, l/100 km
Display Settings	Language	Select the language for text displayed in the message center.
	Temperature	Select the units for the external temperature reading: <ul style="list-style-type: none"> ● Celsius ● Fahrenheit
Service Menu	VIN Display	Displays the Vehicle Identification Number.
	Oil Level Display	Displays the oil level display.
	HBA Sensitivity	Change sensitivity of High Beam Assist system: <ul style="list-style-type: none"> ● Normal Mode ● Alternate Mode

Warning Messages

Warning messages are displayed in the message center when a fault is detected or an alert state is triggered. There are three categories of messages that may be displayed in the message center; the driver is made aware of the message by an accompanying warning indicator illuminating.

The warning indicators illuminate in one of three colors, which indicate the level of importance of the warning as follows:

- Critical = red indicator accompanied with and audible alert
- Warning = amber indicator
- Information = green indicator.

• **NOTE:** Messages are displayed in order of importance with 'Critical' messages taking priority.

Priority Group 'P1' **Critical** - This group includes messages which have a direct affect on the driving ability and safety of the vehicle. This type of message requires an urgent and immediate reaction from the driver in response to the message. P1 messages are also accompanied by an appropriate warning indicator symbol and an audible alert. If more than one P1 message is present, each message is displayed in turn at 3 second intervals. Critical messages are displayed in the message center until either the fault condition that caused the message has been rectified or the message is suppressed by using the menu control on the steering wheel. Critical messages can also be recalled by using the menu control. If a critical message has been suppressed the accompanying warning symbol will remain illuminated to indicate that a problem exists.

Priority Group 'P2' **Warning** - This group includes messages which do not directly affect driving ability or safety of the vehicle. P2 messages are also accompanied by appropriate warning indicator symbol. This message must be noted by the driver and the cause rectified as soon as possible. Each message is indicated once for a maximum of 23 seconds. Warning messages are displayed in the message center until either the fault condition that caused the message has been rectified or the message is suppressed by using the menu control on the steering wheel. Warning messages can also be recalled by using the menu control. If a warning message has been suppressed the warning symbol will remain illuminated to indicate that a problem exists.

Priority Group 'P3' **Information** – This group displays messages which relate to fluid levels 'LOW WASHER FLUID' for example, or when an alert state is triggered when driving the vehicle. For example, cancelling cruise control will display the message 'CRUISE CANCELLED'. Depending on the message, some are only displayed at the end of a journey to avoid irritation to the driver. Information messages are displayed for four seconds before extinguishing.

Information Message



E123786

The messages are displayed in a language applicable to the vehicle market configuration and can be changed using the instrument cluster menu. The following list shows the possible messages which can be displayed.

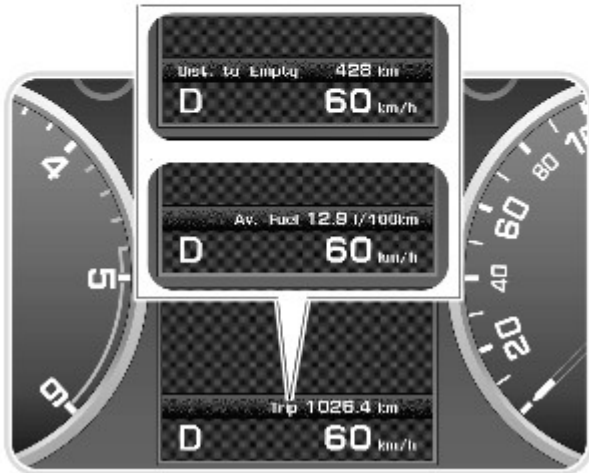
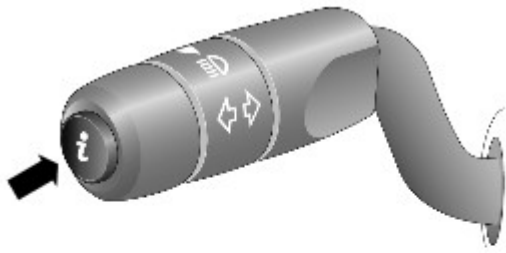
- **NOTE:** If the instruction given in the 'Action' column does not resolve the message display, use the [Workshop Manual Diagnosis and Testing](#) section for the applicable vehicle system to determine the fault and perform any additional action required.

AMBIENT TEMPERATURE

The ambient temperature is displayed in the right-hand position at the top of the message center. The temperature can be displayed in Fahrenheit or Centigrade and this is selectable by the driver using the instrument cluster menu.

ODOMETER AND TRIP METER

Trip Meter



E123787

The odometer is located in a central position at the bottom of the message center. In addition to displaying the total distance the vehicle has traveled. Short presses of the 'i' button, on the end of the 'left-hand' steering column multifunction switch will scroll through the following statistics:

- Odometer
- Trip distance
- Trip average speed
- Trip average fuel consumption
- Instantaneous, short term average, fuel consumption
- Range available from remaining fuel
- Blank display

There are three trip memories available: A, B and Auto. The instrument cluster menu is used to select which trip recording is displayed.

The Auto trip is always available and is reset each time the engine is started and the vehicle moves. Previous trips can be added to form a continuous trip recording by pressing and holding the trip button when the automatic trip information is displayed. The message center will confirm that the previous journey information has been added and pressing and holding the trip button for 1 second will add the data. The previous trip information can also be deleted by pressing and holding the trip button when the automatic trip information is displayed. The message center will confirm deletion of the previous journey data and pressing and holding the trip button for 1 second will delete the previous trip information.

Trip A and B can be reset by the driver at any time. When the required trip information is displayed, pressing and holding the trip button for 2 seconds will erase the previous trip information stored. Resetting trip A or B will not affect the other trip information, for example, if trip A is reset, trip B will retain its information until it is reset.

GEAR POSITION DISPLAY

Gear Position Display



E123789

The gear position shows the current selector position: P, R, N, D or S.

When the transmission is in manual 'CommandShift' mode, the display will show the currently selected gear S1, S2, S3, S4, S5 or S6.

The gear position is illuminated in response to 'CAN' bus messages from the [TCM \(transmission control module\)](#).

The instrument cluster has no control over the gear position display and obtains the information by monitoring the controlling CAN bus messages. If the instrument cluster detects ten incorrect CAN bus messages, 'TRANS. FAILSAFE PROG' is illuminated in the message center.

If a correct CAN bus message is received when the ignition is next switched on, the error is erased and the message removed.

SERVICE INTERVAL INDICATOR

A service interval message will automatically appear in the message center when a pre-determined distance or time before a scheduled service is reached. The kilometer or mileage countdown is controlled by the engine management system and is adjusted to allow for driving style and conditions to gauge when the appropriate service becomes necessary.

Service Interval Message



E123788

The service indicator displays information calculated by the [ECM \(engine control module\)](#) to the remaining distance to the next service based on the amount of fuel used since the last service interval indicator reset.

The ECM counts down the distance to engine service and the instrument cluster rounds this down to the nearest 50 miles. The fuel used based count down starts from 3200 miles displaying the required figure in the trip computer message center, for example 'Service Required in 1950 miles'.

When the ECM has calculated the distance to service is 0 miles, the ECM will request the instrument cluster to display 'Service Required' in the message center.

The ECM also monitors and calculates when the time to the next oil service is required, 'Service Required' is displayed in the message center. This message takes priority over the distance to service calculation.

The service information is displayed in the message center for 4 seconds at each ignition cycle. There is no minus figure if the service distance is exceeded, 'Service Required' is displayed until the ECM service counter is reset using an approved diagnostic system.

Information and Message Center - Information and Message Center

Diagnosis and Testing

Principles of Operation

For a detailed description of the information and entertainment system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Multi-Media Remote Control Switch ● Multifunction Display Screen 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Electrical connector(s) ● Battery condition, state of charge ● Multi-Media Remote Control Switch ● Multifunction Display Module

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Instrument Cluster \(IPC\)](#) (100-00 General Information, Description and Operation).

Warning Devices -

Torque Specifications

Description	Nm	lb-ft
Low tire pressure module bolts	10	7

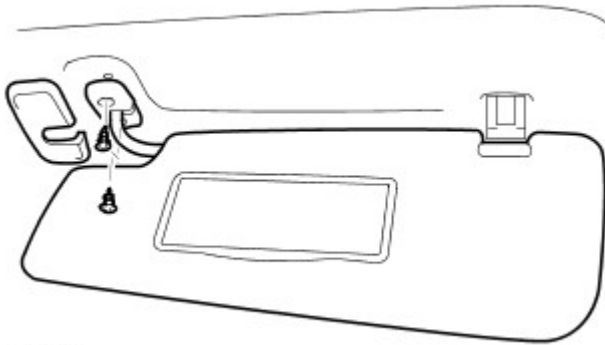
Warning Devices - Low Tire Pressure Module

Removal and Installation

Removal

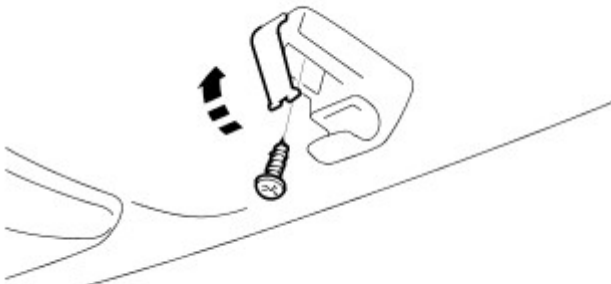
• NOTE: If the tire pressure module is to be replaced then T4 must be connected and the correct procedures adhered to, prior to battery disconnection.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the LH A-pillar upper trim panel.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the LH B-pillar upper trim panel.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the LH C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Remove the LH sun visor.
 - Remove the cover.
 - Remove the 2 screws.
 - Disconnect the electrical connector.



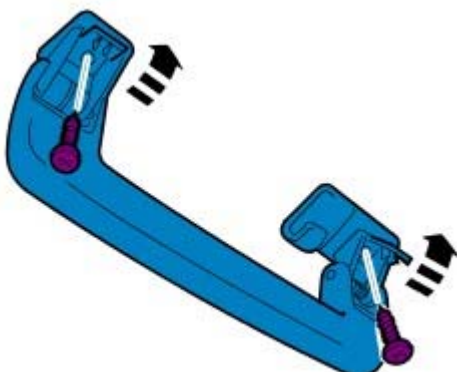
E49766

6. Remove the sun visor retaining clip.
 - Release the screw cover.
 - Remove the screw.

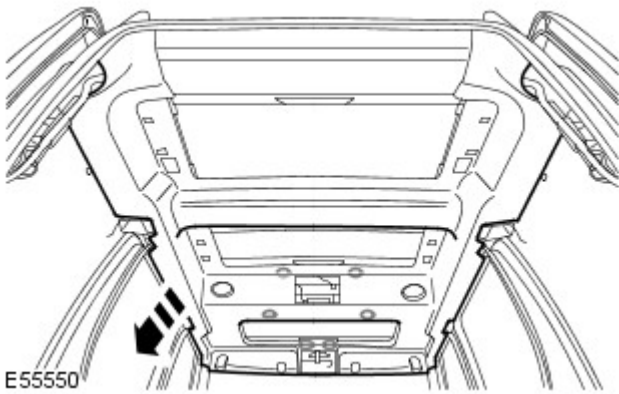


E49688

7. Remove the LH passenger assist handles.
 - Carefully release the 6 screw covers.
 - Remove the 6 screws.

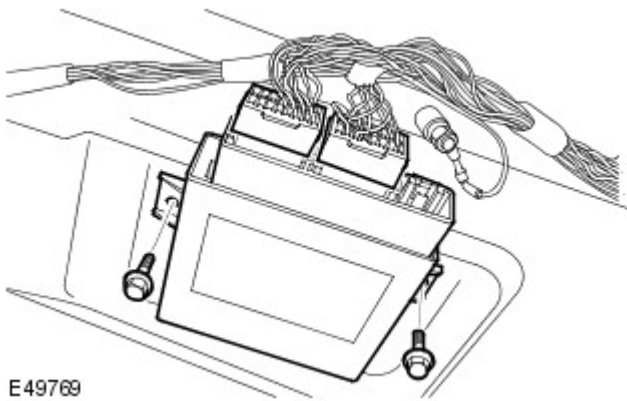


E49689



8. Release the LH side of the headliner.

- Release the 6 clips.



9. Remove the low tire pressure module.

- Disconnect the 2 electrical connectors.
- Remove the 2 bolts.

Installation

1. Install the low tire pressure module.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect the electrical connectors.

2. Secure the LH side of the headliner.

- Carefully secure the clips.

3. Install the LH passenger assist handles.

- Install the screws.
- Install the screw covers.

4. Install the sun visor retaining clip.

- Install the screw.
- Install the screw cover.

5. Install the LH sun visor.

- Install the screws.
- Install the screw covers.
- Connect the electrical connector.

6. Install the LH C-pillar upper trim panel.

For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Install the LH B-pillar upper trim panel.

For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

8. Install the LH A-pillar upper trim panel.

For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

9. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Protection System -

Torque Specifications

Description	Nm	lb-ft
Passive anti-theft system (PATS) module bolts	10	7

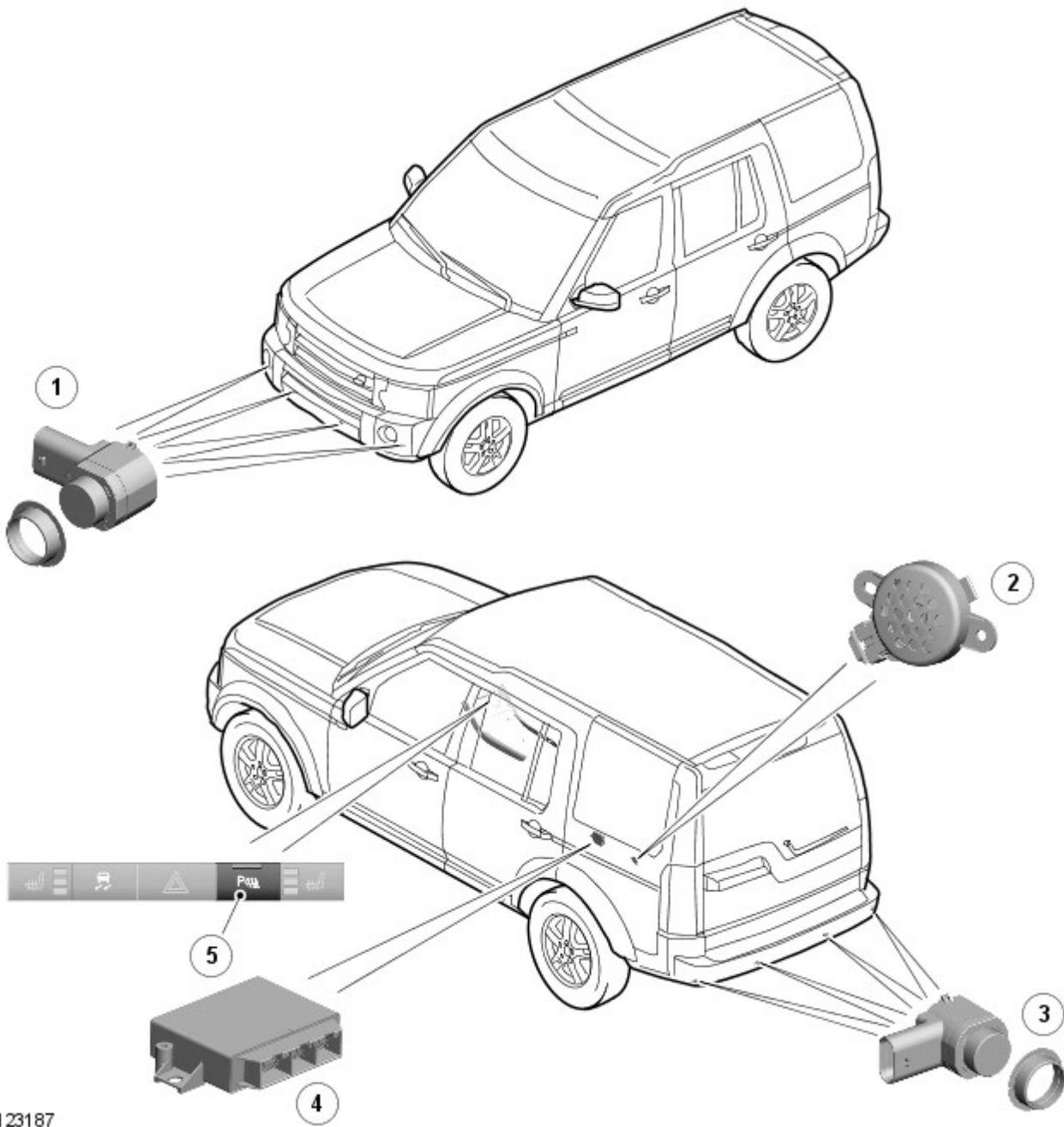
Parking Aid -

Description	Nm	lb-ft
Parking aid module nuts	5	4

Parking Aid - Parking Aid

Description and Operation

Parking Aid Component Location



E123187

Item	Part Number	Description
1	-	Front sensors
2	-	Parking aid sounder
3	-	Rear sensors
4	-	Parking aid module
5	-	Parking aid switch

OVERVIEW

A proximity camera system has been introduced as an optional fit. The system provides additional guidance to the driver when maneuvering at low-speeds and parking the vehicle. The proximity camera system is discussed in detail after the 'Parking Aid' section.

The camera system has also been developed to aid the driver when towing and reversing a trailer; refer to 'Tow Assist' for further information.

PARKING AID OVERVIEW

The parking aid provides an audible warning to the driver when any obstacles are in the path of the vehicle during a forward (if front sensors fitted) or reversing manoeuvre. The purpose of the system is to assist the driver when parking or

maneuvering in restricted space. It is not designed as a crash avoidance system or a replacement for visual interpretation by the driver.

The parking aid system is not standard on all vehicles and some vehicles may be fitted with rear sensors only. Higher specification vehicles may be fitted with both front and rear sensors.

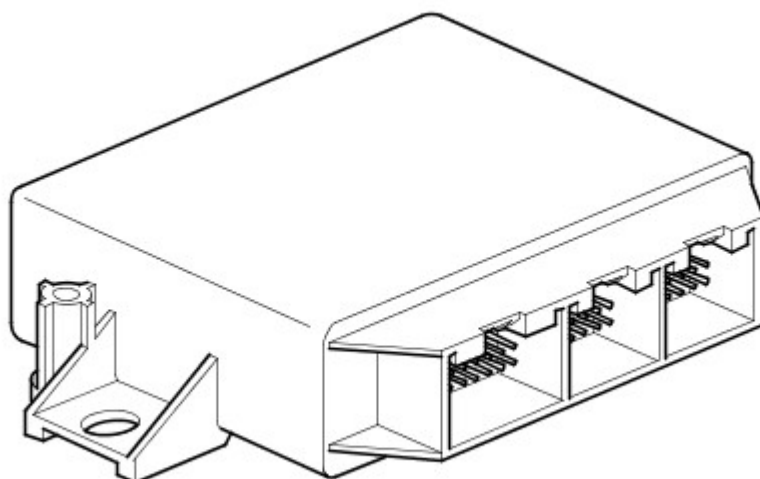
The system comprises 4 ultrasonic sensors in the rear bumper, 4 ultrasonic sensors in the front bumper (if fitted), a control module, a fascia mounted control switch, a rear sounder unit and a front sounder unit (integral with the instrument cluster).

The system operates using ultrasonic signals which are transmitted by the sensors. The reflected echo from this output is received by the sensors and used by the parking aid module to calculate the distance from an object.

The fascia mounted switch allows the driver to deactivate the rear and front (if fitted) parking aid system, if operation is not required.

Parking Aid Module

The parking aid module is located in the rear left hand side of the luggage compartment, behind the side trim panel.



E44157

The parking aid module uses a single microprocessor to perform the following tasks:

- Control of the ultrasonic sensors
- Monitoring of the sensors
- Evaluation of received echo signals from the sensors
- Noise and disturbance suppression
- Control of the parking aid sounders
- Monitoring of the sounders and associated wiring
- Control and monitoring of the switch status **LED (light emitting diode)** and associated wiring
- Evaluation and monitoring of the control inputs
- Management of diagnostic and test functions
- Monitoring of power supply
- Communication via diagnostic link.

Inputs and Outputs

Three connectors on vehicles with front and rear sensors and two connectors on vehicles with rear sensors only provide the interface between the parking aid module and the external parking aid components.

The module receives inputs from the following:

- Reverse selected - **CAN (controller area network)** message from transmission control module (automatic transmission) or transfer box control module (manual transmission)
- Forward gear selected (not in reverse or neutral) - CAN message from transmission control module (automatic transmission) or transfer box control module (manual transmission)
- Parking aid switch
- Parking brake applied - CAN message
- Trailer fitted - CAN message for **CJB (central junction box)**
- Ignition - power supply

The module outputs signals to the following:

- Sensors - power and ground connections
- Sensors - digital signal - transmit and receive signals
- Rear sounder - varying frequency output
- Front sounder - CAN message to instrument cluster
- Parking aid switch - power supply for switch LED operation

Controller Area Network (CAN) Signals

The parking aid module sends and receives a number of digital signals via the medium speed CAN. The received signals are used for operation of the parking aid system.

The parking aid module receives the messages shown in the following table which are used to control the parking aid system.

Message	Transmitted by
Vehicle speed	ABS (anti-lock brake system) module
Selected gear position - Automatic transmission	Transmission control module
Selected gear position - Manual transmission	Transfer case control module
Electric park brake on/off	Electric park brake module
Vehicle movement status	ABS module
Trailer connected	CJB
Ambient temperature	ATC (automatic temperature control) module
Engine running status	Diesel engine control module
Stored odometer reading	Instrument cluster
Vehicle voltage level	Instrument cluster
Minute counter	Instrument cluster
Car configuration	Instrument cluster
Diagnostic physical request	A Land Rover approved diagnostic system via diagnostic socket
Diagnostic functional request	A Land Rover approved diagnostic system via diagnostic socket
Master configuration identification	Instrument cluster

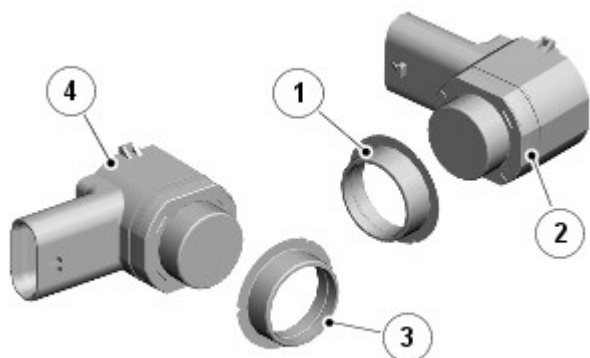
Diagnostics

The parking aid module has a diagnostic connection via the medium speed CAN to enable faults to be retrieved using a Land Rover approved diagnostic system. Additionally, an on-board diagnostic routine within the parking aid module constantly monitors the system and alerts the driver to a system fault by emitting a tone from the front or rear sounder, depending on the fault.

If a parking aid system fault has occurred, the parking aid module will relay the occurrence of the fault to the driver in the following ways:

- The status LED will flash at a frequency of 2Hz if the system is active and fault is detected in the sensors, sounders, related wiring or the module.
- The front sounder will emit an error tone for 3 seconds at a frequency of 1500Hz if a fault is detected with the front sensors or the rear sounder develops a fault.
- The rear sounder will emit an error tone for 3 seconds at a frequency of 1500Hz if a fault is detected with the rear sensors, the switch, the LED in the switch or if there is a CAN bus error.

Sensors



E125149

Item	Part Number	Description
1	-	Front sensor housing
2	-	Front sensor
3	-	Rear sensor housing
4	-	Rear sensor

Four sensors are positioned in the rear bumper and the front bumper (if fitted). Each sensor housing has two raised location keys which locate in corresponding grooves in the bumper mounting hole and sets the correct orientation for the sensor bodies. The housings are clipped into the bumper from the front. The sensors are then clipped into the housings from the rear.

Each sensor has a three pin connector which connects into a common harness linking all four sensors. This harness is connected to the main vehicle body harness for the rear sensors or the engine compartment harness for the front sensors. The three pins are for sensor negative and positive feeds and a signal line.

Each sensor comprises a plastic housing which contains a piezoelectric disc. The disc resonates at a frequency of 38.4 kHz, producing an ultrasonic signal output. The disc also receives the reflected echo signal.

The parking aid module controls the operating mode of each sensor by the output of a digital signal on the signal line. Each sensor has two modes of operation; combined transmitter and receiver mode or receiver mode only.

In the combined mode, the sensor emits a series of ultrasonic impulses and then switches to receiver mode to receive the echo reflected by an obstacle in the detection range. These echo signals are amplified and converted from an analogue signal to a digital signal by the sensor. The digital signal is then transmitted to the parking aid module and compared with

preprogrammed data stored in an **EEPROM (electrically erasable programmable read only memory)** within the module. The module receives this data via the signal line from the sensor and calculates the distance to the obstacle according to the elapsed time between the transmitted and received impulse. The duration of the impulse transmission is determined by the module. The frequency of the impulse is determined by the sensor.

In the receiver mode, the sensor will receive impulses that were emitted by adjacent sensors. The module uses this information to precisely determine position and distance of the obstacle.

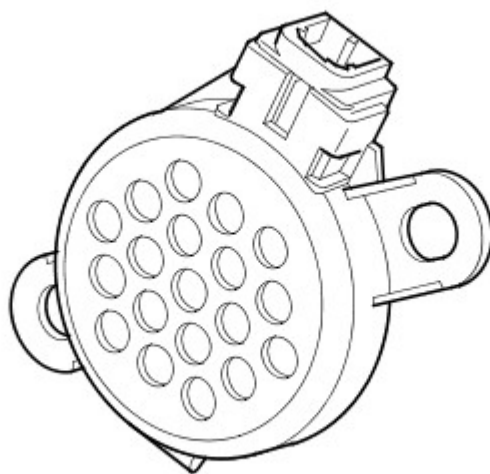
Parking Aid Switch



E 122823

The parking aid switch, located in the center console, is non-latching with an integral LED. The switch receives a 12V output to drive the LED when required. The switch is also connected to ground. When the switch is operated, the momentary completion of the ground is interpreted by the parking aid module as a signal to enable or disable the parking aid system.

Parking Aid Sounder



E44161

The parking aid sounder is controlled by the parking aid module and emits a series of tones of varying frequency to inform the driver of the distance between the vehicle and a detected object.

The rear parking aid sounder is located in the left-hand side of the luggage compartment, behind the side trim panel, below the window. The sounder is secured with two, self tapping screws into the body. The sounder is connected to the parking aid module via a harness connector.

The front parking aid uses the instrument cluster sounder and is activated by CAN messages from the parking aid module to the instrument cluster.

PARKING AID OPERATION AND DISTANCE CALCULATION

On vehicles with rear only parking aid sensors, when reverse gear is selected, the parking aid sensors are automatically activated. The parking aid module only activates the system if reverse is selected for more than 1 second. This avoids nuisance audible warnings when the gear selector lever is being moved between Drive and Park.

When the rear system is activated, the parking aid module illuminates the indicator LED in the parking aid switch, switches on the ultrasonic sensors and generates a single chime on the parking aid sounder to indicate the system is active. If an object is in the range of the sensors when the system is activated, a series of audible warnings are emitted by the parking aid sounder immediately.

If parking aid operation is not required, it can be suspended temporarily by pressing the parking aid switch. On vehicles with rear only parking aid sensors, the system can be enabled again by pressing the switch again or switching the ignition

'off' then 'on'. The parking aid will then automatically become active again in reverse gear. The system also remains on when going from reverse gear to neutral. The assumption being that the driver may still want to manoeuvre the vehicle going backwards in neutral.

The parking aid module receives a signal on the CAN from the CJB when a trailer is fitted. When this signal is detected, the parking aid module suspends operation of the rear parking aid sensors.

On vehicles with front and rear systems, the front system is activated when the ignition is 'on', the vehicle is out of Park and the EPB (electronic parking brake) is off. If the vehicle speed subsequently goes above approximately 10 mph (16 km/h), the front system will switch off. When the speed drops below approximately 6 mph (16 km/h), the front system activates again. If the EPB is applied or Park is selected, the Parking Aid system is deactivated.

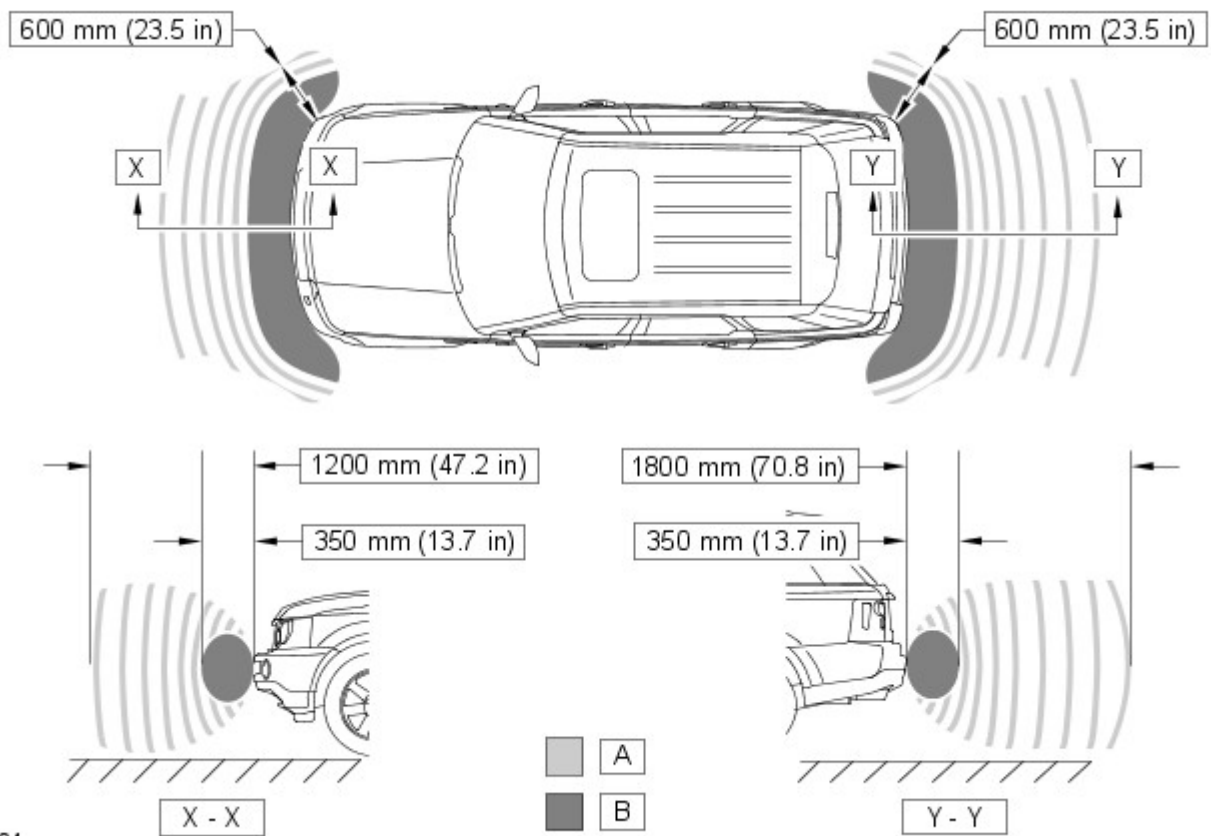
Sensor Operation

The parking aid module processes the distance readings from the ultrasonic sensors to determine if there are any objects within the detection areas. If there are no objects in the detection areas, there are no further audible warnings. If an object is detected, repeated audible warnings are produced on the parking aid sounder.

The maximum detection range is 1800 mm (70 in). When an object is detected, the time delay between the audible warning tones decreases as the distance between the detected object and the vehicle decreases until, at approximately 350 mm (13.7 in), the audible warning tone is continuous.

After the initial detection of an object, if there is no decrease in the distance between an object and the central sensors, the time delay between the audible warnings remains constant. If an object is detected by one of the corner sensors only, the audible warnings stop after about 5 seconds if there is no change in the distance between the object and the corner sensor.

Detection Area



E57204

Item	Part Number	Description
A	-	Intermittent Warning Tone
B	-	Continuous Warning Tone

Detection Calculation

When operating in the combined transmitter and receiver mode, the sensor outputs a number of ultrasonic pulses and receives the reflected echo signal. The parking aid module amplifies the received echo signals and compares them with a preprogrammed threshold to calculate the distance to the object. This is achieved by determining the elapsed time between the transmission and reception of the ultrasonic signal.

When operating in receiver mode, the sensor receives echo signals transmitted by an adjacent sensor. This mode is used to improve the accuracy of the system.

The detection cycle consists of the parking aid module operating one sensor in the combined transmitter and receiver mode and transmitting a number of ultrasonic pulses. The module then switches the transmitting sensor and the adjacent sensor(s) to receiver mode. After a short time delay, this sequence is repeated using a different sensor to transmit the ultrasonic pulse and continues until all four sensors have output an ultrasonic signal. This sequence is completed in 100ms. The module uses several measurements of the same sensors to remove errors from the calculation.

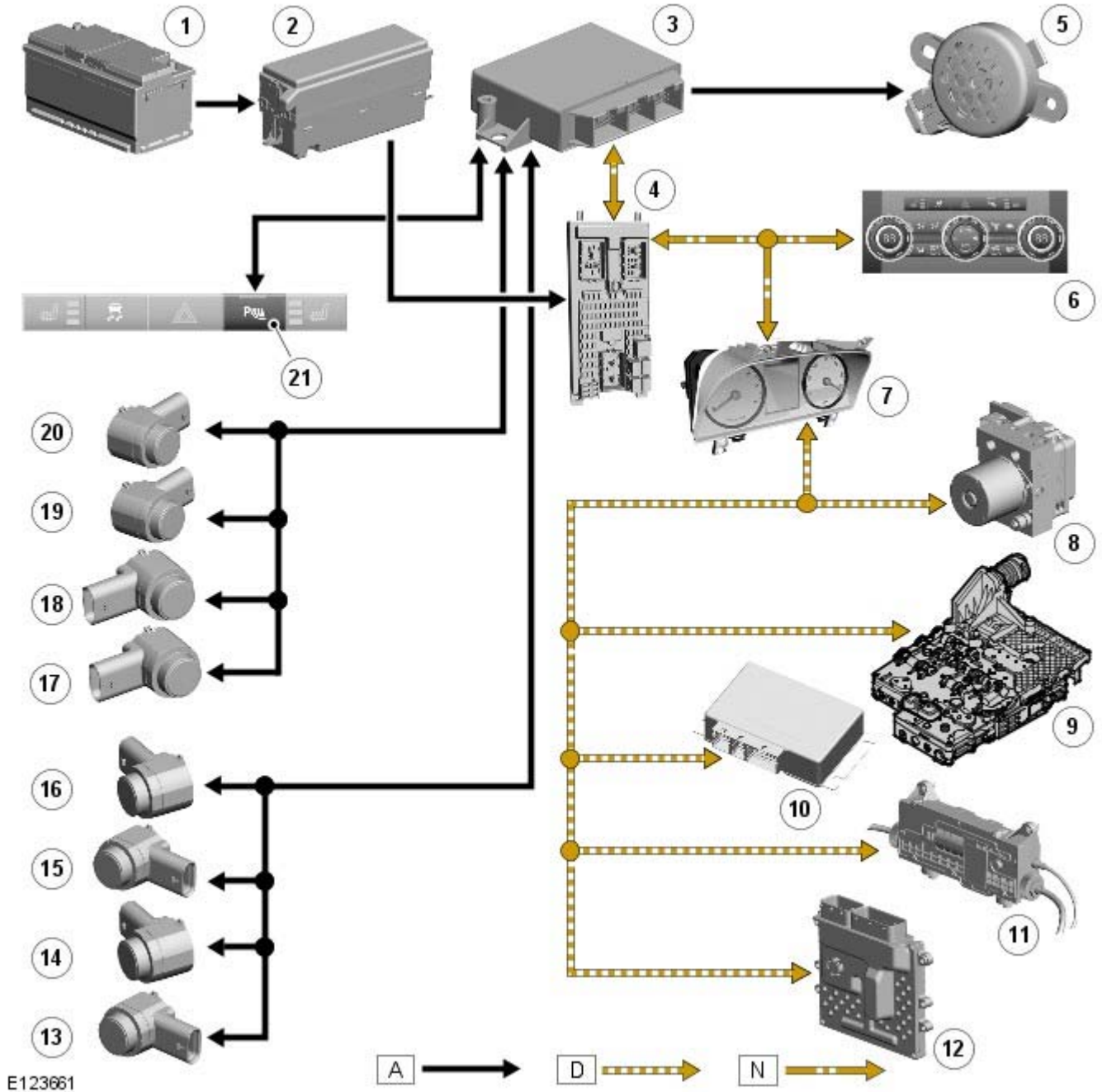
If the object is directly behind a sensor, the distance is calculated using the time between the transmission and reception of the signal. If the object is positioned between two sensors, the parking aid module uses both signals to determine the correct distance using triangulation.

To perform the triangulation calculation, the parking aid module must know the distance between the individual sensors in the bumper. This information is stored in the module memory. From the received distance from each sensor and using the known distance between adjacent sensors, the module can calculate the minimum distance from the vehicle to the object.

When approaching several objects, the module recognizes the distance from the vehicle to the nearest object.

CONTROL DIAGRAM

• NOTE: **A** = Hardwired; **D** = High Speed CAN Bus; **N** = Medium Speed CAN Bus



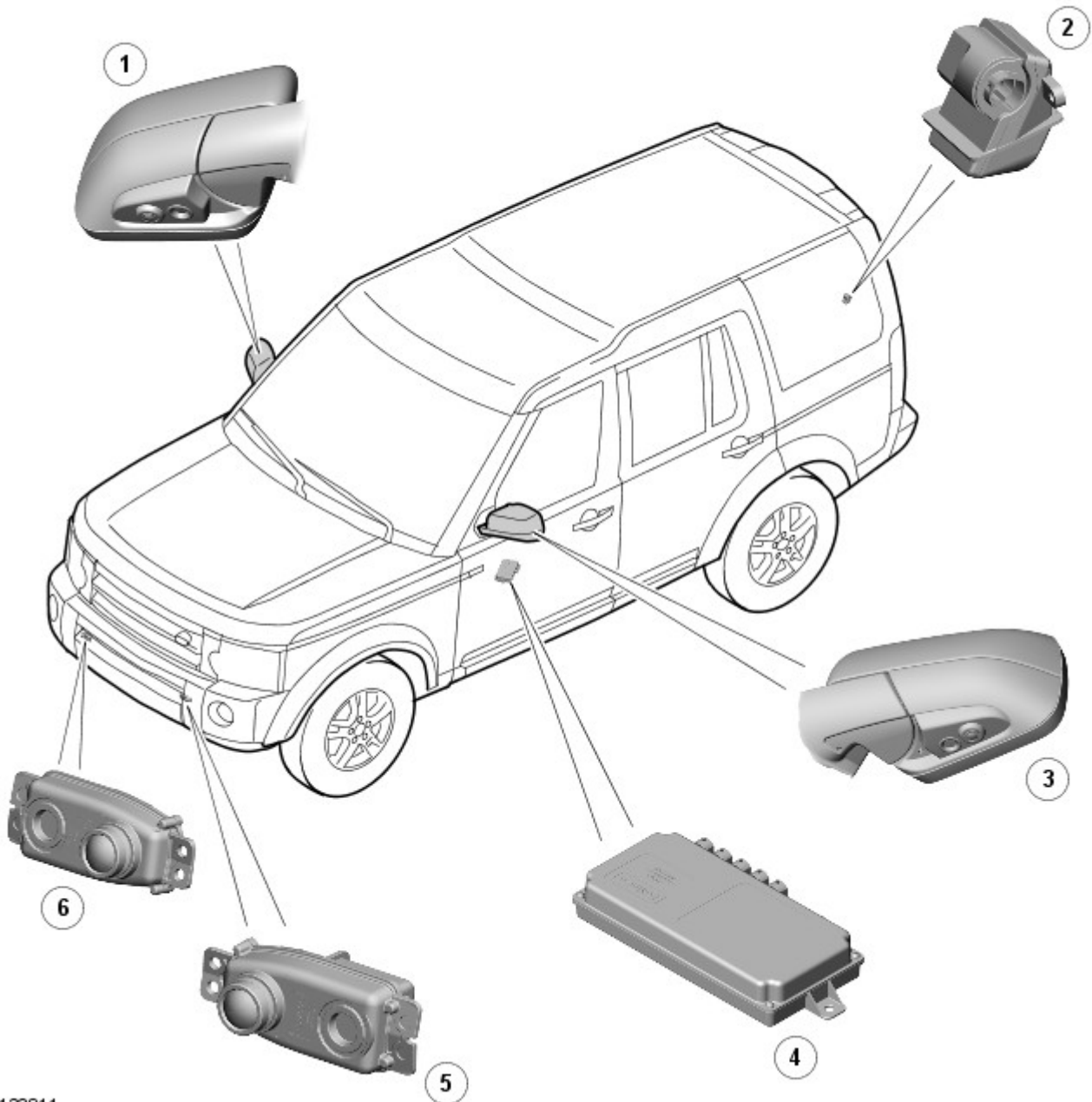
E123661

Item	Part Number	Description
1	-	Battery
2	-	Battery Junction Box (BJB)
3	-	Parking aid module
4	-	Central Junction Box (CJB)
5	-	Rear parking aid sounder
6	-	Automatic Temperature Control (ATC) module
7	-	Instrument cluster
8	-	ABS module
9	-	Transmission control module
10	-	Transfer box control module
11	-	Electric park brake module

12	-	Engine control module
13	-	Left outer front sensor
14	-	Left inner front sensor
15	-	Right inner front sensor
16	-	Right outer front sensor
17	-	Left outer rear sensor
18	-	Left inner rear sensor
19	-	Right inner rear sensor
20	-	Right outer rear sensor
21	-	Parking aid switch

PROXIMITY CAMERA SYSTEM

Proximity Camera Component Location



E123811

Item	Part Number	Description
1	-	Right-hand mirror camera
2	-	Rear view camera
3	-	Left-hand mirror camera
4	-	Control module
5	-	Left-hand-front bumper camera
6	-	Right-hand-front bumper camera

OVERVIEW

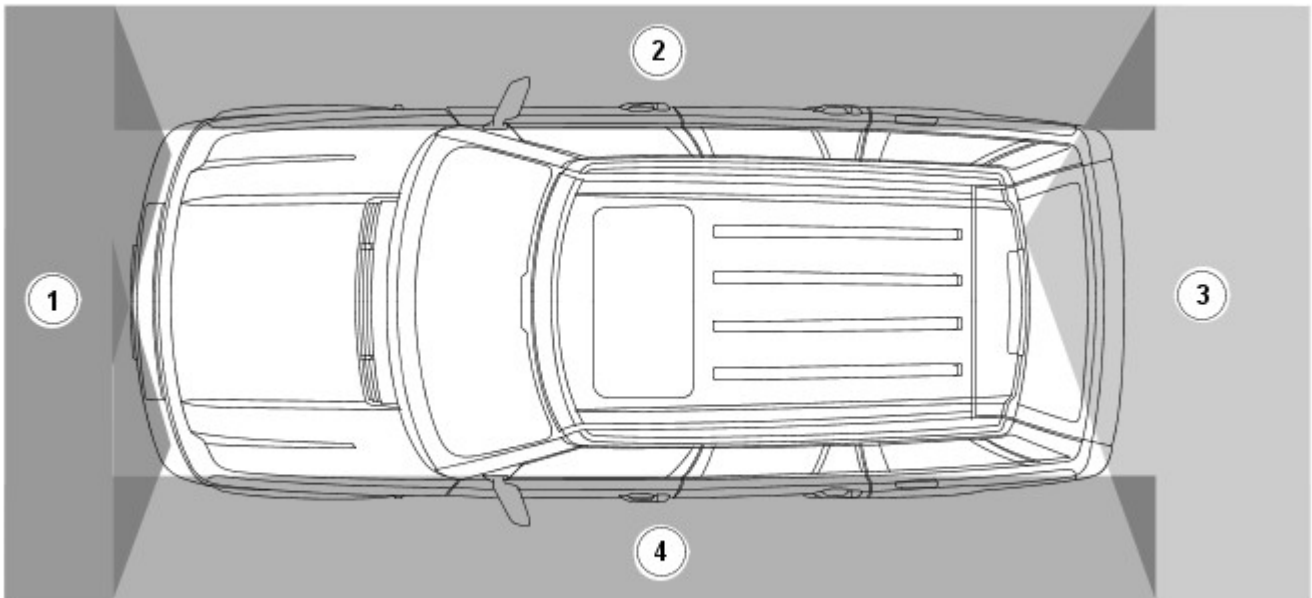
The proximity camera system provides the driver with a visual-aid when maneuvering the vehicle at low speeds. The

system uses a dedicated control module to capture the camera data and display the resulting images on the TSD (Touch Screen Display), providing the driver with a 360° view around the vehicle. The camera system is also supported by various driving-aid features where graphical information and warnings are superimposed onto the images displayed on the TSD.

The proximity camera system uses five VGA (Video Graphic Array) resolution cameras:

- two mounted in the front bumper
- one mounted in each door mirror
- one mounted in the rear tailgate handle assembly.

Camera Coverage Zones

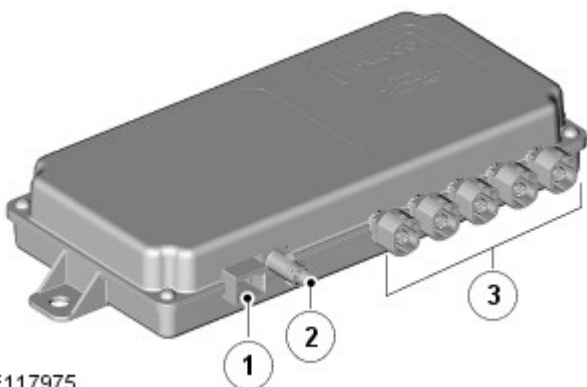


E117972

Item	Part Number	Description
1	-	Front camera coverage zone
2	-	Right-hand mirror camera coverage zone
3	-	Rear camera coverage zone
4	-	Left-hand mirror camera coverage zone

SYSTEM DESCRIPTION

Proximity Camera Control Module



E117975

Item	Part Number	Description
1	-	Power supply, ground and BUS connector
2	-	Connection to touch screen display
3	-	Five camera connections

The proximity camera control module is located under the left-hand-front seat; connections to the module include:

- medium speed CAN network
- five camera inputs
- video signal output to the TSD
- power supply and ground.

The control module gathers the camera images and analyses and alters them by adjusting perspectives and applying corrections. The resulting processed images are then relayed to the touch screen display via the NTSC (National Television System Committee) analogue video line.

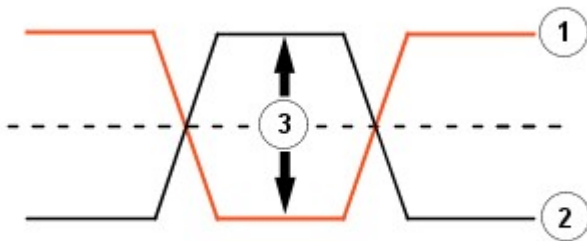
The control module also adds guidance and warning overlays to the camera images to create the various driving-aid features supported by the camera proximity system; for example, visual direction is made available when reversing the vehicle.

The module communicates with each individual camera via the LIN (local interconnect network) bus connection. This data link transmits diagnostic information, for example camera serial numbers and fault notifications to the control module. Camera adjustments, for instance a correction to color-balance are also communicated via the LIN bus link to the camera.

Image signals are relayed to the control module via the LVDS (Low Voltage Differential Signal) lines. The system uses the LVDS communication protocol to enable fast, interference-free data transmission. Data transmission speeds run in the region of 800 Mbps, this however is dependant on image content.

This LVDS communication link features a twisted pair of wires carrying a 'high' signal and a 'low' signal, similar to the high speed CAN with regard to a 'mirrored' signal. The voltage differential level operates between 250 - 450 mV.

LVDS Signal



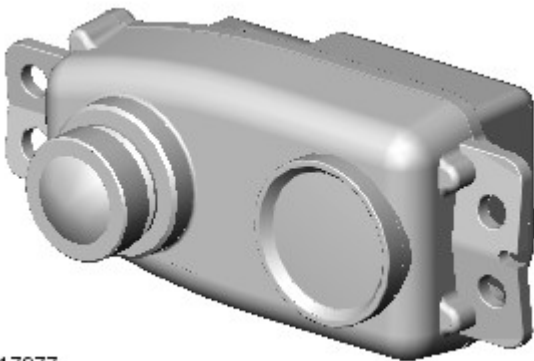
E118323

Item	Part Number	Description
1	-	LVDS 'low' signal
2	-	LVDS 'high' signal
3	-	250 – 450 mV Differential

In addition to the data lines the camera receives a power supply and a ground from the control module.

- NOTE: Care must be taken when routing, disconnecting and reconnecting the camera harnesses.

Cameras



E117977

The system uses five VGA resolution cameras, permanently powered whenever the ignition is 'on'. Each camera provides an image covering a zone approximately 130° wide by 112° deep and is capable of capturing approximately thirty frames per second.

The cameras employ high-quality digital, HDR (High Dynamic Range) imaging, which is a set of techniques that allows a greater range of luminance between light and dark areas of an image scene. This allows HDR to more accurately represent the varying intensity levels found in the image scenes that can range from direct sunlight to deep shadows.

HDR Image Comparisons

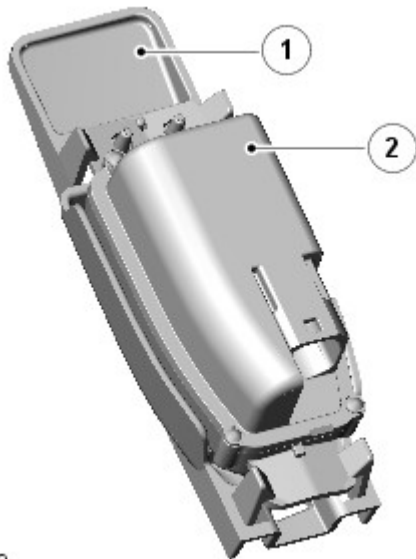


E123186

Item	Part Number	Description
1	-	Shadow without HDR
2	-	Shadow with HDR
3	-	Sunlight without HDR
4	-	Sunlight with HDR

• NOTE: Reversing lights are crucial to successful night operation of the rear view camera.

Camera mounting



E117979

Item	Part Number	Description
1	-	Camera 'break free' bracket
2	-	Camera

To reduce the cost of accident repair the mounting of the front bumper cameras feature a 'snap free' bracket. On impact, the bracket will release the camera preventing damage to the camera itself. Depending on the severity of the accident it may also be possible to reuse the brackets as they are manufactured from a memory type plastic.

The front cameras are not 'handed' so therefore interchangeable. This is also applicable for the door-mirror cameras, although these cameras do feature the approach lighting LED integral within the camera body.

The positioning accuracy of all the cameras is crucial for the successful operation of the proximity camera system. The

8	-	Mirror camera
9	-	Rear view camera
10	-	Touch Screen Display (TSD)
11	-	Central Junction Box (CJB)

SYSTEM OPERATION

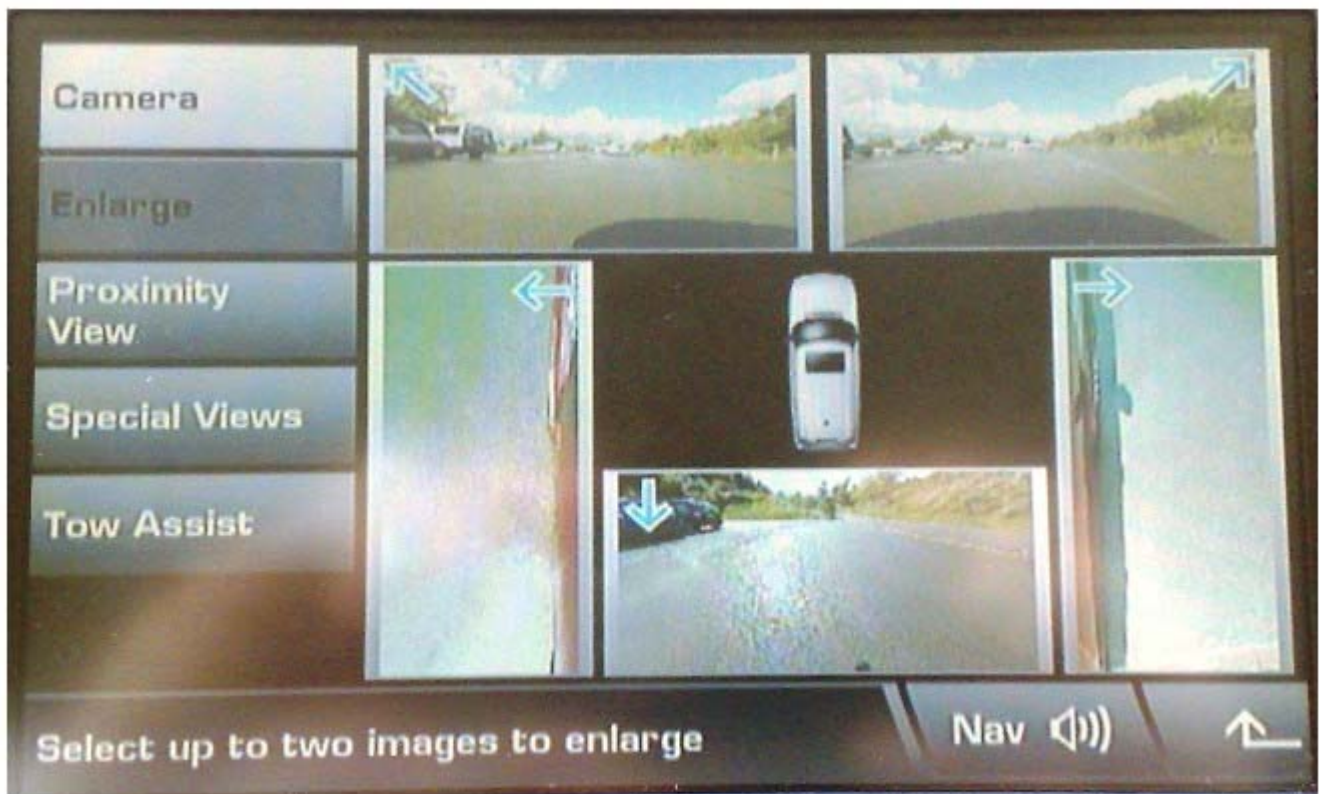
Automatic Operation

- With the ignition 'on' and either 'Park' or 'Neutral' selected the screen displays images of the area surrounding the vehicle.
- When either 'Drive' or 'Reverse' are selected the relevant camera view for the direction of movement is shown.
- Once the vehicle speed exceeds 18 km/h (11 mile/h) the images will automatically switch off.
- Once automatically switched off, the camera view will be disabled until:
 - another ignition cycle occurs and the system is automatically functioned, or
 - the camera system is manually selected on the Touch Screen Display (TSD).

Manual Operation

- The camera home page is accessed using the 'Cameras' icon on the 'Navigation' home screen on the TSD
- Camera views can be accessed when the vehicle is stationary with either 'Park' or 'Neutral' selected.
- Camera views can also be accessed when either 'Drive' or 'Reverse' are selected and will remain viewable when the vehicle is in motion.

Selecting Views



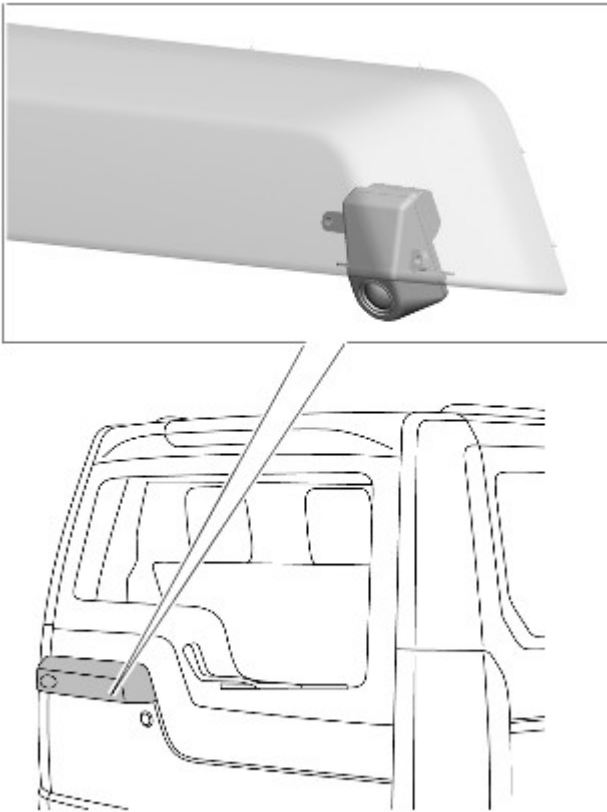
E123183

- Displayed on the home page are real-time images transmitted from each of the five cameras.
- Any two of the images can be selected and enlarged to view side-by-side on the screen.
- When viewing any two images, any single image can then be selected to view as a full screen image which can be zoomed and panned around using the magnifier and arrow icons.

Manual Proximity View

- Selecting proximity view from the camera home screen will display a combination of three images from the front passenger side cameras. These images provide the driver with an enhanced view of the area forward and opposite the driver.

Rear View Camera



E123188

The rear view camera provides additional information to the driver when reversing the vehicle. When reverse gear is selected the camera integrated into the tailgate handle assembly, automatically displays a wide-angle color image of the view from the rear of the vehicle onto the TSD.

The rear view images are overlaid with:

- Dashed lines representing the perimeter of the vehicle.
- Solid lines representing the predicted trajectory of the vehicle; calculated from the steering wheel angle sensor.
- Colored bars represent the amount of distance between the vehicle and the object being approached. Working in conjunction with the standard 'rear parking aid' this adds a visual representation to the existing audible warning. The distance data is received from the parking aid module via the medium speed CAN.

The reversing-aid graphics can be disabled for the current drive cycle in the settings menu.

Reversing Visual Warnings



E117982

Item	Part Number	Description
1	-	Object being approached - 'yellow strip' with steady intermittent warning tone
2	-	Object being approached - 'orange strip' with faster intermittent warning tone
3	-	Object being approached - 'red strip' with continuous warning tone

The rear view image will not be displayed when any of the following apply:

- Drive is selected for longer than 15 seconds.
- Drive is selected and the vehicle speed is greater than 18 km/h (11 mile/h).

Special Views



E124989

The special views are a selection of pre-set views that provide the driver with some useful driving aids. These can be considered as a shortcut to some pre-determined images that have been developed to assist the driver in various situations:

- Curb view: downward view from the two door mirror cameras.
- Junction view: outward view from the two front cameras.
- Trailer view: rear camera view of trailer being towed.

System Calibration

To achieve viewing accuracy from the proximity cameras, strict tolerances are calibrated into the system when the vehicle is static. Continual dynamic adaptation of the system then takes place when the vehicle is in motion. This is an automated process performed by the proximity camera control module.

This level of accuracy must be maintained after any service procedures are performed on the vehicle that affects the proximity camera system. Should the control module or any one of the cameras require replacement, static re-calibration must be carried out using the approved Land Rover diagnostic equipment.

Camera replacement is detected by the proximity camera control module, through the recognition of a new serial number during the 'camera count' procedure that takes place during the 'ignition on' phase via the [LIN](#). This detection will log a [DTC \(diagnostic trouble code\)](#) advising a calibration routine should be performed.

Alignment adjustments to the cameras are performed using the diagnostic equipment and the vehicle's TSD (touch screen display). During the calibration procedure, setup software in the control module overlays fine colored lines on the TSD highlighting reference points on the bodywork. For example, the mirror camera image must capture the side repeater indicator, the shut-line of the doors and the lower sill trim.

Direction arrows are pressed to shift the image in the desired direction to meet the reference points viewed on the TSD.

Adjustments include:

- Up
- Down
- Left
- Right
- Rotation

When the reference points correspond exactly, the setting is saved and the calibration procedure is complete for that camera.

• **NOTE:** If body repairs are performed that affect the camera system, a calibration procedure must be executed after the repairs are completed.

System Fault

There are two possible types of fault relative to the cameras:

- Camera fault (no communication).

- Camera view obscured (see 'Camera Obstruction Detection' section for further information).

In the event of camera fault, a [DTC](#) is logged in the proximity camera control module and an icon is presented to the driver on the TSD (touch screen display) where the camera image would normally be viewed.

Each camera view has an orientation icon displayed in the top left hand corner and has two color states:

- Blue – ok
- Amber – camera problem

TOW HITCH ASSIST

The rear view camera provides additional information to the driver when hitching a trailer to the vehicle. When reverse gear is selected the camera integrated into the tailgate handle assembly, automatically displays a wide-angle color image of the view from the rear of the vehicle onto the TSD (touch screen display).

Within the settings menu the driver can activate the Hitch Guidance and Auto-towball Zoom feature. Hitch guidance provides a trajectory line indicating the path of the towball in relation to the steering angle applied to the vehicle. 'Auto-towball Zoom' initiates an automatic image zoom when the trailer is within 60cm of the towball to allow more accurate alignment of vehicle to trailer.



E125150

Item	Part Number	Description
1	-	Touch Screen Display – Auto towball Zoom feature
2	-	Tow ball trajectory line
3	-	Automatic zoom

TOW ASSIST

Tow Assist aids the driver with the reversing of a trailer by displaying information on the TSD (touch screen display).

The system uses a tracking target sticker attached to the trailer to monitor and predict the direction of the trailer. Calculations are made by the proximity camera control module, based on the relationship of angles between the vehicle and trailer and the current steering wheel position.

Tow Assist becomes active when a trailer is attached to the vehicle and the trailer electrical plug is attached to the vehicle socket. The [CJB](#) detects the connection has been made and sends a message via the medium speed [CAN](#) to the proximity camera control module.

- **NOTE:** If the connection is not detected, setup can be manually prompted by touching the 'Tow Assist' icon on the 'Camera' menu.

Tow Assist – New Trailer

When the CJB detects the trailer electrical plug has been connected, the trailer setup screen is displayed automatically on the TSD with the question: 'Has a trailer been connected?'

Selecting 'Yes' will bring up the first of a number of trailer setup screens. On first use the setup screens take the user

through a series of configuration options for the connected trailer. To configure a new trailer select 'Add New' and then 'OK'.

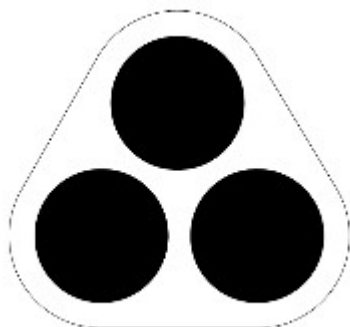
Trailer Setup – Step 1 of 6

- Choose from the list of generic trailer descriptive names for the trailer attached, then select 'Next'.

Trailer Setup – Step 2 of 6

- Position the trailer straight behind the vehicle, to allow more accurate positioning of the target. Stick the self adhesive tracking target to the front of the trailer within the orange highlighted zone as displayed, then select 'Next'.
- The highlighted zone will turn green when the target sticker is correctly positioned.

Tracking target sticker



E125745

Trailer Setup – Step 3 of 6

- Select the correct number of axles for the chosen trailer, then select 'Next'.

Trailer Setup – Step 4 of 6

- Select the preferred camera view for use with this trailer, then select 'Next'.
- **NOTE:** The Side Cameras view is more suited to tall and/or long trailers for example caravans. The Reverse Camera view is more suited to small and/or short trailers.

Trailer Setup – Step 5 of 6

- Using the numeric pad, enter the Hitch Length of the trailer, then select 'Next'.
- **NOTE:** Hitch Length is the distance from the hitch point to the pivot point of the trailer. The pivot point will vary depending on the number of axles, and will be:
 - the center-line of the axle on a single axle trailer,
 - the mid-point between the axles on a twin axle trailer,
 - the center line of the center axle on a triple axle trailer.

Trailer Setup – Step 6 of 6

- Using the distance adjustment buttons, set the orange overlay graphics at the width of the trailer wheels, or trailer edges when a tall trailer is to be used, then select 'Finish'.
- **NOTE:** The orange overlay graphics determine the position of the trailer reverse guidance lines.

A confirmation message will appear to show that the trailer information has been retained.

Finally, highlight the trailer that has been memorized, and select 'OK'.

- **NOTE:** In order to learn the central position of the trailer, the vehicle must be driven forwards at less than 15mph with the steering wheel in the straight-ahead position. There is currently no confirmation for when this process has completed, however the status can be derived by selecting Reverse gear and noting the presence of message 'Trailer tracking in progress'. Whilst tracking feature is learning the central position, the trailer trajectory lines will appear in a light blue color, when process is complete they will change to a dark purple color.

The Tow Assist feature is now ready to use.

Tow Assist – Previously Saved Trailer

When the CJB detects the trailer electrical plug has been connected, the trailer setup screen is displayed automatically on the TSD with the question: 'Has a trailer been connected?'

Selecting 'Yes' from the previous screen brings a list of pre-set, or previously saved, trailers. Highlight the required trailer, and select 'OK'.

- **NOTE:** In order to learn the central position of the trailer, the vehicle must be driven forwards at less than 15mph with the steering wheel in the straight-ahead position. There is currently no confirmation for when this process has completed, however the status can be derived by selecting Reverse gear and noting the presence of message 'Trailer tracking in progress'. Whilst tracking feature is learning the central position, the trailer trajectory lines will appear in a light blue

color, when process is complete they will change to a dark purple color.

The Tow Assist feature is now ready to use.

Parking Aid - Parking Aid

Diagnosis and Testing

Principle of Operation

For a detailed description of the parking aid system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Parking Aid](#) (413-13 Parking Aid, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.
 - NOTE: Do not change sensors under warranty that have damage to the sensor face.
1. **1.** Verify the customer concern.
 2. **2.** Ensure that the sensor face is clear of contamination that could effect the performance of the sensor.
 3. **3.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Sensor condition and installation ● Sounder(s) ● Switch 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Sensor(s) ● Parking aid switch ● Parking Aid Module (PAM)

4. **4.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
5. **5.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

On-Board Self-test

As part of the strategy of the system, the self-test will inform the driver of any faults by a combination of the LED and tones:

- The status LED will flash if the system is active and a fault is detected in the sensors, sounders, wiring or module
- The front sounder will emit an error tone for 3 seconds if a fault is detected with the front sensors or if the rear sounder develops a fault
- The rear sounder will emit an error tone for 3 seconds if a fault is detected with the rear sensors, the switch, or the LED in the switch, or if there is a Controller Area Network (CAN) bus error

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Parking Aid Module \(PAM\)](#) (100-00 General Information, Description and Operation).

Parking Aid - Parking Aid Camera

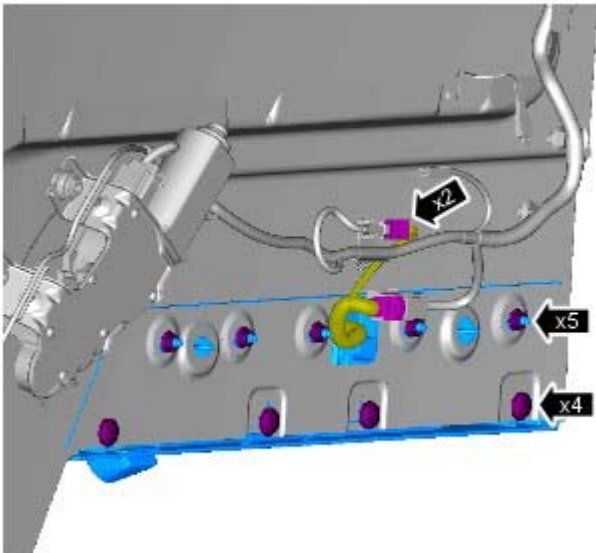
Removal and Installation

Removal

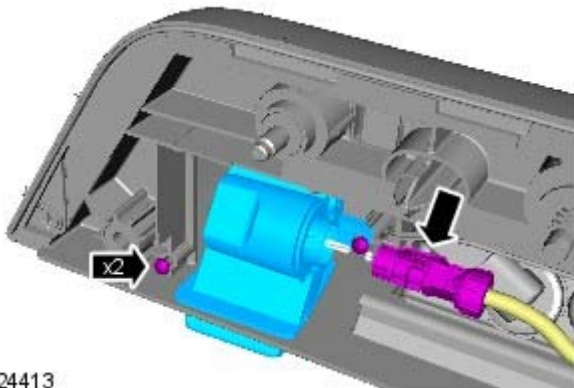
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: The ignition must be switched off.

1. Refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Oramentation, Removal and Installation).

2. Torque: 10 Nm



E124412



E124413

3.  CAUTION: Take extra care not to damage the wiring harnesses.

Installation

1. To install, reverse the removal procedure.

Parking Aid - Parking Aid Camera Module

Removal and Installation

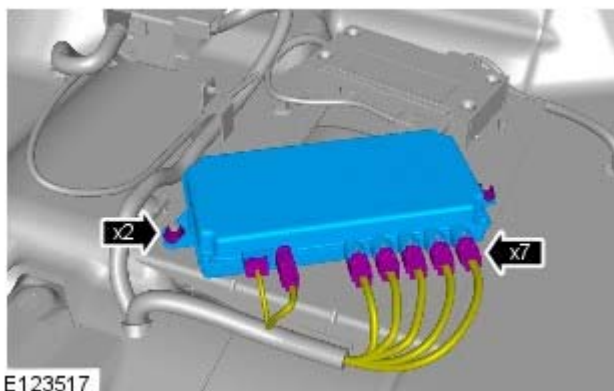
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).



3.  CAUTION: Take extra care not to damage the wiring harnesses.

Torque: 5 Nm

Installation

1.  CAUTION: If a new component has been installed, configure using Land Rover approved diagnostic equipment.

To install, reverse the removal procedure.

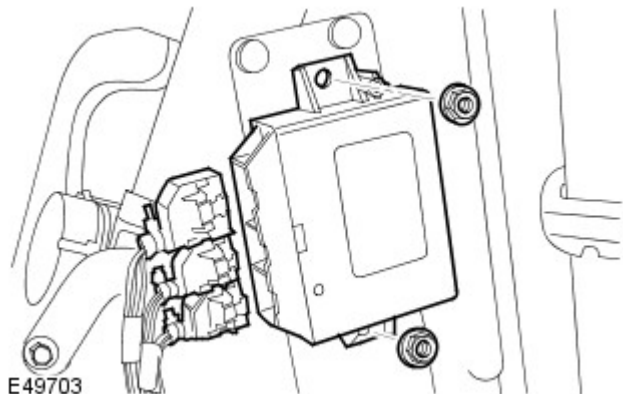
Parking Aid - Parking Aid Module

Removal and Installation

Removal

1. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the parking aid module.

- Disconnect the 3 electrical connectors.
- Remove the 2 nuts.



Installation

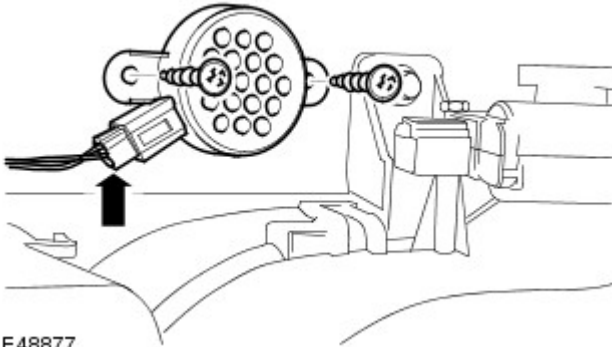
1. Install the parking aid module.
 - Tighten the nuts to 5 Nm (4 lb.ft).
 - Connect the electrical connectors.
2. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Parking Aid - Parking Aid Speaker

Removal and Installation

Removal

1. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the loadspace trim mounting bracket.
 - Remove the 2 screws.
 - Release the 2 clips.
3. Remove the rear parking aid speaker.
 - Disconnect the electrical connector.
 - Remove the 2 screws.



E48877

Installation

1. To install, reverse the removal procedure.

Parking Aid - Front Parking Aid Camera

Removal and Installation

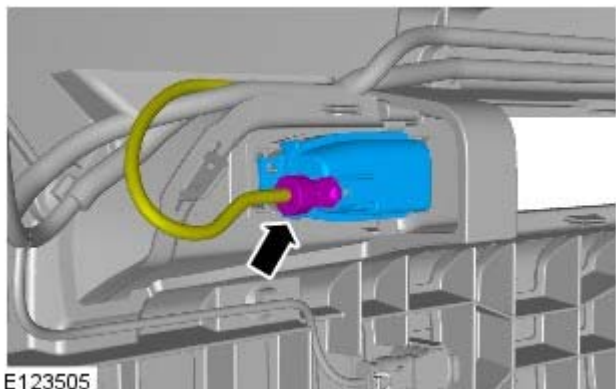
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: The ignition must be switched off.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Front Bumper Cover](#) (501-19 Bumpers, Removal and Installation).



3. **3. CAUTIONS:**



LH illustration shown, RH is similar.



Make sure that the component is correctly located on the locating dowels.



Take extra care not to damage the wiring harnesses.

Installation

1.  **CAUTION:** If a new component has been installed, configure using Land Rover approved diagnostic equipment.

To install, reverse the removal procedure.

Parking Aid - Front Inner Parking Aid Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

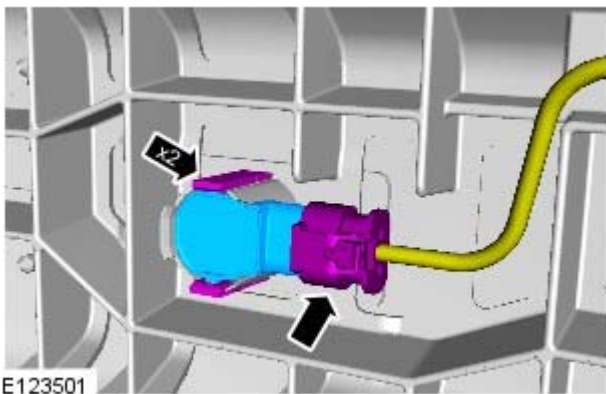
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Front Bumper Cover](#) (501-19 Bumpers, Removal and Installation).



- 4.

Installation

1. To install, reverse the removal procedure.

Parking Aid - Front Outer Parking Aid Sensor

Removal and Installation

Removal

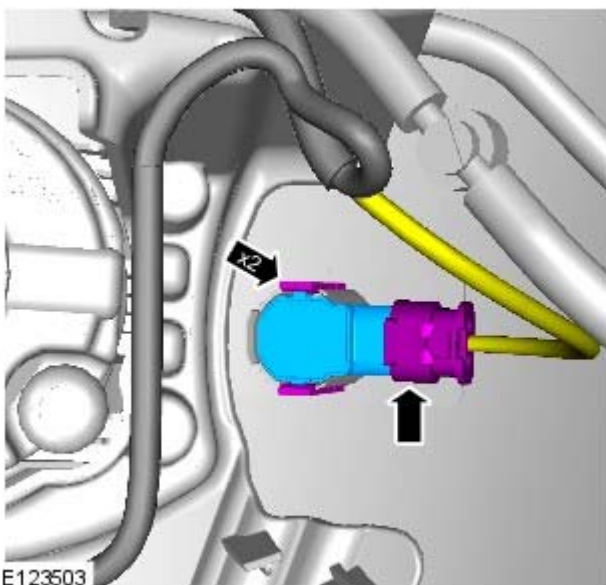
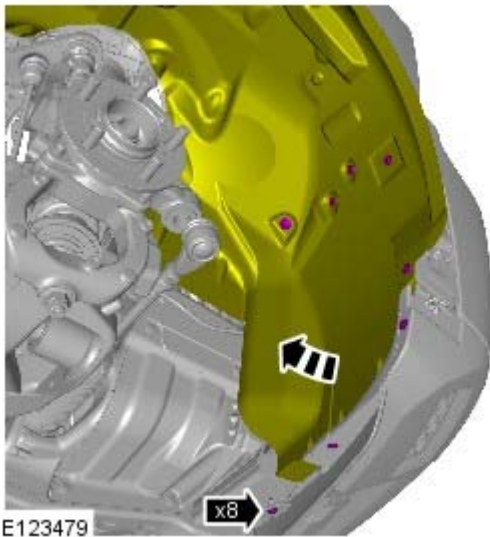
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: RH illustration shown, LH is similar.
- NOTE: The ignition must be switched off.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Remove the front wheel and tire.

2. Refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

3. Torque: 1 Nm



- 4.

Installation

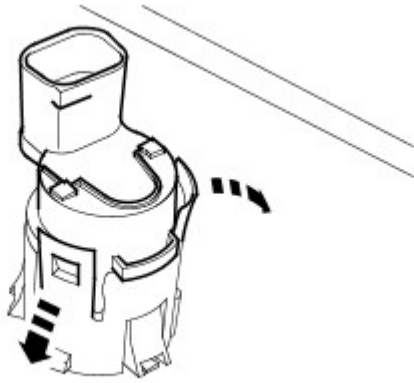
1. To install, reverse the removal procedure.

Parking Aid - Rear Inner Parking Aid Sensor

Removal and Installation

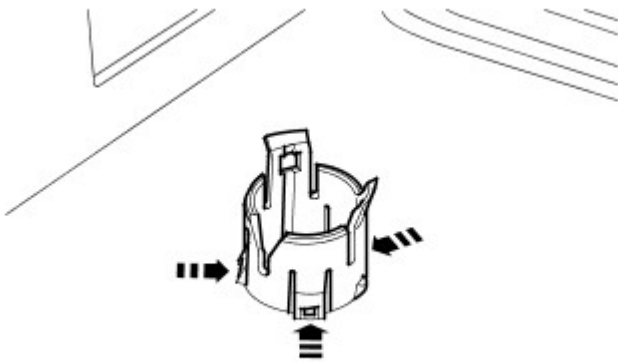
Removal

1. Remove the rear bumper cover.
For additional information, refer to: Rear Bumper (501-19, Description and Operation).
2. Remove the parking aid sensor.
 - Release the 2 clips.



E45116

3. Remove the parking aid sensor trim panel.
 - Release the 3 clips.



E45117


Installation

1. Install the parking aid sensor trim panel.
2. Install the parking aid sensor.
3. Install the rear bumper cover.
For additional information, refer to: Rear Bumper (501-19, Description and Operation).

Parking Aid - Rear Outer Parking Aid Sensor

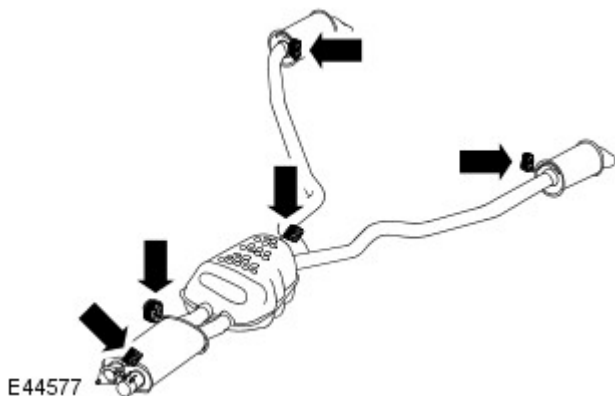
Removal and Installation

Removal

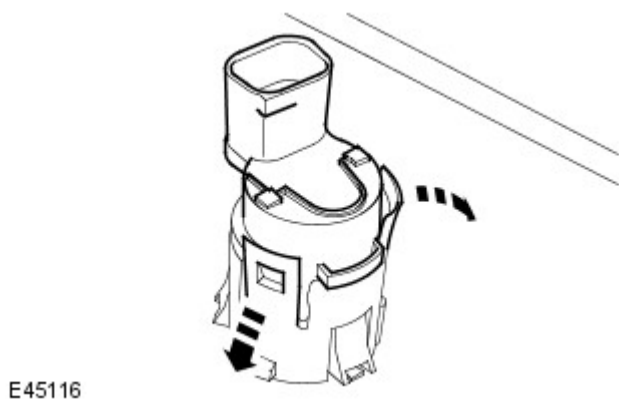
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

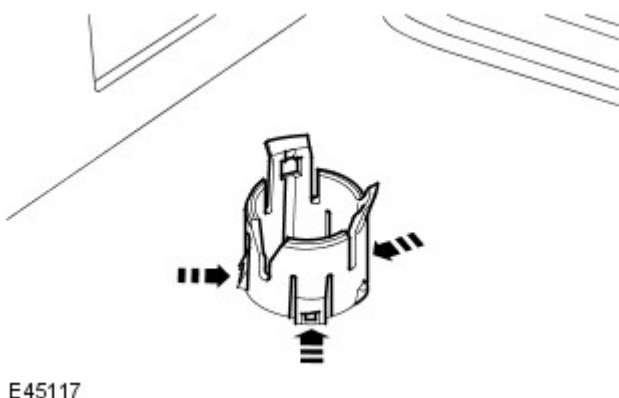
2. Release the 5 exhaust hangers.
 - Support the exhaust assembly.



3. Remove the parking aid sensor.
 - Disconnect the electrical connector.
 - Release the 2 clips.



4. Remove the parking aid sensor trim panel.
 - Release the 3 clips.



Installation

1. To install, reverse the removal procedure.

Parking Aid - Side Parking Aid Camera

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: RH illustration shown, LH is similar.
- NOTE: The ignition must be switched off.

1. Refer to: [Exterior Mirror Cover](#) (501-09 Rear View Mirrors, Removal and Installation).

2. **2. CAUTIONS:**



Take extra care not to damage the component.



Take extra care not to damage the wiring harnesses.

Torque: 0.5 Nm



Installation

1.  **CAUTION:** If a new component has been installed, configure using Land Rover approved diagnostic equipment.

To install, reverse the removal procedure.

Battery and Charging System - General Information -

Battery

Item	Specifications
All Gasoline (Petrol) Models:	
Type	Maintenance free lead-calcium
Capacity	690 amps - 75 amp/hour
Reserve capacity	150 minutes @ 25 amps
Diesel Models:	
Type	Maintenance free lead-calcium
Capacity	825 amps - 90 amp/hour
Reserve capacity	190 minutes @ 25 amps

Battery Disconnect/Connect



CAUTION: The vehicle status and battery condition must be established before attempting battery disconnect/connect. Reference must be then made to the following table to establish the relevant procedure to be followed.

Vehicle status	Battery charged Procedure	Battery discharged Procedure
Engine running	1	
Vehicle powered down, locked and alarmed	2	3
Vehicle unlocked	4	5

Procedure 1

Disconnect battery	Connect battery
1. If possible, apply parking brake or alternatively, chock wheels	1. Ensure that all electrical loads are switched OFF
2. Switch off ignition	2. Connect battery leads - GROUND lead last
3. Wait 2 minutes for engine management system to 'power down'	3. Switch on ignition
4. Open the hood	4. Operate parking brake switch several times until parking brake warning lamp is extinguished
5. Disconnect battery - GROUND lead first	5. Reset electric window one-touch facility. Power window up to hard stop, release switch, reapply and hold for 1 second (relay in door will click). One touch should now work

Procedure 2

Disconnect battery	Connect battery
1. Unlock the vehicle and disarm the alarm using the 'plip' button	1. Ensure that all electrical loads are switched OFF
2. Enter the vehicle, turn the ignition key to position II, apply the parking brake or chock the wheels and then turn the ignition key to position 0. Remove the key to 'power down' the ICE system	2. Connect battery leads - GROUND lead last
3. Wait 2 minutes for engine management system to 'power down'	3. Switch on ignition
4. Open the hood	4. Operate parking brake switch several times until parking brake warning lamp is extinguished
5. Disconnect battery - GROUND lead first	5. Reset electric window one-touch facility. Power window up to hard stop, release switch, reapply and hold for 1 second (relay in door will click). One touch should now work

• NOTE: 1. **Disconnect battery** - The door unlock process initialises the ICE system.

Procedure 3

Disconnect battery	Connect battery
1. Unlock the vehicle from the left hand front door using the key	1. Ensure that all electrical loads are switched OFF
2. Enter the vehicle, turn the ignition key to position II, apply the parking brake or chock the wheels and then turn the ignition key to position 0. Remove the key to 'power down' the ICE system	2. Connect battery leads - GROUND lead last
3. Wait 2 minutes for engine management system to 'power down'	3. Switch on ignition
4. Open the hood	4. Operate parking brake switch several times until parking brake warning lamp is extinguished
5. Disconnect battery - GROUND lead first	5. Reset electric window one-touch facility. Power window up to hard stop, release switch, reapply and hold for 1 second (relay in door will click). One touch should now work

• NOTE: 1. - **Disconnect battery** - The door unlock process initialises the ICE system

• NOTE: 1. **Connect battery** - If there is insufficient capacity in the battery to disarm the alarm, the alarm may sound on reconnection of the battery - Step 3 will disarm the alarm

Procedure 4

Disconnect battery	Connect battery
--------------------	-----------------

1. Enter the vehicle, turn the ignition key to position II, apply the parking brake or chock the wheels and then turn the ignition key to position 0. Remove the key to 'power down' the ICE system	1. Ensure that all electrical loads are switched OFF
2. Wait 2 minutes for engine management system to 'power down'	2. Connect battery leads - GROUND lead last
3. Open the hood	3. Switch on ignition
4. Disconnect battery - GROUND lead first	4. Operate parking brake switch several times until parking brake warning lamp is extinguished
	5. Reset electric window one-touch facility. Power window up to hard stop, release switch, reapply and hold for 1 second (relay in door will click). One touch should now work

Procedure 5


Disconnect battery	Connect battery
1. Enter the vehicle, turn the ignition key to position II, apply the parking brake or chock the wheels and then turn the ignition key to position 0. Remove the key to 'power down' the ICE system	1. Ensure that all electrical loads are switched OFF
2. Wait 2 minutes for engine management system to 'power down'	2. Connect battery leads - GROUND lead last
3. Open the hood	3. Switch on ignition
4. Disconnect battery - GROUND lead first	4. Operate parking brake switch several times until parking brake warning lamp is extinguished
	5. Reset electric window one-touch facility. Power window up to hard stop, release switch, reapply and hold for 1 second (relay in door will click). One touch should now work


• **NOTE: 1. Disconnect battery** - If the remote control module (RCM) is not functioning, it will be necessary to manually unlock the vehicle using the key.

Vehicle Jump (Emergency) Starting - Using Another Vehicle

Carry out the following operations in the sequence given
1. Connect one end of the BLACK (-) booster cable to the GROUND (-) battery terminal of the DONOR vehicle
2. Connect the other end of the BLACK (-) booster cable to a good earth point e.g. unpainted metal surface or engine mounting at least 0.5 m (20.0 in) from the battery or fuel lines on the DISABLED vehicle
3. Connect one end of the RED (+) booster cable to the positive (+) battery terminal of the DONOR vehicle
4. Connect the other end of the RED (+) booster cable to the positive (+) battery terminal of the DISABLED vehicle
5. Start the engine of the DONOR vehicle and allow it to idle for a few minutes
6. Start the engine of the DISABLED vehicle
7. Allow engines of both vehicles to idle for a few minutes then switch off the engine of the DONOR vehicle
8. Disconnect the RED (+) booster cable from the battery of the PREVIOUSLY DISABLED vehicle
9. Disconnect the RED (+) booster cable from the battery of the DONOR vehicle
10. Disconnect the BLACK (-) booster cable from the earth point of the PREVIOUSLY DISABLED vehicle
11. Disconnect the BLACK (-) booster cable from the battery of the DONOR vehicle

• **WARNINGS:**

 During normal use, batteries emit explosive hydrogen gas sufficient to cause severe explosions and capable of causing serious injury - keep sparks and naked lights away from the engine compartment.


 DO NOT attempt to start the disabled vehicle if it is suspected that the electrolyte in the battery is frozen.

 Suitable eye protection must be worn when working in the vicinity of the battery.

 Take care when working near rotating parts of the engine.

 Prior to attempting to start the disabled vehicle, ensure that the parking brake is applied or suitably chock the wheels. Ensure that 'P' - PARK - Automatic Gearbox or NEUTRAL - Manual Gearbox is selected.

• **CAUTIONS:**

 Ensure that all electrical loads are switched OFF prior to connecting booster cables and disconnect booster cables prior to using any electrical equipment.

 Ensure that the battery of the DONOR vehicle is of 12 volt capacity and that all electrical loads on the disabled vehicle are switched OFF prior to connecting booster cables.

 Ensure that there is no physical contact between the donor and disabled vehicles other than the booster cables.

Vehicle Jump (Emergency) Starting - Using a Slave Battery/Starting Aid

Carry out the following operations in the sequence given
1. Connect the end of the BLACK (-) booster cable to the ground (-) battery terminal of the vehicle
2. Connect the end of the RED (+) booster cable to the positive (+) battery terminal of the vehicle

Carry out the following operations in the sequence given

3. Start the engine of the vehicle and allow it to idle
4. Disconnect the RED (+) booster cable from the battery terminal of the vehicle
5. Disconnect the BLACK (-) booster cable from the battery terminal of the vehicle

• WARNINGS:



During normal use, batteries emit explosive hydrogen gas sufficient to cause severe explosions and capable of causing serious injury - keep sparks and naked lights away from the engine compartment.



DO NOT attempt to start the disabled vehicle if it is suspected that the electrolyte in the battery is frozen.



Suitable eye protection must be worn when working in the vicinity of the battery.



Take care when working near rotating parts of the engine.



Prior to attempting to start the disabled vehicle, ensure that the parking brake is applied or suitably chock the wheels. Ensure that 'P' - PARK - Automatic Gearbox or NEUTRAL - Manual Gearbox is selected.

• CAUTIONS:



Ensure that all electrical loads are switched OFF prior to connecting booster cables and disconnect booster cables prior to using any electrical equipment.



Ensure that the slave battery/starting aid are of 12 volt capacity and that all electrical loads on the disabled vehicle are switched OFF prior to connecting booster cables.

Battery and Charging System - General Information - Battery Care

Description and Operation

12V LEAD ACID BATTERY CARE MANUAL FOR DEALER / RETAILER USE

1. INTRODUCTION

2. GENERAL RULES FOR BATTERY CARE

3. EQUIPMENT (MINIMUM STANDARD)

4. HEALTH AND SAFETY PRECAUTIONS

5. DETERMINING BATTERY CONDITION

6. BATTERY CHARGING AND MAINTENANCE

7. CHARGING SYSTEM TEST AND DIAGNOSIS

8. VEHICLE QUIESCENT CURRENT TESTING

APPENDIX A: BATTERY TEST PROCESS

APPENDIX B: BATTERY REPORT FORM - IN SERVICE BATTERIES ONLY

1. INTRODUCTION

This publication sets out, for the benefit of dealers / retailers worldwide, requirements for the care and maintenance of batteries, from the vehicles hand-over to the dealer / retailer to the handover to the customer or in the case of a spare part battery from its delivery to the dealer / retailer to its fitment to a customer vehicle.

It applies to all types of 12 volt Lead Acid Batteries used, whether they are conventional flooded technology or Absorbed Glass Mat (AGM) technology and also applies to both Primary and Secondary or Auxiliary Batteries.

The clearly laid out and illustrated sections guide dealers / retailers through each stage of the vehicles or spare parts receipt, storage, pre-delivery and customer hand-over. This publication can be used as a guide to the handling and care of batteries in service. It is vital to appreciate that unless each process is rigorously applied on all vehicles, the customer will receive a vehicle with a battery or a spare part battery which will not provide a satisfactory service life.

It is very important that all tests quoted throughout this publication are adhered to. If they are applied incorrectly batteries could be scrapped unnecessarily. Refer to the battery testing section for detailed information.

It is equally important therefore to note the following key points:

- Most new vehicles leave the factory with either a transit relay installed and/or have a transit mode programmed into the vehicle control modules. The transit relay must be removed and the transit mode disabled (where applicable) using an approved diagnostic system, **NOT MORE THAN 24 HOURS** before the customer takes delivery.
- 12 Volt Lead Acid Batteries rely on internal chemical processes to create a voltage and deliver current. These processes and the internal chemical structure of the battery can be damaged if the battery is allowed to discharge over a number of weeks / months, or is left in a discharged state for a lengthy time period. For this reason the battery must be tested / re-charged if necessary every month, and **MUST BE** re-charged after every three month period of storage. Refer to the vehicle storage manual and update the vehicle history sheet.
- Under no circumstances should the battery be disconnected with the engine running because under these conditions the alternator can give a very high output voltage. This high transient voltage will damage the electronic components in the vehicle. Loose or incomplete battery connections may also cause high transient voltage.
- On vehicles with conventional ignition keys, these must not be left in the ignition lock barrel when the transit relay has been removed, otherwise quiescent current will increase and the battery will discharge more rapidly.
- Two types of Lead acid batteries are used; standard Flooded type and AGM (Absorbed Glass Mat) or VRLA (Valve regulated Lead Acid) types. AGM batteries offer improved resistance to cycling as seen in stop start applications. AGM Batteries are fully sealed and cannot have the electrolyte level topped up.

Dealers and retailers involved in the storage, handling of vehicles and spare parts batteries have a responsibility to ensure that only vehicles and spare parts having a fully satisfactory battery may be processed further through the distribution selling chain.

• **NOTE:** It is very important that test processes quoted throughout this publication are adhered to.

If they are not adhered to correctly batteries could be scrapped unnecessarily or a battery with an issue remains in use. Refer to the battery testing section for detailed information.

2. GENERAL RULES FOR BATTERY CARE

Frequency of Battery Condition Checks.

Any battery in storage whether it is in a vehicle or in spare parts inventory must have its charge status checked every 30 days as described in Appendix A, and must be recharged every 90 days as described in the "Battery Charging and Maintenance" section of this manual.

Dealer Demonstration Vehicles

Due to the high depth of discharge a dealer demonstration vehicle battery may experience, batteries that are fitted to vehicles used as dealer demonstration vehicles must be connected to a power supply / charger capable of delivering 50 Amps or more whilst the vehicle is being demonstrated and the engine is not running. This will prevent the battery from being damaged from "energy throughput " wear out during a demonstration.

Software Reflash, SDD work or Ignition On related Workshop Activities.

Due to the high electrical current demand and high depth of Discharge that can occur during vehicle software re-flash activities, SDD work or ignition on related work in the workshop, vehicles that are undergoing such activities MUST have the electrical system on the vehicle supported with a power supply / charger / vehicle maintainer capable of delivering 50 Amps or more.

Jump Starting New vehicles Before They Have Been Delivered to the Customer.

- It is the dealer / retailers responsibility to ensure the battery is not allowed to go flat by following the instructions and processes defined in this manual.
- However if circumstances dictate that a new vehicle must be jump started due to a flat battery whilst the vehicle is in the dealer / retailers care, the battery on this vehicle must be replaced with a new one prior to delivery to the customer at the dealer / retailers liability.
- The vehicle should also undergo investigation as to why the battery went flat.
- Do not connect the jump starting cable to the negative (-) terminal of the battery. Always connect to the recommended earthing point. As defined in the owners handbook or service documentation for that vehicle.

Jump Starting or Boost Charging Vehicles in Service

Do not connect the jump starting cable to the negative (-) terminal of the battery. Always connect to the recommended earthing point. As defined in the owners handbook or service documentation for that vehicle.

Charging AGM Batteries

AGM batteries must not be charged with voltages above 14.8 Volts. Doing so will damage them.

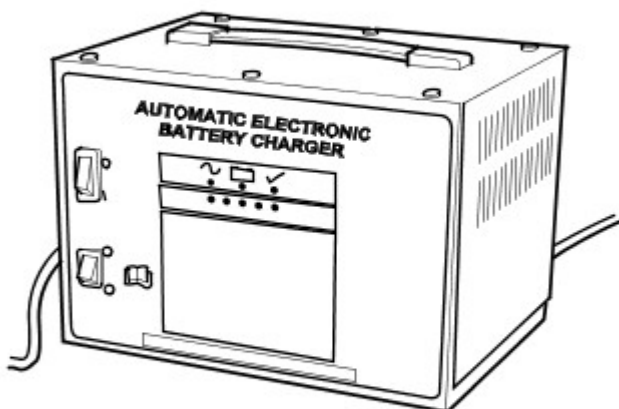
Testing AGM Batteries

Midtronics 393, 394, 493 and 494 testers are not capable of testing AGM batteries. Doing so can give an incorrect result.

When it is necessary to test an AGM battery use the Midtronics EXP1080 tester or the GR1 Diagnostics Charger.

3. EQUIPMENT (MINIMUM STANDARD) (pictures are for illustration only)

Traction Battery Charger (or similar stand-alone charger)



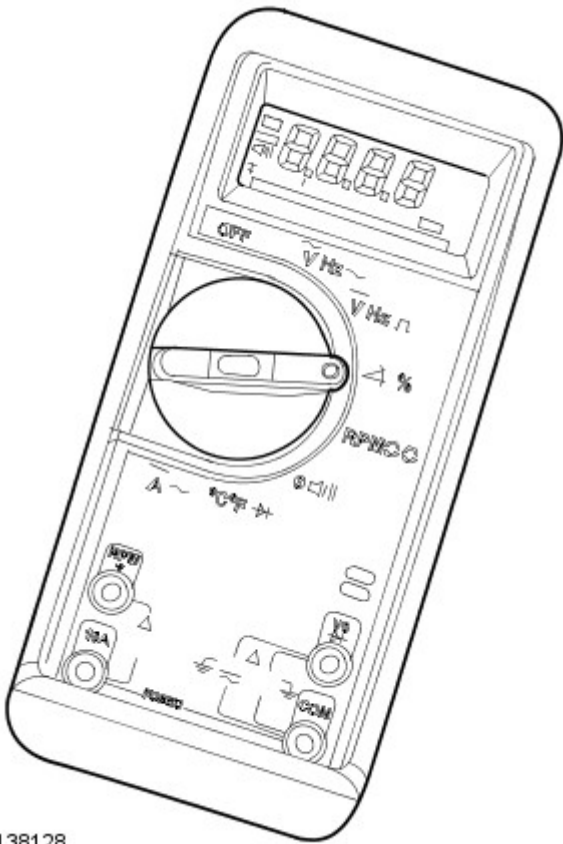
E138126

Midtronics EXP1080 Hand-Held Tester



E138131

Digital Multi-Meter or Digital Volt-Ohm Meter (DVOM)



E138128

Midtronics GR-1 Diagnostic Charger



E138129

4. HEALTH AND SAFETY PRECAUTIONS

• WARNINGS:



BATTERY CELLS CONTAIN SULPHURIC ACID AND EXPLOSIVE MIXTURES OF HYDROGEN AND OXYGEN GASES. IT IS THEREFORE ESSENTIAL THAT THE FOLLOWING SAFETY PRECAUTIONS ARE OBSERVED.



Batteries emit highly explosive hydrogen at all times, particularly during charging. To prevent any potential form of ignition occurring when working in the vicinity of a battery:

- Do not smoke when working near batteries.
- Avoid sparks, short circuits or other sources of ignition in the battery vicinity.
- Switch off current before making or breaking electrical connections.
- Ensure battery charging area is well ventilated.
- Ensure the charger is switched off when: a) connecting to a battery; b) disconnecting from the battery.
- Always disconnect the ground cable from the battery terminal first and reconnect it last.



Batteries contain poisonous and highly corrosive acid. To prevent personal injury, or damage to clothing or the vehicle, the following working practices should be followed when topping up, checking electrolyte specific gravity, removal, refitting or carrying batteries:

- Always wear suitable protective clothing (an apron or similar), safety glasses, a face mask and suitable gloves.
- If acid is spilled or splashed onto clothing or the body, it must be neutralized immediately and then rinsed with clean water. A solution of baking soda or household ammonia and water may be used as a neutralizer.
- In the event of contact with the skin, drench the affected area with water. In the case of contact with the eyes, bathe the affected area with cool clean water for approximately 15 minutes and seek urgent medical attention.
- If battery acid is spilled or splashed on any surface of a vehicle, it should be neutralized and rinsed with clean water.
- Heat is generated when acid is mixed with water. If it becomes necessary to prepare electrolyte of a desired specific gravity, SLOWLY pour the concentrated acid into water (not water into acid), adding small amounts of acid while stirring. Allow the electrolyte to cool if noticeable heat develops. With the exception of lead or lead-lined containers, always use non-metallic receptacles or funnels. Do not store acid in excessively warm locations or in direct sunlight.



Due to their hazardous contents, the disposal of batteries is strictly controlled. When a battery is scrapped, ensure it is disposed of safely, complying with local environmental regulations. If in doubt, contact your local authority for advice on disposal facilities.

5. DETERMINING BATTERY CONDITION

The tools used for determining the condition of the battery will depend upon whether it is installed in a vehicle or in spare parts inventory. Concerning an installed battery, procedures will vary if the vehicle is new, or already in service with a

customer.

• NOTE: The term 'New Vehicle' refers to a vehicle at any part of the delivery process from leaving the factory to arriving at a port of entry, dealership, retailer, including any storage facilities en route or a vehicle being stored prior to sale at dealership / retailer.

• NOTE: Midtronics 393, 394, 493 and 494 testers must not be used to test AGM batteries as these testers are not capable of correctly testing AGM batteries and can give an incorrect result. For AGM battery testing use the EXP1080 tester or the GR1 Diagnostics charger.

NEW VEHICLES

A Midtronics tester should be used to assess the condition of the battery for new vehicles. The test results should be recorded on the Storage History Sheet (see Vehicle Storage manual).

Scenario 1 - Dealership / Retailer (Responsibility: Dealer / Retailer)

1. Within 24 hours of arrival at the dealer / retailer proceed as follows:

- Perform a Midtronics battery test (See Appendix A.)
- Carry out the recommended actions accordingly.

2. If the Midtronics result is "Good Battery" the vehicle may be stored.

- For all new vehicles in storage the transit relay MUST be fitted, or the Transit Mode enabled where used. For vehicles without a transit relay or a Transit Mode, the battery negative cable MUST BE DISCONNECTED from the battery.

3. The battery must be tested and/or re-charged every month and MUST be re-charged after every three month period.

4. Record your test results on the Storage History Sheet (see Vehicle Storage Manual) to indicate when a re-charge will be necessary.

Scenario 2 - Delivery to the Customer (Responsibility: Dealer / Retailer)

• NOTE: It is essential that the following actions are conducted in the 24 hours prior to the agreed hand over time:

1. Perform a Midtronics Battery test (See Appendix A).

2. Carry out the recommended actions accordingly.

3. The vehicle should only be released to the customer if Midtronics has tested the battery as "Good Battery"

Spare Part Batteries

Lead acid batteries will, as a result of natural chemical processes, slowly self discharge themselves over a period of time (even when open circuit and no electrical load applied).

In the case of spare parts batteries, a Midtronics tester should be used to assess the condition of new spare parts batteries.

The batteries must be stored such that they cannot get wet and are not in direct sunlight.

Any batteries which are dropped must be scrapped. This applies even if no external damage is apparent.

Scenario 1 - Spare Part Batteries Within Dealer Stock But Not Yet Fitted To A Vehicle (Responsibility: Dealer / Retailer)

1. For a battery in the Dealer parts or in ready to use stock but not yet fitted to a vehicle the following rules must be followed:

- Check the battery condition on receipt by performing a Midtronics battery test (See Appendix A).
- Batteries should only be returned to storage if the Midtronics tester indicates "Good Battery".
- The battery condition should be rechecked every 30 days by performing a Midtronics battery test (See Appendix A).
- If required batteries should be recharged as described in the "Battery Charging and Maintenance" section of this manual.

2. All batteries must be controlled via a FIFO (First In First Out) process to ensure aged batteries are not held and the batteries are not allowed to age unnecessarily.

VEHICLES IN SERVICE

The Midtronics hand-held tester or the Midtronics Diagnostic Charger are the preferred tools to assess battery condition for vehicles in service. The test results should be recorded on the In-Service Battery Report Form (See Appendix B).

Midtronics Testing - In-Service Testing Only

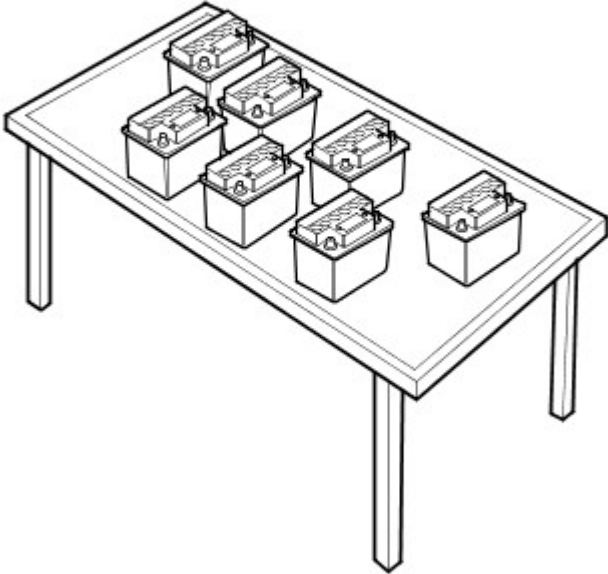
• NOTE: The battery surface charge must be removed before this test in accordance with the procedure in Appendix A. Ensure that the battery terminal connectors are clean. When connecting the Midtronics testing equipment, connect the RED clip to the positive (+) battery terminal first, and then connect the BLACK clip to the negative (-) battery terminal. Rock the clips backward and forward to ensure a good connection to the battery.

1. Perform a Midtronics battery test (See Appendix A).

2. Carry out the recommended actions accordingly.

6. BATTERY CHARGING AND MAINTENANCE

BATTERY CHARGING



E138130

It is essential that a suitably ventilated defined area exists in each dealership / retailer for battery charging. Likewise, an area should be allotted for scrap batteries, and clearly indicated as such. It is recommended that dealers / retailers always have fully charged batteries ready for use. However the battery **MUST BE** tested and charged if necessary every month, and charged after three months irrespective of any test.

• CAUTIONS:



Batteries must be re-charged after a maximum of 3 months storage (see Storage History sheet in the New Vehicle Storage Manual).



It is very important that when charging batteries using the traction charger or other stand-alone chargers that the charger is set for the correct type of battery before charging commences. If the wrong switch is selected the result would be a battery that is not charged fully and / or overheating can occur. Follow the manufacturers operating instructions.



Do not charge AGM batteries with voltages over 14.8 volts as this will damage the battery.

To bring a serviceable but discharged battery back to a fully charged condition proceed as follows:

- Check and if necessary top-up the battery electrolyte level.
- Charge the battery using the Midtronics Diagnostic Charger (USA) or Traction Charger (all other markets) following the manufacturers operating instructions.

• **NOTE:** When using the Midtronics Diagnostic Charger, automatic mode must always be used. After charging and analysis, the charger may display 'Top-Off Charging', press STOP to end. Do not stop charging until the current falls to 5A or less, otherwise the battery will not be fully charged.

POST-CHARGE TEST METHODS

New Batteries, Batteries in Storage and In-Service Batteries

The purpose of this test is to ensure that the charging process has fully charged the battery.

• **NOTE: IT IS RECOMMENDED THAT THIS TEST IS CONDUCTED AT LEAST 24 HOURS AFTER THE CHARGE CYCLE IS COMPLETED.**



E138131

 **CAUTION:** DO NOT connect the tester to any other circuit or chassis point.

1. Attach the Midtronics Tester to the battery.
2. Follow the instructions on the tester to test the battery. Ensure the correct battery type and size is selected.
3. Perform the action based on the tester results (see the tester results chart in the Vehicles in Service sub -section of Determining Battery Condition Section).
4. Enter the readings and test code obtained on the In Service Battery Report Form.

• **NOTE:** Midtronics 393, 394, 493 and 494 testers must not be used to test AGM batteries as these testers are not capable of correctly testing AGM batteries and can give an incorrect result. For AGM battery testing use the EXP1080 tester or the GR1 Diagnostics charger.

BATTERY REPLACEMENT

If it is determined that a battery requires replacement, always refer to the appropriate section of the workshop manual for instructions on removing and installing the battery from the vehicle.

On in service vehicles fitted with a Battery Monitoring System (BMS), the BMS module must be reset following the installation of a new battery. The BMS module reset procedure must be performed using an approved diagnostic system.

CHECK/TOP-UP BATTERY ELECTROLYTE – Only Applicable to certain Flooded Types of Battery.

• **WARNINGS:**

 **AGM TECHNOLOGY BATTERIES ARE FULLY SEALED FOR LIFE AND NO ATTEMPT SHOULD BE MADE TO CHECK OR TOP UP THE ELECTROLYTE LEVEL.**

 **BEFORE CHECKING AND TOPPING-UP THE BATTERY ELECTROLYTE, REFER TO THE HEALTH AND SAFETY PRECAUTIONS SECTION.**

Check to ensure the battery is of a type suitable for topping up. These types of batteries will have cell plugs visible on the top face of the battery or a removable access panel to allow access to the cells.

On batteries with a clear or opaque case and level marks, check the electrolyte level by visual inspection of the maximum level indicator mark on the battery casing indicating adequate level above the battery separators.

On batteries with black cases, remove the cell plugs or access panel and ensure the electrolyte level is level with the indicator in the cell hole. A flashlight may be required to see the electrolyte level on this type of battery.

 **CAUTION:** DO NOT overfill.

If the electrolyte level is low, top-up using distilled water.

Maintenance free and Valve Regulated (AGM) batteries are sealed and therefore cannot be topped up.

CHARGING SYSTEM TEST AND DIAGNOSIS

For all vehicles, refer to the Charging System - Diagnosis and Testing in section 414-00 of the Workshop Manual.

VEHICLE QUIESCENT CURRENT TESTING

• NOTE: On vehicles fitted with a Battery Monitoring System (BMS), the diagnostic routine for quiescent drain testing in the approved diagnostic system should be utilized.

• NOTE: If a customer complains of a vehicle battery that discharges continuously or when left for a prolonged period of time, it is recommended that a quiescent drain test is performed as described below.

• NOTE: The battery drain should be measured using an approved diagnostic system or a Digital Multi-Meter (DVOM).

The vehicle should be in the locked/armed state (for example vehicle alarm fully armed), all doors, engine and luggage compartment lids are open and latched (so as to appear closed from an electrical point of view). The test should take place after the vehicle has entered shutdown mode. The time taken for this to occur after the ignition is switched off varies according to model - Refer to Quiescent Drain in section 414-00 of the Workshop Manual.

• NOTE: When the vehicle is armed, the effect of the security system Light Emitting Diode (LED) flashing is to cause a pulsation in the measured current drain. In this case, either the average current should be taken (using a Digital Multi-Meter (DVOM) with an averaging system) or the current reading taken, ignoring the brief high current peaks.

EQUIPMENT

Approved diagnostic system with current probe or Digital Multi-Meter (DVOM) with current probe.

METHOD OF MEASUREMENT

Using an Approved Diagnostic System

1. Switch off all electrical loads and ensure that the ignition is off.
2. Connect the current probe to the approved diagnostic system.
3. Calibrate the probe.
4. Install a clamp around the battery lead/junction box lead.
5. Go to the Quiescent Current Testing section.

Using a Digital Multi-Meter (DVOM)

• NOTE: Do not use an in-line DVOM to measure the quiescent drain on vehicles fitted with an electronic throttle. The current exceeds the maximum amount the fuse in the DVOM is capable of handling.

1. Switch off all electrical loads and ensure that the ignition is off.
2. Connect the current probe to the DVOM.
3. Calibrate the probe.
4. Install a clamp around the battery lead/junction box lead.
5. Go to the following Quiescent Current Testing section.

QUIESCENT CURRENT TESTING

1. Switch ignition to 'on' or select ignition mode in keyless vehicles and switch to 'off' (do not crank).
2. Remove key from ignition switch (where applicable).
3. Open and latch all doors, hood and luggage compartment lid.
4. Lock the vehicle using the remote function on the remote handset. (Single lock only to avoid volumetric alarm arming).
5. Remove any other potential electrical drains such as accessories plugged into accessory sockets.
6. Record the amperage readings after the shutdown period. The model specific Amperage readings for quiescent drain are referenced in Quiescent Drain in section 414-00 of the Workshop Manual
7. Record the final reading on the battery report form Appendix B.

• NOTE: The preferred method of testing following an excessive current consumption figure is to use a current probe around individual junction box leads to the various suspected circuits to identify a potential cause. This is in preference to the old method of removing fuses for the following reasons:

- Many modules take a considerable time to power down. Each time a fuse is removed and re-fitted, the quiescent drain current may take an extended period of time to return to normal (typically up to 45 minutes).
- The drain may be caused by a module remaining active and preventing the quiescent drain from reducing to normal levels.
- The drain may be caused by a relay winding that is activated. Pulling the fuse can allow this to 'reset' and the drain will be lost and go un-diagnosed.

General Information	YES / NO		YES / NO	
Diagnostics (Battery Testing)				
1: Loose battery clamps	Yes	*	No	*
2: Loose hold down clamps	Yes		No	
3: Corroded terminal posts	Yes	*	No	*
4: Physical damage/leaks	Yes		No	
5: Low electrolyte	Yes	*	No	*
6: FEAD belt tension	OK	*	Not OK	*
7: Surface charge removed	Yes	*	No	*
8: Voltage (appendix A)	Yes	*	No	*
9: Quiescent Drain	mA	*		
10: Vent tube correctly installed	Yes		No	
11: Midtronics test				
Code before charging	*			
If Midtronics indicates that the battery needs re-charging, charge the battery for 24 hours				
Code after charge	*			
Result after charge	*			
If "good and re-charge" charge the battery for an additional 24 hours.				
If "charge and re-test" for both before and after 24 hours charge renew the battery				
Only renew the battery if "renew battery", "bad cell" or charge and re-test has been displayed twice.				
Comments				
-				
-				
-				
-				
-				

Battery and Charging System - General Information - Quiescent Drain

Description and Operation

QUIESCENT DRAIN - TYPICAL VALUES

- NOTE: The quiescent drain after the initial shutdown period should not exceed the value shown in the table.

Land Rover Quiescent Drain Values

MODEL	SHUT DOWN PERIOD (minutes)	TYPICAL VALUES BATTERY DRAIN (mA)
Range Rover (LM) - Up to 2009MY	30	16.0 - 18.0
Range Rover (LM) - From 2010MY	20 (after lock/arm condition) ²	<30
	33 (unlocked)	<30
Range Rover Sport (LS) - Up to 2007MY	20	<22
Range Rover Sport (LS) - From 2007MY to 2010MY	30	<25
Range Rover Sport (LS) - From 2010MY	3 (after lock/arm condition) ²	<30
	33 (unlocked)	<30
Range Rover Evoque (LV) - From 2012MY	20 (after lock and arm condition)	<20
Discovery 3/LR3 (LA) - Up to 2007MY	20	<22
Discovery 3/LR3 (LA) - From 2007MY to 2010MY	30	<25
Discovery 4/LR4 (LA) - From 2010MY	3 (after lock/arm condition) ²	<30
	33 (unlocked)	<30
Freelander 2/LR2 (LF) - From 2007MY	35 (single locked or unlocked)	<23.6
	12 (double locked)	<23.6
Freelander (LN) - Up to 2007MY	10	24-25 - without Becker Navigation system
	10	27-28 - with Becker Navigation system
Defender (LD) - 1998MY to 2007MY	30	<21
Defender (LD) - from 2007MY	<30	<30
Discovery Series 2 (LT)	30	<30

- NOTE:

1. The total current drain will be higher if certain approved accessories are fitted (for example: tracker, trailer module, etc.)

2. Applies to vehicles without Tire Pressure Monitoring System (TPMS). Vehicle shut-down period with TPMS is approximately 15 minutes.

Battery and Charging System - General Information - Charging System

Diagnosis and Testing

Principle of Operation

For a detailed description of the charging system and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Generator ● Drive belt ● Drive belt tensioner ● Generator pulley ● Check the security of the generator fittings 	<ul style="list-style-type: none"> ● Generator ● Battery ● Battery connections ● Starter motor ● Harnesses and connectors ● Fuses ● Charge warning lamp function ● Engine Control Module (ECM)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Charge warning lamp does not come on	<ul style="list-style-type: none"> ● Bulb/Circuit fault ● Generator fault ● CAN circuit fault ● Engine control module fault 	Check the warning lamp function with the ignition on and the engine off. Replace bulbs or repair the circuit(s) as necessary. Check for DTCs indicating a generator, CAN or engine control module fault.
Charge warning lamp stays on/battery discharges	<ul style="list-style-type: none"> ● Accessory drive belt broken ● Generator pulley slipping on shaft ● Generator fault ● Battery cable fault ● CAN circuit fault ● Engine control module fault 	Check the battery and generator cables. Refer to the electrical guides. Check for DTCs indicating a generator fault. Check the accessory drive belt condition and tension. Check that the pulley does not rotate independently of the generator. Check for DTCs indicating a CAN or engine control module fault.
Charge warning lamp intermittent	<ul style="list-style-type: none"> ● Accessory drive belt slipping ● Battery cable fault ● Generator wiring fault ● Generator fault ● CAN circuit fault 	Check the accessory drive belt condition and tension. Check the battery and generator cables. Refer to the electrical guides. Check for DTCs indicating a generator or CAN circuit fault. Note that the use of a power pack or boost charger may bring the warning lamp on until disconnected.
Battery discharges without the charge warning lamp staying on	<ul style="list-style-type: none"> ● Battery fault ● Battery quiescent drain ● Intermittent generator fault 	Check the battery condition, check for battery quiescent drain. Check for DTCs indicating a generator fault. It is possible for the altcom circuit to short circuit to ground without setting a DTC. If no other reason for discharge can be found, check this circuit. Refer to the electrical guides.
Noise (mechanical)	<ul style="list-style-type: none"> ● Accessory drive belt slipping ● Generator fault 	Check the accessory drive belt condition and tension. Disconnect the accessory drive belt and check that the generator rotates freely.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Battery, Mounting and Cables -

General Specification

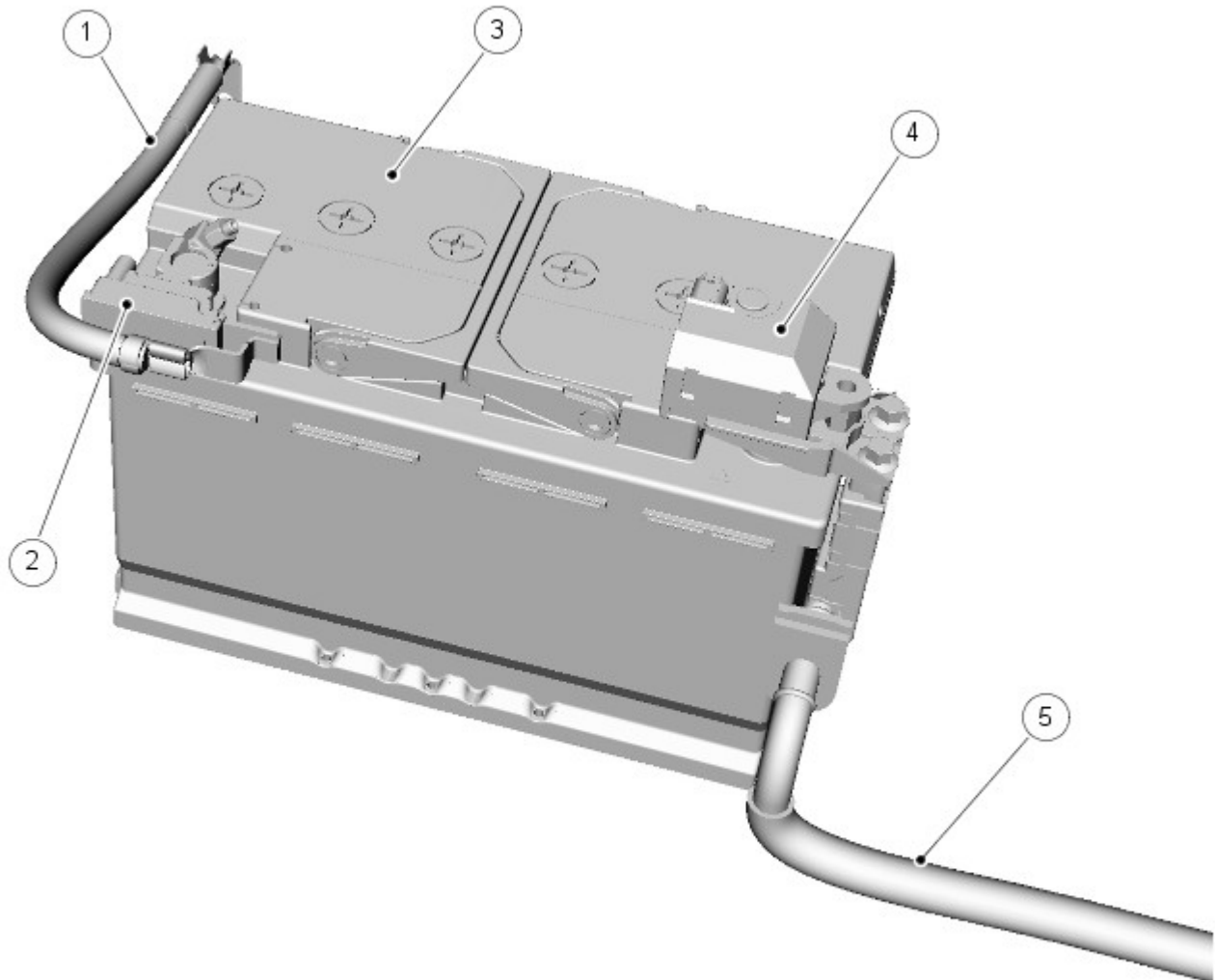
Item	Specification	Land Rover Part No.
Battery - 4.0 and 4.4 litre petrol engines:		
<ul style="list-style-type: none"> ● Voltage ● Capacity ● Reserve capacity 	<ul style="list-style-type: none"> ● 12 ● 75 amp/hour, 690 amps ● 150 minutes 	YGD500030
Battery - 2.7 litre diesel engine:		
<ul style="list-style-type: none"> ● Voltage ● Capacity ● Reserve capacity 	<ul style="list-style-type: none"> ● 12 ● 90amp/hour, 825 amps ● 190 minutes 	YGD500040

Torque Specifications

Description	Nm	lb-ft
Battery clamp bolts	10	7
Battery terminal nuts	10	7
Battery tray nuts	12	9
Auxiliary battery tray nuts	12	9

Battery, Mounting and Cables - Battery and Cables

Description and Operation



E133243

Item	Part Number	Description
1	-	-VE battery cable
2	-	Battery monitoring module
3	-	Battery
4	-	Transit relay
5	-	+VE battery cable

GENERAL

The battery is located between the bulkhead and the secondary bulkhead, in a protective box, on the passenger side. It sits in a tray and is secured with clamp plates and bolts.

The battery terminal posts allow for the battery cables to be connected with clamp type connections. The battery positive terminal uses a pyrotechnic attachment, which detaches the battery cable in the event of a crash of a severity to trigger the airbags. For additional information, refer to: Air Bag and Safety Pretensioner Supplemental Restraint System (SRS) (descop 501-20B).

All models are fitted with Delphi lead-calcium, maintenance free battery. Each battery is similar in construction with the battery rating varying according to application. There are two different battery sizes:

- H7 - All petrol variants
- H8 - TdV6

The battery uses 'calcium expanded' technology, which has both positive and negative plates with grids expanded from a strip lead-calcium alloy.

The battery is semi-sealed. Each casing has a vent to allow for thermal expansion and to vent oxygen and hydrogen gases, which are produced under certain charging conditions.

The battery incorporates an integral, temperature compensated hydrometer to provide a visual indication of the relative density and level of the electrolyte. The indicator shows different colours to show battery condition as follows:

- GREEN – shows that the battery is charged and in a serviceable condition
- DARK (turning to black) – shows that the battery is in a low state of charge and requires recharging
- CLEAR or YELLOW – the battery is no longer serviceable and must be replaced.

If the battery shows CLEAR or YELLOW the battery has an internal fault. Do not attempt to charge or jump-start the vehicle with the battery in this condition.

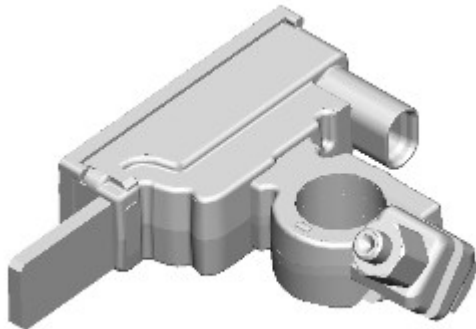
When removing the battery, ensure that the alarm is disarmed and that the ignition is switched off. Always disconnect the negative terminal first and then the positive terminal. When refitting the battery, always fit the positive terminal first followed by the negative terminal.

If the battery requires recharging, always use an approved constant current charger, designed for lead-calcium batteries. DO NOT use a fast charger, permanent damage to the battery may occur.

Delivery Mode

The vehicle is fitted with a transit relay. This is a disposable device and **NOT** for use by the customer. This relay fits in series with the battery and ground; it disconnects the battery from the vehicle's ground and thus eliminates quiescent current during delivery. The relay must be removed before delivery to the customer.

Battery Monitoring System



E115177

Optimal battery health is a fundamental factor in the correct operation of the Stop/Start system, therefore to calculate and communicate the battery status a Battery Monitoring System (BMS) module is introduced.

Battery, Mounting and Cables - Battery

Diagnosis and Testing

For further information refer to the battery care manual and,
REFER to: [Charging System](#) (414-00 Battery and Charging System - General Information, Diagnosis and Testing).

Battery, Mounting and Cables - Battery Tray

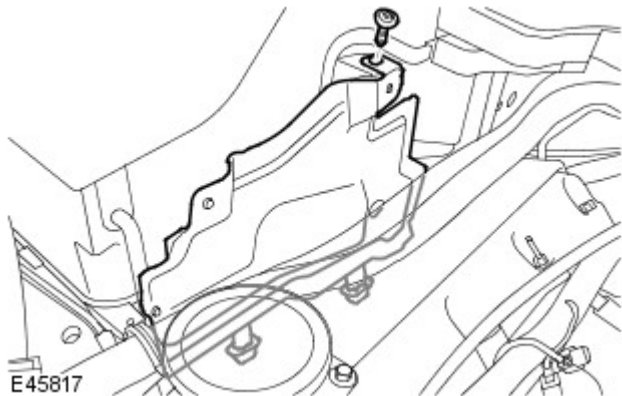
Removal and Installation

Removal

1. Remove the battery.
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

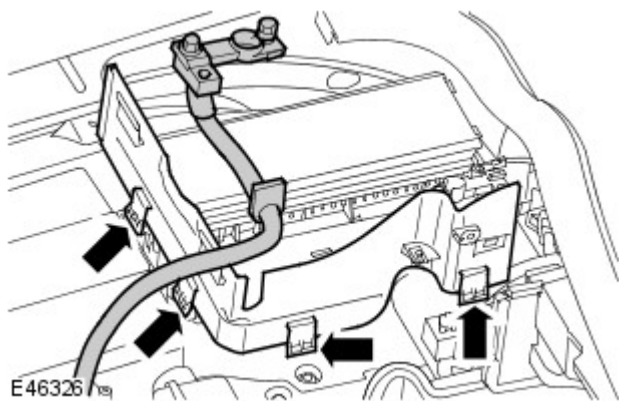
2. Remove the engine compartment upper heat shield.

- Remove the screw.
- Release the 2 clips.



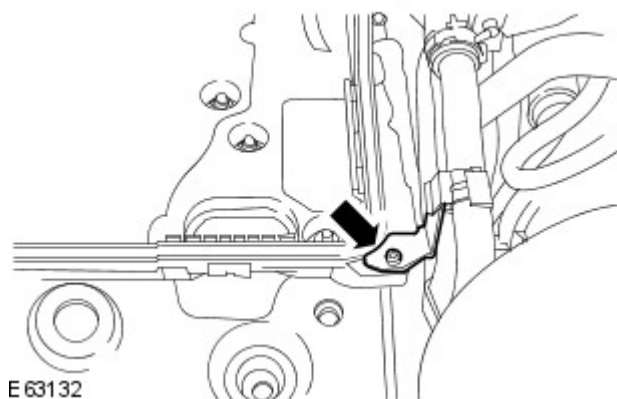
3. Remove the battery compartment side wall.

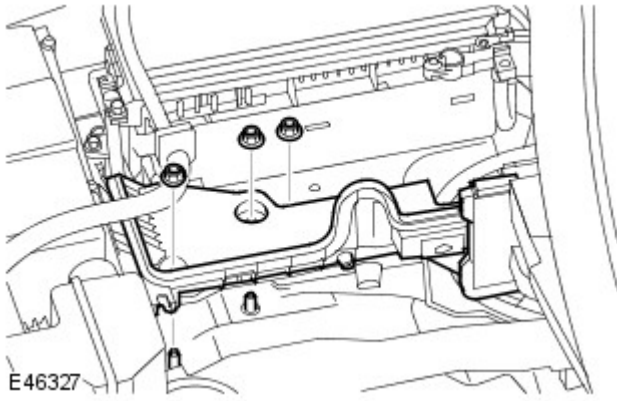
- Release the battery positive cable and grommet.
- Release the four clips.



4. Release the heater pipes.

- Remove the retaining screw.





5. Remove the battery tray.

- Remove the three retaining nuts.

Installation

1. To install, reverse the removal procedure.

- Tighten the nuts to 12 Nm (9 lb.ft).

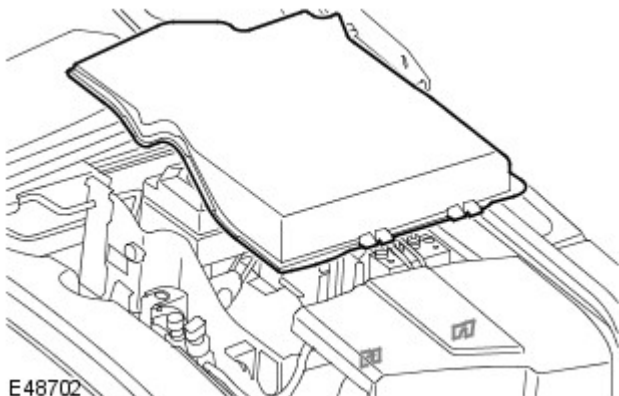
Battery, Mounting and Cables - Auxiliary Battery Tray

Removal and Installation

Removal

1. Remove the battery cover.

- Release the 2 clips.



E48702

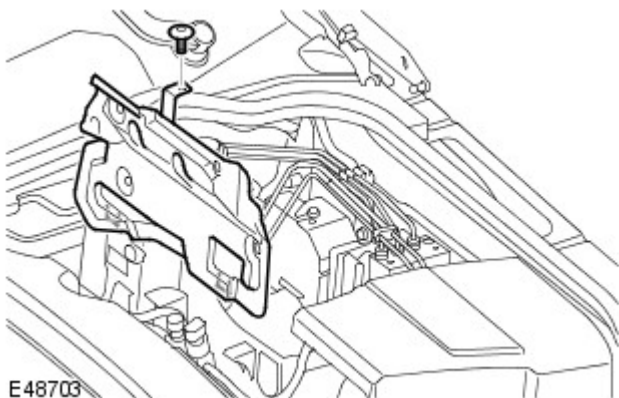
2. Disconnect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. If installed, remove the auxiliary battery.

4. Remove the engine compartment upper heat shield.

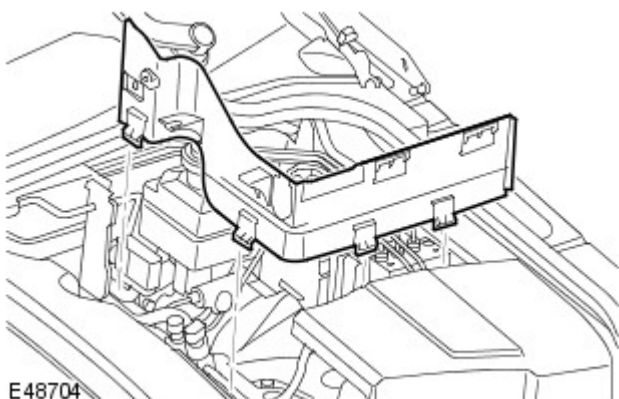
- Remove the screw.
- Release the 2 clips.



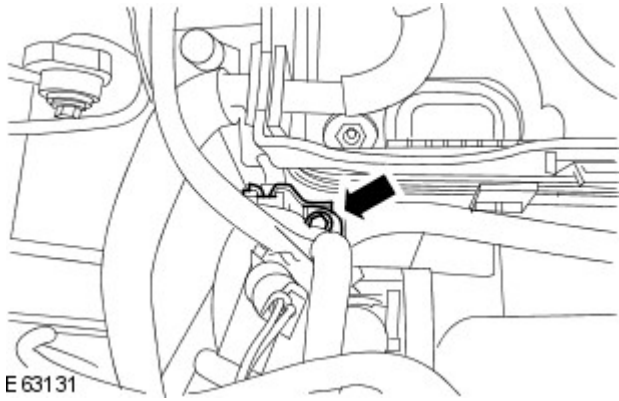
E48703

5. Remove the auxiliary battery compartment side wall.

- Release the battery positive cable and grommet.
- Release the four clips.

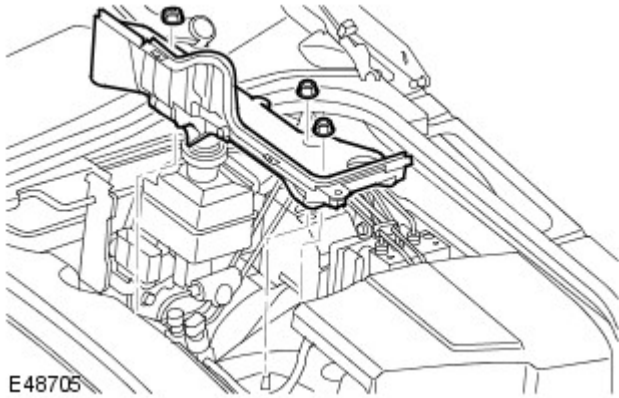


E48704



6. Release the A/C pipes.

- Remove the retaining screw.



7. Remove the auxiliary battery tray.

- Remove the three retaining nuts.

Installation

1. To install, reverse the removal procedure.

- Tighten the nuts to 12 Nm (9 lb.ft).

Battery, Mounting and Cables - Battery

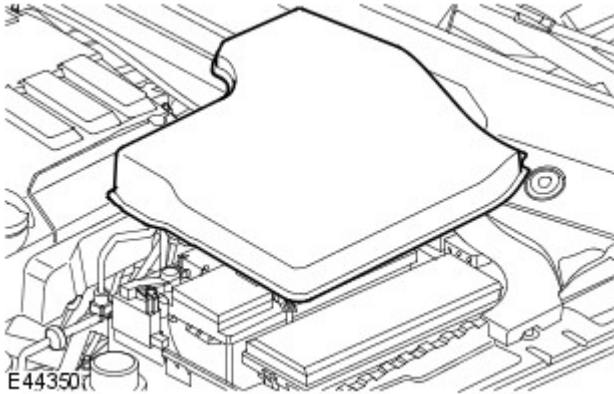
Removal and Installation

Removal

1. Secure the hood in the service position.

- Release the support struts.

2. Remove the battery cover.

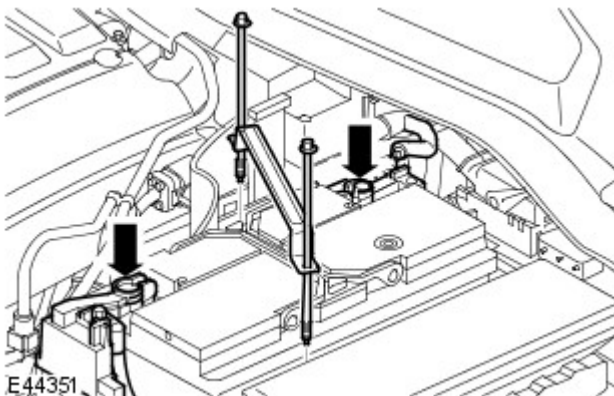


3. Disconnect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

4. Disconnect the battery positive cable.

5. Remove 2 bolts securing the battery clamp and remove the clamp.



6. Remove the battery.

Installation

1. **NOTE:** Apply petroleum jelly to the battery terminals.

To install, reverse the removal procedure.

- Tighten the battery clamp bolts to 5 Nm (4 lb.ft).
- Tighten the battery terminals to 5 Nm (4 lb.ft).

Generator and Regulator - TDV6 2.7L Diesel -

General Specification

Item	Specification
Generator:	
Make/Type	Denso SC2
Output	90/150 amps @ 25° C
Voltage control	By Power Control Module (PCM)
Voltage setpoint regulation	Controlled by Engine Management System (EMS)

Torque Specifications

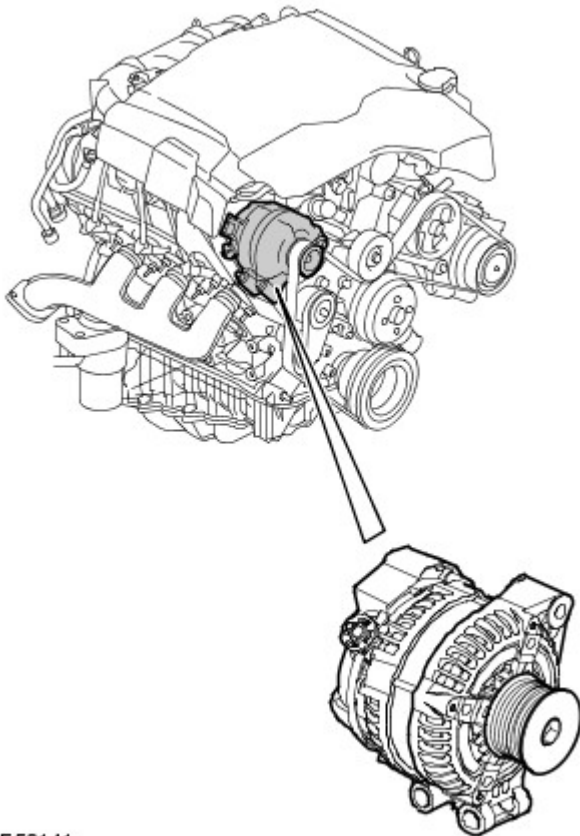
Description	Nm	lb-ft
* Battery harness connection nut	10	7



CAUTION: * Damage to the internal connections will result if this torque is exceeded

Generator and Regulator - TDV6 2.7L Diesel - Generator

Description and Operation



E50141

GENERAL

The generator is located at the front RH side of the engine, in front of the RH cylinder head. The generator has an output of 85/150 Amps and is manufactured by Denso. An eight-ribbed polyvee belt drives the generator pulley, which in turn is driven from the engine crankshaft pulley.

The generator pulley incorporates a one-way clutch mechanism, which allows the pulley to free wheel, reducing the amount of inertia applied to the engine during deceleration (coast).

The generator comprises a stator, a rotor, a rectifier pack and a regulator. There is a three-pin connector (C0053) on the generator:

- Pin 1 – Voltage reference line to the battery via the Battery Junction Box (BJB)
- Pin 2 – Pulse Width Modulated (PWM) signal from the Engine Control Module (ECM) to the generator (generator control)
- Pin 3 – PWM signal from the generator to the ECM (generator monitoring)

The generator is connected to earth via its mountings.

The rotor comprises a field winding, wound around an iron core and mounted on a shaft. The iron core has extensions at each end, which form North and South poles as current flows through the field winding. The rotor is located inside the stator and is mounted on bearings for smooth running and to support the rotor due to the high side loading applied by the drive belt tension.

The stator has three sets of coils made from copper wire. The three coil windings are connected in a 'star' connection, where one end of the winding is connected to the other two windings. The output current is supplied from the opposite end of each winding. Rotation of the rotor causes ac current to be produced in the coils.

The rectifier converts the ac current produced in the stator coils into dc (rectified) current required by the vehicle electrical system. The rectifier comprises semi-conductor diodes mounted on a heatsink to dissipate heat. An equal number of the diodes are on the negative and positive side, with an additional diode in the regulator to control feedback through the battery voltage signal line. The rectifier also prevents current flow from the battery to the generator when the output voltage is less than the battery voltage.

The 'smart' regulator controls the output voltage from the generator to protect the battery; at low temperatures battery charge acceptance is very poor so the voltage needs to be high to maximise any re-chargeability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing with consequent water loss. The EMS, which controls the regulator, will calculate the voltage set point required for the ensuing conditions. The 'traditional' regulator controls voltage against generator temperature, which means the battery temperature will lag a long way behind so there will be significant periods of operation when battery charging is compromised. With this system, the EMS can set the voltage by inferring the battery temperature from information received from its various sensors, hence voltage will follow the battery's needs a lot more accurately.

The regulator has transistors, which rapidly switch on and off to regulate the voltage output according to the voltage sensed internally. The regulator also provides a PWM signal output to the ECM, which uses the signal to adjust the idle speed under varying electrical loads.

Initially, the ignition switch supply provides an excitation current to the rotor at low generator speeds via brushes, which contact slip rings at the end of the rotor shaft. As the generator speed increases the generator becomes self-exciting.

The charge warning lamp function is transmitted to the EMS and then on to the Controller Area Network (CAN) bus to the instrument pack.

LOAD MANAGEMENT SYSTEM

The load management system comprises software resident in the Automatic Temperature Control Module (ATCM). For additional information, refer to: Control Components (412-04 Control Components, Description and Operation). Its purpose is to protect battery state-of-charge during abnormal usage of the vehicle. The system will request the Media Orientated System Transport (MOST) ring and the air suspension to go into 'power save' mode, and will modulate features such as seat heating and screen heating to prevent the battery being dragged down to a point where the car becomes unoperational. A 'WARNING - LOW BATTERY' message will be displayed in the message centre.

Generator and Regulator - TDV6 2.7L Diesel - Generator

Diagnosis and Testing

For further information,

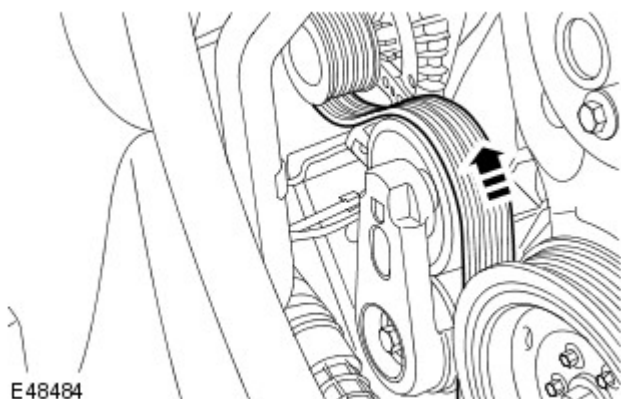
REFER to: [Charging System](#) (414-00 Battery and Charging System - General Information, Diagnosis and Testing).

Generator and Regulator - TDV6 2.7L Diesel - Generator

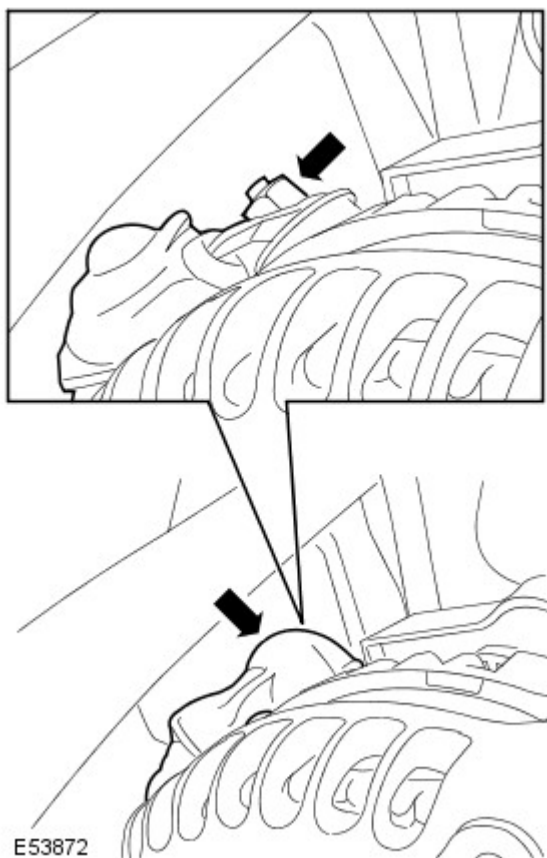
Removal and Installation

Removal

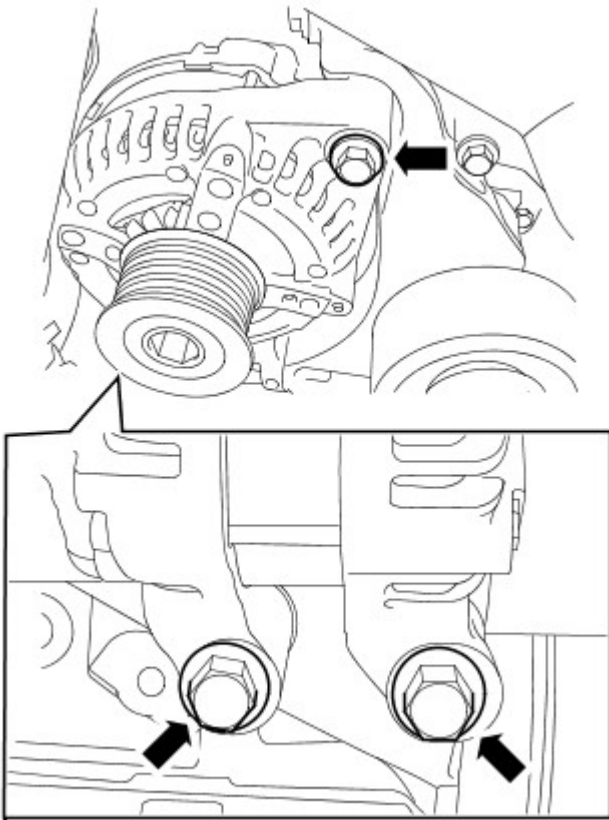
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
3. Release the accessory drive belt.



4. Disconnect the generator harness.
 - Reposition the rubber insulator.
 - Remove the retaining nut.



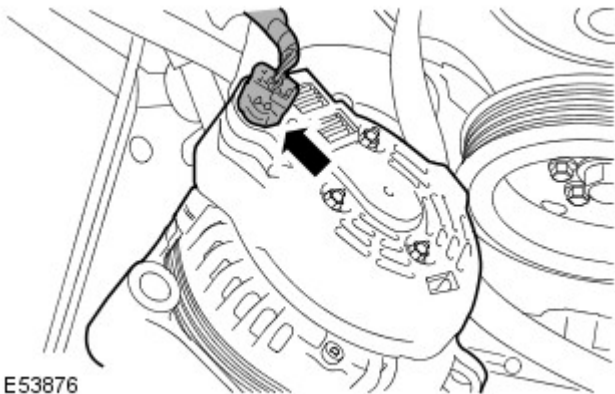
5. Remove the three generator retaining bolts.



E53874

6. Remove the generator.

- Reposition the generator.
- Disconnect the electrical connector.



E53876

Installation

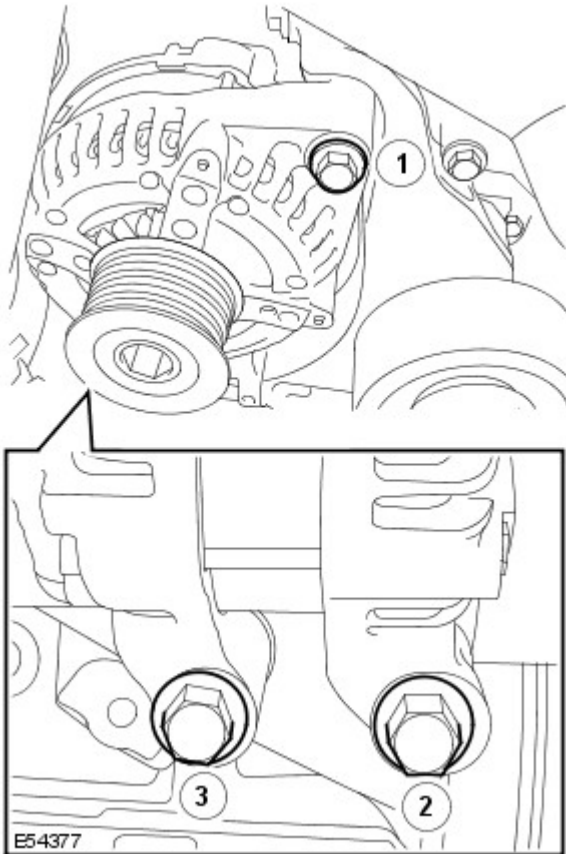
1. Install the generator.

- Connect the electrical connector.
- Reposition the generator.

2. NOTE: Tighten the retaining bolts in the sequence shown.

Install the three generator retaining bolts.

- Tighten to 47 Nm (35 lb.ft).



3. Connect the generator harness.

- Tighten the retaining nut to 12 Nm (9 lb.ft).
- Reposition the rubber insulator.

4. Attach the accessory drive belt.

5. Install the cooling fan shroud.

For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

6. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Generator and Regulator - TDV6 3.0L Diesel -

Description	Nm	lb-ft	lb-in
Generator retaining bolts	47	35	-
Battery positive cable retaining nut	12	9	-

Generator and Regulator - TDV6 3.0L Diesel - Generator - Component

Location

Description and Operation



E117288

Generator and Regulator - TDV6 3.0L Diesel - Generator - Overview

Description and Operation

OVERVIEW

The charging system consists of a 180 Amp output generator and regulator assembly. The generator and regulator assembly generates electrical power for the vehicle electrical system and maintains the battery in a charged state. When the engine is running the generator produces an alternating current, which is converted to a direct current internally. The output from the generator is controlled by the voltage regulator (located inside the generator) and then supplied to the battery through the main battery positive cable.

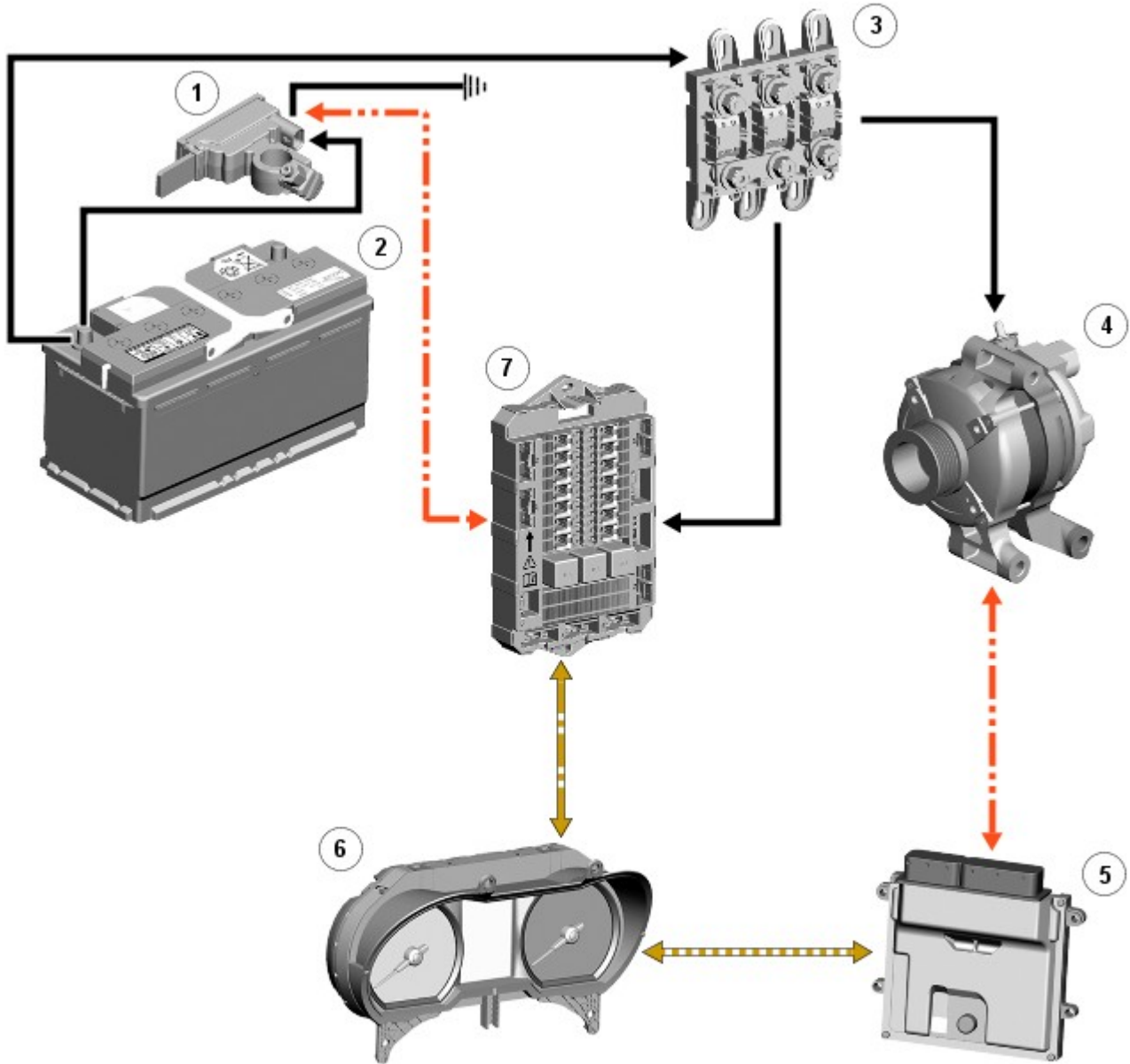
The generator is mounted on the front right side of the engine and driven at approximately 3 times engine speed by the accessory drive belt.

Generator and Regulator - TDV6 3.0L Diesel - Generator - System Operation and Component Description

Description and Operation

Control Diagram

• NOTE: **A** = Hardwired; **D** = High speed CAN (controller area network) bus; **N** = Medium speed CAN bus; **O** = LIN (local interconnect network) bus.



E96985



ItemDescription

1	Battery monitoring system module
2	Battery
3	BJB (battery junction box)
4	Generator and regulator
5	ECM (engine control module)
6	Instrument cluster
7	RJB (rear junction box)

System Operation

OPERATION

The output voltage required from the generator and regulator is calculated by the battery monitoring system. Refer to: Battery and Cables (414-01, Description and Operation).

The battery monitoring system signals the calculated voltage to the [ECM](#) via the [RJB](#) and the instrument cluster. The [ECM](#) then transmits the calculated voltage to the generator and regulator on the [LIN \(local interconnect network\)](#) bus connection.

The [ECM](#) will over-ride the voltage value requested by the battery monitoring system if it detects a fault in the generator and regulator. The [ECM](#) also signals the instrument cluster to display a warning message if it detects a fault with the generator and regulator. Refer to: Instrument Cluster (413-01, Description and Operation).

Component Description

DESCRIPTION

The regulator provides a controlled variable voltage output from the generator. Two electrical terminals are provided on the outer casing of the generator. One terminal supplies the [DC \(direct current\)](#) voltage output from the generator to the battery positive terminal. The second terminal provides the [LIN](#) bus connection between the regulator and the [ECM](#).

Generator and Regulator - TDV6 3.0L Diesel - Generator

Diagnosis and Testing

For further information,

REFER to: [Charging System](#) (414-00 Battery and Charging System - General Information, Diagnosis and Testing).

Generator and Regulator - TDV6 3.0L Diesel - Generator

Removal and Installation

Removal

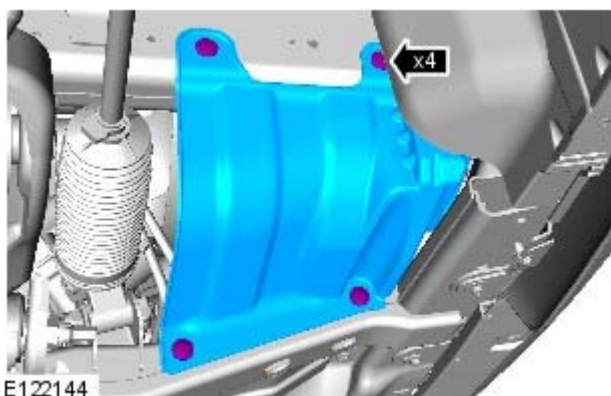
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

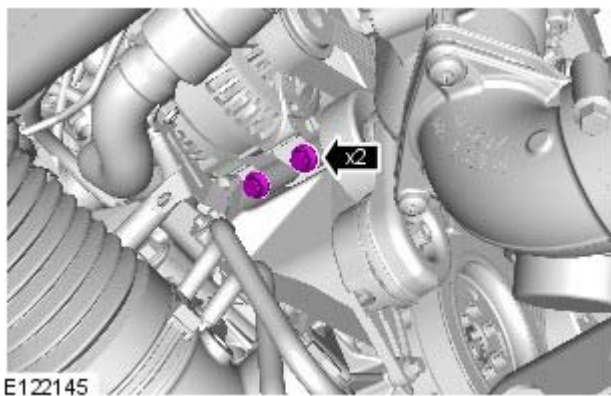
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

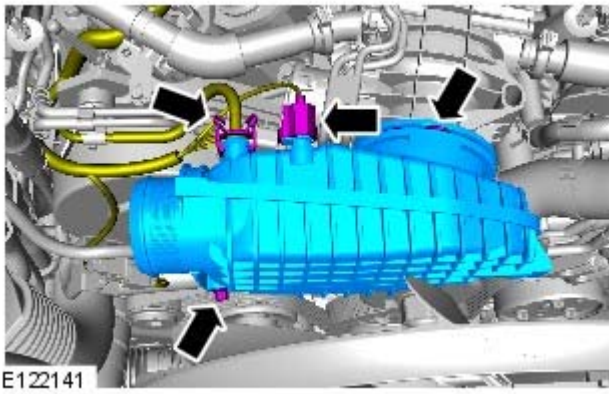
- 3.



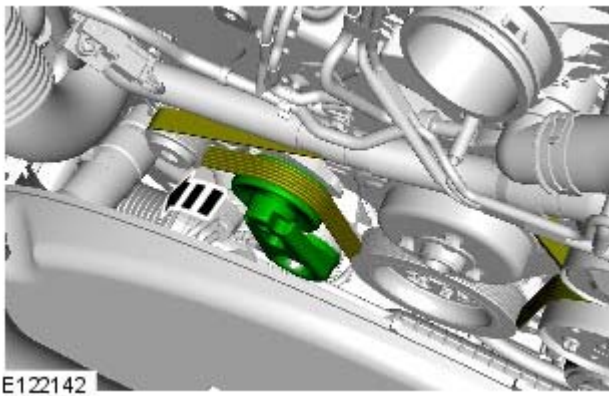
4. *Torque:* 47 Nm



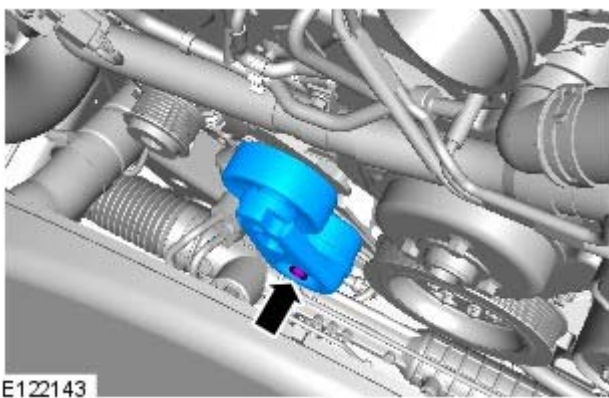
5. Lower the vehicle.
6. Refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
7. Refer to: [Cooling Fan](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, Removal and Installation).



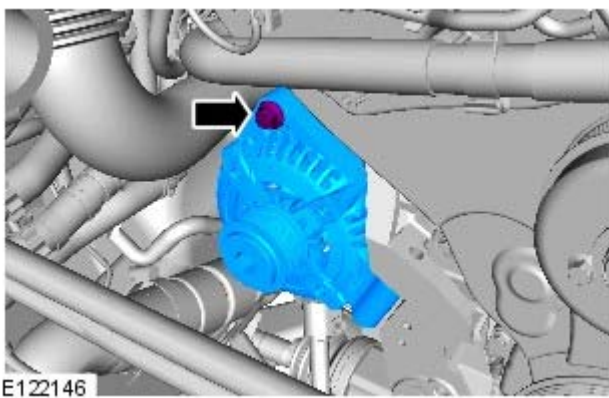
8. *Torque:* 10 Nm



9.



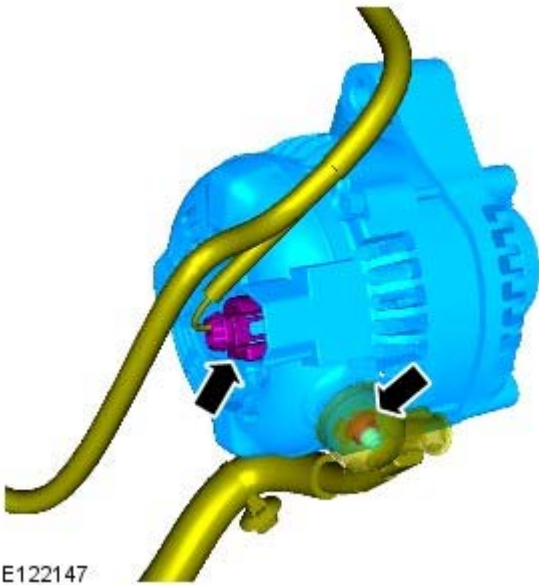
10. *Torque:* 47 Nm



11. **⚠ CAUTION:** Take extra care not to damage the wiring harnesses.

Torque: 47 Nm

12. Torque: 12 Nm



E122147

Installation

1. To install, reverse the removal procedure.

Generator and Regulator - V6 4.0L Petrol -

General Specification

Item	Specification
Generator:	
Make/Type	Denso SC2
Output	90/150 amps @ 25° C
Voltage control	By Power Control Module (PCM)
Voltage setpoint regulation	Controlled by Engine Management System (EMS)

Torque Specifications

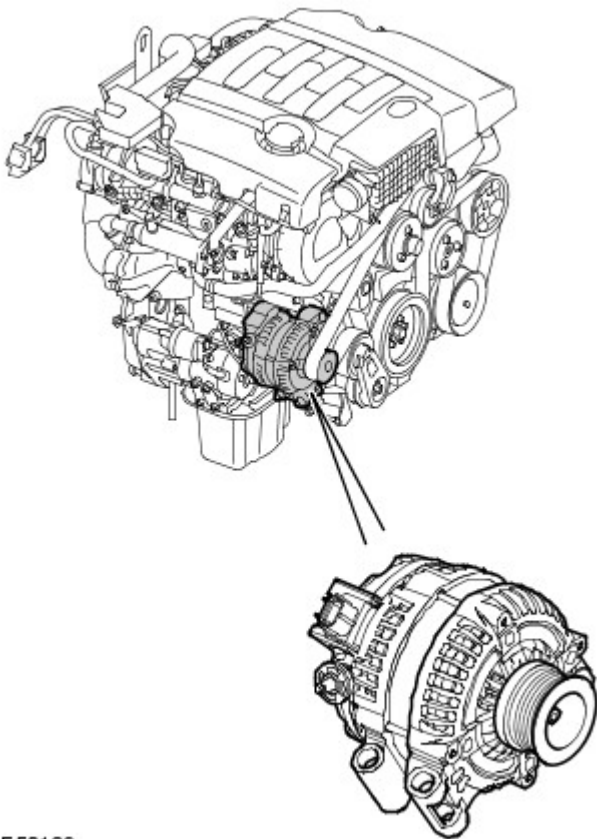
Description	Nm	lb-ft
* Battery harness connection nut	10	7



CAUTION: * Damage to the internal connections will result if this torque is exceeded

Generator and Regulator - V6 4.0L Petrol - Generator

Description and Operation



E50139

The generator is located at the front RH side of the engine, in front of the RH cylinder head. The generator has an output of 85/150 Amps and is manufactured by Denso. A six-ribbed polyvee belt drives the generator pulley, which in turn is driven from the engine crankshaft pulley.

The generator comprises a stator, a rotor, a rectifier pack and a regulator. There is a three-pin connector (C0053) on the generator:

- Pin 1 – Pulse Width Modulated (PWM) signal from the generator to the Engine Control Module (ECM) (generator monitoring)
- Pin 2 – PWM signal from the ECM to the generator (generator control)
- Pin 3 – Voltage reference line to the battery via the Battery Junction Box (BJB).

The generator is connected to ground via its mountings.

The rotor comprises a field winding, wound around an iron core and mounted on a shaft. The iron core has extensions at each end, which form North and South poles as current flows through the field winding. The rotor is located inside the stator and is mounted on bearings for smooth running and to support the rotor due to the high side loading applied by the drive belt tension.

The stator has three sets of coils made from copper wire. The three coil windings are connected in a 'star' connection, where one end of the winding is connected to the other two windings. The output current is supplied from the opposite end of each winding. Rotation of the rotor causes ac current to be produced in the coils.

The rectifier converts the ac current produced in the stator coils into dc (rectified) current required by the vehicle electrical system. The rectifier comprises semi-conductor diodes mounted on a heatsink to dissipate heat. An equal number of the diodes are on the negative and positive side, with an additional diode in the regulator to control the feedback through the battery voltage signal line. The rectifier also prevents current flow from the battery to the generator when the output voltage is less than the battery voltage.

The 'smart' regulator controls the output voltage from the generator to protect the battery; at low temperatures battery charge acceptance is very poor so the voltage needs to be high to maximise any re-chargeability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing at the battery with consequent water loss. The EMS, which controls the regulator, will calculate the voltage set point required for the ensuing conditions. The 'traditional' regulator controls voltage against generator temperature, which means the battery temperature will lag a long way behind so there will be significant periods of operation when battery charging is compromised. With this system, the EMS can set the voltage by inferring the battery temperature from information received from its various sensors, hence voltage will follow the battery's needs a lot more accurately.

The regulator has transistors, which rapidly switch on and off to regulate the voltage output according to the voltage sensed internally. The regulator also provides a PWM signal output to the ECM, which uses the signal to adjust the idle speed under varying electrical loads.

Initially, the ignition switch supply provides an excitation current to the rotor at low generator speeds via brushes, which

contact slip rings at the end of the rotor shaft. As the generator speed increases the generator becomes self-exciting.

The charge warning lamp function is transmitted to the EMS and then on to the Controller Area Network (CAN) bus to the instrument pack.

LOAD MANAGEMENT SYSTEM

The load management system comprises software resident in the Automatic Temperature Control Module (ATCM). For additional information, refer to: Control Components (412-04 Control Components, Description and Operation). Its purpose is to protect battery state-of-charge during abnormal usage of the vehicle. The system will request the Media Orientated System Transport (MOST) ring and the air suspension to go into 'power save' mode, and will modulate features such as seat heating and screen heating to prevent the battery being dragged down to a point where the car becomes unoperational. A 'WARNING - LOW BATTERY' message will be displayed in the message centre.

Generator and Regulator - V6 4.0L Petrol - Generator

Diagnosis and Testing

For further information,

REFER to: [Charging System](#) (414-00 Battery and Charging System - General Information, Diagnosis and Testing).

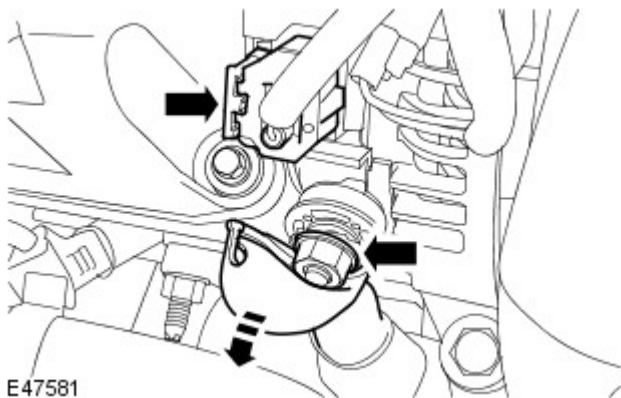
Generator and Regulator - V6 4.0L Petrol - Generator

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).
3. Disconnect the generator electrical connectors.

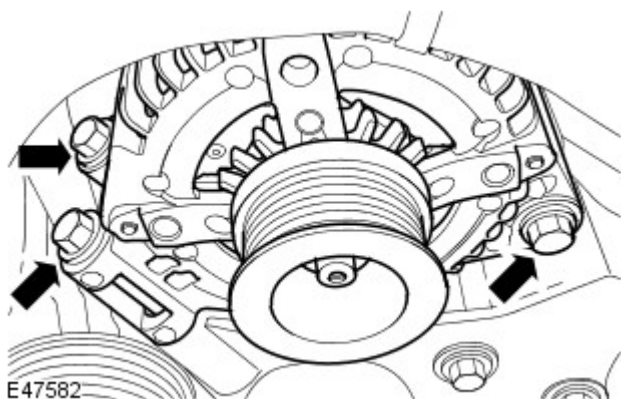
- Release the gaiter, remove the nut and disconnect the cable.
- Disconnect the electrical connector.



E47581


4. Remove the generator.

- Remove the 3 bolts.



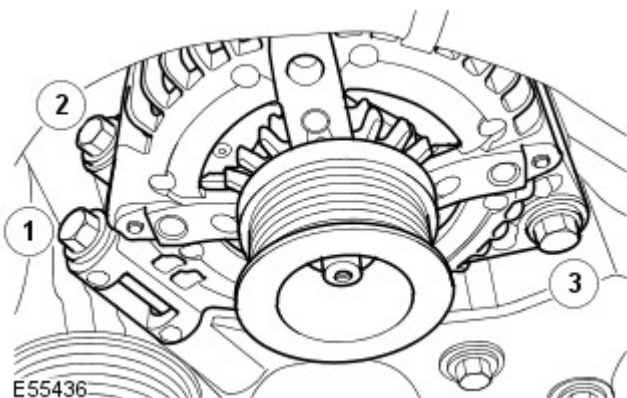
E47582

Installation

1.  **CAUTION:** Tighten the bolts in the sequence shown.

Install the generator.

- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).



E55436

2. Connect the generator electrical connectors.

- Tighten the nut to 10 Nm (7 lb.ft).
- Connect and secure the electrical connector.

3. Install the accessory drive belt.

For additional information, refer to: [Accessory Drive Belt](#) (303-05C Accessory Drive - V6 4.0L Petrol, Removal and Installation).

4. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

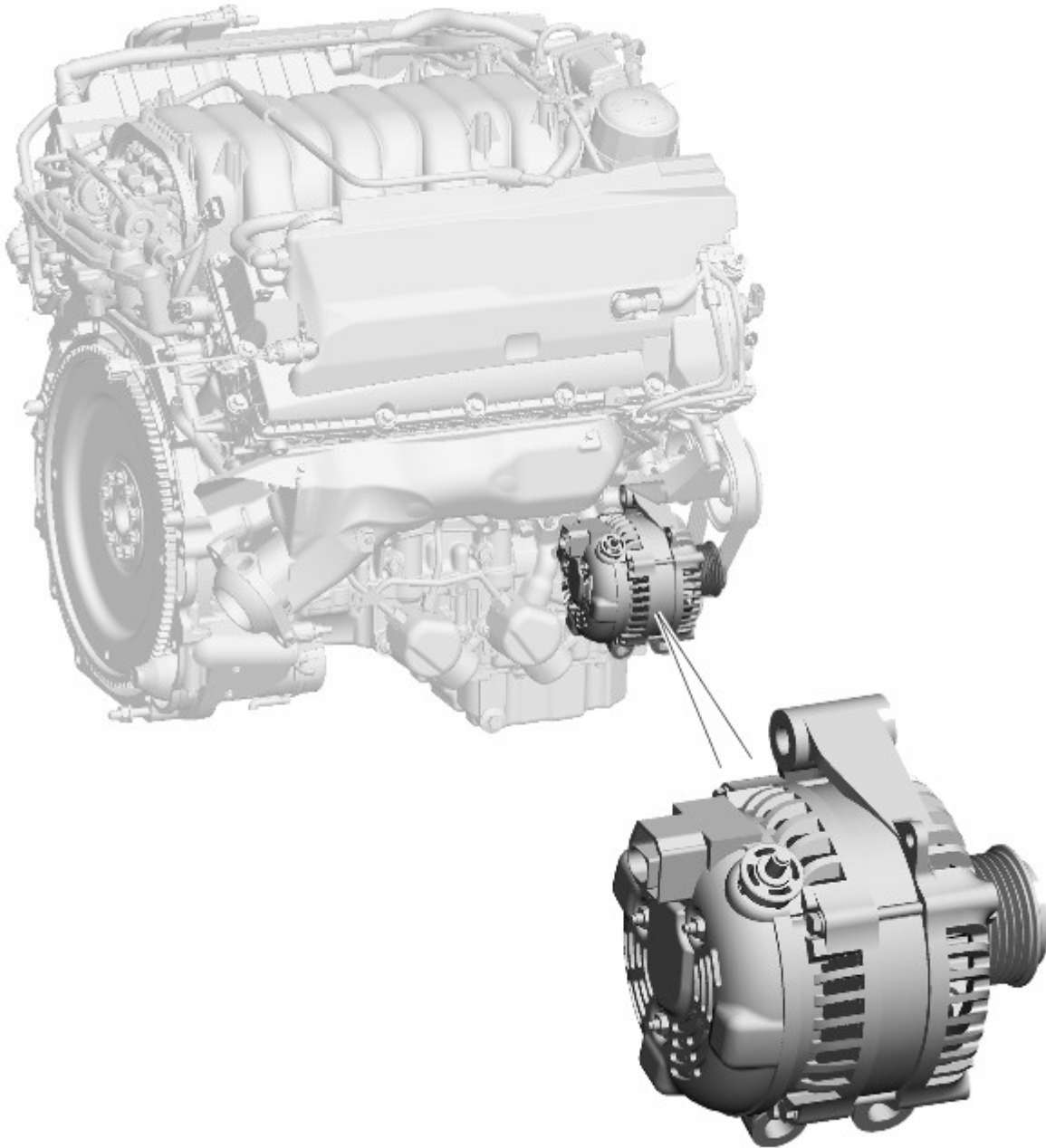
Generator and Regulator - V8 5.0L Petrol -

Description	Nm	lb-ft	lb-in
Generator retaining bolts	47	35	-
Battery positive cable retaining nut	12	9	-

Generator and Regulator - V8 5.0L Petrol - Generator - Component Location

Description and Operation

COMPONENT LOCATION



E118331

Generator and Regulator - V8 5.0L Petrol - Generator - Overview

Description and Operation

OVERVIEW

On 5.0L V8 vehicles (naturally aspirated and supercharger), the charging system consists of a 150 Amp output generator and regulator assembly. The generator and regulator assembly generates electrical power for the vehicle electrical system and maintains the battery in a charged state.

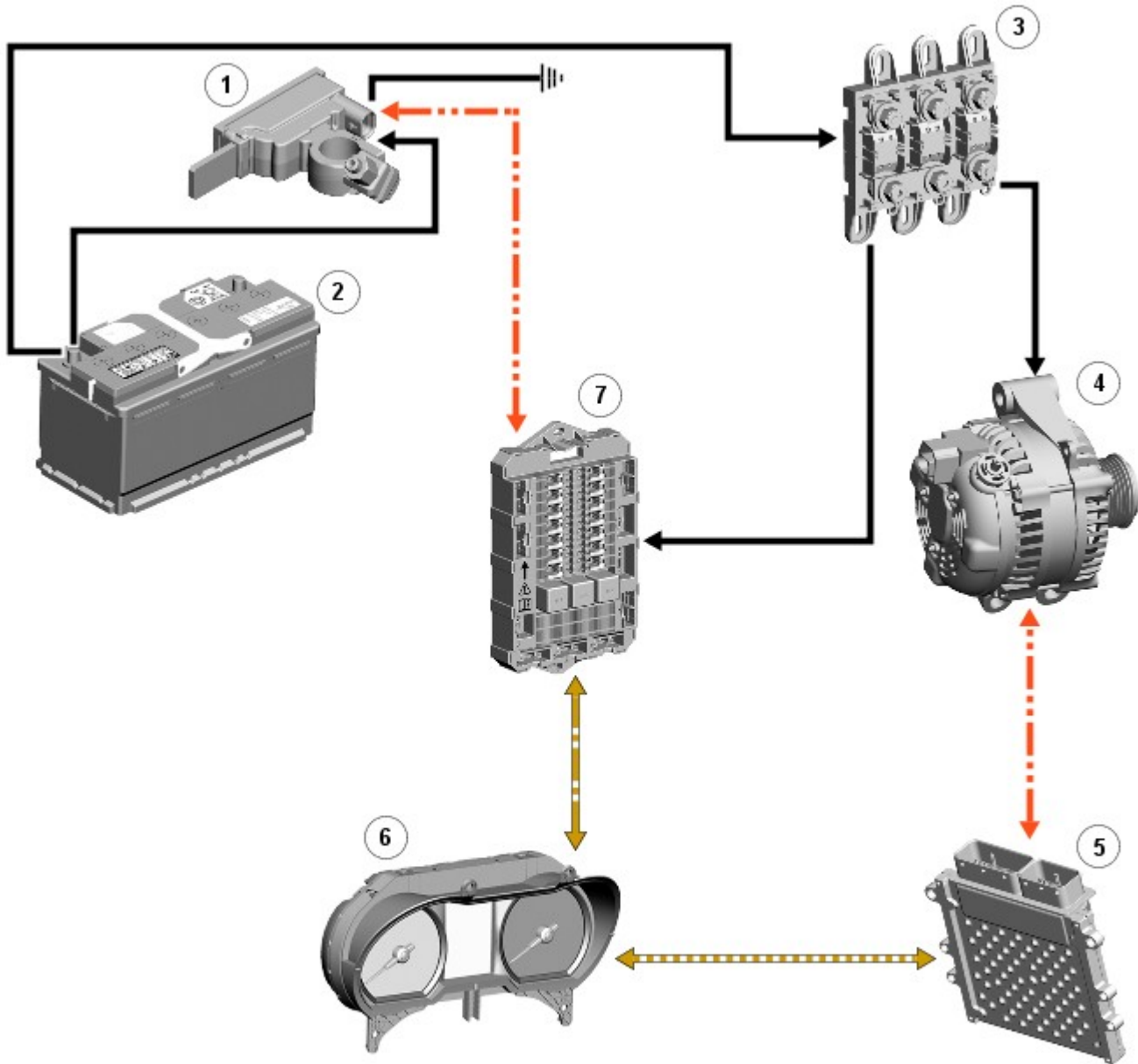
When the engine is running the generator produces an alternating current, which is converted to a direct current internally. The output from the generator is controlled by the voltage regulator (located inside the generator) and then supplied to the battery through the main battery positive cable. The generator is mounted on the front right side of the engine and driven at approximately 3 times engine speed by the accessory drive belt.

Generator and Regulator - V8 5.0L Petrol - Generator - System Operation and Component Description

Description and Operation

Control Diagram

• NOTE: **A** = Hardwired; **D** = High speed CAN (controller area network) bus; **N** = Medium speed CAN bus; **O** = LIN (local interconnect network) bus



E118332



ItemDescription

1	Battery monitoring system module
2	Battery
3	BJB (battery junction box)
4	Generator and regulator
5	ECM (engine control module)
6	Instrument cluster
7	RJB (rear junction box)

System Operation

GENERAL

The output voltage required from the generator and regulator is calculated by the battery monitoring system. For additional information refer to Battery, Mounting and Cables 414-01.

The battery monitoring system signals the calculated voltage to the [ECM](#) via the [RJB](#) and the instrument cluster. The [ECM](#) then transmits the calculated voltage to the generator and regulator on the [LIN](#) bus connection.

The [ECM](#) will over-ride the voltage value requested by the battery monitoring system if it detects a fault in the generator and regulator. The [ECM](#) also signals the instrument cluster to display a warning message if it detects a fault with the generator and regulator. For additional information refer to Instrument Cluster 413-01.

Component Description

GENERATOR AND REGULATOR

The regulator provides a controlled variable voltage output from the generator. Two electrical terminals are provided on the outer casing of the generator. One terminal supplies the [DC \(direct current\)](#) voltage output from the generator to the battery positive terminal. The second terminal provides the [LIN](#) bus connection between the regulator and the [ECM](#).

Generator and Regulator - V8 5.0L Petrol - Generator

Diagnosis and Testing

For further information,

REFER to: [Charging System](#) (414-00 Battery and Charging System - General Information, Diagnosis and Testing).

Generator and Regulator - V8 5.0L Petrol - Generator

Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

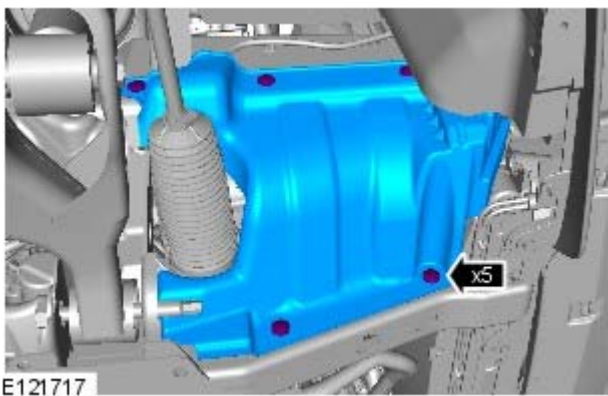
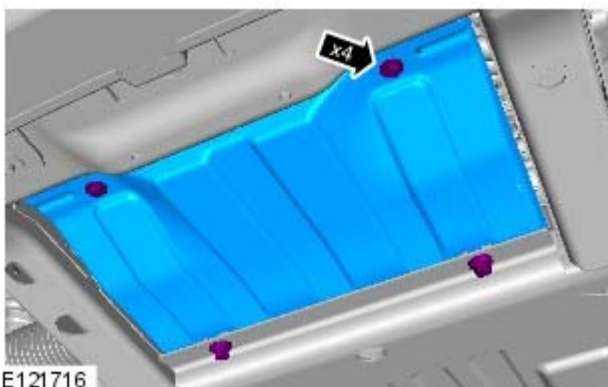
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

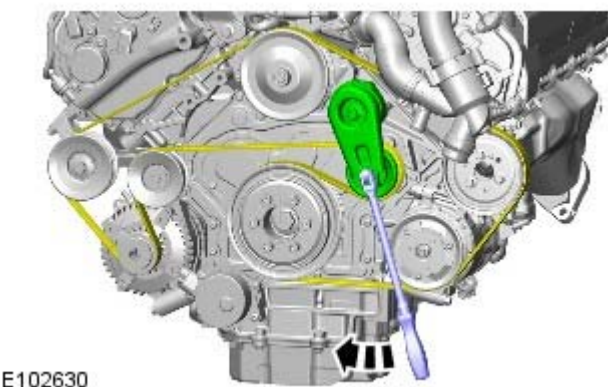
2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

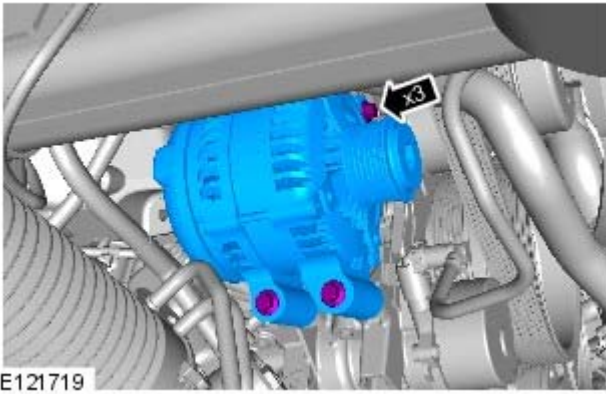
3. Torque: 62 Nm



- 4.

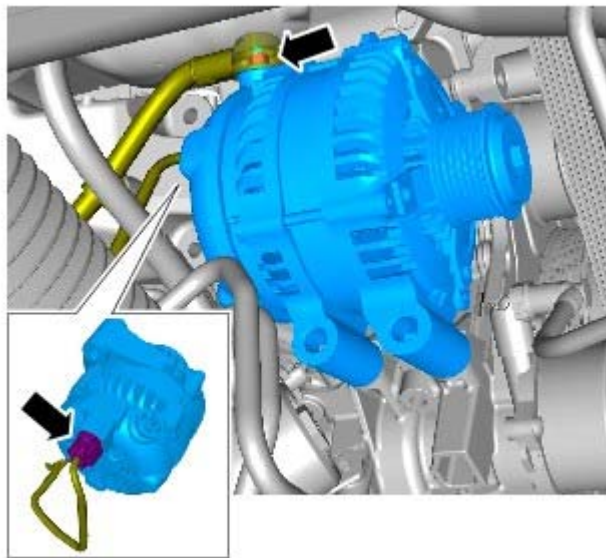


5. **5. NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



6.  CAUTION: Take extra care not to damage the wiring harnesses.

Torque: 47 Nm



7. *Torque:* 12 Nm

Installation

1. To install, reverse the removal procedure.

Information and Entertainment System - General Information - Cellular Phone

Diagnosis and Testing

Principle of Operation

For a detailed description of the Cellular phone system and operation, refer to the relevant Diagnosis and Testing section of the workshop manual. REFER to:

Audio System (415-01 Audio Unit, Description and Operation),
[Antenna](#) (415-02 Antenna, Description and Operation),
 Speakers (415-03 Speakers, Description and Operation),
 Video System (415-07 Video System, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check all information and entertainment system modules ● Speakers ● Switch(s) stuck or damaged ● Touch screen display 	<ul style="list-style-type: none"> ● Fuses ● Electrical harnesses ● Harness connectors ● Battery condition, state of charge

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, refer to the Symptom Chart below, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Action
Unable to pair	● GO to Pinpoint Test A .
Not Auto Connecting	● GO to Pinpoint Test B .
Poor Quality Audio	● GO to Pinpoint Test C .
No Audio to 3rd Party	● GO to Pinpoint Test D .
No Audio from 3rd Party	● GO to Pinpoint Test E .
No Audio	● GO to Pinpoint Test E .

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Bluetooth Module - High Line \(TEL\)](#) (100-00 General Information, Description and Operation).

Pinpoint Tests

PINPOINT TEST A : UNABLE TO PAIR	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: 'NO PHONE FITTED' DISPLAY	
• NOTE: Prior to continuing with any diagnosis, ensure that the Customer telephone and level of software is included on the JLR approved list, the telephone battery is fully charged and in a serviceable condition, the bluetooth function is activated and the telephone handset is placed within the vehicle cabin area.	
	1 Carry out checks to determine if 'No Phone Fitted' is shown on vehicle display.
	Is 'No Phone Fitted' displayed? Yes GO to A2.
	No Locate the connected telephone and if not Customer telephone, disconnect from the system.
A2: TELEPHONE BLUETOOTH DEVICE SEARCH	

	<p>1 Carry out Bluetooth device search using Customer handset.</p>
	<p>Is 'Land Rover' identified in Bluetooth device list?</p> <p>Yes Select device from list, then continue with diagnosis. GO to A3.</p> <p>No Carry out further Bluetooth device search, to a maximum of 4 times, waiting approximately 20 seconds between searches. If 'Land Rover' still not identified in Bluetooth device list, set ignition status to OFF, wait approximately 30 seconds and set ignition status to ON. Carry out further Bluetooth device search, to a maximum of 4 times, waiting approximately 20 seconds between searches. If 'Land Rover' still not identified in Bluetooth device list, contact your local in market support for further assistance.</p>
A3: TELEPHONE HANDSET ERROR	
	<p>1 Check for any error shown on the telephone handset when 'Land Rover' is selected from the Bluetooth device list.</p>
	<p>Was an error immediately shown on the telephone handset?</p> <p>Yes Wait approximately 10 seconds then re-attempt selection, to a maximum of 4 times, waiting approximately 10 seconds between each attempt. If error still being displayed, contact your local in market support for assistance.</p> <p>No Enter PIN '2121' then continue with diagnosis. GO to A4.</p>
A4: PIN ENTRY STATUS	
	<p>1 Check for successful PIN entry.</p>
	<p>Was PIN entry successful?</p> <p>Yes GO to A5.</p> <p>No Wait approximately 10 seconds then re-attempt PIN entry, to a maximum of 4 times, waiting approximately 10 seconds between each attempt. If PIN entry is still un-successful, contact your local in market support for assistance.</p>
A5: 'NO PHONE FITTED' DISPLAY	
	<p>1 Carry out checks to determine if 'No Phone Fitted' is still shown on vehicle display.</p>
	<p>Is 'No Phone Fitted' still displayed?</p> <p>Yes From the telephone handset, select the connect option for the 'Land Rover' device identified in the Bluetooth device list. If 'No Phone Fitted' is still displayed, suspect a telephone handset fault. Carry out Pinpoint test again using known good telephone handset.</p> <p>No The telephone is paired and connected to the system. No further action is required for this symptom.</p>

PINPOINT TEST B : NOT AUTOMATICALLY CONNECTING

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: CUSTOMER TELEPHONE IN POSITION 1	
<p>• NOTE: Prior to continuing with any diagnosis, ensure that the Customer telephone and level of software is included on the JLR approved list, the telephone battery is fully charged and in a serviceable condition, the bluetooth and auto connect functions are activated and the telephone handset is placed within the vehicle cabin area.</p>	
	<p>1 Carry out checks to determine if the Customer telephone is in position 1 in the Bluetooth Module device list.</p>
	<p>Is the Customer telephone in position 1?</p> <p>Yes GO to B2.</p> <p>No Advise Customer that delays in connection will occur if telephone is not listed in position 1.</p>
B2: BLUETOOTH CONNECTION	
	<p>1 Carry out checks to determine if Bluetooth connection to the vehicle has been achieved.</p>
	<p>Has Bluetooth connection to the vehicle been achieved?</p> <p>Yes No further action is required for this symptom.</p> <p>No GO to B3.</p>
B3: 'NO PHONE FITTED' DISPLAY	
	<p>1 Carry out checks to determine if 'Land Rover' is shown in the Customer Bluetooth telephone device display.</p>
	<p>Is 'Land Rover' identified in the Customer Bluetooth device list?</p> <p>Yes Select the device to connect then follow pairing instructions.</p> <p>No Carry out the 'Unable to Pair' Pinpoint Test. GO to A.</p>

PINPOINT TEST C : POOR QUALITY AUDIO

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: SIGNAL STRENGTH	
<p>• NOTE: Prior to continuing with any diagnosis, ensure that the Customer telephone and level of software is included on the JLR approved list, the telephone battery is fully charged and in a serviceable condition, the telephone is placed within the vehicle cabin area and is connected to the vehicle via bluetooth.</p>	
	<p>1 Check the signal strength displayed on the telephone handset.</p>
	<p>Are at least two signal strength bars shown on the telephone handset display?</p> <p>Yes GO to C2.</p> <p>No Suspect GSM Network issue. This can explain intermittent audio and dropped calls, and the inability to initiate calls.</p>

C2: POOR AUDIO FROM THIRD PARTY ONLY	
	1 Establish from Customer feedback/symptom if there is poor audio from the Third Party only.
	Is the poor audio from the Third Party only? Yes Suspect GSM Network issue. This can explain intermittent audio and dropped calls, and the inability to initiate calls. No GO to C3.
C3: POOR AUDIO TO THIRD PARTY ONLY	
	1 Establish from Customer feedback/symptom if there is poor audio to the Third Party only.
	Is the poor audio to the Third Party only? Yes Check and install a new microphone as necessary. No GO to C4.
C4: POOR AUDIO WITH VEHICLE STATIONARY	
	1 Establish from Customer feedback/symptom if there is poor audio when the vehicle is stationary only.
	Is the poor audio when the vehicle is stationary only? Yes Check and install a new microphone as necessary. No GO to C5.
C5: THIRD PARTY MOVING VEHICLE	
	1 Establish from Customer feedback/symptom if the Third Party is in a moving vehicle.
	Is the Third Party in a moving vehicle? Yes There are limitations to the way the system can improve audio, and in this situation it is not possible to determine the source of the audio degradation. No GO to C6.
C6: CUSTOMER HEARING ECHO	
	1 Establish from Customer feedback/symptom if the Customer is hearing an echo.
	Is the Customer hearing an echo? Yes Echo from the Third Party is not vehicle failure, it is the Third Party set-up. No further action is required for this symptom. No Contact your local in market support for assistance.

PINPOINT TEST D : NO AUDIO TO THIRD PARTY	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: MICROPHONE DIAGNOSTIC TROUBLE CODES (DTCs)	
• NOTE: Prior to continuing with any diagnosis, ensure that the Customer telephone and level of software is included on the JLR approved list, the telephone battery is fully charged and in a serviceable condition, the telephone is placed within the vehicle cabin area and is connected to the vehicle via bluetooth.	
	1 Using the Manufacturer approved diagnostic system, check for any logged microphone DTCs in Audio Front Control module.
	Is DTC B1D79-01 logged? Yes Carry out diagnosis of electrical failure as advised in Action column of DTC Index. No Contact your local in market support for assistance.

PINPOINT TEST E : NO AUDIO FROM THIRD PARTY	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: 'IN CALL' DISPLAY	
• NOTE: Prior to continuing with any diagnosis, ensure that the Customer telephone and level of software is included on the JLR approved list, the telephone battery is fully charged and in a serviceable condition, the telephone is placed within the vehicle cabin area and is connected to the vehicle via bluetooth.	
	1 Carry out checks to determine if 'In Call' is shown on the vehicle display.
	Is vehicle display showing 'In Call'? Yes Contact your local in market support for assistance. No Call has ended. No further action is required for this symptom.

PINPOINT TEST F : NO AUDIO	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
F1: AUDIO FROM THIRD PARTY	
• NOTE: Prior to continuing with any diagnosis, ensure that the Customer telephone and level of software is included on the JLR approved list, the telephone battery is fully charged and in a serviceable condition, the telephone is placed within the vehicle cabin area and is connected to the vehicle via bluetooth.	
	1 Establish from Customer feedback/symptom if there is Audio from the Third Party.
	Is there Audio from the Third Party? Yes GO to F2. No Refer to the 'No Audio From Third Party' Pinpoint test. GO to E.
F2: AUDIO TO THIRD PARTY	

	<p>1 Establish from Customer feedback/symptom if there is Audio to the Third Party.</p> <p>Is there Audio to the Third Party?</p> <p>Yes GO to F3.</p> <p>No Refer to the 'No Audio To Third Party' Pinpoint test.GO to D.</p>
F3: CD OR RADIO AUDIO	
	<p>1 Establish from Customer feedback/symptom if there is Audio from the CD or Radio.</p> <p>Is there Audio from the CD or Radio?</p> <p>Yes GO to F4.</p> <p>No Suspect MOST ring fault, refer to electrical circuit diagrams and check/rectify MOST ring as necessary.</p>
F4: TELEPHONE HANDSET AUDIO	
	<p>1 Establish from Customer feedback/symptom if there is Audio from the telephone handset.</p> <p>Is there Audio from the telephone handset?</p> <p>Yes Ensure vehicle is parked. Disconnect and reconnect handset. If issue not resolved, contact your local in market support for assistance.</p> <p>No Contact you local in market support for assistance.</p>

Information and Entertainment System - General Information - Information and Entertainment System

Diagnosis and Testing

Principles of Operation

For a detailed description of the information and entertainment system and operation, refer to the relevant Diagnosis and Testing section of the workshop manual. REFER to:

Audio System (415-01 Audio Unit, Description and Operation),
[Antenna](#) (415-02 Antenna, Description and Operation),
 Speakers (415-03 Speakers, Description and Operation),
 Video System (415-07 Video System, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check all information and entertainment system modules ● Compact disc player jammed, not loading ● Scratched/dirty compact discs ● Speakers ● Switch(s) stuck or damaged 	<ul style="list-style-type: none"> ● Fuses ● Electrical harnesses ● Harness connectors ● Battery condition, state of charge

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Satellite Digital Audio Radio Service (SDARS) Diagnosis

The following information is intended to aid in the diagnosis of basic faults with the satellite radio system.

The diagnostic trouble codes are the main source of information in diagnosing other than basic faults.

There are five conditions which may affect the available channels:

A: No signal available

The signal is not reaching the module.

The vehicle must have clear line of sight to a satellite, which means being outside and having no blockages between the vehicle and the satellite.

• **NOTE:** If the vehicle is outside America, this is the only condition which will be possible.

B: More than 6 months without subscribing

There is a 6 month free period of channel 184 being broadcast to allow testing of the system.

After this period, no channels can be received, and an **unsubscribed** message will be displayed.

C: Less than 6 months without subscribing

This will allow the vehicle to receive channel 184 only, all other channels will display **unsubscribed**.

D: Subscribed to the family package

All channels should be audible, but adult content channels will be blocked, and the message **unsubscribed** will be shown on these channels.

E: Subscribed to the full package

All channels should be available, with the exception of some pay channels.

In this case, the message **unsubscribed** will be shown on these channels.

System testing

Tune to channel 184 (this is usually the default channel for all presets).

Select the direct channel input feature by pressing the "#" key.

This will allow the audio to be routed to the speakers if condition C, D or E exist.

If condition B exists, a subscription will have to be made.

1. **1.** Are other systems affected?
 - The most common symptom would be the loss of audio from other entertainment features, although the display sticking on the logo screen is a good indicator of a MOST issue.
 - If other systems **are** affected, check the entertainment circuits for loose or broken connectors, etc. Refer to the electrical guides.
2. **2.** If only the satellite radio system is affected, retrieve the DTCs from the module using the approved diagnostic system or a scan tool.

Symptom Chart

Display	Symptom	Possible Causes	Action
No signal or Acquiring signal	No channels available	<ul style="list-style-type: none"> ● Antenna connections 	Check for DTCs. Check the connections from the module to the antenna and the antenna to the harness. Rectify as necessary.
	No audio	<ul style="list-style-type: none"> ● MOST connection 	Check for DTCs. Check the function of other audio system components. Check the connections to other MOST components.
Unsubscribed	No channels available	<ul style="list-style-type: none"> ● The free period has expired 	Carry out the checks above.
Weather/Emergency	No audio on CD or other component	<ul style="list-style-type: none"> ● Other audio component may be faulty 	Check for DTCs. Check the function of other audio system components.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: (100-00 General Information)

[Diagnostic Trouble Code \(DTC\) Index - DTC: Audio Amplifier Module \(AAM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Audio Front Control Module - High Line \(ACM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Audio Front Control Module - Low Line \(ACM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Bluetooth Module - High Line \(TEL\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Digital Audio Broadcast Module \(DABM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Digital Audio Control Module C \(DACMC\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Front Entertainment Module \(FEM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Image Processing Module B \(IPMB\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Portable Audio Interface Module \(APIM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Rear Entertainment Module \(REM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Satellite Digital Audio Radio System Module \(SARM\)](#) (Description and Operation),
[Diagnostic Trouble Code \(DTC\) Index - DTC: Television Control Module \(TVM\)](#) (Description and Operation).

Information and Entertainment System - General Information - Navigation System

Diagnosis and Testing

Principles of Operation

Inspection and Verification

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.
3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

Principles of Operation

The information in this section is intended to help with basic diagnosis of the navigation system.

For a detailed description of the Navigation System, refer to the relevant Description and Operation section in the Workshop Manual.

Touch Screen Display (TSD) and Navigation Diagnostics

The TSD and the navigation module both have built in self tests that allow the technician to diagnose fault conditions. Fault codes and diagnostics can also be retrieved/achieved using the manufacturer approved diagnostic system.

TSD Diagnostics

The TSD has in built diagnostics to aid the diagnosis of system faults. The diagnostics allow the technician to interrogate the following:

- Hard Key Test
- Touch Switch Test
- DTC Information
- Vehicle Configurations
- Configurations
- Vehicle Signals
- Video Inputs Test
- Self Test
- MOST Test
- Colour bar
- Loading
- HDD information
- Vehicle information
- Microphone
- Voice output check

The built in diagnostics are accessed as follows:

- Once the system is powered up enter the 'Home' menu page
- Press and hold the TSD in the centre at the top of the screen for approximately 5 seconds and then press and hold the TSD at the top left corner of the screen for approximately 5 seconds.
- A 'Diag PIN Entry' box will appear' Type in the access code 753
- Once this code has been accepted the Diagnostic Menu screen will be displayed

Hard Key Test

The hard key test is used to check the operation of the hard switches.

If switch operation is normal, the switch colour on the screen will change when a hard switch is pressed. (Power switch operation cannot be checked on this screen.)

Touch Switch Test

The touch switch test calibrates the touch switch coordinates and checks touch switch operation.

Start Calibration - Calibrates the switch coordinates. Calibrate the coordinates by touching each of the "+" marks in the four corners of the screen.

- **NOTE: Do not touch any locations other than the "+" marks. (Touching other locations may invalidate the calibration.)**

Touch Switch Check - Checks for deviation in the coordinates. Check the coordinates of the touched location by verifying the displayed values. Touch and hold "press here" to return to the previous screen. If there is a large deviation in the coordinates, calibrate the touch switch using the "Start Calibration" function.

DTC Information

Search for the meaning of the displayed DTC.

Vehicle Configurations

Display the status of each vehicle system.

Speed Lock Configuration - Display the status of compulsory navigation settings (setting status of switches that cannot be operated) when driving.

Configurations

Display primary system information.

Vehicle Signals

Display the status of vehicle signals inputted to the Touch Screen Display (TSD). These signals include:

- Lights (on or off)
- Ambient light sensor voltage
- Backlight dimming duty
- Graphic illumination dimming duty
- Vehicle speed, GPS speed, MOST km/h
- Battery voltage
- Reverse gear / Parking brake position (electric park brake on or off)
- Speed inhibit
- MOST Fibre Optic Transceiver (FOT) temperature
- Output audio allocation

Video Inputs Test

This screen will allow the testing of video inputs that are connected to the Touch Screen Display (TSD). These include:

- Companion camera
- Rear view / Proximity camera
- TV/DVD

Self Test

Performs system self-diagnosis and displays the diagnostic results.

If an abnormality is present, a DTC is displayed.

MOST Test

Display the MOST connection status, and reception/transmission messages related to MOST.

"Mpr" displays the number of MOST devices existing on MOST. When "0" or "1" is displayed, communication is not possible.

Colour bar

This function allows the technician to test the colours generated by the TSD. A second screen displays six solid colours, selecting the colour will fill the screen with the chosen colour and pressing the TSD again will revert back to the colour test screen.

Loading

Update the navigation program.

For details on the update method, refer to the "Navigation Update Tool" operation manual.

HDD information

Display information on the Hard Disc Drive (HDD).

SMART test (Self-Monitoring Analysis and Reporting Technology) is initiated from this screen

Vehicle information

Display information on the vehicle.

- Car configuration - Displays information on vehicle environment settings.
 - Unit (distance) - Units of distance
 - Unit (time) - Units of time
 - Language - Displayed language
 - Fuel information - Remaining fuel quantity
 - Mileage information - Vehicle mileage display
 - Time information - Current time display
 - Override information - Status of switch operation inhibitions (Setting status of switches that cannot be operated.)
- GPS information - Display GPS related information.
 - Received position - Displays the latitude and longitude (displayed in degrees, minutes, and seconds) for the position information calculated by GPS.
 - Map matched position - Displays the latitude and longitude (displayed in degrees, minutes, and seconds) for the position information being used for map matching.
 - Satellites - Number of acquired satellites.
 - Current address - Address of the current location.
 - Satellite Information - Displays satellite information for up to 12 GPS satellite search targets.
 - Measurement HDOP - Positioning accuracy.
 - Status - Positioning status.
 - Date - Displays the current date and time in the following order: day, month, year, hour, minute, second. The

- year is displayed using the four-digit western calendar; time is displayed in Greenwich Mean Time (GMT).
- Vehicle sensor - Display vehicle signals inputted to the Touch Screen Display (TSD).
 - REV - Reverse signal status.
 - Speed - Current vehicle speed.
 - Speed pulse count - Speed pulse count value.
 - Distance calibration - Learning information for distance calibration.
 - Voltage/Offset - Gyro sensor output voltage value/voltage correction value.
 - Relative bearing - Relative bearing (0° when navigation is started.)
 - Gyro sense - Learning value for gyro sensitivity.
 - Reset - Resets the gyro sensor relative bearing value.
- RDS-TMC information - Display RDS-TMC related information.
 - Date/time (GMT) - Date and time for the TMC signal.
 - Frequency - TMC signal frequency.
 - PI code - Personal identification code for the broadcast station.
 - PS name - Broadcast station name.
 - Country code - Database country code.
 - LTN - Database location number (location table number.)
 - Service ID - Service provider identification number.
 - Air data - TMC data.

Microphone

Check the volume for the voice recognition microphone inputted to the Touch Screen Display (TSD). These include:

- PTT switch status - Checks the PTT switch connection. When the PTT switch is pressed, a signal will be outputted, and the indicator displays in green.
- Microphone input level judging - If a sampling of the user's voice command is at or above the threshold value, the indicator displays in blue.
- Microphone level - Displays the microphone input level.

Voice output check

Check the audio output.

- ON (Normal) - Outputs ADPCM voice (1 kHz sine wave) for five seconds.
- ON (Max) - Outputs ADPCM voice (maximum 1 kHz sine wave) for five seconds.

Inspection and Verification

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of damage, water ingress and system integrity.
3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Visual Inspection

Visual Inspection	Electrical
<ul style="list-style-type: none"> ● Battery ● Fuses <ul style="list-style-type: none"> - Central and Battery Junction Boxes - Megafuses ● Wiring harness ● Damaged, loose or corroded connectors ● Touch Screen Display (TSD) ● GPS antenna ● TV antenna ● Satellite antenna ● FM antenna ● Companion camera ● Rear view camera ● Microphone ● Accessory USB Unit (AUU) ● Steering wheel controls ● Clock spring ● Integrated Head Unit (IHU) ● Audio amplifier ● Anti-lock Brake System (ABS) module ● Wheel speed sensors ● Vehicle Information and Communication System (VICS Japan only) receiver ● VICS beacon antenna (Japan only) ● Controller Area Network (CAN) circuits ● Media Oriented System Transport (MOST) system ● Gigabit Video Interface (GVIF) ● Central Junction Box (CJB) ● Terrain Response ● Mobile Telephone 	

Symptom Chart

Symptom	Possible Cause	Action
Black screen (navigation and audio screens do not	● Temperature in passenger	GO to Pinpoint Test A.

Symptom	Possible Cause	Action
display.)	<ul style="list-style-type: none"> compartment too low ● Condensation in passenger compartment ● Electrical harness open/short circuit, dis-connected ● Component failure 	
The navigation screen does not display, even when the "NAVIGATION" button is pressed (screen does not change.)	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test B.
The hard switches do not respond.	<ul style="list-style-type: none"> ● Component failure ● Switch failure 	GO to Pinpoint Test C.
The audio screen cannot be operated (does not display.)	<ul style="list-style-type: none"> ● Media Oriented System Transport (MOST) system ● Electrical harness open/short circuit, dis-connected 	GO to Pinpoint Test D.
The screen does not dim.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test E.
Noise on the screen, screen colour is abnormal.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test F.
The touch switches do not respond.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test G.
There is considerable deviation between the displayed vehicle position and the actual position.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test H.
The GPS no reception mark does not disappear.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure ● No reception from satellite 	GO to Pinpoint Test I.
No sound is emitted.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure ● Incorrect system settings 	GO to Pinpoint Test J.
There is no navigation voice guidance.	<ul style="list-style-type: none"> ● Volume level set too low ● The amplifier and speakers are incorrectly connected 	GO to Pinpoint Test K.
Voice recognition does not function.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test L.
The vehicle position rotates randomly.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure ● Vehicle on a turntable in a parking building 	GO to Pinpoint Test M.
The vehicle mark display is unstable.	<ul style="list-style-type: none"> ● Electrical harness open/short circuit, dis-connected ● Component failure ● No reception from satellite 	GO to Pinpoint Test N.
The vehicle position does not update.	<ul style="list-style-type: none"> ● HDD contaminated/damaged ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test O.
The map display is incomplete.	<ul style="list-style-type: none"> ● HDD contaminated/damaged ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test P.
Calls cannot be received or placed with Bluetooth; Bluetooth cannot connect with the vehicle.	<ul style="list-style-type: none"> ● Incompatible bluetooth telephone ● Incorrect initial connection settings ● Electrical harness open/short circuit, dis-connected ● Component failure 	GO to Pinpoint Test Q.
The map cannot be updated.	<ul style="list-style-type: none"> ● Refer to the "Navigation Update Tool" operation manual 	Refer to the "Navigation Update Tool" operation manual

Symptom	Possible Cause	Action
An error screen displays on the navigation screen.	<ul style="list-style-type: none"> ● Access to the map data has not been granted 	GO to Pinpoint Test R .
The dual view cannot be switched.	<ul style="list-style-type: none"> ● Incorrect car configuration data received ● Media Oriented System Transport (MOST) system ● Component failure 	GO to Pinpoint Test S .

Pinpoint Tests

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval Program is in operation, prior to the installation of a new module/component.

• NOTE: The built in diagnostics are accessed as follows:

- 1. With the vehicle at rest, place the ignition switch "ON", or start the engine.
- 2. Press and hold the TSD in the centre at the top of the screen for approximately 5 seconds and then press and hold the TSD at the top left corner of the screen for approximately 5 seconds.
- 3. A 'Diag PIN Entry' box will appear. Type in the access code 753.
- 4. Once this code has been accepted the Diagnostic Menu screen will be displayed.

PINPOINT TEST A : BLACK SCREEN (NAVIGATION AND AUDIO SCREENS DO NOT DISPLAY.)	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: THE SCREEN SAVER FUNCTION WORKS	
	1 Check the screen saver function works.
	Does the screen saver function work? Yes Operation is normal. No Proceed to the next step. GO to A2.
A2: THE DISPLAY BACKLIGHT EMITS LIGHT	
	1 Check the display backlight emits light.
	Does the display backlight emits light? Yes Proceed to the next step. No GO to A12.
A3: THE SCREEN IS TURNED OFF	
	1 Check the screen is not turned off.
	Do the navigation and audio screens display when the screen is turned on? Yes Operation is normal. No GO to A4.
A4: THE VEHICLE INTERIOR TEMPERATURE IS -20°C OR LESS	
	1 Check the cabin internal temperature.
	Is the cabin internal temperature -20°C or lower? Yes Raise the cabin internal temperature, re-test the vehicle. No GO to A5.
A5: CONDENSATION IS FORMING INSIDE THE VEHICLE	
	1 Check for condensation occurring inside the passenger compartment.
	Is condensation occurring inside the passenger compartment? Yes Dry out the passenger compartment, re-test the vehicle. No GO to A6.
A6: THE LED FOR THE POWER SUPPLY BUTTON IS FLASHING. (RANGE ROVER ONLY)	
	1 Check the status of the audio power button LED.
	Is the audio power button flashing? Yes Carry out MOST Ring diagnostics to locate fault. No GO to A7.
A7: ONLY THE NAVIGATION SCREEN OR AUDIO SCREEN IS BLACK	
	1 Check to see if only the navigation screen is blank.
	Is only the navigation screen blank? Yes Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index. No GO to A8.
A8: ONLY THE BACK MONITOR SCREEN IS BLACK	
	1 Check to see if only the audio screen is blank.

	Is only the audio screen blank? Yes Proceed to the next step. No GO to A10.
A9: AFTER INITIATING THE "VIDEO INPUT TEST" DIAGNOSIS, VIDEO CAN BE DISPLAYED	
	1 Carry out the "Video Input Test" diagnosis' (PIN code 753).
	Are the results of the "Video Input Test" diagnosis' normal? Yes Re-check the system. No Refer to the electrical circuit diagrams and check the cameras control module.
A10: ONLY THE TV SCREEN IS BLACK	
	1 Check to see if only the TV screen is black.
	Is only the TV screen blank? Yes Proceed to the next step. No GO to A12.
A11: AFTER INITIATING THE "VIDEO INPUT TEST" DIAGNOSIS, VIDEO CAN BE DISPLAYED	
	1 Carry out the "Video Input Test" diagnosis' (PIN code 753).
	Are the results of the "Video Input Test" diagnosis' normal? Yes Re-check the system. No Refer to the electrical circuit diagrams and check the TV control module.
A12: THE CONNECTIONS BETWEEN THE VISUAL NAVIGATION AND POWER SUPPLY WIRING HARNESS AND CONNECTORS ARE CORRECT	
	1 Check the display and power supply harness, power, auxiliary and ground circuits, for short, open circuits and are correctly connected.
	Was a fault identified with the display and power supply harness, power auxiliary and ground connections? Yes Rectify the fault and re-test the vehicle. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST B : THE NAVIGATION MAP SCREEN DOES NOT DISPLAY, EVEN WHEN THE "NAVIGATION" BUTTON IS PRESSED (SCREEN DOES NOT CHANGE.)

• NOTE: When re-confirming the symptoms after inspecting the wiring harness/connector, turn the ignition status to OFF, wait for the Audio power button LED on the display to turn OFF, then turn the ignition status to ON and run the diagnosis again from the beginning.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: NO RESPONSE TO PRESSING NAVIGATION MENU	
• NOTE: 15 minutes are required for the program to update. If the ignition is accidentally turned OFF, turn the ignition ON again, and wait for 15 minutes.	
	1 Check that the ignition was not turned 'OFF' during a navigation software update.
	Was the ignition turned 'OFF' during a navigation software update? Yes Wait for 15 minutes with the ignition ON. Then turn the ignition to OFF then ignition ON. No Refer to electrical circuit diagrams and check integrity of navigation system wiring harness and connectors. GO to B2.
B2: NO RESPONSE TO PRESSING NAVIGATION MENU	
	1 Wait for 15 minutes with the ignition ON. Then turn the ignition to OFF then ignition ON.
	Does the navigation screen displays when the "NAVIGATION" button is pressed. Yes Operation is normal. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST C : THE HARD SWITCHES DO NOT RESPOND.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: CHECK FOR FOREIGN OBJECTS	
	1 Check for foreign objects near to the button.
	Are there any foreign objects close to the button causing it to be pressed? Yes Remove foreign objects and re-test vehicle. No GO to C2.
C2: DISPLAY DIAGNOSTICS CHECK	
	1 Check to see if the display diagnostics can be displayed.

	Can the display diagnostics be displayed? Yes Proceed to the next step. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.
--	---

C3: HARD KEY TEST

	1 Carry out the display diagnostics hard key test.
--	---

	Is the operation normal when carrying out the display diagnostics hard key test? Yes Operation is normal. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.
--	---

PINPOINT TEST D : THE AUDIO SCREEN CANNOT BE OPERATED (DOES NOT DISPLAY.)

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
-----------------	-------------------------

D1: CD CHANGER CHECK

	1 Check to see if a CD changer is installed.
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	Is a CD changer installed? Yes Proceed to the next step. No Normal operation, CD screen will not be displayed when there is no CD changer installed.
--	--

D2: THE AUDIO SCREEN DISPLAYS WHEN THE "AUDIO VIDEO" HARD SWITCH IS PRESSED.

	1 The audio screen displays when the "AUDIO VIDEO" hard switch is pressed.
--	---

	Does the audio screen displays when the "AUDIO VIDEO" hard switch is pressed? Yes Proceed to the next step. No Refer to the hard switches do not respond diagnosis.
--	---

D3: THE AUDIO SCREEN DISPLAYS WHEN "AUDIO VIDEO" ON THE "HOME MENU" IS PRESSED.

	1 The audio screen displays when "Audio Video" on the "Home Menu" is pressed.
--	--

	Does the audio screen displays when "Audio Video" on the "Home Menu" is pressed? Yes Proceed to the next step. No Refer to the touch switches do not respond diagnosis.
--	---

D4: EACH SWITCH (AM FM, CD, IPOD/USB, TV/DVD.) ON THE AUDIO SCREEN RESPONDS.

	1 Each switch (AM FM, CD, iPod/USB, TV/DVD.) on the audio screen responds.
--	---

	Does each switch (AM FM, CD, iPod/USB, TV/DVD.) on the audio screen respond? Yes Carry out MOST Ring diagnostics to locate fault. No GO to D5.
--	--

D5: THE IGNITION IS TURNED FROM IGNITION ON TO OFF, AND AFTER WAITING FOR APPROXIMATELY 30 SECONDS, THE TOUCH SCREEN DISPLAY (TSD) POWER SUPPLY LED WENT OUT. WHEN THE IGNITION IS TURNED ON, THE AUDIO SCREEN CAN BE OPERATED.

	1 The ignition is turned from Ignition ON to OFF, and after waiting for approximately 30 seconds, the Touch Screen Display (TSD) power supply LED went out.
--	--

	When the ignition is turned to ON, can the audio screen be operated? Yes Operation is normal. No Carry out MOST Ring diagnostics to locate fault.
--	---

PINPOINT TEST E : THE SCREEN DOES NOT DIM.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
-----------------	-------------------------

E1: CHECK FOR FOREIGN OBJECTS

	1 Check for foreign objects adhered to the display light sensor. <ul style="list-style-type: none">● Range Rover - Top right of display● Discovery/Range Rover Sport - Instrument panel
--	--

	Are there any foreign objects adhered to the display light sensor? Yes Remove foreign objects and re-test vehicle. No GO to E2.
--	---

E2: DISPLAY LIGHT SENSOR CHECK

	1 Check to see if display screen switches to low light when sensor is covered.
--	---

	Does the display screen switch to low light when the sensor is covered? Yes Operation is normal. No GO to E3.
--	---

E3: VEHICLE LIGHT SWITCH TESTS

	1 Check to see if display screen switches to low light when the vehicle light switch is pressed.
--	---

	2 When the vehicle exterior lights are switched on, check diagnostic menu "Vehicle Signals" lights on the diagnostics screen is "ON."
	Does the display screen switch to low light when the vehicle light switch is pressed? Yes Operation is normal. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST F : NOISE ON THE SCREEN; SCREEN COLOUR IS ABNORMAL.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
F1: DISPLAY POWER AND GROUND CHECKS	
	1 Refer to electrical circuit diagrams and check battery power and power ON relay voltage, and ground resistance.
	Is the battery power and power ON relay voltage between 10.5 and 16 volts, and continuity to ground? Yes Proceed to the next step. No Check and rectify the vehicle wiring harness and connectors.
F2: CONTRAST CHECK	
	1 Check to see if the screen colour is normal when the screen setting (contrast) is re-ret to the default values.
	Is the screen colour normal with the default values? Yes Operation is normal. No GO to F3.
F3: CABIN INTERNAL TEMPERATURE CHECK	
	1 Check the cabin internal temperature.
	Is the cabin internal temperature -20°C or lower? Yes Raise the cabin internal temperature and re-test. No GO to F4.
F4: ADDITIONAL SCREEN CHECKS	
	1 Check all other screens.
	Are all other screens beside the navigation display screen normal? Yes Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index. No GO to F5.
F5: COLOUR BAR CHECK	
	1 Carry out the display diagnostics colour bar check test.
	Are the results of the display diagnostics colour bar check normal? Yes Operation is normal. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST G : THE TOUCH SWITCHES DO NOT RESPOND.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
G1: TOUCH SWITCH TEST	
	1 The touch switches not responding on the navigation screen only
	Are the touch switches not responding on the navigation screen only? Yes Proceed to the next step. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.
G2: TOUCH SWITCH CHECK	
	1 Carry out the touch switch check in the display diagnostics.
	Are the results of the display diagnostics touch switch check normal? Yes Check the symptoms again. Operation is normal. No GO to G3.
G3: START CALIBRATION ROUTINE	
	1 Carry out the start calibration routine from the display diagnostics touch switch test.
	Is normal operation resumed after correction? Yes Operation is normal. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST H : THERE IS CONSIDERABLE DEVIATION BETWEEN THE DISPLAYED VEHICLE

POSITION AND THE ACTUAL POSITION.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
H1: GPS MARK DISPLAY CHECK	
1	The GPS no reception mark is displayed.
	Is the GPS no reception mark displayed on the display screen? Yes Refer to GPS no reception mark does not disappear diagnosis. No GO to H2.
H2: LOCATION CHECK	
1	Check for symptom occurring in particular locations - parallel roads, elevated roads, loop roads, parking centres (buildings) etc.
	Does the symptom occur in a particular location? Yes In places where the vehicle position is hard to specify, the vehicle position may be matched incorrectly and result in position discrepancies. Additionally, a new road layout will mean the Gyro does not match the map position. No Proceed to the next step.
H3: DISTANCE CALIBRATION CHECK	
• NOTE: Refer to diagnostic menu "Vehicle Sensor" – Distance Calibration, this value should be approximately 200mm, a large deviation from this value indicates a speed signal fault or incorrect wheel size.	
1	Check to see if distance calibration is being performed.
	Is distance calibration being performed? Yes Monitor the condition until distance calibration is complete (drive for over 10km/6.2 miles) No GO to H4.
H4: VEHICLE SIGNAL INSPECTION	
1	Check vehicle sensor display screen, from vehicle information diagnostics menu for the following: vehicle speed signal, REV: ON is indicated when the gear shift lever is in the REV position and gyro sensor input status are normal.
	Are the vehicle speed signal, REV signal, and gyro sensor input status normal? Yes GO to H5. No Refer to the electrical circuit diagrams and check the integrity of the wiring harness and connectors, and CAN circuit, to the Touch Screen Display (TSD).
H5: TIRE CHECK	
1	Check to see if new tires have recently been installed.
	Have new tires been recently installed? Yes From the navigation map screen, enter the navigation menu, select navigation setup then select calibration, press 'Distance' then drive the vehicle for 10 to 20 km. Operation will return to normal after performing distance calibration and driving the vehicle for 10 to 20 km. No Adjust the current location, and after the GPS no signal mark has disappeared, drive the vehicle for a while to monitor conditions.

PINPOINT TEST I : THE GPS NO RECEPTION MARK DOES NOT DISAPPEAR.

- NOTE: Move the vehicle to an open area, radio waves from satellites may not be received inside buildings.
- NOTE: Correct the vehicle cursor to the current location.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
I1: RETRO-INSTALL INSTALLATIONS CHECK	
1	Check to see if there are any retro-install installations (anti-theft, radar, etc.)
	Are there any retro-install installations? Yes GO to I2. No GO to I3.
I2: RETRO-INSTALL INSTALLATIONS RF CHECK	
1	Turn power supply (including back-up power) to OFF status.
	Does the GPS no reception mark disappear? Yes GPS reception may deteriorate when devices receiving radio waves are retro-installed. Alter the position of the retro-install device, and re-test vehicle. No GO to I4.
I3: SATELLITE RECEPTION CHECKS	
1	Check to see if a 'P' or 'T' is displayed in the 'STS' column of the navigation diagnostics GPS information screen after 10 minutes have passed.
	Is a 'P' or a 'T' displayed? Yes Wait for reception of another satellite so that position calculation can be performed. No Refer to the electrical circuit wiring diagrams and check the integrity of the wiring harness and connectors to the GPS antenna. Proceed to the next step.
I4: GPS ANTENNA REPLACEMENT	

	1 Install a new GPS antenna.
	Does the GPS no signal mark disappears when the GPS antenna is replaced. Yes Fault has been rectified. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST J : NO SOUND IS EMITTED.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
J1: SOUND OUTPUT CHECK	
	1 Check sound output across all systems.
	Is there no sound output across all systems? Yes GO to J2. No GO to J3.
J2: VOLUME LEVEL CHECK	
	1 Check the volume level is not set too low.
	Is the volume level set too low? Yes Increase the volume level and re-test vehicle. No GO to J3.
J3: INTEGRITY OF AMPLIFIER AND SPEAKER WIRING.	
	1 The amplifier and speaker wiring harnesses are correctly connected.
	Are the amplifier and speaker wiring harnesses correctly connected? Yes Check the MOST devices. GO to J4. No Refer to the electrical circuit diagrams and check integrity of amplifier and speaker wiring harness and connections.
J4: ONLY VOICE RECOGNITION DOES NOT OUTPUT	
	1 Check to see if only voice recognition does not output.
	Is there no output only from the voice recognition? Yes GO to J5. No Proceed to step 8.
J5: VOICE GUIDANCE	
	1 Check the volume level for voice guidance is not set too low.
	Is the volume level for voice guidance set too low? Yes Increase the volume level and re-test vehicle. No GO to J6.
J6: VOICE GUIDANCE SETTINGS	
	1 Check to see if the voice guidance is set to 'OFF' in the navigation settings.
	Is the voice guidance set to 'OFF' in the navigation settings? Yes Set to 'ON' and re-test the vehicle. No GO to J7.
J7: ADDITIONAL ITEMS	
	1 Check to see if the following items apply. <ul style="list-style-type: none"> ● There is no destination set ● There is no movement along the route
	Do the two items apply? Yes Normal operation, confirm customer symptom and re-test vehicle. No Check MOST connection at the Touch Screen Display (TSD), check the MOST devices.Proceed to the next step.
J8: ONLY VOICE RECOGNITION DOES NOT OUTPUT	
	1 Check to see if only voice recognition does not output.
	Is there no output only from the voice recognition? Yes Refer to the there is no navigation voice guidance diagnosis. No GO to J9.
J9: SOUND IS ONLY ABSENT WHEN USING THE AUDIO SYSTEM OR TELEPHONE.	
	1 Check to see if sound is only absent when using the audio system or telephone.
	Does only the audio system or telephone sound not output? Yes Check MOST connection at the Touch Screen Display (TSD), check the MOST devices. No Refer to the electrical circuit diagrams and check integrity of wiring harness and connections.

PINPOINT TEST K : THERE IS NO NAVIGATION VOICE GUIDANCE.	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
K1: SOUND MISSING AUDIO SYSTEM ONLY	
	1 Sound is only absent from the audio system (CD, radio.)
	Is sound only absent from the audio system (CD, radio.)? Yes GO to K4. No Proceed to the next step.
K2: VOICE MISSING NAVIGATION SYSTEM ONLY	
	1 Voice is only absent from the navigation system.
	Is voice only absent from the navigation system? Yes GO to K3. No GO to K3.
K3: NAVIGATION VOICE GUIDANCE CANNOT BE HEARD	
	1 Operate the navigation replay switch and raise the volume.
	Can navigation voice guidance be heard after pressing the navigation replay switch, and raising the volume? Yes Operation is normal. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.
K4: INTEGRITY OF AMPLIFIER AND SPEAKER WIRING.	
	1 The amplifier and speaker wiring harnesses are correctly connected.
	Are the amplifier and speaker wiring harnesses correctly connected? Yes GO to K5. No Refer to the electrical circuit diagrams and check integrity of amplifier and speaker wiring harness and connections.
K5: VOLUME LEVEL CHECK	
	1 Check the volume level is not set too low.
	Is the volume level set too low? No Increase the volume level and re-test vehicle. No Refer to the electrical circuit diagrams and check integrity of complete audio system.

PINPOINT TEST L : VOICE RECOGNITION DOES NOT FUNCTION.	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
L1: AUDIO SOUND IS MUTED WHEN PTT SWITCH IS DEPRESSED	
	1 Check to see if the audio sound is muted when the PTT switch is depressed.
	Is the audio sound muted? Yes GO to L3. No GO to L2.
L2: PTT SWITCH STATUS	
	1 Check to see if the PTT switch status is ok in the navigation diagnostics, manual check, microphone test.
	Is the PTT switch status, in navigation diagnostics, ok? Yes Check MOST connection at the Touch Screen Display (TSD), check the MOST devices. No Replace the MOST master, or the gateway module.
L3: TALK BACK	
	1 Check to see if there is talk back when other voice recognition demands are executed.
	Is there talk back? Yes System operation is normal, (advise change in manner of speech, as incorrect recognition is occurring). No GO to L4.
L4: HARNESS/CONNECTOR CHECKS	
	1 Refer to the electrical circuit diagrams and check integrity of Touch Screen Display (TSD) harness and connections.
	Has a fault been identified with the Touch Screen Display (TSD) harness or connections? Yes Rectify the fault and re-test the vehicle. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST M : THE VEHICLE POSITION ROTATES RANDOMLY.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
M1: VEHICLES CURRENT POSITION MARK TURNS ON ITS OWN	
	1 Determine if the ignition status was turned to Auxiliary or On, while the vehicle was on a turntable in a parking building etc.
	Was ignition status set to Auxiliary or On? Yes The angular speed of the vehicle at the time of the ignition status change will be logged as the standard value. To re-set the standard value, turn ignition status to 'OFF' then to 'Auxiliary' or 'On' with the vehicle stationary. Re-test the vehicle. No Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index.

PINPOINT TEST N : THE VEHICLE MARK DISPLAY IS UNSTABLE.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
N1: VEHICLE SPEED SIGNAL	
	1 The vehicle speed signal is being properly inputted under "Vehicle Sensor" on the "Vehicle information" diagnostics screen.
	Is the vehicle speed input correctly? Note: MOST and navigation system module speeds are approximately the same. Yes GO to N2. No Carry out MOST ring circuit checks. Check the Anti-Lock Brake System Module for related DTCs and refer to the relevant DTC Index. Carry out network integrity tests using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check CAN circuits if required. Repair wiring harness as required. Rectify the fault and re-test the vehicle.

N2: CHECK NUMBER OF SATELLITES

	1 "0" is displayed in the "Satellites" column under "GPS Information" (on the "Vehicle information" diagnostics screen.)
	Is the number of satellites displayed on the screen 0? Yes Refer to GPS no reception mark does not disappear diagnosis. No GO to N3.

N3: CHECK IF SYMPTOMS ARE OCCURRING IN PARTICULAR LOCATIONS

	1 Confirm if the 'car current position not stable' symptom is occurring in particular locations.
	Is the 'car current position not stable' symptom occurring in particular locations? Yes System operation is normal. Signal reflections from buildings or a particular location may be responsible. No Refer to GPS no reception mark does not disappear diagnosis.

PINPOINT TEST O : THE VEHICLE POSITION DOES NOT UPDATE.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
O1: VEHICLE POSITION DOES NOT UPDATE	
	1 Check the GPS no reception mark.
	Has the GPS no reception mark disappeared? Yes GO to O2. No Refer to GPS no reception mark does not disappear diagnosis.

O2: VEHICLE POSITION DOES NOT UPDATE

	1 Check the map screen scroll function.
	Can the map screen be touched scrolled? Yes GO to O3. No Initiate the "SMART test" on the "HDD information" diagnostics screen.

O3: VEHICLE POSITION DOES NOT UPDATE

	1 The vehicle speed signal is being properly inputted under "Vehicle Sensor" on the "Vehicle information" diagnostics screen.
	Is the vehicle speed input correctly? Note: MOST and navigation system module speeds are approximately the same. Yes Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index. No Carry out MOST ring circuit checks. Check the Anti-Lock Brake System Module for related DTCs and refer to the relevant DTC Index. Carry out network integrity tests using the manufacturer approved diagnostic system. Refer to electrical circuit diagrams and check CAN circuits if required. Repair wiring harness as required. Rectify the fault and re-test the vehicle.

PINPOINT TEST P : THE MAP DISPLAY IS INCOMPLETE.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
P1: MAP DISPLAY IS INCOMPLETE	

	1 Check to see if the map screen displays correctly when it is touch scrolled.
	Does the map screen display correctly when it is touch scrolled? Yes GO to P2. No Initiate the "SMART test" on the "HDD information" diagnostics screen.
P2: MAP DISPLAY IS INCOMPLETE	
	1 Check to see if the map screen scale can be reduced.
	Can the map screen scale be reduced? Yes GO to P3. No Initiate the "SMART test" on the "HDD information" diagnostics screen.
P3: MAP DISPLAY IS INCOMPLETE	
	1 Check to see if a point of interest search can be performed.
	Can a point of interest search be performed? Yes Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index. No Initiate the "SMART test" on the "HDD information" diagnostics screen.

PINPOINT TEST Q : CALLS CANNOT BE RECEIVED OR PLACED WITH BLUETOOTH; BLUETOOTH CANNOT CONNECT WITH THE VEHICLE.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1: DISPLAY CHECK	
	1 Press the telephone button.
	Is 'Telephone not connected' displayed on the screen? Yes GO to Q2. No Proceed to step 7.
Q2: BLUETOOTH COMPATIBILITY CHECK	
	1 Check to see if the telephone handset is Bluetooth compatible.
	Is the telephone handset Bluetooth compatible? Yes GO to Q3. No Use a Bluetooth compatible telephone handset.
Q3: HANDSET POWER CHECK	
	1 Check to see if the handset is switched 'ON'.
	Is the telephone handset switched 'ON'? Yes GO to Q4. No Switch handset 'ON' and re-test.
Q4: INITIAL CONNECTION SETTINGS	
	1 Check to see if the initial connection settings to the in-vehicle system have been performed.
	Have the initial connection settings to the in-vehicle system been performed? Yes GO to Q5. No Perform the initial connection settings.
Q5: HANDSET COMMUNICATION CHECK	
	1 Check to see if the telephone handset recognizes the in-vehicle system.
	Does the telephone handset recognize the in-vehicle system? Yes GO to Q6. No Re-test using a different Bluetooth compatible telephone handset. If the fault is still evident, suspect the telephone module. Refer to the new module/component installation note at the top of this procedure.
Q6: HANDSET COMMUNICATION CHECK	
	1 Switch the Bluetooth telephone handset 'OFF' then back 'ON' again.
	Does the telephone handset recognize the in-vehicle system? Yes Operation is normal. No Suspect the telephone module. Refer to the new module/component installation note at the top of this procedure.
Q7: HANDSET COMMUNICATION CHECK	
	1 Check to see if the telephone is within communications range.
	Is the telephone within a 10 metre range of the bluetooth telephone module? Yes GO to Q8. No Move the telephone handset to within a 10 metre range of the bluetooth telephone module.
Q8: HANDSET COMMUNICATION CHECK	
	1 Check to see if when transmitting, the telephone handset is also receiving.

	When transmitting, is the telephone handset also receiving? Yes Check MOST connection at the Touch Screen Display (TSD), check the MOST devices. No Replace the telephone handset.
--	--

PINPOINT TEST R : AN ERROR SCREEN DISPLAYS ON THE NAVIGATION SCREEN.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
R1: MAP DATA CANNOT BE READ	
	1 Access to the map data has not been granted.
	Has new Touch Screen Display (TSD) been installed? Yes Initiate the "Map Lock routine." No Check that a valid activation code for the particular map version installed is available and is being used, it may be necessary to purchase a new activation code from Navteq. If the activation code is valid but map cannot be activated, check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index. Initiate the "Map Lock routine."

PINPOINT TEST S : THE DUAL VIEW CANNOT BE SWITCHED.

• NOTE: Prior to troubleshooting, verify that the vehicle and the Touch Screen Display (TSD) are compatible with Dual Directional View.

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
S1: AUDIO VIDEO HARD SWITCH CHECK	
	1 The audio screen displays when the "AUDIO VIDEO" hard switch is pressed.
	Does the audio screen displays when the "AUDIO VIDEO" hard switch is pressed? Yes GO to S2. No Refer to the hard switches do not respond diagnosis.
S2: AUDIO SOURCE	
	1 TV or DVD is the audio source.
	Does TV or DVD display? Yes GO to S3. No Switch the audio source to TV or DVD and carry out diagnosis again.
S3: VIDEO AND SOUND CORRECTLY DISPLAYED	
	1 Video with sound is displayed on the passenger side from the audio screen after the "AUDIO VIDEO" hard switch is pressed.
	Is video with sound displayed on the passenger side from the audio screen after the "AUDIO VIDEO" hard switch is pressed? Yes Operation is normal. No GO to S4.
S4: VIDEO AND SOUND INCORRECTLY DISPLAYED	
	1 Video with sound is incorrectly displayed on the passenger side from the audio screen after the "AUDIO VIDEO" hard switch is pressed
	Is video with sound incorrectly displayed on the passenger side from the audio screen after the "AUDIO VIDEO" hard switch is pressed? Yes Refer to the black screen (navigation and audio screens do not display) diagnosis. No GO to S5.
S5: VEHICLE CONFIGURATION	
	1 The following set values are present on the "Vehicle Configuration" diagnostics screen. <ul style="list-style-type: none"> ● HLDF = Dual view ● HLDF is fitted ● Hand of Drive is correct for vehicle being tested
	Are values present on the "Vehicle Configuration" diagnostics screen. Yes Check and install a new Touch Screen Display (TSD) as required. Refer to the new module/component installation note at top of DTC Index. No Contact dealer technical support to assist in re-configuring the Car Configuration File (CCF) using the manufacturers approved diagnostic system. Clear the DTC, switch off the ignition and allow sufficient time for the infotainment relay to power down. Check MOST connection at the Touch Screen Display (TSD), check the MOST devices.

DTC Index

For a complete list of all Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Navigation Control Module \(NAV\)](#) (100-00 General Information, Description and Operation).

Audio Unit -**Torque Specifications**

Description	Nm	lb-ft
Audio amplifier bolts	10	7

Audio Unit - Audio System

Diagnosis and Testing

For additional information.

REFER to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

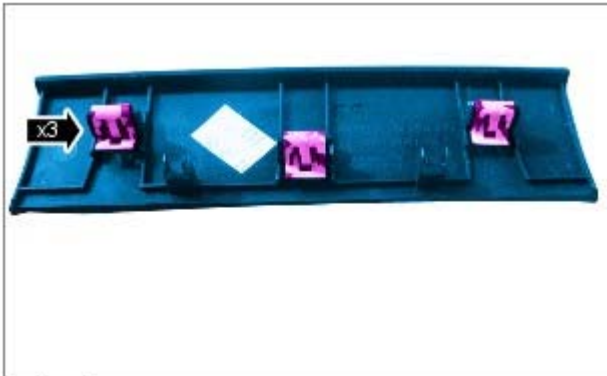
Audio Unit - Audio Unit

Removal and Installation

Removal

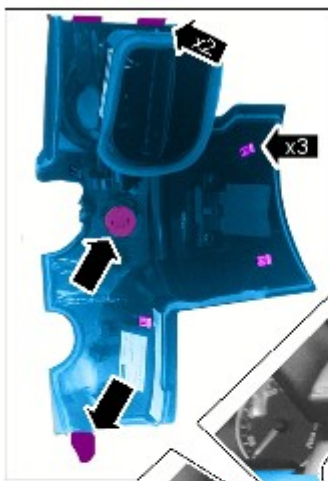
- NOTE: Removal steps in this procedure may contain installation details.

1.



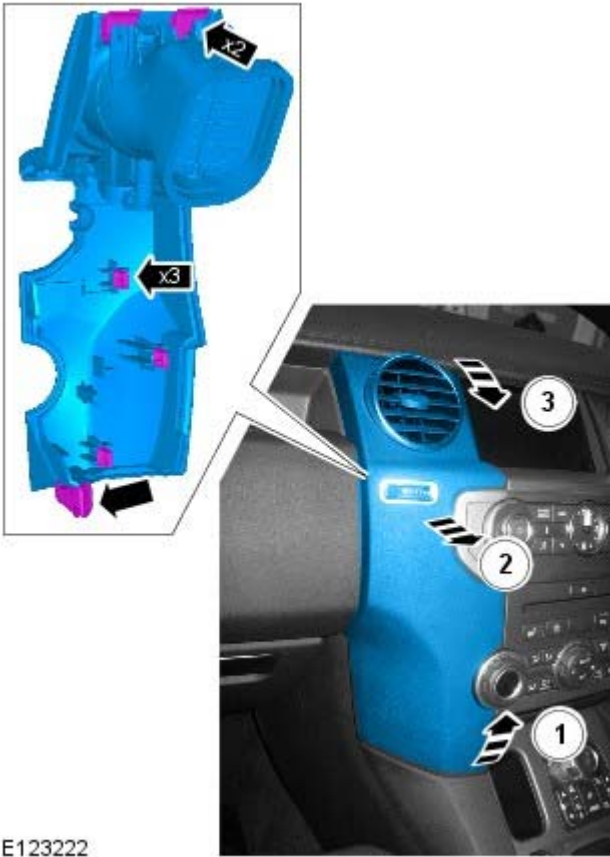
2. Torque: 2.5 Nm





3.

4. 4. NOTE: LHD illustration shown, RHD is similar.



E123222

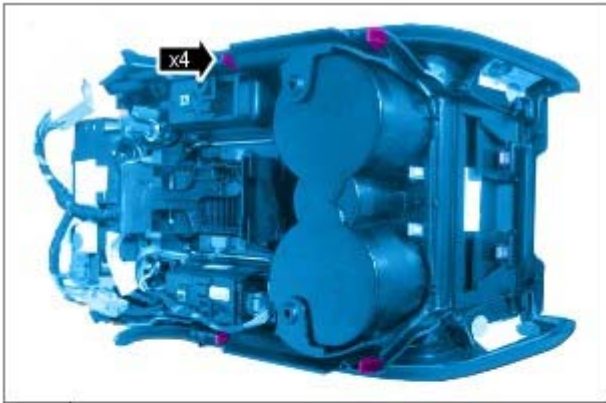
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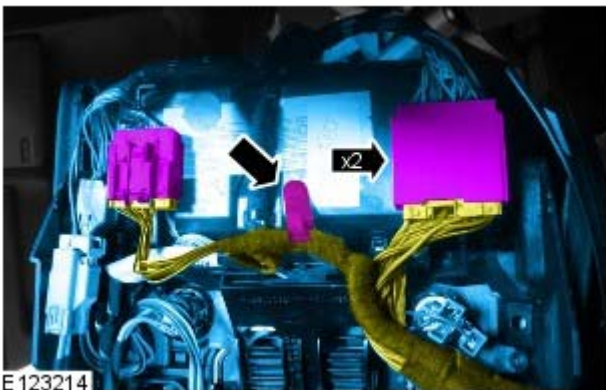
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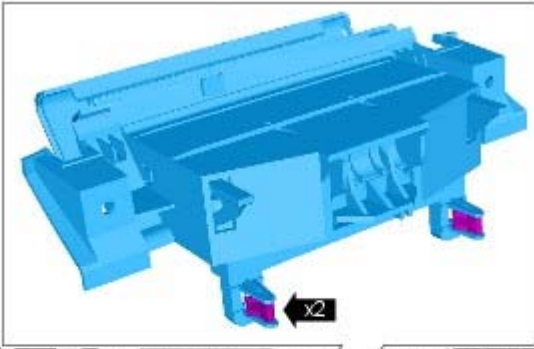
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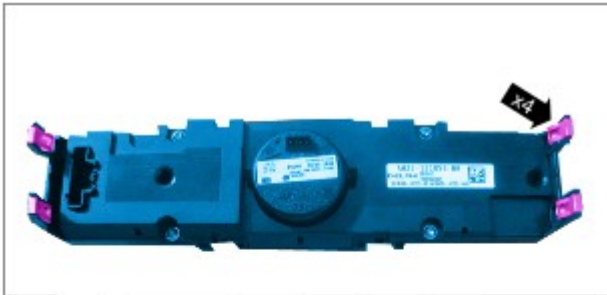
E 123214

9. Torque: 2.5 Nm

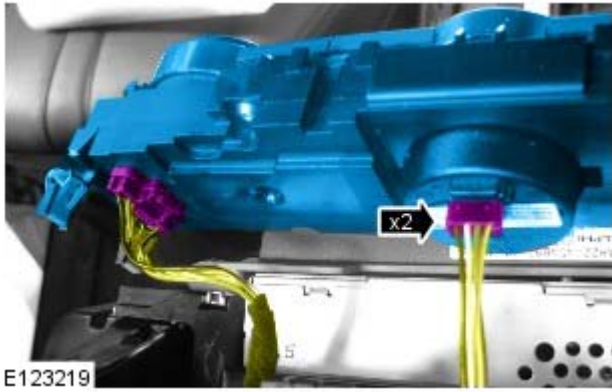


E123298

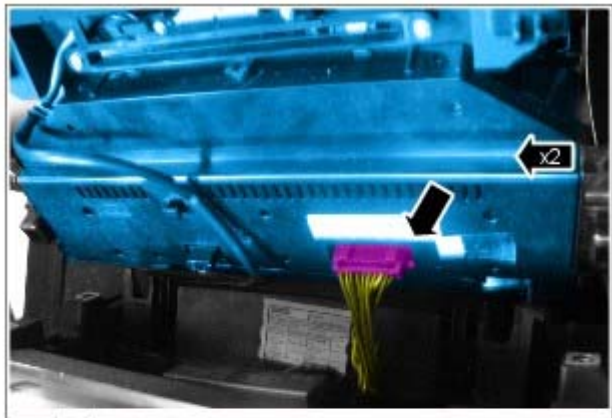
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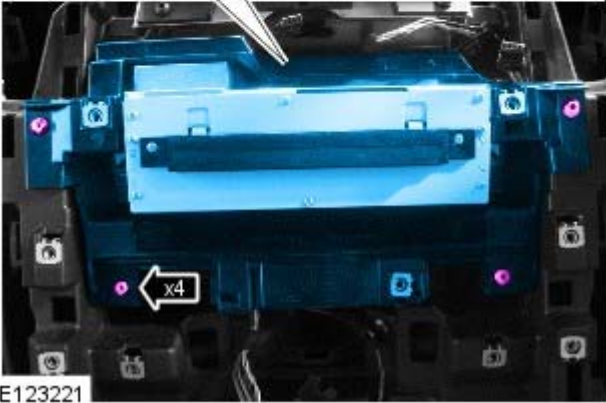


11.



12. Torque: 2.5 Nm





E123221

13. Torque: 2.5 Nm

14. **14.** NOTE: Do not disassemble further if the component is removed for access only.

Torque: 2.5 Nm



E122787

Installation


1. To install, reverse the removal procedure.

Audio Unit - Audio Amplifier

Removal and Installation

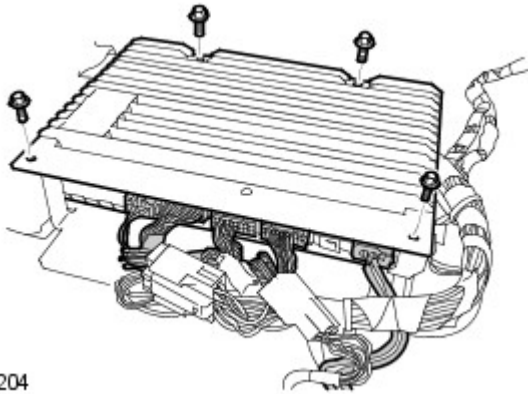
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the RH front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

3.  **CAUTION:** Cover fiber optic cable connectors to minimize dust ingress and avoid bending the cables in a radius of less than 30 mm.

Remove the amplifier.

- Remove the 4 bolts.
- Disconnect the 5 electrical connectors.



E54204

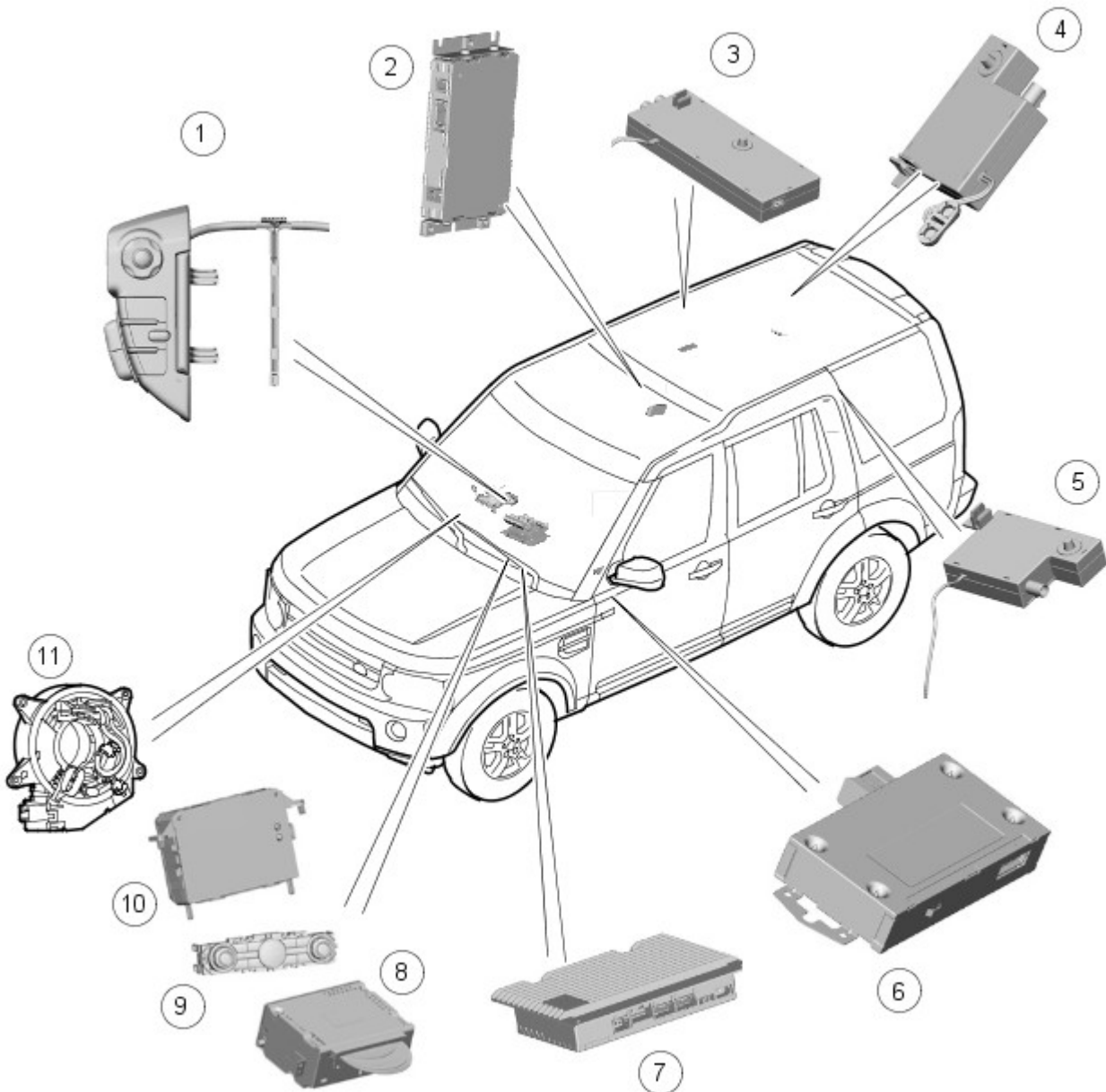
Installation

1. Install the amplifier.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
 - Connect and secure the electrical connectors.
2. Install the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Using the Land Rover approved diagnostic equipment, follow the on-screen instructions and configure the audio unit amplifier.

Information and Entertainment System - Audio System

Description and Operation

LOW/MID LINE AUDIO SYSTEM - COMPONENT LOCATION

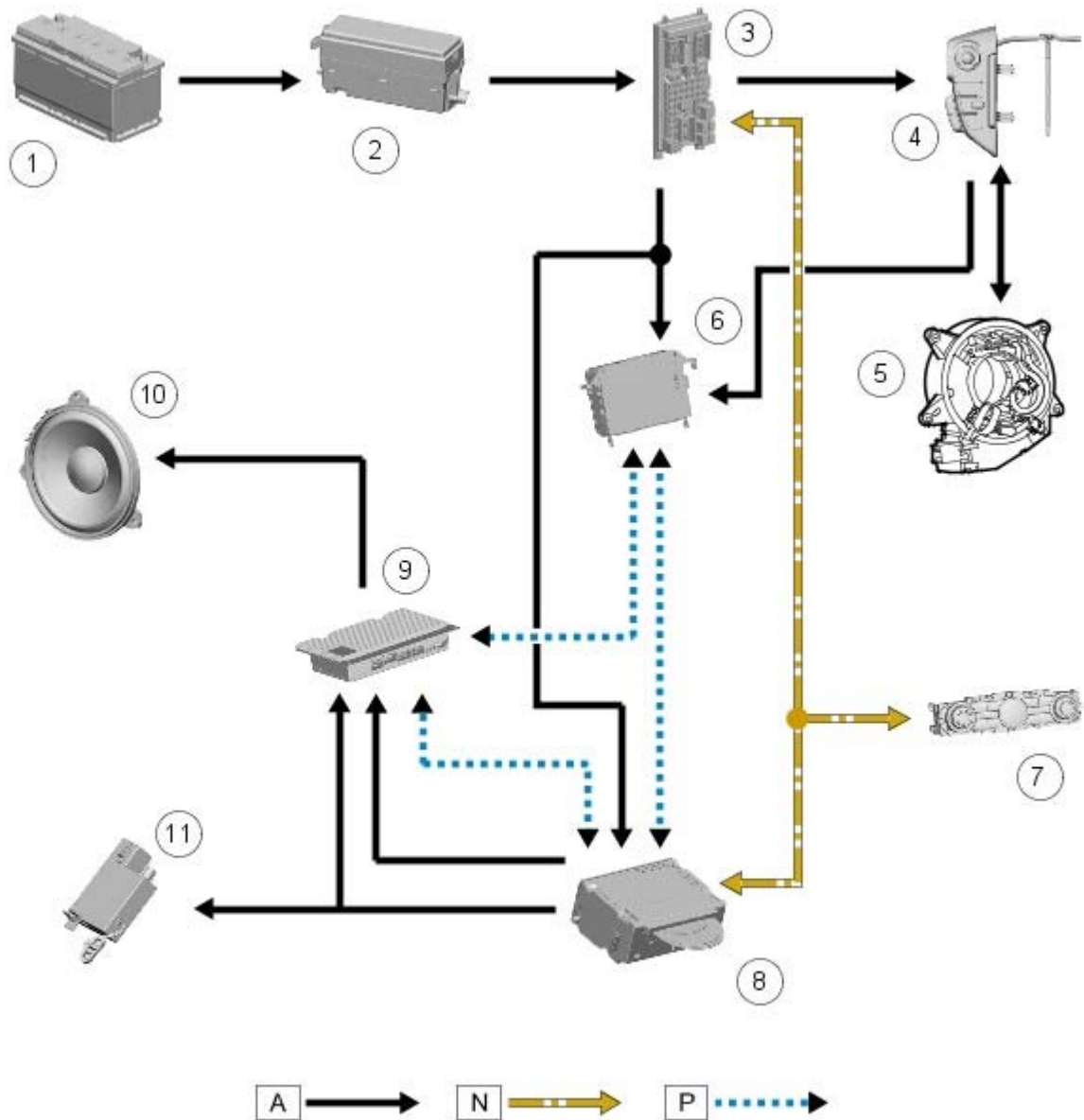


E132315

Item	Part Number	Description
1	-	Audio control switches
2	-	DAB/SDARS tuner module
3	-	AM (amplitude modulation)/FM (frequency modulation) diversity antenna amplifier
4	-	FM antenna amplifier
5	-	DAB antenna amplifier
6	-	Portable audio module interface
7	-	Power amplifier
8	-	Head Unit (HU)
9	-	Lower integrated control panel
10	-	Display
11	-	Clock spring

HEAD UNIT - AUDIO CONTROL DIAGRAM

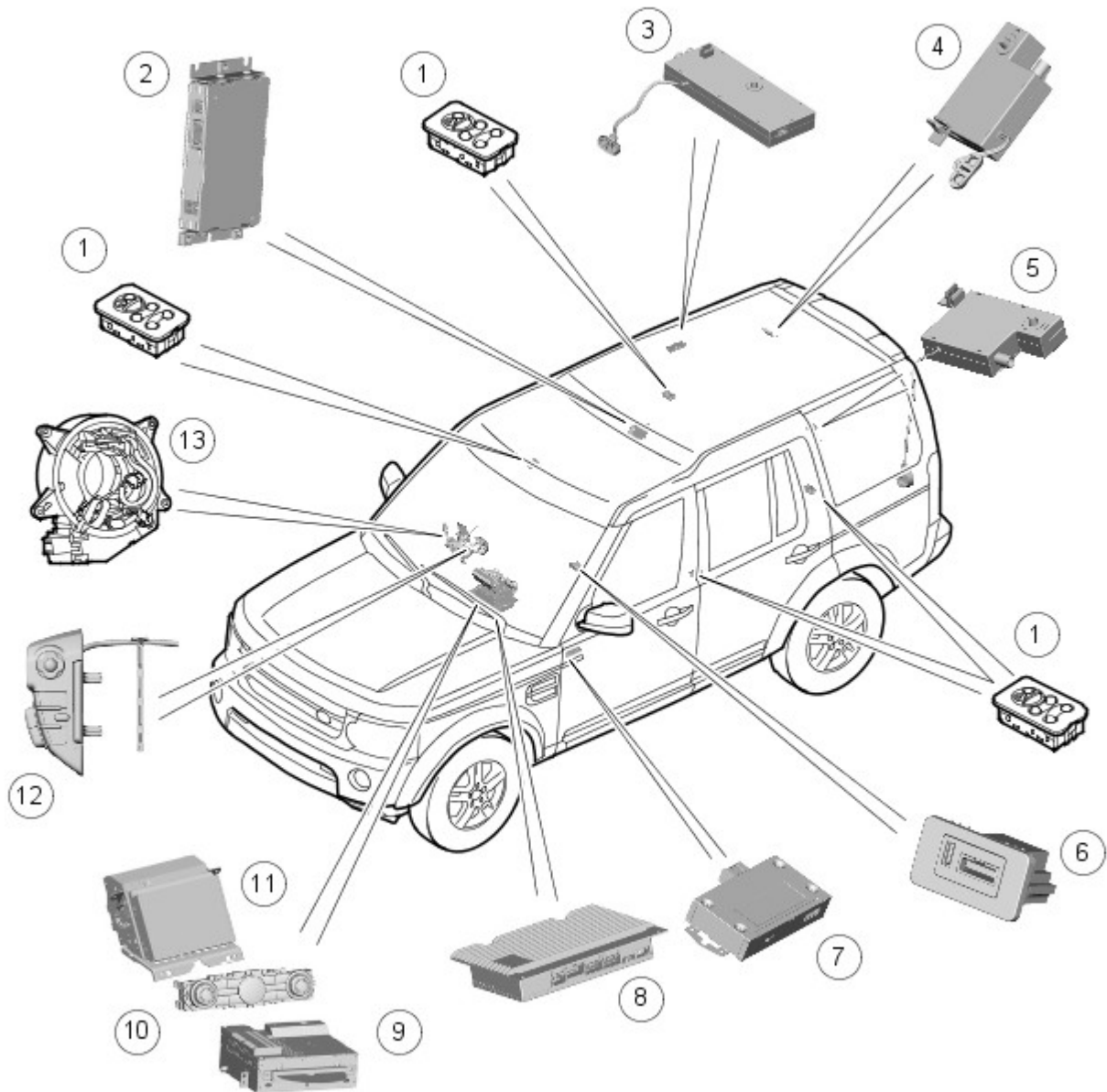
• NOTE: **A** = Hardwired; **N** = Medium Speed CAN; **P** = MOST



E132375

Item	Part Number	Description
1	-	Battery
2	-	BJB (battery junction box)
3	-	CJB (central junction box)
4	-	Audio control switches
5	-	Clock spring
6	-	Display
7	-	Lower integrated control panel
8	-	Head Unit (HU)
9	-	Power amplifier
10	-	Speakers
11	-	AM/FM antenna amplifier

HIGH LINE AUDIO SYSTEM - COMPONENT LOCATION

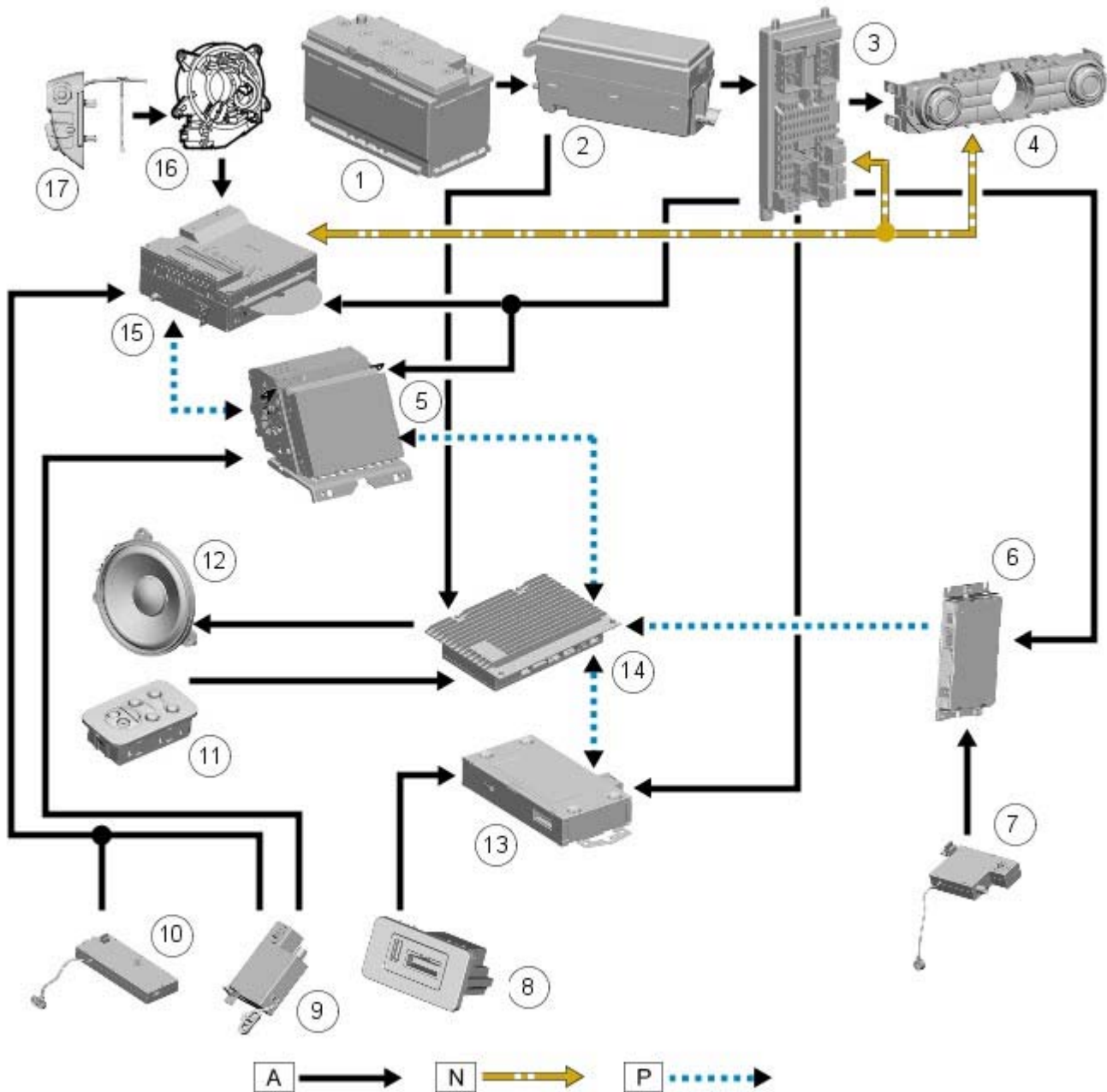


E132311

Item	Part Number	Description
1	-	Row two/three remote audio controls
2	-	DAB/SDARS tuner module
3	-	AM/FM diversity antenna amplifier
4	-	FM antenna amplifier
5	-	DAB antenna amplifier
6	-	Portable audio interface consol
7	-	Portable audio interface module
8	-	Power amplifier
9	-	Head Unit (HU)
10	-	Lower integrated control panel
11	-	Touch screen display
12	-	Audio control switches
13	-	Clock spring

HEAD UNIT (HU) - AUDIO CONTROL DIAGRAM

• NOTE: **A** = Hardwired; **N** = Medium Speed CAN; **P** = MOST



E132374

Item	Part Number	Description
1	-	Battery
2	-	BJB
3	-	CJB
4	-	Lower integrated control panel
5	-	Touch screen display
6	-	DAB/SDARS tuner module
7	-	DAB antenna amplifier
8	-	Portable audio interface consol
9	-	FM antenna amplifier
10	-	AM/FM diversity antenna amplifier
11	-	Row two/three remote audio controls
12	-	Speakers
13	-	Portable audio interface module
14	-	Power amplifier
15	-	Head Unit (HU)
16	-	Clock spring
17	-	Audio control switches

COMPONENT DESCRIPTION

Head Units

The audio systems have three levels: low line, mid line and high line versions. All the audio systems (low, mid, high) are based around a head unit which communicates on the Media Orientated System Transport (MOST) ring and the medium

speed controller area network (CAN) bus.

Low/Mid Line Head Unit



E121832

The Head Unit (HU) is located in the instrument panel and incorporates the following systems:

- HD Radio (where fitted)
- Bluetooth® receiver (telephone and audio streaming)
- 40 Gb Hard drive
- USB controller (front)
- Audio AUX
- CD player

The low line HU contains the following functionality:

- Radio tuner
- Single disc compact disc (CD) player
- Amplifier

The HU communicates with other vehicle systems on the CAN bus.

Transit Mode

Transit mode is used to reduce the vehicle battery current drain whilst the vehicle is being stored or transported. Transit mode is entered/exited via a CAN signal from T4. In transit mode the following circuits will be disabled:

- Amplifiers
- Aux and phone call
- Clock
- Antenna power
- light emitting diode (LED) illumination

In transit mode the CAN port and the ON/OFF switch are the only circuits that are left active.

The CAN port is left open to allow the EXIT from transit mode signal to be received. The ON/OFF switch is left active to allow feedback to the driver via the HU liquid crystal display (LCD), that the unit is in Transit mode should the driver attempt to power up the HU. This will only occur when the vehicle engine is running and the battery is above 12.3 Volts.

Radio Function

The radio tuner is located in the head unit. The radio is capable of receiving AM and FM waveband and can store 18 FM pre-sets and 12 amplitude modulation (AM) pre-sets. The AM presets are stored as follows:

European AM Preset Storage

- 6 MW
- 6 MWa
- 6 LW
- 6LWa

NAS AM Preset Storage

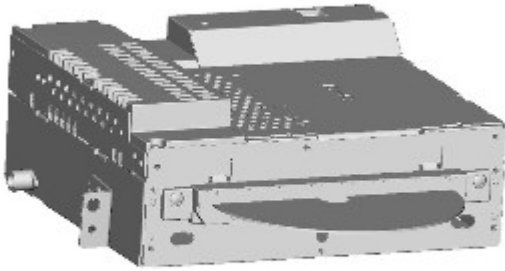
- 6 MW1
- 6 MW2
- 6 MWa

CD Function

The HU includes single play CD player. The CD player has all the usual functions of a CD player:

- CD play
- Previous/next track
- Shuffle tracks
- Load/eject CD
- Scan
- Repeat

High Line Head Unit



E132910

The high line HU contains the following functionality:

- Radio tuner.
- CD player (Six disc in dash changer).
- Integrated telephone control.
- Auxiliary input (for any device featuring a 3.5mm jack plug output).

The HU is woken up by CAN bus activity and is not woken up from the ignition aux position.

The HU is the Bus Master for the MOST system and contains the timing master for the MOST system.

Tuner

The HU incorporates a AM/frequency modulation (FM) tuner which allows for 18 FM pre-sets and 12 AM (6 MW and 6 LW) pre-set stations to be stored in the HU memory. The radio tuner also incorporates the following radio functions:

- Auto tune
- Traffic announcements (TA)
- radio data system (RDS) EON function
- Seek station
- Tune up/down

CD Player

The CD player is a 6 disc in dash mounted device. The CD multi changer is capable of playing commercial CDs, CDRs, CDRWs and MP3 discs.

Random Play

The Random feature only works on the CD, which has been selected. The Random feature plays all the tracks on the selected CD in a random order. All the tracks on that disc will be played before a new random sequence is played. If a new CD is selected while in random mode, the random mode will be cancelled and play will commence from track 1.

Repeat

The Repeat feature allows the current track to be repeated in an endless loop, when selected by the user.

MP3

The CD player has the capability to play MP3 files. The MP3 discs follow a format of folders and files within the folder. It is also possible to place all the files in the root directory on the CD.

The random and repeat features follow the normal CD random and repeat feature functions.

Scan

Scan allows the user to play the first 10 seconds of each track on the CDs in the unit.

Automatic Volume Control-AVC

The AVC feature is designed to adjust output volume to compensate for the rising level noise of the vehicle as the vehicle travels faster.

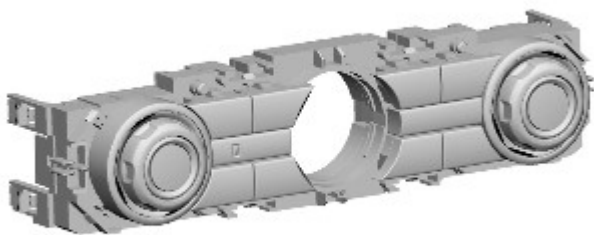
There are 10 settings for AVC, where 0 = off, 1 is the lowest setting (minimum volume change with speed and 9 the maximum).

The vehicle speed signal is used to enable the HU to calculate the volume adjustment required. The vehicle speed signal is received over the CAN from the anti-lock brake system (ABS) control module. The signal is an average of the four wheel speed sensor signals.

Control of the AVC is carried out by the audio amplifier.

Should an invalid speed signal be received the AVC will not alter the output volume.

ICP (Integrated Control Panel)

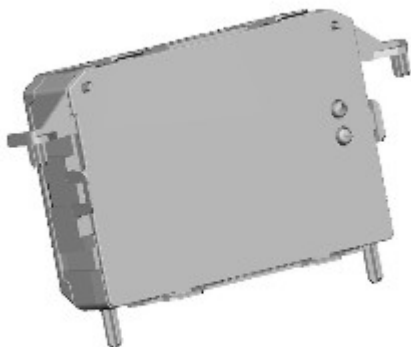


E131563

The ICP duplicates many of the touch-screen audio user control features. Any volume setting made whilst in audio, TV, phone, navigation or voice activation mode will be memorized for that system. The ICP communicates with the IAM on the medium speed CAN (controller area network) . The IAM converts control/command signals from the ICP and then distributes the information onto the MOST system to the audio system and other information and entertainment systems. No configuration procedure is required if the ICP is replaced. There is no option to calibrate the ICP using the Land Rover approved diagnostic equipment.

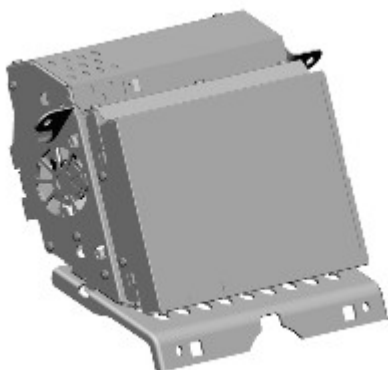
Touch Screen Displays

Low/mid line display



E132909

High line display



E131562

The Touch Screen Display (TSD) is located in the center of the instrument panel and is the driver control interface for the infotainment system. The TSD is connected to the MOST ring and communicates with the other components in the audio/infotainment system.

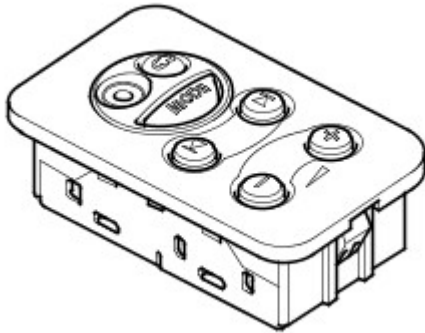
The TSD also provides driver display and control of the audio system, telephone, the rear view camera, proximity cameras, the Traffic Message Channel (TMC) and the navigation system.

The RSE and other systems are operated by 'virtual' buttons displayed on the touch screen.

Care should be taken with the TSD to ensure its correct operation

- The screen should be cleaned with a lightly, water moistened cloth. Do not use chemical agents or domestic products to clean the screen or any part of the surround.
- Only use your finger to operate the touch screen. Ensure you only use one finger to avoid incorrect entries.
- A short light press of the touch screen is sufficient. Excessive pressure can damage the screen.

Remote Audio Controls



E48224

The second and third row seat passenger can use standard headphones to listen to audio from any of the sources fitted to the vehicle. These include:

- Television
- Compact Disc (CD)
- Radio
- DVD
- AUX Input

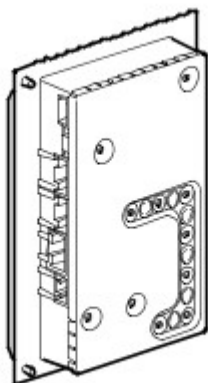
There are four remote audio control modules, two in the rear doors incorporating the rear window switches and two in the rear load space each side of the third row seats.

The remote audio control modules allow the user to select which source to listen to. The remote controls cannot override what the driver has selected to listen to. If the driver is listening to a CD the rear passenger cannot control the CD player.

The remote audio control modules allow the user to alter the volume in the head phones, change track/disc up/down or repeat on a CD, change pre-set radio stations or tune up/down on the radio and television.

AMPLIFIERS

Harman Kardon High Line/Logic 7 Amplifier



E47726

The audio system has three amplification options:

- Internal amplification
- Harman Kardon
- Harman Kardon Logic 7

The amplifier is located under the right-hand (RH) front seat and is connected to the audio system via the MOST bus.

Speaker Connector C0491 for Harman Kardon Amplifier

Pin No	Description	Input/Output
1	left-hand (LH) rear door speaker -	-
2	RH rear door speaker -	-

Pin No	Description	Input/Output
3	Not used	-
4	Not used	-
5	LH front door speaker -	-
6	RH front door speaker -	-
7	Subwoofer left -	-
8	Subwoofer right -	-
9	LH rear door speaker +	Output
10	RH rear door speaker +	Output
11	Not used	-
12	Not used	-
13	LH front door speaker +	Output
14	RH front door speaker +	Output
15	Subwoofer left +	Output
16	Subwoofer right +	Output

Speaker Connector C0491 for Harman Kardon Logic 7 Amplifier

Pin No	Description	Input/Output
1	LH rear door speaker -	-
2	RH rear door speaker -	-
3	LH front bass speaker -	-
4	RH front bass speaker -	-
5	Rear surround left -	-
6	Rear surround right -	-
7	Subwoofer left -	-
8	Subwoofer right -	-
9	LH rear door speaker +	Output
10	RH rear door speaker +	Output
11	LH front bass speaker +	Output
12	RH front bass speaker +	Output
13	Rear surround left +	Output
14	Rear surround right +	Output
15	Subwoofer left +	Output
16	Subwoofer right +	Output

Speaker Connector C0492 for Harman Kardon Amplifier

Pin No	Description	Input/Output
1	Not used	
2	Not used	
3	Not used	
4	Not used	
5	Headphone module 1 left channel	Output
6	Headphone module 1 right channel	Output
7	Headphone module 2 right channel	Output
8	Headphone module 2 left channel	Output
9	Not used	-
10	Not used	-
11	Not used	-
12	Not used	-
13	Not used	-
14	Not used	-
15	Headphone module 1 left ground	-
16	Headphone module 1 right ground	-
17	Headphone module 2 left ground	-
18	Headphone module 2 right ground	-
19	Not used	-
20	Not used	-

Speaker Connector C0493 for Harman Kardon Amplifier

Pin No	Description	Input/Output
1	Headphone module 3 left channel	Output
2	Headphone module 3 right channel	Output
3	Headphone module 4 left channel	Output
4	Headphone module 4 right channel	Output
5	Headphone module 1 control signal	Output
6	Headphone module 2 control signal	Output
7	Headphone module 3 control signal	Output
8	Headphone module 4 control signal	Output
9	Not used	-
10	Not used	-
11	Headphone module 3 left ground	-
12	Headphone module 3 right ground	-
13	Headphone module 4 left ground	-
14	Headphone module 4 right ground	-
15	Headphone module 1 control ground	-
16	Headphone module 2 control ground	-
17	Headphone module 3 control ground	-
18	Headphone module 4 control ground	-

Pin No	Description	Input/Output
19	Not used	-
20	Not used	-

Speaker Connector C0492 for Harman Kardon Logic 7 Amplifier

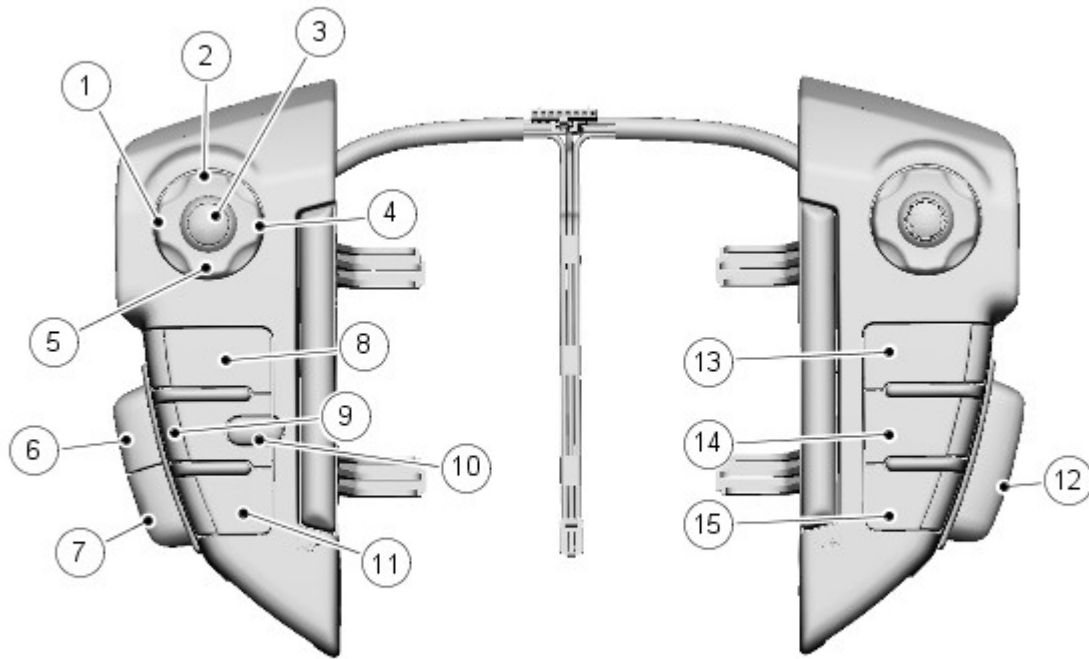
Pin No	Description	Input/Output
1	LH front mid/high range speaker -	-
2	RH front mid/high range speaker -	-
3	Center fill speaker -	-
4	Not used	-
5	Headphone module 1 left channel	Output
6	Headphone module 1 right channel	Output
7	Headphone module 2 left channel	Output
8	Headphone module 2 right channel	Output
9	Not used	-
10	Not used	-
11	LH front mid/high range speaker +	Output
12	RH front mid/high range speaker +	Output
13	Center fill speaker +	Output
14	Not used	-
15	Headphone module 1 left channel ground	-
16	Headphone module 1 right ground	-
17	Headphone module 2 left ground	-
18	Headphone module 2 right ground	-
19	Not used	-
20	Not used	-

Speaker Connector C0493 for Harman Kardon Logic 7 Amplifier

Pin No	Description	Input/Output
1	Headphone module 3 left channel	Output
2	Headphone module 3 right channel	Output
3	Headphone module 4 left channel	Output
4	Headphone module 4 right channel	Output
5	Headphone module 1 control signal	Output
6	Headphone module 2 control signal	Output
7	Headphone module 3 control signal	Output
8	Headphone module 4 control signal	Output
9	Not used	-
10	Not used	-
11	Headphone module 3 left channel ground	-
12	Headphone module 3 right channel ground	-
13	Headphone module 4 left channel ground	-
14	Headphone module 4 right channel ground	-
15	Headphone module 1 control ground	-
16	Headphone module 2 control ground	-
17	Headphone module 3 control ground	-
18	Headphone module 4 control ground	-
19	Not used	-
20	Not used	-

STEERING WHEEL CONTROLS

Steering Wheel Audio Controls



E132140

Item	Part Number	Description
1	-	Search down
2	-	Volume up
3	-	Mode select
4	-	Search up
5	-	Volume down
6	-	Gap decrease
7	-	Gap increase
8	-	Set or increase the speed
9	-	Resume set speed
10	-	Cancels without erasing memorised speed
11	-	Decrease the speed
12	-	Heated steering wheel
13	-	Answer call/dial switch
14	-	End/reject call switch
15	-	Voice control

The HU can be remotely controlled via steering wheel mounted controls. The steering wheel controls are mounted to the right hand side of the steering wheel.

The switches are a resistive ladder type. The HU supplies a reference voltage to the switches, which then return an altered voltage to the HU depending on which switch is pressed.

The controls allow the user to adjust the volume, change CD tracks/radio pre-sets, answer and end a phone call (where a phone is fitted) and use the voice recognition system.

SATELLITE DIGITAL AUDIO RADIO SERVICE (SDARS NAS only)

The SDARS systems operate in the S-Band frequency range (2.3 GHz) and, as a result of the use of satellite transmission have the ability to provide CD quality audio broadcasts over very large areas (typically continents). SDARS service providers transmit a signal from their up-link facility (which is the original point of transmission of data, voice or other information through an antenna system) to a satellite where the signal is then down linked to both the terrestrial repeater network and the individual SDARS car radios. The radio switches between the satellite signal and the repeater signal depending on the strength of the signal at any given time.

Land Rover will be using the Sirius Satellite Radio service provider in the USA.

The Sirius SDARS systems comprise:

- Satellites
- Ground repeaters
- Up-link ground stations
- Radio receiver systems

The Sirius SDARS system uses three satellites on an inclined elliptical orbit. This ensures that each satellite spends approximately 16 hours a day over the continent of the USA, with at least one satellite over the country at any one time.

The satellites beam their signals down to the ground where the signal is picked up by receivers or is transmitted to repeater stations to cover built up areas where the signal is obscured.

TRAFFIC MESSAGE CHANNEL (TMC)

The TMC system is a European only system whereby traffic information is received by the TMC tuner and used by the navigation computer to recalculate the route being used to avoid the traffic disruption. This system information is broadcast on the RDS data carriers.

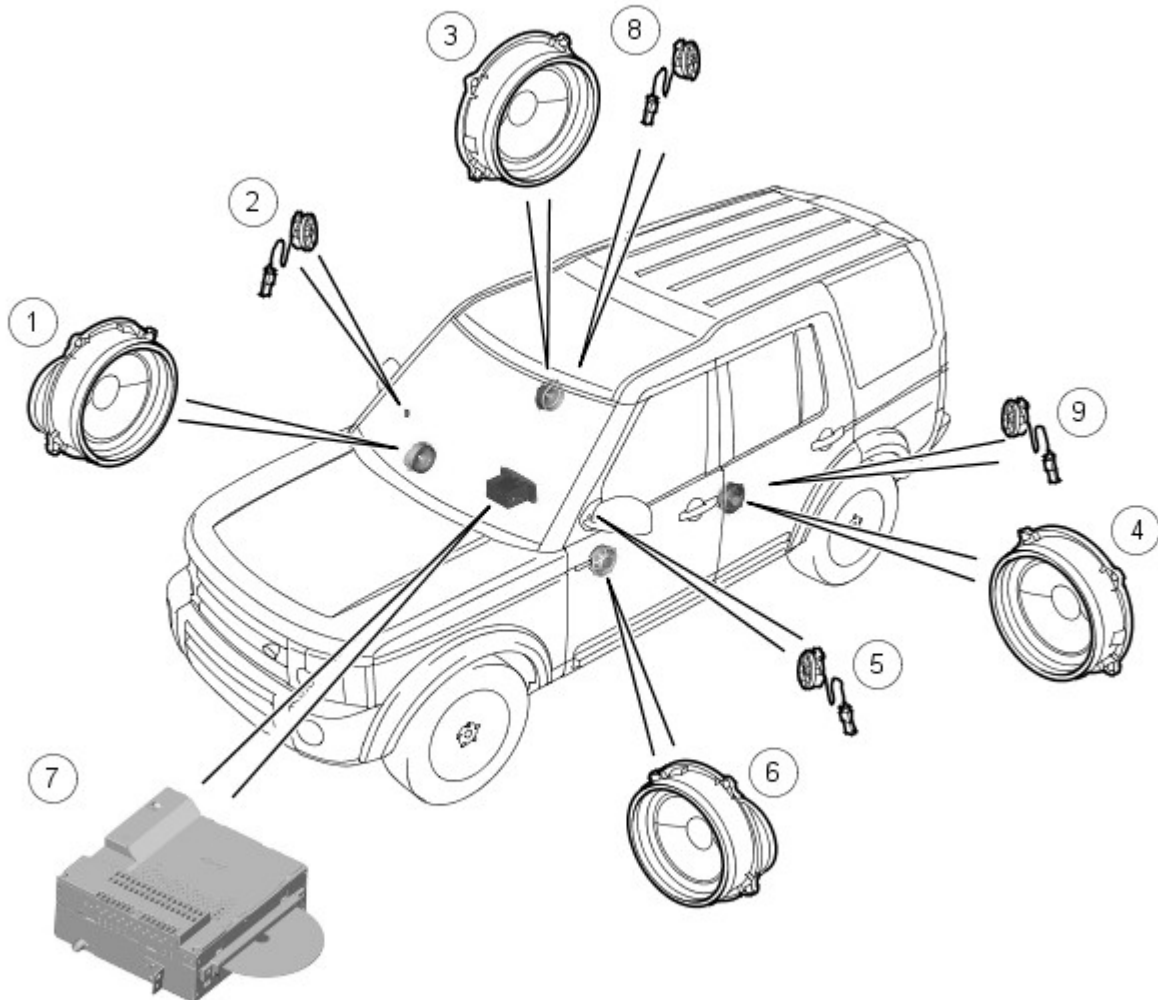
Information and Entertainment System - Speakers

Description and Operation

The speaker configuration depends on the level of audio and head unit fitted to the vehicle. The following details the speaker configuration and control for each system.

LOW LINE AUDIO SYSTEM

Low Line Audio System Speaker Component Location

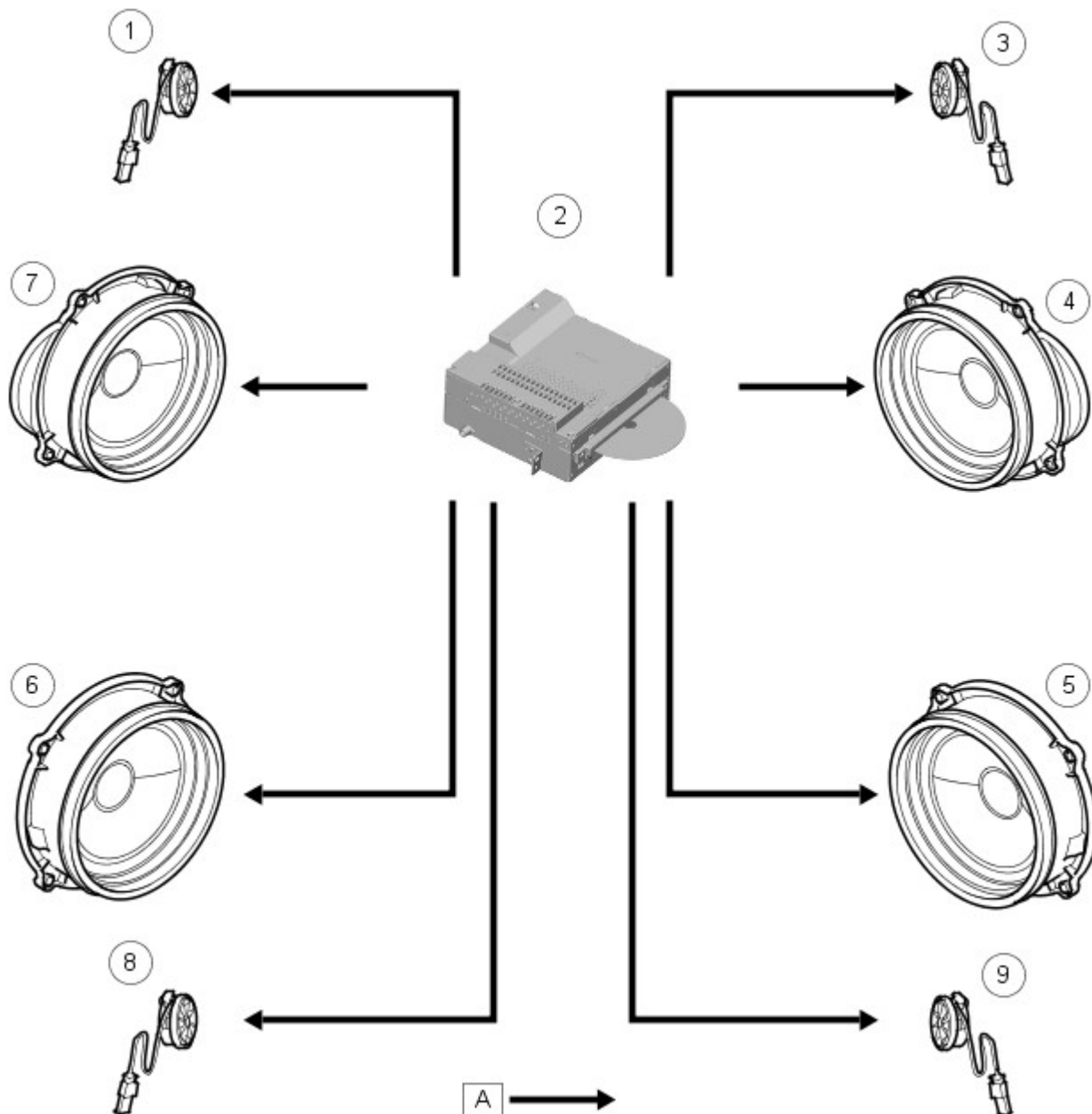


E132119

Item	Part Number	Description
1	70451	Front RH door mid/bass speaker
2	-	Front RH door tweeter
3	-	Rear RH door full range speaker
4	-	Rear LH door full range speaker
5	-	Front LH door tweeter
6	-	Front LH door mid/bass speaker
7	-	Head unit
8	-	Rear RH door tweeter
9	-	Rear LH door tweeter

Low Line Audio System Speaker Control Diagram

• NOTE: A= Hardwired



E132120

Item	Part Number	Description
1	-	Front LH tweeter
2	-	Head unit
3	-	Front RH tweeter
4	-	Front RH mid/bass speaker
5	-	Rear RH full range speaker
6	-	Rear LH full range speaker
7	-	Front LH mid/bass speaker
8	-	Rear LH tweeter
9	-	Rear RH tweeter

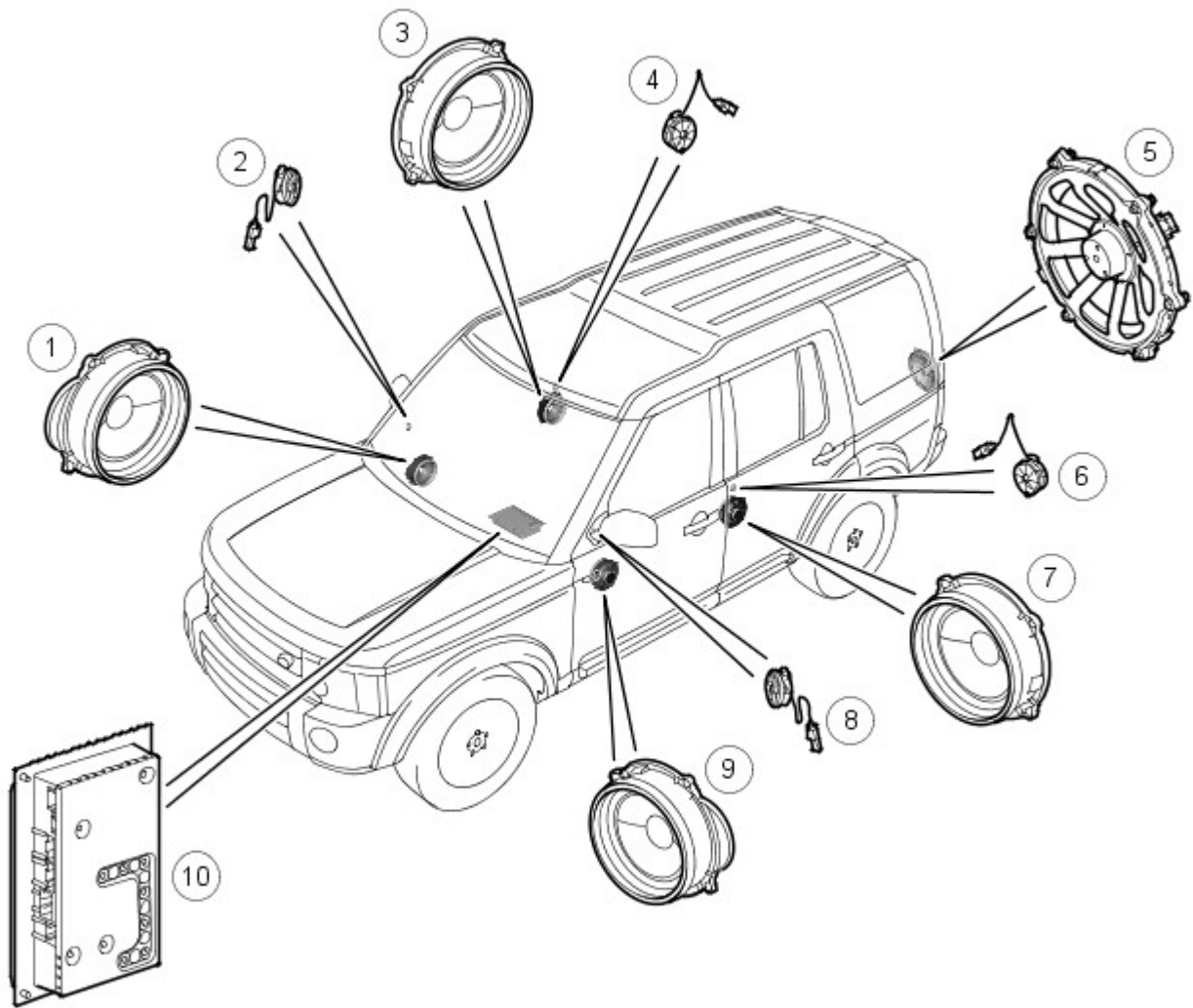
The low line audio speaker system is driven directly from the audio head unit. For additional information, refer to: [Audio System](#) (415-01B Information and Entertainment System, Description and Operation).

The system comprises:

- Head unit
- Two front door mounted mid/bass speakers (one per side)
- Two front door mounted tweeters (one per side)
- Two rear door mounted full range speakers (one per side)
- Two rear door mounted tweeters (one per side)

HIGH LINE-HARMAN/KARDON AUDIO SYSTEM

High line-Harman/Kardon Audio System Speaker Component Location

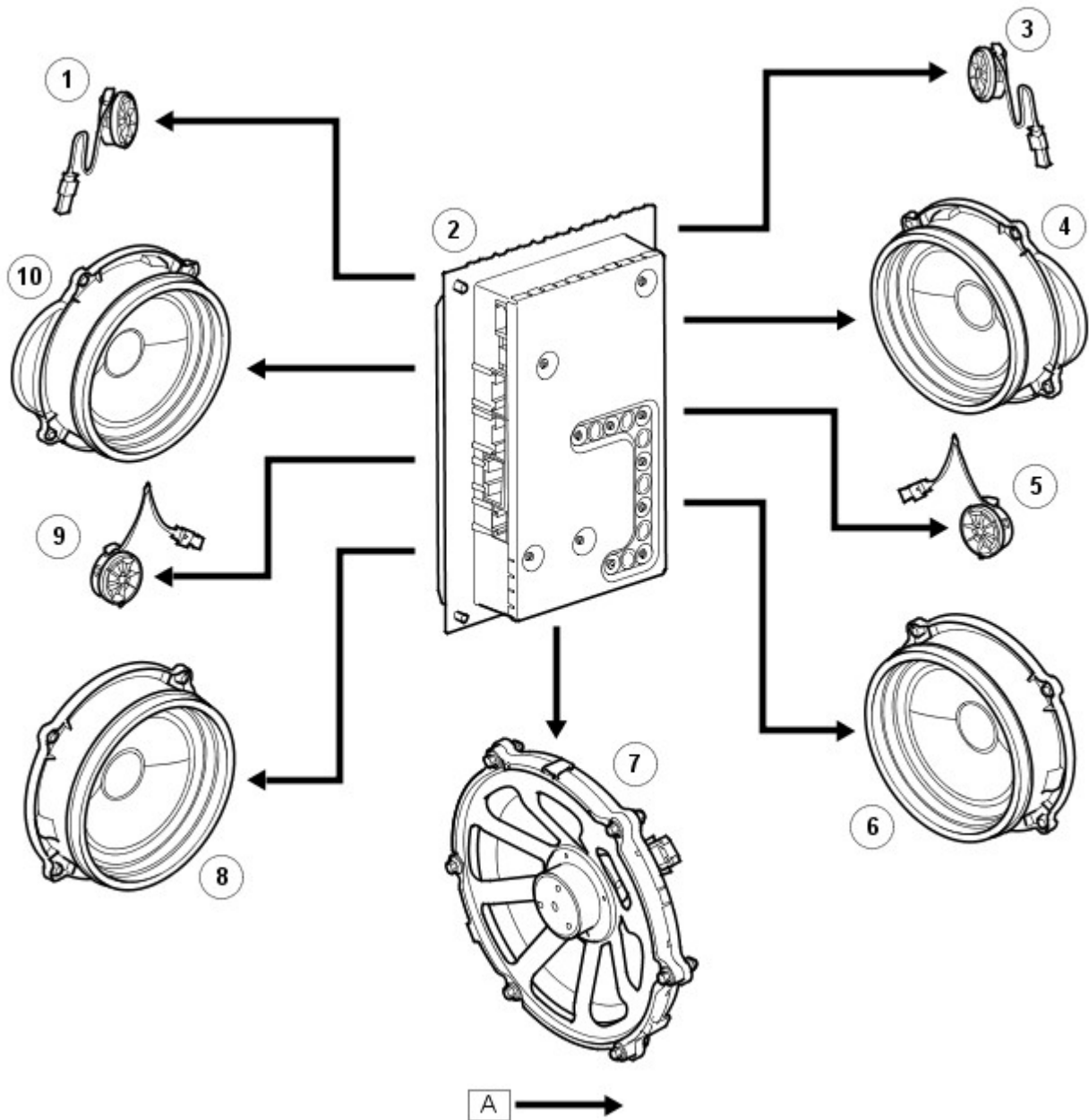


E49743

Item	Part Number	Description
1	-	Front RH mid/bass speaker
2	-	Front RH tweeter
3	-	Rear RH mid/bass range
4	-	Rear RH tweeter
5	-	Sub-woofer
6	-	Rear LH tweeter
7	-	Rear LH mid/bass range
8	-	Front LH tweeter
9	-	Front LH mid/bass speaker
10	-	High line amplifier

High line-Harman/Kardon Audio System Speaker Control Diagram

• NOTE: A= Hardwired



E48353

Item	Part Number	Description
1	-	Front LH tweeter
2	-	High line amplifier
3	-	Front RH tweeter
4	-	Front RH mid/bass speaker
5	-	Rear RH tweeter
6	-	Rear RH mid/bass speaker
7	-	Sub-woofer
8	-	Rear LH mid/bass speaker
9	-	Rear LH tweeter
10	-	Front LH mid/bass speaker

The High line-Harman/Kardon audio speaker system is driven by an amplifier located under the RH front seat. The amplifier is controlled by the Integrated Head Unit (IHU) on the MOST bus and supplies 6x50 watts output, giving a total system power rating of 300 watts

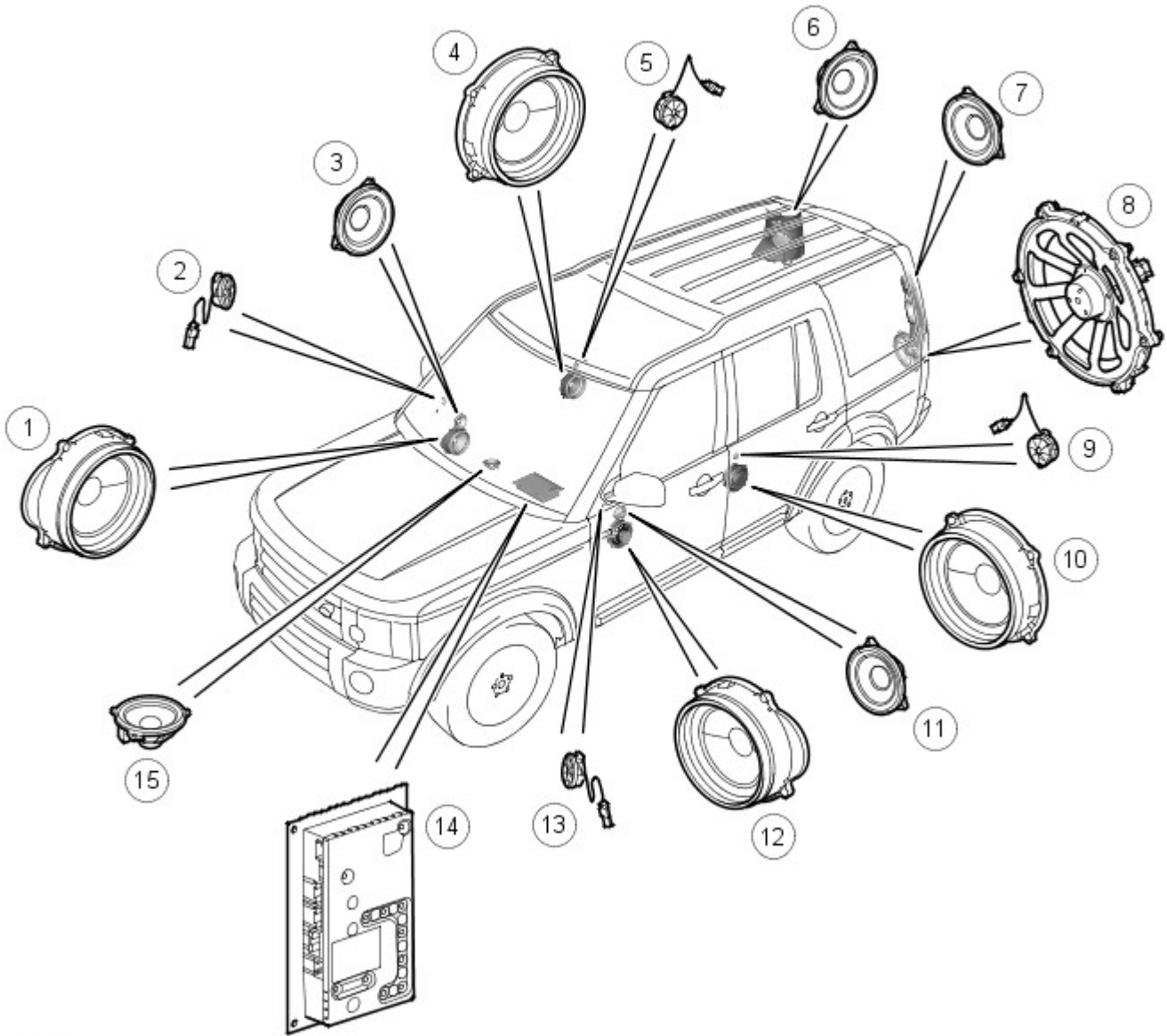
For additional information, refer to: [Audio System](#) (415-01B Information and Entertainment System, Description and Operation).

. The system comprises:

- Integrated Head Unit (IHU) Head unit.
- Two front door mounted mid/bass range speakers (one per side).
- Two front door mounted tweeters (one per side).
- Two rear door mounted mid/bass range speakers (one per side).
- Two rear door mounted tweeters (one per side).
- A sub-woofer located in the lower tailgate.
- An audio amplifier located under the front RH seat.

PREMIUM AUDIO SYSTEM - HARMAN/KARDON LOGIC7

Premium Audio - Harman/Kardon LOGIC7 Audio System Speaker Component Location

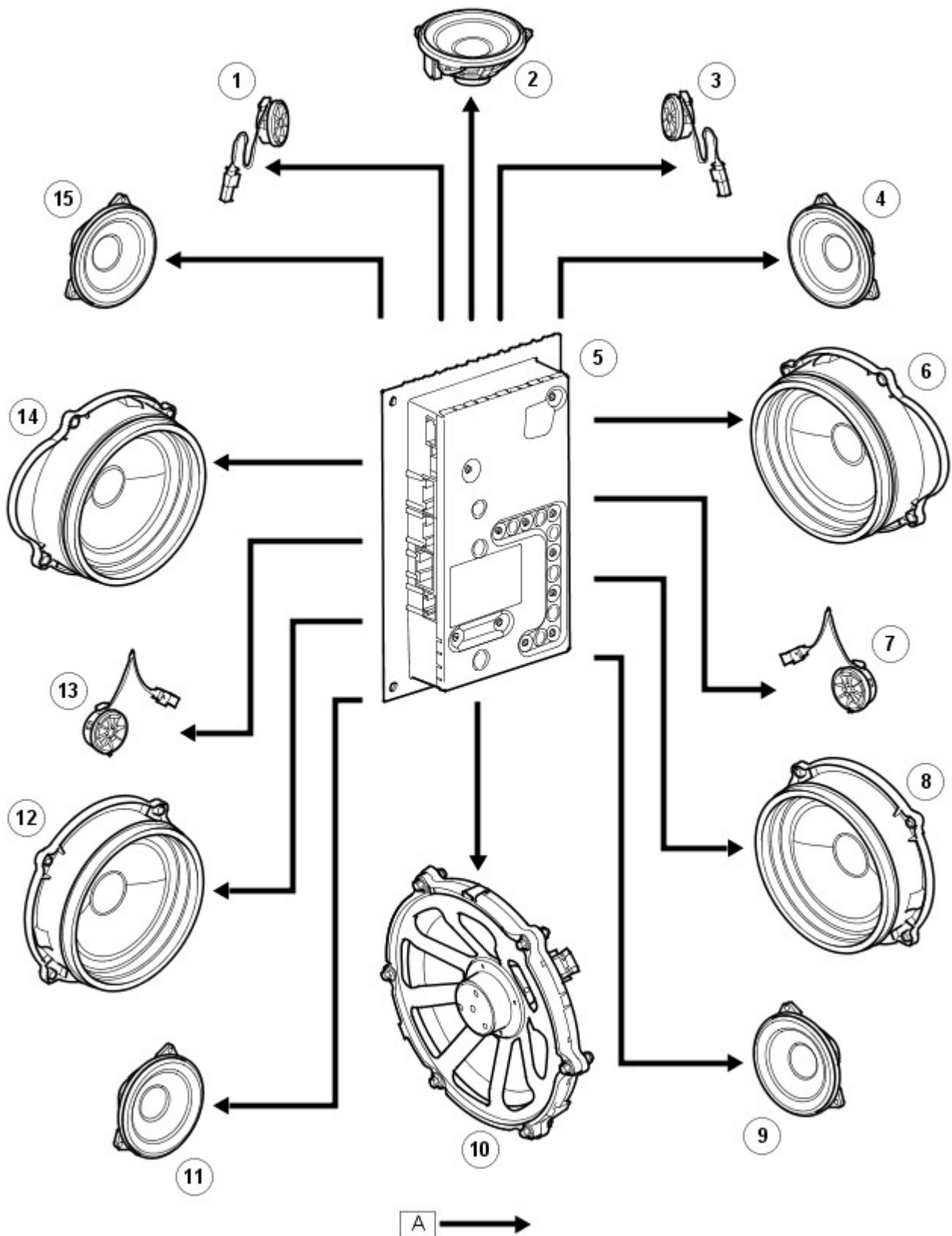


E49744

Item	Part Number	Description
1	-	Front RH bass speaker
2	-	Front RH tweeter
3	-	Front RH mid range speaker
4	-	Rear RH mid/bass speaker
5	-	Rear RH tweeter
6	-	Rear RH surround speaker
7	-	Rear LH surround speaker
8	-	Sub-woofer
9	-	Rear LH tweeter
10	-	Rear LH mid/bass speaker
11	-	Front LH mid range speaker
12	-	Front LH bass speaker
13	-	Front LH tweeter
14	-	Premium amplifier
15	-	Front centre fill speaker

Premium Audio - Harman/Kardon LOGIC7 Audio System Speaker Control Diagram

• NOTE: A= Hardwired



E48354

Item	Part Number	Description
1	-	Front LH tweeter
2	-	Front centre fill speaker
3	-	Front RH tweeter
4	-	Front RH mid range speaker
5	-	Premium amplifier
6	-	Front RH bass speaker
7	-	Rear RH tweeter
8	-	Rear RH mid/bass range speaker
9	-	Rear RH surround speaker
10	-	Sub-woofer
11	-	Rear LH surround speaker

12	-	Rear LH mid/bass range speaker
13	-	Rear LH tweeter
14	-	Front LH bass speaker
15	-	Front LH mid range speaker

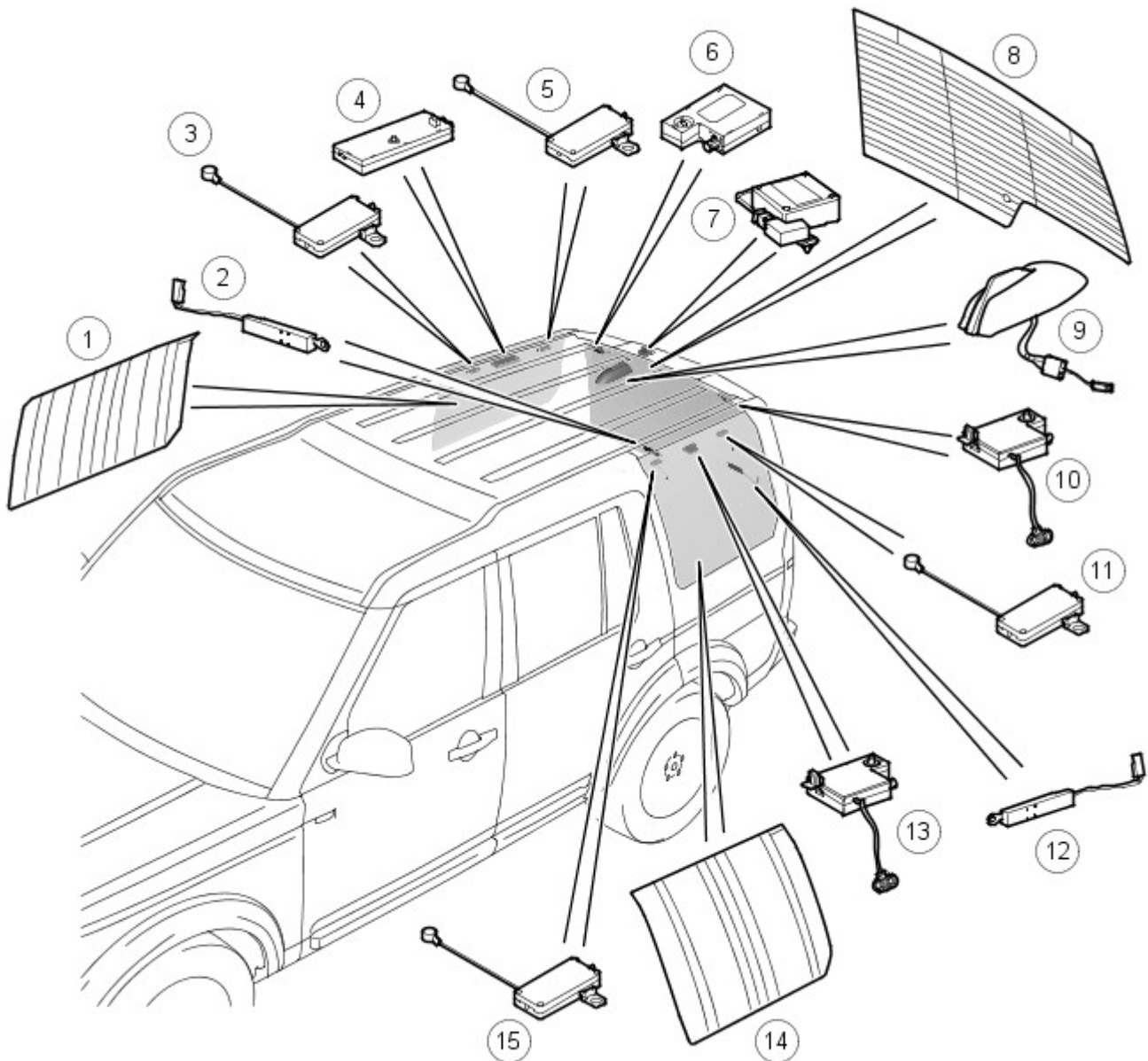
The Premium Audio - Harman/Kardon LOGIC7 audio speaker system is driven by an amplifier located under the RH front seat. The amplifier is controlled by the Integrated Head Unit (IHU) on the MOST bus and supplies 12x50 watts output, giving a total system power rating of 600 watts. The system comprises:

- Integrated Head Unit (IHU) Head unit
- Two front door mounted mid range speakers (one per side)
- Two front door mounted bass speakers (one per side)
- Two front door mounted tweeters (one per side)
- Two rear door mounted mid/bass range speakers (one per side)
- Two rear door mounted tweeters (one per side)
- A sub-woofer located in the lower tailgate
- Two rear surround speakers in the E post (one per side)
- One centre fill speaker located in the centre of the instrument panel
- Premium amplifier

Antenna - Antenna

Description and Operation

Antenna Amplifier Component Location

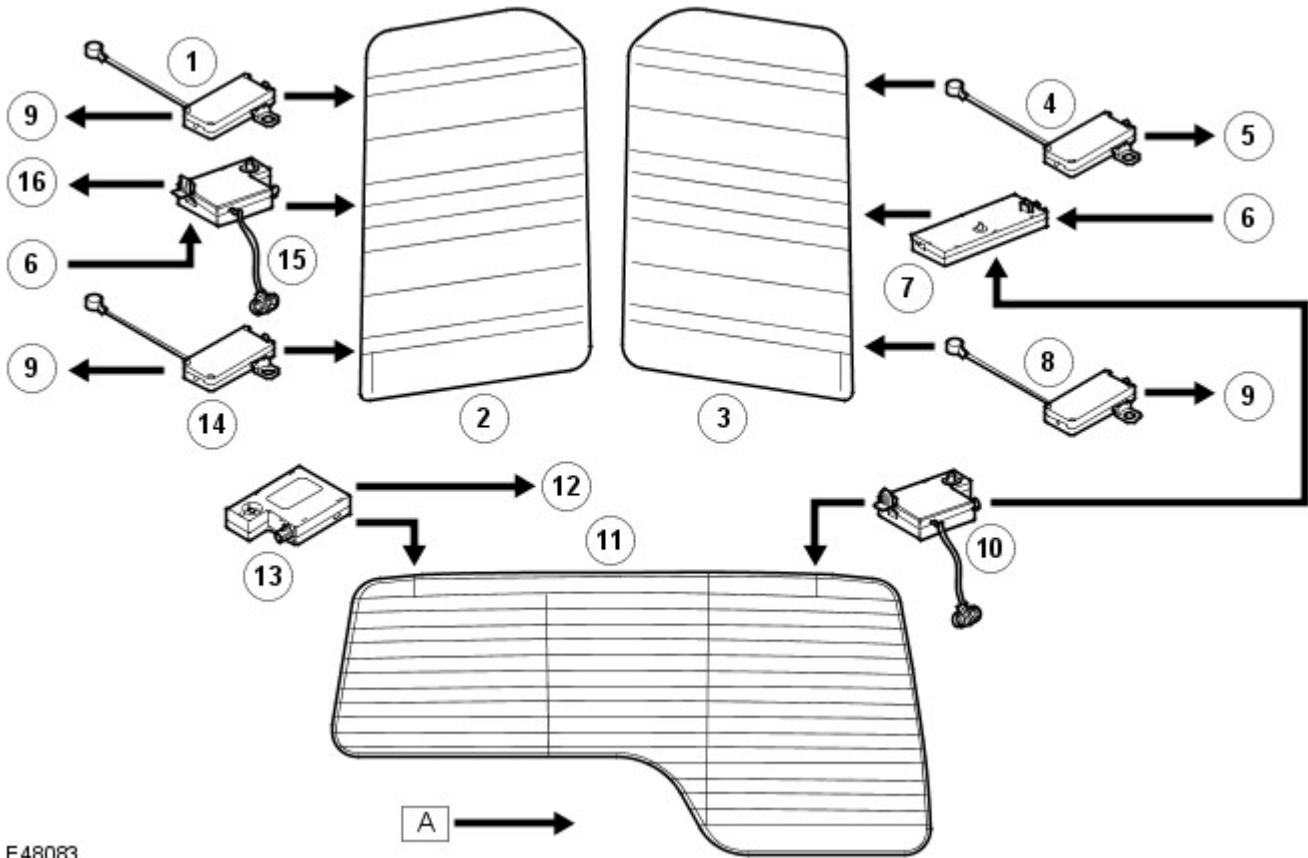


E48082

Item	Part Number	Description
1		FM Antenna
2		Suppressor
3		TV antenna amplifier
4		FM diversity antenna amplifier
5		TV antenna amplifier
6	-	FM antenna amplifier
7	-	GPS antenna
8	-	Rear screen mounted antennas
9	-	Telephone and SDARS antennas
10	-	VICS/ TMC antenna amplifier
11	-	TV antenna amplifier
12	-	Suppressor
13	-	VICS antenna amplifier
14	-	Side screen television antennas
15	-	TV antenna amplifier

Screen Antenna Layout

- NOTE: A=Hardwired



E48083

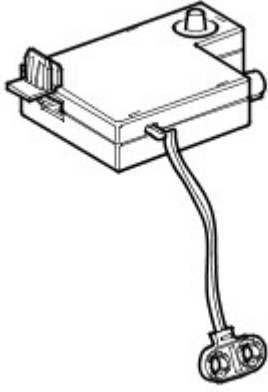
Item	Part Number	Description
1		TV antenna amplifier
2		LH Side screen antennas
3		RH Side screen antennas
4	-	TV antenna amplifier
5	-	TV tuner module
6	-	Integrated Head Unit (IHU)
7	-	AM/FM diversity antenna amplifier
8	-	TV antenna amplifier
9	-	TV tune module
10	-	FM Diversity tuning amplifier
11	-	Rear screen antennas
12	-	VICS/TMC tuner
13	-	VICS/TMC antenna amplifier
14	-	TV antenna amplifier
15	-	VICS antenna amplifier
16	-	VICS tuner

The antenna systems fitted to the vehicle comprise:

- AM (glass mounted)
- FM (glass mounted)
- FM diversity (glass mounted, where fitted)
- TV (glass mounted, where fitted)
- Multiband telephone antenna (roof mounted, where fitted)
- GPS antenna (rear spoiler mounted, where fitted)
- SDARS (roof mounted NAS only)
- VICS antenna and beacon antenna (Japan only where fitted)

FM ANTENNAS

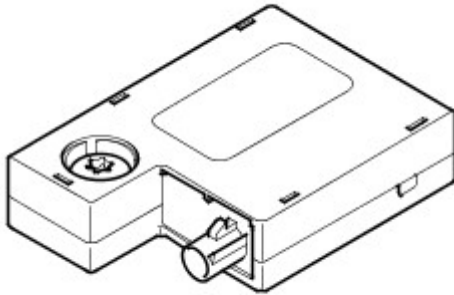
FM Antenna Amplifier



E48084

The AM/FM antennas are located in the side and rear window. ON vehicles with the low line audio system the AM/FM antenna is located in the RH rear side screen. On vehicles with a high line audio systems the system will be equipped with FM diversity tuning. This system ensures that the strongest of two signals is used by the radio system to ensure the best possible FM reception. The standard AM/FM antenna is screen mounted in the RH rear side window and is connected to an antenna amplifier located above the screen. The diversity system uses the same side window antenna and amplifier but also uses a rear heated screen element antenna and an FM antenna amplifier mounted at the top of the rear screen in the tail gate.

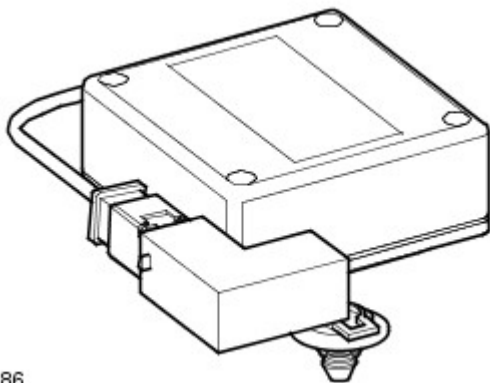
TMC ANTENNA AMPLIFIER



E48087

The Traffic Message Channel (TMC) signals are received through the normal radio signals via the RDS network. The signals are routed separately from the radio signals via a separate antenna amplifier located on the RH rear side window. For additional information, refer to: [Navigation System](#) (419-07 Navigation System, Description and Operation).

GPS ANTENNA

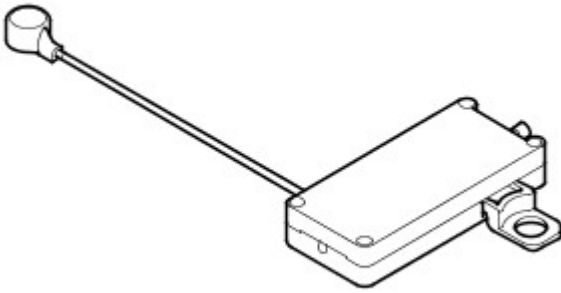


E48086

The GPS antenna is located in the RH side of the upper tailgate mounted spoiler. The GPS antenna is connected to the navigation computer by a coaxial cable. For additional information, refer to: [Navigation System](#) (419-07 Navigation System, Description and Operation).

TV ANTENNA

TV Antenna Amplifier

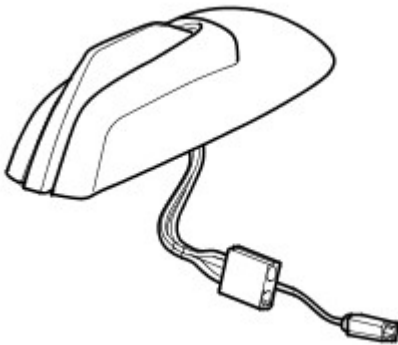


E48088

Where a television system is specified there are four TV antenna elements two in each of the rear side windows. Each element has an antenna amplifier which is connected to the TV tuner module by a coaxial cable. For additional information, refer to: Video System (415-07 Video System, Description and Operation).

MULTIBAND TELEPHONE ANTENNA

Multiband Telephone Antenna



E48085

The multiband telephone antenna is located in the roof mounted pod, which is located in the centre of the roof at the rear of the vehicle and is connected directly to the Telephone Control Module (TCM) via a single coaxial cable. For additional information, refer to: [Cellular Phone](#) (419-08 Cellular Phone, Description and Operation).

SATELLITE DIGITAL AUDIO RADIO SYSTEM (SDARS) ANTENNA (NAS ONLY)

SDARS antenna



E48085

The SDARS antenna is located in the roof mounted pod, which is located in the centre of the roof at the rear of the vehicle. The SDARS antenna has two connections to the SDARS tuner, one for satellite transmissions the other for terrestrial transmissions from repeater stations.

The antenna comprises two antenna elements:

- A printed dipole antenna for receiving satellite signals
- A printed monopole antenna for receiving terrestrial signals

The two antennas allow the system to receive SDARS transmissions in built up areas where signals from satellites would normally be blocked.

For additional information, refer to: Audio System (415-01 Audio Unit, Description and Operation).

VICS ANTENNAS (Japan only)

VICS Beacon Antenna



E48091

The VICS control module uses the rear RH side window antenna to receive VICS information. The Control module also uses an infra red beacon antenna located in the middle on top of the instrument panel adjacent to the sunlight sensor. For additional information, refer to: Navigation System (419-07 Navigation System, Diagnosis and Testing).

Antenna - Antenna

Diagnosis and Testing

For additional information.

REFER to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

Speakers -

Torque Specifications

Description	Nm	lb-ft
Tailgate speaker to casing bolts	10	7
Tailgate speaker to tailgate Torx screws	10	7

Speakers - Speakers

Diagnosis and Testing

For additional information.

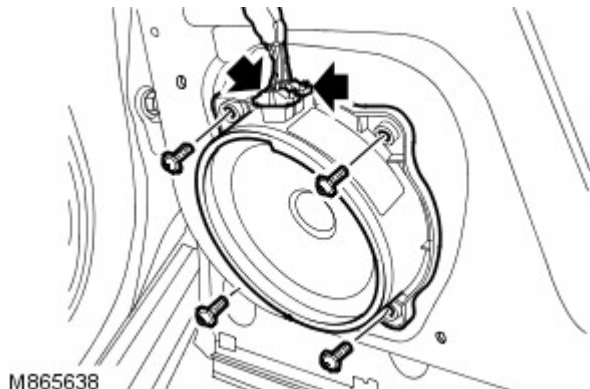
REFER to: [Information and Entertainment System](#) (415-00 Information and Entertainment System - General Information, Diagnosis and Testing).

Speakers - Front Door Speaker

Removal and Installation

Removal

1. Remove the front door trim panel.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).
2. Remove the front door speaker wiring harness.
3. Remove the front door speaker.
 - Remove the 4 screws.
 - Disconnect the electrical connector.



Installation

1. Install the front door speaker.
 - Connect the electrical connector.
 - Install the screws.
2. Install the front door speaker wiring harness.
3. Install the front door trim panel.
For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

Speakers - Rear Door Speaker

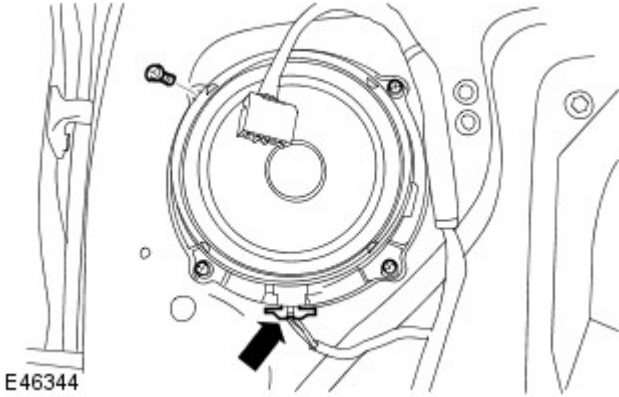
Removal and Installation

Removal

1. Remove the rear door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

2. Remove the speaker.

- Disconnect the electrical connector.
- Remove the 4 screws.



Installation

1. Install the speaker

- Tighten the screws.
- Connect the electrical connector.

2. Install the rear door trim panel.

For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

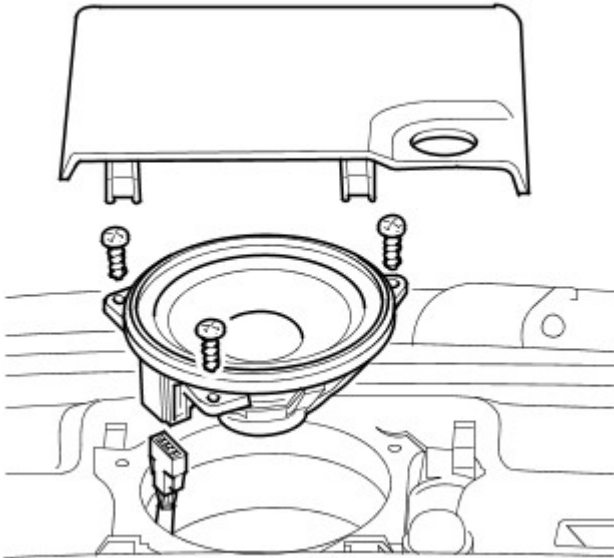
Speakers - Instrument Panel Speaker

Removal and Installation

Removal

1. Remove the instrument panel speaker.

- Remove the speaker grille.
- Remove the 3 screws.
- Disconnect the electrical connector.



E47228

Installation

1. To install, reverse the removal procedure.

Speakers - Quarter Panel Speaker

Removal and Installation

Removal

- NOTE: The procedure to remove the quarter panel speaker is shown in the D-pillar trim panel procedure.

1. Remove the D-pillar trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Installation

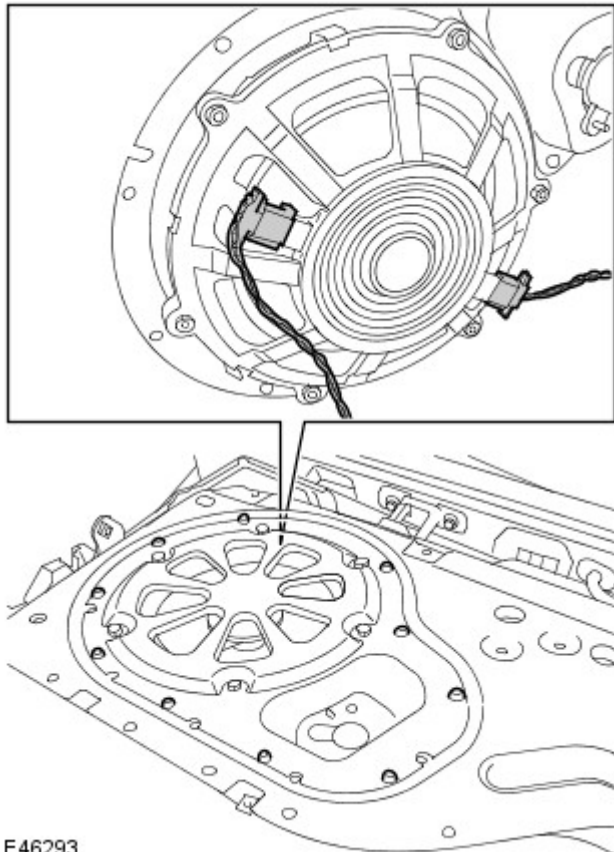
1. Install the D-pillar trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Speakers - Tailgate Speaker

Removal and Installation

Removal

1. Remove the tailgate trim panel.
For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the tailgate speaker assembly.



E46293

- Remove the 10 Torx bolts.
- Disconnect the 2 electrical connectors.

3. **NOTE: Do not disassemble further if the component is removed for access only.**

Remove the tailgate speaker.

- Remove the 6 bolts.



E46294

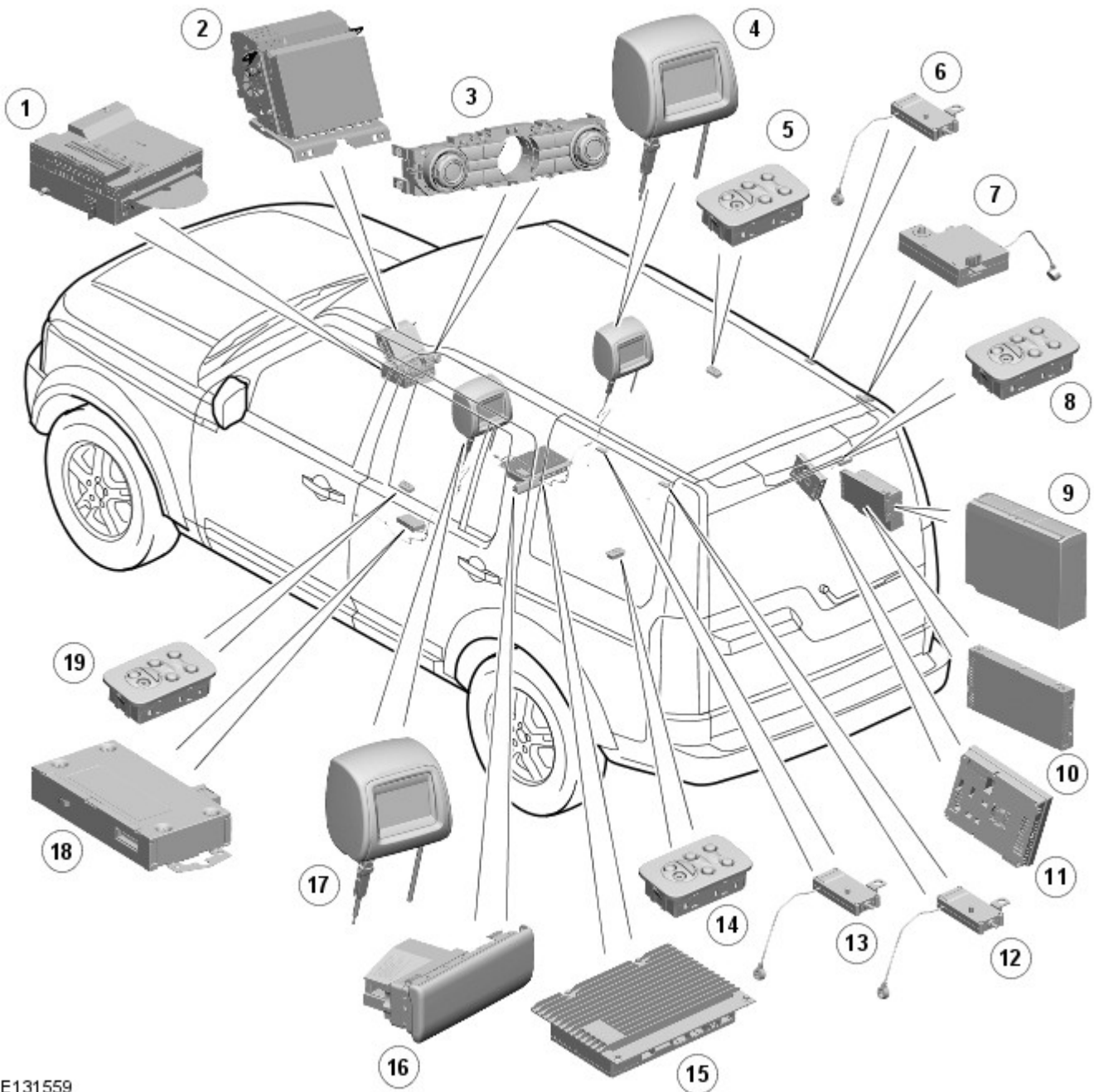
Installation

1. Install the tailgate speaker.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the tailgate speaker assembly.
 - Connect the electrical connectors.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
3. Install the tailgate trim panel.

For additional information, refer to: [Tailgate Trim Panel](#)
(501-05 Interior Trim and Ornamentation, Removal and
Installation).

Video System - Video System

Description and Operation

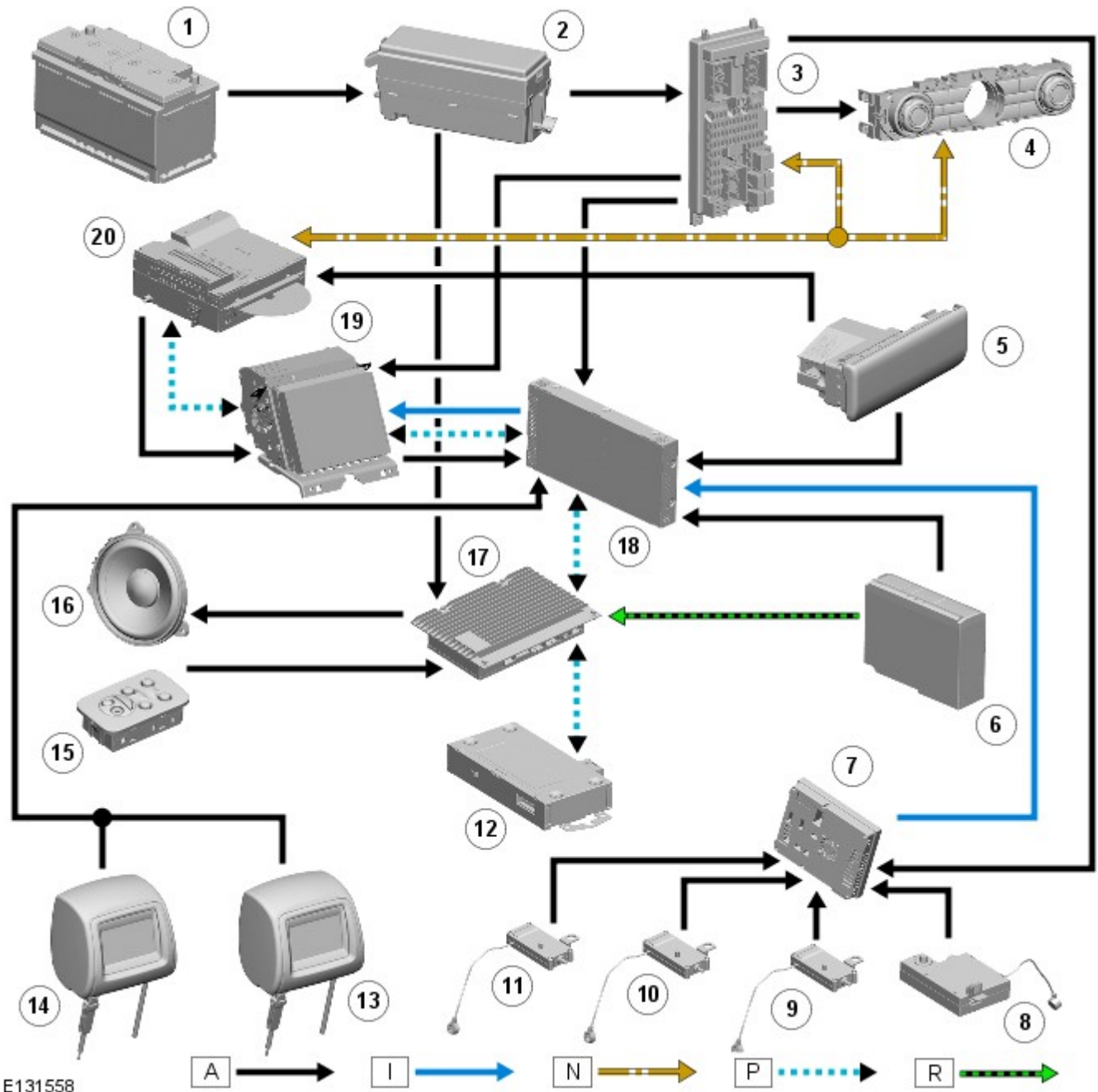


E131559

Item	Part Number	Description
1	-	IAM (integrated audio module)
2	-	Touch screen display
3	-	ICP (integrated control panel)
4	-	RH (right-hand) rear LCD screen
5	-	right-hand (RH) row two remote audio controls
6	-	TV Antenna
7	-	TV Antenna
8	-	RH row three remote audio controls
9	-	DVD Changer
10	-	Rear entertainment module
11	-	Television tuner module
12	-	TV Antenna
13	-	TV Antenna
14	-	left-hand (LH) row three remote audio controls
15	-	Audio amplifier
16	-	Audio/Video input/output panel
17	-	LH (left-hand) rear LCD screen
18	-	Portable audio module
19	-	LH row two remote audio controls

Video System Control Diagram

• NOTE: **A** = Hardwired; **N** = Medium Speed CAN Bus; **P** = MOST **R** = SPDIF (Sony); **I** = CVBS



E131558

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	CJB (central junction box)
4	-	ICP (integrated control panel)
5	-	Audio/Video input/output panel
6	-	DVD changer
7	-	TV tuner
8	-	TV antenna
9	-	TV antenna
10	-	TV antenna
11	-	TV antenna
12	-	Portable audio module
13	-	RH rear LCD screen
14	-	LH rear LCD screen
15	-	Remote audio controls
16	-	Speakers
17	-	Amplifier
18	-	Rear entertainment module
19	-	Touch screen display (TSD)

The Video system comprises:

- Front screen (Navigation Touch screen Display TSD)
- Television tuner module
- Television antennas
- Rear remote control headphone modules

TELEVISION

The television system receives television signals from television antennas in the rear side screens. The antennas are connected to the television tuner via coaxial leads.

For additional information, refer to: [Antenna](#) (415-02 Antenna, Description and Operation).

COMPONENT DESCRIPTION

Touch Screen Display



E131562

The Touch Screen Display (TSD) is located in the center of the instrument panel and is the driver control interface for the infotainment system. The TSD is connected to the MOST ring and communicates with the other components in the audio/infotainment system.

The TSD communicates with the RSE module via a co-axial cable. The TSD processes its own video for system operation but receives the video image data from the RSE via the co-axial cable.

The TSD also provides driver display and control of the audio system, telephone, the rear view camera, proximity cameras, the Traffic Message Channel (TMC) and the navigation system.

The RSE and other systems are operated by 'virtual' buttons displayed on the touch screen.

Care should be taken with the TSD to ensure its correct operation

- The screen should be cleaned with a lightly, water moistened cloth. Do not use chemical agents or domestic products to clean the screen or any part of the surround.
- Only use your finger to operate the touch screen. Ensure you only use one finger to avoid incorrect entries.
- A short light press of the touch screen is sufficient. Excessive pressure can damage the screen.

IAM (Integrated Audio Module)

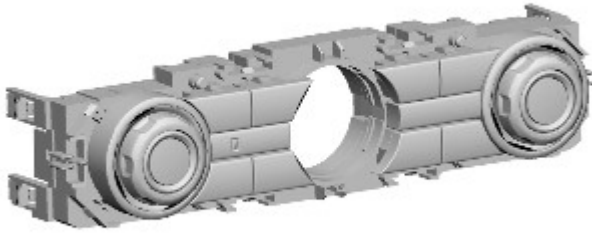


E121832

The IAM is located in the Instrument panel and incorporates the following systems:

- HD Radio (where fitted)
- Bluetooth® receiver (telephone and audio streaming)
- 40 Gb Hard drive
- USB controller (front)
- Audio AUX
- CD player

ICP (Integrated Control Panel)

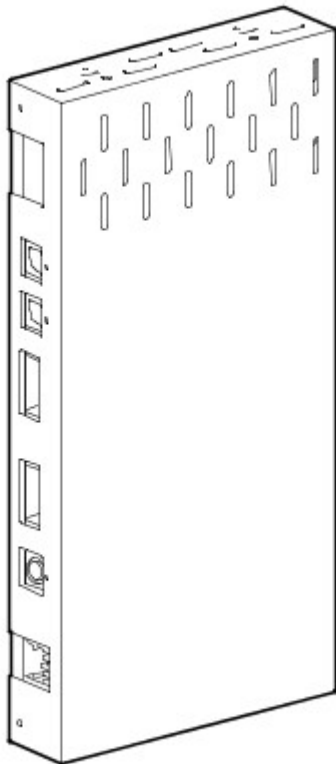


E131563

The ICP duplicates many of the touch-screen audio user control features. Any volume setting made whilst in audio, TV, phone, navigation or voice activation mode will be memorized for that system. The ICP communicates with the IAM on the medium speed CAN (controller area network) . The IAM converts control/command signals from the ICP and then distributes the information onto the MOST system to the audio system and other information and entertainment systems.

No configuration procedure is required if the ICP is replaced. There is no option to calibrate the ICP using the Land Rover approved diagnostic equipment.

Rear Seat Entertainment Module



M866142

The Rear Seat Entertainment (RSE) module is located in the rear RH side of the luggage compartment. The RSE module is an interface between the video and audio inputs from other system components and the video display and audio outputs.

The RSE module communicates with the audio systems via the MOST connection. Audio output from the DVD autochanger or the AVIO panel is processed by the RSE module and passed on the MOST ring to the audio amplifier to allow audio output to be played through the vehicle speakers or the headphones.

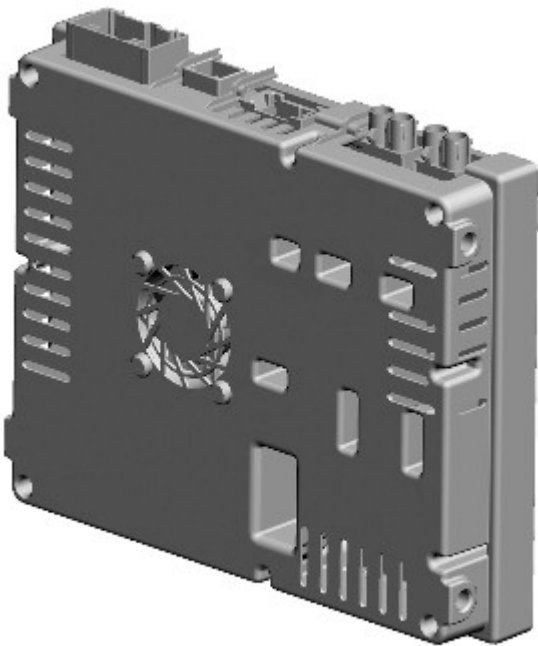
Video input from the TV tuner, DVD (digital versatile disc) autochanger and the Audio Video Input/Output (AVIO) panel is also processed by the module and passed to the two RSE LCD (liquid crystal display) screens and the TSD on separate video connections. The RSE module also controls the power supplies to the RSE LCD (liquid crystal display) screens and relays the infra-red remote control signals received by the RSE LCD (liquid crystal display) screen infra-red sensors to the DVD (digital versatile disc) autochanger. The infra-red signals are passed from the RSE LCD (liquid crystal display) screens to the RSE module on a bus system known as the IS bus.

The RSE module has two modes of operation; engine running mode and reduced operation mode. With the engine running the RSE module has full functionality. When the engine is not running the RSE module has reduced functionality to prevent excessive drain on the vehicle battery. The reduced functionality comprises a reduced audio volume and time limit on system operation.

The reduced audio volume is only active when the engine is not running. The audio volume is limited reduce battery consumption. If the volume was set at a higher level than this when the engine was running, when the engine is subsequently started, the volume level will gradually increase to the previously selected setting. This prevents the user being distracted by a sudden increase in volume.

The time limit operation is active when the ignition is off and the system is manually switched on using the TSD. The system will operate for a maximum of one hour. The battery voltage is continually monitored by the IHU. If the IHU detects that the battery voltage has fallen to a predetermined level, the IHU will shut the infotainment system down to prevent further battery drain. Once the system has shut down due to low battery voltage, it can only be restarted when the engine is running and the battery voltage has risen above the threshold level for more than one minute.

Television Tuner



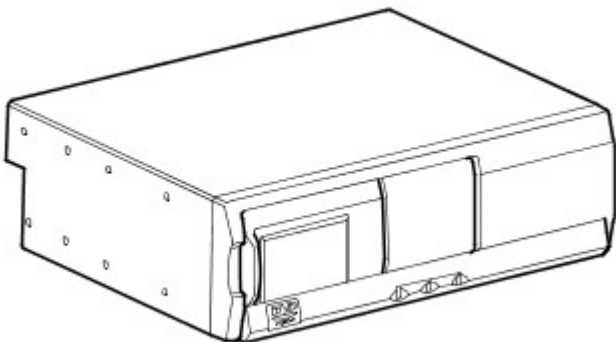
E128344

The television tuner module is located in the rear RH side of the luggage compartment. The television tuner is connected to the rest of the video system on the MOST bus. Audio and control signals are passed on the MOST bus while video is transmitted via a coaxial cable to the Touch Screen Display (TSD).

Television audio can be heard through the vehicle speakers and the remote control rear headphone modules. The audio will continue to be heard whilst the vehicle is moving, however the television picture will stop displaying once the vehicle starts to move.

- **NOTE:** The television tuner module is located beneath the RH front seat on Japanese specification vehicles.

DVD Autochanger



M866141

The DVD (digital versatile disc) autochanger is located in the rear RH side of the luggage compartment. The DVD (digital versatile disc) player is a six disc design which will accept DVD (digital versatile disc) movies, video CD (compact disc) (VCD) and music CD (compact disc) on CD-R or CD-RW. The discs are housed in a magazine to allow six discs to be stored in the unit. Additional magazines can be purchased to allow greater flexibility. The magazine is accessible via a sliding

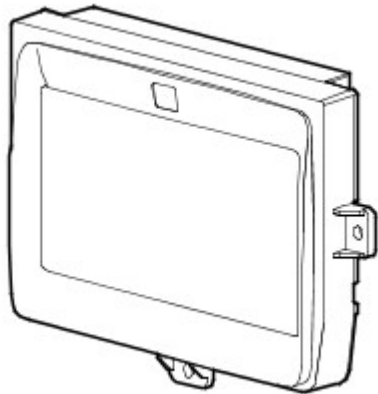
door on the front of the unit. An eject button, located behind the door automatically ejects the magazine from the unit when pressed.

The DVD (digital versatile disc) autochanger is operated using a remote control unit supplied with the vehicle. The remote control is an infra-red unit which transmits the infra-red signal to receivers located in each RSE LCD (liquid crystal display) screen.

The DVD (digital versatile disc) autochanger receives the remote control information from the RSE LCD (liquid crystal display) screens.

A Sony Philips Digital Interface Format (SPDIF) is used to output the audio from the DVD (digital versatile disc) autochanger to the audio amplifier. The SPDIF is an optical system connected between the DVD (digital versatile disc) autochanger and the audio amplifier. SPDIF is a standard audio file transfer format which allows the transfer of digital audio signals from one device to another without having to be converted first to an analog format which maintains the viability of the digital audio signal.

LCD Screens



M866194

The RSE LCD screens are located in the rear of the front seat head restraints. The screen is secured in the head restraint with three screws which are covered by a removable surround. The screen is a 6.5 inch, auto dimming, high resolution LCD (liquid crystal display) monitor, manufactured by Alpine

An infra-red receiver sensor is located centrally in the upper screen surround. The receiver sensor receives infra-red transmissions from the DVD (digital versatile disc) remote control and passes them to the DVD (digital versatile disc) autochanger, via the RSE module on a bus system known as the IS bus. All screen settings can be changed using the RSE remote control.

The screen should be cleaned with a lightly, water moistened cloth. Do not use chemical agents or domestic products to clean the screen or any part of the surround.

Each RSE LCD (liquid crystal display) screen is connected to the infotainment system using a 20 pin harness connector.

Remote Control



M866143

The remote control for operation of the DVD autochanger is a universal type. A switch on the rear of the control selects either the LH (left-hand) or RH (right-hand) screens and allows the individual settings for each screen to be changed as required. The switch has a central position which disables the remote control and prevents battery drain.

The remote control transmits an infra-red signal in response to operation of a button. The infra-red signal is received by a receiver sensor located on each RSE LCD (liquid crystal display) screen and is passed, via an IS bus to the RSE module and from the RSE module on an Alpine proprietary bus known as the Ai Net, to the DVD (digital versatile disc) autochanger. The remote control also allows selection of an auxiliary input from the AVIO panel (video or games console) or selection of audio (radio or CD (compact disc)).

The remote control is powered by two 'AAA' batteries located in the rear of the control and are accessible by removing a sliding cover. When inserting the batteries it is important that the battery polarity is observed as marked in the battery compartment. LED (light emitting diode) at the top left and right hand corner of the control indicates that the remote control is operating when a button is pressed. Only one LED (light emitting diode) will illuminate depending on which screen is selected. If the LED (light emitting diode) fails to illuminate when a button is pressed, the battery voltage may be low or the switch on the rear of the control may be set in the central 'off' position.

Remote Audio Controls



E48224

The second and third row seat passenger can use standard headphones to listen to audio from any of the sources fitted to the vehicle. These include:

- Television
- compact disc (CD)
- Radio
- DVD
- AUX Input

There are four remote audio control modules, two in the rear doors incorporating the rear window switches and two in the

rear load space each side of the third row seats.

The remote audio control modules allow the user to select which source to listen to. The remote controls cannot override what the driver has selected to listen to. If the driver is listening to a CD the rear passenger cannot control the CD player.

The remote audio control modules allow the user to alter the volume in the head phones, change track/disc up/down or repeat on a CD, change pre-set radio stations or tune up/down on the radio and television.

Video System - Video System

Diagnosis and Testing

Principle of Operation

For a detailed description of the video system and operation, refer to the relevant Diagnosis and Testing section of the workshop manual. REFER to: Video System (415-07 Video System, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Front touch screen display (TSD) installation and condition ● Rear seat entertainment (RSE) screen installation and condition ● Digital versatile disc (DVD) multi-changer installation and condition ● Television antennae (two in each rear side window) 	<ul style="list-style-type: none"> ● Fuses ● Electrical harnesses ● Fibre optic cable harnesses ● Infotainment relay ● Display screens ● DVD multi-changer ● Television tuner module ● RSE module ● Television antenna amplifiers (4) ● Remote control and batteries

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
The DVD does not operate	<ul style="list-style-type: none"> ● DVD multi-changer fuse blown ● No power to display screens ● Condensation 	Check the DVD circuits for a short circuit causing fuse failure and rectify as necessary. Refer to the electrical guides. Check for power to the display screens, rectify as necessary. Refer to the electrical guides. Wait at least one hour for the condensation to dry out.
Remote control operation is unstable	<ul style="list-style-type: none"> ● Handset batteries low on power ● Remote control receiver sensor or transmitter is dirty 	Check and renew the batteries as necessary. Check and clean the receiver and transmitter as necessary.
There is no picture	<ul style="list-style-type: none"> ● The display screen is set to an incorrect mode 	Use the switch on the back of the handset to select the correct mode.
Playback does not start	<ul style="list-style-type: none"> ● Disc is loaded upside-down ● An incorrect format of disc is loaded ● Parental lock is set ● The setup menu is displayed 	Check that the disc is correctly loaded. Check that the disc format is compatible. Cancel parental lock or check the rating of the disc. Press SET for at least 2 seconds to turn the setup menu off.
The picture is unclear or noisy	<ul style="list-style-type: none"> ● The disc is being fast forwarded or rewind ● The vehicle battery power is low 	The picture may be slightly distorted in fast forward or rewind modes. Check the vehicle battery condition and state of charge.
The image "freezes"	<ul style="list-style-type: none"> ● The disc is scratched 	Load an undamaged disc.
NO MAG is displayed	<ul style="list-style-type: none"> ● There is no magazine loaded into the DVD multi-changer 	Load a magazine.
NO DISC is displayed	<ul style="list-style-type: none"> ● There is no disc loaded into the magazine ● The disc is dirty 	Load a disc into the magazine. Clean the disc as necessary.

Symptom	Possible Causes	Action
REGIONAL CODE VIOLATION is displayed	<ul style="list-style-type: none"> The disc loaded does not match the regional code number 	Load a disc which matches the regional code number.
VIDEO SIGNAL IS NOT CORRECT is displayed	<ul style="list-style-type: none"> An NTSC disc is loaded into a PAL system, or vice versa 	Load a disc of the correct format.
HI TEMP is displayed	<ul style="list-style-type: none"> The system protective circuit is activated as it has detected a high temperature 	Turn the power OFF on the unit and then back on again. If the display does not clear, leave the power off until the temperature decreases and turn the power ON again.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Television Control Module \(TVM\)](#) (100-00 General Information, Description and Operation).

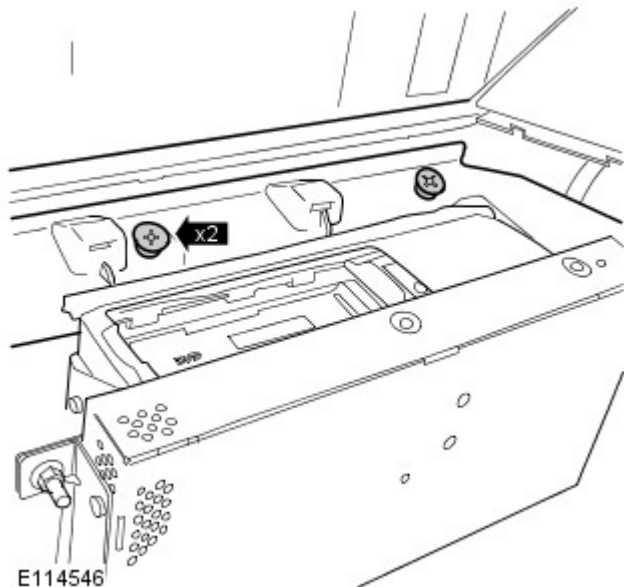
Video System - Digital Versatile Disc (DVD) Player

Removal and Installation

Removal

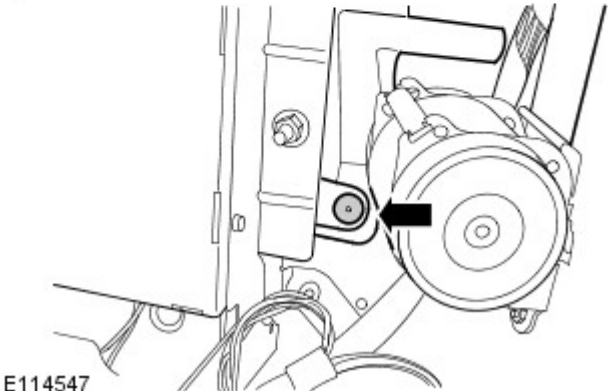
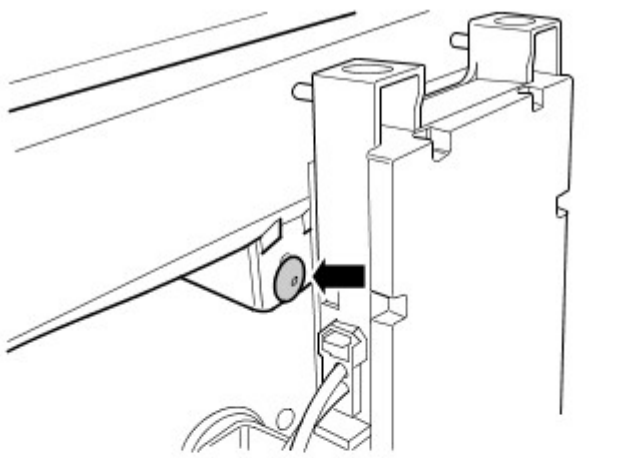
1. Remove the RH rear quarter trim panel.
For additional information, refer to: [Loadspace Trim Panel RH](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Release the rear quarter trim panel mounting bracket.

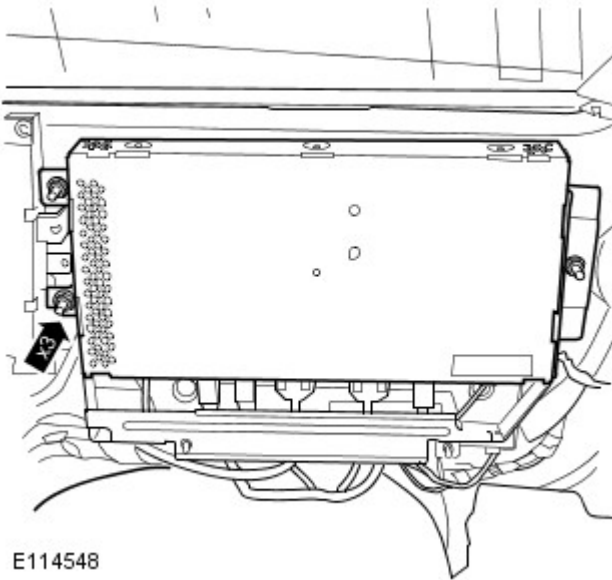
- Remove the 2 screws.




3. Remove the rear quarter trim panel mounting bracket.

- Release the 2 clips.



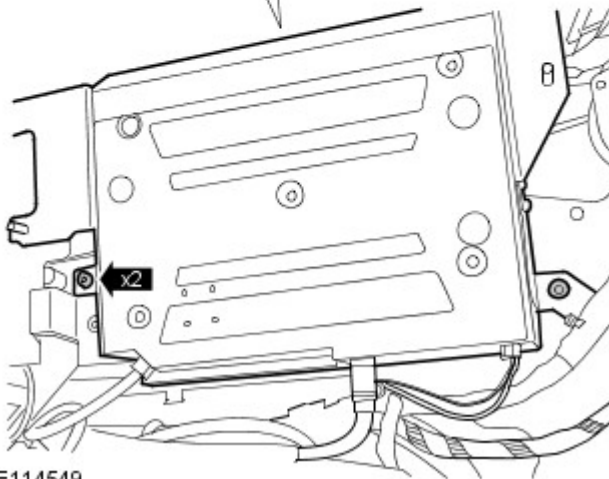
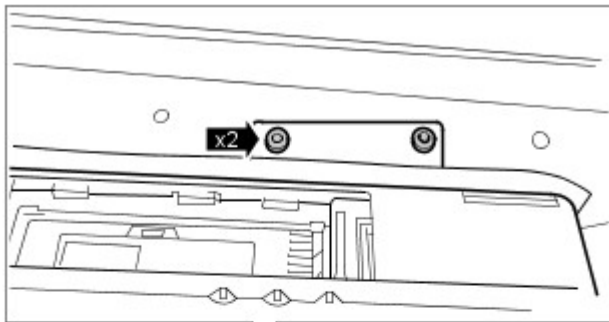


E114548

4.  CAUTION: Make sure that the fiber optic cables are not bent to a radius of less than 25 mm.

Release the rear seat entertainment module.

- Remove the 3 nuts. TORQUE: 10 Nm
- Position aside.



E114549

5. Release the DVD player from the body.

- Remove the 4 Torx bolts.

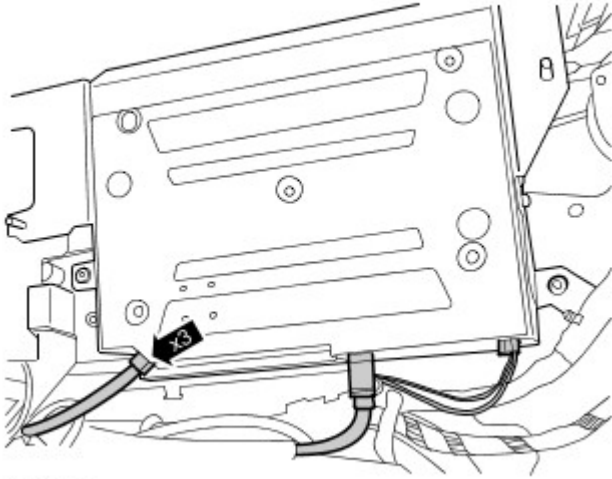
6. CAUTIONS:

 Make sure that the fiber optic cables are not bent to a radius of less than 25 mm.

 Make sure that the optical connectors are clean and free of foreign material.

Remove the DVD player.

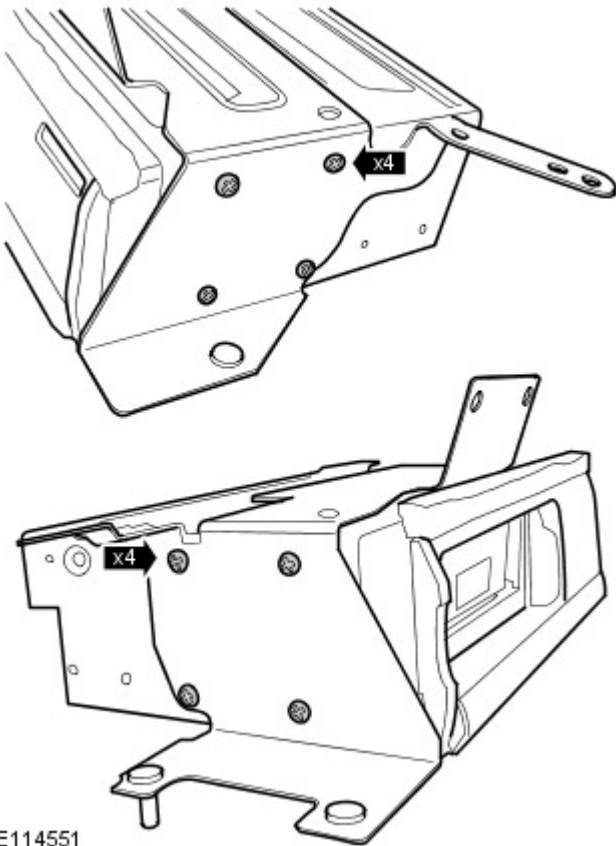
- Disconnect the 3 electrical connectors.



E114550

7. Remove the DVD player mounting bracket.

- Remove the 8 screws.



E114551

Installation

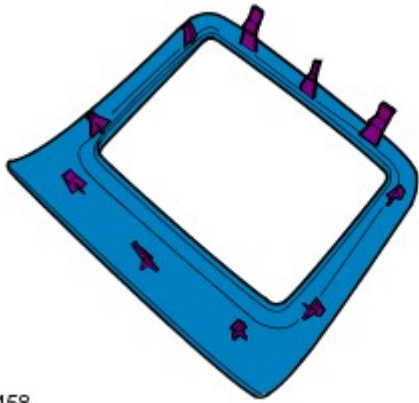
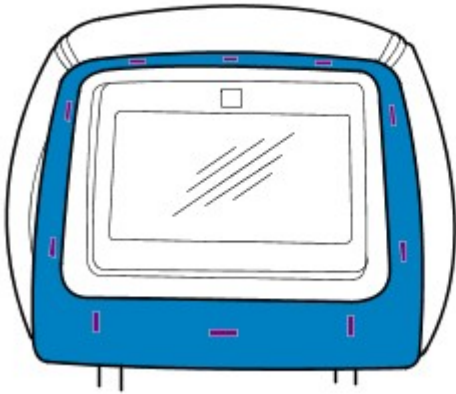
1. To install, reverse the removal procedure.

Video System - Video Display

Removal and Installation

Removal

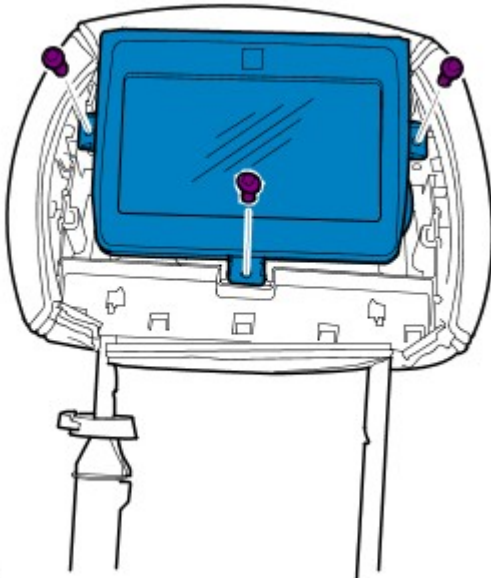
1. Remove the screen surround.



E93458

2. Release the video display.

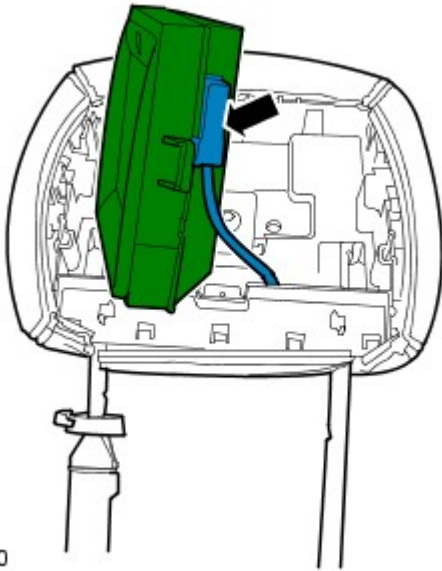
- Remove the 3 Torx screws.



E93459

3. Remove the video display.

- Disconnect the electrical connector.



E93460

Installation

1. To install, reverse the removal procedure.

Exterior Lighting -

Sealants

Item	Land Rover Kit Part No.	
High mounted stop lamp (HMSL) sealant	BHM 705L	
Bulb	Type	Rating
* Halogen headlamps - Low beam	Halogen H7	55W
* Halogen headlamps - High beam	Halogen H7	55W
+ * Xenon headlamps - Low/High beam	Xenon D2S	35W
Front fog lamps	Halogen H11	55W
Rear fog lamps	Bayonet	21W
Turn signal indicators - Front	Bayonet	21W
Turn signal indicators - Rear	Bayonet	21W
Turn signal indicators - Side Repeaters	Capless	5W
Side lamps - Front	Bayonet	5W
** Stop/Tail lamps	Bayonet - Twin filament	21W/5W
High mounted stop lamp (HMSL)	LED's	-
License plate lamps	Festoon	5W
Reverse lamps	Bayonet	21W
Cornering lamp/Static bending lamp	Halogen H8	35W
NAS - Side marker lamps - front/rear	Capless	3W



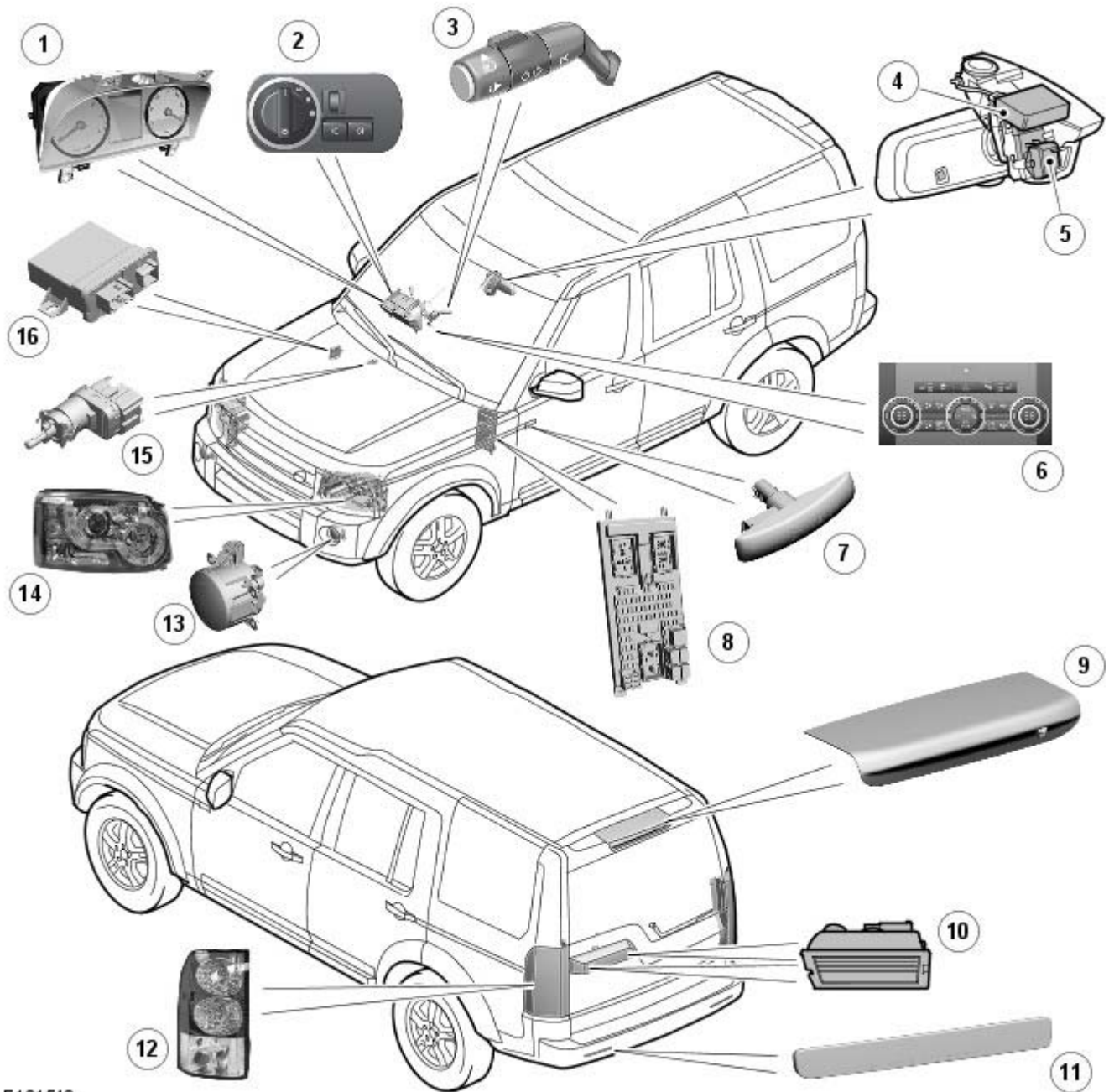
WARNING: + Refer to the General Information - Electrical Precautions section of this manual prior to carrying out any procedures on the Xenon headlamp system fitted to certain vehicles.

- NOTE: * NAS vehicles - Cornering lamps are not fitted to these vehicles.
- NOTE: ** Note: 21W filament is not functional on lower tail lamp.

Exterior Lighting - Exterior Lighting

Description and Operation

Exterior Lighting Component Location



E121548

Item	Part Number	Description
1	-	Instrument cluster
2	-	Lighting control switch
3	-	Left Hand (LH) steering column multifunction switch
4	-	Rain/light sensor
5	-	Auto high beam control module and image sensor
6	-	Hazard warning lamp switch
7	-	Side repeater turn signal indicator lamp
8	-	Central Junction Box (CJB)
9	-	High mounted stop lamp
10	-	License plate lamps
11	-	Reflector
12	-	Rear lamp assembly
13	-	Front fog lamp
14	-	Headlamp assembly
15	-	Stop lamp switch
16	-	Adaptive Front lighting System (AFS) control module

GENERAL

The exterior lighting system comprises the following exterior lamps:

- Front and rear side lamps
- License plate lamps
- Side marker lamps (if fitted)
- Front and rear turn signal indicator lamps
- Side turn signal indicator lamps
- Stoplamps and high mounted stop lamp
- Reversing lamps
- Rear fog lamps
- Front fog lamps (if fitted)
- Cornering/Static bending lamps (if fitted) - All except NAS
- Low and high beam headlamps.

Exterior Bulb Type/Rating and LED Table

The following table shows the bulbs/LED's used for the exterior lighting system and their type and specification (where applicable).

Bulb	Type	Rating
Halogen Headlamps - Low beam	Halogen H7	55W
Xenon headlamps - Low/High Beam	Xenon D3S	35W
Headlamps - High Beam	Halogen H7	55W
Front fog lamps	Halogen H11	55W
Rear fog lamps	Bayonet P21	21W
Turn signal indicator lamps - Front	PY24W	24W
Side repeater turn signal indicator lamps	Capless W5W	5W
Turn signal indicator lamps - Rear	12 LED's	-
Side lamps - Front - Xenon headlamps	10 LED's	-
Side lamps - Front - Halogen headlamps	Capless W5W	5W
Stop lamps	12 LED's	-
Side lamps - Rear	12 LED's (each side lamp)	-
High mounted stop lamp	LED's	-
License plate lamps	Capless W5W	5W
Reverse lamps	Bayonet P21	21W
Cornering lamp/Static bending lamp	Halogen H8	35W
NAS - Side marker lamp - Front	Capless W3W	3W
NAS - Side marker lamp - Rear	Capless W5W Rear	5W

The bulbs and the Light Emitting Diode (LED)'s are driven by Metal Oxide Semiconductor Field Effect Transistors (MOSFET's) within the Central Electronics Module (CEM) which is an integral component of the Central Junction Box (CJB). An exception to this is the front and rear position lamps, front fog lamps and the reversing lamps which are supplied with power via relays within the CJB and are protected by conventional fuses.

CENTRAL JUNCTION BOX

The CJB is located behind the glove compartment and is connected to the vehicle wiring harness with 8 multiplugs.

The CJB receives four permanent battery power supplies via the Engine Junction Box (EJB).

The lighting circuits are not all protected by conventional fuses as some are protected by MOSFET's. The control circuitry within the CJB for each individual circuit can detect and isolate a problem circuit.

Failure of a lamp is not notified to the driver. If a turn signal indicator fails the turn signal warning indicator in the instrument cluster will flash at double speed.

Input Signals for Lamp Control

The CJB receives inputs from the following switches:

- Lighting control switch for side lamps, headlamps and auto headlamps (if fitted)
- Momentary push switches for front and rear fog lamps
- Left hand steering column multifunction switch for turn signal indicators and high beam/headlamp flash and Auto High Beam system
- Brake pedal switch
- Momentary push switch for hazard warning.

The switches are supplied with a 10mA supply from the CJB and switch to ground when operated. The CJB detects that a switch has been operated (ON) when its closing resistance is less than 100 Ohm and is detected as OFF when its resistance is more than 10K Ohm.

The lighting control switch uses a binary system which is detected by the CJB which determines the selected position. The output from the lighting control switch is shown in the following table:

Switch State	Switch 1	Switch 2
Off	1	1
Side lamps	1	0
Headlamps	0	0
Auto headlamps	0	1

The CJB also receives ignition status via hard wired connections from the stop/start switch.

A reverse gear engaged signal is also received on the high speed Controller Area Network (CAN) bus from the Transmission Control Module (TCM) to enable the CJB to activate the reverse lamps.

The CJB can receive a hazard warning indicator activation message from the Restraints Control Module (RCM), via the high speed CAN bus, in the event of a crash. The CJB can also activate the hazard warning indicators to signify vehicle locking to the driver.

On vehicles with Auto High Beam, the auto high beam control module outputs signals on the medium speed CAN bus to the CJB to control the high beam headlamps. Power for the auto high beam control module is supplied via a relay located in the EJB.

Circuit Protection

Operation of the lamps is performed using overload proof Metal Oxide Semiconductor Field Effect Transistors (MOSFETs). The MOSFETs can detect overload, load interruption with the lamps switched on and short circuit to positive with the lamps switched off.

The MOSFETs are protected against short circuits, removing the requirement for the lamps circuits to be protected by fuses. The MOSFETs respond to heat generated by increased current flow caused by a short circuit. Normally this would cause the fuse to blow. The MOSFETs react to the heat increase and cut the supply to the affected circuit. Once the fault has been rectified or the MOSFET has cooled, the MOSFET will automatically reset and operate the circuit normally.

If an overload occurs, the current flow is dependant on the temperature of the related MOSFET and can be up to 20 times the rated current of the lamp. The MOSFET heats up and deactivates the load applied to the circuit. When the MOSFET cools the circuit is once again reactivated. This thermal cycling occurs continuously in the event of an overload occurring.

A number of lamps are controlled by relays and these circuits are protected by conventional fuses.

Bulb Monitoring

Bulb failure monitoring is performed by the CJB processor. The lamps are cold and warm monitored by the MOSFETs in order to detect bulb failure.

- **NOTE: Relay controlled lamps have no diagnostic monitoring.**

The CJB processor provides outputs to each MOSFET. The output switches the MOSFET to supply the required output to power the applicable lighting circuit. The microprocessor evaluates the circuits by detecting the returned signals from the controlling MOSFET.

When the bulb or LED is functioning normally, the output signal voltage from the controlling MOSFET is 0V. If a bulb or LED in the circuit fails, an open circuit occurs and the MOSFET outputs a signal of 5V to the processor. The signal is interpreted as a bulb or LED failure and generates a Diagnostic Trouble Code (DTC) which can be retrieved using an approved Land Rover diagnostic system.

Warm monitoring is performed continuously when the lights are switched on by evaluating the diagnostic output of the MOSFET switches. Cold monitoring is performed at 32 second intervals when the lights are switched off. The MOSFETs briefly switch on the lights for approximately 1 millisecond (this is insufficient to illuminate the bulb or LED) and checks the bulb or LED as per warm monitoring.

Cold monitoring is not possible for the low/high beam headlamps of vehicles using xenon bulbs. On these vehicles the cold monitoring of the low/high beam headlamps is switched off in the CJB. The CJB detects a failed xenon bulb via a reduction in current flow to the affected headlamp's xenon control module.

When a xenon bulb fails, the control module's current consumption falls to 60mA, which the CJB detects as unsuccessful bulb illumination.

Alarm Indications

The CJB can also display alarm visual indications for alarm arm, disarm and triggered conditions.

If the hazard warning lamps are active when a lock or unlock request is made, the hazard warning cycle is interrupted to allow the visual indication of the requested lock cycle. When visual indication is completed, the hazard warning operation will continue.

If the vehicle is involved in crash of a severity for the RCM to initiate deployment of the airbags, the control module outputs a hazard warning lamps on request on the medium speed CAN bus to the CJB. The hazard warning lamps will be activated and will continue until the RCM outputs a message to deactivate the hazard warning lamps.

Redundant Data Storage

The CJB stores data relating to the Vehicle Identification Number (VIN), total mileage and service interval indicator. This data is received by the CJB from the instrument cluster and used as a back-up in the event of instrument cluster replacement.

If the CJB is to be replaced, an approved Land Rover diagnostic system must be connected to the vehicle and the CJB replacement procedure followed to ensure that the stored data is transferred to the new unit.

Low Voltage Operation

If the battery voltage falls below 11.2V, the CJB operates the minimum lighting to preserve the remaining battery charge.

Crash Signal Activation

In the event of an accident of a severity to activate and deploy the airbags, the RCM requests various electrical operations to assist with the crash situation. The RCM requests via the bus systems to the CJB to activate the hazard warning lamps.

Security System Activation

In the event of the security system being triggered, the CJB requests activation of the hazard warning lamps.

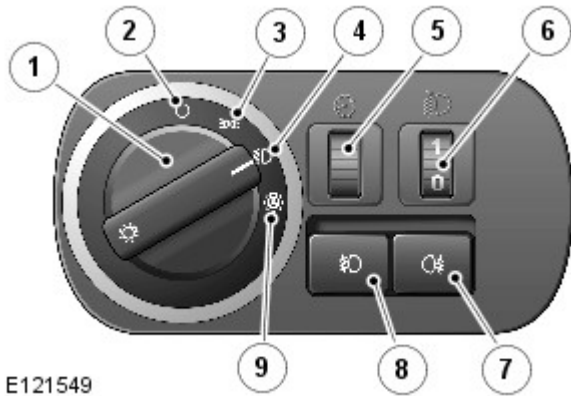
Instrument Panel and Switch Illumination Dimming

The CJB controls the instrument cluster backlighting illumination and also illumination of all instrument panel switches.

The CJB supplies a power output to all switch illumination bulbs at a voltage determined by the position of the manual dimmer rheostat. The switch illumination is activated when the lighting control switch is in the side lamp or headlamp position.

LIGHTING CONTROL SWITCH

The lighting control switch is located in the driver's side of the instrument panel, below the outer fresh air vent. The switch contains a rotary switch for selecting the vehicle exterior lighting functions, a rheostat for instrument illumination dimmer, a front fog lamp switch and a rear fog lamp switch.



E121549

Item	Part Number	Description
1	-	Lighting rotary control switch
2	-	OFF position
3	-	Side lamps position
4	-	Headlamps position
5	-	Instrument illumination dimmer control
6	-	Headlamp leveling control (if fitted)
7	-	Rear fog lamp switch
8	-	Front fog lamp switch
9	-	Auto headlamps position

The rotary side and headlamp control switch has 2 connections to the CJB. These 2 connections supply a hardwired binary code to the CJB which correspond to the switch position selection made.

The front and rear fog lamp switches operate by completing earth paths for a reference voltage from the CJB when the switch is pressed. The fog lamp switches are momentary, non-latching switches which briefly complete an earth path which is sensed by the CJB.

Lighting Control Switch Illumination

The switch legends on the lighting control switch are illuminated at the same brightness as the instrument panel switches when the lighting control switch is moved from the 'O' (off) position to the side, headlamp or AUTO position.

Manual Headlamp Leveling Control (if fitted)

The manual headlamp leveling control is only available on vehicles with coil spring suspension and is used to lower the headlamps when an excessive load is placed on the rear of the vehicle, altering the vehicle attitude and raising the headlamp beam.

The control uses a rotary thumbwheel which is connected to a rheostat which gives a variable output to the leveling Direct Current (DC) motors. The motors respond to the output and move to adjust the headlamp position as required.

The control has three marked positions; 0 to 3. The rotary wheel moves in 6, half positions to give fine adjustment control over the headlamp position. The positions relate to vehicle loading or driving conditions as follows: Position 0 is the normal position for unladen driving. Positions 1 to 3 lower the headlamp beam to compensate for a drop in height of the rear of the vehicle.

- 0 = Driver only or driver and front seat passenger
- 0.5 = Driver, front seat passenger
- 1 = All seats occupied
- 1.5 = All seats occupied and maximum rear axle loading
- 2 = Driver only and maximum rear axle loading
- 3 = Can be used under certain driving conditions, i.e. off-road

Dimmer Control

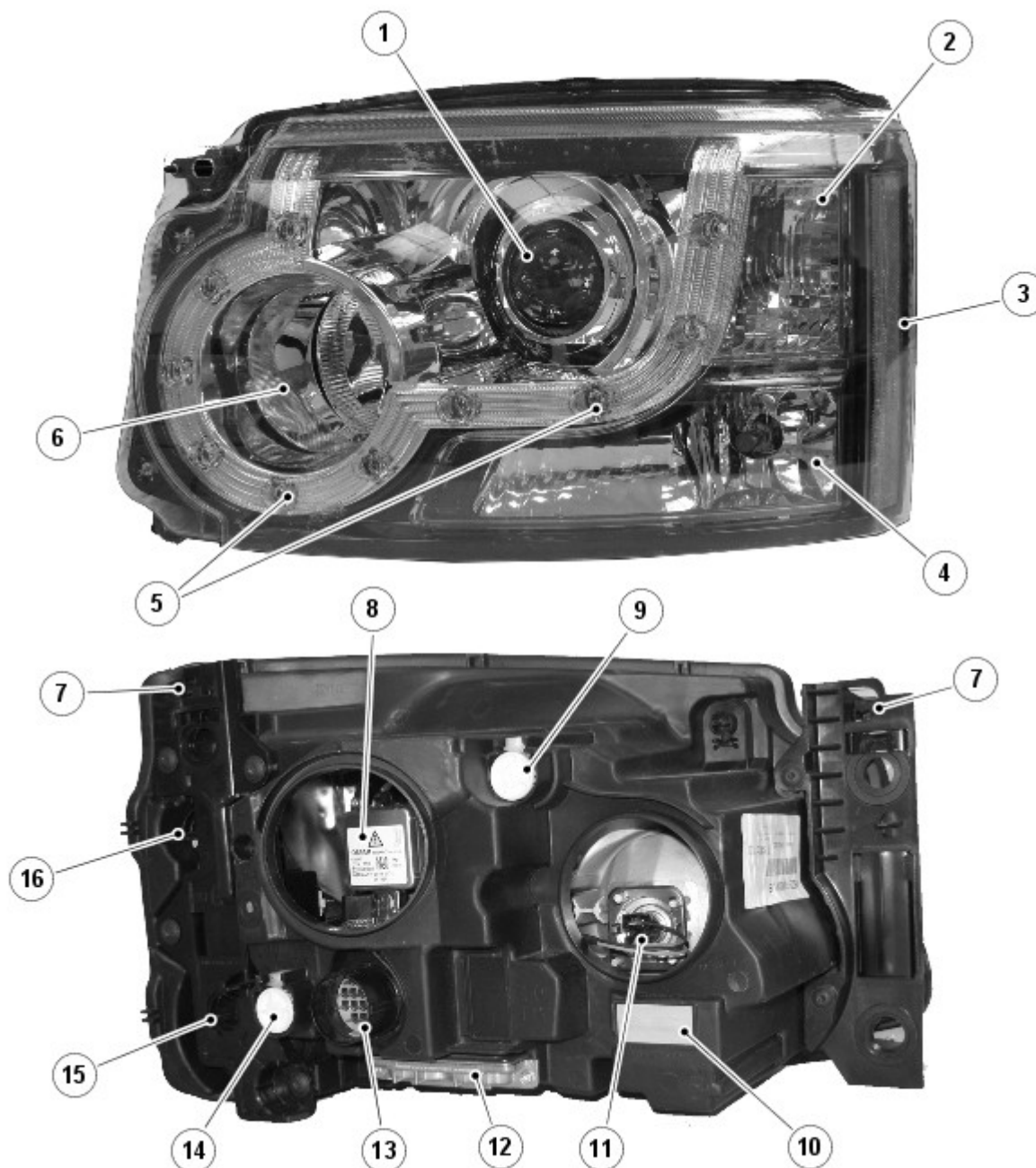
The CJB provides a Pulse Width Modulation (PWM) output to control the illumination brightness of the instrument panel and other fascia illumination. The dimmer switch operates using a rotary thumbwheel which is connected to a rheostat.

The rheostat is a variable resistor which provides a high or low resistance according to its set position. The CJB provides an output to the rheostat measure the voltage passing through to ground. The CJB measures this voltage and uses it to calculate a PWM output of between 8 and 12V to determine the brightness of the illumination.

Automatic Headlamps

Refer to Automatic Headlamps in this section.

HEADLAMP ASSEMBLY



E121550

Item	Part Number	Description
1	-	Low beam headlamp
2	-	Turn signal indicator lamp
3	-	Side marker lamp (NAS only)
4	-	Side lamp (halogen headlamps), cornering lamp (Xenon headlamps) or cornering/static bending lamp (AFS headlamps)
5	-	Side lamp LED's (xenon headlamps only)
6	-	High beam halogen 'fill-in' headlamp
7	-	Locking plate
8	-	Low beam halogen bulb (halogen headlamps) or xenon bulb (xenon headlamps)
9	-	Vertical adjuster
10	-	Waterproof breather
11	-	High beam 'fill-in' lamp bulb
12	-	Xenon control module (not fitted to halogen headlamps)
13	-	Electrical connector
14	-	Horizontal adjuster
15	-	Side lamp or cornering/static bending lamp cover (hidden)
16	-	Turn signal indicator lamp access cover (hidden)

Three types of headlamp are available; Halogen, Xenon or Xenon with Adaptive Front lighting System (AFS). The headlamps share a common, clear lens.

The headlamps are located behind the front carrier assembly. Each headlamp is secured to the front carrier assembly with two locking plates. The locking plate slides in grooves in the rear of the headlamp and two holes in each plate locate on pins on the carrier. Each locking plate is pressed down to lock the pins in the locking plate holes. The locking plates allow removal of the headlamp from the carrier for bulb changing without the requirement for special tools.

The rear of the headlamp unit has removable access panels which allow access to the bulbs for replacement. A large rubber cover allows access to the low/high beam bulb on both halogen and xenon headlamps. Another removable rubber cover provides access to the high beam only halogen bulb which is retained by a push fit. A smaller cover can also be rotated anti-clockwise to provide access to the turn signal indicator lamp bulb. The indicator bulb is a PH24WY orange bulb and is clipped into the cover and is pulled to remove. Below this cover is a removable cover which provides access to the side lamp bulb on halogen headlamps or the cornering lamp/static bending lamp bulb on xenon headlamps and the side marker lamp bulb on NAS models. On xenon headlamps the side lamps are LED's and therefore are not serviceable components.

The headlamps have two adjustment screws on the rear which allow for the manual setting of the vertical and horizontal alignment. On NAS vehicles the headlamp is regarded as Visual Optically Left (VOL) aiming. The adjustment screws have to be turned equal amounts to maintain the correlation in the vertical axis only. There is no horizontal adjustment. Refer to the Service Repair Procedures manual for headlamp alignment data.

Each headlamp has an integral sixteen pin connector which provides inputs and outputs for the various functions of the headlamp assembly. The usage of the pins differs between model variants, refer to the Electrical Reference Library (ERL) for pin details.

The low beam headlamps are switched on when the ignition is in ignition mode 6 and:

- the lighting control switch is in the headlamp position
- the lighting control switch is in the AUTO position and a 'lights on' signal is received by the CJB from the rain/light sensor.

The low beam headlamps can also be operated by the headlamp delay feature.

The high beam headlamps are switched on when the ignition is in ignition mode 6 and:

- the low beam headlamps are selected on in the headlamp position or activated via the AUTO feature
- The left hand steering column multifunction switch is pushed forward away from the driver
- The auto high beam system (if fitted) has switched on the high beam headlamps.

The high beam headlamps will be switched off when:

- The left hand steering column multifunction switch is moved rearward towards the driver
- The low beam headlamps are switched off
- The ignition mode is changed to the accessory mode 4 or ignition off
- The auto high beam system (if fitted) has switched off the high beam headlamps.

Common Headlamp Features

Turn Signal Indicator Lamp

The turn signal indicator lamp is incorporated into the outer part of the headlamp assembly. The lamp is located above the side lamp on halogen headlamps and the static bending/cornering lamp on Xenon headlamps. The turn signal indicator lamp uses an PH24W orange colored bulb module. The module is fitted into a holder which is connected via contacts on the headlamp housing to the main connector in the headlamp housing. The module is a snap fit in the holder and needs to be pulled sharply to remove. The holder is fitted with a seal and is located into an aperture in the headlamp housing and rotated to lock into position. Access to the holder requires removal of the headlamp from the front carrier assembly and removal of the outer locking plate from the headlamp.

The turn signal indicator lamps are operated by the left hand steering column multifunction switch or by the hazard flasher switch. The steering column multifunction switch is only active with the ignition in ignition mode 6, the hazard flasher switch is active at all times. When active, the turn signal indicator lamps will flash at a frequency cycle of 400ms on and 400ms off.

If a bulb fails, the remaining turn signal indicator lamps bulbs continue to flash at normal speed. The turn signal indicators in the instrument cluster will flash at double speed to indicate the failure to the driver.

Side Lamp - Halogen Headlamps

The side lamp is incorporated into the outer part of the headlamp assembly and is located below the turn signal indicator lamp.

The side lamp uses a capless W5W wedge fitting bulb which locates into a holder which is connected via wires to the main connector on the headlamp housing. The holder is a push fit into a receptacle in the headlamp housing. The bulb is accessible via a removable cover at the rear of the headlamp housing. Access to the cover requires removal of the headlamp from the front carrier assembly and removal of the outer locking plate from the headlamp.

The side lamps are operated by selecting side lamps or headlamps on the lighting control switch. The side lamps are operational at all times and are not dependant on the ignition switch position. The side lamps will also be illuminated when the lighting control switch is in the AUTO position and a 'lights on' signal is received by the CJB from the rain/light sensor.

Side Lamp - Xenon Headlamps

The side lamps on all Xenon headlamps are LED's. The 10 LED's are arranged around the outer part of the halogen fill-in lamp and the xenon projector module.

The side lamps are operated by selecting side lamps or headlamps on the lighting control switch. The side lamps are operational at all times and are not dependant on the ignition switch position. The side lamps will also be illuminated when the lighting control switch is in the AUTO position and a 'lights on' signal is received by the CJB from the rain/light sensor.

Cornering Lamp - Xenon (non-AFS headlamps only)

- **NOTE:** The cornering lamps are not fitted to NAS market vehicles

The cornering lamps are an optional feature designed to illuminate the direction of travel when cornering at low speeds. The design of the lens projects a spread of light from the vehicle at approximately 45 degrees to the vehicle axis.

The cornering lamp is incorporated into the outer part of the headlamp assembly and shares the same housing and reflector as the side lamp.

The cornering lamp uses a 35W Halogen H8 bulb which locates in a holder which is connected on the headlamp housing. The holder is located in an aperture in the headlamp housing and rotated to lock. The bulb is accessible via a removable cover at the rear of the headlamp housing.

The cornering lamps are controlled by the left hand steering column multifunction switch with the lighting control switch in the headlamp position and the ignition in ignition power mode 6. The cornering lamps are supplied power via the ignition circuit to ensure that they do not function with the headlamp delay feature. The cornering lamps are deactivated if the vehicle speed exceeds 25 mph (40 km/h).

Only one cornering lamp will illuminate at any one time. If the left hand turn signal indicators are selected on, the left hand cornering lamp will be illuminated and visa versa, providing the vehicle speed and lighting control switch positions are correct. Cornering lamps are disabled when reverse gear is selected.

Cornering/Static Bending Lamps (Xenon AFS headlamps only)

- **NOTE:** The cornering/static bending lamps are not fitted to NAS market vehicles

The cornering/static bending lamps are a standard feature on AFS headlamps designed to illuminate the direction of travel when cornering at low speeds. The design of the lens projects a spread of light from the vehicle at approximately 45 degrees to the vehicle axis. The static bending lamps are powered by the CJB and controlled by the AFS control module. The cornering lamp functionality is controlled by the CJB as described for non-AFS headlamps.

The cornering lamp and static bending lamp is incorporated into the outer part of the headlamp assembly.

The cornering/static bending lamp uses a 35W Halogen H8 bulb which locates in a holder which is connected via wires to the main connector on the headlamp housing. The holder is located in an aperture in the headlamp housing and rotated to lock. The bulb is accessible via a removable cover at the rear of the headlamp housing.

AFS Control

On headlamps with AFS, the cornering lamp function is as described previously for the Xenon non-AFS headlamps.

The static bending lamps operate with a steering angle sensor signal which is received by the AFS control module. The AFS control module sends a static bending lamp on request to the CJB which activates the static bending lamp bulb.

The static bending lamp operation is variable with the speed of the vehicle and the steering wheel angle. The static bending lamps illuminate at 0 mph (0 km/h) when the steering wheel rotation reaches 20 degrees. At 43 mph (70 km/h) the static bending lamps will illuminate when the steering wheel angle reaches 10 degrees. The static bending lamps will be switched off when the vehicle speed exceeds 43 mph (70 km/h).

The operation of the static bending lamps is controlled by the AFS control module. When the operation parameters of the lamp are reached, the CJB fades the static bending lamp bulb on using a PWM voltage over a period of approximately 2 seconds. When the lamp is switched off, the CJB fades the bulb off by decreasing the PWM voltage.

Halogen Headlamps

The halogen headlamps use a projector module for the low beam headlamp and a complex surface reflector for the halogen high beam lamp. The low and high beam bulbs are quartz halogen H7, with a rating of 55W. The bulbs are retained in the headlamp unit with conventional wire retaining clips.

The projector module comprises a reflector, the lens and the halogen bulb. The projector module only operates as a low beam halogen headlamp.

The high beam lamp reflector is divided into separate parabolic segments, with each segment having a different focal length.

The halogen headlamp uses a side lamp bulb which is located in the position used by the cornering/static bending lamp on xenon headlamps. The lens pattern for the side lamp in this position differs from the lens pattern used for the cornering/static bending lamp.

The halogen headlamps do not require adhesive decals to be applied to the clear outer lens to mask the beam cut-off when driving in opposite drive hand markets. A tourist lever mechanism is located on the right hand side of the projector module. This mechanism moves to blank off a portion of the beam spread to enable the vehicle to be driven in opposite drive hand markets without applying blanking decals to the headlamp lens. The beam is changed by removing the access cover at the rear of the lamp assembly and moving a small lever located near the bulb holder, at the side of the projector module. Make sure that the headlamps are off before removing the access cover.



CAUTION: This lever can be very hot if the lamps have been operating. Allow sufficient time to cool before operating the lever.

Xenon Headlamps

Safety Precautions

⚠ WARNING: The Xenon system generates up to 28000 volts and contact with this voltage could lead to fatality. Make sure that the headlamps are switched off before working on the system.

The following safety precautions must be followed when working on the xenon headlamp system:

- **DO NOT** attempt any procedures on the xenon headlamps when the lights are switched on.
- Handling of the D3S Xenon bulb must be performed using suitable protective equipment, e.g. gloves and goggles. The glass part of the bulb must not be touched.
- Only operate the lamp in a mounted condition in the reflector.

The xenon headlamps use a complex surface reflector for the Halogen fill in high beam lamp only lighting unit, which is of the same design as the high beam unit used on the Halogen headlamps. This type of reflector has the reflector divided into separate parabolic segments, with each segment having a different focal length.

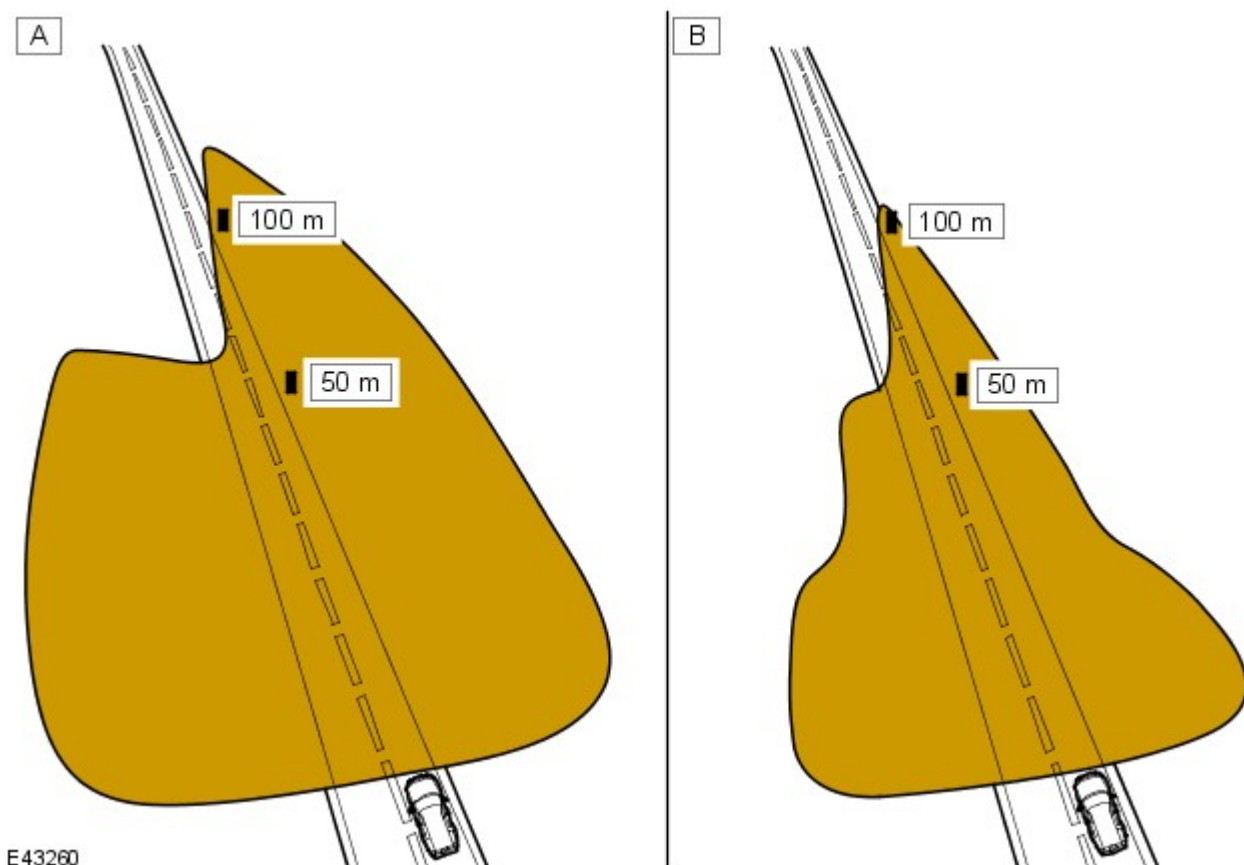
The high beam bulbs are quartz halogen H7, with a rating of 55W. The bulbs are retained in the headlamp unit with conventional wire retaining clips.

The Bi-Xenon™ (the Bi-Xenon™ trademark is the property of Hella KGaA Hueck & Co., Germany) projector module headlamp operates as both low beam and high beam headlamp unit. The Xenon lamp (or High Intensity Discharge (HID) lamp), comprises an ellipsoidal lens with a solenoid controlled shutter to change the beam output from low to high beam. The bulb is retained with a locking ring which must be rotated to facilitate removal of the D3S bulb.

• **NOTE:** If the lighting control switch is in the OFF position, the xenon lamps do not operate when the high beam 'flash' function is operated. If the lighting switch is in the headlamps position or AUTO position with the low beam lamps active, the xenon low beam will remain on when the high beam 'flash' function is operated.

The xenon headlamp system is controlled by the CJB using a control module for each headlamp and an igniter. The control modules and the igniters provide the regulated power supply required to illuminate the xenon bulbs through their start-up phases of operation.

Xenon/Halogen Headlamp Beam Comparison



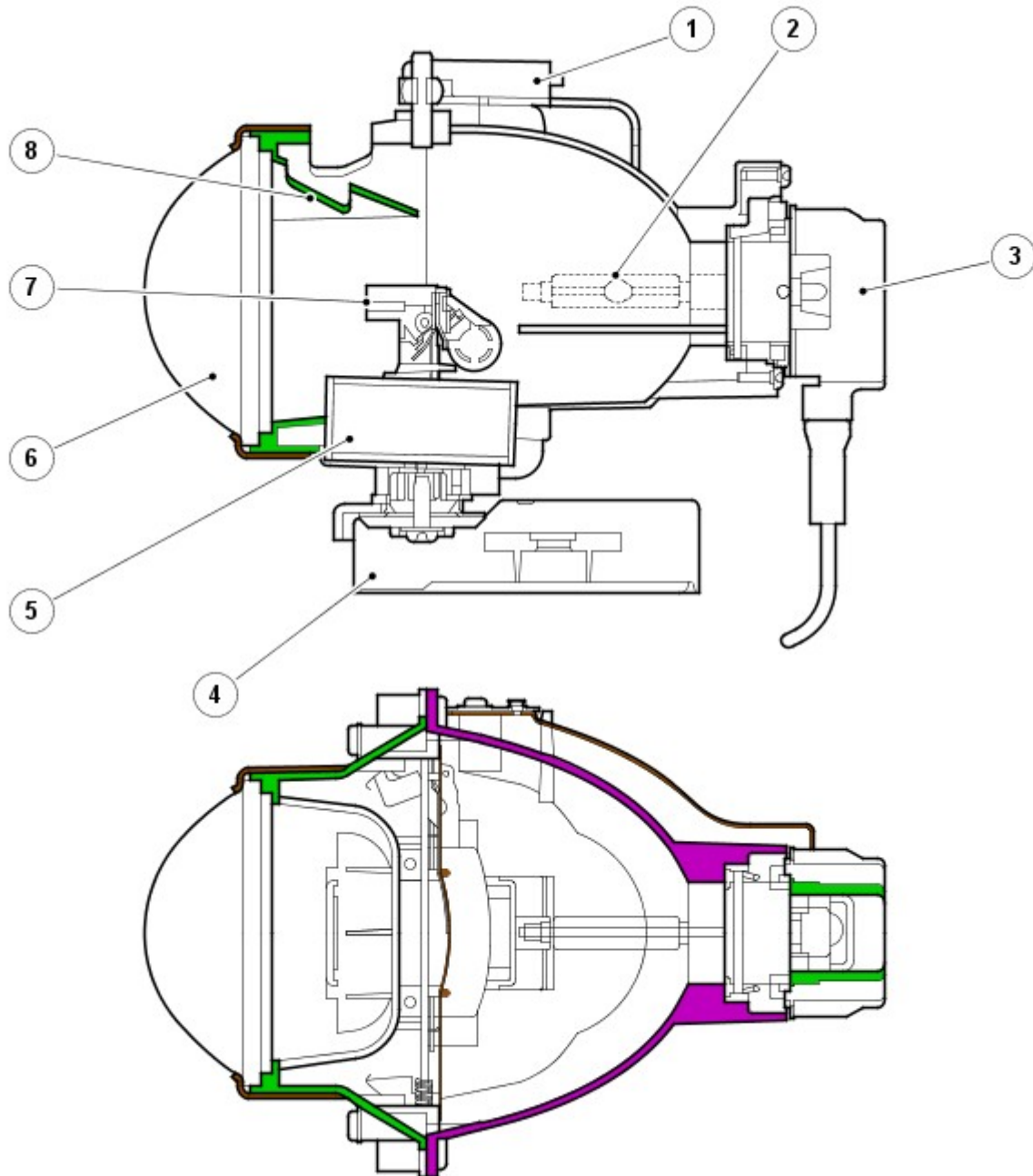
Item	Part Number	Description
A	-	Xenon
B	-	Halogen

The Xenon low/high beam headlamps use ellipsoidal technology for the lens and reflector providing improved night time visibility compared to conventional halogen headlamps. The Xenon headlamps provide the following benefits when compared to halogen headlamps:

- Longer bulb life - Approximately 3 to 5 times longer than a halogen bulb
- Increased light output - Xenon headlamps output 3 to 4 times more light on the road surface than halogen headlamps
- Blue/White light which is closer to natural daylight - Xenon lamps produce a blue/white light compared to a yellow light produced by a halogen bulb
- Improved night time driving visibility - Xenon lamps produce a wider and brighter beam in front of the vehicle than

- conventional halogen bulbs
- Lower running temperatures
- Lower power consumption
- Mercury free.

Xenon Headlamp Construction



E43261

Item	Part Number	Description
1	-	Bracket
2	-	D3S xenon bulb
3	-	D3S connector
4	-	Swivel actuator (AFS lamp only)
5	-	Solenoid
6	-	Aspheric lens
7	-	Shade
8	-	Shade
9	-	Lens support

The Xenon headlamp is a self contained unit located within the headlamp assembly. The unit comprises a reflector, an adaptor ring, the lens, a shutter controller and the Xenon 35W D3S bulb, which as an assembly is known as the projector module.

The reflector is curved and provides the mounting for the xenon bulb. The bulb locates in a keyway to ensure correct alignment in the reflector and is secured by rotating a locking ring on the projector module to lock. The bulb has a pin connector which is a push to lock fitting.

The shutter controller is a solenoid which operates the shutter via a lever mechanism. The shutter is used to change the beam projection from low beam to high beam and visa versa.

A tourist lever mechanism is located on the right hand side of the projector module. This mechanism moves to blank off a portion of the beam spread to enable the vehicle to be driven in opposite drive hand markets without applying blanking decals to the headlamp lens. The beam is changed by removing the access cover at the rear of the lamp assembly and moving a small lever located near the bulb holder, at the side of the projector module. Make sure that the headlamps are off before removing the access cover.

The Xenon bulbs illuminate when an arc of electrical current is established between two electrodes within the bulb. The xenon gas sealed in the bulb reacts to the electrical excitation and the heat generated by the current flow. The xenon gas reaction to the controlled current flow between the electrodes produces the blue/white light.

To operate at full efficiency, the xenon bulb goes through three stages of operation before full output for continuous operation is achieved. The three phases are; start-up phase, warm-up phase and continuous phase.

In the start-up phase, the bulb requires an initial high voltage starting pulse of 18000 to 28000 volts to establish the arc. This is produced by the igniters. The warm-up phase begins once the arc is established. The Xenon control modules regulate the supply to the bulbs to 2.6A which gives a lamp output of 75W. During this phase, the Xenon gas begins to illuminate brightly and the environment within the bulb stabilizes ensuring a continual current flow between the electrodes. When the warm-up phase is complete, the xenon control modules change to continuous phase. The supply voltage to the bulb is reduced and the operating power required for continual operation is reduced to 35W.

The Xenon system is controlled by the CJB, the two xenon control modules and the two igniters. The xenon control modules (one per headlamp) receive an operating voltage from the CJB when the headlamps are switched on. The modules regulate the power supply required through the phases of start-up.

The igniters (one per headlamp) generate the initial high voltage required to establish the arc. The igniters have integral coils which generate high voltage pulses required for start-up. Once the xenon bulbs are operating, the igniters provide a closed circuit for regulated power supply from the control modules.

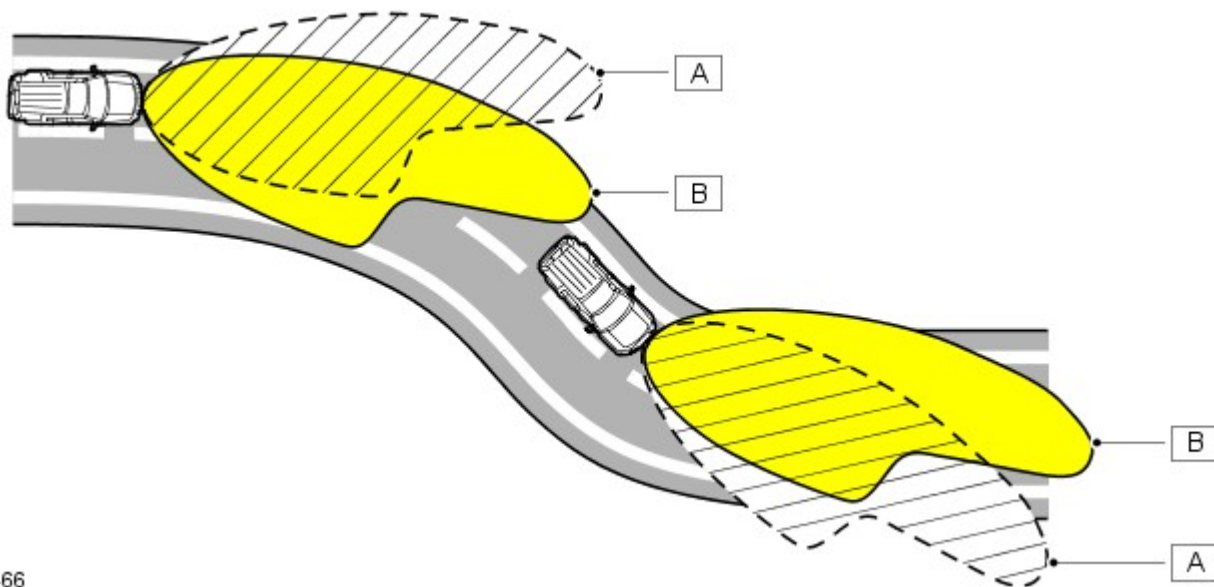
ADAPTIVE FRONT LIGHTING SYSTEM (AFS)

The AFS is a system to improve driver visibility under differing driving conditions. AFS provides a larger visible area which is illuminated when cornering by adjusting the position of the beam distribution on the road. Horizontal adjustment is made automatically to the most suitable orientation for the driving conditions using steering angle and information from other vehicle sensors.

AFS is only available with adaptive Bi-Xenon™ headlamps. The 'Xenon' module within the headlamp is controlled by actuator motors which rotate the projector module on its horizontal axis to adjust the beam output to suit the cornering conditions and vehicle inclination. Only the adaptive bi-xenon™ lamp projector module swivels, the non adaptive xenon and halogen high beam lamp units remains static.

The AFS system is controlled by an AFS control module which is located at the bottom of the passenger side 'A' pillar. The control module controls the horizontal alignment of the adaptive Bi-Xenon™ projector module. The operation of the static bending lamp is controlled by the AFS control module, but powered by the CJB.

AFS Concept



E43466

Item	Part Number	Description
A	-	Conventional headlamp beam distribution
B	-	AFS swivel headlamp beam distribution

AFS Control Module

The AFS control module is connected to the high speed CAN bus and receives inputs from other vehicle systems on the status of the following parameters:

- Steering angle - from steering angle sensor
- Vehicle speed - from ABS module
- Low beam status - from instrument cluster
- Suspension height - from air suspension control module
- Odometer value - for diagnostics only

- Engine running - from ECM
- Gear position - From transmission control module or transfer box control module
- Engine crank - from ECM
- Exterior/interior temperature - for diagnostics only.

The AFS will only operate when the AFS control module receives an engine running signal on the CAN bus. When the engine running signal is received, the AFS control module performs an initialization routine which is only performed at engine crank (power mode 9).

The AFS will also function when the lighting control switch is in the AUTO position and the AFS control module receives a lights on signal from the rain/light sensor and an engine running signal.

The AFS control module then monitors the inputs from the other vehicle systems to control the AFS functionality according to cornering angles and vehicle speed.

The AFS control module is connected to each headlamp on a private Local Interconnect Network (LIN) bus. The AFS control module then drives the DC motor actuators inside the headlamp assembly.

The AFS control module controls the swiveling angle of each projector module using speed and steering angle signals. The angles of each projector module differ to give the correct spread of light, For example, when turning left, the Left Hand (LH) projector module will have a greater swiveling angle than the Right Hand (RH) projector module

Reverse mode disables the swivel function when reverse gear is selected. The AFS projector modules move to their central straight ahead position and the static bending lamp, if active, will go off. When reverse gear is deselected, the AFS projector modules will move to a position to match the steering angle and the static bending lamp will illuminate if the operating conditions are correct (for example vehicle speed above 1.86 mph (3 km/h)).

Xenon Headlamp Assembly with AFS Construction

The AFS xenon headlamp construction is similar to the non-AFS xenon headlamp assembly. The AFS assembly contains an additional carrier frame which provides the location for the AFS components. The remaining lamps are as described previously for the Xenon headlamp assembly. The functionality of the static bending lamp on the AFS headlamp is different from the functionality of the cornering lamp on the xenon headlamp.

The carrier frame has a radial bearing at the top and a thrust washer at the bottom which provide the horizontal pivot points for the xenon projector module. The lamp module lower pivot has a splined end which locates in the mating splines of the AFS horizontal actuator motor. The carrier frame is suspended on two flexible mountings at the top which provide for the vertical pivot points for the xenon projector module which allow for the vertical adjustment of the projector module. The bottom of the carrier frame is attached to the AFS vertical actuator motor.

The AFS actuator motors are dc motors which are driven by a power output from the CJB in response to signals from the AFS control module.

The actuators contain a potentiometer which is connected via wires with gold plated connector pins to the AFS control module. The two wires to each actuator provide a feedback signal to the AFS control module to give the precise position of the xenon projector module.

The AFS control module receives vehicle speed signals from the ABS module to adjust the projector module vertically to increase the beam range as the vehicle speed increases.

Initialization

When the AFS control module receives an engine running signal, the control module performs the initialisation procedure which ensures that the headlamps are correctly aligned on their horizontal axis.

The AFS swivel initialization is completed in less than 1 second. The LH and RH AFS motors flick the headlamps to calibrate the centre position of the headlamps.

Failure Mode

In the event of a failure of the AFS system, a warning indicator in the instrument cluster is illuminated to warn the driver. The AFS warning indicator illuminates when the ignition is in accessory power mode 4 or ignition power mode 6 and will flash continuously until the fault is rectified. The AFS warning indicator will also be illuminated if a failure of the steering angle sensor or the vehicle speed signal is detected.

Illumination of the AFS warning indicator does not necessarily mean that there is a fault with the AFS system. The fault may be caused by a failure of another system preventing the AFS system operating correctly.

The AFS control module performs a diagnostic routine every time AFS is requested. If any fault is found, the AFS control module will suspend the operation of the AFS function.

If the AFS system has failed with the xenon projector module in a position other than the correct straight ahead position, the AFS control module will attempt to drive the xenon projector module to the zero (straight ahead) position. If this is not possible, the AFS control module will lower the projector module using the leveling actuator motors to prevent excess glare to oncoming vehicles.

The AFS control module software can detect an internal failure of the control module control circuits. The control module will power the projector modules to the zero position and prevent further operation.

Faults can be investigated by interrogating the AFS control module using an approved Land Rover diagnostic system to check for fault codes.

AUTOMATIC HEADLAMP OPERATION

The automatic headlamp function is a driver assistance system. The driver can override the system operation by selection of side lamp or headlamp on if the ambient light conditions require front and rear lighting to be active. The automatic

headlamp system uses a light sensor and the CJB, which are connected via the LIN bus to control the headlamp functionality.

A light sensor is incorporated in the rain/light sensor located on the inside of the windshield, below the rear view mirror. The wiper system also uses the rain/light sensor for automatic wiper operation.

For additional information, refer to: [Wipers and Washers](#) (501-16 Wipers and Washers, Description and Operation). The light sensor measures the ambient light around the vehicle in a vertical direction and also the angular light level from the front of the vehicle. The rain/light sensor uses vehicle speed signals, wiper switch position and the park position of the front wipers to control the system.

The automatic headlamp operation uses ambient light levels which are monitored by photodiode incorporated in the rain/light sensor. The rain/light sensor sends a lights on/off request to the CJB on the LIN bus, which responds by switching on the low beam headlamps, front side lamps and rear tail lamps.

The automatic headlamps are activated under the following conditions:

- Twilight
- Darkness
- Rain
- Snow
- Tunnels
- Underground or multistoried car parks.

Operation of the automatic headlamps requires the ignition to be in ignition mode 6, the lighting control switch to be in the 'AUTO' position and a lights on request signal from the light sensor.

HEADLAMP LEVELING

Headlamp leveling provides for the adjustment of the vertical aim of the headlamps. The leveling system is primarily required to minimise glare to other road users when a heavy load is in the rear of the vehicle.

Two systems of headlamp leveling are available; manual and static.

Manual Headlamp Leveling

Manual headlamp leveling is only available on vehicles with halogen headlamps and coil spring suspension.

The manual system comprises the following components:

- Two headlamp leveling motors
- Headlamp leveling rheostat rotary control.

When the ignition is in ignition mode 6, power is supplied to the lighting control switch via the ignition relay in the battery junction box and to the headlamp leveling motor in each headlamp assembly via the CJB. When the lighting control rotary switch is moved to the side lamp or headlamp position, the supply from the ignition relay is passed to the leveling rotary control.

Movement of the leveling rotary control produces a variable voltage output, which is sensed by the motors. The motors react to the supplied voltage and move the headlamp to the requested position which relates to the supplied voltage from the leveling rotary control.

The headlamps can only be lowered from their unladen position to compensate for changes in vehicle attitude due to loading.

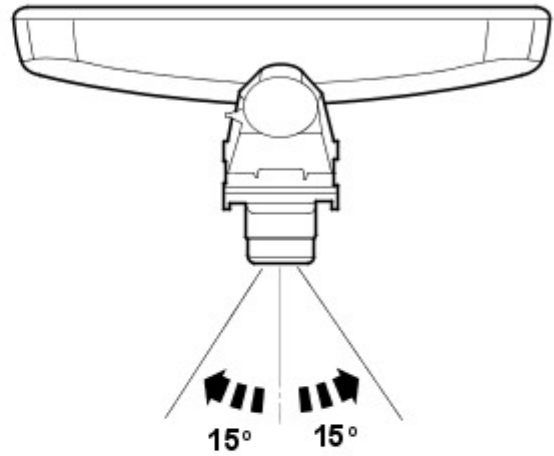
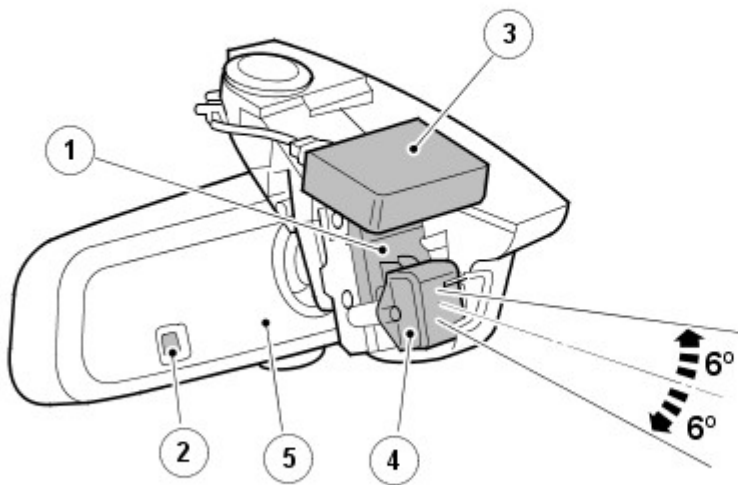
Vehicle Headlamp Leveling

Vehicle headlamp leveling is only available on vehicles with air suspension.

Vehicle headlamp leveling is performed by the air suspension system and the air suspension control module. The suspension system constantly monitors the vehicle attitude and adjusts the height of the front and/or rear of the vehicle accordingly. This maintains the correct vehicle attitude and consequently maintains the correct headlamp beam alignment.

The vehicle leveling system is fully automatic, therefore the lighting control switch does not have the manual leveling rotary control.

HIGH BEAM ASSIST



E117701

Item	Part Number	Description
1	-	Rear view mirror calibration bracket
2	-	Ambient light sensor (High beam assist)
3	-	Rain/light sensor (Auto headlamps)
4	-	Image sensor
5	-	High beam assist control module (inside mirror body)

High beam assist is a driving aid which automatically controls the high beam function. If required, the system can be overridden by the driver.

⚠ CAUTION: The high beam assist system is designed as a driving aid only. Should the road conditions require, it is the driver's responsibility to consider other road users and operate the high beam headlamps in a safe manner. In certain circumstances the driver will be required to intervene.

High Beam Assist Warning Indicator



E117699

Item	Part Number	Description
1	-	Warning indicator (green)

The high beam assist system is controlled by a high beam assist control module which is located in the interior rear view mirror body and by the CJB. The module and the CJB are connected via the medium speed CAN bus.

The high beam assist control module receives a power supply from the CJB when the ignition is in power mode 6 (ignition on). The rear view mirror also includes a low resolution camera (image) sensor which detects headlamps and tail lamps of preceding vehicles. The sensor is connected to the control module which evaluates the image data, checking for light intensity and location.

If conditions are correct, the control module will activate the high beam assist by sending a high or low beam request message to the CJB via the medium speed CAN bus. The CJB then controls the shutter in the Xenon projector module

together with the high beam fill-in lamp.

High Beam Assist Operation

The high beam assist operates as part of the automatic headlight system. When driving at night with the lighting control switch in the automatic position and the LH steering column multifunction switch in the central position, with sufficient darkness (approximately 1 lux or less) and a suitable road speed, the high beam assist will automatically operate the high beam lighting when necessary. A warning symbol in the instrument cluster confirms to the driver when the high beam assist system is selected and enabled.

• **NOTE:** The function of the normal 'blue' high beam indicator remains unchanged and it always reflects the actual status of the high beam lamps

• **NOTE:** The exterior lighting 'on' threshold for the auto headlamps system is approximately 100 lux which is measured by the rain/light sensor. At light levels below this value the low beam headlamps and exterior lights will be switched on. The high beam assist will not function until the light level has reached approximately 1 lux. At light levels above 1 lux high beam is not required and therefore is not activated.

Activation (system ready)

High beam assist will only activate and illuminate the warning indicator to show system is ready or 'primed' for high beam control, when the following conditions are met:

- High beam assist has been first 'enabled' via the instrument cluster menu
- Lighting control switch is in the 'Auto' position
- LH steering column multifunction switch in the central position
- The ambient light level is below 100 lux – refer to 'Light Levels' section that follows
- The system has not been overridden or cancelled – refer to 'Override' section that follows
- The camera (image) sensor view is not blocked.

High Beam Control

When activated, high beam assist will switch the headlamps to high beam when all the following conditions occur:

- No relevant oncoming traffic
- No relevant preceding traffic
- In non-urban environment, i.e. with no street lighting
- Ambient light level is below 1 lux – refer to 'Light Levels' section that follows
- Road speed is suitable – refer to 'Road Speed' section that follows.

Low Beam Control

When activated, high beam assist will switch the headlamps to low beam when any of the following conditions occur:

- Relevant Oncoming traffic is present
- Relevant Preceding traffic is present
- In urban environment, i.e. with street lighting
- Ambient light level is above 1 lux – refer to 'Light Levels' section that follows
- Road speed is not suitable – refer to 'Road Speed' section that follows
- Unrecognisable reflective inputs from road signs or markings – refer to 'System Limitations' section that follows.

Light Levels

The exterior lighting 'on' threshold for the normal 'auto headlamps' feature is approximately 100 lux and is measured by the windscreen mounted 'rain/light' sensor. When the light level falls to this value the low beam headlamps and exterior lights will be switched on together with the high beam assist warning indicator.

This warns the driver that the system is activated and ready to automatically switch on the high beam headlamps when the light level falls a little further to approximately 1 lux, as measured by the 'ambient light sensor' located in the mirror body. High beam is generally not required with light levels above 1 lux.

Road Speed

A road speed signal is received by the CJB from the Anti-lock Braking System (ABS) module via the high speed CAN bus. When the other activation conditions are correct, the CJB will switch the headlamps to high beam when the road speed has increased above 40 km/h (25 mph).

When the road speed falls to below 24 km/h (15mph), the CJB will switch the headlamps to low beam. The 10 mph (15 km/h) difference between the on and off road speed thresholds prevents the system continually switching between high and low beam at low speeds.

Override

The driver can manually override the high beam assist system at any time. When the high beam assist system is activated, pulling the LH steering column multifunction switch to the high beam 'flash' position or pushing it forward to the high beam position will de-activate the system and the high beam assist warning indicator in the instrument cluster will extinguish.

When the multifunction switch is returned to the central position, from a forward high beam position, the system is re-activated and the high beam assist warning indicator will illuminate again.

Correct Performance

In addition, high beam assist will only exhibit best performance if all of the following conditions are met:

- No false inputs are received by the camera (image) sensor, such as reflected light from certain static signs – refer to 'System Limitations' section that follows

- Headlamps are correctly aligned
- High beam assist system has been set for correct 'hand of traffic' via the driver menu settings – refer to 'Setting Hand of Traffic' section that follows
- Headlamps have been set for correct 'hand of traffic' via the mechanical tourist lever in headlamp casing – refer to 'Setting Hand of Traffic' section that follows
- Camera (image) sensor has been through a self learning 'auto aim' calibration procedure if any components have been replaced – refer to 'Calibration' section that follows
- There are no large reflective items, white papers, etc., sitting on top of the dash board in near view of the camera (image) sensor, or stickers placed directly in front of the camera (image) sensor

Driver Menu Features

The high beam assist feature must first be enabled using the configuration menu available in the instrument cluster. However if required, the high beam assist system can be permanently disabled leaving the basic 'Auto Lamps' system still operative.

Within this menu the system can also be configured for driving on the alternate side of the road (Hand of Traffic). This enables the system to be used in different regions and it's setting is important for correct operation.

Setting 'Hand of Traffic' and High Beam Assist 'Enable'

To set the high beam assist options the following steps must be sequenced:

- With the ignition in power mode 6 (ignition on), and the engine not running, use the controls on the steering wheel to select on the instrument cluster menu:
 - Menu > Vehicle Set-up > High Beam Assist
 - Configure the 'Hand of Traffic' setting by selecting the appropriate 'Drive on Left' (of road) or 'Drive on Right' (of road) to the applicable Market condition
 - Enable the feature by setting 'Activate Assist' if not already selected.
- NOTE: Enabling or disabling high beam assist will not affect the 'Hand of Traffic' settings once set.
- NOTE: The headlamps still require manual adjustment using the tourist lever for driving abroad in countries where the alternate side of the road is used.

The instrument cluster menu also includes a 'High Beam Assist Sensitivity' selection. This is a requirement option for NAS market vehicles only but it is not recommended for normal use and has been superseded.

- NOTE: In other markets the 'Sensitivity' selection is greyed out and cannot be selected.

For additional information, refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Description and Operation).

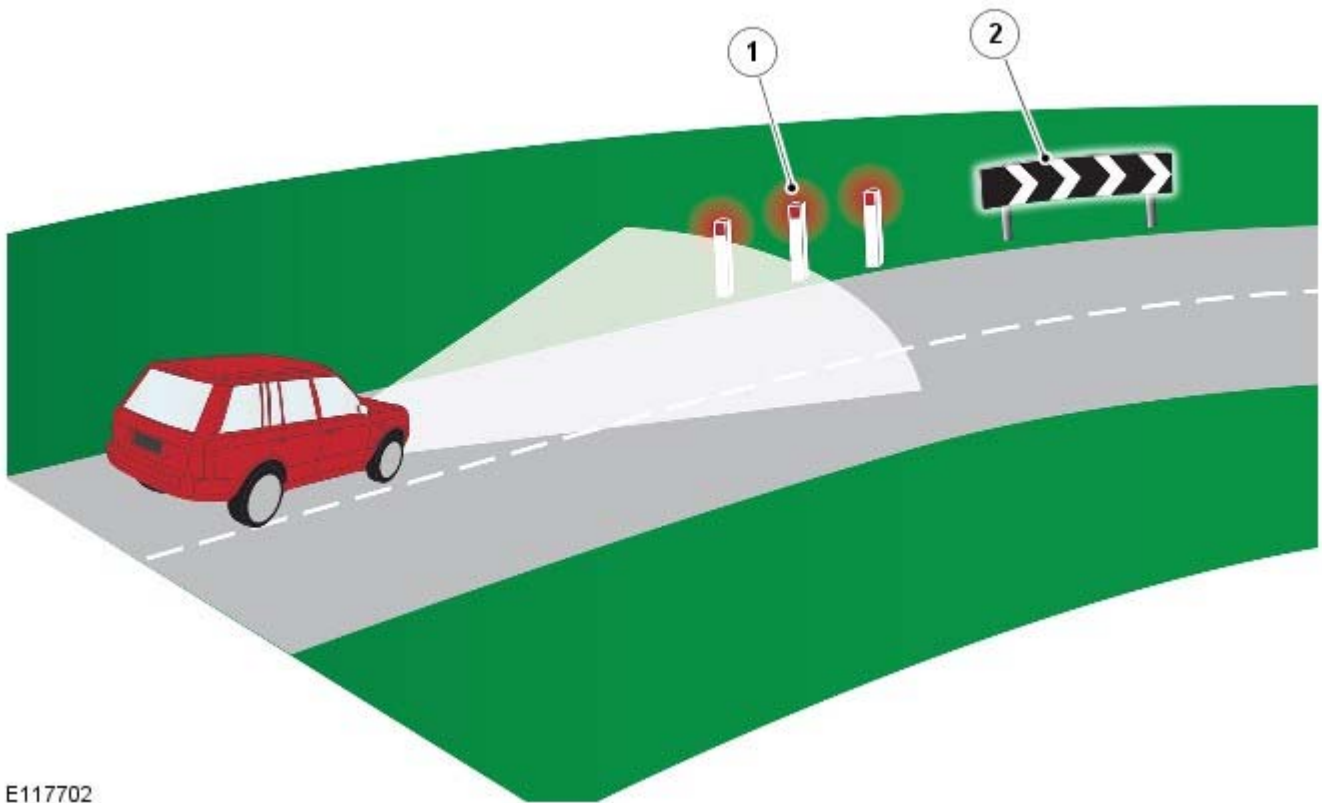
System Limitations

The high beam assist system can occasionally have difficulty distinguishing between light from other vehicles or reflected light from static highly reflective road signs.

These situations may cause the high beam assist system to undesirably operate the high beam headlamps or take no action at all. Examples of these situations are as follows:

- Dips, hollows or crests in the road
- Highly reflective static Road signs
- Tight bends
- Poorly illuminated vehicles e.g. cyclists or small mopeds
- Motorway central barriers
- Extreme weather conditions e.g. Fog, heavy snow
- Exterior domestic or industrial lighting

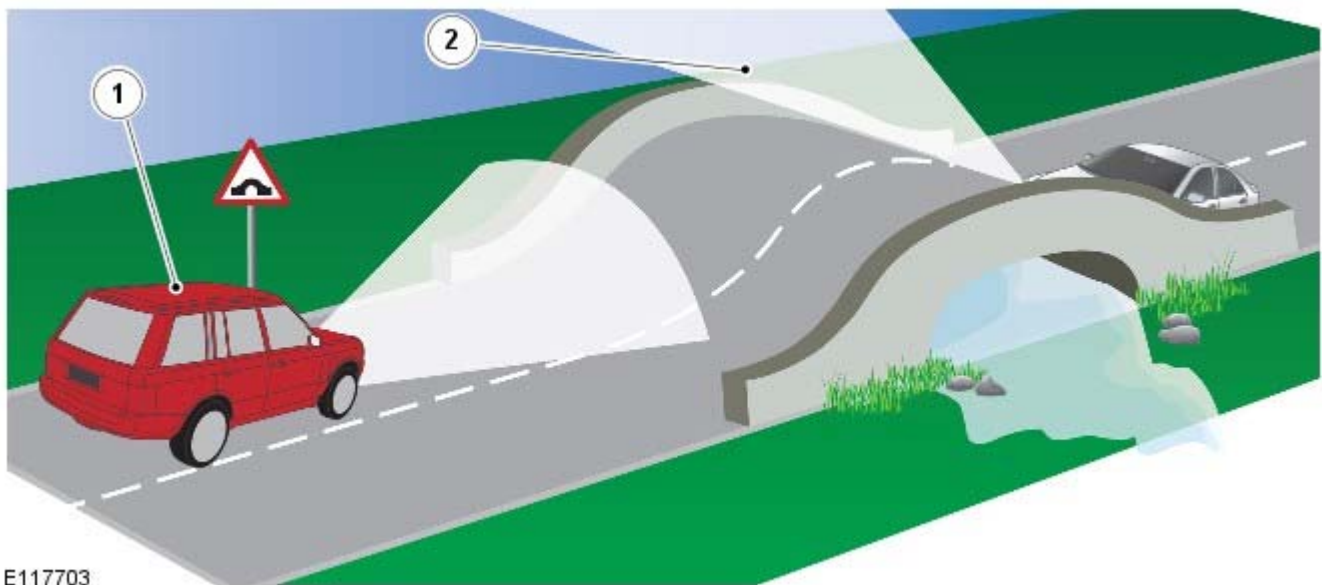
Reflective Static Signs



E117702

Item	Part Number	Description
1	-	Red reflective signs could be detected as rear tail lamps
2	-	Large reflective signs could affect the system

Manual Deactivation



E117703

Item	Part Number	Description
1	-	Vehicle equipped with high beam assist
2	-	Oncoming vehicle headlamps can be seen by the driver before the high beam assist image sensor detects the oncoming light input

There are situations when a driver is able to judge if a high beam deactivation is desirable before the high beam assist system actually operates, for example over a crest of a hill. Headlamps from an oncoming vehicle can sometimes be seen on the horizon prior to the detection sensor receiving an input. It is the driver's preference to determine if early intervention is desired in this and similar situations.

System Diagnosis

- NOTE: Windshield stickers, stone chips, dirt and general road film will affect the successful operation of the image sensor if sufficient blocking is present. Avoid placing reflective objects on the instrument panel, for example white paper which can affect the image sensor.

High beam assist has a self diagnosis capability by comparing data from the ambient light sensor input (located in the rear view mirror) to light levels detected by the image sensor. If a deviation is detected it is assumed that the ambient light available to the image sensor is being restricted by dirt or other blockage and the system will be deactivated. Diagnostic Trouble Code (DTC)'s are stored in the control module's memory and can be accessed using an approved Land Rover diagnostic system. Within the diagnostic system is a procedure to test the basic operation of the camera function.

In the event of a fault, the warning strategy to the driver is as follows:

- Image sensor internal fault - green icon will extinguish with no additional message to driver
- CJB has lost all communication with image sensor - green icon will extinguish with no additional message to driver
- Image sensor blocked - green icon will extinguish with an additional "High Beam Assist Sensor Blocked" message within the message centre

System Calibration

To achieve effective operation of the high beam assist system, a calibration routine is performed on vehicle build and system tolerances are set to an accuracy of +/- 0.2 degrees.

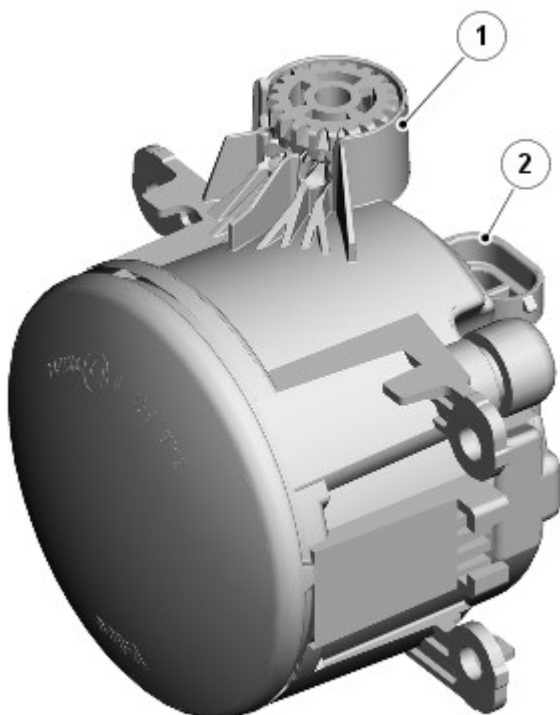
This initial calibration is a 'one time only' procedure. Should the high beam assist components or the windshield require replacement at the dealership, an automatic calibration routine will be performed. This 'auto aim' calibration procedure is a continual process that takes place during a normal drive cycle at night and could take between 10 - 30 minutes dependant on the following driving conditions:

- If sufficient road markings (lane markings) are visible to the image sensor - approximately 10 minutes
 - If insufficient road markings are visible, the system uses the tail lights of preceding vehicles - approximately 30 minutes.
- NOTE: Until this calibration is complete the system may not react correctly during operation. This should be made clear to the customer before vehicle handover. During any calibration or rectification work the headlamps should be checked for correct alignment.
- NOTE: Due to mechanical calibration tolerance the correct mirror assembly must be used for the vehicle model types in question and it is not exchangeable with other vehicle model types.
- NOTE: After any rectification work and before any calibration drives, the headlamps should be checked for correct alignment.

DAYTIME RUNNING LAMPS (DRL)

For additional information, refer to: [Daytime Running Lamps \(DRL\)](#) (417-04 Daytime Running Lamps (DRL), Description and Operation).

FRONT FOG LAMP (If Fitted)



E120184

Item	Part Number	Description
1	-	Vertical adjustment wheel
2	-	Electrical connector

Front fog lamps are an optional fitment on low specification vehicles and a standard fitment on high specification vehicles.

Two front fog lamps are located in apertures in the front bumper. The front fog lamps are located in the front bumper. Each lamp is secured to three lugs in the bumper and retained with self tapping screws and fasteners. Each lamp has an adjustment wheel which provide for the vertical alignment of the beam. Access to the adjustment wheel requires removal of the lamp bezel.

The fog lamp uses a 55W halogen H11 bulb which is located in a holder. The holder is located in a hole in the rear of the fog lamp housing and is turned to lock in position.

The front fog lamps are controlled by the lighting control switch. When the ignition is in ignition mode 6 and the lighting control switch is in the side lamp or headlamp position, the lighting control fog lamp switch can be pushed to activate the front fog lamps.

If the switch is pushed a second time the front fog lamps are switched off. A front fog lamp warning indicator is illuminated in the instrument cluster when the front fog lamps are active.

If the fog lamps are active when the lighting control switch is moved to the off position or the ignition is switched off, the fog lamps are de-activated and will need to be reselected on (if required) when the side lamps or headlamps are next selected on.

Front Fog Lamps Functionality (NAS and Canadian Markets Only)

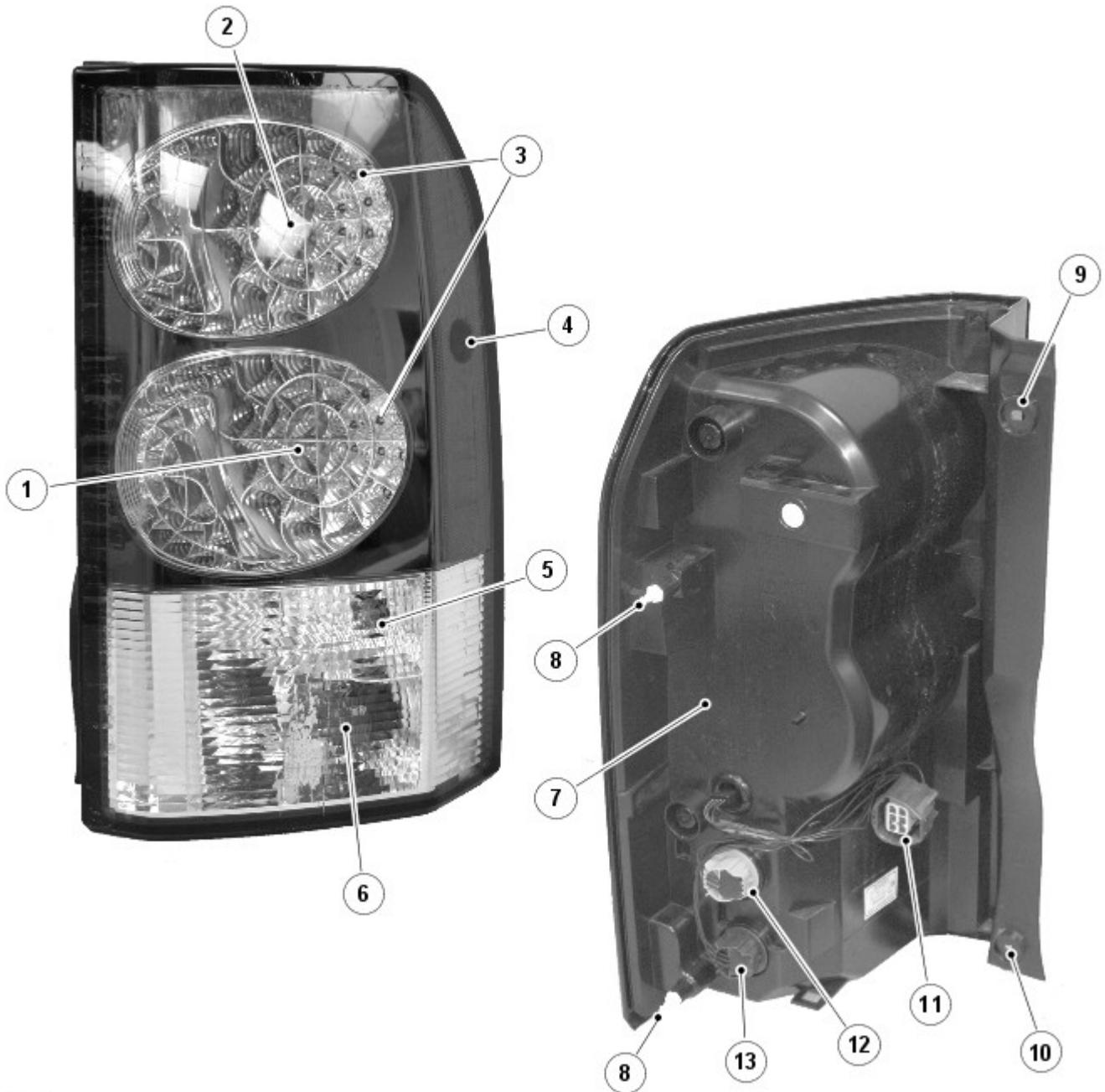
The front fog lamps are powered by an additional relay (relay 5) which is located in the EJB in the engine compartment.

The front fog lamps operate as described previously but with the following differences which cover local laws governing lamp usage.

If the low beam headlamps and the front fog lamps are on at the same time, when the high beam headlamps are switched on, the front fog lamps will be automatically switched off. When the high beam headlamps are switched off, the front fog lamps will be switched back on automatically.

- NOTE: The front fog lamps will also be switched off if the headlamp high beam flash function is operated.

REAR LAMP ASSEMBLY



E121551

Item	Part Number	Description
1	-	Turn signal indicator lamp LED's
2	-	Stop lamp LED's
3	-	Side lamp LED's
4	-	Side marker lamp (NAS only)
5	-	Reverse lamp
6	-	Fog lamp
7	-	Side marker lamp bulb holder (NAS only)
8	-	Location studs
9	-	Attachment hole
10	-	Attachment hole
11	-	Electrical connector
12	-	Reverse lamp bulb holder
13	-	Fog lamp bulb holder

The rear lamp assembly is a one piece unit which contains a stop lamp, a rear side lamp, a turn signal indicator lamp, a second rear side lamp, a reversing lamp and a fog lamp. Light Emitting Diode (LED)'s are used for the tail lamp, stop lamp and turn signal indicator lamp. Reversing lamp and fog lamp use bayonet fitting bulbs. These are located in holders which fit into the applicable hole in the lamp housing and are locked by rotating. Each bulb holder is connected by wires to a connector on the rear of the lamp housing.

The rear lamp assembly is located in a recess in the vehicle body. Two studs on the outer edge of the lamp housing locate in the vehicle body. The lamp is secured with two screws which are located on the inner edge of the lamp housing, near the tailgate aperture.

Rear Stop Lamp

The upper lamp is the inner section of the upper of the two main lamps and uses 12 LED's.

The stop lamp is activated when the ignition is in ignition mode 6 and the brake pedal switch is active (by depressing the brake pedal). The high mounted stop lamp will also be activated when the brake pedal is pressed.

The stop lamps can also be activated by the ABS when Hill Descent Control (HDC) is active. A signal from the ABS module energises a relay which supplies power to the stop lamps and high mounted stop lamp. For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).

Turn Signal Indicator Lamp

The turn signal indicator lamp is the inner section of the lower of the two main lamps and uses 12 LED's.

The turn signal indicator lamps are operated by the LH steering column multifunction switch or by the hazard flasher switch. The steering column multifunction switch is only active with the ignition switch is in ignition mode 6, the hazard flasher switch is active at all times. When active, the turn signal indicator lamps will flash at a frequency cycle of 400ms on and 400ms off.

Side Lamp

The side lamp is the outer ring of both upper lamps and use 12 LED's in each lamp.

The lamps are operated by selecting side lamps or headlamps on the lighting control switch. The lamps are operational at all times and are not dependant on the Ignition switch position. The lamps will also be illuminated when the lighting control switch is in the AUTO position and a 'lights on' signal is received by the CJB from the rain/light sensor.

On NAS market vehicles a side marker lamp is incorporated into the side of the lamp assembly and uses a 5W capless wedge bulb.

Reversing Lamp

The reversing lamp is located below the tail lamp and uses a 21W bayonet fitting bulb.

The reverse lamp is active when the ignition is in ignition mode 6 and the CJB receives a reverse selected signal on the CAN bus. Both manual and automatic transmissions have a reverse switch which senses when reverse is selected.

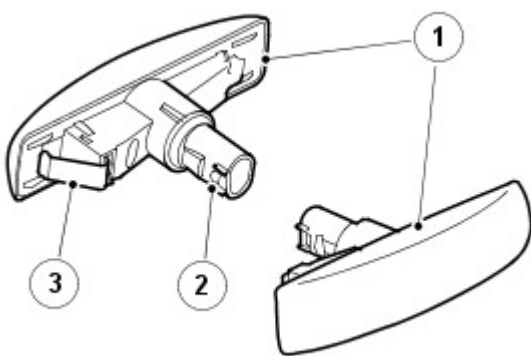
Rear Fog Lamp

The rear fog lamp is located at the bottom of the rear lamp and uses a 21W bayonet fitting bulb.

The rear fog lamp is controlled by a non-latching switch on the lighting control switch. When the ignition is in ignition mode 6 and the lighting control switch is in the side lamp or headlamp position, the rear fog lamp switch can be pressed to activate the rear fog lamps. A second press of the switch will de-activate the rear fog lamps. A rear fog lamp warning indicator is illuminated in the instrument cluster when the rear fog lamps are active.

If the rear fog lamps are active when the lighting control switch is moved to the off position or the ignition is switched off, the fog lamps are de-activated and will need to be reselected on (if required) when the side lamps or headlamps are next selected on.

SIDE REPEATER LAMP



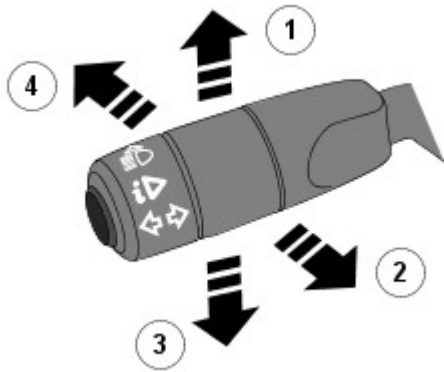
E43272

Item	Part Number	Description
1	-	Side repeater
2	-	Bulb holder
3	-	Clip

The side repeater turn signal indicator lamps are located in the driver and passenger doors, below each door mirror. The lamps are clipped into an aperture in the door panel and can be removed by sliding rearwards and releasing the front edge of the lamp from the door. The side repeater lamps use a W5W capless bulb which is located in a holder.

The side repeater lamps have the same functionality as the front and rear turn signal indicator lamps and are operated by the LH steering column multifunction switch or by the hazard flasher switch. The steering column multifunction switch is only active with the ignition is in ignition mode 6, the hazard flasher switch is active at all times. When active, the side repeater lamps will flash at a frequency cycle of 400ms on and 400ms off. If a lamp bulb fails, the remaining turn signal indicator lamps continue to flash at the normal rate.

LEFT HAND STEERING COLUMN MULTIFUNCTION SWITCH



E43273

Item	Part Number	Description
1	-	RH turn signal lamp
2	-	Headlamp flash
3	-	LH turn signal lamp
4	-	Headlamp high beam

The steering column multifunction switch is located on the left hand side of the steering column and controls the following functions:

- Headlamp low/high beam
- Auto high beam function
- Headlamp high beam flash
- Left/right turn signal indicator lamps
- Trip computer functions.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

The high beam on and flash functions are connected on separate wires to the CJB. When the switch is operated in either position an earth path is completed which is sensed by the CJB which activates the selected function.

The turn signal indicator lamps are connected and operate in a similar way with the earth path completed through a separate wire which is sensed by the CJB which activates the applicable turn signal indicator lamps. The turn signal indicators have a 'lane change' feature which operates the turn signal indicators 3 times when the LH steering column switch is operated against spring pressure and released. This feature is controlled by the CJB.

HAZARD FLASHERS

The hazard flashers are controlled by a non-latching switch in the centre of the instrument panel. The hazard flashers operate at all times when selected and are not dependant on ignition mode.

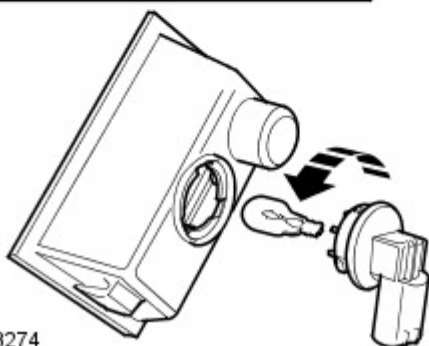
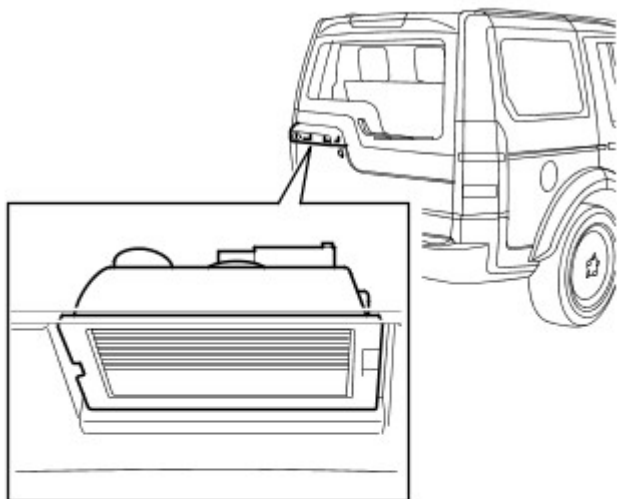
When the hazard flashers are selected on, all of the front, rear and side turn signal indicator lamps operate as previously described and both left and right turn signal warning indicator in the instrument cluster also flash. The hazard warning flashers flash at a rate of 380ms on and 380ms off. When the hazard flashers are active, they override any request for turn signal indicator lamp operation.

If a trailer is fitted, the trailer turn signal indicator lamps will flash at the same frequency as the vehicle indicators. The trailer warning indicator in the instrument cluster will also flash. If a trailer bulb is defective, the trailer warning indicator will not flash.

The hazard flashers can also be activated by a crash signal from the Restraints Control Module (RCM). This is received by the CJB which activates the hazard flashers. The hazard flashers can be cancelled by changing the ignition mode to accessory mode 4 or off or the crash mode is cancelled by the RCM.

For additional information, refer to: [Air Bag and Safety Belt Pretensioner Supplemental Restraint System \(SRS\)](#) (501-20B Supplemental Restraint System, Description and Operation).

LICENSE PLATE LAMPS

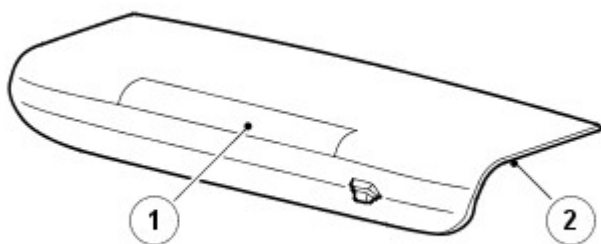


E43274

Two license plate lamps are fitted in the tailgate handle, above the license plate in the upper tailgate. Each lamp uses a 5W capless wedge type bulb. The lamps are secured in the upper tail gate handle with integral clips. The lamps can be released from the handle using a small, flat blade screwdriver.

The license plate lamps are active at all times when the side lamps or headlamps are switched on.

HIGH MOUNTED STOP LAMP



E43275

Item	Part Number	Description
1	-	High mounted stop lamp
2	-	Housing

The high mounted stop lamp is located in the upper tailgate. The stop lamp housing also provides location for the tail door window washer jet.

The lamp comprises a plastic housing with a red coloured lens. The lamp is illuminated by a number of LED's.

The high mounted stop lamp is activated, along with the stop lamps, when the ignition is in ignition mode 6 and the brake pedal switch is active (by depressing the brake pedal).

The high mounted stop lamp and the stop lamps can also be activated by the ABS when Hill Descent Control (HDC) is active. A signal from the ABS module energises a relay which supplies power to the stop lamps.

For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).

TRAILER LIGHTING

Several different types of trailer socket can be fitted to the vehicle depending on market specifications. Refer to the Electrical Reference Library for specific socket details.

The CJB monitors the turn signal lamps and can detect if more than two lamps are fitted (the side repeater turn signal indicator lamps are not monitored). When a trailer is detected, the trailer warning indicator in the instrument cluster will flash in synchronisation with the turn signal indicators.

If one or more of the turn signal indicator lamps on the vehicle or the trailer are defective, the trailer warning indicator will not flash to alert the driver to the bulb failure.

DIAGNOSTICS

The diagnostic socket is located in the lower instrument panel closing panel, on the driver's side, below the steering column. Various lighting system functions are monitored by different systems which can store fault information. This can be retrieved using an approved Land Rover diagnostic system or other suitable scan tool.

AFS Control Module Fault Monitoring

The AFS control module has the capability to monitor faults within the AFS. The control module can store Diagnostic Trouble Codes (DTC's) relating to the symptoms shown in the following table.

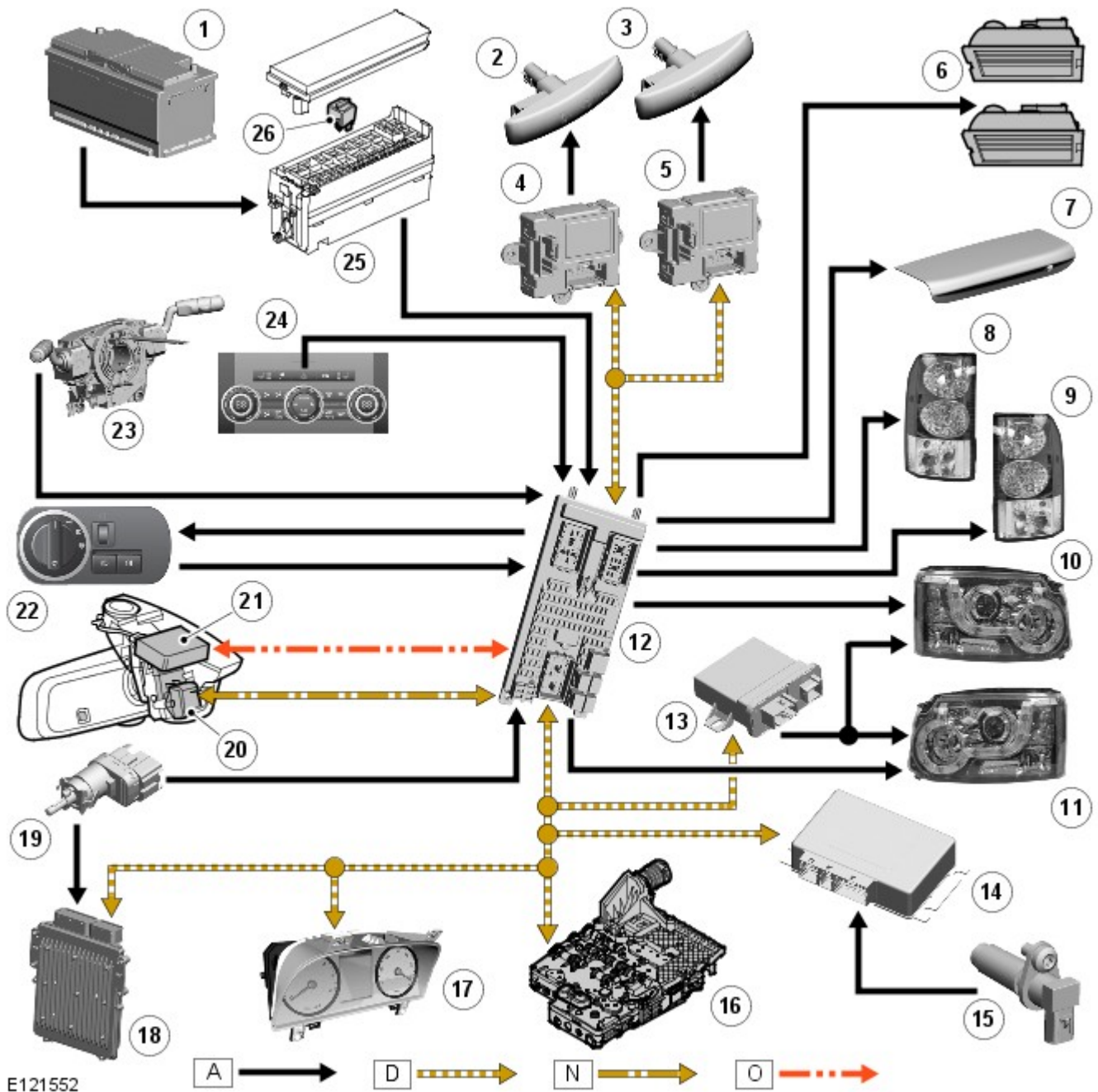
DTC Symptom Description	Customer Symptom	Possible Cause
LH or RH AFS actuator - Communication failure	Swivelling does not function	Open circuit or short circuit to earth
LH or RH AFS Actuator failure	Swivelling does not function	Open circuit or short circuit to earth
LH or RH Leveling Motor Failure	Leveling does not function	Open circuit or short circuit to earth or 12V
CAN bus failure	Swivelling and leveling do not function. Other vehicle system functions perhaps also inoperative	Open circuit or short circuit to earth or 12V

Central Junction Box (CJB)

The CJB monitors the status of the lighting circuits, relays and switches. If a fault occurs, the CJB stores a fault code applicable to the specific fault which can be retrieved using an approved Land Rover diagnostic system or other suitable scan tool.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **D** = High Speed CAN Bus; **N** = Medium speed CAN bus; **O** = LIN Bus

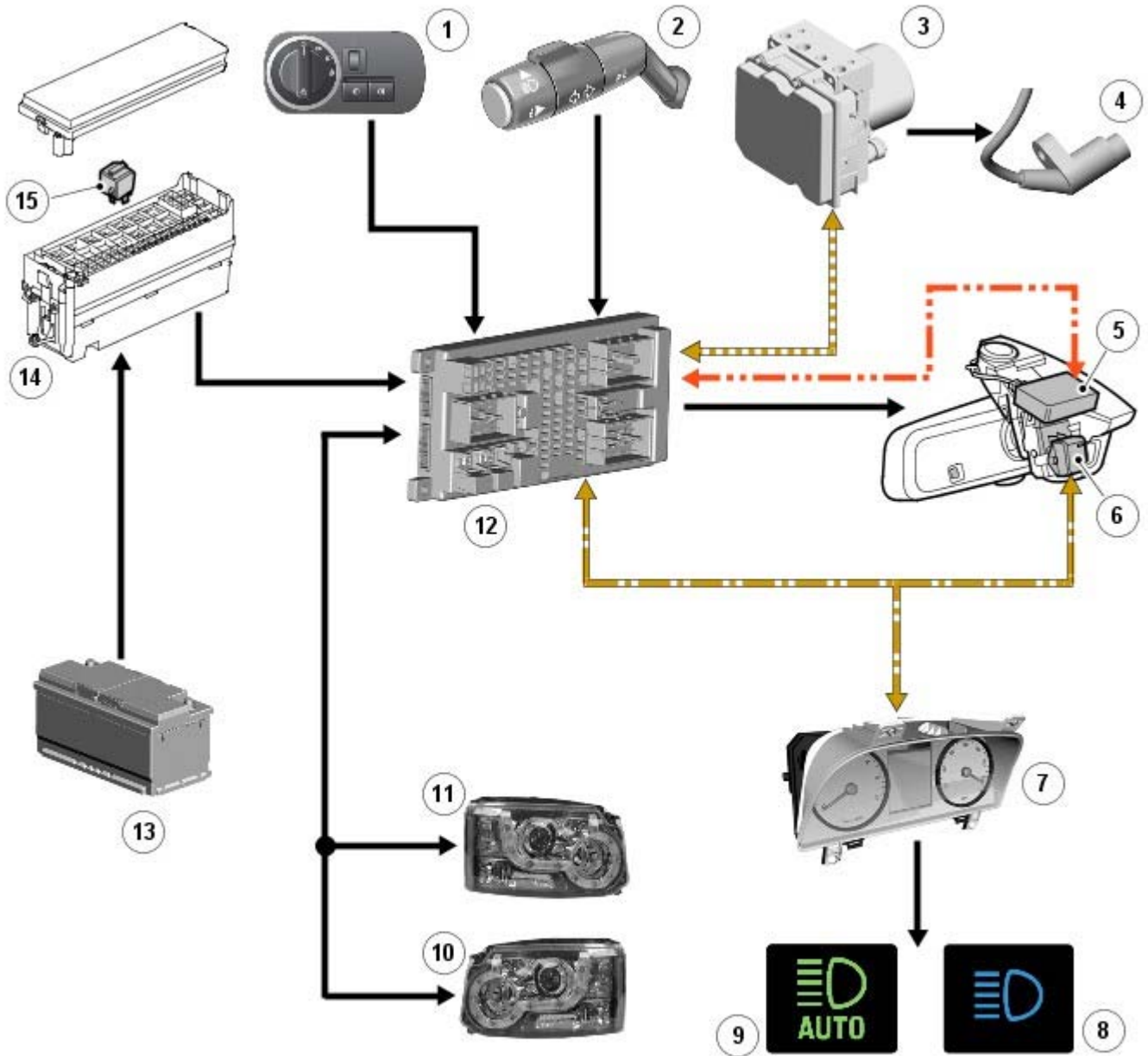


Item	Part Number	Description
1	-	Battery
2	-	LH side repeater turn signal indicator
3	-	RH side repeater turn signal indicator
4	-	LH Door module
5	-	RH Door module
6	-	License plate lamps (2 off)
7	-	High mounted stop lamp
8	-	LH rear lamp assembly
9	-	RH rear lamp assembly
10	-	LH headlamp assembly
11	-	RH headlamp assembly
12	-	Central Junction Box (CJB)
13	-	AFS control module
14	-	Transfer box control module
15	-	Transmission reverse switch (manual transmission only)
16	-	Transmission Control Module (TCM) (Automatic transmission only)
17	-	Instrument cluster
18	-	Engine Control Module (ECM)
19	-	Stop lamp switch
20	-	Auto high beam image sensor and control module
21	-	Rain/light sensor
22	-	Lighting control switch
23	-	LH steering column multifunction switch
24	-	Hazard warning indicators switch

25	-	Engine Junction Box (EJB)
26	-	Auto high beam relay

AUTO HIGH BEAM CONTROL DIAGRAM

• NOTE: **A** = Hardwired; **D** = High Speed CAN; **N** = Medium Speed CAN; **O** = LIN Bus



E121553



Item	Part Number	Description
1	-	Lighting control switch
2	-	LH steering column multifunction switch
3	-	Anti-lock Brake System (ABS) module
4	-	Wheel speed sensor
5	-	Rain/light sensor (Ref)
6	-	Auto high beam control module and image sensor
7	-	Instrument cluster
8	-	High beam warning indicator
9	-	Auto high beam warning indicator
10	-	LH headlamp assembly
11	-	RH headlamp assembly
12	-	Central Junction Box (CJB)
13	-	Battery
14	-	Engine Junction Box (EJB)
15	-	Auto high beam relay

Exterior Lighting - Headlamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Safety Information



WARNING: The xenon headlamp system generates up to 28,000 volts. Make sure that the headlamps are switched off before working on the system. Failure to follow this instruction may result in personal injury.

The following safety precautions must be followed when working on the xenon headlamp system:

1. **1.** DO NOT attempt any procedures on the xenon headlamps when the lights are switched on.
2. **2.** Handling of the xenon bulb must be performed using suitable protective equipment, e.g. gloves and goggles. The glass part of the bulb must not be touched.
3. **3.** Xenon bulbs must be disposed of as hazardous waste.
4. **4.** Only operate the lamp in a mounted condition in the reflector.

There are comprehensive instructions on the correct procedures for xenon headlamp system repairs in the workshop manual, refer to section 100-00 - General Information, Standard Workshop Procedures.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Headlamp(s) condition and installation ● Bulb(s) and installation ● Bulb holder(s) and installation ● Lighting control switch and installation ● Left-hand steering column multifunction switch and installation 	<ul style="list-style-type: none"> ● Fuses ● Relays ● Wiring harness ● Loose or corroded connector(s) ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Adaptive Front Lighting System (AFS) module ● Headlamp power modules ● Instrument Cluster (IPC) ● Steering Angle Sensor Module (SASM) ● Transmission Control Module (TCM) ● Engine Control Module (ECM) ● Anti-lock Brake System (ABS) control module ● Air Suspension Control module ● Local Interconnect Network (LIN) circuits ● Controller Area Network (CAN) circuits

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Low beam lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Lighting control switch fault 	Check the bulb and fuse condition. Check the headlamp circuits. Check the lighting control switch function. Check the left-hand steering column multifunction switch operation. Refer to the electrical guides. Check for DTCs indicating a headlamp or related circuit fault.
High beam lamp(s) inoperative	<ul style="list-style-type: none"> ● Left-hand steering column multifunction switch fault 	

Symptom	Possible Causes	Action
Low beam lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Tourist lever set in the wrong position ● Circuit fault ● Lighting control switch fault ● Left-hand steering column multifunction switch fault 	Check the bulb condition and rating. Check the tourist lever is set correctly. Check the headlamp circuits. Check the lighting control switch function. Check the left-hand steering column multifunction switch function. Refer to the electrical guides.
High beam lamp(s) dim		
Low beam lamp(s) stuck on	<ul style="list-style-type: none"> ● Circuit fault ● Lighting control switch fault ● Left-hand steering column multifunction switch fault ● Headlamp timer function fault 	Check the headlamp circuits. Check the lighting control switch function. Check the left-hand steering column multifunction switch operation. Check the headlamp timer function. Refer to the electrical guides. Check for DTCs indicating a headlamp circuit fault.
High beam lamp(s) stuck on		
Headlamp low/high beam switching function inoperative	<ul style="list-style-type: none"> ● Circuit fault ● Left-hand steering column multifunction switch fault ● Xenon lamp shutter mechanism fault 	Check the headlamp circuits. Check the left-hand steering column multifunction switch operation. Check the xenon lamp shutter mechanism operation. Refer to the electrical guides. Check for DTCs indicating a headlamp circuit fault.
Warning lamp(s) inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Lighting control switch fault ● Left-hand steering column multifunction switch inoperative ● Circuit fault ● Instrument cluster fault 	Check the fuse(s). Check the lighting control switch function. Check the left-hand steering column multifunction switch function. Check the warning lamp circuits. Refer to the electrical guides. Check for DTCs indicating an instrument cluster or CAN system fault.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Headlamp Control Module A \(HCM\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Headlamp Control Module B \(HCM2\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Headlamp Leveling

Diagnosis and Testing

Principle of Operation

For a detailed description of the headlamp leveling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Headlamp leveling motor(s) and linkage(s) condition and installation ● Lighting control switch and installation ● Left-hand steering column multifunction switch and installation 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded connector(s) ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Adaptive Front Lighting System (AFS) module ● Headlamp power modules ● Engine Control Module (ECM) ● Anti-lock Brake System (ABS) control module ● Air suspension control module ● Local Interconnect Network (LIN) circuits ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Headlamp leveling system inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Leveling motor/linkage fault 	Check the fuse(s) condition. Check the headlamp leveling motor and linkage condition. Check the headlamp leveling circuit. Refer to the electrical guides. Check for DTCs indicating headlamp leveling circuit and air suspension system fault(s).
Headlamp alignment incorrect	<ul style="list-style-type: none"> ● Headlamp leveling circuit fault ● Air suspension system fault 	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Headlamp Control Module A \(HCM\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Headlamp Control Module B \(HCM2\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Stoplamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Stoplamp condition and installation ● Bulbs and installation ● Bulb holders and installation ● Stoplamp switch condition and installation 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded connector(s) ● Hill descent relay ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Anti-lock Braking Control module (ABS) ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Stoplamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● LED lamp failure ● Fuse(s) blown ● Circuit fault ● Stoplamp switch fault 	Check the bulb, LED lamp and fuse condition. Check the stoplamp circuits. Check the stoplamp switch function. Refer to the electrical guides. Check for DTCs indicating a stoplamp circuit fault.
Stoplamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault 	Check the bulb condition and rating. Check the stoplamp circuits. Refer to the electrical guides.
Stoplamp(s) stuck on	<ul style="list-style-type: none"> ● Stoplamp switch fault ● Circuit fault ● Hill descent relay circuit fault 	Check the stoplamp switch function. Check the stoplamp circuits. Refer to the electrical guides. Check for DTCs indicating a stoplamp circuit fault.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Turn Signal, Cornering and Hazard Lamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Turn signal lamp(s) condition and installation ● Cornering lamp(s) condition and installation ● Bulbs and installation ● Bulb holders and installation ● Lighting control switch and installation ● Left-hand steering column multifunction switch and installation ● Hazard lamp switch condition and installation 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded connector(s) ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Steering angle sensor ● Anti-lock Braking Control Module (ABS) ● Instrument Cluster (IPC) ● Adaptive Front Lighting System (AFS) module ● Restraints Control Module ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Turn signal/hazard lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Left-hand steering column multifunction switch fault ● Hazard lamp switch fault 	Check the bulb and fuse condition. Check the turn signal/hazard lamp circuits. Check the left-hand steering column multifunction switch function. Check the hazard lamp switch function. Refer to the electrical guides. Check for DTCs indicating a turn signal/hazard lamp circuit fault.
Turn signal/hazard lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault ● Left-hand steering column multifunction switch fault ● Hazard lamp switch fault 	Check the bulb condition and rating. Check the turn signal/hazard lamp circuits. Check the left-hand steering column multifunction switch function. Check the hazard lamp switch function. Refer to the electrical guides.
Turn signal/hazard lamp(s) stuck on	<ul style="list-style-type: none"> ● Left-hand steering column multifunction switch fault ● Hazard lamp switch fault ● Circuit fault 	Check the turn signal/hazard lamp circuits. Check the left-hand steering column multifunction switch function. Check the hazard lamp switch function. Refer to the electrical guides. Check for DTCs indicating a turn signal/hazard lamp circuit fault.
Warning lamp(s) inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Left-hand steering column multifunction switch inoperative ● Hazard lamp switch inoperative ● Circuit fault ● Instrument cluster fault 	Check the fuse(s). Check the left-hand steering column multifunction switch function. Check the hazard lamp switch function. Check the warning lamp circuits. Refer to the electrical guides. Check for DTCs indicating an instrument cluster or CAN system fault.

Symptom	Possible Causes	Action
Cornering lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Left-hand steering column multifunction switch fault ● Lighting control switch fault 	Check the bulb and fuse condition. Check cornering lamp circuits. Check the lighting control switch function. Check the left-hand steering column multifunction switch function. Refer to the electrical guides. Check for DTCs indicating a cornering lamp circuit fault.
Cornering lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault ● Left-hand steering column multifunction switch fault ● Lighting control switch fault 	Check the bulb condition and rating. Check the cornering lamp circuits. Check the left-hand steering column multifunction switch function. Check the lighting control switch function. Refer to the electrical guides.
Cornering lamp(s) stuck on	<ul style="list-style-type: none"> ● Left-hand steering column multifunction switch fault ● Lighting control switch fault ● Circuit fault 	Check the cornering lamp circuits. Check the left-hand steering column multifunction switch function. Check the lighting control switch function. Refer to the electrical guides. Check for DTCs indicating a cornering lamp circuit fault.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Parking, Rear and License Plate Lamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Rear lamp(s) condition and installation ● License lamp(s) condition and installation ● Bulbs and installation ● Bulb holders and installation ● Lighting control switch and installation ● Rain/Light sensor condition and installation 	<ul style="list-style-type: none"> ● Fuses ● Relays ● Wiring harness ● Loose or corroded connector(s) ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Rain/Light sensor control module ● Local Interconnect Network (LIN) circuits ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Rear/License lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Lighting control switch fault 	Check the bulb and fuse condition. Check the rear/license lamp circuits. Check the lighting control switch function. Refer to the electrical guides. Check for DTCs indicating a rear/license lamp circuit fault.
Rear/License lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault ● Lighting control switch fault 	Check the bulb condition and rating. Check the rear/license lamp circuits. Check the lighting control switch function. Refer to the electrical guides.
Rear/License lamp(s) stuck on	<ul style="list-style-type: none"> ● Circuit fault ● Lighting control switch fault 	Check the rear/license lamp circuits. Check the lighting control switch function. Refer to the electrical guides. Check for DTCs indicating a rear/license lamp circuit fault.
Rear/License lamp(s) inoperative when the automatic headlamp switch option is selected	<ul style="list-style-type: none"> ● Fuse(s) blown ● Lighting control switch fault ● Circuit fault ● Rain/Light sensor fault ● LIN circuit fault 	Check the fuse(s). Check the lighting control switch function. Check the automatic headlamp circuit. Refer to the electrical guides. Check for DTCs indicating a rain/light sensor or LIN system fault.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Front Fog Lamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Front fog lamp condition and installation ● Bulb and installation ● Bulb holder and installation ● Adjuster screw ● Fog lamp switch condition and installation 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded connector(s) ● Fog lamp relay ● Fog lamp warning indicator ● Fog lamp switch ● Battery Junction Box (BJB) ● Central Junction Box (CJB)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Fog lamp inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Switch inoperative 	Check the bulb condition. Check the fuse(s). Check the fog lamp circuits. Check the switch function. Refer to the electrical guides.
Fog lamp dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault ● Switch fault 	Check the bulb condition and rating. Check the fog lamp circuits. Check the switch function. Refer to the electrical guides.
Fog lamp lighting coverage poor	<ul style="list-style-type: none"> ● Fog lamp alignment incorrect 	Check and adjust fog lamp alignment.
Warning lamp inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Switch inoperative ● Circuit fault ● Instrument cluster fault 	Check the fuse(s). Check the switch function. Check the warning lamp circuits. Refer to the electrical guides. Check for DTCs indicating an instrument cluster fault.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Rear Fog Lamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Rear fog lamp condition and installation ● Bulb holder and installation ● Bulb and installation ● Fog lamp switch condition and installation 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded connector(s) ● Fog lamp relay ● Fog lamp warning indicator ● Fog lamp switch ● Battery Junction Box (BJB) ● Central Junction Box (CJB)

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Fog lamp inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Switch inoperative 	Check the bulb condition. Check the fuse(s). Check the fog lamp circuits. Check the switch function. Refer to the electrical guides.
Fog lamp dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault ● Switch fault 	Check the bulb condition and rating. Check the fog lamp circuits. Check the switch function. Refer to the electrical guides.
Warning lamp inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Switch inoperative ● Circuit fault ● Instrument cluster fault 	Check the fuse(s). Check the switch function. Check the warning lamp circuits. Refer to the electrical guides. Check for DTCs indicating an instrument cluster fault.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Reversing Lamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Reversing lamp condition and installation ● Bulb and installation ● Bulb holder and installation 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Loose or corroded connector(s) ● Reversing lamp relay ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Transmission Control Module (TCM) ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Reversing lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Missing reversing switch signal 	Check the bulb and fuse condition. Check the reversing lamp circuits. Refer to the electrical guides. Check for DTCs indicating a reversing lamp circuit fault.
Reversing lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault 	Check the bulb condition and rating. Check the reversing lamp circuits. Refer to the electrical guides.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Trailer Lamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.
- NOTE: Prior to carrying out fault diagnosis of the trailer lamp system, verify the operation of the towing vehicle lighting system with the trailer lighting plug(s) disconnected from the vehicle socket(s).

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Trailer lamp(s) condition and installation ● Bulbs and installation ● Bulb holders and installation ● Trailer socket(s), plug(s) and installation 	<ul style="list-style-type: none"> ● Fuses ● Relays ● Stop lamp switch ● Wiring harness ● Loose or corroded connector(s) ● Trailer socket(s) ground circuit(s) ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Trailer fuse box ● Trailer relay box ● Instrument Cluster (IPC) ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Trailer brake lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Brake lamp switch fault 	Check the bulb and fuse condition. Check the trailer brake lamp circuit. Check the brake lamp switch function. Refer to the electrical guides.
Trailer brake lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault ● Brake lamp switch fault 	Check the bulb condition and rating. Check the trailer brake lamp circuit. Check the brake lamp switch function. Refer to the electrical guides.
Trailer brake lamp(s) stuck on	<ul style="list-style-type: none"> ● Circuit fault ● Brake lamp switch fault 	Check the trailer brake lamp circuits. Check the brake lamp switch function. Refer to the electrical guides.
Trailer fog lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault 	Check the bulb and fuse condition. Check the trailer fog lamp circuit. Refer to the electrical guides.
Trailer fog lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault 	Check the bulb condition and rating. Check the trailer fog lamp circuit. Refer to the electrical guides.
Trailer fog lamp(s) stuck on	<ul style="list-style-type: none"> ● Circuit fault 	Check the trailer fog lamp circuit. Refer to the electrical guides.
Trailer tail and number plate lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Trailer side lamp relay fault 	Check the bulb and fuse condition. Check the trailer tail and number plate lamp circuit. Check the trailer tail and number plate lamp relay function. Refer to the electrical guides.

Symptom	Possible Causes	Action
Trailer tail and number plate lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault ● Trailer side lamp relay fault 	Check the bulb condition and rating. Check the trailer tail and number plate lamp circuit. Check the trailer side lamp relay function. Refer to the electrical guides.
Trailer tail and number plate lamp(s) stuck on	<ul style="list-style-type: none"> ● Circuit fault ● Trailer tail and number plate lamp relay fault 	Check the trailer tail and number plate lamp circuit. Check the trailer tail and number plate lamp relay function. Refer to the electrical guides.
Trailer turn signal lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault 	Check the bulb and fuse condition. Check the trailer turn signal lamp circuit. Refer to the electrical guides.
Trailer turn signal lamp(s) dim	<ul style="list-style-type: none"> ● Incorrect bulb rating ● Circuit fault 	Check the bulb condition and rating. Check the trailer turn signal lamp circuits. Refer to the electrical guides.
Trailer turn signal lamp(s) stuck on	<ul style="list-style-type: none"> ● Circuit fault 	Check the bulb and fuse condition. Check the trailer turn signal lamp circuit. Refer to the electrical guides.
Trailer reverse lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Trailer reverse lamp relay fault 	Check the bulb and fuse condition. Check the trailer reverse lamp circuit. Check the trailer reverse lamp relay function. Refer to the electrical guides.
Trailer reverse lamp(s) dim	<ul style="list-style-type: none"> ● Circuit fault ● Trailer reverse lamp relay fault 	Check the bulb condition and rating. Check the trailer reverse lamp circuit. Check the trailer reverse lamp relay function. Refer to the electrical guides.
Trailer reverse lamp(s) stuck on	<ul style="list-style-type: none"> ● Circuit fault ● Trailer reverse lamp relay fault 	Check the trailer reverse lamp circuit. Check the trailer reverse lamp relay function. Refer to the electrical guides.
Warning lamp(s) inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Circuit fault ● Instrument cluster fault 	Check the fuse(s). Check the warning lamp circuit. Refer to the electrical guides. Check for DTCs indicating an instrument cluster or CAN system fault.
Trailer socket battery feed missing	<ul style="list-style-type: none"> ● Fuse(s) blown ● Circuit fault 	Check the fuse condition. Check the trailer battery feed circuit. Refer to the electrical guides.
Trailer socket ignition feed missing	<ul style="list-style-type: none"> ● Fuse(s) blown ● Circuit fault ● Trailer socket relay faulty 	Check the fuse condition. Check the trailer ignition feed circuit. Check the trailer ignition feed relay operation. Refer to the electrical guides.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Autolamps

Diagnosis and Testing

Principle of Operation

For a detailed description of the exterior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Lighting control switch and installation ● Rain/Light sensor condition and installation ● Wiper control switch and installation 	<ul style="list-style-type: none"> ● Fuses ● Relays ● Wiring harness ● Loose or corroded connector(s) ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Rain/Light sensor control module ● Local Interconnect Network (LIN) circuits ● Controller Area Network (CAN) circuits

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Side and headlamp(s) inoperative when the automatic headlamp switch option is selected	<ul style="list-style-type: none"> ● Fuse(s) blown ● Lighting control switch fault ● Wiper control switch fault ● Circuit fault ● Rain/Light sensor fault ● LIN circuit fault 	Check the fuse(s). Check the lighting and wiper control switch functions. Check the automatic headlamp circuit. Refer to the electrical guides. Check for DTCs indicating a rain/light sensor or LIN system fault.
Automatic headlamp switch illumination inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Lighting control switch fault ● Circuit fault ● Automatic headlamp relay fault 	Check the fuse(s). Check the lighting control switch function. Check the automatic headlamp relay circuit. Refer to the electrical guides. Check for DTCs indicating an automatic headlamp fault.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Exterior Lighting - Brake Pedal Position (BPP) Switch Adjustment

General Procedures

1. Adjust the brake pedal position (BPP) switch.
 - For vehicles with petrol engine,
For additional information, refer to: [Brake Pedal Position \(BPP\) Switch Adjustment](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, General Procedures) / [Brake Pedal Position \(BPP\) Switch Adjustment](#) (303-14D Electronic Engine Controls - V8 5.0L Petrol, General Procedures).
 - For vehicles with diesel engine,
For additional information, refer to: [Brake Pedal Position \(BPP\) Switch Adjustment](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, General Procedures) / [Brake Pedal Position \(BPP\) Switch Adjustment](#) (303-14B Electronic Engine Controls - TDV6 3.0L Diesel, General Procedures).

Exterior Lighting - Headlamp Adjustment

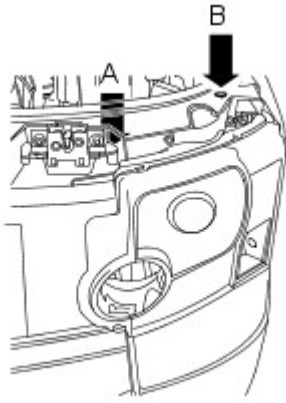
General Procedures

- NOTE: With self leveling suspension, make sure the vehicle is at the standard ride height.
- NOTE: The headlamp setting is 1.2 % below horizontal and parallel.
- NOTE: NAS vehicles have vertical adjustment only.

1. Align the headlamp beam setting equipment to one headlamp.
2. Switch the headlamps on and to dipped beam.
3. NOTE: NAS vehicles have vertical adjustment only.

Adjust the headlamps with a Philips screwdriver.

- Rotate the adjusters A and B by an equal amount for vertical alignment.
- Rotate the adjusters A or B for horizontal alignment.



E49806

4. To adjust the second headlamp, repeat the above procedure.

Exterior Lighting - Front Fog Lamp Adjustment

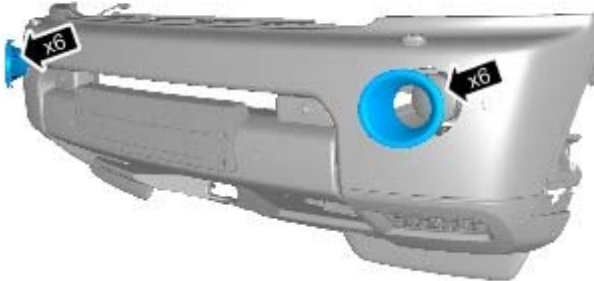
General Procedures

Check

- NOTE: With self leveling suspension, make sure the vehicle is at the standard ride height.

1. 1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- NOTE: The fog lamp setting is 2% below horizontal.

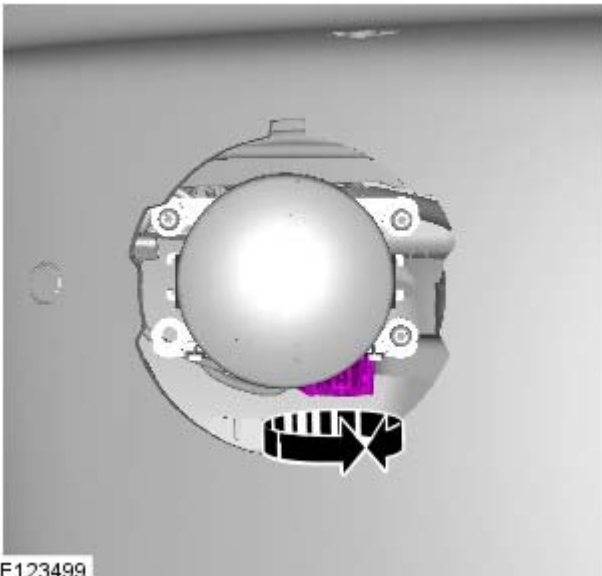


E123793

Adjustment

- NOTE: With self leveling suspension, make sure the vehicle is at the standard ride height.

1. 2. NOTE: The procedure must be carried out on both sides.



E123499

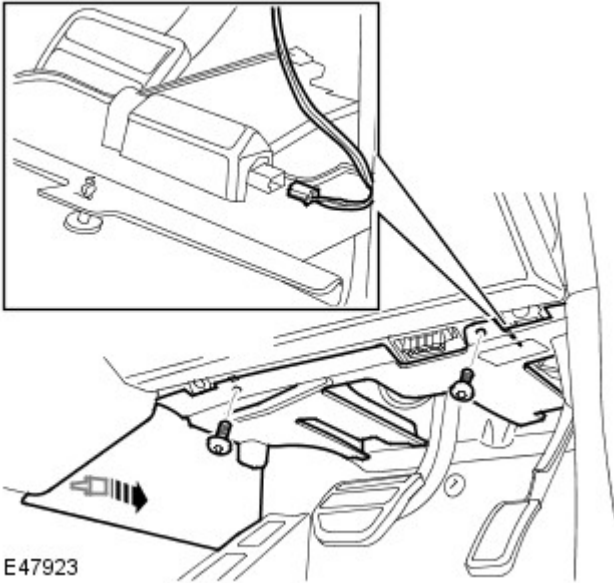
Exterior Lighting - Stoplamp Switch

Removal and Installation


Removal

1. Remove the closing trim panel.

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.

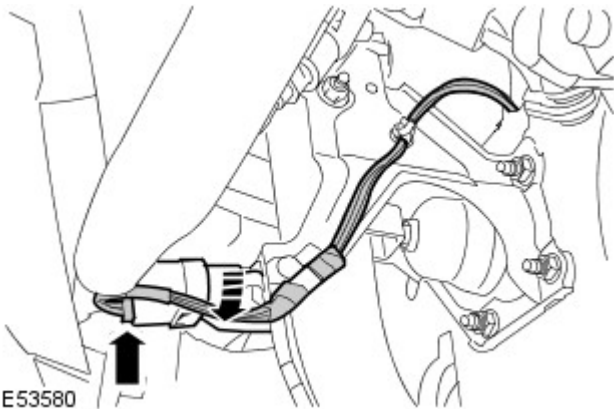


E47923

2.  CAUTION: The brake pedal MUST NOT be depressed during this operation. Failure to comply will result in damage to the stoplamp switch.

Remove the stoplamp switch.


- Disconnect the electrical connector.
- Rotate the switch clockwise.




E53580

Installation

1. CAUTIONS:

 The brake pedal MUST NOT be depressed during this operation. Failure to comply will result in damage to the stoplamp switch.

 Make sure that excessive force is not used when installing the stoplamp switch. Failure to follow this instruction may result in damage to the stoplamp switch.

Install the stoplamp switch.

- Rotate the switch counterclockwise.
- Connect the electrical connector.

2. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.

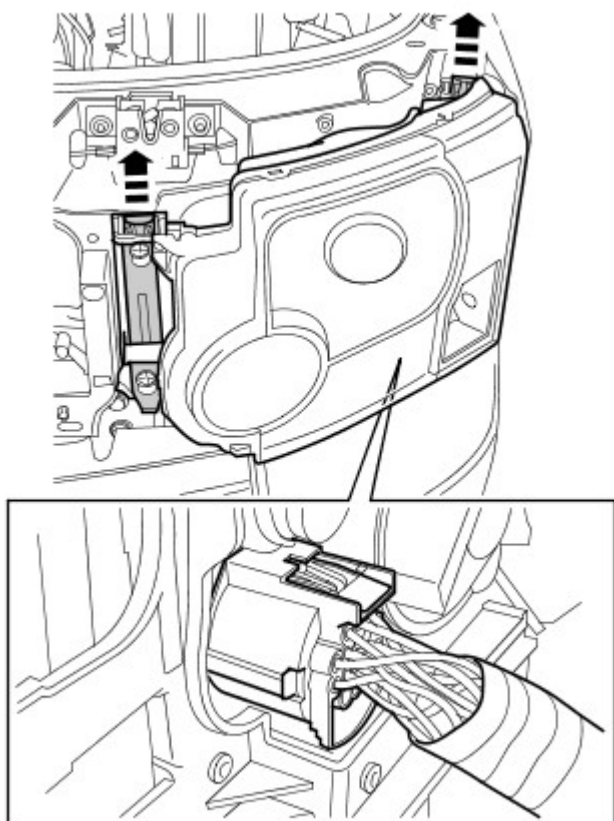
Exterior Lighting - Headlamp Assembly

Removal and Installation

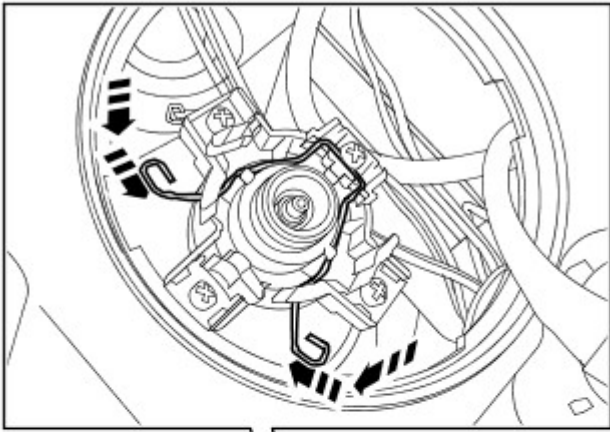
Removal

⚠ WARNING: Vehicles fitted with Xenon headlamps, the following precautions must be observed. Failure to comply may result in exposure to ultra violet rays, severe electric shock, burns or the risk of explosion. Ensure the headlamps are switched off at all times. Eye and hand protection must be worn. Never switch on the lamps or test the bulbs with the lamp holder released from the headlamp.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
3. Remove the headlamp assembly.
 - Release the 2 clips.
 - Disconnect the electrical connector.



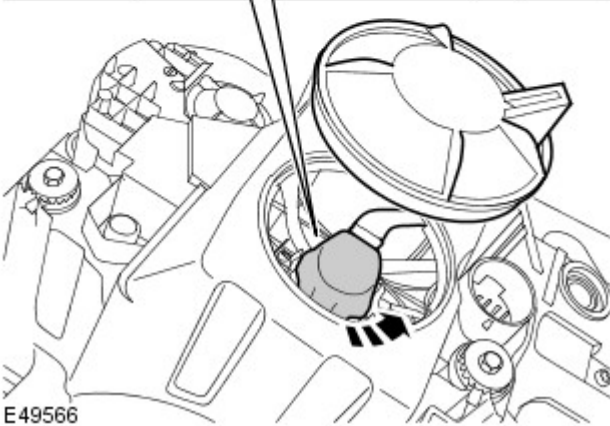
E49565



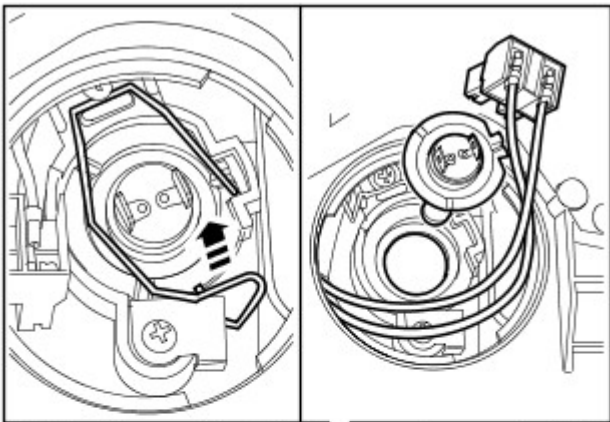
4. NOTE: High intensity discharge lamp bulb illustrated.
- NOTE: Do not disassemble further if the component is removed for access only.
 - NOTE: If installed, leave the Silica Gel sachet in place.

Remove the headlamp bulb.

- Remove the cover.
- Disconnect the electrical connector.
- Release the clip.

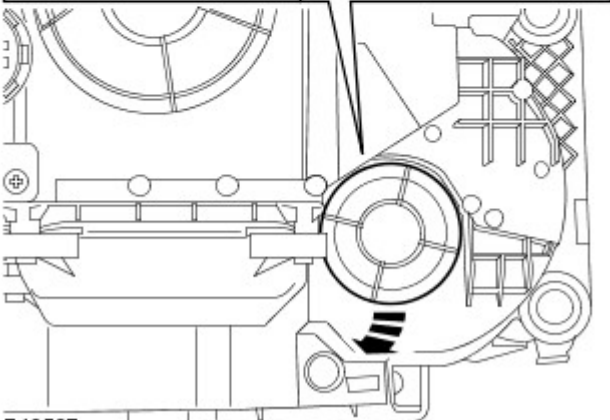


E49566



5. Remove the headlamp inner bulb.

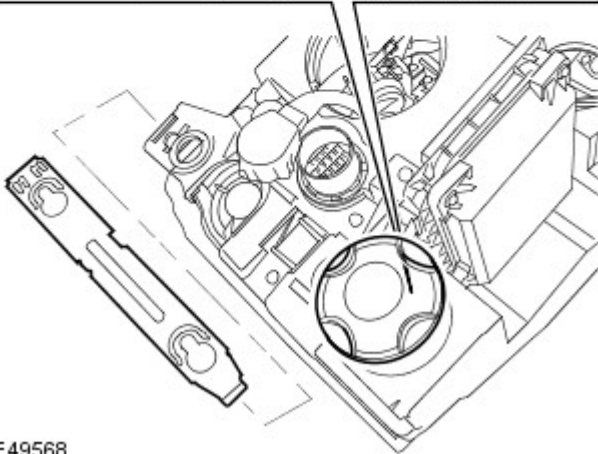
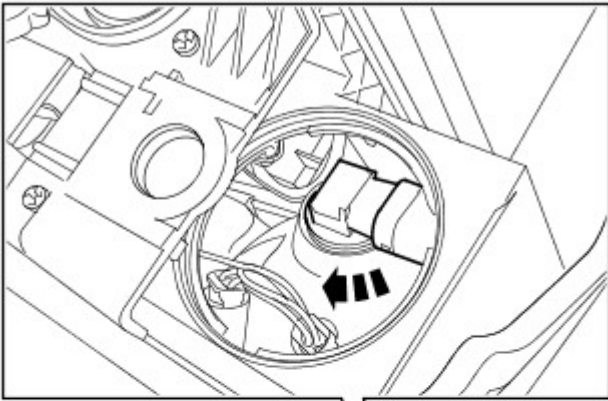
- Remove the cover.
- Disconnect the electrical connector.
- Release the clip.



E49567

6. Remove the headlamp outer bulb.

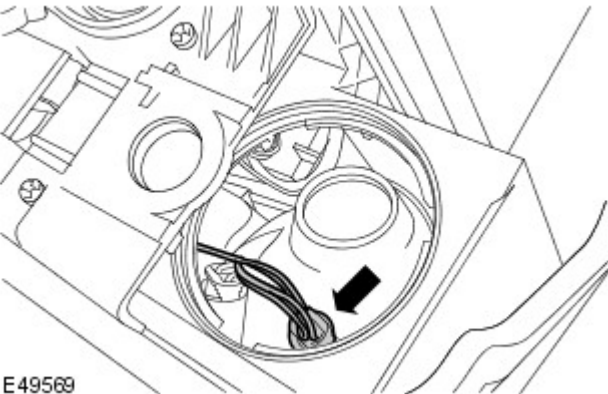
- Remove the headlamp outer retaining clip.
- Remove the cover.
- Release the electrical connector.



E49568

7. Remove the side lamp bulb.

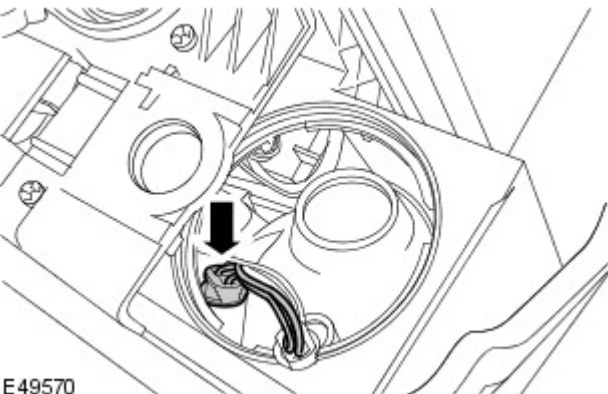
- Release the bulb holder.



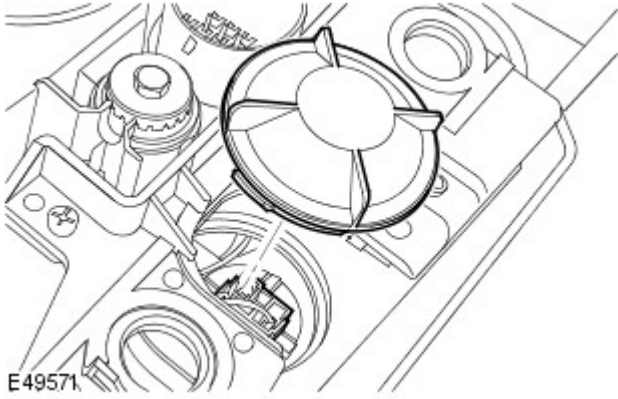
E49569

8. Remove the side marker bulb.

- Release the bulb holder.

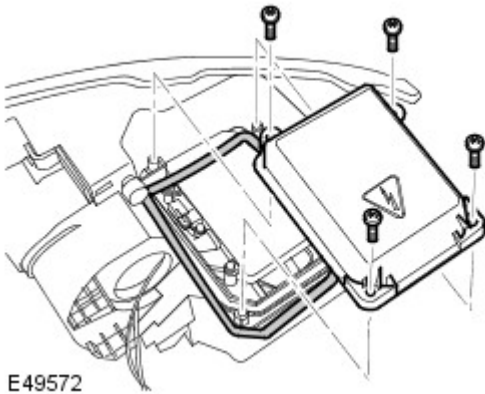


E49570



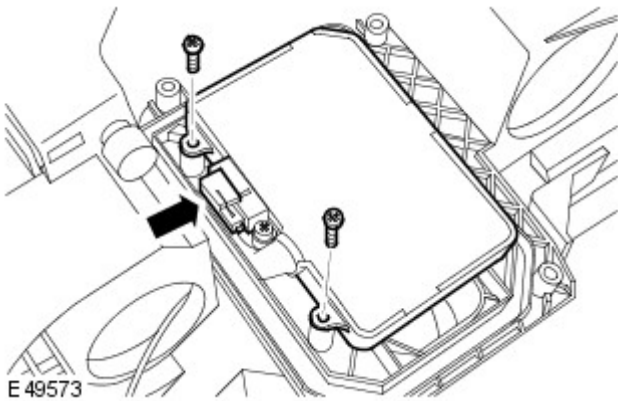
9. Remove the turn signal indicator bulb.

- Remove the cover.
- Release the bulb holder.



10. Remove the gas discharge module cover.

- Remove the 4 screws.
- Remove the seal.



11. Remove the gas discharge module.

- Remove the 2 screws.
- Disconnect the electrical connector.

Installation


1. Install the gas discharge module.
 - Connect the electrical connector.
 - Tighten the 2 screws.
2. Install the gas discharge module cover.
 - Install the seal.
 - Tighten the screws.
3. Install the turn signal indicator bulb.
 - Secure the bulb holder.
 - Install the cover.
4. Install the side marker bulb.
 - Install the bulb holder.

5. Install the side lamp bulb.

- Install the bulb holder.


6. Install the headlamp outer bulb.

- Connect the electrical connector.
- Install the cover.
- Install the headlamp outer retaining clip.

7.  CAUTION: Make sure the seal is installed correctly.

Install the headlamp inner bulb.

- Secure with the clip.
- Connect the electrical connector.
- Install the cover.

8.  CAUTION: Make sure the seal is installed correctly.

Install the headlamp bulb.

- Secure with the clip.
- Connect the electrical connector.
- Install the cover.

9. Install the headlamp assembly.

- Connect the electrical connector.
- Secure with the 2 clips.

10. Install the radiator grille.

For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

11. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

12. NOTE: The headlamp setting is 1.2 % below horizontal and parallel.

Check the headlamp beam alignment.

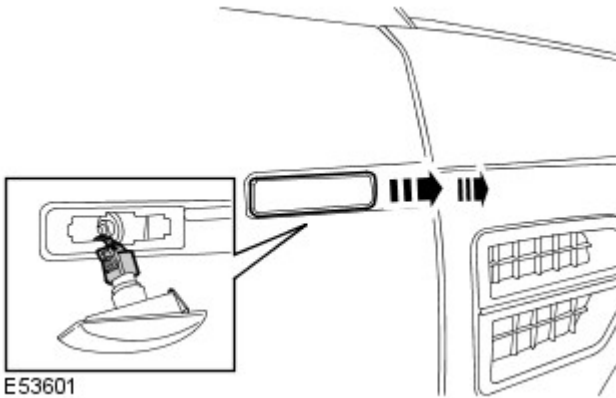
Exterior Lighting - Side Turn Signal Lamp

Removal and Installation

Removal

1. Remove the side turn signal lamp.

- Push the lamp forwards to release it from the door.
- Disconnect the electrical connector.



Installation

1. To install, reverse the removal procedure.

Exterior Lighting - Rear Lamp Assembly

Removal and Installation

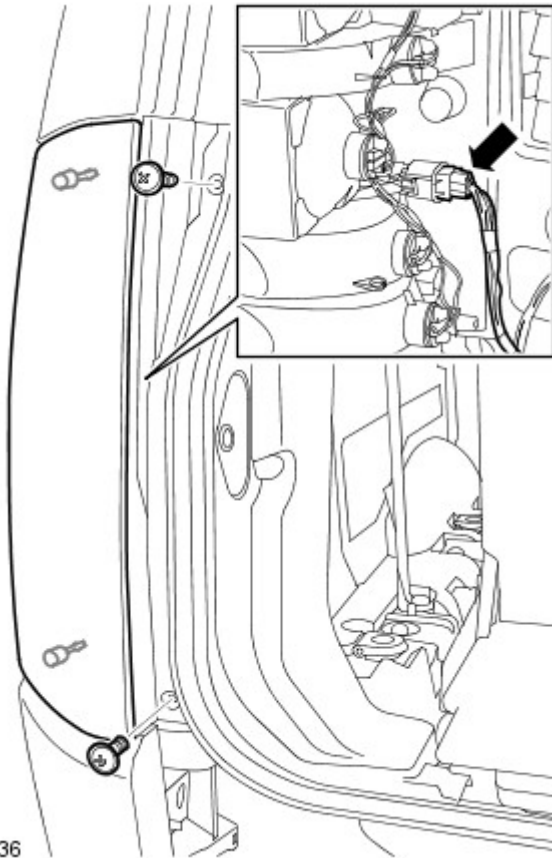
Removal

1. Open the liftgate and tailgate.

2.  **CAUTION:** Always protect paintwork and glass when removing exterior components.

Remove the rear lamp assembly.

- Remove the 2 screws.
- Release the 2 clips.
- Disconnect the electrical connector.



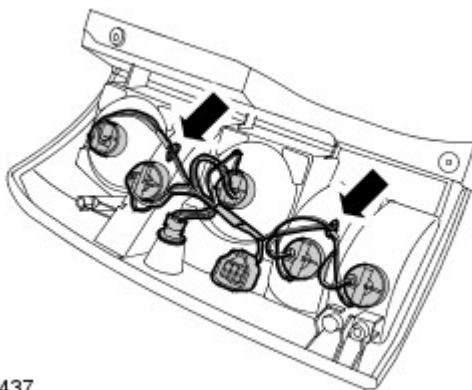
E45436

3. **NOTE:** Do not disassemble further if the component is removed for access only.

- **NOTE:** Note the fitted position.

Remove the wiring harness.

- Release the wiring harness from the 2 clips.
- Release the 6 bulb holders.
- Release the electrical connector.



E45437

Installation

1. Install the wiring harness.

- Install the 6 bulb holders.
- Install the electrical connector.
- Secure the wiring harness in the clips.

2. Install the rear lamp assembly.

- Connect the electrical connector.
- Secure with the 2 clips.
- Tighten the screws.

Exterior Lighting - Front Fog Lamp

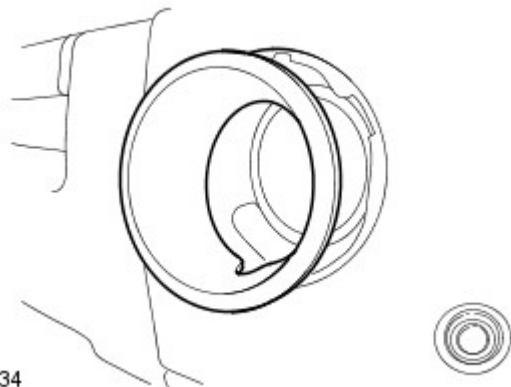
Removal and Installation

Removal

1. **NOTE:** Release each clip individually. Clips may fall off if care is not taken.

Remove the front fog lamp bezel.

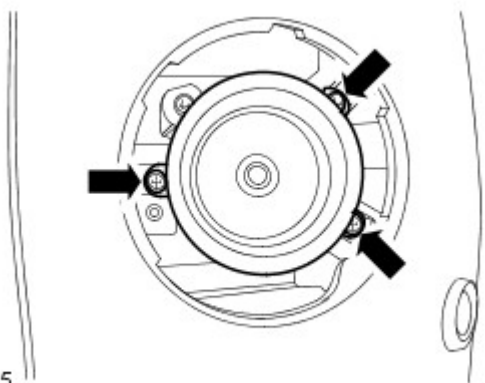
- Release the 6 clips.



E47034

2. Release the front fog lamp.

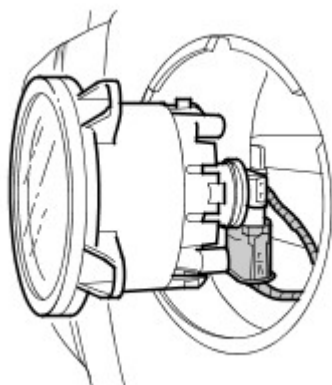
- Remove the 3 screws.



E47035

3. Remove the front fog lamp.

- Disconnect the front fog lamp electrical connector.



E47036

Installation

1. Connect the front fog lamp electrical connector.

2. Install the front fog lamp.

- Tighten the screws.

3. Install the front fog lamp bezel.

- Secure the clips.

4. Check the fog lamp beam alignment.

Exterior Lighting - High Mounted Stoplamp

Removal and Installation

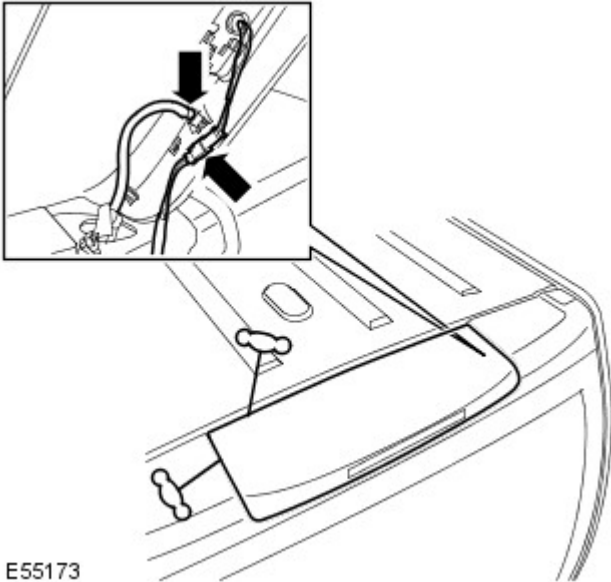
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **CAUTION:** Always protect paintwork and glass when removing exterior components.

Remove the high mounted stoplamp.

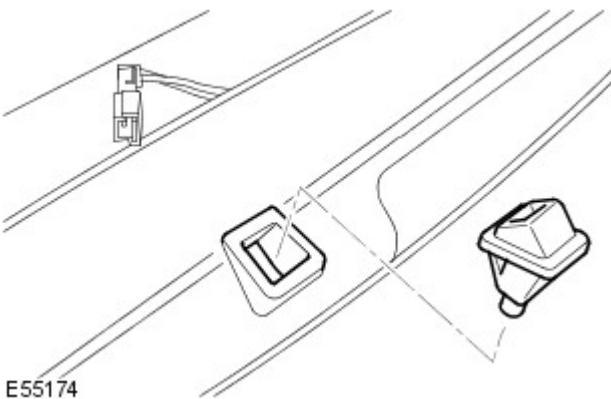
- Carefully cut through the sealant using a glazing knife.
- Disconnect the electrical connector.
- Disconnect the washer jet hose.



E55173

3. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the washer jet.

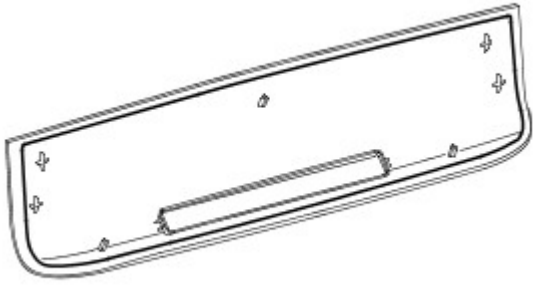


E55174

Installation

1. Install the washer jet.
2. Carefully remove the sealant from the body to leave a smooth surface.
3. Install the high mounted stoplamp.
 - Check for correct alignment.
4. Remove the high mounted stoplamp.
5. Apply etch primer to any bare metal.
6. Apply primer over the etch primer.
7. Apply activator to the high mounted stoplamp.
8. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.

9. Apply an 8.0 mm (0.30 in) wide continuous bead of sealant, 15.0 mm (0.60 in) in, from the outer edge of the high mounted stoplamp as shown.



E55183

10. Install the high mounted stoplamp.

- Connect the washer jet hose.
- Connect and secure the electrical connector.

11. Connect the battery ground cable.

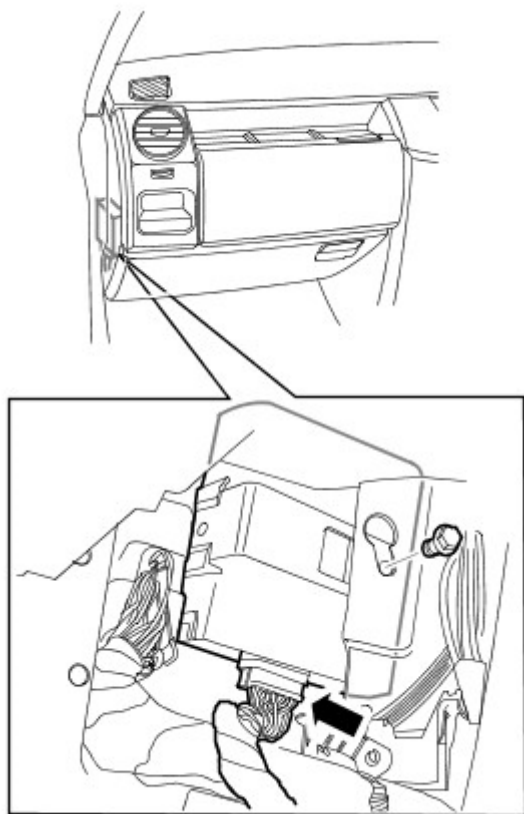
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Exterior Lighting - Adaptive Front Lighting Module

Removal and Installation

Removal

1. Passenger side: Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the CJB.
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
3. Remove the adaptive front lighting module.
 - Disconnect the electrical connector.
 - Remove the bolt.



E55696

Installation

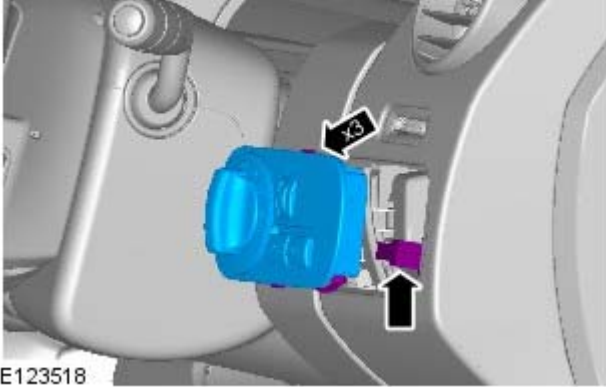
1. Install the adaptive front lighting module.
 - Tighten the bolt to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Install the CJB.
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
3. Install the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Exterior Lighting - Headlamp Switch

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.



1.  CAUTION: Protect the surrounding trim to avoid damage.

- NOTE: The ignition must be switched off.

Installation

1. To install, reverse the removal procedure.

Exterior Lighting - Approach Lamp Vehicles With: Parking Aid Camera

Removal and Installation


Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: RH illustration shown, LH is similar.
- NOTE: The ignition must be switched off.

1. Refer to: [Exterior Mirror Cover](#) (501-09 Rear View Mirrors, Removal and Installation).

2. **2. CAUTIONS:**

 Take extra care not to damage the component.

 Take extra care not to damage the wiring harnesses.

Torque: 0.5 Nm



E123783

Installation

1. To install, reverse the removal procedure.

Interior Lighting -

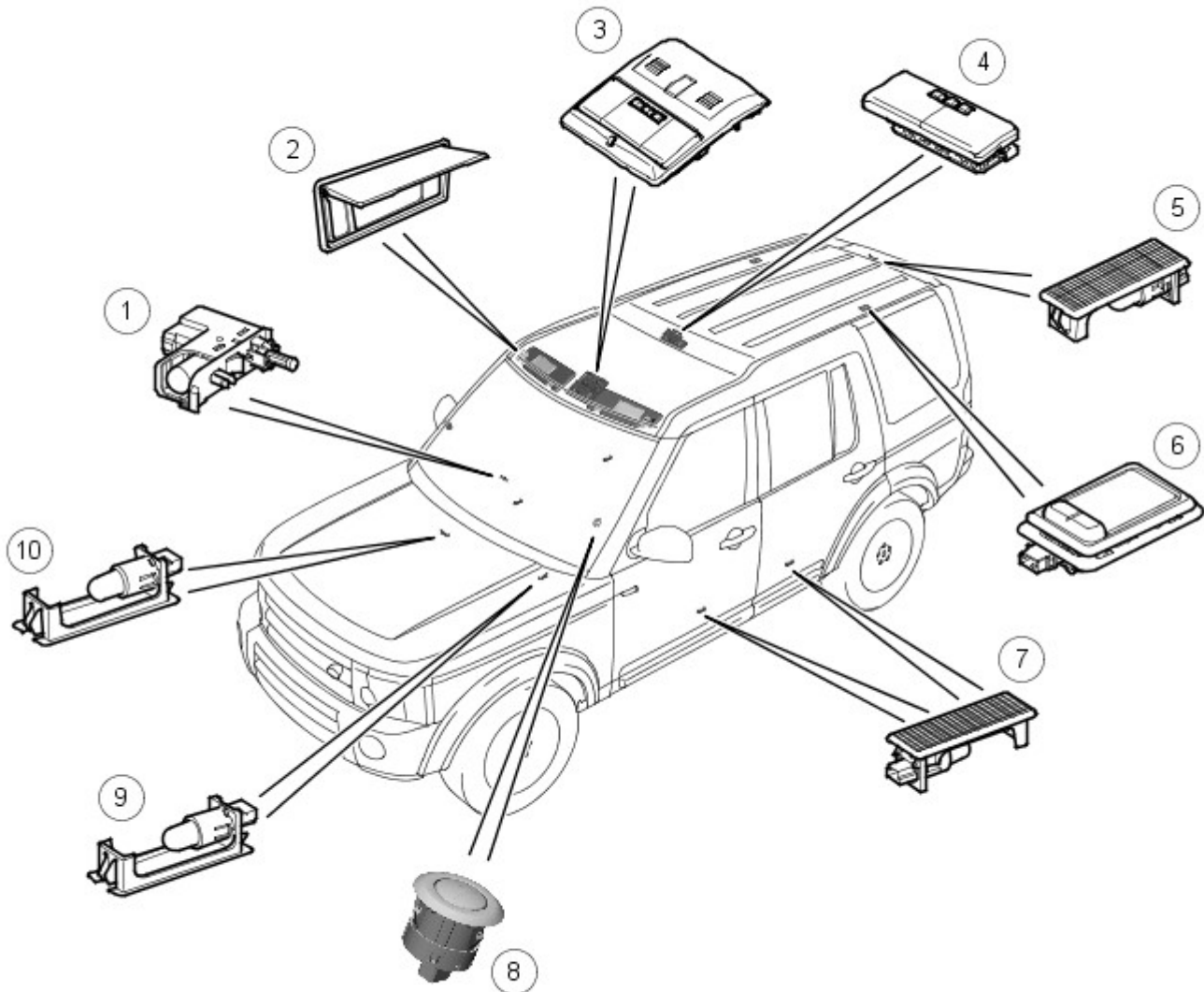
Lamp bulbs

Bulb	Type	Rating
Puddle lamps	Capless	W5W
Footwell lamps	Capless	W5W
Map lamps	Capless	W5W
Courtesy lamps	Capless	W5W
Interior lamps	Capless	W5W
Loadspace lamps	Capless	W5W

Interior Lighting - Interior Lighting

Description and Operation

Interior Lighting Component Location



E131968

Item	Part Number	Description
1	-	Glove compartment lamp and switch
2	-	Vanity mirror lamps
3	-	1st row interior lamp and map reading lamps
4	-	2nd row interior lamp and map reading lamps
5	-	Luggage compartment lamp
6	-	3rd row map lamps (if fitted)
7	-	Puddle lamps
8	-	Ignition push button illumination
9	-	Driver footwell lamp
10	-	Passenger footwell lamp

GENERAL

The interior lighting system comprises the following interior lamps:

- Interior lamps
- Map reading lamps
- Glove compartment lamp
- Luggage compartment lamps

- Vanity mirror lamps
- Footwell lamps
- Puddle lamps
- Ignition push button illumination

Interior Bulb/Type Rating

The following table shows the bulbs used for the interior lighting system and their type and specification.

Bulb	Type	Rating
Front and rear interior lamps	Capless	5W
Front and rear map reading lamps	Capless	5W
Luggage compartment lamp	Capless	5W
Vanity mirror lamps	Festoon	14V 0.1A (1.4W)
Door puddle lamps	Capless	5W
Lower instrument panel footwell lamps	Capless	5W
Glove compartment lamp	Festoon	5W

CENTRAL JUNCTION BOX

The Central Junction Box (CJB) is an integrated unit located behind the instrument panel on the passenger side of the bulkhead. The CJB contains fuses, relays and a number of microprocessors which control the power supply and functionality of the interior lighting system and other vehicle systems.

The interior lamps are controlled by the CJB and have two types, Courtesy (switched by the doors; key; etc) and Demand lighting (controlled by the user). The Courtesy mode divided into Manual (the interior lamps can be switched on and off using the momentary and latching switches adjacent to each lamp or disabled completely using the same switches) and Automatic (the interior lamp functionality is controlled by the CJB on receipt of various input signals).

Input signals

The CJB receives the following inputs which affect the operation of the interior lamps:

- Ignition mode
- Door switches
- Tailgate switch
- Glove compartment lamp switch
- Lock/unlock signal
- Interior lamp switches
- Map reading lamp switches
- Battery saver relay
- Vanity mirror lamp switches

Circuit Protection

The CJB provides circuit protection for all interior lamp circuits. The following interior lamp circuits are protected by Field Effect Transistors (FETs):

- Luggage compartment lamps
- Footwell lamps
- Courtesy lights
- Ignition push button illumination
- Puddle lamps.

The above components are protected by FETs which can detect overloads and short circuits. The FETs respond to heat generated by increased current flow caused by a short circuit. On a normal circuit this would cause the fuse to blow, rendering that component and circuit inoperative. The FETs respond to the heat increase and disconnect the supply to the affected circuit. When the fault is rectified or the FET has cooled, the FET will reset and operate the circuit normally.

The following interior lamps circuits are protected by Fuse 57P (10A) in the CJB and part of the Battery Saver mode:

- Glove compartment lamp
- Map reading lamps
- Vanity mirror lamps.

Interior Lamp Time-out

The interior lamps are controlled by a timer within the CJB which allows a 60 second delay period for the lamps to remain on after the ignition mode has been changed to off power mode 0 or when the vehicle is unlocked. The following interior lamps are subject to the delay period:

- Interior lamps
- Footwell lamps
- Luggage compartment lamps
- Puddle lamps

The time-out delay is activated when the CJB receives one of the following signals:

- An unlock signal from the Smart Key via the keyless vehicle module.
- Ignition mode is changed from the crank power mode 9 or ignition power mode 6 to the accessory power mode 4 to the off power mode 0.

If a second occurrence of one of the above actions occurs within the time-out period, the timer will be reset and the delay period will start again.

The time-out delay is deactivated when the CJB receives one of the following signals:

- A lock signal from the Smart Key via the keyless vehicle module
- Ignition mode is changed from the off power mode 0 to the accessory power mode 4 or ignition power mode 6.
- The CJB receives a door opened signal (even if door is subsequently closed)

Battery Saver

The battery saver feature provides automatic shut-off of the interior lamps after a period of 15 minutes in order to prevent excessive drain on the battery. The lamp(s) fade off as described in the 'Interior Lighting' section that follows.

The battery saver feature is additional to the time-out delay feature and prevents battery drain when an lamp is accidentally left switched on, e.g. glove compartment left open.

When the ignition mode is changed from the ignition power mode 6 or accessory power mode 4 to the off power mode 0, the CJB starts a timer which automatically switches off all interior lamps when the 15 minute period has expired.

Once the timer has expired and the lamps are off, any one of the following will 'wake-up' the battery saver and the interior lamps will function again. The timer will be restarted as soon as an input from one of the following is received by the CJB:

- Ignition mode changed from off power mode 0 to accessory power mode 4, ignition power mode 6 or crank power mode 9.
- Any door, including the tailgate is opened
- An unlock request is received from the Smart Key via the keyless vehicle module
- Front interior lamp switch is pressed.

DELIVERY MODE

Delivery mode is set at the factory on vehicles to minimise battery drain. The modes enables the switching off of non-critical electrical components, including the interior lighting. The delivery mode feature can be cancelled by the dealer at pre-delivery inspection using T4.

CRASH ILLUMINATION

When a crash signal is received from the restraints control module, the central junction box activates the interior lamps once the vehicle speed has reduced to 5 km/h (3.1 mph). The lamps remain on until they are switched off manually or the crash signal no longer exists.

For additional information, refer to: [Air Bag and Safety Belt Pretensioner Supplemental Restraint System \(SRS\)](#) (501-20B Supplemental Restraint System, Description and Operation).

INTERIOR LIGHTING

Interior lighting is lighting provided to enable the safe entry and departure from the vehicle for the driver and passengers in low ambient light conditions, without any manual switching of the interior lamps.

- **NOTE:** The term interior lamps also includes the door mirror approach lamps.

When the interior lighting system switches the interior lamps on, the central junction box ramps the lamps on up to full power over period of 1.3 seconds. When the system switches the lamps off, after the time-out delay period has expired, the central junction box fades the lamps off over a period of 2.6 seconds.

The interior lighting system will illuminate the interior lamps when one of the following events occurs:

- The CJB receives an unlock signal from the Smart Key via the keyless vehicle module
- Any door is opened including the tailgate
- The ignition mode is changed from ignition power mode 6 or accessory power mode 4 to off power mode 0.

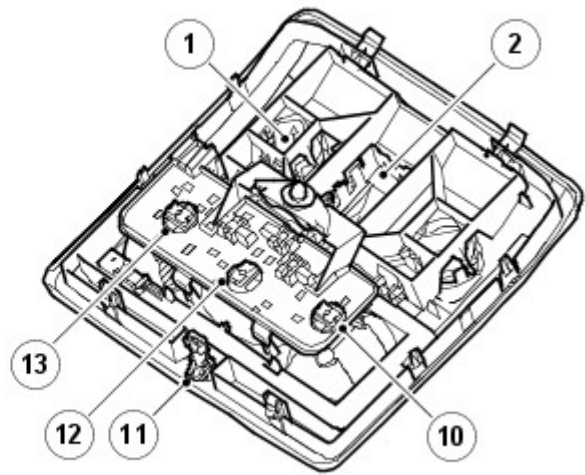
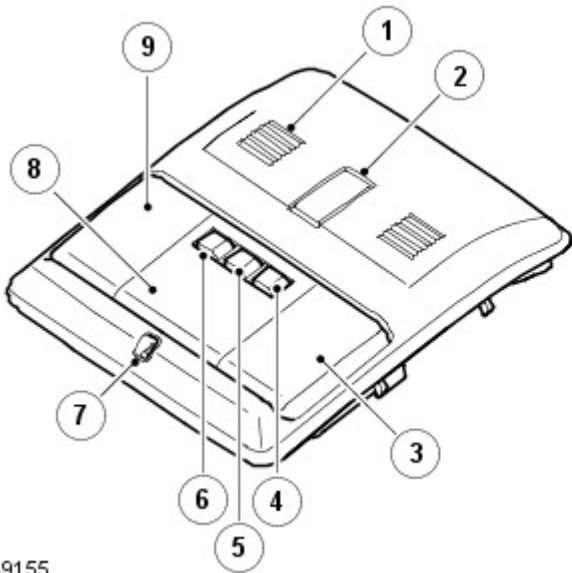
The interior lighting system will turn off the interior lamps when one of the following events occurs:

- Once the delay time-out timer has expired since the lamps were either activated or the last door is closed and the vehicle is not locked
- The ignition is in off power mode 0 and an external lock is requested (using either the door lock buttons or the Smart Key) with all doors closed
- The ignition mode is changed from the off power mode 0 or the accessory power mode 4 to the ignition power mode 6
- The last door is closed while or after the vehicle is externally locked using the key or the remote handset
- The last door is closed and the vehicle is externally locked on receipt of an unlock request from the Smart Key or door handle when the time-out timer is still active.
- The last door is closed when the ignition is in power mode 6.

The interior lamps can be permanently switched off, preventing automatic operation when a door is opened or the vehicle is unlocked using the remote handset. This is achieved by pressing and holding the central switch of the 1st row interior lamp for 3 seconds. The interior lamps will remain off until the procedure is repeated.

ROW 1 AND 2 INTERIOR LAMP ASSEMBLY

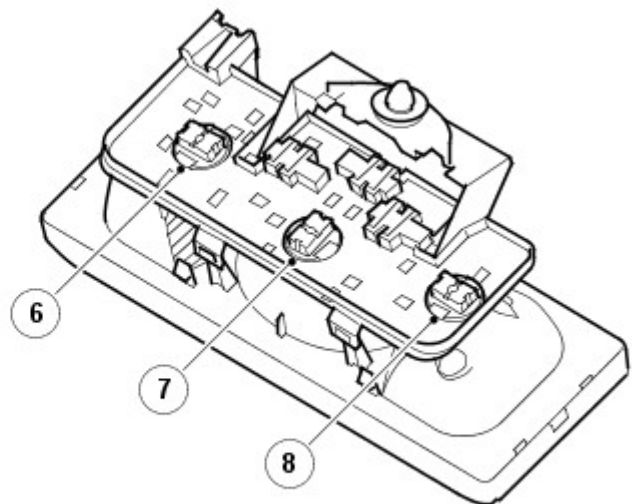
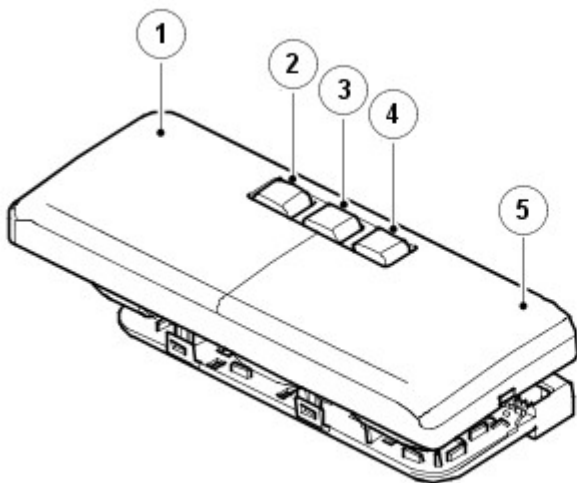
Row 1 Interior Lamp



E49155

Item	Part Number	Description
1	-	Microphone
2	-	Sunroof switch
3	-	Map reading lamp
4	-	Map reading lamp switch
5	-	Interior lamp switch
6	-	Map reading lamp switch
7	-	Waterfall lighting LED
8	-	Interior lamp
9	-	Map reading lamp
10	-	Map reading lamp bulb holder
11	-	LED connector
12	-	Interior lamp bulb holder
13	-	Map reading lamp bulb holder

Row 2 Interior Lamp (Low line shown)



E49156

Item	Part Number	Description
1	-	Map reading lamp
2	-	Map reading lamp switch
3	-	Interior lamp switch
4	-	Map reading lamp switch
5	-	Map reading lamp
6	-	Map reading lamp bulb holder
7	-	Interior lamp bulb holder
8	-	Map reading lamp bulb holder

The row 1 and 2 interior lamp assemblies are common to all models, however, their location can differ between model specification. Both lamp assemblies have three switches; one for the main interior lamp and two for the map reading lamps.

On low line specification vehicles, the interior lamps are located directly into apertures in the headlining with a bezel finish

surround.

On high line specification vehicles, the row 1 (front) interior lamp is located in a housing which can also contain the sunroof switch and/or the voice activation microphones, depending on specification. The row 2 (rear) interior lamp is also located in a housing which contains the rear heating controls.

The main interior lamps operate as part of the automatic interior lighting system. The map reading lamps only operate manually.

Both the interior and map reading lamps use 5W capless bulbs.

The row 1 interior lamp unit also contains an LED for the waterfall lighting. Waterfall lighting is part of the lighting control switch functionality which also controls the brightness of the switch and instrument cluster display illumination. Waterfall lighting provides very limited illumination for the center of the fascia and the center console, when the vehicle is being driven, without affecting the driver's night vision.

Main Interior Lamp

The main interior lamps operate independently of the ignition mode and can be operated automatically by one of a number of inputs to the CJB or manually by pressing the central switch on the lamp assembly. The switch is a momentary switch which is connected directly to and completes a circuit to the CJB. This completed circuit is a signal for the CJB to activate or deactivate the row 1 interior lamp (and also the row 2 interior lamp, if fitted). The lamps will remain on until the switch is pressed a second time.

The interior lamps can be permanently switched off as previously described by pressing and holding the central switch for at least 3 seconds. The 3 second completion of the circuit is sensed by the CJB which grants the permanent off request.

Map Reading Lamps

Both row 1 and 2 interior lamp assemblies contain map reading lamps which are located adjacent to the main interior lamp. The lamps are operated by two momentary switches on the lamp unit, which are located on either side of the main interior lamp switch.

ROW 3 MAP READING LAMPS

The row 3 map reading lamps are located in the headlining, above the rear side windows. These map reading lamps are only fitted to vehicles fitted with the seven seat, third row seating option.

The lamps operate independently of the ignition mode. The lamps have a latching rocker switch which allows the lamps to be manually switched on and off. The map reading lamps have a non-adjustable beam.

The lamps are not part of the automatic interior lighting system and therefore can only be switched on manually.

The map reading lamps use 5W capless bulbs.

GLOVE COMPARTMENT LAMP

The glove compartment lamp is located inside the glove compartment and contains an integral switch. The switch is operated when the glove compartment lid is opened and closed, switching the lamp on and off.

The glove compartment lamp uses a 5W festoon bulb.

PUDDLE LAMPS

Each door is fitted with a puddle lamp which illuminates the ground below the door when the door is opened. The puddle lamps are located in the bottom of the door trim panel on each front and rear door.

The puddle lamps are part of the automatic interior lighting functionality. Each lamp uses a 5W capless bulb.

FOOTWELL LAMPS

Two footwell lamps are located under the instrument panel, one on each side, to illuminate the footwell area. The footwell lamps are controlled by the CJB and operate as part of the interior lighting functionality.

The footwell lamps use a 5W capless bulb.

LUGGAGE COMPARTMENT LAMP

A luggage compartment lamp is located in a central position in the rear header trim panel at the rear of the vehicle, above the tail gate aperture. The luggage compartment lamp is controlled by the CJB and operates as part of the interior lighting functionality.

The luggage compartment lamp uses a 5W capless bulb.

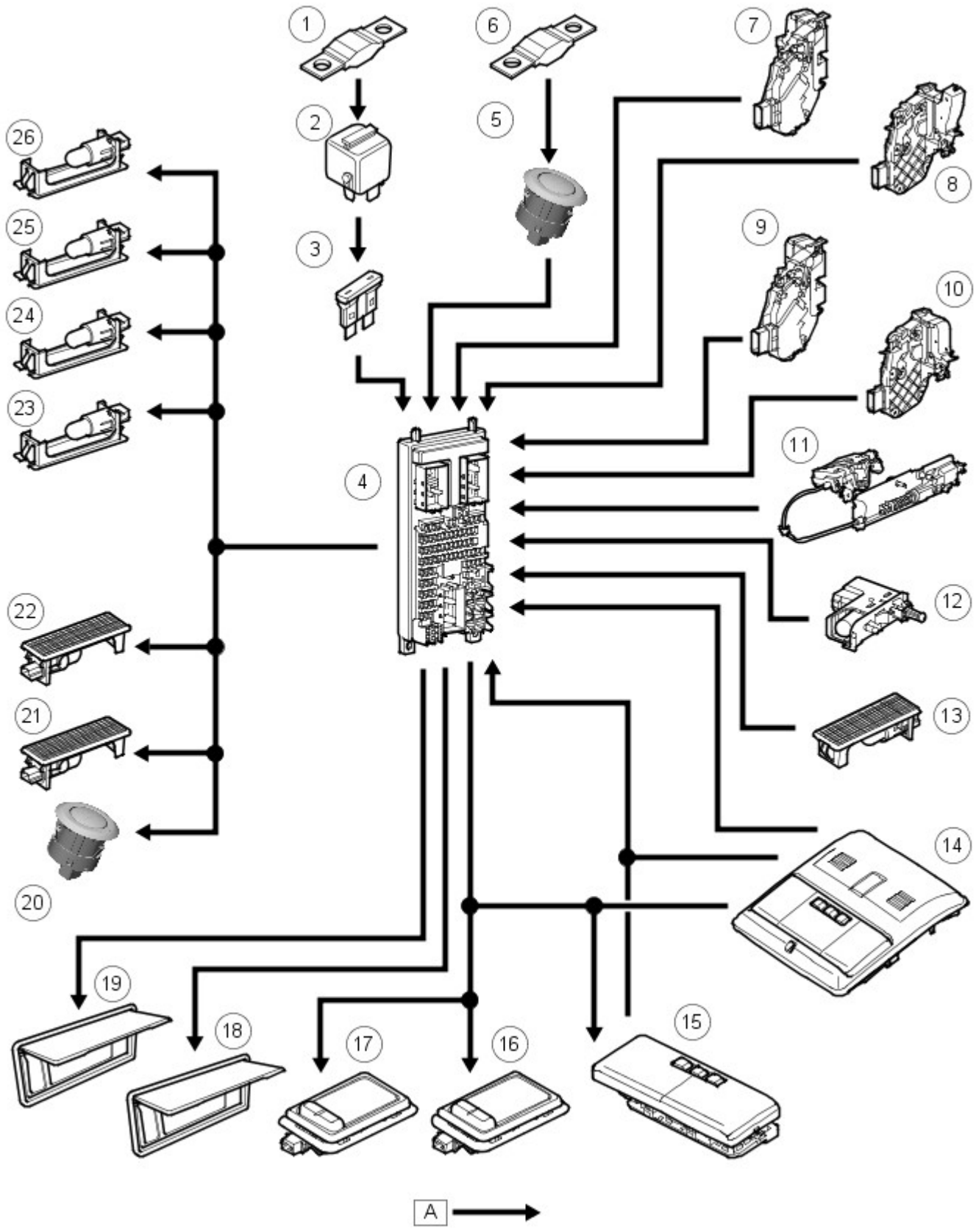
VANITY MIRROR LAMPS

Four vanity mirror lamps are fitted, two in each vanity mirror. The lamps are illuminated when the mirror cover is raised. The vanity mirror lamps operate independently of the ignition mode and separately to the interior lighting functionality, although they are subject to the battery saver feature of the CJB.

The vanity mirrors use low voltage, 1.4W festoon type bulbs.

CONTROL DIAGRAM

• NOTE: A = Hardwired



E 131969

Item	Part Number	Description
1	-	Fusible link 15E (40A) (Permanent 12V supply)
2	-	Battery saver relay (located inside CJB)
3	-	Fuse 57P (10A)
4	-	Central Junction Box (CJB)
5	-	Ignition push button
6	-	Fusible link 17E (50A)

7	-	Passenger door CDL motor
8	-	Driver's door CDL motor
9	-	RH rear door CDL motor
10	-	LH rear door CDL motor
11	-	Tailgate release motor
12	-	Glove compartment lamp
13	-	Luggage compartment lamp
14	-	Row 1 interior lamp assembly
15	-	Row 2 interior lamp assembly
16	-	Row 3 RH map reading lamp
17	-	Row 3 LH map reading lamp
18	-	RH vanity mirror lamp
19	-	LH vanity mirror lamp
20	-	Ignition push button illumination
21	-	RH footwell lamp
22	-	LH footwell lamp
23	-	RH rear puddle lamp
24	-	LH rear puddle lamp
25	-	RH front puddle lamp
26	-	LH front puddle lamp

Interior Lighting - Interior Lighting

Diagnosis and Testing

Principle of Operation

For a detailed description of the interior lighting system and operation, refer to the relevant Description and Operation section of the workshop manual.

REFER to: [Interior Lighting](#) (417-02 Interior Lighting, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Main interior lamp condition and installation ● Map reading lamp(s) condition and installation ● Vanity mirror lamp(s) condition and installation ● Glove compartment lamp condition and installation ● Footwell lamp(s) condition and installation ● Ignition switch glow ring condition and installation ● Door mirror approach lamp(s) condition and installation ● Puddle lamp(s) condition and installation ● Luggage compartment lamp condition and installation 	<ul style="list-style-type: none"> ● Bulbs ● Fuses ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Wiring harness ● Loose or corroded connector(s) ● Main interior lamp switch ● Map reading lamp switches ● Vanity mirror lamp switches ● Glove compartment lamp switch ● Waterfall lighting LED ● Tailgate lamp switch

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Main interior lamp inoperative	<ul style="list-style-type: none"> ● Bulb(s) failure ● Fuse(s) blown ● Circuit fault ● Switch fault 	Check the bulb(s) condition. Check the fuse(s). Check the lamp circuits. Check the switch function. Refer to the electrical guides.
Waterfall lighting LED inoperative	<ul style="list-style-type: none"> ● LED failure ● Fuse(s) blown ● Circuit fault 	Check the LED condition. Check the LED connector. Check the fuse(s). Check the lamp circuits. Refer to the electrical guides.
Map reading lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb(s) failure ● Fuse(s) blown ● Circuit fault ● Switch fault 	Check the bulb(s) condition. Check the fuse(s). Check the lamp circuits. Check the switch function. Refer to the electrical guides.
Vanity mirror lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Switch fault 	Check the bulb condition. Check the fuse(s). Check the lamp circuits. Check the switch function. Refer to the electrical guides.
Glove compartment lamp inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Switch fault 	Check the bulb condition. Check the fuse(s). Check the lamp circuits. Check the switch function. Refer to the electrical guides.
Footwell lamp inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault 	Check the bulb condition. Check the fuse(s). Check the lamp circuits. Refer to the electrical guides.
Ignition switch glow ring inoperative	<ul style="list-style-type: none"> ● Bulb/Glow ring failure ● Fuse(s) blown ● Circuit fault 	Check the bulb/glow ring condition. Check the fuse(s). Check the lamp circuits. Refer to the electrical guides.

Symptom	Possible Causes	Action
Door mirror approach lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault 	Check the bulb condition. Check the fuse(s). Check the lamp circuits. Refer to the electrical guides.
Puddle lamp(s) inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault 	Check the bulb condition. Check the fuse(s). Check the lamp circuits. Refer to the electrical guides.
Luggage compartment lamp inoperative	<ul style="list-style-type: none"> ● Bulb failure ● Fuse(s) blown ● Circuit fault ● Switch fault 	Check the bulb condition. Check the fuse(s). Check the lamp circuits. Check the switch function. Refer to the electrical guides.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Daytime Running Lamps (DRL) - Daytime Running Lamps (DRL)

Description and Operation

DRL use the full intensity low beam headlamps which are permanently illuminated when the vehicle is being driven. DRL are used in a number of markets and there are two systems to cover these markets.

DRL CANADIAN MARKET

DRL for this market use full intensity low beam headlamps. The side marker lamps and license plate lamps will be on, but instrument cluster illumination will be off. DRL are active when the following parameters are met:

- Parking brake is off on vehicles with manual transmission or PARK is not selected on vehicles with automatic transmission
 - Ignition switch is in the ignition position (II)
 - The central junction box receives an engine running signal
 - The lighting control switch is in the off or side lamps position.
- NOTE: If the lighting control switch is moved to the headlamp position, DRL are deactivated and normal side lamp and headlamp functionality is operational.
 - NOTE: Adaptive Front Lighting System (AFS) (where fitted) is not available when the DRL are active.
 - NOTE: When DRL are active, the headlamp flash function using the left hand steering column multifunction switch will operate normally. The high beam headlamp function using the left hand steering column multifunction switch will be deactivated.

When the parking brake is applied on manual transmission vehicles or the selector lever is in the PARK position on automatic transmission vehicles, DRL are turned off. This is to reduce battery discharge during long periods of engine idling in cold climate conditions. When the parking brake is released or the selector lever is moved from the PARK position, normal DRL functionality is restored.

DRL DENMARK, HOLLAND, NORWAY, SWEDEN, FINLAND & POLAND

DRL for these markets use full intensity low beam headlamps. Side lamps and license plate lamps will be on, but instrument cluster illumination will be off. DRL are active when the following parameters are met:

- Ignition switch is in the ignition position (II)
 - The central junction box receives an engine running signal
 - The lighting control switch is in the off position.
- NOTE: When DRL are active, the headlamp flash function using the left hand steering column multifunction switch will operate normally. The high beam headlamp function using the left hand steering column multifunction switch will be deactivated.

If the lighting control switch is moved to the side lamp or headlamp positions, DRL are deactivated and normal side lamp and headlamp functionality is operational.

Module Communications Network -**Torque Specifications**

Description	Nm	lb-ft
Central junction box bracket retaining nuts	10	7
Central junction box bracket retaining bolts	25	18
Engine compartment ground cable nuts	25	18
Body panel ground cable nuts	25	18
Vehicles with auxiliary heating - Heater pipes to body panel nut	10	7
Wiring harness to plenum chamber nuts	4	3
Vehicles with auxiliary climate control - A/C lines to body panel nut	10	7
Battery ground cable to body nut	25	18
Battery junction box retaining bolt	6	4
Ground cables to the lower A-pillar nut	10	7
Battery positive cable to the battery junction box (BJB) nut	25	18

Module Communications Network - Communications Network

Diagnosis and Testing

Principles of Operation

For a detailed description of the Communications Network, refer to the relevant Description and Operation section in the workshop manual. REFER to: Communications Network (418-00 Module Communications Network, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Electrical
<ul style="list-style-type: none"> ● Fuses (refer to electrical guide) ● Wiring harness ● Correct engagement of electrical connectors ● Loose or corroded connections ● Routing of fibre optic harnesses ● Correct engagement of optical connectors ● Correct placement of optical connectors (ring order) ● Correct assembly of optical connectors (backout, etc) ● Damage to fibre (chafing, abrasion, kinking, cuts, etc)

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

CAN Network Integrity Checks

In the event that one or more control modules are not communicating on either the Medium Speed (MS) or High Speed (HS) CAN Buses, checks can be performed to confirm the integrity of the CAN harness.

The following information is applicable to HS and MS CAN Buses accessible via the J1962 diagnostic connector.

Module Connections to the CAN Harness

Modules are connected to the CAN harness either in a 'loop' or 'spur' configuration. In the 'loop' type configuration the CAN harness loops into the module (via two connector pins) and then loops out of the module (via another two connector pins). In the 'spur' type configuration, a harness spur is spliced into the main 'backbone' of the CAN harness and the module is connected to the harness spur via two connector pins.

CAN Harness Architecture

For a detailed description of the CAN Networks and architecture, refer to the relevant Description and Operation section in the Workshop Manual.

REFER to: Communications Network (418-00 Module Communications Network, Description and Operation).

IDS Vehicle Integrity Test

If a control module is suspected of non-communication, the Network Integrity test application available on the manufacturer approved diagnostic system can be used to confirm if communication is possible between the control modules on the vehicle and the manufacturer approved diagnostic system (via the J1962 diagnostic connector). The results from the test can be used to determine if either a single module or multiple modules are failing to communicate.

CAN Terminating Modules

If the Network Integrity test indicates that one or more module on one of the CAN networks (HS or MS) are failing to communicate, there are several checks that can be made. The first step is to identify if both of the CAN terminating modules on each individual CAN Bus are communicating. If both CAN terminating modules for each individual CAN Bus are communicating (identified via the Network Integrity test), then it can be confirmed that the main 'backbone' of the CAN harness is complete. The main 'backbone' of the CAN harness consists of all the modules connected to the CAN harness via a 'loop' configuration and also includes the two terminating modules.

Communication with both CAN terminating modules via the Network Integrity test confirms the physical integrity of the main 'backbone' of the CAN harness (and the harness spur to the J1962 diagnostic connector). This means that there is no requirement to check the resistance of the CAN Network. This is because the standard check for 60 ohms across the CAN High and CAN Low lines will not provide any additional information regarding the physical condition of the CAN harness, beyond what has already been determined from the Network Integrity test.

Non-Communication of a Terminating Module

If a Network Integrity test reveals a terminating module is failing to communicate it can indicate a break in the main 'backbone' of the CAN harness. The first checks should always be to confirm the power and ground supplies to the non-communicating module are correct. Providing these are correct, the resistance between the CAN High and CAN Low lines at the J1962 connector can be checked to determine the integrity of the main 'backbone' of the CAN harness. After disconnecting the battery a reading of 120 ohms would indicate an open circuit in the main 'backbone' of the CAN harness. Alternatively, a reading of 60 ohms would indicate that there is no open circuit fault with the main 'backbone' of the CAN harness.

It is worth noting that even if one of the terminating modules is disconnected from the CAN harness, communications between the modules still connected may still be possible. Therefore communication between the manufacturer approved diagnostic system and the connected modules may also be possible.

Locating CAN Harness Open Circuits

In the case where multiple modules, including a terminating module, are failing to communicate, having first confirmed the power and ground supplies are correct, the approximate location of the open circuit can be identified from analysis of the Network Integrity test results and reference to the relevant CAN network circuit diagrams. For example, if an open circuit existed in a certain position on the CAN harness, any module positioned on the Network between the J1962 connector and the open circuit should return a response during the Network Integrity test. No responses would be returned from any modules past the open circuit fault in the Network.

CAN Harness 'Spur' Type Configuration Circuits

If, after the initial checks (Network Integrity test using the manufacturer approved diagnostic system, and power and ground supplies to the module have been checked and confirmed as correct), a module that is connected to the CAN harness via a 'spur' type configuration is suspected of not communicating, then the physical integrity of the CAN harness 'spur' can be checked.

This is most easily undertaken by individually checking the continuity of the CAN High and CAN Low lines between the non-communicating module connector (with the module disconnected) and the J1962 diagnostic connector.

'Lost Communications' DTCs

As well as the methods described so far in this document, which can be used to determine the location of an open circuit in the CAN harness, 'Lost Communications' DTCs can also be used for this purpose. Lost communication DTCs mean that a module is not receiving CAN information from another module.

For example, if a global DTC read were to be carried out, only DTCs stored in the modules that the manufacturer approved diagnostic system could communicate with would be displayed. If there was an open circuit fault in a certain position on the CAN harness, the modules that could display DTCs would all be prior to the open circuit on the Network, and these modules should display 'Lost Communications' DTCs with all the modules located on the Network past the open circuit fault.

'Bus off' DTCs

The references to bus and its condition refer to the network concerned and the modules on that network.

If a module logs a 'Bus Off' DTC, it means that the module has detected CAN transmission errors and has disabled its own CAN transmissions and disconnected itself from the network in an attempt to allow the rest of the network to function. At this point the 'Bus Off' DTC is set. A common cause of 'Bus Off' DTCs can be a short circuit in the CAN network.

Media oriented systems transport (MOST) diagnosis

Overview

The basic guidelines are covered in the description and operation section, such as not attempting to repair fibre optic cables, but additional precautions include:

- Do not touch the exposed ends of the optical fibres (grease from skin can contaminate the fibre)
- Whenever the fibre optic cable is disconnected, cover the connectors to prevent dust contamination
- Do not expose the fibre optic cable to heat
- Do not bend the fibre optic cable through less than a 25 mm (one inch) radius
- Do not use laser pens to test the fibre optic cable's ability to pass light
 - There is a dedicated tester to use with the MOST network modules and fibre optic harness to assist with diagnosis and to test the fibre optic cable's ability to pass light

MOST tester

Before connecting the tester to the network, turn on the unit and check that the red **power on** indicator is illuminated.

If not, the battery should be replaced before using the tester.

2+0 Self-test

1. Set the connector selector switch to 2+0.
2. Select **beep** or **LED** on the tester, depending on your choice of indicator.
3. Turn the tester ON and check the operation of the power indicator.
4. Using the 2+0 loop-back lead from the kit, push it into the 2+0 connector housing in the tester until it clicks into place.
5. Press the red **test** button in the center of the tester.
6. Depending on your choice in step 2, the tester will give either an audible tone or a green light.

- If the tester continues to give a tone or light after the test button is released this does not indicate a fault, only that there is a signal feed-back within the tester which will stop when the loop-back lead is removed.

2+4 Self-test

Carry out the self-test in the same way as for 2+0, but using the 2+4 loop-back lead and select 2+4 on the connector selector switch.

Vehicle diagnosis



CAUTION: Make sure the tester is not connected to the MOST network when either switching the tester on or switching between 2+0 and 2+4, as the tester emits a brief pulse of light which could introduce a fault into the network.

7. **7.** Use the approved diagnostic system or a scan tool to retrieve any DTCs.
8. **8.** Set the connector selector switch to **2+0**.
9. **9.** Disconnect the intermediate fibre optic cable connector and connect the male half to the tester connector at the top of the unit using the adaptor in the kit.
10. **10.** Turn the tester on and check the operation of the power indicator.
11. **11.** Set the **LED/beep** selector to **LED**.
12. **12.** Turn the ignition switch to the **ON** position.
13. **13.** If the green LED is active, a signal has been received indicating that the first half of the optical ring is functioning.
14. **14.** If the green LED is **NOT** active, no signal has been received indicating that the first half of the optical ring is **NOT** functioning.
 - A ring break code should be set as a result of this. Use the approved diagnostic system to trace the fault and clear the code.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

Module Communications Network - Battery Junction Box (BJB)V6 4.0L

Petrol

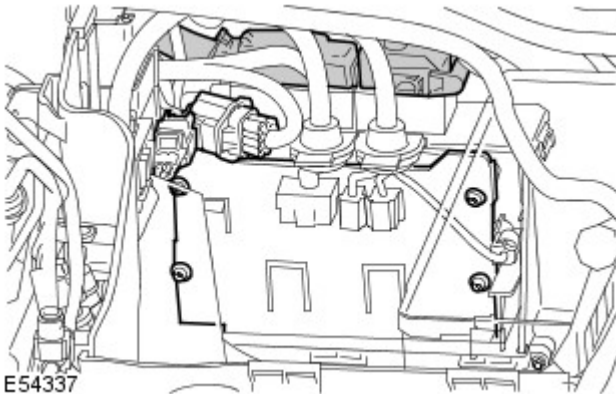
Removal and Installation

Removal

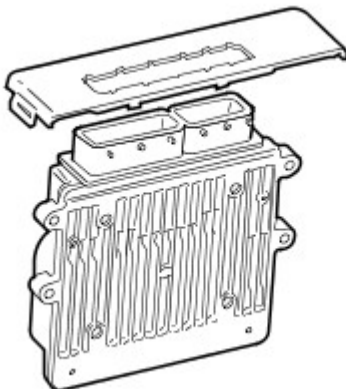
- NOTE: The BJB is an integral component of the engine compartment wiring harness and cannot be removed separately.

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove both inboard ignition coils.
For additional information, refer to: [Ignition Coil](#) (303-07A Engine Ignition - V6 4.0L Petrol, Removal and Installation).
4. Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
5. Remove the air cleaner assembly.
For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
6. Remove the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
7. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
8. Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
9. Remove the ECM cover.
 - Disconnect 2 electrical connectors for access.
 - Disconnect the 2 ECM electrical connectors.
 - Remove the 4 Torx screws.



10. Remove the ECM.
 - Remove the ECM top cover.

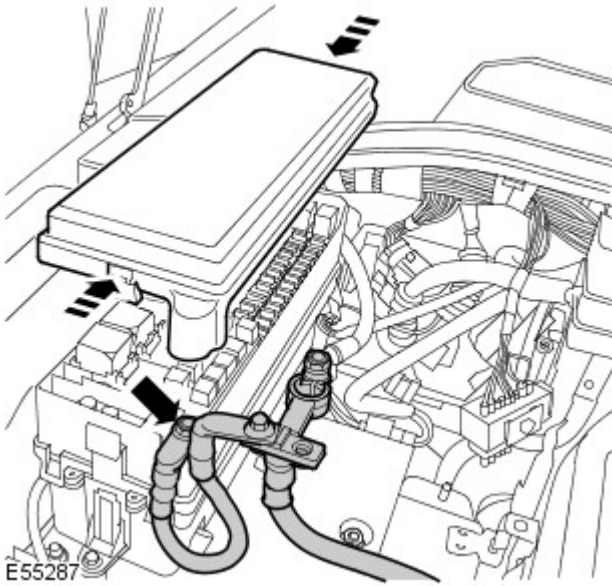


11. Remove the BJB cover.

- Release the clip.

12. Disconnect the battery positive cable from the BJB.

- Remove the nut.



13. Remove both cowl side trim panels.

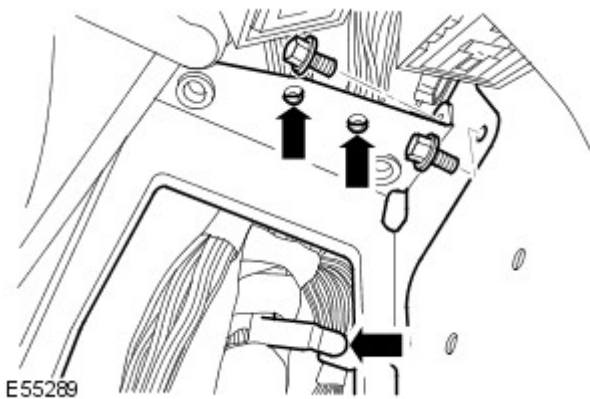
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

14. Remove the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

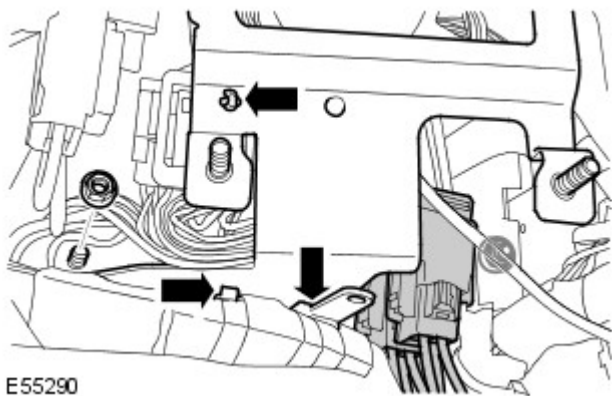
15. Release the CJB bracket.

- Release the 3 upper wiring harness clips.
- Remove the 2 bolts.



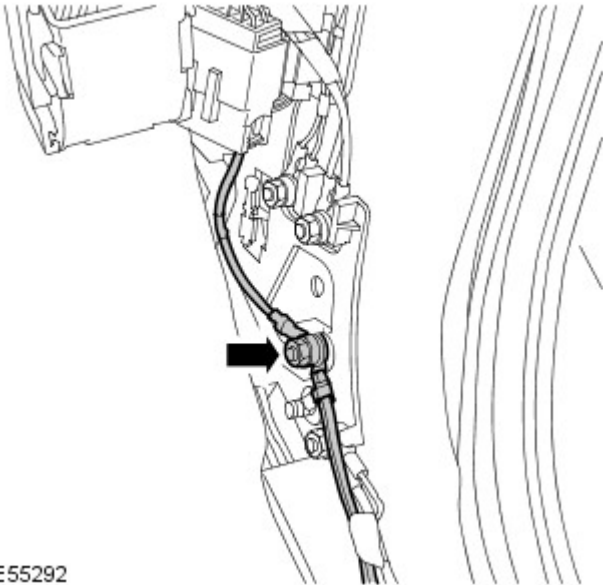
16. Remove the CJB bracket.

- Disconnect the 2 electrical connectors.
- Release the 3 lower wiring harness clips.
- Remove the 2 nuts.



17. Release the 2 ground cables from the lower A-pillar.

- Remove the nut.



E55292

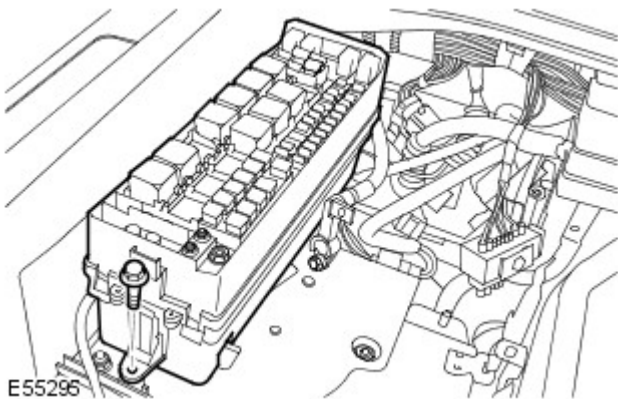
18. Disconnect the heater motor electrical connector.



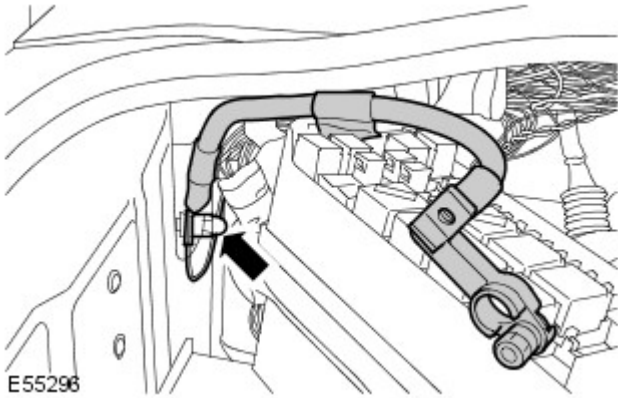
E55293

19. Release the BJB from the bracket.

- Remove the bolt.

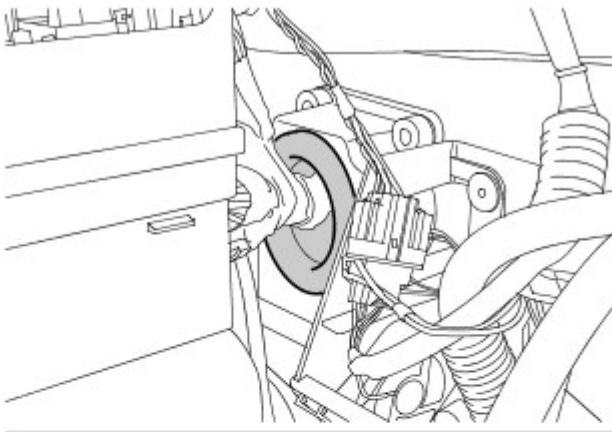


E55296



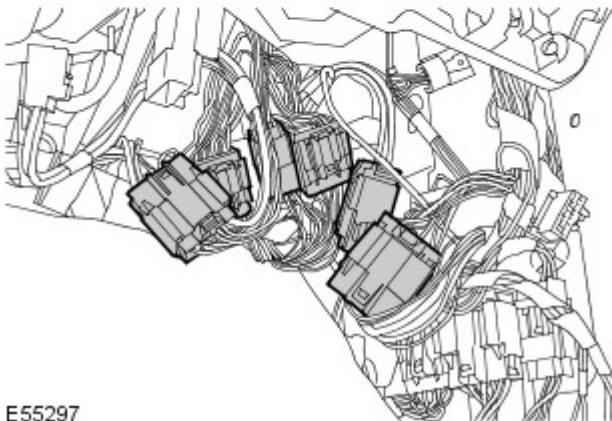
20. Remove the battery ground cable.

- Remove the nut.
- Release the additional ground cable.



21. Release the BJB wiring harness from the bulkhead.

- Disconnect the 6 electrical connectors.
- Release the grommet.



E55297

22. Raise and support the vehicle.

23. Remove both front fender splash shields.

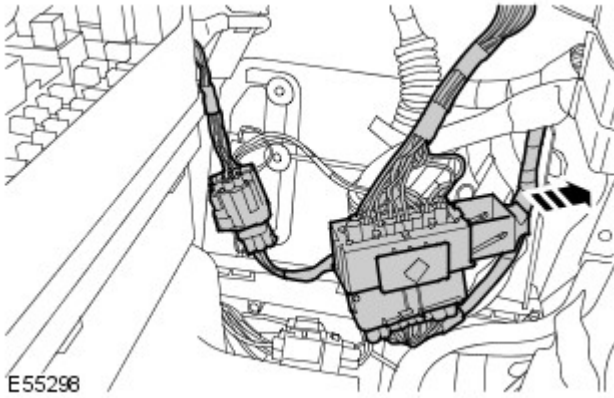
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

24. Remove both headlamps.

For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

25. Passenger side: Disconnect the engine wiring harness electrical connector.

26. Passenger side: Disconnect the transfer case electrical connector.



27. LH side: Disconnect the washer jet hose.



28. LH side: Disconnect the adaptive front lighting control module electrical connector.



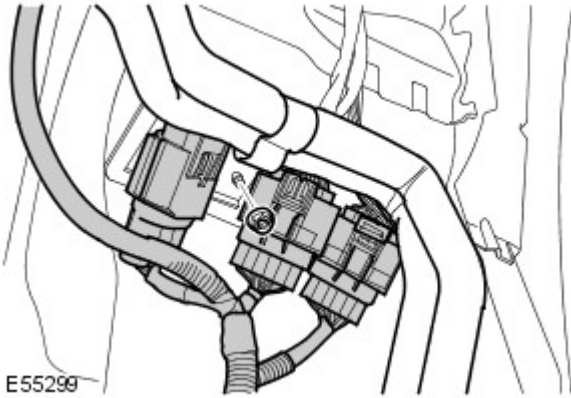
Vehicles with auxiliary climate control

29. LH side: Release the A/C lines from the body panel.

- Remove the nut.

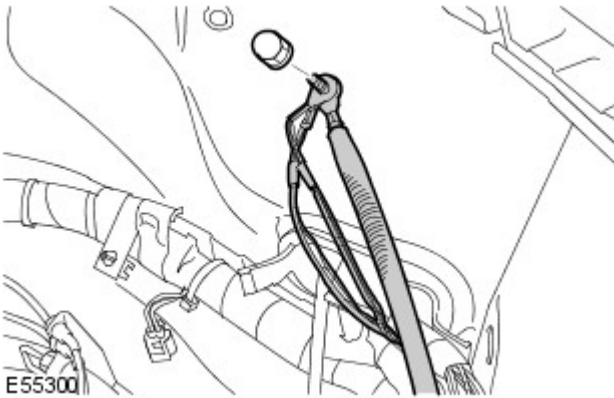
All vehicles

30. LH side: Disconnect the 3 body panel electrical connectors.



31. LH side: Release the 3 body panel ground cables.

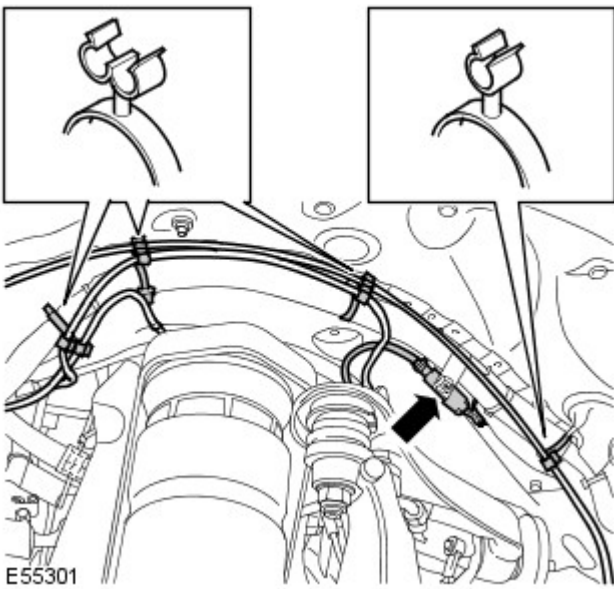
- Remove the nut.



32. LH side: Release the 2 air suspension pipes from the wiring harness.

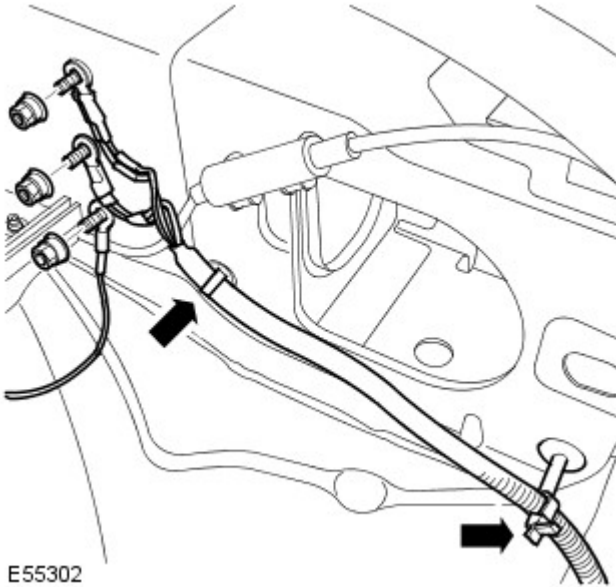
- Release the 7 clips.

33. LH side: Disconnect the ABS electrical connector.



34. LH side: Release 3 engine compartment ground cables.

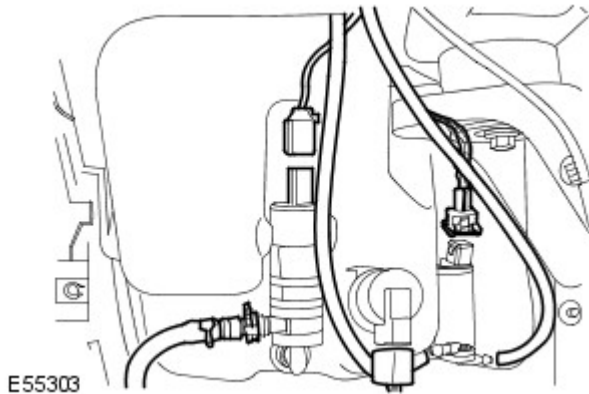
- Remove the 3 nuts.
- Release the 2 clips.



E55302

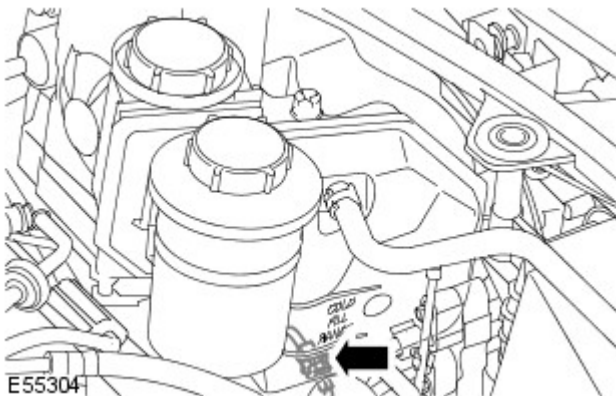
35. LH side: Release the washer reservoir wiring harness.

- Disconnect the 3 electrical connectors.
- Disconnect the 2 washer jet hoses.



E55303

36. LH side: Disconnect the coolant expansion tank level switch electrical connector.

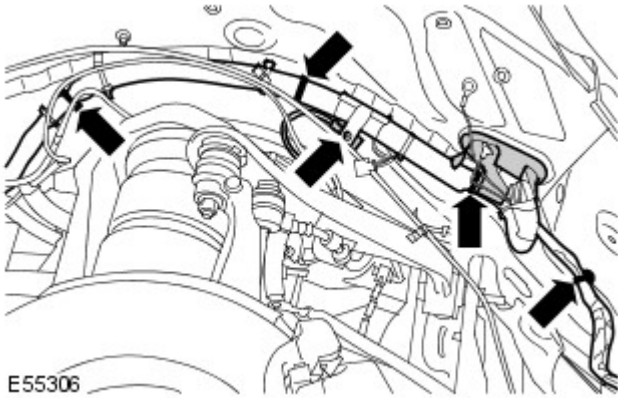


E55304

37. LH side: Disconnect the brake pad wear sensor electrical connector.

38. LH side: Release the wiring harness.

- Release the grommet.
- Release the 4 clips.



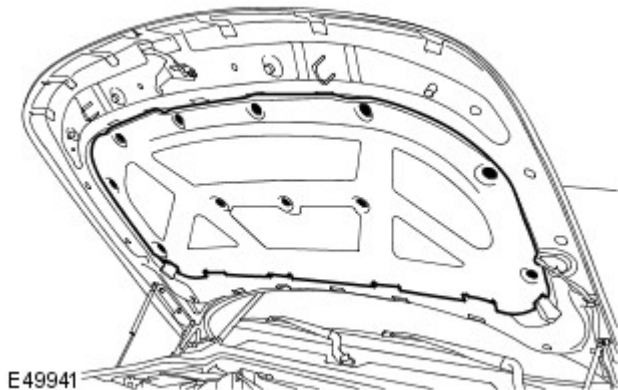
E55306

39. Remove the windshield wiper motor.

For additional information, refer to: [Windshield Wiper Motor](#) (501-16 Wipers and Washers, Removal and Installation).

40. Remove the hood pad.

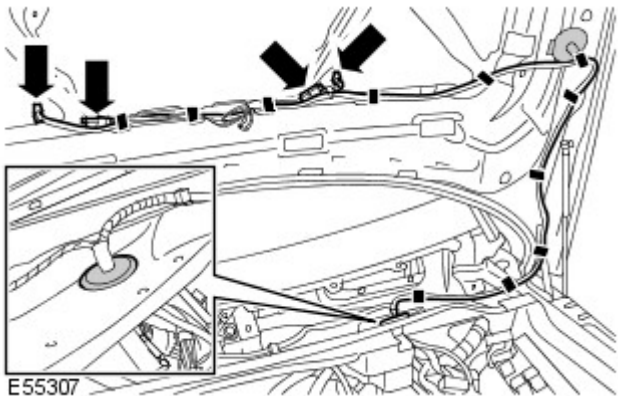
- Remove the 11 clips.



E49941

41. Release the hood wiring harness.

- Disconnect the 2 washer jet hoses.
- Disconnect the 2 electrical connectors.
- Release the 10 clips.
- Remove the wiring harness cover.
- Release the grommet.



E55307

42. Disconnect the brake booster vacuum pump electrical connector.



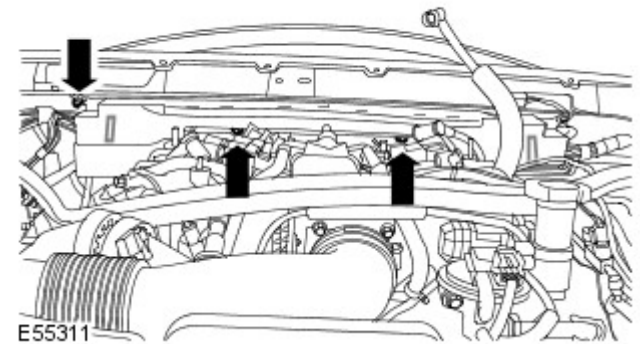
E55308



43. Disconnect the A/C pressure transducer electrical connector.

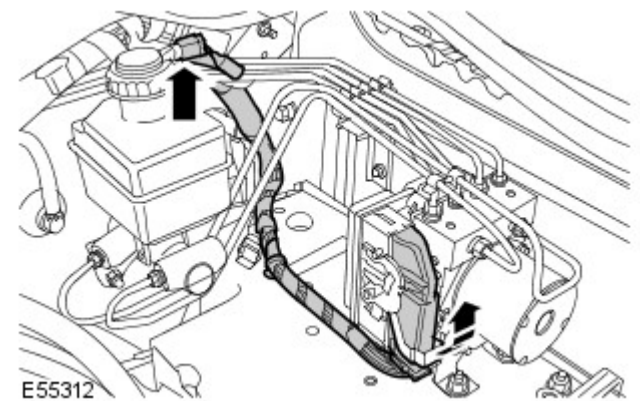


44. Disconnect the battery to engine compartment wiring harness electrical connector.



45. Release the wiring harness from the plenum.

- Release the 2 clips.
- Remove the 3 nuts.



46. Disconnect the brake fluid reservoir electrical connector.

47. Disconnect the ABS module electrical connector.

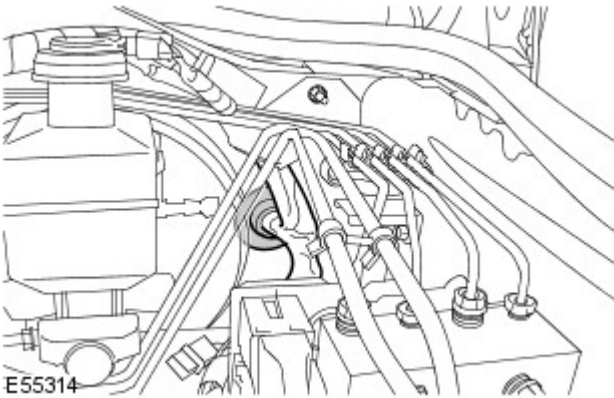
48. Remove the air suspension control module.
For additional information, refer to: [Air Suspension Control Module](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

- 49.** Driver side: Disconnect 2 electrical connectors from the lower A-pillar.



- 50.** Driver side: Release the wiring harness from the bulkhead.

- Release the grommet.



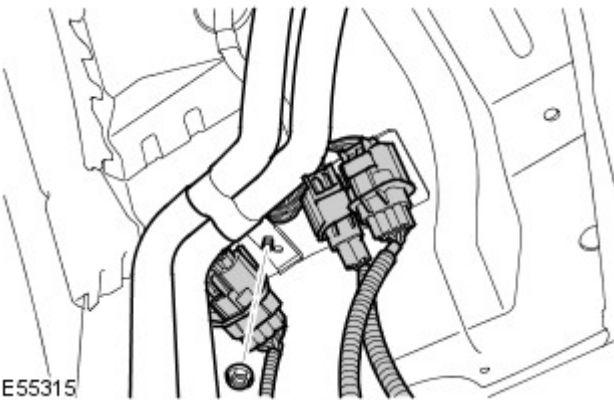
Vehicles with auxiliary heating

- 51.** RH side: Release the heater pipes from the body panel.

- Remove the nut.

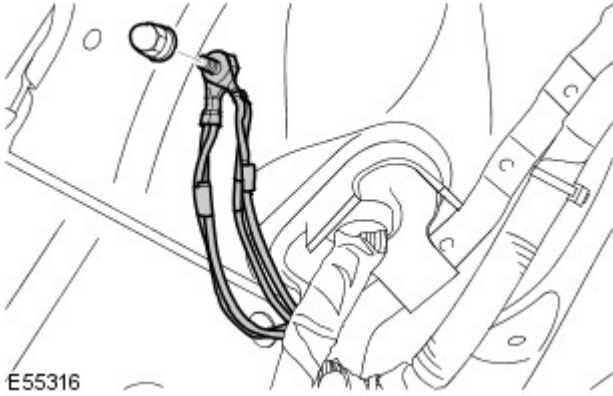
All vehicles

- 52.** RH side: Disconnect the 3 body panel electrical connectors.



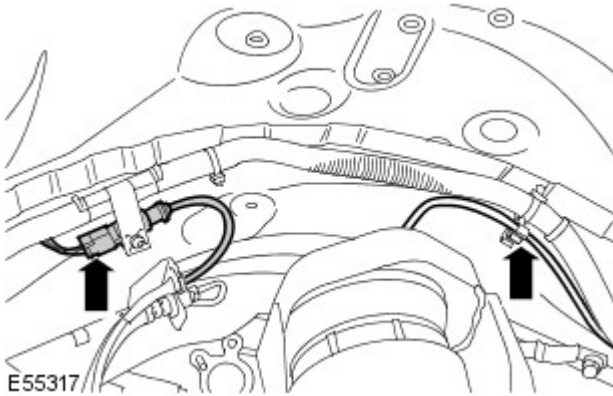
53. RH side: Release the 3 body panel ground cables.

- Remove the nut.



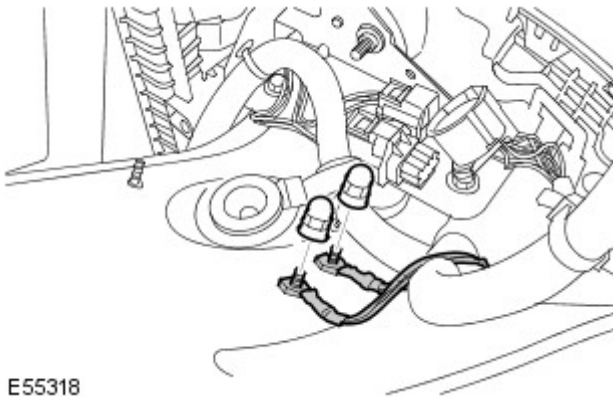
54. RH side: Disconnect the ABS electrical connector.

55. RH side: Release the air suspension pipe from the wiring harness clip.



56. RH side: Release 2 engine compartment ground cables.

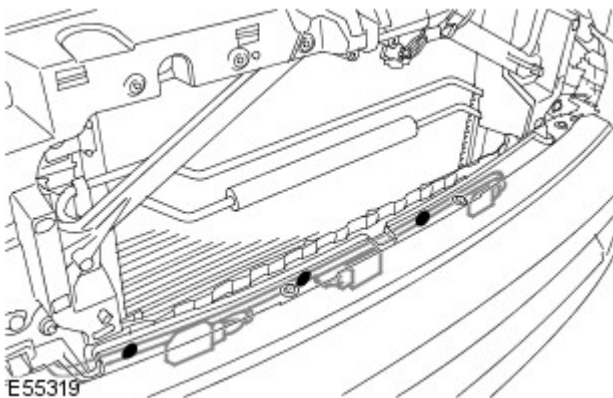
- Remove the 2 nuts.



57. Disconnect the ambient air temperature sensor electrical connector.

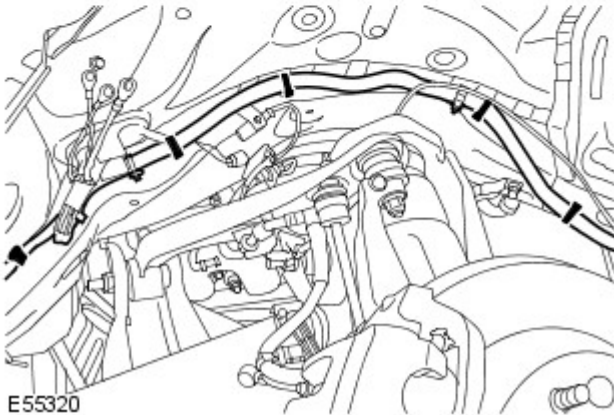
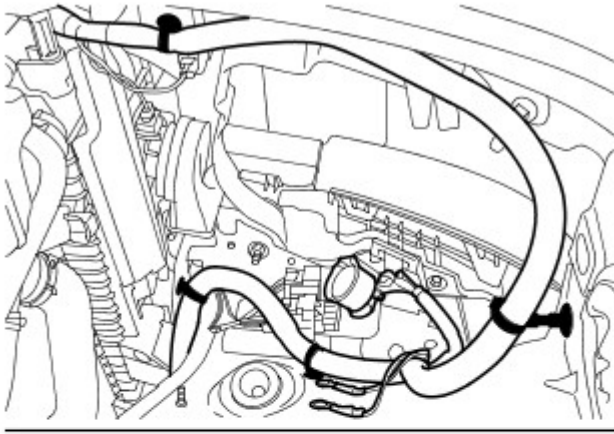
58. Disconnect both front impact severity sensor electrical connectors.

- Release the 3 clips.



59. RH side: Release the wiring harness.

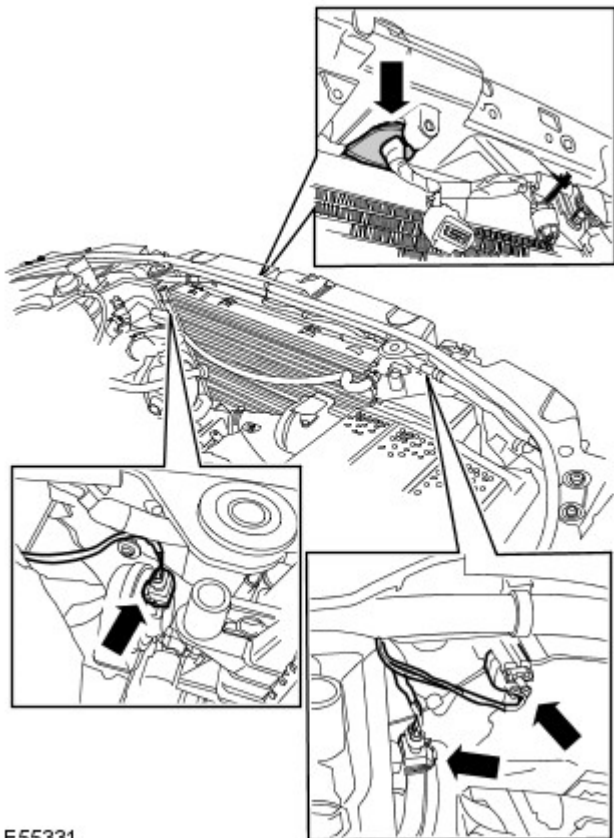
- Release the 9 clips.



E55320

60. Disconnect the hood switch electrical connector.

61. Disconnect both horn electrical connectors.



E55331

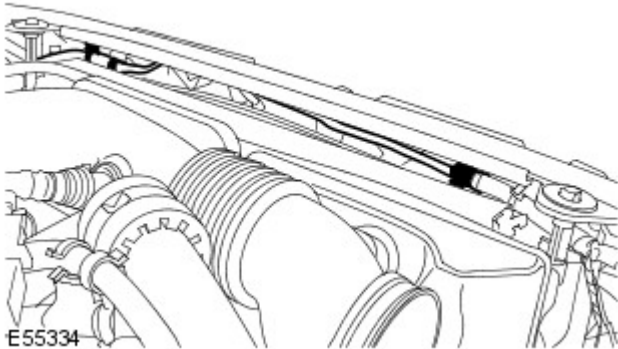
62. If installed, disconnect the speed control module electrical connector.

63. If installed, disconnect the pollution sensor electrical connector.

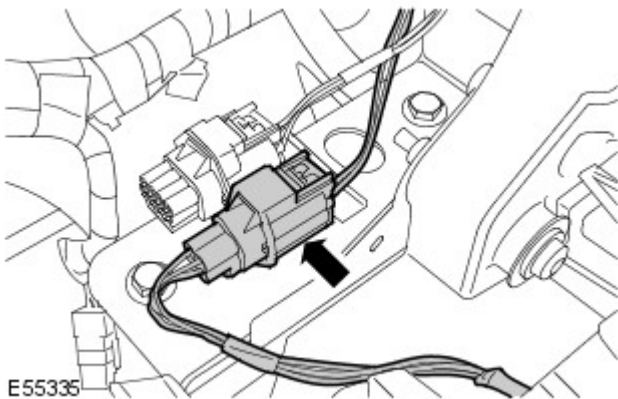
- Release the clip.
- Release the grommet.

64. Release the hood release cable.

- Release from the 3 clips.



65. Disconnect the front bumper wiring harness electrical connector.



66. With assistance, remove the BJB and wiring harness.

Installation

All vehicles

1. With assistance, install the BJB and wiring harness.
2. Connect the front bumper wiring harness electrical connector.
3. Attach the hood release cable.
 - Secure with the clips.
4. If installed, connect the pollution sensor electrical connector.
 - Install the grommet.
 - Secure the clip.
5. If installed, connect the speed control module electrical connector.
6. Connect the horn electrical connectors.
7. Connect the hood switch electrical connector.
8. RH side: Secure the wiring harness.
 - Secure the clips.
9. Connect both front impact electrical connectors.
 - Secure the clips.
10. RH side: Attach the air suspension pipe.
11. Connect the ambient air temperature sensor electrical connector.
12. RH side: Attach the engine compartment ground cables.

- Tighten the nuts to 25 Nm (18 lb.ft).

13. RH side: Connect the ABS electrical connector.

14. RH side: Attach the body panel ground cables.

- Tighten the nut to 25 Nm (18 lb.ft).

15. RH side: Connect the body panel electrical connectors.

Vehicles with auxiliary heating

16. RH side: Secure the heater pipes to the body panel.

- Tighten the nut to 10 Nm (7 lb.ft).

All vehicles

17. Driver side: Attach the wiring harness to the bulkhead.

- Install the grommet.

18. Driver side: Connect the lower A-pillar electrical connectors.

19. Install the air suspension control module.

For additional information, refer to: [Air Suspension Control Module](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

20. Connect the ABS module electrical connector.

21. Connect the brake fluid reservoir electrical connector.

22. Attach the wiring harness to the plenum.

- Secure the clips.
- Tighten the nuts to 4 Nm (3 lb.ft).

23. Connect the battery to engine compartment wiring harness electrical connector.

24. Connect the A/C pressure transducer electrical connector.

25. Connect the brake booster vacuum pump electrical connector.

26. Attach the hood wiring harness.

- Install the grommet.
- Install the cover.
- Secure with the clips.
- Connect the electrical connectors.
- Connect the washer jet hoses.

27. Install the hood pad.

- Install the clips.

28. Install the windshield wiper motor.

For additional information, refer to: [Windshield Wiper Motor](#) (501-16 Wipers and Washers, Removal and Installation).

29. LH side: Attach the wiring harness.

- Install the grommet.
- Secure the clips.

30. LH side: Connect the brake pad wear sensor electrical connector.

31. LH side: Connect the coolant expansion tank level switch electrical connector.

32. LH side: Attach the washer reservoir wiring harness.

- Connect the washer jet hoses.
- Connect the electrical connectors.

33. LH side: Attach the engine compartment ground cables.

- Secure the clips.

- Tighten the nuts to 25 Nm (18 lb.ft).
34. LH side: Connect the ABS electrical connector.
 35. LH side: Attach the air suspension pipes.
 - Secure the clips.
 36. LH side: Attach the body panel ground cables.
 - Tighten the nut to 25 Nm (18 lb.ft).
 37. LH side: Connect the body panel electrical connectors.

Vehicles with auxiliary climate control

38. LH side: Secure the A/C lines to the body panel.
 - Tighten the nut to 10 Nm (7 lb.ft).

All vehicles

39. LH side: Connect the adaptive front lighting control module electrical connector.
40. LH side: Connect the washer jet hose.
41. Passenger side: Connect the transfer case electrical connector.
42. Passenger side: Connect the engine wiring harness electrical connector.
43. Install the headlamps.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
44. Install the fender splash shields.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
45. Attach the BJB wiring harness to the bulkhead.
 - Connect the electrical connectors.
 - Install the grommet.
46. Install the battery ground cable.
 - Attach the additional ground cable.
 - Tighten the nut to 25 Nm (18 lb.ft).
47. Secure the BJB to the bracket.
 - Tighten the bolt to 6 Nm (4 lb.ft).
48. Connect the heater motor electrical connector.
49. Connect the ground cables to the lower A-pillar.
 - Tighten the nut to 10 Nm (7 lb.ft).
50. Install the CJB bracket.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 - Secure the clips.
 - Connect the electrical connectors.
 - Tighten the bolts to 25 Nm (18 lb.ft).
51. Install the CJB.
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
52. Connect the battery positive cable to the BJB.
 - Tighten the nut to 25 Nm (18 lb.ft).
53. Install the BJB cover.
 - Secure the clip.

- 54.** Install the ECM.
 - Install the ECM top cover.
- 55.** Install the ECM cover.
 - Tighten the Torx screws.
 - Connect the electrical connectors.
- 56.** Install the auxiliary battery tray.

For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- 57.** Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- 58.** Install the four-wheel drive control module.

For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
- 59.** Install the air cleaner assembly.

For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
- 60.** Install the radiator grille.

For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- 61.** Install the ignition coils.

For additional information, refer to: [Ignition Coil](#) (303-07A Engine Ignition - V6 4.0L Petrol, Removal and Installation).
- 62.** Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- 63.** Check the headlamp beam alignment.

For additional information, refer to: [Headlamp Adjustment](#) (417-01 Exterior Lighting, General Procedures).

Module Communications Network - Battery Junction Box (BJB)V8 5.0L

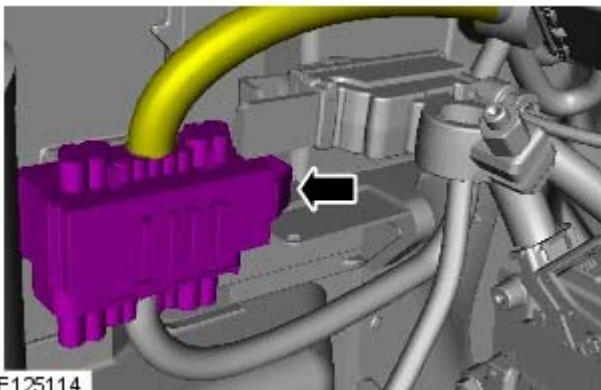
Petrol

Removal and Installation

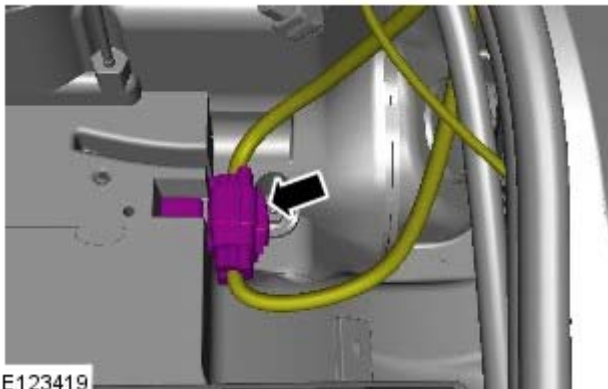
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

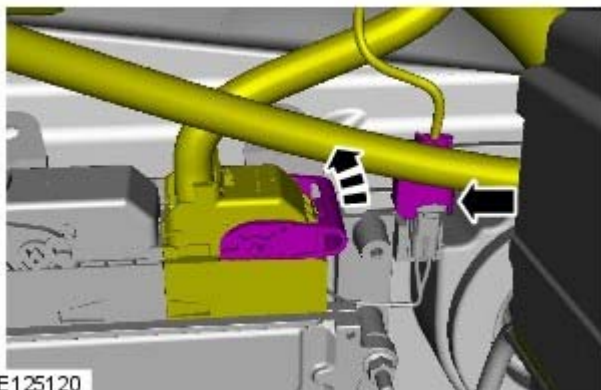
1. For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
2. For additional information, refer to: [Air Cleaner LH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
3. For additional information, refer to: [Air Cleaner RH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
- 4.



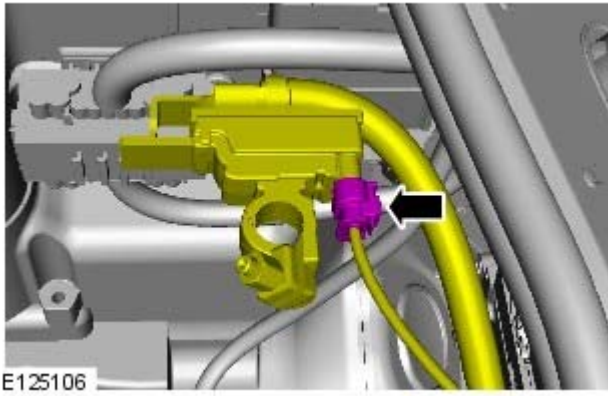
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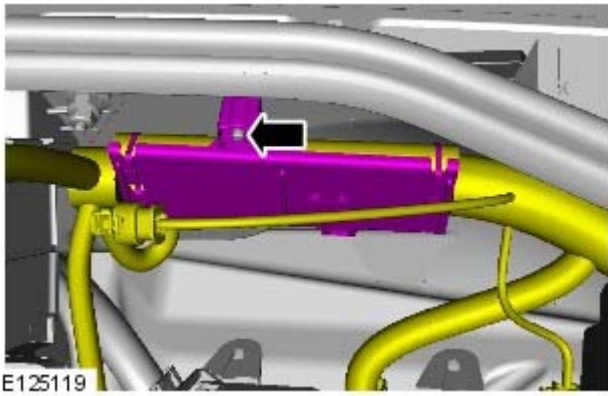
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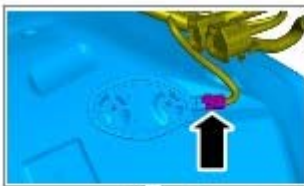


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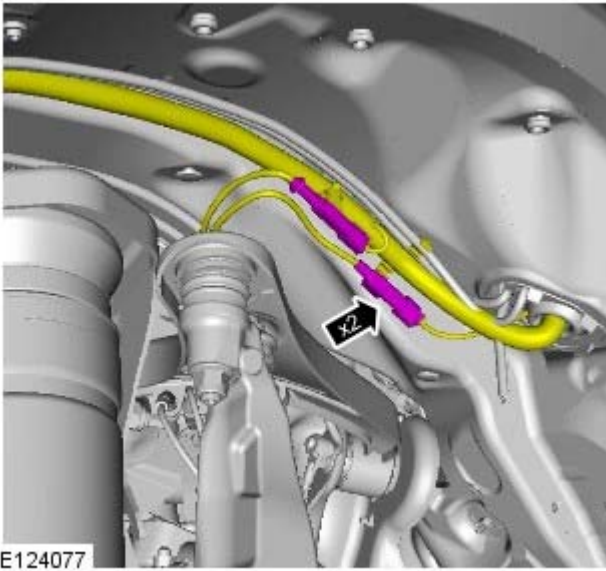


9. Remove the front LH road wheel and tire.

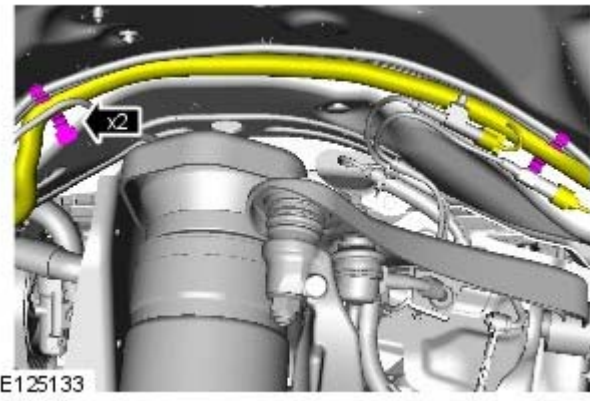
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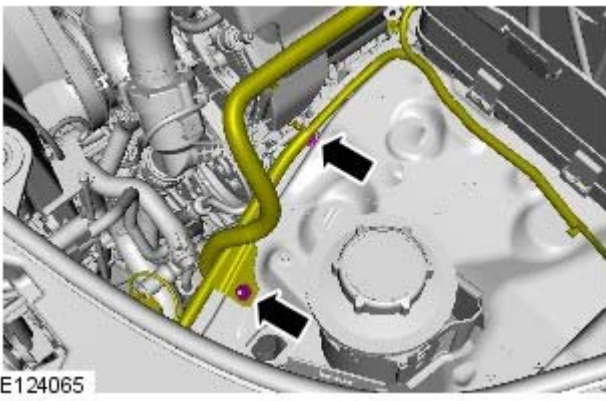
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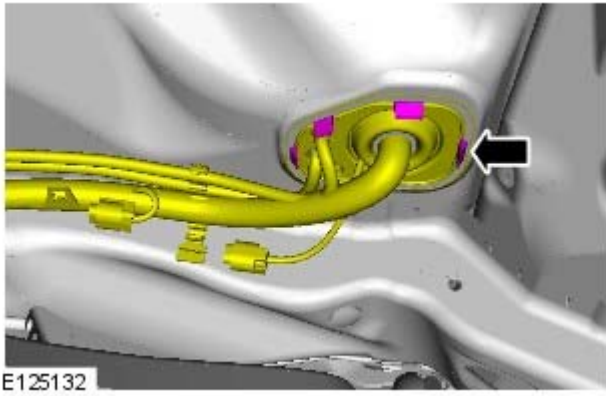
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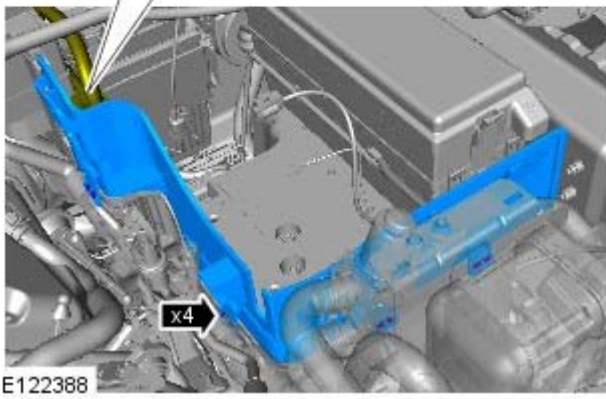
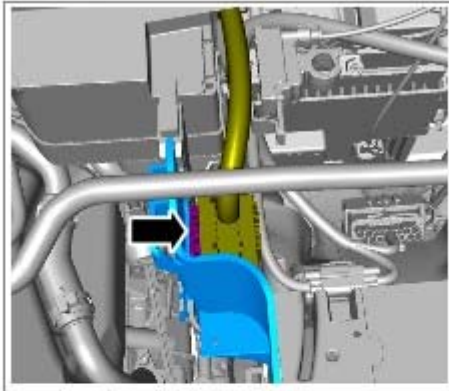
13. TORQUE: 10 Nm



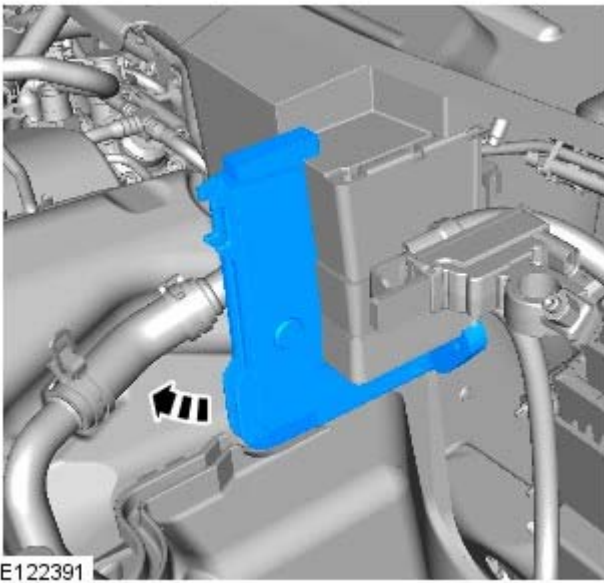
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15. NOTE: RHD illustration shown, LHD is similar.

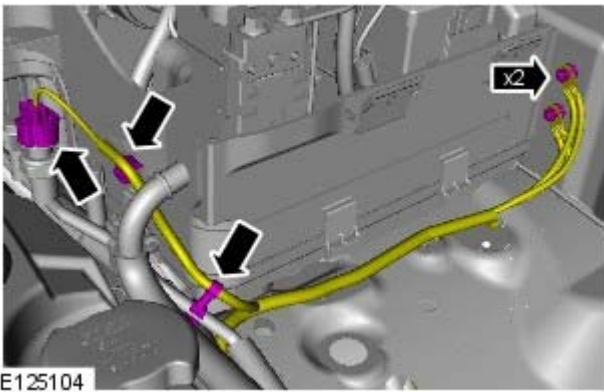


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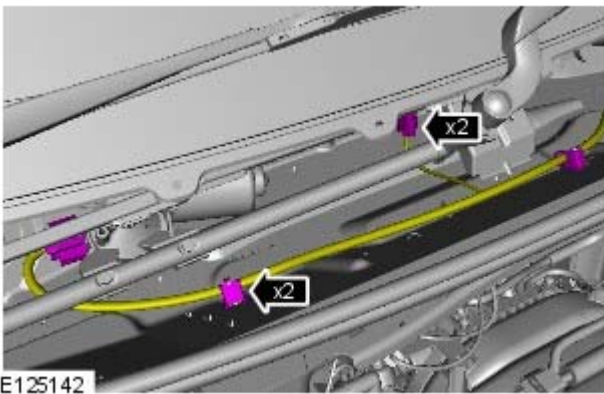
E122391

17. TORQUE: 12 Nm



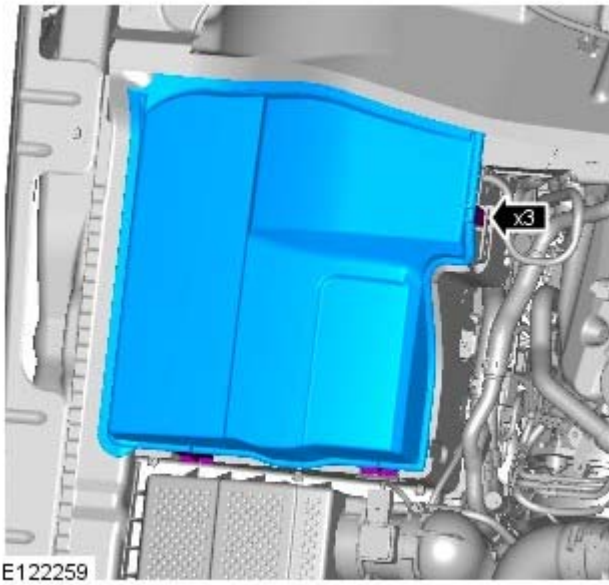
E125104

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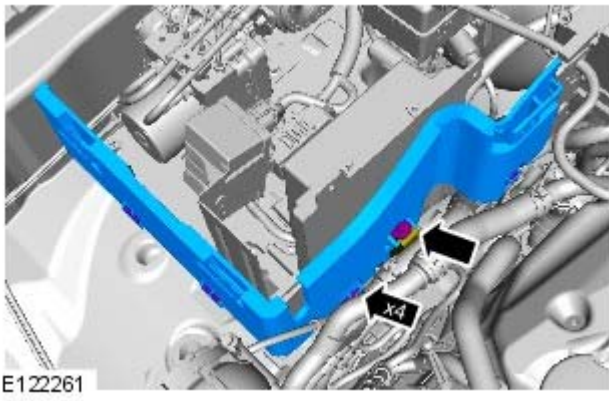


E125142

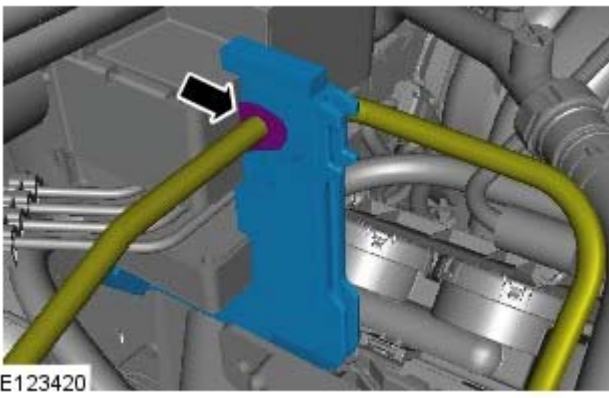
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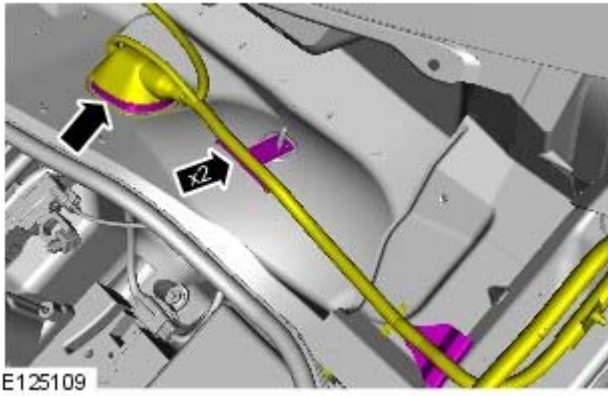
20. TORQUE: 10 Nm



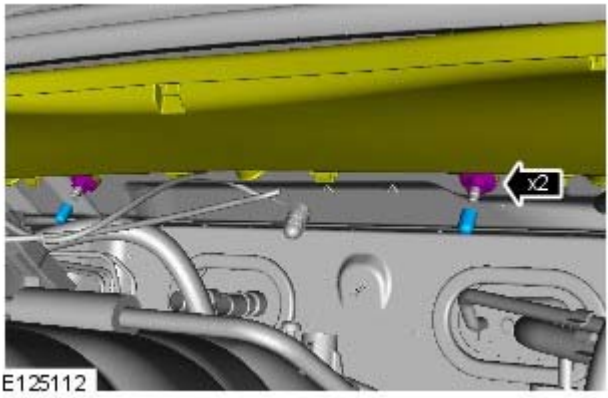
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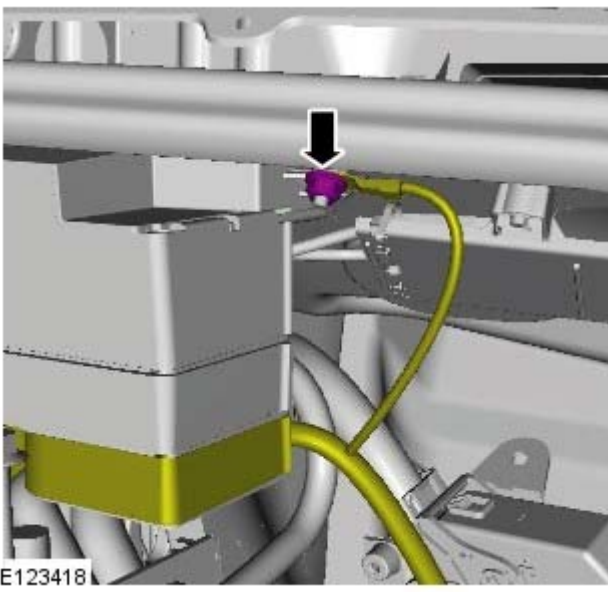
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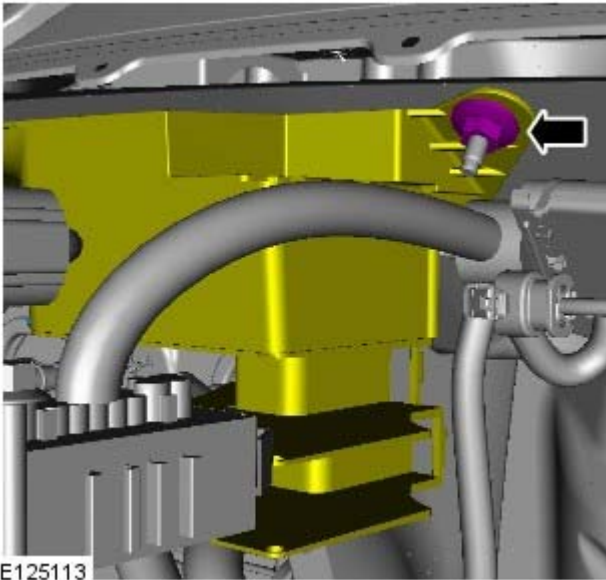
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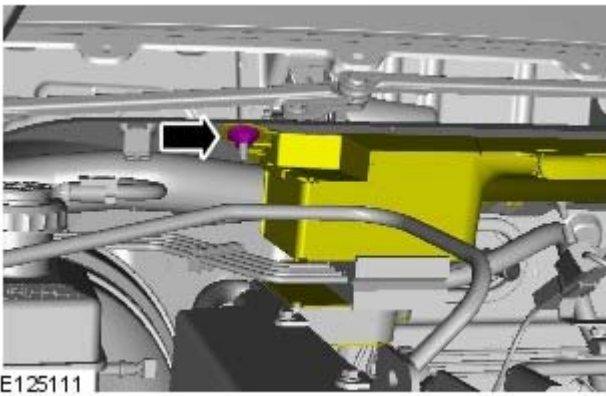
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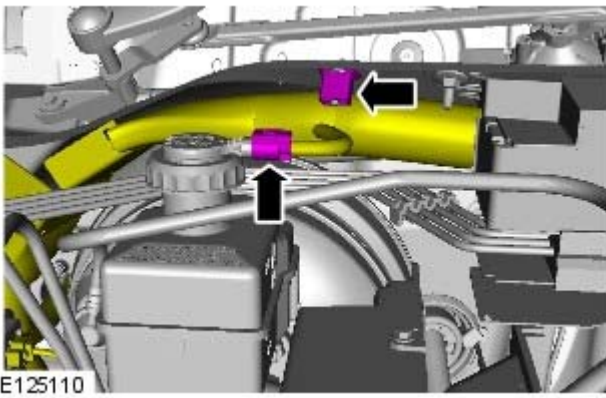
25. TORQUE: 10 Nm



26. TORQUE: 10 Nm

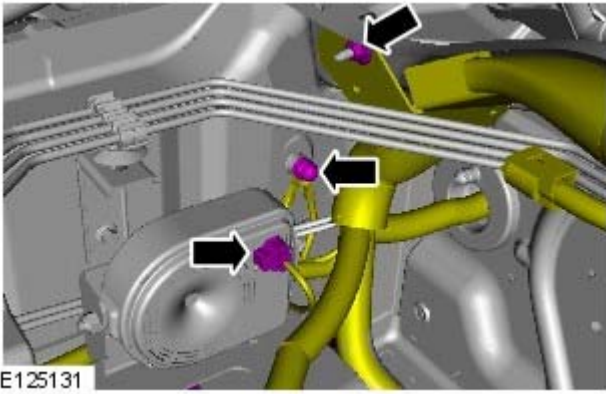


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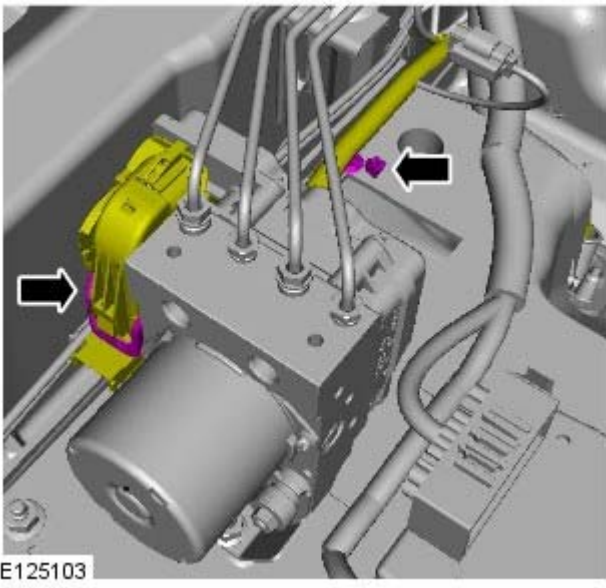


28. For additional information, refer to: [Brake Booster](#) (206-07 Power Brake Actuation, Removal and Installation).

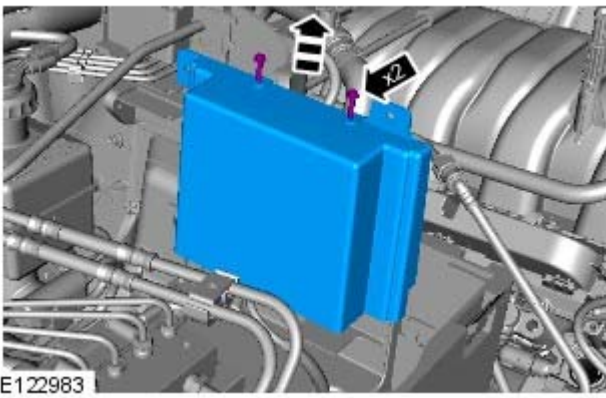
29. TORQUE: 10 Nm



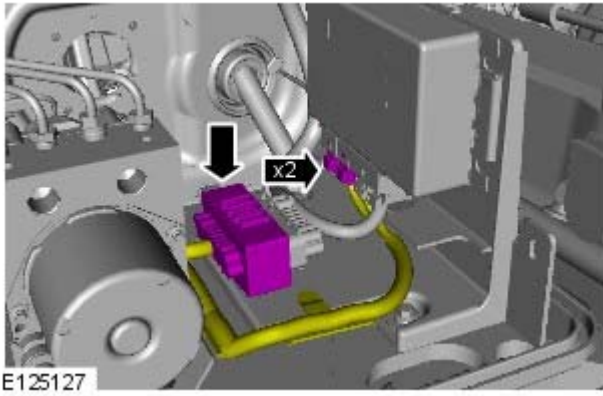
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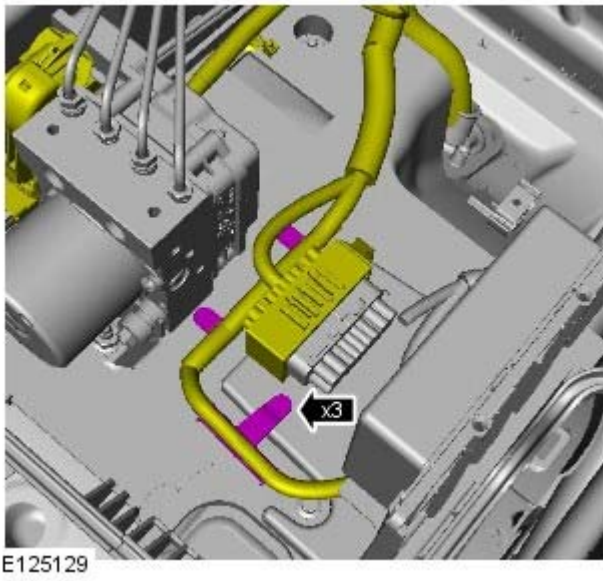
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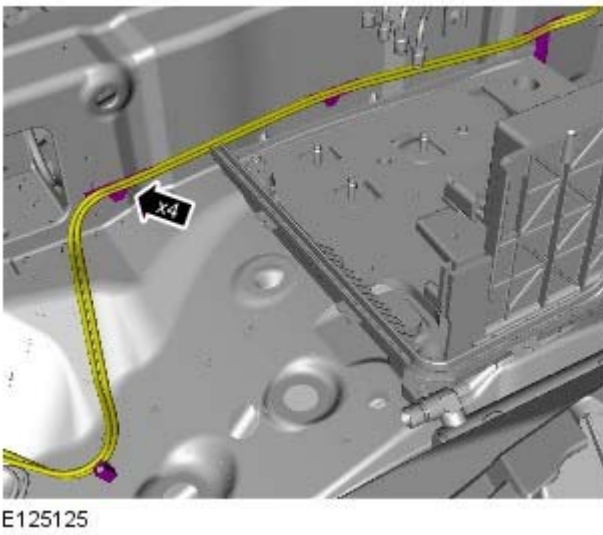
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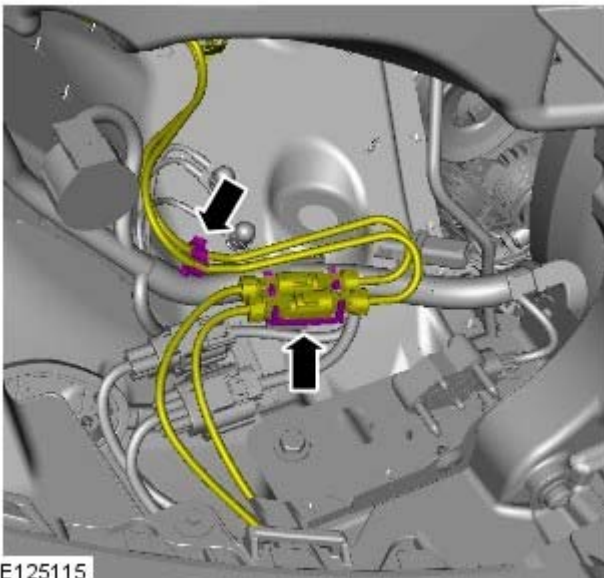
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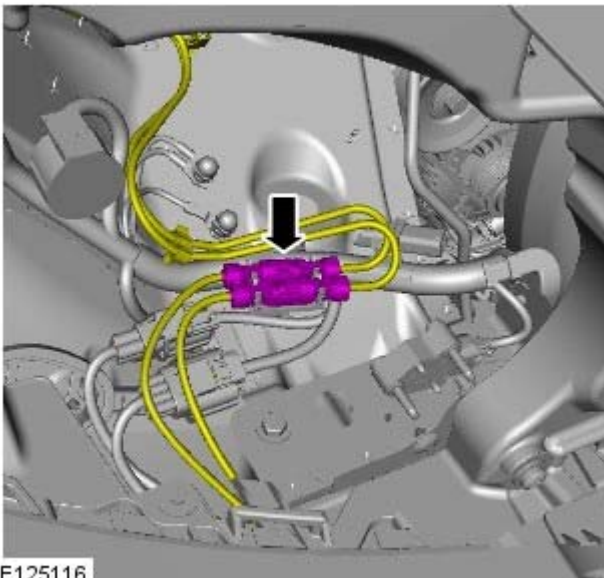


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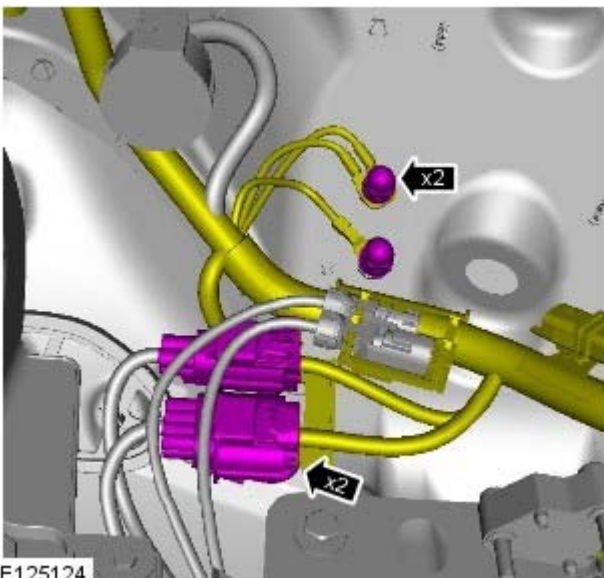
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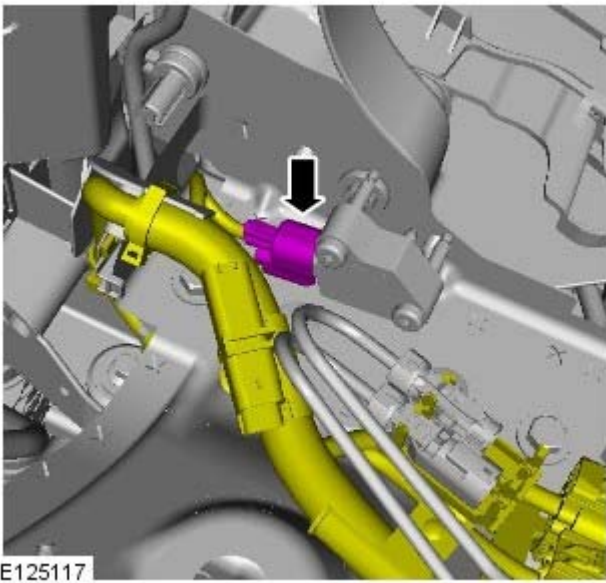
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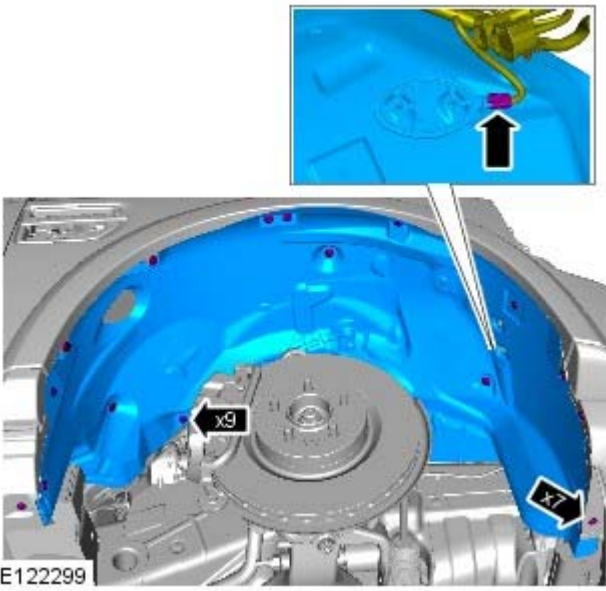


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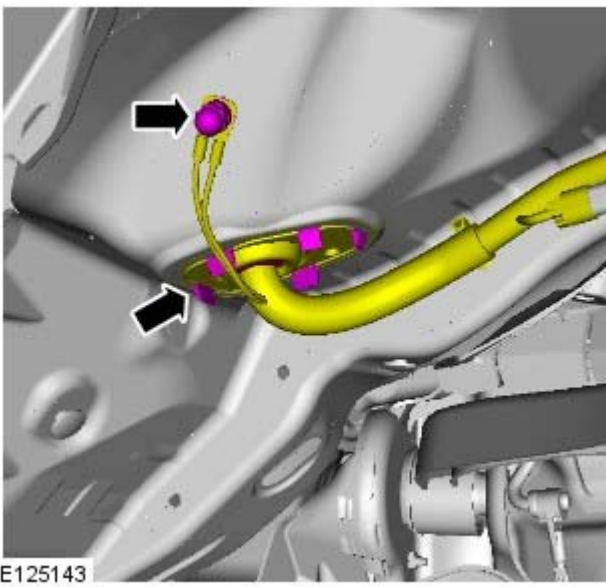
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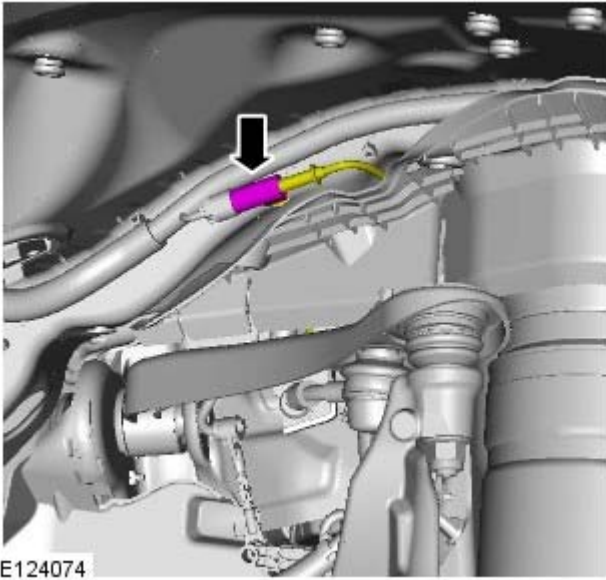
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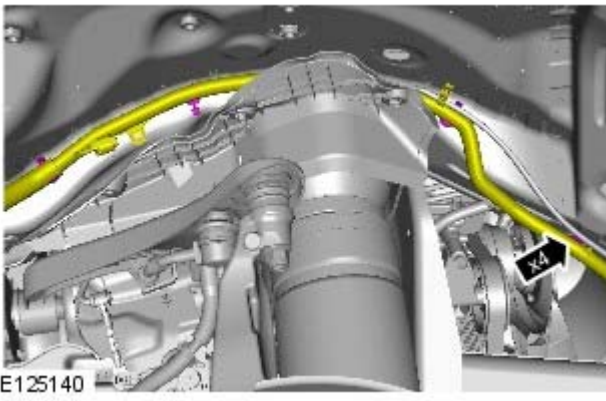
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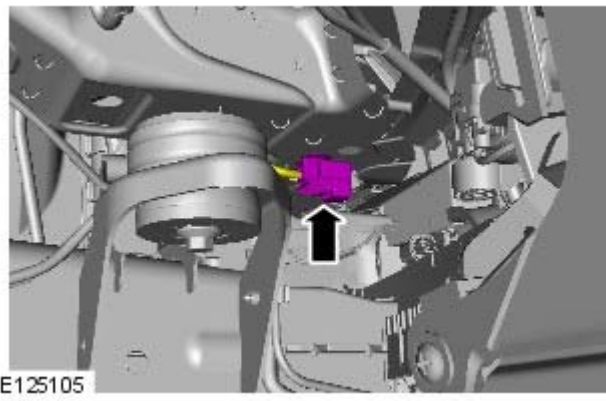
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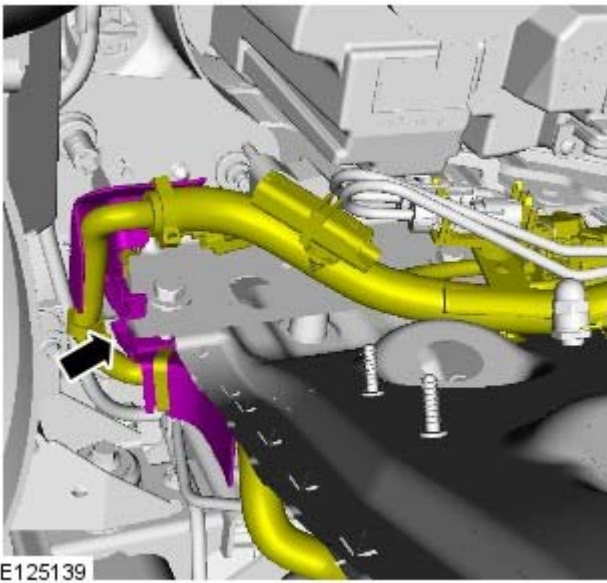
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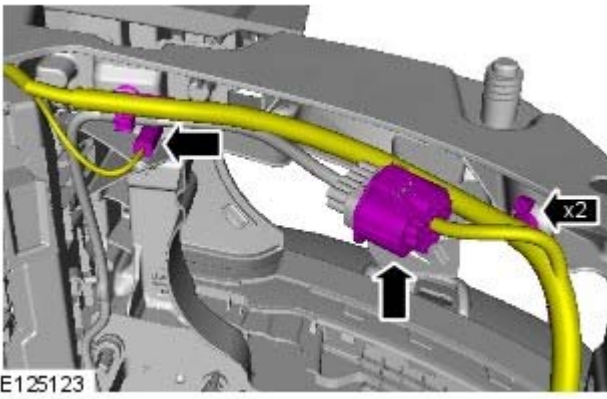
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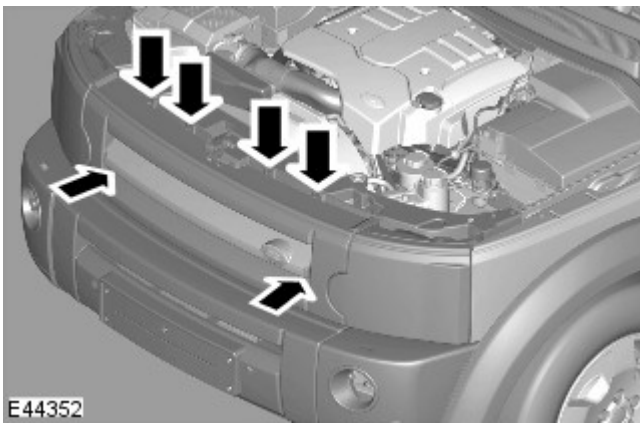
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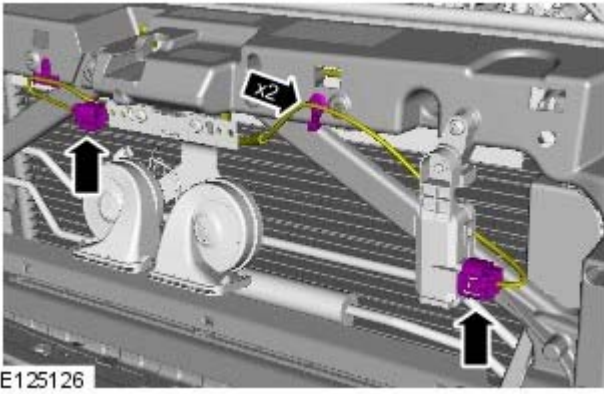
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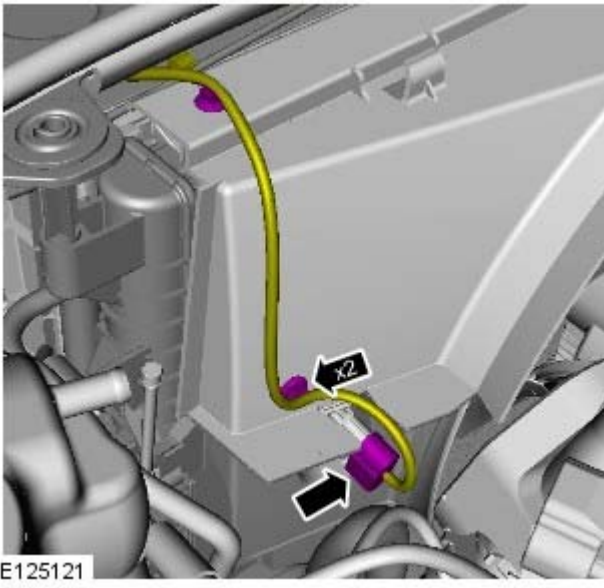
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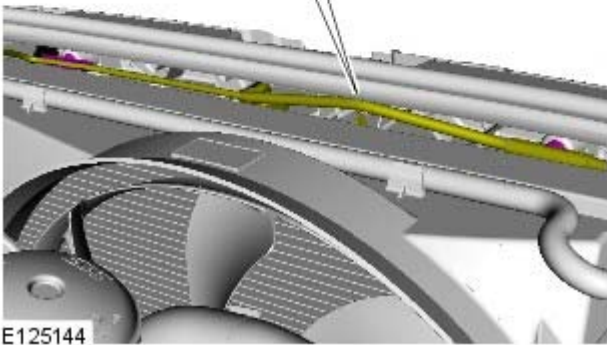
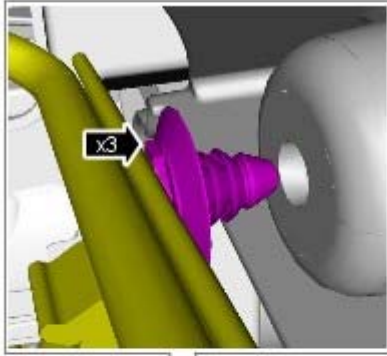
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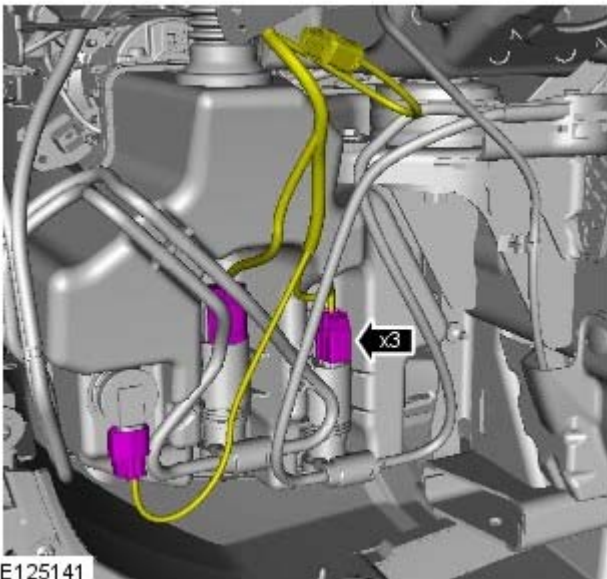


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E125144

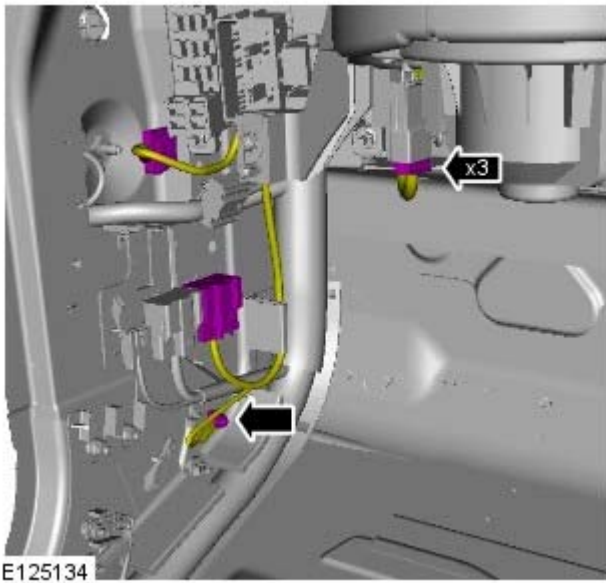
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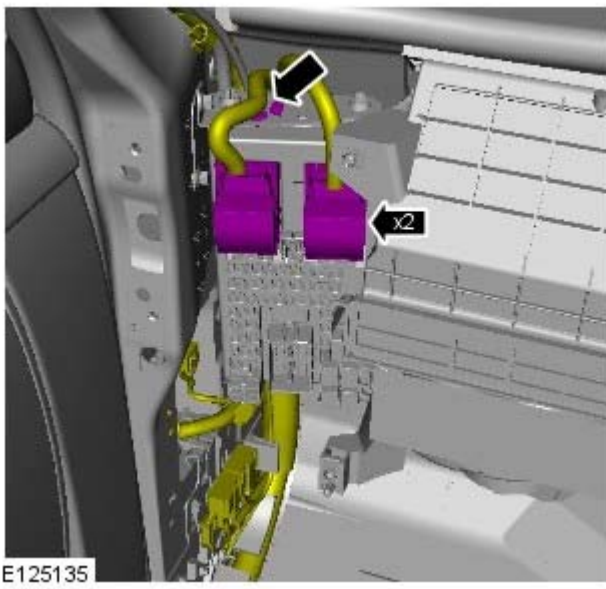
E125141

51. For additional information, refer to: [Instrument Panel](#) (501-12 Instrument Panel and Console, Removal and Installation).

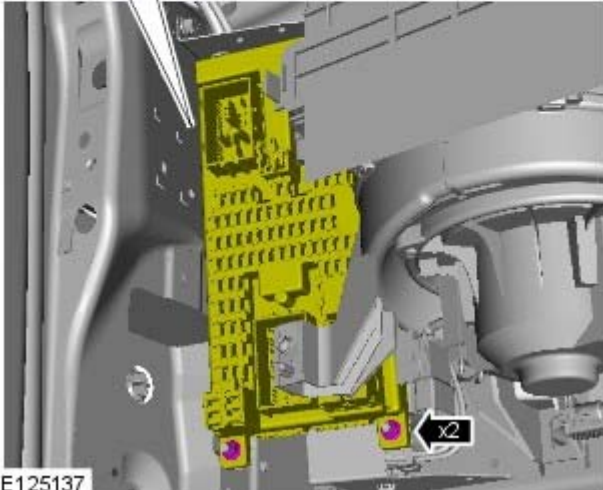
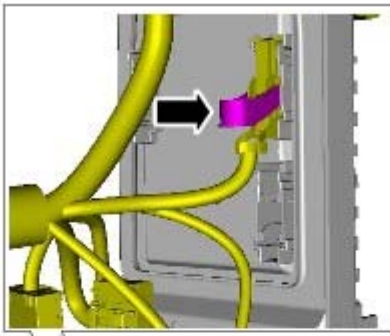
52. TORQUE: 10 Nm



53.

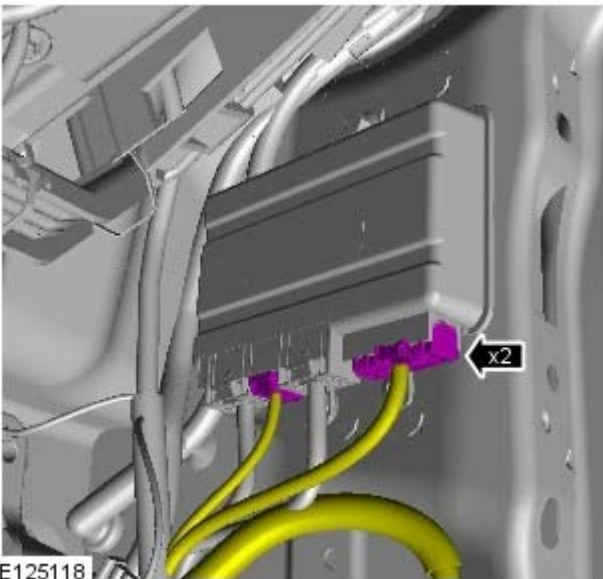


54. TORQUE: 10 Nm



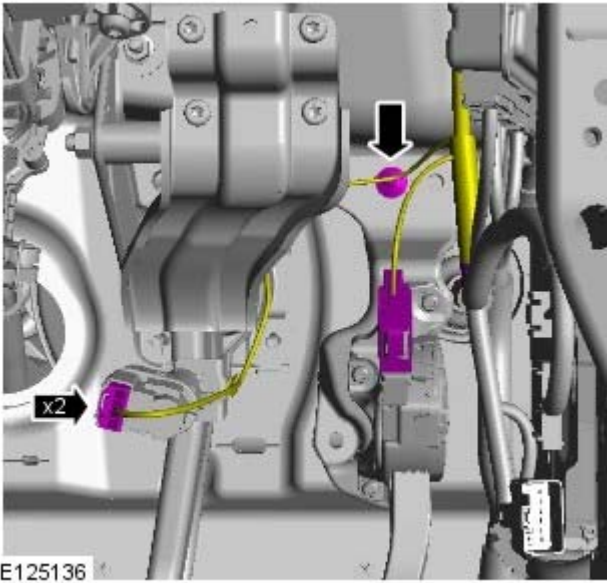
E125137

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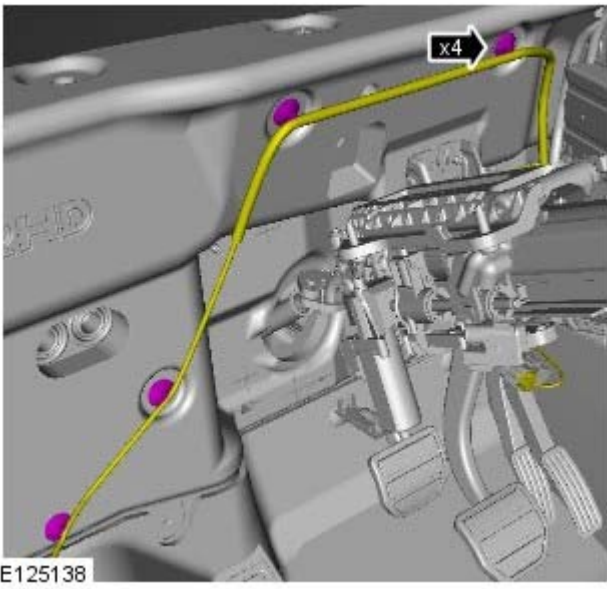


E125118

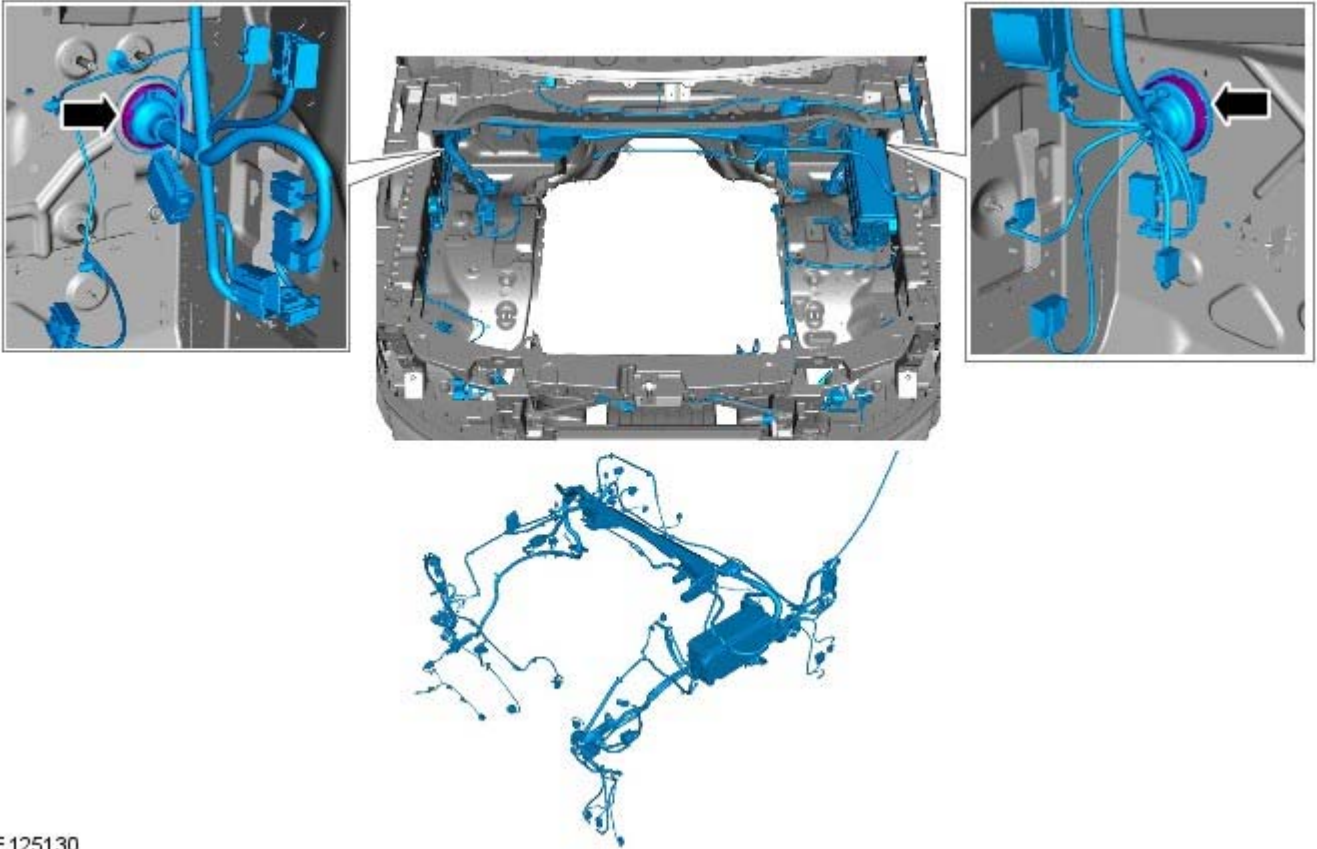
56.



57.



58.



E125130

Installation

1. To install, reverse the removal procedure.

Module Communications Network - Battery Junction Box (BJB)TDV6 2.7L Diesel

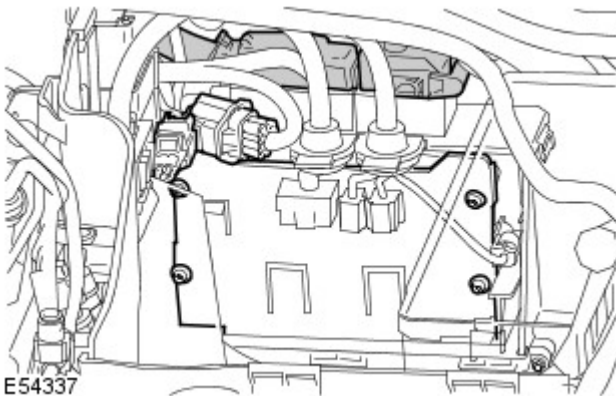
Removal and Installation

Removal

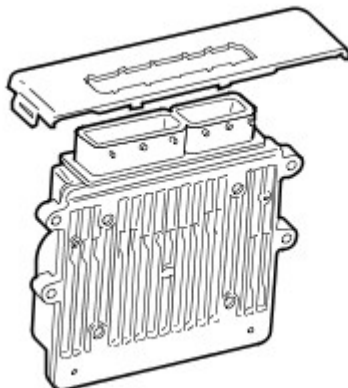
- NOTE: The BJB is an integral component of the engine compartment wiring harness and cannot be removed separately.

All vehicles

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
5. Remove the air cleaner assembly.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
6. Remove the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
7. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
8. Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
9. Remove the ECM cover.
 - Disconnect 2 electrical connectors for access.
 - Disconnect the 2 ECM electrical connectors.
 - Remove the 4 Torx screws.

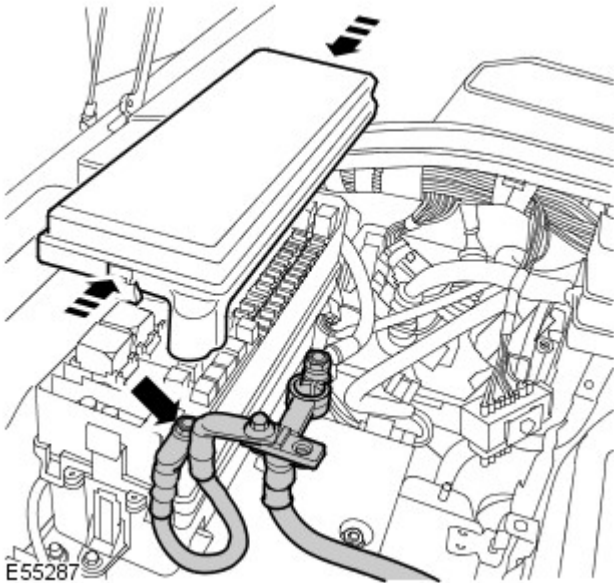


10. Remove the ECM.
 - Remove the ECM top cover.
 - Release the clip.



12. Disconnect the battery positive cable from the BJB.

- Remove the nut.



13. Remove both cowl side trim panels.

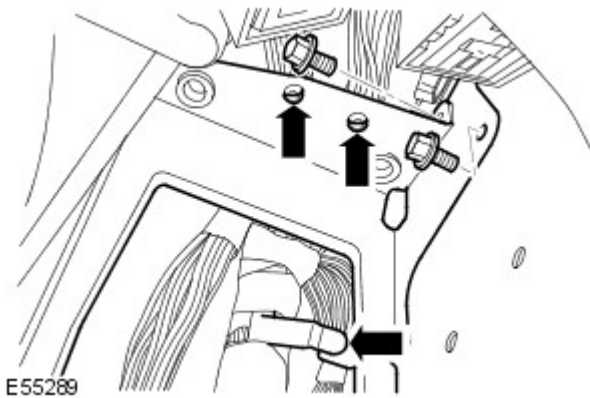
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

14. Remove the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

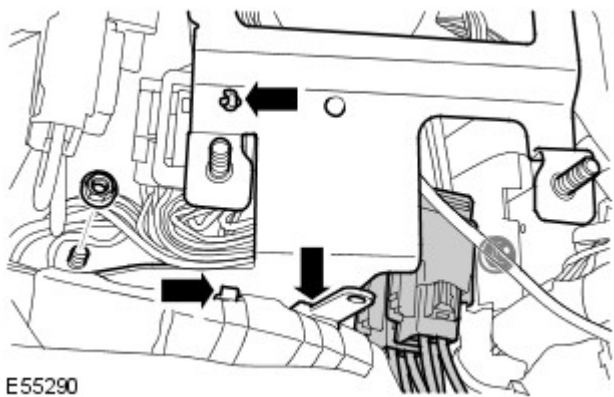
15. Release the CJB bracket.

- Release the 3 upper wiring harness clips.
- Remove the 2 bolts.



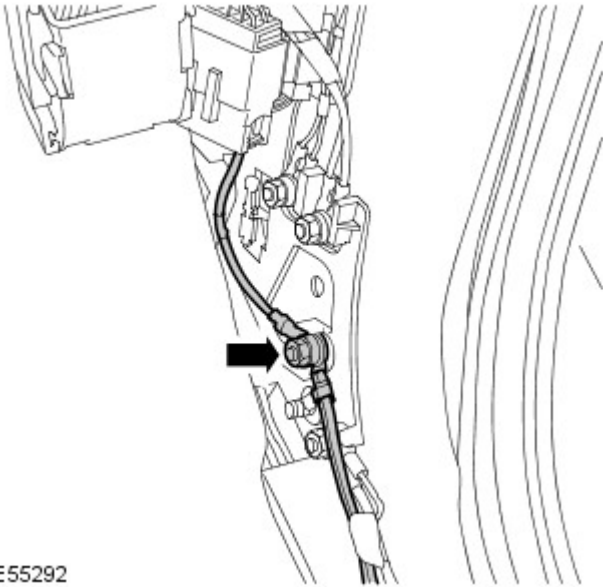
16. Remove the CJB bracket.

- Disconnect the 2 electrical connectors.
- Release the 3 lower wiring harness clips.
- Remove the 2 nuts.



17. Release the 2 ground cables from the lower A-pillar.

- Remove the nut.



E55292

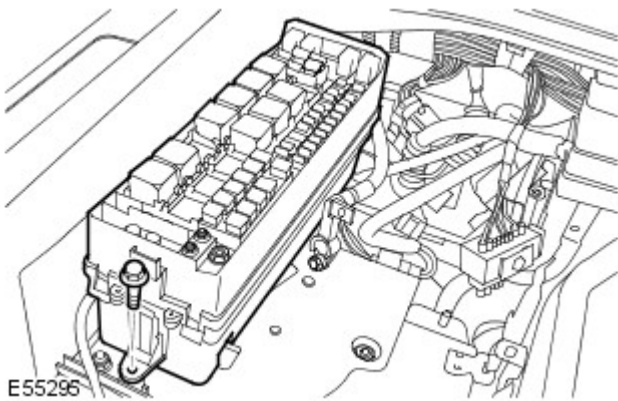
18. Disconnect the heater motor electrical connector.



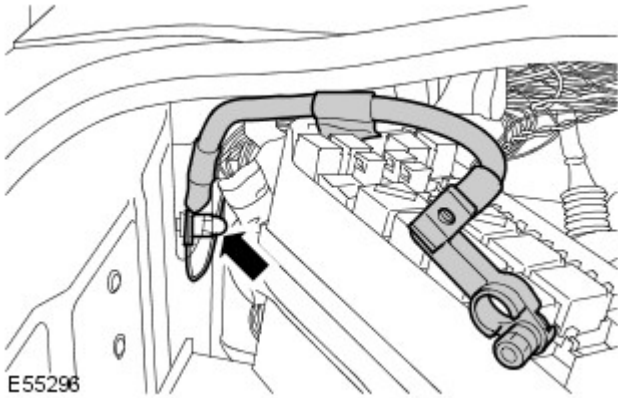
E55293

19. Release the BJB from the bracket.

- Remove the bolt.

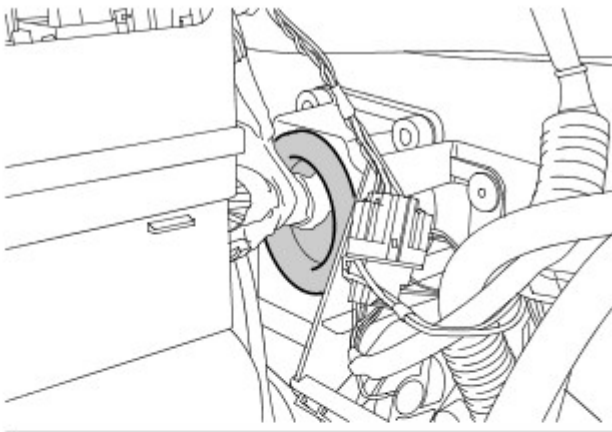


E55296



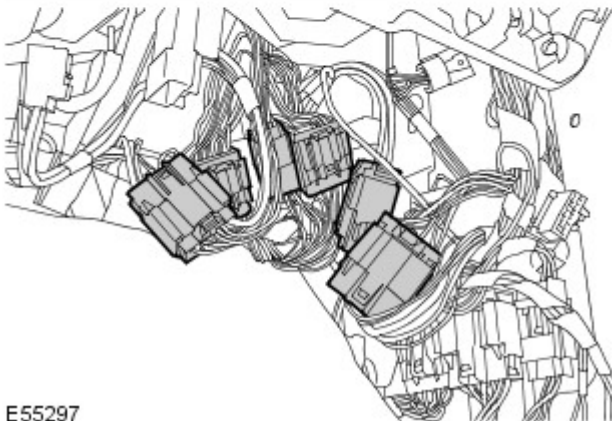
20. Remove the battery ground cable.

- Remove the nut.
- Release the additional ground cable.



21. Release the BJB wiring harness from the bulkhead.

- Disconnect the 6 electrical connectors.
- Release the grommet.



22. Raise and support the vehicle.

23. Remove both front fender splash shields.

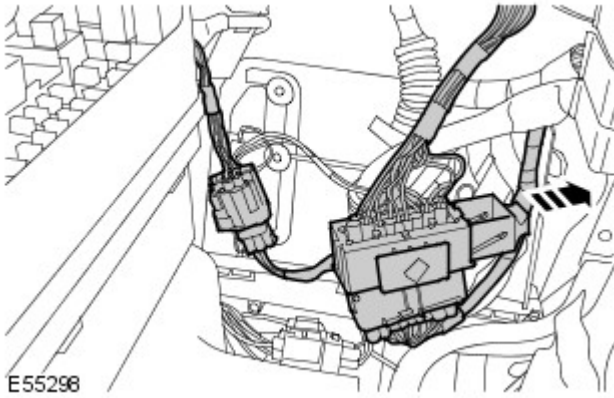
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

24. Remove both headlamps.

For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

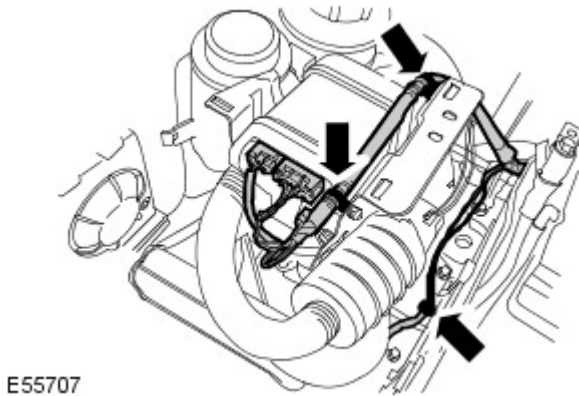
25. Passenger side: Disconnect the engine wiring harness electrical connector.

26. Passenger side: Disconnect the transfer case electrical connector.



27. LH side: Release the wiring harness from the fuel fired heater.

- Disconnect the 3 electrical connectors.
- Release the 3 clips.



28. LH side: Disconnect the washer jet hose.



29. LH side: Disconnect the adaptive front lighting control module electrical connector.

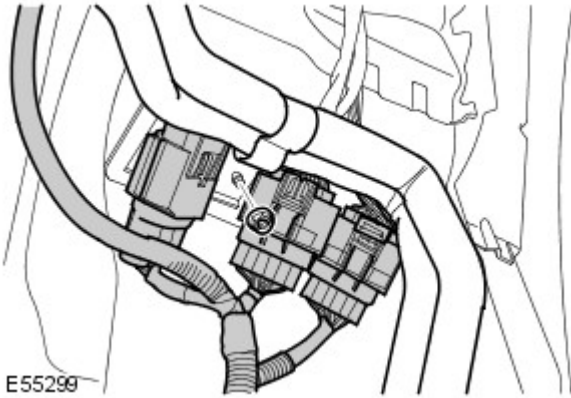


Vehicles with auxiliary climate control

30. LH side: Release the A/C lines from the body panel.
All vehicles

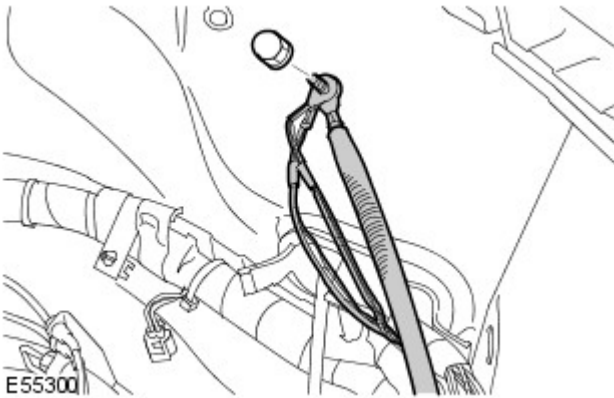
- Remove the nut.

31. LH side: Disconnect the 3 body panel electrical connectors.



32. LH side: Release the 3 body panel ground cables.

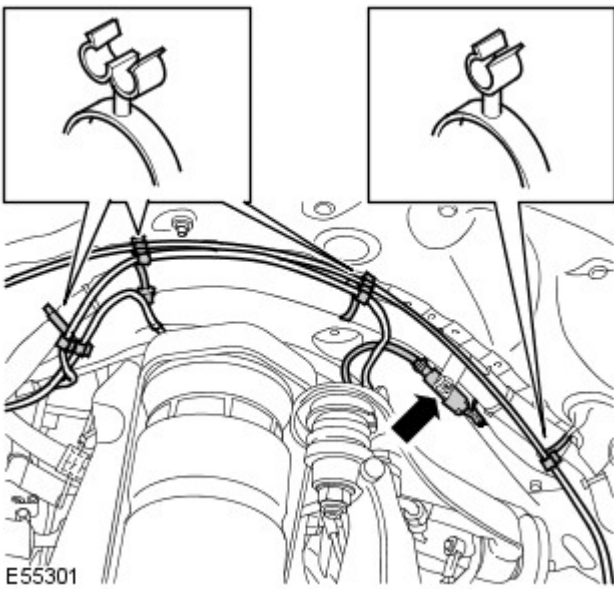
- Remove the nut.



33. LH side: Release the 2 air suspension pipes from the wiring harness.

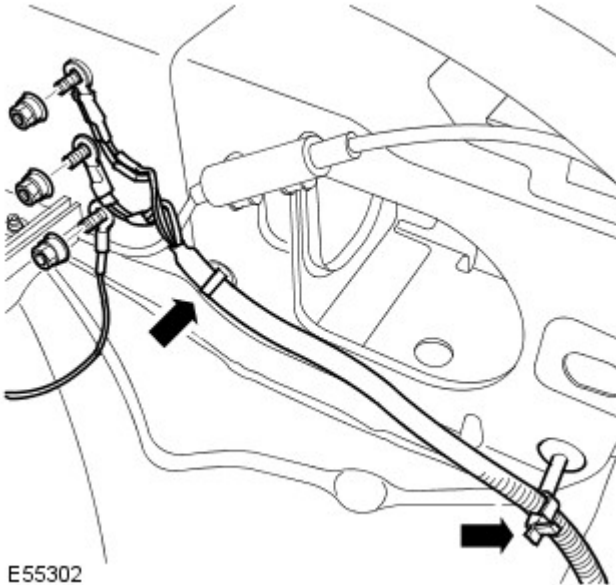
- Release the 7 clips.

34. LH side: Disconnect the ABS electrical connector.



35. LH side: Release 3 engine compartment ground cables.

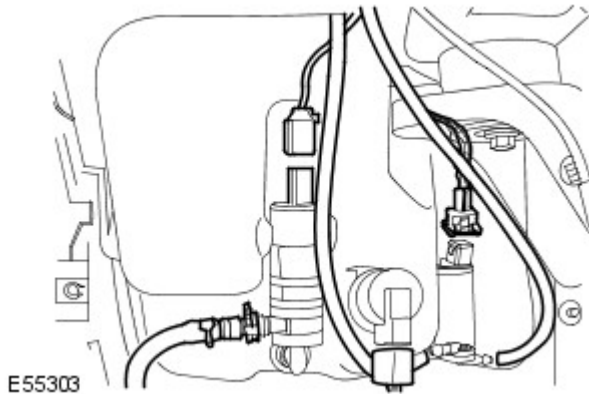
- Remove the 3 nuts.
- Release the 2 clips.



E55302

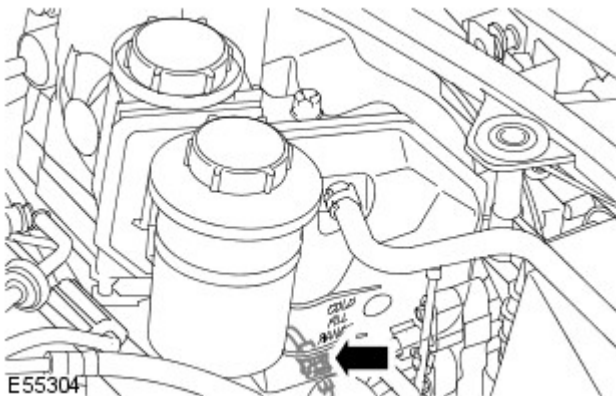
36. LH side: Release the washer reservoir wiring harness.

- Disconnect the 3 electrical connectors.
- Disconnect the 2 washer jet hoses.



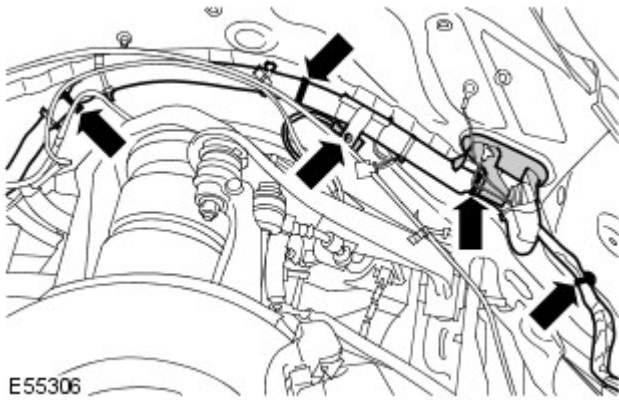
E55303

37. LH side: Disconnect the coolant expansion tank level switch electrical connector.



E55304

38. LH side: Disconnect the brake pad wear sensor electrical connector.



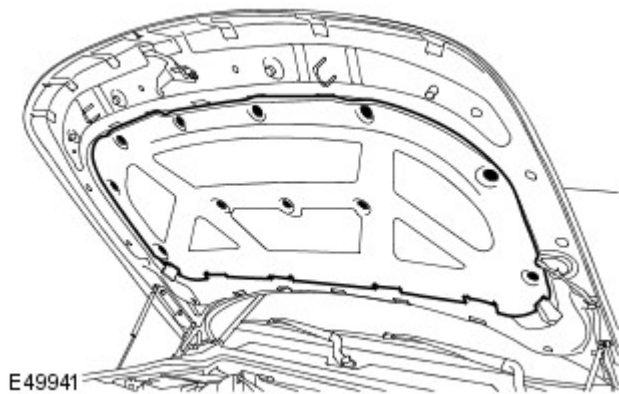
39. LH side: Release the wiring harness.

- Release the grommet.
- Release the 4 clips.

40. Remove the windshield wiper motor.
For additional information, refer to: [Windshield Wiper Motor](#) (501-16 Wipers and Washers, Removal and Installation).

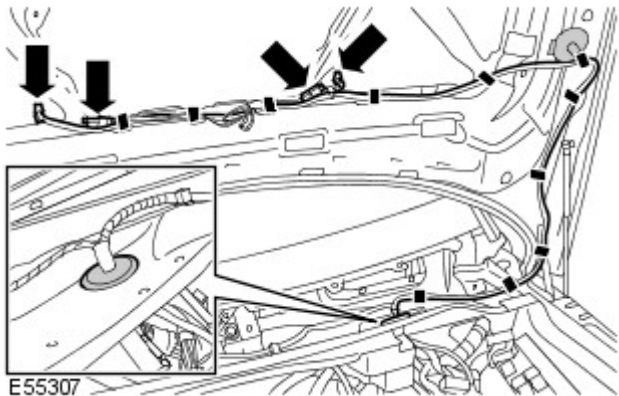
41. Remove the hood pad.

- Remove the 11 clips.



42. Release the hood wiring harness.

- Disconnect the 2 washer jet hoses.
- Disconnect the 2 electrical connectors.
- Release the 10 clips.
- Remove the wiring harness cover.
- Release the grommet.



43. NOTE: 4.0L illustration shown, 2.7L Diesel is similar.

Disconnect the A/C pressure transducer electrical connector.





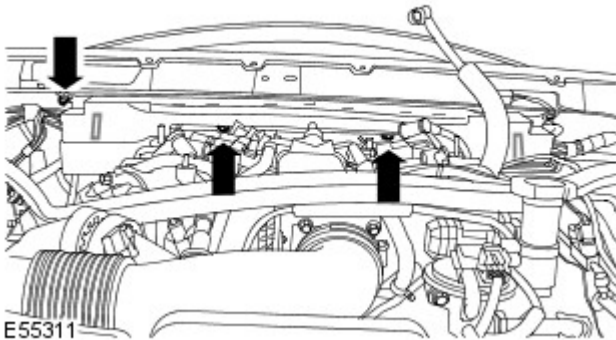
44. NOTE: 4.0L illustration shown, 2.7L Diesel is similar.

Disconnect the battery to engine compartment wiring harness electrical connector.

45. NOTE: 4.0L illustration shown, 2.7L Diesel is similar.

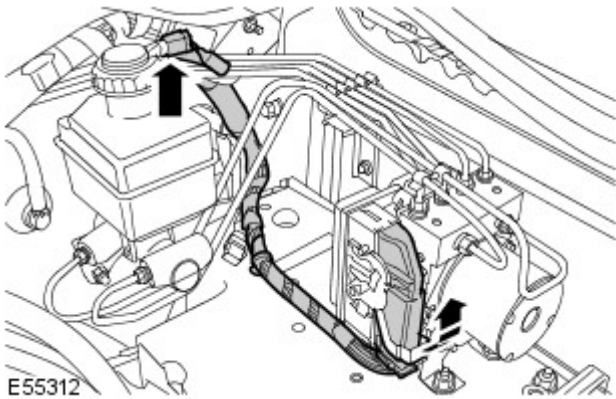
Release the wiring harness from the plenum.

- Release the 2 clips.
- Remove the 3 nuts.



46. Disconnect the brake fluid reservoir electrical connector.

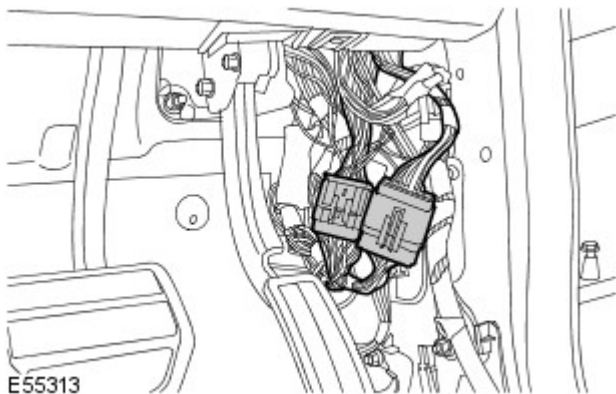
47. Disconnect the ABS module electrical connector.



48. Remove the air suspension control module.

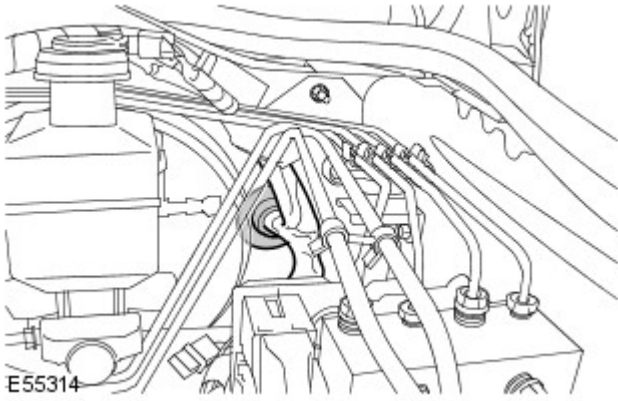
For additional information, refer to: [Air Suspension Control Module](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

49. Driver side: Disconnect 2 electrical connectors from the lower A-pillar.



50. Driver side: Release the wiring harness from the bulkhead.

- Release the grommet.



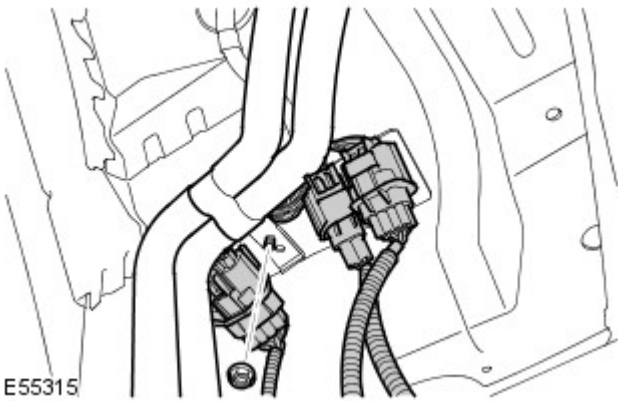
Vehicles with auxiliary heating

51. RH side: Release the heater pipes from the body panel.

- Remove the nut.

All vehicles

52. RH side: Disconnect the 3 body panel electrical connectors.



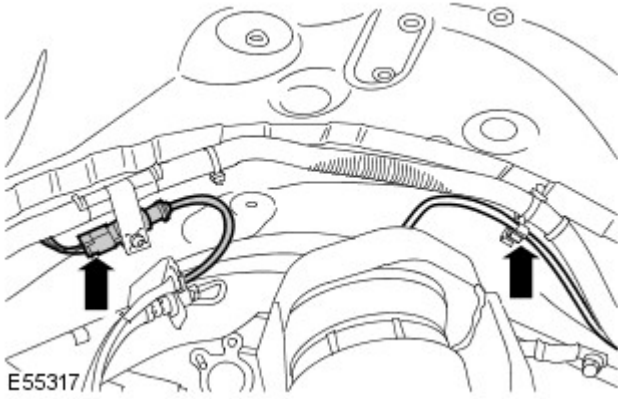
53. RH side: Release the 3 body panel ground cables.

- Remove the nut.



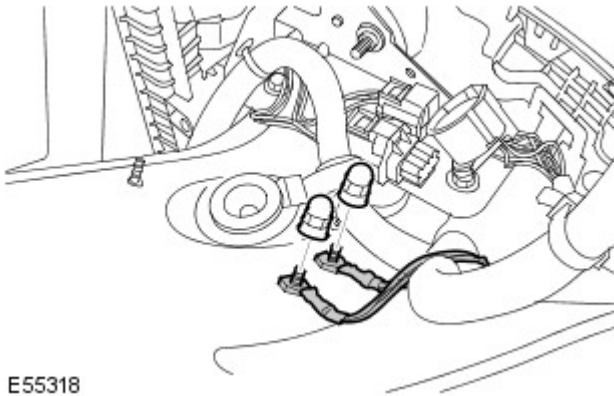
54. RH side: Disconnect the ABS electrical connector.

55. RH side: Release the air suspension pipe from the wiring harness clip.



56. RH side: Release 2 engine compartment ground cables.

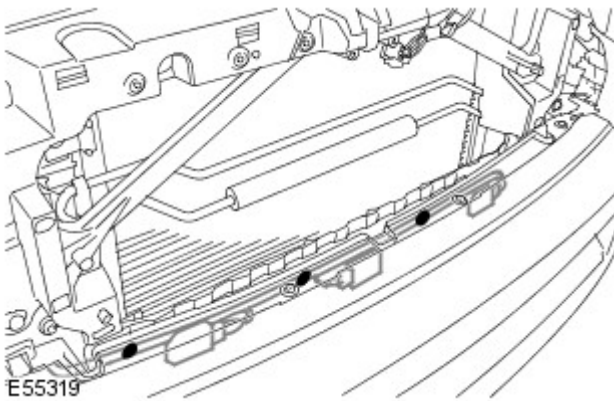
- Remove the 2 nuts.



57. Disconnect the ambient air temperature sensor electrical connector.

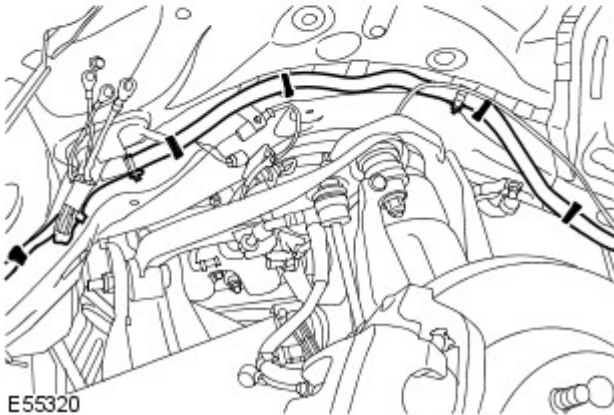
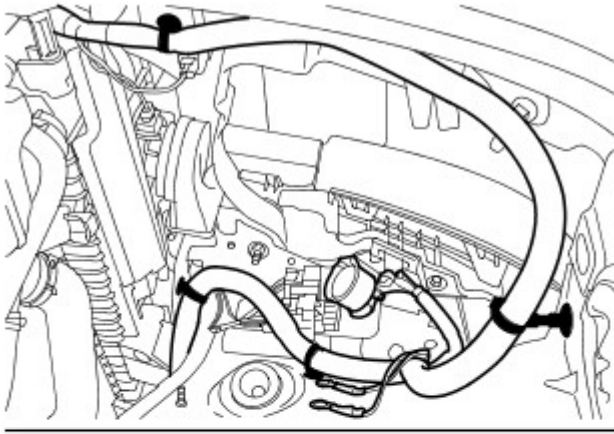
58. Disconnect both front impact severity sensor electrical connectors.

- Release the 3 clips.



59. RH side: Release the wiring harness.

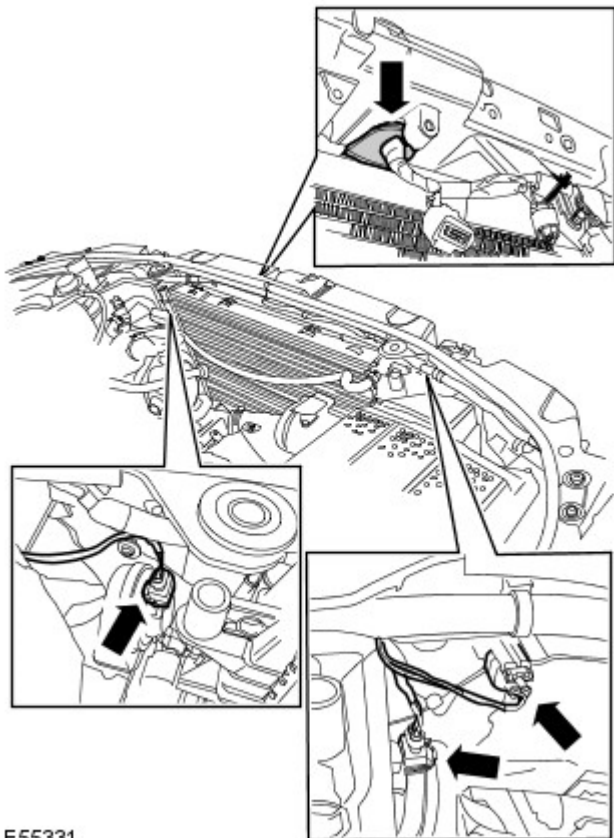
- Release the 9 clips.



E55320

60. Disconnect the hood switch electrical connector.

61. Disconnect both horn electrical connectors.



E55331

62. If installed, disconnect the speed control module electrical connector.

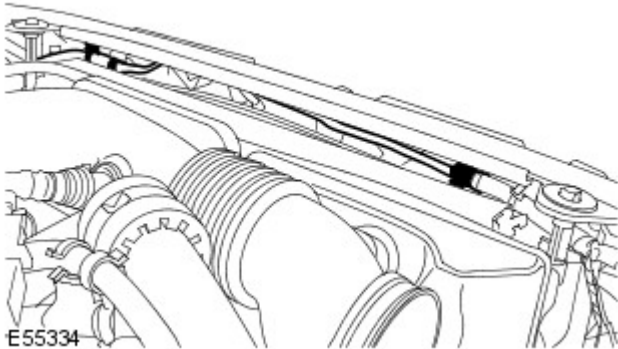
63. If installed, disconnect the pollution sensor electrical connector.

- Release the clip.
- Release the grommet.

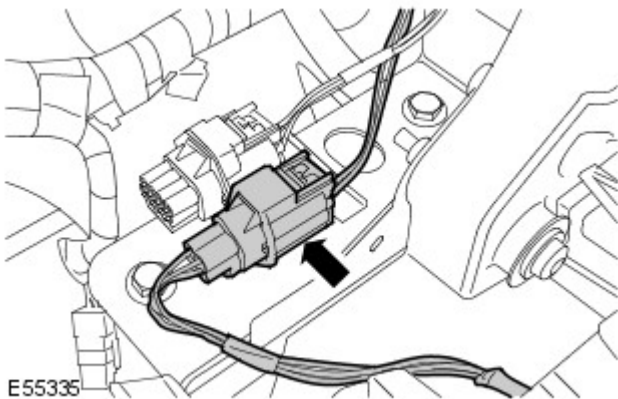
64. NOTE: 4.0L illustration shown, 2.7L Diesel is similar.

Release the hood release cable.

- Release from the 3 clips.



65. Disconnect the front bumper wiring harness electrical connector.



66. With assistance, remove the BJB and wiring harness.

Installation

All vehicles

1. With assistance, install the BJB and wiring harness.
2. Connect the front bumper wiring harness electrical connector.
3. Attach the hood release cable.
 - Secure with the clips.
4. If installed, connect the pollution sensor electrical connector.
 - Install the grommet.
 - Secure the clip.
5. If installed, connect the speed control module electrical connector.
6. Connect the horn electrical connectors.
7. Connect the hood switch electrical connector.
8. RH side: Secure the wiring harness.
 - Secure the clips.
9. Connect both front impact electrical connectors.
 - Secure the clips.
10. RH side: Attach the air suspension pipe.
11. Connect the ambient air temperature sensor electrical connector.
12. RH side: Attach the engine compartment ground cables.

- Tighten the nuts to 25 Nm (18 lb.ft).

13. RH side: Connect the ABS electrical connector.

14. RH side: Attach the body panel ground cables.

- Tighten the nut to 25 Nm (18 lb.ft).

15. RH side: Connect the body panel electrical connectors.

Vehicles with auxiliary heating

16. RH side: Secure the heater pipes to the body panel.

- Tighten the nut to 10 Nm (7 lb.ft).

All vehicles

17. Driver side: Attach the wiring harness to the bulkhead.

- Install the grommet.

18. Driver side: Connect the lower A-pillar electrical connectors.

19. Install the air suspension control module.

For additional information, refer to: [Air Suspension Control Module](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

20. Connect the ABS module electrical connector.

21. Connect the brake fluid reservoir electrical connector.

22. Attach the wiring harness to the plenum.

- Secure the clips.
- Tighten the nuts to 4 Nm (3 lb.ft).

23. Connect the battery to engine compartment wiring harness electrical connector.

24. Connect the A/C pressure transducer electrical connector.

25. Attach the hood wiring harness.

- Install the grommet.
- Install the cover.
- Secure with the clips.
- Connect the electrical connectors.
- Connect the washer jet hoses.

26. Install the hood pad.

- Install the clips.

27. Install the windshield wiper motor.

For additional information, refer to: [Windshield Wiper Motor](#) (501-16 Wipers and Washers, Removal and Installation).

28. LH side: Attach the wiring harness.

- Install the grommet.
- Secure the clips.

29. LH side: Connect the brake pad wear sensor electrical connector.

30. LH side: Connect the coolant expansion tank level switch electrical connector.

31. LH side: Attach the washer reservoir wiring harness.

- Connect the washer jet hoses.
- Connect the electrical connectors.

33. LH side: Attach the engine compartment ground cables.

33. LH side: Connect the ABS electrical connector.

34. LH side: Attach the air suspension pipes.

35. LH side: Attach the body panel ground cables.

- Secure the clips to 25 Nm (18 lb.ft).

- Tighten the nut to 25 Nm (18 lb.ft).

36. LH side: Connect the body panel electrical connectors.

Vehicles with auxiliary climate control

37. LH side: Secure the A/C lines to the body panel.

- Tighten the nut to 10 Nm (7 lb.ft).

All vehicles

38. LH side: Connect the adaptive front lighting control module electrical connector.

39. LH side: Connect the washer jet hose.

40. LH side: Attach the wiring harness to the fuel fired heater.

- Connect the electrical connectors.
- Secure with the clips.

41. Passenger side: Connect the transfer case electrical connector.

42. Passenger side: Connect the engine wiring harness electrical connector.

43. Install the headlamps.

For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

44. Install the fender splash shields.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

45. Attach the BJB wiring harness to the bulkhead.

- Connect the electrical connectors.
- Install the grommet.

46. Install the battery ground cable.

- Attach the additional ground cable.
- Tighten the nut to 25 Nm (18 lb.ft).

47. Secure the BJB to the bracket.

- Tighten the bolt to 6 Nm (4 lb.ft).

48. Connect the heater motor electrical connector.

49. Connect the ground cables to the lower A-pillar.

- Tighten the nut to 10 Nm (7 lb.ft).

50. Install the CJB bracket.

- Tighten the nuts to 10 Nm (7 lb.ft).
- Secure the clips.
- Connect the electrical connectors.
- Tighten the bolts to 25 Nm (18 lb.ft).

51. Install the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

52. Connect the battery positive cable to the BJB.

- Tighten the nut to 25 Nm (18 lb.ft).

53. Install the BJB cover.

- Secure the clip.

54. Install the ECM cover.

- Install the ECM top cover.
- Tighten the Torx screws.

- Connect the electrical connectors.

- 56.** Install the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- 57.** Install the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- 58.** Install the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
- 59.** Install the air cleaner assembly.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
- 60.** Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- 61.** Install the engine cover.
For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
- 62.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- 63.** Check the headlamp beam alignment.
For additional information, refer to: [Headlamp Adjustment](#) (417-01 Exterior Lighting, General Procedures).

Module Communications Network - Battery Junction Box (BJB)TDV6 3.0L

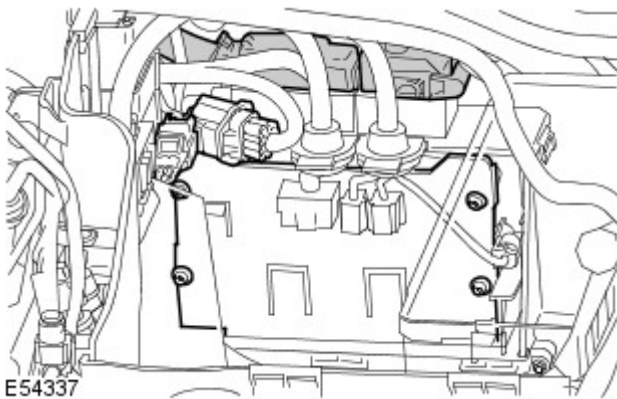
Diesel

Removal and Installation

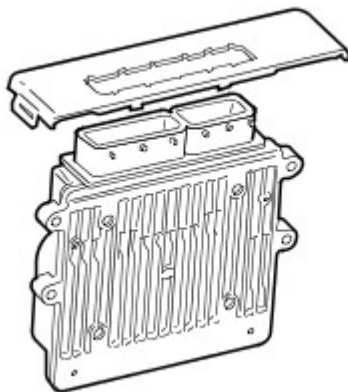
Removal

- NOTE: The BJB is an integral component of the engine compartment wiring harness and cannot be removed separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: Standard Workshop Practices (100-00 General Information, Description and Operation).
3. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the radiator grille.
For additional information, refer to: Radiator Grille (501-08 Exterior Trim and Ornamentation, Removal and Installation).
5. Remove the air cleaner assembly.
6. Remove the four-wheel drive control module.
For additional information, refer to: Four-Wheel Drive (4WD) Control Module (308-07 Four-Wheel Drive Systems, Removal and Installation).
7. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
8. Remove the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
9. Remove the ECM cover.
 - Disconnect 2 electrical connectors for access.
 - Disconnect the 2 ECM electrical connectors.
 - Remove the 4 Torx screws.



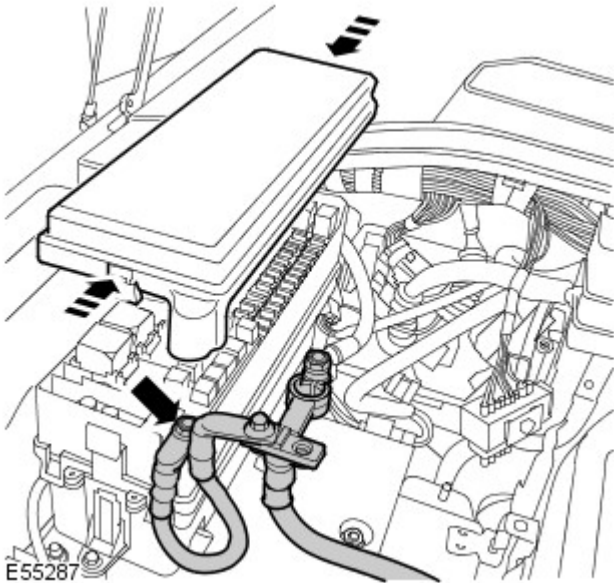
10. Remove the ECM.
 - Remove the ECM top cover.



11. Remove the BJB cover.
 - Release the clip.

12. Disconnect the battery positive cable from the BJB.

- Remove the nut.



13. Remove both cowl side trim panels.

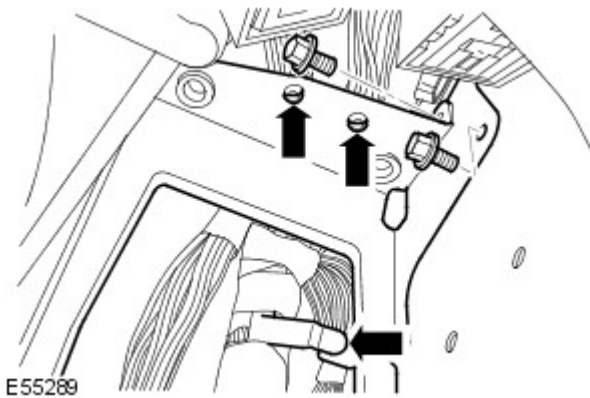
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

14. Remove the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

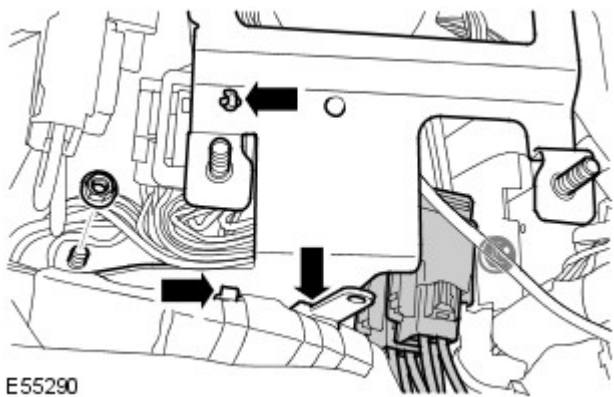
15. Release the CJB bracket.

- Release the 3 upper wiring harness clips.
- Remove the 2 bolts.



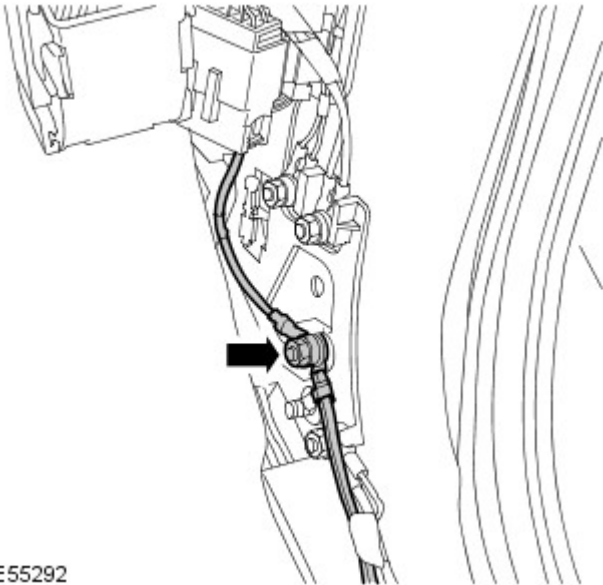
16. Remove the CJB bracket.

- Disconnect the 2 electrical connectors.
- Release the 3 lower wiring harness clips.
- Remove the 2 nuts.



17. Release the 2 ground cables from the lower A-pillar.

- Remove the nut.



E55292

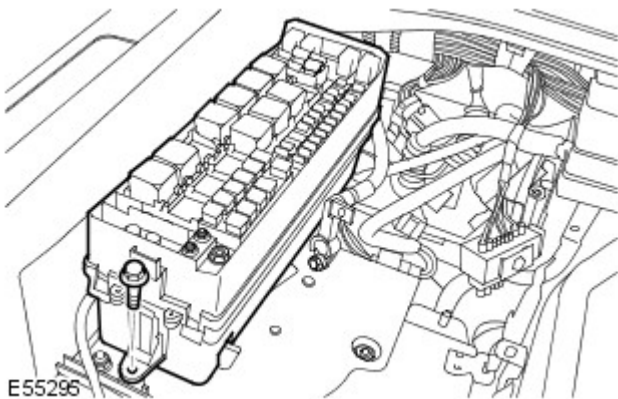
18. Disconnect the heater motor electrical connector.



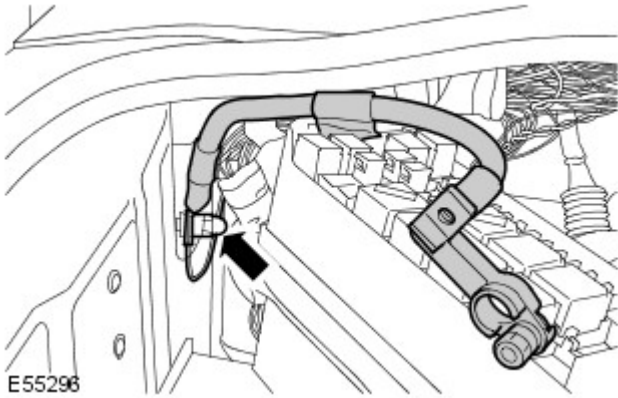
E55293

19. Release the BJB from the bracket.

- Remove the bolt.

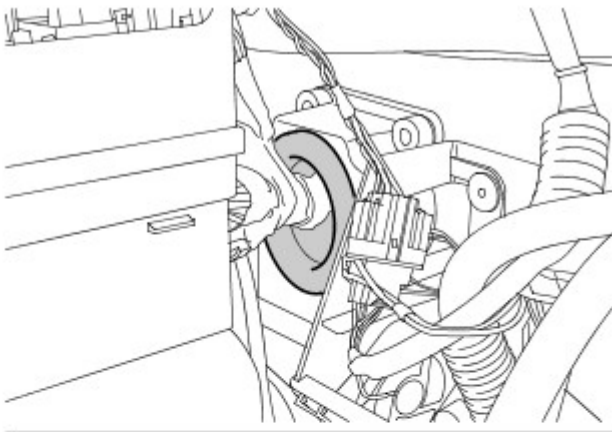


E55296



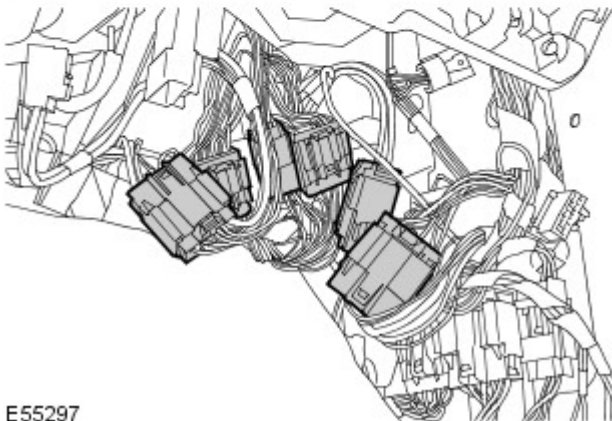
20. Remove the battery ground cable.

- Remove the nut.
- Release the additional ground cable.



21. Release the BJB wiring harness from the bulkhead.

- Disconnect the 6 electrical connectors.
- Release the grommet.



E55297

22. Raise and support the vehicle.

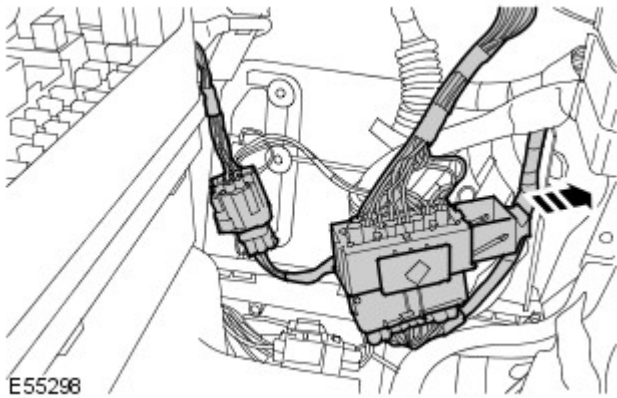
23. Remove both front fender splash shields.

For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

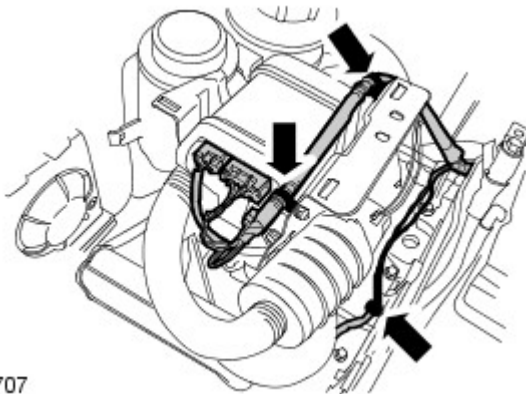
24. Remove both headlamps.

For additional information, refer to: Headlamp Assembly (417-01 Exterior Lighting, Removal and Installation).

25. Passenger side: Disconnect the engine wiring harness electrical connector.



26. Passenger side: Disconnect the transfer case electrical connector.

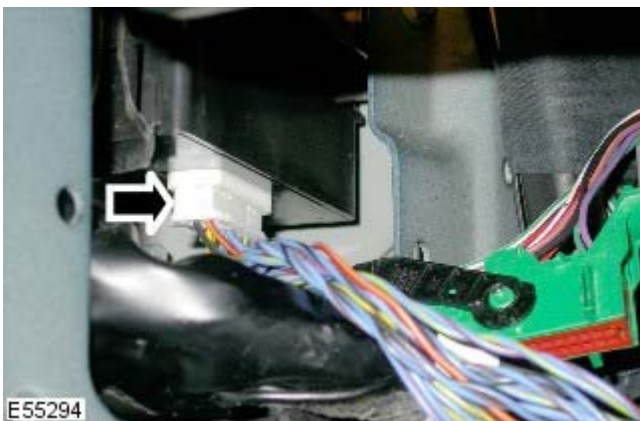


27. LH side: Release the wiring harness from the fuel fired heater.

- Disconnect the 3 electrical connectors.
- Release the 3 clips.

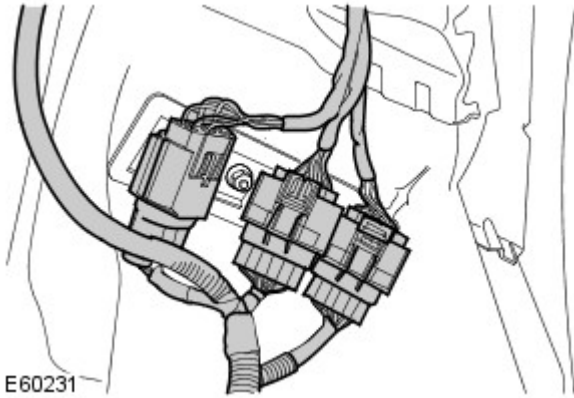


28. LH side: Disconnect the washer jet hose.



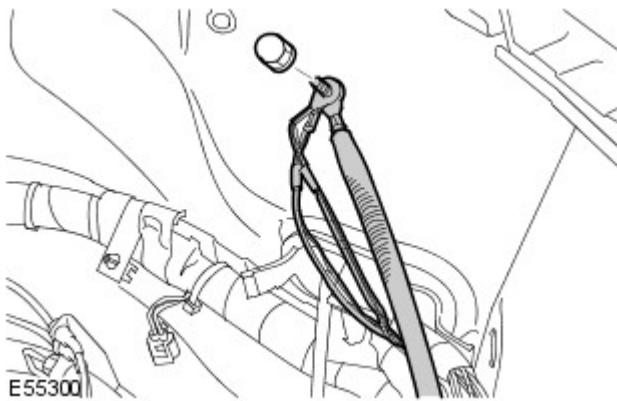
29. LH side: Disconnect the adaptive front lighting module electrical connector.

30. LH side: Disconnect the 3 body panel electrical connectors.



31. LH side: Release the 3 body panel ground cables.

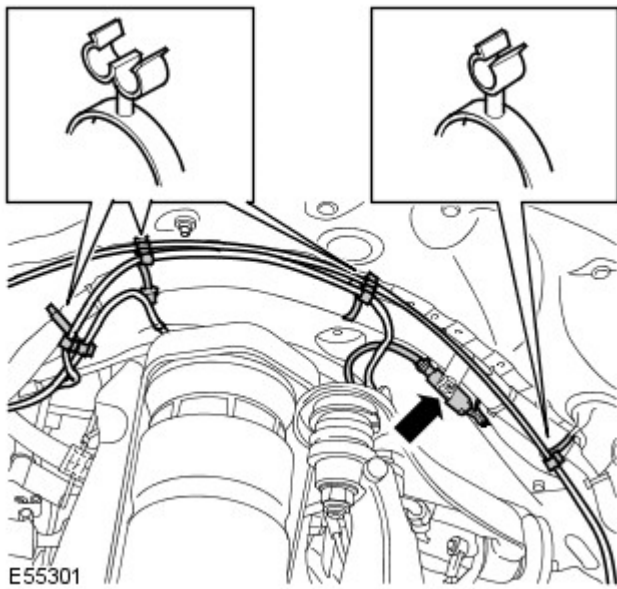
- Remove the nut.



32. LH side: Release the 2 air suspension pipes from the wiring harness.

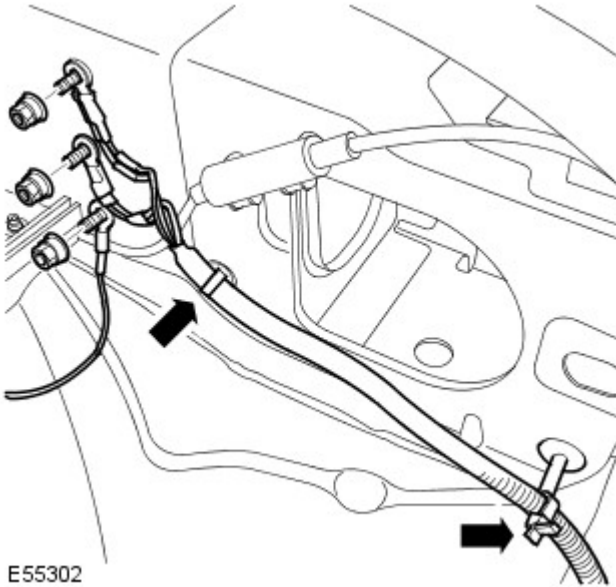
- Release the 7 clips.

33. LH side: Disconnect the ABS electrical connector.



34. LH side: Release 3 engine compartment ground cables.

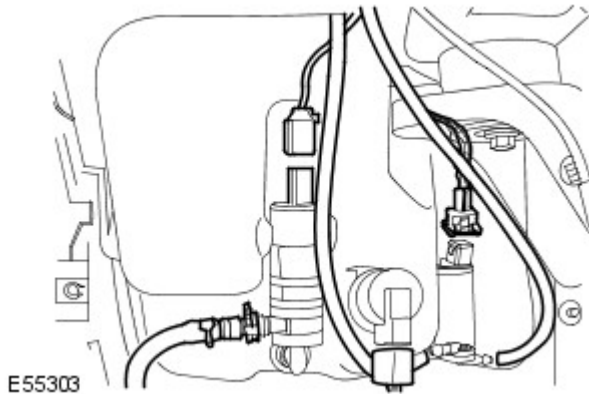
- Remove the 3 nuts.
- Release the 2 clips.



E55302

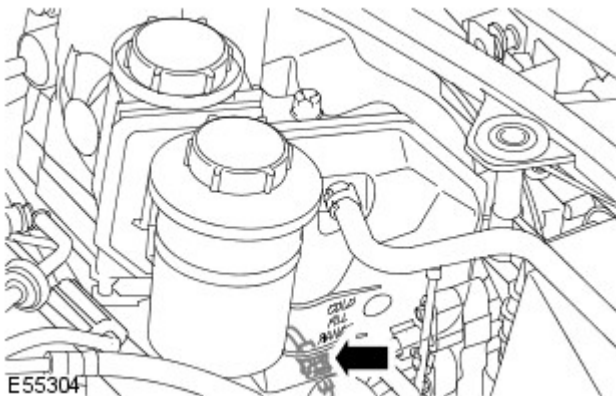
35. LH side: Release the washer reservoir wiring harness.

- Disconnect the 3 electrical connectors.
- Disconnect the 2 washer jet hoses.



E55303

36. LH side: Disconnect the coolant expansion tank level switch electrical connector.

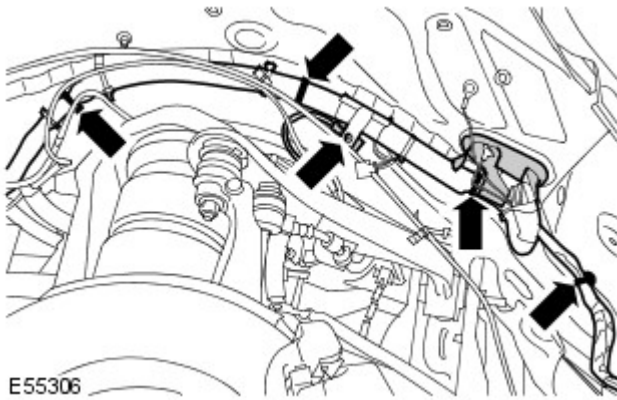


E55304

37. LH side: Disconnect the brake pad wear sensor electrical connector.

38. LH side: Release the wiring harness.

- Release the grommet.
- Release the 4 clips.

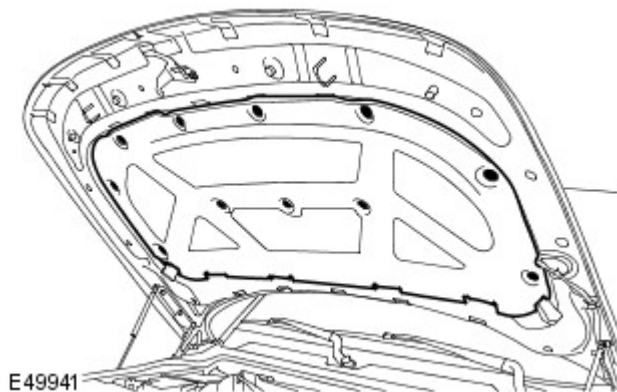


39. Remove the windshield wiper motor.

For additional information, refer to: [Windshield Wiper Motor \(501-16 Wipers and Washers, Removal and Installation\)](#).

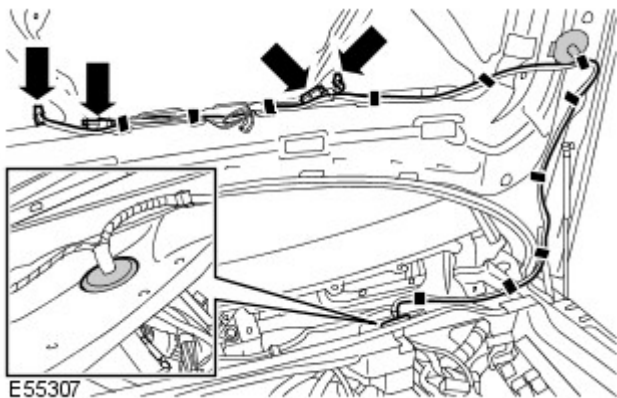
40. Remove the hood pad.

- Remove the 11 clips.



41. Release the hood wiring harness.

- Disconnect the 2 washer jet hoses.
- Disconnect the 2 electrical connectors.
- Release the 10 clips.
- Remove the wiring harness cover.
- Release the grommet.



42. Disconnect the A/C pressure transducer electrical connector.



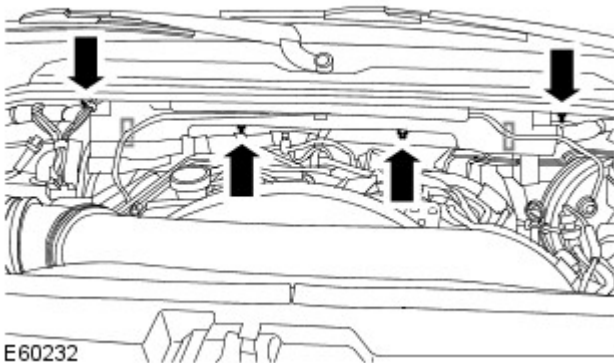


43. NOTE: 4.0L illustration shown, 2.7L Diesel is similar.

Disconnect the battery to engine compartment wiring harness electrical connector.

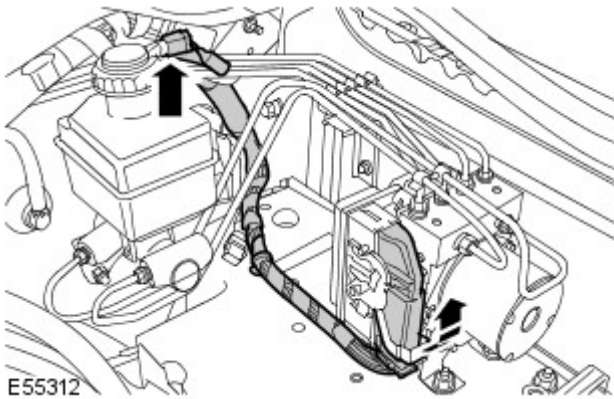
44. Release the wiring harness from the plenum.

- Remove the 3 nuts.
- Release the clip.



45. Disconnect the brake fluid reservoir electrical connector.

46. Disconnect the ABS module electrical connector.



47. Remove the air suspension control module.

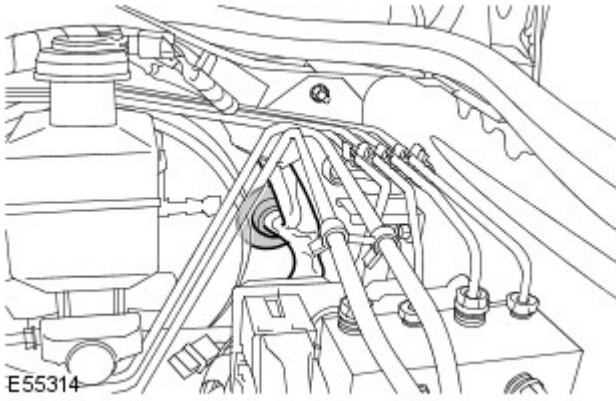
For additional information, refer to: [Air Suspension Control Module](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

48. Driver side: Disconnect 2 electrical connectors from the lower A-pillar.



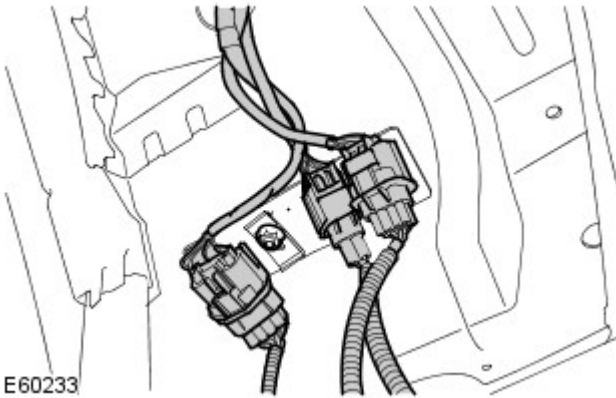
49. Driver side: Release the wiring harness from the bulkhead.

- Release the grommet.



E55314

50. RH side: Disconnect the 3 body panel electrical connectors.



E60233

51. RH side: Release the 3 body panel ground cables.

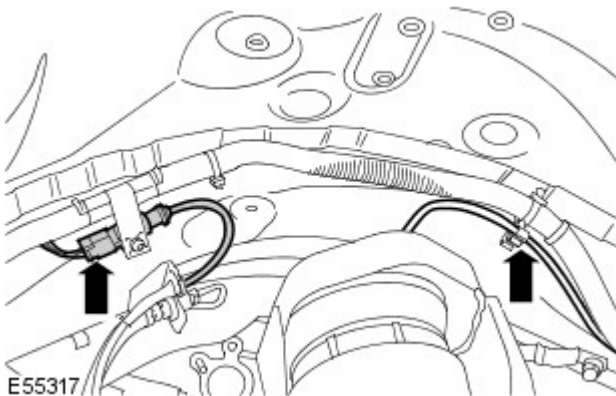
- Remove the nut.



E55316

52. RH side: Disconnect the ABS electrical connector.

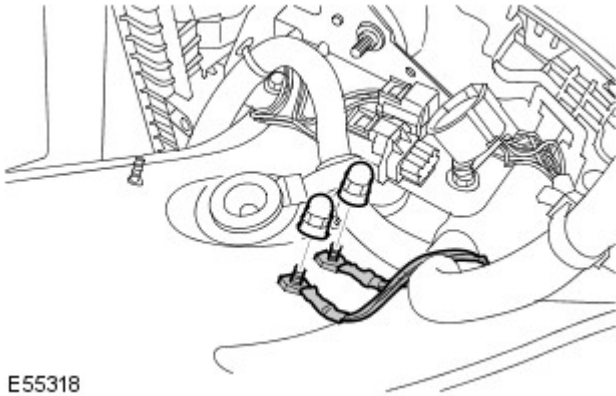
53. RH side front: Release the air suspension pipe from the wiring harness clip.



E55317

54. RH side: Release 2 engine compartment ground cables.

- Remove the 2 nuts.

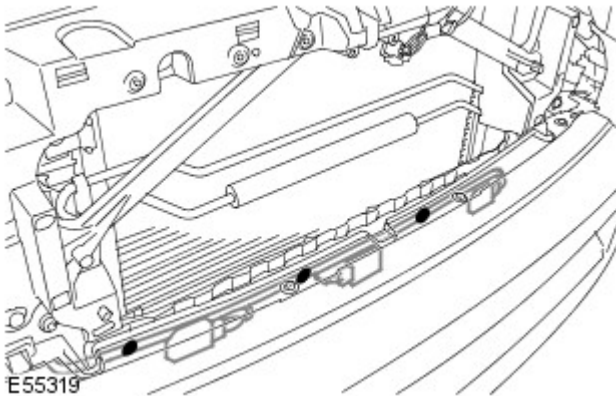


E55318

55. Disconnect the ambient air temperature sensor electrical connector.

56. Disconnect both front impact severity sensor electrical connectors.

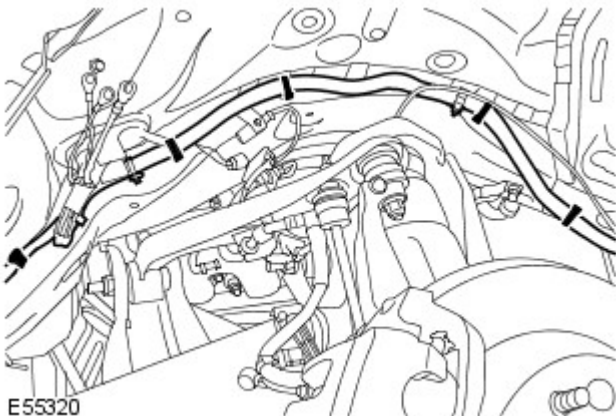
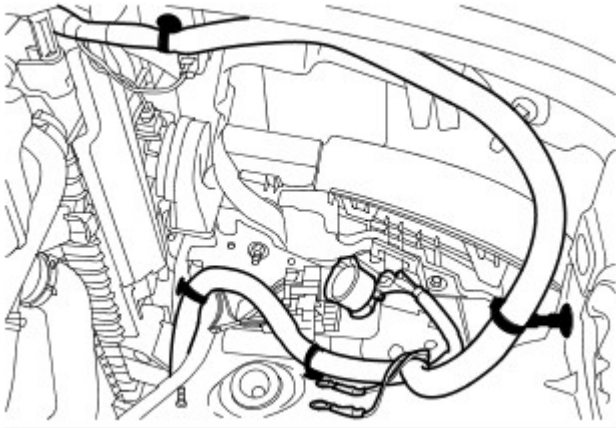
- Release the 3 clips.



E55319

57. RH side: Release the wiring harness.

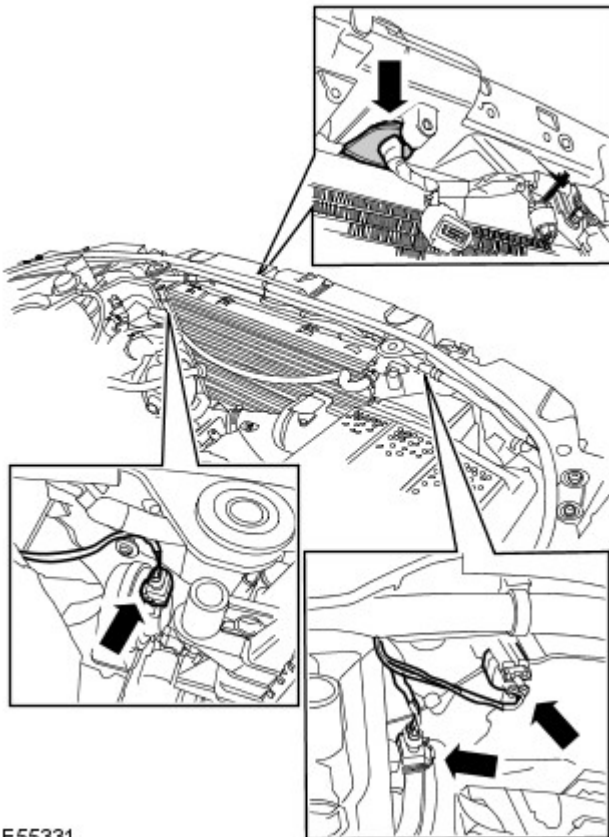
- Release the 9 clips.



E55320

58. Disconnect the hood switch electrical connector.

59. Disconnect both horn electrical connectors.



E55331

60. If installed, disconnect the speed control module electrical connector.

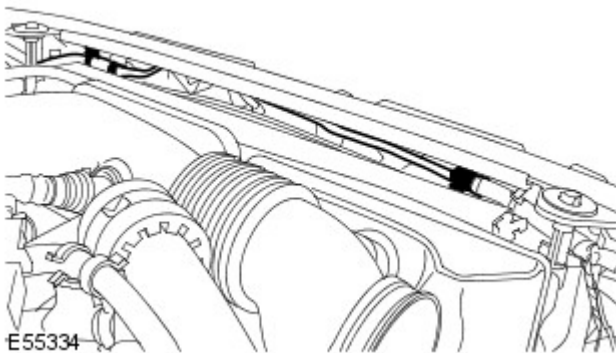
61. If installed, disconnect the pollution sensor electrical connector.

- Release the clip.
- Release the grommet.

62. NOTE: 4.0L illustration shown, 2.7L Diesel is similar.

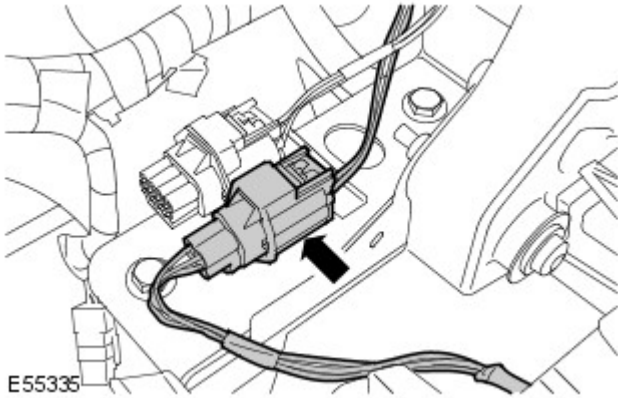
Release the hood release cable.

- Release from the 3 clips.



E55334

63. Disconnect the front bumper wiring harness electrical connector.



64. With assistance, remove the BJB and wiring harness.

Installation

1. With assistance, install the BJB and wiring harness.
2. Connect the front bumper wiring harness electrical connector.
3. Attach the hood release cable.
 - Secure with the clips.
4. If installed, connect the pollution sensor electrical connector.
 - Install the grommet.
 - Secure the clip.
5. If installed, connect the speed control module electrical connector.
6. Connect the horn electrical connectors.
7. Connect the hood switch electrical connector.
8. RH side: Secure the wiring harness.
 - Secure the clips.
9. Connect both front impact electrical connectors.
 - Secure the clips.
10. RH side: Attach the air suspension pipe.
11. Connect the ambient air temperature sensor electrical connector.
12. RH side: Attach the engine compartment ground cables.
 - Tighten the nuts to 25 Nm (18 lb.ft).
13. RH side: Connect the ABS electrical connector.
14. RH side: Attach the body panel ground cables.
 - Tighten the nut to 25 Nm (18 lb.ft).
15. RH side: Connect the body panel electrical connectors.
16. Driver side: Attach the wiring harness to the bulkhead.
 - Install the grommet.
17. Driver side: Connect the lower A-pillar electrical connectors.
18. Install the air suspension control module.
For additional information, refer to: [Air Suspension Control Module](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).
19. Connect the ABS module electrical connector.
20. Connect the brake fluid reservoir electrical connector.
21. Attach the wiring harness to the plenum.
22. Connect the battery to engine compartment wiring harness electrical connector.
 - Secure the clips.
23. Connect the A/C pressure transducer electrical connector.
 - Tighten the nuts to 4 Nm (3 lb.ft).

- 24.** Attach the hood wiring harness.
 - Install the grommet.
 - Install the cover.
 - Secure with the clips.
 - Connect the electrical connectors.
 - Connect the washer jet hoses.
- 25.** Install the hood pad.
 - Install the clips.
- 26.** Install the windshield wiper motor.
For additional information, refer to: [Windshield Wiper Motor \(501-16 Wipers and Washers, Removal and Installation\)](#).
- 27.** LH side: Attach the wiring harness.
 - Install the grommet.
 - Secure the clips.
- 28.** LH side: Connect the brake pad wear sensor electrical connector.
- 29.** LH side: Connect the coolant expansion tank level switch electrical connector.
- 30.** LH side: Attach the washer reservoir wiring harness.
 - Connect the washer jet hoses.
 - Connect the electrical connectors.
- 31.** LH side: Attach the engine compartment ground cables.
 - Secure the clips.
 - Tighten the nuts to 25 Nm (18 lb.ft).
- 32.** LH side: Connect the ABS electrical connector.
- 33.** LH side: Attach the air suspension pipes.
 - Secure the clips.
- 34.** LH side: Attach the body panel ground cables.
 - Tighten the nut to 25 Nm (18 lb.ft).
- 35.** LH side: Connect the body panel electrical connectors.
- 36.** LH side: Connect the adaptive front lighting module electrical connector.
- 37.** LH side: Connect the washer jet hose.
- 38.** LH side: Attach the wiring harness to the fuel fired heater.
 - Connect the electrical connectors.
 - Secure with the clips.
- 39.** Passenger side: Connect the transfer case electrical connector.
- 40.** Passenger side: Connect the engine wiring harness electrical connector.
- 41.** Install the headlamps.
For additional information, refer to: Headlamp Assembly (417-01 Exterior Lighting, Removal and Installation).
- 42.** Install the fender splash shields.
For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).
- 43.** Attach the BJB wiring harness to the bulkhead.
 - Connect the electrical connectors.
 - Install the grommet.
- 44.** Install the battery ground cable.

- Attach the additional ground cable.
 - Tighten the nut to 25 Nm (18 lb.ft).
- 45.** Secure the BJB to the bracket.
- Tighten the bolt to 6 Nm (4 lb.ft).
- 46.** Connect the heater motor electrical connector.
- 47.** Connect the ground cables to the lower A-pillar.
- Tighten the nut to 10 Nm (7 lb.ft).
- 48.** Install the CJB bracket.
- Tighten the nuts to 10 Nm (7 lb.ft).
 - Secure the clips.
 - Connect the electrical connectors.
 - Tighten the bolts to 25 Nm (18 lb.ft).
- 49.** Install the CJB.
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
- 50.** Connect the battery positive cable to the BJB.
- Tighten the nut to 25 Nm (18 lb.ft).
- 51.** Install the BJB cover.
- Secure the clip.
- 52.** Install the ECM.
- Install the ECM top cover.
- 53.** Install the ECM cover.
- Tighten the Torx screws.
 - Connect the electrical connectors.
- 54.** Install the auxiliary battery tray.
For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- 55.** Install the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
- 56.** Install the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07 Four-Wheel Drive Systems, Removal and Installation).
- 57.** Install the air cleaner assembly.
- 58.** Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- 59.** Install the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
- 60.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

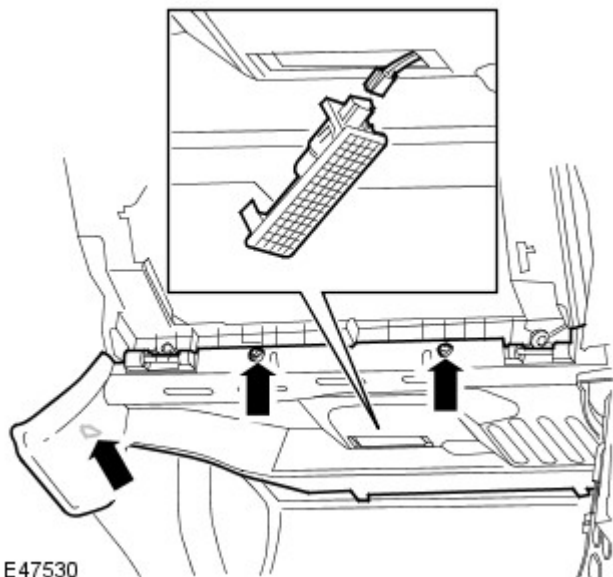
Module Communications Network - Central Junction Box (CJB)

Removal and Installation

Removal

1. If the central junction box (CJB) is to be replaced, connect T4 to the vehicle.
2. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the passenger side closing trim panel.

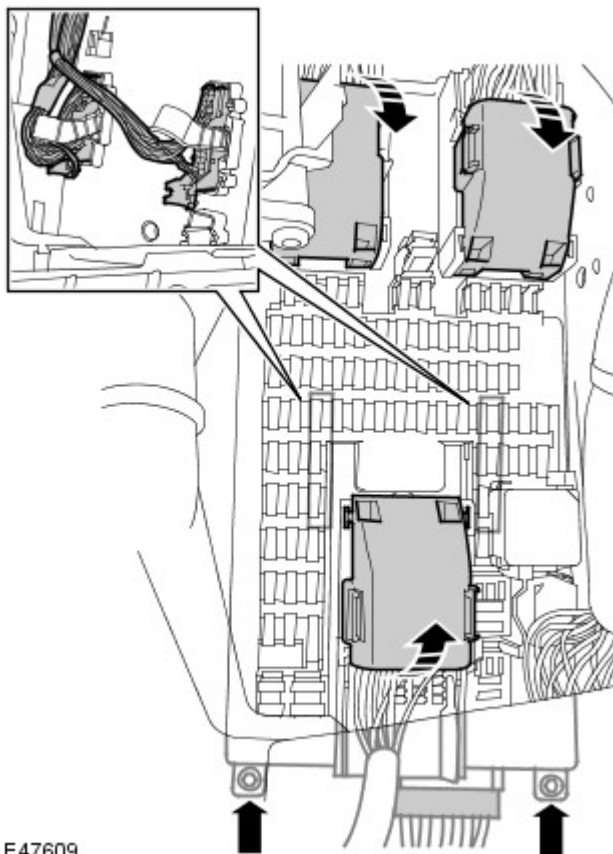
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47530

4. Remove the CJB.

- Remove the 2 nuts.
- Disconnect the 6 electrical connectors.



E47609

Installation

1. Install the CJB.

- Connect the electrical connectors.
 - Tighten the nuts to 10 Nm (7 lb.ft).
2. Install the closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 3. Install the glove compartment.
For additional information, refer to: [Glove Compartment](#)
(501-12 Instrument Panel and Console, Removal and Installation).
 4. Initiate a new CJB using T4.

Wiring Harnesses -

Torque Specifications

Description	Nm	lb-ft
Electrical harness bridge bolts - 4.0 Litre	45	33
Fusebox main feed cable bolt - 4.0 Litre	10	7
Purge valve bolt - 4.4 Litre	6	4
A/C compressor mounting bracket bolts - 4.4 Litre	25	18
A/C compressor bolts - 4.4 Litre	25	18
Upper suspension arm and brake line heat shield nuts and bolts - 4.4 Litre	10	7
Road wheel nuts	140	103
Cylinder head ground connector bolt	10	7
Wiring harness support bracket bolts - 4.4 Litre	10	7
Fusebox main feed cable bolt	10	7
Radiator access panel bolts	10	7
* Starter motor solenoid nut	8	6
PAS pump mounting bracket bolts	25	18

* **Caution: damage to the internal connections will result if this torque is exceeded**

Wiring Harnesses - Wiring Harness

Description and Operation

Introduction



CAUTION: Do **not** use any other heat shrink sleeve other than the approved glue lined heat shrink sleeve mentioned in the repair procedure.

The purpose of this document is to promote quick and efficient minor repair to harness connectors or cables using approved methods and the wiring harness repair kit. Repairs may only be made to cables and connectors which have been mechanically, **not electrically** damaged. It also applies where the whole extent of the damage can be clearly identified and rectified.

Care and neatness are essential requirements in making a perfect repair.

Caution:

At the time of this first issue of the Harness Repair Guide, do not approve repairs to any of the following circuits:

- Any media orientated system transport network harnesses.
- Supplement restraint system (SRS) firing circuits (Air bags).
- Link lead assemblies, which are unique to safety critical circuits such as anti-lock brake system (ABS) and thermocouple circuits. An example of this is the ABS wheel speed sensors with moulded connectors.
- 4. Screened cables, leads and wiring harness(s).

If any harness(s) with defective electrical connector terminals or wires from the above circuits are a concern, new components must be installed.

Repair Kit



CAUTION: Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

The wiring harness repair kit has been produced which comprises:

- Pre-terminated wiring harness(s) of different sizes and types
- Three sizes of butt splice connectors
- A selection of colored cable identification sleeves
- Two sizes of glue lined heat shrink sleeves
- Crimping pliers
- A wire cutter and insulation stripper
- An electrical connector terminal extraction handle and tips

A suitable heat source, for shrinking heat shrink sleeves will be required.

The pre-insulated diamond grip range of electrical connector terminals and in-line, butt splice connectors contained within the wiring harness repair kit are the **only** acceptable product for the repairs of wiring harnesses. The butt connectors not only grip the wire but also the insulation, making a very secure joint.

If an electrical connector terminal is not included in the wiring harness repair kit then approval for the repair is **NOT** given and in these circumstances a new wiring harness must be installed.

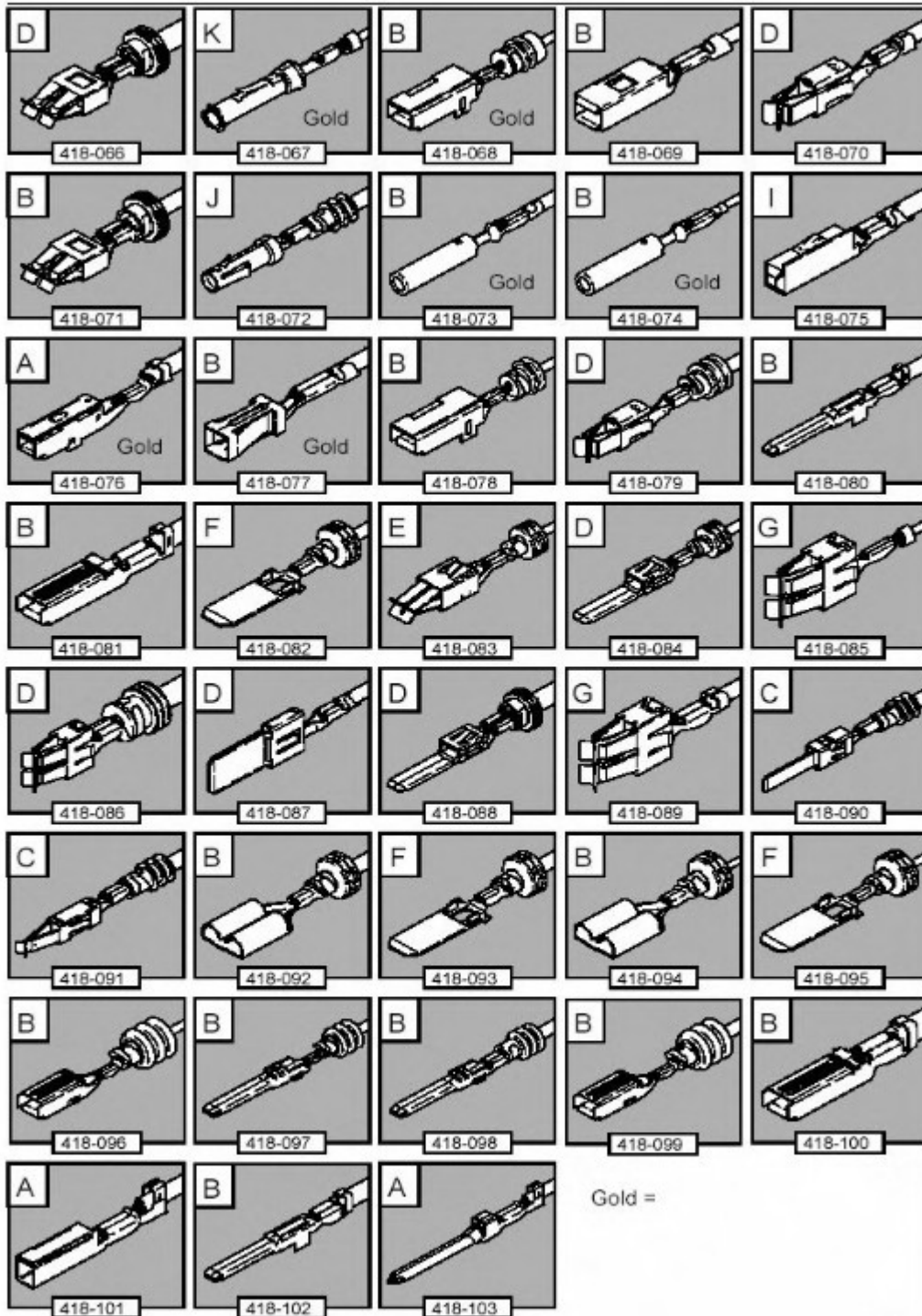
Pre-Terminated Wiring Harness(s) and Butt Splice Connectors

All pre-terminated wiring harness(s) and butt splice connectors in the wiring harness repair kit are contained in bags which can be resealed after use. Each bag is marked with the part number of the items stored within the bag. Each storage compartment in the wiring harness repair kit is identified with the corresponding part number. Make sure that pre-terminated wiring harness(s) and connectors are not mixed up it is advisable to only open one bag at a time and to reseat the bag securely before opening another bag. Also, replace the bag in its mating part number compartment within the case.

The pre-terminated wiring harness(s) are supplied with the insulation in one of three colors, red, blue or yellow. The colors do not apply to any particular circuit but to the harness wire size. See the Relationship Table in the Repair Method section.

Butt splice connectors are also supplied with red, blue or yellow coverings, which must be matched to the pre-terminated wiring harness insulation color.

Pre-Terminated Wiring Harness(s)



E130741

The illustration shows:

- The pre-terminated wiring harness(s) which are included in the wiring harness repair kit
- The part number of the pre-terminated wiring harness
- The letter showing the extractor tip which must be used to remove this type of electrical connector terminal
- Those electrical connector terminals which are gold

Some of the pre-terminated wiring harness(s) have seals installed to the insulation for sealed connector applications. It is essential for prevention of moisture ingress that a sealed pre-terminated wiring harness must be used where a sealed terminal was removed.



CAUTION: Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the

glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

Two sizes of heat shrink sleeving are supplied in the wiring harness repair kit. Each heat shrink sleeve contains a sealant glue. These must be used when connecting wiring harness(s) or electrical connector terminal(s) at all times. The smaller diameter heat shrink sleeve is to be used with the red and blue butt splice connectors and the larger diameter sleeve with the yellow butt splice connectors.

For ease and speed, some of the pre-terminated wiring harness(s) may already have the insulation partly stripped at the splice end. If the repair requires insulation to be stripped from the cable, refer to the Relationship Table for the correct length of insulation to be stripped.

The Pre-Terminated Wiring Harness(s) illustration shows the electrical connector terminal type, the part number of the pre-terminated wiring harness and the letter of the extractor tip which must be used to extract the electrical connector terminal from the connector housing. Additionally, those electrical connector terminal(s) which are gold are identified, all others are therefore, tinned and not gold.

Wiring Harness Cable Identification Sleeves

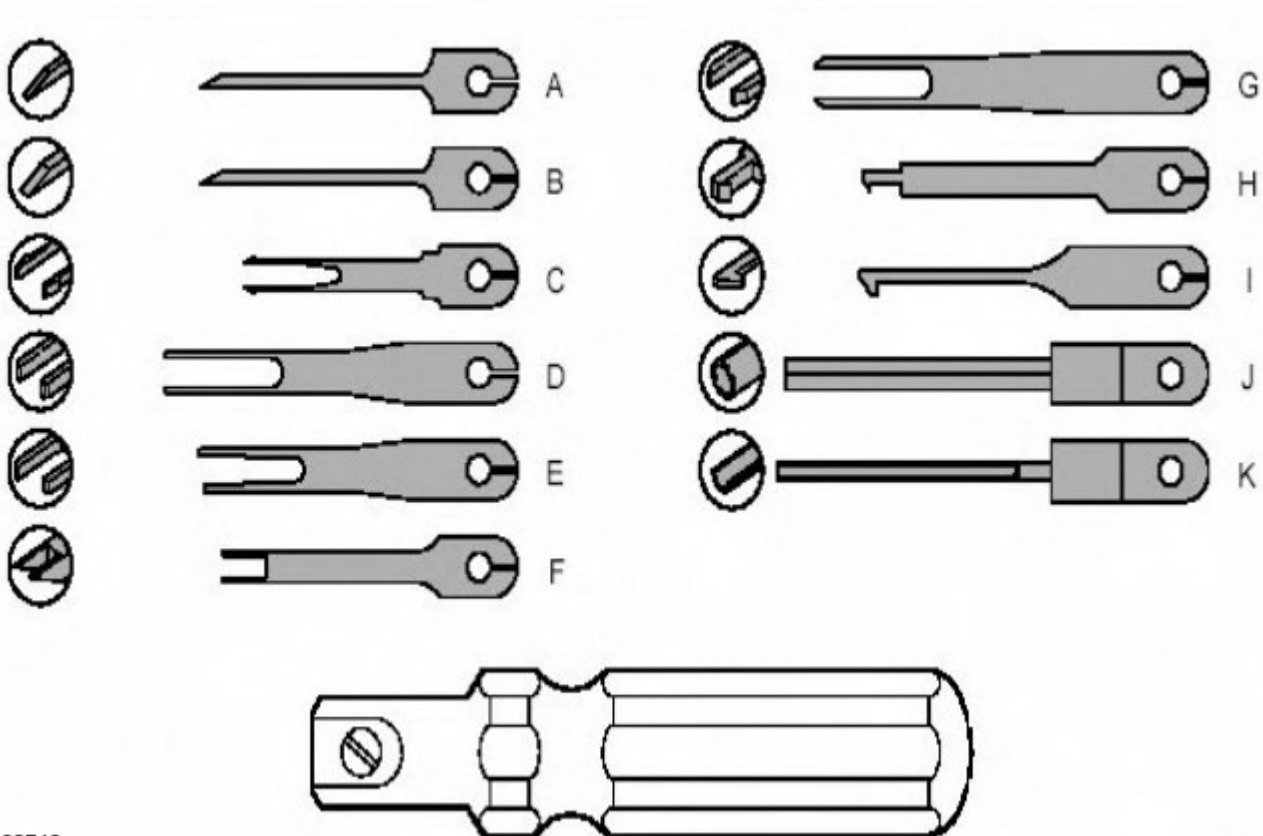
A selection of colored sleeves are contained in the wiring harness repair kit for maintaining the wiring harness cable identification on the pre-terminated wiring harness. Place the correct colored sleeve(s) over the pre-terminated wiring harness insulation as near to the electrical connector as possible with the main wiring harness cable color nearest to the electrical connector.

For example, if the original wiring harness cable color is pink with a black trace put the pink wiring harness cable identification sleeve on the pre-terminated wiring harness first followed by a black sleeve, and slide both along the wiring harness cable to the electrical connector terminal.

Extraction Handle and Tips

The extraction handle, in conjunction with the correct tip, is used to remove a terminal from an electrical connector. Each tip contained in the wiring harness repair kit is marked with an identification letter, A to K inclusive. Each tip has been specially designed to extract a particular type of electrical connector terminal. The use of any other tool is **not** recommended and is liable to cause damage to the electrical connector. The tip is fastened to the handle by a screw which holds the tip firmly yet allows it to be easily replaced.

Extraction Handle and Tips

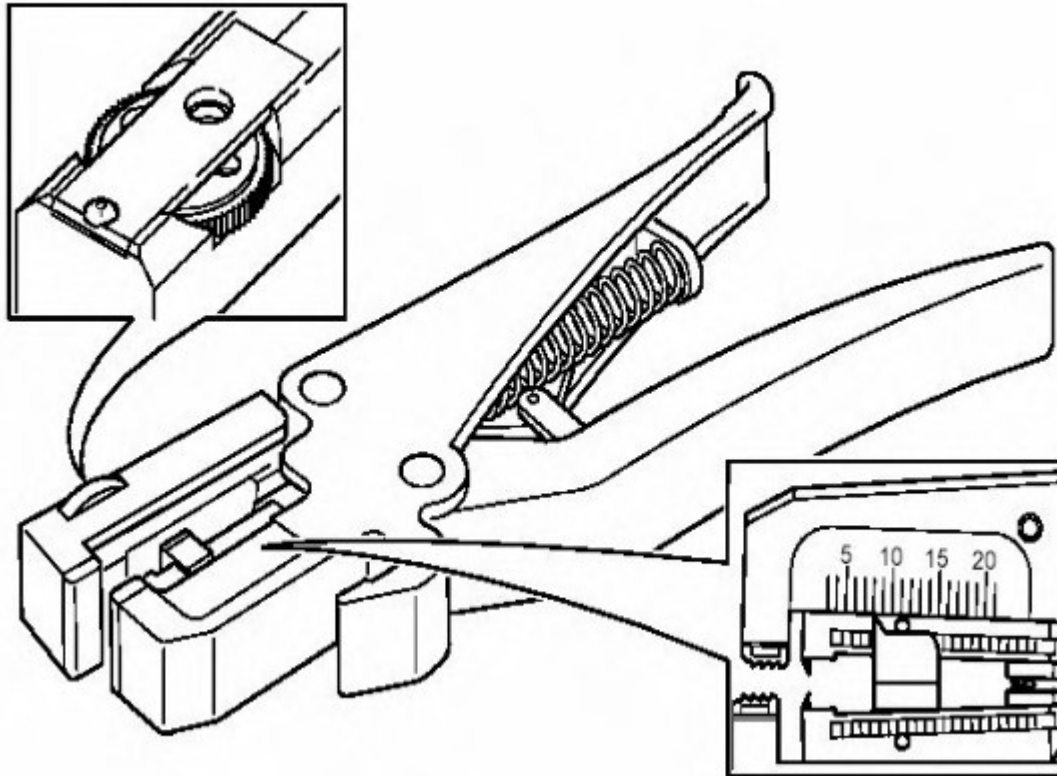


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Insulation Stripper

The moving jaw has an adjuster wheel which has a series of holes in it. Turning the wheel and placing the cable in the matching size hole will automatically adjust the jaw to the correct pressure. Note that some wiring harness(s) may have a harder insulation and slight adjustment of the wheel may be needed to make a clean strip but exercise care not to damage the wire.

Insulation Stripper

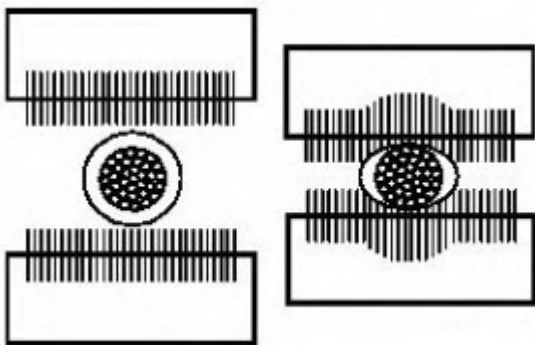


E130743

By pressing the outer edges of the wiring harness cable length stop together the adjuster can be slid up or down the jaw. This decreases or increases the length by which the wiring harness cable insulation will be stripped from the pre-terminated wiring harness or wiring harness wire. The adjuster has a position indicator to align with a graduated scale and this sets the correct length in millimetres, of insulation to be stripped is shown in the Relationship Table.

The illustration shows the insulation stripper tool and a wiring harness correctly gripped in the jaws. A wire cutter is provided on the outer side of the fixed jaw.

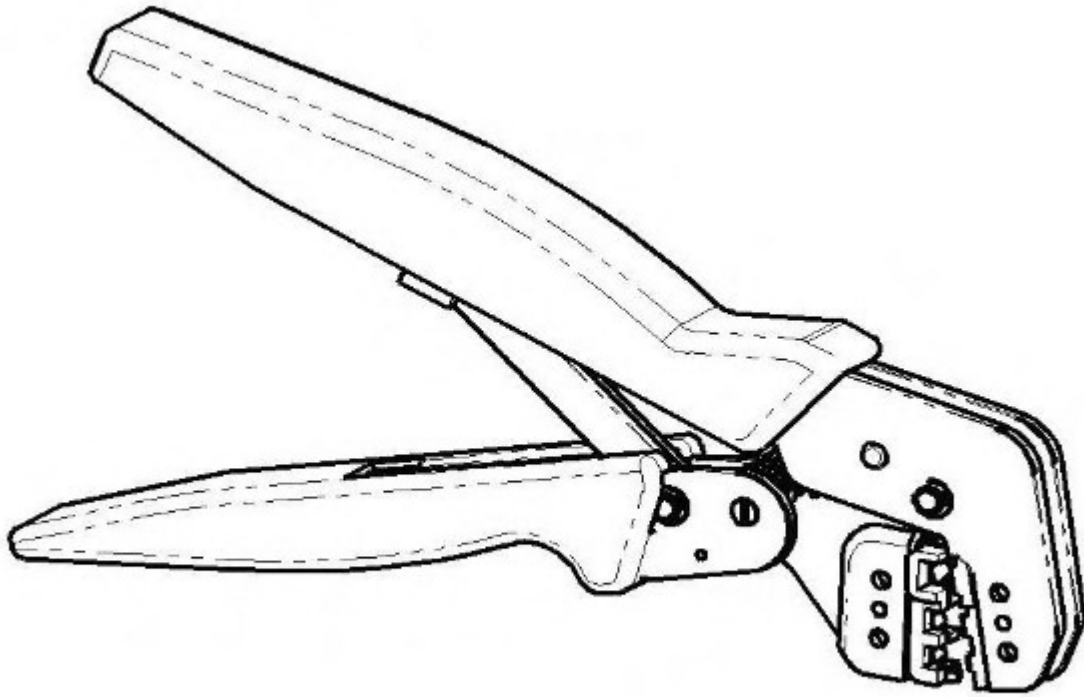
Cable Correctly Gripped in Stripper Blades



E130744

Crimping Pliers

Crimping Pliers



E130745

The crimping pliers have a moving jaw and a stationary jaw, with three different sized crimping enclosures. Each of the enclosures is identified by a red, blue or yellow coloured dot which corresponds to the three colours of the pre-terminated wiring harness(s) and butt splice connector colors.

List of Parts

Description	Part Number	Quantity
Wiring Harness Repair Kit	418-S065	1
Pre-Terminated Wiring Harness(s)	418-066 to 418-103 inclusive	10 each
Glue Lined Heat Shrink Pack – small diameter	418-104	25 per pack
Glue Lined Heat Shrink Pack – larger diameter	418-105	10 per pack
Case Assembly Comprising – carry case, lid, inner lid, base, insert, trays foam spacers	418-106	1
Butt Splice Connector – Red	418-107	50 per pack
Butt Splice Connector – Blue	418-108	50 per pack
Butt Splice Connector – Yellow	418-109	20 per pack
Extraction Tool Handle	418-110	1
Extraction Tip Pack consists of 2 spare screws plus	418-S111	1
Tip A	418-118	1
Tip B	418-119	1
Tip C	418-120	1
Tip D	418-121	1
Tip E	418-122	1
Tip F	418-123	1
Tip G	418-124	1
Tip H	418-125	1
Tip I	418-126	1
Tip J	418-127	1
Tip K	418-128	1
Sleeve Identification Pack – for Red insulation	418-112	500
Sleeve Identification Pack – for Blue insulation	418-113	500
Sleeve Identification Pack – for Yellow insulation	418-114	500
Instruction Manual	JTP 593	1
Crimping Pliers	YRW500010	1
Wire Stripping Tool	418-117	1

Items can be ordered from:

SPX United Kingdom Limited

Ironstone Way

Brixworth

Northants

NN6 9UD

United Kingdom

Telephone: +44 (0) 1327 704461

Fax: +44 (0) 1327 706632

Repair Methods



CAUTION: Several different types and sizes of terminal may be found in a single electrical connector housing.

It is necessary to identify:

- The conductor (wire) size of the affected wiring harness
- The electrical connector range from which the damaged wiring harness is to be removed
- The terminal type

Use of the approved diagnostic tool will greatly assist in the quick identification of electrical connectors and faulty pin terminal(s).

Reference can also be made to the vehicle Electrical Guides, held by Dealers, to identify wiring harness(s) and electrical connector(s).

By using the Relationship Table, the wiring harness conductor (wire) size can be related to a suitable pre-terminated wiring harness by the color of the insulation. Also, the correct length of insulation to be stripped from the wiring harness lead is identified.

Relationship Table

CABLE RANGE	SPLICE	STRIP LENGTH
0.35 mm ² to 1.50 mm ²	RED	6.00 to 7.00 mm
1.00 mm ² to 2.50 mm ²	BLUE	6.00 to 7.00 mm
4.00 mm ² to 6.00 mm ²	YELLOW	9.00 to 9.50 mm

Electrical Connector Terminal Extraction

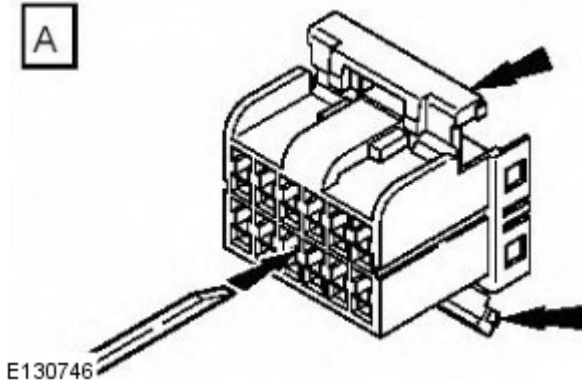
It must be noted that some electrical connector(s) have anti-backout devices which prevent the terminals from being removed from the electrical connector. Some examples of these are shown in following illustrations. The anti-backout device must be released before attempting to remove the terminal from the electrical connector. Some anti-backout devices require a special tip to release the device and these have been included in the kit. Most can be released by carefully using a suitable small screwdriver.

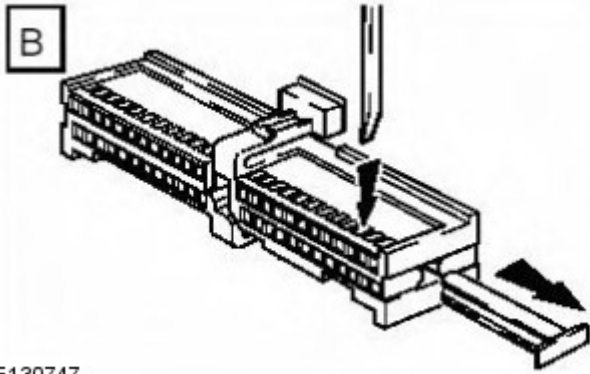
Various types of electrical connector have seals installed internally or externally to prevent moisture ingress. These normally do not have to be removed but make sure that they are installed when the electrical connectors are connected.

The illustrations show examples of each tip used on different types of electrical connector(s). There are a large number of different types of electrical connector used on vehicles therefore only one example using each tip is shown. Technicians experience and judgement will dictate which type of tip should be used for those electrical connector(s) which are not shown. Care should be exercised to avoid further damage when removing the terminals from the electrical connector.

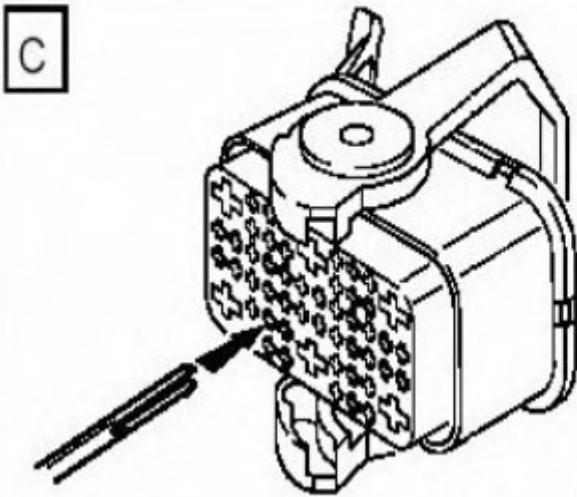
- **NOTE: Examples of the extraction tips and anti-backout tips.**

A

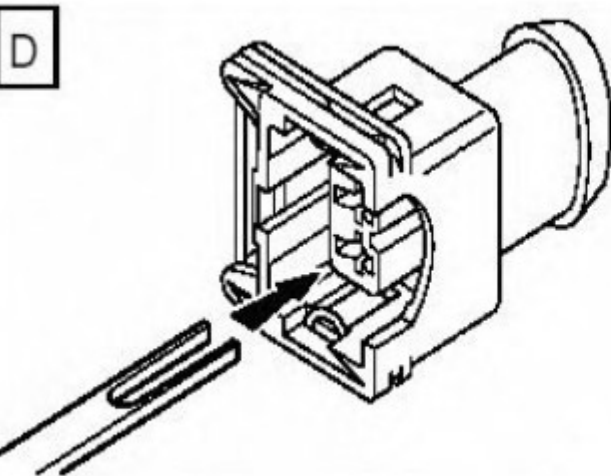
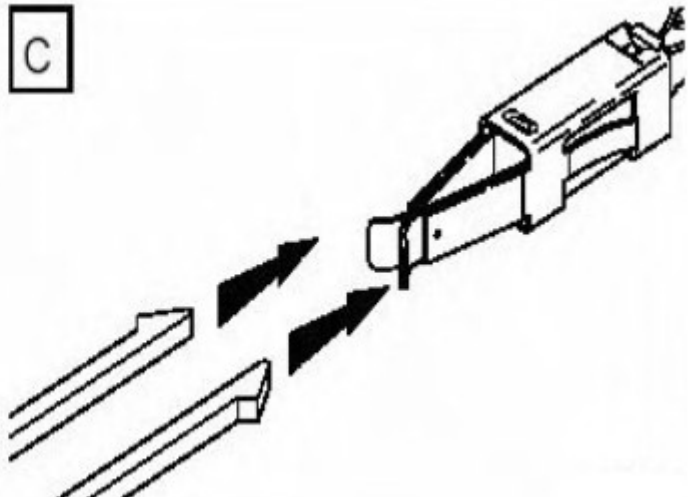




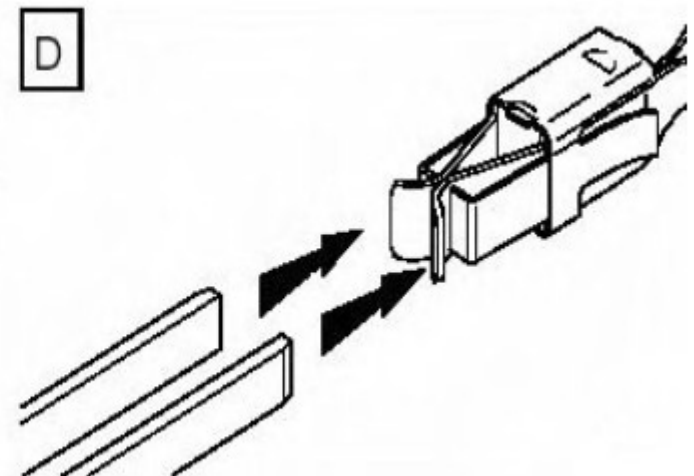
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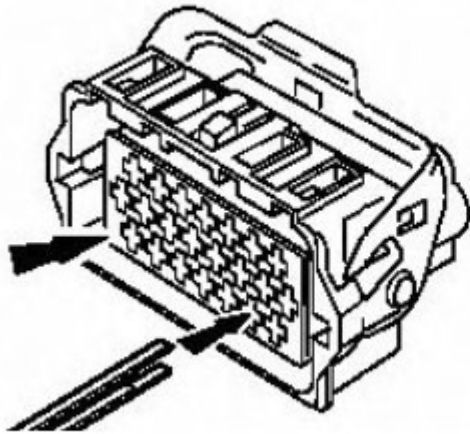
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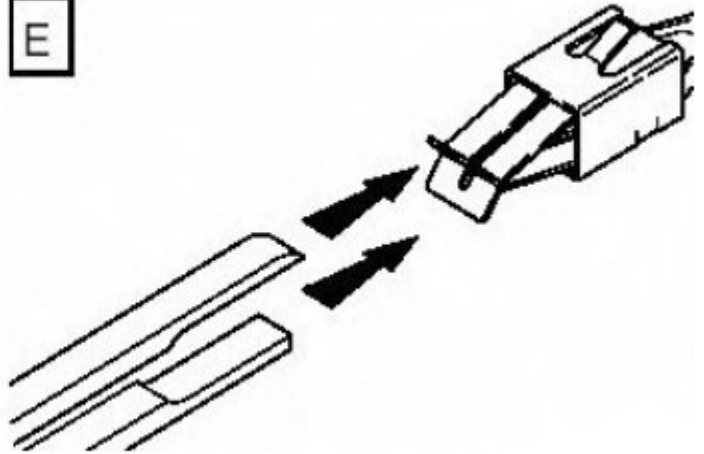
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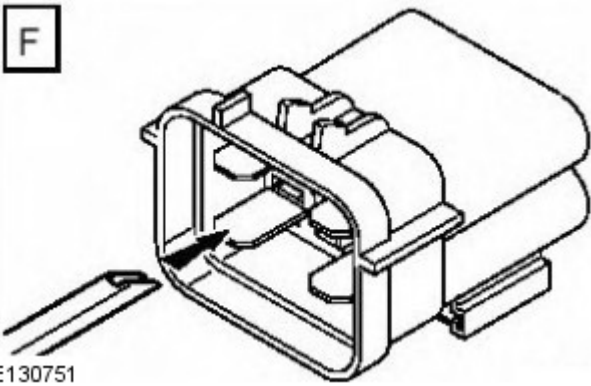


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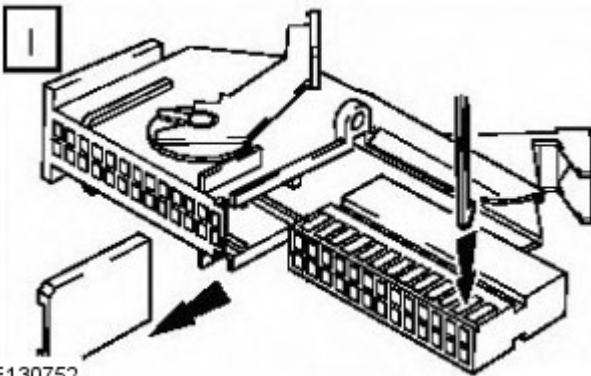
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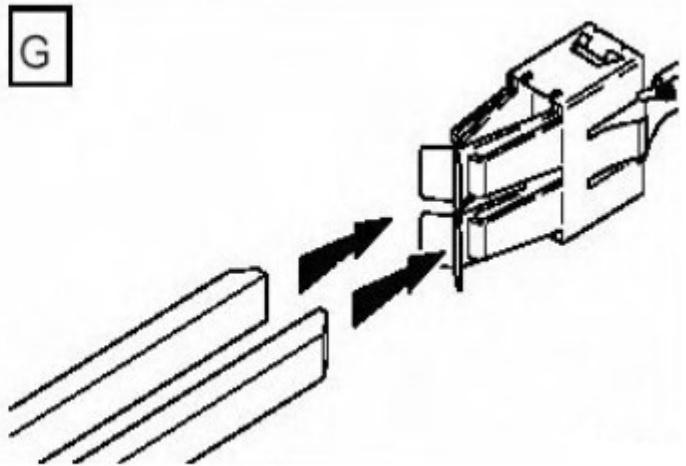
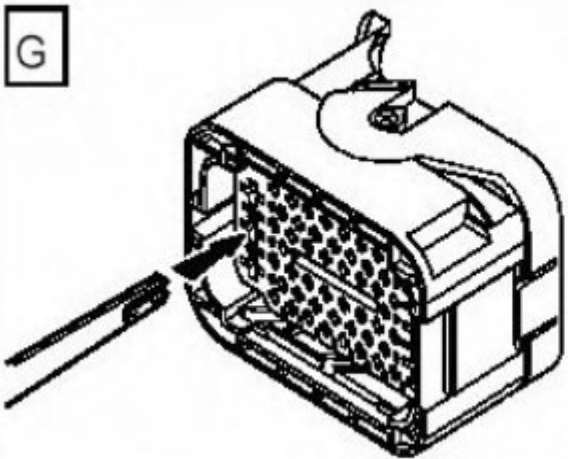


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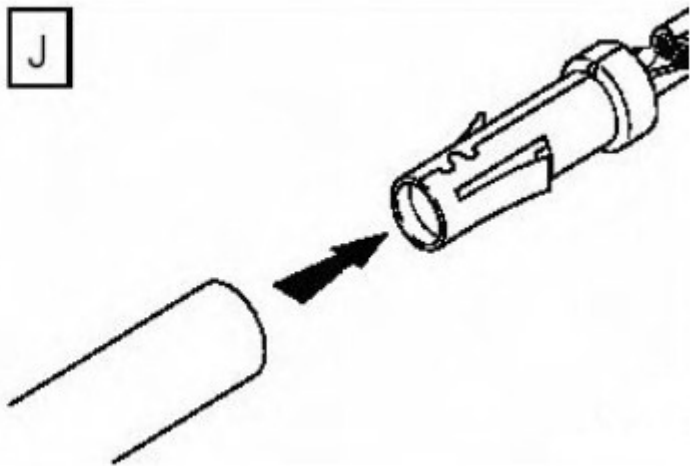
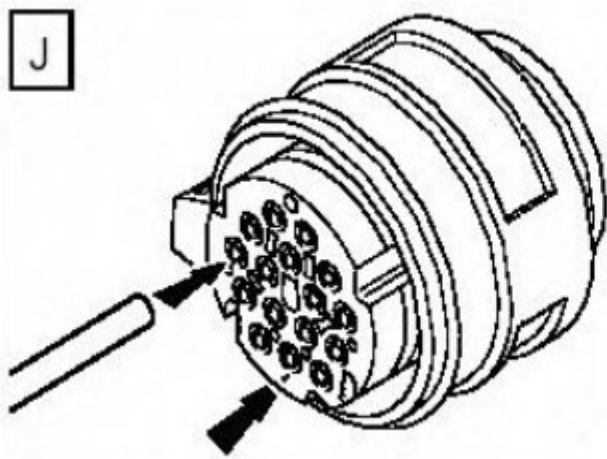
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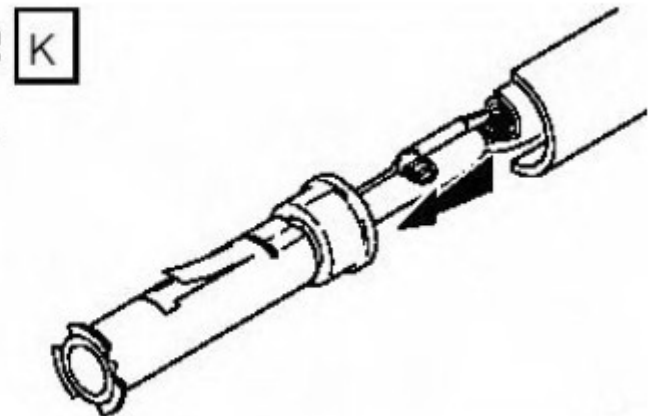
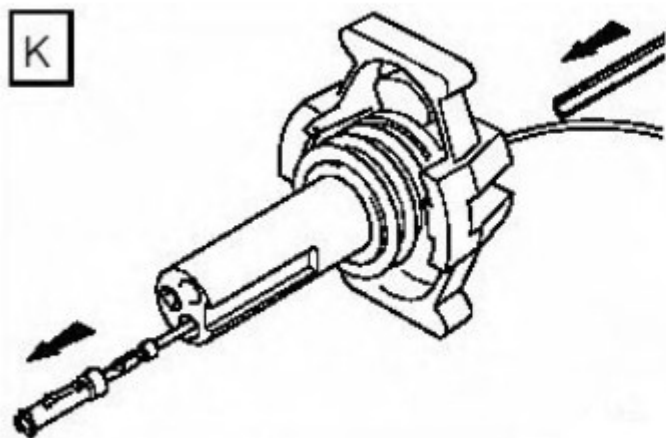
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• NOTE: The chart shows the electrical connector types, terminal pins/sockets, extractor tip and anti-backout tip.

Electrical connector terminal type	Pin or socket	Extractor tip	Anti-backout tip
Multilock 040 series	D	A	
Multilock 040 series	B	A	
Multilock 070 series	B	B	

Electrical connector terminal type	Pin or socket	Extractor tip	Anti-backout tip
Multilock 040 series	D	B	
Econoseal III 070 series	D	B	
Econoseal III 070 series	B	B	
Econoseal III 070 series	B	B	
Econoseal III J2	D	B	
Econoseal III 250 series	B	F	
Econoseal III 250 series	D	B	
Econoseal III 250 series	B	F	
Econoseal III 250 series	D	B	
Micro-timer II 1.5mm	D	C	
Micro-timer II 1.5mm	B	C	
Std power timer 4.8 flat	D	G	
Std power timer 5.8 flat	B	D	
Std power timer 5.8 flat	B	D	
Std power timer 2.8 flat	D	D	
Std power timer 4.8 flat	D	G	
Std power timer 5.8 flat	B	D	
Ford 2.8 flat	D	E	H
Multilock 070 series	D	B	
Multilock 070 series	B	B	
Junior power timer 2.8 flat	D	D	
Sumitomo TS90 connector	B	B	H
Modu IV gold plated	D	B	
Multilock 040 series gold plated	D	A	
Micro qualock	D	I	
EECV	D	B	
EECV	D	B	
Kostal dia 1.50 series	D	J	
AMP 6.3 flat	D	B	
Junior power timer 2.8 flat	D	D	
2.8 series	D	B	I
Sumitomo TS90 connector	D	B	H
Ducon 0.60 gold plated	D	K	
AMP 6.3 flat	D	D	
Econoseal III 250 series	B	F	

Repair Procedure

• CAUTIONS:



Do not use crimping pliers, insulation strippers, butt splice connectors, heat shrink sleeves or pre-terminated wiring harness(s) that are not supplied with the Jaguar wiring harness repair kit. Each part has been designed to be used only with the other parts in this wiring harness repair kit.



Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

It is not correct to make more than five repair joints on the wiring harness to any electrical connector and if more damage is found at the same electrical connector then a new wiring harness must be installed.

- Remove the faulty terminal from the electrical connector using the extractor tool and correct tip. Make sure that any anti-backout device is released before trying to remove the terminal.
- **CAUTION:** : A number of electrical connector terminals are gold plated or gold flashed. When defective, they must be installed with a gold pre-terminated wiring harness(s) from the wiring harness repair kit. It is not always easy to identify the female as gold but the male pins are visually easier, therefore always check both male and female terminals to identify those which are gold. Under no circumstances are gold and tin terminals to be mixed as this will lead to early failure of the electrical contact.
 - **NOTE:** Never use a harness lead with a smaller diameter than the original harness lead.


Select the correct size and type of pre-terminated wiring harness and butt splice connector from the wiring harness repair kit.

- Using the wire cutter on the stripping tool, cut the pre-terminated wiring harness and the harness cable to the required length.
- **NOTE:** See illustration: **Stripping Insulation**

From the Relationship Table, find the correct length of insulation to be stripped from the pre-terminated wiring harness and set the adjustable cable length stop to the correct length. Place the pre-terminated wiring harness in the wire stripper and remove the insulation.

- Put the cable identification sleeve(s) on to the wiring harness with the main cable colour nearest to the terminal.
- During this next step do not overtighten. Place the selected butt splice connector in the crimping tool, matching the aperture and the butt connector colours. Make sure that the window indentation in the butt connector is resting over the guide bar on the lower jaw. Partially close the grip until the butt connector is securely held in the aperture. This will give support to the butt connector while the pre-terminated wiring harness is inserted into it.
- **NOTE:** See illustration: **Splice Correctly Located**

Insert the pre-terminated wiring harness into the butt connector and make sure that the wire is against the wire stop. Close the grip firmly, crimping the lead to the butt connector. When the handles have been completely closed the butt connector will be freed from the tool as the handles are released. If the handles have not been completely closed then the jaws will hold the butt connector and it cannot be removed from the tool until the crimp is fully made by closing the handles completely.

- Make sure that the harness cable has been squarely cut and the correct length of insulation removed. If more than one splice is needed the butt connectors must be not be crimped to the wiring harness at the same distance from the connector. The splices must be staggered to prevent a bulk of splices in the same area of the wiring harness.
- It is preferable to cover the butt splice joint with heat shrink sleeve. This is desirable not essential, except where the electrical connector is a sealed electrical connector. Use the smaller diameter sleeve for red and blue pre-terminated wiring harness(s) and the large diameter sleeve for the yellow pre-terminated wiring harness(s). It is advisable to place the heat shrink over the completed joint but in some instances the sleeve will not pass over the terminal. Check, and if required, place the correct size sleeve onto the harness cable or pre-terminated wiring harness before crimping the butt splice to the wiring harness.
- Place the harness cable into the butt splice with the splice window over the guide bar. Make sure that the cable harness wire is against the stop in the butt splice, crimp the butt splice connector to the wiring harness.
- Gently pull the harness cables each side of the butt splice to make sure that a secure joint has been made.
-  **WARNING:** Do not use a naked flame in areas where fuel or oil have been spilt. Clean the area of residual oil and fuel and wait until the fuel spill has fully evaporated.

• CAUTIONS:



When using a heat source make sure that it is localised and causes no damage to surrounding materials.

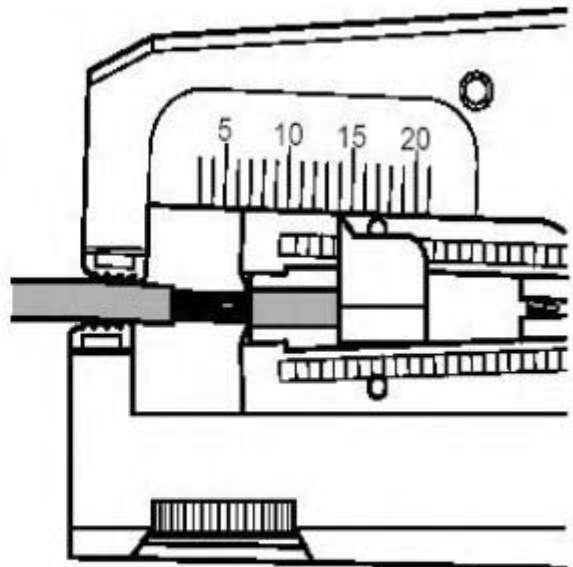
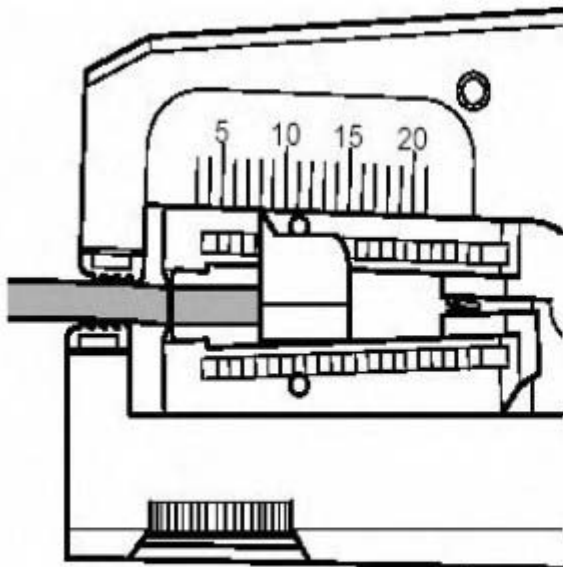


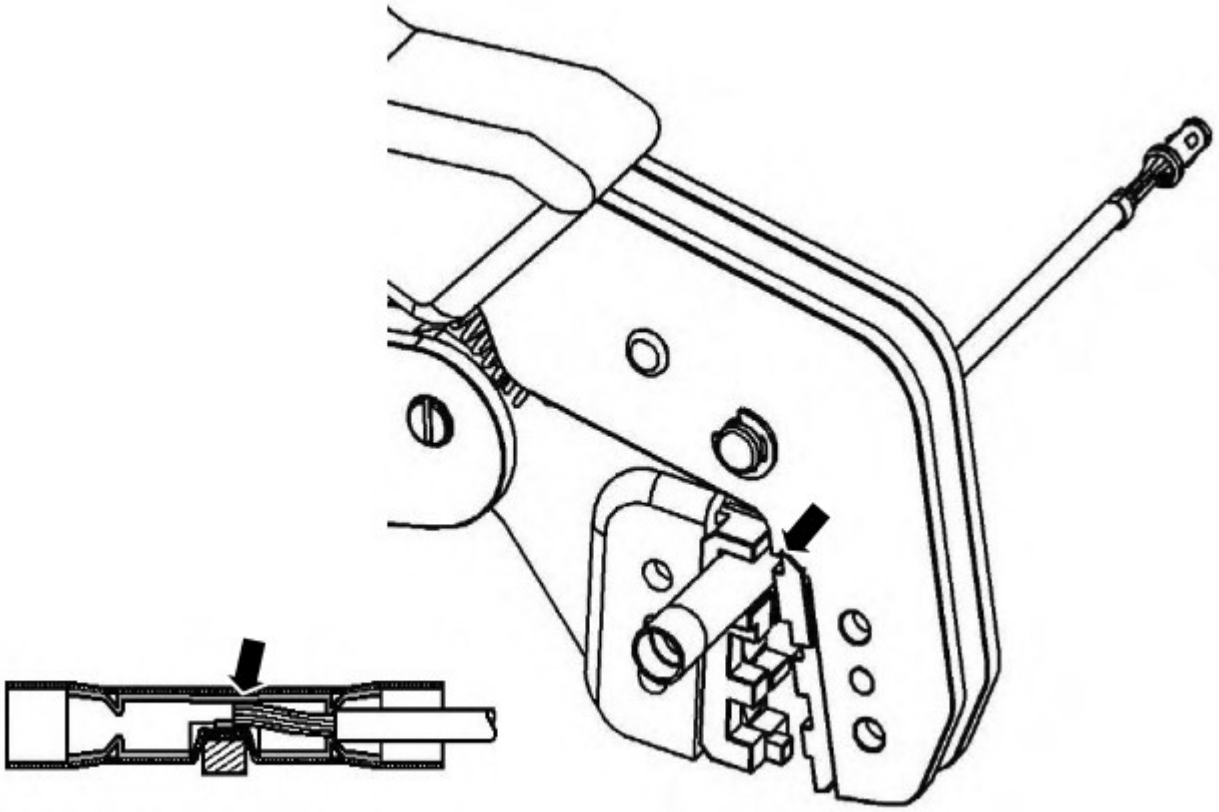
Where the repair procedure indicates that a glue lined heat shrink sleeve should be applied, apply sufficient heat to the glue lined heat shrink to melt the glue in order to provide a water tight seal. Do **not** over heat the glue lined heat shrink sleeve so that the wiring harness insulation becomes damaged.

Using a suitable heat source, shrink the sleeve over the butt splice.

- If further pre-terminated wiring harness(s) are to be installed to the same electrical connector, make sure that the lead is cut at a different length to the previous joint. This makes sure that the splices will, where possible, be staggered on the wiring harness and prevent a bulk of splices in one area.
- When all of the splices have been made, fit the terminal(s) to the electrical connector, taking care that the terminals are correctly orientated.
- Install the wiring harness cover and secure with adhesive electrical tape. Do not cover the wiring harness right to the electrical connector as the terminals must have a little movement and not be firmly bound to the electrical connector or wiring harness. Make sure that the cable identification sleeve(s) are showing at the wiring harness electrical connector.

Stripping Insulation





E130757

Wiring Harnesses - Wiring Harness Repair

General Procedures

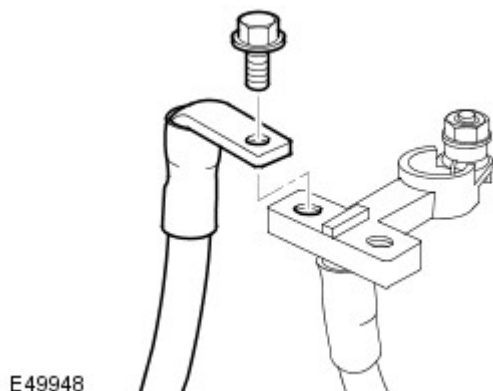
1. For additional information, refer to: [Wiring Harness](#) (418-02 Wiring Harnesses, Description and Operation).

Wiring Harnesses - Engine Wiring Harness V6 4.0L Petrol

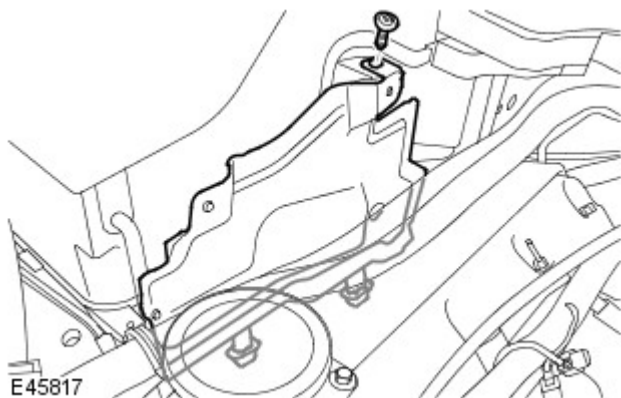
Removal and Installation

Removal

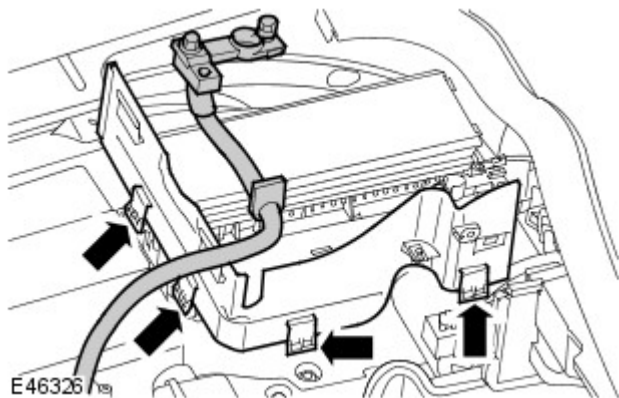
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
4. Remove the battery.
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
5. Remove the engine compartment fuse box main feed cable.
 - Remove the bolt.



6. Remove the engine compartment upper heat shield.
 - Remove the screw.
 - Release the 2 mounting clips.

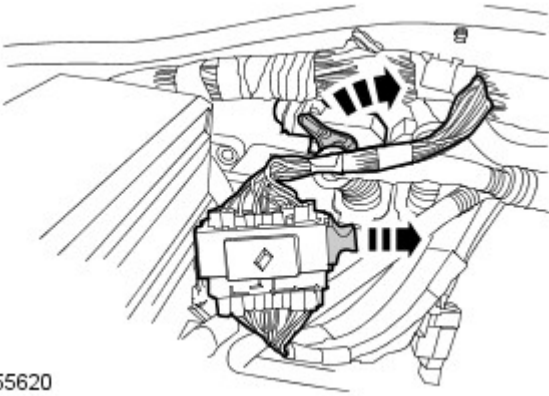


7. Remove the battery compartment side wall.
 - Release the battery positive cable and grommet.
 - Release the 4 clips.



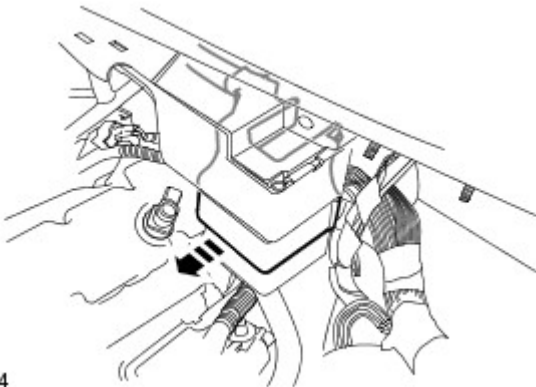
8. Release the engine harness from the battery compartment.

- Disconnect the 2 electrical connectors.



E55620

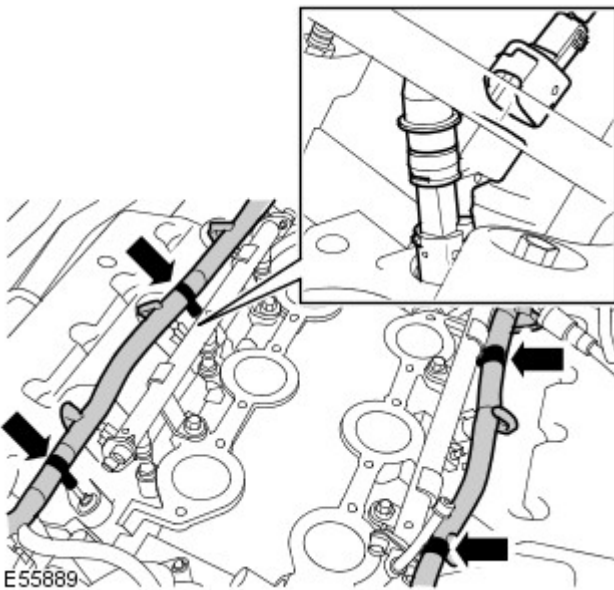
9. Release the 2 clips on the harness protective cover.



E55564

10. Disconnect the fuel injector electrical connectors.

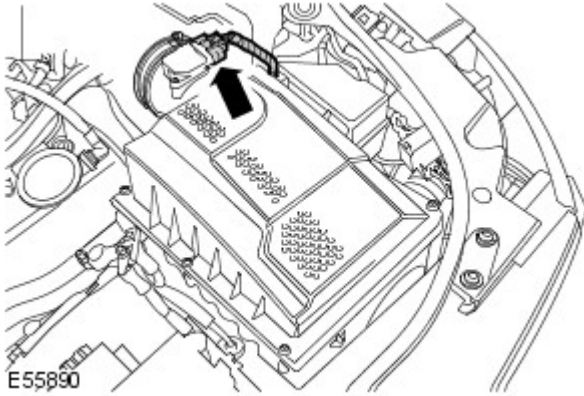
- Release the 4 clips.



E55889

11. Disconnect the mass air flow (MAF) sensor electrical connector.

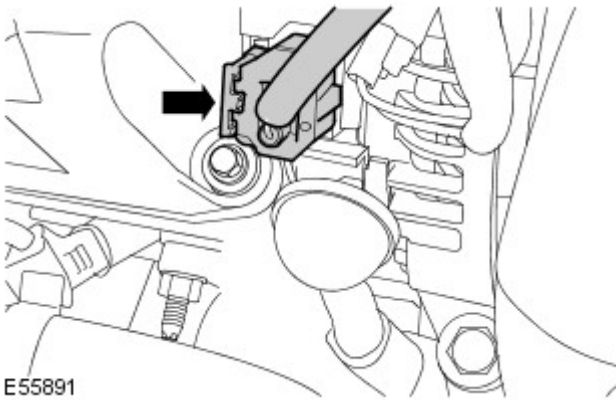
- Release the clip.



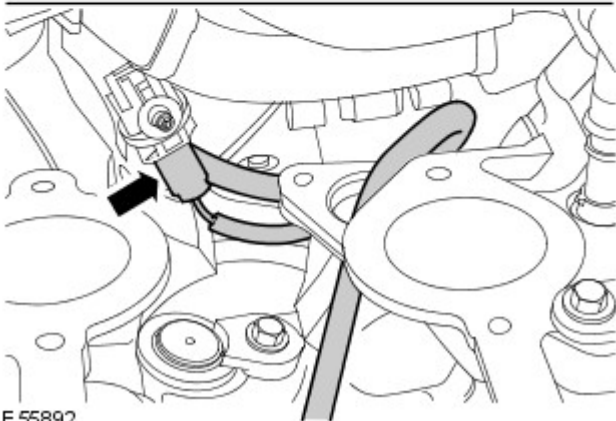
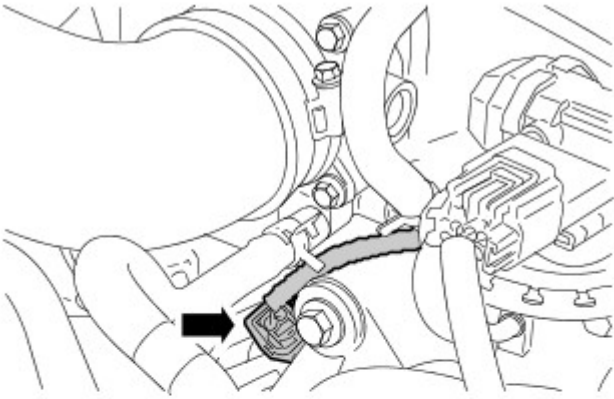
12. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



13. Disconnect the generator connector.



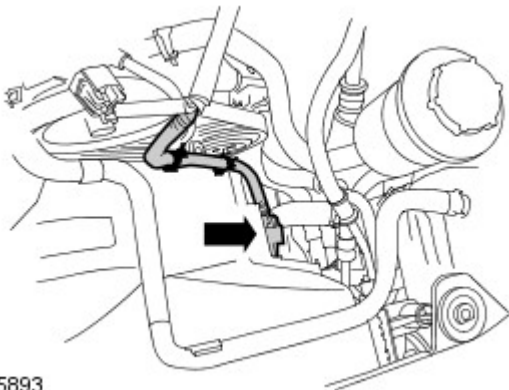
14. Disconnect the knock sensor (KS) electrical connectors.



E 55892

15. Disconnect the cooling fan control electrical connector.

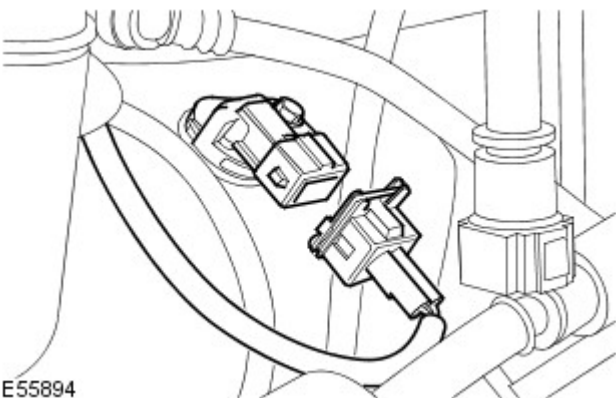
- Release the 2 clips.



E55893

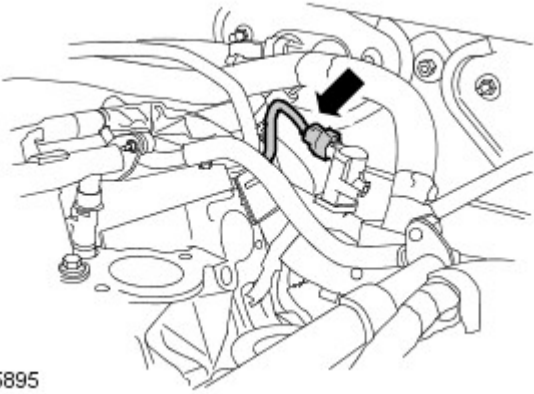
16. Disconnect the camshaft position (CMP) sensor electrical connector.

- Release the clip.



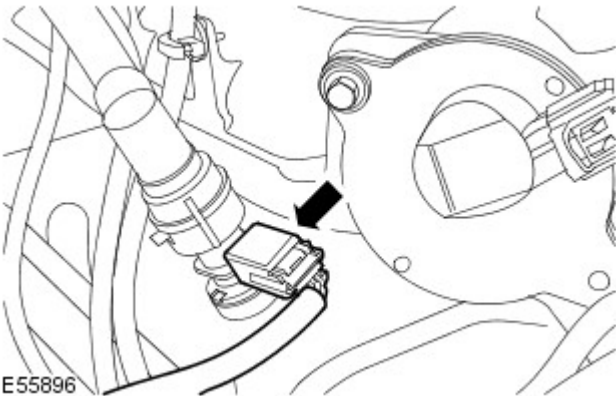
E55894

17. Disconnect the purge control valve (PCV) electrical connector.



E55895

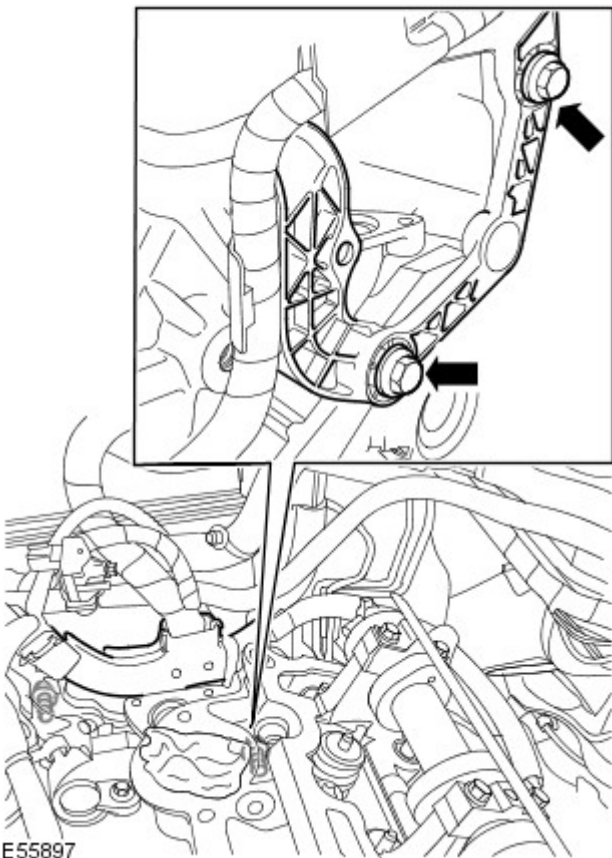
18. Disconnect the LH breather electrical connector.



E55896

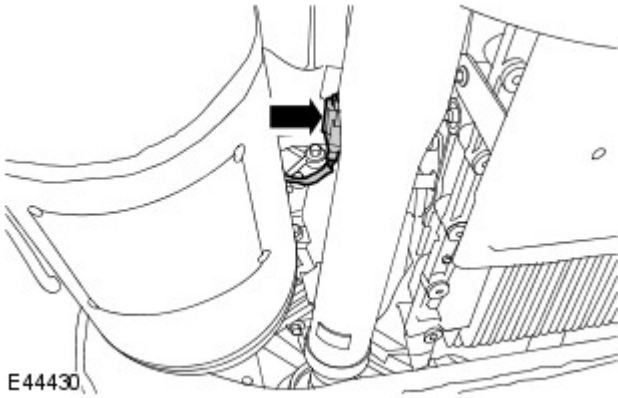
19. Release the wiring harness bridge.

- Remove the 2 bolts.



E55897

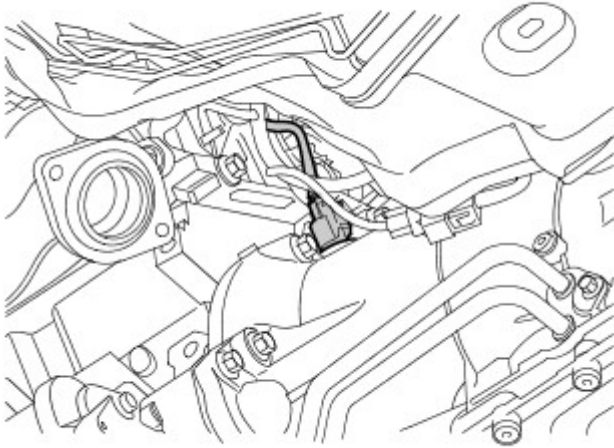
20. Disconnect the LH HO2S and release the clip.



21. Disconnect the RH HO2S and release the clip.



22. Disconnect the crankshaft position (CKP) sensor electrical connector.



E55898

23. NOTE: Note the fitted position.

Remove the engine wiring harness.

Installation

1. NOTE: Align to the position noted on removal.

Install the engine wiring harness.

2. Connect the CKP sensor electrical connector.

3. Connect the HO2S electrical connectors.

4. Install the electrical harness bridge.

- Tighten the bolts to 45 Nm (33 lb.ft).

5. Connect the breather electrical connector.

6. Connect the PCV electrical connector.
7. Connect the CMP sensor electrical connector.
 - Secure the clip.
8. Connect the cooling fan electrical connector.
 - Carefully secure the clips.
9. Connect the KS electrical connectors.
10. Connect the generator.
11. Connect the ECT sensor electrical connector.
12. Connect the MAF sensor electrical connector.
 - Secure the clip.
13. Connect the fuel injector electrical connectors.
 - Carefully secure the clips.
14. Connect the engine wiring harness.
 - Install the clips on the harness protective cover.
 - Connect and secure the electrical connectors.
15. Install the battery compartment side wall.
 - Secure the clips.
 - Install the battery positive cable and grommet.
16. Install the engine compartment upper heat shield.
 - Secure the clips.
 - Tighten the screw.
17. Install the fusebox main feed cable.
 - Install the bolt and tighten to 10 Nm (7 lb.ft).
18. Install the battery.

For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
19. Install the intake manifold.

For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
20. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
21. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Wiring Harnesses - Engine Wiring Harness V8 5.0L Petrol

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

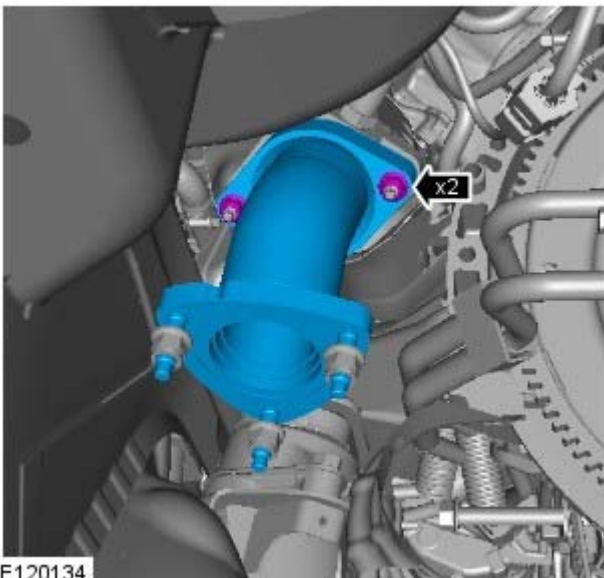
All vehicles

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

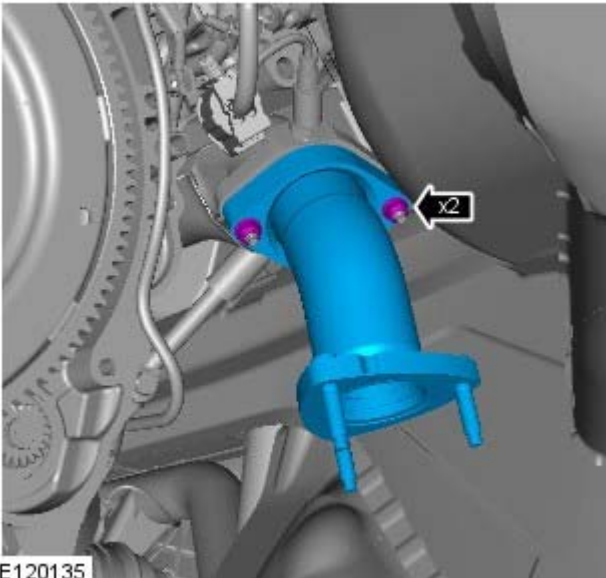
2. For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. For additional information, refer to: [Auxiliary Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
4. For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
5. For additional information, refer to: [Air Cleaner Outlet Pipe LH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
6. For additional information, refer to: [Air Cleaner Outlet Pipe RH](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).
7. For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
8. For additional information, refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).
9. NOTE: Remove and discard the gasket.

TORQUE: 48 Nm



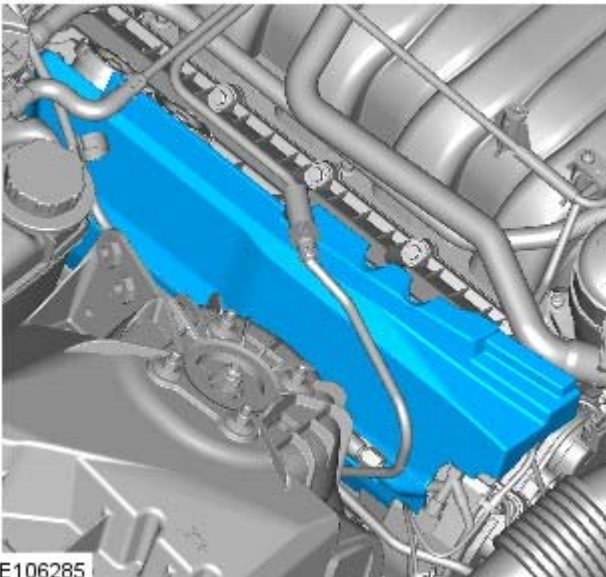
10. NOTE: Remove and discard the gasket.

TORQUE: 48 Nm




E120135

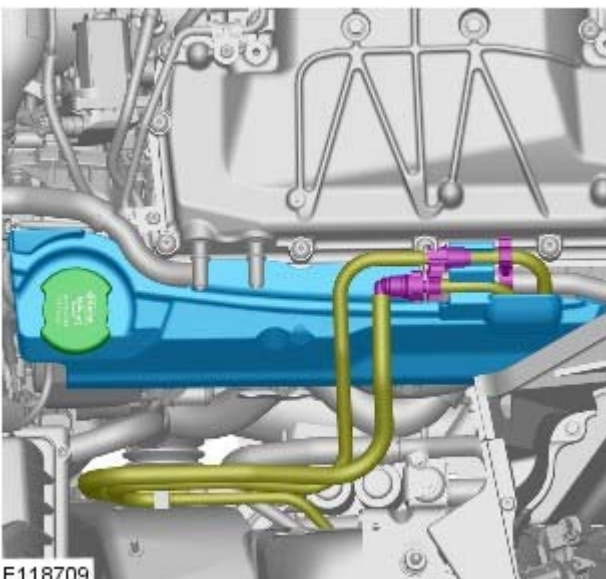
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E106285

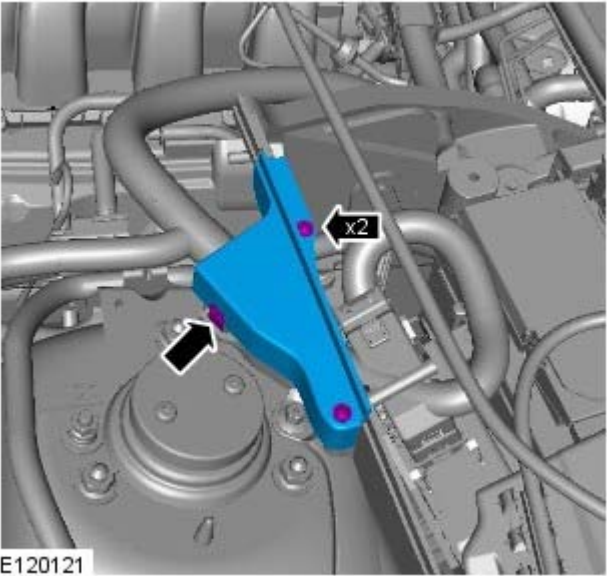
12.  WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

 CAUTION: Be prepared to collect escaping fuel.

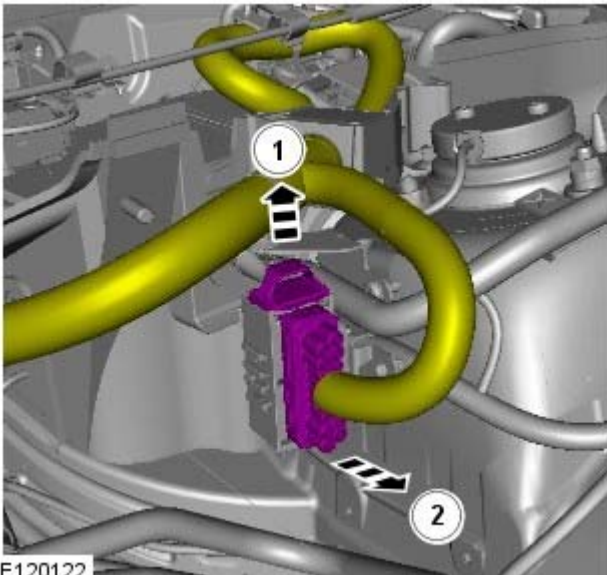


E118709

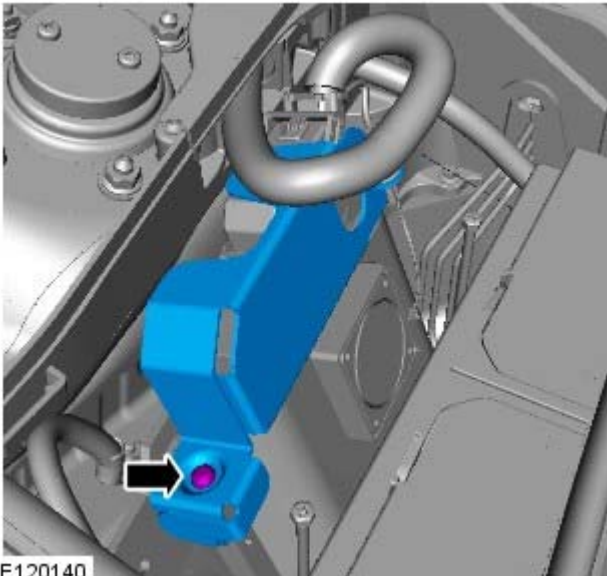
13. NOTE: RHD illustration shown, LHD is similar.



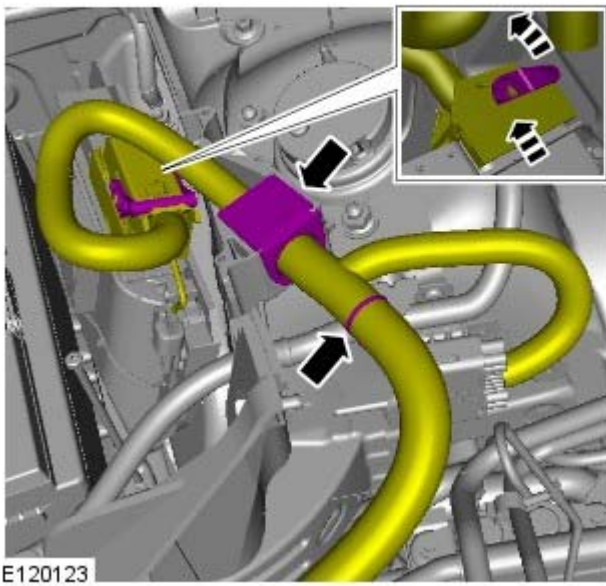
14.



15.

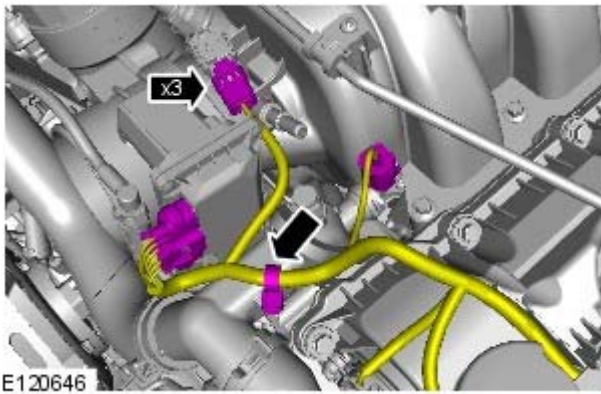


16. NOTE: Make sure the electrical connector is correctly secured.



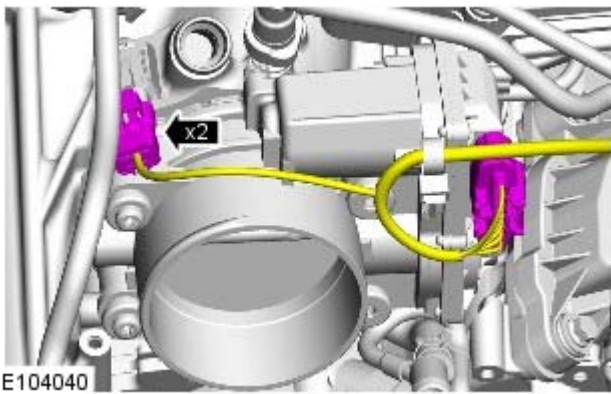
Vehicles without supercharger

17.



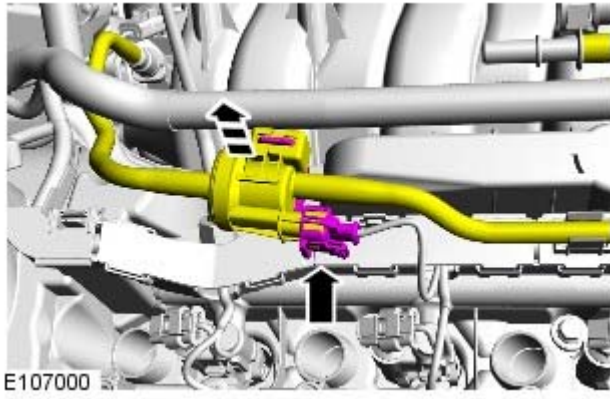
Vehicles with supercharger

18.

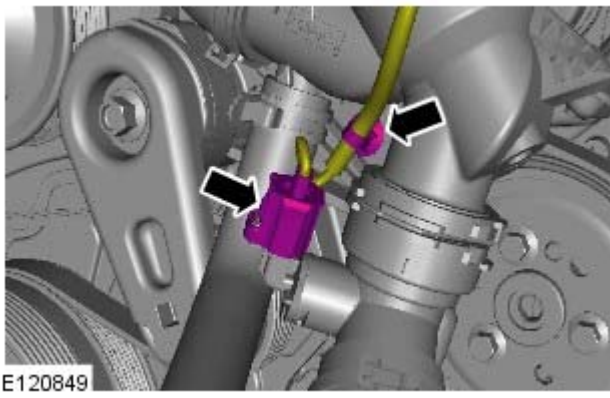


All vehicles

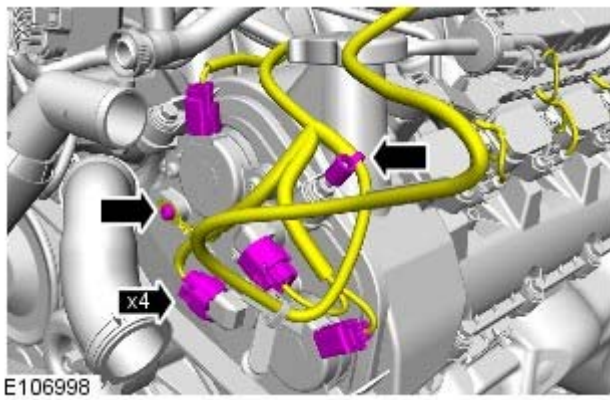
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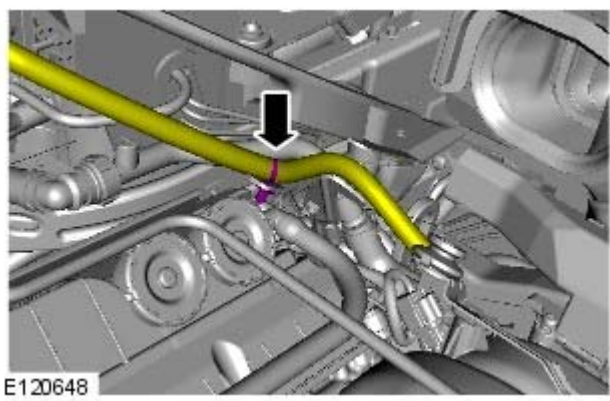
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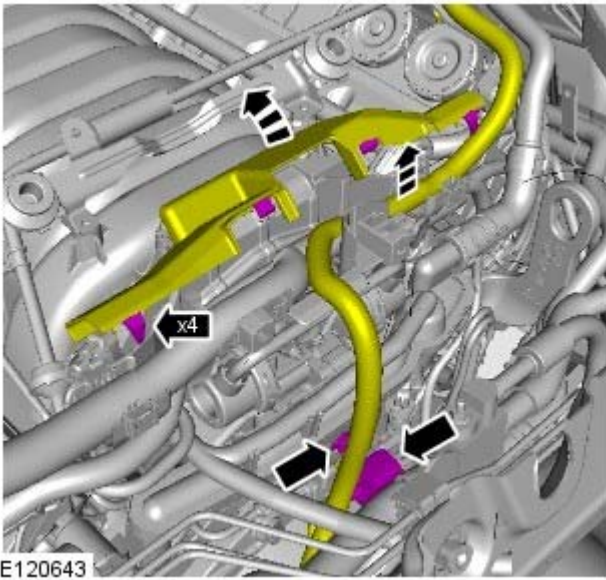
21. TORQUE: 10 Nm



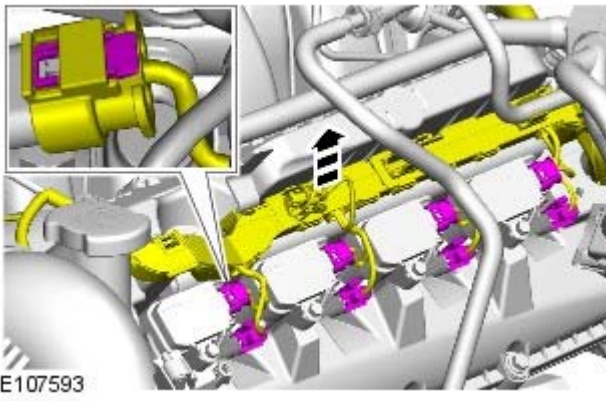
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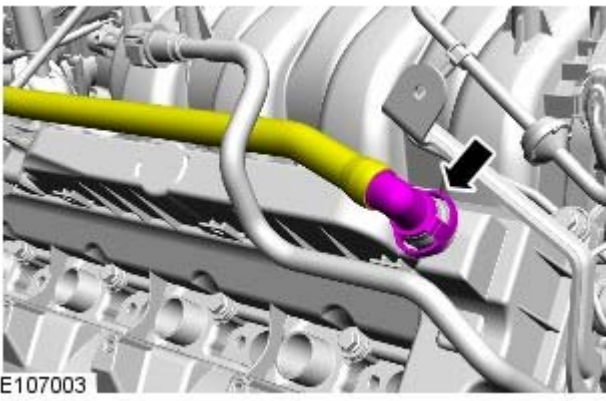
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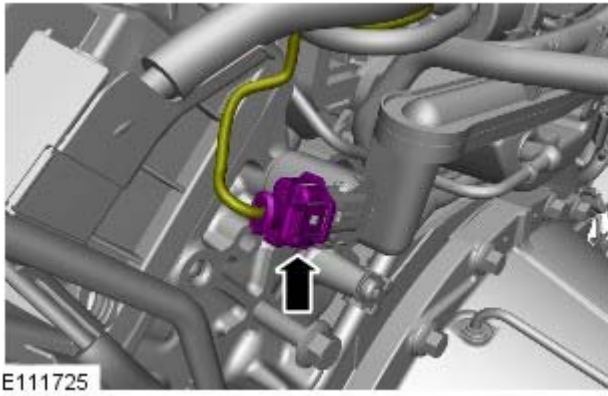
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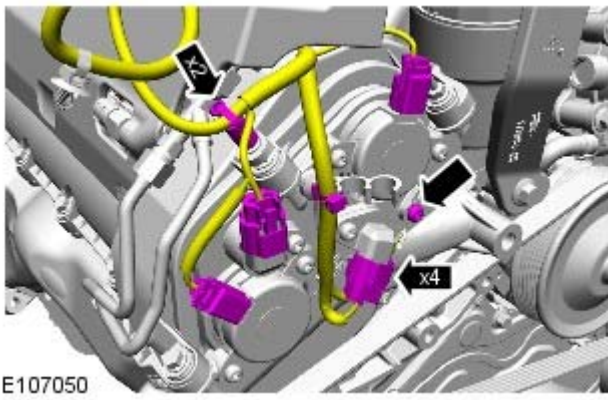
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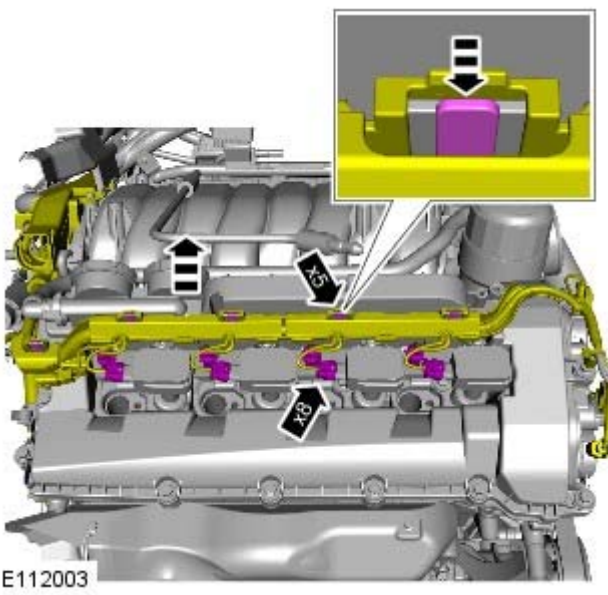
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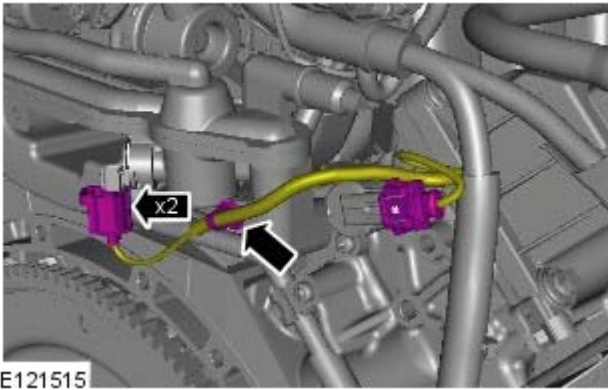
27. TORQUE: 10 Nm



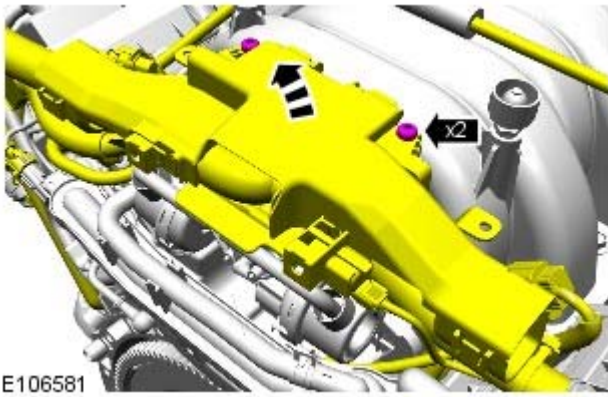
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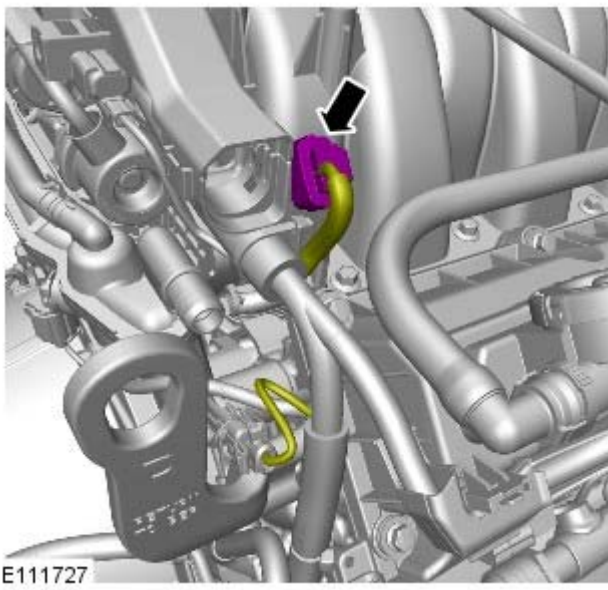
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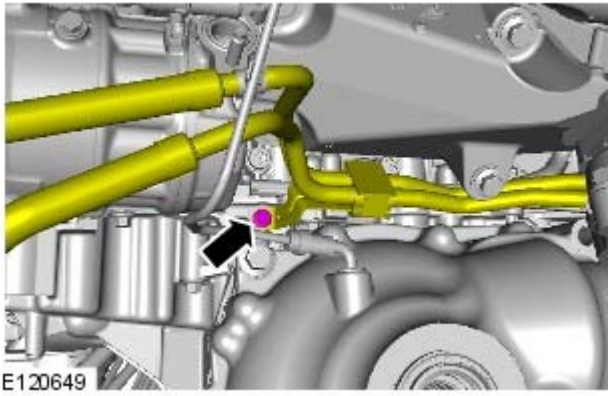
30. TORQUE: 6 Nm



31.

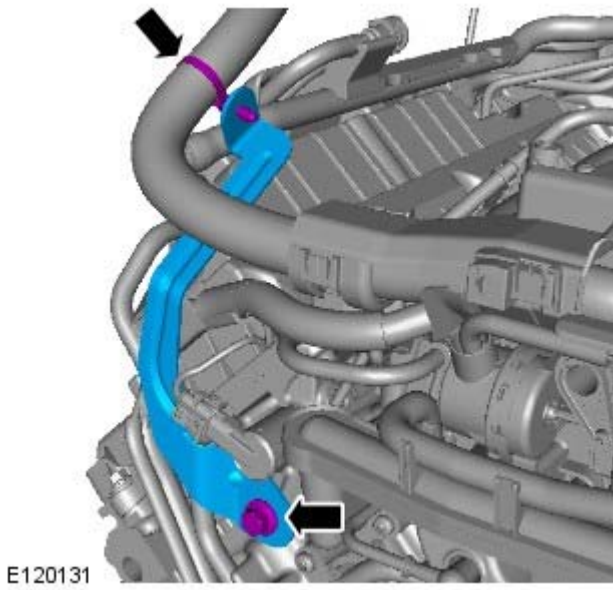


32. TORQUE: 10 Nm



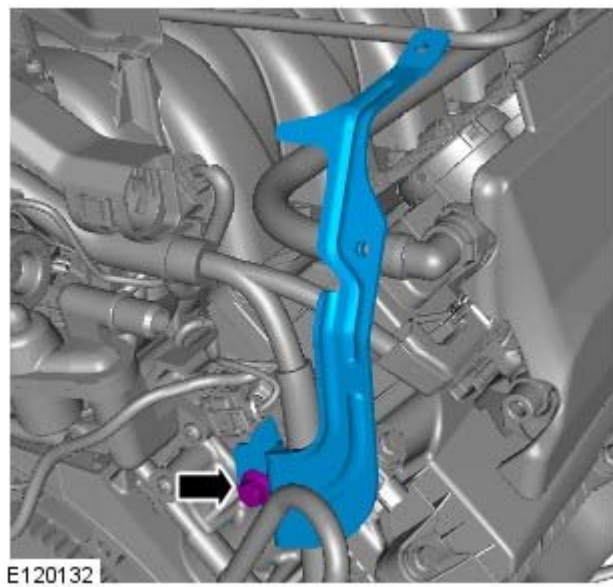
33. NOTE: RHD illustration shown, LHD is similar.

TORQUE: 47 Nm Nm

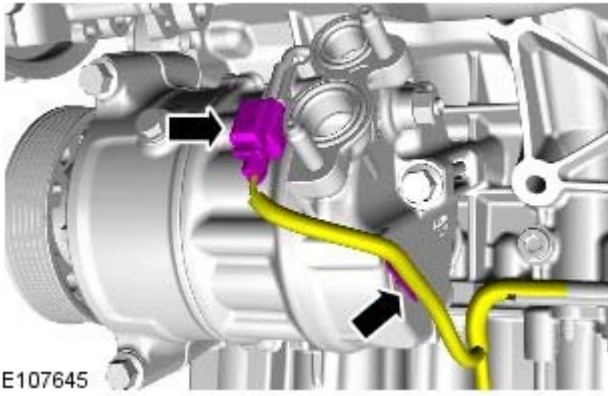


34. NOTE: RHD illustration shown, LHD is similar.

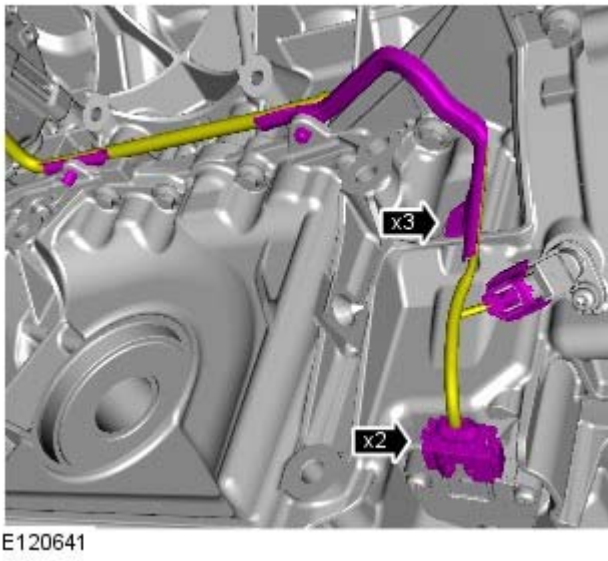
TORQUE: 47 Nm Nm



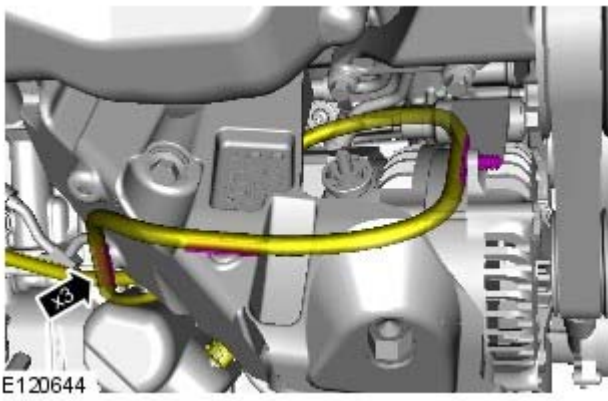
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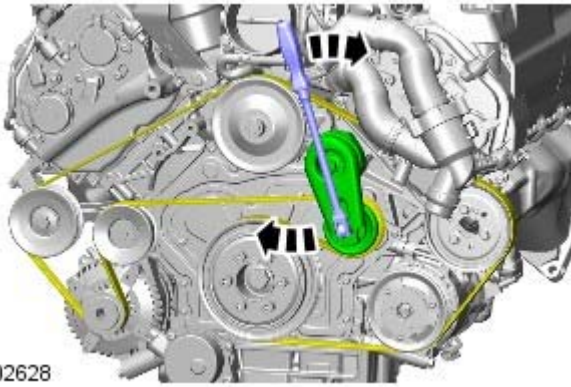
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37.

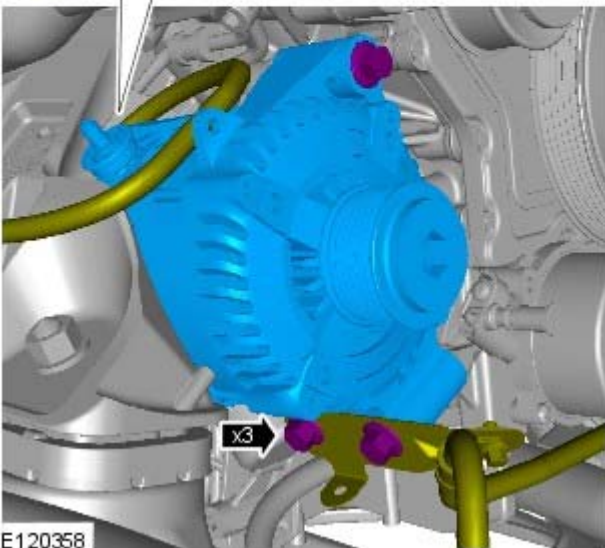
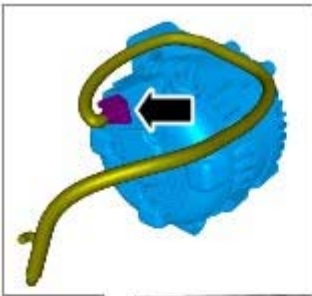


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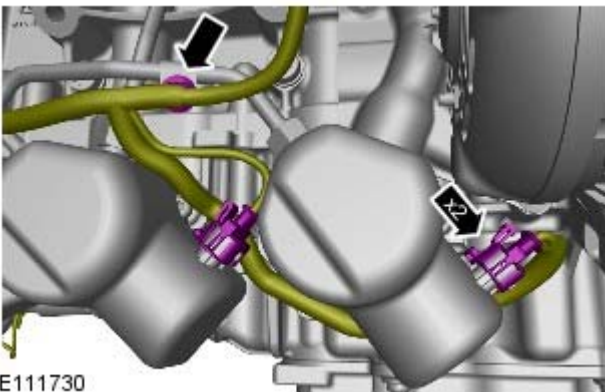
E102628

39. TORQUE: 48 Nm



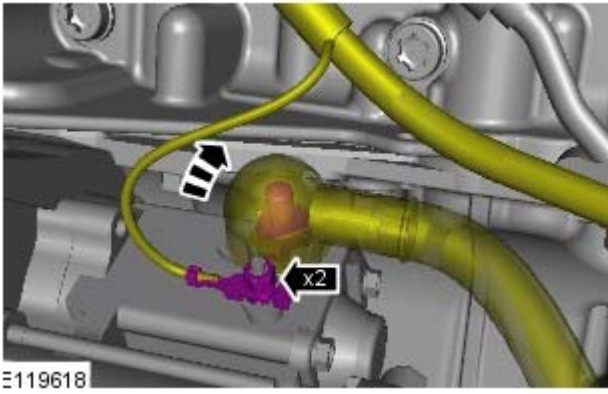
E120358

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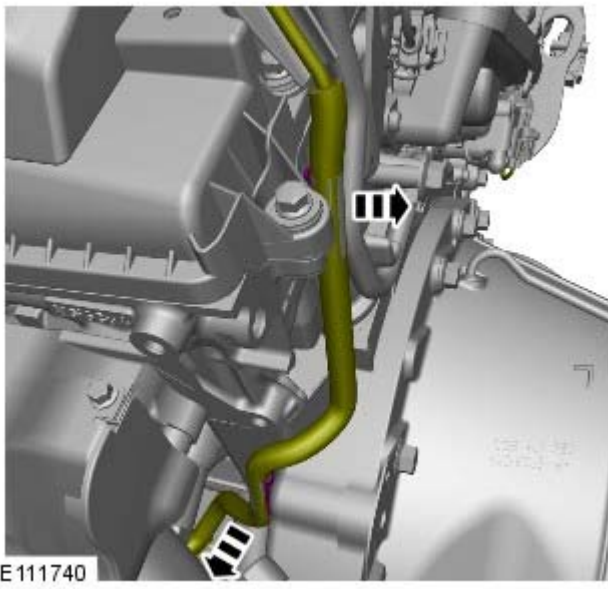


E111730

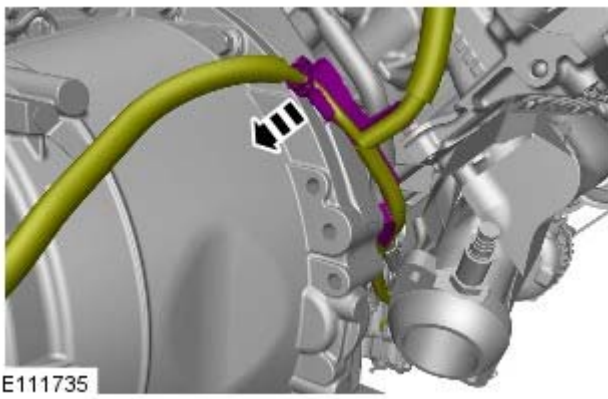
41.



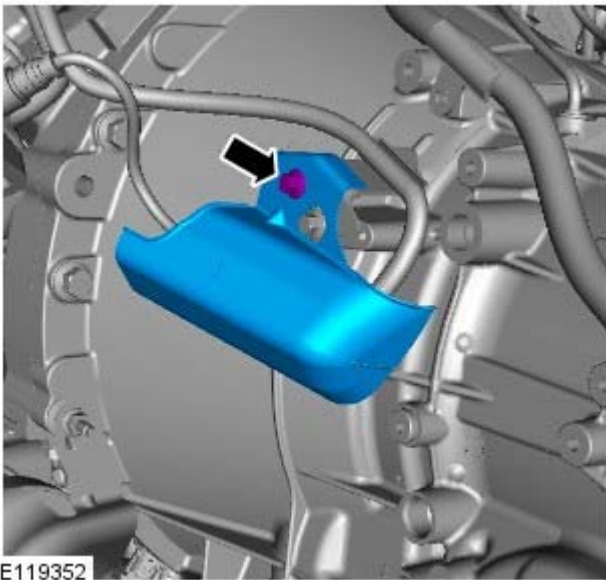
42.



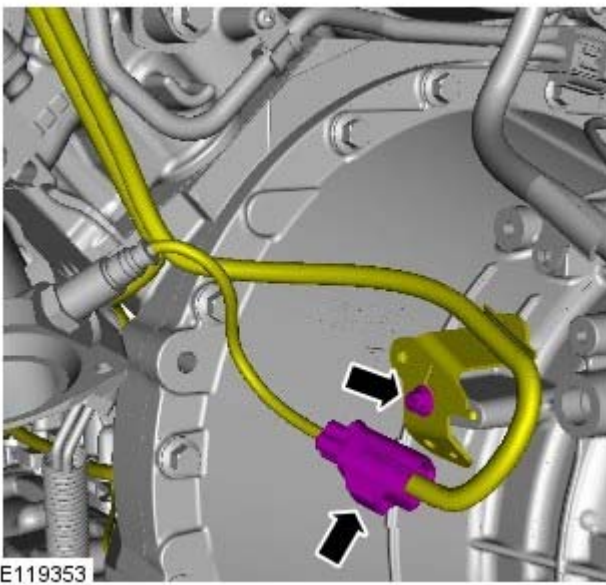
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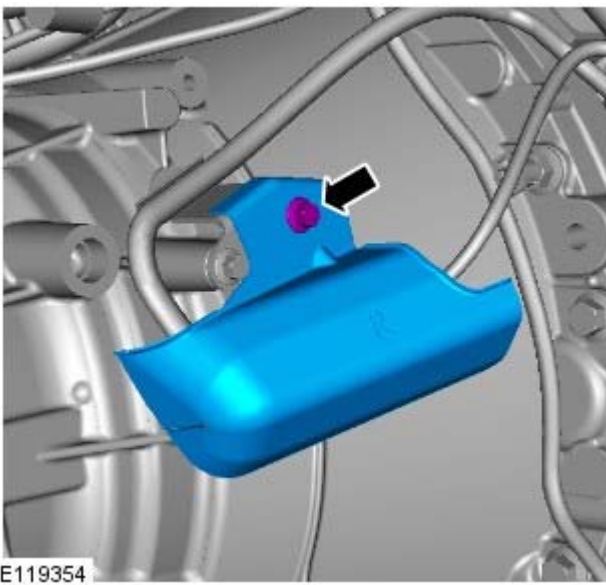
44. TORQUE: 10 Nm



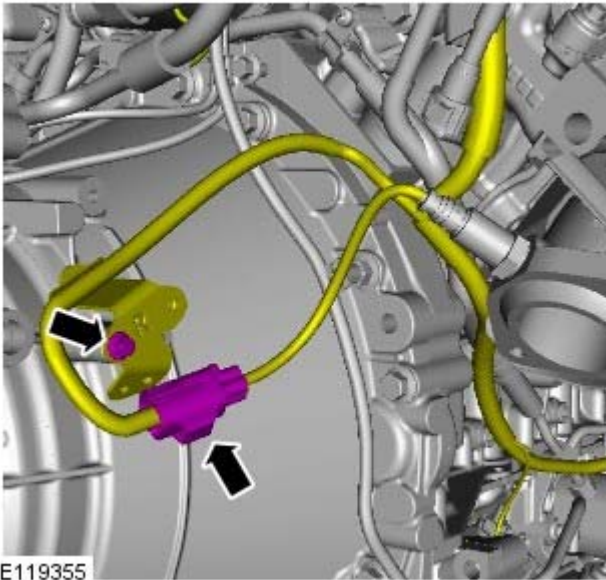
45. TORQUE: 10 Nm



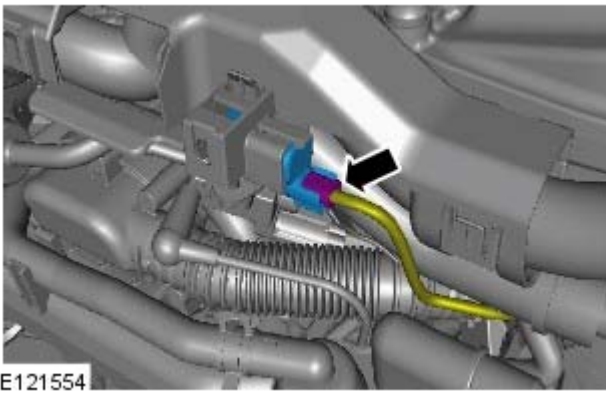
46. TORQUE: 10 Nm



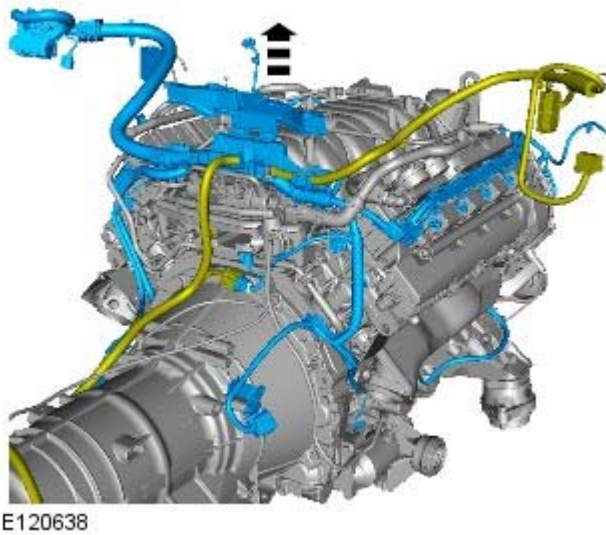
47. TORQUE: 10 Nm



48.



49. NOTE: RHD illustration shown, LHD is similar.



Installation

1. NOTE: After the engine harness has been installed, test using Land Rover/ Jaguar approved diagnostic equipment.

To install, reverse the removal procedure.

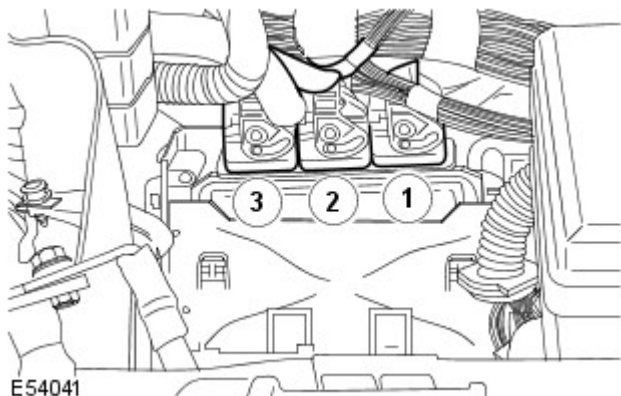
Wiring Harnesses - Engine Wiring Harness TDV6 2.7L Diesel

Removal and Installation

Removal

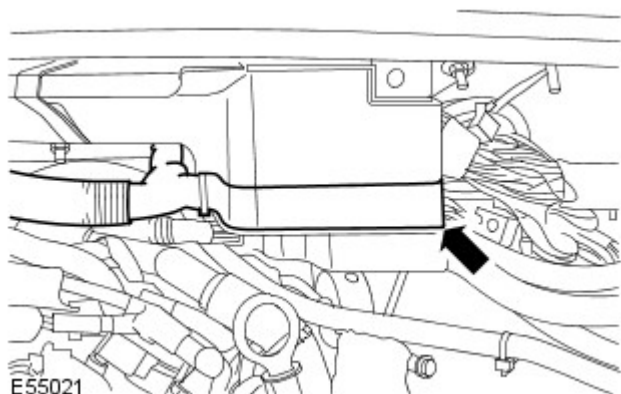
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the crankcase vent oil separator.
For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08, Removal and Installation).
3. Remove the battery.
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
4. **NOTE:** Right hand drive shown, for Left hand drive reverse the sequence.

Disconnect the three engine harness electrical connectors.



E54041

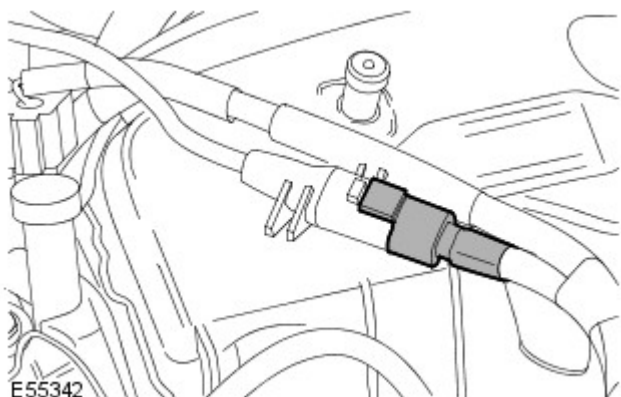
5. Release the engine wiring harness from the bulkhead.



E55021

6. **NOTE:** Left-hand shown, right-hand similar.

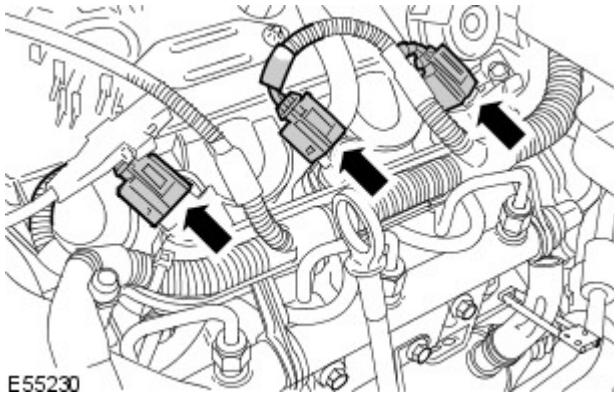
Disconnect the knock sensor (KS) electrical connectors.



E55342

7. NOTE: Left-hand shown, right-hand similar.

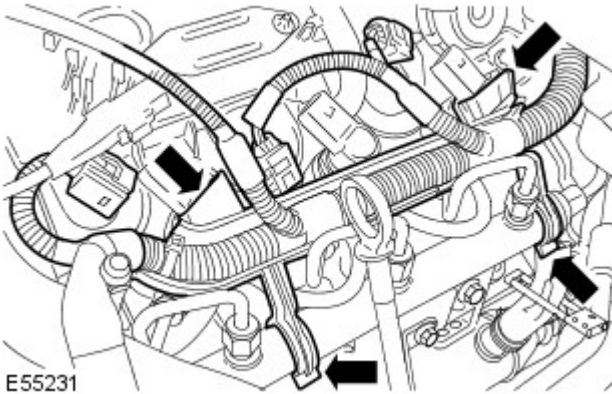
Disconnect the fuel injector electrical connectors.



E55230

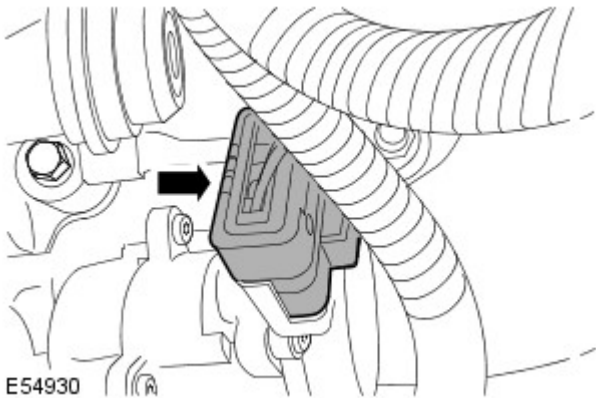
8. NOTE: Left-hand shown, right-hand similar.

Release the engine wiring harness from the fuel supply manifolds.



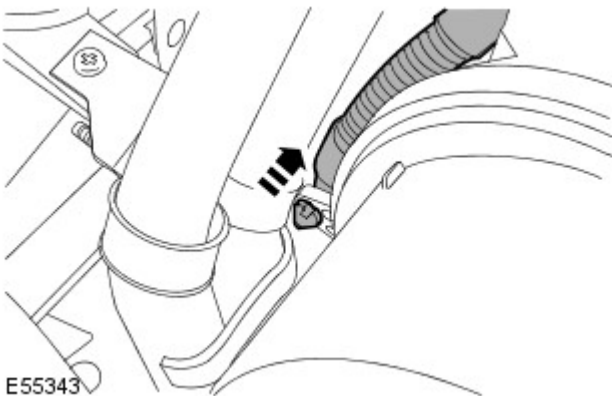
E55231

9. Disconnect the RH EGR valve electrical connector.

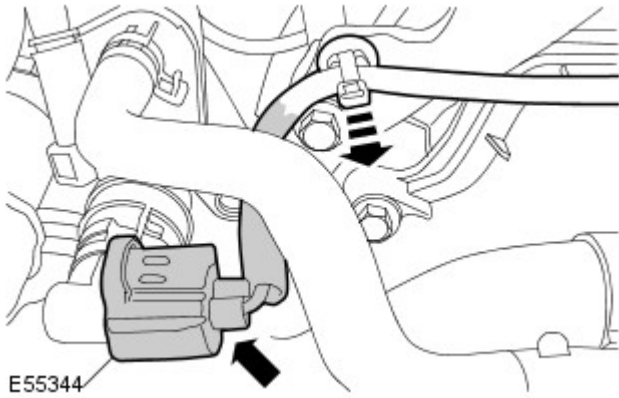


E54930

10. Release the engine wiring harness from the timing cover.

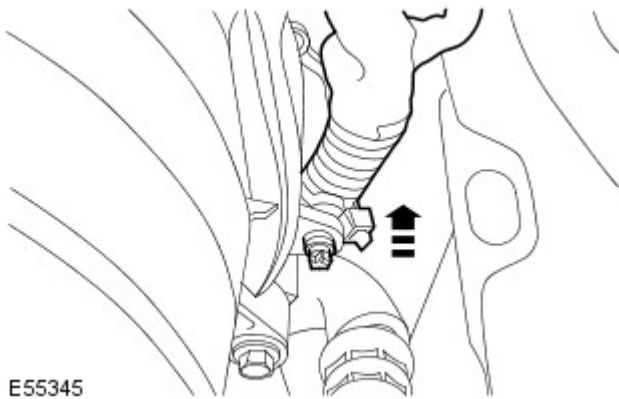


E55343



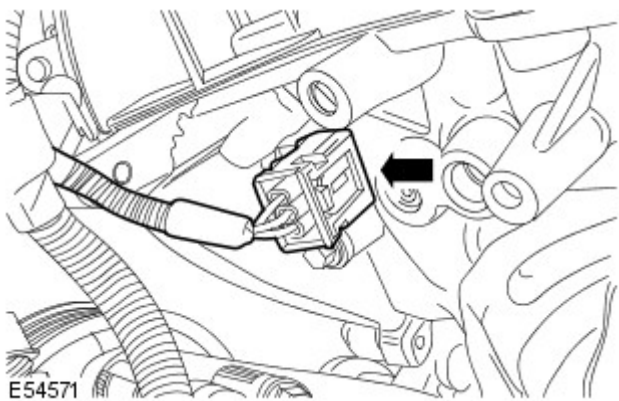
11. Disconnect the engine coolant temperature (ECT) sensor electrical connector.

- Release the engine wiring harness from the engine lifting bracket.



12. Release the engine wiring harness from the timing cover.

13. Remove the LH exhaust gas recirculation (EGR) valve.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve LH - Vehicles Without Diesel Particulate Filter \(DPF\)](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).

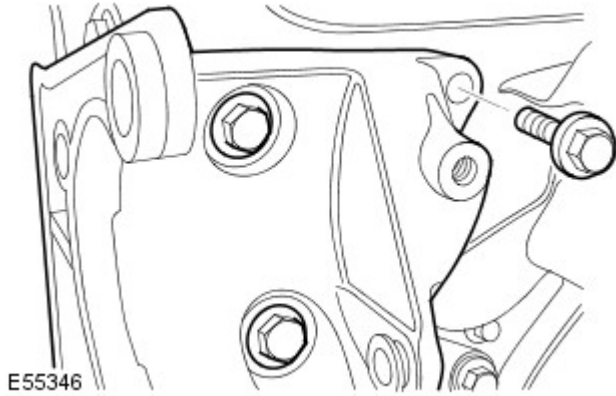


14. Disconnect the camshaft position (CMP) sensor electrical connector.

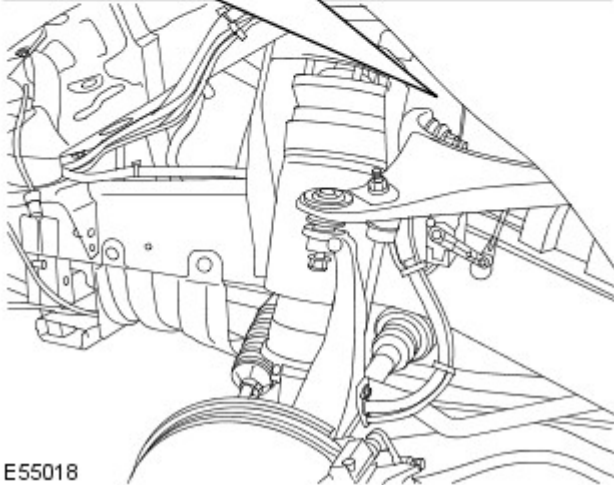
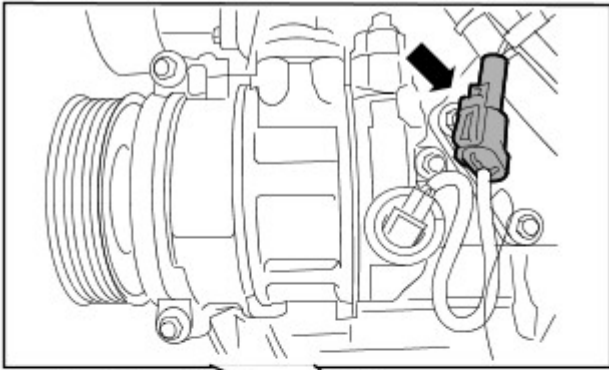
15. Remove the power steering pump.
For additional information, refer to: [Power Steering Pump - 2.7L Diesel \(211-02, Removal and Installation\)](#).

16. Remove the power steering pump mounting bracket.

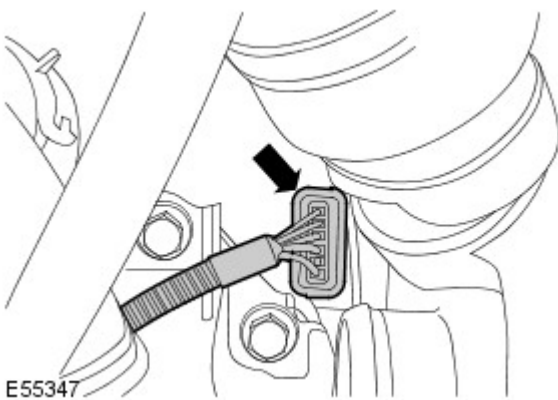
- Remove the three retaining bolts.



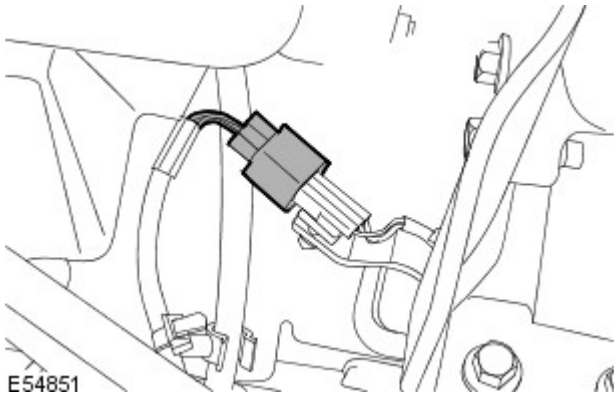
17. Disconnect the A/C compressor electrical connector.



18. Disconnect the turbocharger electrical connector.



19. Disconnect the crankshaft position (CKP) sensor electrical connector.

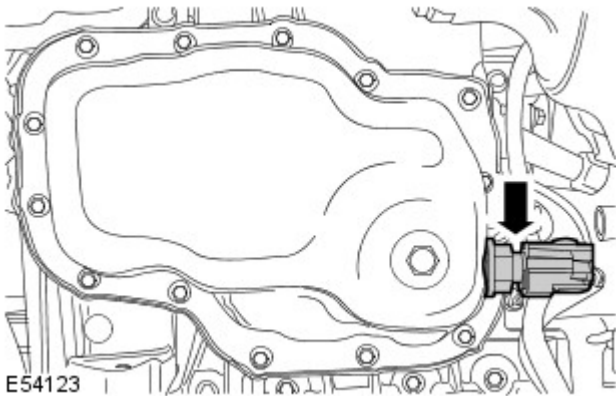


E54851

20. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

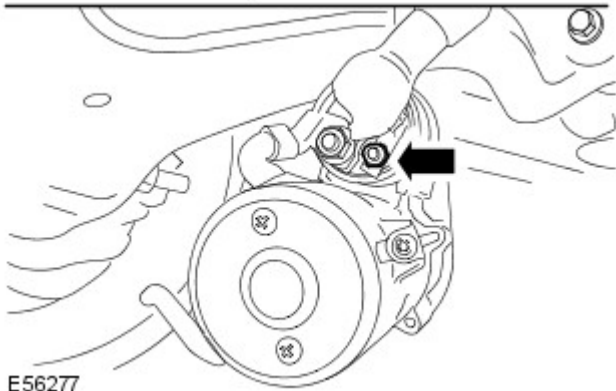
21. Disconnect the engine oil temperature sensor electrical connector.

- Release the engine wiring harness from the oil pan.



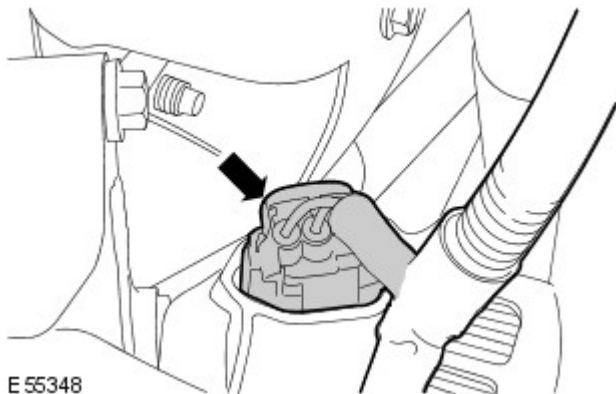
E54123

22. Disconnect the starter motor solenoid electrical connector.



E56277

23. Disconnect the generator electrical connector.



E 55348

24. Remove the engine wiring harness.

Installation

1. Install the engine wiring harness.
2. Connect the generator electrical connector.
3. Connect the starter motor solenoid electrical connector.
 - Tighten to 7 Nm (5 lb.ft).
4. Connect the engine oil temperature sensor electrical connector.
 - Attach the engine wiring harness to the oil pan.
5. Install the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
6. Connect the CKP sensor electrical connector.
7. Connect the turbocharger electrical connector.
8. Connect the A/C compressor electrical connector.
9. Install the power steering pump mounting bracket.
 - Tighten the retaining bolts to 25 Nm (18 lb.ft).
10. Install the power steering pump.
For additional information, refer to: [Power Steering Pump - 2.7L Diesel \(211-02, Removal and Installation\)](#).
11. Connect the CMP sensor electrical connector.
12. Install the LH EGR valve.
For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve LH - Vehicles Without Diesel Particulate Filter \(DPF\)](#) (303-08A Engine Emission Control - TDV6 2.7L Diesel, Removal and Installation).
13. Attach the engine wiring harness to the timing cover.
14. Connect the ECT sensor electrical connector.
 - Attach the engine wiring harness to the engine lifting bracket.
15. Attach the engine wiring harness to the timing cover.
16. Connect the RH EGR valve electrical connector.
17. Attach the engine wiring harness to the fuel supply manifolds.
18. Connect the fuel injector electrical connectors.
19. Connect the KS electrical connectors.
20. Attach the engine wiring harness to the bulkhead.
21. Connect the three engine wiring harness electrical connectors.
22. Install the battery.
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
23. Install the crankcase vent oil separator.
For additional information, refer to: [Crankcase Vent Oil Separator](#) (303-08, Removal and Installation).
24. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Wiring Harnesses - Engine Wiring Harness TDV6 3.0L Diesel

Removal and Installation

Removal

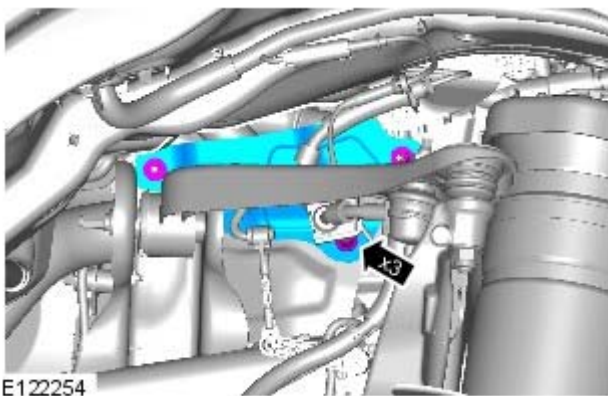
- NOTE: RHD shown, LHD is similar.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

1. Remove the battery.
For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
2. For additional information, refer to: [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. For additional information, refer to: [Exhaust System](#) (309-00B Exhaust System - TDV6 3.0L Diesel, Removal and Installation).
4. For additional information, refer to: [Starter Motor](#) (303-06B Starting System - TDV6 3.0L Diesel, Removal and Installation).
5. For additional information, refer to: [Generator](#) (414-02B Generator and Regulator - TDV6 3.0L Diesel, Removal and Installation).
6. For additional information, refer to: [Exhaust Gas Recirculation \(EGR\) Valve LH](#) (303-08B Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).
7. For additional information, refer to: [Air Conditioning \(A/C\) Compressor](#) (412-03B Air Conditioning - TDV6 3.0L Diesel, Removal and Installation).
8. For additional information, refer to: [Power Steering Pump - TDV6 3.0L Diesel](#) (211-02 Power Steering, Removal and Installation).

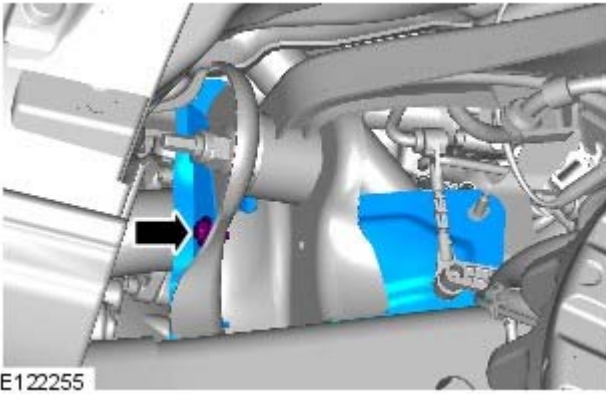
9.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

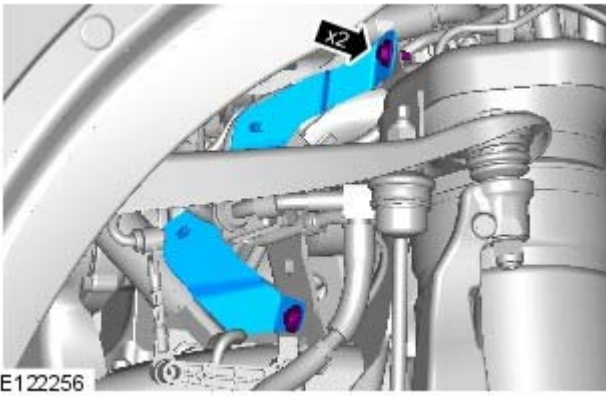
10. Remove the front road wheels and tires.
 - TORQUE: 140 Nm
11. TORQUE: 9 Nm



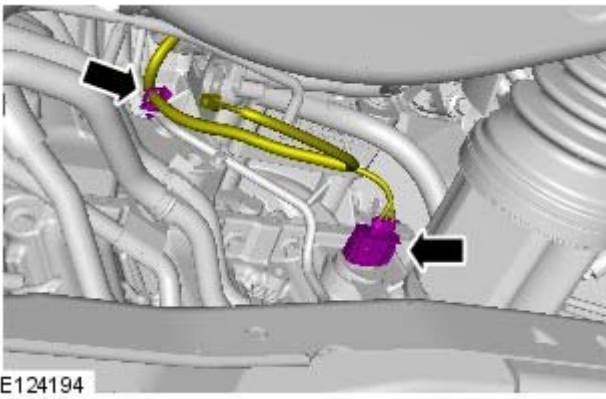
12. TORQUE: 9 Nm



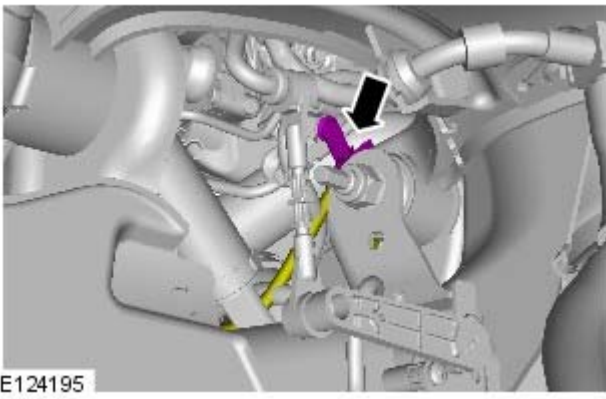
13. TORQUE: 9 Nm



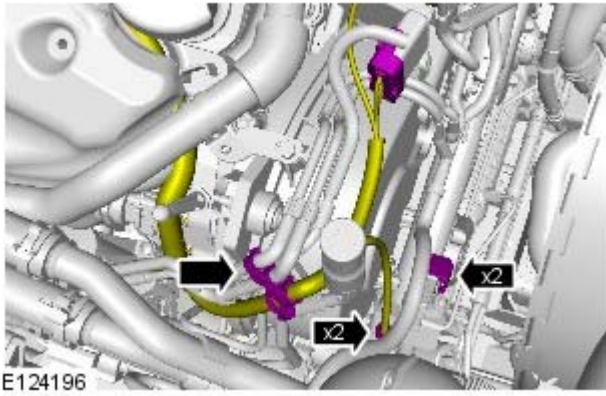
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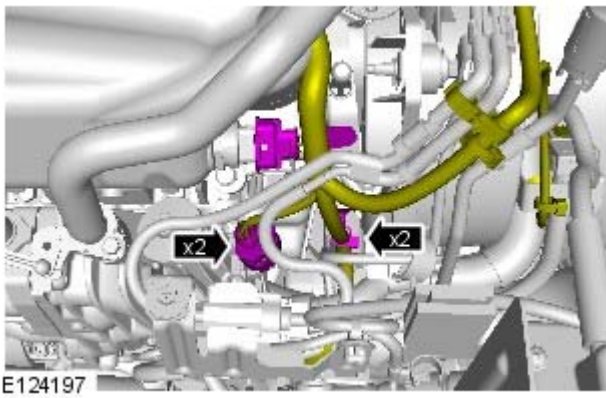
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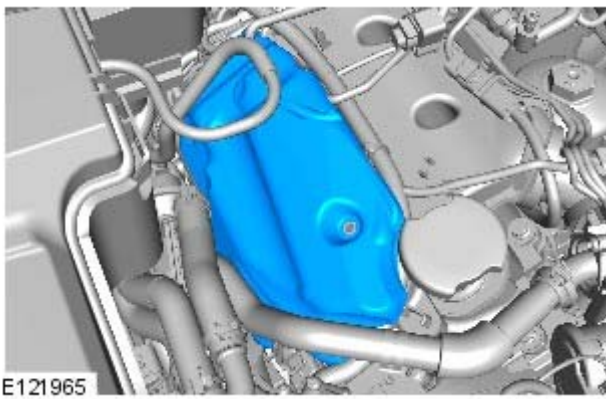
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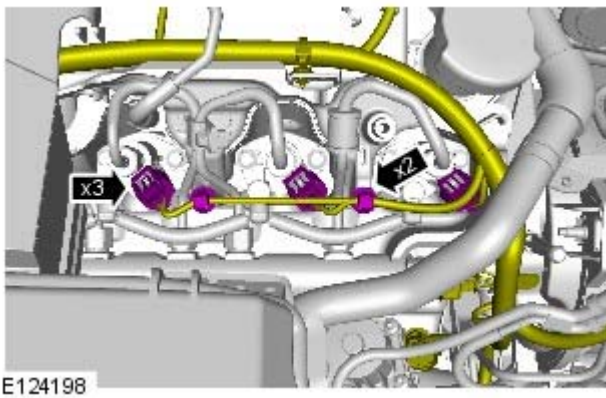
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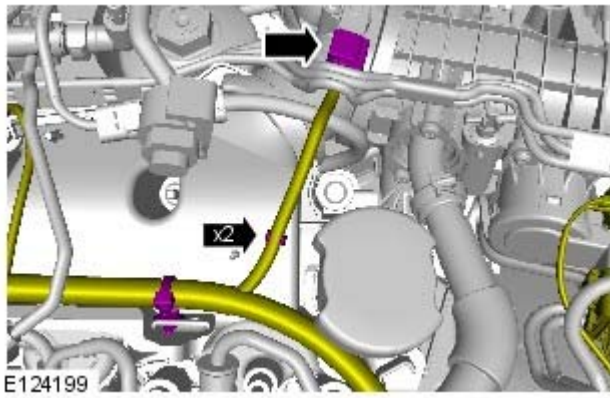
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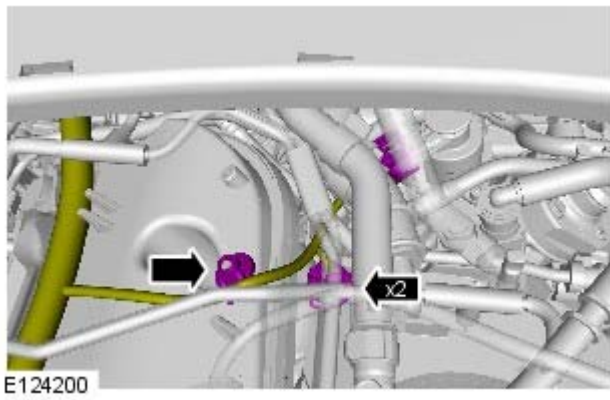
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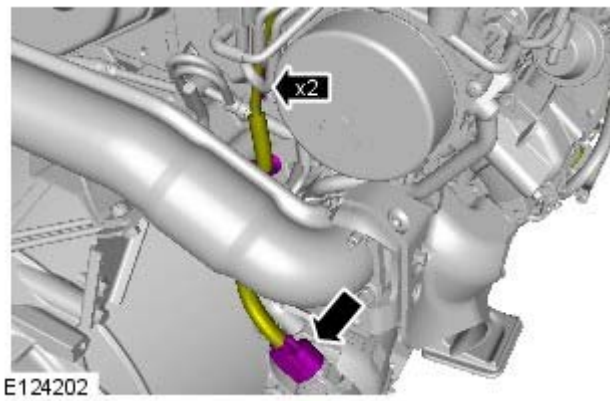
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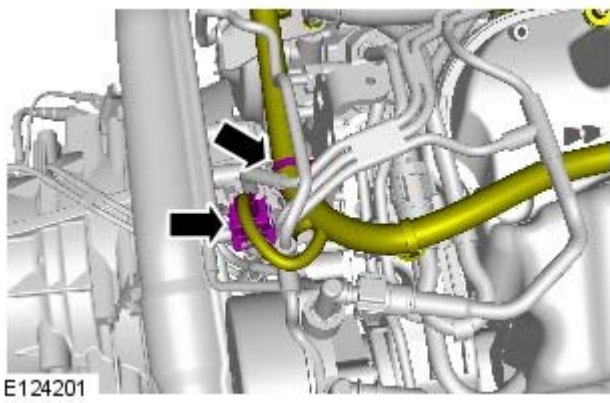
21.



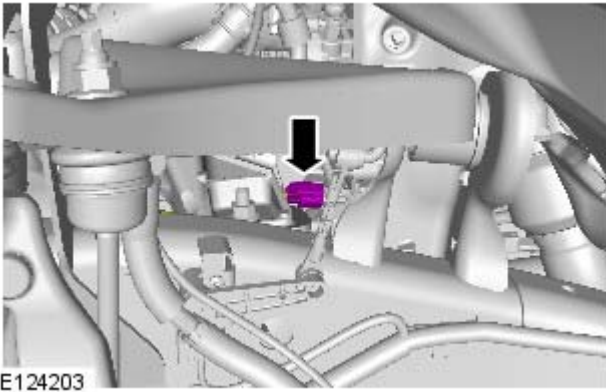
22. NOTE: Engine shown removed for clarity.



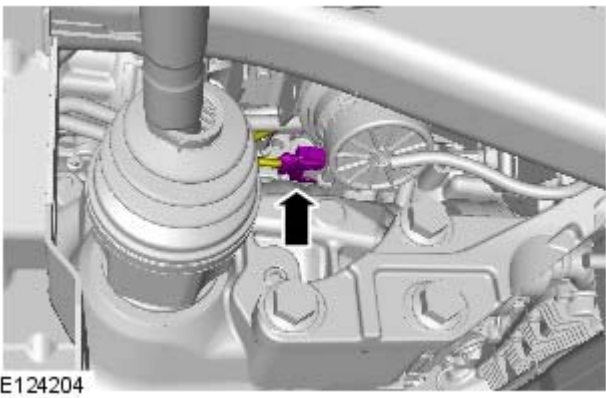
23. NOTE: Engine shown removed for clarity.



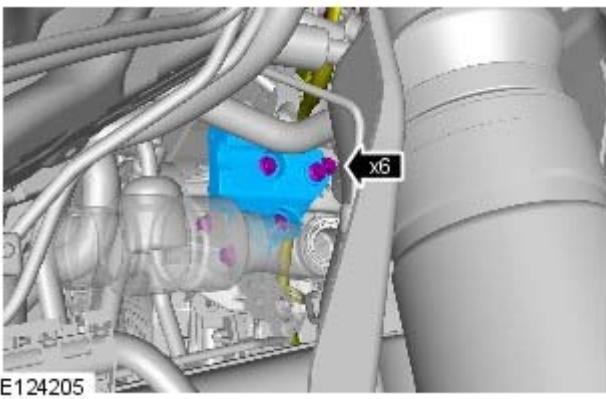
24.



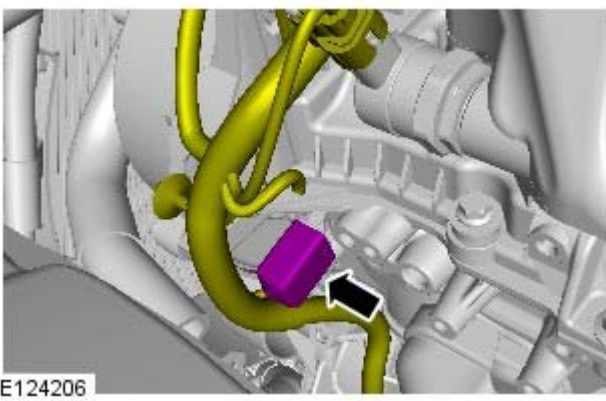
25.



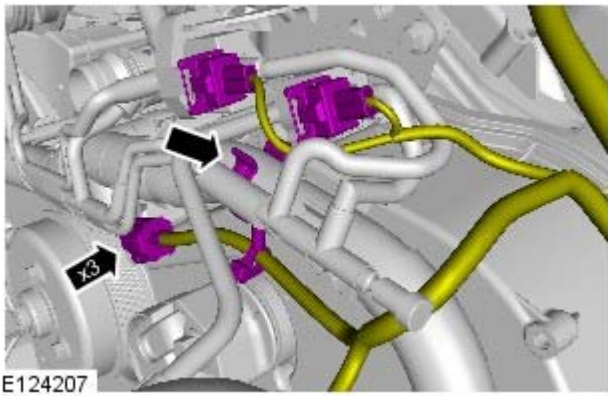
26. TORQUE: 25 Nm



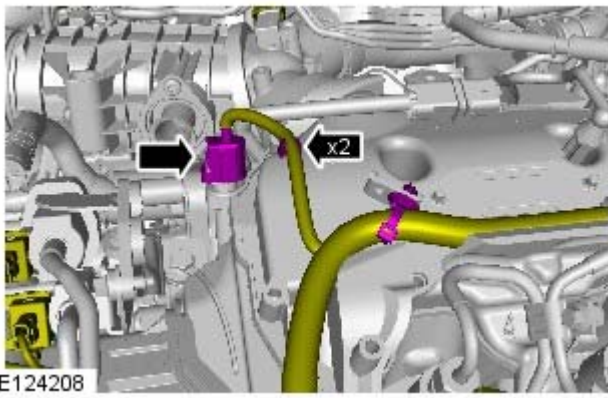
27.



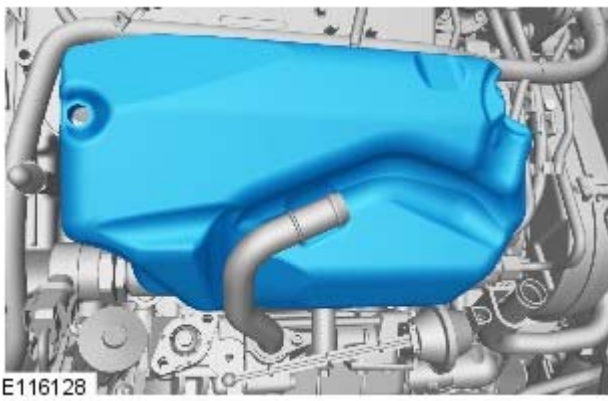
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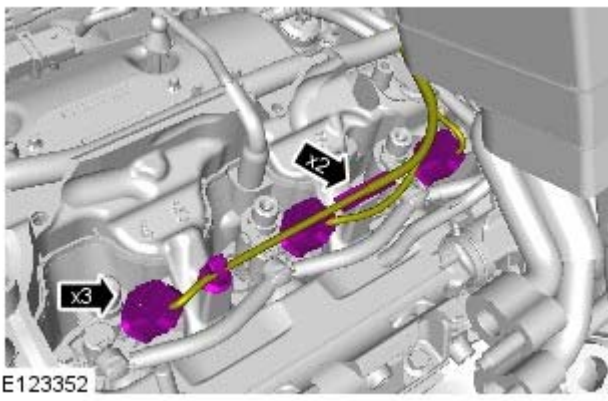
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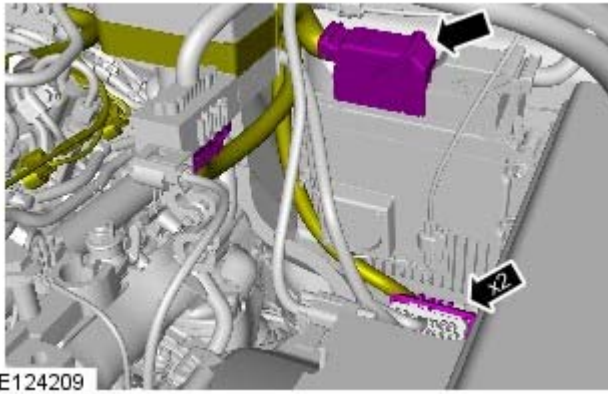
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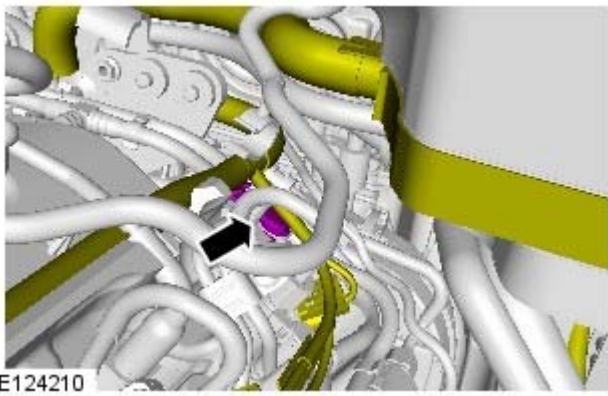
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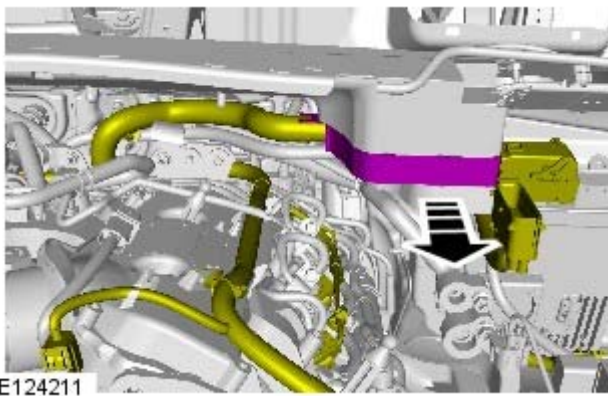
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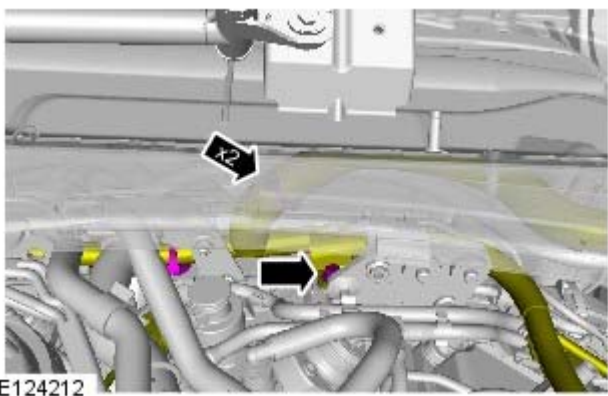
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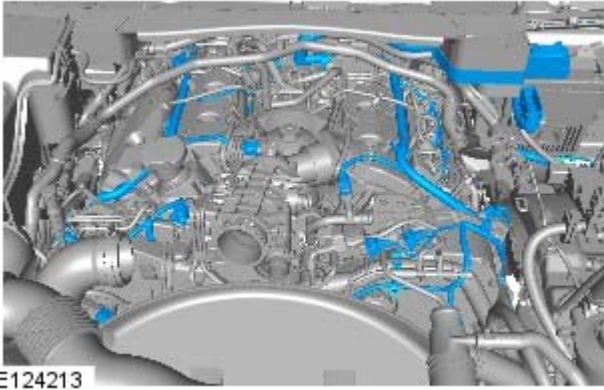


34.



35. TORQUE: 10 Nm





36.  CAUTION: Take extra care not to damage the wiring harnesses.

• NOTE: Note the position of the wiring harnesses to aid installation.

Installation

1. To install, reverse the removal procedure.

Wiring Harnesses - Frame Wiring Harness Vehicles Built From: 01/2007

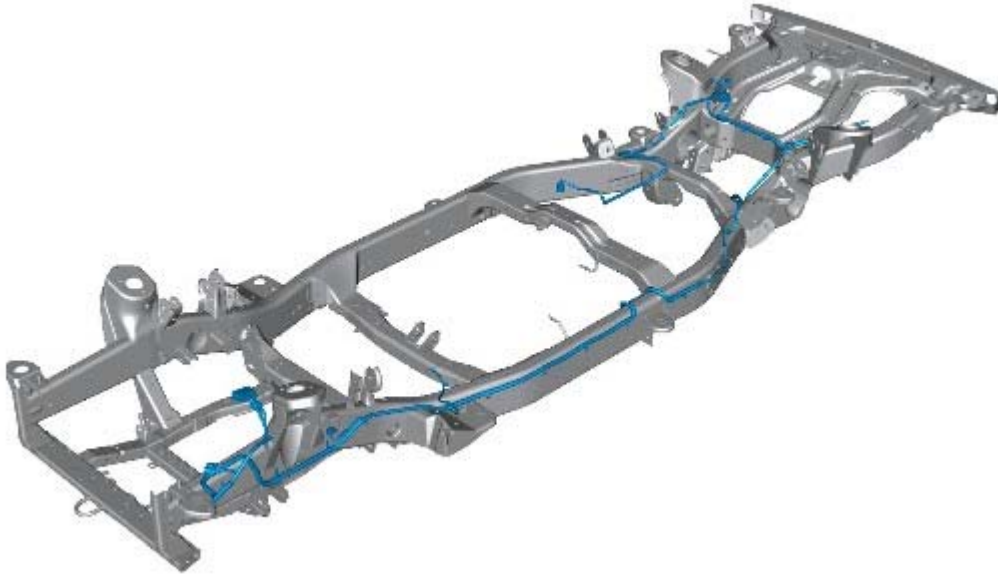
Removal and Installation

Removal

All vehicles

1. **NOTE:** All of the clips on the harness can be access with the integrated body installed to the frame. The graphic is to give guidance of the routing of the harness.


The frame wiring harness routing.



E92590

2. Open the upper liftgate and lower tailgate.

3. Remove the spare wheel and tire.

4.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

5. Remove the wheels and tires.

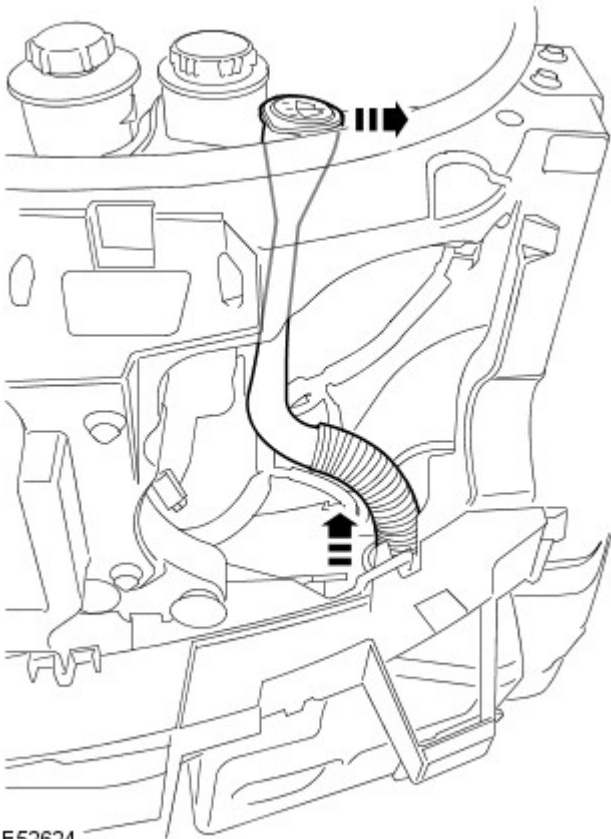
6. Disconnect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

7. Remove the LH front wheel arch liner.

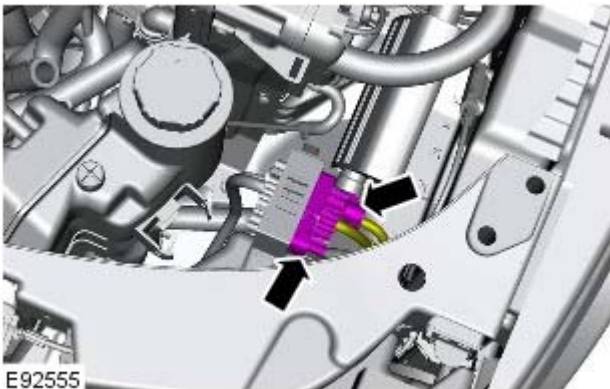
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

8. Remove the windshield washer reservoir filler neck.



E52624

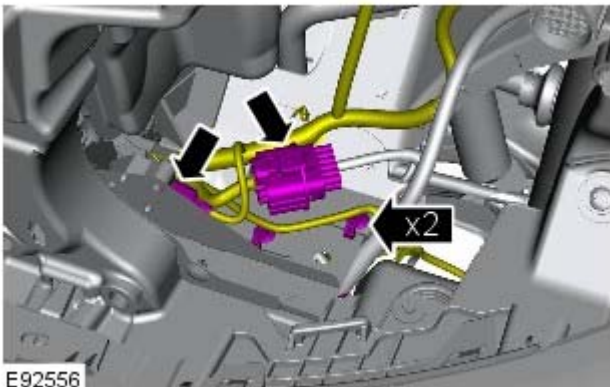
9. LH side behind the front headlamp: Disconnect the frame wiring harness electrical connector.



E92555

10. LH side behind the front panel: Disconnect the 2 electrical connectors from the frame wiring harness.

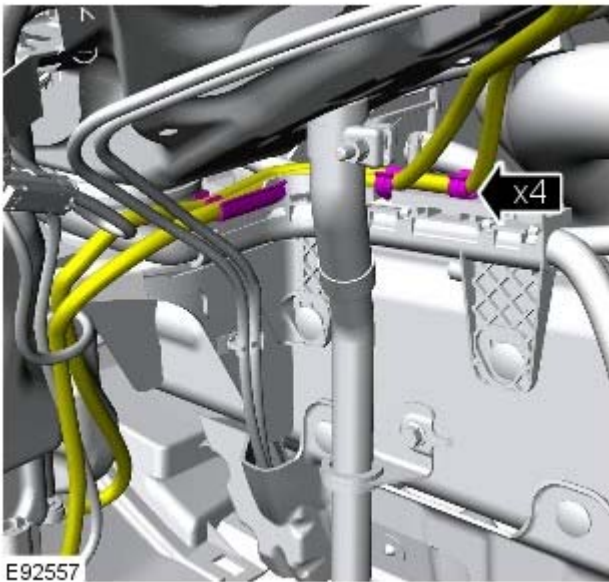
11. LH side behind headlamp: Release the 2 clips from the inner fender.



E92556

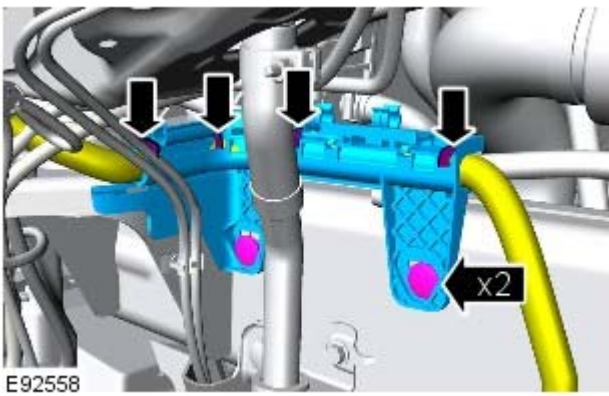
12. LH side behind headlamp: Reposition the frame wiring harness down to the inner fender.

13. LH side front: Release the 2 windshield washer jet hoses.

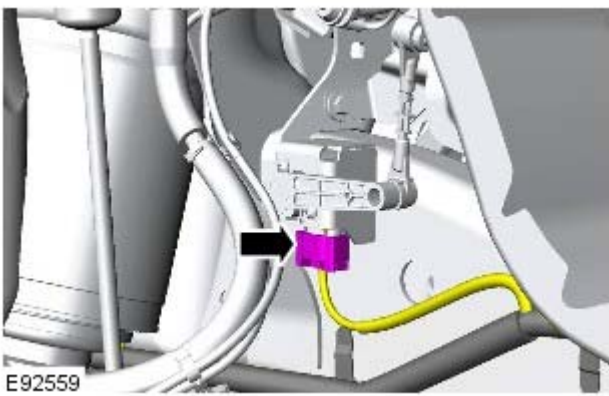


14. Remove the frame wiring harness carrier.

- Remove and discard the 4 tie straps.
- Release the 2 clips.

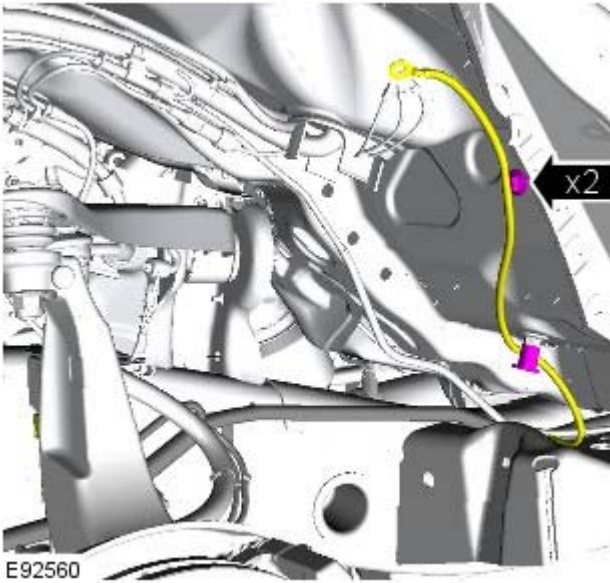


15. LH side front: Disconnect the height sensor electrical connector.



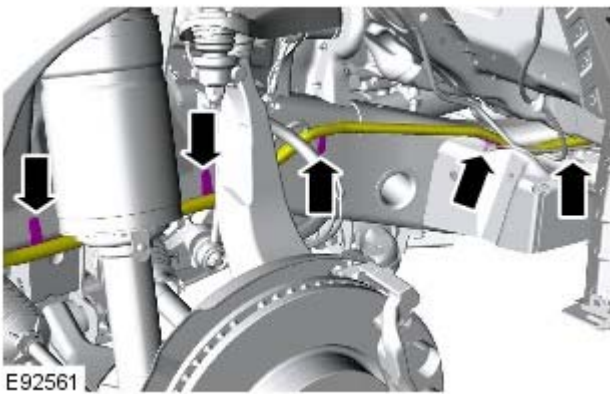
16. Disconnect the ground cable from the wheel arch earth stud.

- Release the 2 clips.



17. LH front side: Release the frame wiring harness from the frame.

- Release the 5 clips.

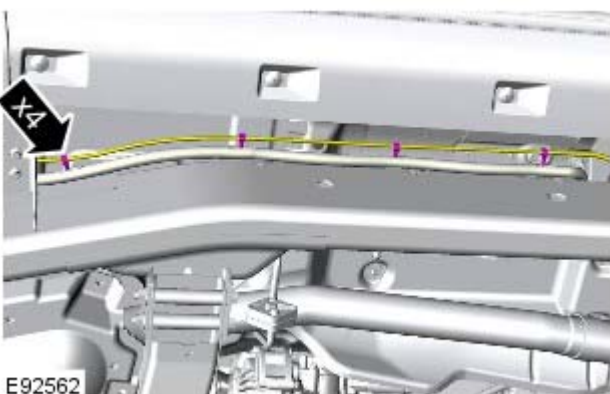


18. Remove the air suspension reservoir.

For additional information, refer to: [Air Suspension Reservoir \(204-05 Vehicle Dynamic Suspension, Removal and Installation\)](#).

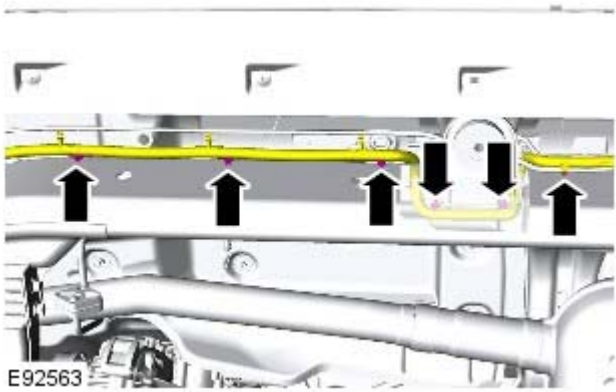
19. LH side: Release air suspension line from the frame wiring harness.

- Release the 4 clips.



20. LH side: Release the frame wiring harness from the frame.

- Release the 6 clips.



21. Remove the air suspension silencer.

For additional information, refer to: [Air Suspension Muffler](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

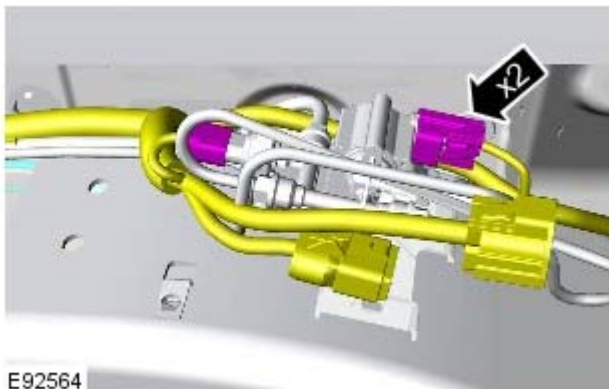
All except vehicles with diesel engine

22. Remove the evaporative emission canister.

For additional information, refer to: [Evaporative Emission Canister](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Removal and Installation).

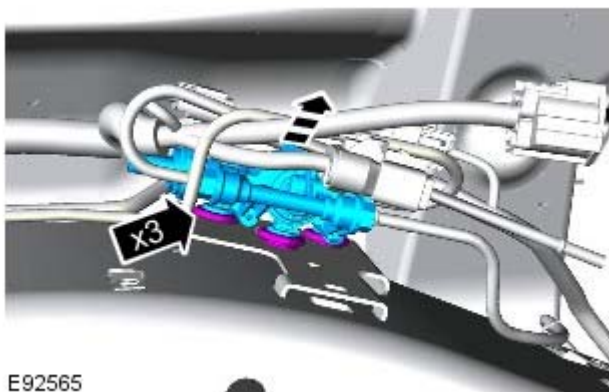
All vehicles

23. Disconnect the 2 electrical connectors from the air suspension solenoid.

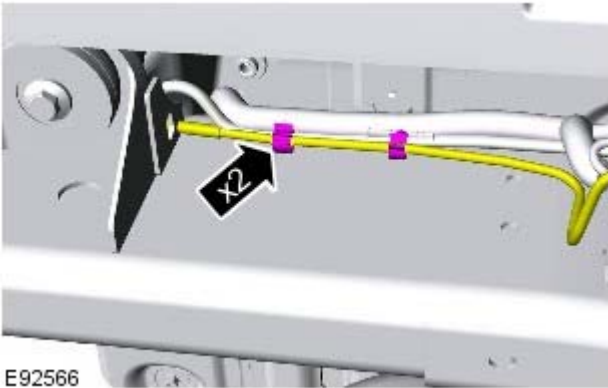


24. Release the air suspension compressor valve block.


- Release the 3 grommets.



25. LH side: Release air suspension line from the frame wiring harness.

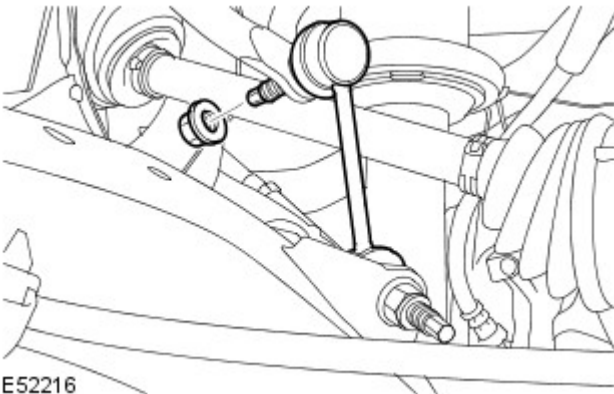


E92566

26.  CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

Release both stabilizer bar links.

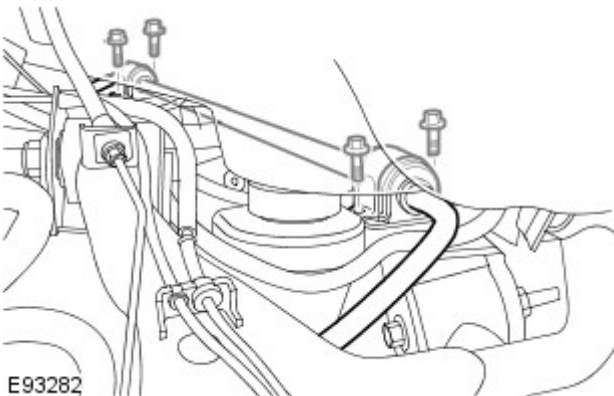
- Remove the 2 nuts.



E52216

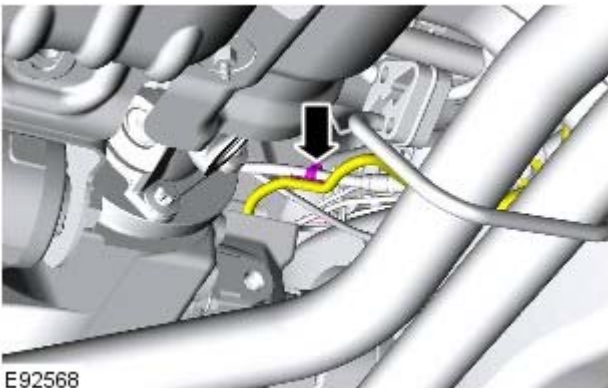
27. Release the stabilizer bar.

- Remove the 4 bolts.

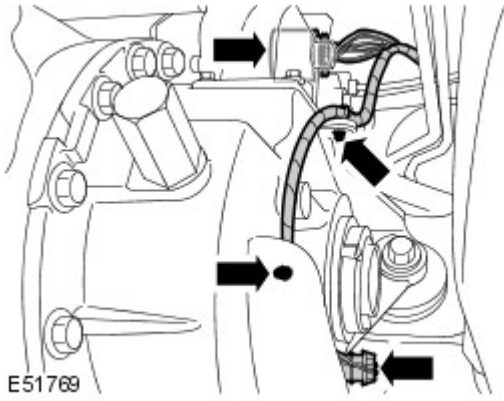


E93282

28. Release the frame wiring harness from the parking brake cable.

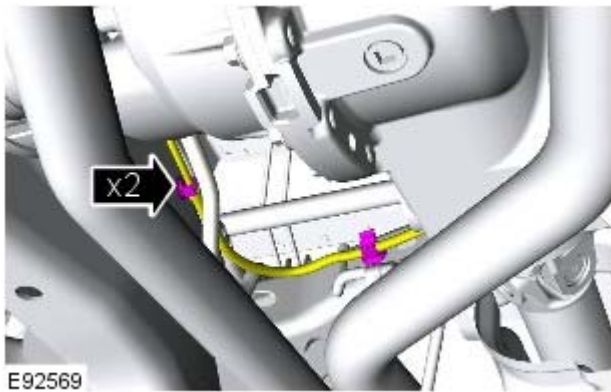


E92568



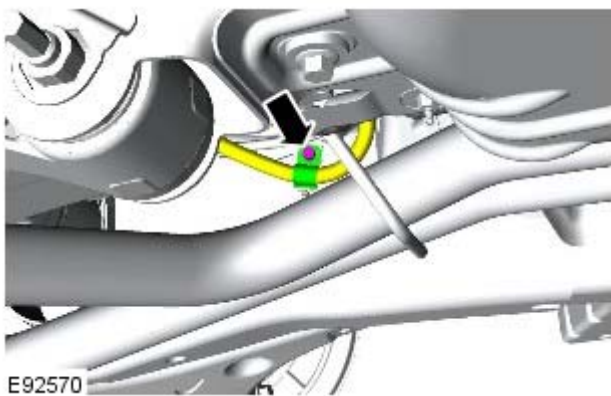
29. Vehicles with differential locking motor: Disconnect the 2 electrical connectors.

- Release the 2 wiring harness clips.



30. Release the parking brake emergency release cable.

- Release the 2 clips.

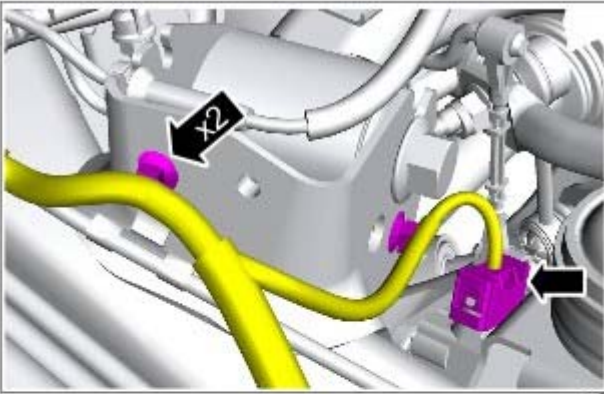


31. LH side: Release the frame wiring harness.

- Remove the bolt.

32. Disconnect the electrical connector from the rear LH height sensor.

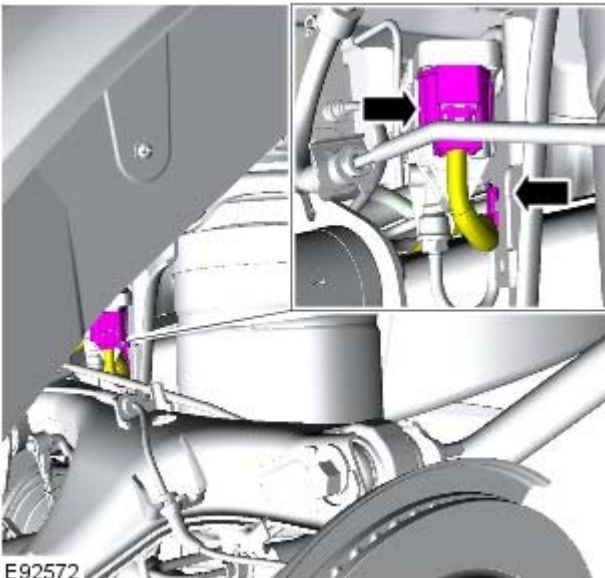
- Release the 2 clips.



E92571

33. LH side rear: Disconnect the air suspension rear valve block electrical connector.

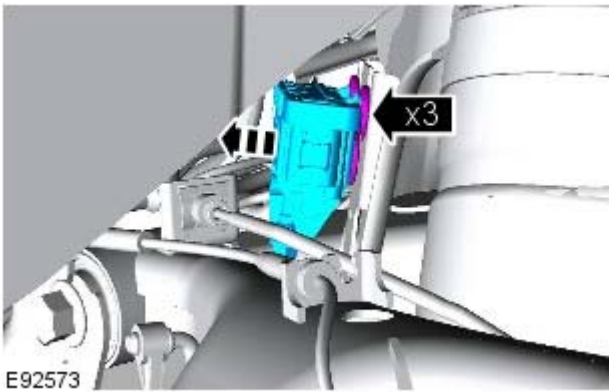
- Release the clip.



E92572

34. Release the valve block from its mounting bracket.

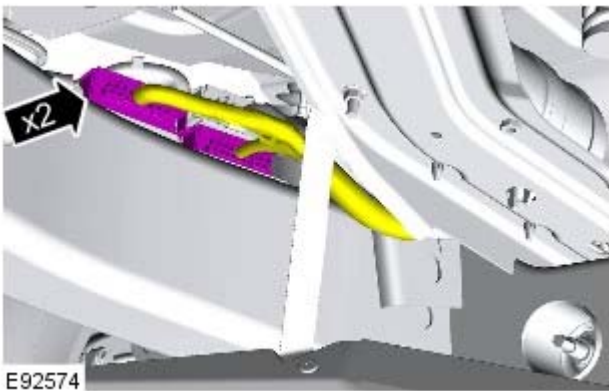
- Release the 3 grommets.



35. Reposition the frame wiring harness to above the frame.

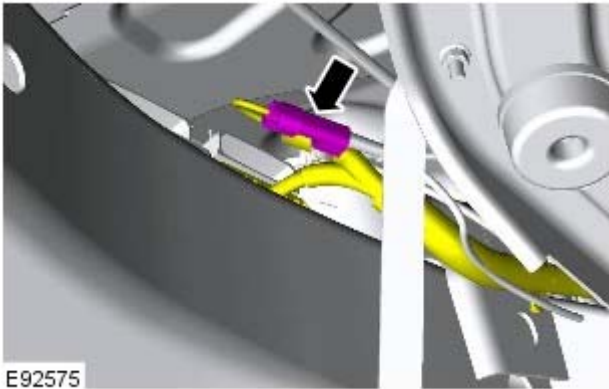
36. LH side rear: Disconnect the 2 electrical connectors from the frame wiring harness.

- Release the 2 electrical connectors.



37. Disconnect the LH rear ABS sensor.

- Release the clip.

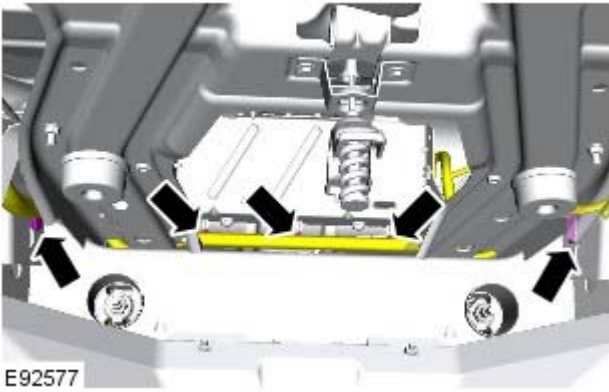


38. Release the parking brake actuator mount bracket.



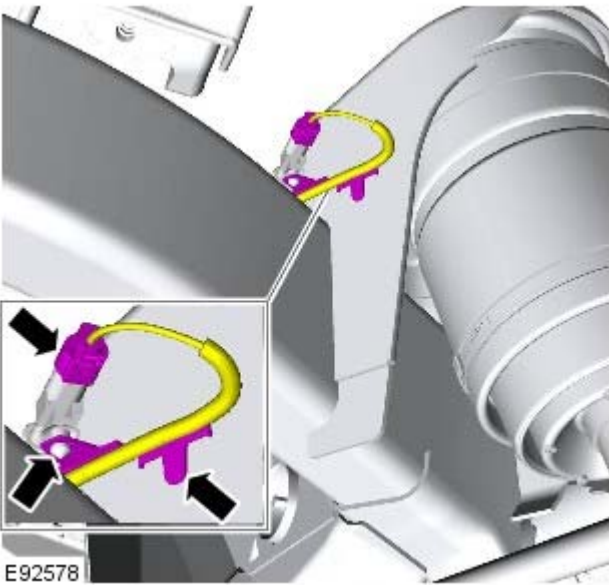
39. Spare wheel aperture: Release the frame wiring harness.

- Release the 5 clips.



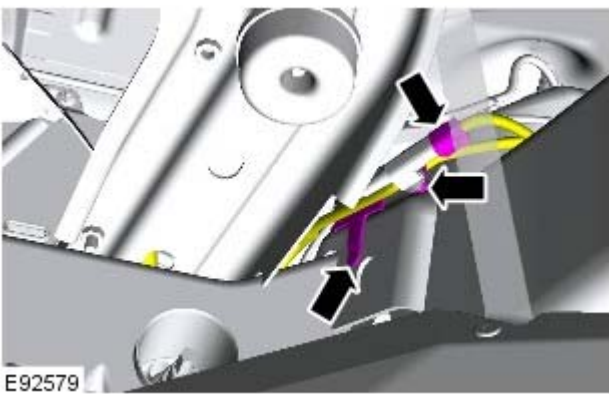
40. RH side rear: Disconnect the ABS sensor electrical connector.

- Release the 2 clips.



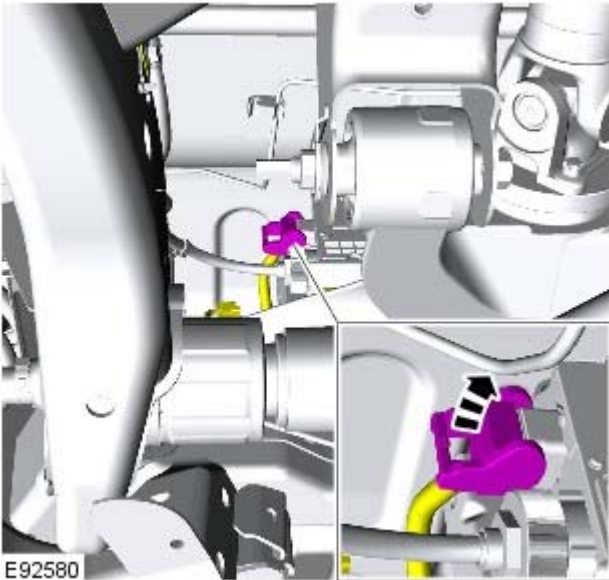
41. RH side rear: Disconnect the low brake pad warning lamp electrical connector.

- Release the 2 clips.



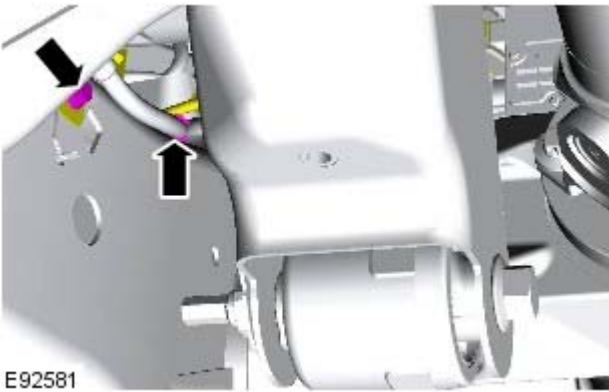
42. Disconnect the electronic parking brake actuator electrical connector.

- Release the clip.



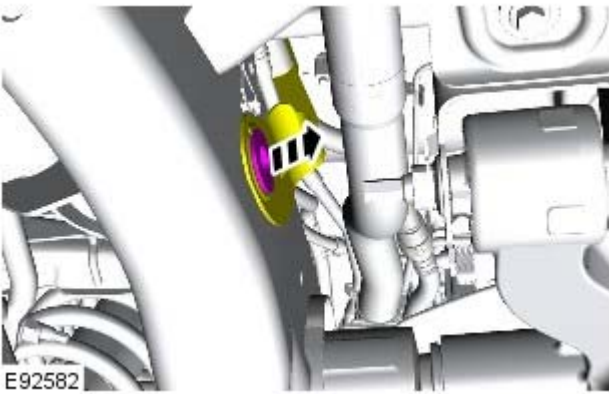
43. Release the RH parking brake cable.

- Remove the bolt.
- Release the clip.

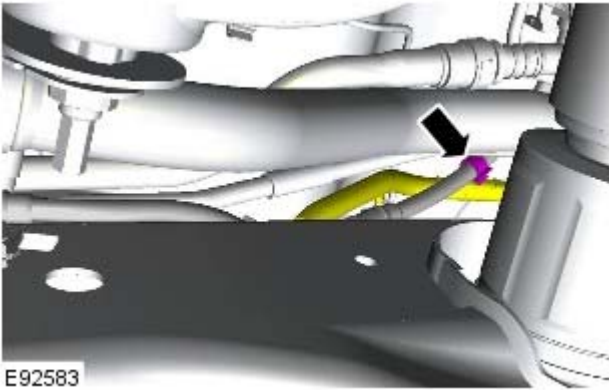


44. Release the fuel line support bracket.

- Remove the inner section of the fuel line support bracket.
- Release the clip.



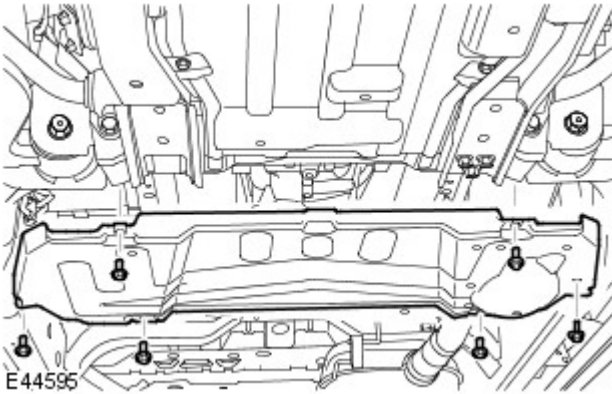
45. Release the frame wiring harness from the parking brake cable.



46. RH side: Release the frame wiring harness from the frame.

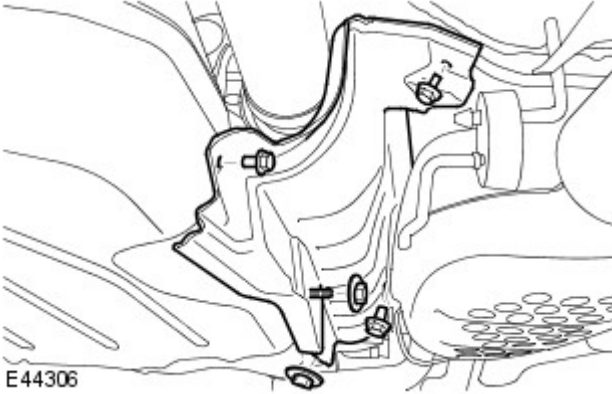
47. Remove the transmission under shield.

- Remove the 6 bolts.



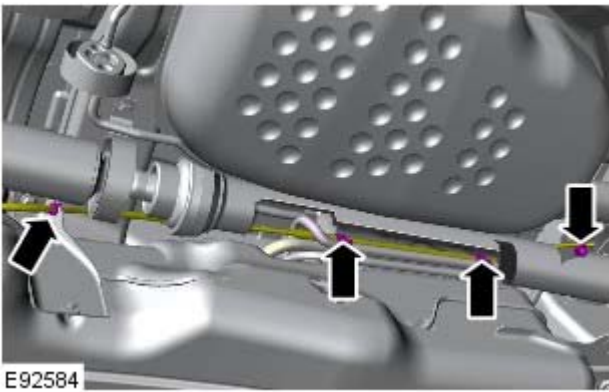
48. Remove the fuel tank heat shield.

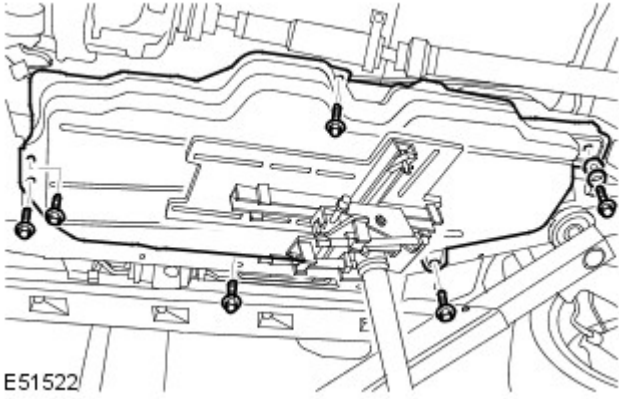
- Remove the 3 bolts and 2 nuts.



49. Release the parking brake emergency release cable.

- Release the 4 clips



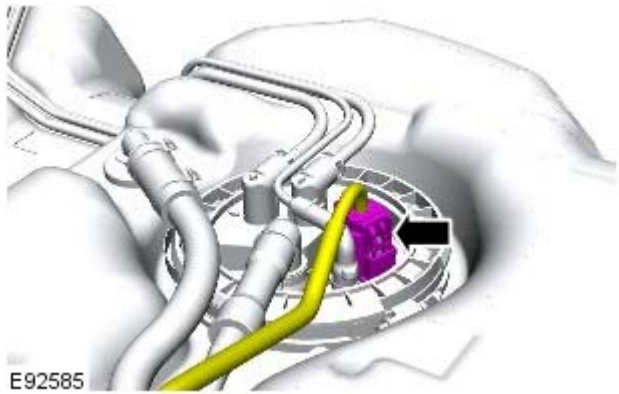


50.  **WARNING:** Secure the component to the transmission jack.

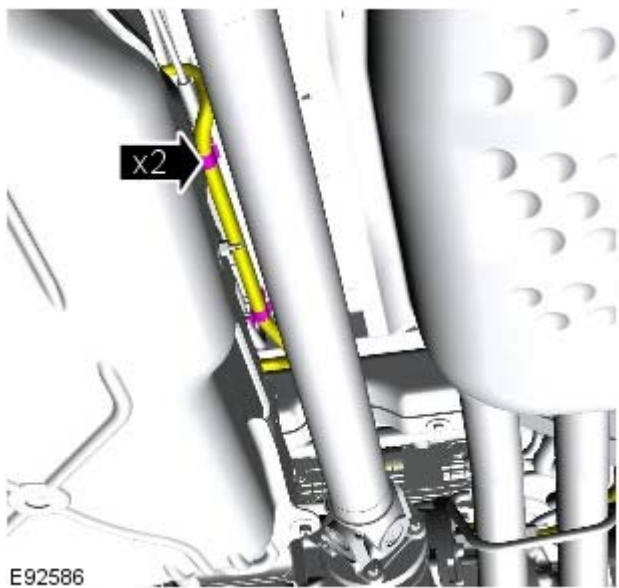
 **CAUTION:** Note the rear bolt is fitted with 2 washers.

Using a transmission jack, lower the fuel tank.

- Remove the 6 bolts.



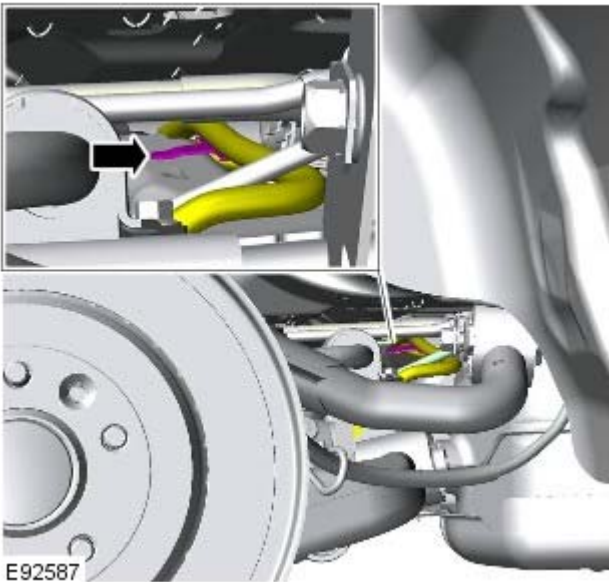
51. Disconnect the fuel pump module electrical connector.



52. Release the frame wiring harness from the fuel tank.

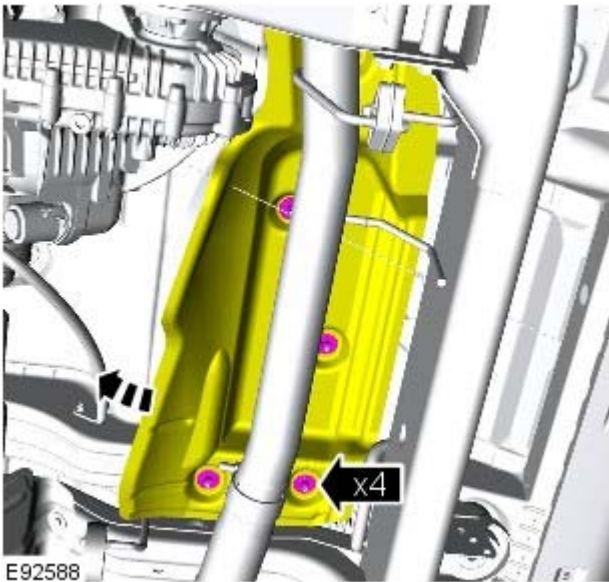
53. Rear of fuel tank: Release the frame wiring harness from the top of the frame crossmember.

- Release the clip.

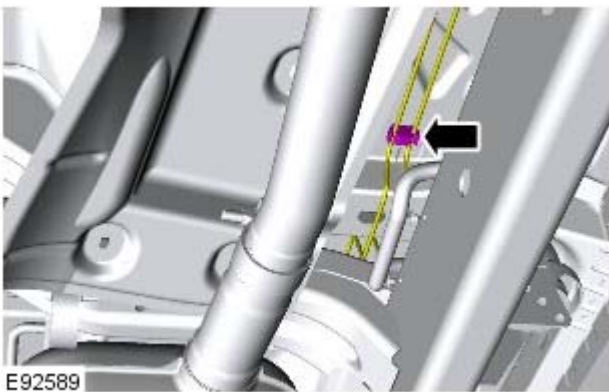


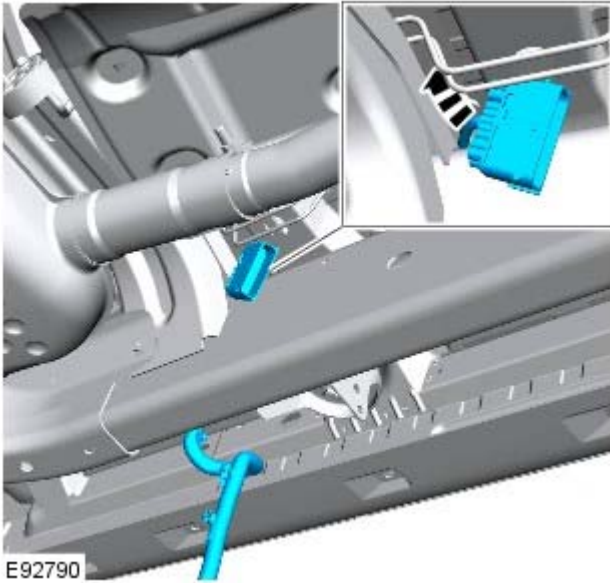
54. Secure the fuel tank.

55. Release the exhaust heat shield for access.



56. Release the brake pipes.






57. With assistance, remove the frame wiring harness.

- Position both ends of the frame wiring harness to the LH center body mount.
- Route the front end of the frame wiring harness between the body and center crossmember.
- With assistance, remove the frame wiring harness.

Installation

1. Check the old frame wiring harness against the new frame wiring harness to make sure that they are the same.
2. **NOTE:** Make sure the wiring harness is routed correctly.

With assistance, install the frame wiring harness.

- Route all of the frame wiring harness electrical connectors and clips into position.
3. Secure the brake pipes.
 4. Secure the exhaust heat shield.
 5.  **WARNING:** Secure the component to the transmission jack.



6. **CAUTION:** Note the rear bolt is fitted with 2 washers.

Using a transmission jack, lower the fuel tank.

- Remove the 4 bolts.
6. Connect the fuel pump module electrical connector.
 7. RH side: Secure the frame wiring harness to the fuel tank.
 8. Rear of fuel tank: Secure the frame wiring harness to the top of the frame crossmember.



9. **CAUTION:** Note the rear bolt is fitted with 2 washers.

Install the fuel tank.

- Tighten the bolts to 45 Nm (33 lb.ft).
10. Secure the parking brake emergency release cable.
 - Secure in the 4 clips.
 11. Install the fuel tank heat shield.
 - Tighten the bolts to 6 Nm (4 lb.ft).
 - Tighten the nuts to 3 Nm (2 lb.ft).
 12. Install the transmission under shield.
 - Tighten the bolts to 10 Nm (7 lb.ft).

13. RH side: Secure the frame wiring harness to the frame.
14. Secure the frame wiring harness to the RH parking brake

- cable.
- 15.** Secure the RH parking brake cable bracket.
 - Install the inner section of the parking brake cable bracket.
 - 16.** Secure the RH parking brake cable.
 - Secure the clip.
 - Tighten the new bolts to 22 Nm (16 lb.ft).
 - 17.** Connect the electronic parking brake actuator electrical connector.
 - Secure the clip.
 - 18.** RH side rear: Connect the low brake pad warning lamp electrical connector.
 - Secure the 2 clips.
 - 19.** RH side rear: Connect the ABS sensor electrical connector.
 - Secure the 2 clips.
 - 20.** Spare wheel aperture: Secure the frame wiring harness.
 - Secure the 5 clips.
 - 21.** Secure the parking brake actuator mount bracket.
 - Tighten the bolts to 22 Nm (16 lb.ft).
 - 22.** Connect the LH rear ABS sensor.
 - Secure the clip.
 - 23.** LH side rear: Connect the 2 electrical connectors to the frame wiring harness.
 - Secure the electrical connectors.
 - 24.** Reposition the rear valve block electrical connector.
 - 25.** Reposition the RH side rear height sensor electrical connector.
 - 26.** LH side rear: Connect the air suspension valve block electrical connector.
 - Secure the clip.
 - 27.** Connect the electrical connector to the rear LH height sensor.
 - Secure the clip.
 - 28.** Secure the valve block to its mounting.
 - 29.** LH side: Secure the frame wiring harness.
 - Tighten the bolt to 22 Nm (16 lb.ft).
 - 30.** Secure the parking brake emergency release cable.
 - Secure the clips.
 - 31.** Secure the frame wiring harness to the LH parking brake cable.
 - 32.** Attach both stabilizer bar links.
 - Tighten the nuts to 115 Nm (85 lb.ft).
 - 33.** Secure the stabilizer bar.
 - Tighten the bolts to 62 Nm (46 lb.ft).
 - 34.** Install the rear wheels and tires.
 - 35.** Secure the air suspension compressor valve block.
 - 36.** Connect the electrical connectors to the air suspension

solenoid.

37. Install the air suspension silencer.

For additional information, refer to: [Air Suspension Muffler](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

38. LH side: Secure the air suspension line to the frame wiring harness.

39. LH side: Secure the frame wiring harness to the frame.

- Secure the 6 clips.

40. Install the air suspension reservoir.

For additional information, refer to: [Air Suspension Reservoir](#) (204-05 Vehicle Dynamic Suspension, Removal and Installation).

41. Connect the ground cable to the wheel arch earth stud.

- Tighten the nut to 25 Nm (18 lb.ft).
- Secure the 2 clips.

42. LH side front: Connect the height sensor electrical connector.

43. Install the frame wiring harness carrier.

- Install new tie straps.
- Secure to the clips.

44. LH side front: Secure the 2 windshield washer jet hoses.

45. Reposition the frame wiring harness through the inner fender.

46. LH side behind headlamp: Secure the 2 clips to the inner wing.

47. LH side behind the front panel: Connect the 2 electrical connectors to the frame wiring harness.

48. LH side behind the front headlamp: Connect the frame wiring harness electrical connector.

49. Install the windshield washer reservoir filler neck.

50. Install the LH front wheel arch liner.

For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).

51. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Wiring Harnesses - Front Parking Aid Camera Wiring Harness - Front Section RHD AWD

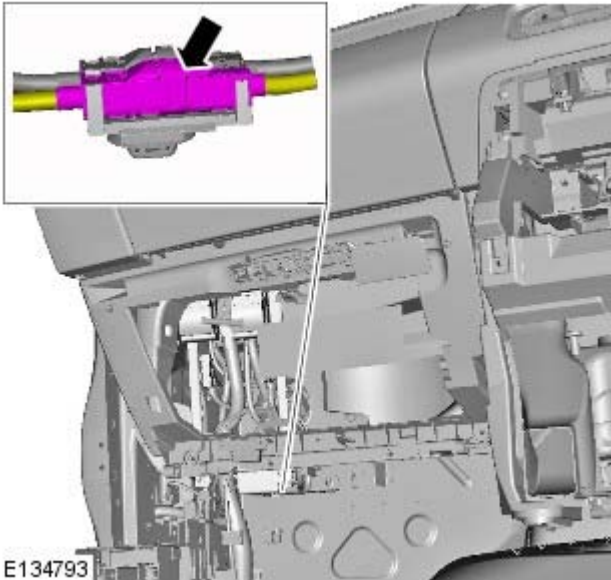
Removal and Installation

Removal



CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

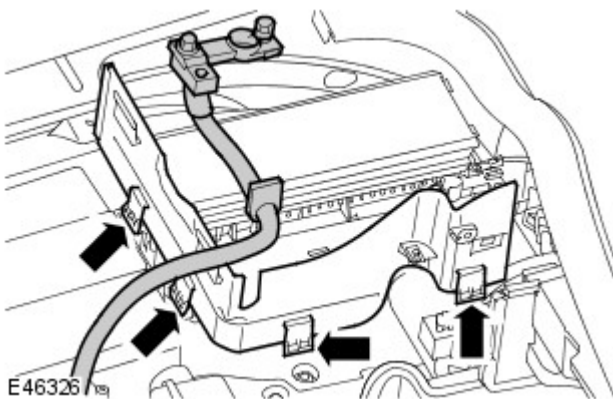
1. Remove the central junction box (CJB). For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
2. **NOTE:** The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.



Disconnect the electrical connector.

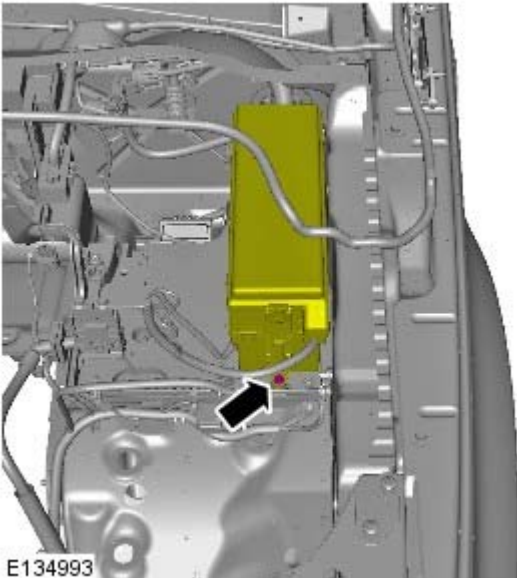
3. Remove the battery. For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

4. Remove the battery compartment side wall.
 - Release the battery positive cable and grommet.
 - Release the 4 clips.

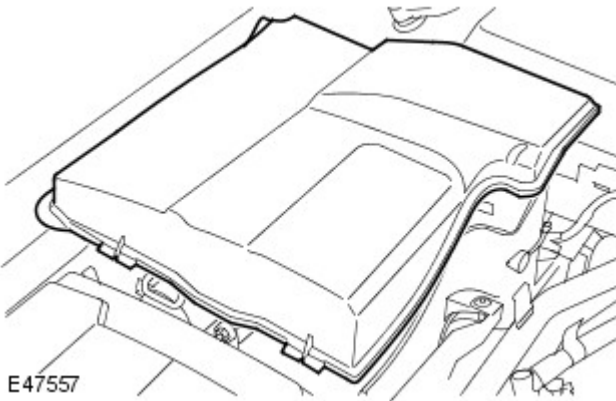


5. Release the engine compartment fuse box.

- Remove the bolt.

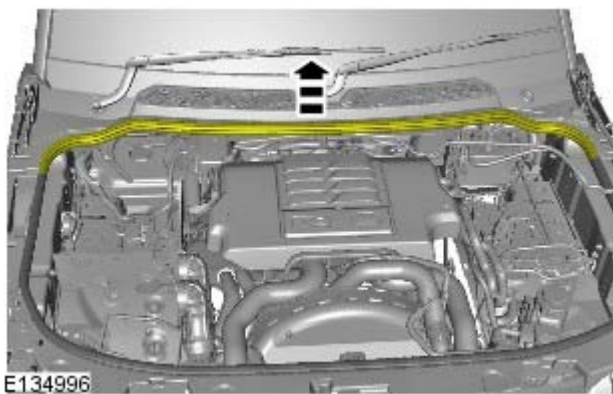


6. Remove the brake master cylinder cover.



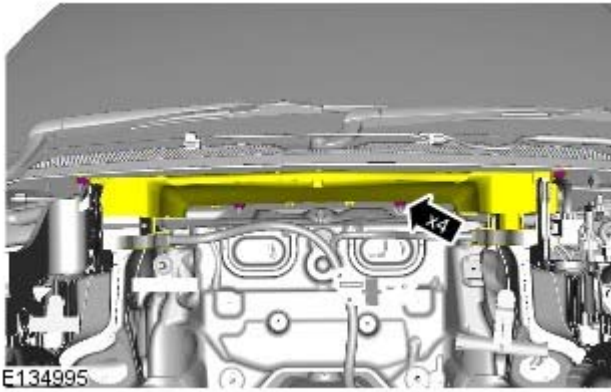
7. Remove the air cleaner. For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).

8. Release the hood seal.

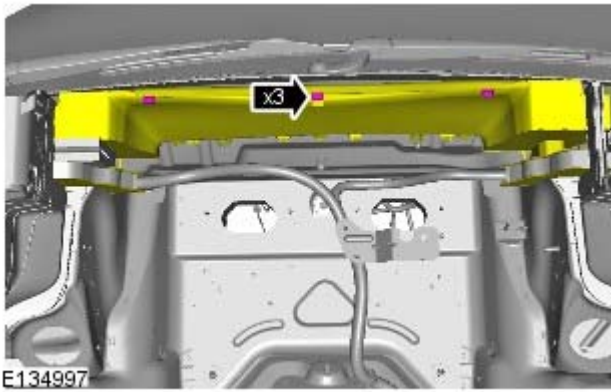


9. Release the wiring harness carrier.

- Remove the 4 nuts.



10. Release the 3 clips.

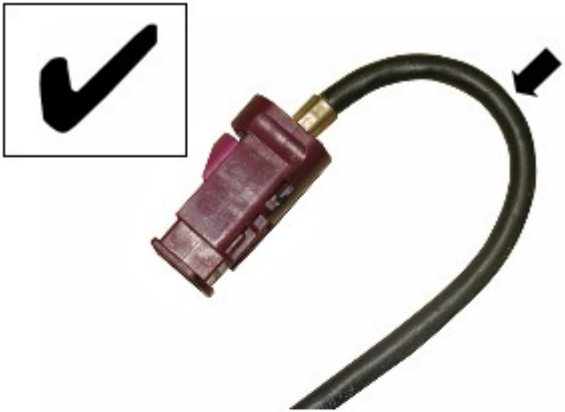



11. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured green.

Disconnect the electrical connector.



Installation



1.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness



E135323

2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

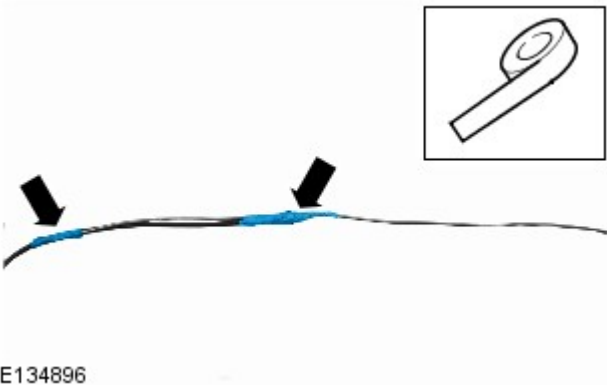
Remove the connector from the camera overlay wiring harness.

- Remove the locking tab.
- Carefully release the clip.
- Apply suitable tape to protect the end of the camera overlay wiring harness.



E133998

3. Using suitable tape, secure a suitable rod to the camera overlay wiring harness.



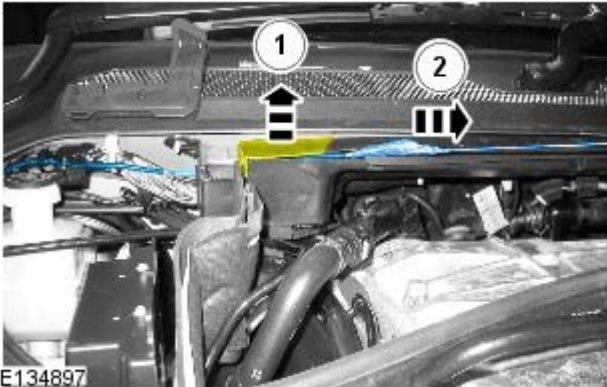
E134896

4. Carefully feed the camera overlay wiring harness under the bracket.



E134898

5. Carefully feed the camera overlay wiring harness through the wiring harness carrier.



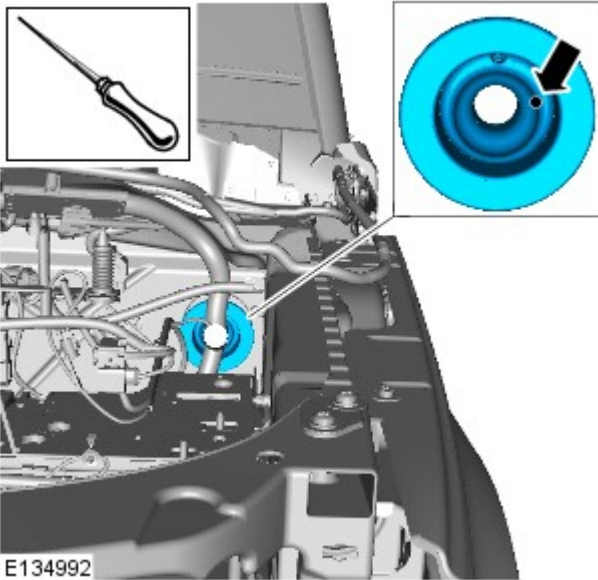
E134897

6. Carefully feed the camera overlay wiring harness through the wiring harness carrier.

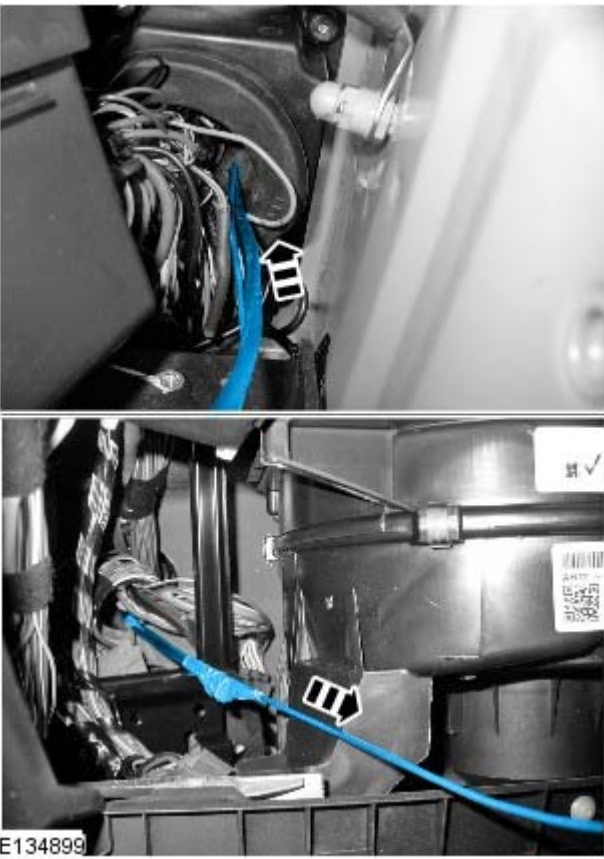


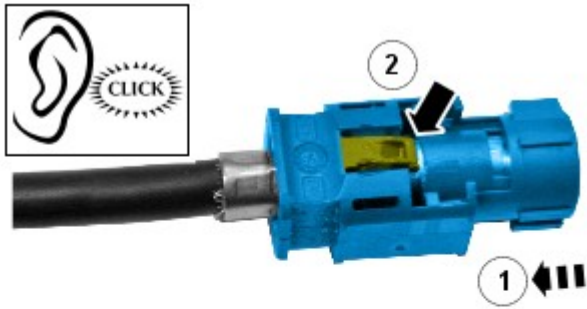
E134900

7. Using a suitable tool, make a hole in grommet in the position shown.



8. With the aid of another technician, carefully feed the camera overlay wiring harness through the grommet.

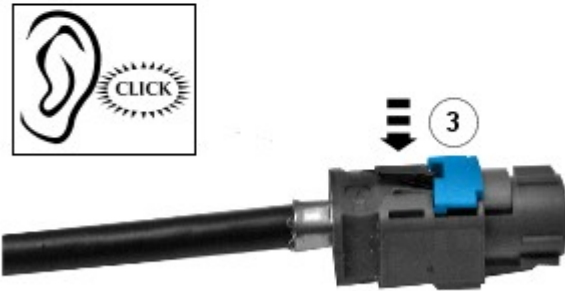




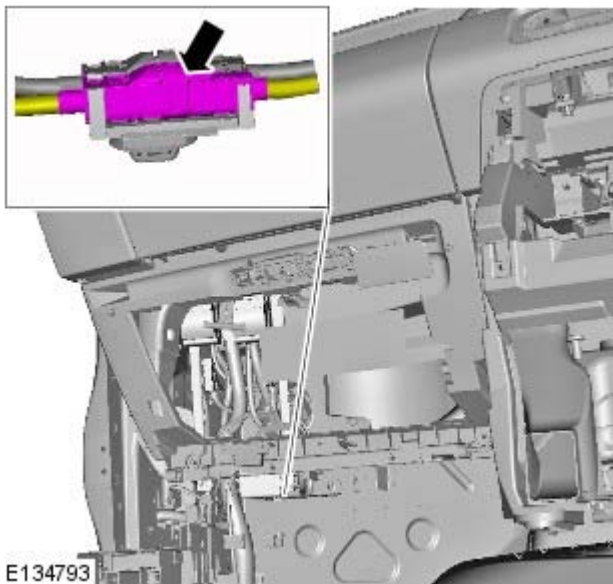
9. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Install the connector to the camera overlay wiring harness.

- Remove the protective tape.
- Install the electrical connector.
- Secure the locking tab.



E134007



10. NOTE: The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.

Connect the electrical connector.

E134793

11. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured green.

Connect the electrical connector.

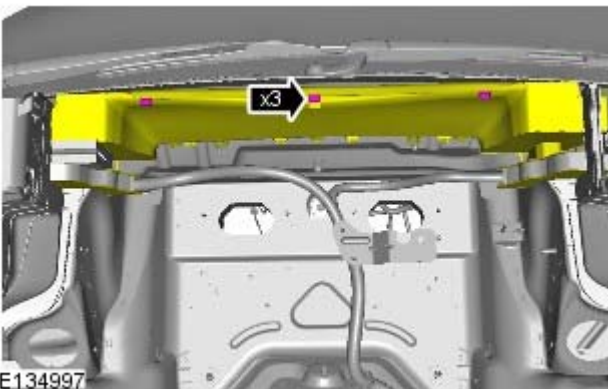


E134994

12. ⚠ CAUTION: Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the harness.

Using suitable tie straps, secure the camera overlay wiring harness to the main body wiring harness.

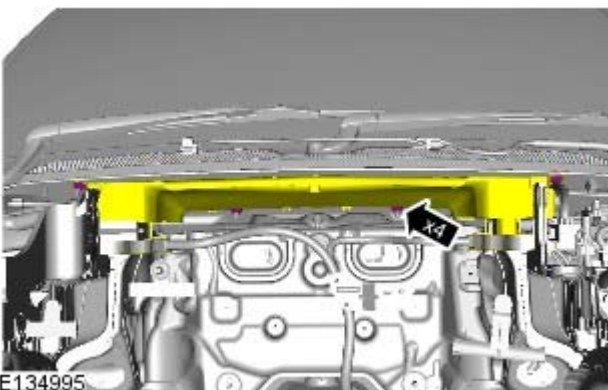
13. Secure the 3 clips.



E134997

14. Secure the wiring harness carrier.

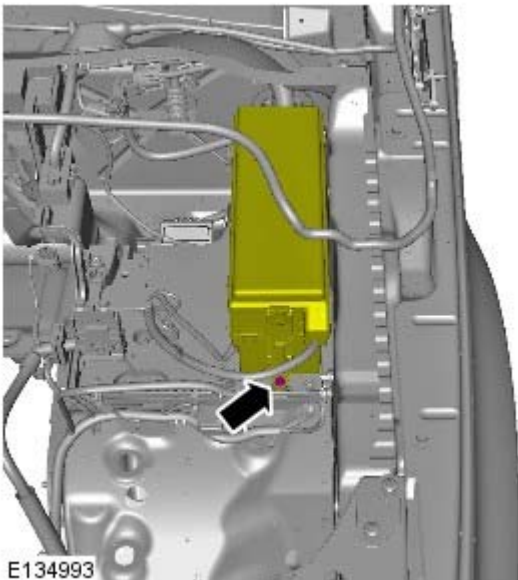
- Tighten the 4 nuts.



E134995

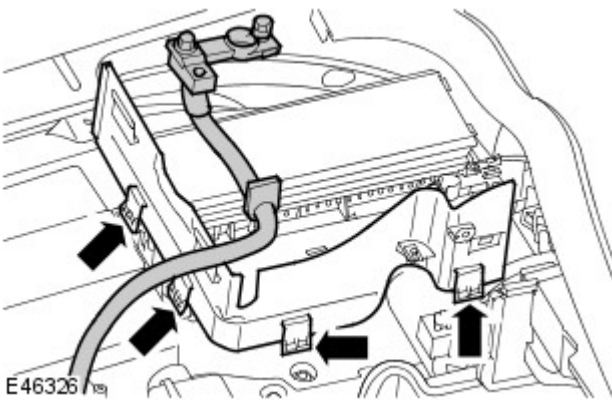
15. Secure the engine compartment fuse box.

- Tighten the bolt.



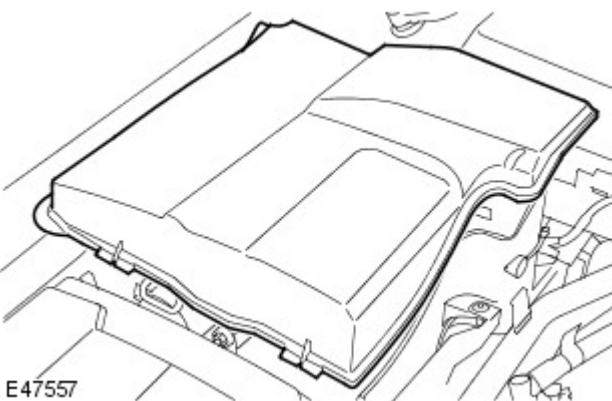
16. Install the battery compartment side wall.

- Secure the 4 clips.
- Install the battery positive cable and grommet.



17. Install the air cleaner. For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).

18. Install the brake master cylinder cover.



19. Secure the hood seal.

20. Install the CJB. For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

21. Install the battery. For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

Wiring Harnesses - Front Parking Aid Camera Wiring Harness - Front Section LHD AWD

Removal and Installation

Removal



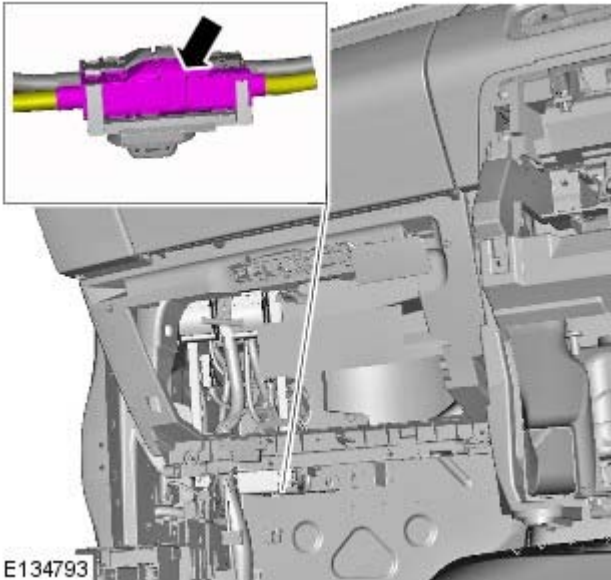
CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

1. Remove the central junction box (CJB). For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

2. NOTE: RHD shown, LHD similar.

- NOTE: The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.

Disconnect the electrical connector.

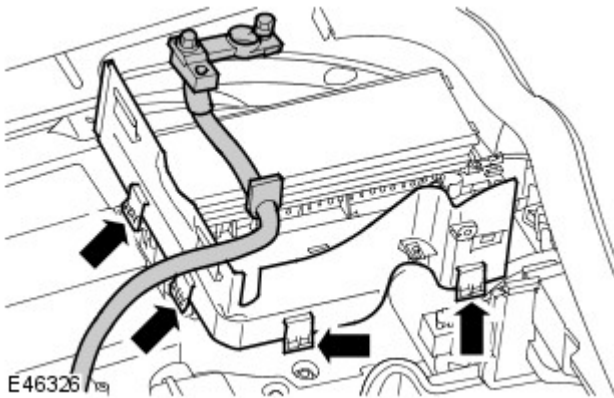


E134793

3. Remove the battery. For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

4. Remove the battery compartment side wall.

- Release the battery positive cable and grommet.
- Release the 4 clips.

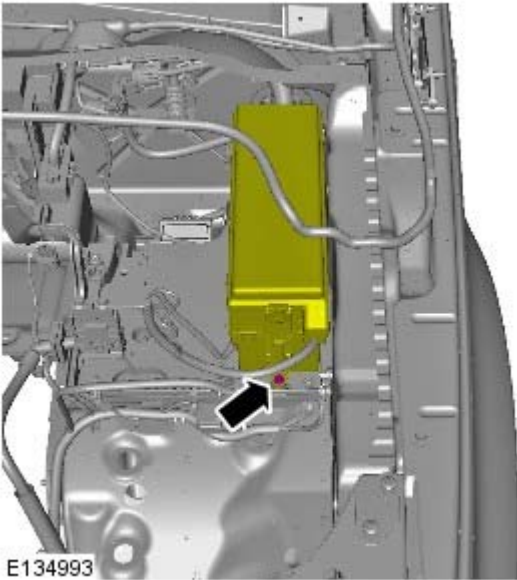


E46326

5. NOTE: RHD shown, LHD similar.

Release the engine compartment fuse box.

- Remove the bolt.



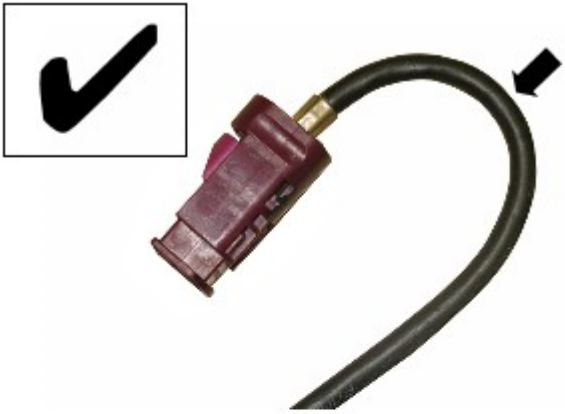
6. Remove the air cleaner. For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).


7. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured green.

Disconnect the electrical connector.

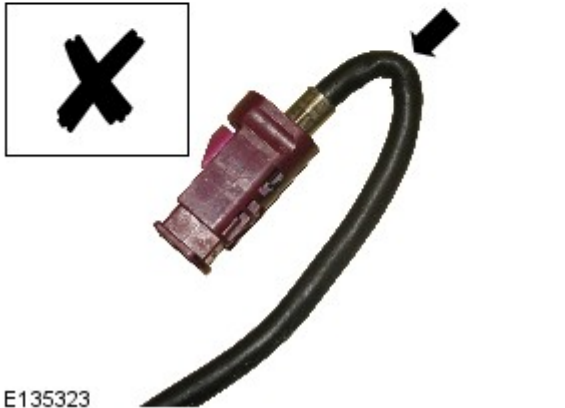


Installation



1.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness



E135323

2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

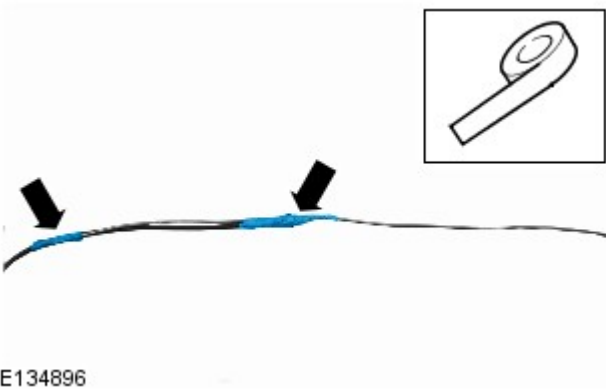
Remove the connector from the camera overlay wiring harness.

- Remove the locking tab.
- Carefully release the clip.
- Apply suitable tape to protect the end of the camera overlay wiring harness.



E133998

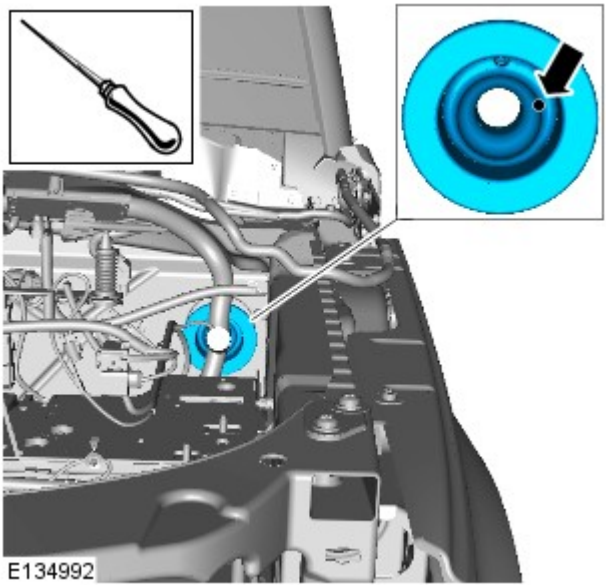
3. Using suitable tape, secure a suitable rod to the camera overlay wiring harness.



E134896

4. NOTE: RHD shown, LHD similar.

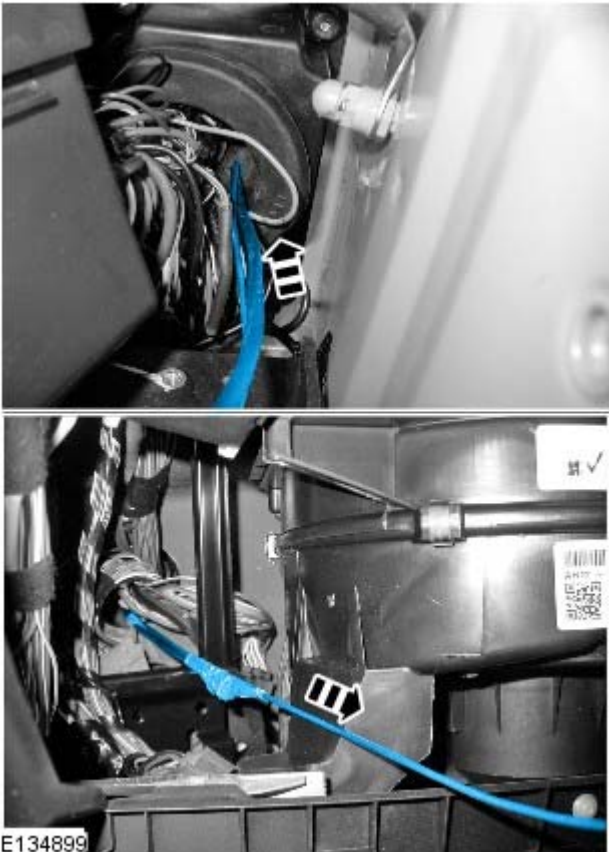
Using a suitable tool, make a hole in grommet in the position shown.



E134992

5. NOTE: RHD shown, LHD similar.

With the aid of another technician, carefully feed the camera overlay wiring harness through the grommet.

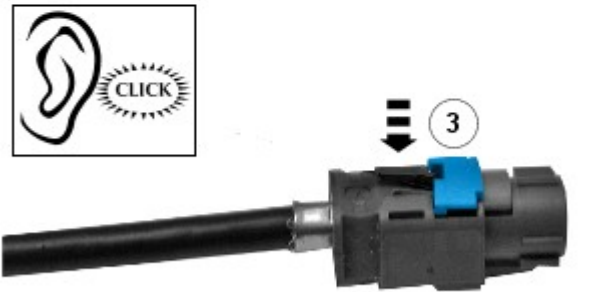
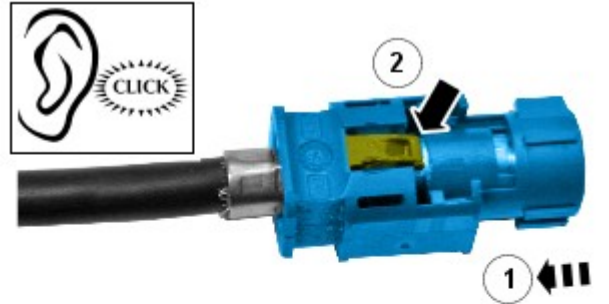


E134899

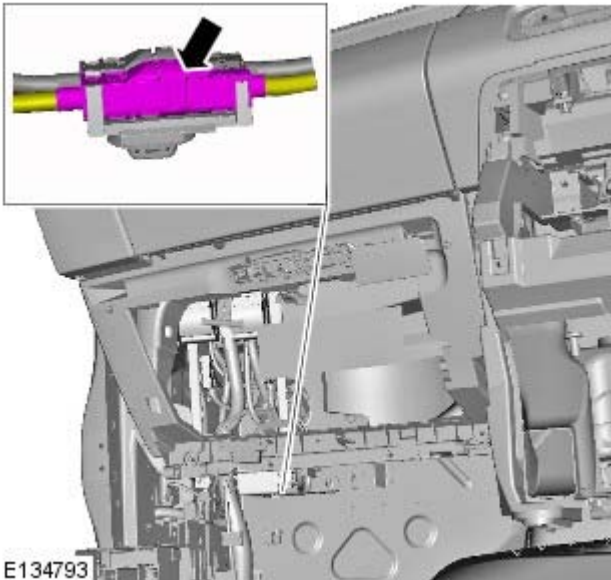
6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Install the connector to the camera overlay wiring harness.

- Remove the protective tape.
- Install the electrical connector.
- Secure the locking tab.



E134007



7. NOTE: RHD shown, LHD similar.


- NOTE: The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.

Connect the electrical connector.



8. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured green.

Connect the electrical connector.

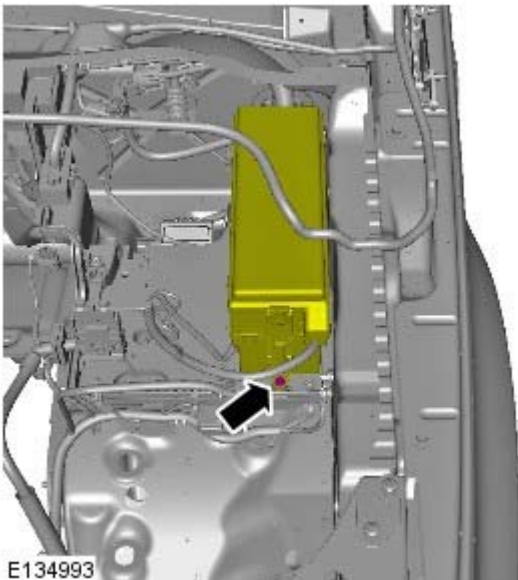
9.  CAUTION: Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the harness.

Using suitable tie straps, secure the camera overlay wiring harness to the main body wiring harness.

10. NOTE: RHD shown, LHD similar.

Secure the engine compartment fuse box.

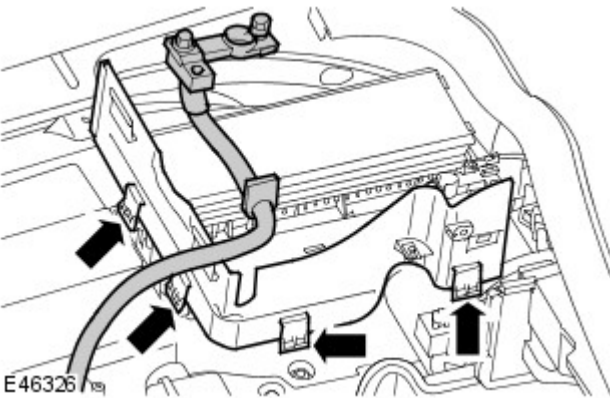
- Tighten the bolt.



E134993

11. Install the battery compartment side wall.

- Secure the 4 clips.
- Install the battery positive cable and grommet.



E46326

12. Install the air cleaner. For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).

13. Install the CJB. For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

14. Install the battery. For additional information, refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

Wiring Harnesses - Front Parking Aid Camera Wiring Harness - Main Body

Section RHD AWD

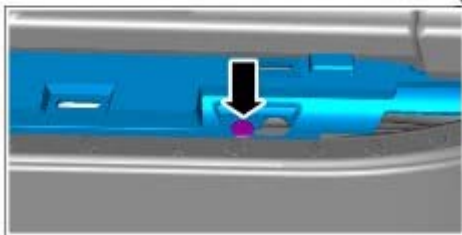
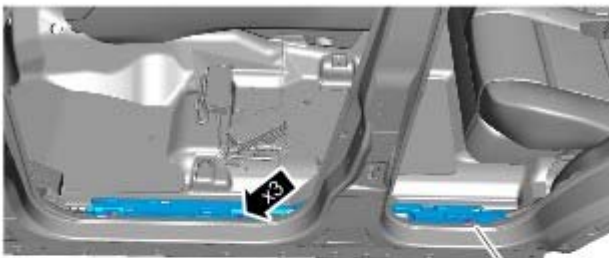
Removal and Installation

Removal

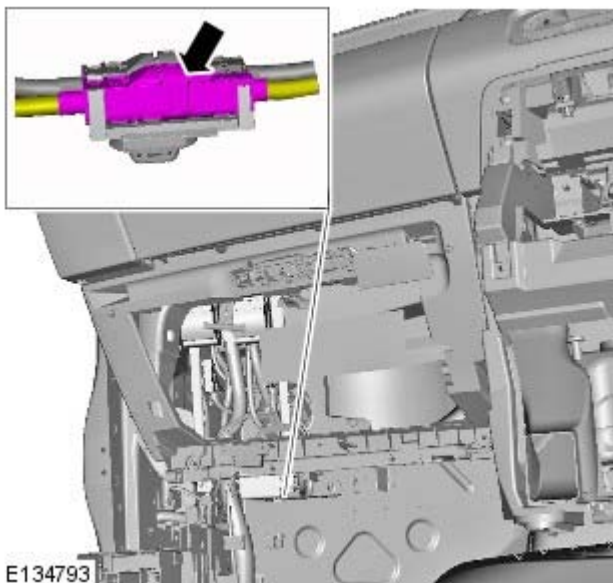


CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

1. Remove the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
2. Remove the central junction box (CJB). For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
3. Remove the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Release the wiring harness cover.
 - Release the 3 clips.



E134771



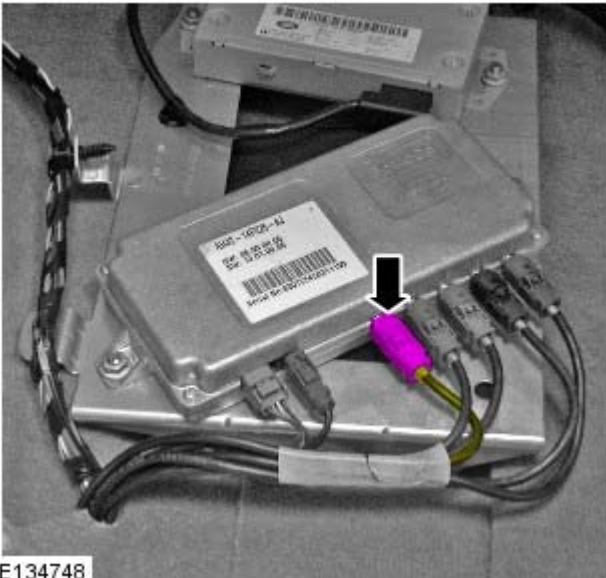
E134793

5. **NOTE:** The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.

Disconnect the electrical connector.

6. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured black.


Disconnect the electrical connector.



E134748

Installation

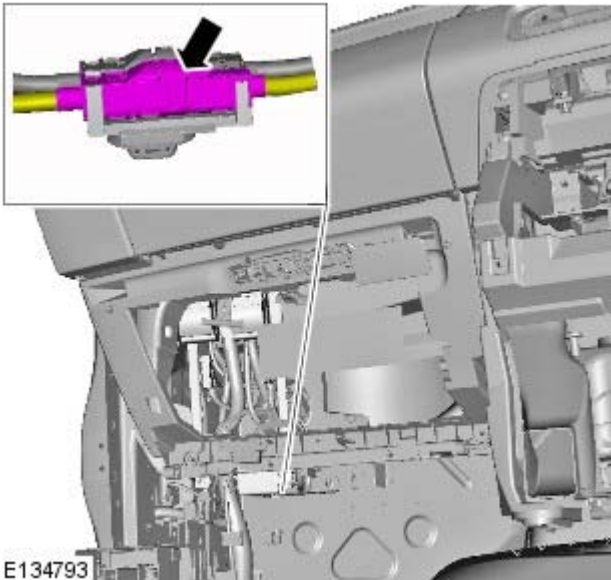


1.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness




E135323



2. NOTE: The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.

Connect the electrical connector.

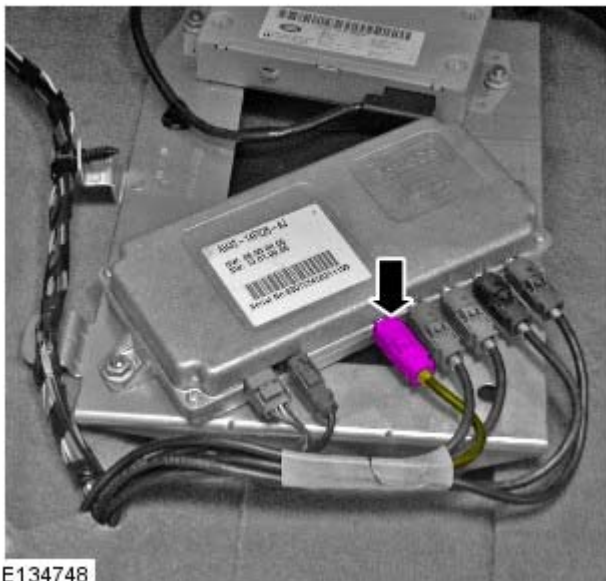
3.  CAUTION: Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the harness.

Feed the camera overlay wiring harness along the main wiring harness to the camera module.

- Using suitable tie straps, secure the camera overlay wiring harness to the main body wiring harness.

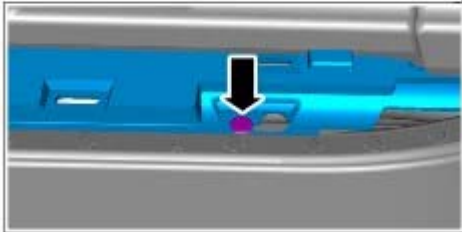
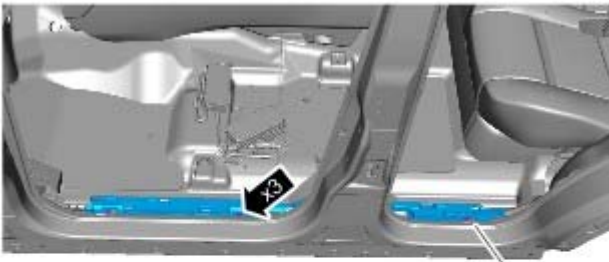
4. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured black.

Connect the electrical connector.



5. Install the wiring harness cover.

- Secure the 3 clips.



E134771

6. Install the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
7. Install the CJB. For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
8. Install the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

Wiring Harnesses - Front Parking Aid Camera Wiring Harness - Main Body

Section LHD AWD

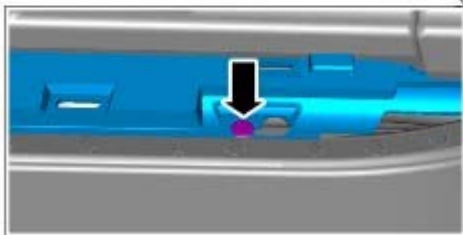
Removal and Installation

Removal



CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

1. Remove the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
2. Repeat procedure for the other side.
3. Remove the floor console. For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Remove the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Repeat procedure for the other side.
6. Release the wiring harness cover.
 - Release the 3 clips.



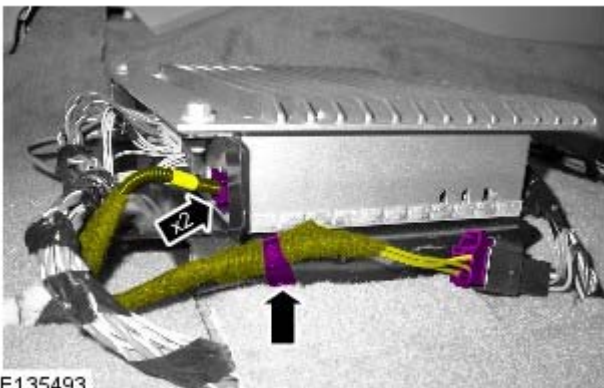
E134771

7. Repeat procedure for the other side.
8. Remove the central junction box (CJB). For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

9. NOTE: RHD shown, LHD similar.
 10. Disconnect the 2 electrical connectors:

- Release the 2 clips.
- NOTE: The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.

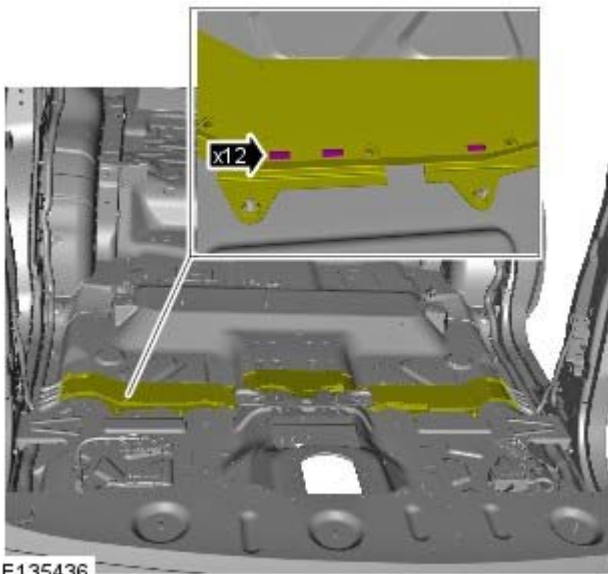
Disconnect the electrical connector.



E135493



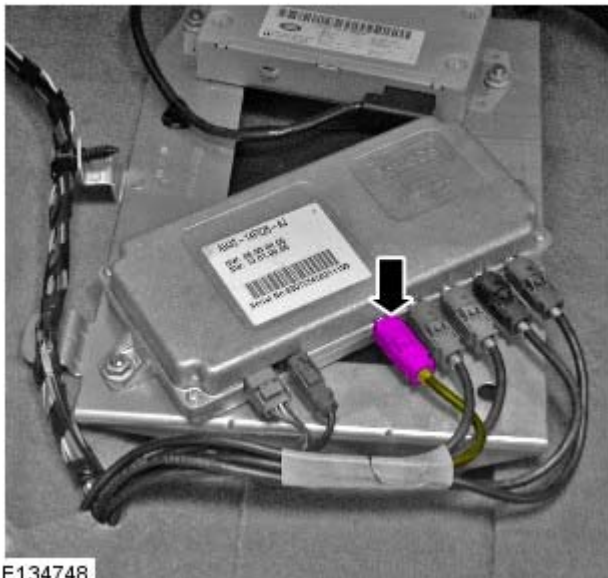
E135494



E135436

12. Release the wiring harness cover.

- Reposition the floor covering for access.
- Using a suitable tool, carefully cut through the wiring harness cover retaining tape.
- Release the 12 clips.

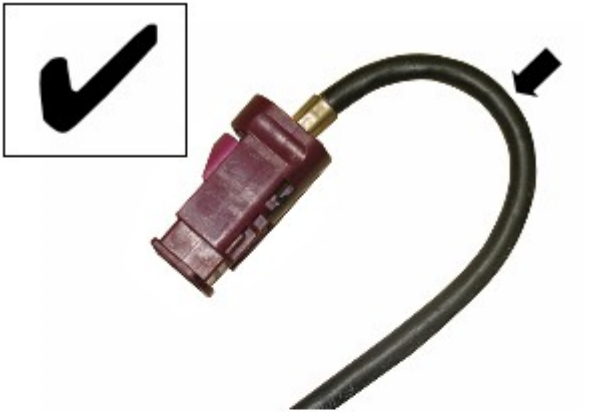



E134748

13. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured black.

Disconnect the electrical connector.

Installation




1.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness



E135323

2.  CAUTION: Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the harness.

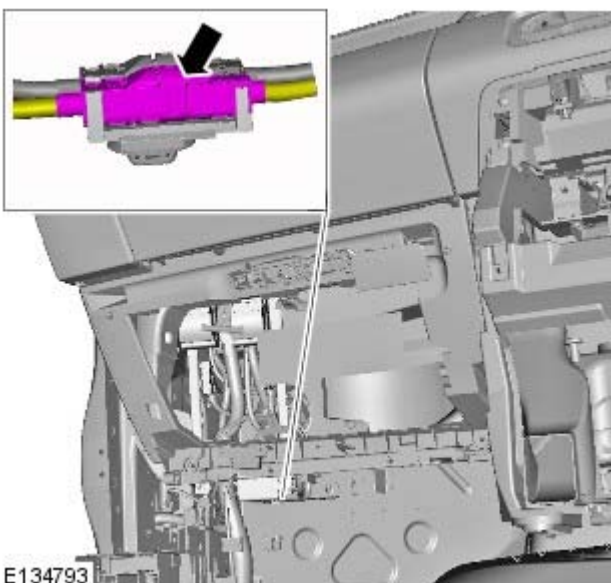
Carefully feed the camera overlay wiring harness along the main body wiring harness from the camera module to the RH A-pillar.

- Using suitable tie straps, secure the camera overlay wiring harness to the main body wiring harness.

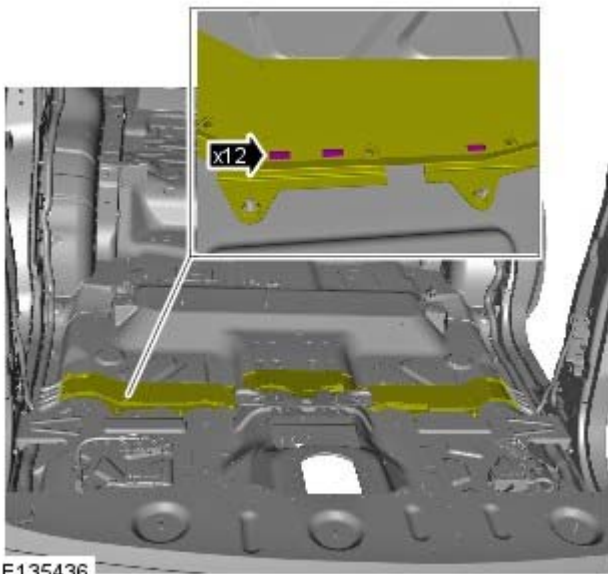
3. NOTE: RHD shown, LHD similar.

- NOTE: The left hand front camera wiring harness connectors are coloured magenta, the right hand front camera wiring harness connectors are coloured blue.

Connect the electrical connector.



E134793



E135436

4. Secure the wiring harness cover.

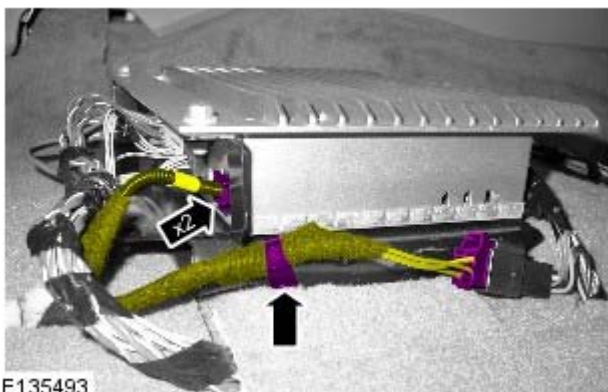
- Secure the 12 clips.
- Re-apply suitable tape to the wiring harness cover in the positions previously secured.
- Install the floor covering.



E135494

5. Connect the 2 electrical connectors.

- Secure the 3 clips.



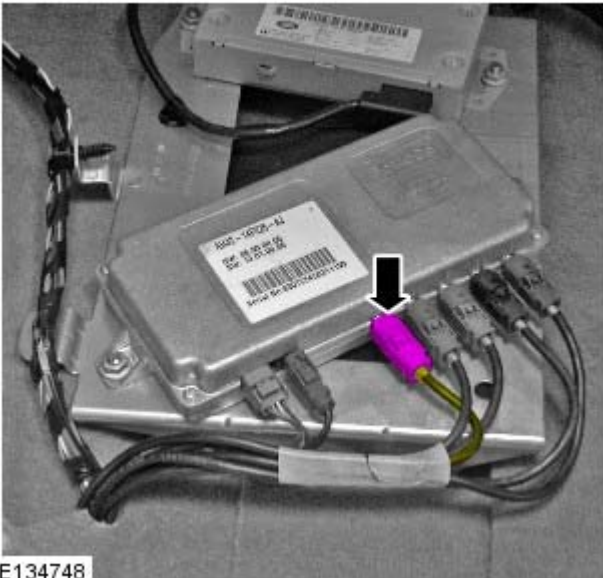
E135493

6. Connect the 2 electrical connectors.

- Secure the clip.

7. NOTE: The left hand front camera wiring harness connectors are coloured white, the right hand front camera wiring harness connectors are coloured black.

Connect the electrical connector.

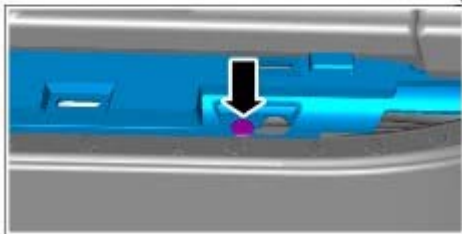


E134748

8. Install the CJB. For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

9. Install the LH wiring harness cover.

- Secure the 3 clips.



E134771

10. Repeat procedure for the other side.

11. Install the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

12. Repeat procedure for the other side.

13. Install the floor console. For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).

14. Install the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

15. Repeat procedure for the other side.

Wiring Harnesses - Left Hand Parking Aid Camera Wiring Harness

Removal and Installation

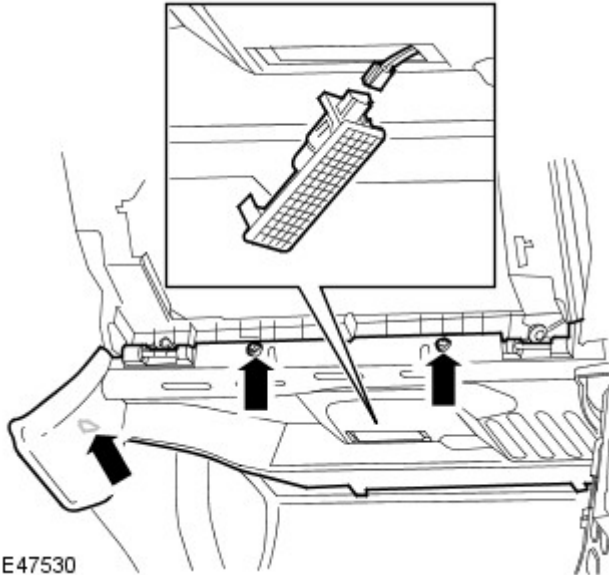
Removal



CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

1. Remove the closing trim panel.

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47530

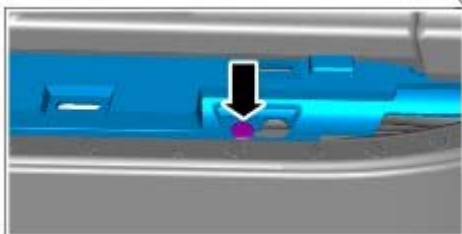
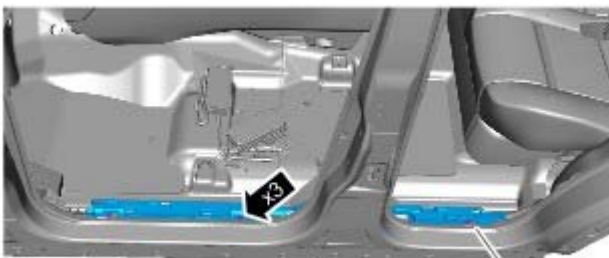
2. Remove the cowl side trim panel. For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

3. Remove the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

4. Remove the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

5. Release the wiring harness cover.

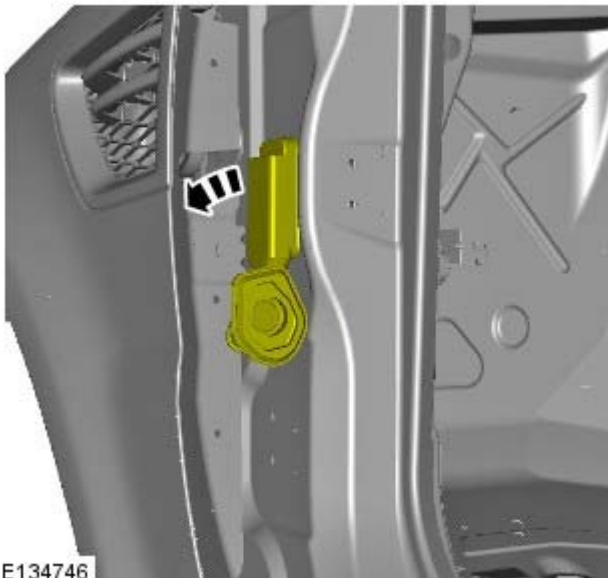
- Release the 3 clips.



E134771

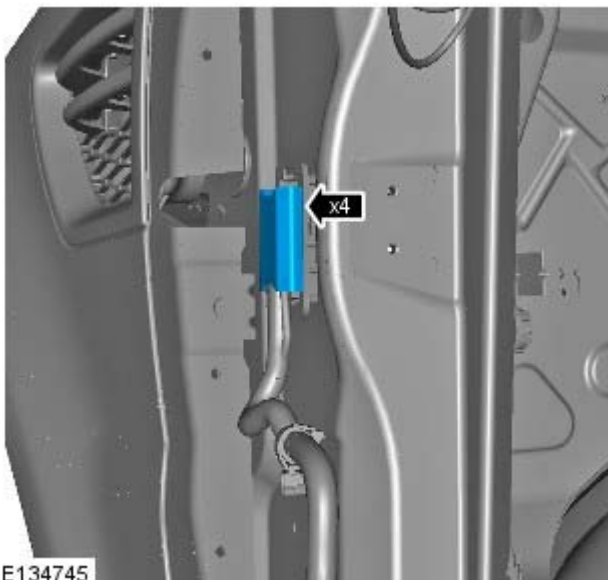
6. NOTE: Door shown removed for clarity.

Release the gaiter.



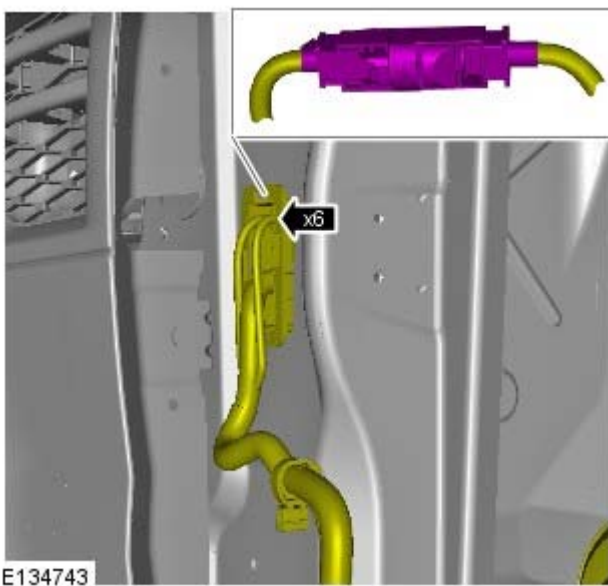
7. Remove the wiring harness cover.

- Release the 4 clips.

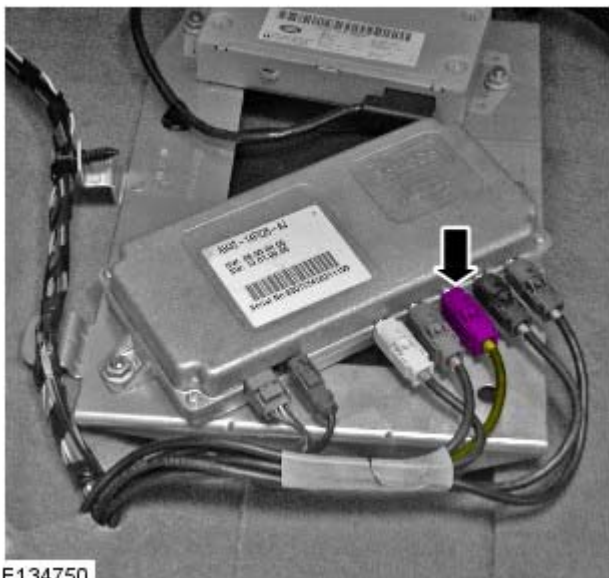


8. Disconnect the electrical connector.

- Release the electrical connector bracket.
- Release the 6 clips.




9. Disconnect the electrical connector.



E134750

Installation



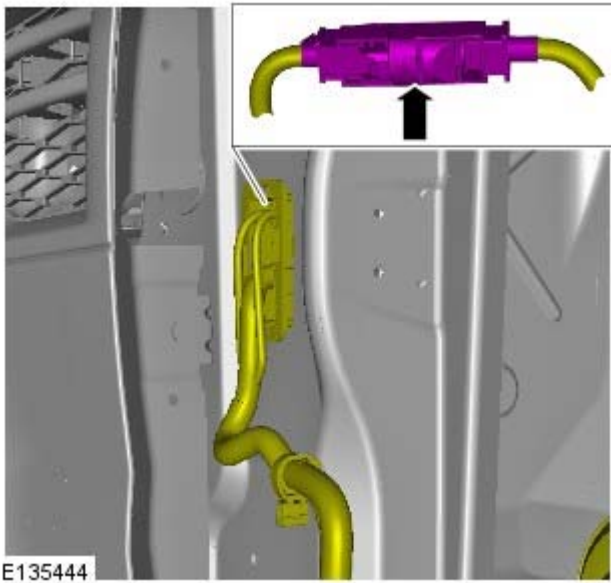
1.  **CAUTION:** Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness.



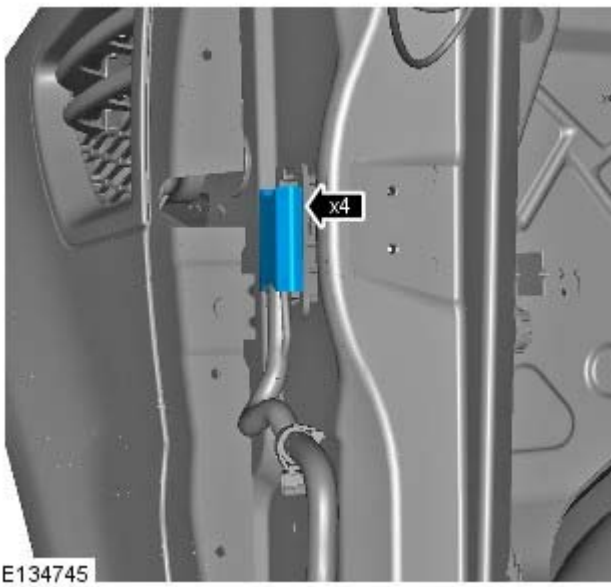
E135323

2. Connect the electrical connector.

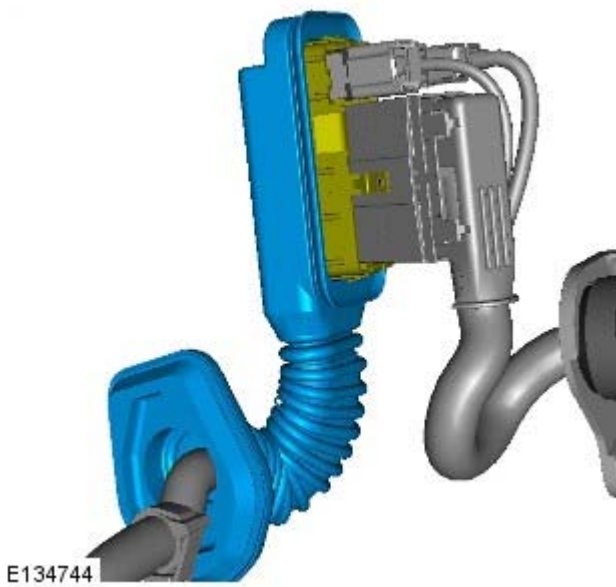


3. Install the wiring harness cover.

- Secure the 4 clips.

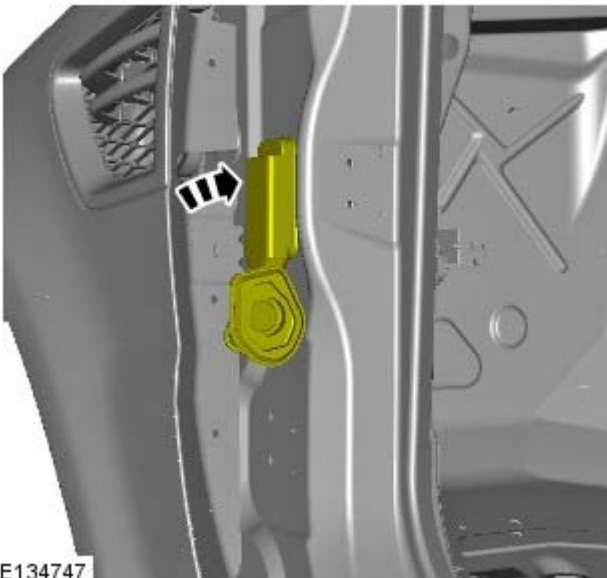


4. Install the gaiter.




5. Secure the bracket.

- Secure the 6 clips.



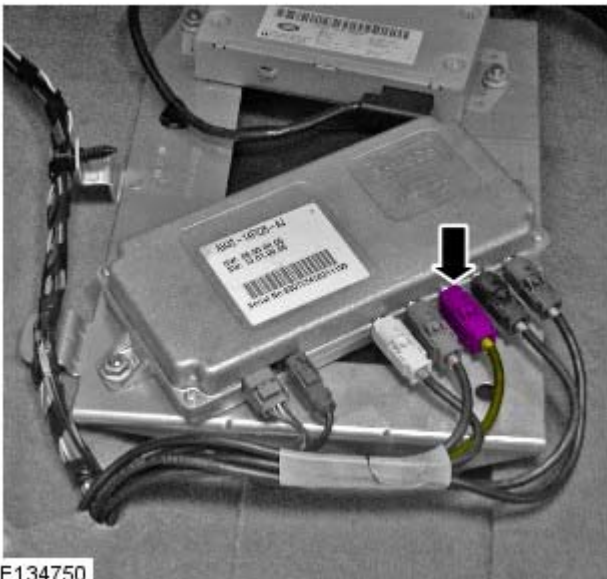
E134747

6.  CAUTION: Make sure that any tie straps used are not tightened excessively on the camera wiring harness and link leads. Failure to follow this instruction may result in damage to the harness.

Feed the camera overlay wiring harness along the main wiring harness to the parking aid camera module.

- Using suitable tie straps, secure the camera overlay wiring harness to the main body wiring harness.

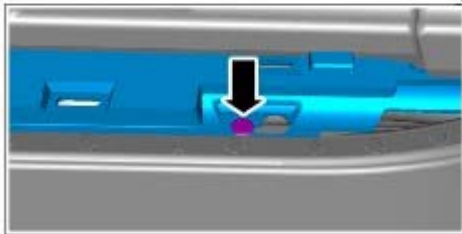
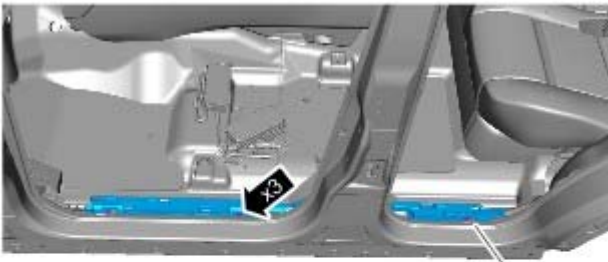
7. Connect the electrical connector.



E134750

8. Install the wiring harness cover.

- Secure the 3 clips.



E134771

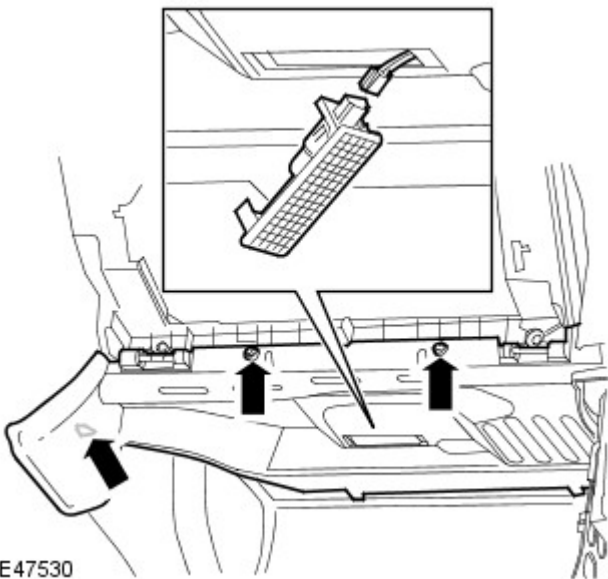
9. Install the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

10. Install the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

11. Install the cowl side trim panel. For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

12. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.



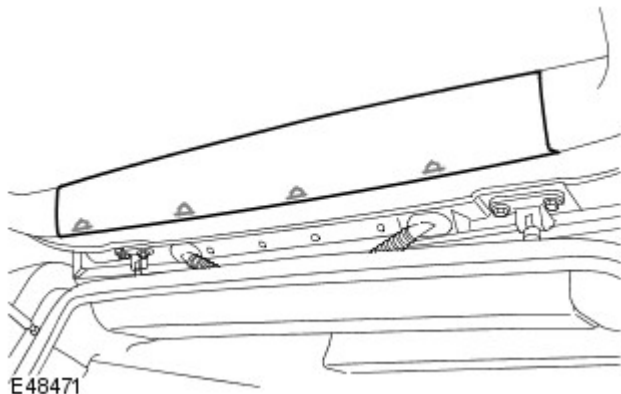
E47530

Wiring Harnesses - Liftgate Wiring Harness

Removal and Installation

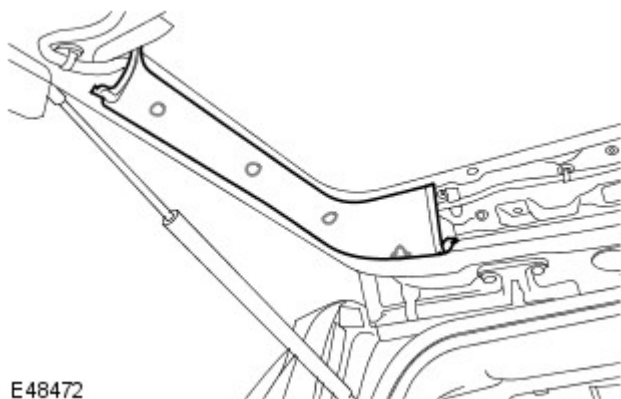
Removal

1. Open the liftgate and tailgate.
2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove the liftgate lower trim panel.
For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the liftgate upper trim panel.
 - Release the 4 clips.



5. Remove the liftgate side trim panel.

- Release the 5 clips.
- Repeat the above procedure for the other side.



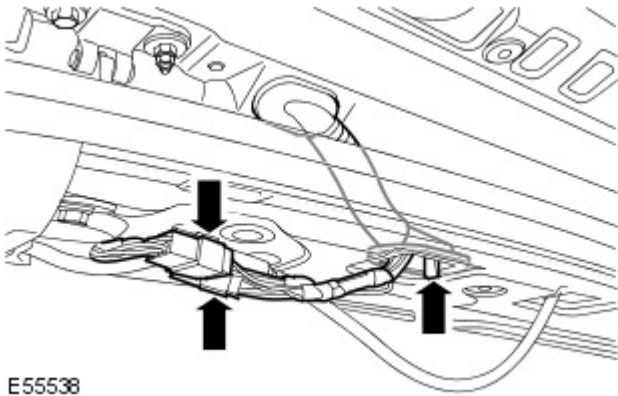
6. Remove the rear headliner trim panel.

- Release the 7 clips.
- Disconnect the electrical connector.



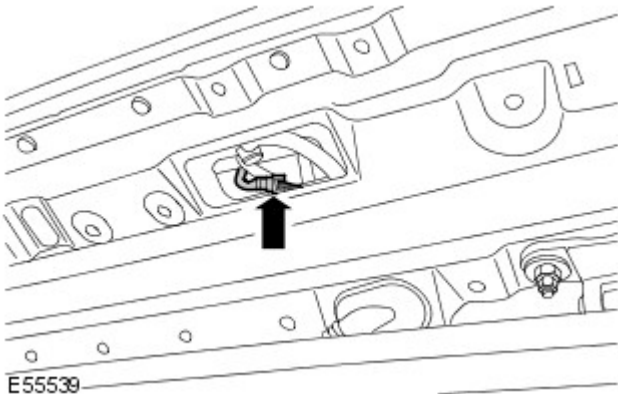
7. Release the liftgate wiring harness.

- Disconnect the 2 electrical connectors.
- Release the grommet.



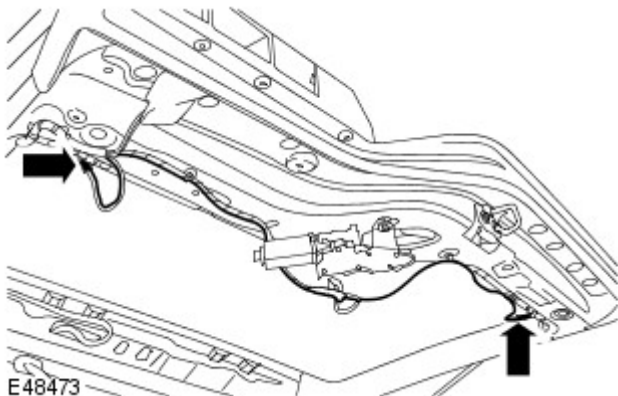
E55538

8. Disconnect the high mounted stoplamp electrical connector.



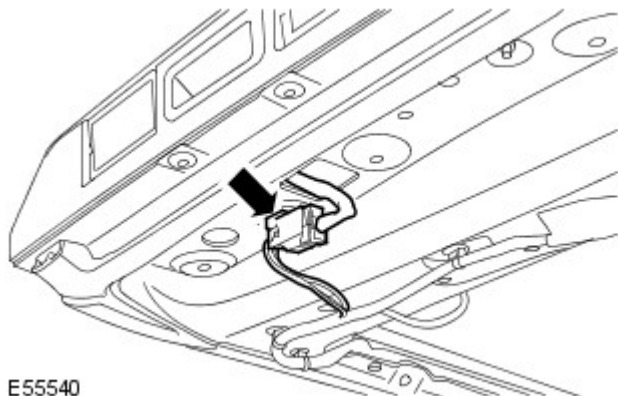
E55539

9. Disconnect both heated rear window electrical connectors.



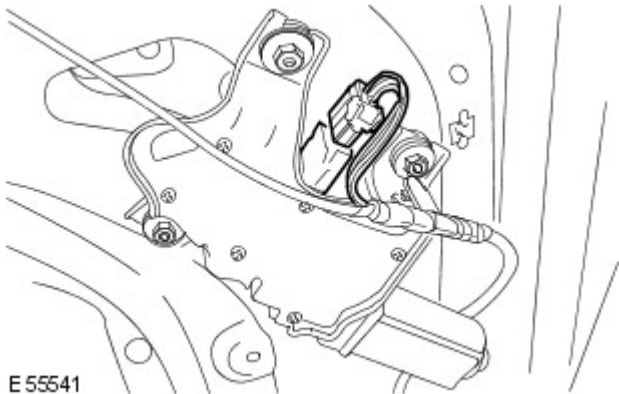
E48473

10. Disconnect the license plate lamp electrical connector.

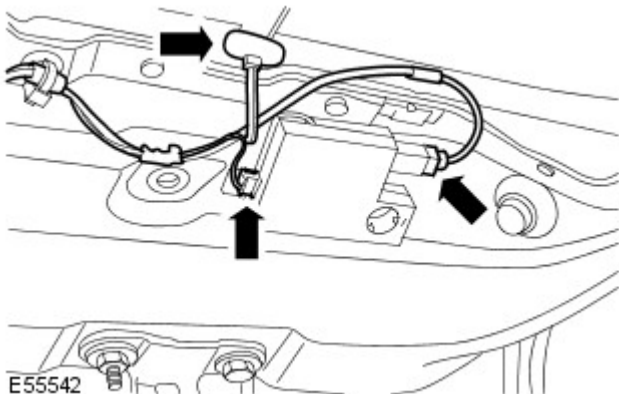


E55540

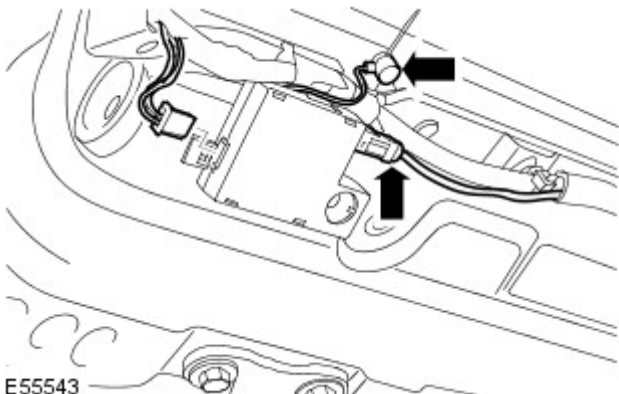
11. Disconnect the wiper motor electrical connector.



12. If installed, disconnect the diversity amplifier electrical connector and antenna cable.

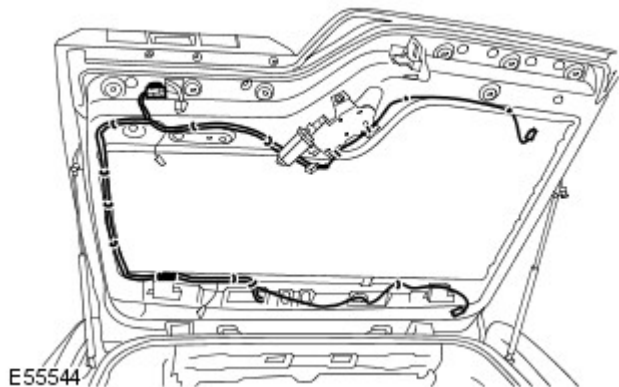


13. If installed, disconnect the navigation system traffic amplifier electrical connector and antenna cable.



14. Remove the liftgate wiring harness.

- Release the 15 clips.



Installation

1. Install the liftgate wiring harness.
 - If installed, connect the navigation system traffic amplifier electrical connector and antenna cable.
 - Secure the clips.

3. If installed, connect the diversity amplifier electrical connector and antenna cable.
4. Connect the wiper motor electrical connector.
5. Connect the license plate lamp electrical connector.
6. Connect the heated rear window electrical connectors.
7. Connect the high mounted stoplamp electrical connector.
8. Attach the liftgate wiring harness.
 - Install the grommet.
 - Connect the electrical connectors.
9. Install the rear headliner trim panel.
 - Connect the electrical connector.
 - Secure with the clips.
10. Install the liftgate side trim panel.
 - Secure with the clips.
 - Repeat the above procedure for the other side.
11. Install the liftgate upper trim panel.
 - Secure with the clips.
12. Install the liftgate lower trim panel.
For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
13. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Wiring Harnesses - Right Hand Parking Aid Camera Wiring Harness

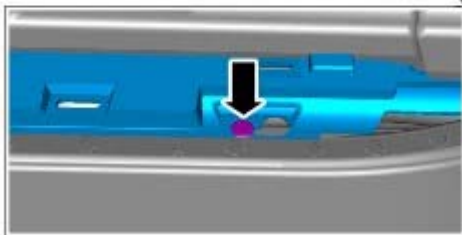
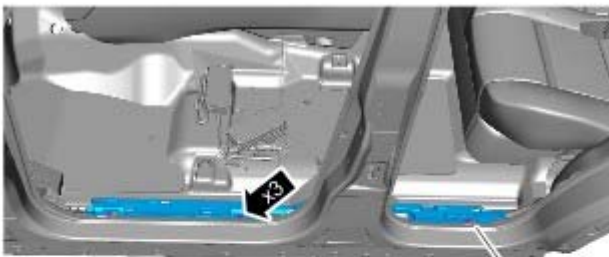
Removal and Installation

Removal



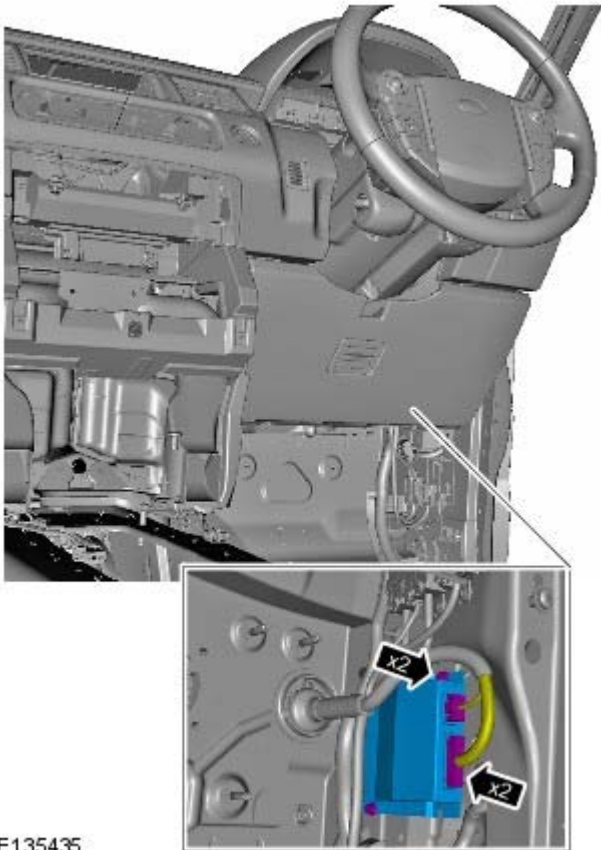
CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

1. Remove the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
2. Repeat procedure for the other side.
3. Remove the floor console. For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Remove the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Repeat procedure for the other side.
6. Release the wiring harness cover.
 - Release the 3 clips.



E134771

7. Repeat procedure for the other side.
8. Remove the RH cowl side trim panel. For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
9. Remove the accelerator pedal assembly. For additional information, refer to: [Accelerator Pedal](#) (310-02A Acceleration Control - TDV6 2.7L Diesel, Removal and Installation).



E135435

10. Remove the dynamic response module.

- Remove the 2 bolts.
- Disconnect the 2 electrical connectors.



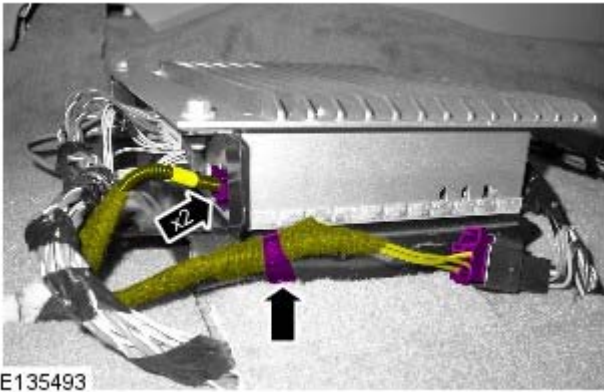
E135494

11. Disconnect the 2 electrical connectors.

- Release the 3 clips.

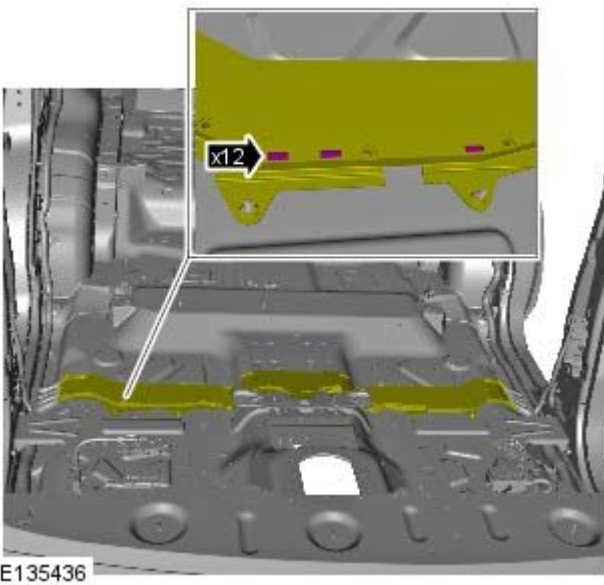
12. Disconnect the 2 electrical connectors.

- Release the clip.



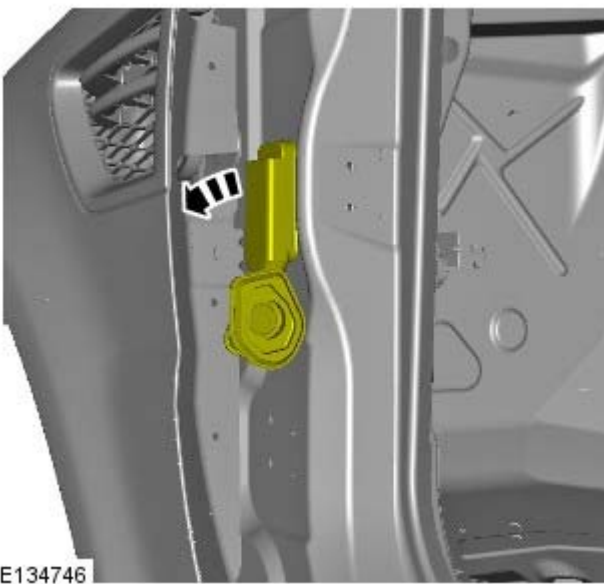
13. Release the wiring harness cover.

- Reposition the floor covering for access.
- Using a suitable tool, carefully cut through the wiring harness cover retaining tape.
- Release the 12 clips.



14. NOTE: Door shown removed for clarity.

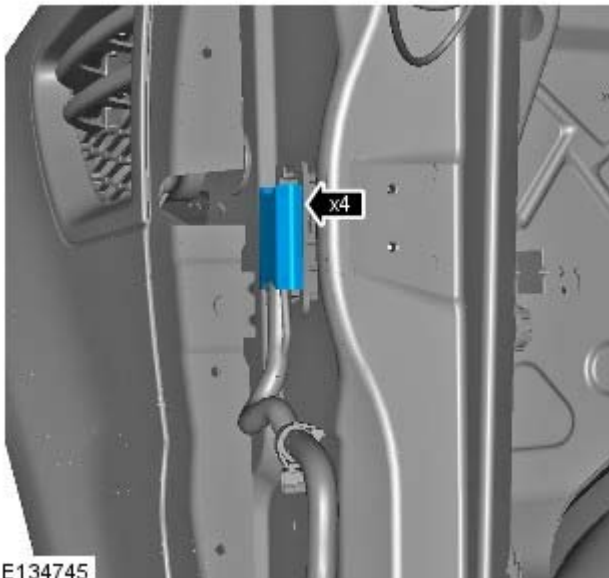
- NOTE: Left-hand shown, right-hand similar.
- Release the gaiter.



15. NOTE: Left-hand shown, right-hand similar.

Remove the wiring harness cover.

- Release the 4 clips.

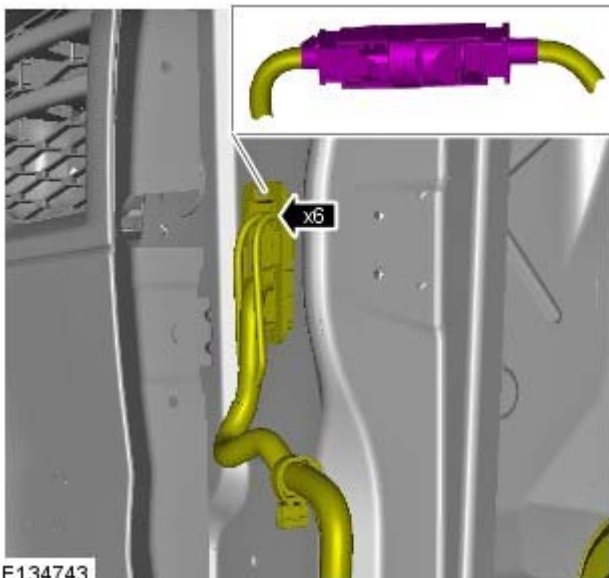


E134745

16. NOTE: Left-hand shown, right-hand similar.

Disconnect the electrical connector.

- Release the electrical connector bracket.
- Release the 6 clips.



E134743

17. Disconnect the electrical connector.




E134752


Installation



E135323

1.  **CAUTION:** Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness

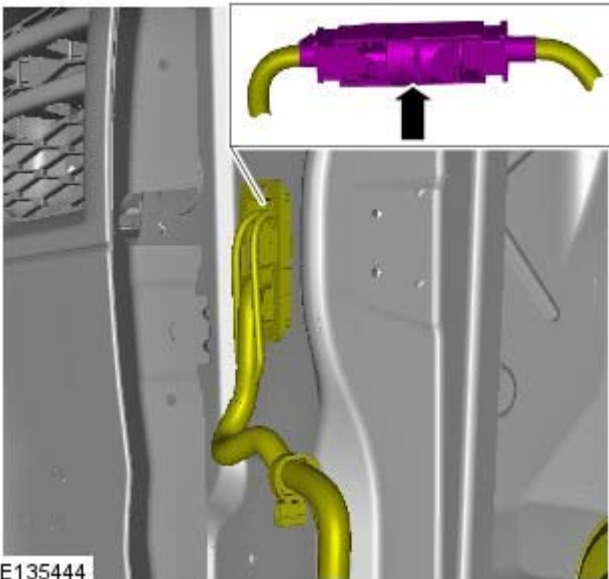
2.  **CAUTION:** Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the vehicle.

Carefully feed the camera overlay wiring harness along the main body wiring harness from the camera module to the RH A-pillar.

- Using suitable tie straps, secure the camera overlay wiring harness to the main body wiring harness.

3. **NOTE:** Left-hand shown, right-hand similar.

Connect the electrical connector.

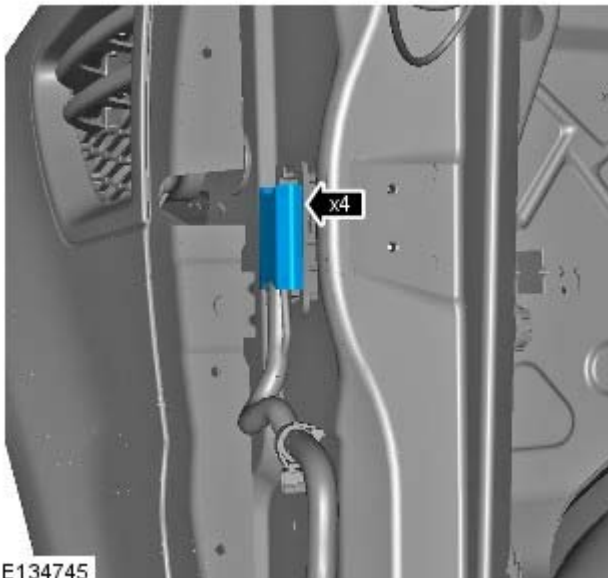


E135444

4. NOTE: Left-hand shown, right-hand similar.

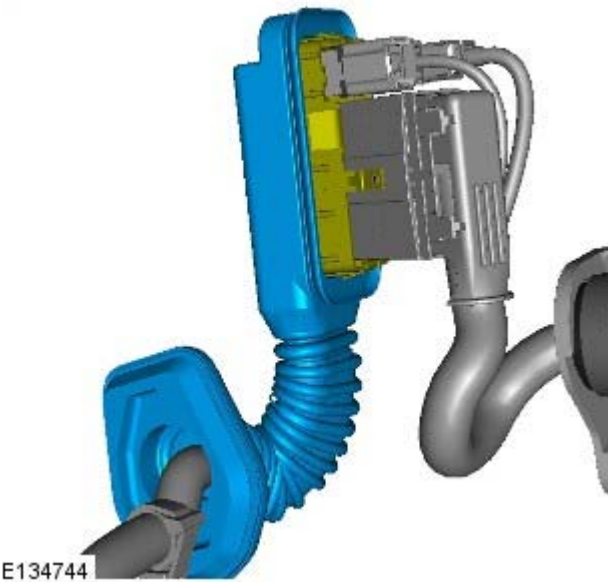
Install the wiring harness cover.

- Secure the 4 clips.



5. NOTE: Left-hand shown, right-hand similar.

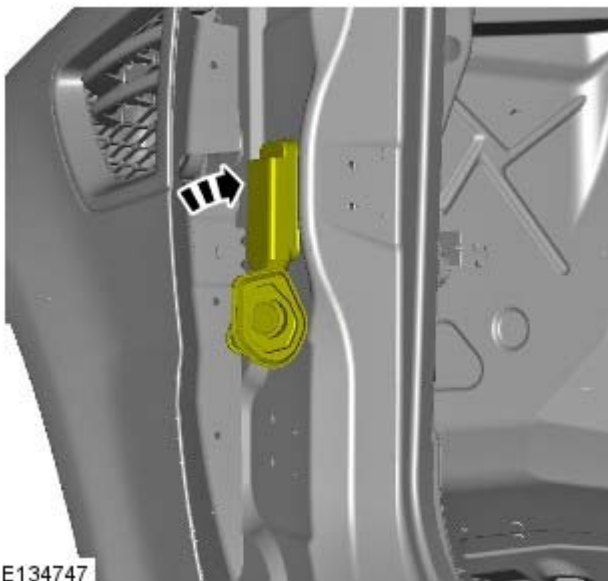
Install the gaiter.

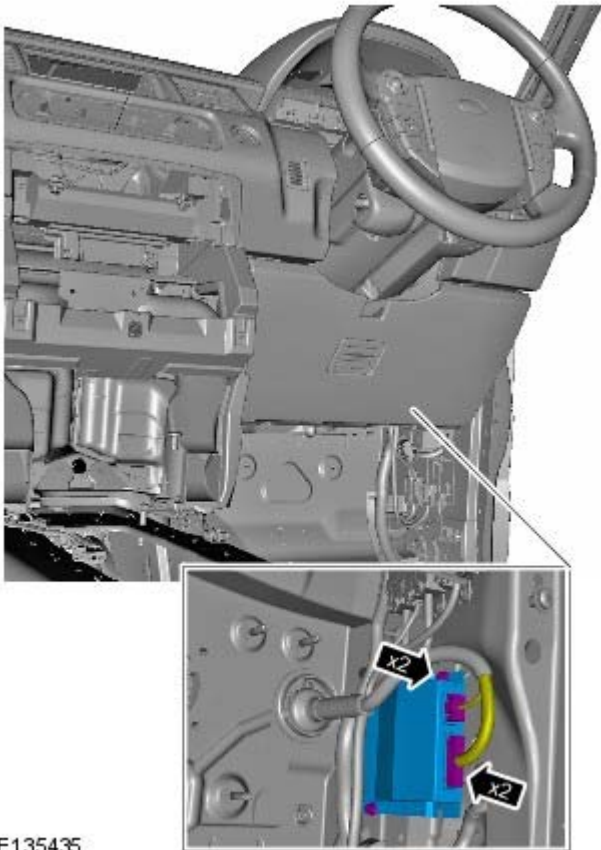


6. NOTE: Left-hand shown, right-hand similar.

Secure the bracket.

- Secure the 6 clips.

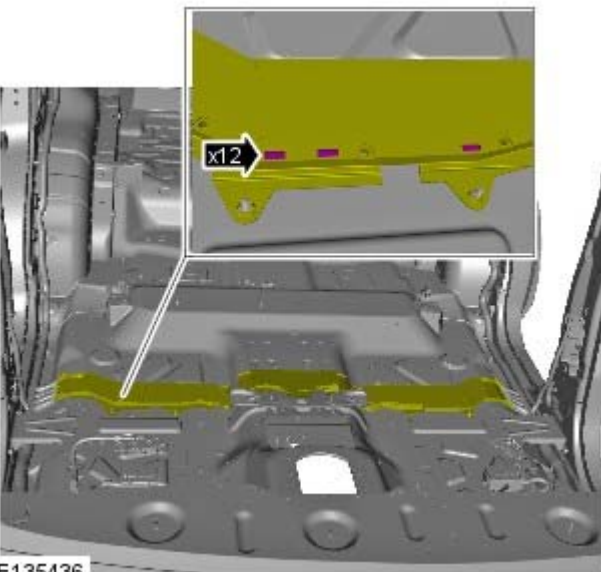




E135435

7. Install the dynamic response module.

- Connect the 2 electrical connectors.
- Tighten the 2 bolts.



E135436

8. Secure the wiring harness cover.

- Secure the 12 clips.
- Re-apply suitable tape to the wiring harness cover in the positions previously secured.
- Install the floor covering.

9. Connect the 2 electrical connectors.

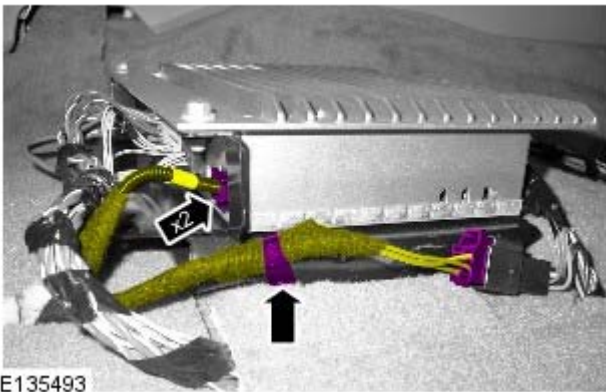
- Secure the 3 clips.



E135494

10. Connect the 2 electrical connectors.

- Secure the clip.



E135493

11. Connect the electrical connector.



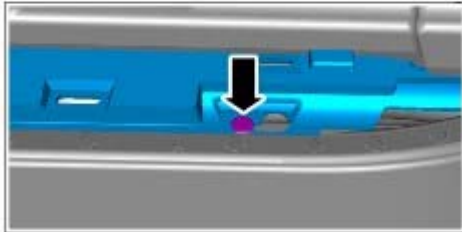
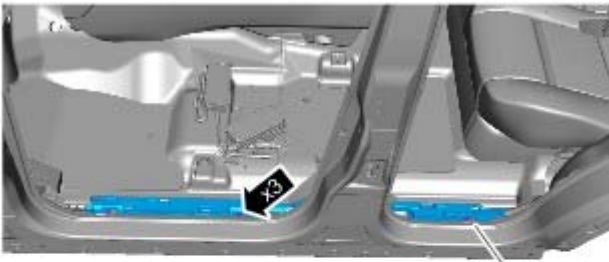
E134752

12. Install the accelerator pedal assembly. For additional information, refer to: [Accelerator Pedal](#) (310-02A Acceleration Control - TDV6 2.7L Diesel, Removal and Installation).

13. Install the RH cowl side trim panel. For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

14. Install the LH wiring harness cover.

- Secure the 3 clips.



E134771

15. Repeat procedure for the other side.

16. Install the LH scuff plate trim panel. For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

17. Repeat procedure for the other side.

18. Install the floor console. For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).

19. Install the LH front seat. For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

20. Repeat procedure for the other side.

Wiring Harnesses - Rear Parking Aid Camera Wiring Harness

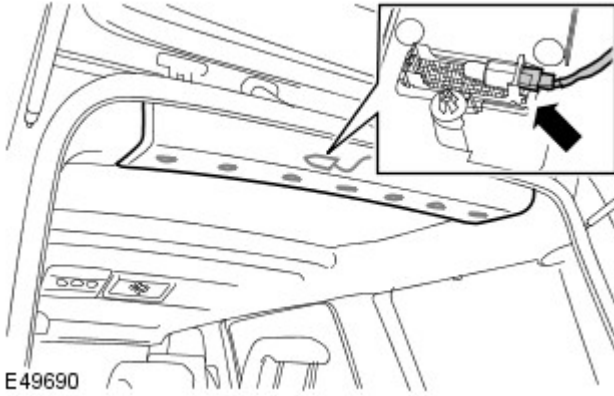
Removal and Installation

Removal



CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

1. Remove the LH D-pillar trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the rear headliner trim panel.



E49690

- Release the 7 clips.
- Disconnect the electrical connector.

3. Disconnect the electrical connector.

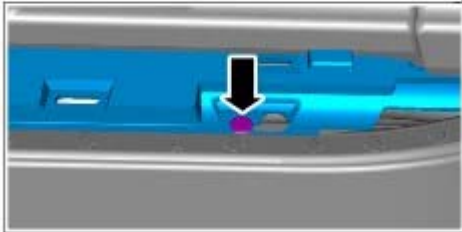
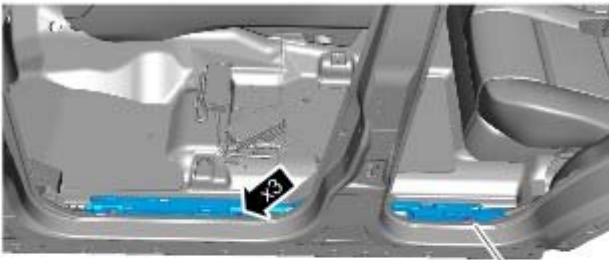


E135785

4. Remove the LH front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
5. Remove the LH scuff plate trim panel.
For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

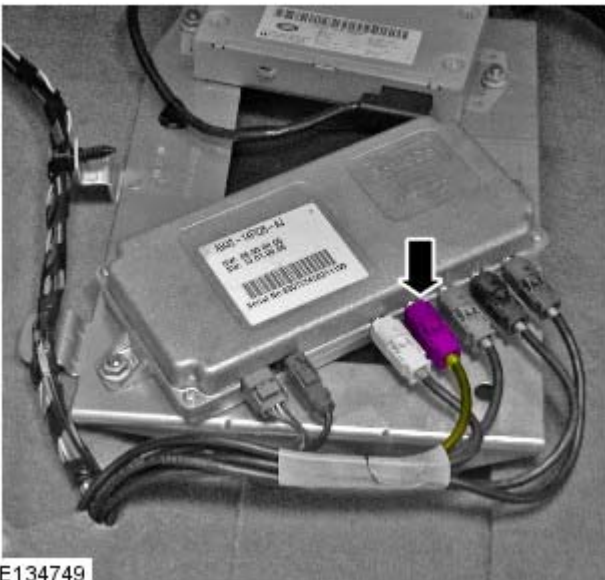
6. Release the wiring harness cover.

- Release the 3 clips.



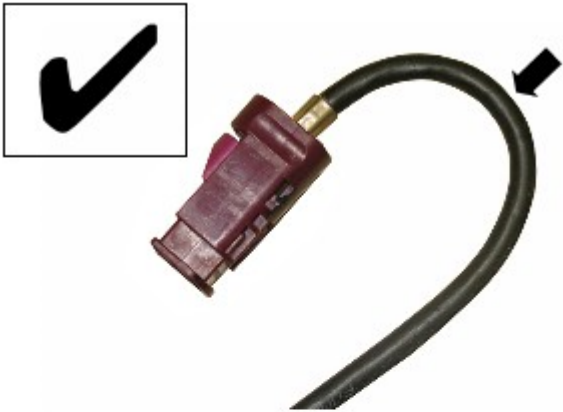
E134771


7. Disconnect the electrical connector.



E134749

Installation




1.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness



E135323

2. Feed the camera overlay wiring harness along the main wiring harness to the parking aid camera module.

3.  CAUTION: Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the harness.

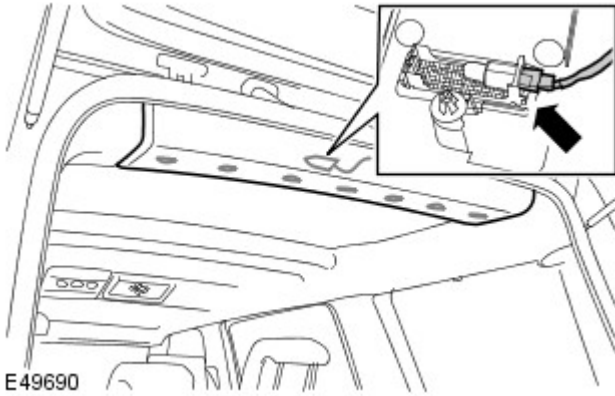
Using suitable tie straps, secure the camera overlay wiring harness to the main body wiring harness.

4. Connect the electrical connector.



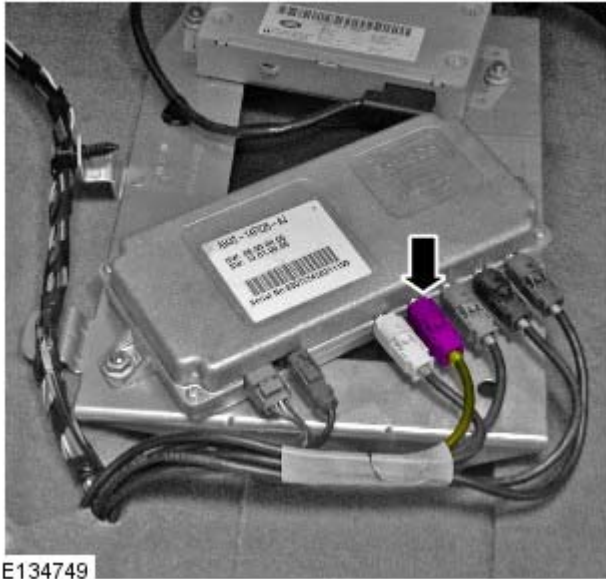
E135785

5. Install the LH D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



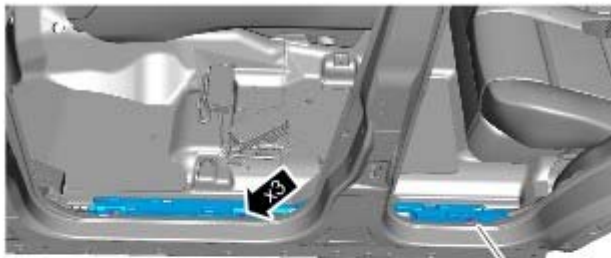
E49690

6. Install the rear headliner trim panel.
 - Connect the electrical connector.
 - Secure the 7 clips.



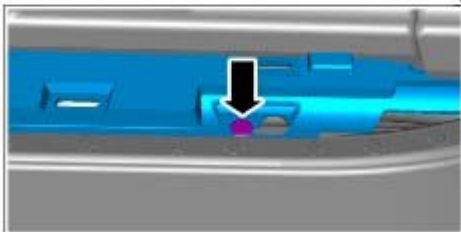
E134749

7. Connect the electrical connector.



E134771

8. Secure the wiring harness cover.
 - Secure the 3 clips.



9. Install the LH scuff plate trim panel.
For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
10. Install the LH front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

Wiring Harnesses - Parking Aid Camera Signal Filter

Removal and Installation


Removal


• NOTE: Identify the correct parking aid camera wiring harness:

- The LH front camera has white connectors.
- The rear camera has blue connectors.
- The LH side view camera has green connectors.
- The RH front camera has black connectors.
- The RH side view camera has magenta connectors.

1. Re-position the LH front seat to the full forward and full height position.

2. CAUTIONS:

 Make sure that the camera wiring harness and link leads are not bent excessively during these procedures. Failure to follow this instruction may result in damage to the harness.

 Make sure that any tie straps used are not tightened excessively on the camera wiring harness and link leads, Failure to follow this instruction may result in damage to the harness.

Take care when handling the wiring harness and link lead.



E135323

3. NOTE: RH front camera shown, other parking aid cameras similar.

• NOTE: LH front seat shown removed for clarity.

Disconnect the appropriate electrical connector.



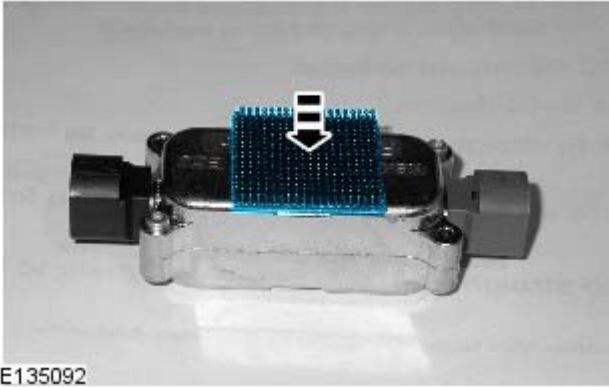
E134751

Installation

1. NOTE: Make sure that the dual lock tape is adhered to the side of the parking aid camera signal filter that has writing on.

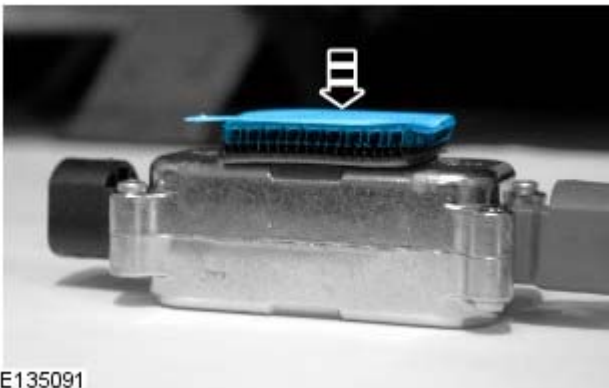
Secure one piece of the dual lock tape to the parking aid camera signal filter.

- Remove the backing strip from the dual lock tape.



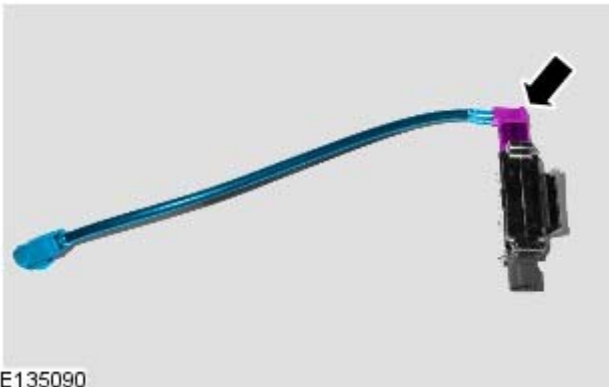
2.  CAUTION: Do not remove the backing strip from the second piece of dual lock tape.

Secure another piece of the dual lock tape to the parking aid camera signal filter.



3. NOTE: RH front camera, LH front camera and rear camera only.

Install the link lead to the parking aid camera signal filter.

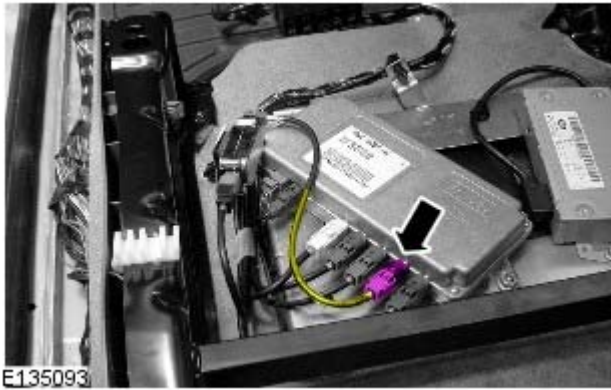


4. NOTE: RH front camera, LH front camera and rear camera only.

• NOTE: RH front camera shown, LH front camera and rear camera similar.

Connect the parking aid camera signal filter assembly to the camera wiring harness.





5. NOTE: RH front camera, LH front camera and rear camera only.

- NOTE: RH front camera shown, LH front camera and rear camera similar.

Connect the camera wiring harness link lead to the module.



6. NOTE: RH front camera only

- NOTE: Make sure that the parking aid camera signal filter is in the correct position before securing the dual lock tape to the seat base.

Secure the parking aid camera signal filter to the seat base in the position shown.

- Remove the backing strip from the dual lock tape.



7. NOTE: LH front camera only

- NOTE: Make sure that the parking aid camera signal filter is in the correct position before securing the dual lock tape to the seat base.

Secure the parking aid camera signal filter to the seat base in the position shown.

- Remove the backing strip from the dual lock tape.



8. NOTE: Rear camera only

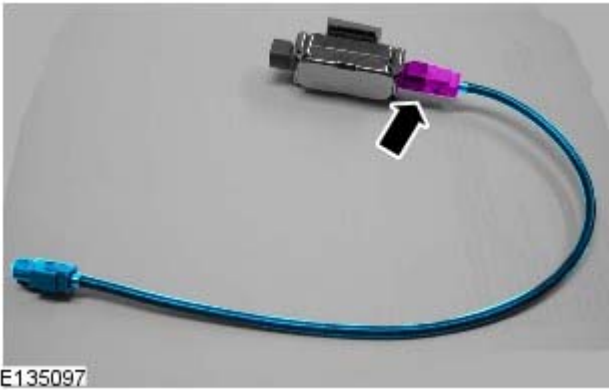
- NOTE: Make sure that the parking aid camera signal filter is in the correct position before securing the dual lock tape to the seat base.

Secure the parking aid camera signal filter to the seat base in the position shown.

- Remove the backing strip from the dual lock tape.

9. NOTE: RH side view camera and LH side view camera only

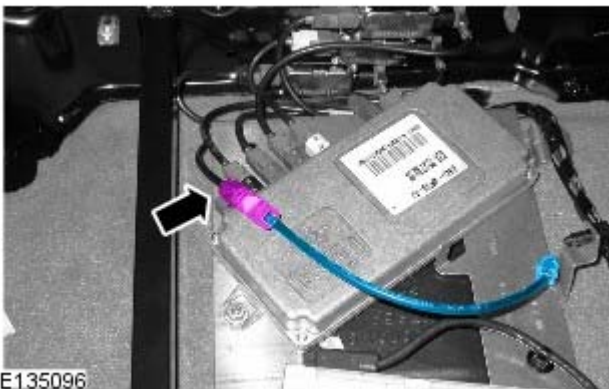
Install the longer link lead to the parking aid camera signal filter.



10. NOTE: RH side view camera and LH side view camera only

• NOTE: RH side view camera shown, LH side view camera similar.

Install the shorter link lead to the camera wiring harness.



11. NOTE: RH side view camera only.

• NOTE: Make sure that the parking aid camera signal filter is in the correct position before securing the dual lock tape to the vehicle.

Install the parking aid camera signal filter assembly.

- Connect the parking aid camera signal filter assembly to the module.
- Connect the parking aid camera signal filter assembly to the camera wiring harness link lead.
- Remove the backing strip from the dual lock tape.
- Secure the parking aid camera signal filter to the vehicle in the position shown.

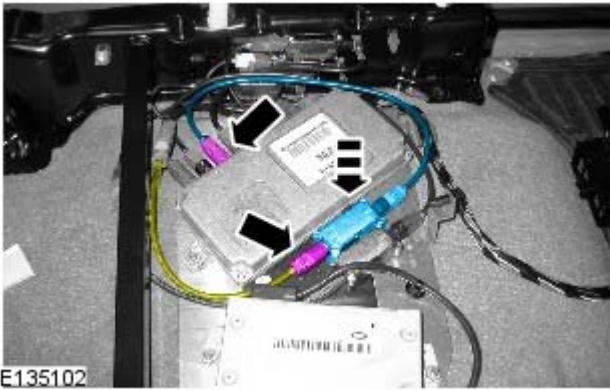


12. NOTE: RH side view camera only.

Using a suitable tie strap, secure the camera wiring harness to the seat base in the position shown.



13. NOTE: LH side view camera only.

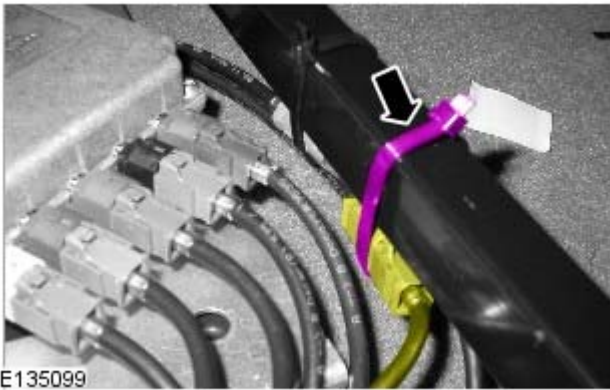


- NOTE: Make sure that the parking aid camera signal filter is in the correct position before securing the dual lock tape to the vehicle.

Install the parking aid camera signal filter assembly.

- Connect the parking aid camera signal filter assembly to the module.
- Connect the parking aid camera signal filter assembly to the camera wiring harness link lead.
- Remove the backing strip from the dual lock tape.
- Secure the parking aid camera signal filter to the vehicle in the position shown.

14. NOTE: LH side view camera only.



Using a suitable tie strap, secure the camera wiring harness to the seat base in the position shown.

15. NOTE: RH side view camera and LH side view camera only



Make sure that the wiring harness is correctly routed and does not contact against the modules in the positions shown.

Wiring Harnesses - Front Parking Aid Camera Wiring Harness – Bumper Section

Removal and Installation

Removal

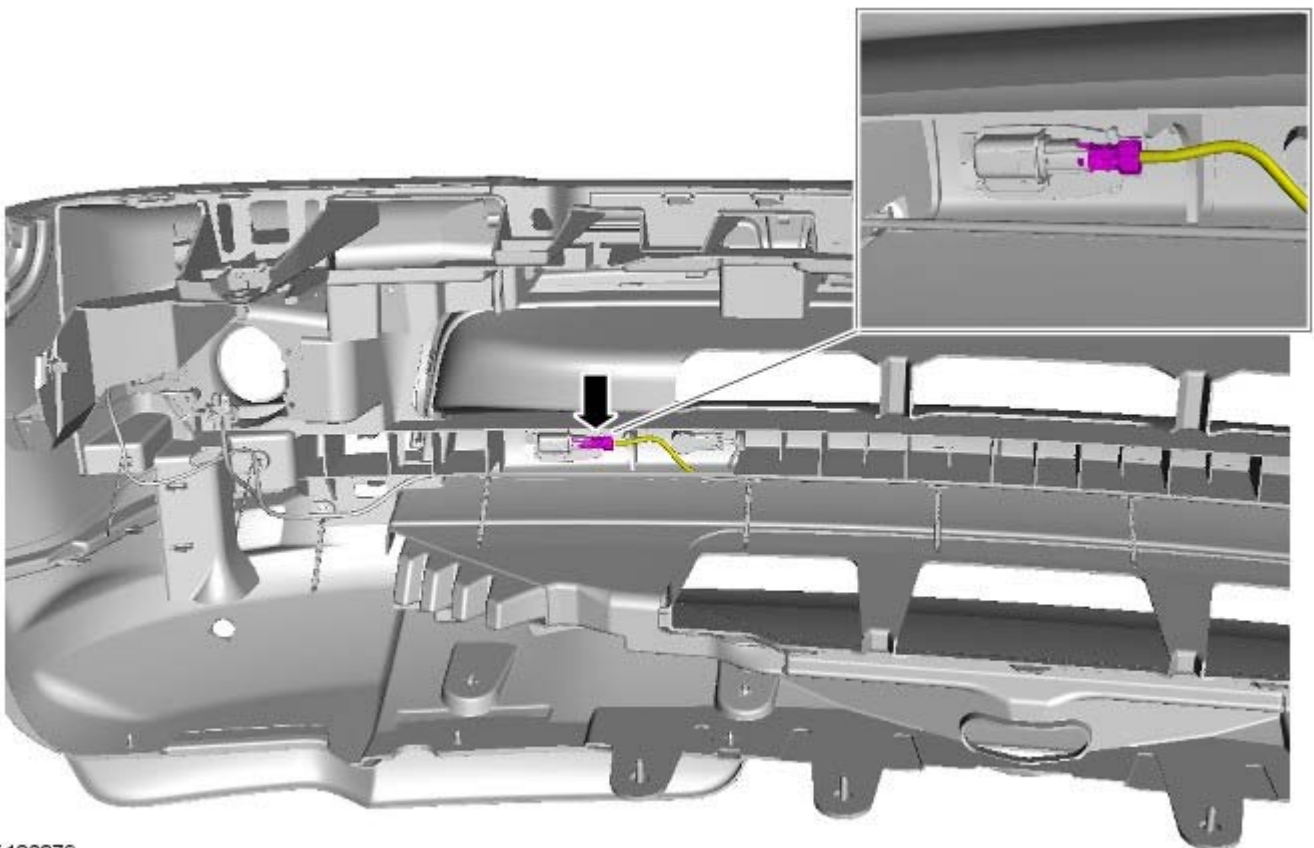
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Remove the front bumper cover.
For additional information, refer to: [Front Bumper Cover \(501-19 Bumpers, Removal and Installation\)](#).
3. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

- **NOTE:** Left-hand shown, right-hand similar.


Disconnect the electrical connector.



E136379

Installation



1.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the wiring harness

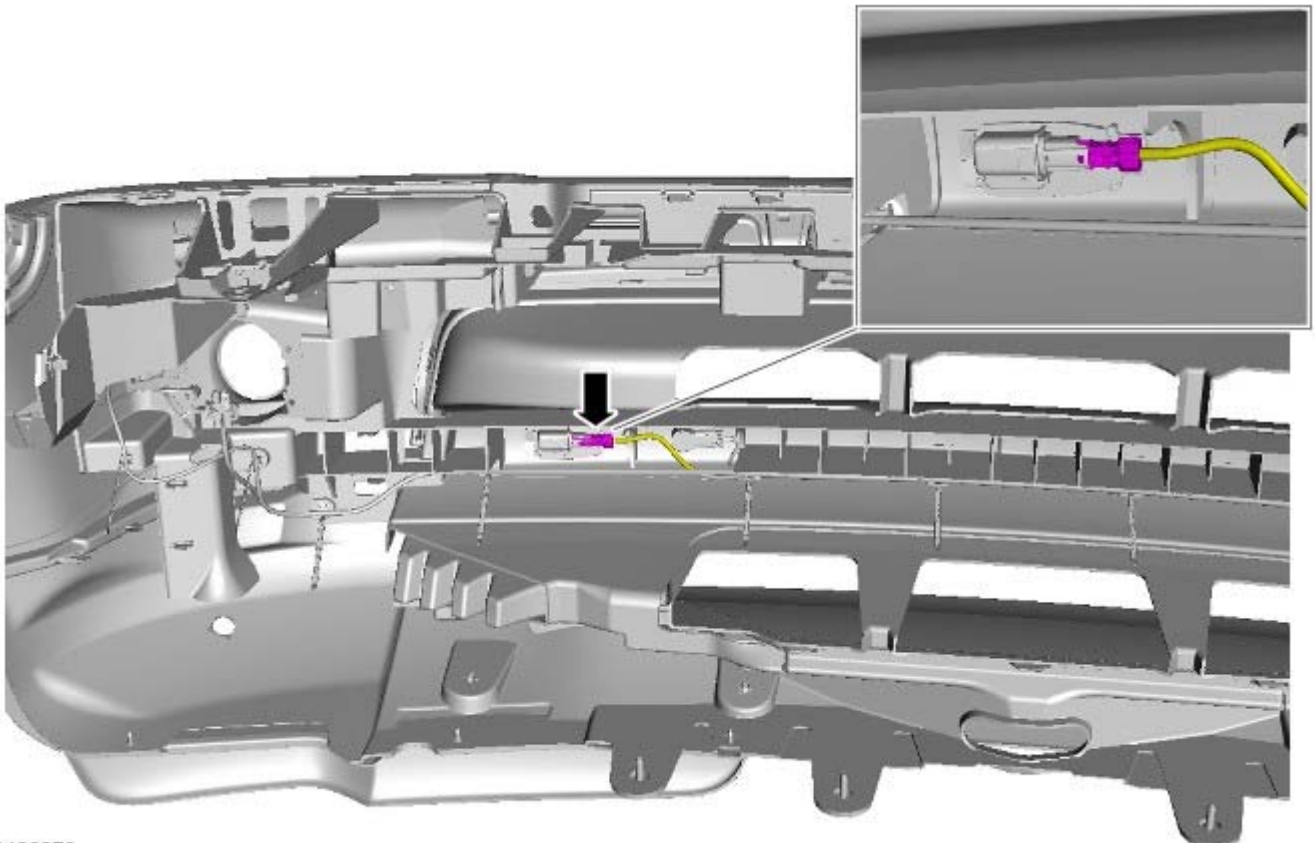


E135323


2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- NOTE: Left-hand shown, right-hand similar.

Connect the electrical connector.



E 136379

3.  CAUTION: Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the vehicle.

Using suitable tie straps, secure the camera overlay wiring harness to the bumper wiring harness.

4. Install the front bumper cover.
For additional information, refer to: [Front Bumper Cover](#) (501-19 Bumpers, Removal and Installation).

Wiring Harnesses - Rear Parking Aid Camera Wiring Harness – Liftgate

Section

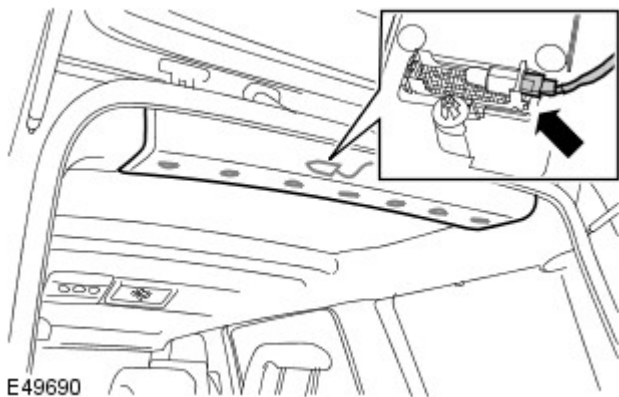
Removal and Installation

Removal



CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

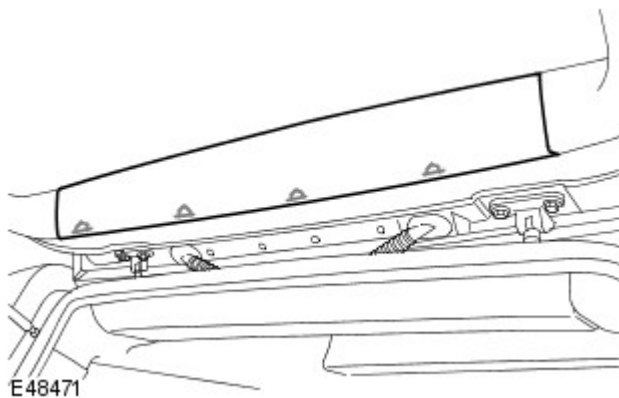
1. Remove the rear headliner trim panel.
 - Release the 7 clips.
 - Disconnect the electrical connector.



2. Disconnect the electrical connector.

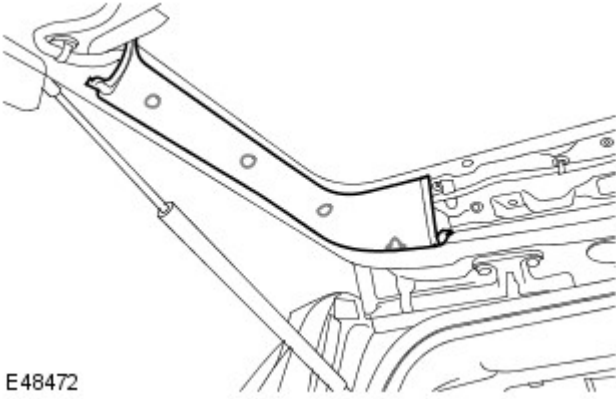


3. Remove the liftgate lower trim panel.
For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Oramentation, Removal and Installation).
4. Remove the liftgate upper trim panel.
 - Release the 4 clips.



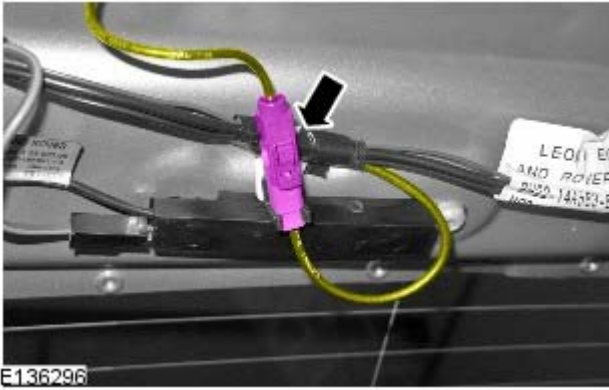
5. Remove the liftgate side trim panel.

- Release the 5 clips.



E48472

6. Disconnect the electrical connector.



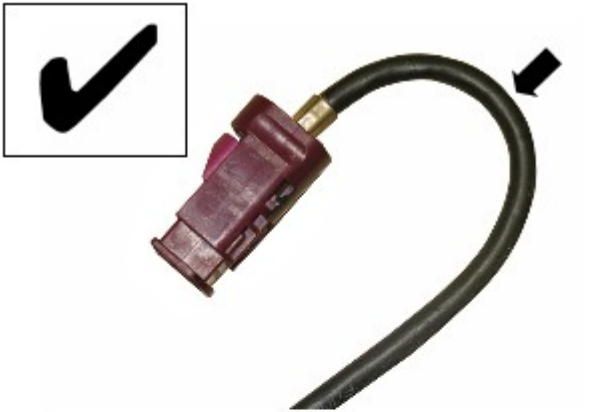
E136296


7. Release the liftgate conduit.



E136294

Installation

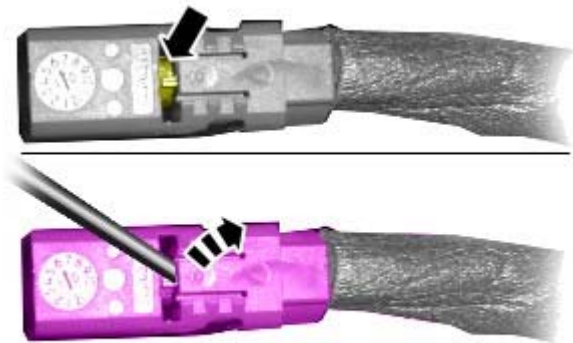


1.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness.



E135323

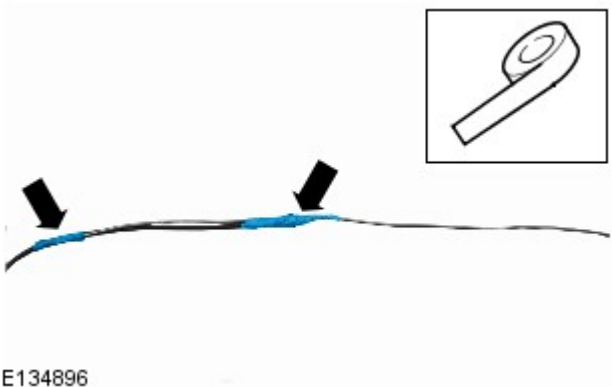


E136297

2. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Remove the electrical connector from the camera overlay wiring harness.

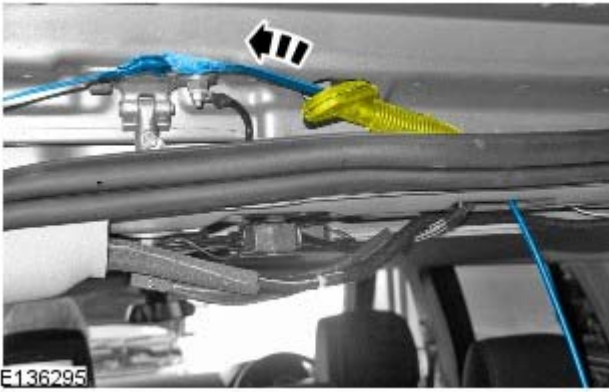
- Align the camera wiring harness tang with the electrical connector clip.
- Carefully release the clip.
- Apply suitable tape to protect the end of the camera overlay wiring harness.



E134896

3. Using suitable tape, secure a suitable rod to the camera overlay wiring harness.

4. Carefully feed the camera overlay wiring harness through the conduit.



5. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Install the connector to the camera overlay wiring harness.


- Remove the protective tape.
- Align the camera wiring harness tang with the electrical connector clip.
- Install the electrical connector.



E136298

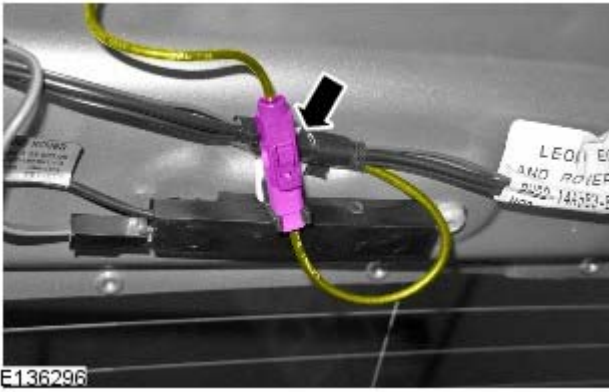
6. Connect the electrical connector.



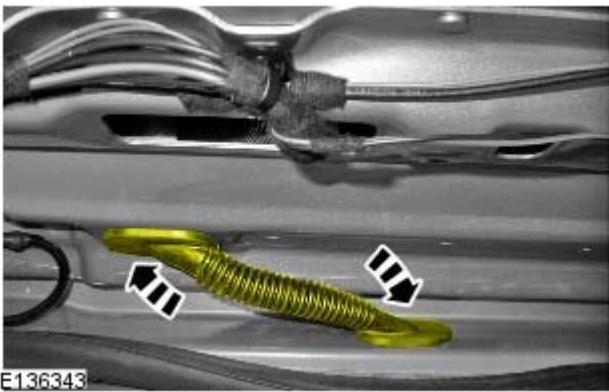
7.  CAUTION: Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the vehicle.

Using suitable tie straps, secure the camera overlay wiring harness to the tailgate harness.

8. Connect the electrical connector.

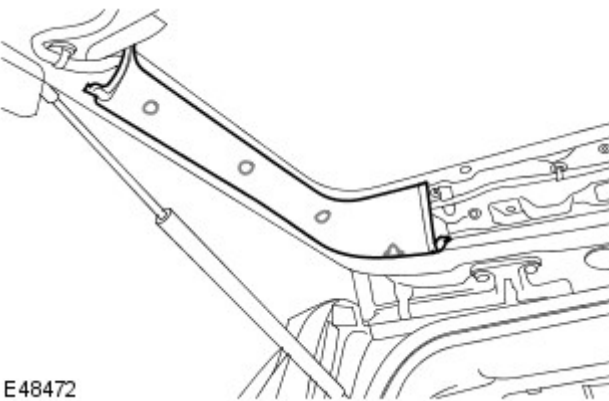


9. Secure the liftgate conduit.



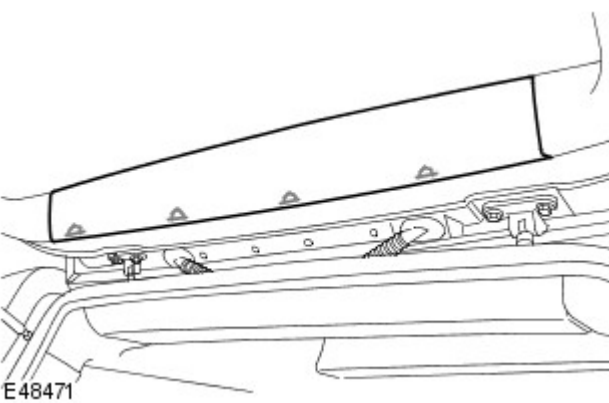
10. Install the liftgate side trim panel.

- Secure the 5 clips.



11. Install the liftgate upper trim panel.

- Secure the 4 clips.



12. Install the liftgate lower trim panel.

For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

13. Install the rear headliner trim panel.

- Connect the electrical connector.
- Secure the 7 clips.

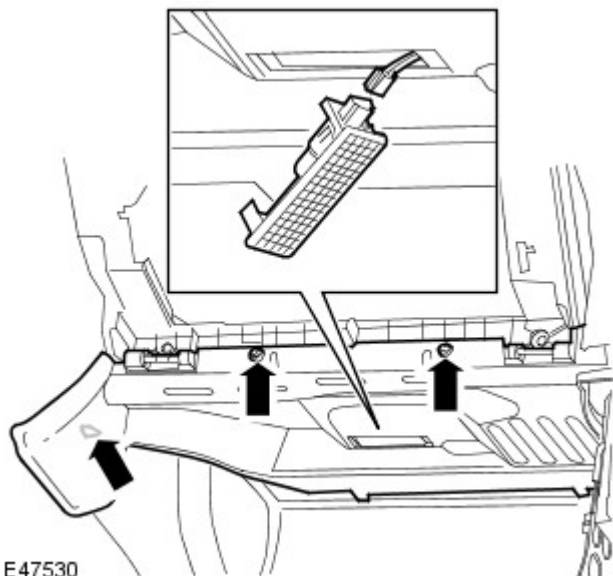
Wiring Harnesses - Side Parking Aid Camera Wiring Harness – Front Door Section

Removal and Installation

Removal

1. Remove the closing trim panel.

- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47530

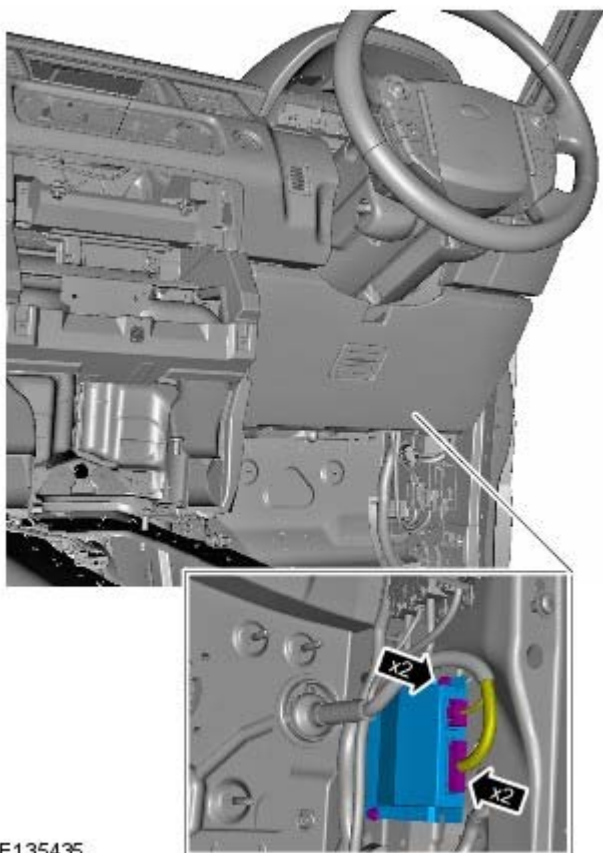
2. Remove the cowl side trim panel.

For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. NOTE: RHD shown, LHD is similar.

If equipped, remove the dynamic stability control module.

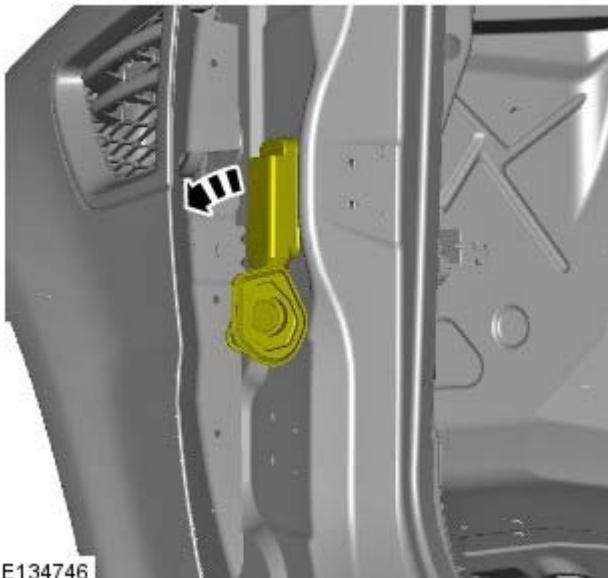
- Disconnect the 2 electrical connectors.
- Remove the 2 bolts.



E135435

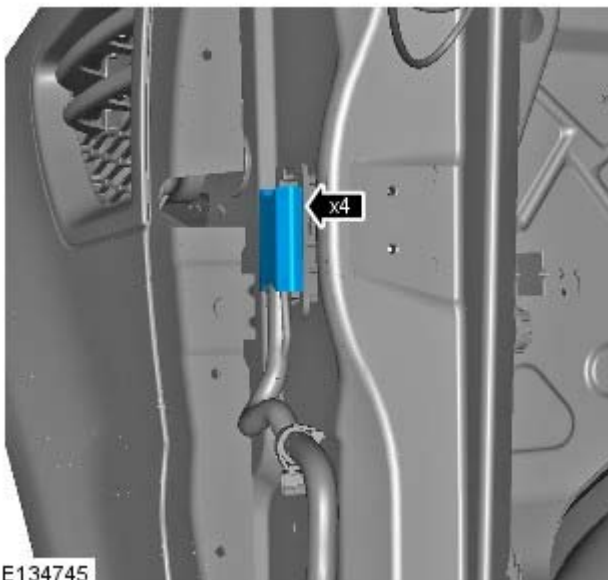
4. NOTE: Door shown removed for clarity.

Release the gaiter.



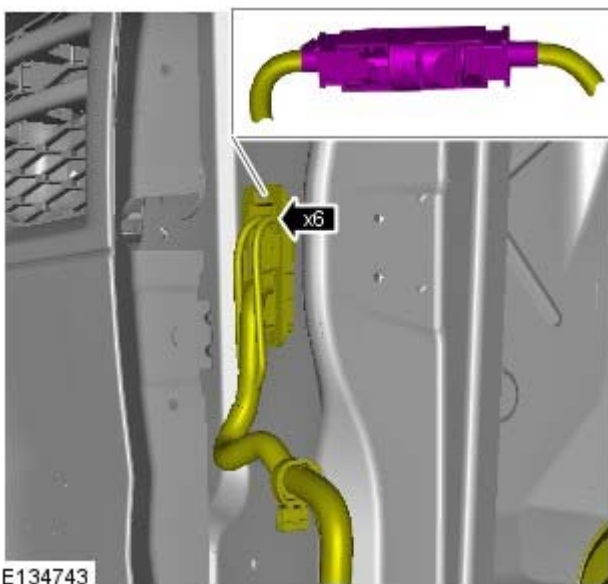
5. Remove the wiring harness cover.

- Release the 4 clips.



6. Disconnect the electrical connector.

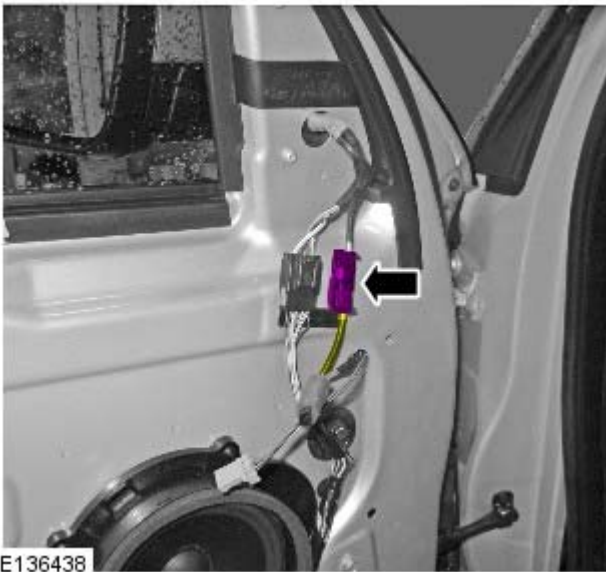
- Release the electrical connector bracket.
- Release the 6 clips.



7. Remove the front door trim panel.

For additional information, refer to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

8. Disconnect the electrical connector.

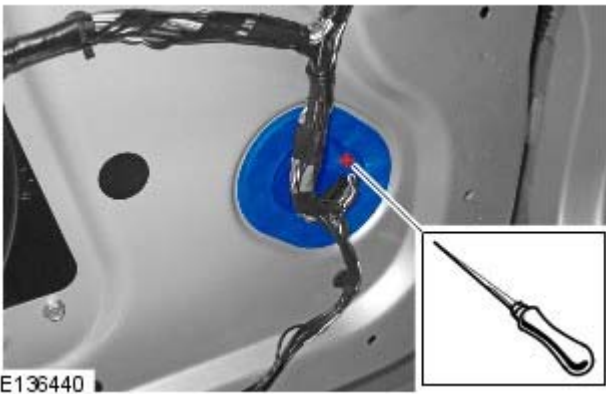


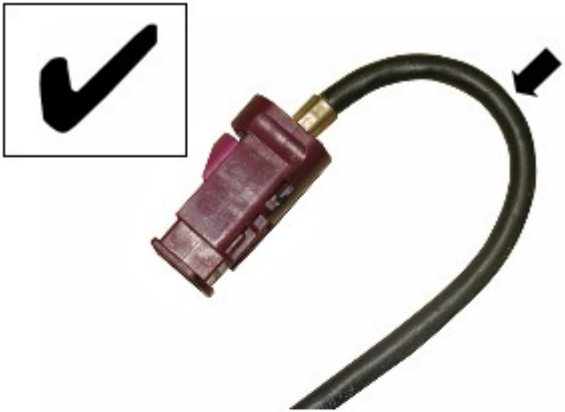
Installation


1. Release the grommet.



2. Using a suitable tool, make a hole in grommet in the position shown.





3.  CAUTION: Make sure that the camera overlay wiring harness is not bent excessively during this procedure. Failure to follow this instruction may result in damage to the harness.

Install the camera overlay wiring harness.



E135323

4. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

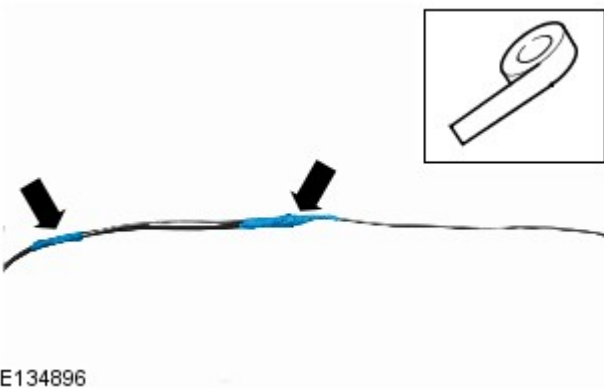
Remove the connector from the camera wiring harness.

- Remove the locking tab.
- Carefully release the clip.
- Apply suitable tape to protect the end of the camera wiring harness.



E133998

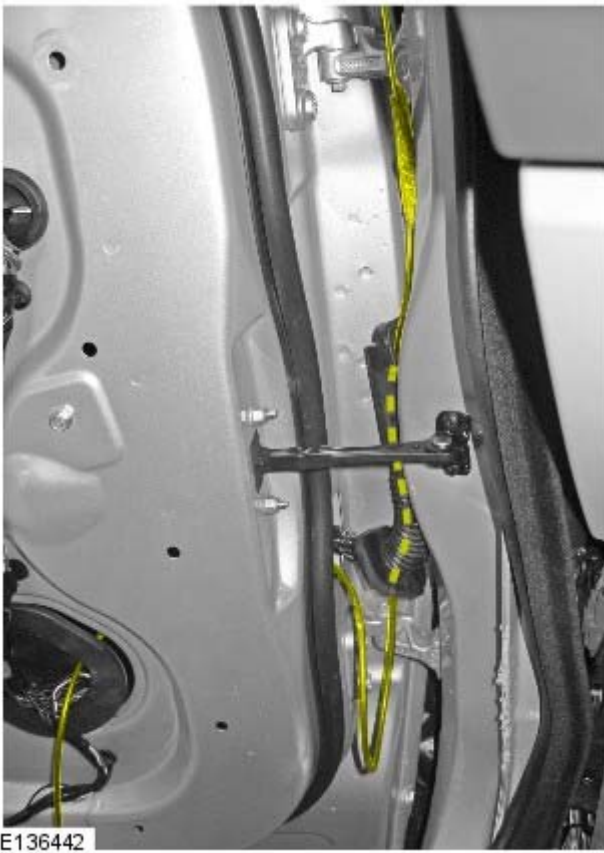
5. Using suitable tape, secure a suitable rod to the camera overlay wiring harness.



6. Carefully feed the wiring harness through the grommet.



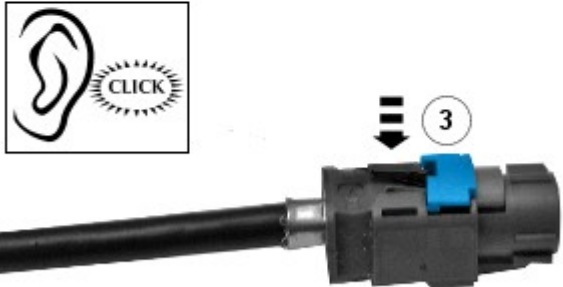
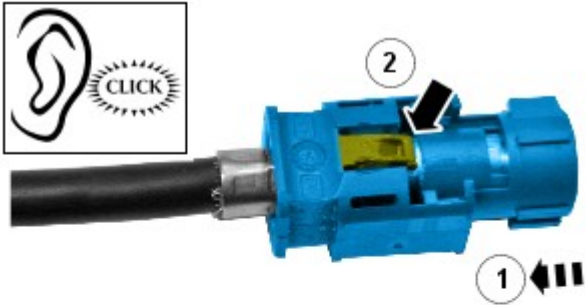
7. Carefully feed the camera overlay wiring harness through the gaiter.



8. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

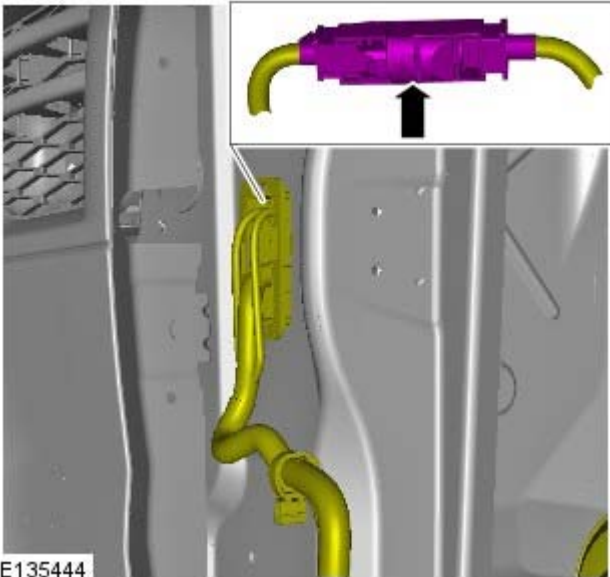
Install the connector to the camera wiring harness.

- Remove the protective tape.
- Install the electrical connector.
- Secure the locking tab.



E134007

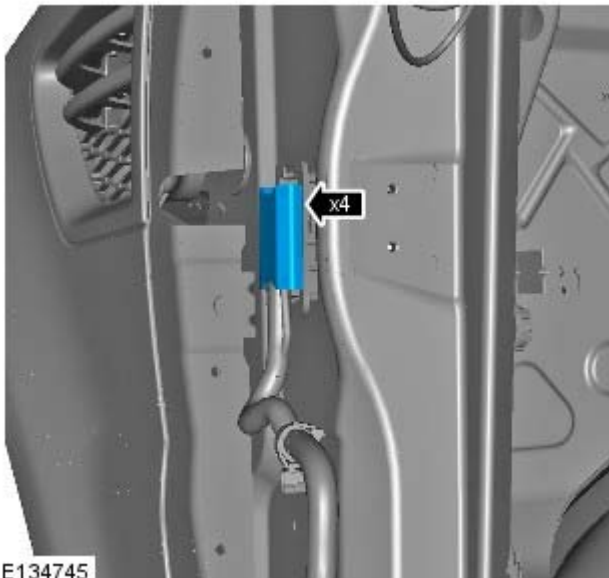
9. Connect the electrical connector.



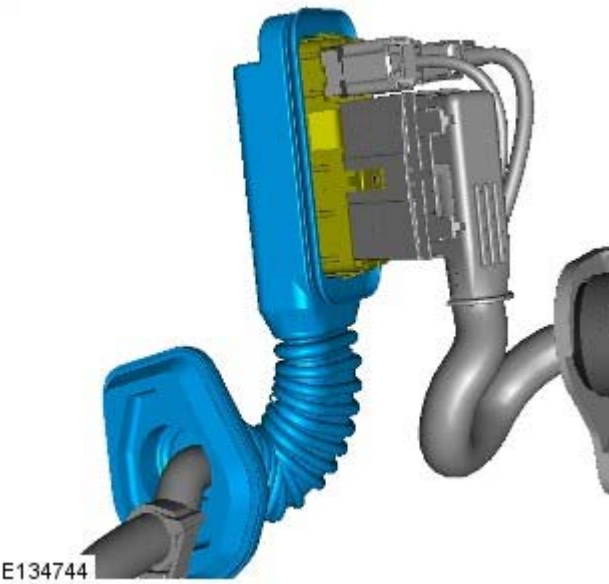
E135444

10. Install the wiring harness cover.

- Secure the 4 clips.

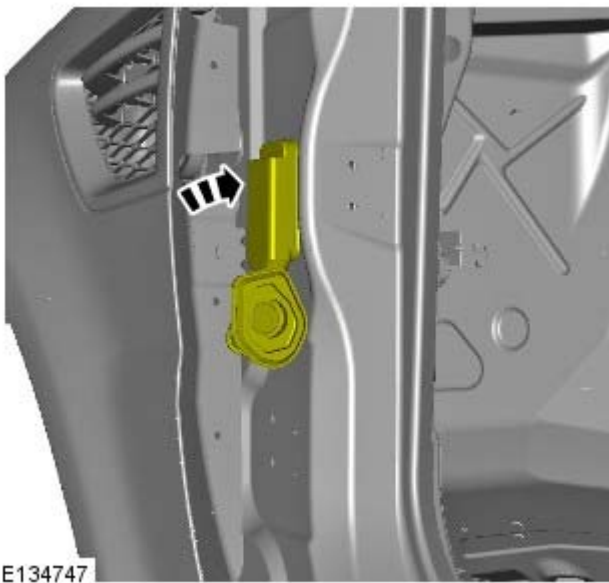


11. Install the gaiter.





12. Secure the bracket.

- Secure the 6 clips.



13. CAUTIONS:

 Make sure that excessive force is not used when installing the tie straps to the wiring harness. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that the camera overlay harness is correctly routed and clear of the front door window regulator and motor. Failure to follow this instruction may result in damage to the vehicle.

Using suitable tie straps, secure the camera overlay harness to the door wiring harness.

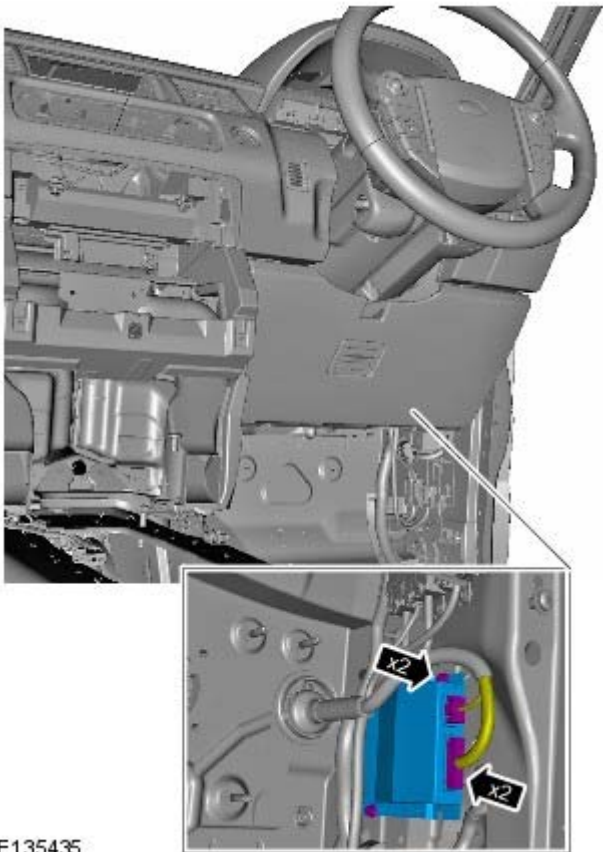
14. Secure the grommet.



15. NOTE: RHD shown, LHD is similar.

If equipped, install the dynamic response control module.

- Tighten the 2 bolts.
- Connect the 2 electrical connectors.

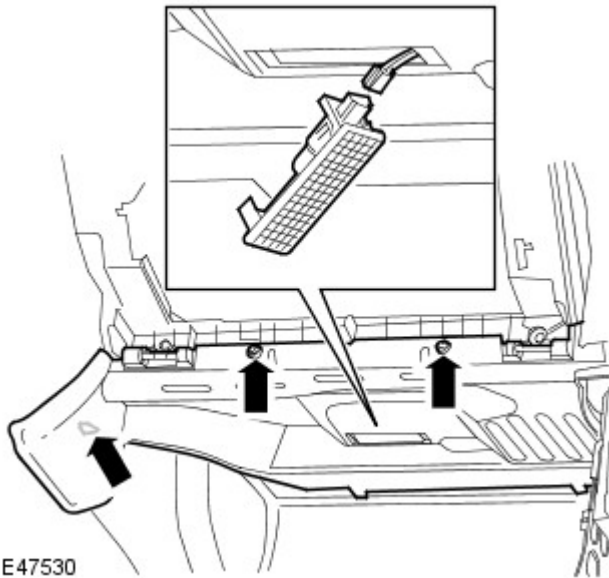


16. Install the cowl side trim panel.

For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

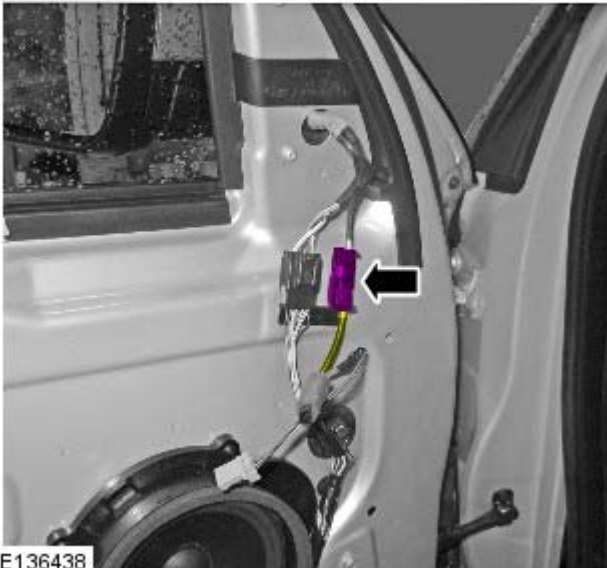
17. Install the closing trim panel.

- Connect the electrical connector.
- Secure the clip.
- Tighten the screws.



E47530

18. Connect the electrical connector.



E136438

19. Install the front door trim panel.

For additional information, refer to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).

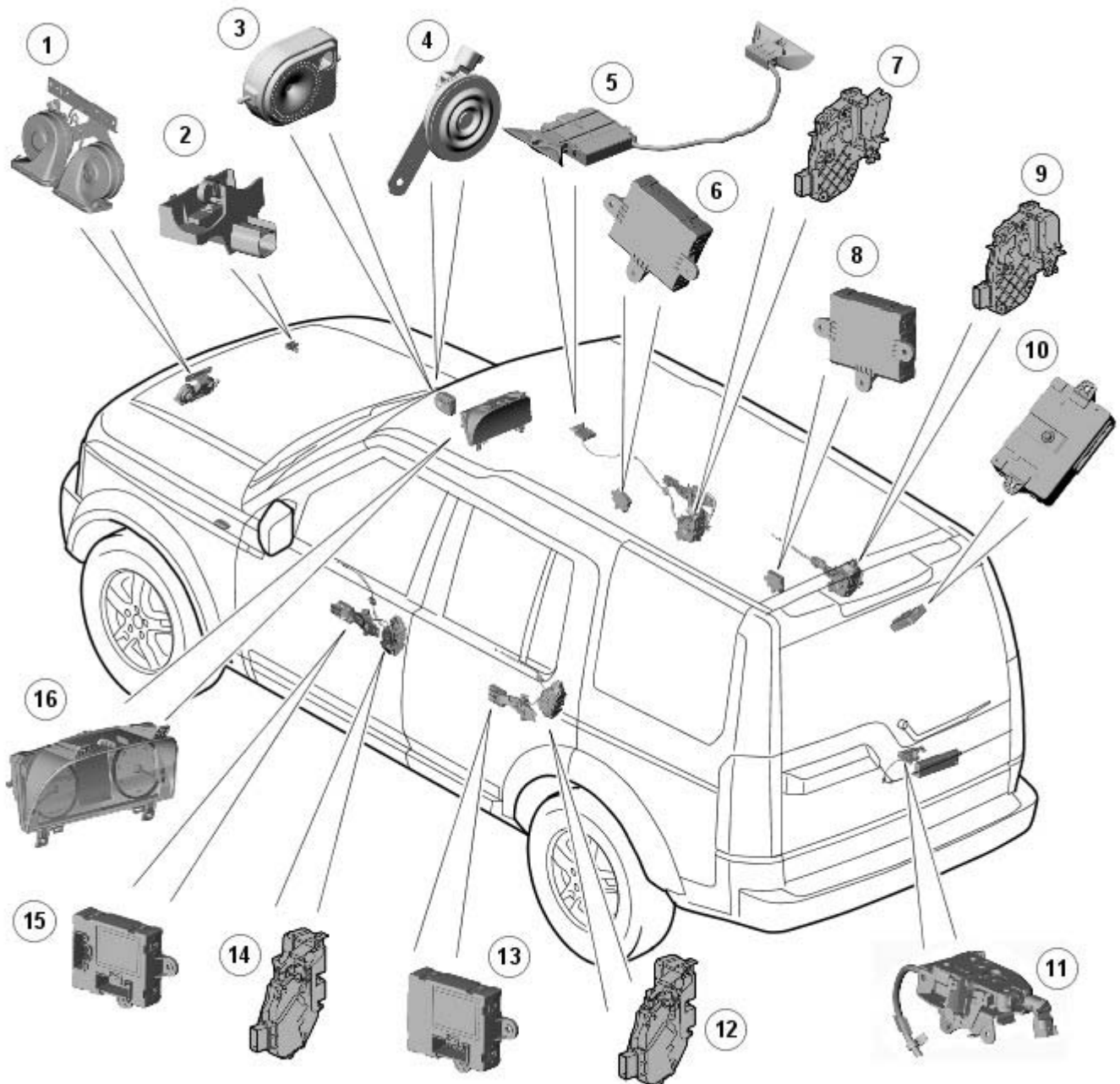
Anti-Theft - Active -**Torque Specifications**

Description	Nm	lb-ft
RH Hood latch Torx bolts	10	7
Security antenna	6	4

Anti-Theft - Active - Anti-Theft - Active

Description and Operation

COMPONENT LOCATION



E129744

Item	Part Number	Description
1	-	Horns
2	-	Hood ajar switch
3	-	Battery backed-up sounder and inclination sensor (if fitted)
4	-	Passive sounder (if fitted)
5	-	Interior motion sensor
6	-	Driver door module
7	-	Driver door latch
8	-	Rear door module
9	-	Rear door latch
10	-	Keyless vehicle module
11	-	Upper tailgate latch
12	-	Rear door latch
13	-	Rear door module
14	-	Passenger door latch
15	-	Passenger door module
16	-	Instrument cluster

OVERVIEW

The active anti-theft system is available with three different levels of vehicle protection depending on market specification:

- Hinged panel sensing
- Hinged panel and intrusion sensing
- Hinged panel, intrusion and inclination sensing.

The system is controlled by software in the [CJB \(central junction box\)](#) which indicates an alarm trigger condition:

- Visually, using the direction indicators.
- Audibly, using the vehicle horn and, depending on market specification, either a passive or active sounder.

The passive sounder is an anti-theft disc horn and the active sounder is a BBUS (battery backed-up sounder).

The BBUS is an intelligent unit which communicates to the [CJB](#) over a [LIN \(local interconnect network\)](#) connection. The BBUS is fitted with an inclination sensor.

Monitoring of the hinged panels is carried out using switches located in each door latch assembly, the hood latch assembly, and the tailgate latch assembly. The condition of the switches is monitored by the [CJB](#).

Monitoring of front door lock status is carried out using switches located in the door latch mechanisms. The condition of the switches is monitored by the front door modules and transmitted to the [CJB](#) over the medium-speed [CAN \(controller area network\)](#).

Monitoring of the cabin interior is carried out using an interior motion sensor, which comprises an ultrasonic sound wave sensor to determine if there is movement within the cabin. Information from the interior motion sensor is communicated to the [CJB](#) over a [LIN](#) connection.

When armed, the active anti-theft system can be triggered in one of the following ways:

- A door ajar switch indicates a door is open.
- The hood or upper tailgate ajar switches indicate that either is open.
- Either front door latch mechanism indicates a door has been unlocked.
- The emergency key blade is used to open the [LH \(left-hand\)](#) front door.
- The [CJB](#) is disconnected (this may result in only a partial trigger).
- An attempt is made to start the engine without a valid signal from the Smart Key.
- The BBUS is disconnected (partial trigger only).
- The vehicle battery is disconnected on a vehicle fitted with a BBUS (partial trigger only).
- The inclination sensor detects a change in vehicle attitude.
- The interior motion sensor detects movement within the cabin.
- Panic alarm from the Smart Key.

• **CAUTIONS:**



The interior motion sensor electrical connections, particularly those to the sensors mounted in the roof console, are very delicate and must be handled with care.



The interior motion sensor is an electro-statically sensitive part and should only be handled in an electro-statically controlled environment.

Alarm Indicator

The alarm indicator is a [LED \(light emitting diode\)](#) located in the instrument cluster, operation of the alarm indicator is controlled by a hardwired input the [CJB](#). When the ignition is off the indicator gives a visual indication of the active anti-theft system to show if the alarm system is active or not active.

The alarm [LED](#) will begin to flash once every 2 seconds to indicate that the vehicle alarm is armed.

Door Modules

The door modules provide the interface between the door latch-motors, the door latch-switches and the [CJB](#). The door modules provide door switch status information and enable the door latch-motors on request from the [CJB](#) or the keyless vehicle module.

Keyless Vehicle Module

The Keyless Vehicle Module interfaces with the Central locking, RF (radio frequency) receiver and collects RF signal information which is transmitted from the Smart Key. This information is translated into commands which are passed on the medium-speed [CAN](#) to the:

- [CJB](#),
- front door modules, and
- instrument cluster.

The keyless vehicle module also monitors:

- four interior antennas,
- two load-space antennas,
- four door handle antennas and one rear bumper antenna, if passive entry is fitted.

On vehicles with passive entry, the additional fast latch motors are controlled via the keyless vehicle module and the locking status is passed to the [CJB](#) on the medium speed [CAN](#).

Passive Anti-Theft Horn

The passive anti-theft horn is hardwired to the [CJB](#) and activates when the alarm is triggered.

Battery Backed-Up Sounder (BBUS)

The BBUS uses an integral sounder to produce an audio warning when the alarm is triggered. An inclination sensor is incorporated into the BBUS, to monitor vehicle attitude, see Inclination Sensor.

Operation of the BBUS is controlled by the [CJB](#) via exchange signals on the [LIN](#). Under normal operation the BBUS is powered by a permanent battery power supply from the [CJB](#). However, if the power feed is disrupted an integral rechargeable battery powers the BBUS.

On receipt of the arming signals, the BBUS sounder and the inclination sensor respond with a status signal. If there is no response to the arming signals within 12 seconds, the [CJB](#) assumes there is a fault and sends a disarm signal to the sounder or the inclination sensor, as appropriate. The [CJB](#) also stores a related fault code.

If the alarm is subsequently triggered, with the BBUS sounder disarmed, the [CJB](#) uses the passive anti-theft horn or vehicle horn to sound the audio warning.

Inclination Sensor

The inclination sensor measures the longitudinal and lateral angle of the vehicle over a range of $\pm 16^\circ$ from the horizontal. When the anti-theft alarm system is armed in the intrusion detection mode, the BBUS stores the current angles in memory and monitors the inclination sensor readings. If the vehicle attitude changes in either direction by more than the alarm limit, the BBUS activates the sounder.

Interior Motion Sensor

When the vehicle is double locked, the interior motion sensor monitors for movement in the vehicle's cabin.

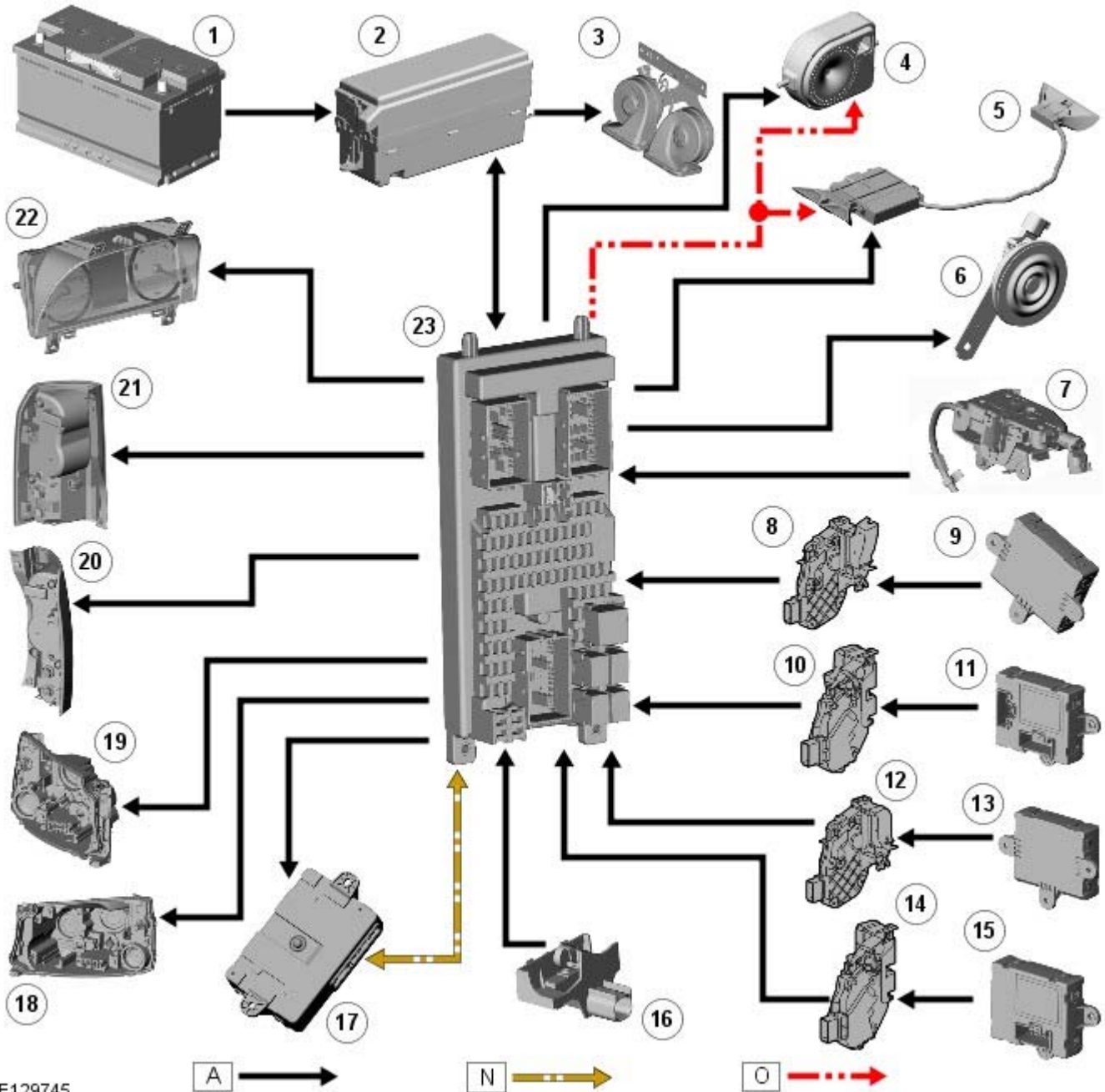
The interior motion sensor consists of a micro-controller, two acoustic transmitters and one acoustic receiver. The receiver and one of the transmitters face forward and the other transmitter faces rearward to ensure complete coverage of the vehicle's cabin.

The interior motion sensor is powered by a feed from the [CJB](#) and activates and de-activates the interior motion sensor. When the interior motion sensor is active it outputs ultrasonic pulses from the transmitters and checks the echoes picked up by the receiver for changes to the passenger compartment profile. If it detects a change of profile, indicating movement in the passenger compartment, the interior motion sensor reports the alarm to the [CJB](#).

Each time the interior motion sensor is armed, it performs a self test. If there are no faults the interior motion sensor sends an acknowledgment signal to the [CJB](#). If the [CJB](#) does not receive the acknowledgment signal it de-activates the interior motion sensor.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **N** = Medium Speed CAN Bus; **O** = LIN Bus



E129745

Item	Part Number	Description
1	-	Battery
2	-	Engine junction box
3	-	Horns
4	-	Battery backed-up sounder with integrated inclination sensor (if fitted)
5	-	Interior motion sensor
6	-	Passive sounder (if fitted)
7	-	Upper tailgate latch
8	-	Driver door latch
9	-	Driver door module
10	-	Passenger door latch
11	-	Passenger door module
12	-	Rear door latch
13	-	Rear door module
14	-	Rear door latch
15	-	Rear door module
16	-	Hood ajar switch
17	-	Keyless vehicle module
18	-	Left-hand front lamp (indicator)
19	-	Right-hand front lamp (indicator)
20	-	Left-hand tail lamp (indicator)
21	-	Right-hand tail lamp (indicator)
22	-	Instrument cluster
23	-	CJB

PRINCIPLES OF OPERATION

The active anti-theft system arms and disarms in conjunction with the locking and unlocking of the central locking system. For additional information, refer to: [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

Depending on the configuration of the [CJB](#), the active anti-theft system can be armed and disarmed when the locking system is activated with the Smart Key. Visual and audible confirmation of the arming and disarming is provided by the direction indicators and the BBUS.

On vehicles not fitted with the interior motion sensor and BBUS, the anti-theft alarm system is armed in the perimeter mode when the vehicle is either single or double locked.

On vehicles with the interior motion sensor the anti-theft alarm system is armed in one of two modes:

- Single Locking: only the hinged panels are monitored.
- Double Locking: the hinged panels the vehicle interior, and if the BBUS is incorporated the vehicle attitude, are monitored.

When the vehicle is double-locked, the [CJB](#) sends an arming signal to the BBUS and interior motion sensor. If the [CJB](#) does not receive an acknowledgment signal from the BBUS and the interior motion sensor, the [CJB](#) disables the associated alarm feature for the remainder of the armed cycle.

Locking and Arming the Vehicle

• **NOTE:** The vehicle will only lock, if all door, tailgate and hood apertures are closed. If a lock attempt is made when an aperture is open, the vehicle will not lock and two audible error warnings will sound.

Single locking:

- Pressing the lock button briefly on either the door handle or Smart Key, will initiate the [CJB](#) to arm the anti-theft alarm system in the perimeter mode and send an arming signal to the sounder in the BBUS. This secures the vehicle and prevents the doors being opened from outside of the vehicle; however they can still be unlocked and opened from inside the vehicle. The hazard warning lamps will flash once as confirmation and 'if enabled' an audible warning will also sound. The alarm indicator in the instrument cluster will flash continuously.

Double locking:

- Pressing the lock button twice within three seconds on either the door handle or Smart Key, will initiate the [CJB](#) to arm the anti-theft alarm system in the perimeter mode and interior motion detection mode. The [CJB](#) will also send an arming signal to the BBUS. Double locking secures the vehicle and prevents the doors being unlocked or opened from inside or outside of the vehicle, except with a recognized Smart Key. The perimeter alarm and interior motion protection are turned on. The hazard warning lamps will flash twice, with a long second flash as confirmation and if enabled an audible warning will also sound.
- The vehicle set-up menu in the message center allows the intrusion detection and inclination protection to be temporarily disabled the next time the vehicle is locked using the Smart Key. This feature prevents accidental triggering of the active anti-theft system during transportation of the vehicle or if a pet is left in the vehicle. The sensor override functionality will be active for one lock/unlock cycle only and will default back to sensor active mode automatically.

Emergency Disarming

If the alarm has been triggered and cannot be disarmed with the Smart Key, it can be disarmed using the emergency Smart Key blade. This is achieved by unlocking the left-hand front door with the key blade and deactivating the alarm by:

- pressing the unlock button on the Smart Key, or by
- pressing the engine START/STOP button with the Smart Key inside the vehicle.

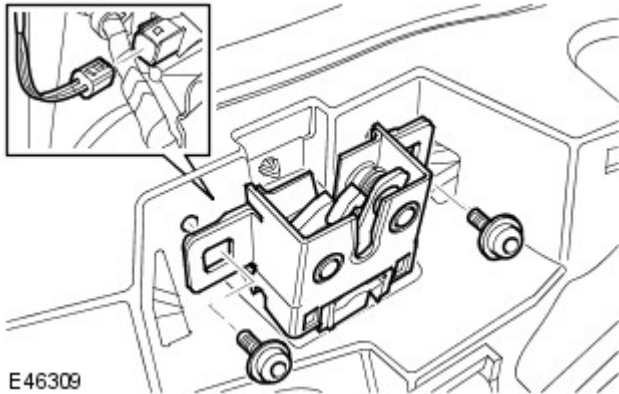
Anti-Theft - Active - Hood Switch

Removal and Installation

Removal

• **NOTE:** Before installing a new hood switch, diagnose the hood switch by using a digital multimeter. Make sure that continuity through hood switch is present when the switch is pressed (hood closed condition). Repeat the test to make sure continuity IS NOT present when the switch IS NOT pressed. If the hood switch continuity is NOT present, continue with this procedure. If the continuity is present, install the original hood switch to the vehicle.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Release the RH hood latch.



- Remove the 2 Torx bolts.
- Disconnect the electrical connector.

3. Remove the hood switch.

Installation

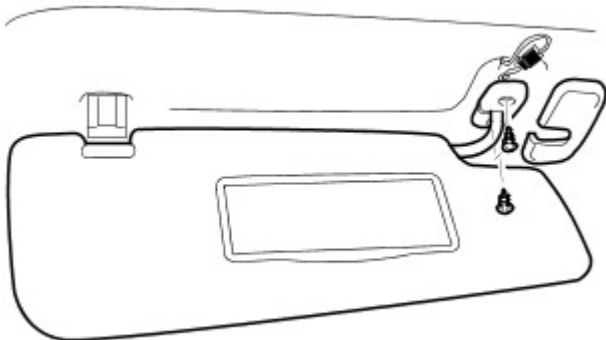
1. Install the hood switch.
2. Install the RH hood latch.
 - Connect the electrical connector.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
3. Open and close the hood to check the hood latch operation.
4. Adjust the hood latch.
 - Loosen the 2 hood latch Torx bolts.
 - Lower the hood and check for alignment.
 - Open the hood and tighten the Torx bolts to 10 Nm (7 lb.ft).
 - Check for the correct operation of the hood safety catch.
 - If necessary, repeat the above adjustment procedure.

Anti-Theft - Active - Antenna

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the RH A-pillar upper trim panel.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the RH B-pillar upper trim panel.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the RH C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Remove the RH sun visor.
 - Remove the screw covers.
 - Remove the 2 screws.
 - Release and disconnect the electrical connector.



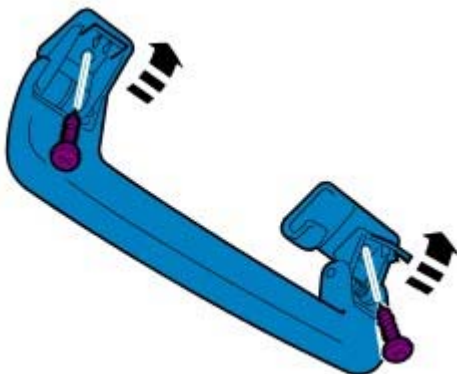
E49687

6. Remove the sun visor retaining clip.
 - Release the screw cover.
 - Remove the screw.

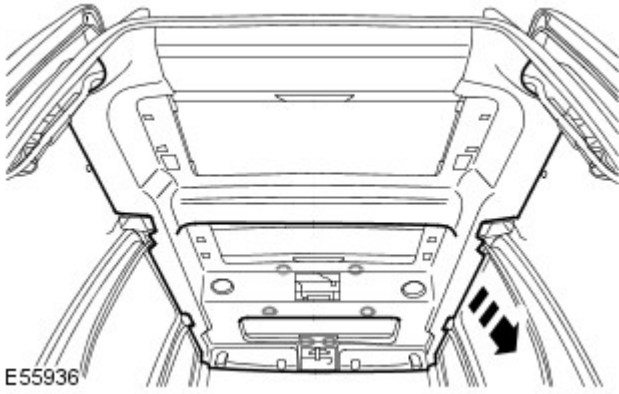


E49688

7. Remove the RH passenger assist handles.
 - Carefully release the 6 screw covers.
 - Remove the 6 screws.

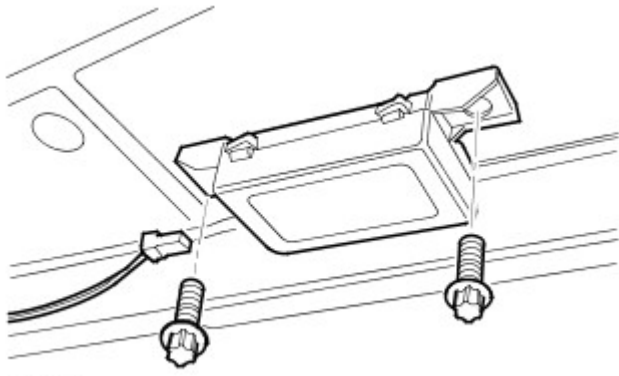


E49689



8. Release the RH side of the headliner.

- Release the 6 clips.



9. Remove the alarm antenna.

- Disconnect the electrical connector.
- Remove the 2 bolts.

Installation

1. Install the alarm antenna.

- Connect the electrical connector.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. Secure the RH side of the headliner.

- Carefully secure the clips.

3. Install the RH passenger assist handles.

- Install the screws.
- Install the screw covers.

4. Install the sun visor retaining clip.

- Install the screw.
- Install the screw cover.

5. Install the RH sun visor.

- Connect and secure the electrical connector.
- Install the screws.
- Install the screw covers.

6. Install the RH C-pillar upper trim panel.

For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Install the RH B-pillar upper trim panel.

For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

8. Install the LH A-pillar upper trim panel.

For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

9. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

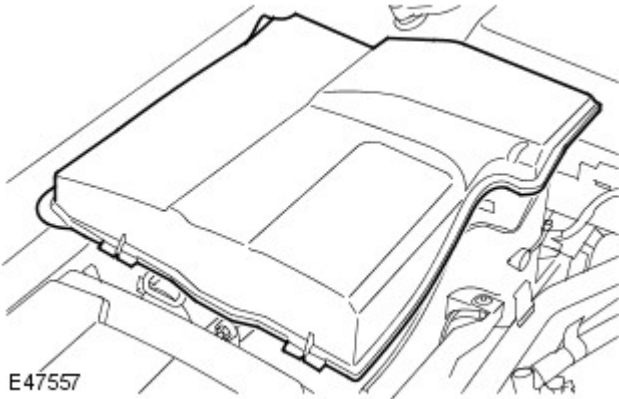
Anti-Theft - Active - Anti-Theft Alarm Horn with Integral Battery

Removal and Installation

Removal

1. Remove the auxiliary battery box cover.

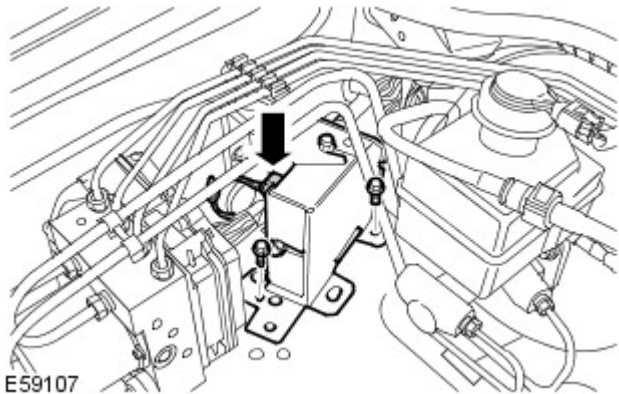
- Release the 2 clips.



E47557

2. Remove the anti-theft alarm horn.

- Disconnect the electrical connector.
- Remove the 2 bolts.



E59107

Installation

1. Install the anti-theft alarm horn.

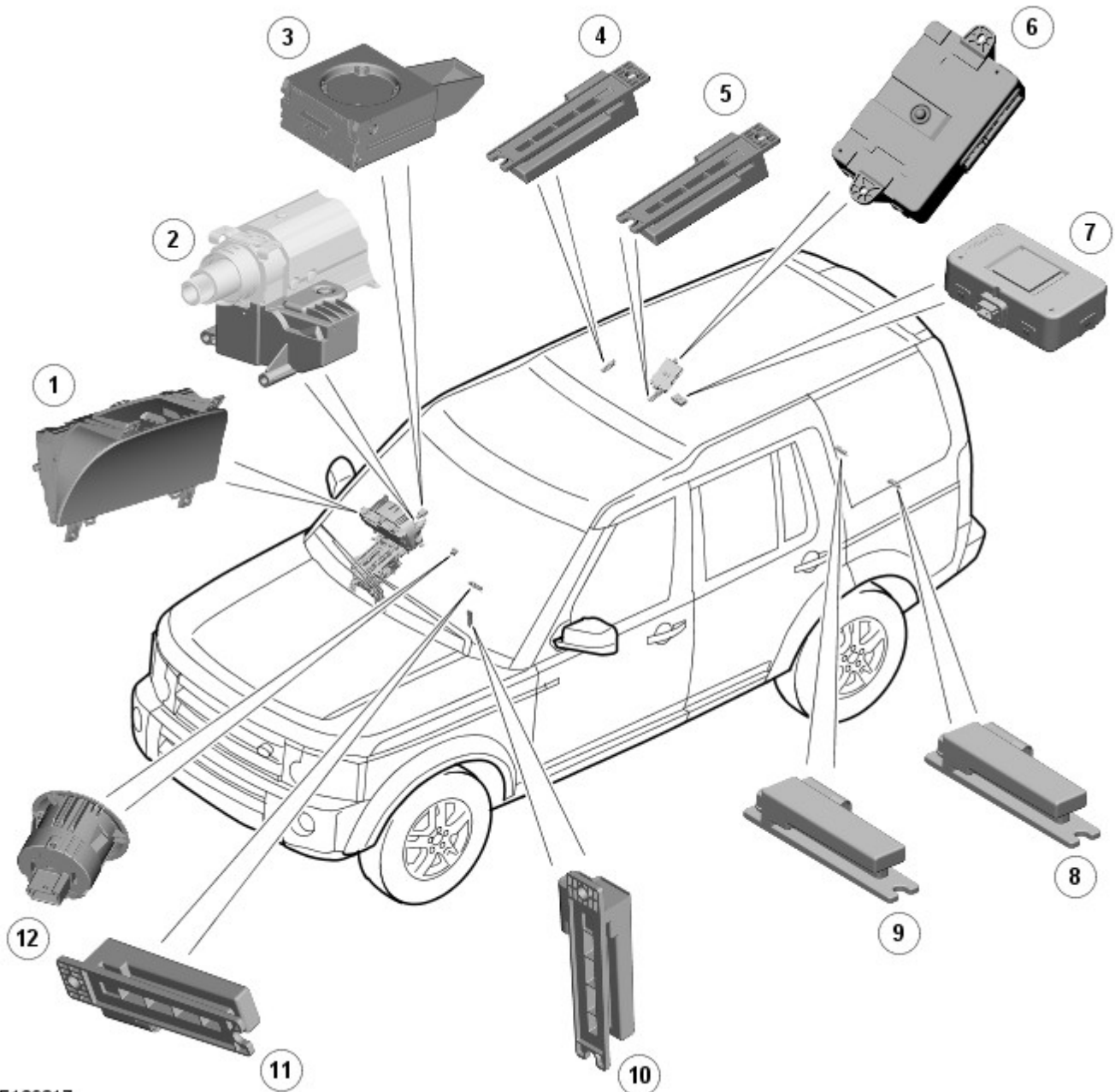
- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect the electrical connector.

2. Install the auxiliary battery box cover.

Anti-Theft - Passive - Anti-Theft - Passive

Description and Operation

COMPONENT LOCATION



E129817

Item	Part Number	Description
1	-	Instrument cluster
2	-	Steering column lock
3	-	Immobilizer antenna unit
4	-	Interior Antenna – roof lining
5	-	Interior Antenna – roof lining
6	-	Keyless Vehicle Module
7	-	Radio frequency receiver
8	-	Interior Antenna – luggage compartment
9	-	Interior Antenna – luggage compartment
10	-	Interior Antenna – front compartment
11	-	Interior Antenna – front compartment
12	-	Start/Stop Switch

OVERVIEW

Passive Start

The passive start system relies on the detection of a uniquely coded Smart Key and low frequency antennas strategically

situated within the vehicle. The antennas ensure the Smart Key is always within the active transmission zone of the antennas wherever the Smart Key is placed inside the vehicle. For this reason the orientation and positioning of the antennas is critical to the correct functioning of the system. The Smart Key also operates the passive entry system. For additional information, refer to: [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

The system provides a secure interface between the [CJB \(central junction box\)](#) and the [ECM \(engine control module\)](#) to prevent unauthorized starting of the engine. This is achieved by immobilization of the engine crank system and the fuel system, using encoded data exchange between the Smart Key and multiple control modules.

Engine starting is initiated when the encoded data exchange between the Smart Key and the control modules is verified. The engine management system will then allow engine crank and fueling when an authorization data message is received from the [CJB](#).

The engine can be started by pressing the start/stop button and depending on the type of transmission:

- Automatic; when the drive selector is in the 'Park' position and the brake pedal is pressed.
- Manual; when the gear selector is in 'Neutral' and the clutch pedal is pressed.

COMPONENT DESCRIPTION

Immobilizer Antenna Unit

The IAU (immobilizer antenna unit) is used if the keyless vehicle module is unable to authorize the Smart Key. If the keyless vehicle module is unable to identify the Smart Key, for example if the Smart Key battery voltage is low or there is local RF interference, the transponder within the Smart Key can be read in the conventional manner. The driver will be alerted to this by a chime and a message in the instrument cluster message center 'SMART KEY NOT FOUND REFER TO HANDBOOK'.

Refer to Keyless Start Backup section.

Low Frequency Antenna

Six LF (low Frequency) antennas for the passive start system are positioned in specific locations within the vehicle.

The keyless vehicle module transmits an LF signal via the antennas which is received by the Smart Key. The Smart Key then responds by transmitting a RF (radio Frequency) signal which is received by the RF receiver and passed to the KVM (Keyless Vehicle Module) for authorization.

Keyless Vehicle Module

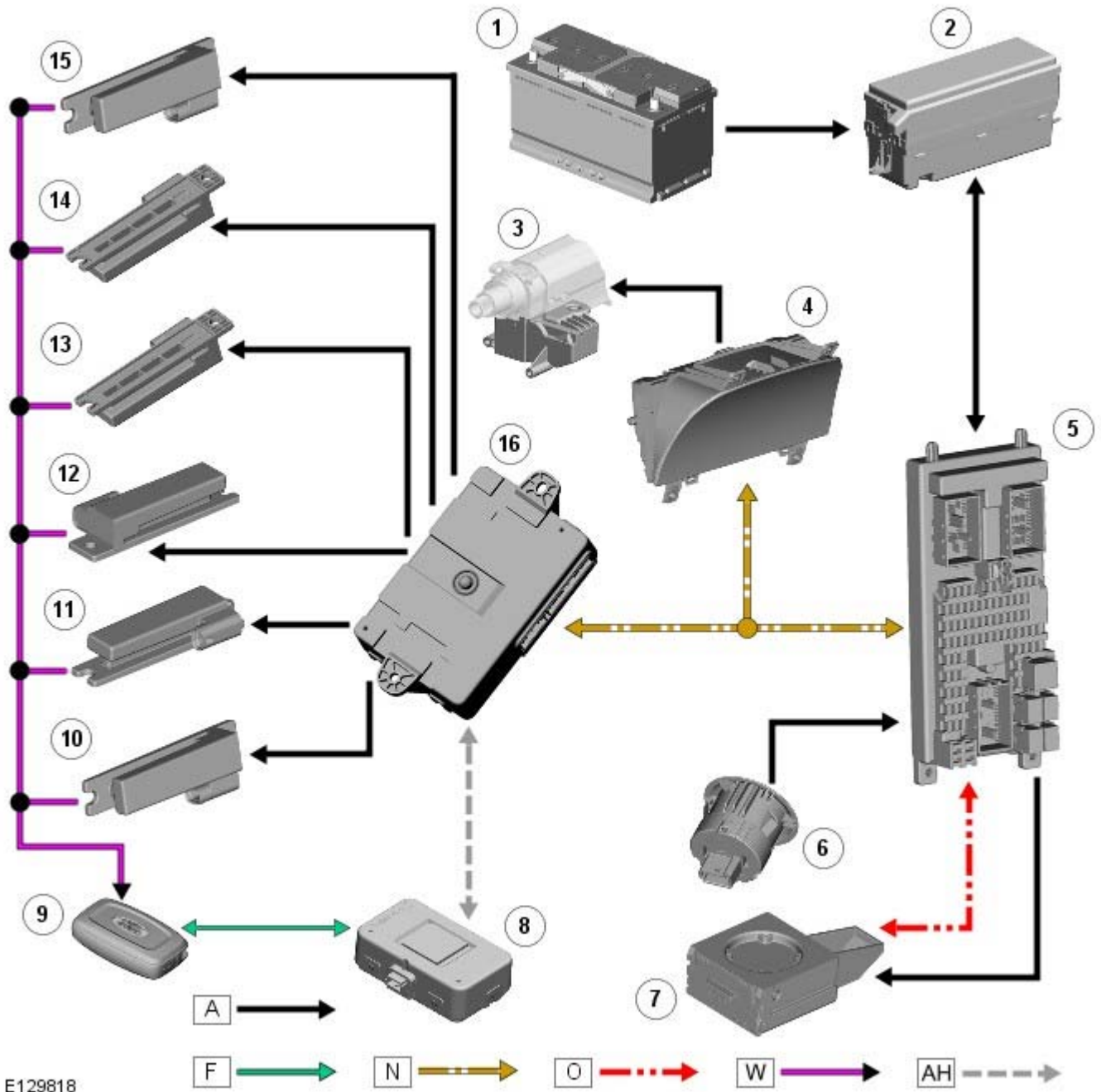
The keyless vehicle module controls signal transmissions to and from the Smart Key and provides authorization to allow the vehicle to be started. The module has a medium-speed [CAN \(controller area network\)](#) connection to the [CJB](#) for authorizing vehicle starting.

Radio Frequency Receiver

The RF (radio frequency) receiver transmission is received from the Smart Key to enable key identification.

CONTROL DIAGRAM

• NOTE: **A** = Hardwired connection; **F** = RF Transmission; **N** = Medium speed CAN bus; **O** LIN bus; **W** = LF Transmission; **AH** = Serial Communications Link



E129818

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	Steering column lock
4	-	Instrument cluster
5	-	CJB
6	-	Start/Stop Switch
7	-	Immobilizer antenna unit
8	-	Radio frequency receiver
9	-	Smart Key
10	-	Interior Antenna – roof lining
11	-	Interior Antenna – roof lining
12	-	Interior Antenna – luggage compartment
13	-	Interior Antenna – luggage compartment
14	-	Interior Antenna – front compartment
15	-	Interior Antenna – front compartment
16	-	KVM (Keyless Vehicle Module)

PRINCIPLES OF OPERATION

Passive Start

At the request of the [CJB](#) the KVM (Keyless Vehicle Module) prompts each of the internal low-frequency antennas to output a signal. When the Smart Key is in the vehicle cabin, it detects the low-frequency signals and responds with a RF radio frequency data-identification signal back to the KVM via the RF receiver.

If the data received matches that stored in the KVM it continues the passive start process by communicating a 'Smart Key valid' signal to the [CJB](#) via the medium-speed [CAN](#) bus.

Once the [CJB](#) receives the authorization and confirms the response with an internal calculation, it passes coded data to the [ECM](#) on the high-speed [CAN](#) bus. Upon confirmation from the [ECM](#) the ignition is enabled.

Before [CJB](#) sends a mobilization signal to the [ECM](#) it will exchange encrypted data with the electric steering lock mechanism to authorize unlocking of the steering column. The instrument cluster only provides a ground for the steering lock motor.

The [CJB](#) will enable the fuel pump relay which, on diesel vehicles operates the fuel pump and on gasoline vehicles sends a battery voltage supply to the fuel pump driver module to operate the fuel pump in conjunction with the [ECM](#).

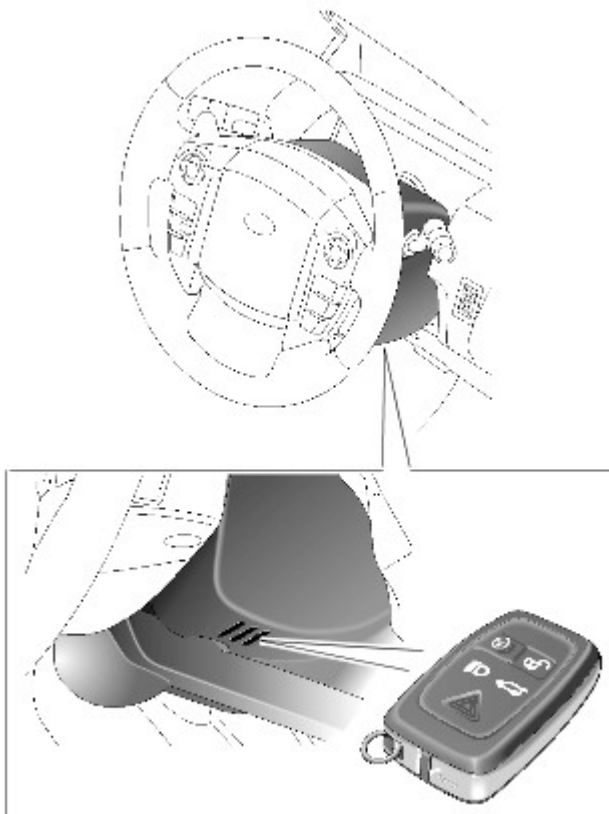
• **NOTE:** If the KVM fails to locate the Smart Key, a message 'SMART KEY NOT FOUND REFER TO HANDBOOK' will appear in the instrument cluster message center and the keyless start back-up process will have to be used to mobilize and start the vehicle.

Keyless Start Backup

If the vehicle has been unlocked using the emergency key blade or the Smart Key is not detected by the vehicle, it will be necessary to use the keyless start backup to disarm the alarm and start the engine. The following process must be followed in this event:

- Position the Smart Key against the underside of the fascia, on the outboard side of the steering column, with the buttons facing downwards. This is the location of the IAU (immobilizer antenna unit).
- Holding the Smart Key in position and the brake / clutch pedal depressed, press the start/stop button to start the engine.

Smart Key positioned next to immobilizer antenna unit



E129977

This process bypasses the data exchange between the KVM and the [CJB](#); this is an inductive process and will operate if the battery in the Smart Key is discharged. A transponder within the Smart Key is detected by the IAU. The IAU confirms the code output from the transponder and communicates this code confirmation with the [CJB](#) via a LIN (local interconnect network) bus connection. The [CJB](#) then initiates the vehicle start process in the normal manner.

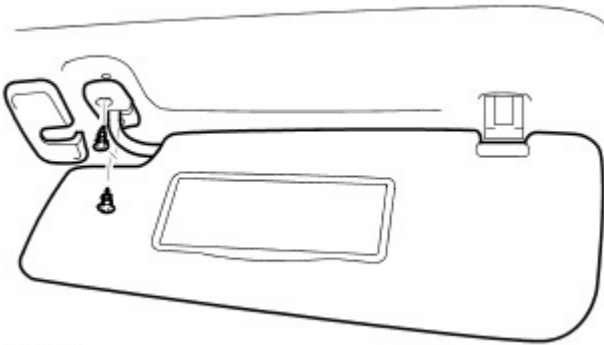
Anti-Theft - Passive - Passive Anti-Theft System (PATS) Module

Removal and Installation

Removal

• NOTE: If the PATS module is to be replaced then T4 must be connected and the correct procedures adhered to, prior to the battery disconnection.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the RH A-pillar upper trim panel.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the RH B-pillar upper trim panel.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the RH C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Remove the RH sun visor.
 - Remove the screw covers.
 - Remove the 2 screws.



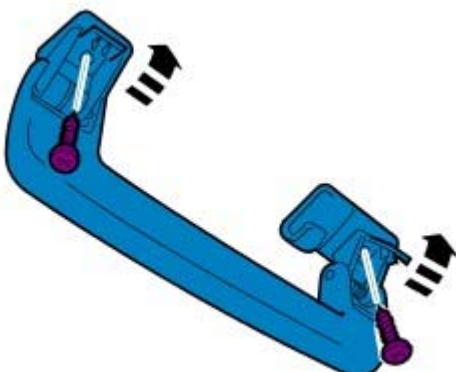
E49766

6. Remove the sun visor retaining clip.
 - Release the screw cover.
 - Remove the screw.

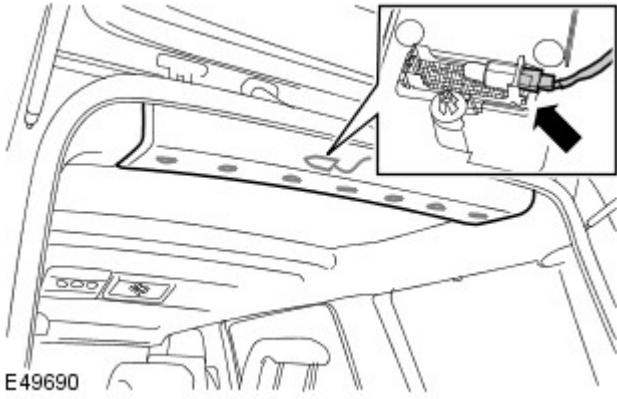


E49688

7. Remove the RH passenger assist handles.
 - Carefully release the 4 screw covers.
 - Remove the 4 screws.

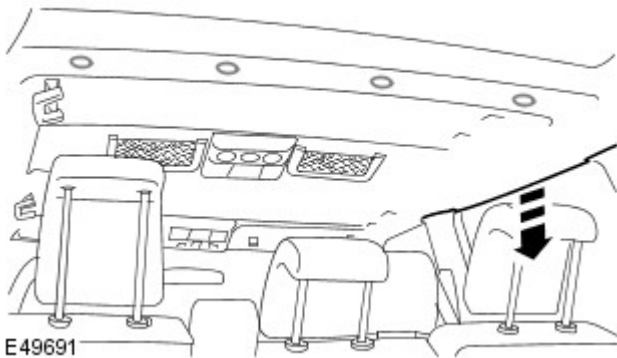


E49689



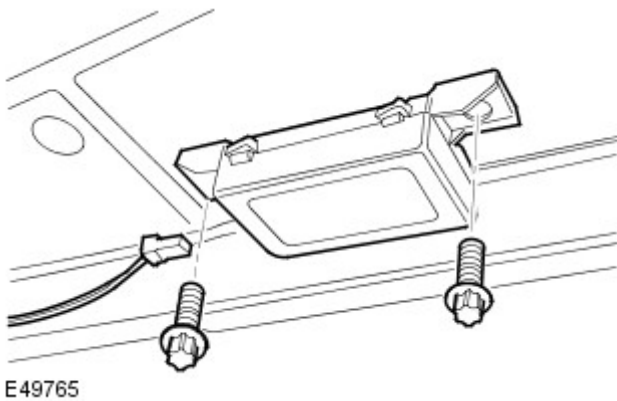
8. Remove the rear headliner trim panel.

- Release the 7 clips.



9. Release the RH side of the headliner.

- Carefully release the 4 clips.



10. Remove the PATS module.

- Disconnect the electrical connector.
- Remove the 2 bolts.

Installation

1. Install the PATS module.

- Connect the electrical connector.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. Secure the RH side of the headliner.

- Carefully secure the clips.

3. Install the rear headliner trim panel.

- Secure the clips.

4. Install the RH passenger assist handles.

- Install the screws.
- Install the screw covers.

5. Install the sun visor retaining clip.

- Install the screw.
 - Install the screw cover.
6. Install the RH sun visor.
- Install the screws.
 - Install the screw covers.
7. Install the RH C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
8. Install the RH B-pillar upper trim panel.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
9. Install the LH A-pillar upper trim panel.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
10. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
11. Initiate a new PATS module using T4.

Remote Convenience - Universal Transmitter

Diagnosis and Testing

Principles of Operation

For a detailed description of the universal transmitter system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Universal Transmitter (419-02 Remote Convenience, Description and Operation).

Inspection and Verification

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
<ul style="list-style-type: none"> ● Damaged universal transmitter ● Damaged receiver

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom	Possible Causes	Action
Universal transmitter inoperative	<ul style="list-style-type: none"> ● Universal transmitter ● Receiver unit 	Refer to the electrical circuits and check universal transmitter and receiver unit circuits.

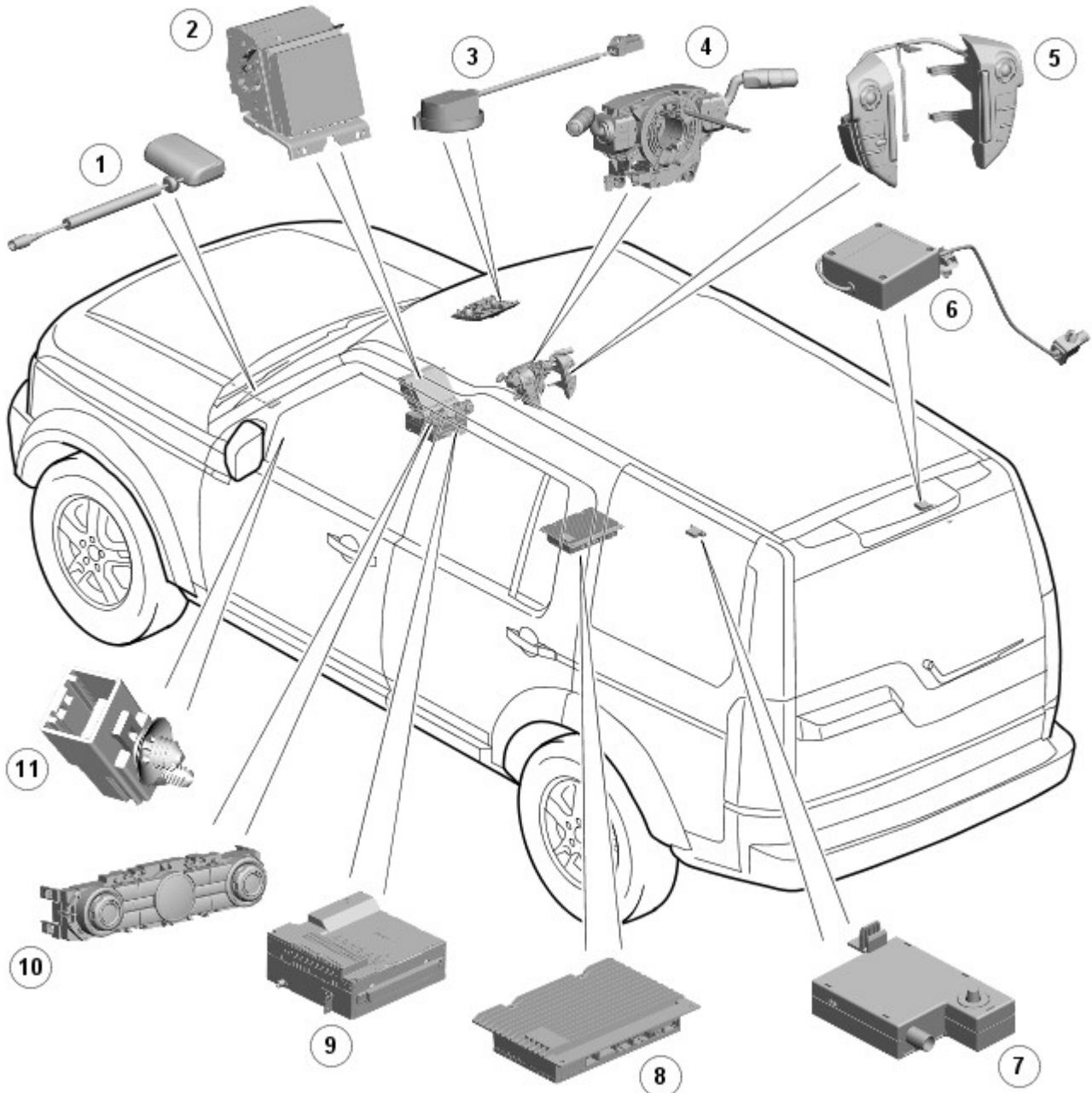
DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Remote Function Actuator \(RFA\)](#) (100-00 General Information, Description and Operation).

Navigation System - Navigation System

Description and Operation

COMPONENT LOCATION



E124878

Item	Part Number	Description
1	-	VICS (vehicle information and communication system) beacon antenna - Japan only
2	-	TSD (touch screen display)
3	-	Microphone - voice recognition
4	-	Clockspring
5	-	Steering wheel switches
6	-	GPS (global positioning system) antenna
7	-	'TMC (traffic message channel) tuner' or 'VICS receiver - Japan only'
8	-	Power amplifier
9	-	IHU (integrated head unit)
10	-	Integrated control panel, incorporating navigation switch
11	-	Navigation update socket

OVERVIEW

The navigation system provides audible and visual route guidance information to enable the driver to reach a desired destination. The system allows the driver to choose the route to the destination using minor or major roads or highways with the option of three routes. Directions to hospitals, museums, monuments and hotels are also available. Map information stored on a hard-drive located within the TSD (touch screen display) is used to determine the best route for

the journey and provide the driver with details of directions and approaching junctions.

If the vehicle requires a map upgrade or a new region loading, an enabling code along with the map data must be purchased. Map upgrades to the hard-drive unit need to be carried out by a Land Rover dealer using Land Rover approved diagnostic equipment.

TRAFFIC MESSAGE CHANNEL

The TMC (traffic message channel) traffic data is received via the **FM (frequency modulation)** radio antenna and broadcast in many European countries.

TMC is a function of the FM, **RDS (radio data system)**, which broadcasts real-time traffic and weather information. Data messages are received and decoded by the TSD and passed onto the navigation system to inform the driver of impending traffic congestion and if possible provide an alternative route.

TMC conforms to a global standard that has been adopted by:

- Traffic data gatherers
- Information service providers
- Broadcasters
- Vehicle/receiver manufacturers

All TMC receivers use the same list of event codes, while the location database (on the hard-drive) contains both a country-specific set of location codes for the strategic European road network.

VEHICLE INFORMATION AND COMMUNICATION SYSTEM

VICS (vehicle information and communication system) is broadcast in the Japanese market.

VICS supplies the navigation system with information that enables the TSD to inform the vehicle driver of traffic conditions in the vehicle's vicinity and calculate an alternative route if necessary. Information is transmitted to the navigation system through three routes as headlined below:

Radio Frequency Transmission

Radio frequency transmission is generally transmitted from road side beacons mainly on highways. The information transmitted is:

- Traffic congestion
- Travel time to next intersection
- Traffic conditions in surrounding areas and highway junctions
- Traffic accidents
- Speed limits
- Lane regulations
- Tire chains regulations
- Parking availability at highway service areas and parking areas.

Infra-red Transmission

Infra-red transmission is received by the VICS beacon antenna mounted on the top of the instrument panel. Infra-red transmissions are transmitted from road-side beacons on major trunk roads. The information transmitted is:

- Traffic congestion and travel time
- Traffic accidents
- Breakdowns
- Road works restrictions
- Parking availability.

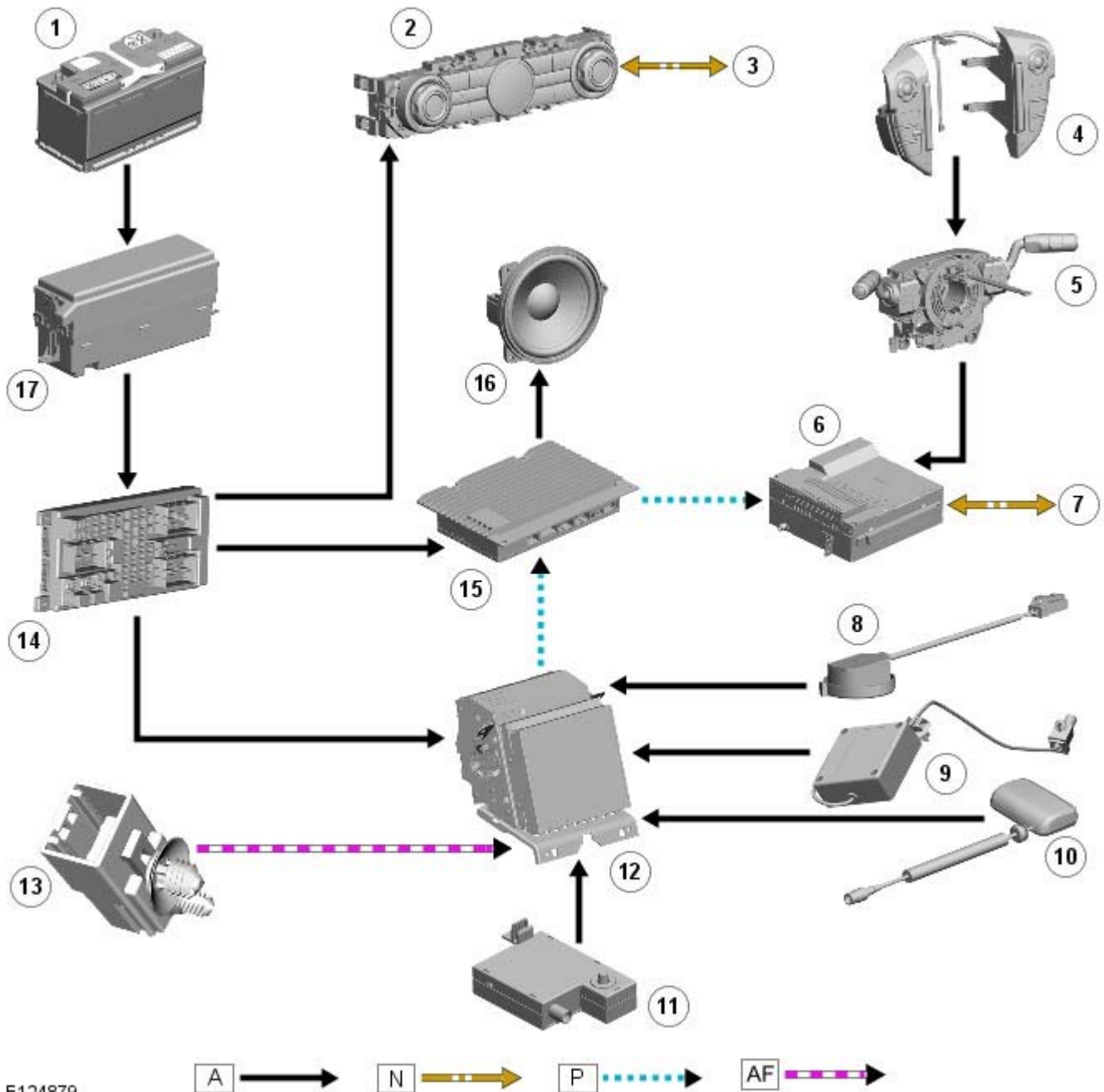
FM Transmissions

FM transmissions are received via the FM antenna and broadcast as part of the normal RDS FM transmission. The information transmitted is:

- Traffic congestion and travel time for wide areas
- Traffic accidents, road works, speed limits and lane restrictions for a wide area
- Parking availability information.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **N** = Medium Speed CAN; **P** = MOST; **AF** = Firewire.



Item	Part Number	Description
1	-	Battery
2	-	Integrated control panel, incorporating navigation switch
3	-	Medium speed CAN bus connection to other vehicle systems
4	-	Steering wheel switches
5	-	Clockspring
6	-	IHU (integrated head unit)
7	-	Medium speed CAN bus connection to other vehicle systems
8	-	Microphone - voice recognition
9	-	GPS antenna
10	-	VICS beacon antenna - Japan only
11	-	'TMC (traffic message channel tuner' or 'VICS receiver - Japan only'
12	-	TSD (touch screen display)
13	-	Navigation update socket
14	-	CJB (central junction box)
15	-	Power amplifier
16	-	Speakers
17	-	EJB (engine junction box)

PRINCIPLES OF OPERATION

The system used to calculate the current position of the vehicle is called the [GPS](#). Satellites transmit radio signals to provide information about the satellite's position, for example the latitude, longitude, altitude, almanac data and an accurate time signal generated by an on-board atomic clock. Each satellite contains four atomic clocks.

The vehicle needs to receive data from at least four different satellites to give a three dimensional fix on its current

position.

As the vehicle moves, this information is continually being updated. The TSD determines which satellites are 'visible' to the system and their current position and relationship to each other. Using this information the TSD can account for positional deviations of the satellites and compensate to enhance the accuracy of the navigation system.

The GPS signal is also known as the PPS (precision positioning signal).

PPS predictable accuracy is:

- 22 meters horizontal accuracy
- 27.7 meters vertical accuracy
- 200 nanoseconds time accuracy.

The navigation system receives GPS information via the GPS antenna. The GPS signals are used by the TSD to calculate the vehicles position. Once the driver has input a desired destination the TSD can calculate a route, based on the driver's pre-determined preferences or the default settings in the TSD.

The navigation system is accessed by pressing the navigation switch on the integrated control panel.

Navigation is initiated by the driver entering a destination. This can be achieved by:

- Entering in an address using the touch screen display.
- Entering a post code.
- Choosing a previous destination.
- Choosing a point of interest from the hard drive database.
- Choosing the home location.
- Choosing a memory stored location.

The driver is then guided to the destination by a scrolling map display and voice guidance. The display can be varied by scale and display type.

In addition to the navigation system there are two market dependant systems that supply extra information to the navigation system and the driver. These are:

- TMC (traffic message channel – Europe only).
- VICS (vehicle information and communication system) - Japan only.

Limited Satellite Contact

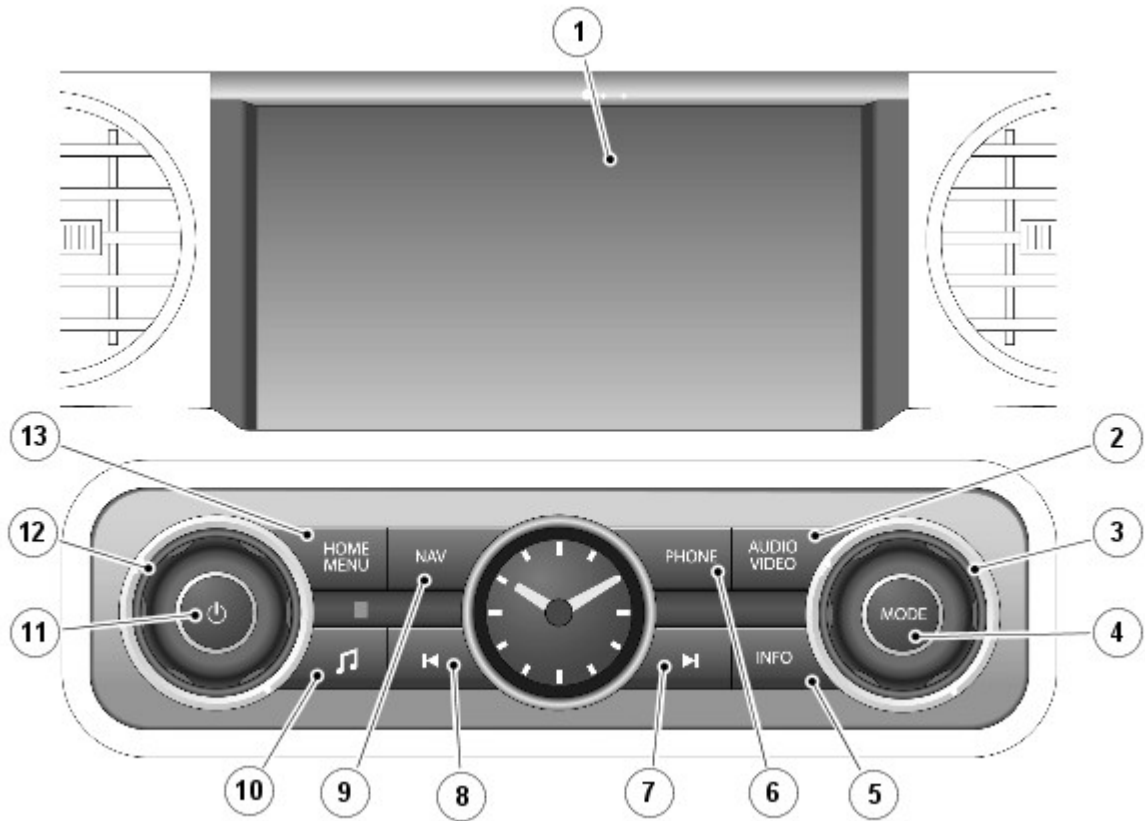
It is possible to maintain the vehicle's positional information when there is limited or no satellite contact, for example when the vehicle is in a:

- tunnel or underpass
- covered car park
- street lined with tall buildings
- or dense forest.

When the vehicle is in one of these conditions the vehicle's position is maintained by both the gyroscope sensor contained in the TSD and the vehicle speed signal. The speed signal is supplied by the ABS module and transmitted via the high-speed CAN to the CJB it is then transmitted by a hard-wired signal to the TSD.

NAVIGATION SYSTEM COMPONENTS

Touch Screen Display (TSD)



E124877

Item	Part Number	Description
1	-	Touch screen display
2	-	Access Audio/Video Menu
3	-	Scroll up down (menu control)
4	-	Mode
5	-	Traffic/News information
6	-	Access Phone Menu
7	-	Search up/increase
8	-	Search down/increase
9	-	Access Navigation Menu
10	-	Tone hard key
11	-	Audio on/off
12	-	Volume
13	-	Access touch screen Home Menu

The TSD (touch screen display) and Integrated Control Panel are located in the center of the instrument panel and are the driver's control interface for the navigation system. The TSD is connected to the MOST ring and communicates with the other components in the audio/infotainment system.

The TSD is a seven inch touch sensitive, 1280 X 480 pixels LCD (liquid crystal display) VGA screen.

In addition to the navigation system the TSD and the Integrated Control Panel provides the driver with display and control of various other vehicle functions.

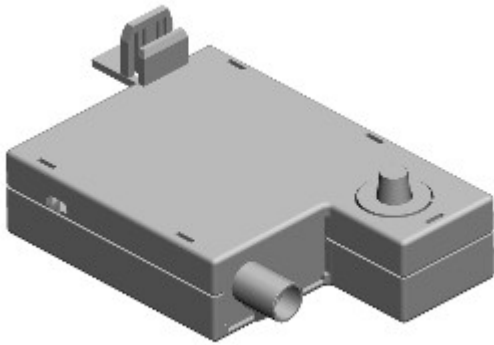
Microphone



E124819

The microphone is located in the front interior lamp console. The standard, directional type microphone is connected to the Touch Screen Display (TSD) for voice recognition of the navigation system and the telephone. The microphone has an integrated noise suppression system for hands-free telephone use.

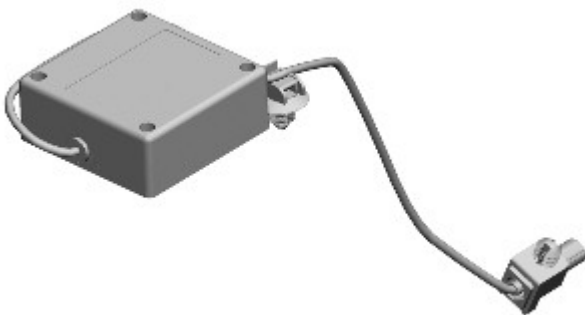
TMC Antenna Amplifier



E124881

The TMC (traffic message channel) antenna amplifier is located above the rear left-hand-side window and is connected to the FM antenna which is integrated into the window. The TMC signals are received through the normal radio signals via the RDS (radio data system) and are routed separately from the radio signals via the TMC antenna amplifier to the Touch Screen Display unit.

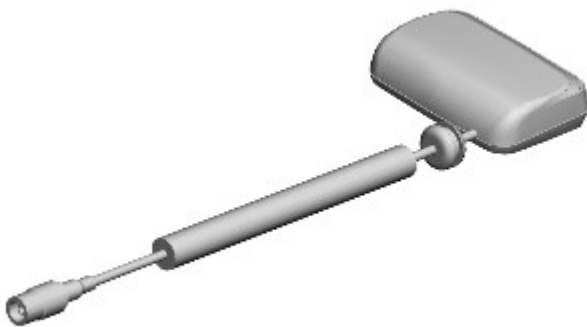
Global Positioning System Antenna



E124882

The [GPS](#) antenna is located in the rear spoiler and connected to the Touch Screen Display unit.

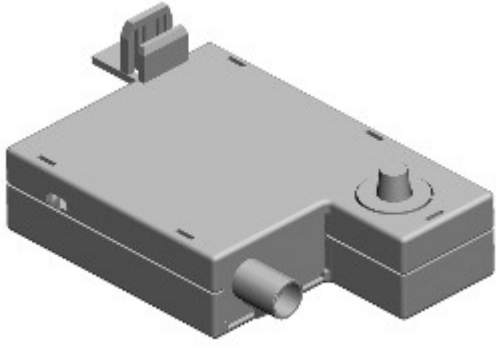
VICS Beacon Antenna (Japan only)



E124822

The VICS beacon is located on top of the instrument panel on the left-hand-side. The beacon is connected to the TSD via a screened co-axial cable.

VICS Antenna Amplifier (Japan only)



E124881

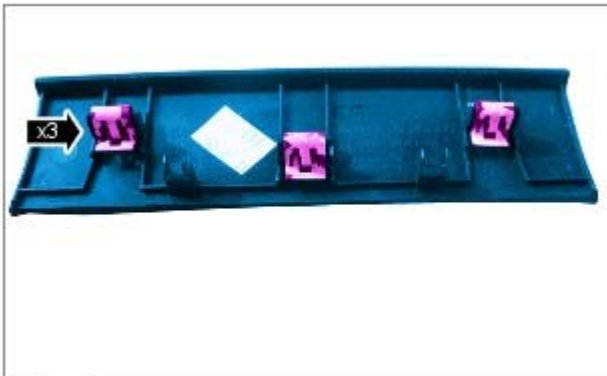
The VICS antenna amplifier is located above the rear left-hand-side window. The amplifier is connected to the TSD unit.

Navigation System - Navigation System Display Module

Removal and Installation

Removal

1.



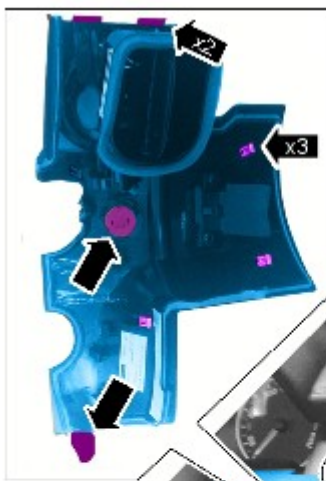
2. *Torque: 2.5 Nm*





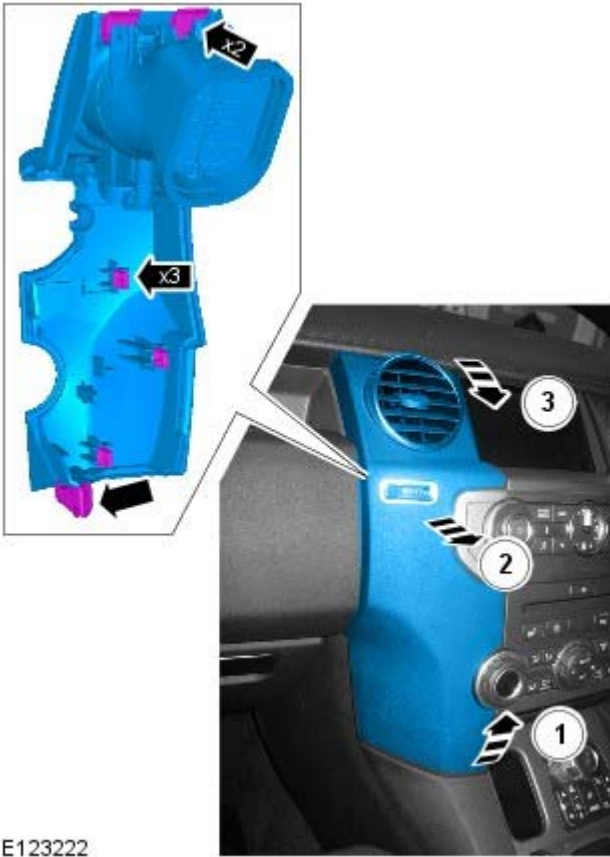
E123217

3.



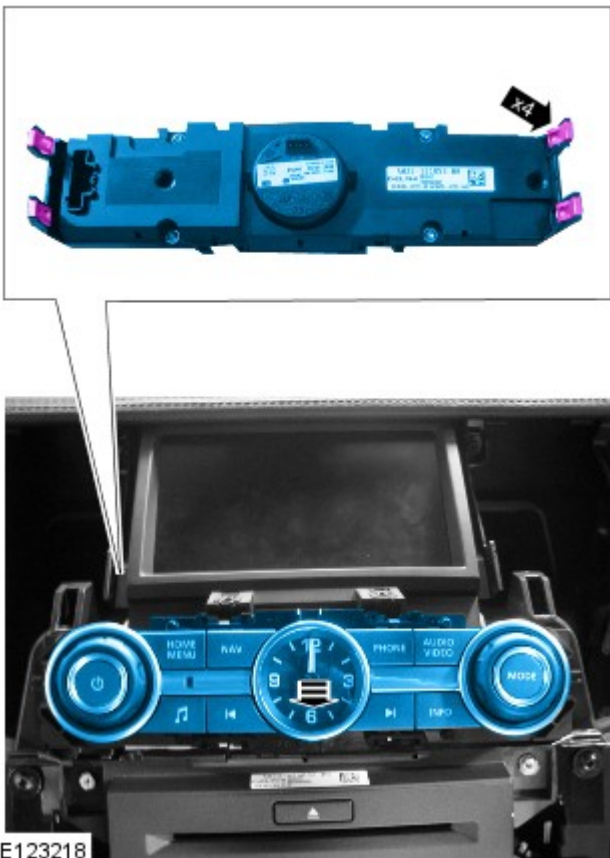
E122691

4. 4. NOTE: LHD illustration shown, RHD is similar.



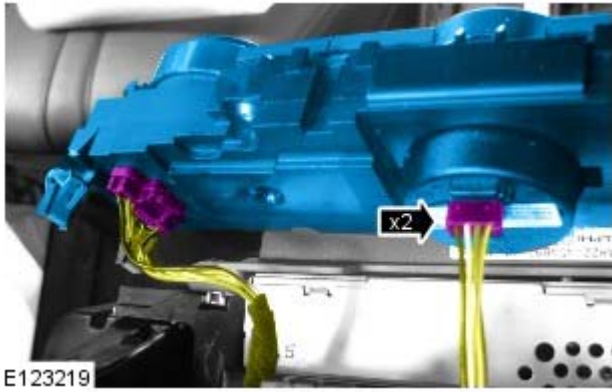
E123222

5.



E123218

6.



7.



8. Torque: 2.5 Nm





9. **NOTE:** Do not disassemble further if the component is removed for access only.

Installation

1. To install, reverse the removal procedure.
2. If a new component has been installed, configure using Land Rover approved diagnostic equipment.

Navigation System - Navigation System Traffic Amplifier

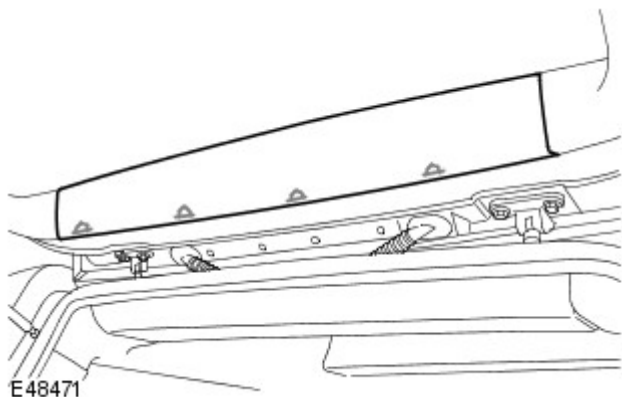
Removal and Installation

Removal

• NOTE: The navigation system traffic amplifier is located on the LH side of the liftgate. The diversity amplifier is located on the RH side of the liftgate. The procedure is similar for both components.

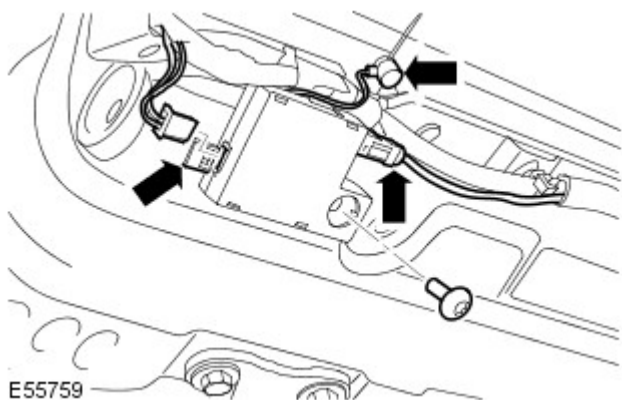
1. Remove the liftgate upper trim panel.

- Release the 4 clips.



2. Remove the navigation system traffic amplifier.

- Disconnect the 2 antenna cables.
- Disconnect the electrical connector.
- Remove the Torx bolt.
- Release the clip.



Installation

1. Install the navigation system traffic amplifier.

- Secure the clip.
- Tighten the Torx bolt to 10 Nm (7 lb.ft).
- Connect the electrical connector.
- Connect the antenna cables.

2. Install the liftgate upper trim panel.

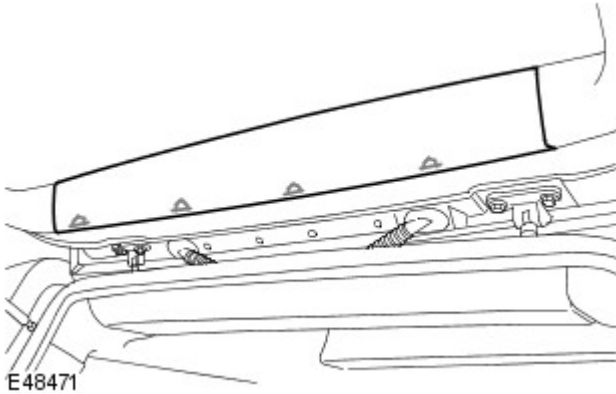
- Secure with the clips.

Navigation System - Navigation System Antenna

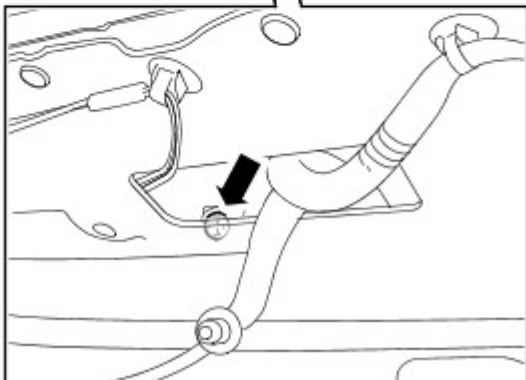
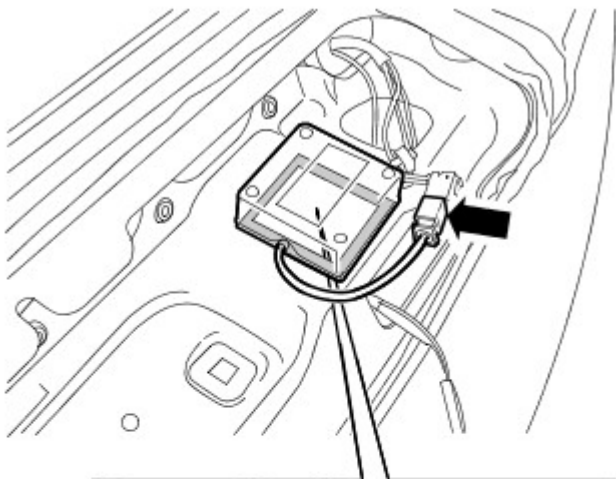
Removal and Installation

Removal

1. Remove the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the high mounted stoplamp.
For additional information, refer to: [High Mounted Stoplamp](#) (417-01 Exterior Lighting, Removal and Installation).
3. Remove the liftgate trim panel.
 - Release the 4 clips.



4. Remove the navigation system antenna.
 - Remove the screw.
 - Release and disconnect the electrical connector.
 - Cut through the adhesive retaining pad.



Installation

1. Clean the adhesive contact area.
2. Install the antenna.
 - Connect and secure the electrical connector.
 - Tighten the screw.

3. Install the liftgate upper trim panel.

- Secure the clips.

4. Install the high mounted stoplamp.

For additional information, refer to: [High Mounted Stoplamp](#) (417-01 Exterior Lighting, Removal and Installation).

5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Cellular Phone -

Torque Specifications

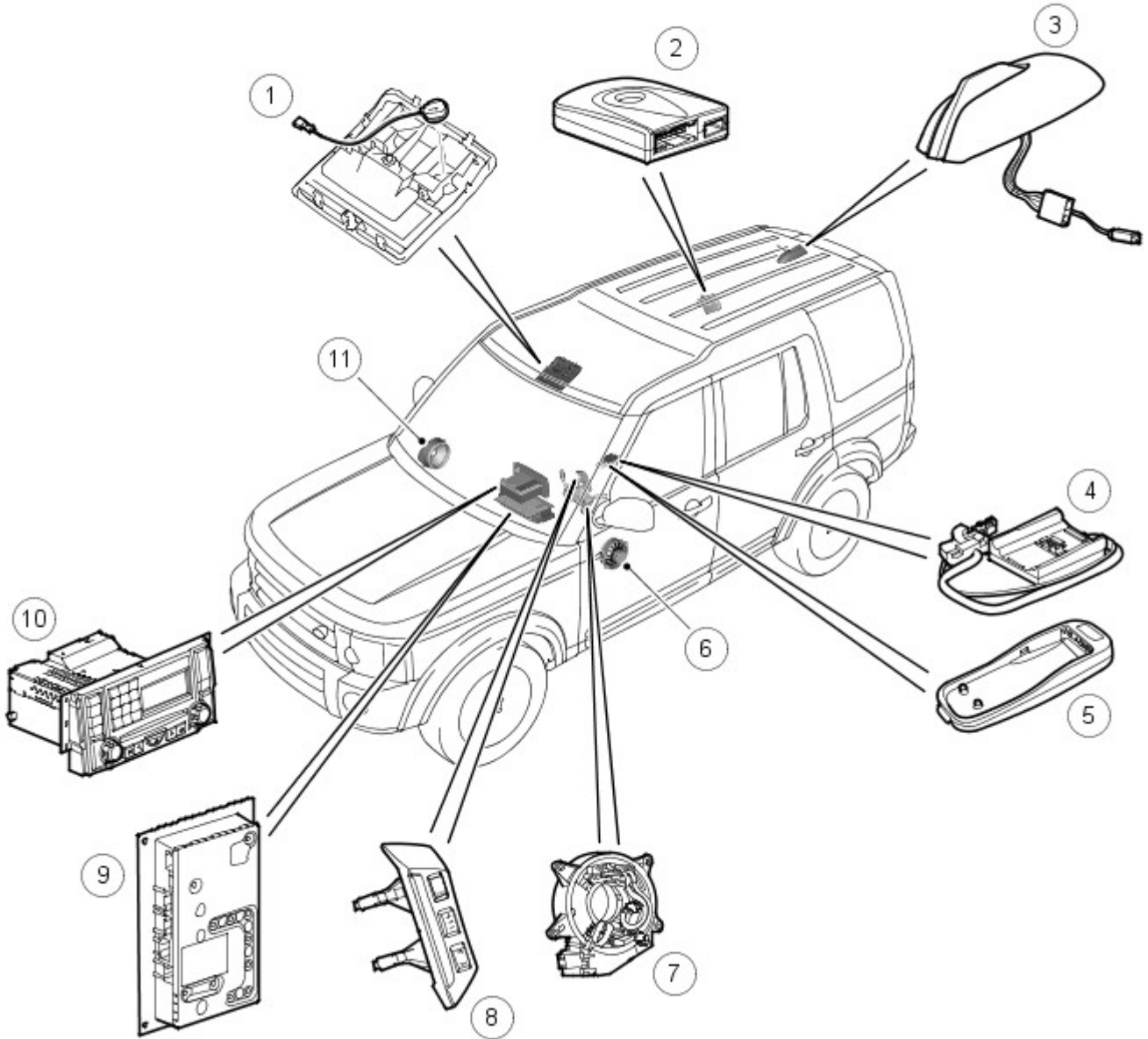
Description	Nm	lb-ft
Cellular phone antenna Torx screw	10	7

Cellular Phone - Cellular Phone

Description and Operation

CELLULAR PHONE SYSTEM (up to 2009 MY)

Cellular Phone Component Location (up to 2009 MY)



E48168

Item	Part Number	Description
1	-	Microphone
2	-	Transceiver Module (TM)
3	-	Cellular Phone Antenna
4	-	Base plate adaptor
5	-	Adaptor cradle
6	-	Speaker
7	-	Clock spring
8	-	Steering wheel switches
9	-	Amplifier
10	-	IHU
11	-	Speakers

The cellular phone system comprises:

- Transceiver Module (TM)
- Base plate adaptor
- Telephone cradle

- Microphone
- Cellular Phone Antenna

The telephone system fitted to the vehicle allows the driver to dock their own handset to the vehicle hands free telephone system. This is achieved using an adaptor cradle which is telephone specific. This cradle is mated to a standard baseplate which in turn is connected to the TM. The TM is connected to the MOST ring for communication with the rest of the system. For additional information, refer to: Communications Network (418-00 Module Communications Network, Description and Operation).

Transceiver Module



E48172

The Transceiver Module (TM) is located in the rear RH quarter of the luggage compartment. The TM is the interface between the telephone and the Integrated Head Unit (IHU). The TM also contains the telephone voice recognition hardware and software.

Transceiver Module Connector Pin Out C2777

Pin No	Description	Input/Output
1 to 15	NC	-
16	Ignition	Input
17	Battery voltage	Input
18	Battery voltage	Input
19 to 32	NC	-
33	Ground	-
34	Ground	-
35	NC	-
36	NC	-
37	Cellular phone ear piece +	Output
38	Cellular phone ear piece -	-
39	Cellular phone Mic piece +	Input
40	Cellular phone Mic. piece -	-
41	Wake up signal (non Nokia phone in cradle)	Input
42	Wake up signal (Nokia phone in cradle)	Input
43	NC	-
44	Steering wheel push to talk button	Input
45	Transmit/receive to phone	Input/Output
46	Shield ground	-
47	Serial transmission + (Nokia F bus)	Output
48	Serial transmission - (Nokia F bus)	-
49	Serial receive + (Nokia F bus)	Input
50	Serial receive - (Nokia F bus)	-
51	Cradle ID signal	Input
52	Cradle voltage supply	Input
53	Phone charge ground	-
54	Battery charging voltage	Output

Microphone



E48173

A single microphone is used for hands-free telephone operation and for the voice recognition system. The microphone has an integrated noise suppression system for hands-free telephone use. The microphone is a standard directional type and is located in the front roof console.

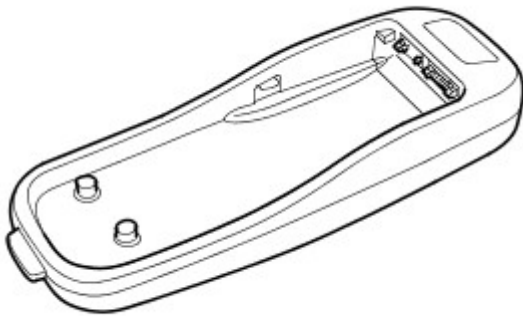
Cellular Phone Antenna



E48085

The Cellular Phone Antenna is located in the roof mounted pod and is connected via a single coaxial cable to the TM. For additional information, refer to: [Antenna](#) (415-02 Antenna, Description and Operation).

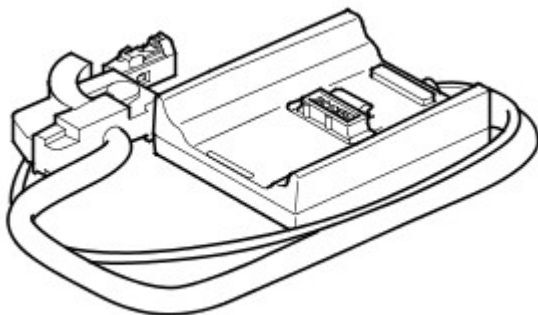
Telephone Adaptor Cradle



E48170

The telephone system allows for the use of different types/manufacturers handsets. This is achieved using a handset specific cradle which is mated to a standard base plate. The design of the adaptor cradle will vary to accommodate different types of phones.

Telephone Adaptor Base Plate



E48171

The base plate is located in the centre arm rest. The base plate is connected to the TM via a dedicated serial link.

TELEPHONE SYSTEM OPERATION (up to 2009 MY)

Telephone System

The telephone system can be operated from the IHU or via voice commands. The telephone system has the following functions:

- Receive a call
- Make a call
- Phone book

- Text message receive
- Telephone phone book download

The telephone system is accessed via the IHU. Once the phone is docked in the cradle it is possible to read/ download the phones own phone book to find a contact or phone number. A phone number can also be dialled into the key pad on the IHU.

Calls can be received or made by pressing the push to talk button on the steering wheel mounted controls.

SMS messages can only be made via the IHU with the handset in the cradle.

VOICE RECOGNITION (up to 2009 MY)

The Voice recognition system controls the following systems where fitted:

- Telephone
- Radio (inc satellite radio)
- CD / MP3 Changer
- Touch Screen Display (TSD)
- Note Pad
- Navigation

Voice control will not control Television or climate control system.

On vehicles without navigation system fitted the voice recognition software is held in the Transceiver Module (TM) and the microphone is hardwired directly into the TM. ON vehicles with navigation the voice recognition software is held in the navigation computer and the microphone is wired directly into the navigation computer and the TM. Vehicles with only no navigation system will have a slightly reduced functionality compared with vehicles that have navigation fitted as well as the phone.

The TM only houses voice recognition software for the telephone system.

Voice control enables the driver to activate important functions of the car telephone and navigation systems without needing to operate any controls manually. This allows the driver to concentrate fully on driving the vehicle. Whenever the driver issues one of the defined voice commands with the system active, the voice control system converts the command into a control signal for the telephone or navigation system. The system recognises which system the command is directed at and routes the direction accordingly. The driver is guided through the dialogues by announcements or questions.

Telephone

The telephone system allows the following to be accessed and controlled by the voice recognition function.

Dial Number

This allows the user to dial a number (up to 20 digits) by digit entry with editing facility and with number as built up and displayed on the instrument pack message centre. The maximum number of recognised digits to be entered in one go is 16.

Phonebook

This allows the user to store inputted phone numbers against inputted nametag. Nametags are user repeatable association names given to identify the numeric destination of the phone call.

This facility will allow 50 nametags with corresponding telephone numbers to be stored within the voice recognition Phonebook. This phonebook should not be confused with the phonebook held within the Sim card or mobile phone. The facility shall allow editing of the nametags and phonebook and also provide audible feedback of the recorded nametag. Where nametags are part of the audible Feedback the corresponding phone number shall be displayed in text form on the instrument pack message centre.

It is also possible to use the add name feature to enter a telephone number onto the IHU and then by voice recognition append a nametag and store this within the voice recognition phonebook.

Radio

The radio system allows the following to be accessed and controlled by the voice recognition function.

Radio On

This allows the user to switch on the radio function. "Radio On" switches the ICE system to Radio with the last station played.

Radio Tune

This allows the user to tune the radio the radio into the desired frequency and band.

Radio Presets

This allows the user to allocate frequency against a given band preset. The user must be tuned into the desired frequency and band prior to preset allocation. If a preset has already a stored frequency and band against that preset then the new frequency and band shall be allotted.

The Auto store feature instructs the radio to select the six strongest signals and allocate them against the auto store presets.

There shall be nine preset memory locations within each of the following band settings, FM, FMA, AM, AMA, MW, MWA and LW (only nine presets available for LW band therefore no Auto store available).

Voice commands will be available to allow the user to tune the radio to a given preset within the band that is currently tuned.

Radio Directory

This function allows the user to nametag the current frequency and band including satellite radio (SDARS). Nametags are user repeatable association names given to identify the frequency and band information thus allowing the radio to tune into the desired signal. This facility shall allow 20 nametags to be stored within the voice recognition. It shall be possible for the system to replay the whole of the directory with the ability to play or delete the stations announced. It should also be possible to individually delete nametags.

Where nametags are part of the audible Feedback the corresponding Frequency and Band shall be displayed in text form on the instrument pack message centre.

CD Changer

The CD changer system allows the following to be accessed and controlled by the voice recognition function.

The voice commands are standard control features with exception of controls that can be accessed on the steering wheel. Commands shall be available for up to 256 tracks on a CD. Text numeric format shall be 3 numbers i.e. track 6 is displayed as "006". MP3 Format discs have commands for Folder up/down. For additional information, refer to: Audio System (415-01 Audio Unit, Description and Operation).

Display

This function allows the user to change the TSD display mode by voice command.

Voice Recognition Settings

Voice Feedback On / Off

Allows the user to choose between having audible feedback or not for functions, other than some necessary functions, which must have audible feedback to operate.

Replay

The replay command requests the voice recognition system to repeat it's last dialogue response within a list in both audible and associated text feedback.

Notepad

The notepad function allows the user to record a series of 10 notes for up to 5 min.

The user shall be able to replay or delete the notes in the order that they were recorded. It shall also be possible to delete the whole notepad.

TMC

The TMC system is part of the navigation system and provides real time traffic information to the navigation system. The voice commands are On or Off.

For additional information, refer to: [Navigation System](#) (419-07 Navigation System, Description and Operation).

TMC also offers Dynamic route guidance. This is also a voice operated on/off function.

BLUETOOTH® (up to 2009 MY)

The TM has Bluetooth® functionality. Bluetooth® allows the user to connect their own mobile phone (Bluetooth® enabled only) to the vehicle telephone system. Once connected the user can use the vehicle hands free functions system. The Bluetooth® system limits the functions available to those that are present in the Bluetooth® hands free profile. The available features include:

- Make/receive a call.
- Voice calls using the phones own voice tags (where set up).

Bluetooth® will not allow the following to be accessed via the IHU:

- SMS
- No signal strength indication in the IHU
- Phonebook download to the IHU
- Missed calls
- Last number redial
- Calls list

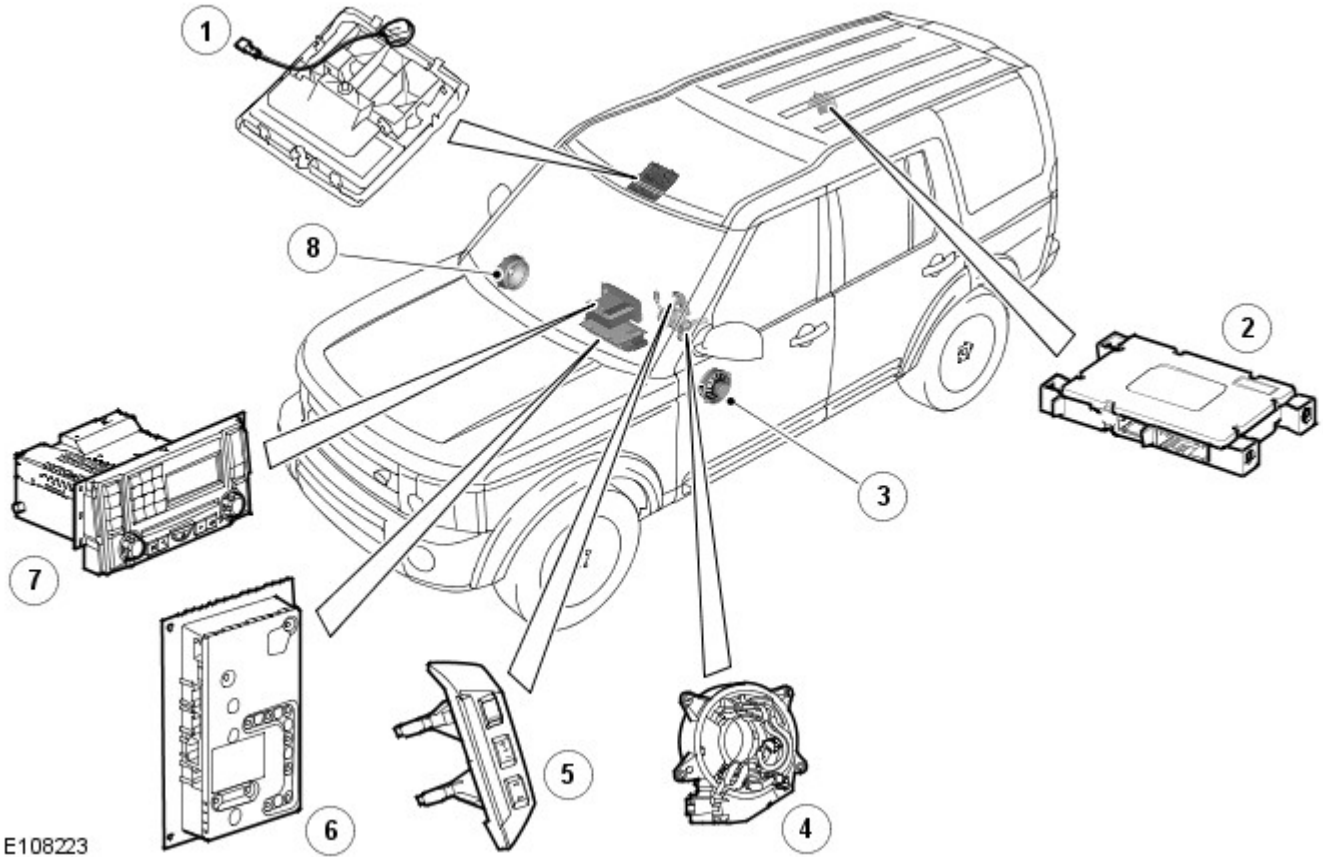
Prior to the Bluetooth® equipped phone being used on the vehicle hands free system the phone must be paired to the TM. The following describes the pairing process.

- Switch Bluetooth "ON" on the handset.
- The user initiates a search for other Bluetooth devices from the handset.
- The TM acknowledges the existence of the Bluetooth® phone.
- Land Rover appears in the handset available device list.
- The user selects Land Rover from the device list and the TM will attempt pairing.
- TM requests a PIN number from the phone.
- The user enters the phone PIN number (this will be supplied by the dealer or will be marked on the side of the TM, use the last four characters of the serial number).
- If the PIN number is correct the phone is paired with the TM and its details are stored in the TM EEPROM.
- If the PIN number is correct the phone is paired with the TM and the TM details are stored in the handset.

7	-	Transceiver Module (TM)
8	-	Cellular Phone Antenna
9	-	Clock spring
10	-	Steering wheel switches
11	-	Microphone

CELLULAR PHONE SYSTEM (2009 MY Onwards)

Cellular Phone Component Location (2009 MY Onwards)



E108223

Item	Part Number	Description
1	-	Microphone
2	-	Bluetooth® phone module
3	-	Speaker
4	-	Clock spring
5	-	Steering wheel switches
6	-	Amplifier
7	-	Integrated head unit
8	-	Speaker

BLUETOOTH® (2009 MY Onwards)

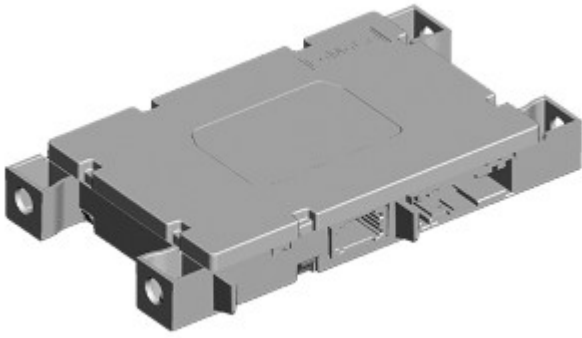
The Bluetooth® phone module allows the user to connect their own mobile phone handset (Bluetooth® enabled only) to the vehicle telephone system.

Once connected, the user can use the vehicle hands free functions although, the Bluetooth® system limits the functions to those available in the Bluetooth® hands free profile.

The available features include:

- Make/receive call
- Voice calls using the phones own voice tags (where set up)
- Signal strength indication on the Touch Screen Display (if supported by the telephone handset software)
- Phonebook download
- Missed calls
- Last number redial
- Calls list.

Bluetooth® Phone Module



E96494

The Bluetooth® phone module is connected to the MOST ring and is the interface between the telephone and the Integrated Header Unit, it processes all instructions and audio 'from and to' the phone.

TELEPHONE SYSTEM OPERATION (2009 MY Onwards)

Compatible Bluetooth® mobiles can communicate with the vehicle's inbuilt telephone system. Connection must be made with ignition on or engine running.

Initial pairing of the phone to the vehicle

To prepare the mobile phone for pairing to the system, refer to the telephone manufacturer's instructions, or follow the table in the vehicle handbook for generic commands.

When the handset has been successfully paired to the system, Bluetooth® will appear on the phone menu screen.

Bluetooth® selection

A maximum of 5 phones can be paired to the vehicle.

When the starter key is turned on, the vehicle searches for up to 5 previously paired phones, starting with the most recent pairing.

Before attempting a new pairing, wait for 30 seconds for this process to complete.

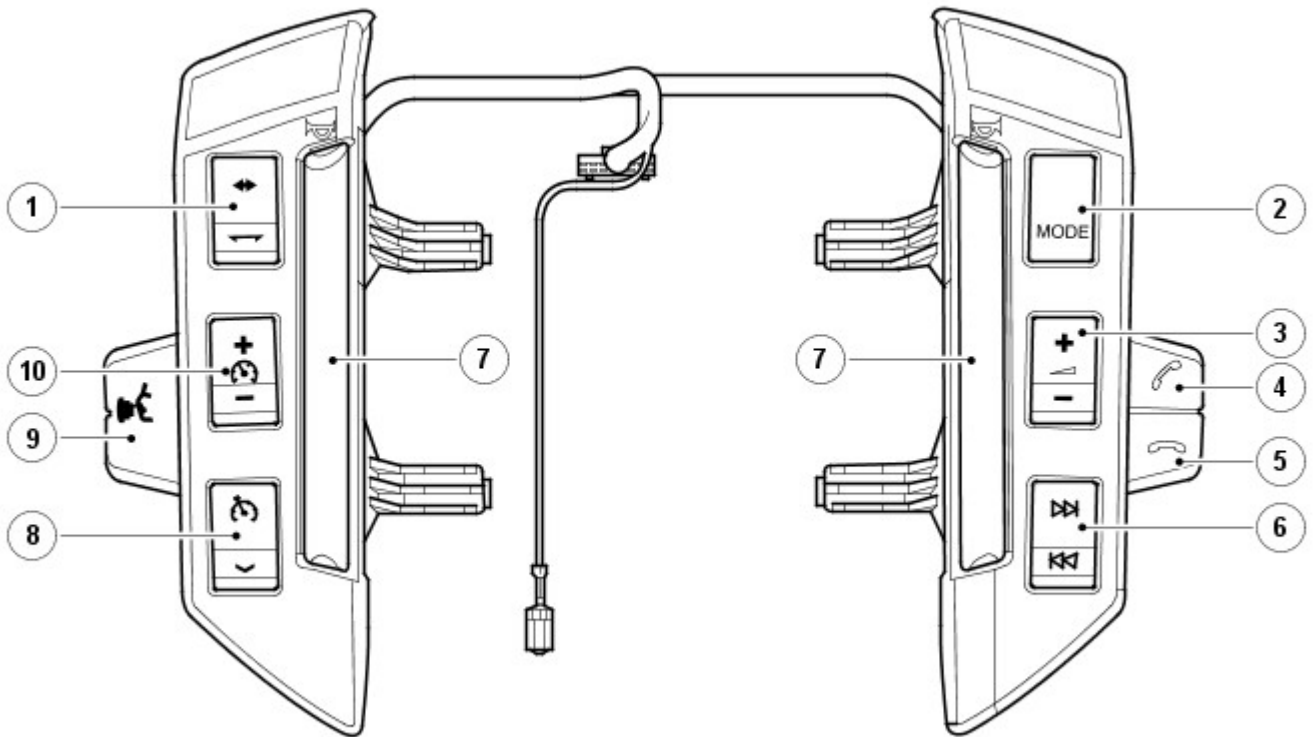
Making a call

Refer to vehicle's handbook.

Voice recognition

There is no Voice Recognition system on the Bluetooth® phone; refer to section **Voice Recognition (up to 2009 MY)**, for voice recognition information on other vehicle systems.

Steering Wheel Control Switches



E58417

Item	Part Number	Description
1	-	Adaptive speed control gap adjustment switches
2	-	Audio mode change switch
3	-	Audio volume control
4	-	Send key
5	-	End key
6	-	Audio system up/down
7	-	Horn
8	-	Speed control ON/OFF/ set speed
9	-	Push to talk voice recognition switch (Navigation System Only)
10	-	Speed control set speed adjust

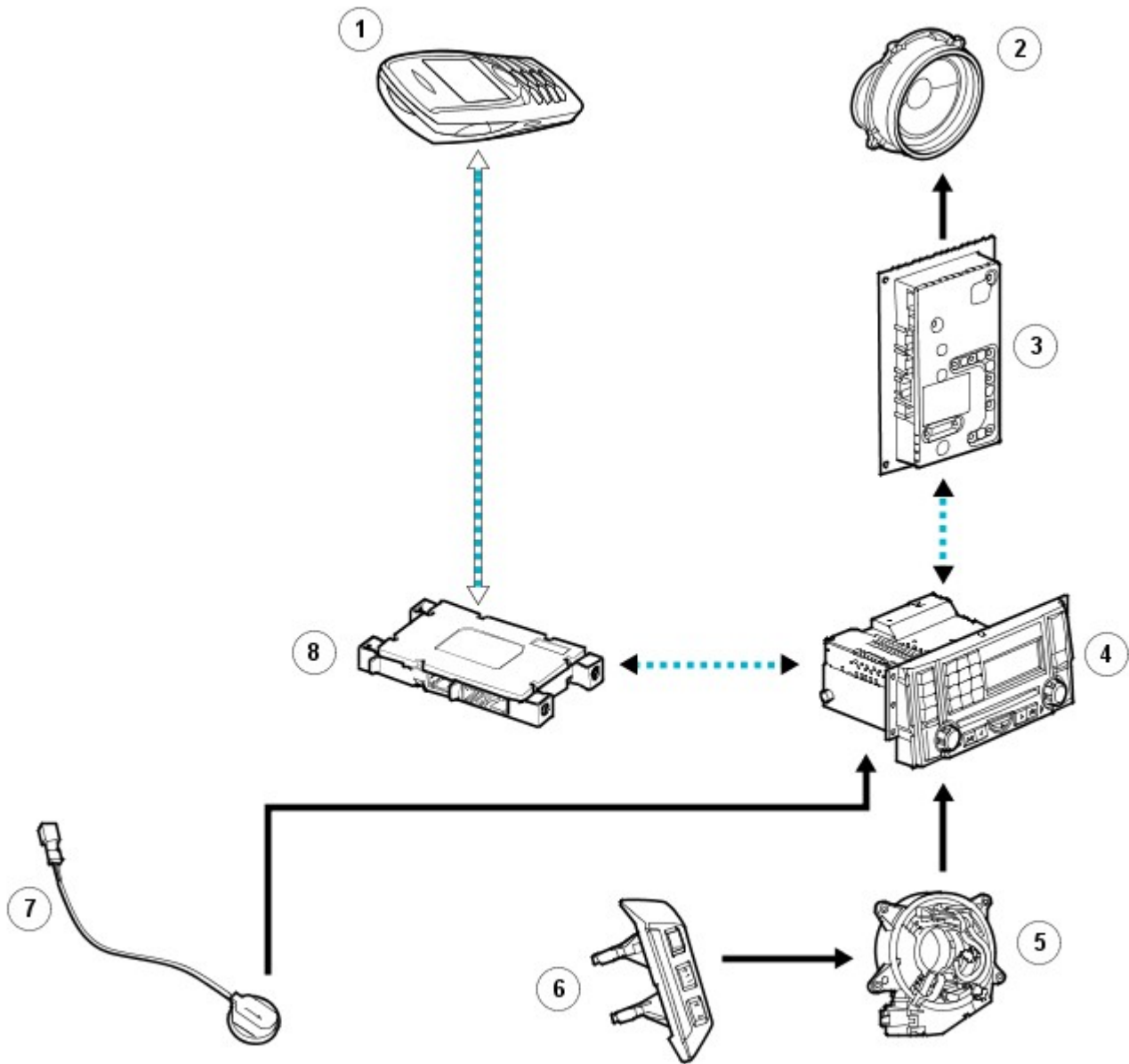
The Steering wheel control switches allow the driver to:

- Receive a phone call.
- End a phone call.

The switches operate on a resistive ladder principle. A voltage is supplied to the switches and dependant upon which button is pressed a reduced voltage is returned to the head unit or the applicable vehicle system.

Cellular Phone Control Diagram (2009 MY Onwards)

- NOTE: A = Hardwired; P = MOST; AB = Bluetooth®



E108191

A →

P - - - - - →

AB ······ →

Item	Part Number	Description
1	-	Bluetooth® cellular phone
2	-	Speaker
3	-	Amplifier
4	-	Integrated head unit
5	-	Clockspring
6	-	Steering wheel switches
7	-	Microphone
8	-	Bluetooth® phone module

Cellular Phone - Cellular Phone Antenna Vehicles With: Metal Roof Panel

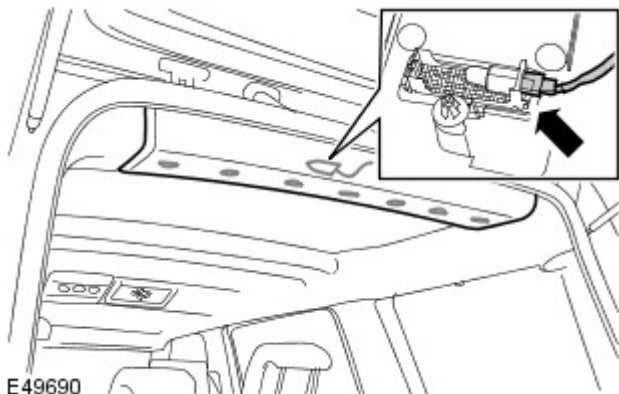
Removal and Installation

Removal

- NOTE: For certain markets, the SDARS antenna is also part of the cellular phone antenna.

1. Remove the rear headliner trim panel.

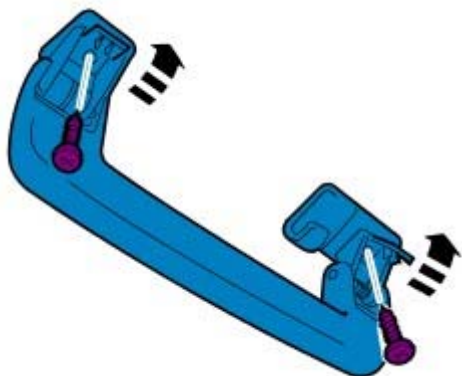
- Release the 7 clips.
- Disconnect the interior light electrical connector.



E49690

2. If installed remove the LH third row seat passenger assist handle.

- Carefully release the screw covers.
- Remove the 2 screws.



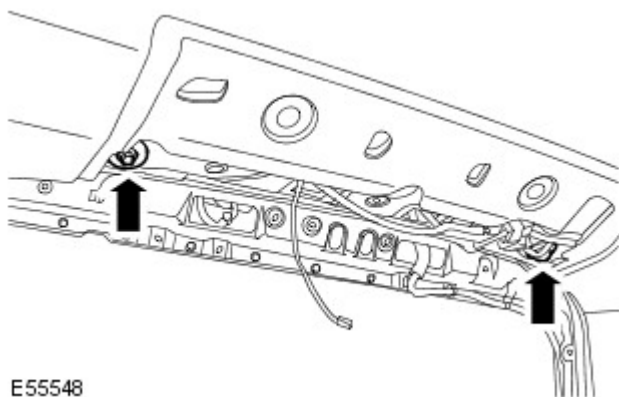
E49689

3. If installed, remove the RH third row seat passenger assist handle.

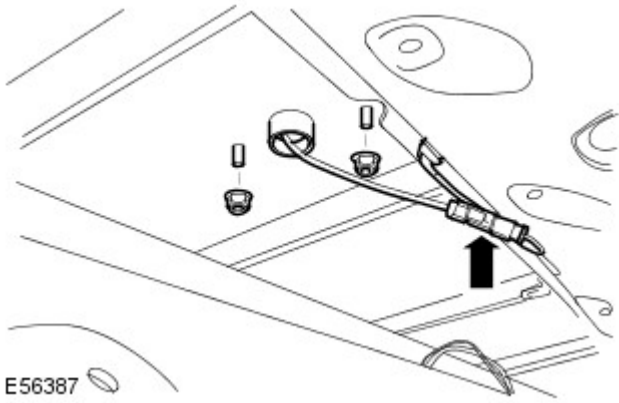
- Carefully release the screw covers.
- Remove the 2 screws.

4. Release the rear of the headliner.

- Release the 2 clips.



E55548




5. Remove the cellular phone antenna.
 - Disconnect the electrical connector.
 - Remove the 2 nuts.

Installation

1. Install the cellular phone antenna.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Attach the rear of the headliner.
 - Secure with the clips.
3. Install the RH third row seat passenger assist handle, if installed.
 - Tighten the screws.
 - Attach the covers.
4. Install the LH third row seat passenger assist handle, if installed.
 - Tighten the screws.
 - Attach the covers.
5. Install the rear headliner trim panel.
 - Secure in the clips.
 - Connect the electrical connector.

Cellular Phone - Cellular Phone Antenna Vehicles With: Glass Roof Panel

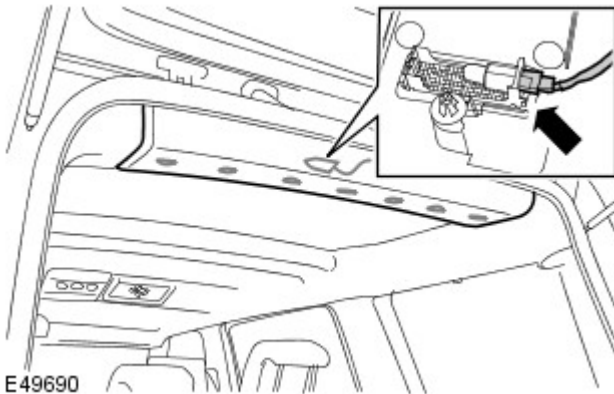
Removal and Installation

Special Tool(s)	
<div>419-002</div>  <div>E57688</div>	Torx bit, phone/SDARS antenna 419-002

Removal

- NOTE: For certain markets, the SDARS antenna is also part of the cellular phone antenna.

1. Remove the rear headliner trim panel.

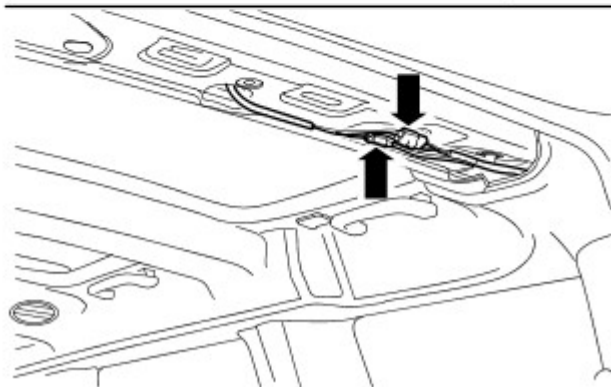
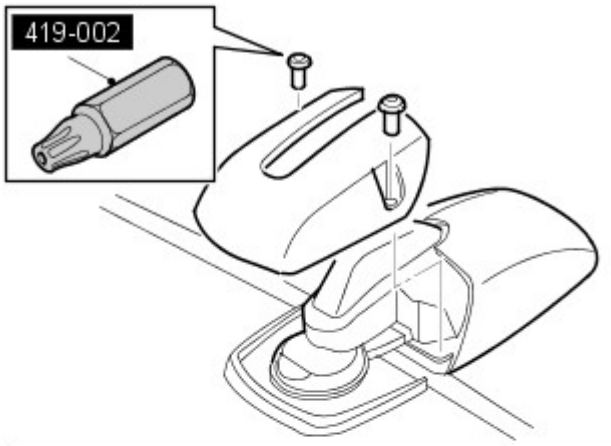


E49690

- Release the 7 clips.
- Disconnect the interior light electrical connector.

2. Remove the cellular phone antenna.

- Disconnect the electrical connector.
- Using the special tool, remove the 2 Torx bolts.



E56388

Installation

1. Install the cellular phone antenna.

- Tighten the bolts to 6 Nm (4 lb.ft).
- Connect the electrical connector.

2. Install the rear headliner trim panel.

- Secure in the clips.
- Connect the electrical connector.

Cellular Phone - Transceiver Module

Removal and Installation

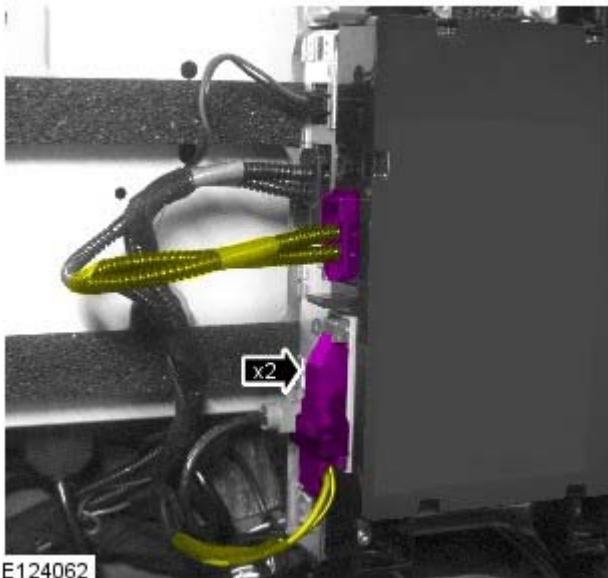
Removal

- NOTE: Removal steps in this procedure may contain installation details.

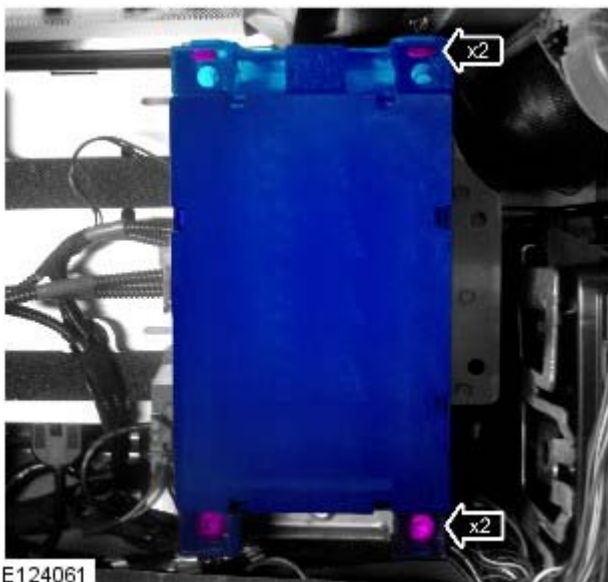
1. Remove the RH lower rear quarter trim panel.

Refer to: [Rear Quarter Trim Panel](#) (501-05 Interior Trim and Ornementation, Removal and Installation).

- 2.



3. Torque: 10 Nm



Installation

1. To install, reverse the removal procedure.

Multifunction Electronic Modules - Driver Door Module (DDM)

Diagnosis and Testing

Principles of Operation

For a detailed description of the Driver/Passenger door systems and operation, refer to the relevant Description and Operation sections in the workshop manual.

Inspection and Verification

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Switches/mechanisms 	<ul style="list-style-type: none"> ● Fuses ● Electrical connectors ● Harnesses ● Modules

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of DTCs that may be logged on this vehicle, refer to the DTC Index in section 100-00.

REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Door Module \(DDM/PDM\)](#) (100-00 General Information, Description and Operation).

Multifunction Electronic Modules - Driver Seat Module (DSM)

Diagnosis and Testing

Principles of Operation

For a detailed description of the Driver/Passenger seat systems and operation, refer to the relevant Description and Operation sections in the workshop manual.

Inspection and Verification

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Switches/mechanisms 	<ul style="list-style-type: none"> ● Fuses ● Electrical connectors ● Harnesses ● Modules

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

For a list of DTCs that may be logged on this vehicle, refer to the DTC Index in section 100-00.

REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Front Seat Module \(DSM/PSM\)](#) (100-00 General Information, Description and Operation).

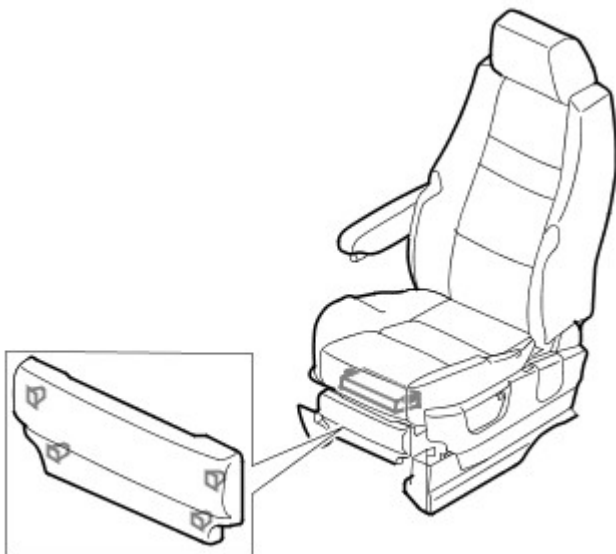
Multifunction Electronic Modules - Driver Seat Module (DSM)

Removal and Installation

Removal

1. Remove the front seat cushion front access cover.

- Release the 4 clips.



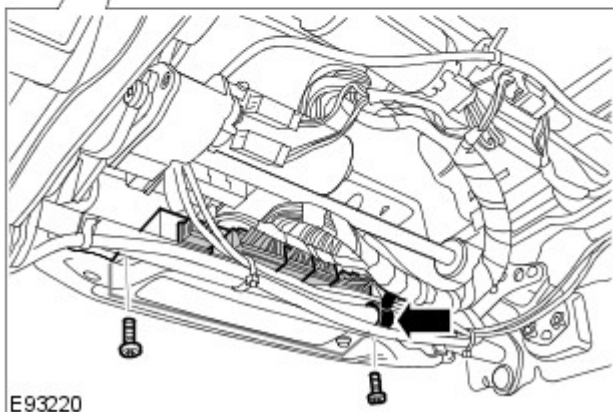
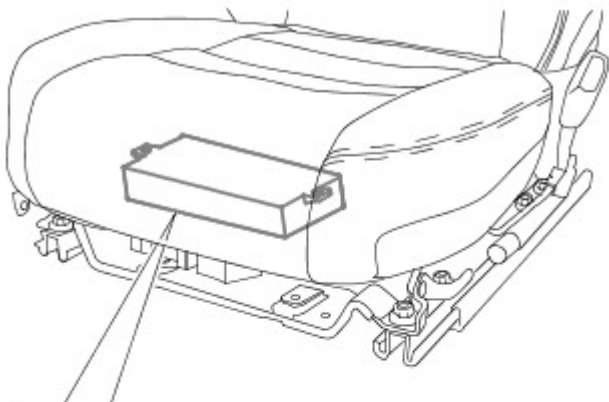
E93329

2.  CAUTION: Note of the routing of the wiring harnesses.

- NOTE: Raise the seat base for access.


Remove the driver seat module.

- Remove the 2 Torx screws.
- Release the harness clip.
- Disconnect the 5 electrical connectors.



E93220

Installation

1.  CAUTION: Make sure that the wiring harnesses are correctly routed.

Install the driver seat module.

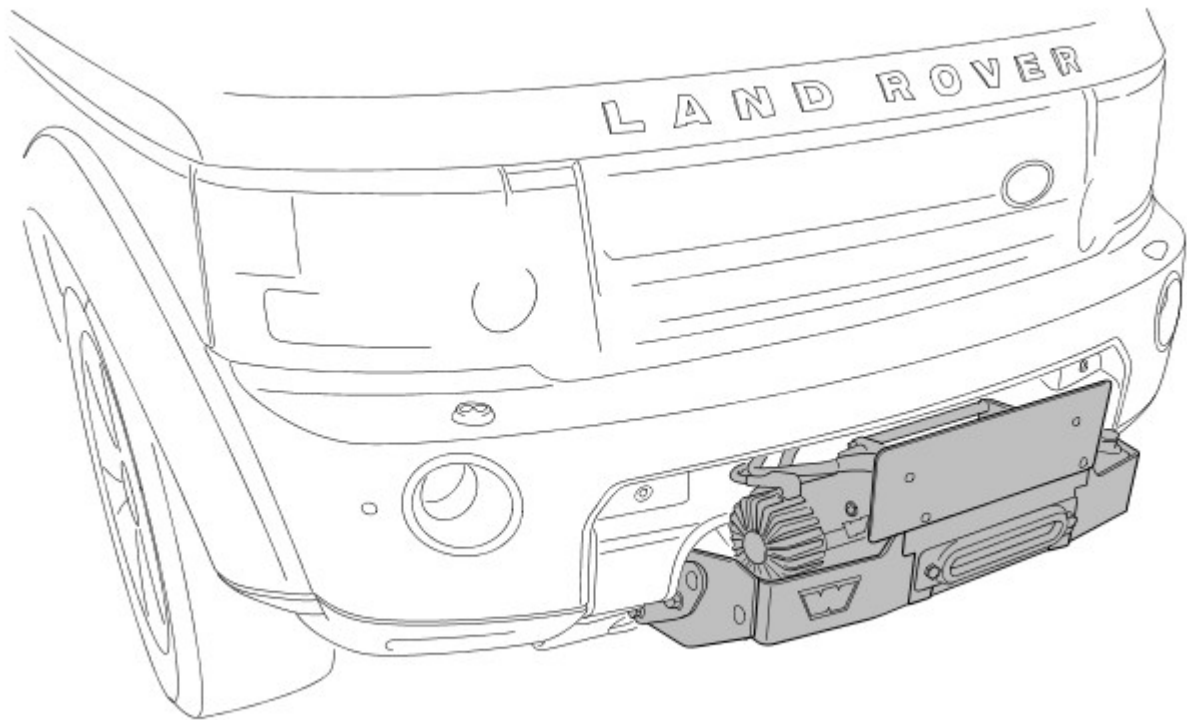
- Connect the electrical connectors.

- Attach the wiring harness clip.
 - Install and tighten the Torx screws.
2. Install the access cover.
- Secure in the 4 clips.
3. If a new module has been installed, carry out initialization.
- Using each adjustment switch in turn, move the seat fully in all directions.

Winch - Winch - Component Location

Description and Operation

COMPONENT LOCATION



E136475

Winch - Winch - Overview

Description and Operation

OVERVIEW

The 9.5XP winch is manufactured by WARN in the U.S.A. The winch features a 6 Horse Power (HP) High Output Parallel Series Wound winch motor.

The winch has 3-stage planetary gearing and full-face contact drum seals, motor and end housing gaskets for extreme duty water resistance.

SPECIFICATIONS:

- WARN Part number: 70100 (12V)
- Rated Line Pull: 9,500 lbs. (4310 kgs) single-line
- Intended Use/Application: Vehicle Recovery
- Motor: 12V 6 hp, High Output Parallel Series Wound
- Remote Control: Remote switch, 12' (3.7m) lead
- Geartrain: 3-Stage Planetary Gear Ratio: 156:1
- Lubrication: 76 Moly low temperature
- Clutch (freespooling): Sliding Ring Gear
- Brake: Automatic Direct Drive Cone
- Wire Rope: 100', 5/16" diameter (30m, 8mm diam.)
- Fairlead: Hawse
- Recommended Battery: 650 CCA minimum for winching
- Battery Leads: 2 gauge, 85" (2.20m)
- Finish: High-gloss dark gray powder coat
- Drum Diameter/Length: 2.5"/9.0" (6.4cm/23cm)
- Weight: 87 lbs. (39.5 kgs.) (winch only, not including mounting cradle).

12V DC PERFORMANCE SPECIFICATIONS:

Line Pull Lbs.(Kgs.)	Line Speed FT./min(M/min.)	Motor Current	Pull by Layer: Layer/Lbs(Kgs.)
0	38 (11.6)	70 Amps	1/9500 (4313)
2000 (910)	16.8 (5.1)	175 Amps	2/8650 (4927)
4000 (1818)	12.8 (3.9)	262 Amps	3/7920 (3595)
6000 (2720)	10.1 (3.1)	335 Amps	4/7400 (3359)
8000 (3630)	8.8 (2.7)	425 Amps	5/6940 (3150)
9500 (4310)	7.6 (2.3)	480 Amps	-

The above performance figures are based on the first layer of the drum.

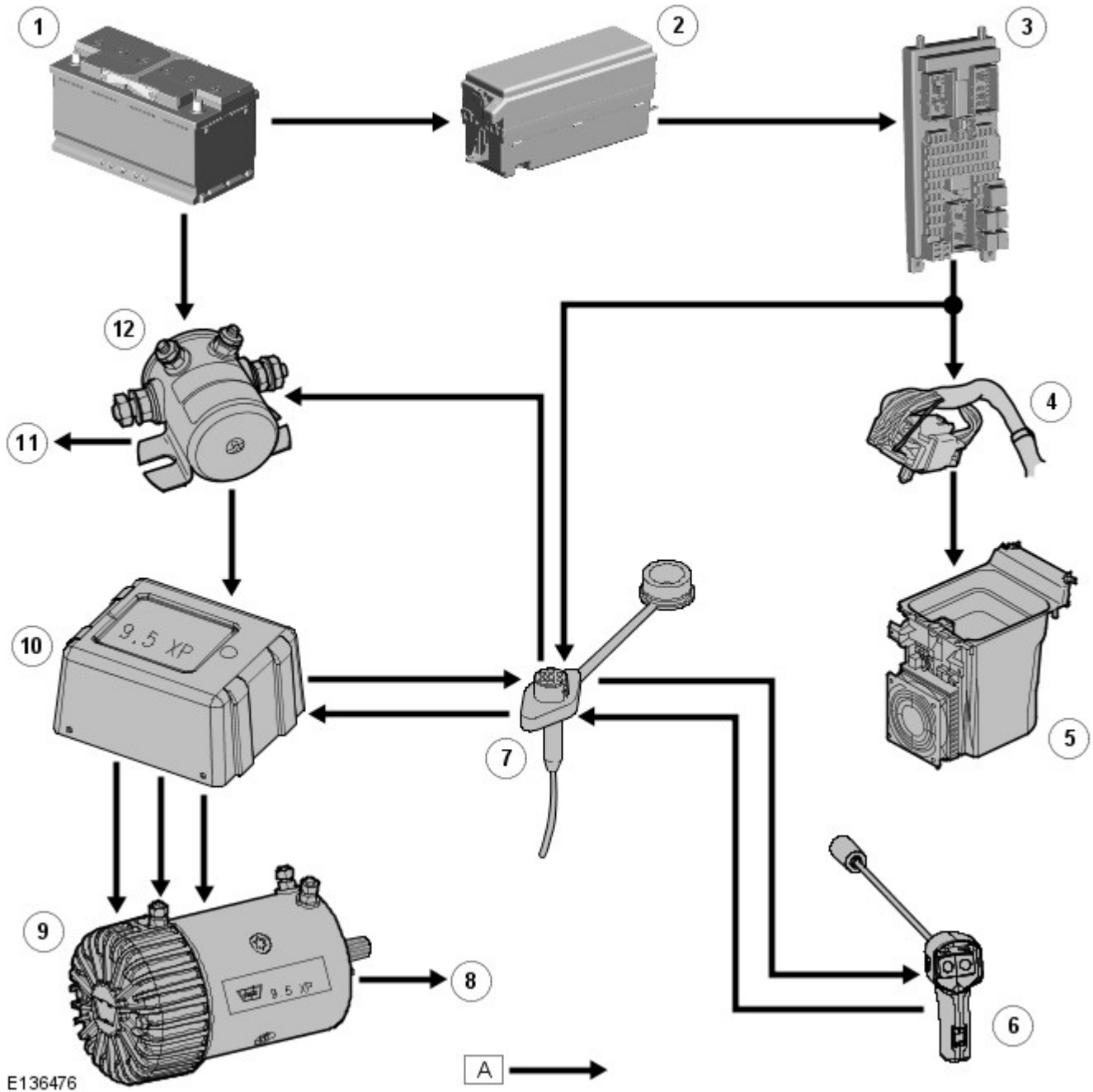
Winch - Winch - System Operation and Component Description

Description and Operation

Control Diagram

• NOTE: A = Hardwired

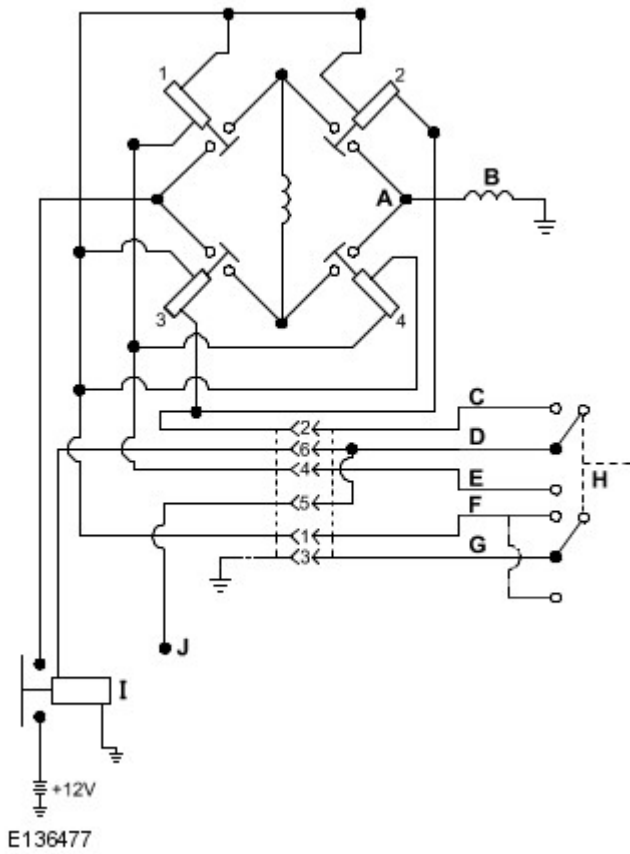
Vehicle connection



E136476

ItemDescription

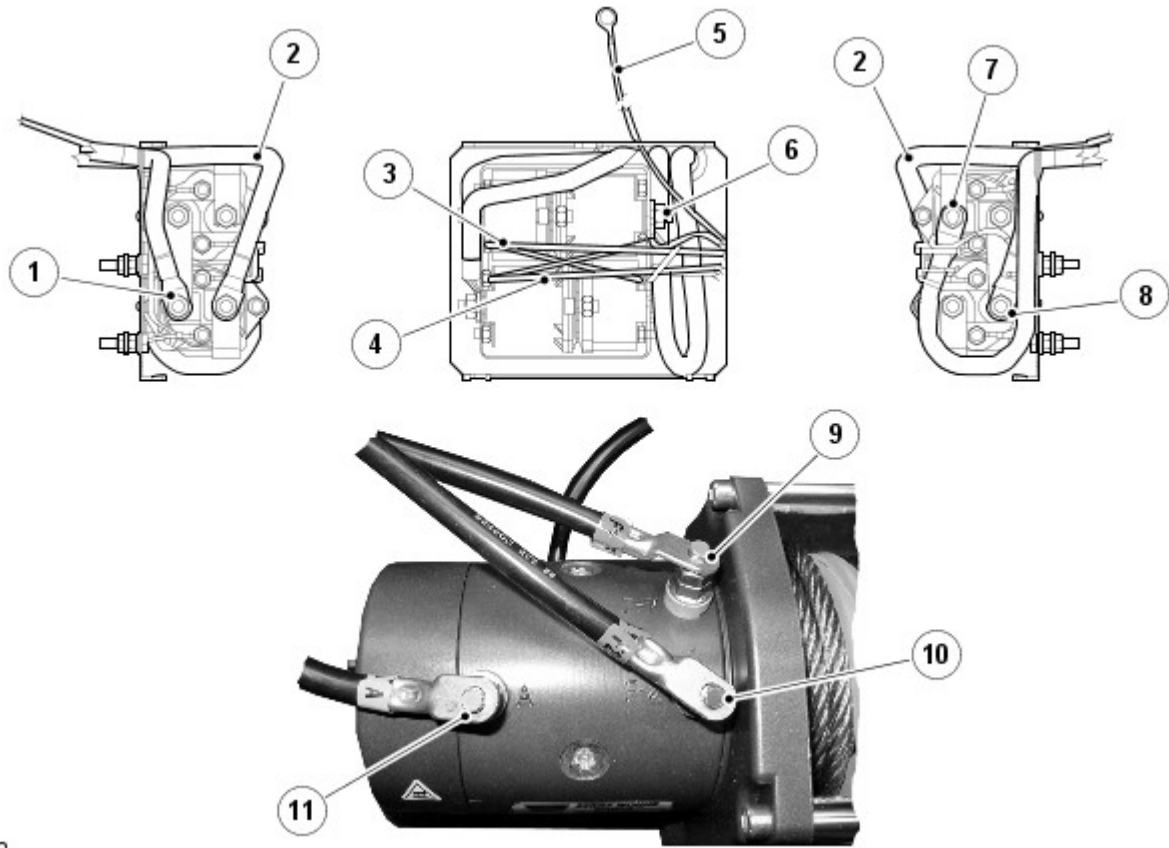
1	Battery
2	Battery Junction Box (BJB)
3	Central Junction Box (CJB)
4	Harness connector (C2053-12 LR3 or C2754S-13 LR4) (ref only)
5	Floor console cool box (ref only)
6	Remote control
7	Remote control socket
8	Winch motor ground
9	Winch motor
10	Control box
11	Winch power interrupt solenoid ground



ItemDescription

A	Field
B	Armature
C	Black wire
D	White wire
E	Green wire
F	Brown wire
G	Red wire
H	Remote control assembly
I	Winch power interrupt solenoid
J	Ignition power supply - Blue wire

Winch Motor/Control Box Connections



E137052

ItemDescription

1	Field cable F1
2	Armature cable A
3	Black wire
4	Green wire
5	Motor ground wire
6	Battery positive (+) cable
7	Battery positive (+) cable terminal
8	Field cable F2
9	Field cable F1
10	Field cable F2
11	Armature cable A

System Operation

OPERATION

⚠ WARNING: Observe all Warnings and Cautions detailed in the WARN Winch Operator's Guide and the WARN Basic Guide to Winching Techniques before and during winch operation.

The winch motor is powered by the vehicle battery. The motor provides rotational power to the gear mechanism, which in turn rotates the winch drum and winds the cable.

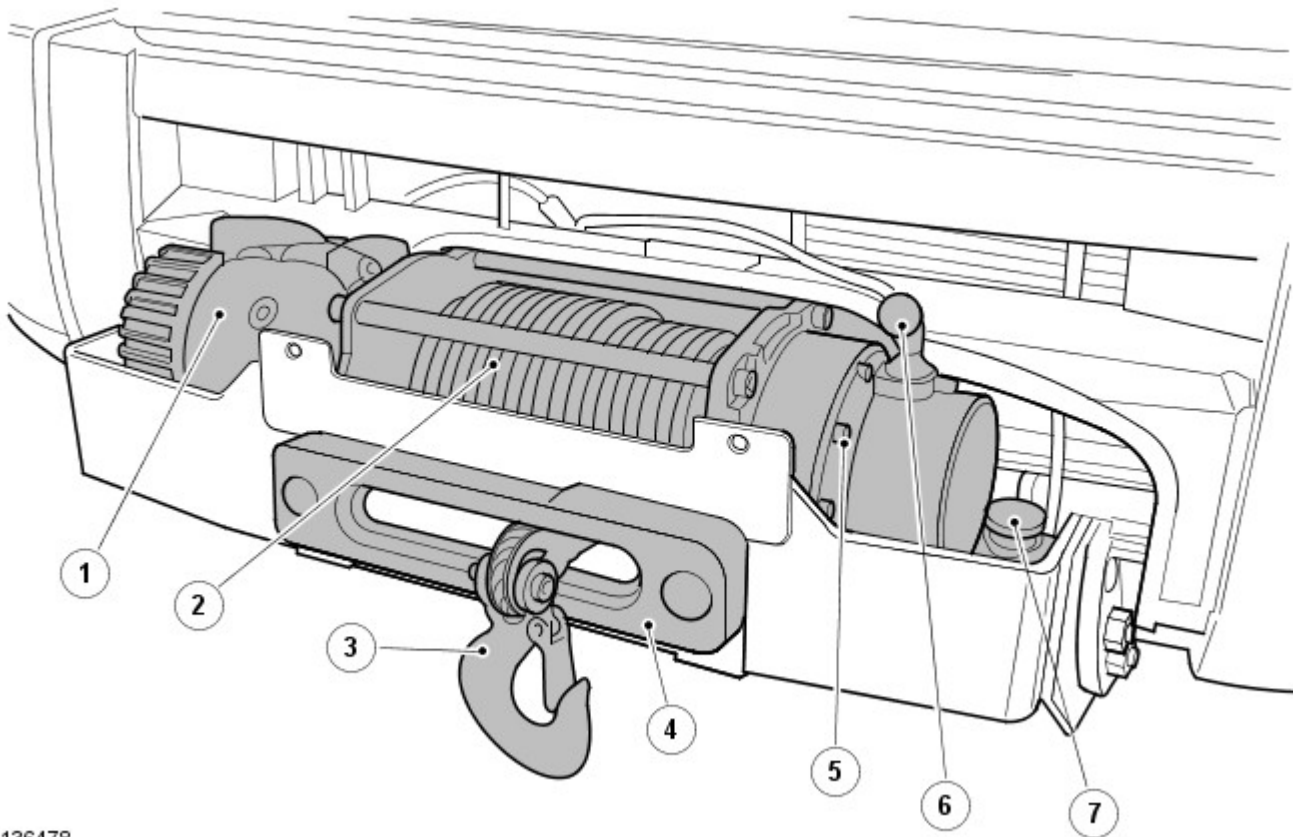
A remote control is used to operate the winch. The remote lead plugs into a remote control connector which is connected to the control box and allows the operator to control the winch winding direction while standing at a safe distance from the wire rope.

The clutch allows rope to be pulled off the drum without motor operation. Refer to the WARN Basic Guide to Winching Techniques.

Component Description

DESCRIPTION

Winch



E136478

ItemDescription

1	Motor
2	Winch drum and wire rope
3	Latching hook
4	Fairlead
5	Gear train housing
6	Clutch lever
7	Remote control socket

The winch is mounted on a bracket which is attached to the vehicle chassis frame. Two additional brackets are attached to the front bumper armature mounting plates. The brackets allow the attachment of the winch mounting bracket. The winch is secured to the bracket with four bolts, washers and nuts.

The winch control box is located on the rear of the front bumper armature. Two additional holes are drilled in the armature and the control box is attached with two bolts, washers and nuts.

The winch control box manages the power supplies to the winch motor and also receives the input from the remote control for winch operation. A remote control socket is located at the **LH (left-hand)** end of the winch mounting bracket and allows for the connection of the remote control.

The winch will operate with the ignition on and the engine not running, but this is not recommended due to excessive battery drain. Therefore it is recommended that the engine is running at all times when the winch is in operation.

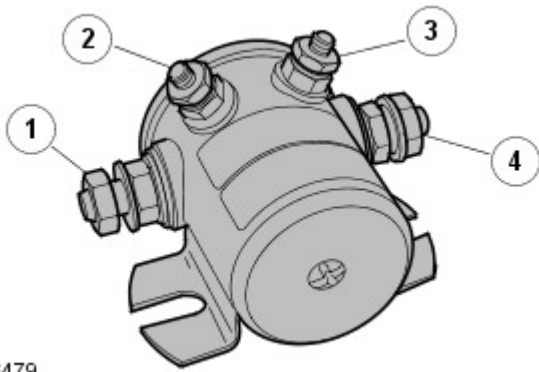
Winch/Vehicle Electrical Connections

A blue wire from the winch remote control socket is routed via a joint below the **EJB (engine junction box)**, through the vehicle bulkhead grommet behind the **EJB**. The blue wire is then routed behind the glove compartment and along the floor console to connector C0253-12 on LR3 vehicles (up to VIN 513325) and C2754S-13 on LR4 vehicles (from VIN 513326), which is located below the cup holder, behind the transmission selector lever. The wire is spliced into the green/white wire into the connector. This connection on the blue wire provides an ignition on signal to the winch control box when the remote control is plugged in.

A red cable is attached from the battery positive (+) terminal to the positive terminal on the winch power interrupt solenoid. This connection is the main power supply to the winch power interrupt solenoid for the winch motor and control box. The winch power interrupt solenoid is located on the plenum in the driver's side of the engine compartment.

A white wire from the winch remote control socket is connected to the winch power interrupt solenoid and energizes the solenoid relay when the ignition on signal is received. A large red wire from the winch power interrupt solenoid is routed to the winch control box. Power is not supplied to the winch control box until the remote control is connected to the remote control socket and the ignition is on.

Winch Power Interrupt Solenoid

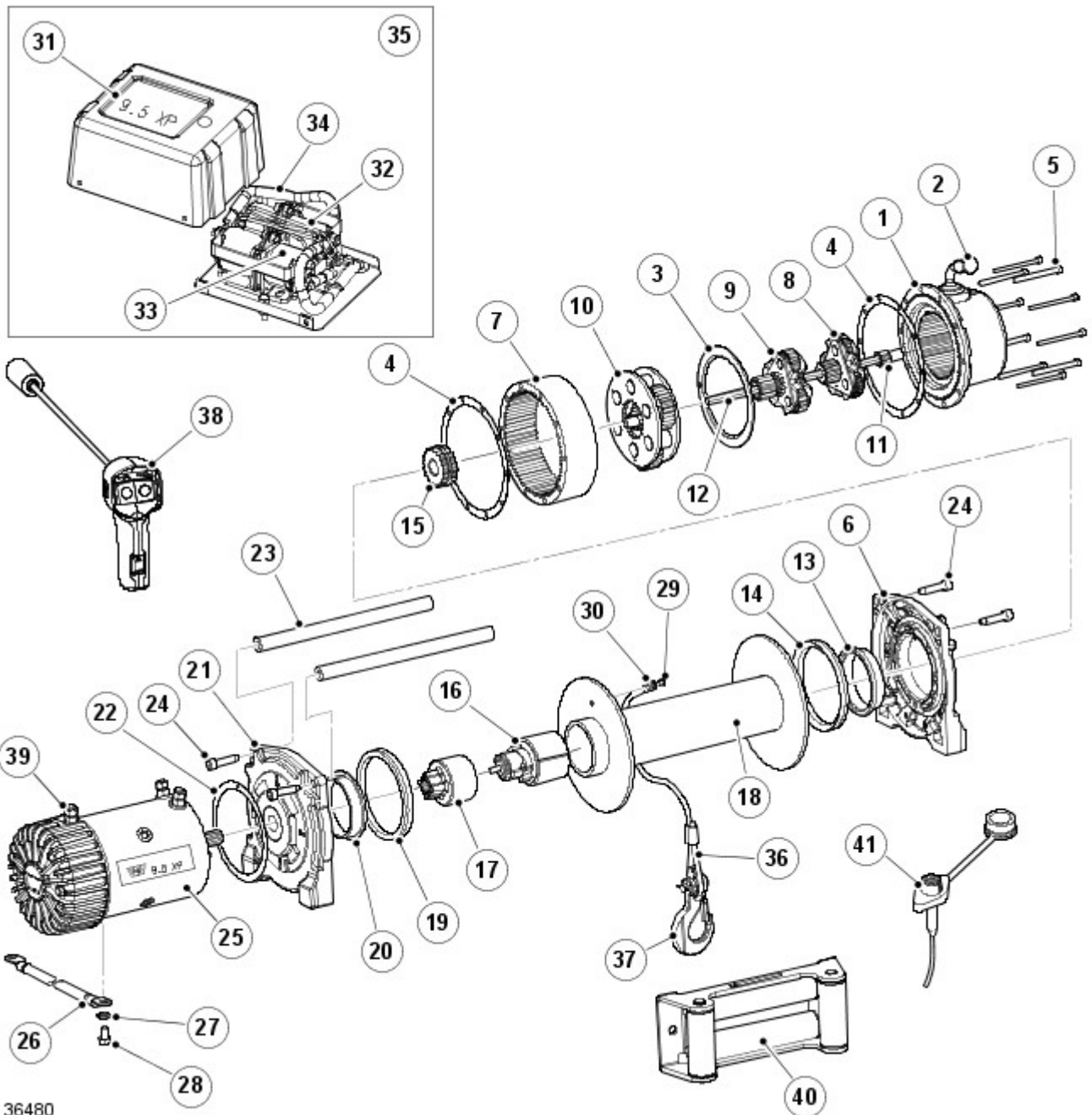


E136479

ItemDescription

1	Power to winch motor
2	Ground
3	Solenoid power supply (ignition on)
4	Power supply from vehicle battery

Winch Exploded View



E136480

ItemDescription

End housing assembly
2 Clutch lever
3 Nylon thrust washer
4 Housing gasket
5 Socket head capscrew (10 off)
6 Gear support drum
7 Ring gear
8 Planet carrier assembly (stage 1)
9 Planet carrier assembly (stage 2)
10 Planet carrier assembly (stage 3)
11 Sun gear
12 Drive shaft
13 Drum bushing
14 V-ring seal
15 Drive spline
16 Brake assembly
17 Motor coupler
18 Drum assembly
19 V-ring seal
20 Drum bushing
21 Motor drum support
22 Motor gasket
23 Tie rod (2 off)
24 Socket head cap screw (4 off)
25 Motor (4.5" Series wound)
26 Electrical cable (black)
27 Helical washer
28 Hex head cap screw
29 Button head cap screw
30 Terminal kit
31 Control pack cover
32 High current solenoid - Power in (2 off)
33 Solenoid - Power out (2 off)
34 Electrical cable (red)
35 Control pack 9.5XP
36 Wire rope assembly
37 Latching hook
38 Remote control assembly
39 Nut (3 off)
40 Fairlead Hawse (roller type shown)
41 Remote control socket assembly

• NOTE: The WARN part numbers for the above components are listed on the WARN web site: www.warn.com

Winch - Winch

Diagnosis and Testing

Principle of Operation

For a detailed description of the winch system and operation, refer to the relevant Description and Operation section in the workshop manual. REFER to: (419-12 Winch)

[Winch](#) (Description and Operation),
[Winch](#) (Description and Operation),
[Winch](#) (Description and Operation).

Inspection and Verification



WARNING: Observe all Warnings and Cautions detailed in the WARN Winch Operator's Guide before and during winch operation.



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Incorrect installation ● Winch motor ● Gearbox ● Wire rope 	<ul style="list-style-type: none"> ● Fuses ● Battery (650 CCA minimum) ● Loose, corroded or damaged electrical connections ● Winch power interrupt solenoid ● Control box ● Remote control

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

Symptom Chart

Symptom	Possible causes	Action
No winch operation	<ul style="list-style-type: none"> ● Battery/power or ground supply fault ● Remote control internal failure ● Control box internal failure ● Winch motor internal failure 	<ul style="list-style-type: none"> ● Refer to the electrical circuit diagrams, check the winch power interrupt solenoid supply fused link ((Fuse 16 to vin 513325)(Fuse 59p from vin 513326)) central junction box ● For midtronics battery test GO to Pinpoint Test A. ● For remote control circuit checks GO to Pinpoint Test C. ● For winch circuit checks GO to Pinpoint Test B.
No winch operation (Clicking sound when remote control switch is activated)	<ul style="list-style-type: none"> ● Battery/power or ground supply fault ● Control box internal failure 	<ul style="list-style-type: none"> ● For midtronics battery test GO to Pinpoint Test A. ● For winch circuit checks GO to Pinpoint Test B.
Winch lacks power, pulls slowly, stalls	<ul style="list-style-type: none"> ● Battery/power or ground supply fault ● Winch motor internal failure ● Gearbox internal failure 	<ul style="list-style-type: none"> ● For midtronics battery test GO to Pinpoint Test A. ● For winch circuit checks GO to Pinpoint Test B.
When the remote control is activated, winch operates in only one direction	<ul style="list-style-type: none"> ● Battery/power or ground supply fault ● Remote control internal failure ● Control box internal failure 	<ul style="list-style-type: none"> ● For remote control circuit checks GO to Pinpoint Test C. ● For winch circuit checks GO to Pinpoint Test B.
Difficulty in spooling rope from drum by hand	<ul style="list-style-type: none"> ● Wire rope incorrectly wound on drum (Rubbing/binding) ● Distorted drum flange ● Worn drum bushes 	<ul style="list-style-type: none"> ● Confirm the rope is spooled correctly onto the drum ● Install a new winch as required. REFER to: Winch (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

Symptom	Possible causes	Action
	<ul style="list-style-type: none"> ● Damaged free spool clutch (inside gear train) ● Corroded clutch ring gear 	<ul style="list-style-type: none"> ● Install a new winch gearbox as required. REFER to: Winch Gear Assembly (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
Winch does not hold load	<ul style="list-style-type: none"> ● Rope is spooled onto the drum in the wrong direction ● Winch drum brake is worn or broken 	<ul style="list-style-type: none"> ● Confirm the rope is spooled correctly onto the drum ● Confirm the clutch is fully engaged ● Install a new winch as required. REFER to: Winch (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component
Remote control fault	<ul style="list-style-type: none"> ● Winch remote connector terminals damaged ● Remote switch internal failure 	<ul style="list-style-type: none"> ● For remote control circuit checks GO to Pinpoint Test C.
Clutch lever fault	<ul style="list-style-type: none"> ● Cable under load ● Clutch or gearbox mechanism internal failure 	<ul style="list-style-type: none"> ● Rotate clutch lever on winch. If clutch lever will not rotate, remove tension from the rope and hook by powering out for about 1 second ● Attempt to rotate the clutch lever with tension removed. If clutch lever still does not rotate, Install a new winch gearbox as required. REFER to: Winch Gear Assembly (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

PINPOINT TEST A : BATTERY TEST

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: MIDTRONICS BATTERY TEST	
1	Confirm that the vehicle battery charged, in good condition, and the correct specification (650 CCA minimum)
2	Using a Midtronics hand held tester or the Midtronics GR-1 diagnostic charger, carry out the "Midtronics battery test" as detailed in the battery care manual. Refer to (Service/Maintenance information/Battery care manual)
3	Record battery diagnostic result on the provided form
	Does the battery pass the "Midtronics battery test"? Yes Check for correct operation, refer to the symptom chart above if customer concern is still evident No Install a new battery as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation

PINPOINT TEST B : CIRCUIT CHECKS

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: WINCH POWER INTERRUPT SOLENOID - CONNECTIONS	
• NOTE: The winch power interrupt solenoid supplies power to the winch control box	
• NOTE: The ignition feed is supplied to the remote control connector (terminal 5) linked internally to (terminal 6) then supplied to (solenoid terminal 3) to energize the winch power interrupt solenoid	
1	Refer to the landrover electrical circuit diagrams, check the winch power interrupt solenoid supply fused link (Fuse 16 to vin 513325)(Fuse 59p from vin 513326) central junction box
2	Refer to the winch circuit diagrams REFER to: Winch (419-12 Winch, Description and Operation).
3	Confirm the circuit connections to the winch power interrupt solenoid (Terminal 1 - power to winch control box, Terminal 2 - solenoid ground, Terminal 3 - solenoid power ((C2053-12 to vin 513325)(C2754S-13 from vin 513326)), Terminal 4 - battery supply)
	Are all the electrical connections to the winch power interrupt solenoid clean and secure? Yes GO to B2. No Clean and secure the electrical connections. Check for correct winch operation
B2: WINCH POWER INTERRUPT SOLENOID - OPERATION	
1	With the ignition state on, and the remote control connected
2	Using a multimeter, check for battery voltage between terminal 1 (power to winch control box) and terminal 2 (winch power interrupt solenoid ground)

	<p>Is battery voltage present? (approx. 12 volts)</p> <p>Yes GO to B3.</p> <p>No Replace the winch power interrupt solenoid as required. REFER to: Winch Solenoid (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation</p>
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B3: POWER SUPPLY - CONTROL BOX

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

• **NOTE:** The winch power interrupt solenoid supplies power to the winch control box

	1 With the ignition state on, and the remote control connected
	2 Using a multimeter, check for battery voltage between the red power feed to the control box and vehicle ground

	<p>Is battery voltage present? (approx. 12 volts)</p> <p>Yes GO to B4.</p> <p>No Carry out circuit checks to investigate the loss of supply. Rectify as required. Check for correct winch operation</p>
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B4: CONTROL BOX INPUT - REMOTE CONTROL

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

• **NOTE:** The winch control box controls the winch motor direction

• **NOTE:** Power out - The remote control supplies power to remote connector **terminal 2** and grounds **terminal 1**

• **NOTE:** Power in - The remote control supplies power to remote connector **terminal 4** and grounds **terminal 1**

	1 Refer to the winch circuit diagrams REFER to: Winch (419-12 Winch, Description and Operation).
	2 Using a multimeter, monitor terminal 2 (Black) , terminal 4 (Green) and terminal 1 (White)

	<p>Do the terminals 2 and 4 (Power) and terminal 1 (Ground) respond correctly when the remote control is used?</p> <p>Yes GO to B5.</p> <p>No Carry out circuit checks to investigate the loss of supply. Rectify as required. Check for correct winch operation</p>
--	--

B5: CONTROL BOX - OUTPUT

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

• **NOTE:** When activated the winch control box supplies power to the winch motor

• **NOTE:** Power out - The control box supplies power to the winch motor terminal **F1** and connects winch motor terminal **F2** to terminal **A**(Armature)

• **NOTE:** Power in - The control box supplies power to the winch motor terminal **F2** and connects winch motor terminal **F1** to terminal **A**(Armature)

	1 Refer to the winch circuit diagrams REFER to: Winch (419-12 Winch, Description and Operation).
	2 Using a multimeter, monitor terminals F1, F2

	<p>Do the terminals F1, and F2 respond correctly when the remote control is used?</p> <p>Yes GO to B6.</p> <p>No Check the connections to the control box. If all the connections are clean and secure, install a new control box as required. REFER to: Winch Control Unit (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation</p>
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B6: MOTOR CONNECTIONS

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

	1 Refer to the winch circuit diagrams REFER to: Winch (419-12 Winch, Description and Operation).
	2 Check the connections to the winch motor

	<p>Are all the connections clean and secure?</p> <p>Yes GO to B7.</p> <p>No Clean and secure the electrical connections. Check for correct winch operation</p>
--	--

B7: WINCH MOTOR TEST

 **WARNING:** Ensure the winch clutch is in free spool mode (Refer to winch operation manual)

	1 Disconnect the positive lead from the battery (leave the ground lead attached)
	2 Label and disconnect the three cables that run from the control pack to the three posts on the winch motor
	3 Stamped next to the three posts on the winch motor will be A, F1 and F2 . Connect a test cable (Jump leads work well) from A to F1 and supply power from the battery to F2 . The winch motor should operate
	4 Connect a test cable from A to F2 and supply power from the battery to F1 . The winch motor should operate in the opposite direction

	<p>Does the winch motor operate in both directions?</p> <p>Yes Check for correct operation, refer to the symptom chart above if customer concern is still evident</p> <p>No Check the connections to the winch motor. If all the connections are clean and secure, install a new winch motor as required. REFER to: Winch Motor (419-12 Winch, Removal and Installation). Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation</p>
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PINPOINT TEST C : REMOTE CONTROL

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: REMOTE CONTROL - CONTINUITY TEST	
<ul style="list-style-type: none"> • NOTE: Visually inspect the winch remote connector terminals for damage, repair or replace as required • NOTE: The winch remote should be tested for continuity using a multimeter 	
	<p>1 With the winch remote disconnected check for continuity, using the instructions below</p> <p>2 Move the switch to the power out position - Check for continuity between terminals (1) and (3), Check for continuity between terminals (2) and (6)</p> <p>3 Move the switch to the power in position - Check for continuity between terminals (1) and (3), Check for continuity between terminals (4) and (6)</p>
	<p>Did the winch remote pass the continuity test (Resistance less than 1 ohm)?</p> <p>Yes Check for correct operation, refer to the symptom chart above if customer concern is still evident</p> <p>No Install a new winch remote as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Check for correct winch operation</p>

Winch - Winch

Removal and Installation

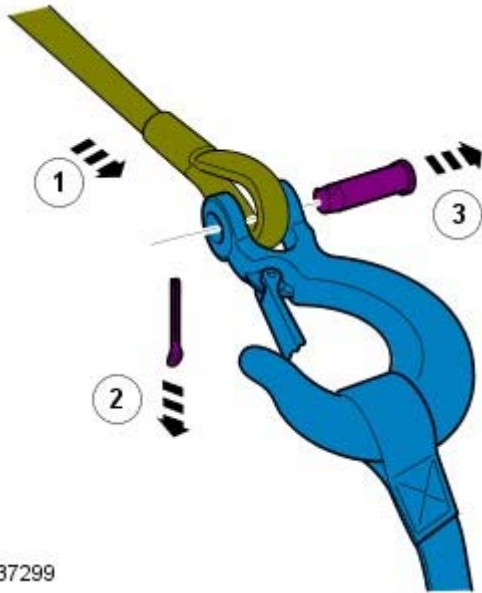
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

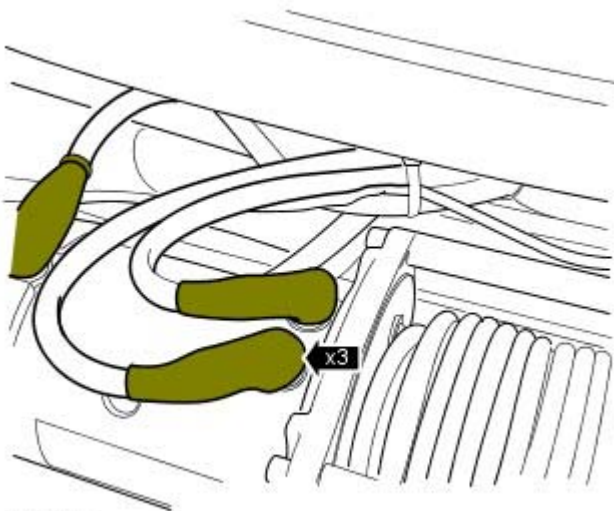
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

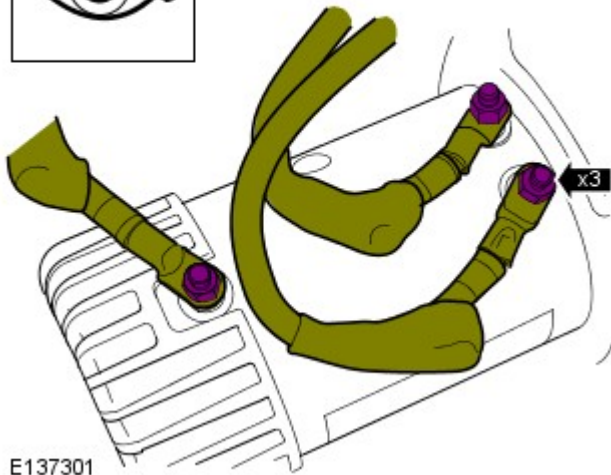
- 2.




- 3.



E137300

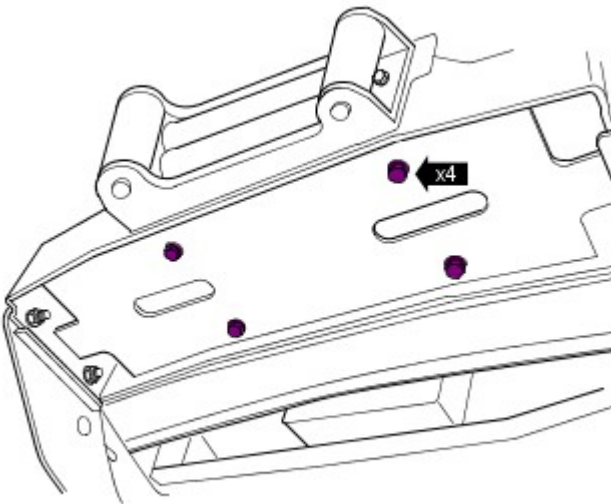


E137301

4.  CAUTION: To prevent damage to components, use an additional wrench when loosening or tightening terminals.

- NOTE: Note the position of the wiring harnesses to aid installation.

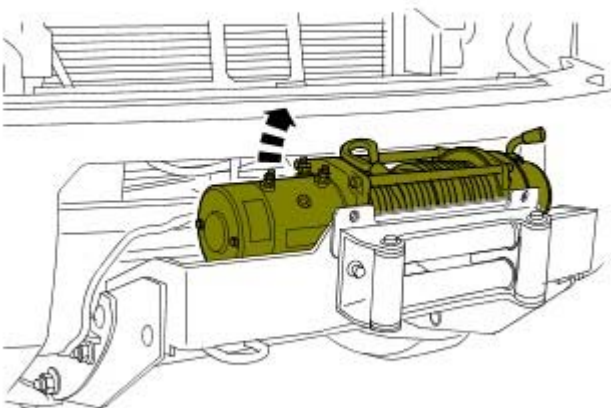
- Torque: 25 Nm



E137302

- 5.

- Torque: 40 Nm

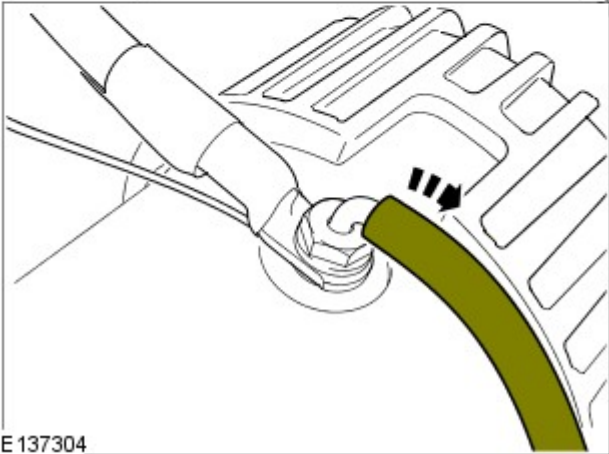
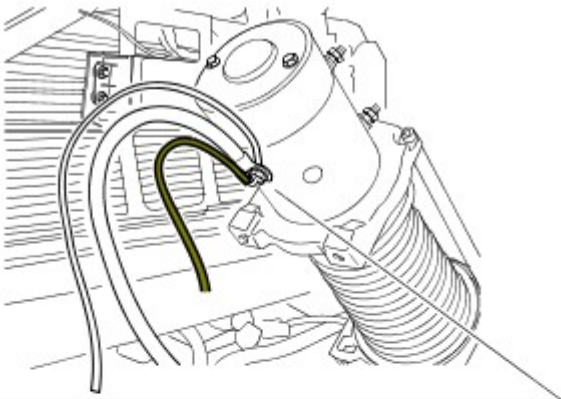


E137303

- 6.

- Raise the motor end of the winch to gain access to the winch ground point.

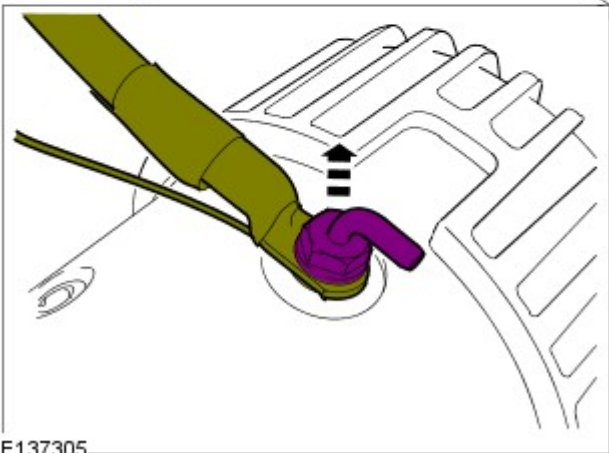
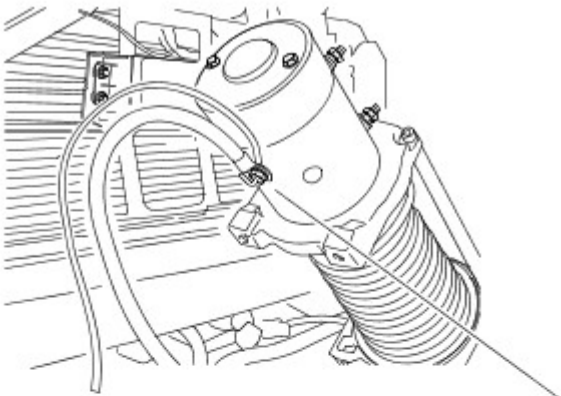
7.




E137304

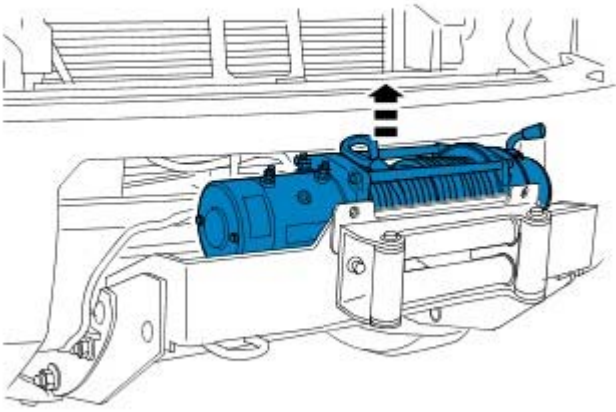
8.

- Torque: 25 Nm



E137305

9.  **WARNING:** This step requires the aid of another technician.



E137306

Installation

1. To install, reverse the removal procedure.

Winch - Winch Motor

Removal and Installation

Removal


- NOTE: Removal steps in this procedure may contain installation details.


1. Disconnect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Winch](#) (419-12 Winch, Removal and Installation).

3. **3. CAUTIONS:**

 If the armature is dislodged from the motor, the motor brushes will need to be reset to allow reinstallation.

 Make sure that the armature shaft is removed with the motor housing.

 Use a suitable tool if required to move the armature with the motor.

- Torque: 8 Nm



Installation

1. To install, reverse the removal procedure.

Winch - Winch Solenoid

Removal and Installation

Removal

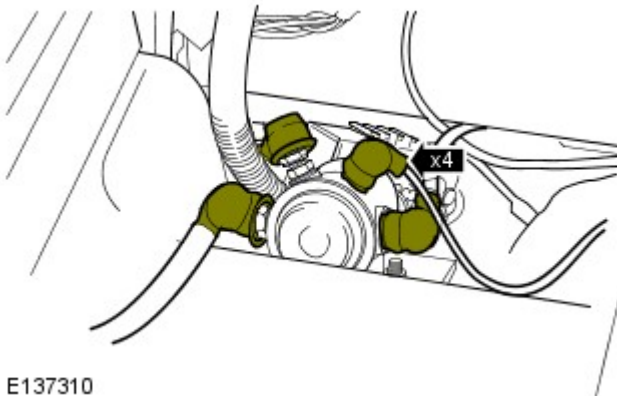
- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.


Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

3.

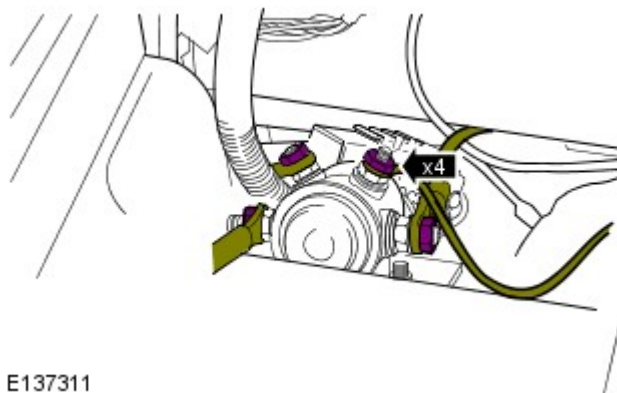


E137310

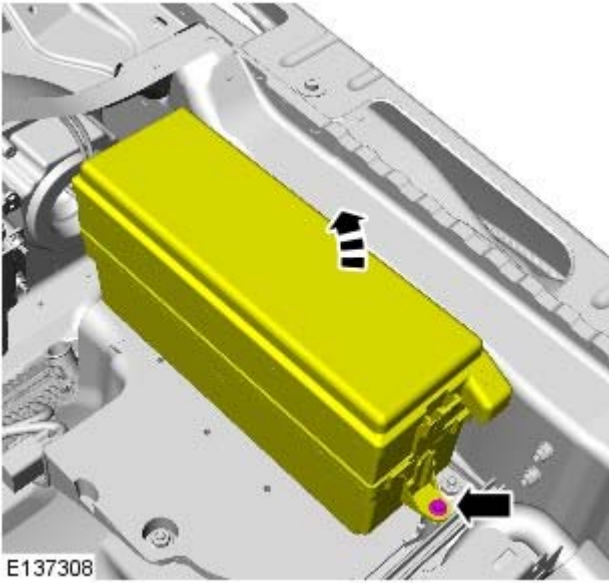
4.  CAUTION: To prevent damage to components, use an additional wrench when loosening or tightening terminals.

- NOTE: Note the position of the electrical connectors.

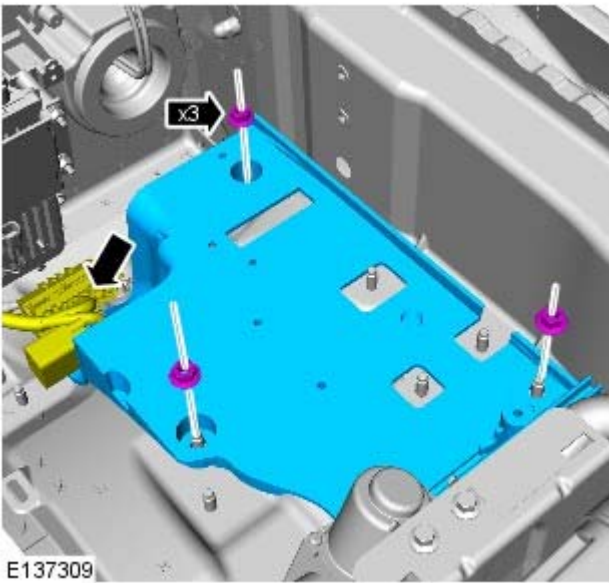
- *Torque:*
Two center terminals 10 Nm
Two outer terminals 7 Nm



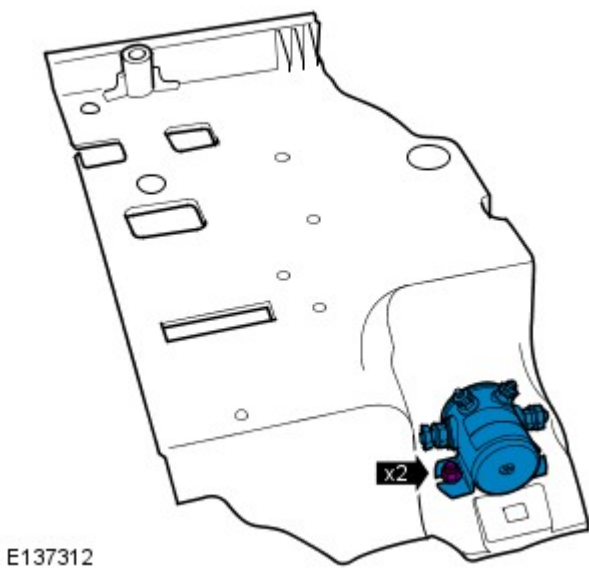
E137311



5. ● Torque: 5 Nm



6. ● Torque: 12 Nm



7. ● Torque: 10 Nm

Installation

1. To install, reverse the removal procedure.

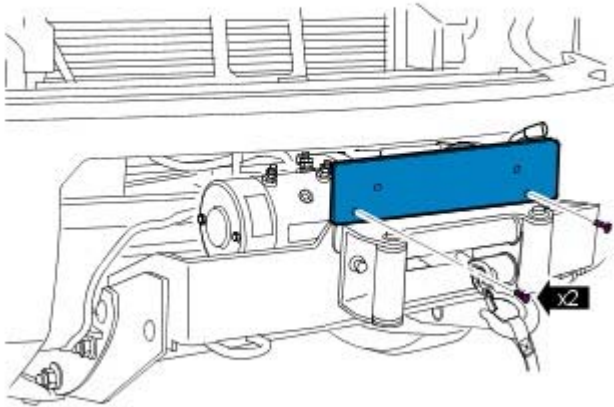
Winch - Licence Plate Panel

Removal and Installation

Removal

1.
 - If installed: Remove the license plate.

2.



E137298

Installation

1. To install, reverse the removal procedure.

Winch - Winch Cable Roller Assembly

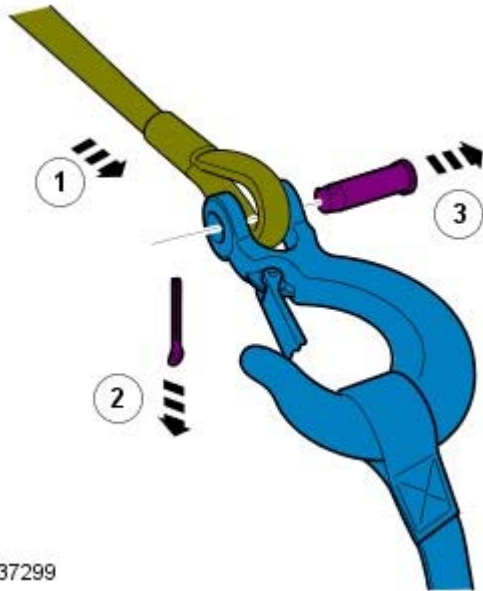
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Licence Plate Panel](#) (419-12 Winch, Removal and Installation).

2.



E137299

3.

- Torque: 43 Nm



E137315

Installation

1. To install, reverse the removal procedure.

Winch - Winch Control Unit

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

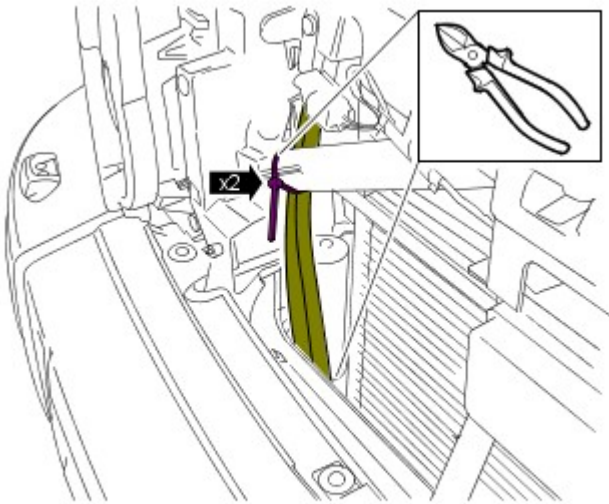
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

3. Refer to: [Winch](#) (419-12 Winch, Removal and Installation).

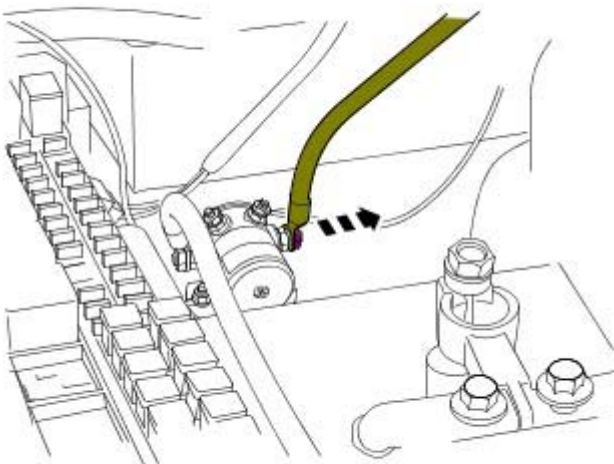
4.



E138614

5. Refer to: [Front Bumper Cover](#) (501-19 Bumpers, Removal and Installation).

6.



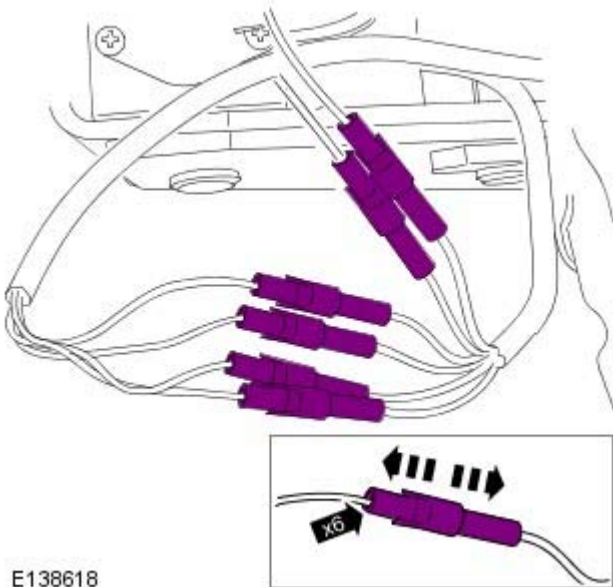
E138616

8.



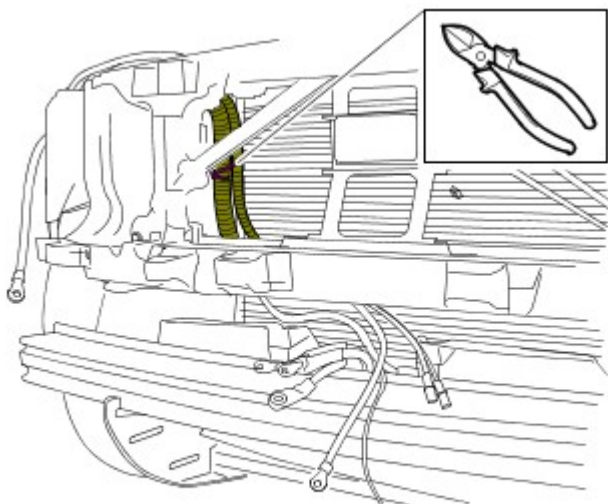
E138617

9.



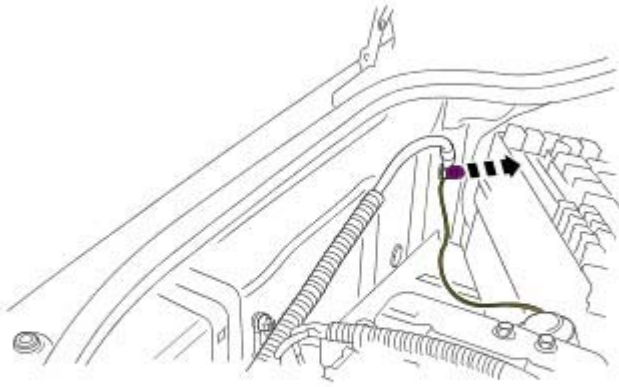
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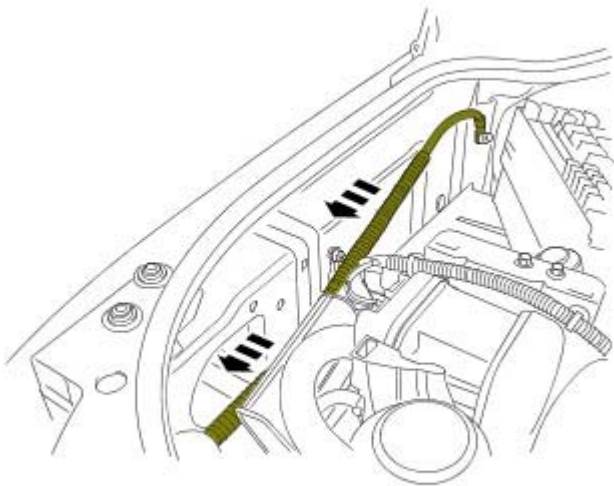
E138619

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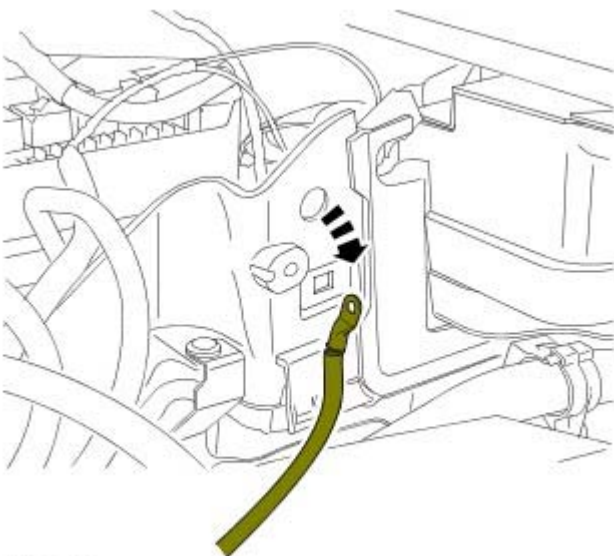
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12.



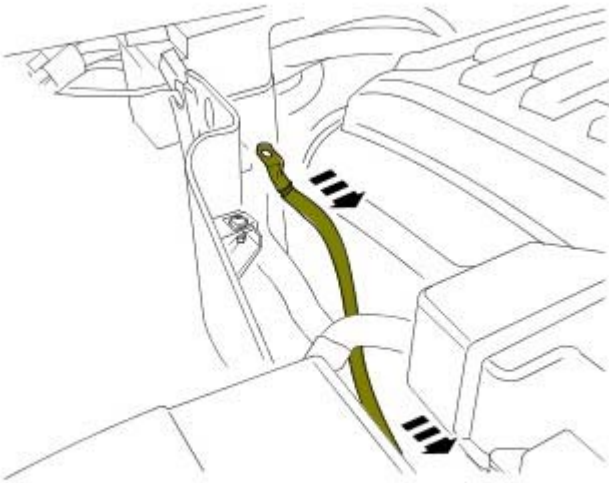
E138621

13.



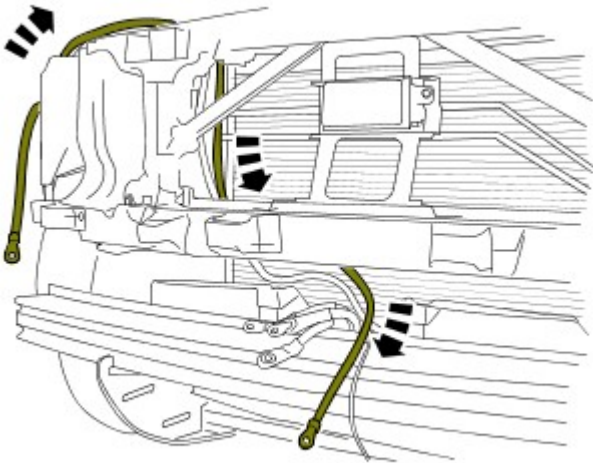
E138622

14.



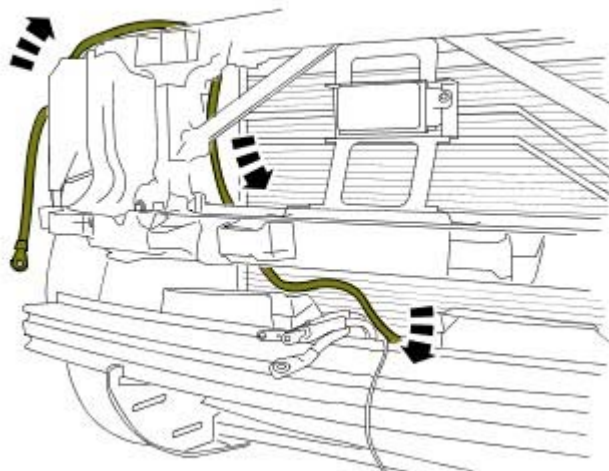
E138623

15.

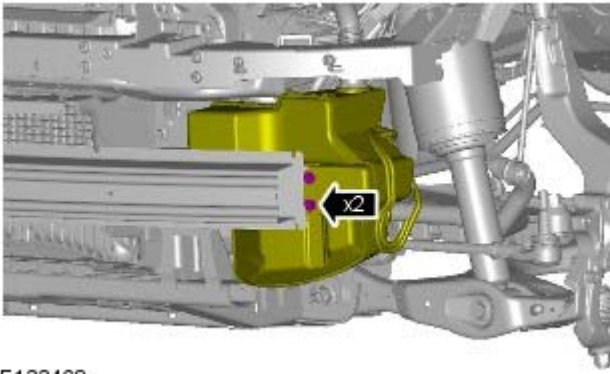


E138625

16.



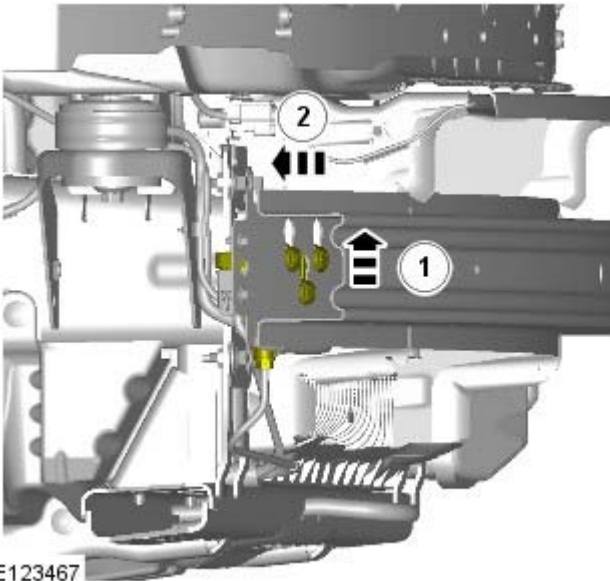
E138626



E123468

17. **17.** NOTE: Support as necessary.

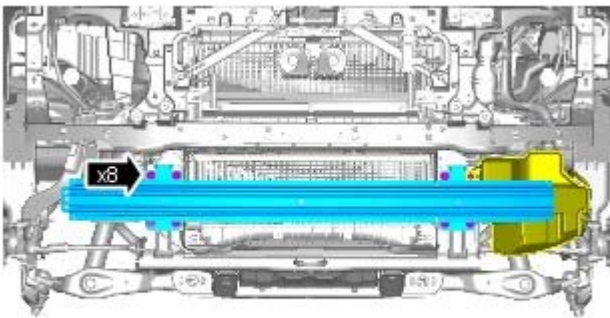
Torque: 10 Nm



E123467

18. **18.**  CAUTION: Take extra care not to damage the component.

• NOTE: Support as necessary.

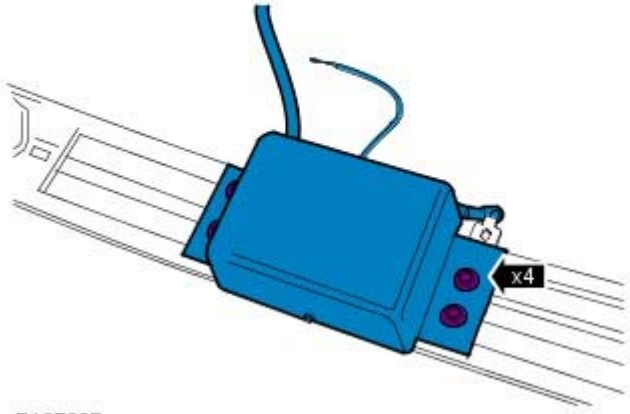


E123469

19. **19.** NOTE: With assistance remove the component.


Torque: 25 Nm

20. Torque: 10 Nm



E137307

Installation

1.  CAUTION: Do not route wires over sharp edges. Take care to avoid chaffing, and damage to the insulation.

To install, reverse the removal procedure.

Winch - Winch Gear Assembly

Removal and Installation

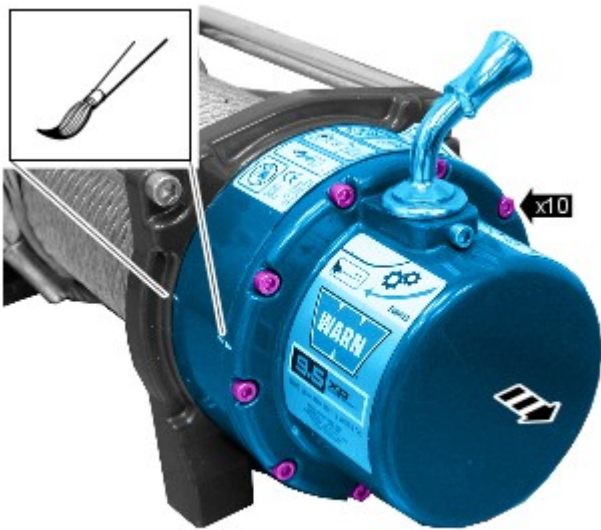
Removal

• NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Refer to: [Winch](#) (419-12 Winch, Removal and Installation).



E138329

3.  CAUTION: Mark the components to aid installation.

- Torque: 10 Nm

- 4.




E138330



E138331

Installation

5.  CAUTION: Make sure that the mating faces are clean and free of foreign material.
 - NOTE: Remove and discard the gasket.

1. 1. NOTE: Align to the position noted on removal.
 - NOTE: Install a new gasket.To install, reverse the removal procedure.

Front End Body Panels -

Torque Specifications

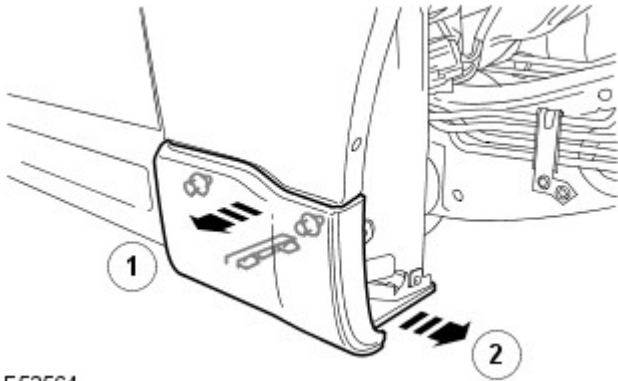
Description	Nm	lb-ft
Engine undershield bolts	62	46
Front fender bolts	10	7
Front fender nut	10	7

Front End Body Panels - Fender

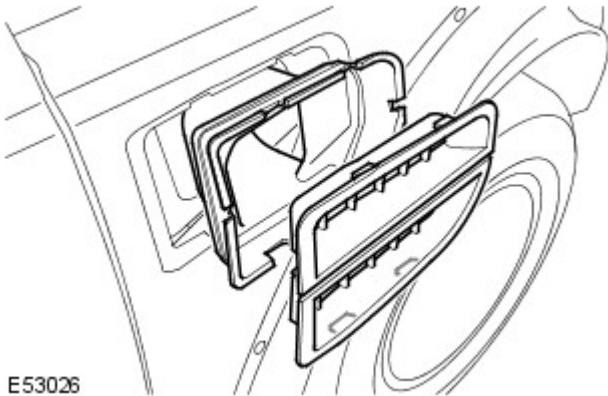
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
3. Remove the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
4. Remove the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
5. Remove the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ormentation, Removal and Installation).
6. Remove the fender lower moulding.
 - Release the 4 clips.



E52564



E53026

7. Remove the fender air intake grille.
 - Release the 4 clips.
 - Remove the air ducting.

8. Remove the front fender.
NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. Install the fender rear trim.
Remove the nut.
 - Remove the 3 clips.
2. Install the front fender.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
 - Install the nut and tighten to 10 Nm (7 lb.ft)
3. Install the fender air intake grille.
 - Install the air ducting.




E52568

4. Install the lower fender moulding.
 - Secure in the clips.
5. Install the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
6. Install the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
7. Install the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
8. Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
9. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Front End Body Panels - Fender Splash Shield

Removal and Installation

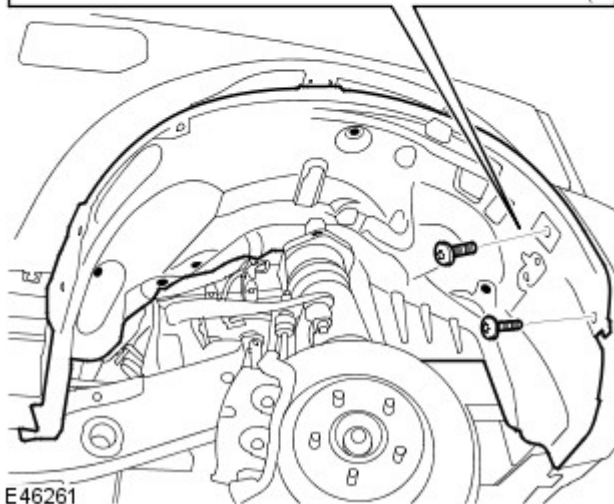
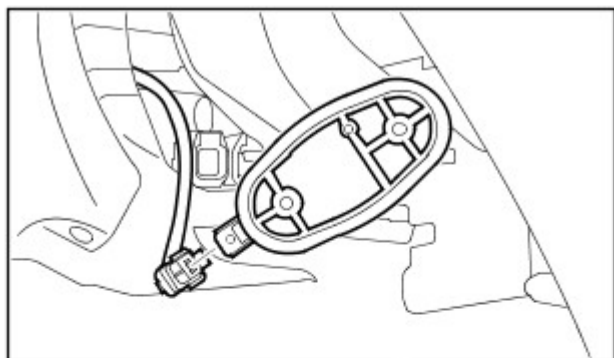
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

3. Remove the fender splash shield.
 - Remove the 2 screws.
 - Remove the 6 retainers.
 - Disconnect the electrical connector.

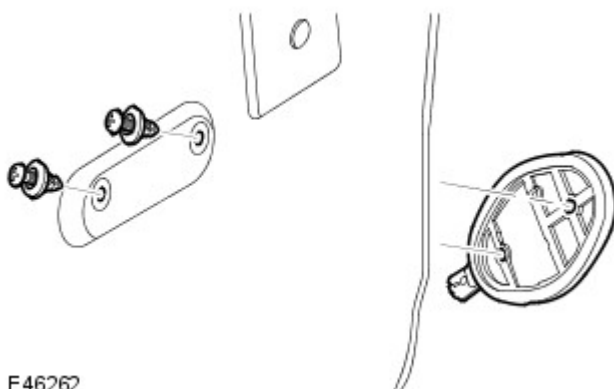


E46261

4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the tire pressure antenna.

- Remove the 2 retainers.



E46262

Installation

1. Install the tire pressure antenna.
 - Install the retainers.
2. Install the fender splash shield.

- Connect the electrical connector.
- Install the retainers.
- Install the screws.


3. Install the fender moulding.

For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).


Front End Body Panels - Engine Undershield

Removal and Installation

Removal

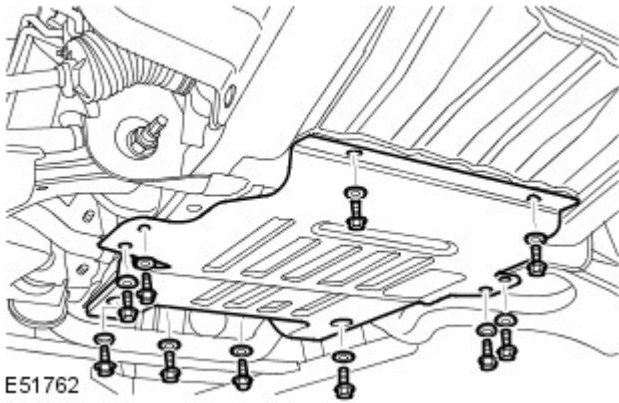
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2.  **CAUTION:** Note the special washer.

Remove the engine undershield.

- Remove the 10 bolts.



Installation


1. To install, reverse the removal procedure.

- Tighten the bolts to 62 Nm (46 lb.ft).

Body Closures - Body Closures

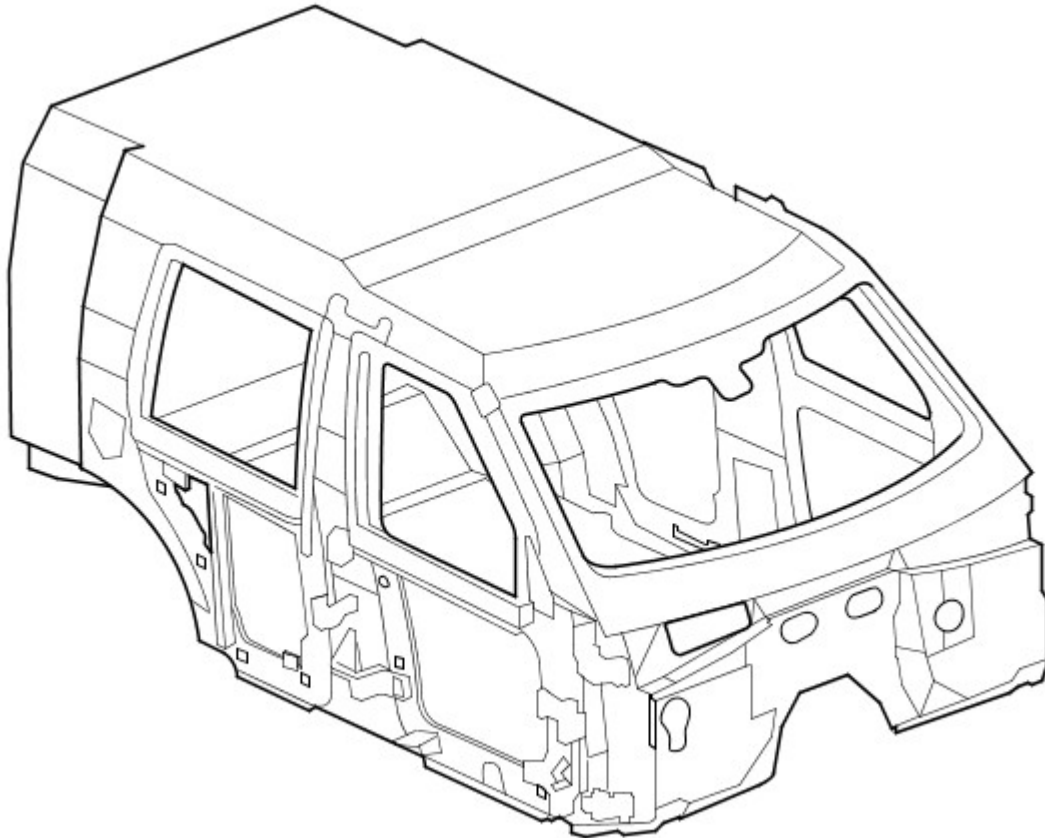
Description and Operation

Body Protection

 **WARNING:** The weight of the armoured components fitted to the vehicle are far in excess of those fitted to the standard vehicle. As an example, the windshield weighs approximately 100 Kg (220 lb). Therefore, always be aware of the weight of components and have suitable lifting equipment available before attempting to remove any component from the vehicle.

Body Shell

Armoured cell



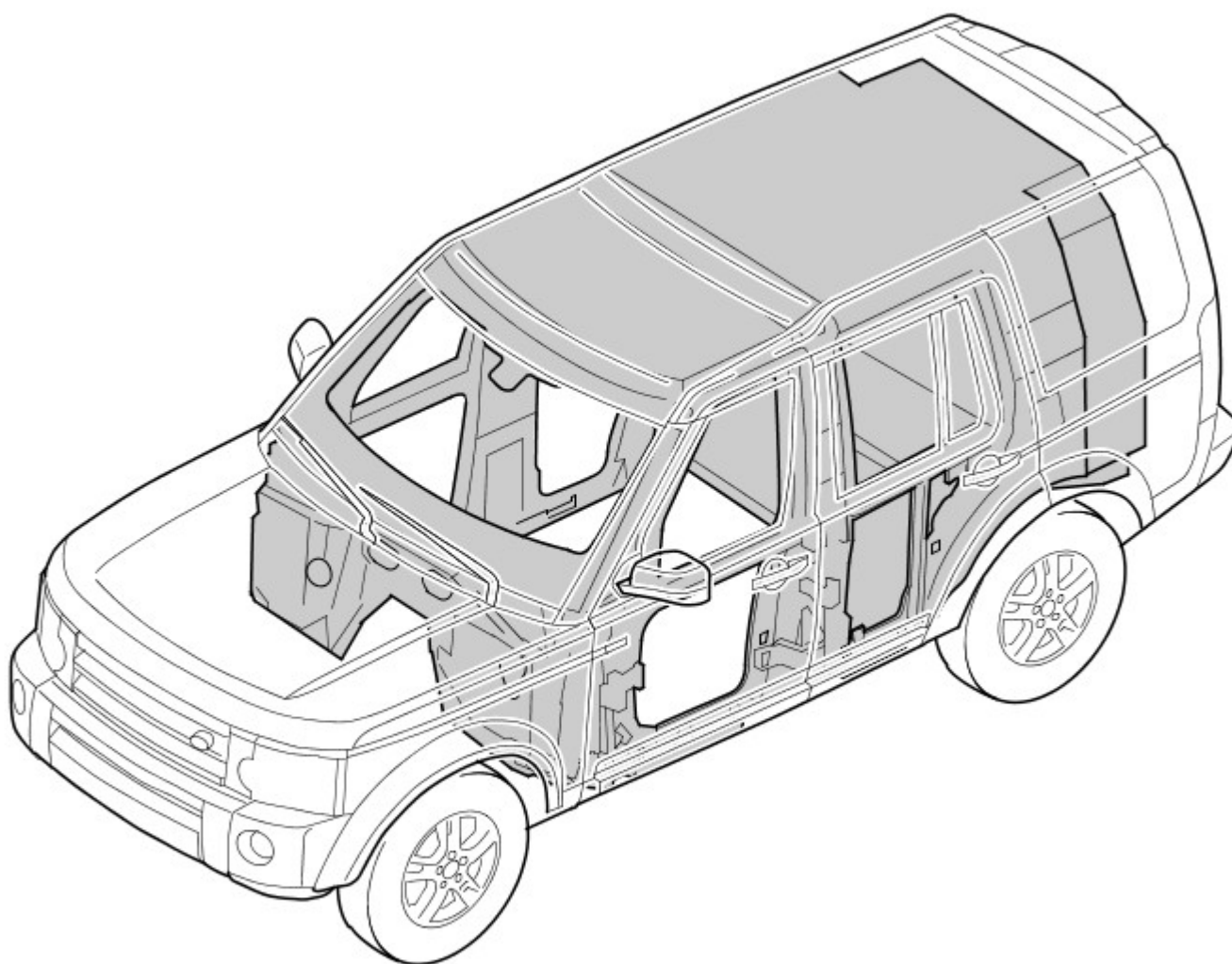
E101511

The vehicle passengers are protected by a steel armoured cell assembled inside the vehicle's bodywork. The cell provides armoured protection to the following areas of the vehicle:

- Bulkhead
- Roof
- Rear three-quarter panels
- 'A' posts
- 'B/C' posts
- 'D' posts
- Sills
- Floor pan

In addition to the floor pan armour, floor protection is also provided by a woven Kevlar blanket, available as an optional fit.

Armoured cell in position



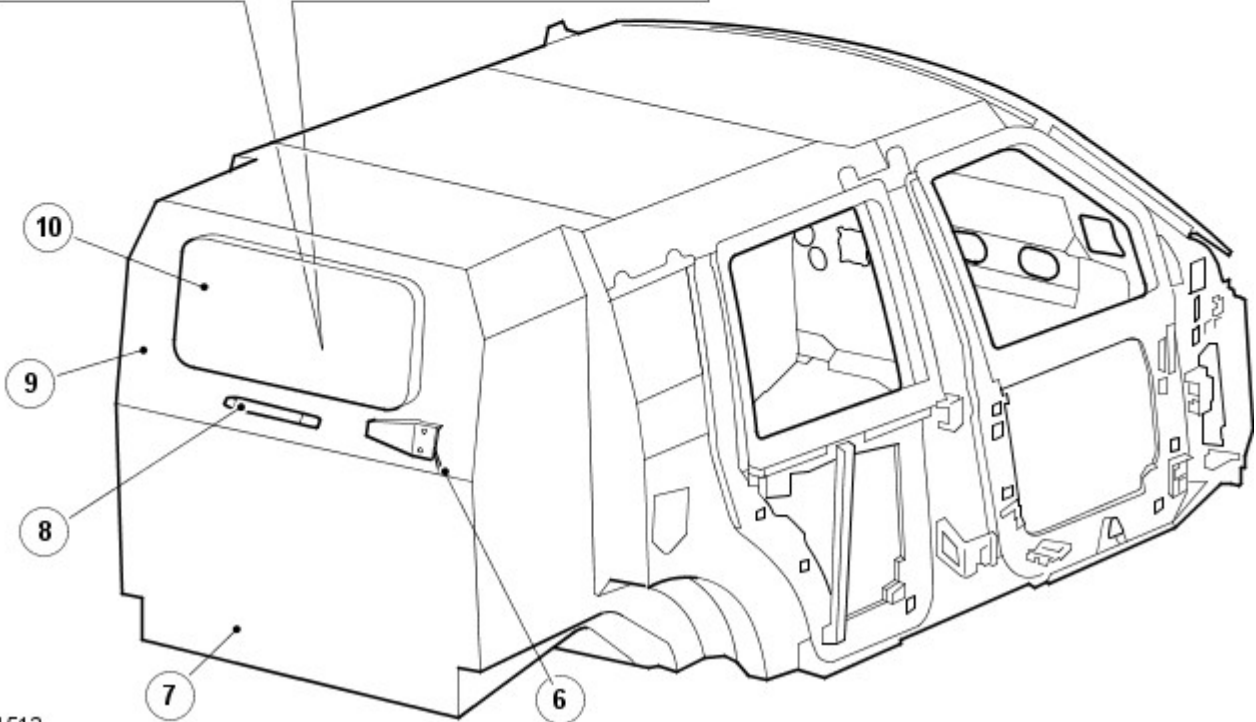
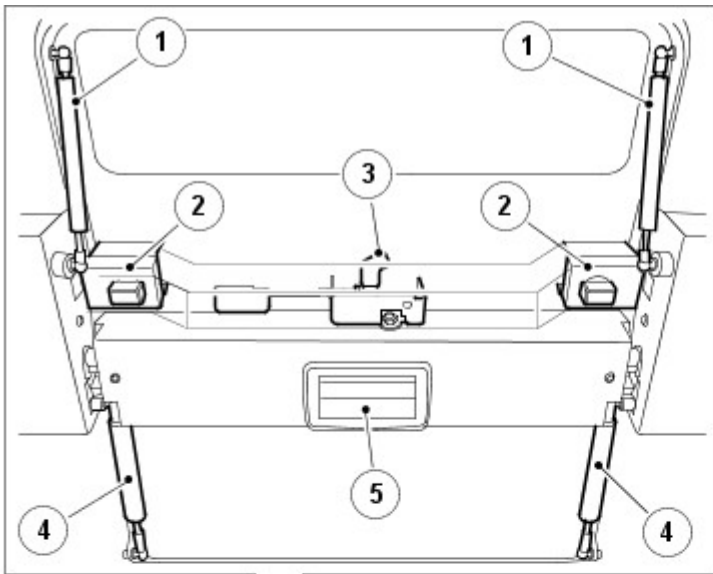
E101513

Doors and Tailgate

The vehicle's doors are reinforced with steel armour, with the exception of the tailgate which remains standard. The armoured cell offers rear-end protection to the vehicle's occupants with the option of either:

- a solid armoured rear end with armoured window; or
- an armoured rear access with armoured window.

Armoured cell rear-access



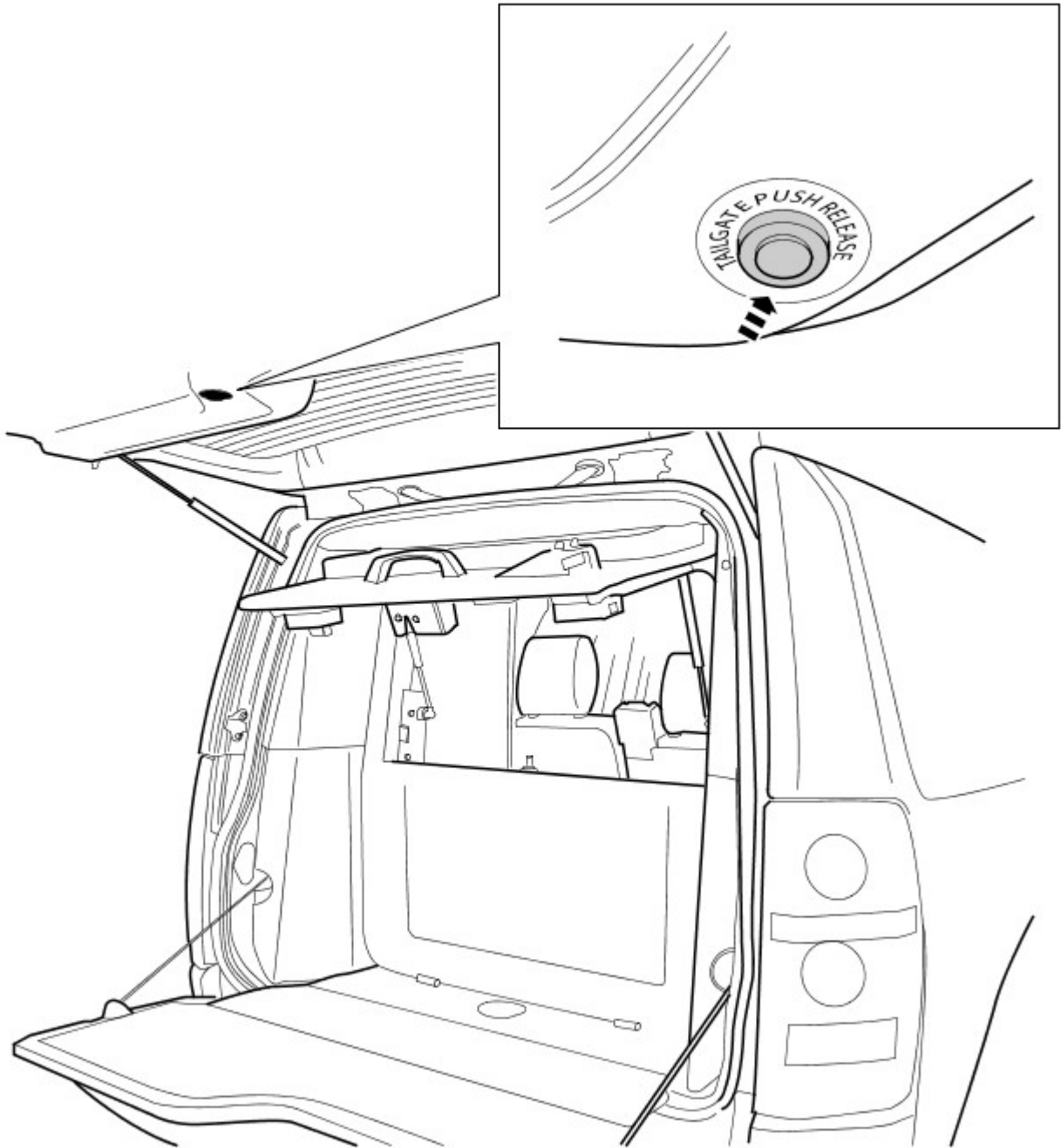
E101512

Item	Part Number	Description
1	-	Upper access panel - gas struts
2	-	Upper access panel - dead locks
3	-	Upper access panel – internal release lever
4	-	Lower access panel – gas struts
5	-	Lower access panel – internal release handle
6	-	Upper access panel – external release lever
7	-	Lower access panel
8	-	Upper access panel - grab handle
9	-	Upper access panel
10	-	Armoured glass window *

* For additional information, refer to: Glass, Frames and Mechanisms (501-11, Description and Operation).

The armoured access option replicates the vehicle's tailgate by having upper and lower access panels. The access panels can be opened manually both internally and externally if the dead-locks are in the unlocked position. Gas struts fitted to the access panels aid their opening and reduce involuntary shutting.


Tailgate interior release button



E101515

A release button fitted to the interior of the vehicle's upper standard tailgate provides access to the tailgate from inside the vehicle. The release button is a momentary type switch, wired in parallel to the standard release switch on the exterior tailgate handle.

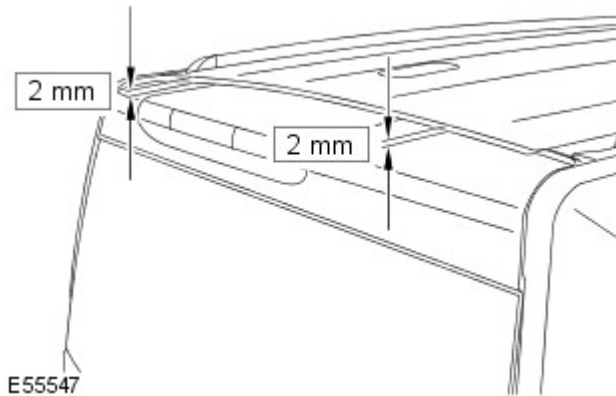
The door hinges, spindles and door stop mechanisms, on the driver and passenger doors are reinforced to support the additional weight of the armour. Gas struts have been fitted to aid door opening and reduce involuntary shutting.

 **CAUTION:** It is recommended that the driver and passenger doors are not opened until the vehicle has come to a complete stop. The combined effect of the vehicle's residual speed and the weight of the door could overcome the door stop mechanism.

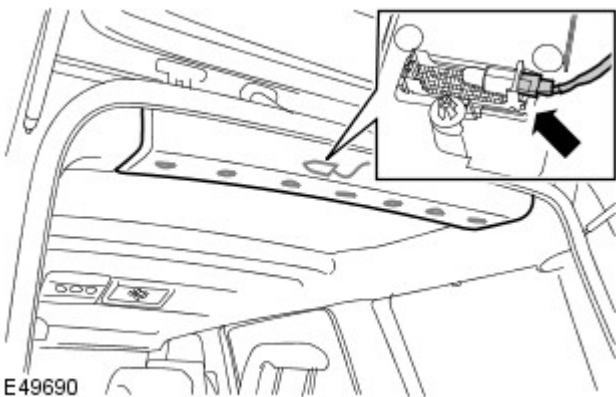
Body Closures - Liftgate Alignment

General Procedures

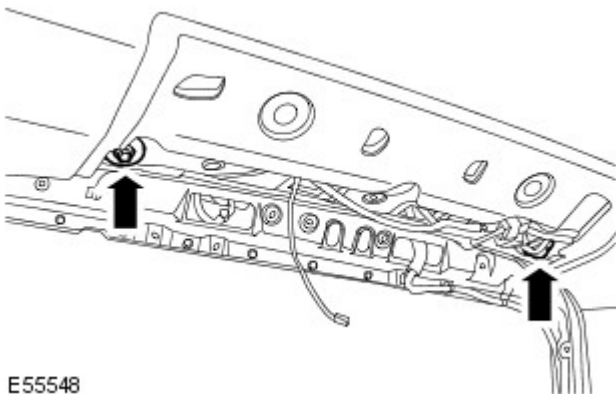
1. With the liftgate closed, check the alignment of the liftgate to roof panel. The liftgate should be central in its aperture. Profile of the liftgate to roof panel should be 2 mm below flush.



2. Remove the rear headliner trim panel.
 - Release the 7 clips.
 - Disconnect the electrical connector.




3. Loosen, but do not remove both liftgate hinge to body bolts.



4. Position the liftgate central to the aperture.

☞ ☞ move the LH liftgate to body bolt.

6.  **CAUTION:** When setting the liftgate profile, make sure that the liftgate hinge NOT being adjusted has its retaining bolt fitted.

- **NOTE:** Turning the Allen key clockwise will raise the liftgate.

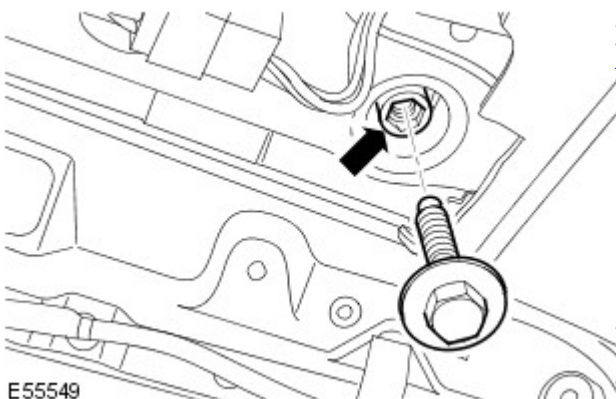
Using a 13 mm Allen key, adjust the LH liftgate hinge until a profile of 2 mm below flush to the roof panel is achieved.

- Install the bolt and tighten to 40 Nm (30 lb.ft).

7. Repeat the above procedure for the RH liftgate hinge.

8. Check for correct operation of the liftgate, and if necessary adjust the liftgate and tailgate strikers.

9. Install the rear headliner trim panel.



- Connect the electrical connector.
- Secure with the clips.

Body Closures - Fuel Filler Door Assembly

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the fuel filler interlock catch assembly.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).

3. WARNINGS:



Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.



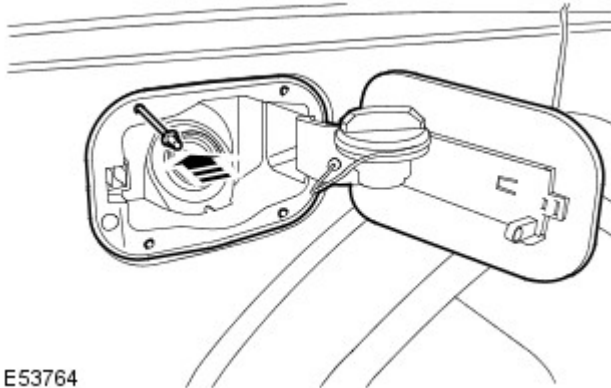
Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

Remove the fuel filler door and inner assembly.

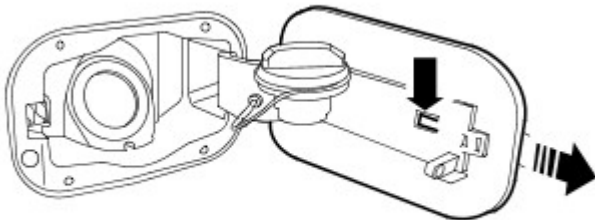
- Open the fuel filler door and remove the cap.
- Using a 2mm metal rod, pierce the inner assembly and release the 4 clips.
- Release from the filler neck.
- Replace the filler cap.

4. Remove the fuel filler door.

- Release the clip.



E53764



E55132

Installation

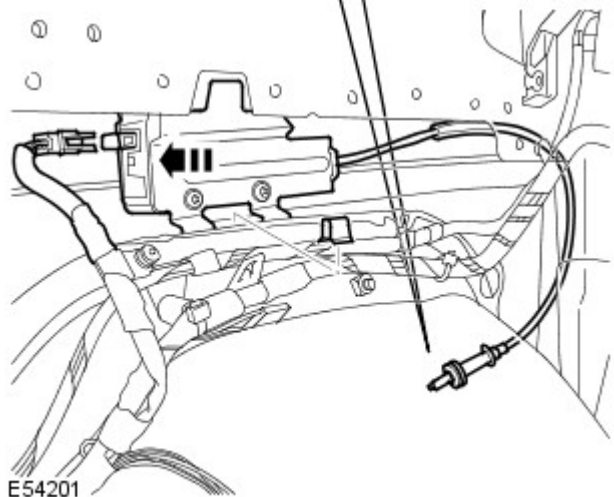
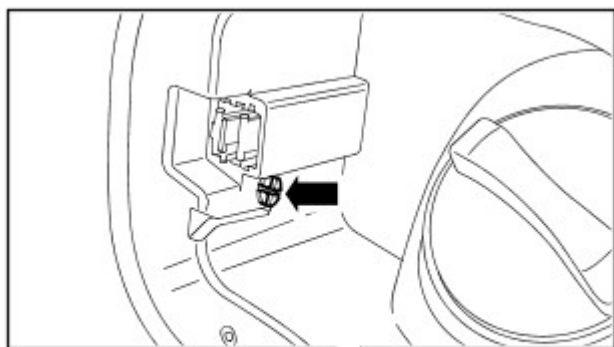
1. Install the filler door.
2. Install the fuel filler door assembly.
 - Clean the component mating faces.
 - Install the filler cap.
 - Close the fuel filler door.
3. Install the fuel filler interlock catch assembly.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Body Closures - Fuel Filler Interlock Catch

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
3. Remove the fuel filler interlock catch assembly.

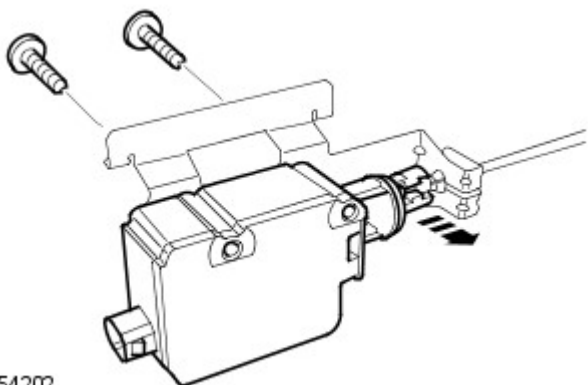


E54201

- Remove the clip.
- Release the cable.
- Disconnect the electrical connector.

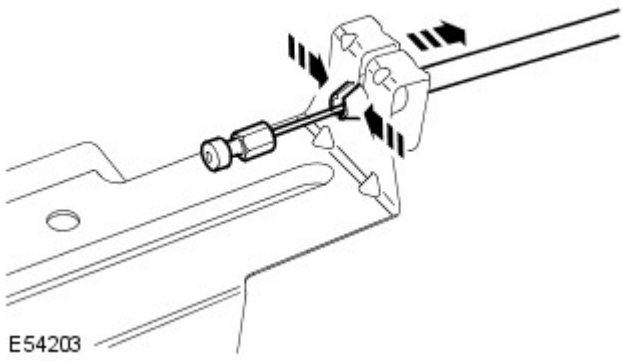
4. Remove the solenoid.

- Remove the 2 Torx screws.
- Release the cable.



E54202

5. NOTE: Do not disassemble further if the component is removed for access only.



Release and remove the cable.

- Release the clip.

Installation

1. Install the cable.
 - Secure the clip.
2. Install the solenoid.
 - Attach the cable.
 - Install the Torx screws.
3. Install the fuel filler flap latch assembly.
 - Connect and secure the electrical connector.
 - Carefully secure the clips.
4. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Body Closures - Liftgate

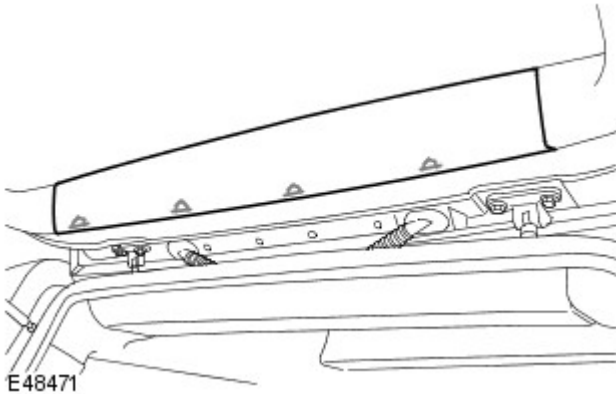
Removal and Installation

Removal

1. Open the liftgate and tailgate.
2. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

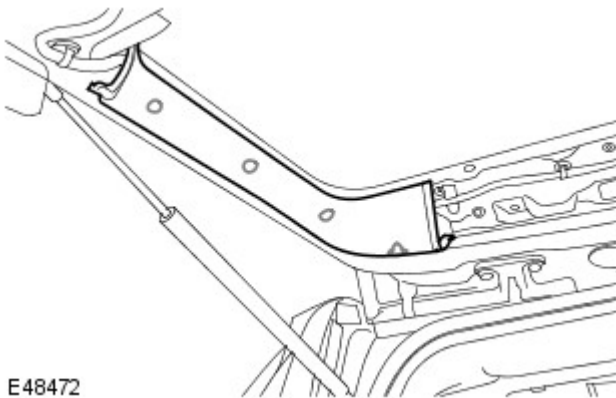
3. Remove the liftgate upper trim panel.

- Release the 4 clips.



4. Remove the liftgate side trim panel.

- Release the 5 clips.
- Repeat the above procedure for the other side.



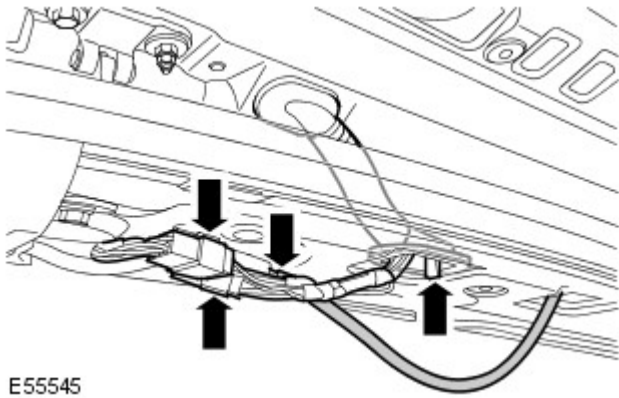
5. Remove the rear headliner trim panel.

- Release the 7 clips.
- Disconnect the electrical connector.



6. Disconnect the washer jet hose.

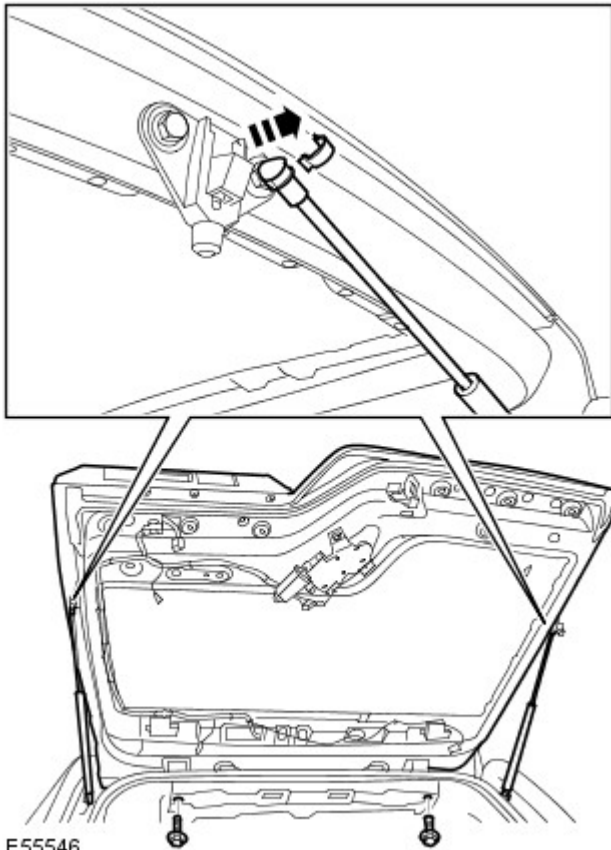
- Release the grommet.



E55545

7. Release the liftgate wiring harness.

- Disconnect the 2 electrical connectors.
- Release the grommet.



E55546

8. With assistance, remove the liftgate assembly.

- Release the clips and disconnect the struts.
- Remove the 2 bolts.

Installation

1. With assistance, install the liftgate assembly.

- Tighten the bolts to 40 Nm (30 lb.ft).
- Connect the struts and secure with the clips.

2. Attach the liftgate wiring harness.

- Install the grommet.
- Connect the electrical connectors.

3. Connect the washer jet hose.

- Install the grommet.

4. Install the liftgate side trim panel.

- Secure with the clips.
- Repeat the above procedure for the other side.

5. Install the liftgate upper trim panel.
 - Secure with the clips.
6. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
7. Check and adjust the liftgate to roof panel profile.
For additional information, refer to: [Liftgate Alignment](#) (501-03 Body Closures, General Procedures).

Interior Trim and Ornamentation -

Torque Specifications

Description	Nm	lb-ft
Safety belt lower anchorage to seat Torx bolt	40	30
Tailgate support strut spigot	25	18
C-pillar lower trim panel Torx screw	8	6
C-pillar upper trim panel Torx screw	3	2
A-pillar trim panel Torx screw	3	2
* Safety belt anchorage Torx bolt	40	30
Foot rest nuts	10	7

* New bolt must be fitted

Interior Trim and Ornamentation - Engine Cover V6 4.0L Petrol

Removal and Installation

Removal

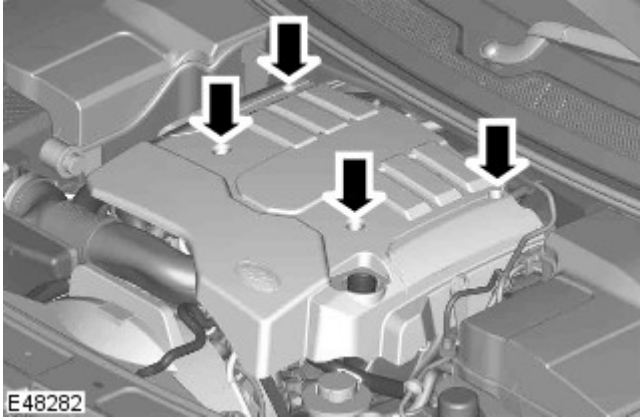
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the oil filler cap.

3. **NOTE:** Note the fitted position of the spacers

Remove the engine cover.

- Remove the 4 nuts.
- Collect the spacers.



4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the acoustic pad.

- Remove the 7 clips.
- Remove the 4 mounts and compression limiters.

Installation

1. Install the acoustic pad.

- Position and secure the clips.
- Install the grommets.
- Install the compression limiters.

2. Install the engine cover.

- Install the spacers.
- Tighten the nuts to 10 Nm (7 lb.ft).

3. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

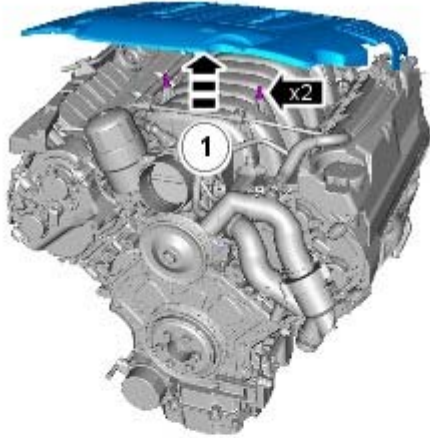
Interior Trim and Ornamentation - Engine Cover V8 5.0L Petrol

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



E134600

Installation

1. To install, reverse the removal procedure.

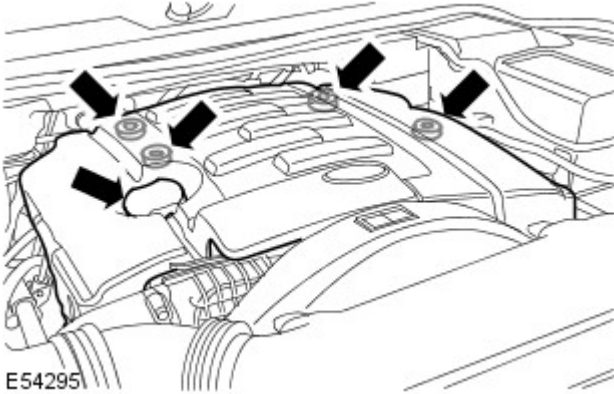
Interior Trim and Ornamentation - Engine Cover 2.7L V6 - TdV6

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.

- Remove the oil filler cap.
- Release the 4 clips.



Installation

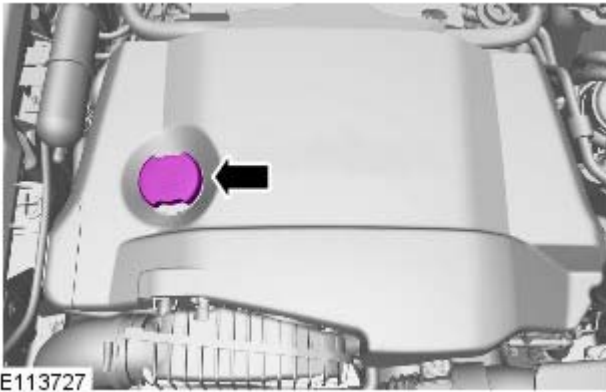
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - Engine CoverTDV6 3.0L Diesel

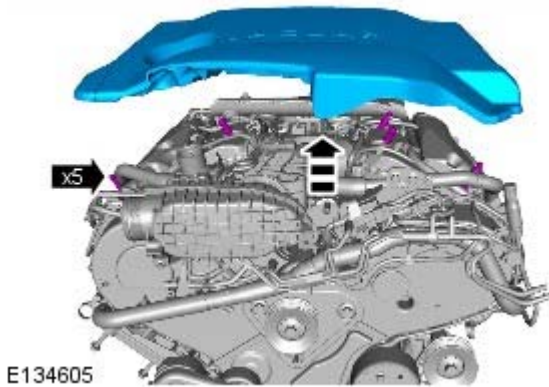
Removal and Installation

Removal

1. Remove the oil filler cap.



- 2.



Installation

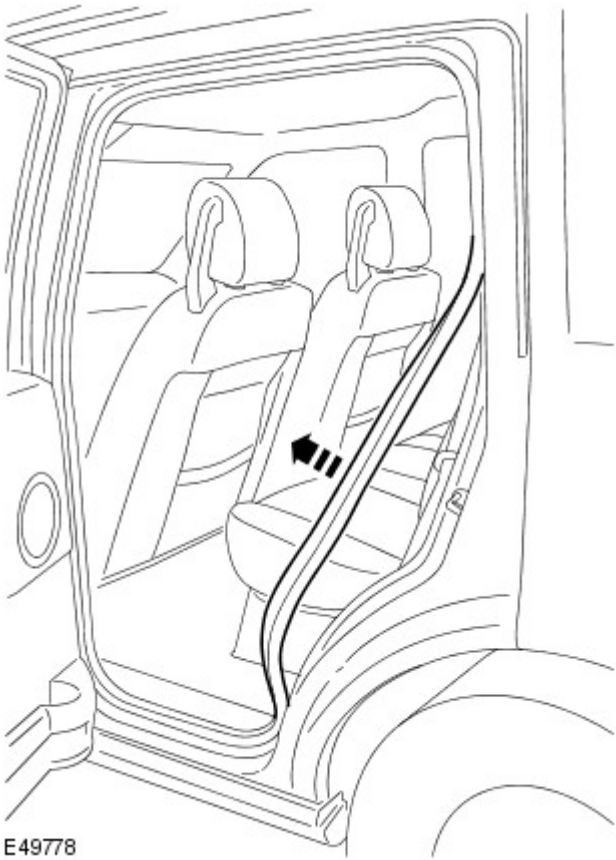
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - Rear Quarter Trim Panel

Removal and Installation

Removal

1. Fold down the rear seat backrest.
2. Release the door aperture weatherstrip.



E49778

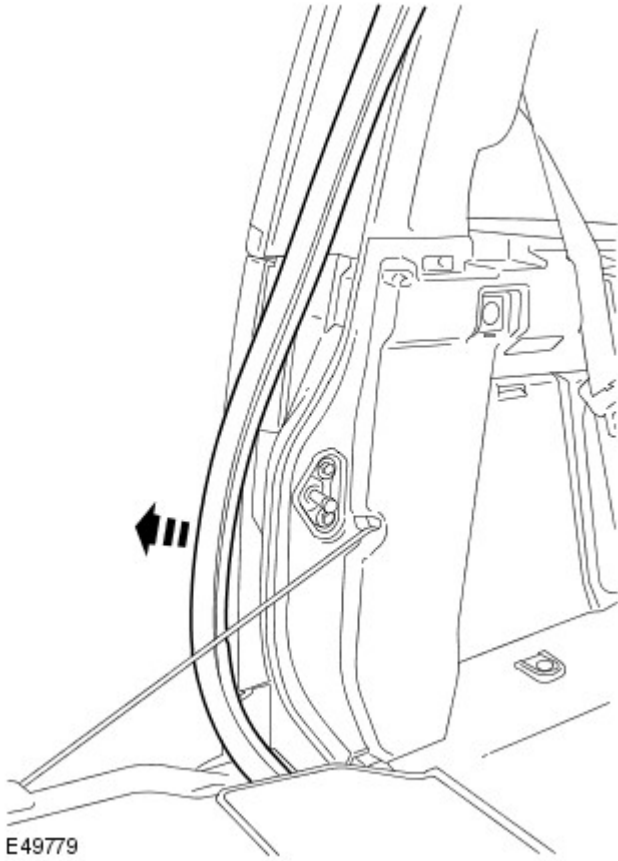
3. Release the safety belt anchor.

- Remove and discard the bolt.



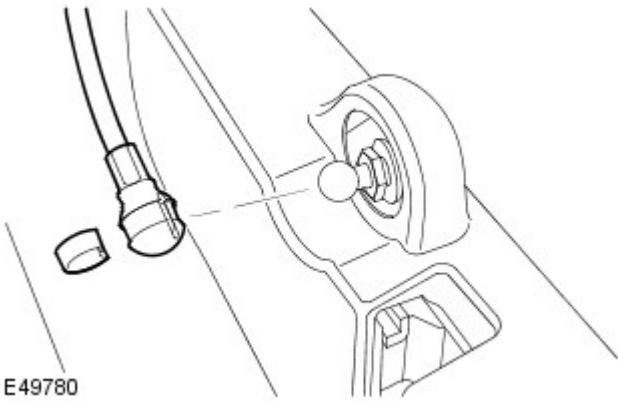
E49594

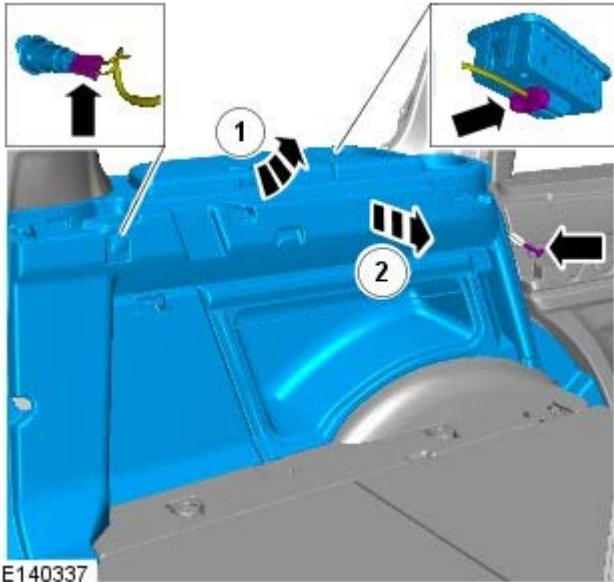
4. Release the tailgate aperture seal.



5. Remove the support spigot from the tailgate.

- Release the clip.





6. Remove the rear quarter trim panel.

- Remove the Torx screw.
- Lift the storage box lid and using a firm grip, release the window clips by pulling the trim inboard.
- Release the remaining 6 plastic clips using a suitable tool.
- Disconnect the 2 electrical connectors.

7. NOTE: Do not disassemble further if the component is removed for access only.

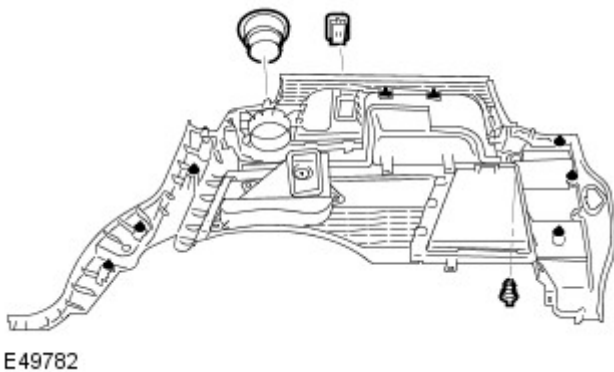
Remove the stowage tray.

- Release the cover.

8. Remove the audio control switch.

- Release the 2 clips.

9. Remove the accessory socket.



Installation

1. Install the accessory socket.
2. Install the audio control switch.
 - Secure the clips.
3. Install the stowage tray.
 - Install the cover.
4. Install the rear quarter trim panel.
 - Install the clips.
 - Tighten the Torx screw to 8 Nm (6 lb.ft).
 - Connect the electrical connector.
5. Install the support spigot to the tailgate.
 - Install the clip.
6. Install the tailgate aperture seal.

7. Install the safety belt anchor.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).

8. Install the door aperture weatherstrip.

9. Return the seat backrest to the upright position.

Interior Trim and Ornamentation - A-Pillar Trim Panel

Removal and Installation

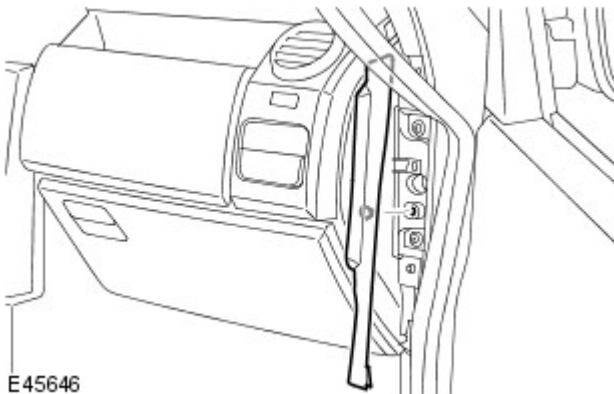
Removal

1. Release the door weatherstrip to access the A-pillar upper trim panel and instrument panel end panel.



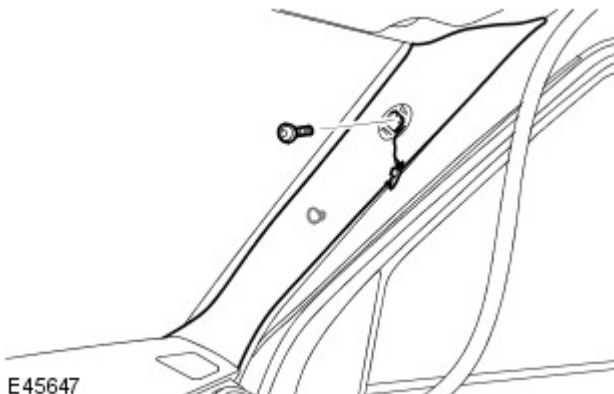
E45650

2. Remove the instrument panel end panel.
 - Release the clip.



E45646

3. Remove the A-pillar upper trim panel.
 - Release the screw cover.
 - Remove and discard the Torx screw.
 - Release the clip.

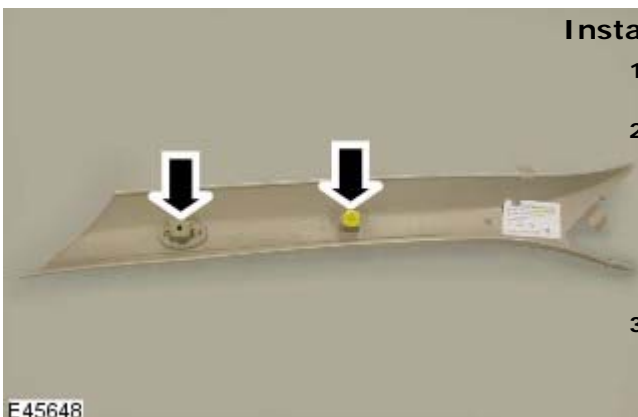


E45647

4. NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. Install the screw cover and clip from the A-pillar upper trim panel.
2. Install the A-pillar upper trim panel.
 - Secure with the clip.
 - Install a new Torx screw and tighten to 3 Nm (2 lb.ft).
 - Install the screw cover.
3. Install the instrument panel end panel.
 - Secure with the clip.



E45648

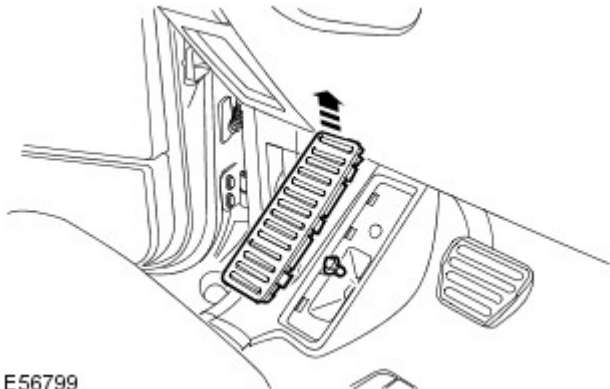
4. Attach the door weatherstrip.

Interior Trim and Ornamentation - Cowl Side Trim Panel

Removal and Installation

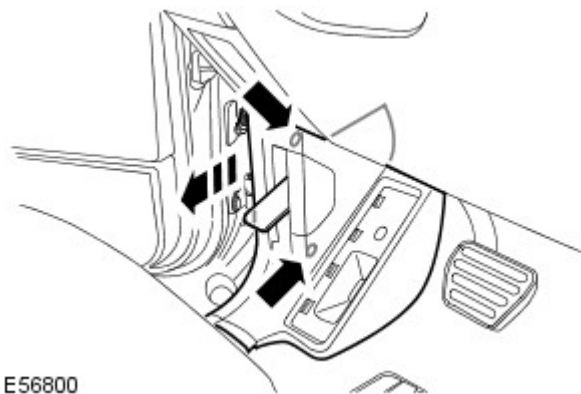
Removal

1. Remove the front scuff plate trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Driver side: Remove the footrest trim panel bolt.
 - Remove the cover.



E56799

3. Remove the cowl side trim panel.
 - Driver side: Release the hood release lever.
 - Release from the 2 clips.



E56800

Installation

1. Install the cowl side trim panel.
 - Align the hood release lever.
 - Secure with the clips.
2. Driver side: Tighten the footrest trim panel bolt to 5 Nm (4 lb.ft).
 - Install the cover.
3. Install the front scuff plate trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

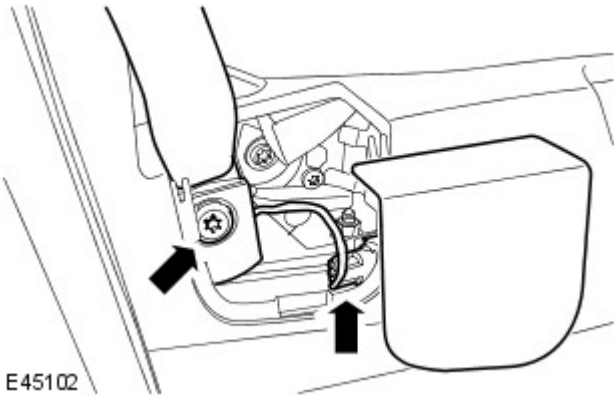
Interior Trim and Ornamentation - B-Pillar Upper Trim Panel

Removal and Installation

Removal

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the safety belt lower anchor from the seat.

- Remove the bolt cover.
- Passenger side, disconnect the electrical connector.
- Remove the Torx bolt.



E45102

4. **NOTE:** Make sure the seat belt height adjuster is at its lowest point prior to removal of the B-pillar upper trim panel.

Remove the B-pillar upper trim panel.

- Release the front and rear door weatherstrips for access.
- Release the 2 lower clips, then the remaining upper clip.
- Release the safety belt.



E45728

Installation

1. Install the B-pillar upper trim panel.
 - Secure with the clips.
 - Attach the safety belt.
 - Attach the door weatherstrips.
2. Attach the safety belt lower anchor to the seat.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
 - Passenger side, connect the electrical connector.
 - Install the bolt cover.
3. Install the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Interior Trim and Ornamentation - B-Pillar Lower Trim Panel

Removal and Installation

Removal

1. Remove the B-pillar lower trim panel.

- Release weatherstrip from both sides of the B-pillar lower trim panel.
- Release the 4 clips.



E43145

2. NOTE: Do not disassemble further if the component is removed for access only.

Remove 4 clips from the B-pillar lower trim panel.



E43146

Installation

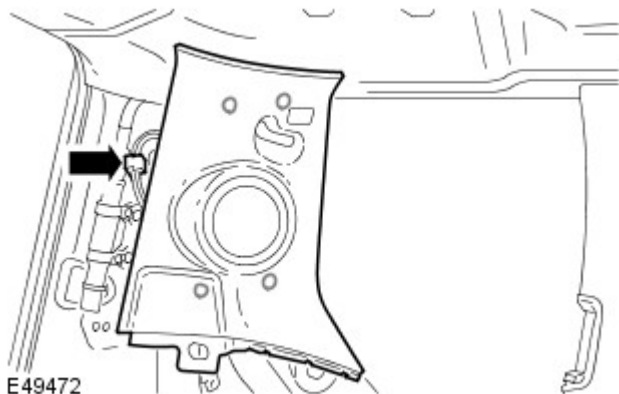
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - D-Pillar Trim Panel

Removal and Installation

Removal

1. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Vehicles fitted with 7 seats: Release the seat belt.
 - Remove and discard the bolt.
3. Remove the D-pillar upper trim panel.
 - Release the 4 clips.
 - Disconnect the electrical connector.



4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the speaker.

- Remove the 3 screws.

Installation

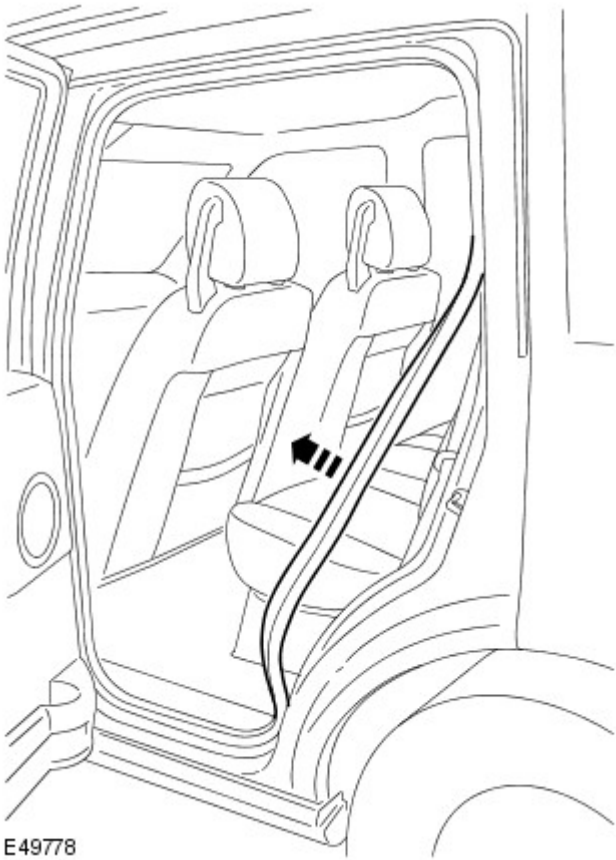
1. To install, reverse the removal procedure.
 - Tighten the new Torx bolt to 40 Nm (30 lb.ft).

Interior Trim and Ornamentation - C-Pillar Lower Trim Panel

Removal and Installation

Removal

1. Fold down the rear seat backrest.
2. Release the door aperture weatherstrip.



E49778

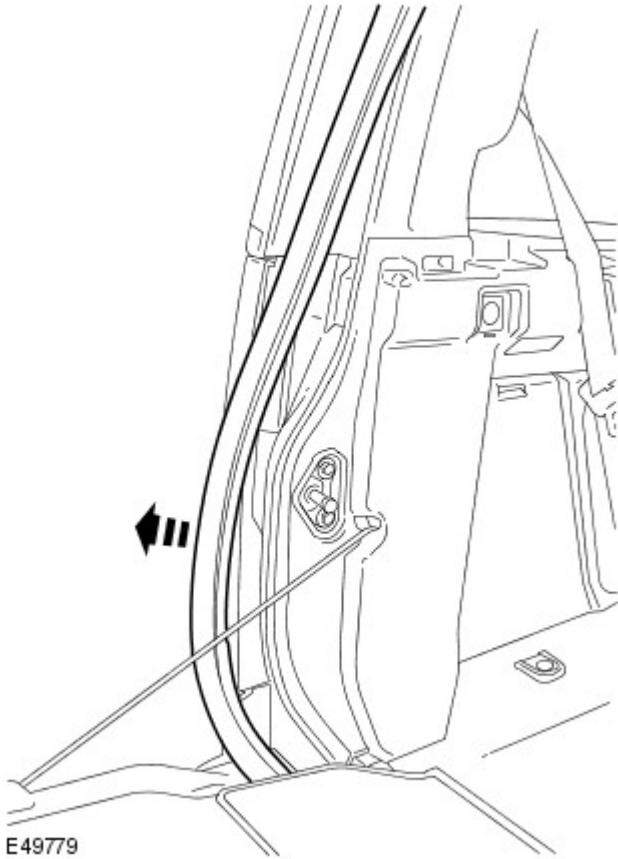
3. Release the safety belt anchor.

- Remove and discard the bolt.



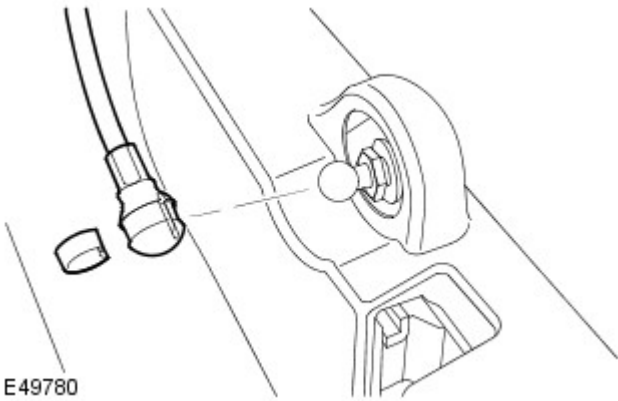
E49594

4. Release the tailgate aperture seal.



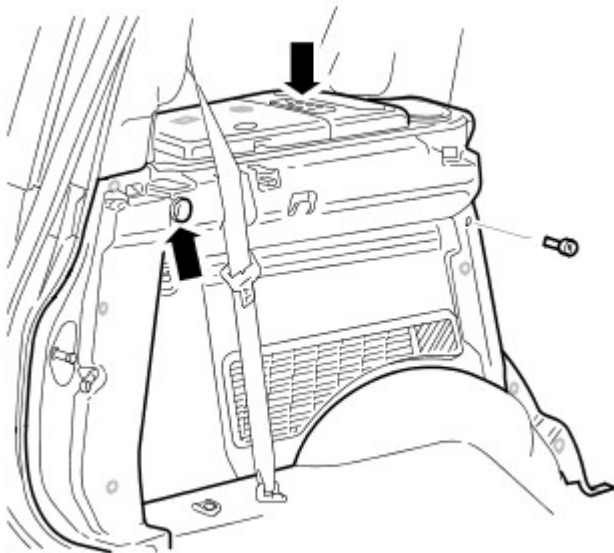
5. Remove the support spigot from the tailgate.

- Release the clip.



6. Remove the C-pillar lower trim panel.

- Remove the Torx screw.
- Release the 8 clips.
- Disconnect the 2 electrical connectors.



E49781

7. NOTE: Do not disassemble further if the component is removed for access only.

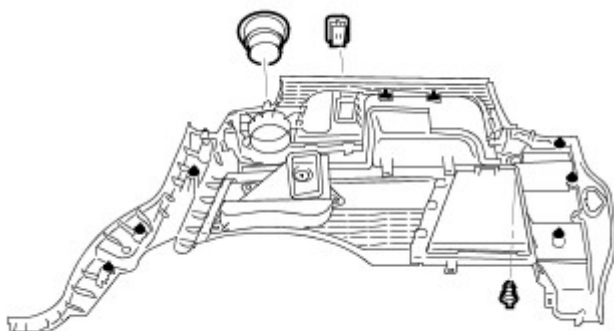
Remove the stowage tray.

- Release the cover.

8. Remove the audio control switch.

- Release the 2 clips.

9. Remove the accessory socket.



E49782

Installation

1. Install the accessory socket.

2. Install the audio control switch.

- Secure the clips.

3. Install the stowage tray.

- Install the cover.

4. Install the C-pillar lower trim panel.

- Install the clips.
- Tighten the Torx screw to 8 Nm (6 lb.ft).
- Connect the electrical connector.

5. Install the support spigot to the tailgate.

- Install the clip.

6. Install the tailgate aperture seal.

7. Install the safety belt anchor.

- Tighten the Torx bolt to 45 Nm (33 lb.ft).

8. Install the door aperture weatherstrip.

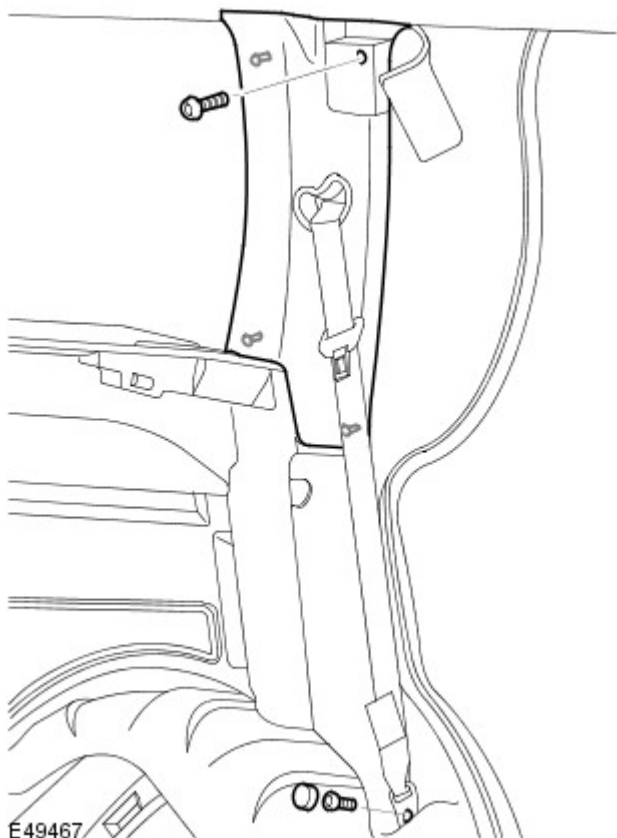
9. Return the seat backrest to the upright position.

Interior Trim and Ornamentation - C-Pillar Upper Trim Panel

Removal and Installation

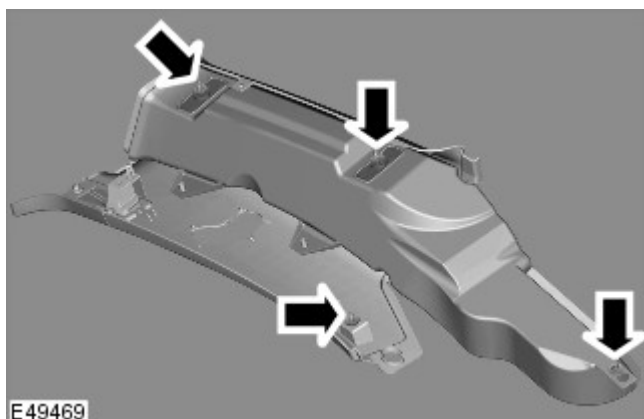
Removal

1. Fold down the rear seat backrest.
2. Release the door aperture weatherstrip.
3. Release the safety belt lower anchor.
 - Remove and discard the Torx bolt.
4. Release the upper trim access cover.
5. Remove the C-pillar upper trim panel.
 - Remove and discard the Torx screw.
 - Release the 4 clips.
 - Release the safety belt from the seat.



6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 4 clips from the C-pillar upper trim panel.



Installation

1. Install the clips to the C-pillar upper trim panel.
2. Install the C-pillar upper trim panel.
 - Attach the safety belt.
 - Secure with the clips.

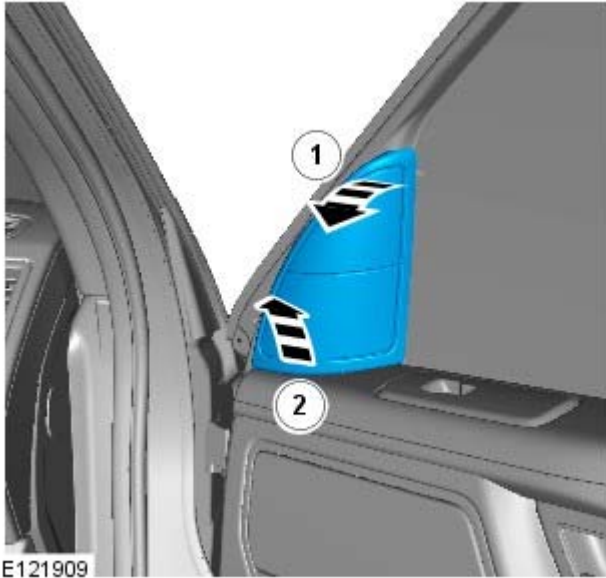
- Install a new Torx screw and tighten to 3 Nm (2 lb.ft).
3. Install the upper trim access cover.
 4. Install the safety belt lower anchor.
 - Tighten the new Torx bolt to 40 Nm (30 lb.ft).
 5. Install the door aperture weatherstrip.
 6. Return the seat backrest to the upright position.

Interior Trim and Ornamentation - Front Door Trim Panel

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

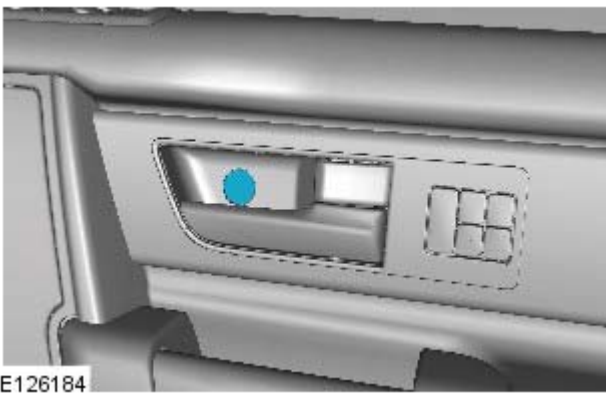


1. **1. CAUTIONS:**

 Take extra care not to damage the component.

 Make sure that the clips are correctly located.

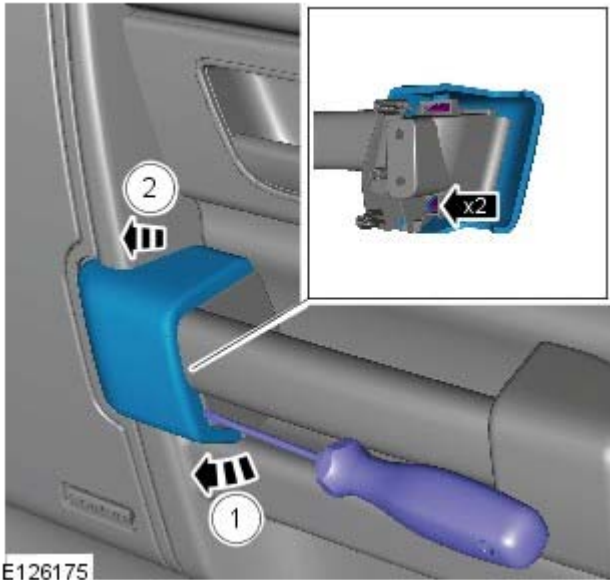
Disconnect the tweeter speaker electrical connector.



2.



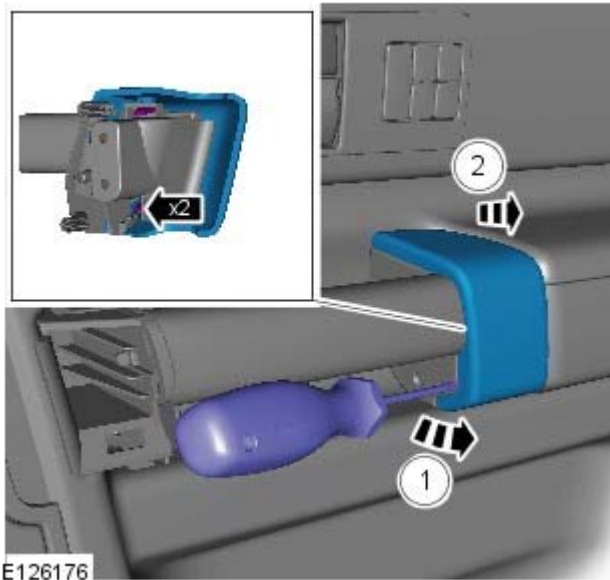
3.



E126175

4. 4. CAUTIONS:

- ⚠ Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.
- ⚠ When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.
- ⚠ Make sure that the clips are correctly located.



E126176

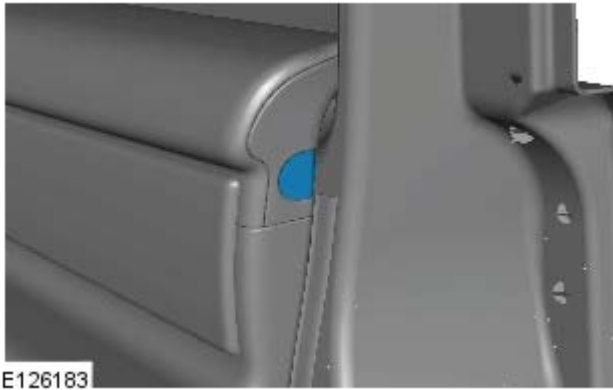
5. 5. CAUTIONS:

- ⚠ Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.
- ⚠ When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.
- ⚠ Make sure that the clips are correctly located.



E126173

6.



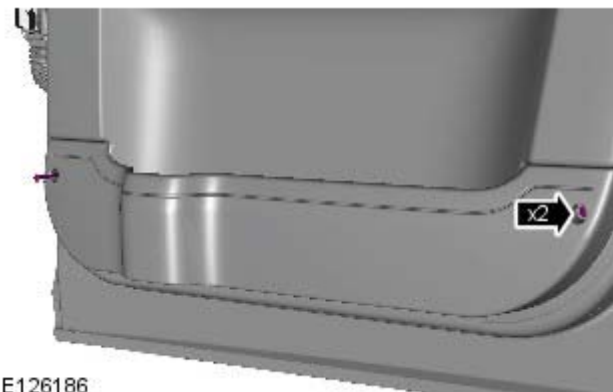
7.

E126183



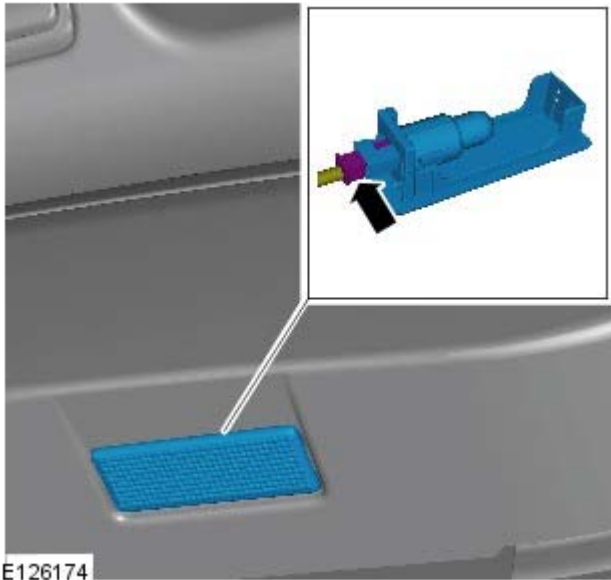
8.

E126185

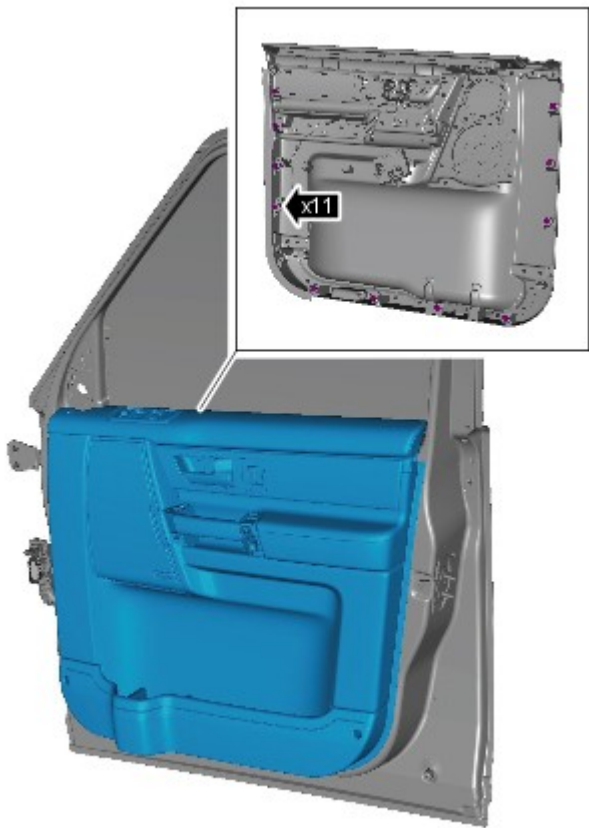


9.

E126186

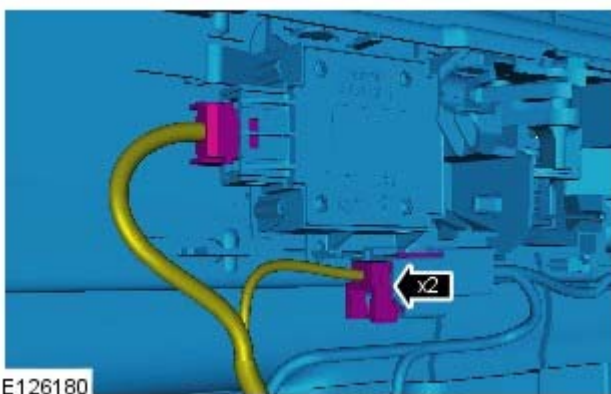


10.

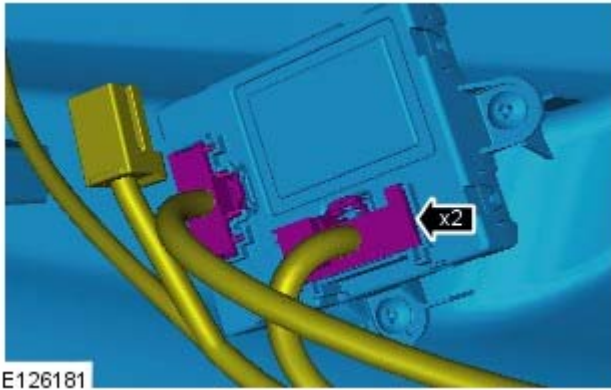


11. **11.**  **CAUTION:** Take extra care not to damage the wiring harnesses.

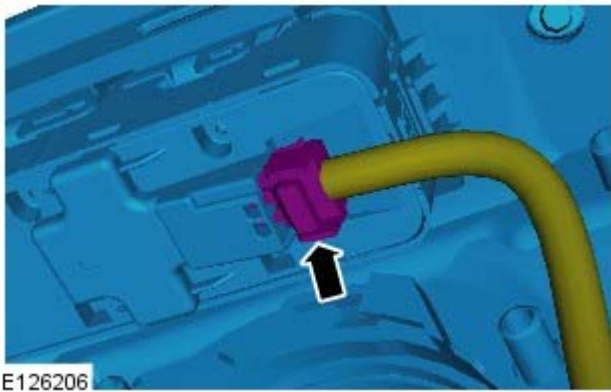
Detach the front door trim panel.



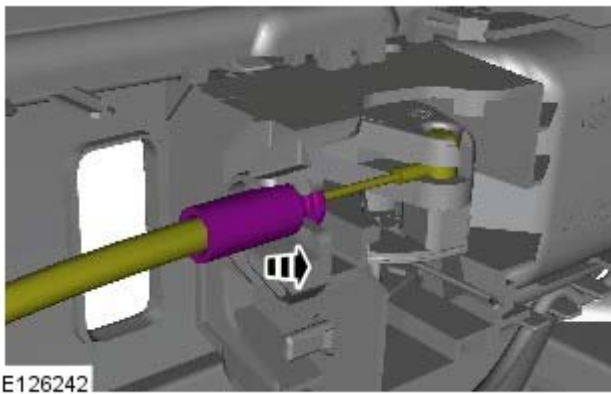
12.




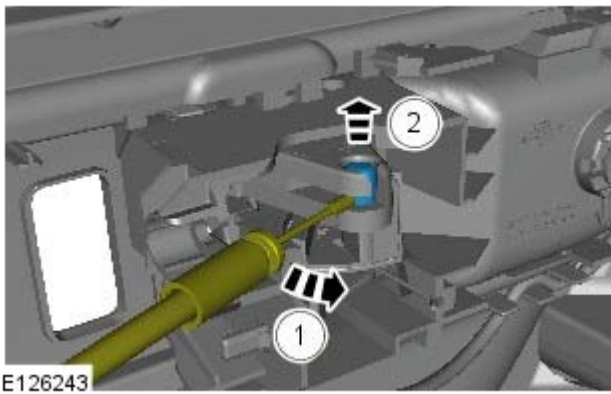
13.



14.

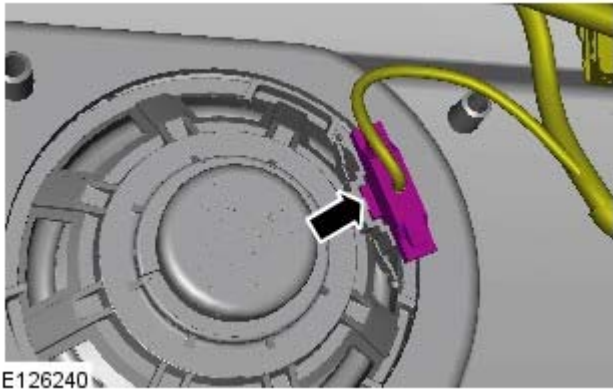


15.  CAUTION: Make sure that the release cable is removed from the door trim panel using the plastic fixing and not using the cable.

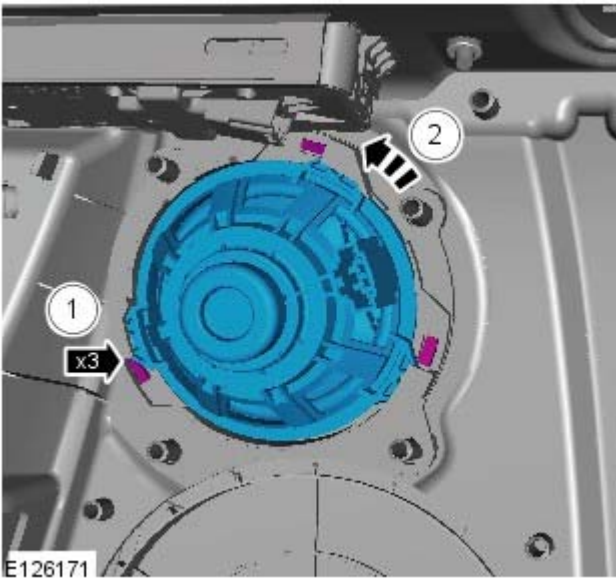


16.

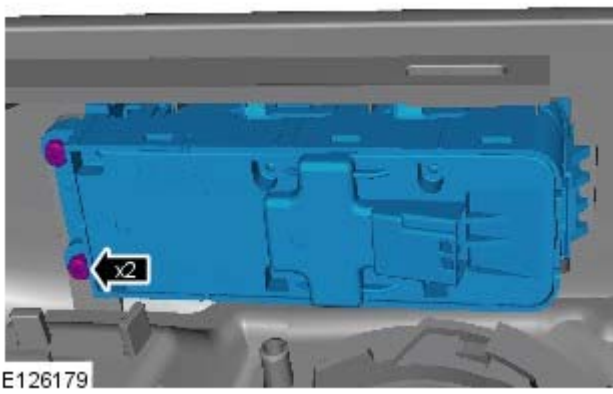
17. Remove the front door trim panel.



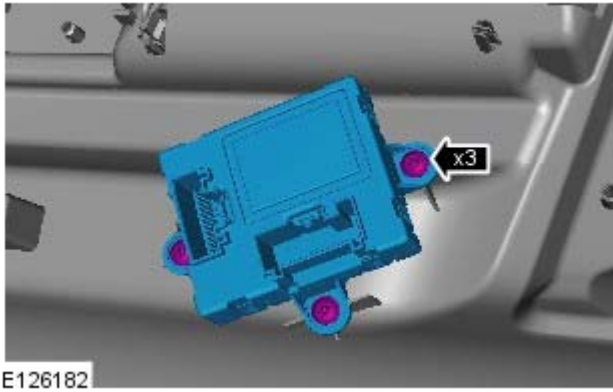
18. **18.** NOTE: Do not disassemble further if the component is removed for access only.



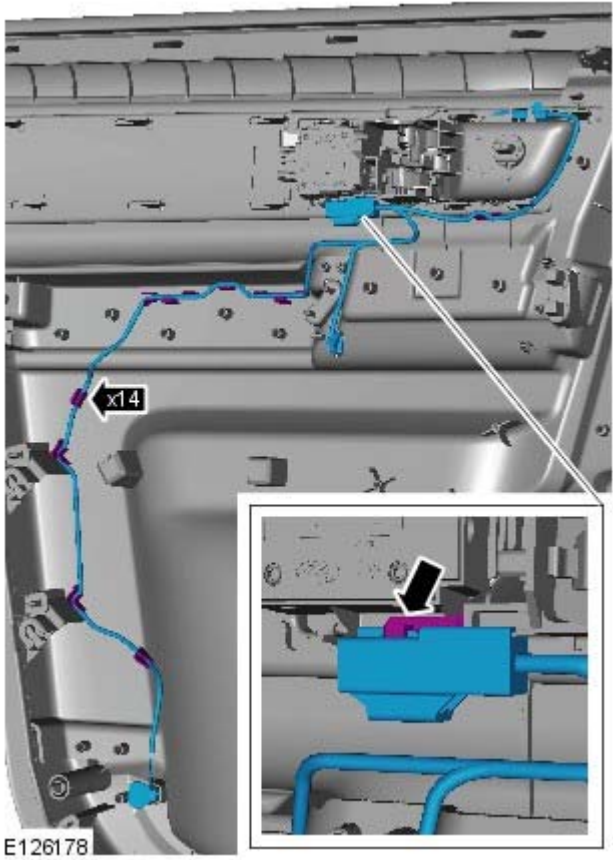
19.



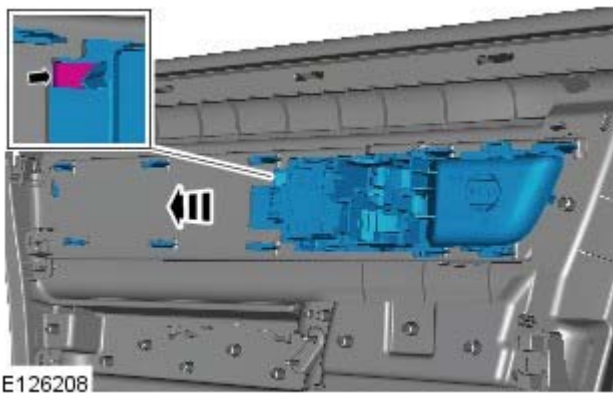
20.



21.

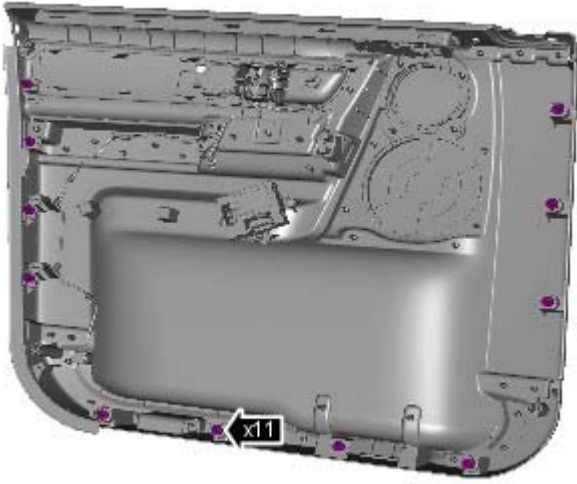


22.



23. Release the retaining tang.

24.



E126172

Installation

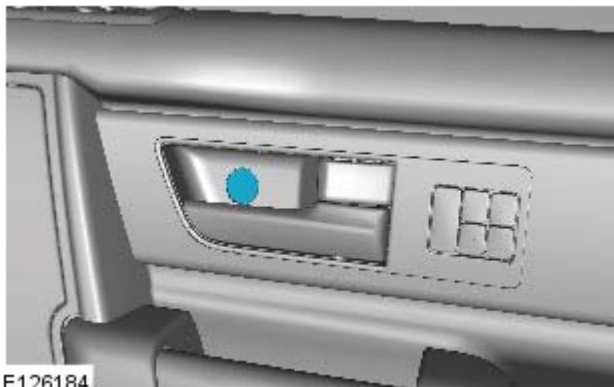
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - Rear Door Trim Panel

Removal and Installation

Removal

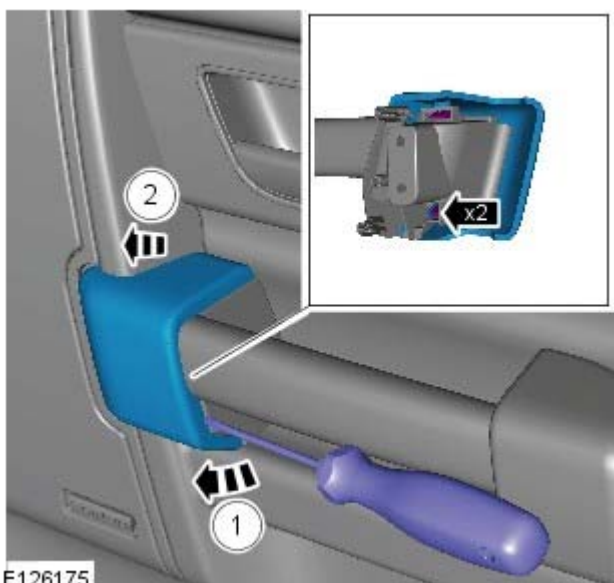
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**



1.

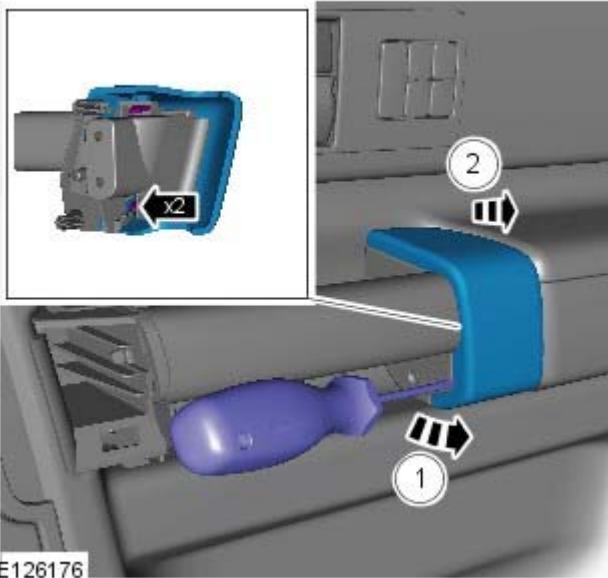


2.




3. **3. CAUTIONS:**


- ⚠ Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.
- ⚠ When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.
- ⚠ Make sure that the clips are correctly located.



E126176

4. **4. CAUTIONS:**

 Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.

 When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.

 Make sure that the clips are correctly located.



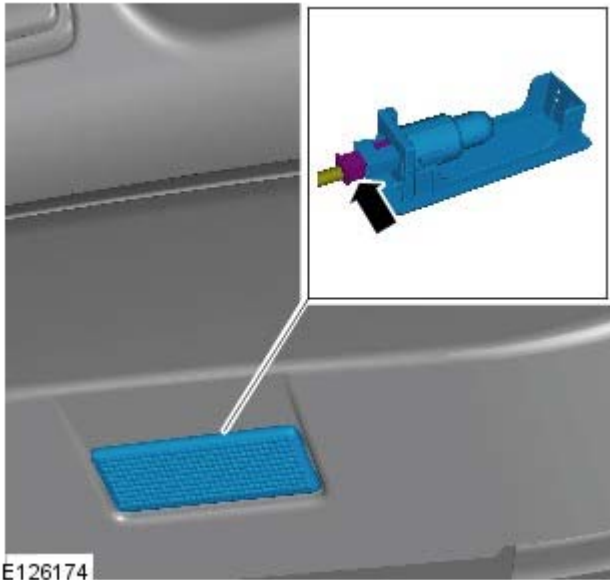
E126173

5.



E126225

6.

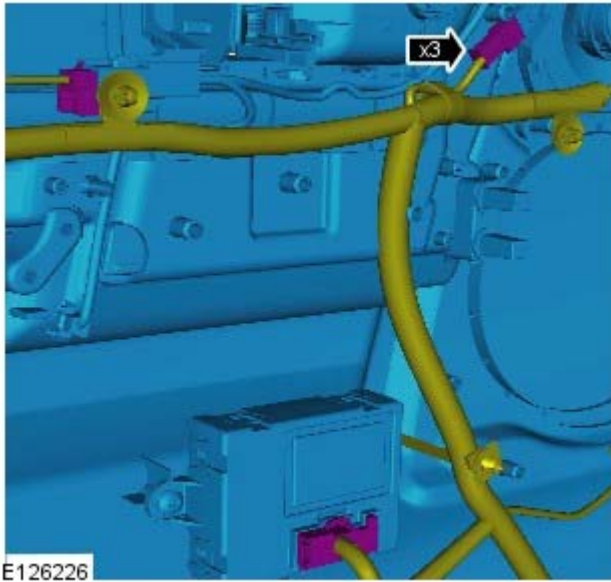


7.

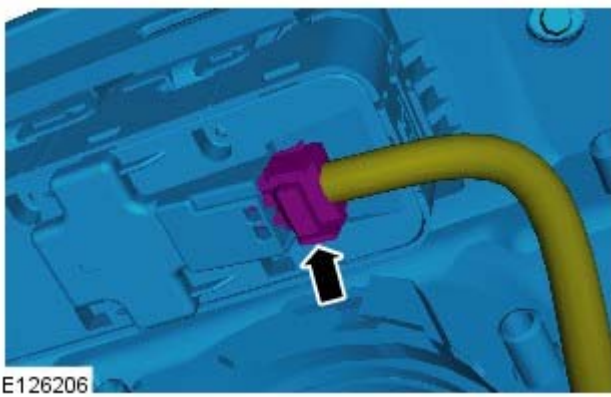


8.  CAUTION: Take extra care not to damage the wiring harnesses.

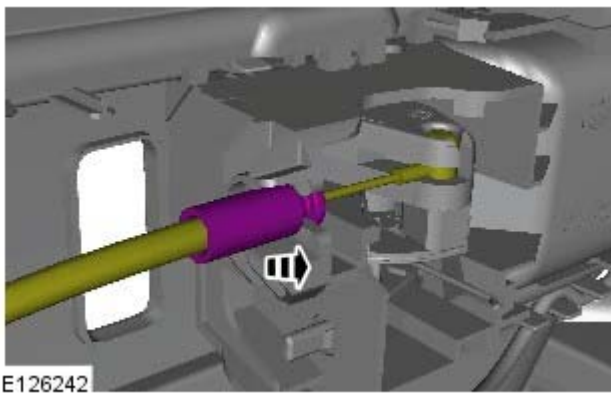
Detach the rear door trim panel.




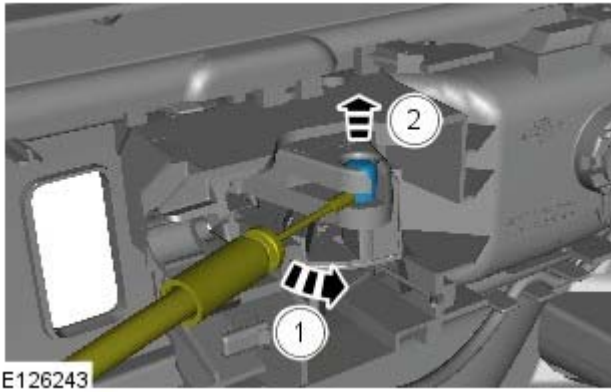
9.



10.



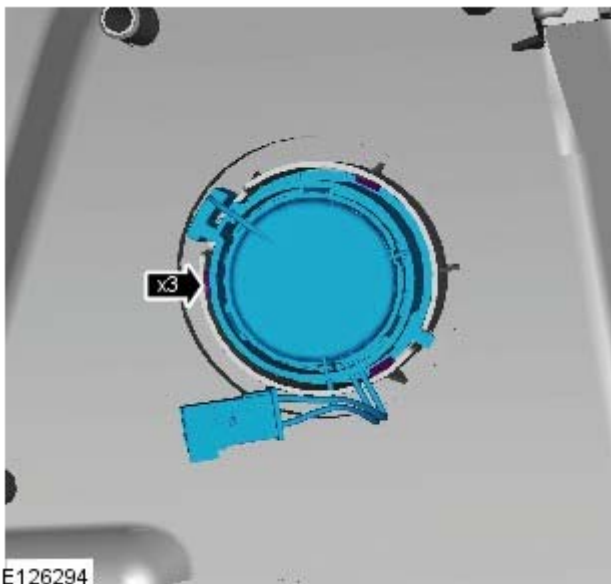
11. **11.**  CAUTION: Make sure that the release cable is removed from the door trim panel using the plastic fixing and not using the cable.



12.

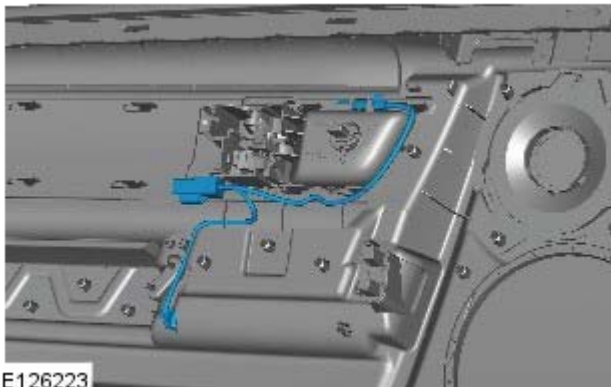
E126243

13. Remove the rear door trim panel.



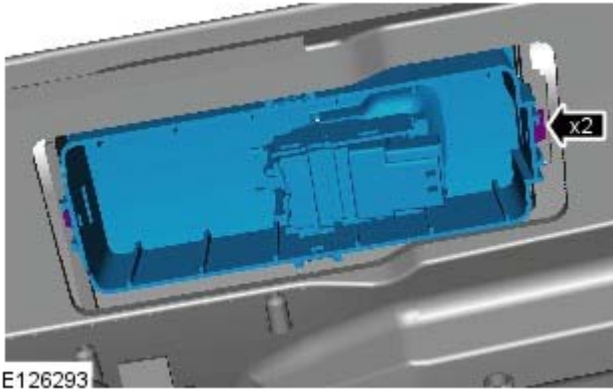
14. **14.** NOTE: Do not disassemble further if the component is removed for access only.

E126294

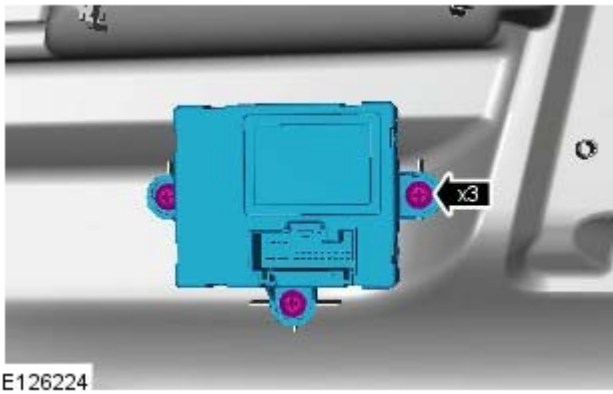


15.

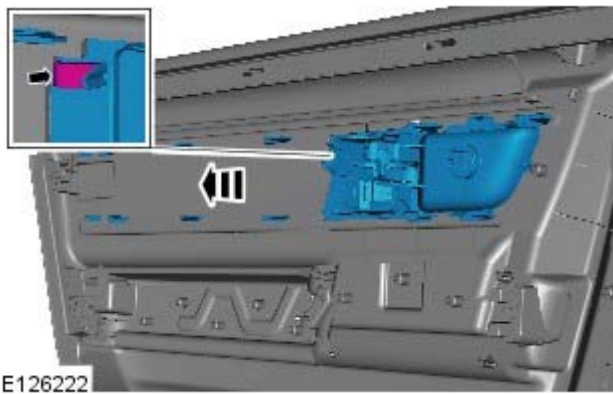
E126223



16.



17.



18. Release the retaining tang.

19.



E126227

Installation

1. To install, reverse the removal procedure.

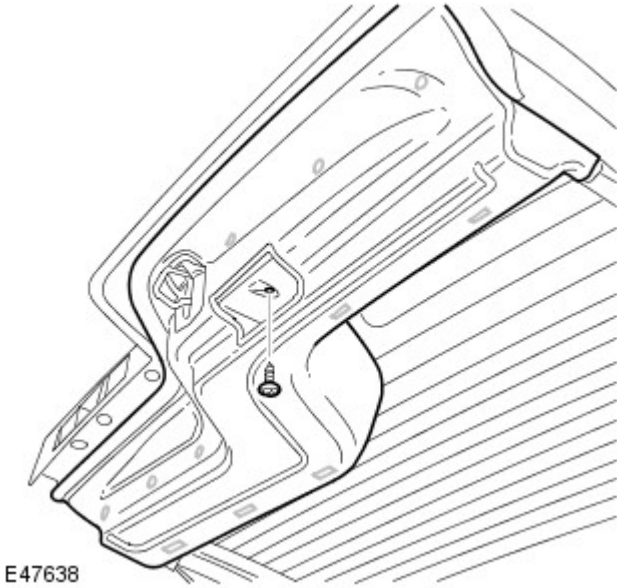
Interior Trim and Ornamentation - Liftgate Trim Panel

Removal and Installation

Removal

1. Remove the liftgate trim panel.

- Remove the screw.
- Release the 11 clips.

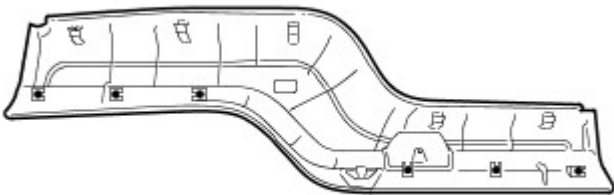


E47638

2. Remove the liftgate striker trim panel.

3. NOTE: Do not disassemble further if the component is removed for access only.

Remove 6 clips from the liftgate trim panel.



E47639

Installation

1. To install, reverse the removal procedure.

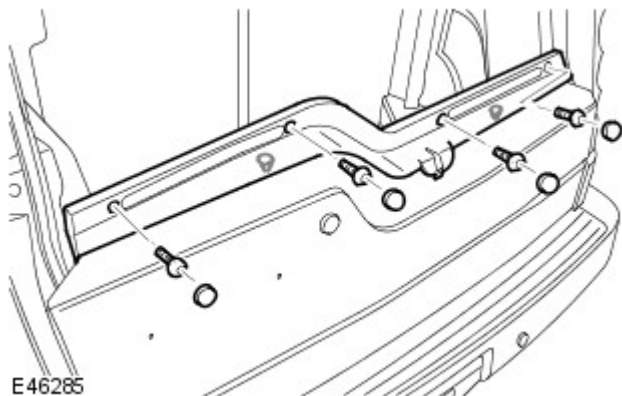
Interior Trim and Ornamentation - Tailgate Trim Panel

Removal and Installation


Removal

1. Remove the tailgate upper trim panel.

- Remove the 4 screw covers.
- Remove the 4 screws.
- Release the 2 clips.

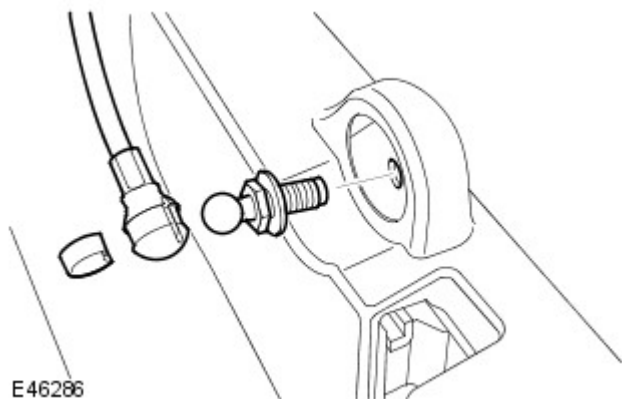


E46285

2.  CAUTION: To protect the paintwork, the tailgate must be supported at all times.

Release the 2 support cables from the tailgate.

- Release the 2 clips.



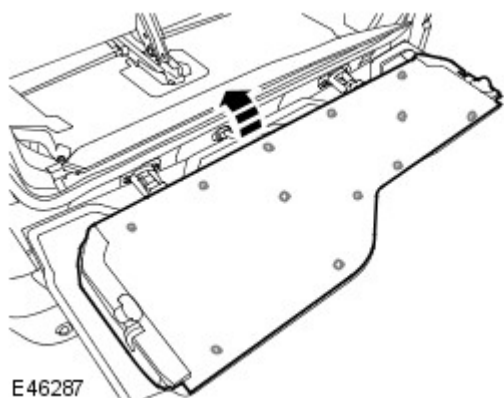
E46286

3. Remove the 2 support cable spigots from the tailgate.

4. Lift the tailgate hinge cover for access.

5. Remove the tailgate trim panel.

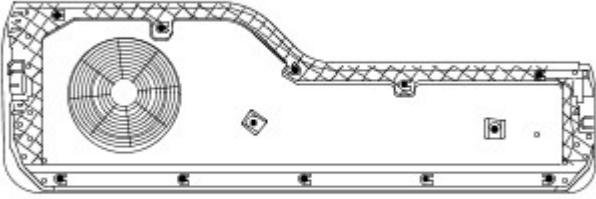
- Release from the 12 clips.



E46287

6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 12 clips from the tailgate trim panel.



E46288

Installation

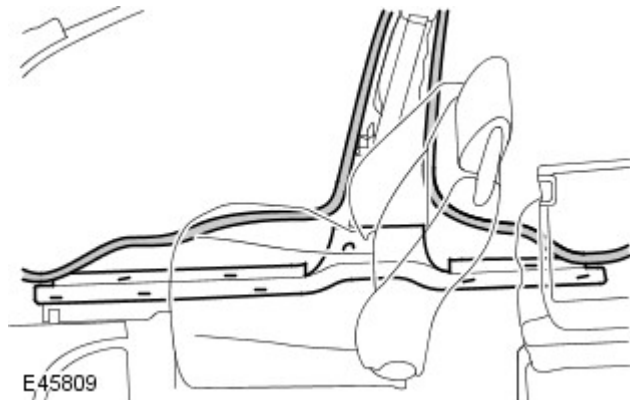
1. Install the tailgate trim panel.
 - Install the clips.
2. Lower the tailgate hinge cover.
3. Tighten the support strut spigot to 25 Nm (18 lb.ft).
4. Position the support cables to the tailgate and secure with the clips.
5. Install the tailgate upper trim panel.
 - Secure with the clips.
 - Install the screws.
 - Install the screw covers.

Interior Trim and Ornamentation - Scuff Plate Trim Panel

Removal and Installation

Removal

1. Remove the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Release the front and rear door weatherstrips to access the scuff plate trim panel.

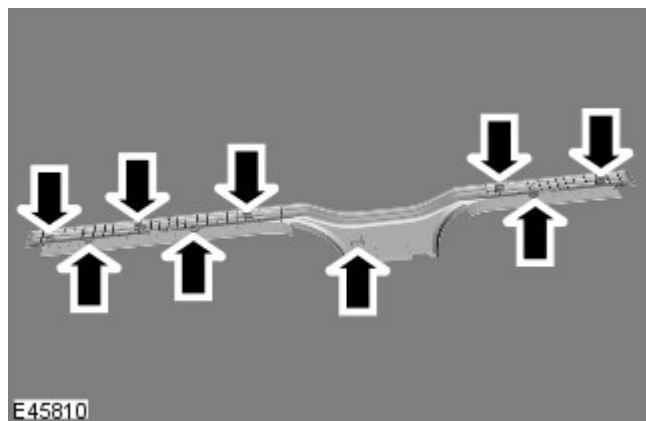


3. Remove the scuff plate trim panel.

- Remove the 9 clips.

4. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 9 clips from the scuff plate trim panel.



Installation

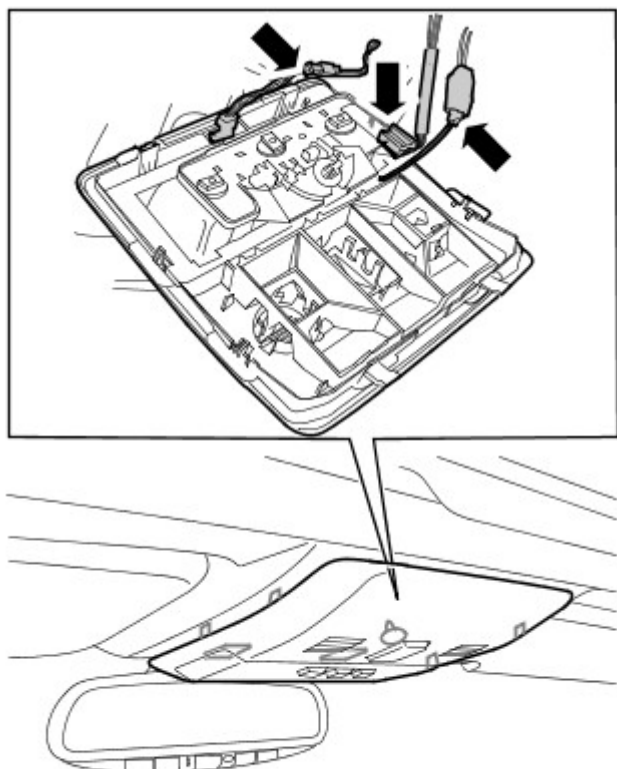
1. Install the scuff plate trim panel.
 - Install the clips.
 - Secure with the clips.
2. Attach the door weatherstrips.
3. Install the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Interior Trim and Ornamentation - Headliner

Removal and Installation

Removal

1. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove both C-pillar upper trim panels.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove both D-pillar upper trim panels.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Remove the front overhead console.

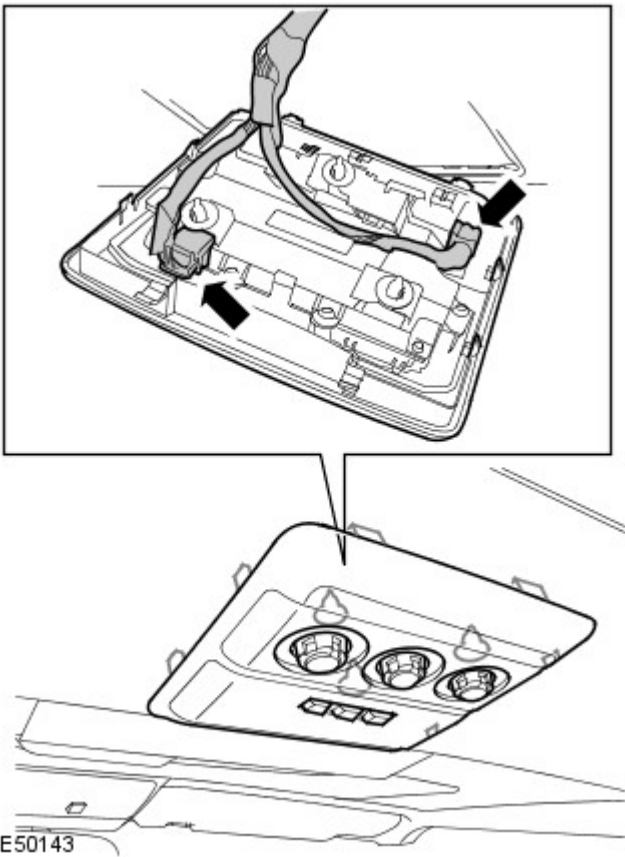


- Carefully release the 7 clips.
- Disconnect the 3 electrical connectors.

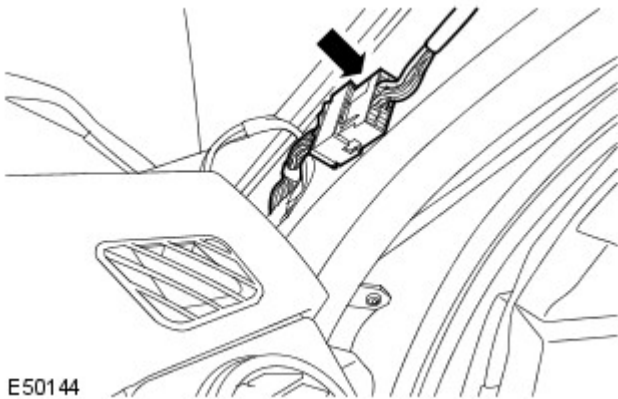
E50142

6. Remove the rear overhead console.

- Carefully release the 9 clips.
- Disconnect the 2 electrical connectors.

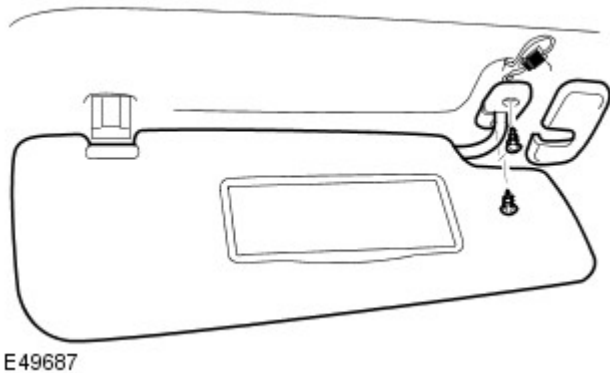


7. Disconnect the RH A-pillar electrical connector.



8. Remove the sun visor.

- Remove the cover.
- Remove the 2 screws.
- Release from the clip.
- Disconnect the electrical connector.
- Repeat the above procedure for the other side.



9. Remove the sun visor retaining clip.

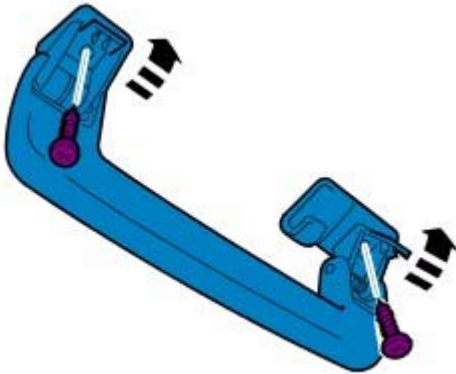
- Release the screw cover.
- Remove the screw.
- Repeat the above procedure for the other side.



E49688

10. Remove the passenger assist handle.

- Release the 2 screw covers.
- Remove the 2 screws.
- Repeat the above procedure for the remaining 5 handles.



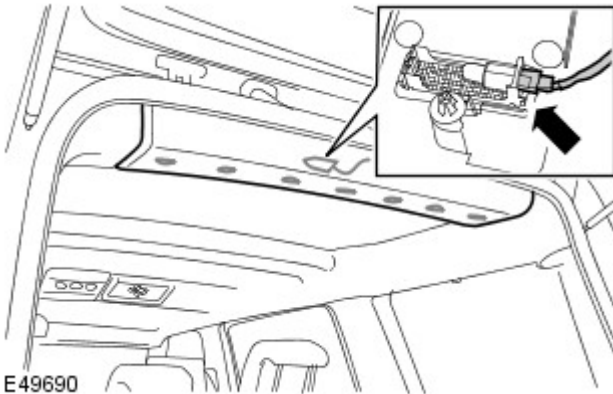
E49689

11. Position the front seats fully forward.

12. Position the rear seats fully forward.

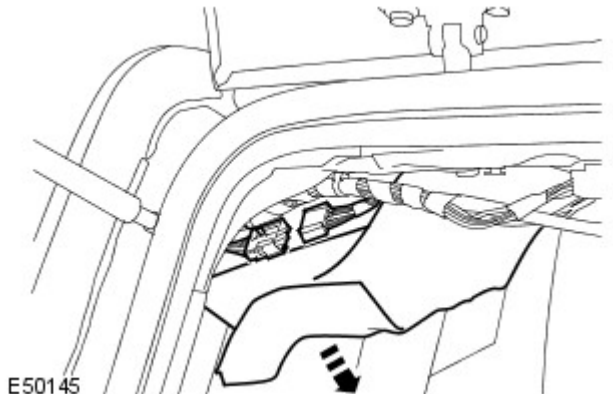
13. Remove the rear headliner trim panel.

- Release the 7 clips.
- Disconnect the electrical connector.

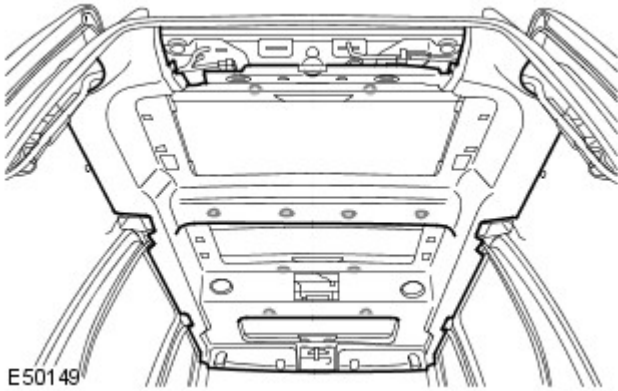


E49690

14. Disconnect the headliner wiring harness rear electrical connector.

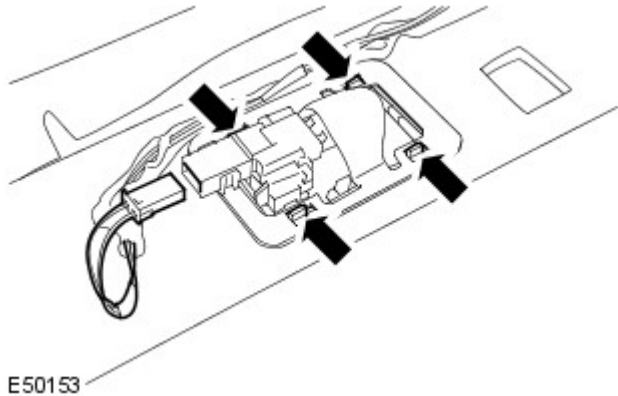


E50145



15. With assistance, carefully remove the headliner.

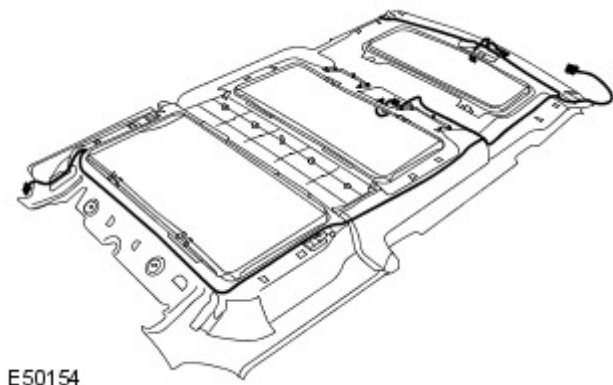
- Release the 14 clips.



16. NOTE: Do not disassemble further if the component is removed for access only.

Remove the rear interior lamp.

- Release the clip.
- Disconnect the electrical connector.
- Repeat the above procedure for the other side.



17. Remove the headliner wiring harness.

Installation

1. Install the headliner wiring harness.
 - Secure the wiring harness to the headliner.
2. Install the interior lamp.
 - Secure with the clip.
 - Connect the electrical connector.
 - Repeat the above procedure for the other side.
3. With assistance, carefully install the headliner.
 - Secure with the clips.
4. Connect the headliner wiring harness rear electrical connector.
5. Install the rear headliner trim panel.
 - Secure the clips.

6. Reposition the rear seats.
7. Reposition the front seats.
8. Install the passenger assist handles.
 - Install the screws.
 - Secure the screw covers.
9. Install the sun visors.
 - Install the clips.
 - Install the screws.
 - Install the screw covers.
 - Connect the electrical connectors.
10. Connect the RH A-pillar electrical connector.
11. Install the rear overhead console.
 - Connect the electrical connectors.
 - Carefully secure the clips.
12. Install the front overhead console.
 - Connect the electrical connectors.
 - Carefully secure the clips.
13. Install both D-pillar upper trim panels.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
14. Install both C-pillar upper trim panels.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
15. Install both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
16. Install both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

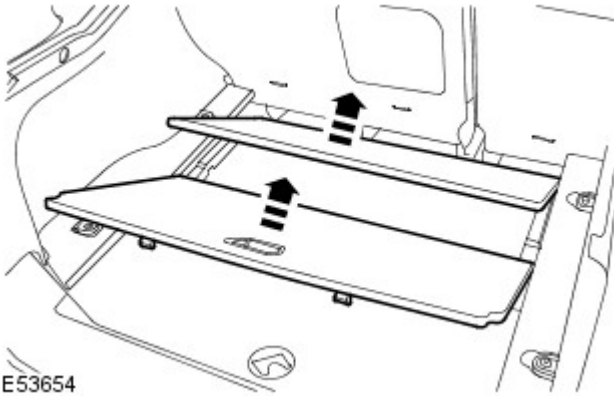
Interior Trim and Ornamentation - Loadspace Trim Panel RH

Removal and Installation

Removal

1. Remove the loadspace floor panels.

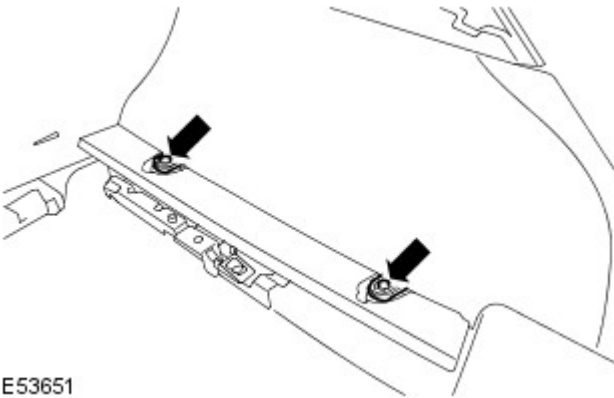
- Lift and remove the front panel.
- Lift and remove the rear panel.



E53654

2. Remove the loadspace compartment anchors.

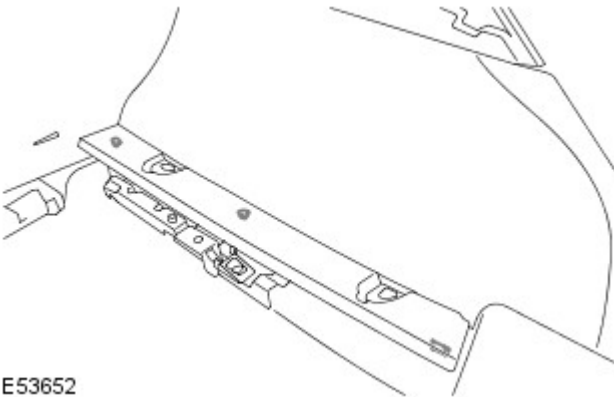
- Remove the bolt.
- Repeat the above procedure for the other anchor.



E53651

3. Remove the loadspace trim panel.

- Release the 3 clips.



E53652

4. NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. Install the trim clips.

2. Install the loadspace trim panel.

- Secure the clips.
- Position the locating pegs.

3. Install the loadspace compartment anchors.

- Position the locating peg.
- Tighten the bolt to 25 Nm (18 lb.ft).
- Repeat the above procedure for the other anchor.



E53653

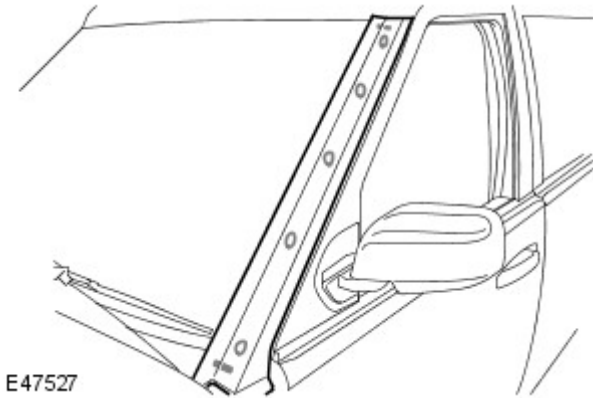
4. Install the loadspace floor panels.

Exterior Trim and Ornamentation - A-Pillar Moulding LH

Removal and Installation

Removal

- NOTE: This procedure is also applicable for the RH moulding.



1. Open the bonnet.
2. Remove the A-pillar moulding.
 - Release and discard the 5 clips.

Installation

1. NOTE: The lower clip is unique to the others and must only be installed to the lowest position on the moulding.

To install, reverse the removal procedure.


1. New clips must be used.

Exterior Trim and Ornamentation - Front Fender Moulding

Removal and Installation

Removal

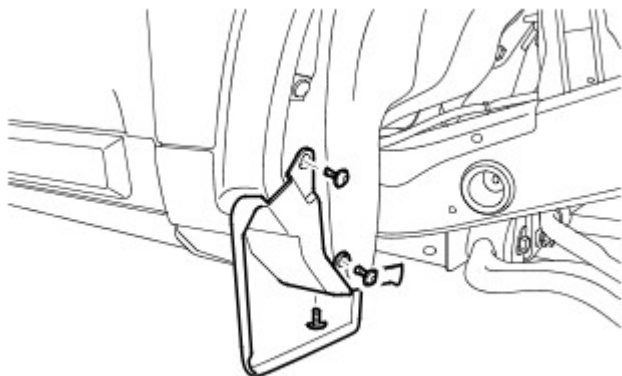
1. Remove the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

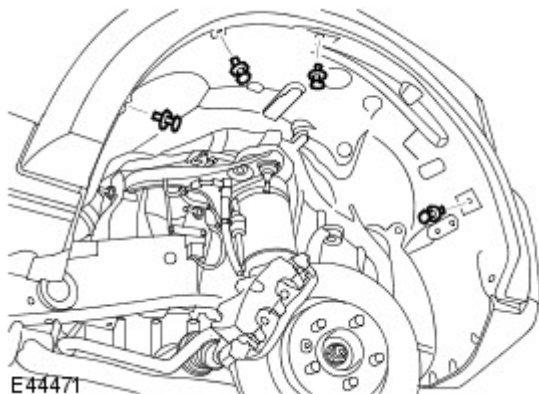
3. Remove the mud flap.

- Remove the 3 retaining screws.



E44470

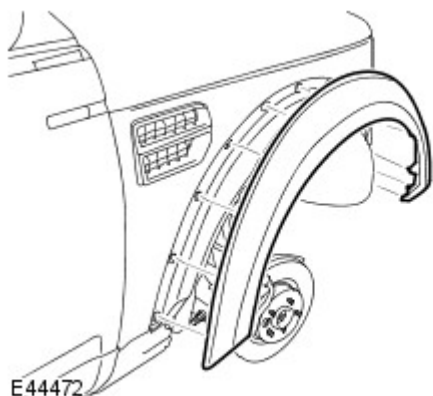
4. Remove the 4 retainers.



E44471

5. Remove the fender moulding.

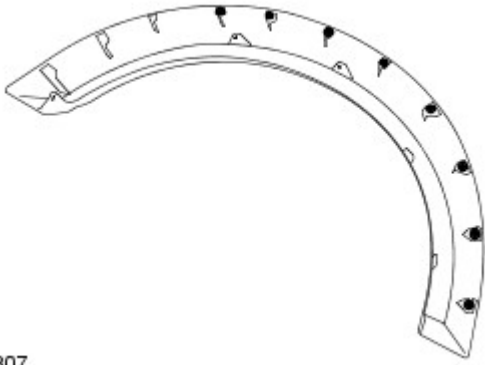
- Remove the 2 screws.
- Carefully release the 10 clips.



E44472

6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the clips from the moulding.



E53307

Installation

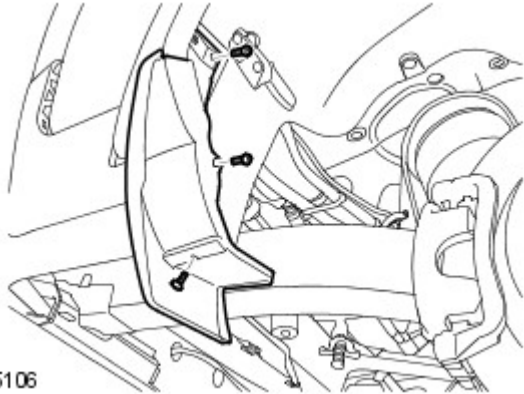
1. To install, reverse the removal procedure.
2. Install the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

Exterior Trim and Ornamentation - Rear Quarter Panel Moulding

Removal and Installation

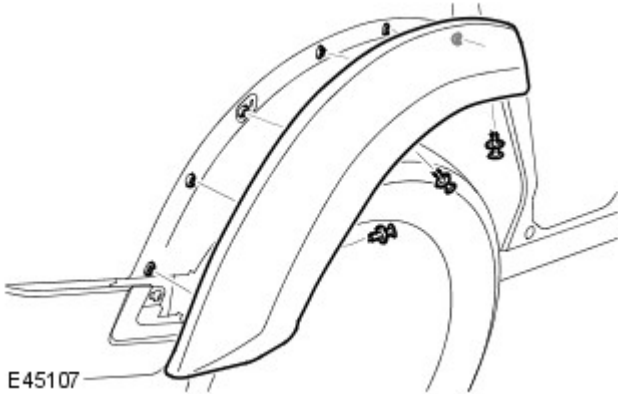
Removal

1. Remove the mud flap.
 - Remove the 3 screws.



E45106

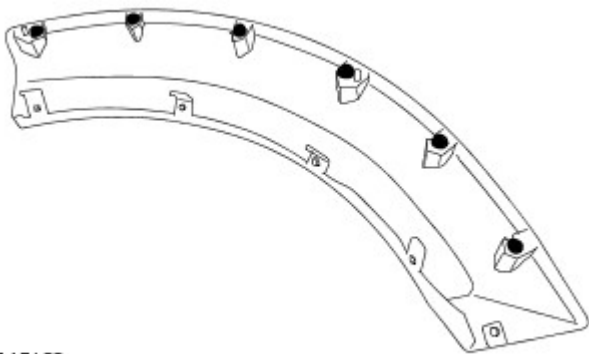
2. Remove the rear quarter panel moulding.
 - Remove the 3 clips from the underside of the moulding.
 - Release the 6 clips from the rear quarter panel.



E45107

3. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the clips from the moulding.



E45108

Installation

1. To install, reverse the removal procedure.

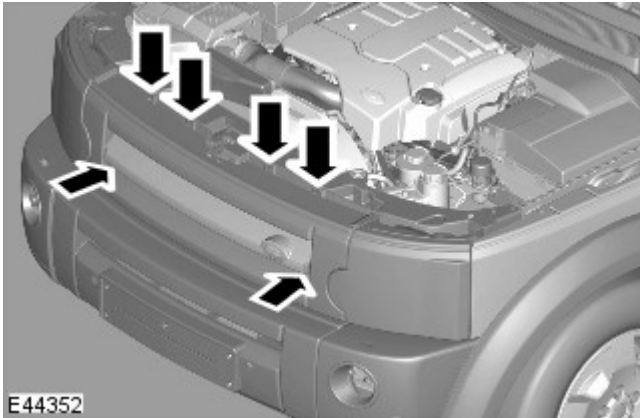
Exterior Trim and Ornamentation - Radiator Grille

Removal and Installation

Removal

1. Remove the radiator grille.

- Open the hood.
- Release the 6 clips.



Installation

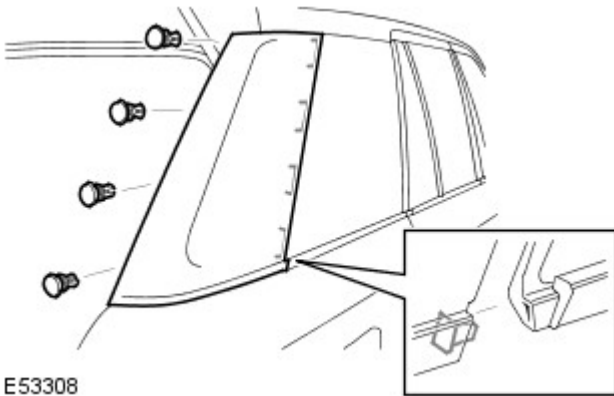
1. To install, reverse the removal procedure.

Exterior Trim and Ornamentation - Rear Quarter Window Moulding

Removal and Installation

Removal

1. Open the liftgate.
2. Remove the rear quarter window moulding.
 - Remove the 4 clips.
 - Release the locating peg.



E53308

Installation

1. Install the rear quarter window moulding.
 - Position the locating peg.
 - Secure the clips.

Rear View Mirrors -

Torque Specifications

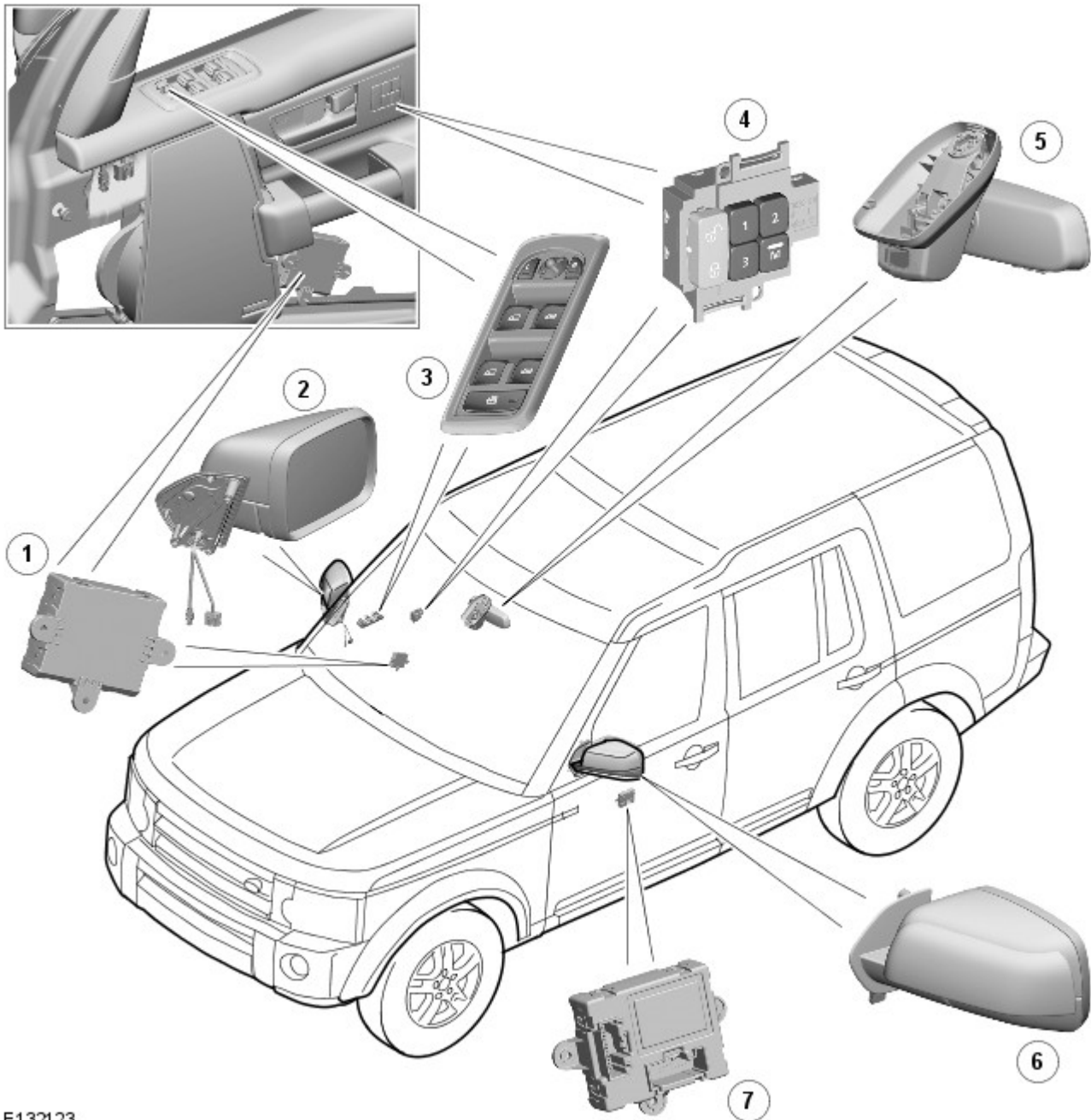
Description	Nm	lb-ft
Exterior mirror bolts	6	4

Rear View Mirrors - Rear View Mirrors

Description and Operation

COMPONENT LOCATION

- NOTE: RHD (right-hand drive) installation shown, LHD (left-hand drive) installation similar.



E132123

Item	Part Number	Description
1	-	DDM (driver door module)
2	-	Driver exterior mirror
3	-	Exterior mirror switches
4	-	Memory switches
5	-	Interior mirror (automatic dimming version shown)
6	-	Passenger exterior mirror
7	-	PDM (passenger door module)

GENERAL

Rear view mirrors consist of an interior mirror on the windshield and an exterior mirror on each front door cheater.

The interior mirror incorporates either manual dimming or automatic dimming. Depending on vehicle model and market, the automatic dimming interior mirror may also incorporate:

- A HomeLink® universal transmitter. NOTE: HomeLink is a registered trademark owned by Johnson Controls Inc.
- The automatic high beam function.

For additional information, refer to: [Exterior Lighting](#) (417-01 Exterior Lighting, Description and Operation).

The exterior mirrors on all models incorporate electrical heating and adjustment. Depending on vehicle model and market, the exterior mirrors may also incorporate:

- Memory recall.
- Reverse dipping.
- Mirror foldback.
- Approach lamps and proximity cameras. For additional information, refer to:
[Interior Lighting](#) (417-02 Interior Lighting, Description and Operation),
[Parking Aid](#) (413-13 Parking Aid, Description and Operation).

The door modules operate the exterior mirror functions under the control of the [CJB \(central junction box\)](#) and switches in the driver door switchpack.

INTERIOR MIRROR

Interior mirrors consist of mirror glass in a housing that is connected to a mounting stem by a ball joint. The mounting stem is attached to a pad bonded onto the windscreen.

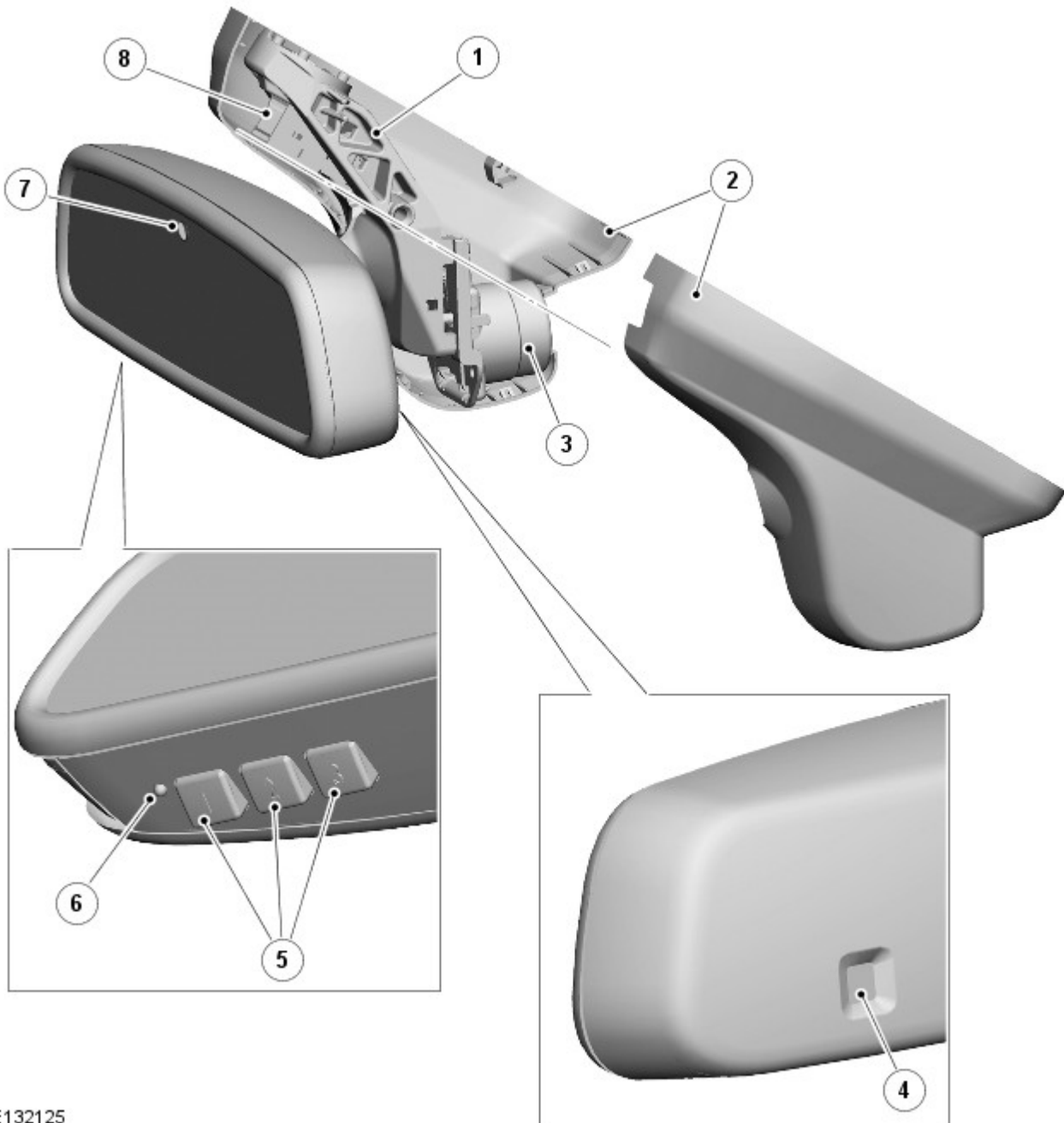
Manual Dimming Mirror



E132124

Manual dimming is performed with a lever on the underside of the mirror body.

Automatic Dimming Mirror



E132125

Item	Part Number	Description
1	-	Mounting stem
2	-	Covers
3	-	Auto high beam control module and sensor (where fitted)
4	-	Front light sensor
5	-	Universal transmitter channel buttons
6	-	Universal transmitter status indicator
7	-	Rear light sensor
8	-	Electrical connector

Automatic dimming is performed by electrochromic mirror glass that automatically dims to reduce glare from the headlights of following vehicles in dark or low light conditions.

Light sensors on the front and rear of the interior mirror provide light level inputs for the automatic dimming function.

Automatic dimming interior mirrors are connected to the vehicle wiring by an electrical connector concealed by covers installed over the mounting stem. On vehicles with the automatic high beam function, the covers also contain the auto high beam control module.

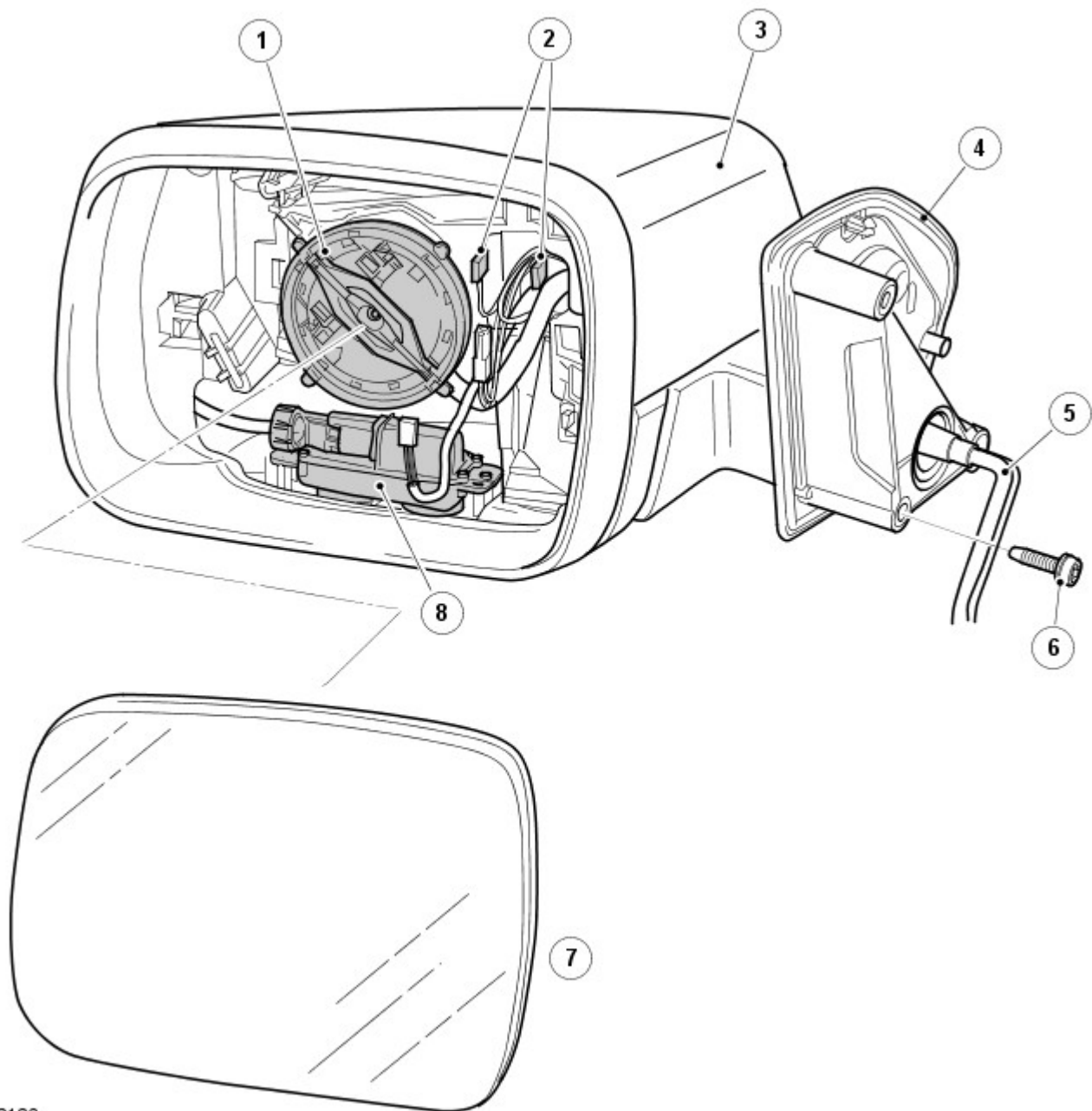
Interior mirrors which incorporate a HomeLink® universal transmitter have operating buttons on the lower face. They also have a red **LED (light emitting diode)** status indicator, next to the buttons, which illuminates when the universal transmitter is transmitting.

The universal transmitter can operate up to three home or office remotely operated systems (e.g. garage door/gate openers, lighting and security systems), replacing the individual hand held transmitters required for each system. Universal transmitter operating frequencies vary across markets.

Power for the feature(s) in the automatic dimming interior mirror is provided by an ignition feed from the **EJB (engine**

junction box).

EXTERIOR MIRRORS



E132126

Item	Part Number	Description
1	-	Actuator
2	-	Heating element connectors
3	-	Cover
4	-	Body assembly
5	-	Fly leads
6	-	Screw (3 off)
7	-	Mirror glass
8	-	Combined approach lamp and proximity camera (where fitted)

The exterior mirrors are attached to the front door structure and connected to the door harness.

The door mirrors fold forwards or rearwards on impact. On vehicles without the mirror foldback option, the mirrors can be folded into a park position by pushing the mirror housing towards the side window.

Exterior mirror heating is provided by heater elements bonded to the back of the mirror glass. The power supply to the heater elements is controlled by the respective door modules, in response to signals from the [CJB](#).

The exterior mirrors each incorporate an actuator which contains two adjustment motors for the mirror glass. One for horizontal (left/right) adjustment and one for vertical (up/down) adjustment. Power to the motors is controlled by the respective door modules in response to signals from the driver door switchpack. On vehicles with memory recall, the exterior mirrors incorporate horizontal and vertical plane position sensors.

Exterior mirrors with the foldback feature incorporate a foldback motor in the hinge. Operation of the foldback motor is

controlled by the respective door modules in response to signals from the driver door switchpack.

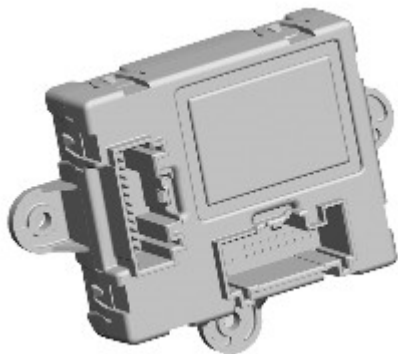
EXTERIOR MIRROR SWITCHES



E132127

Left and right select switches and an adjustment switch for the exterior mirrors are incorporated into the driver door switchpack in the top of the door casing. The switchpack is connected to the door harness and powered by a permanent battery feed from the [CJB](#).

FRONT DOOR MODULES



E132128

Each front door module is attached to the inside of the related door casing and connected to the door harness.

The two front door modules interpret the signals from the [CJB](#), the driver door switchpack and the interior mirror into appropriate outputs for the related exterior mirrors. For operation of the various exterior mirror functions each door module is powered by a permanent battery feed from the [CJB](#). The live feed to the mirror foldback motors goes off 5 minutes after the ignition is switched off.

OPERATION

Automatic Dimming Interior Mirror


Power for the feature(s) in the automatic dimming interior mirror is provided in power mode 6 (ignition).

Automatic Dimming

The light sensor in the front of the mirror monitors ambient light at the front of the vehicle and the light sensor in the rear of the mirror monitors the light coming from behind the vehicle. When the light from behind the vehicle exceeds the ambient light level, the automatic dimming circuits darken the interior mirror.

Automatic dimming is inhibited when reverse gear is selected, to provide the driver with maximum vision. The reverse gear signal is provided by a battery voltage signal from the reverse relay in the central junction box (CJB).

Universal Transmitter

 **WARNING:** The universal transmitter must not be used with any garage door that lacks a safety stop and reverse feature, as required by federal safety standards (this includes any garage or door opener model manufactured before April 1 1982). A garage door opener which cannot detect an object in the path of a closing door, and then automatically stop and reverse the door, does not meet current federal safety standards. Using a garage door opener without these features increases the risk of serious injury or death.

The universal transmitter has three channels, with separate operating buttons for each channel. When one of the buttons is pressed the universal transmitter outputs the radio signal programmed for the related channel (if any) and illuminates the status indicator to confirm transmission.

Hand held transmitters are programmed into the universal transmitter as follows:

- Turn the ignition on.

-  **WARNING:** When programming the universal transmitter in the vicinity of the affected system, the system will operate. If the system controls garage doors or gates, ensure they are clear of people and objects to prevent personal injury or damage to equipment.

Press and hold the outer two buttons of the universal transmitter until the status indicator begins to flash, then release the buttons. This initializes the universal transmitter and erases previous settings from all three channels.

- Place the signal emitting end of the hand held transmitter against the underside of the interior mirror.
- Simultaneously press and hold the activation button on the hand held transmitter and the chosen button of the universal transmitter. When the status indicator flashes rapidly, indicating the channel has been programmed, release the buttons (the status indicator flashes slowly at first and can take up to a minute before it flashes rapidly).
- To program another channel on the universal transmitter, repeat steps C. and D.
- Turn the ignition off.

The radio signals used to operate some home/office systems incorporate a code protection feature. After a channel has been programmed from the hand held transmitter, these systems will need to be trained to accept the signal from the universal transmitter. To check if a system is code protected, press the appropriate universal transmitter button. If the status indicator flashes rapidly for 1 to 2 seconds, before illuminating permanently, the system has a code protection feature.

The system is trained to the universal transmitter, as follows:

- Locate the training button on the receiver system (refer to the system's literature for details).
- Press the training button for 1 to 2 seconds, then perform step C. within 30 seconds.
- On the vehicle, press and release the appropriate universal transmitter button, twice. The receiver system should now be trained to the universal transmitter.
- If the system does not operate, repeat the procedure, but in step C. press and release the universal transmitter button three times.

Additional information on the universal transmitter can be found on: www.homelink.com

Exterior Mirrors

Heating

The [CJB](#) receives the ambient air temperature value from the [ECM \(engine control module\)](#) on the high speed [CAN \(controller area network\)](#) bus. The [CJB](#) converts the ambient air temperature value to an on-time percentage and transmits it on the medium speed [CAN](#) bus to the two door modules, which then energize the exterior mirror heating elements accordingly. The on-time percentage is increased while the windshield wipers are on.

Exterior Mirror Heating Percentage On-times

On-times	Ambient Air Temperature, °C (°F)			
	<8 (<46)	8 to 15 (46 to 59)	>15 to 25 (>59 to 77)	>25 (>77)
Wipers Off	50%	33%	0%	0%
Wipers On	50%	33%	25%	0%

On vehicles with the parked heating function, exterior mirror heating may also operate when the parked heating function is active, depending on the ambient air temperature.

For additional information, refer to: [Auxiliary Heater](#) (412-02B Auxiliary Heating, Description and Operation).

Adjustment

Adjustment is enabled while the ignition is on and, provided the driver door is not opened, for up to five minutes after the ignition is switched off.

When the L or R select switch is pressed, the tell-tale [LED](#) in the switch illuminates and the adjustment switch can be used to move the mirror glass of the related exterior mirror. The driver door switchpack interprets adjustment switch movement and transmits it to the [DDM](#) on a [LIN \(local interconnect network\)](#) bus. Adjustment signals for the passenger door exterior mirror are transmitted from the [DDM](#) to the [PDM](#) on the medium speed [CAN](#) bus. On receipt of an adjustment signal, the appropriate door module connects a power supply and ground to the relevant adjustment motor to produce the required movement of the mirror glass. When the adjustment switch is tilted in the opposite direction, the door module reverses the polarity of the adjustment motor, to move the mirror glass in the opposite direction.

Memory recall

The vehicle can memorize up to three different positions for the exterior mirrors, the driver seat and the steering column. This enables three different drivers to achieve their optimum driving position at the touch of a button. The memory store and memory pre-set switches are located on the driver door casing.

The memory function is incorporated into the [CJB](#).

Memory Switches



E132129

The memory switches form a resistive ladder in hardwired connections with the driver seat switchpack. When a position is stored or recalled for channels 1 to 3, the driver seat switchpack transmits the information on a [LIN](#) bus to the seat memory module, which relays it to the [CJB](#) on the medium speed [CAN](#) bus. It is then relayed to the door modules. Each door module evaluates the recall or storage command and performs the necessary adjustments to the exterior mirrors. If a manual mirror adjustment is selected while a memory recall is operating, it will over-ride the memory recall movement.

For mirror memory to operate, the mirror adjustment potentiometers must deliver a voltage value in the range of 80 mV - 4.8 V. Should a voltage applied be outside of this range the mirror will not operate when memory is selected.

Reverse dipping

Reverse dipping can be enabled and disabled in the vehicle set-up section of the vehicle information and settings menu. If reverse dipping is enabled, both of the exterior mirrors automatically dip, to provide a better view of the kerb, when the ignition is on and reverse gear is engaged. The mirrors return to their original position immediately reverse gear is disengaged, or if the vehicle speed in reverse exceeds 12 km/h (7.5 mph).

The dipped positions of the exterior mirrors are stored in the [CJB](#), which signals the front door modules on the medium speed [CAN](#) to move the mirror glass into and out of the dipped positions. Reverse gear engagement and disengagement is signaled to the [CJB](#) on the high speed [CAN](#) bus by the [TCM \(transmission control module\)](#) (automatic transmission) or the transfer box control module (manual transmission).

The dipped mirror position can be adjusted using the mirror switches while reverse gear is selected and the ignition is on.

On vehicles with an automatic transmission, reverse gear must be selected for approximately 0.5 second before the exterior mirrors move to the dipped position. The time delay prevents nuisance movement of the exterior mirrors when the transmission selection moves between Park and Drive.

Mirror foldback

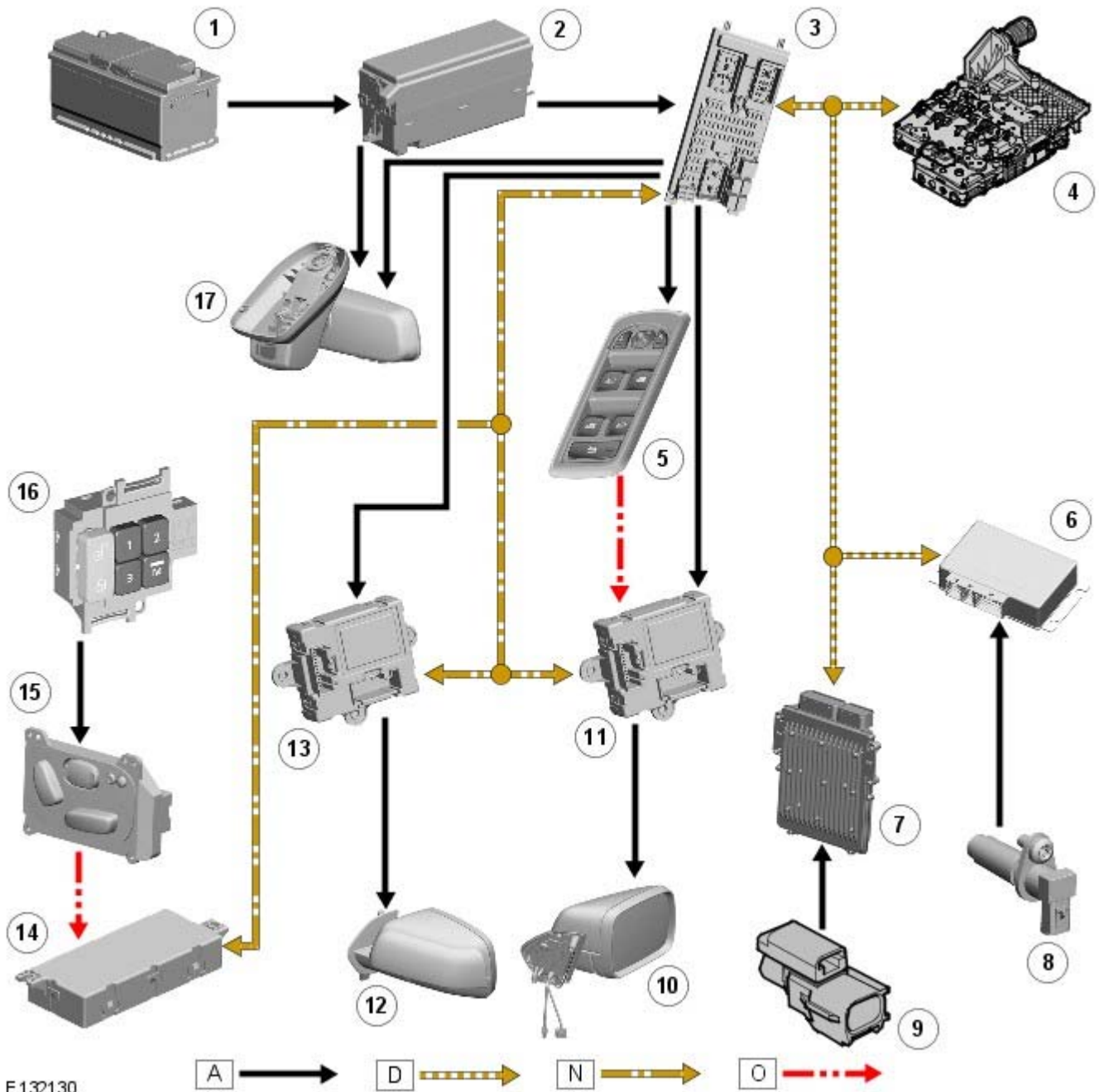
If mirror foldback is incorporated, pressing the L and R mirror select switches at the same time folds the exterior mirrors. Pressing both of the switches again unfolds the mirrors. Operation of mirror foldback is inhibited at speeds over 110 km/h (70 mph). If the mirrors are accidentally knocked out of synchronization (i.e. with one mirror folded and the other in the normal position), pressing both of the switches again re-synchronizes them.

On vehicles with mirror foldback, automatic operation can be enabled and disabled using Land Rover approved diagnostic equipment. When automatic operation is enabled, the exterior mirrors automatically fold and unfold when the vehicle is locked and unlocked using the smart key. However, if the mirrors are folded using the mirror switches, they will not automatically unfold when the vehicle is unlocked.

To prevent the foldback motors from overheating, the foldback function is disabled for 3 minutes if the mirror foldback function is selected ten times within 60 seconds. On the tenth selection within 60 seconds, the exterior mirrors will only unfold; if the selection is for the exterior mirrors to fold, the selection is ignored.

CONTROL DIAGRAM

• NOTE: A = Hardwired connection; D = High speed [CAN](#); N = Medium speed controller area network (CAN) bus; O = [LIN](#) bus.



Item	Part Number	Description
1	-	Battery
2	-	EJB
3	-	CJB
4	-	TCM (automatic transmission vehicles)
5	-	Driver door switchpack
6	-	Transfer box module (manual transmission vehicles)
7	-	ECM
8	-	Reverse gear switch (manual transmission vehicles)
9	-	Ambient temperature sensor
10	-	Driver door mirror
11	-	DDM
12	-	Passenger door mirror
13	-	PDM
14	-	Driver seat module
15	-	Driver seat switchpack
16	-	Memory switches
17	-	Interior mirror

Rear View Mirrors - Rear View Mirrors

Diagnosis and Testing

Principle of Operation

For a detailed description of the rear view mirror systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Rear View Mirrors](#) (501-09 Rear View Mirrors, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Door mirror switch condition and installation ● Door mirror condition and installation 	<ul style="list-style-type: none"> ● Battery condition and state of charge ● Fuses ● Harnesses and connectors ● Washer jet and mirror heater relay ● Memory control module(s) ● Door mirror switch(s) ● Door mirror motor(s) ● Ignition switch ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Automatic Temperature Control (ATCM) module ● Local Interconnect Network (LIN) circuit

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Mirrors do not defrost/washer jets freeze	<ul style="list-style-type: none"> ● Fuse fault ● Washer jet and mirror heater relay fault ● Circuit fault: high resistance ● Circuit fault: short circuit to ground ● Automatic temperature control module fault 	Check the fuses. Check the operation of the washer jet and mirror heater relay. Check the washer jet and mirror heater circuits. Refer to the electrical guides. Refer to the warranty policy and procedures manual if a module is suspect.
Mirrors inoperative in one or more directions	<ul style="list-style-type: none"> ● Mechanical fault ● Switch fault ● Motor fault ● Circuit fault: high resistance ● Circuit fault: short circuit to ground 	Operate the mirror switch and listen for the motor(s). If the motor(s) can be heard, check the mechanical condition of the mirror and linkages. Rectify as necessary. Check for DTCs indicating a switch, motor or circuit fault.
Memorized mirror position is not resumed	<ul style="list-style-type: none"> ● Battery voltage below 10.5 volts ● Position not stored ● Switch operated during "one-touch" memory recall ● EEPROM fault 	Before condemning a memory component, check the function from the switch and refer to the symptoms above. Make sure the battery voltage is adequate. Make sure that the desired position is correctly stored. Make sure that the memory store/recall procedure is being followed. Refer to the relevant section of the workshop manual.
'Lazy entry' function inoperative	<ul style="list-style-type: none"> ● Remote transmitter fault (battery, transmitter programming, etc) ● Battery voltage below 10.5 volts ● Position not stored ● Switch operated during "one-touch" memory 	Check that the remote transmitter operates the central locking, etc. If it does, the fault is not with the transmitter. Make sure the battery voltage is adequate. Make sure that the desired position is correctly stored. Make sure that the memory store/recall procedure is being followed. Refer to the relevant section of the workshop manual.

Symptom	Possible Causes	Action
	recall <ul style="list-style-type: none"> ● EEPROM fault 	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Door Module \(DDM/PDM\)](#) (100-00 General Information, Description and Operation).

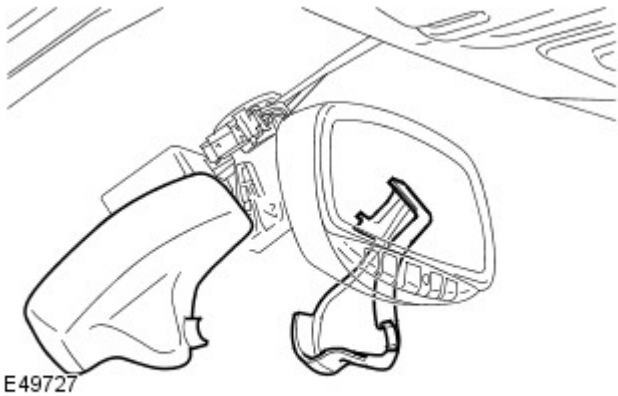
Rear View Mirrors - Interior Mirror

Removal and Installation

Removal

1. If installed, remove the interior mirror upper and lower covers.

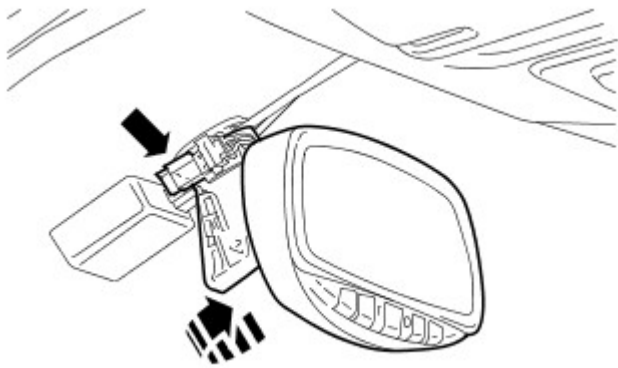
- Release the 2 clips.



E49727

2. Vehicles with an auto-dimming interior mirror, remove the interior mirror.

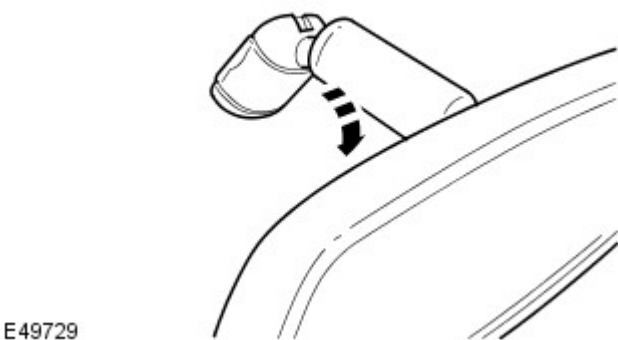
- Disconnect the electrical connector.
- Rotate the mirror stem at its base to release from the windshield.



E49728

3. Vehicles without an auto-dimming interior mirror, remove the interior mirror.

- Pull the mirror away from the windshield to release the clip.

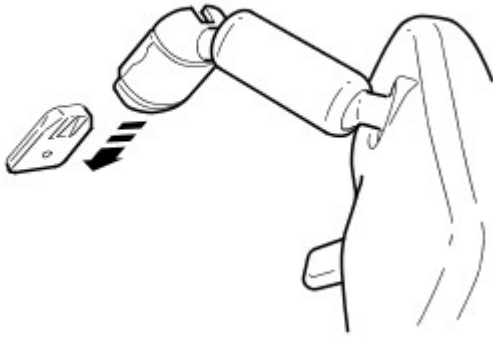


E49729

Installation

1. Vehicles without an auto-dimming interior mirror, install the interior mirror.

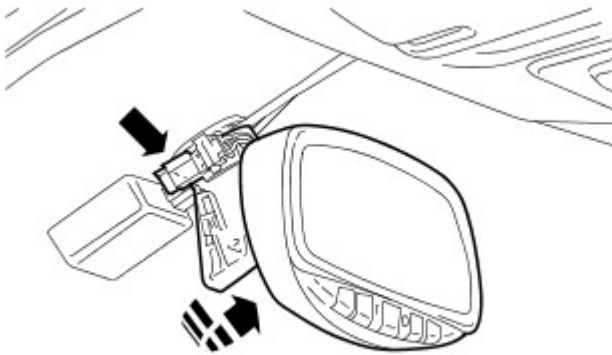
- Slide the mirror onto the boss from above to engage the clip.



E49730

2. Vehicles with an auto-dimming interior mirror, install the interior mirror.

- Rotate the mirror stem at its base to secure to the windshield.
- Connect the electrical connector.



E49731

3. Install the interior mirror covers.

- Secure with the clips.

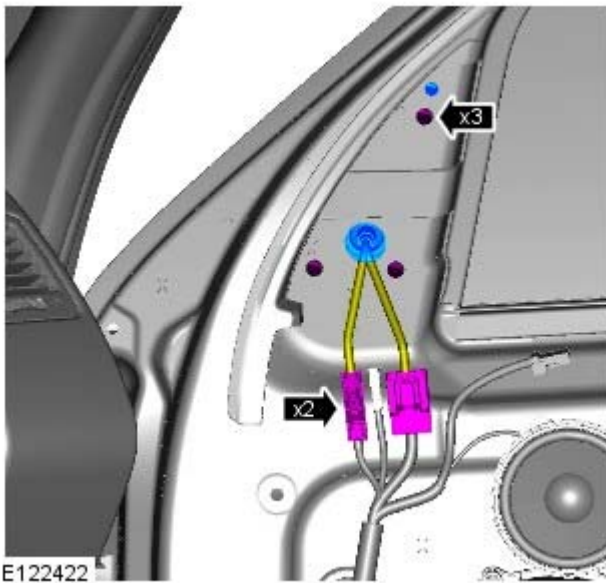
Rear View Mirrors - Exterior Mirror Vehicles With: Parking Aid Camera

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: RH illustration shown, LH is similar.
- NOTE: The ignition must be switched off.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

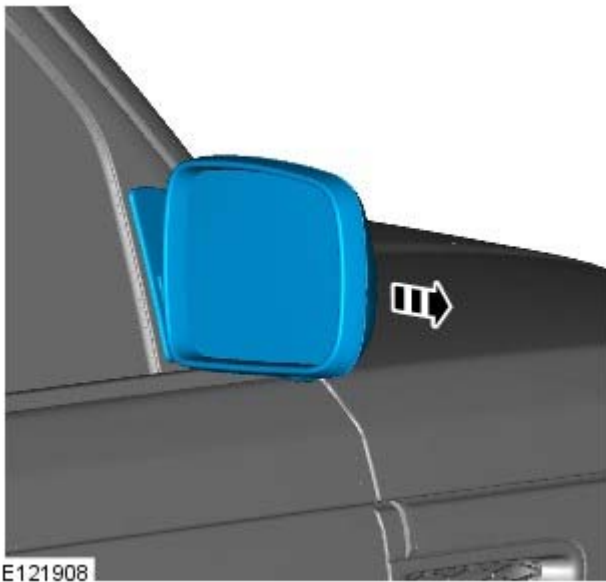


2.  CAUTION: Take extra care not to damage the wiring harnesses.

- NOTE: Support as necessary.

Torque: 6 Nm

- 3.



Installation

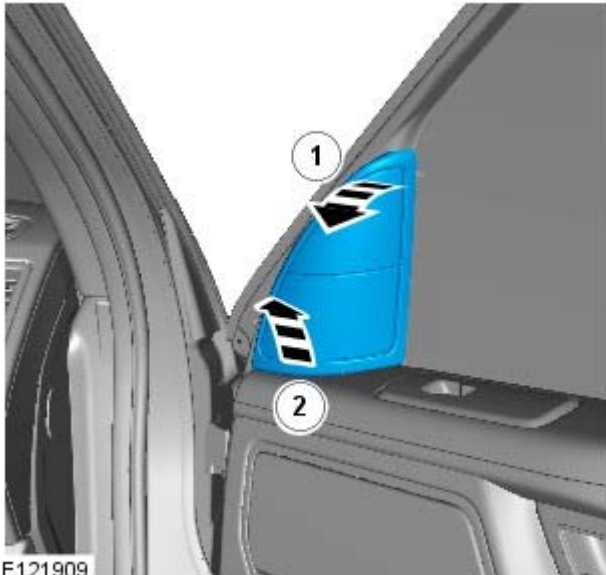
1. To install, reverse the removal procedure.

Rear View Mirrors - Exterior Mirror Vehicles Without: Parking Aid Camera

Removal and Installation

Removal

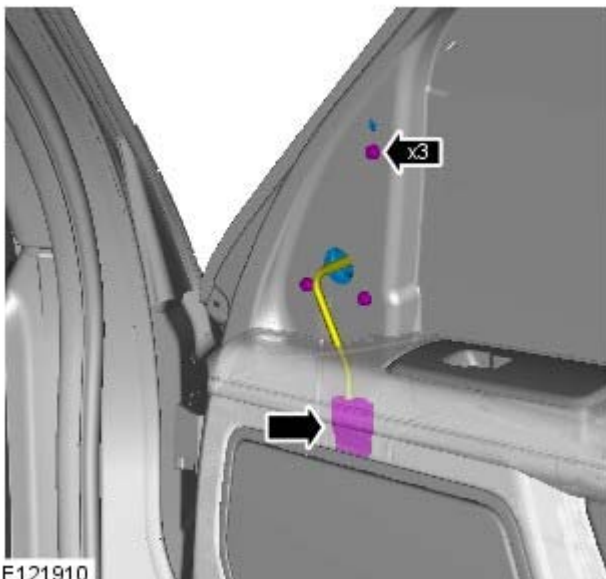
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: RH illustration shown, LH is similar.
- NOTE: The ignition must be switched off.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



1. 1. CAUTIONS:


 Take extra care not to damage the component.

 Make sure that the clips are correctly located.



2. 2. CAUTIONS:

 Take extra care not to damage the wiring harnesses.

 Make sure the electrical connector is securely in the service position, before disconnection. If the connector springs back after disconnection the internal door trim panel will have to be removed for access.

- NOTE: Support as necessary.

Torque: 6 Nm

3.



Installation

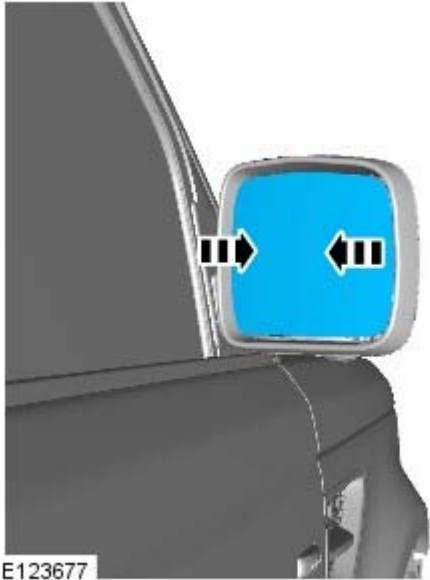
1. To install, reverse the removal procedure.

Rear View Mirrors - Exterior Mirror Glass

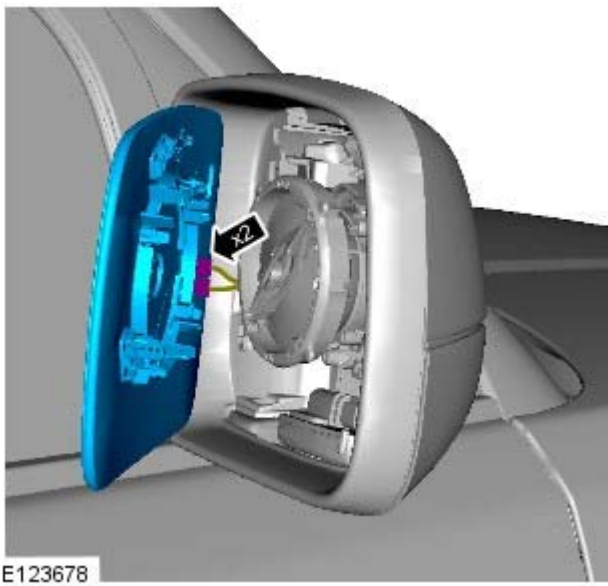
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



1.  CAUTION: Take extra care not to damage the clips.



- 2.

Installation

1. To install, reverse the removal procedure.

Rear View Mirrors - Exterior Mirror Cover

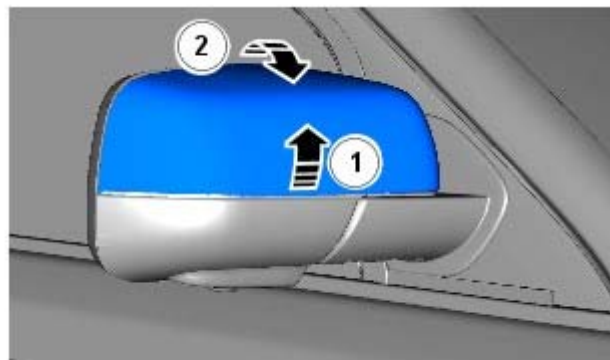
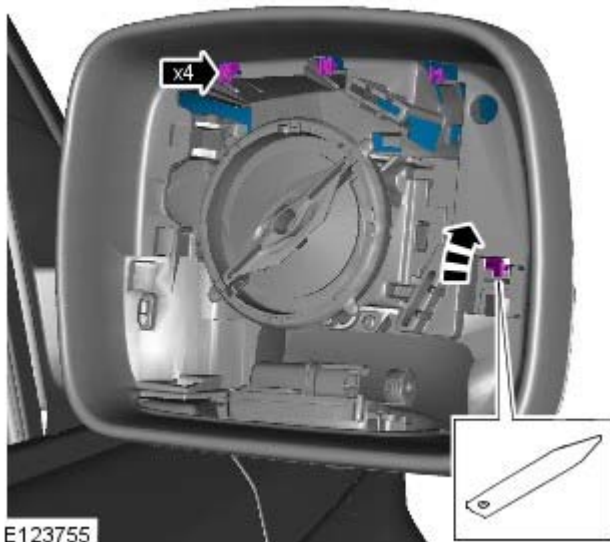
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Exterior Mirror Glass](#) (501-09 Rear View Mirrors, Removal and Installation).

2.

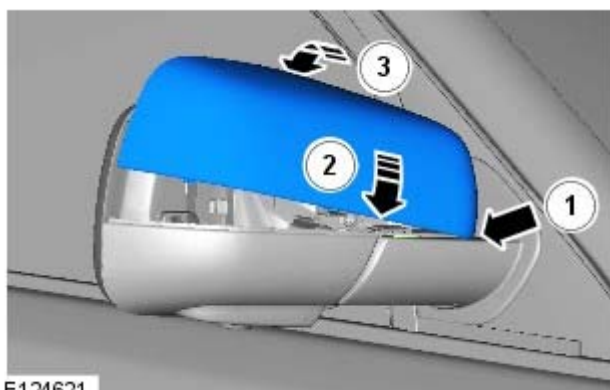


E123754

3. **3. CAUTIONS:**

- ⚠ Take extra care not to damage the clips.
- ⚠ Protect the surrounding trim to avoid damage.
- ⚠ Protect the surrounding paintwork to avoid damage.

Installation



E124621

1. **1. CAUTIONS:**

- ⚠ Take extra care not to damage the clips.
- ⚠ Protect the surrounding trim to avoid damage.
- ⚠ Protect the surrounding paintwork to avoid damage.

To install, reverse the removal procedure.


Rear View Mirrors - Exterior Mirror Motor

Removal and Installation

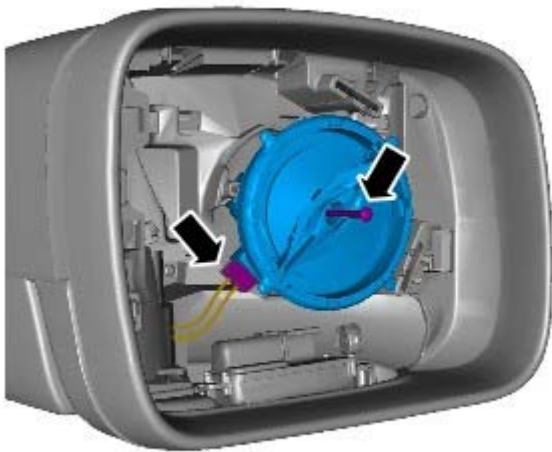
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: The ignition must be switched off.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Exterior Mirror Glass](#) (501-09 Rear View Mirrors, Removal and Installation).

2.  CAUTION: Make sure the locating tangs are aligned. Failure to follow this instruction may result in damage to the vehicle.

Torque: 1.2 Nm



E123679

Installation

1. To install, reverse the removal procedure.

Seating -

Torque Specifications

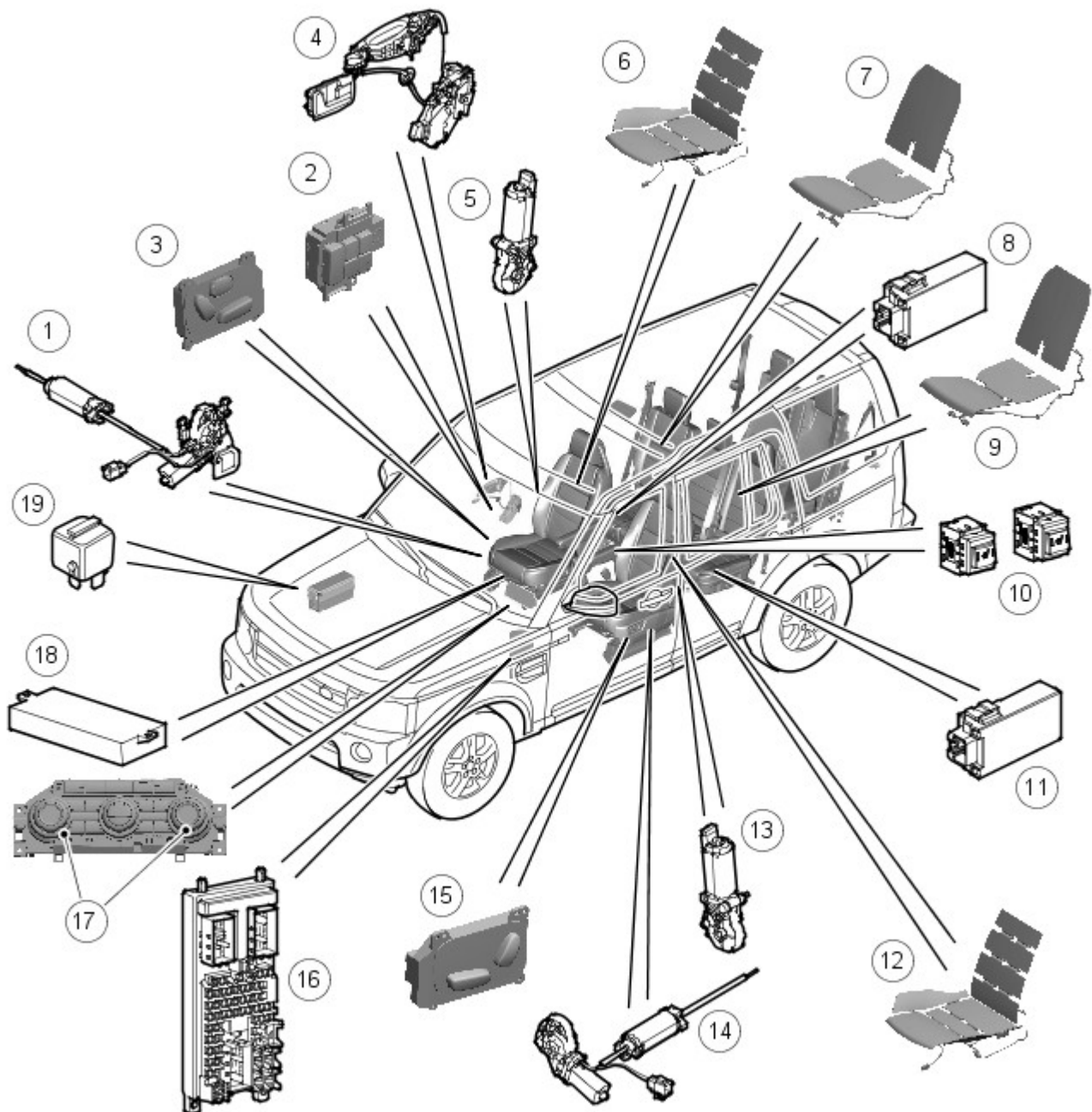
Description	Nm	lb-ft
Seat belt lower anchorage to seat Torx bolt	40	30
Front seat belt buckle to front seat Torx bolt	40	30
Front seat Torx bolts	40	30
Front seat armrest Torx bolt	10	7
Front seat grab handle Torx bolts	25	18
Front seat height adjustment motor nuts	25	18
Front seat position sensor nuts	4	3
Front seat tilt motor Torx bolts	10	7
Front seat backrest assembly Torx bolts	25	18
Front seat recliner motor Torx bolt	10	7
Seat module bracket Torx bolts	10	7
Front seat track motor nuts	25	18
Front seat base nuts	25	18
Front seat cushion Torx bolts	25	18
Third row seat Torx bolts	40	30
Third row seat cushion frame Allen bolts	25	18
Loadspace compartment anchor bolts	25	18
Rear seat Torx bolts	40	30
Rear seat backrest assembly Torx bolts	45	33

Seating - Seats

Description and Operation

Component Location

• NOTE: RH drive shown, LH drive similar



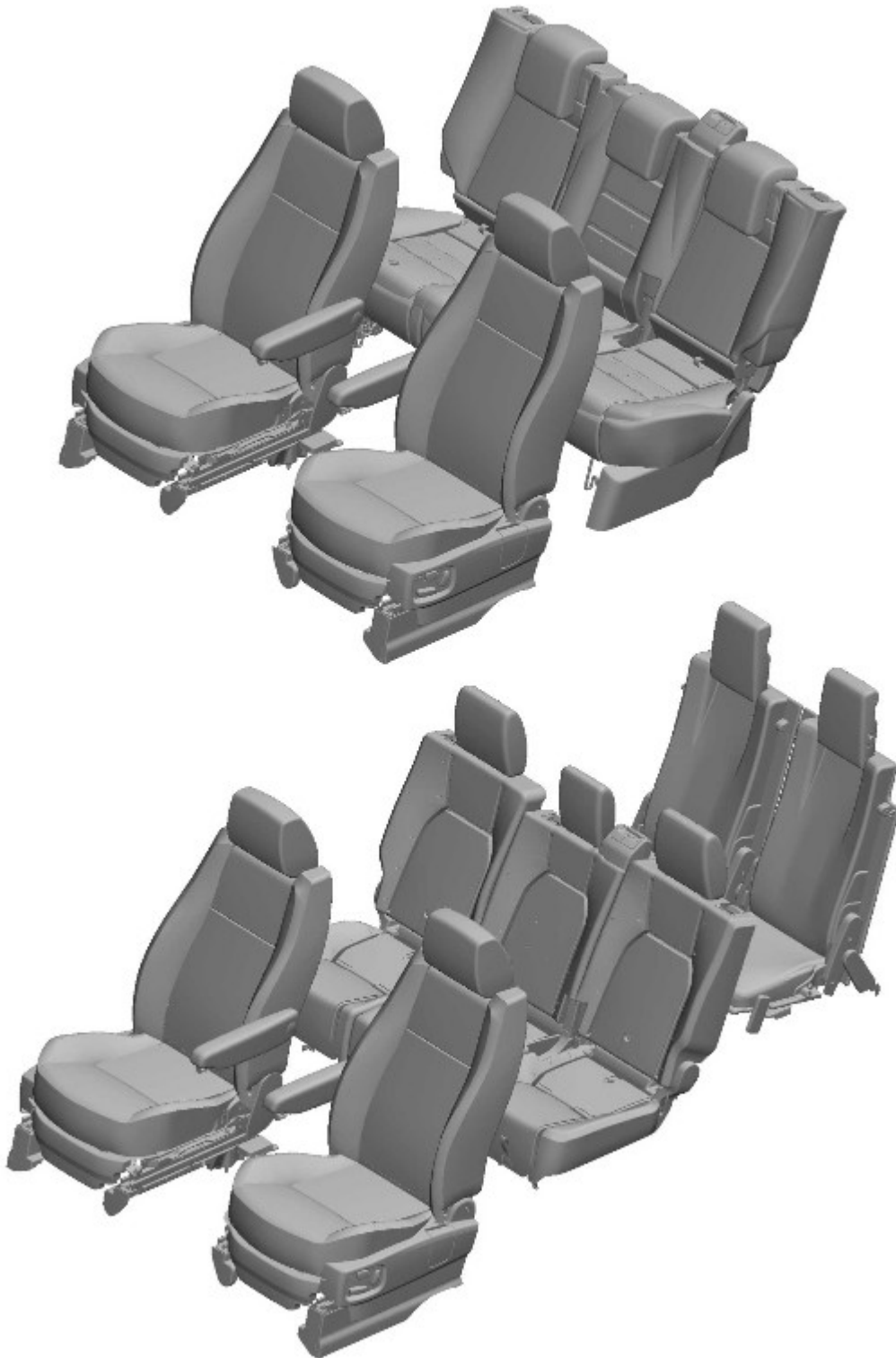
E137099

Item	Part Number	Description
1	-	Driver's seat cushion adjustment motor assembly
2	-	Driver's seat memory switch pack
3	-	Driver's seat non-memory switch pack
4	-	Driver's door ajar switch
5	-	Driver's seat squab motor
6	-	Driver's seat heating element
7	-	Second row RH (right-hand) seat heating element
8	-	Second row RH seat heating module
9	-	Second row LH (left-hand) seat heating element
10	-	Second row heated seat switches (vehicles without rear air conditioning)
11	-	Second row LH seat heating module
12	-	Front passenger seat heating element
13	-	Front passenger seat squab motor
14	-	Front passenger seat cushion adjustment motor assembly
15	-	Front passenger seat switch pack
16	-	CJB (central junction box)

17	-	Front heated seat switch pack (climate control system)
18	-	Memory control module
19	-	Front passenger seat power relay

OVERVIEW

Seat Configuration



E138147

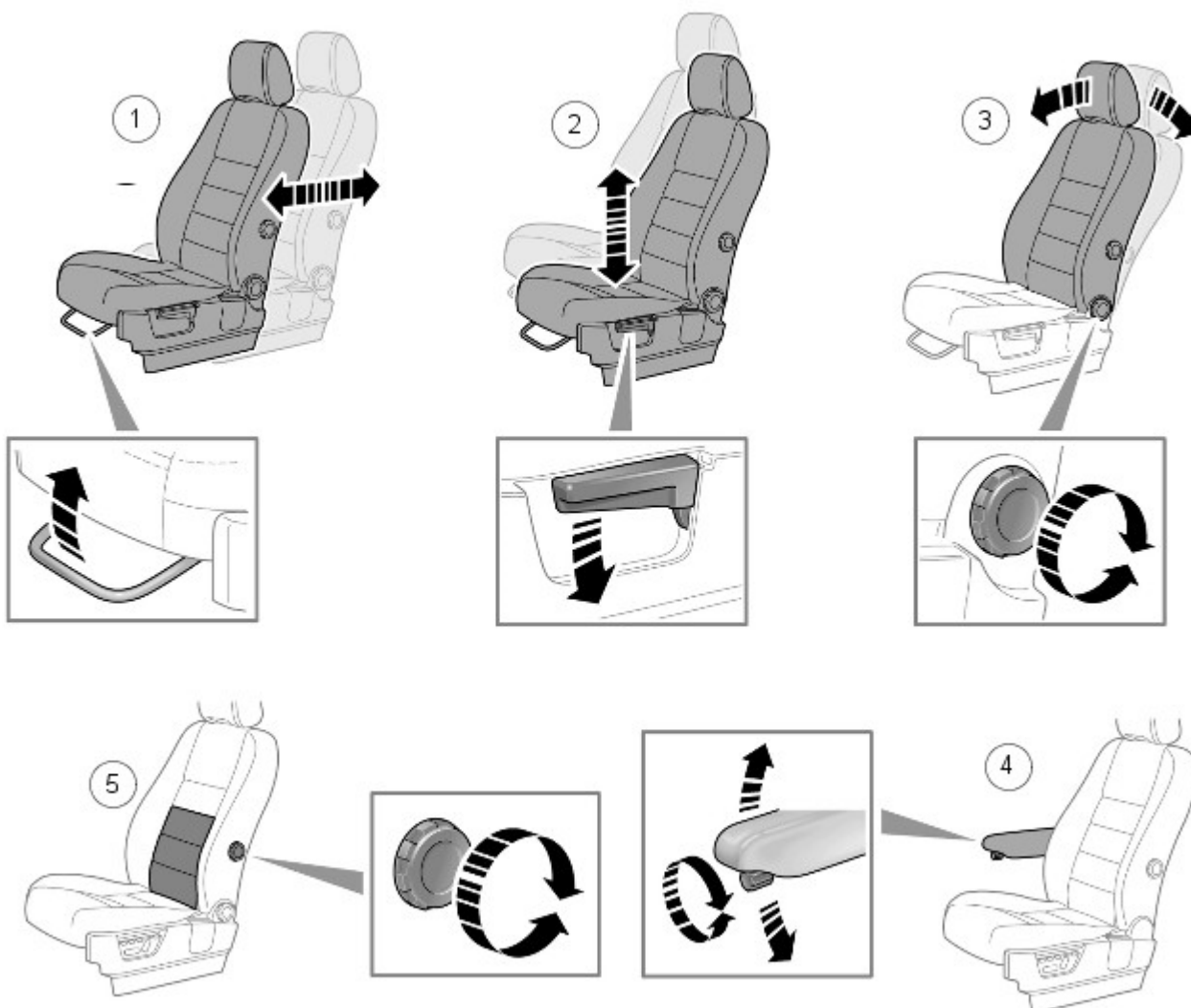
Discovery is available in a 5 or 7 seat configuration. The driver's seat has the option of an 8-way power adjustment, with or without memory functionality, or a 6-way manual adjustment. The front passenger seat has the option of a 6 way power

adjustment or a 4-way, non-height, manual adjustment. On vehicles from 2008MY, the front passenger seat can be fitted with an 8-way power adjustment.

The type of second row seats depends upon whether the 7-seat option is fitted. If the vehicle supports 5 seats, the 2nd row is designed as a 60/40 split, flip and fold configuration, whereas a vehicle that supports the 7 seat option is designed as a 35/30/35 split with the 2 outer seats having the ability to 'jack-knife', allowing access to the 3rd row of seats.

All seats are available in a fabric, duragrain or leather finish depending on model specification.

MANUAL FRONT SEATS



E137621

Item	Part Number	Description
1	-	Fore and aft adjustment
2	-	Height adjustment
3	-	Backrest adjustment
4	-	Lumber support adjustment
5	-	Armrest height adjustment

Height adjustment (driver's seat only)

Pumping the handle controls seat height. Pumping the lever upwards raises the seat; downwards lowers the seat.

Recline adjustment

The angle of the backrest is adjusted by turning the rotary wheel either clockwise or anticlockwise.

Forward/backward adjustment

Lifting the tomel bar at the front of the seat and sliding the seat to the desired position achieves the forwards/backwards adjustment.

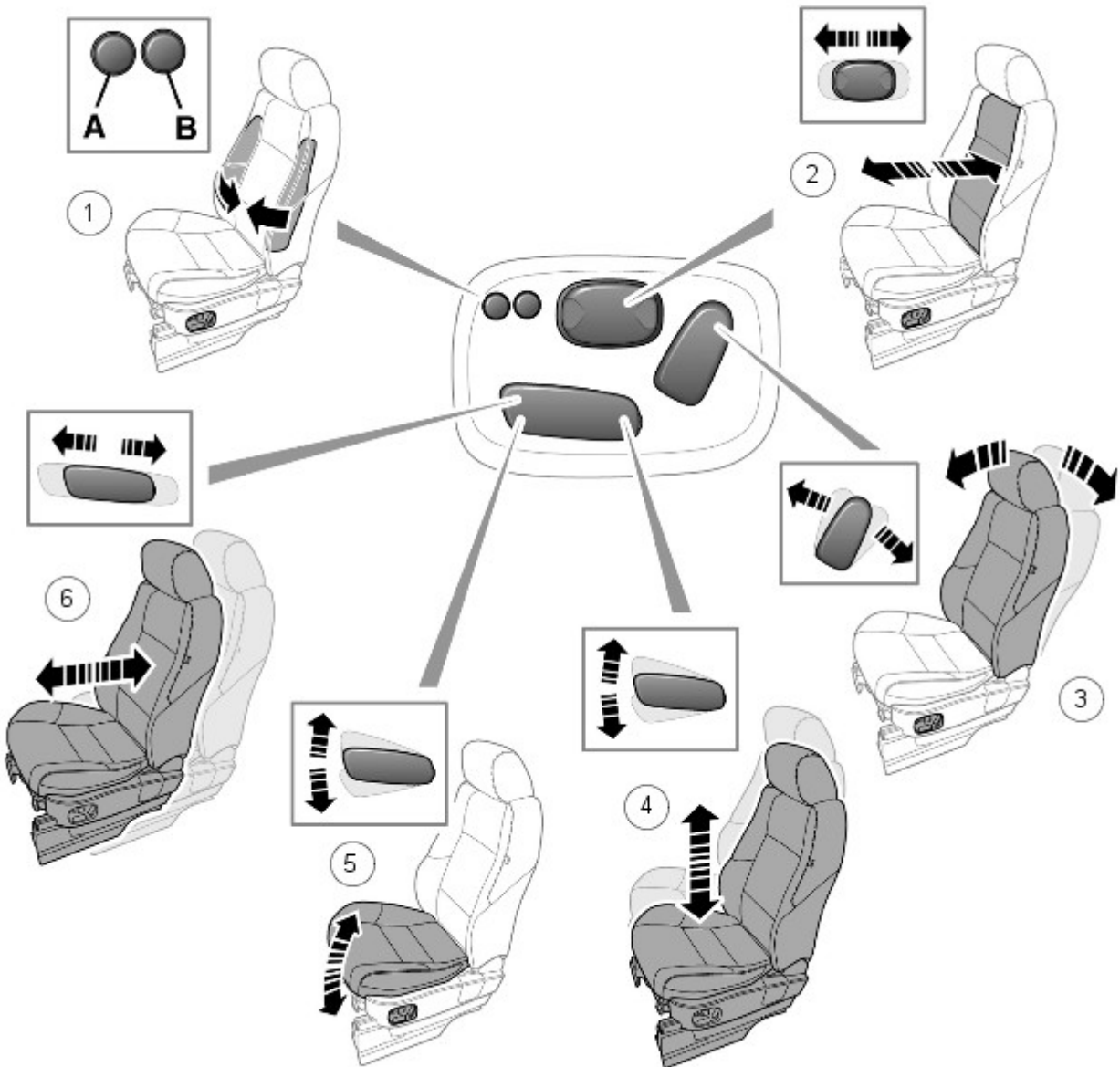
Lumber support adjustment

A hand wheel in the side of the seat provides for adjustment of lumbar support.

Folding armrest adjustment (if fitted)

Some vehicles are fitted with adjustable front seat armrests. These are used in the horizontal position or can be stowed vertically alongside the seat back rest. The horizontal position can be adjusted for height by turning the knob set into the end of the armrest.

POWER OPERATED FRONT SEATS (NON-MEMORY)



E137620

Item	Part Number	Description
1	-	Bolster adjustment: A - Bolster inflate; B - Bolster deflate
2	-	Lumbar support adjustment
3	-	Backrest adjustment
4	-	Height adjustment
5	-	Cushion tilt adjustment
6	-	Fore and aft adjustment

Forward/Backward adjustment

Push and hold the switch forwards or backwards to move the seat to the desired position.

Seat back adjustment

Twist the switch forwards or backwards until the desired seat back angle is achieved.

Seat cushion height adjustment

Push the switch up or down to raise or lower the cushion.

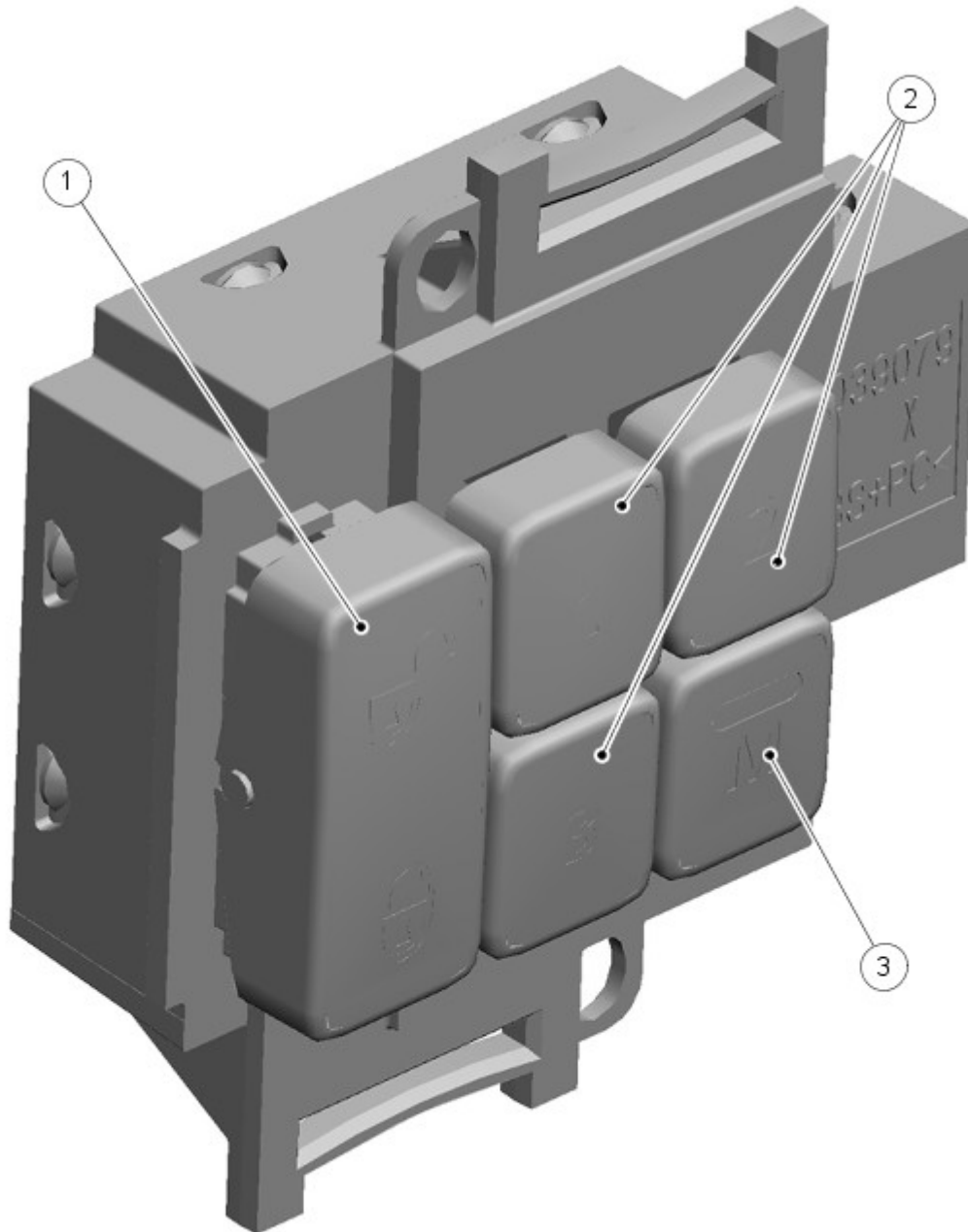
Front Seat Motors



• NOTE: On vehicles from 2008MY, the passenger seat can also be fitted with 8-way electrical adjustment.

The seat motors are a permanent magnet motor type coupled to a rack and pinion assembly. Should the motor seize or stick an internal thermal cut-out switch will trip to remove voltage from the motor. Two pins within each of the seat switch packs control the seat motors. Both pins are normally earthed. Operating the switch applies voltage to one of the pins while the other pin remains earthed. Operating the switch in the opposite direction reverses power and earth to the motor allowing the motor to run in the opposite direction.

DRIVER'S MEMORY SEAT



E137100

Item	Part Number	Description
1	-	Lock/unlock button
2	-	Memory preset buttons
3	-	Memory store button

Once the power operated driver's seat, steering column and exterior mirrors are adjusted, the vehicle can memorize these settings for future use.

1. Press the memory store (M) button to activate the memory function. The switch indicator will illuminate.
2. Press one of the preset buttons within 5 seconds to memorize the current settings. MEMORY (1, 2 or 3) SETTINGS SAVED will be displayed on the message center, accompanied by an audible chime to confirm the settings have been memorized.
3. To recall a stored position press the relevant preset button. MEMORY (1, 2 OR 3) RECALLED will be displayed in the message center.

• NOTE: A seat position will only be memorized during the 5 second active period. Any existing settings will be over-written when programming a memory position.

- NOTE: If the driver's seat or steering column are adjusted during entry or exit operation, automatic movement will stop.

Memory Recall

Memory recall has three memory positions stored for the seats, exterior mirrors and electric steering column (where fitted). The switches for this function are located on driver's seat outer side trim panel. Pressing the appropriate numbered memory switch allows the seat to start moving to the position appropriate to that memory.

When a memory recall is initiated, to limit the overall current consumption, only two-seat axis will move towards their intended position at any one time. To minimize current load as the motors start, the initiation of each axis is phased with a 10ms delay between each motor starting.

The following procedure will store a memory position:

- Ensure reverse gear is not engaged
- Manually adjust the seat to the desired position, using the seat switches
- Press and release the 'memory store' switch
- Press and release the desired numbered memory switch within 5 seconds

If any of the seat adjustment or memory switches are activated during a 'one touch' memory recall, the recall will be overridden and the seat will begin to move in the direction corresponding to the switch that has been pressed.

Both mirrors move simultaneously about the vertical axis first (left/right), and then, once all vertical axis movements are complete, about the horizontal axis (up/down). To minimize the number of mirror motor's required, a method of sharing is implemented, which dictates that all movement about one axis is complete before movement about the other axis commences.

Mirror movement coincides with the following table:

Action	Control Module Pin 14	Control Module Pin 7	Control Module Pin 13	Control Module Pin 8
Driver Mirror Up	Battery	-	-	-
Driver Mirror Down	Ground	-	-	-
Driver Mirror Left	-	Ground	-	-
Driver Mirror Right	-	Battery	-	-
Passenger Mirror Up	-	-	Battery	-
Passenger Mirror Down	-	-	Ground	-
Passenger Mirror Left	-	-	-	Ground
Passenger Mirror Right	-	-	-	Battery

Lazy Entry

Pressing the unlock button on the remote transmitter will initiate a memory recall. This feature is known as 'lazy entry'. If the seat movement, memory switch or the lock button on the remote transmitter is pressed, then the 'lazy entry' feature will stop immediately.

The memory settings are stored within **EEPROM (electrically erasable programmable read only memory)** of the memory control module each time the ignition switch is cycled from position II to position I. These are the positional values that a lazy entry request uses when the remote unlock button for that particular key is next pressed.

The lazy entry feature can be activated or deactivated via the customer personalization feature of the high line instrument cluster. This provides the driver with the option to enable or disable lazy entry as required.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Immediate Adjustment

Pressing one of the manual adjustment switches will initiate the corresponding motor for that axis until the switch is released.

Only two seat motors can be driven at any one time. However, due to the sharing of relays, there are certain combinations of motors that cannot be driven together. The following table indicates which axis can and cannot be operated at the same time:

	Recline Up	Recline Down	Tilt Up	Tilt Down	Height Up	Height Down	Slide Forward	Slide Backward
Recline Up	-	No	Yes	Yes	Yes	Yes	Yes	Yes
Recline Down	No	-	Yes	Yes	Yes	Yes	Yes	Yes
Tilt Up	Yes	Yes	-	No	Yes	Yes	No*	No*
Tilt Down	Yes	Yes	No	-	Yes	Yes	No*	No*
Height Up	Yes	Yes	Yes	Yes	-	No	No*	No*
Height Down	Yes	Yes	Yes	Yes	No	-	No*	No*
Slide Forward	Yes	Yes	No*	No*	No*	No*	-	No
Slide Backward	Yes	Yes	No*	No*	No*	No*	No	-

Key

- - = Not applicable
- Yes = Can be activated together
- No = Cannot be activated together (Physically impossible)
- No* = Cannot be activated together (Relay sharing restriction)

If two axis are being driven and a third axis is requested to move, the third switch request is ignored until either of the two axis switches, already active, are released. The third axis movement may only be initiated providing the switch has been released and re-selected.

Seat adjustment can be initiated simultaneously with any mirror movement.

REVERSE GEAR MIRROR POSITION

To give the driver a clear view of the kerbs when reversing, the exterior door mirrors can be dipped when reverse gear is selected. The level of mirror dipping is set to a predetermined amount when the vehicle leaves the factory but has the ability to be customer programmed.

The following procedure will store a reverse gear mirror position:

- Perform a memory recall procedure
- Ensure reverse gear is engaged
- Manually adjust the mirrors to the desired position
- Press and release the 'memory store' switch
- Press and release the desired numbered memory switch
- Reverse gear mirror dip setting will be stored for that particular memory setting.

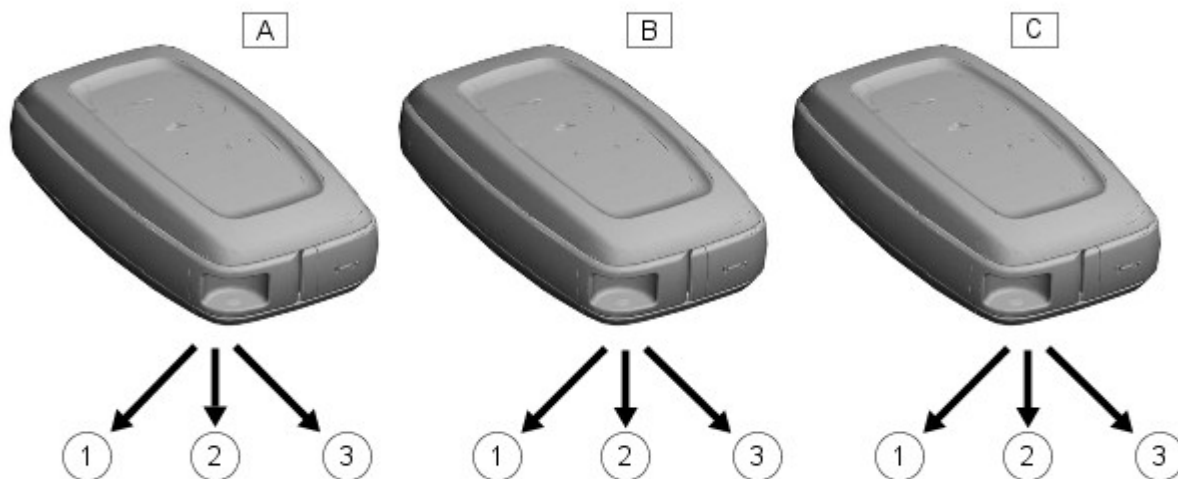
A single chime will be emitted from the instrument cluster to indicate that the store operation has been successful and 'Mirror Dip Stored' message will be displayed in the message center.

Once this sequence has been completed, the stored mirror position will be the position that the mirrors move to when reverse gear is next selected.

Storing a memory position with reverse gear selected only affects reverse gear mirror positions, the remainder of the memory positions remain unchanged.

To protect against an accidental setting, the mirror position will only be stored if a mirror adjustment has been made since reverse gear was selected. If there is no reverse gear mirror position stored, then a default setting, stored in the memory control module, is adopted.

There are three customer personalization memory settings per key. For each of these settings there are 3 possible reverse gear mirror position stores. This equates to a possible nine reverse gear mirror position settings. personalization memory setting relates to the 3 most recent ignition keys.



E137622

Item	Part Number	Description
A	-	Most recent ignition key
B	-	Second most recent ignition key
C	-	Third most recent ignition key
1	-	First reverse gear mirror position store
2	-	Second reverse gear mirror position store
3	-	Third reverse gear mirror position store

The reverse gear mirror position feature can be activated or deactivated via the customer personalization feature of the high line instrument cluster. This provides the driver with the option to enable or disable reverse gear mirror position as required.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Information regarding the reverse gear mirror status, for both manual and automatic transmissions, is transmitted as a message on the LIN (local interconnect network) bus.

When the reverse gear mirror position feature is toggled 'OFF', all 3 memory settings associated with that personalization memory will return to the default reverse gear mirror settings.

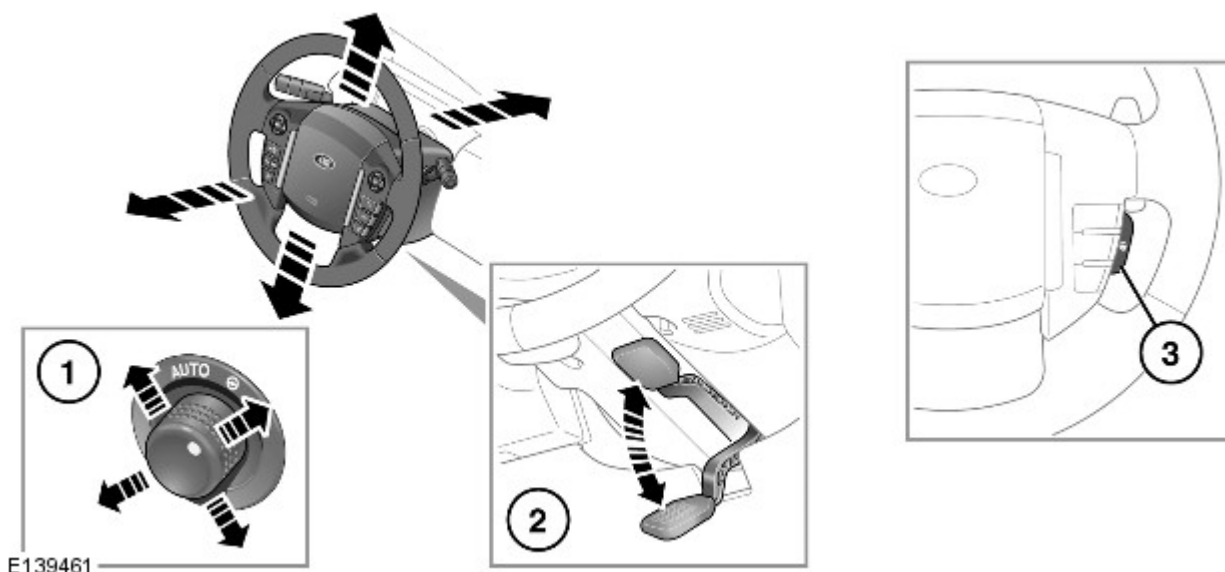
- **NOTE:** Reverse gear status is only available with the ignition in position II.

When reverse gear is de-selected, the mirror position immediately prior to reverse selection will be resumed, unless a memory recall has been requested whilst reverse has been selected, in which case the mirrors will move to the requested memory position when reverse is de-selected.

On vehicles fitted with the ZF automatic transmission there is a delay of 0.5 second following the selection of reverse gear, prior to the reverse mirror position being recalled. This is to prevent any movement of the mirrors as the gear selector is moved through the reverse position on the way to, and from, the park position.

STEERING COLUMN ADJUST (where fitted)

The memory control module controls the electric adjustable steering column in a rake (up and down) and reach (in and out). The steering column can be adjusted for rake and reach by operating the rotary joystick control switch on the LH side of the steering column.



Item	Part Number	Description
1	-	Electric adjustment
2	-	Manual adjustment
3	-	Heated steering wheel

Entry/Exit Mode

Entry/Exit mode provides automatic movement of the steering column and driver's seat to allow easier entry to or exit from the vehicle.

Entry/Exit mode is selected by setting the steering column adjustment switch to the 'AUTO' position.

- NOTE: If the adjustment switch is moved away from 'AUTO' whilst the steering column is tilted away, the steering column will move back to its memorized position. Entry/Exit mode will then be cancelled.
- NOTE: If the adjustment switch is moved during entry/exit operation, steering column movement will stop.

Exit

When the ignition key is removed, the steering column will move to the uppermost rake and innermost reach positions and the driver's seat will move slightly rearwards and lower.

Entry

When the key is inserted in the ignition the steering column and seat will return to their previous positions. If, however, the memorised driver position has been changed (using the seat memory switches or another key transmitter), the steering wheel and seat will move to the new position.

Steering Column Control

Adjustment of the steering column is achieved by a single DC (direct current) motor. Each adjustment movement is transmitted through a solenoid actuated clutch; one clutch for reach movement and one for rake movement.

When engaged, a clutch can be released only if the system is unstressed. As the clutches are mounted on the same motor spindle, the sequence for position adjustment is as follows:

- Engage the selected clutch by powering the appropriate solenoid
- After a time period (approximately 0.1 of a second), the motor is powered in the desired direction
- When the motor reaches the stop position the solenoid and motor is released/unpowered. The clutch remains engaged under stress
- After a time period (approximately 0.1 of a second), the motor is powered in the opposite direction to enable the clutch to disengage when the stress is released.

Motor Rotation Direction	Clockwise	Counter Clockwise
Reach movement	IN	OUT
Rake movement	UP	DOWN

Simultaneous rake and reach movements are not possible since the motor must reverse direction as soon as the first axis has reached its required position.

Steering column rake and reach is controlled via potentiometer feedback.

AUDIBLE AND VISUAL CONFIRMATIONS

An audible confirmation is generated by the instrument cluster to provide confirmation to the driver that the requested operation has been successfully completed. The following operations support an audible confirmation:

Operation	Audible Confirmation	Conditions
Memory Store	Single Chime	Successful store operation completed
Memory Recall	Double Chime	Only issued if all axis of movement successfully reach the intended position
Reverse Gear Mirror Position Store	Single Chime	Successful store operation for reverse mirror position completed

In addition to audible confirmation there is also a visual confirmation via the instrument cluster message center. For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

MEMORY CONTROL MODULE



E 138149

Memory Control Module Location (LHD shown, RHD similar)

Item	Part Number	Description
1	-	Memory control module

The memory control module, located under the driver's seat, relies upon a number of inputs and controls a number of outputs. As with all electronic control modules, the unit needs information regarding the current operating conditions of the engine and other related systems before it can make calculations, which determine the appropriate outputs.

All memory values are stored in the non-volatile memory, [EEPROM](#). The current motor positions, which are monitored by the control modules integral Hall sensors, are stored in the [EEPROM](#). If a loss of power occurs, upon power reconnection

the current motor position are recalled from memory and adopted as the current positions. This will allow the relative memory positions to be retained without any need to re-calibrate. The memory control module checks the integrity of all data stored in the [EEPROM](#) each time it exits stand-by mode. In the event that the data is corrupt, the control module adopts the default values for all of the programming options. All memory positions are deemed as invalid and the software will perform as if there are no memory positions stored. Memory store operations will reset the relevant memory and allow full functionality.

Stall Detection

Seat, steering column (where fitted) and mirror motors are deemed to have stalled if there is no change in the inputs that are received from the corresponding feedback sensors for 200ms (seat), 1000ms (mirror & steering column) while that axis is being driven.

If a stall condition is detected then the drive to that axis is cancelled for the remainder of that memory operation (memory recall) or until the switch is re-selected (manual movement).

If the motor movement has stopped due to loss of sensor feedback, either stall or sensor failure, then that axis may be activated again, to move past the stall position, by re-selecting the appropriate switch. This allows control of the motor to be maintained if sensor feedback is lost.

Upon re-selection of movement, if sensor pulses are detected then the motor will continue to be driven until the switch is released or another stall condition is detected. If sensor feedback is not detected then the motor is only driven for 0.5 second and then stops until the switch is released and then pressed again, when a further 0.5 second of activation is permitted, and so on.

For all seat motor and steering column manual movements, whenever a motor is driven and a stall occurs, the memory control module records the position at which the stall occurred. If movement occurs beyond a stall position, then that position is erased from the control modules memory. This will always allow movement past a previously recorded stall position once movement has been registered beyond that position. This is the case for both manual and memory movement.

Initialization

When a replacement memory control module is fitted to a seat it should be initialized so that the control module can learn the seats and steering column maximum and minimum adjustment values. This is achieved by:

- adjusting all seat movement axis from one end of travel to the other; slide, recline, height and tilt
- adjusting all steering column movement from one end of travel to the other; rake and reach.

Battery Monitor

If the battery voltage drops below 10.5 Volts, then the memory control module ignores all requests for a memory recall, including lazy entry, or easy entry/exit until the battery voltage has reached 11.5 Volts. This will conserve as much power in the vehicle battery as possible to enable engine cranking.

Stand-by Mode

The memory control module supports a stand-by mode to keep power consumption to a minimum.

The control module will enter stand-by mode upon receipt of a [LIN](#) bus 'SLEEP' message from the [CJB](#). Alternatively, a time period of 3 seconds after the [LIN](#) bus network has remained quiet provided there are no motors being driven at that time and there are no valid switch requests.

If there is a failure with the [LIN](#) bus network then the seat will be operational in 'inch mode' only.

If the control module is being prevented from entering stand-by mode due to motor movement, memory recall or switch operation, then it will enter stand-by mode when the current function has terminated.

• **NOTE:** In the case of a memory recall, all memory recall operations should be carried out before entering stand-by mode, not just the current motor movement.

The control module will exit stand-by mode if there is any [LIN](#) bus activity. When the control module exits stand-by mode it must verify the 'System Enable Status' in order to recognize when it should respond to a switch request.

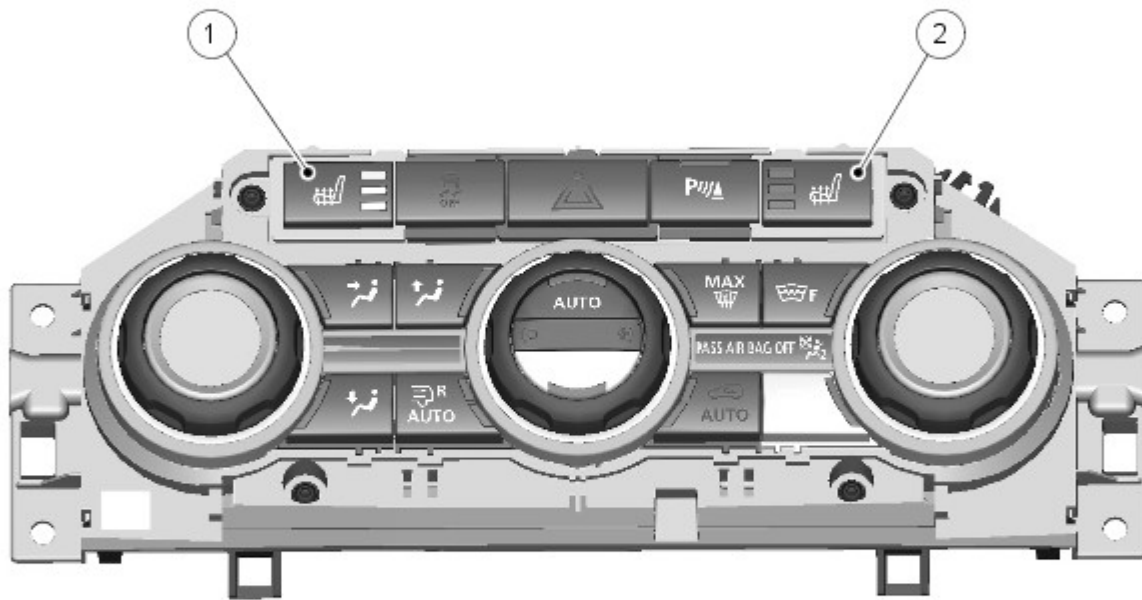
SEAT HEATING



E138150

Front Seats

Front Seat Heater Switches



E138151

Item	Part Number	Description
1	-	LH front seat heater switch
2	-	RH front seat heater switch

The heated front seat system is available on both manual and electric seats and is controlled by the Automatic Temperature Control Module (ATCM).

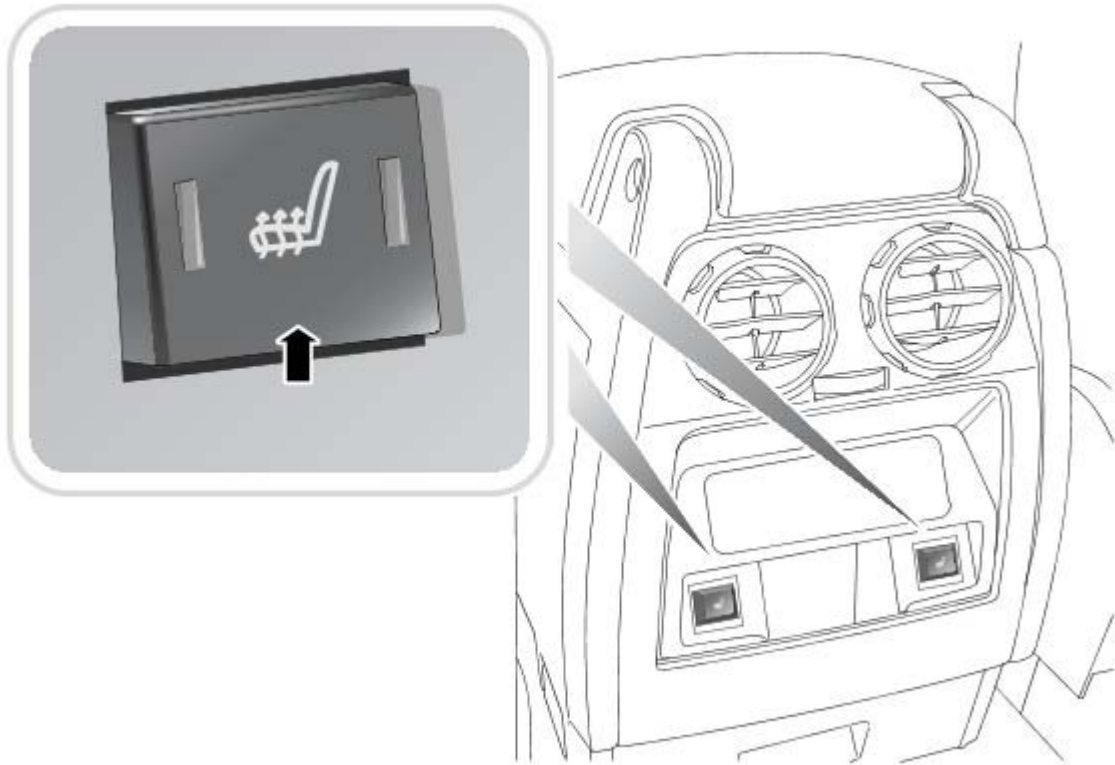
When the front seat heater switch is operated, power is supplied to the heater elements in the seat, causing the seat to heat up. The ATCM senses seat temperature via the sensor in the cushion and regulates voltage to the seat heater elements to maintain a constant temperature.

For additional information, refer to: Control Components (412-04, Description and Operation).

Rear Seat Heaters

Rear Seat Heater Switches

- NOTE: [Rear air conditioning variant shown](#)



E138152

The [RH](#) and [LH](#) rear seats support three integral heating elements, squab, back rest and bolster. The optional rear child booster seat also supports an integral seat-heating element.

- **NOTE:** The rear center seat is not available with seat heating.

The rear seat heaters are enabled when the ignition switch is position II, and operate at one of two temperature settings. With the first press of a rear seat heater switch the relative rear seat heat control module ([RH](#) or [LH](#)) adopts the higher temperature setting, supplies a power feed to the related rear seat heater elements and illuminates two amber [LED](#) (light emitting diode)'s in the switch. At the second press of the switch the control module adopts the lower temperature setting and extinguishes one of the [LED](#)'s. At the third press of the switch the control module de-energizes the heater elements and extinguishes the second [LED](#). The seat heaters remain on until selected off or the ignition is turned off.

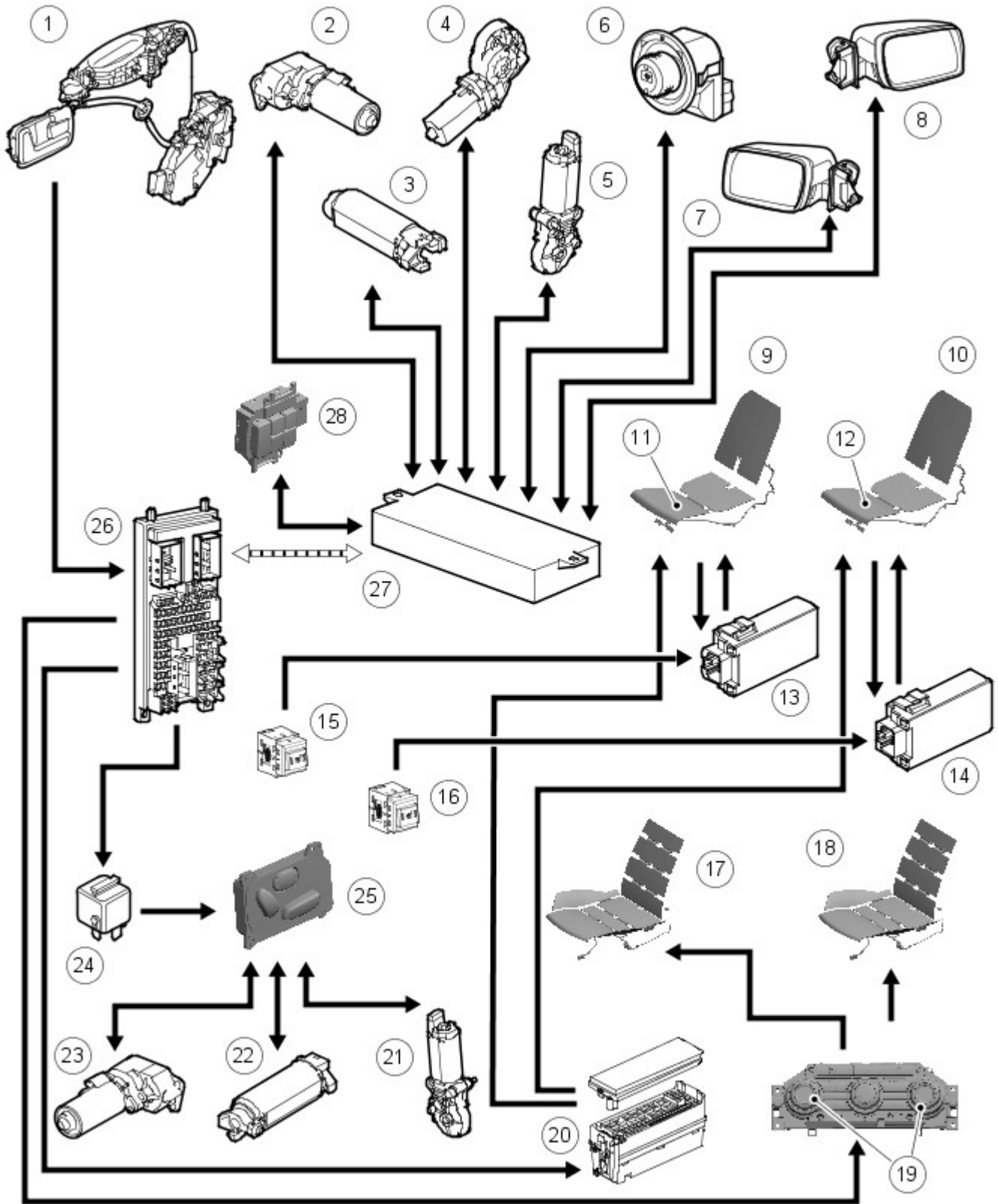
The rear seat heat control modules receive an input from a temperature sensor in [RH](#) and [LH](#) rear seats, and regulate the power feed of the heater elements to control the seat temperature at the appropriate temperature setting between 35 and 45 °C (95 and 113 °F). The actual temperature settings vary with the type of seat covering, to allow for the different heat conduction properties of the different seat covering materials.

DIAGNOSTICS

The exchange of information between the diagnostic unit and the memory control module is via the [CJB](#), which are interconnected via the hi-speed [CAN](#) (controller area network) bus and [LIN](#) bus. There is a non-volatile memory ([EEPROM](#)) for saving detected errors. Its contents are not lost when the power supply is disconnected. Only a Land Rover approved diagnostic system can erase the error memory.

CONTROL DIAGRAM

- **NOTE:** A = Hardwired; J = CAN bus



A → J →

E137101

Item	Part Number	Description
1	-	Driver's door ajar switch
2	-	Driver's seat height motor
3	-	Driver's seat slide motor
4	-	Driver's seat tilt motor
5	-	Driver's seat recline motor
6	-	Mirror adjustment switch
7	-	LH mirror motor
8	-	RH mirror motor

9	-	LH rear seat heater
10	-	RH rear seat heater
11	-	LH rear seat heater cut-off switch
12	-	RH rear seat heater cut-off switch
13	-	LH rear seat heater control module
14	-	RH rear seat heater control module
15	-	LH rear seat heater switch
16	-	RH rear seat heater switch
17	-	Driver's seat heater
18	-	Front passenger seat heater
19	-	Front seat heater switches
20	-	BJB (battery junction box)
21	-	Front passenger seat recline motor
22	-	Front passenger seat slide motor
23	-	Front passenger seat height motor
24	-	Front passenger seat power relay
25	-	Front passenger seat switch pack
26	-	CJB
27	-	Memory control module
28	-	Driver's seat memory switch pack

Seating - Seats

Diagnosis and Testing

Principle of Operation

For a detailed description of the seating systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Seats (501-10 Seating, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Seat runners ● Seat frames ● Seat movement switch condition and installation ● Seat heater switch condition and installation ● Seat motor(s) condition and installation ● Steering column switch condition and installation ● Steering column condition and installation ● Door mirror switch condition and installation ● Door mirror condition and installation 	<ul style="list-style-type: none"> ● Battery condition and state of charge ● Fuses ● Harnesses and connectors ● Seat movement switch(s) ● Seat heater switch(s) ● Seat heater elements ● Seat motor(s) ● Seat module(s) ● Memory control module(s) ● Steering column switch ● Steering column motor ● Door mirror switch(s) ● Door mirror motor(s) ● Ignition switch ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Local Interconnect Network (LIN) circuit

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Seat does not move when the switch is operated (forward, backward, tilt, etc)	<ul style="list-style-type: none"> ● Runner or mechanism jammed ● Switch fault ● Motor fault ● Thermal cut-out engaged ● Circuit fault ● Module fault 	Check for obstructions at the seat runners, mechanisms, etc, rectify as necessary. The thermal cut-out may engage if there is a motor or mechanism fault. Check for DTCs indicating a switch, motor or module fault.
Steering column does not move when the switch is operated	<ul style="list-style-type: none"> ● Switch fault ● Motor fault ● Clutch/Solenoid fault 	Check for DTCs indicating a switch, motor or clutch/solenoid fault.
Mirrors do not move when the switch is operated	<ul style="list-style-type: none"> ● Mechanical fault ● Switch fault ● Motor fault ● Circuit fault: high resistance ● Circuit fault: short circuit to ground 	For mirror tests, refer to the relevant section of the workshop manual.
Memorized seat/steering column/mirror position is not resumed	<ul style="list-style-type: none"> ● Battery voltage below 10.5 volts ● Position not stored ● Switch operated during "one-touch" memory recall ● EEPROM fault 	Before condemning a memory component, check the function from the switch and refer to the symptoms above. Make sure the battery voltage is adequate. Make sure that the desired position is correctly stored. Make sure that the memory store/recall procedure is being followed. Refer to the relevant section of the workshop manual.

Symptom	Possible Causes	Action
"Lazy entry" function inoperative	<ul style="list-style-type: none"> ● Remote transmitter fault (battery, transmitter programming, etc) ● See list for "position is not resumed" 	Check that the remote transmitter operates the central locking, etc. If it does, the fault is not with the transmitter. Refer to "position is not resumed".
Entry/Exit mode inoperative	<ul style="list-style-type: none"> ● Switch not in AUTO mode ● Switch fault ● Motor fault ● Clutch/Solenoid fault 	Make sure the function is enabled and that the switch is correctly set. Check for DTCs indicating a switch, motor or clutch/solenoid fault.
Seat does not get warm	<ul style="list-style-type: none"> ● Switch fault ● Fuses ● Circuit fault ● Temperature sensor ● Battery voltage is greater than 16.5 volts 	Check the LEDs at the switches as a quick check of the switch function. If the LEDs illuminate when the switches are operated, there is power to the switches and the switches are operating at least one level. Check the seat heater circuits, refer to the electrical guides. Check the temperature sensor function. If the battery voltage is higher than 16.5 volts for more than 5 seconds, seat heating is suspended. Refer to the relevant section of the workshop manual.
Part(s) of the seat does not get warm	<ul style="list-style-type: none"> ● Element fault 	There are up to three elements in each seat, if the rest of the seat operates normally, check the element connections and continuity. Refer to the electrical guides.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Front Seat Module \(DSM/PSM\)](#) (100-00 General Information, Description and Operation).

Seating - Heater Mats

Diagnosis and Testing

Principles of Operation

Heated seats incorporate heater elements in the cushion and the backrest of the seat. Each cushion heater element has a thermal sensor, which supplies a feedback temperature signal to the related seat heater module. The backrest heater elements do not have a thermal sensor, and are regulated at the same temperature as the cushion heater elements.

For a detailed description of the seat heater mat, refer to the relevant Description and Operation section in the workshop manual. REFER to: Seats (501-10, Description and Operation).

Inspection and Verification

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Seat heater switches condition and installation 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Seat heater module ● Seat heater switches ● Seat heater mat

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart.

• NOTE: If the control module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the warranty policy and procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

• NOTE: Generic scan tools may not read the codes listed, or may read only five digit codes. Match the five digits from the scan tool to the first five digits of the seven digit code listed to identify the fault (the last two digits give additional information read by the manufacturer approved diagnostic system).

• NOTE: When performing electrical voltage or resistance tests, always use a digital multimeter (DMM) accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

• NOTE: Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.

• NOTE: If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.

DTC Index

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to section 100-00.

Seat Heater Mat Application Chart

• NOTE: To ensure an accurate resistance reading, calibrated test equipment **must be used**

Vehicle /Year	Cushion / Backrest	Heater Mat / NTC Resistor	Left Hand Drive		Right Hand Drive		Minimum Resistance Ohms At 20°C ±10°C	Maximum Resistance Ohms At 20°C ±10°C
			Passenger Side Connector / Pin	Driver Side Connector / Pin	Passenger Side Connector / Pin	Driver Side Connector / Pin		
Discovery 3 2006	Cushion	Heater mat	C2950-1 and C2950-4	C0085-1 and C0085-4	C2950-1 and C2950-4	C0085-1 and C0085-4	0,75	1,0
		NTC resistor	C2950-2 and C2950-3	C0085-2 and C0085-3	C2950-2 and C2950-3	C0085-2 and C0085-3	4 000	10 000
	Backrest	Heater mat	connected in series	connected in series	connected in series	connected in series	0,44	0,59
Discovery 4 2010	Cushion	Heater mat	C3542-1 and C3542-4	C3542-1 and C3542-4	C3542-1 and C3542-4	C3542-1 and C3542-4	0,70	1,0
		NTC resistor	C3542-2 and C3542-3	C3542-2 and C3542-3	C3542-2 and C3542-3	C3542-2 and C3542-3	4 000	10 000
	Backrest	Heater mat	C3543-1 and C3543-2	C3543-1 and C3543-2	C3543-1 and C3543-2	C3543-1 and C3543-2	0,4	0,7
Range Rover Sport 2010	Cushion	Heater mat	C3542-1 and C3542-4	C3542-1 and C3542-4	C3542-1 and C3542-4	C3542-1 and C3542-4	0,93	1,25
		NTC resistor	C3542-2 and C3542-3	C3542-2 and C3542-3	C3542-2 and C3542-3	C3542-2 and C3542-3	4 000	10 000
	Backrest	Heater mat	C3543-1 and C3543-2	C3543-1 and C3543-2	C3543-1 and C3543-2	C3543-1 and C3543-2	0,43	0,6

Vehicle /Year	Cushion / Backrest	Heater Mat / NTC Resistor	Left Hand Drive		Right Hand Drive		Minimum Resistance	Maximum Resistance
			Passenger Side Connector / Pin	Driver Side Connector / Pin	Passenger Side Connector / Pin	Driver Side Connector / Pin	Ohms At 20°C ±10°C	Ohms At 20°C ±10°C
Freelander 2	Cushion	Heater mat	C3HS08C-1 and C3HS08C-4	C3HS03C-1 and C3HS03C-4	C3HS08C-1 and C3HS08C-4	C3HS03C-1 and C3HS03C-4	0,8	1,0
		NTC resistor	C3HS08C-2 and C3HS08C-3	C3HS03C-2 and C3HS03C-3	C3HS08C-2 and C3HS08C-3	C3HS03C-2 and C3HS03C-3	4 000	10 000
	Backrest	Heater mat	C3HS08B-1 and C3HS08B-2	C3HS03B-1 and C3HS03B-2	C3HS08B-1 and C3HS08B-2	C3HS03B-1 and C3HS03B-2	0,5	0,7

PINPOINT TEST A : SEAT HEATER MAT

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: CHECK FOR DTC'S	
	<ol style="list-style-type: none"> Where possible use the manufacturer approved diagnostic system to review any logged seat heater mat DTC's
	<p>Were any seat heater mat DTC's logged?</p> <p>Yes Carry out the help text action for any logged DTC's. Clear the DTC and retest. If DTC's return follow the tests listed below GO to A2.</p> <p>No GO to A2.</p>
A2: MANUAL CHECK	
• NOTE: On full power the seat should be hot to touch	
	<ol style="list-style-type: none"> If required operate the vehicle air conditioning on full for 10 minutes to reduce the in vehicle ambient temperature Operate the seat heater on full power
	<p>Does the seat heater operate correctly?</p> <p>Yes Clear any stored DTC's and retest. If seat heater operation is correct no further action required</p> <p>No GO to A3.</p>
A3: SHORT CIRCUIT TO GROUND	
	<ol style="list-style-type: none"> Refer to the electrical circuit diagrams and the seat heater mat application chart (see above) to identify the connector Disconnect the connector Refer to the electrical circuit diagrams and check the seat heater mat (heater circuit) and (thermal sensor circuit) for short circuit to ground
	<p>Are either of the circuits short circuit to ground?</p> <p>Yes Repair the circuit or replace the seat heater mat as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Clear any stored DTC's and retest</p> <p>No GO to A4.</p>
A4: CIRCUIT CONTINUITY TEST	
	<ol style="list-style-type: none"> Refer to the electrical circuit diagrams and check the seat heater mat (heater circuit) for circuit continuity
	<p>Does the seat heater mat heater circuit pass the continuity test?</p> <p>Yes GO to A5.</p> <p>No Repair the circuit or replace the seat heater mat as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Clear any stored DTC's and retest</p>
A5: POWER CONSUMPTION	
• NOTE: The seat heater power supply cycles on and off dependant on the seat and cabin temperature and may only switch on for 5 seconds in 30 seconds	
	<ol style="list-style-type: none"> Reconnect the connector Operate the vehicle air conditioning on full for 10 minutes to reduce the in vehicle ambient temperature Refer to the electrical circuit diagrams and check the seat heater mat (heater circuit) using a current clamp Operate the seat heater on full power Use the chart above to calculate typical value (V/R=I) (Volts divided by Resistance equals Current in Amps) Examples (12 volts / 0.5 ohms =24 amps) (12 volts / 1 ohms = 12 amps) (12 volts / 2 ohms = 6 amps)
	<p>Does the seat heater mat consume the correct level of current?</p> <p>Yes Clear any stored DTC's and retest. If operation correct, no further action required</p> <p>No GO to A6.</p>
A6: RESISTANCE CHECK	

<ul style="list-style-type: none"> NOTE: Ensure the multimeter used is calibrated and a resistance reading of 0 ohms is shown when the test leads are connected together, alternately subtract any resistance shown from the result NOTE: The seat heater mat circuits should be checked at the seat heater module connector NOTE: Refer to the electrical circuit diagrams and to confirm the total resistance of the circuit the cushion and backrest are connected in series 	
	<ol style="list-style-type: none"> 1 Refer to the electrical circuit diagrams and the seat heater mat application chart (see above) to identify the terminals 2 Disconnect the connector 3 Using a multimeter, carry out a resistance check of the seat heater mat heater circuit and the NTC resistor circuit. Record the results 4 Compare the results to the chart (see above)
	<p>Are the results within specification at the given ambient temperature? (tolerance +/- 0.5 Ohms)</p> <p>Yes Reconnect the connector. Clear any stored DTC's and retest. If customer concern or DTC's return refer to electrical circuit diagrams and investigate the power and ground supply circuits</p> <p>No Replace the seat heater mat as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component. Clear any stored DTC's and retest</p>

Seating - Front Seat Cushion

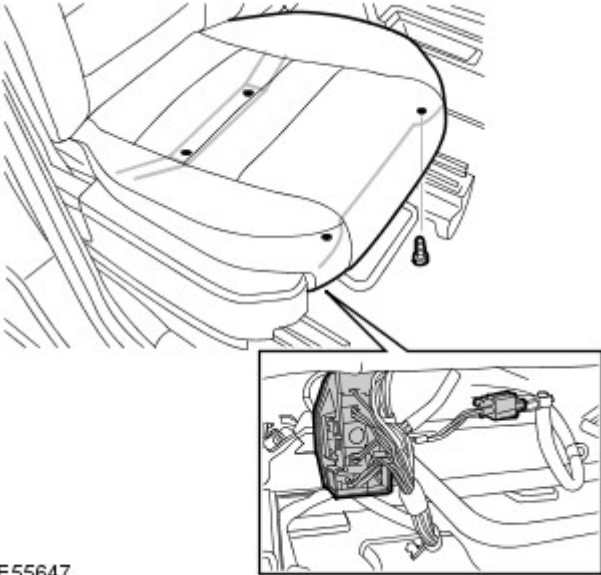
Removal and Installation

Removal

• NOTE: In this procedure the cushion is removed as an assembly. There is a separate procedure showing removal of the cushion cover.

1. Remove the front seat cushion assembly.

- Release and disconnect the 2 electrical connectors.
- Remove the 4 Torx bolts.



E55647

Installation

1. Install the front seat cushion assembly.

- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- Connect and secure the electrical connectors.

Seating - Front Seat

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



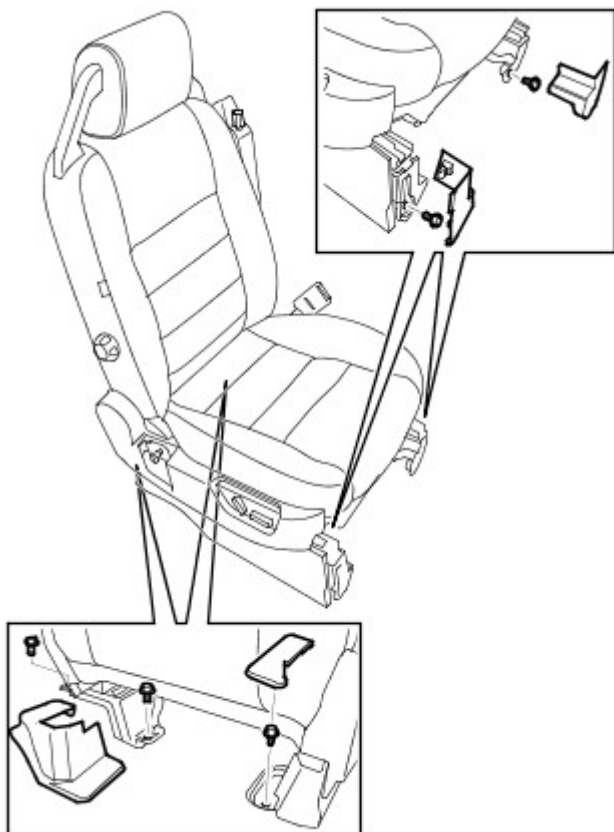
Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. **NOTE:** Torx bolts may be re-used.

Release the front seat.

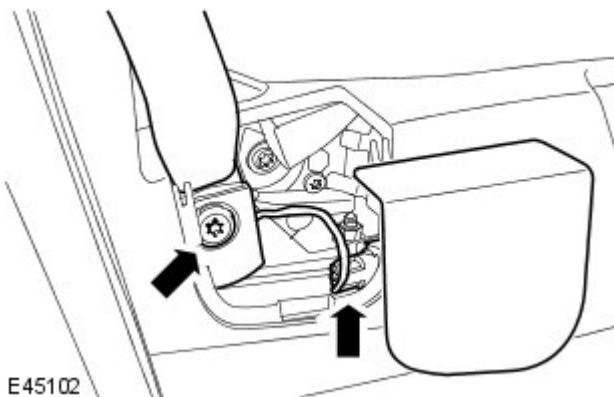
- Remove the bolt covers.
- Remove and the 5 Torx bolts.



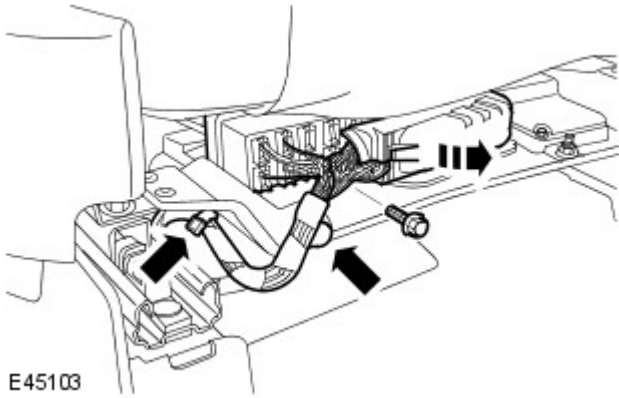
E45101

3. Release the safety belt lower anchor from the seat.

- Remove the bolt cover.
- Passenger side, disconnect the electrical connector.
- Remove and discard the Torx bolt.



E45102



4. With assistance, remove the front seat.

- Protect the rocker panel.
- Remove the bolt.
- Disconnect the 2 electrical connectors.
- Release the 2 wiring harness clips.

Installation

1. With assistance, install the front seat.

- Connect the electrical connectors.
- Secure the wiring harness clips.

2. Attach the safety belt lower anchor to the seat.

- Tighten the new Torx bolt to 40 Nm (30 lb.ft).
- Passenger side, connect the electrical connector.
- Install the bolt cover.

3. Secure the front seat.

- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Install the bolt covers.

4. Connect the battery ground cable.

Seating - Third Row Seat

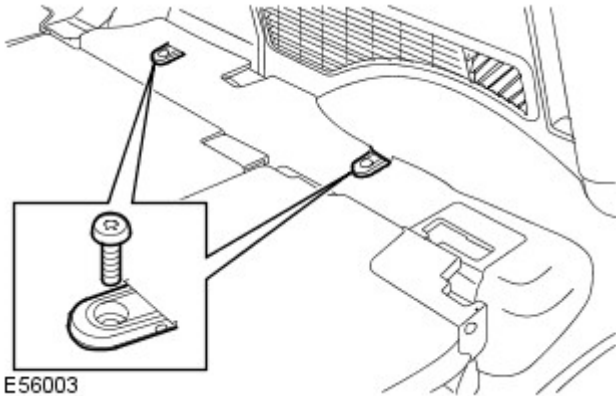
Removal and Installation

Removal

- NOTE: Third row seats must be removed as a pair.

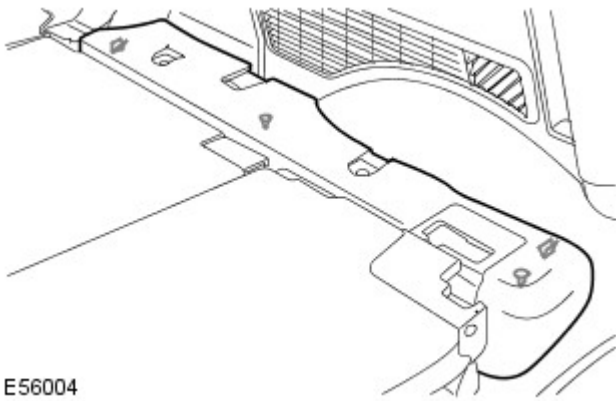
1. Remove the loadspace compartment anchors.

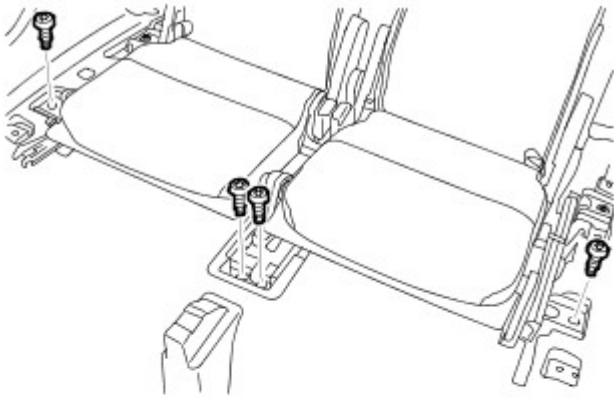
- Remove the 4 Torx bolts.



2. Remove the loadspace trim panels.

- Release from the 4 clips.

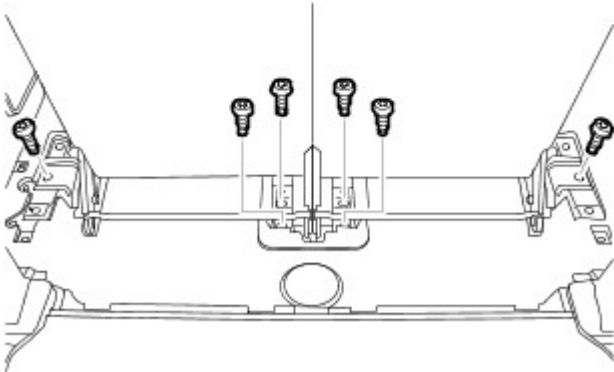




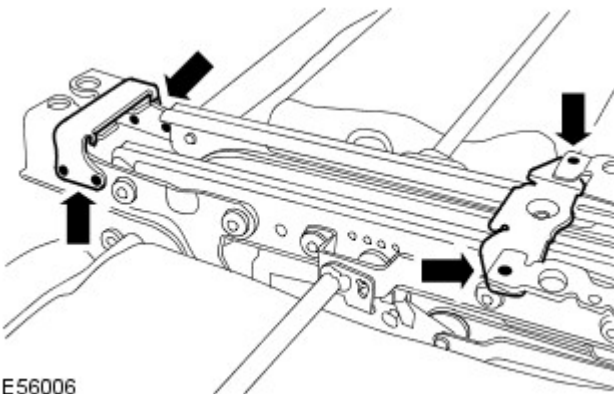
3. NOTE: Torx bolts may be re-used.

Remove the third row seats.

- Release the trim cover.
- Remove the 10 Torx bolts.



E56005



E56006

4. NOTE: Do not disassemble further if the component is removed for access only.

Separate the third row seats.

- Remove the seat frame finisher.
- Drill out the 6 rivets.
- Remove the 2 brackets.

Installation

1. Attach the third row seats.

- Install the brackets.
- Install the rivets.

2. Install the third row seats.

- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Secure the trim cover.

3. Install the loadspace trim panels.

- Secure in the clips.

4. Install the loadspace compartment anchors.

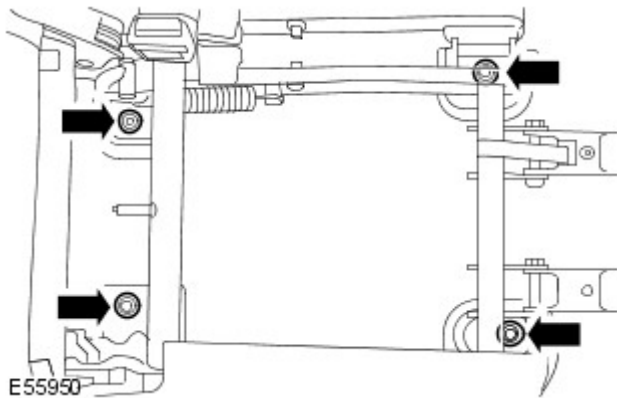
- Tighten the Torx bolts to 25 Nm (18 lb.ft).

Seating - Rear Seat Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

- NOTE: This procedure shows the removal and installation of both the LH and the RH seats.



1. NOTE: The Torx bolts can be re-used.

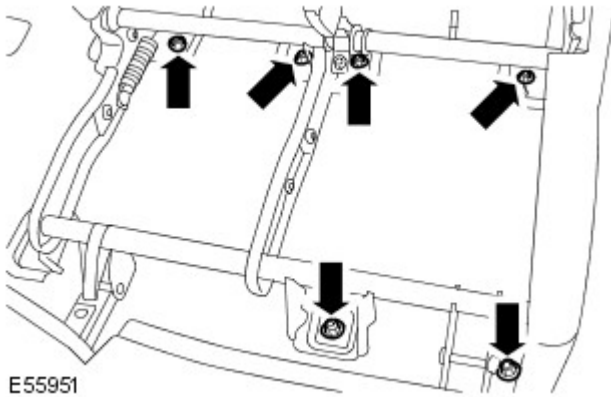
Release the RH rear seat.

- Fold the LH seat cushion forward.
- Remove the 4 Torx bolts.
- Fold down the rear seat backrest.

2. Remove the RH rear seat.

3. NOTE: The Torx bolts can be re-used.

Release the LH rear seat.



- Fold the LH seat cushion forward.
- Remove the 6 Torx bolts.
- Fold down the rear seat backrest.

4. With assistance, remove the LH rear seat assembly.

Installation

1. With assistance, install the LH rear seat assembly.

- Position the seat on the dowels.

2. Secure the LH rear seat.

- Return the seat backrest to the upright position.
- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

3. Install the RH rear seat.

- Position the seat on the dowels.

4. Secure the RH rear seat.

- Return the seat backrest to the upright position.
- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

Seating - Rear Seat Vehicles With: 40/20/40 Split Seat

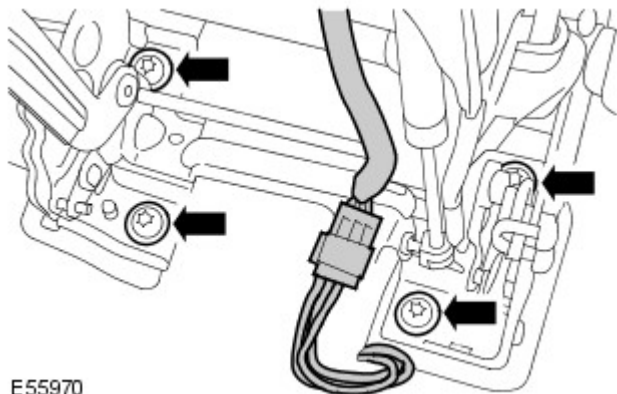
Removal and Installation

Removal

1. NOTE: The Torx bolts can be re-used.

Release the rear seat.

- Remove the front 2 Torx bolts.
- Fold the seat assembly forwards.
- Disconnect the electrical connector.
- Remove the rear 2 Torx bolts.



E55970

2. Remove the rear seat assembly.

Installation

1. Install the rear seat assembly.

2. Secure the rear seat.

- Connect the electrical connector.
- Tighten the rear Torx bolts to 45 Nm (33 lb.ft).
- Fold seat assembly rearwards.
- Tighten the front Torx bolts to 45 Nm (33 lb.ft).

Seating - Front Seat Cushion Cover

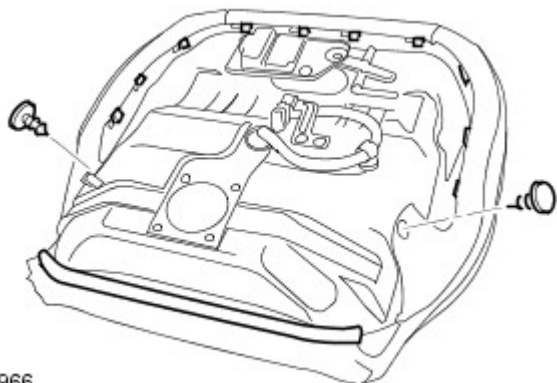
Removal and Installation

Removal

1. Remove the front seat cushion assembly.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).

2. Release the front seat cushion cover.

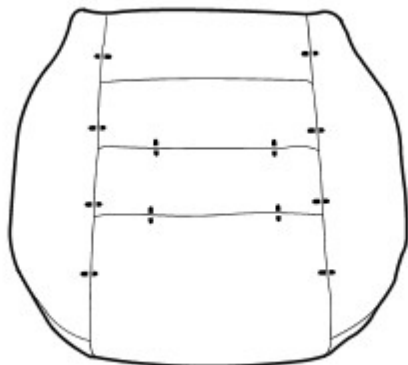
- Release the 13 clips.



E55966

3. Remove the front seat cushion cover.

- Remove the 12 hog rings.



E56020

Installation

1. Install the front seat cushion cover.

- Install the hog rings.
- Attach the cover and secure with the clips.

2. Install the front seat cushion assembly.

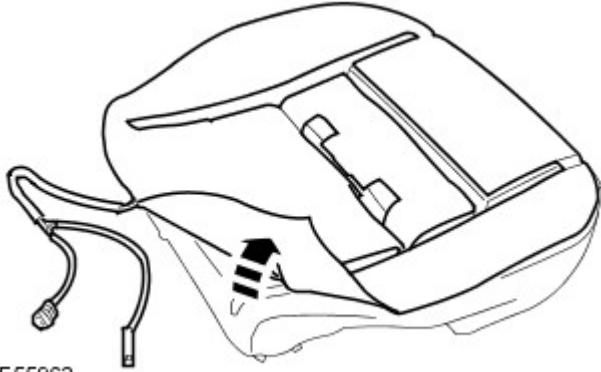
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).

Seating - Front Seat Cushion Heater Mat

Removal and Installation

Removal

1. Remove the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).
2. Remove the front seat cushion heater mat.



E55962

Installation

1. Install the front seat cushion heater mat.
2. Install the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).

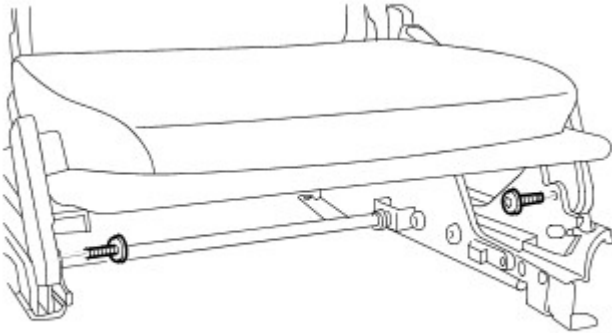
Seating - Third Row Seat Cushion Cover

Removal and Installation

Removal

1. Remove the occasional seat cushion assembly.

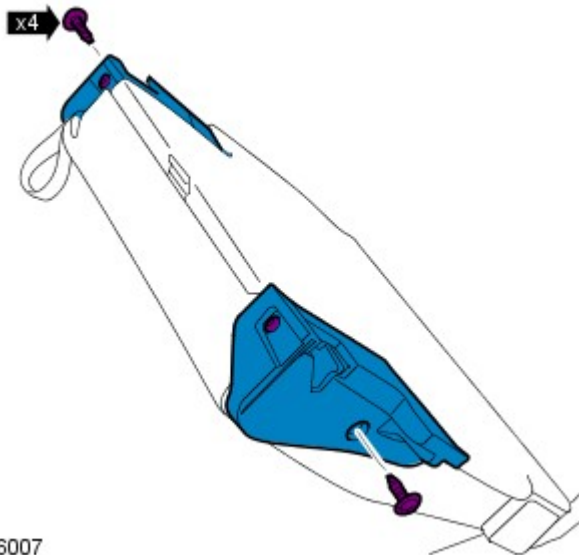
- Remove the 2 Torx bolts.



E56012

2. Remove the third row seat cushion latch covers.

- Remove the 4 screws.

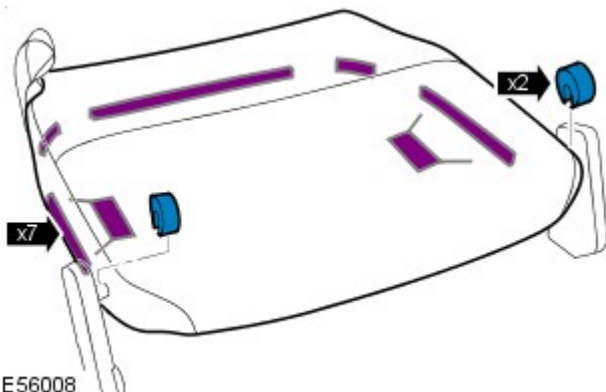


E56007

3. NOTE: Note the fitted position.

Remove the third row seat cushion cover.

- Remove the 2 spacers.
- Release the 7 clips.



E56008

Installation

1. To install, reverse the removal procedure.

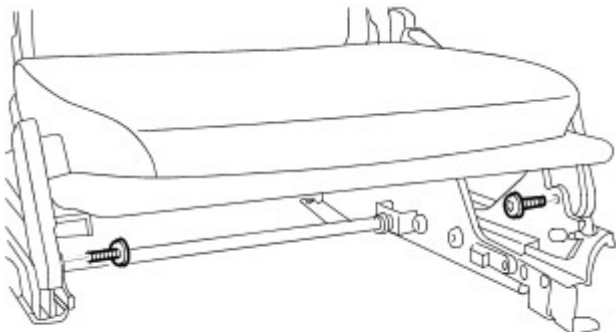
- Tighten the Torx bolt to 25 Nm (18 lb.ft).

Seating - Third Row Seat Cushion

Removal and Installation

Removal

• NOTE: In this procedure the cushion is removed as an assembly. There is a separate procedure for removing and installing the cushion cover.



E56012

1. Remove the third row seat cushion.

- Remove the 2 Allen bolts.
- Release the cushion from the seat frame.

Installation

1. NOTE: Ensure seat cushion return springs are correctly located.

Install the third row seat cushion.

- Attach the cushion to the seat frame.
- Tighten the Allen bolts to 25 Nm (18 lb.ft).

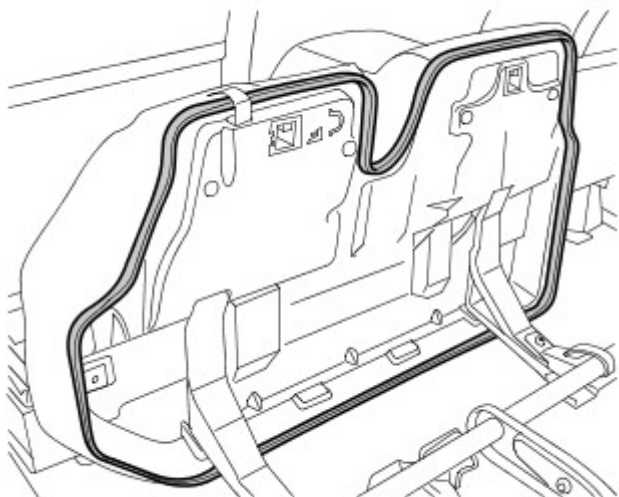
Seating - Rear Seat Cushion Cover Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

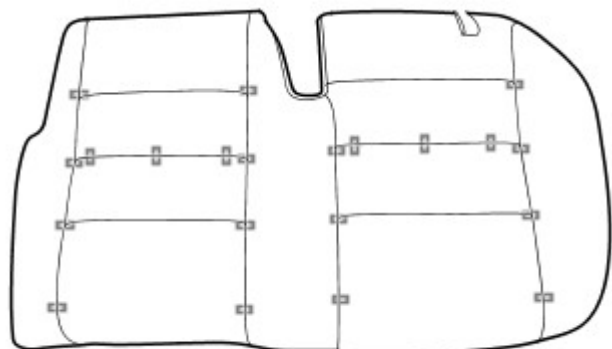
• NOTE: This procedure shows the removal and installation of both the LH and the RH covers.

1. Fold the seat cushion forward.
2. Release the rear LH seat cushion cover.
 - Release the clip.



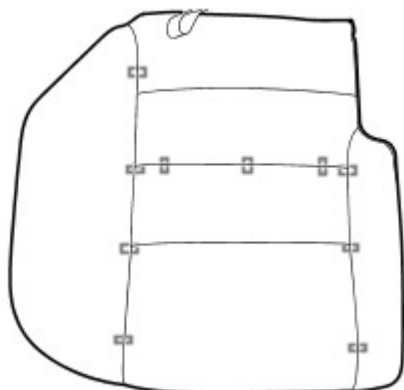
E55996

3. Remove the rear LH seat cushion cover.
 - Remove the 21 hog rings.



E56015

4. Release the rear RH seat cushion cover.
 - Release the clip.



E56016



E55997

Installation

1. Install the rear seat cushion cover.
 - Install the hog rings.

- Attach the retaining clip.

2. Fold the seat cushion rearwards.

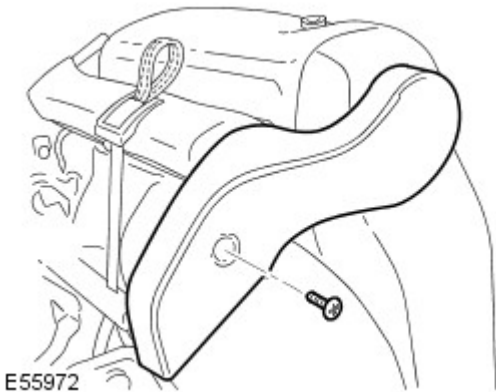
Seating - Rear Seat Cushion Cover Vehicles With: 40/20/40 Split Seat

Removal and Installation

Removal

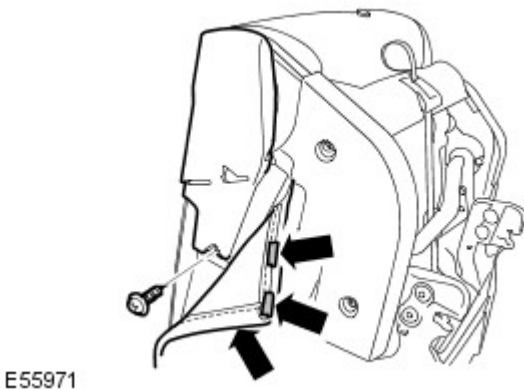
1. Remove the outer backrest hinge cover.

- Fold the seat assembly forwards.
- Remove the screw.



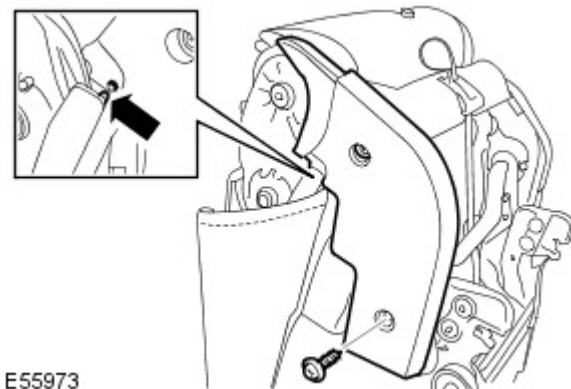
2. Remove the inner backrest hinge cover.

- Release the backrest cover side clip.
- Release the 2 clips.
- Remove the screw.



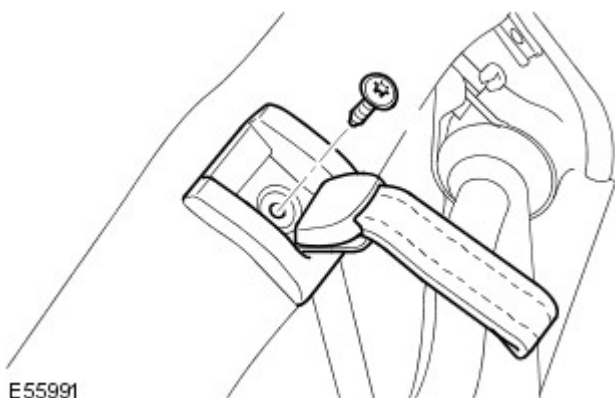
3. Remove the rear seat cushion side finisher.

- Remove the 2 screws.



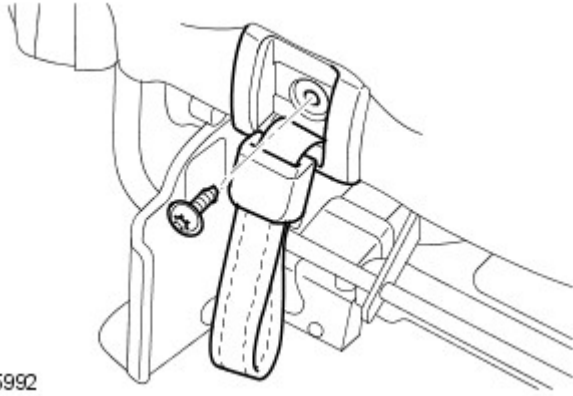
4. Remove the seat rear release strap finisher.

- Remove the screw.



5. Remove the seat front release strap finisher.

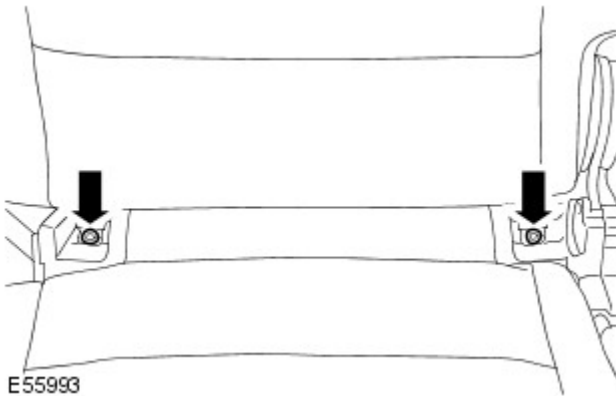
- Remove the screw.



E55992

6. Remove the seat cushion finishers.

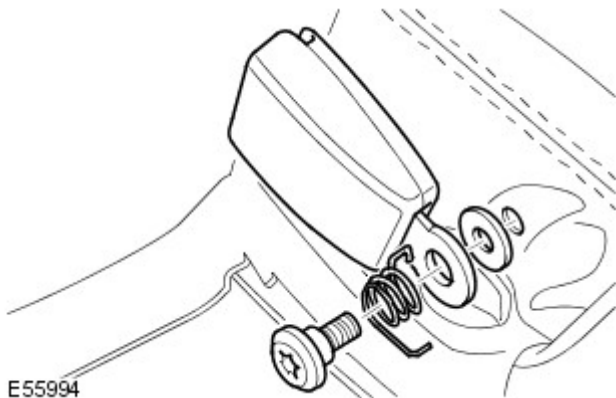
- Remove the 2 screws.



E55993

7. Remove the rear safety belt buckle.

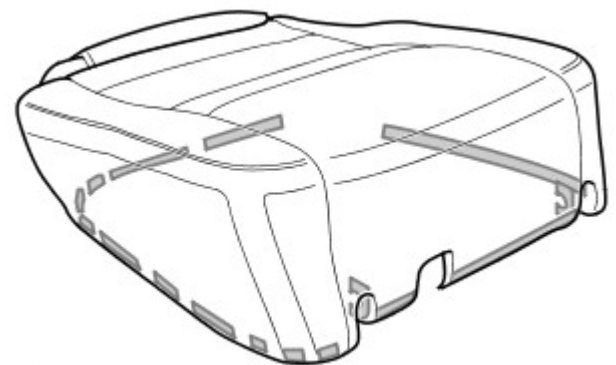
- Remove the Torx bolt.
- Release the spring.



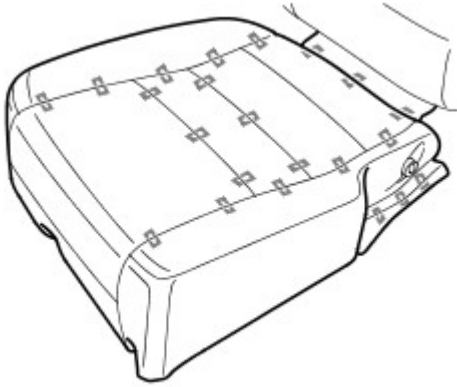
E55994

8. Release the rear seat cushion cover.

- Release the 15 clips.



E55995



E56017

9. Remove the rear seat cushion cover.

- Remove the 22 hog rings.

Installation

1. Install the rear seat cushion cover.

- Install the hog rings.
- Install the clips.

2. Install the rear safety belt buckle.

- Attach the spring.
- Tighten the Torx bolt to 45 Nm (33 lb.ft).

3. Install the seat cushion finishers.

- Tighten the screws.

4. Install the seat front release strap finisher.

- Remove the screw.
- Tighten the screw.

5. Install the seat rear release strap finisher.

- Tighten the screw.

6. Install the inner backrest hinge cover.

- Attach the clips.
- Tighten the screw.

7. Install the outer backrest hinge cover.

- Tighten the screw.
- Fold seat assembly rearwards.

8. Install the rear seat cushion side finisher.

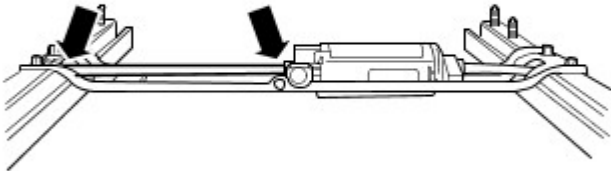
- Tighten the screws.

Seating - Front Seat Track Motor

Removal and Installation

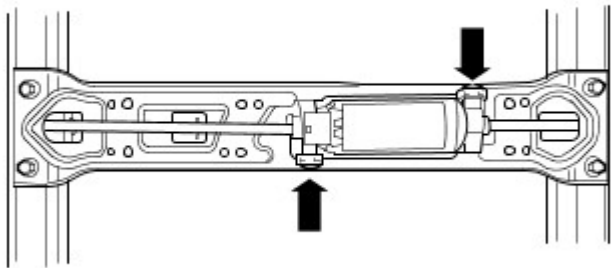
Removal

1. Raise the seat base for access.
2. Remove the drive cable.
 - Disconnect the seat motor electrical connector.



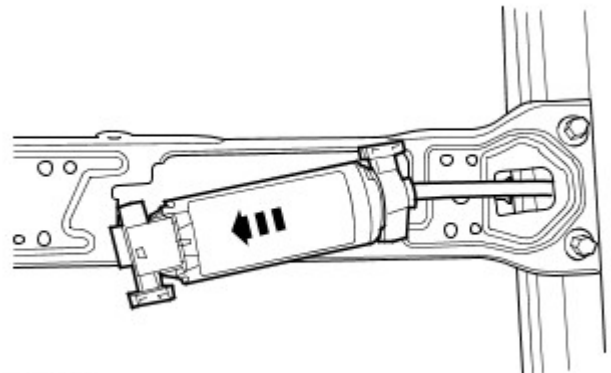
E131397

3. Remove the 2 clips.



E131398

4. Remove the front seat track motor.



E131399

Installation

1. Install the front seat track motor.
 - Install the drive cable.
 - Install the 2 clips.
2. Install the drive cable.
 - Connect the seat motor electrical connector.

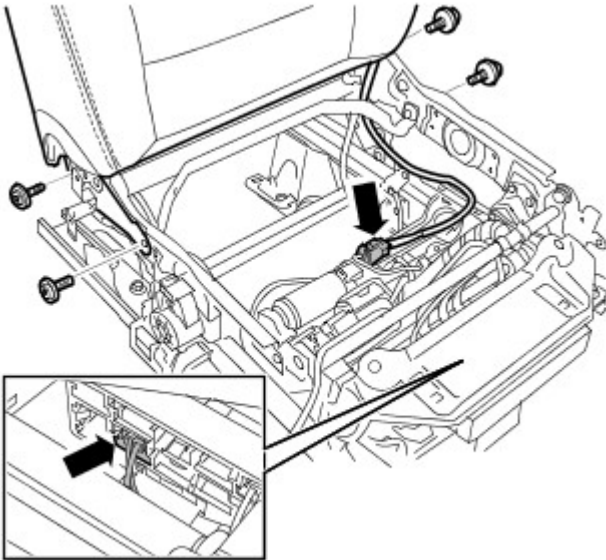
Seating - Front Seat Height Adjustment Motor

Removal and Installation

Removal

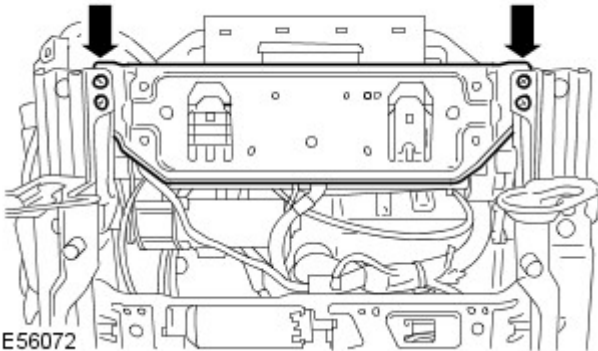
- NOTE: Front seat height adjustment motor is supplied as part of the front seat frame assembly.

1. Remove the front safety belt buckle.
For additional information, refer to: Front Safety Belt Buckle (501-20, Removal and Installation).
2. Remove the front seat cushion assembly.
For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).
3. Remove the front seat backrest assembly.
 - Release and disconnect the 2 electrical connectors.
 - Remove the 4 Torx bolts.



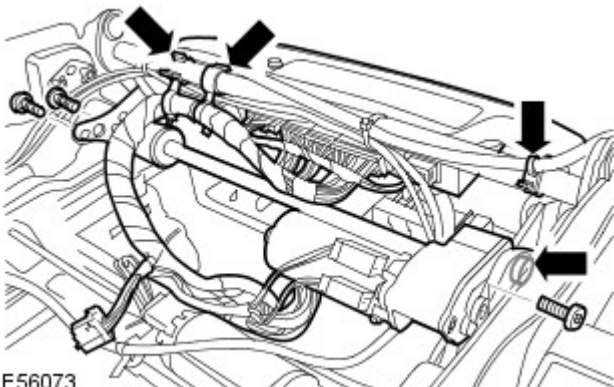
E56071

4. Remove the front seat electrical connector bracket.
 - Remove the 4 screws.

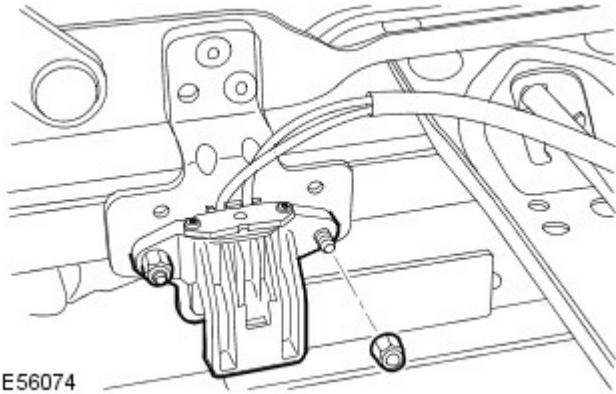


E56072

5. Remove the front seat tilt motor.
 - Release the 3 wiring harness clips.
 - Remove the 4 Torx bolts.

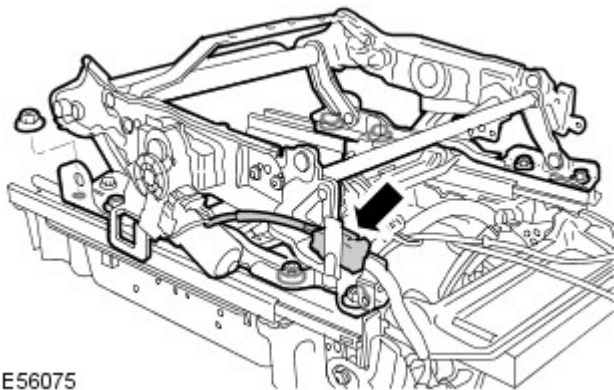


E56073



6. Remove the front seat position sensor.

- Remove the 2 nuts.



7. Remove the front seat height adjustment motor.

- Disconnect the electrical connector.
- Remove the 8 nuts.

Installation

1. Install the front seat height adjustment motor.

- Tighten the nuts to 25 Nm (18 lb.ft).
- Connect the electrical connector.

2. Install the front seat position sensor.

- Tighten the nuts to 4 Nm (3 lb.ft).

3. Install the front seat tilt motor.

- Tighten the Torx bolts to 10 Nm (7 lb.ft).
- Attach the wiring harness.

4. Install the front seat electrical connector bracket.

- Tighten the screws.

5. Install the front seat backrest assembly.

- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- Connect and secure the electrical connectors.

6. Install the front seat cushion assembly.

For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).

7. Install the front safety belt buckle.

For additional information, refer to: Front Safety Belt Buckle (501-20, Removal and Installation).

Seating - Front Seat Tilt Motor

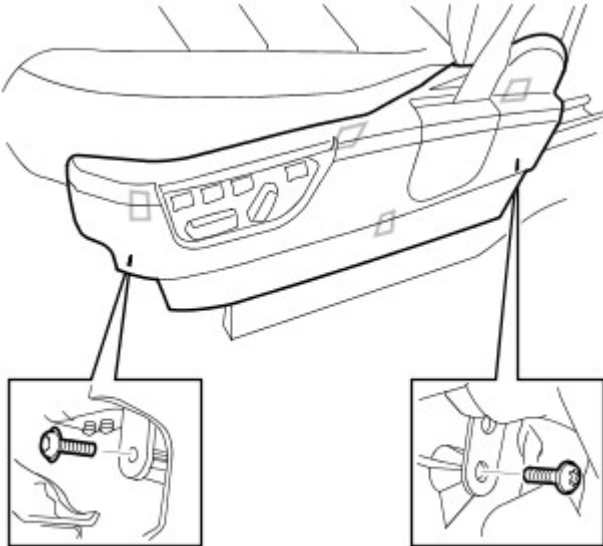
Removal and Installation

Removal

1. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

2. Remove the front seat cushion side finisher.

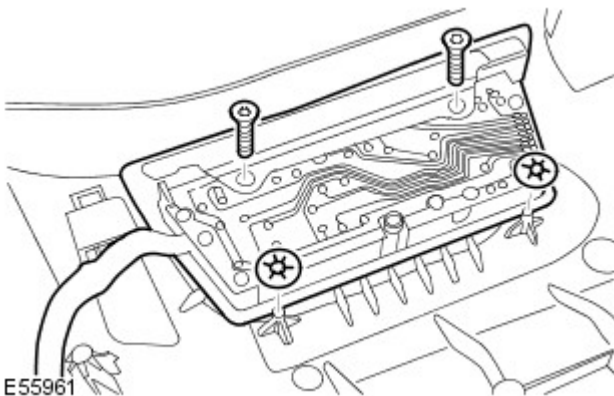
- Remove the 2 Torx screws.
- Release from the 3 clips.



E56089

3. Release the front seat control switch.

- Remove the 2 screws.
- Remove the 2 clips.

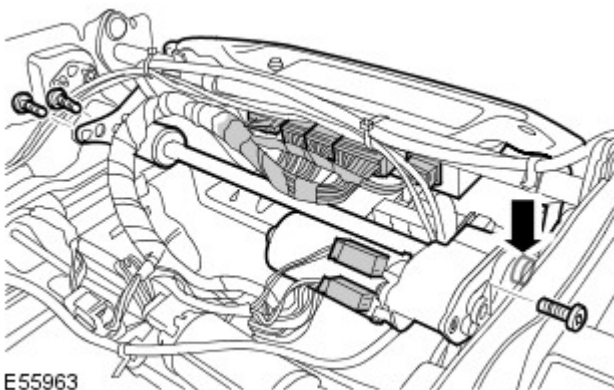


E55961

4. Remove the front seat cushion assembly.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).

5. Remove the front seat tilt motor assembly.

- Remove the 4 Torx bolts.
- Disconnect the 7 electrical connectors.

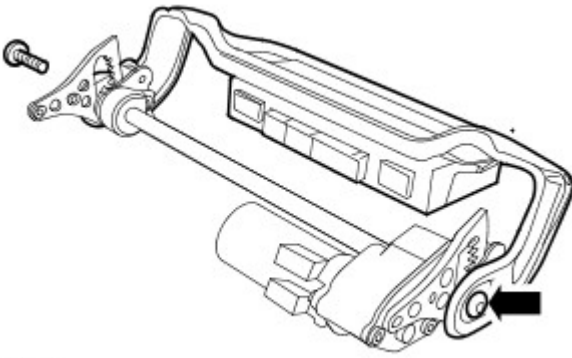


E55963

6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the seat module bracket.

- Remove the 2 Torx bolts.



E55964

Installation

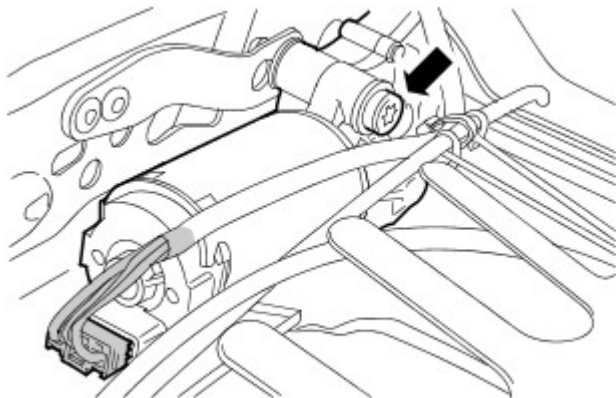
1. Install the seat module bracket.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
2. Install the front seat tilt motor assembly.
 - Tighten the 4 Torx bolts to 10 Nm (7 lb.ft).
 - Connect the electrical connectors.
3. Install the front seat cushion assembly.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).
4. Install the front seat cushion side finisher.
 - Secure in the clips.
 - Tighten the screws.
5. Install the front seat control switch.
 - Secure in the clips.
 - Tighten the screws.
6. Install the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

Seating - Front Seat Recliner Motor

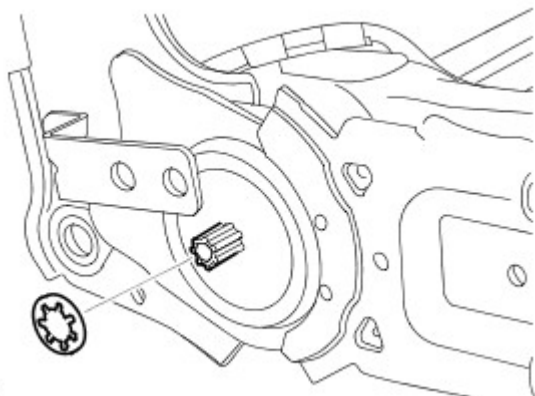
Removal and Installation

Removal

1. Remove the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).
2. Remove the front seat backrest pad.
3. Remove the front seat recliner motor.



- Disconnect the electrical connector.
- Remove the Torx bolt.
- Remove the front seat backrest shaft clip.
- Remove the front seat backrest shaft.



E55965

Installation

1. Install the front seat recliner motor.
 - Install the front seat backrest shaft.
 - Install the front seat backrest shaft clip.
 - Tighten the Torx bolt to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Install the front seat backrest pad.
3. Install the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).

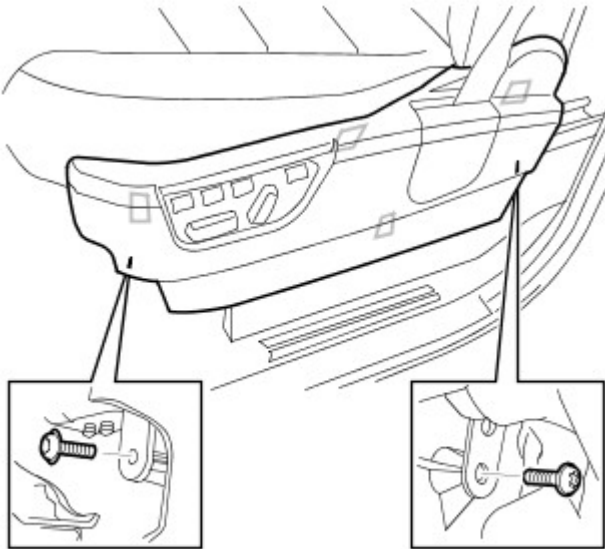
Seating - Front Seat Control Switch

Removal and Installation

Removal

1. Remove the front seat cushion side finisher.

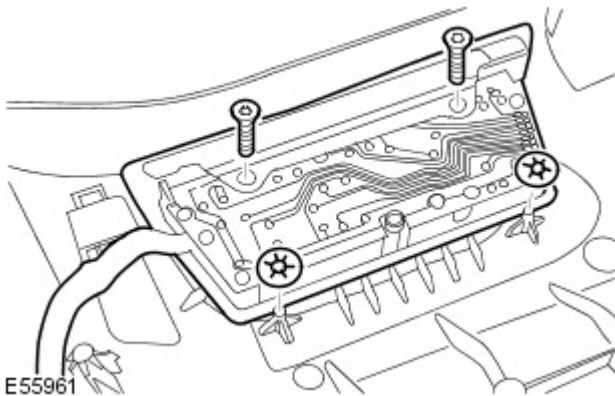
- Remove the 2 screws.
- Release from the 3 clips.



E55954

2. Remove the front seat control switch.

- Disconnect the electrical connector.
- Release the front seat control switch harness.
- Remove the 2 screws.
- Remove the 2 clips.



E55961

Installation

1. Install the front seat cushion side finisher.

- Secure in the clips.
- Tighten the screws.

2. Install the front seat control switch.

- Secure in the clips.
- Tighten the screws.
- Connect the electrical connector.
- Attach the wiring harness.

Seating - Front Seat Backrest Cover

Removal and Installation

Removal

• WARNINGS:



To avoid accidental deployment, the restraints control module backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.



Always wear safety glasses when working on an air bag equipped vehicle and when handling an air bag module. Failure to follow this instruction may result in personal injury.



To minimize the possibility of premature deployment, do not use radio key code savers when working on the supplemental restraint system. Failure to follow this instruction may result in personal injury.



To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.



To minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure to follow these instructions may result in personal injury.



Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.



Painting over the driver air bag module trim cover or instrument panel could lead to deterioration of the trim cover and air bags. Do not for any reason attempt to paint discolored or damaged air bag module trim covers or instrument panel. Install a new component. Failure to follow this instruction may result in personal injury.



Make sure that sufficient time has elapsed after disconnecting the battery ground cable(s), before commencing work on the supplemental restraint system (SRS). Failure to follow these instructions may result in personal injury.

1. Make the SRS system safe.

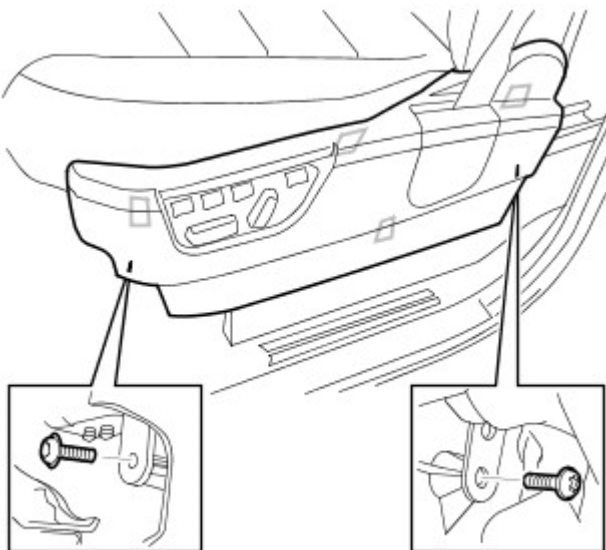
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the front safety belt buckle.

For additional information, refer to: [Front Safety Belt Buckle](#) (501-20A Safety Belt System, Removal and Installation).

3. Remove the front seat cushion side trim.

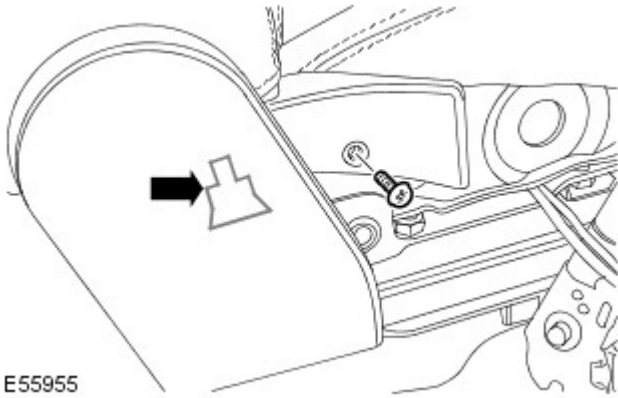
- Remove the 2 screws.
- Release from the 3 clips.



E55954

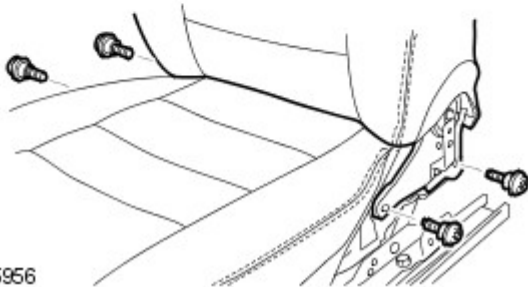
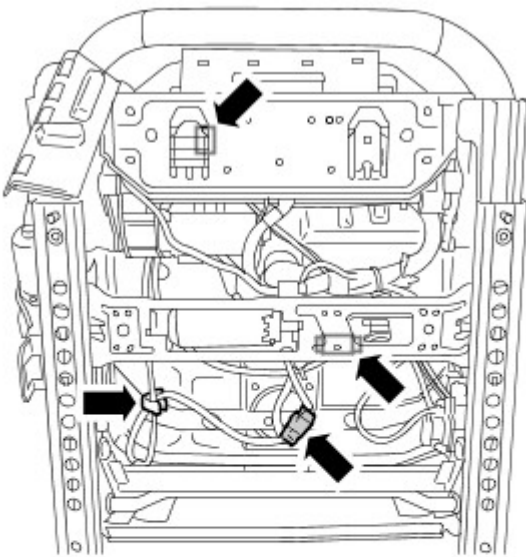
4. Remove the front seat backrest hinge cover.

- Remove the 2 screws.
- Release from the clip.



5. Remove the front seat backrest assembly.

- Release the retaining clips and disconnect the three electrical connectors.
- Remove the 4 Torx bolts.



E55956

6. Remove the front seat grab handles.

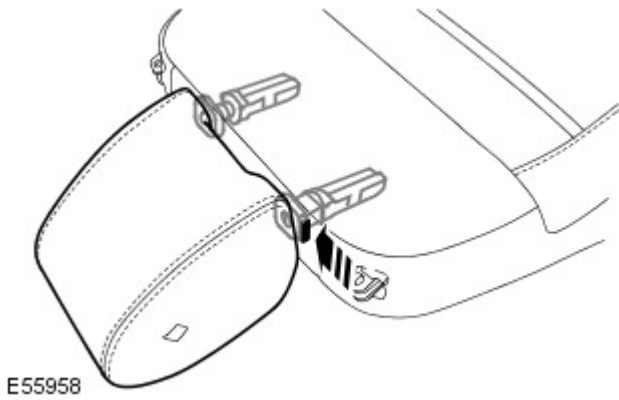
- Remove the bolt covers.
- Remove the 2 bolts.



7. NOTE: Head restraint release latch is underneath backrest cover.

Remove the front seat head restraint.

- Release the front seat head restraint latch.



8. Remove the seat armrest.

For additional information, refer to: Front Seat Armrest (501-10, Removal and Installation).

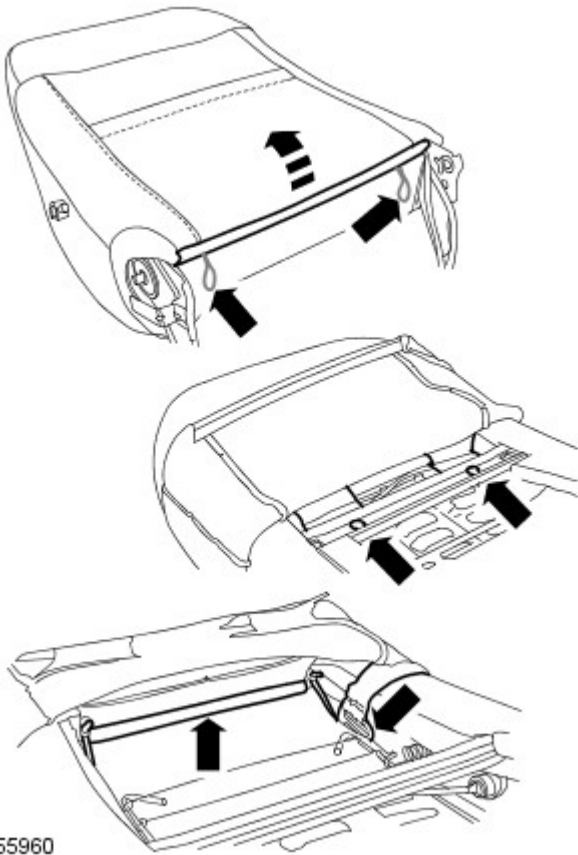
9. Remove the front seat lumbar adjustment knob.

- Pull sharply to release from lumbar mechanism.



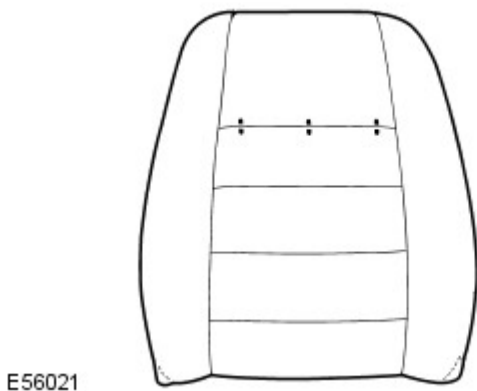
10. Release the front seat backrest cover.

- Release the 5 clips.
- Release the tension straps.



11. Remove the front seat backrest cushion and cover from the front seat frame.

- Remove the 3 hog rings.



Installation

1. Install the front seat backrest cover.

- Install the hog rings.
- Install the clips.
- Attach the tension straps.

2. Install the front seat lumbar adjustment knob.

- Push firmly to secure to the lumbar mechanism.

3. Install the seat armrest.

For additional information, refer to: Front Seat Armrest (501-10, Removal and Installation).

4. Install the front seat head restraint.

5. Install the front seat grab handles.

- Tighten the bolts to 25 Nm (18 lb.ft).
- Install the bolt covers.

6. Install the front seat backrest assembly.
 - Tighten the Torx bolts to 25 Nm (18 lb.ft).
 - Connect and secure the electrical connectors.
7. Install the front seat backrest hinge cover.
 - Tighten the screws.
 - Fit the clip.
8. Install the front seat cushion side trim.
 - Position and secure in the clips.
 - Install the screws.
9. Install the front safety belt buckle.
For additional information, refer to: [Front Safety Belt Buckle](#)
(501-20A Safety Belt System, Removal and Installation).

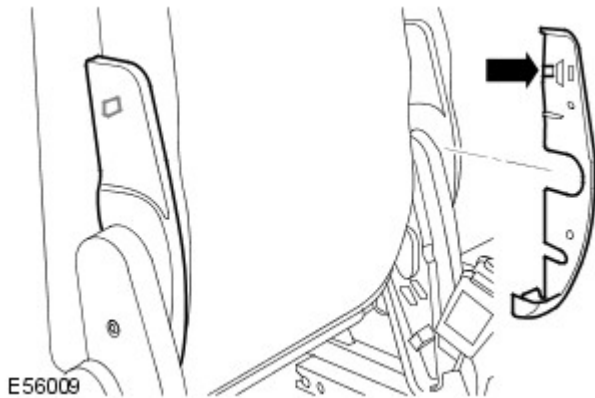
Seating - Third Row Seat Backrest Cover

Removal and Installation

Removal

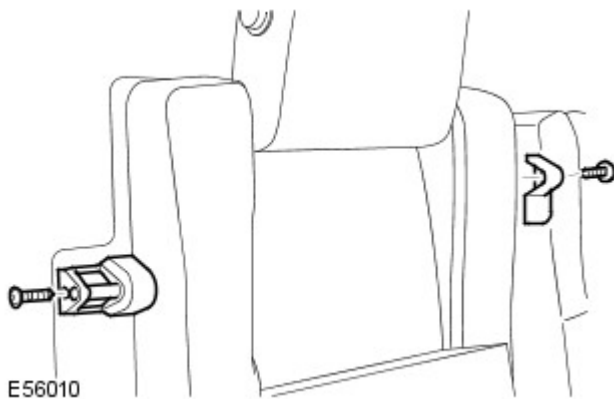
1. Fold the seat cushion assembly forwards.
2. Remove the seat backrest hinge inner covers.

- Release the clip.



3. Remove the seat backrest latch covers.

- Remove the 2 screws.



4. Remove the seat backrest cover.

- Fold the seat cushion forward.
- Release the 14 clips.



Installation

1. To install, reverse the removal procedure.

Seating - Front Seat Backrest Heater Mat

Removal and Installation

Removal

1. Remove the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).
2. NOTE: Front seat cushion heater mat shown in illustration.
Removal of backrest heater mat is the same.

Remove the front seat backrest heater mat.



E55962

Installation

1. Install the front seat backrest heater mat.
2. Install the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).

Seating - Rear Seat Backrest Cover Vehicles With: 60/40 Split Seat

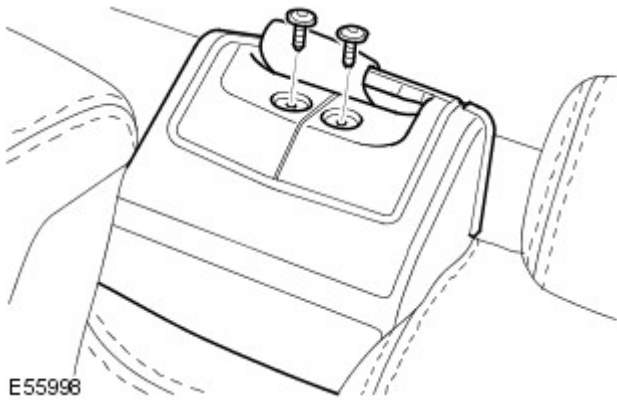
Removal and Installation

Removal

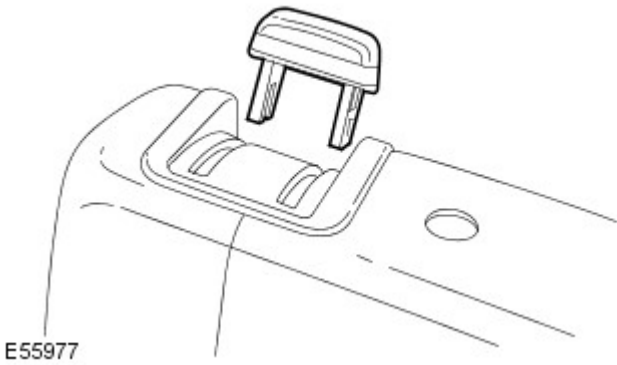
- NOTE: This procedure shows the removal of both the LH and RH covers.

1. LH seat only: Remove the safety belt retractor cover and guide.

- Remove the 2 screws.

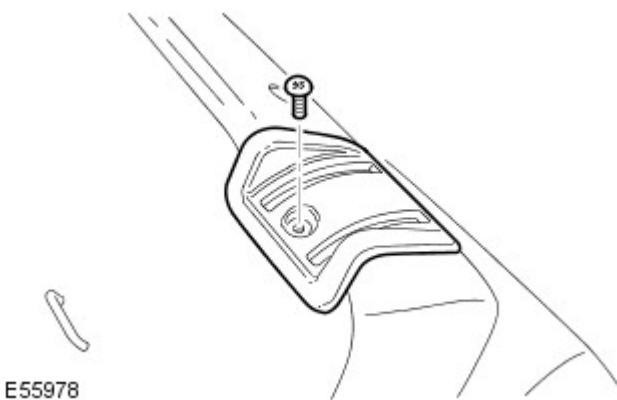


2. Remove the rear seat release handle.



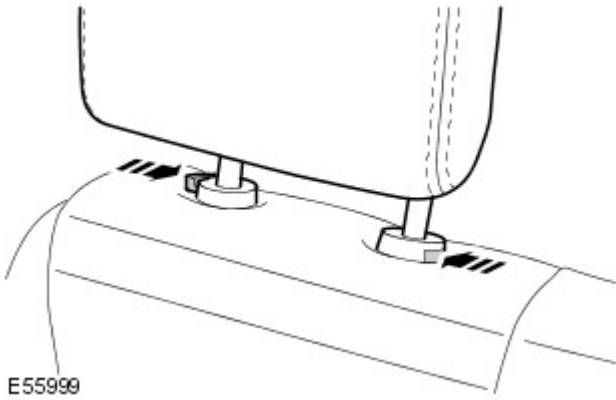
3. Remove the rear seat release handle finisher.

- Remove the screw.

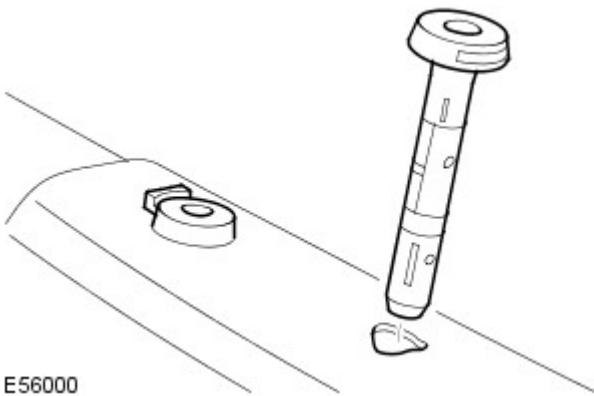


4. Remove the rear seat head restraint.

- Depress the 2 retaining clips.

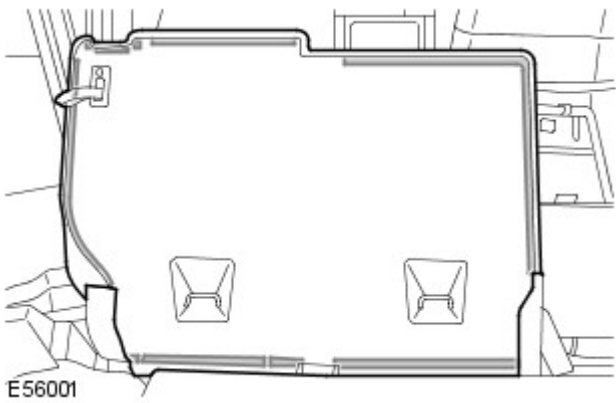


5. Remove the rear seat head restraint retaining clips.



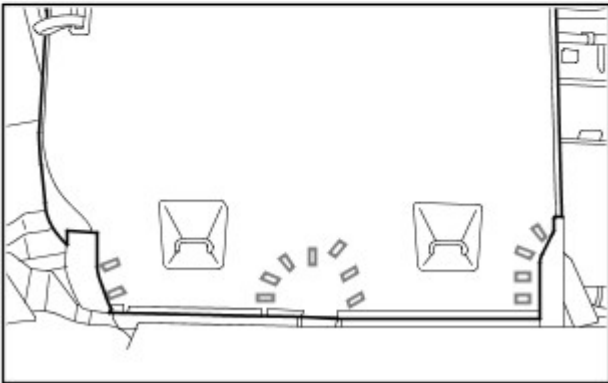
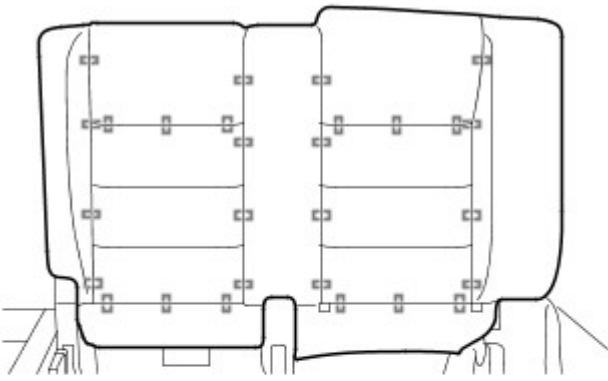
6. Release the rear LH seat backrest cover.

- Release the 10 clips.



7. Remove the rear LH seat backrest cover.

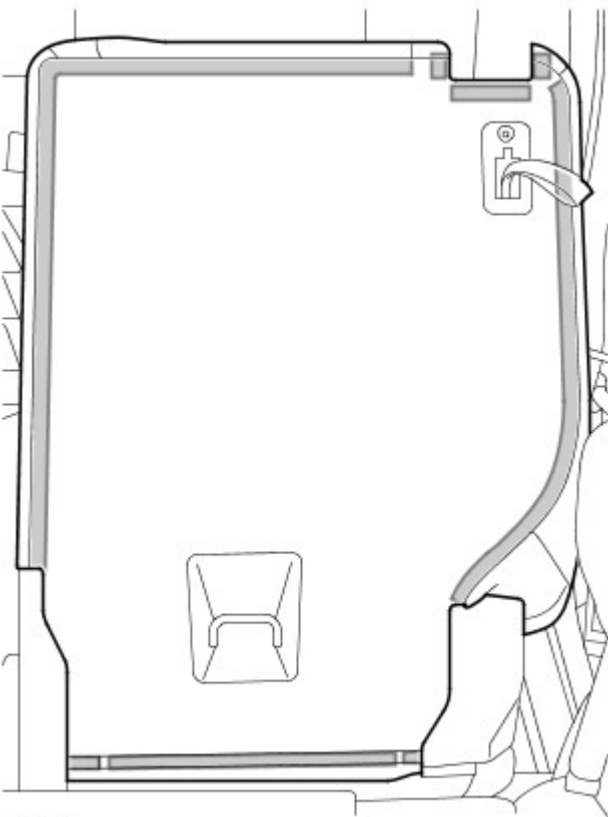
- Remove the 41 hog rings.



E56013

8. Release the rear RH seat backrest cover.

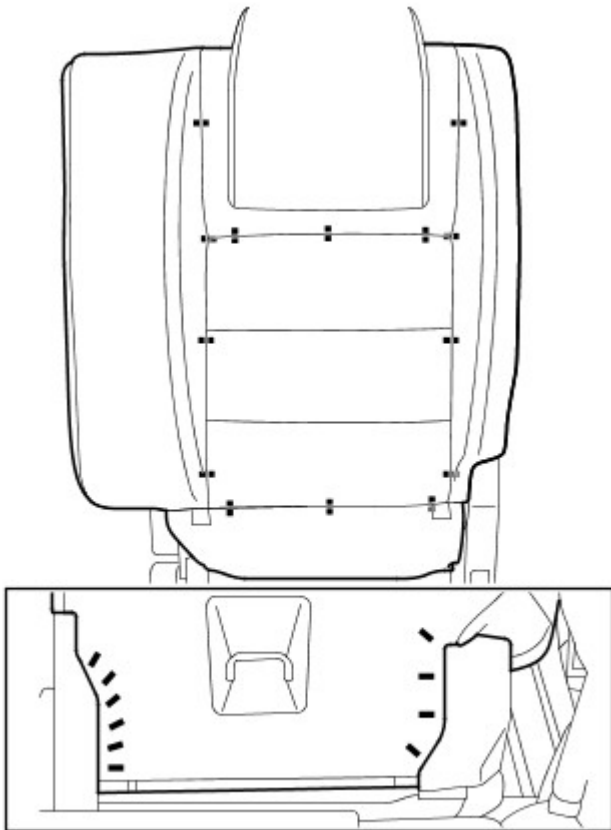
- Release the 9 clips.



E56002

9. Remove the rear RH seat backrest cover.

- Remove the 24 hog rings.



E56014

Installation

1. Install the rear seat backrest cover.

- Install the hog rings.
- Attach the clips.

2. Install the rear seat head restraint retaining clips.

3. Install the rear seat head restraint.

4. Install the rear seat release handle finisher.

- Tighten the screw.

5. Install the rear seat release handle.

6. Install the safety belt guide and retractor cover.

- Attach the safety belt guide and retractor cover.
- Tighten the screws.

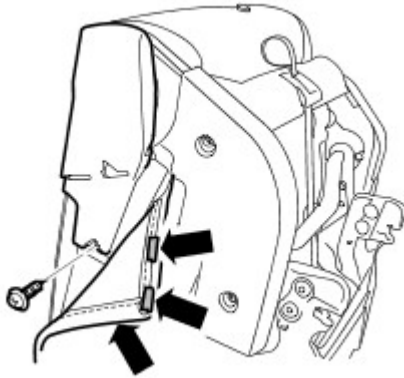
Seating - Rear Seat Backrest Cover Vehicles With: 40/20/40 Split Seat

Removal and Installation

Removal

1. Remove the inner backrest hinge cover.

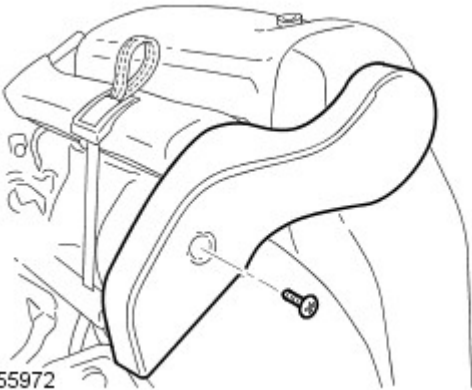
- Release the backrest cover side clip.
- Remove the screw.
- Release the 2 clips.



E55971

2. Remove the outer backrest hinge cover.

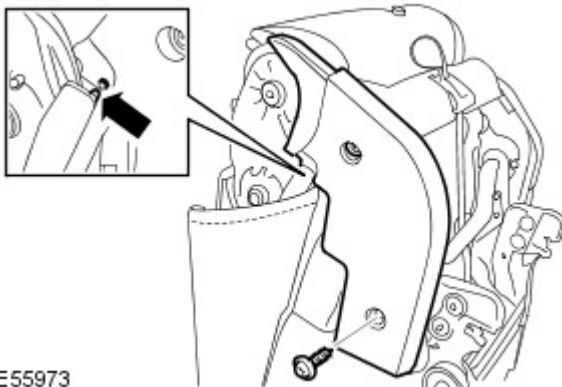
- Remove the screw.



E55972

3. Remove the rear seat cushion side finisher.

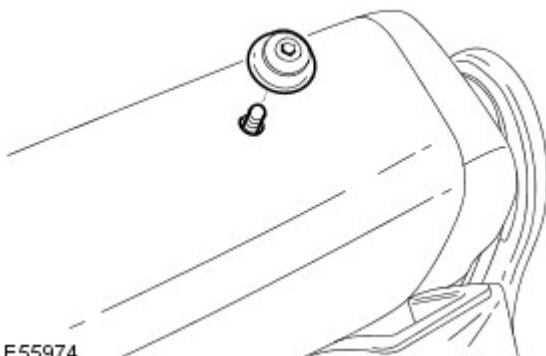
- Remove the 2 screws.



E55973

4. Remove the luggage strap tether.

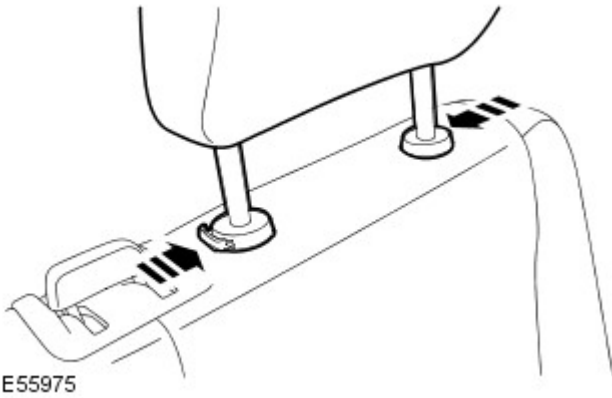
- Remove the Allen bolt.



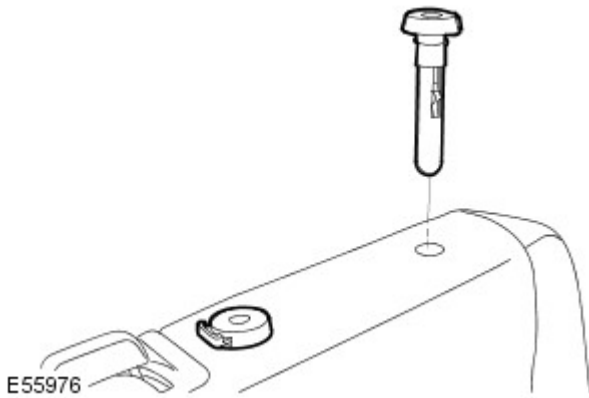
E55974

5. Remove the rear seat head restraint.

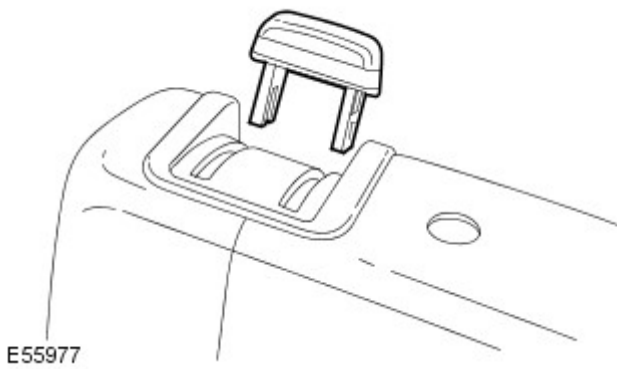
- Depress the 2 retaining clips.



6. Remove the rear seat head restraint retaining clips.



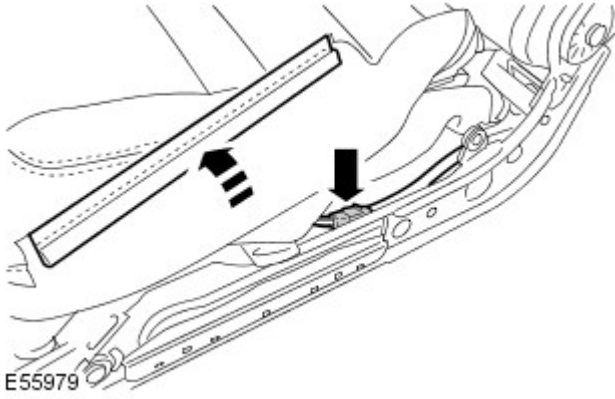
7. Remove the rear seat release handle.



8. Remove the rear seat release handle finisher.

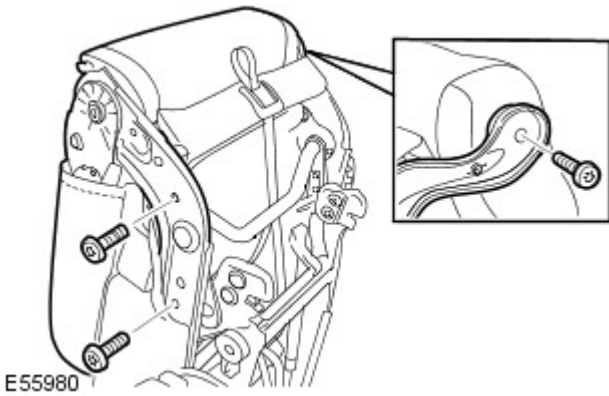
- Remove the screw.





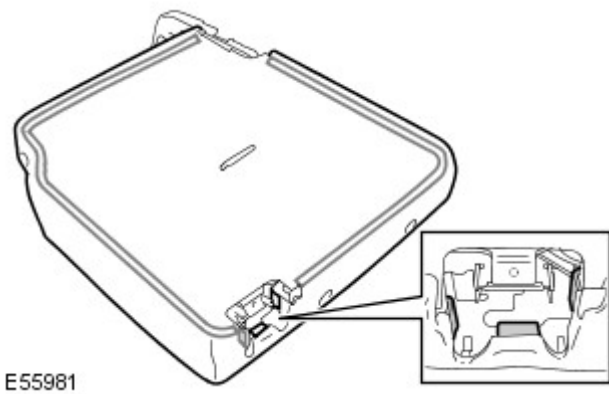
9. Disconnect the backrest heater mat electrical connector.

- Release the rear seat cushion side clip.



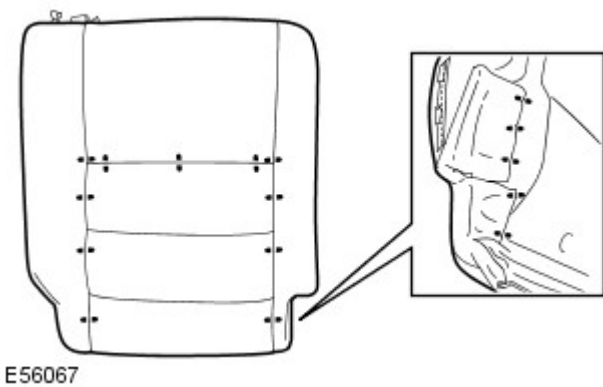
10. Remove the rear seat backrest assembly.

- Remove the 3 Torx bolts.



11. Release the rear seat backrest cover.

- Release the 5 clips.



12. Remove the rear seat backrest cover.

- Remove the 16 hog rings.

Installation

1. Install the rear seat backrest cover.

- Install the 16 hog rings.

- Attach the 4 clips.
2. Install the rear seat backrest assembly.
 - Tighten the Torx bolts to 45 Nm (33 lb.ft).
 3. Connect the backrest heater mat electrical connector.
 - Attach the rear seat cushion side clip.
 4. Install the rear seat release handle finisher.
 - Tighten the screw.
 5. Install the rear seat release handle.
 6. Install the rear seat head restraint retaining clips.
 7. Install the rear seat head restraint.
 8. Install the luggage strap tether.
 9. Install the rear seat cushion side finisher.
 - Tighten the screws.
 10. Install the outer backrest hinge cover.
 - Tighten the screws.
 - Tighten the screw.
 11. Install the inner backrest hinge cover.
 - Attach the clips.
 - Tighten the screw.
 - Attach the backrest cover side clip.

Seating - Seat Track Vehicles Without: Power Seats

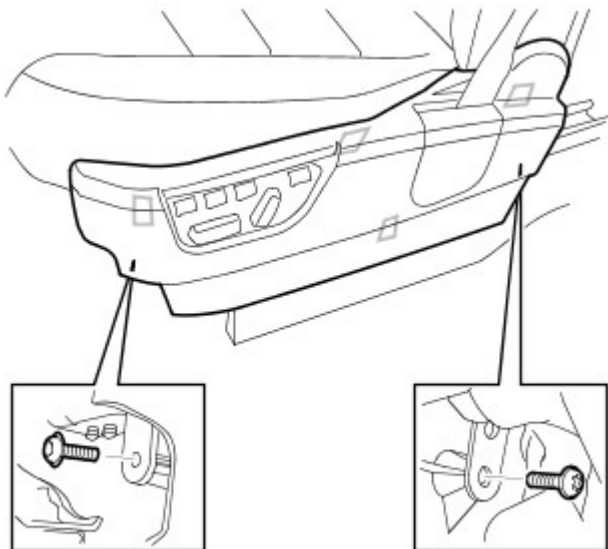
Removal and Installation

Removal

1. Remove the front safety belt buckle.
For additional information, refer to: [Front Safety Belt Buckle](#) (501-20A Safety Belt System, Removal and Installation).

2. Remove the front seat cushion side trim.

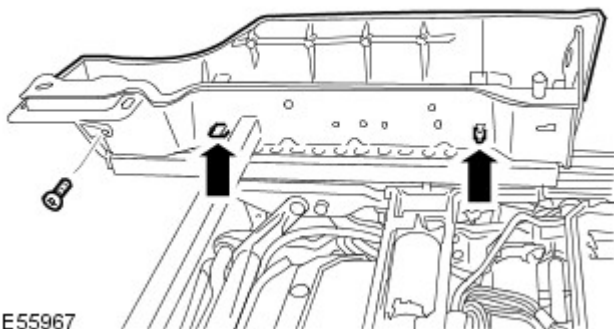
- Remove the 2 Torx screws.
- Release from the 4 clips.



E56089

3. Remove the front seat base trim.

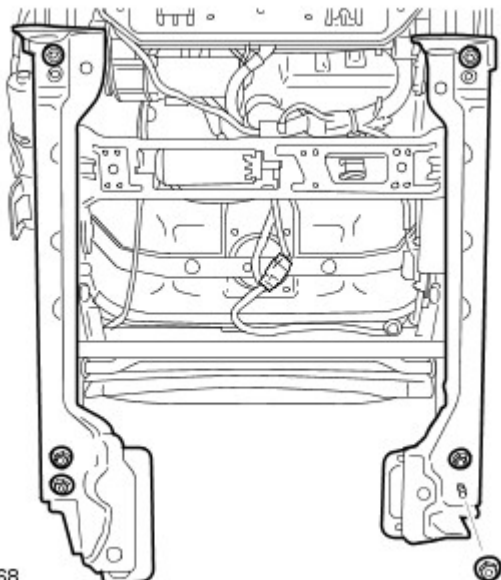
- Remove the screw.
- Release the 2 clips.



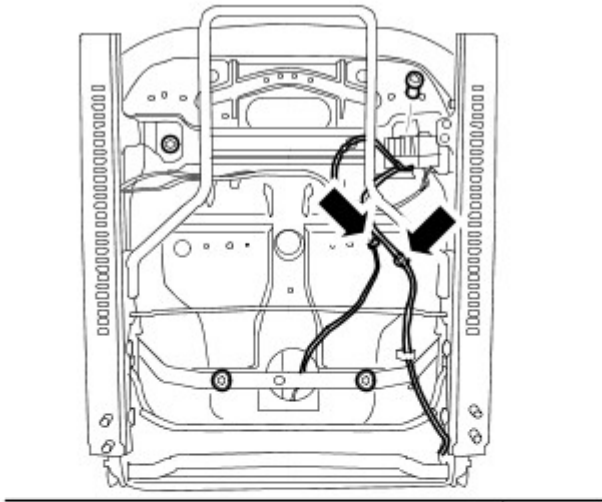
E55967

4. Remove the front seat base.

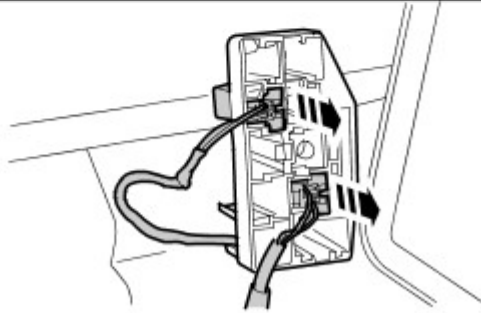
- Remove the 6 nuts.



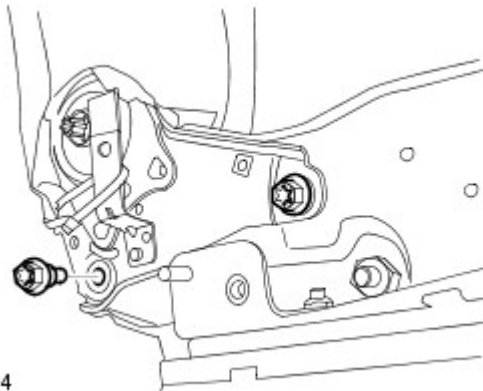
E55968



5. Remove the front seat cushion assembly.
 - Release and disconnect the 2 electrical connectors.
 - Remove the 4 Torx bolts.



E59785



E59784

6. Remove the seat track assembly.
 - Remove the 4 Torx bolts.

Installation

1. Install the seat track assembly.
 - Tighten the Torx bolts to 25 Nm (18 lb.ft).
2. Install the front seat cushion assembly.
 - Tighten the Torx bolts to 25 Nm (18 lb.ft).
 - Connect and secure the electrical connectors.
3. Install the front seat base.
 - Tighten the nuts to 25 Nm (18 lb.ft).
4. Install the front seat base trim.
 - Secure in the clips.
 - Tighten the screw.
5. Install the front seat cushion side trim.

- Secure in the clips.
- Tighten the screws.

6. Install the front safety belt buckle.

For additional information, refer to: [Front Safety Belt Buckle](#)
(501-20A Safety Belt System, Removal and Installation).

Seating - Seat Track Vehicles With: Power Seats

Removal and Installation

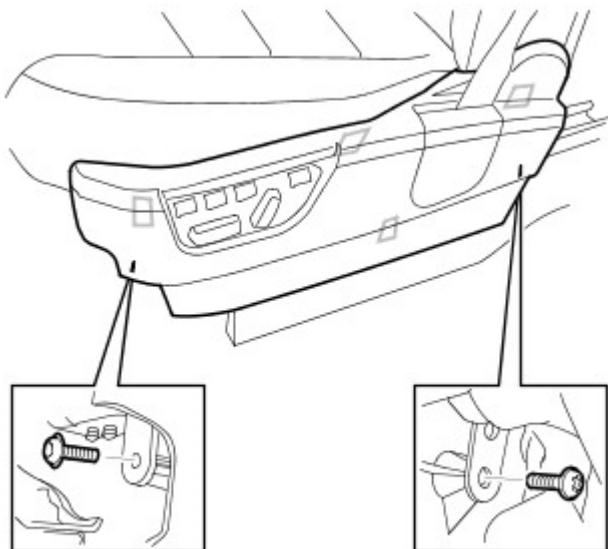
Removal

- NOTE: The front seat track motor is supplied as part of the front seat lower frame assembly.

1. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

2. Remove the front seat cushion side trim.

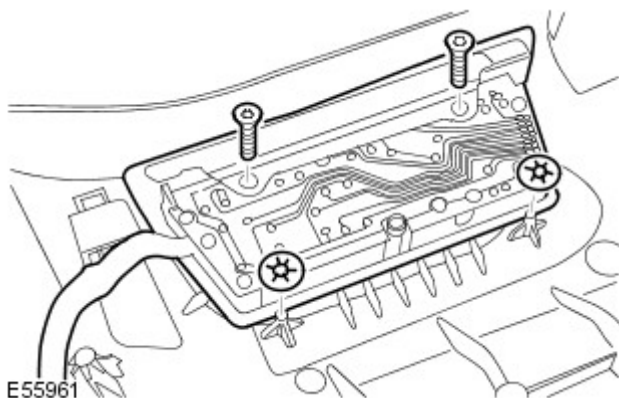
- Remove the 2 Torx screws.
- Release from the 4 clips.



E56089

3. Release the seat control switch.

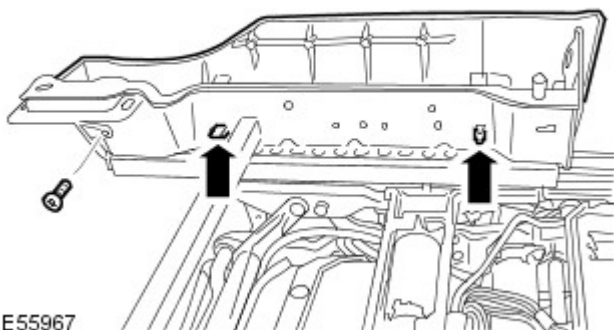
- Remove the 2 screws.
- Remove the 2 clips.



E55961

4. Remove the front seat base trim.

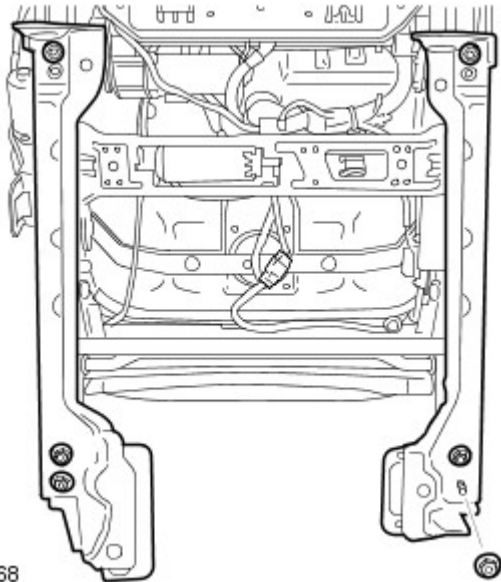
- Remove the screw.
- Release the 2 clips.



E55967

5. Remove the front seat base.

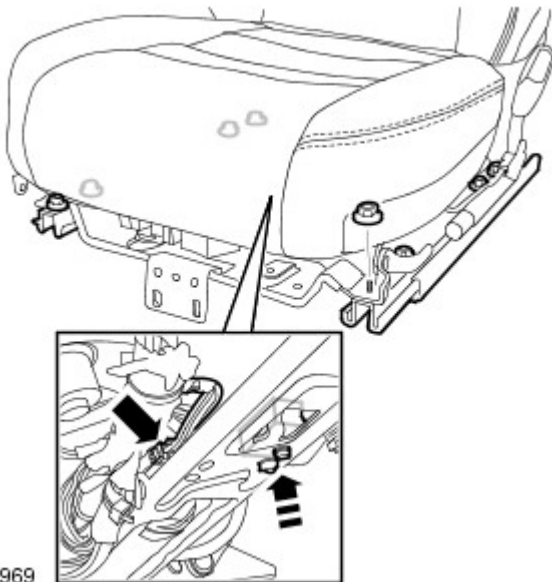
- Remove the 6 nuts.



E55968

6. Remove the front seat track motor.

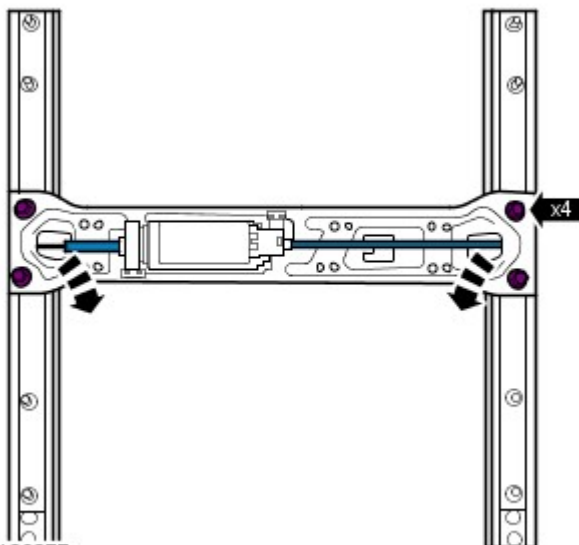
- Disconnect the electrical connector.
- Release the electrical connector.
- Remove the 8 nuts.



E55969

7. Remove the front seat track motor assembly from the seat rails.

- Remove the 4 bolts.
- Release the flexi drive from the seat rails.

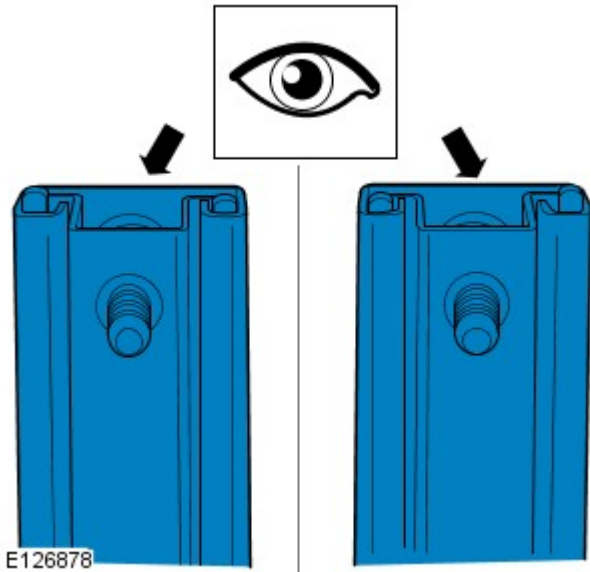


E126877

Installation

1. Make sure the seat rails are installed as a matched pair as supplied.

- Make sure the seat rails are correctly aligned.



2. Install the front seat track motor assembly to the seat rails.

- Install the 4 bolts.
- Tighten the nuts to 10 Nm (7 lb.ft).

3. Install the front seat track motor.

- Tighten the nuts to 22 Nm (16 lb.ft).
- Connect the electrical connector.
- Secure the electrical connector.

4. Install the front seat base.

- Tighten the nuts to 22 Nm (16 lb.ft).

5. Install the front seat base trim.

- Secure in the clips.
- Tighten the screw.

6. Install the front seat cushion side trim.

- Secure in the clips.
- Tighten the screws.

7. Install the seat control switch.

- Secure in the clips.
- Tighten the screws.

8. Install the front seat.

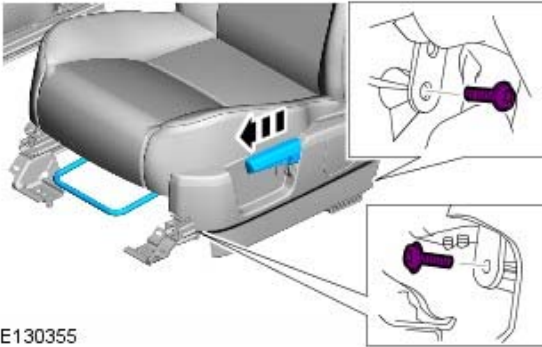
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

Seating - Front Seat Manual Height Adjustment Lever

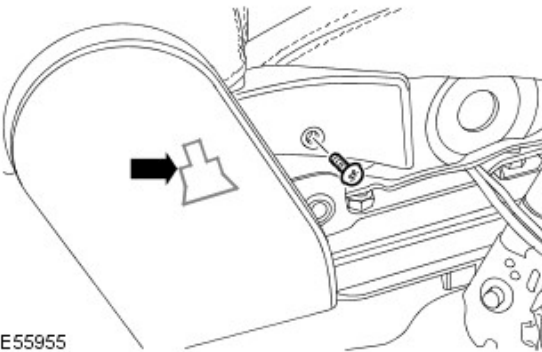
Removal and Installation

Removal

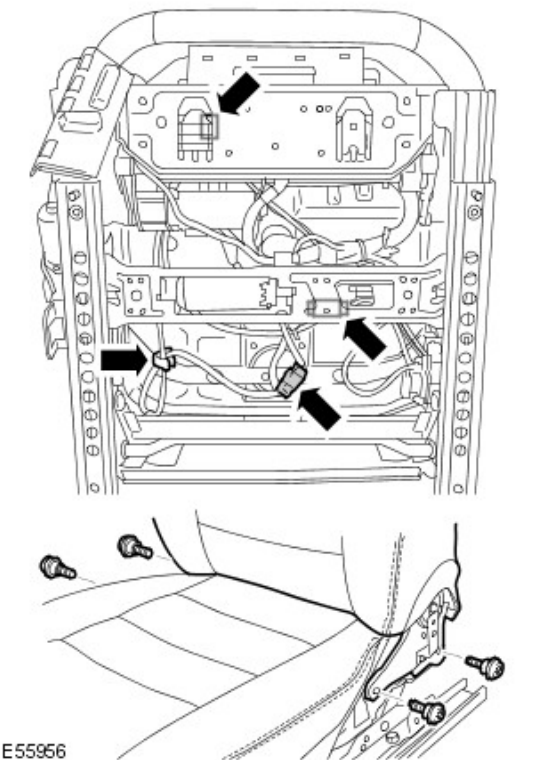
1. Remove the drivers side seat slides.
For additional information, refer to: [Seat Track - Vehicles With: Power Seats](#) (501-10 Seating, Removal and Installation).
2. Remove the front seat cushion base.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).
- 3.



4.



5. TORQUE: 25 Nm



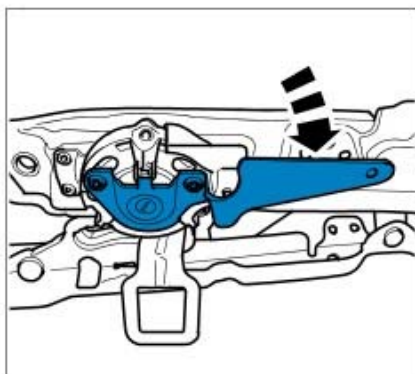
6. CAUTIONS:

 Tie straps must be fitted, failure to follow this instruction may result in personal injury.

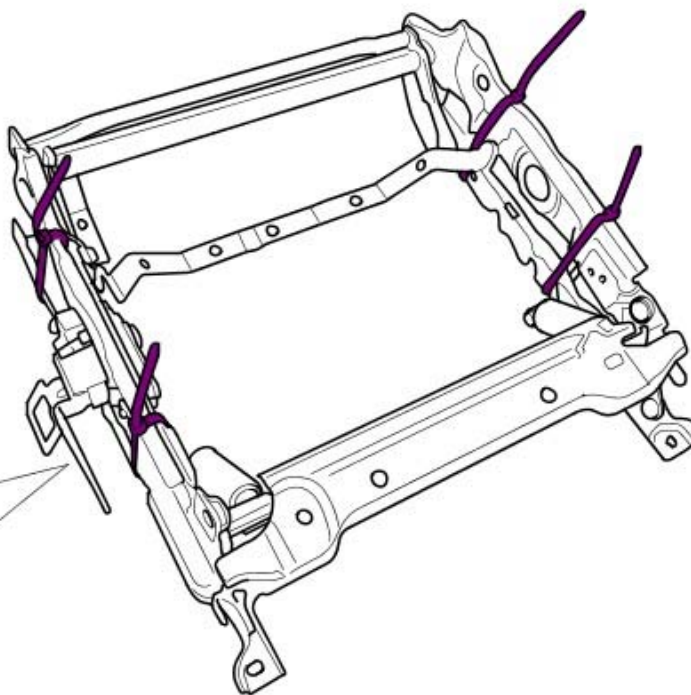
 Failure to follow this instruction may cause damage to the vehicle.

Secure the seat base using the 4 tie straps supplied, as shown.

- Using the seat height adjuster, lower the seat base to its lowest position.

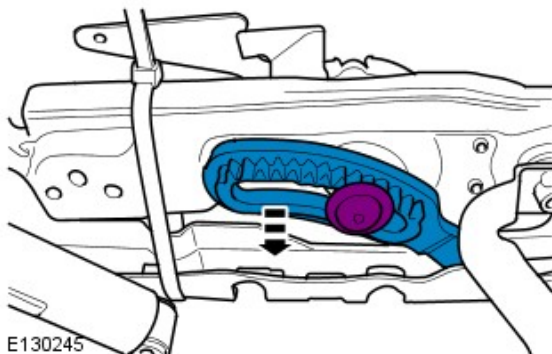


E130243



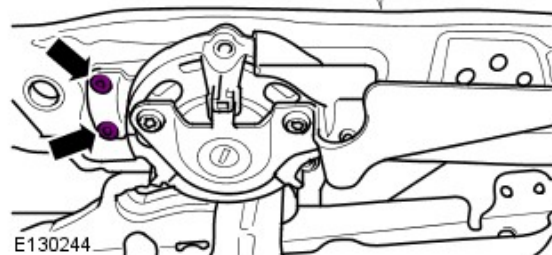
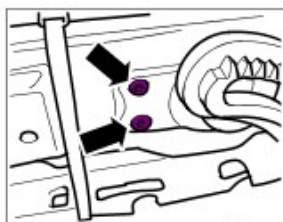
7. Release the arm from the height adjuster.

- Remove the Torx bolt.



E130245

8. Drill out the 4 rivets.



E130244

Installation

1. To install, reverse the removal procedure.

Glass, Frames and Mechanisms -**Sealants**

Application	Land Rover Sealant kit Part No.
Windshield	CES 500020
Liftgate glass	CES 500020
Glass roof panel	CES 500020
Rear quarter window glass	CES 500020

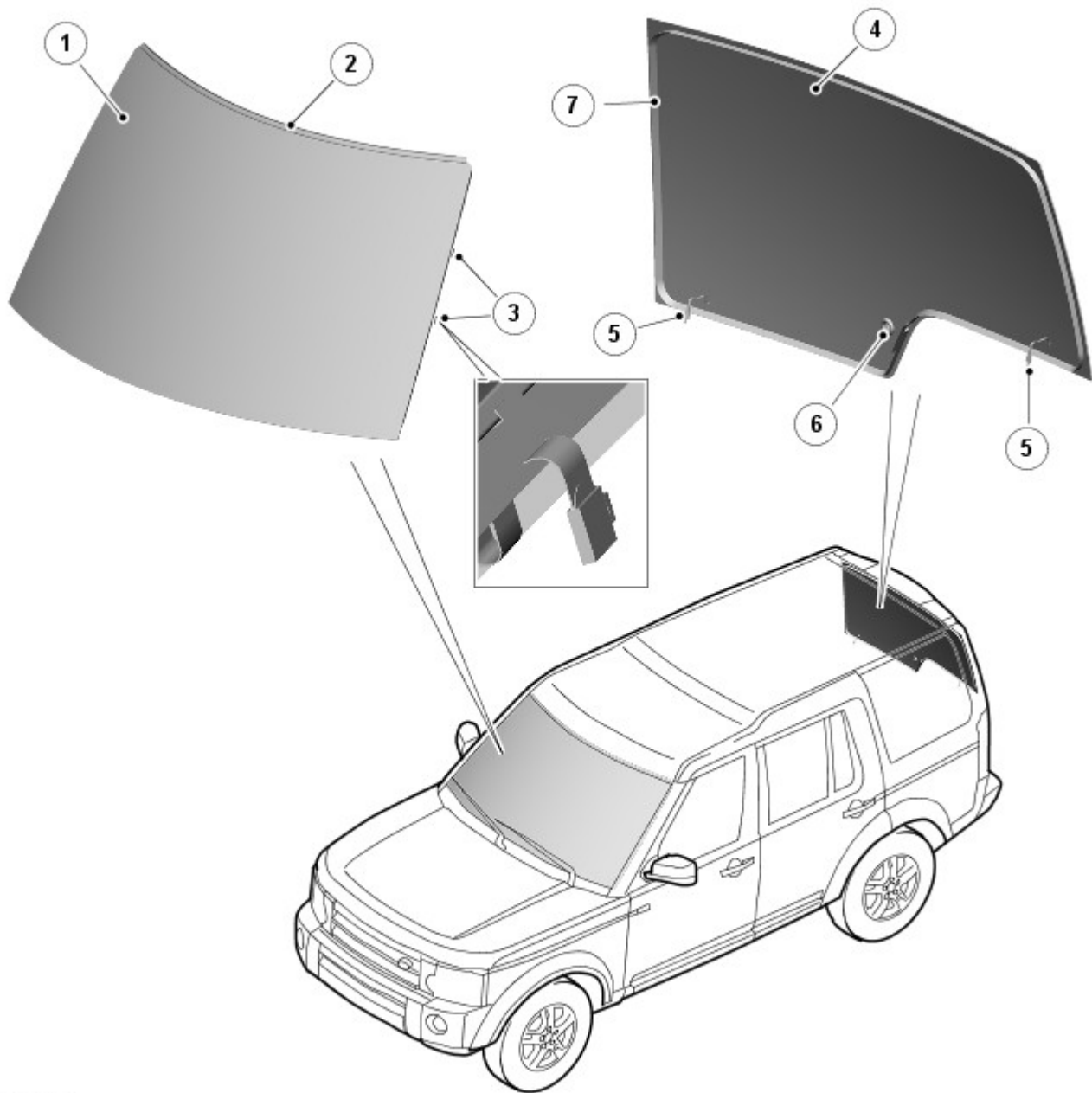
Torque Specifications

Description	Nm	lb-ft
Rear door window fixed glass Torx screw	10	7
Rear door window motor and regulator to door nuts and bolts	10	7
Front door window regulator and motor nuts and bolts	10	7
Front door window glass guide channel bolt	10	7
Liftgate glass retaining nuts	25	18

Glass, Frames and Mechanisms - Glass, Frames and Mechanisms

Description and Operation

COMPONENT LOCATION - SHEET 1 OF 2

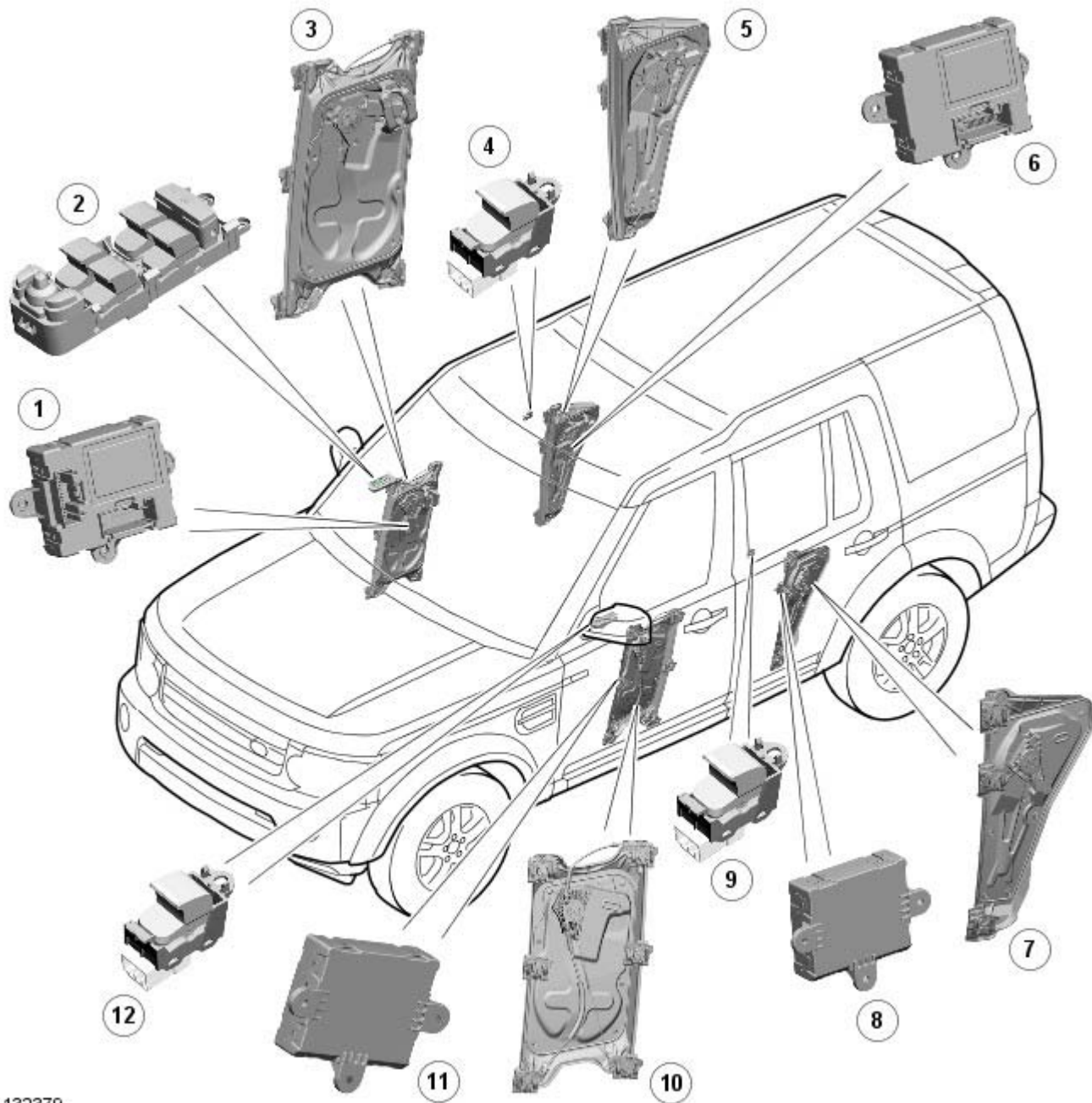


E132378

Item	Part Number	Description
1	-	Windshield
2	-	Finisher
3	-	Heated windshield connectors
4	-	Rear window
5	-	Heated rear window connectors
6	-	Rear wiper motor aperture
7	-	Sealant

COMPONENT LOCATION - SHEET 2 OF 2

• NOTE: RHD (right-hand drive) shown, LHD (left-hand drive) similar.



E132379

Item	Part Number	Description
1	-	DDM (driver door module)
2	-	Driver window switches
3	-	Driver window regulator
4	-	RH (right-hand) rear window switch
5	-	RH rear window regulator
6	-	RHRDM (rear door module)
7	-	LH (left-hand) rear window regulator
8	-	LHRDM
9	-	LH rear window switch
10	-	Front passenger window regulator
11	-	PDM (passenger door module)
12	-	Front passenger window switch

GENERAL

Windshield

The laminated windshield is bonded and sealed to the body aperture using PU sealant. Heat bonded to the inner surface of the screen is the optical unit for the rain sensor and the interior mirror mounting boss.

Vertical fine-wire multi-strand elements are fitted between the glass laminations to de-ice and demist the screen. At the bottom of the screen six horizontal heating elements bonded to the interior glass surface prevent the wiper blades freezing to the screen during adverse weather conditions.

The screen is supplied with the heating element flat foil connectors fitted to a sealed terminal block. This terminal block is

wired to a connector for connecting to the vehicle harness.

Rear Window

The tempered glass tinted green rear window is bonded to the upper tail doorframe using PU sealant. Fitted to the inner surface of the rear window are the heating elements and antennas.

The heating element is connected by two Lucar terminals while the antenna is connected to the vehicle by a twin and single stud connector at the top of the screen.

Electric Windows

Electric windows are installed in all four doors. All of the electric windows incorporate one-shot up, one-shot down and anti-trap features.

In each door, the window is operated by a regulator, which is controlled by the related door module in response to inputs from window switches. The door modules also operate the windows in response to inputs from the [CJB \(central junction box\)](#) for global opening and closing.

WINDOW SWITCHES

Driver Window Switches



E132380

Passenger Window Switch



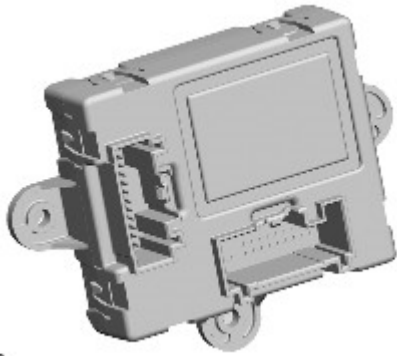
E132381

Individual window switches are installed in each of the three passenger doors. Window switches for all of the windows and a rear window isolation switch are installed in the driver door switchpack in the top surface of the door trim.

All window switches are of the non-latching rocker type. The switches have two switching positions in each direction, inch up/down and one-shot up/down. Operating the switch to the second detent position will activate the one-shot feature.

The driver door switchpack is powered by a permanent battery feed from the [CJB](#). When the switches in the driver door switchpack are used, the switchpack translates the switch movement into a [LIN \(local interconnect network\)](#) bus message. A [LIN](#) bus connects the driver door switchpack to the driver door module and the driver side [RDM](#). Each passenger window switch is hardwired into circuits with the related door module.

DOOR MODULES



E132128

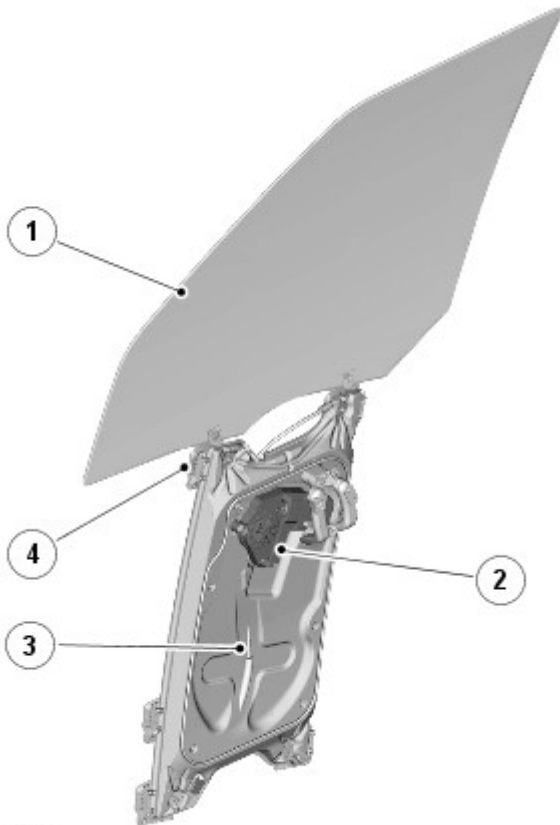
Each door module is attached to the inside of the related door casing and connected to the door harness.

The door modules interpret the window operation requests into appropriate outputs for the motor in the related window regulators. Each door module is powered by a permanent battery feed from the [CJB](#).

A [LIN](#) bus connects the two door modules on the driver side of the vehicle to the driver door switchpack. The two door modules on the front passenger side of the vehicle are connected together by a second [LIN](#) bus. The [DDM](#) and the [PDM](#) are also connected to the medium speed [CAN \(controller area network\)](#) bus.

WINDOW REGULATORS

Front Window Regulators



E133133

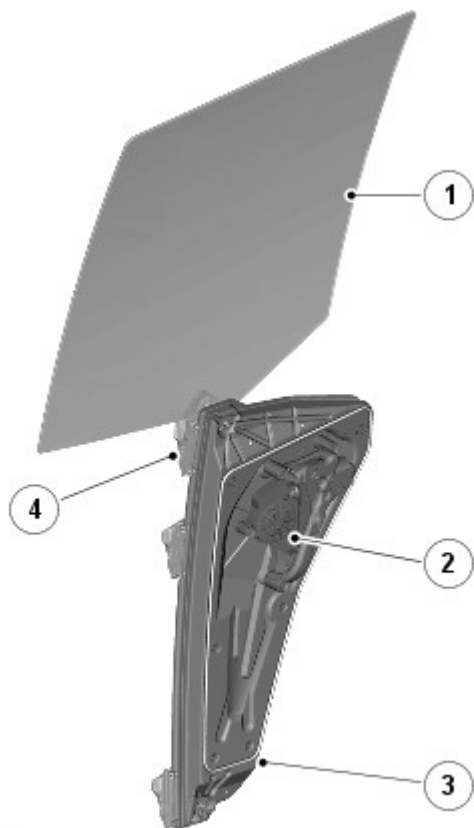
Item	Part Number	Description
1	-	Window Glass
2	-	Window motor
3	-	Mounting frame
4	-	Glass carrier

The front window regulator and motor is supplied as an assembly and is handed. Each assembly comprises a front and rear runner, a continuous cable and a motor.

The runners are secured in the door frame with four screws. The door glass is located in two carriers, which are located in tracks in the runners. The glass is retained in friction pads in each carrier and secured with clamp screws.

Each carrier is attached to the cable which, in turn, is attached to a drum driven by the motor. When the motor is operated the drum pulls the cable in the required direction to raise or lower the glass.

Rear Window Regulators



E133134

Item	Part Number	Description
1	-	Window Glass
2	-	Window motor
3	-	Mounting frame
4	-	Glass carrier

The rear window regulator and motor is supplied as an assembly and is handed. Each assembly comprises a runner, a continuous cable and a motor.

The runner is secured in the door frame with four bolts. The door glass is located in a carrier located in a track in the runner. The glass is retained in friction pads in the carrier and secured with a clamp screw.

The carrier is attached to the cable which, in turn, is attached to a drum driven by the motor. When the motor is operated, the drum pulls the cable in the required direction to raise or lower the glass.

OPERATION

The electric windows will operate in power modes 6 (ignition on) and 7 (engine running), and for five minutes after the ignition is switched off provided none of the doors are opened.

When a window open or closed selection is made, the related door module supplies power to the window motor to drive it in the appropriate direction. In the inch mode, the motor stops when the switch is released or the window reaches the end of its travel. In the one-shot mode, the motor stops when if the switch is operated again (either up or down) or the window reaches the end of its travel.

When the passenger window switches are used, they produce an open or close request by completing a circuit with the related door module.

When the driver window switches are used, the driver door switchpack outputs a request message for the appropriate door module on the [LIN](#) bus. If the message is for a door module on the opposite side of the vehicle to the driver, the [DDM](#) relays the message to the [PDM](#) on the medium speed [CAN](#) bus. If necessary, the [PDM](#) then sends a [LIN](#) bus message to the [RDM](#) on its side of the vehicle.

If any of the passenger windows have opposing up and down requests from two separate switches, for example, a passenger window switch and the related window switch on the driver door switchpack, then the operation of that window will cease, until one or both of the switches are released.

While the isolator switch engaged, the switch tell-tale is illuminated and the rear door modules ignore requests from their related passenger window switches.

Global opening and closing requests are output from the [CJB](#) on the medium speed [CAN](#) bus. The [DDM](#) and the [PDM](#) then relay the request to their respective [RDM](#).

One-shot Window Operation Reset

If the battery is disconnected or discharged, or the power supply to a door module is interrupted, one-shot window operation is disabled until the window position is re-established by the affected door module(s). To reset one-shot window operation:

- Close the window fully.
- Release the switch, then pull up and hold the switch for one second.
- If necessary, repeat the procedure for the other windows.

Anti-trap Protection

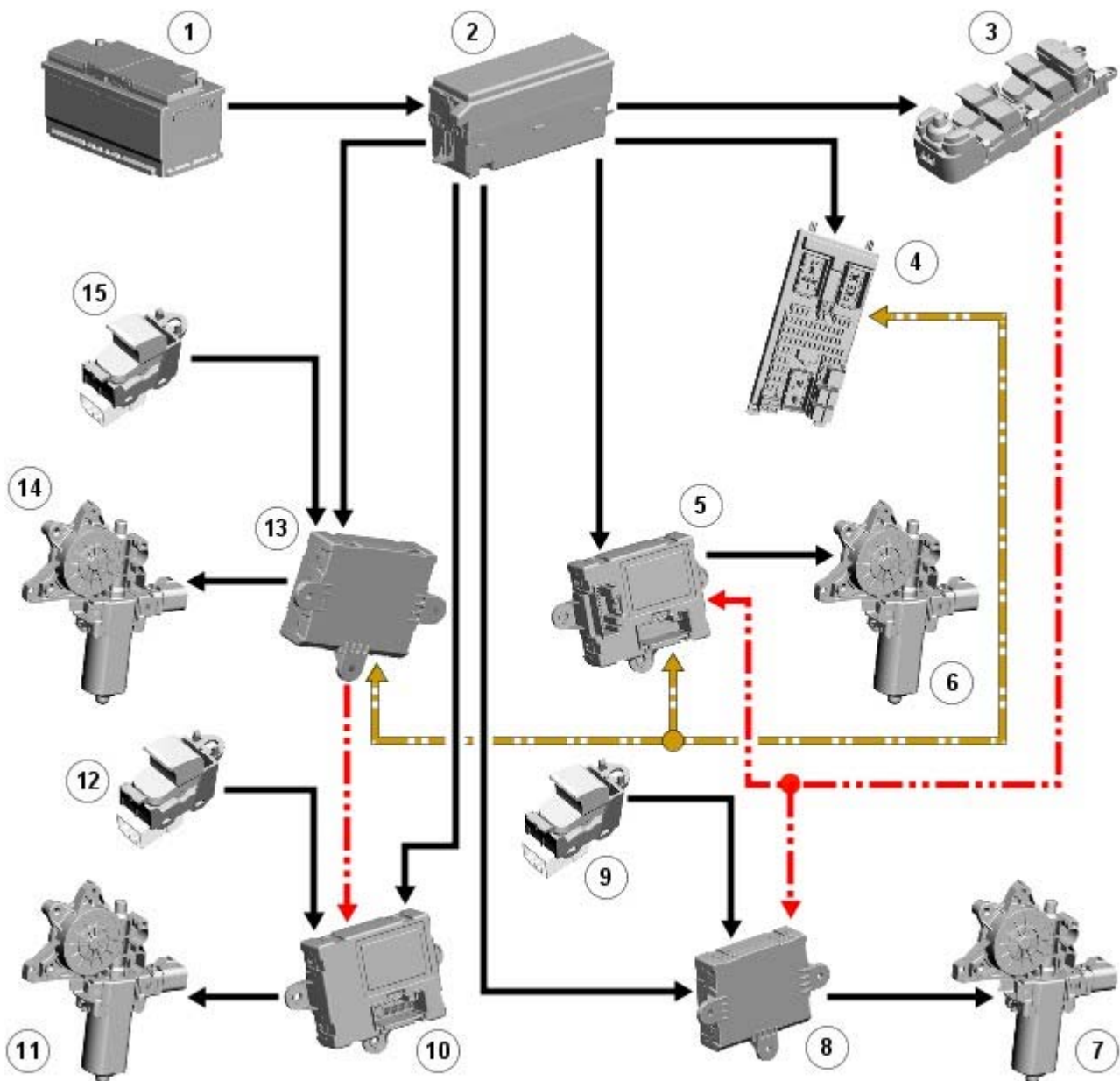
The anti-trap feature is incorporated for all of the door windows in both the inching and one-shot modes. If the anti-trap function is activated while a window is closing, the window motor reverses for 0.5 second.

Each window motor has a Hall sensor to enable the related door module to monitor the motor speed. If the motor speed decreases below a set threshold, indicating an obstruction, the power feed to the motor is reversed so the window goes back down.

If it is still necessary to raise the window, the anti-trap protection can be overridden by attempting to close the window at intervals of less than 10 seconds. On the third attempt the window will move up with increased force to try and overcome the obstruction. If the obstruction cannot be overcome, one-shot operation is disabled.

WINDOW CONTROL DIAGRAM

• NOTE: A = Hardwired, N = Medium speed CAN bus; LIN bus.



E132382



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	Driver window switches
4	-	CJB
5	-	DDM

6	-	Driver window motor
7	-	Driver side rear window motor
8	-	Driver side RDM
9	-	Driver side rear window switch
10	-	Passenger side RDM
11	-	Passenger side rear window motor
12	-	Passenger side rear window switch
13	-	PDM
14	-	Passenger window motor
15	-	Passenger window switch

Glass, Frames and Mechanisms - Glass, Frames and Mechanisms

Diagnosis and Testing

Principle of Operation

For a detailed description of the glass, frames and mechanisms and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Glass, Frames and Mechanisms](#) (501-11 Glass, Frames and Mechanisms, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Window control switches condition and installation ● Window motors/regulators ● Window channels/runners ● Window cables ● Door window glass retaining brackets 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Window lift relay ● Window control switches ● Window motors

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Window(s) inoperative	<ul style="list-style-type: none"> ● Fuse(s) ● Switch fault ● Front switch isolator fault ● Motor/Regulator fault ● Channel/Runner fault ● Cable fault ● Harness fault 	<ul style="list-style-type: none"> ● Check the fuses. Check the suspect window operation from the individual door switch and from the driver door master switch (it is unlikely that both switches would fail at the same time, so if the window is inoperative from either switch, suspect a fault other than a switch). If the inoperative window is a rear unit, check the function of the isolator at the master switch. ● If the concern persists and a noise cannot be heard when operating the door window glass, GO to Pinpoint Test B.
Window(s) 'one-shot' function inoperative	<ul style="list-style-type: none"> ● Window motor initialization required ● Switch fault 	<ul style="list-style-type: none"> • NOTE: Do not install a new door window regulator motor for this concern. <p>If the battery has been disconnected, carry out the initialization procedure. REFER to: Door Window Motor Initialization (501-11 Glass, Frames and Mechanisms, General Procedures). Check the switch function after initialization.</p>
Rear window does not defrost	<ul style="list-style-type: none"> ● Fuse ● Switch fault ● Relay fault ● Element fault ● Circuit fault 	Check fuse. Check the operation of the heated rear window switch and relay. Check the element for continuity. Check the heated rear window circuit. Refer to the electrical guides.
Window(s) noisy during operation	<ul style="list-style-type: none"> ● Channel/Runner fault ● Cable fault ● Motor/Regulator fault 	<ul style="list-style-type: none"> • NOTE: Door window glass retaining bracket adjustment procedure <p>GO to Pinpoint Test A.</p>
Slow or partial window operation	<ul style="list-style-type: none"> ● Fuse ● Switch fault ● Relay fault ● Element fault ● Circuit fault 	GO to Pinpoint Test C.
Rear door window glass bounce back	<ul style="list-style-type: none"> ● Window motor initialization required (using the manufacturers approve diagnostic system) 	<ul style="list-style-type: none"> • NOTE: Do not install a new door window regulator motor for this concern. <p>Refer to IDS/SDD.</p>

Symptom	Possible Causes	Action
Front door window glass bounce back	<ul style="list-style-type: none"> Window motor initialization required Channel/Runner fault 	<ul style="list-style-type: none"> NOTE: Do not install a new door window regulator motor for this concern. GO to Pinpoint Test D .

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Door Module \(DDM/PDM\)](#) (100-00 General Information, Description and Operation).

Pinpoint Test

PINPOINT TEST A : WINDOW(S) NOISY DURING OPERATION	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: CHECK THE DOOR WINDOW GLASS IS SECURE	
	<ol style="list-style-type: none"> Remove the door window glass outer waist seal. Check if the door glass installed correctly and secured to the door window regulator.
	Is the door window glass correctly installed and secure? Yes GO to A2 . No Install a new door window glass as necessary. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).
A2: CHECK THE OPERATION OF THE DOOR WINDOW REGULATOR MOTOR	
	<ol style="list-style-type: none"> Remove the door window glass as necessary. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation). Operate the door window regulator four times.
	Does the door window regulator operate correctly (without noise)? Yes Ensure that an anti-rattle pad (available from the parts department) is installed to the door window glass retaining bracket and installed correctly. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation). Test the system for normal operation. If the concern persists, GO to A3 . No Install a new door window regulator motor as necessary. REFER to: Front Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation).
A3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL	
	<ol style="list-style-type: none"> Check for any foreign material or obstruction in the door window glass seal.
	Is the door window glass seal free from foreign material? Yes GO to A4 . No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.
A4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY	
	<ol style="list-style-type: none"> Check that the door window glass seal is installed correctly.
	Is the door window glass seal installed correctly? Yes GO to A5 . No Install the door window glass seal correctly. Test the system for normal operation.
A5: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS	
	<ol style="list-style-type: none"> Visually check that the door window glass seal is not worn in the door channels.
	Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No Install the door window glass and adjust the door window glass. Test the system for normal operation.
PINPOINT TEST B : WINDOW(S) INOPERATIVE (MOTOR NOISE CANNOT BE HEARD)	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: CHECK FOR DOOR WINDOW REGULATOR MOTOR NOISE	
	<ol style="list-style-type: none"> Operate the door window regulator motor as necessary.
	Is there a noise from the door window regulator motor when operated? Yes GO to B2 . No

	<p>Install a new door window regulator motor as necessary. REFER to: Front Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation).</p>
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B2: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL

	<p>1 Check for any foreign material or obstruction in the door window glass seal.</p>
	<p>Is the door window glass seal free from foreign material? Yes GO to B3. No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.</p>

B3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY

	<p>1 Check that the door window glass seal is installed correctly.</p>
	<p>Is the door window glass seal installed correctly? Yes GO to B4. No Install the door window glass seal correctly. Test the system for normal operation.</p>

B4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS

	<p>1 Visually check that the door window glass seal is not worn in the door channels.</p>
	<p>Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No Install the door window glass. Adjust the door window glass referring to the door window glass retaining bracket procedure at the end of this section (see below). Test the system for normal operation. If the concern persists, Test the system for normal operation.</p>

PINPOINT TEST C : SLOW OR PARTIAL WINDOW OPERATION

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: CHECK THE OPERATION OF THE DOOR WINDOW REGULATOR MOTOR	
	<p>1 Remove the door window glass as necessary. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).</p>
	<p>2 Operate the door window regulator as necessary.</p>
	<p>Does the door window regulator operate correctly? Yes GO to C2. No GO to C5.</p>

C2: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL

	<p>1 Check for any foreign material or obstruction in the door window glass seal.</p>
	<p>Is the door window glass seal free from foreign material? Yes GO to C3. No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.</p>

C3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY

	<p>1 Check that the door window glass seal is installed correctly.</p>
	<p>Is the door window glass seal installed correctly? Yes GO to C4. No Install the door window glass seal correctly. Test the system for normal operation.</p>

C4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS

	<p>1 Visually check that the door window glass seal is not worn in the door channels.</p>
	<p>Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No Adjust the door window glass referring to the door window glass retaining bracket procedure at the end of this section (see below). Test the system for normal operation.</p>

C5: CHECK THE VOLTAGE TO THE DOOR WINDOW REGULATOR MOTOR

• NOTE: The door window regulator motor can be removed from the regulator. Install a new door window regulator motor not the complete assembly for this concern.

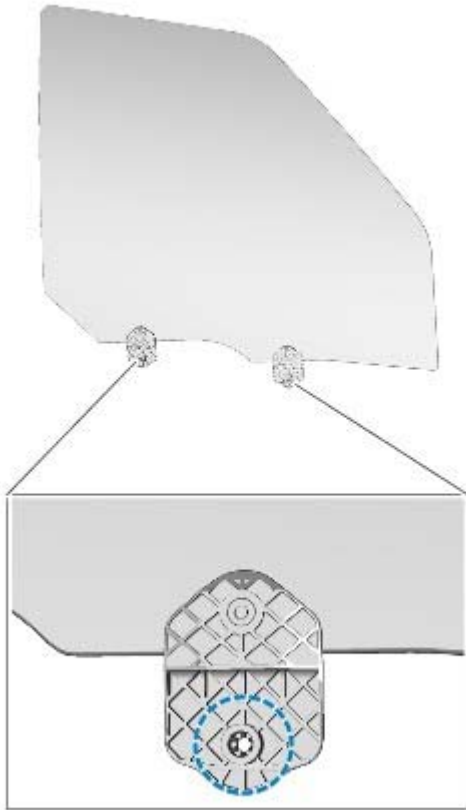
	<p>1 Using a multimeter, check the voltage to the door window regulator motor.</p>
	<p>Is the voltage greater than 10 volts? Yes Install a new door window regulator motor as necessary. No Repair the wiring harness. Test the system for normal operation. If the concern continues, install a new door window regulator motor as necessary.</p>

PINPOINT TEST D : FRONT DOOR WINDOW GLASS BOUNCE BACK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: CHECK WINDOW MOTOR INITIALIZATION	
	<p>1 Initialize the door window motor. REFER to: Door Window Motor Initialization (501-11 Glass, Frames and Mechanisms, General Procedures).</p>
	<p>Did the initialization work? Yes Test the system for normal operation. No GO to D2.</p>
D2: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL	
	<p>1 Check for any foreign material or obstruction in the door window glass seal.</p>
	<p>Is the door window glass seal free from foreign material? Yes GO to D3. No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.</p>
D3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY	
	<p>1 Check that the door window glass seal is installed correctly.</p>
	<p>Is the door window glass seal installed correctly? Yes GO to D4. No Install the door window glass seal correctly. Test the system for normal operation.</p>
D4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS	
	<p>1 Visually check that the door window glass seal is not worn in the door channels.</p>
	<p>Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No GO to D5.</p>
D5: CHECK THE DOOR WINDOW GLASS IS SECURE	
	<p>1 Remove the door window glass outer waist seal.</p>
	<p>2 Check if the door glass installed correctly and secured to the door window regulator.</p>
	<p>Is the door window glass correctly installed and secure? Yes Test the system for normal operation. No Adjust the door window glass referring to the door window glass retaining bracket procedure in this procedure. Test the system for normal operation. If the concern persists, install a new door window regulator motor as necessary. REFER to: Front Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation).</p>

Door window glass retaining bracket adjustment procedure

1. **1.** Remove the door window glass as necessary.
REFER to: [Front Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation) / [Rear Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
2. **2.** Check for any foreign material or obstruction in the door window glass seal and channels. Clean all areas prior to adjustment to allow correct alignment.
3. **3.** Release but do not remove the door window glass retaining bracket(s) bolt(s).
4. **4.** Push the door window glass retaining bracket(s) to the edge of the door window glass to achieve minimum parallel gap.
5. **5.** Tighten the door window glass retaining bracket(s) bolt(s).
 - Tighten the retaining bolt(s) to 6Nm.

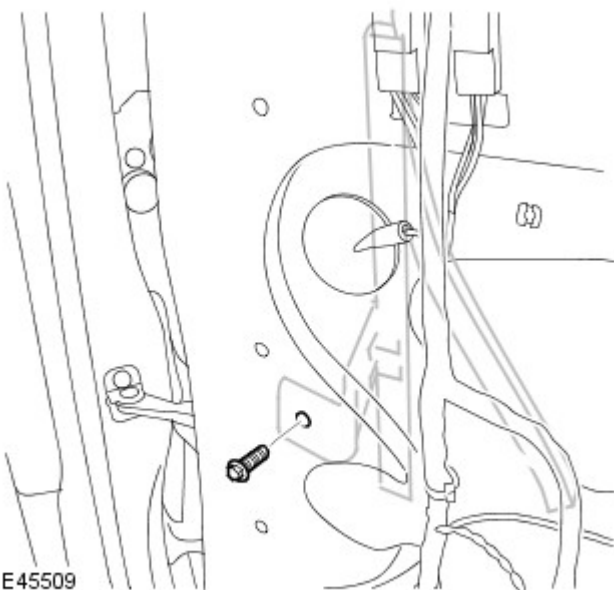


E136430

6. **6.** Apply lubricate (RYL500010) to the lower part of the door window glass retaining brackets prior to installation of the door window glass.
7. **7.** Install the door window glass as necessary.
REFER to: [Front Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation) / [Rear Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
8. **8.** Check the system for normal operation.

Door glass channel setting procedure

1. **1.** Remove the door trim panel as necessary.
REFER to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Rear Door Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



E45509

2. • **NOTE:** Do not remove the door window glass channel.
2. Release the door window glass channel retaining bolt.
3. **3.** Lower the door window glass.

4. **4.** Tighten the door window glass channel retaining bolt.
5. **5.** Check the system for normal operation.

Glass, Frames and Mechanisms - Door Window Motor Initialization

General Procedures

1. NOTE: After the battery has been disconnected it is necessary to initialize each door window motor separately to operate the "one-touch" up function.

• **NOTE:** Make sure a minimum of 2 minutes from initial disconnect of battery has elapse prior to reconnecting the battery. The initialising of the window glass motor must be conducted with the engine running.

Operate the window control switch until the door window glass is in the fully closed position, continue to operate the window control switch for a further two seconds.

2. Release the window control switch.

3. Operate the window control switch in the closed position and continue to operate the window control switch for a further two seconds.

4. Operate the window control switch until the door window glass is in the fully open position ("one-touch" down).

5. NOTE: If the door window motor initialization has been completed correctly, when the window control switch is operated, the door window glass should move to the fully closed position ("one-touch" up) automatically.

• **NOTE:** If the door window glass does not fully close automatically ("one-touch" up), repeat the complete procedure.

Operate the window control switch once to the close position.

6. Repeat the door window motor initialization for each door window motor.

Glass, Frames and Mechanisms - Rear Door Window Glass

Removal and Installation

Removal

• NOTE: Once the rear door window fixed glass has been removed the rear door glass can be simply lifted and removed from the door.

• NOTE: The door glass should be lowered by approximately one third.

1. Remove the rear door window fixed glass.
For additional information, refer to: [Rear Door Fixed Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

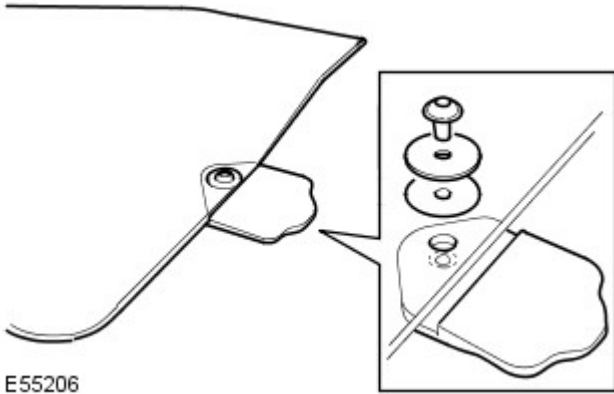
2. Remove the rear door window glass.

3. NOTE: Do not disassemble further if the component is removed for access only.

• NOTE: Note the fitted position.

Remove the glass retaining clip.

- Remove the Torx bolt.
- Remove the spacer washer.
- Remove the flat washer.



E55206

Installation

1. Install the glass retaining clip.

- Install the spacer.
- Install the washer.
- Tighten the Torx screws to 8 Nm (6 lb.ft).

2. Install the rear door window glass.

3. Install the rear door window fixed glass.

For additional information, refer to: [Rear Door Fixed Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

Glass, Frames and Mechanisms - Liftgate Window Glass

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



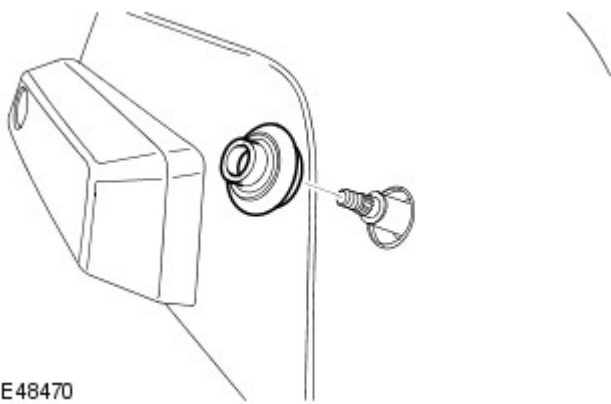
Always protect the interior components when removing body glass.



Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

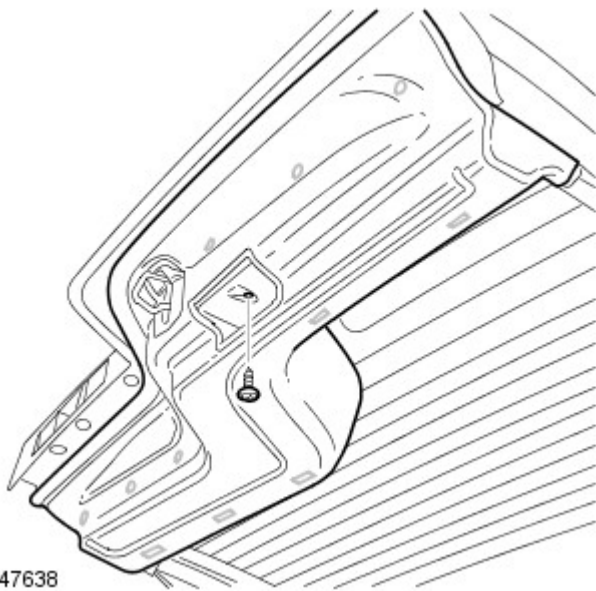
• NOTE: The following equipment is required: | Cutting wire and handles | Kent knife | Glazing knife | Glass replacement kit | Sealant applicator gun | Suction cups | A felt covered table or stand to support glass

1. Remove the rear wiper arm.
For additional information, refer to: [Rear Wiper Pivot Arm](#) (501-16 Wipers and Washers, Removal and Installation).
2. Remove the rear wiper drive spindle seal.



E48470

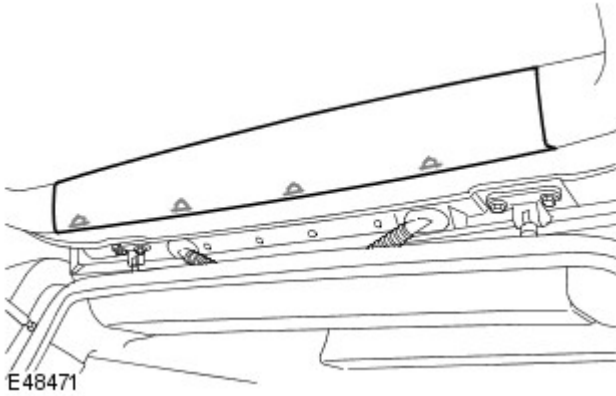
3. Remove the liftgate lower trim panel.
For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ormentation, Removal and Installation).



E47638

4. Remove the liftgate upper trim panel.

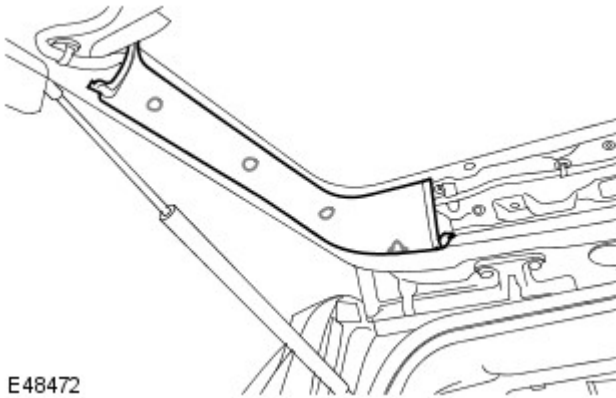
- Release the 4 clips.



E48471

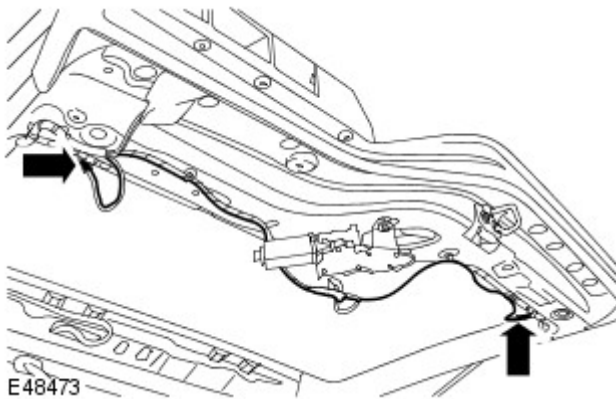
5. Remove the liftgate side trim panel.

- Release the 4 clips.
- Repeat the above procedure for the other side.



E48472

6. Disconnect both heated rear window electrical connectors.

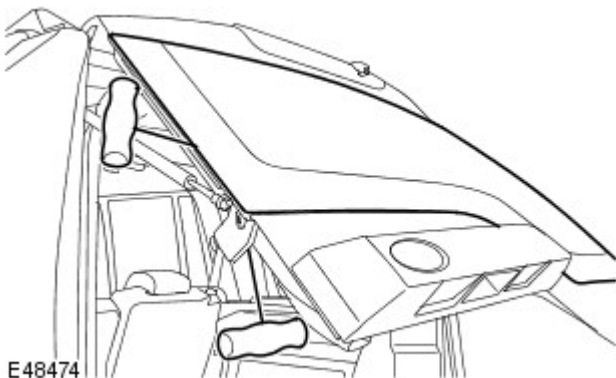


E48473

7.  **WARNING:** Eye protection must be worn.

With assistance, remove the liftgate window glass.

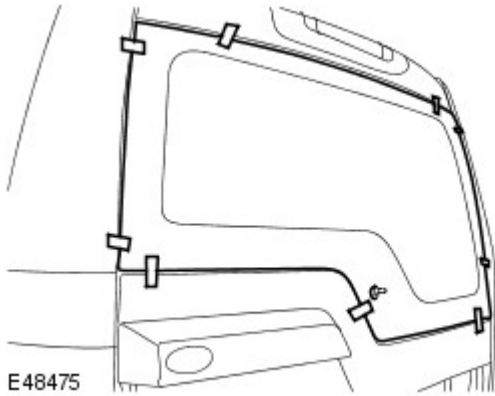
- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 5 spacers.



E48474

Installation

1. Carefully remove the sealant from the body to leave a smooth surface.



2. Install the liftgate window glass.

- Install the spacers equally as shown.
- Use masking tape to establish reference marks as an alignment aid.

3. Remove the liftgate window glass.

- Clean the component mating faces.

4. Apply etch primer to any bare metal.

5. Apply primer over the etch primer.

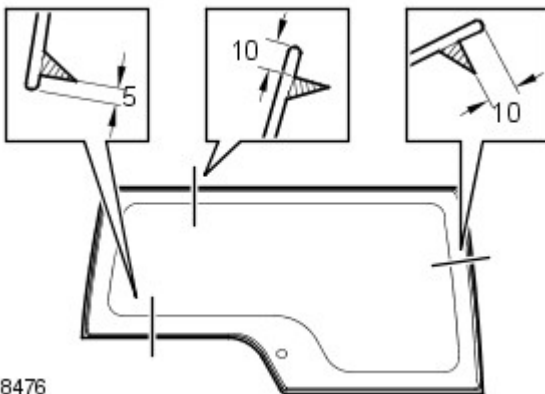
6. Apply glass primer to the sealant face on the liftgate window glass and allow to cure.

7. Apply activator over the old sealant on the liftgate and allow to cure.

8. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.

- Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.

9. Apply a continuous bead of sealant to the liftgate window glass as shown.



10. With assistance, install and align the liftgate window glass.

- Lightly press the window glass to seat the sealer.

11. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.

12. Connect the heated rear window electrical connectors.

13. Install the liftgate side trim panel.

- Secure with the clips.
- Repeat the above procedure for the other side.

14. Install the liftgate upper trim panel.

- Secure with the clips.

15. Install the liftgate lower trim panel.

For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and

Installation).

16. Install the rear wiper drive spindle seal.

17. Install the rear wiper arm.

For additional information, refer to: [Rear Wiper Pivot Arm](#)
(501-16 Wipers and Washers, Removal and Installation).

Glass, Frames and Mechanisms - Rear Door Fixed Window Glass

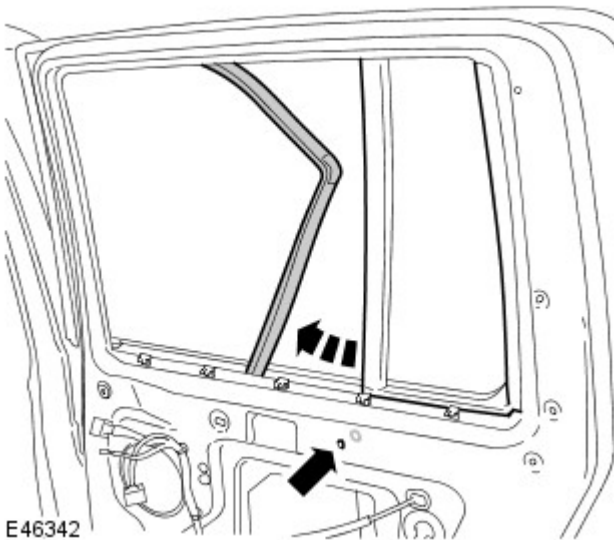
Removal and Installation

Removal

1. Remove the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
2. Lower the rear door glass to the bottom of the door.
 - Remove the wedge.
3. Remove the rear door frame trim.
 - Release the 2 clips.
 - Carefully release the door trim.
4. Carefully remove the inner waist seal.



5. Release the lining from the glass rear channel.
6. Remove the rear door window fixed glass.
 - Remove the grommet.
 - Loosen the Torx screw, but do not remove it completely at this stage.
 - Pull the lower edge of the glass forward to release it from the door frame.



Installation

1. Install the rear door window fixed glass.
 - Make sure the locating peg on the fixed glass has engaged with the door frame.
 - Tighten the Torx screw to 10 Nm (7 lb.ft).
2. Install the channel lining.
3. Install the inner waist seal.
4. Install the door frame trim.

- Clean the component mating faces.
- Remove backing tape from adhesive strip.
- Secure the clips.

5. NOTE: Wedge the glass in this position.

Raise the rear door glass fully.

- Engage the door glass with the channel.

6. Install the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

Glass, Frames and Mechanisms - Windshield Glass

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



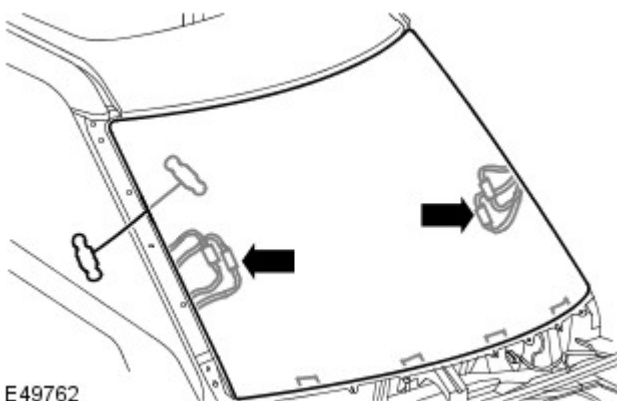
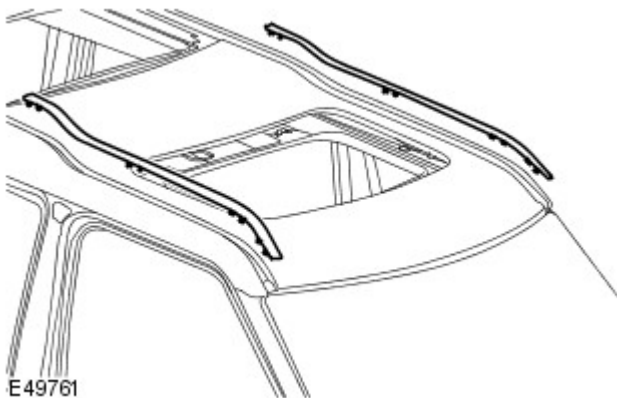
Always protect the interior components when removing body glass.



Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

• NOTE: The following equipment is required: | Cutting wire and handles | Kent knife | Glazing knife | Windshield replacement kit | Sealant applicator gun | Suction cups | A felt covered table or stand to support glass

1. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
2. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the rain sensor.
For additional information, refer to: [Rain Sensor](#) (501-16 Wipers and Washers, Removal and Installation).
4. Remove the roof moulding.
 - Release the 6 clips.
 - Repeat the above procedure for the other side.



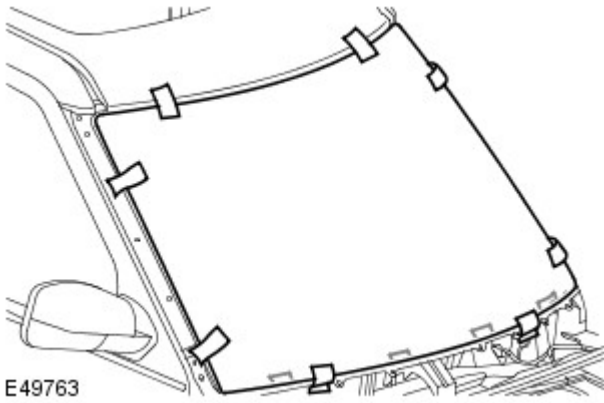
5. **WARNING:** Eye protection must be worn.

With assistance, remove the windshield glass.

- If installed, disconnect the 4 electrical connectors.
- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 4 spacers.

Installation

1. Carefully remove the sealant from the body to leave a smooth surface.



2. Install the windshield glass.

- Install the spacers equally as shown.
- Use masking tape to establish reference marks as an alignment aid.

3. Remove the windshield glass.

- Clean the component mating faces.

4. Apply etch primer to any bare metal.

5. Apply primer over the etch primer.

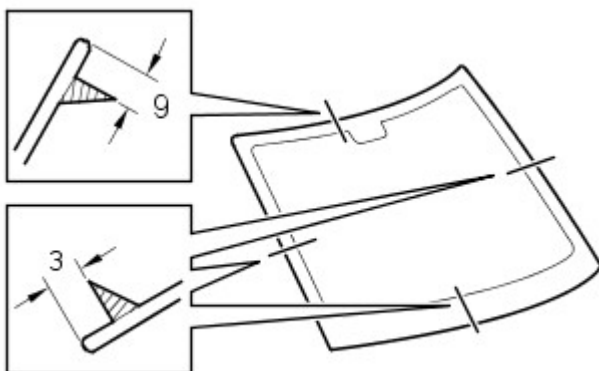
6. Apply glass primer to the sealant face on the windshield glass and allow to cure.

7. Apply activator over the old sealant on the windshield glass and allow to cure.

8. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.

- Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.

9. Apply a continuous bead of sealant to the windshield glass as shown.



10. With assistance, install the window glass.

- Lightly press the window glass to seat the sealer.
- Connect the electrical connectors.

11. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.

12. Install the roof mouldings.

- Secure with the clips.

13. Install the rain sensor.

For additional information, refer to: [Rain Sensor](#) (501-16 Wipers and Washers, Removal and Installation).

14. Install both A-pillar upper trim panels.

For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

15. Install the plenum chamber panel.

For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Glass, Frames and Mechanisms - Glass Roof Panel

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



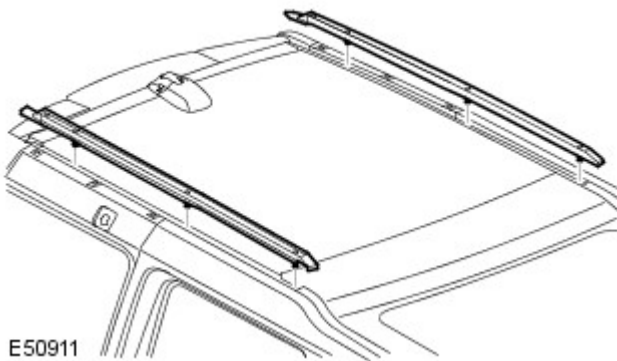
Always protect the interior components when removing body glass.



Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

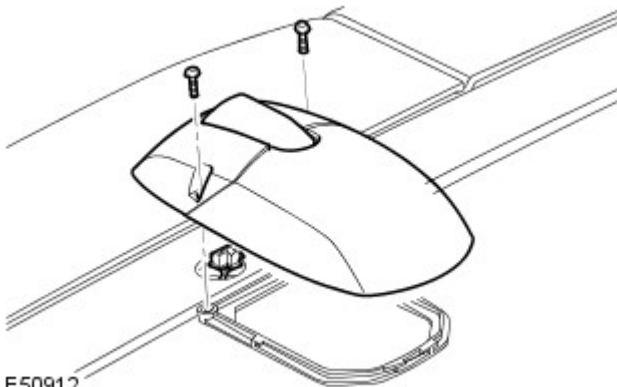
• NOTE: The following equipment is required: | Cutting wire and handles | Kent knife | Glazing knife | Glass replacement kit | Sealant applicator gun | Suction cups | A felt covered table or stand to support glass

1. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the roof moulding.
 - Release the 3 clips.
 - Repeat the above procedure for the other side.



E50911

3. Remove the antenna.
 - Disconnect the cable.
 - Remove the 2 screws.

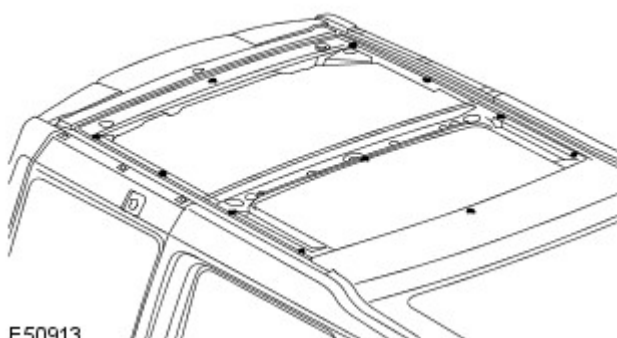


E50912

4.  **WARNING:** Eye protection must be worn.

With assistance, remove the roof panel fixed glass.

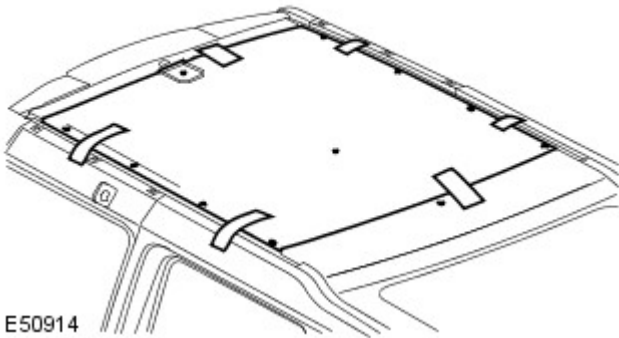
- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 11 spacers.



E50913

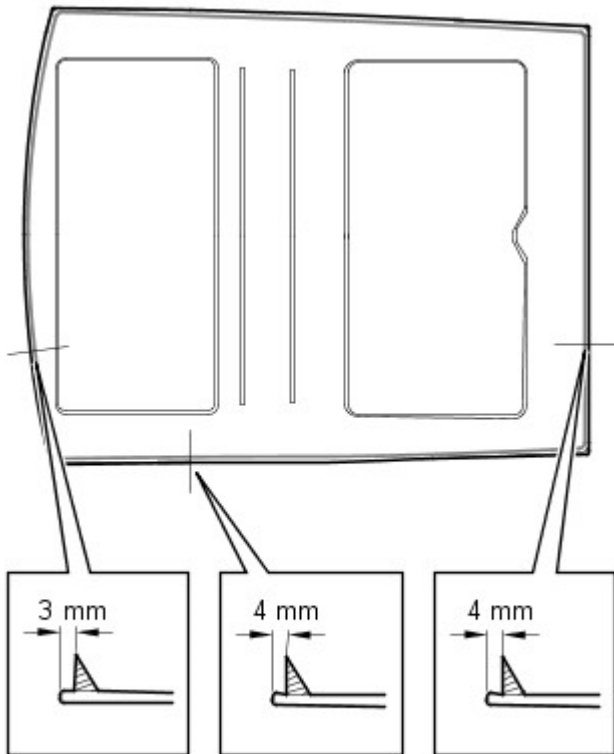
Installation

1. Carefully remove the sealant from the body to leave a smooth surface.
2. Install the roof panel fixed glass.
 - Install the spacers equally as shown.
 - Use masking tape to establish reference marks as an alignment aid.



E50914

3. With assistance, remove the roof panel fixed glass.
 - Clean the component mating faces.
4. Apply etch primer to any bare metal.
5. Apply primer over the etch primer.
6. Apply glass primer to the sealant face on the roof panel fixed glass and allow to cure.
7. Apply activator over the old sealant on the roof panel and allow to cure.
8. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.
 - Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.
9. Apply a continuous bead of sealant to the roof panel fixed glass as shown.



E50915

10. With assistance, install and align the roof panel fixed glass.

- Lightly press the roof panel fixed glass to seat the sealer.

11. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.

12. Install the antenna.

- Tighten the screws.
- Connect the cable.

13. Install the roof mouldings.

- Secure with the clips.

14. Install the headliner.

For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Glass, Frames and Mechanisms - Rear Quarter Window Glass

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



Always protect the interior components when removing body glass.

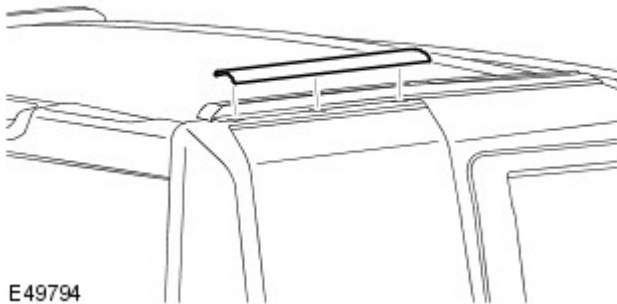


Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

• NOTE: The following equipment is required:

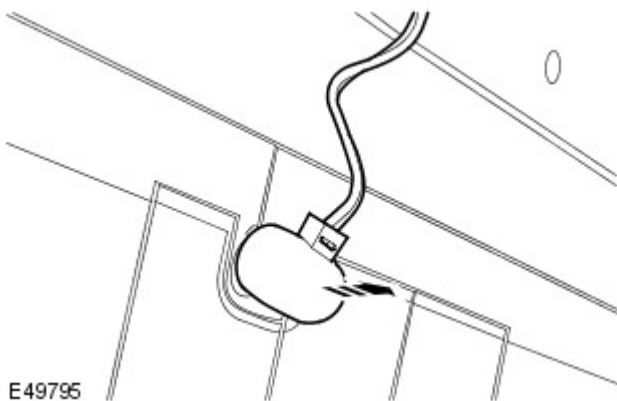
- Cutting wire and handles
- Kent knife
- Glazing knife
- Glass replacement kit
- Sealant applicator gun
- Suction cups
- A felt covered table or stand to support glass

1. Remove the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the rear quarter window glass panel.
 - Release the 3 clips.

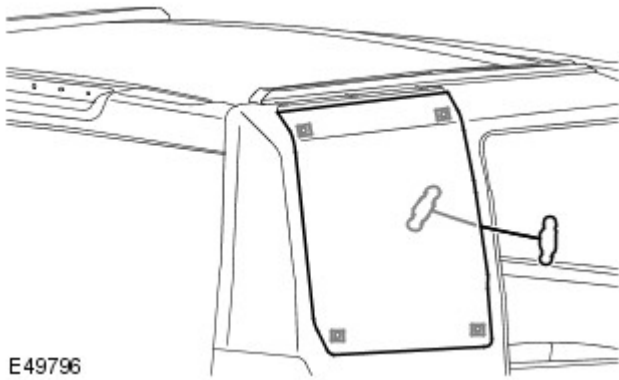


E49794

3. Disconnect the rear quarter window glass antenna connector.



E49795



E49796

4.  **WARNING:** Eye protection must be worn.

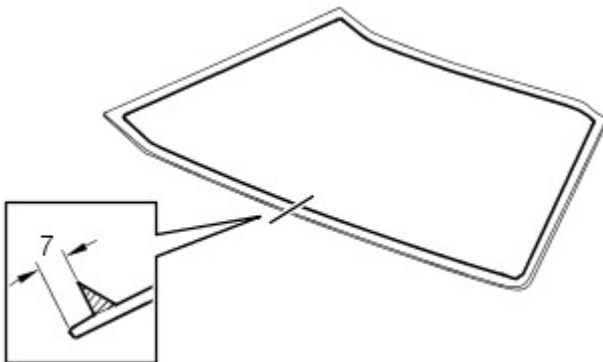
 **CAUTION:** Care must be taken not to damage the air bag curtain module when cutting through the sealant.

With assistance, remove the rear quarter window glass.

- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 4 spacers.

Installation

1. Carefully remove the sealant from the body to leave a smooth surface.
2. Apply etch primer to any bare metal.
3. Apply primer over the etch primer.
4. Apply glass primer to the sealant face on the rear quarter window glass and allow to cure.
5. Apply activator over the old sealant on the rear quarter window glass and allow to cure.
6. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.
 - Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.
7. Apply a continuous bead of sealant to the rear quarter window glass as shown.




E49797

8. With assistance, install and align the rear quarter window glass.
 - Install the spacers equally as shown.
 - Lightly press the window glass to seat the sealer.
9. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.
10. Connect the rear quarter window glass antenna connector.
 - Clean the component mating faces.
11. Install the rear quarter window glass panel.
 - Secure with the clips.
12. Install the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Glass, Frames and Mechanisms - Rear Door Window Regulator and Motor

Removal and Installation

Special Tool(s)	
 <p>501-114</p> <p>E54200</p>	<p>Door glass release lever</p> <p>501-114</p>

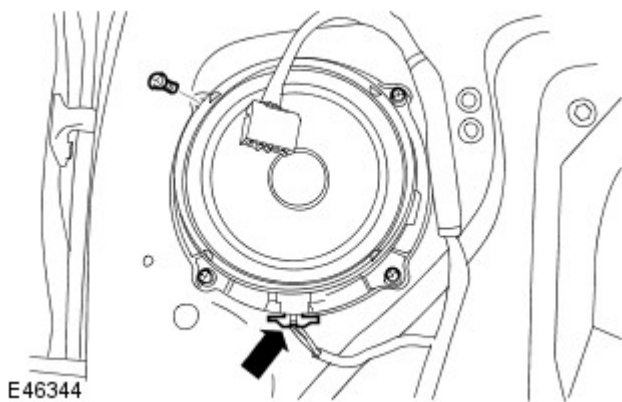
Removal

- NOTE: The door glass should be lowered by approximately one third.

1. Remove the rear door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

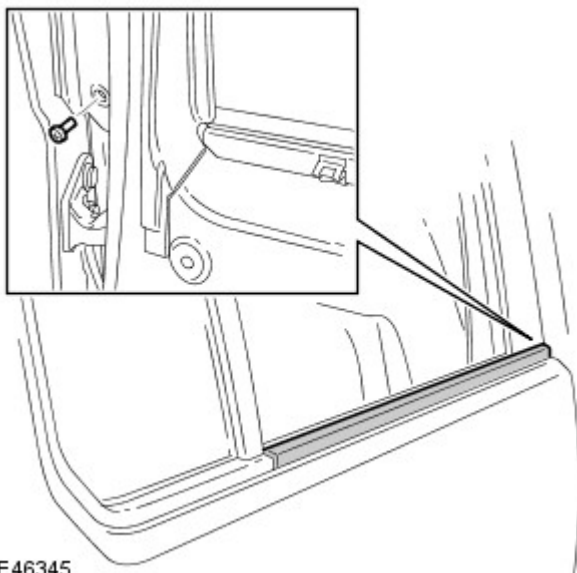
2. Remove the speaker.

- Disconnect the electrical connector.
- Remove the 4 screws.



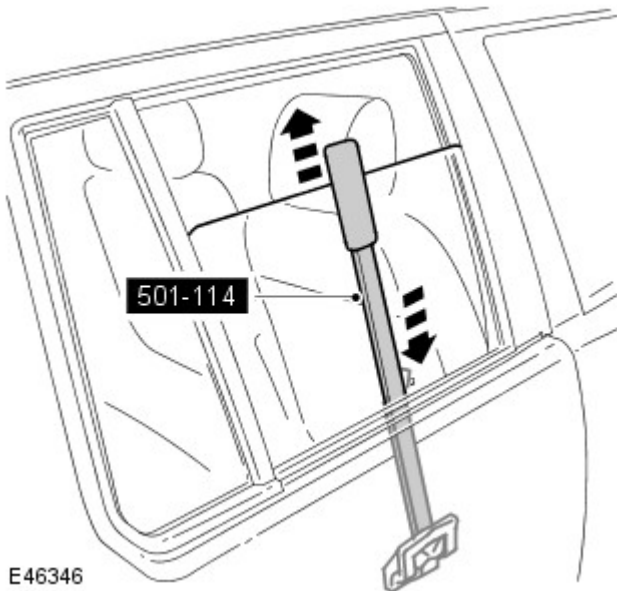
3. Carefully remove the outer waist seal.

- Remove the screw.



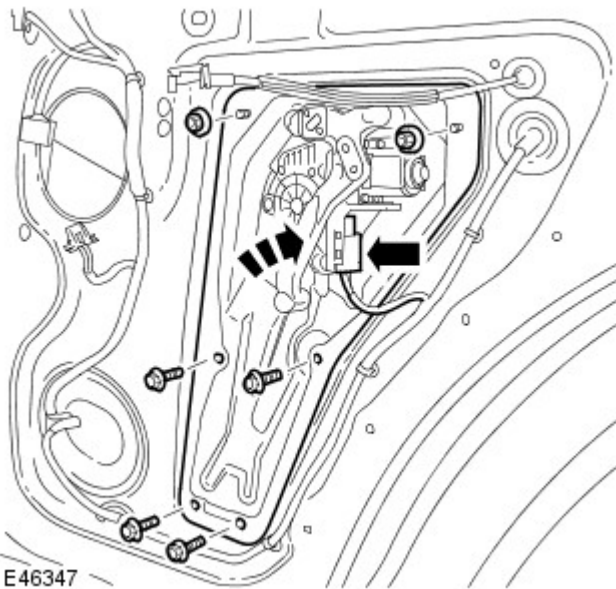
4. NOTE: Wedge the glass in this position.

Using the special tool, release the clip and lift the glass to the top of the door frame.



5. Remove the window motor and regulator assembly.

- Disconnect the electrical connector.
- Remove the 4 bolts.
- Remove the 2 nuts.
- Rotate the assembly 90 degrees clockwise, to remove the upper part of the assembly from the rear side of the aperture first.



Installation

1. Install the window motor and regulator assembly.
 - Tighten the bolts and nuts to 10 Nm (7 lb.ft).
 - Connect the electrical connector.

2. Secure the glass to the glass regulator.

- Remove the wedge.
- Lower the glass.

3. Install the outer waist seal.

4. Install the speaker

- Tighten the screws.
- Connect the electrical connector.

5. Install the rear door trim panel.

For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

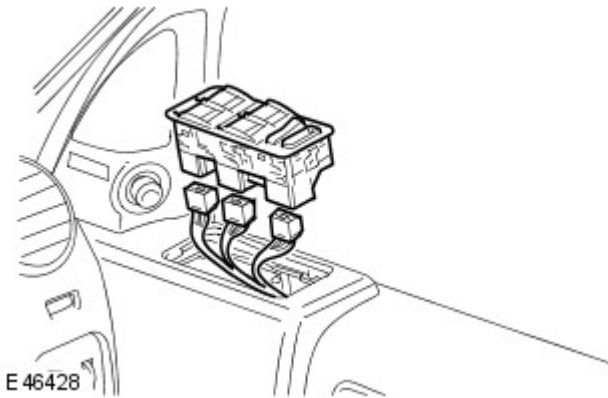
Glass, Frames and Mechanisms - Front Door Window Control Switch

Removal and Installation

Removal

1. Remove the window control switch.

- Carefully release the switch.
- Disconnect the 3 electrical connectors.



Installation

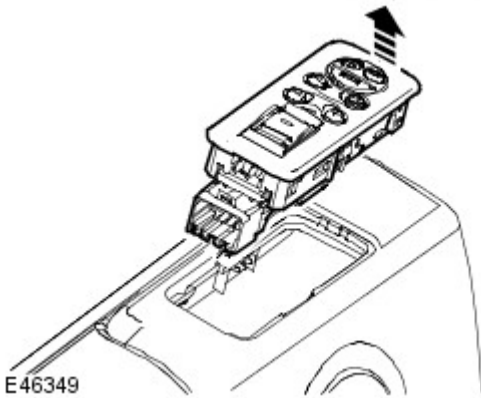
1. To install, reverse the removal procedure.

Glass, Frames and Mechanisms - Rear Door Window Control Switch

Removal and Installation

Removal

1. Remove the window control switch.
 - Carefully release the front of the switch.
 - Disconnect the electrical connector.




Installation

1. To install, reverse the removal procedure.

Glass, Frames and Mechanisms - Front Door Window Glass

Removal and Installation

Special Tool(s)

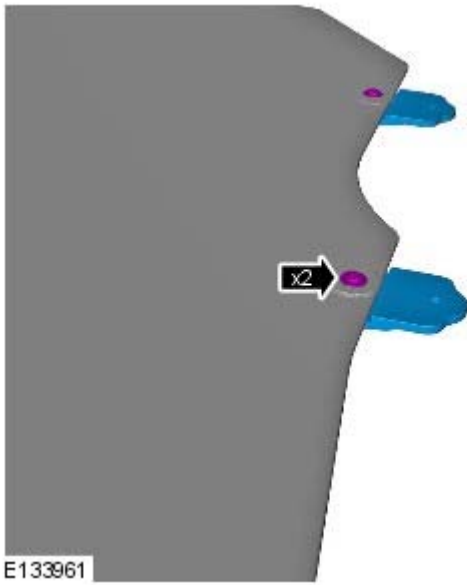
 <p>501-114 E54200</p>	<p>501-114 Release Lever, Door Glass</p>
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Removal

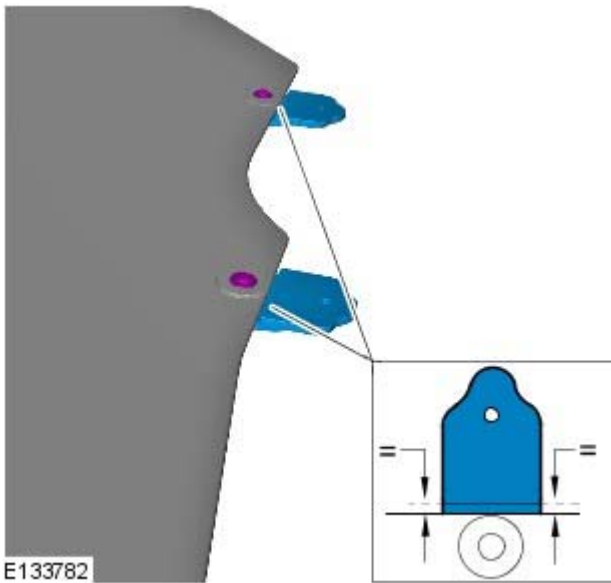
1. *Special Tool(s):* [501-114](#)




2.

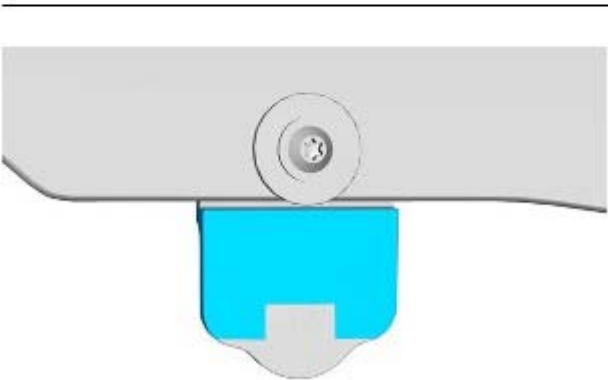
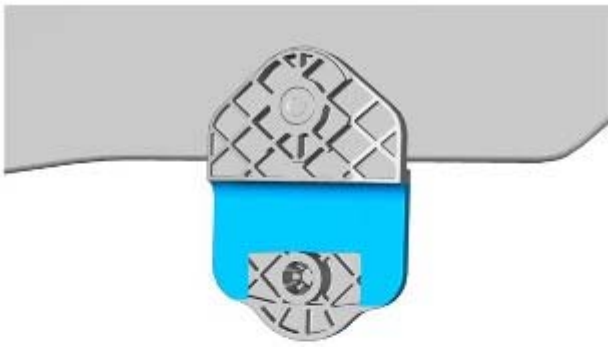


Installation




1.  **CAUTION:** Make sure that the door glass retaining brackets are pushed to the edge of the door window glass to achieve minimum parallel gap.
- **NOTE:** This operation must be done for both retaining brackets.


Torque: 6 Nm



E140674

2. **2. CAUTIONS:**

 Make sure that any grease or lubricant is removed from the retaining brackets prior to installation of the anti-rattle pads.

 Make sure that the anti-rattle pad is installed in the orientation illustrated.

• **NOTE:** This operation must be done for both retaining brackets.

3. To install, reverse the removal procedure.

Glass, Frames and Mechanisms - Front Door Window Regulator and Motor

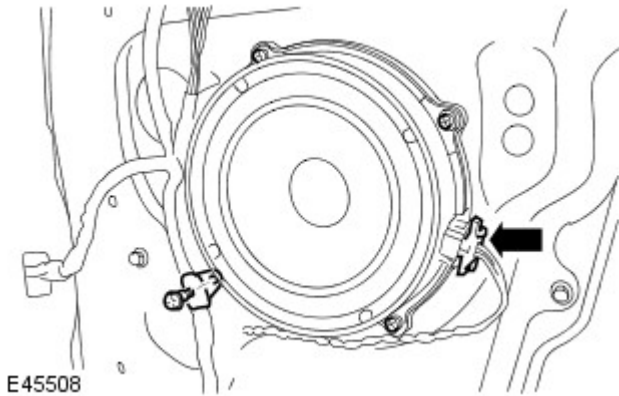
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

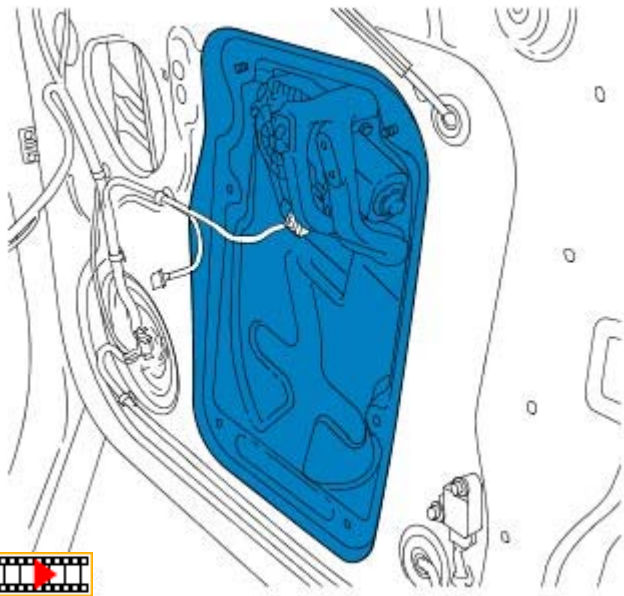
1. Refer to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
2. Refer to: [Front Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

3.



4. *Torque:*

- Front door window regulator and motor retaining bolts 10 Nm
- Front door window regulator and motor retaining nuts 10 Nm
- Door window glass guide channel retaining bolt 10 Nm



Installation

1. To install, reverse the removal procedure.

Instrument Panel and Console -

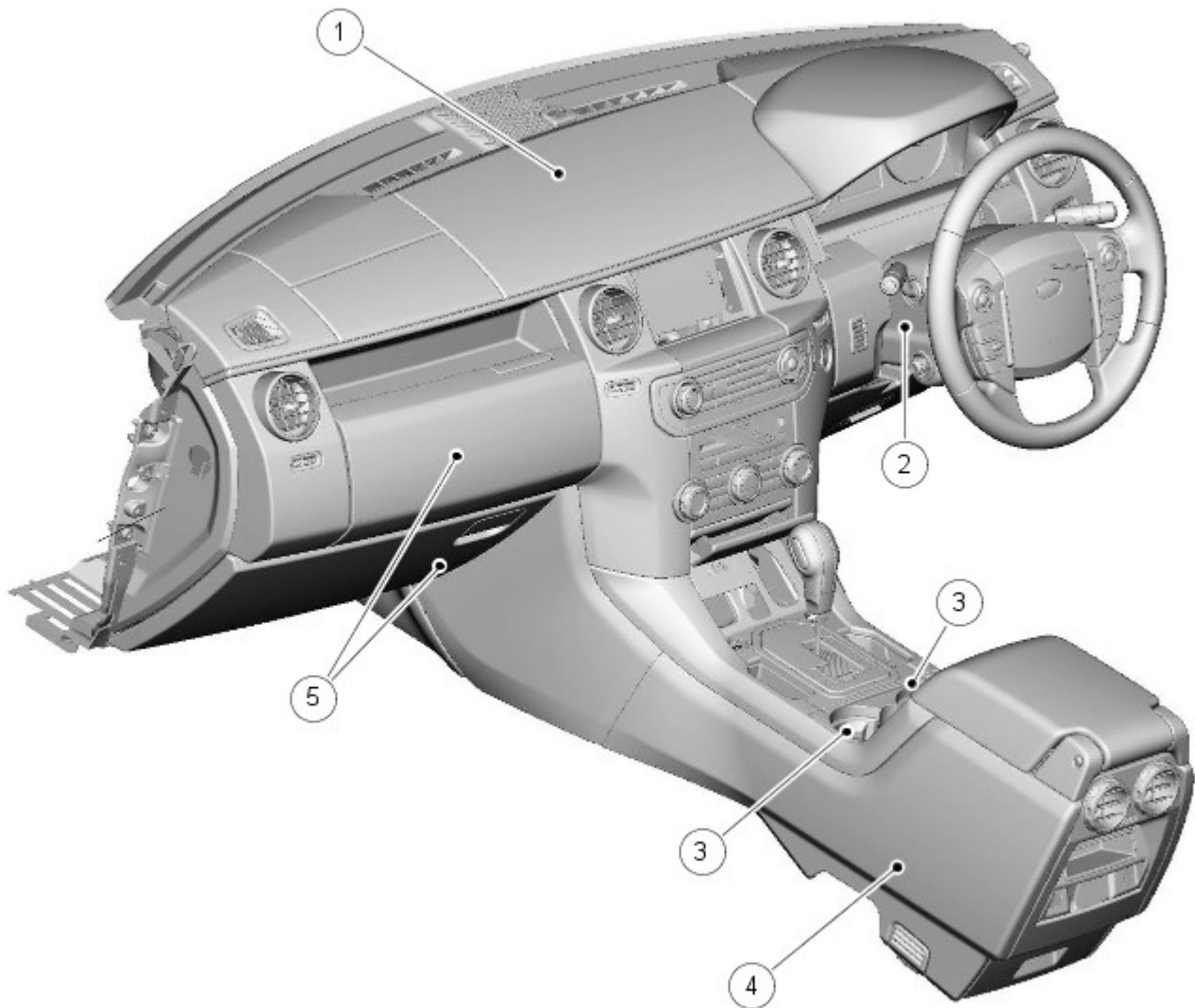
Torque Specifications

Description	Nm	lb-ft
Floor console lid Torx bolts	3	2
Floor console Torx bolts	10	7
Passenger air bag module nuts	10	7
Passenger air bag module bracket Torx screws	25	18
Instrument panel Torx bolts	25	18
Heater housing to bulkhead Torx bolts	6	4
Ground cables to passenger/driver side lower A-pillar nuts	10	7
Adaptor panel(s) nuts	10	7
A/C lines to bulkhead bolt	10	7
A/C lines to body nuts	10	7
EGR coolant crossover pipe bolts	10	7
Instrument panel carrier to bulkhead Torx bolt	25	18
Instrument panel upper section to body Torx bolt	10	7
Instrument panel center bracket Torx bolts	25	18
* Steering column intermediate shaft nut	22	16
Transmission selector lever bolts	10	7
Front door bolts	10	7
Door check strap to A-pillar bolts	10	7
Steering column switch assembly Torx bolts	3	2

* **New nut must be fitted**

Instrument Panel and Console - Instrument Panel

Description and Operation



E131962

Item	Part Number	Description
1	-	Instrument panel
2	-	Steering column cover
3	-	Cup holders
4	-	Centre console
5	-	Glove compartment

The instrument panel assembly houses the main instrument cluster, passenger air bag module, glovebox, navigation/message centre, headlamp leveling switch, in-vehicle temperature sensor, engine start/stop switch, audio control panel, steering column, climate control panel, ashtray and air distribution registers, all of which can be removed without removing the instrument panel assembly from the vehicle. The instrument panel wiring harness is located within the instrument panel assembly to facilitate easy installation in vehicle. The instrument panel assembly must be removed from the vehicle to gain access to the wiring harness.

Console

The floor console is located between the front seats and consists of the gear selector, passenger cup-holders, cigar lighter/power socket and a padded armrest. The armrest feature has a hinged lid which can be opened to expose, depending on option specification, a USB connectivity panel, and either a deep stowage unit or a cool box (which will keep items placed within at a temperature 20 degrees lower than the main vehicle cabin). Situated in the rear of the center console is a rear cup-holder unit for second row occupants, and further air distribution registers. Depending on trim level, the rear of the console will also have a rear entertainment console, with a further USB connection point.

For further information on the Audio & Climate control panels refer to the following:

- Control Components (412-04, Description and Operation)
- Audio Unit (415-01B, Description and Operation).

Instrument Panel and Console - Overhead Console

Description and Operation

For additional information, refer to: [Interior Lighting](#) (417-02 Interior Lighting, Description and Operation).

Instrument Panel and Console - Floor Console

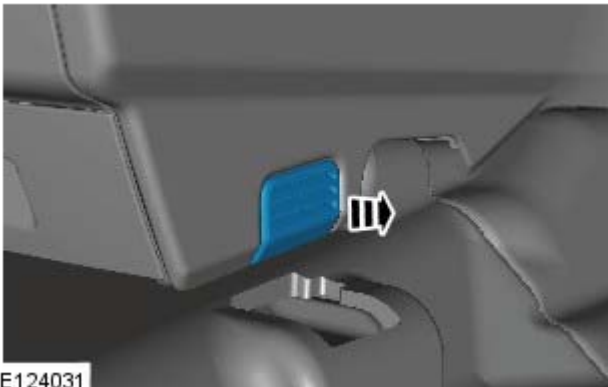
Removal and Installation

Removal

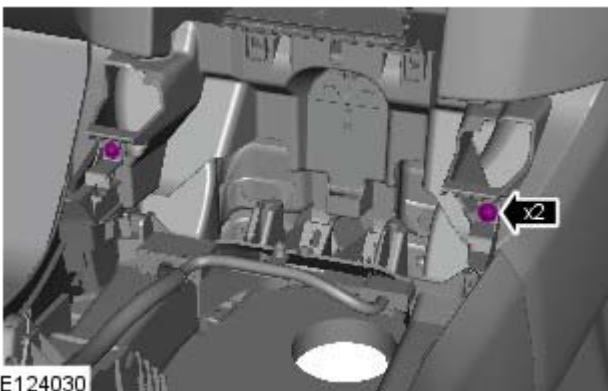
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

1. Refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

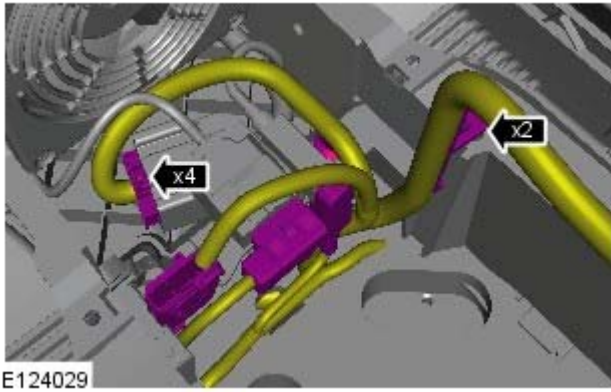
2. **2.** NOTE: Right-hand shown, left-hand similar.



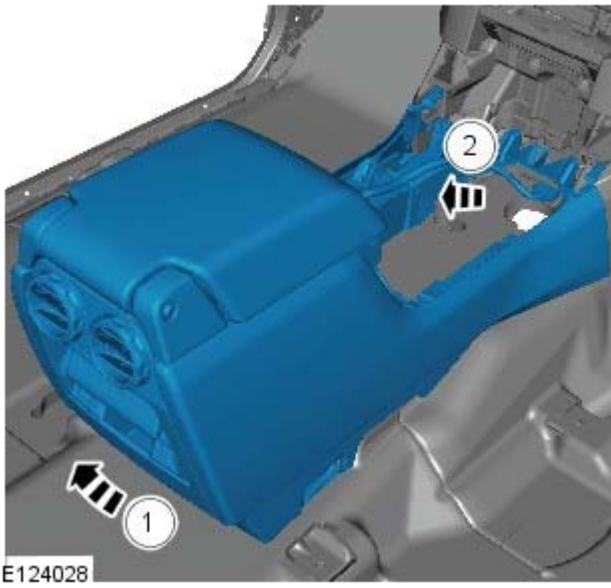
3.



4.



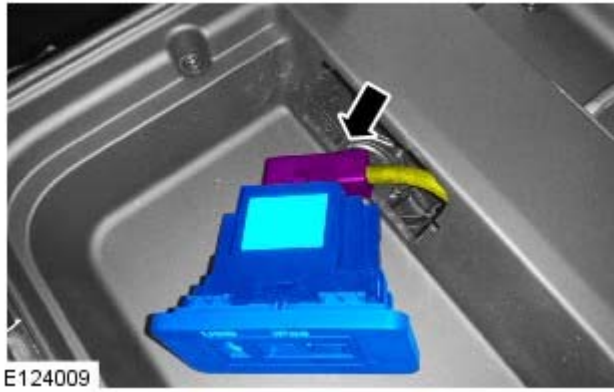
5.



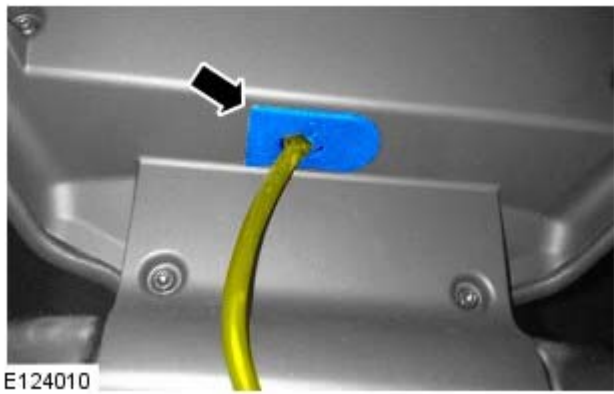
6.



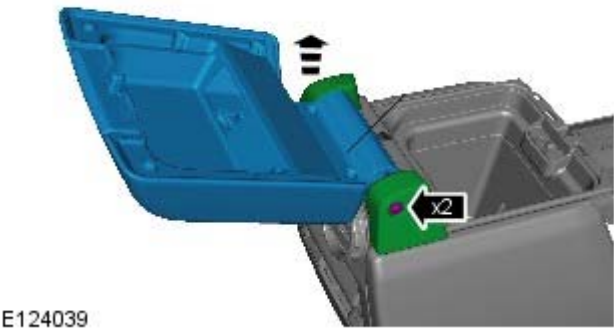
7. **7. NOTE:** Do not disassemble further if the component is removed for access only.



8.

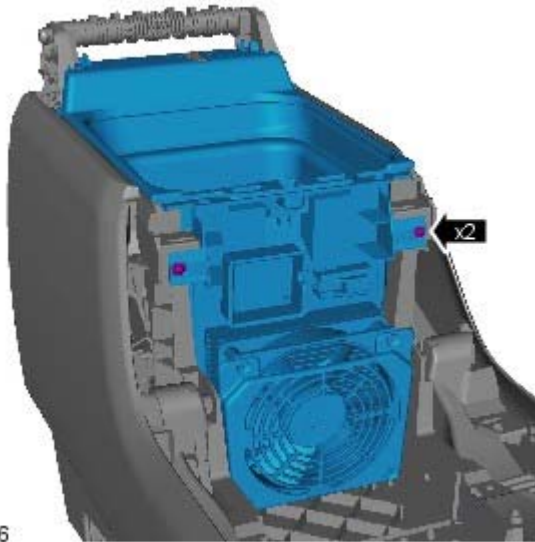


9.



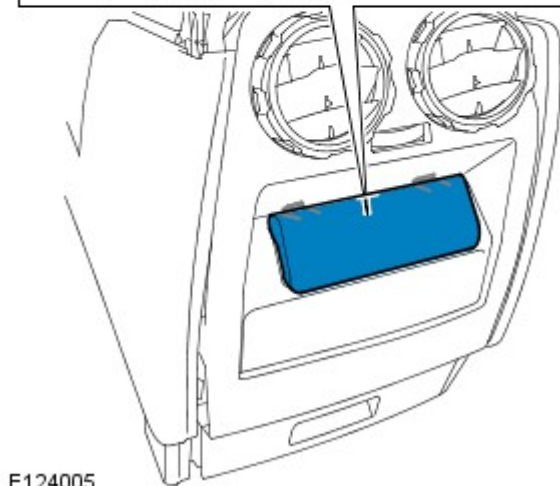
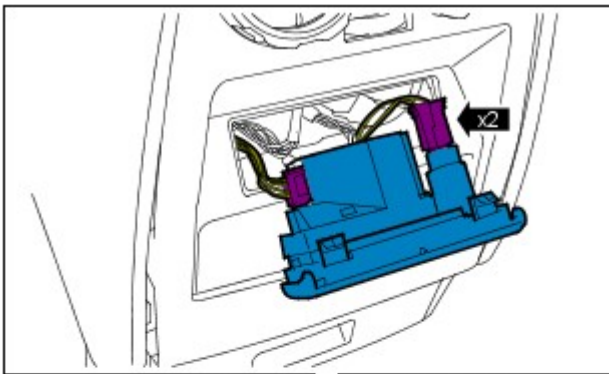
10.

11.



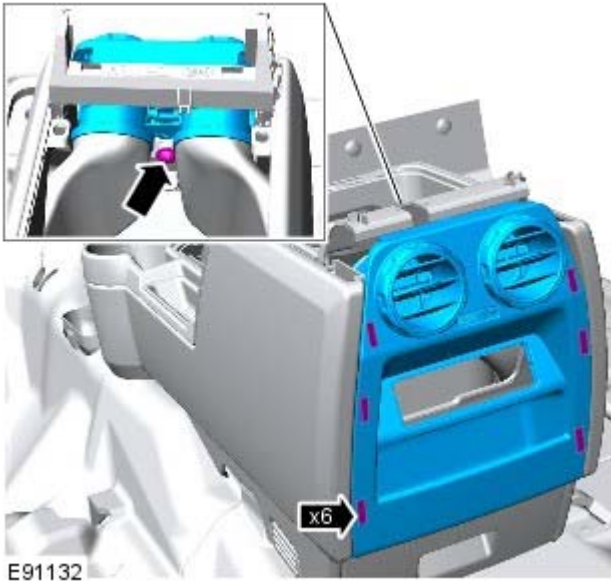
E124026

12.



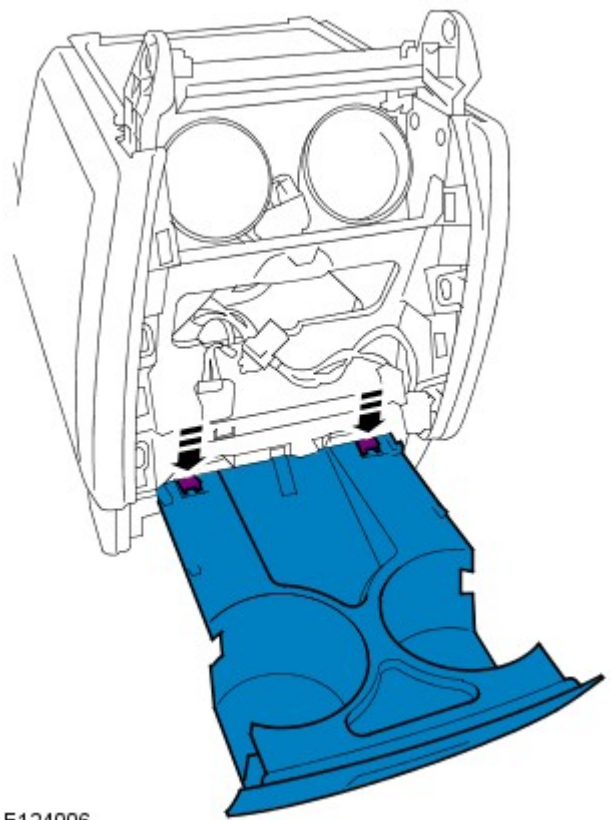
E124005

13.



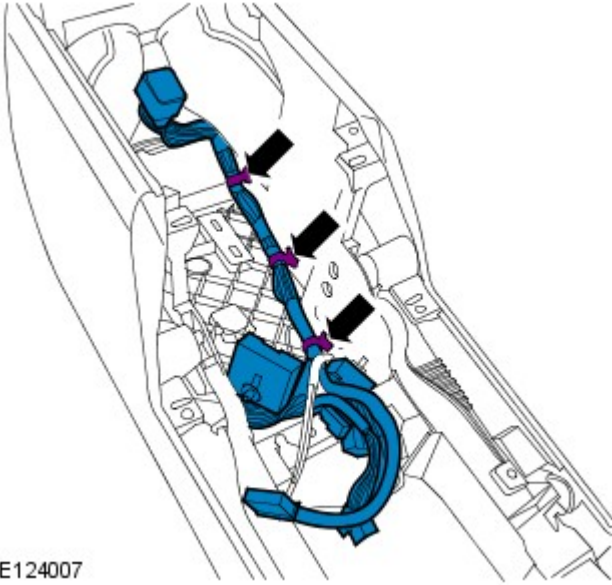
E91132

14.



E124006

15.



E124007

Installation

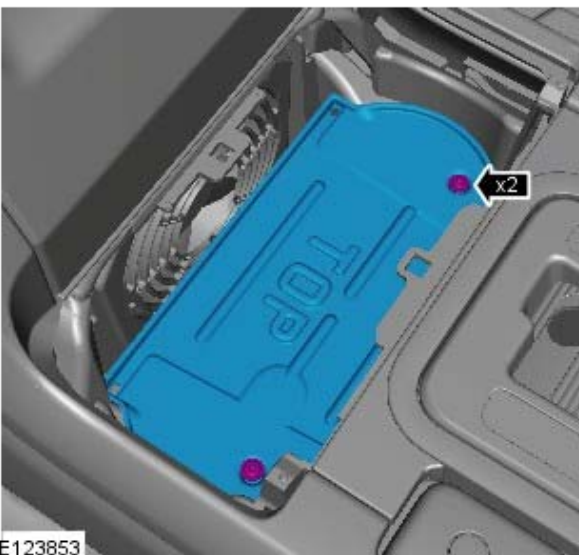
1. To install, reverse the removal procedure.

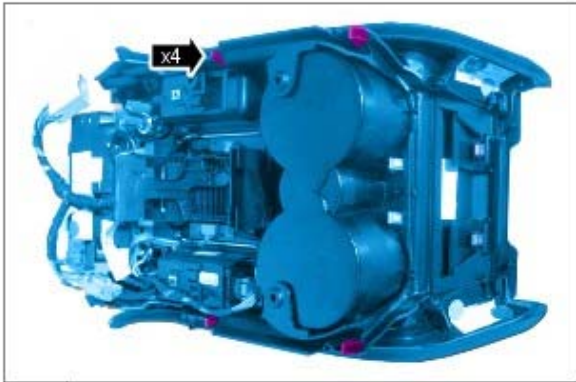
Instrument Panel and Console - Floor Console Upper Section

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Make sure that the gear selector lever is in position N before removing any components.





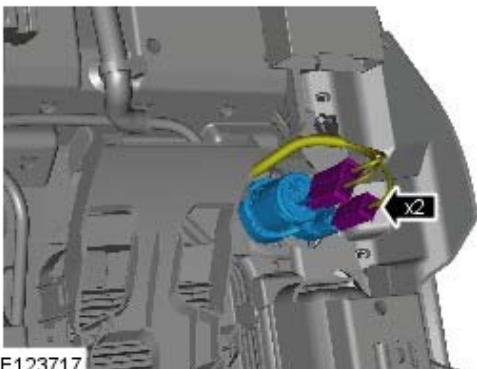
E123213

4.



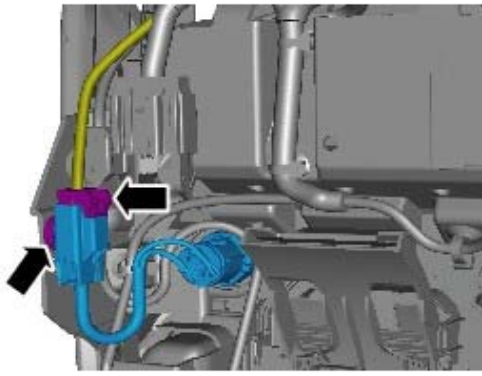
E123214

5.



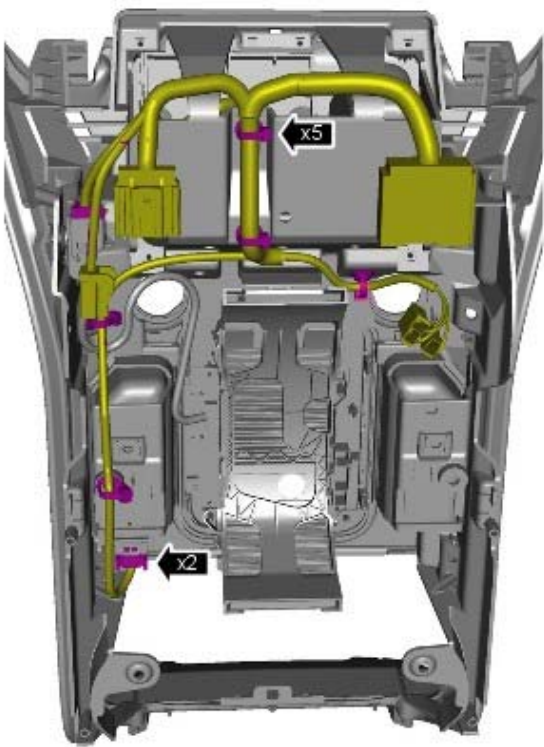
E123717

6. **NOTE:** Do not disassemble further if the component is removed for access only.

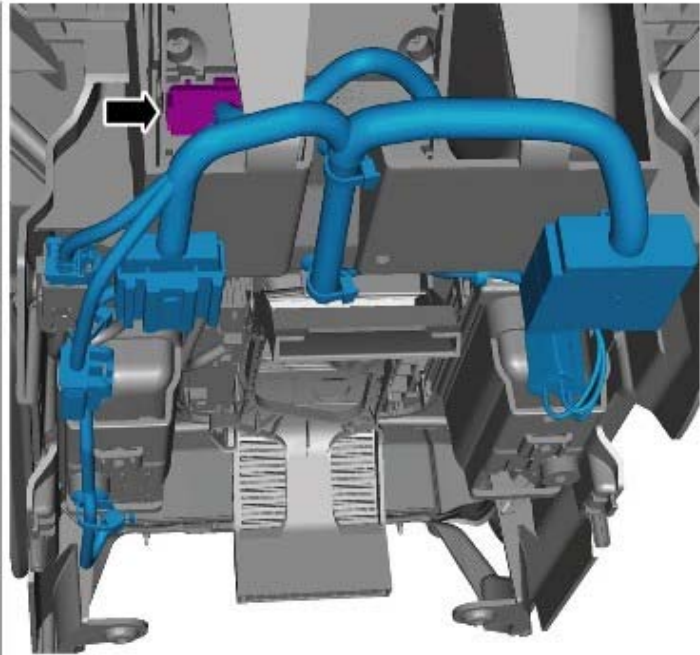


E123720

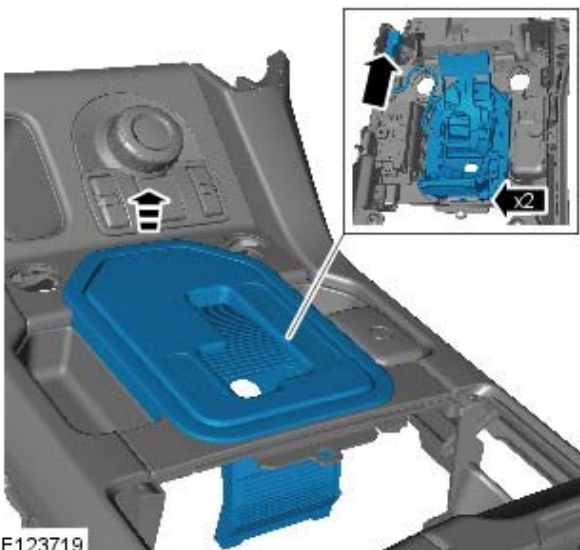
7.



E123718



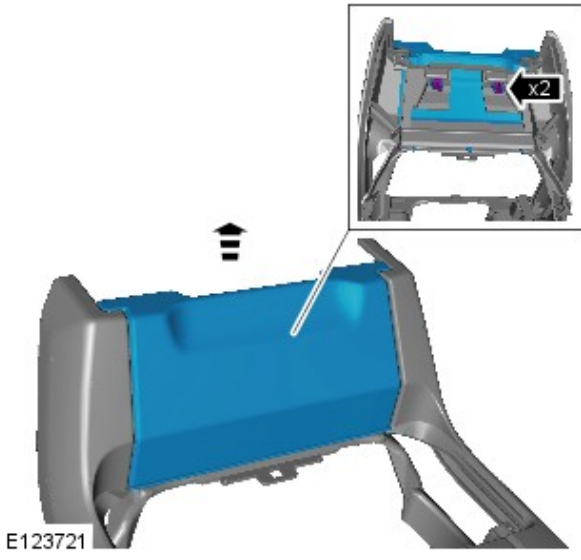
8.



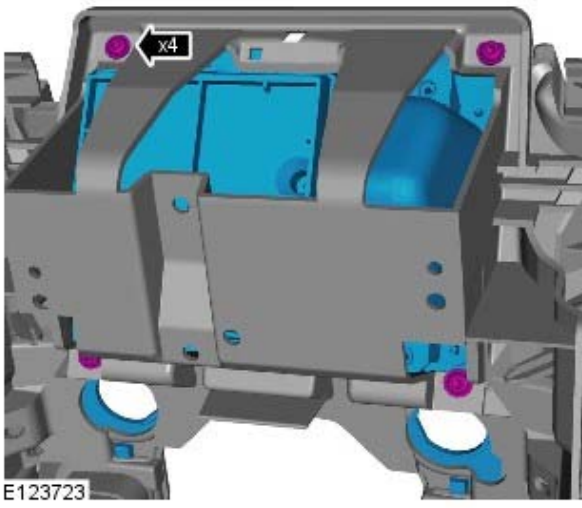
E123719

9.

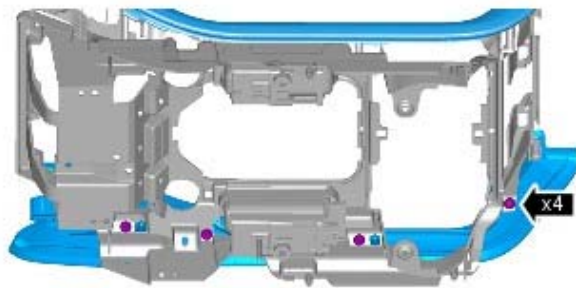
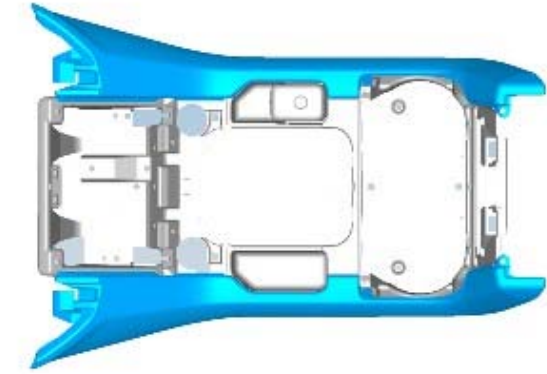
10.



11.

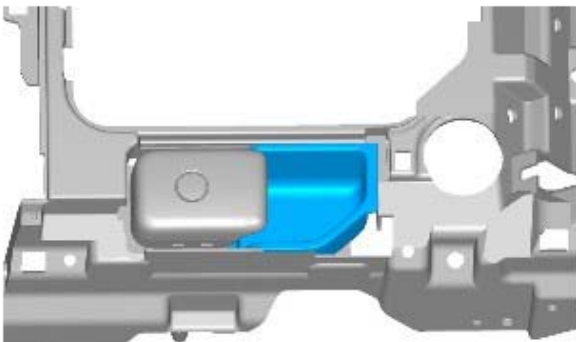


12.



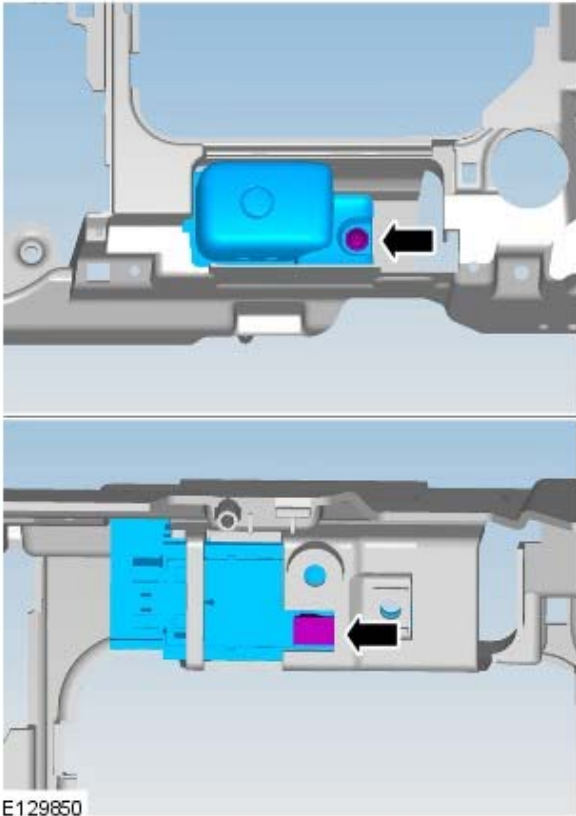
E129849

13.



E129851

14.



E129850

Installation

1. To install, reverse the removal procedure.

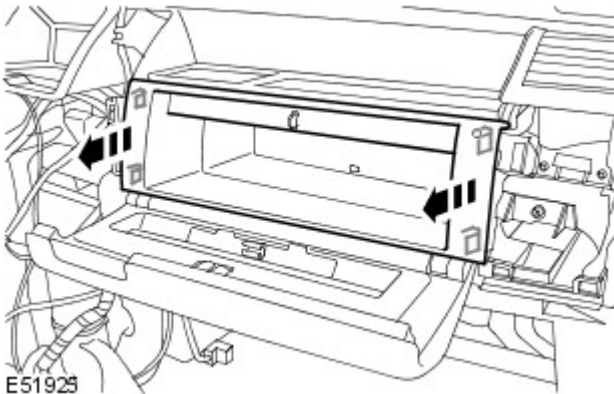
Instrument Panel and Console - Instrument Panel Upper Section

Removal and Installation

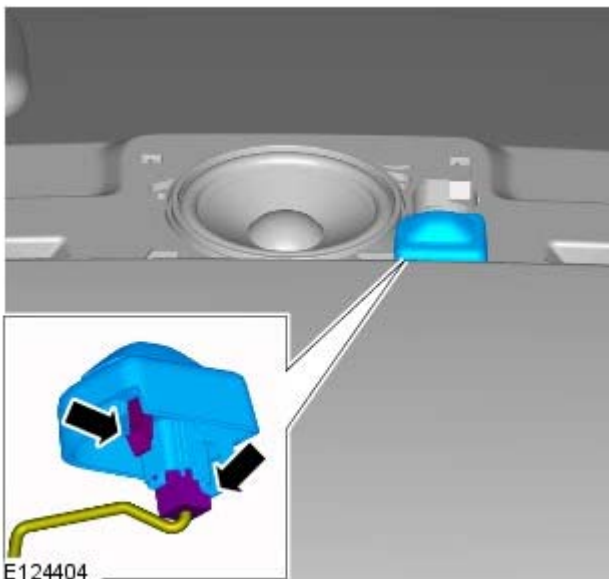
Removal

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

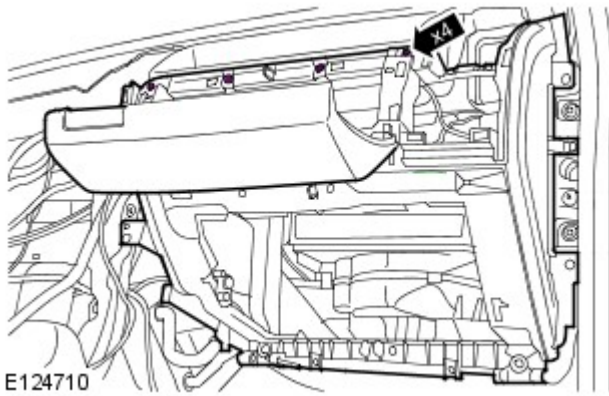
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Remove the passenger side register trim panel.
For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).
5. Remove the stowage compartment tray.
 - Release the 4 clips.



6. Remove the instrument panel speaker.
For additional information, refer to: [Instrument Panel Speaker](#) (415-03 Speakers, Removal and Installation).
7. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
8. Remove the sunload sensor.
 - Release the clips.
 - Disconnect the electrical connector.

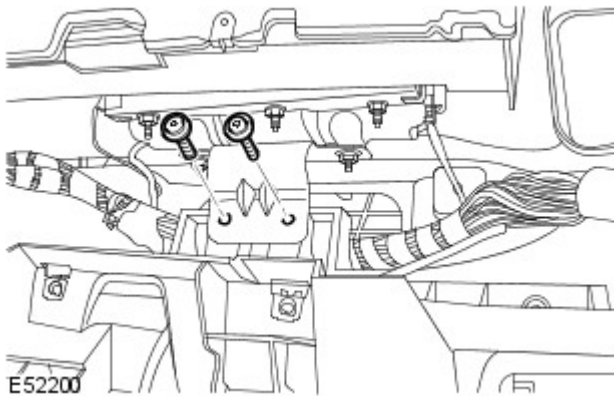


9. Remove the instrument panel passenger side reinforcement upper retaining screws.

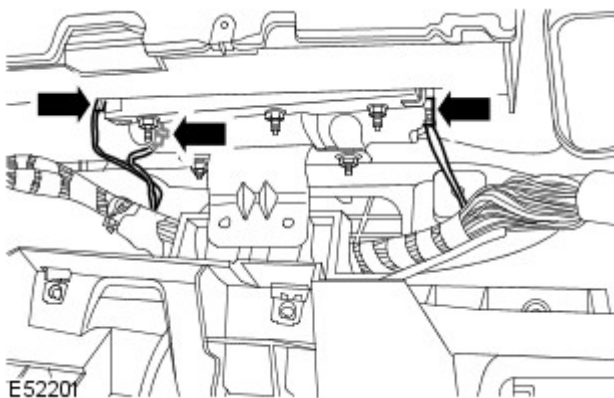


10. Release the passenger air bag module bracket.

- Remove the 2 Torx screws.

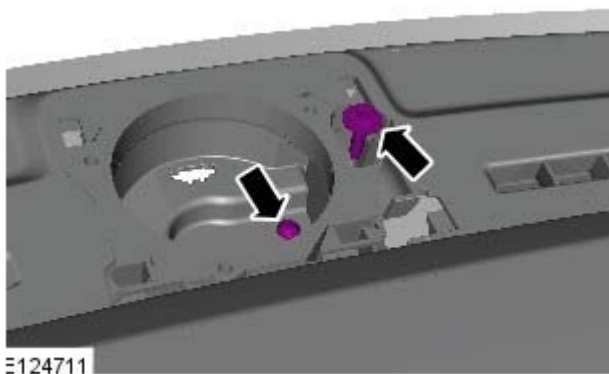


11. Disconnect the 3 electrical connectors from the passenger air bag module.



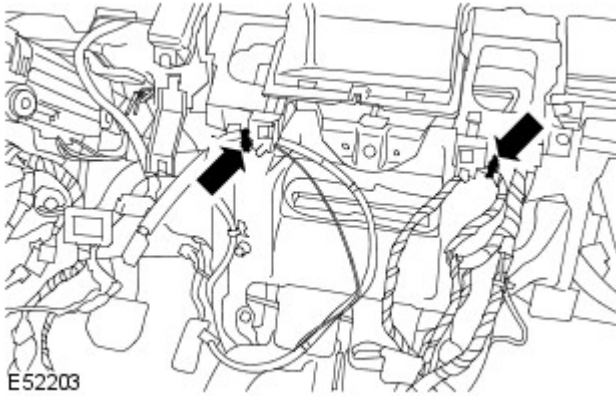
12. NOTE: Avoid dropping the screw inside the instrument panel.

Remove 1 Torx screw and 1 bolt, from the instrument panel upper section speaker aperture.



13. Release the instrument panel wiring harness.

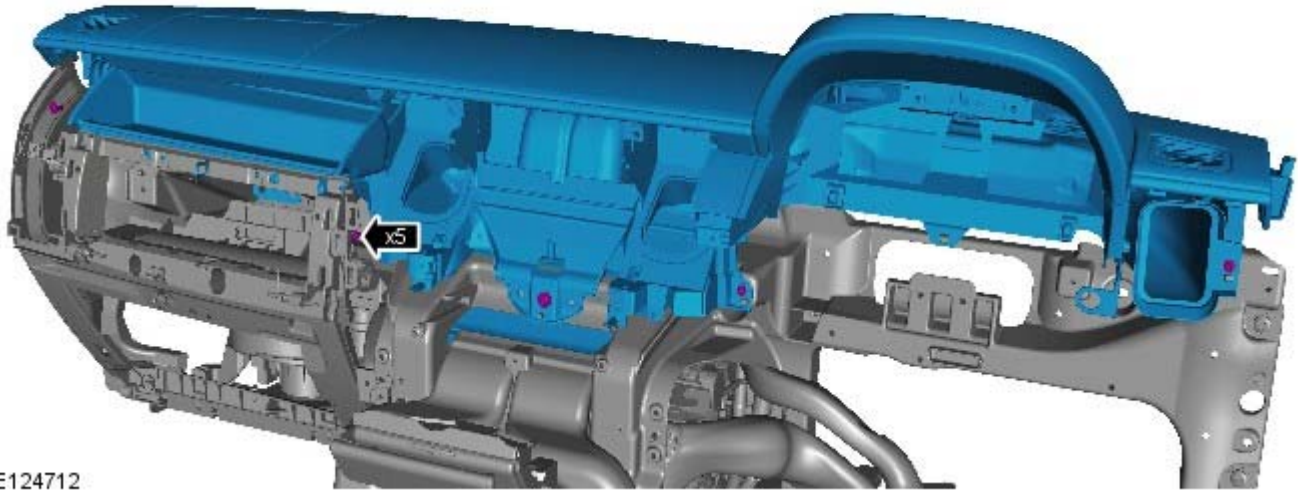
- Release the 2 clips.



E52203

14. With assistance, remove the instrument panel upper section.

- Remove the 5 Torx screws.



E124712

15. NOTE: Do not disassemble further if the component is removed for access only.

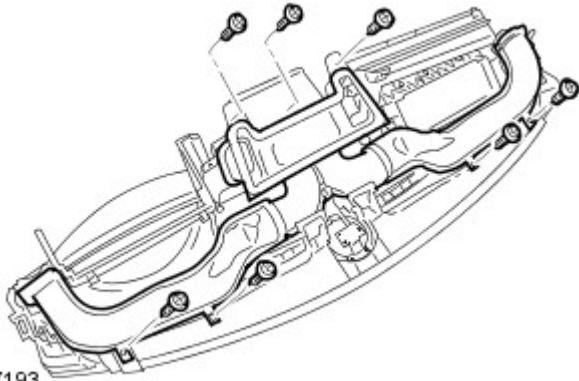
Remove the passenger air bag module.

- Remove the 4 nuts.



E47176

E47193



16. Remove the windshield defroster duct.

- Remove the 7 screws.

Installation

1. Install the windshield defroster duct.

- Tighten the screws.

2. Install the passenger air bag module.

- Tighten the nuts to 10 Nm (7 lb.ft).

3. With assistance, install the instrument panel upper section.

- Tighten the screws.
- Attach the wiring harness.

4. Tighten the instrument panel upper section speaker aperture bolt to 10 Nm (7 lb.ft).

5. Secure the passenger air bag module bracket.

- Tighten the Torx screws to 25 Nm (18 lb.ft).

6. Connect the passenger air bag module electrical connectors.

7. Install the instrument panel passenger side reinforcement upper retaining screws.

8. Install the sunload sensor.

- Connect the electrical connector.
- Secure with the clips.

9. Install the A-pillar trim panels.

For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

10. Install the speaker

For additional information, refer to: [Instrument Panel Speaker](#) (415-03 Speakers, Removal and Installation).

11. Install the stowage compartment tray.

- Secure the 4 clips.

12. Install the passenger side register trim panel.

For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).

13. Install the instrument panel driver side reinforcement.

For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

14. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Instrument Panel and Console - Instrument Panel


Removal and Installation

Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. Evacuate the air conditioning (A/C) system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

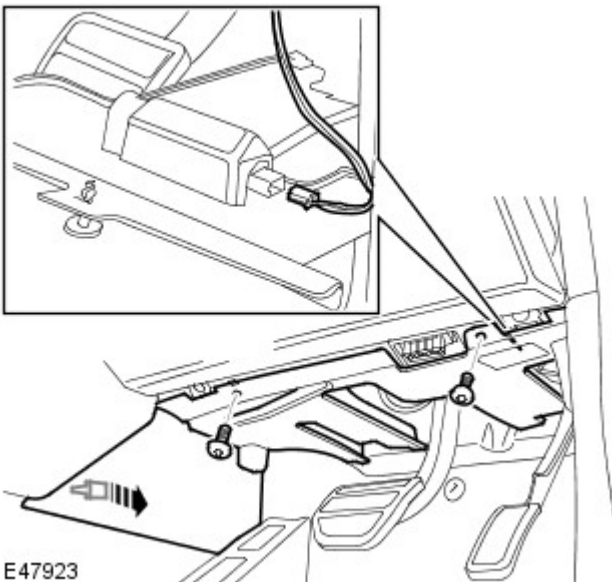
4. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

5. Remove the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).

6. Remove both cowl side trim panels.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Remove the driver side closing trim panel.

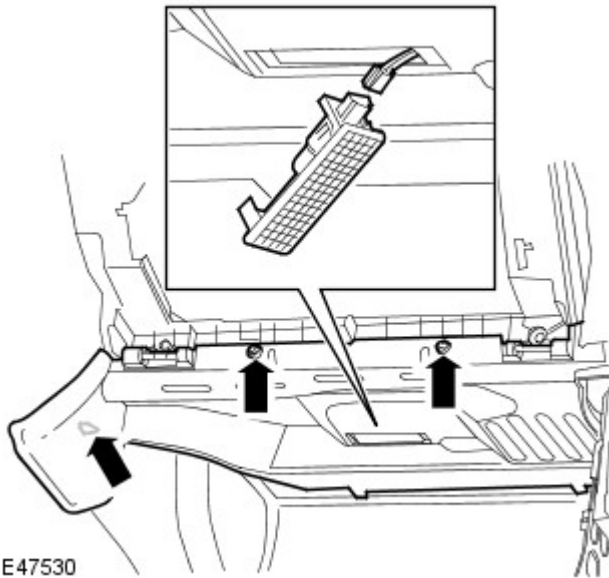
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47923

8. Remove the passenger side closing trim panel.

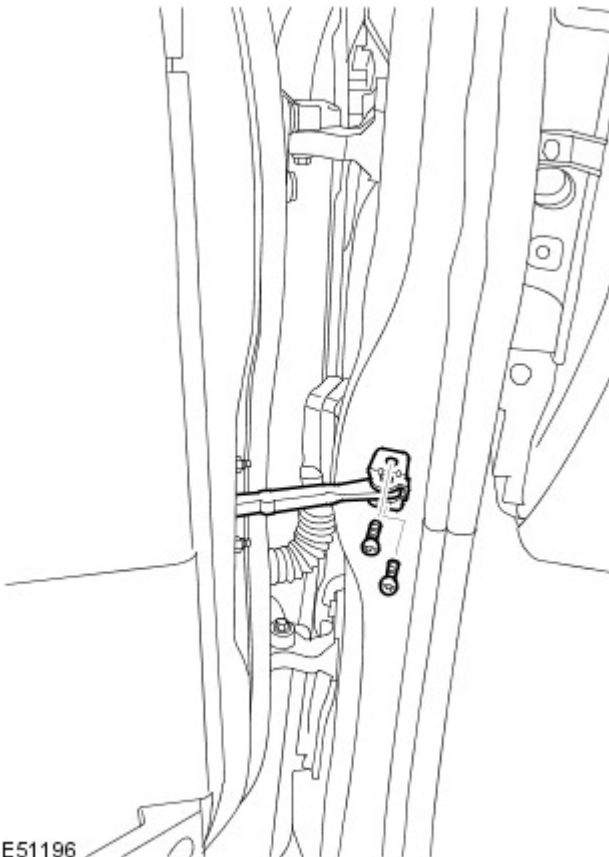
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47530

9. Release the door check strap from the A-pillar.

- Remove the 2 Torx bolts.

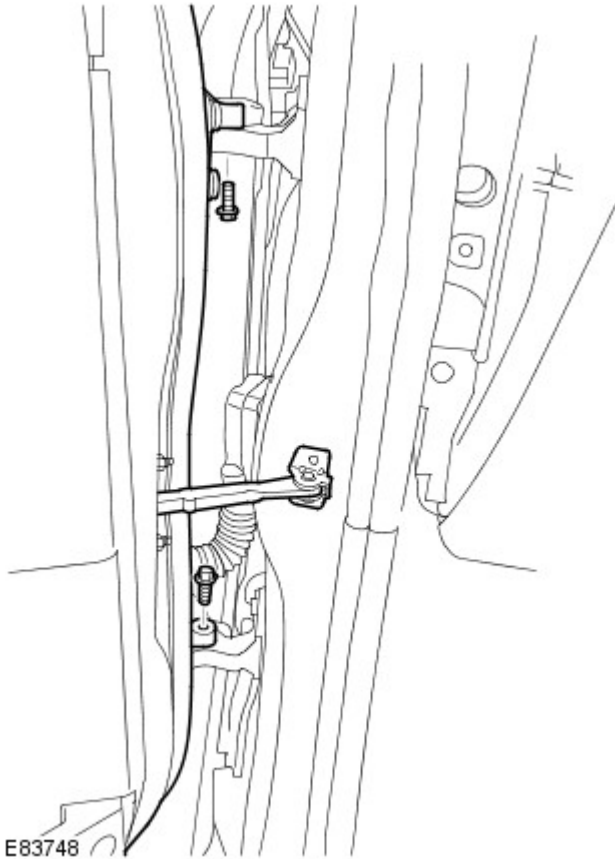


E51196

10. NOTE: The door is still attached by its harness at this stage.

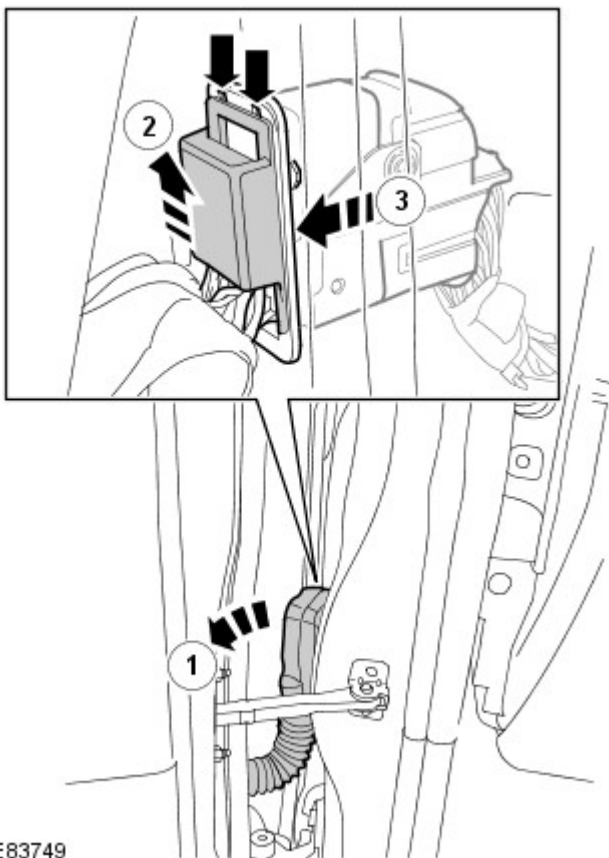
With assistance, release and support the door assembly.

- Remove the 2 bolts.



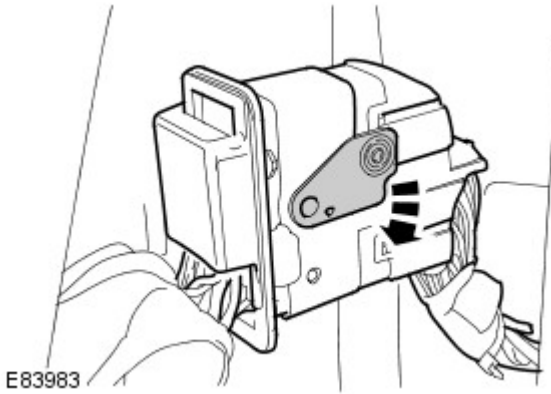
11. Release the electrical connector from the A-Pillar.

- Release the grommet.
- Carefully release, then slide the latch to locate in the indents, arrowed.



12. Remove the door.

- Disconnect the electrical connector.



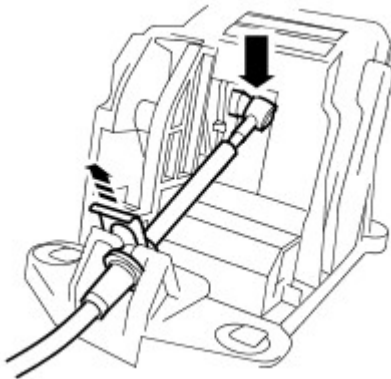
E83983

13. Remove the front seats.

For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

14. Release the transmission selector lever cable.

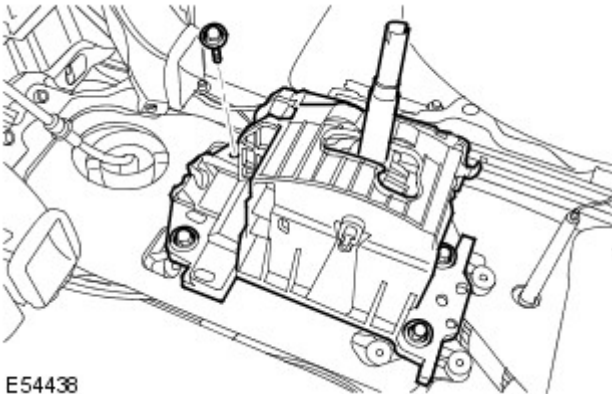
- Remove the clip.
- Release the cable.



E44788

15. Remove the transmission selector lever.

- Remove the 4 bolts.



E54438

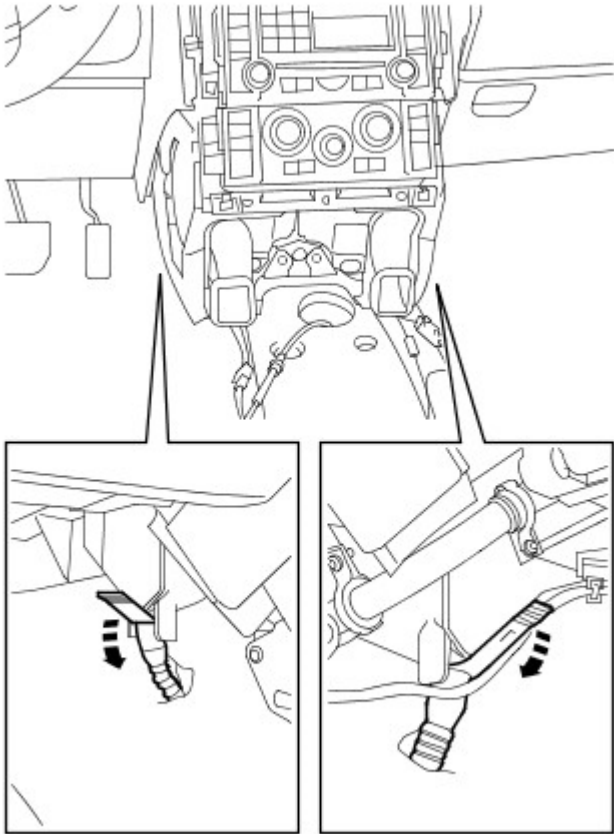
16. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.



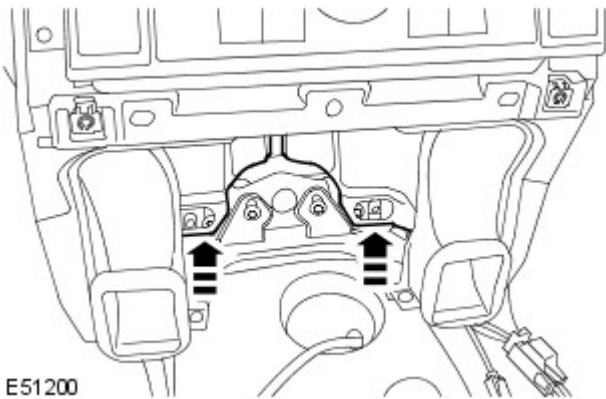
E49465

17. Disconnect 2 drain tubes from the heater housing.



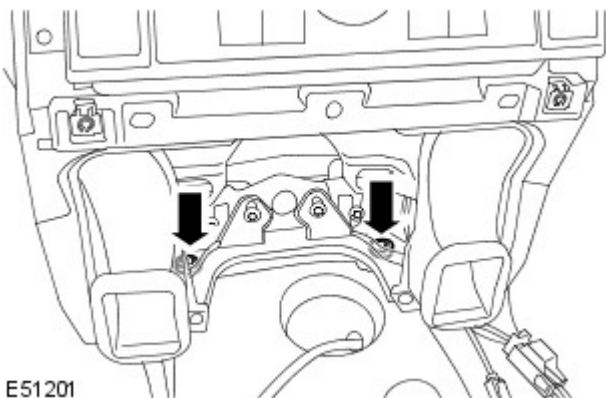
E51199

18. Position the heater housing center ducts aside for access.



E51200

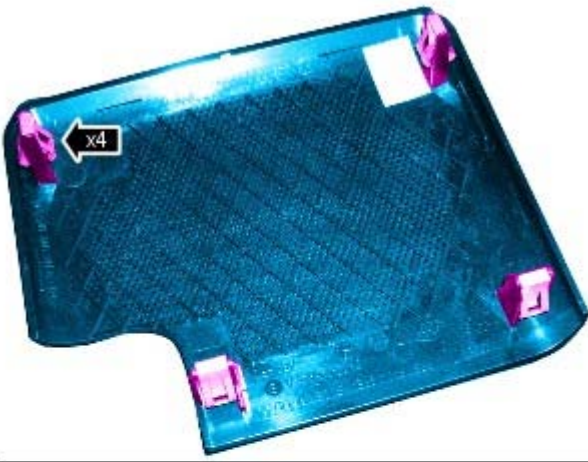
19. Remove 2 Torx bolts from the instrument panel center bracket.



E51201

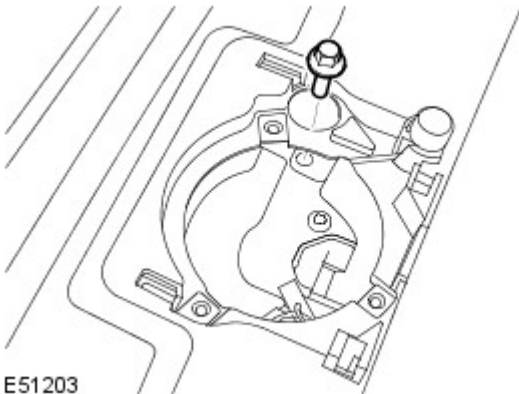
20. Remove the instrument panel center speaker grille.

- Release the 4 clips.



E124403

21. Remove the instrument panel upper section to body bolt.

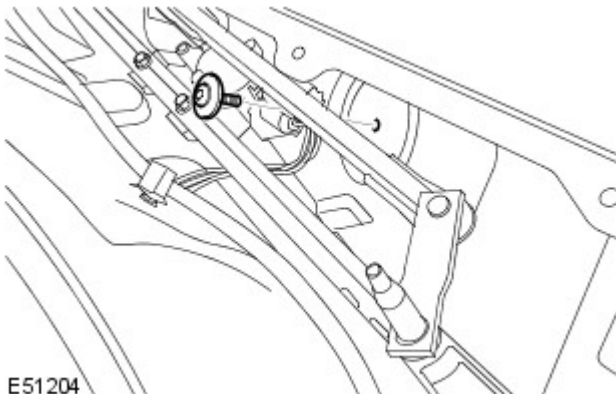


E51203


22. Remove the plenum chamber panel.

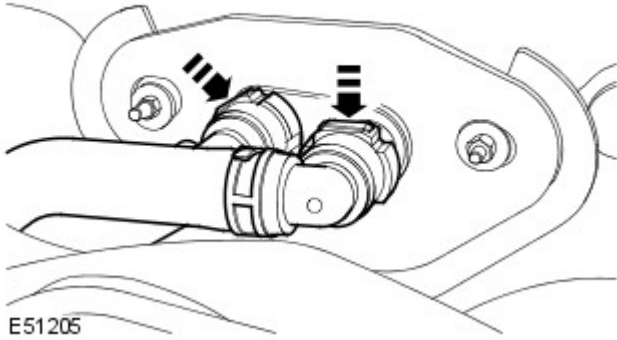
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

23. Remove the instrument panel carrier to bulkhead Torx bolt.



E51204

24.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



Disconnect 2 heater hoses from the bulkhead.

- Release the 2 clips.

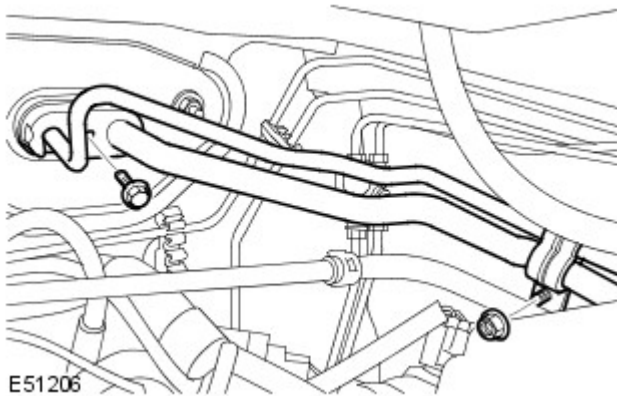
25. Release 2 A/C lines from the body.

- Remove the nut.

26.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

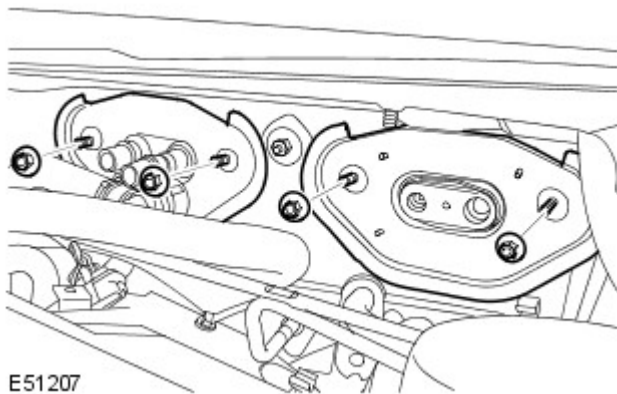
Release 2 A/C lines from the bulkhead.

- Remove the bolt.
- Remove and discard the O-ring seals.



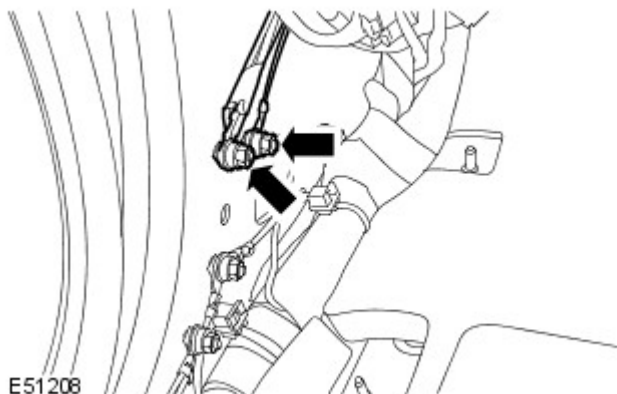
27. Remove the 2 adapter panels.

- Remove the 4 nuts.

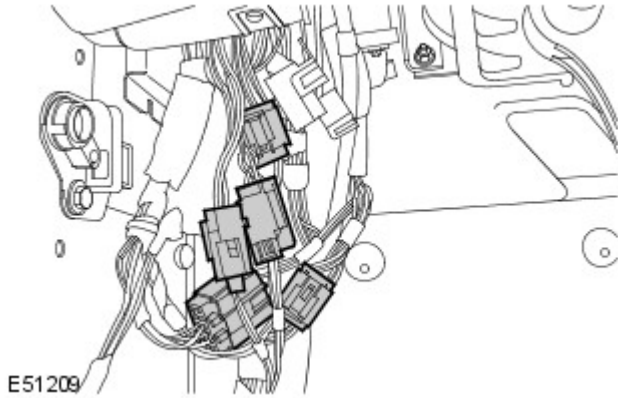


28. Release the 3 ground cables from the driver side lower A-pillar.

- Remove the 2 nuts.

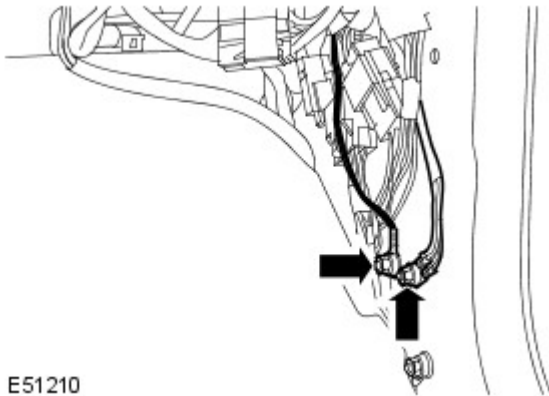


29. Disconnect the 5 electrical connectors from the driver side lower A-pillar.



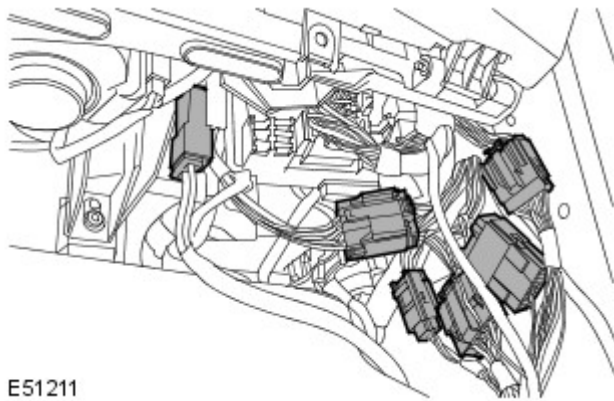
30. Release the 3 ground cables from the passenger side lower A-pillar.

- Remove the 2 nuts.

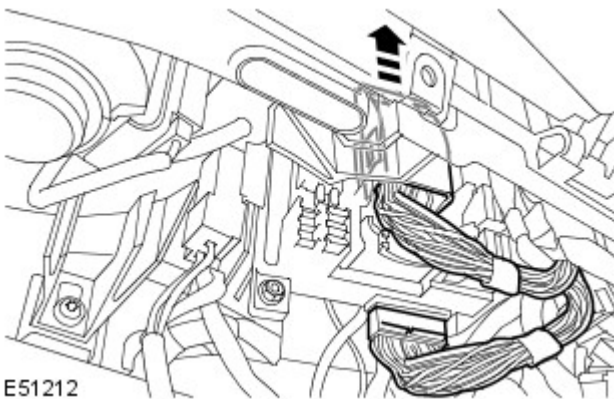


31. Disconnect the 5 electrical connectors from the passenger side lower A-pillar.

32. Disconnect the heater motor electrical connector.



33. Disconnect 2 central junction box (CJB) electrical connectors.



34. Disconnect 2 electrical connectors from the instrument panel center reinforcement.

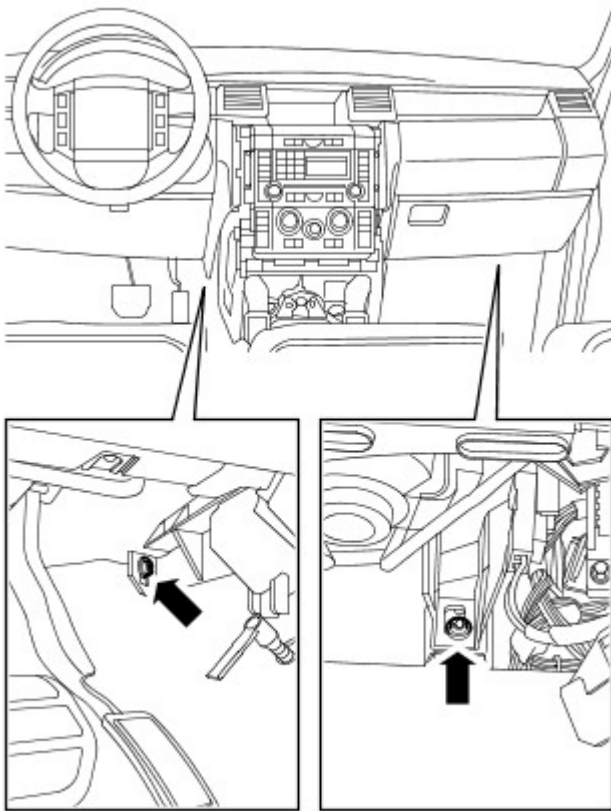


35. If installed, disconnect the instrument panel center reinforcement fibre optic cables.

- Disconnect the electrical connector.

36. Driver side: Remove the heater housing to bulkhead Torx bolt.

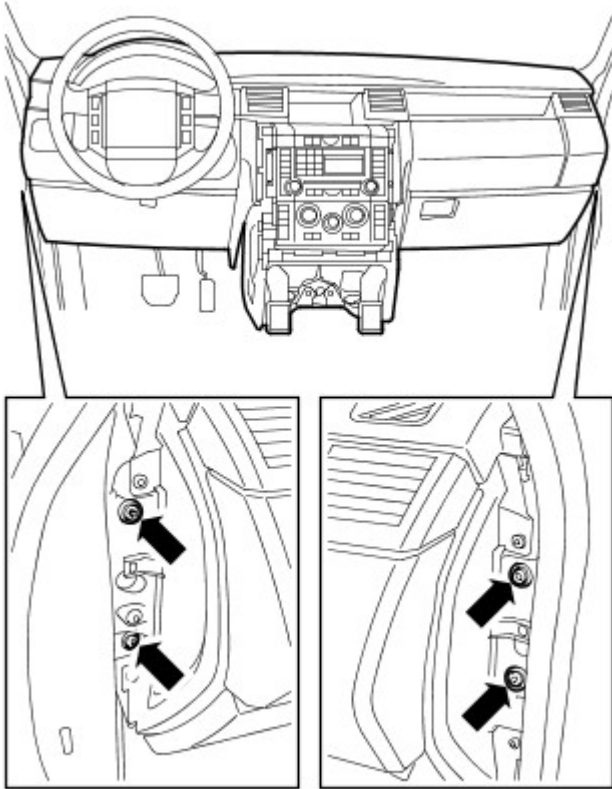
37. Passenger side: Remove the heater housing to bulkhead Torx bolt.



E51214

38. With assistance, remove the instrument panel.

- Remove the 4 Torx bolts.



E51215

Installation

1. With assistance, install the instrument panel.

- Tighten the Torx bolts to 25 Nm (18 lb.ft).

2. Passenger side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).

3. Driver side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).

4. Connect the instrument panel center reinforcement fibre optic cables.

5. Connect the instrument panel center reinforcement electrical connectors.

6. Connect the CJB electrical connectors.

7. Connect the heater motor electrical connector.

8. Connect the electrical connectors to the passenger side lower A-pillar.

9. Connect the ground cables to the passenger side lower A-pillar.

- Tighten the nuts to 10 Nm (7 lb.ft).

10. Connect the electrical connectors to the driver side lower A-pillar.

11. Connect the ground cables to the driver side lower A-pillar.

- Tighten the nuts to 10 Nm (7 lb.ft).

12. Install the adapter panels.

- Tighten the nuts to 10 Nm (7 lb.ft).

13. Secure the A/C lines to the bulkhead.

- Tighten the nuts to 10 Nm (7 lb.ft).

- Install new O-ring seals.

15. Connect the bulkhead heater hoses.

- Tighten the bolt to 10 Nm (7 lb.ft).

16. Install the instrument panel carrier to bulkhead Torx bolt and tighten to 25 Nm (18 lb.ft).
17. Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
18. Install the instrument panel upper section to body bolt and tighten to 10 Nm (7 lb.ft).
19. Install the speaker grille.
 - Secure with the clips.
20. Install the instrument panel center bracket Torx bolts and tighten to 25 Nm (18 lb.ft).
21. Attach the heater housing center ducts.
22. Connect the drain tubes to the heater housing.
23. Connect the steering column intermediate shaft.
 - Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).
24. Install the transmission selector lever.
 - Tighten the bolts to 10 Nm (7 lb.ft).
25. Attach the transmission selector lever cable.
 - Install the clip.
26. Install the front seats.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
27. With assistance, install the door assembly.
 - Connect the electrical connector.
 - Secure the electrical connector.
 - Secure the grommet.
 - Tighten the bolts to 10 Nm (7 lb.ft).
28. Attach the door check strap to the A pillar.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
29. Install the driver side closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.
30. Install the passenger side closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.
31. Install the cowl side trim panels.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
32. Install the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
33. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

34. Recharge the A/C system.

For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

35. Install the engine cover.

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) /

[Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) /

[Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) /

[Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Instrument Panel and Console - Instrument Panel Driver Side Reinforcement

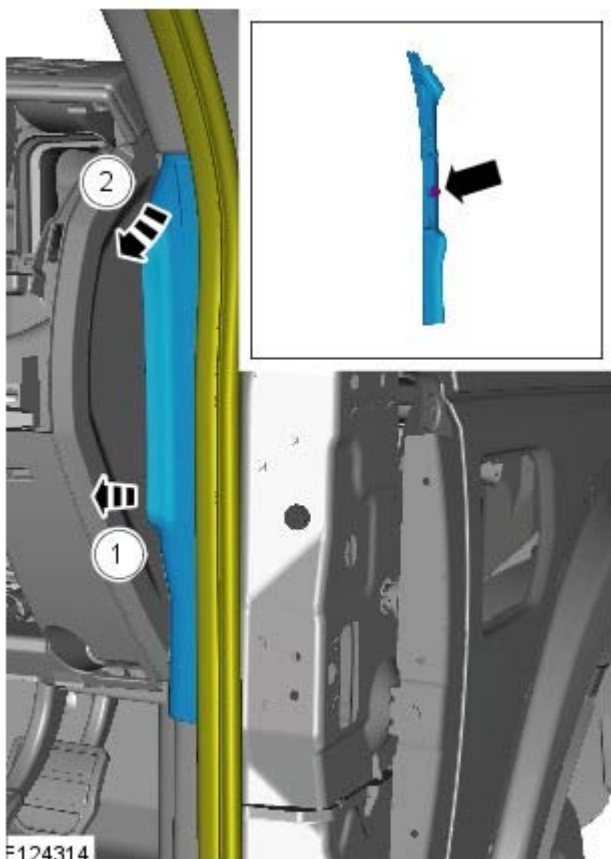
Removal and Installation

Removal

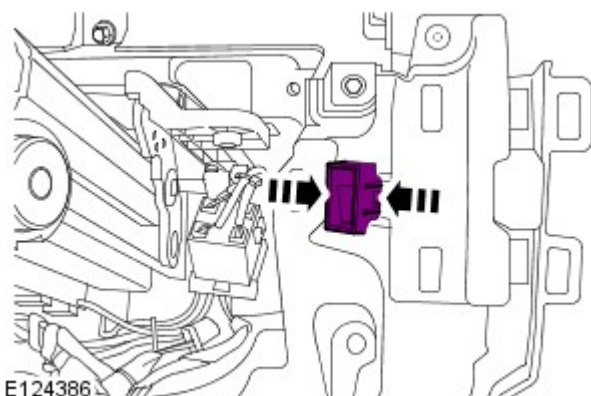
• NOTE: Removal steps in this procedure may contain installation details.

1. Fully extend the steering column for access.
2. Refer to: [Steering Wheel](#) (211-04 Steering Column, Removal and Installation).
3. Refer to: [Instrument Panel Center Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Removal and Installation).

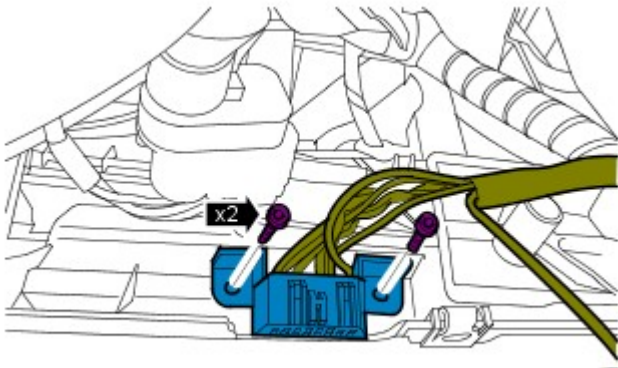
5.



6.

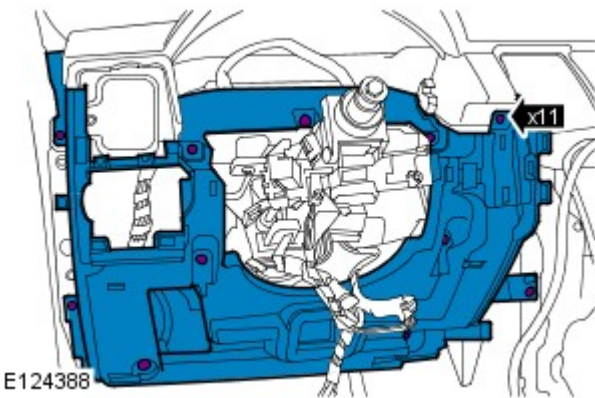


7.



E124387

8. **8.** NOTE: Left-hand drive shown, right-hand drive similar.



E124388

Installation

1. To install, reverse the removal procedure.

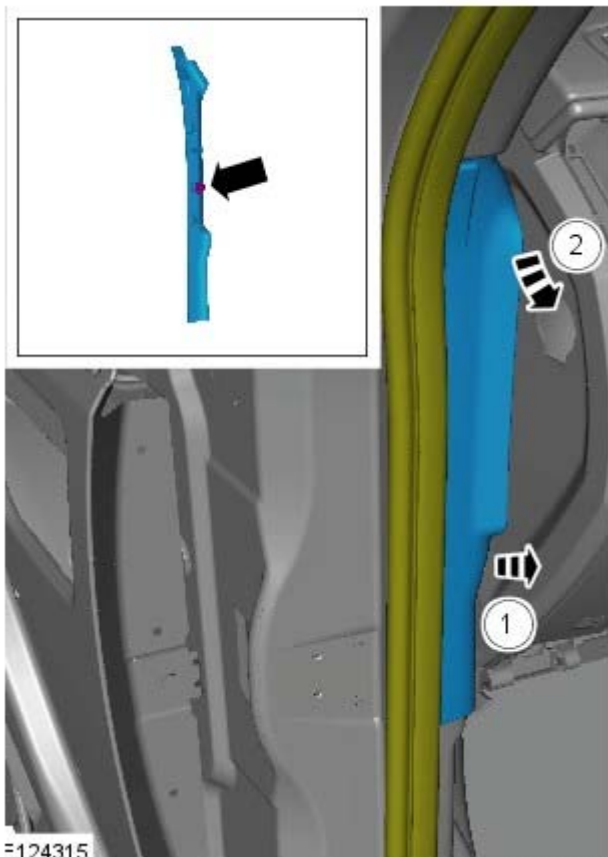
Instrument Panel and Console - Instrument Panel Passenger Side Reinforcement

Removal and Installation

Removal

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the PAD switch.
For additional information, refer to: [Passenger Air Bag Deactivation \(PAD\) Switch](#) (501-20B Supplemental Restraint System, Removal and Installation).
2. Remove the instrument panel center reinforcement.
For additional information, refer to: [Instrument Panel Center Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Detach the door weatherstrip and remove the side trim panel.

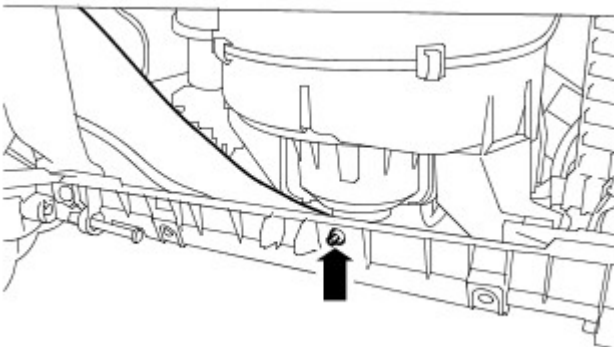


E124315

1. Release the trim panel retaining clip.
2. Remove the trim panel.

5. Remove the passenger side footwell duct.

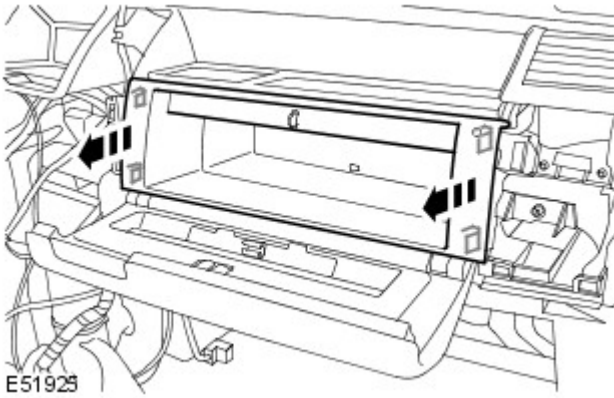
- Remove the clip.



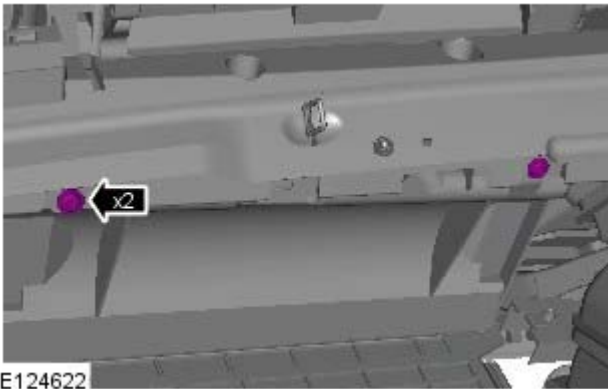
E51923

6. Remove the stowage compartment tray.

- Release the 4 clips.

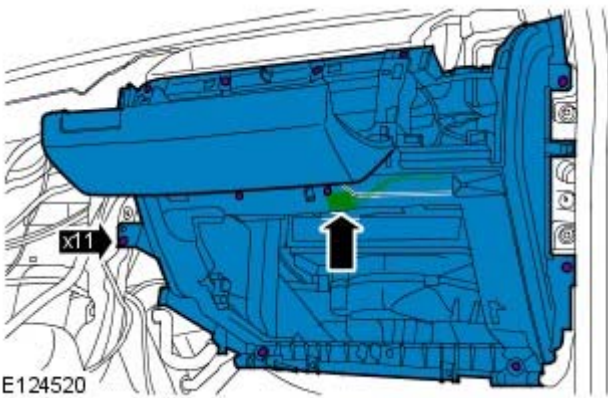


7. Remove the passenger side support bracket lower retaining screws.



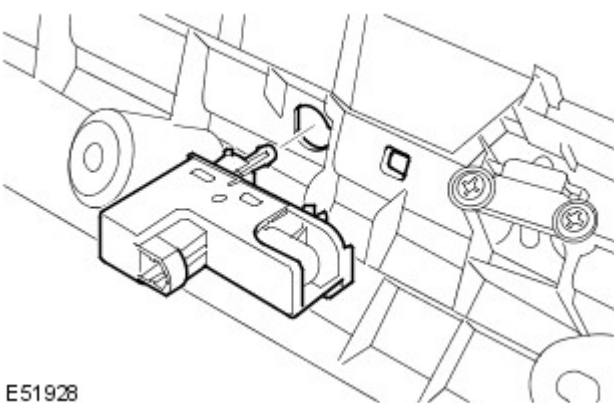
8. Remove the instrument panel passenger side reinforcement.

- Remove the 11 Torx screws.
- Disconnect the electrical connector.



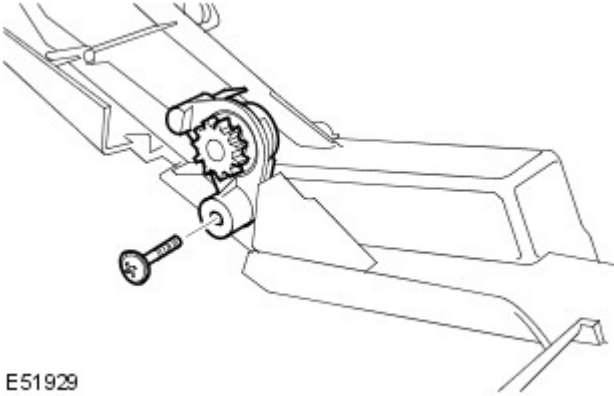
9. NOTE: Do not disassemble further if the component is removed for access only.

Remove the glove compartment lamp.



10. Remove the glove compartment damper.

- Remove the Torx screw.

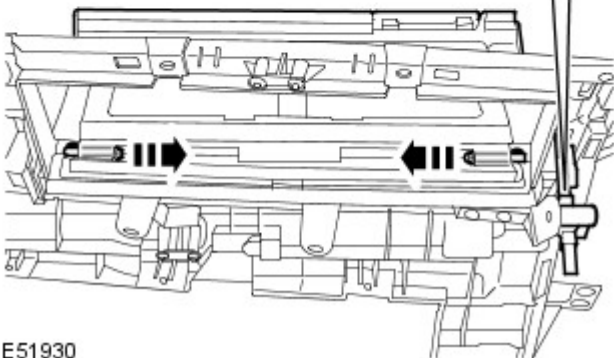
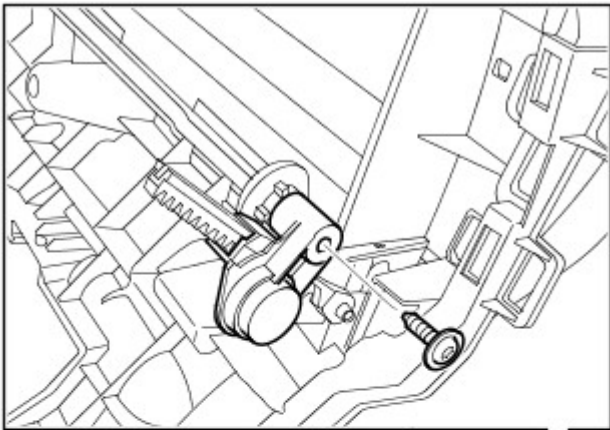


E51929

11. NOTE: Note the position of the hinge pin and spring prior to removal.

Remove the stowage compartment lid.

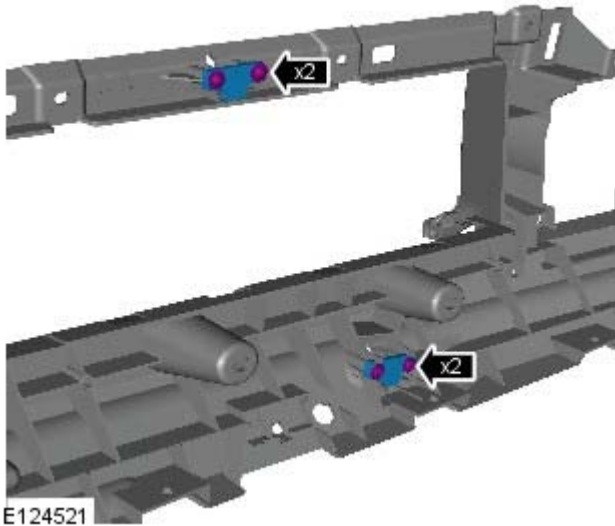
- Remove the 2 hinge pins.
- Release the 2 hinge springs.
- Remove the Torx screw and remove the damper.



E51930

12. Remove the glove and stowage compartment strikers.

- Remove the 4 Torx screws.



Installation

1. Install the glove compartment damper.
 - Tighten the Torx screw.
2. Install the stowage compartment lid.
 - Install the damper and tighten the Torx screw.
 - Attach the hinge springs.
 - Install the hinge springs.
3. Install the glove and stowage compartment strikers.
 - Tighten the screws.
4. Install the glove compartment lamp.
5. Install the instrument panel passenger side reinforcement.
 - Connect the electrical connector.
 - Tighten the Torx screws.
6. Install the passenger side support bracket lower retaining screws.
7. Install the passenger side footwell duct.
 - Install the clip.
8. Install the stowage compartment tray.
 - Secure the clips.
9. Install the side trim panel and attach the door weatherstrip.
10. Install the glove compartment.

For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).
11. Install the instrument panel center reinforcement.

For additional information, refer to: [Instrument Panel Center Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
12. Install the PAD switch.

For additional information, refer to: [Passenger Air Bag Deactivation \(PAD\) Switch](#) (501-20B Supplemental Restraint System, Removal and Installation).

Instrument Panel and Console - Instrument Panel Center Reinforcement

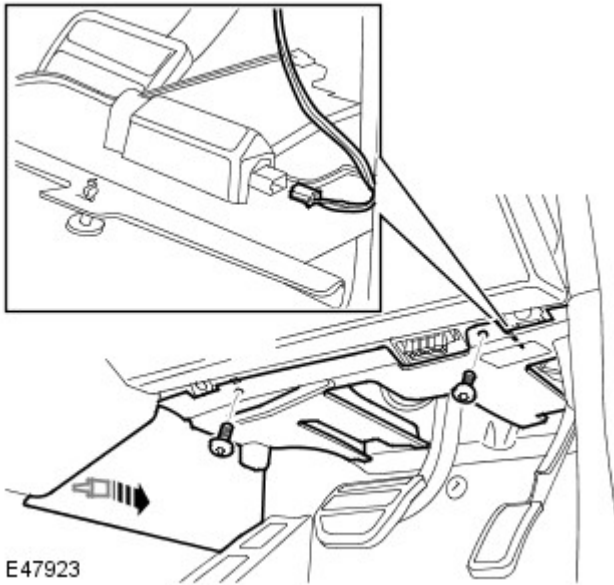
Removal and Installation

Removal

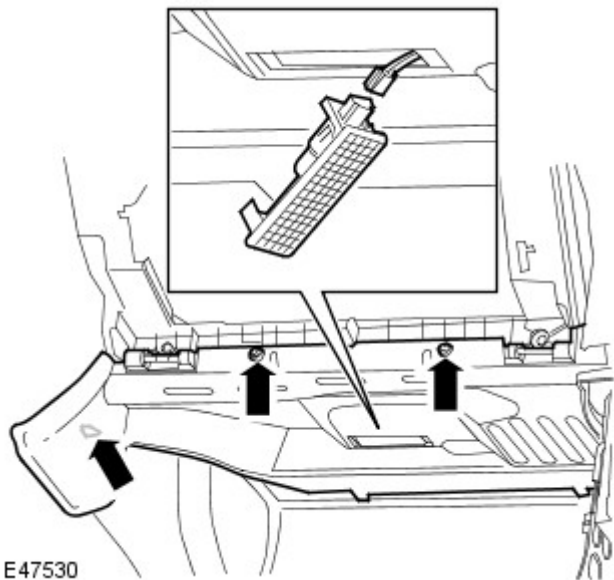
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

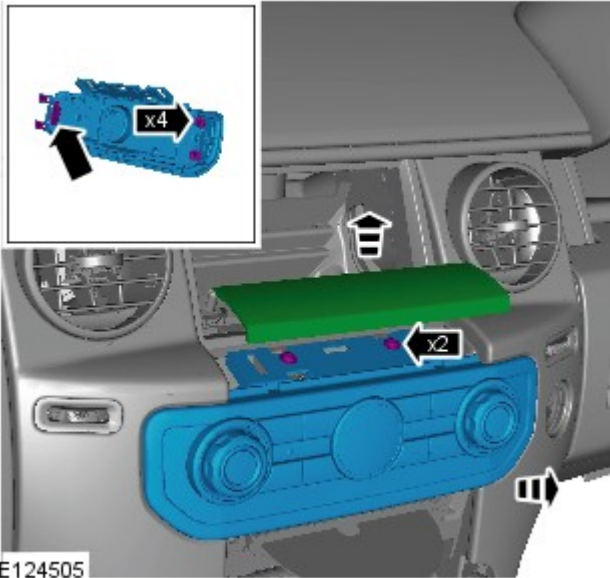
1. Refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).

2.



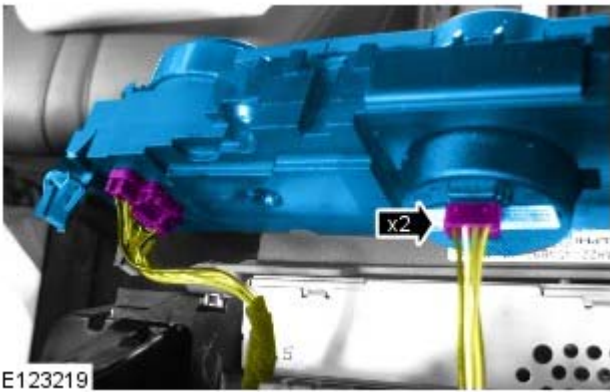
3.





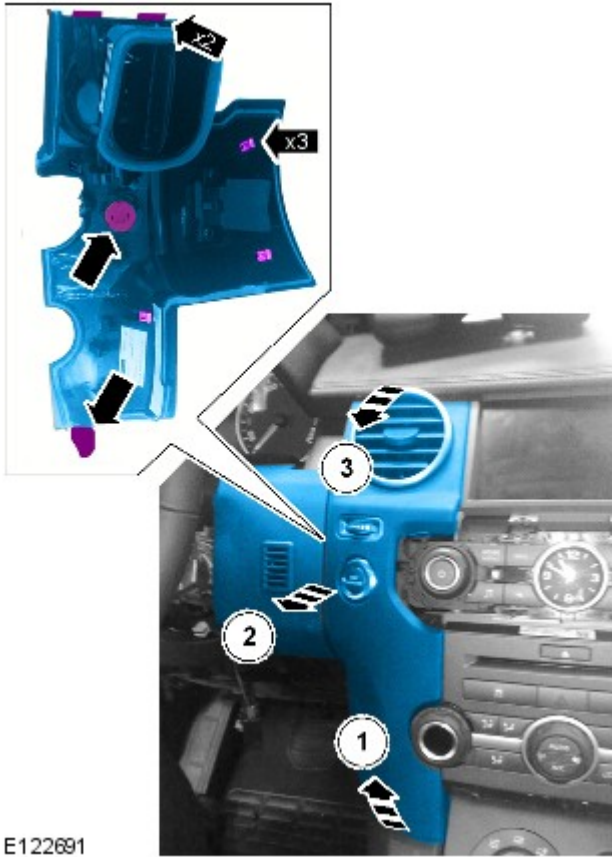
E124505

4.



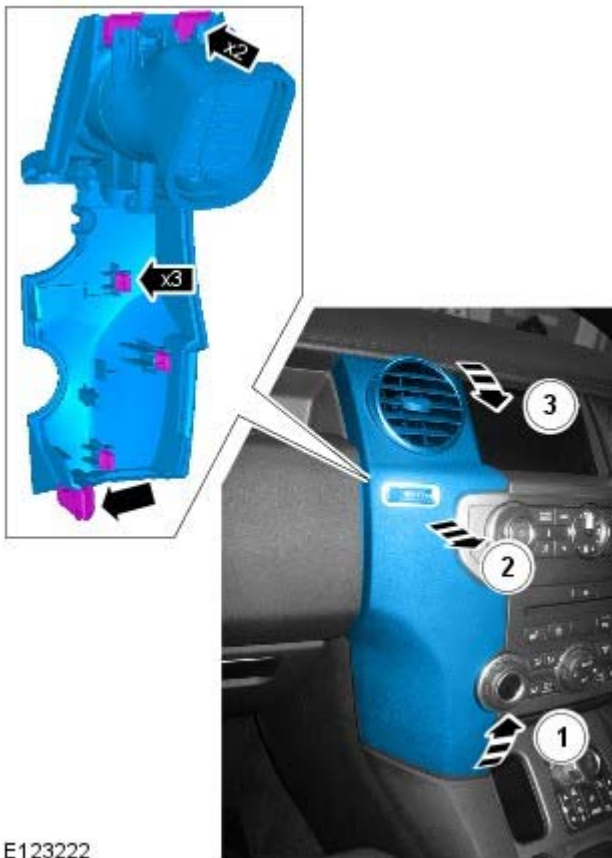
E123219

5.



E122691

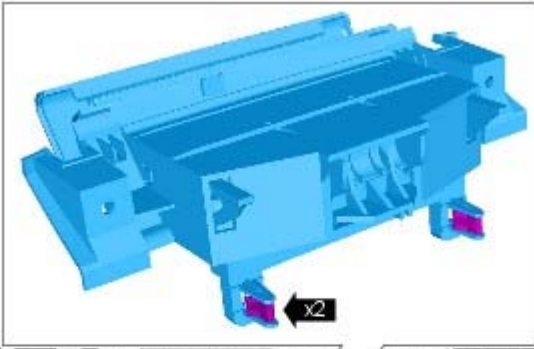
6. 6. NOTE: LHD shown, RHD similar.



E123222

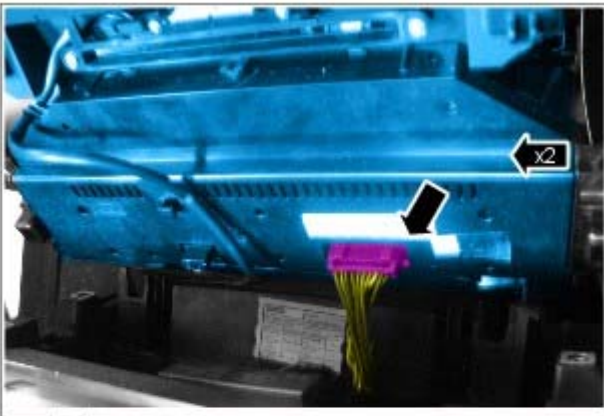
7. 7. NOTE: RHD shown, LHD similar.

8.



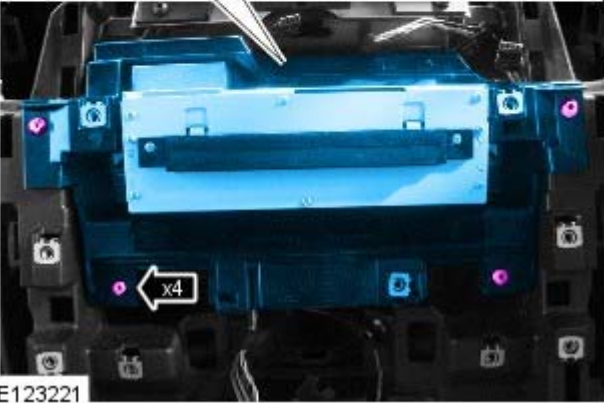
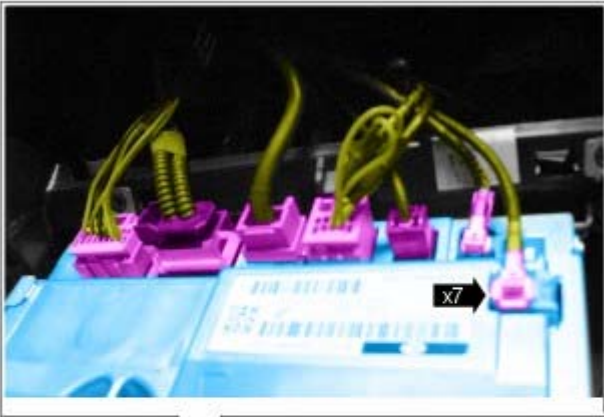
E123298

9.



E123220

10.



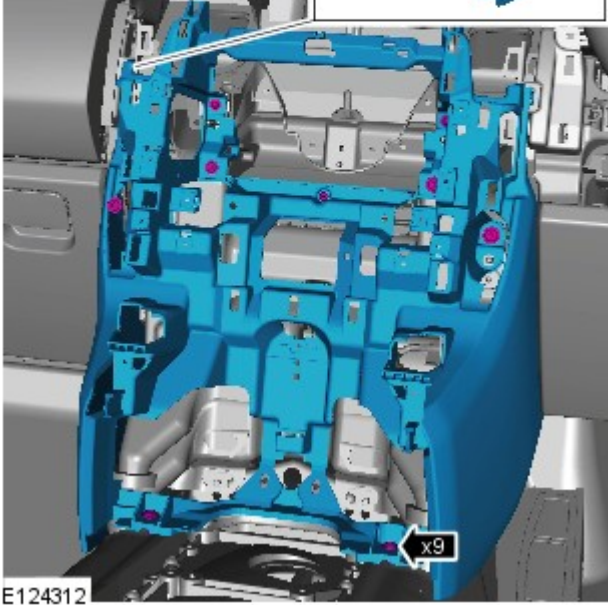
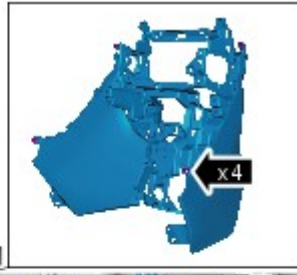
E123221

11.



E 122790

12.




E124312

Installation

1. To install, reverse the removal procedure.

Instrument Panel and Console - Glove Compartment

Removal and Installation

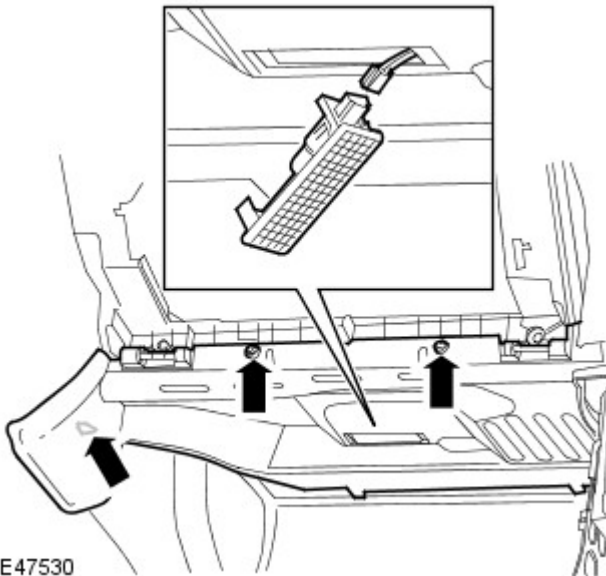
Special Tool(s)	
	Glove compartment hinge pin remover
	501-113

E54897

Removal

1. Remove the closing trim panel.

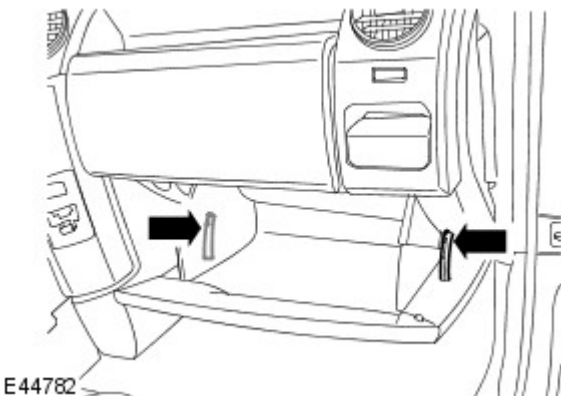
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



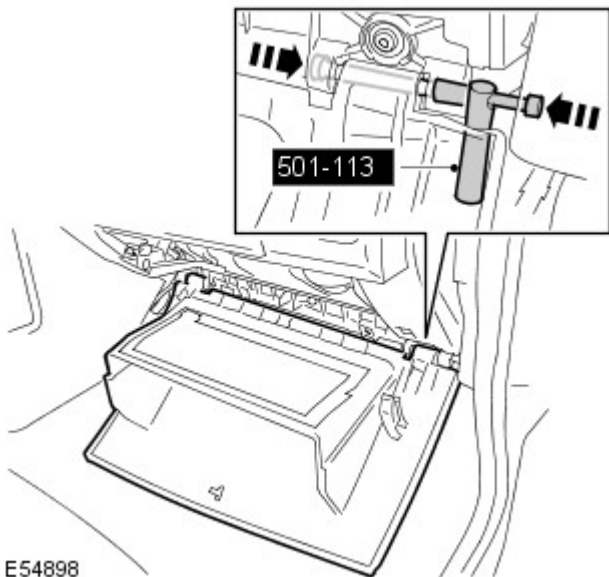
E47530

2. Open the glove compartment to the service condition.

- Release the glove compartment latch stops.



E44782



E54898

3.  **CAUTION:** If the hinge pin will not release, rotate the pin through 90 degrees to aid removal.

Using the special tool, remove the glove compartment.

- Apply pressure to the head of the hinge pin and install the special tool. Remove the hinge pin.
- Repeat the above procedure for the remaining hinge pin.

Installation

1. Install the glove compartment.
 - Install the hinge pins.
2. Close the glove compartment.
 - Secure the latch stops.
3. Install the closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.

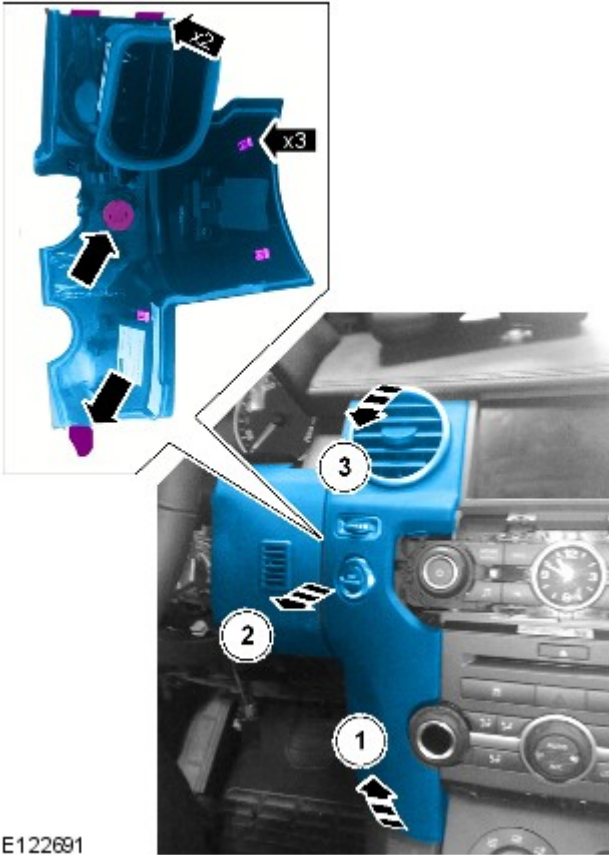
Instrument Panel and Console - Instrument Panel Console Switch Assembly

Removal and Installation

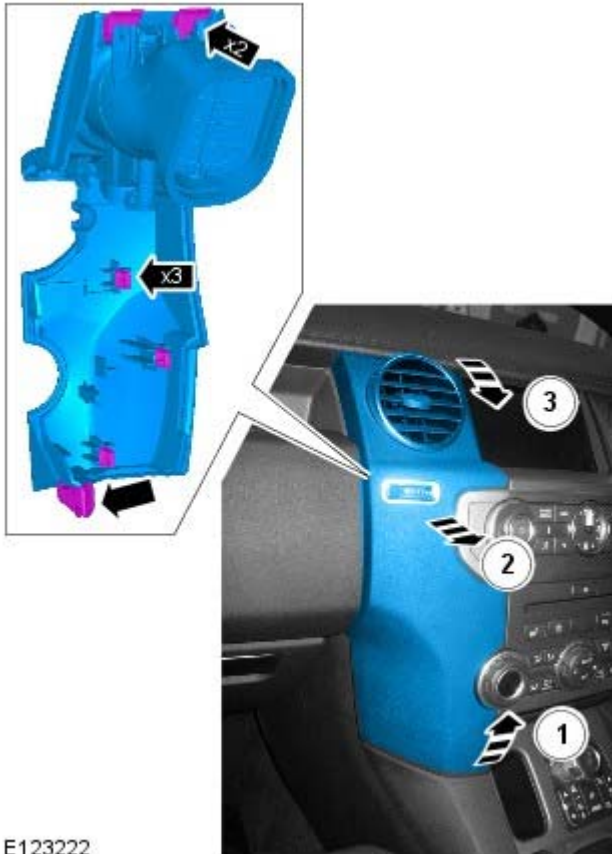
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

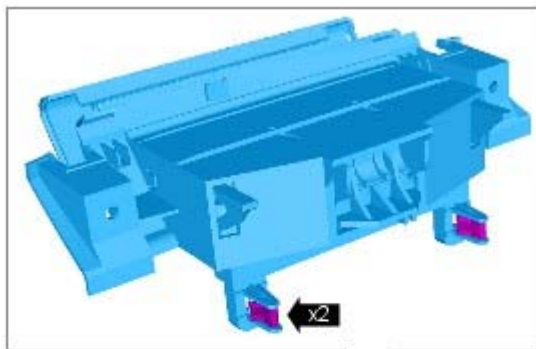
1. 1. NOTE: LHD shown, RHD similar.



E122691

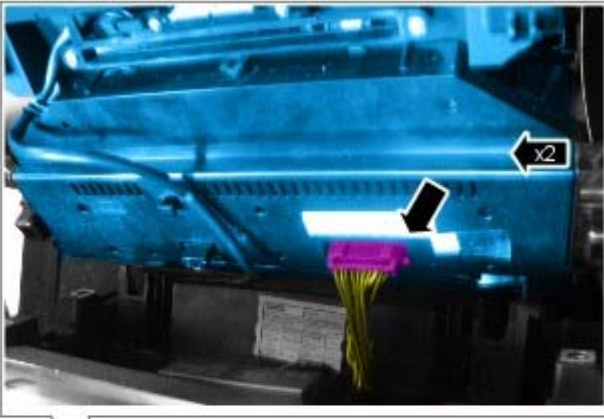


2. **2.** NOTE: RHD shown, LHD similar.



3. **3.** NOTE: Floor console shown removed for clarity.

4.



Installation

1. To install, reverse the removal procedure.

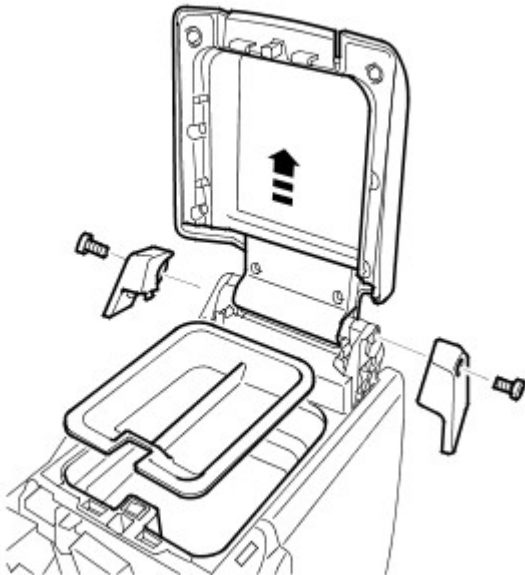
Instrument Panel and Console - Cool Box

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the floor console upper panel.
For additional information, refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the floor console lid.

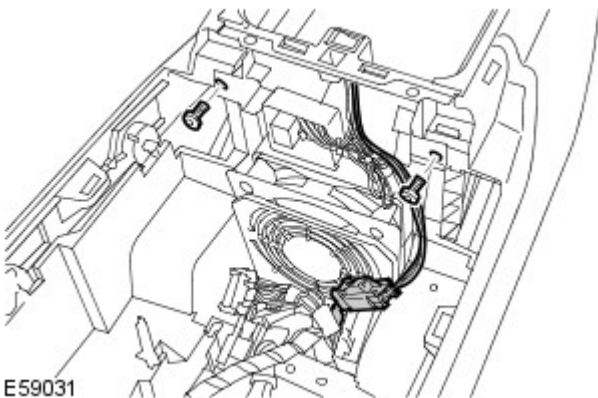
- Open the lid.
- Remove the 2 Torx bolts.
- Remove the 2 covers.



E59030

4. Remove the floor console cool box.

- Remove the 2 Torx screws.
- Disconnect the electrical connector.



E59031

Installation

1. Install the floor console cool box.
 - Connect the electrical connector.
 - Tighten the screws.
2. Install the floor console lid.
 - Install the covers.
 - Tighten the Torx bolts to 3 Nm (2 lb.ft).
3. Install the floor console upper panel.
For additional information, refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Handles, Locks, Latches and Entry Systems -

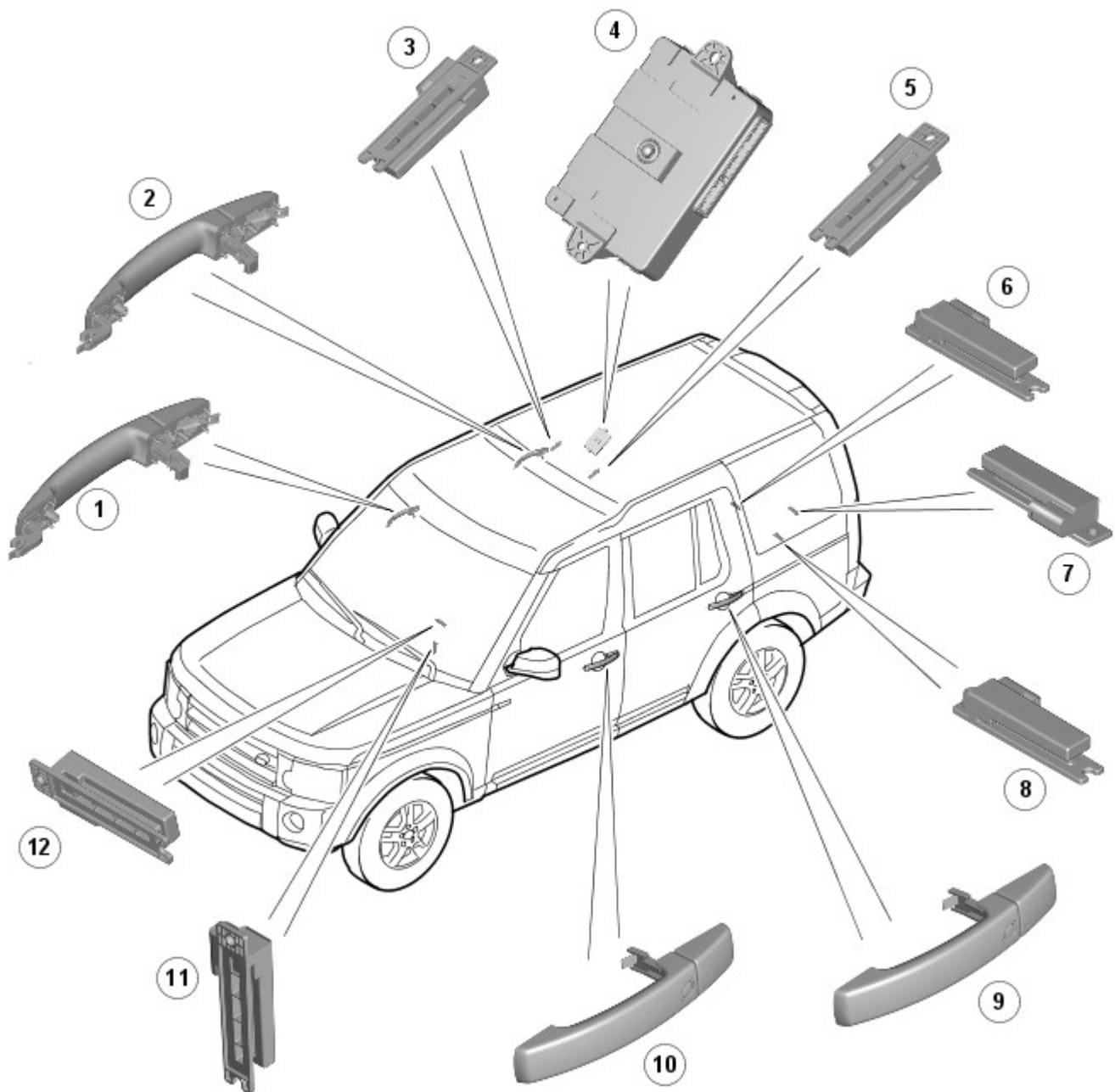
Torque Specifications

Description	Nm	lb-ft
Hood latch release handle bolt	5	3.7
Liftgate latch actuator bolts	10	7
Liftgate latch Torx screws	10	7
Liftgate striker bolts	25	18
Tailgate latch striker bolts	25	18
Tailgate latch Torx screws	25	18
Front door latch Torx screws	10	7
Rear door latch Torx screws	10	7

Handles, Locks, Latches and Entry Systems - Handles, Locks, Latches and Entry Systems

Description and Operation

Passive Entry - Antenna and Keyless Vehicle Module Location



E130381

Item	Part Number	Description
1	-	Door Antenna - right-hand-front
2	-	Door Antenna - right-hand-rear
3	-	Interior Antenna - roof lining
4	-	Keyless Vehicle Module
5	-	Interior Antenna - roof lining
6	-	Interior Antenna - luggage compartment
7	-	Bumper Antenna - rear bumper
8	-	Interior Antenna - luggage compartment
9	-	Door Antenna - left-hand-rear
10	-	Door Antenna - left-hand-front
11	-	Interior Antenna - front compartment (passive start only)
12	-	Interior Antenna - front compartment

OVERVIEW

The hinged panels are secured with latches and strikers. A remotely operated central locking system controls the locking

and unlocking of the door and luggage compartment latches.

A radio frequency Smart Key allows the vehicle to be locked and unlocked by pressing the appropriate handset buttons. Two levels of central locking system are available:

- Remote central locking, and an
- optional passive entry.

The passive entry and associated passive start system allows the driver to unlock and start the vehicle without using a vehicle key in a door-lock or ignition switch. The passive entry system is an optional fitment while the passive start system is a standard fitment on all vehicles. The passive start system is combined with the passive anti-theft immobilization system.

For additional information, refer to: [Anti-Theft - Passive](#) (419-01B Anti-Theft - Passive, Description and Operation).

Emergency access to the vehicle is provided by a concealed key barrel located in the front left-hand door handle. The key barrel is concealed by a plastic cover which can be removed by inserting the blade of the emergency key into a slot in the cover. The removable emergency key blade is located in the Smart Key.

Operation of the key barrel unlocks the vehicle but does not disarm the alarm system. Locking and unlocking conditions using the emergency key in the door key barrel are:

- If the alarm is not armed the vehicle can be centrally unlocked.
- If the alarm is armed the door only can be opened and the alarm will be triggered.
- The vehicle cannot be double locked or the alarm system armed using the emergency key.

The vehicle can be centrally locked and unlocked from inside using the interior handle release levers on the front doors only. The driver can select locking options, single point entry or drive away locking for example, from a menu available on the touch screen.

Central Locking – Radio Frequency Remote System

The radio frequency central locking system provides locking and unlocking from inside the vehicle and outside within a 20 meter range. The system is operated using buttons on the Smart Key, which transmits radio frequency signals to the radio frequency receiver.

Additional buttons on the Smart Key provide for the convenience operation of the headlamp delay, panic alarm and tailgate release.

Depending on vehicle market, functions offered by the Smart Key include:

- Double locking the doors from outside the vehicle if the lock button on the Smart Key is pressed twice within 3 seconds.
- Drive-away locking - switched on or off by the customer using the vehicle security settings menu available on the touch screen.
- Single or two stage unlocking - single-stage unlocking unlocks all doors with a single press; two-stage unlocking unlocks the driver's door only with a single press and all other doors with a second press.

Changing the unlocking mode between single stage and two-stage also affects the unlocking mode for passive entry (see below). The single or two-stage unlocking function can be switched on or off, as can remote global open or close for the electric windows using the vehicle security settings menu available on the touch screen.

The fuel filler flap is locked by the global locking function. It is not locked by drive-away locking, or if doors are locked from inside the vehicle using the handles.

Actuated from the front door levers only, the doors can be locked from inside the vehicle by pressing the interior door release levers inwards and unlocked by pulling the levers. The touch-screen incorporates a valet mode feature which inhibits access to the glove box while also limiting the use of the touch-screen.

On leaving the vehicle with passive entry the user must press an external button on the door handle once to centrally lock the vehicle or twice within 3 seconds to double lock. The user has a further 3 seconds to pull the door handle to check the vehicle is locked without the Smart Key proximity function unlocking the door again. Pulling the handle after the 3 seconds has lapsed will unlock the door as normal.

If any aperture is not fully closed when the locking process is initiated, either passively or by the Smart Key transmitter, the locking function will be inhibited and an audible error indication will be given. If the ignition is left on an audible warning will be given if the user exits the vehicle, if the user attempts to lock the vehicle (ignition on), another audible indication will be given, and the locking function will be inhibited.

If the door is closed without locking and no key left in the car the ignition will be switched off immediately. If the ignition is left on at any time without starting the vehicle it will switch off automatically after 60 minutes.

If the door is opened by the mechanical key, the full alarm system will sound until the user enters the vehicle and presses either:

- the start/stop button, or
- Smart Key unlock button.

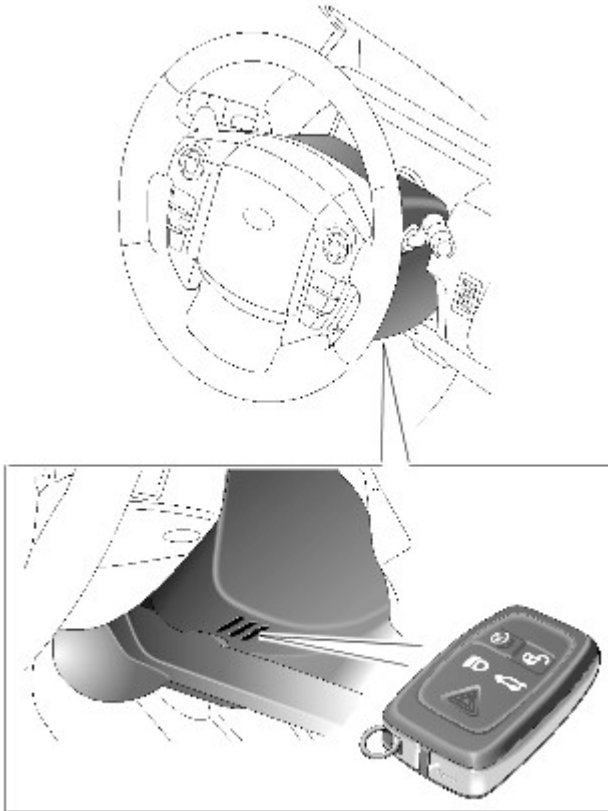
• **NOTE:** If the KVM (keyless vehicle module) fails to locate the Smart Key, a message 'SMART KEY NOT FOUND REFER TO HANDBOOK' will appear in the instrument cluster message center and the keyless start back-up process will have to be used to mobilize and start the vehicle.

Keyless Start Backup

If the vehicle has been unlocked using the emergency key blade or the Smart Key is not detected by the vehicle, it will be necessary to use the keyless start backup to disarm the alarm and start the engine. The following process must be followed in this event:

- Position the Smart Key against the underside of the fascia, on the outboard side of the steering column, with the buttons facing downwards. This is the location of the IAU (immobilizer antenna unit).
- Holding the Smart Key in position and the brake / clutch pedal depressed, press the start/stop button to start the engine.

Smart Key positioned next to immobilizer antenna unit



E129977

This process bypasses the data exchange between the KVM and the [CJB \(central junction box\)](#); this is an inductive process and will operate if the battery in the Smart Key is discharged. A transponder within the Smart Key is detected by the IAU. The IAU confirms the code output from the transponder and communicates this code confirmation with the [CJB](#) via a LIN (local interconnect network) bus connection. The [CJB](#) then initiates the vehicle start process in the normal manner.

PASSIVE ENTRY SYSTEM

The passive entry system is controlled by the KVM and low frequency antennas in each door handle and one in the rear bumper; antennas are also strategically situated within the vehicle. When inside the vehicle, the antennas ensure the Smart Key is always within the active transmission zone of the antennas no matter where the Smart Key is placed inside the vehicle. For this reason the orientation and positioning of the antennas is critical to the correct functioning of the system.

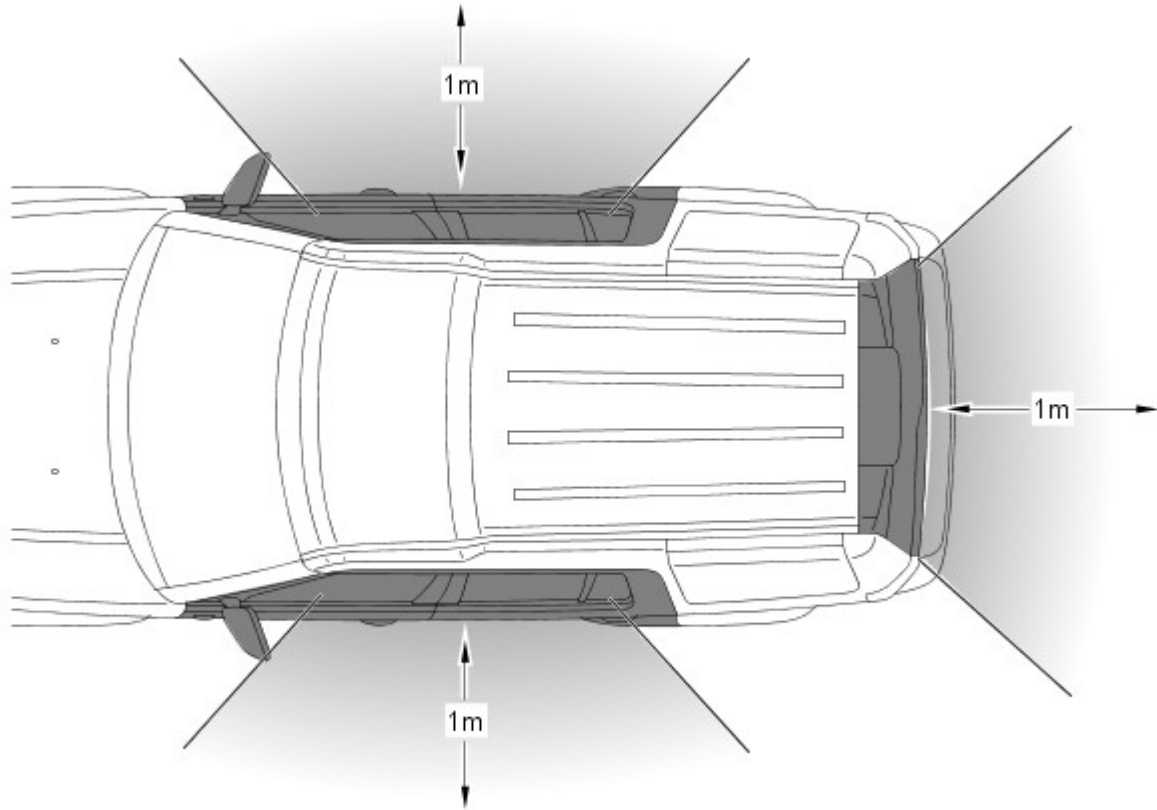
The vehicle can be unlocked without the use of a key-blade or buttons on the Smart Key.

When an external door handle is grasped and the Smart Key is within one meter (3.3ft.) of the handle; the Smart Key receives a low-frequency signal transmitted from the handle.

The Smart Key responds with a radio frequency transmission of its authorization code. The radio frequency signal is received by the Radio-Frequency receiver and passed to the keyless vehicle module which checks and approves the code as valid.

The KVM then drives the fast latch directly to allow the door to be opened. The keyless vehicle module also transmits an unlock request to the [CJB](#). The [CJB](#) then passes an unlock request to the door modules.

Door-handle antenna operating area



E117707

Locking of the vehicle is performed by pressing one of the buttons located on each exterior door handle, with the Smart Key within a one meter range of the vehicle. When the door handle button is pressed, the KVM transmits a low-frequency signal via the handle antenna to the Smart Key. The Smart Key transmits a radio frequency signal which is verified by the KVM and allows the doors to be locked or double locked and the alarm system to be armed.

To double lock the vehicle, the button on the exterior door handle must be pressed twice within three seconds, with the Smart Key within one meter range of the vehicle. If a door, hood or the tailgate door is ajar when an attempt to lock the vehicle is made, an error tone is emitted and no locking action will occur. For additional information, refer to: [Anti-Theft - Active](#) (419-01A Anti-Theft - Active, Description and Operation).

When unlocking the vehicle using passive entry with single stage unlocking selected and a valid Smart key present, grasping the door handle will centrally unlock the vehicle. When the vehicle is configured for two stage unlocking and the drivers door handle is grasped with a valid Smart Key present only the drivers door will unlock, however if a passenger door handle is grasped with a valid Smart Key present the vehicle will centrally unlock.

- NOTE: Placing the key in a metallic container, a metal briefcase for example, may hinder its operation.
- NOTE: Passive locking will only activate if the key is outside the vehicle. If no key is present, two audible error warnings will sound.

To globally close the vehicle pressing and holding the button on the door handle locks the vehicle, arms the alarm and closes all open windows, not the sunroof. The windows will stop closing when the button is released.

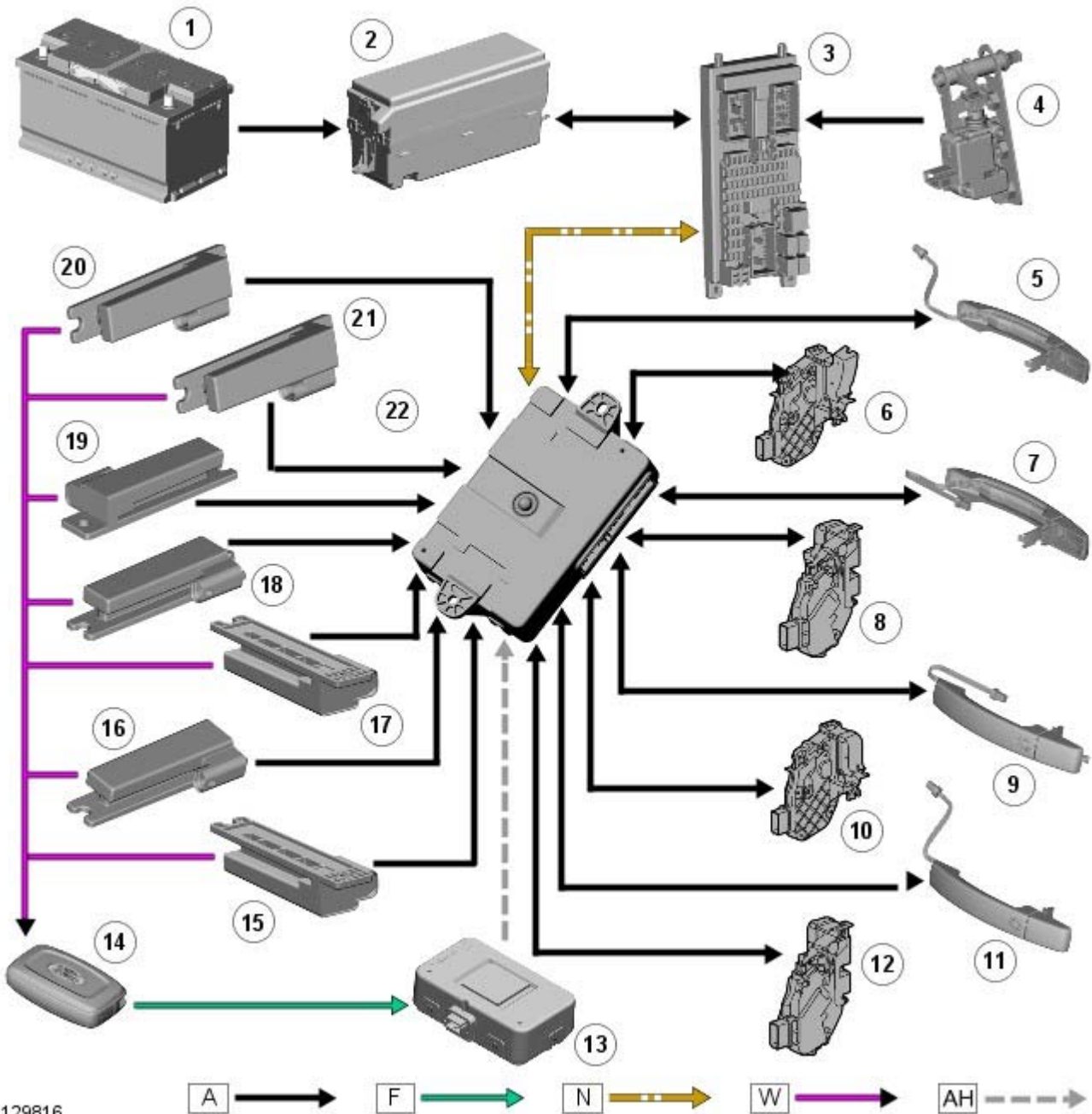
Capacitive Door Handle

The new exterior door operates using the following principle. A capacitive plate is molded internally within the handle, the vehicle exterior body acts as a second capacitive plate; air between the two acts as an insulator. The control electronics within the door handle evaluate the capacitance of the circuit, when a hand interrupts the space between the electrical field is altered and thus the capacitance of the capacitor. This signal is used to trigger the KVM to initiate the unlock process. This signal is calibrated so as not to detect false activations, for example, rain water or soiling.

- NOTE: Extreme water levels can trigger an unlock signal, for example, when washing a locked vehicle with a hose or high powered jet nozzle, providing the key is in the detection zone.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **F** = RF transmission; **N** = Medium Speed CAN; **W** = LF transmission; **AH** = Serial Communication Link



E129816



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	CJB
4	-	Tailgate release switch
5	-	Door handle, lock/unlock switch and antenna – right-hand-front
6	-	Door latch and fast latch - right-hand-front
7	-	Door handle, lock/unlock switch and antenna – left-hand-front
8	-	Door latch and fast latch - left-hand-front
9	-	Door handle, lock/unlock switch and antenna – right-hand-rear
10	-	Door latch and fast latch - right-hand-rear
11	-	Door handle, lock/unlock switch and antenna – left-hand-rear
12	-	Door latch and fast latch - left-hand-rear
13	-	Radio frequency receiver
14	-	Smart Key
15	-	Antenna
16	-	Antenna
17	-	Antenna
18	-	Antenna
19	-	Antenna
20	-	Antenna
21	-	Antenna
22	-	Keyless Vehicle Module

PRINCIPLES OF OPERATION

Passive Entry - Locking/Unlocking Process

The vehicle unlocking procedure is carried out in the following way.

With the key within one meter of the approached door and the handle grasped a signal is sent to the KVM which responds with the following simultaneous actions:

- The KVM energizes the low frequency antenna in the door handle which transmits a 125 KHz signal to the key.
- On receipt of the low frequency signal the Smart Key transmits a radio frequency signal '433.92 MHz Europe' '315 MHz NAS / ROW' containing its authorization code to the RF (radio frequency) receiver.
- The RF receiver relays the code, via a serial communication line, to the KVM which checks and approves the code as valid.
 - The KVM will only respond if the radio frequency signal produced is from a valid key for the vehicle.
- The KVM transmits the unlock request to the [CJB](#) via the medium-speed [CAN \(controller area network\)](#) bus.
- The [CJB](#) confirms and sends the request, via the medium speed [CAN](#) bus, to the front door modules.
- The front door modules respond with the following simultaneous actions:
 - Drive the motors to unlock the front doors.
 - Transmit the door unlock request via a [LIN \(local interconnect network\)](#) data signal to the rear door modules.
- The rear door modules drive the motors to unlock the rear doors.
- When the door handle reaches 80 percent of its travel the handle clutch switch is closed and grounded sending a hardwired switched signal to the KVM.
- The KVM drives the fast latch release motors in the door latch assemblies releasing the door latches as the approached door handle is pulled through its full travel, the door can be opened.

Handles, Locks, Latches and Entry Systems - Locks, Latches and Entry Systems

Diagnosis and Testing

Principle of Operation

For a detailed description of the locks, latches and entry systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Incorrectly aligned door(s), hood or tailgate ● Fuel filler door lock actuator ● Hood release handle ● Hood release cables ● Hood latch(es) ● Exterior door handle(s) ● Interior door handle(s) ● Cable(s) ● Tailgate release switch ● Rear window release switch 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Wiring connector(s) ● Door lock actuator(s) ● Remote transmitter (key-fob or smart key) ● Central locking switches ● Controller Area Network (CAN) circuits ● Radio frequency (RF) receiver ● Central junction box (CJB) ● Loose or corroded connections

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

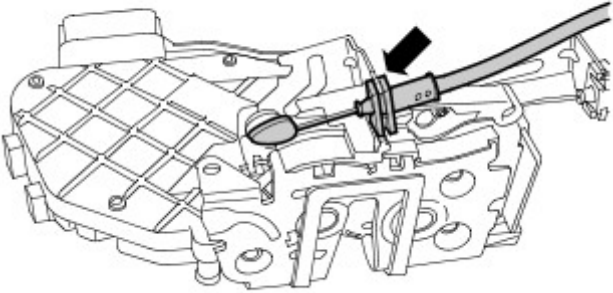
Symptom	Possible causes	Action
Door(s) will not open from outside	<ul style="list-style-type: none"> ● Exterior door handle condition/installation ● Exterior release cable disconnected from exterior door handle or door latch ● Door latch failure 	<ul style="list-style-type: none"> ● Check the exterior door handle condition and installation ● Check the condition and security of the exterior release cable ● Check the operation of the latch GO to Pinpoint Test A.
Door(s) will not open from inside	<ul style="list-style-type: none"> ● Child lock(s) engaged ● Interior door handle condition/installation ● Interior release cable disconnected from interior door handle or door latch ● Door latch failure 	<ul style="list-style-type: none"> ● Check that the child locks are disengaged ● Check the interior door handle condition and installation ● Check the condition and security of the interior release cable ● Check the operation of the latch. GO to Pinpoint Test A.
The message center indicates that the hood, the tailgate or a door is open when it appears to be closed Vehicle indicates a miss-lock when the hood, tailgate and doors appear to be closed	<ul style="list-style-type: none"> ● Incorrect striker alignment/adjustment ● Ajar switch circuit short circuit to ground ● Ajar switch failure 	<ul style="list-style-type: none"> ● Check/adjust the strikers as necessary ● Check for DTCs indicating an ajar switch fault. Refer to the DTC index
Fuel flap does not lock/unlock	<ul style="list-style-type: none"> ● Fuel flap cable detached from body ● Fuel flap actuator detached from mounting bracket ● Fuel flap actuator disconnected ● Fuel flap actuator failure 	<ul style="list-style-type: none"> ● Check the condition and installation of the fuel flap cable ● Check the security of the fuel flap actuator and bracket ● Check the security of the actuator electrical connector ● Check for DTCs indicating a fuel flap actuator fault. Refer to the DTC index

Symptom	Possible causes	Action
Door latching and locking function test	<ul style="list-style-type: none"> ● Door latch ● Cable fault ● Door handle ● Door lock switch ● Wiring harness ● Central junction box (CJB) 	<ul style="list-style-type: none"> • NOTE: Complete the diagnostic steps below to confirm any concern prior replacing the component ● Check for relevant stored DTCs ● Once any DTC related faults have been rectified continue with the diagnostic steps below ● The first component that should be checked when experiencing locking or latching issues are the door latch release cables, then the door latch. These can be tested as a discrete components to confirm if the specific component is working as designed or is demonstrating a fault ● Single door will not open from the outside (but opens from the inside)GO to Pinpoint Test A. ● Single Door Will Not Open From The Inside (but opens from the outside)GO to Pinpoint Test B. ● Door Latching and Locking Function TestGO to Pinpoint Test C. ● No lock / unlock function from key-fobGO to Pinpoint Test E.
Latch mounted door ajar switch test	<ul style="list-style-type: none"> ● Door latch ● Wiring harness ● Instrument cluster 	<ul style="list-style-type: none"> ● Latch Mounted Door Ajar Switch TestGO to Pinpoint Test D.
Vehicle electrical system test	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Wiring connector(s) 	<ul style="list-style-type: none"> ● Vehicle Electrical System TestGO to Pinpoint Test E. ● Check for relevant stored DTCs ● Refer to the electrical circuit diagrams to locate the fault ● Carry out continuity test to confirm circuit integrity

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Door Module \(DDM/PDM\)](#) (100-00 General Information, Description and Operation).

Pinpoint Test

PINPOINT TEST A : SINGLE DOOR WILL NOT OPEN FROM THE OUTSIDE (BUT OPENS FROM THE INSIDE)	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: CHECK THE EXTERIOR DOOR RELEASE CABLE TO EXTERIOR DOOR HANDLE IS INSTALLED CORRECTLY	
	<ol style="list-style-type: none"> 1 Remove the door trim panel as necessary. REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation). 2 Confirm the exterior door release cable is correctly installed to the exterior door handle
	<p>Is the cable correctly installed?</p> <p>Yes GO to A2.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation.</p>
A2: CHECK THE EXTERIOR DOOR HANDLE RELEASE CONNECTION TO THE DOOR LATCH	
 <p>E45779</p>	<ol style="list-style-type: none"> 1 Confirm the exterior door handle release connection to the door latch is installed correctly

	<p>Is the exterior door handle release cable installed correctly?</p> <p>Yes GO to Pinpoint Test C.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation.</p>
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PINPOINT TEST B : SINGLE DOOR WILL NOT OPEN FROM THE INSIDE (BUT OPENS FROM THE OUTSIDE)

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
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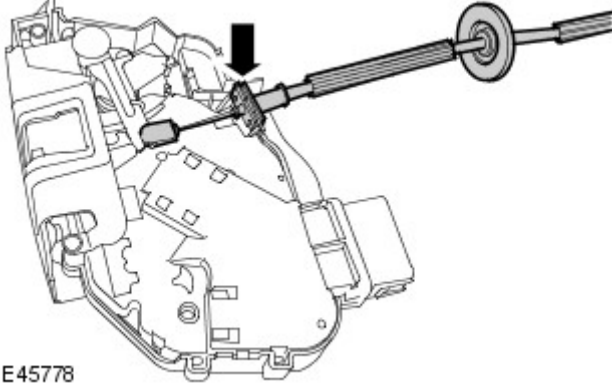
B1: CHECK THE INTERIOR DOOR RELEASE CABLE TO INTERIOR DOOR HANDLE IS INSTALLED CORRECTLY

	<p>• NOTE: Figure A - Child lock off position shown</p> <p>1 Make sure the child lock is disengaged (rear door only)</p>
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	<p>2 Remove the door trim panel as necessary REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).</p> <p>3 Confirm the interior door release cable is correctly installed to the interior door handle</p>
--	--




	<p>Is the cable correctly installed?</p> <p>Yes GO to B2.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation</p>
--	--

B2: CHECK THE INTERIOR DOOR HANDLE RELEASE CONNECTION TO THE DOOR LATCH

	<p>1 Confirm the interior door handle release connection to the door latch is installed correctly</p>
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	<p>Is the interior door handle release cable installed correctly?</p> <p>Yes GO to Pinpoint Test C.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation.</p>
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PINPOINT TEST C : DOOR LATCHING AND LOCKING FUNCTION TEST

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p>C1: DOOR LATCH TEST</p> <p>• NOTE: Test as a single component to ensure that the door latch is not replaced unnecessarily, when another component may be at fault</p>	<ol style="list-style-type: none"> 1 Remove door trim from door REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation). 2 Remove module plate / closing panel from door 3 Remove latch module from door REFER to: (501-14 Handles, Locks, Latches and Entry Systems) Front Door Latch (Removal and Installation), Rear Door Latch (Removal and Installation). 4 Inspect latch module for any visual damage 5 Disconnect interior release bowden cable at door latch 6 Disconnect exterior release bowden cable at door latch 7 With the latch in hand, connect the electrical connector(s) to connect door latch to door harness <p>• NOTE: THE LATCH IS NOW READY TO TEST</p> <ol style="list-style-type: none"> 8 Close all vehicle doors except the door being investigated
<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">1</div>  </div> <hr/> <div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="display: flex; align-items: center; margin-right: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">2</div> <div style="font-size: 48px; margin-right: 10px;">X</div> </div>  </div> <hr/> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">3</div> <div style="font-size: 48px; margin-right: 10px;">✓</div>  </div> </div> <p>E139349</p>	<ol style="list-style-type: none"> 9 Rotate latch claw (using a small screw driver or similar) to the fully latched position (Figure 3) <p>• NOTE: Figure 1 - Unlatched position shown</p> <p>• NOTE: Figure 2 - First safety latched position shown</p> <p>• NOTE: Figure 3 - Fully latched position shown</p> <p>• NOTE: Test will not work if latch is only in first safety latch position</p>



• NOTE: Unlocked position shown

10 Confirm that the latch interior release lever is in the unlocked position as shown



• NOTE: Locked position shown

11 Press the **lock** button on the key-fob or smart key

Does the latch interior release lever move from the unlocked position to the locked position?
Yes
[GO to C2.](#)
No
If this is a repeat test and the vehicle electrical test section has been completed and confirmed that vehicle is working correctly, then replace the door latch. If replacing latch as part of a warranty claim, please quote reference code **LKINOP** in the technician comments section of the warranty claim

C2: TEST 1 DOOR LATCH

 <p>E139351</p>	<p>• NOTE: Locked position shown</p> <p>1 With the latch in the locked state (i.e. the latch interior release lever is in the locked position), press the key-fob or smart key unlock button</p>
	<p>Does the latch interior release lever move from the locked position to the unlocked position?</p> <p>Yes GO to C3.</p> <p>No GO to Pinpoint Test E. If pinpoint test E has been completed and confirmed that vehicle is correctly supplying signals to latch, then replace the door latch. If replacing latch as part of a warranty claim, please quote reference code UNLKINOP in the technician comments section of the warranty claim</p>
<p>C3: TEST 2 DOOR LATCH</p>	
 <p>E139352</p>	<p>• NOTE: Fully latched position shown</p> <p>1 With the latch in its unlocked state, push the latch exterior release lever against its return spring, whilst simultaneously applying a light pressure to release the latch claw using a small screw driver or similar</p>
	<p>Does the latch claw release?</p> <p>Yes GO to C4.</p> <p>No Repeat tests C2 and C3 to confirm the fault. GO to C2. If the repeat test has confirmed that the exterior release lever will not release the claw on an unlocked latch replace the door latch. If replacing latch as part of a warranty claim, please quote reference code EXTINOP in the technician comments section of the warranty claim</p>
<p>C4: TEST 3 DOOR LATCH</p>	



E139353

• NOTE: Fully latched position shown

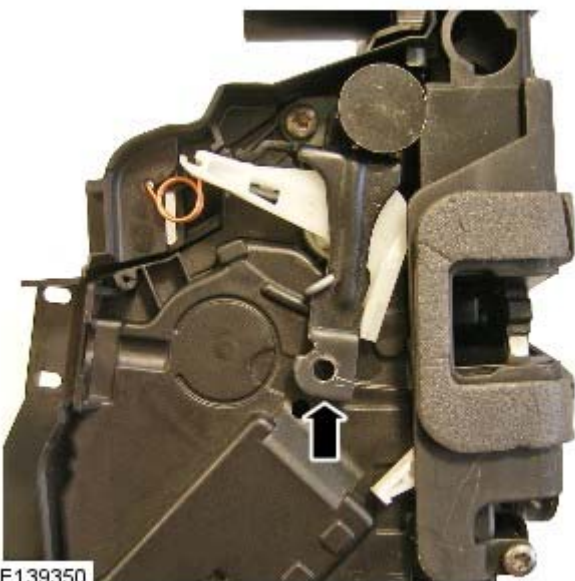
- 1 Using a small screw driver or similar, rotate latch claw to the second fully latched position



E139354


• NOTE: Figure A - Child lock off position shown

- 2 If testing a rear door latch, ensure that the child lock is turned to the off position




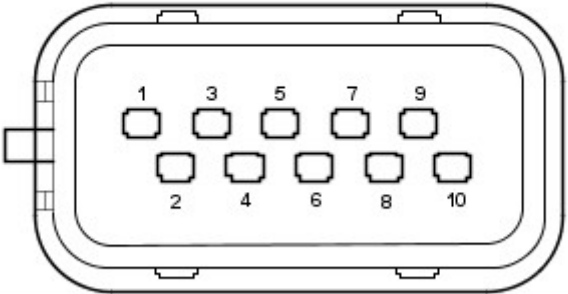


E139350

- 3 Confirm that the latch interior release lever is in the unlocked position as shown

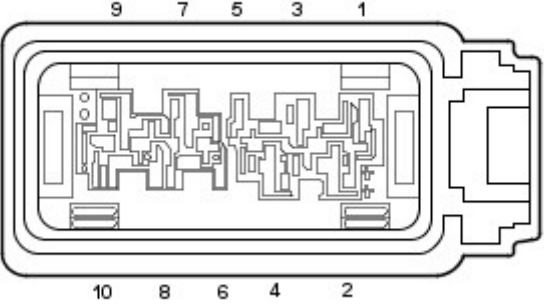
 <p>E139355</p>	<p>4] Whilst the latch is still in its unlocked state, push the latch interior release lever against its return spring, whilst simultaneously applying a light pressure to release the latch claw using a small screw driver or similar</p>
	<p>Does the latch claw release</p> <p>Yes Latch has passed all tests to confirm its correct function. DO NOT REPLACE LATCH as part of any attempts to resolve any locking functionality issues. GO to Pinpoint Test E. To confirm vehicle electrical signal is received by the latch</p> <p>No Repeat this test GO to C4. If repeat test has confirmed that the interior release lever will not release the claw when the latch is in the unlocked state, then replace the latch. If replacing latch as part of a warranty claim, please quote reference code INTINOP in the technician comments section of the warranty claim</p>

PINPOINT TEST D : LATCH MOUNTED DOOR AJAR SWITCH TEST	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: TEST 4 DOOR LATCH	
<p>• NOTE: If a customer is complaining of issues relating to a door ajar signal e.g. door latch won't lock, or alarm system triggering (indicated via DTC's), there may be several components that generate the fault, including</p>	
<ul style="list-style-type: none"> ● Door Latch ajar switch ● Alarm control module ● Central junction box ● Body wiring harness / connectors ● Door wiring harness / connectors 	
<p>• NOTE: To investigate the functioning of the door ajar switch contained within the door latch, to prove or eliminate the door latch mounted door ajar switch as the root cause, follow the process below. This will prevent the unnecessary replacement of a correctly functioning door latch</p>	
	<p>1] Remove door trim from door REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).</p> <p>2] Remove module plate / closing panel from door</p> <p>3] Remove latch module from door REFER to: (501-14 Handles, Locks, Latches and Entry Systems) Front Door Latch (Removal and Installation), Rear Door Latch (Removal and Installation).</p> <p>4] Inspect latch module for any visual damage</p>

<p>①</p> 	<ul style="list-style-type: none"> • NOTE: Figure 1 - Unlatched position shown • NOTE: Figure 2 - First safety latched position shown • NOTE: Figure 3 - Fully latched position shown • NOTE: Test will not work if latch is only in first safety latch position
<p>②</p> 	
<p>③</p>  <p>E139349</p>	<p>⑤ Using a small screw driver or similar, rotate latch claw to the second fully latched position (figure 3)</p>
 <p>E139356</p>	<p>⑥ Carry out continuity test between terminals 1 and 4 (left side) or 8 and 4 (right side) with claw closed</p>
	<p>Does the continuity test pass?</p> <p>Yes The latch ajar switch is working correctly. Do not replace latch. Investigate for fault elsewhere in vehicle system</p> <p>No Release latch claw and repeat test from step 5 to confirm result. If this is a repeat test and you are sure that the ajar switch does not provide continuity when fully latched. Replace the latch. If replacing latch as part of a warranty claim, please quote reference code AJARINOP in the technician comments section of the warranty claim</p>

PINPOINT TEST E : VEHICLE ELECTRICAL SYSTEM TEST

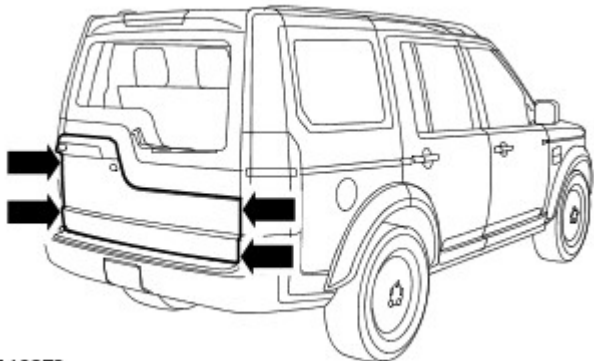
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: TEST 5 LOCK COMMAND	

 <p>E139357</p>	<p>1 Disconnect electrical connector from latch</p>
	<p>2 Close all vehicle doors apart from door being investigated, please note which door, left side or right side is under investigation</p> <p>3 Monitor the circuit for momentary power when locking the vehicle via the key-fob or smart key between terminals 1 and 10 left side or 8 and 10 right side</p>
	<p>Is there momentary power (for approx 8 seconds) between terminals 1 and 10 left side or 8 and 10 right side when locking the vehicle via the key-fob or smart key</p> <p>Yes The vehicle electrical system is locking correctly, providing the signal to the latch. GO to E2.</p> <p>No Refer to the electrical circuit diagrams and investigate why vehicle electrical system is not providing signals to the latch. Using the manufacturer approved diagnostic system check for logged DTCs to localize the fault</p>
<p>E2: TEST 6 UNLOCK COMMAND</p>	
	<p>1 Monitor the circuit for momentary power when unlocking the vehicle via the key-fob or smart key between terminals 1 and 9 left side or 8 and 9 right side</p>
	<p>Is there momentary power (for approx 8 seconds) between terminals 1 and 9 left side and 8 and 9 right side when unlocking the vehicle via the key-fob or smart key</p> <p>Yes The vehicle electrical system is unlocking correctly, providing the signal to the latch. Plug electrical connector back in to latch. Rebuild vehicle and check for correct operation</p> <p>No Refer to the electrical circuit diagrams and investigate why vehicle electrical system is not providing signals to the latch. Using the manufacturer approved diagnostic system check for logged DTCs to localize the fault</p>

Handles, Locks, Latches and Entry Systems - Tailgate Striker Adjustment

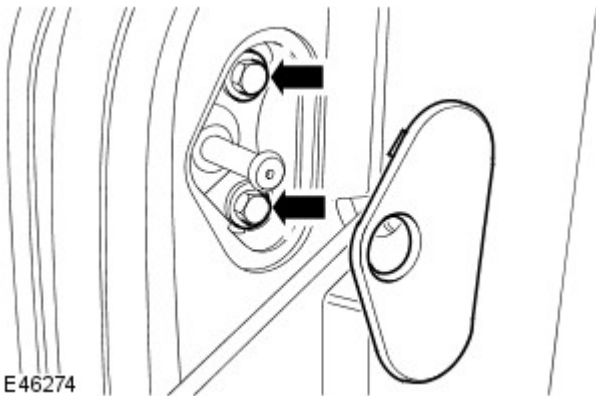
General Procedures

1. Check for an equal gap and alignment to the adjacent panels. If incorrect, follow the adjust procedure below.



E46273

2. Remove the tailgate striker trim panel.
3. Loosen the 2 tailgate striker bolts.



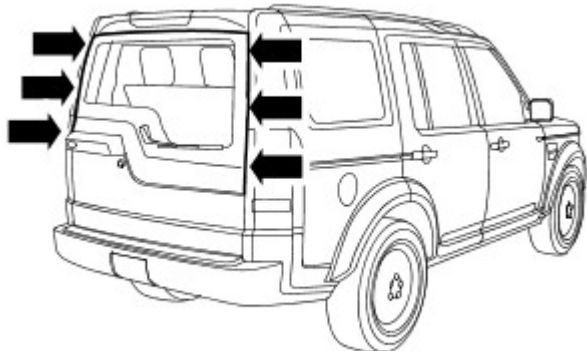
E46274

4. Close the tailgate and check for an equal gap and alignment to the adjacent panels.
5. Open the tailgate and tighten the tailgate striker bolts to 25 Nm (18 lb.ft).
6. Install the tailgate striker trim panel.

Handles, Locks, Latches and Entry Systems - Liftgate Striker Adjustment

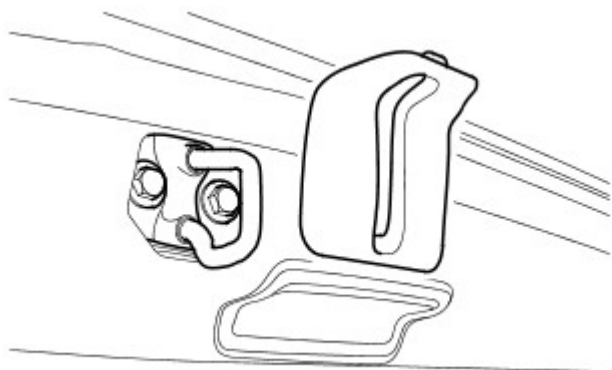
General Procedures

1. Check for an equal gap and alignment to the adjacent panels. If incorrect, follow the adjust procedure below.



E45607

2. Remove the liftgate striker trim panel.



E45600

3. Loosen the 2 liftgate striker bolts.
4. Close the liftgate and check for an equal gap and alignment to the adjacent panels.
5. Open the liftgate and tighten the liftgate striker bolts to 25 Nm (18 lb.ft).
6. Install the liftgate striker trim panel.

Handles, Locks, Latches and Entry Systems - Ignition Lock Cylinder

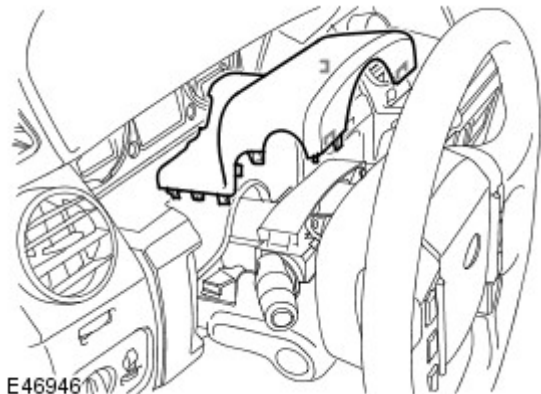
Removal and Installation

Removal

• NOTE: This procedure is for removal and installation of the ignition lock cylinder. The ignition lock and door lock cylinders are replaced in sets.

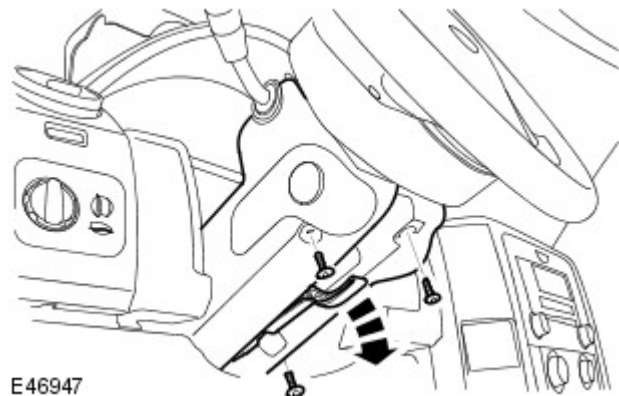
1. Fully extend the steering column for access.
2. Remove the steering column upper shroud.

- Release the 4 clips.



3. Remove the steering column lower shroud.

- Remove the 3 Torx screws.
- Release the steering column adjustment lever.

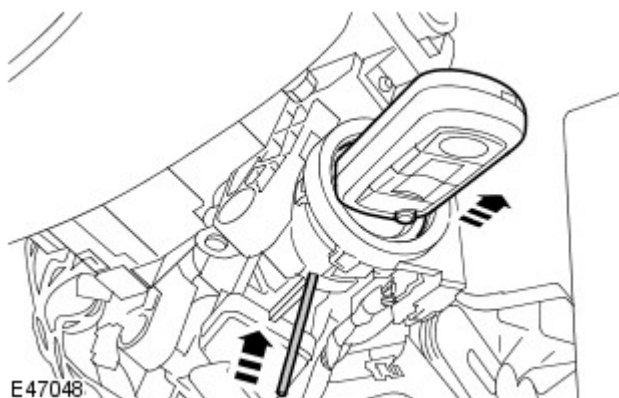


4. Remove the passive coil.

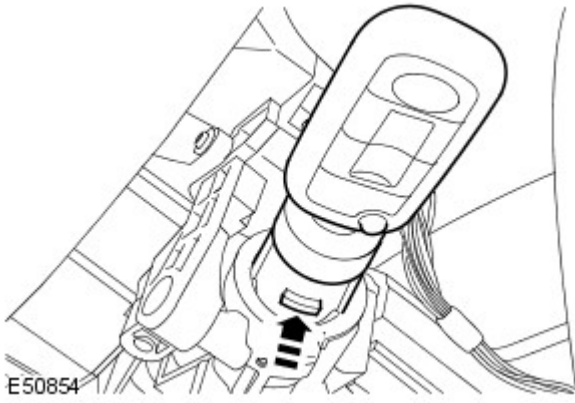
- Disconnect the electrical connector.
- Release the 2 clips.

5. Remove the ignition lock cylinder.

- Turn the ignition key to position 1.
- Insert a pin, not exceeding 2 mm diameter, through the access hole in the ignition lock cylinder housing to depress the plunger, and release the ignition lock cylinder.



Installation



1. Install the ignition lock cylinder.

- Turn the ignition key to position 1.
- Locate into guides and depress the plunger.

2. Install the passive coil.

- Secure the clips.
- Connect the electrical connector.

3. Install the steering column shrouds.

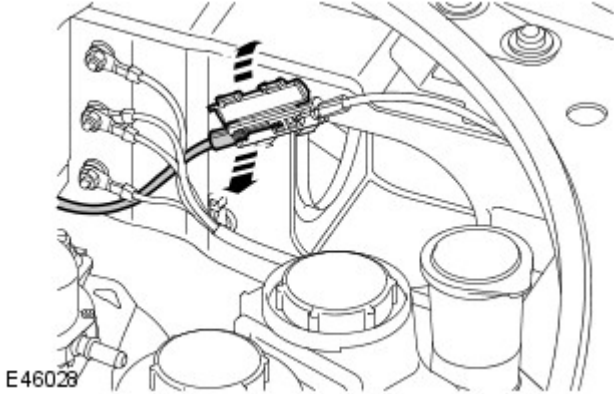
- Tighten the Torx screws.
- Secure the clips.
- Secure the adjustment lever.

Handles, Locks, Latches and Entry Systems - Hood Latch Release Handle

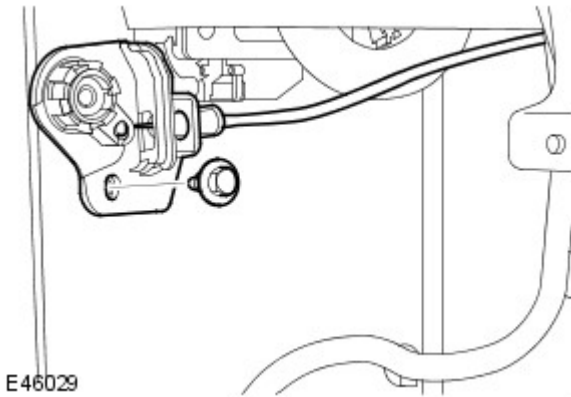
Removal and Installation

Removal

1. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Disconnect the hood release cable from the connecting box.
 - Open the connecting box cover.



3. Remove the hood release lever housing.
 - Remove the bolt.
 - Disconnect the hood release cable.



Installation


1. Install the hood release lever housing.
 - Connect the hood release cable.
 - Tighten the bolt to 5 Nm (3.7 lb.ft).
2. Attach the hood release cable to the connecting box.
 - Close the connecting box cover.
3. Install the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Front Door Latch

Removal and Installation

Removal

1. Remove the window motor and regulator assembly.
For additional information, refer to: Front Door Window Regulator and Motor (501-11, Removal and Installation).

2.  **CAUTION:** Release the exterior door handle and screw cover clips from inside the door.

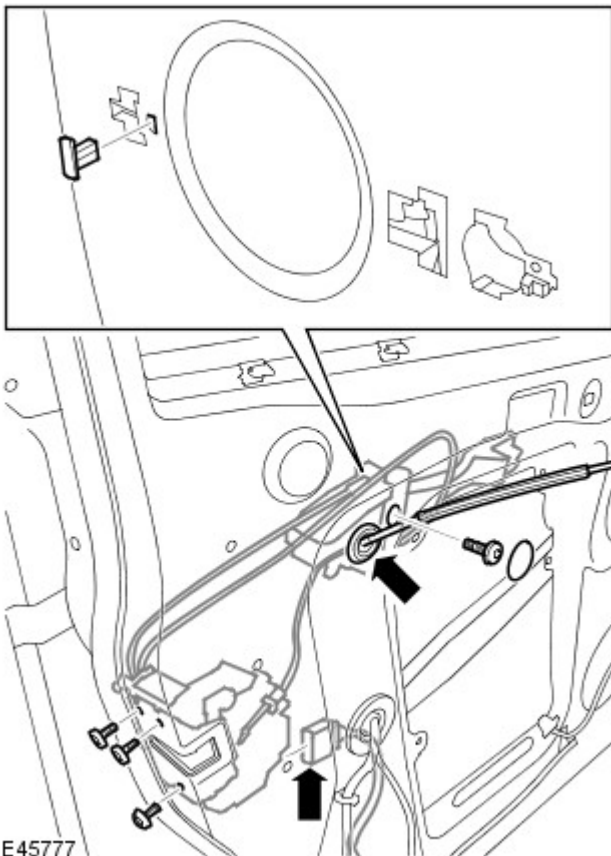
Remove the front door exterior handle.

For additional information, refer to: [Exterior Front Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

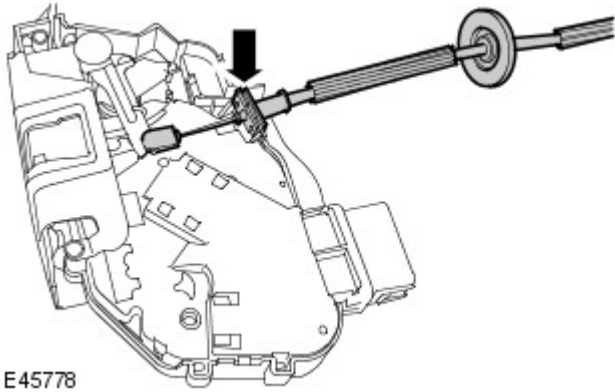
3. Release the remote control cable.
 - Release the grommet.

4. Release the door exterior handle mechanism.
 - Remove the adhesive tape from the access hole.
 - Remove the Torx screw.
 - Remove the locking pin.

5. Remove the front door latch assembly.
 - Disconnect the electrical connector.
 - Remove the 3 Torx screws.



E45777



6. NOTE: Do not disassemble further if the component is removed for access only.

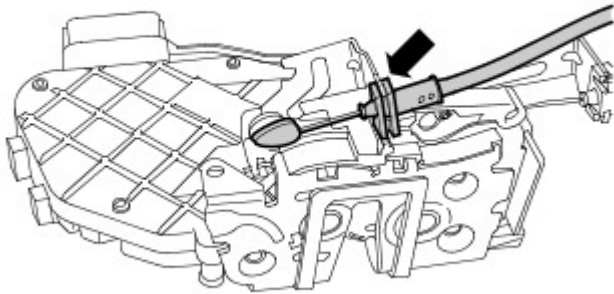
Remove the door latch remote control cable.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.

E45778

7. Release the exterior door handle mechanism cable from the door latch.

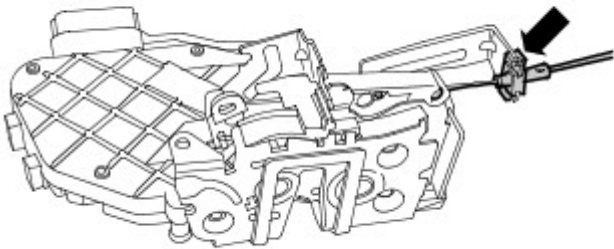
- Release the cable from the abutment bracket.
- Remove the cable from the lever.



E45779

8. LH side: Release the door lock cylinder cable from the door latch.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.



E45780

Installation

1. LH side: Connect the door lock cylinder cable to the door latch.

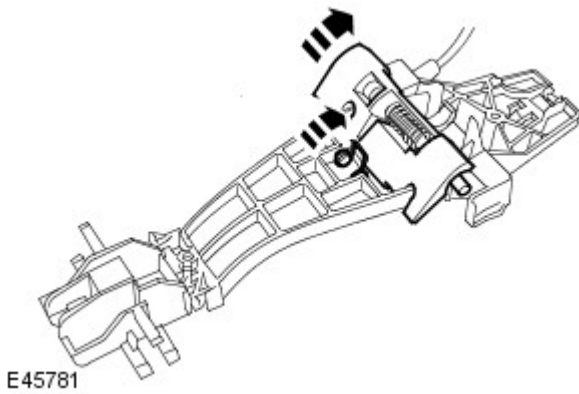
- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

2. Connect the door exterior handle mechanism cable to the door latch.

- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

3. Install the remote control cable to the door latch.

- Connect the cable to the lever.
- Secure the cable to the abutment bracket.



4. Set the exterior handle mechanism.

- Rotate the lever.
- Engage the retaining tang.

5. Install the front door latch assembly.

- Tighten the Torx screws to 10 Nm (7 lb.ft).
- Connect the electrical connector.

6. Install the door exterior handle mechanism.

- Position the mechanism to the door.
- Fit the locking pin.
- Fit and tighten the Torx screw.

7. LH side: Position the control cables into the retainers.

8. Position the remote control cable to the door.

- Install the grommet.

9. Install the front door exterior handle.

For additional information, refer to: [Exterior Front Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

10. Install the window motor and regulator assembly.


For additional information, refer to: Front Door Window Regulator and Motor (501-11, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Rear Door Latch

Removal and Installation

Removal

1. Remove the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

2.  **CAUTION:** Release the exterior door handle and screw cover clips from inside the door.

Remove the rear door exterior handle.

For additional information, refer to: [Exterior Rear Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

3. Release the remote control cable.

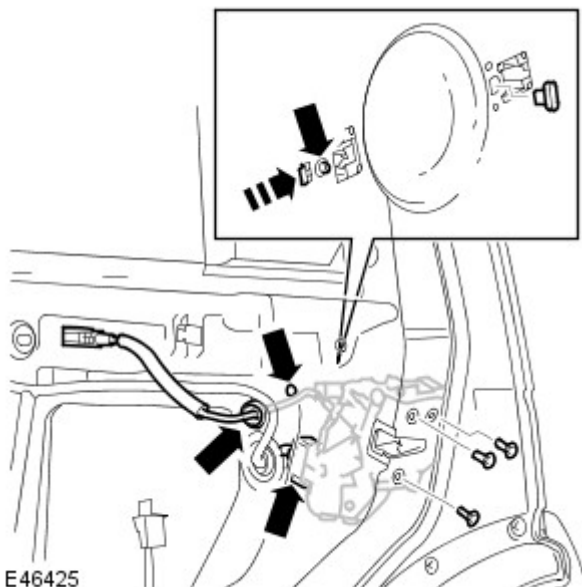
- Release the grommet.

4. Release the door exterior handle mechanism.

- Remove the 2 Torx screws.
- Remove the locking pin.

5. Remove the rear door latch assembly.

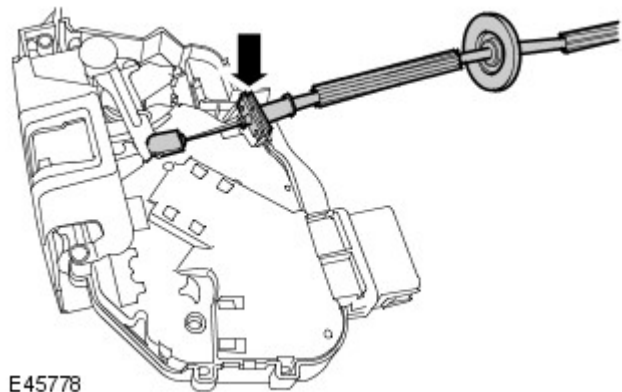
- Disconnect the electrical connector.
- Remove the 3 Torx screws.



6. **NOTE:** Do not disassemble further if the component is removed for access only.

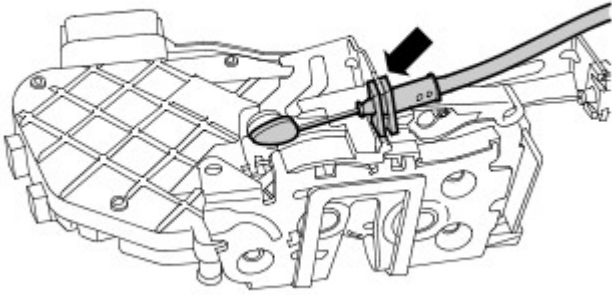
Remove the door latch remote control cable.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.



7. Release the exterior door handle mechanism cable from the door latch.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.



E45779

Installation

1. Connect the door exterior handle mechanism cable to the door latch.

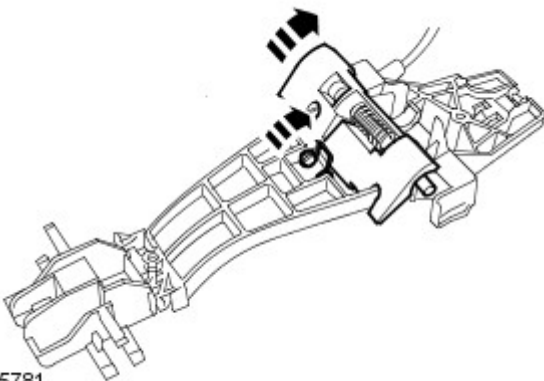
- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

2. Install the remote control cable to the door latch.

- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

3. Set the exterior handle mechanism.

- Rotate the lever.
- Engage the retaining tang.



E45781

4. Install the rear door latch assembly.

- Tighten the Torx screws to 10 Nm (7 lb.ft).
- Connect the electrical connector.

5. Install the door exterior handle mechanism.

- Position the mechanism to the door.
- Fit the locking pin.
- Install and tighten the Torx screws.

6. Position the remote control cable to the door.

- Install the grommet.

7. Install the rear door exterior handle.

For additional information, refer to: [Exterior Rear Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

8. Install the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Liftgate Latch

Removal and Installation

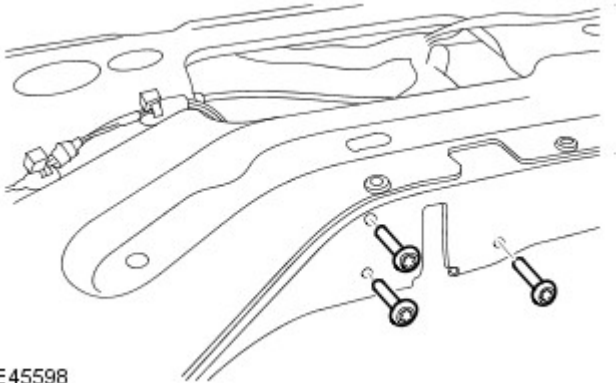
Removal

1. Remove the tailgate trim panel.
For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. Remove the tailgate water shedder.

3. Release the liftgate latch.

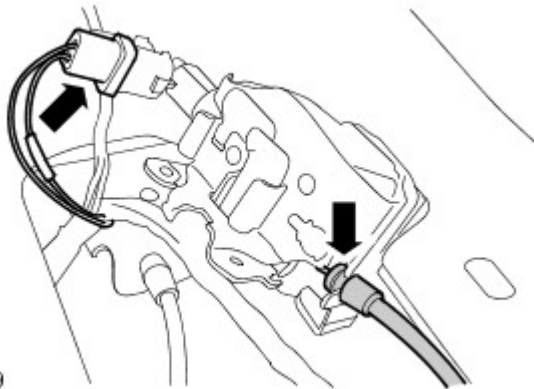
- Remove the 3 Torx screws.



E45598

4. Remove the liftgate latch.

- Disconnect the electrical connector.
- Release the liftgate latch to actuator cable.



E45599

Installation

1. Install the liftgate latch.

- Attach the liftgate latch to actuator cable.
- Connect the electrical connector.
- Tighten the Torx screws to 10 Nm (7 lb.ft).

2. Install the tailgate water shedder.

3. Install the tailgate trim panel.

For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Adjust the liftgate striker.

For additional information, refer to: [Liftgate Striker Adjustment](#) (501-14 Handles, Locks, Latches and Entry Systems, General Procedures).

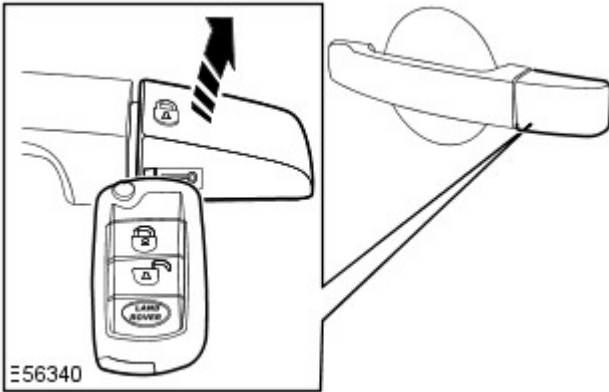
Handles, Locks, Latches and Entry Systems - Door Lock Cylinder

Removal and Installation

Removal

1. Remove the front door lock cylinder cover.

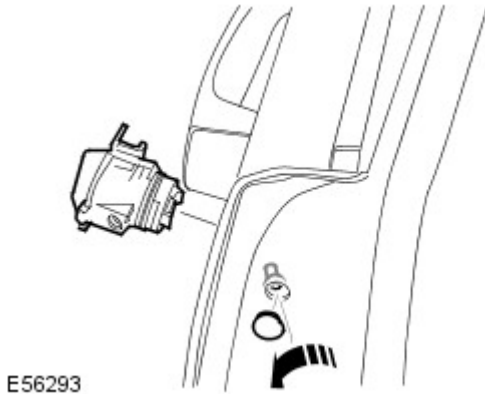
- Use the ignition key.



2. NOTE: The Torx screw remains in the door lock housing.

Remove the front door lock cylinder.

- Open the door.
- Remove the access plug.
- Loosen the Torx screw to release the lock.



Installation

1. To install, reverse the removal procedure.

Handles, Locks, Latches and Entry Systems - Tailgate Latch

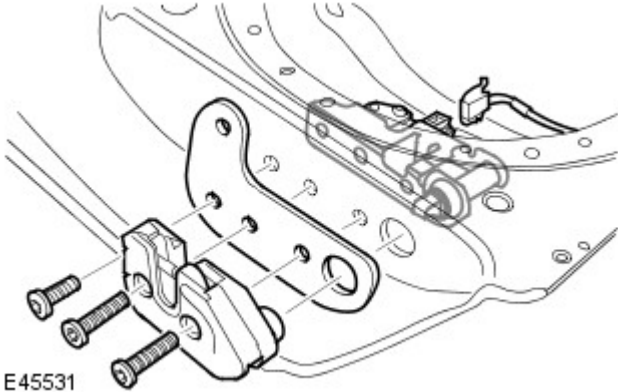
Removal and Installation

Removal

1. Remove the tailgate speaker assembly.
For additional information, refer to: [Tailgate Speaker](#) (415-03 Speakers, Removal and Installation).

2. Remove the tailgate latch assembly.

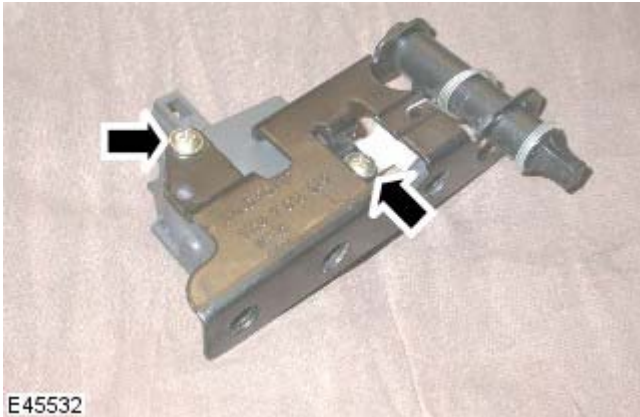
- Remove the 3 Torx bolts.
- Disconnect the electrical connector.
- Remove the latch.
- Remove the latch plate.
- Remove the latch actuator assembly.



3. NOTE: Do not disassemble further if the component is removed for access only.

Remove the latch actuator.

- Remove the 2 screws.



Installation

1. Install the latch actuator.

- Tighten the screws.

2. Install the tailgate latch assembly.

- Install the latch actuator assembly.
- Install the latch plate.
- Install the latch.
- Tighten the Torx screws to 25 Nm (18 lb.ft).
- Connect the electrical connector.

3. Install the tailgate speaker assembly.

For additional information, refer to: [Tailgate Speaker](#) (415-03 Speakers, Removal and Installation).

4. Adjust both the tailgate strikers.

For additional information, refer to: [Tailgate Striker Adjustment](#) (501-14 Handles, Locks, Latches and Entry Systems, General Procedures).

Handles, Locks, Latches and Entry Systems - Exterior Front Door Handle

Removal and Installation

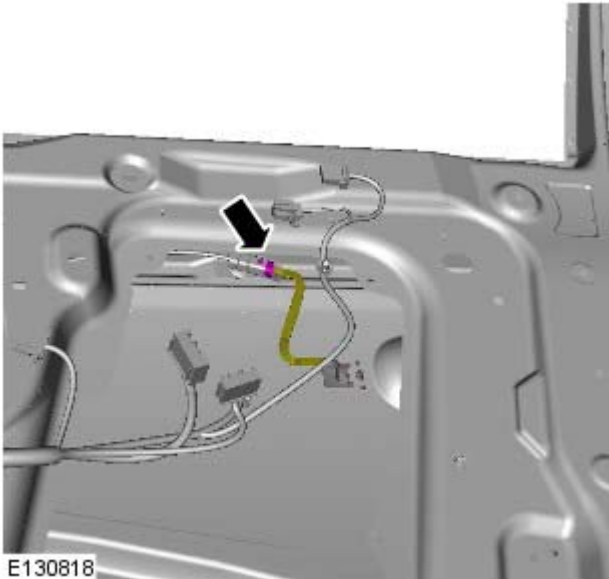
Removal

- NOTE: This procedure details removal and installation of both the LH and RH exterior front door handles.
- NOTE: If the exterior handle is to be removed in conjunction with additional door internal items, then it is recommended that the exterior handle and screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.

1. NOTE: Vehicles with passive entry system.

Remove the window regulator assembly.
For additional information, refer to: [Front Door Window Regulator and Motor \(501-11, Removal and Installation\)](#).

2. Disconnect the electrical connector.



3. NOTE: All vehicles.

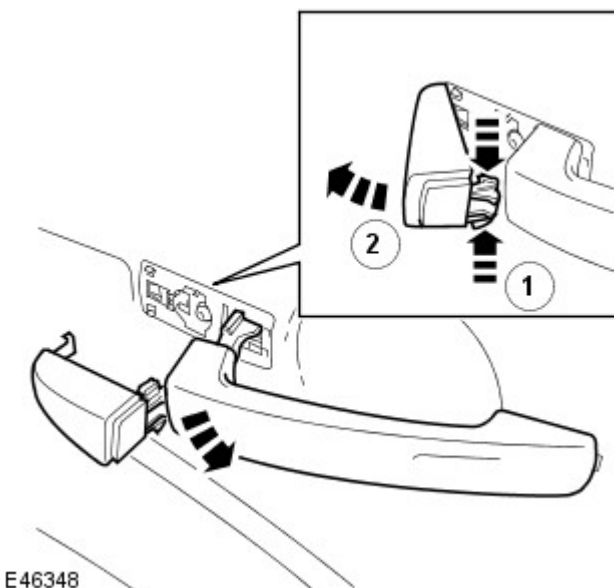
LH side: Remove the private lock.
For additional information, refer to: [Door Lock Cylinder \(501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation\)](#).

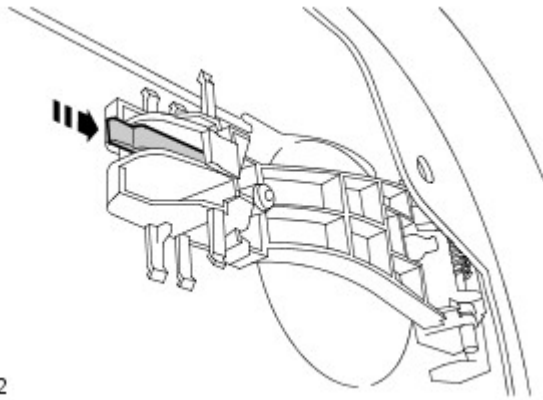
4. NOTE: Removal of the screw cover may break the retaining clips.

- NOTE: If the screw cover is to be removed in conjunction with additional door internal items, then it is recommended that the screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.

RH side: Remove the screw cover.

- Release the 2 clips.





E66202

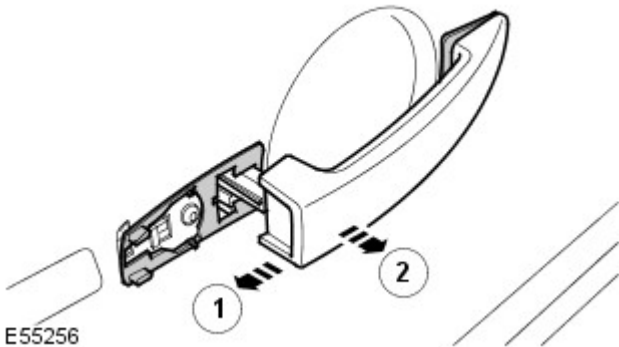
5. To remove the exterior front door handle, after removal of the door trim pad and regulator.

- Using a nylon mallet, carefully release the clip.
- Remove the 2 gaskets.

6. NOTE: Vehicles without passive entry system.

To remove the exterior front door handle, without removal of the door trim pad.

- Slide the handle firmly rearward, then pivot the handle away from the door to remove it.
- Remove the 2 gaskets.

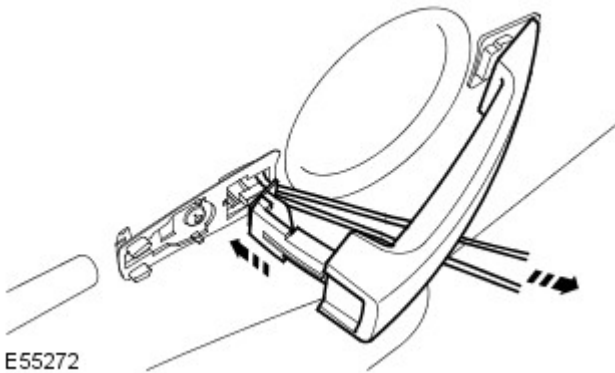


E55256

Installation

1. NOTE: Use a length of cord to hold the lock lever against spring pressure while engaging the outside handle.

To install, reverse the removal procedure.



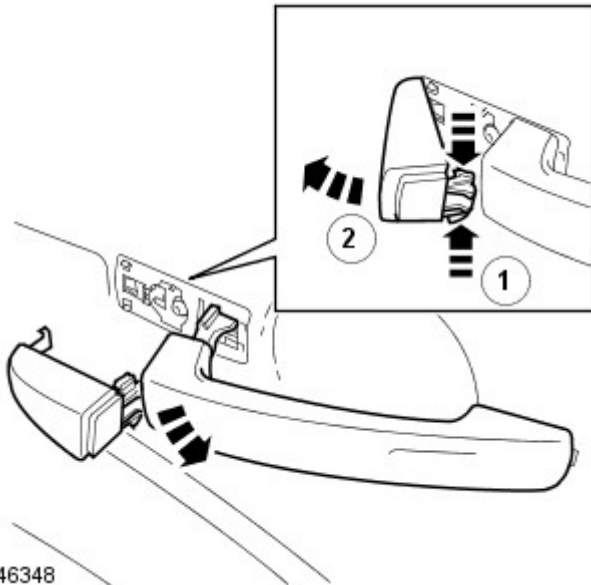
E55272

Handles, Locks, Latches and Entry Systems - Exterior Rear Door Handle

Removal and Installation

Removal

• NOTE: If the exterior handle is to be removed in conjunction with additional door internal items, then it is recommended that the exterior handle and screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.



1. NOTE: Removal of the screw cover may break the retaining clips.

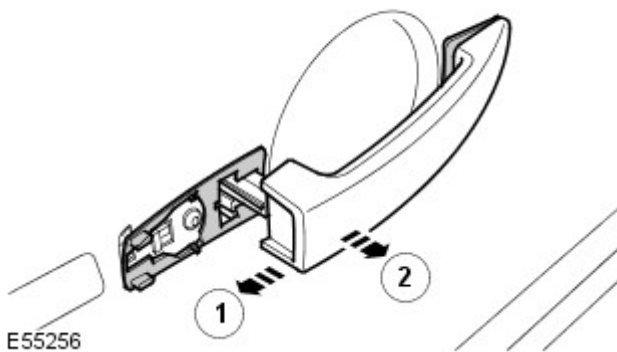
• NOTE: If the screw cover is to be removed in conjunction with additional door internal items, then it is recommended that the screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.

Remove the screw cover.

- Release the 2 clips.

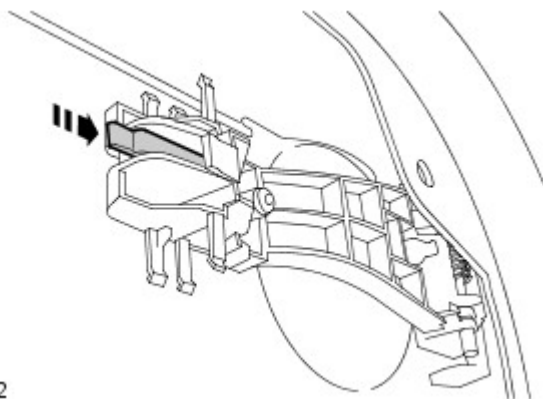
2. To remove the exterior rear door handle, without removal of the door trim pad.

- Slide the handle firmly rearward, then pivot the handle away from the door to remove it.
- Remove the 2 gaskets.



3. To remove the exterior rear door handle, after removal of the door trim pad and regulator.

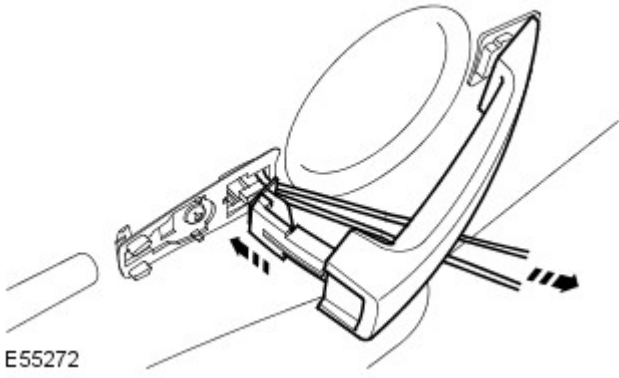
- Using a nylon mallet, carefully release the clip.
- Remove the 2 gaskets.



Installation

1. NOTE: Use a length of cord to hold the lock lever against spring pressure while engaging the outside handle.

To install, reverse the removal procedure.



E55272

Handles, Locks, Latches and Entry Systems - Liftgate Latch Actuator

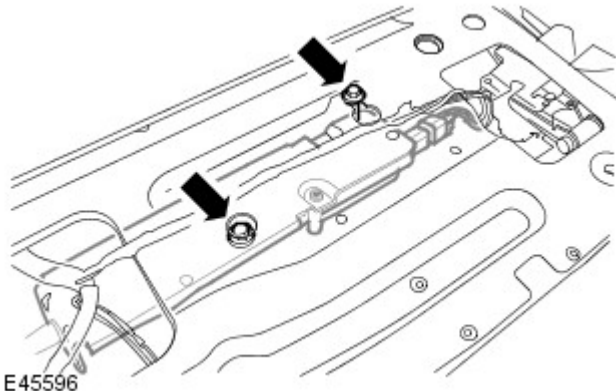
Removal and Installation

Removal

1. Remove the tailgate trim panel.
For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

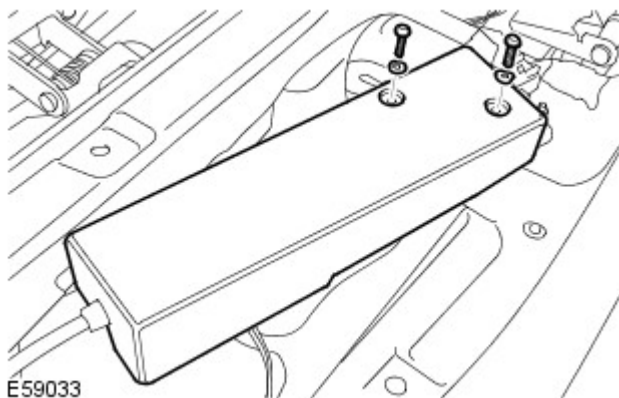
2. Release the liftgate actuator.

- Loosen the 2 bolts.
- Disconnect the electrical connector.



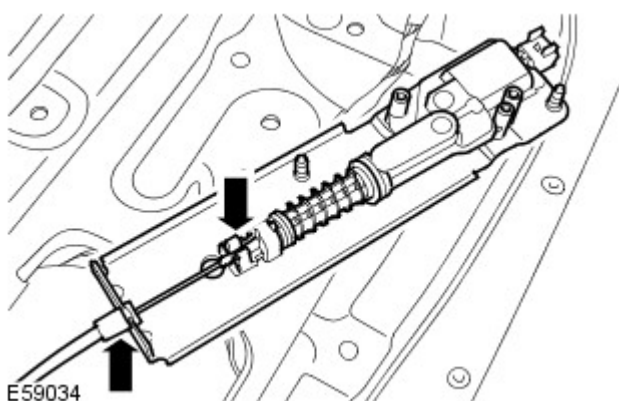
3. Remove the actuator cover.

- Remove the 2 Torx screws.

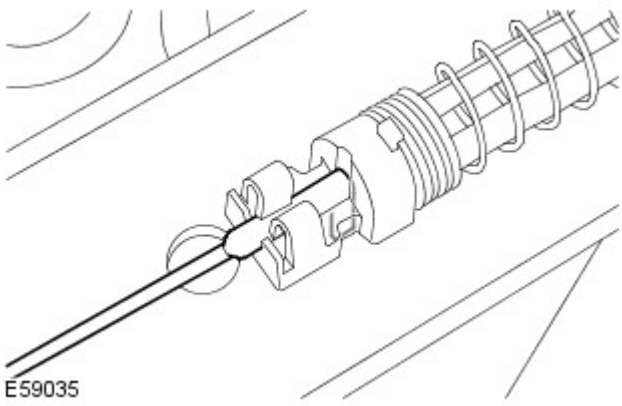



4. Remove the liftgate actuator.

- Release the liftgate latch to actuator cable.



Installation



1.  CAUTION: It is possible to incorrectly install the cable, ensure the ferrule and clip are fully engaged.

Attach the actuator to the liftgate latch cable.

2. Install the cover.

- Tighten the Torx screws.

3. Install the liftgate actuator.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect and secure the electrical connector.

4. Install the tailgate trim panel.

For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Wipers and Washers -

Capacities

Item	Description
Windscreen washer reservoir	6.3 litres (11.0 pints) (6.6 US quarts)

General Specifications

Item	Description
Front wiper motor make	Trico
Rear wiper motor make	Mitsuba
Windscreen washer pump make	MES
Power washer pump make	Textron

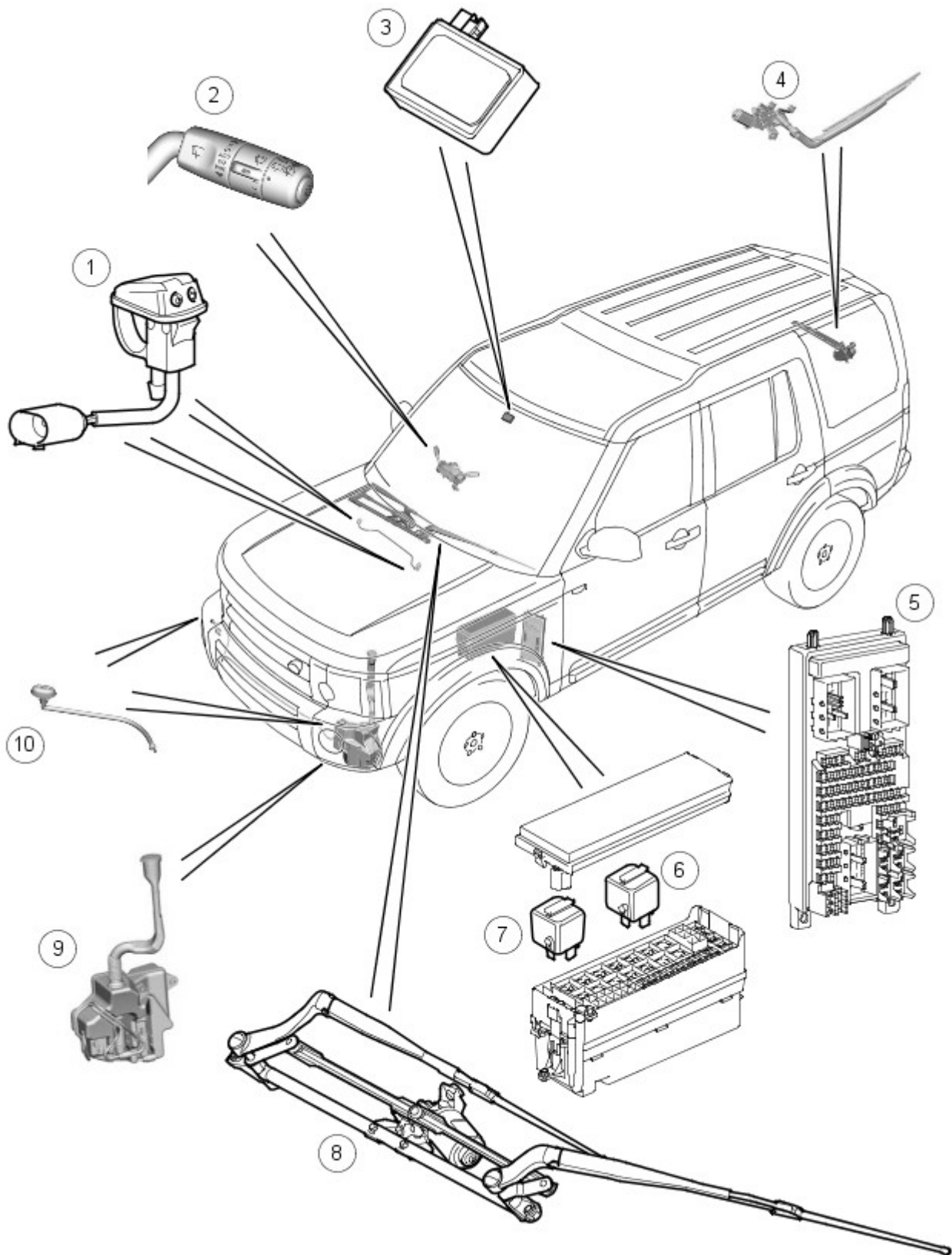
Torque Specifications

Description	Nm	lb-ft
Front wiper arms to linkage nut	18	13
Rear window wiper motor nuts	10	7
Rear wiper arm to motor nut	18	13
Wiper linkage to front wiper motor:		
Nut	25	18
Bolts	10	7
Wiper linkage to body bolts	6	4
Washer reservoir and pump assembly to body bolts	6	4
Washer reservoir and pump assembly to bumper armature bolts	22	16

Wipers and Washers - Wipers and Washers

Description and Operation

Wiper and Washer System Component Location



E 132362

Item	Part Number	Description
1	-	Front washer jets

2	-	Wiper control switch
3	-	Rain/Light sensor
4	-	Rear wiper linkage and motor assembly
5	-	CJB (central junction box)
6	-	Wiper relay 1 (located in BJB (battery junction box))
7	-	Wiper relay 2 (located in BJB)
8	-	Front wiper linkage and motor assembly, including wiper arms and blades
9	-	Washer reservoir and pumps
10	-	Headlamp washer jets

GENERAL

The wiper and washer system is controlled by the [CJB](#) on receipt of requests made by the driver or the rain/light sensor unit (if fitted). All wiper functions for the front and rear wipers are controlled from a multi-function wash/wipe switch assembly located on the right hand side of the steering column.

The wiper and washer system comprises:

- Front and rear wiper motors
- A front wiper linkage
- Two front and one rear wiper arms and blades
- Two front washer jets and one rear washer jet
- A washer reservoir and pump
- A wash/wipe control column switch.

The following optional items can be added to enhance the wiper system:

- A rain/light sensor for automatic wiper control
- Heated front washer jets
- Headlamp washers
- Low fluid level sensor (fitted to vehicles with headlamp washers).

The wiper system can be optionally equipped with a rain/light sensor. The sensor, located below the interior rear view mirror, detects rain drops on the windscreen and automatically operates the wipers in the intermittent mode. The column stalk switch must be in the intermittent position for rain/light sensor controlled wiper operation.

The front wiper system has five stages of operation and six intermittent delay periods.

The five wiper stages are as follows:

- Flick wipe
- Off
- Intermittent
- Normal (slow) speed continuous
- Fast speed continuous

Speed Control Intermittent Mode

The intermittent, slow and fast speeds are affected by road speed, providing the speed control intermittent wipe mode has been configured. The intermittent wiper delay periods change with the road speed and wiper sensitivity positions with the delay decreasing as the road speed increases.

Speed Dependant Wipe Mode

When the speed dependant wipe mode has been configured, the normal continuous operation changes to intermittent operation when the vehicle is stationary. The fast speed operation changes to normal operation when the vehicle is stationary.

The wiper and washers operate with the ignition switch in positions I or II. Wiper functions are suspended during engine cranking to reduce battery power consumption under high load conditions.

Diagnostic information for the wiper system is available and can be retrieved using T4.

CENTRAL JUNCTION BOX

The [CJB](#) is an integrated unit located behind the fascia on the passenger side of the bulkhead. The [CJB](#) contains fuses, relays and a number of microprocessors, which control the power supply and functionality of the wash/wipe system and other vehicle systems.

Inputs and Outputs

The [CJB](#) receives and sends the following wiper and washer system inputs and outputs:

Inputs

- Intermittent front wipe switch
- Rear wipe park switch
- Rain/light sensor, if fitted
- Normal (slow) speed continuous switch
- Fast speed continuous switch
- Flick wipe switch
- Front screen wash switch
- Rear screen wash switch
- Ignition switch
- Lighting switch

- Low level reservoir status, via CAN
- Vehicle speed, via CAN
- Front wiper motor park switch
- Reverse switch, via CAN
- Tail gate open switch
- Ambient temperature, via CAN

Outputs

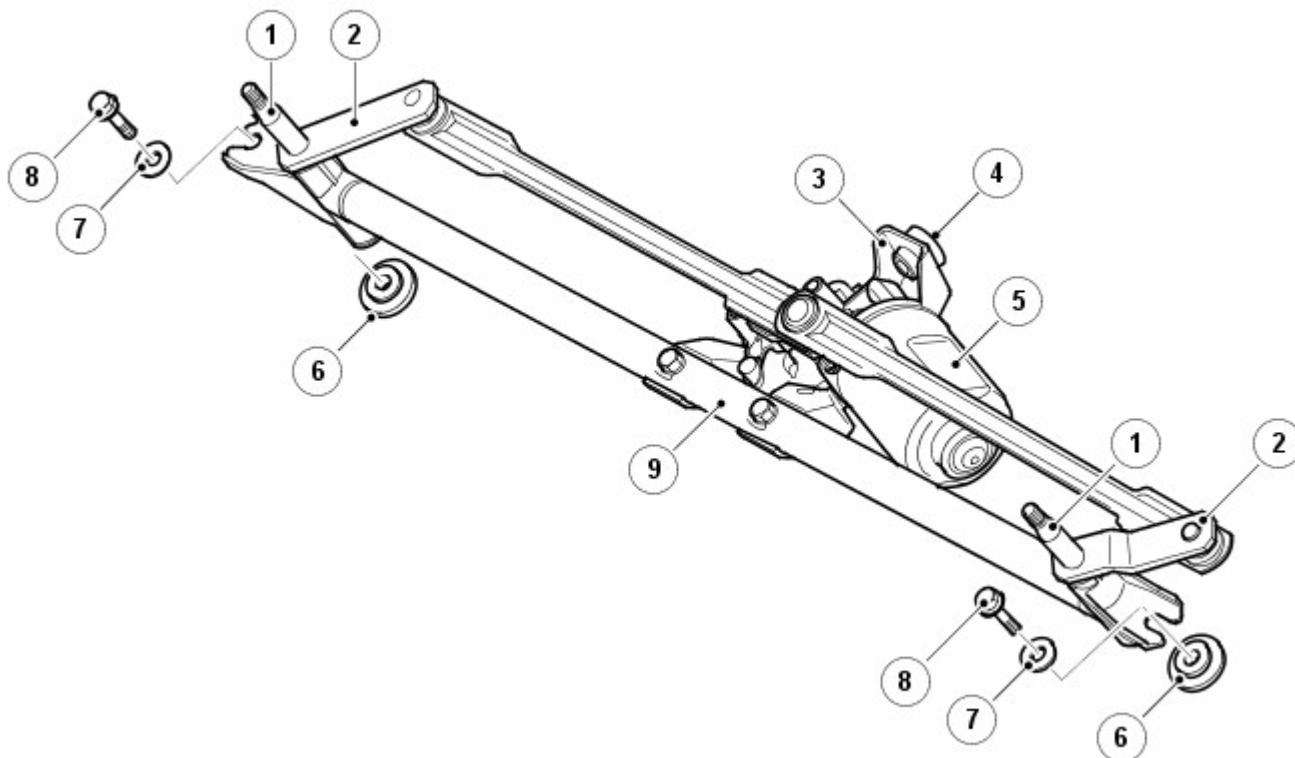
- Front wiper motor (normal)
- Front wiper motor (fast)
- Washer motors
- Heated washer jets (if fitted)
- Rear wiper motor relay
- Headlamp power wash motor

FRONT WIPER ASSEMBLY

The front wiper assembly comprises:

- Wiper motor and linkage assembly
- Wiper arms and blades
- Washer reservoir and pumps.

Wiper Linkage



E43319

Item	Part Number	Description
1	-	RH pivot housing assembly
2	-	Link rod
3	-	Bracket
4	-	Bush
5	-	Motor assembly
6	-	Bush
7	-	Washer
8	-	Bolt
9	-	Link rod

The wiper linkage and motor assembly are available as separate components. The wiper linkage and motor differs between LH and RH drive models.

The assembly is located below the plenum grill in the engine compartment and is secured with bushes, sleeves and bolts. The rubber bushes isolate the assembly from the body mountings.

The linkage assembly comprises a main tube, with a pivot housing at each end and the motor is attached directly to the tube. A motor crank is positively attached to the motor output shaft. Two link rods then attach to the motor crank which transfers power directly to each pivot crank.

The motor crank converts rotary motion from the motor output shaft into linear movement of the link rods. The cranks, connected between the each link rod and pivot housing, convert the linear motion to reciprocating motion at the pivot housing. This reciprocating motion is passed to the wiper arms and blades causing the blades to wipe an arc across the windscreen.

Wiper Motor

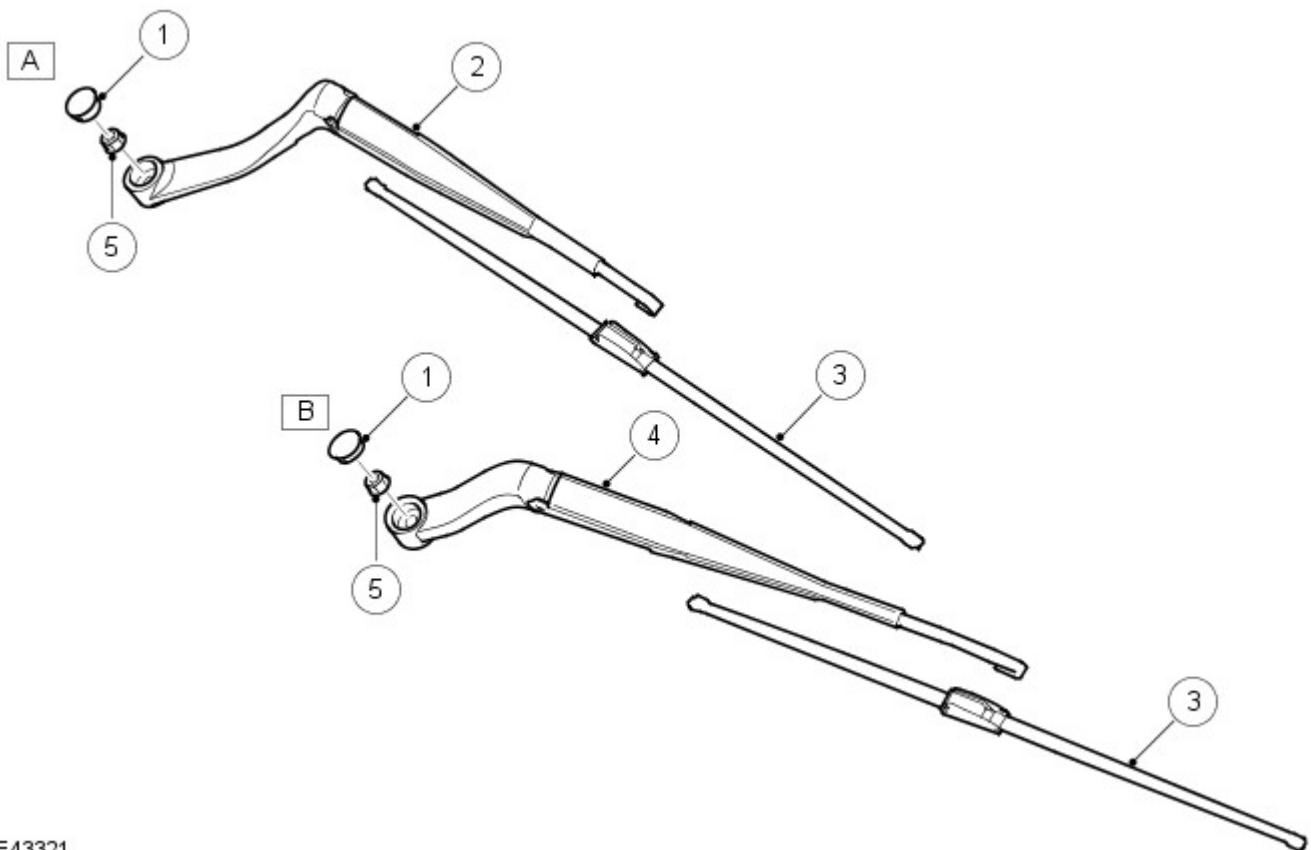
The motor assembly comprises a dc motor, which drives a gear wheel via a worm drive attached to the motor spindle. The gear wheel has a central spigot, which provides the attachment point for the motor crank.

The motor is connected electrically by a five-pin connector. The connector supplies two battery voltage feeds to the motor (when switched). The motor has three sets of brushes with one brush connected to ground. One feed is direct to the motor brush opposite the ground brush and operates the motor at normal (slow) speed. The second feed is connected to a motor brush, which is offset from the ground brush and operates the motor at fast speed. With the power supplied through this brush, the current flows through fewer coil windings. This results in a lower resistance to the current flow to the ground brush and gives a higher motor rotational speed.

Output control of the wiper motor is through a double contact relay. The relay is located in the [BJB](#).

The motor has an internal track switch, which signals the [CJB](#) when the wipers have reached the park position. The park signal is closed circuit when the wipers are in the park position. When the wipers are switched off and the [CJB](#) receives the park position signal from the motor, the [CJB](#) shorts the motor via a relay bridge circuit. This short circuit has the effect of applying a brake to the motor, giving precise positioning of the wiper blades in the park position.

Wiper Arms



E43321

Item	Part Number	Description
1	-	Spindle caps
2	-	RH Wiper arm
3	-	Wiper blades
4	-	LH wiper arm
5	-	Self locking nuts

The wiper arms are positively located on tapered splines on the wiper linkage spindles.

The wiper arm has a pivot point, midway between the spindle attachment and the blade. A tension spring is connected to the wiper arm on each side of the pivot point and applies pressure to maintain the wiper blade in contact with the windscreen.

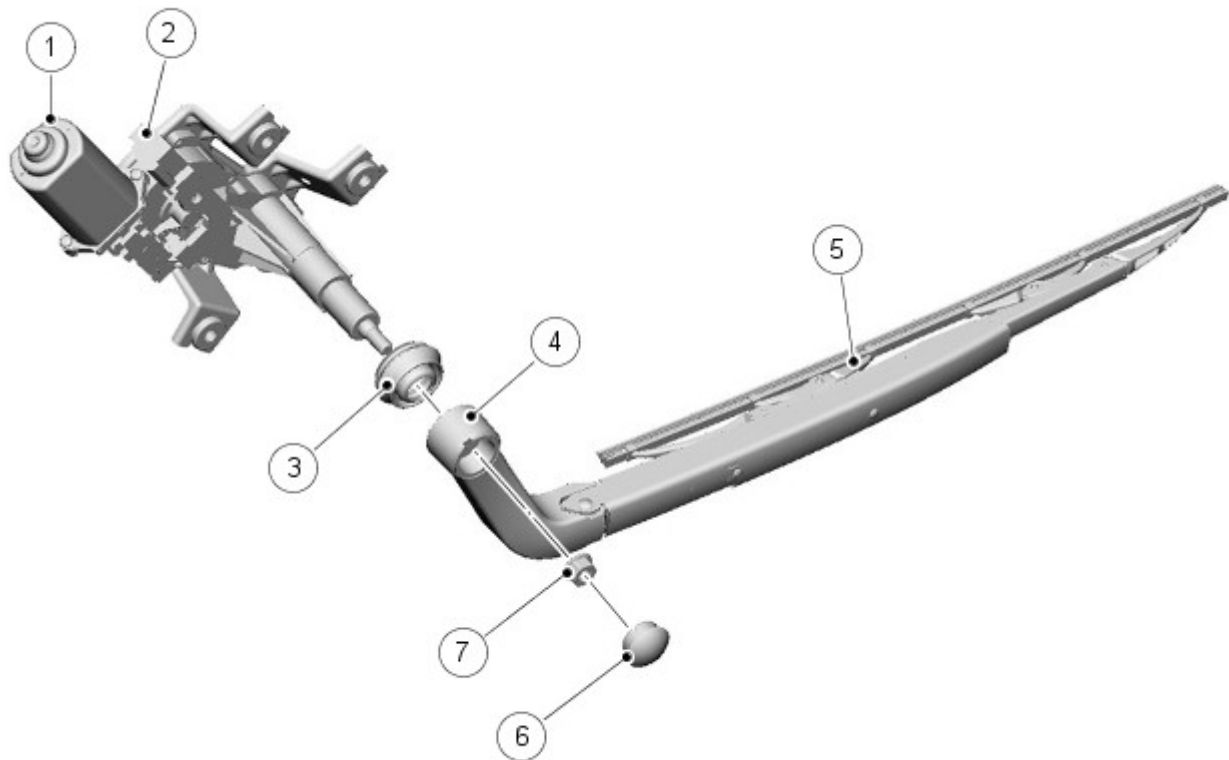
The wiper blades are attached to the wiper arms with clips that allow the blade to pivot. The wiper blades comprise of a sprung steel curved backbone which applies the pressure evenly to the windscreen, to which is applied the wiping lip to the bottom surface and an aerofoil section to the top which presses the blades onto the windscreen at high vehicle speeds.

REAR WIPER ASSEMBLY

The rear wiper assembly comprises:

- Wiper motor
- Rear washer pump
- Rear washer jet
- Wiper arm and blade.

Wiper Motor



E132363

Item	Part Number	Description
1	-	Motor assembly
2	-	Harness connector
3	-	Grommet
4	-	Pivot housing connection
5	-	Wiper arm
6	-	Spindle cap
7	-	Self locking nut

The rear wiper and washers operation is controlled by the [CJB](#), via the rear wiper relay, which is located in the LH rear 'D' post.

The rear wiper motor is located in the upper tail gate, behind a trim panel. The assembly is secured to the body of the upper tail gate with three M6 nuts. Bushes isolate the motor assembly from the body, which help reduce the transmission of motor operating noise to the tail gate.

The motor is located on a worm drive gearbox mechanism, which converts the rotary motion of the motor output spindle into the required arc for the rear wiper blade.

The feed hose, for the separate rear washer jet, is located at the rear of the motor spindle. The hose is going directly to the washer jet, housed in the spoiler. A Non-Return Valve (NRV) is located in the hose, near the motor, and prevents fluid returning to the reservoir.

The motor spindle is a conventional design with a taper spline location for the wiper arm and a threaded shank to secure the arm to the spindle.

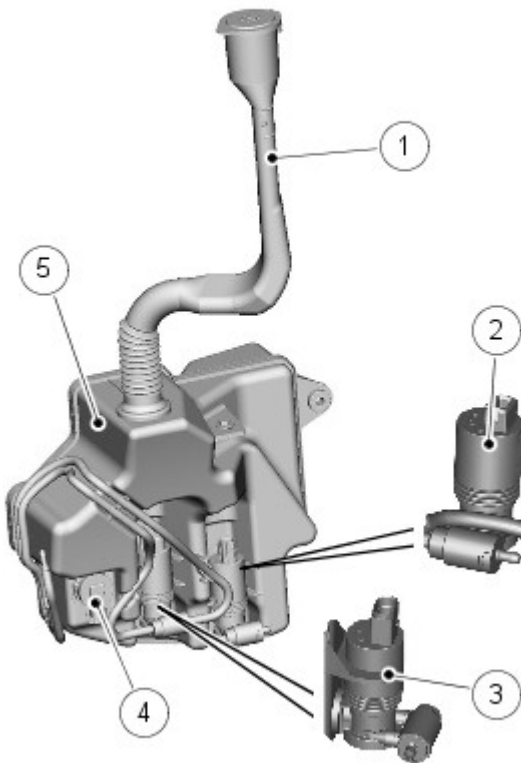
Wiper Arm

The wiper arm is similar in design to the front wiper arms. The arm attachment hole has tapered splines, which mate with the splines on the wiper spindle. The arm is secured to the wiper motor spindle with a nut. The wiper arm has a pivot point, close to the spindle attachment. A tension spring is connected to the wiper arm on each side of the pivot point and applies pressure to maintain the wiper blade in contact with the windscreen.

The wiper blade is attached to the wiper arm with a clip that allows the blade to pivot. The blade comprises a number of levers and yokes to, which the rubber wiper blade is attached. The levers and yokes ensure that the pressure applied by the arm tension spring is distributed evenly along the full length of the blade and also allow the blade to adjust to the curvature and contour of the windscreen.

A plastic cap located on the arm pivot point, covers the spindle attachment nut.

WASHER RESERVOIR AND PUMPS



E132364

Item	Part Number	Description
1	-	Filler tube and cap
2	-	Front and rear washer pump
3	-	Headlamp washer pump (if fitted)
4	-	Fluid level sensor
5	-	Reservoir

The windscreen washer system comprises:

Vehicles without headlamp washers:

- A reservoir
- A washer pump
- Two washer jets
- Hoses

Vehicles with headlamp washers:

- A reservoir
- Two washer pumps
- A level sensor
- Four washer jets - two windshield and two headlamp washers
- Hoses

The plastic, moulded reservoir is located in the LH wheel arch, behind the liner and has a capacity of 11.08 pints (6.3 litres). It is secured to the body and front panel with bolts. A boss on the reservoir locates in a slot in the front panel and provides additional support.

The reservoir has two recessed holes on its rear face, which provide location for the combined front/rear pump and headlamp washer pumps. The pumps are push fitted into grommets, which seal the pumps in their locations. A hole in the top of the reservoir allows for the fitment of a flexible filler tube. The front and rear wash hoses are integrated into the harness and so follow it's routing. The headlamp washer hose comes front the bumper around the bottle to attach to the headlamp washer pump.

A hole with a grommet in the side of the reservoir provides the location for the fluid level sensor.

The low level sensor has a float, with integral magnet. The sensor has a contact, which is normally closed when the reservoir is full. When the fluid level reduces to approximately 1 litre, the magnetic float pivots down, which causes the switch contact to open. This open circuit is sensed by the instrument cluster, which displays the low fluid level message and transmits the switch status on the CAN bus.

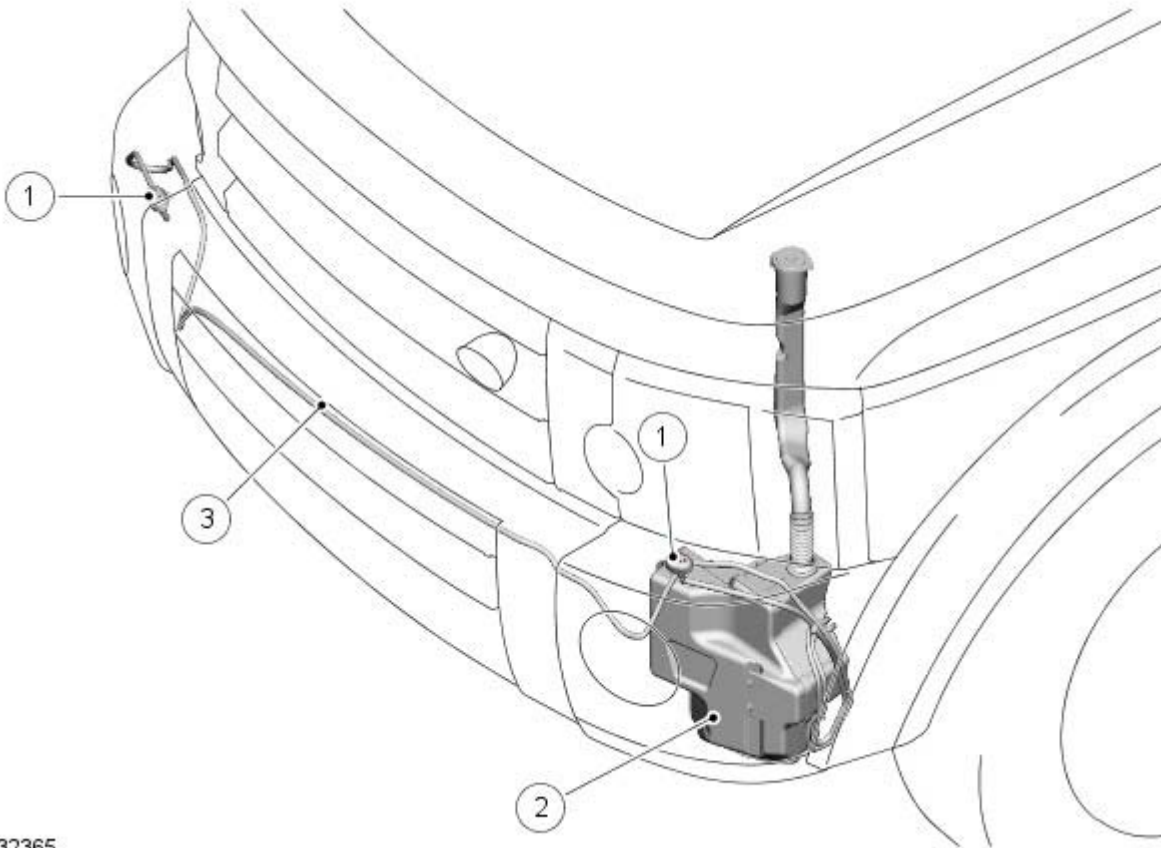
The sensor cannot determine the precise amount of fluid in the reservoir, but can detect when the fluid level has fallen below a certain point. When the fluid level is low, the magnetic float closes the sensor contacts, completing a circuit through the sensor. This completed circuit is sensed by the instrument cluster, to which the sensor is directly connected.

The fluid level sensor is monitored continuously by the instrument cluster. The instrument cluster checks the fluid level

sensor when the ignition is switched on to give the driver an early warning of the low fluid level. The instrument cluster then monitors the sensor value over a 25 second period when the ignition is on to prevent invalid messages due to fluid 'sloshing' in the reservoir.

When a low fluid level signal is transmitted to the high line instrument cluster, a 'WASHER FLUID LOW' message is displayed in the instrument cluster's message centre. On the low line instrument cluster a low fluid level indicator is illuminated. The first display of this message, or illumination of the indicator, is accompanied by a 'chime' sound to alert the driver to the low fluid level.

HEADLAMP WASHERS



E132365

Item	Part Number	Description
1	-	Headlamp washer jets
2	-	Reservoir
3	-	Washer fluid tube

The headlamp washer assembly is located below each headlamp.

The headlamp washer operation is controlled by the [CJB](#) via a headlamp washer relay. The relay is located in the [BJB](#).

Head Lamp Wash Only (No Wipe Function)

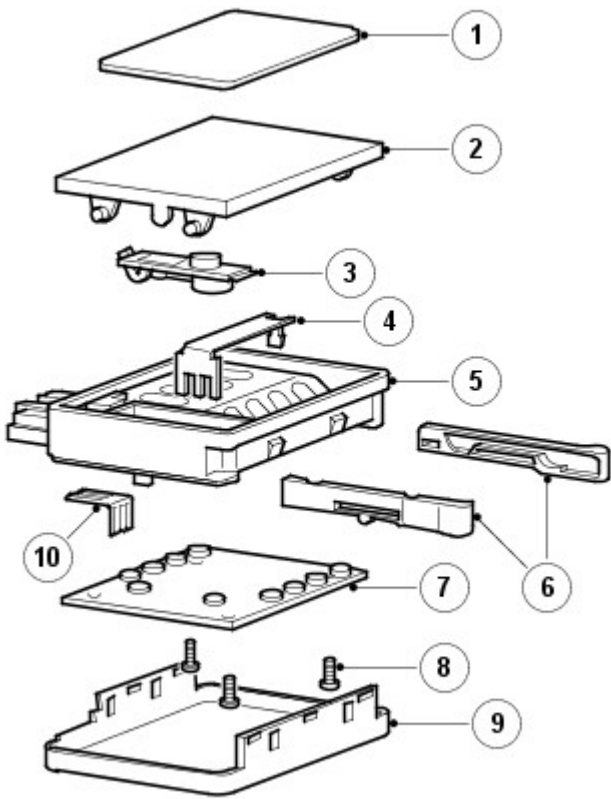
The headlamp washers are only active when the headlamps and ignition are switched on. If the washer reservoir fluid level becomes low, the instrument cluster sends a message, via the CAN bus, to the [CJB](#), which suspends headlamp wash operation to preserve washer fluid in the reservoir.

With the ignition and lights on, headlamp wash is activated on the first operation of the wiper column control switch in the wash/wipe position. The [CJB](#) then suspends headlamp wash activation for the next 10 minutes and four operations of the wash/wipe switch.

The [CJB](#) monitors the operation of the wash/wipe switch and maintains a counter to restrict headlamp washer operation to every fourth operation of the wash/wipe switch in conjunction with a 10 minute timer. The timer prevents a second operation of the headlamp washers within a 10 minute period. Should the washer switch be activated for more than four programmed wipe requests during the 10 minute period, the headlamp washer will remain disabled. Only the next consecutive programmed wipe request, after the 10 timer has expired, will the headlamp washers be enabled. The counter and timer are reset when the ignition is switched off.

When headlamp wash is active, the [CJB](#) energises the washer pump twice per cycle. The headlamp washer pump is powered for a 0.5 second period.

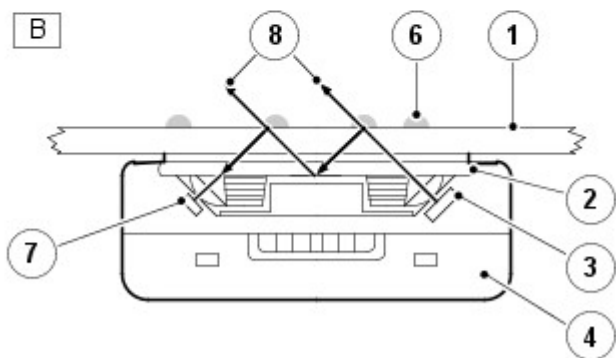
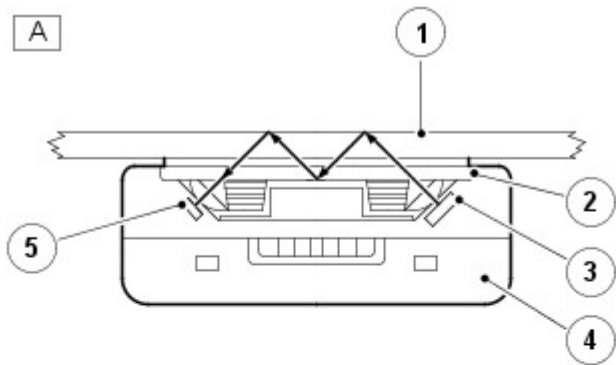
RAIN/LIGHT SENSOR



E43325

Item	Part Number	Description
1	-	Adhesive pad
2	-	Optical element
3	-	Sub-assembly light guide
4	-	Heater
5	-	Housing
6	-	Locking device
7	-	Printed Circuit Board (PCB)
8	-	Screws
9	-	Cover
10	-	Contact pins

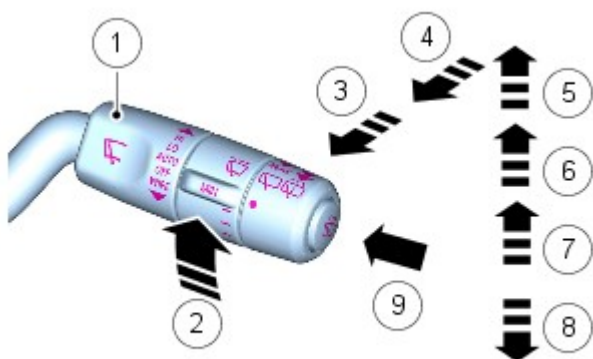
Rain Sensor Functionality



E43326

Item	Part Number	Description
A	-	Clean and dry windscreen
B	-	Wet and dirty windscreen
1	-	Windscreen - Outside surface
2	-	Optical unit
3	-	Transmitter diodes (100% light transmitted)
4	-	Rain/Light sensor unit
5	-	Receiver diodes (100% received)
6	-	Water droplets/film
7	-	Receiver diodes (less than 100% light received)
8	-	Lost light

WIPER CONTROL COLUMN SWITCH



E132366

Item	Part Number	Description
1	-	Wash/wipe control column switch
2	-	Intermittent variable delay rotary control
3	-	Intermittent/continuous rear wipe
4	-	Rear wash position
5	-	Fast speed wipe position
6	-	Normal speed wipe position
7	-	Intermittent/rain sensor wipe position
8	-	Flick wipe position
9	-	Front windscreen washer control

The wiper control column switch is located on the right hand side of the steering column and controls all front and rear wiper functions.

The switch comprises 8 switch positions and the intermittent rotary control. The switch positions each complete a combination of earth paths to connections on the [CJB](#). The [CJB](#) interprets the selected combination of switches and operates the respective function accordingly.

Flick Wipe

Moving the switch down selects the front wiper flick wipe function. The front wipers will operate at fast speed for as long as the flick wipe switch position is operated. Once the switch is released the front wiper motor will revert to a normal (slow) speed operation until a park position has been detected.

Intermittent

Moving the switch up one position from 'OFF', selects intermittent front wiper operation. The rotary potentiometer on the stalk selects one of six delay periods. The delay period is also influenced by vehicle speed (should speed control intermittent wipe mode be configured), using a signal value derived from the ABS control module. The selected delay period decreases with an increase in road speed. When a rain/light sensor is incorporated into the system, the intermittent position also initiates wiper operation controlled by the rain/light sensor. The sensitivity of the rain/light sensor is also adjusted by rotating the rotary switch to one of the six positions.

The rotary switch selects differing output values for each position. The switch is wired to three data input terminals of the [CJB](#).

Normal (Slow) Speed

The normal (slow) speed continuous wiper operation is selected by moving the switch vertically to the second detente position from 'OFF'. The wipers will operate continuously when the vehicle is moving. When the vehicle is stationary, or less than 5 mph (8 km/h), the [CJB](#) operates the wipers in the intermittent mode (if speed dependant wipe mode is configured), using a 3 second intermittent delay period.

Fast Speed

The fast speed continuous wiper operation is selected by moving the switch vertically to the third detente position. The wipers will operate continuously at fast speed when the vehicle is moving. When the vehicle is stationary, or less than 5 mph (8 km/h), the [CJB](#) operates the wipers in normal (slow) speed mode (if speed dependant wipe mode is configured).

Wash/Wipe

When the non-latching wiper stalk button is pushed the front screen washer is operated. If the wipers are off and the button is pressed for less than 0.5 seconds, only the washer will operate. If the button is pressed for more than 0.5 seconds, the wipers will come on and perform two wipes. When headlamp washers are fitted, the headlamp washers will operate if the front windscreen washer is operated and the headlamps are on – refer to headlamp wash section for detail of operation. The [CJB](#) monitors the wash/wipe switch operation and after the switch is released, if a programmed wipe is enabled, the [CJB](#) allows two further wipe cycles to be completed.

Rear Wash/wipe

Moving the switch rearwards, towards the driver, selects the intermittent rear wash/wipe function. The intermittent delay period will vary according to the sensitivity settings and vehicle speed.

When the switch is moved rearwards to the second position and held, the washer pump will operate. If the switch is operated for more than 10 seconds, the pump will be disabled. When the switch is released, the rear wiper will complete a further two full wipe cycles and then operate on an intermittent function until selected off.

HEATED WINDSCREEN WASHER JETS

Two windscreen washer jets are located on the bonnet outer surface. The washer fluid feed hose from the front screen pump is connected to a 'Y' piece connector located between the two jets. Two short lengths of hose connect the jets to the 'Y' piece. Each jet contains a NRV to prevent washer fluid draining back to the reservoir and also to limit the amount of washer fluid, which can be forced by gravity from the jet during cornering.

Each washer jet has two ball nozzles, which can rotate in their housing's to obtain the optimum fluid application onto the windscreen. Each washer jet contains a heater element, which prevents the fluid freezing in the nozzles in very cold conditions and a Positive Temperature Coefficient (PTC) sensor, which regulates the temperature. The jet heater elements are controlled by the Automatic Temperature Control Module (ATCM) and a heated washer jet relay in the [BJB](#). For additional information, refer to: Control Components (descop 412-04).

REVERSE GEAR INPUT

The intermittent delay period (below) depends on speed dependant wipe mode being enabled or disabled.

The rear wiper also operates if reverse gear is selected and the front wipers are on. If the front wipers are operating continuously when reverse is selected, the rear wiper will also operate continuously as long as reverse gear is engaged. If the front wipers are operating intermittently when reverse is engaged, the rear wiper will complete one wipe cycle then wipe intermittently.

On vehicles fitted with rain/light sensor, when reverse gear is selected while the front wipers are in intermittent mode but the rain/light sensor indicates that the front wipers are off, the rear wiper will not operate. If the rain/light sensor subsequently calls for a single wipe, the rear wiper will operate a single wipe cycle. If the rain/light sensor calls for a slow or fast wipe, the rear wiper will operate continuously.

The [CJB](#) will operate the rear wiper (providing the front wipers are on) upon receipt of a reverse gear signal from the Electronic Automatic Transmission (EAT) module on the CAN bus, via the instrument cluster. On vehicles with manual transmission, the gear position signal is transmitted directly from the transfer box control module and picked by the [CJB](#) as an CAN bus message, via the instrument cluster.

'TAIL GATE OPEN' DISABLE

If the rear wiper is switched on or is already running and the tail gate is opened, the rear wiper should not start to run, or should immediately become disabled during a wipe cycle. If the tail gate is subsequently closed, the wiper will resume its normal operation after a delay of three seconds. Should the vehicle speed input be more than 4 mph (6km/h), then the tail gate switch will be deemed as closed.

The CJB receives the 'tail gate open' signal directly from the upper tail gate central locking motor.

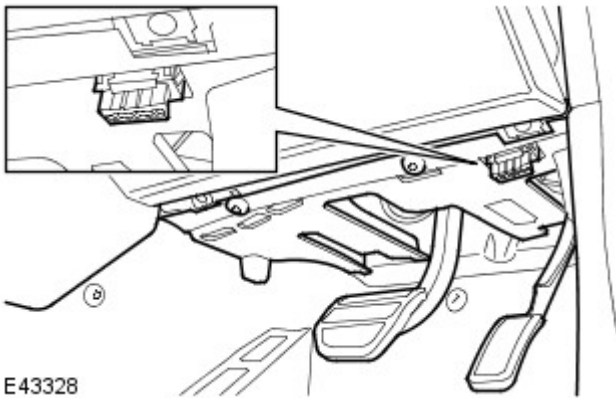
FRONT AND REAR WIPER MOTOR BLOCKING PROTECTION

The wiper park signal is also used by the CJB for blocking protection of the front wiper motor. This feature protects the motor in the event of the wiper operation being obstructed.

If the CJB does not receive a wiper park signal status change for a period of 6 seconds, when the wiper motor is active, the CJB removes the power supply to the motor. The motor will remain disabled until either an alternative motor mode has been selected, or the ignition has been moved to position 0 and back to position I. Should a stall condition be achieved 3 times during a single ignition position I status, then the wiper relay will remain disabled, regardless of wiper switch positions, for 180 seconds. The CJB will not automatically switch the motor on, to prevent the risk of injury. The wiper switch must be moved off and then on to reactivate the wiper motor. The blocking protection is active in all wiper switch positions and can only be reset by turning the ignition off.

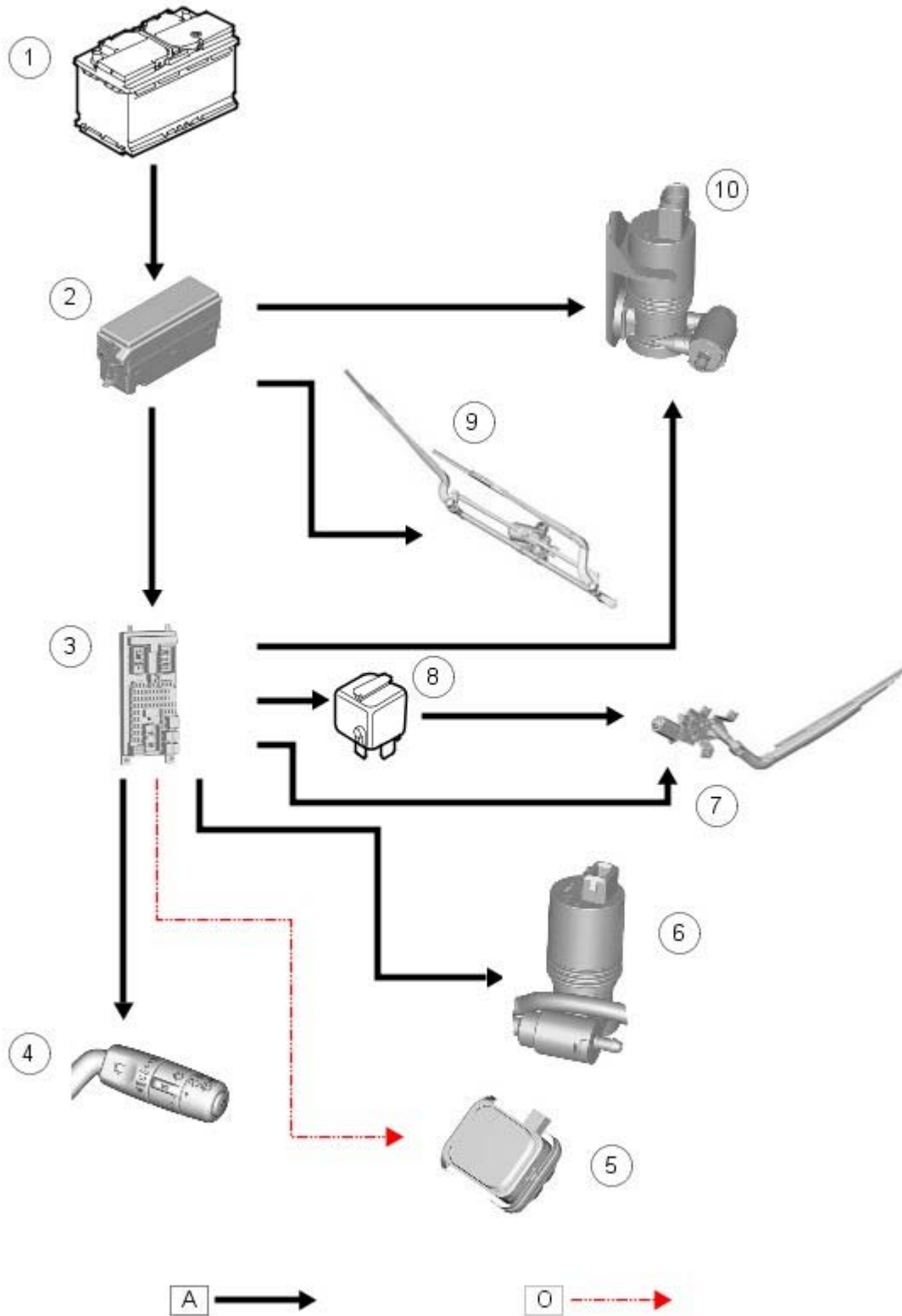
The rear wiper algorithm contains the same logic as mentioned above.

DIAGNOSTICS



CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **O** = LIN BUS



≡ 132367

Item	Part Number	Description
1	-	Battery
2	-	BJB
3	-	CJB
4	-	Wiper control switch
5	-	Rain/light sensor
6	-	Front and rear washer pump
7	-	Rear wiper linkage and motor assembly
8	-	Rear wiper relay

9	-	Front wiper motor
10	-	Headlamp washer pump

Wipers and Washers - Wipers and Washers

Diagnosis and Testing

Principle of Operation

For a detailed description of the wipers and washers systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Wipers and Washers](#) (501-16 Wipers and Washers, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Windshield and rear window for damage or contamination e.g. road film or general residue deposits ● Wiper blades, arms and linkage for wear, security, damage and freedom of movement ● Windshield/Rear window/Headlamp washer fluid level ● Washer pipes and jets for leaks, restrictions and damage 	<ul style="list-style-type: none"> ● Battery condition and state of charge ● Fusible links ● Fuses ● Relays ● Electrical connections ● Front and rear wiper motors ● Wiper switch ● Washer pumps ● Rain/light sensor ● Heated front washer jets ● Ignition switch ● Light switch ● Ambient air temperature sensor ● Central Junction Box (CJB) ● Battery Junction Box (BJB) ● Anti-Lock Braking System (ABS) module ● Automatic Temperature Control Module (ATCM) ● Instrument Cluster (IPC) module ● Controller Area Network (CAN) circuits

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Wiper blade(s) drag/judder across the windshield/rear window	<ul style="list-style-type: none"> ● Contamination of the windshield/rear window ● Incorrectly installed wiper arm(s) ● Wiper arm(s) incorrectly aligned to the screen ● Wiper arm(s) spring tension inadequate 	Clean the windshield/rear window. Check for the correct installation and tension of the wiper arm(s). Refer to the relevant section of the workshop manual. Rectify as necessary.
Very slow operation of the wiper(s) across the windshield/rear window	<ul style="list-style-type: none"> ● Low battery voltage ● Front wiper linkage seized or fouling ● Wiper circuit fault ● Wiper switch fault, high resistance 	Check the battery condition and state of charge. Check the wiper linkage for fouling. Disconnect the motor from the linkage. Refer to the relevant section of the workshop manual. Check the linkage operation. Check for DTCs indicating a wiper circuit fault. Rectify as necessary.
Wiper(s) inoperative		
Noisy operation of wiper(s)	<ul style="list-style-type: none"> ● Wiper motor/linkage fault 	Lift the wiper arm(s) from the windshield/rear window and recheck the noise level during the wiper sweep operation.

Symptom	Possible Causes	Action
Noisy operation of washers	<ul style="list-style-type: none"> ● Washer motor(s) faulty ● Washer system blocked or partially blocked 	Listen for washer motor operation. Check and top up washer fluid level. Check and rectify blocked washer circuit. Check the wiper/washer circuit for DTCs indicating a fault. Rectify as necessary.
Washers do not operate	<ul style="list-style-type: none"> ● Fluid level low ● Washer circuit blocked ● Washer circuit faulty 	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Wipers and Washers - Windshield Washer Reservoir

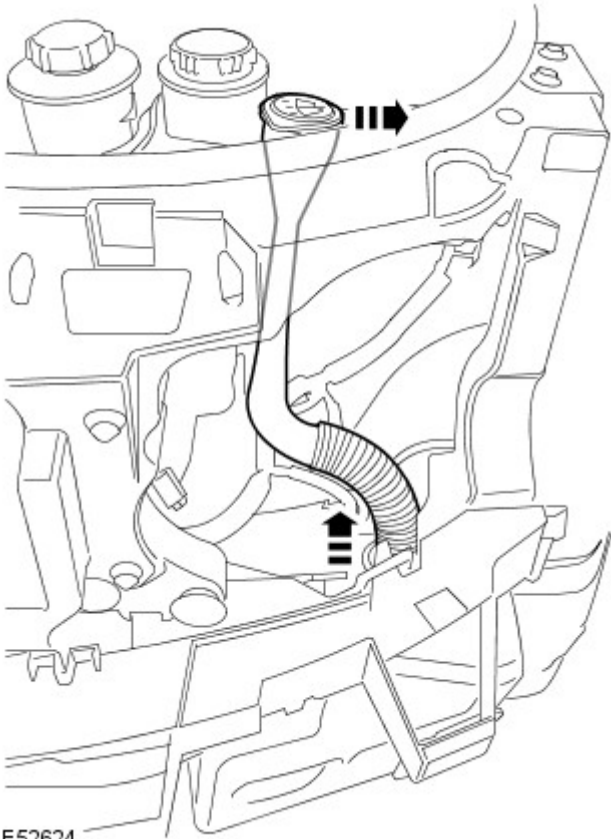
Removal and Installation

Removal

1. Remove the front bumper cover.
For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

2. Remove the windshield washer reservoir filler neck.

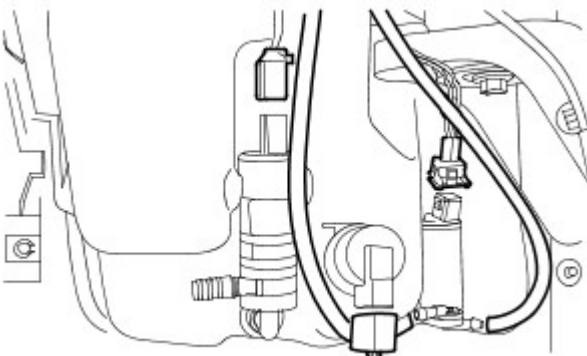
- Release the windshield washer reservoir filler neck from the coolant expansion tank.
- Remove and if necessary, discard the seal.



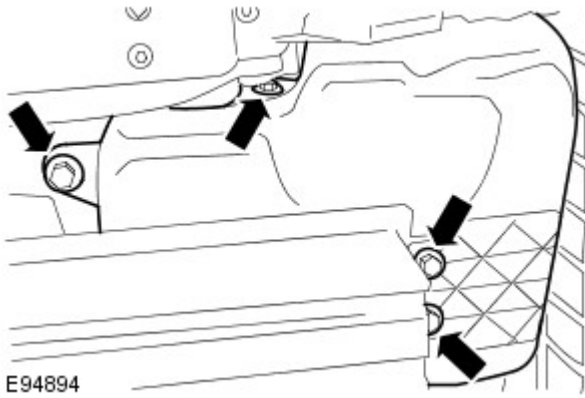
3. **NOTE:** Some fluid spillage is inevitable during this operation.

Disconnect the 2 hoses from the windshield washer reservoir pumps.

- Drain the washer reservoir fluid.
- Disconnect the 3 electrical connectors.



E94895



4. Remove the windshield washer reservoir.

- Remove the 4 bolts.

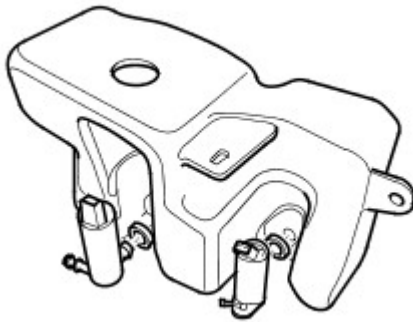
5. NOTE: Do not disassemble further if the component is removed for access only.

Remove the windshield washer pump.

- Remove and if necessary, discard the seal.

6. Remove the headlamp washer pump.

- Remove and if necessary, discard the seal.



Installation

1. Install the windshield washer pump.

- If necessary, install a new seal.

2. Install the headlamp washer pump.

- If necessary, install a new seal.

3. Install the windshield washer reservoir.

- Tighten the M6 bolts to 6 Nm (4 lb.ft).
- Tighten the M8 bolt to 25 Nm (18 lb.ft).

4. Connect the 2 hoses to the windshield washer reservoir pumps.

- Connect the electrical connectors.

5. Install the windshield washer reservoir filler neck.

- If necessary, install a new seal.
- Lubricate the seal.
- Secure in the clip.


6. Install the front bumper cover.

For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

Wipers and Washers - Windshield Washer Pump

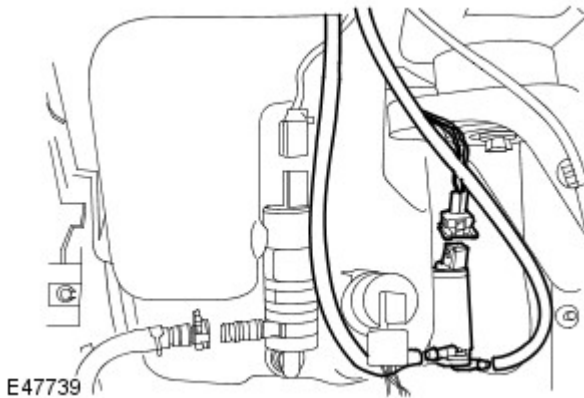
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Release the windshield washer pump hoses.
 - Drain the washer reservoir fluid.
4. Disconnect the windshield washer pump electrical connector.
5. Remove the windshield washer pump.
 - Discard the O-ring seal.



Installation

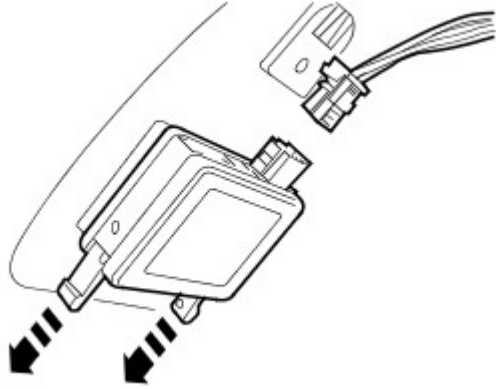
1. Install the windshield washer pump.
 - Install a new O-ring seal.
2. Connect the windshield washer pump electrical connector.
3. Connect the windshield washer pump hoses.
4. Install the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
5. Lower the vehicle.
6. Top-up the windshield washer reservoir.

Wipers and Washers - Rain Sensor

Removal and Installation

Removal

1. Remove the interior mirror.
For additional information, refer to: [Interior Mirror](#) (501-09 Rear View Mirrors, Removal and Installation).
2. Remove the rain sensor.



E49707

- Release the 2 clips.
- Disconnect the electrical connector.

Installation

1. To install, reverse the removal procedure.

Wipers and Washers - Front Wiper Pivot Arm

Removal and Installation

Removal

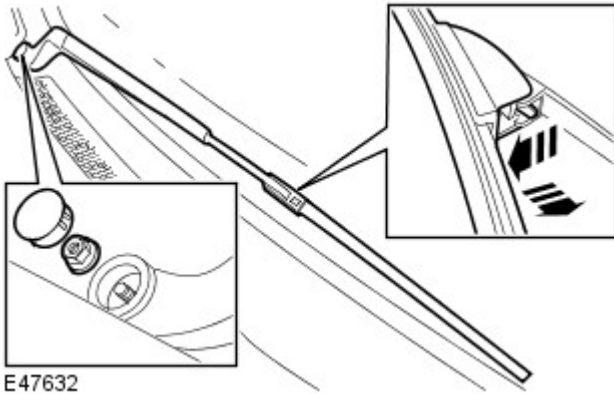
1. Noting the fitted position, remove the front wiper pivot arm.

- Remove the nut cover.
- Remove the nut.

2. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the wiper blade.

- Release the clip.



E47632

Installation

1. To install, reverse the removal procedure.

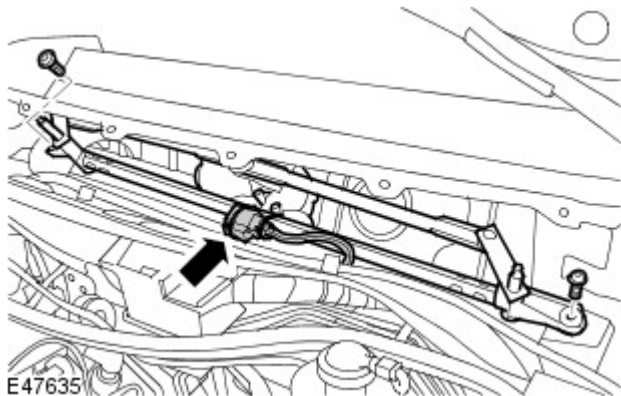
- Tighten the nut to 18 Nm (13 lb.ft).

Wipers and Washers - Windshield Wiper Motor

Removal and Installation

Removal

1. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
2. Remove the windshield wiper motor and linkage.



- Remove the 2 bolts.
- Remove the 2 clips.
- Disconnect the electrical connector.


3. NOTE: Do not disassemble further if the component is removed for access only.

Noting the fitted position, remove the wiper linkage.

- Remove the 2 bolts.
- Remove the nut.



Installation

1. Install the wiper linkage.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Tighten the nut to 25 Nm (18 lb.ft).
2.  CAUTION: Make sure the windshield wiper motor is located on its stud prior to installing the bolts.

Install the windshield wiper motor and linkage.

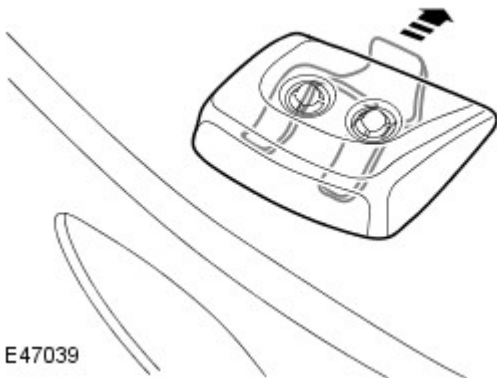
- Tighten the bolts to 6 Nm (4 lb.ft).
 - Connect the electrical connector.
 - Install the clips.
3. Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Wipers and Washers - Headlamp Washer Jet

Removal and Installation

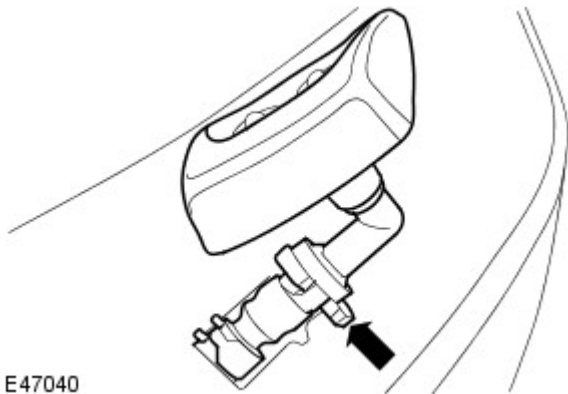
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front fog lamp.
For additional information, refer to: [Front Fog Lamp](#) (417-01 Exterior Lighting, Removal and Installation).
3. Release the washer jet assembly.
 - Release the clip.



E47039

4. Remove the washer jet.
 - Release the hose clip and disconnect the hose.



E47040


Installation

1. To install, reverse the removal procedure.

Wipers and Washers - Headlamp Washer Pump

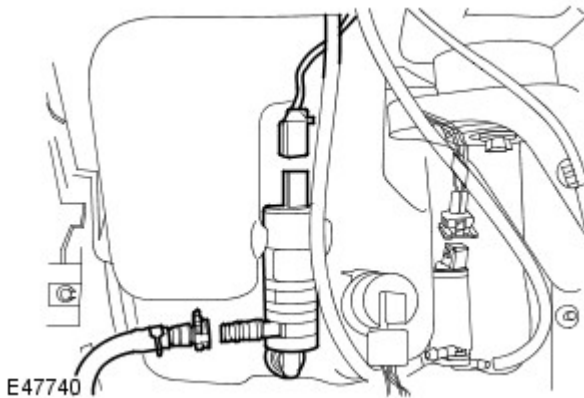
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Release the headlamp washer pump hose.
 - Drain the washer reservoir fluid.
4. Disconnect the headlamp washer pump electrical connector.
5. Remove the headlamp washer pump.
 - Discard the O-ring seal.

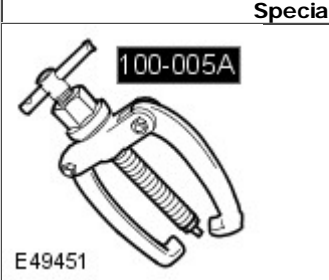


Installation

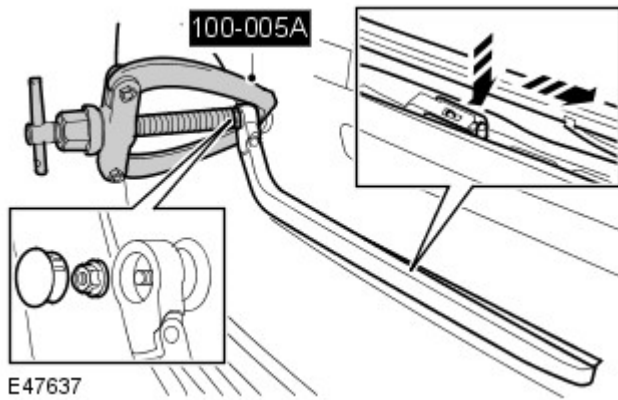
1. Install the headlamp washer pump.
 - Install a new O-ring seal.
2. Connect the headlamp washer pump electrical connector.
3. Connect the headlamp washer pump hose.
4. Install the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
5. Lower the vehicle.
6. Top-up the windshield washer reservoir.

Wipers and Washers - Rear Wiper Pivot Arm

Removal and Installation

Special Tool(s)	
	General purpose puller 100-005A (LRT-99-500A)

Removal



1. Noting the fitted position and using the special tool, remove the rear wiper pivot arm.

- Remove the nut cover.
- Remove the nut.

2. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the wiper blade.

- Release the clip.

Installation

1. To install, reverse the removal procedure.

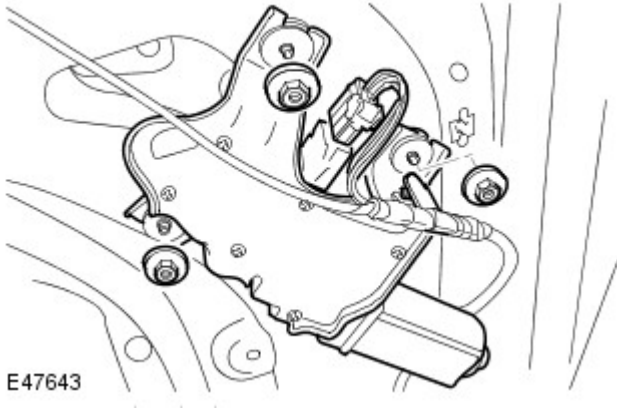
- Tighten the nut to 15 Nm (11 lb.ft).

Wipers and Washers - Rear Window Wiper Motor

Removal and Installation

Removal

1. Remove the liftgate trim panel.
For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the rear window wiper arm.
For additional information, refer to: [Rear Wiper Pivot Arm](#) (501-16 Wipers and Washers, Removal and Installation).
3. Remove the rear window wiper motor.
 - Disconnect the electrical connector.
 - Release the clip.
 - Remove the 3 nuts.



4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the 3 rubber insulators.

- Remove the metal inserts.



Installation

1. To install, reverse the removal procedure.
 - Tighten the nuts to 10 Nm (7 lb.ft).

Roof Opening Panel -

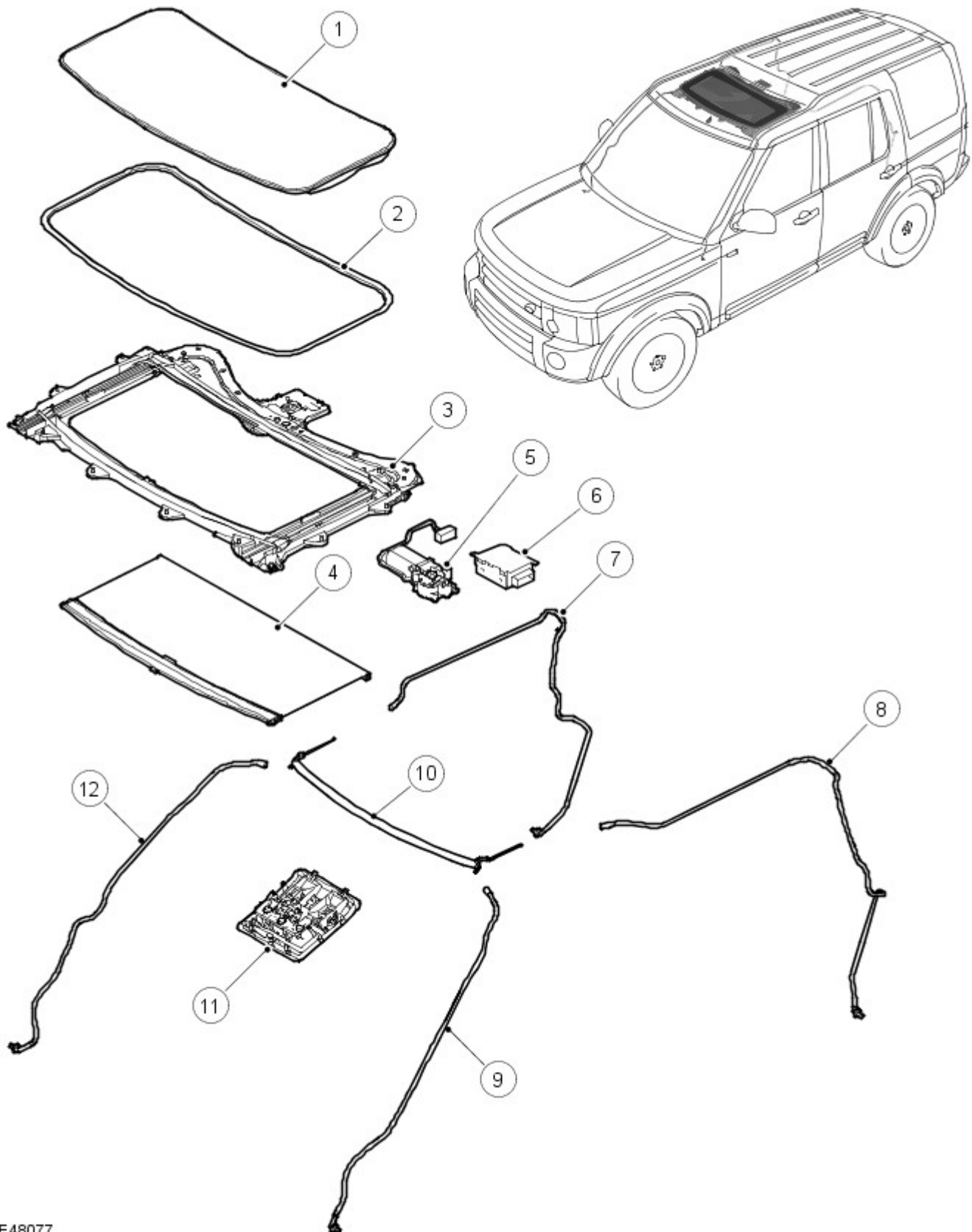
Torque Specifications

Description	Nm	lb-ft
Roof opening panel motor Torx screws	4	3
Roof opening panel bolts	10	7
Roof opening panel alignment Torx screws	6	4

Roof Opening Panel - Roof Opening Panel

Description and Operation

Roof Opening Panel Components

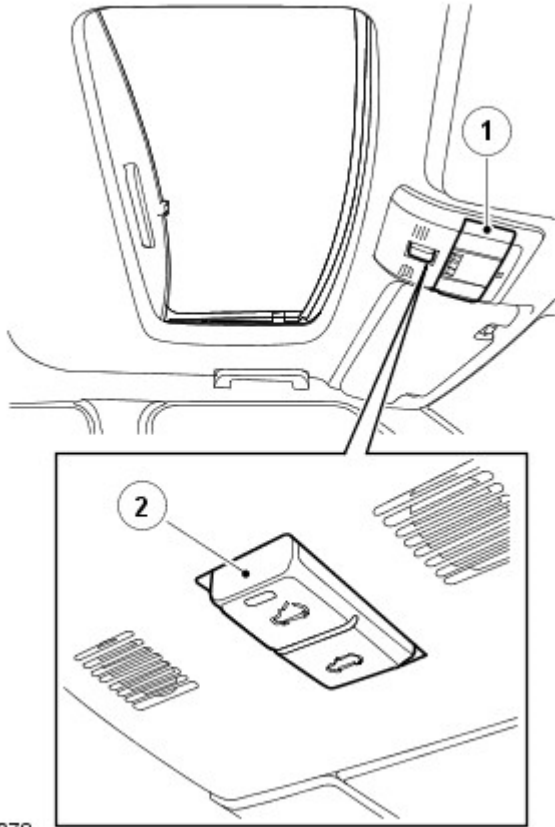


E48077

Item	Part Number	Description
1	-	Glass panel assembly
2	-	Glass panel seal
3	-	Frame assembly
4	-	Sunblind

5	-	Motor
6	-	Control module
7	-	RH rear drain tube
8	-	LH rear drain tube
9	-	LH front drain tube
10	-	Deflector
11	-	Access panel
12	-	RH front drain tube

GENERAL



E48078

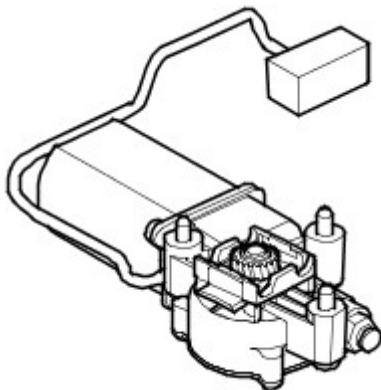
Item	Part Number	Description
1	-	Access panel
2	-	Switch

The sunroof is electrically operated through a two-way rocker switch located on the roof mounted centre console. An electric motor, attached to the sunroof frame, drives the glass sunroof panel to the tilt or open positions. The glass panel is operated by two cables, which are driven by the motor.

The sunroof frame is bolted to eleven mounting points on the roof panel. The frame is a large injection moulding and supports all of the sunroof components. Two aluminium guides held in the frame, on each side. The sunroof motor attaches to the rear of this frame. The motor is supported on the frame with three screws.

The sunroof glass panel is attached to the guide at the extreme front and rear. The tilt and slide positions are achieved by driving the attachment points on the panel over two fixed curves, one in the guide and one fixed to the panel.

Sunroof Motor



E48079

The sunroof motor has a worm drive, which drives a gear in a cast housing attached to the end of the motor. The gear has

a small pinion gear attached to the outer part of its spindle. The pinion engages with the helixed cables to form a rack and pinion drive. Rotation of the motor turns the pinion, which in turn drives the cables in the required direction.

Sunroof Motor Pin Out Information

Pin	Description	Input/Output
1	Hall sensor Ground	-
2	Hall sensor Supply	Input
3	Hall sensor Speed	Output
4	Hall sensor Direction	Output
5	Motor A	Input
6	Motor B	Input

The two cables are attached either side of the pinion. One end of each cable is attached to the guide. The opposite end is trapped in its position on the pinion by a metal insert in the frame. The cables run in channels in the frame to the guides. As the sunroof panel is closed, the cables are pushed through channels in the rear of the frame. The displaced cable is guided into a further two channels in the frame, which protect the cable and prevent the cable snagging creating noise. The cables are made from rigid spring steel and therefore can pull as well as push the sunroof along the guides.

A sun blind is also located in the guides integrated into the frame. The sunblind is operated manually, independently of the glass panels position. To move to the closed position the sunblind handle is pushed forward until it latches into the frame. To move the sunblind to the open position the sunblind handle is pushed up, to unlatch and either released or retracted to the open position. The sunblind can only be in either the fully open or fully closed positions.

Drain hoses are connected to the front and rear corners of the frame. The drain hoses are located inside of the cabin on the 'A' and 'C' post pillars to allow water, which has collected in the frame to escape. A one-way valve is fitted to the end of each drain hose to prevent the ingress of dirt and moisture.

SUNROOF CONTROL MODULE

The sunroof control module is mounted on the rear of the frame, and is connected to the motor at one end as described above, and to the vehicle electrical system at the other. It takes the inputs from the vehicle, such as LIN (Local Interconnect Network) bus signals and switch signals, and controls motor movement appropriately. It also contains the algorithm for the anti-trap system.

Sunroof Control Module Pin Out Information

Pin	Description	Input/Output
1	Switch Ground	-
2	Switch Open	Input
3	Switch Close	Input
4	Not used	-
5	Not used	-
6	Emergency (see note below)	Input
7	ECU Ground	-
8	Battery	Input
9	Not used	-
10	Not used	-
11	Not used	-
12	LIN	Input

• NOTE: Pin 6 is for use in an emergency only in the event of the vehicle LIN bus not being functional. It is not connected on the vehicle harness or in the connector.

• NOTE: Putting pin 6 to ground will enable the sunroof control module but without one touch operation or anti trap. The sunroof will not require re-calibrating unless the battery has been disconnected.

• NOTE: The sunroof control module will remain awake and enabled until pin 6 is disconnected again. Under no circumstances is this pin to be left grounded for long periods.

• NOTE: There is no emergency key access in the headlining for manual sunroof operation should the motor fail for any reason.

OPERATION

The sunroof can be operated with the ignition in power modes 4 accessory or 6 on. The sunroof can also be operated for up to 40 seconds after the ignition power mode 0 'off' provided the driver's or passenger's door is not opened. During the 40 second period the one touch function is inoperative.

The motor contains a micro-switch and a Hall effect sensor. Two gears, driven by the motor at one end of the pinion drive spindle, trip the micro-switch every thirteen revolutions of the spindle. When the micro-switch is tripped, the sunroof control module senses an open circuit signal. The sunroof control module, to calculate the exact position of the sunroof, uses the signal from the micro-switch combined with signals received from the Hall effect sensor. The Hall effect sensor is also responsible for the operation of the anti-trap function.

If the anti-trap feature is activated while the sunroof is closing, the roof panel is reversed for 200mm or as far as possible. The Hall sensor, located in the sunroof motor, monitors the speed of the motor and if the speed decreases below a set threshold, indicating an obstruction, the power feed to the motor is reversed so the sunroof goes back. In an emergency the anti-trap function can be overridden by holding the sunroof switch in the closed position.

Tilt

With the sunroof panel closed, pushing the upper part of the rocker switch operates the sunroof motor to 'tilt' the rear of the sunroof upwards. The motor operates for as long as the switch is operated until the glass is tilted to its full extent. If the switch is released before the full tilt position is reached, the sunroof panel stops at the chosen position. A single press (between 0.5 and 1 second) of the switch operates the motor so that the panel automatically retracts to the fully tilted position.

When the tilt function is requested, the cables pull the guide rearward, forcing the panel attachment up a curve, which raises the sunroof panel to the tilt position.

With the sunroof panel in the tilted position, pushing the lower part of the rocker switch operates the sunroof motor to lower the sunroof panel. The motor operates to lower the panel for as long as the switch is operated until the panel is fully lowered. If the switch is released before the fully lowered position is reached, the sunroof panel stops at the chosen position.

Open (slide)

With the sunroof panel tilted, pushing the upper part of the rocker switch operates the sunroof motor to raise the sunroof panel and retract it backwards. A single press (between 0.5 and 1 second) of the switch operates the motor so that the panel automatically retracts to the fully open position. When the panel retracts, a wind deflector automatically raises at the front of the sunroof aperture, which serves to reduce wind noise.

When the open function is requested, the cables pull in a rearward direction, driving the glass panel attachments to slide the panel over the exterior roof skin.

With the sunroof panel half or fully open, pushing the lower part of the switch operates the motor to close the sunroof panel. A single press (between 0.5 and 1 second) of the switch operates the motor so that the panel automatically closes to the fully tilted position.

If only partial opening or closing is desired, pressing the switch momentarily (less than 0.5 seconds) in either direction will stop the sunroof panel movement. When movement is desired in either direction, pressing the switch will operate the motor to move the panel.

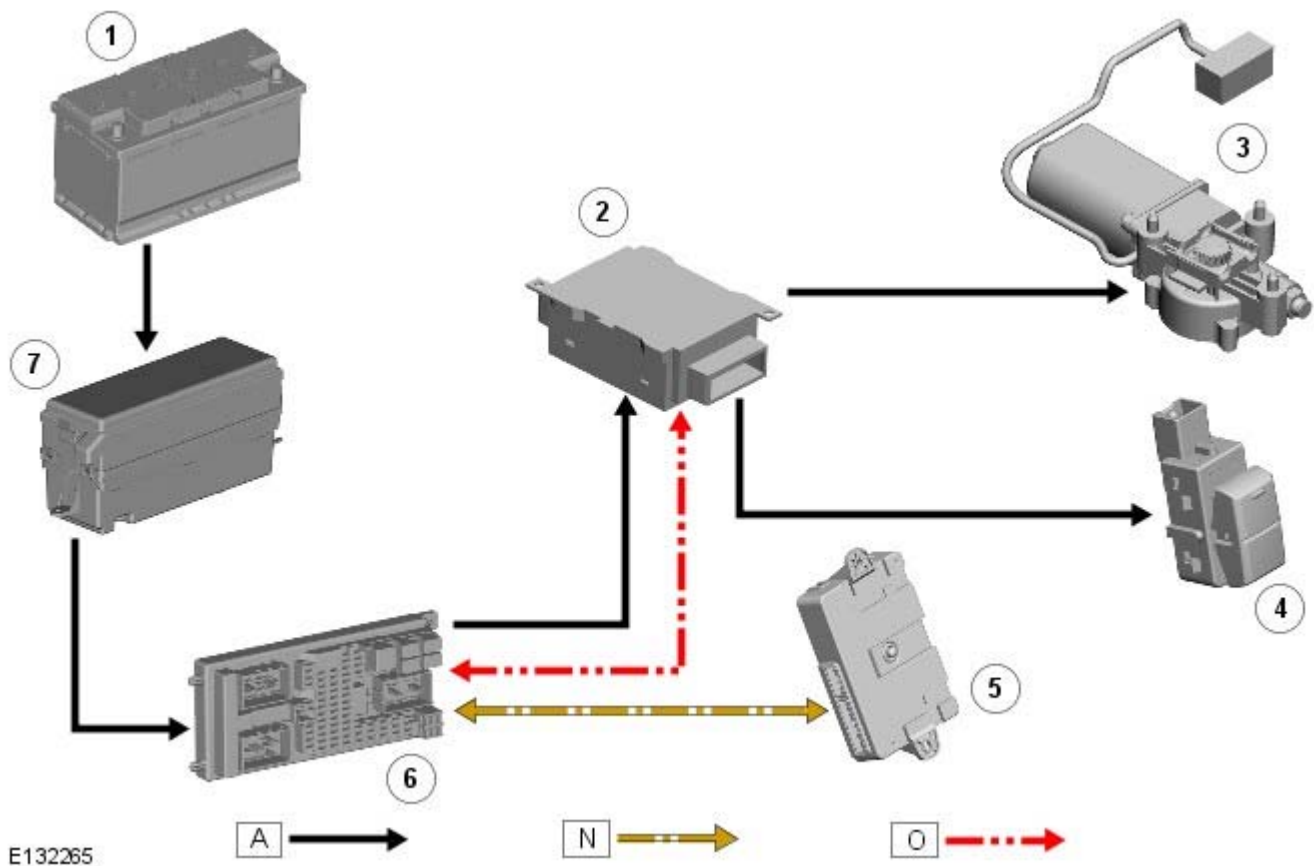
The sunroof has an 'anti-trap' function which prevents the sunroof panel from closing if an obstruction is sensed. When an obstruction is sensed, the motor will automatically retract the panel by 200mm or as far as possible. When the obstruction is removed, the panel can be closed by the normal method.

Battery Disconnection

If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Pressing the lower part of the sunroof switch for 20 seconds will start the sunroof's calibration routine. The sunroof will complete a full cycle in order to re-learn the parameters required for one-touch open and close and the anti-trap function. The sunroof will still have manual movement available until the sunroof is re-calibrated.

SUNROOF CONTROL DIAGRAM

• NOTE: **A** = Hardwired; **N** = Medium speed CAN bus; **P** = Local Interconnect Network (LIN) bus



Item	Part Number	Description
1	-	Battery
2	-	Sunroof control module
3	-	Sunroof motor
4	-	Sunroof switch
5	-	Keyless Vehicle Module (KVM)

6	-	Central Junction Box (CJB)
7	-	Engine Junction Box (EJB)

Roof Opening Panel - Roof Opening Panel

Diagnosis and Testing

Principle of Operation

For a detailed description of the roof opening panel system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Roof Opening Panel](#) (501-17 Roof Opening Panel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Glass panel assembly ● Glass panel seal ● Frame assembly ● Sunblind ● Deflector ● Access panel ● Roof opening panel cables ● Drain tube(s) 	<ul style="list-style-type: none"> ● Fuses ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Wiring harness ● Loose or corroded connector(s) ● Roof opening panel motor and control module ● Roof opening panel switch

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Roof opening panel inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Circuit fault ● Switch fault ● Motor fault 	Check the fuse(s). Check the roof opening panel circuits. Check the switch and motor function. Refer to the electrical guides.
Roof opening panel sticking	<ul style="list-style-type: none"> ● Debris in the channels/guides ● Cable(s) sticking/damaged ● Roof opening panel not correctly aligned ● Switch fault ● Motor fault 	Check for general debris. Inspect, clean and lubricate the cable(s) and guides. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual. Check the switch and motor function. Refer to the electrical guides.
Roof opening panel juddering	<ul style="list-style-type: none"> ● Debris in the channels/guides ● Cable(s) sticking/damaged ● Roof opening panel not correctly aligned ● Motor fault 	Check for general debris. Inspect, clean and lubricate the cable(s) and guides. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual. Check the motor function.
Water ingress from roof opening panel	<ul style="list-style-type: none"> ● Debris in the channels/guides ● Drain tube(s) blocked ● Damage to the glass panel seal ● Roof opening panel not correctly aligned 	Check for general debris and blocked drain tube(s). Inspect, clean and lubricate the cable(s) and guides. Check the glass panel seal. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual.
Wind noise	<ul style="list-style-type: none"> ● Damage to the glass panel seal ● Cable(s) sticking/damaged ● Roof opening panel not correctly aligned 	Check the glass panel seal. Inspect, clean and lubricate the cable(s) and guides. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Roof Opening Panel - Roof Opening Panel Alignment

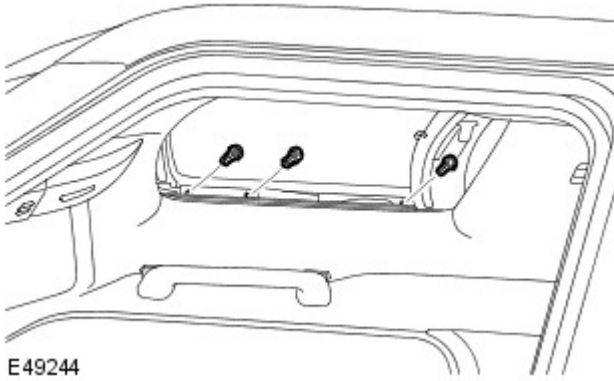
General Procedures

1. With the roof opening panel closed, check the alignment of the glass to the roof panel. The glass should be central in its aperture. Profile of sunroof to body:

1. Front edge, set flush or up to 1.0 mm (0.040") low.
1. Rear edge, set flush or up to 1.0 mm (0.040") high.

2. Open the roof opening panel blind.

3. Loosen the 6 roof opening panel Torx bolts.



4. Align the roof opening panel.

- Tighten the Torx screws to 6 Nm (4 lb.ft).

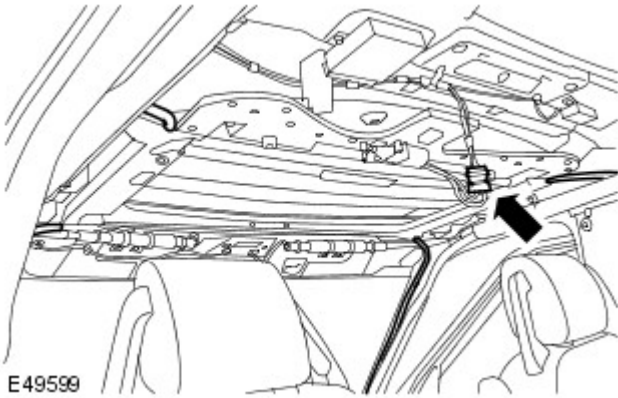
5. Close the roof opening panel blind.

Roof Opening Panel - Roof Opening Panel

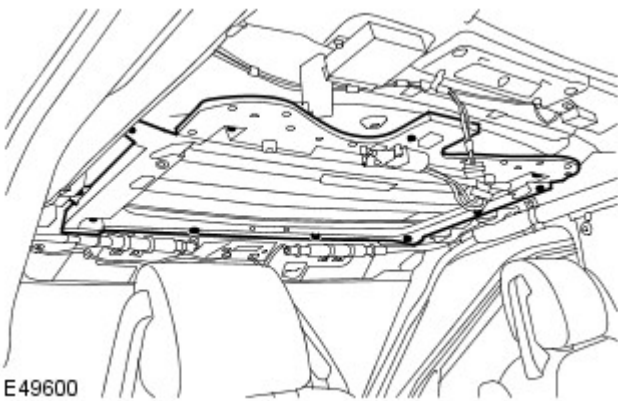
Removal and Installation

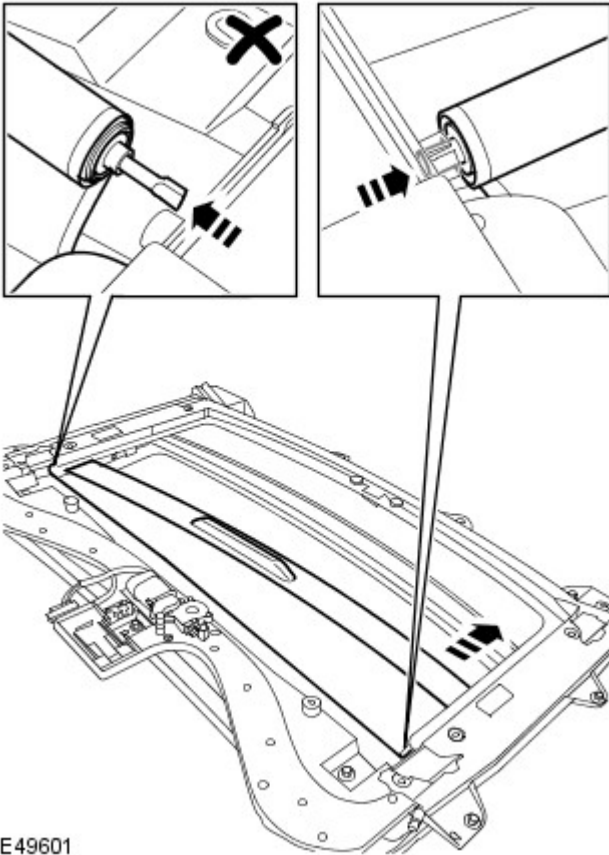
Removal

1. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Release the 4 drain hoses from the roof opening panel.
3. Disconnect the roof opening panel motor electrical connector.



4. With assistance, remove the roof opening panel assembly.
 - Remove the 11 bolts.





E49601

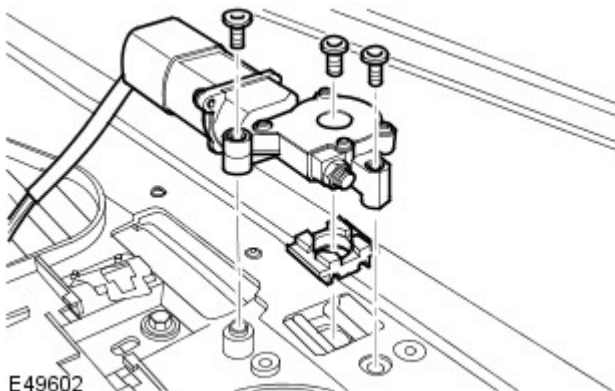
5.  **CAUTION:** Do not depress the RH plunger to remove the blind.

• **NOTE:** Do not disassemble further if the component is removed for access only.

• **NOTE:** Note the fitted position.

Remove the roof opening panel blind.

- Twist to release the handle.
- Depress the LH plunger.



E49602

6. Remove the roof opening panel motor.

- Remove the 3 Torx screws.
- Remove the spacer.

Installation

1. Install the roof opening panel motor.

- Install the spacer.
- Tighten the Torx screws to 4 Nm (3 lb.ft).

2. **NOTE:** Align to the position noted on removal.

Install the roof opening panel blind.

- Secure in the guides.
- Locate the tensioner peg.
- Depress the LH plunger.

3. With assistance, install the roof opening panel assembly.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).

4. Connect the roof opening panel motor electrical connector.

5. Connect the drain hoses.

- Make sure the drain hoses are clear prior to connection.

6. Install the headliner.

For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Using T4, configure a new roof opening panel.

- 8.** If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Close the roof opening panel and continue to hold the switch for a further 20 seconds to allow the sunroof to complete a full cycle. This will complete the roof opening panels calibration routine and reset these functions.

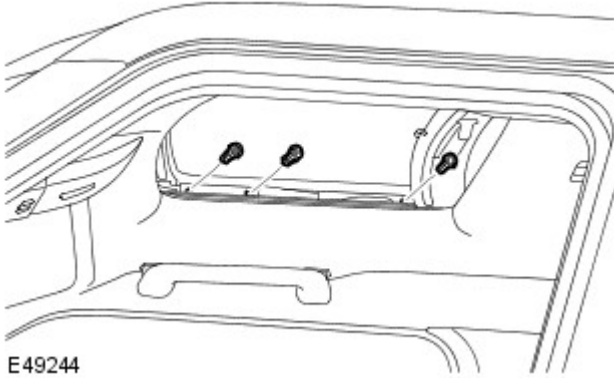
Roof Opening Panel - Roof Opening Panel Glass

Removal and Installation

Removal

1. Open the roof opening panel blind.
2. Open the roof opening panel to the tilt position.
3. Remove the roof opening panel glass.

- Remove the 3 Torx screws.
- Repeat the above procedure for the other side.



E49244

Installation

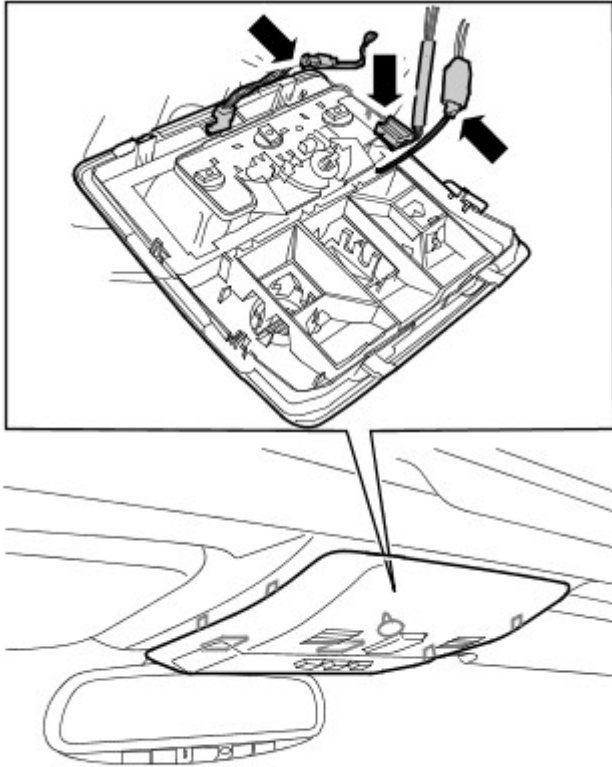
1. Install the roof opening panel glass.
 - Install the Torx bolts, but do not tighten fully at this stage.
2. Align the roof opening panel glass.
For additional information, refer to: [Roof Opening Panel Alignment](#) (501-17 Roof Opening Panel, General Procedures).

Roof Opening Panel - Roof Opening Panel Motor

Removal and Installation

Removal

1. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the front overhead console.

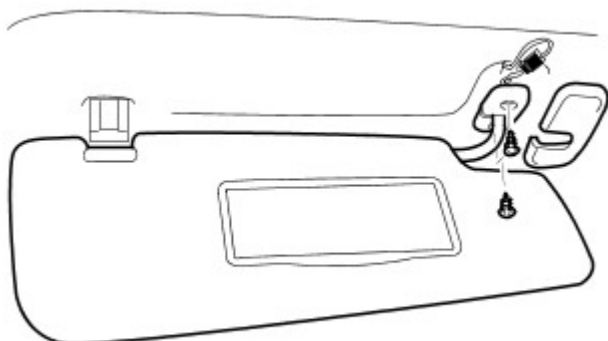


- Carefully release the 7 clips.
- Disconnect the electrical connector.

E50142

4. Remove the sun visor.

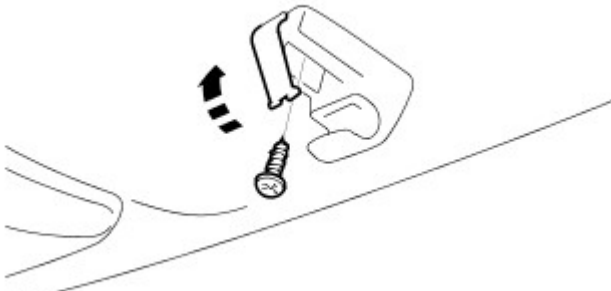
- Remove the cover.
- Remove the 2 screws.
- Release from the clip.
- Disconnect the electrical connector.
- Repeat the above procedure for the other side.



E49687

5. Remove the sun visor retaining clip.

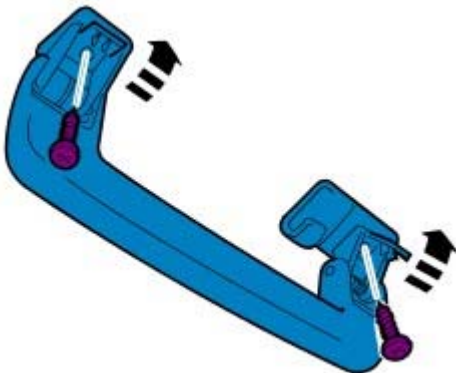
- Release the screw cover.
- Remove the screw.
- Repeat the above procedure for the other side.



E49688

6. Remove the passenger assist handle.

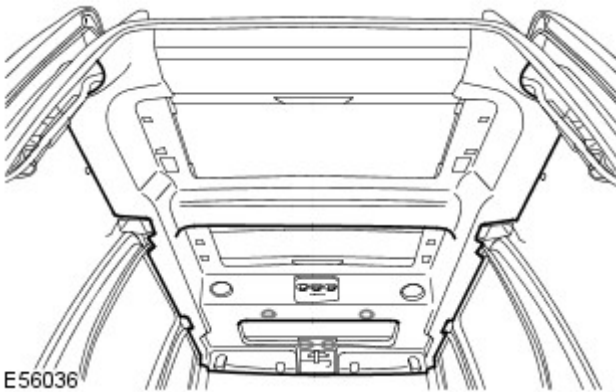
- Release the 2 screw covers.
- Remove the 2 screws.
- Repeat the above procedure for the other side.



E49689

7. Lower the headliner for access.

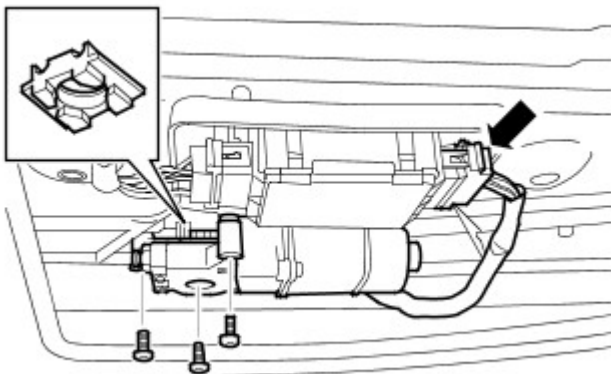
- Release the 4 clips.



E56036

8. Remove the roof opening panel motor.

- Disconnect the electrical connector.
- Remove the 3 Torx screws.
- Remove the spacer.



E55446

Installation

1. Install the roof opening panel motor.

- Install the spacer.

- Tighten the Torx screws to 4 Nm (3 lb.ft).
 - Connect the electrical connector.
2. Position the headliner.
- Secure with the clips.
3. Install the passenger assist handles.
- Install the screws.
 - Secure the screw covers.
4. Install the sun visors.
- Install the clips.
 - Install the screws.
 - Install the screw covers.
 - Connect the electrical connectors.
5. Install the front overhead console.
- Connect the electrical connector.
 - Carefully secure the clips.
6. Install both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
7. Install both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
8. Using T4, configure a new roof opening panel motor.
9. If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Close the roof opening panel and continue to hold the switch for a further 20 seconds to allow the sunroof to complete a full cycle. This will complete the roof opening panel calibration routine and reset these functions.

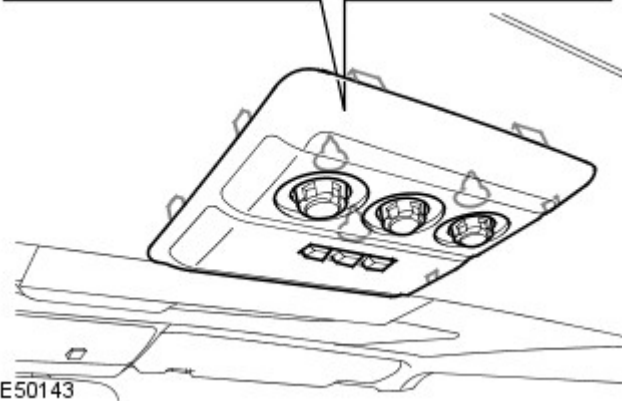
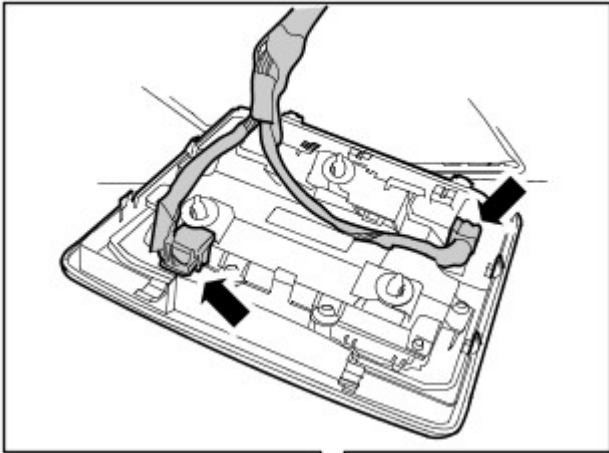
Roof Opening Panel - Roof Opening Panel Module

Removal and Installation

Removal

1. Remove the rear overhead console.

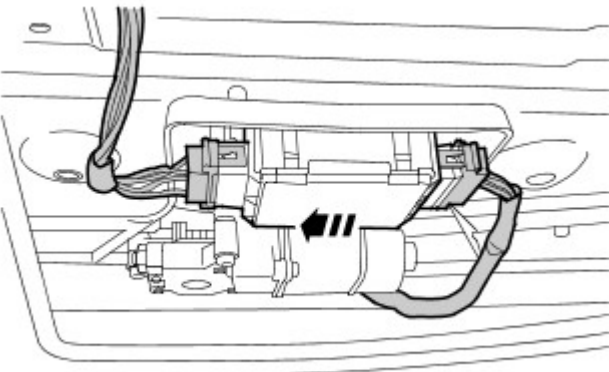
- Carefully release the 9 clips.
- Disconnect the 2 electrical connectors.



E50143

2. Remove the roof opening panel module.

- Slide the module to the LH side to release it from the bracket.
- Disconnect the 2 electrical connectors.



E55397

Installation

1. Install the roof opening panel module.

- Connect the electrical connectors.
- Secure the module to the bracket.

2. Install the rear overhead console.

- Connect the electrical connectors.
- Carefully secure the clips.

3. Using T4, configure a new roof opening panel module.

4. If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Close the roof

opening panel and continue to hold the switch for a further 20 seconds to allow the sunroof to complete a full cycle. This will complete the roof opening panels calibration routine and reset these functions.

Bumpers -

Description	Nm	lb-ft
Front bumper bolts	25	18
Windshield washer reservoir bolts	5	3.5
Front bumper cover bolts	5	3.5

Bumpers - Front Bumper

Removal and Installation

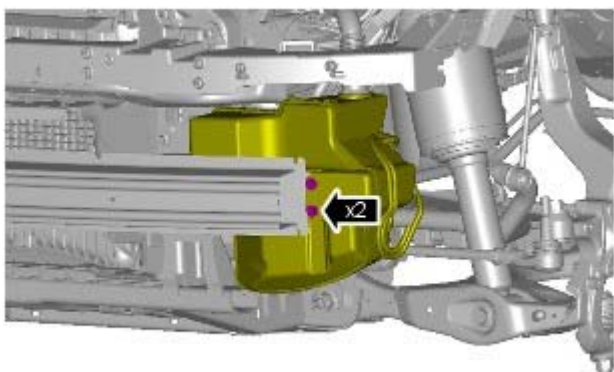
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

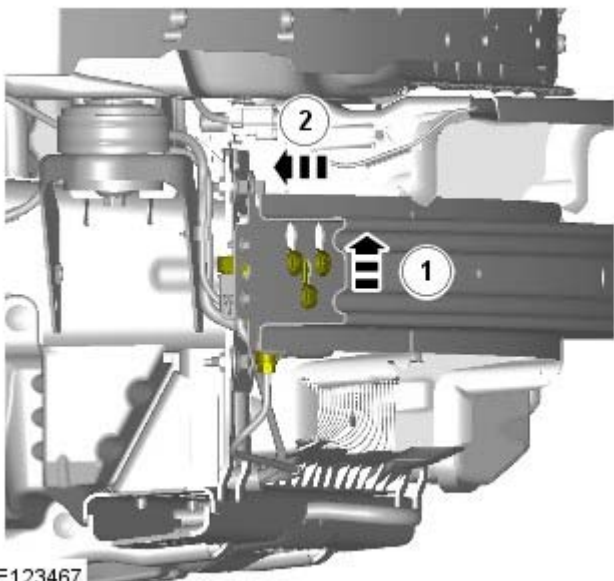
2. Refer to: [Front Bumper Cover](#) (501-19 Bumpers, Removal and Installation).



E123468

3. **3.** NOTE: Support as necessary.

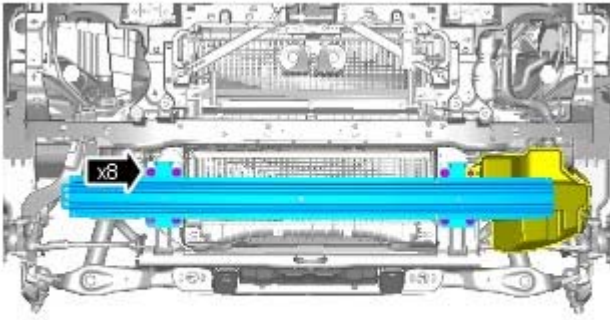
Torque: 10 Nm



E123467

4. **4.**  CAUTION: Take extra care not to damage the component.

- NOTE: Support as necessary.



5. **NOTE:** With assistance remove the component.

Torque: 25 Nm

E123469

Installation

1. To install, reverse the removal procedure.

Bumpers - Front Bumper Cover

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

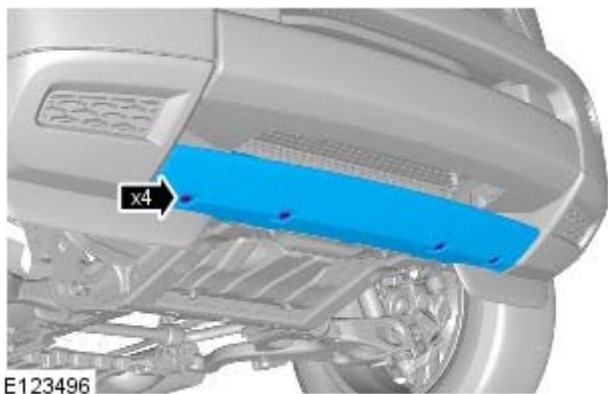
2. Refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

3.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

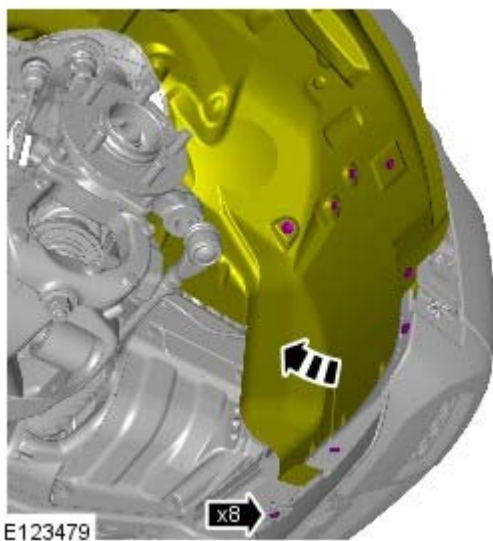
4. Remove both the front wheels and tires.

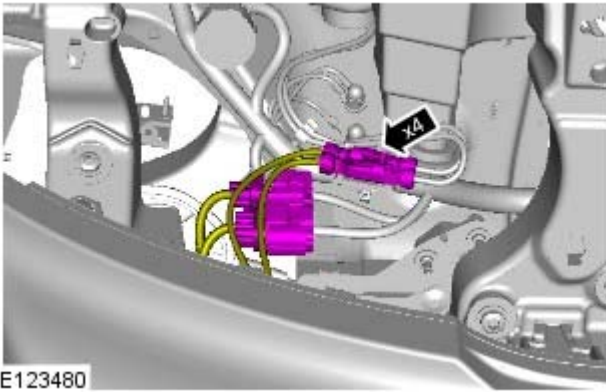
5.



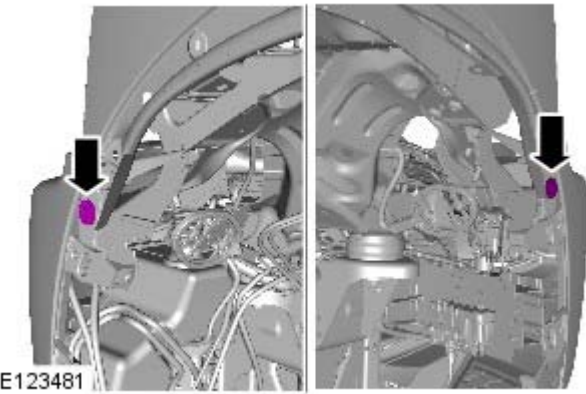
6. **NOTE:** The procedure must be carried out on both sides.

Torque: 1 Nm

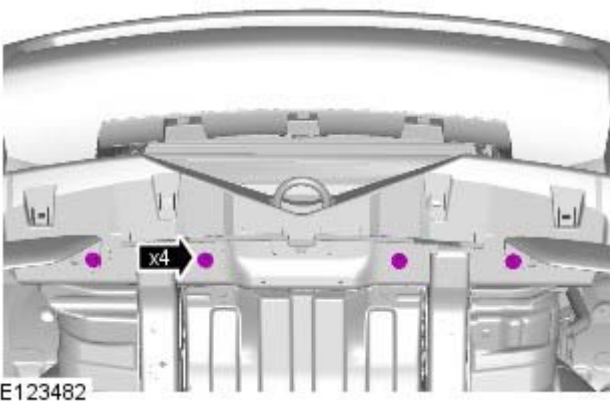




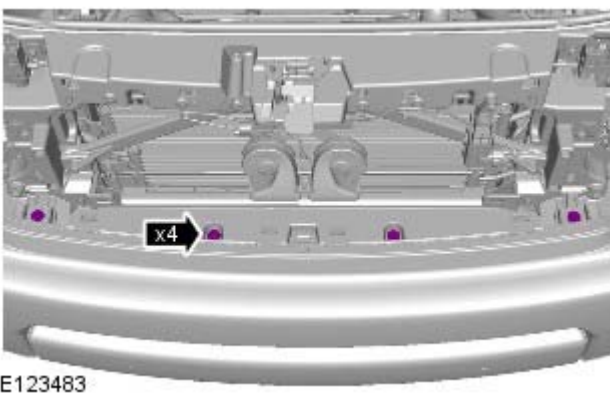
7.  CAUTION: Take extra care not to damage the wiring harnesses.



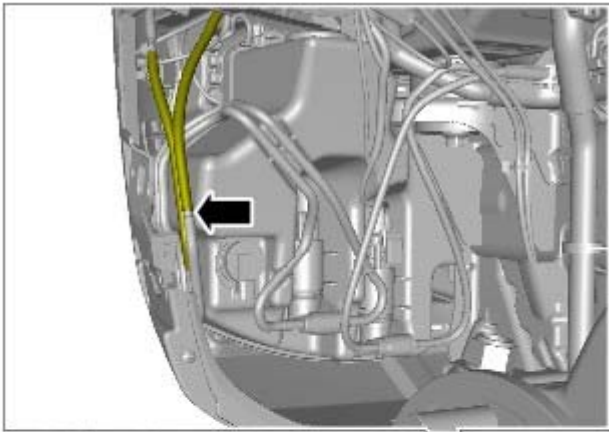
8. Torque: 5 Nm



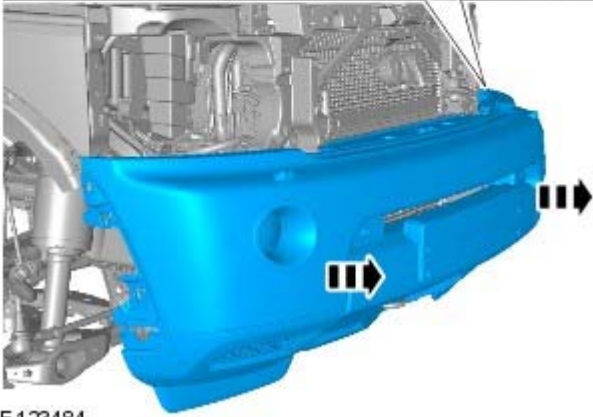
9. Torque: 5 Nm



10. Torque: 5 Nm



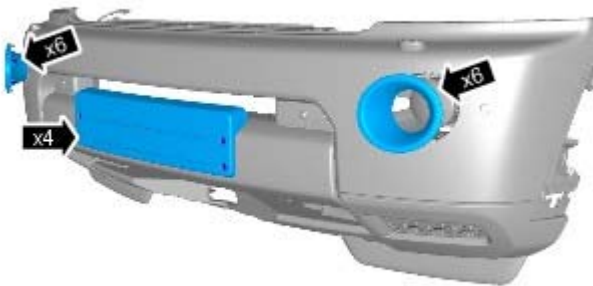
11. **11.** NOTE: With assistance remove the component.



E 123484

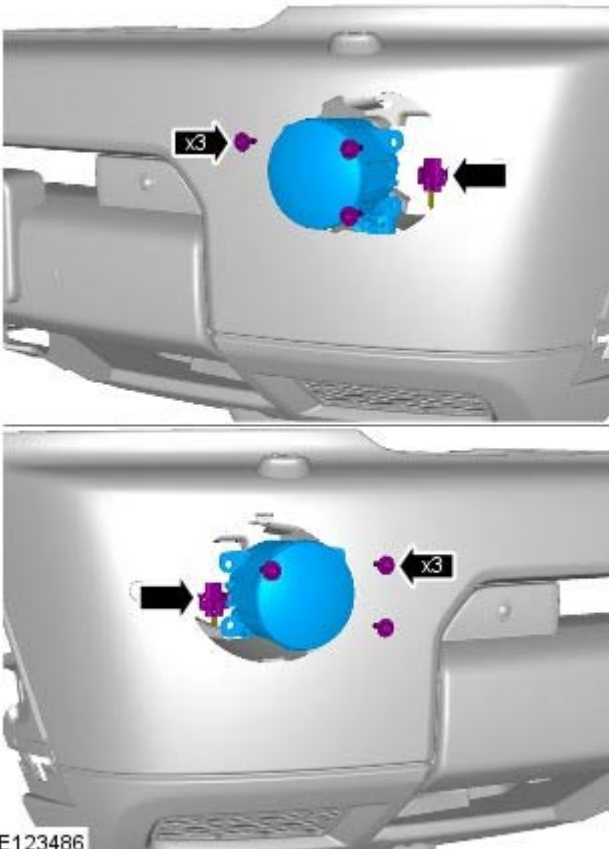
12. **12.** NOTE: Do not disassemble further if the component is removed for access only.

Torque: 1 Nm



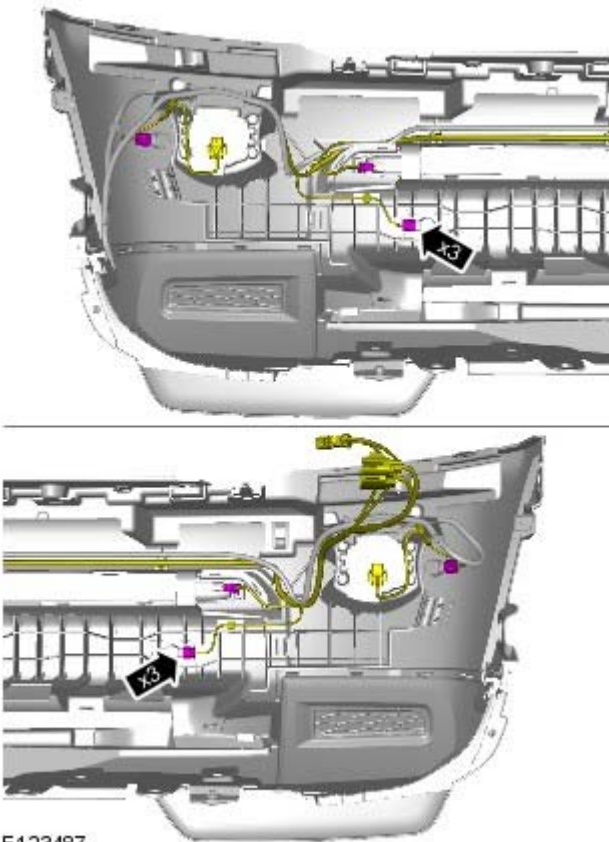
E 123485

13. Torque: 1.5 Nm



E123486

14.




E123487

15. Torque: 1 Nm



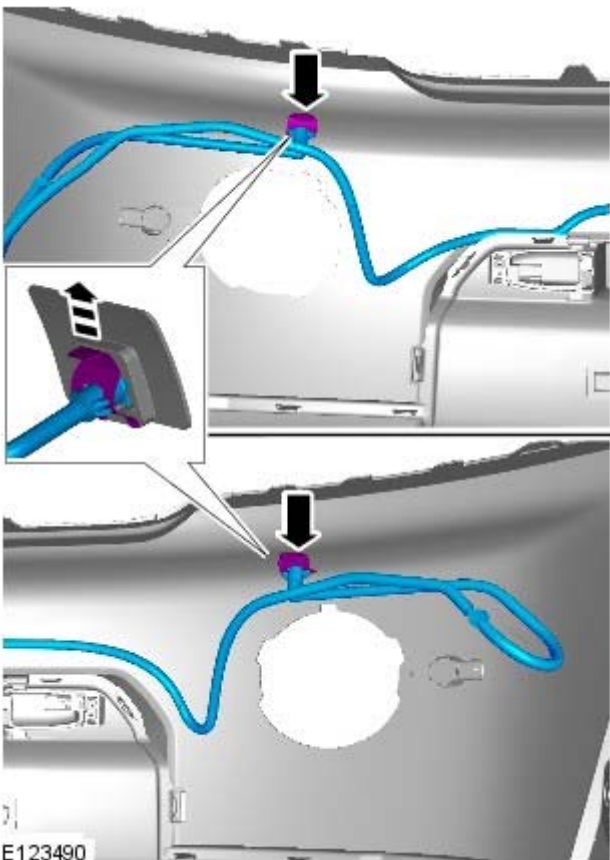
E123488

16.  CAUTION: Make sure the locating tangs are aligned. Failure to follow this instruction may result in damage to the vehicle.



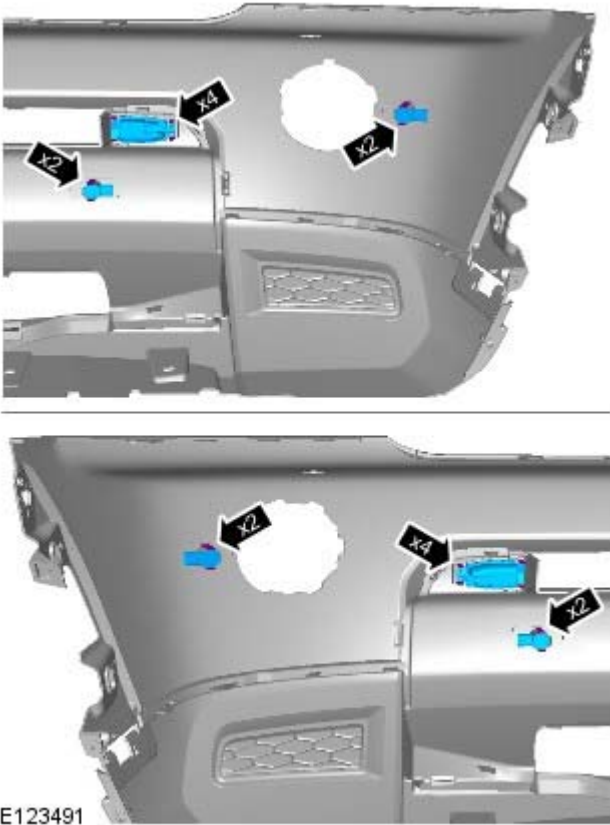
E123489

17.



E123490

18.



E123491

Installation

1. To install, reverse the removal procedure.

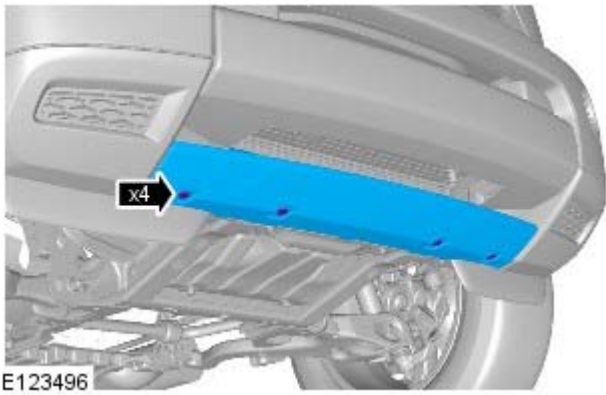
Bumpers - Front Bumper Lower Cover

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.



Installation


1. To install, reverse the removal procedure.

Bumpers - Rear Bumper Cover

Removal and Installation

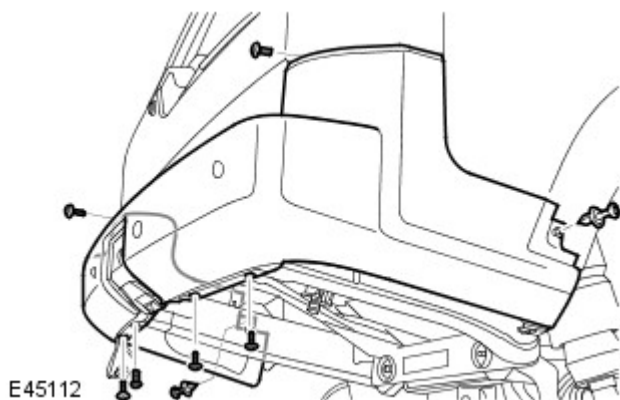
Removal

All vehicles

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

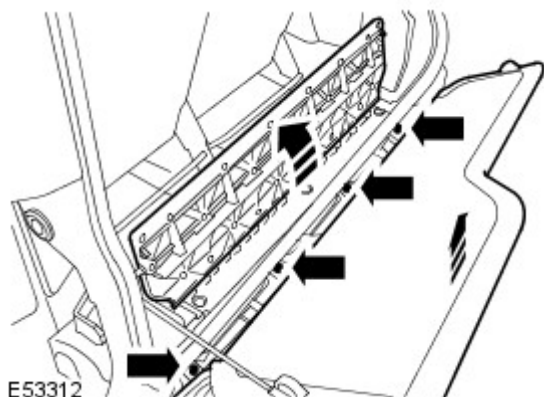
Raise and support the vehicle.

2. Remove both rear lamp assemblies.
For additional information, refer to: [Rear Lamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
3. Remove both rear quarter panel mouldings.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
4. Remove 4 screws, 2 clips and 2 bolts from the rear bumper cover.



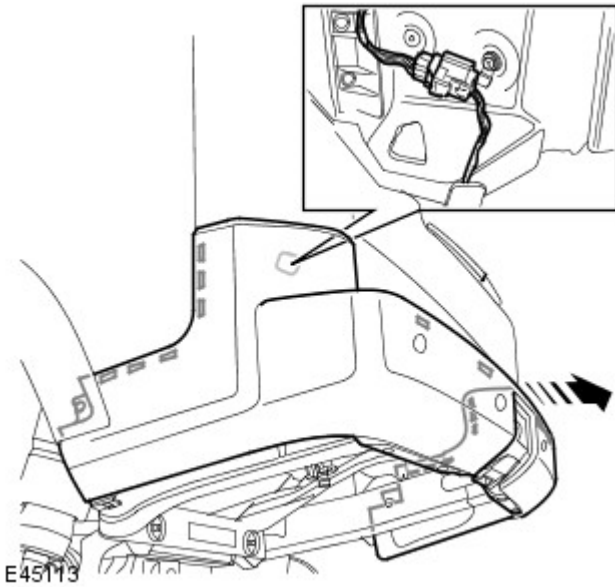
5. With assistance, remove 4 clips from the inner edge of the bumper cover.

- Tilt the tailgate for access.
- Open the tailgate hinge cover.



6. Remove the rear bumper cover.

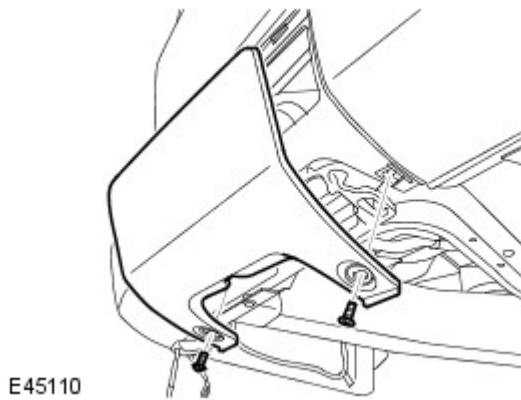
- Release from the 12 clips.
- If installed, disconnect the parking aid sensor wiring harness electrical connector.



7. NOTE: Do not disassemble further if the component is removed for access only.

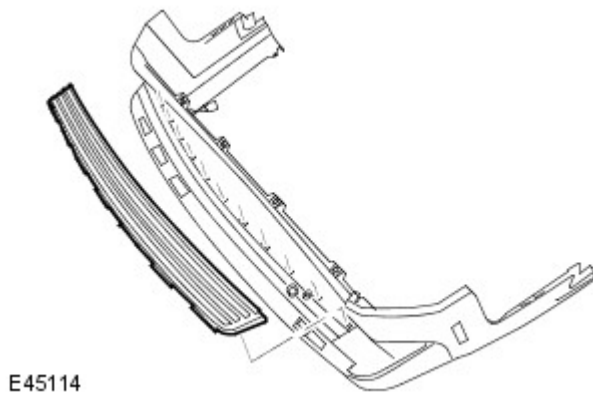
Remove the towing eye cover.

- Remove the 2 screws.



8. Remove the rear bumper trim panel.

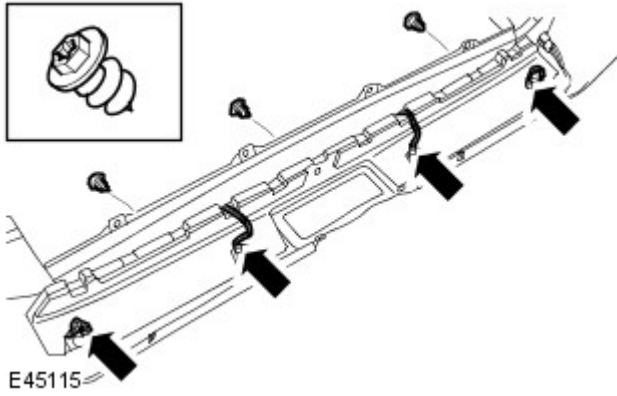
- Release the 11 clips.



9. Remove the bumper insert.

- Remove the 3 screws.

Vehicles with parking aid



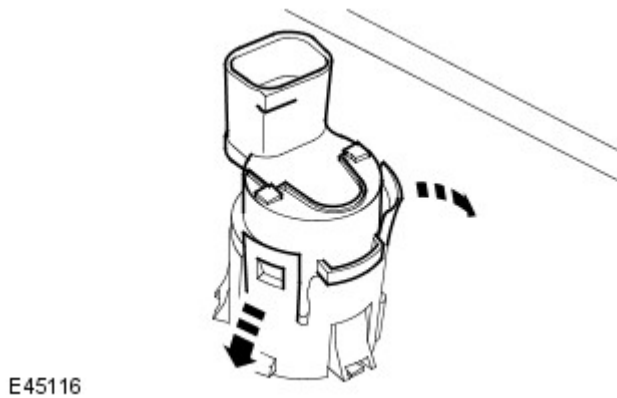
10. Remove the parking aid sensor wiring harness.

- Disconnect the 4 electrical connectors.

Vehicles with parking aid

11. Remove the parking aid sensor.

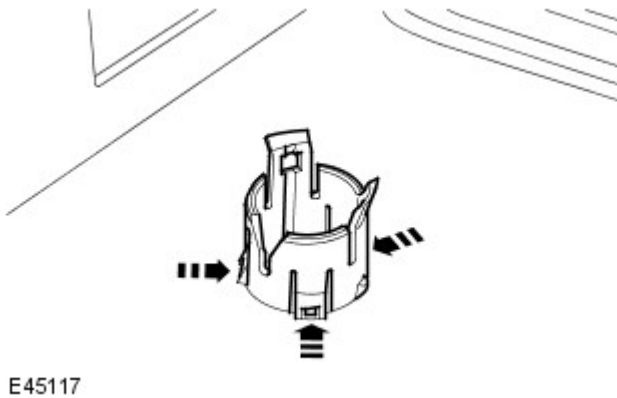
- Release the 2 clips.
- Repeat the above procedure for the remaining 3 sensors.



Vehicles with parking aid

12. Remove the parking aid sensor trim panel.

- Release the 3 clips.
- Repeat the above procedure for the remaining 3 sensor trim panels.



Installation

Vehicles with parking aid

1. Install the parking aid sensor trim panels.

Vehicles with parking aid

2. Install the parking aid sensors.

Vehicles with parking aid

3. Install the parking aid sensor wiring harness.

- Connect the electrical connectors.

4. Install the bumper insert.

- If installed, secure the parking aid sensor wiring harness.

- Tighten the screws.
5. Install the rear bumper trim panel.
 6. Install the towing eye cover.
 - Tighten the screws.
 7. Install the rear bumper cover.
 - If installed, connect the parking aid sensor wiring harness electrical connector.
 - Secure with the clips.
 - Tighten the screws.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 8. Install both rear quarter panel mouldings.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
 9. Install both of the rear lamp assemblies.
For additional information, refer to: [Rear Lamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

Safety Belt System -

Torque Specifications

Description	Nm	lb-ft
Front safety belt retractor Torx bolt	40	30
Front safety belt buckle Torx bolt	40	30
+ Front safety belt upper anchor Torx bolt	40	30
Second row safety belt retractor Torx bolt	40	30
+ Second row safety belt upper anchor Torx bolt	40	30
Third row safety belt retractor Torx bolt	40	30
+ Third row safety belt upper anchor Torx bolt	40	30
Luggage compartment Torx bolts	25	18
Rear safety belt buckle Torx bolt	25	18
Rear safety belt buckle - RH - Torx bolt	40	30
Rear safety belt buckle - LH - Torx bolt - 60-40 split	25	18
Rear center safety belt buckle Torx bolt - 40-20-40 split	40	30
Rear safety belt buckle Torx bolt - 40-20-40 split	25	18
+ Rear seat Torx bolts	40	30

+ New Torx bolt must be fitted

Safety Belt System - Safety Belt System

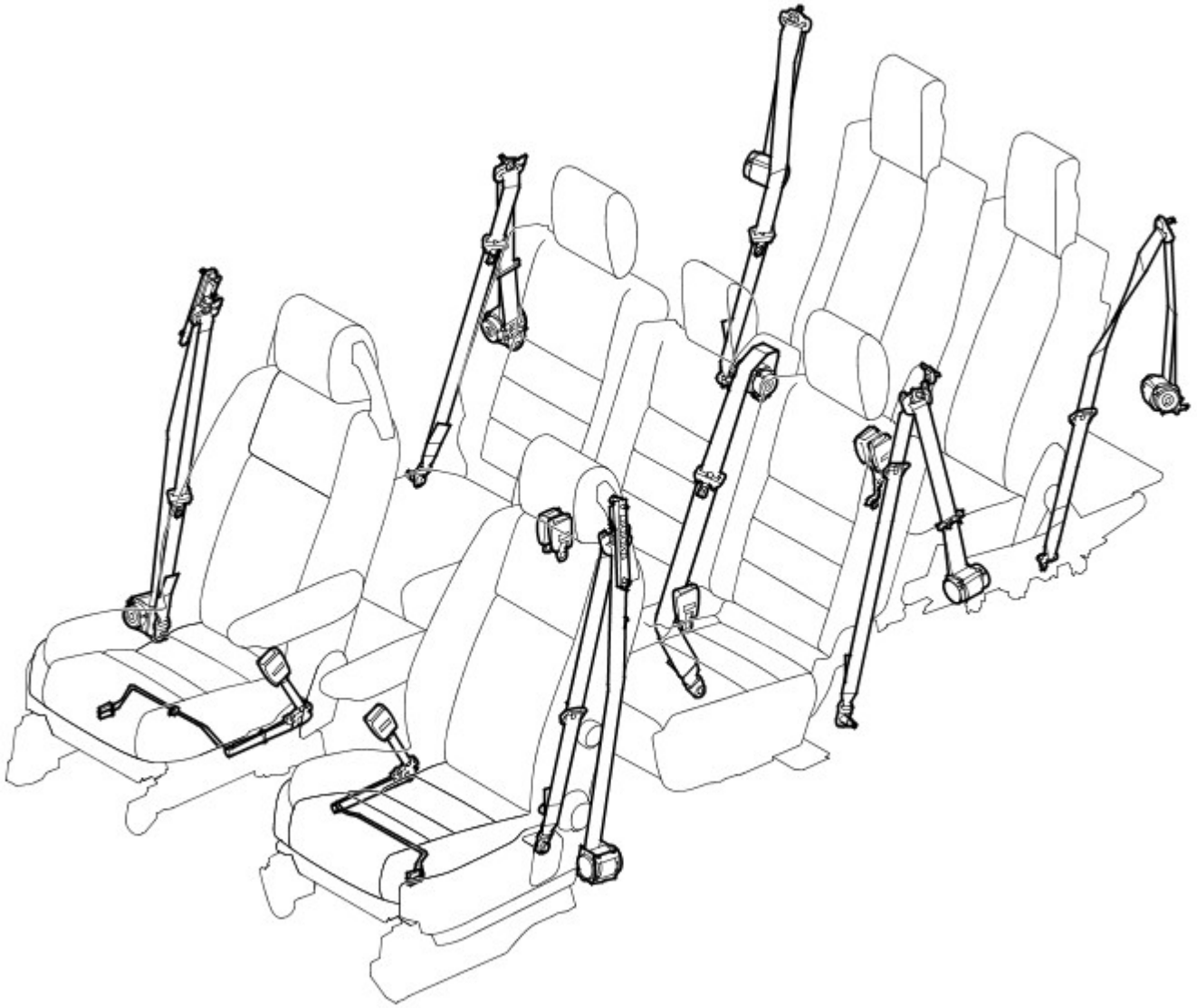
Description and Operation

COMPONENT LOCATIONS (FIVE SEAT VEHICLES)



E44815

COMPONENT LOCATIONS (SEVEN SEAT VEHICLES)



E44835

GENERAL

A three point safety belt is installed at each seat position. Except in North American Specification (NAS) markets, all of the safety belts have Emergency Locking Retractors (ELR). In NAS markets, only the driver seat is fitted with an ELR; all of the passenger safety belts have Automatic Locking Retractors (ALR).

Both types of retractor incorporate a liftshaft locking system with webbing sensor and car sensor activating mechanisms. The webbing sensor activates the locking system if the webbing is subjected to a sharp pull. The car sensor activates the locking system if the vehicle is subjected to sudden deceleration or a severe tilt angle.

The ALR has a mode of operation where the retractor will take up slack in the webbing, but not allow any slack to be paid out. This mode of operation can be used to secure a child seat.

- **To engage the ALR child seat mode of operation:** Pull the webbing out of the retractor to its full extent.
- **To cancel the ALR child seat mode of operation:** Allow the retractor to fully rewind the webbing.

A safety belt warning indicator is installed in the instrument cluster to remind the front seat occupants to fasten their safety belts. On NAS vehicles, when the ignition switch is turned to position II, the warning indicator illuminates if the safety belt of an occupied front seat is not fastened. The warning indicator remains illuminated until the safety belt of each occupied front seat is fastened, or the ignition is switched off. In all markets except NAS, a belt minder function provides a more intrusive reminder to fasten the front safety belts.

FRONT SAFETY BELTS

The retractor of each front safety belt is attached to the related B pillar. The webbing runs from the retractor through an upper mounting, attached to a shoulder height adjuster on the B pillar, to an anchor point on the front seat.

On NAS vehicles, a tension sensor is integrated into the anchor point of the passenger front safety belt. The tension

sensor is part of the occupant classification system.

For additional information, refer to: [Air Bag and Safety Belt Pretensioner Supplemental Restraint System \(SRS\)](#) (501-20B Supplemental Restraint System, Description and Operation).

The retractor for each front safety belt incorporates a load limiter that allows the retractor reel to partially unwind when the load on the webbing exceeds a predetermined limit.

The buckle for each front safety belt is attached to a pretensioner secured to the inboard side of the related front seat frame. Each buckle incorporates a safety belt buckle sensor that provides a status input to the restraints control module, which uses the input to determine the air bag and pretensioner activation strategies. The restraints control module also relays the status of the safety belts to the instrument cluster on the high speed CAN bus.

Belt Minder Function (Where Fitted)

The belt minder function provides warnings to the driver if the appropriate front safety belts are not fastened when driving. The belt minder function is controlled by the instrument cluster using medium speed CAN bus messages, from the restraints control module, to monitor the status of the front safety belts.

When the ignition switch is turned to position II, the instrument cluster illuminates the safety belt warning indicator until one of the front safety belts is fastened or the belt minder function is triggered. The belt minder function is triggered when the ignition switch is in position II and the following conditions coexist:

- The belt minder function is enabled.
- Vehicle speed is 8 km/h (5 mph) or more.
- The vehicle is not in reverse.
- The driver safety belt or, if the front passenger seat is occupied, the front passenger safety belt, is unfastened.

When the belt minder is triggered, the instrument cluster generates the following warnings for 10 seconds.

- Flashes the safety belt warning indicator at 2 Hz.
- Sounds a repeating chime in sequence with the flashing safety belt warning indicator.

After 10 seconds, the repeating chime is discontinued and the safety belt warning indicator changes from flashing to continuously illuminated. While the trigger conditions still coexist, the warnings are repeated every 30 seconds until one of the following occurs:

- 5 minutes has elapsed from when the warnings were first triggered.
- The safety belt of each occupied front seat is fastened.
- The ignition switch is turned to position 0.
- The vehicle speed decreases to 5 km/h (3 mph).

The belt minder function can be enabled and disabled using the driver safety belt switch. The instrument cluster changes the state of the belt minder function if, within 60 seconds of first turning the ignition switch to position II, the driver safety belt is fastened and unfastened nine times. Successful completion of the change is indicated by a single chime and the safety belt warning indicator flashing five times, at 2 Hz. The belt minder function can also be enabled and disabled using T4.

Safety Belt Warning Indicator



SECOND ROW SAFETY BELTS

The retractor of each outboard second row safety belt is attached to the body immediately behind the D pillar. The webbing runs from the retractor, through an upper mounting on the D pillar, to an anchor point at the front of the related wheel arch.

The retractor for the center second row safety belt is installed in the top of the seat back. The webbing runs from the retractor, over the top of the seat, to an anchor point at the base of the seat frame.

The buckles for the second row safety belts are attached to the related seat frame.

THIRD ROW SAFETY BELTS (WHERE FITTED)

The retractor of each third row safety belt is attached to the E pillar. The webbing runs from the retractor, through a mounting on the E pillar to an anchor point on the floor.

The buckles for the third row safety belts are attached to the related seat frame.

Safety Belt System - Safety Belt System

Diagnosis and Testing

Principle of Operation

For a detailed description of the safety belt system and operation, refer to the relevant description and operation section of the workshop manual REFER to: [Safety Belt System](#) (501-20A Safety Belt System, Description and Operation).

Safety Information

• WARNINGS:



To avoid accidental deployment the back-up power supply must be depleted before beginning any work on the SRS system or its components. Failure to follow this instruction may result in personal injury



Do not use a multimeter to probe an SRS module. It is possible for the power from the multimeter battery to trigger the activation of the module. Failure to follow this instruction may result in personal injury

• NOTE: Do not to use a cellular phone or to have a cellular phone in close proximity when working on the SRS system or components

Power supply depletion

Before beginning any work on the SRS system or related components:

1. **1.** Remove the ignition key
2. **2.** Disconnect the battery leads, ground first
3. **3.** Wait 2 minutes for the power circuit to discharge

There are comprehensive instructions on the correct procedures for SRS system repairs, refer to the relevant section of the workshop manual

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle

• NOTE: Check and rectify basic faults before beginning diagnostic routines including pinpoint tests

1. **1.** Verify the customer concern by operating the safety belt
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage

Visual Inspection


Mechanical	Electrical
<ul style="list-style-type: none"> ● Check for the installation of non-standard accessories which may affect or obstruct the function of the safety belt system ● Frayed or damaged webbing ● Missing or damaged button stop ● Pretensioner(s) Buckles/Stalks 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness fault ● Correct engagement of electrical connectors ● Loose or corroded connections ● Warning lamp bulb(s) ● Impact sensor(s) ● Buckle sensor(s) ● Pretensioner(s) ● Belt tension sensor(s) ● Restraints control module

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. **4.** If the cause is not visually evident, carry out the test methods described below, alternatively check for diagnostic trouble codes and refer to the relevant diagnostic trouble code index

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Restraints Control Module \(RCM\)](#) (100-00 General Information, Description and Operation).

Symptom Chart for Safety Belt Rows 1, 2 and 3

Symptom	Possible Causes	Action
Safety belt jammed - Webbing tight	<ul style="list-style-type: none"> ● Backlock effect-in action (webbing retracted quickly and came to sudden stop) ● Safety belt retractor not installed correctly ● Rear centre belt only. Mini-button (webbing travel limit stop) missing and seat squab has been moved 	<ul style="list-style-type: none"> ● GO to Pinpoint Test A. ● GO to Pinpoint Test E. ● GO to Pinpoint Test H. ● See the automatic locking retractor description below

Symptom	Possible Causes	Action
	<ul style="list-style-type: none"> causing tight fit Automatic locking retractor activated (clicking – during retraction only) 	
Seat squab will not fold/jammed	<ul style="list-style-type: none"> • NOTE: Rear centre belt only • Mini-button (webbing travel limit stop) missing and seat squab has been moved causing excessive tension 	<ul style="list-style-type: none"> • GO to Pinpoint Test H.
Safety belt jammed - Webbing loose	<ul style="list-style-type: none"> • Safety belt webbing trapped in seat • Safety belt retractor webbing guide loose • Twist in webbing • Interference in webbing routing • D-loop not rotating correctly 	<ul style="list-style-type: none"> • GO to Pinpoint Test B. • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test E. • GO to Pinpoint Test G.
Safety belt - Intermittent jamming	<ul style="list-style-type: none"> • Safety belt retractor not installed correctly 	<ul style="list-style-type: none"> • GO to Pinpoint Test F.
Safety belt - Slow retraction	<ul style="list-style-type: none"> • Safety belt retractor webbing guide loose • Twist in safety belt webbing • Interference in webbing routing • Safety belt retractor not installed correctly • D-loop not rotating correctly • Foreign object/debris 	<ul style="list-style-type: none"> • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test E. • GO to Pinpoint Test F. • GO to Pinpoint Test G. • GO to Pinpoint Test E.
Safety belt - Not retracting	<ul style="list-style-type: none"> • Safety belt retractor webbing guide loose • Twist in safety belt webbing • D-loop not rotating correctly • Interference in webbing routing • Foreign object/debris 	<ul style="list-style-type: none"> • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test G. • GO to Pinpoint Test E. • GO to Pinpoint Test E.
Safety Belt - Not extracting	<ul style="list-style-type: none"> • Backlock effect-in action (webbing retracted quickly and came to sudden stop) • Safety belt retractor not installed correctly • Safety belt retractor webbing guide loose • Twist in safety belt webbing • D-loop not rotating correctly • Interference in webbing routing • Foreign object/debris • Automatic locking retractor activated (clicking – during retraction only) 	<ul style="list-style-type: none"> • GO to Pinpoint Test A. • GO to Pinpoint Test F. • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test G. • GO to Pinpoint Test E. • GO to Pinpoint Test E. • See the automatic locking retractor description below
Safety belt - Noisy during operation	<ul style="list-style-type: none"> • Automatic locking retractor activated (clicking–during retraction only) • Interference in webbing routing (rubbing) 	<ul style="list-style-type: none"> • GO to Pinpoint Test B. • GO to Pinpoint Test E.
Safety belt buckle - Not latching / jammed	<ul style="list-style-type: none"> • Foreign object/debris 	 CAUTION: Do not insert any objects or tools into the buckle head <ul style="list-style-type: none"> • GO to Pinpoint Test I.

Inertia Reel Safety Belts

The vehicle is equipped with (two row one), (three row two), and (two row three (seven seat versions only)) inertia reel safety belts

These safety belts are "**dual sensitive**" which means that they have:

- **Car sense system - A vehicle motion sensor, which locks the safety belt webbing under braking, cornering, on steep hills and in adverse camber conditions, when parked on a steep incline or driveway or two wheels on a high curb**
- **Webb sense system - A webbing motion sensor, which locks when the safety belt webbing is extracted suddenly**

The safety belts in the following positions are equipped with an automatic locking retractor function:

Carline	Market	Seat position	Automatic Locking Retractor Installed	From Model Year
Defender (L316)	All	All	No	2007
Discovery / Range Rover Sport (L319/L320)	All	Driver	No	2008
Discovery / Range Rover Sport (L319/L320)	US	Passenger	Yes	2005
Discovery / Range Rover Sport (L319/L320)	All	Driver	No	2005
Discovery / Range Rover Sport (L319/L320)	ROW	Passenger	No	2005
Discovery (L319)	All	Row 2	Yes	2005
Discovery (L319)	All	Row 3	Yes	2005
Range Rover Sport (L320)	All	Row 2	Yes	2006
Freelander (L359)	All	Driver	No	2007
Freelander (L359)	ROW	Passenger	No	2007
Freelander (L359)	US	Passenger	Yes	2007
Freelander (L359)	ROW	Row 2	No	2007
Freelander (L359)	US	Row 2	Yes	2007

Carline	Market	Seat position	Automatic Locking Retractor Installed	From Model Year
Range Rover Evoque (L358)	All	Driver	No	2011
Range Rover Evoque (L358)	ROW	Passenger	No	2011
Range Rover Evoque (L358)	US	Passenger	Yes	2011
Range Rover Evoque (L358)	ROW	Row 2	No	2011
Range Rover Evoque (L358)	US	Row 2	Yes	2011
Range Rover (L322)	All	Driver	No	2003
Range Rover (L322)	ROW	Passenger	No	2003
Range Rover (L322)	US	Passenger	Yes	2003
Range Rover (L322)	ROW	Row 2	No	2003
Range Rover (L322)	US	Row 2	Yes	2003

The **automatic locking retractor function** is a feature to secure a child seat or heavy load to the seat

Activation	Deactivation
<ul style="list-style-type: none"> NOTE: When automatic locking retractor is activated, no further webbing can be drawn from the safety belt retractor, prior to disengagement of the automatic locking. This can be mistaken as a jammed safety belt retractor 	Automatic locking retractor is deactivated by allowing the webbing to retract until the clicking stops (close to park position)
Activated by total extraction of the webbing	
When activated the automatic locking retractor is identified by a clicking noise during webbing retraction	When deactivated the automatic locking retractor safety belt changes state, from a static safety belt to an automatic safety belt

Safety Belt Locking Test

With the vehicle stationary and on level ground take firm hold of the safety belt webbing (on the tongue side of the upper safety belt anchor) and withdraw sharply, **the retractor should lock**. Preventing further webbing release (**repeat this test 3 times**). Any safety belt retractor which fails to lock **must not be used** and a **new safety belt must be installed**.

DTC Index

For a list of diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00 or for removal and installation/description and operation see Section 501-20

Diagnostic Guide Inertia Reel Safety Belts

PINPOINT TEST A : BACKLOCK	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: BACKLOCK	
	<ol style="list-style-type: none"> 1 Visually inspect the condition of the suspect safety belt 2 Draw a maximum of 20mm of the webbing from the safety belt retractor with moderate force. Then release the webbing 3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes No further action required No For first row safety belt GO to Pinpoint Test C . For second and third row safety belts GO to Pinpoint Test B .

PINPOINT TEST B : WEBBING-TRAPPED IN SEAT	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: WEBBING-TRAPPED IN SEAT	
	<ol style="list-style-type: none"> 1 Visually inspect the condition of the suspect safety belt 2 Lift the seat base or release the seat backrest as required 3 Free the trapped webbing, allow the webbing to retract Note: If the automatic locking retractor is activated, allow the webbing to retract until the clicking stops 4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes No further action required No GO to Pinpoint Test C .

PINPOINT TEST C : SAFETY BELT RETRACTOR-WEBBING GUIDE LOOSE	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: SAFETY BELT RETRACTOR-WEBBING GUIDE LOOSE	
	<ol style="list-style-type: none"> 1 Refer to 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and safety belt retractor 2 Check the webbing is not trapped or twisted and is centrally located on the safety belt retractor spindle 3 Attempt to withdraw the webbing from the safety belt retractor NOTE: If the safety belt webbing is jammed, the automatic locking retractor could be engaged 4 To release the automatic locking retractor, manually wind the webbing onto the spindle until the automatic locking retractor deactivates (clicking stops) 5 Fully extract webbing

	6 Confirm webbing guide location is correct , Confirm the fixing lugs are correctly located in the retractor frame
	7 Allow webbing to retract
	8 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test D.

PINPOINT TEST D : TWIST IN WEBBING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: TWIST IN WEBBING	
	1 Refer to section 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point)
	2 Twist the webbing back the correct way in the loop
	3 Pass the twist through the pillar loop or escutcheon as required
	4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test E.

PINPOINT TEST E : INTERFERENCE-WEBBING ROUTING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: INTERFERENCE-WEBBING ROUTING	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point)
	2 Remove obstructions and foreign objects ensure the webbing does not catch or rub
	3 Confirm the safety belt does not contact the wiring harness
	4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test E.

PINPOINT TEST F : SAFETY BELT RETRACTOR-INCORRECT INSTALLATION	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
F1: SAFETY BELT RETRACTOR-INCORRECT INSTALLATION	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and the safety belt retractor
	2 Refer to the 501-20 removal and installation section of the workshop manual, correctly reinstall the safety belt retractor ensure that the locating "T bar" and "anti rotation pins" are correctly located
	3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component


PINPOINT TEST G : D-LOOP NOT ROTATING CORRECTLY	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
G1: D-LOOP NOT ROTATING CORRECTLY	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and the safety belt retractor
	2 Ensure there are no obstructions and the webbing does not catch or rub, the D loop (anchor point) rotates correctly and if installed the confirm the height adjuster operates correctly
	3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No

Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

PINPOINT TEST H : MINI BUTTON-MISSING/DAMAGED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
H1: MINI BUTTON-MISSING/DAMAGED	
• NOTE: This test applies to the rear centre safety belt retractor installed in the seat back	
	<ol style="list-style-type: none"> <li>1 Refer to the 501-20 removal and installation section of the workshop manual, remove the seat cushion and the plastic escutcheon at the top of the seat back (where the webbing exits to expose the lower anchor fixing point of the center safety belt) <li>2 Remove the lower anchorage of the safety belt <li>3 With the seat back correctly latched, allow up to 20mm webbing to retract, then extract the webbing
	<p>Is the mini-button (webbing travel limit stop) correctly installed to the webbing and in good condition?</p> <p>Yes Feed the mini-button back through the plastic escutcheon if required. Correctly reinstall the escutcheon to the seat back, extract the webbing then allow to retract, ensure the mini-button comes to rest outside the escutcheon stop</p> <p>No Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component</p>

PINPOINT TEST I : SAFETY BELT BUCKLE-NOT LATCHING/JAMMED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
I1: SAFETY BELT BUCKLE-NOT LATCHING/JAMMED	
 CAUTION: Do not insert any objects or tools into the buckle head	
	<ol style="list-style-type: none"> <li>1 Visually inspect the buckle head for evidence of damage. If damaged replace as required <li>2 Depress the buckle release (red button) and (Using a torch) carry out visual inspection for any evidence of debris/material or foreign objects in the buckle head <li>3 If required remove the pretensioner from the vehicle. Remove the seat. Remove the pretensioner from the seat frame <li>4 Do not insert any objects or tools buckle head With the buckle removed invert and attempt to shake out any debris <li>5 Attempt to latch the tongue in the buckle
	<p>Does the seat belt buckle operate correctly</p> <p>Yes Reinstall any components, no further action required</p> <p>No Replace the pretensioner, Refer to section 501 20</p>

Safety Belt System - Front Safety Belt Retractor

Removal and Installation

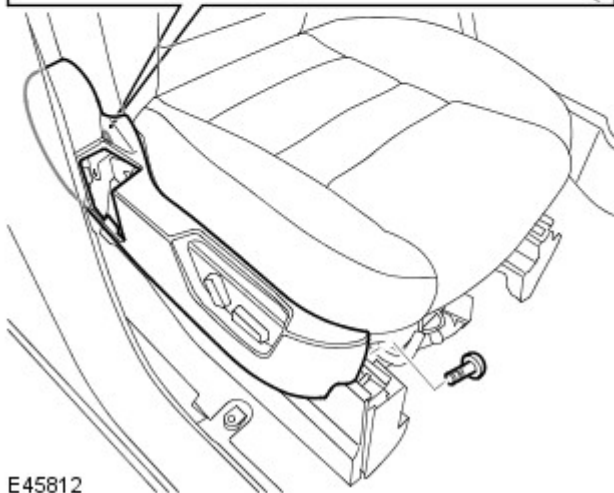
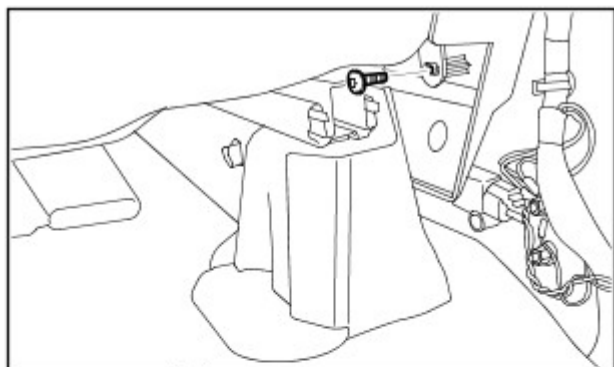
Removal

1. Position the front seat fully forwards.
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the B-pillar upper trim panel.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Release the safety belt upper anchor from the B-pillar.
 - Remove and discard the Torx bolt.



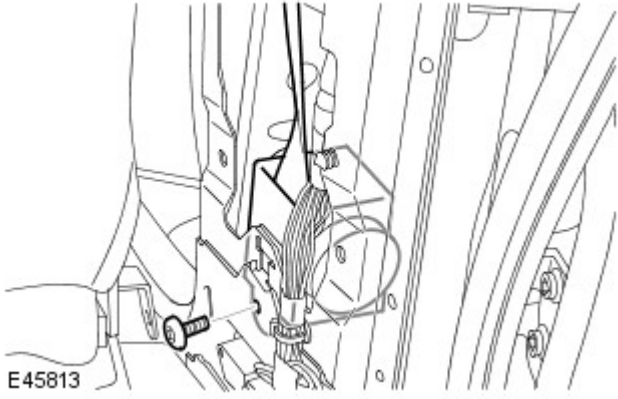
5. Release the front seat switch pack trim panel for access.

- Remove the 2 screws.



6. Remove the front safety belt retractor.

- Remove and discard the Torx bolt.



Installation

1. Install the front safety belt retractor.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).

2. Install the front seat switch pack trim panel.

- Tighten the screws.

3. Attach the safety belt upper anchor.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).

4. Install the B-pillar upper trim panel.

For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

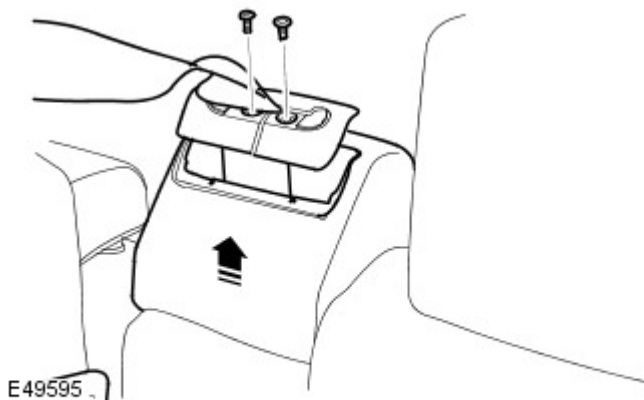
Safety Belt System - Second Row Center Safety Belt Retractor Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

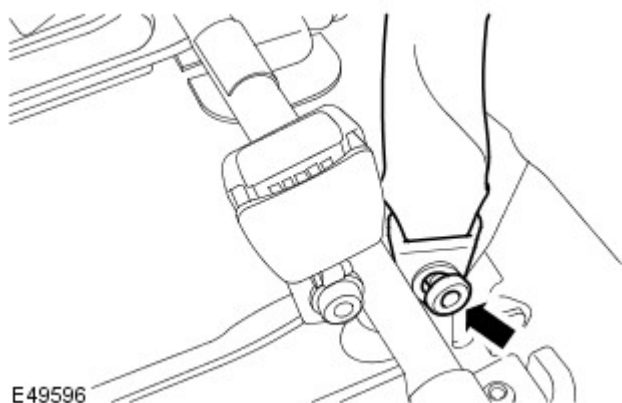
1. Release the safety belt retractor cover and guide

- Remove the 2 screws.
- Remove the safety belt guide.
- Remove the retractor cover.



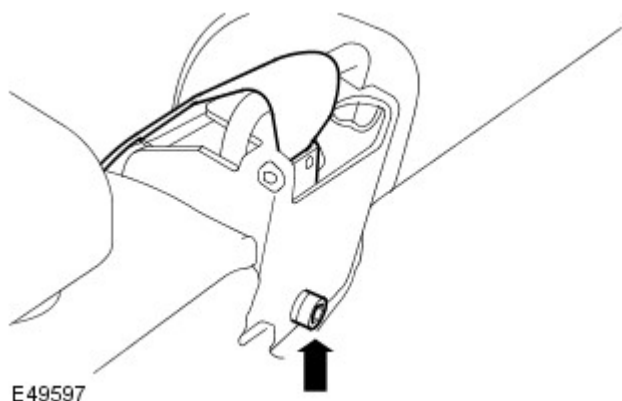
2. Remove the safety belt lower anchor.

- Raise the seat cushion.
- Remove and discard the nut.



3. Remove the safety belt retractor assembly.

- Remove and discard the Torx bolt.



Installation

1. Install the safety belt retractor assembly.

- Tighten the new Torx bolt to 40 Nm (30 lb.ft).

2. Install the safety belt guide and retractor cover.

- Attach the safety belt guide and retractor cover.
- Tighten the screws.

3. Install the safety belt lower anchor.

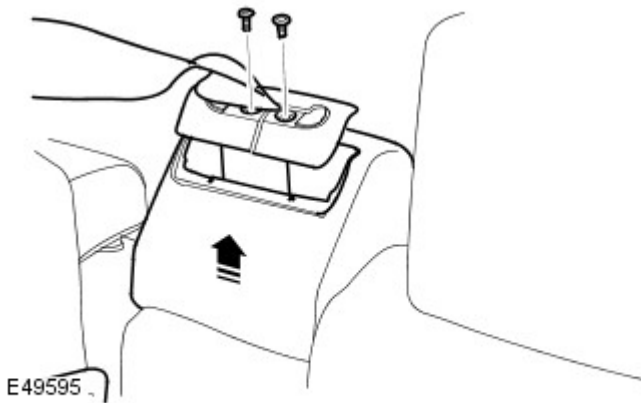
- Tighten the new nut to 40 Nm (30 lb.ft).
- Lower the seat cushion.

Safety Belt System - Second Row Center Safety Belt Retractor Vehicles With: 40/20/40 Split Seat

Removal and Installation

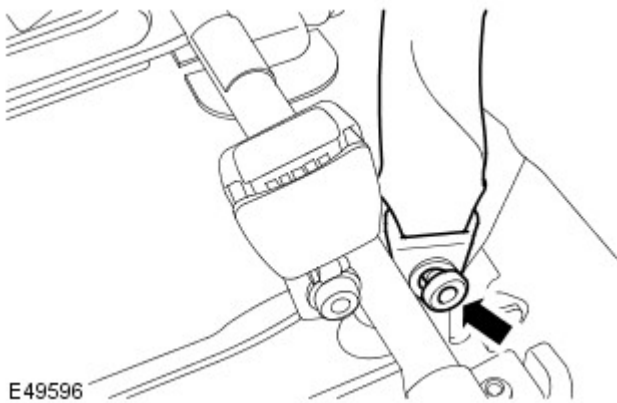
Removal

1. Remove the center seat.
For additional information, refer to: [Rear Seat - Vehicles With: 40/20/40 Split Seat](#) (501-10 Seating, Removal and Installation).



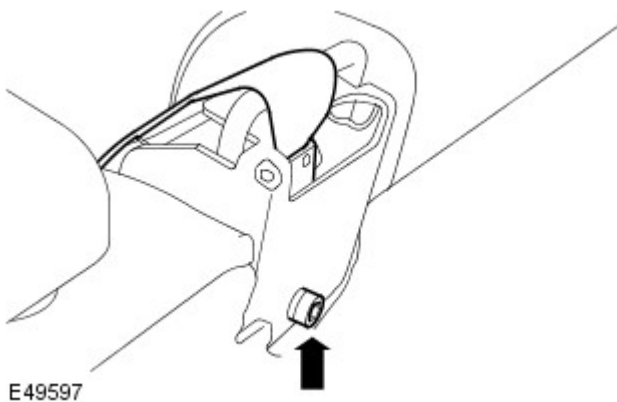
2. Release the safety belt retractor cover and guide

- Remove the 2 screws.
- Remove the safety belt guide.
- Remove the retractor cover.



3. Remove the safety belt lower anchor.

- Fold the LH outer seat assembly forwards.
- Remove and discard the Torx bolt.



4. Remove the safety belt retractor assembly.

- Remove and discard the Torx bolt.

Installation

1. Install the safety belt retractor assembly.
 - Tighten the new Torx bolt to 40 Nm (30 lb.ft).
2. Install the safety belt guide and retractor cover.

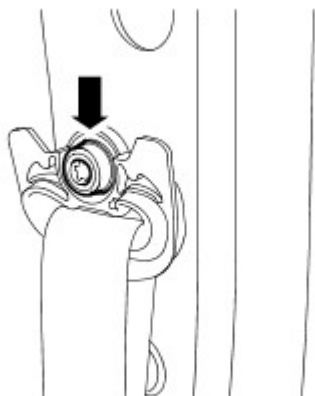
- Attach the safety belt guide and retractor cover.
 - Tighten the screws.
- 3.** Install the safety belt lower anchor.
- Tighten the new nut to 40 Nm (30 lb.ft).
 - Lower the seat cushion.
- 4.** Install the center seat.
For additional information, refer to: [Rear Seat - Vehicles With: 40/20/40 Split Seat](#) (501-10 Seating, Removal and Installation).

Safety Belt System - Second Row Safety Belt Retractor

Removal and Installation

Removal

1. Remove the C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the safety belt upper anchor.
 - Remove and discard the Torx bolt.



E49593

4. Remove the second row safety belt retractor.
 - Remove and discard the Torx bolt.



E49594

Installation

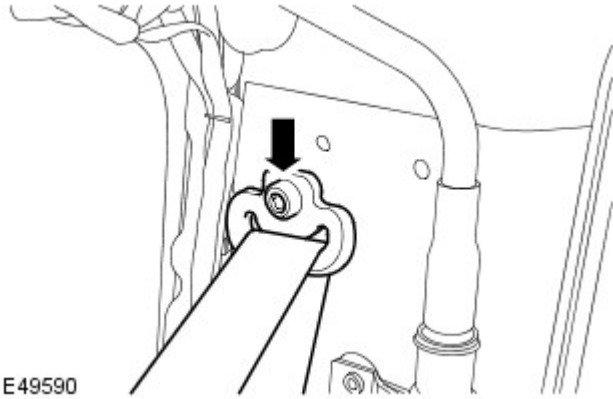
1. Install the second row safety belt retractor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
2. Install the safety belt upper anchor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
3. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Install the C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Safety Belt System - Third Row Safety Belt Retractor

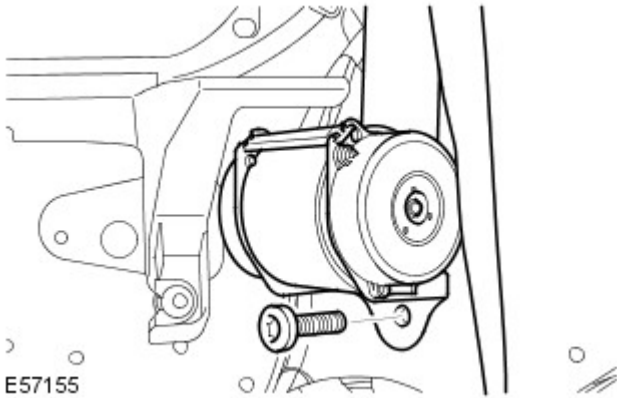
Removal and Installation

Removal

1. Remove the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Release the safety belt upper anchor.
 - Remove and discard the Torx bolt.



3. Remove the third row safety belt retractor.
 - Remove and discard the Torx bolt.



Installation

1. Install the third row safety belt retractor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
2. Install the safety belt upper anchor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
3. Install the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Safety Belt System - Front Safety Belt Buckle

Removal and Installation

Removal

• WARNINGS:

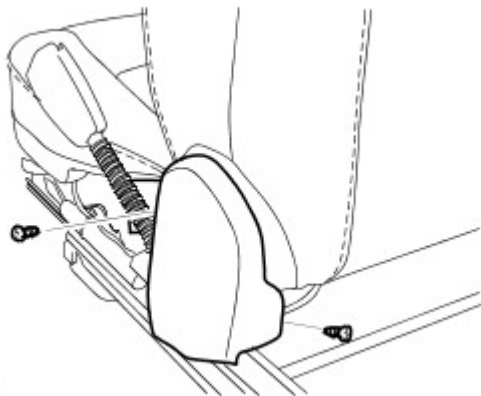


It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

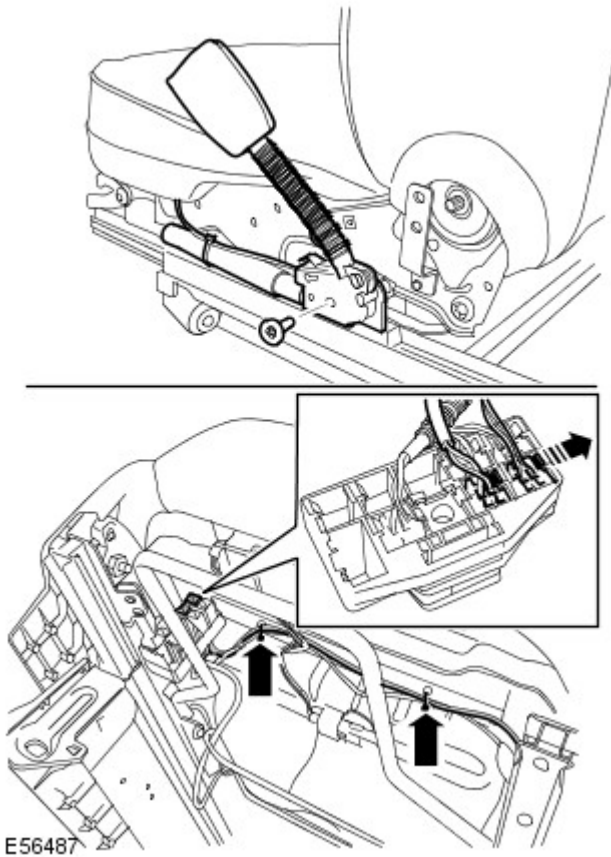
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
4. Remove the seat backrest hinge cover.
 - Remove the 2 screws.



E56486

5. Remove the front safety belt buckle.

- Remove the Torx bolt.
- Disconnect the 2 electrical connectors.
- Release the wiring harness.



Installation

1. Install the front safety belt buckle.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).
- Connect the electrical connectors.
- Attach the wiring harness.

2. Install the seat backrest hinge cover.

- Tighten the screws.

3. Install the front seat.

For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

4. Connect the battery ground cable.

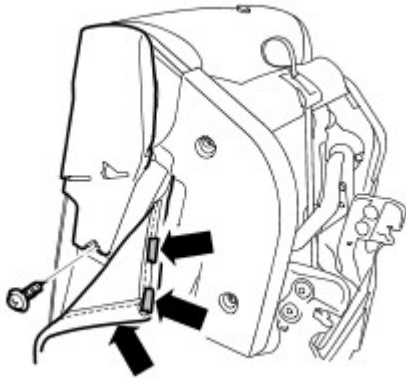
Safety Belt System - Rear Safety Belt Buckle Vehicles With: 40/20/40 Split Seat

Removal and Installation

Removal

1. Remove the inner backrest hinge cover.

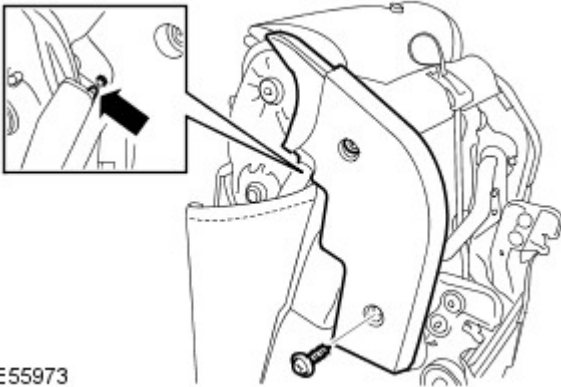
- Release the backrest cover side clip.
- Remove the screw.
- Release the 2 clips.



E55971

2. Remove the rear seat cushion side finisher.

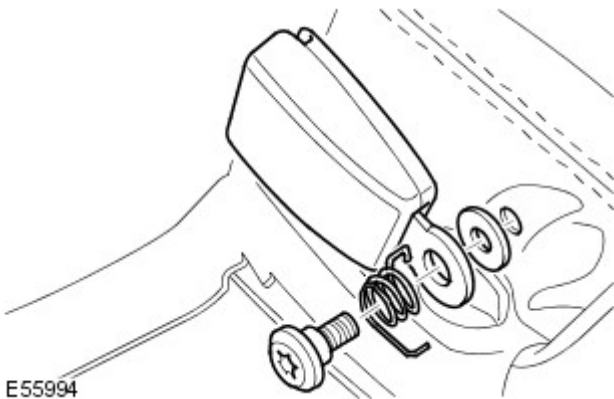
- Remove the 2 screws.
- Release the tension strap.



E55973

3. Remove the safety belt buckle.

- Fold the seat assembly forwards.
- Remove the Torx bolt.
- Release the tension spring.



E55994

Installation

1. Install the safety belt buckle.

- Attach the tension spring.
- Tighten the Torx bolt to 25 Nm (18 lb.ft).
- Fold seat assembly rearwards.

2. Install the rear seat cushion side finisher.

- Attach the tension strap.
- Tighten the screws.

3. Install the inner backrest hinge cover.

- Attach the clips.
- Tighten the screw.
- Attach the backrest cover side clip.

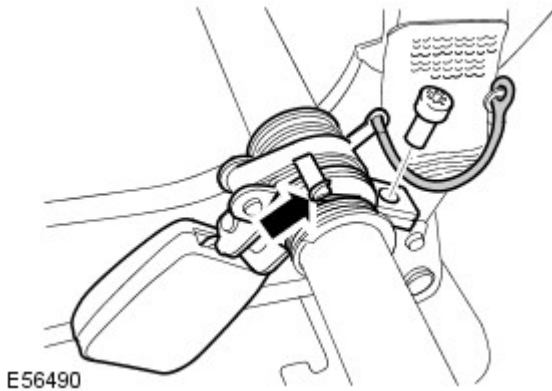
Safety Belt System - Rear Safety Belt Buckle LH Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

1. Remove the safety belt buckle.

- Raise the seat cushion.
- Release the retaining strap.
- Remove the Torx bolt.
- Release the tension spring.



Installation

1. Install the safety belt buckle.

- Attach the tension spring.
- Tighten the Torx bolt to 25 Nm (18 lb.ft).
- Attach the retaining strap.
- Lower the seat cushion.

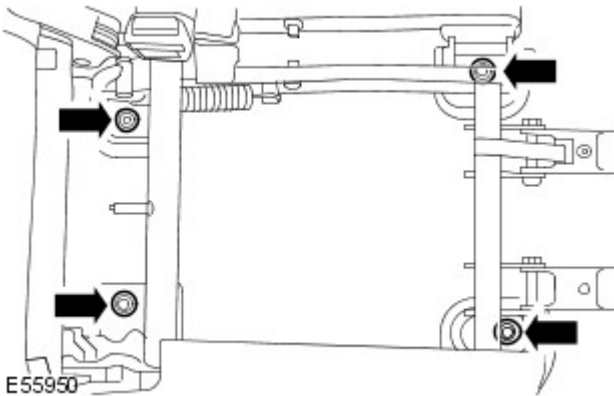
Safety Belt System - Rear Safety Belt Buckle RH Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

1. Release the RH rear seat.

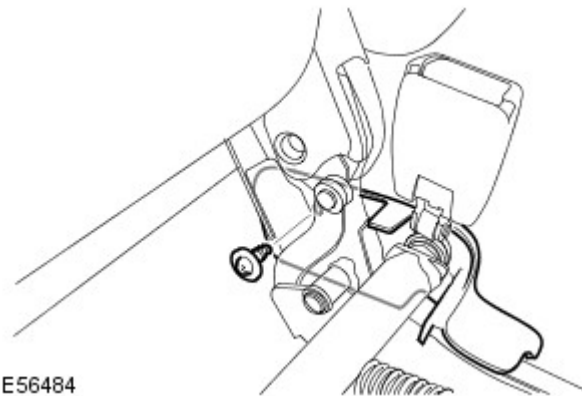
- Fold the seat cushion forward.
- Remove and discard the 4 Torx bolts.
- Fold down the rear seat backrest.



2. Remove the RH rear seat.

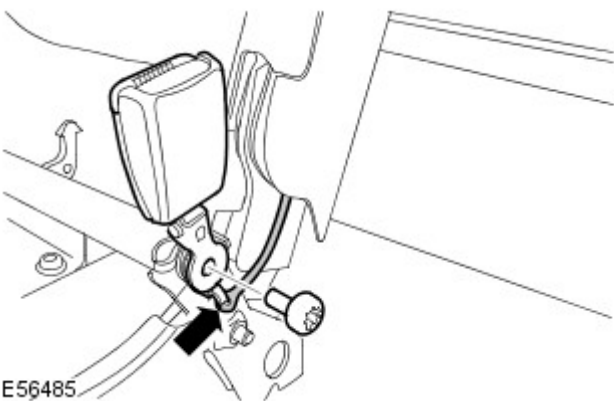
3. Remove the rear seat cushion side finisher.

- Remove the screw.



4. Remove the safety belt buckle.

- Raise the seat cushion.
- Release the retaining strap.
- Remove and discard the bolt.



Installation

1. Install the safety belt buckle.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).
- Attach the retaining strap.
- Lower the seat cushion.

2. Install the rear seat cushion side finisher.

- Tighten the screw.

3. Install the RH rear seat.

- Position the seat on the dowels.

4. Secure the RH rear seat.

- Return the seat backrest to the upright position.
- Tighten the new bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

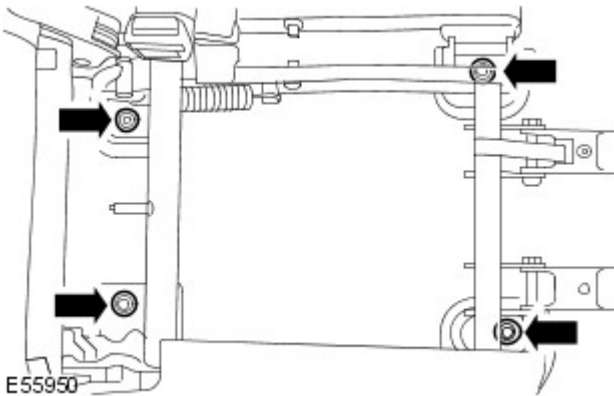
Safety Belt System - Rear Center Safety Belt Buckle Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

1. Release the RH rear seat.

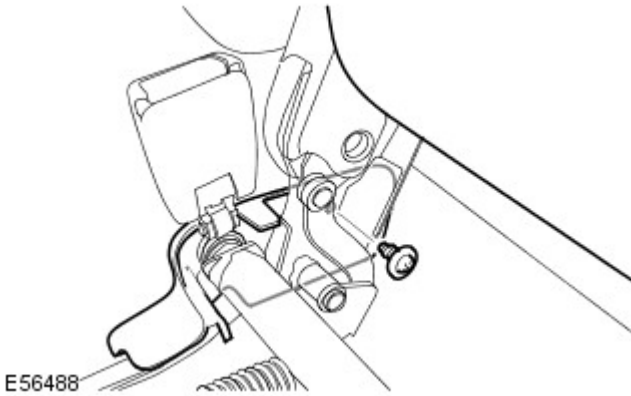
- Fold the seat cushion forward.
- Remove and discard the 4 Torx bolts.
- Fold down the rear seat backrest.



2. Remove the RH rear seat.

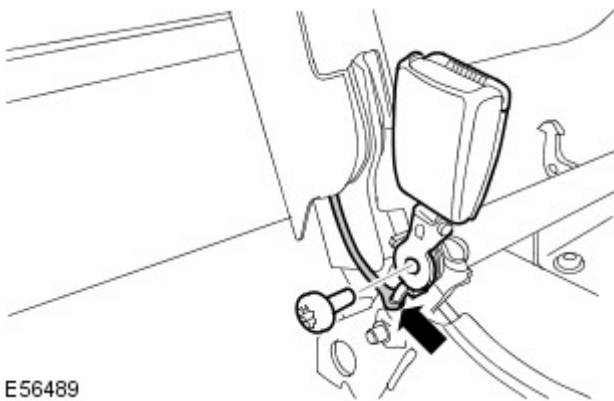
3. Remove the rear seat cushion side finisher.

- Raise the seat cushion.
- Remove the screw.



4. Remove the safety belt buckle.

- Release the retaining strap.
- Remove and discard the bolt.



Installation

1. Install the safety belt buckle.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).
- Attach the retaining strap.
- Lower the seat cushion.

2. Install the rear seat cushion side finisher.

- Tighten the screw.

3. Install the RH rear seat.

- Position the seat on the dowels.

4. Secure the RH rear seat.

- Return the seat backrest to the upright position.
- Tighten the new bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

Supplemental Restraint System -

Torque Specifications

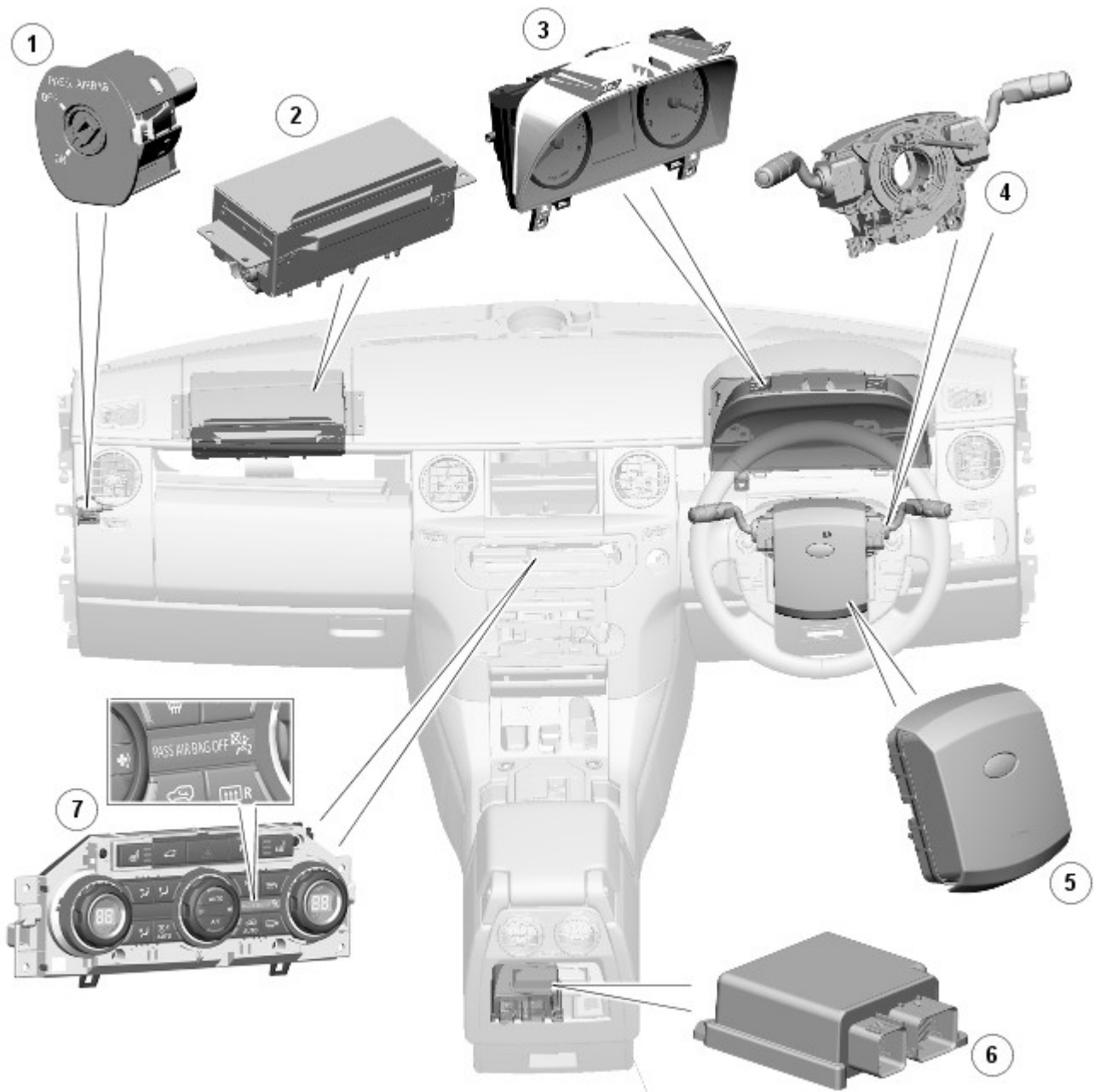
Description	Nm	lb-ft
Passenger air bag module bracket nuts	10	7
Passenger air bag module nuts	10	7
Rear side air curtain module Torx screws	10	7
C-pillar side impact sensor Torx bolts	8	6
Side air curtain module Torx screws	10	7
B-pillar side impact sensor Torx screws	8	6
Restraints control module (RCM) Torx screws	10	7
Front door side impact sensor Torx bolts	8	6
Side air bag module nuts	10	7
Front impact sensor Torx bolts	8	6

Supplemental Restraint System - Air Bag and Safety Belt Pretensioner

Supplemental Restraint System (SRS)

Description and Operation

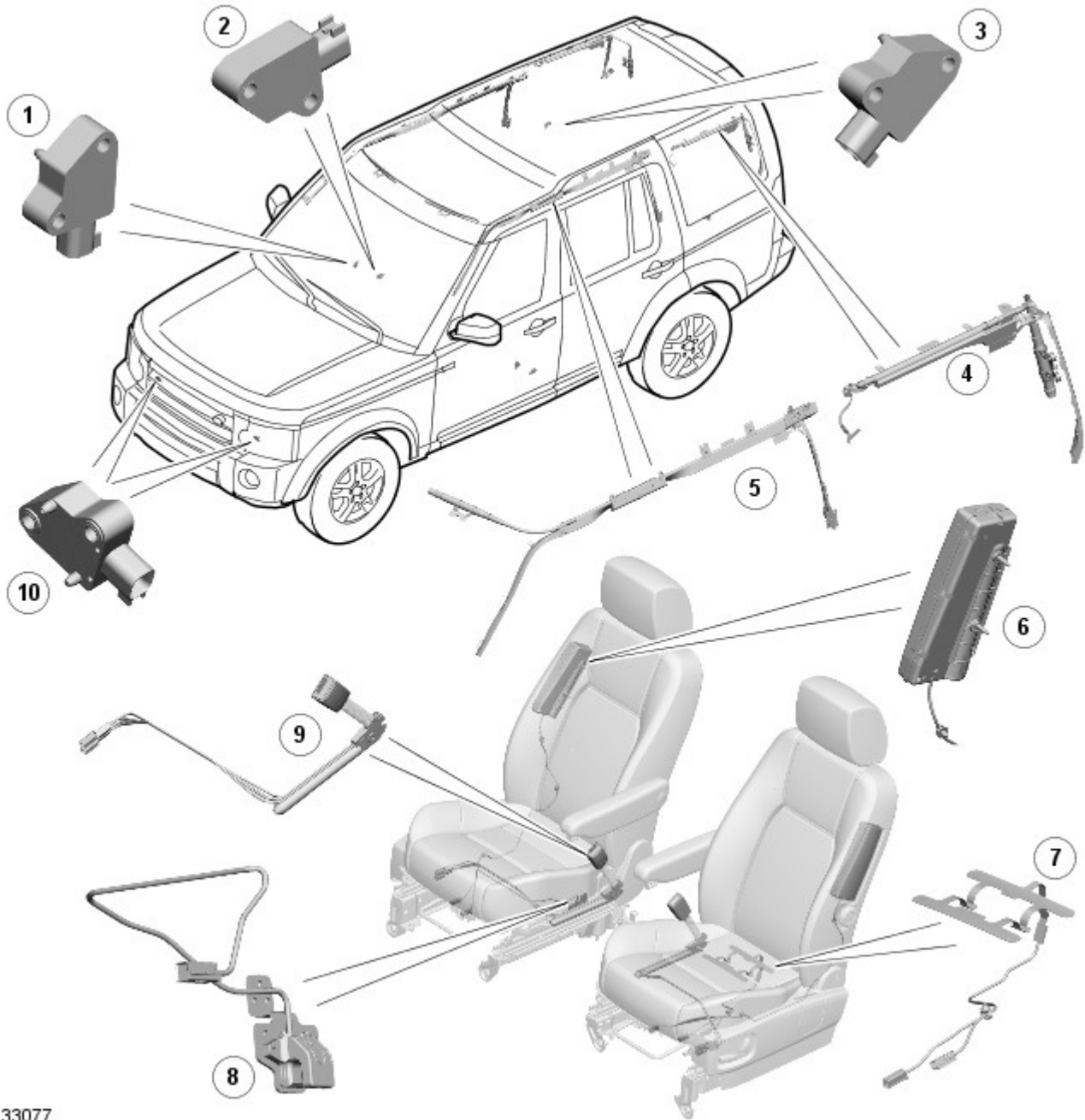
COMPONENT LOCATION - SHEET 1 OF 2



E133076

Item	Part Number	Description
1	-	supplemental restraint system (SRS) warning indicator
2	-	Driver air bag
3	-	Clockspring
4	-	Passenger air bag deactivation indicator
5	-	Passenger air bag
6	-	Passenger air bag deactivation switch (all except NAS (North American specification) and Australia)
7	-	restraints control module (RCM)

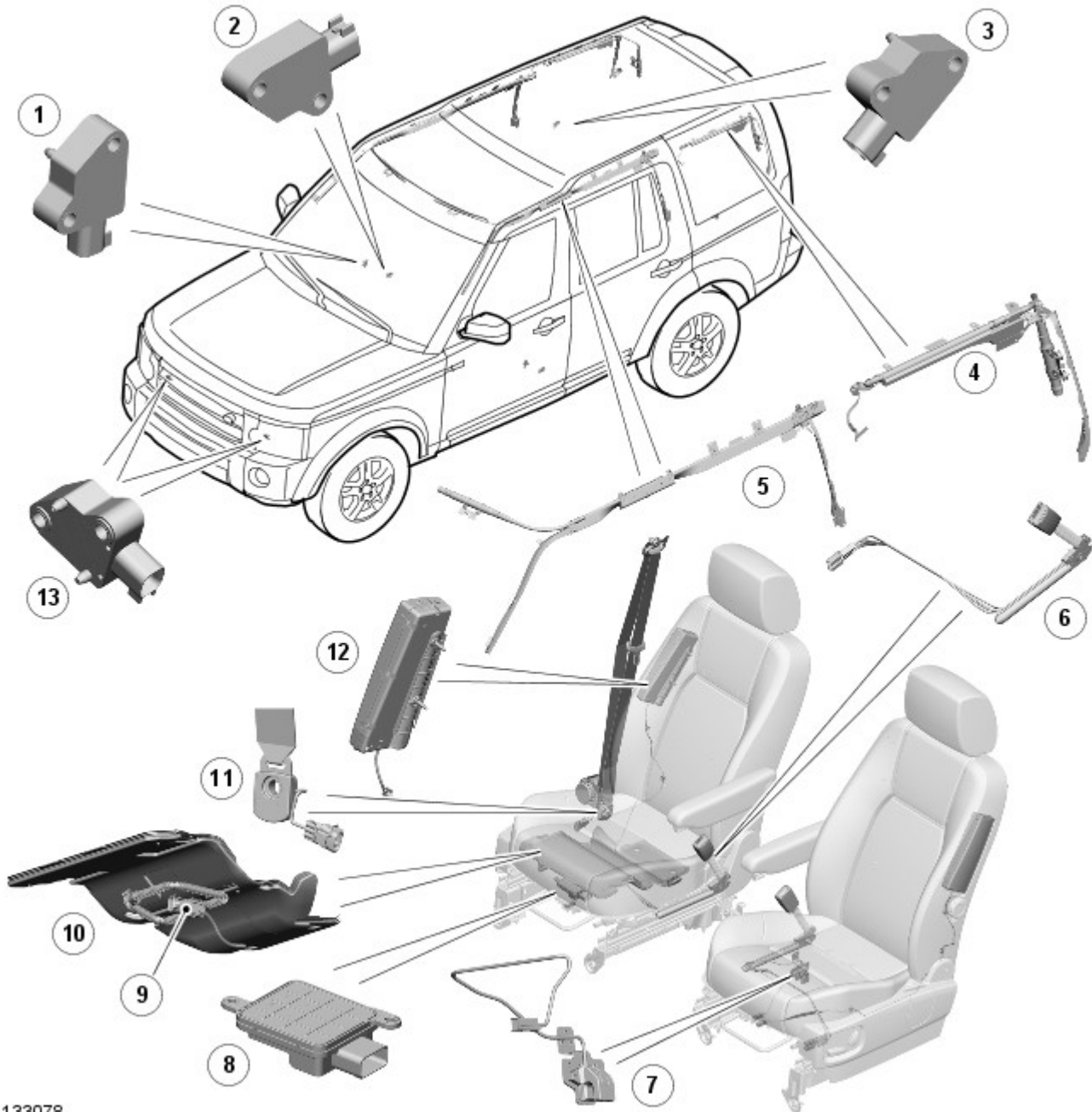
COMPONENT LOCATION - SHEET 2 OF 2 (ALL EXCEPT NAS)



E133077

Item	Part Number	Description
1	-	Door side impact sensor
2	-	B pillar side impact sensor
3	-	Rear quarter side impact sensor
4	-	Third row side air curtain
5	-	First and second row side air curtain
6	-	Safety belt pretensioner and buckle switch
7	-	Seat position sensor
8	-	Occupant classification module (NAS only)
9	-	Seat cushion pressure sensor (NAS only)
10	-	Seat cushion pressure pad (NAS only)
11	-	Safety belt tension sensor (NAS only)
12	-	Side air bag
13	-	Front impact sensors

COMPONENT LOCATION - SHEET 2 OF 2 (NAS)



E133078

Item	Part Number	Description
1	-	Door side impact sensor
2	-	B pillar side impact sensor
3	-	Rear quarter side impact sensor
4	-	Third row side air curtain
5	-	First and second row side air curtain
6	-	Safety belt pretensioner and buckle switch
7	-	Seat position sensor
8	-	Occupant classification module (NAS only)
9	-	Seat cushion pressure sensor (NAS only)
10	-	Seat cushion pressure pad (NAS only)
11	-	Safety belt tension sensor (NAS only)
12	-	Side air bag
13	-	Front impact sensors

GENERAL

The SRS provides additional protection for occupants in certain vehicle accident conditions. The SRS consists of:

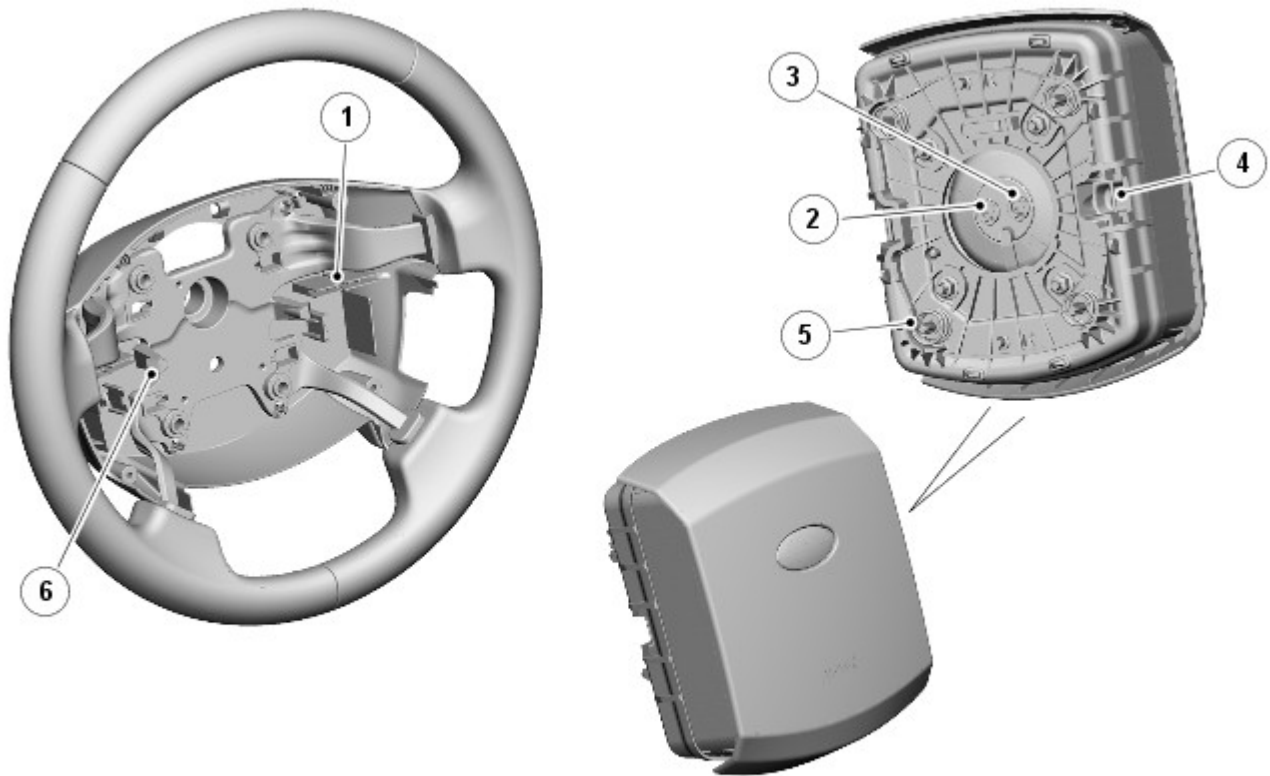
- A driver air bag
- A passenger air bag
- A side air bag on each front seat
- Side air curtains for first and second row seats
- Side air curtains for third row seats (where fitted)
- A pretensioner for each front safety belt
- A buckle sensor for each front safety belt

- Front and side impact sensors
- A passenger air bag deactivation indicator
- A passenger air bag deactivation switch (all except NAS and Australia)
- An occupant monitoring system for the front passenger seat
- A position sensor for the driver seat
- A SRS warning indicator
- A clockspring
- A RCM.

⚠ WARNING: All pyrotechnic devices are dangerous. Before performing any procedures on any pyrotechnic device, read all information contained within the Standard Workshop Practices section of this manual. For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

The SRS features selective activation of the air bags and pretensioners, and two stage driver and passenger air bags. The RCM monitors internal and external sensors and activates the required safety belt pretensioners and air bags if the sensors detect an impact or roll-over above preset limits.

DRIVER AIR BAG



E133079

Item	Part Number	Description
1	-	Release tool slot and guide channel
2	-	Inflator stage 1 connector
3	-	Inflator stage 2 connector
4	-	Latch spring
5	-	Locating pin and spring
6	-	Latch hook

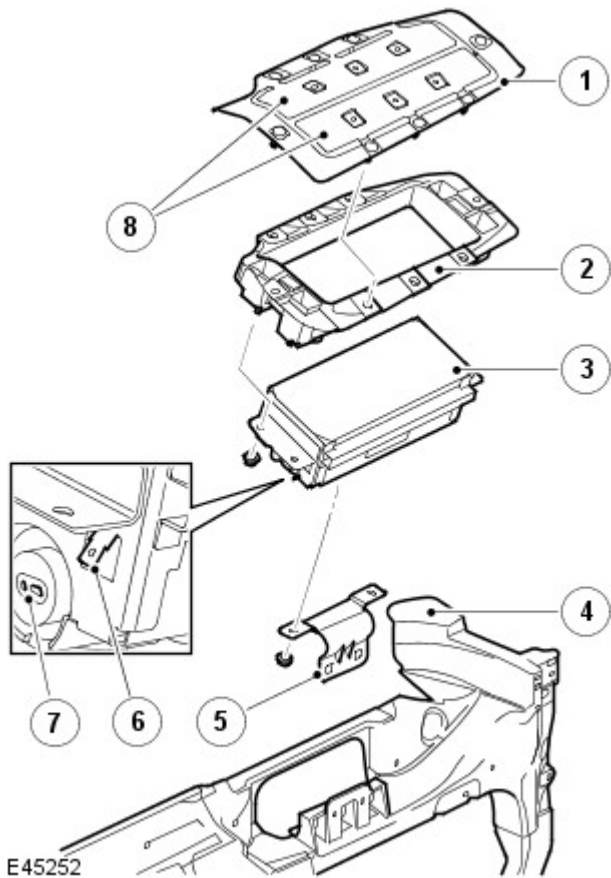
The driver air bag forms the center pad of the steering wheel. The latches consist of wire springs on each side of the driver air bag which engage with hooks in the steering wheel. The driver air bag is released from the steering wheel by pulling on the wire springs with a special tool inserted through a slot on each side of the steering wheel hub. Springs on the locating pins then push the driver air bag away from the steering wheel.

A Lucar connector attaches a ground to the driver air bag.

The driver air bag has a two stage inflator, with separate electrical connectors for each stage. The inflator contains a non-azide propellant as the gas generator.

Lines moulded into the inner surface of the driver air bag cover provide weak points that split open in a controlled manner when the driver air bag deploys. The inflated volume of the air bag is 57 liters (2.01 ft³).

PASSENGER AIR BAG



Item	Part Number	Description
1	-	Reinforcement lid
2	-	Chute
3	-	Passenger air bag
4	-	In-vehicle crossbeam
5	-	Mounting bracket
6	-	Lucar connector
7	-	Inflator connector
8	-	Deployment doors

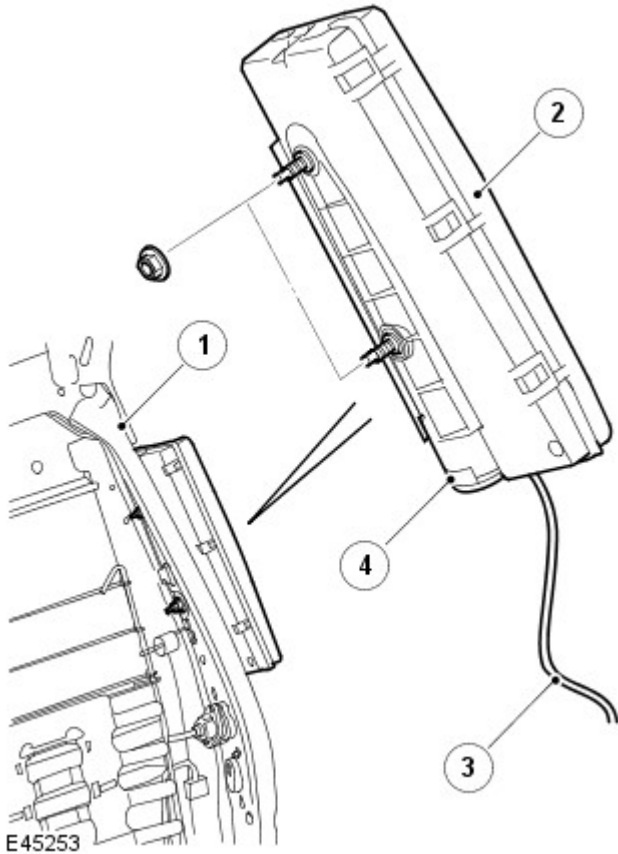
The passenger air bag is located in the instrument panel, behind the upper glove compartment. The bottom of the passenger air bag is attached to a mounting bracket on the in-vehicle crossbeam. The top of the passenger air bag is attached to a chute, which, in turn, is attached to a reinforcement lid in the top of the instrument panel. When the air bag deploys, the chute guides the air bag to the underside of the reinforcement lid. The reinforcement lid incorporates two deployment doors that are forced open, splitting the instrument panel covering, when the air bag deploys.

A Lucar connector attaches a ground to the passenger air bag.

The passenger air bag has a two stage inflator, with separate electrical connectors for each stage. The inflator contains a non-azide propellant as the gas generator. The inflator uses a high pressure mix of air and hydrogen gas as the inflation medium. The inflated volume of the air bag is 130 liters (4.59 ft³).

SIDE AIR BAGS

- NOTE: Left side air bag shown, right side air bag is mirror image



E45253

Item	Part Number	Description
1	-	Seat backrest frame
2	-	Side air bag
3	-	Cable
4	-	Inflator

A side air bag is attached to the outside of each front seat backrest frame, under the backrest cover.

The side air bags are handed, and each consist of a moulded plastic case which contains the folded air bag and the inflator. A cable connects the igniter of the inflator to a connector in the main seat harness connector block located under the front edge of the seat cushion.

When the air bag deploys it forces the front edge of the moulded plastic case apart and splits open the backrest cover.

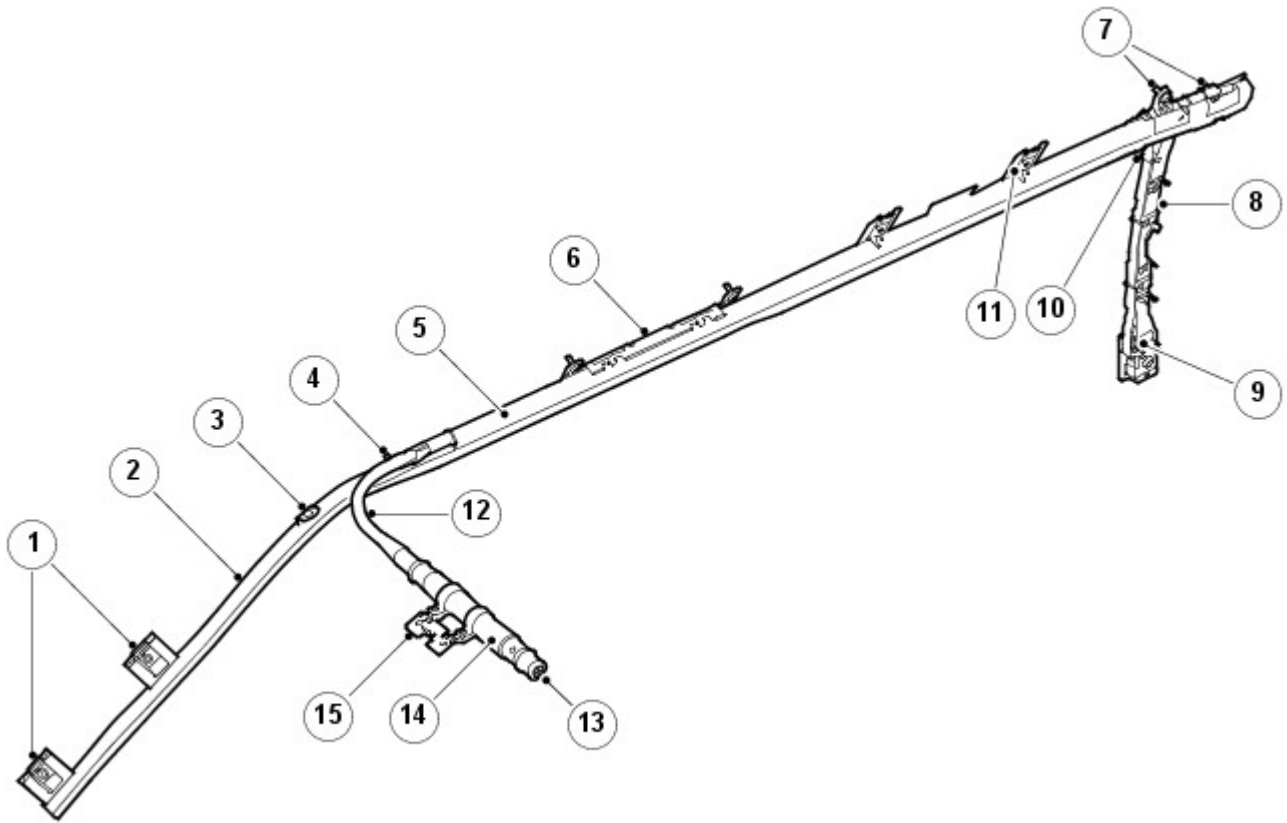
The side air bags use compressed argon as the inflation medium. The inflated volume of each side air bag is 12 liters (0.42 ft³).

SIDE AIR CURTAINS

The side air curtains are designed to protect the head and upper body in side impact and roll-over situations. The first and second row side air curtains are a standard fit on all vehicles. The third row side air curtains are fitted on seven seat vehicles only. The side air curtains use compressed argon as the inflation medium.

First and Second Row Side Air Curtain

- NOTE: Right side air curtain shown, left side air curtain is mirror image.



E45254

Item	Part Number	Description
1	-	Air curtain anchorage points
2	-	Non inflatable section of air curtain
3	-	Air curtain clip (manufacturing aid)
4	-	Front gas guide attachment
5	-	Inflatable section of air curtain
6	-	B pillar ramp
7	-	Securing screws
8	-	Active tether device
9	-	Rear tether anchor
10	-	Rear tether
11	-	Cant rail clip
12	-	Gas guide pipe
13	-	Inflator electrical connector
14	-	Inflator
15	-	Inflator mounting bracket

The first and second row side air curtains are installed on the cant rails above the front and rear doors, behind the headliner.

Each side air curtain has an inflator, which is attached to the header rail by a mounting bracket and two screws. The inflator is connected to the air curtain by a gas guide pipe.

The gas guide pipe and air curtain are secured along the cant rail by a fixing at the front of the gas guide pipe, two fixings at the B pillar ramp, two clips and two screws, and two fixings at the end of the gas guide pipe and C pillar ramp.

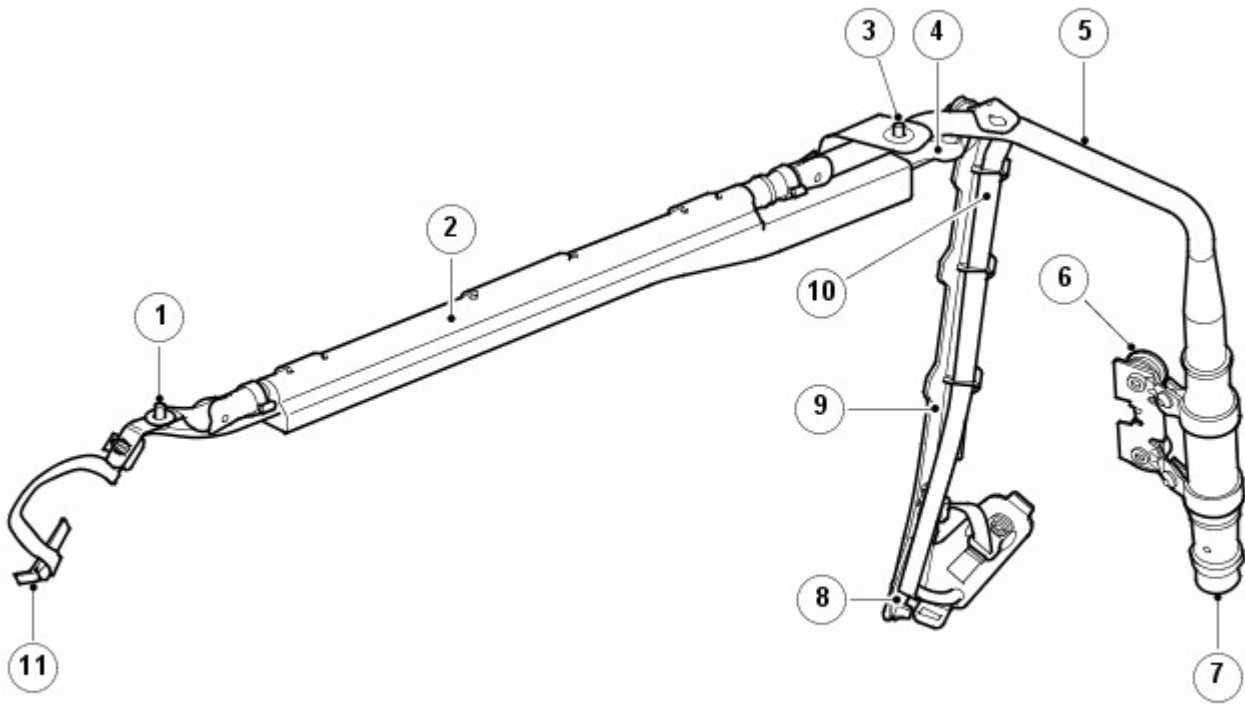
At the rear of the air curtain, an active tether device is clipped in two positions down the C pillar. At the bottom of the active tether device is a fixing anchorage.

The front of the air curtain is secured to the A pillar by two fixings.

When the side air curtain deploys, it breaks out of the B pillar ramp and the clips on the cant rail and extends downwards from behind the headliner. The deploying air curtain is tensioned between the anchorage points on the A pillar and the active tether device on the C pillar. This retains the air curtain in position against the upper part of the doors and the B pillar.

Third Row Side Air Curtain

- NOTE: Right side air curtain shown, left side air curtain is mirror image.



E45255

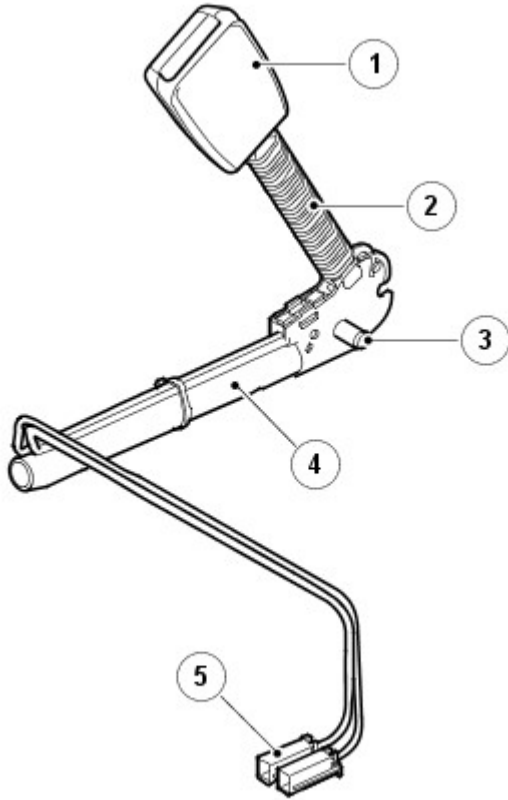
Item	Part Number	Description
1	-	Securing screw
2	-	Air curtain
3	-	Securing screw
4	-	Rear tether
5	-	Gas guide pipe
6	-	Inflator mounting bracket
7	-	Inflator
8	-	Rear tether anchor
9	-	Tether housing
10	-	Rear tether
11	-	Front tether anchor

The third row side air curtains are installed on the cant rails above the rear quarter windows, behind the headliner.

Each side air curtain has an inflator, which is attached to the D pillar by a mounting bracket and two screws. The inflator is connected to the air curtain by a gas guide pipe. The gas guide pipe and air curtain are secured to the cant rail by two screws. Tethers are attached to the front and rear of the air curtain. The front tether is anchored to the C pillar. The rear tether is anchored to the D pillar and held in position by a tether housing.

When a third row side air curtain deploys, it extends downwards from behind the headliner. The expanding air curtain tightens the tethers, which retain the air curtain in position against the rear quarter window.

PRETENSIONERS



E45256

Item	Part Number	Description
1	-	Safety belt buckle
2	-	Boot
3	-	Anchor bolt
4	-	Piston and tube
5	-	Electrical connectors for inflator and buckle switch

The pretensioners are used to tighten the front safety belts during a collision to ensure the occupants are securely held in their seats. A pretensioner is integrated into each front safety belt buckle.

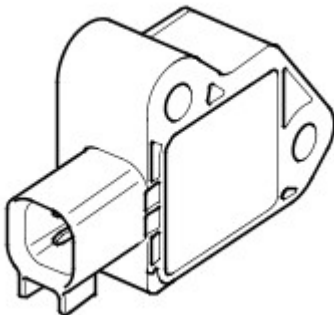
Each pretensioner has a tube containing an inflator and a piston. The inflator is connected to the RCM. The piston is attached to a steel cable, the opposite end of which is attached to the safety belt buckle.

On receipt of a fire signal from the RCM, the inflator generates nitrogen gas that rapidly expands to drive the piston along the tube, pulling the cable and drawing the safety belt buckle downwards.

SAFETY BELT SENSORS

The buckle of each front safety belt incorporates a Hall effect sensor that provides a safety belt status signal to the RCM. The RCM broadcasts the status of the two front safety belts on the high speed controller area network (CAN) bus for use by the instrument cluster.

IMPACT SENSORS



E45257

Impact sensors are installed in the front and both sides of the vehicle. The use of multiple impact sensors provides shorter air bag trigger times, through faster detection of lateral and longitudinal acceleration, and improves detection accuracy.

There are two front impact sensors attached to brackets on the body front support frame, just above each front longitudinal.

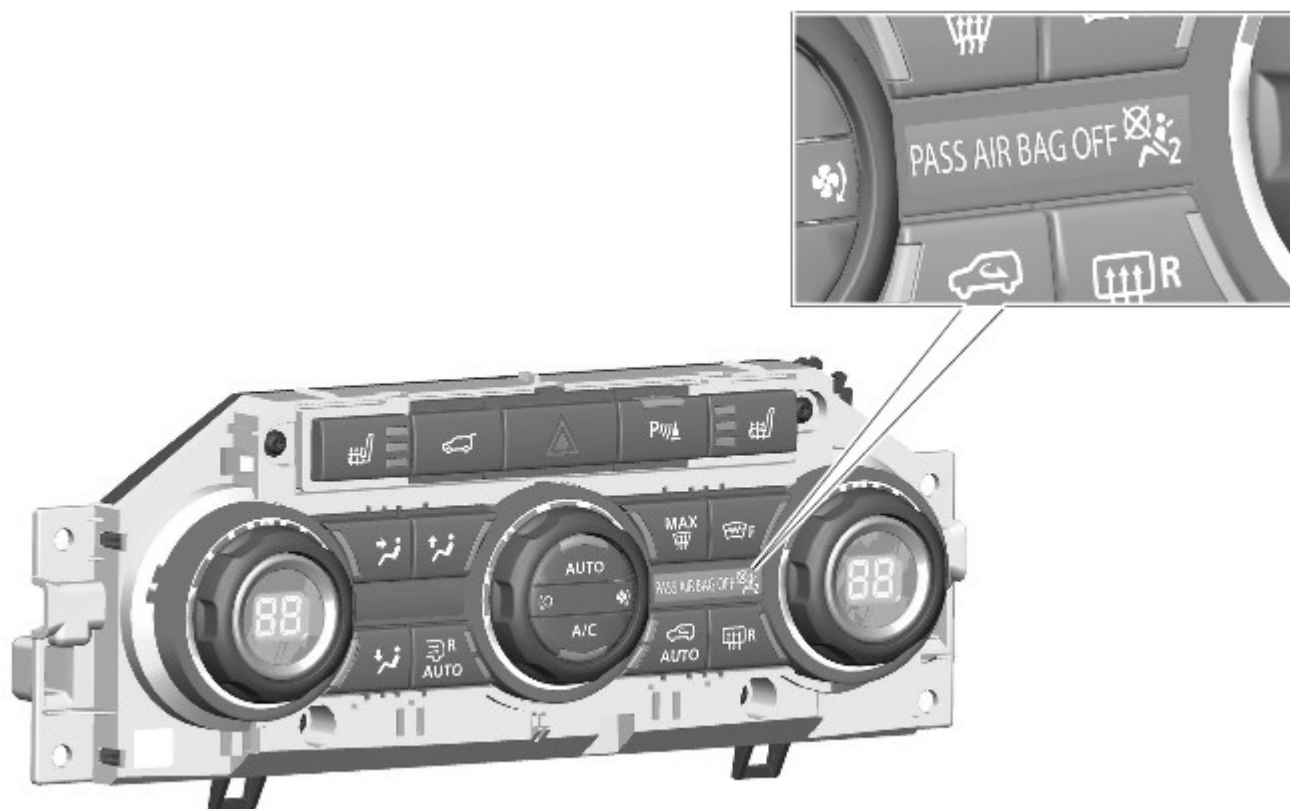
There are six side impact sensors located in the passenger compartment, as follows:

- One attached to each front door.
- One attached to the base of each B pillar.
- One installed in each rear quarter, above the rear wheelarch.

Each impact sensor incorporates an accelerometer and a microcontroller powered by a feed from the RCM. The power feed also provides the interface connection through which the impact sensor communicates with the RCM using serial data messages. Acceleration is evaluated by the microcontroller and transmitted to the RCM, which then makes the decision on whether or not to activate the air bags and pretensioners.

When the ignition is switched on the RCM supplies power to the impact sensors, which perform a self test. After satisfactory self tests the impact sensors continually output 'sensor active' messages to the RCM. If a fault is detected the relevant impact sensor sends a fault message, instead of the sensor active message, to the RCM. The RCM then stores a related fault code and illuminates the SRS warning indicator.

PASSENGER AIR BAG DEACTIVATION INDICATOR



E133080

The **PAD (passenger air bag deactivation)** indicator is installed on the climate control module in the center of the instrument panel. When appropriate, the indicator illuminates to advise front seat occupants that the passenger air bag is disabled. Operation of the indicator is controlled by the RCM based on seat occupancy status derived from the occupant classification system (NAS vehicles) or the passenger air bag deactivation switch (all except NAS and Australian specification vehicles).

The RCM illuminates the indicator:

- When the passenger air bag is deactivated with the **PAD** switch (where fitted).
- When required by passenger seat occupant monitoring (NAS vehicles only).

PASSENGER AIR BAG DEACTIVATION SWITCH



E45259

The [PAD](#) switch provides a method of manually disabling the passenger air bag on all vehicles except Australian specification and those fitted with the occupant classification system. The switch is installed in the front passenger end of the instrument panel and can be operated by the emergency key blade in the smart key.

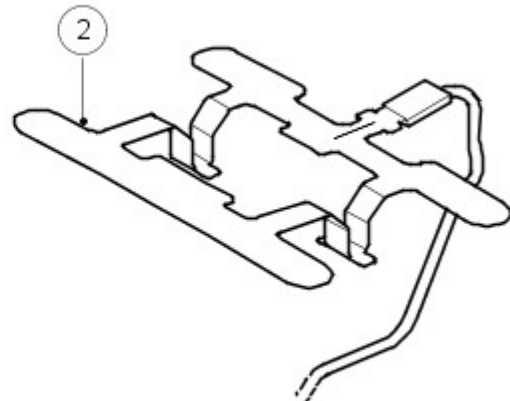
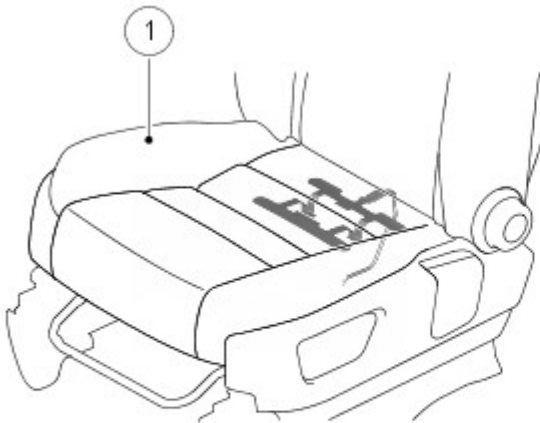
When the [PAD](#) switch is operated, it changes a ground connection between two pins in the connectors of the RCM. When the [PAD](#) switch is selected to OFF, the RCM disables the passenger air bag and, if the front passenger seat is occupied, illuminates the [PAD](#) indicator.

OCCUPANT SENSING

There are two types of occupant sensing:

- In all markets except North America, vehicles have an occupant detection system to activate the seat belt minder
- On NAS vehicles, an occupant classification system provides signals to the RCM to allow the correct arming of the passenger air bag and corresponding indicator.

Occupant Detection System



E46657

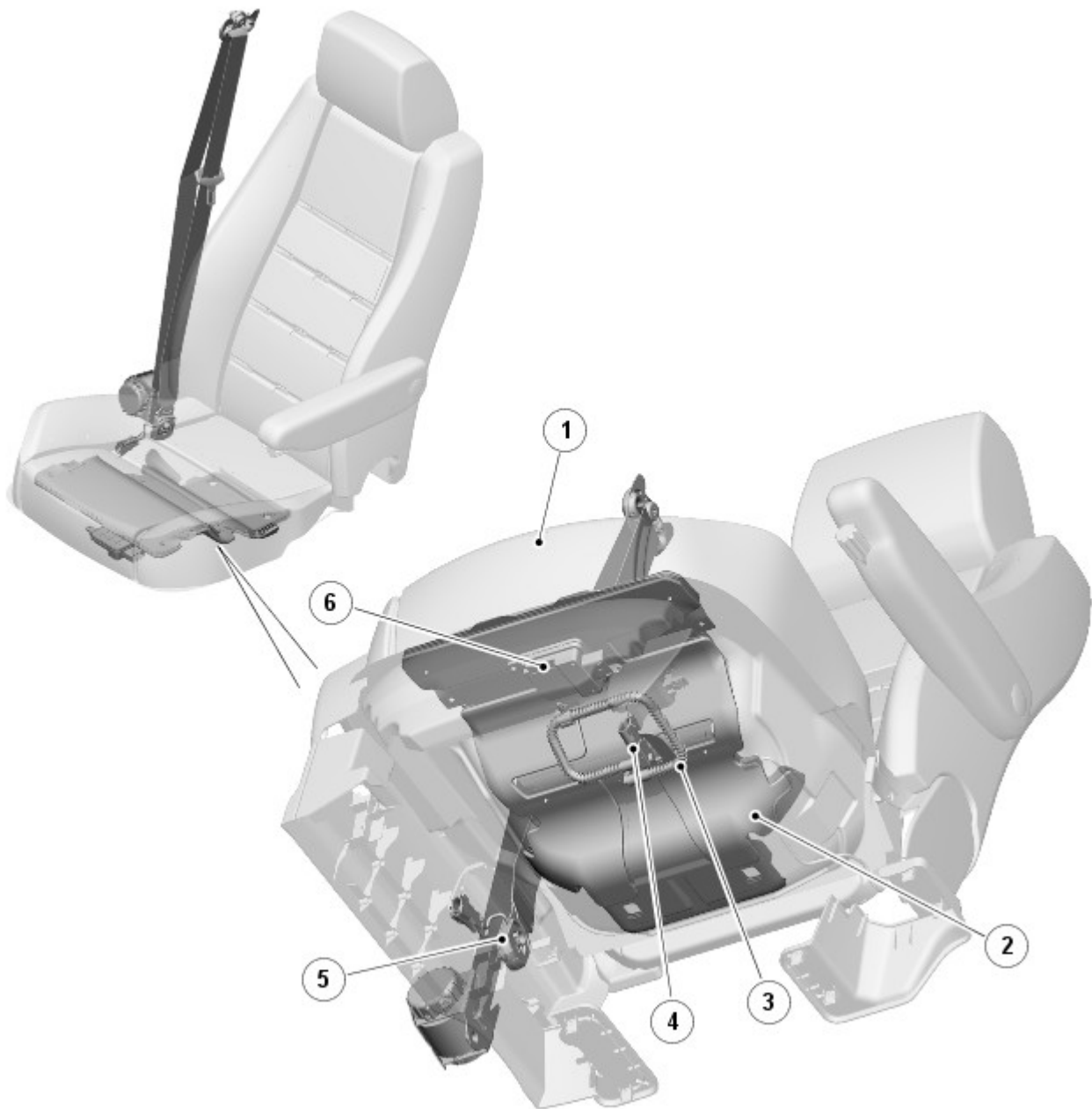
Item	Part Number	Description
1	-	Seat cushion
2	-	Pressure switch

The occupant detection system can only determine if the front passenger seat is occupied or unoccupied. The occupant detection system consists of a pressure switch installed between the foam padding and the cover of the front passenger seat cushion.

The pressure switch incorporates a number of load cells connected in series and embedded in a plastic film. Weight on the pressure sensor increases the resistance of the circuit.

The instrument cluster supplies a reference voltage to the pressure switch and measures the current draw to determine the occupancy status. From the occupancy status, and the status of the front passenger safety belt (received from the RCM on the high speed CAN bus), the instrument cluster determines the belt minder status.

Occupant Classification System



E133081

Item	Part Number	Description
1	-	Seat cushion
2	-	Pressure pad
3	-	Pressure tube
4	-	Pressure sensor
5	-	Safety belt tension sensor
6	-	Occupant classification module

The occupant classification system comprises an occupant classification module attached to the underside of the seat, a silicon filled bladder and pressure sensor fitted between the cushion foam and the seat pan and a seat belt tension sensor. When an occupant sits on the seat a pressure is created in the bladder and the occupant weight is determined from the pressure generated. The weight is compared against four classification thresholds. These are:

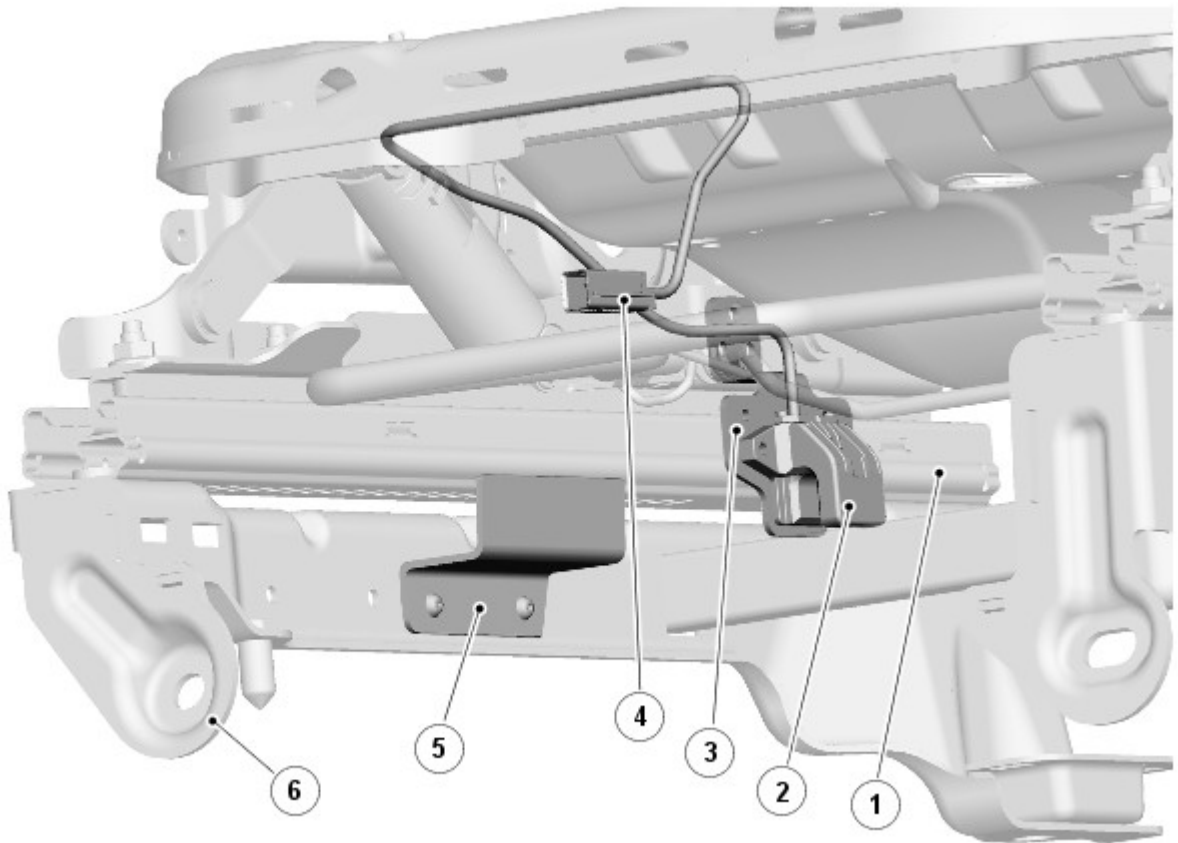
- Empty
- Occupied inhibit status (6 year old child, 3 year old child, rear facing/forward facing 12 month infant seats and booster seats)
- Occupied allow status (weight greater than 5th percentile female) and the air bag enabled/disabled as appropriate
- Indeterminate state.

Classification	PAD Indicator	SRS Warning Indicator
Seat unoccupied	OFF	OFF
Occupied inhibit	ON	OFF
Occupied allow	OFF	OFF
Indeterminate state	OFF	ON

The occupant classification module contains accelerometers and algorithms to compensate for the effects of longitudinal, lateral and vertical forces acting on the vehicle whilst being driven. The belt tension sensor is used to offset loads forced into the seat by 'cinched' child seats (where a child seat load on the seat is increased by a highly tensioned seat belt) and also dynamic belt loading (off-road/aggressive driving styles).

The belt minder system on vehicles with the occupant classification system uses the RCM to detect seat occupancy status based on calculations within the RCM, with the instrument cluster then determining whether a seat belt reminder should be activated based on the status of the seat belt buckle switches and the vehicle speed.

SEAT POSITION SENSOR



E133082

Item	Part Number	Description
1	-	Seat frame
2	-	Mounting plate
3	-	Seat position sensor
4	-	Electrical connector
5	-	Target plate
6	-	Seat base

The seat position sensor allows the RCM to detect when the driver seat is forward of a given point on the seat track. The seat position sensor consists of a Hall effect sensor attached to the driver seat frame and a target plate on the seat base. While the ignition is on, the RCM supplies the sensor with a power supply of 12 V nominal, and monitors the return voltage. When the seat frame moves forwards, the sensor moves over the target plate, which changes the reluctance of the sensor. The change of voltage is detected by the RCM and used as a switching point. The switching point is when the center of the sensor is 3 ± 4 mm from the leading edge of the target plate.

When the driver seat is forward of the switching point, the RCM increases the time delay between firing the two stages of the inflator in the driver air bag. When the driver seat is rearward of the switching point, the RCM uses the normal time delay between firing the two stages.

SRS WARNING INDICATOR

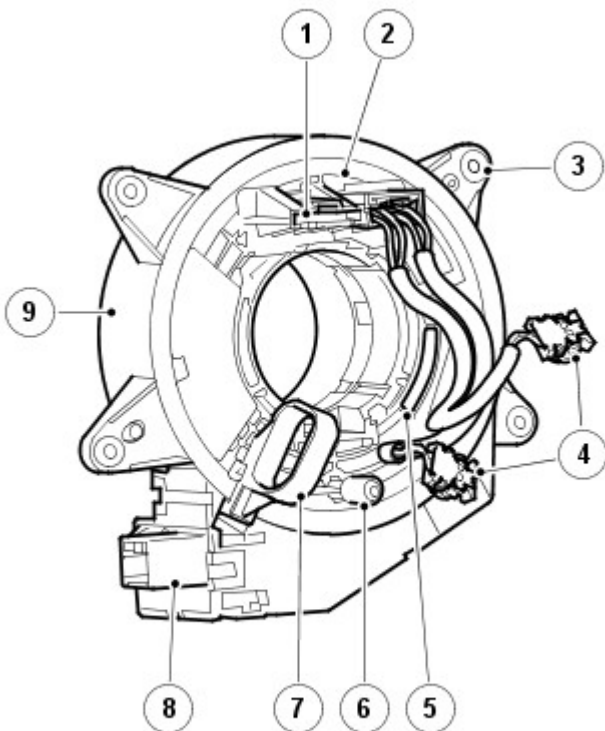


E133083

The SRS warning indicator consists of a red light emitting diode (LED) behind a SRS graphic in the speedometer of the instrument cluster.

Operation of the SRS warning indicator is controlled by a high speed CAN bus message from the RCM to the instrument cluster. The RCM illuminates the SRS warning indicator if a fault is detected, and for approximately 6 seconds during the bulb check at the beginning of each ignition cycle.

CLOCKSPRING



E45264

Item	Part Number	Description
1	-	Electrical connector for steering wheel switch packs and horn
2	-	Inner rotor
3	-	Outer housing securing lug
4	-	Driver air bag link leads
5	-	Viewing window
6	-	Drive peg
7	-	Stopper
8	-	Electrical connector for steering column harness
9	-	Outer cover

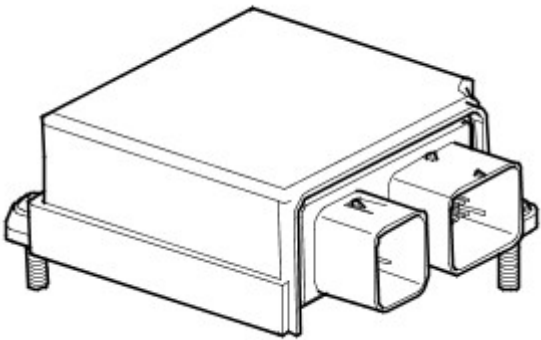
The clockspring is installed on the steering column to provide the electrical interface between the fixed wiring harness of the steering column and the components that rotate with the steering wheel, i.e. the driver air bag, the horn and the steering wheel switch packs.

The clockspring consists of a plastic cassette which incorporates an outer cover fixed to the steering column and an inner rotor which turns with the steering wheel. Four securing lugs attach the cover to the multifunction switch on the steering column. The rotor is keyed to the steering wheel by a drive peg. A lug on the underside of the rotor operates the self-cancelling feature of the turn signal indicator switch. A ribbon lead, threaded on rollers in the rotor, links two connectors on the cover to two connectors on the rotor. Link leads for the driver air bag are installed in one of the connectors on the rotor.

To prevent damage to the ribbon lead, both the steering and the clockspring must be centralized when removing and installing the clockspring or the steering wheel. The clockspring is centralized when the drive peg is at six o'clock and 50 - 100% of a yellow wheel is visible in the viewing window.

Replacement clocksprings are fitted with a stopper, which locks the cover to the rotor, in the central position. The stopper must be broken off when the replacement clockspring is installed.

RCM



E45265

The RCM is installed on the top of the transmission tunnel, in line with the B pillars, and controls operation of the [SRS \(supplemental restraint system\)](#). The main functions of the RCM include:

- Crash detection and recording.
- Air bag and pretensioner firing.
- Self test and system monitoring, with status indication via the SRS warning lamp, and non volatile storage of fault information.

A safing sensor in the RCM provides confirmation of an impact to verify if air bag and pretensioner activation is necessary. A roll-over sensor monitors the lateral attitude of the vehicle. Various firing strategies are employed by the RCM to ensure that during an accident only the appropriate air bags and pretensioners are fired. The firing strategy used also depends on the inputs from the safety belt switches and the occupant monitoring system.

An energy reserve in the RCM ensures there is always a minimum of 150 milliseconds of stored energy available if the power supply is disrupted during a crash. The stored energy is sufficient to produce firing signals for the driver air bag, the passenger air bag and the safety belt pretensioners.

When the ignition is switched on the RCM performs a self test and then performs cyclical monitoring of the system. If a fault is detected the RCM stores a related fault code and illuminates the SRS warning indicator. The faults can be retrieved by Land Rover approved diagnostic equipment. If a fault that could cause a false fire signal is detected, the RCM disables the related firing circuit, and keeps it disabled during a crash event.

SRS OPERATION

General

In a collision, the sudden deceleration or acceleration is measured by the safing sensor in the RCM and by the impact sensors. The RCM evaluates the readings to determine the impact point on the vehicle and whether the deceleration/acceleration readings exceed the limits for firing any of the air bags or pretensioners. During a collision, the RCM only fires the air bags and pretensioners if the safing sensor confirms that the data from the remote sensor(s) indicates an impact limit has been exceeded. The RCM also monitors the vehicle for a roll-over accident using the internal roll-over sensor and high speed [CAN \(controller area network\)](#) bus messages from the anti-lock brake system (ABS) module and the steering angle sensor.

The RCM incorporates the following impact thresholds to cater for different accident scenarios:

- Front impact, pretensioners.
- Front impact, driver and passenger air bags stage 1, belt unfastened.
- Front impact, driver and passenger air bags stage 2, belt unfastened.
- Front impact, driver and passenger air bags stage 1, belt fastened.
- Front impact, driver and passenger air bags stage 2, belt fastened.
- Rear impact.
- LH (left-hand) side impact.
- RH (right-hand) side impact.
- Roll-over.

The front impact thresholds increase in severity from pretensioners, through to driver and passenger air bag stage 2, belt fastened.

Firing Strategies

The seat belt pretensioners are fired when either the pretensioner impact limit or the roll-over limit is exceeded. The RCM only fires the pretensioners if the related safety belt is fastened. For the front passenger pretensioner to fire, the seat must also be occupied by a large person, i.e. someone over a given weight (NAS only).

The driver and passenger air bags are only fired in a frontal impact that exceeds the stage 1 threshold. Both stages of the inflator in the driver and passenger air bags are fired. At impacts between the stage 1 and 2 thresholds, the delay between the firing of the two stages varies with the severity of the impact; the more severe the impact the shorter the delay. At stage 2 impact thresholds and above, the two stages of the inflator are fired almost simultaneously. The passenger air bag is disabled unless the front passenger seat is occupied by a large person (NAS only), or the passenger air bag deactivation switch is on (all except NAS). The time delay between firing the two stages of the inflator in the driver air bag is increased if the driver seat is forward of the seat position sensor switching point.

If there is a fault with a safety belt buckle sensor, the RCM assumes the related safety belt is fastened for the pretensioner firing strategy and unfastened for the driver and passenger air bag firing strategies. If there is a fault with the occupant detection system, or if there is a fault with the passenger air bag deactivation switch, the RCM increase the time delay between firing the two stages of the inflator in the passenger air bag.

If a side impact limit is exceeded, the RCM fires the side air bag and the side air curtain(s) on that side of the vehicle. If the side impact limit on the front passenger side of the vehicle is exceeded, the RCM also evaluates the input from the occupant classification system, and fires the side air bag only if the front passenger seat is occupied by a large person (NAS only).

The side air curtain(s) on both sides of the vehicle are fired if the roll-over limit is exceeded.

If multiple impacts occur during a crash event, after responding to the primary impact the RCM will output the appropriate fire signals in response to any further impacts if unfired units are available.

Crash Signal

When the RCM outputs any of the fire signals, it also outputs a hard wired crash signal to the [ECM \(engine control module\)](#) and the [CJB \(central junction box\)](#), and changes the high speed CAN bus output message from 'no crash' to 'crash condition'.

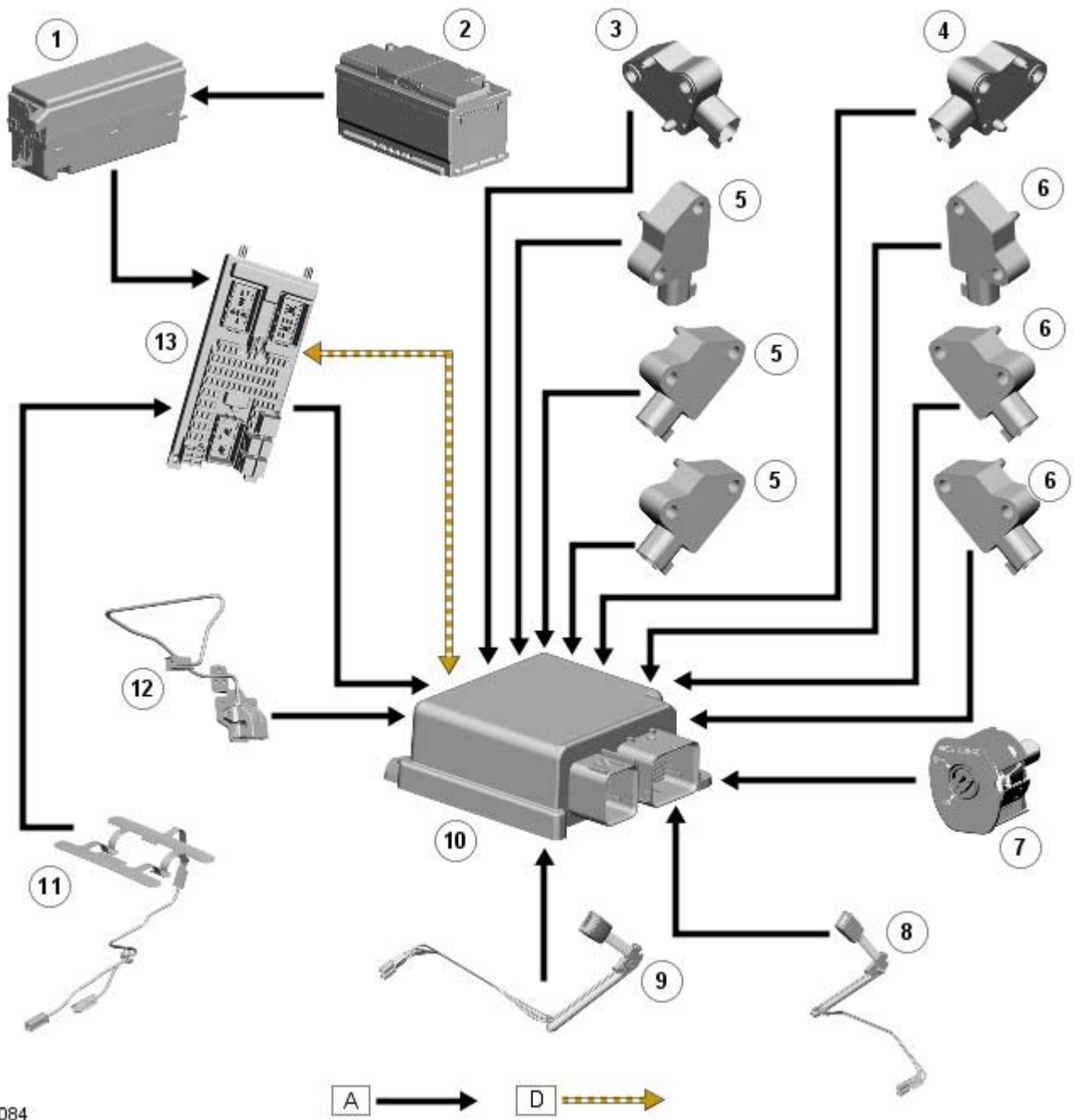
On receipt of the crash signals:

- The engine control module (ECM) disables the fuel pump.
- Where fitted, the operation of the FFBH is disabled.
- The central junction box (CJB) enters the crash mode and:
 - Activates all of the unlock signals of the vehicle locking system, even if the vehicle is already unlocked. After 3 seconds, the CJB activates the unlock signals again.
 - Ignores all locking and superlocking inputs until the crash mode is cancelled, when it returns the locking system to normal operation.
 - Activates all of the courtesy lamps, except for the approach lamps. The activated courtesy lamps remain on until they are manually switched off at the lamp unit, or the CJB crash mode is cancelled, after which they return to normal operation.
 - Activates the hazard warning lamps. The hazard warning lamps remain on until cancelled by turning the ignition off the crash mode is cancelled.

The crash mode is cancelled by cycling the ignition.

CONTROL DIAGRAM - SHEET 1 OF 2 (ALL EXCEPT NAS)

- NOTE: A = Hardwired connections.



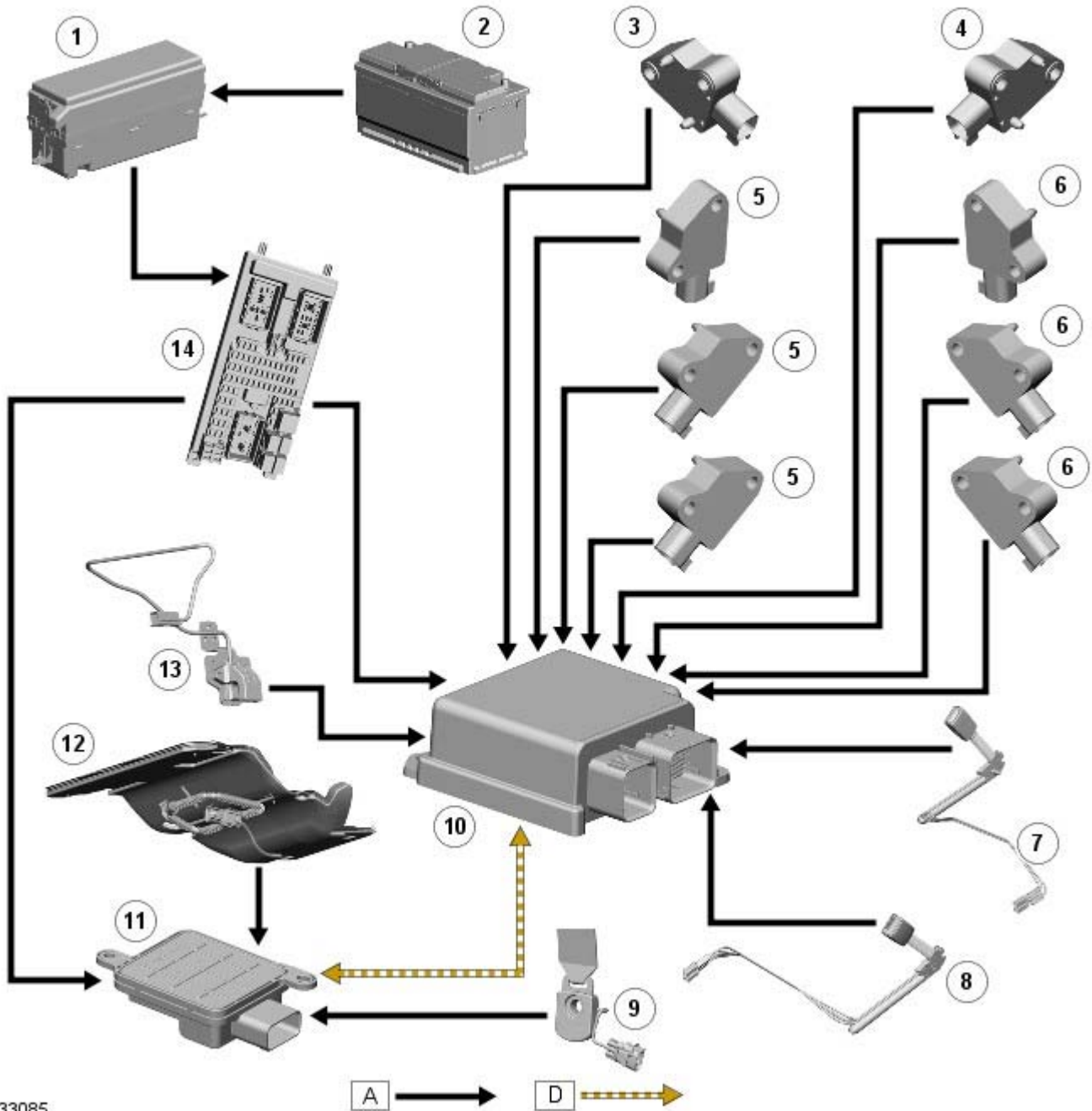
E133084



Item	Part Number	Description
1	-	Fusible link 11E, battery junction box (BJB)
2	-	Battery
3	-	Left front impact sensor
4	-	Right front impact sensor
5	-	Left side impact sensor
6	-	Right side impact sensor
7	-	Passenger air bag deactivation switch
8	-	Left safety belt buckle sensor
9	-	Instrument cluster
10	-	Right safety belt buckle sensor
11	-	Occupant detection pressure sensor
12	-	Seat position sensor
13	-	RCM
14	-	Fuse 9P, CJB
15	-	Ignition switch
16	-	Fuse 68P, CJB
17	-	Passenger air bag deactivation indicator

CONTROL DIAGRAM - SHEET 1 OF 2 (NAS)

• NOTE: A = Hardwired connections; D = High speed CAN bus.

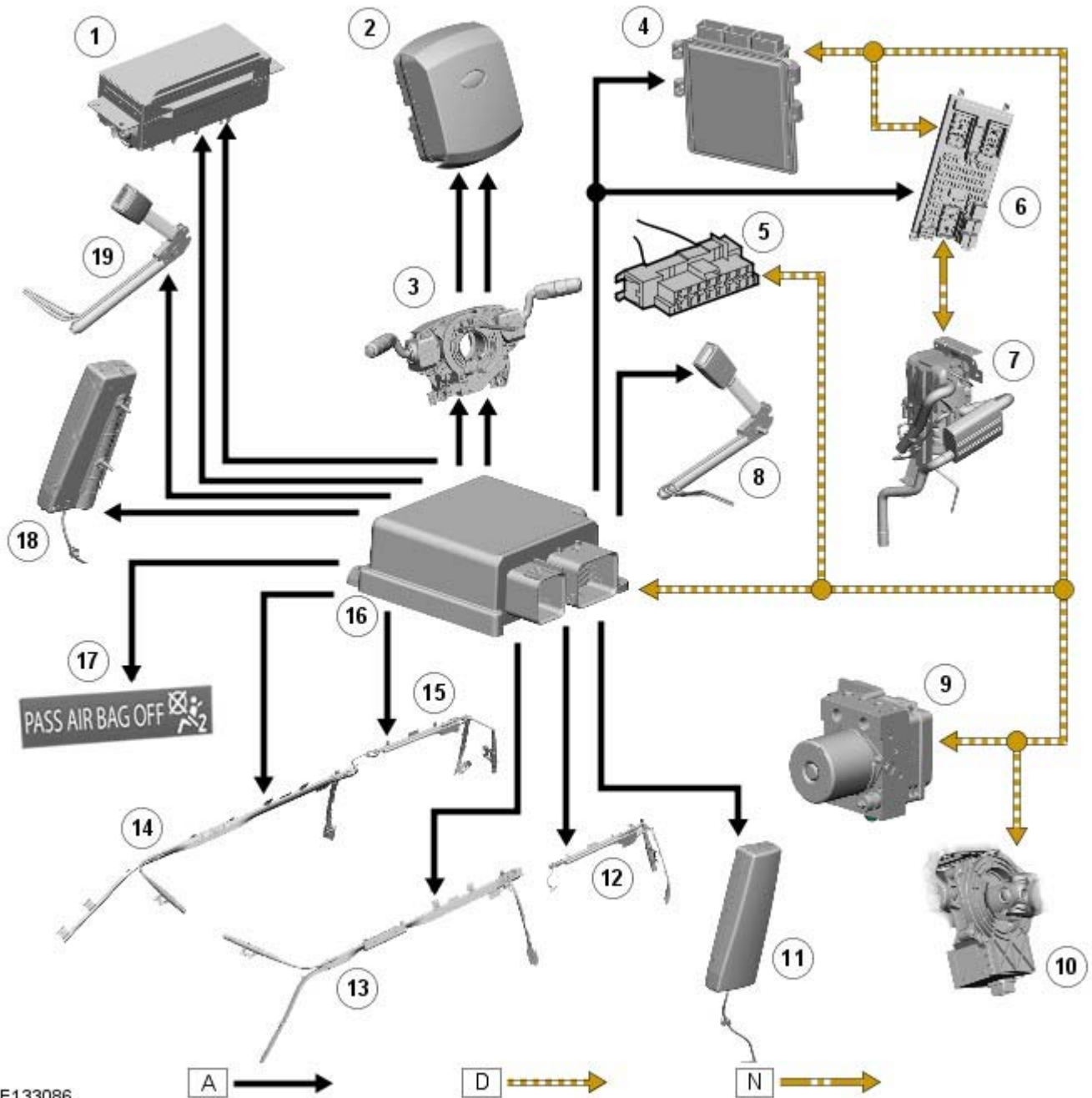


E133085

Item	Part Number	Description
1	-	Fusible link 11E, BJB
2	-	Battery
3	-	Left front impact sensor
4	-	Right front impact sensor
5	-	Left side impact sensor
6	-	Right side impact sensor
7	-	Left safety belt buckle switch
8	-	Right safety belt buckle switch
9	-	Instrument cluster
10	-	Safety belt tension sensor
11	-	Occupant classification module
12	-	Pressure pad and sensor
13	-	Seat position sensor
14	-	RCM
15	-	Fuse 9P, CJB
16	-	Ignition switch
17	-	Fuse 68P, CJB
18	-	Passenger air bag deactivation indicator

CONTROL DIAGRAM - SHEET 2 OF 2 (ALL MARKETS)

• NOTE: A = Hardwired connections; D = High speed CAN bus; N = Medium speed CAN bus.



E133086

Item	Part Number	Description
1	-	Passenger air bag
2	-	Driver air bag
3	-	Clockspring
4	-	ECM
5	-	Diagnostic socket
6	-	Left pretensioner
7	-	Left side air bag
8	-	Left third row side air curtain
9	-	Left first and second row side air curtain
10	-	Right third row side air curtain
11	-	Right first and second row side air curtain
12	-	RCM
13	-	Right side air bag
14	-	Right pretensioner

Supplemental Restraint System - Air Bag Supplemental Restraint System (SRS)

Diagnosis and Testing

Principle of Operation

For a detailed description of the air bag supplemental restraint system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Air Bag and Safety Belt Pretensioner Supplemental Restraint System \(SRS\)](#) (501-20B Supplemental Restraint System, Description and Operation).

Safety Information

• WARNINGS:



To avoid accidental deployment the back-up power supply must be depleted before beginning any work on the SRS system or its components. Failure to follow this instruction may result in personal injury.



Do not use a multimeter to probe an SRS module. It is possible for the power from the meter battery to trigger the activation of the module. Failure to follow this instruction may result in personal injury.

• NOTE: It is advisable not to use a cellular phone or to have a cellular phone in close proximity when working on the SRS system or components.

• NOTE: Given the legal implications of a restraints system failure, harness repairs to Air Bag module circuits are not acceptable. Where the text refers to "REPAIR the circuit", this will normally mean the replacement of a harness.

Power supply depletion

Before beginning any work on the SRS system or related components:

1. 1. Remove the ignition key.
2. 2. Disconnect the battery leads, ground first.
3. 3. Wait 2 minutes for the power circuit to discharge.

There are comprehensive instructions on the correct procedures for SRS system repairs in the workshop manual. Refer to the relevant section of the workshop manual.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
 - Confirm the function of the warning lamp (if the warning lamp is inoperative, system faults will be signalled by an audible chime)
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check for the installation of non-standard accessories which may affect or obstruct the function of the SRS system ● Check the condition of trim, etc at the SRS system components ● Sensor(s) ● Pretensioner(s) ● Air bag module(s) ● Occupant detection/classification sensors ● Seat position sensor 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Make sure all electrical connector(s) are engaged correctly on the air bag circuits ● Make sure the Restraints Control Module (RCM) is correctly installed ● Warning lamp bulb(s) ● Impact sensor(s) ● Buckle sensor(s) ● Pretensioner(s) ● Air bag module(s) ● Air bag deactivation switch ● Air bag deactivation warning lamp ● Occupant detection/classification sensors ● Seat position sensor ● Clockspring


3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Restraints Control Module \(RCM\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Occupant Classification System \(OCS\)](#) (100-00 General Information, Description and Operation).

Supplemental Restraint System - Driver Air Bag Module

Removal and Installation

Special Tool(s)	
 <p>501-106</p> <p>E48291</p>	<p>Airbag module remover</p> <p>501-106</p>

Removal

• WARNINGS:



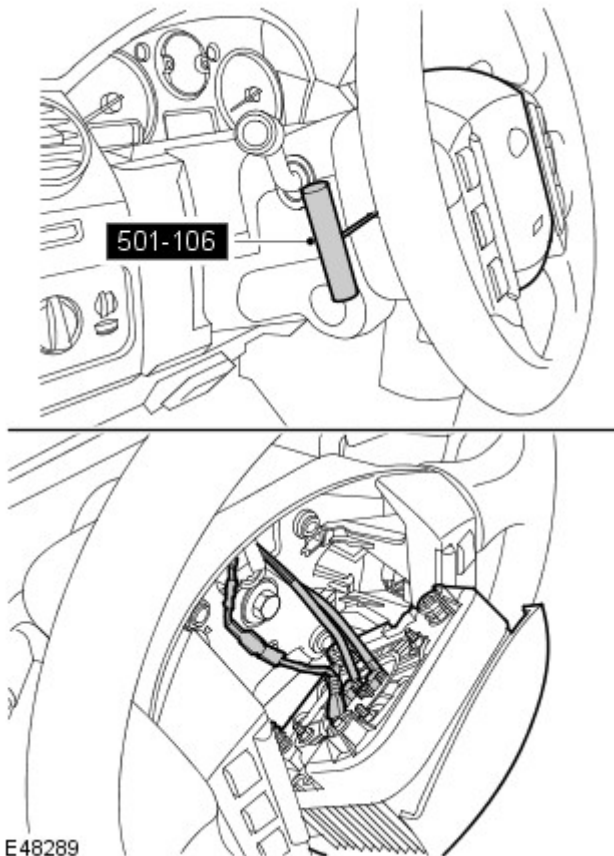
It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.


• NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the driver air bag module.
 - Using the special tool, release the clip.
 - Repeat the above procedure for the other side.
 - Disconnect the ground cable.
 - Release the clips and disconnect the 2 electrical connectors.




Installation

1.  **WARNING:** The SRS electrical connectors are unique. DO NOT force, or attempt to connect electrical connectors to the wrong sockets.

 **CAUTION:** Make sure the cables/harnesses are not twisted before connecting them to the airbag module. Once connected, do not rotate the air bag module as this will cause the wires to twist, which can lead to harness damage and SRS faults.

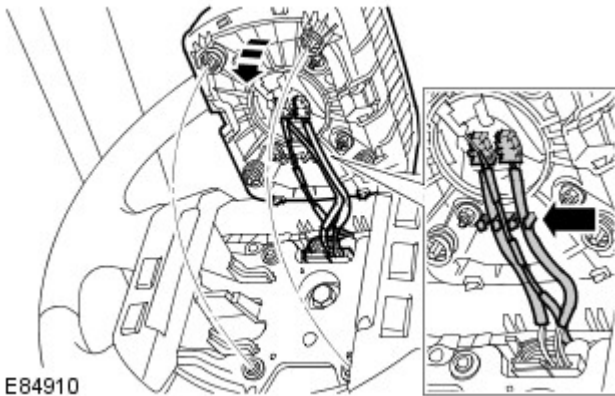
Attach the driver air bag module.

- Connect the ground cable.
- Connect the electrical connectors.

2.  **WARNING:** Driver air bag module installation can be confirmed by hearing 2 audible clicks, 1 for each spring. The module edges should also be flush with the steering wheel.

Install the driver air bag module.

- Install top edge of module, then hinge upwards and make sure wires are connected to clips.
- Make sure the wires are not trapped behind the module.
- Hold wires in place while hinging module closed.
- Align the locating pins and springs.



E84910

Supplemental Restraint System - Passenger Air Bag Module

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

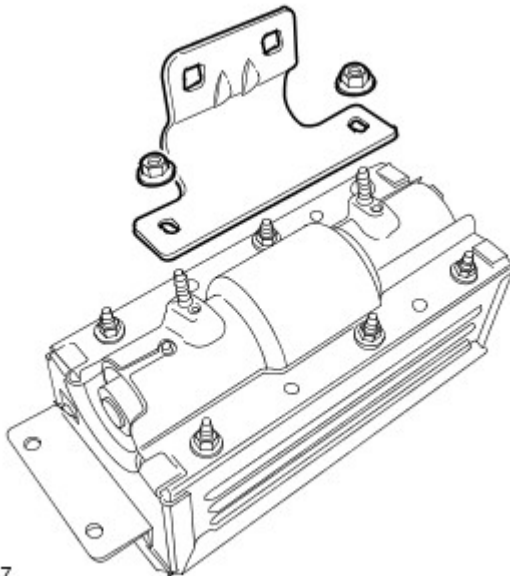
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Remove the passenger air bag module.
 - Remove the 4 nuts.



5. NOTE: Do not disassemble further if the component is removed for access only.

Remove the passenger air bag module bracket.

- Remove the 2 nuts.



Installation

1. Install the passenger air bag module bracket.
 - Tighten the nuts to 10 Nm (7 lb.ft).

2. Install the passenger air bag module.

- Tighten the nuts to 10 Nm (7 lb.ft).

3. Install the instrument panel upper section.

For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

Supplemental Restraint System - Rear Side Air Curtain Module

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.

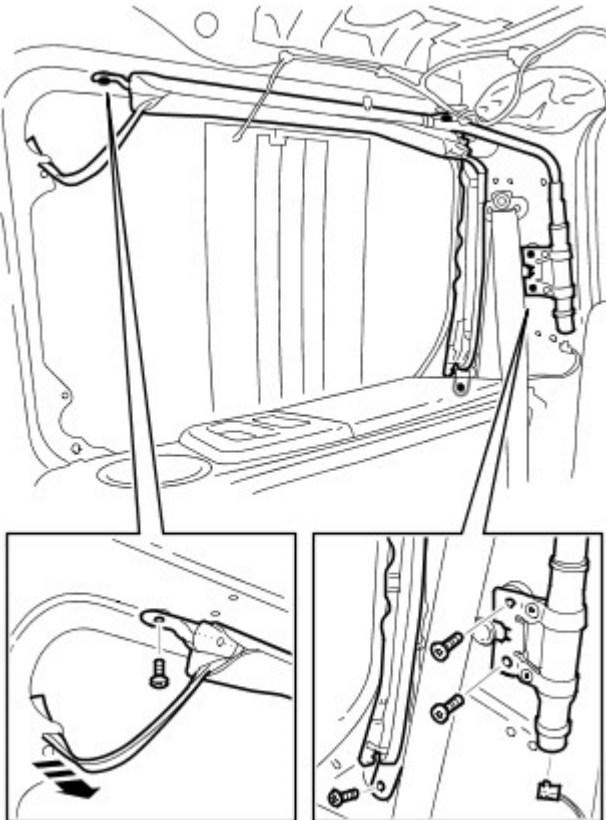


Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the side air curtain module.

- Disconnect the electrical connector.
- Remove the 5 Torx screws.
- Release the retaining strap.



E 49973

Installation

1. Install the side air curtain module.
 - Tighten the Torx screws to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
 - Secure the retaining strap.
2. Install the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Supplemental Restraint System - Front Impact Severity Sensor

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.

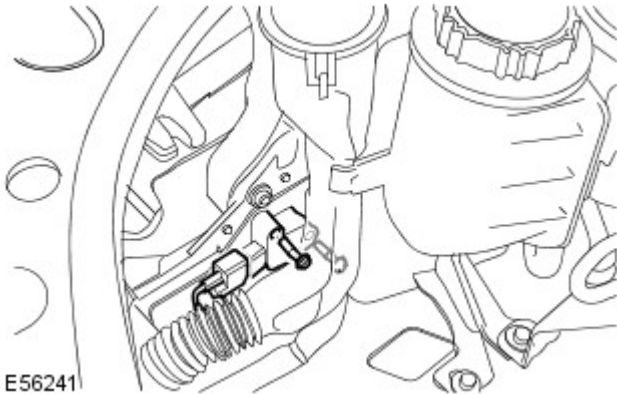


Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
3. Remove the front impact sensor.

- Disconnect the electrical connector.
- Remove the 2 Torx bolts.



Installation

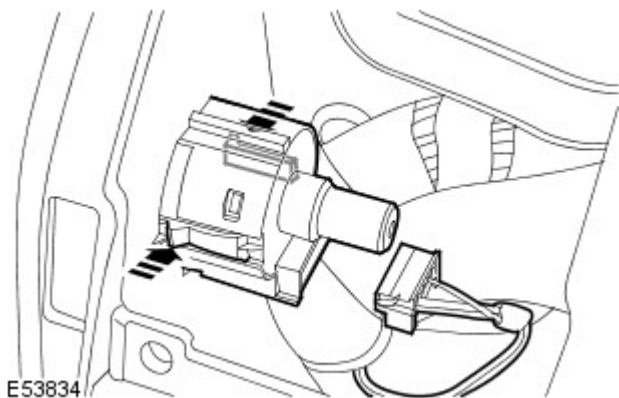
1. Install the front impact sensor.
 - Tighten the Torx bolts to 8 Nm (6 lb.ft).
 - Connect the electrical connector.
2. Install the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

Supplemental Restraint System - Passenger Air Bag Deactivation (PAD) Switch

Removal and Installation

Removal

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the passenger side register trim panel.
For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).
3. Remove the PAD switch.
 - Disconnect the electrical connector.
 - Release the 2 clips.



E53834

Installation

1. Install the PAD switch.
 - Connect the electrical connector.
 - Secure with the clips.
2. Install the passenger side register trim panel.
For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Supplemental Restraint System - Clockspring

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• CAUTIONS:



Make sure the wheels are in the straight-ahead position. Failure to follow this instruction may result in damage to the components.

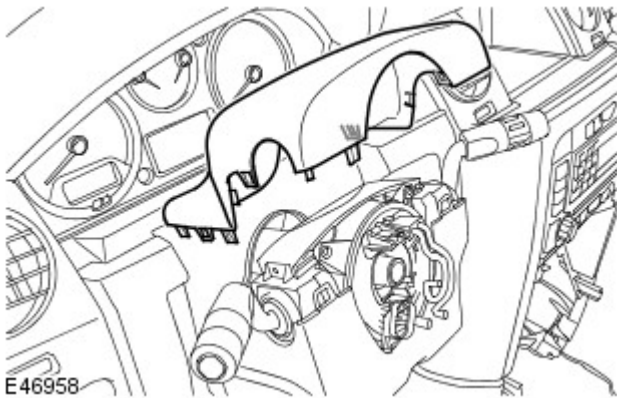


Correct clockspring alignment can be found by viewing a yellow marker through the window situated on the clockspring face. If the marker is not visible, carefully turn the clockspring. If the turning force increases before the marker is visible, reverse the direction to avoid component damage.

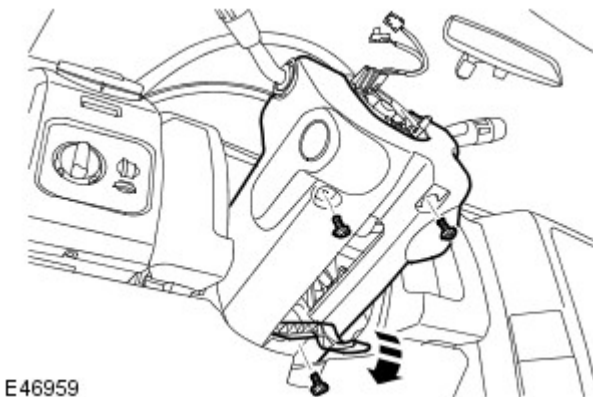
• NOTE: test piece

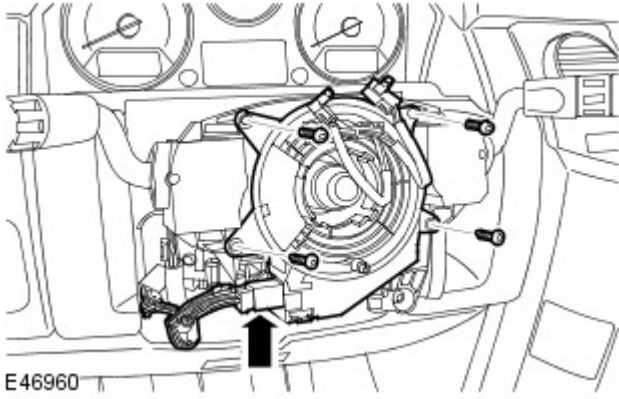
• NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Fully extend the steering column for access.
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the steering wheel.
For additional information, refer to: Steering Wheel (211-04, Removal and Installation).
4. Remove the steering column upper shroud.
 - Release the 6 clips.



5. Remove the steering column lower shroud.
 - Remove the 3 Torx screws.
 - Release the steering column adjustment lever.






6.  CAUTION: Do not dismantle the clockspring, it has no servicable parts and must be replaced as a complete assembly.

Remove the clockspring.

- Disconnect the 2 electrical connectors.
- Remove the 4 screws.

Installation

1.  CAUTION: Correct clockspring alignment can be found by viewing a yellow marker through the window situated on the clockspring face. If the marker is not visible, carefully turn the clockspring. If the turning force increases before the marker is visible, reverse the direction to avoid component damage.

To install, reverse the removal procedure.

Supplemental Restraint System - B-Pillar Side Impact Sensor

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.

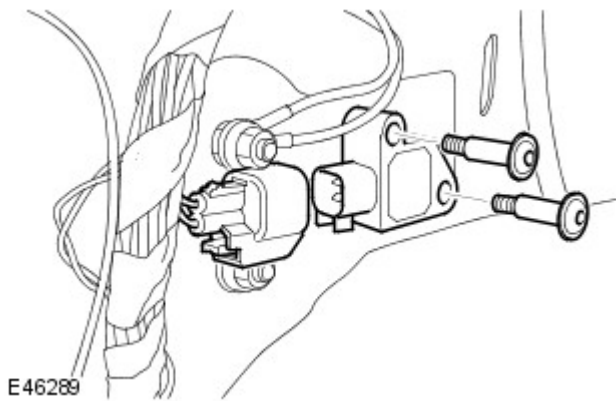
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the scuff plate trim panel.

For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Remove the side impact sensor.

- Remove the 2 Torx bolts.
- Disconnect the electrical connector.



Installation

1. Install the side impact sensor.

- Connect the electrical connector.
- Tighten the Torx bolts to 8 Nm (6 lb.ft).

2. Install the scuff plate trim panel.

For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Supplemental Restraint System - C-Pillar Side Impact Sensor

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.

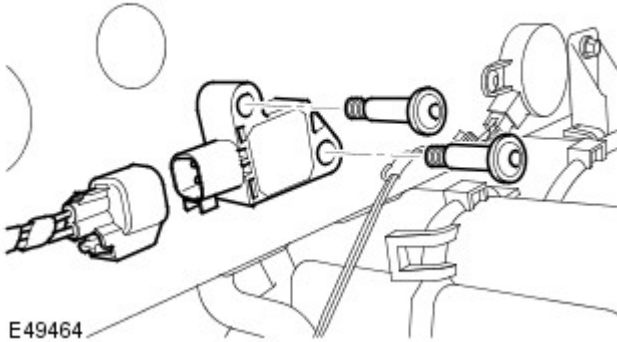
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the C-pillar lower trim panel.

For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Remove the side impact sensor.

- Remove the 2 Torx bolts.
- Disconnect the electrical connector.



Installation

1. Install the side impact sensor.

- Tighten the Torx bolts to 8 Nm (6 lb.ft).
- Connect the electrical connector.

2. Install the C-pillar lower trim panel.

For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Supplemental Restraint System - Front Door Side Impact Sensor

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.

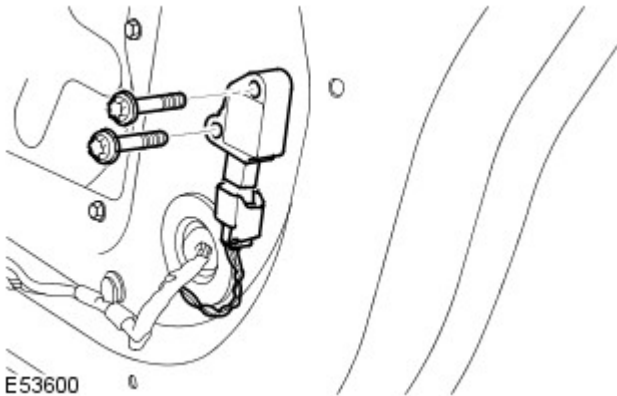
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the front door trim panel.

For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

3. Remove the front door side impact sensor.

- Disconnect the electrical connector.
- Remove the 2 Torx bolts.



Installation

1. Install the front door side impact sensor.

- Tighten the Torx bolts to 8 Nm (6 lb.ft).
- Connect the electrical connector.

2. Install the front door trim panel.

For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

Supplemental Restraint System - Side Air Bag Module

Removal and Installation

Removal

• WARNINGS:

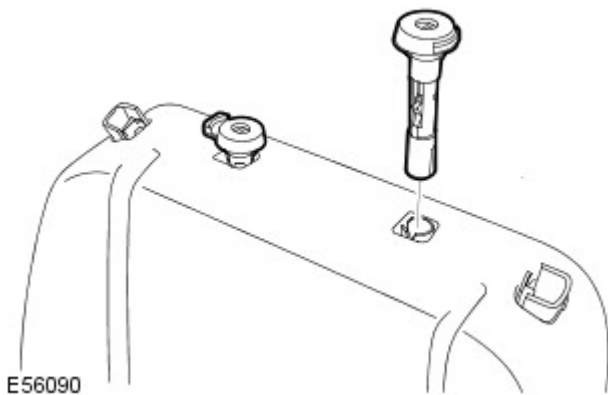


It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

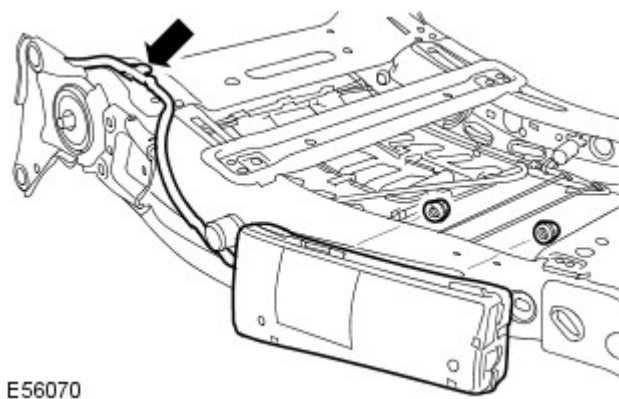
1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).
3. Remove the front seat backrest pad.
 - Remove the front seat head restraint retaining clips.



4. NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

Remove the side air bag module.

- Release the side air bag module harness.
- Remove the 2 nuts.



Installation

1. Install the side air bag module.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 - Attach the wiring harness.
2. Install the front seat backrest pad.
 - Install the front seat head restraint retaining clips.
3. Install the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).

Supplemental Restraint System - Side Air Curtain Module

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.

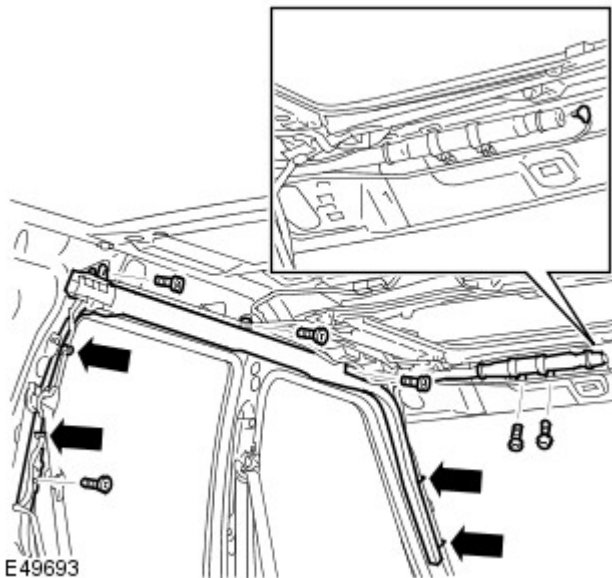


Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the roof opening panel drain tube from the securing clips.
4. Release the tire deflation wiring harness from securing clips.
5. Remove the side air curtain module.

- Remove the 8 screws.
- Remove the 5 Torx screws.
- Disconnect the electrical connector.



Installation

1. Install the side air curtain module.
 - Tighten the Torx screws to 10 Nm (7 lb.ft).
 - Tighten the screws.
 - Connect the electrical connector.
2. Secure the tire deflation wiring harness into the clips.
3. Secure the roof opening panel drain tube into the clips.
4. Install the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Supplemental Restraint System - Restraints Control Module (RCM)

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the restraints control module (RCM) is to be replaced then T4 must be connected and the correct procedures adhered to, prior to battery disconnection.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

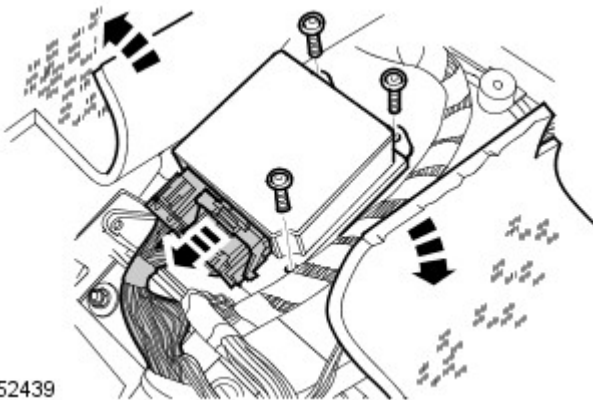
3. Remove the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).



CAUTION: Make sure the wiring harness is protected when cutting the carpet.

Remove the restraints control module (RCM).

- Cut the carpet for access.
- Disconnect the 2 electrical connectors.
- Remove the 3 Torx screws.



E52439

Installation

1. Install the RCM.
 - Tighten the Torx screws to 10 Nm (7 lb.ft).
 - Connect the electrical connectors.
 - Position the carpet.
2. Install the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).
3. Initiate a new RCM using T4.

Supplemental Restraint System - Occupant Classification Sensor

Removal and Installation

Removal

- NOTE: The occupant classification sensor is part of the passenger seat cushion. The sensor is only fitted to NAS models.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).

Installation

1. Install the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).
2. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Using T4, configure a new occupant classification sensor.

Body Repairs - General Information - Body Repairs

Description and Operation

General Information

Introduction

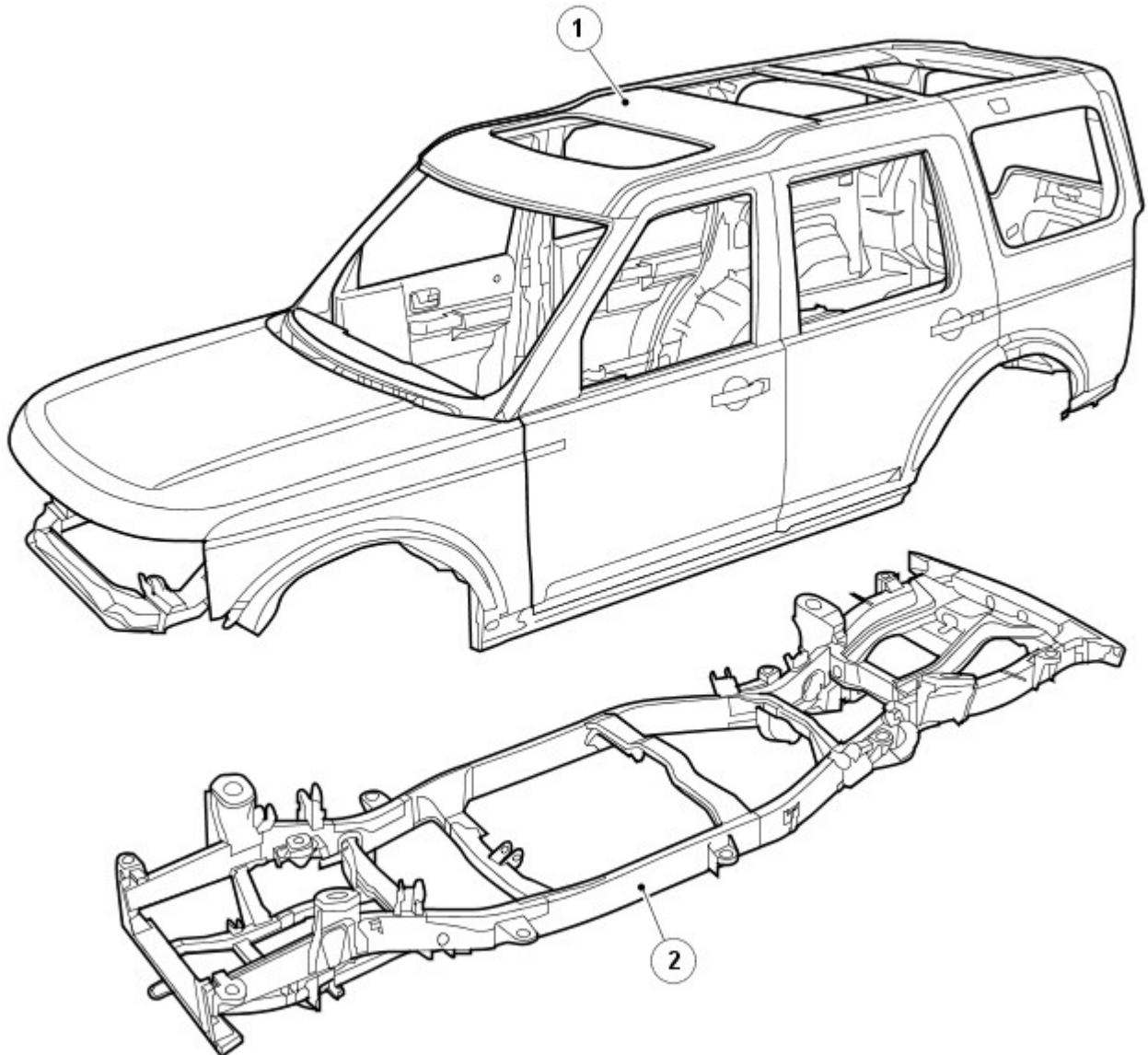
The body plays a significant role in the increasing trend of ever more rapidly changing model variants. The different customer groups are strongly influenced by the design and shape of the body. At the same time the stability of the body plays the most important part in ensuring passenger and driver safety. Lightweight construction, alternative materials, composite materials, plastics and appropriate joining processes are all design features that characterise modern Land Rover vehicle bodies.

In terms of manufacturing technology, modern safety cell bodies can be produced almost without any problems. Land Rover guarantee high quality standards by ensuring that mechanical strength properties are tried and tested in numerous computer simulations, crash tests, by testing materials and by employing sophisticated manufacturing technologies. In the event of repairs it is vital that the production quality standards are upheld. This requires a well-equipped workshop, and places particular emphasis on the qualifications of the workshop technicians. Up-to-date knowledge of current manufacturing technologies and continuous training on new repair methods and techniques are vital for high-quality body repairs. The model-specific repair manuals and the general repair techniques provide valuable support when undertaking body repairs.

Always follow the repair instructions published in this manual. Failure to observe this instruction can result in serious impairment of vehicle safety. All specified safety requirements must be met after the work has been carried out.

Vehicle design

Vehicle design



E55853

Item	Part Number	Description
1	-	Body
2	-	Integral body Frame

High Strength Steels

Land Rover vehicles are constructed from a number of different steels, partly to obtain an optimised body (collision, safety, rigidity, fuel economy, etc).

Steels are divided into several groups according to their tensile and yield strength, that is to say the force necessary to bring about plastic deformation of the material.

Yield Summary

Yield is the strength at which the metal changes from elastic to plastic in behaviour, the point of no return.

Tensile Summary

Tensile strength is the breaking strength of a material when subjected to a tensile (stretching) force, the point of no return.

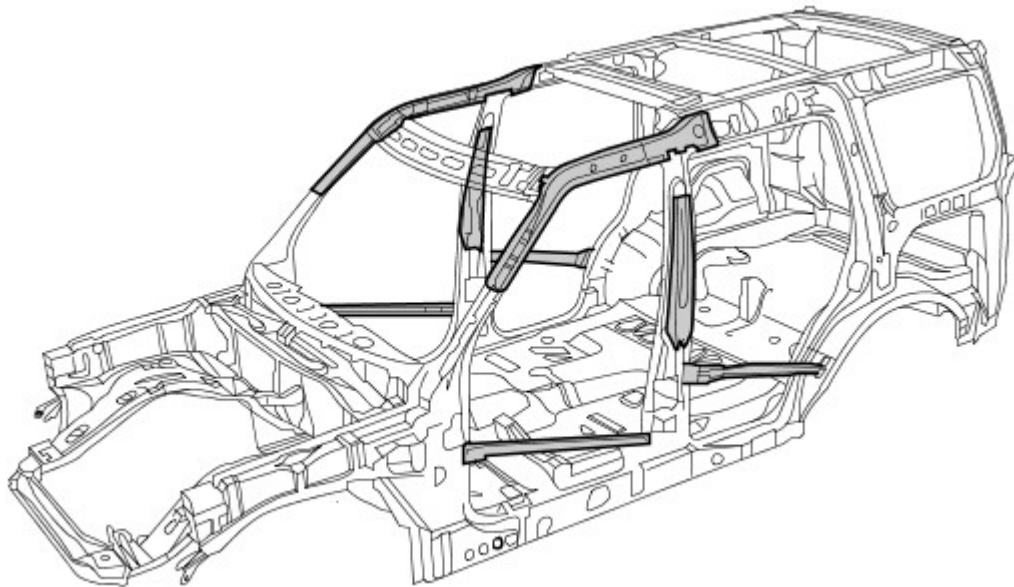
Abbreviation	Steel type	Yield Point
SS	Soft Steel	Maximum Yield point of 220 MPa
DP	Dual Phase Steel	Steel With a Yield Point up to 400 MPa
HS	High Strength Steel	Steel With a Yield Point 220 - 450 MPa
EHS	Extra High Strength Steel	Steel With a Yield Point 450 - 800 MPa
UHS	Ultra High Strength Steel	Steel With a Yield Point up to 1400 MPa

Ultra High Strength

The addition of ultra high strength steel in the A Pillar, B-Pillar and cantrail gives the body greater strength in a front or side impact.

No attempt should be made to straighten ultra high strength steel, due to its brittleness.

Ultra High Strength steel in body structure



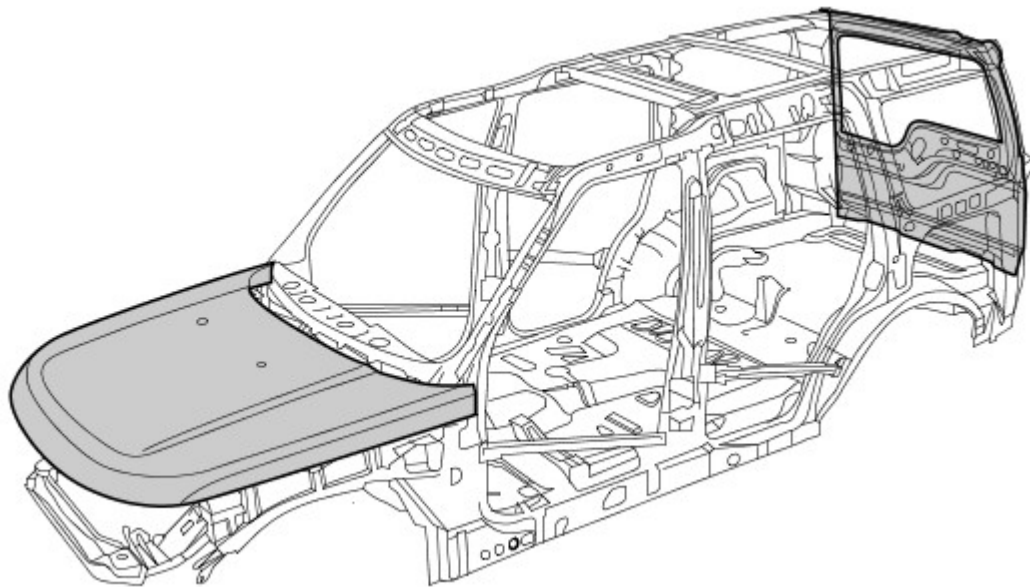
E55726

Aluminium

Aluminium 6000 series is used in the hood, tailgate and liftgate. It is made from magnesium/copper aluminium alloy and is heat treated during manufacturing/paint bake process resulting in a panel with increased strength and dent resistance.

When repairing aluminium you must use tools that have only been used on aluminium and never on steel panels, this is to prevent cross-contamination

Aluminium in body structure



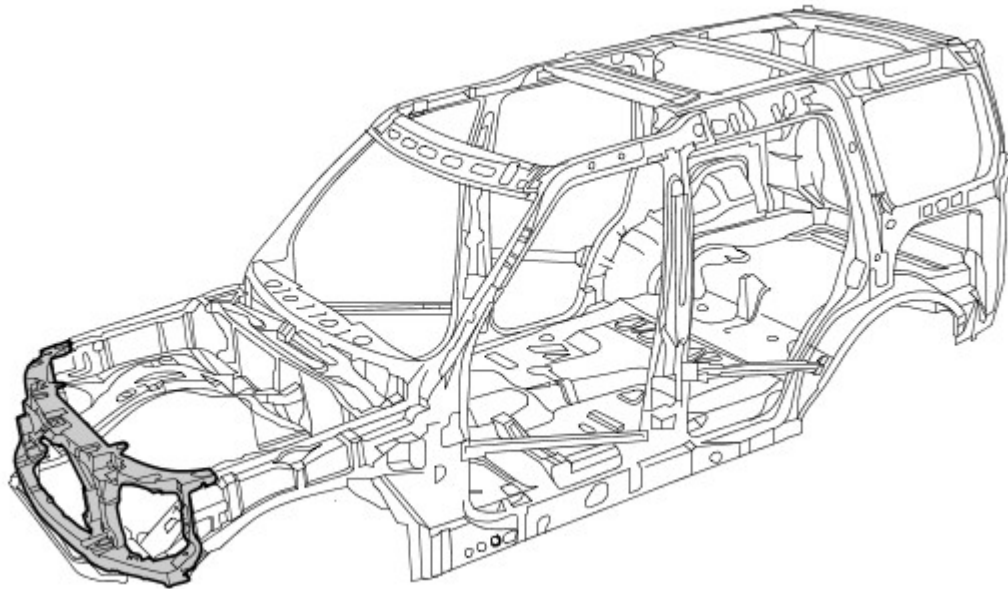
E55727

Magnesium

Magnesium AM60B is used to make the hood latch panel. It has good ductility and energy absorbing properties. It is also used on the instrument panel mounting beam.

No attempt should be made to weld or straighten the hood latch panel and it should be replaced in the event of an accident. If the corrosive coating is damaged it must be repaired using 'Land Rover Low Temperature Anti-Corrosion Coating', service part no VEP 501 840 PMA

Magnesium in body structure



E56195

Accident damage and diagnosis

General notes

- Exact diagnosis of the extent of damage enables proper repair planning.
- All body repairs must be carried out in accordance with the guidelines in this Body Repair Manual.
- The stability and strength properties of the body must be taken into account during body repairs. The body has exactly defined deformation patterns that must not be affected by any repair work.
- For instance, the crumple zones absorb the bulk of the impact energy. If any unprofessional repair techniques or methods are used in these areas then this can pose a fundamental threat to vehicle safety.

Hidden damage

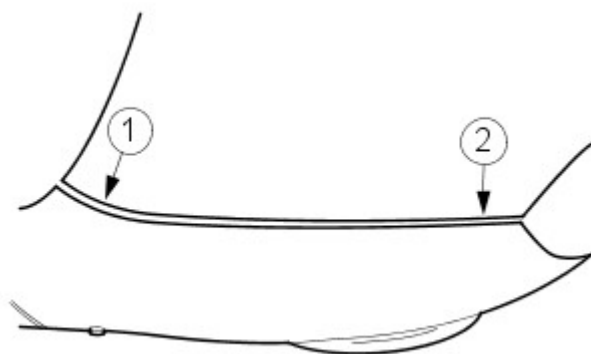
- As well as looking at external indicators like flaked off paint, it is vital to check for hidden body damage or deformation that is not visible from the outside. Large attached parts like bumpers and inner fenders often need to be removed to allow accurate assessment of damage to underlying body parts.

Gap dimensions

For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Gap dimensions offer another alternative for diagnosis by visual inspection. If any changes or misaligned edges are apparent, then this usually indicates that the dimensions of the affected part are incorrect.

Changes in gap dimension



DEE0003919

Item	Part Number	Description
1	-	Gap too wide
2	-	Gap too small

Planning a repair

The following decisions have to be made before the repairs are started:

- Does the vehicle need to be put on a straightening jig, or can it be straightened by other means?
- Does the body need to be measured?
- Do aggregates like engine or axles need to be removed?
- • NOTE: It is preferable to repair body parts rather than to renew them, as this keeps the complete body-shell intact.
- Which body parts need to be renewed?
- Which body parts can be repaired?

Obtaining spare parts

The availability of spare parts often determines how easily the body repairs can be carried out. The following procedure is recommended:

- Obtain all the data for the vehicle, including type, vehicle identification number, trim code, engine identification letters, initial registration etc.
- Establish all of the metal parts that need to be renewed.
- Establish all of the attached parts that need to be renewed, including small parts like rivets, clips etc.

Straightening repairs

Straightening repairs are often required to restore the body to its original shape after an accident. This can be done with:

- Alignment jigs
- Universal straightening and measuring jigs

The following points must be followed to ensure that the repairs are carried out professionally and that all the dimensions are correct after the repairs have been carried out.

- Structure:
 - The repair sequence depends on the individual repair plan (taking any necessary disassembly work into account).
 - Clean the attachment areas.
 - Anchor the vehicle free of stress on the relevant system.
 - Support the aggregates to take strain off the body.
 - Decide on at least three measuring/mounting points that are undamaged and as far apart as possible (for basic adjustment).
 - Check the dimensions of the measuring/mounting points.
- Straightening:
 -
 - **NOTE: Check dimensions and gaps continuously during straightening.**

A body is always straightened in the opposite direction to that of the impact. Always carry out straightening repairs with the complete body shell assembled (do not cut out any parts beforehand). Carry out the straightening work in several stages. This prevents the risk of over stretching or of welded joints tearing out. During the individual straightening steps, relieve tension by striking with an aluminium hammer while the part is subjected to a tensile load (in the area of pre-determined folding points, dents, welded joints etc.).



CAUTION: Ultra High Strength steel in the A-Pillar, B-Pillar and cantrail cannot be straightened.

Panel Beating

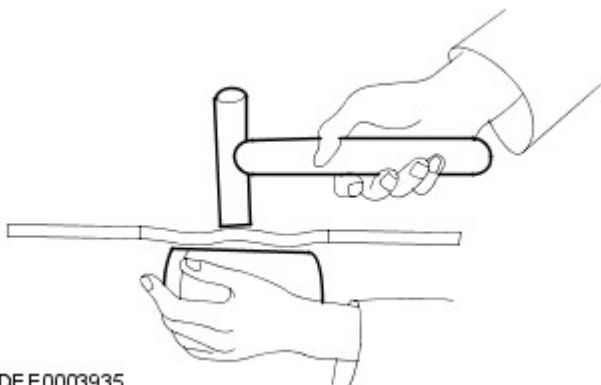
Fundamentals of panel beating

- Before carrying out any sectional replacements or complete replacements of body panels, always check carefully whether the damaged panel(s) can be rectified by panel beating.
- Panel beating is usually the easiest and most economical method of repairing a damaged panel.

Examples of applications of different panel beating techniques:

- Aluminium hammer and mallet
 - Advantage: Low risk of overstretching the panel.
 - Used for repairs of small dents on panels that are accessible from both sides.
 - These two panel beating tools are usually used for "finishing repairs".

Fine straightening with an aluminium hammer and a universal dolly



DEE0003935

- Sliding hammer
 - If the damaged panel is only accessible from the outside, use a sliding hammer to pull it back into shape. The discs or studs needed to mount the sliding hammer are welded onto the bare surface. Dents in the panel can be flattened out using controlled application of the sliding hammer.

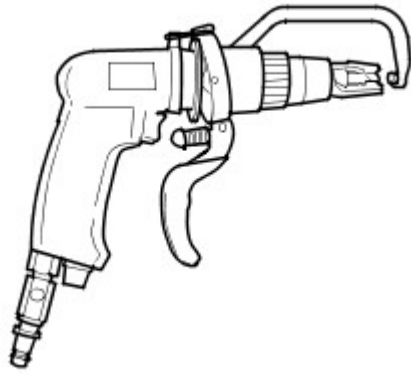
Cutting out body parts

Depending on how the parts are joined/connected, different tools are suitable for cutting/separating body parts.

- NOTE: All other parts like interior equipment, window glass etc. must be protected against flying sparks.
- NOTE: Ensure that the milling depth is set correctly to prevent the remaining flange from being weakened.

Spot-weld mill

Spot-weld mill

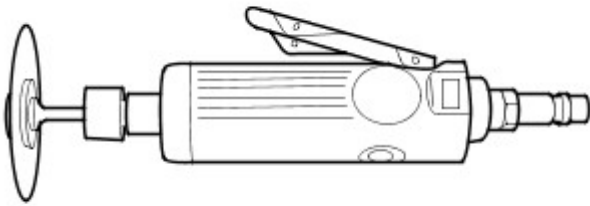


DEE0003924

- Rod sander
 -
 - NOTE: Wear protective clothing. Protect any vulnerable body or glass areas against flying sparks. Remove explosive materials from the vicinity.

Any spot welds that are inaccessible for the spot-weld mill (diameter > 8 mm) should be ground out using a rod sander. The same applies to MIG spot welds or seams.

Rod sander

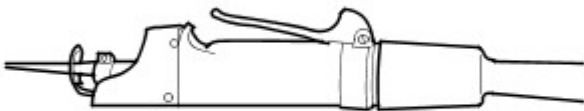


DEE0003925

- -
- NOTE: Underlying metal parts, wiring harnesses, hoses etc. must not be damaged - remove them beforehand if necessary.

Body saws are particularly versatile and are therefore very suitable for making severance cuts on body parts.

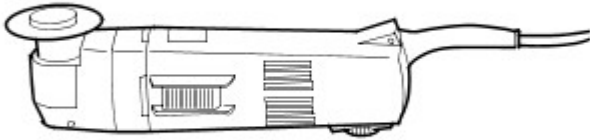
Short stroke saw



DEE0003926

- Reciprocating saw
 - In addition to the short stroke saw, the reciprocating saw can be used. With this, it is possible to make narrow and straight cuts to an exact depth.

Reciprocating saw



DEE0003927

Carrying out the repairs

- Complete replacement
 - In a complete replacement the entire damaged old part is removed at its original joins/connections, and a complete new part is then installed. The following illustration shows a replacement new back panel.

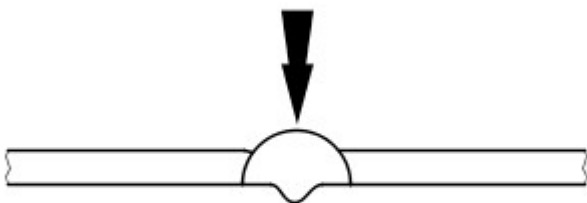
Replacement of a new back panel



E56124

- Sectional replacement
 - In many cases it makes technical and economical sense to carry out a sectional replacement. The two main considerations are firstly, maintaining the original overall body shell structure and secondly, keeping the repair costs to a minimum.
- The main method for sectional replacement:
 - Butt joints
 - New part and old part are joined with a continuous MIG weld seam.
 - Butt joints are most commonly used for sectional replacements on members and pillars, or on short severance cuts.

Butt joint



DEE0003929

• NOTE: The severance cut should always be kept as short as possible on sectional replacement. Only cut at the severance lines shown in the repair chapters.

Do not make any cuts near reinforcements or pre-determined folding lines.

- Prepare parts remaining on the vehicle / new parts.
 - Reshape the adjoining surface of any dented body parts that are to remain on the vehicle using a hammer and a counterhold (ensure that the old part matches the shape of the new part). Grind off left over spot welds or seams with a suitable tool.
 - Cut the new parts to shape.
 - If necessary punch or drill holes for mig plug welding.

-
- NOTE: Do not use a welding torch to remove paint residue (the heat could cause the metal to deform).

Prepare all joining flanges to a bright metal finish on both sides. Do not use an angle grinder for this purpose (this could weaken the metal and damage the zinc layer). Suitable tools: rotating wire brush, belt sander or plastic disc.

- Apply welding primer liberally to all weld flanges.
- The primer must be well stirred or shaken before use.

- NOTE: When using aerosols, take care not to contaminate adjacent parts with spray mist.

fitting the new part.

- It must be ensured that the new part fits exactly to the specified dimensions, to help this it is recommended to use such equipment as:
 - Alignment jig
 - Universal measuring system
 - Jig system
 - Ruler or tape measure
- Any attached body parts that require accurate alignment and fitting must be incorporated in this step; for instance bumpers, seals, headlamps, rear lamps and lock assembly components. If this is not done carefully it may result in water leaks, wind noises and substantial follow-on work.
- Ensure that edges line up with adjacent parts and check that gaps are consistent (compare left and right-hand sides). Make sure that the shape of the vehicle is retained.

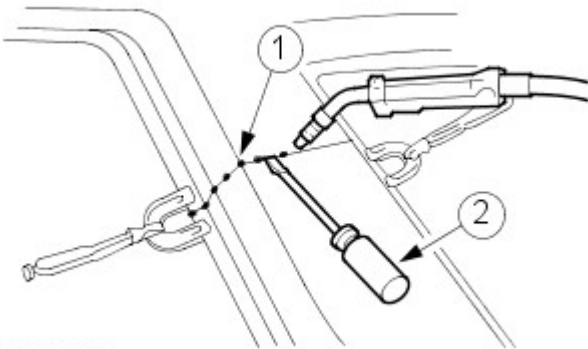
Secure the new part

- NOTE: The need for subsequent follow-on work can be significantly reduced if aligning and tack-welding are carried out with due care.

Depending on accessibility the following methods for securing are available:

- Grip pliers (set of)
- Screw clamp (set of)
- Self-tapping screws
- Tack welds
- Using a suitable tool ensure that the edges of sectional replacements of profiled parts line up. The edge is then tack welded to ensure that it lines up.

Aligning and tack weld

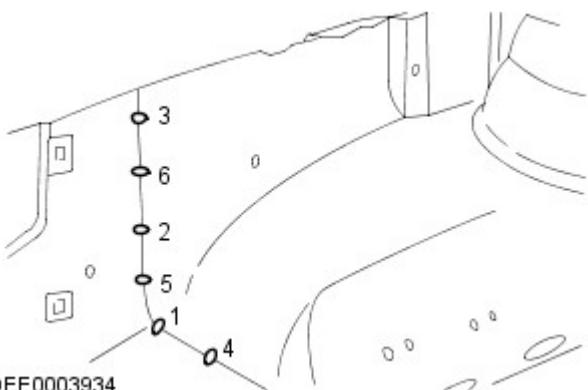


DEE 0003933

Item	Part Number	Description
1	-	Tack welds
2	-	Using a suitable tool to align

- Longer joints are usually tack welded to prevent the panel from warping. It is important to carry out the tack welds in the correct sequence (see diagram).
- Weld in the new part following the instructions in the repair manual.

Correct tack welding sequence



DEE0003934

Safety measures

- The electronic control modules (ECM) fitted to vehicles make it advisable to follow suitable precautions prior to carrying out welding repair operations. Harsh conditions of heat and vibration may be generated during these operations which could cause damage to the modules. In particular, it is essential to follow the appropriate precautions when disconnecting or removing the airbag RCM. For additional information, refer to: [Specifications](#) (501-20B Supplemental Restraint System, Specifications).
- Do not allow electronic modules or lines to come into contact with the ground connection or the welding electrode.
- Connect the ground connection of the electrical welder directly to the part that is to be welded. Ensure that there are no electrically insulating parts between the ground connection and the welding point.

Resistance spot welding

Where resistance spot welds have been used in production, they must be reproduced with new spot welds in replacement where possible. All such reproduction spot welds should be spaced 25 to 30mm apart.

Setting up the equipment and co-ordinating the welding parameters

- Equipment:
 - Follow the equipment manufacturer's instructions for the equipment settings.
 - Select the correct electrode arms (as short as possible).
 - Align the electrode arms and tips exactly.
 - Electrode tips should be convex (rough shaping with a file, fine shaping with a sanding block).
- Body:
 - Ensure that the flanges to be joined lie perfectly flat to one another.
 - Prepare a bare metal joint surface (inside and outside).
- Notes on technique/method:
 - Carry out a test weld on a sample piece of the material coated in welding paste.
 - If any metal parts are located between the electrode arms then there will be a loss of induction and therefore power (adjust current setting).
 - The power needs to be adjusted for high and ultra high-strength steel.
 - Repeated welding on old welding points often leads to poor quality welds.
 - Keep the electrode tips as near as possible to an angle of 90° to the contact surface.
 - The electrodes work best if their shape is convex. Clean the contact surface of the electrodes regularly.

Resistance spot welding panels where the total thickness is 3 mm or more

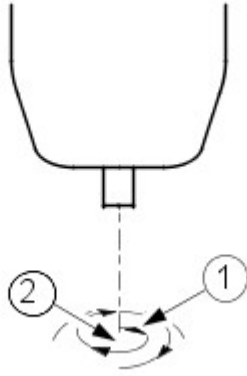
For all repairs to modern Land Rover vehicles, spot-welding equipment should be suitable for reliable welding of zinc-plated, high-strength and high-tensile steels in three or more layers, up to 5 mm total thickness. If these requirements are not fulfilled, plug welding must be used for safety reasons. The electrical specifications (current, resistance, heat) of the spot-welding equipment have different validity, depending upon the type of equipment. Therefore, it is essential that the equipment manufacturer's instructions are observed with regard to the actual welding performance.

MIG / MAG welding

Setting up the equipment and co-ordinating the welding parameters

- Any joints that are MIG/MAG welded in production must also be MIG/MAG welded during repairs. Also during repairs, some resistance spot welds need to be replaced by plug welds.
 - If access is difficult, or if a suitably powerful spot welder (see above) for total panel thicknesses of 3 mm or more is not available, resistance spot welding must be partially replaced by plug welding during repairs. In this case, the increased time needed and the correspondingly more demanding corrosion protection requirements, must be taken into account.
 - Welding repairs can only be carried out properly if the equipment is set up correctly and all the welding parameters are co-ordinated.
 - Equipment:
 - Set up the equipment as directed by the manufacturer.
 - The hoses must be untwisted.
 - The core must be free of abraded rod particles.
 - The gas and current nozzles must be free of slag and scale residue.
 - Pay attention to the quality of the welding wire and the throughput of gas.
 - Body:
 - Ensure that the joint surface is correct.
 - Prepare a bare metal joint surface.
 - Maintain the correct gaps (formation of roots).
 - Notes on technique/method:
 -
 - NOTE: The increased application of heat during MIG welding destroys the welding primer/zinc layer over a much larger area than during resistance spot welding, as a result of which much more care needs to be taken when applying anti-corrosion protection afterwards.
 - NOTE: A test weld should always be carried out to ensure that the welded joint is not just a surface connection.
- Attach the ground cable right next to the welding point (ensure that good contact is made).
- During plug welding start welding on the lower panel to ensure adequate penetration.

Plug welding



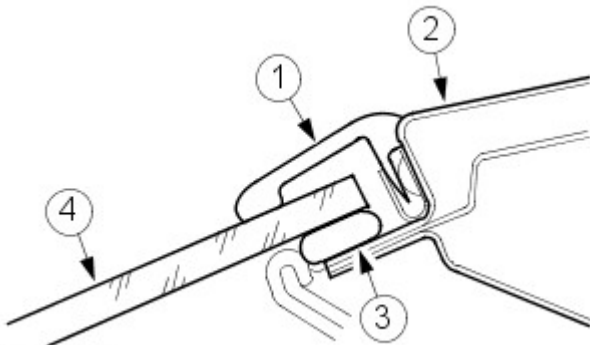
DEE0003936

Item	Part Number	Description
1	-	Welding direction: circular pattern working from the inside outwards
2	-	Welding starting point: centre of hole on lower panel

Bonded glazing

- - The windscreen, side and rear windows are bonded directly onto the window frames on the body and liftgate.
- The windows are bonded primarily for reasons of adhesive strength. Bonded glazing provides additional torsional stiffness to the body.

Adhesive bonding of bonded windows



DEE0003938

Item	Part Number	Description
1	-	Rubber strip
2	-	Window frame
3	-	Adhesive
4	-	Window glass

Removing and installing bonded windows

Safety measures

- The following safety measures must always be followed to prevent personal injury:
 - Wear protective gloves.
 - Wear protective goggles.

Preparations

- Before cutting out a bonded window, undo and remove any attached parts in the cutting area that are at risk, e.g. trim panels and decorative strips, as well as all electrical connections.
- Mask any painted areas that are adjacent to the window.
- Cut off any surplus adhesive, as this makes it easier to cut out the window.
- Secure vertical windows against dropping out.

Cutting out the window

- Cut into the adhesive bead at easily accessible points using the cutting tool.
- Carefully guide the cutting tool around the window, cutting through the adhesive bead.
- Avoid touching the window frame and the body flange.
- Use cup suction tools to lift the cut-out window out of the window aperture.

General preparations for bonding

- Follow the manufacturer's instructions.
- Cut back the remaining adhesive bead on the metal flange to a residual height of about 1mm. Do not touch or clean the cut surface afterwards.
- Carefully rectify any paint damage (apply primer and top coat).
- Renew the window stops as necessary.

Bonding the window glass

- Apply an even bead of adhesive to the window or to the body flange.
- Insert the window glass into the window aperture and centre it (2 technicians required).
- Check the gaps.
- • NOTE: Open the windows and doors while the window is left to dry and do not move the vehicle (slamming doors creates excess pressure which could cause the window to become loose).

Use adhesive tape to prevent the window from falling out or slipping.

Finishing operations

- Reconnect all electrical connections and check that the components operate correctly.
- Install the attached parts and check that the fit is accurate and secure.
 - Carry out a visual inspection to ensure that the gaps and joints are even.
- Thoroughly clean the window glass.

Protective equipment and safety at work

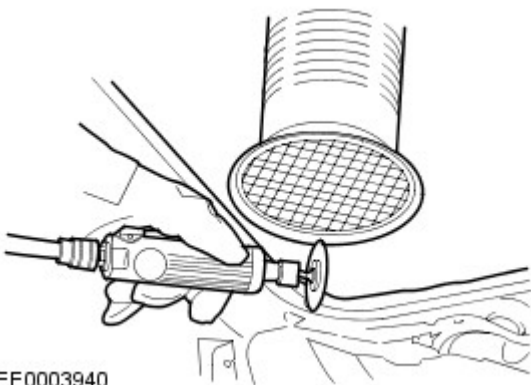
- Various safety measures and legal requirements must be met when carrying out repairs. All regulations relating to health and safety at work must be followed.

Welding safety precautions

- The following safety precautions must be observed to prevent the risk of personal injury:
 - Safety hood (face protection)
 - Welding shield
 - Safety gloves
 - Safety shoes
 - Extraction unit for welding smoke
- Welding should always be carried out in well ventilated areas. A fire extinguisher must also always be within reach.

General body repair safety measures

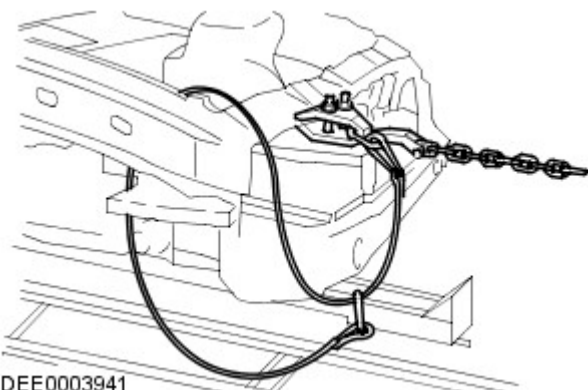
Extraction unit



DEE0003940

- Sealing compound, underbody protection etc. must **not** be burned off with a naked flame. This would produce toxic gases. If for instance PVC is burned, then gases containing hydrochloric acid are produced. For this reason a suitable extraction unit should always be used when performing grinding, welding or soldering work.
- Always ensure good ventilation when working with materials that contain solvents, wear breathing equipment and use an extraction unit.
- Ear defenders should always be worn when cutting, grinding or straightening metal, as the noise levels can reach or even exceed 85 - 90 dB(A).
- When removing components from a vehicle mounted on a lifting ramp, watch out for a shift in its centre-of-gravity. When first placing the vehicle on the ramp, take into account that it may need to be secured against tipping over.
- Chains and chain clamps must be secured with safety ropes during straightening work.

Safety rope



DEE0003941

Paint Preparation

Paint repairs

Before carrying out paintwork repairs, clean the vehicle thoroughly using either a steam cleaner or high pressure washer.

Wash locally repaired areas using a mild water-mixable detergent and wipe them clean with solvent, immediately before paint application.

Ensure damaged paintwork which has led to exposed metal is abraded until the metal is clean, extending beyond the area of the original damage. Treat the bare metal with an etch phosphate to remove all traces of rust and to provide a key for new paint coats. Re-treat the affected area using either a separate acid-etch primer and two pack surfacer or an integrated etch primer/filler, and follow with a two pack paint system. Treat those surfaces not receiving paint using an approved cavity wax, following paint operations

- CAUTIONS:



When preparing bumpers for painting, ensure the PDC sensors are not damaged. Only remove the clear coat if possible. When painting the PDC sensors, do not apply excessive layers of paint as this can hinder the performance of the sensors.



When heat curing paint repairs, the temperature must not exceed 65°C (149°F). Temperature above this figure will cause the reflective elements within the headlamps and tail lamps to distort and may damage other components.

Body Repairs - Corrosion Protection - Corrosion Protection

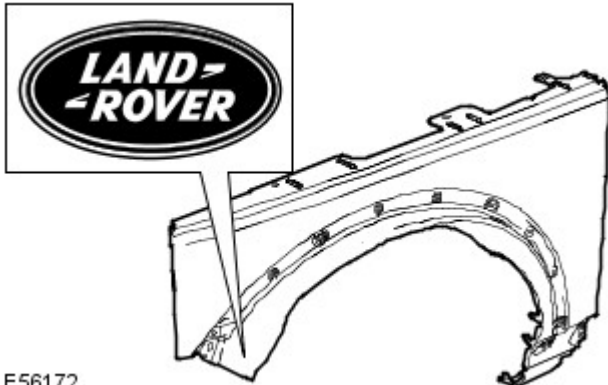
Description and Operation

General

The corrosion protection provided in production must be carefully maintained and/or reproduced during and after body repair work. It is only then that the long-term warranty against penetrative rust damage can be assured.

Only Land Rover original bodywork components and Land Rover approved repair materials (sealer, paint etc.), are to be used for bodywork repairs.

Land Rover original parts



All Land Rover bodywork components have a cathodic base coating. Individual bodywork components are zinc plated on one or both sides (in different areas depending on vehicle model).

Together with elastic paint coating, this guarantees an optimum, highly resistant protection against corrosion caused by the impact of small objects such as gravel.

• **NOTE:** If possible, the individual protective layers (zinc, cathodic base coat) on Land Rover bodywork components must not be damaged or destroyed by sanding or other mechanical operations.

If hairline cracks at "bodywork connection areas" appear after reshaping work (e.g. at door hinges), it must be ensured that the corrosion protection provided in production is recreated. The complete paint covering must be re-created if necessary. The same applies to reshaping work on heavily profiled bodywork components (e.g. floor pan). Renew or touch-up the paint coating, sealing beads and underbody protection as necessary.

After repair, any interior surfaces which are no longer visible or accessible must be primed before cavity wax is applied. To be certain of an even coating on inner surfaces, careful application of spray (twice, with drying time in-between) must be carried out throughout the whole cavity.

If bodywork panels are strongly heated during repair work, this will invariably result in damage to or even destruction of the applied corrosion protection material. The effectiveness of the cavity protection material is reduced if heating occurs. Reworking of the affected areas is therefore vital.

Welded areas should be made good before corrosion protection is applied.

The corrosion protection measures to be taken when bodywork components are renewed are described on the following pages.

Corrosion protection of new components

All new components must be inspected for transport or storage damage such as scratches or dents. The following operations may be necessary, depending on the extent of damage:

Undamaged new component

- Do not grind the cathodic dip primer.
- Thoroughly clean with silicone remover and rob dry.

Slightly damaged new component

- Sand out scratches
- Finely sand the surrounding surface.
- Thoroughly clean with silicone remover and rub dry.
- Apply corrosion protection primer to bare areas.

Damaged new components (bumps and dents)

- Beat out the dented area sand down to bare metal.
- Apply polyester filler (only onto bare metal)
- Apply filler.
- Lightly sand the whole components.
- Thoroughly clean with silicone remover and rob dry.
- Apply corrosion protection primer to bare areas.

The clinched flanges on the hood, doors, tailgate and liftgate must be sealed with clinched flange sealer.

Weld Components

Use a rotating tress wire brush to remove the dip coat on the inside and outside of the area to be welded, taking care not to damage the zinc coating.

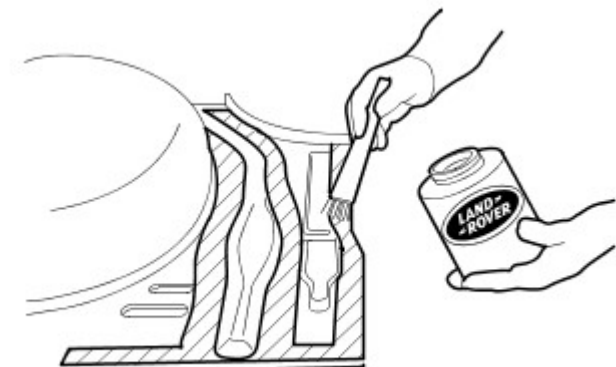
- NOTE: The area to be ground should be kept as small as possible, the corrosion protection applied in production (cathodic primer) should be retained as much as is possible.
- NOTE: The welding primer must be stirred well or shaken before application.

Clean the repair area thoroughly (silicone remover).

Apply welding primer evenly to all weld flanges (old and new components).

- NOTE: The welding primer must be allowed to dry before welding is carried out.

Apply welding primer



E56116

All weld beads must be ground down after all welding is completed, taking care not to weaken the material.

Any unevenness at the joint must be made good.

If necessary, spot weld missing T-pins for trim strip clamps into position. The vehicle must be completely cleaned of sanding dust and metal swarf because of the danger of corrosion.

Clean and prime all internal areas and those to be sealed.

- NOTE: The primer must be dry before sealing mastic or underbody protection is applied. Do not use thinners when applying sealing mastic (the mastic would not dry).

Partial renewal

The procedure to follow when partially renewing components is the same as described in the section "Welded components".

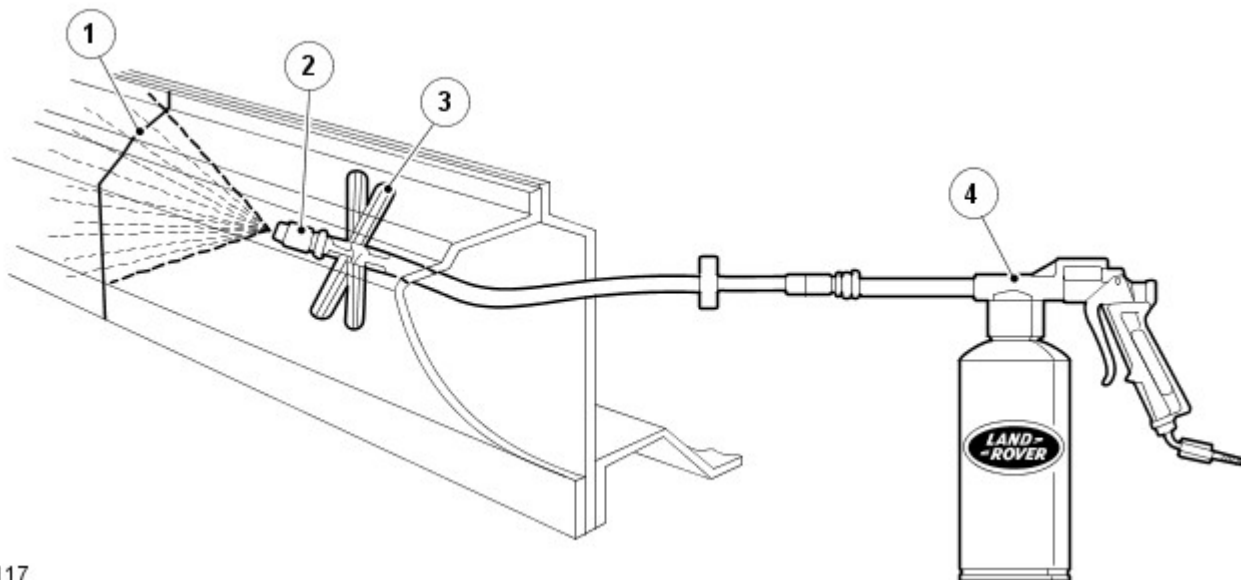
The main difference when components are partially, rather than completely renewed, concerns the preparation of butt or lap joints.

- When bodywork components are cut through, attention must be paid to the adequate removal of the paint and zinc coatings on inner areas. This specially applies to areas which are difficult to access internally.
- It is important for the weld quality that the inner area is bare metal. Zinc and paint residues in the weld area burn and cause serious hole formation during welding.
- If the zinc layer and the paint coating are not removed, the zinc and paint will burn during welding. The soot produced prevents satisfactory cavity protection.

Procedure

- The paint layer must be removed for a width of 30mm from the line of the weld using a rotating tress wire brush.
 - This operation must be carried out on both the new and the old parts of the bodywork.
 - Depending on the bodywork component, a 10mm width of the underlying zinc layer must also be removed along the weld line.
- NOTE: A flat scraper or a wire brush can be used instead of the rotating brush if the cavity is small. Do not use an angle grinder, which would weaken the structure.

Application of cavity wax protection on a door rocker panel after partial repair



E56117

Item	Part Number	Description
1	-	Weld bead
2	-	Spray head
3	-	Distance maintainer
4	-	Spray gun

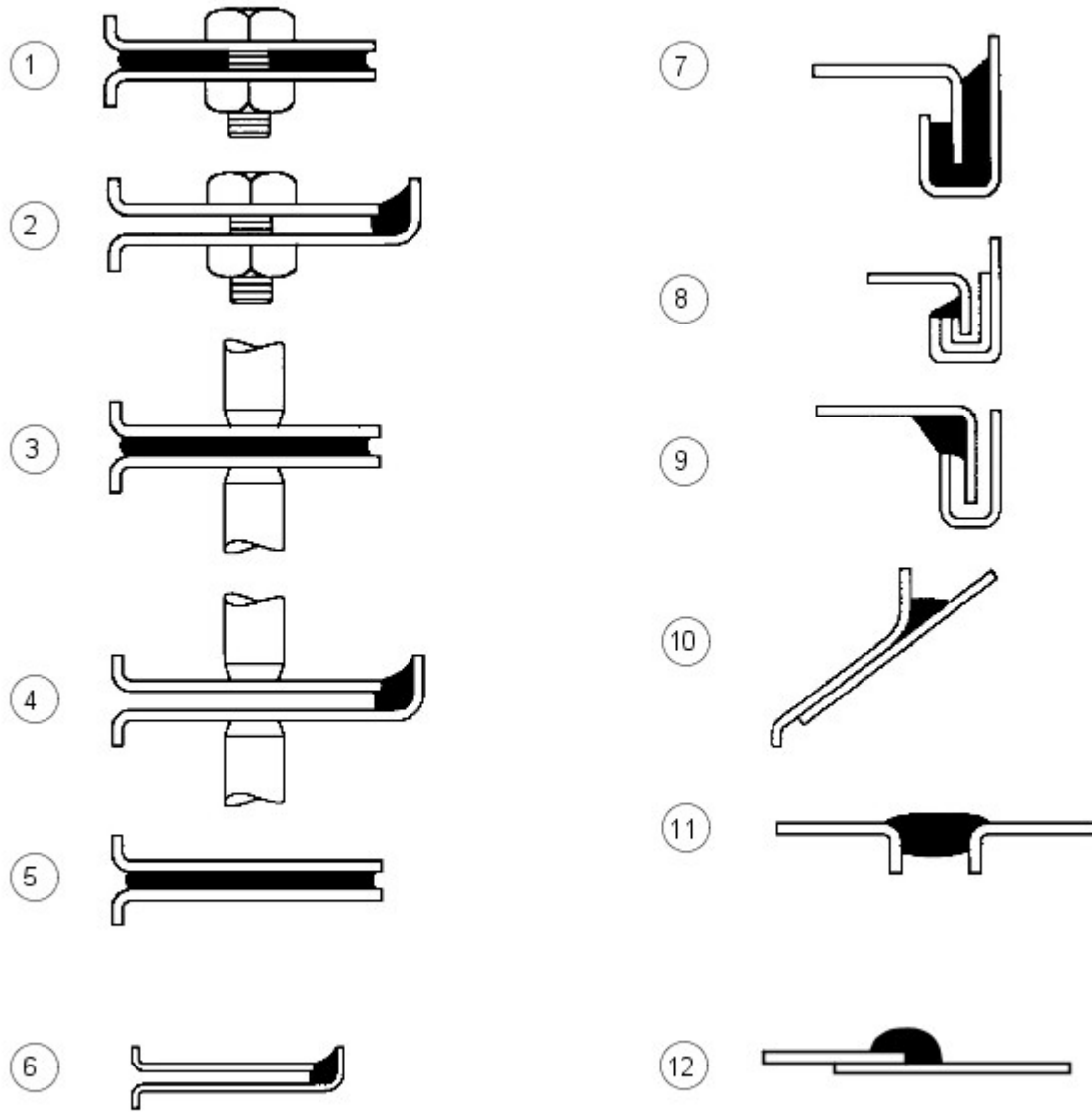
Classification of the different corrosion protection measures for dent removal

Corrosion protection method	Exterior surfaces	Accessible inner surfaces	Inaccessible inner surfaces
Painting	X	X	
Cavity protection			X

Classification of different corrosion protection measures for installation of new components

Corrosion protection method	Weld flanges before welding in place (contact surfaces)	All bare sanded areas	Weld flange area accessible	Weld flange area not accessible
Welding primer	X			
Painting		X	X	
Clinched flange protection			X	
Cavity protection				X

Body sealing materials



E56018

Item	Part Number	Description
1	-	Between Panels - Bolted
2	-	Panel Edge Bolted
3	-	Between Panels - spot welded
4	-	Panel edges - spot welded
5	-	Between panels - bonded
6	-	Panel edges - bonded
7	-	Clinch joints - type A
8	-	Clinch joints - type B
9	-	Clinch joints - type C
10	-	Gaps between panels - type A
11	-	Gaps between panels - type B
12	-	Lap joint

Description - Usage	Supplier	Part Number
Cavity - Wax	-	-
Inner Cavity Wax (Amber)	3M	0890/11/21
Inner Cavity Wax (Transparent)	3M	08909/19/29
Cavity Wax	Croda	PW57
Engine Bay Waxes/Lacquers		
Astrolan Engine Bay Wax and Cosmetic Wax	Astors	DA3243/1
Engine Bay and Cosmetic Wax/Lacquer	Croda	PW197
Engine Bay Cosmetic Lacquer	Dinol	4010
Miscellaneous Materials	-	-
Aerosol Auto Adhesive (Trim) - impact Adhesive for trim Parts	3M	08080

Description - Usage	Supplier	Part Number
Flexible Parts Repair Material - rubber modified polypropylene parts	3M	05900
Acoustic Foam (sika baffle 278) - expanding foam block repair	Sika	LR Part No AZL 500021. Ford Part No 6H22-11840-AA
Flexible Foam (anti - flutter) - between panels	Duramix	4320
Water Shedder Repair (Aerosol)	Teroson	-
Low Temperature Anti-Corrosion Coating (Magnesium)	Land Rover	VEP 501 840 PMA
Seam Sealers		
Body Caulking - type (b) gaps between panels	3M	08568
Drip Chek Clear - bolted, spot welded and bonded panel edges; type (a) and (b) gaps between panels; type ©) clinch joints	3M	08401
Drip Chek Heavy - type (b) gaps between panels; type ©) clinch joints	3M	08531
Polyurethane Seam Sealer - bolted, spot welded and bonded panel edges; type (a) and (b) gaps between panels; type (b) clinch joints	3M	08684/89/94
Polyurethane Sealer (Sachet) - bolted panel edges; type (b) clinch joints	3M	08703/83/88
Sprayable Sealer - lap joints	3M	08800/23
Super Seam Sealer - lap joints; type (b) clinch joints	3M	08537
Weld Thru' Sealer - between spot welded panels	3M	08626
Betafill Clinch and Brushable Sealer - type (b) clinch joints	Gurit-Essex	10211/15/20
Clinch, Joint and Underbody Coating - lap joint	Gurit-Essex	10101/10707
Leak Chek Clear - between bolted panels; spot welded and bonded panel edges; type ©) clinch joints; type (a) gaps between panels	Kent Industries	10075
Putty - type (b) gaps between panels	Kent Industries	-
Polyurethane Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (a) and (b) gaps between panels	PPG	6500
Polyurethane Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (b) gaps between panels	Teroson	92
Terolan Light Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (a) and (b) gaps between panels; between bonded panels; type ©) clinch joints	Teroson	-
Terolan Special Brushable Seam Sealer - lap joints	Teroson	-
Terostat Sprayable Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (b) gaps between panels	Teroson	9320
Terostat 1K PU Seam Sealer (SE 20) - type (a) and (b) gaps between panels; spot welded and bonded panel edges	Teroson	-
Sealing Compound - bolted, spot welded and bonded panel edges; between bonded panels; type (b) gaps between panels	Wurths	8901001/-/6
Structural Adhesives		
Automotive Structural Adhesive - between bonded panels; type (a) clinch joints	3M	08115
Two Part structural Epoxy - between bonded and spot welded panels; type (a) clinch joints	Ciba-Geigy	XB5 106/7
Underbody Sealers		
Body-Schutz	3M	08861
Spray-Schutz	3M	08877
Crodapol Brushable Underbody sealer	Croda	PV75
Terotex Underseal (CP02)	Teroson	9320
Underbody Waxes		
Stone Chip Coating (smooth)	3M	08158/9
Underbody Wax	Croda	PW61
Underbody Wax	Dinol	Tectacote 205
Weld - through Primers		
Weld Thru' Coating	3M	05913
Zinc Spray	3M	09113
Zinc Rich Primer	ICI	p-565 634

Material Equipment/Suppliers

3M

- Automotive Trade Group
- 3M UK Plc
- 3M House
- PO Box 1
- Market Place
- Bracknell
- Berks.
- RG12 1JU
- Telephone (01344) 858611

Cooper Pegler

- Burgess Hill
- Sussex
- RH 15 9LA
- Telephone (014446) 42526

SATA Spray Equipment

- Minden Industrial equipment
- 16 Greyfriars Road
- Moreton Hall

- Bury St Edmunds
- Suffolk
- IP32 7DX
- Telephone (01284) 760791

Teroson

- Watchmead
- Welwyn Garden City
- Hertfordshire
- AL7 1JB
- Telephone 01707 358800

Underbody sealer

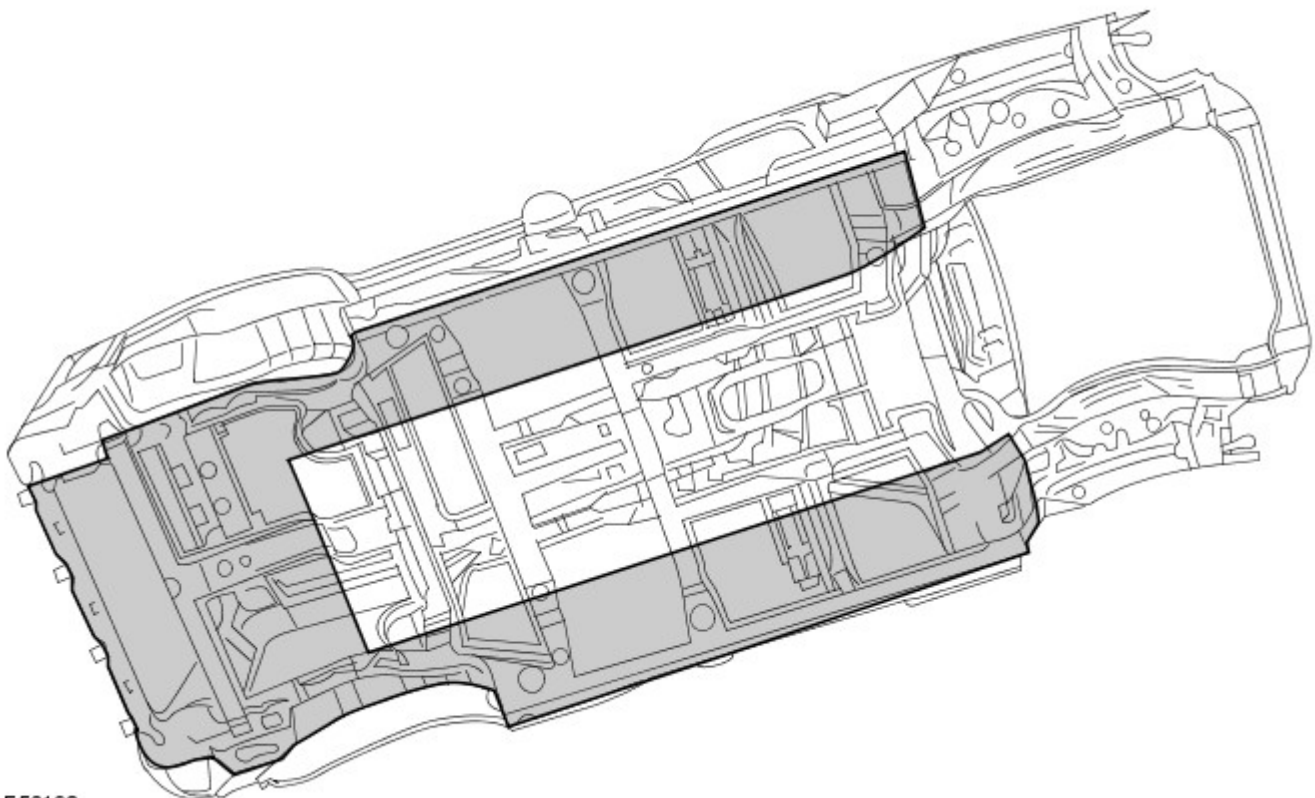
Under floor areas and rocker outer panels are treated with a plastisol PVC underbody sealer. This material is not suitable for re-treatment. When repairing areas of underbody sealer, strip the factory-applied underbody sealer back to a suitable break point. Ensure that a clean metal surface is exposed and that the edge of the existing adheres soundly to the panel.

Apply new underbody sealer between primer and surface paint operations. Apply seam sealer as necessary before application of underbody sealer. Ensure that blanking plugs and grommets in the floor pan (except those used for wax injection) are fitted before underbody sealer application. Refit any heat-fusible plugs which have been disturbed in repair with the aid of a hot air blower, or replace with rubber grommets



CAUTION: Ensure that suspension units, wheels, tires, power unit, drive shafts, exhaust and brakes (including all mounting points) are shielded prior to application of fresh underbody sealer.

Area of underbody sealer application



E56193

Precautions during body repairs and handling

Take care when handling the vehicle in the workshop. Underbody sealers, seam sealers, underbody wax and body panels may be damaged if the vehicle is carelessly lifted.

Proprietary anti-corrosion treatments

The application of proprietary anti corrosion treatments in addition to the factory-applied treatment could invalidate the corrosion warranty and should be discouraged. This does not apply to approved, compatible, preservative waxes which may be applied on top of existing coatings.

Fitting approved accessories

When fitting accessories ensure that the vehicle corrosion protection is not affected, either by breaking the protective coating or by introducing a moisture trap.

Do not screw self-tapping screws directly into body panels. Fit suitable plastic inserts to the panel beforehand. Always

ensure that the edges of holes drilled into panels, chassis members and other body parts are protected with a suitable zinc rich or acid etch primer, and follow with a protective wax coating brushed onto the surrounding area.

Do not attach painted metal surfaces of any accessory directly to the vehicle's bodywork unless suitably protected. Where metal surfaces are bolted together always interpose a suitable interface material such as weldable zinc rich primer, extruded strip, or zinc tape.

Steam Cleaning

Due to the high pressure/temperature generated by steam cleaning equipment, there is a risk that certain adhesives and corrosion prevention material may become softened or liquified.

Take care not to allow the steam jet to dwell on one area, and keep the nozzle at least 300mm from the panel surface.



CAUTION: Do not remove wax or lacquer from underbody areas during repairs.

Inspection during maintenance servicing

It is a requirement of the corrosion warranty that the vehicle is checked for corrosion by an authorised Land Rover Authorised Repairers at least once a year, to ensure that the factory-applied protection remains effective.

Rectify any bodywork damage or evidence of corrosion found during inspection as soon as is practicable, both to minimise the extent of the damage and to ensure the long term effectiveness of the factory-applied corrosion prevention treatment.

Underbody protection repairs

Whenever body repairs have been carried out, ensure that full sealing and corrosion protection treatments are reinstated. This applies both to the damaged areas and also to areas where protection has been indirectly impaired, as a result either of accident damage or repair operations.

Remove corrosion protection from the damaged areas before straightening or panel beating. This applies in particular to panels coated with wax, PVC underbody sealer, sound deadening pads etc.



CAUTION: Do not use oxy-acetylene to remove corrosion prevention material. Large volumes of fumes and gases are liberated by these materials when they burn.

The most common method of removal is by means of a hot air blower with an integral scraper. High temperatures can be generated with this equipment which may cause fumes. Take care during its use.

Structural Adhesive

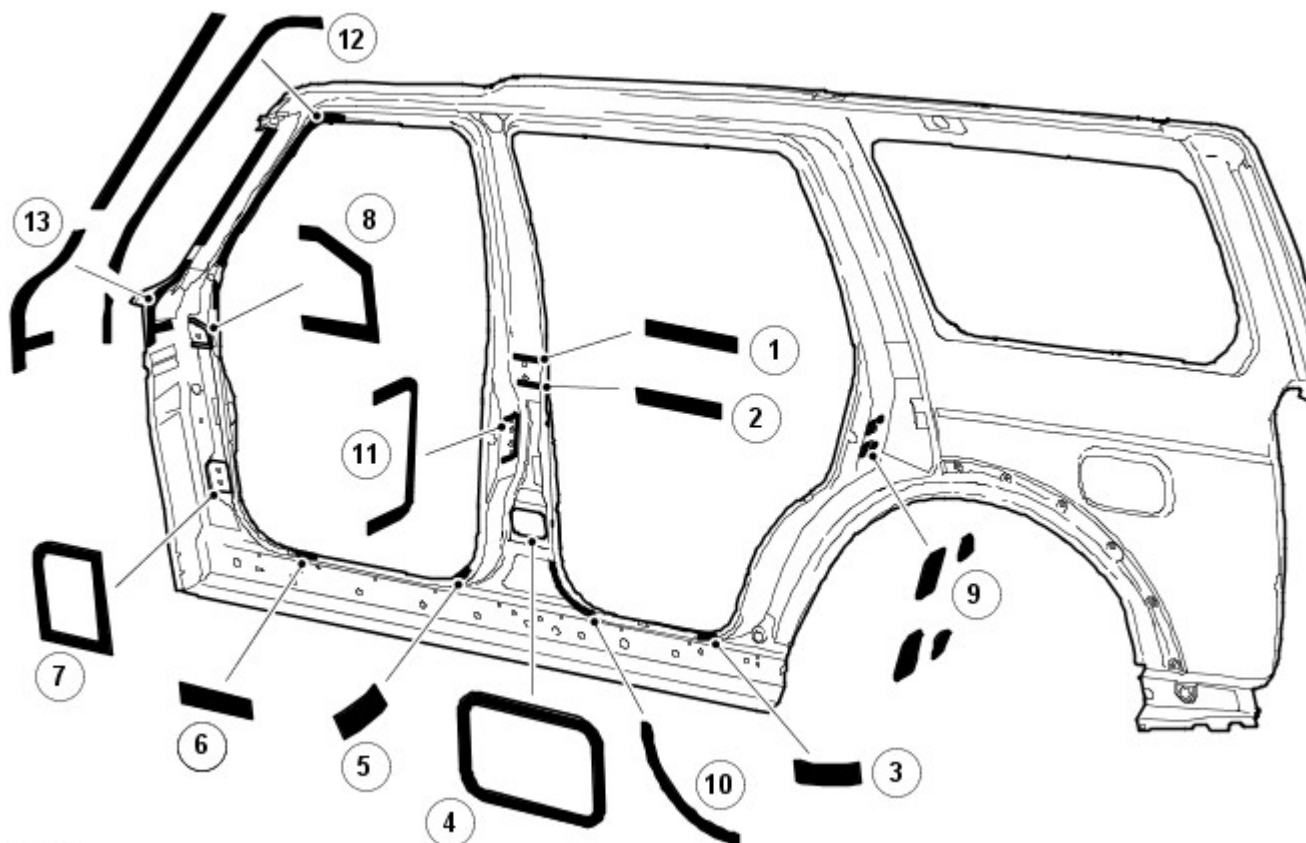
Metal to metal adhesive is applied to critical joint areas during factory assembly. The material used is a high temperature, heat cured, nitrile phenolic which serves to bond two metal surfaces and also to seal the joint against ingress of dust, moisture and fumes. This material is not suitable for service use and, during repair, should be substituted by an approved structural adhesive.



CAUTION: When separating a joint with metal to metal adhesive, it is important to avoid distortion. Heat gradually until the bond weakens sufficiently to permit panel separation.

- **NOTE:** When spot welding through metal to metal adhesive, take particular care to adjust the equipment setting to ensure a suitable weld.

Areas of structural adhesive



E56119

Item	Application	Function
1	B-pillar upper hinge RH/LH	Structural
2	B-pillar upper hinge RH/LH	Structural
3	Rear rocker panel RH/LH	Structural
4	B-pillar lower hinge RH/LH	Structural
5	Front rocker panel RH/LH	Structural
6	Front rocker panel RH/LH	Structural
7	A-pillar lower hinge RH/LH	Structural
8	A-pillar upper hinge RH/LH	Structural
9	C-pillar striker reinforcement	Structural
10	B pillar rear door aperture	Structural
11	B-pillar latch face	Structural
12	A-pillar to front door aperture	Structural
13	A-pillar to W/shield aperture	Structural

Joints symmetrically opposite to those shown are also treated. Apply 3mm diameter beads to all joints shown. Leave rocker drain points free of adhesive.

Expanding Foam Acoustic Seals

Expanding foam acoustic seals are used in various closed-sections of the body to improve vehicle refinement. The seals are installed during the vehicle body manufacture and expand during the paint process up to ten times original size, thus locking them into position. They are located such that they prevent noise accentuation along a section and reflect air borne noise away from the cabin.

The seals have split functionality depending on location. The seals located at the base of the body pillars have a primary function of preventing water ingress when wading. Their secondary function is to prevent noise and dust ingress.

The seal around the fuel filler has a primary function of preventing both fuel and water ingress. With a secondary function of preventing noise and dust ingress.

The remaining seals primary function is to prevent noise accentuation along a section and reflect air borne noise away from the cabin.

Another advantage of the seals is that they marginally increase the overall stiffness of the body and its structural performance in case of a crash.

The seals are manufactured from an expandible polymer, 'Sika Baffle 250.'

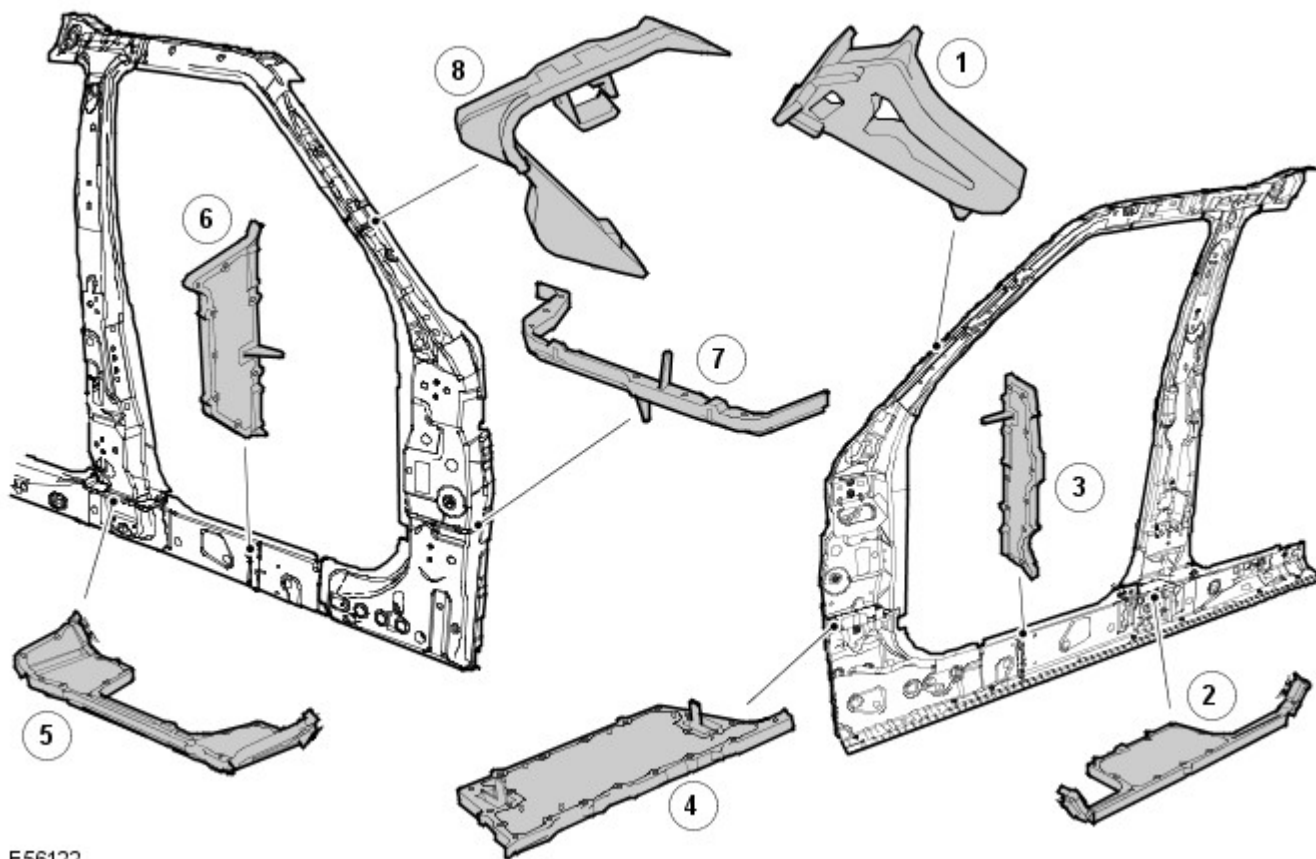
Replacing Foam Acoustic Seals

As paint oven temperatures used in a repair workshop are significantly lower than those that are used during manufacture of the vehicle, a different process is required to replace the seals.

After a repair that involves replacement of a section containing expanding foam acoustic seals, the new expanding foam acoustic seal is installed to the new section and injected with an approved acoustic foam. The acoustic foam should be injected after paint refinishing, where possible. When injecting the foam, ensure the foam fills a complete cross section of

the cavity and around the expanding foam acoustic seal.

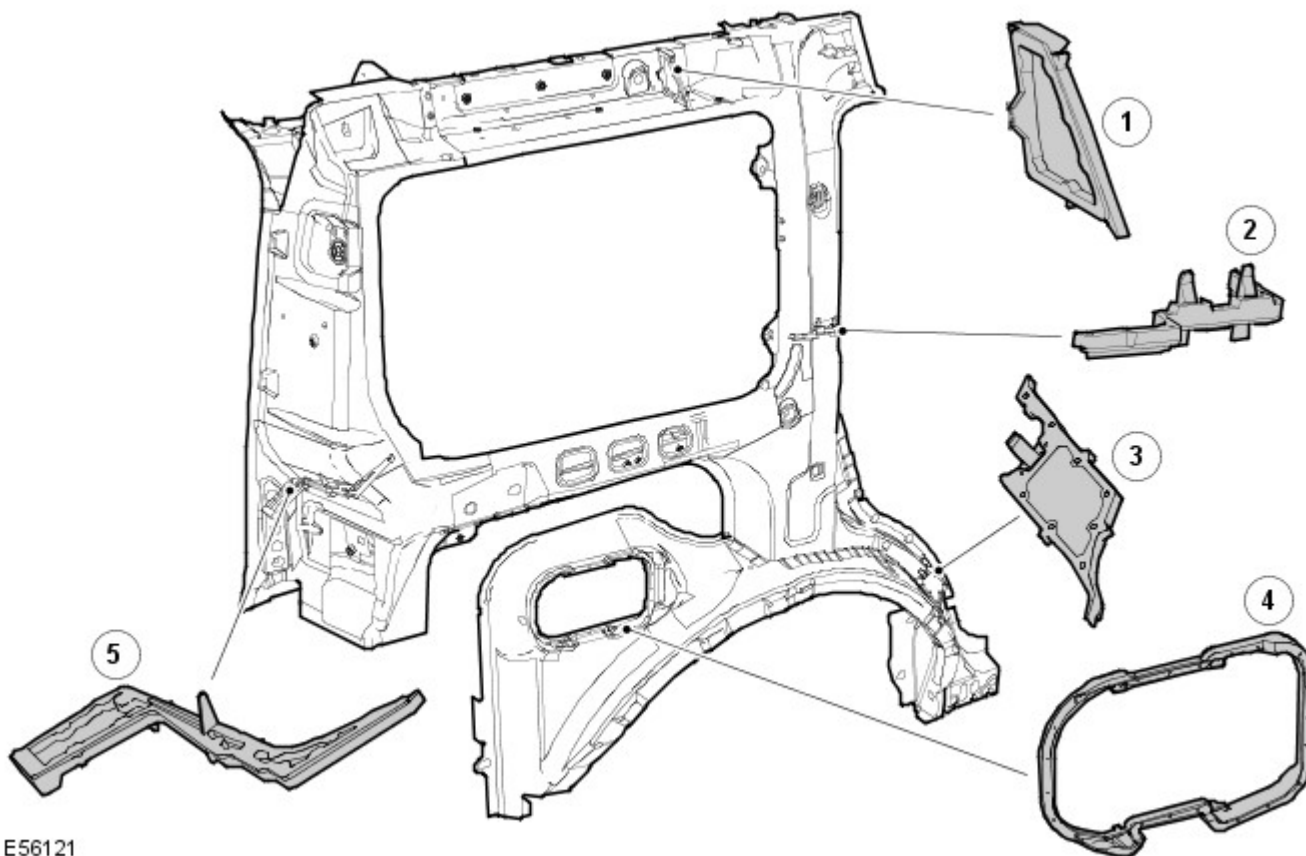
Position of acoustic seals, front reinforcement



E56122

Item	Description	Function	Service part No
1	A-pillar upper inner	Acoustic	EUH000520
2	B-pillar lower inner	Water Ingress/Acoustic	EUH000560
3	Rocker panel middle	Acoustic	EUH000670
4	A-pillar lower inner	Water Ingress/Acoustic	EUH000550
5	B-pillar lower outer	Water Ingress/Acoustic	EUH000570
6	Rocker panel outer	Acoustic	EUH000680
7	A-pillar lower inner	Water Ingress/Acoustic	EUH000540
8	A-pillar upper outer	Acoustic	EUH000530

Position of acoustic seals, rear quarter panel



E56121

Item	Description	Function	Service part No
1	Cantrail rear	Acoustic	EUH000650
2	C-pillar outer	Acoustic	EUH000610
3	Rear wheel arch outer	Water Ingress/Acoustic	EUH000590
4	Fuel filler aperture	Water/Fuel Ingress	ARY 780030
5	D-pillar outer	Acoustic	EUH000630

Seam Sealer

A heat cured, PVC based sealant is applied to specific joint seams during factory assembly. This material is not suitable for service use and during repair, should be substituted by an approved seam sealer.

Apply seam sealers after the application of primer and before the application of top coat. The sealer must form a continuous bead, with the profile of the bead dependent on the type of seam. If the seam sealer is applied with a brush take particular care to maintain the required coverage of the seam.

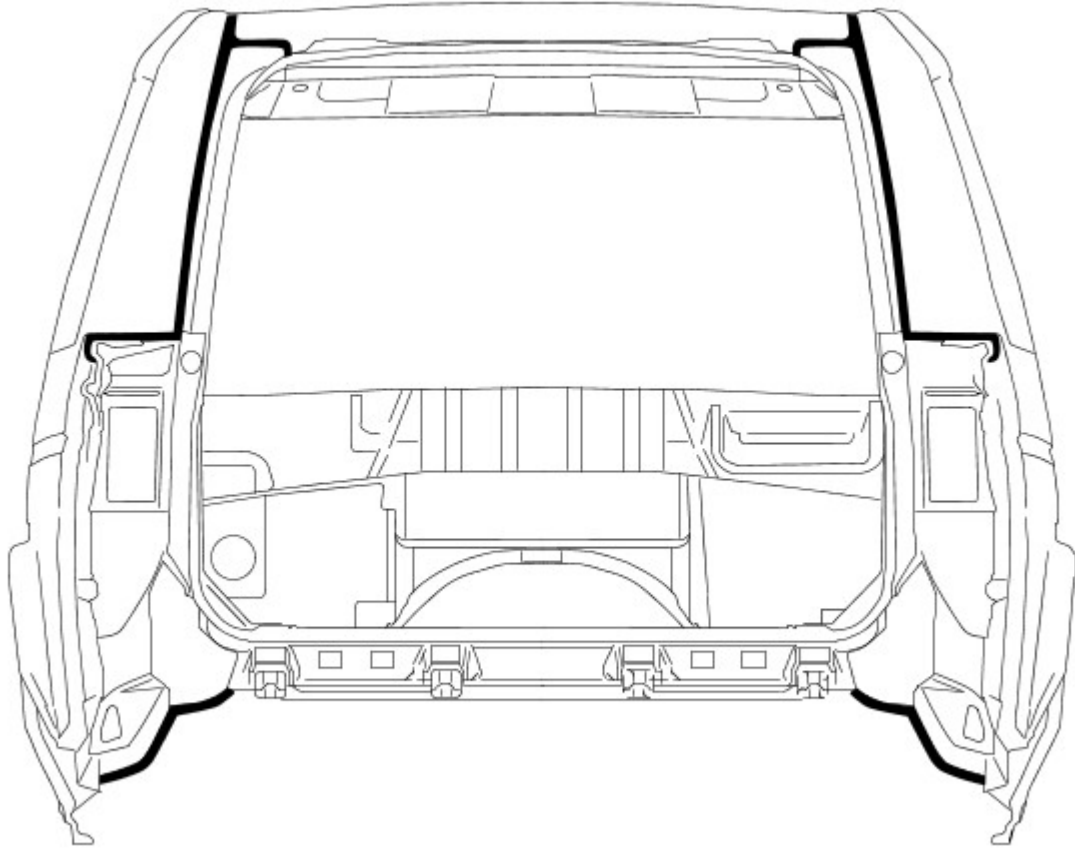
Ensure that all accessible repair seams are sealed following a repair. Damaged to a vehicle often flexes areas of the body remote from the impact. As a result the seam sealer in these areas may be disturbed by subsequent straightening and repair operations. Check all seams in the vicinity of the area undergoing repair for evidence of cracked seam sealer, then clean out as required and apply fresh seam sealer using the following procedure:

- Clean the affected seam and re-treat any exposed metal areas with a suitable etch phosphate primer.
- Treat affected area with an etch-acid primer.
- Apply appropriate seam sealer as necessary.
- apply appropriate colour coat (and under body sealer as applicable).

Where seams are inaccessible following the reassembly or fitting of components, ensure that a paste-type seam sealer is applied to such seams. Certain seams also become inaccessible after the completion of panel repairs. In such instances apply seam sealer and paint before final assembly.

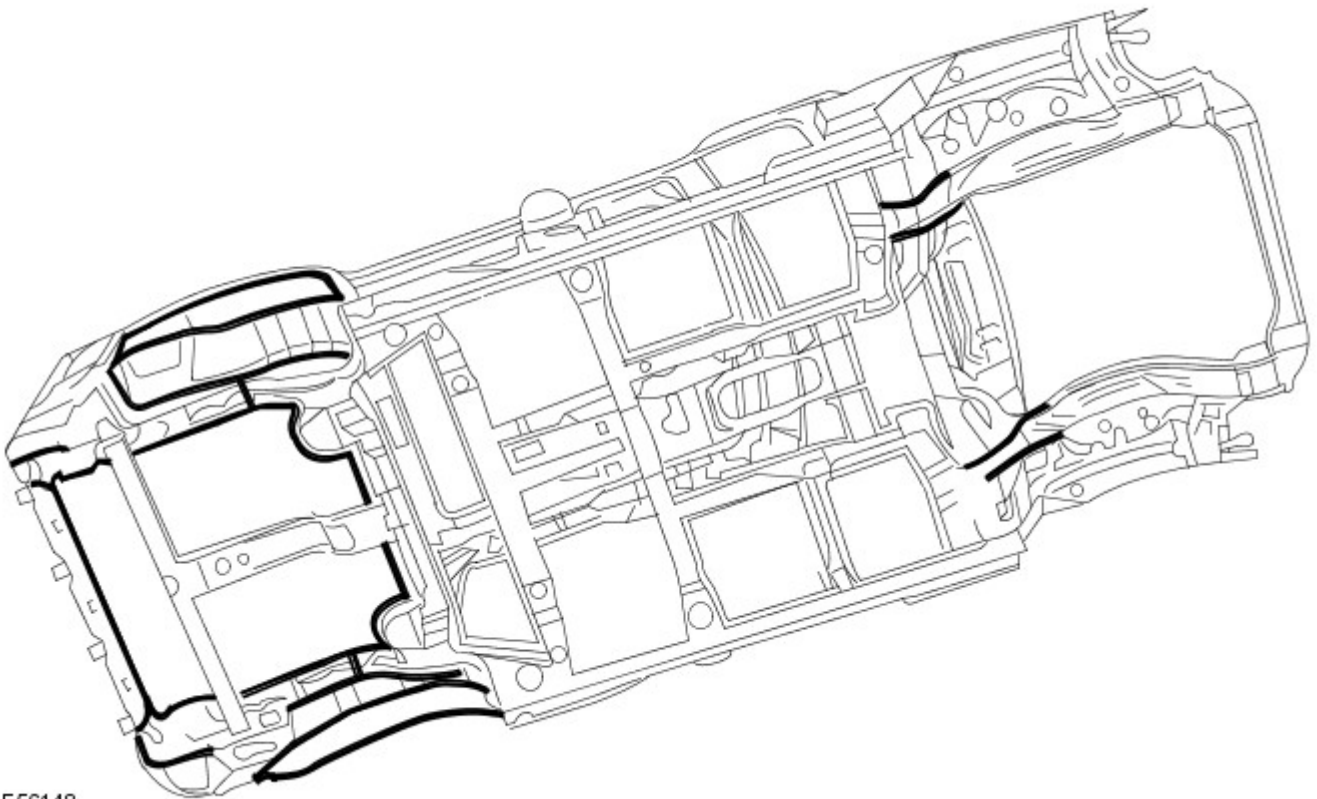
Provided access is adequate, apply seam sealer to both sides of a repair joint. Where access is limited to one side only (eg box section), treat the affected box member with cavity wax.

Seam sealer on the rear end



E56146

Underbody seam sealer



E56148

Cavity Wax

After repairs, always re-treat these areas with an approved cavity wax. In addition, treat all interior surfaces which have been disturbed during repairs whether they have been treated in production or not. This includes all Box members, cavities and door interiors.

Before wax injection, ensure that the cavity to be treated is free from any contamination or foreign matter. Where

necessary, clear out any debris.

Ensure that cavity wax is applied after the final paint process and before refitting any trim components.

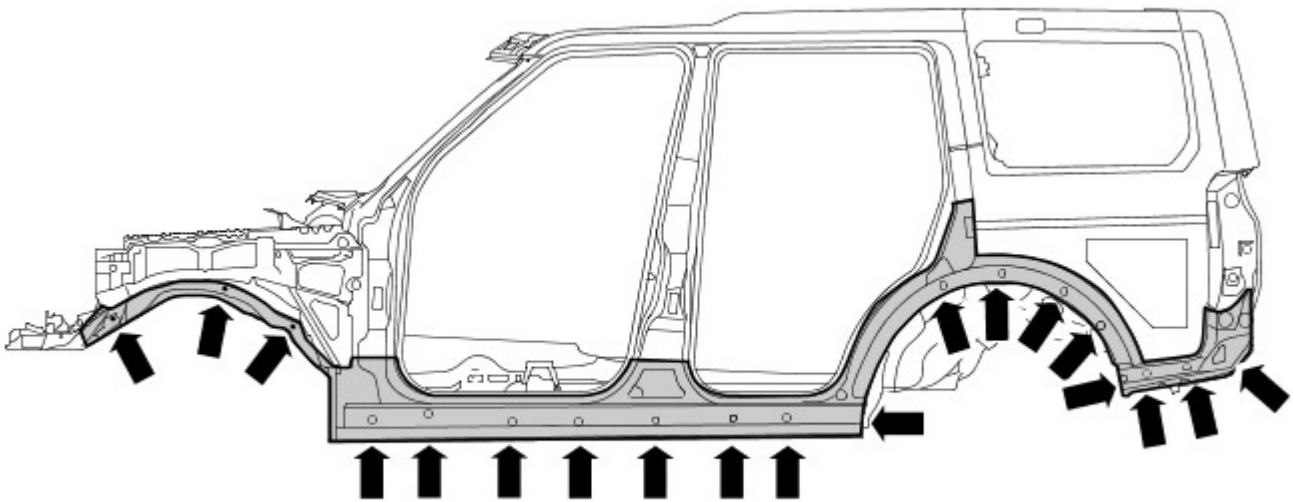
During application ensure that the wax covers all flanges and seam areas and that it is adequately applied to all repaired areas of both new and existing panels.

It should be noted that new panel assemblies and complete body shells are supplied without wax injection treatment. Ensure that such treatment is carried out after repairs.

Effective cavity wax protection is vital. Always observe the following points:

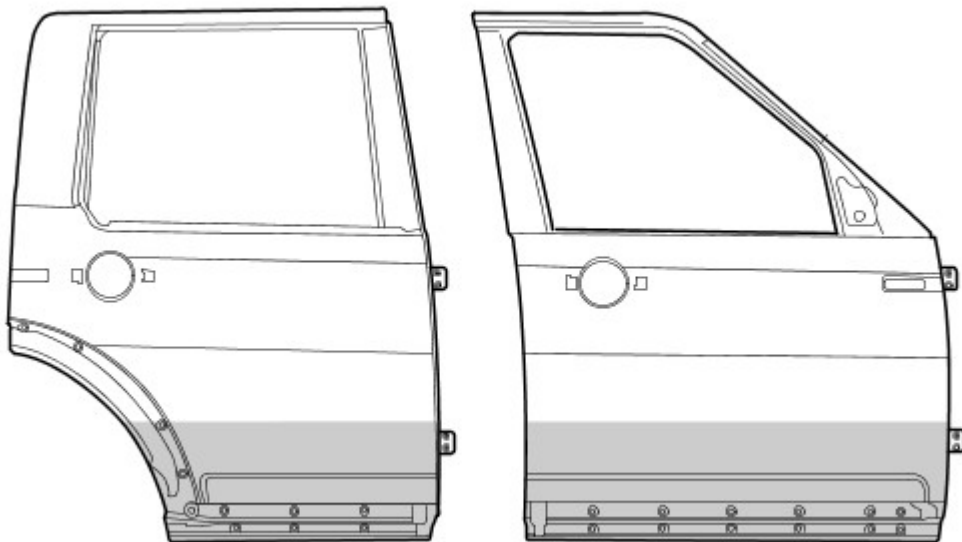
- Complete all paint refinish operations before wax application.
- Check the spray pattern of injection equipment.
- Mask all areas not to be waxed
- Remove body fixings, such as seat belt retractors, if contamination is at all likely.
- Move door glasses to fully closed position before treating door interiors.
- Treat body areas normally covered by trim before refitting items.
- Check that body and door drain holes are clear after the protective wax has dried.
- Keep all equipment clean, especially wax injection nozzles

Wax injection areas, body



E56192

Wax injection areas, doors



E56251

Body Repairs - Water Leaks - Water Leaks

Description and Operation

General

- If water leaks occur after bodywork repairs, the cause can be established using the checks described below. A systematic and logical procedure is required to locate water leaks. Before beginning extensive checks, a thorough visual inspection must be carried out.
- Visual Inspection
 - The following characteristics may indicate existing leaks:
 - Check the clearance and accurate fit of ancillary components such as the hood, tailgate, liftgate, doors, and so on.
 - Check for correct fit and possible damage to sealing elements such as blanking plugs, rubber door seals, and so on.
 - Check water drain holes for unhindered flow.
- Various tests can be used to provide further information on possible leaks:
 - Water test
 - Washer test
 - Road test
 - Chalk (powder) test

Practical execution of tests and checks

Water test

- **NOTE:** Never aim a jet of water directly at a rubber seal.
- Carry out the water test with a second person present (passenger compartment).
- Use variable washer nozzles (concentrated water jet to fine spray mist).
- Start in the lower section and spray the whole area, working upwards in stages.

Washer test

- Further tests can be carried out in the washer system.
- Some leaks originate here, or only occur here.
- The relevant passenger compartment should be checked using a torch during the wash procedure.

Road test

- If no leaks are located during the tests above, road tests should be carried out on wet roads.
- Road tests under various conditions:
 - At various speeds.
 - On various road surfaces (asphalt to cobbles).
 - With loaded or unloaded vehicle.
 - Driving through puddles (splash water).

Chalk test (powder test)

- In this test, the clamping load and the bearing surface of the seal are checked.
- Performing the test:
 - Dust the door seal with powder or coat with chalk.
 - Coat the bearing surface of the seal with a thin film of grease.
 - Slowly close the door and open it again.
 - Check the width and continuity of the imprint on the door seal.

Other test equipment

- Other equipment such as stethoscopes, UV lamps, special mirrors or ultrasound measuring instruments can be used to locate leaks.

Rectifying the leak using recommended tools, auxiliary equipment and materials

- Tools and auxiliary equipment:
 - Dry, absorbent cloths
 - Variable washer nozzle
 - Torch, fluorescent tube
 - Mirror
 - Compressed air
 - Seal lip installer
 - Wet/dry vacuum cleaner
 - Sealing compound compressor
 - Remover for interior trim
 - Cutter blade or pocket knife
 - Wedge (wood or plastic)
 - Hot air blower
 - Special mirror for concealed leaks
 - Air flow checker
- - Sealing compound (tape and plastic compound)
 - Multi-purpose sticker
 - Clinched flange sealer
 - Window sealing compound
 - Water shield (PVC)
 - Double-sided adhesive tape for water shield

- Methylated spirit (available from trade outlets)
- PU adhesive
- Silicone remover
- Tar remover

Water leaks according to mileage or running time

Increasing mileage has an effect on the problem of leaks in a vehicle. Possible influencing factors are:

- Servicing and maintenance of seals:
 - No maintenance, lack of maintenance or incorrect maintenance
 - Using an incorrect agent
- Damaged seals:
 - As a result of aging, wear or incorrect handling/assembly.
- Heavy soiling of the vehicle:
 - Heavy soiling of a vehicle can seriously impair the function of water drainage channels in particular, and also of rubber seals.
- Age-related factors:
 - Environmental factors
 - UV radiation
 - Extreme climatic conditions
- Corrosion can have a serious impact on bodywork, in particular as a result of:
 - Lightly or heavily rusted seal carriers
 - Rusted body seal welds
 - Perforation corrosion

Water leaks after body repairs

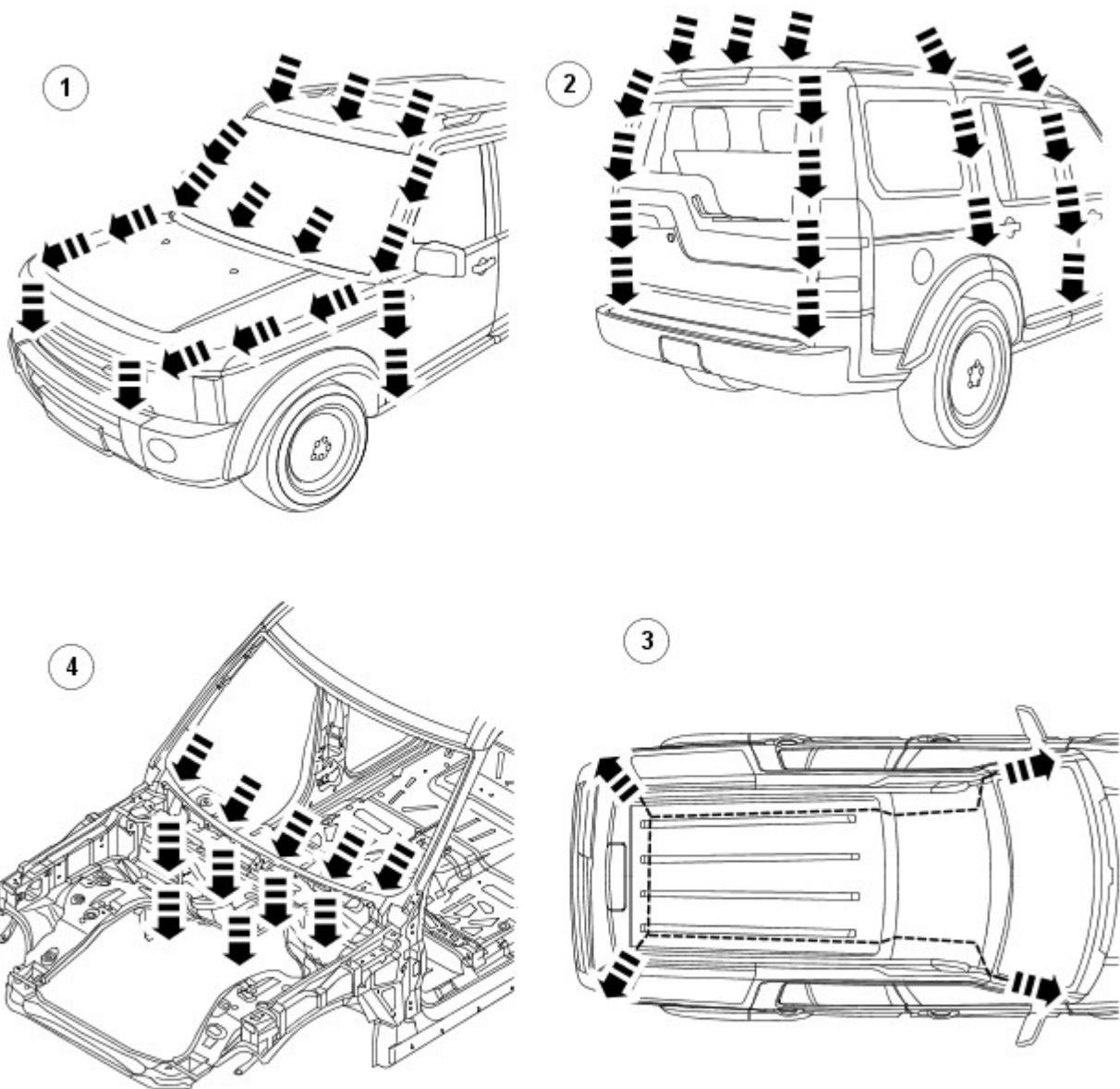
If a vehicle develops a leak after body repairs, the following points must be taken into consideration in particular:

- The correct seating of ancillary components and their seals must be checked.
- The correct alignment of doors/tailgate and liftgate must be checked. The associated seals must not be damaged and must be installed correctly.
- Check that welded seams are correctly sealed.
- The correct seating of rubber grommets must be checked.
- Directly-glazed windows must have correct and complete bonding.

Water drainage system

If a vehicle develops water leaks, then areas into which water is routed or drained should be checked first.

Water drainage system



E56126

Item	Part Number	Description
1	-	Water drainage, front
2	-	Water drainage, side and rear
3	-	Roof drainage
4	-	Engine compartment drainage

Water leaks, diagnosis and corrective action: Front passenger compartment

Windscreen

- Diagnosis:
 - Ingress of water into A-pillar area or instrument cluster area and rocker panel area.
- Cause:
 - Breaks in adhesive beads
- Corrective action:
 - The breaks in adhesive beads can be located from inside by using compressed air. The leak can be identified from outside by the escaping air.
 - The second test method is by means of a water test. The outer trims must be raised carefully using a plastic wedge. The leak should be located from inside by a second assistant.

Side windows

In the case of side windows, the same problems can arise as for a windscreen. The same corrective actions must therefore be used.

Door seal

- Diagnosis:
 - Water ingress in the lower part of the interior door trim or in the rocker panel area.

- Cause:
 - The water shield fitted behind the interior door trim exists to drain off water that has entered the door via the drainage holes, either downwards or outwards. If the water shield seal is damaged or has been fitted incorrectly, then water can get into the passenger compartment.
 - In addition to this, the drainage holes can become clogged with leaves, dirt or excess cavity protection agents. Water gathers in the door and ingresses into the passenger compartment.
 - Check water shield for damage or correct fitting.
 - If the water shield needs to be re-bonded, then approved seam sealer should be used.
 - Before the water shield is installed, the drainage holes must be checked for unhindered flow.

Door seals

- Diagnosis:
 - Ingress of water into the rocker panel area
- Cause:
 - Insufficient clamping load between seal and door.
- Corrective action:
 - Check clamping load:
 - The easiest way to check the clamping load of a seal to the respective bearing surface is by means of a paper strip test. This consists of trapping strips of paper at various points between the door and the seal, and fully closing the door. If it is possible to pull out the paper with no great resistance, then the clamping load is too low.
 - Adjust the clamping load:
 -
 - NOTE: When adjusting the clamping load, the profile alignment of the relevant components must always be taken into consideration.

The clamping load is normally adjusted using the striker. When doing so, the edge alignment from the door to the side panel, or from the front door to the rear door must be taken into account.

- Another setting method is to realign the panel flange for the seal mounting. The clamping load is increased by moving the flange towards the door.

-

• NOTE: Do not realign the flange too far in the direction of the door, as this can reduce the bearing surface of the seal to the door.

Check the bearing surface:

- Apply chalk evenly to the surface of the seal. Evenly coat the bearing surface of the door with vaseline.
- Close the door fully, the lock must engage. Open the door. The imprint of the chalk (bearing surface) can be identified in the film of grease.
- The bearing surface should be at least 5mm across at all points.

- Other causes:
 - The door seal must completely seal the door where it meets the bodywork.
 - Water can ingress directly or indirectly into the interior of the vehicle if the seal is damaged at any point.
- Corrective action:
 - A damaged or worn door seal must always be renewed in full.
 - When renewing the seal, the following must be taken into account:
 - Always fit the seal first in the area of the narrow radii (corner points).
 - Next, secure the seal to the flange evenly by tapping lightly with a rubber hammer. The installed seal must not be kinked at any point.

• NOTE: The prescribed length of a seal must not be shortened.

- Other cause:
 - The door seal is attached to the welded flange all the way round. If this welded flange is uneven or damaged at any point (usually in areas with narrow radii) then this point could be subject to leaks.
 - A stretched seal carrier can also cause a leak.
 - In both cases, water gets into the vehicle interior under the seal carrier.
- Corrective action:
 - Align the deformed welded flange using a hammer and anvil block, prevent and if necessary repair any paint damage.
- Other cause:
 - The door seal is attached to the welded flange all the way round. If this welded flange is uneven or damaged at any point (usually in areas with narrow radii) then this point could be subject to leaks.
 - A stretched seal carrier can also cause a leak.
 - In both cases, water gets into the vehicle interior under the seal carrier.

Sliding roof/tilting roof

- Diagnosis:
 - Ingress of water at sliding roof aperture
- Cause:
 - The sliding roof/tilting roof is installed in a water trap. The water drains off via the water trap, water drain holes and drain hoses. The drain hoses lead downwards on both sides via the A-pillar and C-pillar.
 - The drain holes or drain hoses can become clogged with leaves, dirt, underbody protection and so on.
- Corrective action:
 -
 - NOTE: In the case of a sliding or tilting roof, the external rubber seal and the lock actuator or latch mechanism must be checked first of all.

Check the water trap for leaks.

- Check the drain hoses for leaks and for correct connection to the water trap.
- Check the drainage system for unhindered flow, and blow out with compressed air if necessary.
- Check the external seal and the correct adjustment of the sliding roof.

Tailgate and Liftgate

- Diagnosis:
 - Ingress of water into rear headlining area and luggage area.
- Cause:
 - The leak problems of the tailgate and liftgate correspond to those of the doors.
 - In addition to this, the area to be sealed is much bigger. The routing holes for cables and hoses must also be sealed.
 - The rubber grommets for the routing holes must be checked for damage and correct seating (fully unhooked).
 - The mounting points of the tailgate and liftgate hinges may leak.
- Corrective action:
 - Check the rubber grommets and renew if necessary.
 - Check the hinge mounting points, and re-seal with sealing compound if necessary.

Forced air extraction

- Diagnosis:
 - Ingress of water into side luggage compartment area
- Cause:
 - The forced air extraction for the vehicle interior is located in the D-pillar behind the rear lights.
 - The rubber flap of the forced air extraction must be able to move freely.
- Corrective action:
 - Remove the forced air extraction.
 - Check the seal area between the bodywork and housing, as well as the rubber flap.
 - Renew seal if necessary.

Rear window and moon roof

- Diagnosis:
 - Ingress of water into the luggage compartment area
- Cause:
 - Rear window and moon roof leaking.
 - Check for leak in the same way as for leaking windscreen.

Panel connections with seal welds

- Diagnosis:
 - Ingress of water into the luggage compartment area
- Cause:
 - Several panel connections must be fitted in production in the wheelhouse and luggage compartment areas. These connections are sealed with sealing compound.
 - Uneven application of sealing compound can lead to a break in a seal weld.
- Corrective action:
 - Expose the seal weld.
 - Locate the leak in the seal weld.
 - Re-seal using sealing compound.

Body Repairs - Vehicle Specific Information and Tolerance Checks - Body and Frame

Description and Operation

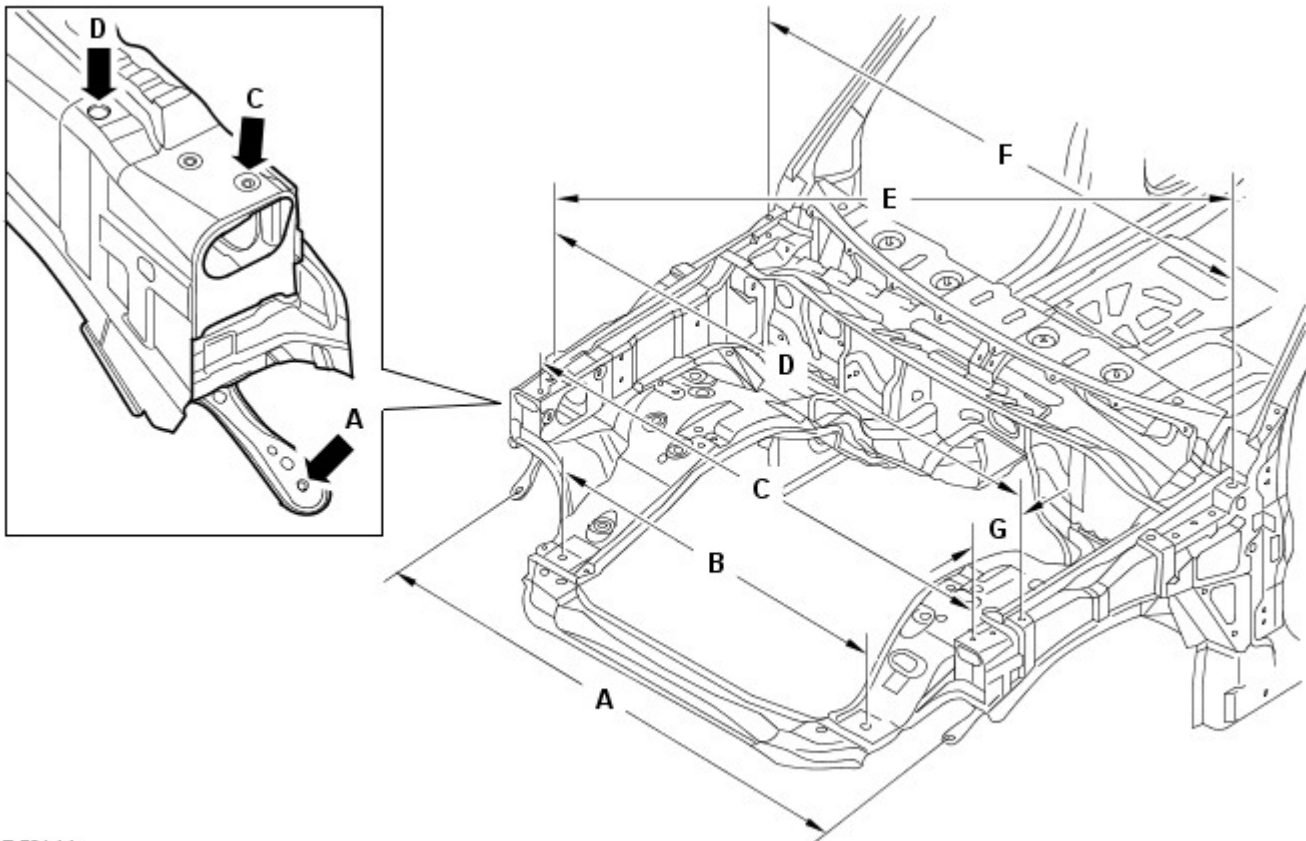
Body Repairs - Tolerance Checks

Measurements shown are in millimetres and inches. The measurements shown in brackets are in inches.

Point-to-Point Dimensional Information

Point-to-point measurements are actual distances between two points. These points can be holes or intersections points. Where holes are taken, the point of measurement is always from the hole centres.

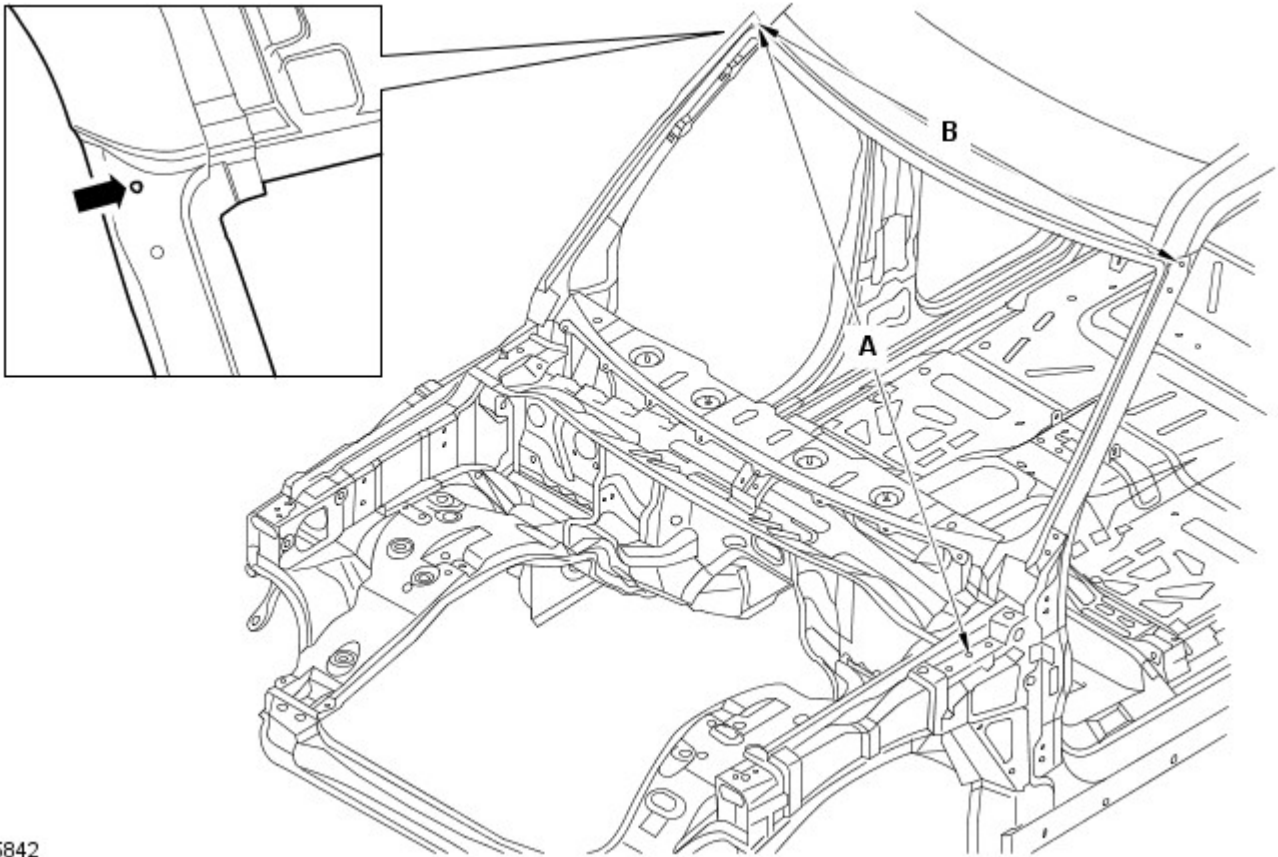
Front end dimensions



E 56144

Item	From	To	Length
A	Hood latch panel, lower LH outer fixing	Hood latch panel, lower RH outer fixing	1503.2 (59.18)
B	Hood latch panel, LH locator slot	Hood latch panel, RH locator slot	900 (35.43)
C	Hood latch panel, LH locator dowel	Hood latch panel, RH locator dowels	1540.4 (60.64)
D	Fender, front LH fixing	Fender, front RH fixing	1617.8 (63.69)
E	Fender, front RH fixing	Fender, rear LH fixing	1780.2 (70.08)
F	Fender, rear LH fixing	Fender, rear RH fixing	1620 (63.77)
G	Fender, front fixing	Hood latch panel, locator dowel	114.23 (4.49)

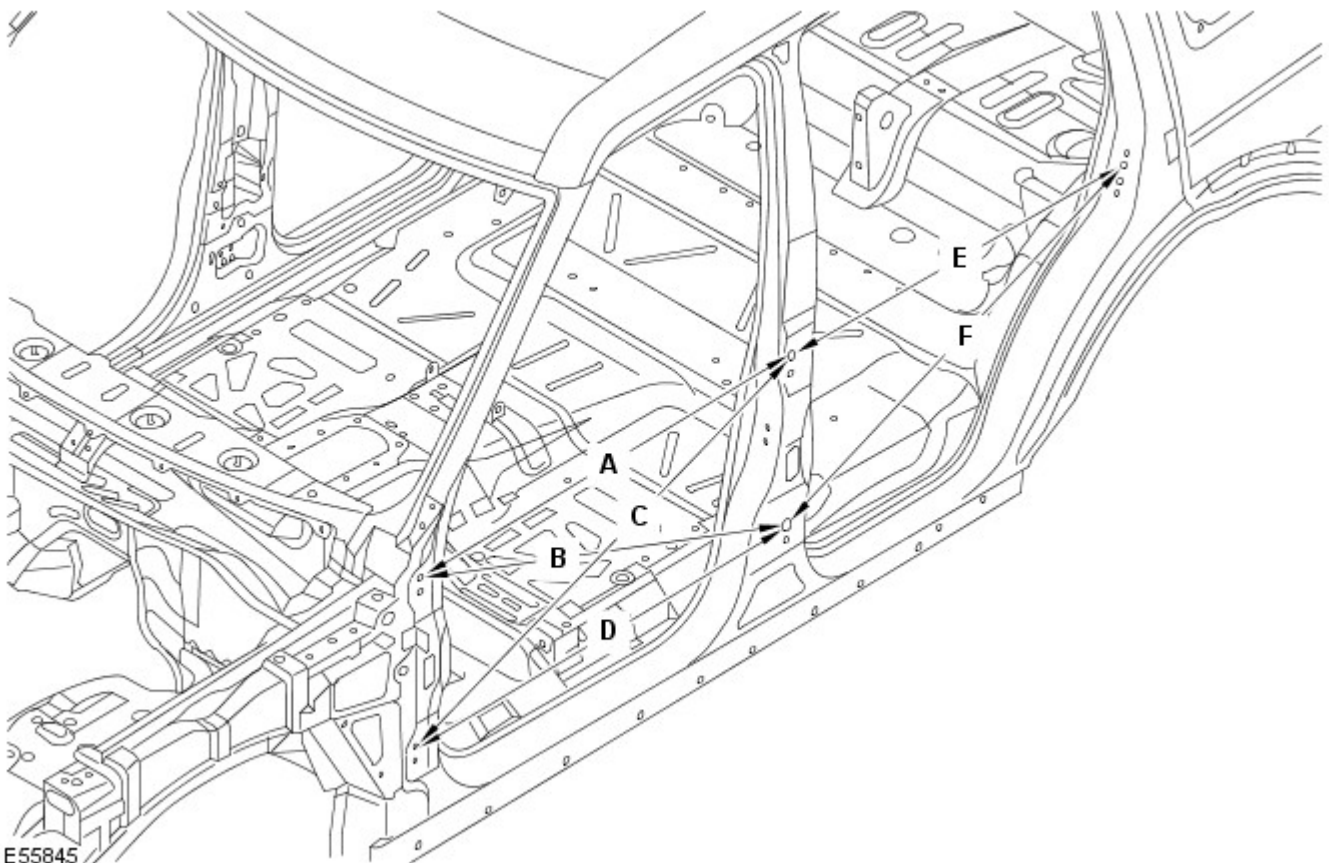
Front end dimensions



E55842

Item	From	To	Length
A	LH hood hinge, middle fixing hole	RH windshield side upper finisher, fixing hole	1827 (71.92)
B	LH windshield side upper finisher, fixing hole	RH windshield side upper finisher, fixing hole	1431.5 (56.35)

Side view dimensions

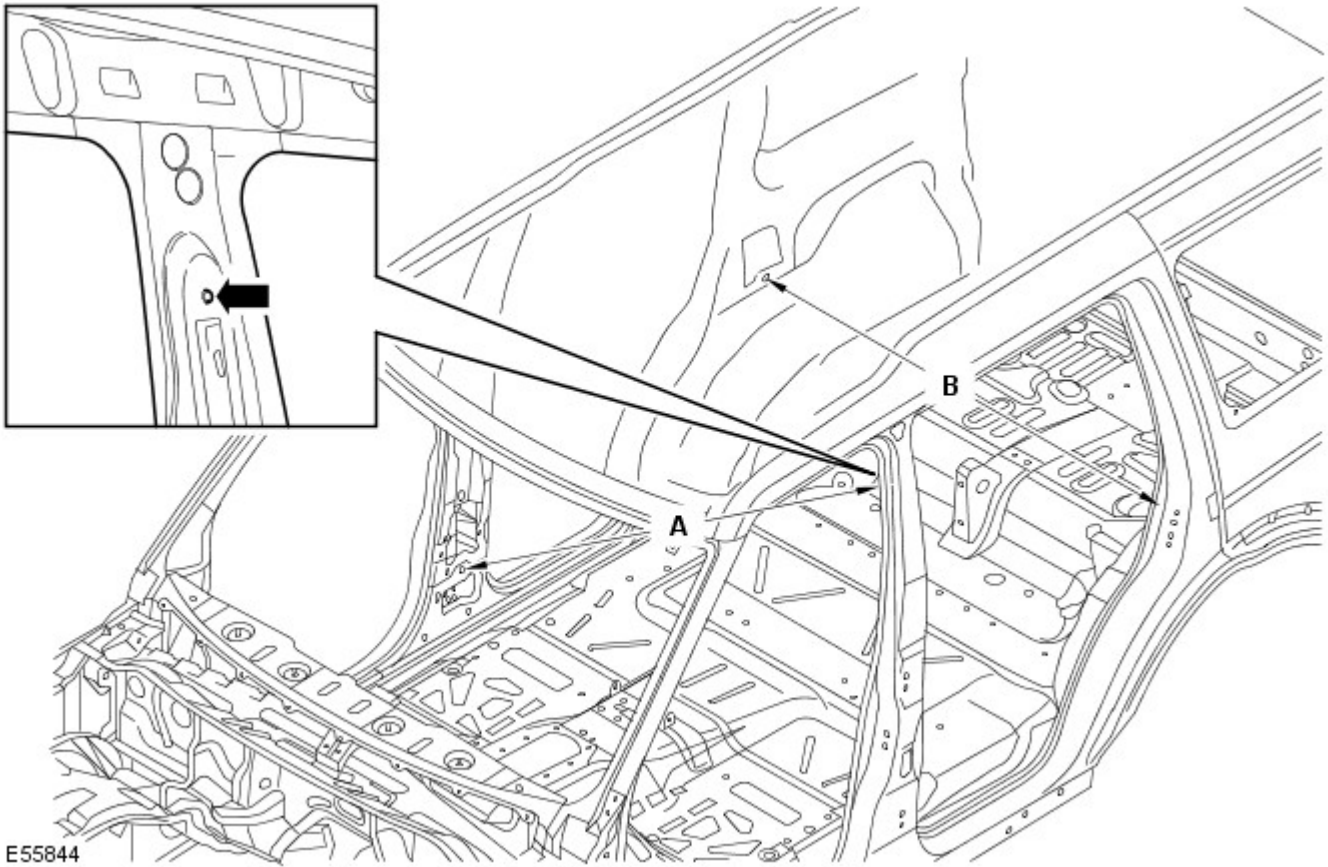


E55845

Item	From	To	Length
A	Front door top hinge, top fixing hole	Rear door top hinge, top fixing hole	1078.9 (42.47)
B	Front door top hinge, top fixing hole	Rear door bottom hinge, top fixing hole	1138.3 (44.81)
C	Front door bottom hinge, top fixing hole	Rear door top hinge, top fixing hole	1174.4 (46.23)

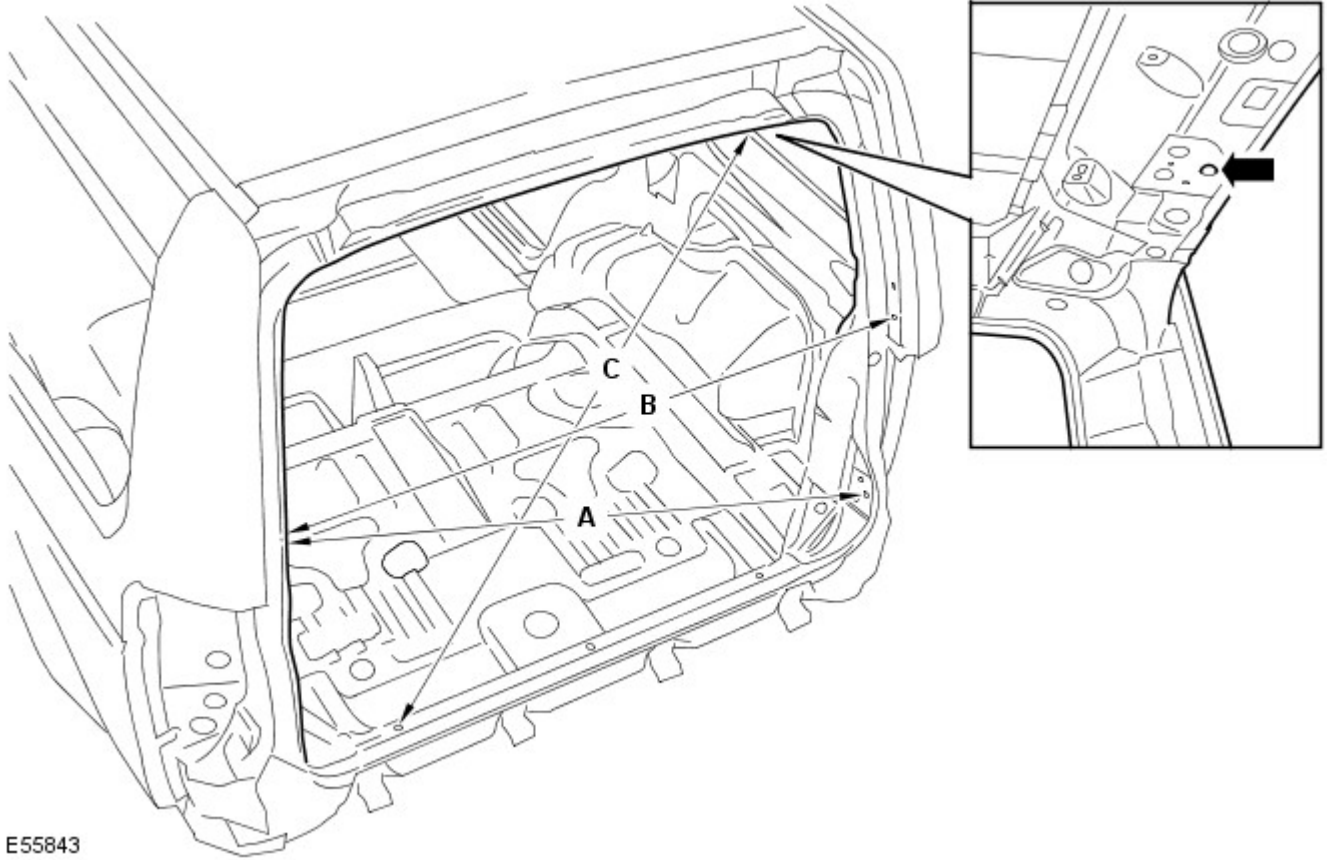
Item	From	To	Length
D	Front door bottom hinge, top fixing hole	Rear door bottom hinge, top fixing hole	1078.9 (42.47)
E	Rear door top hinge, top fixing hole	D pillar striker fixing hole	983.5 (38.72)
F	Rear door bottom hinge, top fixing hole	D pillar striker fixing hole	1069.9 (42.12)

Internal dimensions



Item	From	To	Length
A	LH safety belt anchorage, top fixing	RH safety belt retractor, lower fixing	1743.6 (68.64)
B	RH inner rear wheelarch, lower safety belt retractor fixing	LH inner rear wheelarch, lower safety belt retractor fixing	1518.2 (59.77)

Rear view dimensions

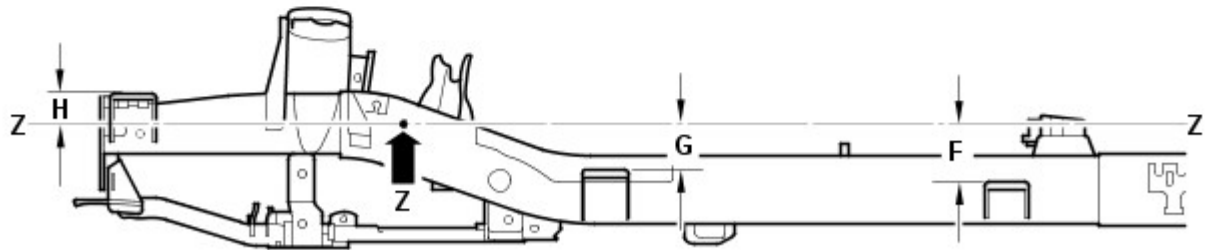
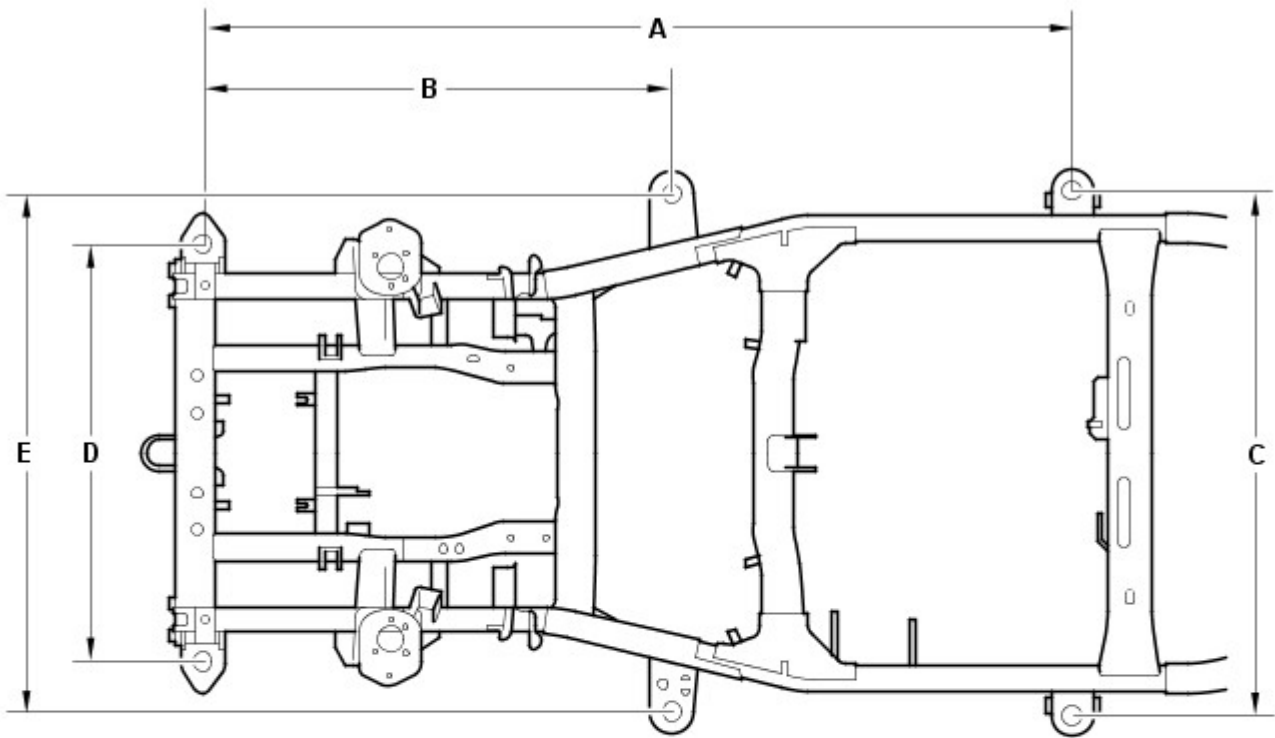


E55843

Item	From	To	Length
A	Liftgate, RH alignment fixing	Tailgate, LH striker fixing	1222.1 (48.11)
B	Liftgate, RH alignment fixing	Liftgate, LH alignment fixing	1186.6 (46.71)
C	Tailgate, LH hinge cover, fixing hole	Rear header, RH location hole	1184.3 (46.62)

Underbody Dimensional Information

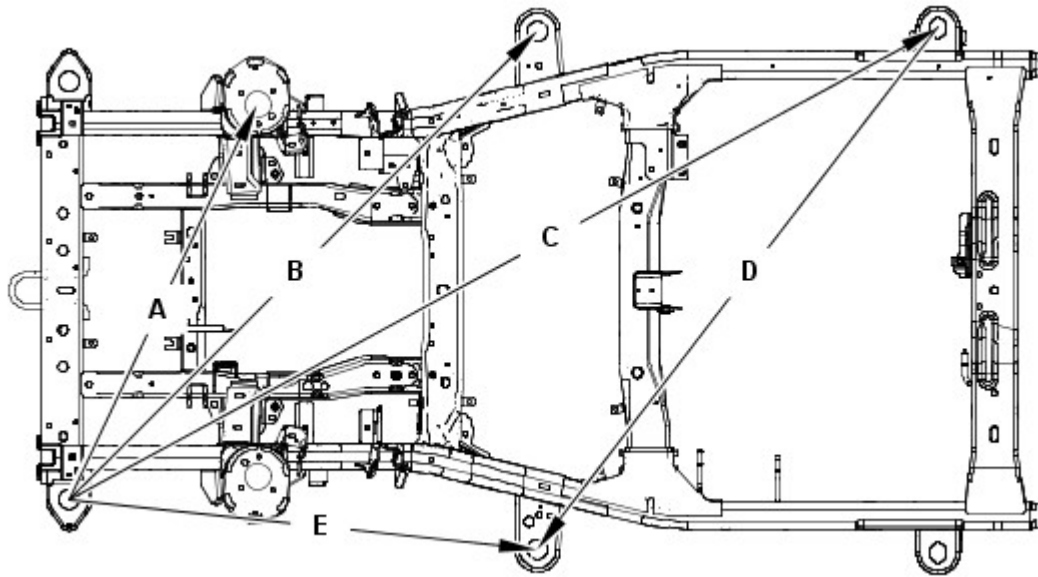
Front integral body frame dimensions



E55836

Item	From	To	Length
A	Body Mount 1 (front)	Body Mount 3	2113 (83.12)
B	Body Mount 1 (front)	Body Mount 2	1139 (44.84)
C	Body Mount 3 (LH)	Body Mount 3 (RH)	1275 (50.196)
D	Body Mount 1 (LH front)	Body Mount 1 (RH front)	1015 (39.96)
E	Body Mount 2 (LH)	Body Mount 2 (RH)	1258 (49.53)
F	Datum Line (Z)	Body Mount 3	136.5 (5.374)
G	Datum Line (Z)	Body Mount 2	105.5 (4.15)
H	Datum Line (Z)	Body Mount 1	78.8 (3.102)

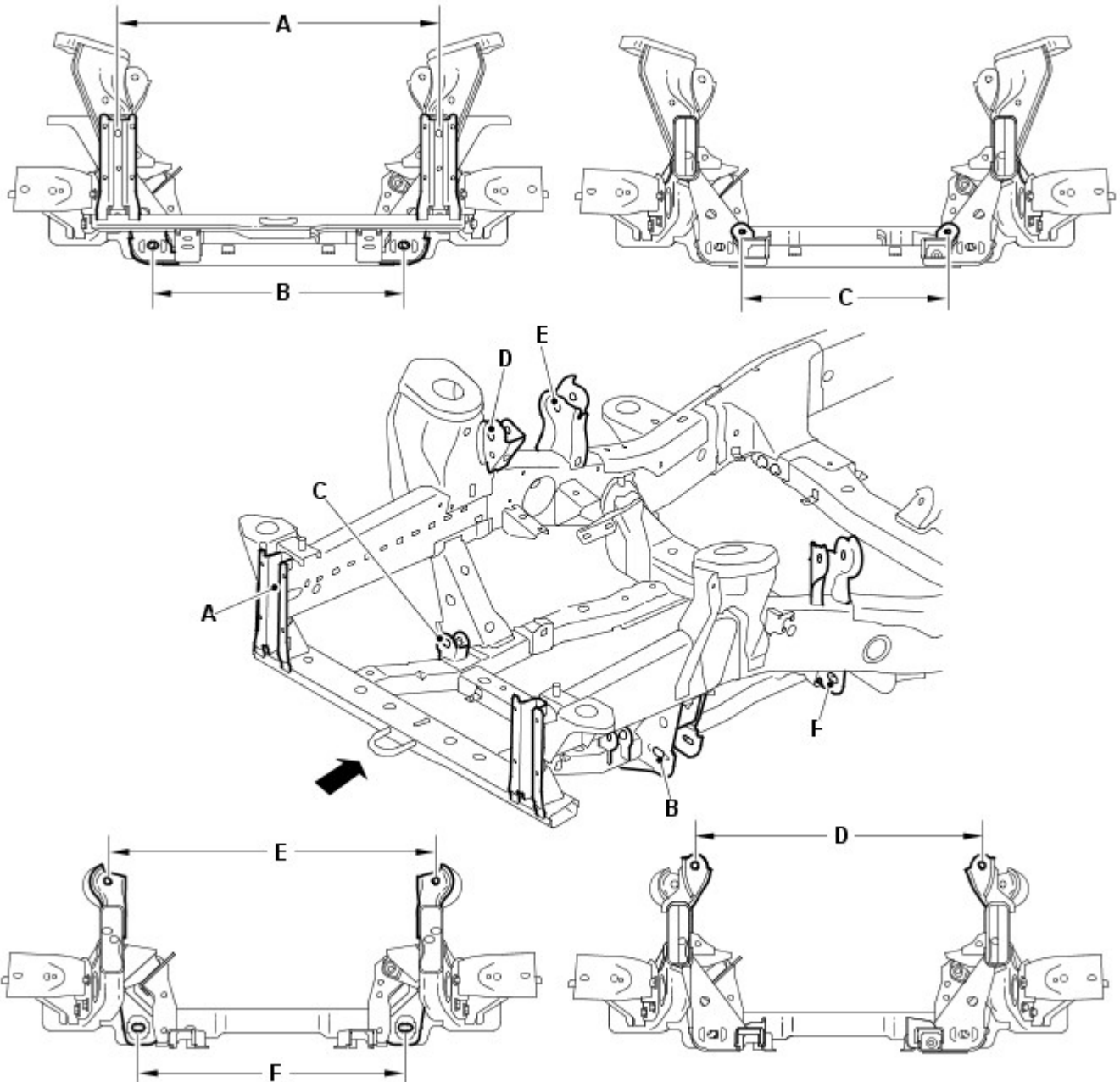
Front integral body frame dimensions



E55835

Item	From	To	Length
A	Body Mount 1 (LH front)	Damper Mounting (RH)	1063.1 (41.85)
B	Body Mount 1 (LH front)	Body Mount 2 (RH)	1609 (63.34)
C	Body Mount 1 (LH front)	Body Mount 3 (RH)	24.3.3 (94.61)
D	Body Mount 2 (LH front)	Body Mount 3 (RH)	1597.7 (62.90)
E	Body Mount 1 (LH front)	Body Mount 2 (LH)	1139 (44.84)

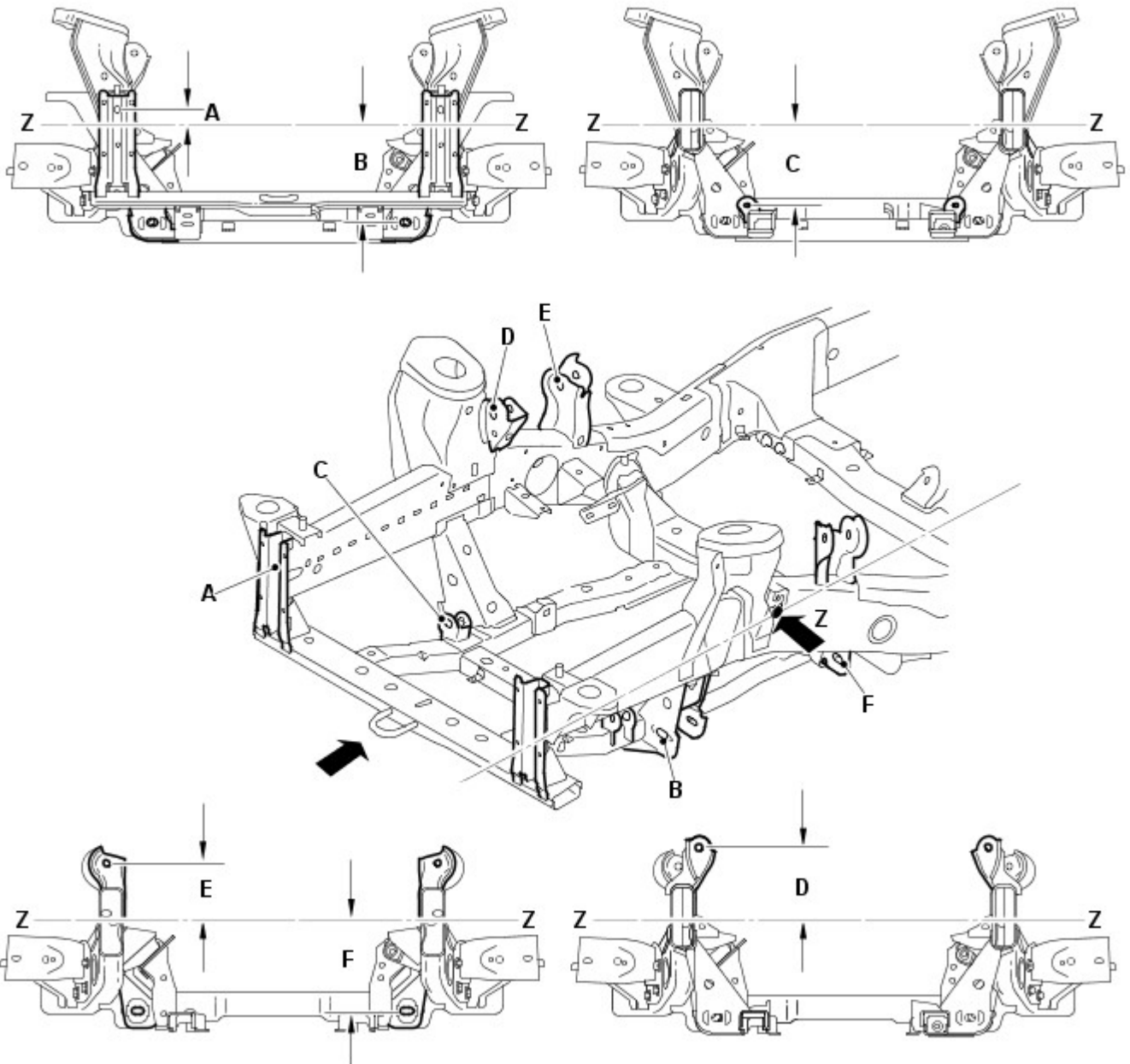
Front integral body frame dimensions



E57095

Item	From	To	Length
A	Front Bumper Mount (L/H)	Front Bumper Mount (R/H)	810 (31.8)
B	Lower Arm (L/H front)	Lower Arm (R/H front)	635.7 (25.02)
C	Steering Gear (L/H)	Steering Gear (R/H)	520 (20.4)
D	Upper Arm (L/H front)	Upper Arm R/H front)	748.7 (29.47)
E	Upper Arm (L/H rear)	Upper Arm (R/H rear)	836.8 (32.9)
F	Lower Arm ((L/H rear)	Lower Arm ((L/H rear)	678.6 (26.71)

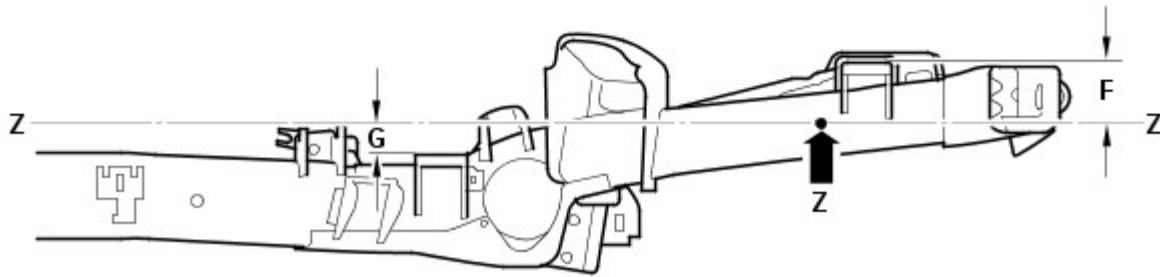
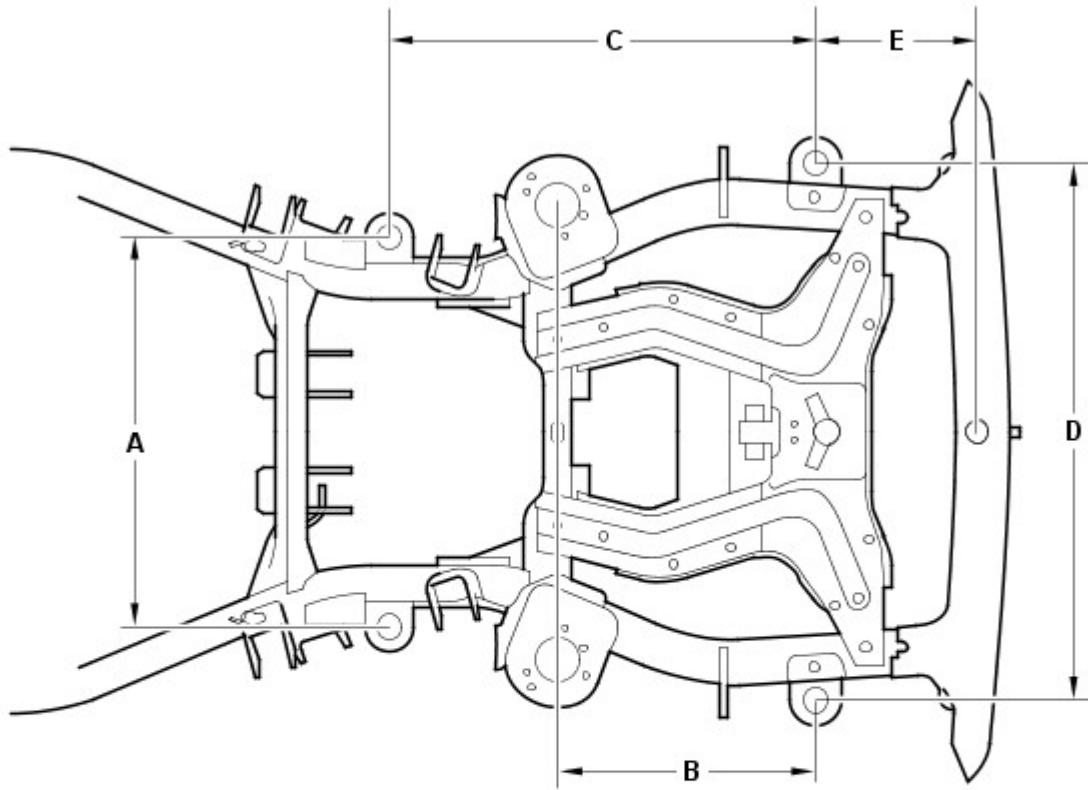
Front integral body frame dimensions



E57470

Item	From	To	Length
A	Datum Line (Z)	Front Bumper Mount	37.81 (1.488)
B	Datum Line (Z)	Lower Arm	249.22 (9.811)
C	Datum Line (Z)	Steering Gear	201.84 (7.946)
D	Datum Line (Z)	Upper Arm front	170.09 (6.696)
E	Datum Line (Z)	Upper Arm Rear	134.17 (5.282)
F	Datum Line (Z)	Lower Arm Rear	236.37 (5.282)

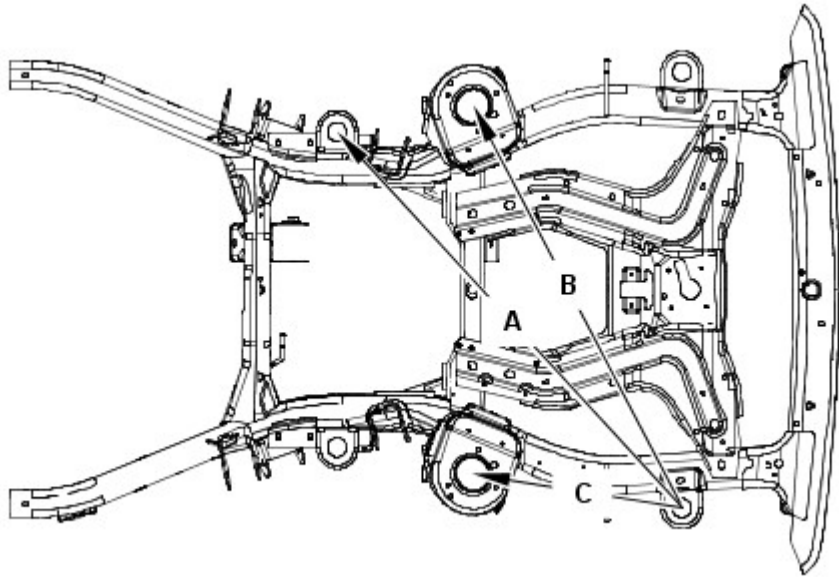
Rear integral body frame dimensions



E55834

Item	From	To	Length
A	Body Mount 4 (LH)	Body Mount 4 (RH)	806 (31.732)
B	Body Mount 5 (rear)	Damper Mounting	533.5 (21.00)
C	Body Mount 5 (rear)	Body Mount 4	882.8 (34.755)
D	Body Mount 5 (LH rear)	Body Mount 5 (RH rear)	1114 (43.858)
E	Body Mount 5 (rear)	Rear Crossmember	332 (13.07)
F	Datum Line (Z)	Body Mount 5 (rear)	127.5 (5.01)
G	Datum Line (Z)	Body Mount 4	61.2 (2.40)

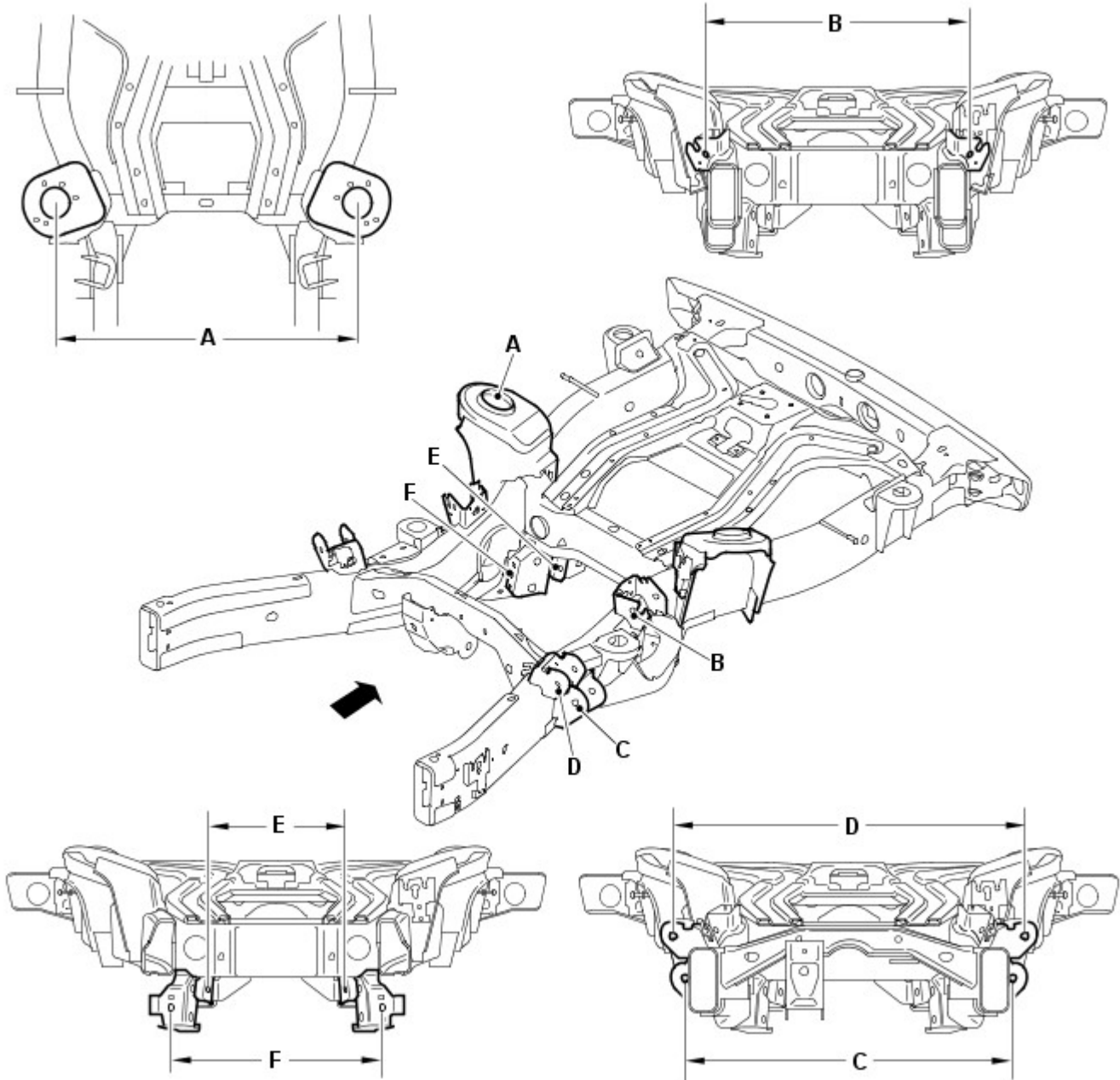
Rear integral body frame dimensions



E55833

Item	From	To	Length
A	Body Mount 5 (LH rear)	Body Mount 4 (RH)	1304.2 (51.34)
B	Body Mount 5 (LH rear)	Rear Damper Mounting (RH)	1156 (45.51)
C	Body Mount 5 (LH rear)	Rear Damper Mounting (LH)	533.5 (21.00)

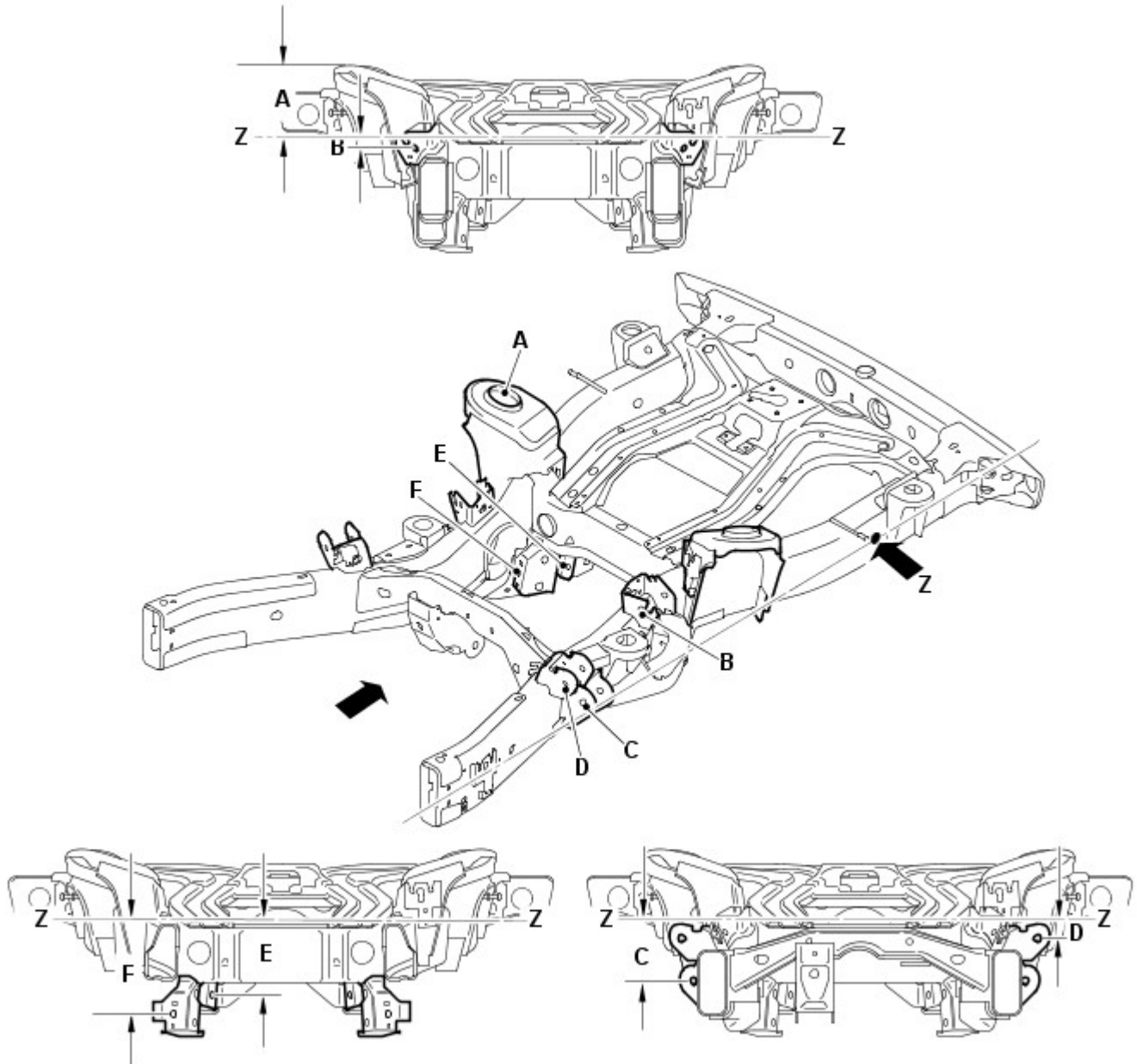
Rear integral body frame dimensions



E57096

Item	From	To	Length
A	Damper (L/H)	Damper (R/H)	937.1 (36.9)
B	Upper Arm (L/H rear)	Upper Arm (R/H rear)	757.4 (29.81)
C	Lower Arm (L/H front)	Lower Arm (R/H front)	818.4 (32.2)
D	Upper Arm (L/H front)	Upper Arm (R/H front)	946.5 (37.2)
E	Toe Link (L/H)	Toe Link (R/H)	439 (17.2)
F	Lower Arm (L/H rear)	Lower Arm (R/H rear)	508.4 (20.01)

Rear integral body frame dimensions



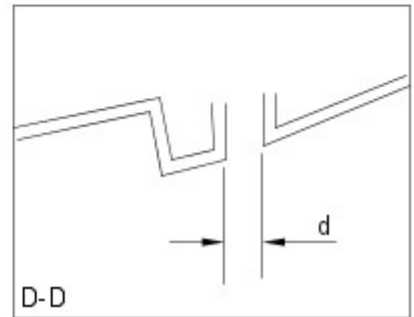
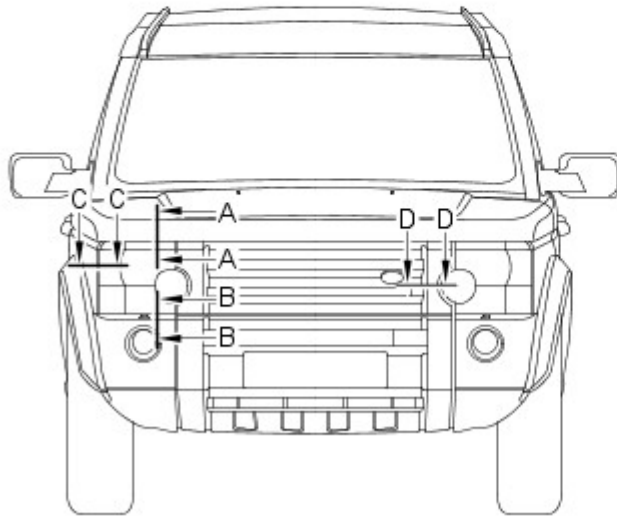
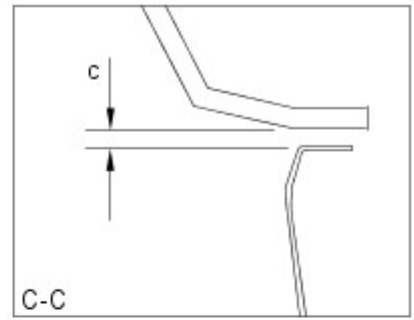
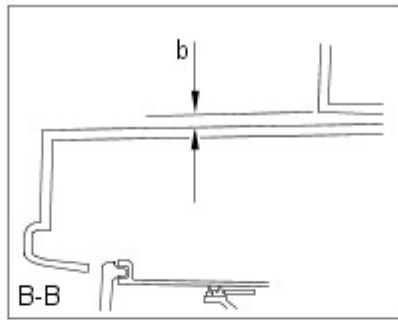
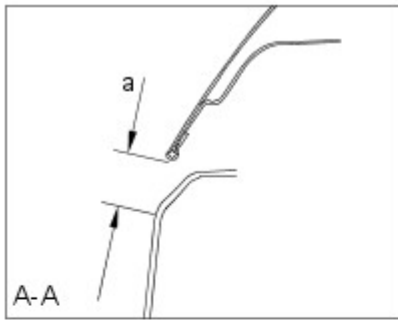
E57471

Item	From	To	Length
A	Datum Line (Z)	Damper	169.97 (6.691)
B	Datum Line (Z)	Upper Arm Rear	32.27 (1.270)
C	Datum Line (Z)	Lower Arm Front	161.04 (6.340)
D	Datum Line (Z)	Upper Arm Front	55.07 (2.168)
E	Datum Line (Z)	Toe Link	200.87 (7.908)
F	Datum Line (Z)	Lower Arm Rear	250.81 (9.874)

Gap and Profile Measurements

The following information is to be used as a guide to assist the technician in installing exterior body panels and trim items so as to achieve a correctly aligned and cosmetically acceptable vehicle.

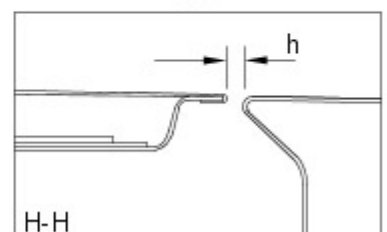
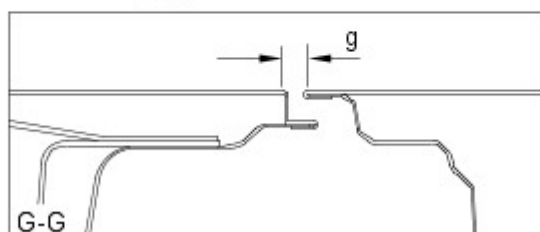
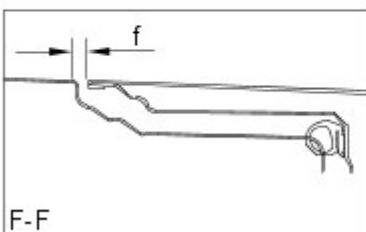
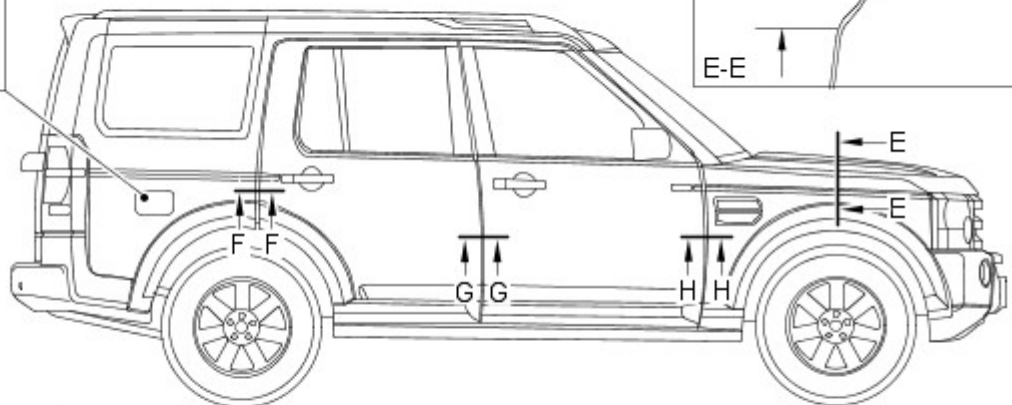
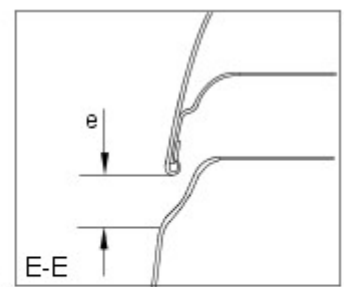
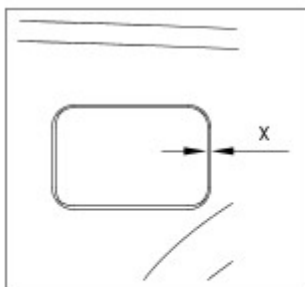
Front view dimensions



E55848

Section	Description	Gap	Profile
A-A	Headlamp to Hood	22.0 (0.866) ± 1.4 (0.055)	N/A
B-B	Headlamp to Bumper	6.0(0.236) ± 1.8 (0.070)	N/A
C-C	Headlamp to Fender	4.0(0.157) ± 1.2 (0.0472)	0.0 ± 1.2 (0.047)
D-D	Headlamp to Grille	4.0(0.157) ± 1.2 (0.0472)	0.0 ± 1.0 (0.039)

Side view dimensions

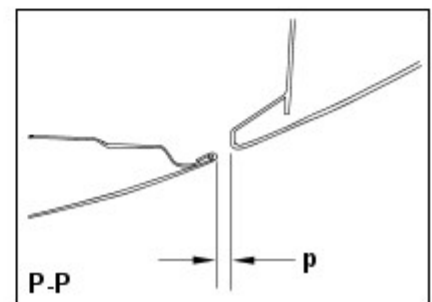
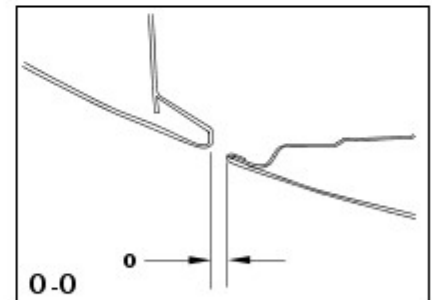
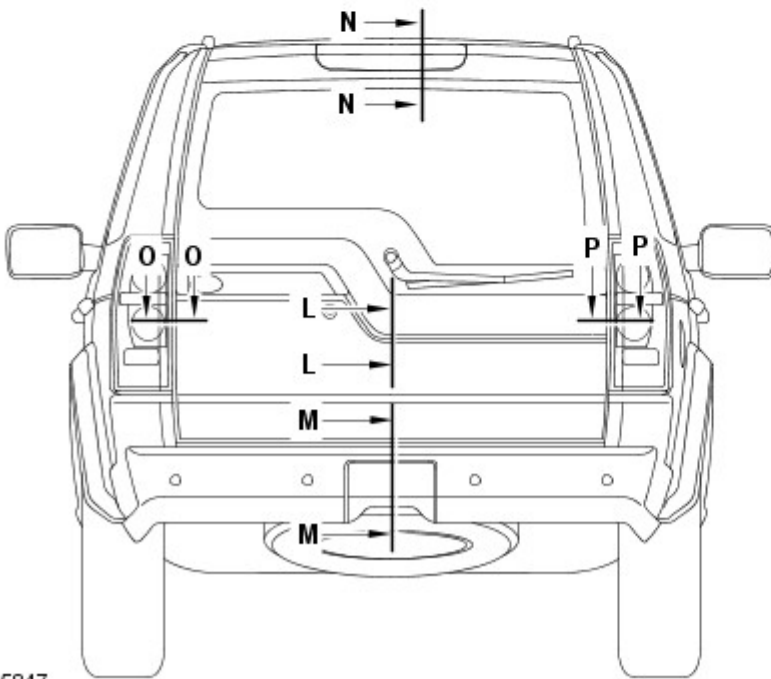
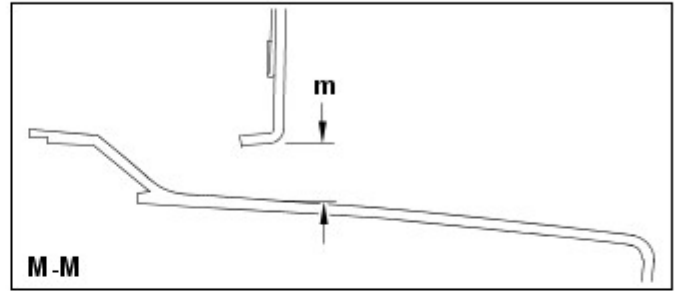
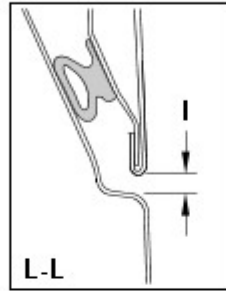
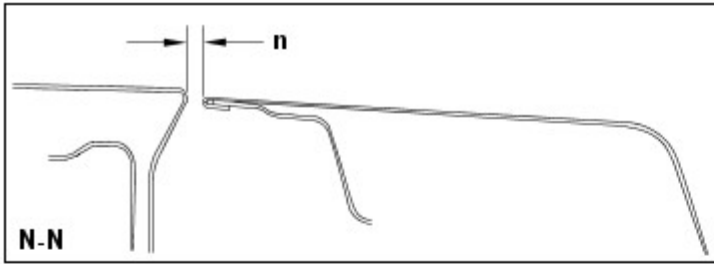


E55846

Section	Description	Gap	Profile
E-E	Hood to Fender	22.0 (0.866) ± 1.4(0.055)	+ 1.0 (0.039)

Section	Description	Gap	Profile
F-F	Rear Door to Bodyside	4.5 (0.177) ± 1.1 (0.043)	0.0 + 1.0 (0.039) - 0.0
G-G	Front Door to Rear Door	5.0 (0.196) ± 1.0 (0.039)	0.0 + 1.0 (0.039) - 0.0
H-H	Front Fender to Front Door	5.0 (0.196) ± 1.0 (0.039)	0.0 + 1.4 (0.055) - 0.0
X-X	Fuel Filler Flap to Bodyside	2.9 (0.114) ± 1.0 (0.039)	1.0 (0.039) ± 1.0 (0.039)

Rear view dimensions



E55847

Section	Description	Gap	Profile
L-L	Liftgate to Tailgate	6.0 (0.236) ± 1.0 (0.039)	0.0 ± 1.0 (0.039)
M-M	Tailgate to Bumper	12.8 (0.503) ± 2.1 (0.0826)	N/A
N-N	Liftgate to Roof	10 (0.393) ± 1.3 (0.0511)	-2.0 (0.078) ± 1.3 (0.0511)
O-O	Tailgate to Rear Lamp	5.0 (0.196) ± 1.6 (0.062)	5.0 (0.196) ± 1.3 (0.0511)
P-P	Liftgate to Rear Lamp	5.0 (0.196) ± 1.6 (0.062)	3.0 (0.118) ± 1.9 (0.074)

Front End Sheet Metal Repairs -

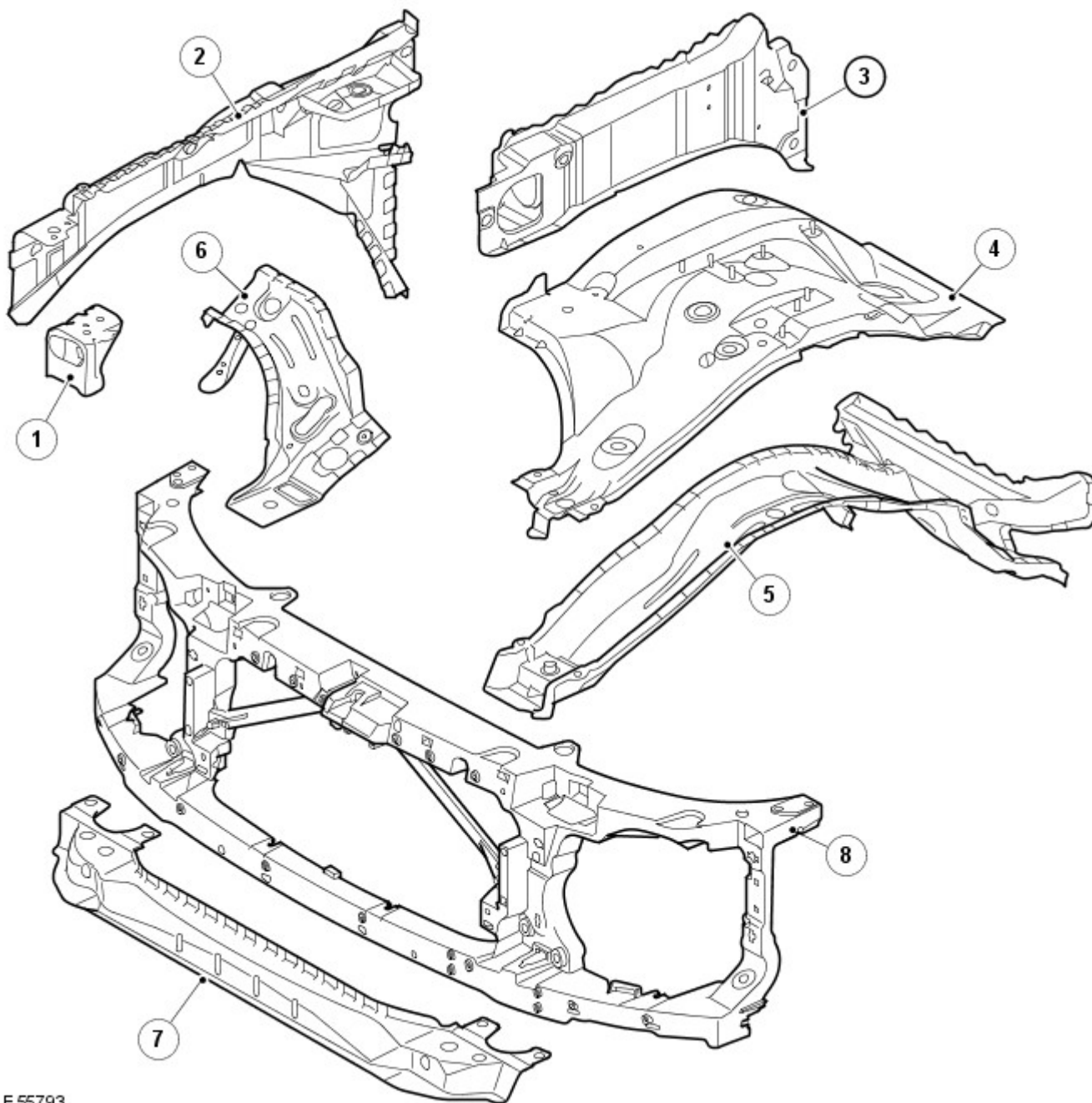
Torque Specifications

Description	Nm	lb-ft
Air deflector bolts	10	7
Hood latch Torx bolts	10	7
Hood panel bolts	25	18
Coolant expansion tank bolts	10	7

Front End Sheet Metal Repairs - Front End Sheet Metal

Description and Operation

Front end service panels



E55793

Item	Description	Service part No
1	Fender apron panel closing.	R/H ABD780100 L/H ABD780110
2	Fender apron panel reinforcement.	R/H ABD780140 L/H ABD780150
3	Fender apron panel.	R/H ABD780220 L/H ABD780230
4	Front wheelhouse.	R/H ANJ780040 L/H ANJ780050
5	Front side member.	R/H AB1780040 L/H AB1780050
6	Front wheelhouse reinforcement.	R/H AWW780020 L/H AWW780030
7	Front crossmember.	ABC780060
8	Hood latch panel.	DIN500020

Time schedules, front end

The following information shows the total time taken to replace single panels and complete assemblies. This time

includes removal of Mechanical, Electrical and Trim (MET) items, plus paint times based on Metallic Clear Over Base Paint.

The times shown were generated by Thatcham (the motor insurance repair and research centre) and are to be used as a guide only.

Single panel times

Panel Description	Petrol	Diesel
Hood	7.8	7.8
Hood latch panel	2.7	2.7
Front fender L/H	7.5	7.5
Front Fender R/H	7.5	7.5
Front Crossmember	6.0	6.0

Combination panel replacement times

The following panel combination times show the total time to remove/refit body panels, MET items and any paint process.

Combination panel times

Panel Description	Petrol	Diesel
Hood		
Front bumper		
Hood latch panel		
Front crossmember		
Front grille		
Front fender		
Total Time	17.6	17.6

Combination panel times

Panel Description	Petrol	Diesel
Hood		
Front bumper		
Hood latch panel		
Front crossmember		
Front grille		
Front fender L/H and R/H		
Total Time	18.1	18.1

Combination panel times

Panel Description	Petrol	Diesel
Body off integrated frame		
Hood		
Front bumper		
Hood latch panel		
Front side member		
Fender apron panel		
Fender apron panel reinforcement		
Front wheelhouse		
Front crossmember		
Front grille		
Front fender L/H and R/H		
Total Time	L/H 39.2 R/H 39.1	L/H 39.6 R/H 39.4

Combination panel times

Panel Description	Petrol	Diesel
Body off integrated frame		
Hood		
Front bumper		
Hood latch panel		
Front side member L/H and R/H		
Fender apron panel L/H and R/H		
Fender apron panel reinforcement L/H and R/H		
Front wheelhouse L/H and R/H		
Front crossmember		
Front grille		
Front fender L/H and R/H		
Total Time	48.8	49.2

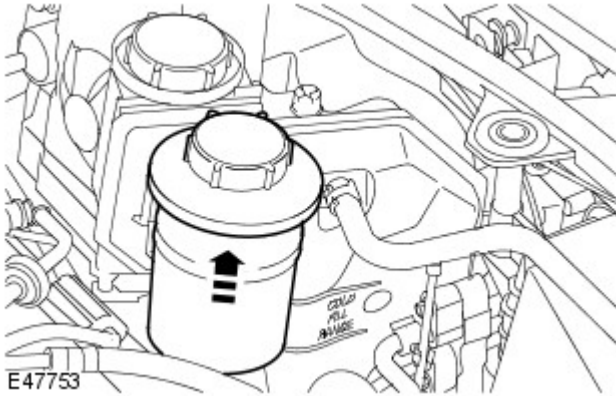
Front End Sheet Metal Repairs - Hood Latch Panel

Removal and Installation

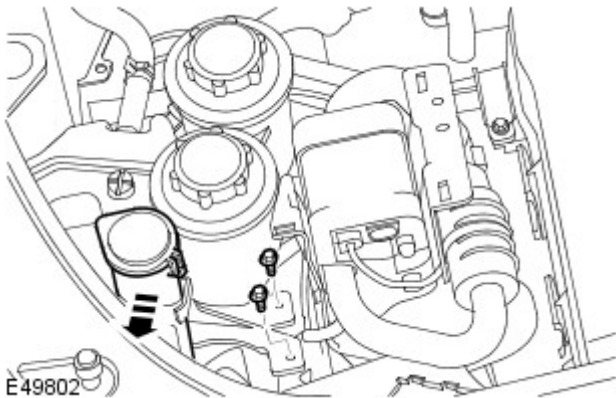
Removal

• **NOTE:** If the hood latch panel coating is damaged or scratched, it must be repaired using the approved coating. For additional information, refer to: [Specifications](#) (501-27 Front End Sheet Metal Repairs, Specifications).

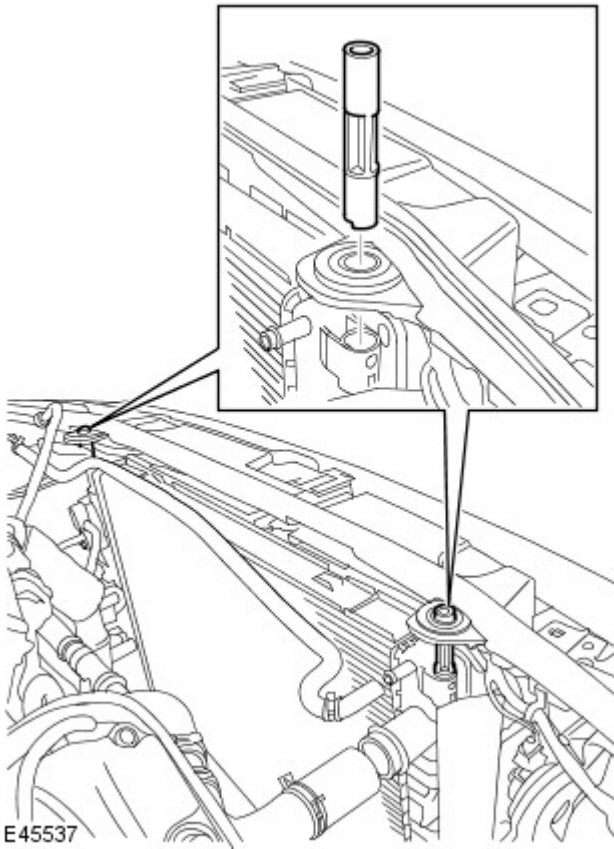
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front bumper.
For additional information, refer to: [Front Bumper](#) (501-19, Removal and Installation).
3. Release the power steering fluid reservoir and position aside.
 - Release the clip.



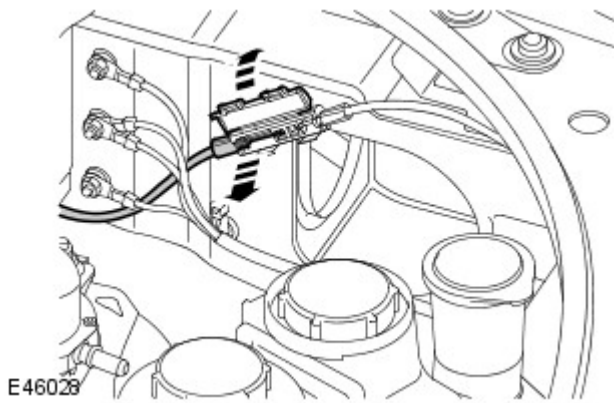
4. Release the washer reservoir filler neck from the coolant tank clip.
5. Remove the 2 coolant expansion tank mounting bolts.
6. Release the coolant expansion tank.
 - Lift coolant expansion tank vertically.



7. Remove the radiator securing pegs.



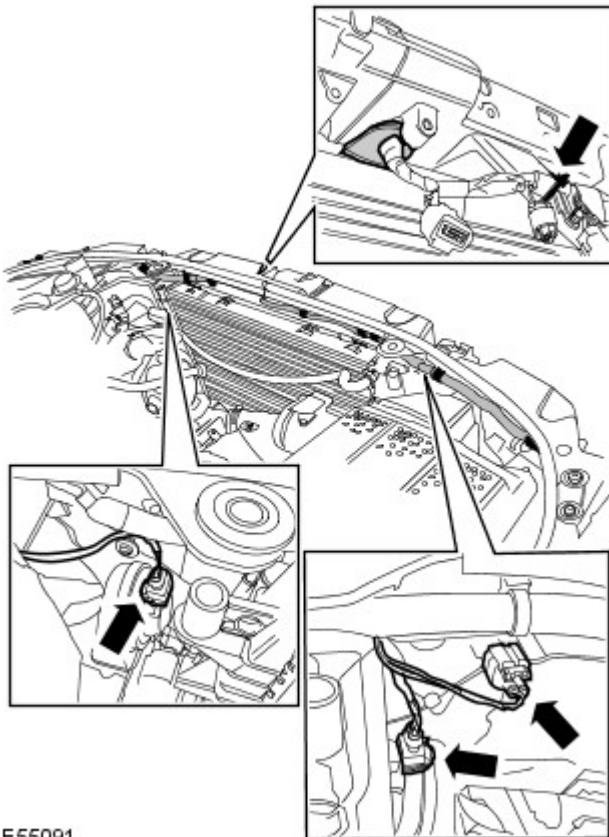
8. Disconnect the hood release cable from the connecting box.



9. NOTE: Note the fitted position.

Release the wiring harness.

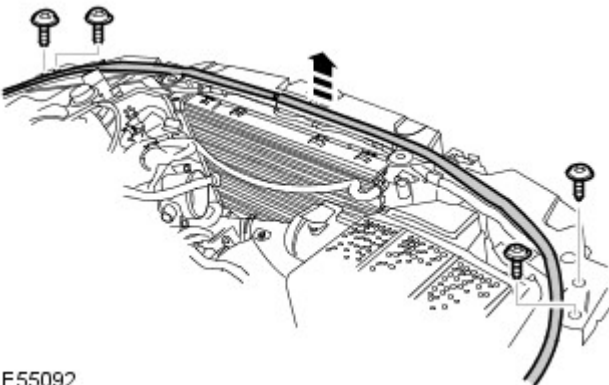
- Disconnect the 3 electrical connectors.
- Release the 9 clips.
- Release the grommet.
- Carefully tie the harness aside.



E55091

10. Remove the panel upper fixings.

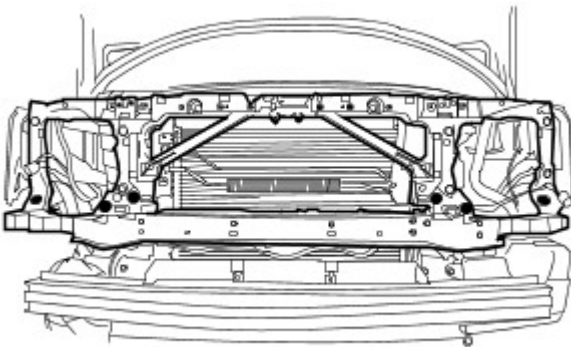
- Remove the 4 Torx bolts.



E55092

11. Remove the panel lower fixings.

- Remove the 6 Torx bolts.



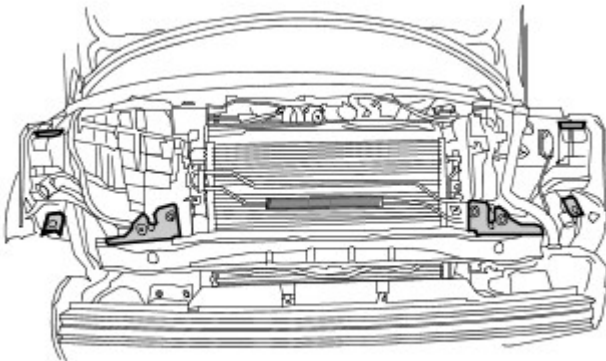
E55093

12. NOTE: Note the fitted position.

With assistance, remove the hood latch panel.

13. Noting the fitted position, remove the 6 spacers.

- Remove the 2 clips.

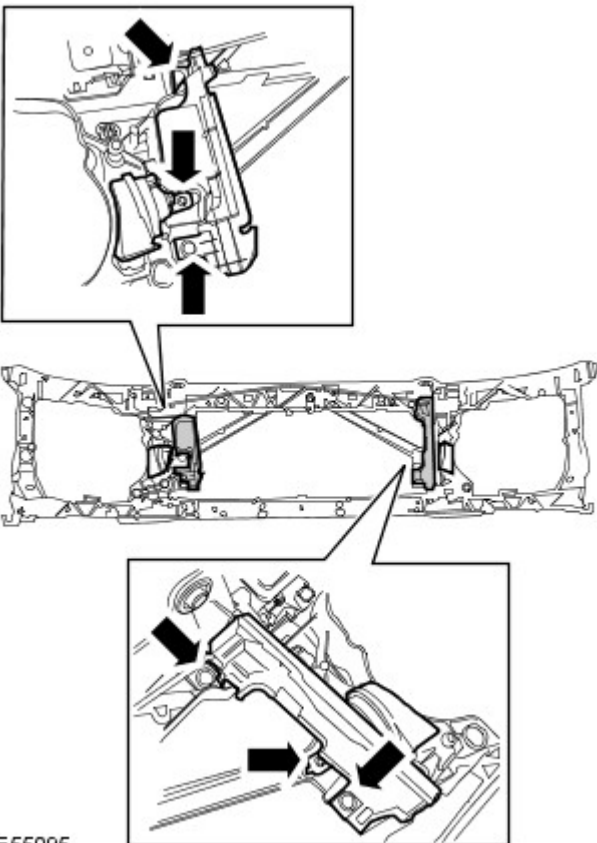


E55094

14. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 2 horn assemblies.

- Remove the 2 air deflectors.
- Remove the 2 Torx bolts.



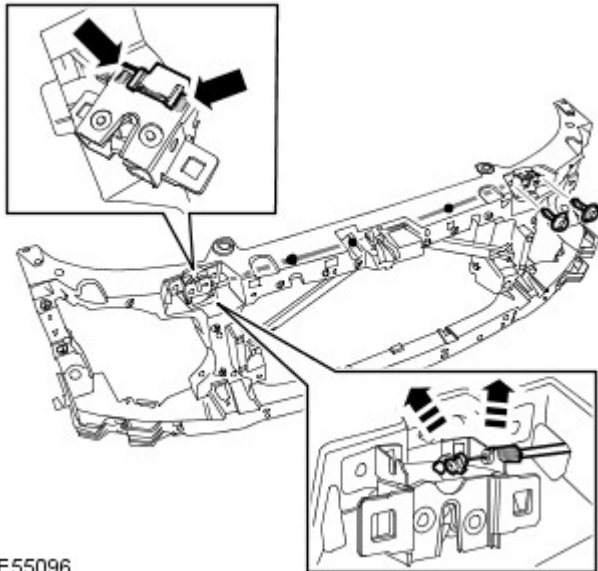
E55095

15. Remove the hood switch.

- Remove the 2 Torx bolts.
- Release the 2 clips.

16. Remove the RH hood latch.

- Release and remove the cable.



E55096

17. Remove the LH hood latch.

- Remove the 2 Torx bolts.

Installation

1. Install the horn assemblies.
 - Install the air deflectors.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
2. Install the LH hood latch.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
3. Install the RH hood latch.
 - Attach the hood release cable.
 - Install the hood switch.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
4. Install the spacers.
 - Install the clips.
5. **NOTE: Align to the position noted on removal.**
 With assistance, install the hood latch panel.
6. Install the panel fixings.
 - Install and tighten the bolts to 25 Nm (18 lb.ft).
7. **NOTE: Align to the position noted on removal.**
 Install the wiring harness.
 - Connect and secure the electrical connector.
 - Carefully secure the clips.
8. Connect the hood release cable.
9. Install the radiator securing pegs.
10. Install the coolant expansion tank.
 - Position the coolant expansion tank, locate the spigot and lug.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
11. Install the windshield washer reservoir filler neck.
 - Locate in clip.
12. Install the power steering fluid reservoir.

- Position and secure to mounting bracket.

13. Install the front bumper.

For additional information, refer to: Front Bumper (501-19, Removal and Installation).

14. Open and close the hood to check the hood latch operation.

15. Adjust both of the hood latches.

- Loosen the 4 hood latch Torx bolts.
- Lower the hood and check for alignment.
- Open the hood and tighten the Torx bolts to 10 Nm (7 lb.ft).
- Check for the correct operation of the hood safety catch.
- If necessary, repeat the above adjustment procedure.

16. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

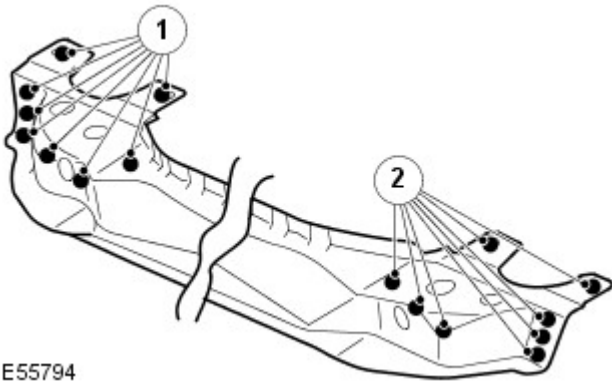
Front End Sheet Metal Repairs - Front Crossmember

Removal and Installation

Removal

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the radiator.
For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
4. Remove both front impact sensors.
For additional information, refer to: [Front Impact Severity Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
5. Release wiring harness from crossmember
6. Remove the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- 7.

Item	Part Number	Description
1	-	8 spot welds.
2	-	8 spot welds.



E55794

8. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Front Side Member

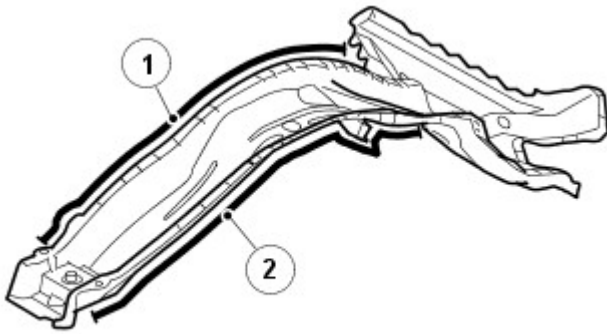
Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
 - NOTE: In this procedure the front side member is replaced in conjunction with hood latch panel, front wheelhouse and the front crossmember.
1. Load vehicle onto ramp.
 2. Disconnect both the battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 3. L/H side: Remove the battery.
 4. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
 5. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 6. Remove the front crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 7. Remove the front wheelhouse.
For additional information, refer to: [Front Wheelhouse](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 8. Remove the hood.
 9. Remove both hood support struts.
 10. Remove the hood wiring harness.
 11. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
 12. Remove both wiper arms and blades.
 13. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
 14. Remove the instrument panel.
For additional information, refer to: Instrument Panel - 2.7L Diesel (501-12 Instrument Panel and Console, Removal and Installation).
 15. Remove the insulation from outer and inner bulkhead.
 16. R/H side: Release the ABS modulator.
 17. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02A Acceleration Control - TDV6 2.7L Diesel, Removal and Installation).
 18. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
 19. Release the wiring harness from bulkhead.
 20. Release the wiring harness from fender apron panel reinforcement.
 21. Release the wiring harness from the side member.
 22. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
 23. Remove the scuff plate trim panel trim.
For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 24. Remove the footrest
 25. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

26. Release the front carpet.

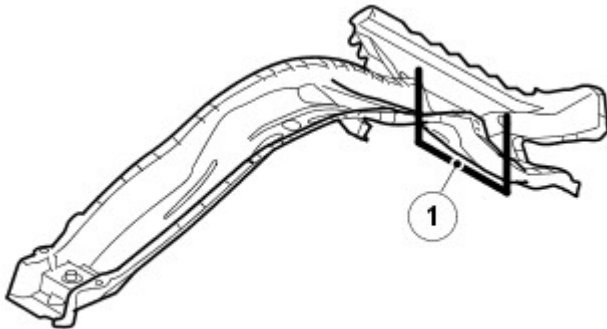
27.



E55830

Item	Part Number	Description
1	-	18 spot welds.
2	-	16 spot welds.

28.



E56906

Item	Part Number	Description
1	-	6 plug welds and a butt weld.

29. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

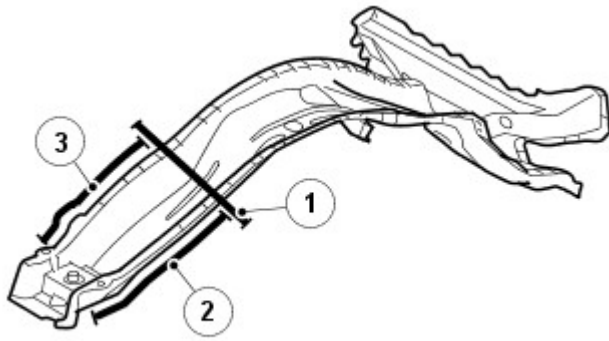
Front End Sheet Metal Repairs - Front Side Member Section

Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
 - NOTE: In this procedure the front side member section is replaced in conjunction with hood latch panel, front wheelhouse and the front crossmember.
1. Load vehicle onto ramp.
 2. Disconnect both the battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 3. L/H side: Remove the battery.
 4. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
 5. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 6. Remove the front wheelhouse.
For additional information, refer to: [Front Wheelhouse](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 7. Remove the front crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 8. Remove the hood.
 9. Remove both hood support struts.
 10. Remove the hood wiring harness.
 11. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
 12. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Cooler - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
 13. Remove the instrument panel.
For additional information, refer to: Instrument Panel - 2.7L Diesel (501-12 Instrument Panel and Console, Removal and Installation).
 14. Remove the insulation from outer and inner bulkhead.
 15. R/H side: Release the ABS modulator.
 16. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02A Acceleration Control - TDV6 2.7L Diesel, Removal and Installation).
 17. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
 18. Release the wiring Harness from bulkhead.
 19. Release the wiring harness from fender apron panel reinforcement.
 20. Release the wiring harness from the side member.
 21. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
 22. Remove the scuff plate trim panel trim
For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 23. Remove the footrest
 24. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 25. Release the front carpet.

26.



E55831

Item	Part Number	Description
1	-	Butt weld
2	-	7 spot welds.
3	-	8 spot welds.

27. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

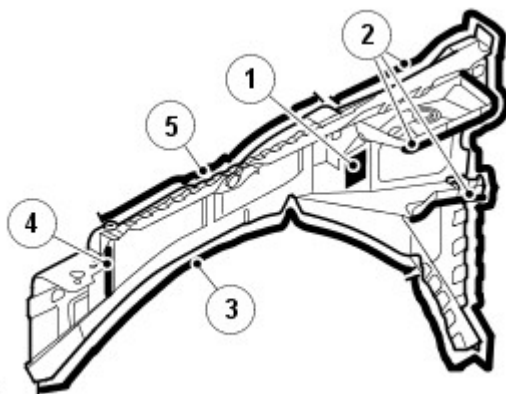
Front End Sheet Metal Repairs - Fender Apron Panel Reinforcement

Removal and Installation

Removal

• NOTE: In this procedure the fender apron panel reinforcement is replaced in conjunction with fender apron panel closing.

1. Disconnect both the battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
6. L/H side: Remove the battery.
7. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: [Fuel Fired Booster Heater](#) (412-02B Auxiliary Heating, Removal and Installation).
8. L/H side: Remove fuel fired booster heater pipes.
9. R/H side: Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
10. R/H side: Release the ABS modulator.
11. Remove the wiring harness.
12. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
13. Remove the hood.
14. Remove both hood support struts.
15. Remove the hood wiring harness.
- 16.



E56916

Item	Part Number	Description
1	-	Acoustic seal.
2	-	34 plug welds.
3	-	13 spot welds.
4	-	3 spot welds.
5	-	14 spot welds.

17. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and

Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

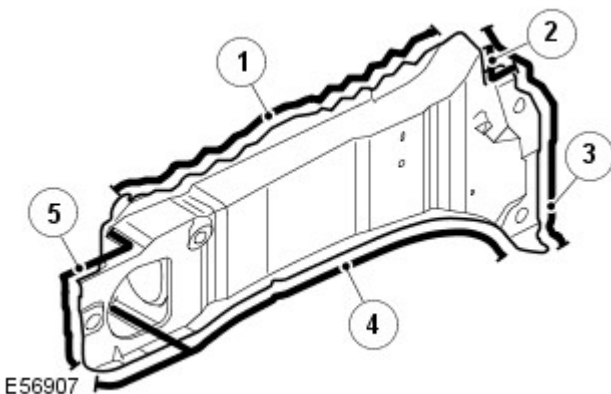
Front End Sheet Metal Repairs - Fender Apron Panel

Removal and Installation

Removal

1. Disconnect both the battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the radiator.
For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
5. Remove the radiator coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
6. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
7. Remove the hood.
8. Remove both hood support struts.
9. Remove the hood wiring harness.
10. Remove both wiper arms and blades.
11. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
12. L/H side: Remove the battery.
13. Remove the wiring harness
14. R/H side: Release the ABS modulator.
15. Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
16. Remove the insulation from outer bulkhead.
17. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: [Fuel Fired Booster Heater](#) (412-02B Auxiliary Heating, Removal and Installation).
18. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).

19.



E56907

Item	Part Number	Description
1	-	14 spot-welds.
2	-	2 mig welds.
3	-	11 mig-plug welds
4	-	19 mig-plug welds.
5	-	5 mig-plug welds.

20. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Fender Apron Panel Section

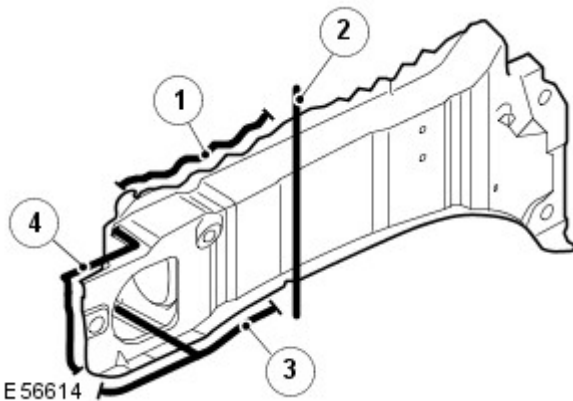
Removal and Installation

Removal

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the radiator coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
5. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
6. Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
7. Remove the hood.
8. Remove both hood support struts.
9. Remove the hood wiring harness.
10. L/H side: Remove the battery.
11. Remove the Wiring harness.
12. R/H side: Release the ABS modulator.
13. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
14. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).

15.

Item	Part Number	Description
1	-	5 spot-welds
2	-	Butt weld
3	-	9 mig-plug welds.
4	-	5 mig-plug welds.



16. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Front Wheelhouse

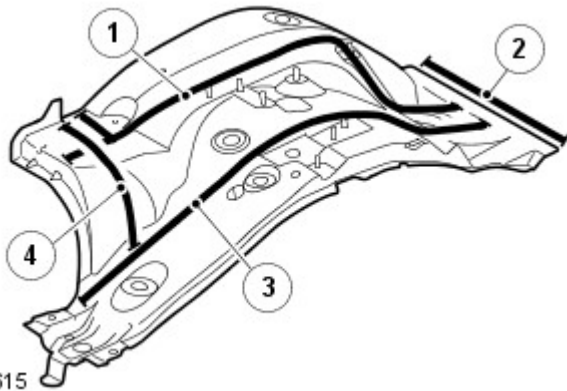
Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
- NOTE: In this procedure the front wheelhouse is replaced in conjunction with the front side member, hood latch panel and front crossmember.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front side member.
For additional information, refer to: [Front Side Member](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).

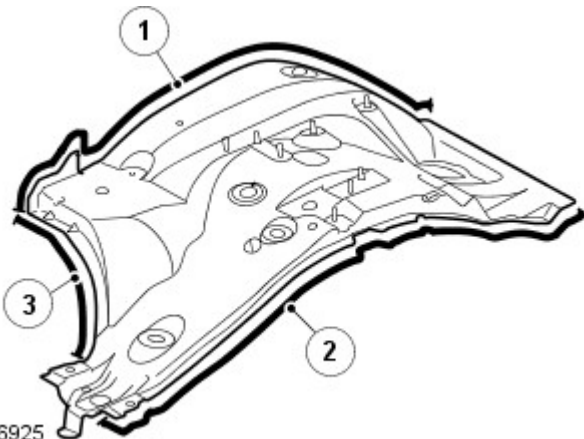
5.



E56615

Item	Part Number	Description
1	-	19 plug welds.
2	-	9 plug welds.
3	-	18 spot welds.
4	-	7 plug welds.

6.



E56925

Item	Part Number	Description
1	-	13 spot welds.
2	-	16 spot welds.
3	-	9 spot welds.

7. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Front Wheelhouse Reinforcement

Removal and Installation

Removal

• **NOTE:** In this procedure the front wheelhouse reinforcement is replaced in conjunction with the front side member and front wheelhouse.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front side member.
For additional information, refer to: [Front Side Member](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the front wheelhouse.
For additional information, refer to: [Front Wheelhouse](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
- 4.



E56616

Item	Part Number	Description
1	-	4 spot welds.
2	-	7 plug welds.
3, 4	-	20 plug welds.
5	-	9 spot welds.

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

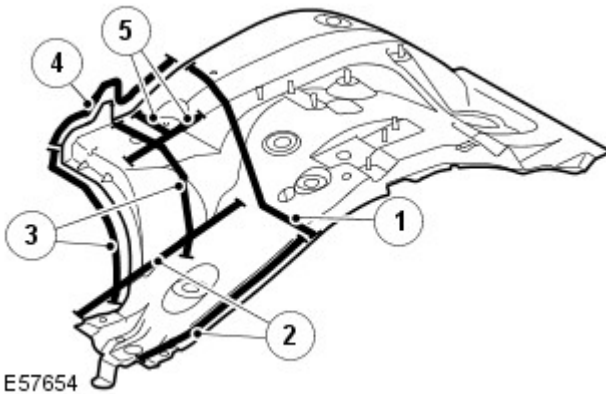
Front End Sheet Metal Repairs - Front Wheelhouse Section

Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
- NOTE: In this procedure the front wheelhouse section is replaced in conjunction with the front side member section, front wheelhouse reinforcement, hood latch panel and front crossmember.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front side member section.
For additional information, refer to: [Front Side Member Section](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the front wheelhouse reinforcement.
For additional information, refer to: [Front Wheelhouse Reinforcement](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
5. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
- 6.



Item	Part Number	Description
1	-	Butt weld
2	-	15 spot welds.
3	-	7 plug welds, 9 spot welds.
4	-	20 spot welds.
5	-	9 plug welds.

7. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

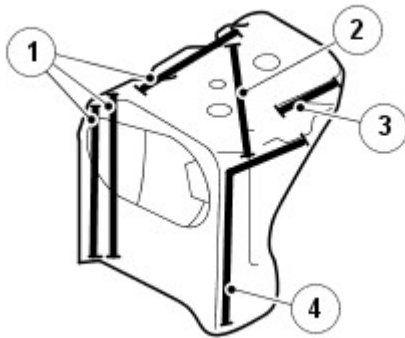
Front End Sheet Metal Repairs - Fender Apron Panel Closing Panel

Removal and Installation

Removal

• NOTE: In this procedure the fender apron closing panel is replaced in conjunction with the fender apron panel or the fender apron panel reinforcement.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the fender apron panel.
For additional information, refer to: [Fender Apron Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the fender apron panel reinforcement.
For additional information, refer to: [Fender Apron Panel Reinforcement](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
- 4.



E56612

Item	Part Number	Description
1	-	7 plug welds.
2	-	2 spot welds.
3	-	2 spot welds.
4	-	5 plug welds.

5. For additional information:
 - Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
 - Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
 - Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

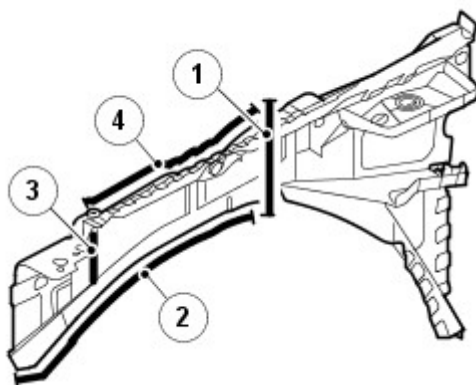
Front End Sheet Metal Repairs - Fender Apron Panel Reinforcement Front Section

Removal and Installation

Removal

• NOTE: In this procedure the fender apron panel reinforcement front section is replaced in conjunction with fender apron panel closing.

1. Disconnect both the battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. L/H side: Remove the radiator coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
6. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
7. L/H side: Remove the battery.
8. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: [Fuel Fired Booster Heater](#) (412-02B Auxiliary Heating, Removal and Installation).
9. L/H side: Remove fuel fired booster heater pipes.
10. R/H side: Release the ABS modulator.
11. Remove the wiring harness.
12. Remove the hood.
13. Remove both hood support struts.
14. Remove the hood wiring harness.
- 15.



E56613

Item	Part Number	Description
1	-	Butt weld.
2	-	20 spot welds.
3	-	3 spot welds.
4	-	11 spot welds.

16. For additional information:

Installation

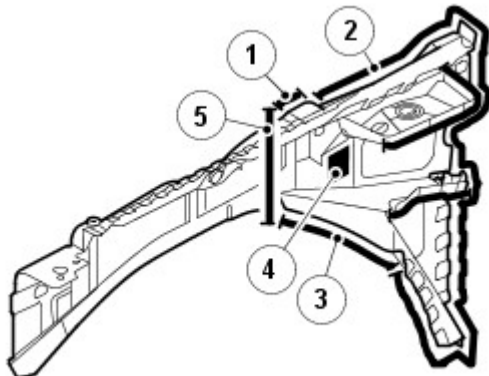
1. Install the reinforcement front section.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
 - Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
 - Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Front End Sheet Metal Repairs - Fender Apron Panel Reinforcement Rear Section

Removal and Installation

Removal

1. Disconnect both the battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
4. L/H side: Remove the battery.
5. R/H side: Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
6. R/H side: Release the ABS modulator.
7. Remove the wiring harness.
8. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
9. Remove the hood.
10. Remove both hood support struts.
11. Remove the hood wiring harness.
- 12.



E56917

Item	Part Number	Description
1	-	3 spot welds.
2	-	34 plug welds.
3	-	7 spot welds.
4	-	Acoustic seal.
5	-	Butt weld.

13. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

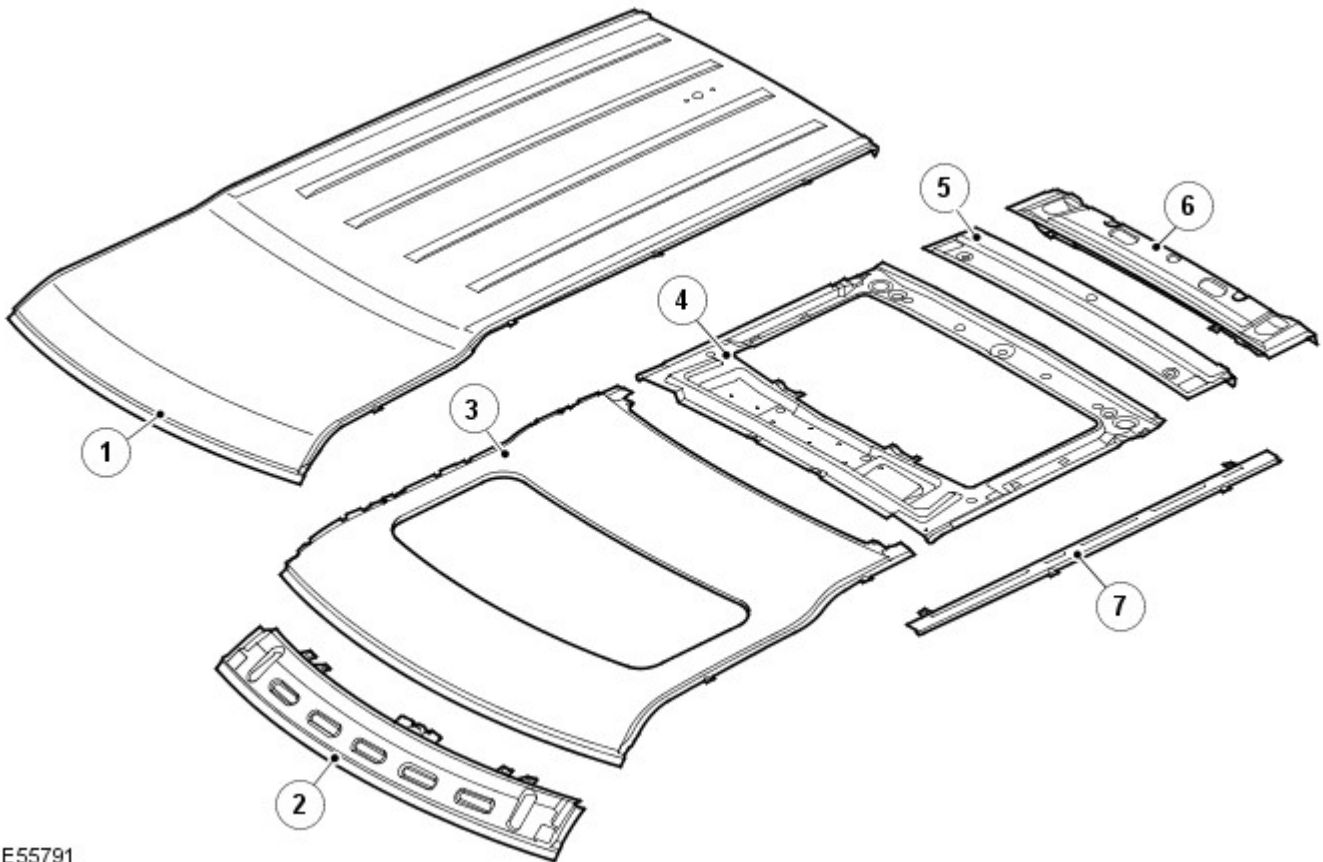
Installation

1. Install is the reversal of removal.

Roof Sheet Metal Repairs - Roof

Description and Operation

Roof service panels



E55791

Item	Description	Service part No
1	Roof panel	AKA780012
2	Header assembly	AKC780050
3	Roof panel (with roof opening panel)	AKB780040
4	Roof reinforcement	AKR780080
5	Roof reinforcement	AKB780031
6	Rear assembly	AKC780090
7	Rail assembly	R/H AK1780021 L/H AK1780031

paragraph

Time schedules, front end

The following information shows the total time taken to replace single panels and complete assemblies. This time includes removal of Mechanical, Electrical and Trim (MET) items, plus paint times based on Metallic Clear Over Base Paint.

The times shown were generated by Thatcham (the motor insurance repair and research centre) and are to be used as a guide only.

Single panel times

Panel Description	Petrol	Diesel
Roof panel	25.8	25.8
Roof glass support panel	1.1	1.1

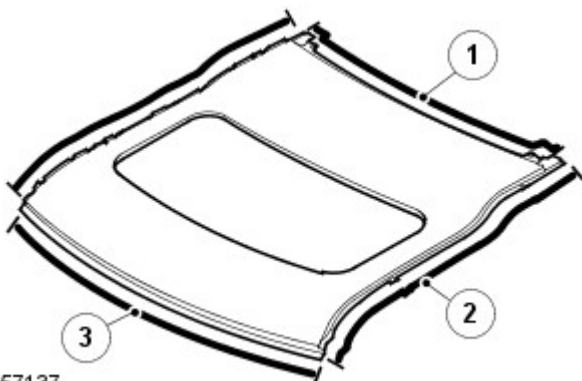
Roof Sheet Metal Repairs - Roof Panel

Removal and Installation

Removal

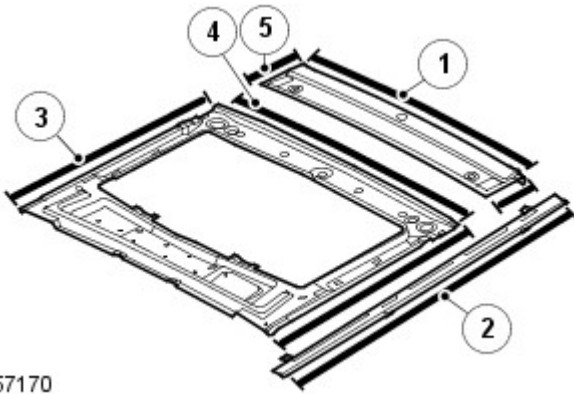
- NOTE: The roof opening panel is supplied with the reinforcement roof aperture.
- NOTE: This procedure shows removal of the roof opening panel. For vehicles with a fixed roof, the procedure is similar.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove both side air curtain modules.
For additional information, refer to: [Side Air Curtain Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
3. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
4. Remove both rear quarter window glass.
For additional information, refer to: [Rear Quarter Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
5. If applicable, remove roof opening panel.
For additional information, refer to: [Roof Opening Panel](#) (501-17 Roof Opening Panel, Removal and Installation).
6. If applicable, remove glass roof panel.
For additional information, refer to: [Glass Roof Panel](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
7. Remove both front seats.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
8. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
9. Release the wiring harness from both A-pillars.
10. Release the wiring harness from the roof.
11. Remove the liftgate.
12. Remove both front door and rear door aperture weatherstrip.
13. Remove the tailgate weatherstrip.
14. Remove both front safety belt retractors.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
15. Remove both second row safety belt retractors.
For additional information, refer to: [Second Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
16. If applicable, remove both third row safety belt retractors.
For additional information, refer to: [Third Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
17. Release the carpet
18. Remove the load space trims.
19. Remove the load space carpets.
- 20.



E57137

Item	Part Number	Description
1	-	33 spot welds.
2	-	31 spot welds. (R/H is symmetrically opposite to L/H).
3	-	43 spot welds.



E57170

21.

Item	Part Number	Description
1	-	12 plug welds and 27 spot welds.
2	-	7 plug welds and 40 spot welds (R/H is symmetrically opposite to L/H).
3	-	23 spot welds.
4	-	32 spot welds.
5	-	4 plug welds. (R/H is symmetrically opposite to L/H).

22. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

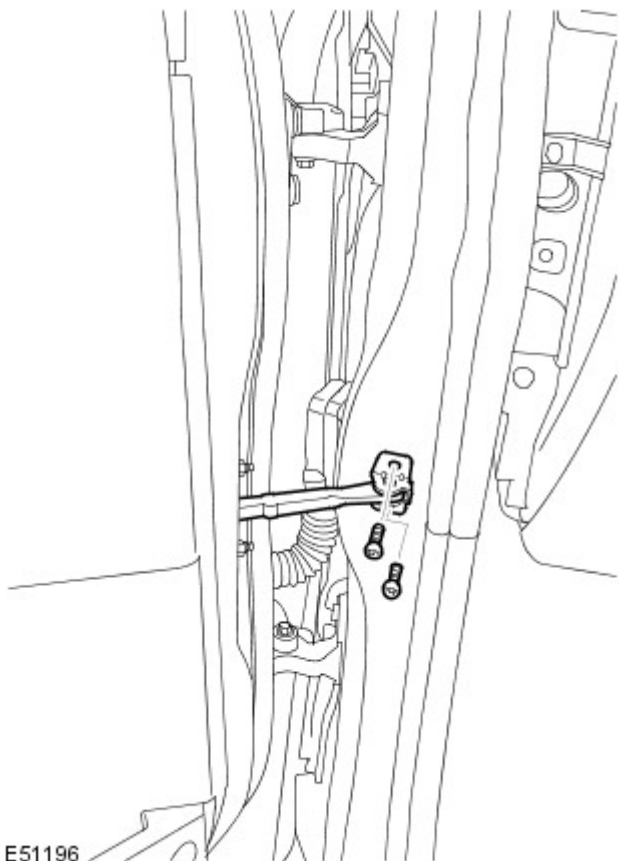
1. Install is the reversal of removal.

Side Panel Sheet Metal Repairs - Rocker Panel

Removal and Installation

Removal

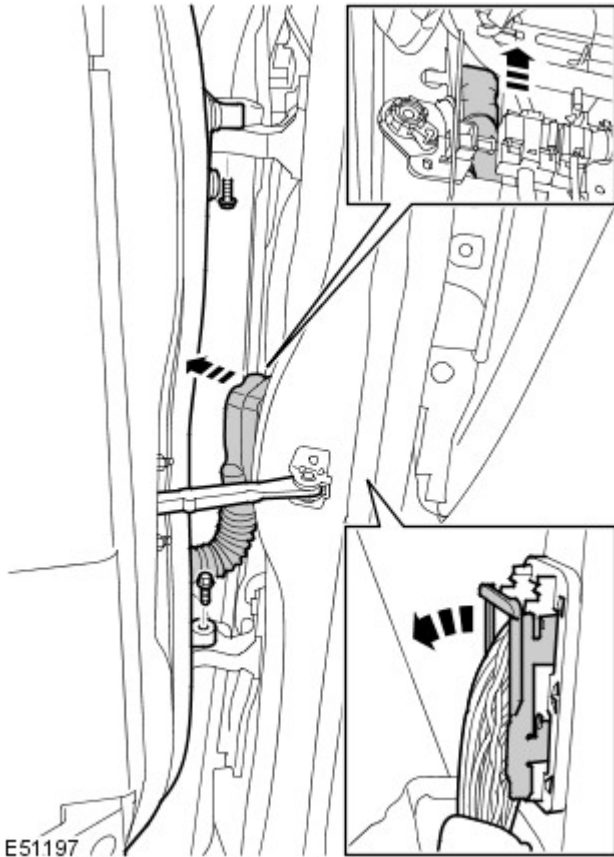
1. Load vehicle onto ramp.
2. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove the rear wheel and tire.
4. Remove the rear fender splash shield.
5. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
6. Release the front door check strap from the A-pillar and release the rear door check strap from the B-pillar.
 - Remove the 2 Torx bolts.



E51196

7. Remove the front and rear door assemblies.

- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts



8. Remove the front and rear door weatherstrips.

9. Remove the front seat.

For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

10. Remove the rear seat.

For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).

11. Remove the cowl side trim panel.

For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

12. Release the wiring harness from A-pillar.

13. Remove the front safety belt retractor.

For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).

14. Remove the B-pillar side impact sensor.

For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).

15. Remove the second row safety belt retractor.

For additional information, refer to: [Second Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).

16. Remove the C-pillar side impact sensor.

For additional information, refer to: [C-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).

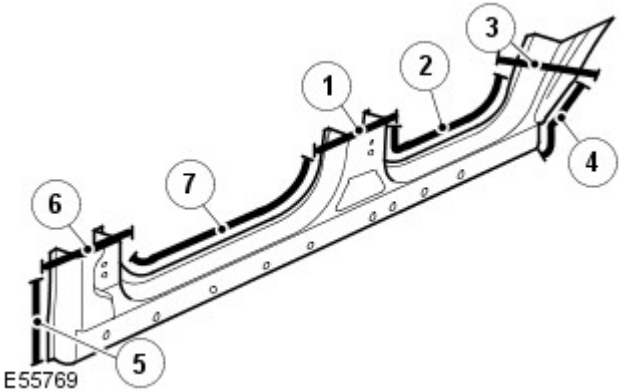
17. Release the rocker panel and B-pillar wiring harness.

18. Release the carpet away from the area of repair.

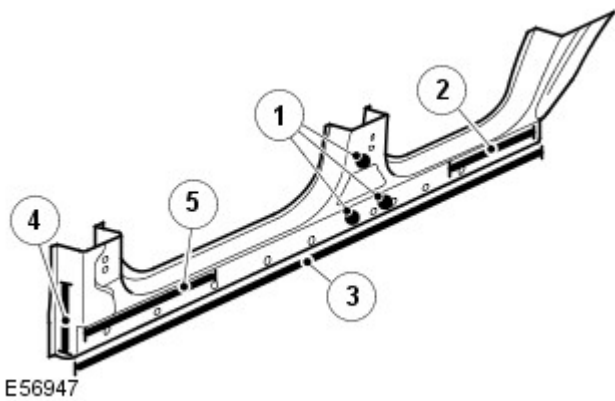
19. Release the wiring harness from rocker panel and B-pillar.

20. Remove the rocker panel finisher.

21.



Item	Part Number	Description
1	-	Butt weld.
2	-	20 spot-welds.
3	-	Butt weld.
4	-	9 spot welds.
5	-	8 spot welds.
6	-	Butt weld.
7	-	35 spot welds.



22.

Item	Part Number	Description
1	-	3 plug welds.
2	-	3 plug welds.
3	-	38 plug welds.
4	-	3 plug welds.
5	-	4 plug welds.

23. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#)
(501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#)
(501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#)
(501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

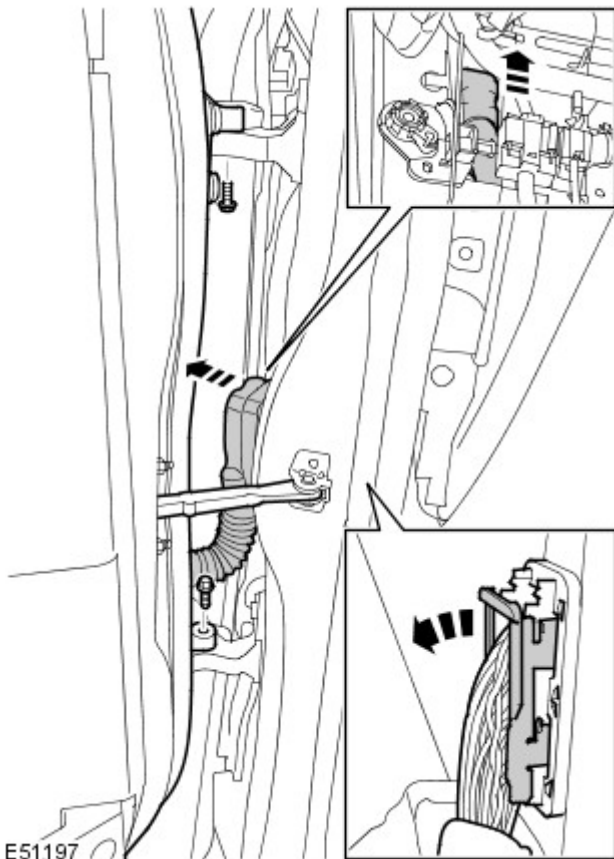
Side Panel Sheet Metal Repairs - A-Pillar Outer Panel

Removal and Installation

Removal

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
3. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. R/H side: Remove the ABS module.
For additional information, refer to: [Anti-Lock Brake System \(ABS\) Module](#) (206-09A Anti-Lock Control - Traction Control, Removal and Installation).
6. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02A Acceleration Control - TDV6 2.7L Diesel, Removal and Installation).
7. R/H side: Remove the brake booster.
For additional information, refer to: [Brake Booster](#) (206-07, Removal and Installation).
8. Remove the front door assembly.

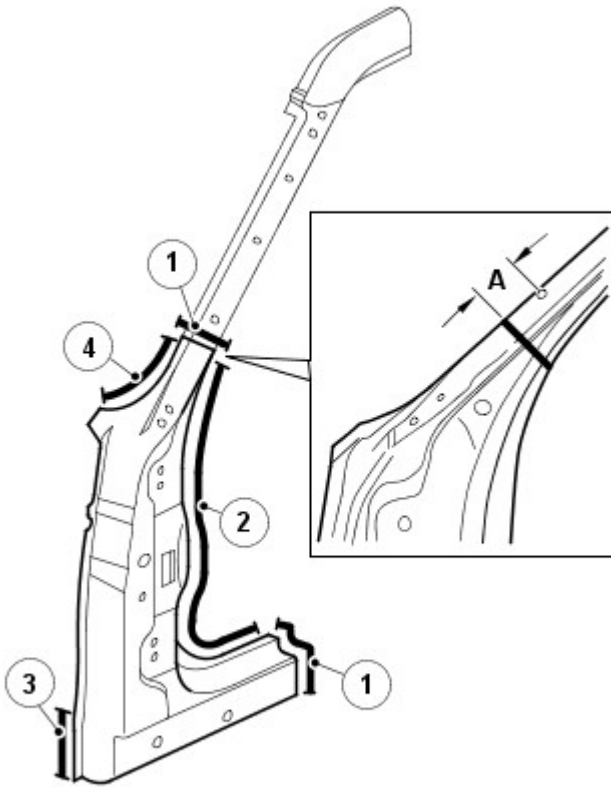
- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts



9. Remove the insulation from the outer and inner bulkhead.
10. Remove the front and rear door weatherstrip.
11. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
12. Release the A-Pillar wiring harness.
13. Remove the footrest.

14. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
15. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
16. Remove the rocker panel outer trim.
17. Release the front carpet.
- 18.

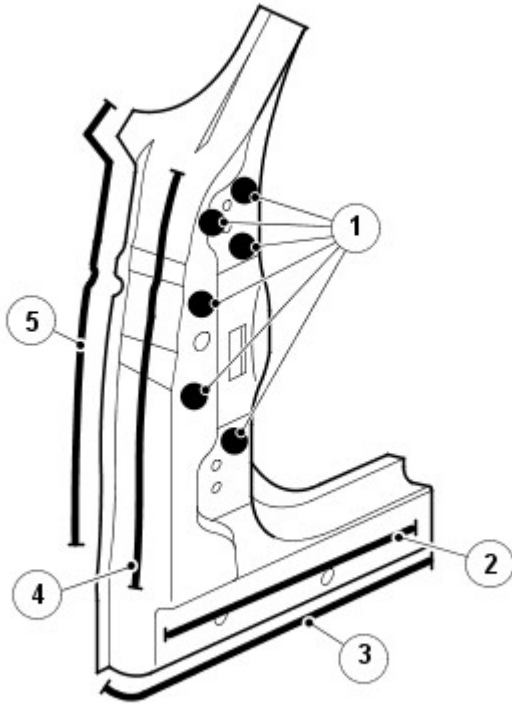
Item	Part Number	Description
A	-	Cut line 55mm (2.165 inches) from A-Pillar trim hole.
1	-	Butt welds.
2	-	30 spot welds.
3	-	8 spot welds.
4	-	15 spot welds.



E55944

19.

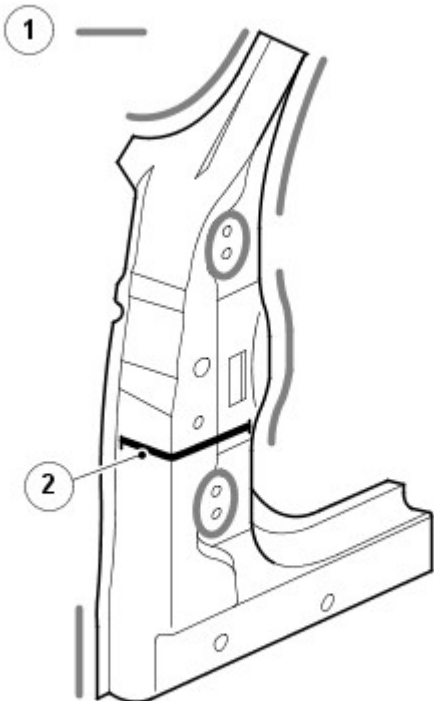
Item	Part Number	Description
1	-	6 plug welds.
2	-	4 plug welds.
3	-	12 plug welds.
4	-	10 plug welds.
5	-	13 plug welds.



E57675

20.

Item	Part Number	Description
1	-	Areas of adhesive.
2	-	Acoustic seal.



E57676

21. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

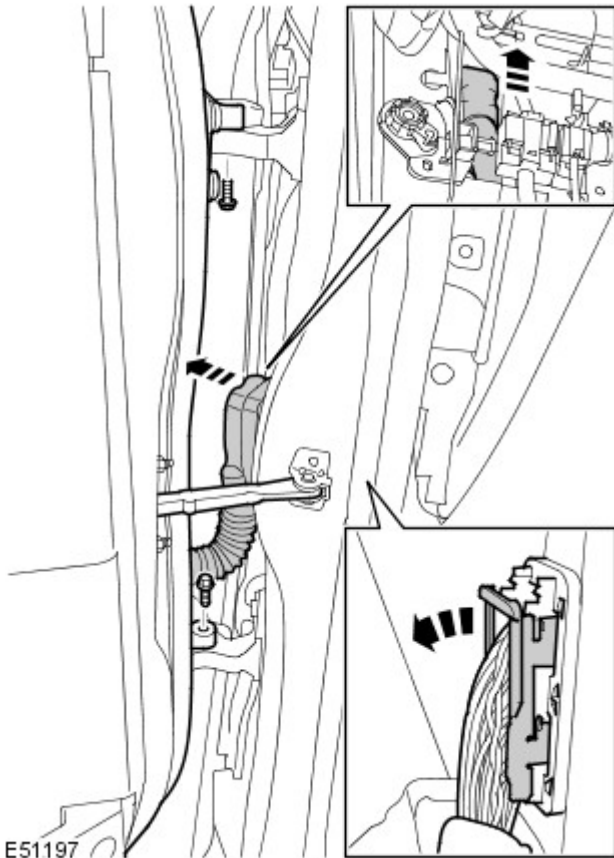
Side Panel Sheet Metal Repairs - Side Panel

Removal and Installation

Removal

1. Load vehicle onto ramp.
2. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
4. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
5. Remove the front and rear door assemblies.

- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts

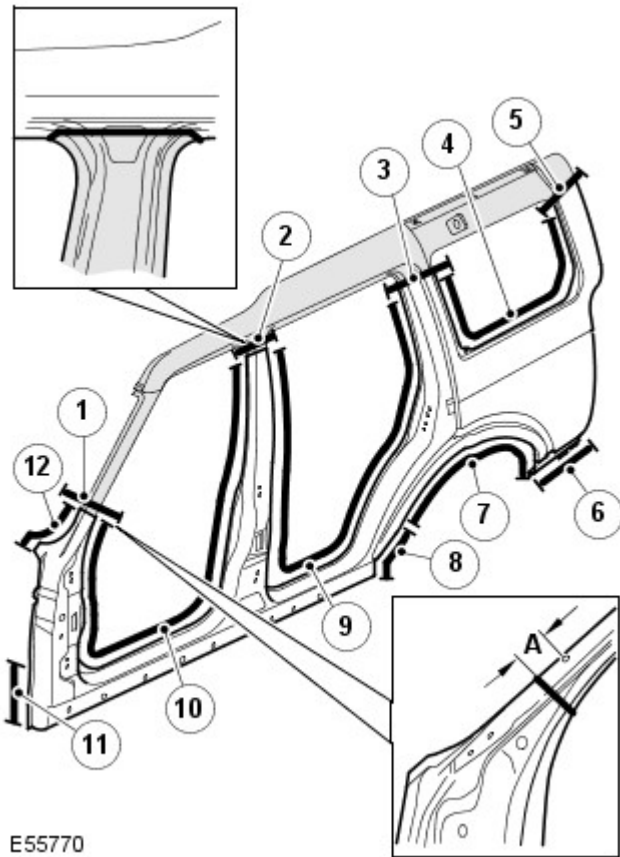


E51197

6. Remove front and rear door strikers.
7. Remove the insulation from the outer and inner bulkhead.
8. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
9. Release the A-Pillar wiring harness.
10. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
11. R/H side: Remove the brake booster.
For additional information, refer to: [Brake Booster](#) (206-07 Power Brake Actuation, Removal and Installation).
12. R/H side: Remove the ABS module.
For additional information, refer to: [Anti-Lock Brake System \(ABS\) Module](#) (206-09A Anti-Lock Control - Traction Control, Removal and Installation).
13. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02A Acceleration Control - TDV6 2.7L Diesel, Removal and Installation).

14. Remove the footrest.
15. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
16. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
17. Remove the front and rear door weatherstrip.
18. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
19. Remove the Second row safety belt retractor.
For additional information, refer to: [Second Row Center Safety Belt Retractor - Vehicles With: 60/40 Split Seat](#) (501-20A Safety Belt System, Removal and Installation).
20. Remove the third row safety belt retractor.
For additional information, refer to: [Third Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
21. Remove the B-Pillar side impact sensor.
For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
22. Remove the side air curtain module.
For additional information, refer to: [Side Air Curtain Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
23. Remove the C-Pillar side impact sensor.
For additional information, refer to: [C-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
24. Remove the wiring harness from the B-Pillar.
25. Release the wiring harness from the rocker panel.
26. Release wiring harness from roof panel.
27. Remove the rocker panel outer trim.
28. Release the front and back carpet.
29. Remove rear wheel and tire.
30. Remove rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
31. Remove forced air extraction grille.
32. R/H side: Remove fuel tank.
For additional information, refer to: [Fuel Tank](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation).
33. R/H side: Remove the fuel tank filler pipe.
For additional information, refer to: [Fuel Tank Filler Pipe](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation).
34. R/H side: Remove the fuel filler interlock catch.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).
35. Remove the rear quarter window glass.
For additional information, refer to: [Rear Quarter Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
36. Remove the exhaust heatshields.
37. Remove the tailgate latch.
For additional information, refer to: [Liftgate Latch](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).
38. Remove tailgate weatherstrip.
39. With assistance remove the tailgate.
40. Remove the load space trims.
41. Remove the load space carpets.
42. Release wiring harness.

43.

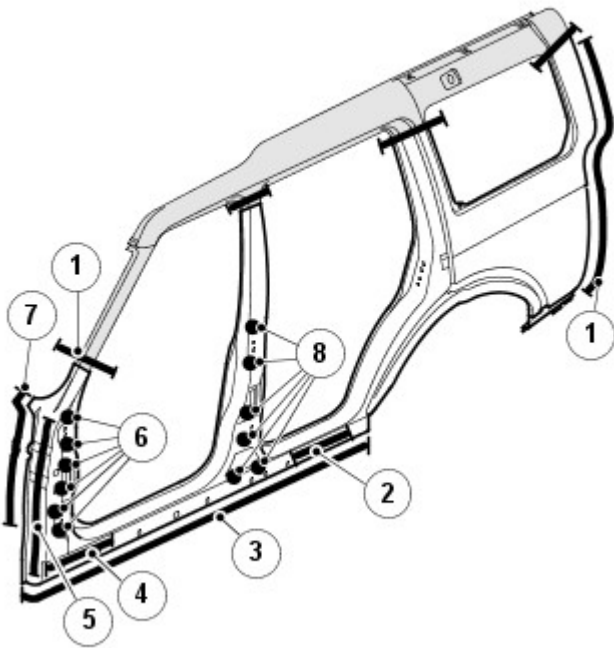


E55770

Item	Part Number	Description
A	-	Cut line is 55mm (2.165 inches) from A-Pillar trim hole.
1	-	Butt weld.
2	-	Cut line and butt weld.
3	-	Butt weld.
4	-	50 spot welds.
5	-	Butt weld.
6	-	5 spot welds.
7	-	40 spot welds.
8	-	9 spot welds.
9	-	100 spot welds.
10	-	98 spot welds.
11	-	8 spot welds.
12	-	15 spot welds.

44.

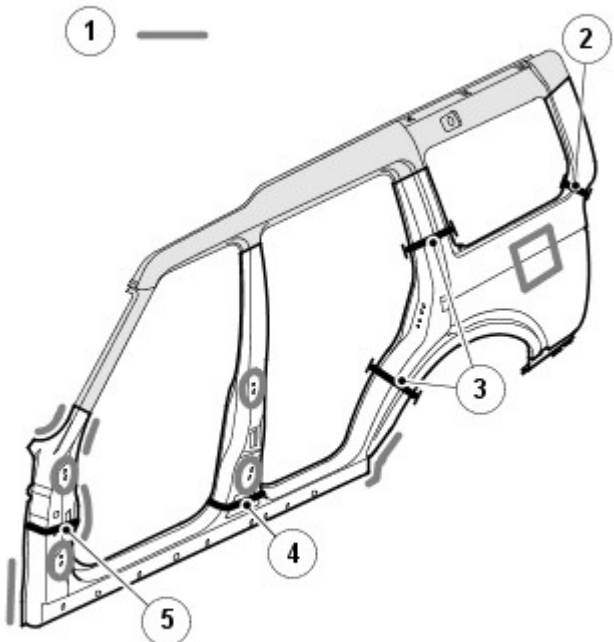
Item	Part Number	Description
1	-	22 plug welds.
2	-	3 plug welds.
3	-	38 plug welds.
4	-	4 plug welds.
5	-	10 plug welds.
6	-	6 plug welds.
7	-	13 plug welds.
8	-	6 plug welds.



E57699

45.

Item	Part Number	Description
1	-	Areas of adhesive.
2	-	Acoustic seal.
3	-	Acoustic seals.
4	-	Acoustic seal.
5	-	Acoustic seal.



E57700

46. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#)
(501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: Corrosion Protection (501-25B, Description and Operation).
- Tolerance checks.
For additional information, refer to: Body and Frame (501-26, Description and Operation).

Installation

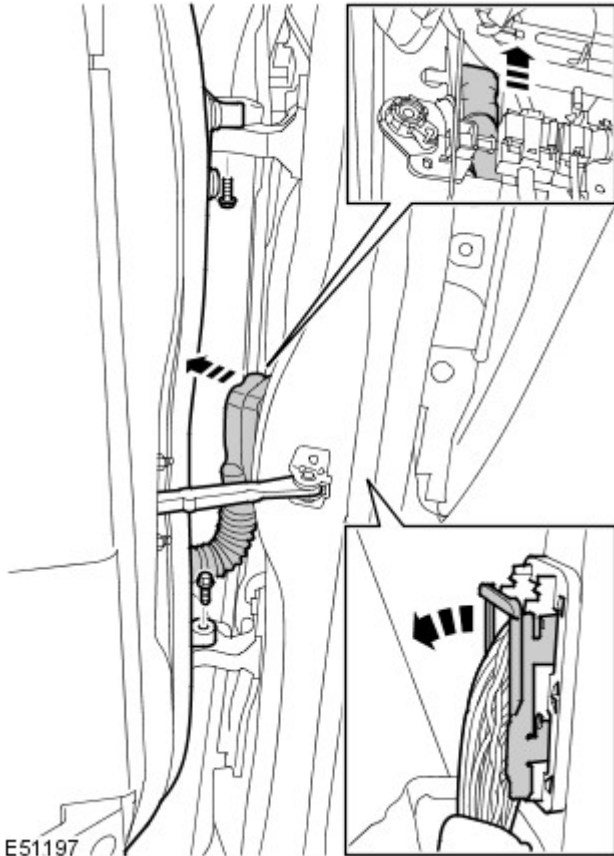
1. Install is the reversal of removal.

Side Panel Sheet Metal Repairs - B-Pillar Outer Panel

Removal and Installation

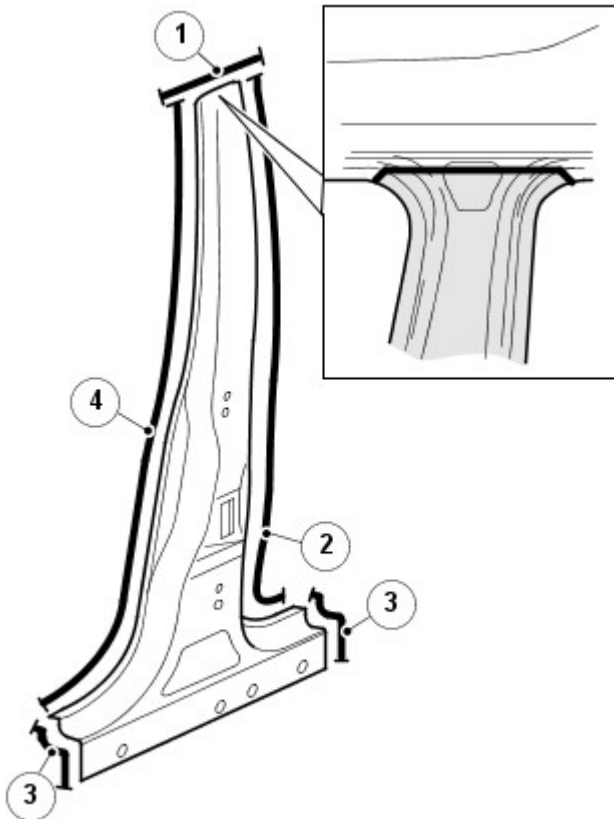
Removal

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the rear door assembly.



- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts

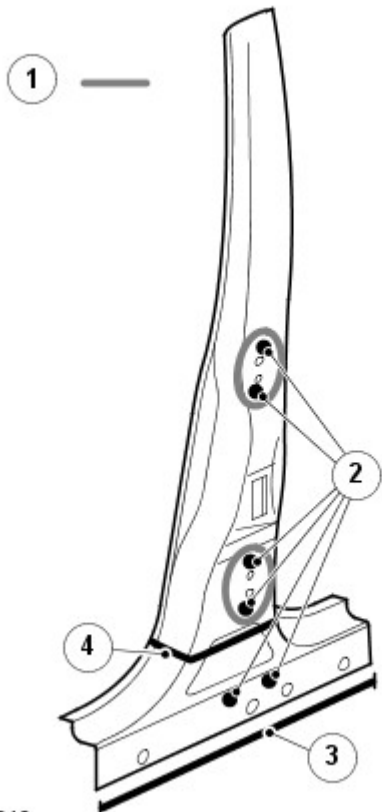
3. Remove front door striker.
4. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
5. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
6. Remove the B-pillar side impact sensor.
For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
7. Remove the side air curtain module.
For additional information, refer to: [Side Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
8. Remove the wiring harness from the B-pillar.
9. Release the wiring harness from the rocker panel.
10. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
11. Remove the rocker panel outer trim.
12. Release the carpet.



E55946

13.

Item	Part Number	Description
1	-	Cut line and butt weld.
2,4	-	81 spot welds.
3	-	Butt welds.



E57346

14.

Item	Part Number	Description
1	-	Adhesive.
2	-	6 plug welds.
3	-	19 plug welds.
4	-	Acoustic seal.

15. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

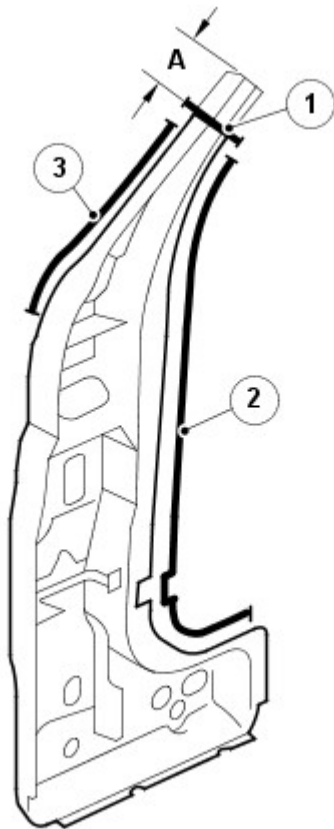
Side Panel Sheet Metal Repairs - A-Pillar Reinforcement

Removal and Installation

Removal

- NOTE: In this procedure the A-Pillar reinforcement is replaced in conjunction with the A-Pillar outer panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the A-Pillar outer panel.
For additional information, refer to: [A-Pillar Outer Panel](#) (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
3. Remove the instrument panel.
For additional information, refer to: Instrument Panel - 2.7L Diesel (501-12, Removal and Installation).
- 4.

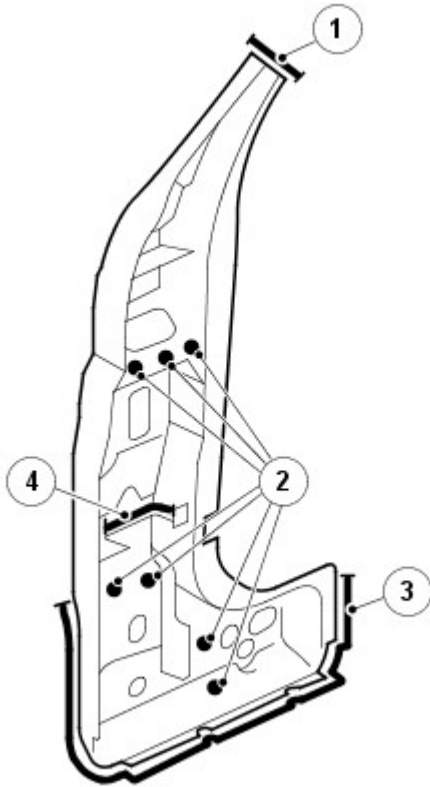


Item	Part Number	Description
A	-	Cut line 80mm (3.149 inches) from edge of A Pillar reinforcement.
1	-	Butt weld.
2	-	30 spot welds.
3	-	17 spot welds.

E55945

5.

Item	Part Number	Description
1	-	Butt weld
2	-	7 Plug welds.
3	-	16 plug welds.
4	-	Acoustic seal.



E57677

6. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Side Panel Sheet Metal Repairs - B-Pillar Reinforcement

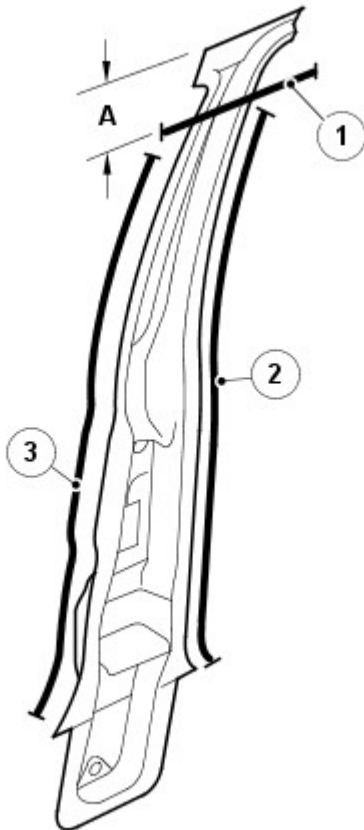
Removal and Installation

Removal

- NOTE: In this procedure the B-Pillar reinforcement is replaced in conjunction with the B-pillar outer panel.
- NOTE: The B-Pillar closing panel is fitted with the B-Pillar reinforcement.

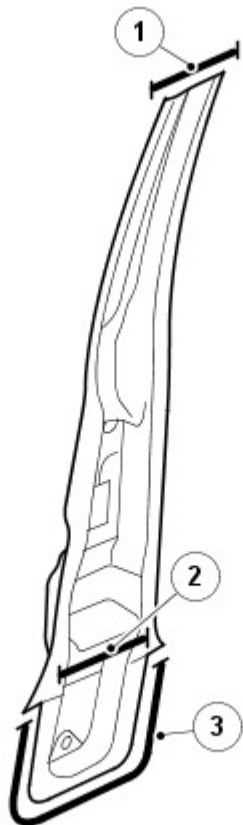
1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the B-pillar outer panel.
For additional information, refer to: [B-Pillar Outer Panel](#) (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).

3.



Item	Part Number	Description
A	-	Cut line 140.0mm (5.51 inches)
1	-	Butt weld.
2,3	-	81 spot welds. (including the B-Pillar closing panel.)

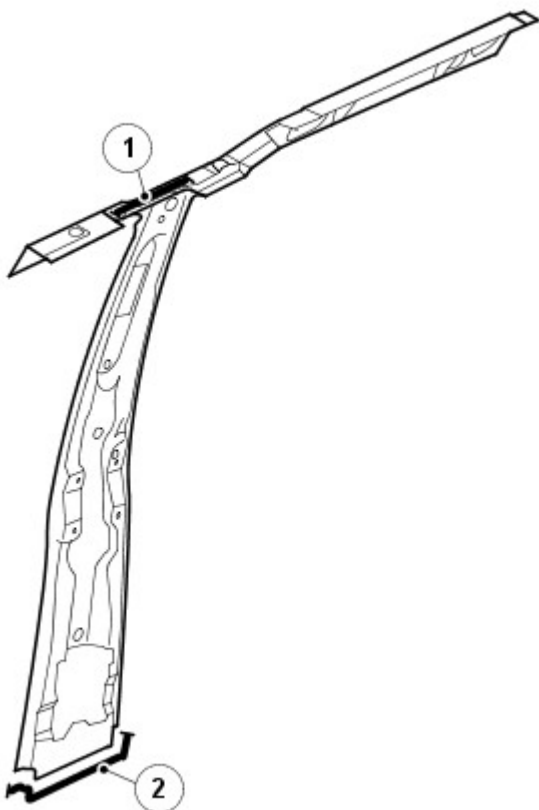
E55947



E57347

4.

Item	Part Number	Description
1	-	Butt weld.
2	-	Acoustic seal.
3	-	12 plug welds.



E55948

5. The B-Pillar closing panel is supplied with the cantrail. Remove the B-Pillar closing panel from the cantrail and fit the B-pillar closing panel to the B-Pillar reinforcement, as shown in graphic E55948 and E55947.

Item	Part Number	Description
1	-	9 plug welds.
2	-	4 spot welds.

6. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

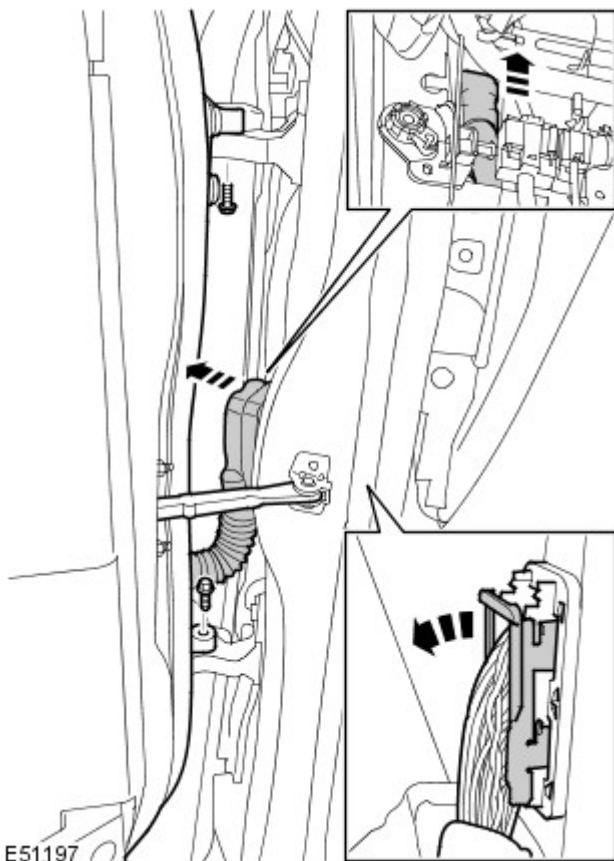
Side Panel Sheet Metal Repairs - Side Panel Front Section

Removal and Installation

Removal

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
3. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. R/H side: Remove the brake booster.
For additional information, refer to: Brake Booster (206-07, Removal and Installation).
6. R/H side: Remove the ABS module.
For additional information, refer to: [Anti-Lock Brake System \(ABS\) Module](#) (206-09A Anti-Lock Control - Traction Control, Removal and Installation).
7. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02A Acceleration Control - TDV6 2.7L Diesel, Removal and Installation).
8. Remove the front and rear door assemblies.

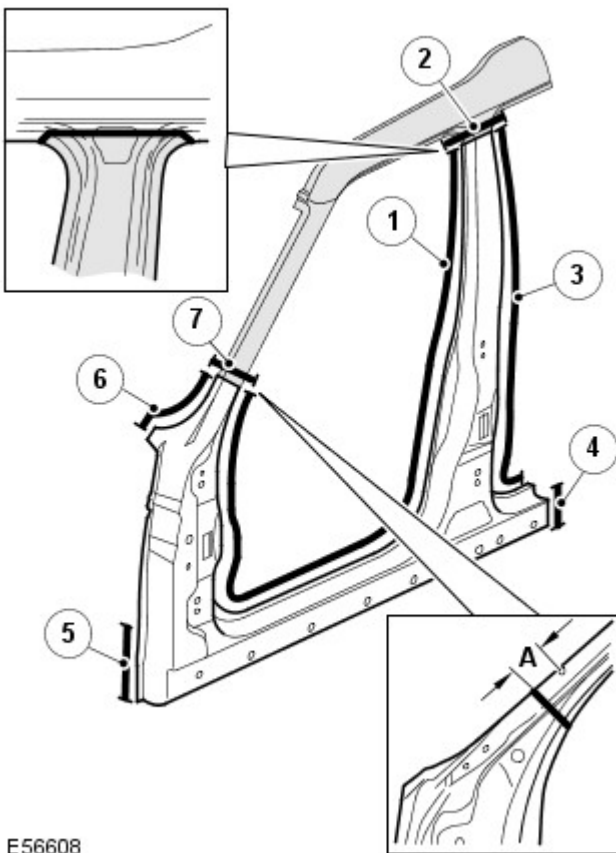
- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts



9. Remove front door striker.
10. Remove the insulation from the outer and inner bulkhead.
11. Remove the front and rear door weatherstrip.
12. Remove the footrest.
13. Release the A-Pillar wiring harness.
14. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#)

(501-20A Safety Belt System, Removal and Installation).

15. Remove the B-Pillar side impact sensor.
For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
16. Remove the side air curtain module.
For additional information, refer to: [Side Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
17. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
18. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
19. Remove the wiring harness from the B-Pillar.
20. Release the wiring harness from the rocker panel.
21. Release wiring harness from roof panel.
22. Remove the rocker panel outer trim.
23. Release the front and back carpet.
- 24.

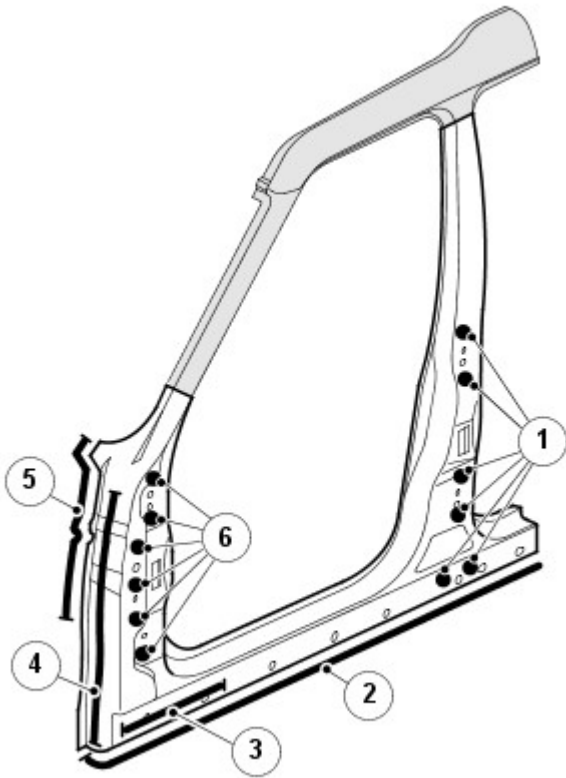


Item	Part Number	Description
A	-	Cut line is 55 mm (2.165 inches) from A-Pillar trim hole.
1	-	98 spot welds.
2	-	Butt weld.
3	-	80 spot welds.
4	-	Butt weld.
5	-	8 spot welds.
6	-	15 spot welds.
7	-	Butt weld.

E56608

25.

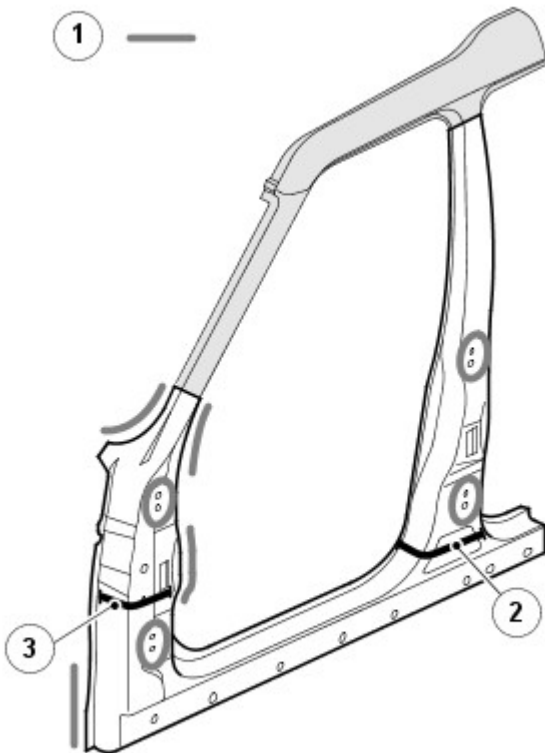
Item	Part Number	Description
1	-	6 plug welds.
2	-	31 plug welds.
3	-	4 plug welds.
4	-	10 plug welds.
5	-	13 plug welds.
6	-	6 plug welds.



E57174

26.

Item	Part Number	Description
1	-	Areas of adhesive.
2	-	Acoustic seal.
3	-	Acoustic seal.



E57175

27. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

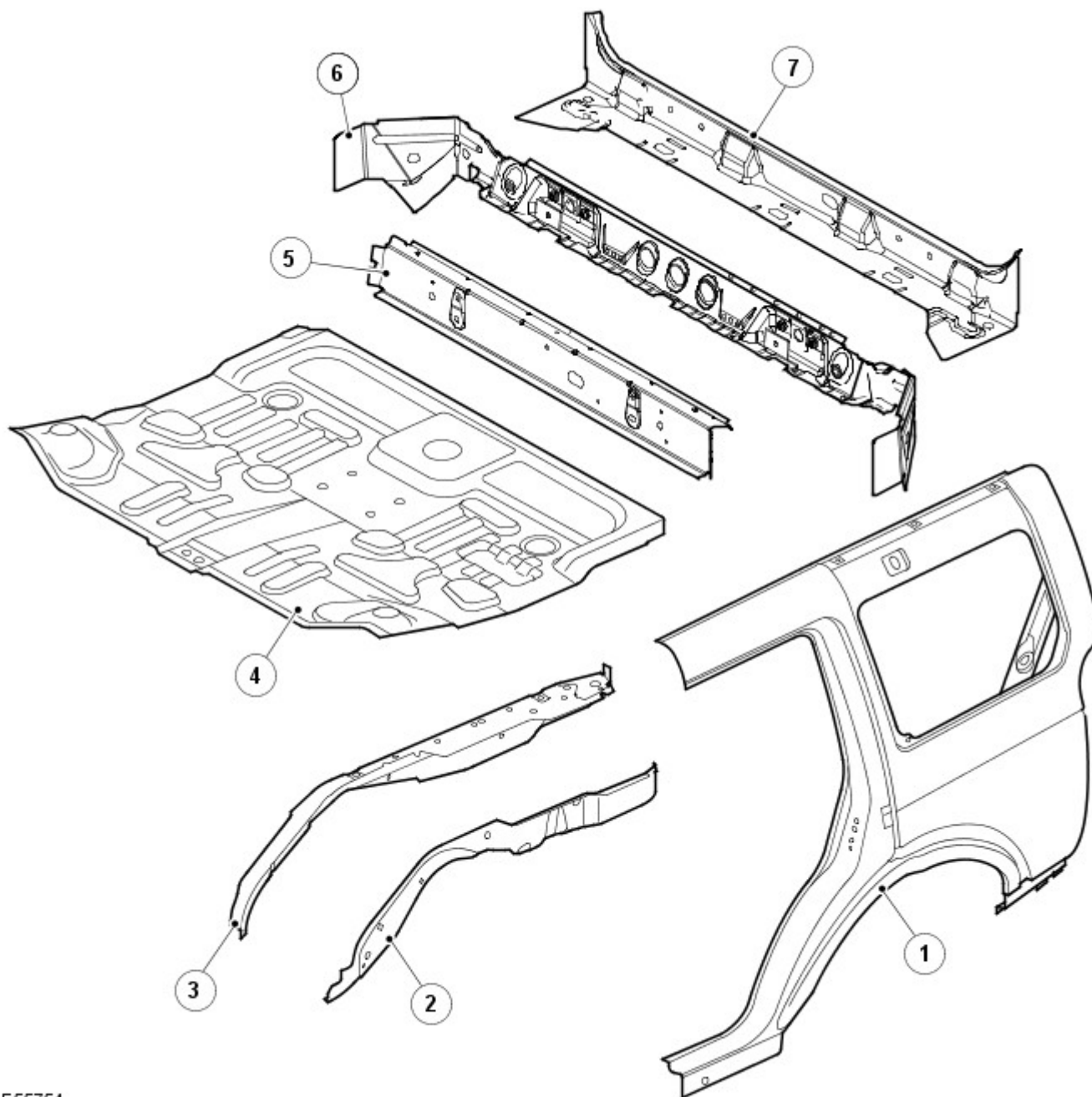
Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Rear End Sheet Metal

Description and Operation

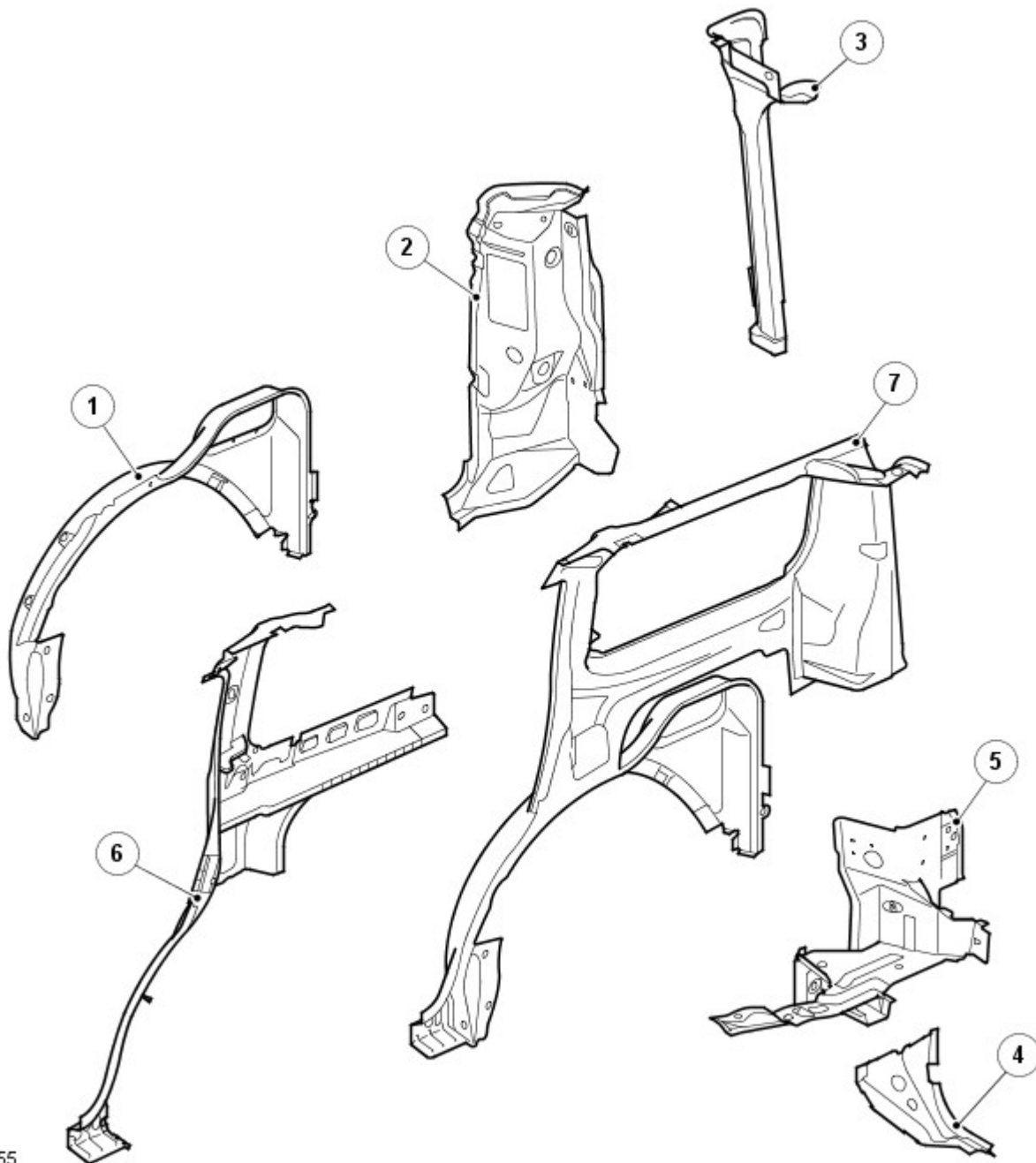
Rear end service panels



E55754

Item	Description	Service part No
1	Quarter panel outer	R/H ALA780100 L/H ALA780110
2	Rear side member	R/H AGA780021 L/H AGA780031
3	Rear side member	R/H AFD780080 L/H AFD780090
4	Rear floor panel	AFD780010
5	Rear crossmember	AQA780050
6	Rear panel reinforcement	AQR780080
7	Rear panel outer	AQA780030

Rear end service panels



E55755

Item	Description	Service part No
1	Rear wheelhouse outer	R/H ALK780100 L/H ALK780110
2	Rear lamp mounting panel	R/H AME780320 L/H AME780330
3	Water drain panel	R/H AME780300 L/H AME780310
4	D-pillar closing panel	R/H AFF780060 L/H AFF780070
5	D-pillar inner lower panel assembly	R/H AGY780060 L/H AGY780070
6	Inner quarter panel	R/H ALR780220 L/H ALR780230
7	Inner quarter panel/side panel rear section	R/H ALJ780120 L/H ALJ780130

Time schedules, front end

The following information shows the total time taken to replace single panels and complete assemblies. This time includes removal of Mechanical, Electrical and Trim (MET) items, plus paint times based on Metallic Clear Over Base Paint.

The times shown were generated by Thatcham (the motor insurance repair and research centre) and are to be used as a guide only.

Single panel times

Panel Description	Petrol	Diesel
Liftgate	9.0	9.0

Panel Description	Petrol	Diesel
Tailgate	6.7	6.7
Quarter panel L/H	23.4	23.4
Quarter panel R/H	23.7	23.7

Combination panel replacement times

The following panel combination times show the total time to remove/refit body panels, MET items and any paint process.

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
D-Pillar closing panel L/H and R/H		
Rear lamp panel		
Rear crossmember		
Rear panel		
Quarter panel		
Tailgate		
Total Time	L/H 35.6 R/H 35.9	L/H 35.6 R/H 35.9

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
D-Pillar closing panel L/H and R/H		
Rear lamp panel L/H and R/H		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel L/H and R/H		
Total Time	62.1	62.1

Combination panel times

Panel Description	Petrol	Diesel
Body off integraed frame		
Rear floor panel section		
Rear bumper		
Rear side member section		
D-Pillar closing panel		
D-Pillar inner lower panel assembly		
Rear lamp panel		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel		
Total Time	L/H 64.1 R/H 64.3	L/H 64.3 R/H 64.5

Combination panel times

Panel Description	Petrol	Diesel
Body off integraed frame		
Rear floor panel section		
Rear bumper		
Rear side member section L/H and R/H		
D-Pillar closing panel L/H and R/H		
D-Pillar inner lower panel assembly L/H and R/H		
Rear lamp panel L/H and R/H		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel L/H and R/H		
Total Time	87.4	87.6

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
D-Pillar closing panel		
D-Pillar inner lower panel assembly		
Rear lamp panel		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel		
Total Time	48.7	48.7

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
Rear lamp panel		
Rear panel		
Rear crossmember		

Panel Description	Petrol	Diesel
D Pillar closing panel L/H and R/H		
Tailgate		
Total Time	27.1	27.1

Rear End Sheet Metal Repairs - Quarter Panel

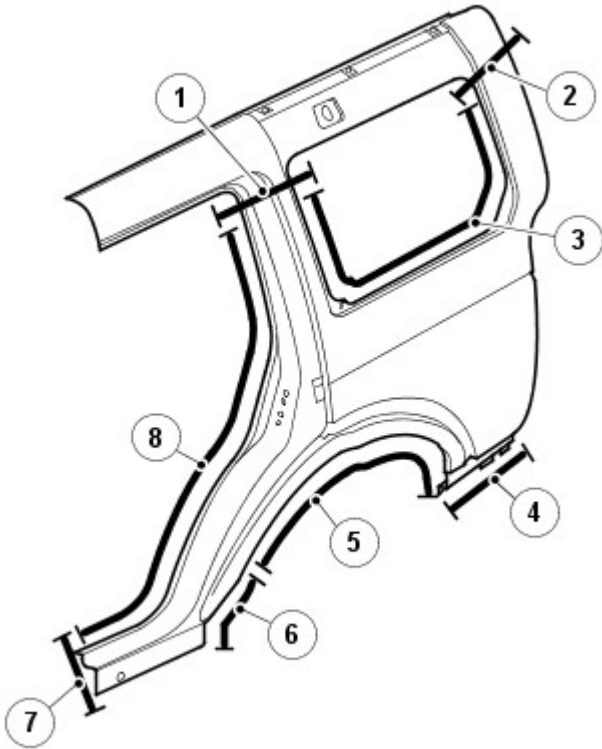
Removal and Installation

Removal

1. Load vehicle onto ramp.
2. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove the rear wheel and tire.
4. Remove the rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
5. Remove the forced air extraction grille.
6. R/H side: Remove fuel tank.
For additional information, refer to: [Fuel Tank](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation).
7. R/H side: Remove the fuel tank filler pipe.
For additional information, refer to: [Fuel Tank Filler Pipe](#) (310-01C Fuel Tank and Lines - 2.7L Diesel, Removal and Installation).
8. R/H side: Remove the fuel filler interlock catch.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).
9. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
10. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
11. Remove the C-pillar side impact sensor.
For additional information, refer to: [C-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
12. Remove the side air curtain module.
For additional information, refer to: [Side Air Curtain Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
13. Remove the rear quarter window glass.
For additional information, refer to: [Rear Quarter Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
14. Remove the rocker panel finisher.
15. Remove the exhaust heatshield.
16. Remove the tailgate latch.
For additional information, refer to: [Tailgate Latch](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).
17. Remove the tailgate weatherstrip.
18. With assistance remove the tailgate.
19. Remove the load space trims.
20. Remove the load space carpets.
21. Release the wiring harness.

22.

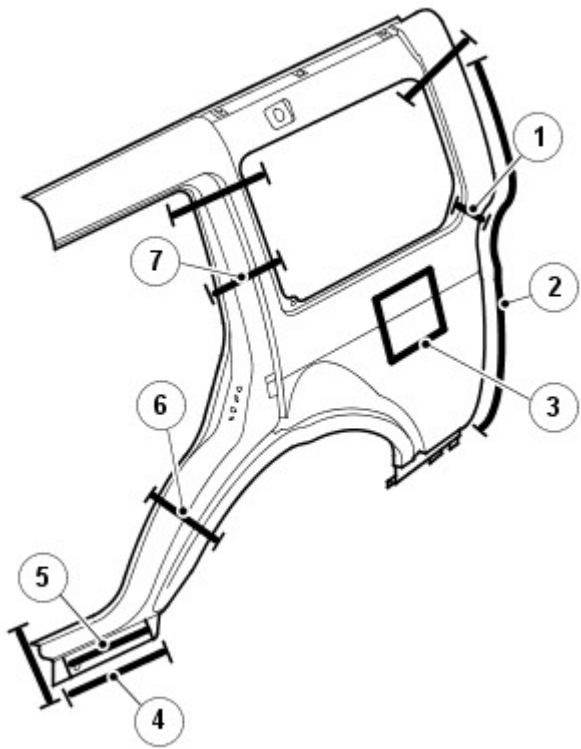
Item	Part Number	Description
1	-	Butt weld.
2	-	Butt weld.
3	-	50 spot welds.
4	-	5 spot welds.
5	-	40 spot welds.
6	-	9 spot welds.
7	-	Butt weld.
8	-	40 spot welds.



E56609

23.

Item	Part Number	Description
1	-	Acoustic seal.
2	-	16 plug welds.
3	-	Acoustic seal R/H.
4	-	7 plug welds.
5	-	3 plug welds.
6	-	Acoustic seal.
7	-	Acoustic seal.



E57109

24. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Inner Quarter Panel

Removal and Installation

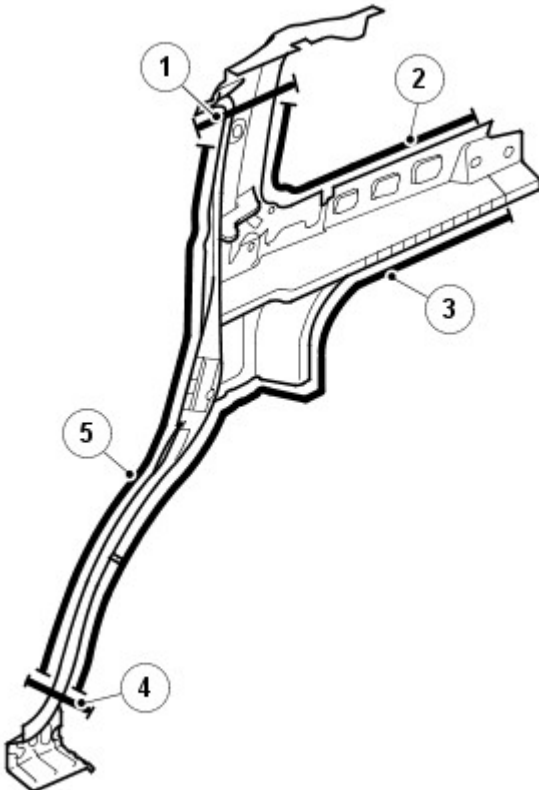
Removal

• NOTE: In this procedure, the inner quarter panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.

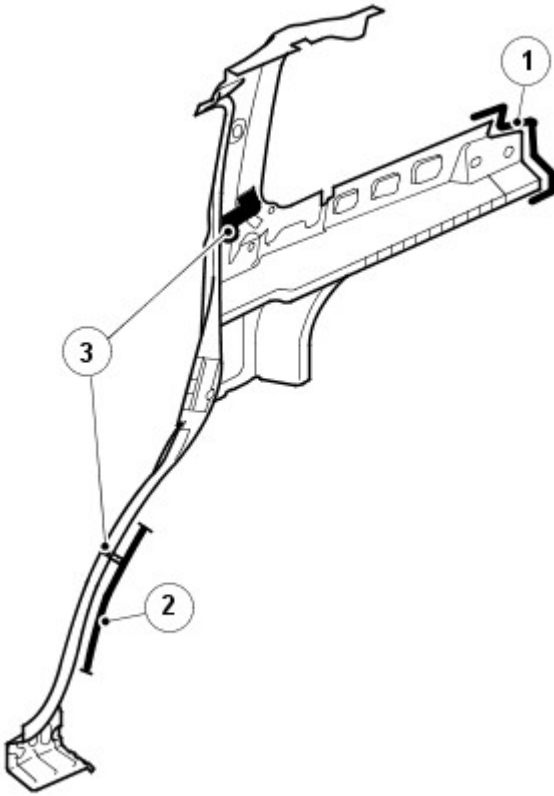
Item	Part Number	Description
1	-	Butt weld.
2	-	24 spot welds.
3	-	11 spot welds.
4	-	Butt weld.
5	-	40 spot welds.



E55760

4.

Item	Part Number	Description
1	-	5 plug welds.
2	-	8 plug welds.
3	-	Acoustic seals



E57103

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Rear Wheelhouse Outer

Removal and Installation

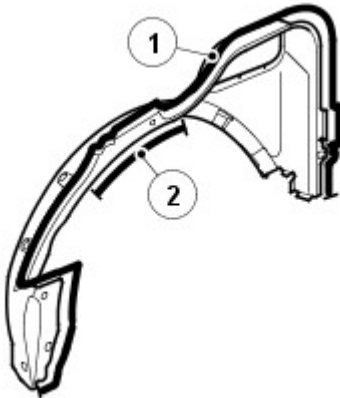
Removal

• NOTE: In this procedure, the rear wheelhouse outer is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Disconnect the parking brake cables.
For additional information, refer to: Parking Brake Cable (206-05 Parking Brake and Actuation, Removal and Installation).
3. Remove the brake line.
4. Remove the rear suspension.
For additional information, refer to: Rear Suspension (204-02 Rear Suspension, Description and Operation).
5. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

6.

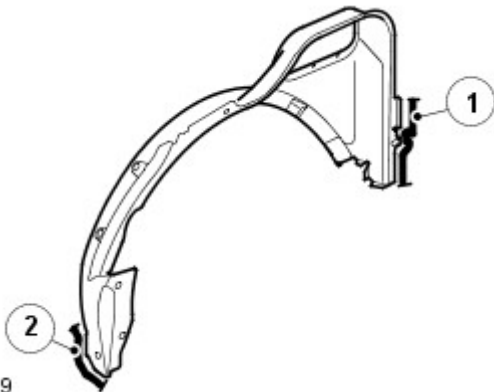
Item	Part Number	Description
1	-	60 spot welds.
2	-	10 spot welds.



E55930

7.

Item	Part Number	Description
1	-	160mm (6.29) adhesive.
2	-	2 plug welds and 5 spot welds.



E57119

8. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Rear Lamp Mounting Panel

Removal and Installation

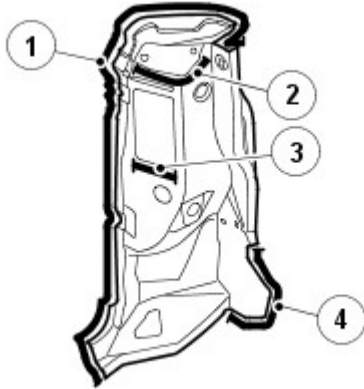
Removal

- NOTE: In this procedure, the rear lamp mounting panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.

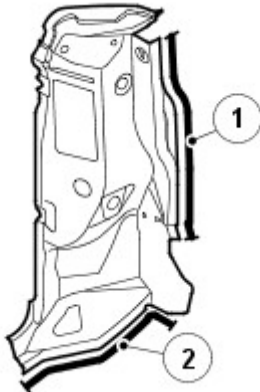
Item	Part Number	Description
1	-	18 plug welds.
2	-	Adhesive.
3	-	3 plug welds.
4	-	2 plug welds.



E57102

4.

Item	Part Number	Description
1	-	16 spot welds.
2	-	11 spot welds.



E55761

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Back Panel

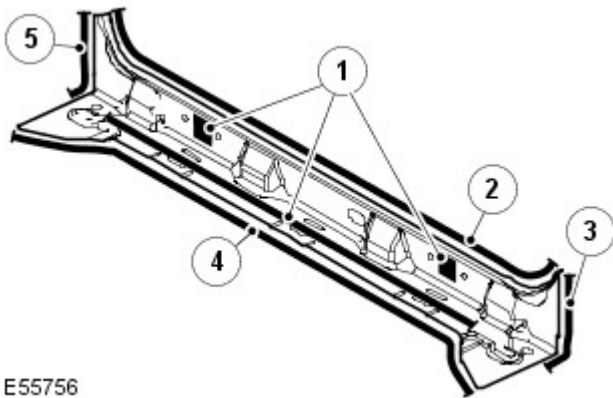
Removal and Installation

Removal

- NOTE: When replacing the back panel it is necessary to remove a section of the rear lamp panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
3. Remove both D-pillar trim panels.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the tailgate hinge trim cover.
5. Remove the tailgate weather seal.
6. Remove the load space trims.
7. Remove the load space carpets.
8. With assistance remove the tailgate.
9. Remove the L/H exhaust heatshield tailpipe.
10. Remove the R/H exhaust heatshield tailpipe.
11. Remove the spare wheel and tire.
12. Release the back panel wiring harness.

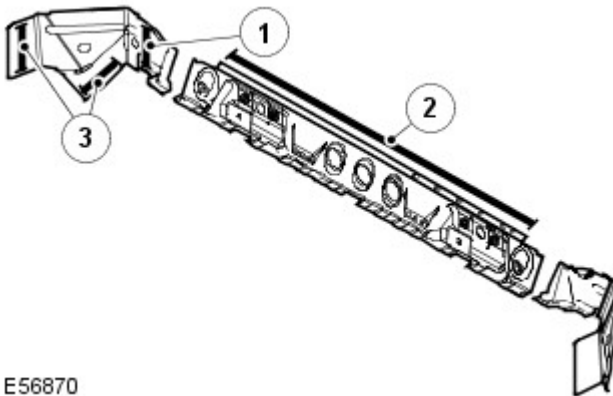
13.



E55756

Item	Part Number	Description
1	-	20 plug welds.
2	-	42 spot welds.
3	-	4 plug welds.
4	-	21 plug welds.
5	-	4 plug welds.

14.



E56870

Item	Part Number	Description
1	-	2 plug welds. (R/H is symmetrically opposite to L/H)
2	-	30 spot welds.
3	-	7 spot welds. (R/H is symmetrically opposite to L/H)

15. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.

For additional information, refer to: [Body and Frame](#)
(501-26 Body Repairs - Vehicle Specific Information and
Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

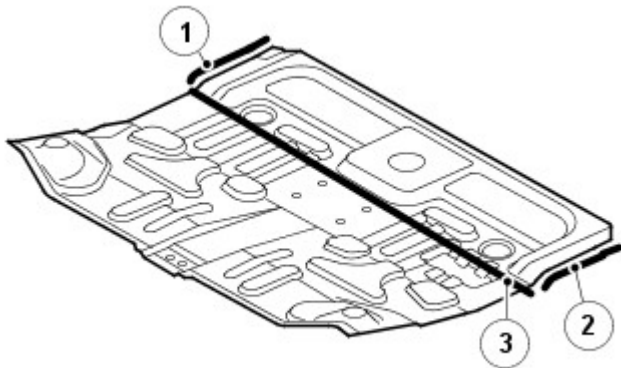
Rear End Sheet Metal Repairs - Rear Floor Panel Section

Removal and Installation

Removal

• NOTE: In this procedure, the rear floor panel section is replaced in conjunction with the back panel and rear crossmember.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the back panel.
For additional information, refer to: [Back Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
3. Remove the rear crossmember.
For additional information, refer to: [Rear Crossmember](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 4.



Item	Part Number	Description
1	-	Mig-weld.
2	-	Mig-weld.
3	-	Mig-welds and 18 plug-welds.

E55762

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Rear Crossmember

Removal and Installation

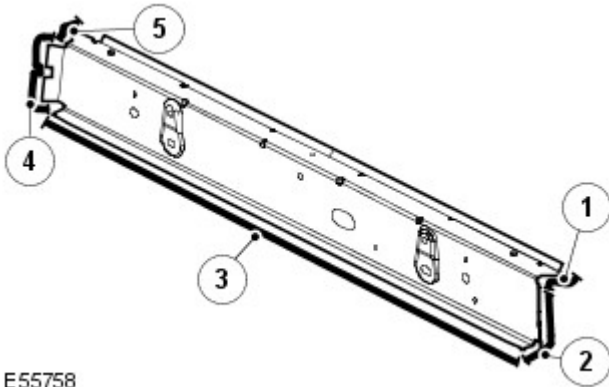
Removal

- NOTE: In this procedure, the rear crossmember is replaced in conjunction with the back panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the back panel.
For additional information, refer to: [Back Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.

Item	Part Number	Description
1	-	Mig weld.
2	-	3 spot welds.
3	-	12 plug welds.
4	-	3 spot welds.
5	-	Mig weld.



E55758

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Quarter/Side Panel Rear Section LH

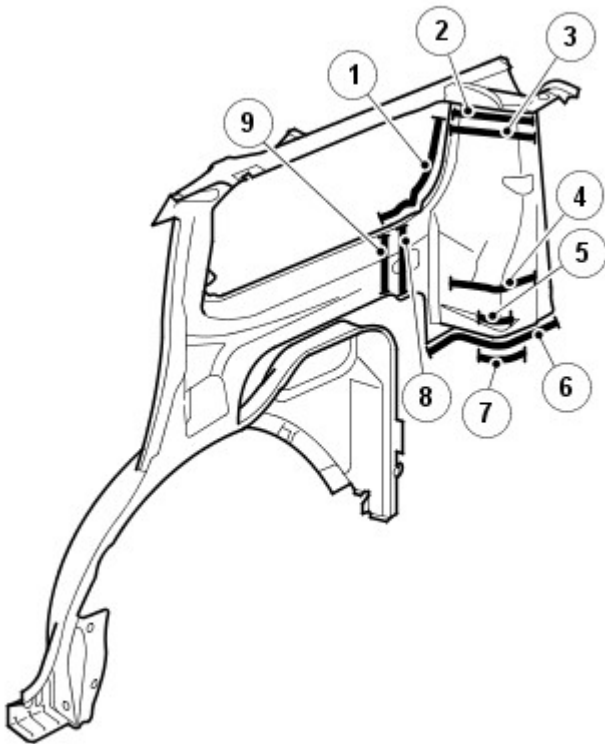
Removal and Installation

Removal

- NOTE: The quarter / side panel rear section R/H is symmetrically opposite to the L/H.
- NOTE: In this procedure, quarter / side panel rear section is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 3.

Item	Part Number	Description
1	-	15 spot welds.
2	-	Butt weld.
3	-	Butt weld.
4	-	Acoustic seal.
5	-	3 plug welds.
6	-	8 plug welds.
7	-	Mig weld.
8	-	5 plug welds.
9	-	Butt weld.



E55933

4. For additional information:
 - Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
 - Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
 - Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

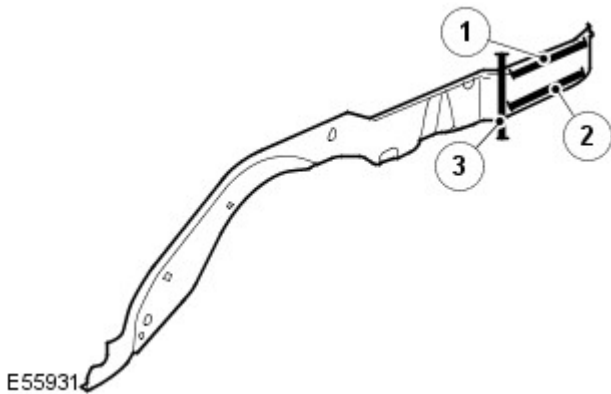
Rear End Sheet Metal Repairs - Rear Side Member Section

Removal and Installation

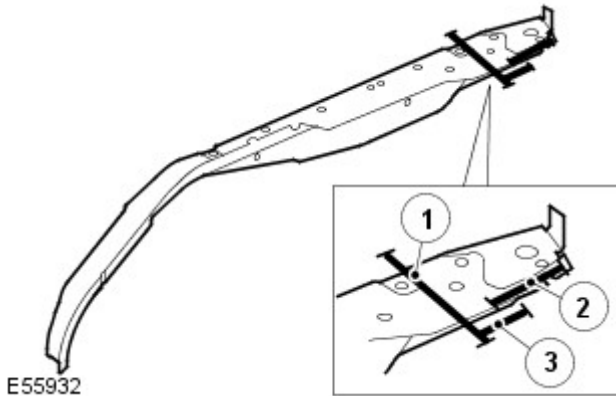
Removal

• **NOTE:** In this procedure, the rear side member section is replaced in conjunction with the back panel and rear crossmember.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the back panel.
For additional information, refer to: [Back Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
3. Remove the rear crossmember.
For additional information, refer to: [Rear Crossmember](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 4.



Item	Part Number	Description
1	-	2 plug welds. (also see graphic E55932)
2	-	2 plug welds.
3	-	Butt weld.



- 5.

Item	Part Number	Description
1	-	Butt weld.
2	-	2 plug welds.
3	-	4 plug welds.

6. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - D-Pillar Inner Lower Panel

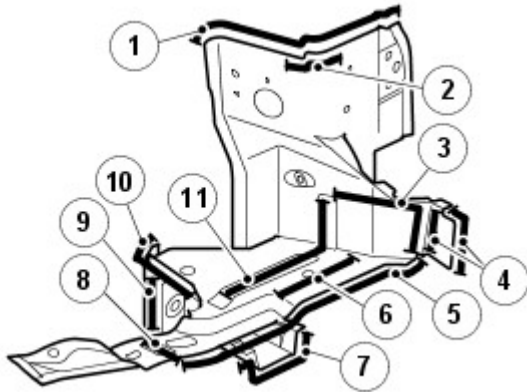
Removal and Installation

Removal

- NOTE: In this procedure the D-Pillar inner lower panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.



E56610

Item	Part Number	Description
1	-	8 plug welds.
2	-	3 plug welds.
3	-	4 plug welds.
4	-	Mig weld.
5	-	7 plug welds.
6	-	6 plug welds.
7	-	4 plug welds.
8	-	Butt weld.
9	-	Adhesive
10	-	4 plug welds.
11	-	6 plug welds.

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - D-Pillar Closing Panel

Removal and Installation

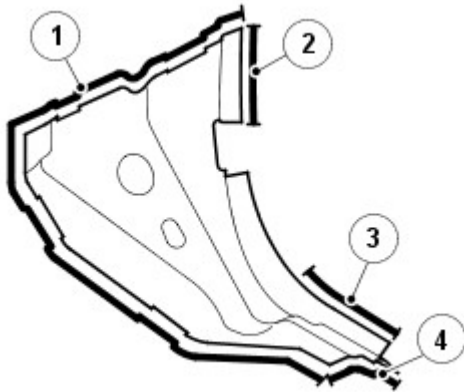
Removal

- NOTE: In this procedure the D-Pillar closing panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.

Item	Part Number	Description
1	-	Mig weld.
2	-	2 plug welds.
3	-	1 plug weld.
4	-	4 plug welds.



E56611

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Body Panels -

Torque Specifications

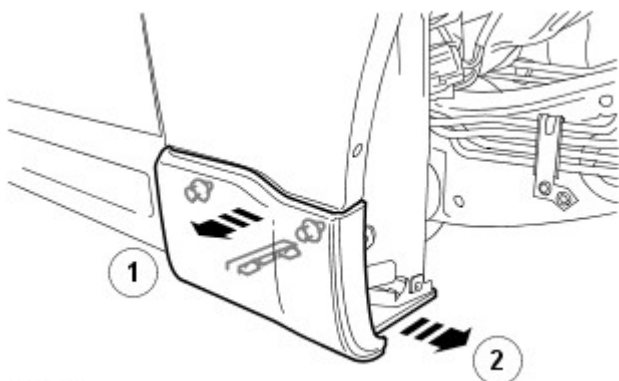
Description	Nm	lb-ft
Engine undershield bolts	62	46
Front fender bolts	10	7
Front fender nut	10	7

Front End Body Panels - Fender

Removal and Installation

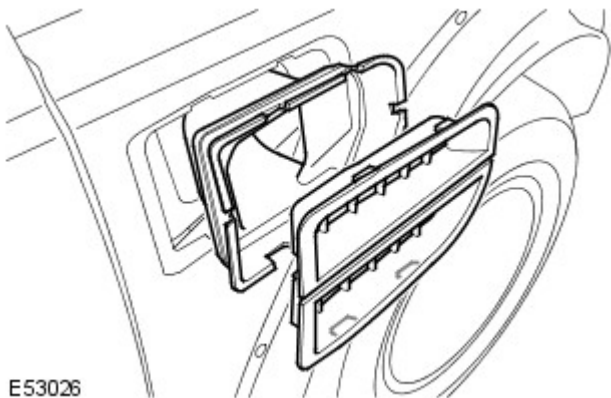
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
3. Remove the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
4. Remove the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
5. Remove the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
6. Remove the fender lower moulding.
 - Release the 4 clips.



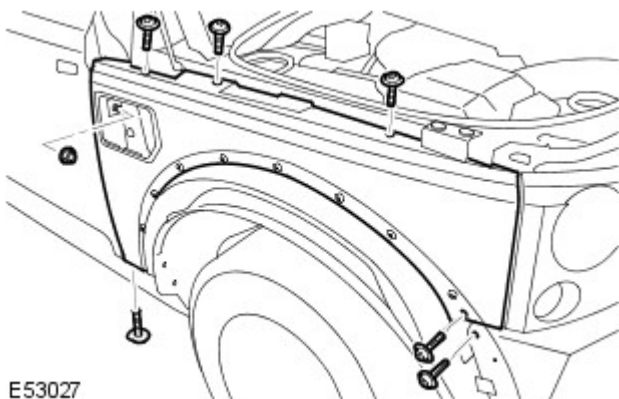
E52564

7. Remove the fender air intake grille.
 - Release the 4 clips.
 - Remove the air ducting.



E53026

8. Remove the front fender.
 - Remove the 6 Torx bolts.
 - Remove the nut.



E53027



9. NOTE: Do not disassemble further if the component is removed for access only.

Remove the fender rear trim.

- Remove the 3 clips.


Installation

1. Install the fender rear trim.
 - Secure in the 3 clips.
2. Install the front fender.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
 - Install the nut and tighten to 10 Nm (7 lb.ft)
3. Install the fender air intake grille.
 - Install the air ducting.
4. Install the lower fender moulding.
 - Secure in the clips.
5. Install the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
6. Install the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
7. Install the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
8. Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
9. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).

Front End Body Panels - Fender Splash Shield

Removal and Installation

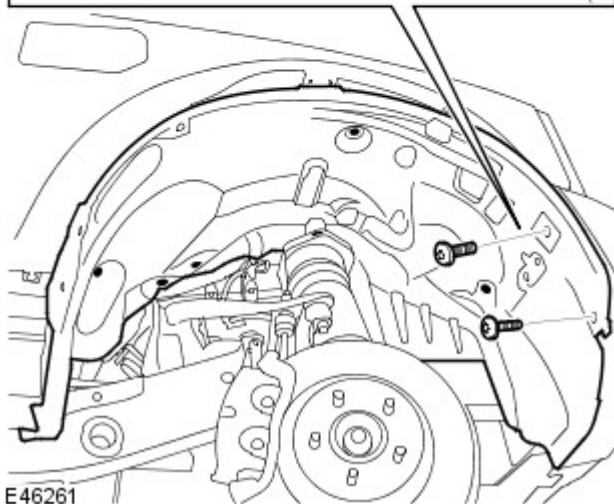
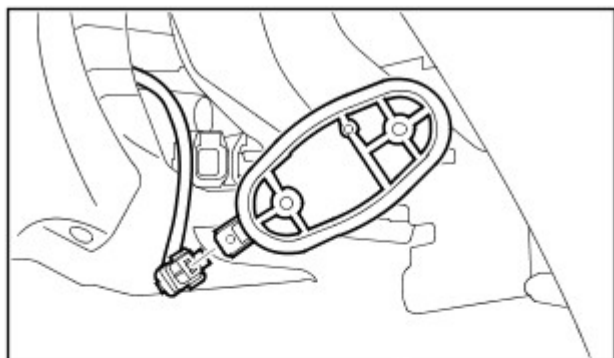
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

3. Remove the fender splash shield.
 - Remove the 2 screws.
 - Remove the 6 retainers.
 - Disconnect the electrical connector.

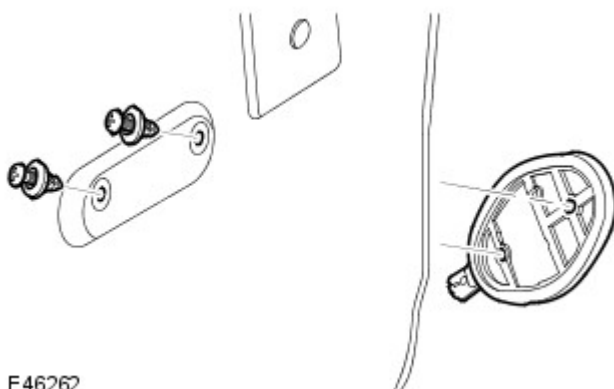


E46261

4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the tire pressure antenna.

- Remove the 2 retainers.



E46262

Installation

1. Install the tire pressure antenna.
 - Install the retainers.
2. Install the fender splash shield.

- Connect the electrical connector.
- Install the retainers.
- Install the screws.


3. Install the fender moulding.

For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).

Front End Body Panels - Engine Undershield

Removal and Installation

Removal

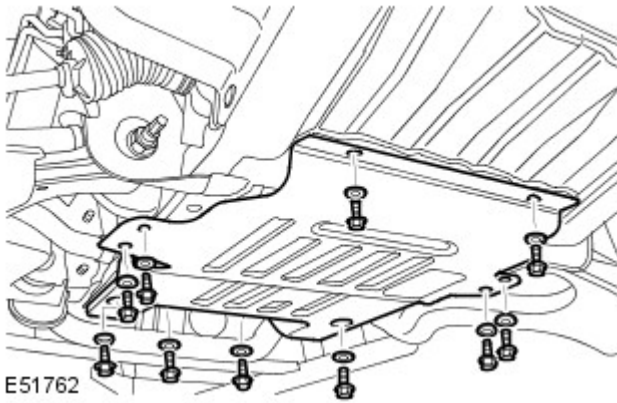
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2.  **CAUTION:** Note the special washer.

Remove the engine undershield.

- Remove the 10 bolts.



Installation


1. To install, reverse the removal procedure.

- Tighten the bolts to 62 Nm (46 lb.ft).

Body Closures - Body Closures

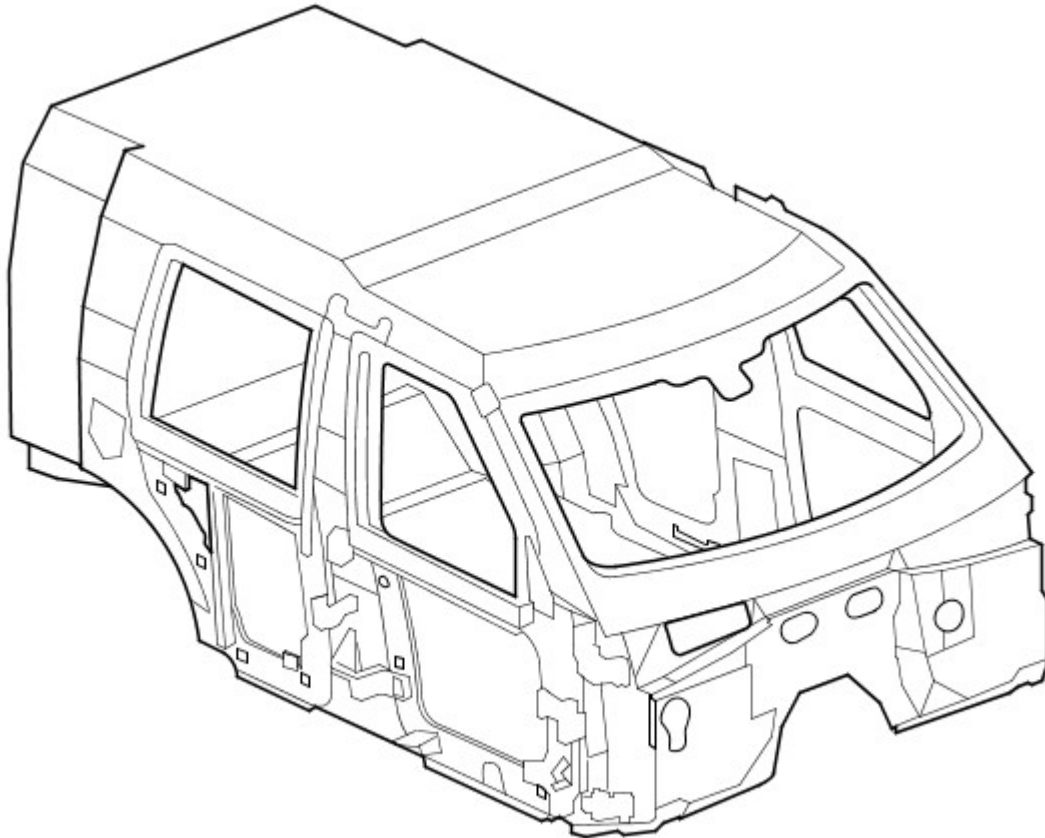
Description and Operation

Body Protection

 **WARNING:** The weight of the armoured components fitted to the vehicle are far in excess of those fitted to the standard vehicle. As an example, the windshield weighs approximately 100 Kg (220 lb). Therefore, always be aware of the weight of components and have suitable lifting equipment available before attempting to remove any component from the vehicle.

Body Shell

Armoured cell



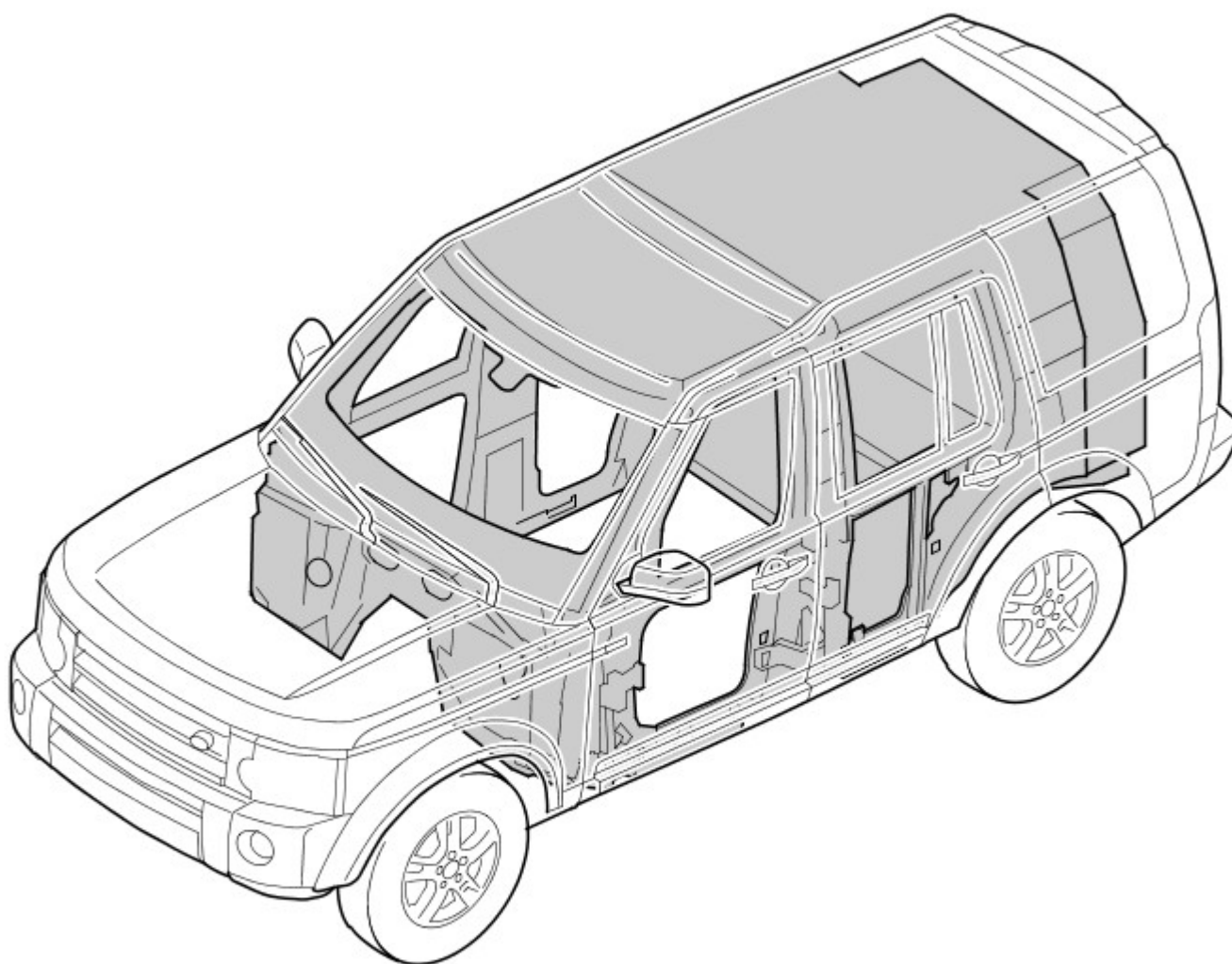
E101511

The vehicle passengers are protected by a steel armoured cell assembled inside the vehicle's bodywork. The cell provides armoured protection to the following areas of the vehicle:

- Bulkhead
- Roof
- Rear three-quarter panels
- 'A' posts
- 'B/C' posts
- 'D' posts
- Sills
- Floor pan

In addition to the floor pan armour, floor protection is also provided by a woven Kevlar blanket, available as an optional fit.

Armoured cell in position



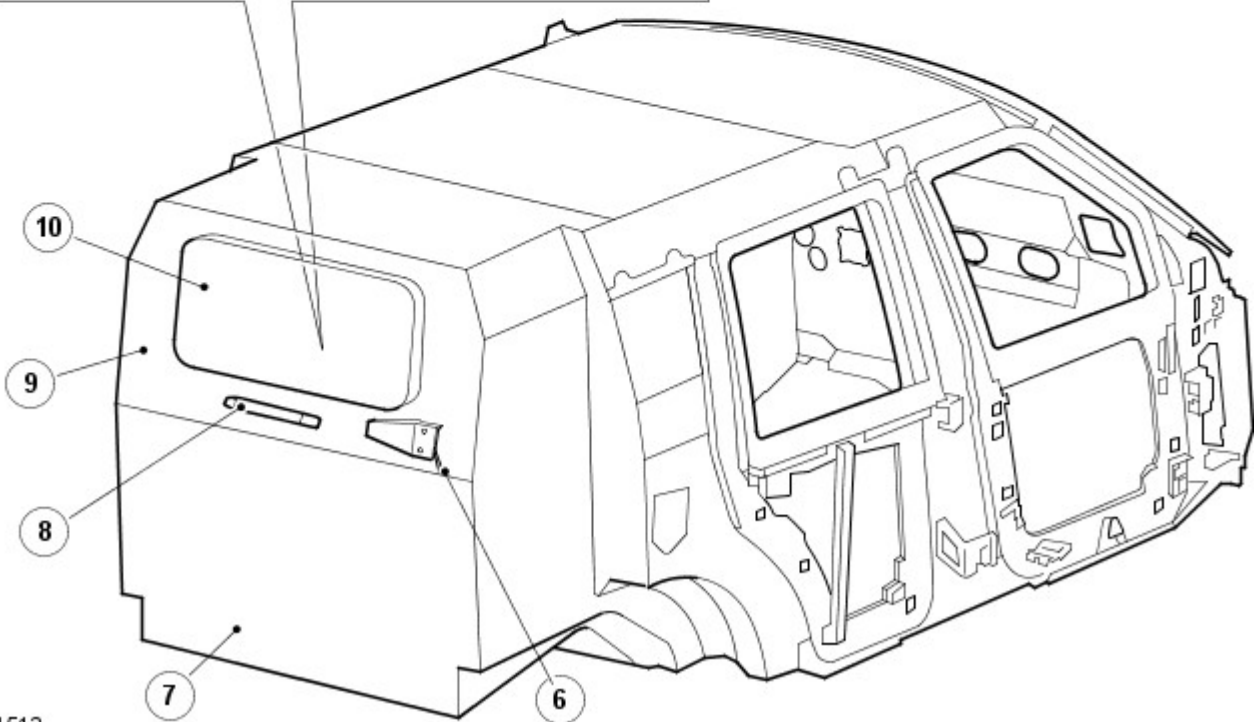
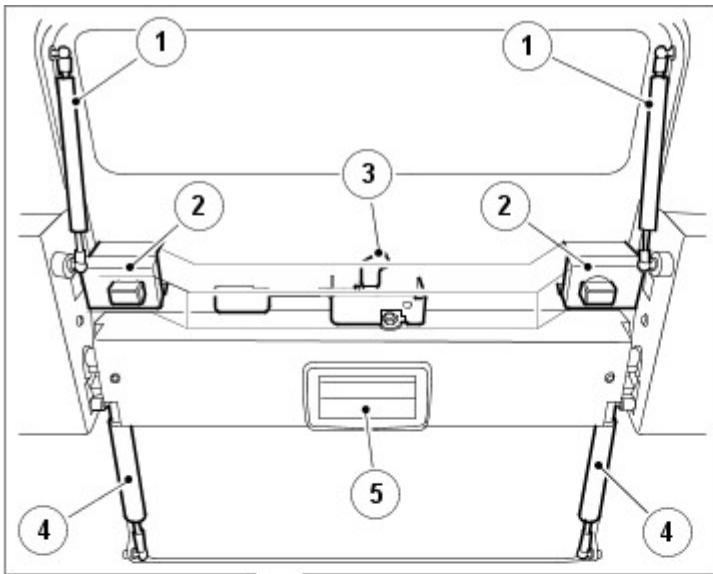
E101513

Doors and Tailgate

The vehicle's doors are reinforced with steel armour, with the exception of the tailgate which remains standard. The armoured cell offers rear-end protection to the vehicle's occupants with the option of either:

- a solid armoured rear end with armoured window; or
- an armoured rear access with armoured window.

Armoured cell rear-access



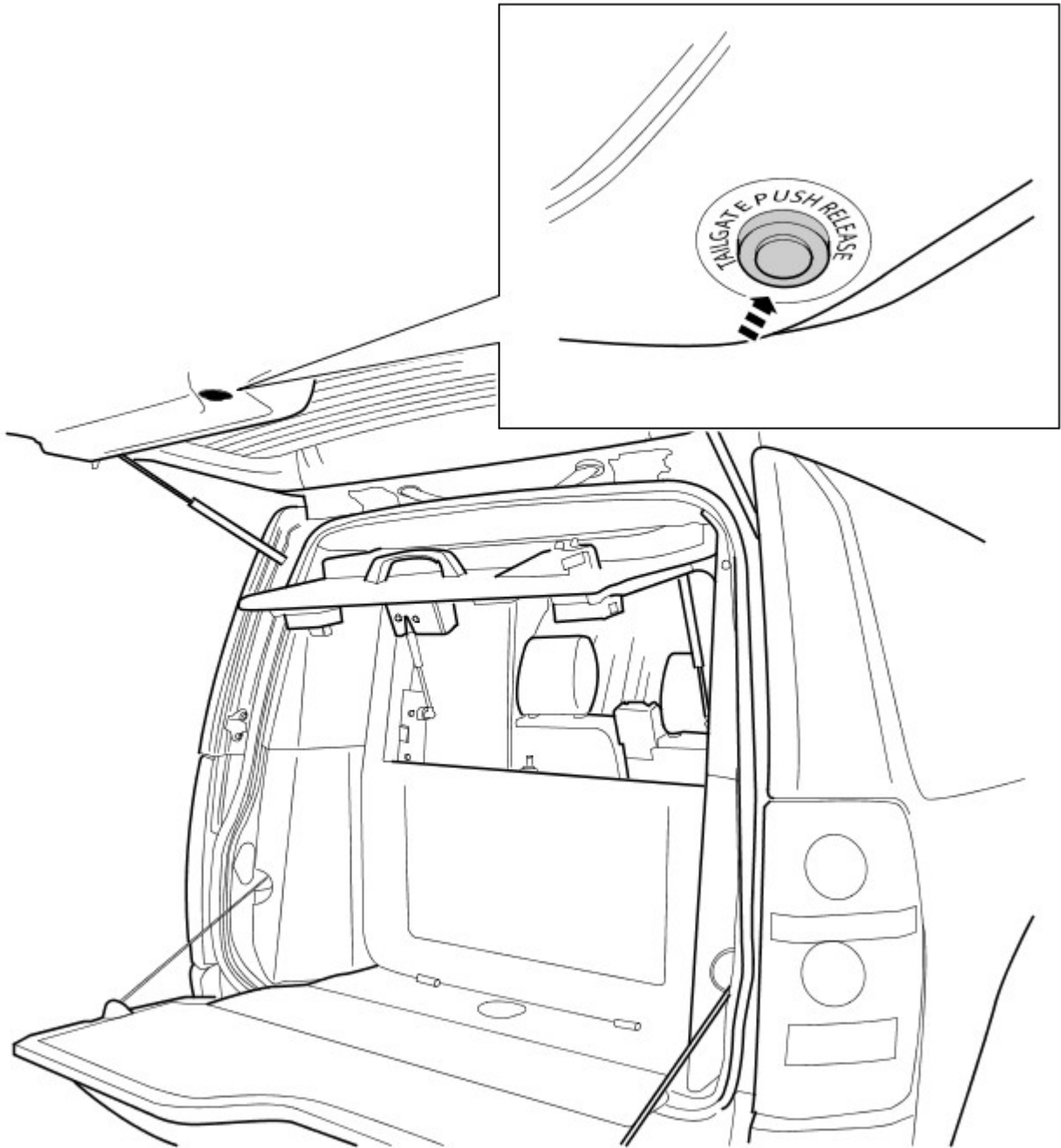
E101512

Item	Part Number	Description
1	-	Upper access panel - gas struts
2	-	Upper access panel - dead locks
3	-	Upper access panel – internal release lever
4	-	Lower access panel – gas struts
5	-	Lower access panel – internal release handle
6	-	Upper access panel – external release lever
7	-	Lower access panel
8	-	Upper access panel - grab handle
9	-	Upper access panel
10	-	Armoured glass window *

* For additional information, refer to: Glass, Frames and Mechanisms (501-11, Description and Operation).

The armoured access option replicates the vehicle's tailgate by having upper and lower access panels. The access panels can be opened manually both internally and externally if the dead-locks are in the unlocked position. Gas struts fitted to the access panels aid their opening and reduce involuntary shutting.


Tailgate interior release button



E101515

A release button fitted to the interior of the vehicle's upper standard tailgate provides access to the tailgate from inside the vehicle. The release button is a momentary type switch, wired in parallel to the standard release switch on the exterior tailgate handle.

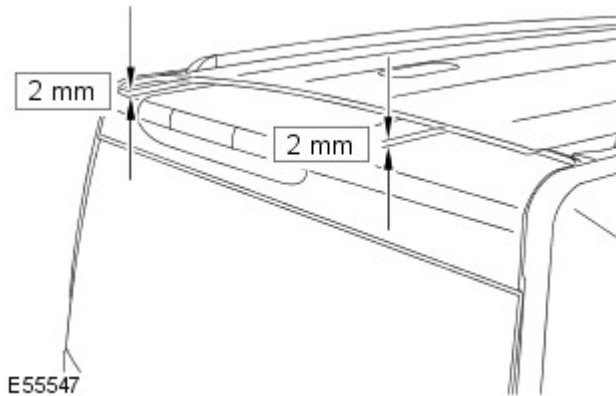
The door hinges, spindles and door stop mechanisms, on the driver and passenger doors are reinforced to support the additional weight of the armour. Gas struts have been fitted to aid door opening and reduce involuntary shutting.

 **CAUTION:** It is recommended that the driver and passenger doors are not opened until the vehicle has come to a complete stop. The combined effect of the vehicle's residual speed and the weight of the door could overcome the door stop mechanism.

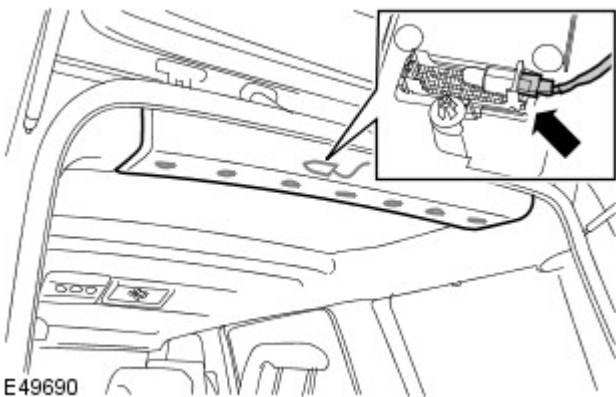
Body Closures - Liftgate Alignment

General Procedures

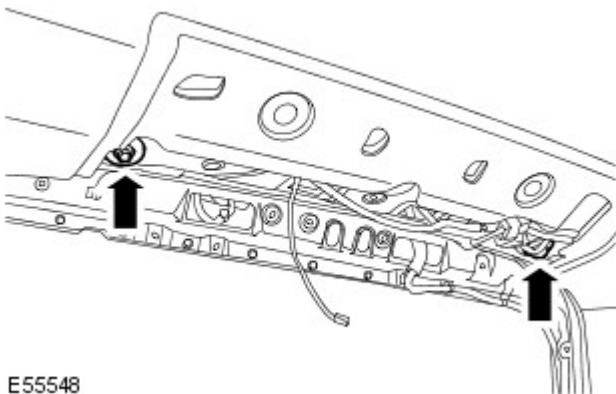
1. With the liftgate closed, check the alignment of the liftgate to roof panel. The liftgate should be central in its aperture. Profile of the liftgate to roof panel should be 2 mm below flush.



2. Remove the rear headliner trim panel.
 - Release the 7 clips.
 - Disconnect the electrical connector.




3. Loosen, but do not remove both liftgate hinge to body bolts.



4. Position the liftgate central to the aperture.

☞ ☞ move the LH liftgate to body bolt.

6.  **CAUTION:** When setting the liftgate profile, make sure that the liftgate hinge NOT being adjusted has its retaining bolt fitted.

- **NOTE:** Turning the Allen key clockwise will raise the liftgate.

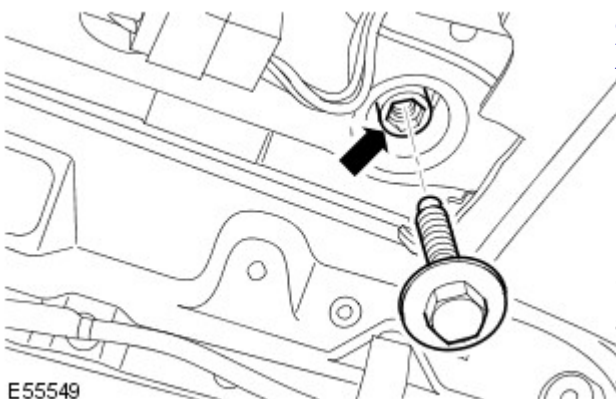
Using a 13 mm Allen key, adjust the LH liftgate hinge until a profile of 2 mm below flush to the roof panel is achieved.

- Install the bolt and tighten to 40 Nm (30 lb.ft).

7. Repeat the above procedure for the RH liftgate hinge.

8. Check for correct operation of the liftgate, and if necessary adjust the liftgate and tailgate strikers.

9. Install the rear headliner trim panel.



- Connect the electrical connector.
- Secure with the clips.

Body Closures - Fuel Filler Door Assembly


Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the fuel filler interlock catch assembly.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).

3. WARNINGS:

 Place the vehicle in a well ventilated, quarantined area and arrange 'No Smoking/Petrol Fumes' signs about the vehicle.

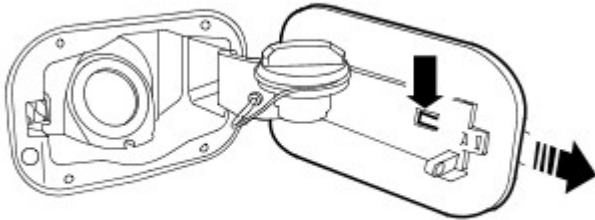
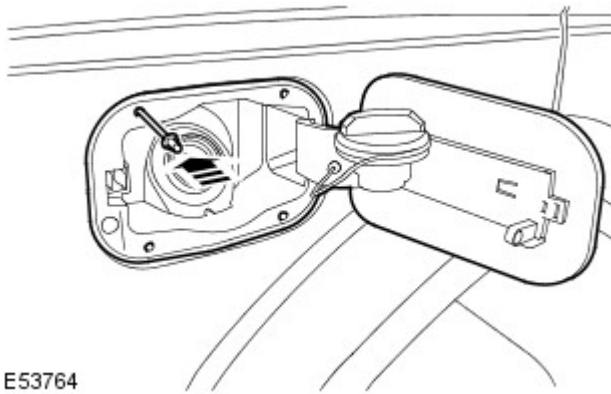
 Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

Remove the fuel filler door and inner assembly.

- Open the fuel filler door and remove the cap.
- Using a 2mm metal rod, pierce the inner assembly and release the 4 clips.
- Release from the filler neck.
- Replace the filler cap.

4. Remove the fuel filler door.

- Release the clip.



Installation

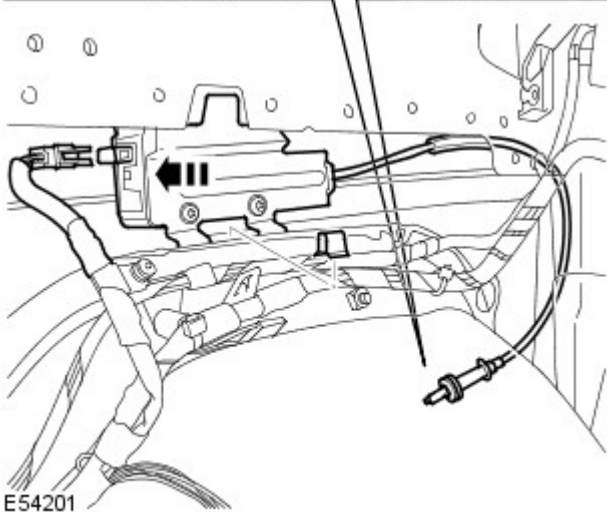
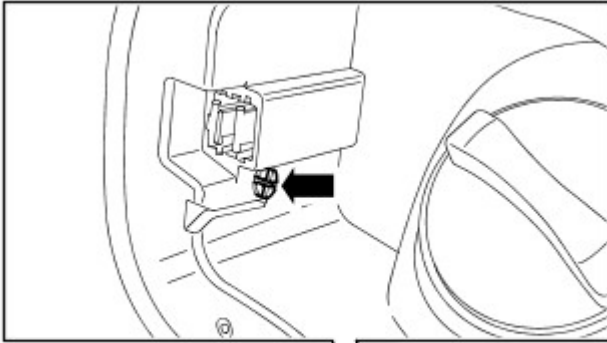
1. Install the filler door.
2. Install the fuel filler door assembly.
 - Clean the component mating faces.
 - Install the filler cap.
 - Close the fuel filler door.
3. Install the fuel filler interlock catch assembly.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).

Body Closures - Fuel Filler Interlock Catch

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the fuel filler interlock catch assembly.

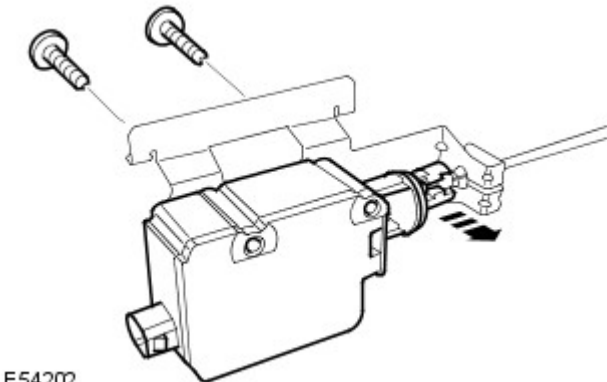


E54201

- Remove the clip.
- Release the cable.
- Disconnect the electrical connector.

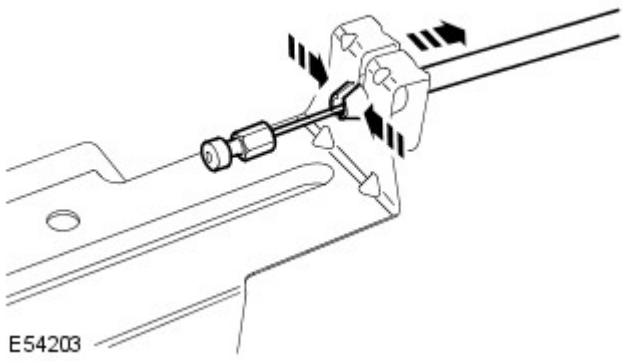
4. Remove the solenoid.

- Remove the 2 Torx screws.
- Release the cable.



E54202

5. NOTE: Do not disassemble further if the component is removed for access only.



Release and remove the cable.

- Release the clip.

Installation

1. Install the cable.
 - Secure the clip.
2. Install the solenoid.
 - Attach the cable.
 - Install the Torx screws.
3. Install the fuel filler flap latch assembly.
 - Connect and secure the electrical connector.
 - Carefully secure the clips.
4. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).

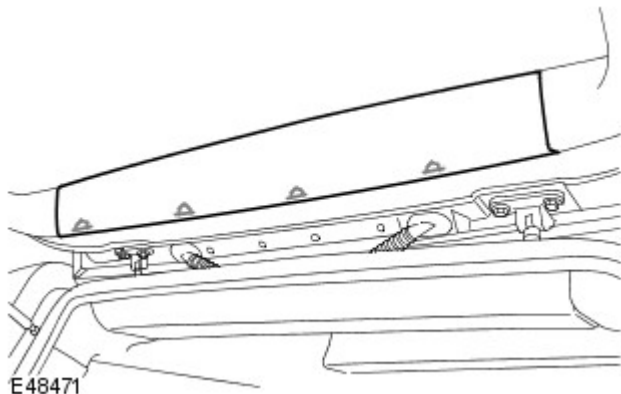
Body Closures - Liftgate

Removal and Installation

Removal

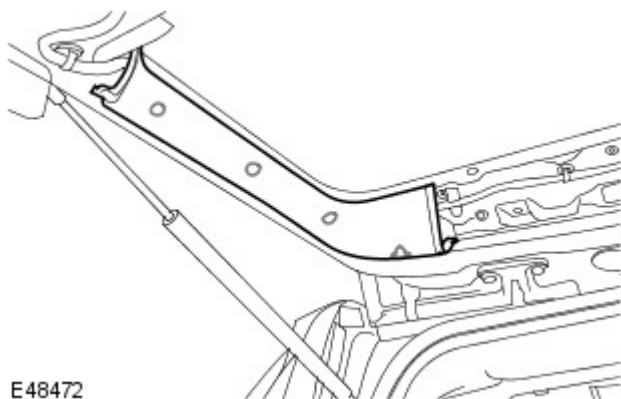
1. Open the liftgate and tailgate.
2. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
3. Remove the liftgate upper trim panel.

- Release the 4 clips.



4. Remove the liftgate side trim panel.

- Release the 5 clips.
- Repeat the above procedure for the other side.



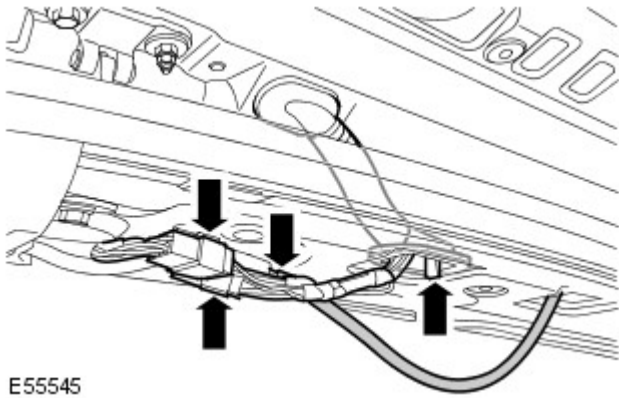
5. Remove the rear headliner trim panel.

- Release the 7 clips.
- Disconnect the electrical connector.



6. Disconnect the washer jet hose.

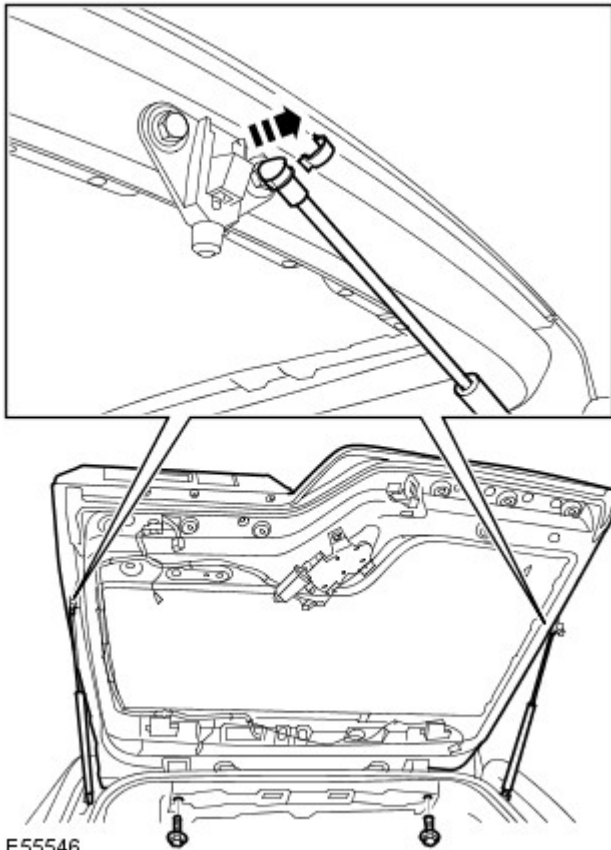
- Release the grommet.



E55545

7. Release the liftgate wiring harness.

- Disconnect the 2 electrical connectors.
- Release the grommet.



E55546

8. With assistance, remove the liftgate assembly.

- Release the clips and disconnect the struts.
- Remove the 2 bolts.

Installation

1. With assistance, install the liftgate assembly.

- Tighten the bolts to 40 Nm (30 lb.ft).
- Connect the struts and secure with the clips.

2. Attach the liftgate wiring harness.

- Install the grommet.
- Connect the electrical connectors.

3. Connect the washer jet hose.

- Install the grommet.

4. Install the liftgate side trim panel.

- Secure with the clips.
- Repeat the above procedure for the other side.

5. Install the liftgate upper trim panel.
 - Secure with the clips.
6. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
7. Check and adjust the liftgate to roof panel profile.
For additional information, refer to: [Liftgate Alignment](#) (501-03 Body Closures, General Procedures).

Interior Trim and Ornamentation -

Torque Specifications

Description	Nm	lb-ft
Safety belt lower anchorage to seat Torx bolt	40	30
Tailgate support strut spigot	25	18
C-pillar lower trim panel Torx screw	8	6
C-pillar upper trim panel Torx screw	3	2
A-pillar trim panel Torx screw	3	2
* Safety belt anchorage Torx bolt	40	30
Foot rest nuts	10	7

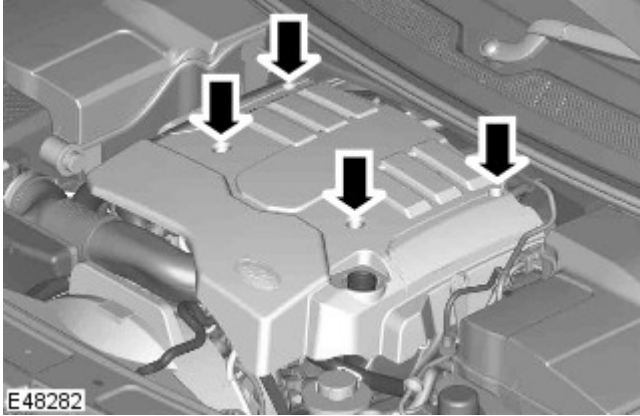
* **New bolt must be fitted**

Interior Trim and Ornamentation - Engine Cover V6 4.0L Petrol

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the oil filler cap.
3. **NOTE:** Note the fitted position of the spacers



Remove the engine cover.

- Remove the 4 nuts.
- Collect the spacers.

4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the acoustic pad.

- Remove the 7 clips.
- Remove the 4 mounts and compression limiters.

Installation

1. Install the acoustic pad.
 - Position and secure the clips.
 - Install the grommets.
 - Install the compression limiters.
2. Install the engine cover.
 - Install the spacers.
 - Tighten the nuts to 10 Nm (7 lb.ft).
3. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).

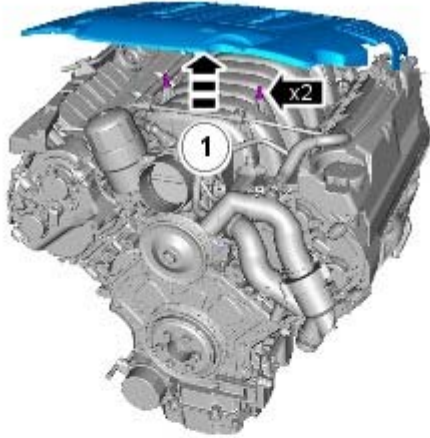
Interior Trim and Ornamentation - Engine Cover V8 5.0L Petrol

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



E134600

Installation

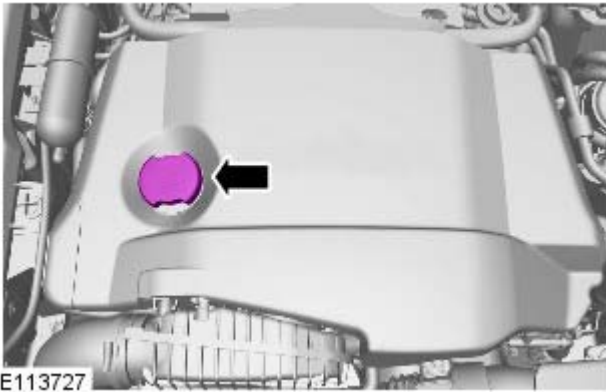
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - Engine CoverTDV6 3.0L Diesel

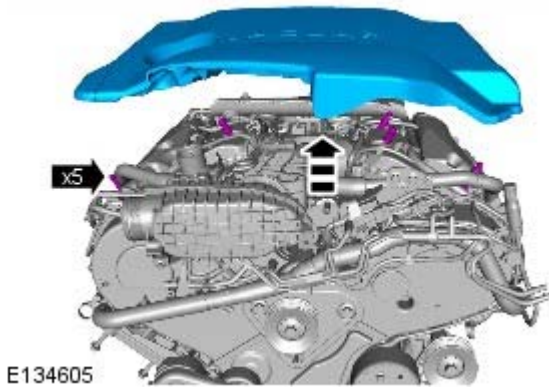
Removal and Installation

Removal

1. Remove the oil filler cap.



- 2.



Installation

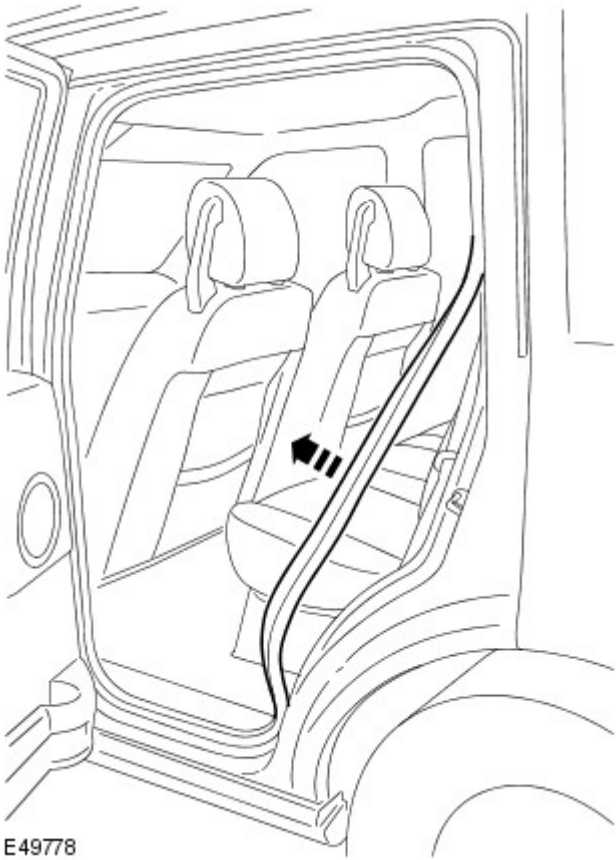
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - Rear Quarter Trim Panel

Removal and Installation

Removal

1. Fold down the rear seat backrest.
2. Release the door aperture weatherstrip.



E49778

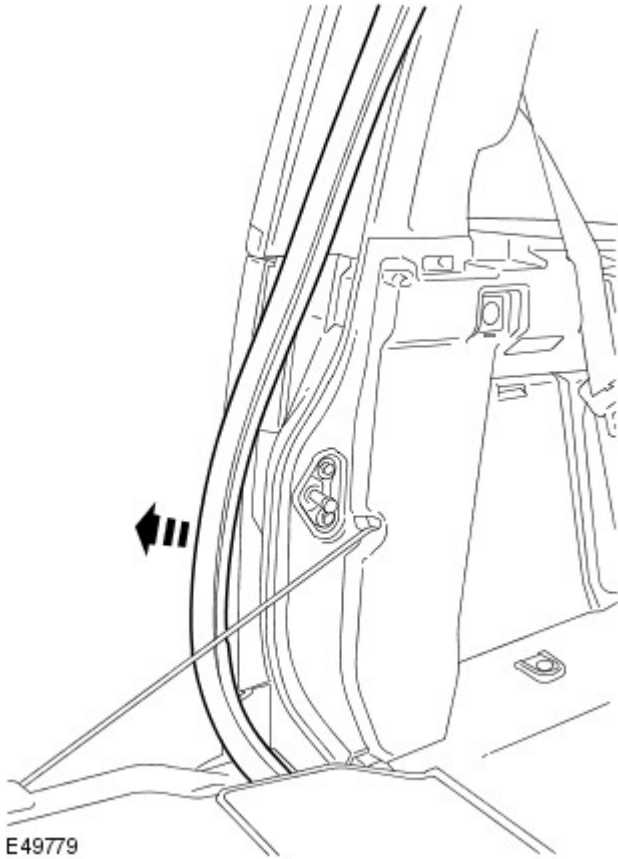
3. Release the safety belt anchor.

- Remove and discard the bolt.



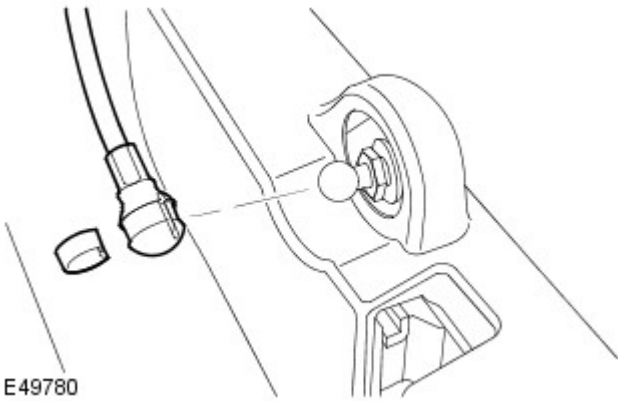
E49594

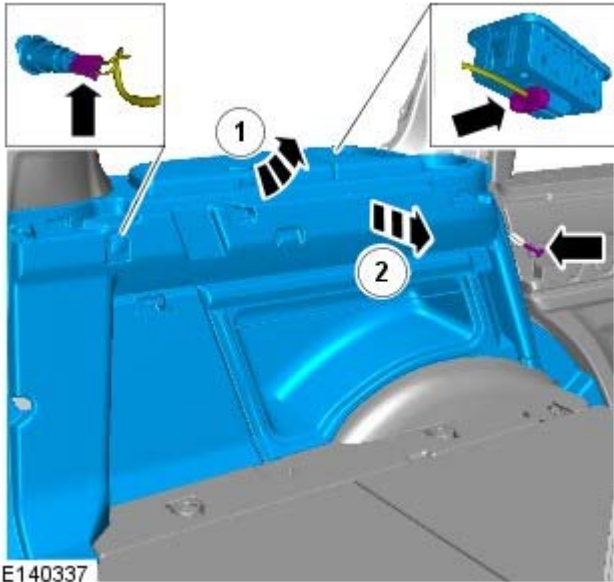
4. Release the tailgate aperture seal.



5. Remove the support spigot from the tailgate.

- Release the clip.





6. Remove the rear quarter trim panel.

- Remove the Torx screw.
- Lift the storage box lid and using a firm grip, release the window clips by pulling the trim inboard.
- Release the remaining 6 plastic clips using a suitable tool.
- Disconnect the 2 electrical connectors.

7. NOTE: Do not disassemble further if the component is removed for access only.

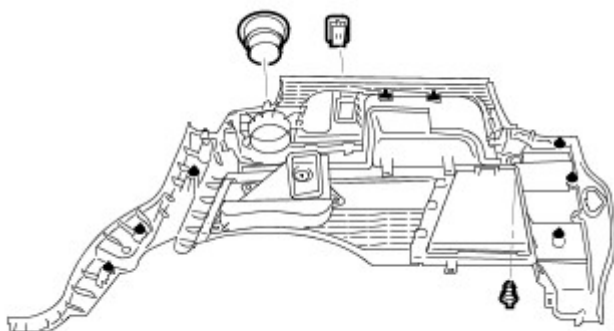
Remove the stowage tray.

- Release the cover.

8. Remove the audio control switch.

- Release the 2 clips.

9. Remove the accessory socket.



E49782

Installation

1. Install the accessory socket.
2. Install the audio control switch.
 - Secure the clips.
3. Install the stowage tray.
 - Install the cover.
4. Install the rear quarter trim panel.
 - Install the clips.
 - Tighten the Torx screw to 8 Nm (6 lb.ft).
 - Connect the electrical connector.
5. Install the support spigot to the tailgate.
 - Install the clip.
6. Install the tailgate aperture seal.

7. Install the safety belt anchor.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).

8. Install the door aperture weatherstrip.

9. Return the seat backrest to the upright position.

Interior Trim and Ornamentation - A-Pillar Trim Panel

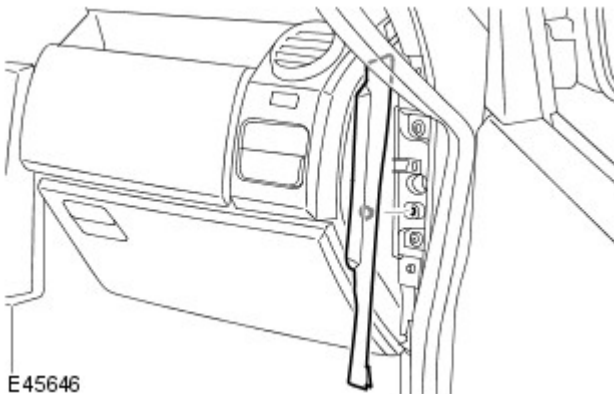
Removal and Installation

Removal

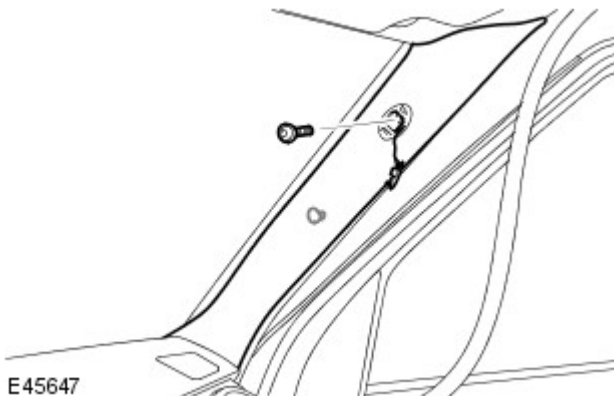
1. Release the door weatherstrip to access the A-pillar upper trim panel and instrument panel end panel.



2. Remove the instrument panel end panel.
 - Release the clip.



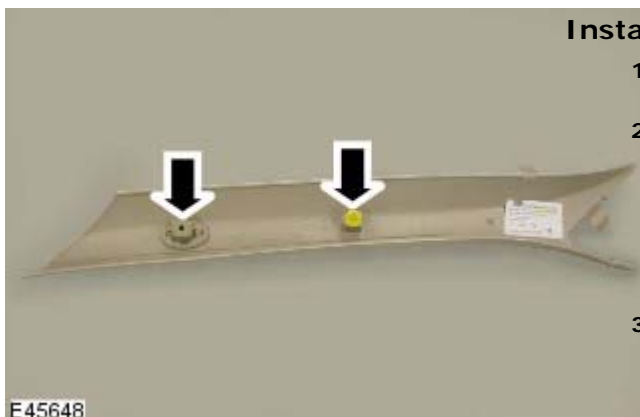
3. Remove the A-pillar upper trim panel.
 - Release the screw cover.
 - Remove and discard the Torx screw.
 - Release the clip.



4. NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. Install the screw cover and clip from the A-pillar upper trim panel.
2. Install the A-pillar upper trim panel.
 - Secure with the clip.
 - Install a new Torx screw and tighten to 3 Nm (2 lb.ft).
 - Install the screw cover.
3. Install the instrument panel end panel.
 - Secure with the clip.

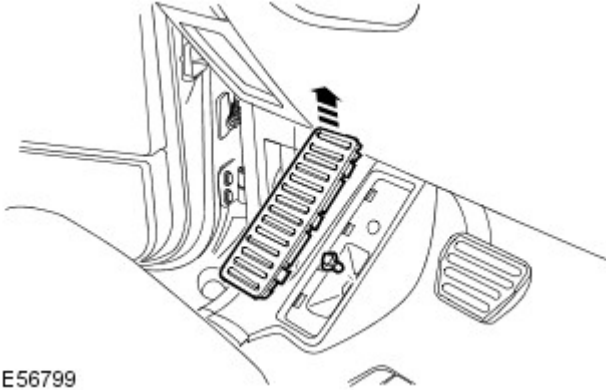


Interior Trim and Ornamentation - Cowl Side Trim Panel

Removal and Installation

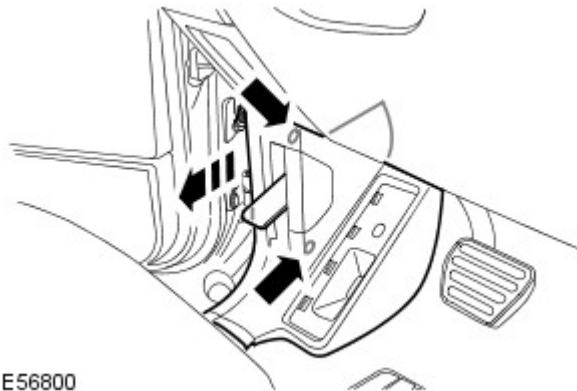
Removal

1. Remove the front scuff plate trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Driver side: Remove the footrest trim panel bolt.
 - Remove the cover.



E56799

3. Remove the cowl side trim panel.
 - Driver side: Release the hood release lever.
 - Release from the 2 clips.



E56800

Installation

1. Install the cowl side trim panel.
 - Align the hood release lever.
 - Secure with the clips.
2. Driver side: Tighten the footrest trim panel bolt to 5 Nm (4 lb.ft).
 - Install the cover.
3. Install the front scuff plate trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

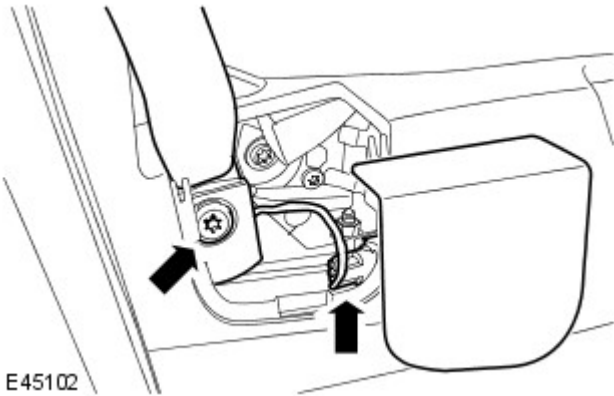
Interior Trim and Ornamentation - B-Pillar Upper Trim Panel

Removal and Installation

Removal

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the safety belt lower anchor from the seat.

- Remove the bolt cover.
- Passenger side, disconnect the electrical connector.
- Remove the Torx bolt.



E45102

4. **NOTE:** Make sure the seat belt height adjuster is at its lowest point prior to removal of the B-pillar upper trim panel.

Remove the B-pillar upper trim panel.

- Release the front and rear door weatherstrips for access.
- Release the 2 lower clips, then the remaining upper clip.
- Release the safety belt.



E45728

Installation

1. Install the B-pillar upper trim panel.
 - Secure with the clips.
 - Attach the safety belt.
 - Attach the door weatherstrips.
2. Attach the safety belt lower anchor to the seat.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
 - Passenger side, connect the electrical connector.
 - Install the bolt cover.
3. Install the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Interior Trim and Ornamentation - B-Pillar Lower Trim Panel

Removal and Installation

Removal

1. Remove the B-pillar lower trim panel.

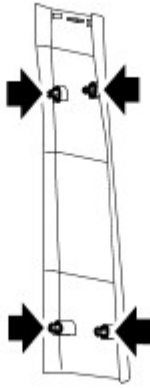
- Release weatherstrip from both sides of the B-pillar lower trim panel.
- Release the 4 clips.



E43145

2. NOTE: Do not disassemble further if the component is removed for access only.

Remove 4 clips from the B-pillar lower trim panel.



E43146

Installation

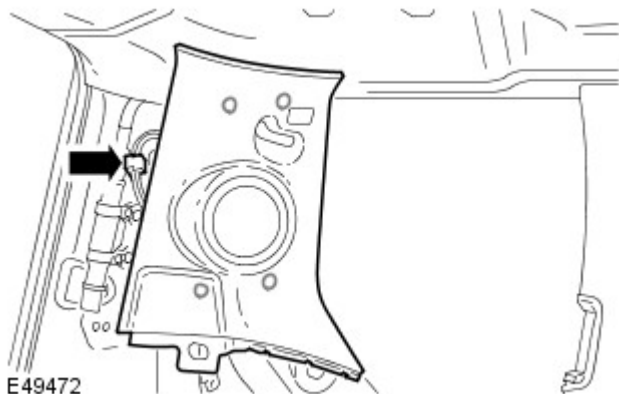
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - D-Pillar Trim Panel

Removal and Installation

Removal

1. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Vehicles fitted with 7 seats: Release the seat belt.
 - Remove and discard the bolt.
3. Remove the D-pillar upper trim panel.
 - Release the 4 clips.
 - Disconnect the electrical connector.



4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the speaker.

- Remove the 3 screws.

Installation

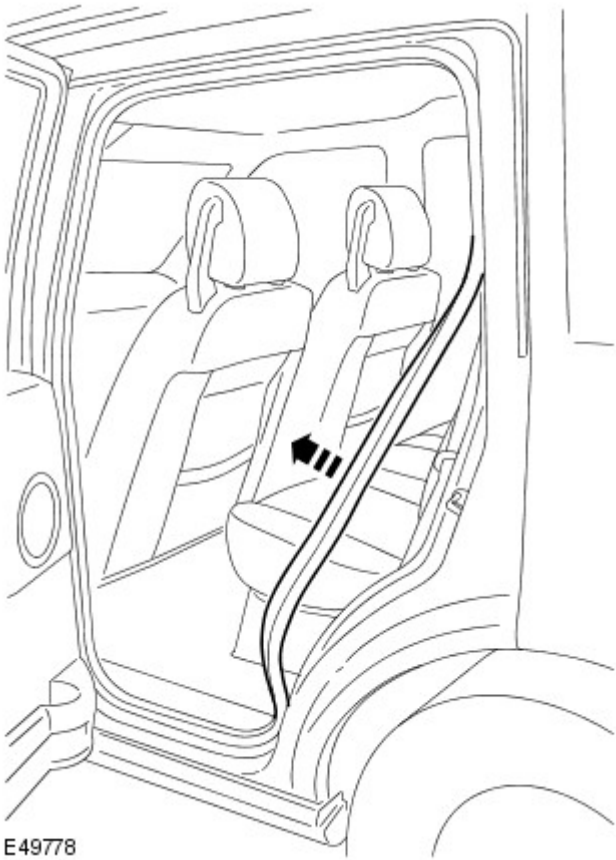
1. To install, reverse the removal procedure.
 - Tighten the new Torx bolt to 40 Nm (30 lb.ft).

Interior Trim and Ornamentation - C-Pillar Lower Trim Panel

Removal and Installation

Removal

1. Fold down the rear seat backrest.
2. Release the door aperture weatherstrip.



E49778

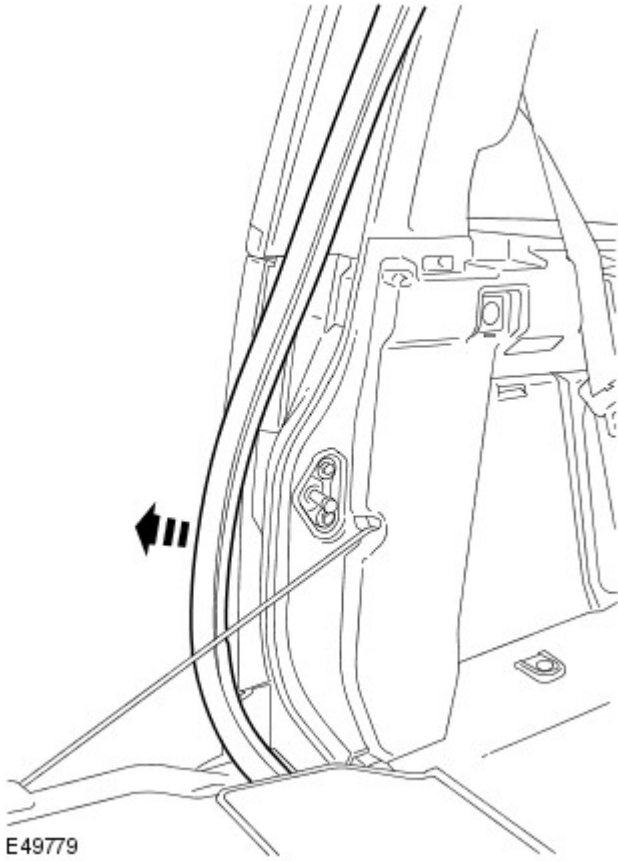
3. Release the safety belt anchor.

- Remove and discard the bolt.



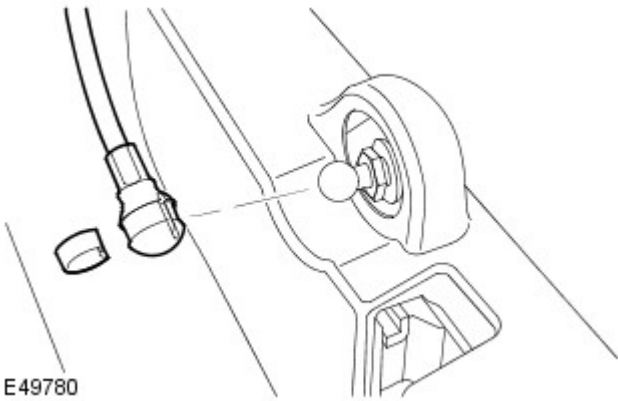
E49594

4. Release the tailgate aperture seal.



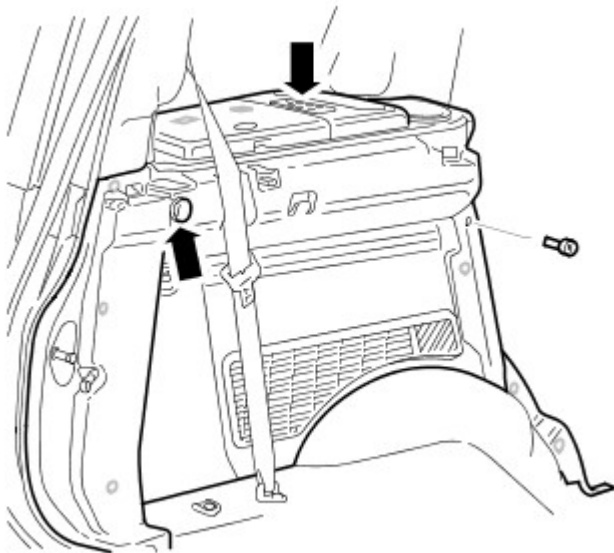
5. Remove the support spigot from the tailgate.

- Release the clip.



6. Remove the C-pillar lower trim panel.

- Remove the Torx screw.
- Release the 8 clips.
- Disconnect the 2 electrical connectors.



E49781

7. NOTE: Do not disassemble further if the component is removed for access only.

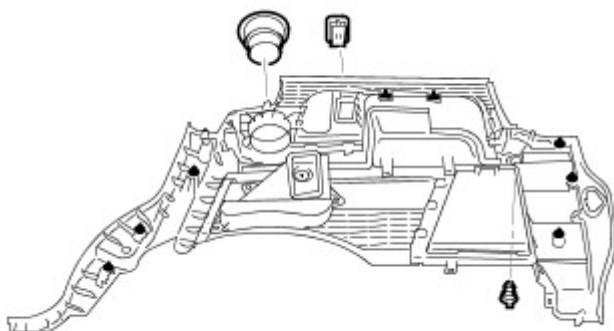
Remove the stowage tray.

- Release the cover.

8. Remove the audio control switch.

- Release the 2 clips.

9. Remove the accessory socket.



E49782

Installation

1. Install the accessory socket.

2. Install the audio control switch.

- Secure the clips.

3. Install the stowage tray.

- Install the cover.

4. Install the C-pillar lower trim panel.

- Install the clips.
- Tighten the Torx screw to 8 Nm (6 lb.ft).
- Connect the electrical connector.

5. Install the support spigot to the tailgate.

- Install the clip.

6. Install the tailgate aperture seal.

7. Install the safety belt anchor.

- Tighten the Torx bolt to 45 Nm (33 lb.ft).

8. Install the door aperture weatherstrip.

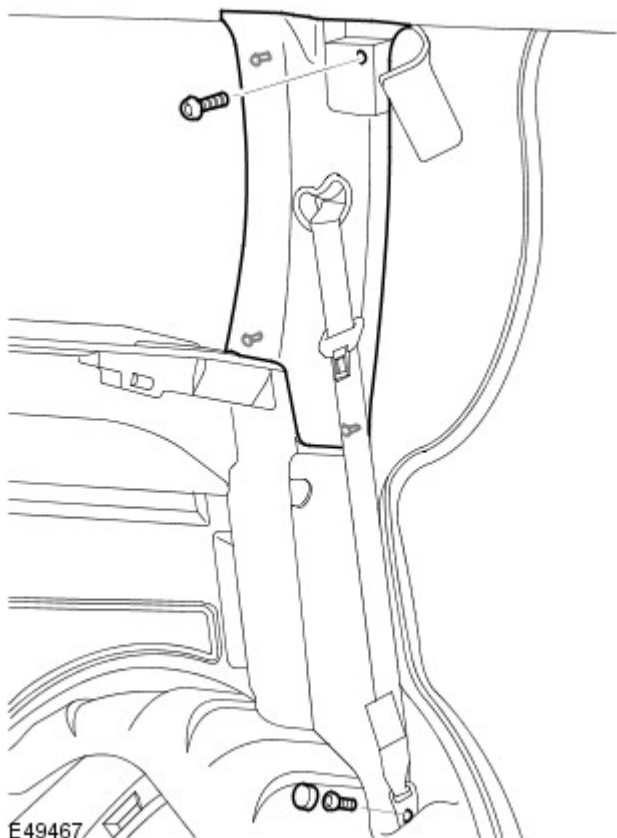
9. Return the seat backrest to the upright position.

Interior Trim and Ornamentation - C-Pillar Upper Trim Panel

Removal and Installation

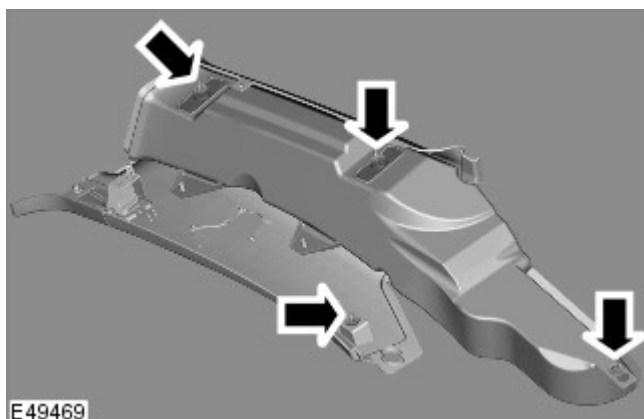
Removal

1. Fold down the rear seat backrest.
2. Release the door aperture weatherstrip.
3. Release the safety belt lower anchor.
 - Remove and discard the Torx bolt.
4. Release the upper trim access cover.
5. Remove the C-pillar upper trim panel.
 - Remove and discard the Torx screw.
 - Release the 4 clips.
 - Release the safety belt from the seat.



6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 4 clips from the C-pillar upper trim panel.



Installation

1. Install the clips to the C-pillar upper trim panel.
2. Install the C-pillar upper trim panel.
 - Attach the safety belt.
 - Secure with the clips.

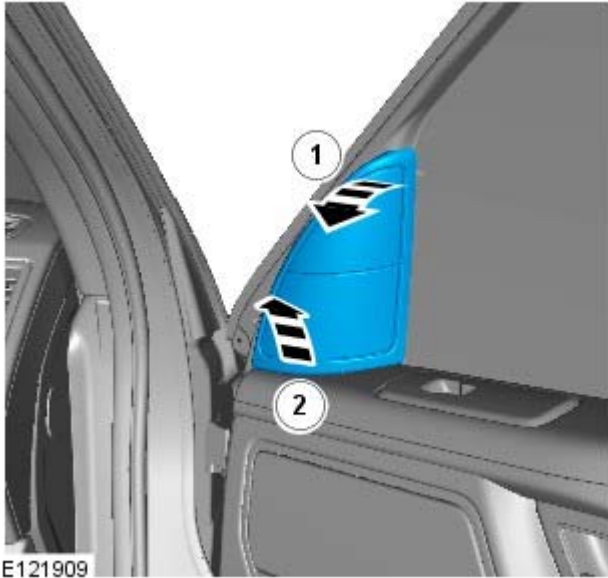
- Install a new Torx screw and tighten to 3 Nm (2 lb.ft).
3. Install the upper trim access cover.
 4. Install the safety belt lower anchor.
 - Tighten the new Torx bolt to 40 Nm (30 lb.ft).
 5. Install the door aperture weatherstrip.
 6. Return the seat backrest to the upright position.

Interior Trim and Ornamentation - Front Door Trim Panel

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

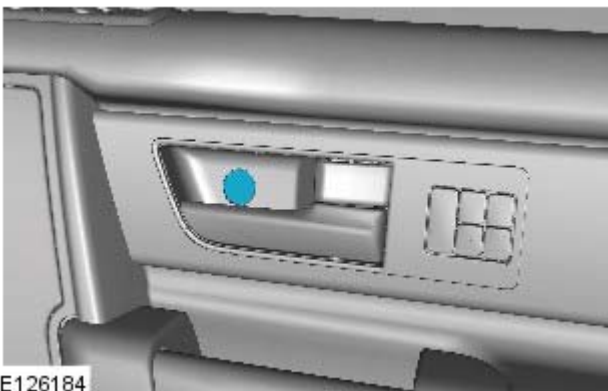


1. **1. CAUTIONS:**

 Take extra care not to damage the component.

 Make sure that the clips are correctly located.

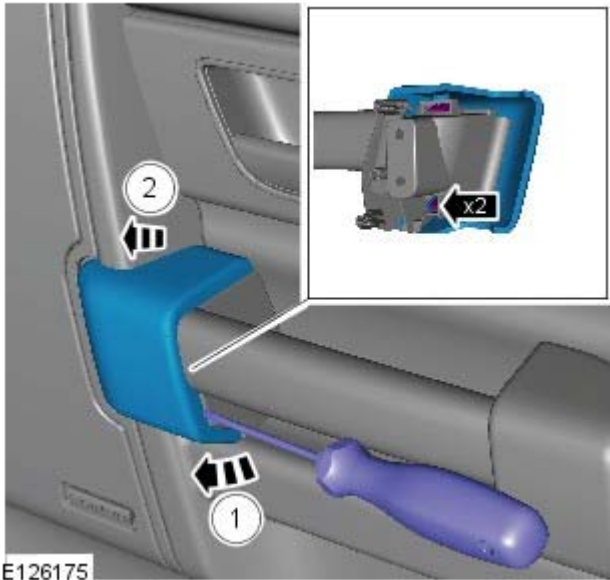
Disconnect the tweeter speaker electrical connector.



2.



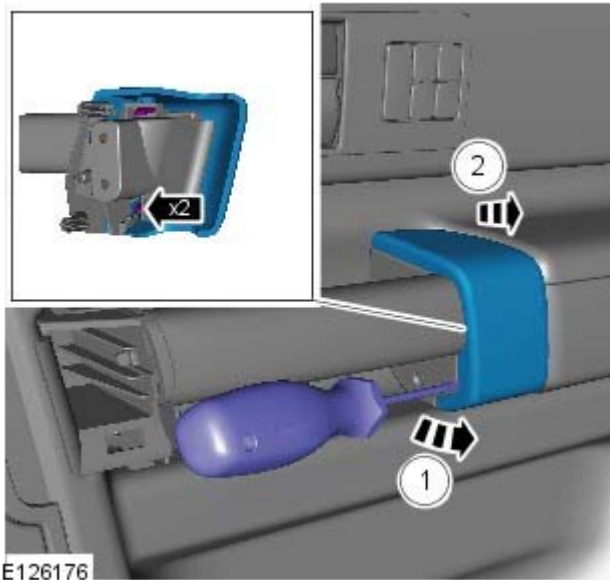
3.



E126175

4. 4. CAUTIONS:

- ⚠ Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.
- ⚠ When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.
- ⚠ Make sure that the clips are correctly located.



E126176

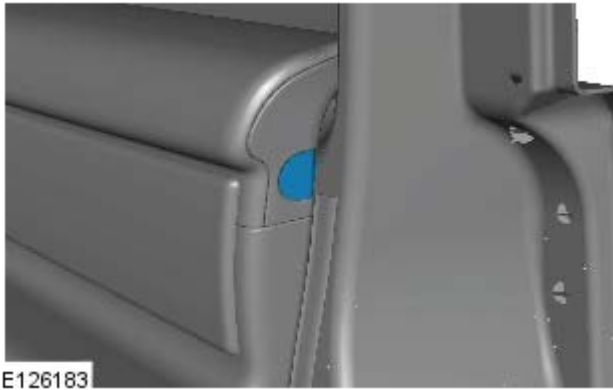
5. 5. CAUTIONS:

- ⚠ Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.
- ⚠ When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.
- ⚠ Make sure that the clips are correctly located.



E126173

6.



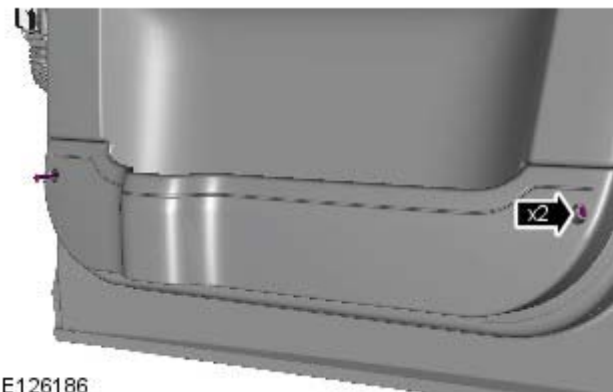
7.

E126183



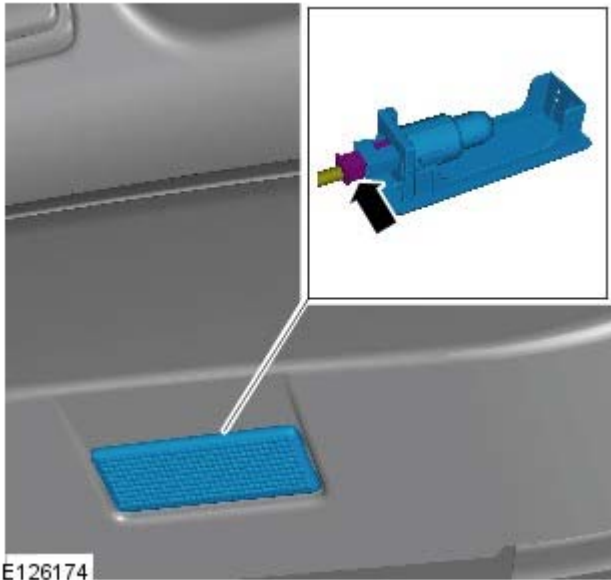
8.

E126185

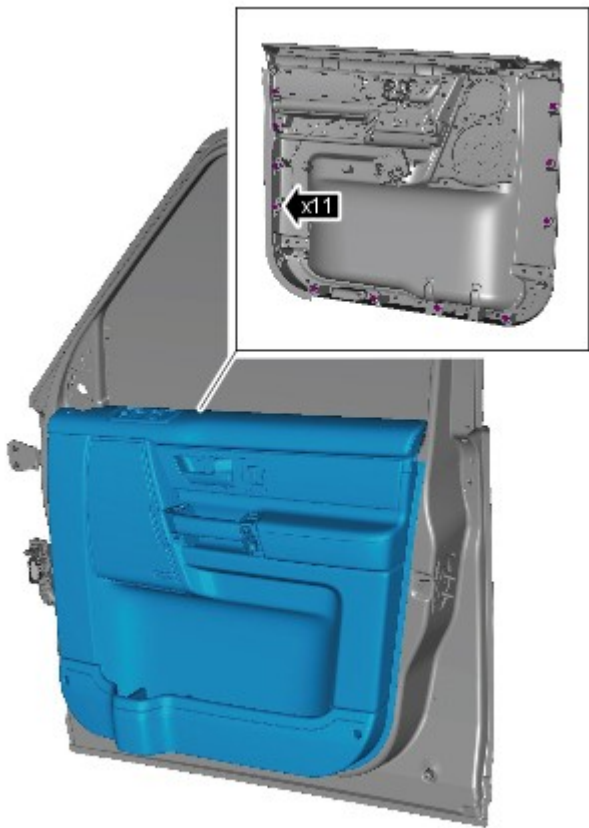


9.

E126186

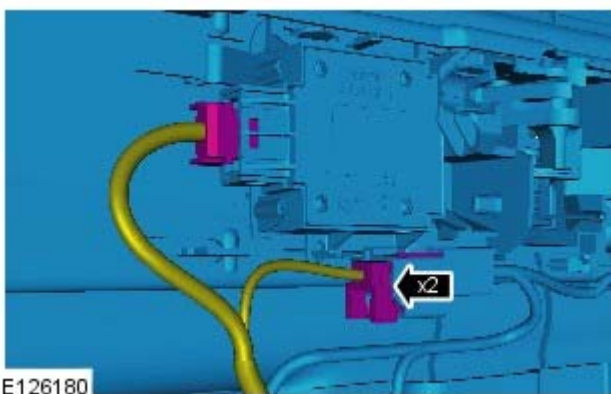


10.

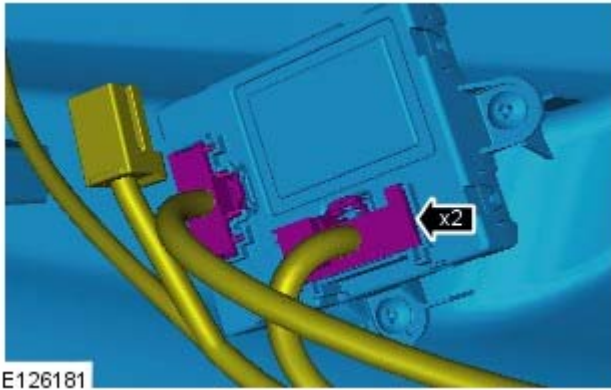


11. **11.**  **CAUTION:** Take extra care not to damage the wiring harnesses.

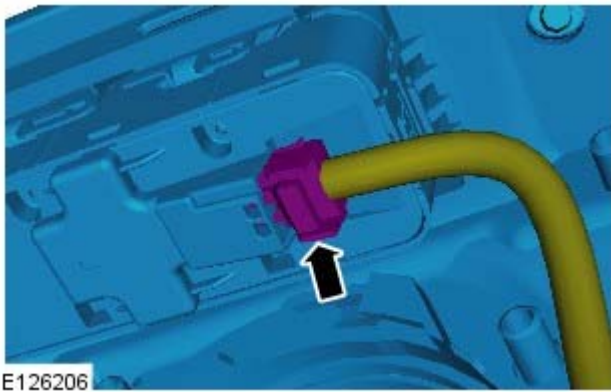
Detach the front door trim panel.



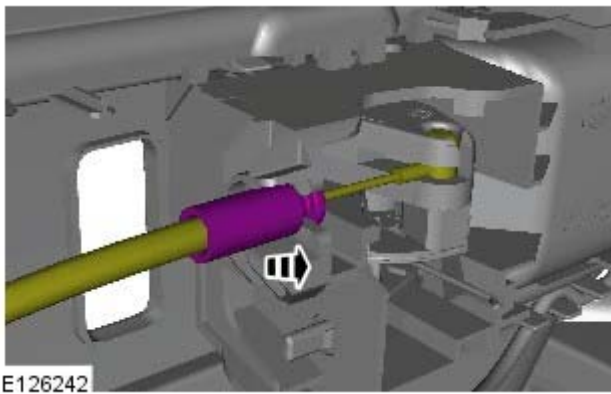
12.




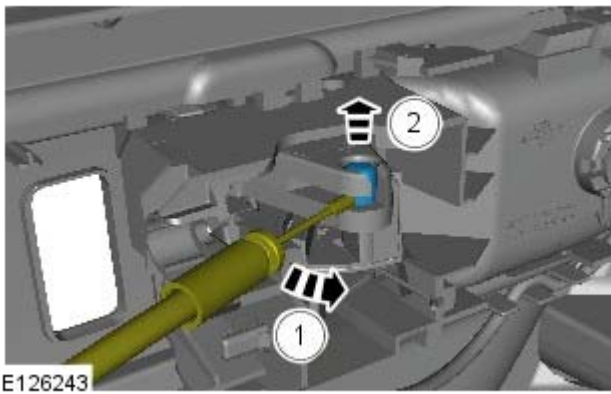
13.



14.

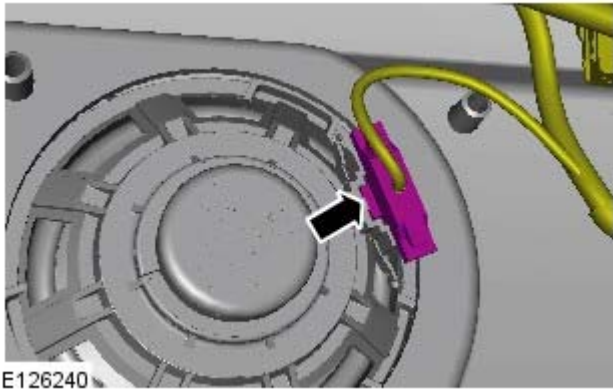


15. **15.**  **CAUTION:** Make sure that the release cable is removed from the door trim panel using the plastic fixing and not using the cable.

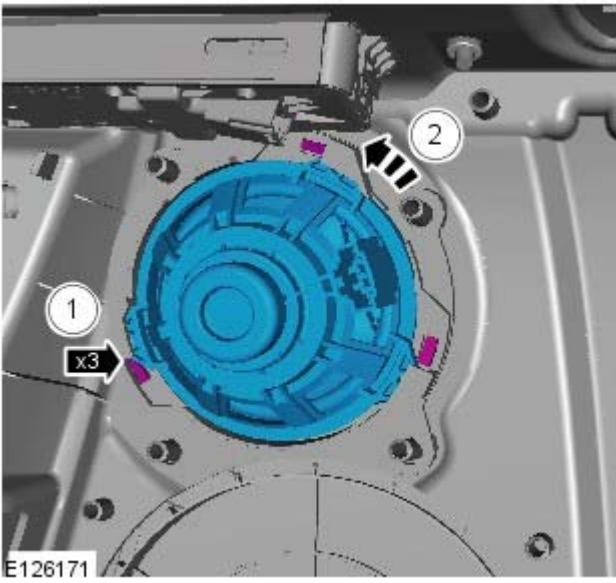


16.

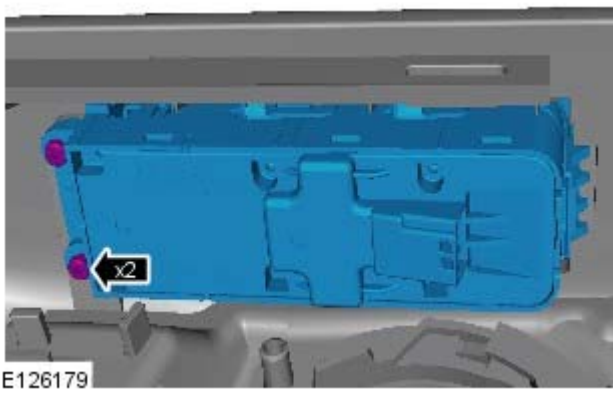
17. Remove the front door trim panel.



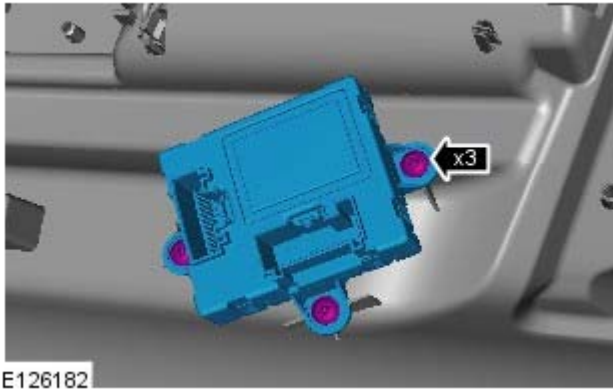
18. **18.** NOTE: Do not disassemble further if the component is removed for access only.



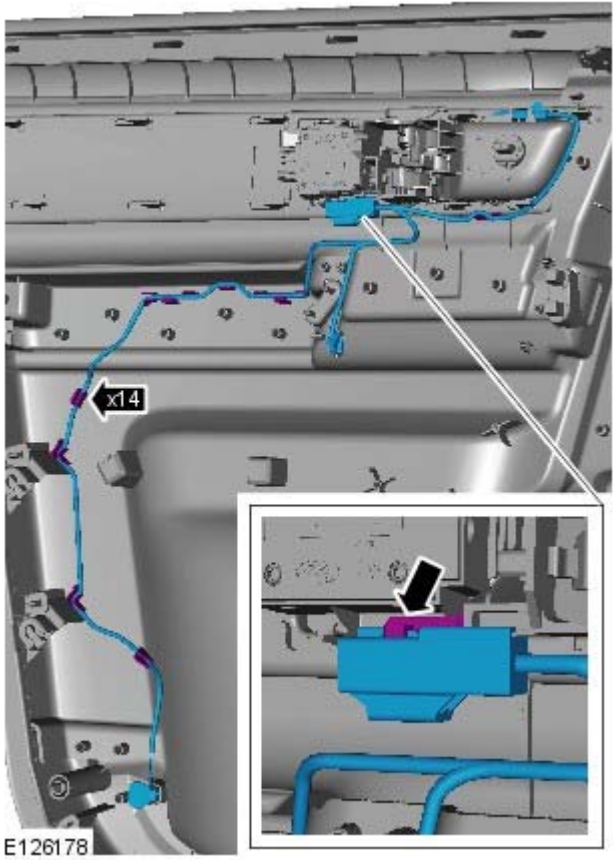
19.



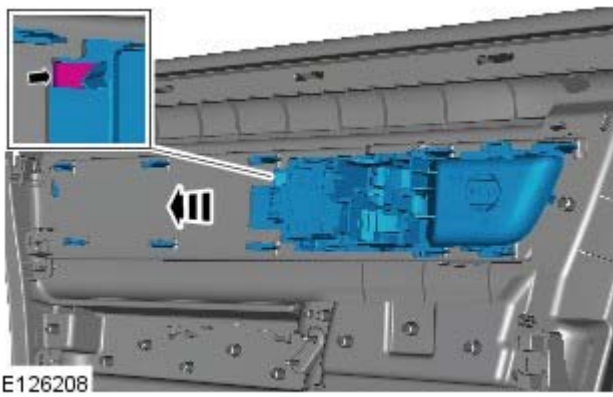
20.



21.

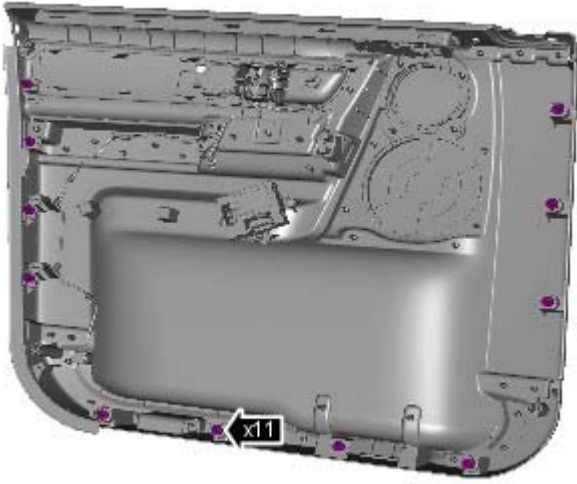


22.



23. Release the retaining tang.

24.



E126172

Installation

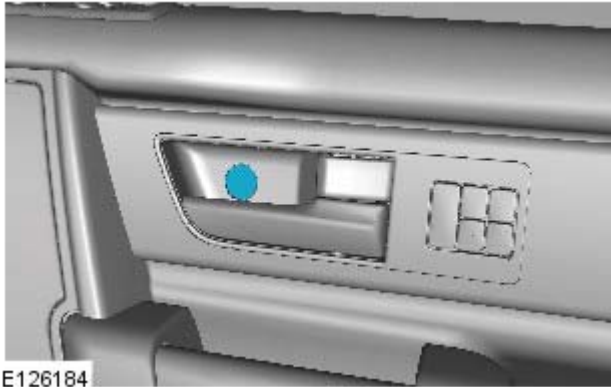
1. To install, reverse the removal procedure.

Interior Trim and Ornamentation - Rear Door Trim Panel

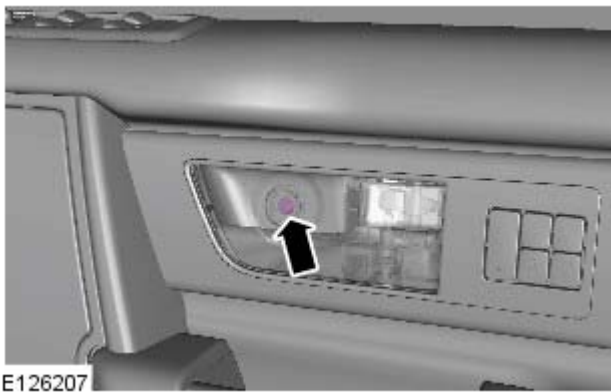
Removal and Installation

Removal

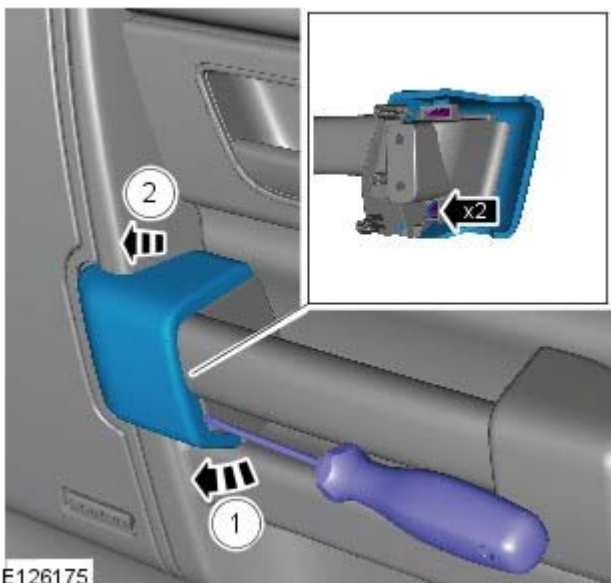
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**



1.

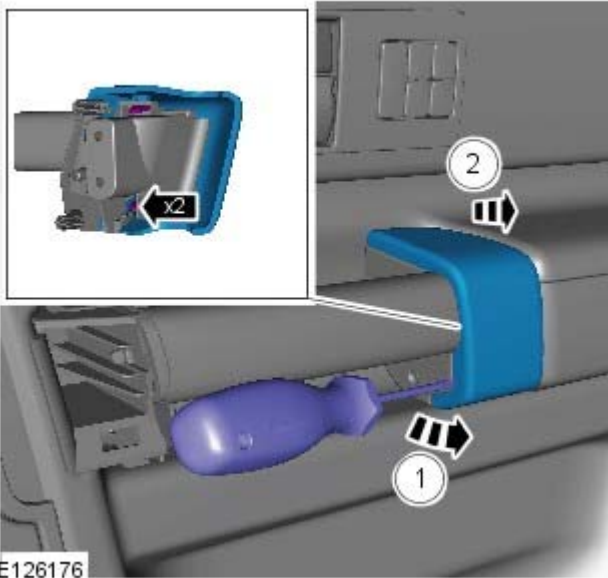


2.




3. **3. CAUTIONS:**


- ⚠ Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.
- ⚠ When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.
- ⚠ Make sure that the clips are correctly located.



E126176

4. **4. CAUTIONS:**

 Take extra care not to damage the component. Apply masking tape to the end of the screwdriver.

 When removing the chrome finisher from the trim panel, make sure the components are not damaged. If necessary protect the surrounding areas using masking tape.

 Make sure that the clips are correctly located.



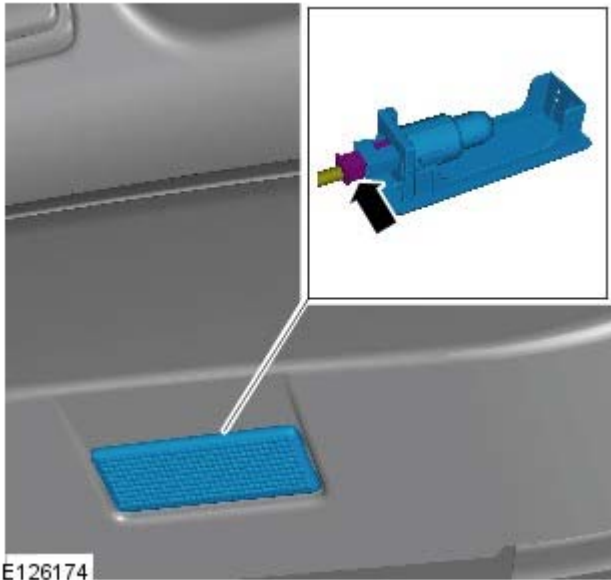
E126173

5.



E126225

6.

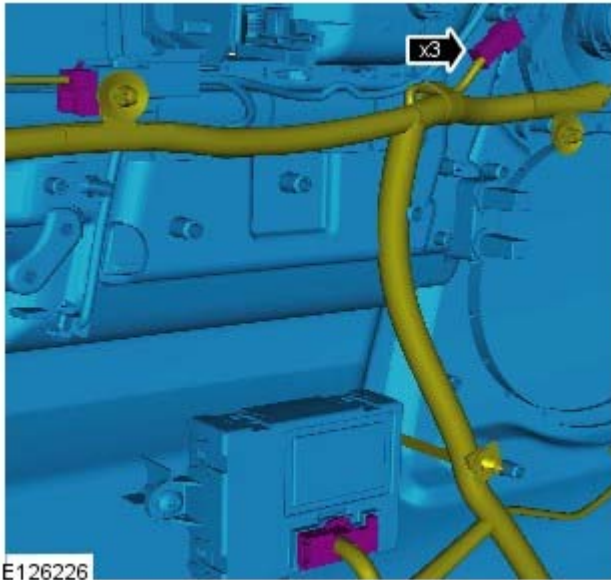


7.

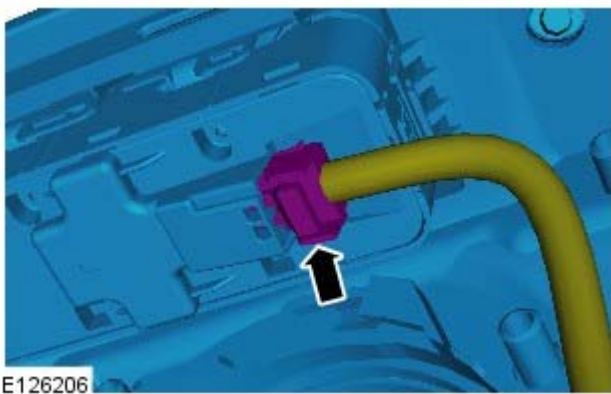


8.  CAUTION: Take extra care not to damage the wiring harnesses.

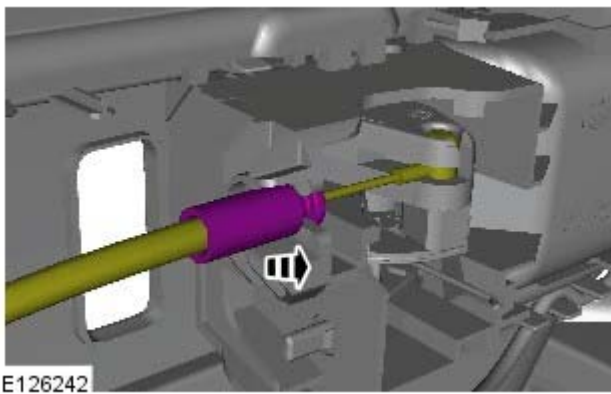
Detach the rear door trim panel.




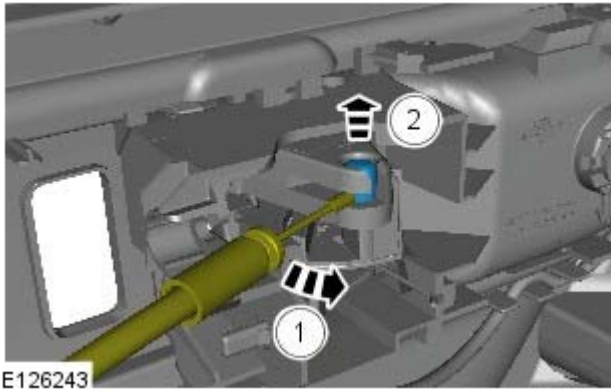
9.



10.



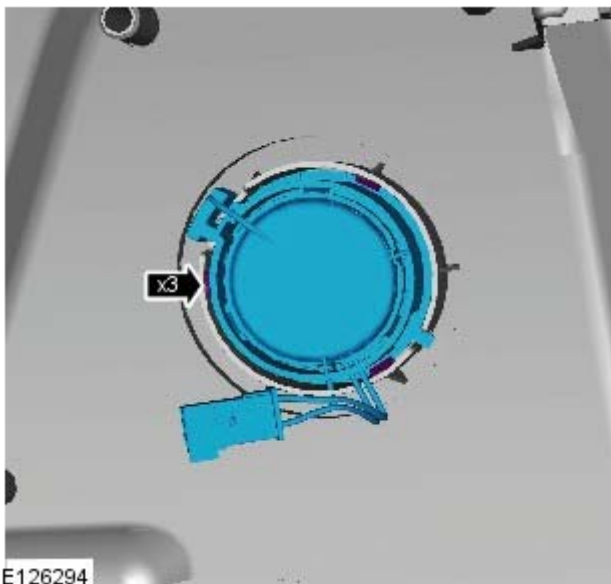
11. **11.**  CAUTION: Make sure that the release cable is removed from the door trim panel using the plastic fixing and not using the cable.



12.

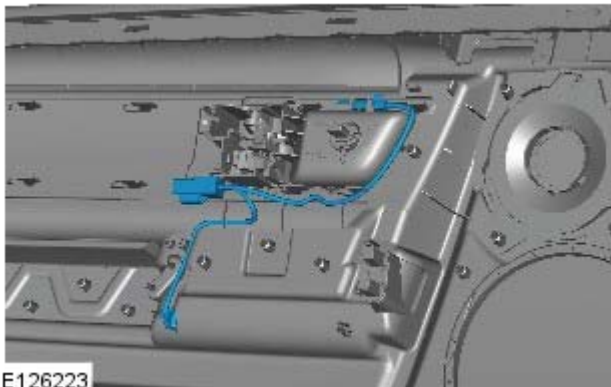
E126243

13. Remove the rear door trim panel.



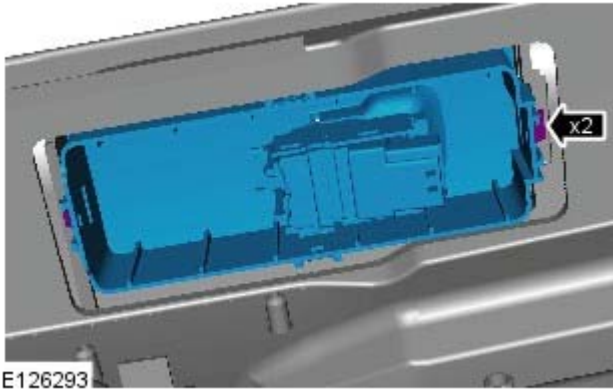
14. **14.** NOTE: Do not disassemble further if the component is removed for access only.

E126294

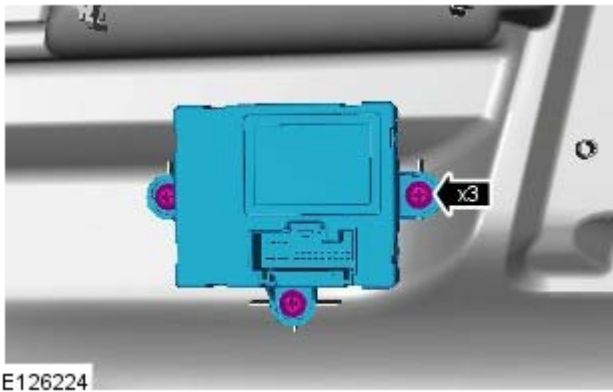


15.

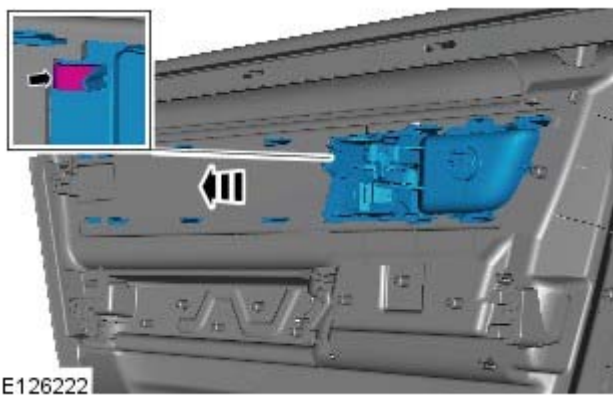
E126223



16.



17.



18. Release the retaining tang.

19.



E126227

Installation

1. To install, reverse the removal procedure.

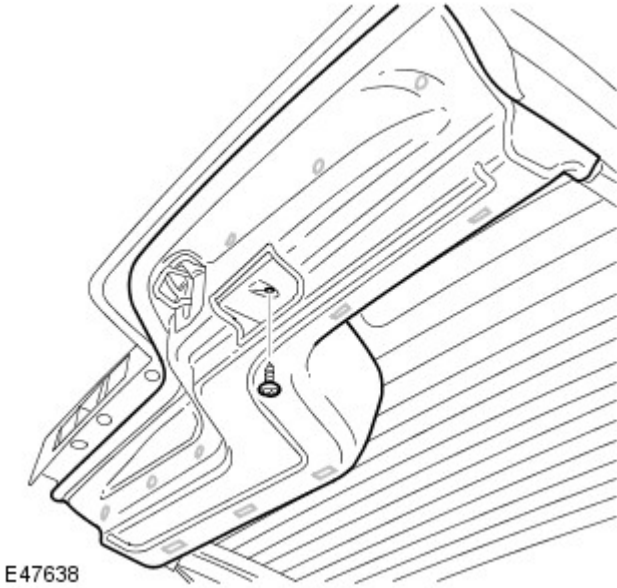
Interior Trim and Ornamentation - Liftgate Trim Panel

Removal and Installation

Removal

1. Remove the liftgate trim panel.

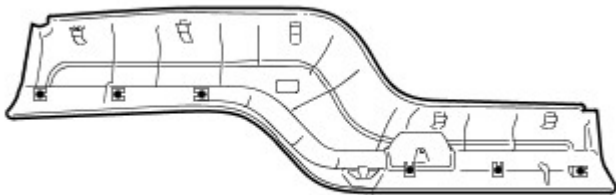
- Remove the screw.
- Release the 11 clips.



2. Remove the liftgate striker trim panel.

3. NOTE: Do not disassemble further if the component is removed for access only.

Remove 6 clips from the liftgate trim panel.



Installation

1. To install, reverse the removal procedure.

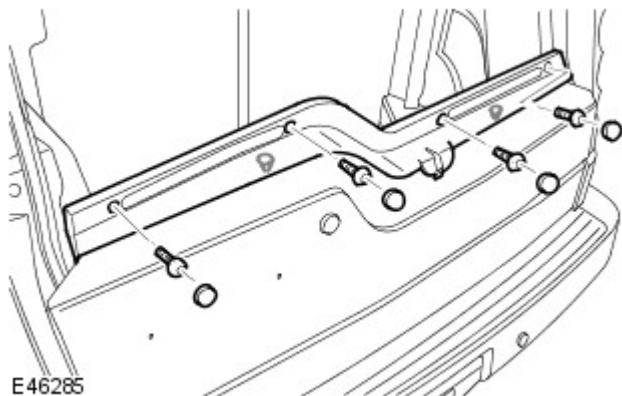
Interior Trim and Ornamentation - Tailgate Trim Panel


Removal and Installation

Removal

1. Remove the tailgate upper trim panel.

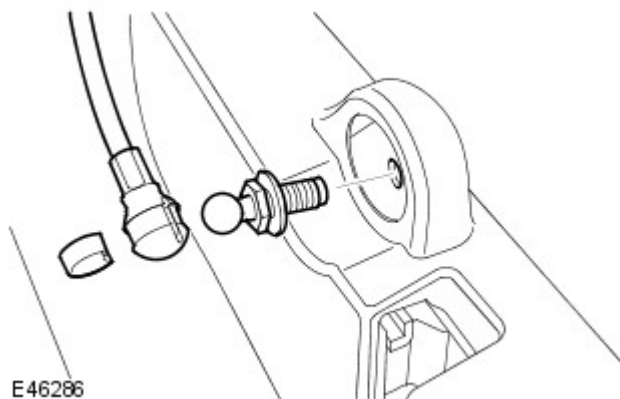
- Remove the 4 screw covers.
- Remove the 4 screws.
- Release the 2 clips.



2.  **CAUTION:** To protect the paintwork, the tailgate must be supported at all times.

Release the 2 support cables from the tailgate.

- Release the 2 clips.

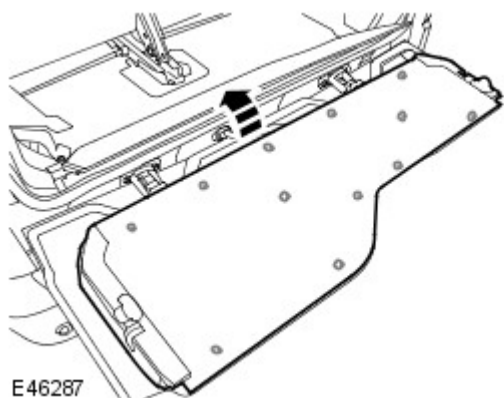


3. Remove the 2 support cable spigots from the tailgate.

4. Lift the tailgate hinge cover for access.

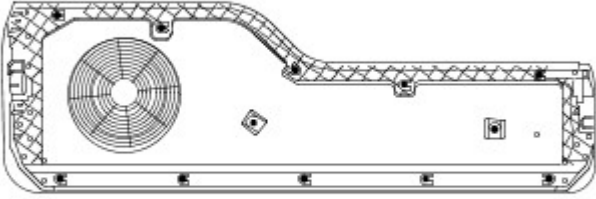
5. Remove the tailgate trim panel.

- Release from the 12 clips.



6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 12 clips from the tailgate trim panel.



E46288

Installation

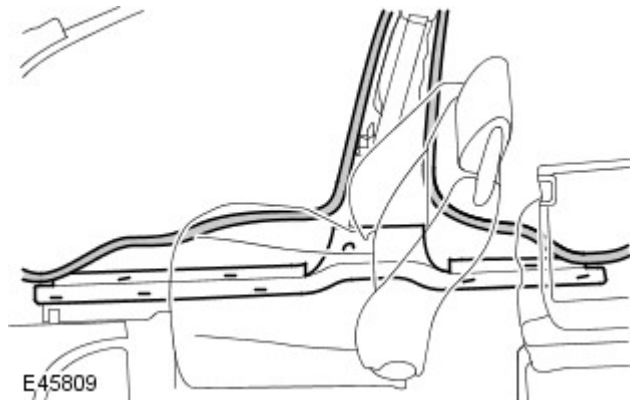
1. Install the tailgate trim panel.
 - Install the clips.
2. Lower the tailgate hinge cover.
3. Tighten the support strut spigot to 25 Nm (18 lb.ft).
4. Position the support cables to the tailgate and secure with the clips.
5. Install the tailgate upper trim panel.
 - Secure with the clips.
 - Install the screws.
 - Install the screw covers.

Interior Trim and Ornamentation - Scuff Plate Trim Panel

Removal and Installation

Removal

1. Remove the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Release the front and rear door weatherstrips to access the scuff plate trim panel.

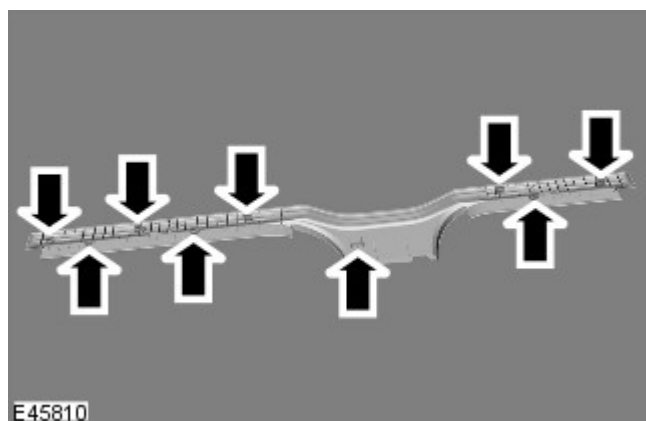


3. Remove the scuff plate trim panel.

- Remove the 9 clips.

4. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 9 clips from the scuff plate trim panel.



Installation

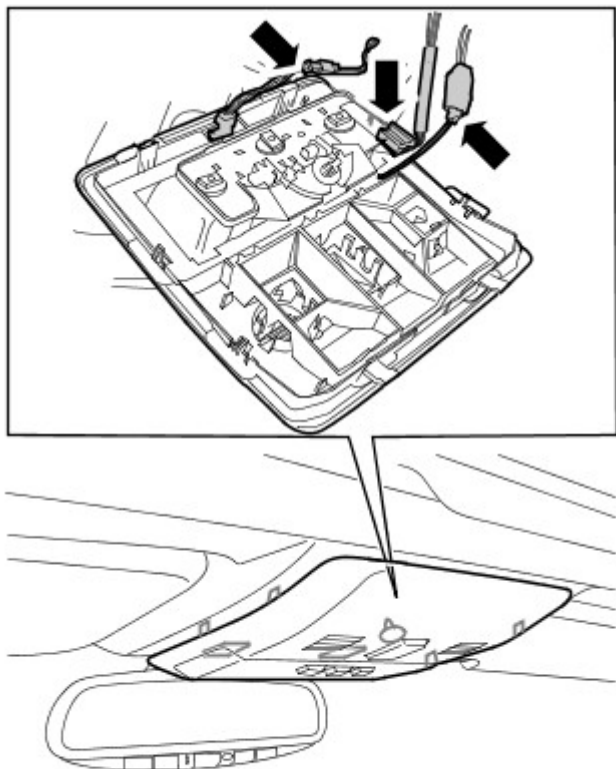
1. Install the scuff plate trim panel.
 - Install the clips.
 - Secure with the clips.
2. Attach the door weatherstrips.
3. Install the B-pillar lower trim panel.
For additional information, refer to: [B-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Interior Trim and Ornamentation - Headliner

Removal and Installation

Removal

1. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove both C-pillar upper trim panels.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove both D-pillar upper trim panels.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
5. Remove the front overhead console.

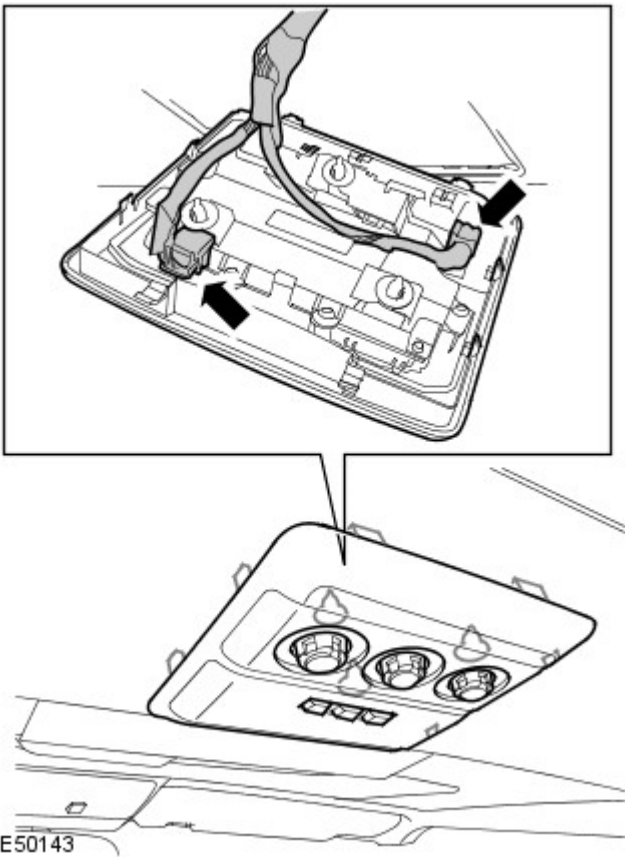


- Carefully release the 7 clips.
- Disconnect the 3 electrical connectors.

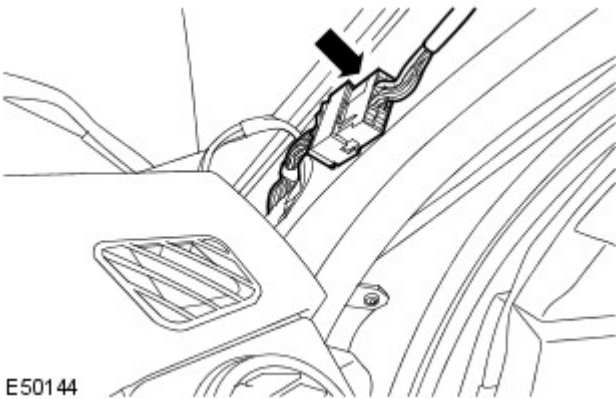
E50142

6. Remove the rear overhead console.

- Carefully release the 9 clips.
- Disconnect the 2 electrical connectors.

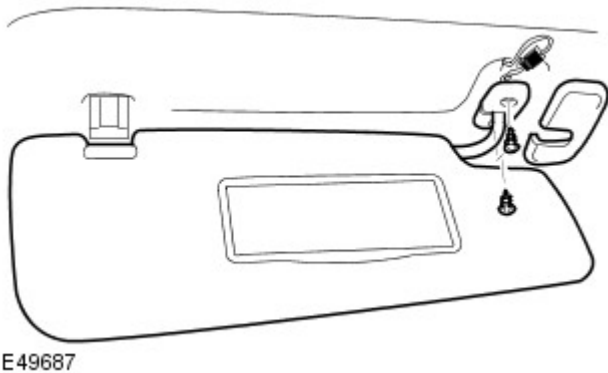


7. Disconnect the RH A-pillar electrical connector.



8. Remove the sun visor.

- Remove the cover.
- Remove the 2 screws.
- Release from the clip.
- Disconnect the electrical connector.
- Repeat the above procedure for the other side.



9. Remove the sun visor retaining clip.

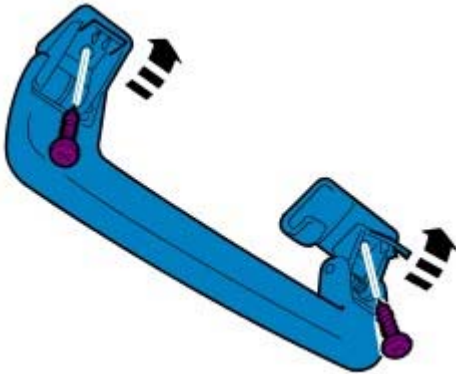
- Release the screw cover.
- Remove the screw.
- Repeat the above procedure for the other side.



E49688

10. Remove the passenger assist handle.

- Release the 2 screw covers.
- Remove the 2 screws.
- Repeat the above procedure for the remaining 5 handles.



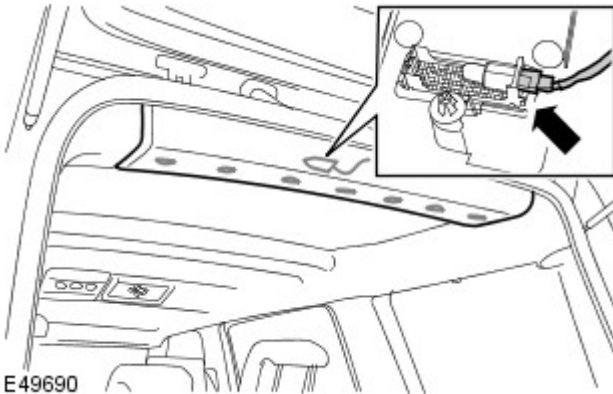
E49689

11. Position the front seats fully forward.

12. Position the rear seats fully forward.

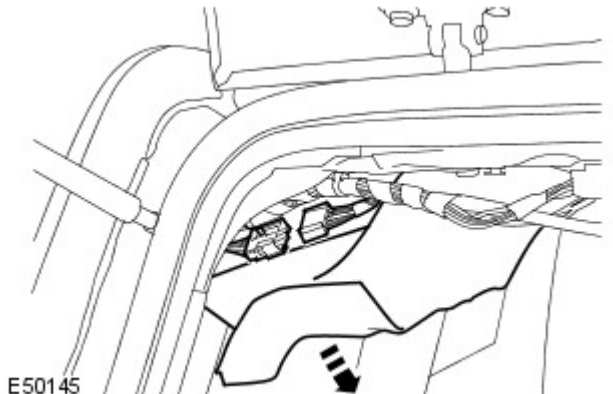
13. Remove the rear headliner trim panel.

- Release the 7 clips.
- Disconnect the electrical connector.

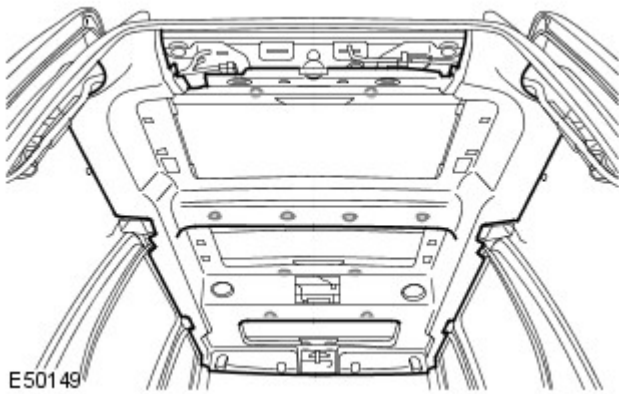


E49690

14. Disconnect the headliner wiring harness rear electrical connector.

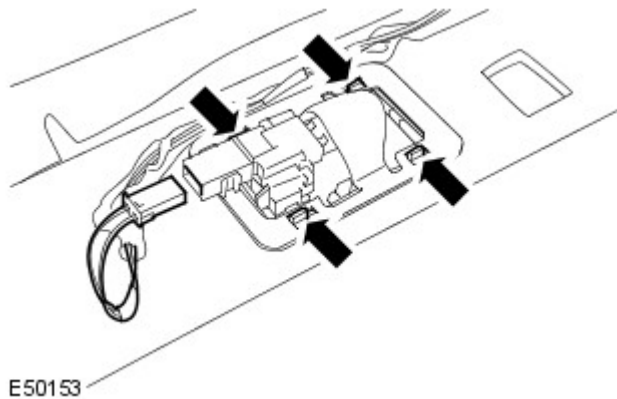


E50145



15. With assistance, carefully remove the headliner.

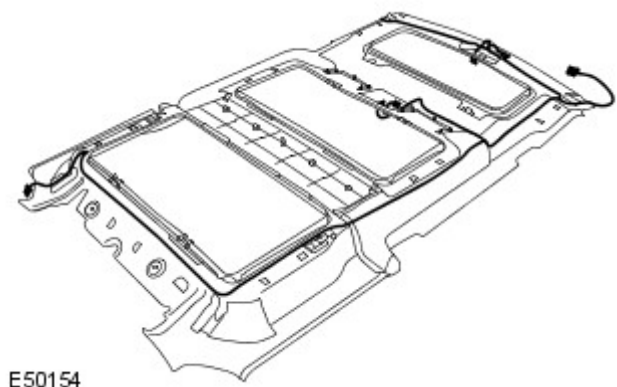
- Release the 14 clips.



16. NOTE: Do not disassemble further if the component is removed for access only.

Remove the rear interior lamp.

- Release the clip.
- Disconnect the electrical connector.
- Repeat the above procedure for the other side.



17. Remove the headliner wiring harness.

Installation

1. Install the headliner wiring harness.
 - Secure the wiring harness to the headliner.
2. Install the interior lamp.
 - Secure with the clip.
 - Connect the electrical connector.
 - Repeat the above procedure for the other side.
3. With assistance, carefully install the headliner.
 - Secure with the clips.
4. Connect the headliner wiring harness rear electrical connector.
5. Install the rear headliner trim panel.
 - Secure the clips.

6. Reposition the rear seats.
7. Reposition the front seats.
8. Install the passenger assist handles.
 - Install the screws.
 - Secure the screw covers.
9. Install the sun visors.
 - Install the clips.
 - Install the screws.
 - Install the screw covers.
 - Connect the electrical connectors.
10. Connect the RH A-pillar electrical connector.
11. Install the rear overhead console.
 - Connect the electrical connectors.
 - Carefully secure the clips.
12. Install the front overhead console.
 - Connect the electrical connectors.
 - Carefully secure the clips.
13. Install both D-pillar upper trim panels.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
14. Install both C-pillar upper trim panels.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
15. Install both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
16. Install both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

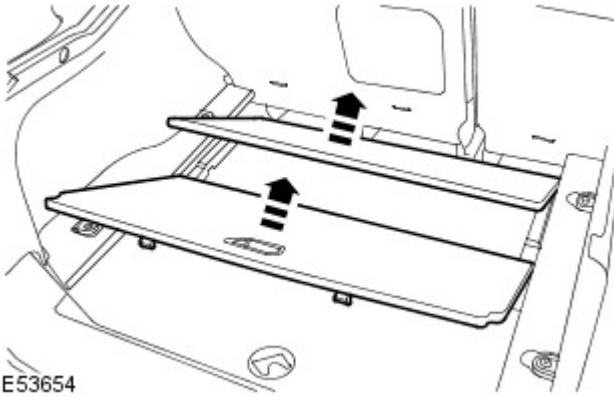
Interior Trim and Ornamentation - Loadspace Trim Panel RH

Removal and Installation

Removal

1. Remove the loadspace floor panels.

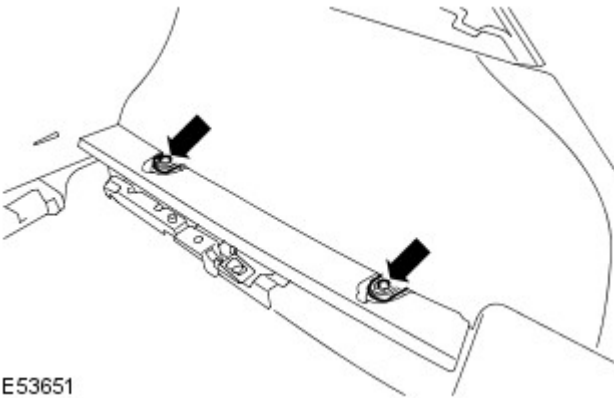
- Lift and remove the front panel.
- Lift and remove the rear panel.



E53654

2. Remove the loadspace compartment anchors.

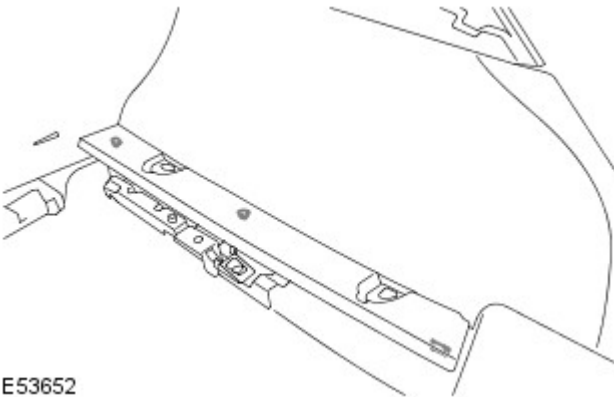
- Remove the bolt.
- Repeat the above procedure for the other anchor.



E53651

3. Remove the loadspace trim panel.

- Release the 3 clips.



E53652

4. NOTE: Do not disassemble further if the component is removed for access only.

Installation

1. Install the trim clips.

2. Install the loadspace trim panel.

- Secure the clips.
- Position the locating pegs.

3. Install the loadspace compartment anchors.

- Position the locating peg.
- Tighten the bolt to 25 Nm (18 lb.ft).
- Repeat the above procedure for the other anchor.



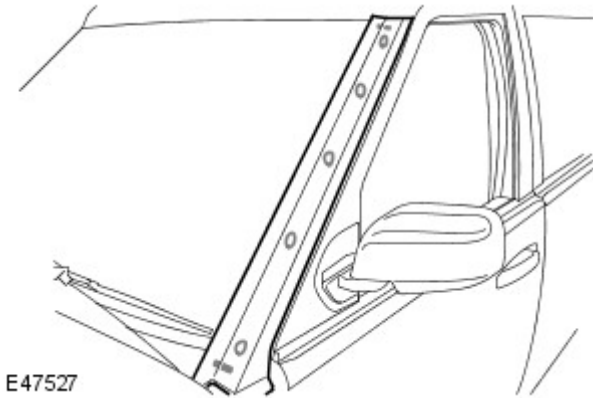
E53653

Exterior Trim and Ornamentation - A-Pillar Moulding LH

Removal and Installation

Removal

- NOTE: This procedure is also applicable for the RH moulding.



1. Open the bonnet.
2. Remove the A-pillar moulding.
 - Release and discard the 5 clips.

Installation

1. NOTE: The lower clip is unique to the others and must only be installed to the lowest position on the moulding.

To install, reverse the removal procedure.


1. New clips must be used.

Exterior Trim and Ornamentation - Front Fender Moulding

Removal and Installation

Removal

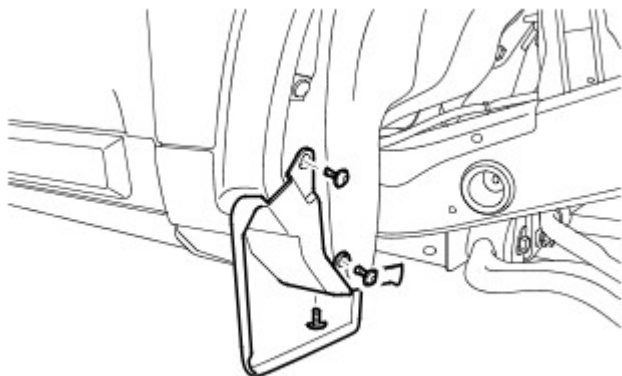
1. Remove the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

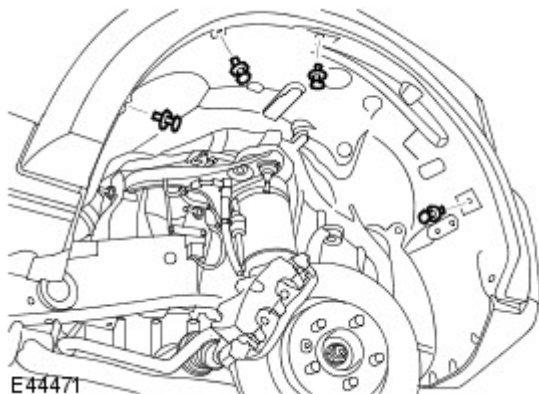
3. Remove the mud flap.

- Remove the 3 retaining screws.



E44470

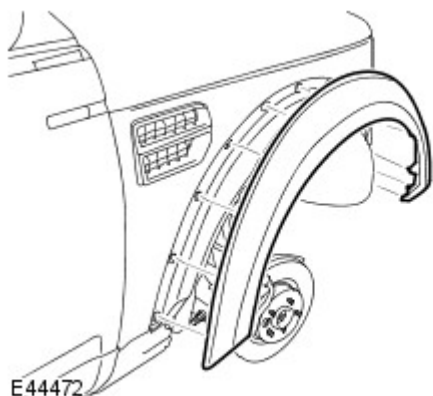
4. Remove the 4 retainers.



E44471

5. Remove the fender moulding.

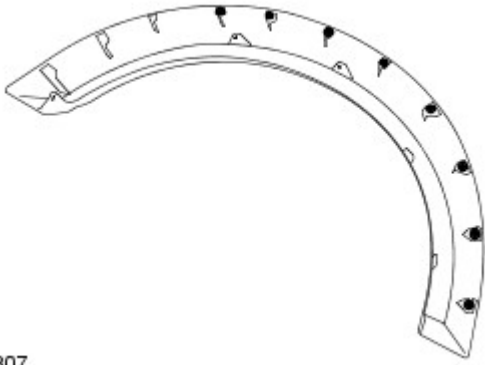
- Remove the 2 screws.
- Carefully release the 10 clips.



E44472

6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the clips from the moulding.



E53307

Installation

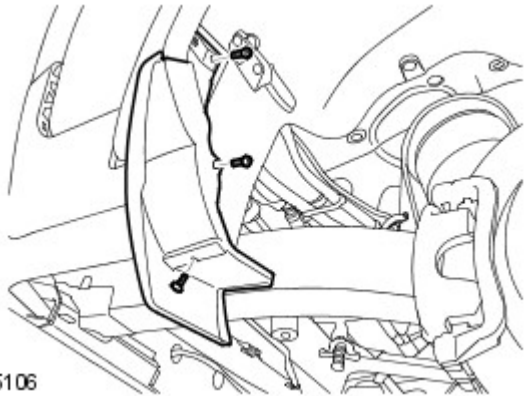
1. To install, reverse the removal procedure.
2. Install the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

Exterior Trim and Ornamentation - Rear Quarter Panel Moulding

Removal and Installation

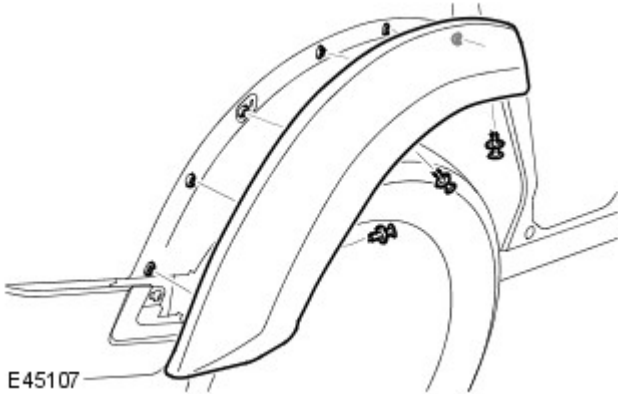
Removal

1. Remove the mud flap.
 - Remove the 3 screws.



E45106

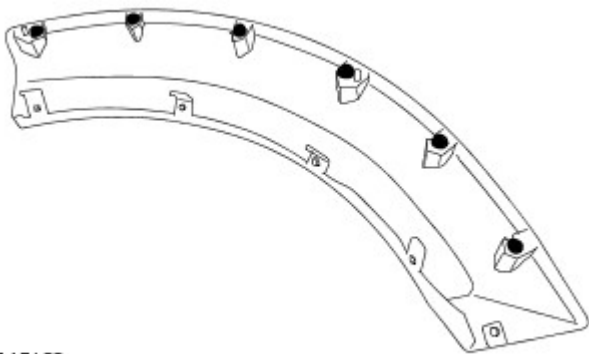
2. Remove the rear quarter panel moulding.
 - Remove the 3 clips from the underside of the moulding.
 - Release the 6 clips from the rear quarter panel.



E45107

3. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the clips from the moulding.



E45108

Installation

1. To install, reverse the removal procedure.

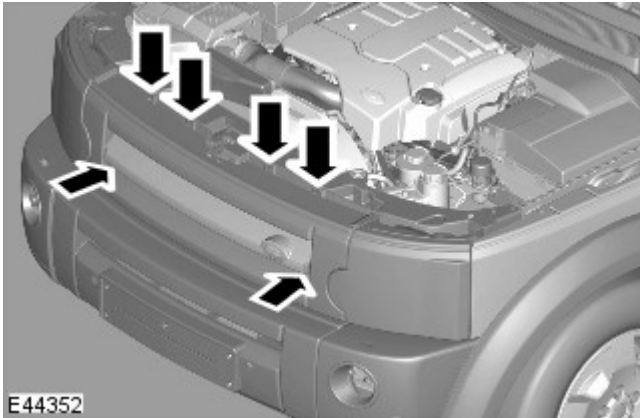
Exterior Trim and Ornamentation - Radiator Grille

Removal and Installation

Removal

1. Remove the radiator grille.

- Open the hood.
- Release the 6 clips.



Installation

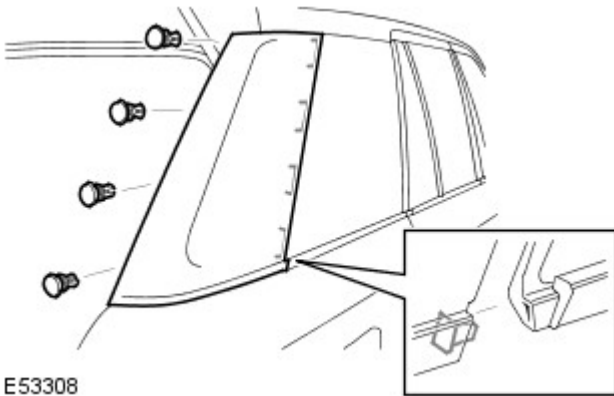
1. To install, reverse the removal procedure.

Exterior Trim and Ornamentation - Rear Quarter Window Moulding

Removal and Installation

Removal

1. Open the liftgate.
2. Remove the rear quarter window moulding.
 - Remove the 4 clips.
 - Release the locating peg.



E53308

Installation

1. Install the rear quarter window moulding.
 - Position the locating peg.
 - Secure the clips.

Rear View Mirrors -

Torque Specifications

Description	Nm	lb-ft
Exterior mirror bolts	6	4

Rear View Mirrors - Rear View Mirrors

Diagnosis and Testing

Principle of Operation

For a detailed description of the rear view mirror systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Rear View Mirrors (501-09 Rear View Mirrors, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Door mirror switch condition and installation ● Door mirror condition and installation 	<ul style="list-style-type: none"> ● Battery condition and state of charge ● Fuses ● Harnesses and connectors ● Washer jet and mirror heater relay ● Memory control module(s) ● Door mirror switch(s) ● Door mirror motor(s) ● Ignition switch ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Automatic Temperature Control (ATCM) module ● Local Interconnect Network (LIN) circuit

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Mirrors do not defrost/washer jets freeze	<ul style="list-style-type: none"> ● Fuse fault ● Washer jet and mirror heater relay fault ● Circuit fault: high resistance ● Circuit fault: short circuit to ground ● Automatic temperature control module fault 	Check the fuses. Check the operation of the washer jet and mirror heater relay. Check the washer jet and mirror heater circuits. Refer to the electrical guides. Refer to the warranty policy and procedures manual if a module is suspect.
Mirrors inoperative in one or more directions	<ul style="list-style-type: none"> ● Mechanical fault ● Switch fault ● Motor fault ● Circuit fault: high resistance ● Circuit fault: short circuit to ground 	Operate the mirror switch and listen for the motor(s). If the motor(s) can be heard, check the mechanical condition of the mirror and linkages. Rectify as necessary. Check for DTCs indicating a switch, motor or circuit fault.
Memorized mirror position is not resumed	<ul style="list-style-type: none"> ● Battery voltage below 10.5 volts ● Position not stored ● Switch operated during "one-touch" memory recall ● EEPROM fault 	Before condemning a memory component, check the function from the switch and refer to the symptoms above. Make sure the battery voltage is adequate. Make sure that the desired position is correctly stored. Make sure that the memory store/recall procedure is being followed. Refer to the relevant section of the workshop manual.
'Lazy entry' function inoperative	<ul style="list-style-type: none"> ● Remote transmitter fault (battery, transmitter programming, etc) ● Battery voltage below 10.5 volts ● Position not stored ● Switch operated during "one-touch" memory 	Check that the remote transmitter operates the central locking, etc. If it does, the fault is not with the transmitter. Make sure the battery voltage is adequate. Make sure that the desired position is correctly stored. Make sure that the memory store/recall procedure is being followed. Refer to the relevant section of the workshop manual.

Symptom	Possible Causes	Action
	recall ● EEPROM fault	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Door Module \(DDM/PDM\)](#) (100-00 General Information, Description and Operation).

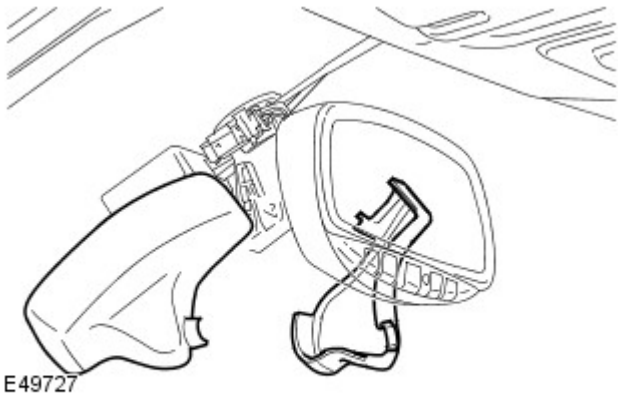
Rear View Mirrors - Interior Mirror

Removal and Installation

Removal

1. If installed, remove the interior mirror upper and lower covers.

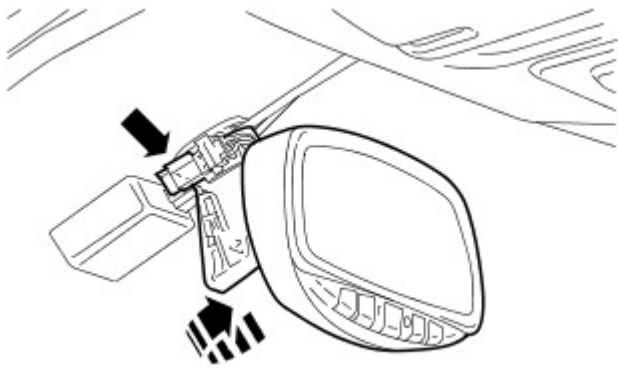
- Release the 2 clips.



E49727

2. Vehicles with an auto-dimming interior mirror, remove the interior mirror.

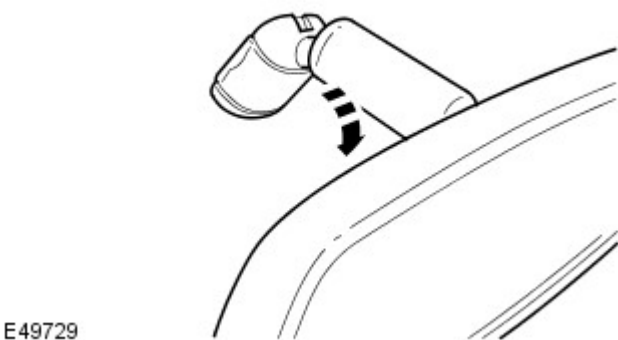
- Disconnect the electrical connector.
- Rotate the mirror stem at its base to release from the windshield.



E49728

3. Vehicles without an auto-dimming interior mirror, remove the interior mirror.

- Pull the mirror away from the windshield to release the clip.

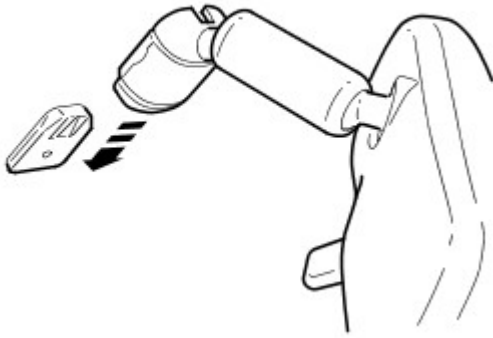


E49729

Installation

1. Vehicles without an auto-dimming interior mirror, install the interior mirror.

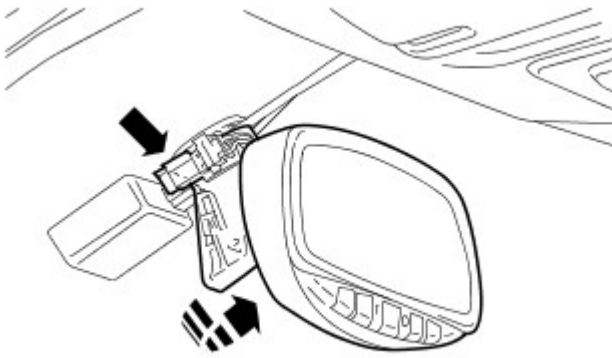
- Slide the mirror onto the boss from above to engage the clip.



E49730

2. Vehicles with an auto-dimming interior mirror, install the interior mirror.

- Rotate the mirror stem at its base to secure to the windshield.
- Connect the electrical connector.



E49731

3. Install the interior mirror covers.

- Secure with the clips.

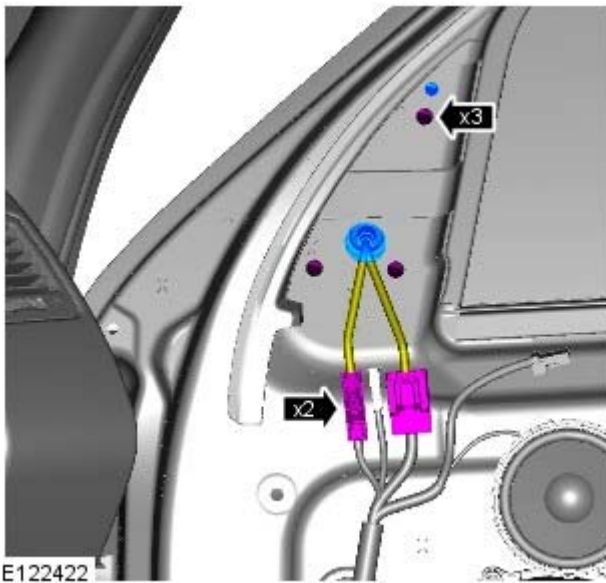
Rear View Mirrors - Exterior Mirror Vehicles With: Parking Aid Camera

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: RH illustration shown, LH is similar.
- NOTE: The ignition must be switched off.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

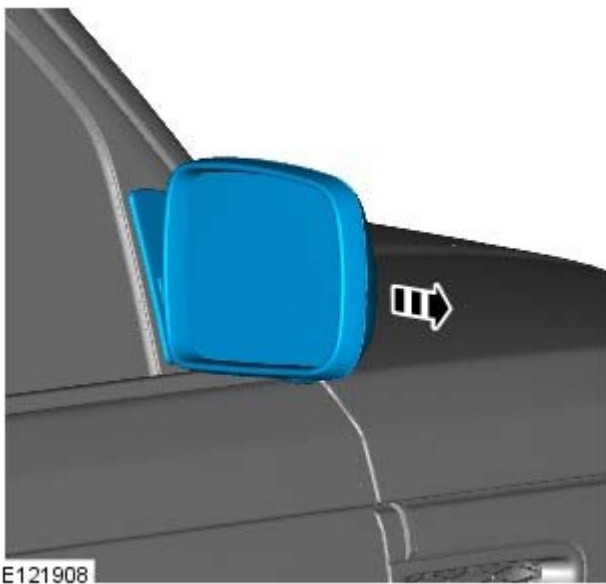


2.  CAUTION: Take extra care not to damage the wiring harnesses.

- NOTE: Support as necessary.

Torque: 6 Nm

- 3.



Installation

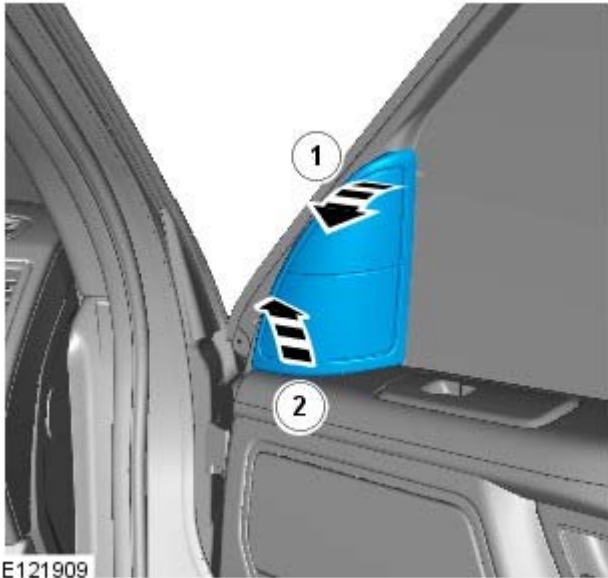
1. To install, reverse the removal procedure.

Rear View Mirrors - Exterior Mirror Vehicles Without: Parking Aid Camera

Removal and Installation

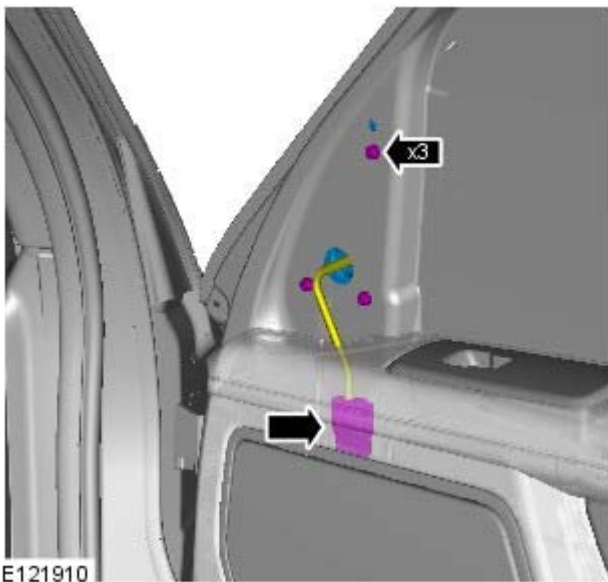
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: RH illustration shown, LH is similar.
- NOTE: The ignition must be switched off.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



1. 1. CAUTIONS:

- ⚠ Take extra care not to damage the component.
- ⚠ Make sure that the clips are correctly located.



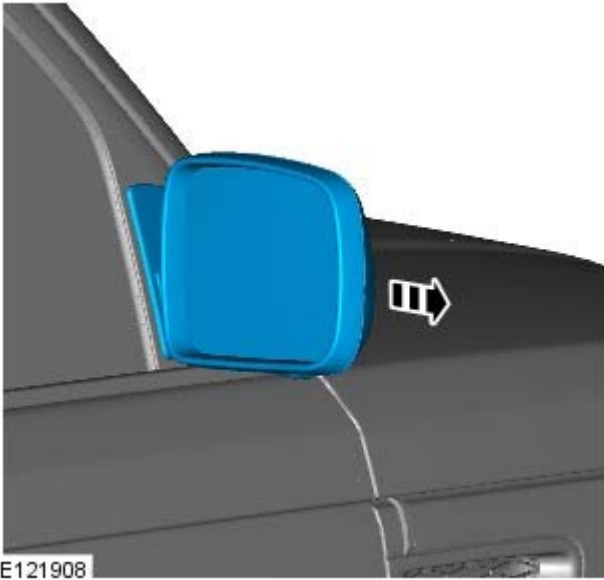
2. 2. CAUTIONS:

- ⚠ Take extra care not to damage the wiring harnesses.
- ⚠ Make sure the electrical connector is securely in the service position, before disconnection. If the connector springs back after disconnection the internal door trim panel will have to be removed for access.

- NOTE: Support as necessary.

Torque: 6 Nm

3.



Installation

1. To install, reverse the removal procedure.

Rear View Mirrors - Exterior Mirror Glass

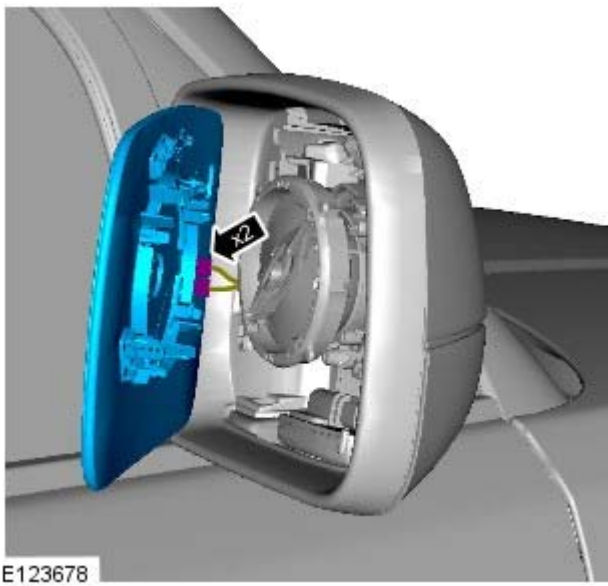
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



1.  CAUTION: Take extra care not to damage the clips.



- 2.

Installation

1. To install, reverse the removal procedure.

Rear View Mirrors - Exterior Mirror Cover

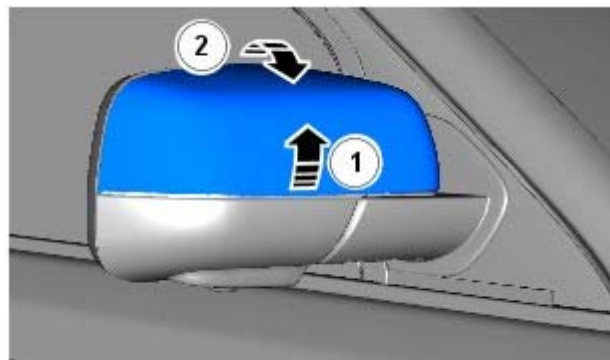
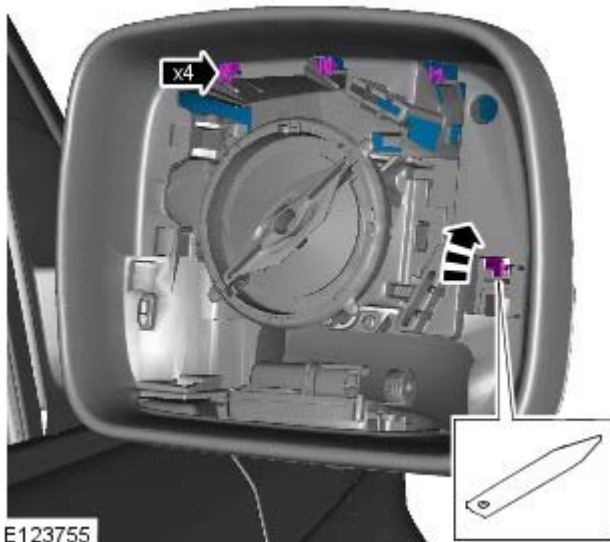
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Exterior Mirror Glass](#) (501-09 Rear View Mirrors, Removal and Installation).

2.

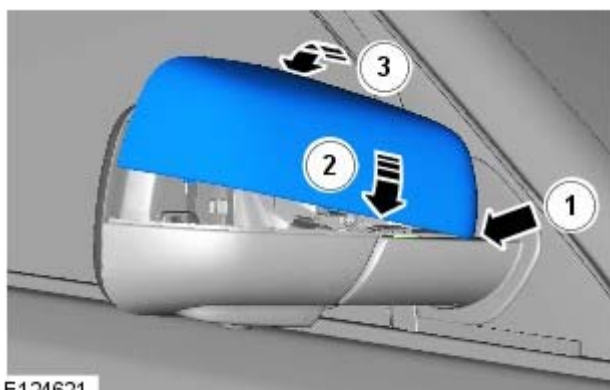


E123754

3. **3. CAUTIONS:**

- ⚠ Take extra care not to damage the clips.
- ⚠ Protect the surrounding trim to avoid damage.
- ⚠ Protect the surrounding paintwork to avoid damage.

Installation



E124621

1. **1. CAUTIONS:**

- ⚠ Take extra care not to damage the clips.
- ⚠ Protect the surrounding trim to avoid damage.
- ⚠ Protect the surrounding paintwork to avoid damage.

To install, reverse the removal procedure.


Rear View Mirrors - Exterior Mirror Motor

Removal and Installation

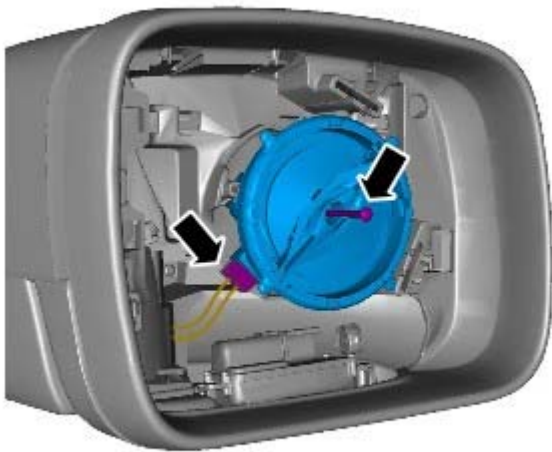
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: The ignition must be switched off.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: [Exterior Mirror Glass](#) (501-09 Rear View Mirrors, Removal and Installation).

2.  CAUTION: Make sure the locating tangs are aligned. Failure to follow this instruction may result in damage to the vehicle.

Torque: 1.2 Nm



E123679

Installation

1. To install, reverse the removal procedure.

Seating -

Torque Specifications

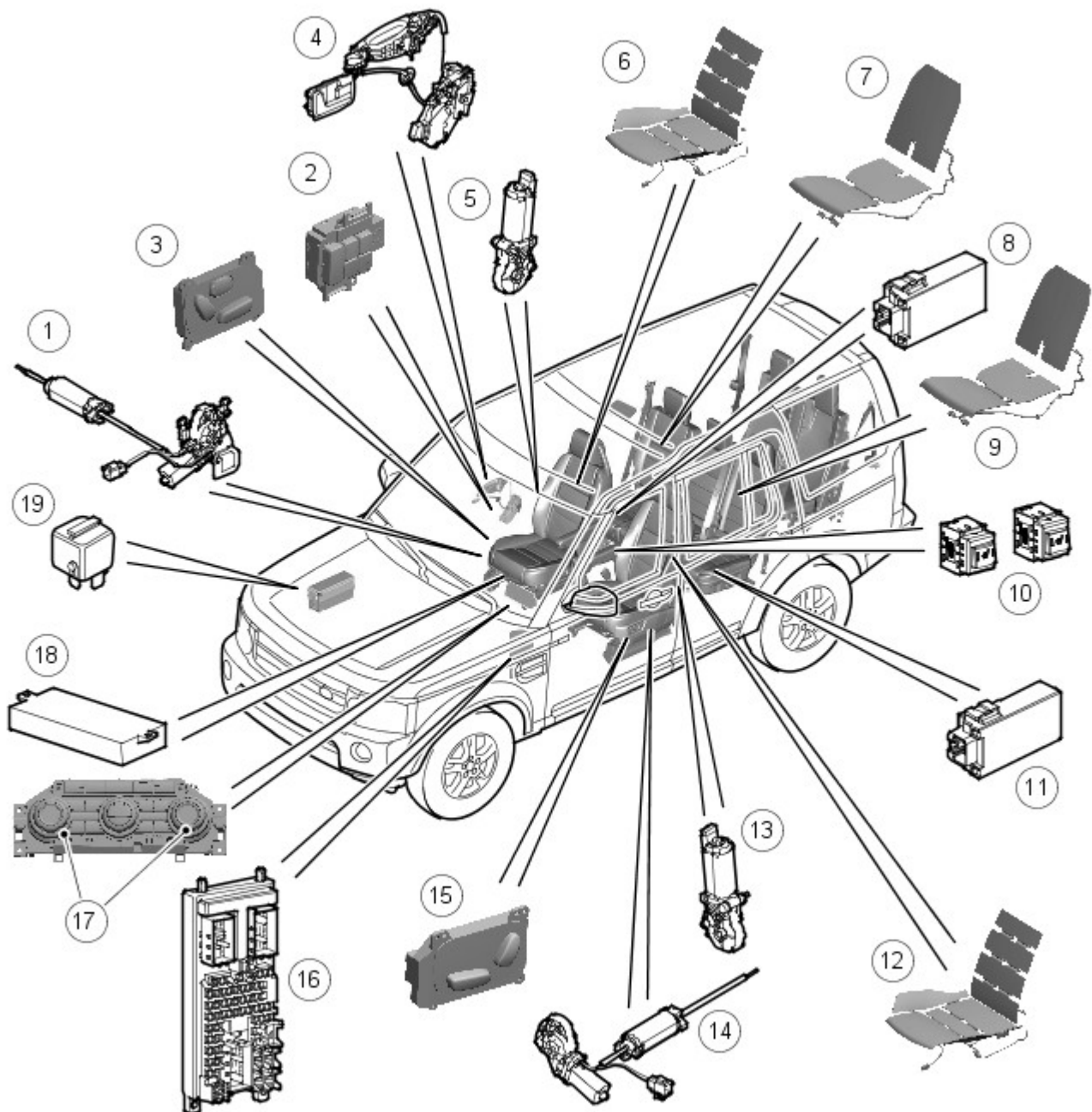
Description	Nm	lb-ft
Seat belt lower anchorage to seat Torx bolt	40	30
Front seat belt buckle to front seat Torx bolt	40	30
Front seat Torx bolts	40	30
Front seat armrest Torx bolt	10	7
Front seat grab handle Torx bolts	25	18
Front seat height adjustment motor nuts	25	18
Front seat position sensor nuts	4	3
Front seat tilt motor Torx bolts	10	7
Front seat backrest assembly Torx bolts	25	18
Front seat recliner motor Torx bolt	10	7
Seat module bracket Torx bolts	10	7
Front seat track motor nuts	25	18
Front seat base nuts	25	18
Front seat cushion Torx bolts	25	18
Third row seat Torx bolts	40	30
Third row seat cushion frame Allen bolts	25	18
Loadspace compartment anchor bolts	25	18
Rear seat Torx bolts	40	30
Rear seat backrest assembly Torx bolts	45	33

Seating - Seats

Description and Operation

Component Location

• NOTE: RH drive shown, LH drive similar



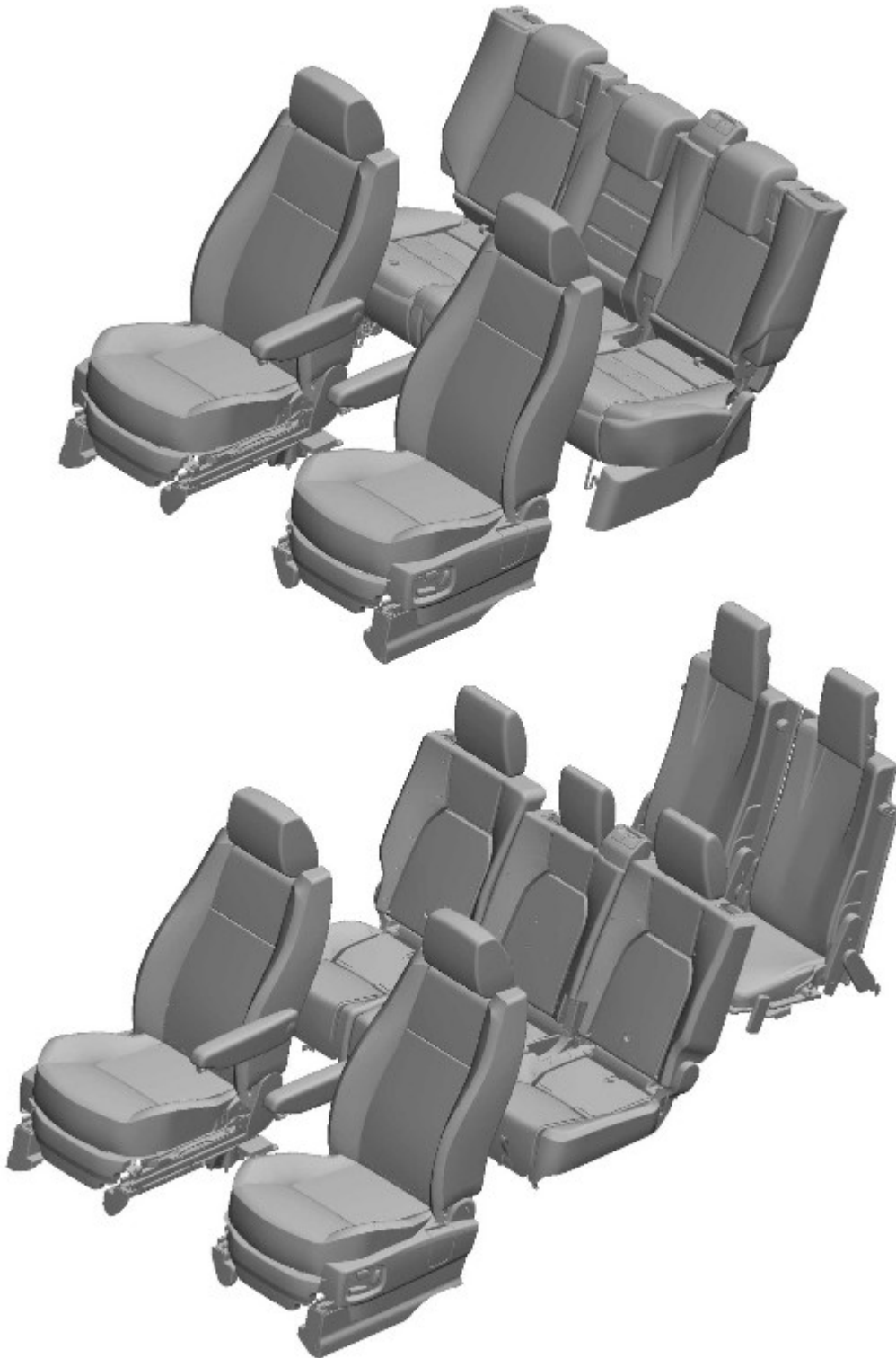
E137099

Item	Part Number	Description
1	-	Driver's seat cushion adjustment motor assembly
2	-	Driver's seat memory switch pack
3	-	Driver's seat non-memory switch pack
4	-	Driver's door ajar switch
5	-	Driver's seat squab motor
6	-	Driver's seat heating element
7	-	Second row RH (right-hand) seat heating element
8	-	Second row RH seat heating module
9	-	Second row LH (left-hand) seat heating element
10	-	Second row heated seat switches (vehicles without rear air conditioning)
11	-	Second row LH seat heating module
12	-	Front passenger seat heating element
13	-	Front passenger seat squab motor
14	-	Front passenger seat cushion adjustment motor assembly
15	-	Front passenger seat switch pack
16	-	CJB (central junction box)

17	-	Front heated seat switch pack (climate control system)
18	-	Memory control module
19	-	Front passenger seat power relay

OVERVIEW

Seat Configuration



E138147

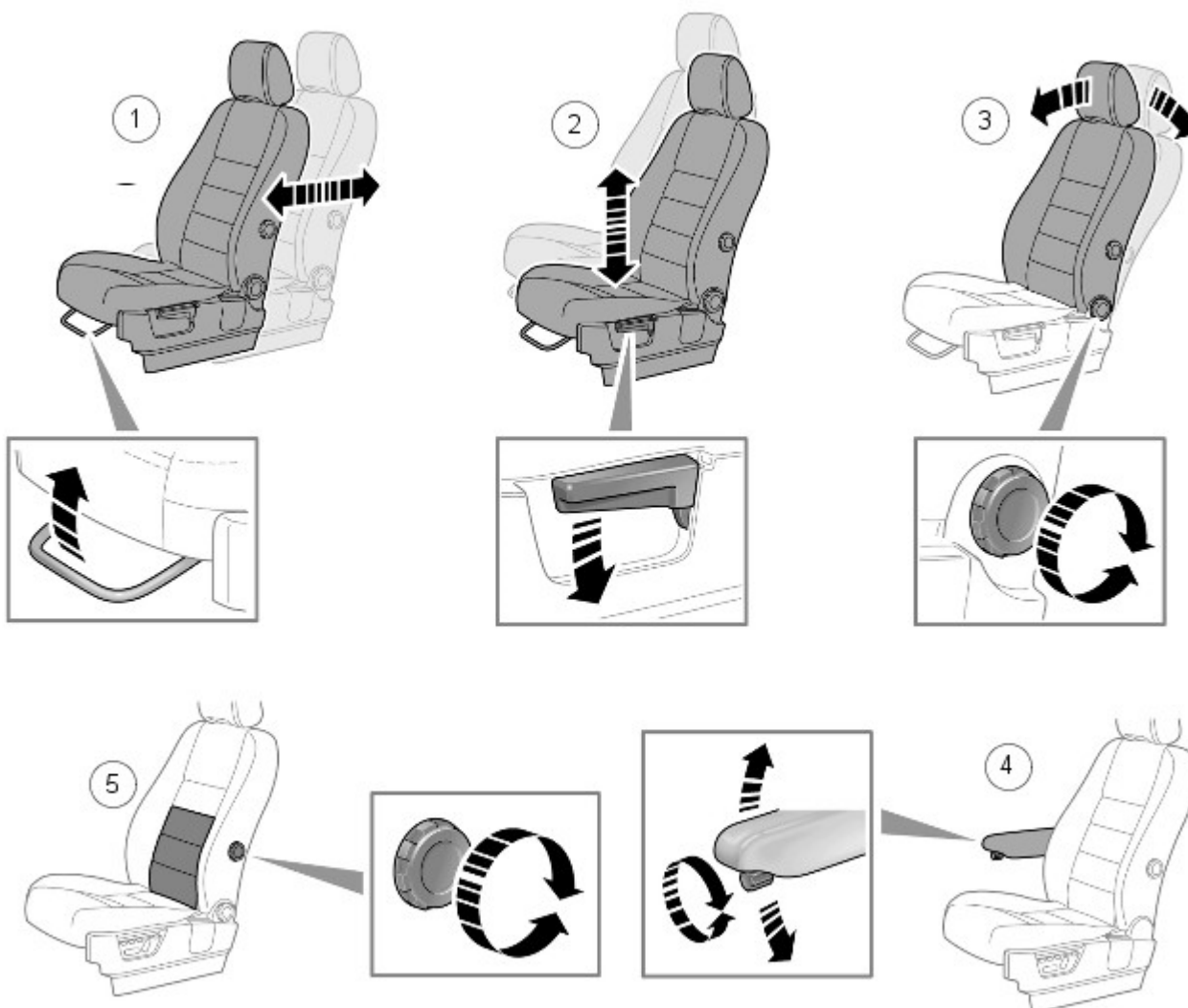
Discovery is available in a 5 or 7 seat configuration. The driver's seat has the option of an 8-way power adjustment, with or without memory functionality, or a 6-way manual adjustment. The front passenger seat has the option of a 6 way power

adjustment or a 4-way, non-height, manual adjustment. On vehicles from 2008MY, the front passenger seat can be fitted with an 8-way power adjustment.

The type of second row seats depends upon whether the 7-seat option is fitted. If the vehicle supports 5 seats, the 2nd row is designed as a 60/40 split, flip and fold configuration, whereas a vehicle that supports the 7 seat option is designed as a 35/30/35 split with the 2 outer seats having the ability to 'jack-knife', allowing access to the 3rd row of seats.

All seats are available in a fabric, duragrain or leather finish depending on model specification.

MANUAL FRONT SEATS



E137621

Item	Part Number	Description
1	-	Fore and aft adjustment
2	-	Height adjustment
3	-	Backrest adjustment
4	-	Lumber support adjustment
5	-	Armrest height adjustment

Height adjustment (driver's seat only)

Pumping the handle controls seat height. Pumping the lever upwards raises the seat; downwards lowers the seat.

Recline adjustment

The angle of the backrest is adjusted by turning the rotary wheel either clockwise or anticlockwise.

Forward/backward adjustment

Lifting the tomel bar at the front of the seat and sliding the seat to the desired position achieves the forwards/backwards adjustment.

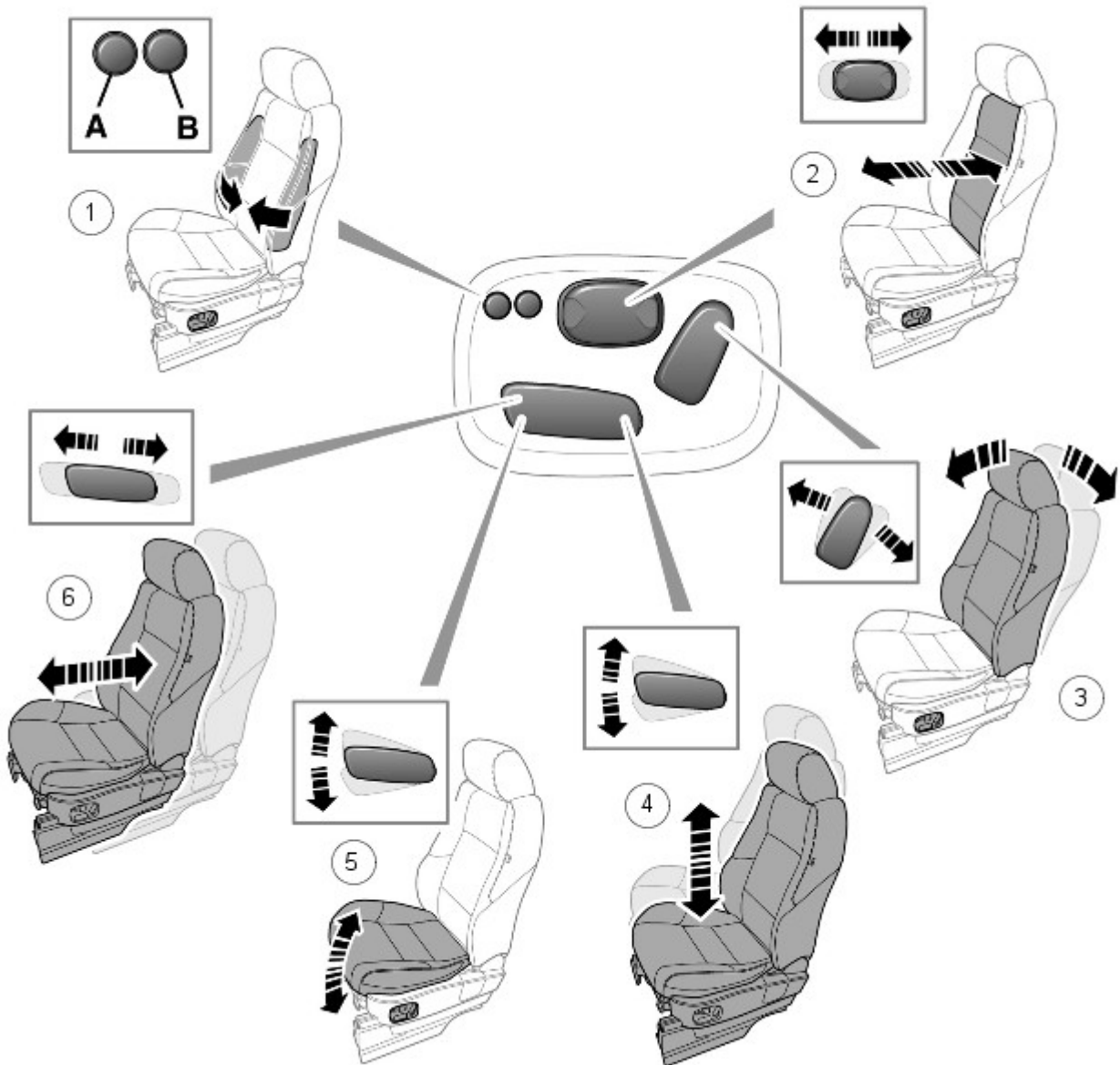
Lumber support adjustment

A hand wheel in the side of the seat provides for adjustment of lumbar support.

Folding armrest adjustment (if fitted)

Some vehicles are fitted with adjustable front seat armrests. These are used in the horizontal position or can be stowed vertically alongside the seat back rest. The horizontal position can be adjusted for height by turning the knob set into the end of the armrest.

POWER OPERATED FRONT SEATS (NON-MEMORY)



E137620

Item	Part Number	Description
1	-	Bolster adjustment: A - Bolster inflate; B - Bolster deflate
2	-	Lumbar support adjustment
3	-	Backrest adjustment
4	-	Height adjustment
5	-	Cushion tilt adjustment
6	-	Fore and aft adjustment

Forward/Backward adjustment

Push and hold the switch forwards or backwards to move the seat to the desired position.

Seat back adjustment

Twist the switch forwards or backwards until the desired seat back angle is achieved.

Seat cushion height adjustment

Push the switch up or down to raise or lower the cushion.

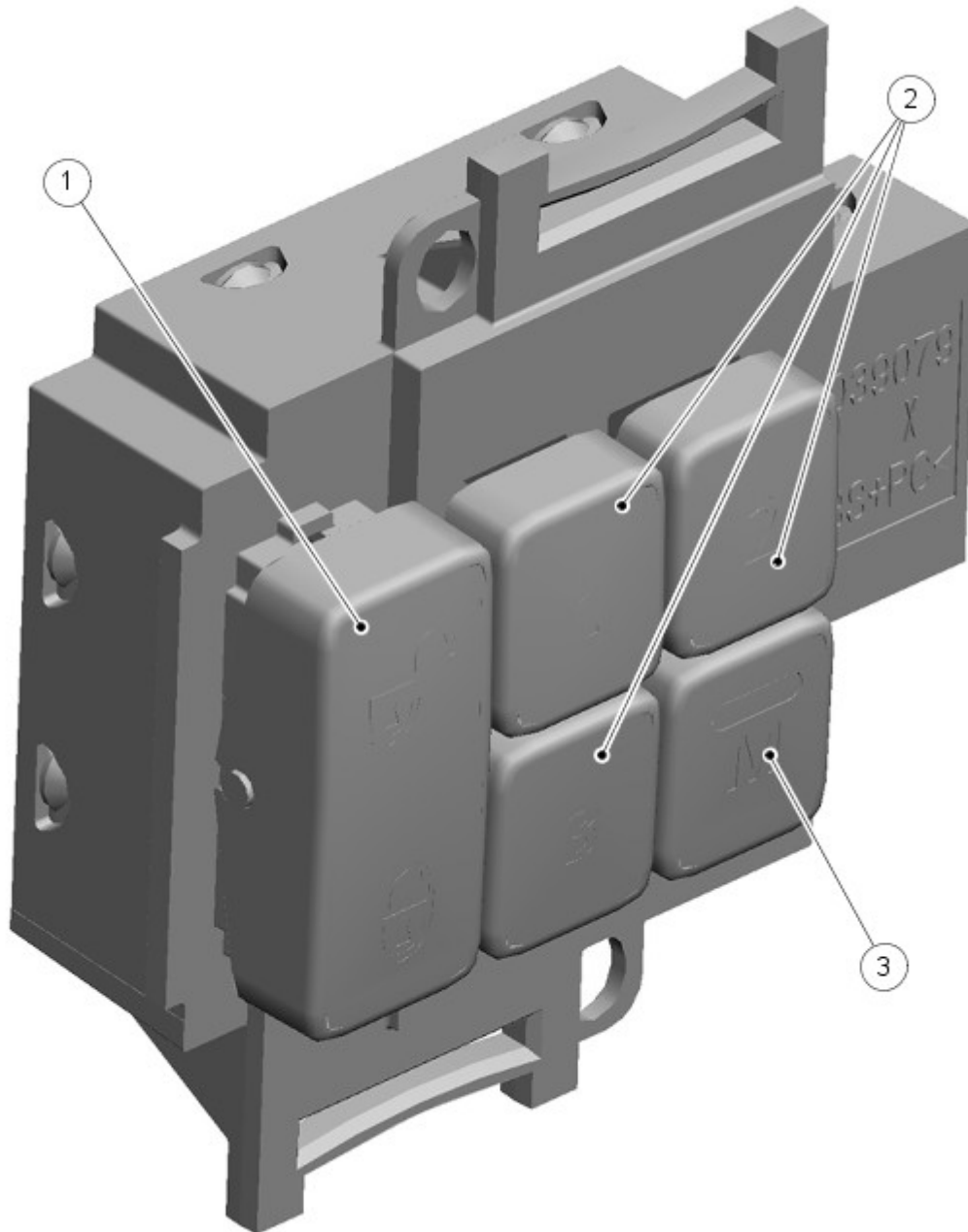
Front Seat Motors



• NOTE: On vehicles from 2008MY, the passenger seat can also be fitted with 8-way electrical adjustment.

The seat motors are a permanent magnet motor type coupled to a rack and pinion assembly. Should the motor seize or stick an internal thermal cut-out switch will trip to remove voltage from the motor. Two pins within each of the seat switch packs control the seat motors. Both pins are normally earthed. Operating the switch applies voltage to one of the pins while the other pin remains earthed. Operating the switch in the opposite direction reverses power and earth to the motor allowing the motor to run in the opposite direction.

DRIVER'S MEMORY SEAT



E137100

Item	Part Number	Description
1	-	Lock/unlock button
2	-	Memory preset buttons
3	-	Memory store button

Once the power operated driver's seat, steering column and exterior mirrors are adjusted, the vehicle can memorize these settings for future use.

1. Press the memory store (M) button to activate the memory function. The switch indicator will illuminate.
2. Press one of the preset buttons within 5 seconds to memorize the current settings. MEMORY (1, 2 or 3) SETTINGS SAVED will be displayed on the message center, accompanied by an audible chime to confirm the settings have been memorized.
3. To recall a stored position press the relevant preset button. MEMORY (1, 2 OR 3) RECALLED will be displayed in the message center.

• NOTE: A seat position will only be memorized during the 5 second active period. Any existing settings will be over-written when programming a memory position.

- NOTE: If the driver's seat or steering column are adjusted during entry or exit operation, automatic movement will stop.

Memory Recall

Memory recall has three memory positions stored for the seats, exterior mirrors and electric steering column (where fitted). The switches for this function are located on driver's seat outer side trim panel. Pressing the appropriate numbered memory switch allows the seat to start moving to the position appropriate to that memory.

When a memory recall is initiated, to limit the overall current consumption, only two-seat axis will move towards their intended position at any one time. To minimize current load as the motors start, the initiation of each axis is phased with a 10ms delay between each motor starting.

The following procedure will store a memory position:

- Ensure reverse gear is not engaged
- Manually adjust the seat to the desired position, using the seat switches
- Press and release the 'memory store' switch
- Press and release the desired numbered memory switch within 5 seconds

If any of the seat adjustment or memory switches are activated during a 'one touch' memory recall, the recall will be overridden and the seat will begin to move in the direction corresponding to the switch that has been pressed.

Both mirrors move simultaneously about the vertical axis first (left/right), and then, once all vertical axis movements are complete, about the horizontal axis (up/down). To minimize the number of mirror motor's required, a method of sharing is implemented, which dictates that all movement about one axis is complete before movement about the other axis commences.

Mirror movement coincides with the following table:

Action	Control Module Pin 14	Control Module Pin 7	Control Module Pin 13	Control Module Pin 8
Driver Mirror Up	Battery	-	-	-
Driver Mirror Down	Ground	-	-	-
Driver Mirror Left	-	Ground	-	-
Driver Mirror Right	-	Battery	-	-
Passenger Mirror Up	-	-	Battery	-
Passenger Mirror Down	-	-	Ground	-
Passenger Mirror Left	-	-	-	Ground
Passenger Mirror Right	-	-	-	Battery

Lazy Entry

Pressing the unlock button on the remote transmitter will initiate a memory recall. This feature is known as 'lazy entry'. If the seat movement, memory switch or the lock button on the remote transmitter is pressed, then the 'lazy entry' feature will stop immediately.

The memory settings are stored within **EEPROM (electrically erasable programmable read only memory)** of the memory control module each time the ignition switch is cycled from position II to position I. These are the positional values that a lazy entry request uses when the remote unlock button for that particular key is next pressed.

The lazy entry feature can be activated or deactivated via the customer personalization feature of the high line instrument cluster. This provides the driver with the option to enable or disable lazy entry as required.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Immediate Adjustment

Pressing one of the manual adjustment switches will initiate the corresponding motor for that axis until the switch is released.

Only two seat motors can be driven at any one time. However, due to the sharing of relays, there are certain combinations of motors that cannot be driven together. The following table indicates which axis can and cannot be operated at the same time:

	Recline Up	Recline Down	Tilt Up	Tilt Down	Height Up	Height Down	Slide Forward	Slide Backward
Recline Up	-	No	Yes	Yes	Yes	Yes	Yes	Yes
Recline Down	No	-	Yes	Yes	Yes	Yes	Yes	Yes
Tilt Up	Yes	Yes	-	No	Yes	Yes	No*	No*
Tilt Down	Yes	Yes	No	-	Yes	Yes	No*	No*
Height Up	Yes	Yes	Yes	Yes	-	No	No*	No*
Height Down	Yes	Yes	Yes	Yes	No	-	No*	No*
Slide Forward	Yes	Yes	No*	No*	No*	No*	-	No
Slide Backward	Yes	Yes	No*	No*	No*	No*	No	-

Key

- - = Not applicable
- Yes = Can be activated together
- No = Cannot be activated together (Physically impossible)
- No* = Cannot be activated together (Relay sharing restriction)

If two axis are being driven and a third axis is requested to move, the third switch request is ignored until either of the two axis switches, already active, are released. The third axis movement may only be initiated providing the switch has been released and re-selected.

Seat adjustment can be initiated simultaneously with any mirror movement.

REVERSE GEAR MIRROR POSITION

To give the driver a clear view of the kerbs when reversing, the exterior door mirrors can be dipped when reverse gear is selected. The level of mirror dipping is set to a predetermined amount when the vehicle leaves the factory but has the ability to be customer programmed.

The following procedure will store a reverse gear mirror position:

- Perform a memory recall procedure
- Ensure reverse gear is engaged
- Manually adjust the mirrors to the desired position
- Press and release the 'memory store' switch
- Press and release the desired numbered memory switch
- Reverse gear mirror dip setting will be stored for that particular memory setting.

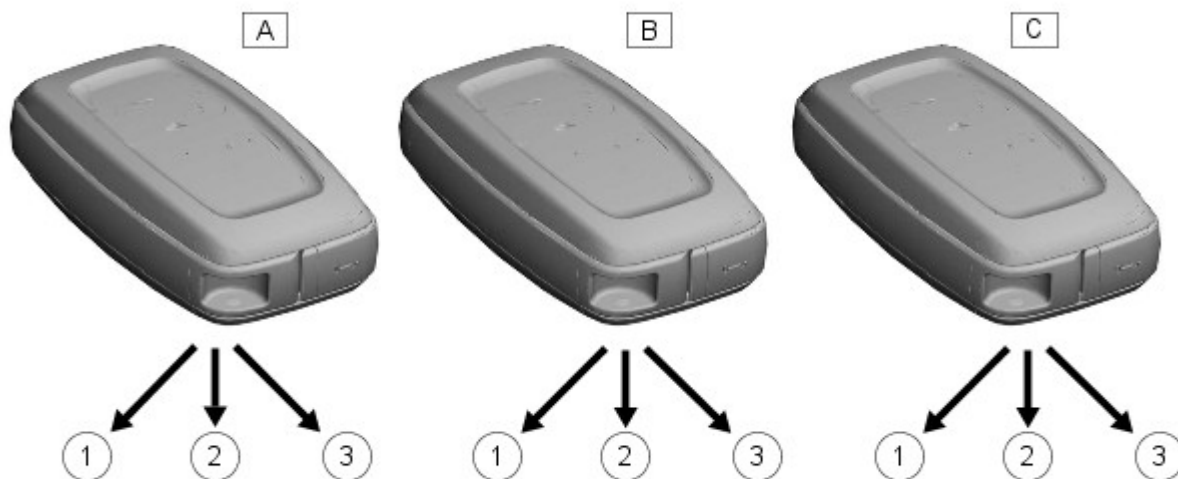
A single chime will be emitted from the instrument cluster to indicate that the store operation has been successful and 'Mirror Dip Stored' message will be displayed in the message center.

Once this sequence has been completed, the stored mirror position will be the position that the mirrors move to when reverse gear is next selected.

Storing a memory position with reverse gear selected only affects reverse gear mirror positions, the remainder of the memory positions remain unchanged.

To protect against an accidental setting, the mirror position will only be stored if a mirror adjustment has been made since reverse gear was selected. If there is no reverse gear mirror position stored, then a default setting, stored in the memory control module, is adopted.

There are three customer personalization memory settings per key. For each of these settings there are 3 possible reverse gear mirror position stores. This equates to a possible nine reverse gear mirror position settings. personalization memory setting relates to the 3 most recent ignition keys.



E137622

Item	Part Number	Description
A	-	Most recent ignition key
B	-	Second most recent ignition key
C	-	Third most recent ignition key
1	-	First reverse gear mirror position store
2	-	Second reverse gear mirror position store
3	-	Third reverse gear mirror position store

The reverse gear mirror position feature can be activated or deactivated via the customer personalization feature of the high line instrument cluster. This provides the driver with the option to enable or disable reverse gear mirror position as required.

For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

Information regarding the reverse gear mirror status, for both manual and automatic transmissions, is transmitted as a message on the LIN (local interconnect network) bus.

When the reverse gear mirror position feature is toggled 'OFF', all 3 memory settings associated with that personalization memory will return to the default reverse gear mirror settings.

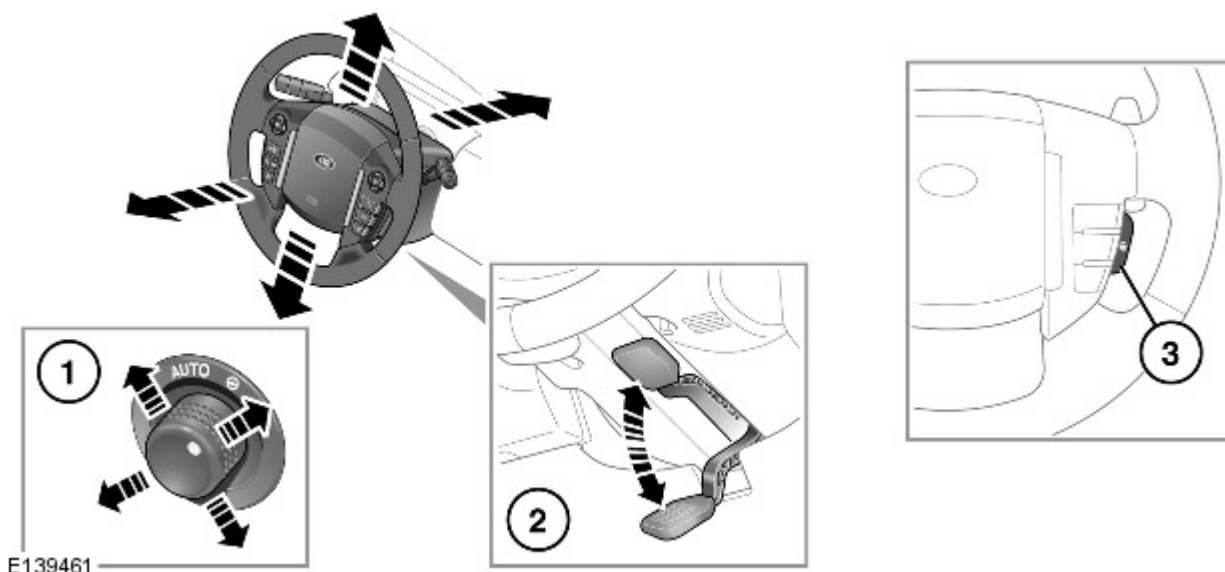
- **NOTE:** Reverse gear status is only available with the ignition in position II.

When reverse gear is de-selected, the mirror position immediately prior to reverse selection will be resumed, unless a memory recall has been requested whilst reverse has been selected, in which case the mirrors will move to the requested memory position when reverse is de-selected.

On vehicles fitted with the ZF automatic transmission there is a delay of 0.5 second following the selection of reverse gear, prior to the reverse mirror position being recalled. This is to prevent any movement of the mirrors as the gear selector is moved through the reverse position on the way to, and from, the park position.

STEERING COLUMN ADJUST (where fitted)

The memory control module controls the electric adjustable steering column in a rake (up and down) and reach (in and out). The steering column can be adjusted for rake and reach by operating the rotary joystick control switch on the LH side of the steering column.



Item	Part Number	Description
1	-	Electric adjustment
2	-	Manual adjustment
3	-	Heated steering wheel

Entry/Exit Mode

Entry/Exit mode provides automatic movement of the steering column and driver's seat to allow easier entry to or exit from the vehicle.

Entry/Exit mode is selected by setting the steering column adjustment switch to the 'AUTO' position.

- NOTE: If the adjustment switch is moved away from 'AUTO' whilst the steering column is tilted away, the steering column will move back to its memorized position. Entry/Exit mode will then be cancelled.
- NOTE: If the adjustment switch is moved during entry/exit operation, steering column movement will stop.

Exit

When the ignition key is removed, the steering column will move to the uppermost rake and innermost reach positions and the driver's seat will move slightly rearwards and lower.

Entry

When the key is inserted in the ignition the steering column and seat will return to their previous positions. If, however, the memorised driver position has been changed (using the seat memory switches or another key transmitter), the steering wheel and seat will move to the new position.

Steering Column Control

Adjustment of the steering column is achieved by a single DC (direct current) motor. Each adjustment movement is transmitted through a solenoid actuated clutch; one clutch for reach movement and one for rake movement.

When engaged, a clutch can be released only if the system is unstressed. As the clutches are mounted on the same motor spindle, the sequence for position adjustment is as follows:

- Engage the selected clutch by powering the appropriate solenoid
- After a time period (approximately 0.1 of a second), the motor is powered in the desired direction
- When the motor reaches the stop position the solenoid and motor is released/unpowered. The clutch remains engaged under stress
- After a time period (approximately 0.1 of a second), the motor is powered in the opposite direction to enable the clutch to disengage when the stress is released.

Motor Rotation Direction	Clockwise	Counter Clockwise
Reach movement	IN	OUT
Rake movement	UP	DOWN

Simultaneous rake and reach movements are not possible since the motor must reverse direction as soon as the first axis has reached its required position.

Steering column rake and reach is controlled via potentiometer feedback.

AUDIBLE AND VISUAL CONFIRMATIONS

An audible confirmation is generated by the instrument cluster to provide confirmation to the driver that the requested operation has been successfully completed. The following operations support an audible confirmation:

Operation	Audible Confirmation	Conditions
Memory Store	Single Chime	Successful store operation completed
Memory Recall	Double Chime	Only issued if all axis of movement successfully reach the intended position
Reverse Gear Mirror Position Store	Single Chime	Successful store operation for reverse mirror position completed

In addition to audible confirmation there is also a visual confirmation via the instrument cluster message center. For additional information, refer to: [Information and Message Center](#) (413-08 Information and Message Center, Description and Operation).

MEMORY CONTROL MODULE



E 138149

Memory Control Module Location (LHD shown, RHD similar)

Item	Part Number	Description
1	-	Memory control module

The memory control module, located under the driver's seat, relies upon a number of inputs and controls a number of outputs. As with all electronic control modules, the unit needs information regarding the current operating conditions of the engine and other related systems before it can make calculations, which determine the appropriate outputs.

All memory values are stored in the non-volatile memory, [EEPROM](#). The current motor positions, which are monitored by the control modules integral Hall sensors, are stored in the [EEPROM](#). If a loss of power occurs, upon power reconnection

the current motor position are recalled from memory and adopted as the current positions. This will allow the relative memory positions to be retained without any need to re-calibrate. The memory control module checks the integrity of all data stored in the [EEPROM](#) each time it exits stand-by mode. In the event that the data is corrupt, the control module adopts the default values for all of the programming options. All memory positions are deemed as invalid and the software will perform as if there are no memory positions stored. Memory store operations will reset the relevant memory and allow full functionality.

Stall Detection

Seat, steering column (where fitted) and mirror motors are deemed to have stalled if there is no change in the inputs that are received from the corresponding feedback sensors for 200ms (seat), 1000ms (mirror & steering column) while that axis is being driven.

If a stall condition is detected then the drive to that axis is cancelled for the remainder of that memory operation (memory recall) or until the switch is re-selected (manual movement).

If the motor movement has stopped due to loss of sensor feedback, either stall or sensor failure, then that axis may be activated again, to move past the stall position, by re-selecting the appropriate switch. This allows control of the motor to be maintained if sensor feedback is lost.

Upon re-selection of movement, if sensor pulses are detected then the motor will continue to be driven until the switch is released or another stall condition is detected. If sensor feedback is not detected then the motor is only driven for 0.5 second and then stops until the switch is released and then pressed again, when a further 0.5 second of activation is permitted, and so on.

For all seat motor and steering column manual movements, whenever a motor is driven and a stall occurs, the memory control module records the position at which the stall occurred. If movement occurs beyond a stall position, then that position is erased from the control modules memory. This will always allow movement past a previously recorded stall position once movement has been registered beyond that position. This is the case for both manual and memory movement.

Initialization

When a replacement memory control module is fitted to a seat it should be initialized so that the control module can learn the seats and steering column maximum and minimum adjustment values. This is achieved by:

- adjusting all seat movement axis from one end of travel to the other; slide, recline, height and tilt
- adjusting all steering column movement from one end of travel to the other; rake and reach.

Battery Monitor

If the battery voltage drops below 10.5 Volts, then the memory control module ignores all requests for a memory recall, including lazy entry, or easy entry/exit until the battery voltage has reached 11.5 Volts. This will conserve as much power in the vehicle battery as possible to enable engine cranking.

Stand-by Mode

The memory control module supports a stand-by mode to keep power consumption to a minimum.

The control module will enter stand-by mode upon receipt of a [LIN](#) bus 'SLEEP' message from the [CJB](#). Alternatively, a time period of 3 seconds after the [LIN](#) bus network has remained quiet provided there are no motors being driven at that time and there are no valid switch requests.

If there is a failure with the [LIN](#) bus network then the seat will be operational in 'inch mode' only.

If the control module is being prevented from entering stand-by mode due to motor movement, memory recall or switch operation, then it will enter stand-by mode when the current function has terminated.

• **NOTE:** In the case of a memory recall, all memory recall operations should be carried out before entering stand-by mode, not just the current motor movement.

The control module will exit stand-by mode if there is any [LIN](#) bus activity. When the control module exits stand-by mode it must verify the 'System Enable Status' in order to recognize when it should respond to a switch request.

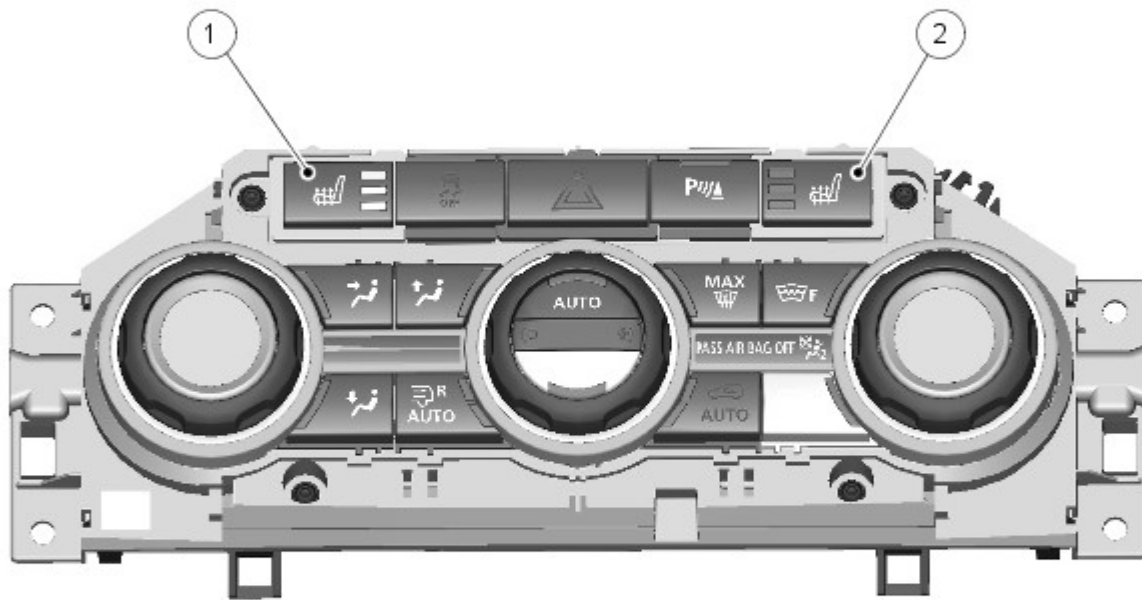
SEAT HEATING



E138150

Front Seats

Front Seat Heater Switches



E138151

Item	Part Number	Description
1	-	LH front seat heater switch
2	-	RH front seat heater switch

The heated front seat system is available on both manual and electric seats and is controlled by the Automatic Temperature Control Module (ATCM).

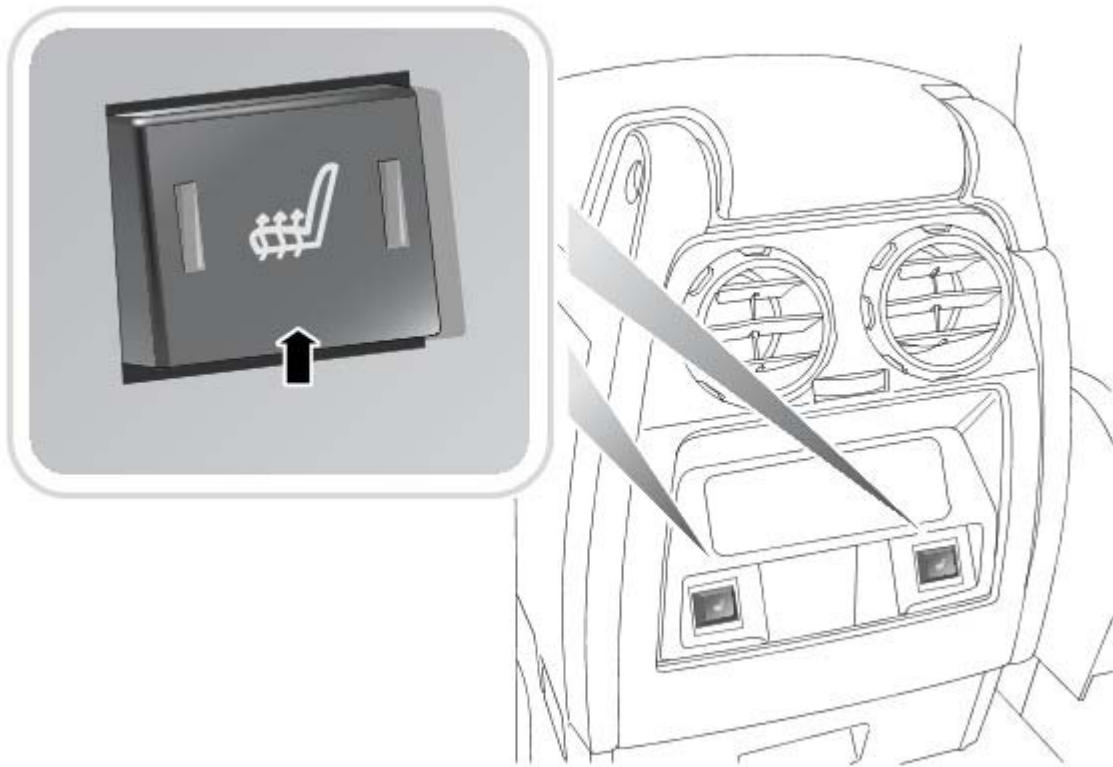
When the front seat heater switch is operated, power is supplied to the heater elements in the seat, causing the seat to heat up. The ATCM senses seat temperature via the sensor in the cushion and regulates voltage to the seat heater elements to maintain a constant temperature.

For additional information, refer to: [Control Components](#) (412-04 Control Components, Description and Operation).

Rear Seat Heaters

Rear Seat Heater Switches

- NOTE: [Rear air conditioning variant shown](#)



E138152

The [RH](#) and [LH](#) rear seats support three integral heating elements, squab, back rest and bolster. The optional rear child booster seat also supports an integral seat-heating element.

- **NOTE:** The rear center seat is not available with seat heating.

The rear seat heaters are enabled when the ignition switch is position II, and operate at one of two temperature settings. With the first press of a rear seat heater switch the relative rear seat heat control module ([RH](#) or [LH](#)) adopts the higher temperature setting, supplies a power feed to the related rear seat heater elements and illuminates two amber **LED (light emitting diode)**'s in the switch. At the second press of the switch the control module adopts the lower temperature setting and extinguishes one of the **LED**'s. At the third press of the switch the control module de-energizes the heater elements and extinguishes the second **LED**. The seat heaters remain on until selected off or the ignition is turned off.

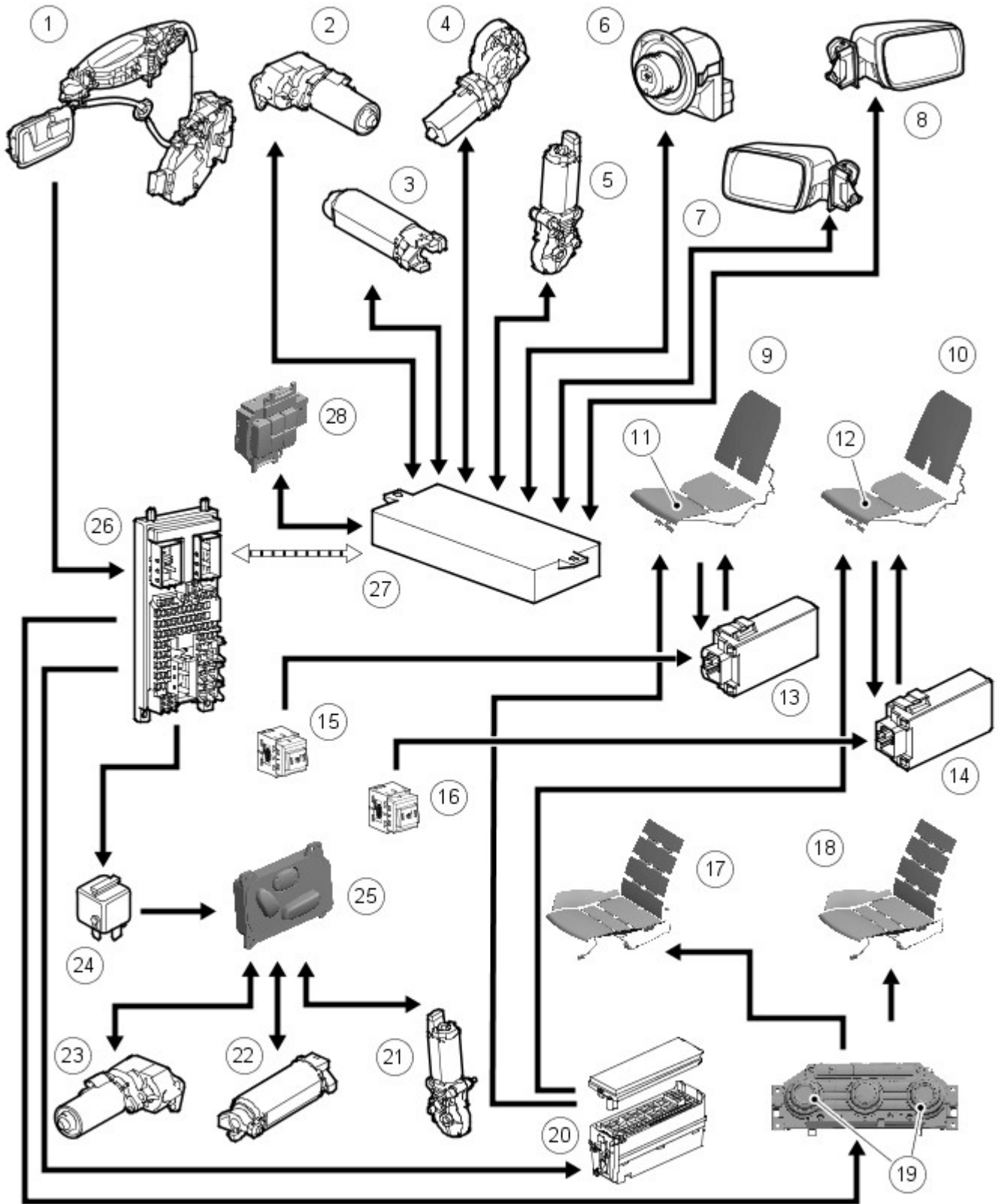
The rear seat heat control modules receive an input from a temperature sensor in [RH](#) and [LH](#) rear seats, and regulate the power feed of the heater elements to control the seat temperature at the appropriate temperature setting between 35 and 45 °C (95 and 113 °F). The actual temperature settings vary with the type of seat covering, to allow for the different heat conduction properties of the different seat covering materials.

DIAGNOSTICS

The exchange of information between the diagnostic unit and the memory control module is via the [CJB](#), which are interconnected via the hi-speed [CAN \(controller area network\)](#) bus and [LIN](#) bus. There is a non-volatile memory (**EEPROM**) for saving detected errors. Its contents are not lost when the power supply is disconnected. Only a Land Rover approved diagnostic system can erase the error memory.

CONTROL DIAGRAM

- **NOTE:** A = Hardwired; J = CAN bus



A → J →

E137101

Item	Part Number	Description
1	-	Driver's door ajar switch
2	-	Driver's seat height motor
3	-	Driver's seat slide motor
4	-	Driver's seat tilt motor
5	-	Driver's seat recline motor
6	-	Mirror adjustment switch
7	-	LH mirror motor
8	-	RH mirror motor

9	-	LH rear seat heater
10	-	RH rear seat heater
11	-	LH rear seat heater cut-off switch
12	-	RH rear seat heater cut-off switch
13	-	LH rear seat heater control module
14	-	RH rear seat heater control module
15	-	LH rear seat heater switch
16	-	RH rear seat heater switch
17	-	Driver's seat heater
18	-	Front passenger seat heater
19	-	Front seat heater switches
20	-	BJB (battery junction box)
21	-	Front passenger seat recline motor
22	-	Front passenger seat slide motor
23	-	Front passenger seat height motor
24	-	Front passenger seat power relay
25	-	Front passenger seat switch pack
26	-	CJB
27	-	Memory control module
28	-	Driver's seat memory switch pack

Seating - Seats

Diagnosis and Testing

Principle of Operation

For a detailed description of the seating systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Seats](#) (501-10 Seating, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Seat runners ● Seat frames ● Seat movement switch condition and installation ● Seat heater switch condition and installation ● Seat motor(s) condition and installation ● Steering column switch condition and installation ● Steering column condition and installation ● Door mirror switch condition and installation ● Door mirror condition and installation 	<ul style="list-style-type: none"> ● Battery condition and state of charge ● Fuses ● Harnesses and connectors ● Seat movement switch(s) ● Seat heater switch(s) ● Seat heater elements ● Seat motor(s) ● Seat module(s) ● Memory control module(s) ● Steering column switch ● Steering column motor ● Door mirror switch(s) ● Door mirror motor(s) ● Ignition switch ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Local Interconnect Network (LIN) circuit

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Seat does not move when the switch is operated (forward, backward, tilt, etc)	<ul style="list-style-type: none"> ● Runner or mechanism jammed ● Switch fault ● Motor fault ● Thermal cut-out engaged ● Circuit fault ● Module fault 	Check for obstructions at the seat runners, mechanisms, etc, rectify as necessary. The thermal cut-out may engage if there is a motor or mechanism fault. Check for DTCs indicating a switch, motor or module fault.
Steering column does not move when the switch is operated	<ul style="list-style-type: none"> ● Switch fault ● Motor fault ● Clutch/Solenoid fault 	Check for DTCs indicating a switch, motor or clutch/solenoid fault.
Mirrors do not move when the switch is operated	<ul style="list-style-type: none"> ● Mechanical fault ● Switch fault ● Motor fault ● Circuit fault: high resistance ● Circuit fault: short circuit to ground 	For mirror tests, refer to the relevant section of the workshop manual.
Memorized seat/steering column/mirror position is not resumed	<ul style="list-style-type: none"> ● Battery voltage below 10.5 volts ● Position not stored ● Switch operated during "one-touch" memory recall ● EEPROM fault 	Before condemning a memory component, check the function from the switch and refer to the symptoms above. Make sure the battery voltage is adequate. Make sure that the desired position is correctly stored. Make sure that the memory store/recall procedure is being followed. Refer to the relevant section of the workshop manual.

Symptom	Possible Causes	Action
"Lazy entry" function inoperative	<ul style="list-style-type: none"> ● Remote transmitter fault (battery, transmitter programming, etc) ● See list for "position is not resumed" 	Check that the remote transmitter operates the central locking, etc. If it does, the fault is not with the transmitter. Refer to "position is not resumed".
Entry/Exit mode inoperative	<ul style="list-style-type: none"> ● Switch not in AUTO mode ● Switch fault ● Motor fault ● Clutch/Solenoid fault 	Make sure the function is enabled and that the switch is correctly set. Check for DTCs indicating a switch, motor or clutch/solenoid fault.
Seat does not get warm	<ul style="list-style-type: none"> ● Switch fault ● Fuses ● Circuit fault ● Temperature sensor ● Battery voltage is greater than 16.5 volts 	Check the LEDs at the switches as a quick check of the switch function. If the LEDs illuminate when the switches are operated, there is power to the switches and the switches are operating at least one level. Check the seat heater circuits, refer to the electrical guides. Check the temperature sensor function. If the battery voltage is higher than 16.5 volts for more than 5 seconds, seat heating is suspended. Refer to the relevant section of the workshop manual.
Part(s) of the seat does not get warm	<ul style="list-style-type: none"> ● Element fault 	There are up to three elements in each seat, if the rest of the seat operates normally, check the element connections and continuity. Refer to the electrical guides.

DTC Index

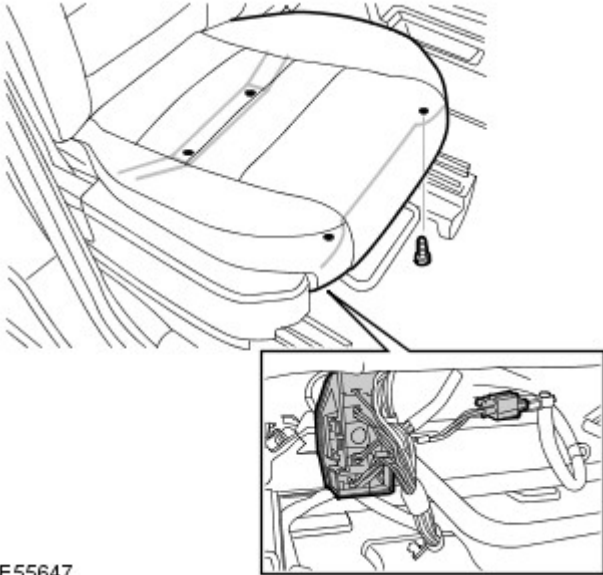
For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Front Seat Module \(DSM/PSM\)](#) (100-00 General Information, Description and Operation).

Seating - Front Seat Cushion

Removal and Installation

Removal

• NOTE: In this procedure the cushion is removed as an assembly. There is a separate procedure showing removal of the cushion cover.



E55647

1. Remove the front seat cushion assembly.

- Release and disconnect the 2 electrical connectors.
- Remove the 4 Torx bolts.

Installation

1. Install the front seat cushion assembly.

- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- Connect and secure the electrical connectors.

Seating - Front Seat

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



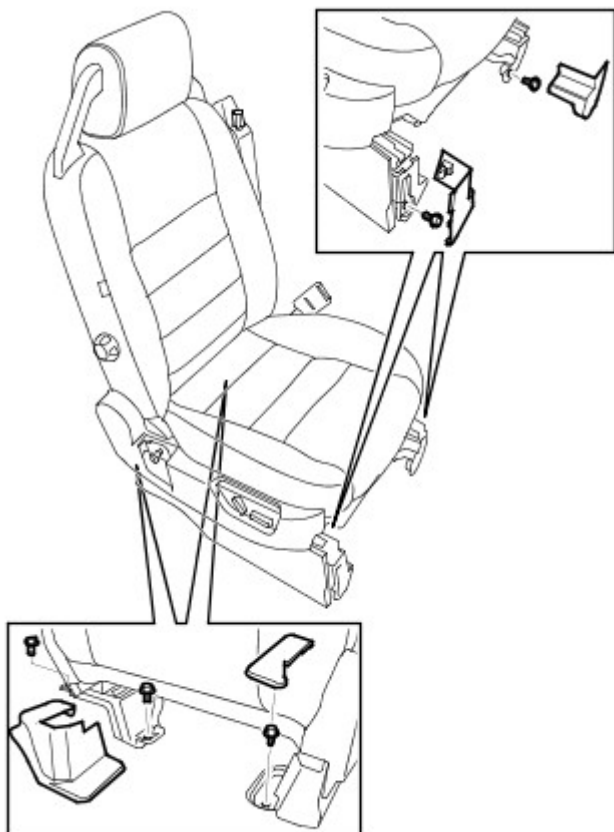
Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. NOTE: Torx bolts may be re-used.

Release the front seat.

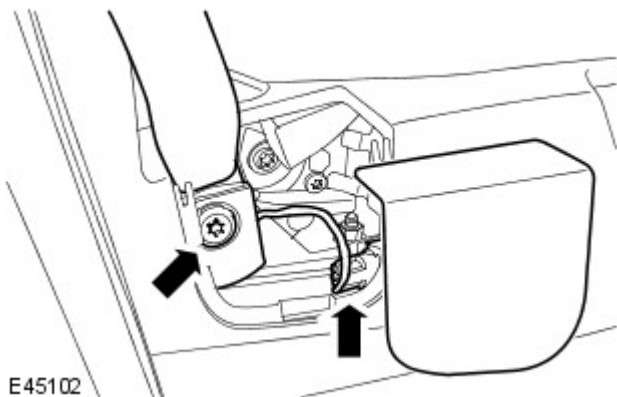
- Remove the bolt covers.
- Remove and the 5 Torx bolts.



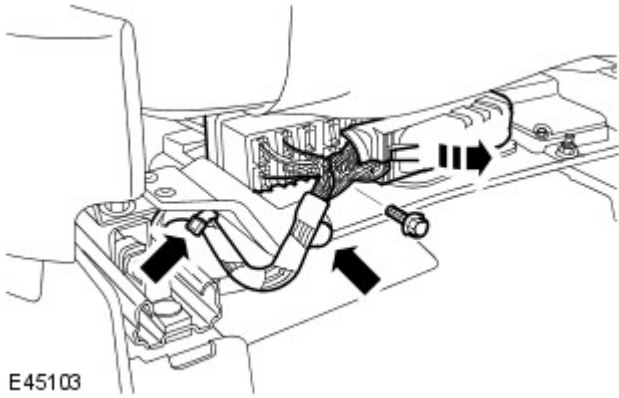
E45101

3. Release the safety belt lower anchor from the seat.

- Remove the bolt cover.
- Passenger side, disconnect the electrical connector.
- Remove and discard the Torx bolt.



E45102



4. With assistance, remove the front seat.

- Protect the rocker panel.
- Remove the bolt.
- Disconnect the 2 electrical connectors.
- Release the 2 wiring harness clips.

Installation

1. With assistance, install the front seat.

- Connect the electrical connectors.
- Secure the wiring harness clips.

2. Attach the safety belt lower anchor to the seat.

- Tighten the new Torx bolt to 40 Nm (30 lb.ft).
- Passenger side, connect the electrical connector.
- Install the bolt cover.

3. Secure the front seat.

- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Install the bolt covers.

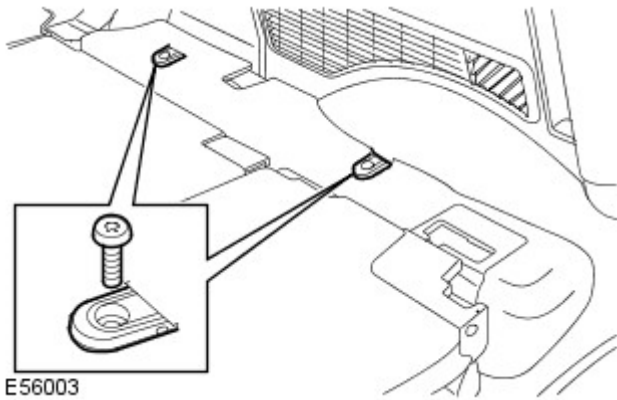
4. Connect the battery ground cable.

Seating - Third Row Seat

Removal and Installation

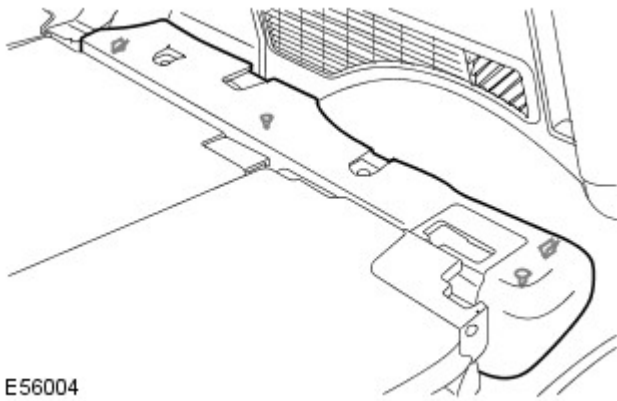
Removal

- NOTE: Third row seats must be removed as a pair.



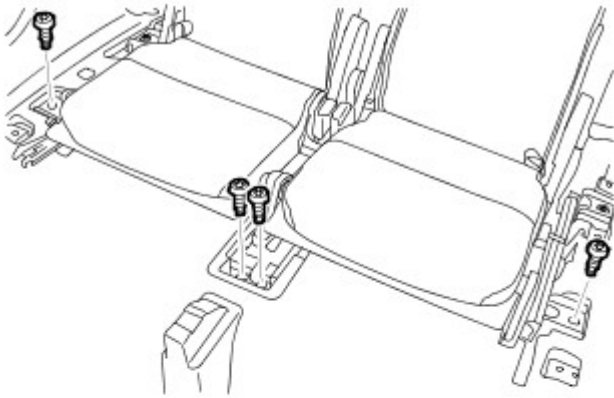
1. Remove the loadspace compartment anchors.

- Remove the 4 Torx bolts.



2. Remove the loadspace trim panels.

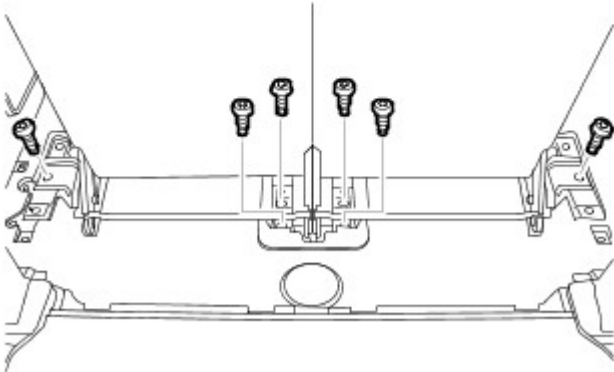
- Release from the 4 clips.



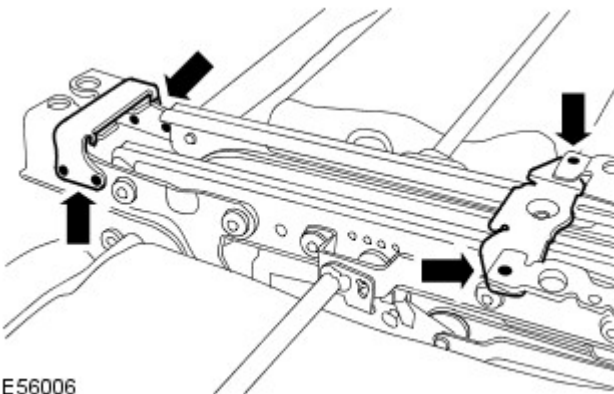
3. NOTE: Torx bolts may be re-used.

Remove the third row seats.

- Release the trim cover.
- Remove the 10 Torx bolts.



E 56005



E56006

4. NOTE: Do not disassemble further if the component is removed for access only.

Separate the third row seats.

- Remove the seat frame finisher.
- Drill out the 6 rivets.
- Remove the 2 brackets.

Installation

1. Attach the third row seats.

- Install the brackets.
- Install the rivets.

2. Install the third row seats.

- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Secure the trim cover.

3. Install the loadspace trim panels.

- Secure in the clips.

4. Install the loadspace compartment anchors.

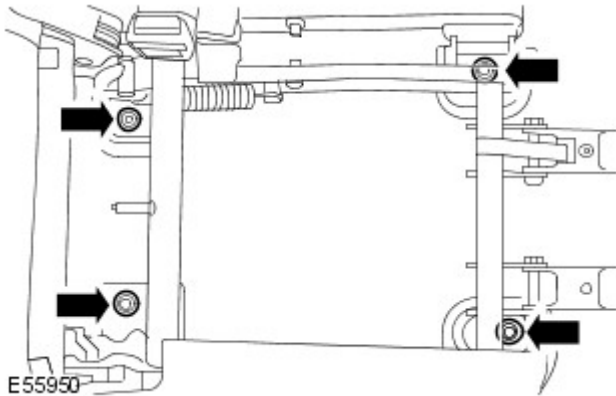
- Tighten the Torx bolts to 25 Nm (18 lb.ft).

Seating - Rear Seat Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

- NOTE: This procedure shows the removal and installation of both the LH and the RH seats.



1. NOTE: The Torx bolts can be re-used.

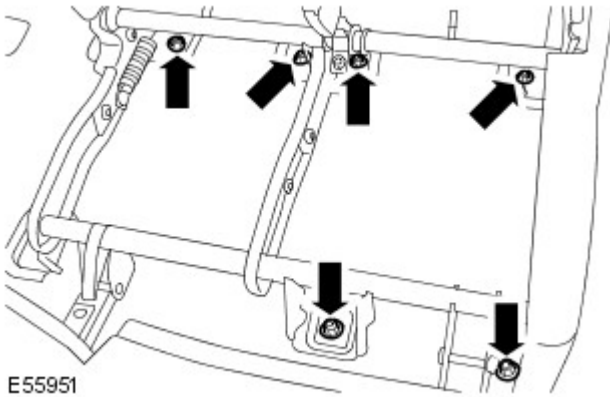
Release the RH rear seat.

- Fold the LH seat cushion forward.
- Remove the 4 Torx bolts.
- Fold down the rear seat backrest.

2. Remove the RH rear seat.

3. NOTE: The Torx bolts can be re-used.

Release the LH rear seat.



- Fold the LH seat cushion forward.
- Remove the 6 Torx bolts.
- Fold down the rear seat backrest.

4. With assistance, remove the LH rear seat assembly.

Installation

1. With assistance, install the LH rear seat assembly.

- Position the seat on the dowels.

2. Secure the LH rear seat.

- Return the seat backrest to the upright position.
- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

3. Install the RH rear seat.

- Position the seat on the dowels.

4. Secure the RH rear seat.

- Return the seat backrest to the upright position.
- Tighten the Torx bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

Seating - Rear Seat Vehicles With: 40/20/40 Split Seat

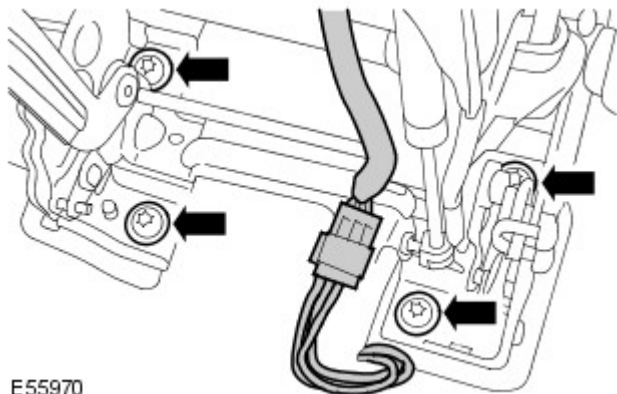
Removal and Installation

Removal

1. NOTE: The Torx bolts can be re-used.

Release the rear seat.

- Remove the front 2 Torx bolts.
- Fold the seat assembly forwards.
- Disconnect the electrical connector.
- Remove the rear 2 Torx bolts.



E55970

2. Remove the rear seat assembly.

Installation

1. Install the rear seat assembly.

2. Secure the rear seat.

- Connect the electrical connector.
- Tighten the rear Torx bolts to 45 Nm (33 lb.ft).
- Fold seat assembly rearwards.
- Tighten the front Torx bolts to 45 Nm (33 lb.ft).

Seating - Front Seat Cushion Cover

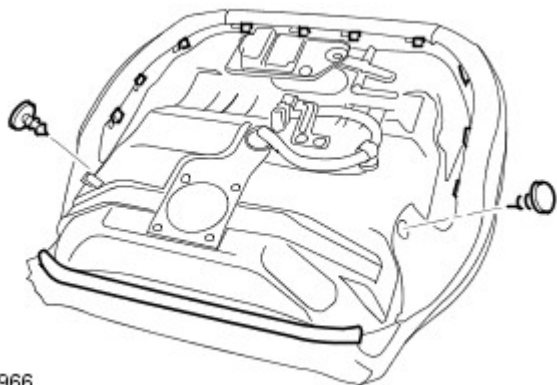
Removal and Installation

Removal

1. Remove the front seat cushion assembly.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).

2. Release the front seat cushion cover.

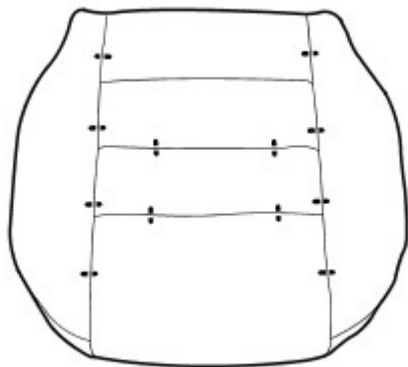
- Release the 13 clips.



E55966

3. Remove the front seat cushion cover.

- Remove the 12 hog rings.



E56020

Installation

1. Install the front seat cushion cover.

- Install the hog rings.
- Attach the cover and secure with the clips.

2. Install the front seat cushion assembly.

For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).

Seating - Front Seat Cushion Heater Mat

Removal and Installation

Removal

1. Remove the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).
2. Remove the front seat cushion heater mat.



E55962

Installation

1. Install the front seat cushion heater mat.
2. Install the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).

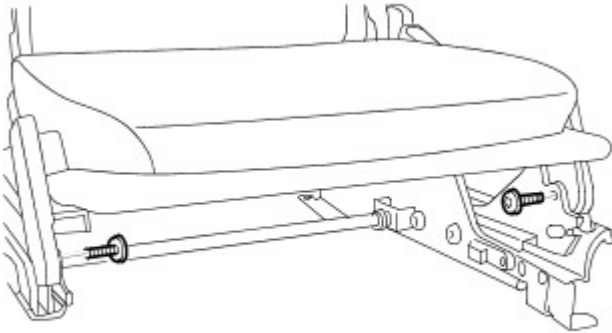
Seating - Third Row Seat Cushion Cover

Removal and Installation

Removal

1. Remove the occasional seat cushion assembly.

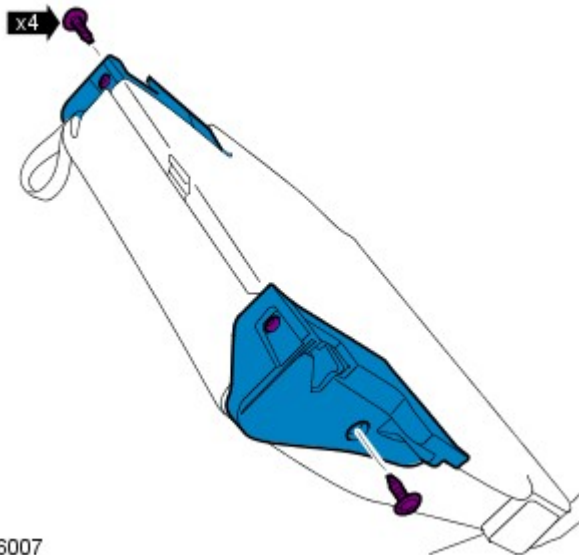
- Remove the 2 Torx bolts.



E56012

2. Remove the third row seat cushion latch covers.

- Remove the 4 screws.

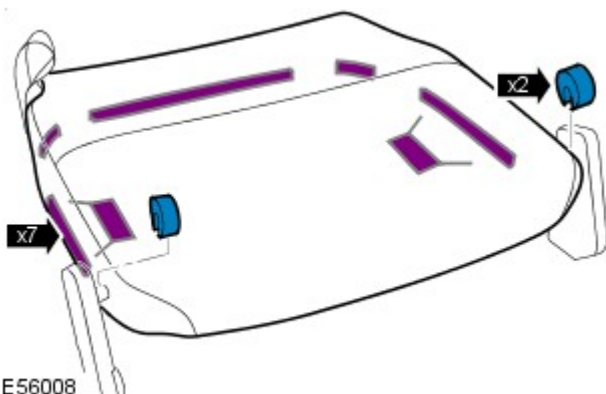


E56007

3. NOTE: Note the fitted position.

Remove the third row seat cushion cover.

- Remove the 2 spacers.
- Release the 7 clips.



E56008

Installation

1. To install, reverse the removal procedure.

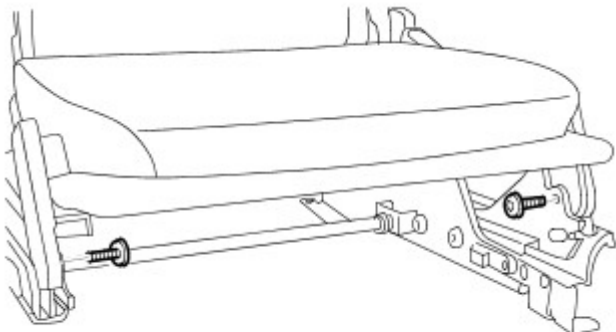
- Tighten the Torx bolt to 25 Nm (18 lb.ft).

Seating - Third Row Seat Cushion

Removal and Installation

Removal

• NOTE: In this procedure the cushion is removed as an assembly. There is a separate procedure for removing and installing the cushion cover.



E56012

1. Remove the third row seat cushion.

- Remove the 2 Allen bolts.
- Release the cushion from the seat frame.

Installation

1. NOTE: Ensure seat cushion return springs are correctly located.

Install the third row seat cushion.

- Attach the cushion to the seat frame.
- Tighten the Allen bolts to 25 Nm (18 lb.ft).

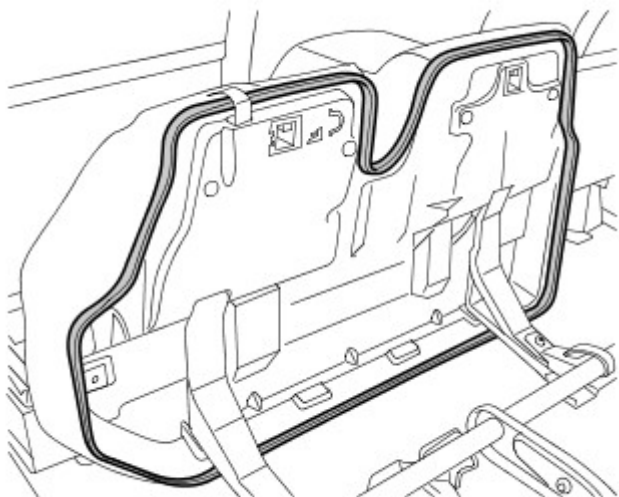
Seating - Rear Seat Cushion Cover Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

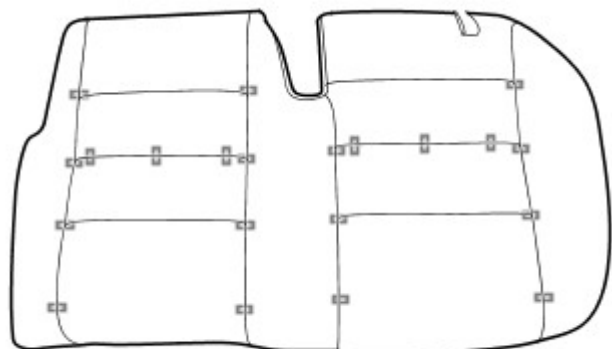
• NOTE: This procedure shows the removal and installation of both the LH and the RH covers.

1. Fold the seat cushion forward.
2. Release the rear LH seat cushion cover.
 - Release the clip.



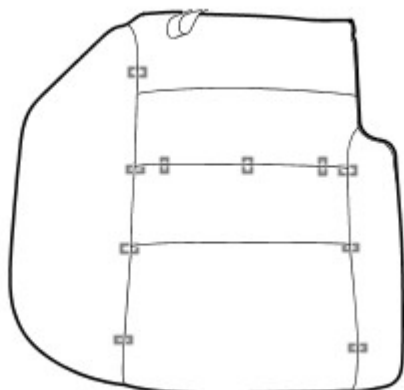
E55996

3. Remove the rear LH seat cushion cover.
 - Remove the 21 hog rings.



E56015

4. Release the rear RH seat cushion cover.
 - Release the clip.



E56016



E55997

Installation

1. Install the rear seat cushion cover.
 - Install the hog rings.

- Attach the retaining clip.

2. Fold the seat cushion rearwards.

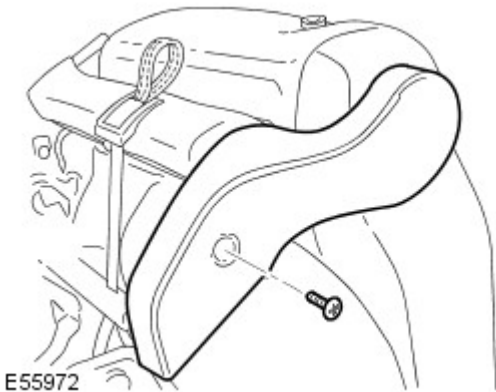
Seating - Rear Seat Cushion Cover Vehicles With: 40/20/40 Split Seat

Removal and Installation

Removal

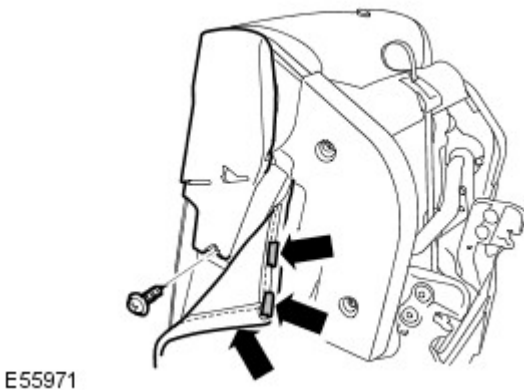
1. Remove the outer backrest hinge cover.

- Fold the seat assembly forwards.
- Remove the screw.



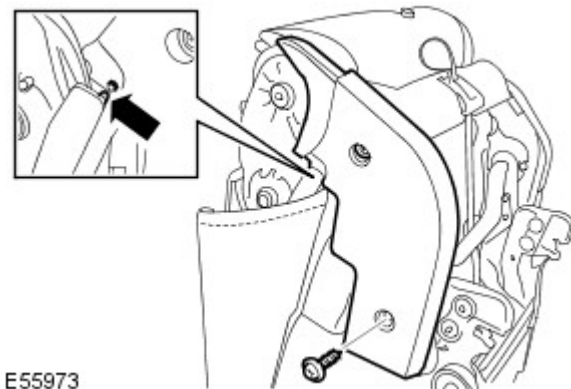
2. Remove the inner backrest hinge cover.

- Release the backrest cover side clip.
- Release the 2 clips.
- Remove the screw.



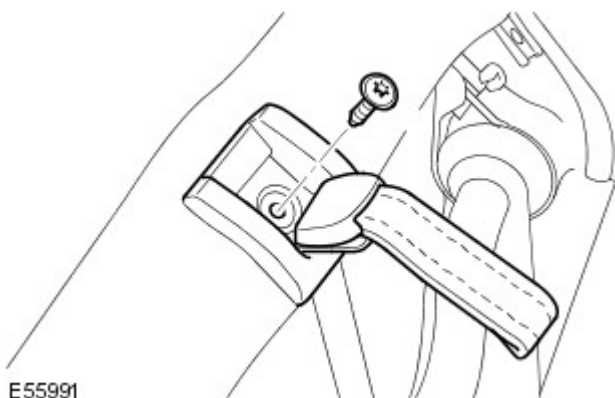
3. Remove the rear seat cushion side finisher.

- Remove the 2 screws.



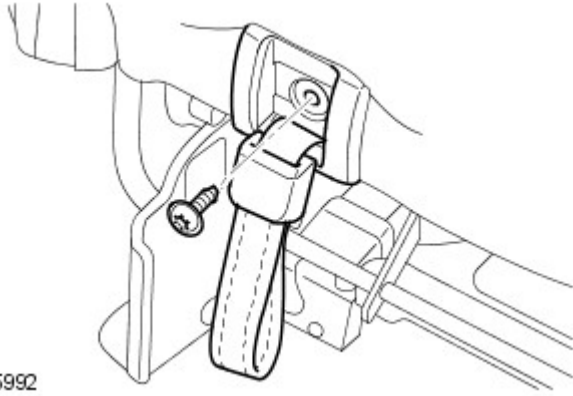
4. Remove the seat rear release strap finisher.

- Remove the screw.



5. Remove the seat front release strap finisher.

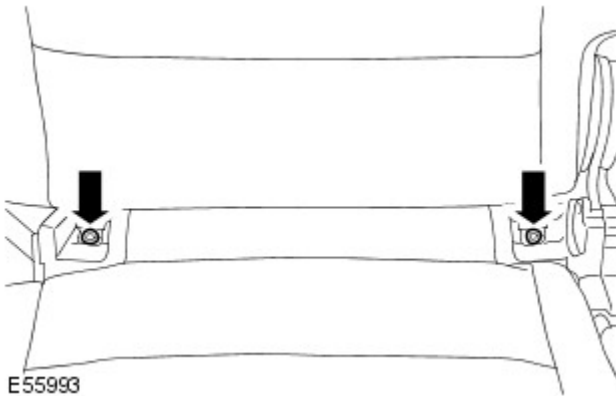
- Remove the screw.



E55992

6. Remove the seat cushion finishers.

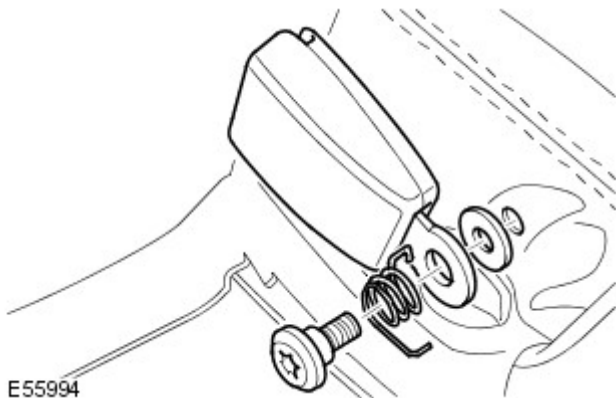
- Remove the 2 screws.



E55993

7. Remove the rear safety belt buckle.

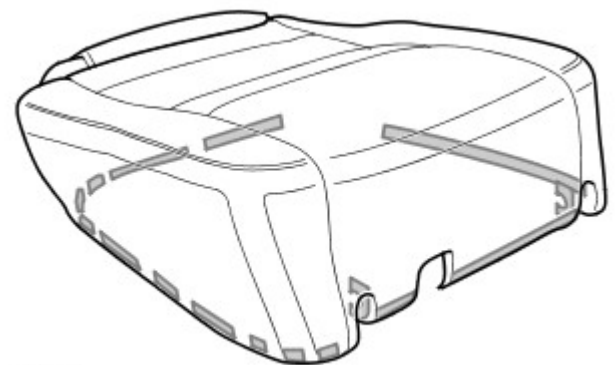
- Remove the Torx bolt.
- Release the spring.



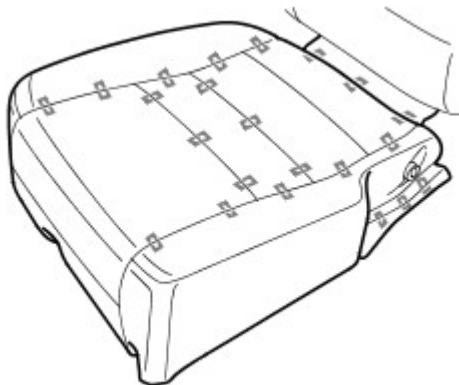
E55994

8. Release the rear seat cushion cover.

- Release the 15 clips.



E55995



E56017

9. Remove the rear seat cushion cover.

- Remove the 22 hog rings.

Installation

1. Install the rear seat cushion cover.

- Install the hog rings.
- Install the clips.

2. Install the rear safety belt buckle.

- Attach the spring.
- Tighten the Torx bolt to 45 Nm (33 lb.ft).

3. Install the seat cushion finishers.

- Tighten the screws.

4. Install the seat front release strap finisher.

- Remove the screw.
- Tighten the screw.

5. Install the seat rear release strap finisher.

- Tighten the screw.

6. Install the inner backrest hinge cover.

- Attach the clips.
- Tighten the screw.

7. Install the outer backrest hinge cover.

- Tighten the screw.
- Fold seat assembly rearwards.

8. Install the rear seat cushion side finisher.

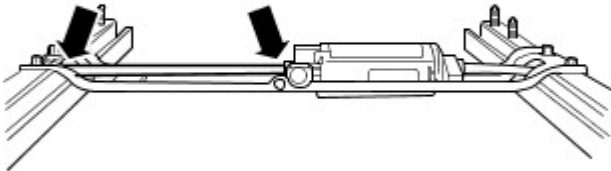
- Tighten the screws.

Seating - Front Seat Track Motor

Removal and Installation

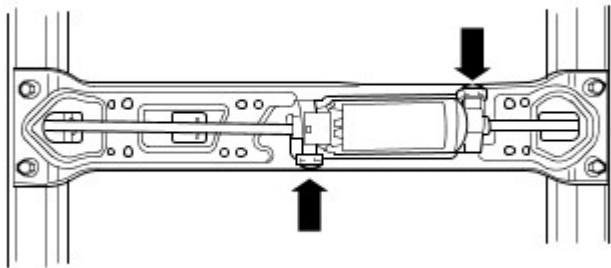
Removal

1. Raise the seat base for access.
2. Remove the drive cable.
 - Disconnect the seat motor electrical connector.



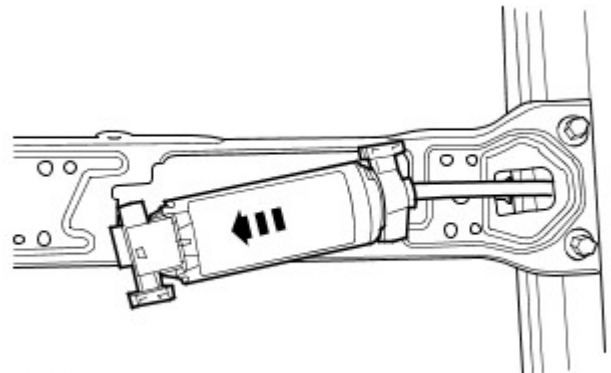
E131397

3. Remove the 2 clips.



E131398

4. Remove the front seat track motor.



E131399

Installation

1. Install the front seat track motor.
 - Install the drive cable.
 - Install the 2 clips.
2. Install the drive cable.
 - Connect the seat motor electrical connector.

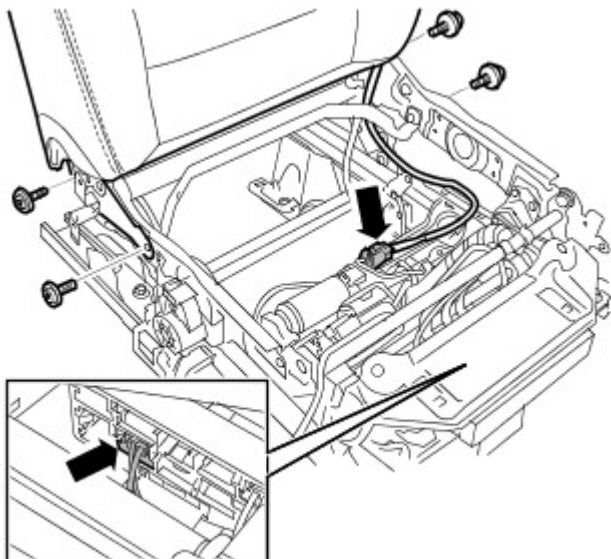
Seating - Front Seat Height Adjustment Motor

Removal and Installation

Removal

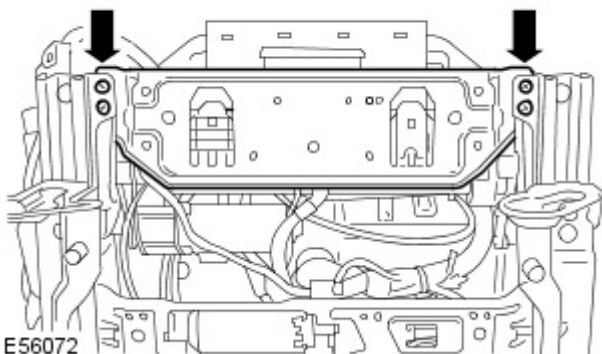
- NOTE: Front seat height adjustment motor is supplied as part of the front seat frame assembly.

1. Remove the front safety belt buckle.
For additional information, refer to: Front Safety Belt Buckle (501-20, Removal and Installation).
2. Remove the front seat cushion assembly.
For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).
3. Remove the front seat backrest assembly.
 - Release and disconnect the 2 electrical connectors.
 - Remove the 4 Torx bolts.



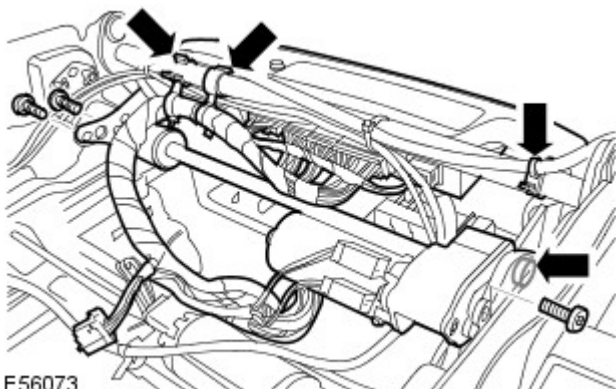
E56071

4. Remove the front seat electrical connector bracket.
 - Remove the 4 screws.

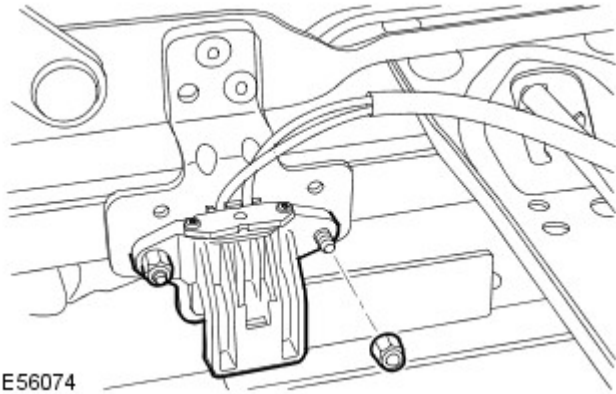


E56072

5. Remove the front seat tilt motor.
 - Release the 3 wiring harness clips.
 - Remove the 4 Torx bolts.



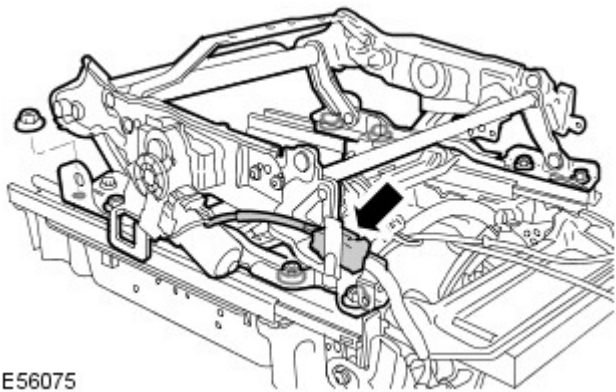
E56073



E56074

6. Remove the front seat position sensor.

- Remove the 2 nuts.



E56075

7. Remove the front seat height adjustment motor.

- Disconnect the electrical connector.
- Remove the 8 nuts.

Installation

1. Install the front seat height adjustment motor.

- Tighten the nuts to 25 Nm (18 lb.ft).
- Connect the electrical connector.

2. Install the front seat position sensor.

- Tighten the nuts to 4 Nm (3 lb.ft).

3. Install the front seat tilt motor.

- Tighten the Torx bolts to 10 Nm (7 lb.ft).
- Attach the wiring harness.

4. Install the front seat electrical connector bracket.

- Tighten the screws.

5. Install the front seat backrest assembly.

- Tighten the Torx bolts to 25 Nm (18 lb.ft).
- Connect and secure the electrical connectors.

6. Install the front seat cushion assembly.

For additional information, refer to: Front Seat Cushion (501-10, Removal and Installation).

7. Install the front safety belt buckle.

For additional information, refer to: Front Safety Belt Buckle (501-20, Removal and Installation).

Seating - Front Seat Tilt Motor

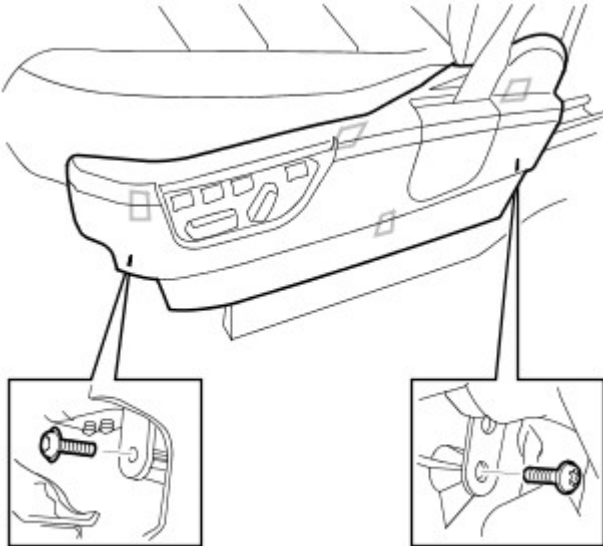
Removal and Installation

Removal

1. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

2. Remove the front seat cushion side finisher.

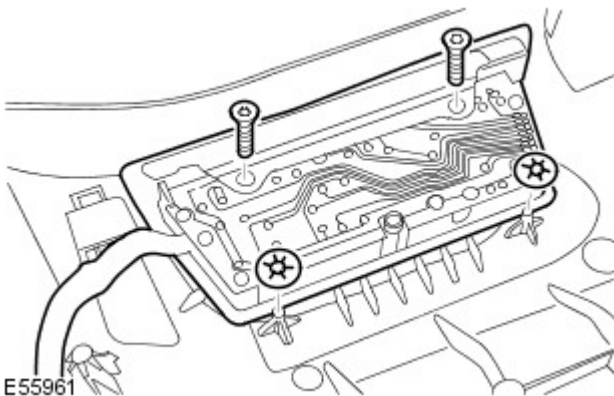
- Remove the 2 Torx screws.
- Release from the 3 clips.



E56089

3. Release the front seat control switch.

- Remove the 2 screws.
- Remove the 2 clips.

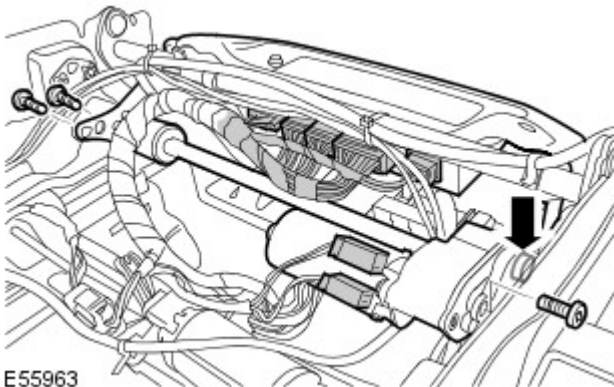


E55961

4. Remove the front seat cushion assembly.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).

5. Remove the front seat tilt motor assembly.

- Remove the 4 Torx bolts.
- Disconnect the 7 electrical connectors.

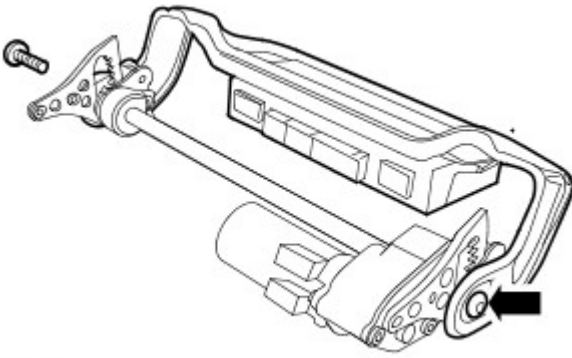


E55963

6. NOTE: Do not disassemble further if the component is removed for access only.

Remove the seat module bracket.

- Remove the 2 Torx bolts.



E55964

Installation

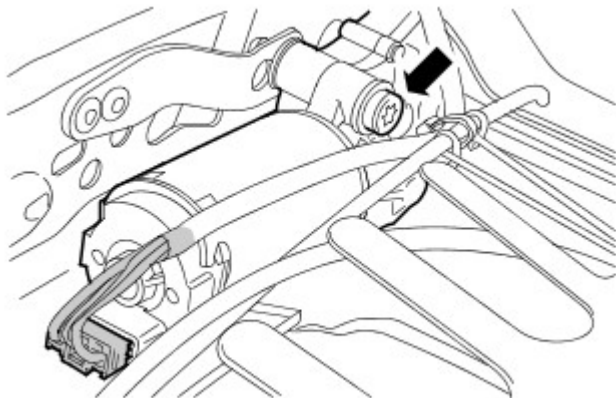
1. Install the seat module bracket.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
2. Install the front seat tilt motor assembly.
 - Tighten the 4 Torx bolts to 10 Nm (7 lb.ft).
 - Connect the electrical connectors.
3. Install the front seat cushion assembly.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).
4. Install the front seat cushion side finisher.
 - Secure in the clips.
 - Tighten the screws.
5. Install the front seat control switch.
 - Secure in the clips.
 - Tighten the screws.
6. Install the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

Seating - Front Seat Recliner Motor

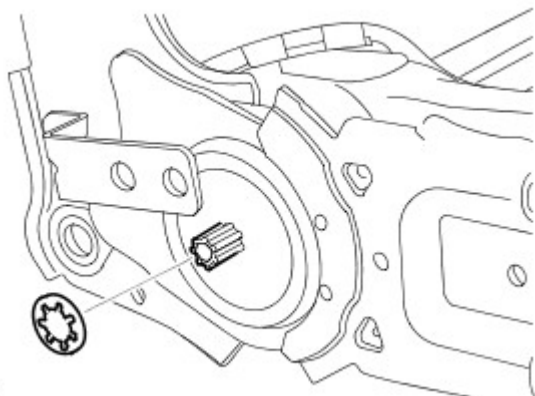
Removal and Installation

Removal

1. Remove the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).
2. Remove the front seat backrest pad.
3. Remove the front seat recliner motor.



- Disconnect the electrical connector.
- Remove the Torx bolt.
- Remove the front seat backrest shaft clip.
- Remove the front seat backrest shaft.



E55965

Installation

1. Install the front seat recliner motor.
 - Install the front seat backrest shaft.
 - Install the front seat backrest shaft clip.
 - Tighten the Torx bolt to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
2. Install the front seat backrest pad.
3. Install the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).

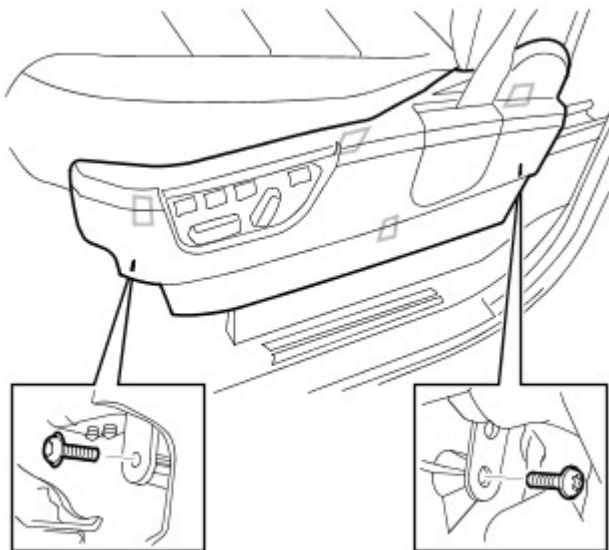
Seating - Front Seat Control Switch

Removal and Installation

Removal

1. Remove the front seat cushion side finisher.

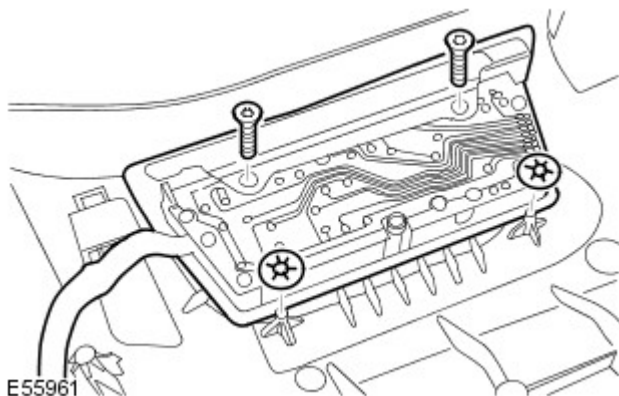
- Remove the 2 screws.
- Release from the 3 clips.



E55954

2. Remove the front seat control switch.

- Disconnect the electrical connector.
- Release the front seat control switch harness.
- Remove the 2 screws.
- Remove the 2 clips.



E55961

Installation

1. Install the front seat cushion side finisher.

- Secure in the clips.
- Tighten the screws.

2. Install the front seat control switch.

- Secure in the clips.
- Tighten the screws.
- Connect the electrical connector.
- Attach the wiring harness.

Seating - Front Seat Backrest Cover

Removal and Installation

Removal

• WARNINGS:



To avoid accidental deployment, the restraints control module backup power supply must be depleted. Wait at least one minute after disconnecting the battery ground cable(s) before commencing any repair or adjustment to the supplemental restraint system (SRS), or any component(s) adjacent to the SRS sensors. Failure to follow these instructions may result in personal injury.



Always wear safety glasses when working on an air bag equipped vehicle and when handling an air bag module. Failure to follow this instruction may result in personal injury.



To minimize the possibility of premature deployment, do not use radio key code savers when working on the supplemental restraint system. Failure to follow this instruction may result in personal injury.



To minimize the possibility of injury in the event of premature deployment, always carry a live air bag module with the bag and trim cover pointed away from the body. Failure to follow this instruction may result in personal injury.



To minimize the possibility of premature deployment, live air bag modules must only be placed on work benches which have been ground bonded and with the trim cover facing up. Failure to follow these instructions may result in personal injury.



Never probe the electrical connectors of air bag modules or any other supplemental restraint system component. Failure to follow this instruction may result in personal injury.



Painting over the driver air bag module trim cover or instrument panel could lead to deterioration of the trim cover and air bags. Do not for any reason attempt to paint discolored or damaged air bag module trim covers or instrument panel. Install a new component. Failure to follow this instruction may result in personal injury.



Make sure that sufficient time has elapsed after disconnecting the battery ground cable(s), before commencing work on the supplemental restraint system (SRS). Failure to follow these instructions may result in personal injury.

1. Make the SRS system safe.

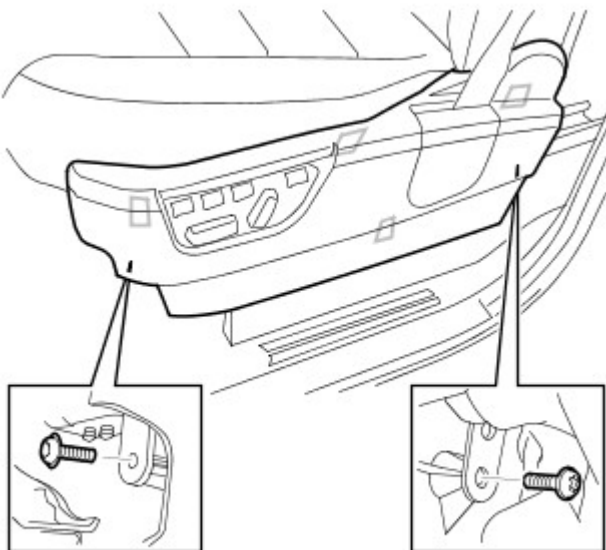
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the front safety belt buckle.

For additional information, refer to: [Front Safety Belt Buckle](#) (501-20A Safety Belt System, Removal and Installation).

3. Remove the front seat cushion side trim.

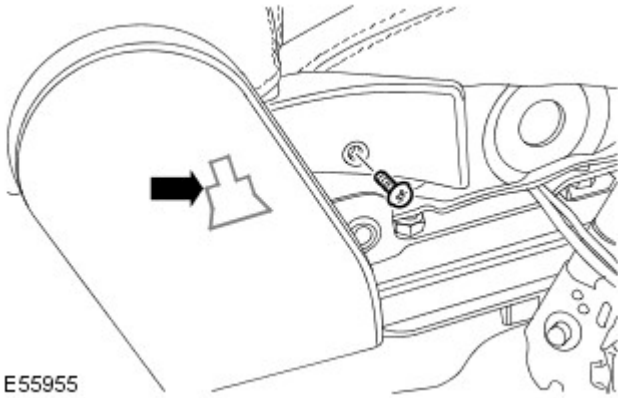
- Remove the 2 screws.
- Release from the 3 clips.



E55954

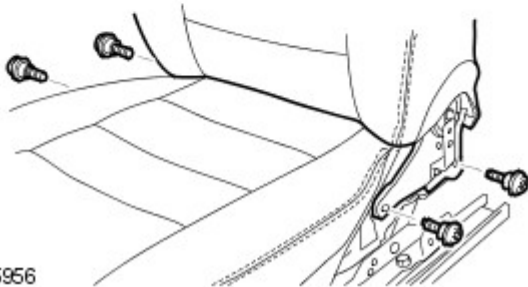
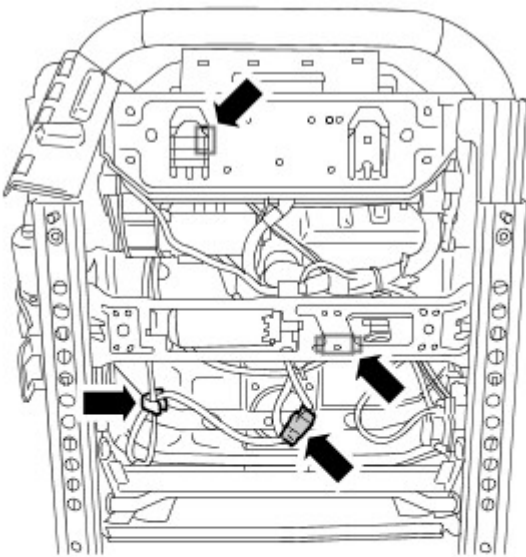
4. Remove the front seat backrest hinge cover.

- Remove the 2 screws.
- Release from the clip.



5. Remove the front seat backrest assembly.

- Release the retaining clips and disconnect the three electrical connectors.
- Remove the 4 Torx bolts.



E55956

6. Remove the front seat grab handles.

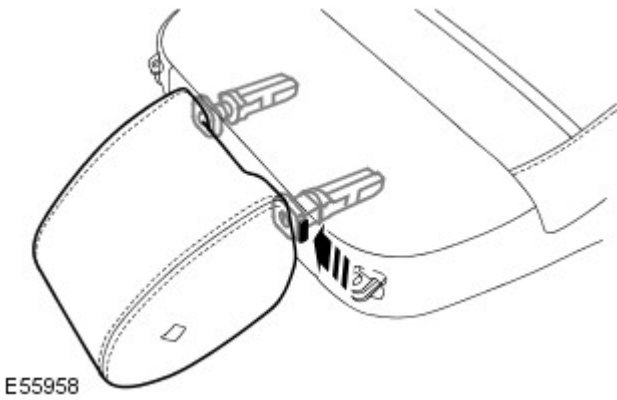
- Remove the bolt covers.
- Remove the 2 bolts.



7. NOTE: Head restraint release latch is underneath backrest cover.

Remove the front seat head restraint.

- Release the front seat head restraint latch.



8. Remove the seat armrest.

For additional information, refer to: Front Seat Armrest (501-10, Removal and Installation).

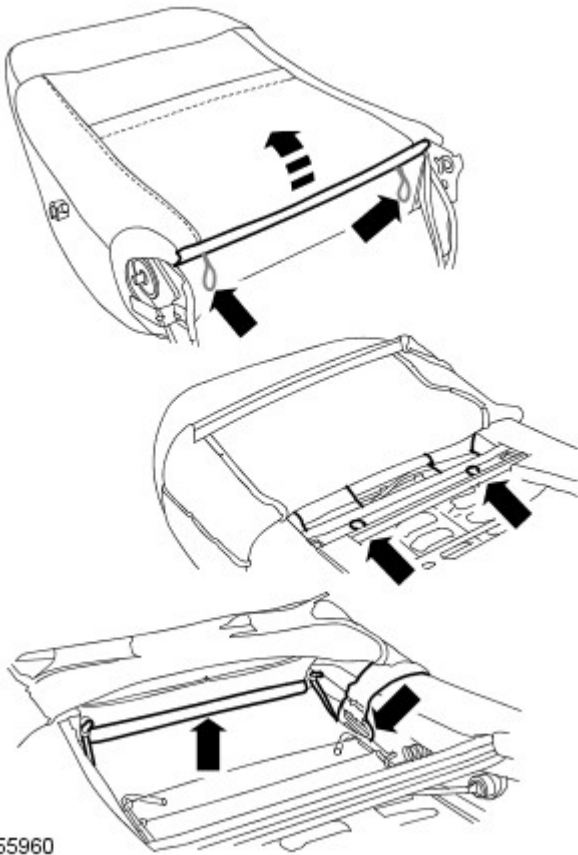
9. Remove the front seat lumbar adjustment knob.

- Pull sharply to release from lumbar mechanism.



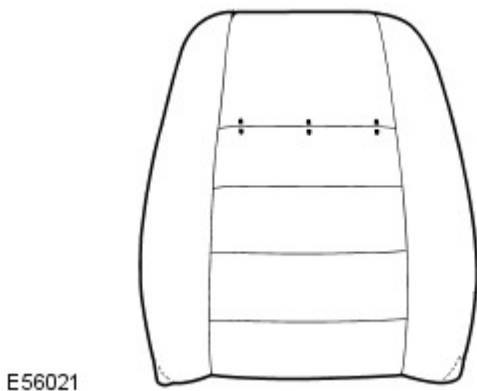
10. Release the front seat backrest cover.

- Release the 5 clips.
- Release the tension straps.



11. Remove the front seat backrest cushion and cover from the front seat frame.

- Remove the 3 hog rings.



Installation

1. Install the front seat backrest cover.

- Install the hog rings.
- Install the clips.
- Attach the tension straps.

2. Install the front seat lumbar adjustment knob.

- Push firmly to secure to the lumbar mechanism.

3. Install the seat armrest.

For additional information, refer to: Front Seat Armrest (501-10, Removal and Installation).

4. Install the front seat head restraint.

5. Install the front seat grab handles.

- Tighten the bolts to 25 Nm (18 lb.ft).
- Install the bolt covers.

6. Install the front seat backrest assembly.
 - Tighten the Torx bolts to 25 Nm (18 lb.ft).
 - Connect and secure the electrical connectors.
7. Install the front seat backrest hinge cover.
 - Tighten the screws.
 - Fit the clip.
8. Install the front seat cushion side trim.
 - Position and secure in the clips.
 - Install the screws.
9. Install the front safety belt buckle.
For additional information, refer to: [Front Safety Belt Buckle](#)
(501-20A Safety Belt System, Removal and Installation).

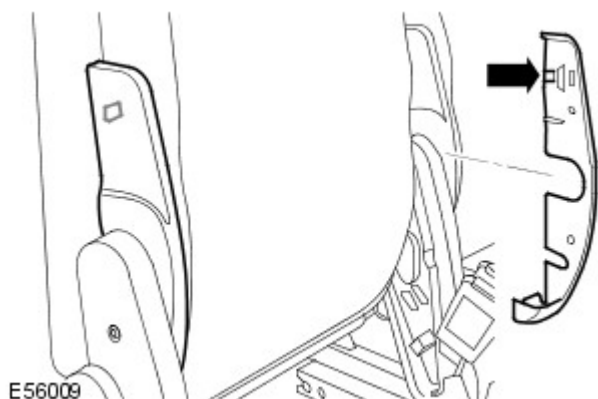
Seating - Third Row Seat Backrest Cover

Removal and Installation

Removal

1. Fold the seat cushion assembly forwards.
2. Remove the seat backrest hinge inner covers.

- Release the clip.



3. Remove the seat backrest latch covers.

- Remove the 2 screws.



4. Remove the seat backrest cover.

- Fold the seat cushion forward.
- Release the 14 clips.



Installation

1. To install, reverse the removal procedure.

Seating - Front Seat Backrest Heater Mat

Removal and Installation

Removal

1. Remove the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).
2. NOTE: Front seat cushion heater mat shown in illustration. Removal of backrest heater mat is the same.

Remove the front seat backrest heater mat.



E55962

Installation

1. Install the front seat backrest heater mat.
2. Install the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).

Seating - Rear Seat Backrest Cover Vehicles With: 60/40 Split Seat

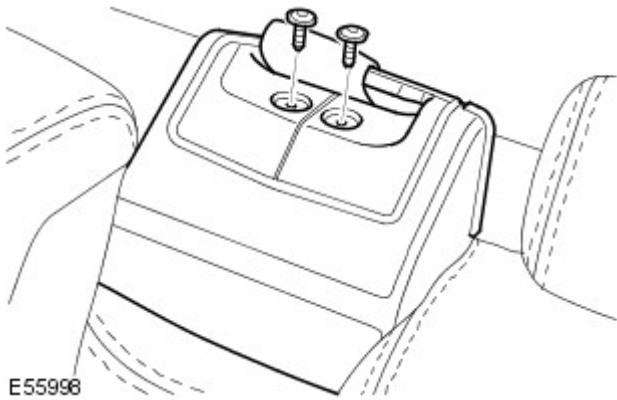
Removal and Installation

Removal

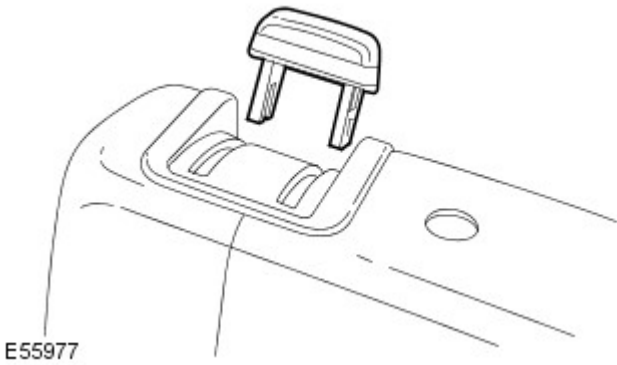
- NOTE: This procedure shows the removal of both the LH and RH covers.

1. LH seat only: Remove the safety belt retractor cover and guide.

- Remove the 2 screws.

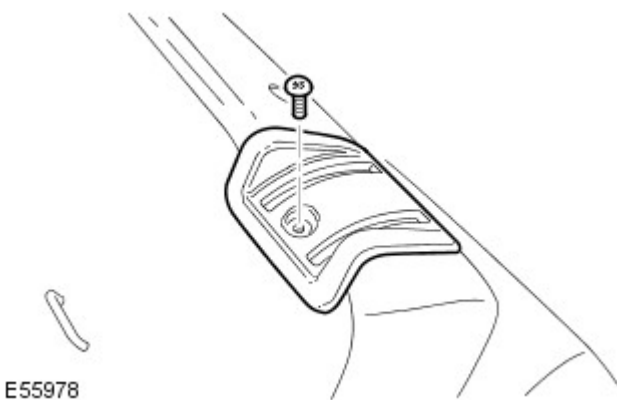


2. Remove the rear seat release handle.



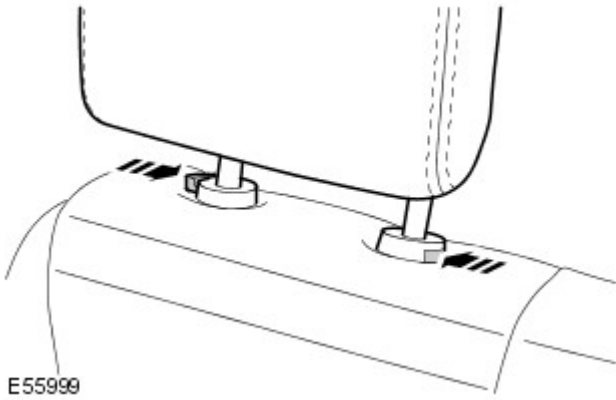
3. Remove the rear seat release handle finisher.

- Remove the screw.

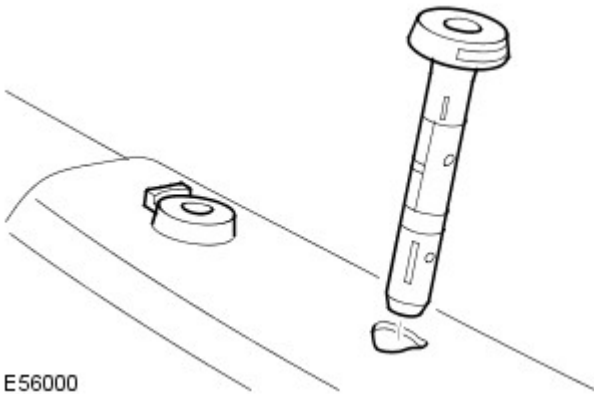


4. Remove the rear seat head restraint.

- Depress the 2 retaining clips.

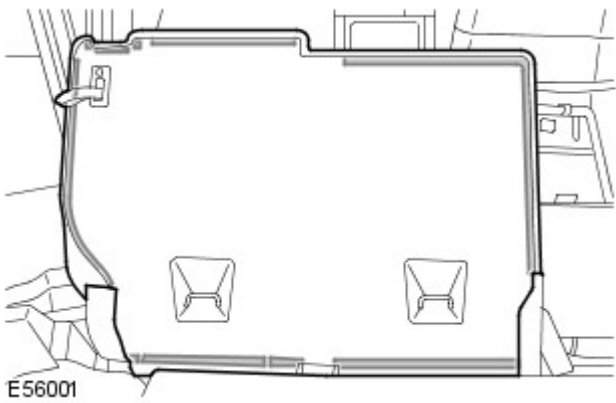


5. Remove the rear seat head restraint retaining clips.



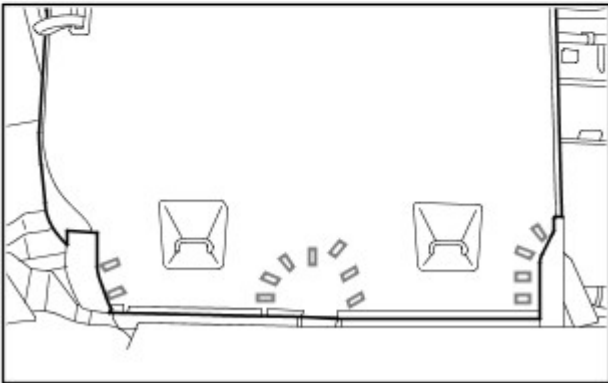
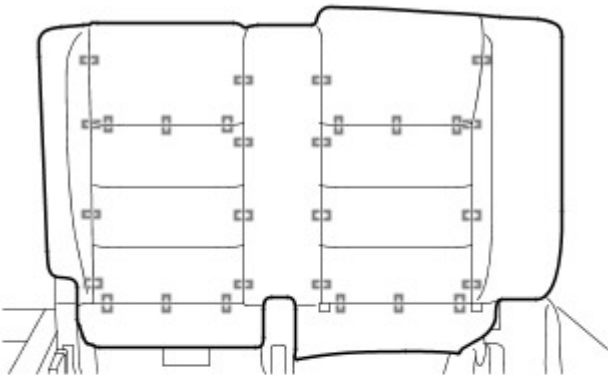
6. Release the rear LH seat backrest cover.

- Release the 10 clips.



7. Remove the rear LH seat backrest cover.

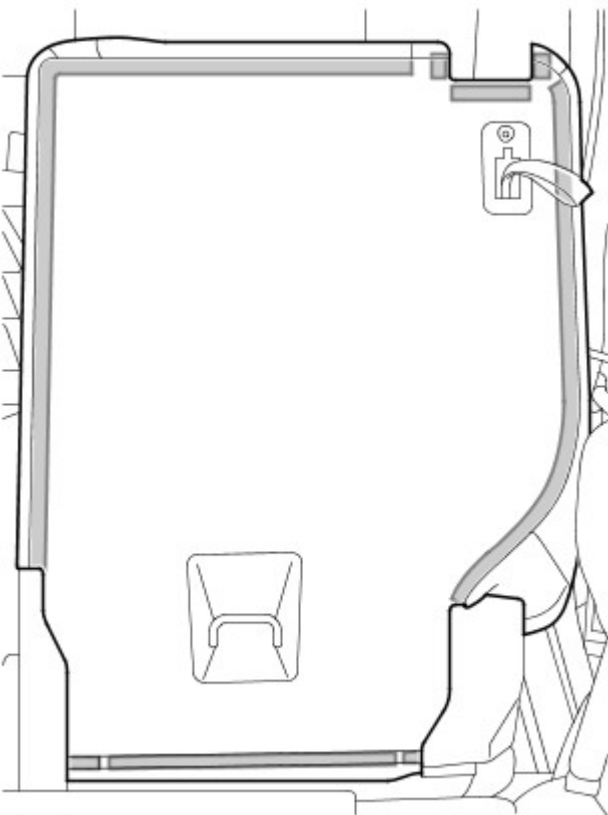
- Remove the 41 hog rings.



E56013

8. Release the rear RH seat backrest cover.

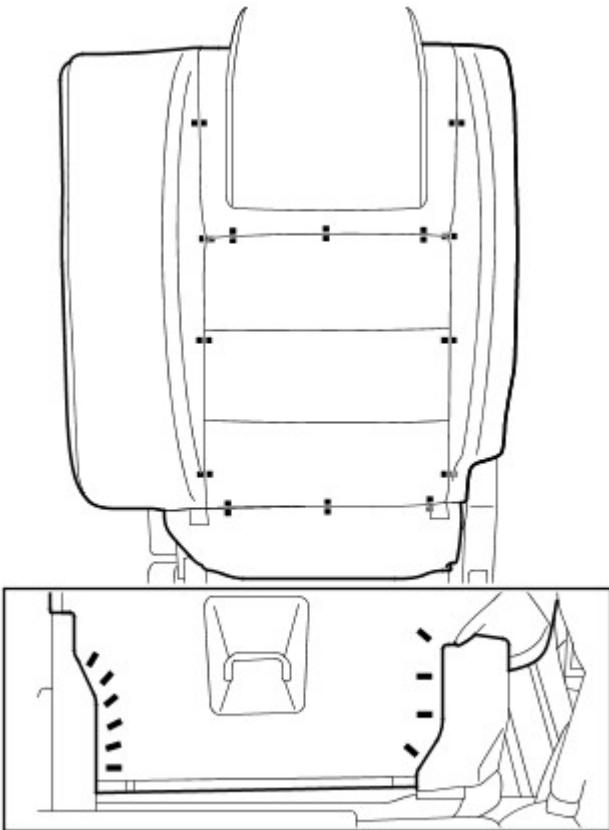
- Release the 9 clips.



E56002

9. Remove the rear RH seat backrest cover.

- Remove the 24 hog rings.



E56014

Installation

1. Install the rear seat backrest cover.

- Install the hog rings.
- Attach the clips.

2. Install the rear seat head restraint retaining clips.

3. Install the rear seat head restraint.

4. Install the rear seat release handle finisher.

- Tighten the screw.

5. Install the rear seat release handle.

6. Install the safety belt guide and retractor cover.

- Attach the safety belt guide and retractor cover.
- Tighten the screws.

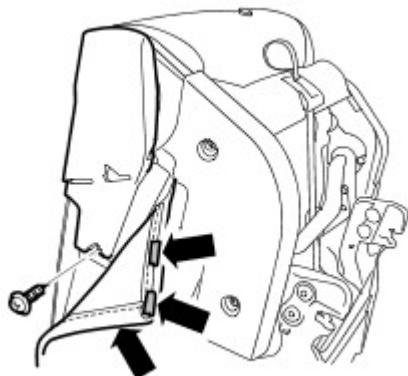
Seating - Rear Seat Backrest Cover Vehicles With: 40/20/40 Split Seat

Removal and Installation

Removal

1. Remove the inner backrest hinge cover.

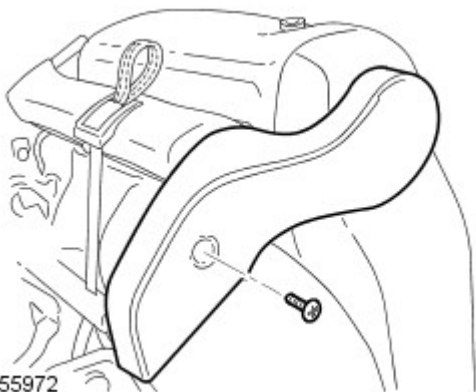
- Release the backrest cover side clip.
- Remove the screw.
- Release the 2 clips.



E55971

2. Remove the outer backrest hinge cover.

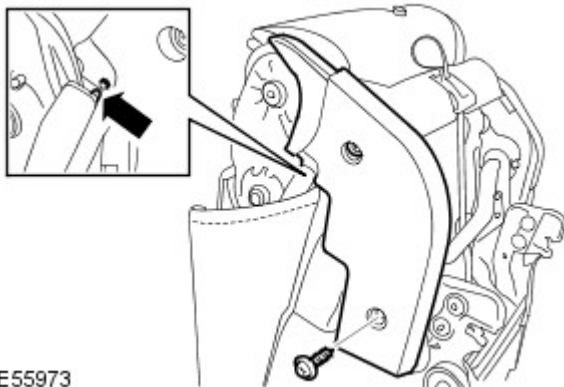
- Remove the screw.



E55972

3. Remove the rear seat cushion side finisher.

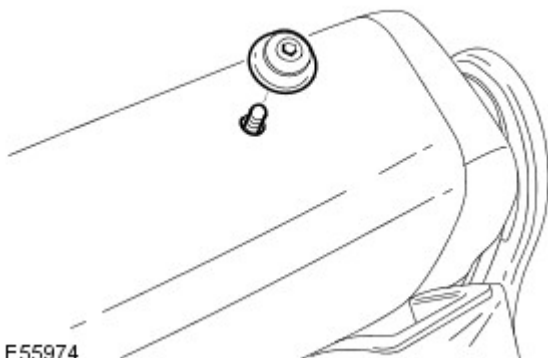
- Remove the 2 screws.



E55973

4. Remove the luggage strap tether.

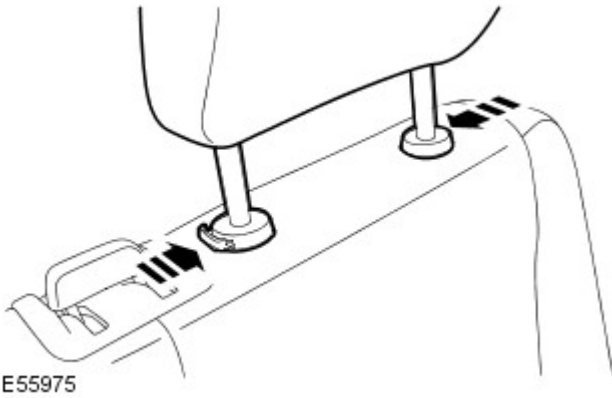
- Remove the Allen bolt.



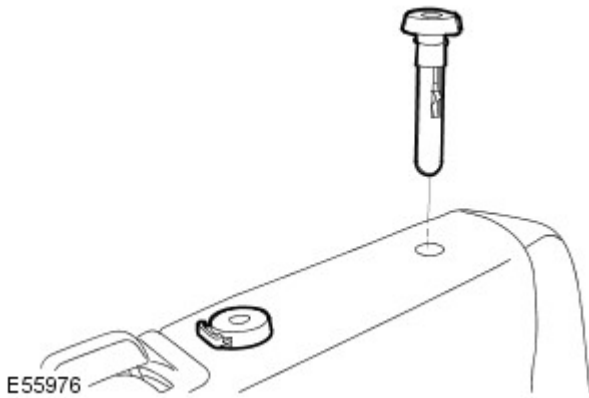
E55974

5. Remove the rear seat head restraint.

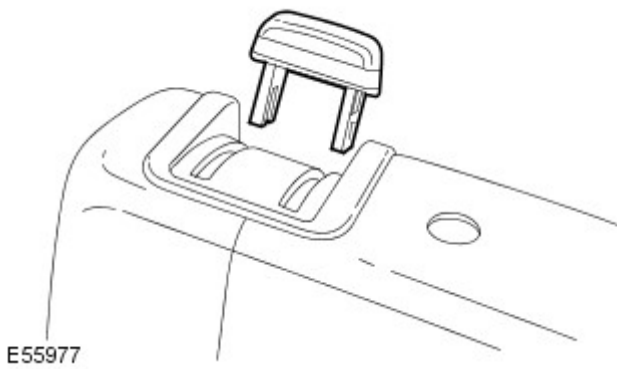
- Depress the 2 retaining clips.



6. Remove the rear seat head restraint retaining clips.



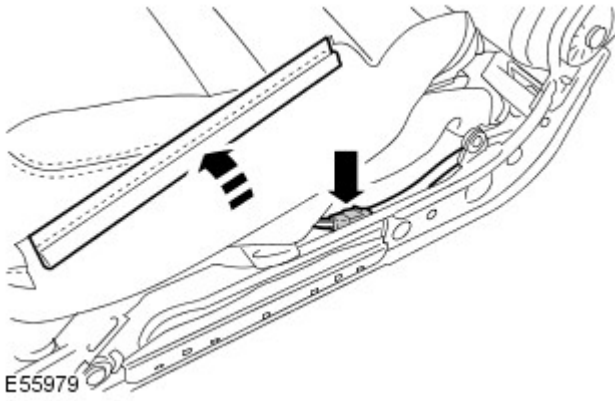
7. Remove the rear seat release handle.



8. Remove the rear seat release handle finisher.

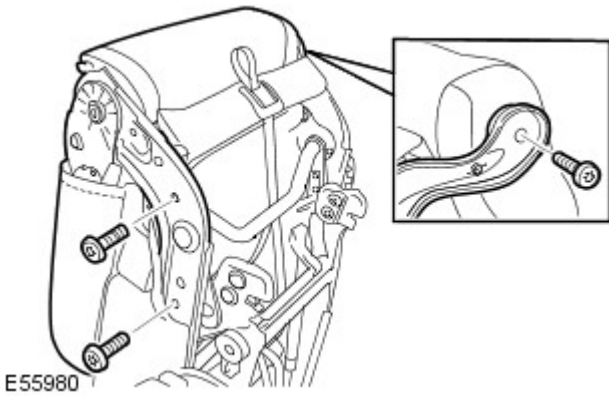
- Remove the screw.





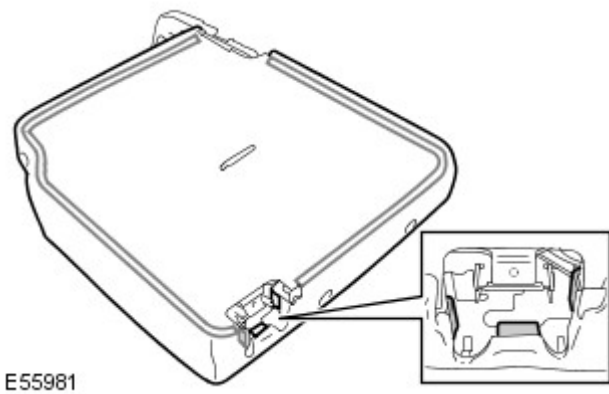
9. Disconnect the backrest heater mat electrical connector.

- Release the rear seat cushion side clip.



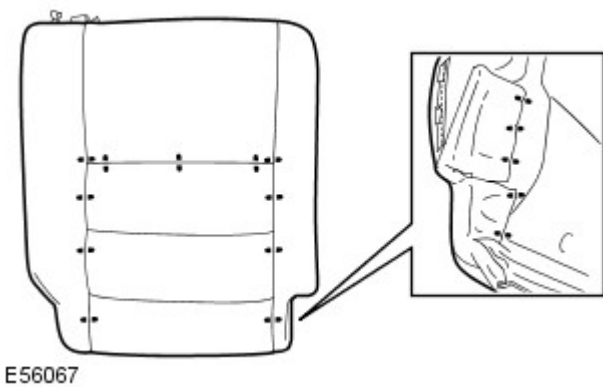
10. Remove the rear seat backrest assembly.

- Remove the 3 Torx bolts.



11. Release the rear seat backrest cover.

- Release the 5 clips.



12. Remove the rear seat backrest cover.

- Remove the 16 hog rings.

Installation

1. Install the rear seat backrest cover.

- Install the 16 hog rings.

- Attach the 4 clips.
2. Install the rear seat backrest assembly.
 - Tighten the Torx bolts to 45 Nm (33 lb.ft).
 3. Connect the backrest heater mat electrical connector.
 - Attach the rear seat cushion side clip.
 4. Install the rear seat release handle finisher.
 - Tighten the screw.
 5. Install the rear seat release handle.
 6. Install the rear seat head restraint retaining clips.
 7. Install the rear seat head restraint.
 8. Install the luggage strap tether.
 9. Install the rear seat cushion side finisher.
 - Tighten the screws.
 10. Install the outer backrest hinge cover.
 - Tighten the screws.
 - Tighten the screw.
 11. Install the inner backrest hinge cover.
 - Attach the clips.
 - Tighten the screw.
 - Attach the backrest cover side clip.

Seating - Seat Track Vehicles Without: Power Seats

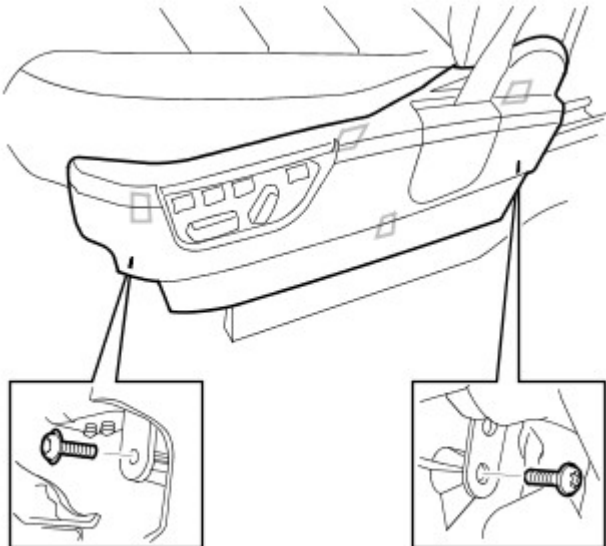
Removal and Installation

Removal

1. Remove the front safety belt buckle.
For additional information, refer to: [Front Safety Belt Buckle](#) (501-20A Safety Belt System, Removal and Installation).

2. Remove the front seat cushion side trim.

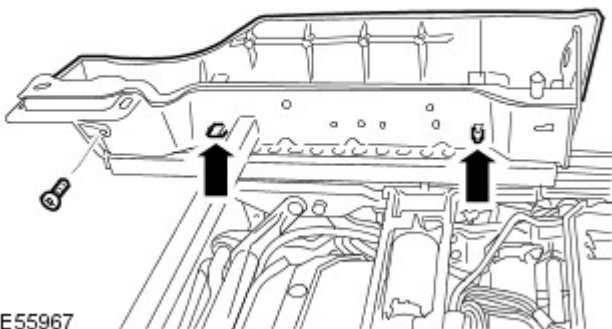
- Remove the 2 Torx screws.
- Release from the 4 clips.



E56089

3. Remove the front seat base trim.

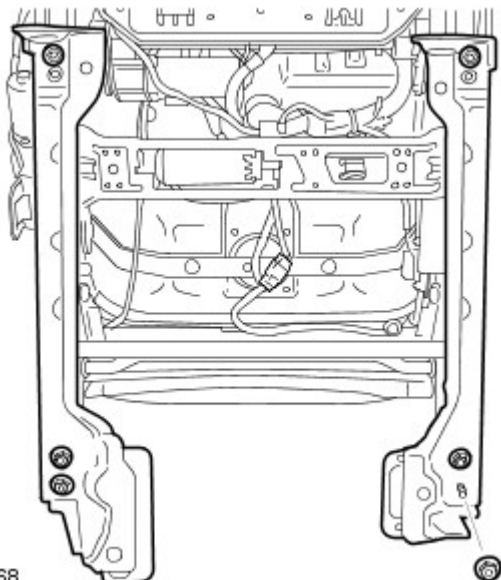
- Remove the screw.
- Release the 2 clips.



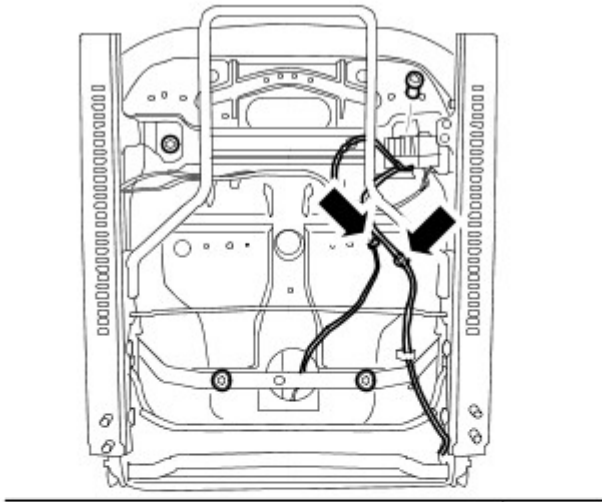
E55967

4. Remove the front seat base.

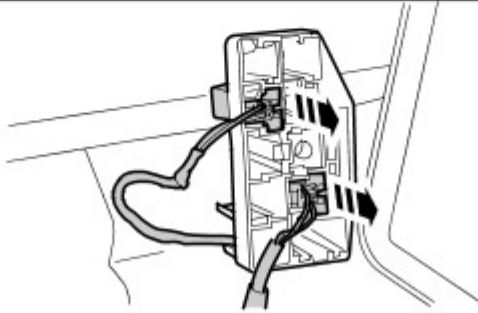
- Remove the 6 nuts.



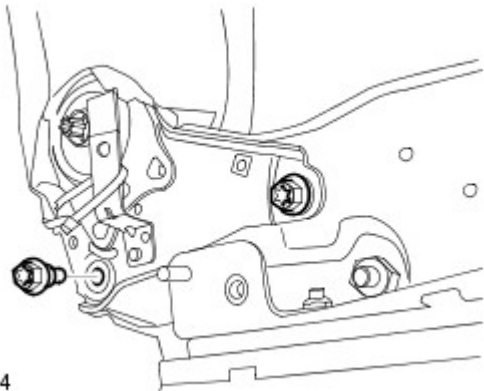
E55968



5. Remove the front seat cushion assembly.
 - Release and disconnect the 2 electrical connectors.
 - Remove the 4 Torx bolts.



E59785



E59784

6. Remove the seat track assembly.
 - Remove the 4 Torx bolts.

Installation

1. Install the seat track assembly.
 - Tighten the Torx bolts to 25 Nm (18 lb.ft).
2. Install the front seat cushion assembly.
 - Tighten the Torx bolts to 25 Nm (18 lb.ft).
 - Connect and secure the electrical connectors.
3. Install the front seat base.
 - Tighten the nuts to 25 Nm (18 lb.ft).
4. Install the front seat base trim.
 - Secure in the clips.
 - Tighten the screw.
5. Install the front seat cushion side trim.

- Secure in the clips.
- Tighten the screws.

6. Install the front safety belt buckle.

For additional information, refer to: [Front Safety Belt Buckle](#)
(501-20A Safety Belt System, Removal and Installation).

Seating - Seat Track Vehicles With: Power Seats

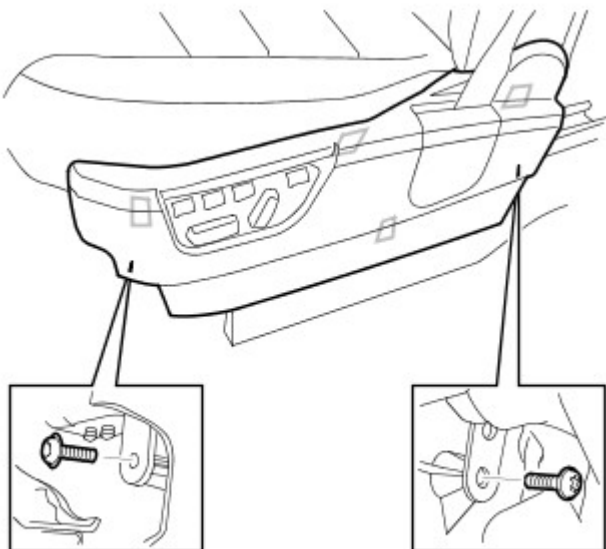
Removal and Installation

Removal

- NOTE: The front seat track motor is supplied as part of the front seat lower frame assembly.

1. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
2. Remove the front seat cushion side trim.

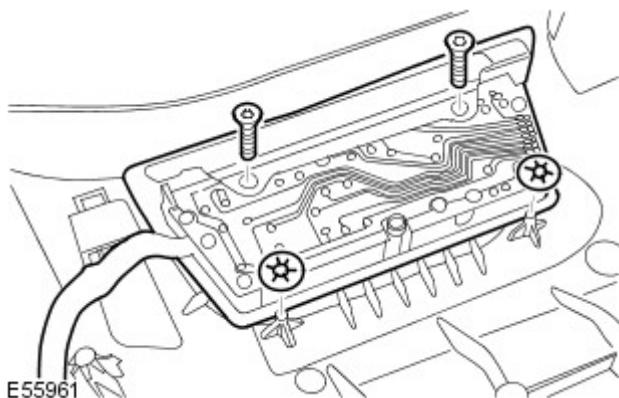
- Remove the 2 Torx screws.
- Release from the 4 clips.



E56089

3. Release the seat control switch.

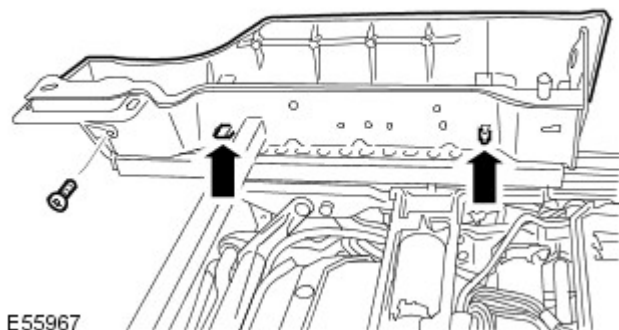
- Remove the 2 screws.
- Remove the 2 clips.



E55961

4. Remove the front seat base trim.

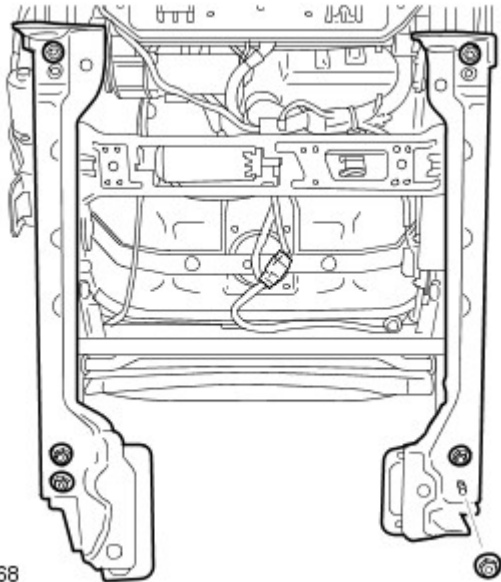
- Remove the screw.
- Release the 2 clips.



E55967

5. Remove the front seat base.

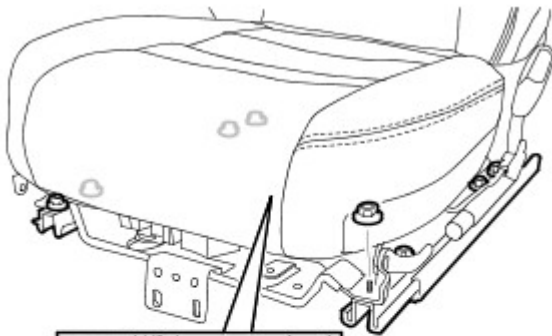
- Remove the 6 nuts.



E55968

6. Remove the front seat track motor.

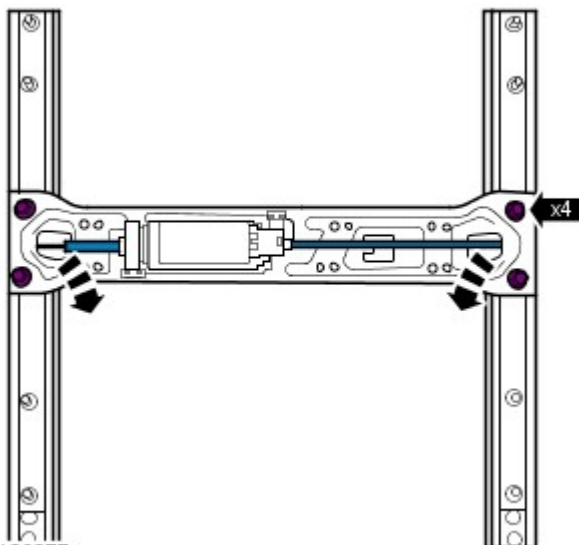
- Disconnect the electrical connector.
- Release the electrical connector.
- Remove the 8 nuts.



E55969

7. Remove the front seat track motor assembly from the seat rails.

- Remove the 4 bolts.
- Release the flexi drive from the seat rails.

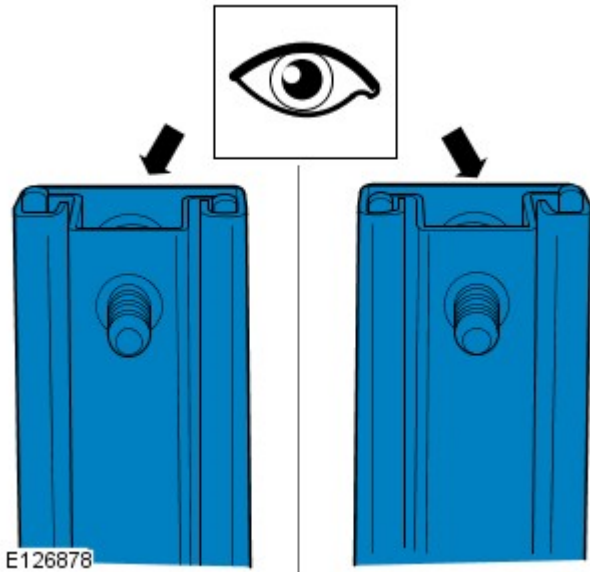


E126877

Installation

1. Make sure the seat rails are installed as a matched pair as supplied.

- Make sure the seat rails are correctly aligned.



2. Install the front seat track motor assembly to the seat rails.

- Install the 4 bolts.
- Tighten the nuts to 10 Nm (7 lb.ft).

3. Install the front seat track motor.

- Tighten the nuts to 22 Nm (16 lb.ft).
- Connect the electrical connector.
- Secure the electrical connector.

4. Install the front seat base.

- Tighten the nuts to 22 Nm (16 lb.ft).

5. Install the front seat base trim.

- Secure in the clips.
- Tighten the screw.

6. Install the front seat cushion side trim.

- Secure in the clips.
- Tighten the screws.

7. Install the seat control switch.

- Secure in the clips.
- Tighten the screws.

8. Install the front seat.

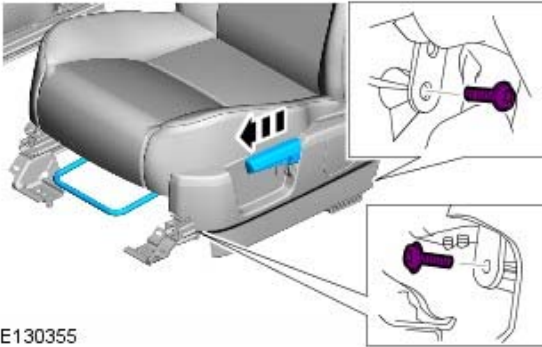
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

Seating - Front Seat Manual Height Adjustment Lever

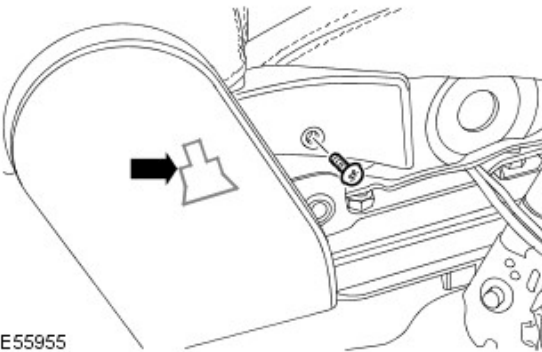
Removal and Installation

Removal

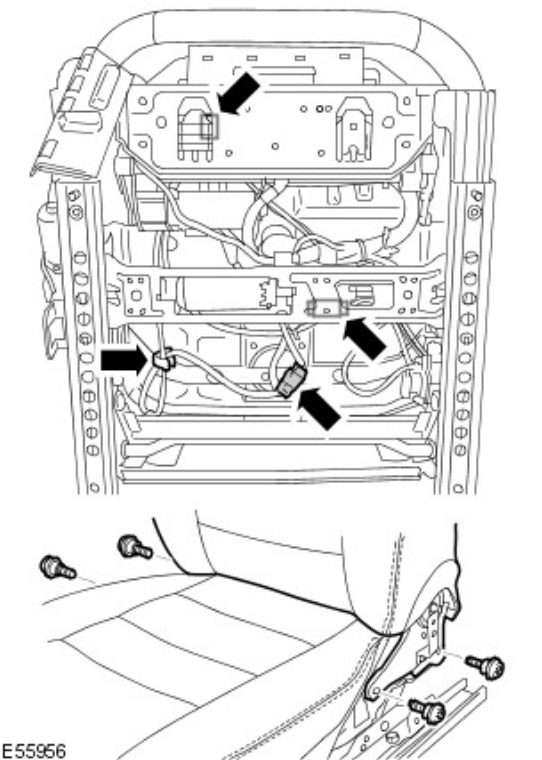
1. Remove the drivers side seat slides.
For additional information, refer to: [Seat Track - Vehicles With: Power Seats](#) (501-10 Seating, Removal and Installation).
2. Remove the front seat cushion base.
For additional information, refer to: [Front Seat Cushion](#) (501-10 Seating, Removal and Installation).
- 3.



4.



5. TORQUE: 25 Nm



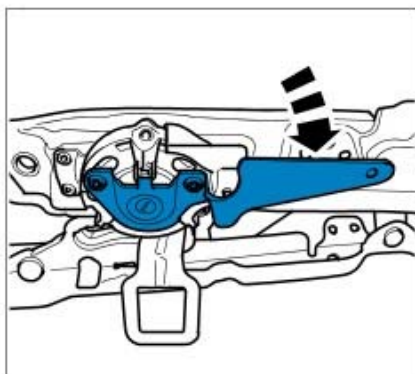
6. CAUTIONS:

 Tie straps must be fitted, failure to follow this instruction may result in personal injury.

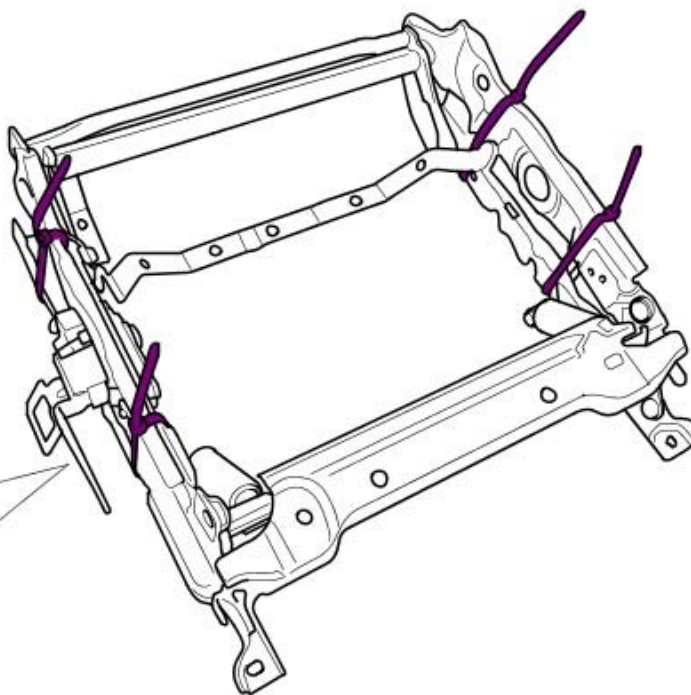
 Failure to follow this instruction may cause damage to the vehicle.

Secure the seat base using the 4 tie straps supplied, as shown.

- Using the seat height adjuster, lower the seat base to its lowest position.

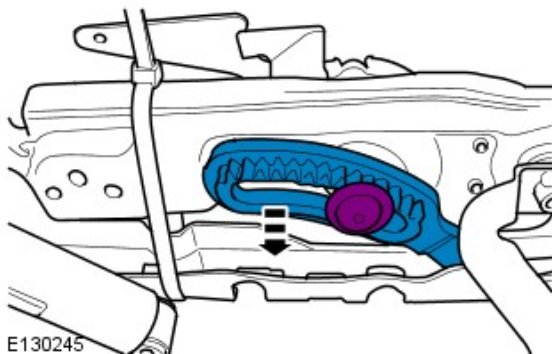


E130243



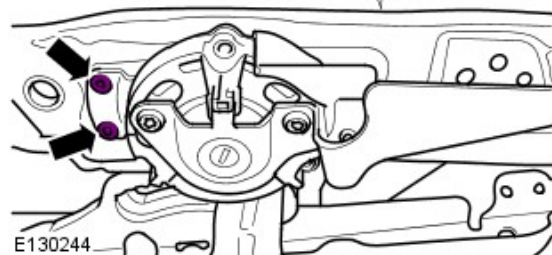
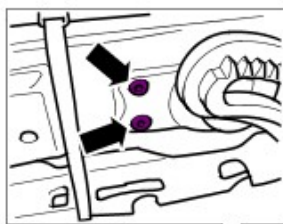
7. Release the arm from the height adjuster.

- Remove the Torx bolt.



E130245

8. Drill out the 4 rivets.



E130244

Installation

1. To install, reverse the removal procedure.

Glass, Frames and Mechanisms -**Sealants**

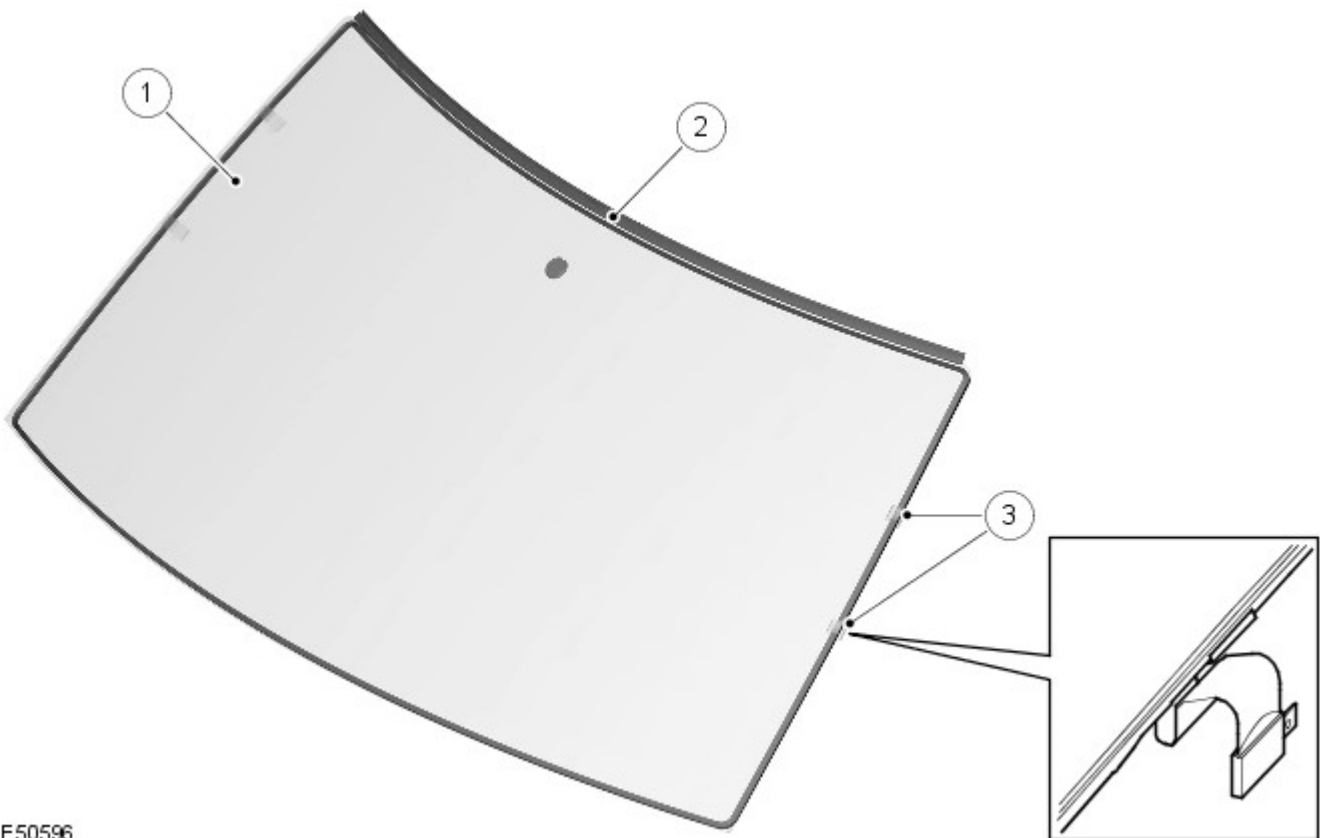
Application	Land Rover Sealant kit Part No.
Windshield	CES 500020
Liftgate glass	CES 500020
Glass roof panel	CES 500020
Rear quarter window glass	CES 500020

Torque Specifications

Description	Nm	lb-ft
Rear door window fixed glass Torx screw	10	7
Rear door window motor and regulator to door nuts and bolts	10	7
Front door window regulator and motor nuts and bolts	10	7
Front door window glass guide channel bolt	10	7
Liftgate glass retaining nuts	25	18

Glass, Frames and Mechanisms - Glass, Frames and Mechanisms

Description and Operation



E50596

Item	Part Number	Description
1.	-	Front screen
2.	-	Finisher
3	-	Heated front screen connectors

FRONT SCREEN

The laminated front screen is bonded, and sealed, to the body aperture using PU sealant. Heat bonded to the inner surface of the screen is the optical unit for the rain sensor and the interior mirror mounting boss.

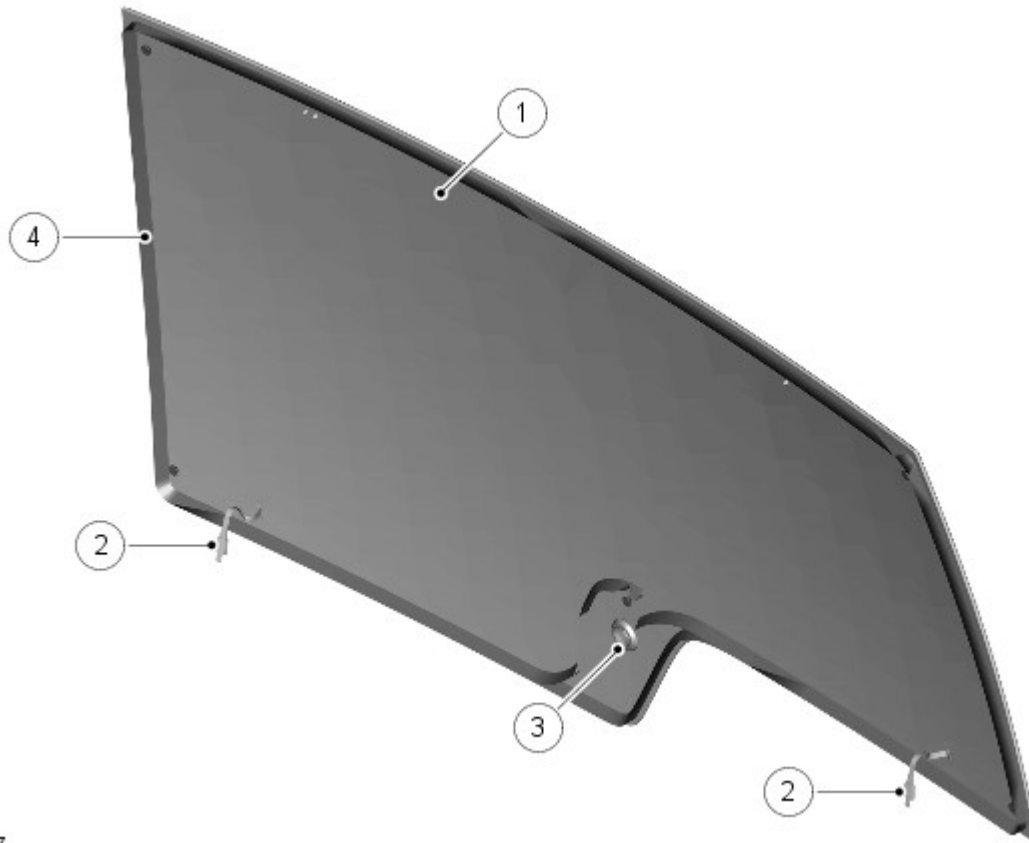
Vertical fine-wire multi-strand elements are fitted between the glass laminations to de-ice and demist the screen. At the bottom of the screen six horizontal heating elements bonded to the interior glass surface prevent the wiper blades freezing to the screen during adverse weather conditions.

For additional information, refer to: Control Components (412-04 Control Components, Description and Operation).

The screen is supplied with the heating element flat foil connectors fitted to a moulded sealed terminal block. This terminal block is wired to a connector for connecting to the vehicle harness.

REAR SCREEN

Rear Screen Components



E50597

Item	Part Number	Description
1.	-	Rear screen
2.	-	Heated rear screen connectors
3	-	Rear wiper motor aperture
4	-	Sealant

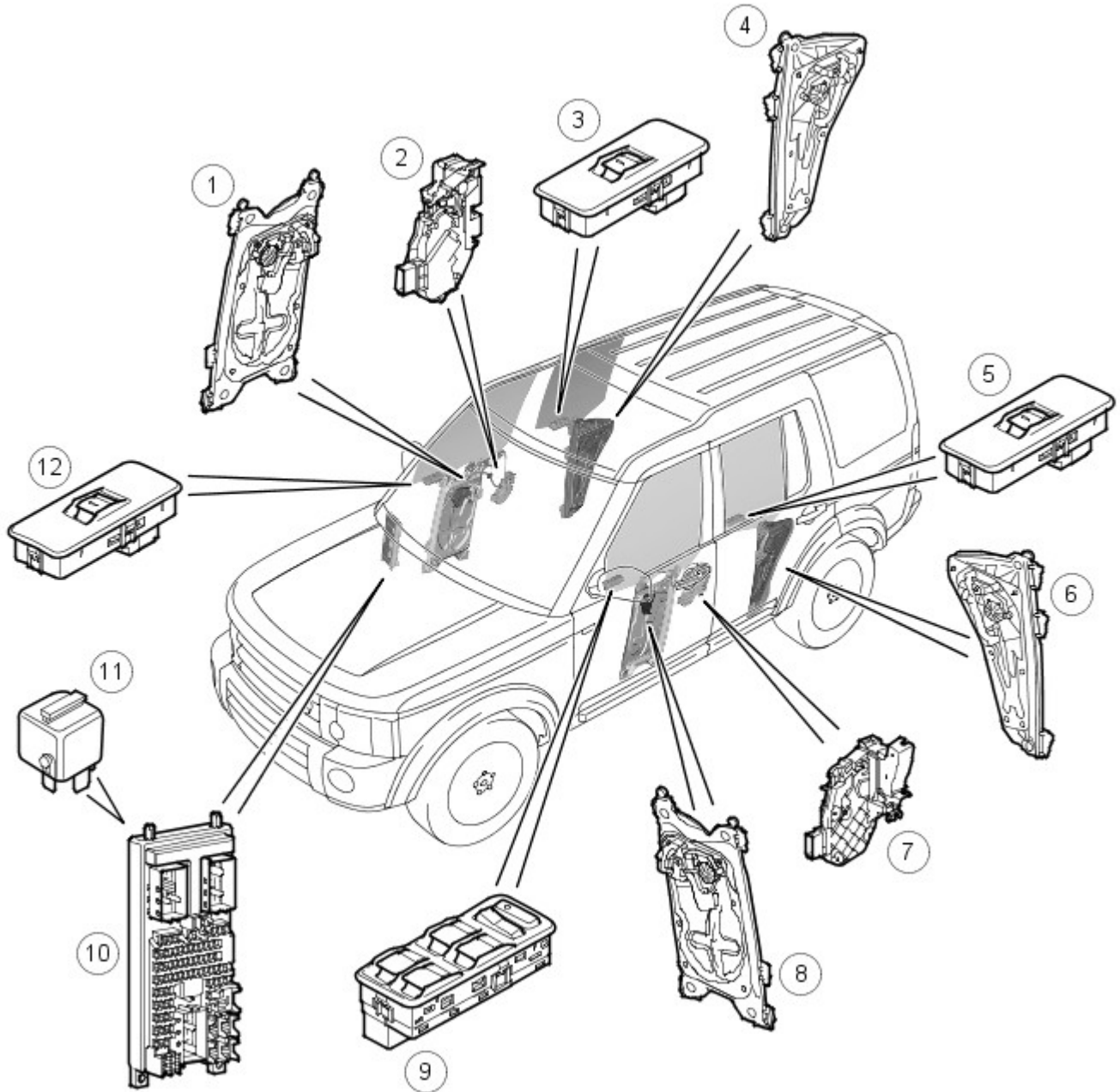
The tempered glass tinted green rear window is bonded to the upper tail doorframe using PU sealant. Fitted to the inner surface of the rear screen are the heating elements and an extra FM antenna for diversity tuning, if fitted. For additional information, refer to: Antenna (415-02 Antenna, Description and Operation).

The heating element is connected by 2 lucar terminals while the antenna is connected to the vehicle by a twin and single stud connector at the top of the screen. For additional information, refer to: Control Components (412-04 Control Components, Description and Operation).

WINDOW REGULATOR CONTROL

Windows Component Location

- NOTE: LH drive shown, RH drive similar.



E47512

Item	Part Number	Description
1	-	Passenger front window motor
2	-	Front passenger door latch (ajar switch)
3	-	RH rear window switch
4	-	RH rear window motor
5	-	LH rear window switch
6	-	LH rear window motor
7	-	Drivers door latch (ajar switch)
8	-	Drivers window motor
9	-	Drivers window switch pack
10	-	Central Junction Box (CJB)
11	-	Window lift relay
12	-	Passenger front window switch

GENERAL

Electric windows are installed in all four doors. The drivers front window incorporates a self-contained 'Anti-trap' regulator, which features one-shot up and one-shot down functionality. All the passenger windows are hard wired and are powered via the window lift relay in the Central Junction Box (CJB). The one-shot and one-shot down feature is also fitted to the front passenger window of vehicles from 2007 model year onwards .

Should any of the passenger windows have opposing up/down requests from two separate switches, for example, the drivers door switch and the switch on the operating window, then the operation of that window will cease, until one or both of the switches are released.

System Inputs and Outputs

Inputs	Outputs
Ignition switch	CJB window enable signal
Drivers door switch pack	CJB window power feeds
Front passenger door window switch	Front window lift motors (LH and RH)
Rear passenger door window switch (LH and RH)	Rear window lift motors (LH and RH)
Drivers door ajar switch	-
Front passenger door ajar switch	-

IGNITION SWITCH

The window lift system is enabled during ignition switch positions I and II, but disabled during cranking.

T4 can be used to monitor the state of the ignition switch.

WINDOW SWITCHES

Individual window switches are installed in each of the three passenger doors. Window switches for all of the windows, are installed in the drivers door in the top surface of the door trim.

All window switches are of the non-latching rocker type and contain illumination bulbs that operate when the side lamps or headlamps are on.

The drivers window switch (and passenger window switch from 2007 model year onwards) has two switching positions in each direction, inch up/down and one-shot up/down. Operating the switch to the second detent position will activate the one-shot feature. All the passenger windows have conventional power motors, providing an inch up/down operation whilst the corresponding switch is held.

When the switches in the drivers door are used to operate the passenger windows or to isolate the rear windows, the drivers door switch pack outputs a signal to the relevant window regulator. While the isolator is engaged, the rear regulators ignore inputs from the rear window switches, and the drivers door switch pack illuminates a LED in the isolator switch.

With the switches in the rest position, there is battery voltage at both sides of each switch as well as at the window motors. Operating any switch provides a ground path through the switch to the window motor. Operating the switch in the opposite direction switches the voltage path and the earth path to the motor allowing the motor to run in the opposite direction.

Power for window operation is supplied from the window lift relay located in the CJB. When energised, the window lift relay provides feed to the following fuses, which are also located in the CJB:

- 30 (25 Amps)
- 17 (20 Amps)
- 31 (20 Amps).

Fuse	Description
Fuse 7	Drivers window regulator
Fuse 17	Drivers switch pack, RH rear - up/down RH rear window switch via isolator
Fuse 30	Drivers switch pack, front passenger - up/down Front passenger switch - up/down
Fuse 31	Drivers switch pack, LH rear - up/down LH rear window switch via isolator

Driver's Door Window Switch Pack Pin Out Information

Connector C0081

Pin No.	Description	Input/Output
1	Front passenger window down	Output
2	Front passenger window up	Output
3	Front passenger battery power supply	Input
4	Front drivers window down	Output
5	Front drivers window up	Output
6	Ground	-

Connector C0343

Pin No.	Description	Input/Output
1	Rear LH battery power supply	Input
2	Rear RH passenger window down	Output
3	Rear RH passenger window up	Output
4	Rear RH battery power supply	Input
5	Rear LH passenger window down	Output
6	Rear LH passenger window up	Output
7	Switch illumination	Input
8	Ground	-

Connector C2654

Pin No.	Description	Input/Output
1	Not used	-
2	Rear RH battery power supply via isolator switch	Input
3	Not used	-
4	Not used	-
5	Not used	-

Pin No.	Description	Input/Output
6	Rear LH battery power supply via isolator switch	Input
7	Child lock status LED	Input
8	Child lock switch	Output

Front Passenger's Door Window Switch Pin Out Information

Connector C0087

Pin No.	Description	Input/Output
1	Up power supply from drivers door switch pack	Input
2	Up power supply to window regulator	Output
3	Down power supply from drivers door switch pack	Input
4	Not used	-
5	Switch illumination ground	-
6	Switch illumination power supply	Input
7	Down power supply to window regulator	Output
8	Power supply from drivers door switch pack	Input

Rear Passenger's Door Window Switch Pin Out Information

Connector C0732

Pin No.	Description	Input/Output
1	Up power supply from drivers door switch pack	Input
2	Up power supply to window regulator	Output
3	Down power supply from drivers door switch pack	Input
4	Not used	-
5	Switch illumination ground	-
6	Switch illumination power supply	Input
7	Down power supply to window regulator	Output
8	Power supply from drivers door switch pack	Input

T4 can not be used to monitor the state of the window switches because they are part of a hard wired circuit.

FRONT DOOR AJAR SWITCHES

Window operation is immediately disabled when a front door is opened during a 40 second timeout period. The door ajar switches are located in the front door latch mechanisms.

T4 can be used to monitor the state of the front door ajar switches.

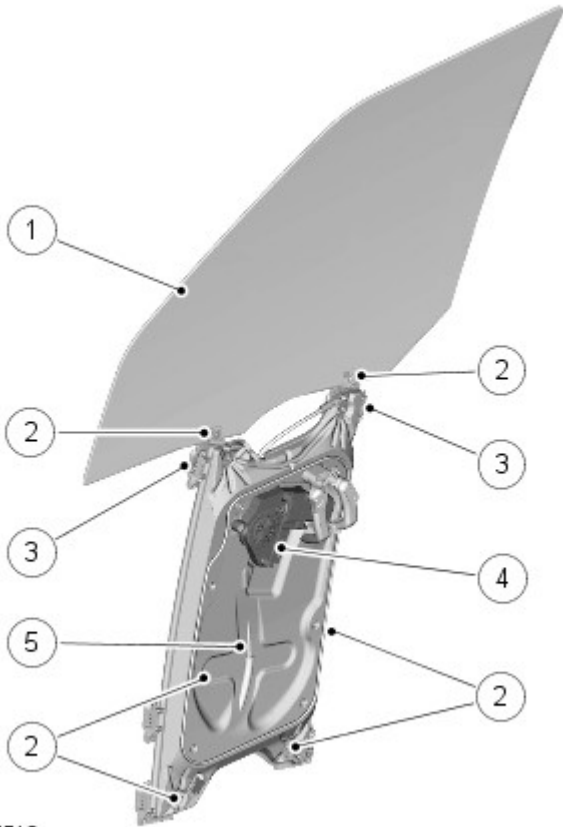
ENABLE LINES

The use of enable lines limits the windows to operate when the ignition switch is in position I or II, and for a period of forty seconds once the ignition has been switched off. If the drivers door or the front passenger door is opened within the forty second period, window operation will be disabled. No window operation is possible during vehicle cranking.

WINDOW REGULATORS

Cable operated window regulators powered by an electric motor are installed in each of the doors.

Front Window Regulators



E47513

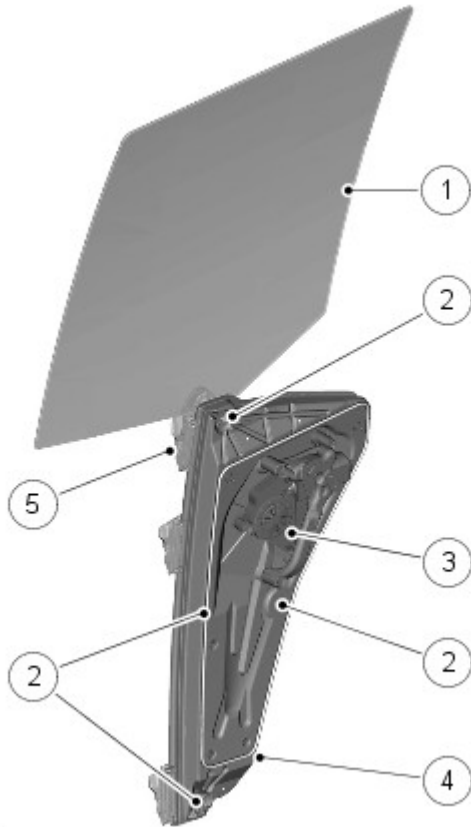
Item	Part Number	Description
1	-	Window Glass
2	-	Fixing points
3	-	Glass carrier
4	-	Window motor
5	-	Mounting frame
6	-	Cable

The front window regulator and motor is supplied as an assembly and is handed. Each assembly comprises a front and rear runner, a continuous cable and a motor.

The runners are secured in the door frame with four screws. The door glass is located in two carriers, which are located in tracks in the runners. The glass is retained in friction pads in each carrier and secured with clamp screws.

Each carrier is attached to the cable which, in turn, is attached to a drum driven by the motor. When the motor is operated the drum pulls the cable in the required direction to raise or lower the glass.

Rear Window Regulators



E47514

Item	Part Number	Description
1	-	Window Glass
2	-	Fixing points
3	-	Window motor
4	-	Mounting frame
5	-	Glass carrier

The rear window regulator and motor is supplied as an assembly and is handed. Each assembly comprises a runner, a continuous cable and a motor.

The runner is secured in the door frame with four bolts. The door glass is located in a carrier located in a track in the runner. The glass is retained in friction pads in the carrier and secured with a clamp screw.

The carrier is attached to the cable which, in turn, is attached to a drum driven by the motor. When the motor is operated, the drum pulls the cable in the required direction to raise or lower the glass.

ANTI-TRAP

The anti-trap function is enabled for the drivers window closing in both the inching and one-shot modes. If the anti-trap feature is activated while a window is closing, the window motor is reversed for 0.5 second.

A Hall sensor, located in the drivers window regulator, monitors the speed of the motor and if the speed decreases below a set threshold, indicating an obstruction, the power feed to the motor is reversed so the window goes back down.

In an emergency the anti-trap function can be overridden by holding the window switch in the one-shot closed position.

After the battery has been disconnected it is necessary to initialize the drivers door window motor to be able to operate the one-shot up function.

Driver's Door Window Motor Initialisation

- Operate the drivers window switch until the window glass is in the fully closed position, continue to operate the window switch for a further two seconds
- Release the window control switch
- Operate the drivers window switch in the closed position and continue to operate the window switch for a further two seconds
- Operate the drivers window switch until the window is in the fully open position (one-shot down)

• NOTE: If the drivers window motor initialisation has been completed correctly, when the drivers window switch is operated, the window should move to the fully closed position (one-shot up) automatically. If the window does not fully close automatically (one-shot up), repeat the complete procedure.

- Operate the drivers window switch once to the close position.

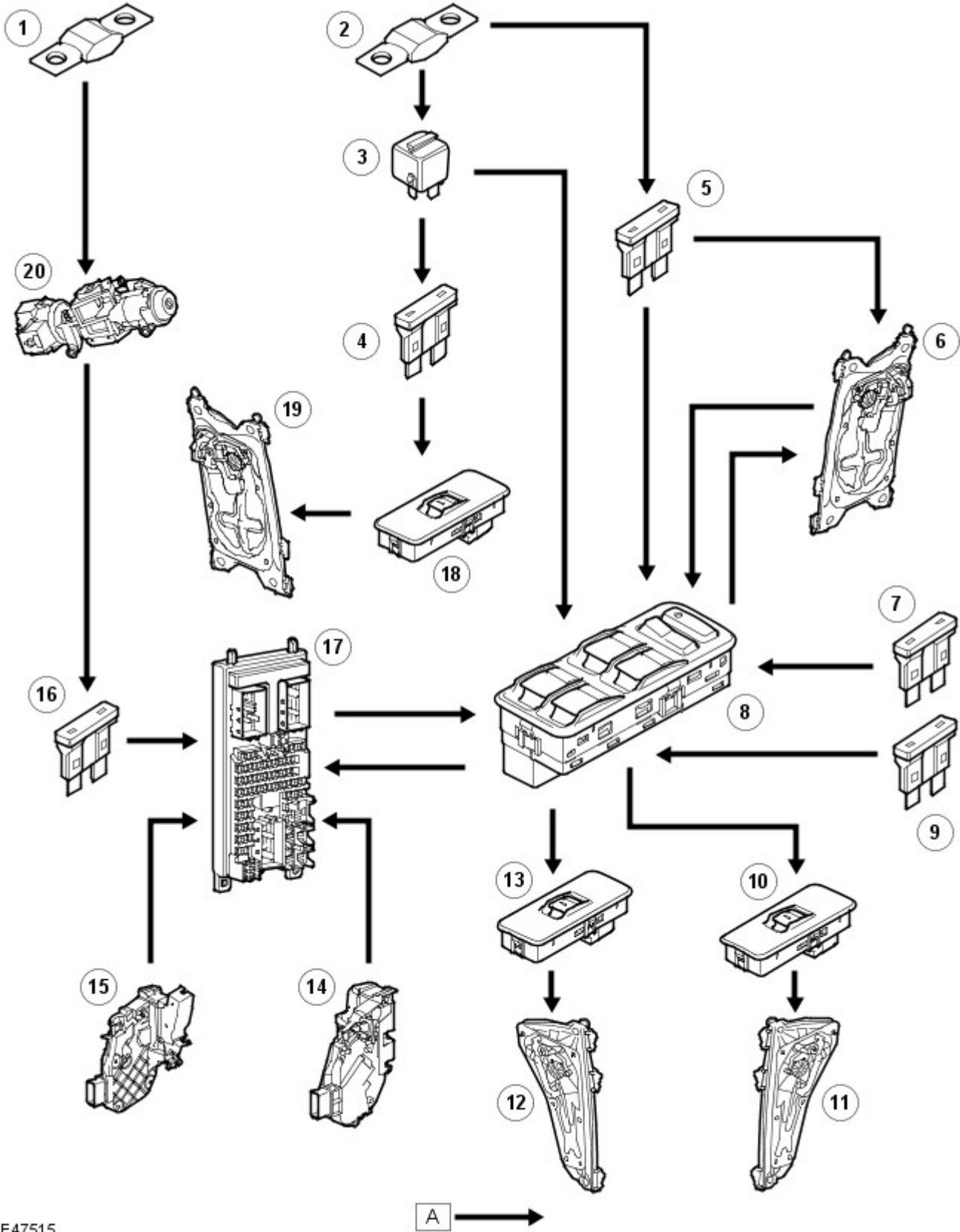
Driver's Door Anti-trap Regulator Pin Out Information

Connector C0740

Pin No.	Description	Input/Output
1	Up signal	Input
2	Down signal	Input
3	Battery supply	Input
4	Ground	-
5	Not used	-
6	Enable line	Input

WINDOW CONTROL DIAGRAM

• NOTE: A = Hardwired



Item	Part Number	Description
1	-	Fusible link 11
2	-	Fusible link 18
3	-	Window lift relay
4	-	Fuse 30
5	-	Fuse 7
6	-	Drivers window motor
7	-	Fuse 31
8	-	Drivers window switch pack
9	-	Fuse 17
10	-	RH rear window switch
11	-	RH rear window motor
12	-	LH rear window motor
13	-	LH rear window switch
14	-	Drivers door latch (ajar switch)
15	-	Passengers front door latch (ajar switch)
16	-	Fuse 60
17	-	Central Junction Box (CJB)
18	-	Passenger front window switch
19	-	Passenger front window motor
20	-	Ignition switch

Glass, Frames and Mechanisms - Glass, Frames and Mechanisms

Diagnosis and Testing

Principle of Operation

For a detailed description of the glass, frames and mechanisms and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Glass, Frames and Mechanisms](#) (501-11 Glass, Frames and Mechanisms, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Window control switches condition and installation ● Window motors/regulators ● Window channels/runners ● Window cables ● Door window glass retaining brackets 	<ul style="list-style-type: none"> ● Fuses ● Harnesses and connectors ● Window lift relay ● Window control switches ● Window motors

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Window(s) inoperative	<ul style="list-style-type: none"> ● Fuse(s) ● Switch fault ● Front switch isolator fault ● Motor/Regulator fault ● Channel/Runner fault ● Cable fault ● Harness fault 	<ul style="list-style-type: none"> ● Check the fuses. Check the suspect window operation from the individual door switch and from the driver door master switch (it is unlikely that both switches would fail at the same time, so if the window is inoperative from either switch, suspect a fault other than a switch). If the inoperative window is a rear unit, check the function of the isolator at the master switch. ● If the concern persists and a noise cannot be heard when operating the door window glass, GO to Pinpoint Test B.
Window(s) 'one-shot' function inoperative	<ul style="list-style-type: none"> ● Window motor initialization required ● Switch fault 	<ul style="list-style-type: none"> • NOTE: Do not install a new door window regulator motor for this concern. <p>If the battery has been disconnected, carry out the initialization procedure. REFER to: Door Window Motor Initialization (501-11 Glass, Frames and Mechanisms, General Procedures). Check the switch function after initialization.</p>
Rear window does not defrost	<ul style="list-style-type: none"> ● Fuse ● Switch fault ● Relay fault ● Element fault ● Circuit fault 	Check fuse. Check the operation of the heated rear window switch and relay. Check the element for continuity. Check the heated rear window circuit. Refer to the electrical guides.
Window(s) noisy during operation	<ul style="list-style-type: none"> ● Channel/Runner fault ● Cable fault ● Motor/Regulator fault 	<ul style="list-style-type: none"> • NOTE: Door window glass retaining bracket adjustment procedure <p>GO to Pinpoint Test A.</p>
Slow or partial window operation	<ul style="list-style-type: none"> ● Fuse ● Switch fault ● Relay fault ● Element fault ● Circuit fault 	GO to Pinpoint Test C.
Rear door window glass bounce back	<ul style="list-style-type: none"> ● Window motor initialization required (using the manufacturers approve diagnostic system) 	<ul style="list-style-type: none"> • NOTE: Do not install a new door window regulator motor for this concern. <p>Refer to IDS/SDD.</p>

Symptom	Possible Causes	Action
Front door window glass bounce back	<ul style="list-style-type: none"> Window motor initialization required Channel/Runner fault 	<ul style="list-style-type: none"> NOTE: Do not install a new door window regulator motor for this concern. GO to Pinpoint Test D .

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Door Module \(DDM/PDM\)](#) (100-00 General Information, Description and Operation).

Pinpoint Test

PINPOINT TEST A : WINDOW(S) NOISY DURING OPERATION	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: CHECK THE DOOR WINDOW GLASS IS SECURE	
	<ol style="list-style-type: none"> Remove the door window glass outer waist seal. Check if the door glass installed correctly and secured to the door window regulator.
	Is the door window glass correctly installed and secure? Yes GO to A2 . No Install a new door window glass as necessary. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).
A2: CHECK THE OPERATION OF THE DOOR WINDOW REGULATOR MOTOR	
	<ol style="list-style-type: none"> Remove the door window glass as necessary. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation). Operate the door window regulator four times.
	Does the door window regulator operate correctly (without noise)? Yes Ensure that an anti-rattle pad (available from the parts department) is installed to the door window glass retaining bracket and installed correctly. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation). Test the system for normal operation. If the concern persists, GO to A3 . No Install a new door window regulator motor as necessary. REFER to: Front Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation).
A3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL	
	<ol style="list-style-type: none"> Check for any foreign material or obstruction in the door window glass seal.
	Is the door window glass seal free from foreign material? Yes GO to A4 . No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.
A4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY	
	<ol style="list-style-type: none"> Check that the door window glass seal is installed correctly.
	Is the door window glass seal installed correctly? Yes GO to A5 . No Install the door window glass seal correctly. Test the system for normal operation.
A5: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS	
	<ol style="list-style-type: none"> Visually check that the door window glass seal is not worn in the door channels.
	Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No Install the door window glass and adjust the door window glass. Test the system for normal operation.
PINPOINT TEST B : WINDOW(S) INOPERATIVE (MOTOR NOISE CANNOT BE HEARD)	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: CHECK FOR DOOR WINDOW REGULATOR MOTOR NOISE	
	<ol style="list-style-type: none"> Operate the door window regulator motor as necessary.
	Is there a noise from the door window regulator motor when operated? Yes GO to B2 . No

	<p>Install a new door window regulator motor as necessary. REFER to: Front Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation).</p>
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B2: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL

	<p>1 Check for any foreign material or obstruction in the door window glass seal.</p>
	<p>Is the door window glass seal free from foreign material? Yes GO to B3. No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.</p>

B3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY

	<p>1 Check that the door window glass seal is installed correctly.</p>
	<p>Is the door window glass seal installed correctly? Yes GO to B4. No Install the door window glass seal correctly. Test the system for normal operation.</p>

B4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS

	<p>1 Visually check that the door window glass seal is not worn in the door channels.</p>
	<p>Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No Install the door window glass. Adjust the door window glass referring to the door window glass retaining bracket procedure at the end of this section (see below). Test the system for normal operation. If the concern persists, Test the system for normal operation.</p>

PINPOINT TEST C : SLOW OR PARTIAL WINDOW OPERATION

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: CHECK THE OPERATION OF THE DOOR WINDOW REGULATOR MOTOR	
	<p>1 Remove the door window glass as necessary. REFER to: Front Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation) / Rear Door Window Glass (501-11 Glass, Frames and Mechanisms, Removal and Installation).</p>
	<p>2 Operate the door window regulator as necessary.</p>
	<p>Does the door window regulator operate correctly? Yes GO to C2. No GO to C5.</p>

C2: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL

	<p>1 Check for any foreign material or obstruction in the door window glass seal.</p>
	<p>Is the door window glass seal free from foreign material? Yes GO to C3. No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.</p>

C3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY

	<p>1 Check that the door window glass seal is installed correctly.</p>
	<p>Is the door window glass seal installed correctly? Yes GO to C4. No Install the door window glass seal correctly. Test the system for normal operation.</p>

C4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS

	<p>1 Visually check that the door window glass seal is not worn in the door channels.</p>
	<p>Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No Adjust the door window glass referring to the door window glass retaining bracket procedure at the end of this section (see below). Test the system for normal operation.</p>

C5: CHECK THE VOLTAGE TO THE DOOR WINDOW REGULATOR MOTOR

• NOTE: The door window regulator motor can be removed from the regulator. Install a new door window regulator motor not the complete assembly for this concern.

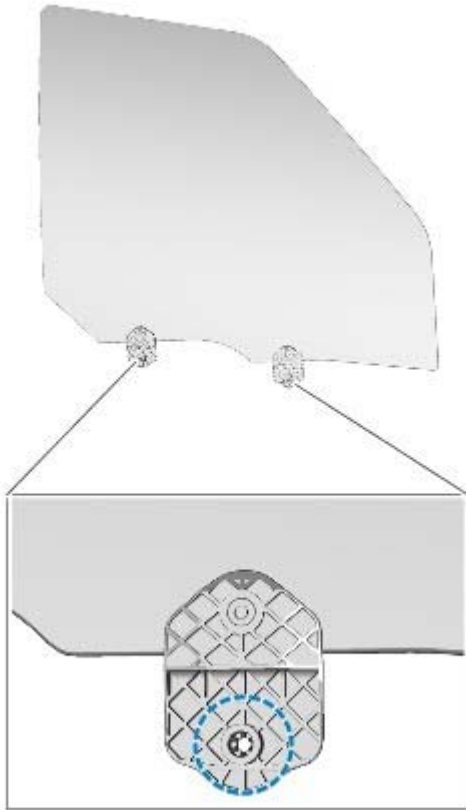
	<p>1 Using a multimeter, check the voltage to the door window regulator motor.</p>
	<p>Is the voltage greater than 10 volts? Yes Install a new door window regulator motor as necessary. No Repair the wiring harness. Test the system for normal operation. If the concern continues, install a new door window regulator motor as necessary.</p>

PINPOINT TEST D : FRONT DOOR WINDOW GLASS BOUNCE BACK

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: CHECK WINDOW MOTOR INITIALIZATION	
	<p>1 Initialize the door window motor. REFER to: Door Window Motor Initialization (501-11 Glass, Frames and Mechanisms, General Procedures).</p>
	<p>Did the initialization work? Yes Test the system for normal operation. No GO to D2.</p>
D2: CHECK THAT THE DOOR WINDOW GLASS SEAL IS FREE FROM FOREIGN MATERIAL	
	<p>1 Check for any foreign material or obstruction in the door window glass seal.</p>
	<p>Is the door window glass seal free from foreign material? Yes GO to D3. No Remove any foreign material from door window glass seal and lubricate the seal. Test the system for normal operation.</p>
D3: CHECK THAT THE DOOR WINDOW GLASS SEAL IS INSTALLED CORRECTLY	
	<p>1 Check that the door window glass seal is installed correctly.</p>
	<p>Is the door window glass seal installed correctly? Yes GO to D4. No Install the door window glass seal correctly. Test the system for normal operation.</p>
D4: CHECK THAT THE DOOR WINDOW GLASS SEAL IS NOT WORN IN THE CHANNELS	
	<p>1 Visually check that the door window glass seal is not worn in the door channels.</p>
	<p>Is the door window glass seal worn in the channels? Yes Install a new door window glass seal as necessary. Test the system for normal operation. No GO to D5.</p>
D5: CHECK THE DOOR WINDOW GLASS IS SECURE	
	<p>1 Remove the door window glass outer waist seal.</p>
	<p>2 Check if the door glass installed correctly and secured to the door window regulator.</p>
	<p>Is the door window glass correctly installed and secure? Yes Test the system for normal operation. No Adjust the door window glass referring to the door window glass retaining bracket procedure in this procedure. Test the system for normal operation. If the concern persists, install a new door window regulator motor as necessary. REFER to: Front Door Window Regulator and Motor (501-11 Glass, Frames and Mechanisms, Removal and Installation).</p>

Door window glass retaining bracket adjustment procedure

1. **1.** Remove the door window glass as necessary.
REFER to: [Front Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation) / [Rear Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
2. **2.** Check for any foreign material or obstruction in the door window glass seal and channels. Clean all areas prior to adjustment to allow correct alignment.
3. **3.** Release but do not remove the door window glass retaining bracket(s) bolt(s).
4. **4.** Push the door window glass retaining bracket(s) to the edge of the door window glass to achieve minimum parallel gap.
5. **5.** Tighten the door window glass retaining bracket(s) bolt(s).
 - Tighten the retaining bolt(s) to 6Nm.

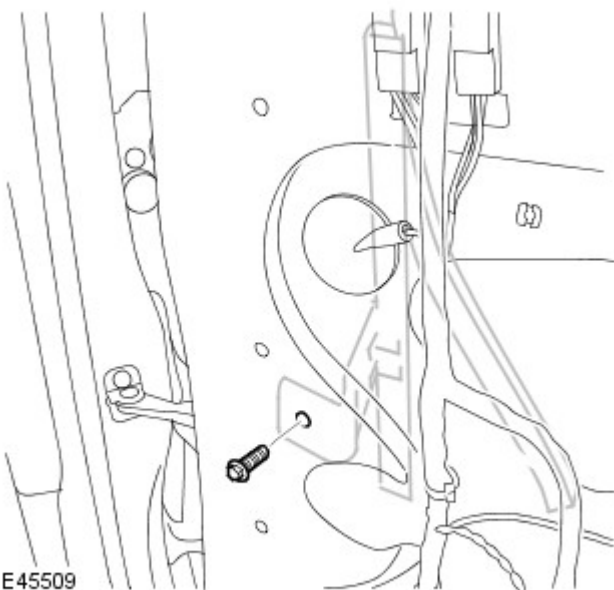


E136430

6. **6.** Apply lubricate (RYL500010) to the lower part of the door window glass retaining brackets prior to installation of the door window glass.
7. **7.** Install the door window glass as necessary.
REFER to: [Front Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation) / [Rear Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
8. **8.** Check the system for normal operation.

Door glass channel setting procedure

1. **1.** Remove the door trim panel as necessary.
REFER to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Rear Door Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



E45509

2. • **NOTE:** Do not remove the door window glass channel.
2. Release the door window glass channel retaining bolt.
3. **3.** Lower the door window glass.

4. **4.** Tighten the door window glass channel retaining bolt.
5. **5.** Check the system for normal operation.

Glass, Frames and Mechanisms - Door Window Motor Initialization

General Procedures

1. NOTE: After the battery has been disconnected it is necessary to initialize each door window motor separately to operate the "one-touch" up function.

• **NOTE:** Make sure a minimum of 2 minutes from initial disconnect of battery has elapse prior to reconnecting the battery. The initialising of the window glass motor must be conducted with the engine running.

Operate the window control switch until the door window glass is in the fully closed position, continue to operate the window control switch for a further two seconds.

2. Release the window control switch.

3. Operate the window control switch in the closed position and continue to operate the window control switch for a further two seconds.

4. Operate the window control switch until the door window glass is in the fully open position ("one-touch" down).

5. NOTE: If the door window motor initialization has been completed correctly, when the window control switch is operated, the door window glass should move to the fully closed position ("one-touch" up) automatically.

• **NOTE:** If the door window glass does not fully close automatically ("one-touch" up), repeat the complete procedure.


Operate the window control switch once to the close position.

6. Repeat the door window motor initialization for each door window motor.

Glass, Frames and Mechanisms - Front Door Window Glass

Removal and Installation

Special Tool(s)

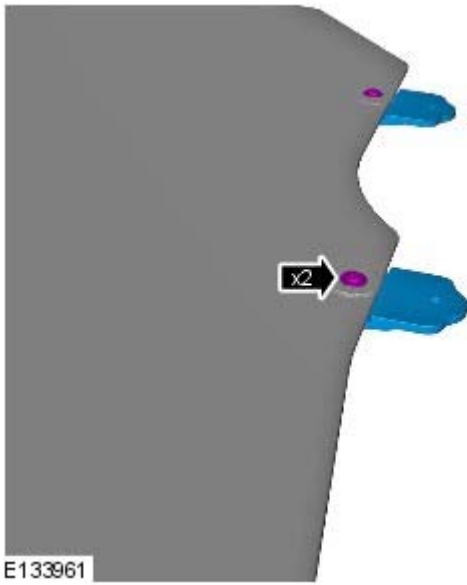
 <p>501-114</p> <p>E54200</p>	<p>501-114 Release Lever, Door Glass</p>
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Removal

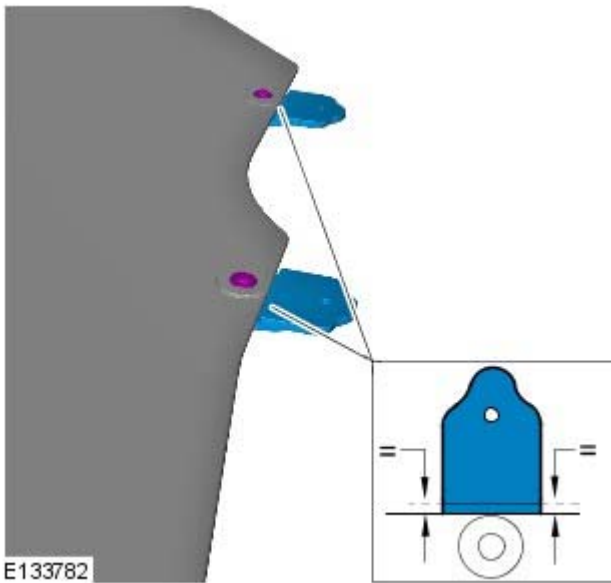
1. *Special Tool(s):* [501-114](#)




2.

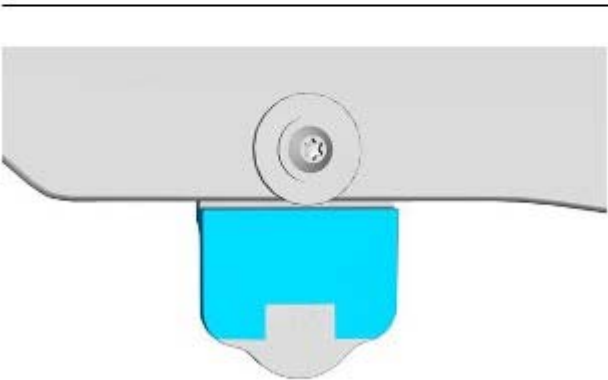
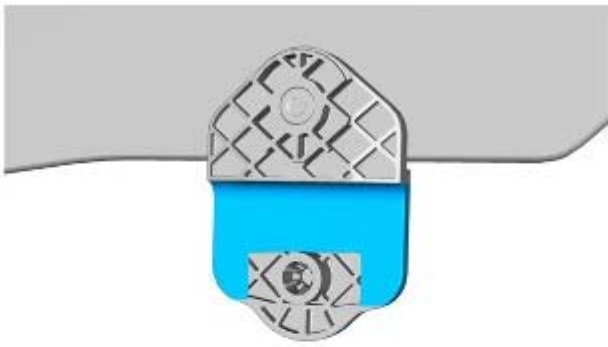


Installation




1.  **CAUTION:** Make sure that the door glass retaining brackets are pushed to the edge of the door window glass to achieve minimum parallel gap.
- **NOTE:** This operation must be done for both retaining brackets.


Torque: 6 Nm



E140674

2. **2. CAUTIONS:**

 Make sure that any grease or lubricant is removed from the retaining brackets prior to installation of the anti-rattle pads.

 Make sure that the anti-rattle pad is installed in the orientation illustrated.

• **NOTE:** This operation must be done for both retaining brackets.

3. To install, reverse the removal procedure.

Glass, Frames and Mechanisms - Rear Door Window Glass

Removal and Installation

Removal

• NOTE: Once the rear door window fixed glass has been removed the rear door glass can be simply lifted and removed from the door.

• NOTE: The door glass should be lowered by approximately one third.

1. Remove the rear door window fixed glass.
For additional information, refer to: [Rear Door Fixed Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

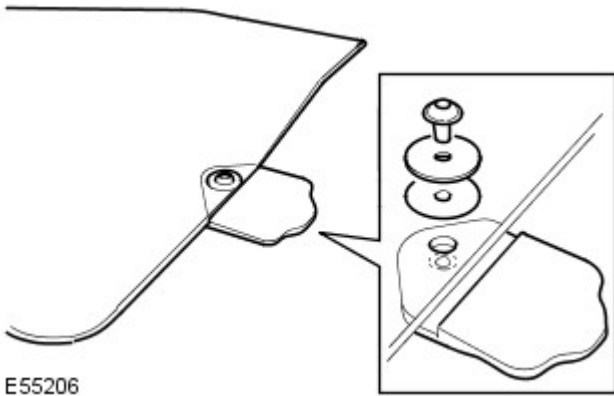
2. Remove the rear door window glass.

3. NOTE: Do not disassemble further if the component is removed for access only.

• NOTE: Note the fitted position.

Remove the glass retaining clip.

- Remove the Torx bolt.
- Remove the spacer washer.
- Remove the flat washer.



Installation

1. Install the glass retaining clip.

- Install the spacer.
- Install the washer.
- Tighten the Torx screws to 8 Nm (6 lb.ft).

2. Install the rear door window glass.

3. Install the rear door window fixed glass.

For additional information, refer to: [Rear Door Fixed Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

Glass, Frames and Mechanisms - Liftgate Window Glass

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



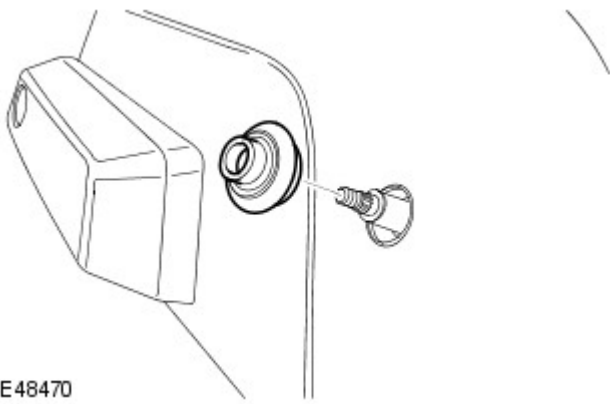
Always protect the interior components when removing body glass.



Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

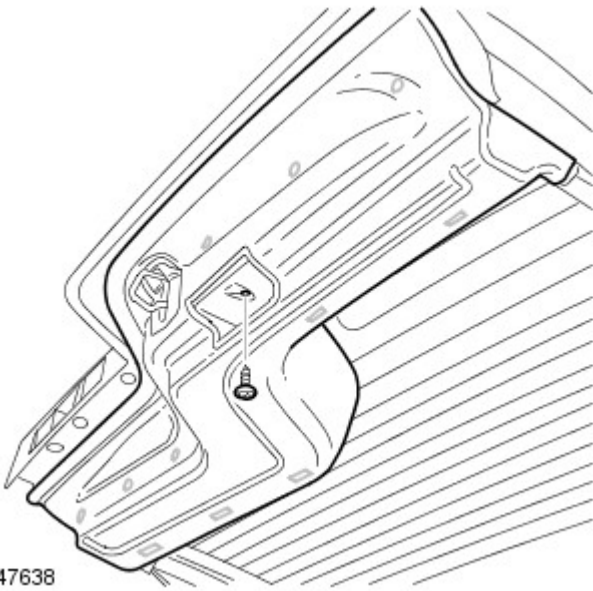
• NOTE: The following equipment is required: | Cutting wire and handles | Kent knife | Glazing knife | Glass replacement kit | Sealant applicator gun | Suction cups | A felt covered table or stand to support glass

1. Remove the rear wiper arm.
For additional information, refer to: [Rear Wiper Pivot Arm](#) (501-16 Wipers and Washers, Removal and Installation).
2. Remove the rear wiper drive spindle seal.



E48470

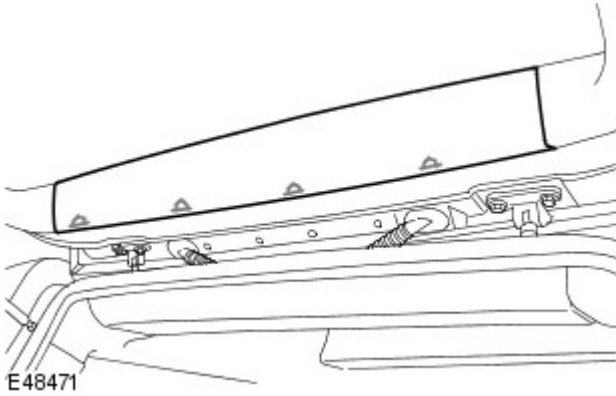
3. Remove the liftgate lower trim panel.
For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ormentation, Removal and Installation).



E47638

4. Remove the liftgate upper trim panel.

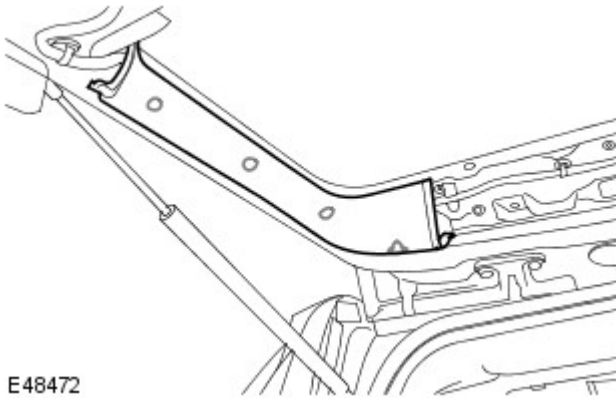
- Release the 4 clips.



E48471

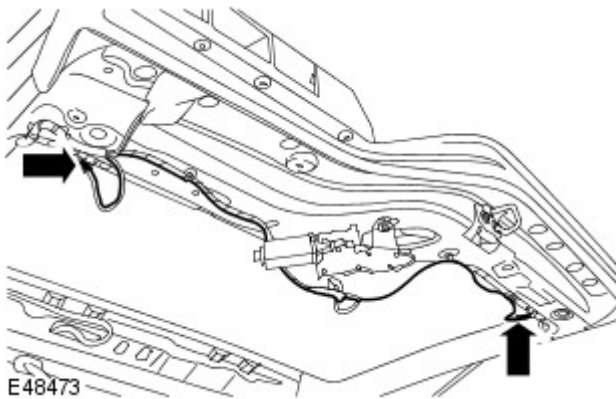
5. Remove the liftgate side trim panel.

- Release the 4 clips.
- Repeat the above procedure for the other side.



E48472

6. Disconnect both heated rear window electrical connectors.

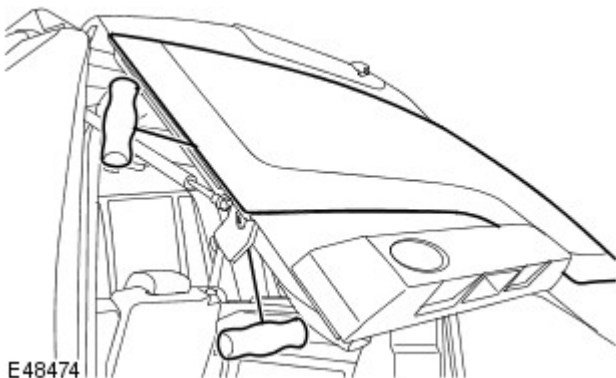


E48473

7.  **WARNING:** Eye protection must be worn.

With assistance, remove the liftgate window glass.

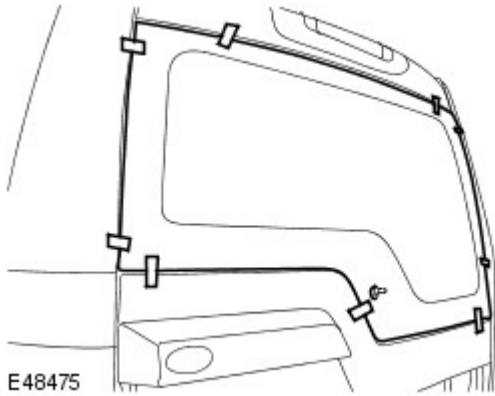
- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 5 spacers.



E48474

Installation

1. Carefully remove the sealant from the body to leave a smooth surface.



2. Install the liftgate window glass.

- Install the spacers equally as shown.
- Use masking tape to establish reference marks as an alignment aid.

3. Remove the liftgate window glass.

- Clean the component mating faces.

4. Apply etch primer to any bare metal.

5. Apply primer over the etch primer.

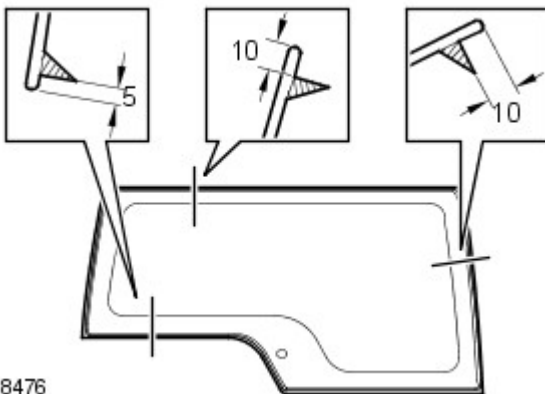
6. Apply glass primer to the sealant face on the liftgate window glass and allow to cure.

7. Apply activator over the old sealant on the liftgate and allow to cure.

8. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.

- Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.

9. Apply a continuous bead of sealant to the liftgate window glass as shown.



10. With assistance, install and align the liftgate window glass.

- Lightly press the window glass to seat the sealer.

11. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.

12. Connect the heated rear window electrical connectors.

13. Install the liftgate side trim panel.

- Secure with the clips.
- Repeat the above procedure for the other side.

14. Install the liftgate upper trim panel.

- Secure with the clips.

15. Install the liftgate lower trim panel.

For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and

Installation).

16. Install the rear wiper drive spindle seal.

17. Install the rear wiper arm.

For additional information, refer to: [Rear Wiper Pivot Arm](#)
(501-16 Wipers and Washers, Removal and Installation).

Glass, Frames and Mechanisms - Rear Door Fixed Window Glass

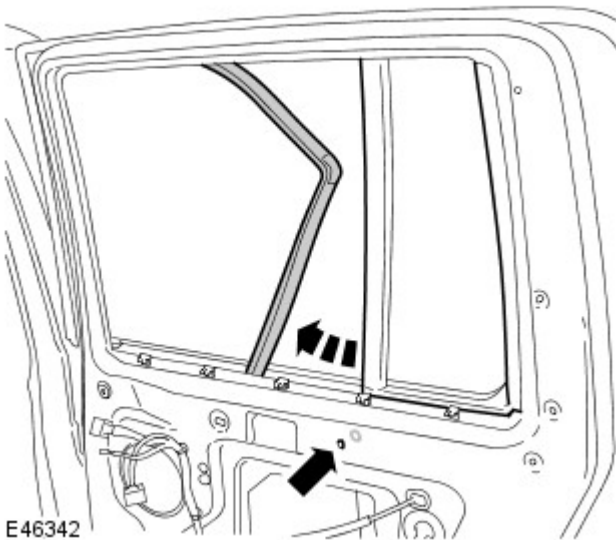
Removal and Installation

Removal

1. Remove the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
2. Lower the rear door glass to the bottom of the door.
 - Remove the wedge.
3. Remove the rear door frame trim.
 - Release the 2 clips.
 - Carefully release the door trim.
4. Carefully remove the inner waist seal.



5. Release the lining from the glass rear channel.
6. Remove the rear door window fixed glass.
 - Remove the grommet.
 - Loosen the Torx screw, but do not remove it completely at this stage.
 - Pull the lower edge of the glass forward to release it from the door frame.



Installation

1. Install the rear door window fixed glass.
 - Make sure the locating peg on the fixed glass has engaged with the door frame.
 - Tighten the Torx screw to 10 Nm (7 lb.ft).
2. Install the channel lining.
3. Install the inner waist seal.
4. Install the door frame trim.

- Clean the component mating faces.
- Remove backing tape from adhesive strip.
- Secure the clips.

5. NOTE: Wedge the glass in this position.

Raise the rear door glass fully.

- Engage the door glass with the channel.

6. Install the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

Glass, Frames and Mechanisms - Windshield Glass

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



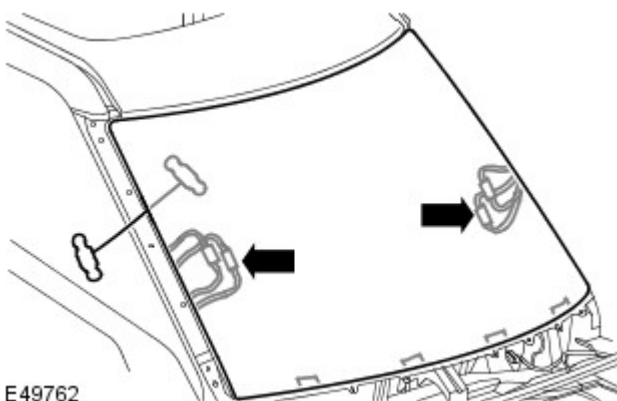
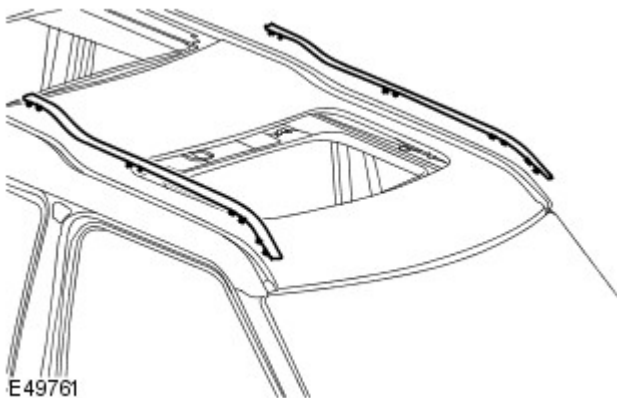
Always protect the interior components when removing body glass.



Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

• NOTE: The following equipment is required: | Cutting wire and handles | Kent knife | Glazing knife | Windshield replacement kit | Sealant applicator gun | Suction cups | A felt covered table or stand to support glass

1. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
2. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the rain sensor.
For additional information, refer to: [Rain Sensor](#) (501-16 Wipers and Washers, Removal and Installation).
4. Remove the roof moulding.
 - Release the 6 clips.
 - Repeat the above procedure for the other side.



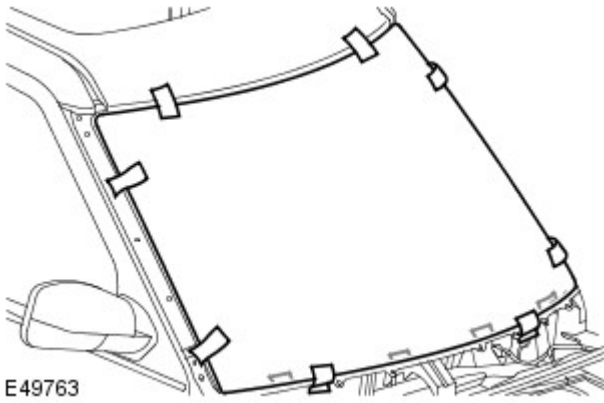
5. **WARNING:** Eye protection must be worn.

With assistance, remove the windshield glass.

- If installed, disconnect the 4 electrical connectors.
- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 4 spacers.

Installation

1. Carefully remove the sealant from the body to leave a smooth surface.



2. Install the windshield glass.

- Install the spacers equally as shown.
- Use masking tape to establish reference marks as an alignment aid.

3. Remove the windshield glass.

- Clean the component mating faces.

4. Apply etch primer to any bare metal.

5. Apply primer over the etch primer.

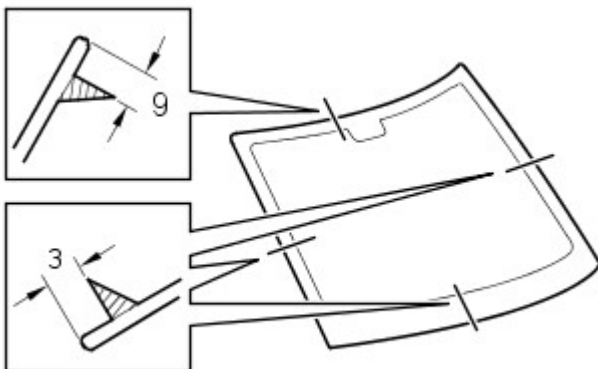
6. Apply glass primer to the sealant face on the windshield glass and allow to cure.

7. Apply activator over the old sealant on the windshield glass and allow to cure.

8. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.

- Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.

9. Apply a continuous bead of sealant to the windshield glass as shown.



10. With assistance, install the window glass.

- Lightly press the window glass to seat the sealer.
- Connect the electrical connectors.

11. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.

12. Install the roof mouldings.

- Secure with the clips.

13. Install the rain sensor.

For additional information, refer to: [Rain Sensor](#) (501-16 Wipers and Washers, Removal and Installation).

14. Install both A-pillar upper trim panels.

For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

15. Install the plenum chamber panel.

For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Glass, Frames and Mechanisms - Glass Roof Panel

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



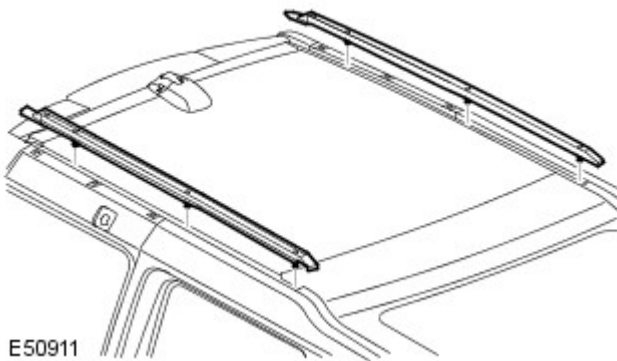
Always protect the interior components when removing body glass.



Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

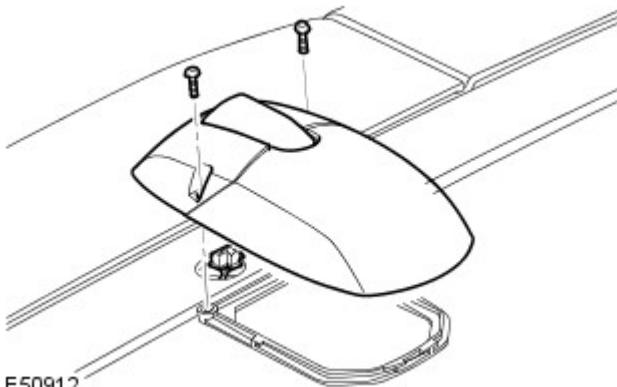
• NOTE: The following equipment is required: | Cutting wire and handles | Kent knife | Glazing knife | Glass replacement kit | Sealant applicator gun | Suction cups | A felt covered table or stand to support glass

1. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the roof moulding.
 - Release the 3 clips.
 - Repeat the above procedure for the other side.



E50911

3. Remove the antenna.
 - Disconnect the cable.
 - Remove the 2 screws.

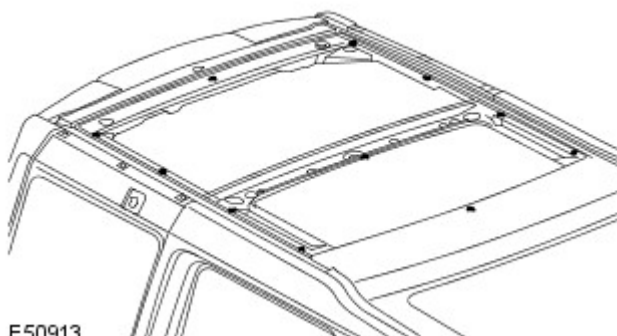


E50912

4.  **WARNING:** Eye protection must be worn.

With assistance, remove the roof panel fixed glass.

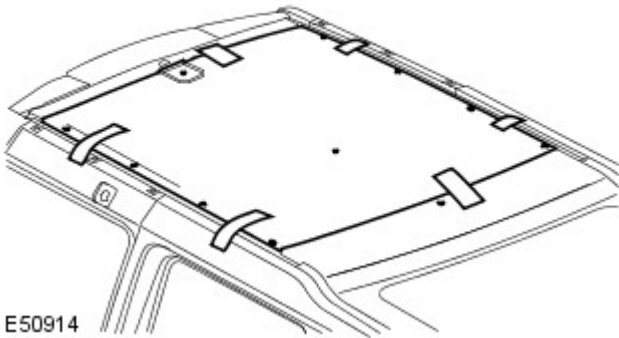
- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 11 spacers.



E50913

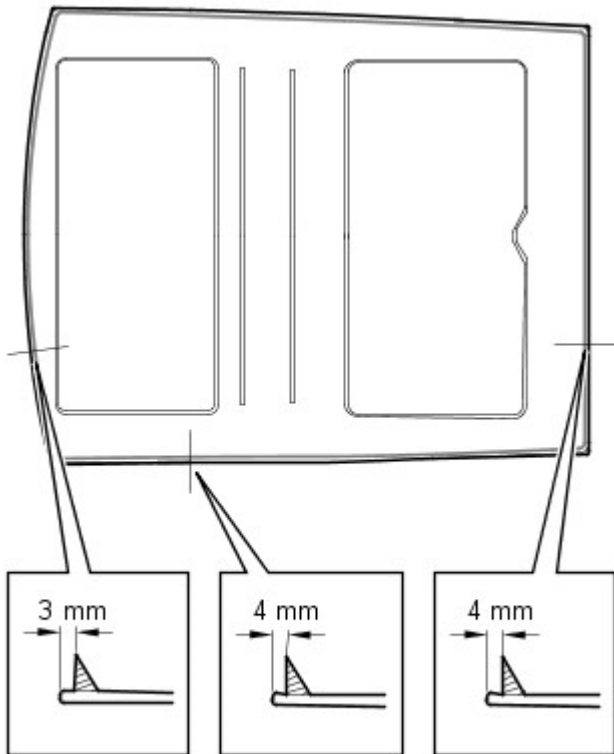
Installation

1. Carefully remove the sealant from the body to leave a smooth surface.
2. Install the roof panel fixed glass.
 - Install the spacers equally as shown.
 - Use masking tape to establish reference marks as an alignment aid.



E50914

3. With assistance, remove the roof panel fixed glass.
 - Clean the component mating faces.
4. Apply etch primer to any bare metal.
5. Apply primer over the etch primer.
6. Apply glass primer to the sealant face on the roof panel fixed glass and allow to cure.
7. Apply activator over the old sealant on the roof panel and allow to cure.
8. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.
 - Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.
9. Apply a continuous bead of sealant to the roof panel fixed glass as shown.



E50915

10. With assistance, install and align the roof panel fixed glass.

- Lightly press the roof panel fixed glass to seat the sealer.

11. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.

12. Install the antenna.

- Tighten the screws.
- Connect the cable.

13. Install the roof mouldings.

- Secure with the clips.

14. Install the headliner.

For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Glass, Frames and Mechanisms - Rear Quarter Window Glass

Removal and Installation

Removal

• CAUTIONS:



Always protect paintwork and glass when removing exterior components.



Always protect the interior components when removing body glass.

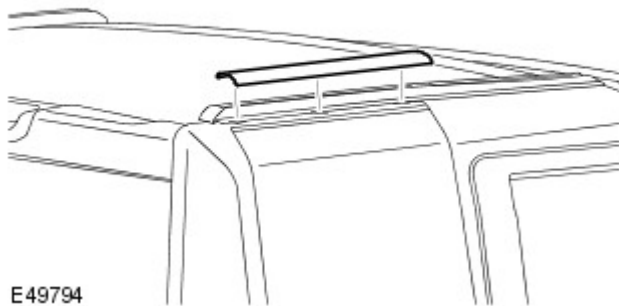


Lay the glass on felt covered supports. Do not stand on edge as this can cause chips which subsequently develop into cracks.

• NOTE: The following equipment is required:

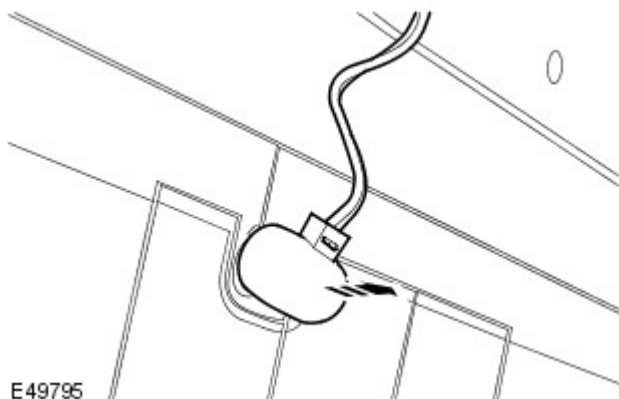
- Cutting wire and handles
- Kent knife
- Glazing knife
- Glass replacement kit
- Sealant applicator gun
- Suction cups
- A felt covered table or stand to support glass

1. Remove the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the rear quarter window glass panel.
 - Release the 3 clips.

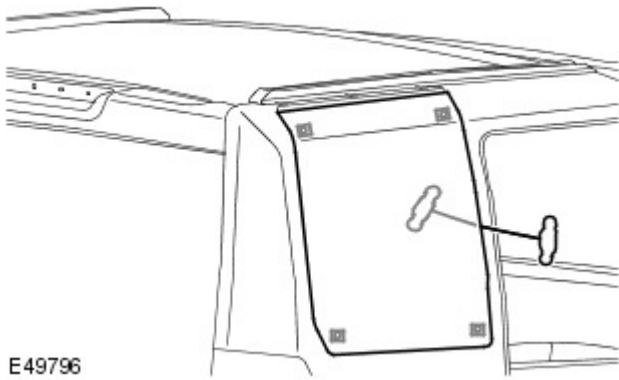


E49794

3. Disconnect the rear quarter window glass antenna connector.




E49795



E49796

4.  **WARNING:** Eye protection must be worn.

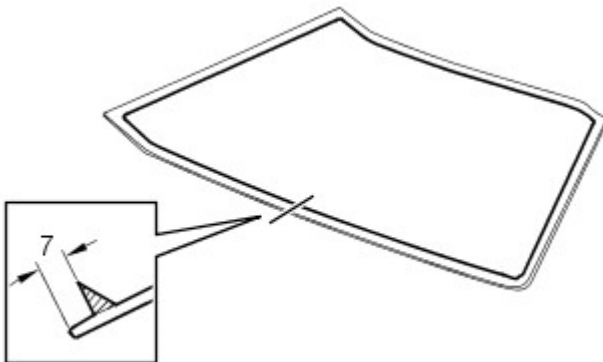
 **CAUTION:** Care must be taken not to damage the air bag curtain module when cutting through the sealant.

With assistance, remove the rear quarter window glass.

- Carefully cut through the sealant using a glazing knife or cutting wire.
- Attach the suction cups.
- Noting fitted position, remove the 4 spacers.

Installation

1. Carefully remove the sealant from the body to leave a smooth surface.
2. Apply etch primer to any bare metal.
3. Apply primer over the etch primer.
4. Apply glass primer to the sealant face on the rear quarter window glass and allow to cure.
5. Apply activator over the old sealant on the rear quarter window glass and allow to cure.
6. Fit a pre-cut nozzle to the sealer cartridge, remove the lid, shake out the crystals and fit the cartridge to the applicator gun.
 - Modify the nozzle to achieve a bead section in the shape of a right angle triangle with a base of 8 mm and a vertical height of 12 mm.
7. Apply a continuous bead of sealant to the rear quarter window glass as shown.



E49797

8. With assistance, install and align the rear quarter window glass.
 - Install the spacers equally as shown.
 - Lightly press the window glass to seat the sealer.
9. Test the sealer for leaks, apply additional sealer if necessary. If water is used, allow sealer to dry before testing. Spray water around the glass and check for leaks. Mark any area that leaks. Dry the glass and sealer then apply additional sealer.
10. Connect the rear quarter window glass antenna connector.
 - Clean the component mating faces.
11. Install the rear quarter window glass panel.
 - Secure with the clips.
12. Install the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Glass, Frames and Mechanisms - Front Door Window Regulator and Motor

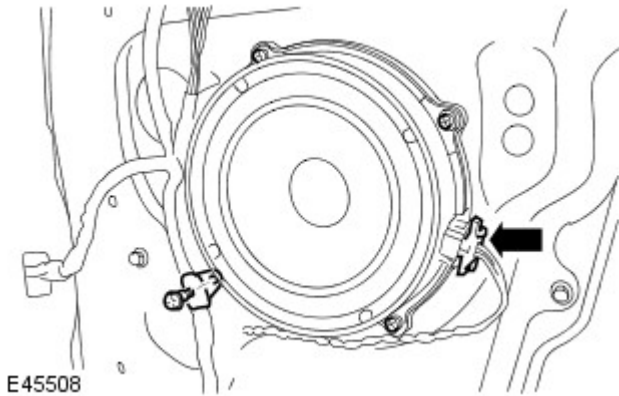
Removal and Installation

Removal

• NOTE: Removal steps in this procedure may contain installation details.

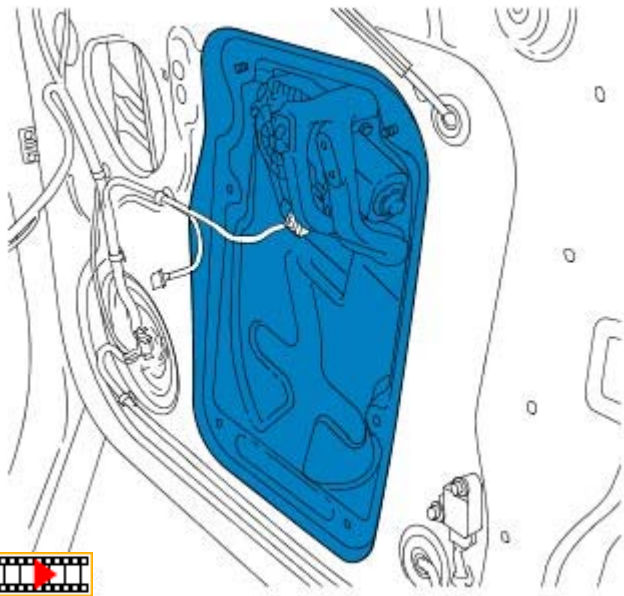
1. Refer to: [Front Door Trim Panel](#) (501-05 Interior Trim and Ornammentation, Removal and Installation).
2. Refer to: [Front Door Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

3.



4. *Torque:*

- Front door window regulator and motor retaining bolts 10 Nm
- Front door window regulator and motor retaining nuts 10 Nm
- Door window glass guide channel retaining bolt 10 Nm




Installation

1. To install, reverse the removal procedure.

Glass, Frames and Mechanisms - Rear Door Window Regulator and Motor

Removal and Installation

Special Tool(s)	
 501-114 E54200	Door glass release lever 501-114

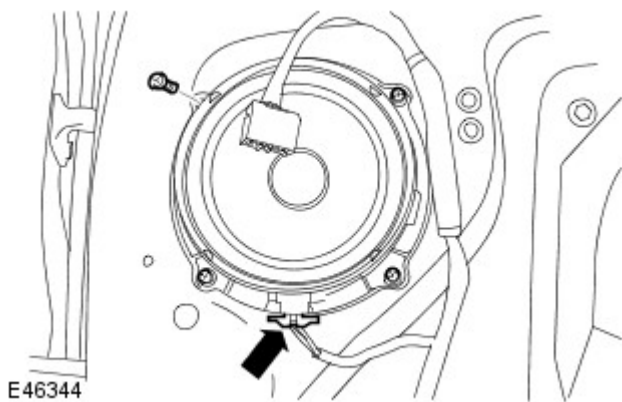
Removal

- NOTE: The door glass should be lowered by approximately one third.

1. Remove the rear door trim panel.
For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

2. Remove the speaker.

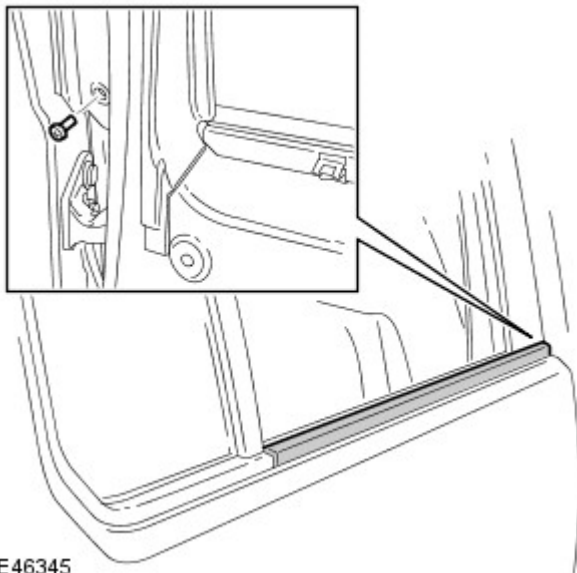
- Disconnect the electrical connector.
- Remove the 4 screws.



E46344

3. Carefully remove the outer waist seal.

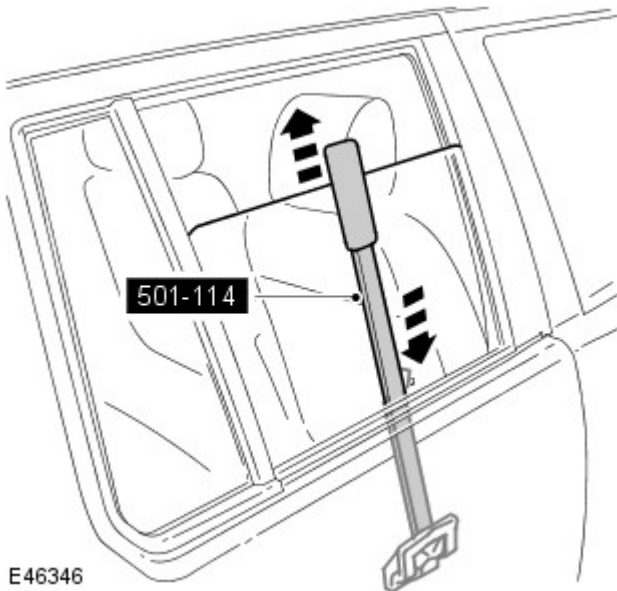
- Remove the screw.



E46345

4. NOTE: Wedge the glass in this position.

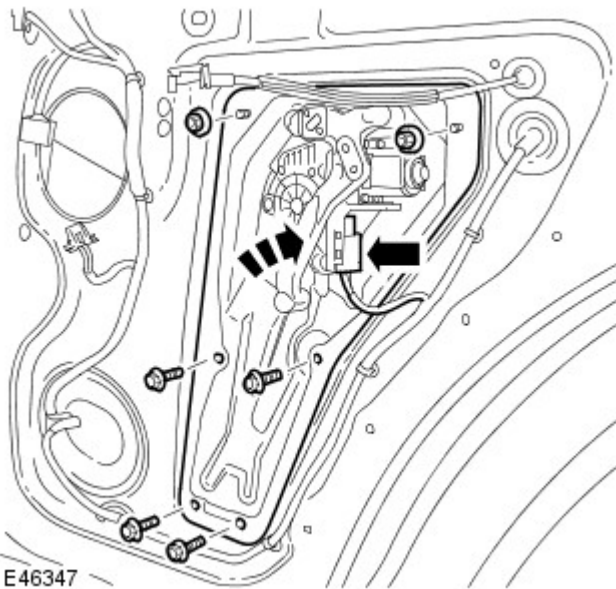
Using the special tool, release the clip and lift the glass to the top of the door frame.



E46346

5. Remove the window motor and regulator assembly.

- Disconnect the electrical connector.
- Remove the 4 bolts.
- Remove the 2 nuts.
- Rotate the assembly 90 degrees clockwise, to remove the upper part of the assembly from the rear side of the aperture first.



E46347

Installation

1. Install the window motor and regulator assembly.
 - Tighten the bolts and nuts to 10 Nm (7 lb.ft).
 - Connect the electrical connector.

2. Secure the glass to the glass regulator.

- Remove the wedge.
- Lower the glass.

3. Install the outer waist seal.

4. Install the speaker

- Tighten the screws.
- Connect the electrical connector.

5. Install the rear door trim panel.

For additional information, refer to: Rear Door Trim Panel (501-05, Removal and Installation).

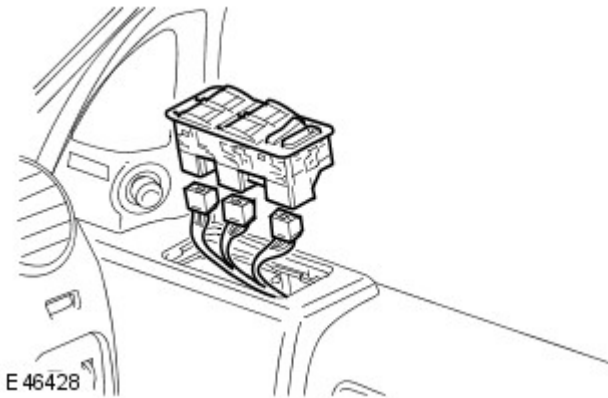
Glass, Frames and Mechanisms - Front Door Window Control Switch

Removal and Installation

Removal

1. Remove the window control switch.

- Carefully release the switch.
- Disconnect the 3 electrical connectors.



Installation

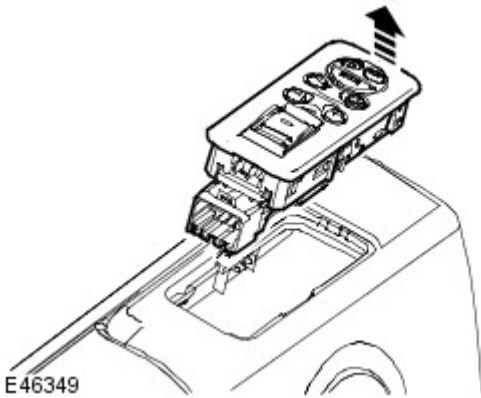
1. To install, reverse the removal procedure.

Glass, Frames and Mechanisms - Rear Door Window Control Switch

Removal and Installation

Removal

1. Remove the window control switch.
 - Carefully release the front of the switch.
 - Disconnect the electrical connector.



Installation

1. To install, reverse the removal procedure.

Instrument Panel and Console -

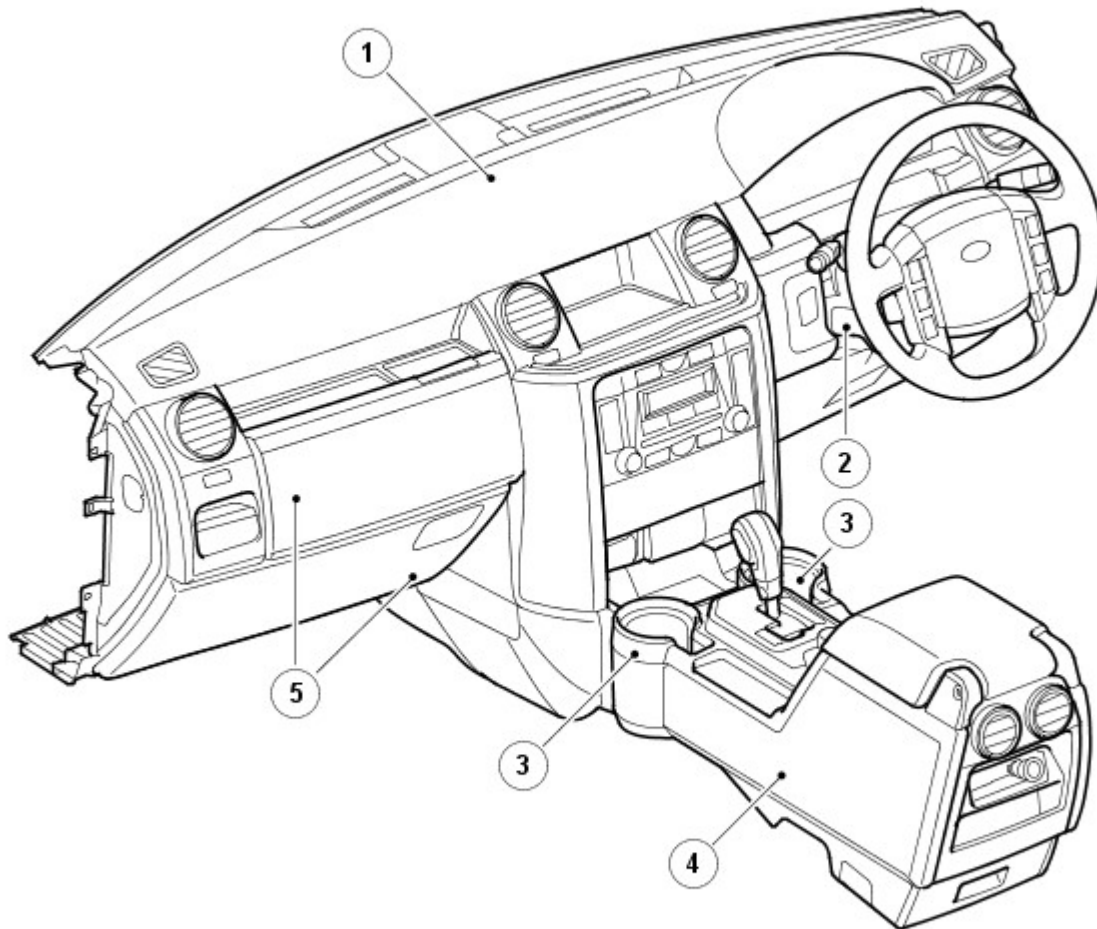
Torque Specifications

Description	Nm	lb-ft
Floor console lid Torx bolts	3	2
Floor console Torx bolts	10	7
Passenger air bag module nuts	10	7
Passenger air bag module bracket Torx screws	25	18
Instrument panel Torx bolts	25	18
Heater housing to bulkhead Torx bolts	6	4
Ground cables to passenger/driver side lower A-pillar nuts	10	7
Adaptor panel(s) nuts	10	7
A/C lines to bulkhead bolt	10	7
A/C lines to body nuts	10	7
EGR coolant crossover pipe bolts	10	7
Instrument panel carrier to bulkhead Torx bolt	25	18
Instrument panel upper section to body Torx bolt	10	7
Instrument panel center bracket Torx bolts	25	18
* Steering column intermediate shaft nut	22	16
Transmission selector lever bolts	10	7
Front door bolts	10	7
Door check strap to A-pillar bolts	10	7
Steering column switch assembly Torx bolts	3	2

* **New nut must be fitted**

Instrument Panel and Console - Instrument Panel

Description and Operation

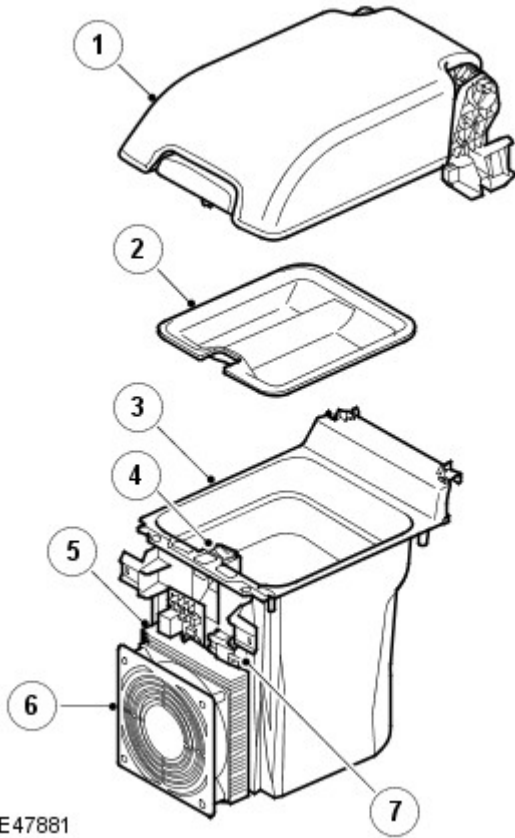


E51470

Item	Part Number	Description
1	-	Instrument Panel
2	-	Steering column cover
3	-	Cup holders
4	-	Centre console
5	-	Glovebox

COOL BOX

On some vehicles, a cool box is incorporated in the centre console between the two front seats.



E47881

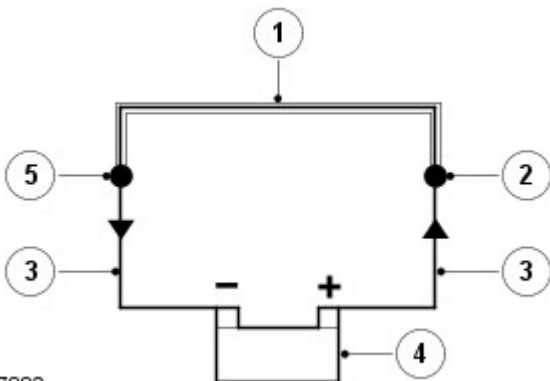
Item	Part Number	Description
1	-	Cubby box lid
2	-	Cubby box tray
3	-	Container
4	-	On/Off switch
5	-	Thermoelectric cooler heatsink
6	-	Fan
7	-	Electrical connector

The cool box is an open topped container with an aluminum liner and an insulating outer layer. A thermoelectric cooler is installed in the front of the container. The top of the container is covered by the cubby box tray and the cubby box lid. An electrical connector on the front of the cool box connects the cool box to the console harness.

Operation of the thermoelectric cooler is controlled by an on/off switch on the top front edge of the container. A permanent battery feed is supplied to the on/off switch from the central junction box (CJB). A light emitting diode (LED) in the on/off switch is illuminated while the cool box is selected on.

The thermoelectric cooler is a solid state heat pump that uses the Peltier Effect to cool the inside of the cool box. The Peltier Effect occurs when a direct current is passed through a circuit of two dissimilar conductors, which are connected together at two junctions; this causes one junction to become cold and one junction to become hot. The potential difference between the two conductors creates an electric field at each junction; when a current is then applied to the circuit the charge flows against the direction of the electric field at one junction, causing it to absorb heat, and with the direction of the electric field at the other junction, causing it to release heat. In thermoelectric coolers, a number of these circuits (known as couples) are connected together, in series, and sandwiched between ceramic plates, then connected to a heatsink and fan. On the cool box, the cold side of the thermoelectric cooler is attached to the aluminum liner and the heatsink and fan are installed on the insulating outer layer.

Peltier Effect Circuit

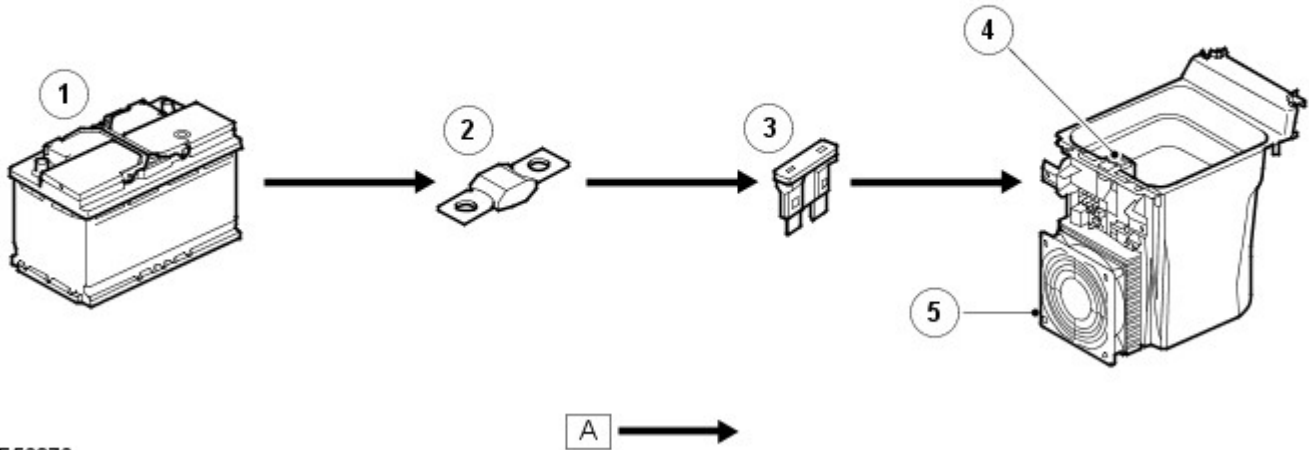


E47882

Item	Part Number	Description
1	-	Conductor material A
2	-	Hot junction
3	-	Conductor material B
4	-	Battery
5	-	Cold junction

When the on/off switch is selected on, the LED in the switch illuminates and power is supplied to the thermoelectric cooler. The couples in the thermoelectric cooler then transfer heat from the liner of the cool box to the heatsink, and the fan runs to cool the heatsink.

CONTROL DIAGRAM



E56376

Item	Part Number	Description
1	-	Battery
2	-	Fusible link 18E, battery junction box (BJB)
3	-	Fuse 59P, CJB
4	-	Cool box on/off switch
5	-	Thermoelectric cooler

Instrument Panel and Console - Floor Console

Description and Operation

For additional information, refer to: [Instrument Panel](#) (501-12 Instrument Panel and Console, Description and Operation).

Instrument Panel and Console - Overhead Console

Description and Operation

For additional information, refer to: [Interior Lighting](#) (417-02 Interior Lighting, Description and Operation).

Instrument Panel and Console - Floor Console

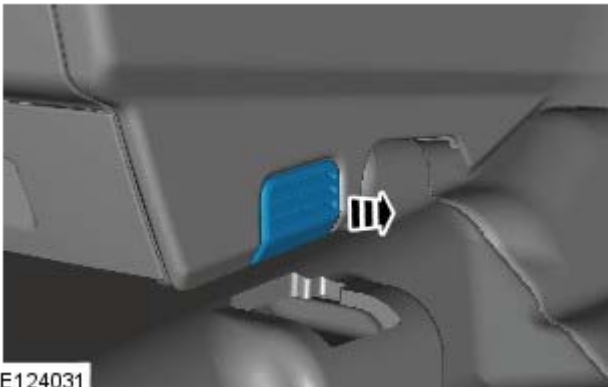
Removal and Installation

Removal

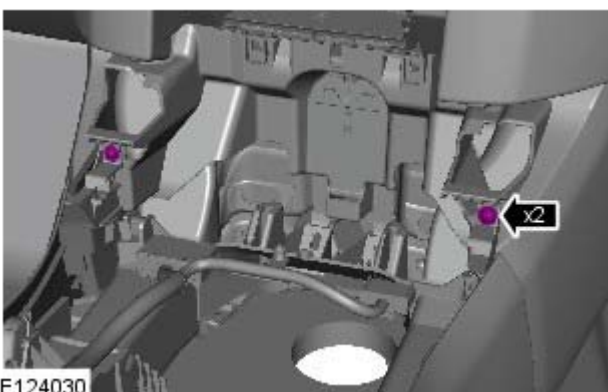
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

1. Refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

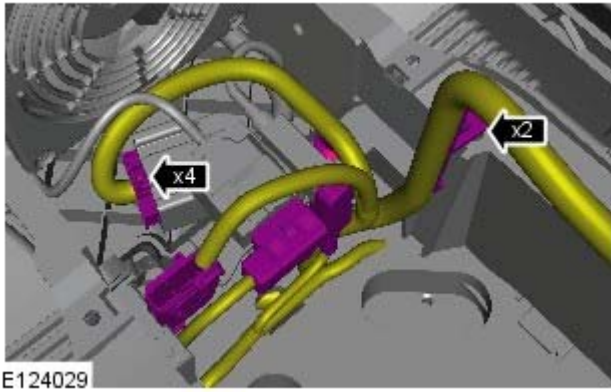
2. **2.** NOTE: Right-hand shown, left-hand similar.



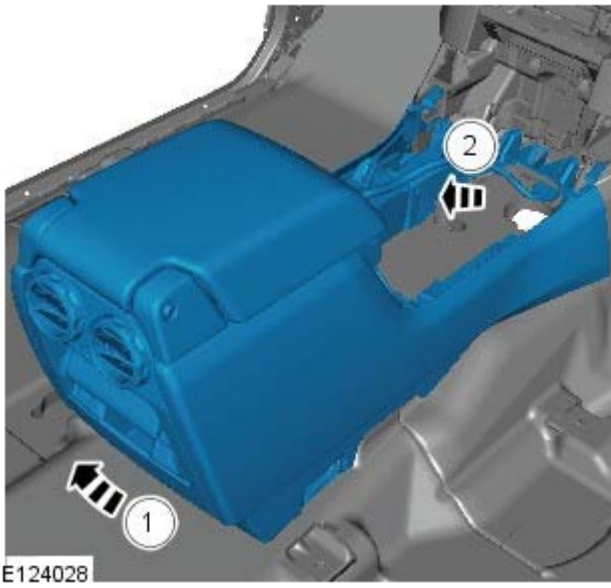
3.



4.



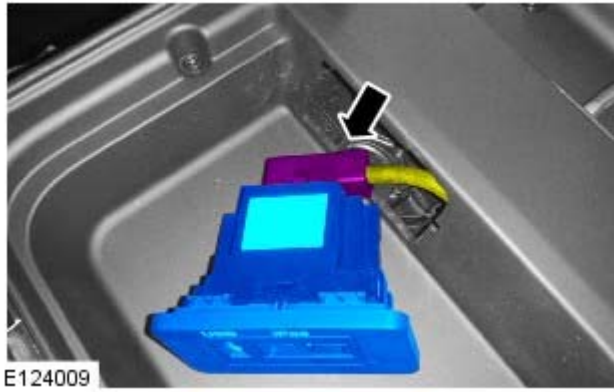
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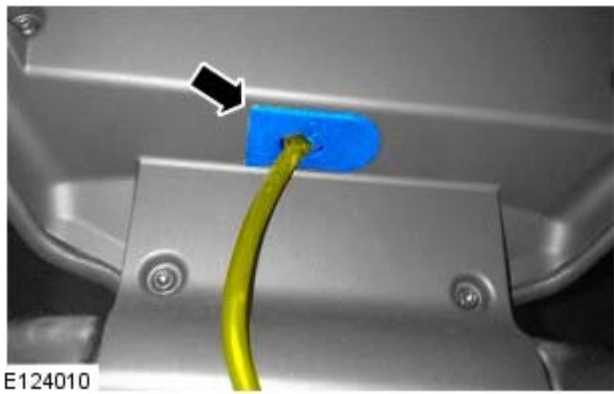
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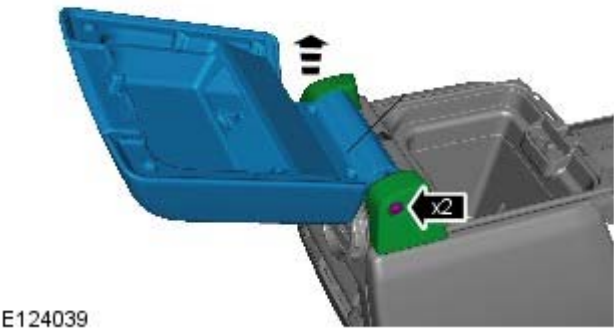
7. **7. NOTE:** Do not disassemble further if the component is removed for access only.



8.

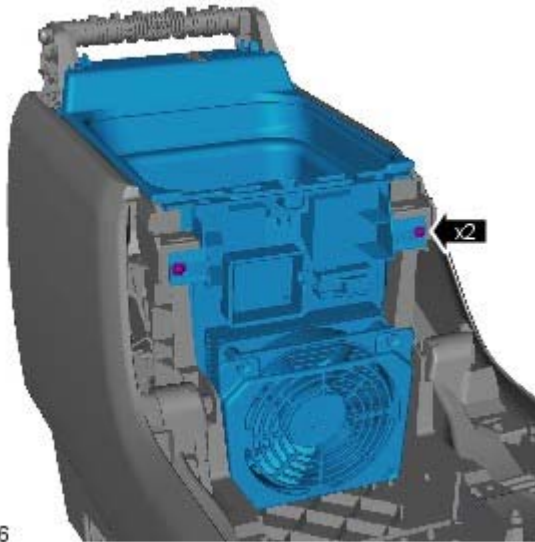


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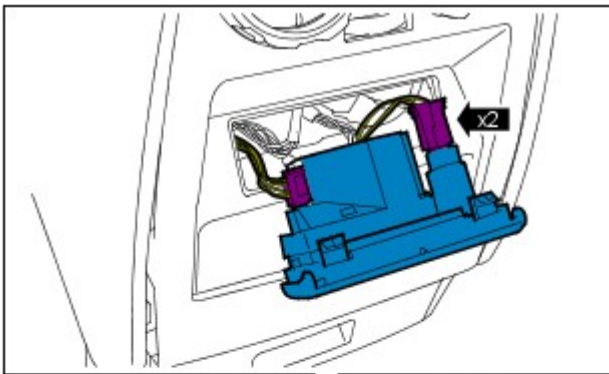
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11.



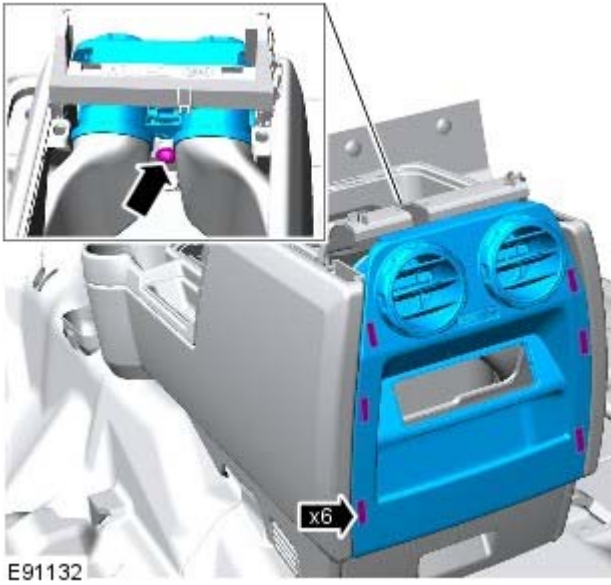
E124026

12.



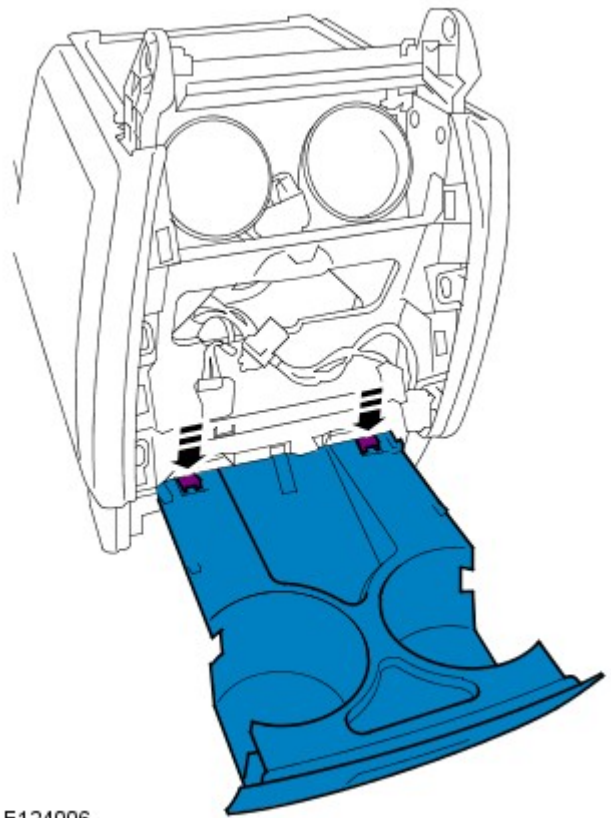
E124005

13.



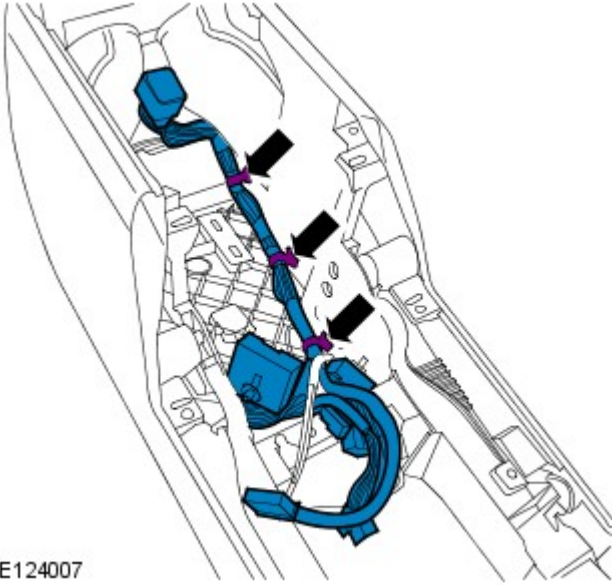
E91132

14.



E124006

15.



E124007

Installation

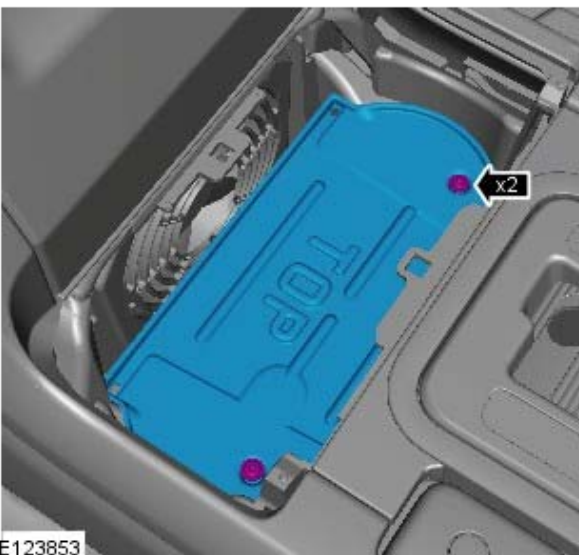
1. To install, reverse the removal procedure.

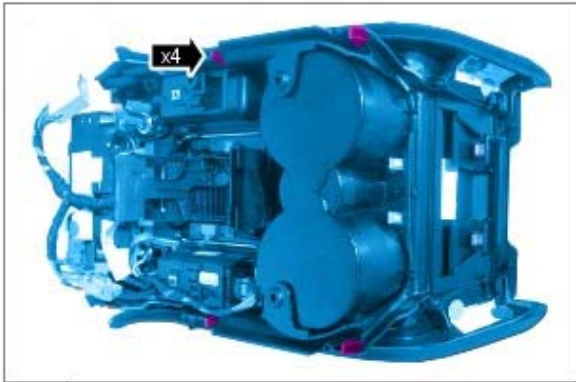
Instrument Panel and Console - Floor Console Upper Section

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Make sure that the gear selector lever is in position N before removing any components.





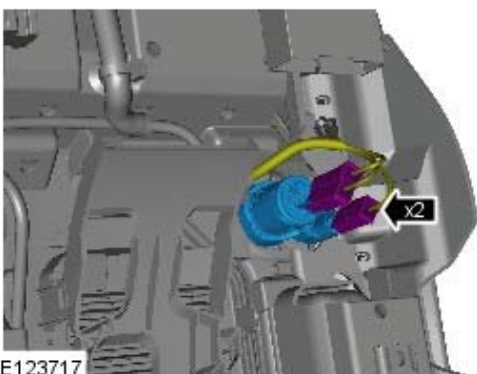
4.



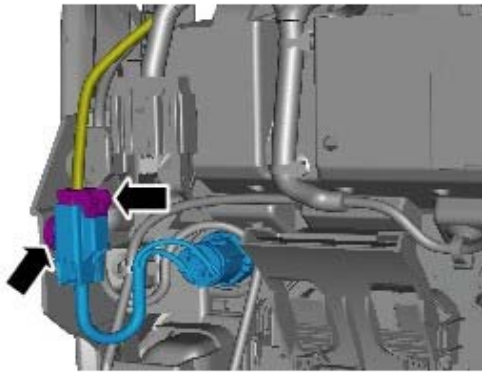
E123213



5.

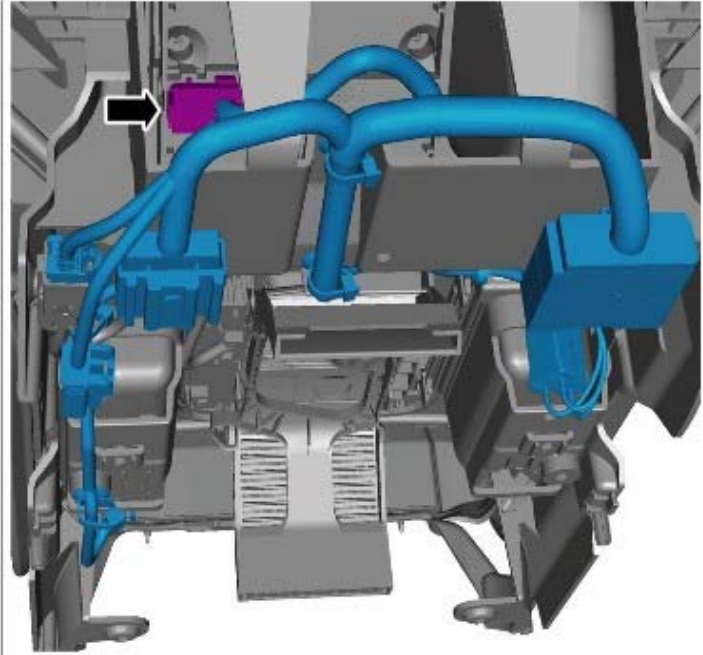
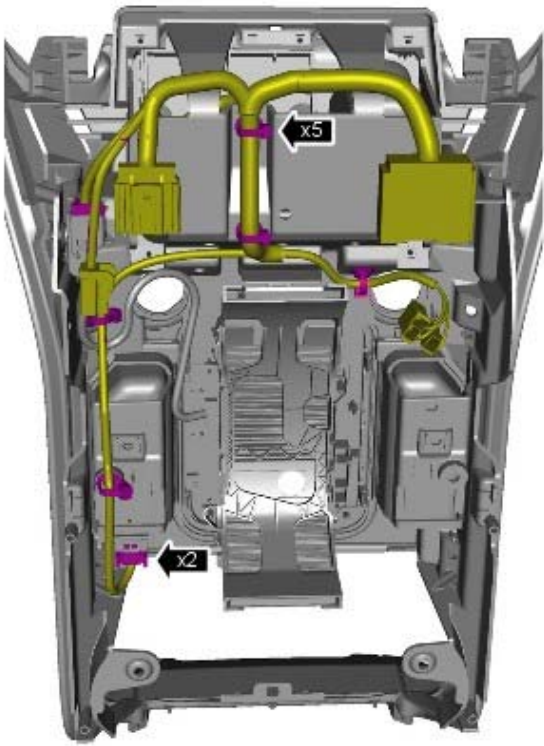


6. **NOTE:** Do not disassemble further if the component is removed for access only.



7.

E123720



8.

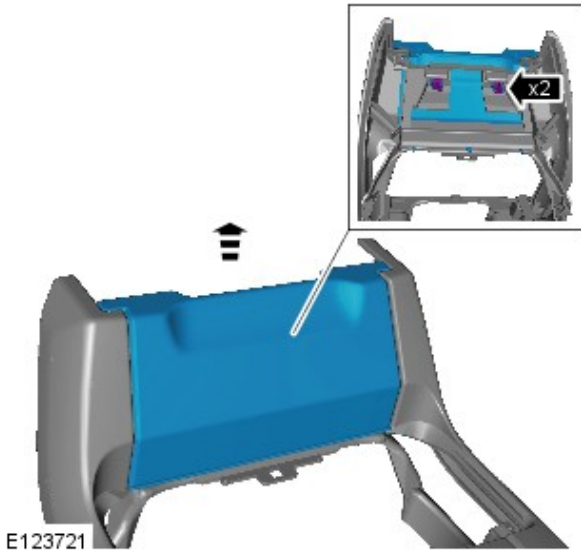
E123718



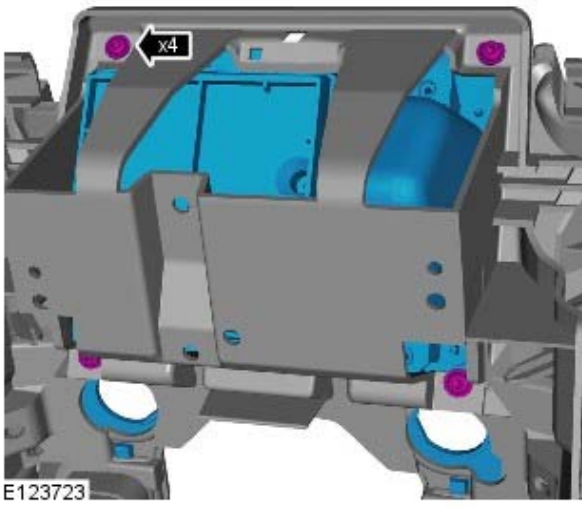
9.

E123719

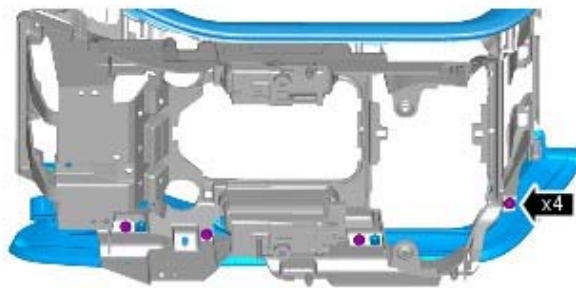
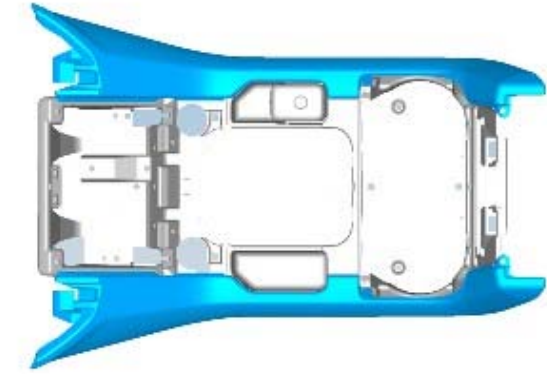
10.



11.

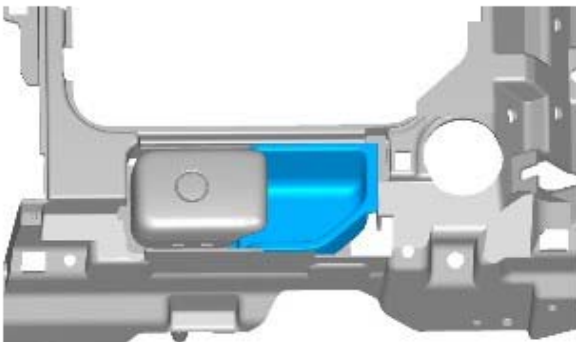


12.



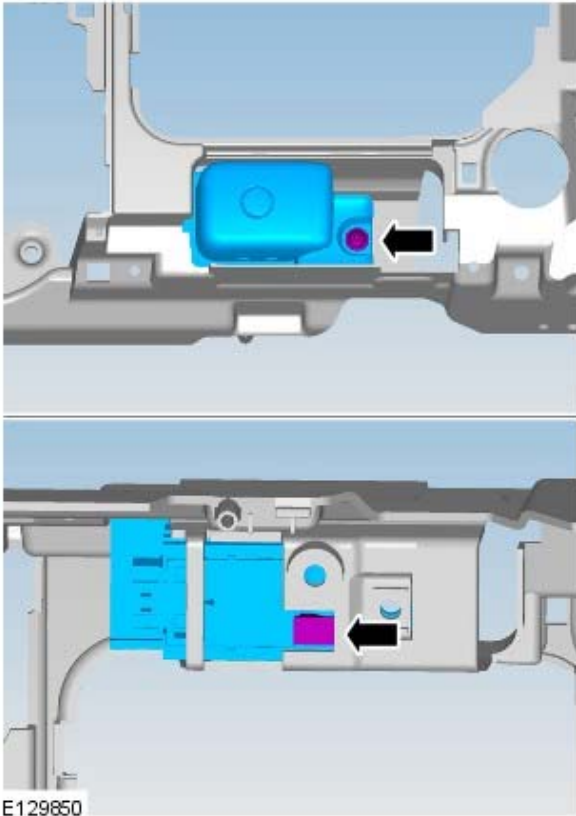
E129849

13.



E 129851

14.



E129850

Installation

1. To install, reverse the removal procedure.

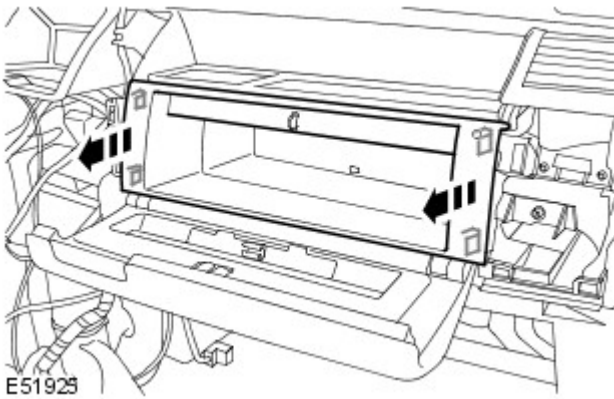
Instrument Panel and Console - Instrument Panel Upper Section

Removal and Installation

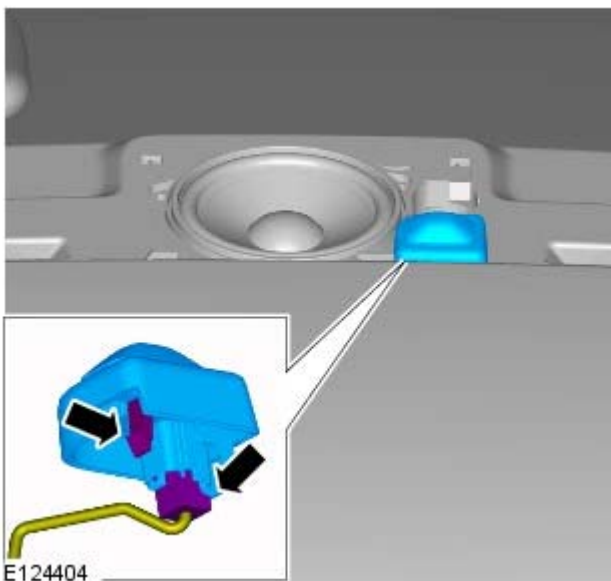
Removal

• **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

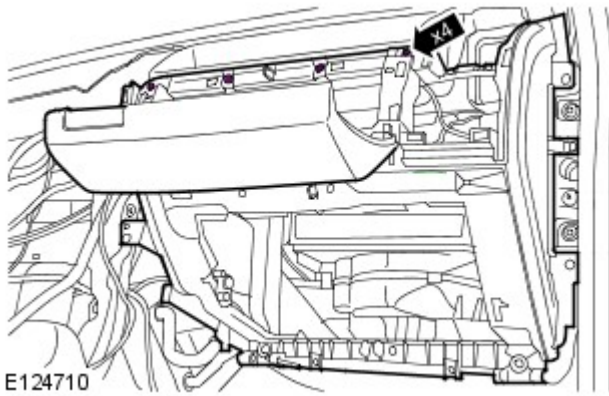
1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the instrument panel driver side reinforcement.
For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Remove the passenger side register trim panel.
For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).
5. Remove the stowage compartment tray.
 - Release the 4 clips.



6. Remove the instrument panel speaker.
For additional information, refer to: [Instrument Panel Speaker](#) (415-03 Speakers, Removal and Installation).
7. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
8. Remove the sunload sensor.
 - Release the clips.
 - Disconnect the electrical connector.

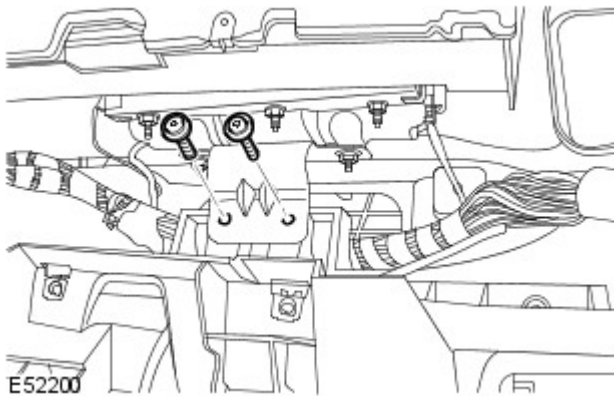


9. Remove the instrument panel passenger side reinforcement upper retaining screws.

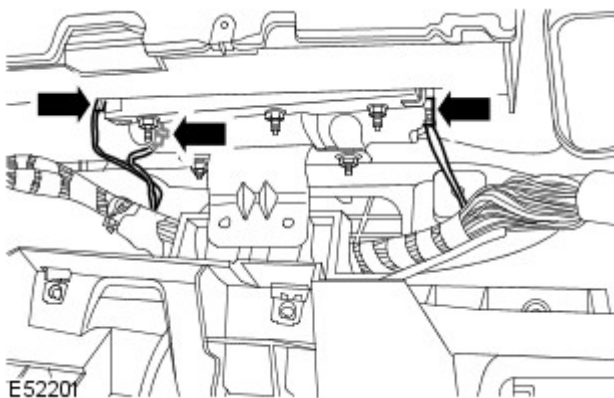


10. Release the passenger air bag module bracket.

- Remove the 2 Torx screws.

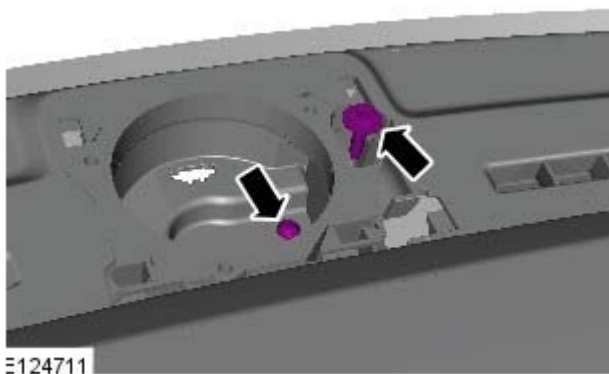


11. Disconnect the 3 electrical connectors from the passenger air bag module.



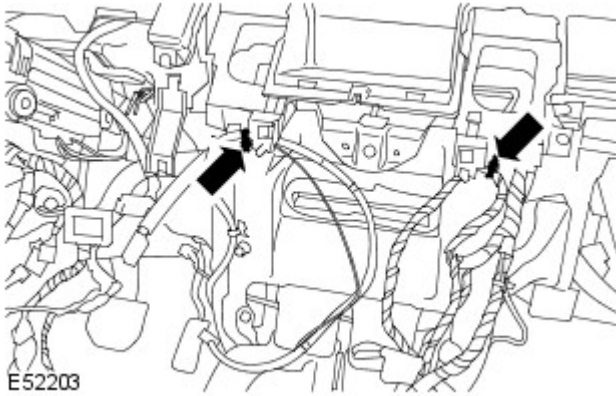
12. NOTE: Avoid dropping the screw inside the instrument panel.

Remove 1 Torx screw and 1 bolt, from the instrument panel upper section speaker aperture.



13. Release the instrument panel wiring harness.

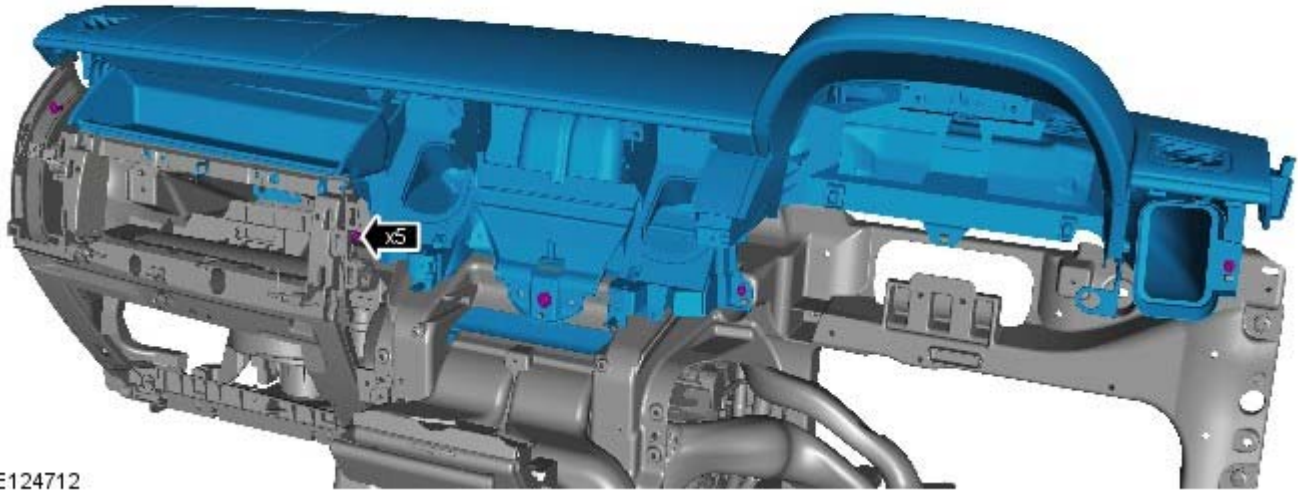
- Release the 2 clips.



E52203

14. With assistance, remove the instrument panel upper section.

- Remove the 5 Torx screws.



E124712

15. NOTE: Do not disassemble further if the component is removed for access only.

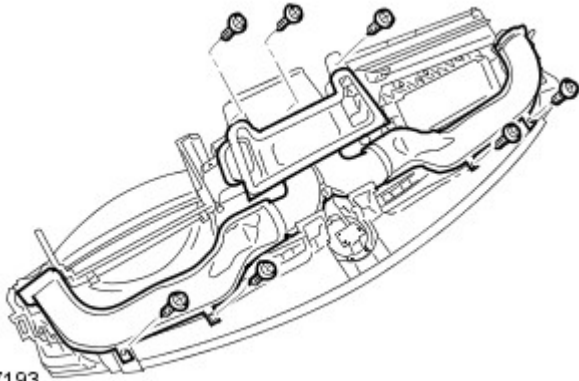
Remove the passenger air bag module.

- Remove the 4 nuts.



E47176

E47193



16. Remove the windshield defroster duct.

- Remove the 7 screws.

Installation

1. Install the windshield defroster duct.

- Tighten the screws.

2. Install the passenger air bag module.

- Tighten the nuts to 10 Nm (7 lb.ft).

3. With assistance, install the instrument panel upper section.

- Tighten the screws.
- Attach the wiring harness.

4. Tighten the instrument panel upper section speaker aperture bolt to 10 Nm (7 lb.ft).

5. Secure the passenger air bag module bracket.

- Tighten the Torx screws to 25 Nm (18 lb.ft).

6. Connect the passenger air bag module electrical connectors.

7. Install the instrument panel passenger side reinforcement upper retaining screws.

8. Install the sunload sensor.

- Connect the electrical connector.
- Secure with the clips.

9. Install the A-pillar trim panels.

For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

10. Install the speaker

For additional information, refer to: [Instrument Panel Speaker](#) (415-03 Speakers, Removal and Installation).

11. Install the stowage compartment tray.

- Secure the 4 clips.

12. Install the passenger side register trim panel.

For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).

13. Install the instrument panel driver side reinforcement.

For additional information, refer to: [Instrument Panel Driver Side Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).

14. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).


Instrument Panel and Console - Instrument Panel

Removal and Installation

Removal

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) / [Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Evacuate the air conditioning (A/C) system.
For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

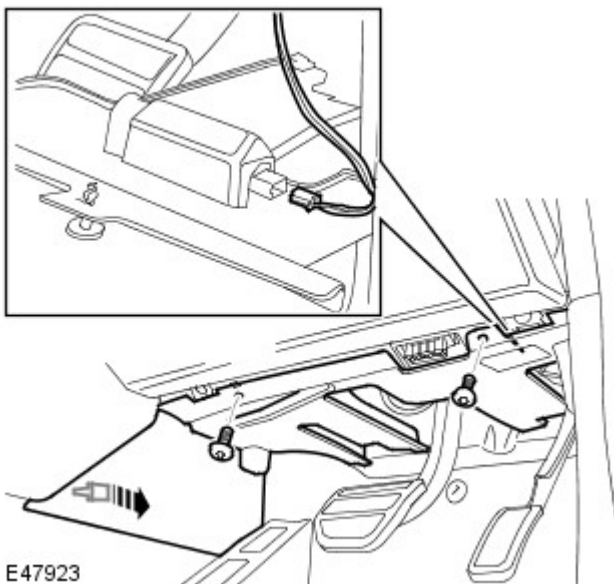
3.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

4. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).
5. Remove the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
6. Remove both cowl side trim panels.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Remove the driver side closing trim panel.

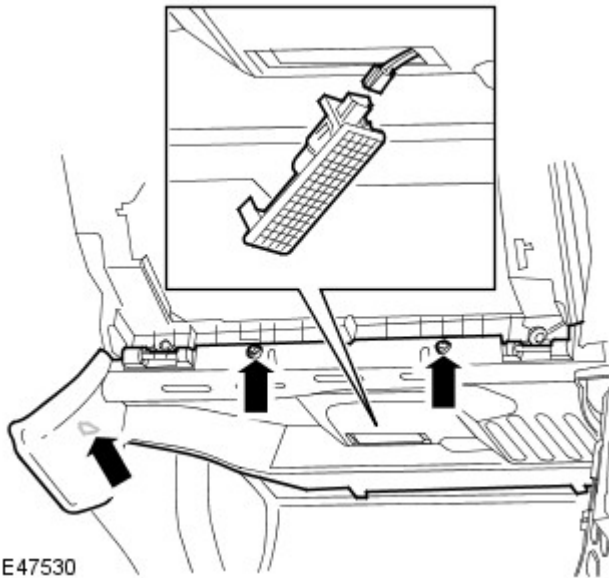
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47923

8. Remove the passenger side closing trim panel.

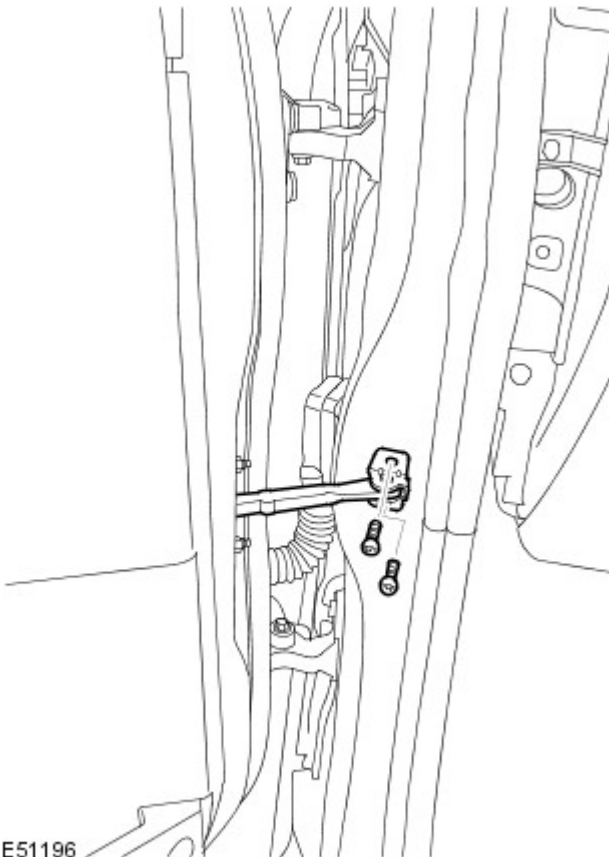
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



E47530

9. Release the door check strap from the A-pillar.

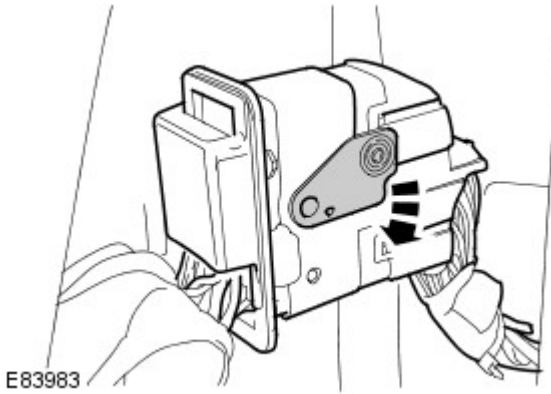
- Remove the 2 Torx bolts.



E51196

12. Remove the door.

- Disconnect the electrical connector.



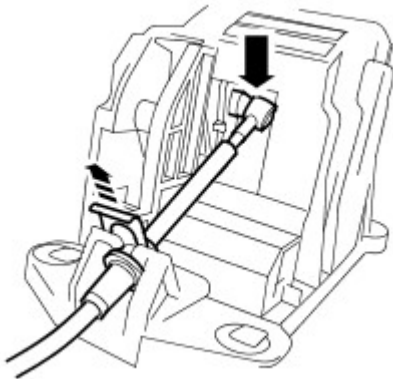
E83983

13. Remove the front seats.

For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

14. Release the transmission selector lever cable.

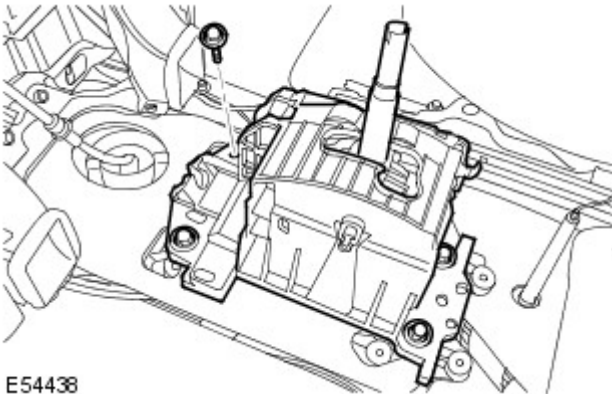
- Remove the clip.
- Release the cable.



E44788

15. Remove the transmission selector lever.

- Remove the 4 bolts.



E54438

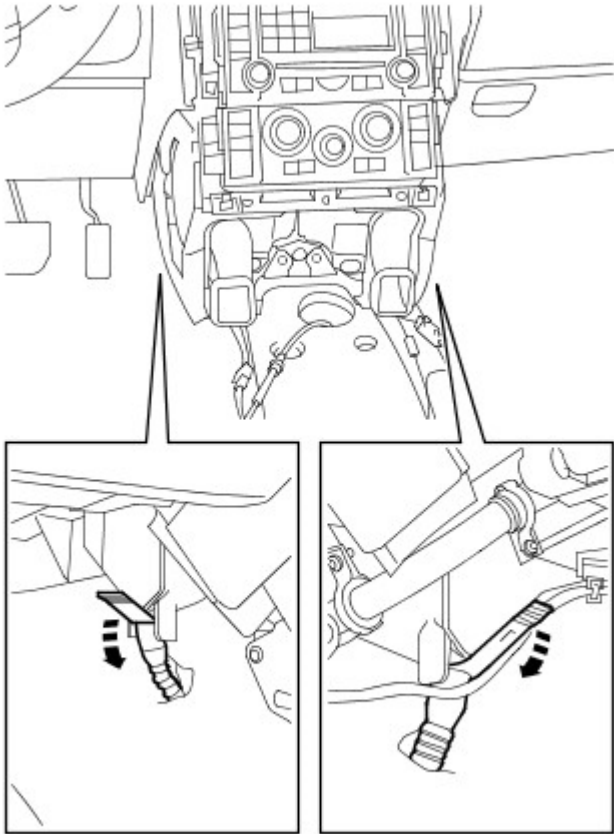
16. Disconnect the steering column intermediate shaft from the steering column.

- Note the fitted position.
- Remove the special bolt and discard the nut.



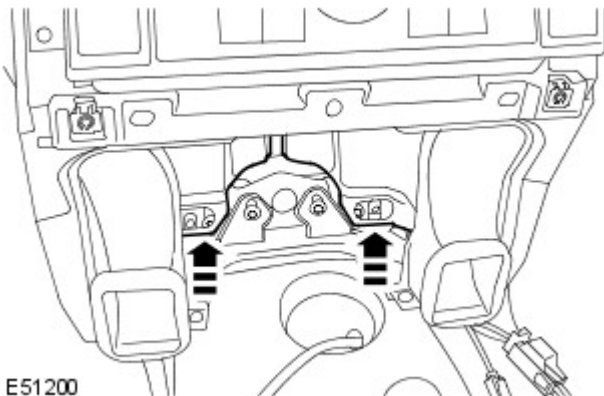
E49465

17. Disconnect 2 drain tubes from the heater housing.



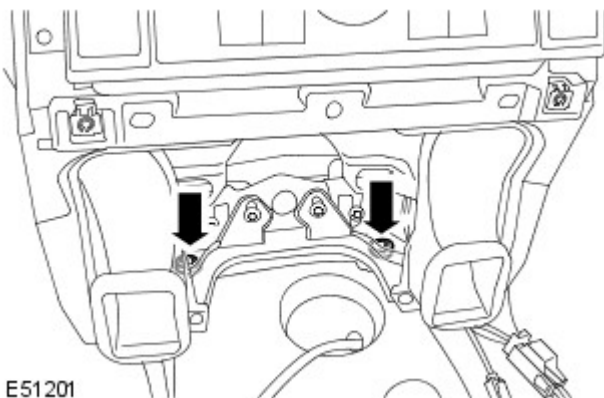
E51199

18. Position the heater housing center ducts aside for access.



E51200

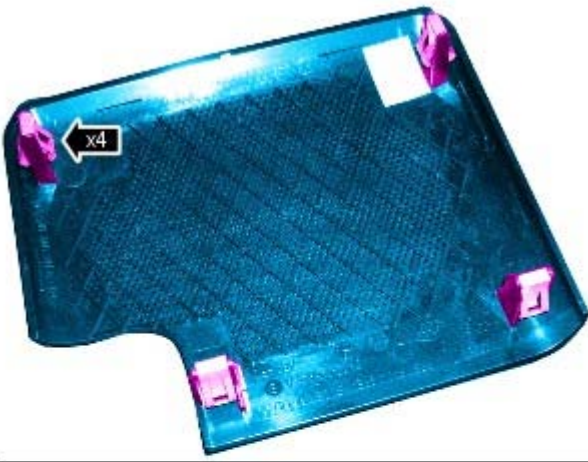
19. Remove 2 Torx bolts from the instrument panel center bracket.



E51201

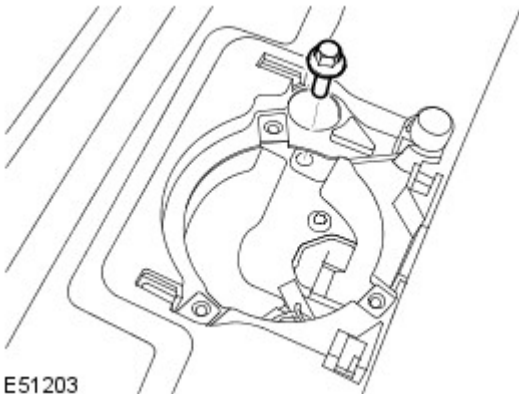
20. Remove the instrument panel center speaker grille.

- Release the 4 clips.



E124403

21. Remove the instrument panel upper section to body bolt.

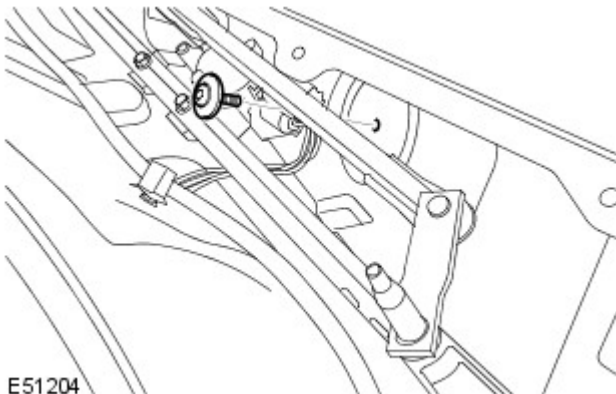


E51203


22. Remove the plenum chamber panel.

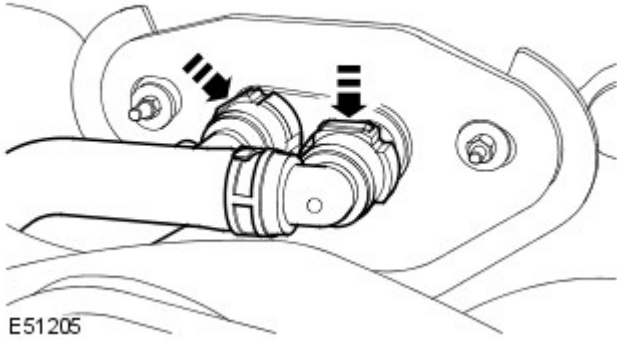
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

23. Remove the instrument panel carrier to bulkhead Torx bolt.



E51204

24.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.



Disconnect 2 heater hoses from the bulkhead.

- Release the 2 clips.

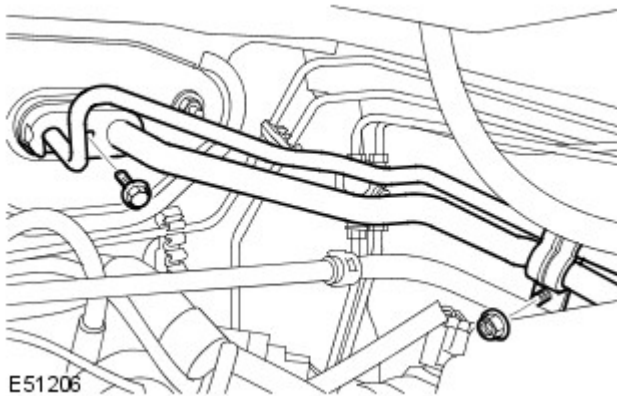
25. Release 2 A/C lines from the body.

- Remove the nut.

26.  **CAUTION:** Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

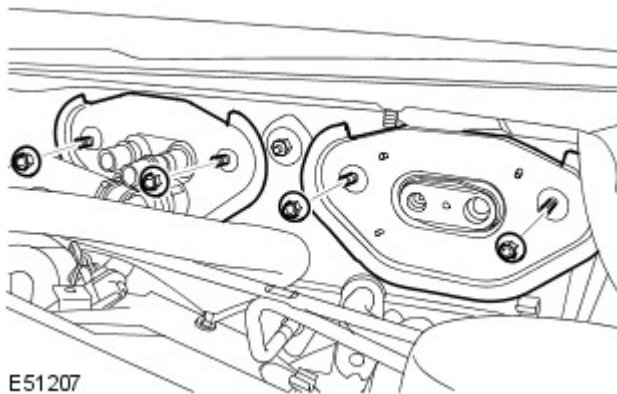
Release 2 A/C lines from the bulkhead.

- Remove the bolt.
- Remove and discard the O-ring seals.



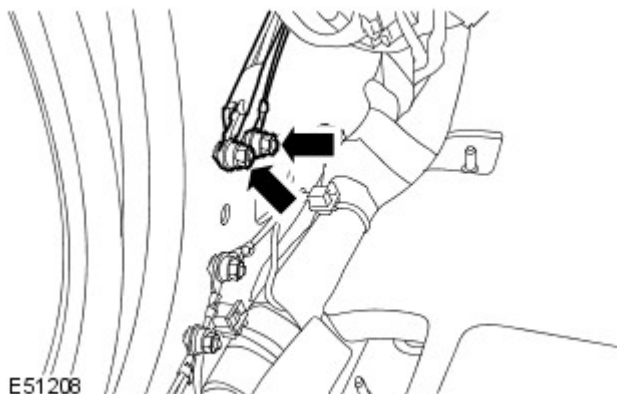
27. Remove the 2 adapter panels.

- Remove the 4 nuts.

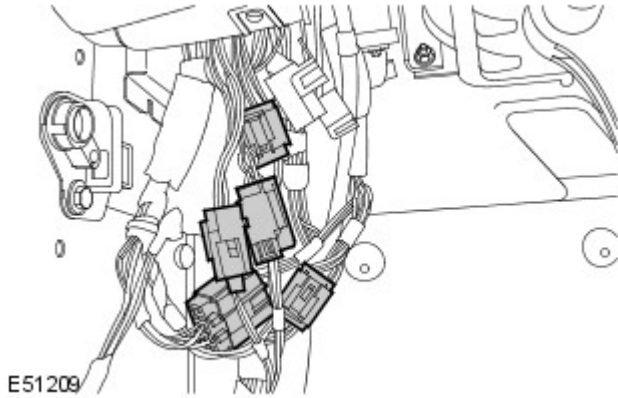


28. Release the 3 ground cables from the driver side lower A-pillar.

- Remove the 2 nuts.

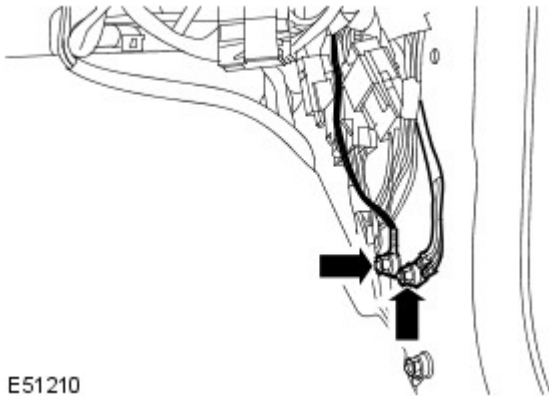


29. Disconnect the 5 electrical connectors from the driver side lower A-pillar.



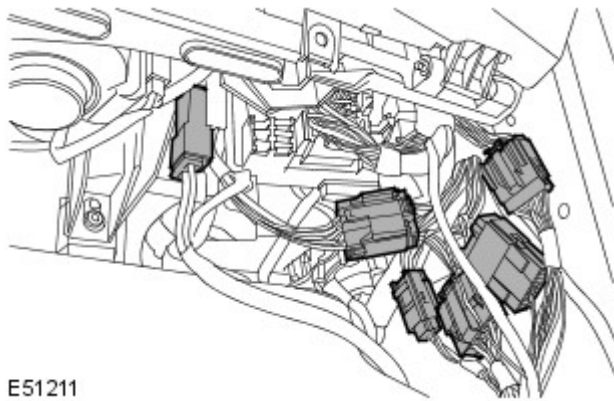
30. Release the 3 ground cables from the passenger side lower A-pillar.

- Remove the 2 nuts.

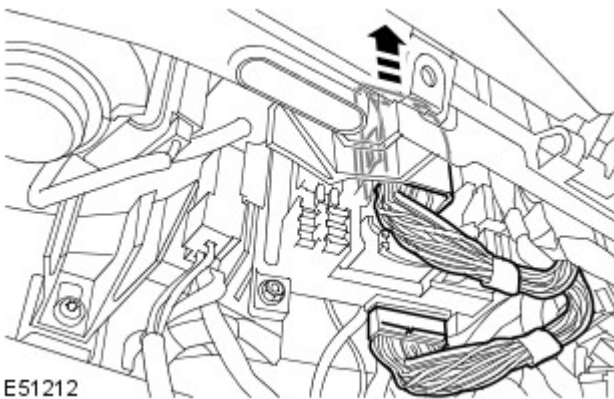


31. Disconnect the 5 electrical connectors from the passenger side lower A-pillar.

32. Disconnect the heater motor electrical connector.



33. Disconnect 2 central junction box (CJB) electrical connectors.



34. Disconnect 2 electrical connectors from the instrument panel center reinforcement.

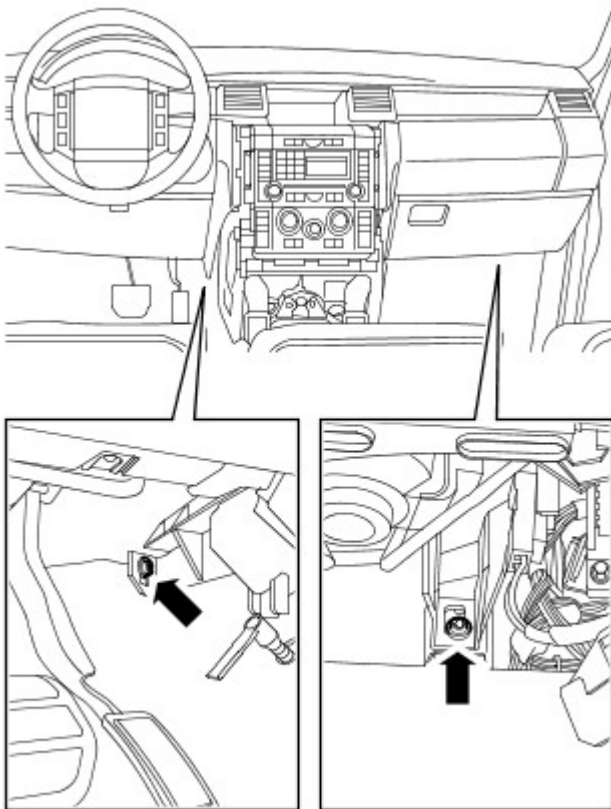


35. If installed, disconnect the instrument panel center reinforcement fibre optic cables.

- Disconnect the electrical connector.

36. Driver side: Remove the heater housing to bulkhead Torx bolt.

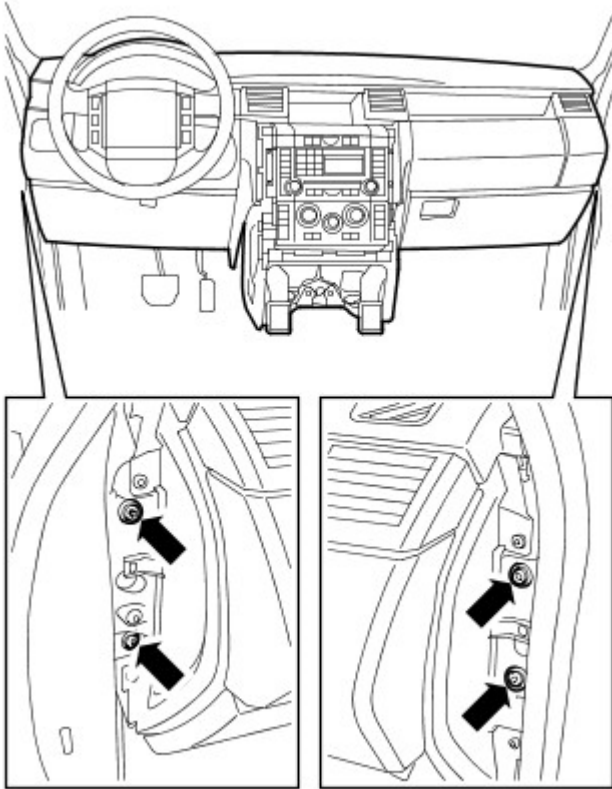
37. Passenger side: Remove the heater housing to bulkhead Torx bolt.



E51214

38. With assistance, remove the instrument panel.

- Remove the 4 Torx bolts.



E51215

Installation

1. With assistance, install the instrument panel.

- Tighten the Torx bolts to 25 Nm (18 lb.ft).

2. Passenger side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).

3. Driver side: Install the heater housing to bulkhead Torx bolt and tighten to 6 Nm (4 lb.ft).

4. Connect the instrument panel center reinforcement fibre optic cables.

5. Connect the instrument panel center reinforcement electrical connectors.

6. Connect the CJB electrical connectors.

7. Connect the heater motor electrical connector.

8. Connect the electrical connectors to the passenger side lower A-pillar.

9. Connect the ground cables to the passenger side lower A-pillar.

- Tighten the nuts to 10 Nm (7 lb.ft).

10. Connect the electrical connectors to the driver side lower A-pillar.

11. Connect the ground cables to the driver side lower A-pillar.

- Tighten the nuts to 10 Nm (7 lb.ft).

12. Install the adapter panels.

- Tighten the nuts to 10 Nm (7 lb.ft).

13. Secure the A/C lines to the bulkhead.

- Tighten the nuts to 10 Nm (7 lb.ft).

- Install new O-ring seals.

15. Connect the bulkhead heater hoses.

- Tighten the bolt to 10 Nm (7 lb.ft).

16. Install the instrument panel carrier to bulkhead Torx bolt and tighten to 25 Nm (18 lb.ft).
17. Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
18. Install the instrument panel upper section to body bolt and tighten to 10 Nm (7 lb.ft).
19. Install the speaker grille.
 - Secure with the clips.
20. Install the instrument panel center bracket Torx bolts and tighten to 25 Nm (18 lb.ft).
21. Attach the heater housing center ducts.
22. Connect the drain tubes to the heater housing.
23. Connect the steering column intermediate shaft.
 - Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).
24. Install the transmission selector lever.
 - Tighten the bolts to 10 Nm (7 lb.ft).
25. Attach the transmission selector lever cable.
 - Install the clip.
26. Install the front seats.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
27. With assistance, install the door assembly.
 - Connect the electrical connector.
 - Secure the electrical connector.
 - Secure the grommet.
 - Tighten the bolts to 10 Nm (7 lb.ft).
28. Attach the door check strap to the A pillar.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
29. Install the driver side closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.
30. Install the passenger side closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.
31. Install the cowl side trim panels.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
32. Install the floor console.
For additional information, refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).
33. Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03B Engine Cooling - TDV6 3.0L Diesel, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03C Engine Cooling - V6 4.0L Petrol, General Procedures) / [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

34. Recharge the A/C system.

For additional information, refer to: [Air Conditioning \(A/C\) System Recovery, Evacuation and Charging](#) (412-00 Climate Control System - General Information, General Procedures).

35. Install the engine cover.

For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) /

[Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) /

[Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation) /

[Engine Cover - TDV6 3.0L Diesel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Instrument Panel and Console - Instrument Panel Driver Side Reinforcement

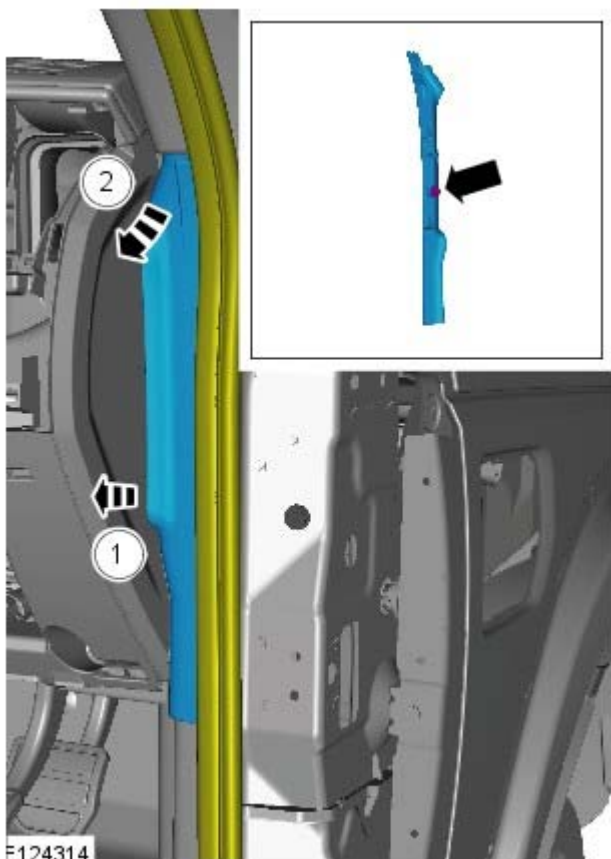
Removal and Installation

Removal

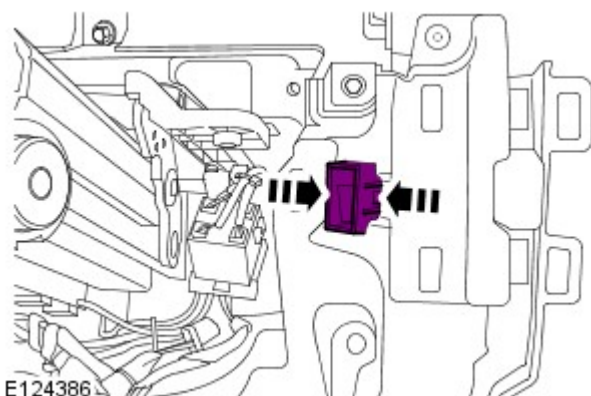
• NOTE: Removal steps in this procedure may contain installation details.

1. Fully extend the steering column for access.
2. Refer to: [Steering Wheel](#) (211-04 Steering Column, Removal and Installation).
3. Refer to: [Instrument Panel Center Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Refer to: [Instrument Cluster](#) (413-01 Instrument Cluster, Removal and Installation).

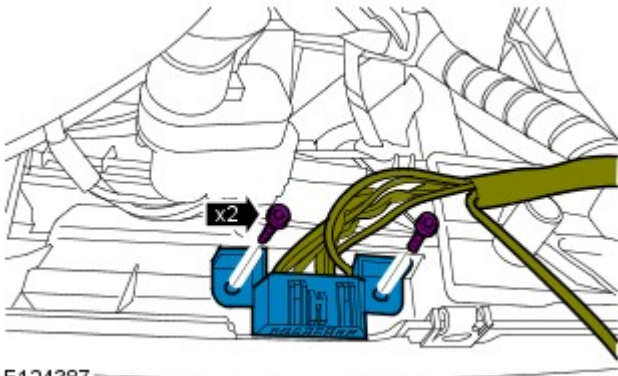
5.



6.

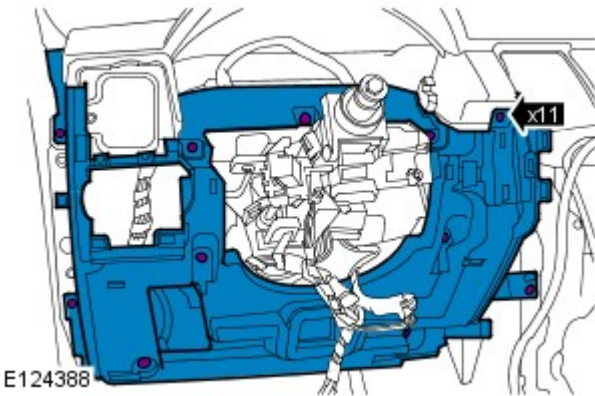


7.



E124387

8. **8.** NOTE: Left-hand drive shown, right-hand drive similar.



E124388

Installation

1. To install, reverse the removal procedure.

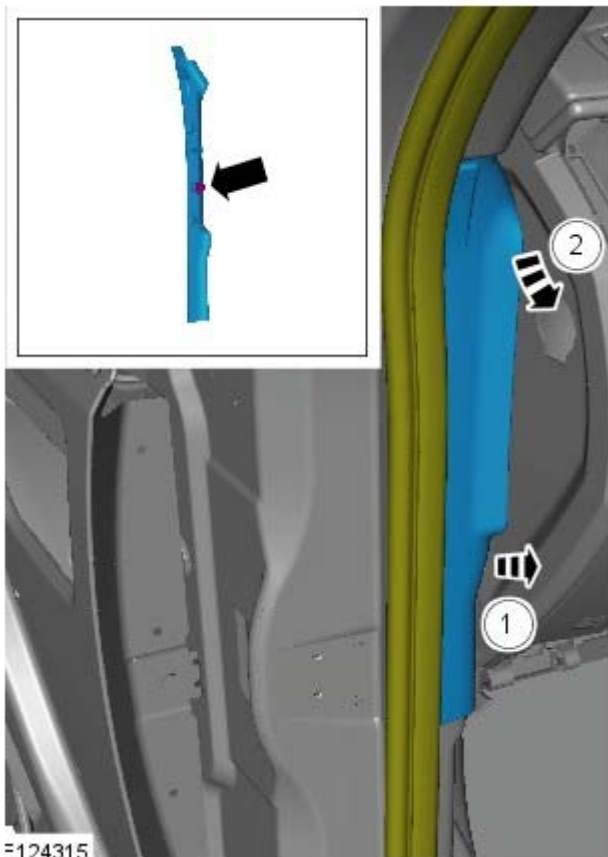
Instrument Panel and Console - Instrument Panel Passenger Side Reinforcement

Removal and Installation

Removal

• NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the PAD switch.
For additional information, refer to: [Passenger Air Bag Deactivation \(PAD\) Switch](#) (501-20B Supplemental Restraint System, Removal and Installation).
2. Remove the instrument panel center reinforcement.
For additional information, refer to: [Instrument Panel Center Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Detach the door weatherstrip and remove the side trim panel.

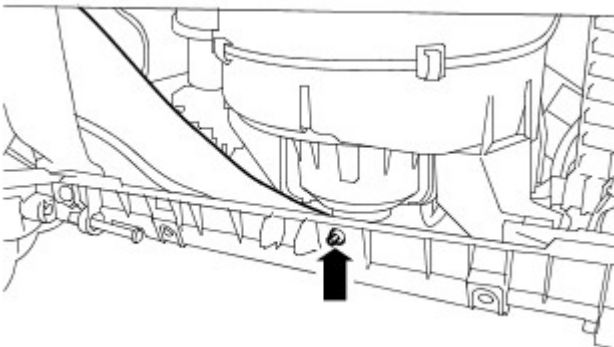


E124315

1. Release the trim panel retaining clip.
2. Remove the trim panel.

5. Remove the passenger side footwell duct.

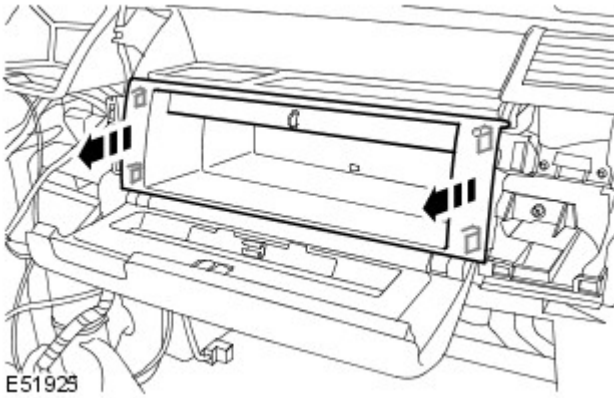
- Remove the clip.



E51923

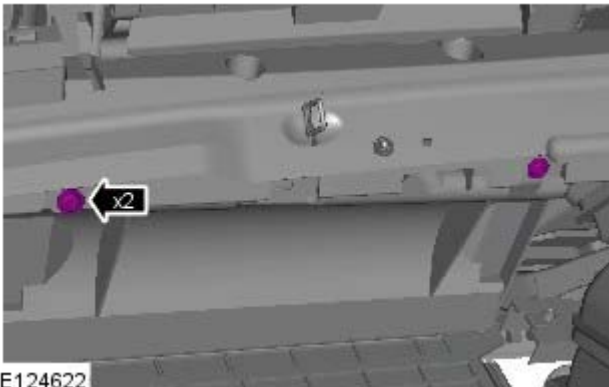
6. Remove the stowage compartment tray.

- Release the 4 clips.



E51925

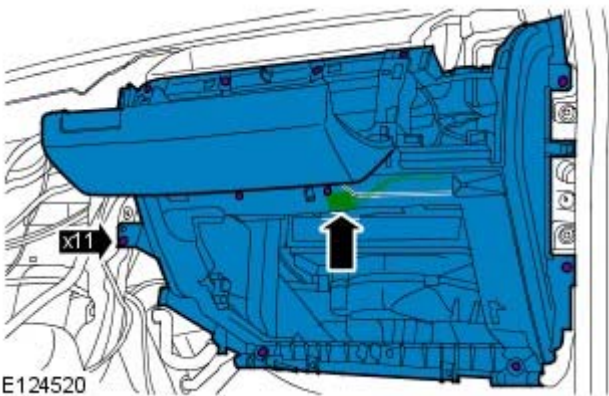
7. Remove the passenger side support bracket lower retaining screws.



E124622

8. Remove the instrument panel passenger side reinforcement.

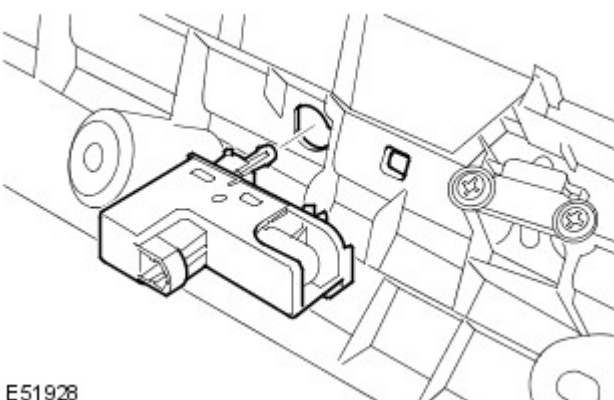
- Remove the 11 Torx screws.
- Disconnect the electrical connector.



E124520

9. NOTE: Do not disassemble further if the component is removed for access only.

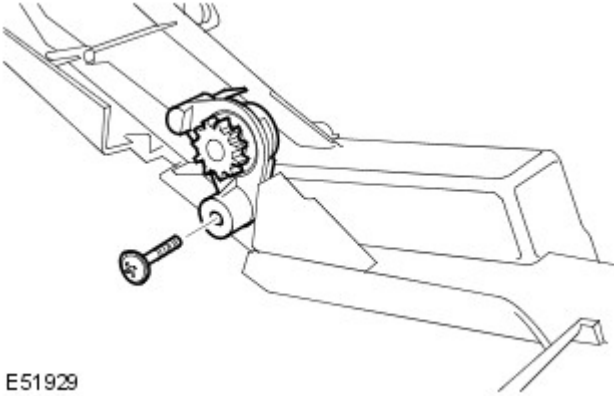
Remove the glove compartment lamp.



E51928

10. Remove the glove compartment damper.

- Remove the Torx screw.

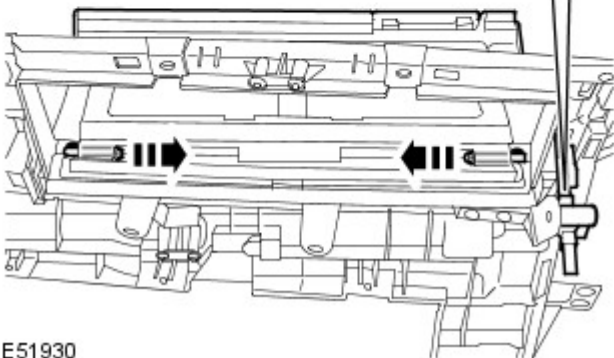
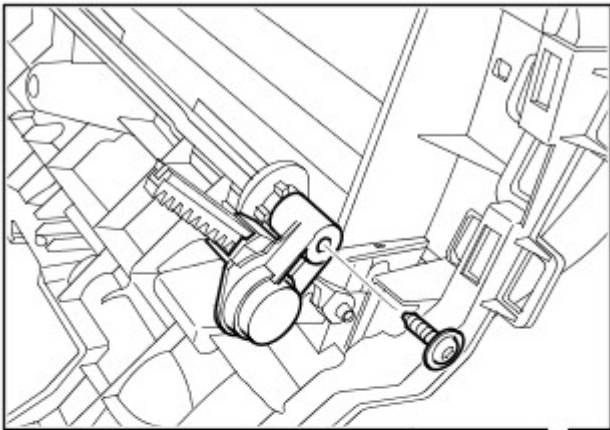


E51929

11. NOTE: Note the position of the hinge pin and spring prior to removal.

Remove the stowage compartment lid.

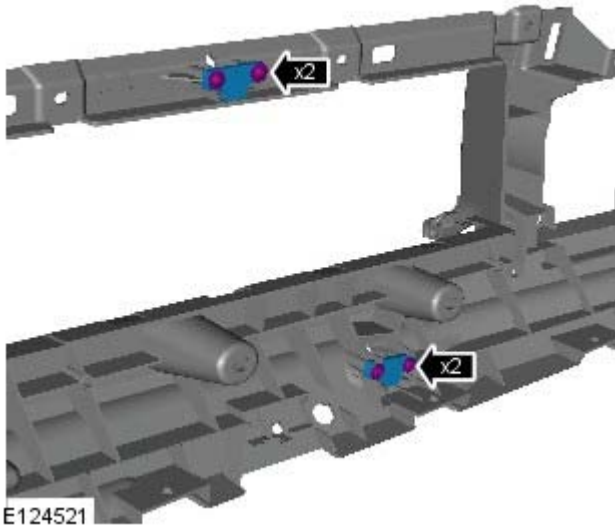
- Remove the 2 hinge pins.
- Release the 2 hinge springs.
- Remove the Torx screw and remove the damper.



E51930

12. Remove the glove and stowage compartment strikers.

- Remove the 4 Torx screws.



Installation

1. Install the glove compartment damper.
 - Tighten the Torx screw.
2. Install the stowage compartment lid.
 - Install the damper and tighten the Torx screw.
 - Attach the hinge springs.
 - Install the hinge springs.
3. Install the glove and stowage compartment strikers.
 - Tighten the screws.
4. Install the glove compartment lamp.
5. Install the instrument panel passenger side reinforcement.
 - Connect the electrical connector.
 - Tighten the Torx screws.
6. Install the passenger side support bracket lower retaining screws.
7. Install the passenger side footwell duct.
 - Install the clip.
8. Install the stowage compartment tray.
 - Secure the clips.
9. Install the side trim panel and attach the door weatherstrip.
10. Install the glove compartment.
For additional information, refer to: [Glove Compartment](#) (501-12 Instrument Panel and Console, Removal and Installation).
11. Install the instrument panel center reinforcement.
For additional information, refer to: [Instrument Panel Center Reinforcement](#) (501-12 Instrument Panel and Console, Removal and Installation).
12. Install the PAD switch.
For additional information, refer to: [Passenger Air Bag Deactivation \(PAD\) Switch](#) (501-20B Supplemental Restraint System, Removal and Installation).

Instrument Panel and Console - Instrument Panel Center Reinforcement

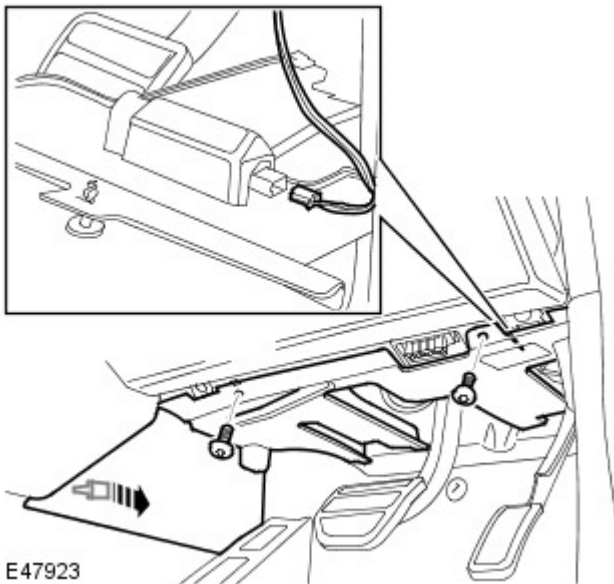
Removal and Installation

Removal

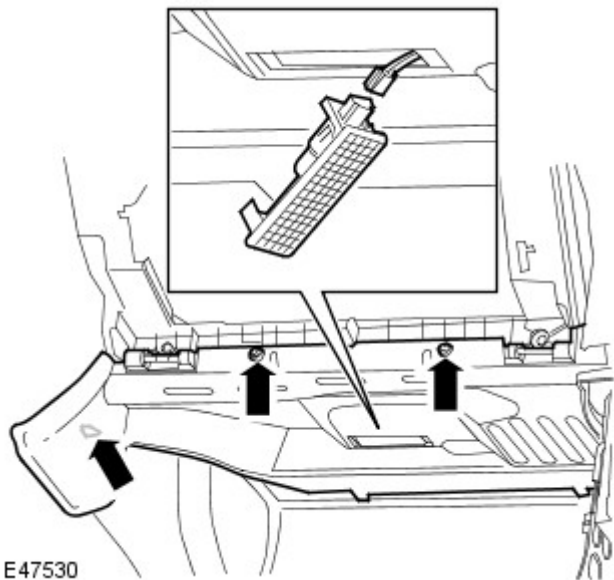
- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

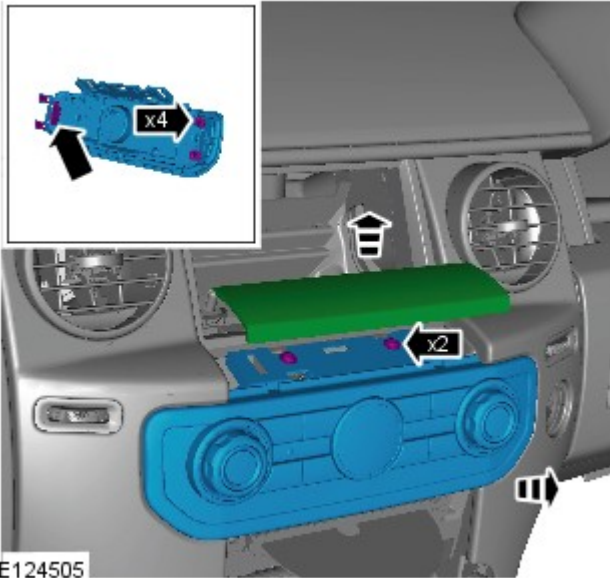
1. Refer to: [Floor Console](#) (501-12 Instrument Panel and Console, Removal and Installation).

2.

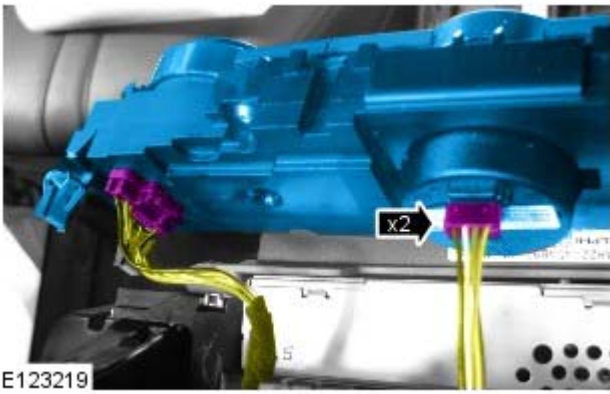


3.

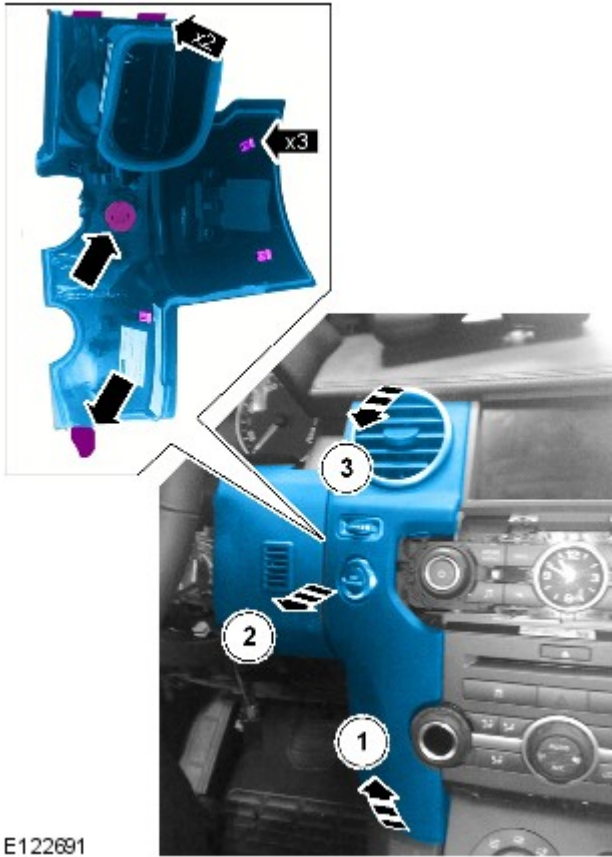




4.

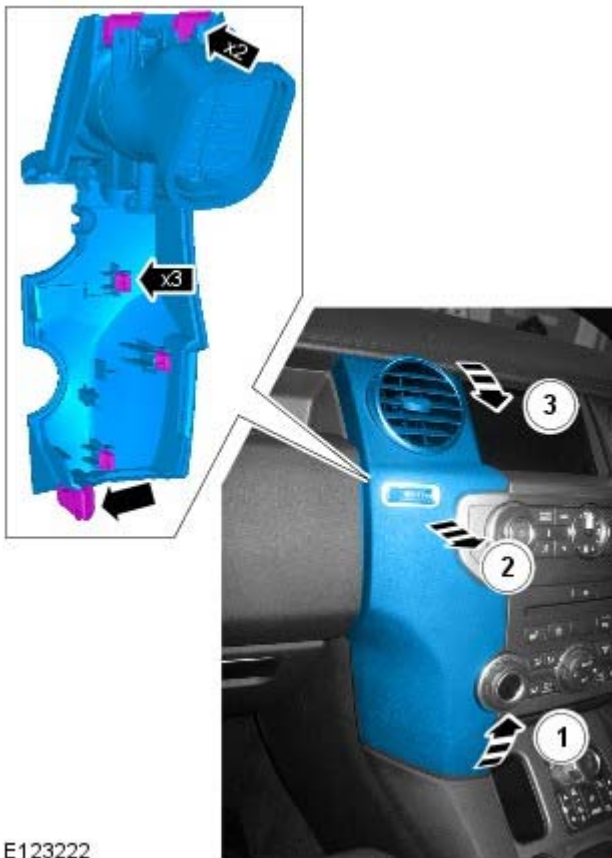


5.



E122691

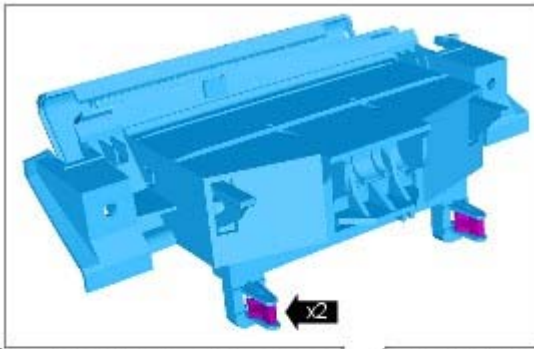
6. **6.** NOTE: LHD shown, RHD similar.



E123222

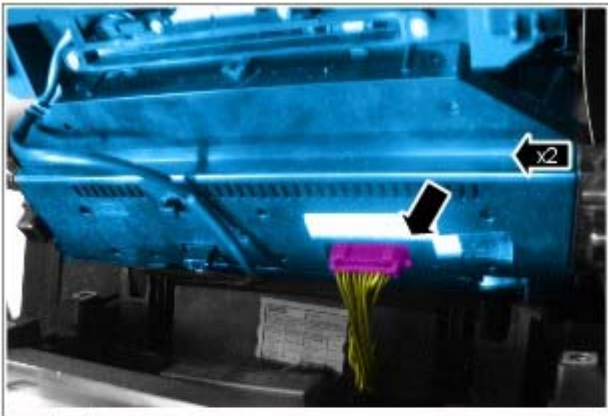
7. **7.** NOTE: RHD shown, LHD similar.

8.



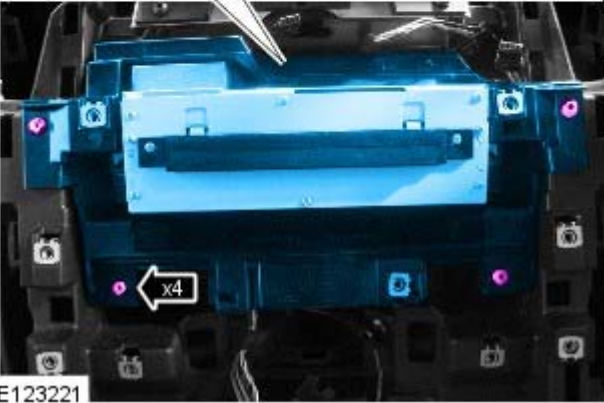
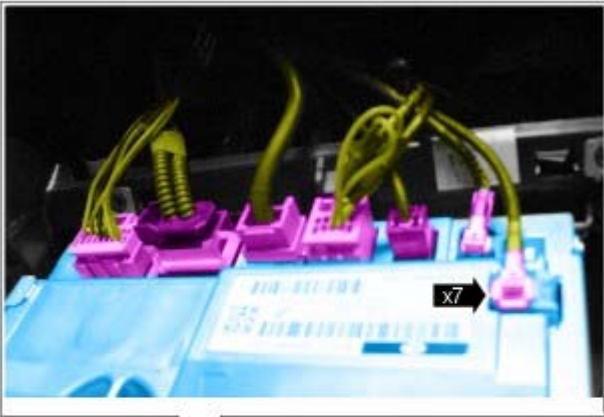
E123298

9.



E123220

10.



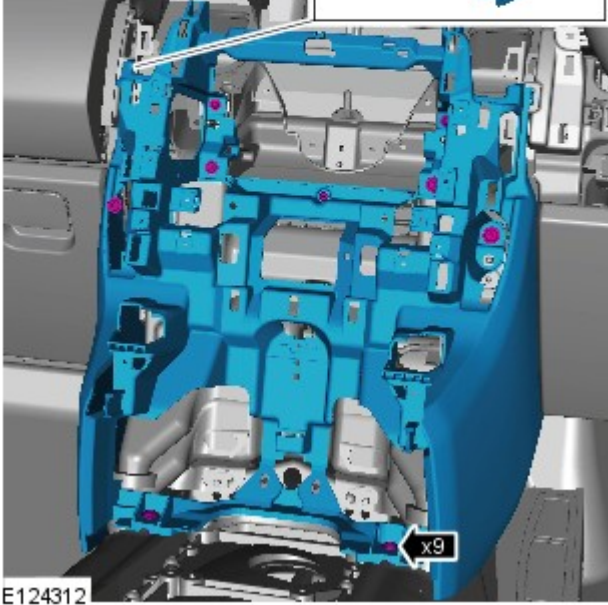
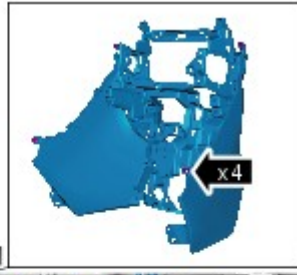
E123221

11.



E 122790

12.




Installation

1. To install, reverse the removal procedure.

Instrument Panel and Console - Glove Compartment

Removal and Installation

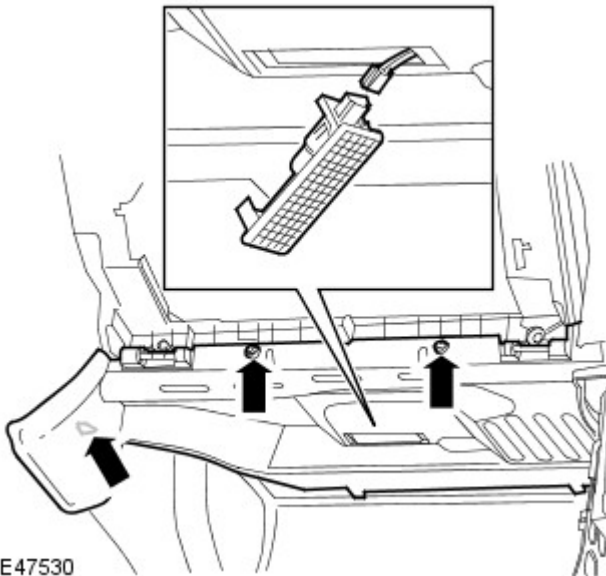
Special Tool(s)	
	Glove compartment hinge pin remover
	501-113

E54897

Removal

1. Remove the closing trim panel.

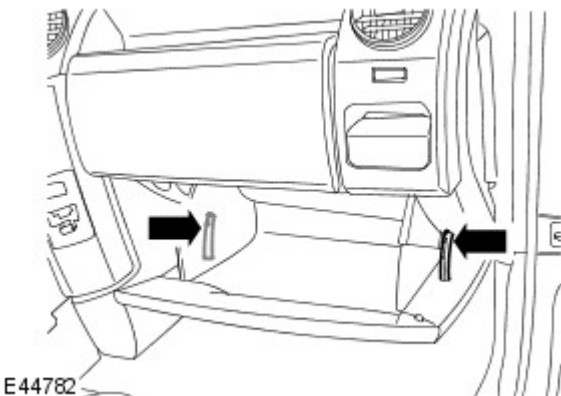
- Release the clip.
- Remove the 2 screws.
- Disconnect the electrical connector.



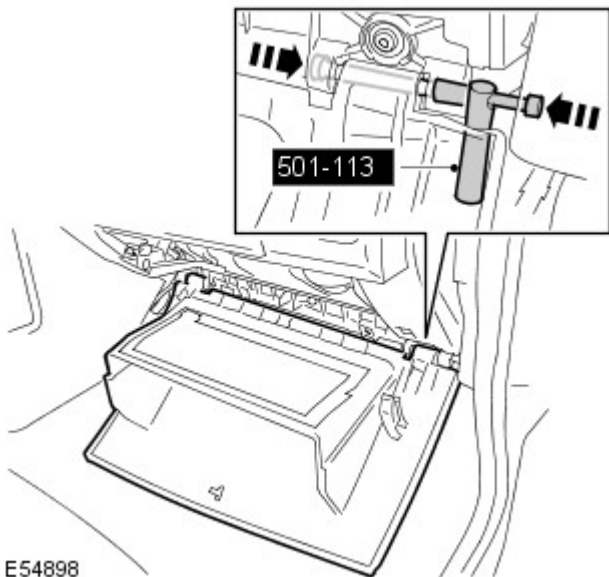
E47530

2. Open the glove compartment to the service condition.

- Release the glove compartment latch stops.



E44782



E54898

3.  CAUTION: If the hinge pin will not release, rotate the pin through 90 degrees to aid removal.

Using the special tool, remove the glove compartment.

- Apply pressure to the head of the hinge pin and install the special tool. Remove the hinge pin.
- Repeat the above procedure for the remaining hinge pin.

Installation

1. Install the glove compartment.
 - Install the hinge pins.
2. Close the glove compartment.
 - Secure the latch stops.
3. Install the closing trim panel.
 - Connect the electrical connector.
 - Secure the clip.
 - Tighten the screws.

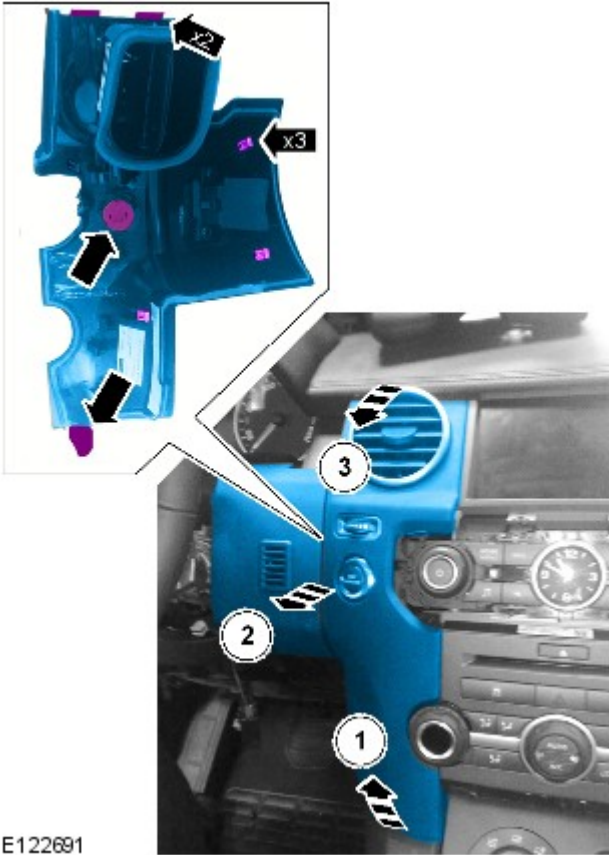
Instrument Panel and Console - Instrument Panel Console Switch Assembly

Removal and Installation

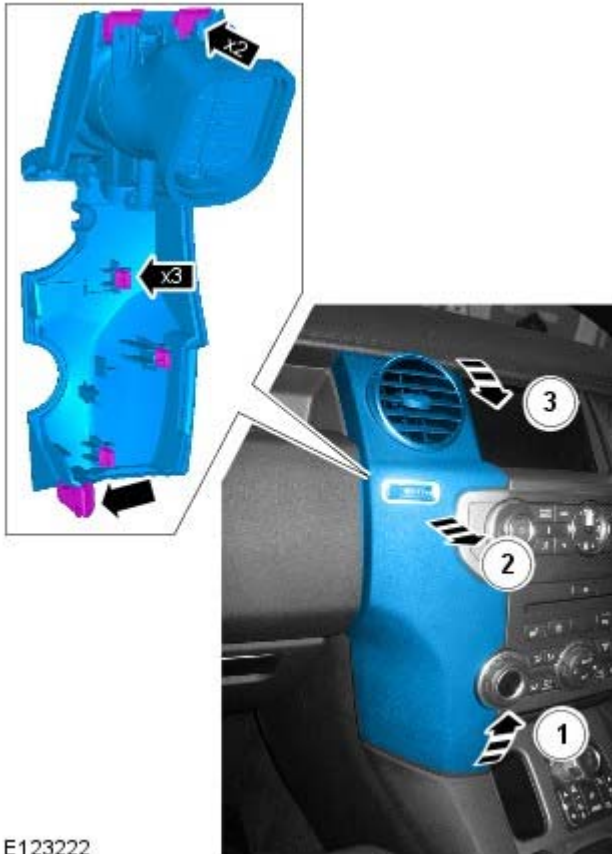
Removal

- NOTE: Removal steps in this procedure may contain installation details.
- NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

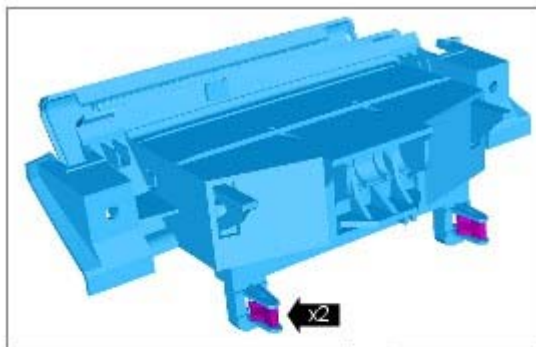
1. 1. NOTE: LHD shown, RHD similar.



E122691

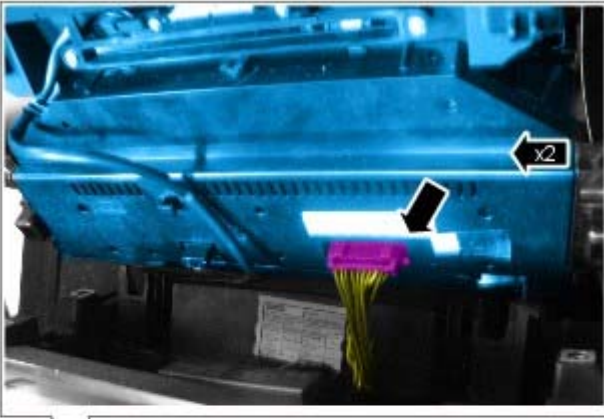


2. **2.** NOTE: RHD shown, LHD similar.



3. **3.** NOTE: Floor console shown removed for clarity.

4.



E123220

Installation

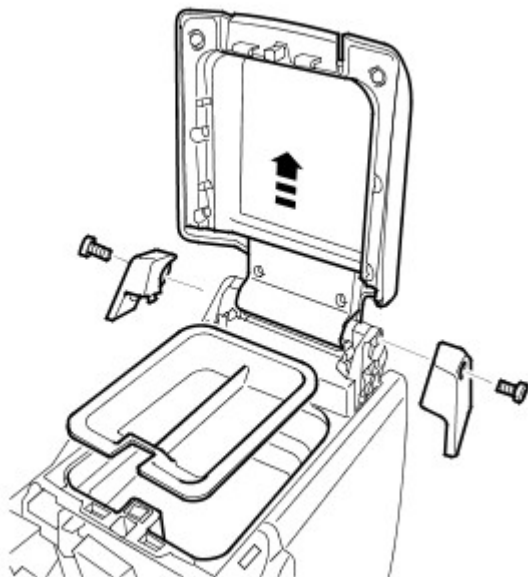
1. To install, reverse the removal procedure.

Instrument Panel and Console - Cool Box

Removal and Installation

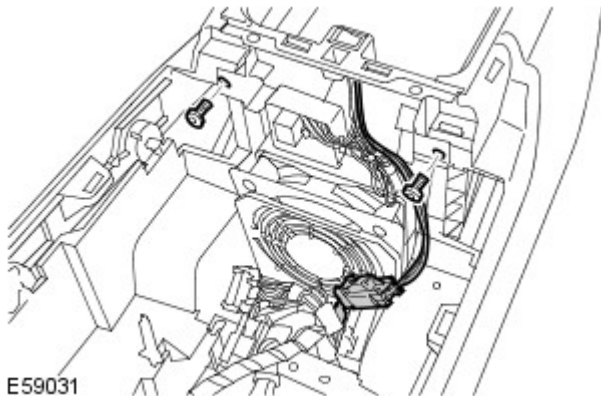
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the floor console upper panel.
For additional information, refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Remove the floor console lid.
 - Open the lid.
 - Remove the 2 Torx bolts.
 - Remove the 2 covers.



E59030

4. Remove the floor console cool box.
 - Remove the 2 Torx screws.
 - Disconnect the electrical connector.



E59031

Installation

1. Install the floor console cool box.
 - Connect the electrical connector.
 - Tighten the screws.
2. Install the floor console lid.
 - Install the covers.
 - Tighten the Torx bolts to 3 Nm (2 lb.ft).
3. Install the floor console upper panel.
For additional information, refer to: [Floor Console Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00,

Handles, Locks, Latches and Entry Systems -

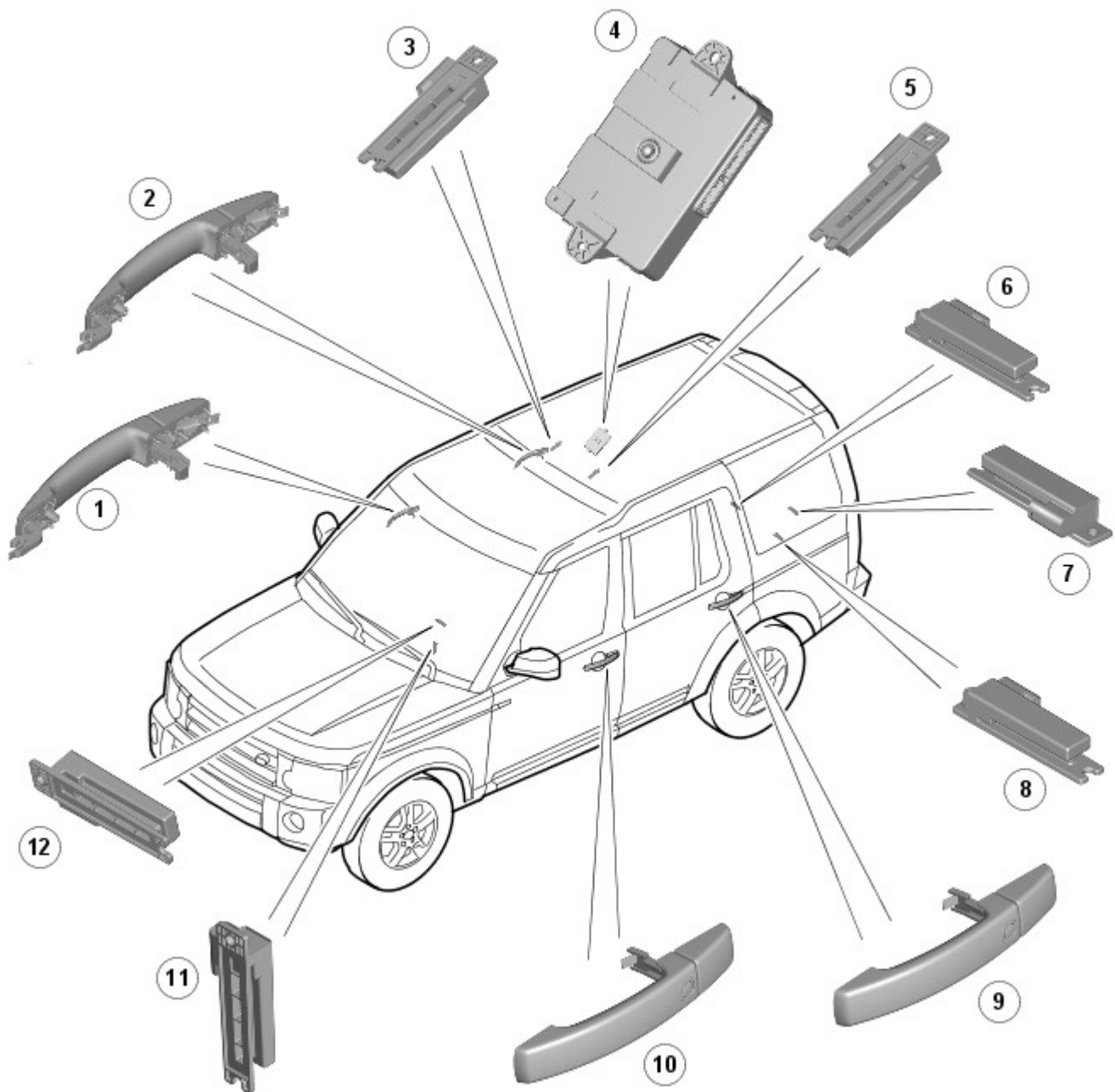
Torque Specifications

Description	Nm	lb-ft
Hood latch release handle bolt	5	3.7
Liftgate latch actuator bolts	10	7
Liftgate latch Torx screws	10	7
Liftgate striker bolts	25	18
Tailgate latch striker bolts	25	18
Tailgate latch Torx screws	25	18
Front door latch Torx screws	10	7
Rear door latch Torx screws	10	7

Handles, Locks, Latches and Entry Systems - Handles, Locks, Latches and Entry Systems

Description and Operation

Passive Entry - Antenna and Keyless Vehicle Module Location



E130381

Item	Part Number	Description
1	-	Door Antenna - right-hand-front
2	-	Door Antenna - right-hand-rear
3	-	Interior Antenna - roof lining
4	-	Keyless Vehicle Module
5	-	Interior Antenna - roof lining
6	-	Interior Antenna - luggage compartment
7	-	Bumper Antenna - rear bumper
8	-	Interior Antenna - luggage compartment
9	-	Door Antenna - left-hand-rear
10	-	Door Antenna - left-hand-front
11	-	Interior Antenna - front compartment (passive start only)
12	-	Interior Antenna - front compartment

OVERVIEW

The hinged panels are secured with latches and strikers. A remotely operated central locking system controls the locking

and unlocking of the door and luggage compartment latches.

A radio frequency Smart Key allows the vehicle to be locked and unlocked by pressing the appropriate handset buttons. Two levels of central locking system are available:

- Remote central locking, and an
- optional passive entry.

The passive entry and associated passive start system allows the driver to unlock and start the vehicle without using a vehicle key in a door-lock or ignition switch. The passive entry system is an optional fitment while the passive start system is a standard fitment on all vehicles. The passive start system is combined with the passive anti-theft immobilization system.

For additional information, refer to: [Anti-Theft - Passive](#) (419-01B Anti-Theft - Passive, Description and Operation).

Emergency access to the vehicle is provided by a concealed key barrel located in the front left-hand door handle. The key barrel is concealed by a plastic cover which can be removed by inserting the blade of the emergency key into a slot in the cover. The removable emergency key blade is located in the Smart Key.

Operation of the key barrel unlocks the vehicle but does not disarm the alarm system. Locking and unlocking conditions using the emergency key in the door key barrel are:

- If the alarm is not armed the vehicle can be centrally unlocked.
- If the alarm is armed the door only can be opened and the alarm will be triggered.
- The vehicle cannot be double locked or the alarm system armed using the emergency key.

The vehicle can be centrally locked and unlocked from inside using the interior handle release levers on the front doors only. The driver can select locking options, single point entry or drive away locking for example, from a menu available on the touch screen.

Central Locking – Radio Frequency Remote System

The radio frequency central locking system provides locking and unlocking from inside the vehicle and outside within a 20 meter range. The system is operated using buttons on the Smart Key, which transmits radio frequency signals to the radio frequency receiver.

Additional buttons on the Smart Key provide for the convenience operation of the headlamp delay, panic alarm and tailgate release.

Depending on vehicle market, functions offered by the Smart Key include:

- Double locking the doors from outside the vehicle if the lock button on the Smart Key is pressed twice within 3 seconds.
- Drive-away locking - switched on or off by the customer using the vehicle security settings menu available on the touch screen.
- Single or two stage unlocking - single-stage unlocking unlocks all doors with a single press; two-stage unlocking unlocks the driver's door only with a single press and all other doors with a second press.

Changing the unlocking mode between single stage and two-stage also affects the unlocking mode for passive entry (see below). The single or two-stage unlocking function can be switched on or off, as can remote global open or close for the electric windows using the vehicle security settings menu available on the touch screen.

The fuel filler flap is locked by the global locking function. It is not locked by drive-away locking, or if doors are locked from inside the vehicle using the handles.

Actuated from the front door levers only, the doors can be locked from inside the vehicle by pressing the interior door release levers inwards and unlocked by pulling the levers. The touch-screen incorporates a valet mode feature which inhibits access to the glove box while also limiting the use of the touch-screen.

On leaving the vehicle with passive entry the user must press an external button on the door handle once to centrally lock the vehicle or twice within 3 seconds to double lock. The user has a further 3 seconds to pull the door handle to check the vehicle is locked without the Smart Key proximity function unlocking the door again. Pulling the handle after the 3 seconds has lapsed will unlock the door as normal.

If any aperture is not fully closed when the locking process is initiated, either passively or by the Smart Key transmitter, the locking function will be inhibited and an audible error indication will be given. If the ignition is left on an audible warning will be given if the user exits the vehicle, if the user attempts to lock the vehicle (ignition on), another audible indication will be given, and the locking function will be inhibited.

If the door is closed without locking and no key left in the car the ignition will be switched off immediately. If the ignition is left on at any time without starting the vehicle it will switch off automatically after 60 minutes.

If the door is opened by the mechanical key, the full alarm system will sound until the user enters the vehicle and presses either:

- the start/stop button, or
- Smart Key unlock button.

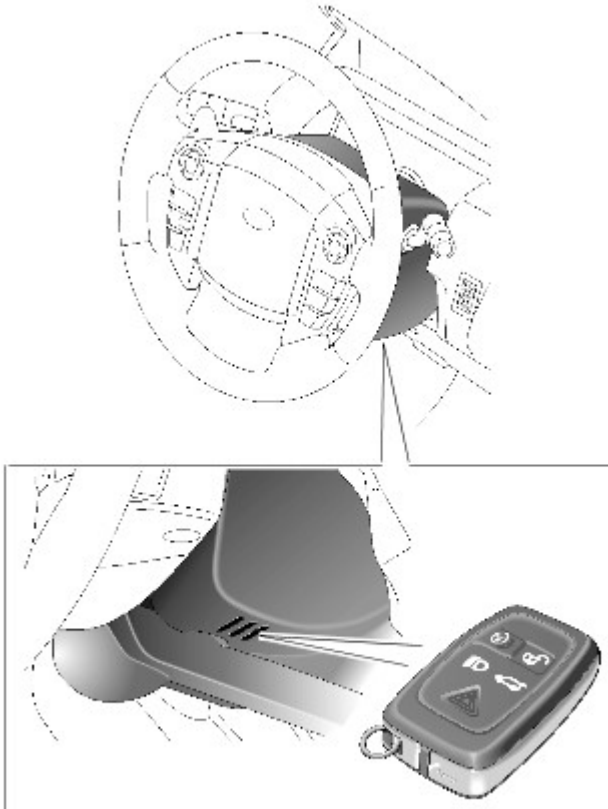
• **NOTE:** If the KVM (keyless vehicle module) fails to locate the Smart Key, a message 'SMART KEY NOT FOUND REFER TO HANDBOOK' will appear in the instrument cluster message center and the keyless start back-up process will have to be used to mobilize and start the vehicle.

Keyless Start Backup

If the vehicle has been unlocked using the emergency key blade or the Smart Key is not detected by the vehicle, it will be necessary to use the keyless start backup to disarm the alarm and start the engine. The following process must be followed in this event:

- Position the Smart Key against the underside of the fascia, on the outboard side of the steering column, with the buttons facing downwards. This is the location of the IAU (immobilizer antenna unit).
- Holding the Smart Key in position and the brake / clutch pedal depressed, press the start/stop button to start the engine.

Smart Key positioned next to immobilizer antenna unit



E129977

This process bypasses the data exchange between the KVM and the [CJB \(central junction box\)](#); this is an inductive process and will operate if the battery in the Smart Key is discharged. A transponder within the Smart Key is detected by the IAU. The IAU confirms the code output from the transponder and communicates this code confirmation with the [CJB](#) via a LIN (local interconnect network) bus connection. The [CJB](#) then initiates the vehicle start process in the normal manner.

PASSIVE ENTRY SYSTEM

The passive entry system is controlled by the KVM and low frequency antennas in each door handle and one in the rear bumper; antennas are also strategically situated within the vehicle. When inside the vehicle, the antennas ensure the Smart Key is always within the active transmission zone of the antennas no matter where the Smart Key is placed inside the vehicle. For this reason the orientation and positioning of the antennas is critical to the correct functioning of the system.

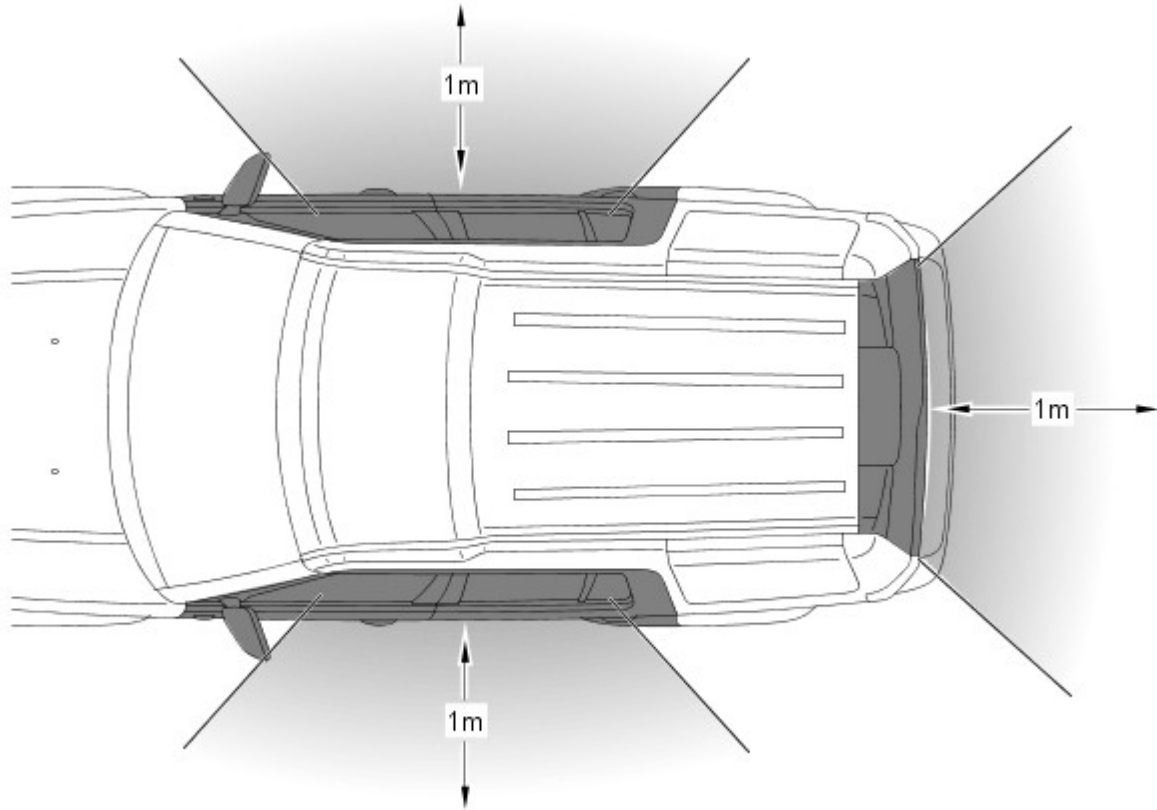
The vehicle can be unlocked without the use of a key-blade or buttons on the Smart Key.

When an external door handle is grasped and the Smart Key is within one meter (3.3ft.) of the handle; the Smart Key receives a low-frequency signal transmitted from the handle.

The Smart Key responds with a radio frequency transmission of its authorization code. The radio frequency signal is received by the Radio-Frequency receiver and passed to the keyless vehicle module which checks and approves the code as valid.

The KVM then drives the fast latch directly to allow the door to be opened. The keyless vehicle module also transmits an unlock request to the [CJB](#). The [CJB](#) then passes an unlock request to the door modules.

Door-handle antenna operating area



E117707

Locking of the vehicle is performed by pressing one of the buttons located on each exterior door handle, with the Smart Key within a one meter range of the vehicle. When the door handle button is pressed, the KVM transmits a low-frequency signal via the handle antenna to the Smart Key. The Smart Key transmits a radio frequency signal which is verified by the KVM and allows the doors to be locked or double locked and the alarm system to be armed.

To double lock the vehicle, the button on the exterior door handle must be pressed twice within three seconds, with the Smart Key within one meter range of the vehicle. If a door, hood or the tailgate door is ajar when an attempt to lock the vehicle is made, an error tone is emitted and no locking action will occur. For additional information, refer to: [Anti-Theft - Active](#) (419-01A Anti-Theft - Active, Description and Operation).

When unlocking the vehicle using passive entry with single stage unlocking selected and a valid Smart key present, grasping the door handle will centrally unlock the vehicle. When the vehicle is configured for two stage unlocking and the drivers door handle is grasped with a valid Smart Key present only the drivers door will unlock, however if a passenger door handle is grasped with a valid Smart Key present the vehicle will centrally unlock.

- NOTE: Placing the key in a metallic container, a metal briefcase for example, may hinder its operation.
- NOTE: Passive locking will only activate if the key is outside the vehicle. If no key is present, two audible error warnings will sound.

To globally close the vehicle pressing and holding the button on the door handle locks the vehicle, arms the alarm and closes all open windows, not the sunroof. The windows will stop closing when the button is released.

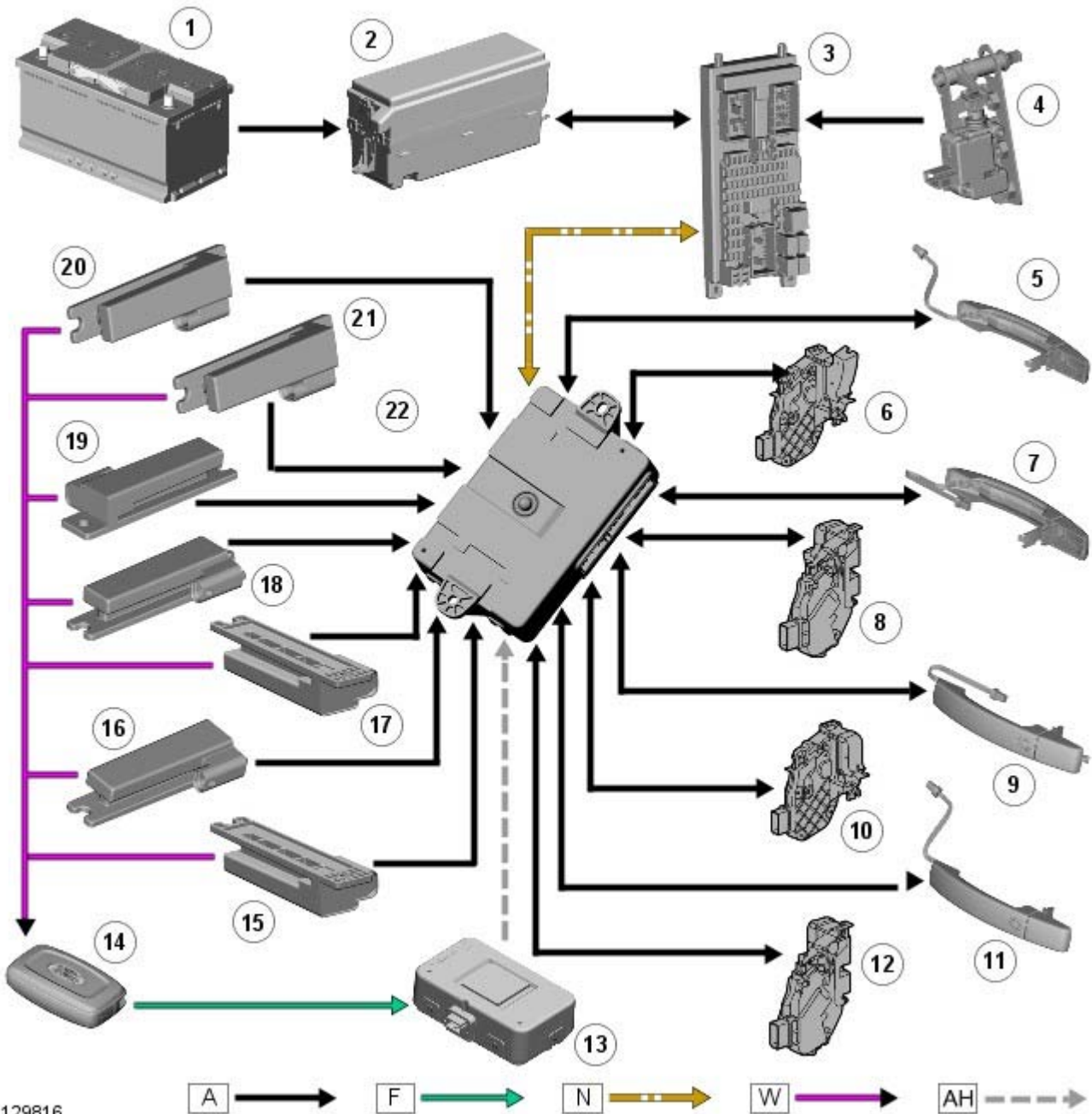
Capacitive Door Handle

The new exterior door operates using the following principle. A capacitive plate is molded internally within the handle, the vehicle exterior body acts as a second capacitive plate; air between the two acts as an insulator. The control electronics within the door handle evaluate the capacitance of the circuit, when a hand interrupts the space between the electrical field is altered and thus the capacitance of the capacitor. This signal is used to trigger the KVM to initiate the unlock process. This signal is calibrated so as not to detect false activations, for example, rain water or soiling.

- NOTE: Extreme water levels can trigger an unlock signal, for example, when washing a locked vehicle with a hose or high powered jet nozzle, providing the key is in the detection zone.

CONTROL DIAGRAM

- NOTE: **A** = Hardwired; **F** = RF transmission; **N** = Medium Speed CAN; **W** = LF transmission; **AH** = Serial Communication Link



E129816



Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	CJB
4	-	Tailgate release switch
5	-	Door handle, lock/unlock switch and antenna – right-hand-front
6	-	Door latch and fast latch - right-hand-front
7	-	Door handle, lock/unlock switch and antenna – left-hand-front
8	-	Door latch and fast latch - left-hand-front
9	-	Door handle, lock/unlock switch and antenna – right-hand-rear
10	-	Door latch and fast latch - right-hand-rear
11	-	Door handle, lock/unlock switch and antenna – left-hand-rear
12	-	Door latch and fast latch - left-hand-rear
13	-	Radio frequency receiver
14	-	Smart Key
15	-	Antenna
16	-	Antenna
17	-	Antenna
18	-	Antenna
19	-	Antenna
20	-	Antenna
21	-	Antenna
22	-	Keyless Vehicle Module

PRINCIPLES OF OPERATION

Passive Entry - Locking/Unlocking Process

The vehicle unlocking procedure is carried out in the following way.

With the key within one meter of the approached door and the handle grasped a signal is sent to the KVM which responds with the following simultaneous actions:

- The KVM energizes the low frequency antenna in the door handle which transmits a 125 KHz signal to the key.
- On receipt of the low frequency signal the Smart Key transmits a radio frequency signal '433.92 MHz Europe' '315 MHz NAS / ROW' containing its authorization code to the RF (radio frequency) receiver.
- The RF receiver relays the code, via a serial communication line, to the KVM which checks and approves the code as valid.
 - The KVM will only respond if the radio frequency signal produced is from a valid key for the vehicle.
- The KVM transmits the unlock request to the [CJB](#) via the medium-speed [CAN \(controller area network\)](#) bus.
- The [CJB](#) confirms and sends the request, via the medium speed [CAN](#) bus, to the front door modules.
- The front door modules respond with the following simultaneous actions:
 - Drive the motors to unlock the front doors.
 - Transmit the door unlock request via a [LIN \(local interconnect network\)](#) data signal to the rear door modules.
- The rear door modules drive the motors to unlock the rear doors.
- When the door handle reaches 80 percent of its travel the handle clutch switch is closed and grounded sending a hardwired switched signal to the KVM.
- The KVM drives the fast latch release motors in the door latch assemblies releasing the door latches as the approached door handle is pulled through its full travel, the door can be opened.

Handles, Locks, Latches and Entry Systems - Locks, Latches and Entry Systems

Diagnosis and Testing

Principle of Operation

For a detailed description of the locks, latches and entry systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Handles, Locks, Latches and Entry Systems](#) (501-14 Handles, Locks, Latches and Entry Systems, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Incorrectly aligned door(s), hood or tailgate ● Fuel filler door lock actuator ● Hood release handle ● Hood release cables ● Hood latch(es) ● Exterior door handle(s) ● Interior door handle(s) ● Cable(s) ● Tailgate release switch ● Rear window release switch 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Wiring connector(s) ● Door lock actuator(s) ● Remote transmitter (key-fob or smart key) ● Central locking switches ● Controller Area Network (CAN) circuits ● Radio frequency (RF) receiver ● Central junction box (CJB) ● Loose or corroded connections

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

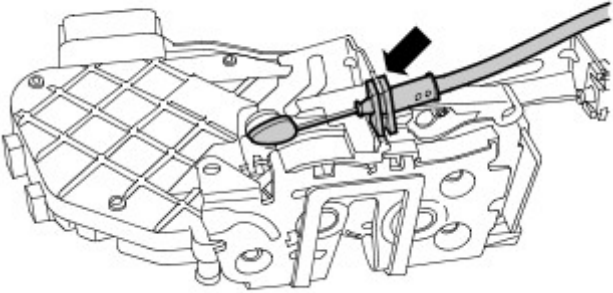
Symptom	Possible causes	Action
Door(s) will not open from outside	<ul style="list-style-type: none"> ● Exterior door handle condition/installation ● Exterior release cable disconnected from exterior door handle or door latch ● Door latch failure 	<ul style="list-style-type: none"> ● Check the exterior door handle condition and installation ● Check the condition and security of the exterior release cable ● Check the operation of the latch GO to Pinpoint Test A.
Door(s) will not open from inside	<ul style="list-style-type: none"> ● Child lock(s) engaged ● Interior door handle condition/installation ● Interior release cable disconnected from interior door handle or door latch ● Door latch failure 	<ul style="list-style-type: none"> ● Check that the child locks are disengaged ● Check the interior door handle condition and installation ● Check the condition and security of the interior release cable ● Check the operation of the latch. GO to Pinpoint Test A.
The message center indicates that the hood, the tailgate or a door is open when it appears to be closed Vehicle indicates a miss-lock when the hood, tailgate and doors appear to be closed	<ul style="list-style-type: none"> ● Incorrect striker alignment/adjustment ● Ajar switch circuit short circuit to ground ● Ajar switch failure 	<ul style="list-style-type: none"> ● Check/adjust the strikers as necessary ● Check for DTCs indicating an ajar switch fault. Refer to the DTC index
Fuel flap does not lock/unlock	<ul style="list-style-type: none"> ● Fuel flap cable detached from body ● Fuel flap actuator detached from mounting bracket ● Fuel flap actuator disconnected ● Fuel flap actuator failure 	<ul style="list-style-type: none"> ● Check the condition and installation of the fuel flap cable ● Check the security of the fuel flap actuator and bracket ● Check the security of the actuator electrical connector ● Check for DTCs indicating a fuel flap actuator fault. Refer to the DTC index

Symptom	Possible causes	Action
Door latching and locking function test	<ul style="list-style-type: none"> ● Door latch ● Cable fault ● Door handle ● Door lock switch ● Wiring harness ● Central junction box (CJB) 	<ul style="list-style-type: none"> • NOTE: Complete the diagnostic steps below to confirm any concern prior replacing the component ● Check for relevant stored DTCs ● Once any DTC related faults have been rectified continue with the diagnostic steps below ● The first component that should be checked when experiencing locking or latching issues are the door latch release cables, then the door latch. These can be tested as a discrete components to confirm if the specific component is working as designed or is demonstrating a fault ● Single door will not open from the outside (but opens from the inside)GO to Pinpoint Test A. ● Single Door Will Not Open From The Inside (but opens from the outside)GO to Pinpoint Test B. ● Door Latching and Locking Function TestGO to Pinpoint Test C. ● No lock / unlock function from key-fobGO to Pinpoint Test E.
Latch mounted door ajar switch test	<ul style="list-style-type: none"> ● Door latch ● Wiring harness ● Instrument cluster 	<ul style="list-style-type: none"> ● Latch Mounted Door Ajar Switch TestGO to Pinpoint Test D.
Vehicle electrical system test	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Wiring connector(s) 	<ul style="list-style-type: none"> ● Vehicle Electrical System TestGO to Pinpoint Test E. ● Check for relevant stored DTCs ● Refer to the electrical circuit diagrams to locate the fault ● Carry out continuity test to confirm circuit integrity

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Driver/Passenger Door Module \(DDM/PDM\)](#) (100-00 General Information, Description and Operation).

Pinpoint Test

PINPOINT TEST A : SINGLE DOOR WILL NOT OPEN FROM THE OUTSIDE (BUT OPENS FROM THE INSIDE)	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: CHECK THE EXTERIOR DOOR RELEASE CABLE TO EXTERIOR DOOR HANDLE IS INSTALLED CORRECTLY	
	<ol style="list-style-type: none"> 1 Remove the door trim panel as necessary. REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation). 2 Confirm the exterior door release cable is correctly installed to the exterior door handle
	<p>Is the cable correctly installed?</p> <p>Yes GO to A2.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation.</p>
A2: CHECK THE EXTERIOR DOOR HANDLE RELEASE CONNECTION TO THE DOOR LATCH	
 <p>E45779</p>	<ol style="list-style-type: none"> 1 Confirm the exterior door handle release connection to the door latch is installed correctly

	<p>Is the exterior door handle release cable installed correctly?</p> <p>Yes GO to Pinpoint Test C.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation.</p>
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PINPOINT TEST B : SINGLE DOOR WILL NOT OPEN FROM THE INSIDE (BUT OPENS FROM THE OUTSIDE)

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
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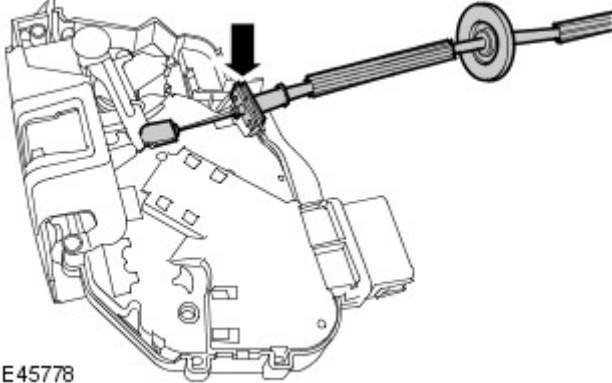
B1: CHECK THE INTERIOR DOOR RELEASE CABLE TO INTERIOR DOOR HANDLE IS INSTALLED CORRECTLY

 <p>E139354</p>	<p>• NOTE: Figure A - Child lock off position shown</p> <p>1 Make sure the child lock is disengaged (rear door only)</p>
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	<p>2 Remove the door trim panel as necessary REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).</p> <p>3 Confirm the interior door release cable is correctly installed to the interior door handle</p>
--	--




	<p>Is the cable correctly installed?</p> <p>Yes GO to B2.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation</p>
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B2: CHECK THE INTERIOR DOOR HANDLE RELEASE CONNECTION TO THE DOOR LATCH

 <p>E45778</p>	<p>1 Confirm the interior door handle release connection to the door latch is installed correctly</p>
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	<p>Is the interior door handle release cable installed correctly?</p> <p>Yes GO to Pinpoint Test C.</p> <p>No Connect the door release cable correctly. If the cable is damaged, install a new door release cable. Test the system for normal operation.</p>
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PINPOINT TEST C : DOOR LATCHING AND LOCKING FUNCTION TEST

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p>C1: DOOR LATCH TEST</p> <p>• NOTE: Test as a single component to ensure that the door latch is not replaced unnecessarily, when another component may be at fault</p>	<ol style="list-style-type: none"> 1 Remove door trim from door REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation). 2 Remove module plate / closing panel from door 3 Remove latch module from door REFER to: (501-14 Handles, Locks, Latches and Entry Systems) Front Door Latch (Removal and Installation), Rear Door Latch (Removal and Installation). 4 Inspect latch module for any visual damage 5 Disconnect interior release bowden cable at door latch 6 Disconnect exterior release bowden cable at door latch 7 With the latch in hand, connect the electrical connector(s) to connect door latch to door harness <p>• NOTE: THE LATCH IS NOW READY TO TEST</p> <ol style="list-style-type: none"> 8 Close all vehicle doors except the door being investigated
<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">1</div>  </div> <hr/> <div style="display: flex; align-items: center; margin-bottom: 10px;"> <div style="display: flex; align-items: center; margin-right: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">2</div> <div style="font-size: 48px; margin-right: 10px;">X</div> </div>  </div> <hr/> <div style="display: flex; align-items: center;"> <div style="display: flex; align-items: center; margin-right: 10px;"> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">3</div> <div style="font-size: 48px; margin-right: 10px;">✓</div> </div>  </div> </div> <p>E139349</p>	<p>• NOTE: Figure 1 - Unlatched position shown</p> <p>• NOTE: Figure 2 - First safety latched position shown</p> <p>• NOTE: Figure 3 - Fully latched position shown</p> <p>• NOTE: Test will not work if latch is only in first safety latch position</p> <ol style="list-style-type: none"> 9 Rotate latch claw (using a small screw driver or similar) to the fully latched position (Figure 3)



• NOTE: Unlocked position shown

10 Confirm that the latch interior release lever is in the unlocked position as shown



• NOTE: Locked position shown

11 Press the **lock** button on the key-fob or smart key

Does the latch interior release lever move from the unlocked position to the locked position?

Yes

[GO to C2.](#)

No

If this is a repeat test and the vehicle electrical test section has been completed and confirmed that vehicle is working correctly, then replace the door latch. If replacing latch as part of a warranty claim, please quote reference code **LKINOP** in the technician comments section of the warranty claim

Does the latch interior release lever move from the unlocked position to the locked position?

Yes

[GO to C2.](#)

No

If this is a repeat test and the vehicle electrical test section has been completed and confirmed that vehicle is working correctly, then replace the door latch. If replacing latch as part of a warranty claim, please quote reference code **LKINOP** in the technician comments section of the warranty claim

C2: TEST 1 DOOR LATCH

 <p>E139351</p>	<p>• NOTE: Locked position shown</p> <p>1 With the latch in the locked state (i.e. the latch interior release lever is in the locked position), press the key-fob or smart key unlock button</p>
	<p>Does the latch interior release lever move from the locked position to the unlocked position?</p> <p>Yes GO to C3.</p> <p>No GO to Pinpoint Test E. If pinpoint test E has been completed and confirmed that vehicle is correctly supplying signals to latch, then replace the door latch. If replacing latch as part of a warranty claim, please quote reference code UNLKINOP in the technician comments section of the warranty claim</p>
<p>C3: TEST 2 DOOR LATCH</p>	
 <p>E139352</p>	<p>• NOTE: Fully latched position shown</p> <p>1 With the latch in its unlocked state, push the latch exterior release lever against its return spring, whilst simultaneously applying a light pressure to release the latch claw using a small screw driver or similar</p>
	<p>Does the latch claw release?</p> <p>Yes GO to C4.</p> <p>No Repeat tests C2 and C3 to confirm the fault. GO to C2. If the repeat test has confirmed that the exterior release lever will not release the claw on an unlocked latch replace the door latch. If replacing latch as part of a warranty claim, please quote reference code EXTINOP in the technician comments section of the warranty claim</p>
<p>C4: TEST 3 DOOR LATCH</p>	



E139353

• NOTE: Fully latched position shown

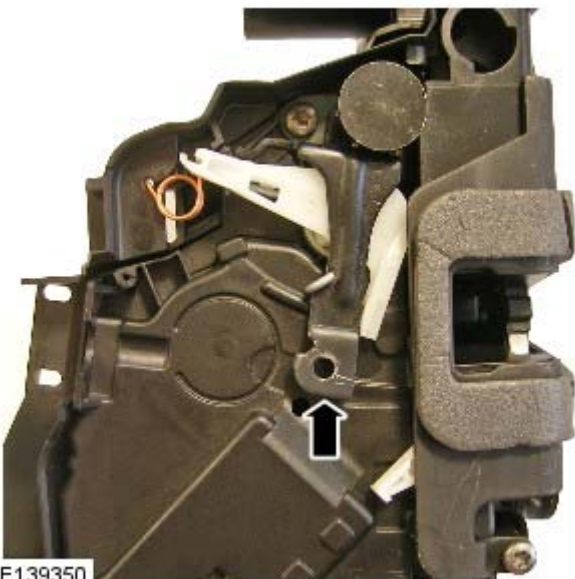
- 1 Using a small screw driver or similar, rotate latch claw to the second fully latched position



E139354


• NOTE: Figure A - Child lock off position shown

- 2 If testing a rear door latch, ensure that the child lock is turned to the off position




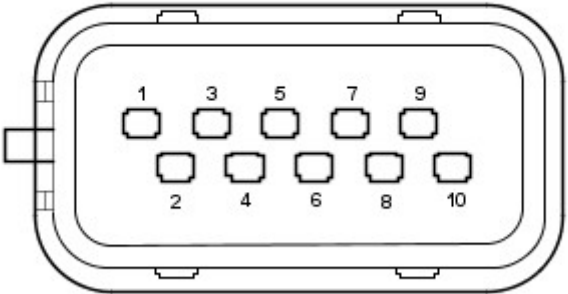


E139350

- 3 Confirm that the latch interior release lever is in the unlocked position as shown

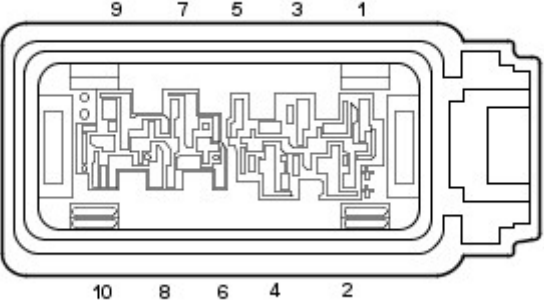
 <p>E139355</p>	<p>4] Whilst the latch is still in its unlocked state, push the latch interior release lever against its return spring, whilst simultaneously applying a light pressure to release the latch claw using a small screw driver or similar</p>
	<p>Does the latch claw release</p> <p>Yes Latch has passed all tests to confirm its correct function. DO NOT REPLACE LATCH as part of any attempts to resolve any locking functionality issues. GO to Pinpoint Test E. To confirm vehicle electrical signal is received by the latch</p> <p>No Repeat this test GO to C4. If repeat test has confirmed that the interior release lever will not release the claw when the latch is in the unlocked state, then replace the latch. If replacing latch as part of a warranty claim, please quote reference code INTINOP in the technician comments section of the warranty claim</p>

PINPOINT TEST D : LATCH MOUNTED DOOR AJAR SWITCH TEST	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
<p>D1: TEST 4 DOOR LATCH</p>	
<p>• NOTE: If a customer is complaining of issues relating to a door ajar signal e.g. door latch won't lock, or alarm system triggering (indicated via DTC's), there may be several components that generate the fault, including</p>	
<ul style="list-style-type: none"> ● Door Latch ajar switch ● Alarm control module ● Central junction box ● Body wiring harness / connectors ● Door wiring harness / connectors 	
<p>• NOTE: To investigate the functioning of the door ajar switch contained within the door latch, to prove or eliminate the door latch mounted door ajar switch as the root cause, follow the process below. This will prevent the unnecessary replacement of a correctly functioning door latch</p>	
	<p>1] Remove door trim from door REFER to: Front Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation) / Rear Door Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).</p> <p>2] Remove module plate / closing panel from door</p> <p>3] Remove latch module from door REFER to: (501-14 Handles, Locks, Latches and Entry Systems) Front Door Latch (Removal and Installation), Rear Door Latch (Removal and Installation).</p> <p>4] Inspect latch module for any visual damage</p>

<p>1</p> 	<ul style="list-style-type: none"> • NOTE: Figure 1 - Unlatched position shown • NOTE: Figure 2 - First safety latched position shown • NOTE: Figure 3 - Fully latched position shown • NOTE: Test will not work if latch is only in first safety latch position <p>5 Using a small screw driver or similar, rotate latch claw to the second fully latched position (figure 3)</p>
<p>2</p> 	
<p>3</p>  <p>E139349</p>	
 <p>E139356</p>	<p>6 Carry out continuity test between terminals 1 and 4 (left side) or 8 and 4 (right side) with claw closed</p>
	<p>Does the continuity test pass?</p> <p>Yes The latch ajar switch is working correctly. Do not replace latch. Investigate for fault elsewhere in vehicle system</p> <p>No Release latch claw and repeat test from step 5 to confirm result. If this is a repeat test and you are sure that the ajar switch does not provide continuity when fully latched. Replace the latch. If replacing latch as part of a warranty claim, please quote reference code AJARINOP in the technician comments section of the warranty claim</p>

PINPOINT TEST E : VEHICLE ELECTRICAL SYSTEM TEST

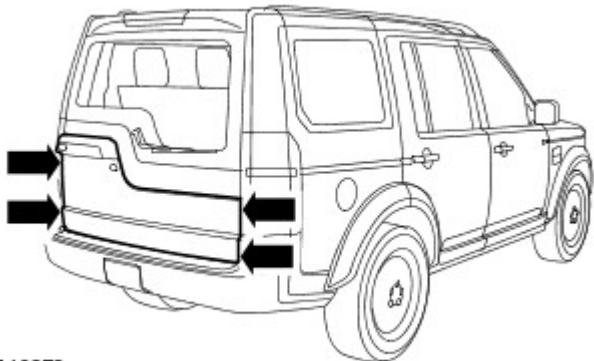
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: TEST 5 LOCK COMMAND	

 <p>E139357</p>	<p>1 Disconnect electrical connector from latch</p>
	<p>2 Close all vehicle doors apart from door being investigated, please note which door, left side or right side is under investigation</p> <p>3 Monitor the circuit for momentary power when locking the vehicle via the key-fob or smart key between terminals 1 and 10 left side or 8 and 10 right side</p>
	<p>Is there momentary power (for approx 8 seconds) between terminals 1 and 10 left side or 8 and 10 right side when locking the vehicle via the key-fob or smart key</p> <p>Yes The vehicle electrical system is locking correctly, providing the signal to the latch. GO to E2.</p> <p>No Refer to the electrical circuit diagrams and investigate why vehicle electrical system is not providing signals to the latch. Using the manufacturer approved diagnostic system check for logged DTCs to localize the fault</p>
<p>E2: TEST 6 UNLOCK COMMAND</p>	
	<p>1 Monitor the circuit for momentary power when unlocking the vehicle via the key-fob or smart key between terminals 1 and 9 left side or 8 and 9 right side</p>
	<p>Is there momentary power (for approx 8 seconds) between terminals 1 and 9 left side and 8 and 9 right side when unlocking the vehicle via the key-fob or smart key</p> <p>Yes The vehicle electrical system is unlocking correctly, providing the signal to the latch. Plug electrical connector back in to latch. Rebuild vehicle and check for correct operation</p> <p>No Refer to the electrical circuit diagrams and investigate why vehicle electrical system is not providing signals to the latch. Using the manufacturer approved diagnostic system check for logged DTCs to localize the fault</p>

Handles, Locks, Latches and Entry Systems - Tailgate Striker Adjustment

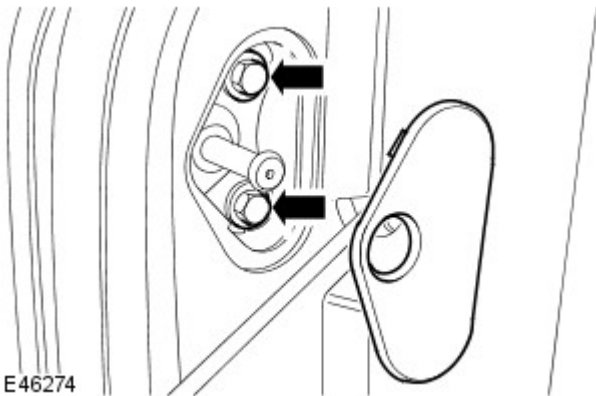
General Procedures

1. Check for an equal gap and alignment to the adjacent panels. If incorrect, follow the adjust procedure below.



E46273

2. Remove the tailgate striker trim panel.
3. Loosen the 2 tailgate striker bolts.



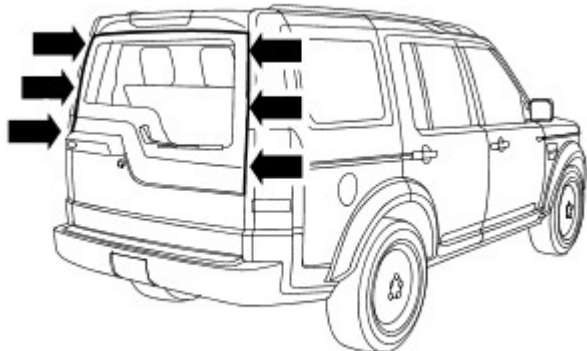
E46274

4. Close the tailgate and check for an equal gap and alignment to the adjacent panels.
5. Open the tailgate and tighten the tailgate striker bolts to 25 Nm (18 lb.ft).
6. Install the tailgate striker trim panel.

Handles, Locks, Latches and Entry Systems - Liftgate Striker Adjustment

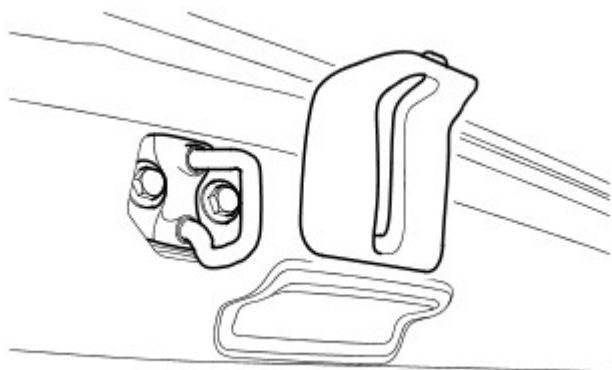
General Procedures

1. Check for an equal gap and alignment to the adjacent panels. If incorrect, follow the adjust procedure below.



E45607

2. Remove the liftgate striker trim panel.



E45600

3. Loosen the 2 liftgate striker bolts.
4. Close the liftgate and check for an equal gap and alignment to the adjacent panels.
5. Open the liftgate and tighten the liftgate striker bolts to 25 Nm (18 lb.ft).
6. Install the liftgate striker trim panel.

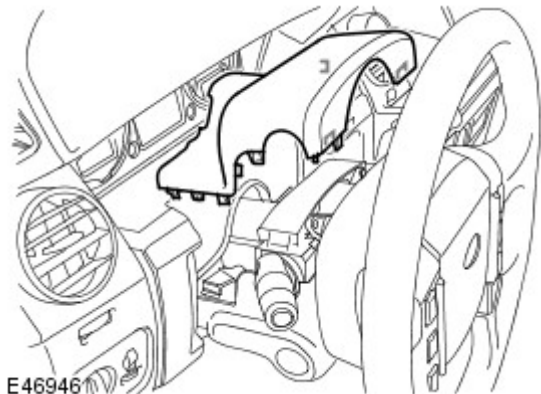
Handles, Locks, Latches and Entry Systems - Ignition Lock Cylinder

Removal and Installation

Removal

• NOTE: This procedure is for removal and installation of the ignition lock cylinder. The ignition lock and door lock cylinders are replaced in sets.

1. Fully extend the steering column for access.
2. Remove the steering column upper shroud.
 - Release the 4 clips.

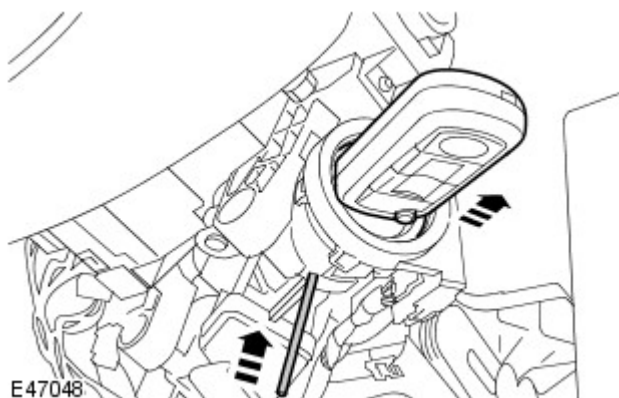


3. Remove the steering column lower shroud.
 - Remove the 3 Torx screws.
 - Release the steering column adjustment lever.

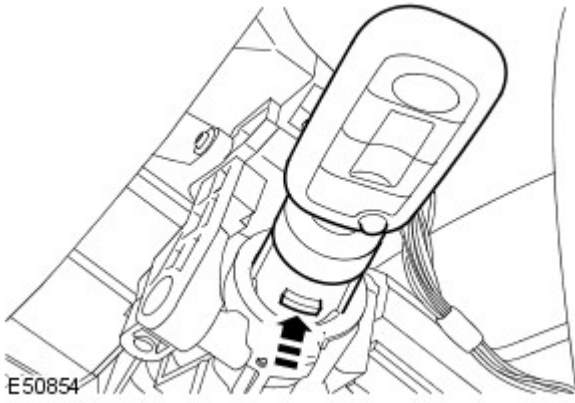


4. Remove the passive coil.
 - Disconnect the electrical connector.
 - Release the 2 clips.

5. Remove the ignition lock cylinder.
 - Turn the ignition key to position 1.
 - Insert a pin, not exceeding 2 mm diameter, through the access hole in the ignition lock cylinder housing to depress the plunger, and release the ignition lock cylinder.



Installation



1. Install the ignition lock cylinder.

- Turn the ignition key to position 1.
- Locate into guides and depress the plunger.

2. Install the passive coil.

- Secure the clips.
- Connect the electrical connector.

3. Install the steering column shrouds.

- Tighten the Torx screws.
- Secure the clips.
- Secure the adjustment lever.

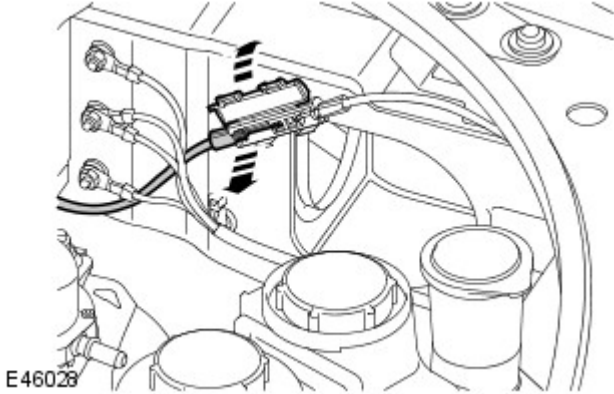
Handles, Locks, Latches and Entry Systems - Hood Latch Release Handle

Removal and Installation

Removal

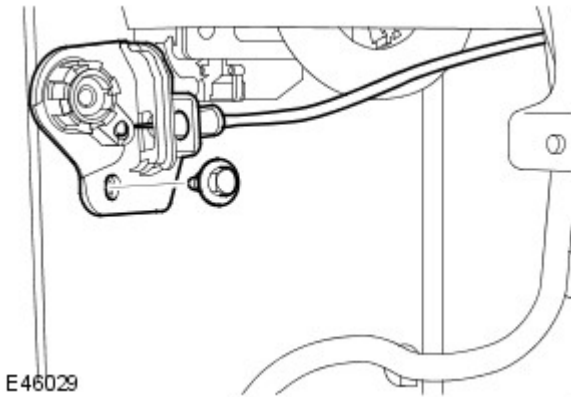
1. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Disconnect the hood release cable from the connecting box.

- Open the connecting box cover.



3. Remove the hood release lever housing.

- Remove the bolt.
- Disconnect the hood release cable.



Installation


1. Install the hood release lever housing.
 - Connect the hood release cable.
 - Tighten the bolt to 5 Nm (3.7 lb.ft).
2. Attach the hood release cable to the connecting box.
 - Close the connecting box cover.
3. Install the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Front Door Latch

Removal and Installation

Removal

1. Remove the window motor and regulator assembly.
For additional information, refer to: Front Door Window Regulator and Motor (501-11, Removal and Installation).

2.  **CAUTION:** Release the exterior door handle and screw cover clips from inside the door.

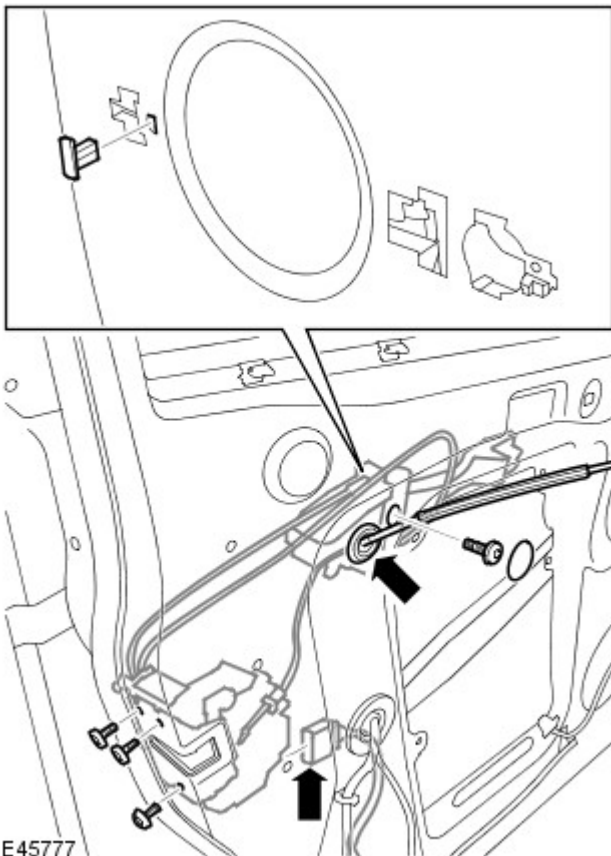
Remove the front door exterior handle.

For additional information, refer to: [Exterior Front Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

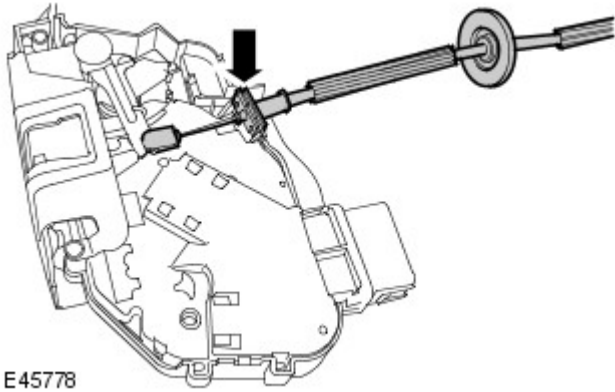
3. Release the remote control cable.
 - Release the grommet.

4. Release the door exterior handle mechanism.
 - Remove the adhesive tape from the access hole.
 - Remove the Torx screw.
 - Remove the locking pin.

5. Remove the front door latch assembly.
 - Disconnect the electrical connector.
 - Remove the 3 Torx screws.



E45777



6. NOTE: Do not disassemble further if the component is removed for access only.

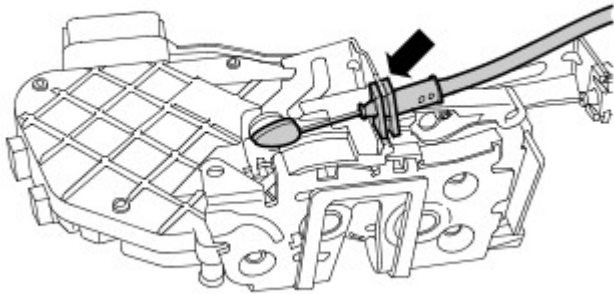
Remove the door latch remote control cable.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.

E45778

7. Release the exterior door handle mechanism cable from the door latch.

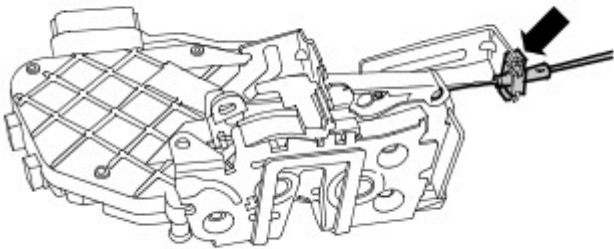
- Release the cable from the abutment bracket.
- Remove the cable from the lever.



E45779

8. LH side: Release the door lock cylinder cable from the door latch.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.



E45780

Installation

1. LH side: Connect the door lock cylinder cable to the door latch.

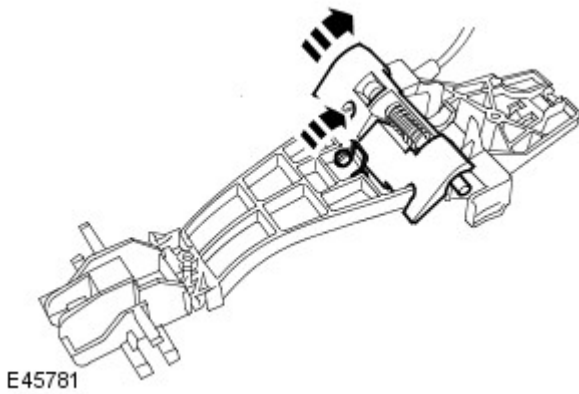
- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

2. Connect the door exterior handle mechanism cable to the door latch.

- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

3. Install the remote control cable to the door latch.

- Connect the cable to the lever.
- Secure the cable to the abutment bracket.



4. Set the exterior handle mechanism.

- Rotate the lever.
- Engage the retaining tang.

5. Install the front door latch assembly.

- Tighten the Torx screws to 10 Nm (7 lb.ft).
- Connect the electrical connector.

6. Install the door exterior handle mechanism.

- Position the mechanism to the door.
- Fit the locking pin.
- Fit and tighten the Torx screw.

7. LH side: Position the control cables into the retainers.

8. Position the remote control cable to the door.

- Install the grommet.

9. Install the front door exterior handle.

For additional information, refer to: [Exterior Front Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

10. Install the window motor and regulator assembly.


For additional information, refer to: Front Door Window Regulator and Motor (501-11, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Rear Door Latch

Removal and Installation

Removal

1. Remove the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

2.  **CAUTION:** Release the exterior door handle and screw cover clips from inside the door.

Remove the rear door exterior handle.

For additional information, refer to: [Exterior Rear Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

3. Release the remote control cable.

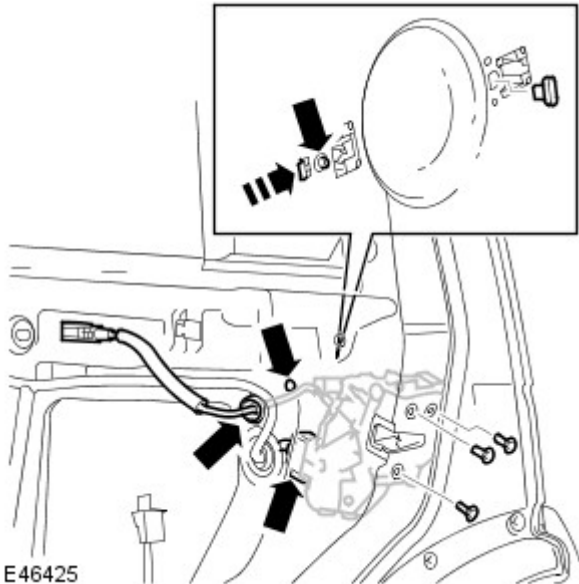
- Release the grommet.

4. Release the door exterior handle mechanism.

- Remove the 2 Torx screws.
- Remove the locking pin.

5. Remove the rear door latch assembly.

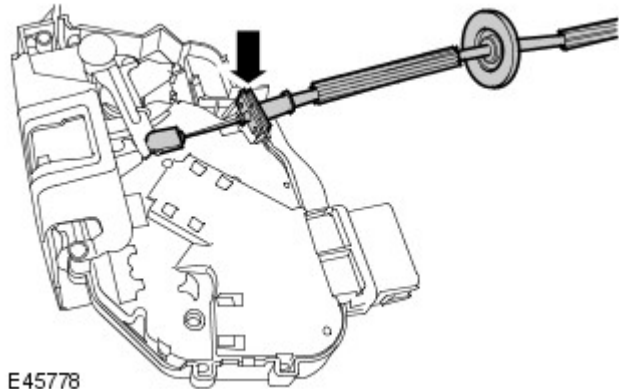
- Disconnect the electrical connector.
- Remove the 3 Torx screws.



6. **NOTE:** Do not disassemble further if the component is removed for access only.

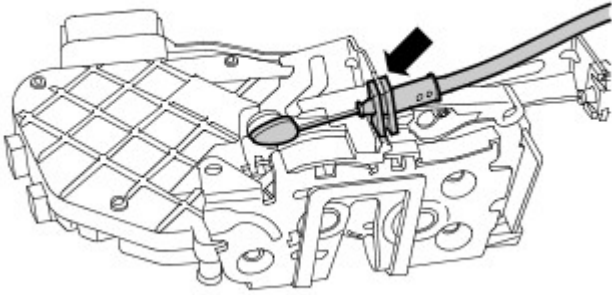
Remove the door latch remote control cable.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.



7. Release the exterior door handle mechanism cable from the door latch.

- Release the cable from the abutment bracket.
- Remove the cable from the lever.



E45779

Installation

1. Connect the door exterior handle mechanism cable to the door latch.

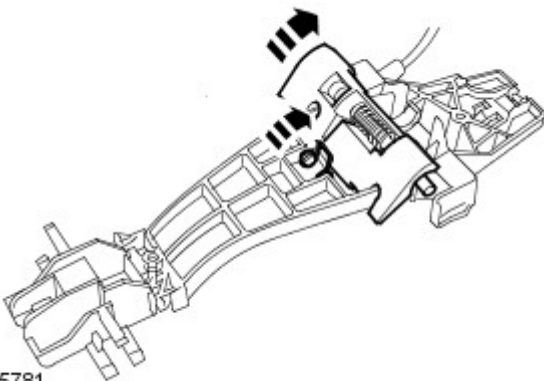
- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

2. Install the remote control cable to the door latch.

- Connect the cable to the lever.
- Secure the cable to the abutment bracket.

3. Set the exterior handle mechanism.

- Rotate the lever.
- Engage the retaining tang.



E45781

4. Install the rear door latch assembly.

- Tighten the Torx screws to 10 Nm (7 lb.ft).
- Connect the electrical connector.

5. Install the door exterior handle mechanism.

- Position the mechanism to the door.
- Fit the locking pin.
- Install and tighten the Torx screws.

6. Position the remote control cable to the door.

- Install the grommet.

7. Install the rear door exterior handle.

For additional information, refer to: [Exterior Rear Door Handle](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).

8. Install the rear door window motor and regulator assembly.
For additional information, refer to: [Rear Door Window Regulator and Motor](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).

Handles, Locks, Latches and Entry Systems - Liftgate Latch

Removal and Installation

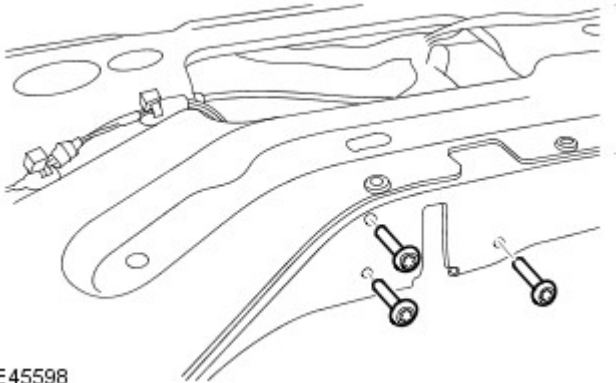
Removal

1. Remove the tailgate trim panel.
For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. Remove the tailgate water shedder.

3. Release the liftgate latch.

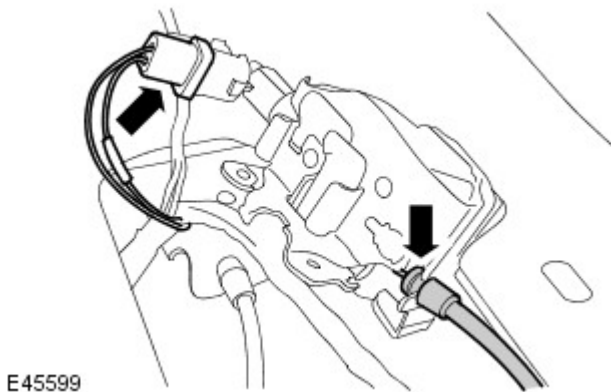
- Remove the 3 Torx screws.



E45598

4. Remove the liftgate latch.

- Disconnect the electrical connector.
- Release the liftgate latch to actuator cable.



E45599

Installation

1. Install the liftgate latch.

- Attach the liftgate latch to actuator cable.
- Connect the electrical connector.
- Tighten the Torx screws to 10 Nm (7 lb.ft).

2. Install the tailgate water shedder.

3. Install the tailgate trim panel.

For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Adjust the liftgate striker.

For additional information, refer to: [Liftgate Striker Adjustment](#) (501-14 Handles, Locks, Latches and Entry Systems, General Procedures).

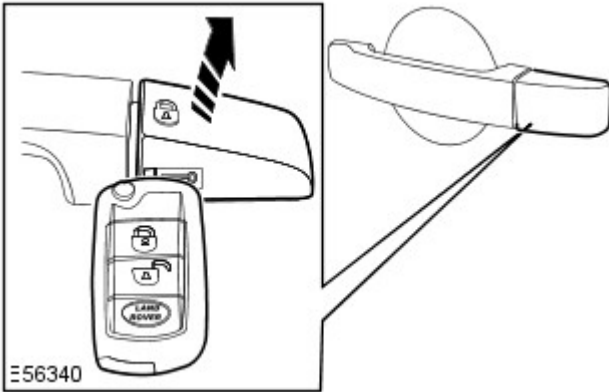
Handles, Locks, Latches and Entry Systems - Door Lock Cylinder

Removal and Installation

Removal

1. Remove the front door lock cylinder cover.

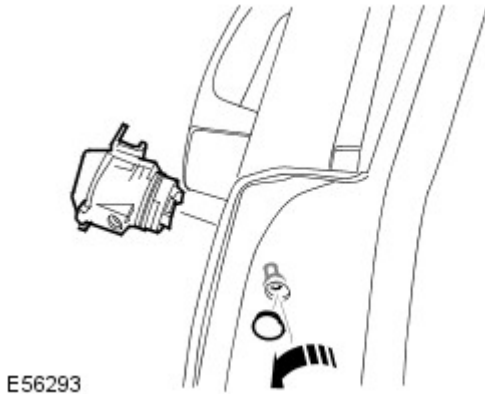
- Use the ignition key.



2. NOTE: The Torx screw remains in the door lock housing.

Remove the front door lock cylinder.

- Open the door.
- Remove the access plug.
- Loosen the Torx screw to release the lock.



Installation

1. To install, reverse the removal procedure.

Handles, Locks, Latches and Entry Systems - Tailgate Latch

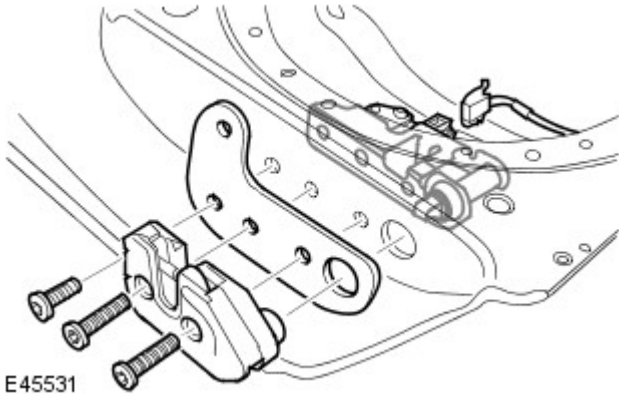
Removal and Installation

Removal

1. Remove the tailgate speaker assembly.
For additional information, refer to: [Tailgate Speaker](#) (415-03 Speakers, Removal and Installation).

2. Remove the tailgate latch assembly.

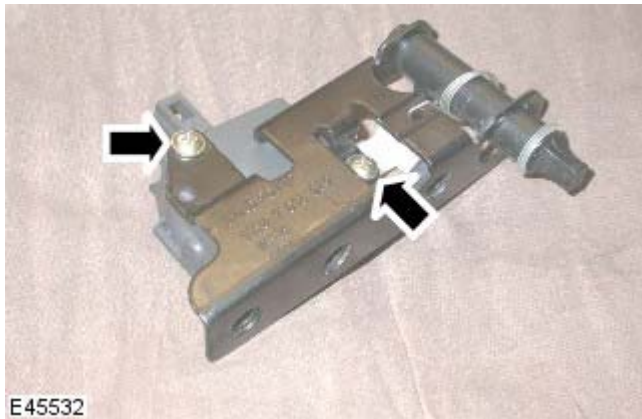
- Remove the 3 Torx bolts.
- Disconnect the electrical connector.
- Remove the latch.
- Remove the latch plate.
- Remove the latch actuator assembly.



3. NOTE: Do not disassemble further if the component is removed for access only.

Remove the latch actuator.

- Remove the 2 screws.



Installation

1. Install the latch actuator.

- Tighten the screws.

2. Install the tailgate latch assembly.

- Install the latch actuator assembly.
- Install the latch plate.
- Install the latch.
- Tighten the Torx screws to 25 Nm (18 lb.ft).
- Connect the electrical connector.

3. Install the tailgate speaker assembly.

For additional information, refer to: [Tailgate Speaker](#) (415-03 Speakers, Removal and Installation).

4. Adjust both the tailgate strikers.

For additional information, refer to: [Tailgate Striker Adjustment](#) (501-14 Handles, Locks, Latches and Entry Systems, General Procedures).

Handles, Locks, Latches and Entry Systems - Exterior Front Door Handle

Removal and Installation

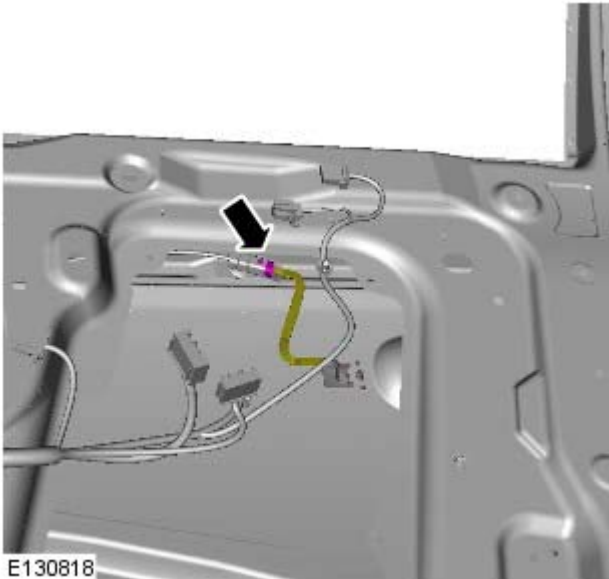
Removal

- NOTE: This procedure details removal and installation of both the LH and RH exterior front door handles.
- NOTE: If the exterior handle is to be removed in conjunction with additional door internal items, then it is recommended that the exterior handle and screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.

1. NOTE: Vehicles with passive entry system.

Remove the window regulator assembly.
For additional information, refer to: [Front Door Window Regulator and Motor \(501-11, Removal and Installation\)](#).

2. Disconnect the electrical connector.



3. NOTE: All vehicles.

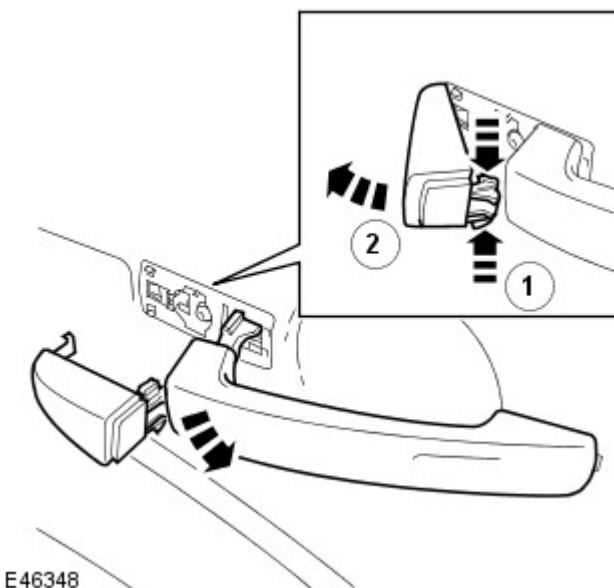
LH side: Remove the private lock.
For additional information, refer to: [Door Lock Cylinder \(501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation\)](#).

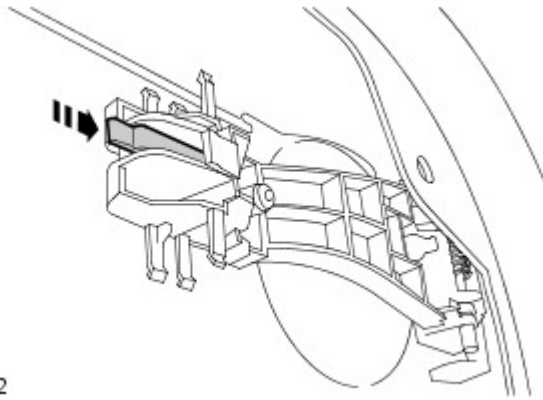
4. NOTE: Removal of the screw cover may break the retaining clips.

- NOTE: If the screw cover is to be removed in conjunction with additional door internal items, then it is recommended that the screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.

RH side: Remove the screw cover.

- Release the 2 clips.





E66202

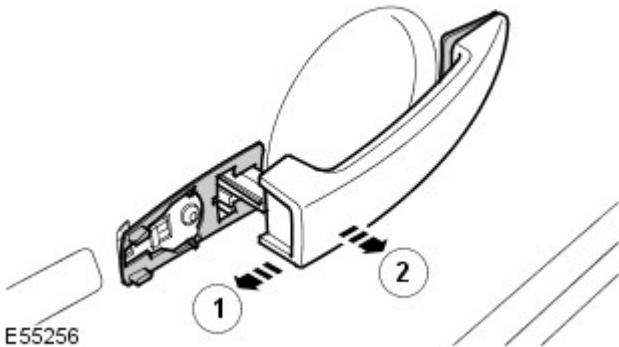
5. To remove the exterior front door handle, after removal of the door trim pad and regulator.

- Using a nylon mallet, carefully release the clip.
- Remove the 2 gaskets.

6. NOTE: Vehicles without passive entry system.

To remove the exterior front door handle, without removal of the door trim pad.

- Slide the handle firmly rearward, then pivot the handle away from the door to remove it.
- Remove the 2 gaskets.

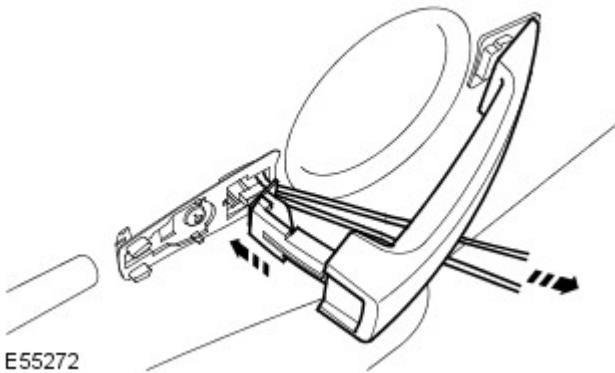


E55256

Installation

1. NOTE: Use a length of cord to hold the lock lever against spring pressure while engaging the outside handle.

To install, reverse the removal procedure.



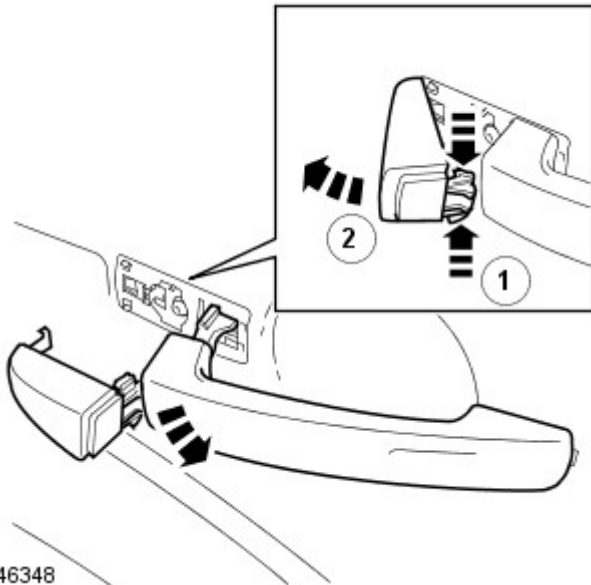
E55272

Handles, Locks, Latches and Entry Systems - Exterior Rear Door Handle

Removal and Installation

Removal

• NOTE: If the exterior handle is to be removed in conjunction with additional door internal items, then it is recommended that the exterior handle and screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.



1. NOTE: Removal of the screw cover may break the retaining clips.

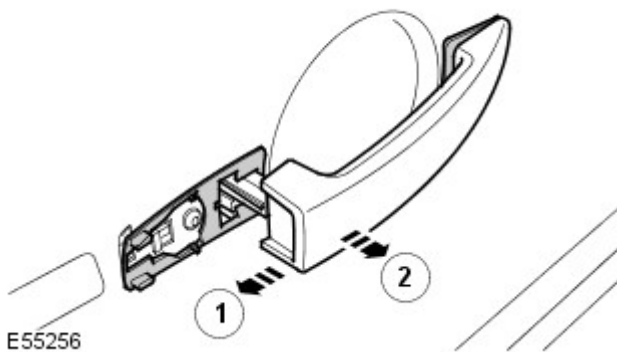
• NOTE: If the screw cover is to be removed in conjunction with additional door internal items, then it is recommended that the screw cover be released from the inside of the door, after removal of the door trim pad, regulator and motor.

Remove the screw cover.

- Release the 2 clips.

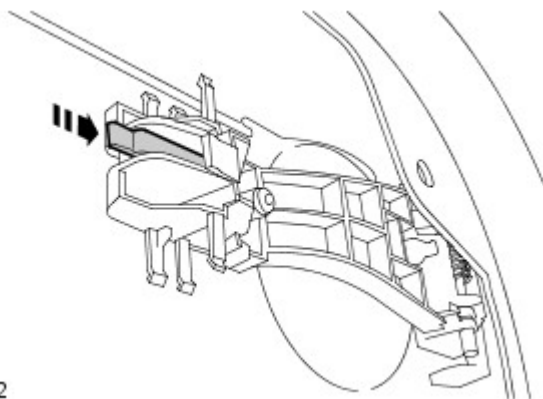
2. To remove the exterior rear door handle, without removal of the door trim pad.

- Slide the handle firmly rearward, then pivot the handle away from the door to remove it.
- Remove the 2 gaskets.



3. To remove the exterior rear door handle, after removal of the door trim pad and regulator.

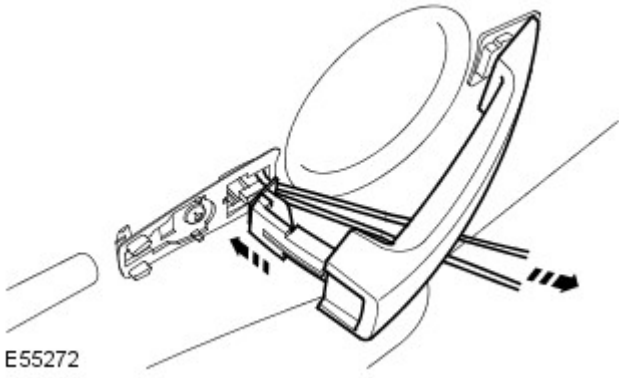
- Using a nylon mallet, carefully release the clip.
- Remove the 2 gaskets.



Installation

1. NOTE: Use a length of cord to hold the lock lever against spring pressure while engaging the outside handle.

To install, reverse the removal procedure.



E55272

Handles, Locks, Latches and Entry Systems - Liftgate Latch Actuator

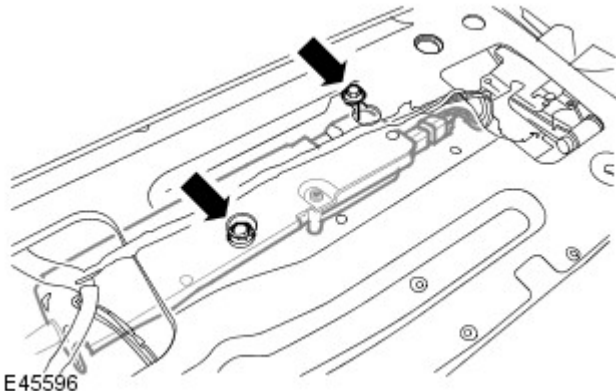
Removal and Installation

Removal

1. Remove the tailgate trim panel.
For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

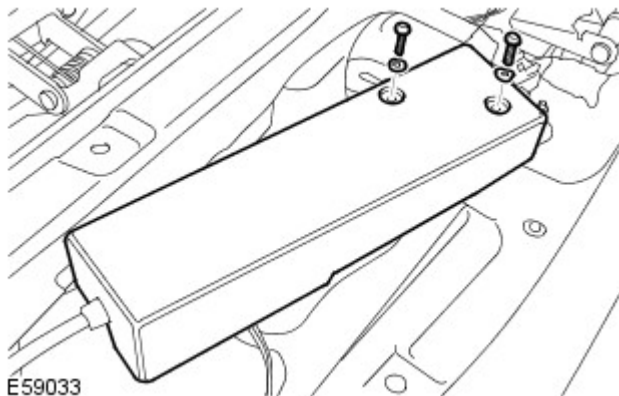
2. Release the liftgate actuator.

- Loosen the 2 bolts.
- Disconnect the electrical connector.



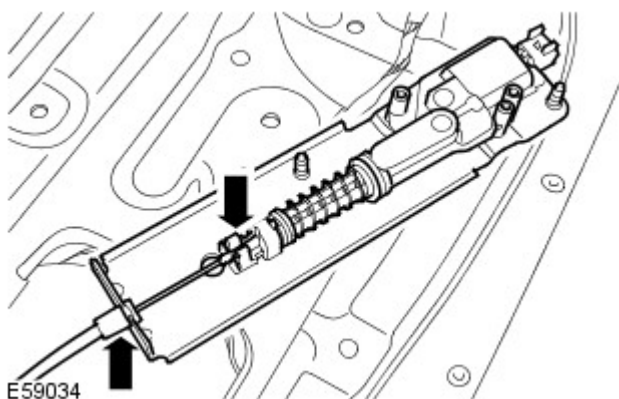
3. Remove the actuator cover.

- Remove the 2 Torx screws.

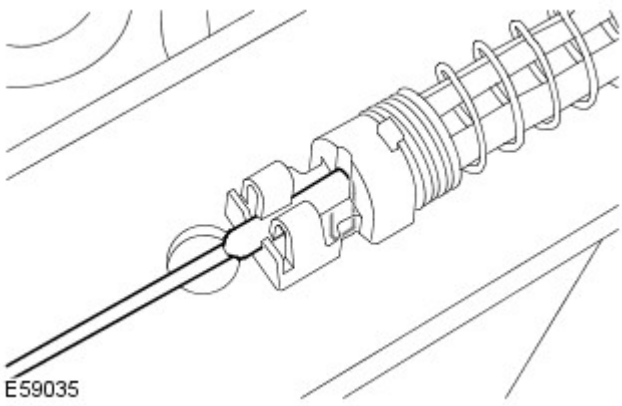



4. Remove the liftgate actuator.

- Release the liftgate latch to actuator cable.



Installation



1.  CAUTION: It is possible to incorrectly install the cable, ensure the ferrule and clip are fully engaged.

Attach the actuator to the liftgate latch cable.

2. Install the cover.

- Tighten the Torx screws.

3. Install the liftgate actuator.

- Tighten the bolts to 10 Nm (7 lb.ft).
- Connect and secure the electrical connector.

4. Install the tailgate trim panel.

For additional information, refer to: [Tailgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Wipers and Washers -

Capacities

Item	Description
Windscreen washer reservoir	6.3 litres (11.0 pints) (6.6 US quarts)

General Specifications

Item	Description
Front wiper motor make	Trico
Rear wiper motor make	Mitsuba
Windscreen washer pump make	MES
Power washer pump make	Textron

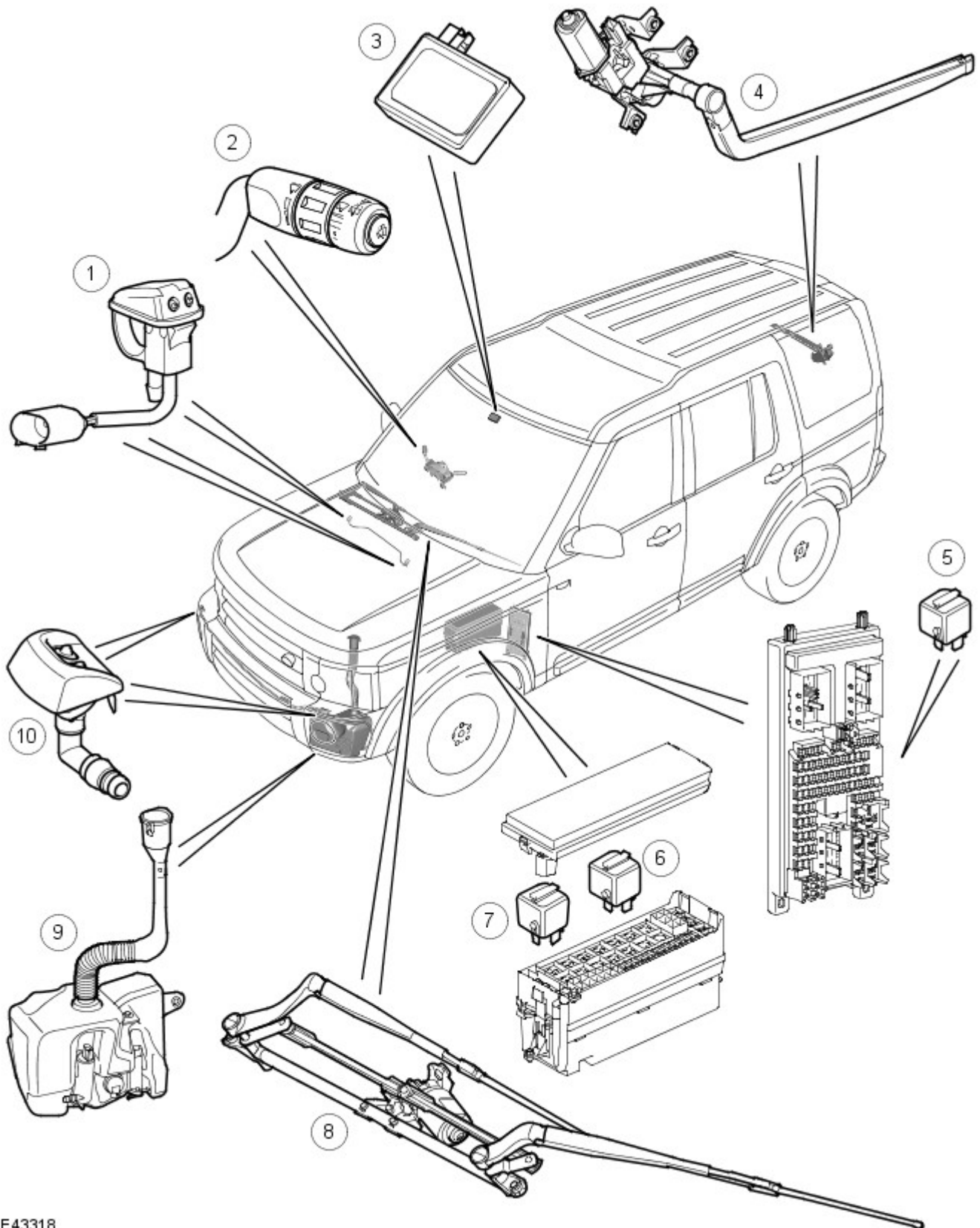
Torque Specifications

Description	Nm	lb-ft
Front wiper arms to linkage nut	18	13
Rear window wiper motor nuts	10	7
Rear wiper arm to motor nut	18	13
Wiper linkage to front wiper motor:		
Nut	25	18
Bolts	10	7
Wiper linkage to body bolts	6	4
Washer reservoir and pump assembly to body bolts	6	4
Washer reservoir and pump assembly to bumper armature bolts	22	16

Wipers and Washers - Wipers and Washers

Description and Operation

Wiper and Washer System Component Location



E43318

Item	Part Number	Description
1	-	Front washer jets
2	-	Wiper control switch
3	-	Rain/Light sensor
4	-	Rear wiper linkage and motor assembly

5	-	Rear wiper relay (located in the Central Junction Box (CJB))
6	-	Wiper relay 1 (located in the Battery Junction Box (BJB))
7	-	Wiper relay 2 (located in the BJB)
8	-	Front wiper linkage and motor assembly, including wiper arms and blades
9	-	Washer reservoir and pumps
10	-	Headlamp washer jets

GENERAL

The wiper and washer system is controlled by the Central Junction Box (CJB) on receipt of requests made by the driver or the rain/light sensor unit (if fitted). All wiper functions for the front and rear wipers are controlled from a multi-function wash/wipe switch assembly located on the right hand side of the steering column.

The wiper and washer system comprises:

- Front and rear wiper motors
- A front wiper linkage
- Two front and one rear wiper arms and blades
- Two front washer jets and one rear washer jet
- A washer reservoir and pump
- A wash/wipe control column switch.

The following optional items can be added to enhance the wiper system:

- A rain/light sensor for automatic wiper control
- Heated front washer jets
- Headlamp washers
- Low fluid level sensor (fitted to vehicles with headlamp washers).

The wiper system can be optionally equipped with a rain/light sensor. The sensor, located below the interior rear view mirror, detects rain drops on the windscreen and automatically operates the wipers in the intermittent mode. The column stalk switch must be in the intermittent position for rain/light sensor controlled wiper operation.

The front wiper system has five stages of operation and six intermittent delay periods.

The five wiper stages are as follows:

- Flick wipe
- Off
- Intermittent
- Normal (slow) speed continuous
- Fast speed continuous

Speed Control Intermittent Mode

The intermittent, slow and fast speeds are affected by road speed, providing the speed control intermittent wipe mode has been configured. The intermittent wiper delay periods change with the road speed, with the delay decreasing as the road speed increases.

Speed Dependant Wipe Mode

When the speed dependant wipe mode has been configured, the normal continuous operation changes to intermittent operation when the vehicle is stationary. The fast speed operation changes to normal operation when the vehicle is stationary.

The wiper and washers operate with the ignition switch in positions I or II. Wiper functions are suspended during engine cranking to reduce battery power consumption under high load conditions.

Diagnostic information for the wiper system is available and can be retrieved using T4.

CENTRAL JUNCTION BOX

The CJB is an integrated unit located behind the fascia on the passenger side of the bulkhead. The CJB contains fuses, relays and a number of microprocessors, which control the power supply and functionality of the wash/wipe system and other vehicle systems.

Inputs and Outputs

The CJB receives and sends the following wiper and washer system inputs and outputs:

Inputs	Outputs
Intermittent front wipe switch	Front wiper motor (normal)
Rear wipe park switch	Front wiper motor (fast)
Rain/light sensor, if fitted	Washer motors
Normal (slow) speed continuous switch	Heated washer jets (if fitted)
Fast speed continuous switch	Rear wiper motor relay
Flick wipe switch	Headlamp power wash motor
Front screen wash switch	-
Rear screen wash switch	-
Ignition switch	-
Lighting switch	-
Low level reservoir status, via CAN	-
Vehicle speed, via CAN	-
Front wiper motor park switch	-

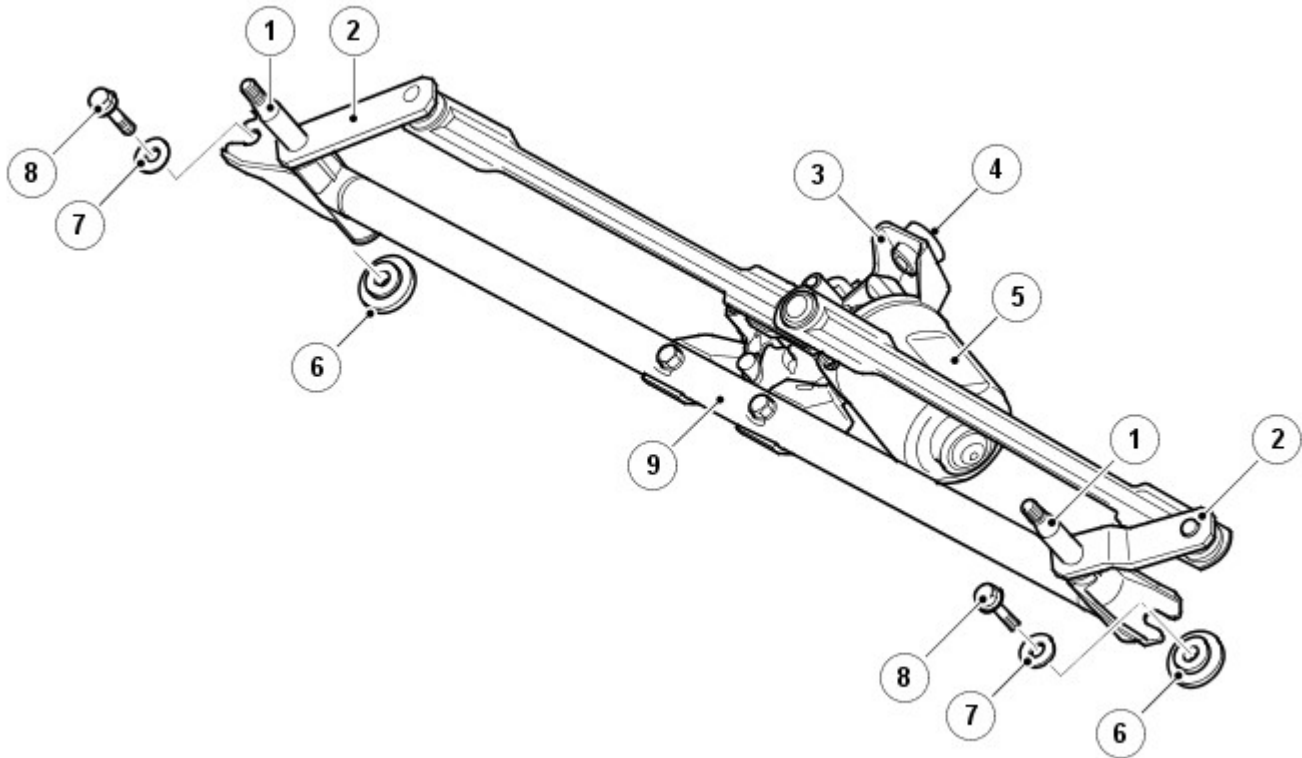
Inputs	Outputs
Reverse switch, via CAN	-
Tail gate open switch	-
Ambient temperature, via CAN	-

FRONT WIPER ASSEMBLY

The front wiper assembly comprises:

- Wiper motor and linkage assembly
- Wiper arms and blades
- Washer reservoir and pumps.

Wiper Linkage



E43319

Item	Part Number	Description
1	-	RH pivot housing assembly
2	-	Link rod
3	-	Bracket
4	-	Bush
5	-	Motor assembly
6	-	Bush
7	-	Washer
8	-	Bolt
9	-	Link rod

The wiper linkage and motor assembly are available as separate components. The wiper linkage and motor differs between LH and RH drive models.

The assembly is located below the plenum grill in the engine compartment and is secured with bushes, sleeves and bolts. The rubber bushes isolate the assembly from the body mountings.

The linkage assembly comprises a main tube, with a pivot housing at each end and the motor is attached directly to the tube. A motor crank is positively attached to the motor output shaft. Two link rods then attach to the motor crank which transfers power directly to each pivot crank.

The motor crank converts rotary motion from the motor output shaft into linear movement of the link rods. The cranks, connected between the each link rod and pivot housing, convert the linear motion to reciprocating motion at the pivot housing. This reciprocating motion is passed to the wiper arms and blades causing the blades to wipe an arc across the windscreen.

Wiper Motor

The motor assembly comprises a dc motor, which drives a gear wheel via a worm drive attached to the motor spindle. The gear wheel has a central spigot, which provides the attachment point for the motor crank.

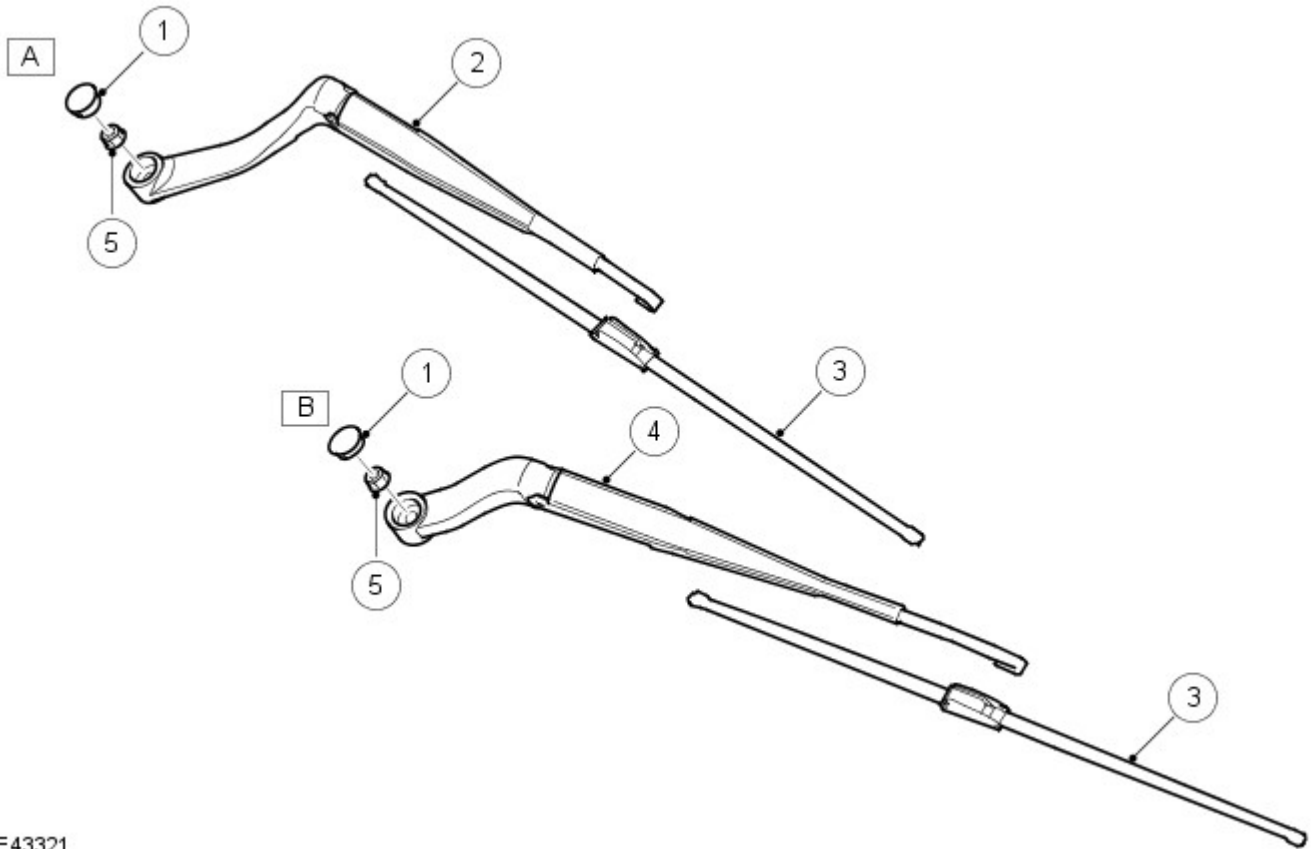
The motor is connected electrically by a five-pin connector. The connector supplies two battery voltage feeds to the motor

(when switched). The motor has three sets of brushes with one brush connected to ground. One feed is direct to the motor brush opposite the ground brush and operates the motor at normal (slow) speed. The second feed is connected to a motor brush, which is offset from the ground brush and operates the motor at fast speed. With the power supplied through this brush, the current flows through fewer coil windings. This results in a lower resistance to the current flow to the ground brush and gives a higher motor rotational speed.

Output control of the wiper motor is through a double contact relay. The relay is located in the Battery Junction Box (BJB).

The motor has an internal track switch, which signals the CJB when the wipers have reached the park position. The park signal is closed circuit when the wipers are in the park position. When the wipers are switched off and the CJB receives the park position signal from the motor, the CJB shorts the motor via a relay bridge circuit. This short circuit has the effect of applying a brake to the motor, giving precise positioning of the wiper blades in the park position.

Wiper Arms



E43321

Item	Part Number	Description
1	-	Spindle caps
2	-	RH Wiper arm
3	-	Wiper blades
4	-	LH wiper arm
5	-	Self locking nuts

The wiper arms are positively located on tapered splines on the wiper linkage spindles.

The wiper arm has a pivot point, midway between the spindle attachment and the blade. A tension spring is connected to the wiper arm on each side of the pivot point and applies pressure to maintain the wiper blade in contact with the windscreen.

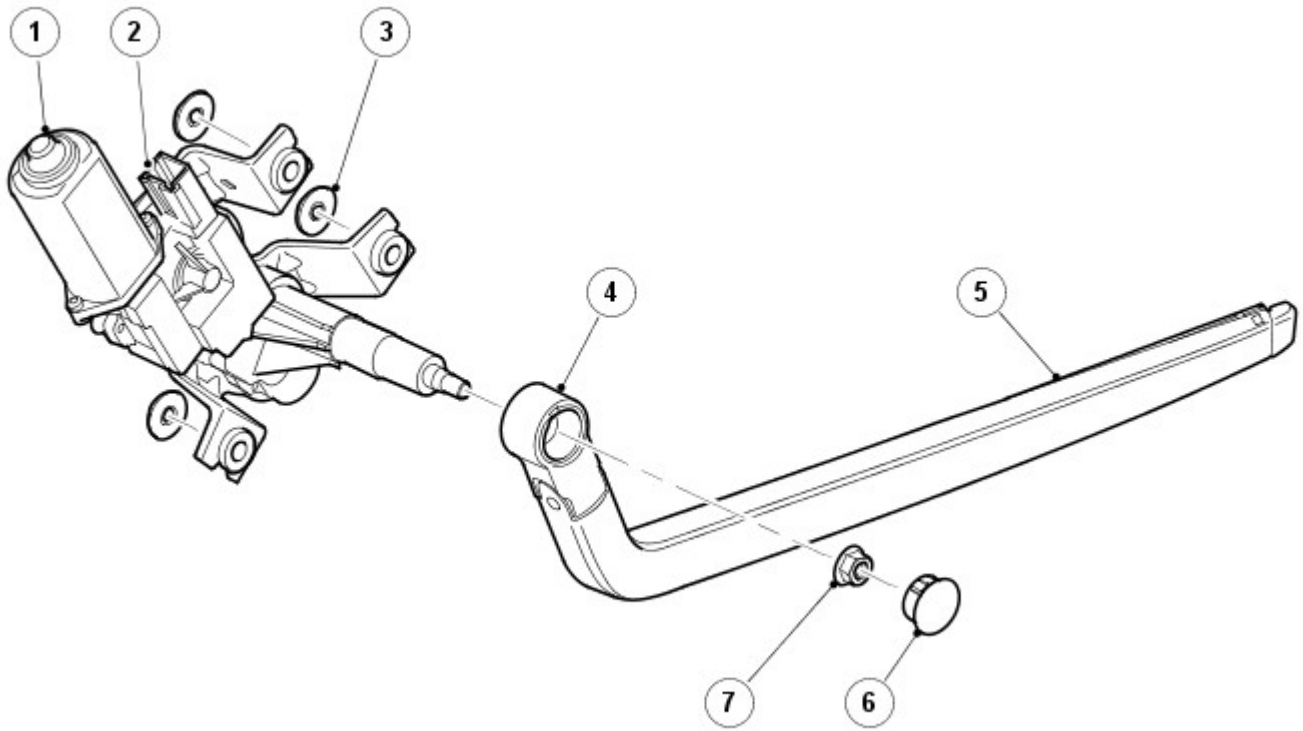
The wiper blades are attached to the wiper arms with clips that allow the blade to pivot. The wiper blades comprise of a sprung steel curved backbone which applies the pressure evenly to the windscreen, to which is applied the wiping lip to the bottom surface and an aerofoil section to the top which presses the blades onto the windscreen at high vehicle speeds.

REAR WIPER ASSEMBLY

The rear wiper assembly comprises:

- Wiper motor
- Rear washer pump
- Rear washer jet
- Wiper arm and blade.

Wiper Motor



E43322

Item	Part Number	Description
1	-	Motor assembly
2	-	Harness connector
3	-	Washers
4	-	Pivot housing connection
5	-	Wiper arm
6	-	Spindle cap
7	-	Self locking nut

The rear wiper and washers operation is controlled by the CJB, via the rear wiper relay, which is located in the LH rear 'D' post.

The rear wiper motor is located in the upper tail gate, behind a trim panel. The assembly is secured to the body of the upper tail gate with three M6 nuts. Bushes isolate the motor assembly from the body, which help reduce the transmission of motor operating noise to the tail gate.

The motor is located on a worm drive gearbox mechanism, which converts the rotary motion of the motor output spindle into the required arc for the rear wiper blade.

The feed hose, for the separate rear washer jet, is located at the rear of the motor spindle. The hose is connected to a 90 degrees connector allowing the washer fluid to flow through the centre of the motor spindle. A Non-Return Valve (NRV) is located in the hose, near the motor, and prevents fluid returning to the reservoir.

The motor spindle is a conventional design with a taper spline location for the wiper arm and a threaded shank to secure the arm to the spindle.

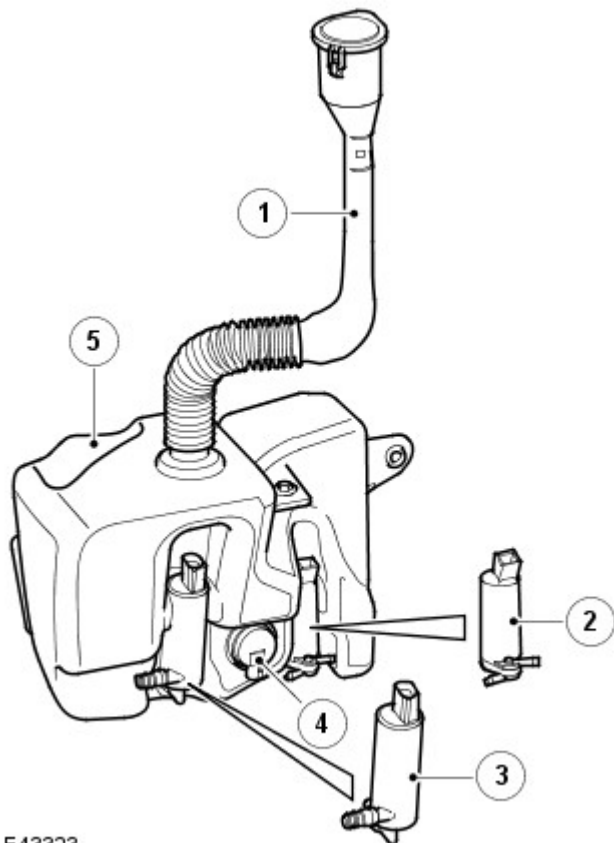
Wiper Arm

The wiper arm is similar in design to the front wiper arms. The arm attachment hole has tapered splines, which mate with the splines on the wiper spindle. The arm is secured to the wiper motor spindle with a nut. The wiper arm has a pivot point, close to the spindle attachment. A tension spring is connected to the wiper arm on each side of the pivot point and applies pressure to maintain the wiper blade in contact with the windscreen.

The wiper blade is attached to the wiper arm with a clip that allows the blade to pivot. The blade comprises a number of levers and yokes to, which the rubber wiper blade is attached. The levers and yokes ensure that the pressure applied by the arm tension spring is distributed evenly along the full length of the blade and also allow the blade to adjust to the curvature and contour of the windscreen.

A plastic cap located on the arm pivot point, covers the spindle attachment nut.

WASHER RESERVOIR AND PUMPS



E43323

Item	Part Number	Description
1	-	Filler tube and cap
2	-	Front and rear washer pump
3	-	Headlamp washer pump (if fitted)
4	-	Fluid level sensor
5	-	Reservoir

The windscreen washer system comprises:

Vehicles without headlamp washers:

- A reservoir
- A washer pump
- Two washer jets
- Hoses

Vehicles with headlamp washers:

- A reservoir
- Two washer pumps
- A level sensor
- Four washer jets - two windshield and two headlamp washers
- Hoses

The plastic, moulded reservoir is located in the LH wheel arch, behind the liner and has a capacity of 11.08 pints (6.3 litres). It is secured to the body and front panel with bolts. A boss on the reservoir locates in a slot in the front panel and provides additional support.

The reservoir has two recessed holes on its rear face, which provide location for the combined front pump, rear pump and headlamp washer pumps. The pumps are push fitted into grommets, which seal the pumps in their locations. A hole in the top of the reservoir allows for the fitment of a flexible filler tube. The front and rear wash hoses are integrated into the harness and so follow its routing. The headlamp washer hose comes front the bumper around the bottle to attach to the headlamp washer pump.

A hole with a grommet in the side of the reservoir provides the location for the fluid level sensor.

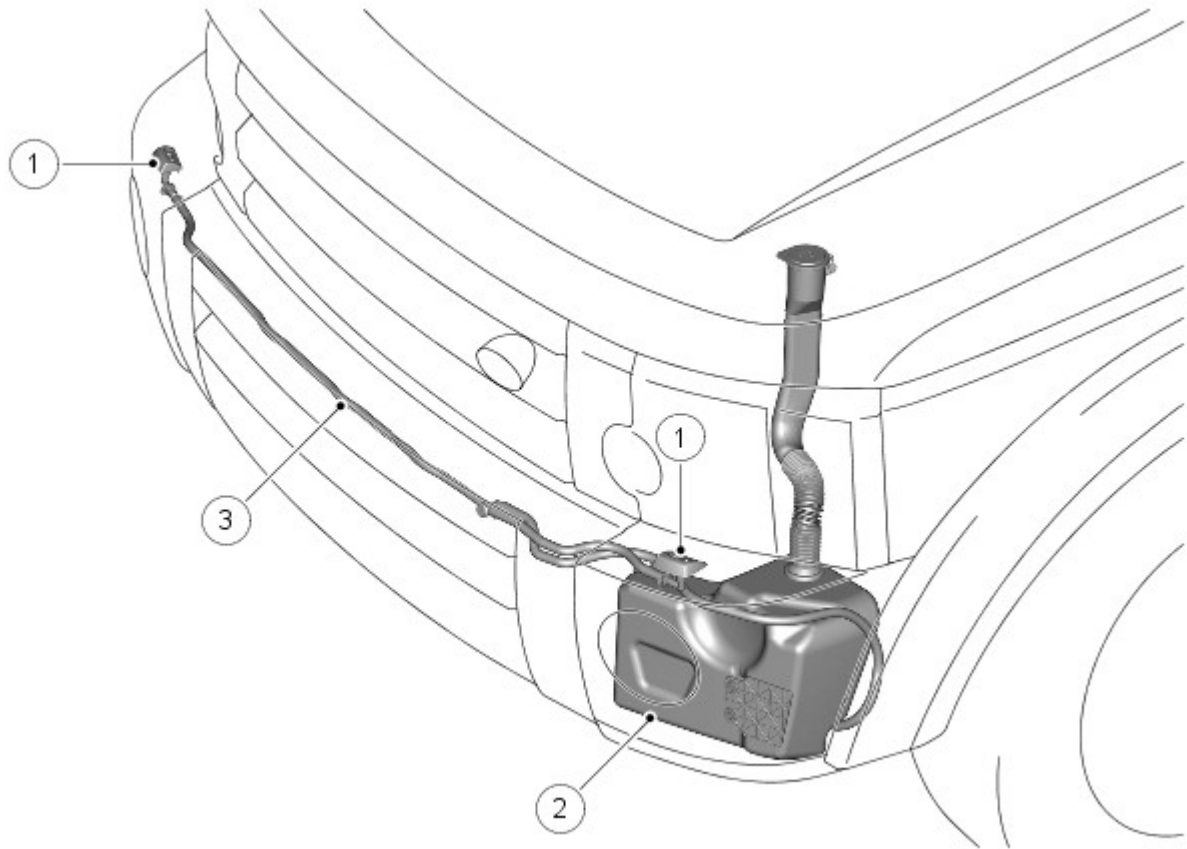
The low level sensor has a float, with integral magnet. The sensor has a contact, which is normally closed when the reservoir is full. When the fluid level reduces to approximately 1 litre, the magnetic float pivots down, which causes the switch contact to open. This open circuit is sensed by the instrument cluster, which displays the low fluid level message and transmits the switch status on the CAN bus.

The sensor cannot determine the precise amount of fluid in the reservoir, but can detect when the fluid level has fallen below a certain point. When the fluid level is low, the magnetic float closes the sensor contacts, completing a circuit through the sensor. This completed circuit is sensed by the instrument cluster, to which the sensor is directly connected.

The fluid level sensor is monitored continuously by the instrument cluster. The instrument cluster checks the fluid level sensor when the ignition is switched on to give the driver an early warning of the low fluid level. The instrument cluster then monitors the sensor value over a 25 second period when the ignition is on to prevent invalid messages due to fluid 'sloshing' in the reservoir.

When a low fluid level signal is transmitted to the high line instrument cluster, a 'WASHER FLUID LOW' message is displayed in the instrument cluster's message centre. On the low line instrument cluster a low fluid level indicator is illuminated. The first display of this message, or illumination of the indicator, is accompanied by a 'chime' sound to alert the driver to the low fluid level.

HEADLAMP WASHERS



E43324

Item	Part Number	Description
1	-	Headlamp washer jets
2	-	Reservoir
3	-	Washer fluid tube

The headlamp washer assembly is located below each headlamp.

The headlamp washer operation is controlled by the CJB via a headlamp washer relay. The relay is located in the Battery Junction Box (BJB).

Head Lamp Wash Only (No Wipe Function)

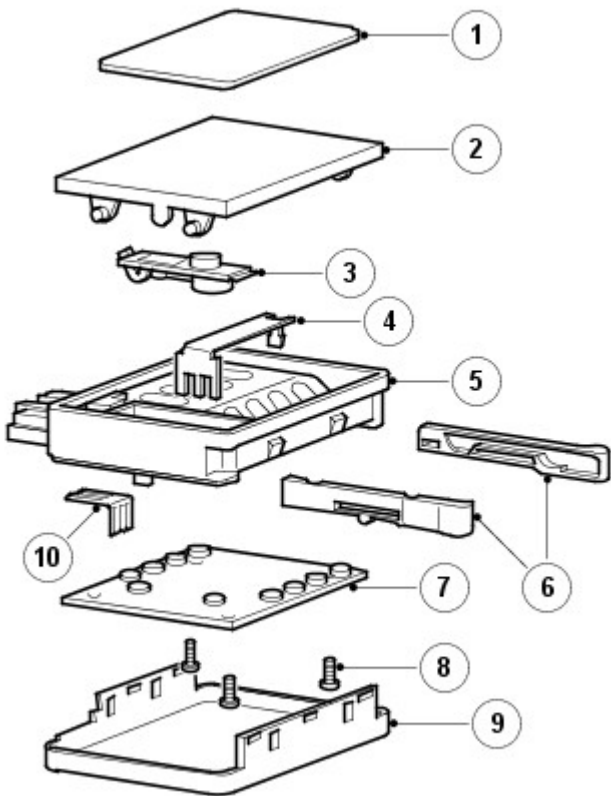
The headlamp washers are only active when the headlamps and ignition are switched on. If the washer reservoir fluid level becomes low, the instrument cluster sends a message, via the CAN bus, to the CJB, which suspends headlamp wash operation to preserve washer fluid in the reservoir.

With the ignition and lights on, headlamp wash is activated on the first operation of the wiper column control switch in the wash/wipe position. The CJB then suspends headlamp wash activation for the next 10 minutes and four operations of the wash/wipe switch.

The CJB monitors the operation of the wash/wipe switch and maintains a counter to restrict headlamp washer operation to every fourth operation of the wash/wipe switch in conjunction with a 10 minute timer. The timer prevents a second operation of the headlamp washers within a 10 minute period. Should the washer switch be activated for more than four programmed wipe requests during the 10 minute period, the headlamp washer will remain disabled. Only the next consecutive programmed wipe request, after the 10 timer has expired, will the headlamp washers be enabled. The counter and timer are reset when the ignition is switched off.

When headlamp wash is active, the CJB energises the washer pump twice per cycle. The headlamp washer pump is powered for a 0.5 second period.

RAIN/LIGHT SENSOR



E43325

Item	Part Number	Description
1	-	Adhesive pad
2	-	Optical element
3	-	Sub-assembly light guide
4	-	Heater
5	-	Housing
6	-	Locking device
7	-	Printed Circuit Board (PCB)
8	-	Screws
9	-	Cover
10	-	Contact pins

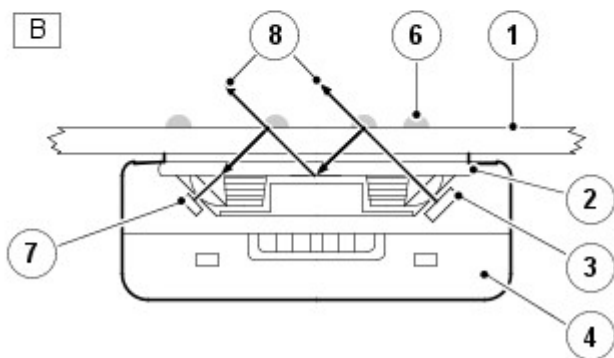
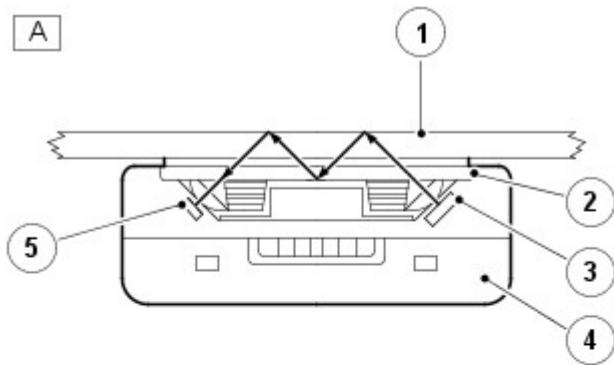
The rain/light sensor is located at the upper edge of the windscreen, behind the interior rear view mirror. The sensor is mounted on an optical unit, which is heat bonded to the inner surface of the windscreen during manufacture. If damage occurs to the optical unit or the windscreen, then a new windscreen will be required and installation can only be performed by an authorised Land Rover dealer.

The rain sensor must be re-initialised to a new windscreen, if fitted, or if transferred to another vehicle, the new rain sensor assembly will automatically re-initialise when powered-up for the first time. In order for this to occur successfully it must be fitted and connected to the optical filaments (bonded to the screen assembly).

The rain/light sensor unit attaches to the optical unit via two clips, which latch onto formed tags on the optical unit. Positive retention is achieved by two retaining clips, which force the clips onto the tags. The retaining clips must be withdrawn to facilitate sensor removal.

The sensor provides information to the CJB for the optimum wiper operation for the prevailing conditions to maintain the screen in a clear condition at all times. The rain/light sensor is an optical unit, which operates on an infrared waveband. The sensor uses the principle of the laws of reflection on interfacing surfaces between materials with differing refraction properties.

Rain Sensor Functionality



E43326

Item	Part Number	Description
A	-	Clean and dry windscreen
B	-	Wet and dirty windscreen
1	-	Windscreen - Outside surface
2	-	Optical unit
3	-	Transmitter diodes (100% light transmitted)
4	-	Rain/Light sensor unit
5	-	Receiver diodes (100% received)
6	-	Water droplets/film
7	-	Receiver diodes (less than 100% light received)
8	-	Lost light

The rain/light sensor contains transmitter and receiver diodes, which transmit and receive infrared light, which is directed onto the windscreen via an optical unit. The light is directed at an angle so that the light is reflected 100% on the outside surface of the screen and is transmitted back into the optical unit. To receive a 100% reflection, the outer screen surface must be clean and dry.

The rain/light sensor is active when the wiper column control switch is in the intermittent position. The rain/light sensor suspends wiper operation when the area of the windscreen for the rain/light sensor is dry and operates the wipers continuously when the windscreen is subject to heavy rainfall.

The sensitivity of the rain/light sensor can be adjusted by the driver using the intermittent rotary switch on the wiper stalk. Six sensitivity levels of the sensor can be selected, which has the effect of increasing or decreasing the wiper delay period, allow driver adjustment for the prevailing conditions. When several continuous wipe cycles have taken place, the sensor will maintain the continuous operation to avoid switching back to intermittent from a continuous wipe and back again.

The rain/light sensor receives vehicle speed information from the Anti-lock Braking System (ABS) module on the Local Interconnect Network (LIN) bus via the CJB. The sensor increases the sensitivity as the speed increases to optimise wiper operation. When the vehicle speed is reduced to less than 5 mph (8 km/h), the sensitivity is automatically reduced. Below this speed the wipers will only operate continuously in very heavy rain.

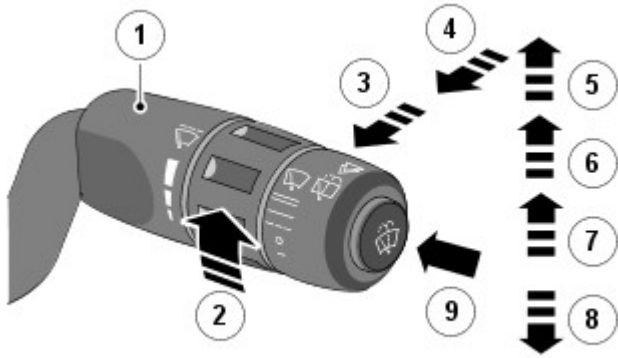
Automatic Headlamp Operation

A light sensor is incorporated in the housing of the rain/light sensor to control the operation of the automatic headlamps.

The automatic headlamps will function when the lighting control switch is in the 'AUTO' position and the CJB receives a lights on signal from the rain/light sensor.

For additional information, refer to: Exterior Lighting (417-01, Description and Operation).

WIPER CONTROL COLUMN SWITCH



E43327

Item	Part Number	Description
1	-	Wash/wipe control column switch
2	-	Intermittent variable delay rotary control
3	-	Intermittent/continuous rear wipe
4	-	Rear wash position
5	-	Fast speed wipe position
6	-	Normal speed wipe position
7	-	Intermittent/rain sensor wipe position
8	-	Flick wipe position
9	-	Front windscreen washer control

The wiper control column switch is located on the right hand side of the steering column and controls all front and rear wiper functions.

The switch comprises 8 switch positions and the intermittent rotary control. The switch positions each complete a combination of earth paths to connections on the CJB. The CJB interprets the selected combination of switches and operates the respective function accordingly.

Flick Wipe

Moving the switch down selects the front wiper flick wipe function. The front wipers will operate at fast speed for as long as the flick wipe switch position is operated. Once the switch is released the front wiper motor will revert to a normal (slow) speed operation until a park position has been detected.

Intermittent

Moving the switch up one position from 'OFF', selects intermittent front wiper operation. The rotary potentiometer on the stalk selects one of six delay periods. The delay period is also influenced by vehicle speed (should speed control intermittent wipe mode be configured), using a signal value derived from the ABS control module. The selected delay period decreases with an increase in road speed. When a rain/light sensor is incorporated into the system, the intermittent position also initiates wiper operation controlled by the rain/light sensor. The sensitivity of the rain/light sensor is also adjusted by rotating the rotary switch to one of the six positions.

The rotary switch selects differing output values for each position. The switch is wired to three data input terminals of the CJB.

Rotary Switch Position	Output Data 1	Output Data 2	Output Data 3
1	Yes	-	-
2	Yes	Yes	-
3	-	Yes	-
4	-	Yes	Yes
5	Yes	Yes	Yes
6	Yes	-	Yes

The time delay periods for the vehicle stationary and when moving at different speeds are shown in seconds (by speed CLASS) in the following tables:

Class	Speed Increase - MPH (KPH)	Speed Decrease - MPH (KPH)
0	Vehicle speed <5 (8), remain in class 0 Vehicle speed >5 (8), increment to class 1	-
1	Vehicle speed >5 (8) and <20 (32), remain in class 1 Vehicle speed >20 (32), increment to class 2	Vehicle speed = 0, Revert to class 0 Vehicle speed > 0 and <20 (32), remain in class 1
2	Vehicle speed >20 (32) and <40 (64), remain in class 2 Vehicle speed >40 (64), increment to class 3	Vehicle speed <10 (16), revert to class 1 Vehicle speed >10 (16) and <40 (64), remain in class 2
3	Vehicle speed >40 (64) and <60 (96), remain in class 3 Vehicle speed >60 (96), increment to class 4	Vehicle speed <30 (48), revert to class 2 Vehicle speed >30 (48) and <60 (96), remain in class 3
4	Vehicle speed >60 (96) and <80 (128), remain in class 4 Vehicle speed >80 (128), increment to class 5	Vehicle speed <50 (80), revert to class 3 Vehicle speed >50 (80) and <80 (128), remain in class 4
5	Vehicle speed >80 (128), remain in class 5 -	Vehicle speed <70 (112), revert to class 4 -

Key:

- < = Less than
- > = Greater than.

Rear Wiper Speed Class Matrix

Rotary Position	Speed Class					
	0	1	2	3	4	5
Position 1	6	5	4	3	2	0
Position 2	10	8	6	4	2	1
Position 3	14	11	8	5	3	1
Position 4	18	15	11	8	5	2
Position 5	22	18	13	9	6	3
Position 6	26	21	16	11	7	4

Front Wiper Speed Class Matrix

Rotary Position	Speed Class					
	0	1	2	3	4	5
Position 1	3.5	3	2.5	2	1.5	1
Position 2	5	4	3.5	3	2.5	2
Position 3	7	6.5	6	5	4	3
Position 4	9	8	7	6	5	4
Position 5	11	9.5	8	7	6	5
Position 6	13	11	9	8	7	6

The rotary switch positions also influence the operation of the rain/light sensor (when fitted) by adjusting its sensitivity. Refer to the Rain/Light Sensor section for details.

Normal (Slow) Speed

The normal (slow) speed continuous wiper operation is selected by moving the switch vertically to the second detente position from 'OFF'. The wipers will operate continuously when the vehicle is moving. When the vehicle is stationary, or less than 5 mph (8 km/h), the CJB operates the wipers in the intermittent mode (if speed dependant wipe mode is configured), using a 3 second intermittent delay period.

Fast Speed

The fast speed continuous wiper operation is selected by moving the switch vertically to the third detente position. The wipers will operate continuously at fast speed when the vehicle is moving. When the vehicle is stationary, or less than 5 mph (8 km/h), the CJB operates the wipers in normal (slow) speed mode (if speed dependant wipe mode is configured).

Wash/Wipe

When the non-latching wiper stalk button is pushed the front screen washer is operated. If the wipers are off and the button is pressed for less than 0.5 seconds, only the washer will operate. If the button is pressed for more than 0.5 seconds, the wipers will come on and perform two wipes. When headlamp washers are fitted, the headlamp washers will operate if the front windscreen washer is operated and the headlamps are on – refer to headlamp wash section for detail of operation. The CJB monitors the wash/wipe switch operation and after the switch is released, if a programmed wipe is enabled, the CJB allows two further wipe cycles to be completed.

Rear Wash/wipe

Moving the switch rearwards, towards the driver, selects the intermittent rear wash/wipe function. The intermittent delay period will vary according to the sensitivity settings and vehicle speed.

When the switch is moved rearwards to the second position and held, the washer pump will operate. If the switch is operated for more than 10 seconds, the pump will be disabled. When the switch is released, the rear wiper will complete a further two full wipe cycles and then operate on an intermittent function until selected off.

HEATED WINDSCREEN WASHER JETS

Two windscreen washer jets are located in the rear trim panel on the bonnet outer surface. The washer fluid feed hose from the front screen pump is connected to a 'Y' piece connector located between the two jets. Two short lengths of hose connect the jets to the 'Y' piece. Each jet contains a NRV to prevent washer fluid draining back to the reservoir and also to limit the amount of washer fluid, which can be forced by gravity from the jet during cornering.

Each washer jet has two ball nozzles, which can rotate in their housing's to obtain the optimum fluid application onto the windscreen. Each washer jet contains a heater element, which prevents the fluid freezing in the nozzles in very cold conditions and a Positive Temperature Coefficient (PTC) sensor, which regulates the temperature. The jet heater elements are controlled by the Automatic Temperature Control Module (ATCM) and a heated washer jet relay in the BJB. For additional information, refer to: Control Components (412-04, Description and Operation).

REVERSE GEAR INPUT

The intermittent delay period (below) depends on speed dependant wipe mode being enabled or disabled.

The rear wiper also operates if reverse gear is selected and the front wipers are on. If the front wipers are operating continuously when reverse is selected, the rear wiper will also operate continuously as long as reverse gear is engaged. If the front wipers are operating intermittently when reverse is engaged, the rear wiper will complete one wipe cycle then wipe intermittently.

On vehicles fitted with rain/light sensor, when reverse gear is selected while the front wipers are in intermittent mode but the rain/light sensor indicates that the front wipers are off, the rear wiper will not operate. If the rain/light sensor subsequently calls for a single wipe, the rear wiper will operate a single wipe cycle. If the rain/light sensor calls for a slow or fast wipe, the rear wiper will operate continuously.

The CJB will operate the rear wiper (providing the front wipers are on) upon receipt of a reverse gear signal from the Electronic Automatic Transmission (EAT) module on the CAN bus, via the instrument cluster. On vehicles with manual transmission, the gear position signal is transmitted directly from the transfer box control module and picked by the CJB as an CAN bus message, via the instrument cluster.

'TAIL GATE OPEN' DISABLE

If the rear wiper is switched on or is already running and the tail gate is opened, the rear wiper should not start to run, or should immediately become disabled during a wipe cycle. If the tail gate is subsequently closed, the wiper will resume its normal operation after a delay of three seconds. Should the vehicle speed input be more than 4 mph (6km/h), then the tail gate switch will be deemed as closed.

The CJB receives the 'tail gate open' signal directly from the upper tail gate central locking motor.

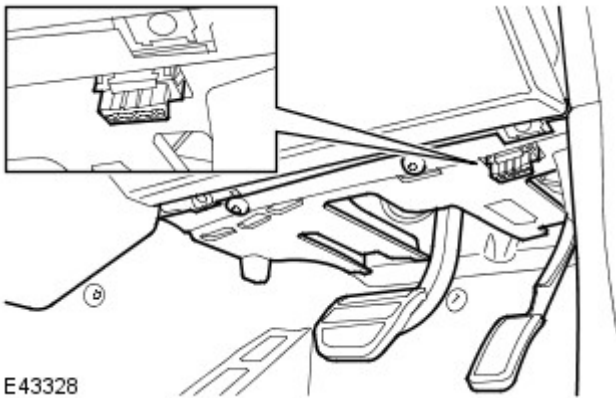
FRONT AND REAR WIPER MOTOR BLOCKING PROTECTION

The wiper park signal is also used by the CJB for blocking protection of the front wiper motor. This feature protects the motor in the event of the wiper operation being obstructed.

If the CJB does not receive a wiper park signal status change for a period of 6 seconds, when the wiper motor is active, the CJB removes the power supply to the motor. The motor will remain disabled until either an alternative motor mode has been selected, or the ignition has been moved to position 0 and back to position I. Should a stall condition be achieved 3 times during a single ignition position I status, then the wiper relay will remain disabled, regardless of wiper switch positions, for 180 seconds. The CJB will not automatically switch the motor on, to prevent the risk of injury. The wiper switch must be moved off and then on to reactivate the wiper motor. The blocking protection is active in all wiper switch positions and can only be reset by turning the ignition off.

The rear wiper algorithm contains the same logic as mentioned above.

DIAGNOSTICS

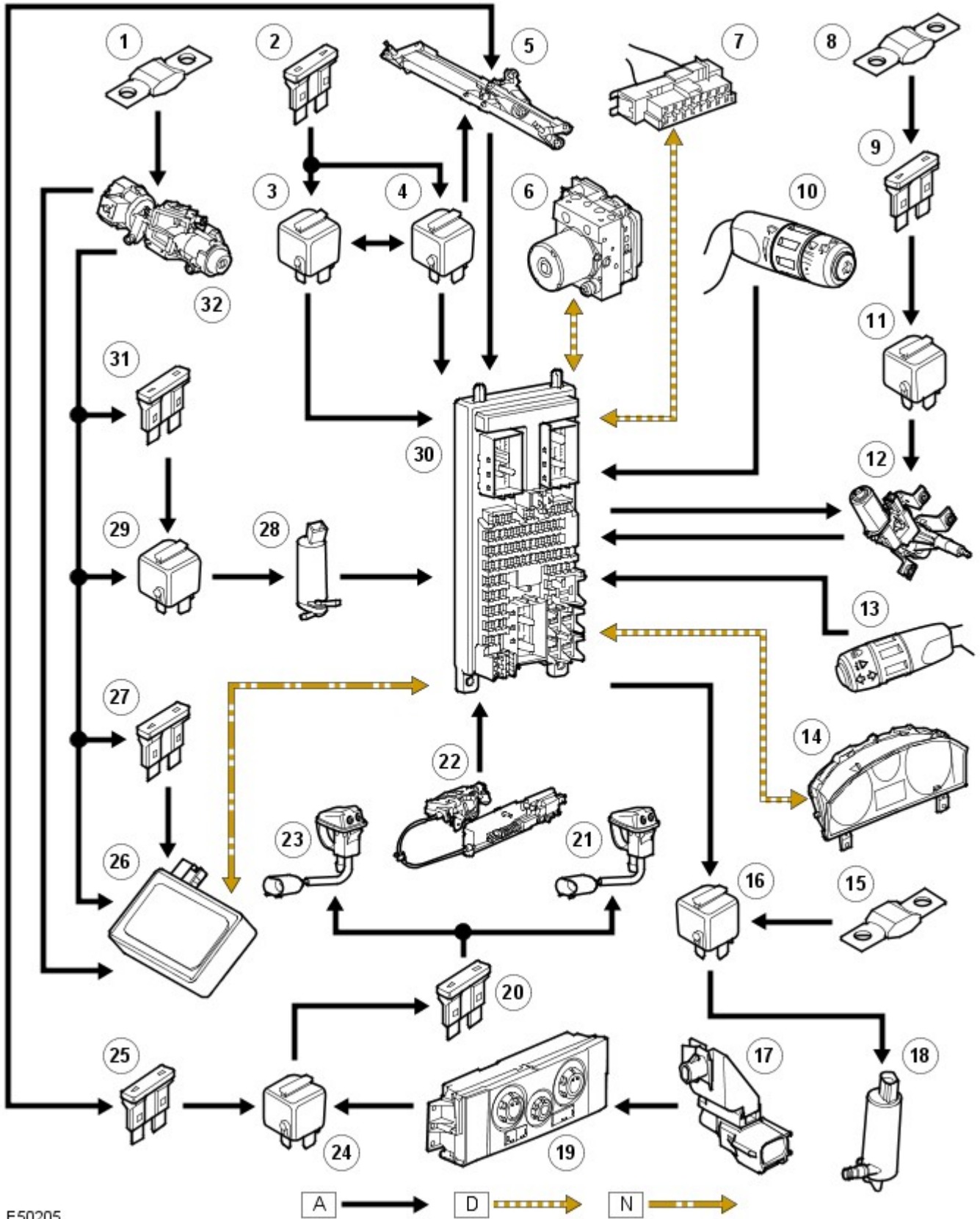


The diagnostic socket allows the transfer of information between the CJB, the rain/light sensor and T4. The diagnostic socket is located in the lower fascia closing panel, on the driver's side, below the steering column.

The rain/light sensor performs an internal self-test in the first 50ms from the ignition being switched to position I and can store fault codes, which can be used to diagnose faults or non-function of the rain/light sensor. The faults are stored in a non-volatile memory which retains the logged fault codes even when the power supply is disconnected. If a rain/light sensor fault prevents the sensor from operating, the CJB will control wiper operation as if a rain/light sensor is not installed in the system.

The CJB monitors all inputs and outputs relative to the wiper system and other CJB controlled functions on the LIN bus. If a fault is detected, a code applicable to that fault is stored in a fault log. Two fault logs are provided within the CJB for internal and external faults.

CONTROL DIAGRAM



E50205

Item	Part Number	Description
1	-	Fusible link 11
2	-	Fuse 29
3	-	Wiper relay 1
4	-	Wiper relay 2
5	-	Front wiper motor
6	-	ABS module
7	-	Diagnostic socket
8	-	Fusible link 18
9	-	Fuse 48
10	-	Wiper switch
11	-	Rear wiper relay

12	-	Rear wiper motor and park switch
13	-	Light switch
14	-	Instrument cluster
15	-	Fusible link 7
16	-	Headlamp washer relay
17	-	Ambient air temperature sensor
18	-	Headlamp washer pump
19	-	ATCM
20	-	Fuse 12
21	-	RH heated washer jet
22	-	Upper tailgate central locking motor
23	-	LH heated washer jet
24	-	Heated washer jet relay
25	-	Fuse 28
26	-	Rain/light sensor
27	-	Fuse18
28	-	Front and rear washer pump
29	-	Washer pump relay
30	-	CJB
31	-	Fuse 11
32	-	Ignition switch

Wipers and Washers - Wipers and Washers

Diagnosis and Testing

Principle of Operation

For a detailed description of the wipers and washers systems and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Wipers and Washers](#) (501-16 Wipers and Washers, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. **1.** Verify the customer concern.
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Windshield and rear window for damage or contamination e.g. road film or general residue deposits ● Wiper blades, arms and linkage for wear, security, damage and freedom of movement ● Windshield/Rear window/Headlamp washer fluid level ● Washer pipes and jets for leaks, restrictions and damage 	<ul style="list-style-type: none"> ● Battery condition and state of charge ● Fusible links ● Fuses ● Relays ● Electrical connections ● Front and rear wiper motors ● Wiper switch ● Washer pumps ● Rain/light sensor ● Heated front washer jets ● Ignition switch ● Light switch ● Ambient air temperature sensor ● Central Junction Box (CJB) ● Battery Junction Box (BJB) ● Anti-Lock Braking System (ABS) module ● Automatic Temperature Control Module (ATCM) ● Instrument Cluster (IPC) module ● Controller Area Network (CAN) circuits

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. **4.** If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Wiper blade(s) drag/judder across the windshield/rear window	<ul style="list-style-type: none"> ● Contamination of the windshield/rear window ● Incorrectly installed wiper arm(s) ● Wiper arm(s) incorrectly aligned to the screen ● Wiper arm(s) spring tension inadequate 	Clean the windshield/rear window. Check for the correct installation and tension of the wiper arm(s). Refer to the relevant section of the workshop manual. Rectify as necessary.
Very slow operation of the wiper(s) across the windshield/rear window	<ul style="list-style-type: none"> ● Low battery voltage ● Front wiper linkage seized or fouling ● Wiper circuit fault ● Wiper switch fault, high resistance 	Check the battery condition and state of charge. Check the wiper linkage for fouling. Disconnect the motor from the linkage. Refer to the relevant section of the workshop manual. Check the linkage operation. Check for DTCs indicating a wiper circuit fault. Rectify as necessary.
Wiper(s) inoperative		
Noisy operation of wiper(s)	<ul style="list-style-type: none"> ● Wiper motor/linkage fault 	Lift the wiper arm(s) from the windshield/rear window and recheck the noise level during the wiper sweep operation.

Symptom	Possible Causes	Action
Noisy operation of washers	<ul style="list-style-type: none"> ● Washer motor(s) faulty ● Washer system blocked or partially blocked 	Listen for washer motor operation. Check and top up washer fluid level. Check and rectify blocked washer circuit. Check the wiper/washer circuit for DTCs indicating a fault. Rectify as necessary.
Washers do not operate	<ul style="list-style-type: none"> ● Fluid level low ● Washer circuit blocked ● Washer circuit faulty 	

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Wipers and Washers - Windshield Washer Reservoir

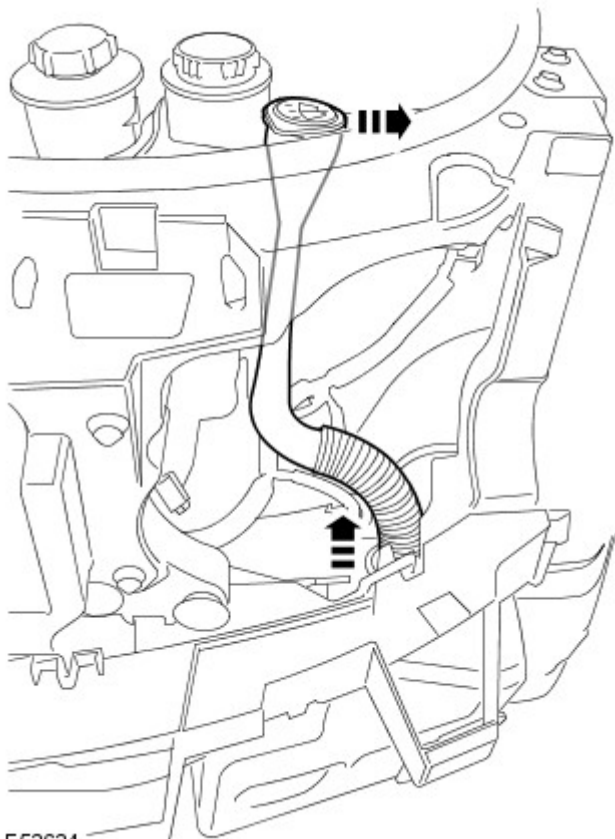
Removal and Installation

Removal

1. Remove the front bumper cover.
For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

2. Remove the windshield washer reservoir filler neck.

- Release the windshield washer reservoir filler neck from the coolant expansion tank.
- Remove and if necessary, discard the seal.

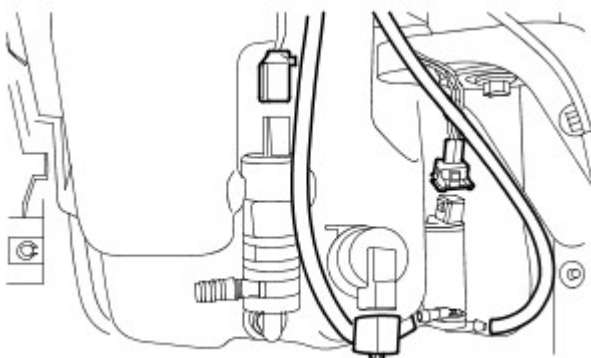


E52624

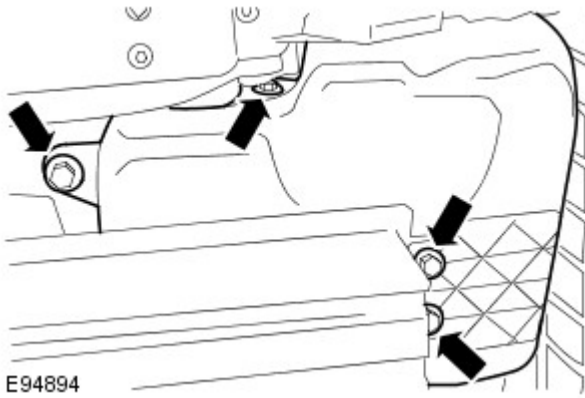
3. **NOTE:** Some fluid spillage is inevitable during this operation.

Disconnect the 2 hoses from the windshield washer reservoir pumps.

- Drain the washer reservoir fluid.
- Disconnect the 3 electrical connectors.



E94895



4. Remove the windshield washer reservoir.

- Remove the 4 bolts.

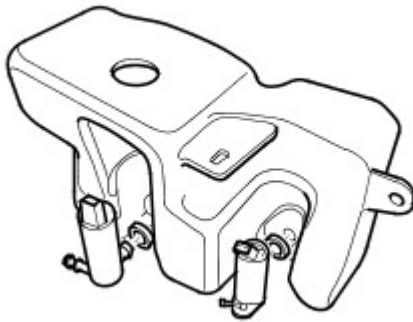
5. NOTE: Do not disassemble further if the component is removed for access only.

Remove the windshield washer pump.

- Remove and if necessary, discard the seal.

6. Remove the headlamp washer pump.

- Remove and if necessary, discard the seal.



Installation

1. Install the windshield washer pump.

- If necessary, install a new seal.

2. Install the headlamp washer pump.

- If necessary, install a new seal.

3. Install the windshield washer reservoir.

- Tighten the M6 bolts to 6 Nm (4 lb.ft).
- Tighten the M8 bolt to 25 Nm (18 lb.ft).

4. Connect the 2 hoses to the windshield washer reservoir pumps.

- Connect the electrical connectors.

5. Install the windshield washer reservoir filler neck.

- If necessary, install a new seal.
- Lubricate the seal.
- Secure in the clip.


6. Install the front bumper cover.

For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

Wipers and Washers - Windshield Washer Pump

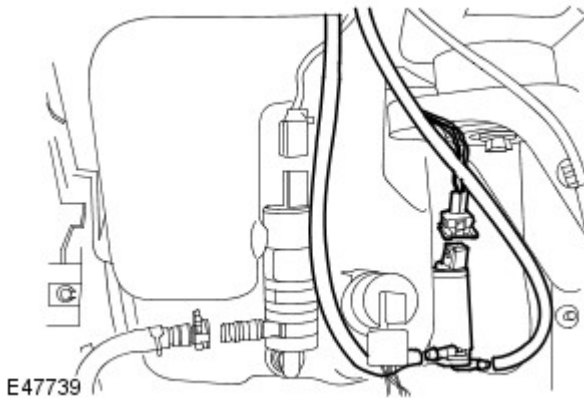
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Release the windshield washer pump hoses.
 - Drain the washer reservoir fluid.
4. Disconnect the windshield washer pump electrical connector.
5. Remove the windshield washer pump.
 - Discard the O-ring seal.



Installation

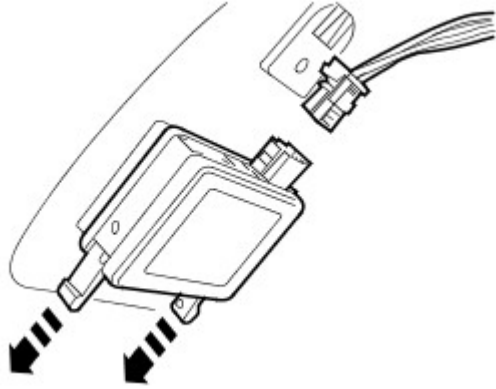
1. Install the windshield washer pump.
 - Install a new O-ring seal.
2. Connect the windshield washer pump electrical connector.
3. Connect the windshield washer pump hoses.
4. Install the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
5. Lower the vehicle.
6. Top-up the windshield washer reservoir.

Wipers and Washers - Rain Sensor

Removal and Installation

Removal

1. Remove the interior mirror.
For additional information, refer to: [Interior Mirror](#) (501-09 Rear View Mirrors, Removal and Installation).
2. Remove the rain sensor.



E49707

- Release the 2 clips.
- Disconnect the electrical connector.

Installation

1. To install, reverse the removal procedure.

Wipers and Washers - Front Wiper Pivot Arm

Removal and Installation

Removal

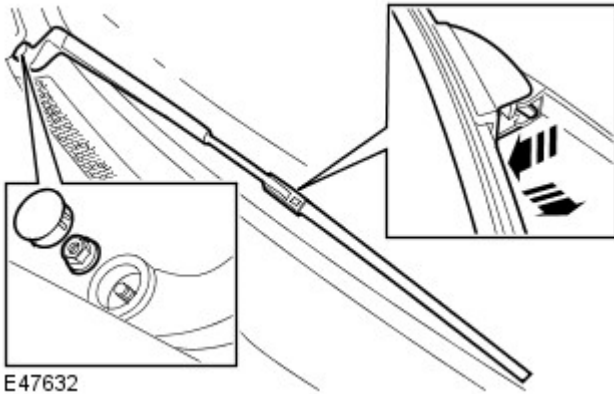
1. Noting the fitted position, remove the front wiper pivot arm.

- Remove the nut cover.
- Remove the nut.

2. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the wiper blade.

- Release the clip.



Installation

1. To install, reverse the removal procedure.

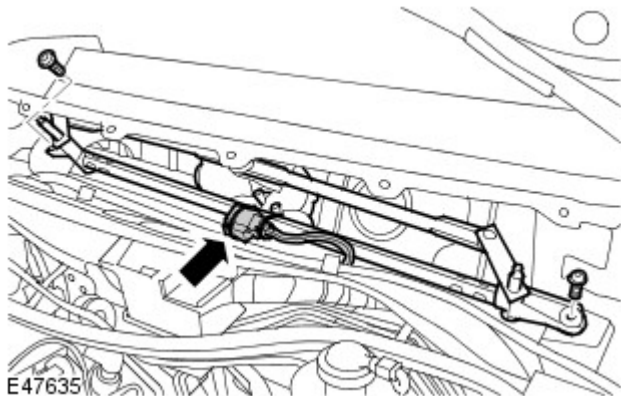
- Tighten the nut to 18 Nm (13 lb.ft).

Wipers and Washers - Windshield Wiper Motor

Removal and Installation

Removal

1. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
2. Remove the windshield wiper motor and linkage.



- Remove the 2 bolts.
- Remove the 2 clips.
- Disconnect the electrical connector.


3. NOTE: Do not disassemble further if the component is removed for access only.

Noting the fitted position, remove the wiper linkage.

- Remove the 2 bolts.
- Remove the nut.



Installation

1. Install the wiper linkage.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 - Tighten the nut to 25 Nm (18 lb.ft).
2.  CAUTION: Make sure the windshield wiper motor is located on its stud prior to installing the bolts.

Install the windshield wiper motor and linkage.

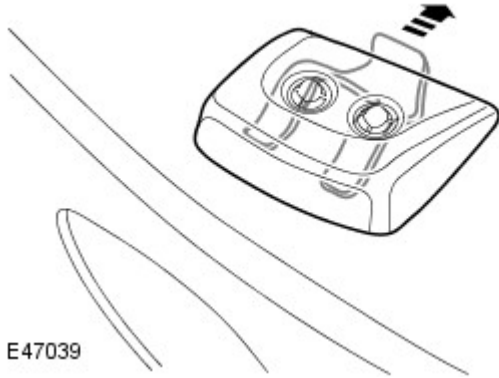
- Tighten the bolts to 6 Nm (4 lb.ft).
 - Connect the electrical connector.
 - Install the clips.
3. Install the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Wipers and Washers - Headlamp Washer Jet

Removal and Installation

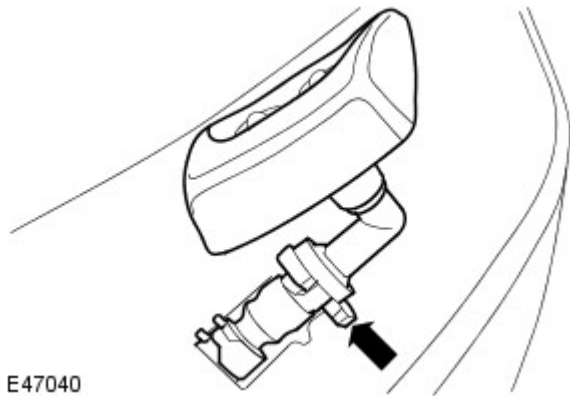
Removal

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front fog lamp.
For additional information, refer to: [Front Fog Lamp](#) (417-01 Exterior Lighting, Removal and Installation).
3. Release the washer jet assembly.
 - Release the clip.



E47039

4. Remove the washer jet.
 - Release the hose clip and disconnect the hose.



E47040


Installation

1. To install, reverse the removal procedure.

Wipers and Washers - Headlamp Washer Pump

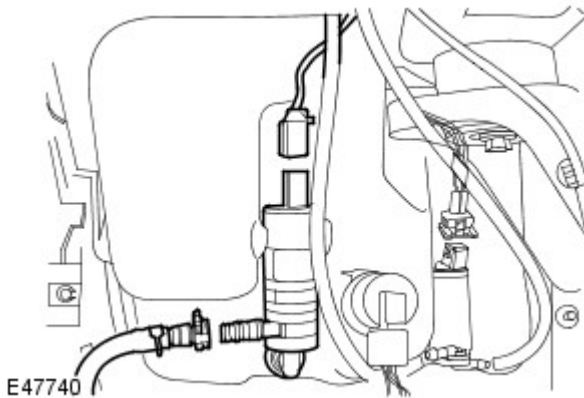
Removal and Installation

Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the LH fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Release the headlamp washer pump hose.
 - Drain the washer reservoir fluid.
4. Disconnect the headlamp washer pump electrical connector.
5. Remove the headlamp washer pump.
 - Discard the O-ring seal.

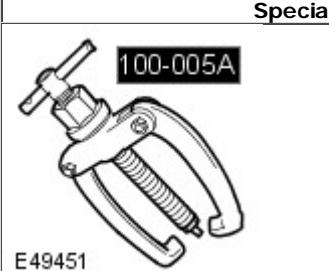


Installation

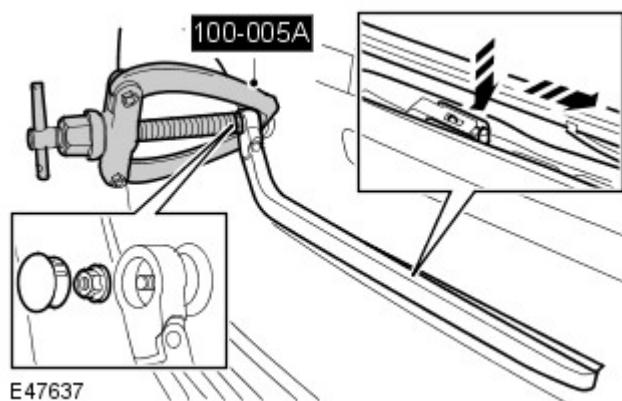
1. Install the headlamp washer pump.
 - Install a new O-ring seal.
2. Connect the headlamp washer pump electrical connector.
3. Connect the headlamp washer pump hose.
4. Install the fender splash shield.
For additional information, refer to: [Fender Splash Shield](#) (501-02 Front End Body Panels, Removal and Installation).
5. Lower the vehicle.
6. Top-up the windshield washer reservoir.

Wipers and Washers - Rear Wiper Pivot Arm

Removal and Installation

Special Tool(s)	
 <p>100-005A</p> <p>E49451</p>	<p>General purpose puller 100-005A (LRT-99-500A)</p>

Removal



1. Noting the fitted position and using the special tool, remove the rear wiper pivot arm.

- Remove the nut cover.
- Remove the nut.

2. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the wiper blade.

- Release the clip.

Installation

1. To install, reverse the removal procedure.

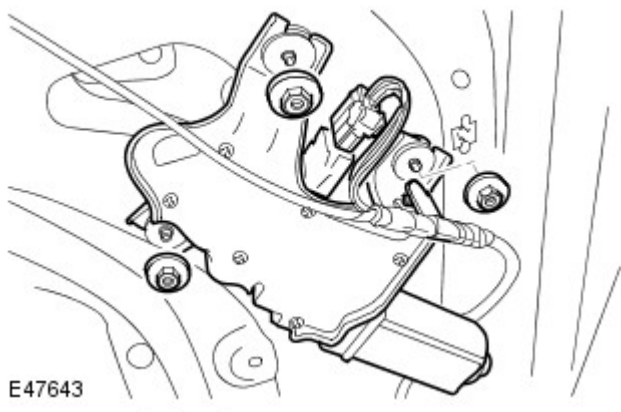
- Tighten the nut to 15 Nm (11 lb.ft).

Wipers and Washers - Rear Window Wiper Motor

Removal and Installation

Removal

1. Remove the liftgate trim panel.
For additional information, refer to: [Liftgate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the rear window wiper arm.
For additional information, refer to: [Rear Wiper Pivot Arm](#) (501-16 Wipers and Washers, Removal and Installation).
3. Remove the rear window wiper motor.
 - Disconnect the electrical connector.
 - Release the clip.
 - Remove the 3 nuts.



4. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the 3 rubber insulators.

- Remove the metal inserts.



Installation

1. To install, reverse the removal procedure.
 - Tighten the nuts to 10 Nm (7 lb.ft).

Roof Opening Panel -

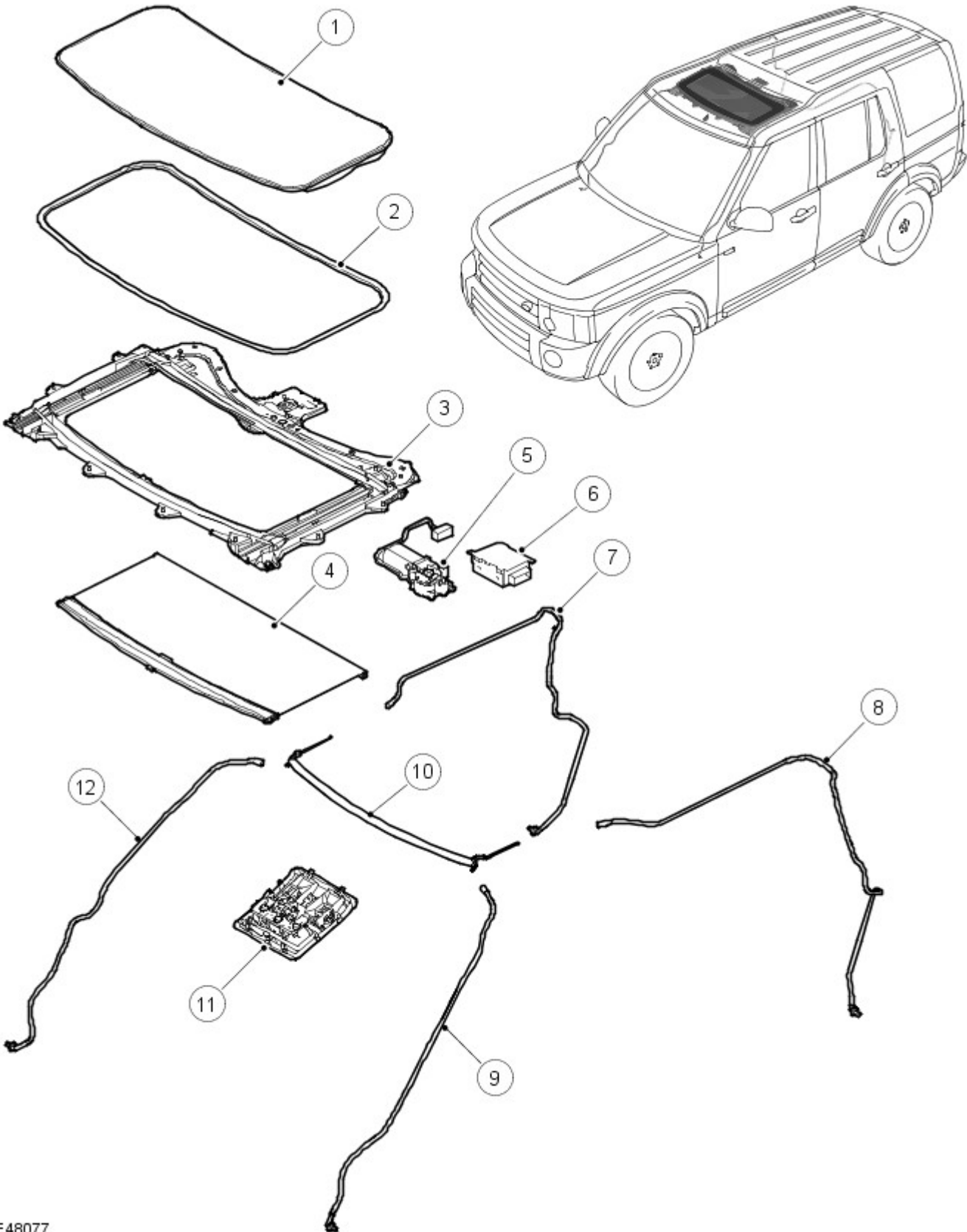
Torque Specifications

Description	Nm	lb-ft
Roof opening panel motor Torx screws	4	3
Roof opening panel bolts	10	7
Roof opening panel alignment Torx screws	6	4

Roof Opening Panel - Roof Opening Panel

Description and Operation

Roof Opening Panel Components

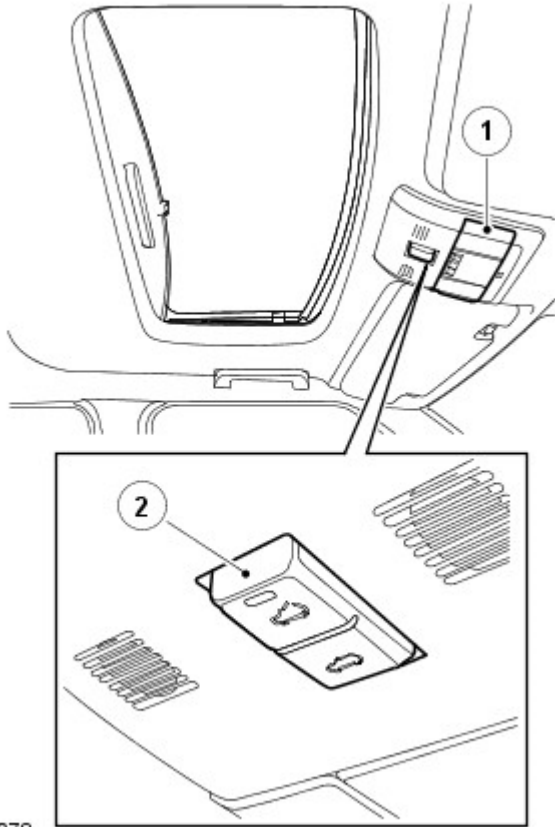


E48077

Item	Part Number	Description
1	-	Glass panel assembly
2	-	Glass panel seal
3	-	Frame assembly
4	-	Sunblind

5	-	Motor
6	-	Control module
7	-	RH rear drain tube
8	-	LH rear drain tube
9	-	LH front drain tube
10	-	Deflector
11	-	Access panel
12	-	RH front drain tube

GENERAL



E48078

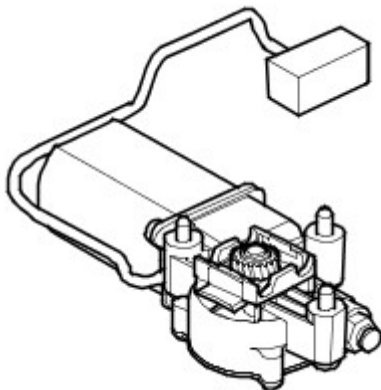
Item	Part Number	Description
1	-	Access panel
2	-	Switch

The sunroof is electrically operated through a two-way rocker switch located on the roof mounted centre console. An electric motor, attached to the sunroof frame, drives the glass sunroof panel to the tilt or open positions. The glass panel is operated by two cables, which are driven by the motor.

The sunroof frame is bolted to eleven mounting points on the roof panel. The frame is a large injection moulding and supports all of the sunroof components. Two aluminium guides held in the frame, on each side. The sunroof motor attaches to the rear of this frame. The motor is supported on the frame with three screws.

The sunroof glass panel is attached to the guide at the extreme front and rear. The tilt and slide positions are achieved by driving the attachment points on the panel over two fixed curves, one in the guide and one fixed to the panel.

Sunroof Motor



E48079

The sunroof motor has a worm drive, which drives a gear in a cast housing attached to the end of the motor. The gear has

a small pinion gear attached to the outer part of its spindle. The pinion engages with the helixed cables to form a rack and pinion drive. Rotation of the motor turns the pinion, which in turn drives the cables in the required direction.

Sunroof Motor Pin Out Information

Pin	Description	Input/Output
1	Hall sensor Ground	-
2	Hall sensor Supply	Input
3	Hall sensor Speed	Output
4	Hall sensor Direction	Output
5	Motor A	Input
6	Motor B	Input

The two cables are attached either side of the pinion. One end of each cable is attached to the guide. The opposite end is trapped in its position on the pinion by a metal insert in the frame. The cables run in channels in the frame to the guides. As the sunroof panel is closed, the cables are pushed through channels in the rear of the frame. The displaced cable is guided into a further two channels in the frame, which protect the cable and prevent the cable snagging creating noise. The cables are made from rigid spring steel and therefore can pull as well as push the sunroof along the guides.

A sun blind is also located in the guides integrated into the frame. The sunblind is operated manually, independently of the glass panels position. To move to the closed position the sunblind handle is pushed forward until it latches into the frame. To move the sunblind to the open position the sunblind handle is pushed up, to unlatch and either released or retracted to the open position. The sunblind can only be in either the fully open or fully closed positions.

Drain hoses are connected to the front and rear corners of the frame. The drain hoses are located inside of the cabin on the 'A' and 'C' post pillars to allow water, which has collected in the frame to escape. A one-way valve is fitted to the end of each drain hose to prevent the ingress of dirt and moisture.

SUNROOF CONTROL MODULE

The sunroof control module is mounted on the rear of the frame, and is connected to the motor at one end as described above, and to the vehicle electrical system at the other. It takes the inputs from the vehicle, such as LIN (Local Interconnect Network) bus signals and switch signals, and controls motor movement appropriately. It also contains the algorithm for the anti-trap system.

Sunroof Control Module Pin Out Information

Pin	Description	Input/Output
1	Switch Ground	-
2	Switch Open	Input
3	Switch Close	Input
4	Not used	-
5	Not used	-
6	Emergency (see note below)	Input
7	ECU Ground	-
8	Battery	Input
9	Not used	-
10	Not used	-
11	Not used	-
12	LIN	Input

• NOTE: Pin 6 is for use in an emergency only in the event of the vehicle LIN bus not being functional. It is not connected on the vehicle harness or in the connector.

• NOTE: Putting pin 6 to ground will enable the sunroof control module but without one touch operation or anti trap. The sunroof will not require re-calibrating unless the battery has been disconnected.

• NOTE: The sunroof control module will remain awake and enabled until pin 6 is disconnected again. Under no circumstances is this pin to be left grounded for long periods.

• NOTE: There is no emergency key access in the headlining for manual sunroof operation should the motor fail for any reason.

OPERATION

The sunroof can be operated with the ignition in power modes 4 accessory or 6 on. The sunroof can also be operated for up to 40 seconds after the ignition power mode 0 'off' provided the driver's or passenger's door is not opened. During the 40 second period the one touch function is inoperative.

The motor contains a micro-switch and a Hall effect sensor. Two gears, driven by the motor at one end of the pinion drive spindle, trip the micro-switch every thirteen revolutions of the spindle. When the micro-switch is tripped, the sunroof control module senses an open circuit signal. The sunroof control module, to calculate the exact position of the sunroof, uses the signal from the micro-switch combined with signals received from the Hall effect sensor. The Hall effect sensor is also responsible for the operation of the anti-trap function.

If the anti-trap feature is activated while the sunroof is closing, the roof panel is reversed for 200mm or as far as possible. The Hall sensor, located in the sunroof motor, monitors the speed of the motor and if the speed decreases below a set threshold, indicating an obstruction, the power feed to the motor is reversed so the sunroof goes back. In an emergency the anti-trap function can be overridden by holding the sunroof switch in the closed position.

Tilt

With the sunroof panel closed, pushing the upper part of the rocker switch operates the sunroof motor to 'tilt' the rear of the sunroof upwards. The motor operates for as long as the switch is operated until the glass is tilted to its full extent. If the switch is released before the full tilt position is reached, the sunroof panel stops at the chosen position. A single press (between 0.5 and 1 second) of the switch operates the motor so that the panel automatically retracts to the fully tilted position.

When the tilt function is requested, the cables pull the guide rearward, forcing the panel attachment up a curve, which raises the sunroof panel to the tilt position.

With the sunroof panel in the tilted position, pushing the lower part of the rocker switch operates the sunroof motor to lower the sunroof panel. The motor operates to lower the panel for as long as the switch is operated until the panel is fully lowered. If the switch is released before the fully lowered position is reached, the sunroof panel stops at the chosen position.

Open (slide)

With the sunroof panel tilted, pushing the upper part of the rocker switch operates the sunroof motor to raise the sunroof panel and retract it backwards. A single press (between 0.5 and 1 second) of the switch operates the motor so that the panel automatically retracts to the fully open position. When the panel retracts, a wind deflector automatically raises at the front of the sunroof aperture, which serves to reduce wind noise.

When the open function is requested, the cables pull in a rearward direction, driving the glass panel attachments to slide the panel over the exterior roof skin.

With the sunroof panel half or fully open, pushing the lower part of the switch operates the motor to close the sunroof panel. A single press (between 0.5 and 1 second) of the switch operates the motor so that the panel automatically closes to the fully tilted position.

If only partial opening or closing is desired, pressing the switch momentarily (less than 0.5 seconds) in either direction will stop the sunroof panel movement. When movement is desired in either direction, pressing the switch will operate the motor to move the panel.

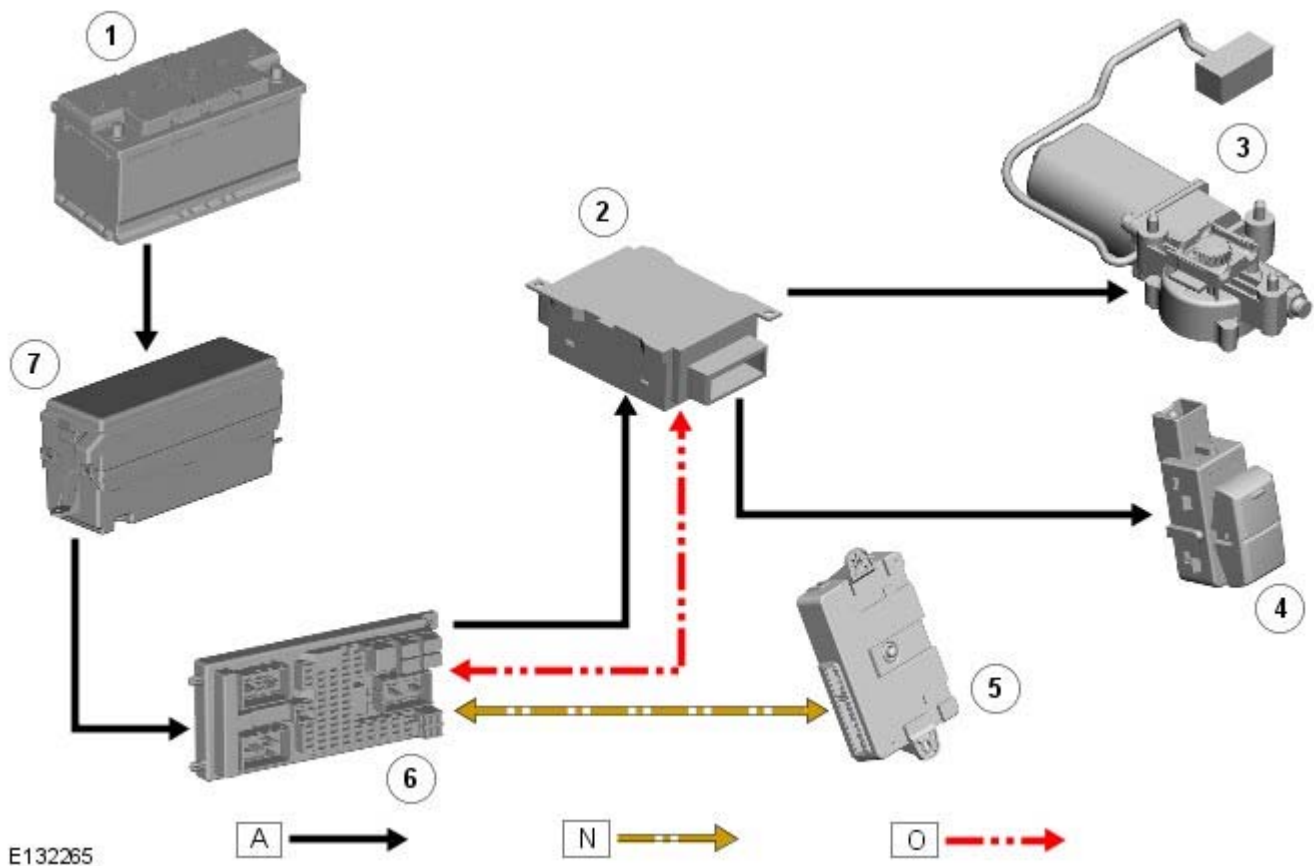
The sunroof has an 'anti-trap' function which prevents the sunroof panel from closing if an obstruction is sensed. When an obstruction is sensed, the motor will automatically retract the panel by 200mm or as far as possible. When the obstruction is removed, the panel can be closed by the normal method.

Battery Disconnection

If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Pressing the lower part of the sunroof switch for 20 seconds will start the sunroof's calibration routine. The sunroof will complete a full cycle in order to re-learn the parameters required for one-touch open and close and the anti-trap function. The sunroof will still have manual movement available until the sunroof is re-calibrated.

SUNROOF CONTROL DIAGRAM

• NOTE: **A** = Hardwired; **N** = Medium speed CAN bus; **P** = Local Interconnect Network (LIN) bus



Item	Part Number	Description
1	-	Battery
2	-	Sunroof control module
3	-	Sunroof motor
4	-	Sunroof switch
5	-	Keyless Vehicle Module (KVM)

6	-	Central Junction Box (CJB)
7	-	Engine Junction Box (EJB)

Roof Opening Panel - Roof Opening Panel

Diagnosis and Testing

Principle of Operation

For a detailed description of the roof opening panel system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Roof Opening Panel (501-17 Roof Opening Panel, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Glass panel assembly ● Glass panel seal ● Frame assembly ● Sunblind ● Deflector ● Access panel ● Roof opening panel cables ● Drain tube(s) 	<ul style="list-style-type: none"> ● Fuses ● Battery Junction Box (BJB) ● Central Junction Box (CJB) ● Wiring harness ● Loose or corroded connector(s) ● Roof opening panel motor and control module ● Roof opening panel switch

3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Roof opening panel inoperative	<ul style="list-style-type: none"> ● Fuse(s) blown ● Circuit fault ● Switch fault ● Motor fault 	Check the fuse(s). Check the roof opening panel circuits. Check the switch and motor function. Refer to the electrical guides.
Roof opening panel sticking	<ul style="list-style-type: none"> ● Debris in the channels/guides ● Cable(s) sticking/damaged ● Roof opening panel not correctly aligned ● Switch fault ● Motor fault 	Check for general debris. Inspect, clean and lubricate the cable(s) and guides. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual. Check the switch and motor function. Refer to the electrical guides.
Roof opening panel juddering	<ul style="list-style-type: none"> ● Debris in the channels/guides ● Cable(s) sticking/damaged ● Roof opening panel not correctly aligned ● Motor fault 	Check for general debris. Inspect, clean and lubricate the cable(s) and guides. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual. Check the motor function.
Water ingress from roof opening panel	<ul style="list-style-type: none"> ● Debris in the channels/guides ● Drain tube(s) blocked ● Damage to the glass panel seal ● Roof opening panel not correctly aligned 	Check for general debris and blocked drain tube(s). Inspect, clean and lubricate the cable(s) and guides. Check the glass panel seal. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual.
Wind noise	<ul style="list-style-type: none"> ● Damage to the glass panel seal ● Cable(s) sticking/damaged ● Roof opening panel not correctly aligned 	Check the glass panel seal. Inspect, clean and lubricate the cable(s) and guides. Check the roof opening panel alignment. Refer to the relevant section of the workshop manual.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

Roof Opening Panel - Roof Opening Panel Alignment

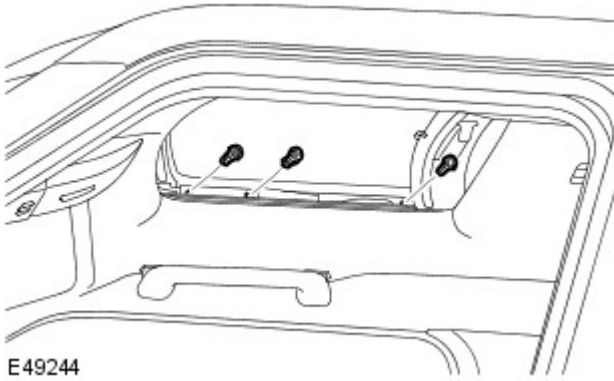
General Procedures

1. With the roof opening panel closed, check the alignment of the glass to the roof panel. The glass should be central in its aperture. Profile of sunroof to body:

1. Front edge, set flush or up to 1.0 mm (0.040") low.
1. Rear edge, set flush or up to 1.0 mm (0.040") high.

2. Open the roof opening panel blind.

3. Loosen the 6 roof opening panel Torx bolts.



4. Align the roof opening panel.

- Tighten the Torx screws to 6 Nm (4 lb.ft).

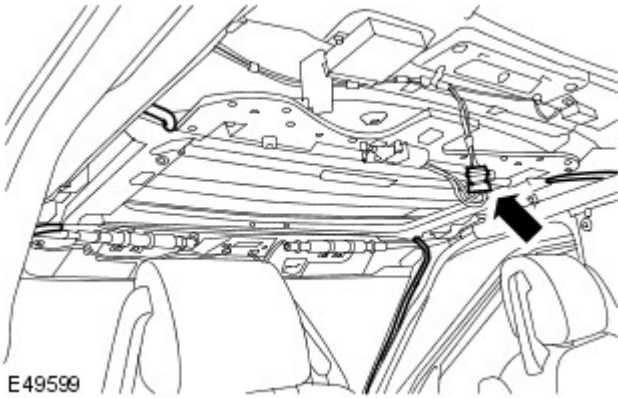
5. Close the roof opening panel blind.

Roof Opening Panel - Roof Opening Panel

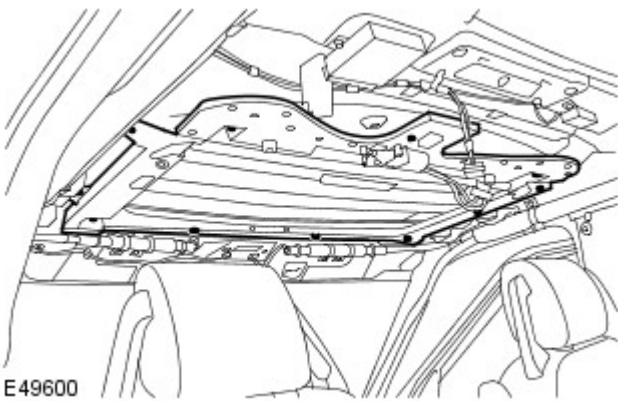
Removal and Installation

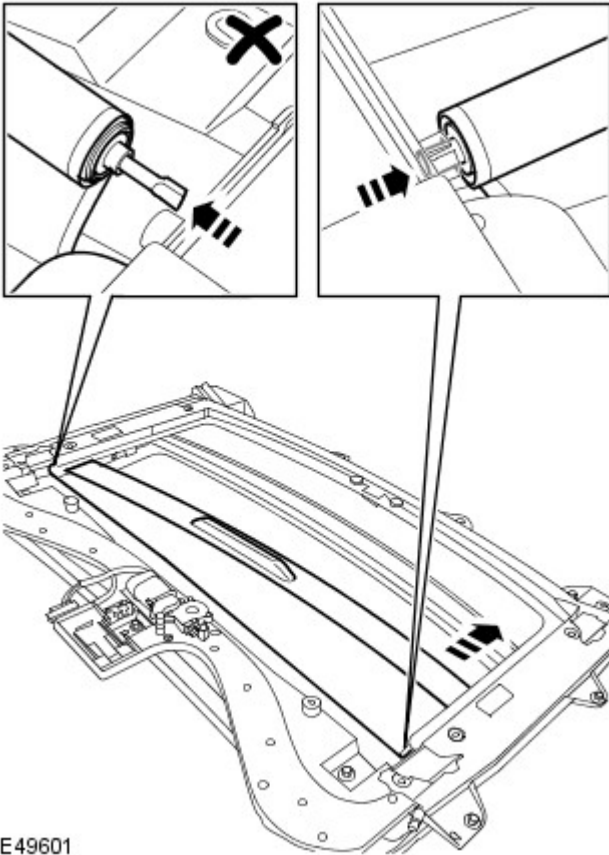
Removal

1. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Release the 4 drain hoses from the roof opening panel.
3. Disconnect the roof opening panel motor electrical connector.



4. With assistance, remove the roof opening panel assembly.
 - Remove the 11 bolts.





E49601

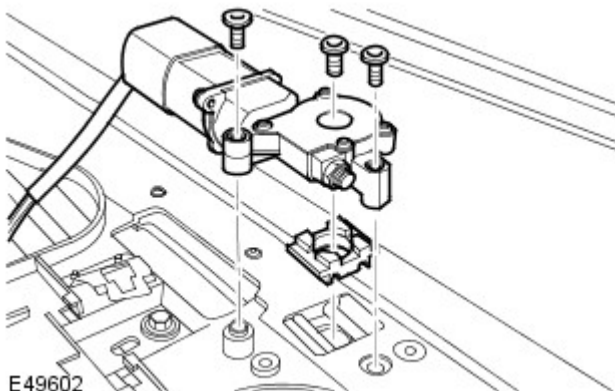
5.  **CAUTION:** Do not depress the RH plunger to remove the blind.

• **NOTE:** Do not disassemble further if the component is removed for access only.

• **NOTE:** Note the fitted position.

Remove the roof opening panel blind.

- Twist to release the handle.
- Depress the LH plunger.



E49602

6. Remove the roof opening panel motor.

- Remove the 3 Torx screws.
- Remove the spacer.

Installation

1. Install the roof opening panel motor.

- Install the spacer.
- Tighten the Torx screws to 4 Nm (3 lb.ft).

2. **NOTE:** Align to the position noted on removal.

Install the roof opening panel blind.

- Secure in the guides.
- Locate the tensioner peg.
- Depress the LH plunger.

3. With assistance, install the roof opening panel assembly.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).

4. Connect the roof opening panel motor electrical connector.

5. Connect the drain hoses.

- Make sure the drain hoses are clear prior to connection.

6. Install the headliner.

For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

7. Using T4, configure a new roof opening panel.

- 8.** If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Close the roof opening panel and continue to hold the switch for a further 20 seconds to allow the sunroof to complete a full cycle. This will complete the roof opening panels calibration routine and reset these functions.

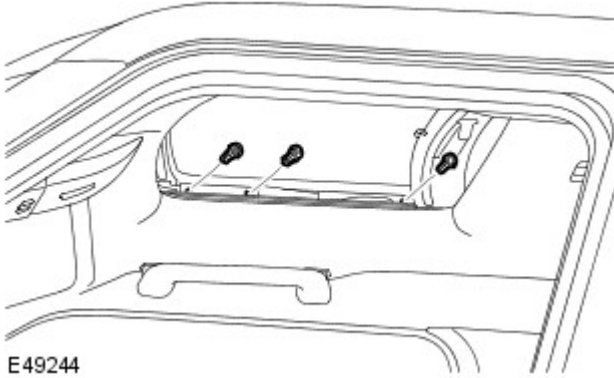
Roof Opening Panel - Roof Opening Panel Glass

Removal and Installation

Removal

1. Open the roof opening panel blind.
2. Open the roof opening panel to the tilt position.
3. Remove the roof opening panel glass.

- Remove the 3 Torx screws.
- Repeat the above procedure for the other side.



Installation

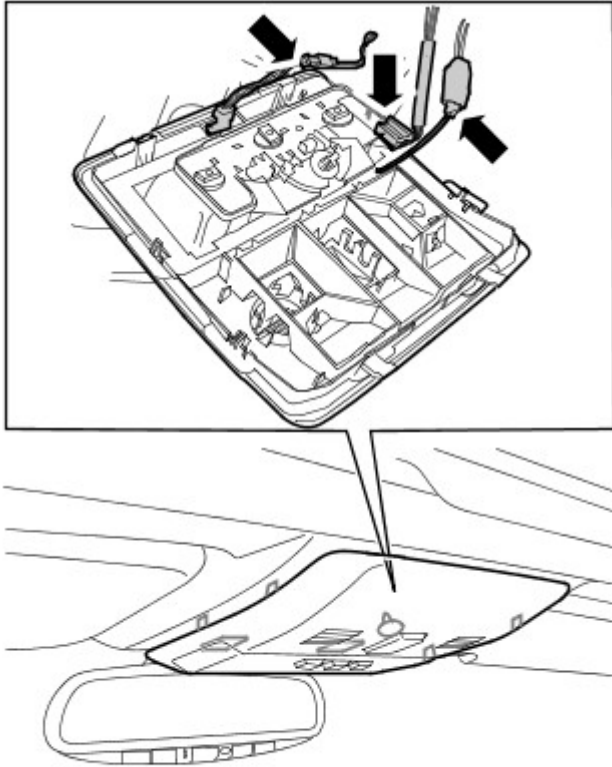
1. Install the roof opening panel glass.
 - Install the Torx bolts, but do not tighten fully at this stage.
2. Align the roof opening panel glass.
For additional information, refer to: [Roof Opening Panel Alignment](#) (501-17 Roof Opening Panel, General Procedures).

Roof Opening Panel - Roof Opening Panel Motor

Removal and Installation

Removal

1. Remove both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the front overhead console.

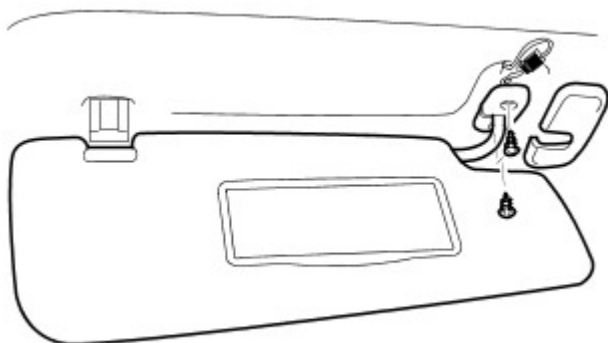


- Carefully release the 7 clips.
- Disconnect the electrical connector.

E50142

4. Remove the sun visor.

- Remove the cover.
- Remove the 2 screws.
- Release from the clip.
- Disconnect the electrical connector.
- Repeat the above procedure for the other side.



E49687

5. Remove the sun visor retaining clip.

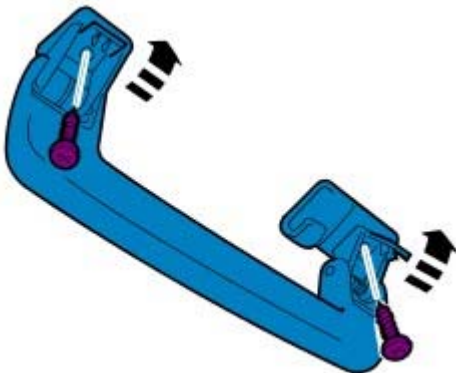
- Release the screw cover.
- Remove the screw.
- Repeat the above procedure for the other side.



E49688

6. Remove the passenger assist handle.

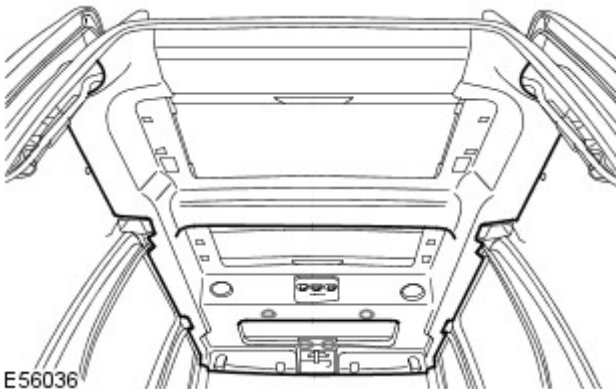
- Release the 2 screw covers.
- Remove the 2 screws.
- Repeat the above procedure for the other side.



E49689

7. Lower the headliner for access.

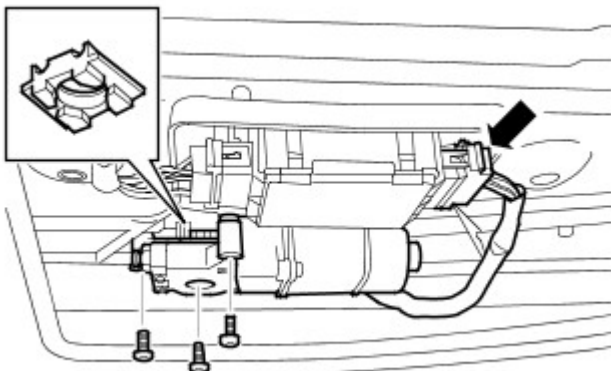
- Release the 4 clips.



E56036

8. Remove the roof opening panel motor.

- Disconnect the electrical connector.
- Remove the 3 Torx screws.
- Remove the spacer.



E55446

Installation

1. Install the roof opening panel motor.

- Install the spacer.

- Tighten the Torx screws to 4 Nm (3 lb.ft).
 - Connect the electrical connector.
2. Position the headliner.
- Secure with the clips.
3. Install the passenger assist handles.
- Install the screws.
 - Secure the screw covers.
4. Install the sun visors.
- Install the clips.
 - Install the screws.
 - Install the screw covers.
 - Connect the electrical connectors.
5. Install the front overhead console.
- Connect the electrical connector.
 - Carefully secure the clips.
6. Install both B-pillar upper trim panels.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
7. Install both A-pillar upper trim panels.
For additional information, refer to: [A-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
8. Using T4, configure a new roof opening panel motor.
9. If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Close the roof opening panel and continue to hold the switch for a further 20 seconds to allow the sunroof to complete a full cycle. This will complete the roof opening panel calibration routine and reset these functions.

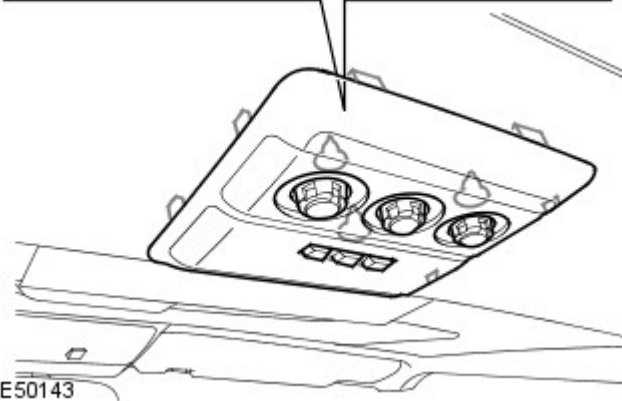
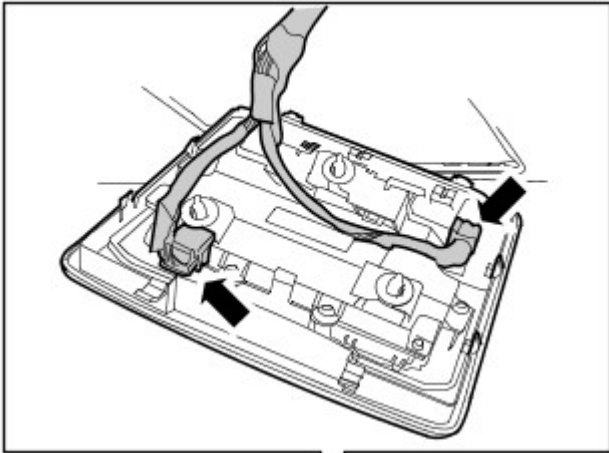
Roof Opening Panel - Roof Opening Panel Module

Removal and Installation

Removal

1. Remove the rear overhead console.

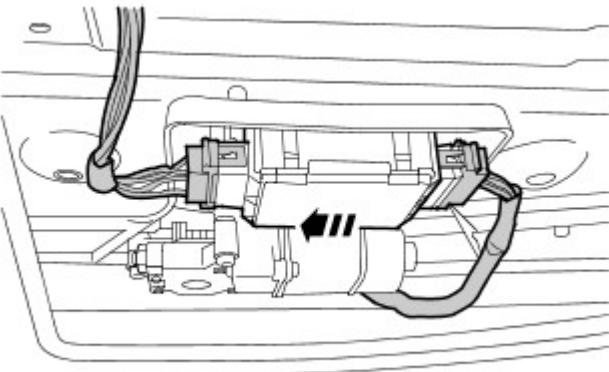
- Carefully release the 9 clips.
- Disconnect the 2 electrical connectors.



E50143

2. Remove the roof opening panel module.

- Slide the module to the LH side to release it from the bracket.
- Disconnect the 2 electrical connectors.



E55397

Installation

1. Install the roof opening panel module.

- Connect the electrical connectors.
- Secure the module to the bracket.

2. Install the rear overhead console.

- Connect the electrical connectors.
- Carefully secure the clips.

3. Using T4, configure a new roof opening panel module.

4. If the battery has been disconnected, the one touch and anti-trap function will become inoperative. Close the roof

opening panel and continue to hold the switch for a further 20 seconds to allow the sunroof to complete a full cycle. This will complete the roof opening panels calibration routine and reset these functions.

Bumpers -

Description	Nm	lb-ft
Front bumper bolts	25	18
Windshield washer reservoir bolts	5	3.5
Front bumper cover bolts	5	3.5

Bumpers - Front Bumper

Removal and Installation

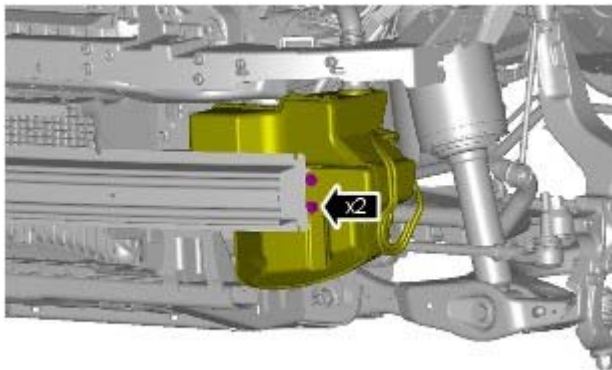
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: Specifications (414-00, Specifications).

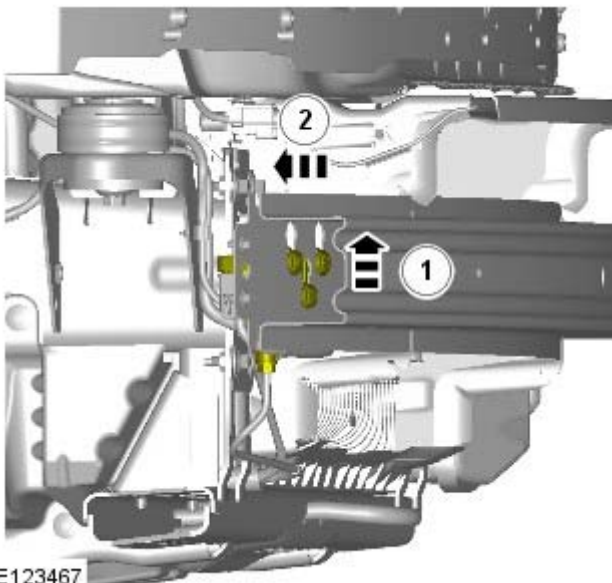
2. Refer to: [Front Bumper Cover](#) (501-19 Bumpers, Removal and Installation).



E123468

3. **3.** NOTE: Support as necessary.

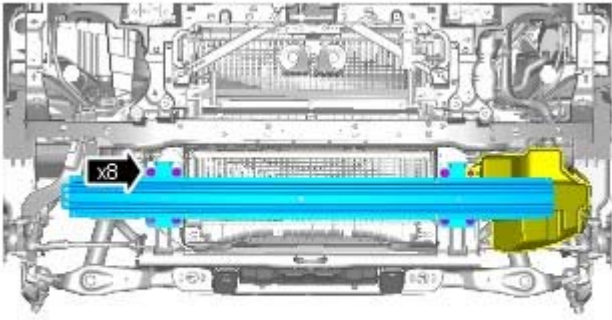
Torque: 10 Nm



E123467

4. **4.**  CAUTION: Take extra care not to damage the component.

- NOTE: Support as necessary.



E123469

Installation

5. **NOTE:** With assistance remove the component.

Torque: 25 Nm

1. To install, reverse the removal procedure.

Bumpers - Front Bumper Cover

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

Refer to: Specifications (414-00, Specifications).

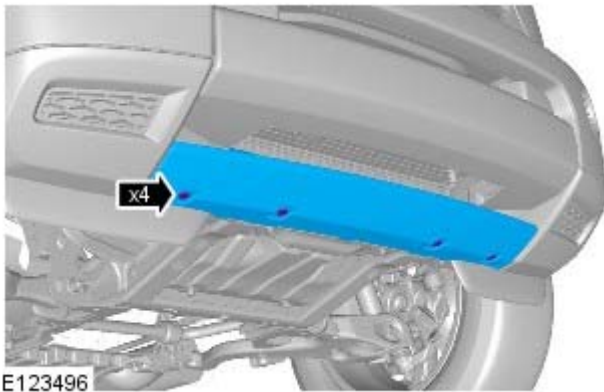
2. Refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ormentation, Removal and Installation).

3.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

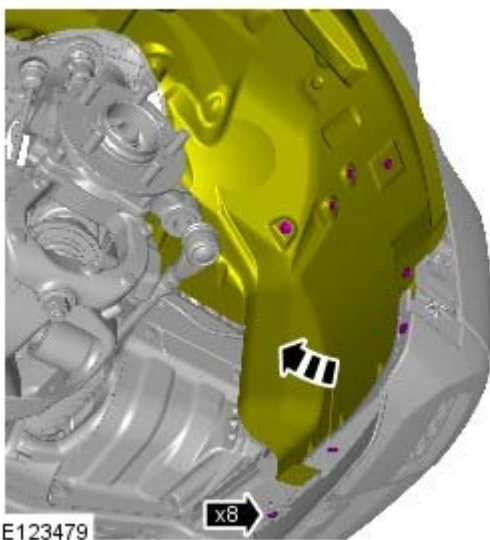
4. Remove both the front wheels and tires.

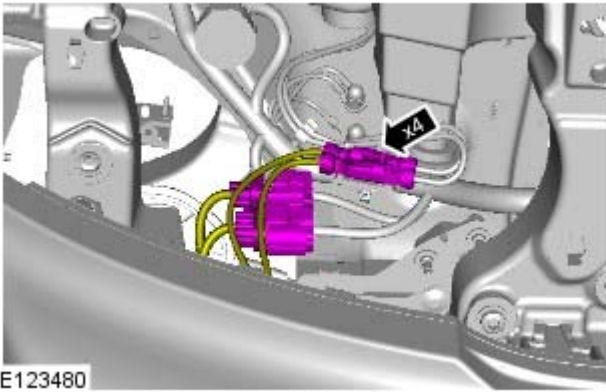
5.



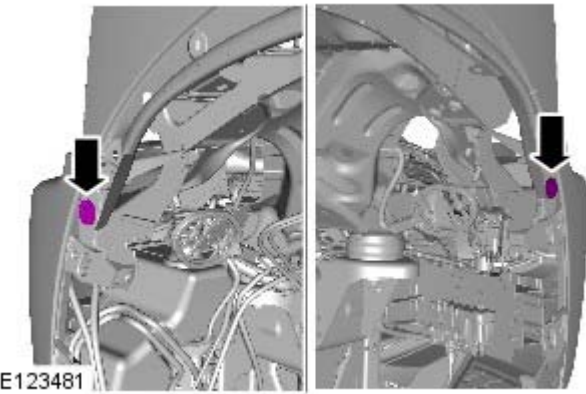
6. **NOTE:** The procedure must be carried out on both sides.

Torque: 1 Nm

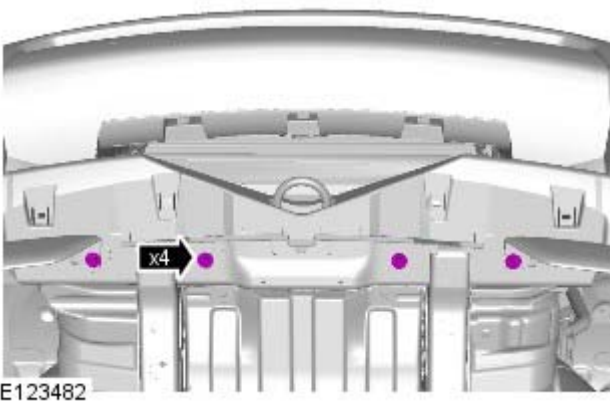




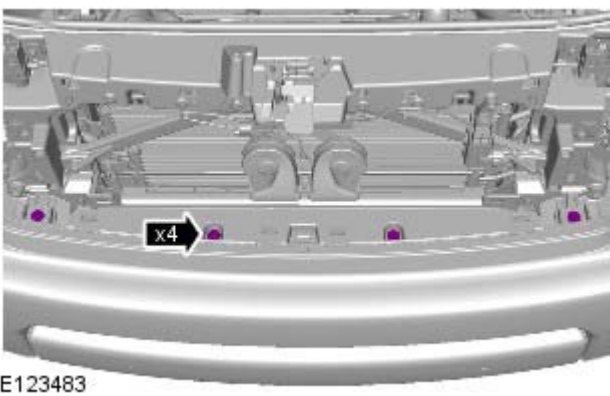
7.  CAUTION: Take extra care not to damage the wiring harnesses.



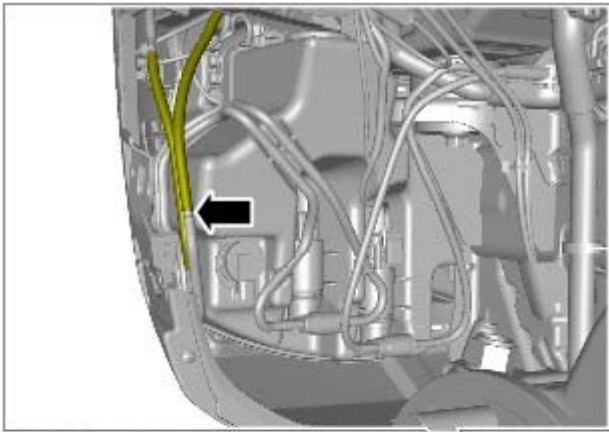
8. Torque: 5 Nm



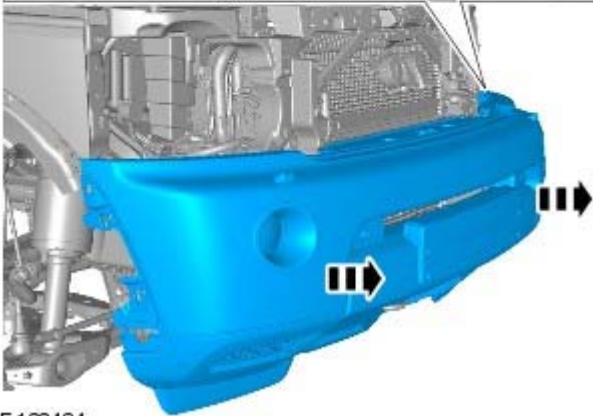
9. Torque: 5 Nm



10. Torque: 5 Nm



11. **11.** NOTE: With assistance remove the component.



E 123484

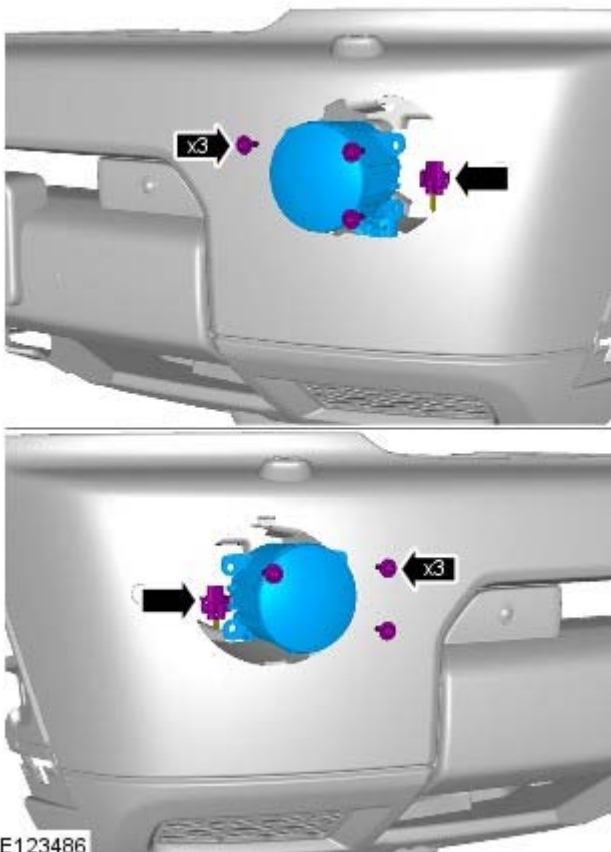
12. **12.** NOTE: Do not disassemble further if the component is removed for access only.

Torque: 1 Nm

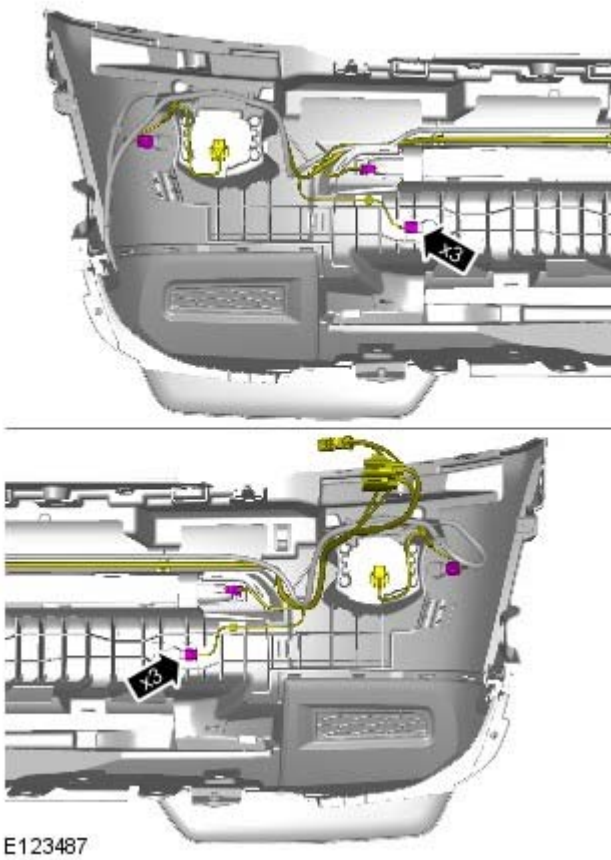


E 123485

13. Torque: 1.5 Nm




14.



15. Torque: 1 Nm



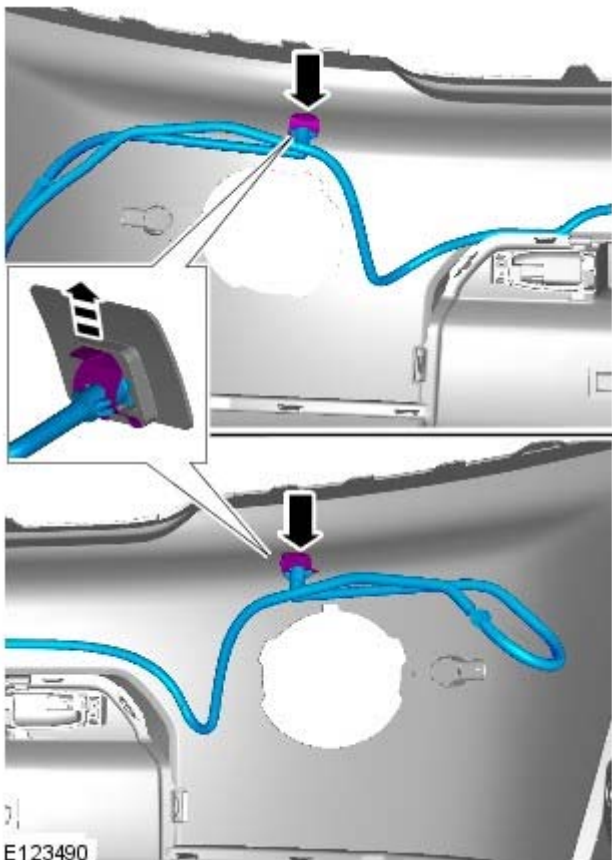
E123488

16.  CAUTION: Make sure the locating tangs are aligned. Failure to follow this instruction may result in damage to the vehicle.



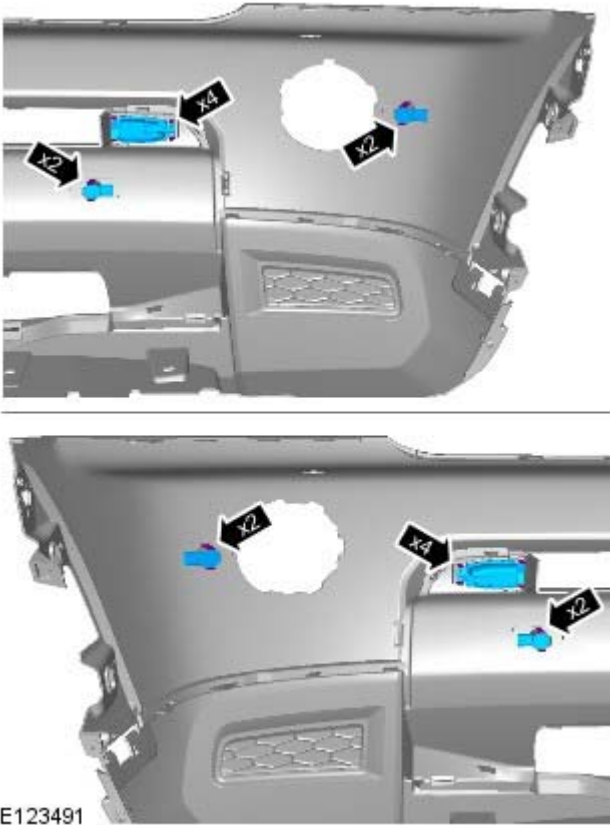
E123489

17.



E123490

18.



E123491

Installation

1. To install, reverse the removal procedure.

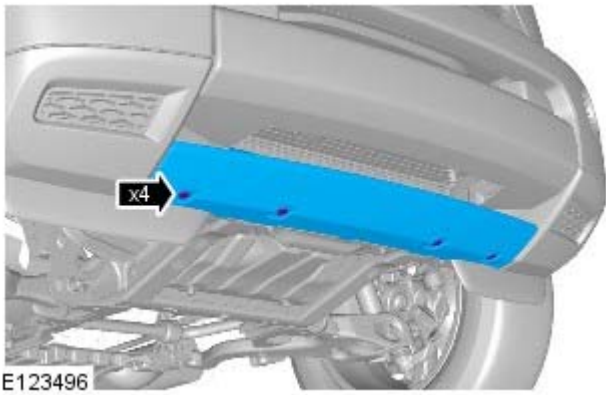
Bumpers - Front Bumper Lower Cover

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.



Installation


1. To install, reverse the removal procedure.

Bumpers - Rear Bumper Cover

Removal and Installation

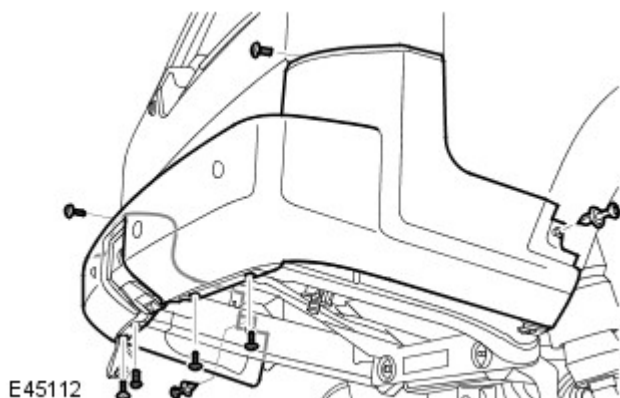
Removal

All vehicles

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

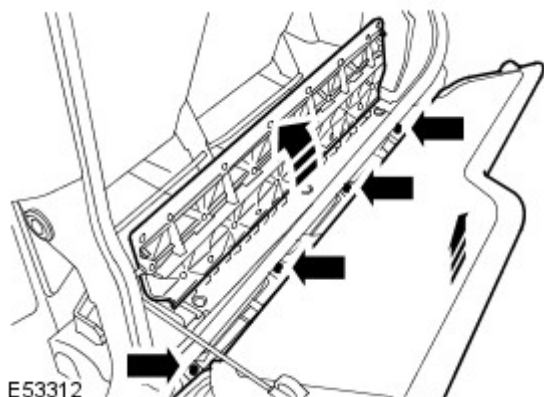
Raise and support the vehicle.

2. Remove both rear lamp assemblies.
For additional information, refer to: [Rear Lamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
3. Remove both rear quarter panel mouldings.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
4. Remove 4 screws, 2 clips and 2 bolts from the rear bumper cover.



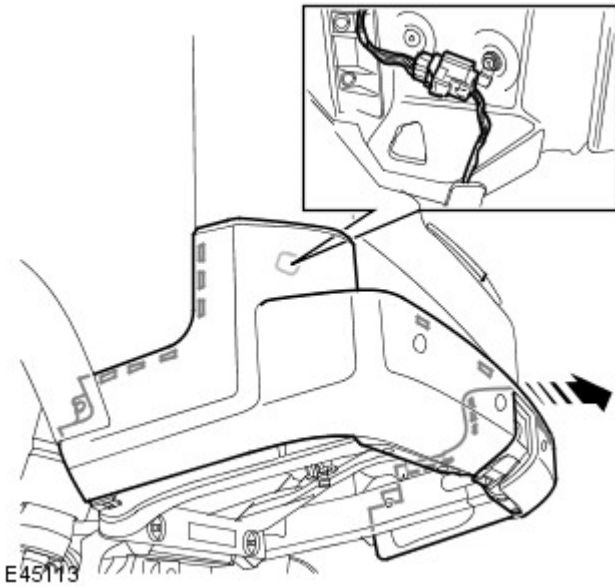
5. With assistance, remove 4 clips from the inner edge of the bumper cover.

- Tilt the tailgate for access.
- Open the tailgate hinge cover.



6. Remove the rear bumper cover.

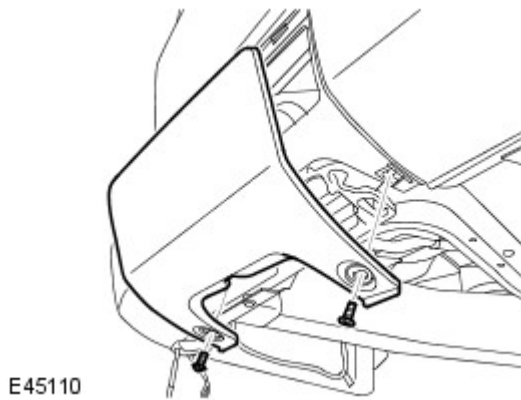
- Release from the 12 clips.
- If installed, disconnect the parking aid sensor wiring harness electrical connector.



7. NOTE: Do not disassemble further if the component is removed for access only.

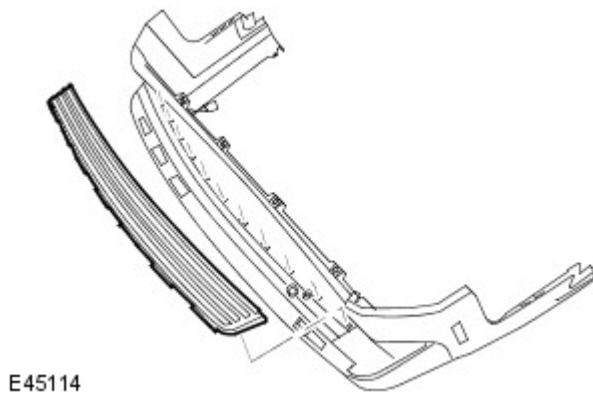
Remove the towing eye cover.

- Remove the 2 screws.



8. Remove the rear bumper trim panel.

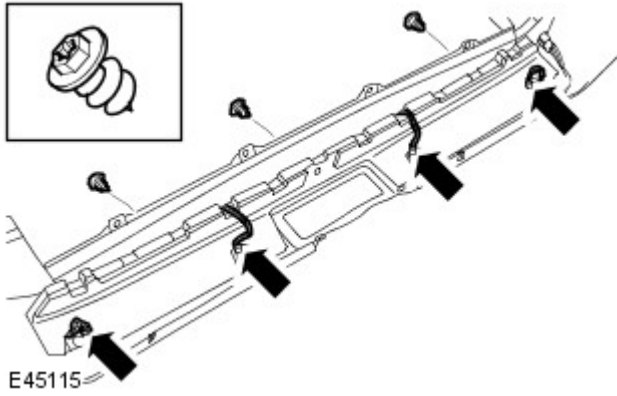
- Release the 11 clips.



9. Remove the bumper insert.

- Remove the 3 screws.

Vehicles with parking aid



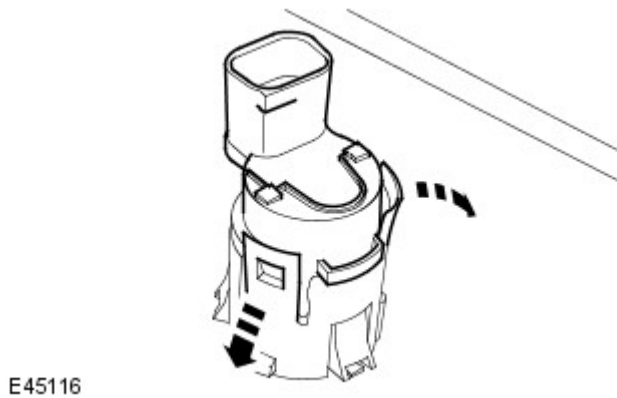
10. Remove the parking aid sensor wiring harness.

- Disconnect the 4 electrical connectors.

Vehicles with parking aid

11. Remove the parking aid sensor.

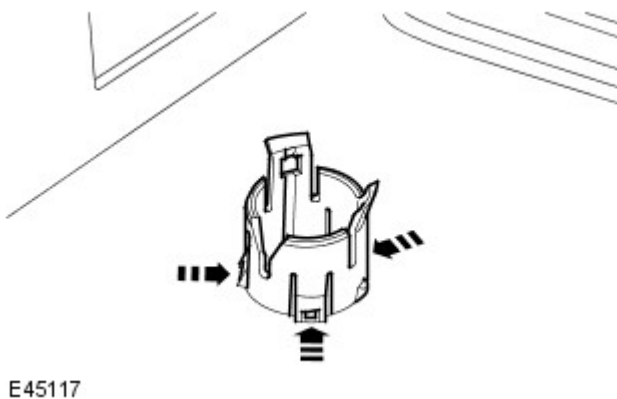
- Release the 2 clips.
- Repeat the above procedure for the remaining 3 sensors.



Vehicles with parking aid

12. Remove the parking aid sensor trim panel.

- Release the 3 clips.
- Repeat the above procedure for the remaining 3 sensor trim panels.



Installation

Vehicles with parking aid

1. Install the parking aid sensor trim panels.

Vehicles with parking aid

2. Install the parking aid sensors.

Vehicles with parking aid

3. Install the parking aid sensor wiring harness.

- Connect the electrical connectors.

4. Install the bumper insert.

- If installed, secure the parking aid sensor wiring harness.

- Tighten the screws.
5. Install the rear bumper trim panel.
 6. Install the towing eye cover.
 - Tighten the screws.
 7. Install the rear bumper cover.
 - If installed, connect the parking aid sensor wiring harness electrical connector.
 - Secure with the clips.
 - Tighten the screws.
 - Tighten the bolts to 10 Nm (7 lb.ft).
 8. Install both rear quarter panel mouldings.
For additional information, refer to: [Rear Quarter Panel Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
 9. Install both of the rear lamp assemblies.
For additional information, refer to: [Rear Lamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

Safety Belt System -

Torque Specifications

Description	Nm	lb-ft
Front safety belt retractor Torx bolt	40	30
Front safety belt buckle Torx bolt	40	30
+ Front safety belt upper anchor Torx bolt	40	30
Second row safety belt retractor Torx bolt	40	30
+ Second row safety belt upper anchor Torx bolt	40	30
Third row safety belt retractor Torx bolt	40	30
+ Third row safety belt upper anchor Torx bolt	40	30
Luggage compartment Torx bolts	25	18
Rear safety belt buckle Torx bolt	25	18
Rear safety belt buckle - RH - Torx bolt	40	30
Rear safety belt buckle - LH - Torx bolt - 60-40 split	25	18
Rear center safety belt buckle Torx bolt - 40-20-40 split	40	30
Rear safety belt buckle Torx bolt - 40-20-40 split	25	18
+ Rear seat Torx bolts	40	30

+ New Torx bolt must be fitted

Safety Belt System - Safety Belt System

Diagnosis and Testing

Principle of Operation

For a detailed description of the safety belt system and operation, refer to the relevant description and operation section of the workshop manual REFER to: Safety Belt System (501-20 Safety Belt System, Description and Operation).

Safety Information

• WARNINGS:



To avoid accidental deployment the back-up power supply must be depleted before beginning any work on the SRS system or its components. Failure to follow this instruction may result in personal injury



Do not use a multimeter to probe an SRS module. It is possible for the power from the multimeter battery to trigger the activation of the module. Failure to follow this instruction may result in personal injury

• NOTE: Do not to use a cellular phone or to have a cellular phone in close proximity when working on the SRS system or components

Power supply depletion

Before beginning any work on the SRS system or related components:

1. **1.** Remove the ignition key
2. **2.** Disconnect the battery leads, ground first
3. **3.** Wait 2 minutes for the power circuit to discharge

There are comprehensive instructions on the correct procedures for SRS system repairs, refer to the relevant section of the workshop manual

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle

• NOTE: Check and rectify basic faults before beginning diagnostic routines including pinpoint tests

1. **1.** Verify the customer concern by operating the safety belt
2. **2.** Visually inspect for obvious signs of mechanical or electrical damage

Visual Inspection


Mechanical	Electrical
<ul style="list-style-type: none"> ● Check for the installation of non-standard accessories which may affect or obstruct the function of the safety belt system ● Frayed or damaged webbing ● Missing or damaged button stop ● Pretensioner(s) Buckles/Stalks 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness fault ● Correct engagement of electrical connectors ● Loose or corroded connections ● Warning lamp bulb(s) ● Impact sensor(s) ● Buckle sensor(s) ● Pretensioner(s) ● Belt tension sensor(s) ● Restraints control module

3. **3.** If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step
4. **4.** If the cause is not visually evident, carry out the test methods described below, alternatively check for diagnostic trouble codes and refer to the relevant diagnostic trouble code index

For a complete list of all diagnostic trouble codes that could be logged on this vehicle, please refer to section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Restraints Control Module \(RCM\)](#) (100-00 General Information, Description and Operation).

Symptom Chart for Safety Belt Rows 1, 2 and 3

Symptom	Possible Causes	Action
Safety belt jammed - Webbing tight	<ul style="list-style-type: none"> ● Backlock effect-in action (webbing retracted quickly and came to sudden stop) ● Safety belt retractor not installed correctly ● Rear centre belt only. Mini-button (webbing travel limit stop) missing and seat squab has been moved 	<ul style="list-style-type: none"> ● GO to Pinpoint Test A. ● GO to Pinpoint Test E. ● GO to Pinpoint Test H. ● See the automatic locking retractor description below

Symptom	Possible Causes	Action
	<ul style="list-style-type: none"> causing tight fit Automatic locking retractor activated (clicking – during retraction only) 	
Seat squab will not fold/jammed	<ul style="list-style-type: none"> • NOTE: Rear centre belt only • Mini-button (webbing travel limit stop) missing and seat squab has been moved causing excessive tension 	<ul style="list-style-type: none"> • GO to Pinpoint Test H.
Safety belt jammed - Webbing loose	<ul style="list-style-type: none"> • Safety belt webbing trapped in seat • Safety belt retractor webbing guide loose • Twist in webbing • Interference in webbing routing • D-loop not rotating correctly 	<ul style="list-style-type: none"> • GO to Pinpoint Test B. • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test E. • GO to Pinpoint Test G.
Safety belt - Intermittent jamming	<ul style="list-style-type: none"> • Safety belt retractor not installed correctly 	<ul style="list-style-type: none"> • GO to Pinpoint Test F.
Safety belt - Slow retraction	<ul style="list-style-type: none"> • Safety belt retractor webbing guide loose • Twist in safety belt webbing • Interference in webbing routing • Safety belt retractor not installed correctly • D-loop not rotating correctly • Foreign object/debris 	<ul style="list-style-type: none"> • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test E. • GO to Pinpoint Test F. • GO to Pinpoint Test G. • GO to Pinpoint Test E.
Safety belt - Not retracting	<ul style="list-style-type: none"> • Safety belt retractor webbing guide loose • Twist in safety belt webbing • D-loop not rotating correctly • Interference in webbing routing • Foreign object/debris 	<ul style="list-style-type: none"> • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test G. • GO to Pinpoint Test E. • GO to Pinpoint Test E.
Safety Belt - Not extracting	<ul style="list-style-type: none"> • Backlock effect-in action (webbing retracted quickly and came to sudden stop) • Safety belt retractor not installed correctly • Safety belt retractor webbing guide loose • Twist in safety belt webbing • D-loop not rotating correctly • Interference in webbing routing • Foreign object/debris • Automatic locking retractor activated (clicking – during retraction only) 	<ul style="list-style-type: none"> • GO to Pinpoint Test A. • GO to Pinpoint Test F. • GO to Pinpoint Test C. • GO to Pinpoint Test D. • GO to Pinpoint Test G. • GO to Pinpoint Test E. • GO to Pinpoint Test E. • See the automatic locking retractor description below
Safety belt - Noisy during operation	<ul style="list-style-type: none"> • Automatic locking retractor activated (clicking–during retraction only) • Interference in webbing routing (rubbing) 	<ul style="list-style-type: none"> • GO to Pinpoint Test B. • GO to Pinpoint Test E.
Safety belt buckle - Not latching / jammed	<ul style="list-style-type: none"> • Foreign object/debris 	 CAUTION: Do not insert any objects or tools into the buckle head <ul style="list-style-type: none"> • GO to Pinpoint Test I.

Inertia Reel Safety Belts

The vehicle is equipped with (two row one), (three row two), and (two row three (seven seat versions only)) inertia reel safety belts

These safety belts are "**dual sensitive**" which means that they have:

- **Car sense system - A vehicle motion sensor, which locks the safety belt webbing under braking, cornering, on steep hills and in adverse camber conditions, when parked on a steep incline or driveway or two wheels on a high curb**
- **Webb sense system - A webbing motion sensor, which locks when the safety belt webbing is extracted suddenly**

The safety belts in the following positions are equipped with an automatic locking retractor function:

Carline	Market	Seat position	Automatic Locking Retractor Installed	From Model Year
Defender (L316)	All	All	No	2007
Discovery / Range Rover Sport (L319/L320)	All	Driver	No	2008
Discovery / Range Rover Sport (L319/L320)	US	Passenger	Yes	2005
Discovery / Range Rover Sport (L319/L320)	All	Driver	No	2005
Discovery / Range Rover Sport (L319/L320)	ROW	Passenger	No	2005
Discovery (L319)	All	Row 2	Yes	2005
Discovery (L319)	All	Row 3	Yes	2005
Range Rover Sport (L320)	All	Row 2	Yes	2006
Freelander (L359)	All	Driver	No	2007
Freelander (L359)	ROW	Passenger	No	2007
Freelander (L359)	US	Passenger	Yes	2007
Freelander (L359)	ROW	Row 2	No	2007
Freelander (L359)	US	Row 2	Yes	2007

Carline	Market	Seat position	Automatic Locking Retractor Installed	From Model Year
Range Rover Evoque (L358)	All	Driver	No	2011
Range Rover Evoque (L358)	ROW	Passenger	No	2011
Range Rover Evoque (L358)	US	Passenger	Yes	2011
Range Rover Evoque (L358)	ROW	Row 2	No	2011
Range Rover Evoque (L358)	US	Row 2	Yes	2011
Range Rover (L322)	All	Driver	No	2003
Range Rover (L322)	ROW	Passenger	No	2003
Range Rover (L322)	US	Passenger	Yes	2003
Range Rover (L322)	ROW	Row 2	No	2003
Range Rover (L322)	US	Row 2	Yes	2003

The **automatic locking retractor function** is a feature to secure a child seat or heavy load to the seat

Activation	Deactivation
<ul style="list-style-type: none"> NOTE: When automatic locking retractor is activated, no further webbing can be drawn from the safety belt retractor, prior to disengagement of the automatic locking. This can be mistaken as a jammed safety belt retractor 	Automatic locking retractor is deactivated by allowing the webbing to retract until the clicking stops (close to park position)
Activated by total extraction of the webbing	
When activated the automatic locking retractor is identified by a clicking noise during webbing retraction	When deactivated the automatic locking retractor safety belt changes state, from a static safety belt to an automatic safety belt

Safety Belt Locking Test

With the vehicle stationary and on level ground take firm hold of the safety belt webbing (on the tongue side of the upper safety belt anchor) and withdraw sharply, **the retractor should lock**. Preventing further webbing release (**repeat this test 3 times**). Any safety belt retractor which fails to lock **must not be used** and a **new safety belt must be installed**.

DTC Index

For a list of diagnostic trouble codes that could be logged on this vehicle, please refer to Section 100-00 or for removal and installation/description and operation see Section 501-20

Diagnostic Guide Inertia Reel Safety Belts

PINPOINT TEST A : BACKLOCK	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: BACKLOCK	
	<ol style="list-style-type: none"> 1 Visually inspect the condition of the suspect safety belt 2 Draw a maximum of 20mm of the webbing from the safety belt retractor with moderate force. Then release the webbing 3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes No further action required No For first row safety belt GO to Pinpoint Test C . For second and third row safety belts GO to Pinpoint Test B .

PINPOINT TEST B : WEBBING-TRAPPED IN SEAT	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
B1: WEBBING-TRAPPED IN SEAT	
	<ol style="list-style-type: none"> 1 Visually inspect the condition of the suspect safety belt 2 Lift the seat base or release the seat backrest as required 3 Free the trapped webbing, allow the webbing to retract Note: If the automatic locking retractor is activated, allow the webbing to retract until the clicking stops 4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes No further action required No GO to Pinpoint Test C .

PINPOINT TEST C : SAFETY BELT RETRACTOR-WEBBING GUIDE LOOSE	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
C1: SAFETY BELT RETRACTOR-WEBBING GUIDE LOOSE	
	<ol style="list-style-type: none"> 1 Refer to 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and safety belt retractor 2 Check the webbing is not trapped or twisted and is centrally located on the safety belt retractor spindle 3 Attempt to withdraw the webbing from the safety belt retractor NOTE: If the safety belt webbing is jammed, the automatic locking retractor could be engaged 4 To release the automatic locking retractor, manually wind the webbing onto the spindle until the automatic locking retractor deactivates (clicking stops) 5 Fully extract webbing

	6 Confirm webbing guide location is correct , Confirm the fixing lugs are correctly located in the retractor frame
	7 Allow webbing to retract
	8 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test D.

PINPOINT TEST D : TWIST IN WEBBING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
D1: TWIST IN WEBBING	
	1 Refer to section 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point)
	2 Twist the webbing back the correct way in the loop
	3 Pass the twist through the pillar loop or escutcheon as required
	4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test E.

PINPOINT TEST E : INTERFERENCE-WEBBING ROUTING	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
E1: INTERFERENCE-WEBBING ROUTING	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point)
	2 Remove obstructions and foreign objects ensure the webbing does not catch or rub
	3 Confirm the safety belt does not contact the wiring harness
	4 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No GO to Pinpoint Test E.

PINPOINT TEST F : SAFETY BELT RETRACTOR-INCORRECT INSTALLATION	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
F1: SAFETY BELT RETRACTOR-INCORRECT INSTALLATION	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and the safety belt retractor
	2 Refer to the 501-20 removal and installation section of the workshop manual, correctly reinstall the safety belt retractor ensure that the locating "T bar" and "anti rotation pins" are correctly located
	3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component


PINPOINT TEST G : D-LOOP NOT ROTATING CORRECTLY	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
G1: D-LOOP NOT ROTATING CORRECTLY	
	1 Refer to the 501-20 removal and installation section of the workshop manual, remove any trim panels required to expose the D loop (anchor point) and the safety belt retractor
	2 Ensure there are no obstructions and the webbing does not catch or rub, the D loop (anchor point) rotates correctly and if installed the confirm the height adjuster operates correctly
	3 Check for correct operation twice
	Does the webbing move freely then retract correctly? Yes Refer to the 501-20 removal and installation section of the workshop manual, reinstall any trim panels, ensure there are no obstructions and the webbing does not catch or rub. No further action required No

Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component

PINPOINT TEST H : MINI BUTTON-MISSING/DAMAGED

TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
H1: MINI BUTTON-MISSING/DAMAGED	
• NOTE: This test applies to the rear centre safety belt retractor installed in the seat back	
	<ol style="list-style-type: none"> <li>1 Refer to the 501-20 removal and installation section of the workshop manual, remove the seat cushion and the plastic escutcheon at the top of the seat back (where the webbing exits to expose the lower anchor fixing point of the center safety belt) <li>2 Remove the lower anchorage of the safety belt <li>3 With the seat back correctly latched, allow up to 20mm webbing to retract, then extract the webbing
	<p>Is the mini-button (webbing travel limit stop) correctly installed to the webbing and in good condition?</p> <p>Yes Feed the mini-button back through the plastic escutcheon if required. Correctly reinstall the escutcheon to the seat back, extract the webbing then allow to retract, ensure the mini-button comes to rest outside the escutcheon stop</p> <p>No Replace as required. Refer to the warranty policy and procedures manual, or determine if any prior approval programme is in operation, prior to the installation of a new module/component</p>

PINPOINT TEST I : SAFETY BELT BUCKLE-NOT LATCHING/JAMMED

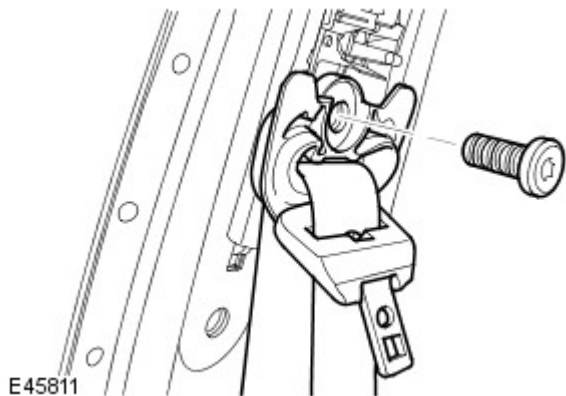
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
I1: SAFETY BELT BUCKLE-NOT LATCHING/JAMMED	
 CAUTION: Do not insert any objects or tools into the buckle head	
	<ol style="list-style-type: none"> <li>1 Visually inspect the buckle head for evidence of damage. If damaged replace as required <li>2 Depress the buckle release (red button) and (Using a torch) carry out visual inspection for any evidence of debris/material or foreign objects in the buckle head <li>3 If required remove the pretensioner from the vehicle. Remove the seat. Remove the pretensioner from the seat frame <li>4 Do not insert any objects or tools buckle head With the buckle removed invert and attempt to shake out any debris <li>5 Attempt to latch the tongue in the buckle
	<p>Does the seat belt buckle operate correctly</p> <p>Yes Reinstall any components, no further action required</p> <p>No Replace the pretensioner, Refer to section 501 20</p>

Safety Belt System - Front Safety Belt Retractor

Removal and Installation

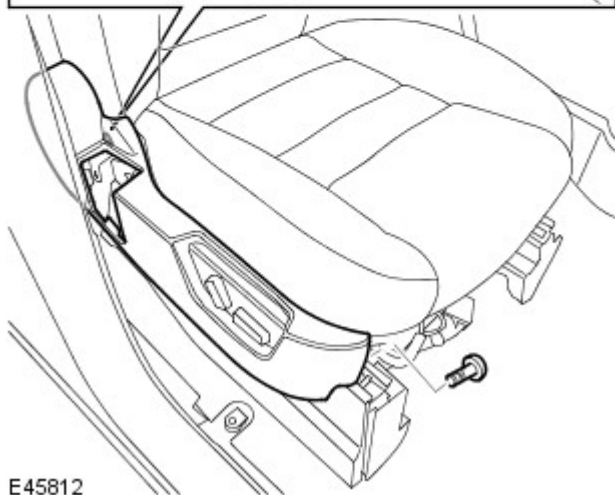
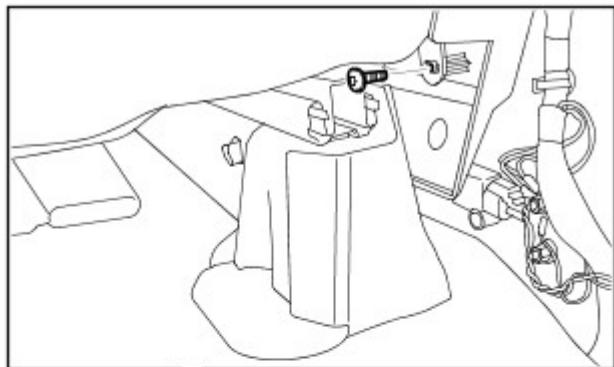
Removal

1. Position the front seat fully forwards.
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the B-pillar upper trim panel.
For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Release the safety belt upper anchor from the B-pillar.
 - Remove and discard the Torx bolt.



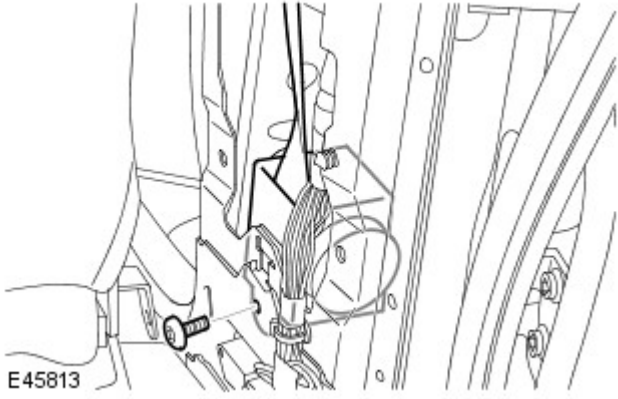
5. Release the front seat switch pack trim panel for access.

- Remove the 2 screws.



6. Remove the front safety belt retractor.

- Remove and discard the Torx bolt.



E45813

Installation

1. Install the front safety belt retractor.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).

2. Install the front seat switch pack trim panel.

- Tighten the screws.

3. Attach the safety belt upper anchor.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).

4. Install the B-pillar upper trim panel.

For additional information, refer to: [B-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

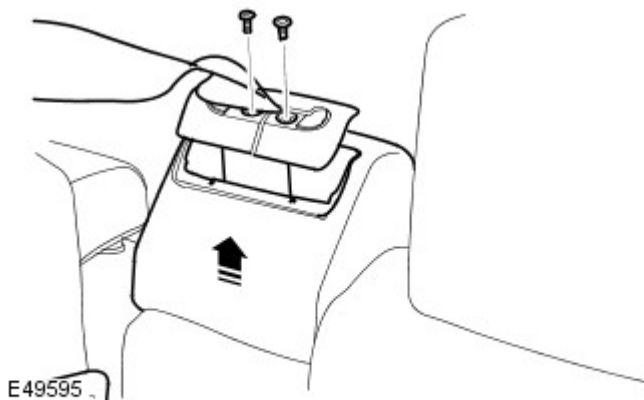
Safety Belt System - Second Row Center Safety Belt Retractor Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

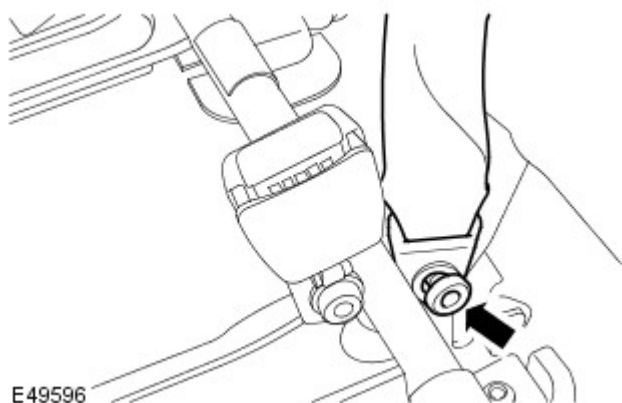
1. Release the safety belt retractor cover and guide

- Remove the 2 screws.
- Remove the safety belt guide.
- Remove the retractor cover.



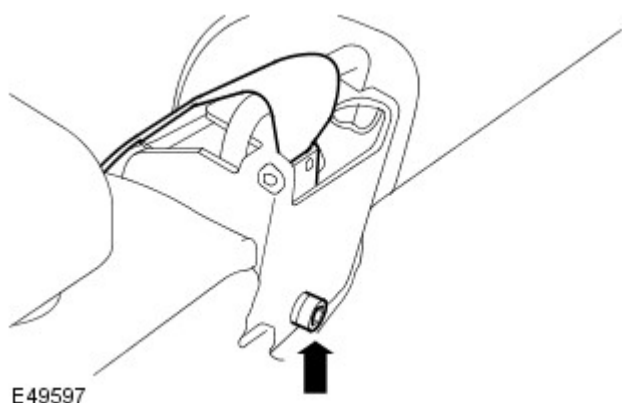
2. Remove the safety belt lower anchor.

- Raise the seat cushion.
- Remove and discard the nut.



3. Remove the safety belt retractor assembly.

- Remove and discard the Torx bolt.



Installation

1. Install the safety belt retractor assembly.

- Tighten the new Torx bolt to 40 Nm (30 lb.ft).

2. Install the safety belt guide and retractor cover.

- Attach the safety belt guide and retractor cover.
- Tighten the screws.

3. Install the safety belt lower anchor.

- Tighten the new nut to 40 Nm (30 lb.ft).
- Lower the seat cushion.

Safety Belt System - Second Row Center Safety Belt Retractor Vehicles With: 40/20/40 Split Seat

Removal and Installation

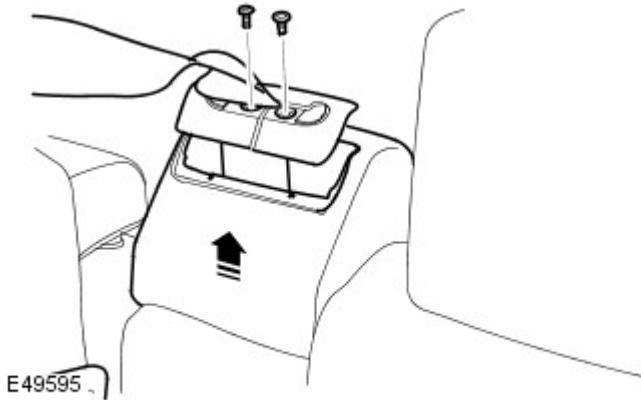
Removal

1. Remove the center seat.

For additional information, refer to: [Rear Seat - Vehicles With: 40/20/40 Split Seat](#) (501-10 Seating, Removal and Installation).

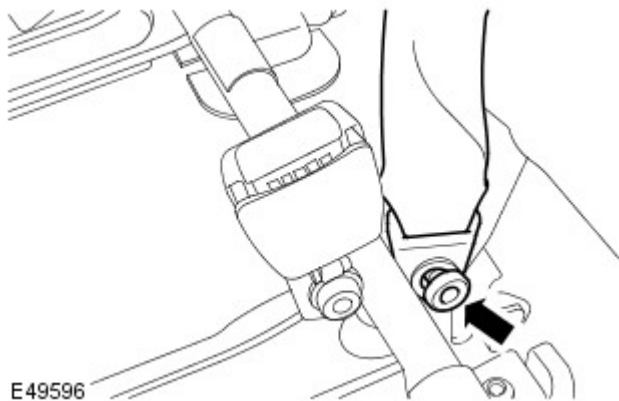
2. Release the safety belt retractor cover and guide

- Remove the 2 screws.
- Remove the safety belt guide.
- Remove the retractor cover.



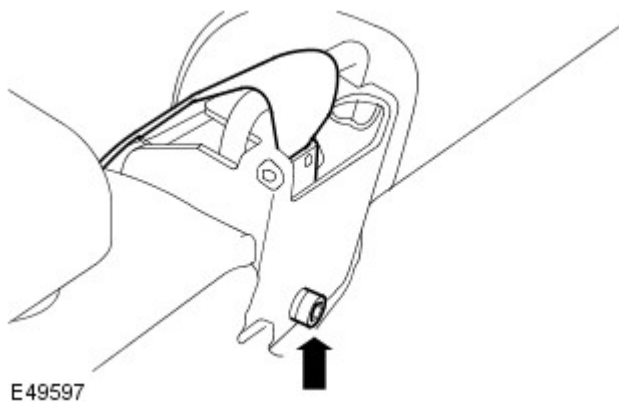
3. Remove the safety belt lower anchor.

- Fold the LH outer seat assembly forwards.
- Remove and discard the Torx bolt.



4. Remove the safety belt retractor assembly.

- Remove and discard the Torx bolt.



Installation

1. Install the safety belt retractor assembly.

- Tighten the new Torx bolt to 40 Nm (30 lb.ft).

2. Install the safety belt guide and retractor cover.

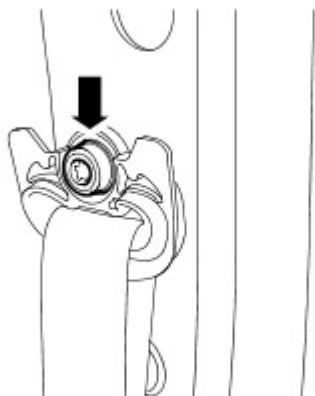
- Attach the safety belt guide and retractor cover.
 - Tighten the screws.
- 3.** Install the safety belt lower anchor.
- Tighten the new nut to 40 Nm (30 lb.ft).
 - Lower the seat cushion.
- 4.** Install the center seat.
For additional information, refer to: [Rear Seat - Vehicles With: 40/20/40 Split Seat](#) (501-10 Seating, Removal and Installation).

Safety Belt System - Second Row Safety Belt Retractor

Removal and Installation

Removal

1. Remove the C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Remove the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the safety belt upper anchor.
 - Remove and discard the Torx bolt.



E49593

4. Remove the second row safety belt retractor.
 - Remove and discard the Torx bolt.



E49594

Installation

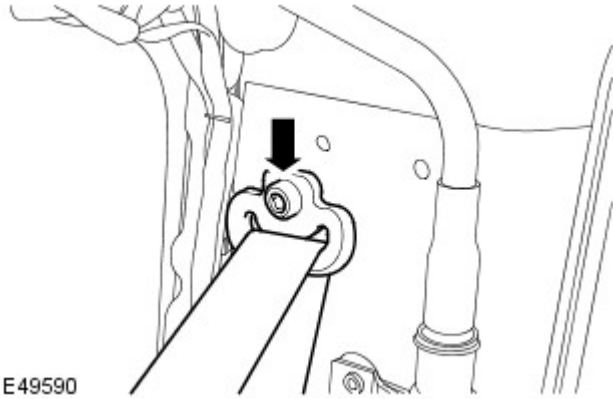
1. Install the second row safety belt retractor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
2. Install the safety belt upper anchor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
3. Install the C-pillar lower trim panel.
For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Install the C-pillar upper trim panel.
For additional information, refer to: [C-Pillar Upper Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Safety Belt System - Third Row Safety Belt Retractor

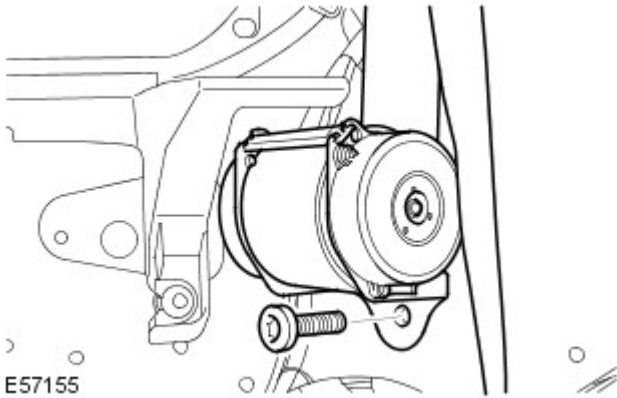
Removal and Installation

Removal

1. Remove the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
2. Release the safety belt upper anchor.
 - Remove and discard the Torx bolt.



3. Remove the third row safety belt retractor.
 - Remove and discard the Torx bolt.



Installation

1. Install the third row safety belt retractor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
2. Install the safety belt upper anchor.
 - Tighten the Torx bolt to 40 Nm (30 lb.ft).
3. Install the D-pillar upper trim panel.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Safety Belt System - Front Safety Belt Buckle

Removal and Installation

Removal

• WARNINGS:

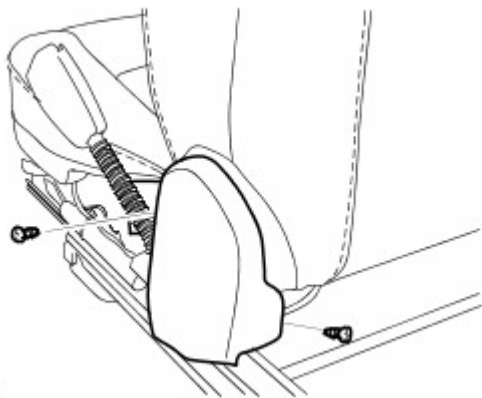


It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

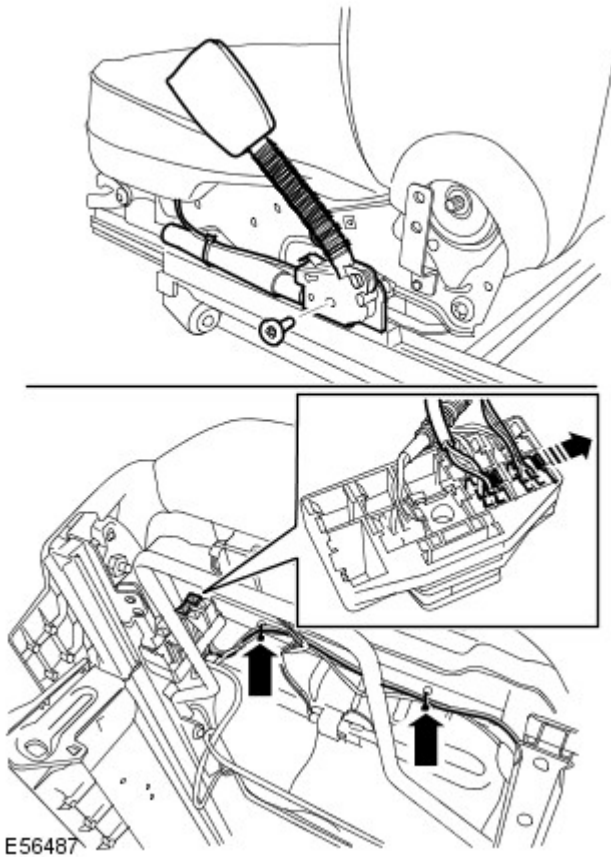
1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
4. Remove the seat backrest hinge cover.
 - Remove the 2 screws.



E56486

5. Remove the front safety belt buckle.

- Remove the Torx bolt.
- Disconnect the 2 electrical connectors.
- Release the wiring harness.



Installation

1. Install the front safety belt buckle.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).
- Connect the electrical connectors.
- Attach the wiring harness.

2. Install the seat backrest hinge cover.

- Tighten the screws.

3. Install the front seat.

For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

4. Connect the battery ground cable.

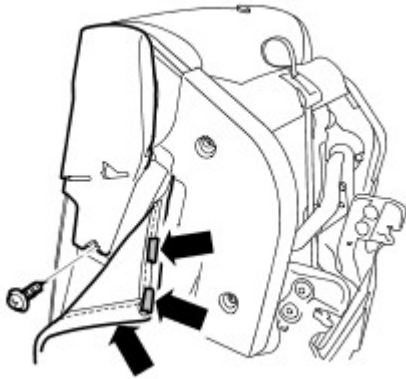
Safety Belt System - Rear Safety Belt Buckle Vehicles With: 40/20/40 Split Seat

Removal and Installation

Removal

1. Remove the inner backrest hinge cover.

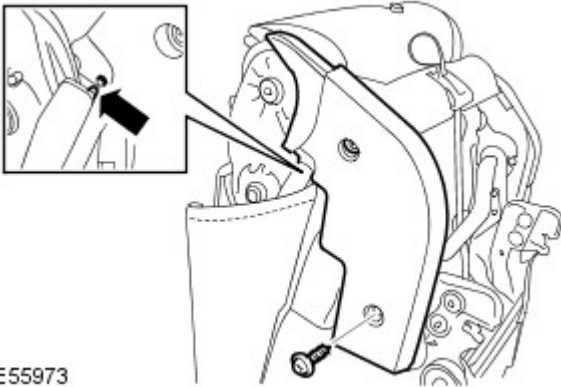
- Release the backrest cover side clip.
- Remove the screw.
- Release the 2 clips.



E55971

2. Remove the rear seat cushion side finisher.

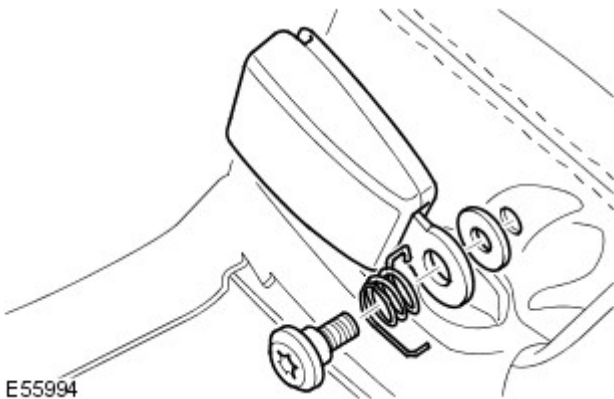
- Remove the 2 screws.
- Release the tension strap.



E55973

3. Remove the safety belt buckle.

- Fold the seat assembly forwards.
- Remove the Torx bolt.
- Release the tension spring.



E55994

Installation

1. Install the safety belt buckle.

- Attach the tension spring.
- Tighten the Torx bolt to 25 Nm (18 lb.ft).
- Fold seat assembly rearwards.

2. Install the rear seat cushion side finisher.

- Attach the tension strap.
- Tighten the screws.

3. Install the inner backrest hinge cover.

- Attach the clips.
- Tighten the screw.
- Attach the backrest cover side clip.

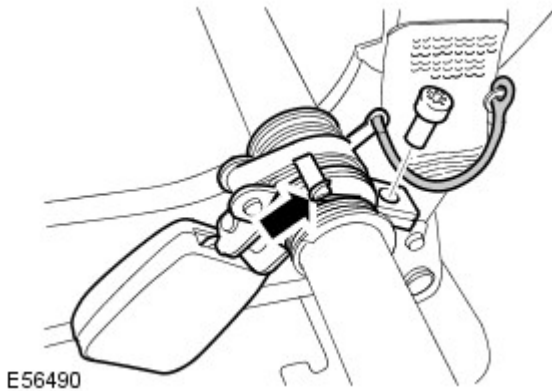
Safety Belt System - Rear Safety Belt Buckle LH Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

1. Remove the safety belt buckle.

- Raise the seat cushion.
- Release the retaining strap.
- Remove the Torx bolt.
- Release the tension spring.



Installation

1. Install the safety belt buckle.

- Attach the tension spring.
- Tighten the Torx bolt to 25 Nm (18 lb.ft).
- Attach the retaining strap.
- Lower the seat cushion.

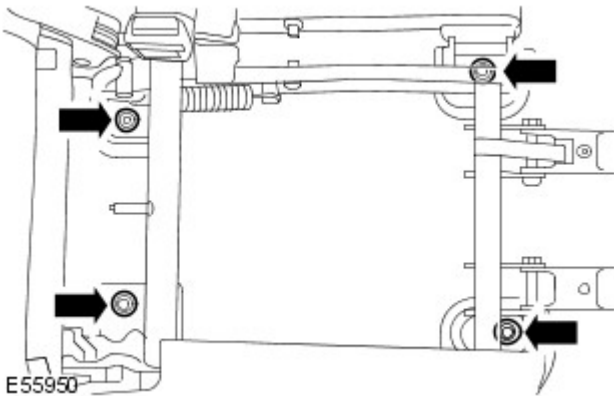
Safety Belt System - Rear Safety Belt Buckle RH Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

1. Release the RH rear seat.

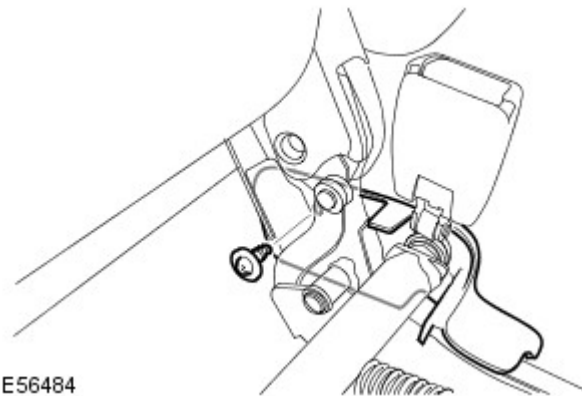
- Fold the seat cushion forward.
- Remove and discard the 4 Torx bolts.
- Fold down the rear seat backrest.



2. Remove the RH rear seat.

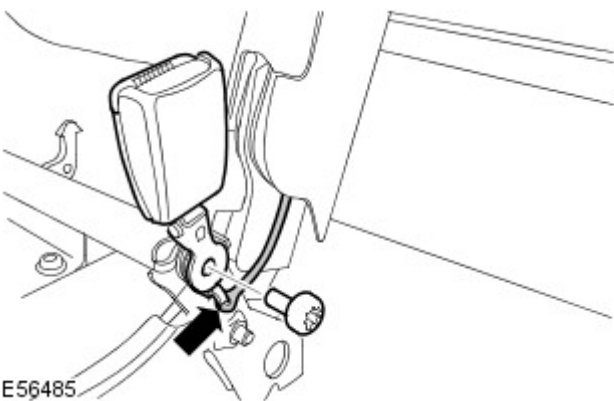
3. Remove the rear seat cushion side finisher.

- Remove the screw.



4. Remove the safety belt buckle.

- Raise the seat cushion.
- Release the retaining strap.
- Remove and discard the bolt.



Installation

1. Install the safety belt buckle.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).
- Attach the retaining strap.
- Lower the seat cushion.

2. Install the rear seat cushion side finisher.

- Tighten the screw.

3. Install the RH rear seat.

- Position the seat on the dowels.

4. Secure the RH rear seat.

- Return the seat backrest to the upright position.
- Tighten the new bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

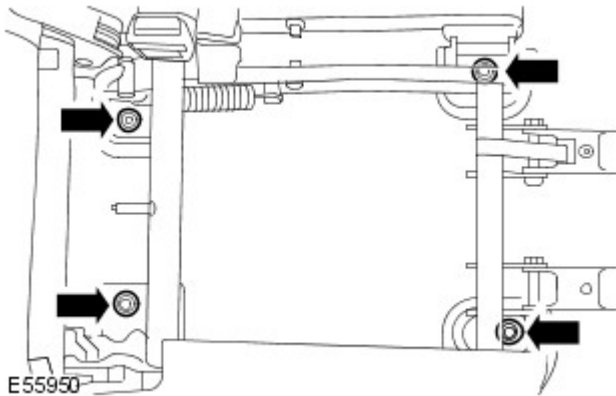
Safety Belt System - Rear Center Safety Belt Buckle Vehicles With: 60/40 Split Seat

Removal and Installation

Removal

1. Release the RH rear seat.

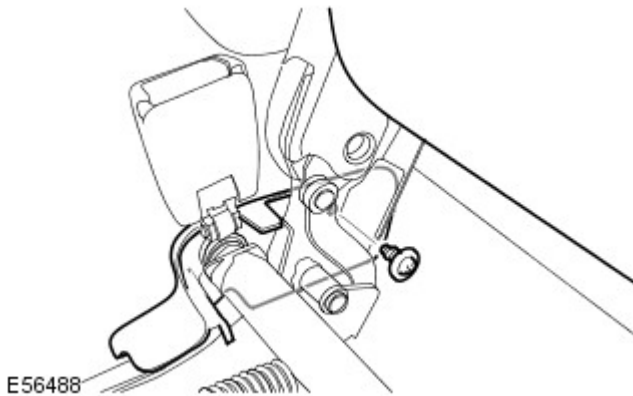
- Fold the seat cushion forward.
- Remove and discard the 4 Torx bolts.
- Fold down the rear seat backrest.



2. Remove the RH rear seat.

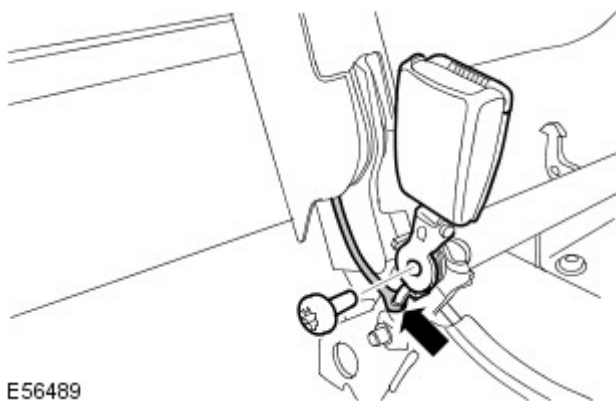
3. Remove the rear seat cushion side finisher.

- Raise the seat cushion.
- Remove the screw.



4. Remove the safety belt buckle.

- Release the retaining strap.
- Remove and discard the bolt.



Installation

1. Install the safety belt buckle.

- Tighten the Torx bolt to 40 Nm (30 lb.ft).
- Attach the retaining strap.
- Lower the seat cushion.

2. Install the rear seat cushion side finisher.

- Tighten the screw.

3. Install the RH rear seat.

- Position the seat on the dowels.

4. Secure the RH rear seat.

- Return the seat backrest to the upright position.
- Tighten the new bolts to 40 Nm (30 lb.ft).
- Fold the seat cushion rearwards.

Supplemental Restraint System -

Torque Specifications

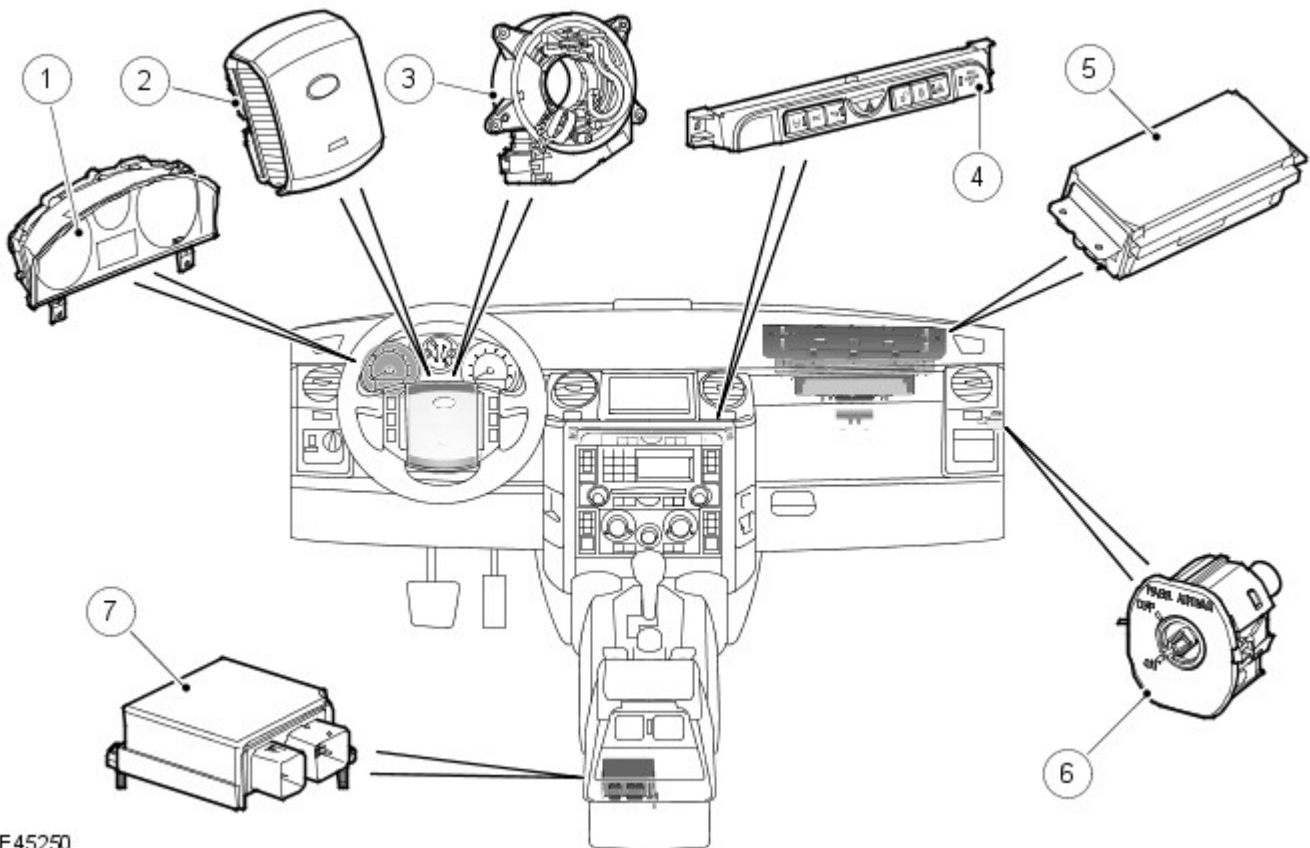
Description	Nm	lb-ft
Passenger air bag module bracket nuts	10	7
Passenger air bag module nuts	10	7
Rear side air curtain module Torx screws	10	7
C-pillar side impact sensor Torx bolts	8	6
Side air curtain module Torx screws	10	7
B-pillar side impact sensor Torx screws	8	6
Restraints control module (RCM) Torx screws	10	7
Front door side impact sensor Torx bolts	8	6
Side air bag module nuts	10	7
Front impact sensor Torx bolts	8	6

Supplemental Restraint System - Air Bag and Safety Belt Pretensioner

Supplemental Restraint System (SRS)

Description and Operation

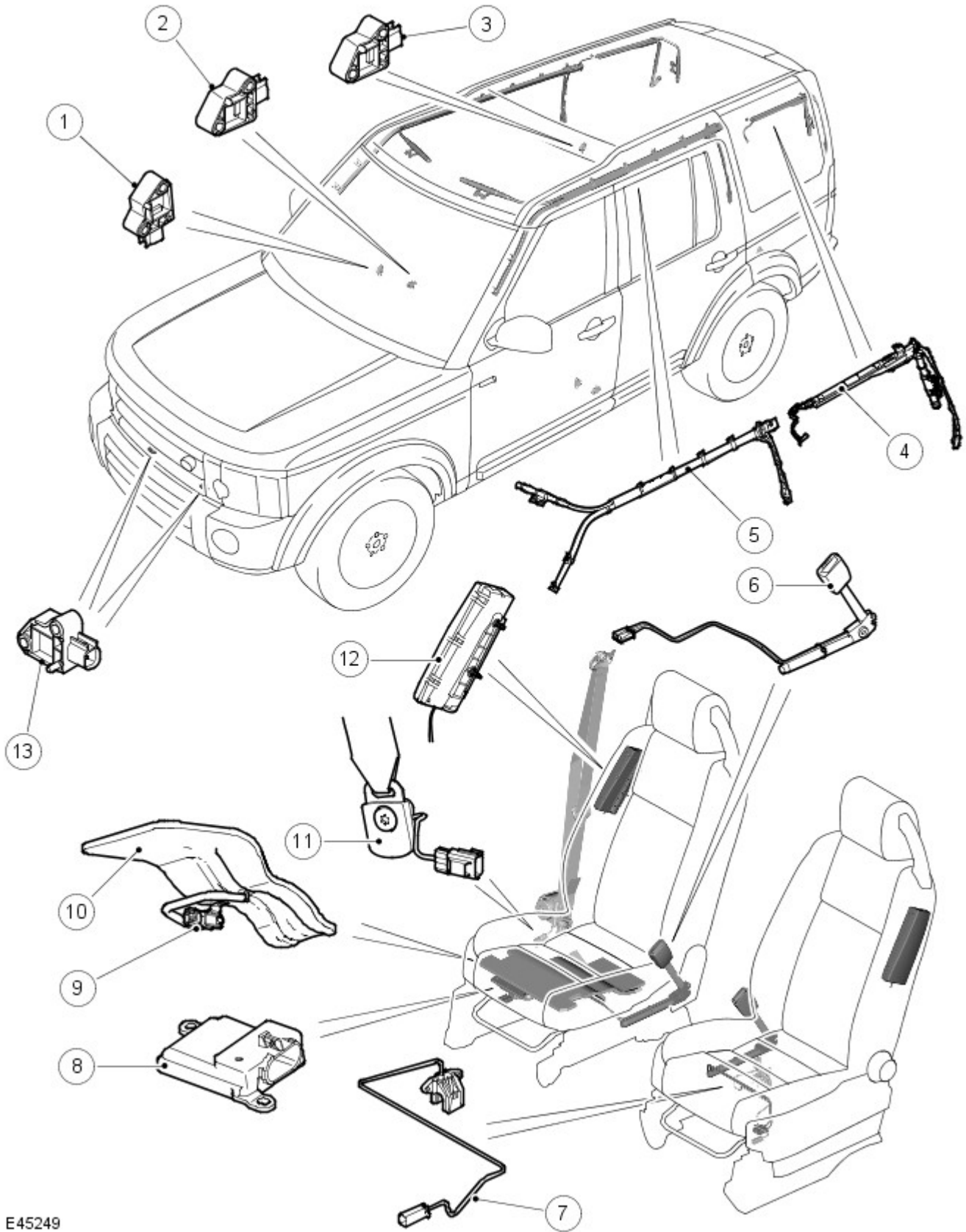
COMPONENT LOCATION - SHEET 1 OF 2



E45250

Item	Part Number	Description
1	-	supplemental restraint system (SRS) warning indicator
2	-	Driver air bag
3	-	Clockspring
4	-	Passenger air bag deactivation indicator
5	-	Passenger air bag
6	-	Passenger air bag deactivation switch (all except NAS (north American specification) and Australia)
7	-	restraints control module (RCM)

COMPONENT LOCATION - SHEET 2 OF 2



E45249

Item	Part Number	Description
1	-	Door side impact sensor
2	-	B pillar side impact sensor
3	-	Rear quarter side impact sensor
4	-	Third row side air curtain
5	-	First and second row side air curtain
6	-	Safety belt pretensioner and buckle switch
7	-	Seat position sensor
8	-	Occupant classification module (NAS only)
9	-	Seat cushion pressure sensor (NAS only)
10	-	Seat cushion pressure pad (NAS only)
11	-	Safety belt tension sensor (NAS only)

12	-	Side air bag
13	-	Front impact sensors

GENERAL

The SRS provides additional protection for occupants in certain vehicle accident conditions. The SRS consists of:

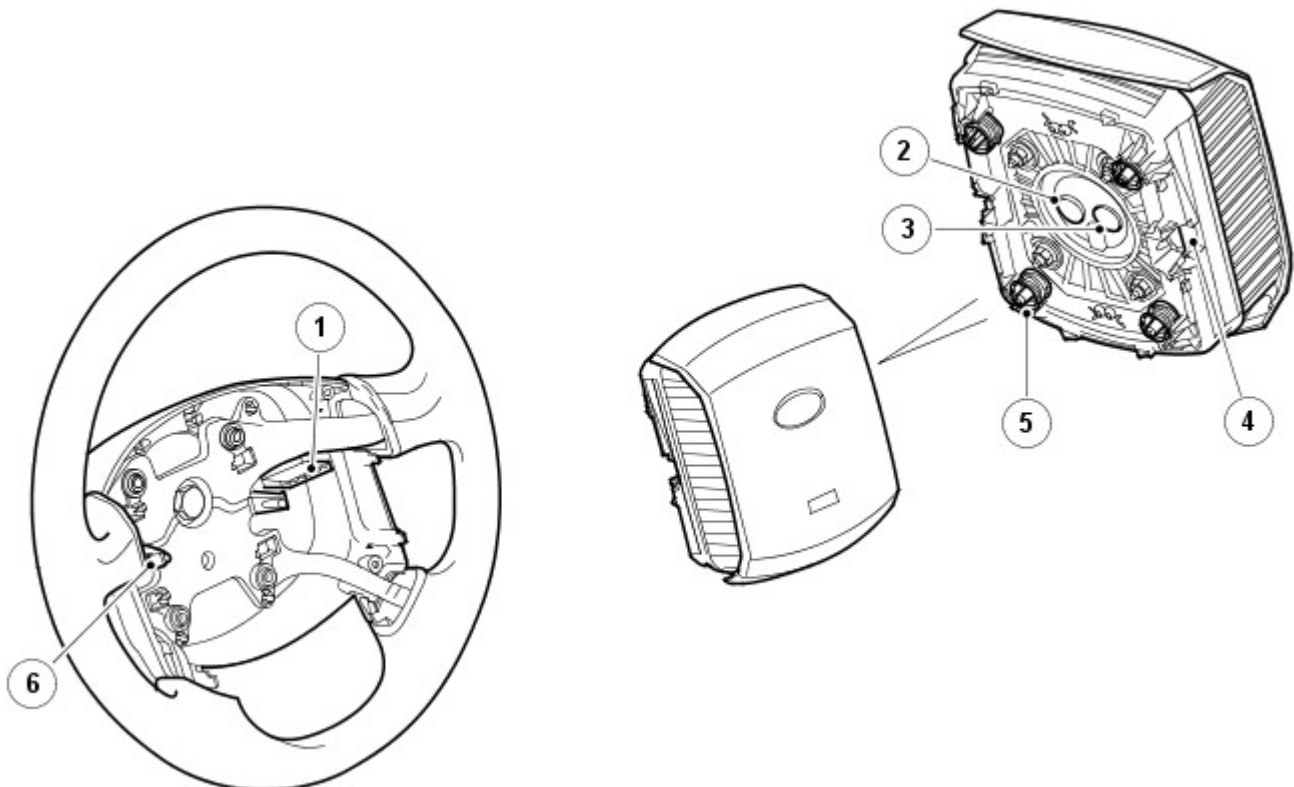
- A driver air bag
- A passenger air bag
- A side air bag on each front seat
- Side air curtains for first and second row seats
- Side air curtains for third row seats (where fitted)
- A pretensioner for each front safety belt
- A buckle sensor for each front safety belt
- Front and side impact sensors
- A passenger air bag deactivation indicator
- A passenger air bag deactivation switch (all except NAS and Australia)
- An occupant monitoring system for the front passenger seat
- A position sensor for the driver seat
- A SRS warning indicator
- A clockspring
- A RCM.



WARNING: All pyrotechnic devices are dangerous. Before performing any procedures on any pyrotechnic device, read all information contained within the Standard Workshop Practices section of this manual. For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

The SRS features selective activation of the air bags and pretensioners, and two stage driver and passenger air bags. The RCM monitors internal and external sensors and activates the required safety belt pretensioners and air bags if the sensors detect an impact or roll-over above preset limits.

DRIVER AIR BAG



E45251

Item	Part Number	Description
1	-	Release tool slot and guide channel
2	-	Inflator stage 1 connector
3	-	Inflator stage 2 connector
4	-	Latch spring
5	-	Locating pin and spring
6	-	Latch hook

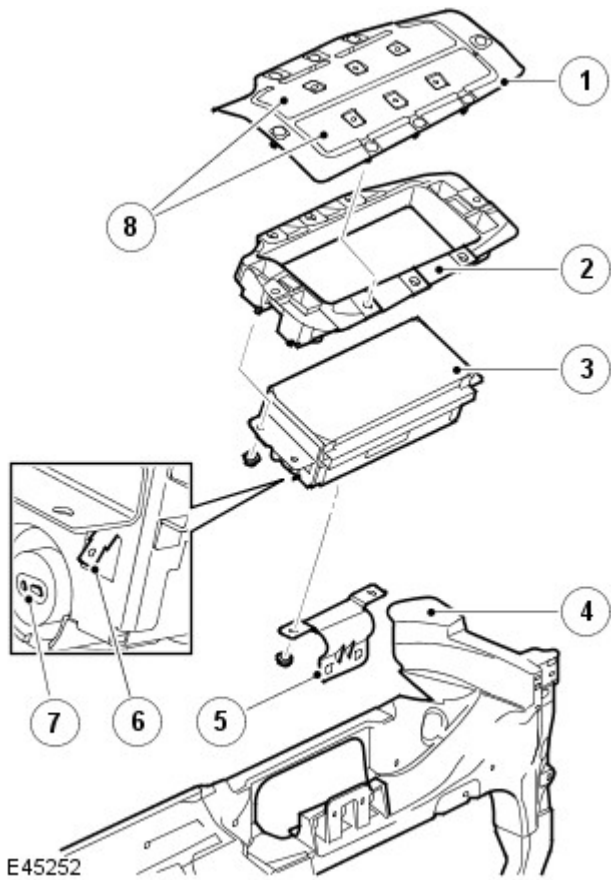
The driver air bag forms the center pad of the steering wheel. Four pins and two latches locate and secure the driver air bag to the steering wheel. The latches consist of wire springs on each side of the driver air bag which engage with hooks in the steering wheel. The driver air bag is released from the steering wheel by pulling on the wire springs with a special tool inserted through a slot on each side of the steering wheel hub. Springs on the locating pins then push the driver air bag away from the steering wheel.

A Lucar connector attaches a ground to the driver air bag.

The driver air bag has a two stage inflator, with separate electrical connectors for each stage. The inflator contains a non-azide propellant as the gas generator.

Lines moulded into the inner surface of the driver air bag cover provide weak points that split open in a controlled manner when the driver air bag deploys. The inflated volume of the air bag is 57 liters (2.01 ft³).

PASSENGER AIR BAG



Item	Part Number	Description
1	-	Reinforcement lid
2	-	Chute
3	-	Passenger air bag
4	-	In-vehicle crossbeam
5	-	Mounting bracket
6	-	Lucar connector
7	-	Inflator connector
8	-	Deployment doors

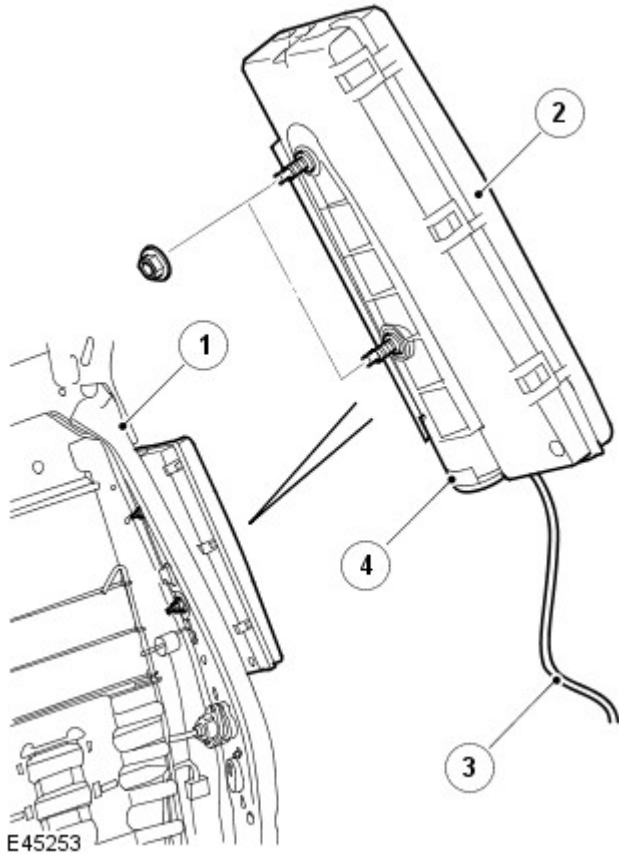
The passenger air bag is located in the instrument panel, behind the upper glove compartment. The bottom of the passenger air bag is attached to a mounting bracket on the in-vehicle crossbeam. The top of the passenger air bag is attached to a chute, which, in turn, is attached to a reinforcement lid in the top of the instrument panel. When the air bag deploys, the chute guides the air bag to the underside of the reinforcement lid. The reinforcement lid incorporates two deployment doors that are forced open, splitting the instrument panel covering, when the air bag deploys.

A Lucar connector attaches a ground to the passenger air bag.

The passenger air bag has a two stage inflator, with separate electrical connectors for each stage. The inflator contains a non-azide propellant as the gas generator. The inflator uses a high pressure mix of air and hydrogen gas as the inflation medium. The inflated volume of the air bag is 130 liters (4.59 ft³).

SIDE AIR BAGS

- NOTE: Left side air bag shown, right side air bag is mirror image



E45253

Item	Part Number	Description
1	-	Seat backrest frame
2	-	Side air bag
3	-	Cable
4	-	Inflator

A side air bag is attached to the outside of each front seat backrest frame, under the backrest cover.

The side air bags are handed, and each consist of a moulded plastic case which contains the folded air bag and the inflator. A cable connects the igniter of the inflator to a connector in the main seat harness connector block located under the front edge of the seat cushion.

When the air bag deploys it forces the front edge of the moulded plastic case apart and splits open the backrest cover.

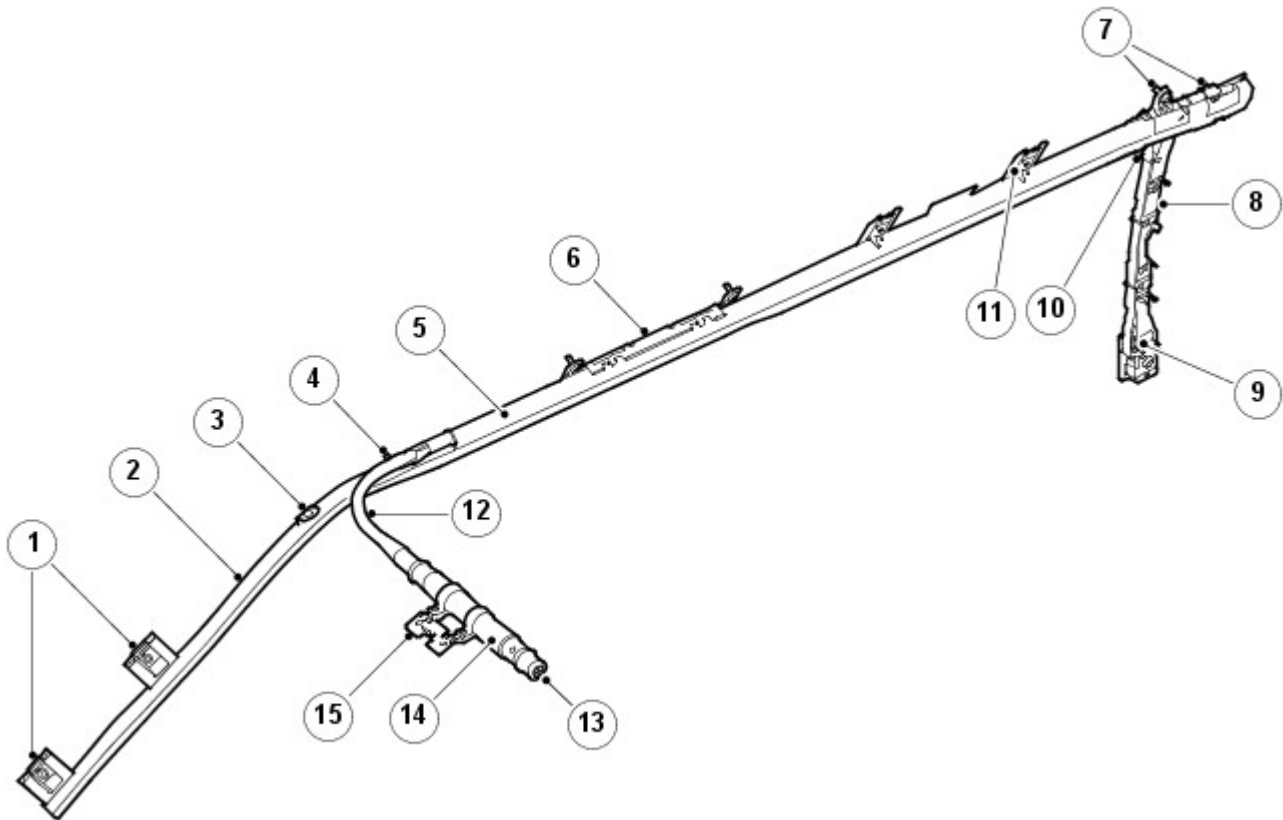
The side air bags use compressed argon as the inflation medium. The inflated volume of each side air bag is 12 liters (0.42 ft³).

SIDE AIR CURTAINS

The side air curtains are designed to protect the head and upper body in side impact and roll-over situations. The first and second row side air curtains are a standard fit on all vehicles. The third row side air curtains are fitted on seven seat vehicles only. The side air curtains use compressed argon as the inflation medium.

First and Second Row Side Air Curtain

- NOTE: Right side air curtain shown, left side air curtain is mirror image



E45254

Item	Part Number	Description
1	-	Air curtain anchorage points
2	-	Non inflatable section of air curtain
3	-	Air curtain clip (manufacturing aid)
4	-	Front gas guide attachment
5	-	Inflatable section of air curtain
6	-	B pillar ramp
7	-	Securing screws
8	-	Active tether device
9	-	Rear tether anchor
10	-	Rear tether
11	-	Cant rail clip
12	-	Gas guide pipe
13	-	Inflator electrical connector
14	-	Inflator
15	-	Inflator mounting bracket

The first and second row side air curtains are installed on the cant rails above the front and rear doors, behind the headliner.

Each side air curtain has an inflator, which is attached to the header rail by a mounting bracket and two screws. The inflator is connected to the air curtain by a gas guide pipe.

The gas guide pipe and air curtain are secured along the cant rail by a fixing at the front of the gas guide pipe, two fixings at the B pillar ramp, two clips and two screws, and two fixings at the end of the gas guide pipe and C pillar ramp.

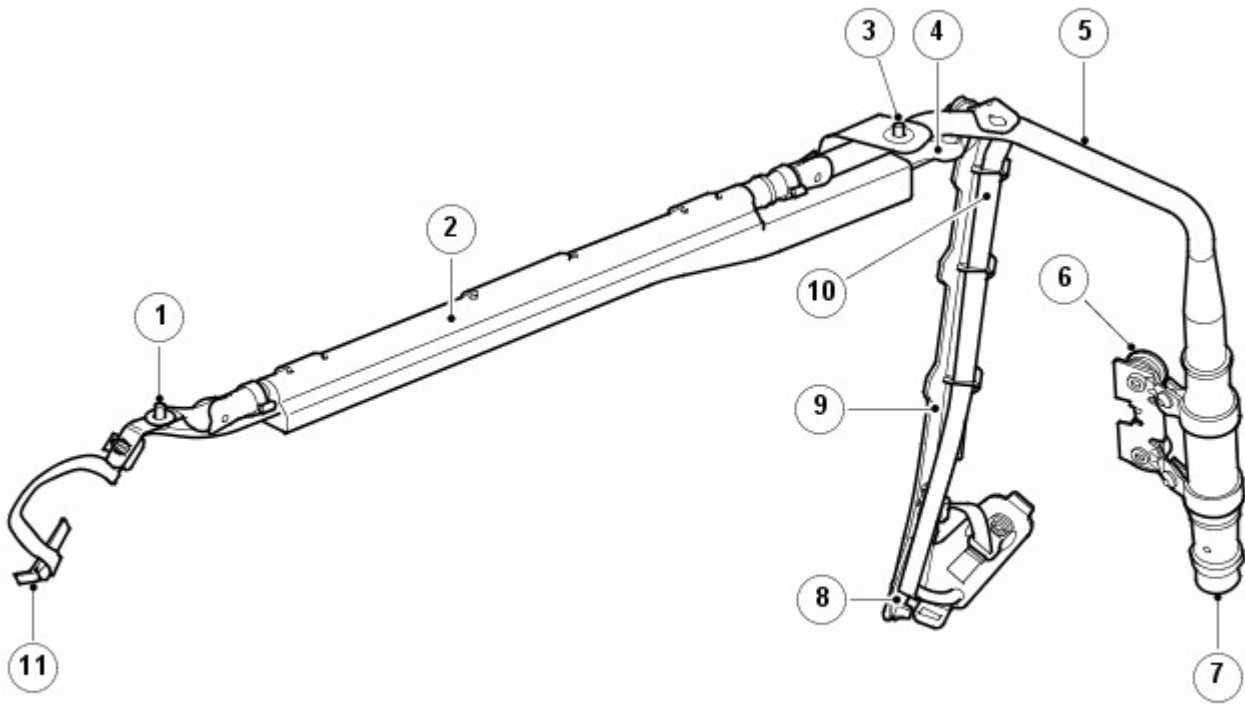
At the rear of the air curtain, an active tether device is clipped in two positions down the C pillar. At the bottom of the active tether device is a fixing anchorage.

The front of the air curtain is secured to the A pillar by two fixings.

When the side air curtain deploys, it breaks out of the B pillar ramp and the clips on the cant rail and extends downwards from behind the headliner. The deploying air curtain is tensioned between the anchorage points on the A pillar and the active tether device on the C pillar. This retains the air curtain in position against the upper part of the doors and the B pillar.

Third Row Side Air Curtain

- NOTE: Right side air curtain shown, left side air curtain is mirror image



E45255

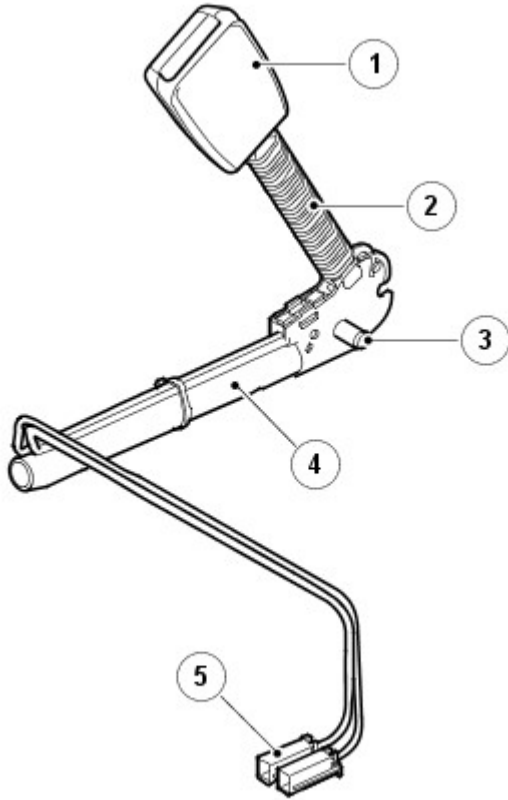
Item	Part Number	Description
1	-	Securing screw
2	-	Air curtain
3	-	Securing screw
4	-	Rear tether
5	-	Gas guide pipe
6	-	Inflator mounting bracket
7	-	Inflator
8	-	Rear tether anchor
9	-	Tether housing
10	-	Rear tether
11	-	Front tether anchor

The third row side air curtains are installed on the cant rails above the rear quarter windows, behind the headliner.

Each side air curtain has an inflator, which is attached to the D pillar by a mounting bracket and two screws. The inflator is connected to the air curtain by a gas guide pipe. The gas guide pipe and air curtain are secured to the cant rail by two screws. Tethers are attached to the front and rear of the air curtain. The front tether is anchored to the C pillar. The rear tether is anchored to the D pillar and held in position by a tether housing.

When a third row side air curtain deploys, it extends downwards from behind the headliner. The expanding air curtain tightens the tethers, which retain the air curtain in position against the rear quarter window.

PRETENSIONERS



E45256

Item	Part Number	Description
1	-	Safety belt buckle
2	-	Boot
3	-	Anchor bolt
4	-	Piston and tube
5	-	Electrical connectors for inflator and buckle switch

The pretensioners are used to tighten the front safety belts during a collision to ensure the occupants are securely held in their seats. A pretensioner is integrated into each front safety belt buckle.

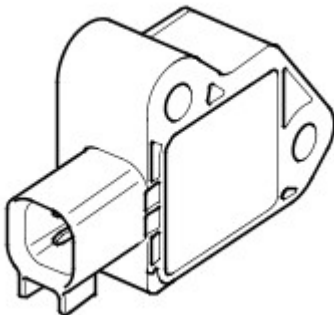
Each pretensioner has a tube containing an inflator and a piston. The inflator is connected to the RCM. The piston is attached to a steel cable, the opposite end of which is attached to the safety belt buckle.

On receipt of a fire signal from the RCM, the inflator generates nitrogen gas that rapidly expands to drive the piston along the tube, pulling the cable and drawing the safety belt buckle downwards.

SAFETY BELT SENSORS

The buckle of each front safety belt incorporates a Hall effect sensor that provides a safety belt status signal to the RCM. The RCM broadcasts the status of the two front safety belts on the high speed controller area network (CAN) bus for use by the instrument cluster.

IMPACT SENSORS



E45257

Impact sensors are installed in the front and both sides of the vehicle. The use of multiple impact sensors provides shorter air bag trigger times, through faster detection of lateral and longitudinal acceleration, and improves detection accuracy.

There are two front impact sensors attached to brackets on the body front support frame, just above each front longitudinal.

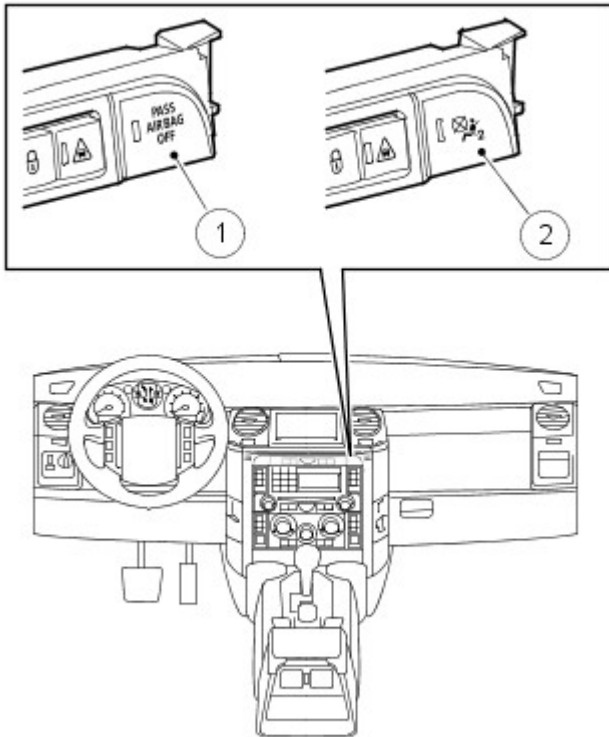
There are six side impact sensors located in the passenger compartment, as follows:

- One attached to each front door.
- One attached to the base of each B pillar.
- One installed in each rear quarter, above the rear wheelarch.

Each impact sensor incorporates an accelerometer and a microcontroller powered by a feed from the RCM. The power feed also provides the interface connection through which the impact sensor communicates with the RCM using serial data messages. Acceleration is evaluated by the microcontroller and transmitted to the RCM, which then makes the decision on whether or not to activate the air bags and pretensioners.

When the ignition is switched on the RCM supplies power to the impact sensors, which perform a self test. After satisfactory self tests the impact sensors continually output 'sensor active' messages to the RCM. If a fault is detected the relevant impact sensor sends a fault message, instead of the sensor active message, to the RCM. The RCM then stores a related fault code and illuminates the SRS warning indicator.

PASSENGER AIR BAG DEACTIVATION INDICATOR



E45258

Item	Part Number	Description
1	-	Deactivation indicator (NAS and Japan)
2	-	Deactivation indicator (all except NAS and Japan)

The passenger air bag deactivation indicator is installed on the center switch pack of the instrument panel. When appropriate, the indicator illuminates to advise front seat occupants that the passenger air bag is disabled. Operation of the indicator is controlled by the RCM based on seat occupancy status derived from the occupant classification system (NAS vehicles) or the passenger air bag deactivation switch (all except NAS and Australian specification vehicles).

The RCM illuminates the indicator when:

- The passenger air bag is deactivated with the passenger air bag deactivation switch (where fitted). OR
- Required by passenger seat occupant monitoring (NAS vehicles only).

PASSENGER AIR BAG DEACTIVATION SWITCH



E45259

The passenger air bag deactivation switch provides a method of manually disabling the passenger air bag on all vehicles except Australian specification and those fitted with the occupant classification system. The switch is installed in the front passenger end of the instrument panel and is operated by the ignition key.

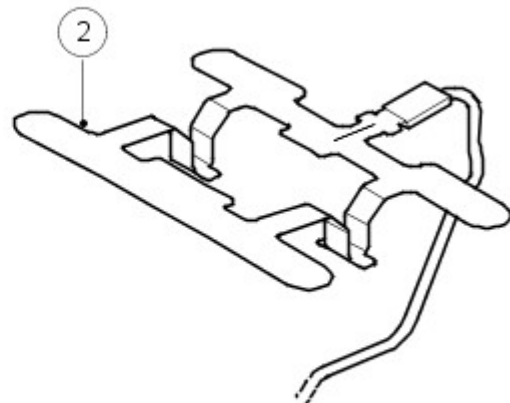
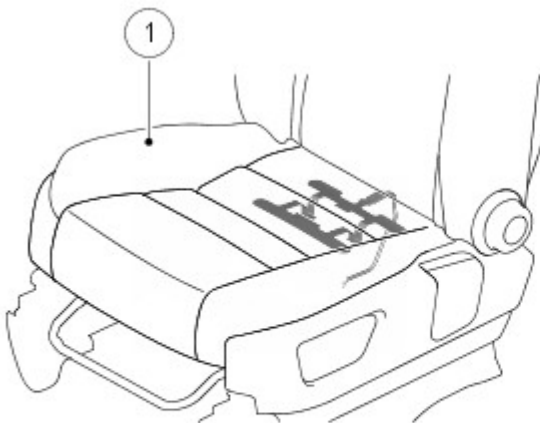
When the passenger air bag deactivation switch is operated, it changes a ground connection between two pins in the connectors of the RCM. When the passenger air bag deactivation switch is selected to OFF, the RCM disables the passenger air bag and, if the front passenger seat is occupied, illuminates the passenger air bag deactivation indicator.

OCCUPANT SENSING

There are 2 types of occupant sensing:

- In all markets except North America, vehicles have an occupant detection system to activate the seat belt minder
- On NAS vehicles, an occupant classification system provides signals to the RCM to allow the correct arming of the passenger air bag and corresponding indicator.

Occupant Detection System



E46657

Item	Part Number	Description
1	-	Seat cushion
2	-	Pressure switch

The occupant detection system can only determine if the front passenger seat is occupied or unoccupied. The occupant detection system consists of a pressure switch installed between the foam padding and the cover of the front passenger seat cushion.

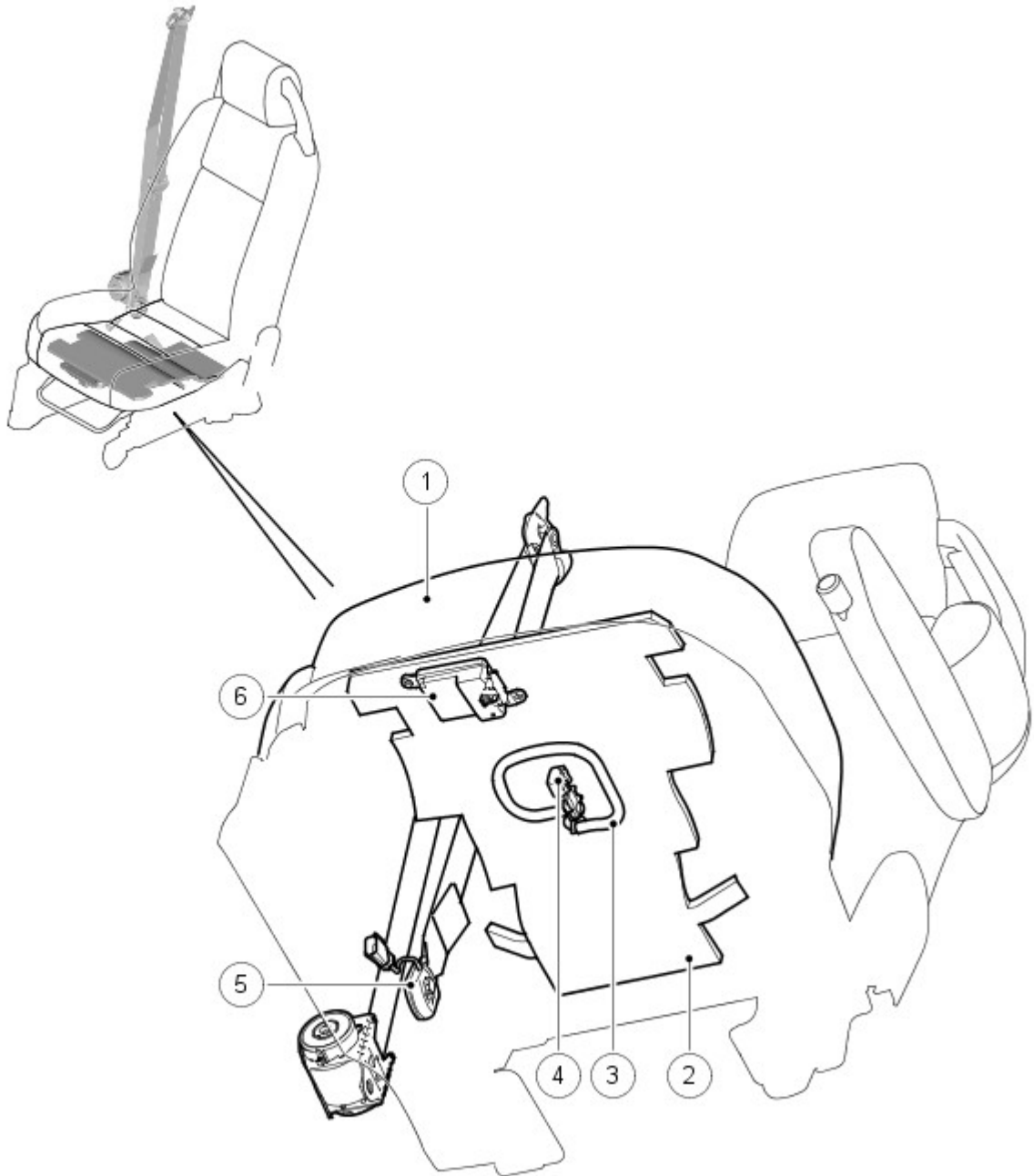
The pressure switch incorporates a number of load cells connected in series and embedded in a plastic film. Weight on the pressure sensor increases the resistance of the circuit.

The instrument cluster supplies a reference voltage to the pressure switch and measures the current draw to determine the occupancy status. From the occupancy status, and the status of the front passenger safety belt (received from the RCM on the high speed CAN bus), the instrument cluster determines the belt minder status.

Occupant Classification System

⚠ WARNING: All Land Rover vehicles, with the exception of Defender, are equipped with passenger air bags. Passenger air bags offer well documented benefits in crash protection for adult front passenger seat occupants but their deployment can be harmful to children and infants sat in the front passenger seat of the vehicle. Land Rover recommends that children and infants are placed in the rear seats of the vehicle.

• NOTE: All new Land Rover vehicles sold in North America comply with the FMVSS208 legislation due to the fitment of the occupant classifications system.



E45261

Item	Part Number	Description
1	-	Seat cushion
2	-	Pressure pad
3	-	Pressure tube
4	-	Pressure sensor
5	-	Safety belt tension sensor
6	-	Occupant classification module

Occupant classification system comprises an ECU, attached to the underside of the seat, a silicon filled bladder with a pressure sensor fitted between the cushion foam and the seat pan and a seat belt tension sensor. When an occupant sits on the seat a pressure is created in the bladder and the occupant weight is determined from the pressure generated. The weight is compared against 4 classification thresholds. These are:

- Empty
- Occupied inhibit status (6 year old child, 3 year old child, rear facing/forward facing 12 month infant seats and booster seats)
- Occupied allow status (weight greater than 5th percentile female) and the airbag enabled/disabled as appropriate
- Indeterminate state.

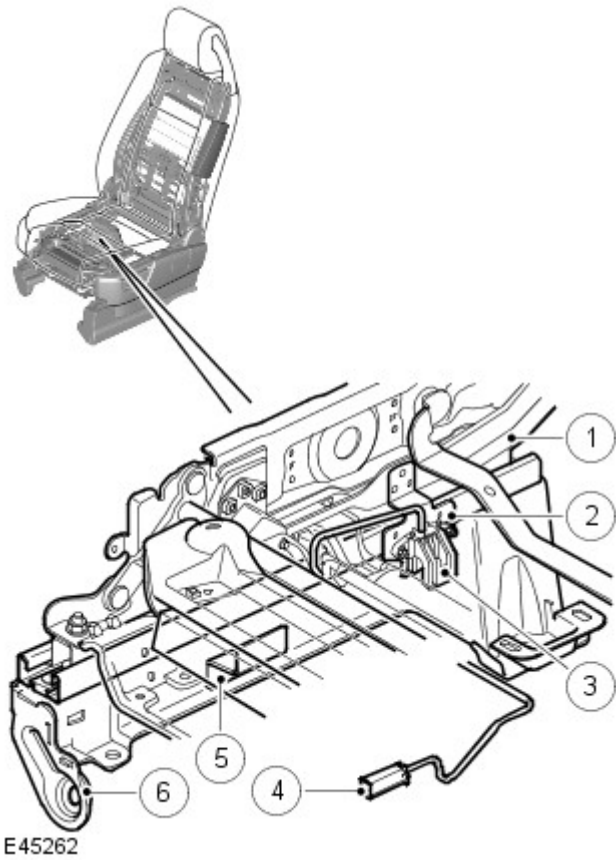
Classification	Deactivation Indicator	SRS Warning Indicator
Seat unoccupied	OFF	OFF
Occupied inhibit	ON	OFF
Occupied allow	OFF	OFF
Indeterminate state	OFF	ON

OCS module contains accelerometers and algorithms to compensate for the effects of longitudinal, lateral and vertical

forces acting on the vehicle whilst being driven. The belt tension sensor is used to offset loads forced into the seat by 'cinched' child seats (where a child seat load on the seat is increased by a highly tensioned seat belt) and also dynamic belt loading (Off-road/aggressive driving styles).

The belt minder system on cars equipped with the occupant classification system uses the RCM to detect seat occupancy status based on calculations within the RCM, with the instrument cluster then determining whether a seat belt reminder should be activated based on the status of the seat belt buckle switches and vehicle speed.

SEAT POSITION SENSOR

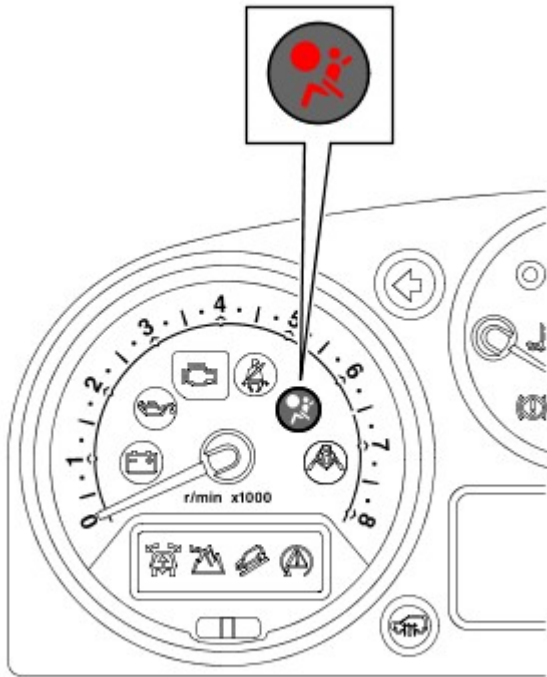


Item	Part Number	Description
1	-	Seat frame
2	-	Mounting plate
3	-	Seat position sensor
4	-	Electrical connector
5	-	Target plate
6	-	Seat base

The seat position sensor allows the RCM to detect when the driver seat is forward of a given point on the seat track. The seat position sensor consists of a Hall effect sensor attached to the driver seat frame and a target plate on the seat base. While the ignition is on, the RCM supplies the sensor with a power supply of 12V nominal, and monitors the return voltage. When the seat frame moves forwards, the sensor moves over the target plate, which changes the reluctance of the sensor. The change of voltage is detected by the RCM and used as a switching point. The switching point is when the center of the sensor is 3 ± 4 mm from the leading edge of the target plate.

When the driver seat is forward of the switching point, the RCM increases the time delay between firing the two stages of the inflator in the driver air bag. When the driver seat is rearward of the switching point, the RCM uses the normal time delay between firing the two stages.

SRS WARNING INDICATOR

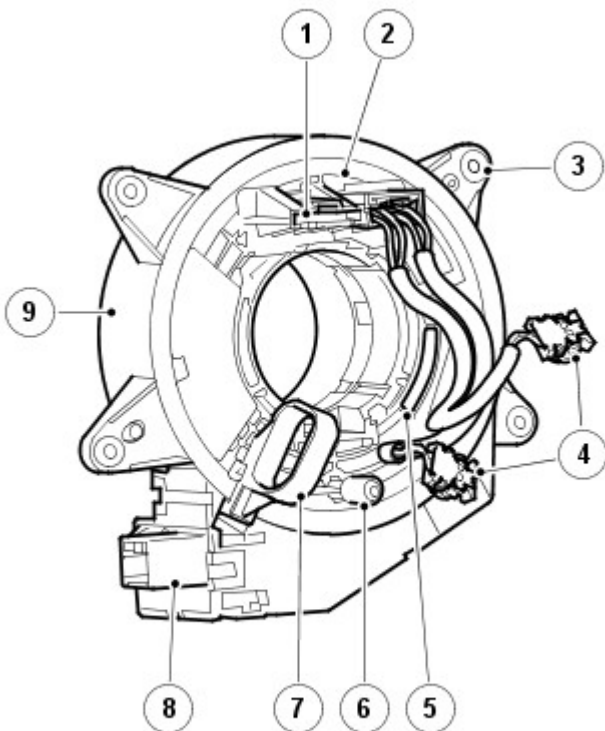


E45263

The SRS warning indicator consists of a red light emitting diode (LED) behind a SRS graphic in the tachometer of the instrument cluster.

Operation of the SRS warning indicator is controlled by a high speed CAN bus message from the RCM to the instrument cluster. The RCM illuminates the SRS warning indicator if a fault is detected, and for approximately 6 seconds during the bulb check at the beginning of each ignition cycle.

CLOCKSPRING



E45264

Item	Part Number	Description
1	-	Electrical connector for steering wheel switch packs and horn
2	-	Inner rotor
3	-	Outer housing securing lug
4	-	Driver air bag link leads
5	-	Viewing window
6	-	Drive peg
7	-	Stopper
8	-	Electrical connector for steering column harness
9	-	Outer cover

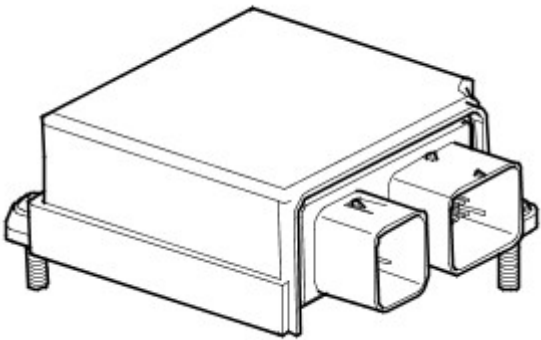
The clockspring is installed on the steering column to provide the electrical interface between the fixed wiring harness of the steering column and the components that rotate with the steering wheel, i.e. the driver air bag, the horn and the steering wheel switch packs.

The clockspring consists of a plastic cassette which incorporates an outer cover fixed to the steering column and an inner rotor which turns with the steering wheel. Four securing lugs attach the cover to the multifunction switch on the steering column. The rotor is keyed to the steering wheel by a drive peg. A lug on the underside of the rotor operates the self-cancelling feature of the turn signal indicator switch. A ribbon lead, threaded on rollers in the rotor, links two connectors on the cover to two connectors on the rotor. Link leads for the driver air bag are installed in one of the connectors on the rotor.

To prevent damage to the ribbon lead, both the steering and the clockspring must be centralized when removing and installing the clockspring or the steering wheel. The clockspring is centralized when the drive peg is at six o'clock and 50 - 100% of a yellow wheel is visible in the viewing window.

Replacement clocksprings are fitted with a stopper, which locks the cover to the rotor, in the central position. The stopper must be broken off when the replacement clockspring is installed.

RCM



E45265

The RCM is installed on the top of the transmission tunnel, in line with the B pillars, and controls operation of the SRS. The main functions of the RCM include:

- Crash detection and recording.
- Air bag and pretensioner firing.
- Self test and system monitoring, with status indication via the SRS warning lamp and non volatile storage of fault information.

A safing sensor in the RCM provides confirmation of an impact to verify if air bag and pretensioner activation is necessary. A roll-over sensor monitors the lateral attitude of the vehicle. Various firing strategies are employed by the RCM to ensure that during an accident only the appropriate air bags and pretensioners are fired. The firing strategy used also depends on the inputs from the safety belt switches and the occupant monitoring system.

An energy reserve in the RCM ensures there is always a minimum of 150 milliseconds of stored energy available if the power supply from the ignition switch is disrupted during a crash. The stored energy is sufficient to produce firing signals for the driver air bag, the passenger air bag and the safety belt pretensioners.

When the ignition is switched on the RCM performs a self test and then performs cyclical monitoring of the system. If a fault is detected the RCM stores a related fault code and illuminates the SRS warning indicator. The faults can be retrieved by the Land Rover approved diagnostic system on a dedicated link between the RCM and the diagnostic socket. If a fault that could cause a false fire signal is detected, the RCM disables the respective firing circuit, and keeps it disabled during a crash event.

SRS OPERATION

General

In a collision, the sudden deceleration or acceleration is measured by the safing sensor in the RCM and by the impact sensors. The RCM evaluates the readings to determine the impact point on the vehicle and whether the deceleration/acceleration readings exceed the limits for firing any of the air bags or pretensioners. During a collision, the RCM only fires the air bags and pretensioners if the safing sensor confirms that the data from the remote sensor(s) indicates an impact limit has been exceeded. The RCM also monitors the vehicle for a roll-over accident using the internal roll-over sensor and high speed CAN bus messages from the anti-lock brake system (ABS) module and the steering angle sensor.

The RCM incorporates the following impact thresholds to cater for different accident scenarios:

- Front impact, pretensioners.
- Front impact, driver and passenger air bags stage 1, belt unfastened.
- Front impact, driver and passenger air bags stage 2, belt unfastened.
- Front impact, driver and passenger air bags stage 1, belt fastened.
- Front impact, driver and passenger air bags stage 2, belt fastened.
- Rear impact.
- LH side impact.
- RH side impact.
- Roll-over.

The front impact thresholds increase in severity from pretensioners, through to driver and passenger air bag stage 2, belt fastened.

Firing Strategies

The seat belt pretensioners are fired when either the pretensioner impact limit or the roll-over limit is exceeded. The RCM only fires the pretensioners if the related safety belt is fastened. For the front passenger pretensioner to fire, the seat must also be occupied by a large person, i.e. someone over a given weight (NAS only).

The driver and passenger air bags are only fired in a frontal impact that exceeds the stage 1 threshold. Both stages of the inflator in the driver and passenger air bags are fired. At impacts between the stage 1 and 2 thresholds, the delay between the firing of the two stages varies with the severity of the impact; the more severe the impact the shorter the delay. At stage 2 impact thresholds and above, the two stages of the inflator are fired almost simultaneously. The passenger air bag is disabled unless the front passenger seat is occupied by a large person (NAS only), or the passenger air bag deactivation switch is on (all except NAS). The time delay between firing the two stages of the inflator in the driver air bag is increased if the driver seat is forward of the seat position sensor switching point.

If there is a fault with a safety belt buckle sensor, the RCM assumes the related safety belt is fastened for the pretensioner firing strategy and unfastened for the driver and passenger air bag firing strategies. If there is a fault with the occupant detection system, or if there is a fault with the passenger air bag deactivation switch, the RCM increase the time delay between firing the two stages of the inflator in the passenger air bag.

If a side impact limit is exceeded, the RCM fires the side air bag and the side air curtain(s) on that side of the vehicle. If the side impact limit on the front passenger side of the vehicle is exceeded, the RCM also evaluates the input from the occupant classification system, and fires the side air bag only if the front passenger seat is occupied by a large person (NAS only).

The side air curtain(s) on both sides of the vehicle are fired if the roll-over limit is exceeded.

If multiple impacts occur during a crash event, after responding to the primary impact the RCM will output the appropriate fire signals in response to any further impacts if unfired units are available.

Crash Signal

When the RCM outputs any of the fire signals, it also outputs a hard wired crash signal to the Engine Control Module (ECM) and changes the high speed CAN bus output message from 'no crash' to 'crash condition'. The high speed CAN bus message is used by the central junction box (CJB) and the FFBH (fuel fired booster heater).

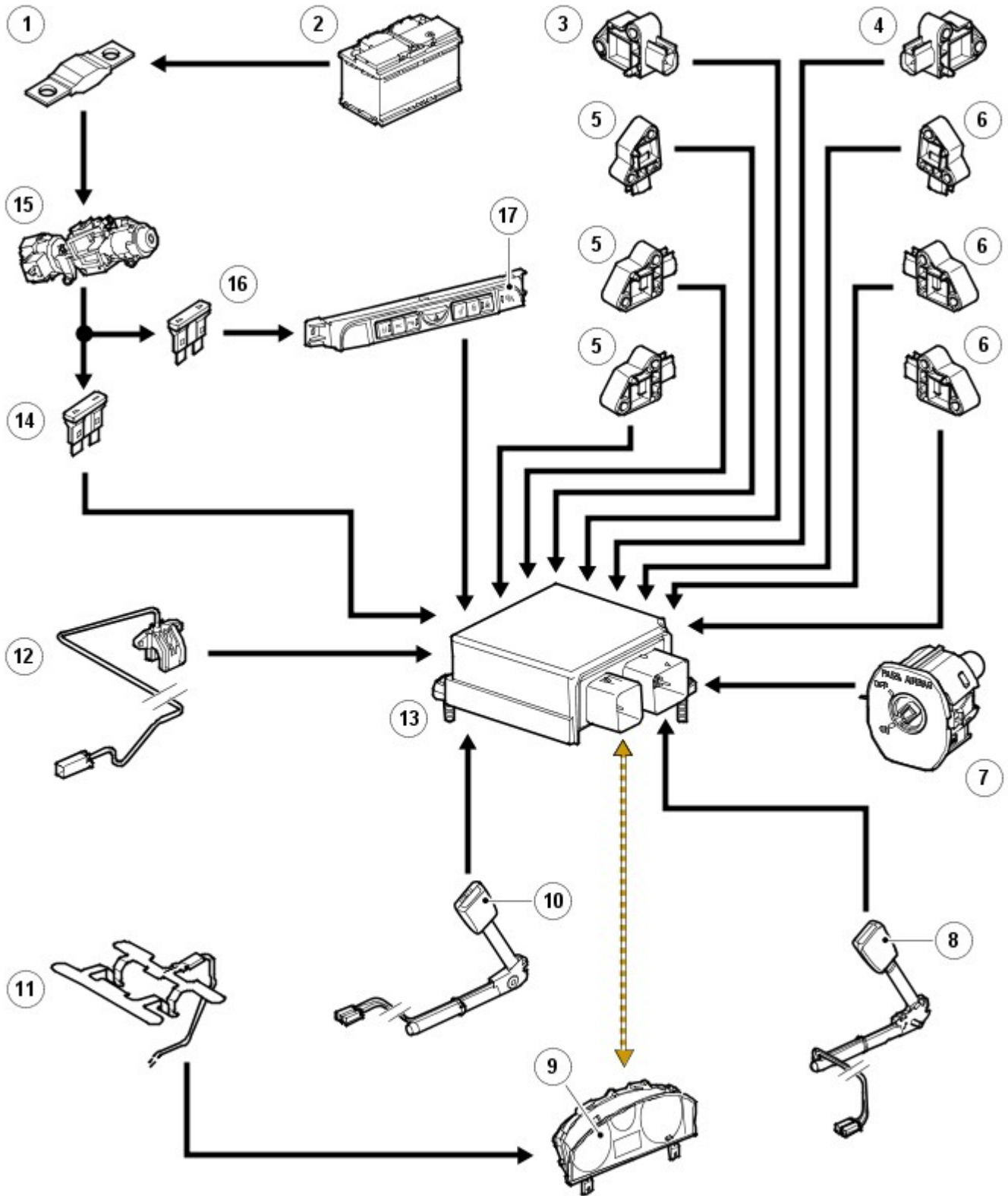
On receipt of the crash signals:

- The engine control module (ECM) disables the fuel pump.
- Operation of the FFBH is disabled.
- The CJB enters the crash mode and:
 - Activates all of the unlock signals of the vehicle locking system, even if the vehicle is already unlocked. After 3 seconds, the CJB activates the unlock signals again, in case a lock button is pressed during the crash, by flailing limbs for example.
 - Ignores all locking and superlocking inputs until the crash mode is cancelled, when it returns the locking system to normal operation.
 - Activates all of the courtesy lamps, except for the approach lamps. The activated courtesy lamps remain on until they are manually switched off at the lamp unit, or the CJB crash mode is cancelled, when they return to normal operation.
 - Activates the hazard warning lamps. The hazard warning lamps remain on until cancelled by turning the ignition switch from position II to position I or 0, or until the crash mode is cancelled.

The crash mode is cancelled by cycling the ignition switch.

CONTROL DIAGRAM - SHEET 1 OF 2 (ALL EXCEPT NAS)

- NOTE: A = Hardwired connections; D = High speed CAN bus



E48032

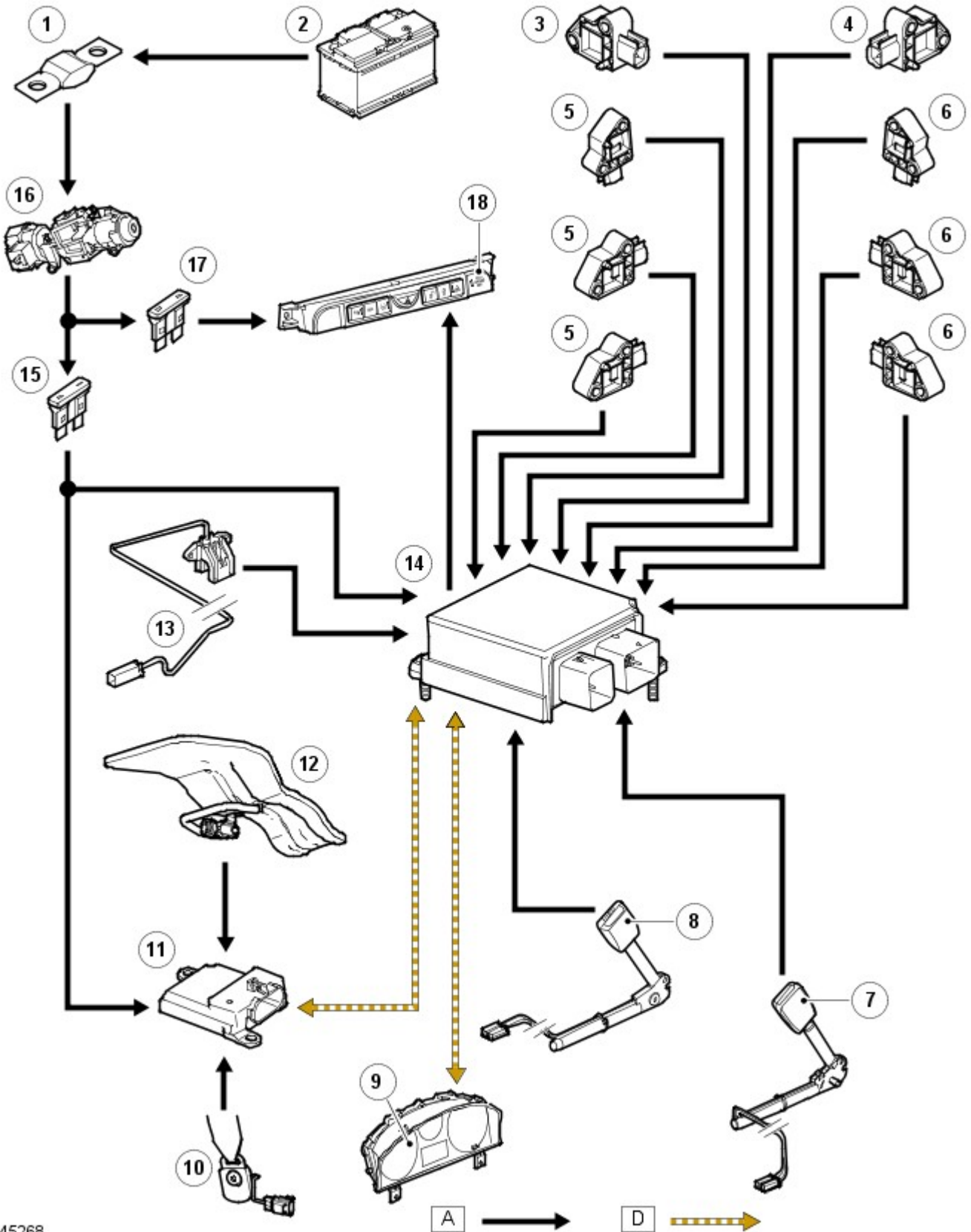


Item	Part Number	Description
1	-	Fusible link 11E, battery junction box (BJB)
2	-	Battery
3	-	Left front impact sensor
4	-	Right front impact sensor
5	-	Left side impact sensor
6	-	Right side impact sensor
7	-	Passenger air bag deactivation switch
8	-	Left safety belt buckle sensor
9	-	Instrument cluster
10	-	Right safety belt buckle sensor
11	-	Occupant detection pressure sensor

12	-	Seat position sensor
13	-	RCM
14	-	Fuse 9P, CJB
15	-	Ignition switch
16	-	Fuse 68P, CJB
17	-	Passenger air bag deactivation indicator

CONTROL DIAGRAM - SHEET 1 OF 2 (NAS ONLY)

• NOTE: A = Hardwired connections; D = High speed CAN bus



E45268

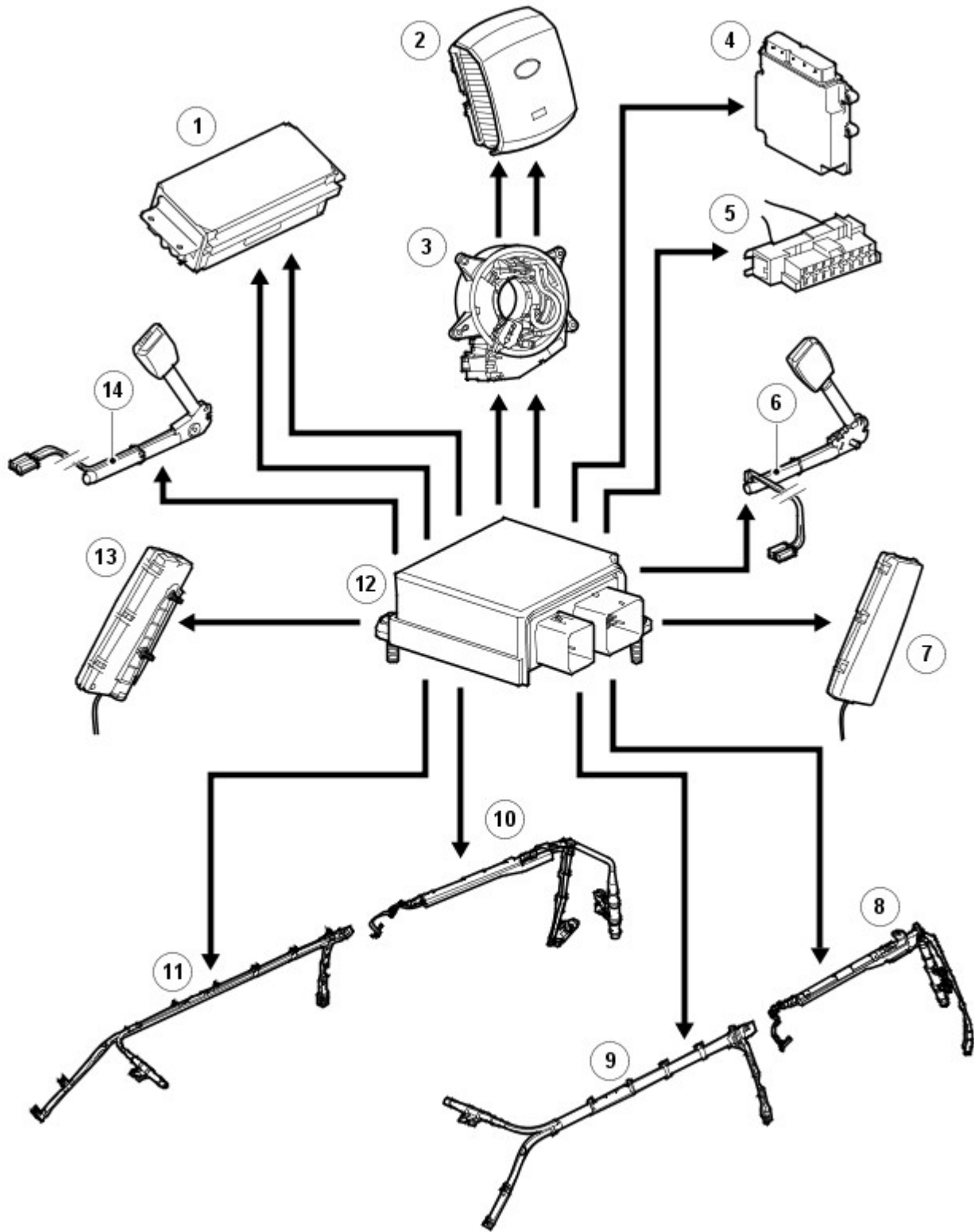


Item	Part Number	Description
------	-------------	-------------

1	-	Fusible link 11E, BJB
2	-	Battery
3	-	Left front impact sensor
4	-	Right front impact sensor
5	-	Left side impact sensor
6	-	Right side impact sensor
7	-	Left safety belt buckle switch
8	-	Right safety belt buckle switch
9	-	Instrument cluster
10	-	Safety belt tension sensor
11	-	Occupant classification module
12	-	Pressure pad and sensor
13	-	Seat position sensor
14	-	RCM
15	-	Fuse 9P, CJB
16	-	Ignition switch
17	-	Fuse 68P, CJB
18	-	Passenger air bag deactivation indicator

CONTROL DIAGRAM - SHEET 2 OF 2 (ALL MARKETS)

- NOTE: A = Hardwired connections



A →

E47315

Item	Part Number	Description
1	-	Passenger air bag
2	-	Driver air bag
3	-	Clockspring
4	-	ECM
5	-	Diagnostic socket
6	-	Left pretensioner
7	-	Left side air bag
8	-	Left third row side air curtain
9	-	Left first and second row side air curtain
10	-	Right third row side air curtain
11	-	Right first and second row side air curtain

12	-	RCM
13	-	Right side air bag
14	-	Right pretensioner

Supplemental Restraint System - Air Bag Supplemental Restraint System (SRS)

Diagnosis and Testing

Principle of Operation

For a detailed description of the air bag supplemental restraint system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Air Bag and Safety Belt Pretensioner Supplemental Restraint System \(SRS\)](#) (501-20B Supplemental Restraint System, Description and Operation).

Safety Information

• WARNINGS:



To avoid accidental deployment the back-up power supply must be depleted before beginning any work on the SRS system or its components. Failure to follow this instruction may result in personal injury.



Do not use a multimeter to probe an SRS module. It is possible for the power from the meter battery to trigger the activation of the module. Failure to follow this instruction may result in personal injury.

• NOTE: It is advisable not to use a cellular phone or to have a cellular phone in close proximity when working on the SRS system or components.

• NOTE: Given the legal implications of a restraints system failure, harness repairs to Air Bag module circuits are not acceptable. Where the text refers to "REPAIR the circuit", this will normally mean the replacement of a harness.

Power supply depletion

Before beginning any work on the SRS system or related components:

1. 1. Remove the ignition key.
2. 2. Disconnect the battery leads, ground first.
3. 3. Wait 2 minutes for the power circuit to discharge.

There are comprehensive instructions on the correct procedures for SRS system repairs in the workshop manual. Refer to the relevant section of the workshop manual.

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

• NOTE: Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. 1. Verify the customer concern.
 - Confirm the function of the warning lamp (if the warning lamp is inoperative, system faults will be signalled by an audible chime)
2. 2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> ● Check for the installation of non-standard accessories which may affect or obstruct the function of the SRS system ● Check the condition of trim, etc at the SRS system components ● Sensor(s) ● Pretensioner(s) ● Air bag module(s) ● Occupant detection/classification sensors ● Seat position sensor 	<ul style="list-style-type: none"> ● Fuses ● Wiring harness ● Make sure all electrical connector(s) are engaged correctly on the air bag circuits ● Make sure the Restraints Control Module (RCM) is correctly installed ● Warning lamp bulb(s) ● Impact sensor(s) ● Buckle sensor(s) ● Pretensioner(s) ● Air bag module(s) ● Air bag deactivation switch ● Air bag deactivation warning lamp ● Occupant detection/classification sensors ● Seat position sensor ● Clockspring


3. 3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. 4. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the relevant DTC Index.

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code \(DTC\) Index - DTC: Restraints Control Module \(RCM\)](#) (100-00 General Information, Description and Operation) / [Diagnostic Trouble Code \(DTC\) Index - DTC: Occupant Classification System \(OCS\)](#) (100-00 General Information, Description and Operation).

Supplemental Restraint System - Driver Air Bag Module

Removal and Installation

Special Tool(s)	
 <p>501-106</p> <p>E48291</p>	Airbag module remover 501-106

Removal

- WARNINGS:



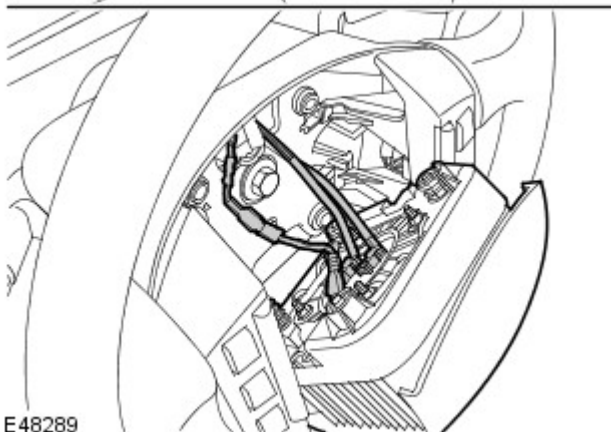
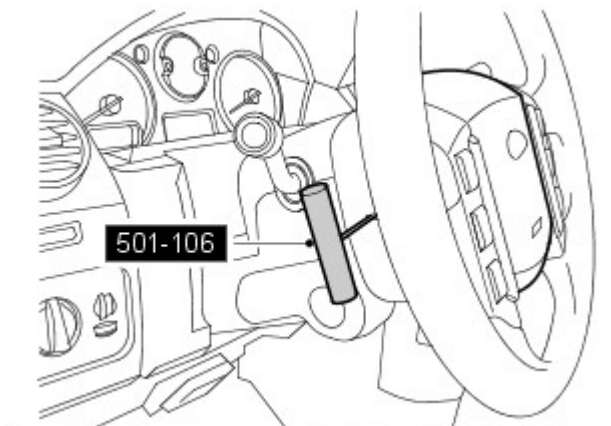
It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

- NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the driver air bag module.
 - Using the special tool, release the clip.
 - Repeat the above procedure for the other side.
 - Disconnect the ground cable.
 - Release the clips and disconnect the 2 electrical connectors.




E48289

Installation


1.  WARNING: The SRS electrical connectors are unique. DO

NOT force, or attempt to connect electrical connectors to the wrong sockets.

 **CAUTION:** Make sure the cables/harnesses are not twisted before connecting them to the airbag module. Once connected, do not rotate the air bag module as this will cause the wires to twist, which can lead to harness damage and SRS faults.

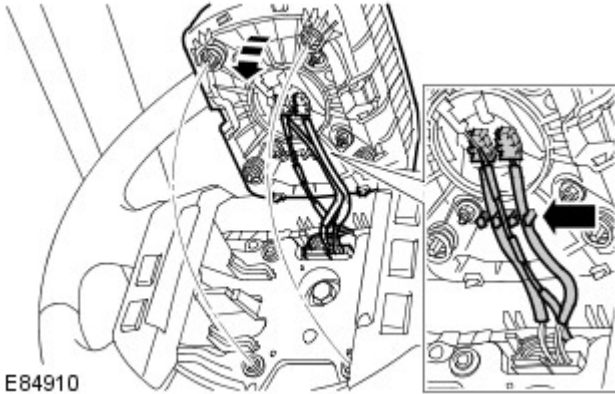
Attach the driver air bag module.

- Connect the ground cable.
- Connect the electrical connectors.

2.  **WARNING:** Driver air bag module installation can be confirmed by hearing 2 audible clicks, 1 for each spring. The module edges should also be flush with the steering wheel.

Install the driver air bag module.

- Install top edge of module, then hinge upwards and make sure wires are connected to clips.
- Make sure the wires are not trapped behind the module.
- Hold wires in place while hinging module closed.
- Align the locating pins and springs.



Supplemental Restraint System - Passenger Air Bag Module

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the instrument panel upper section.
For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).
4. Remove the passenger air bag module.
 - Remove the 4 nuts.

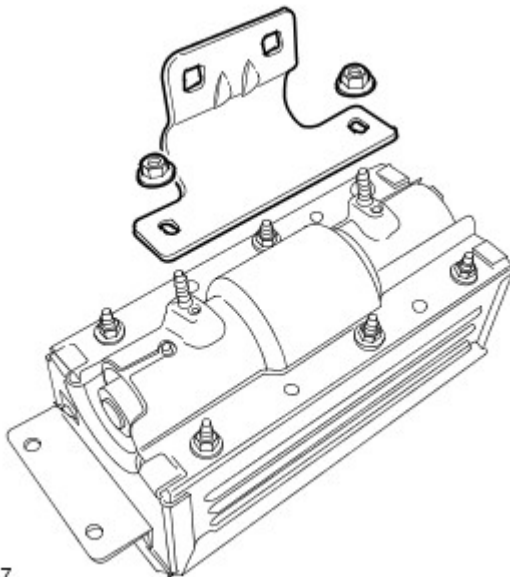


E47176

5. **NOTE:** Do not disassemble further if the component is removed for access only.

Remove the passenger air bag module bracket.

- Remove the 2 nuts.



E47177

Installation

1. Install the passenger air bag module bracket.
 - Tighten the nuts to 10 Nm (7 lb.ft).
2. Install the passenger air bag module.

- Tighten the nuts to 10 Nm (7 lb.ft).

3. Install the instrument panel upper section.

For additional information, refer to: [Instrument Panel Upper Section](#) (501-12 Instrument Panel and Console, Removal and Installation).

Supplemental Restraint System - Rear Side Air Curtain Module

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.

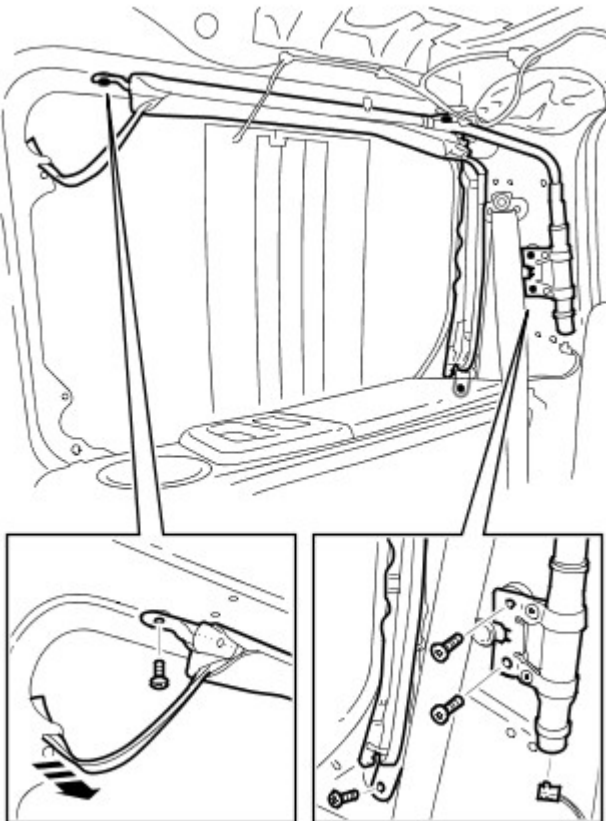


Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the side air curtain module.

- Disconnect the electrical connector.
- Remove the 5 Torx screws.
- Release the retaining strap.



E 49973

Installation

1. Install the side air curtain module.
 - Tighten the Torx screws to 10 Nm (7 lb.ft).
 - Connect the electrical connector.
 - Secure the retaining strap.
2. Install the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Connect the battery ground cable.

For additional information, refer to: Specifications (414-00, Specifications).

Supplemental Restraint System - Front Impact Severity Sensor

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.

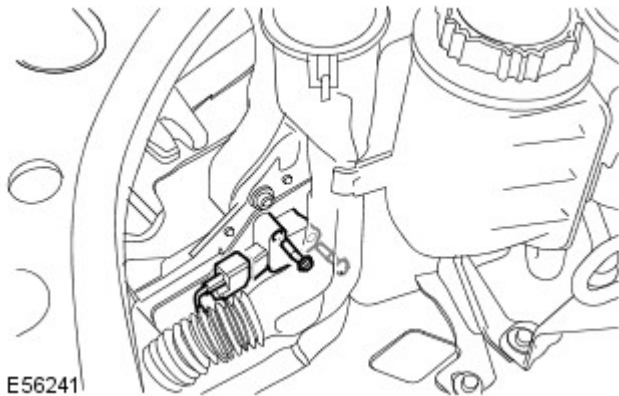


Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
3. Remove the front impact sensor.

- Disconnect the electrical connector.
- Remove the 2 Torx bolts.



Installation

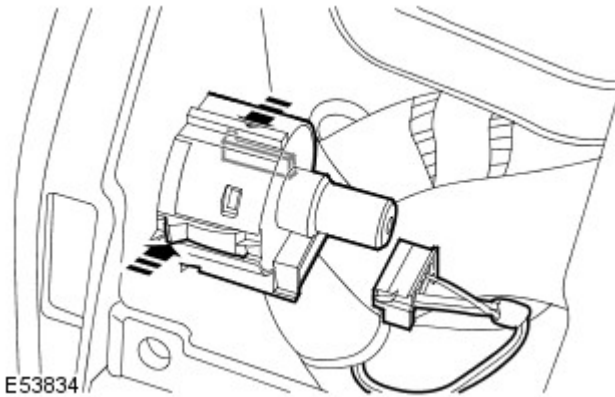
1. Install the front impact sensor.
 - Tighten the Torx bolts to 8 Nm (6 lb.ft).
 - Connect the electrical connector.
2. Install the headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

Supplemental Restraint System - Passenger Air Bag Deactivation (PAD) Switch

Removal and Installation

Removal

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the passenger side register trim panel.
For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).
3. Remove the PAD switch.
 - Disconnect the electrical connector.
 - Release the 2 clips.



Installation

1. Install the PAD switch.
 - Connect the electrical connector.
 - Secure with the clips.
2. Install the passenger side register trim panel.
For additional information, refer to: [Passenger Side Register Trim Panel](#) (412-01 Air Distribution and Filtering, Removal and Installation).

Supplemental Restraint System - Clockspring

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• CAUTIONS:



Make sure the wheels are in the straight-ahead position. Failure to follow this instruction may result in damage to the components.

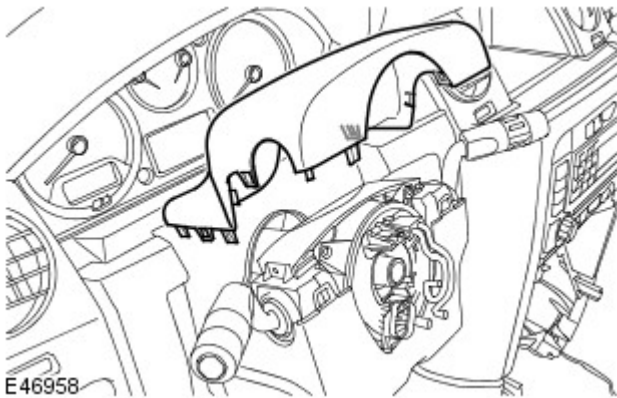


Correct clockspring alignment can be found by viewing a yellow marker through the window situated on the clockspring face. If the marker is not visible, carefully turn the clockspring. If the turning force increases before the marker is visible, reverse the direction to avoid component damage.

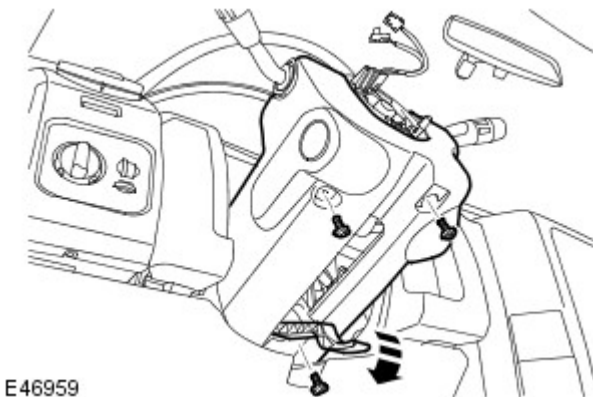
• NOTE: test piece

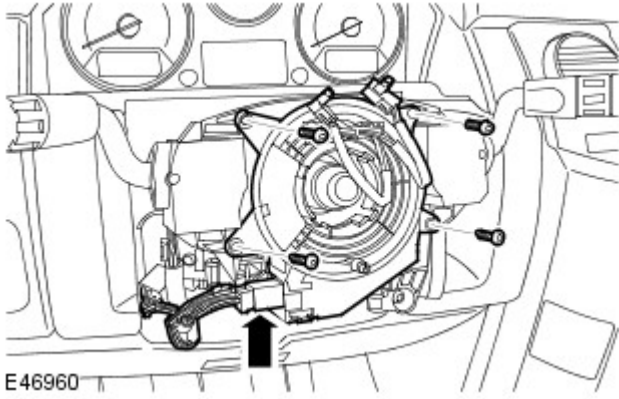
• NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Fully extend the steering column for access.
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the steering wheel.
For additional information, refer to: Steering Wheel (211-04, Removal and Installation).
4. Remove the steering column upper shroud.
 - Release the 6 clips.



5. Remove the steering column lower shroud.
 - Remove the 3 Torx screws.
 - Release the steering column adjustment lever.






6.  CAUTION: Do not dismantle the clockspring, it has no servicable parts and must be replaced as a complete assembly.

Remove the clockspring.

- Disconnect the 2 electrical connectors.
- Remove the 4 screws.

Installation

1.  CAUTION: Correct clockspring alignment can be found by viewing a yellow marker through the window situated on the clockspring face. If the marker is not visible, carefully turn the clockspring. If the turning force increases before the marker is visible, reverse the direction to avoid component damage.

To install, reverse the removal procedure.

Supplemental Restraint System - B-Pillar Side Impact Sensor

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.

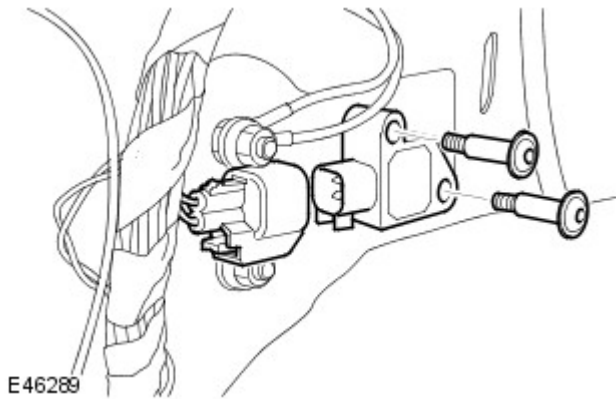
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the scuff plate trim panel.

For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Remove the side impact sensor.

- Remove the 2 Torx bolts.
- Disconnect the electrical connector.



Installation

1. Install the side impact sensor.

- Connect the electrical connector.
- Tighten the Torx bolts to 8 Nm (6 lb.ft).

2. Install the scuff plate trim panel.

For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Supplemental Restraint System - C-Pillar Side Impact Sensor

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.

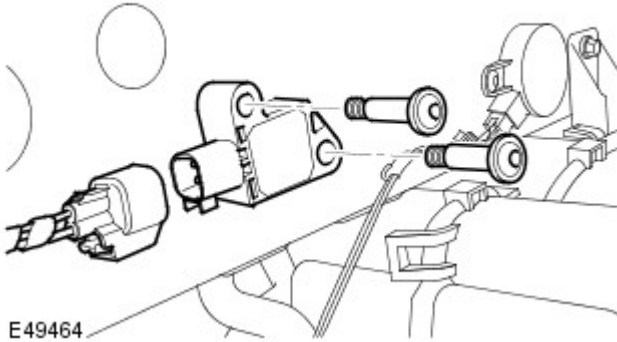
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the C-pillar lower trim panel.

For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

3. Remove the side impact sensor.

- Remove the 2 Torx bolts.
- Disconnect the electrical connector.



Installation

1. Install the side impact sensor.

- Tighten the Torx bolts to 8 Nm (6 lb.ft).
- Connect the electrical connector.

2. Install the C-pillar lower trim panel.

For additional information, refer to: [C-Pillar Lower Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Supplemental Restraint System - Front Door Side Impact Sensor

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.

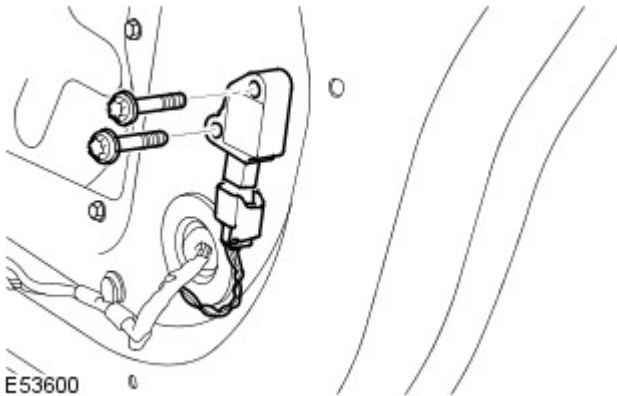
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).

2. Remove the front door trim panel.

For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

3. Remove the front door side impact sensor.

- Disconnect the electrical connector.
- Remove the 2 Torx bolts.



Installation

1. Install the front door side impact sensor.

- Tighten the Torx bolts to 8 Nm (6 lb.ft).
- Connect the electrical connector.

2. Install the front door trim panel.

For additional information, refer to: Front Door Trim Panel (501-05, Removal and Installation).

Supplemental Restraint System - Side Air Bag Module

Removal and Installation

Removal

• **WARNINGS:**

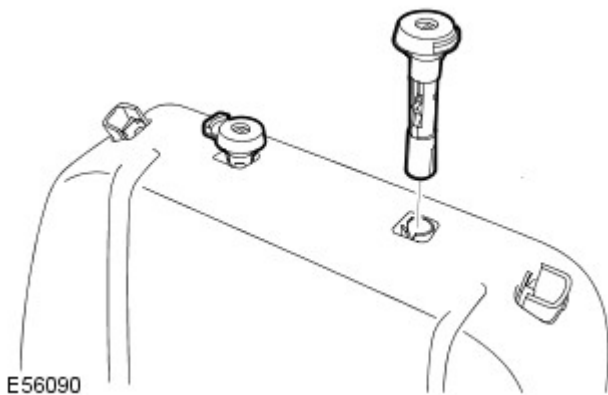


It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

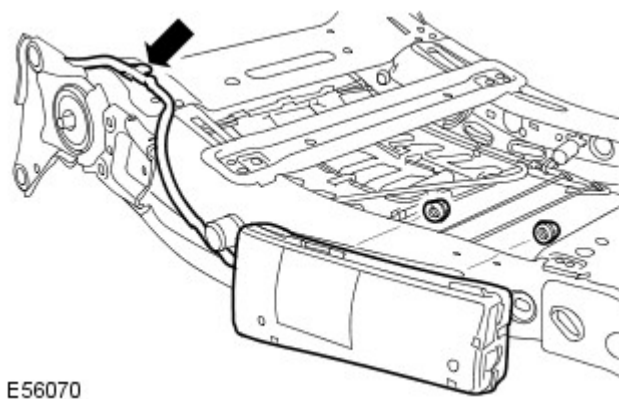
1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).
3. Remove the front seat backrest pad.
 - Remove the front seat head restraint retaining clips.



4. **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

Remove the side air bag module.

- Release the side air bag module harness.
- Remove the 2 nuts.



Installation

1. Install the side air bag module.
 - Tighten the nuts to 10 Nm (7 lb.ft).
 - Attach the wiring harness.
2. Install the front seat backrest pad.
 - Install the front seat head restraint retaining clips.
3. Install the front seat backrest cover.
For additional information, refer to: [Front Seat Backrest Cover](#) (501-10 Seating, Removal and Installation).

Supplemental Restraint System - Side Air Curtain Module

Removal and Installation

Removal

• **WARNINGS:**



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.

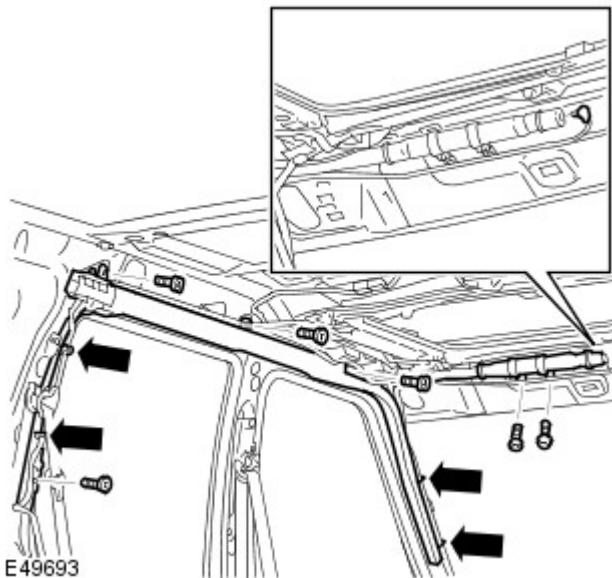


Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• **NOTE:** If the SRS component is to be replaced, the bar code of the new unit must be recorded.

1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Release the roof opening panel drain tube from the securing clips.
4. Release the tire deflation wiring harness from securing clips.
5. Remove the side air curtain module.

- Remove the 8 screws.
- Remove the 5 Torx screws.
- Disconnect the electrical connector.



Installation

1. Install the side air curtain module.
 - Tighten the Torx screws to 10 Nm (7 lb.ft).
 - Tighten the screws.
 - Connect the electrical connector.
2. Secure the tire deflation wiring harness into the clips.
3. Secure the roof opening panel drain tube into the clips.
4. Install the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

Supplemental Restraint System - Restraints Control Module (RCM)

Removal and Installation

Removal

• WARNINGS:



It is imperative that before any work is undertaken on the SRS system, the appropriate information is read thoroughly.



Always disconnect both battery cables before beginning work on the SRS system. Disconnect the ground cable first. Never reverse connect the battery.

• NOTE: If the restraints control module (RCM) is to be replaced then T4 must be connected and the correct procedures adhered to, prior to battery disconnection.

• NOTE: If the SRS component is to be replaced, the bar code of the new unit must be recorded.

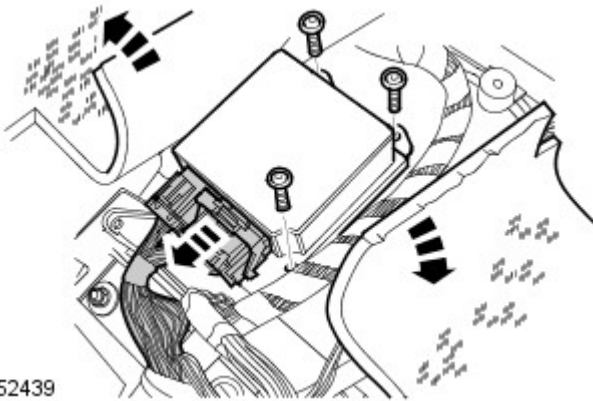
1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
3. Remove the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).



CAUTION: Make sure the wiring harness is protected when cutting the carpet.

Remove the restraints control module (RCM).

- Cut the carpet for access.
- Disconnect the 2 electrical connectors.
- Remove the 3 Torx screws.



E52439

Installation

1. Install the RCM.
 - Tighten the Torx screws to 10 Nm (7 lb.ft).
 - Connect the electrical connectors.
 - Position the carpet.
2. Install the floor console.
For additional information, refer to: Floor Console (501-12, Removal and Installation).
3. Initiate a new RCM using T4.

Supplemental Restraint System - Occupant Classification Sensor

Removal and Installation

Removal

- NOTE: The occupant classification sensor is part of the passenger seat cushion. The sensor is only fitted to NAS models.

1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).

Installation

1. Install the front seat cushion cover.
For additional information, refer to: [Front Seat Cushion Cover](#) (501-10 Seating, Removal and Installation).
2. Connect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
3. Using T4, configure a new occupant classification sensor.

Body Repairs - General Information - Body Repairs

Description and Operation

General Information

Introduction

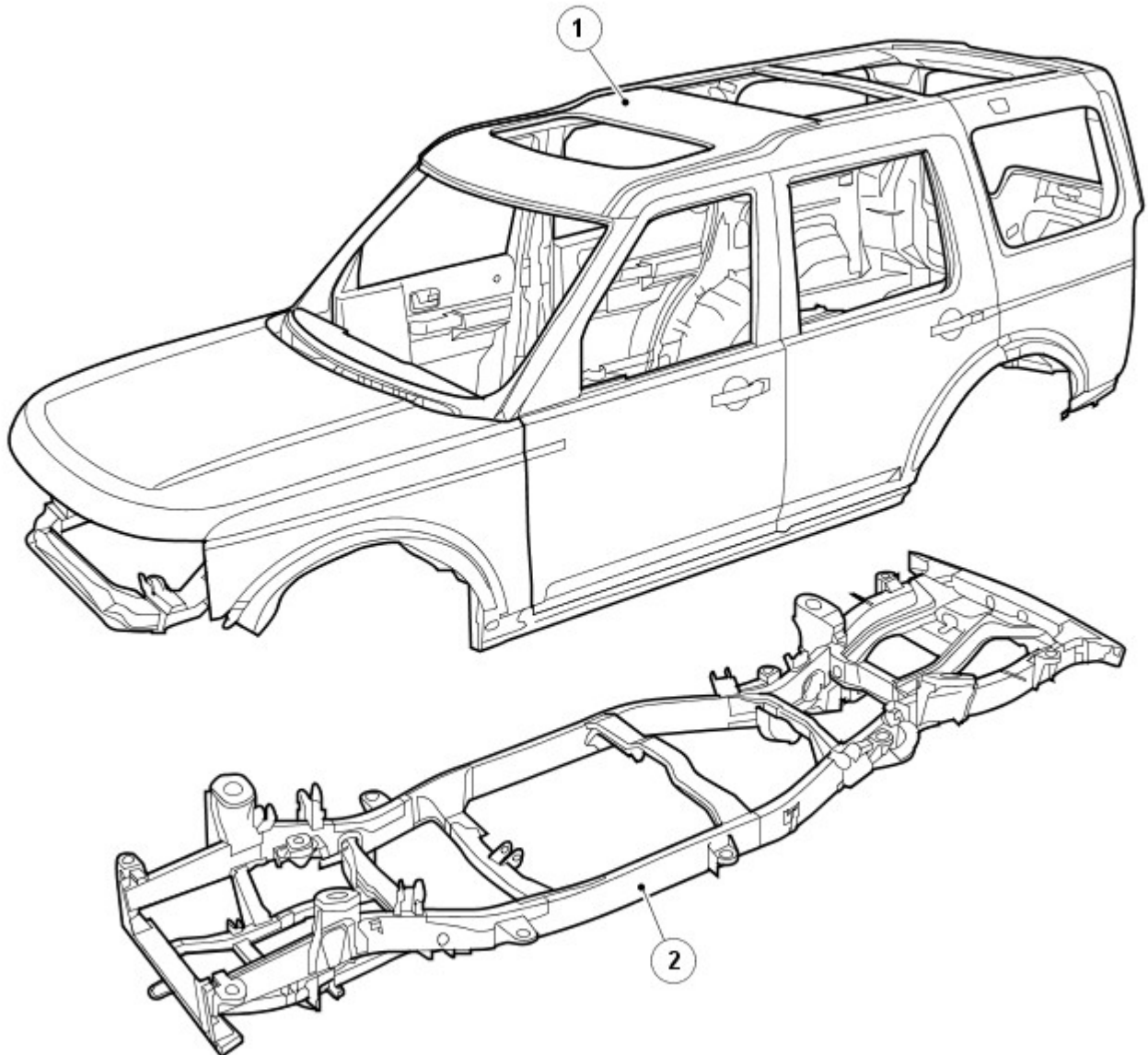
The body plays a significant role in the increasing trend of ever more rapidly changing model variants. The different customer groups are strongly influenced by the design and shape of the body. At the same time the stability of the body plays the most important part in ensuring passenger and driver safety. Lightweight construction, alternative materials, composite materials, plastics and appropriate joining processes are all design features that characterise modern Land Rover vehicle bodies.

In terms of manufacturing technology, modern safety cell bodies can be produced almost without any problems. Land Rover guarantee high quality standards by ensuring that mechanical strength properties are tried and tested in numerous computer simulations, crash tests, by testing materials and by employing sophisticated manufacturing technologies. In the event of repairs it is vital that the production quality standards are upheld. This requires a well-equipped workshop, and places particular emphasis on the qualifications of the workshop technicians. Up-to-date knowledge of current manufacturing technologies and continuous training on new repair methods and techniques are vital for high-quality body repairs. The model-specific repair manuals and the general repair techniques provide valuable support when undertaking body repairs.

Always follow the repair instructions published in this manual. Failure to observe this instruction can result in serious impairment of vehicle safety. All specified safety requirements must be met after the work has been carried out.

Vehicle design

Vehicle design



E55853

Item	Part Number	Description
1	-	Body
2	-	Integral body Frame

High Strength Steels

Land Rover vehicles are constructed from a number of different steels, partly to obtain an optimised body (collision, safety, rigidity, fuel economy, etc).

Steels are divided into several groups according to their tensile and yield strength, that is to say the force necessary to bring about plastic deformation of the material.

Yield Summary

Yield is the strength at which the metal changes from elastic to plastic in behaviour, the point of no return.

Tensile Summary

Tensile strength is the breaking strength of a material when subjected to a tensile (stretching) force, the point of no return.

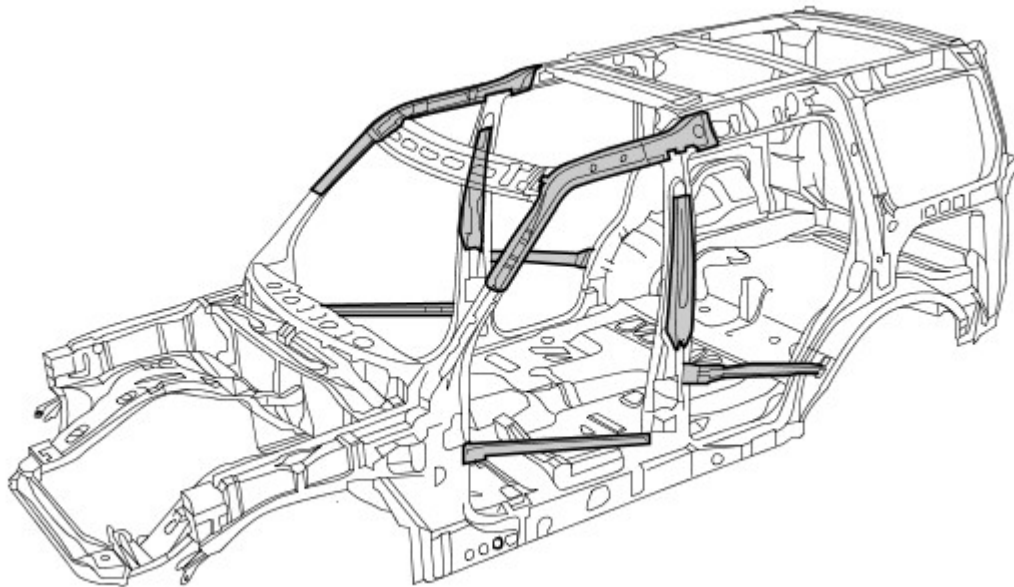
Abbreviation	Steel type	Yield Point
SS	Soft Steel	Maximum Yield point of 220 MPa
DP	Dual Phase Steel	Steel With a Yield Point up to 400 MPa
HS	High Strength Steel	Steel With a Yield Point 220 - 450 MPa
EHS	Extra High Strength Steel	Steel With a Yield Point 450 - 800 MPa
UHS	Ultra High Strength Steel	Steel With a Yield Point up to 1400 MPa

Ultra High Strength

The addition of ultra high strength steel in the A Pillar, B-Pillar and cantrail gives the body greater strength in a front or side impact.

No attempt should be made to straighten ultra high strength steel, due to its brittleness.

Ultra High Strength steel in body structure



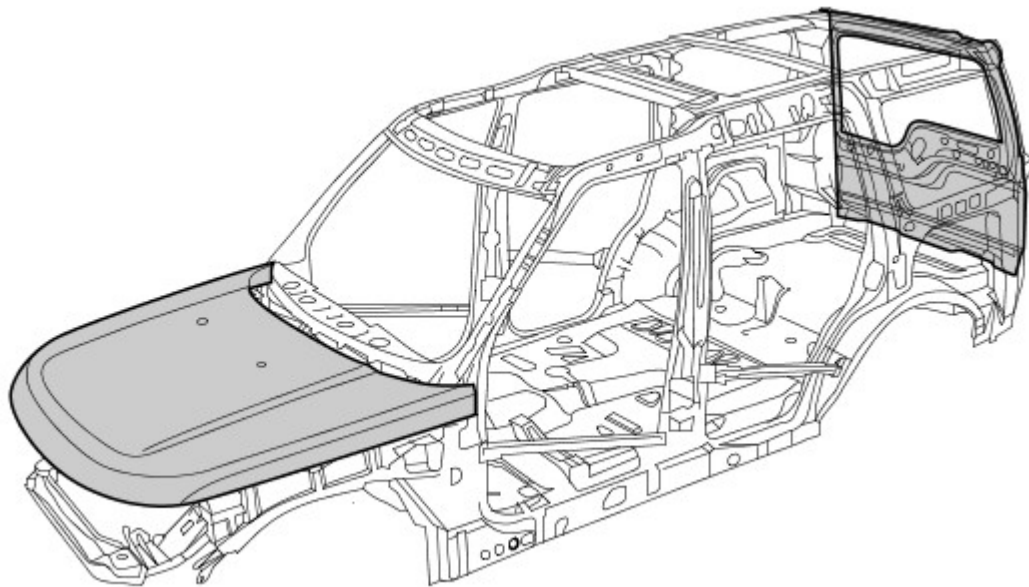
E55726

Aluminium

Aluminium 6000 series is used in the hood, tailgate and liftgate. It is made from magnesium/copper aluminium alloy and is heat treated during manufacturing/paint bake process resulting in a panel with increased strength and dent resistance.

When repairing aluminium you must use tools that have only been used on aluminium and never on steel panels, this is to prevent cross-contamination

Aluminium in body structure



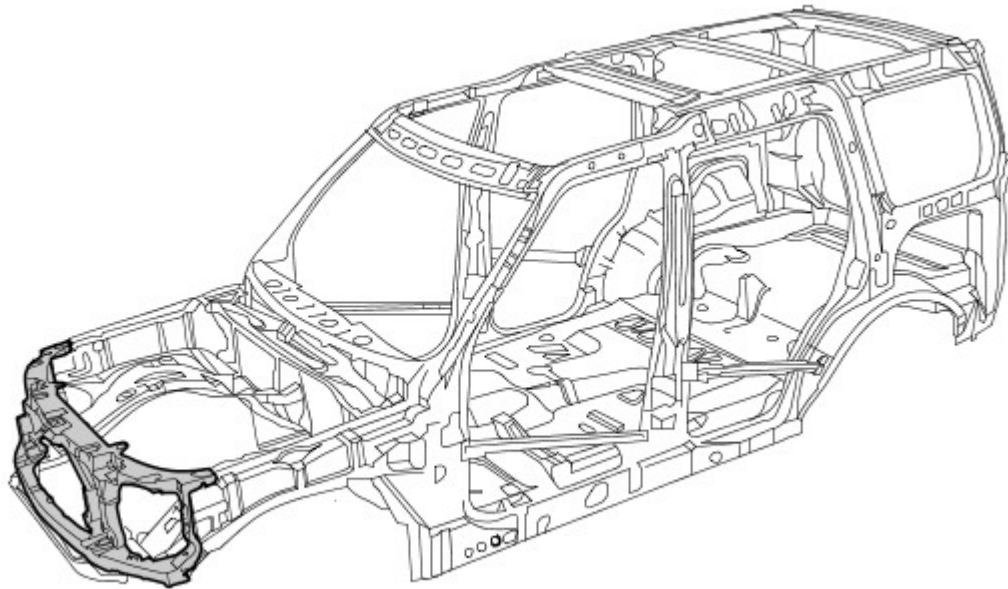
E55727

Magnesium

Magnesium AM60B is used to make the hood latch panel. It has good ductility and energy absorbing properties. It is also used on the instrument panel mounting beam.

No attempt should be made to weld or straighten the hood latch panel and it should be replaced in the event of an accident. If the corrosive coating is damaged it must be repaired using 'Land Rover Low Temperature Anti-Corrosion Coating', service part no VEP 501 840 PMA

Magnesium in body structure



E56195

Accident damage and diagnosis

General notes

- Exact diagnosis of the extent of damage enables proper repair planning.
- All body repairs must be carried out in accordance with the guidelines in this Body Repair Manual.
- The stability and strength properties of the body must be taken into account during body repairs. The body has exactly defined deformation patterns that must not be affected by any repair work.
- For instance, the crumple zones absorb the bulk of the impact energy. If any unprofessional repair techniques or methods are used in these areas then this can pose a fundamental threat to vehicle safety.

Hidden damage

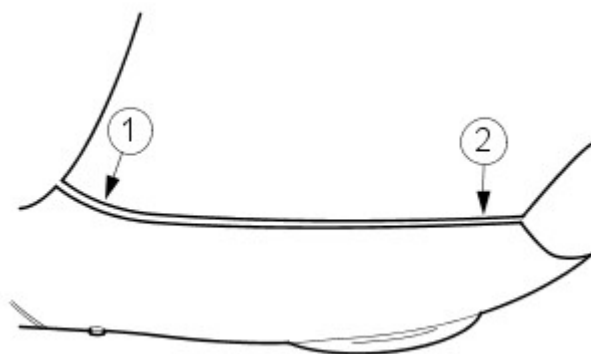
- As well as looking at external indicators like flaked off paint, it is vital to check for hidden body damage or deformation that is not visible from the outside. Large attached parts like bumpers and inner fenders often need to be removed to allow accurate assessment of damage to underlying body parts.

Gap dimensions

For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Gap dimensions offer another alternative for diagnosis by visual inspection. If any changes or misaligned edges are apparent, then this usually indicates that the dimensions of the affected part are incorrect.

Changes in gap dimension



DEE0003919

Item	Part Number	Description
1	-	Gap too wide
2	-	Gap too small

Planning a repair

The following decisions have to be made before the repairs are started:

- Does the vehicle need to be put on a straightening jig, or can it be straightened by other means?
- Does the body need to be measured?
- Do aggregates like engine or axles need to be removed?
- • NOTE: It is preferable to repair body parts rather than to renew them, as this keeps the complete body-shell intact.
- Which body parts need to be renewed?
- Which body parts can be repaired?

Obtaining spare parts

The availability of spare parts often determines how easily the body repairs can be carried out. The following procedure is recommended:

- Obtain all the data for the vehicle, including type, vehicle identification number, trim code, engine identification letters, initial registration etc.
- Establish all of the metal parts that need to be renewed.
- Establish all of the attached parts that need to be renewed, including small parts like rivets, clips etc.

Straightening repairs

Straightening repairs are often required to restore the body to its original shape after an accident. This can be done with:

- Alignment jigs
- Universal straightening and measuring jigs

The following points must be followed to ensure that the repairs are carried out professionally and that all the dimensions are correct after the repairs have been carried out.

- Structure:
 - The repair sequence depends on the individual repair plan (taking any necessary disassembly work into account).
 - Clean the attachment areas.
 - Anchor the vehicle free of stress on the relevant system.
 - Support the aggregates to take strain off the body.
 - Decide on at least three measuring/mounting points that are undamaged and as far apart as possible (for basic adjustment).
 - Check the dimensions of the measuring/mounting points.
- Straightening:
 -
 - **NOTE: Check dimensions and gaps continuously during straightening.**

A body is always straightened in the opposite direction to that of the impact. Always carry out straightening repairs with the complete body shell assembled (do not cut out any parts beforehand). Carry out the straightening work in several stages. This prevents the risk of over stretching or of welded joints tearing out. During the individual straightening steps, relieve tension by striking with an aluminium hammer while the part is subjected to a tensile load (in the area of pre-determined folding points, dents, welded joints etc.).



CAUTION: Ultra High Strength steel in the A-Pillar, B-Pillar and cantrail cannot be straightened.

Panel Beating

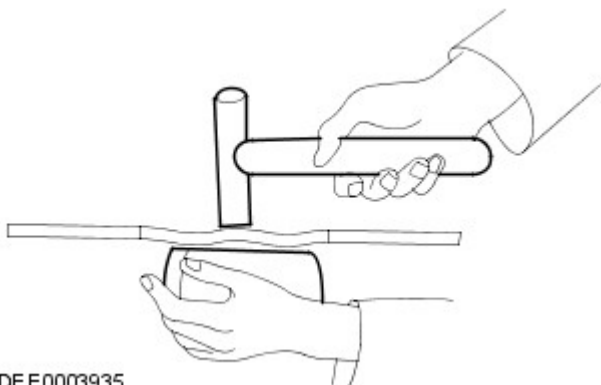
Fundamentals of panel beating

- Before carrying out any sectional replacements or complete replacements of body panels, always check carefully whether the damaged panel(s) can be rectified by panel beating.
- Panel beating is usually the easiest and most economical method of repairing a damaged panel.

Examples of applications of different panel beating techniques:

- Aluminium hammer and mallet
 - Advantage: Low risk of overstretching the panel.
 - Used for repairs of small dents on panels that are accessible from both sides.
 - These two panel beating tools are usually used for "finishing repairs".

Fine straightening with an aluminium hammer and a universal dolly



- Sliding hammer
 - If the damaged panel is only accessible from the outside, use a sliding hammer to pull it back into shape. The discs or studs needed to mount the sliding hammer are welded onto the bare surface. Dents in the panel can be flattened out using controlled application of the sliding hammer.

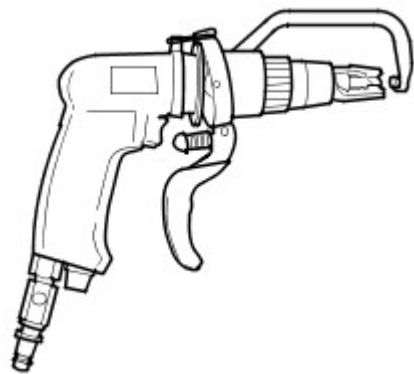
Cutting out body parts

Depending on how the parts are joined/connected, different tools are suitable for cutting/separating body parts.

- NOTE: All other parts like interior equipment, window glass etc. must be protected against flying sparks.
- NOTE: Ensure that the milling depth is set correctly to prevent the remaining flange from being weakened.

Spot-weld mill

Spot-weld mill

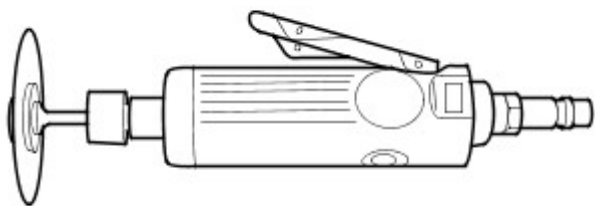


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- Rod sander
 -
 - NOTE: Wear protective clothing. Protect any vulnerable body or glass areas against flying sparks. Remove explosive materials from the vicinity.

Any spot welds that are inaccessible for the spot-weld mill (diameter > 8 mm) should be ground out using a rod sander. The same applies to MIG spot welds or seams.

Rod sander



DEE0003925

- -
- NOTE: Underlying metal parts, wiring harnesses, hoses etc. must not be damaged - remove them beforehand if necessary.

Body saws are particularly versatile and are therefore very suitable for making severance cuts on body parts.

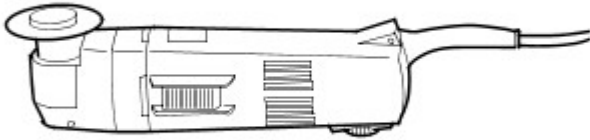
Short stroke saw



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- Reciprocating saw
 - In addition to the short stroke saw, the reciprocating saw can be used. With this, it is possible to make narrow and straight cuts to an exact depth.

Reciprocating saw



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Carrying out the repairs

- Complete replacement
 - In a complete replacement the entire damaged old part is removed at its original joins/connections, and a complete new part is then installed. The following illustration shows a replacement new back panel.

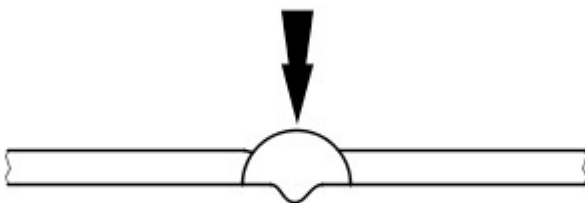
Replacement of a new back panel



E56124

- Sectional replacement
 - In many cases it makes technical and economical sense to carry out a sectional replacement. The two main considerations are firstly, maintaining the original overall body shell structure and secondly, keeping the repair costs to a minimum.
- The main method for sectional replacement:
 - Butt joints
 - New part and old part are joined with a continuous MIG weld seam.
 - Butt joints are most commonly used for sectional replacements on members and pillars, or on short severance cuts.

Butt joint



DEE0003929

• NOTE: The severance cut should always be kept as short as possible on sectional replacement. Only cut at the severance lines shown in the repair chapters.

Do not make any cuts near reinforcements or pre-determined folding lines.

- Prepare parts remaining on the vehicle / new parts.
 - Reshape the adjoining surface of any dented body parts that are to remain on the vehicle using a hammer and a counterhold (ensure that the old part matches the shape of the new part). Grind off left over spot welds or seams with a suitable tool.
 - Cut the new parts to shape.
 - If necessary punch or drill holes for mig plug welding.

-
- NOTE: Do not use a welding torch to remove paint residue (the heat could cause the metal to deform).

Prepare all joining flanges to a bright metal finish on both sides. Do not use an angle grinder for this purpose (this could weaken the metal and damage the zinc layer). Suitable tools: rotating wire brush, belt sander or plastic disc.

- Apply welding primer liberally to all weld flanges.
- The primer must be well stirred or shaken before use.

- NOTE: When using aerosols, take care not to contaminate adjacent parts with spray mist.

fitting the new part.

- It must be ensured that the new part fits exactly to the specified dimensions, to help this it is recommended to use such equipment as:
 - Alignment jig
 - Universal measuring system
 - Jig system
 - Ruler or tape measure
- Any attached body parts that require accurate alignment and fitting must be incorporated in this step; for instance bumpers, seals, headlamps, rear lamps and lock assembly components. If this is not done carefully it may result in water leaks, wind noises and substantial follow-on work.
- Ensure that edges line up with adjacent parts and check that gaps are consistent (compare left and right-hand sides). Make sure that the shape of the vehicle is retained.

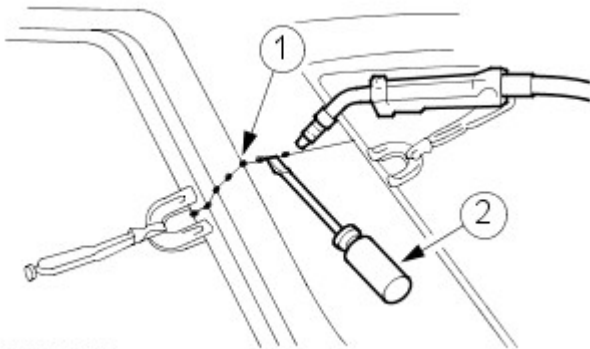
Secure the new part

- NOTE: The need for subsequent follow-on work can be significantly reduced if aligning and tack-welding are carried out with due care.

Depending on accessibility the following methods for securing are available:

- Grip pliers (set of)
- Screw clamp (set of)
- Self-tapping screws
- Tack welds
- Using a suitable tool ensure that the edges of sectional replacements of profiled parts line up. The edge is then tack welded to ensure that it lines up.

Aligning and tack weld

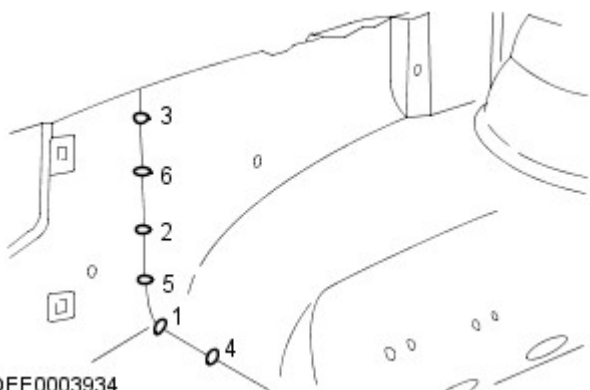


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Item	Part Number	Description
1	-	Tack welds
2	-	Using a suitable tool to align

- Longer joints are usually tack welded to prevent the panel from warping. It is important to carry out the tack welds in the correct sequence (see diagram).
- Weld in the new part following the instructions in the repair manual.

Correct tack welding sequence



DEE0003934

Safety measures

- The electronic control modules (ECM) fitted to vehicles make it advisable to follow suitable precautions prior to carrying out welding repair operations. Harsh conditions of heat and vibration may be generated during these operations which could cause damage to the modules. In particular, it is essential to follow the appropriate precautions when disconnecting or removing the airbag RCM. For additional information, refer to: [Specifications](#) (501-20B Supplemental Restraint System, Specifications).
- Do not allow electronic modules or lines to come into contact with the ground connection or the welding electrode.
- Connect the ground connection of the electrical welder directly to the part that is to be welded. Ensure that there are no electrically insulating parts between the ground connection and the welding point.

Resistance spot welding

Where resistance spot welds have been used in production, they must be reproduced with new spot welds in replacement where possible. All such reproduction spot welds should be spaced 25 to 30mm apart.

Setting up the equipment and co-ordinating the welding parameters

- Equipment:
 - Follow the equipment manufacturer's instructions for the equipment settings.
 - Select the correct electrode arms (as short as possible).
 - Align the electrode arms and tips exactly.
 - Electrode tips should be convex (rough shaping with a file, fine shaping with a sanding block).
- Body:
 - Ensure that the flanges to be joined lie perfectly flat to one another.
 - Prepare a bare metal joint surface (inside and outside).
- Notes on technique/method:
 - Carry out a test weld on a sample piece of the material coated in welding paste.
 - If any metal parts are located between the electrode arms then there will be a loss of induction and therefore power (adjust current setting).
 - The power needs to be adjusted for high and ultra high-strength steel.
 - Repeated welding on old welding points often leads to poor quality welds.
 - Keep the electrode tips as near as possible to an angle of 90° to the contact surface.
 - The electrodes work best if their shape is convex. Clean the contact surface of the electrodes regularly.

Resistance spot welding panels where the total thickness is 3 mm or more

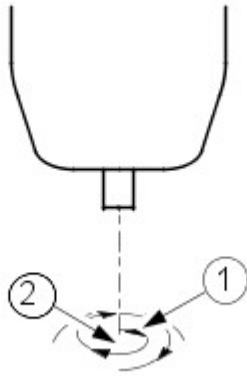
For all repairs to modern Land Rover vehicles, spot-welding equipment should be suitable for reliable welding of zinc-plated, high-strength and high-tensile steels in three or more layers, up to 5 mm total thickness. If these requirements are not fulfilled, plug welding must be used for safety reasons. The electrical specifications (current, resistance, heat) of the spot-welding equipment have different validity, depending upon the type of equipment. Therefore, it is essential that the equipment manufacturer's instructions are observed with regard to the actual welding performance.

MIG / MAG welding

Setting up the equipment and co-ordinating the welding parameters

- Any joints that are MIG/MAG welded in production must also be MIG/MAG welded during repairs. Also during repairs, some resistance spot welds need to be replaced by plug welds.
 - If access is difficult, or if a suitably powerful spot welder (see above) for total panel thicknesses of 3 mm or more is not available, resistance spot welding must be partially replaced by plug welding during repairs. In this case, the increased time needed and the correspondingly more demanding corrosion protection requirements, must be taken into account.
 - Welding repairs can only be carried out properly if the equipment is set up correctly and all the welding parameters are co-ordinated.
 - Equipment:
 - Set up the equipment as directed by the manufacturer.
 - The hoses must be untwisted.
 - The core must be free of abraded rod particles.
 - The gas and current nozzles must be free of slag and scale residue.
 - Pay attention to the quality of the welding wire and the throughput of gas.
 - Body:
 - Ensure that the joint surface is correct.
 - Prepare a bare metal joint surface.
 - Maintain the correct gaps (formation of roots).
 - Notes on technique/method:
 -
 - NOTE: The increased application of heat during MIG welding destroys the welding primer/zinc layer over a much larger area than during resistance spot welding, as a result of which much more care needs to be taken when applying anti-corrosion protection afterwards.
 - NOTE: A test weld should always be carried out to ensure that the welded joint is not just a surface connection.
- Attach the ground cable right next to the welding point (ensure that good contact is made).
- During plug welding start welding on the lower panel to ensure adequate penetration.

Plug welding



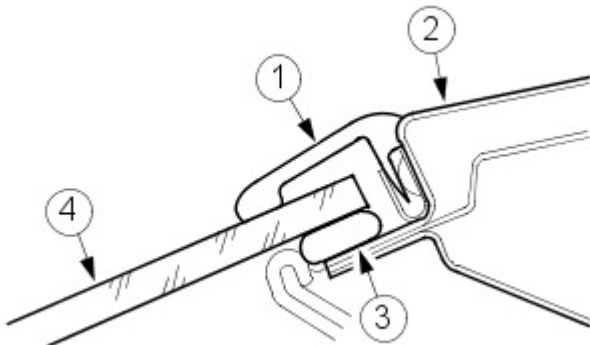
DEE0003936

Item	Part Number	Description
1	-	Welding direction: circular pattern working from the inside outwards
2	-	Welding starting point: centre of hole on lower panel

Bonded glazing

- - The windscreen, side and rear windows are bonded directly onto the window frames on the body and liftgate.
- The windows are bonded primarily for reasons of adhesive strength. Bonded glazing provides additional torsional stiffness to the body.

Adhesive bonding of bonded windows



DEE0003938

Item	Part Number	Description
1	-	Rubber strip
2	-	Window frame
3	-	Adhesive
4	-	Window glass

Removing and installing bonded windows

Safety measures

- The following safety measures must always be followed to prevent personal injury:
 - Wear protective gloves.
 - Wear protective goggles.

Preparations

- Before cutting out a bonded window, undo and remove any attached parts in the cutting area that are at risk, e.g. trim panels and decorative strips, as well as all electrical connections.
- Mask any painted areas that are adjacent to the window.
- Cut off any surplus adhesive, as this makes it easier to cut out the window.
- Secure vertical windows against dropping out.

Cutting out the window

- Cut into the adhesive bead at easily accessible points using the cutting tool.
- Carefully guide the cutting tool around the window, cutting through the adhesive bead.
- Avoid touching the window frame and the body flange.
- Use cup suction tools to lift the cut-out window out of the window aperture.

General preparations for bonding

- Follow the manufacturer's instructions.
- Cut back the remaining adhesive bead on the metal flange to a residual height of about 1mm. Do not touch or clean the cut surface afterwards.
- Carefully rectify any paint damage (apply primer and top coat).
- Renew the window stops as necessary.

Bonding the window glass

- Apply an even bead of adhesive to the window or to the body flange.
- Insert the window glass into the window aperture and centre it (2 technicians required).
- Check the gaps.
- • NOTE: Open the windows and doors while the window is left to dry and do not move the vehicle (slamming doors creates excess pressure which could cause the window to become loose).

Use adhesive tape to prevent the window from falling out or slipping.

Finishing operations

- Reconnect all electrical connections and check that the components operate correctly.
- Install the attached parts and check that the fit is accurate and secure.
 - Carry out a visual inspection to ensure that the gaps and joints are even.
- Thoroughly clean the window glass.

Protective equipment and safety at work

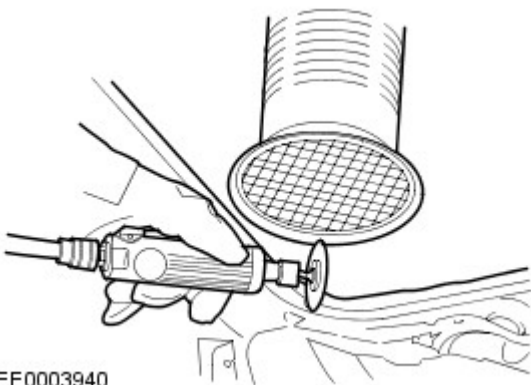
- Various safety measures and legal requirements must be met when carrying out repairs. All regulations relating to health and safety at work must be followed.

Welding safety precautions

- The following safety precautions must be observed to prevent the risk of personal injury:
 - Safety hood (face protection)
 - Welding shield
 - Safety gloves
 - Safety shoes
 - Extraction unit for welding smoke
- Welding should always be carried out in well ventilated areas. A fire extinguisher must also always be within reach.

General body repair safety measures

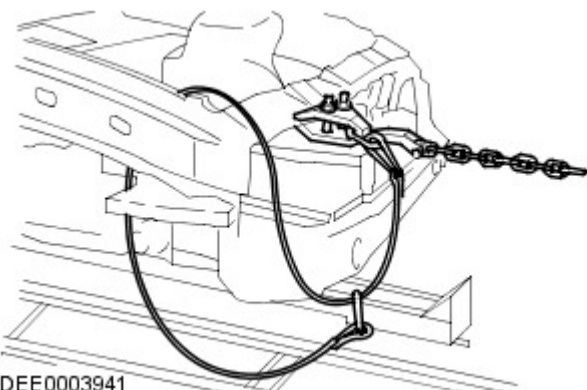
Extraction unit



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- Sealing compound, underbody protection etc. must **not** be burned off with a naked flame. This would produce toxic gases. If for instance PVC is burned, then gases containing hydrochloric acid are produced. For this reason a suitable extraction unit should always be used when performing grinding, welding or soldering work.
- Always ensure good ventilation when working with materials that contain solvents, wear breathing equipment and use an extraction unit.
- Ear defenders should always be worn when cutting, grinding or straightening metal, as the noise levels can reach or even exceed 85 - 90 dB(A).
- When removing components from a vehicle mounted on a lifting ramp, watch out for a shift in its centre-of-gravity. When first placing the vehicle on the ramp, take into account that it may need to be secured against tipping over.
- Chains and chain clamps must be secured with safety ropes during straightening work.

Safety rope



DEE0003941

Paint Preparation

Paint repairs

Before carrying out paintwork repairs, clean the vehicle thoroughly using either a steam cleaner or high pressure washer.

Wash locally repaired areas using a mild water-mixable detergent and wipe them clean with solvent, immediately before paint application.

Ensure damaged paintwork which has led to exposed metal is abraded until the metal is clean, extending beyond the area of the original damage. Treat the bare metal with an etch phosphate to remove all traces of rust and to provide a key for new paint coats. Re-treat the affected area using either a separate acid-etch primer and two pack surfacer or an integrated etch primer/filler, and follow with a two pack paint system. Treat those surfaces not receiving paint using an approved cavity wax, following paint operations

- CAUTIONS:



When preparing bumpers for painting, ensure the PDC sensors are not damaged. Only remove the clear coat if possible. When painting the PDC sensors, do not apply excessive layers of paint as this can hinder the performance of the sensors.



When heat curing paint repairs, the temperature must not exceed 65°C (149°F). Temperature above this figure will cause the reflective elements within the headlamps and tail lamps to distort and may damage other components.

Body Repairs - Corrosion Protection - Corrosion Protection

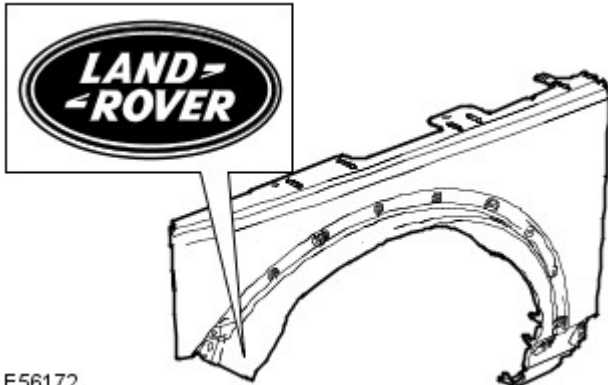
Description and Operation

General

The corrosion protection provided in production must be carefully maintained and/or reproduced during and after body repair work. It is only then that the long-term warranty against penetrative rust damage can be assured.

Only Land Rover original bodywork components and Land Rover approved repair materials (sealer, paint etc.), are to be used for bodywork repairs.

Land Rover original parts



All Land Rover bodywork components have a cathodic base coating. Individual bodywork components are zinc plated on one or both sides (in different areas depending on vehicle model).

Together with elastic paint coating, this guarantees an optimum, highly resistant protection against corrosion caused by the impact of small objects such as gravel.

• **NOTE:** If possible, the individual protective layers (zinc, cathodic base coat) on Land Rover bodywork components must not be damaged or destroyed by sanding or other mechanical operations.

If hairline cracks at "bodywork connection areas" appear after reshaping work (e.g. at door hinges), it must be ensured that the corrosion protection provided in production is recreated. The complete paint covering must be re-created if necessary. The same applies to reshaping work on heavily profiled bodywork components (e.g. floor pan). Renew or touch-up the paint coating, sealing beads and underbody protection as necessary.

After repair, any interior surfaces which are no longer visible or accessible must be primed before cavity wax is applied. To be certain of an even coating on inner surfaces, careful application of spray (twice, with drying time in-between) must be carried out throughout the whole cavity.

If bodywork panels are strongly heated during repair work, this will invariably result in damage to or even destruction of the applied corrosion protection material. The effectiveness of the cavity protection material is reduced if heating occurs. Reworking of the affected areas is therefore vital.

Welded areas should be made good before corrosion protection is applied.

The corrosion protection measures to be taken when bodywork components are renewed are described on the following pages.

Corrosion protection of new components

All new components must be inspected for transport or storage damage such as scratches or dents. The following operations may be necessary, depending on the extent of damage:

Undamaged new component

- Do not grind the cathodic dip primer.
- Thoroughly clean with silicone remover and rob dry.

Slightly damaged new component

- Sand out scratches
- Finely sand the surrounding surface.
- Thoroughly clean with silicone remover and rub dry.
- Apply corrosion protection primer to bare areas.

Damaged new components (bumps and dents)

- Beat out the dented area sand down to bare metal.
- Apply polyester filler (only onto bare metal)
- Apply filler.
- Lightly sand the whole components.
- Thoroughly clean with silicone remover and rob dry.
- Apply corrosion protection primer to bare areas.

The clinched flanges on the hood, doors, tailgate and liftgate must be sealed with clinched flange sealer.

Weld Components

Use a rotating tress wire brush to remove the dip coat on the inside and outside of the area to be welded, taking care not to damage the zinc coating.

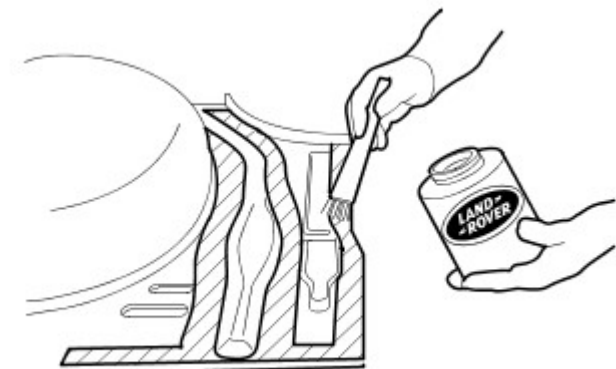
- NOTE: The area to be ground should be kept as small as possible, the corrosion protection applied in production (cathodic primer) should be retained as much as is possible.
- NOTE: The welding primer must be stirred well or shaken before application.

Clean the repair area thoroughly (silicone remover).

Apply welding primer evenly to all weld flanges (old and new components).

- NOTE: The welding primer must be allowed to dry before welding is carried out.

Apply welding primer



E56116

All weld beads must be ground down after all welding is completed, taking care not to weaken the material.

Any unevenness at the joint must be made good.

If necessary, spot weld missing T-pins for trim strip clamps into position. The vehicle must be completely cleaned of sanding dust and metal swarf because of the danger of corrosion.

Clean and prime all internal areas and those to be sealed.

- NOTE: The primer must be dry before sealing mastic or underbody protection is applied. Do not use thinners when applying sealing mastic (the mastic would not dry).

Partial renewal

The procedure to follow when partially renewing components is the same as described in the section "Welded components".

The main difference when components are partially, rather than completely renewed, concerns the preparation of butt or lap joints.

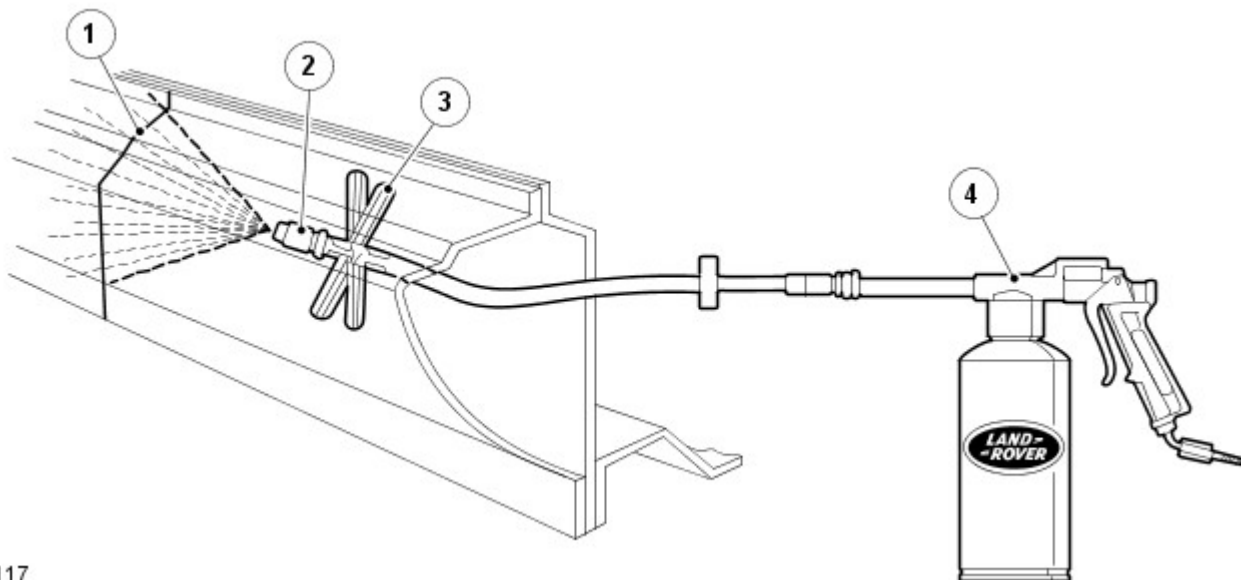
- When bodywork components are cut through, attention must be paid to the adequate removal of the paint and zinc coatings on inner areas. This specially applies to areas which are difficult to access internally.
- It is important for the weld quality that the inner area is bare metal. Zinc and paint residues in the weld area burn and cause serious hole formation during welding.
- If the zinc layer and the paint coating are not removed, the zinc and paint will burn during welding. The soot produced prevents satisfactory cavity protection.

Procedure

- The paint layer must be removed for a width of 30mm from the line of the weld using a rotating tress wire brush.
- This operation must be carried out on both the new and the old parts of the bodywork.
- Depending on the bodywork component, a 10mm width of the underlying zinc layer must also be removed along the weld line.

- NOTE: A flat scraper or a wire brush can be used instead of the rotating brush if the cavity is small. Do not use an angle grinder, which would weaken the structure.

Application of cavity wax protection on a door rocker panel after partial repair



E56117

Item	Part Number	Description
1	-	Weld bead
2	-	Spray head
3	-	Distance maintainer
4	-	Spray gun

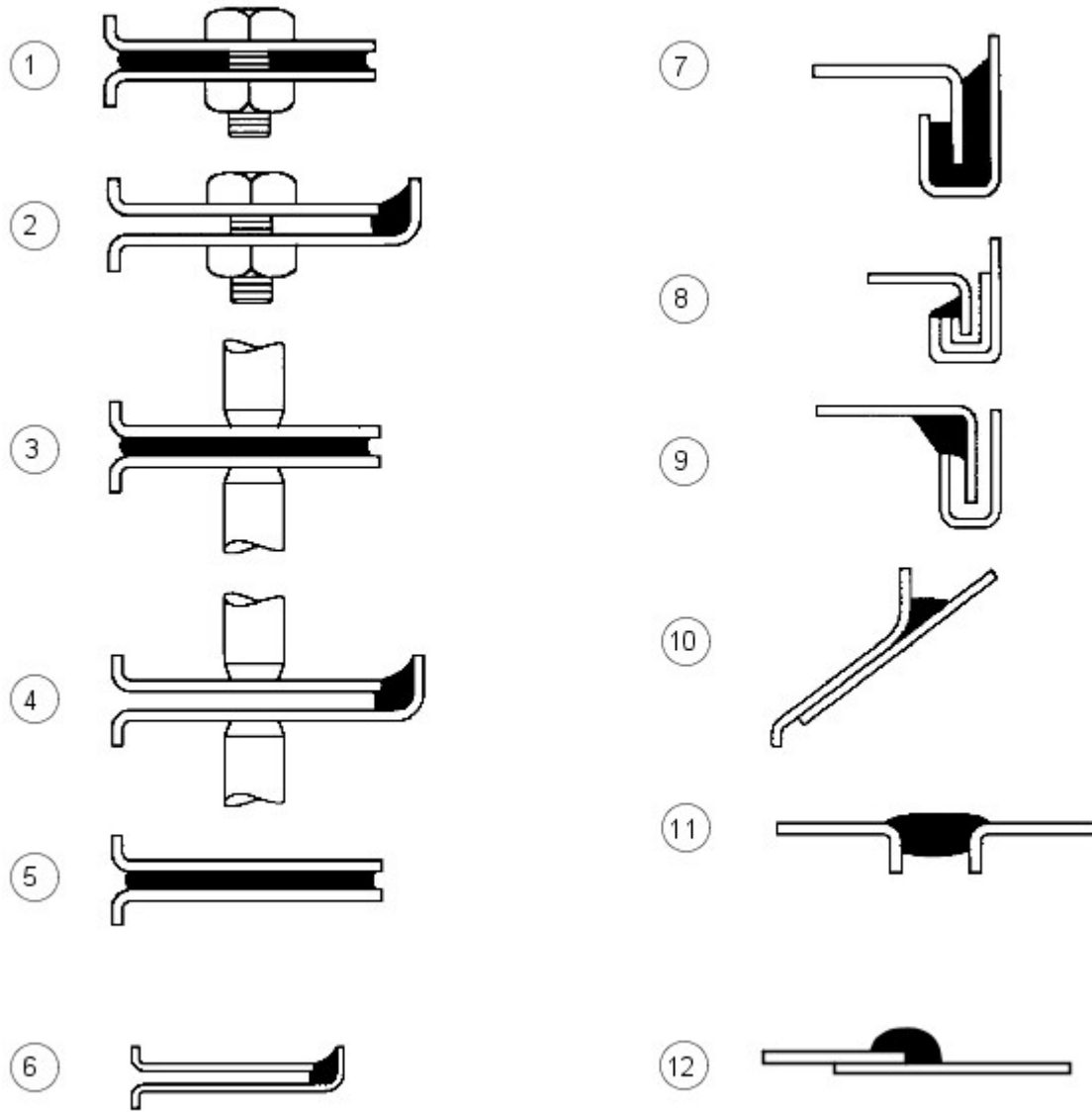
Classification of the different corrosion protection measures for dent removal

Corrosion protection method	Exterior surfaces	Accessible inner surfaces	Inaccessible inner surfaces
Painting	X	X	
Cavity protection			X

Classification of different corrosion protection measures for installation of new components

Corrosion protection method	Weld flanges before welding in place (contact surfaces)	All bare sanded areas	Weld flange area accessible	Weld flange area not accessible
Welding primer	X			
Painting		X	X	
Clinched flange protection			X	
Cavity protection				X

Body sealing materials



E56018

Item	Part Number	Description
1	-	Between Panels - Bolted
2	-	Panel Edge Bolted
3	-	Between Panels - spot welded
4	-	Panel edges - spot welded
5	-	Between panels - bonded
6	-	Panel edges - bonded
7	-	Clinch joints - type A
8	-	Clinch joints - type B
9	-	Clinch joints - type C
10	-	Gaps between panels - type A
11	-	Gaps between panels - type B
12	-	Lap joint

Description - Usage	Supplier	Part Number
Cavity - Wax	-	-
Inner Cavity Wax (Amber)	3M	0890/11/21
Inner Cavity Wax (Transparent)	3M	08909/19/29
Cavity Wax	Croda	PW57
Engine Bay Waxes/Lacquers		
Astrolan Engine Bay Wax and Cosmetic Wax	Astors	DA3243/1
Engine Bay and Cosmetic Wax/Lacquer	Croda	PW197
Engine Bay Cosmetic Lacquer	Dinol	4010
Miscellaneous Materials	-	-
Aerosol Auto Adhesive (Trim) - impact Adhesive for trim Parts	3M	08080

Description - Usage	Supplier	Part Number
Flexible Parts Repair Material - rubber modified polypropylene parts	3M	05900
Acoustic Foam (sika baffle 278) - expanding foam block repair	Sika	LR Part No AZL 500021. Ford Part No 6H22-11840-AA
Flexible Foam (anti - flutter) - between panels	Duramix	4320
Water Shedder Repair (Aerosol)	Teroson	-
Low Temperature Anti-Corrosion Coating (Magnesium)	Land Rover	VEP 501 840 PMA
Seam Sealers		
Body Caulking - type (b) gaps between panels	3M	08568
Drip Chek Clear - bolted, spot welded and bonded panel edges; type (a) and (b) gaps between panels; type ©) clinch joints	3M	08401
Drip Chek Heavy - type (b) gaps between panels; type ©) clinch joints	3M	08531
Polyurethane Seam Sealer - bolted, spot welded and bonded panel edges; type (a) and (b) gaps between panels; type (b) clinch joints	3M	08684/89/94
Polyurethane Sealer (Sachet) - bolted panel edges; type (b) clinch joints	3M	08703/83/88
Sprayable Sealer - lap joints	3M	08800/23
Super Seam Sealer - lap joints; type (b) clinch joints	3M	08537
Weld Thru' Sealer - between spot welded panels	3M	08626
Betafill Clinch and Brushable Sealer - type (b) clinch joints	Gurit-Essex	10211/15/20
Clinch, Joint and Underbody Coating - lap joint	Gurit-Essex	10101/10707
Leak Chek Clear - between bolted panels; spot welded and bonded panel edges; type ©) clinch joints; type (a) gaps between panels	Kent Industries	10075
Putty - type (b) gaps between panels	Kent Industries	-
Polyurethane Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (a) and (b) gaps between panels	PPG	6500
Polyurethane Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (b) gaps between panels	Teroson	92
Terolan Light Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (a) and (b) gaps between panels; between bonded panels; type ©) clinch joints	Teroson	-
Terolan Special Brushable Seam Sealer - lap joints	Teroson	-
Terostat Sprayable Seam Sealer - bolted, spot welded and bonded panel edges; between bonded panels; type (b) gaps between panels	Teroson	9320
Terostat 1K PU Seam Sealer (SE 20) - type (a) and (b) gaps between panels; spot welded and bonded panel edges	Teroson	-
Sealing Compound - bolted, spot welded and bonded panel edges; between bonded panels; type (b) gaps between panels	Wurths	8901001/-/6
Structural Adhesives		
Automotive Structural Adhesive - between bonded panels; type (a) clinch joints	3M	08115
Two Part structural Epoxy - between bonded and spot welded panels; type (a) clinch joints	Ciba-Geigy	XB5 106/7
Underbody Sealers		
Body-Schutz	3M	08861
Spray-Schutz	3M	08877
Crodapol Brushable Underbody sealer	Croda	PV75
Terotex Underseal (CP02)	Teroson	9320
Underbody Waxes		
Stone Chip Coating (smooth)	3M	08158/9
Underbody Wax	Croda	PW61
Underbody Wax	Dinol	Tectacote 205
Weld - through Primers		
Weld Thru' Coating	3M	05913
Zinc Spray	3M	09113
Zinc Rich Primer	ICI	p-565 634

Material Equipment/Suppliers

3M

- Automotive Trade Group
- 3M UK Plc
- 3M House
- PO Box 1
- Market Place
- Bracknell
- Berks.
- RG12 1JU
- Telephone (01344) 858611

Cooper Pegler

- Burgess Hill
- Sussex
- RH 15 9LA
- Telephone (014446) 42526

SATA Spray Equipment

- Minden Industrial equipment
- 16 Greyfriars Road
- Moreton Hall

- Bury St Edmunds
- Suffolk
- IP32 7DX
- Telephone (01284) 760791

Teroson

- Watchmead
- Welwyn Garden City
- Hertfordshire
- AL7 1JB
- Telephone 01707 358800

Underbody sealer

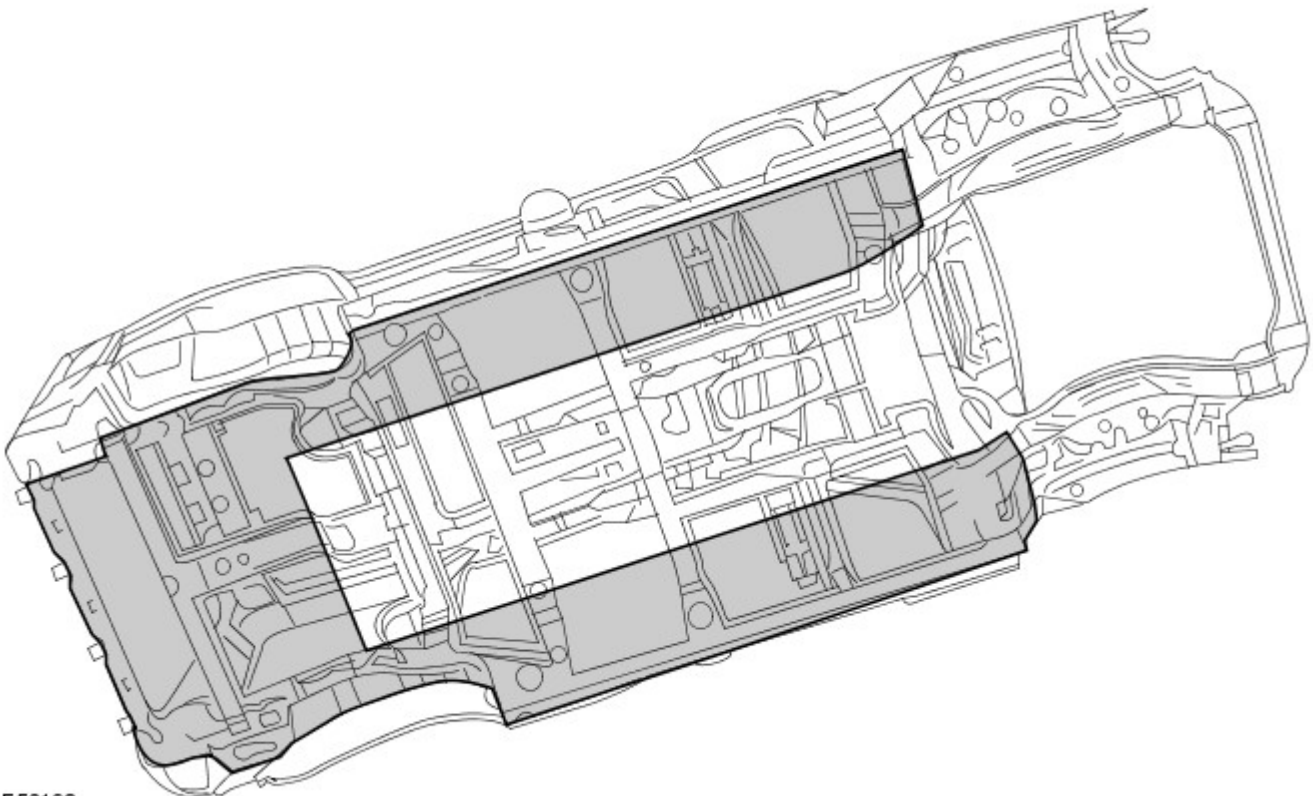
Under floor areas and rocker outer panels are treated with a plastisol PVC underbody sealer. This material is not suitable for re-treatment. When repairing areas of underbody sealer, strip the factory-applied underbody sealer back to a suitable break point. Ensure that a clean metal surface is exposed and that the edge of the existing adheres soundly to the panel.

Apply new underbody sealer between primer and surface paint operations. Apply seam sealer as necessary before application of underbody sealer. Ensure that blanking plugs and grommets in the floor pan (except those used for wax injection) are fitted before underbody sealer application. Refit any heat-fusible plugs which have been disturbed in repair with the aid of a hot air blower, or replace with rubber grommets



CAUTION: Ensure that suspension units, wheels, tires, power unit, drive shafts, exhaust and brakes (including all mounting points) are shielded prior to application of fresh underbody sealer.

Area of underbody sealer application



E56193

Precautions during body repairs and handling

Take care when handling the vehicle in the workshop. Underbody sealers, seam sealers, underbody wax and body panels may be damaged if the vehicle is carelessly lifted.

Proprietary anti-corrosion treatments

The application of proprietary anti corrosion treatments in addition to the factory-applied treatment could invalidate the corrosion warranty and should be discouraged. This does not apply to approved, compatible, preservative waxes which may be applied on top of existing coatings.

Fitting approved accessories

When fitting accessories ensure that the vehicle corrosion protection is not affected, either by breaking the protective coating or by introducing a moisture trap.

Do not screw self-tapping screws directly into body panels. Fit suitable plastic inserts to the panel beforehand. Always

ensure that the edges of holes drilled into panels, chassis members and other body parts are protected with a suitable zinc rich or acid etch primer, and follow with a protective wax coating brushed onto the surrounding area.

Do not attach painted metal surfaces of any accessory directly to the vehicle's bodywork unless suitably protected. Where metal surfaces are bolted together always interpose a suitable interface material such as weldable zinc rich primer, extruded strip, or zinc tape.

Steam Cleaning

Due to the high pressure/temperature generated by steam cleaning equipment, there is a risk that certain adhesives and corrosion prevention material may become softened or liquified.

Take care not to allow the steam jet to dwell on one area, and keep the nozzle at least 300mm from the panel surface.



CAUTION: Do not remove wax or lacquer from underbody areas during repairs.

Inspection during maintenance servicing

It is a requirement of the corrosion warranty that the vehicle is checked for corrosion by an authorised Land Rover Authorised Repairers at least once a year, to ensure that the factory-applied protection remains effective.

Rectify any bodywork damage or evidence of corrosion found during inspection as soon as is practicable, both to minimise the extent of the damage and to ensure the long term effectiveness of the factory-applied corrosion prevention treatment.

Underbody protection repairs

Whenever body repairs have been carried out, ensure that full sealing and corrosion protection treatments are reinstated. This applies both to the damaged areas and also to areas where protection has been indirectly impaired, as a result either of accident damage or repair operations.

Remove corrosion protection from the damaged areas before straightening or panel beating. This applies in particular to panels coated with wax, PVC underbody sealer, sound deadening pads etc.



CAUTION: Do not use oxy-acetylene to remove corrosion prevention material. Large volumes of fumes and gases are liberated by these materials when they burn.

The most common method of removal is by means of a hot air blower with an integral scraper. High temperatures can be generated with this equipment which may cause fumes. Take care during its use.

Structural Adhesive

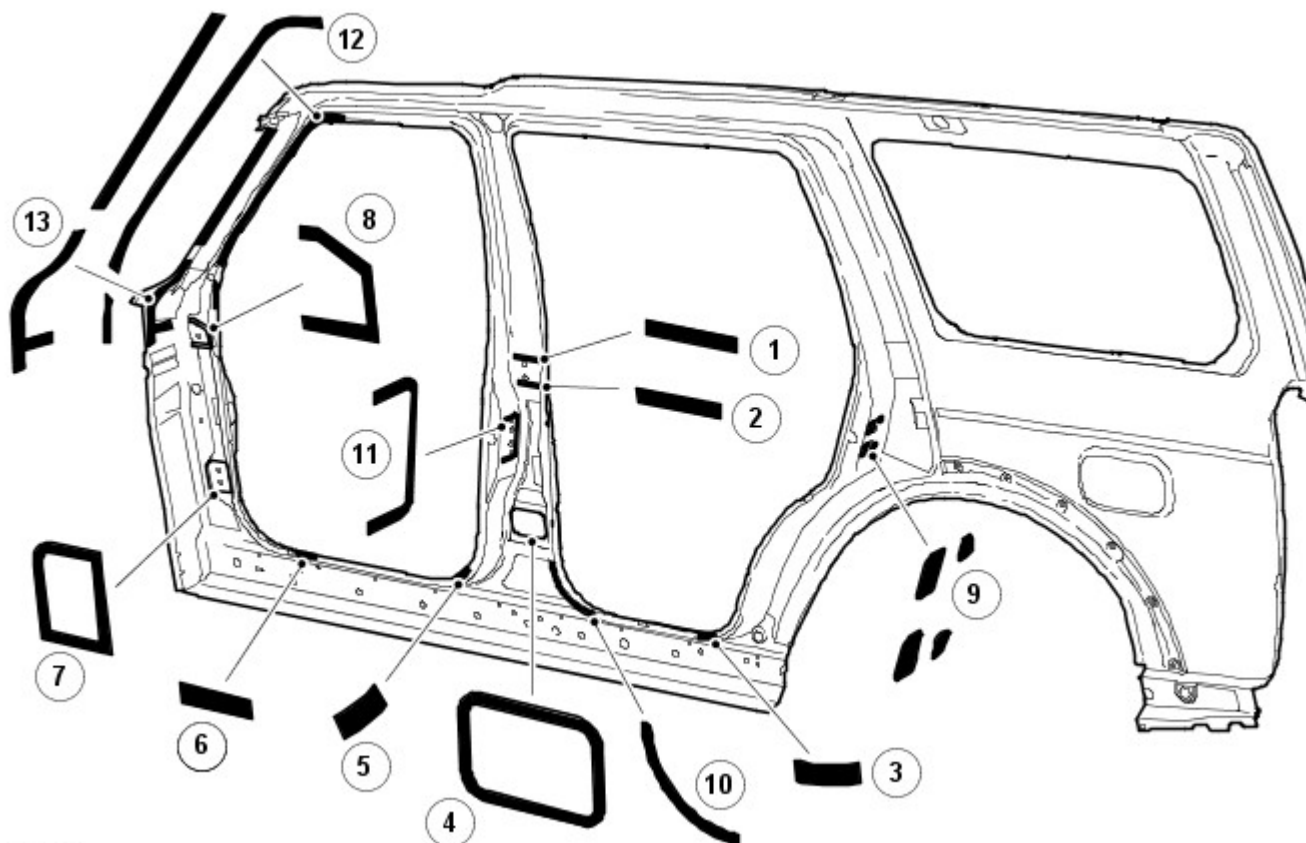
Metal to metal adhesive is applied to critical joint areas during factory assembly. The material used is a high temperature, heat cured, nitrile phenolic which serves to bond two metal surfaces and also to seal the joint against ingress of dust, moisture and fumes. This material is not suitable for service use and, during repair, should be substituted by an approved structural adhesive.



CAUTION: When separating a joint with metal to metal adhesive, it is important to avoid distortion. Heat gradually until the bond weakens sufficiently to permit panel separation.

- **NOTE:** When spot welding through metal to metal adhesive, take particular care to adjust the equipment setting to ensure a suitable weld.

Areas of structural adhesive



E56119

Item	Application	Function
1	B-pillar upper hinge RH/LH	Structural
2	B-pillar upper hinge RH/LH	Structural
3	Rear rocker panel RH/LH	Structural
4	B-pillar lower hinge RH/LH	Structural
5	Front rocker panel RH/LH	Structural
6	Front rocker panel RH/LH	Structural
7	A-pillar lower hinge RH/LH	Structural
8	A-pillar upper hinge RH/LH	Structural
9	C-pillar striker reinforcement	Structural
10	B pillar rear door aperture	Structural
11	B-pillar latch face	Structural
12	A-pillar to front door aperture	Structural
13	A-pillar to W/shield aperture	Structural

Joints symmetrically opposite to those shown are also treated. Apply 3mm diameter beads to all joints shown. Leave rocker drain points free of adhesive.

Expanding Foam Acoustic Seals

Expanding foam acoustic seals are used in various closed-sections of the body to improve vehicle refinement. The seals are installed during the vehicle body manufacture and expand during the paint process up to ten times original size, thus locking them into position. They are located such that they prevent noise accentuation along a section and reflect air borne noise away from the cabin.

The seals have split functionality depending on location. The seals located at the base of the body pillars have a primary function of preventing water ingress when wading. Their secondary function is to prevent noise and dust ingress.

The seal around the fuel filler has a primary function of preventing both fuel and water ingress. With a secondary function of preventing noise and dust ingress.

The remaining seals primary function is to prevent noise accentuation along a section and reflect air borne noise away from the cabin.

Another advantage of the seals is that they marginally increase the overall stiffness of the body and its structural performance in case of a crash.

The seals are manufactured from an expandible polymer, 'Sika Baffle 250.'

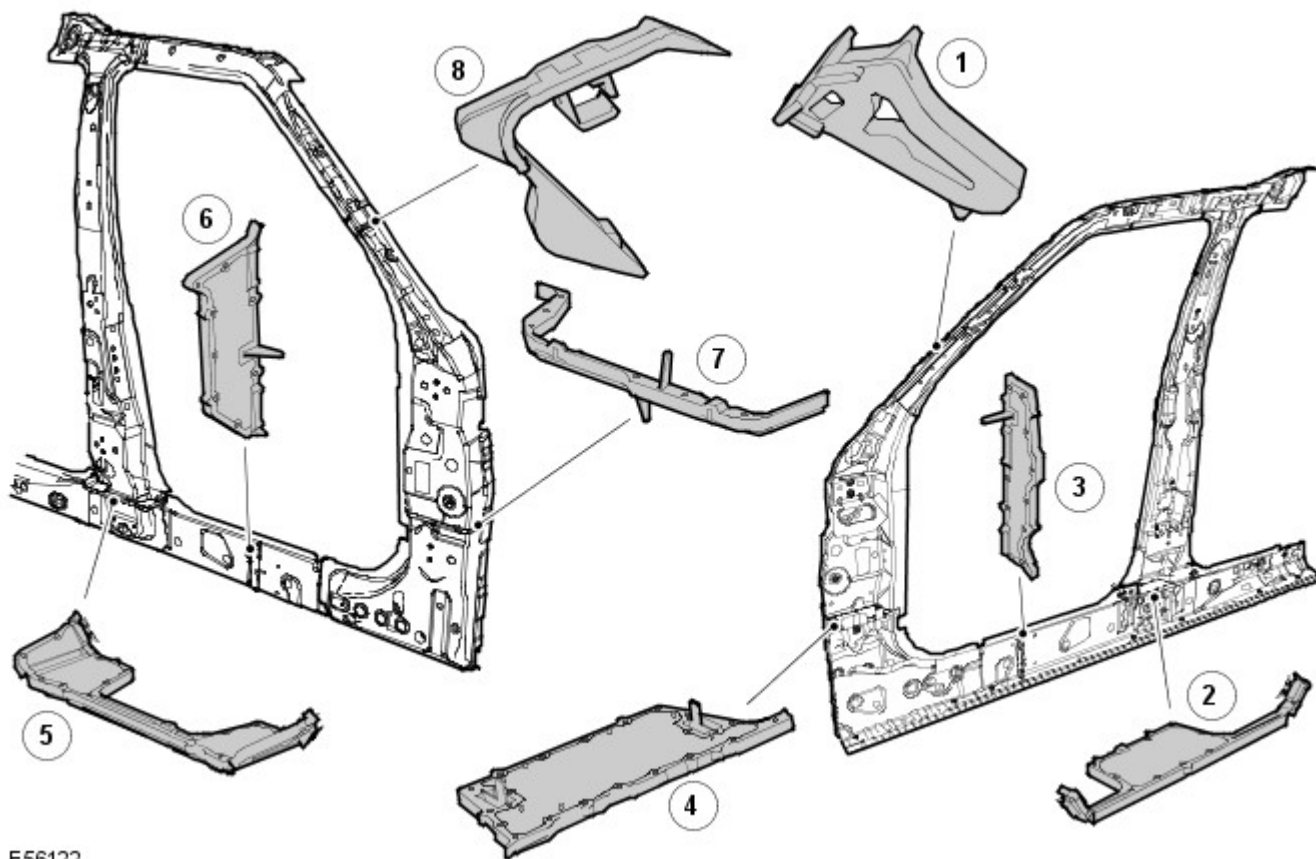
Replacing Foam Acoustic Seals

As paint oven temperatures used in a repair workshop are significantly lower than those that are used during manufacture of the vehicle, a different process is required to replace the seals.

After a repair that involves replacement of a section containing expanding foam acoustic seals, the new expanding foam acoustic seal is installed to the new section and injected with an approved acoustic foam. The acoustic foam should be injected after paint refinishing, where possible. When injecting the foam, ensure the foam fills a complete cross section of

the cavity and around the expanding foam acoustic seal.

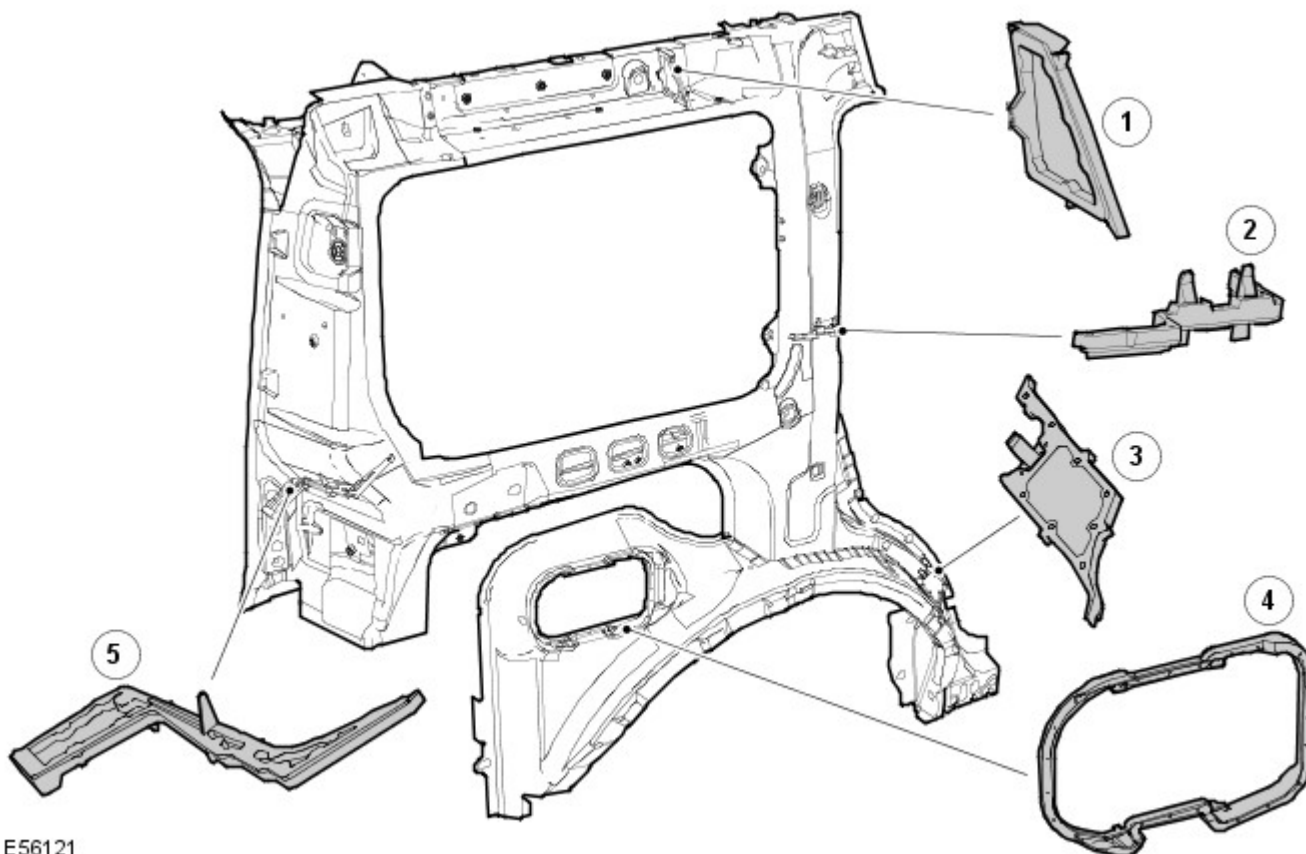
Position of acoustic seals, front reinforcement



E56122

Item	Description	Function	Service part No
1	A-pillar upper inner	Acoustic	EUH000520
2	B-pillar lower inner	Water Ingress/Acoustic	EUH000560
3	Rocker panel middle	Acoustic	EUH000670
4	A-pillar lower inner	Water Ingress/Acoustic	EUH000550
5	B-pillar lower outer	Water Ingress/Acoustic	EUH000570
6	Rocker panel outer	Acoustic	EUH000680
7	A-pillar lower inner	Water Ingress/Acoustic	EUH000540
8	A-pillar upper outer	Acoustic	EUH000530

Position of acoustic seals, rear quarter panel



E56121

Item	Description	Function	Service part No
1	Cantrail rear	Acoustic	EUH000650
2	C-pillar outer	Acoustic	EUH000610
3	Rear wheel arch outer	Water Ingress/Acoustic	EUH000590
4	Fuel filler aperture	Water/Fuel Ingress	ARY 780030
5	D-pillar outer	Acoustic	EUH000630

Seam Sealer

A heat cured, PVC based sealant is applied to specific joint seams during factory assembly. This material is not suitable for service use and during repair, should be substituted by an approved seam sealer.

Apply seam sealers after the application of primer and before the application of top coat. The sealer must form a continuous bead, with the profile of the bead dependent on the type of seam. If the seam sealer is applied with a brush take particular care to maintain the required coverage of the seam.

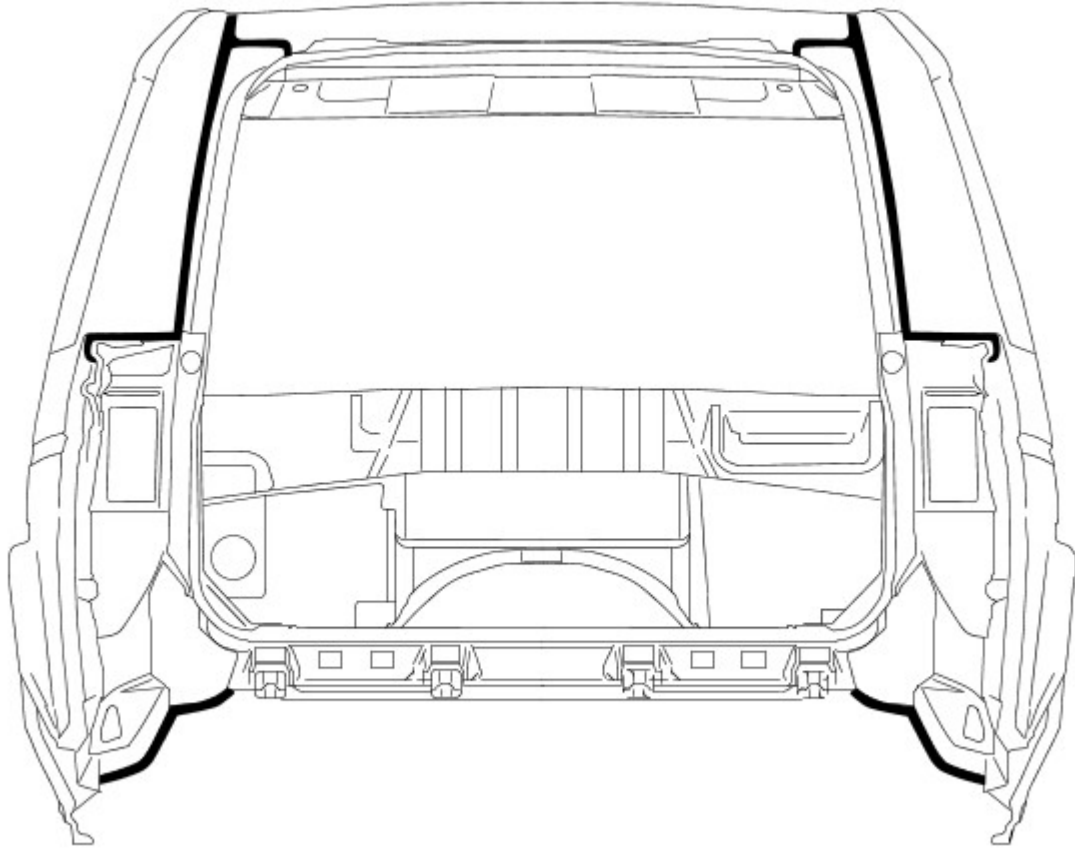
Ensure that all accessible repair seams are sealed following a repair. Damaged to a vehicle often flexes areas of the body remote from the impact. As a result the seam sealer in these areas may be disturbed by subsequent straightening and repair operations. Check all seams in the vicinity of the area undergoing repair for evidence of cracked seam sealer, then clean out as required and apply fresh seam sealer using the following procedure:

- Clean the affected seam and re-treat any exposed metal areas with a suitable etch phosphate primer.
- Treat affected area with an etch-acid primer.
- Apply appropriate seam sealer as necessary.
- apply appropriate colour coat (and under body sealer as applicable).

Where seams are inaccessible following the reassembly or fitting of components, ensure that a paste-type seam sealer is applied to such seams. Certain seams also become inaccessible after the completion of panel repairs. In such instances apply seam sealer and paint before final assembly

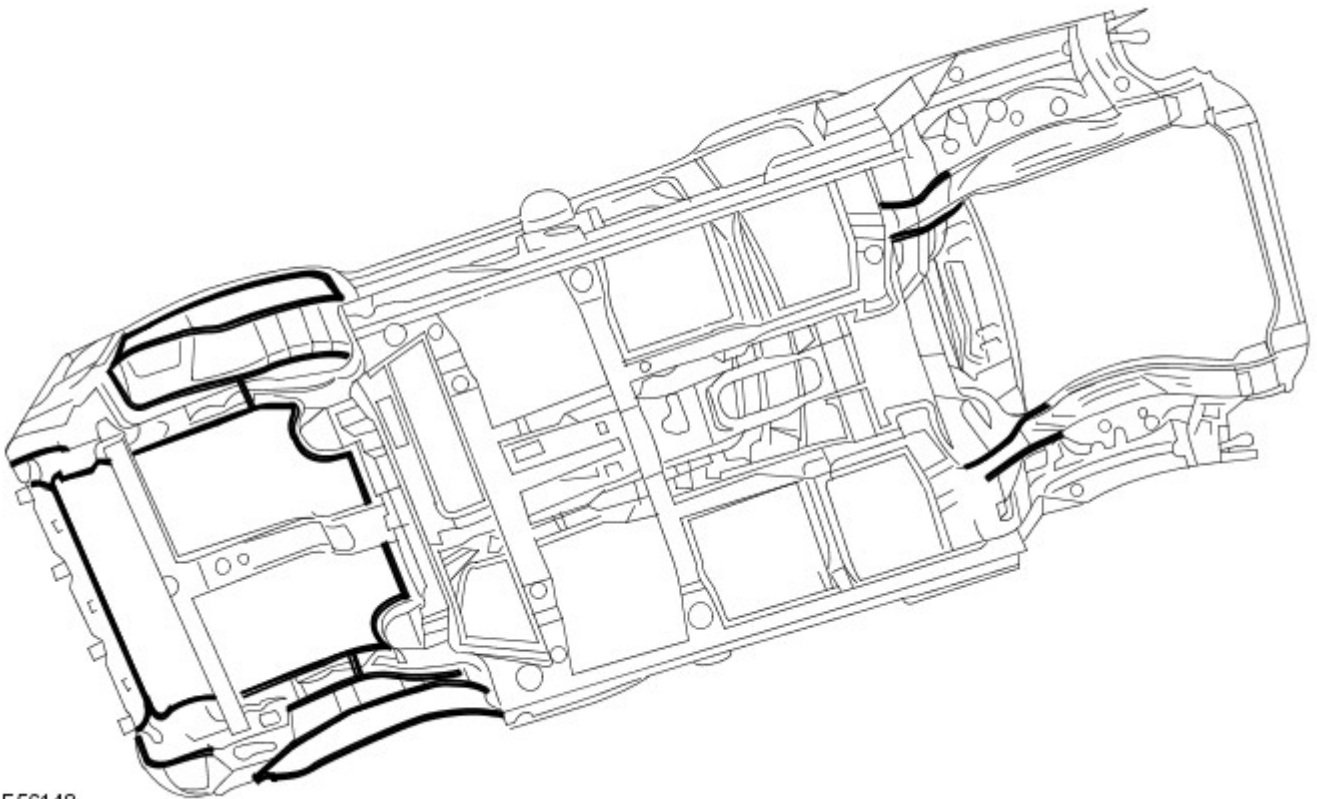
Provided access is adequate, apply seam sealer to both sides of a repair joint. Where access is limited to one side only (eg box section), treat the affected box member with cavity wax

Seam sealer on the rear end



E56146

Underbody seam sealer



E56148

Cavity Wax

After repairs, always re-treat these areas with an approved cavity wax. In addition, treat all interior surfaces which have been disturbed during repairs whether they have been treated in production or not. This includes all Box members, cavities and door interiors.

Before wax injection, ensure that the cavity to be treated is free from any contamination or foreign matter. Where

necessary, clear out any debris.

Ensure that cavity wax is applied after the final paint process and before refitting any trim components.

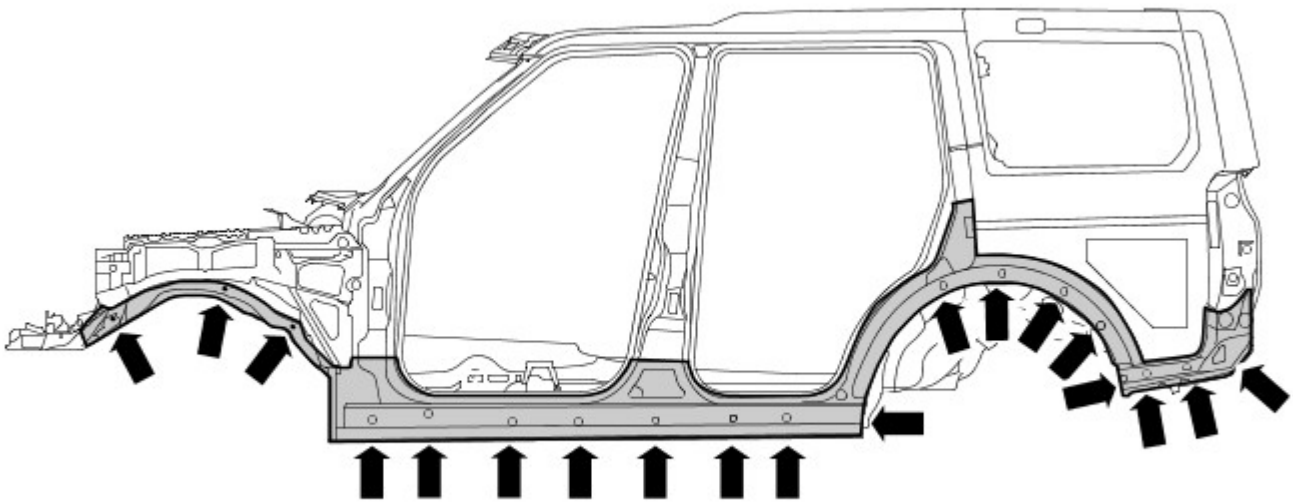
During application ensure that the wax covers all flanges and seam areas and that it is adequately applied to all repaired areas of both new and existing panels.

It should be noted that new panel assemblies and complete body shells are supplied without wax injection treatment. Ensure that such treatment is carried out after repairs.

Effective cavity wax protection is vital. Always observe the following points:

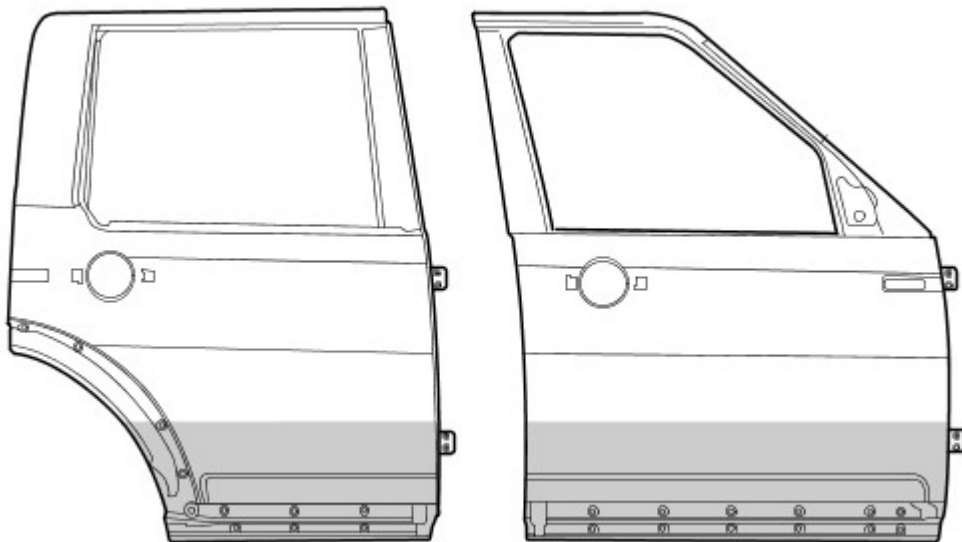
- Complete all paint refinish operations before wax application.
- Check the spray pattern of injection equipment.
- Mask all areas not to be waxed
- Remove body fixings, such as seat belt retractors, if contamination is at all likely.
- Move door glasses to fully closed position before treating door interiors.
- Treat body areas normally covered by trim before refitting items.
- Check that body and door drain holes are clear after the protective wax has dried.
- Keep all equipment clean, especially wax injection nozzles

Wax injection areas, body



E56192

Wax injection areas, doors



E56251

Body Repairs - Water Leaks - Water Leaks

Description and Operation

General

- If water leaks occur after bodywork repairs, the cause can be established using the checks described below. A systematic and logical procedure is required to locate water leaks. Before beginning extensive checks, a thorough visual inspection must be carried out.
- Visual Inspection
 - The following characteristics may indicate existing leaks:
 - Check the clearance and accurate fit of ancillary components such as the hood, tailgate, liftgate, doors, and so on.
 - Check for correct fit and possible damage to sealing elements such as blanking plugs, rubber door seals, and so on.
 - Check water drain holes for unhindered flow.
- Various tests can be used to provide further information on possible leaks:
 - Water test
 - Washer test
 - Road test
 - Chalk (powder) test

Practical execution of tests and checks

Water test

- **NOTE: Never aim a jet of water directly at a rubber seal.**
- Carry out the water test with a second person present (passenger compartment).
- Use variable washer nozzles (concentrated water jet to fine spray mist).
- Start in the lower section and spray the whole area, working upwards in stages.

Washer test

- Further tests can be carried out in the washer system.
- Some leaks originate here, or only occur here.
- The relevant passenger compartment should be checked using a torch during the wash procedure.

Road test

- If no leaks are located during the tests above, road tests should be carried out on wet roads.
- Road tests under various conditions:
 - At various speeds.
 - On various road surfaces (asphalt to cobbles).
 - With loaded or unloaded vehicle.
 - Driving through puddles (splash water).

Chalk test (powder test)

- In this test, the clamping load and the bearing surface of the seal are checked.
- Performing the test:
 - Dust the door seal with powder or coat with chalk.
 - Coat the bearing surface of the seal with a thin film of grease.
 - Slowly close the door and open it again.
 - Check the width and continuity of the imprint on the door seal.

Other test equipment

- Other equipment such as stethoscopes, UV lamps, special mirrors or ultrasound measuring instruments can be used to locate leaks.

Rectifying the leak using recommended tools, auxiliary equipment and materials

- Tools and auxiliary equipment:
 - Dry, absorbent cloths
 - Variable washer nozzle
 - Torch, fluorescent tube
 - Mirror
 - Compressed air
 - Seal lip installer
 - Wet/dry vacuum cleaner
 - Sealing compound compressor
 - Remover for interior trim
 - Cutter blade or pocket knife
 - Wedge (wood or plastic)
 - Hot air blower
 - Special mirror for concealed leaks
 - Air flow checker
- - Sealing compound (tape and plastic compound)
 - Multi-purpose sticker
 - Clinched flange sealer
 - Window sealing compound
 - Water shield (PVC)
 - Double-sided adhesive tape for water shield

- Methylated spirit (available from trade outlets)
- PU adhesive
- Silicone remover
- Tar remover

Water leaks according to mileage or running time

Increasing mileage has an effect on the problem of leaks in a vehicle. Possible influencing factors are:

- Servicing and maintenance of seals:
 - No maintenance, lack of maintenance or incorrect maintenance
 - Using an incorrect agent
- Damaged seals:
 - As a result of aging, wear or incorrect handling/assembly.
- Heavy soiling of the vehicle:
 - Heavy soiling of a vehicle can seriously impair the function of water drainage channels in particular, and also of rubber seals.
- Age-related factors:
 - Environmental factors
 - UV radiation
 - Extreme climatic conditions
- Corrosion can have a serious impact on bodywork, in particular as a result of:
 - Lightly or heavily rusted seal carriers
 - Rusted body seal welds
 - Perforation corrosion

Water leaks after body repairs

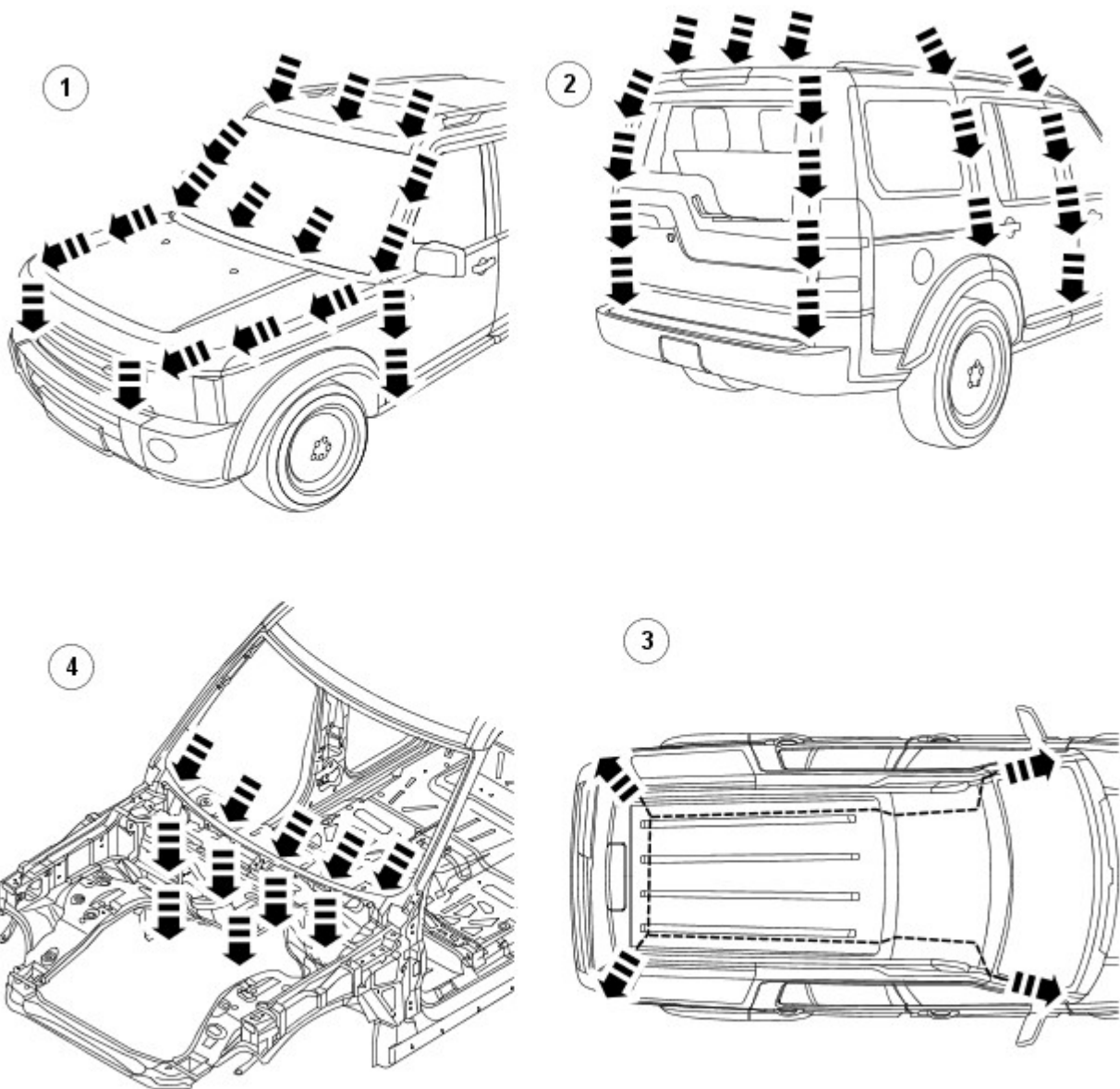
If a vehicle develops a leak after body repairs, the following points must be taken into consideration in particular:

- The correct seating of ancillary components and their seals must be checked.
- The correct alignment of doors/tailgate and liftgate must be checked. The associated seals must not be damaged and must be installed correctly.
- Check that welded seams are correctly sealed.
- The correct seating of rubber grommets must be checked.
- Directly-glazed windows must have correct and complete bonding.

Water drainage system

If a vehicle develops water leaks, then areas into which water is routed or drained should be checked first.

Water drainage system



E56126

Item	Part Number	Description
1	-	Water drainage, front
2	-	Water drainage, side and rear
3	-	Roof drainage
4	-	Engine compartment drainage

Water leaks, diagnosis and corrective action: Front passenger compartment

Windscreen

- Diagnosis:
 - Ingress of water into A-pillar area or instrument cluster area and rocker panel area.
- Cause:
 - Breaks in adhesive beads
- Corrective action:
 - The breaks in adhesive beads can be located from inside by using compressed air. The leak can be identified from outside by the escaping air.
 - The second test method is by means of a water test. The outer trims must be raised carefully using a plastic wedge. The leak should be located from inside by a second assistant.

Side windows

In the case of side windows, the same problems can arise as for a windscreen. The same corrective actions must therefore be used.

Door seal

- Diagnosis:
 - Water ingress in the lower part of the interior door trim or in the rocker panel area.

- Cause:
 - The water shield fitted behind the interior door trim exists to drain off water that has entered the door via the drainage holes, either downwards or outwards. If the water shield seal is damaged or has been fitted incorrectly, then water can get into the passenger compartment.
 - In addition to this, the drainage holes can become clogged with leaves, dirt or excess cavity protection agents. Water gathers in the door and ingresses into the passenger compartment.
 - Check water shield for damage or correct fitting.
 - If the water shield needs to be re-bonded, then approved seam sealer should be used.
 - Before the water shield is installed, the drainage holes must be checked for unhindered flow.

Door seals

- Diagnosis:
 - Ingress of water into the rocker panel area
- Cause:
 - Insufficient clamping load between seal and door.
- Corrective action:
 - Check clamping load:
 - The easiest way to check the clamping load of a seal to the respective bearing surface is by means of a paper strip test. This consists of trapping strips of paper at various points between the door and the seal, and fully closing the door. If it is possible to pull out the paper with no great resistance, then the clamping load is too low.
 - Adjust the clamping load:
 -
 - NOTE: When adjusting the clamping load, the profile alignment of the relevant components must always be taken into consideration.

The clamping load is normally adjusted using the striker. When doing so, the edge alignment from the door to the side panel, or from the front door to the rear door must be taken into account.

- Another setting method is to realign the panel flange for the seal mounting. The clamping load is increased by moving the flange towards the door.

-

• NOTE: Do not realign the flange too far in the direction of the door, as this can reduce the bearing surface of the seal to the door.

Check the bearing surface:

- Apply chalk evenly to the surface of the seal. Evenly coat the bearing surface of the door with vaseline.
- Close the door fully, the lock must engage. Open the door. The imprint of the chalk (bearing surface) can be identified in the film of grease.
- The bearing surface should be at least 5mm across at all points.

- Other causes:
 - The door seal must completely seal the door where it meets the bodywork.
 - Water can ingress directly or indirectly into the interior of the vehicle if the seal is damaged at any point.
- Corrective action:
 - A damaged or worn door seal must always be renewed in full.
 - When renewing the seal, the following must be taken into account:
 - Always fit the seal first in the area of the narrow radii (corner points).
 - Next, secure the seal to the flange evenly by tapping lightly with a rubber hammer. The installed seal must not be kinked at any point.

• NOTE: The prescribed length of a seal must not be shortened.

- Other cause:
 - The door seal is attached to the welded flange all the way round. If this welded flange is uneven or damaged at any point (usually in areas with narrow radii) then this point could be subject to leaks.
 - A stretched seal carrier can also cause a leak.
 - In both cases, water gets into the vehicle interior under the seal carrier.
- Corrective action:
 - Align the deformed welded flange using a hammer and anvil block, prevent and if necessary repair any paint damage.
- Other cause:
 - The door seal is attached to the welded flange all the way round. If this welded flange is uneven or damaged at any point (usually in areas with narrow radii) then this point could be subject to leaks.
 - A stretched seal carrier can also cause a leak.
 - In both cases, water gets into the vehicle interior under the seal carrier.

Sliding roof/tilting roof

- Diagnosis:
 - Ingress of water at sliding roof aperture
- Cause:
 - The sliding roof/tilting roof is installed in a water trap. The water drains off via the water trap, water drain holes and drain hoses. The drain hoses lead downwards on both sides via the A-pillar and C-pillar.
 - The drain holes or drain hoses can become clogged with leaves, dirt, underbody protection and so on.
- Corrective action:
 -
 - NOTE: In the case of a sliding or tilting roof, the external rubber seal and the lock actuator or latch mechanism must be checked first of all.

Check the water trap for leaks.

- Check the drain hoses for leaks and for correct connection to the water trap.
- Check the drainage system for unhindered flow, and blow out with compressed air if necessary.
- Check the external seal and the correct adjustment of the sliding roof.

Tailgate and Liftgate

- Diagnosis:
 - Ingress of water into rear headlining area and luggage area.
- Cause:
 - The leak problems of the tailgate and liftgate correspond to those of the doors.
 - In addition to this, the area to be sealed is much bigger. The routing holes for cables and hoses must also be sealed.
 - The rubber grommets for the routing holes must be checked for damage and correct seating (fully unhooked).
 - The mounting points of the tailgate and liftgate hinges may leak.
- Corrective action:
 - Check the rubber grommets and renew if necessary.
 - Check the hinge mounting points, and re-seal with sealing compound if necessary.

Forced air extraction

- Diagnosis:
 - Ingress of water into side luggage compartment area
- Cause:
 - The forced air extraction for the vehicle interior is located in the D-pillar behind the rear lights.
 - The rubber flap of the forced air extraction must be able to move freely.
- Corrective action:
 - Remove the forced air extraction.
 - Check the seal area between the bodywork and housing, as well as the rubber flap.
 - Renew seal if necessary.

Rear window and moon roof

- Diagnosis:
 - Ingress of water into the luggage compartment area
- Cause:
 - Rear window and moon roof leaking.
 - Check for leak in the same way as for leaking windscreen.

Panel connections with seal welds

- Diagnosis:
 - Ingress of water into the luggage compartment area
- Cause:
 - Several panel connections must be fitted in production in the wheelhouse and luggage compartment areas. These connections are sealed with sealing compound.
 - Uneven application of sealing compound can lead to a break in a seal weld.
- Corrective action:
 - Expose the seal weld.
 - Locate the leak in the seal weld.
 - Re-seal using sealing compound.

Body Repairs - Vehicle Specific Information and Tolerance Checks - Body and Frame

Description and Operation

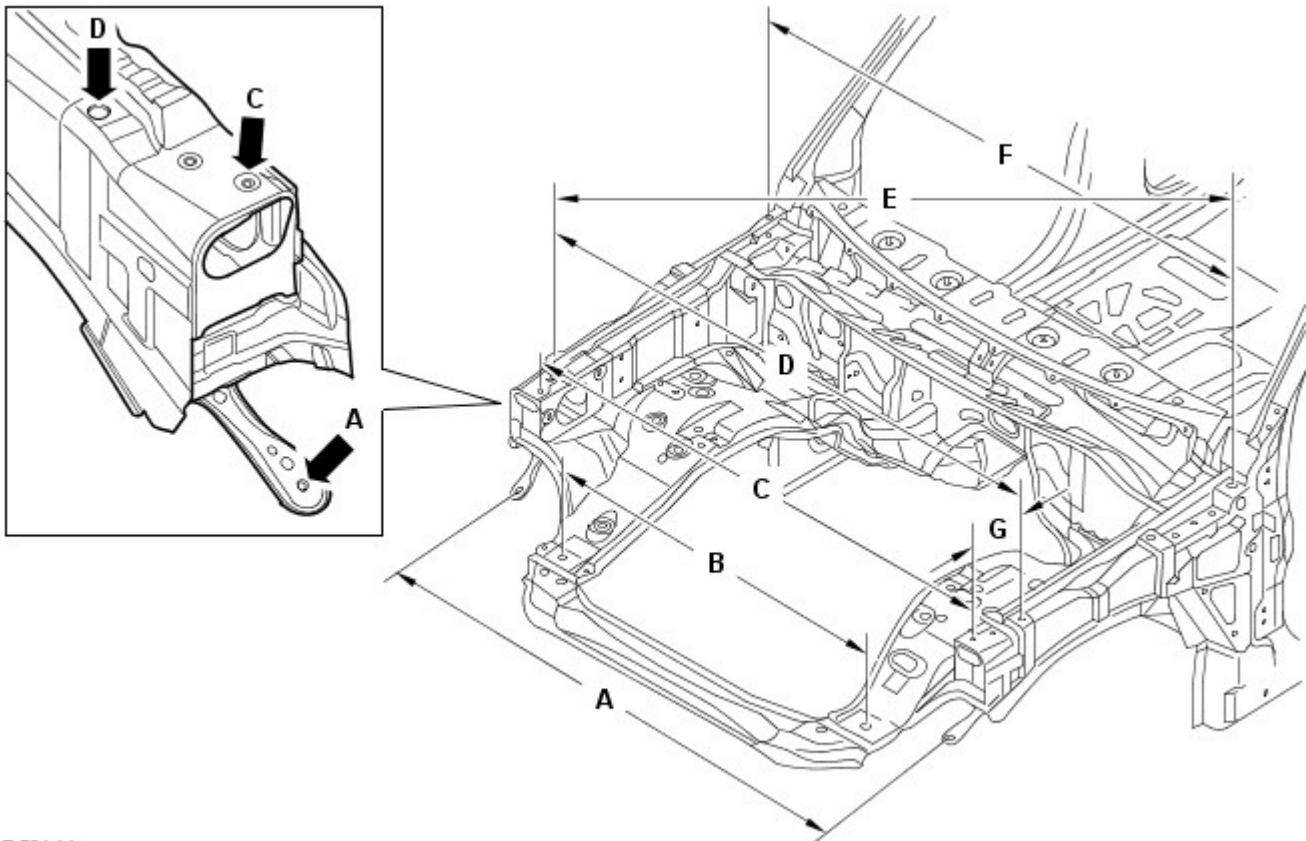
Body Repairs - Tolerance Checks

Measurements shown are in millimetres and inches. The measurements shown in brackets are in inches.

Point-to-Point Dimensional Information

Point-to-point measurements are actual distances between two points. These points can be holes or intersections points. Where holes are taken, the point of measurement is always from the hole centres.

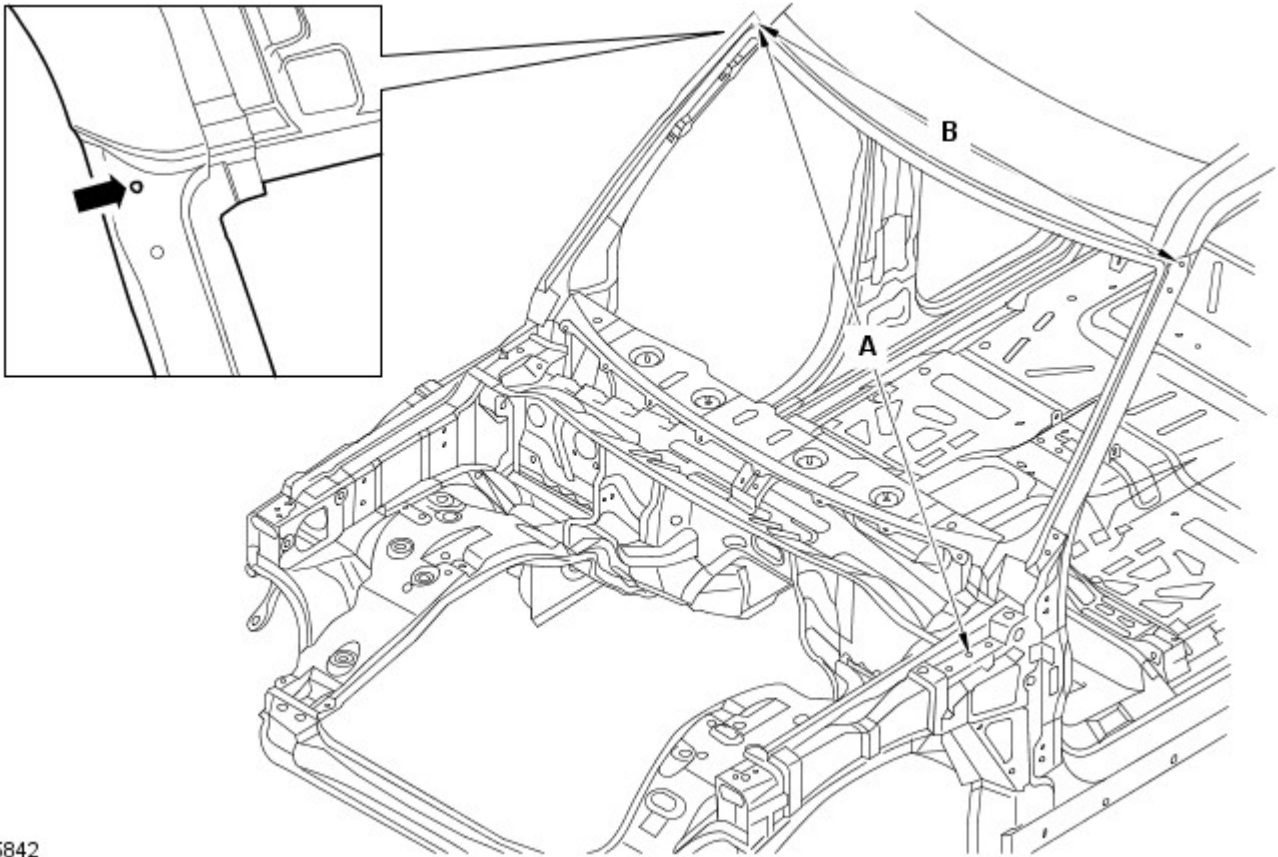
Front end dimensions



E 56144

Item	From	To	Length
A	Hood latch panel, lower LH outer fixing	Hood latch panel, lower RH outer fixing	1503.2 (59.18)
B	Hood latch panel, LH locator slot	Hood latch panel, RH locator slot	900 (35.43)
C	Hood latch panel, LH locator dowel	Hood latch panel, RH locator dowels	1540.4 (60.64)
D	Fender, front LH fixing	Fender, front RH fixing	1617.8 (63.69)
E	Fender, front RH fixing	Fender, rear LH fixing	1780.2 (70.08)
F	Fender, rear LH fixing	Fender, rear RH fixing	1620 (63.77)
G	Fender, front fixing	Hood latch panel, locator dowel	114.23 (4.49)

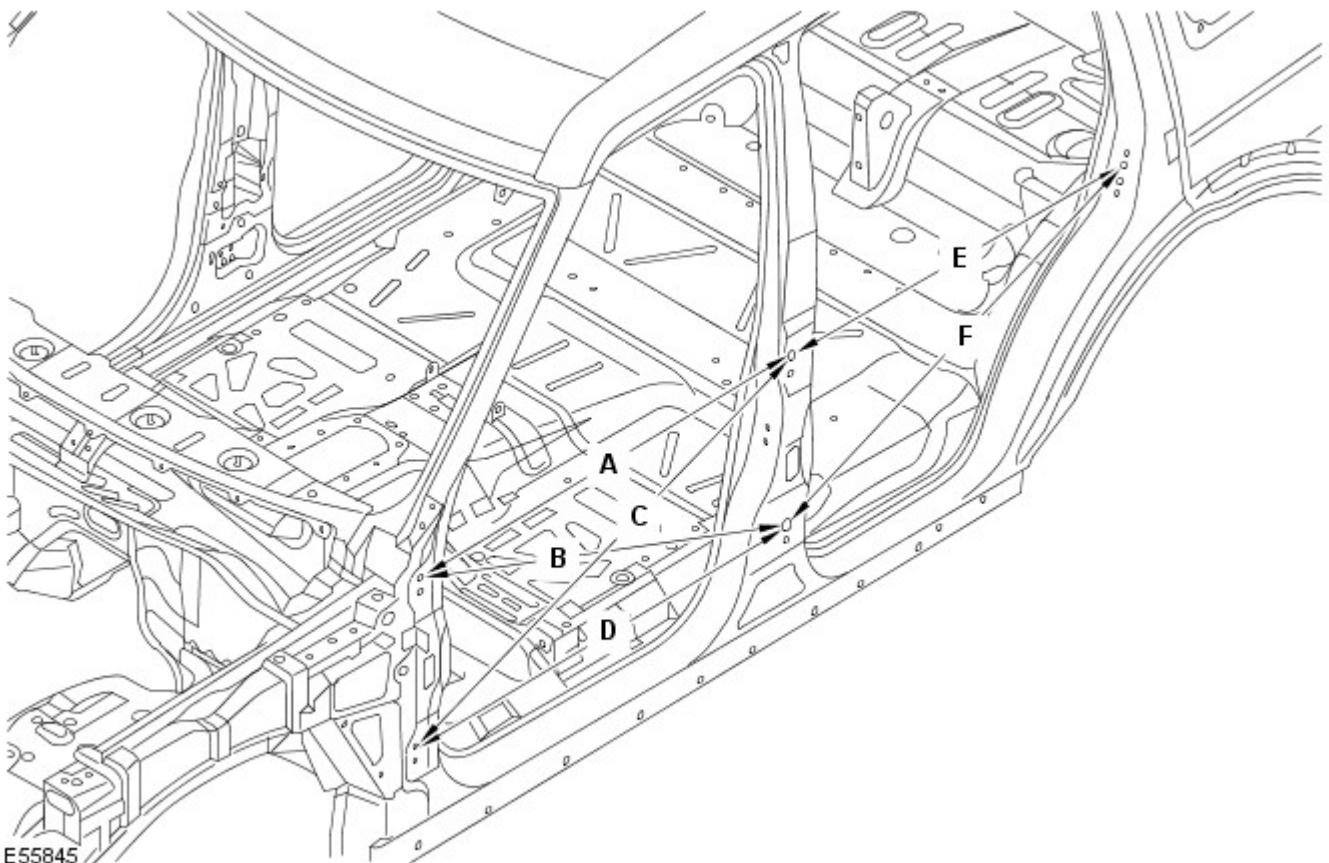
Front end dimensions



E55842

Item	From	To	Length
A	LH hood hinge, middle fixing hole	RH windshield side upper finisher, fixing hole	1827 (71.92)
B	LH windshield side upper finisher, fixing hole	RH windshield side upper finisher, fixing hole	1431.5 (56.35)

Side view dimensions

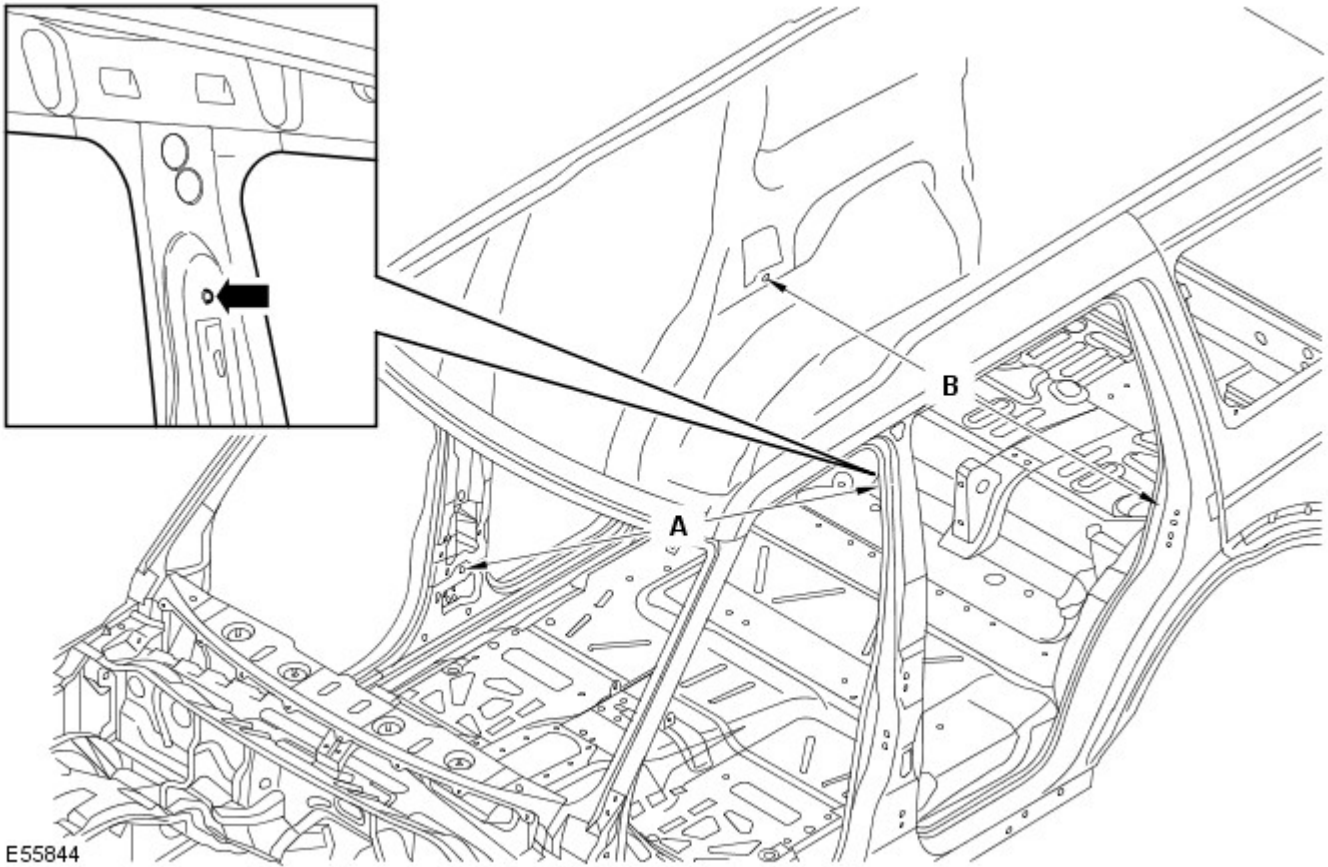


E55845

Item	From	To	Length
A	Front door top hinge, top fixing hole	Rear door top hinge, top fixing hole	1078.9 (42.47)
B	Front door top hinge, top fixing hole	Rear door bottom hinge, top fixing hole	1138.3 (44.81)
C	Front door bottom hinge, top fixing hole	Rear door top hinge, top fixing hole	1174.4 (46.23)

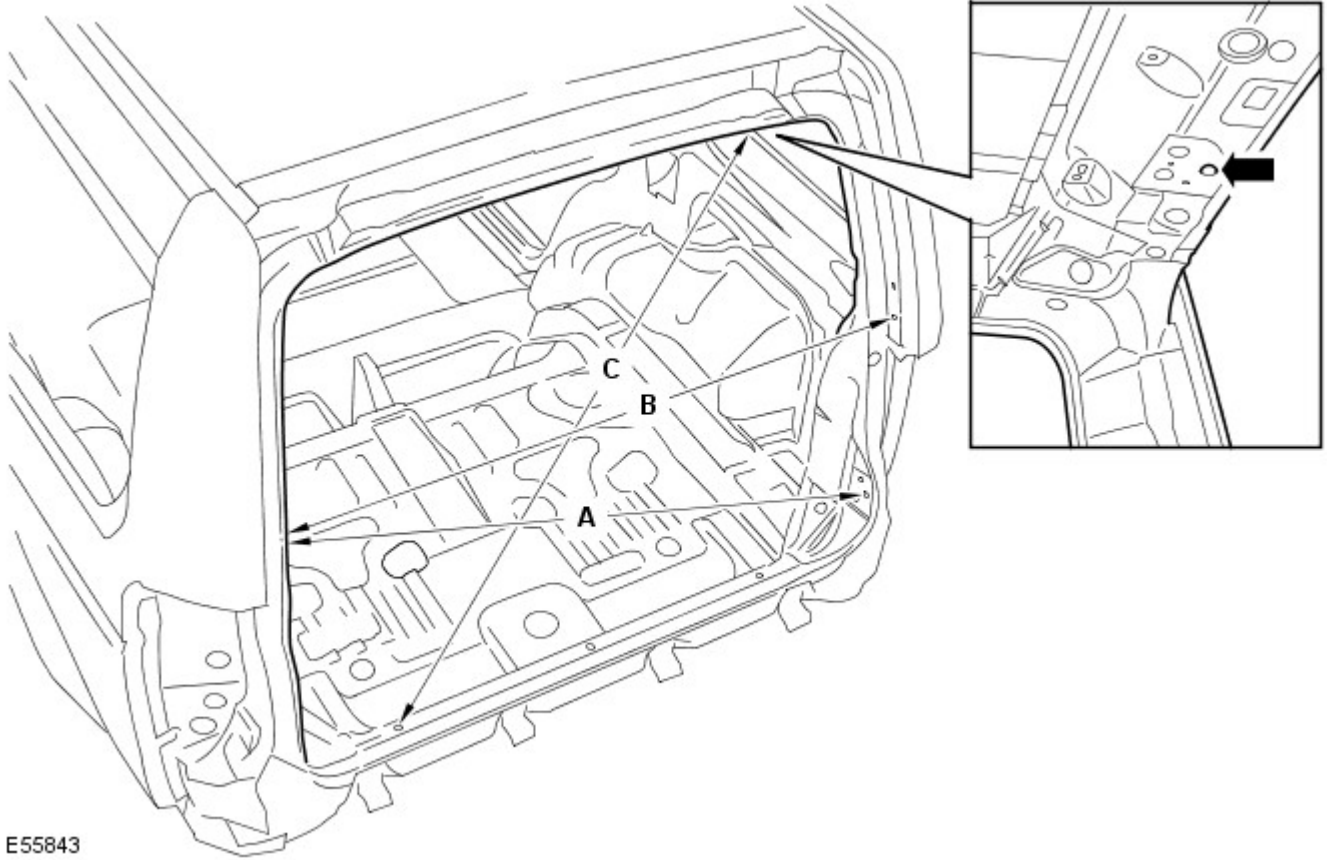
Item	From	To	Length
D	Front door bottom hinge, top fixing hole	Rear door bottom hinge, top fixing hole	1078.9 (42.47)
E	Rear door top hinge, top fixing hole	D pillar striker fixing hole	983.5 (38.72)
F	Rear door bottom hinge, top fixing hole	D pillar striker fixing hole	1069.9 (42.12)

Internal dimensions



Item	From	To	Length
A	LH safety belt anchorage, top fixing	RH safety belt retractor, lower fixing	1743.6 (68.64)
B	RH inner rear wheelarch, lower safety belt retractor fixing	LH inner rear wheelarch, lower safety belt retractor fixing	1518.2 (59.77)

Rear view dimensions

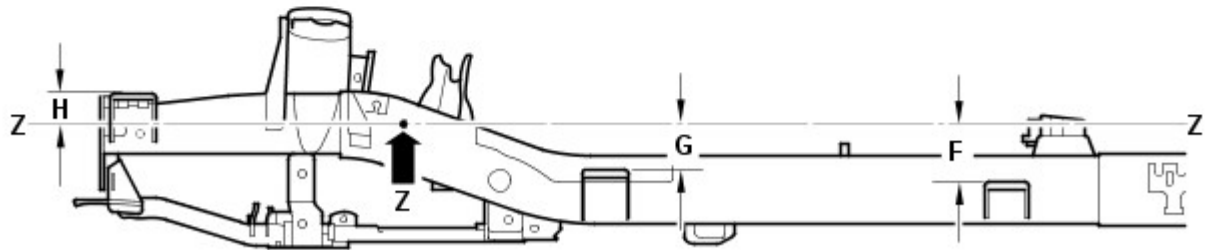
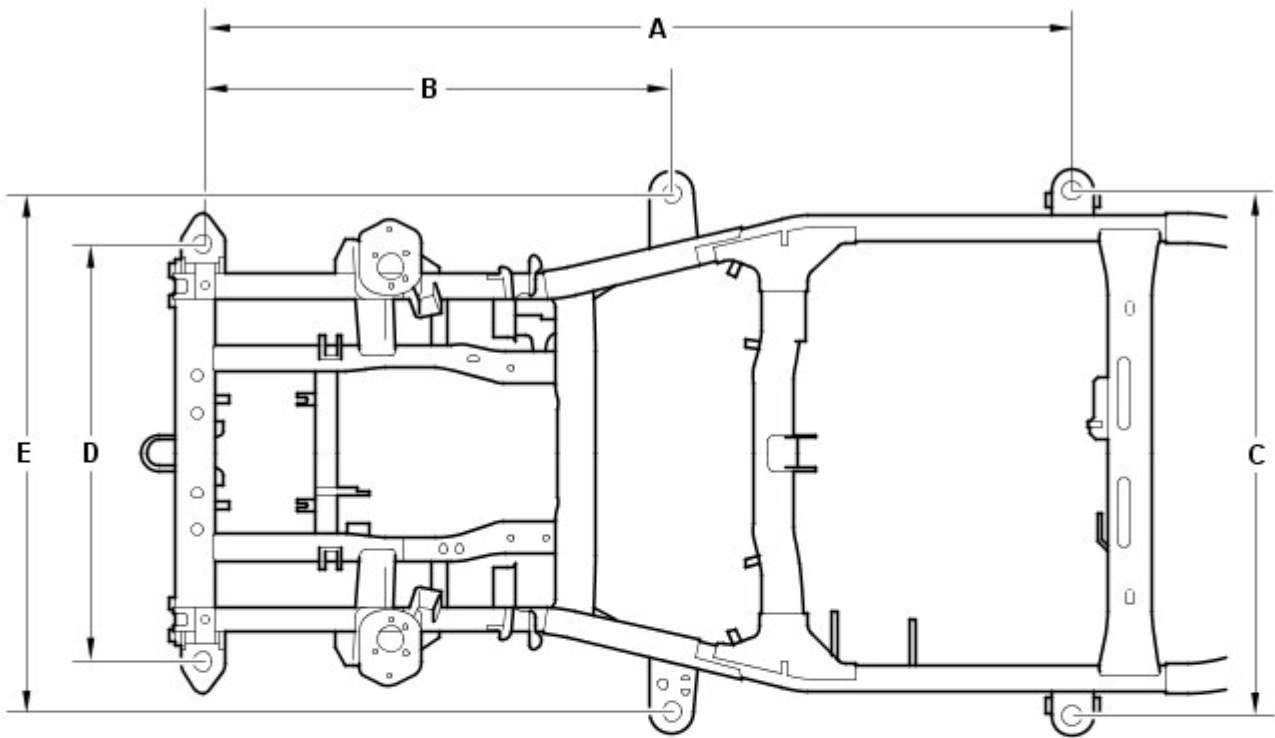


E55843

Item	From	To	Length
A	Liftgate, RH alignment fixing	Tailgate, LH striker fixing	1222.1 (48.11)
B	Liftgate, RH alignment fixing	Liftgate, LH alignment fixing	1186.6 (46.71)
C	Tailgate, LH hinge cover, fixing hole	Rear header, RH location hole	1184.3 (46.62)

Underbody Dimensional Information

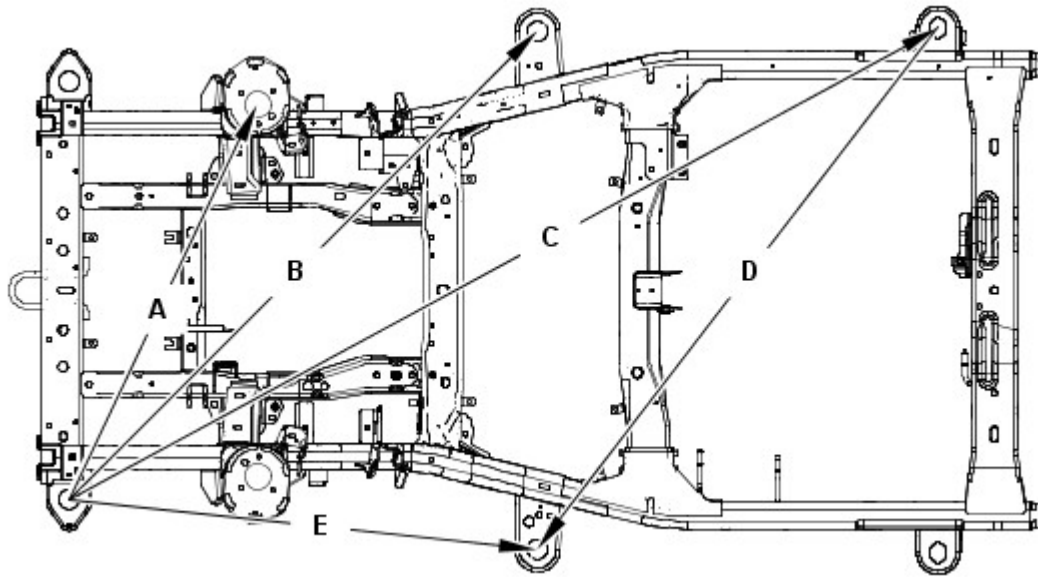
Front integral body frame dimensions



E55836

Item	From	To	Length
A	Body Mount 1 (front)	Body Mount 3	2113 (83.12)
B	Body Mount 1 (front)	Body Mount 2	1139 (44.84)
C	Body Mount 3 (LH)	Body Mount 3 (RH)	1275 (50.196)
D	Body Mount 1 (LH front)	Body Mount 1 (RH front)	1015 (39.96)
E	Body Mount 2 (LH)	Body Mount 2 (RH)	1258 (49.53)
F	Datum Line (Z)	Body Mount 3	136.5 (5.374)
G	Datum Line (Z)	Body Mount 2	105.5 (4.15)
H	Datum Line (Z)	Body Mount 1	78.8 (3.102)

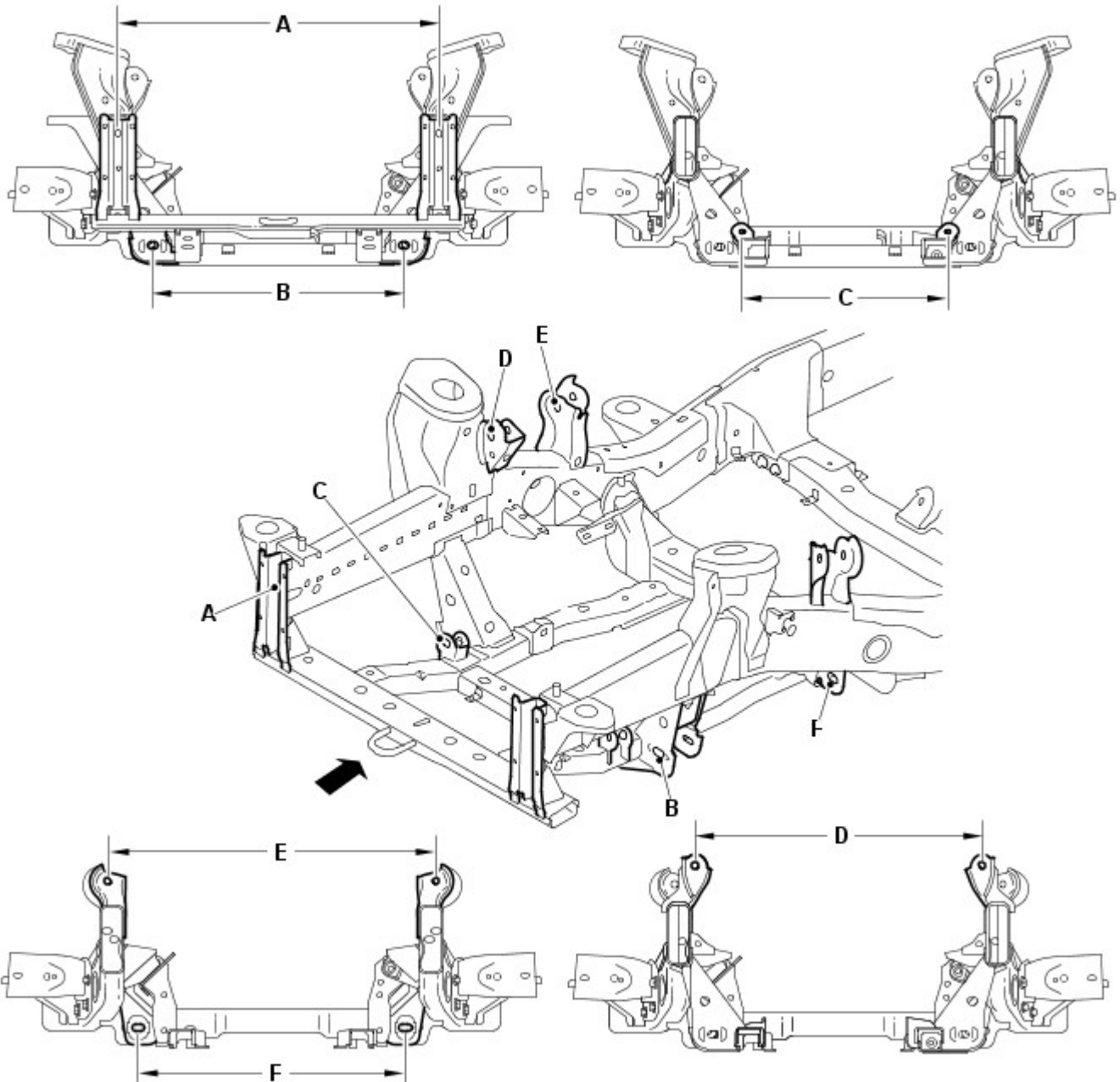
Front integral body frame dimensions



E55835

Item	From	To	Length
A	Body Mount 1 (LH front)	Damper Mounting (RH)	1063.1 (41.85)
B	Body Mount 1 (LH front)	Body Mount 2 (RH)	1609 (63.34)
C	Body Mount 1 (LH front)	Body Mount 3 (RH)	24.3.3 (94.61)
D	Body Mount 2 (LH front)	Body Mount 3 (RH)	1597.7 (62.90)
E	Body Mount 1 (LH front)	Body Mount 2 (LH)	1139 (44.84)

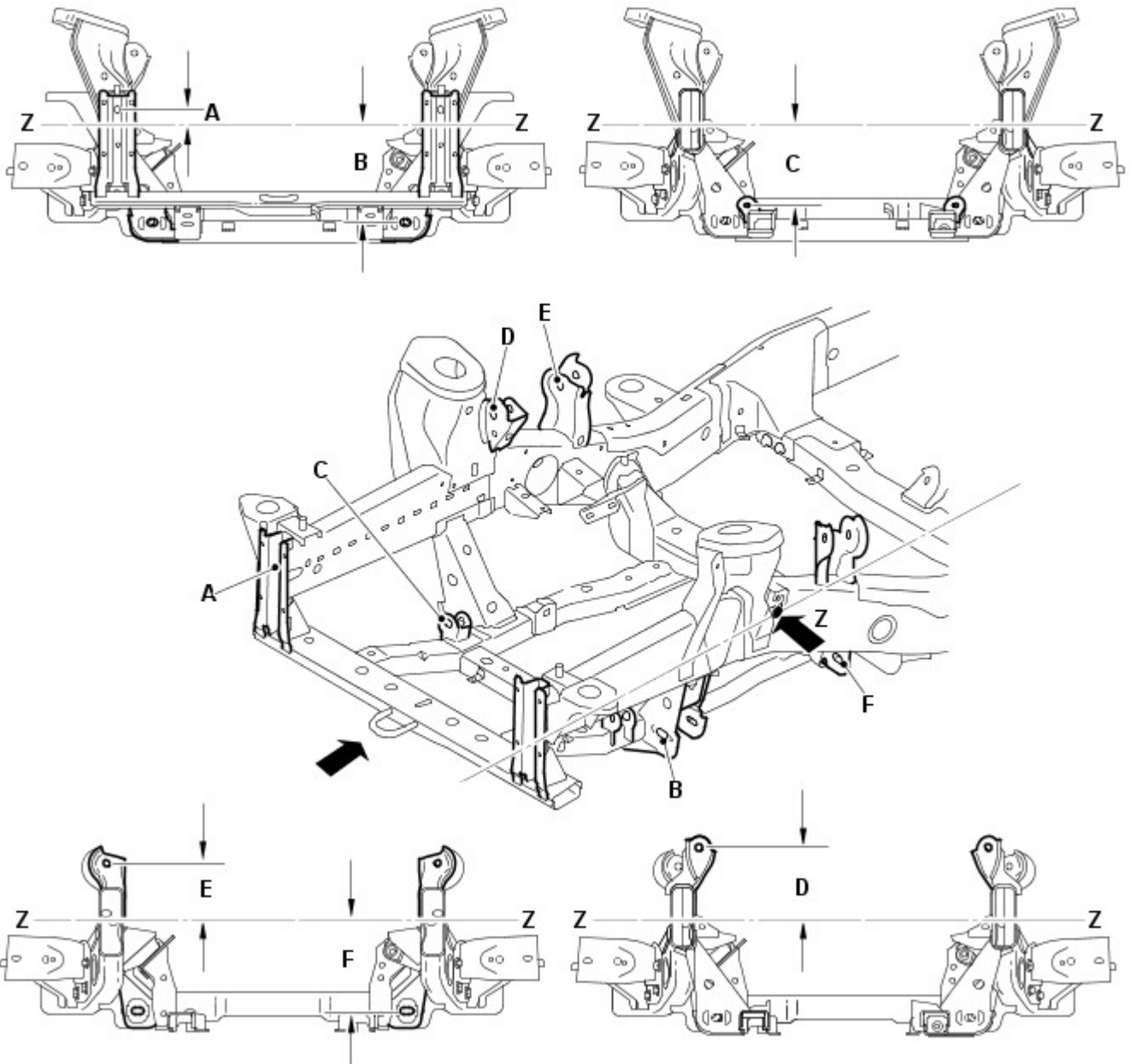
Front integral body frame dimensions



E57095

Item	From	To	Length
A	Front Bumper Mount (L/H)	Front Bumper Mount (R/H)	810 (31.8)
B	Lower Arm (L/H front)	Lower Arm (R/H front)	635.7 (25.02)
C	Steering Gear (L/H)	Steering Gear (R/H)	520 (20.4)
D	Upper Arm (L/H front)	Upper Arm R/H front)	748.7 (29.47)
E	Upper Arm (L/H rear)	Upper Arm (R/H rear)	836.8 (32.9)
F	Lower Arm ((L/H rear)	Lower Arm ((L/H rear)	678.6 (26.71)

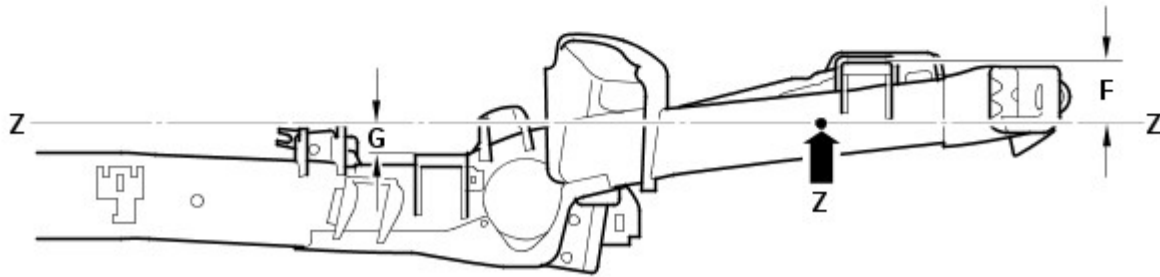
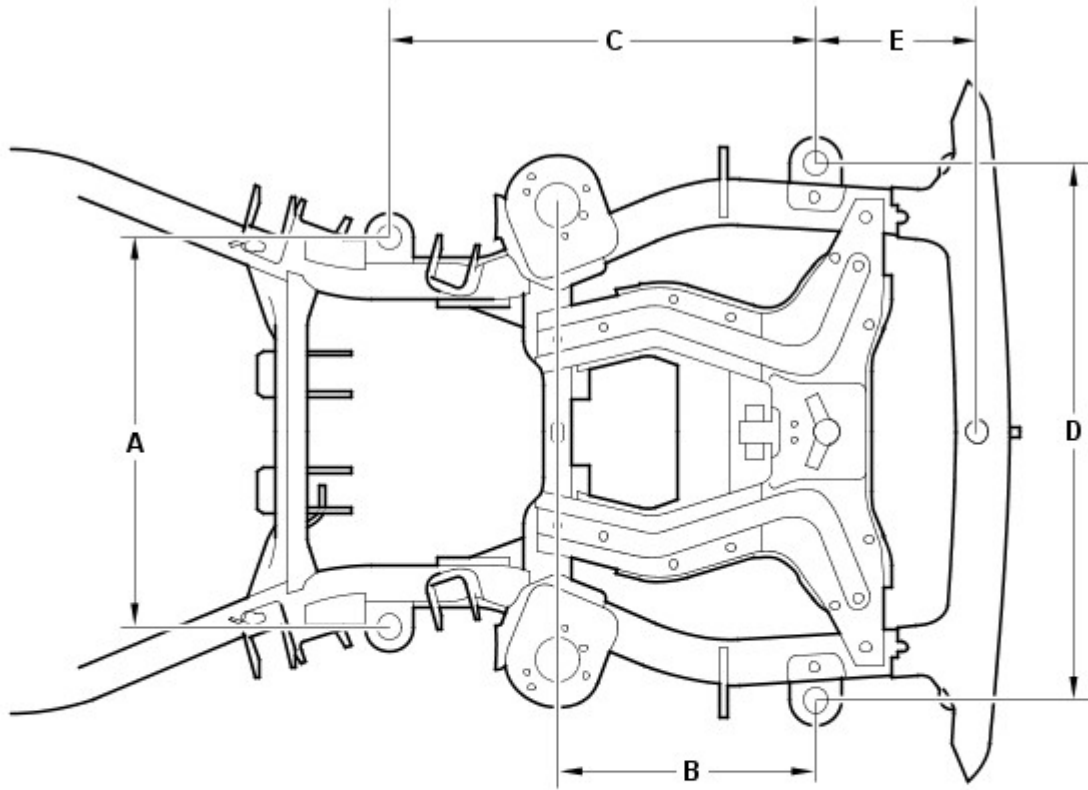
Front integral body frame dimensions



E57470

Item	From	To	Length
A	Datum Line (Z)	Front Bumper Mount	37.81 (1.488)
B	Datum Line (Z)	Lower Arm	249.22 (9.811)
C	Datum Line (Z)	Steering Gear	201.84 (7.946)
D	Datum Line (Z)	Upper Arm front	170.09 (6.696)
E	Datum Line (Z)	Upper Arm Rear	134.17 (5.282)
F	Datum Line (Z)	Lower Arm Rear	236.37 (5.282)

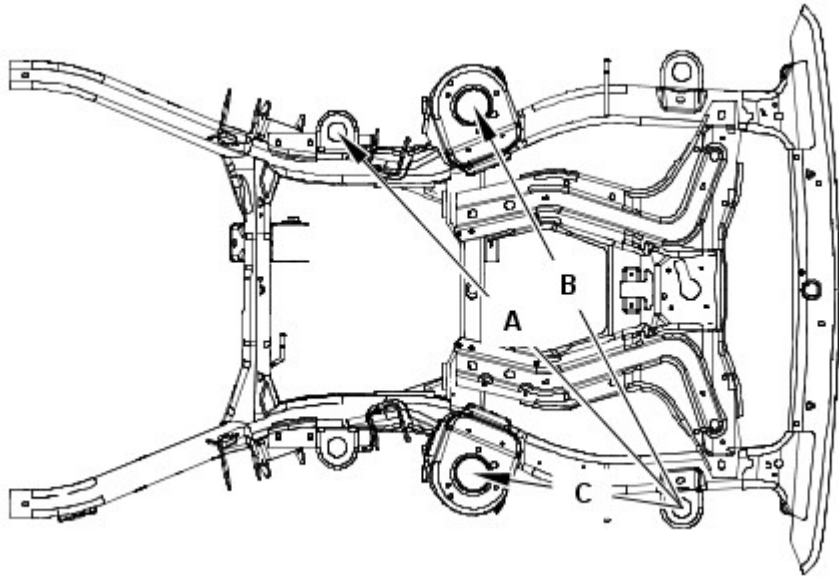
Rear integral body frame dimensions



E55834

Item	From	To	Length
A	Body Mount 4 (LH)	Body Mount 4 (RH)	806 (31.732)
B	Body Mount 5 (rear)	Damper Mounting	533.5 (21.00)
C	Body Mount 5 (rear)	Body Mount 4	882.8 (34.755)
D	Body Mount 5 (LH rear)	Body Mount 5 (RH rear)	1114 (43.858)
E	Body Mount 5 (rear)	Rear Crossmember	332 (13.07)
F	Datum Line (Z)	Body Mount 5 (rear)	127.5 (5.01)
G	Datum Line (Z)	Body Mount 4	61.2 (2.40)

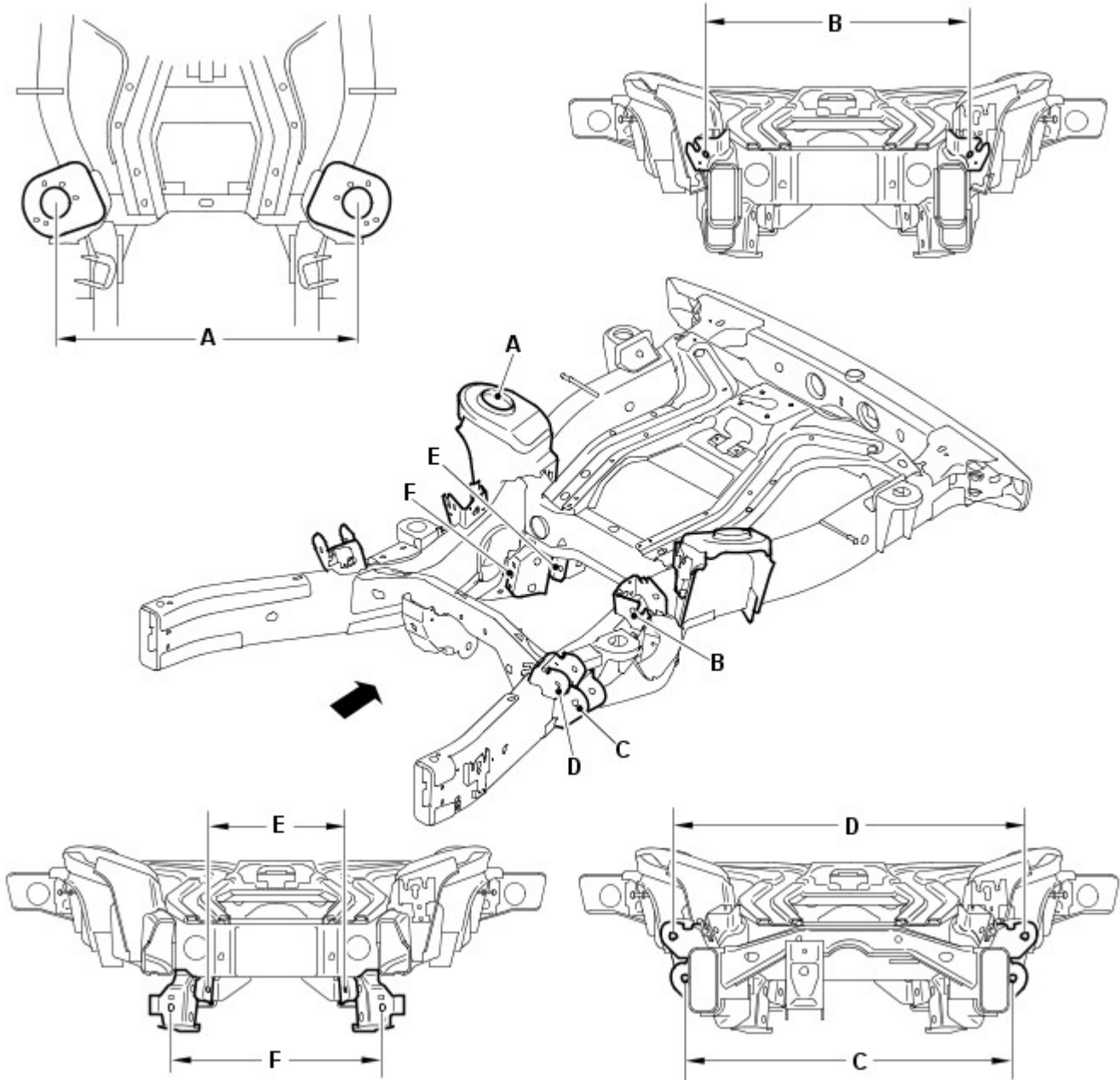
Rear integral body frame dimensions



E55833

Item	From	To	Length
A	Body Mount 5 (LH rear)	Body Mount 4 (RH)	1304.2 (51.34)
B	Body Mount 5 (LH rear)	Rear Damper Mounting (RH)	1156 (45.51)
C	Body Mount 5 (LH rear)	Rear Damper Mounting (LH)	533.5 (21.00)

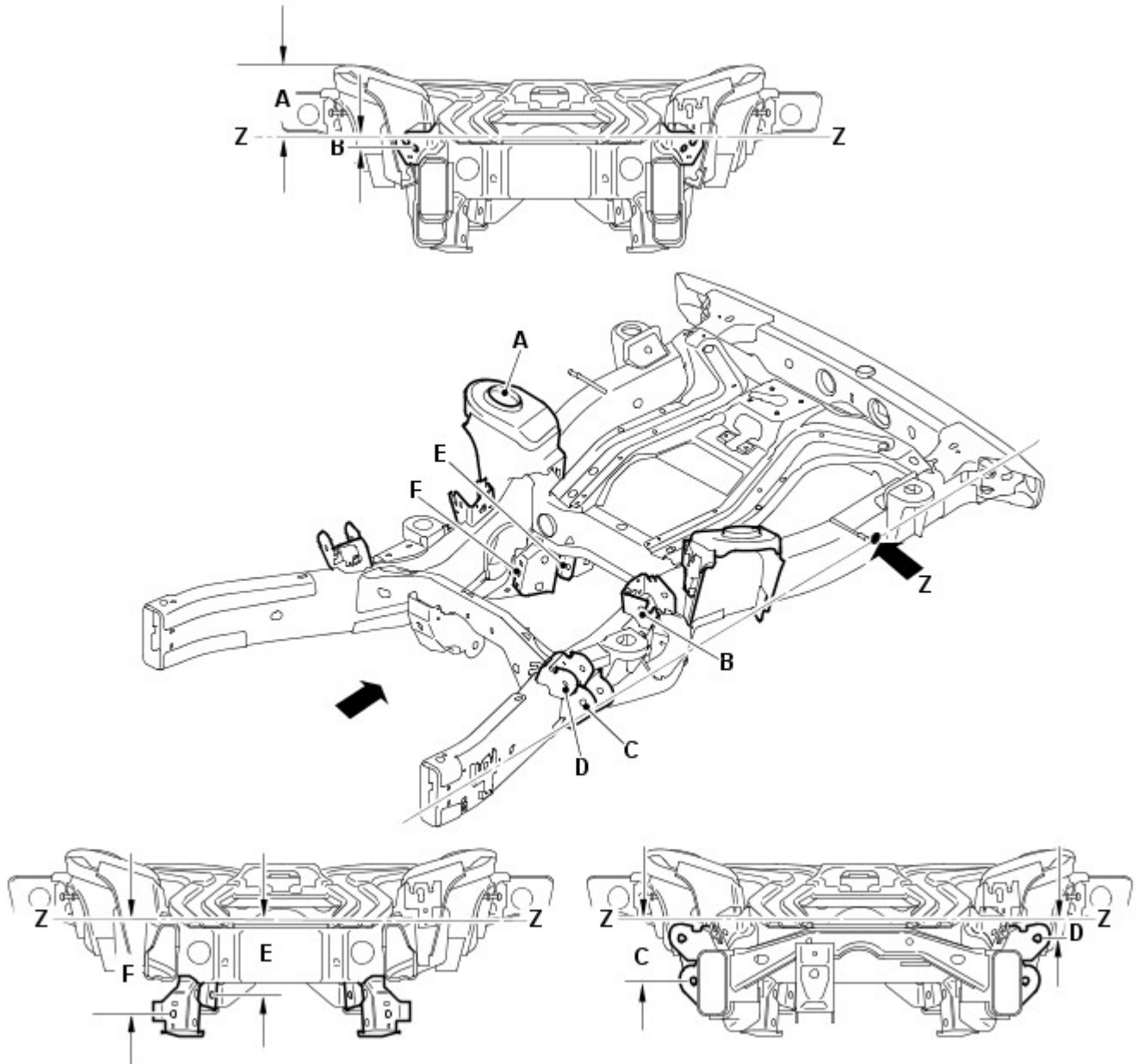
Rear integral body frame dimensions



E57096

Item	From	To	Length
A	Damper (L/H)	Damper (R/H)	937.1 (36.9)
B	Upper Arm (L/H rear)	Upper Arm (R/H rear)	757.4 (29.81)
C	Lower Arm (L/H front)	Lower Arm (R/H front)	818.4 (32.2)
D	Upper Arm (L/H front)	Upper Arm (R/H front)	946.5 (37.2)
E	Toe Link (L/H)	Toe Link (R/H)	439 (17.2)
F	Lower Arm (L/H rear)	Lower Arm (R/H rear)	508.4 (20.01)

Rear integral body frame dimensions



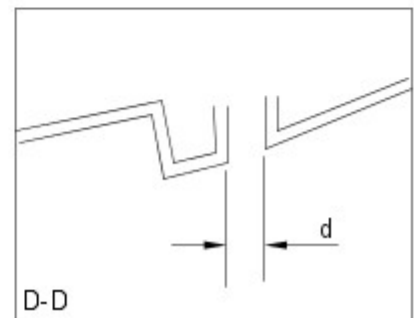
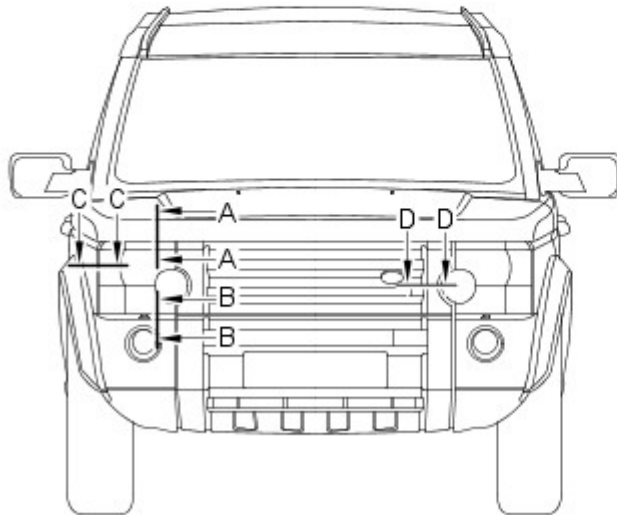
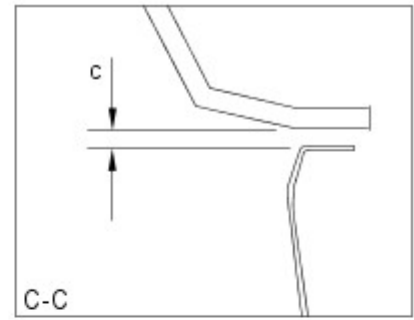
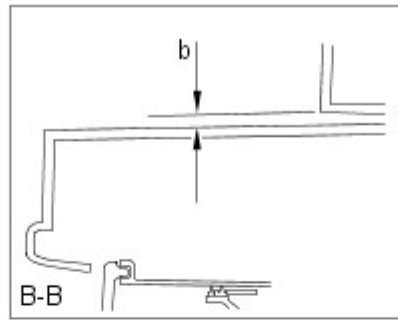
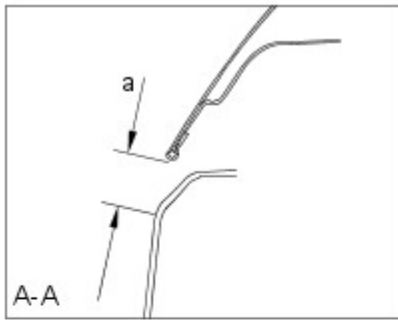
E57471

Item	From	To	Length
A	Datum Line (Z)	Damper	169.97 (6.691)
B	Datum Line (Z)	Upper Arm Rear	32.27 (1.270)
C	Datum Line (Z)	Lower Arm Front	161.04 (6.340)
D	Datum Line (Z)	Upper Arm Front	55.07 (2.168)
E	Datum Line (Z)	Toe Link	200.87 (7.908)
F	Datum Line (Z)	Lower Arm Rear	250.81 (9.874)

Gap and Profile Measurements

The following information is to be used as a guide to assist the technician in installing exterior body panels and trim items so as to achieve a correctly aligned and cosmetically acceptable vehicle.

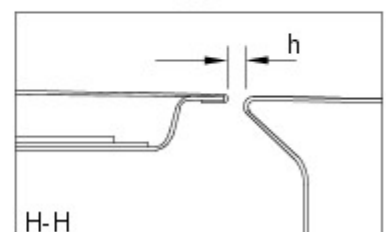
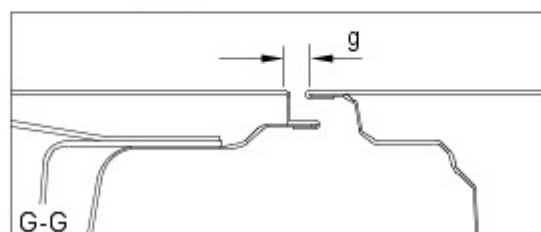
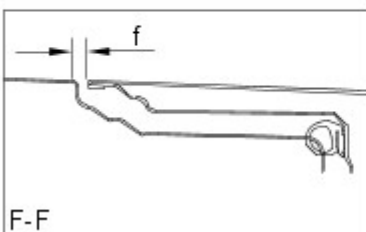
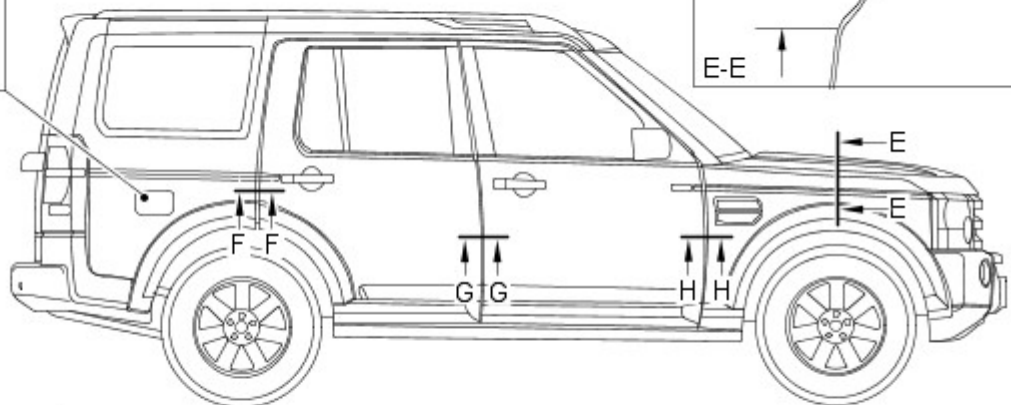
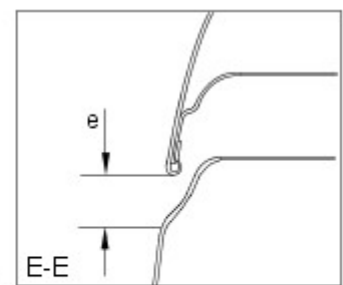
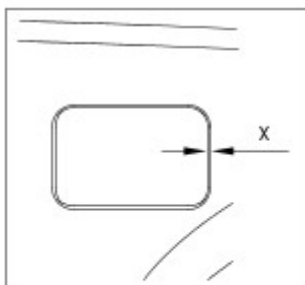
Front view dimensions



E55848

Section	Description	Gap	Profile
A-A	Headlamp to Hood	22.0 (0.866) ± 1.4 (0.055)	N/A
B-B	Headlamp to Bumper	6.0(0.236) ± 1.8 (0.070)	N/A
C-C	Headlamp to Fender	4.0(0.157) ± 1.2 (0.0472)	0.0 ± 1.2 (0.047)
D-D	Headlamp to Grille	4.0(0.157) ± 1.2 (0.0472)	0.0 ± 1.0 (0.039)

Side view dimensions

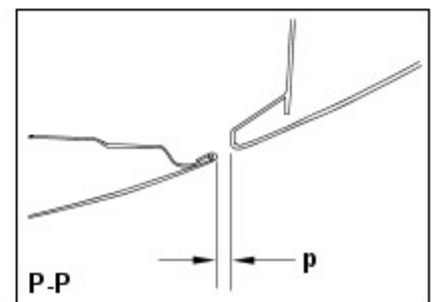
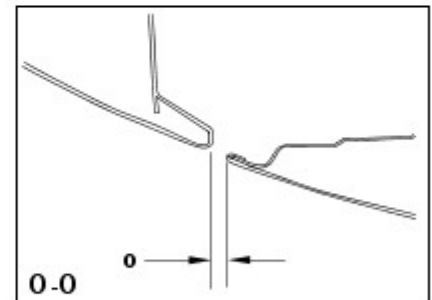
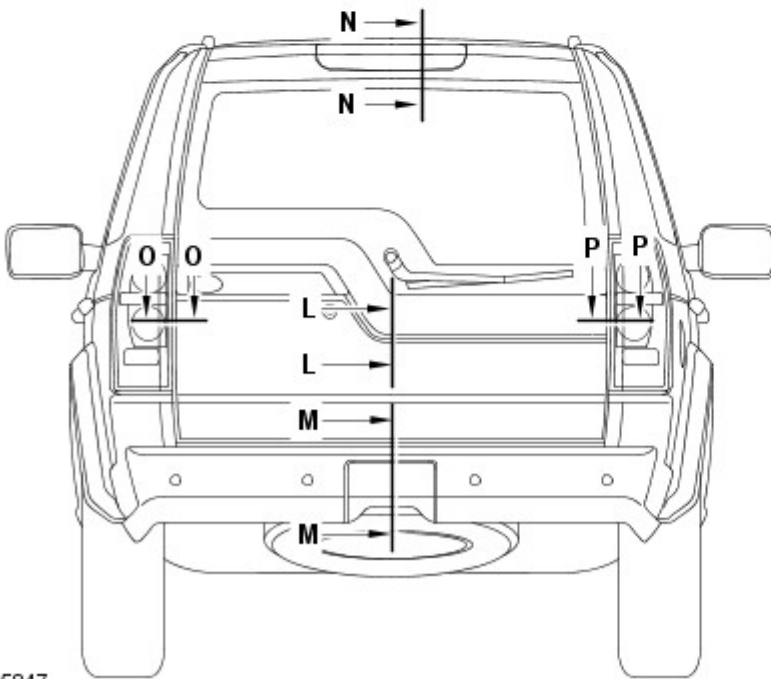
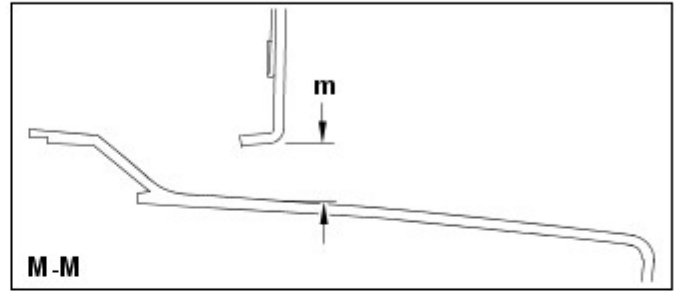
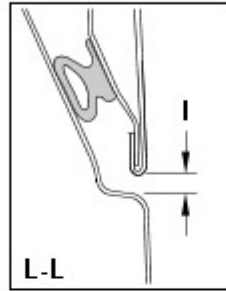
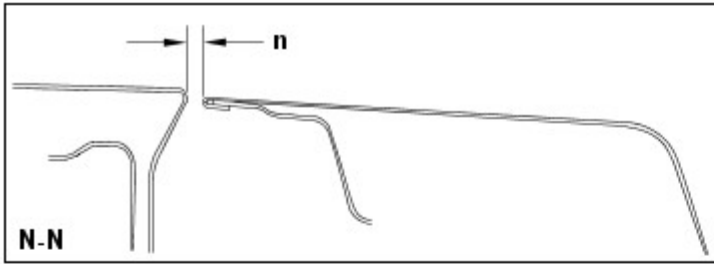


E55846

Section	Description	Gap	Profile
E-E	Hood to Fender	22.0 (0.866) ± 1.4(0.055)	+ 1.0 (0.039)

Section	Description	Gap	Profile
F-F	Rear Door to Bodyside	4.5 (0.177) ± 1.1 (0.043)	0.0 + 1.0 (0.039) - 0.0
G-G	Front Door to Rear Door	5.0 (0.196) ± 1.0 (0.039)	0.0 + 1.0 (0.039) - 0.0
H-H	Front Fender to Front Door	5.0 (0.196) ± 1.0 (0.039)	0.0 + 1.4 (0.055) - 0.0
X-X	Fuel Filler Flap to Bodyside	2.9 (0.114) ± 1.0 (0.039)	1.0 (0.039) ± 1.0 (0.039)

Rear view dimensions



E55847

Section	Description	Gap	Profile
L-L	Liftgate to Tailgate	6.0 (0.236) ± 1.0 (0.039)	0.0 ± 1.0 (0.039)
M-M	Tailgate to Bumper	12.8 (0.503) ± 2.1 (0.0826)	N/A
N-N	Liftgate to Roof	10 (0.393) ± 1.3 (0.0511)	-2.0 (0.078) ± 1.3 (0.0511)
O-O	Tailgate to Rear Lamp	5.0 (0.196) ± 1.6 (0.062)	5.0 (0.196) ± 1.3 (0.0511)
P-P	Liftgate to Rear Lamp	5.0 (0.196) ± 1.6 (0.062)	3.0 (0.118) ± 1.9 (0.074)

Front End Sheet Metal Repairs -

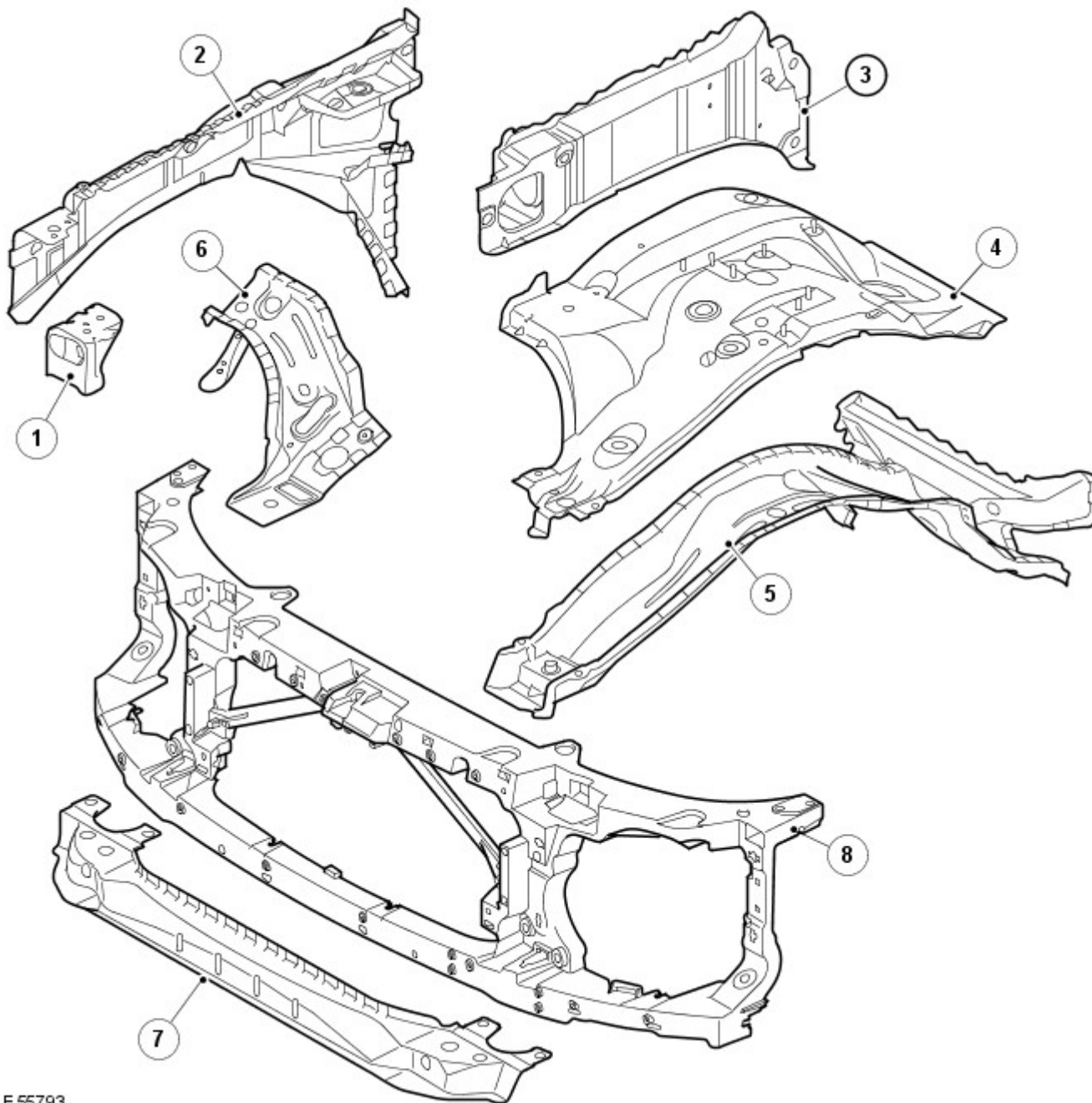
Torque Specifications

Description	Nm	lb-ft
Air deflector bolts	10	7
Hood latch Torx bolts	10	7
Hood panel bolts	25	18
Coolant expansion tank bolts	10	7

Front End Sheet Metal Repairs - Front End Sheet Metal

Description and Operation

Front end service panels



E55793

Item	Description	Service part No
1	Fender apron panel closing.	R/H ABD780100 L/H ABD780110
2	Fender apron panel reinforcement.	R/H ABD780140 L/H ABD780150
3	Fender apron panel.	R/H ABD780220 L/H ABD780230
4	Front wheelhouse.	R/H ANJ780040 L/H ANJ780050
5	Front side member.	R/H AB1780040 L/H AB1780050
6	Front wheelhouse reinforcement.	R/H AWW780020 L/H AWW780030
7	Front crossmember.	ABC780060
8	Hood latch panel.	DIN500020

Time schedules, front end

The following information shows the total time taken to replace single panels and complete assemblies. This time

includes removal of Mechanical, Electrical and Trim (MET) items, plus paint times based on Metallic Clear Over Base Paint.

The times shown were generated by Thatcham (the motor insurance repair and research centre) and are to be used as a guide only.

Single panel times

Panel Description	Petrol	Diesel
Hood	7.8	7.8
Hood latch panel	2.7	2.7
Front fender L/H	7.5	7.5
Front Fender R/H	7.5	7.5
Front Crossmember	6.0	6.0

Combination panel replacement times

The following panel combination times show the total time to remove/refit body panels, MET items and any paint process.

Combination panel times

Panel Description	Petrol	Diesel
Hood		
Front bumper		
Hood latch panel		
Front crossmember		
Front grille		
Front fender		
Total Time	17.6	17.6

Combination panel times

Panel Description	Petrol	Diesel
Hood		
Front bumper		
Hood latch panel		
Front crossmember		
Front grille		
Front fender L/H and R/H		
Total Time	18.1	18.1

Combination panel times

Panel Description	Petrol	Diesel
Body off integrated frame		
Hood		
Front bumper		
Hood latch panel		
Front side member		
Fender apron panel		
Fender apron panel reinforcement		
Front wheelhouse		
Front crossmember		
Front grille		
Front fender L/H and R/H		
Total Time	L/H 39.2 R/H 39.1	L/H 39.6 R/H 39.4

Combination panel times

Panel Description	Petrol	Diesel
Body off integrated frame		
Hood		
Front bumper		
Hood latch panel		
Front side member L/H and R/H		
Fender apron panel L/H and R/H		
Fender apron panel reinforcement L/H and R/H		
Front wheelhouse L/H and R/H		
Front crossmember		
Front grille		
Front fender L/H and R/H		
Total Time	48.8	49.2

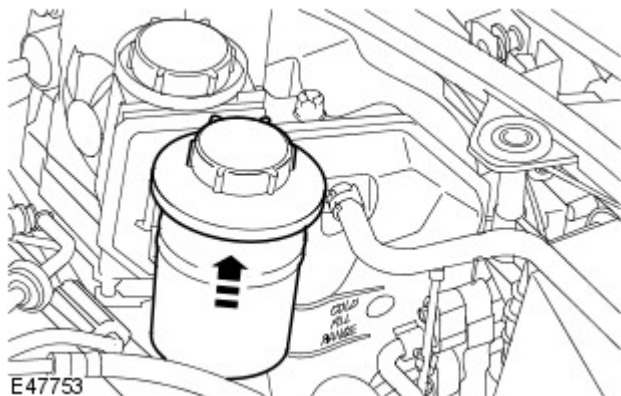
Front End Sheet Metal Repairs - Hood Latch Panel

Removal and Installation

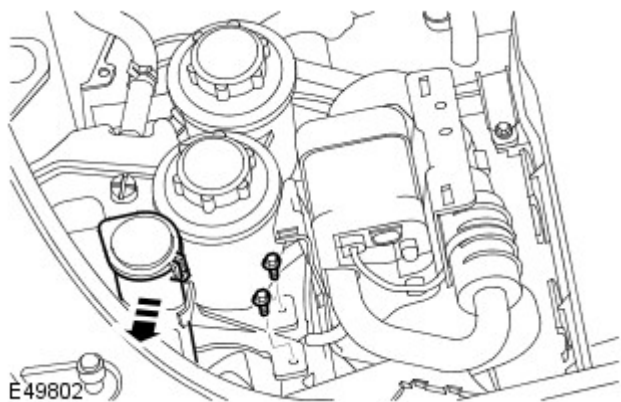
Removal

• **NOTE:** If the hood latch panel coating is damaged or scratched, it must be repaired using the approved coating. For additional information, refer to: [Specifications](#) (501-27 Front End Sheet Metal Repairs, Specifications).

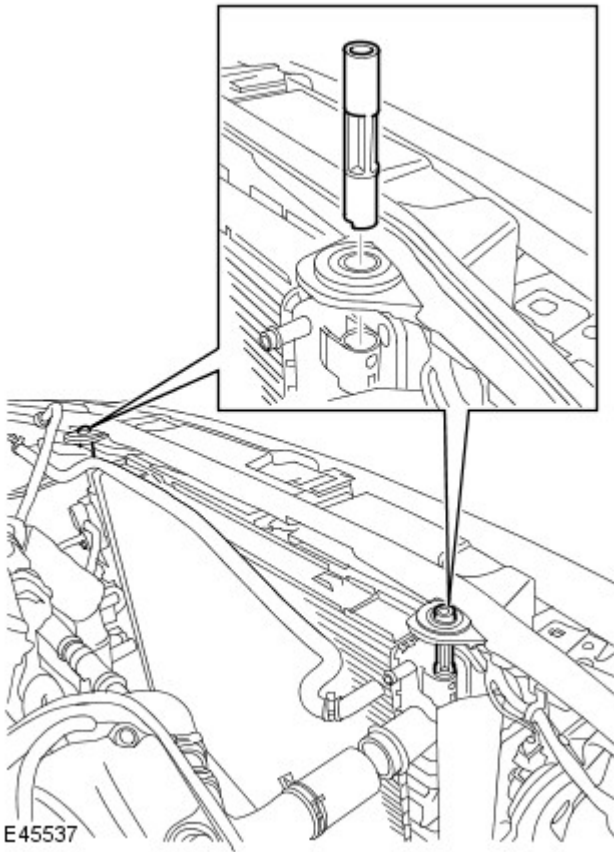
1. Disconnect the battery ground cable.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front bumper.
For additional information, refer to: Front Bumper (501-19, Removal and Installation).
3. Release the power steering fluid reservoir and position aside.
 - Release the clip.



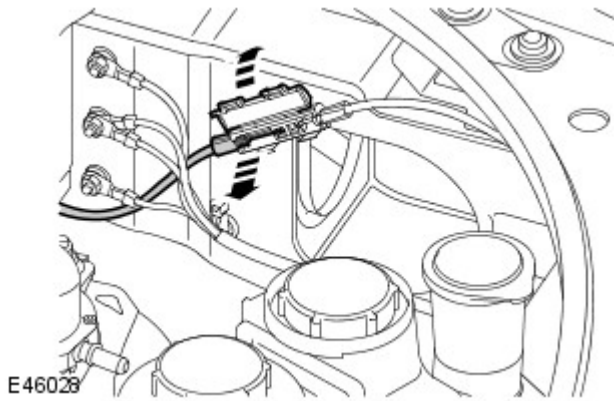
4. Release the washer reservoir filler neck from the coolant tank clip.
5. Remove the 2 coolant expansion tank mounting bolts.
6. Release the coolant expansion tank.
 - Lift coolant expansion tank vertically.



7. Remove the radiator securing pegs.



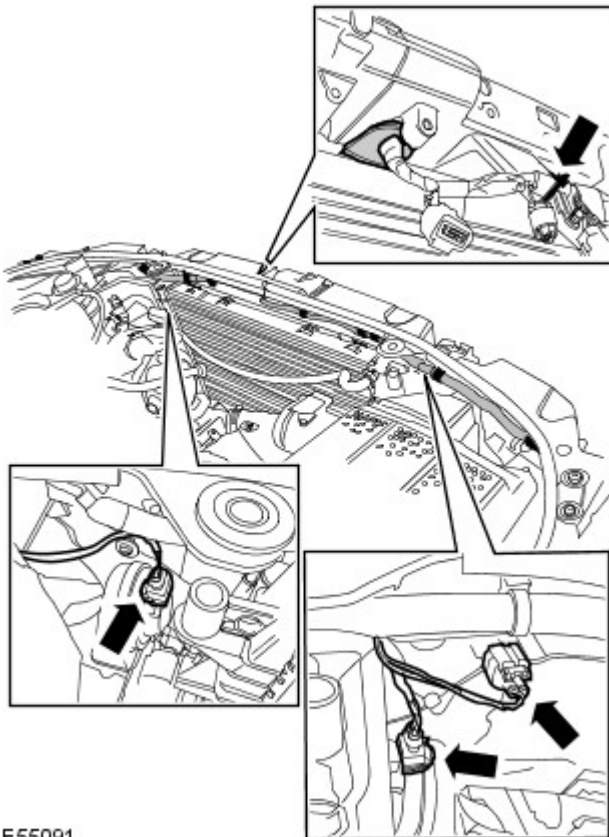
8. Disconnect the hood release cable from the connecting box.



9. NOTE: Note the fitted position.

Release the wiring harness.

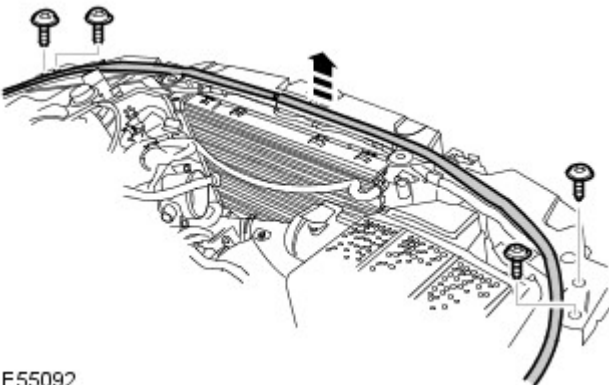
- Disconnect the 3 electrical connectors.
- Release the 9 clips.
- Release the grommet.
- Carefully tie the harness aside.



E55091

10. Remove the panel upper fixings.

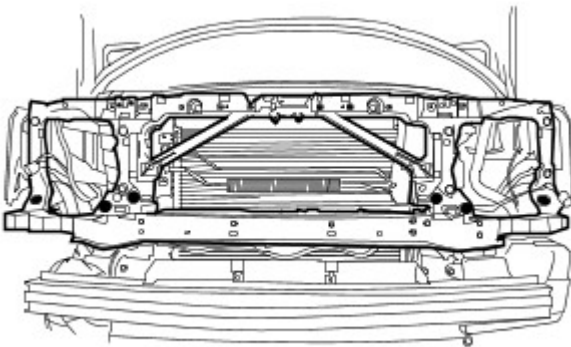
- Remove the 4 Torx bolts.



E55092

11. Remove the panel lower fixings.

- Remove the 6 Torx bolts.



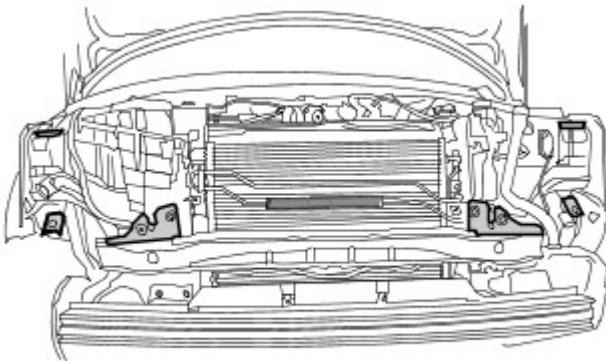
E55093

12. NOTE: Note the fitted position.

With assistance, remove the hood latch panel.

13. Noting the fitted position, remove the 6 spacers.

- Remove the 2 clips.

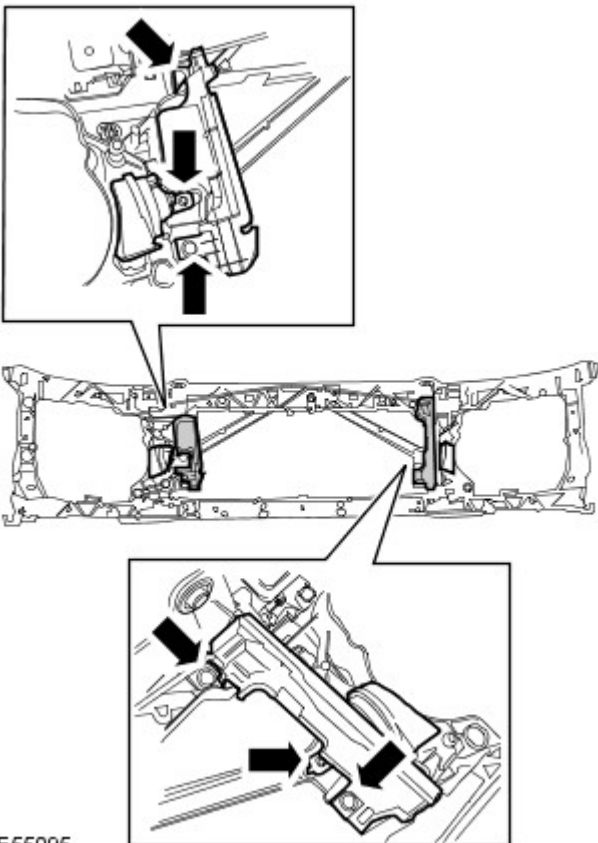


E55094

14. NOTE: Do not disassemble further if the component is removed for access only.

Remove the 2 horn assemblies.

- Remove the 2 air deflectors.
- Remove the 2 Torx bolts.



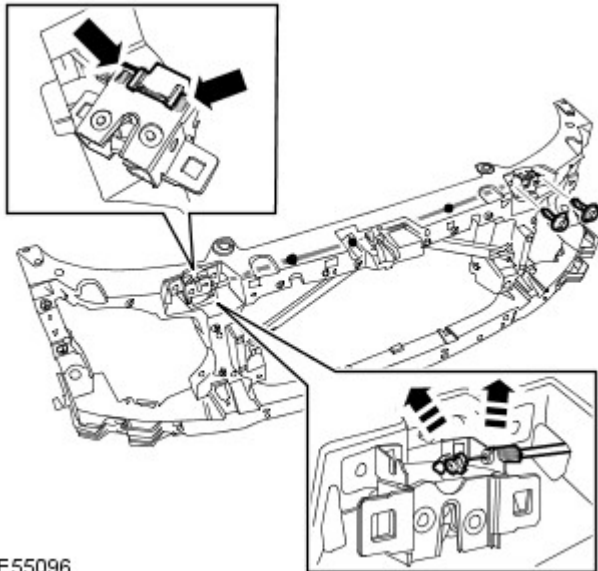
E55095

15. Remove the hood switch.

- Remove the 2 Torx bolts.
- Release the 2 clips.

16. Remove the RH hood latch.

- Release and remove the cable.



E55096

17. Remove the LH hood latch.

- Remove the 2 Torx bolts.

Installation

1. Install the horn assemblies.
 - Install the air deflectors.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
2. Install the LH hood latch.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
3. Install the RH hood latch.
 - Attach the hood release cable.
 - Install the hood switch.
 - Tighten the Torx bolts to 10 Nm (7 lb.ft).
4. Install the spacers.
 - Install the clips.
5. **NOTE: Align to the position noted on removal.**
 With assistance, install the hood latch panel.
6. Install the panel fixings.
 - Install and tighten the bolts to 25 Nm (18 lb.ft).
7. **NOTE: Align to the position noted on removal.**
 Install the wiring harness.
 - Connect and secure the electrical connector.
 - Carefully secure the clips.
8. Connect the hood release cable.
9. Install the radiator securing pegs.
10. Install the coolant expansion tank.
 - Position the coolant expansion tank, locate the spigot and lug.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
11. Install the windshield washer reservoir filler neck.
 - Locate in clip.
12. Install the power steering fluid reservoir.

- Position and secure to mounting bracket.

13. Install the front bumper.

For additional information, refer to: Front Bumper (501-19, Removal and Installation).

14. Open and close the hood to check the hood latch operation.

15. Adjust both of the hood latches.

- Loosen the 4 hood latch Torx bolts.
- Lower the hood and check for alignment.
- Open the hood and tighten the Torx bolts to 10 Nm (7 lb.ft).
- Check for the correct operation of the hood safety catch.
- If necessary, repeat the above adjustment procedure.

16. Connect the battery ground cable.

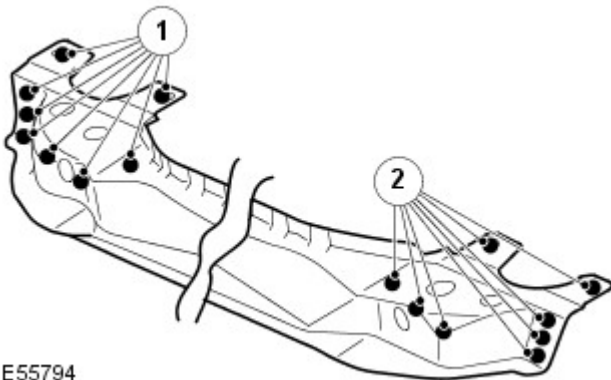
For additional information, refer to: Specifications (414-00, Specifications).

Front End Sheet Metal Repairs - Front Crossmember

Removal and Installation

Removal

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the radiator.
For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
4. Remove both front impact sensors.
For additional information, refer to: [Front Impact Severity Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
5. Release wiring harness from crossmember
6. Remove the fender moulding.
For additional information, refer to: [Front Fender Moulding](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- 7.



E55794

Item	Part Number	Description
1	-	8 spot welds.
2	-	8 spot welds.

8. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Front Side Member

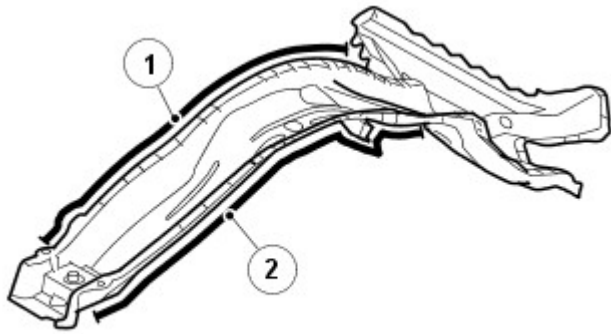
Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
- NOTE: In this procedure the front side member is replaced in conjunction with hood latch panel, front wheelhouse and the front crossmember.

1. Load vehicle onto ramp.
2. Disconnect both the battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
3. L/H side: Remove the battery.
4. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
5. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
6. Remove the front crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
7. Remove the front wheelhouse.
For additional information, refer to: [Front Wheelhouse](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
8. Remove the hood.
9. Remove both hood support struts.
10. Remove the hood wiring harness.
11. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
12. Remove both wiper arms and blades.
13. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
14. Remove the instrument panel.
For additional information, refer to: Instrument Panel - 2.7L Diesel (501-12 Instrument Panel and Console, Removal and Installation).
15. Remove the insulation from outer and inner bulkhead.
16. R/H side: Release the ABS modulator.
17. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02B Acceleration Control - V6 4.0L Petrol, Removal and Installation).
18. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
19. Release the wiring harness from bulkhead.
20. Release the wiring harness from fender apron panel reinforcement.
21. Release the wiring harness from the side member.
22. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
23. Remove the scuff plate trim panel trim
For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
24. Remove the footrest
25. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
26. Release the front carpet.

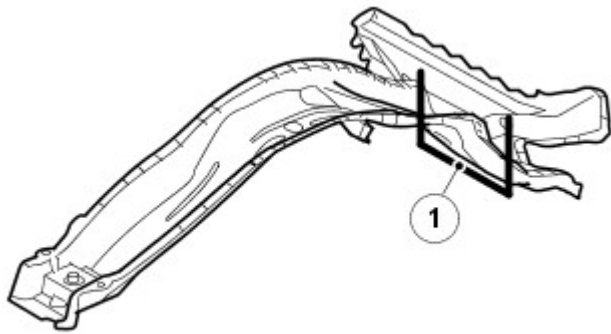
27.



E55830

Item	Part Number	Description
1	-	18 spot welds.
2	-	16 spot welds.

28.



E56906

Item	Part Number	Description
1	-	6 plug welds and a butt weld.

29. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

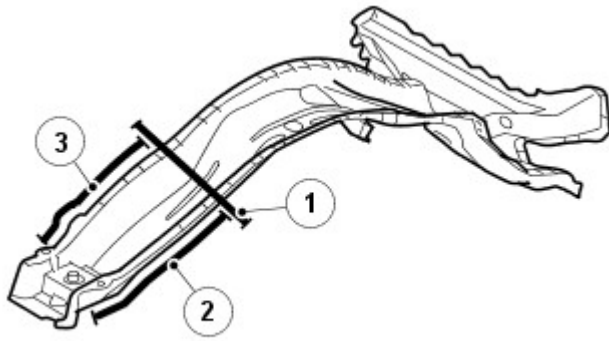
Front End Sheet Metal Repairs - Front Side Member Section

Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
 - NOTE: In this procedure the front side member section is replaced in conjunction with hood latch panel, front wheelhouse and the front crossmember.
1. Load vehicle onto ramp.
 2. Disconnect both the battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
 3. L/H side: Remove the battery.
 4. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
 5. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 6. Remove the front wheelhouse.
For additional information, refer to: [Front Wheelhouse](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 7. Remove the front crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
 8. Remove the hood.
 9. Remove both hood support struts.
 10. Remove the hood wiring harness.
 11. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
 12. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Cooler - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
 13. Remove the instrument panel.
For additional information, refer to: Instrument Panel - 2.7L Diesel (501-12 Instrument Panel and Console, Removal and Installation).
 14. Remove the insulation from outer and inner bulkhead.
 15. R/H side: Release the ABS modulator.
 16. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02B Acceleration Control - V6 4.0L Petrol, Removal and Installation).
 17. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
 18. Release the wiring Harness from bulkhead.
 19. Release the wiring harness from fender apron panel reinforcement.
 20. Release the wiring harness from the side member.
 21. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
 22. Remove the scuff plate trim panel trim
For additional information, refer to: [Scuff Plate Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 23. Remove the footrest
 24. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 25. Release the front carpet.

26.



E55831

Item	Part Number	Description
1	-	Butt weld
2	-	7 spot welds.
3	-	8 spot welds.

27. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Fender Apron Panel Reinforcement

Removal and Installation

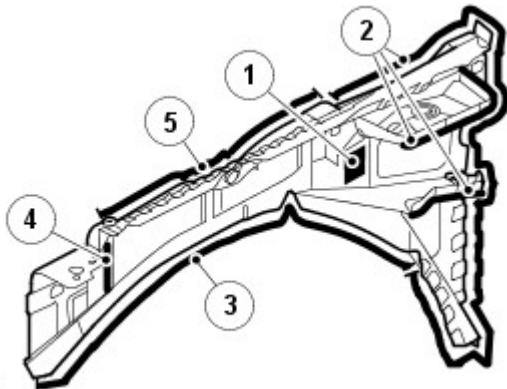
Removal

• NOTE: In this procedure the fender apron panel reinforcement is replaced in conjunction with fender apron panel closing.

1. Disconnect both the battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
6. L/H side: Remove the battery.
7. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: [Fuel Fired Booster Heater](#) (412-02B Auxiliary Heating, Removal and Installation).
8. L/H side: Remove fuel fired booster heater pipes.
9. R/H side: Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
10. R/H side: Release the ABS modulator.
11. Remove the wiring harness.
12. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
13. Remove the hood.
14. Remove both hood support struts.
15. Remove the hood wiring harness.

16.

Item	Part Number	Description
1	-	Acoustic seal.
2	-	34 plug welds.
3	-	13 spot welds.
4	-	3 spot welds.
5	-	14 spot welds.



E56916

17. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

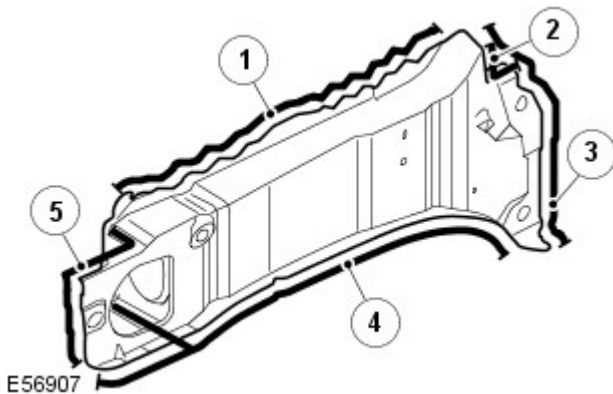
1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Fender Apron Panel

Removal and Installation

Removal

1. Disconnect both the battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the radiator.
For additional information, refer to: [Radiator](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
5. Remove the radiator coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
6. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
7. Remove the hood.
8. Remove both hood support struts.
9. Remove the hood wiring harness.
10. Remove both wiper arms and blades.
11. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
12. L/H side: Remove the battery.
13. Remove the wiring harness
14. R/H side: Release the ABS modulator.
15. Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Removal and Installation).
16. Remove the insulation from outer bulkhead.
17. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
18. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
- 19.



Item	Part Number	Description
1	-	14 spot-welds.
2	-	2 mig welds.
3	-	11 mig-plug welds
4	-	19 mig-plug welds.
5	-	5 mig-plug welds.

20. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.

For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).

- Tolerance checks.

For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Fender Apron Panel Section

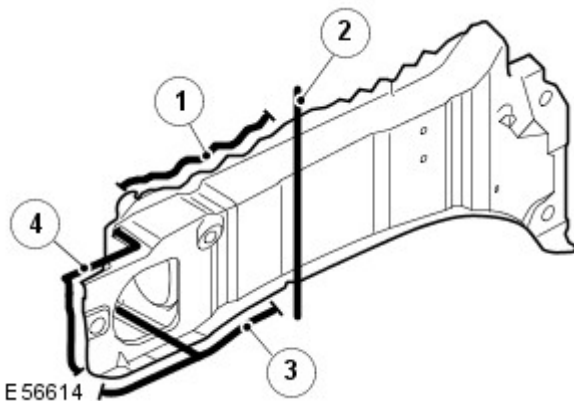
Removal and Installation

Removal

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the radiator coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
5. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
6. Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
7. Remove the hood.
8. Remove both hood support struts.
9. Remove the hood wiring harness.
10. L/H side: Remove the battery.
11. Remove the Wiring harness.
12. R/H side: Release the ABS modulator.
13. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
14. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).

15.

Item	Part Number	Description
1	-	5 spot-welds
2	-	Butt weld
3	-	9 mig-plug welds.
4	-	5 mig-plug welds.



16. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

Front End Sheet Metal Repairs - Front Wheelhouse

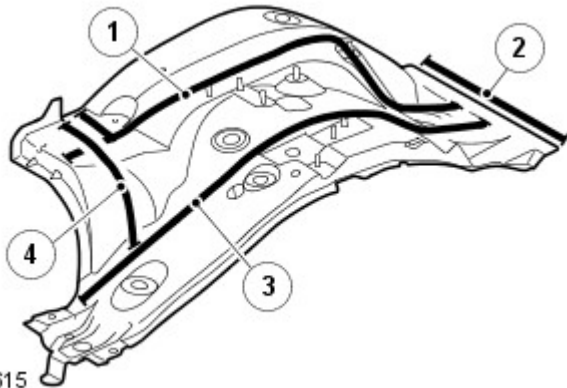
Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
- NOTE: In this procedure the front wheelhouse is replaced in conjunction with the front side member, hood latch panel and front crossmember.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front side member.
For additional information, refer to: [Front Side Member](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).

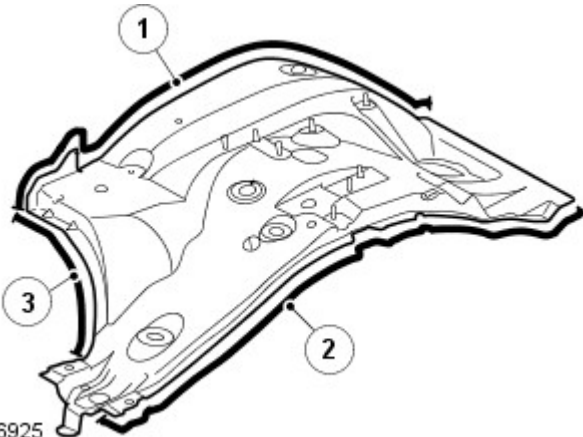
5.



E56615

Item	Part Number	Description
1	-	19 plug welds.
2	-	9 plug welds.
3	-	18 spot welds.
4	-	7 plug welds.

6.



E56925

Item	Part Number	Description
1	-	13 spot welds.
2	-	16 spot welds.
3	-	9 spot welds.

7. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

Front End Sheet Metal Repairs - Front Wheelhouse Reinforcement

Removal and Installation

Removal

• **NOTE:** In this procedure the front wheelhouse reinforcement is replaced in conjunction with the front side member and front wheelhouse.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the front side member.
For additional information, refer to: [Front Side Member](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the front wheelhouse.
For additional information, refer to: [Front Wheelhouse](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
- 4.



E56616

Item	Part Number	Description
1	-	4 spot welds.
2	-	7 plug welds.
3, 4	-	20 plug welds.
5	-	9 spot welds.

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Front Wheelhouse Section

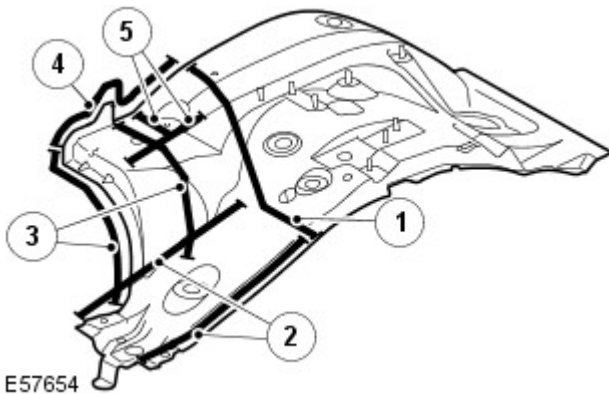
Removal and Installation

Removal

- NOTE: This procedure requires the body to be removed from the integrated body frame.
- NOTE: In this procedure the front wheelhouse section is replaced in conjunction with the front side member section, front wheelhouse reinforcement, hood latch panel and front crossmember.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front side member section.
For additional information, refer to: [Front Side Member Section](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the front wheelhouse reinforcement.
For additional information, refer to: [Front Wheelhouse Reinforcement](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. Remove the crossmember.
For additional information, refer to: [Front Crossmember](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
5. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).

6.



Item	Part Number	Description
1	-	Butt weld
2	-	15 spot welds.
3	-	7 plug welds, 9 spot welds.
4	-	20 spot welds.
5	-	9 plug welds.

7. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Front End Sheet Metal Repairs - Fender Apron Panel Closing Panel

Removal and Installation

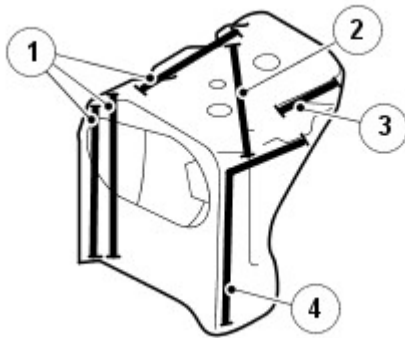
Removal

• **NOTE:** In this procedure the fender apron closing panel is replaced in conjunction with the fender apron panel or the fender apron panel reinforcement.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the fender apron panel.
For additional information, refer to: [Fender Apron Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
3. Remove the fender apron panel reinforcement.
For additional information, refer to: [Fender Apron Panel Reinforcement](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).

4.

Item	Part Number	Description
1	-	7 plug welds.
2	-	2 spot welds.
3	-	2 spot welds.
4	-	5 plug welds.



E56612

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

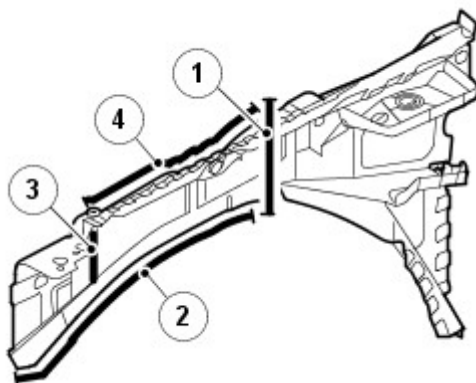
Front End Sheet Metal Repairs - Fender Apron Panel Reinforcement Front Section

Removal and Installation

Removal

• **NOTE:** In this procedure the fender apron panel reinforcement front section is replaced in conjunction with fender apron panel closing.

1. Disconnect both the battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. Remove the hood latch panel.
For additional information, refer to: [Hood Latch Panel](#) (501-27 Front End Sheet Metal Repairs, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. L/H side: Remove the radiator coolant expansion tank.
For additional information, refer to: [Coolant Expansion Tank](#) (303-03C Engine Cooling - V6 4.0L Petrol, Removal and Installation).
6. L/H side: Remove the power steering fluid reservoir.
For additional information, refer to: [Power Steering Fluid Reservoir - TDV6 2.7L Diesel](#) (211-02 Power Steering, Removal and Installation).
7. L/H side: Remove the battery.
8. L/H side: Remove the fuel fired booster heater.
For additional information, refer to: Fuel Fired Booster Heater (412-02B Auxiliary Heating, Removal and Installation).
9. L/H side: Remove fuel fired booster heater pipes.
10. R/H side: Release the ABS modulator.
11. Remove the wiring harness.
12. Remove the hood.
13. Remove both hood support struts.
14. Remove the hood wiring harness.
- 15.



E56613

Item	Part Number	Description
1	-	Butt weld.
2	-	20 spot welds.
3	-	3 spot welds.
4	-	11 spot welds.

16. For additional information:

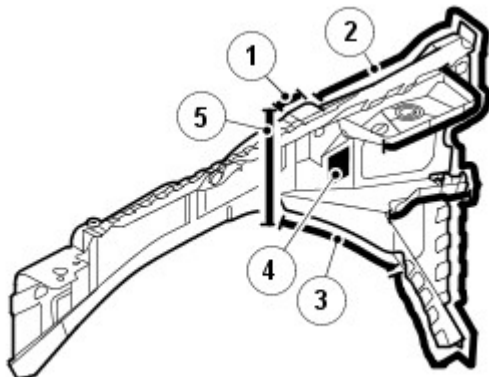
- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Front End Sheet Metal Repairs - Fender Apron Panel Reinforcement Rear Section

Removal and Installation

Removal

1. Disconnect both the battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
3. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
4. L/H side: Remove the battery.
5. R/H side: Remove the air cleaner.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
6. R/H side: Release the ABS modulator.
7. Remove the wiring harness.
8. Remove the plenum chamber panel.
For additional information, refer to: [Plenum Chamber](#) (412-01 Air Distribution and Filtering, Removal and Installation).
9. Remove the hood.
10. Remove both hood support struts.
11. Remove the hood wiring harness.
- 12.



E56917

Item	Part Number	Description
1	-	3 spot welds.
2	-	34 plug welds.
3	-	7 spot welds.
4	-	Acoustic seal.
5	-	Butt weld.

13. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

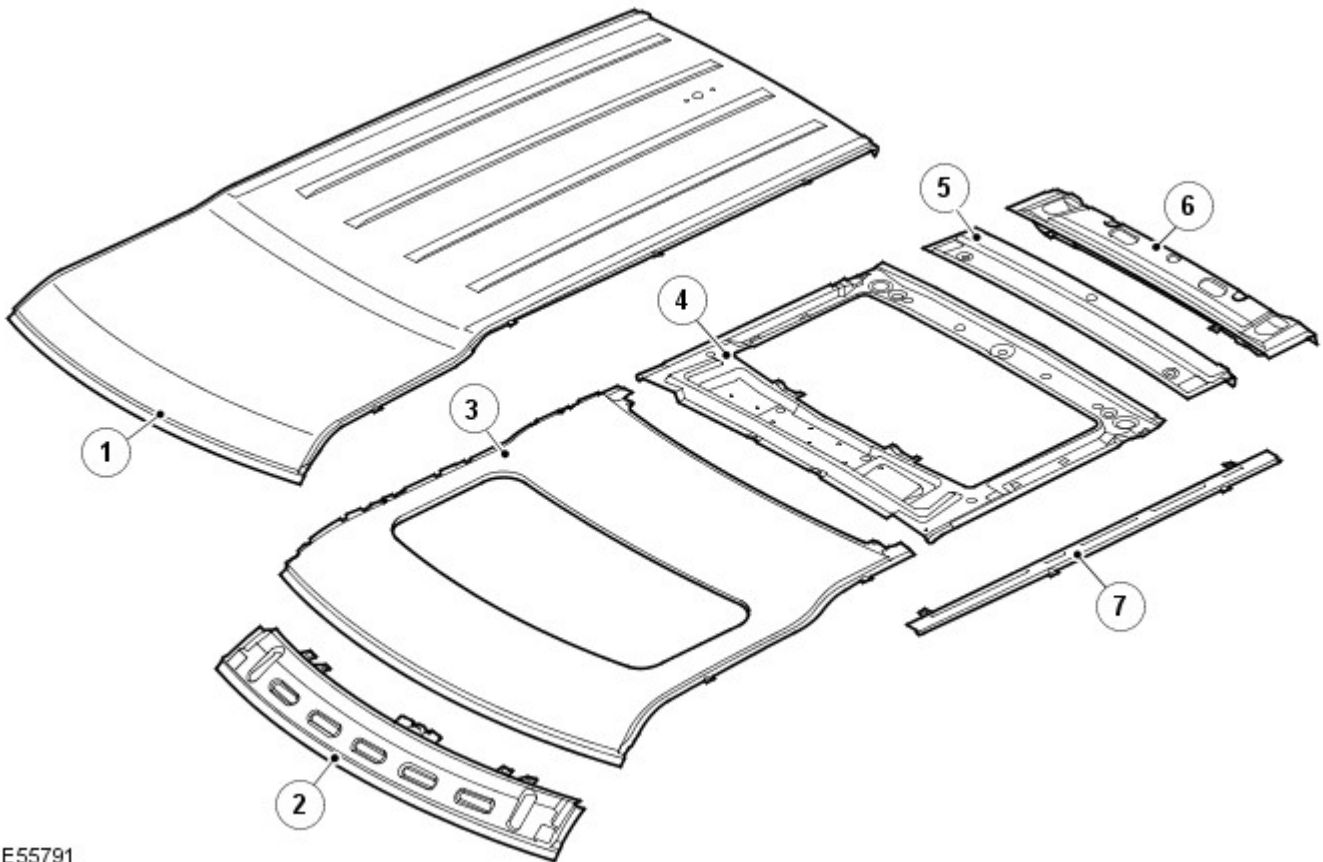
Installation

1. Install is the reversal of removal.

Roof Sheet Metal Repairs - Roof

Description and Operation

Roof service panels



E55791

Item	Description	Service part No
1	Roof panel	AKA780012
2	Header assembly	AKC780050
3	Roof panel (with roof opening panel)	AKB780040
4	Roof reinforcement	AKR780080
5	Roof reinforcement	AKB780031
6	Rear assembly	AKC780090
7	Rail assembly	R/H AK1780021 L/H AK1780031

paragraph

Time schedules, front end

The following information shows the total time taken to replace single panels and complete assemblies. This time includes removal of Mechanical, Electrical and Trim (MET) items, plus paint times based on Metallic Clear Over Base Paint.

The times shown were generated by Thatcham (the motor insurance repair and research centre) and are to be used as a guide only.

Single panel times

Panel Description	Petrol	Diesel
Roof panel	25.8	25.8
Roof glass support panel	1.1	1.1

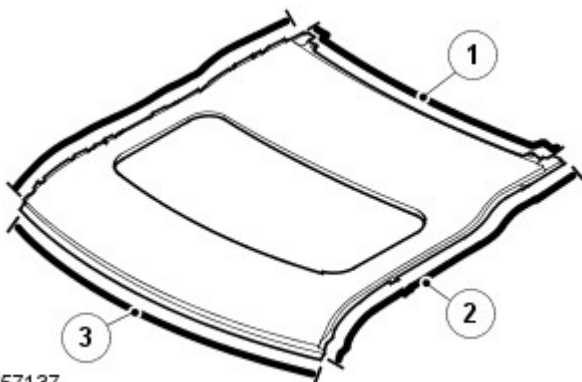
Roof Sheet Metal Repairs - Roof Panel

Removal and Installation

Removal

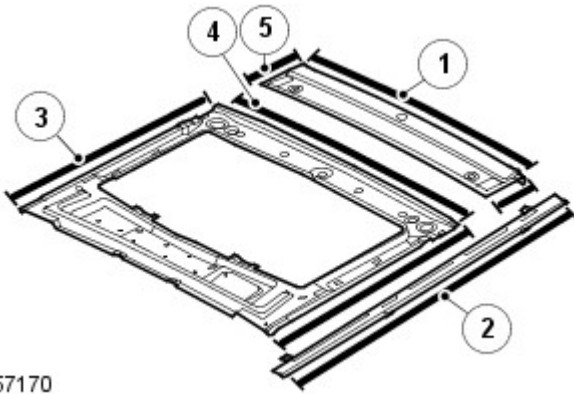
- NOTE: The roof opening panel is supplied with the reinforcement roof aperture.
- NOTE: This procedure shows removal of the roof opening panel. For vehicles with a fixed roof, the procedure is similar.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove both side air curtain modules.
For additional information, refer to: [Side Air Curtain Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
3. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
4. Remove both rear quarter window glass.
For additional information, refer to: [Rear Quarter Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
5. If applicable, remove roof opening panel.
For additional information, refer to: [Roof Opening Panel](#) (501-17 Roof Opening Panel, Removal and Installation).
6. If applicable, remove glass roof panel.
For additional information, refer to: [Glass Roof Panel](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
7. Remove both front seats.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
8. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
9. Release the wiring harness from both A-pillars.
10. Release the wiring harness from the roof.
11. Remove the liftgate.
12. Remove both front door and rear door aperture weatherstrip.
13. Remove the tailgate weatherstrip.
14. Remove both front safety belt retractors.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
15. Remove both second row safety belt retractors.
For additional information, refer to: [Second Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
16. If applicable, remove both third row safety belt retractors.
For additional information, refer to: [Third Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
17. Release the carpet
18. Remove the load space trims.
19. Remove the load space carpets.
- 20.



E57137

Item	Part Number	Description
1	-	33 spot welds.
2	-	31 spot welds.(R/H is symmetrically opposite to L/H).
3	-	43 spot welds.



E57170

21.

Item	Part Number	Description
1	-	12 plug welds and 27 spot welds.
2	-	7 plug welds and 40 spot welds (R/H is symmetrically opposite to L/H).
3	-	23 spot welds.
4	-	32 spot welds.
5	-	4 plug welds. (R/H is symmetrically opposite to L/H).

22. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

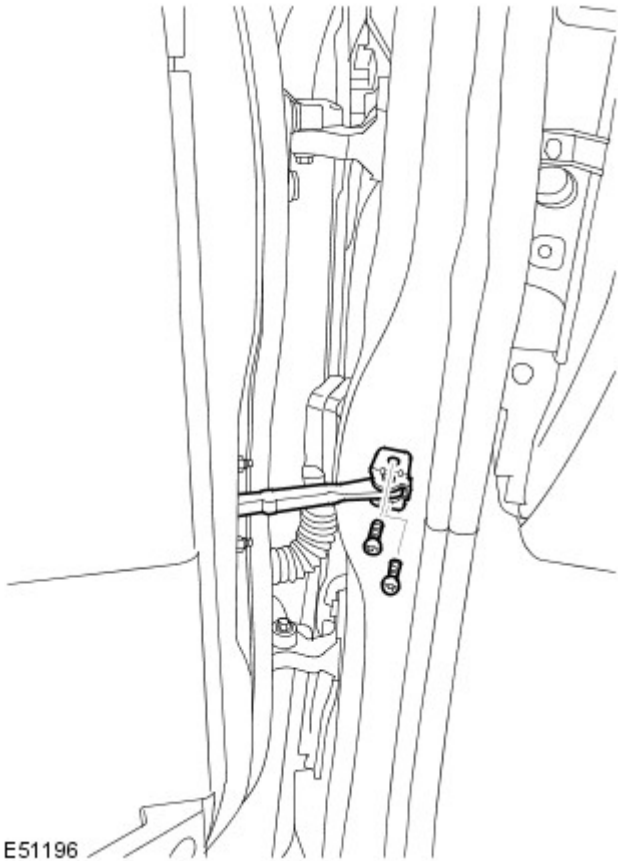
1. Install is the reversal of removal.

Side Panel Sheet Metal Repairs - Rocker Panel

Removal and Installation

Removal

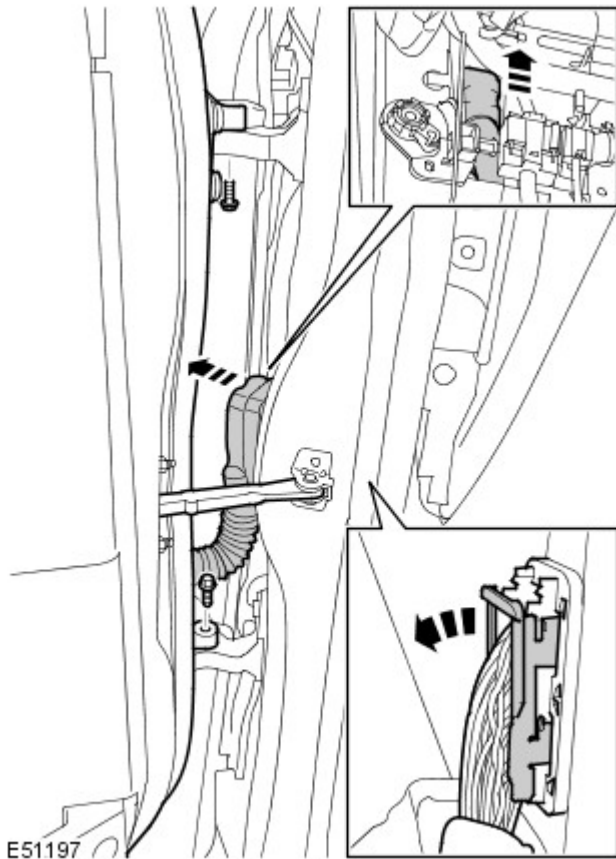
1. Load vehicle onto ramp.
2. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
3. Remove the rear wheel and tire.
4. Remove the rear fender splash shield.
5. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
6. Release the front door check strap from the A-pillar and release the rear door check strap from the B-pillar.
 - Remove the 2 Torx bolts.



E51196

7. Remove the front and rear door assemblies.

- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts



8. Remove the front and rear door weatherstrips.

9. Remove the front seat.

For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).

10. Remove the rear seat.

For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).

11. Remove the cowl side trim panel.

For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

12. Release the wiring harness from A-pillar.

13. Remove the front safety belt retractor.

For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).

14. Remove the B-pillar side impact sensor.

For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).

15. Remove the second row safety belt retractor.

For additional information, refer to: [Second Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).

16. Remove the C-pillar side impact sensor.

For additional information, refer to: [C-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).

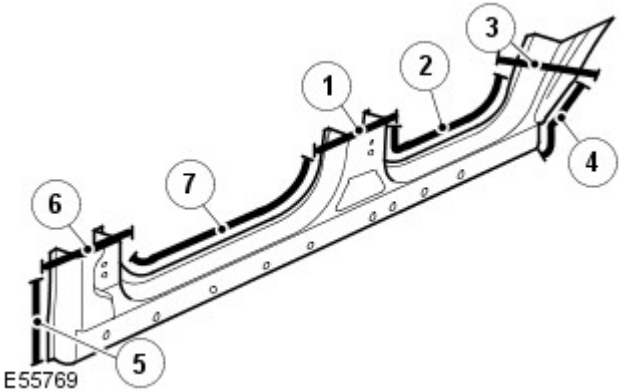
17. Release the rocker panel and B-pillar wiring harness.

18. Release the carpet away from the area of repair.

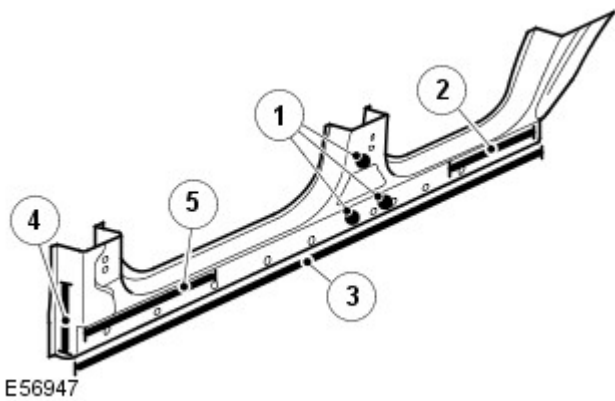
19. Release the wiring harness from rocker panel and B-pillar.

20. Remove the rocker panel finisher.

21.



Item	Part Number	Description
1	-	Butt weld.
2	-	20 spot-welds.
3	-	Butt weld.
4	-	9 spot welds.
5	-	8 spot welds.
6	-	Butt weld.
7	-	35 spot welds.



22.

Item	Part Number	Description
1	-	3 plug welds.
2	-	3 plug welds.
3	-	38 plug welds.
4	-	3 plug welds.
5	-	4 plug welds.

23. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

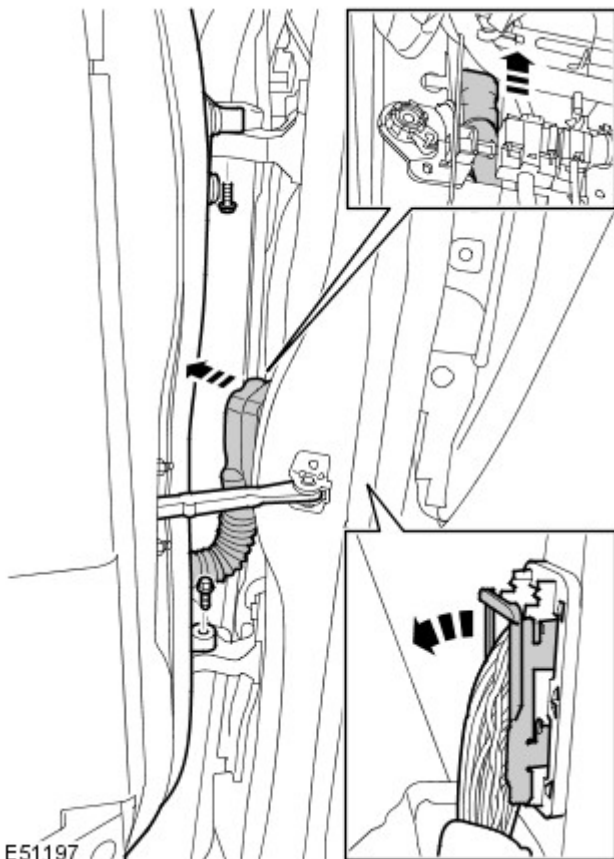
Side Panel Sheet Metal Repairs - A-Pillar Outer Panel

Removal and Installation

Removal

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
3. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. R/H side: Remove the ABS module.
For additional information, refer to: [Anti-Lock Brake System \(ABS\) Module](#) (206-09A Anti-Lock Control - Traction Control, Removal and Installation).
6. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02B Acceleration Control - V6 4.0L Petrol, Removal and Installation).
7. R/H side: Remove the brake booster.
For additional information, refer to: Brake Booster (206-07, Removal and Installation).
8. Remove the front door assembly.

- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts

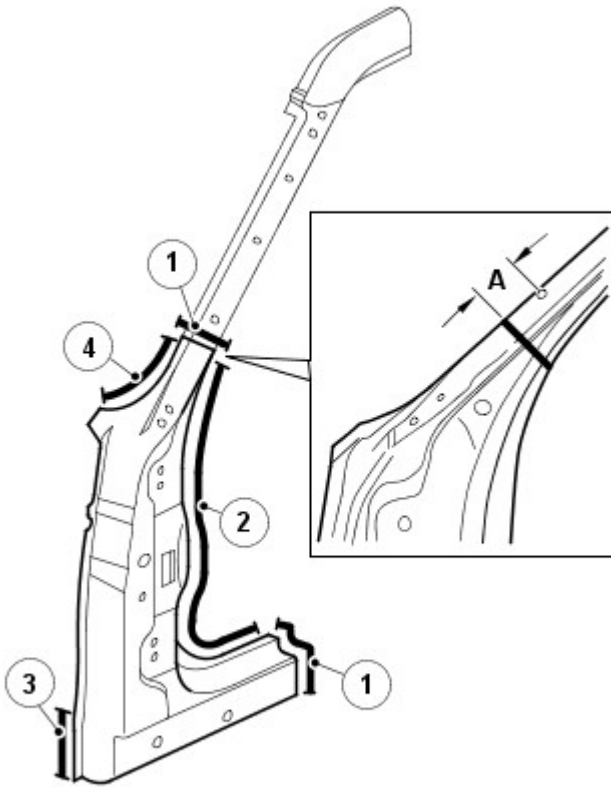


E51197

9. Remove the insulation from the outer and inner bulkhead.
10. Remove the front and rear door weatherstrip.
11. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
12. Release the A-Pillar wiring harness.
13. Remove the footrest.

14. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
15. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
16. Remove the rocker panel outer trim.
17. Release the front carpet.
- 18.

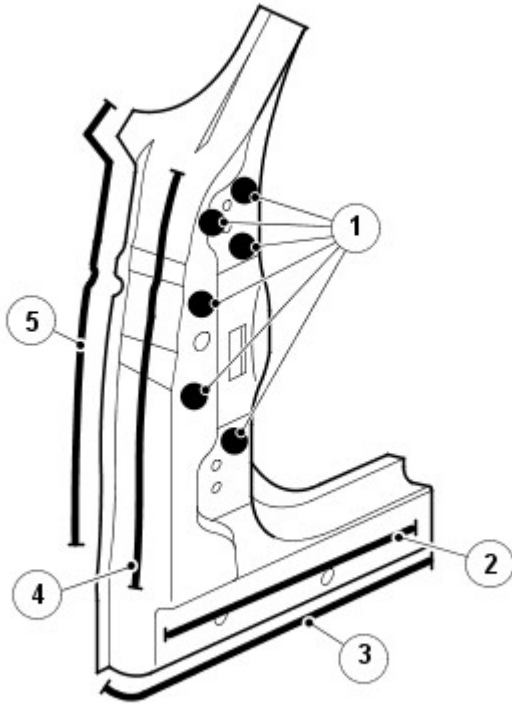
Item	Part Number	Description
A	-	Cut line 55mm (2.165 inches) from A-Pillar trim hole.
1	-	Butt welds.
2	-	30 spot welds.
3	-	8 spot welds.
4	-	15 spot welds.



E55944

19.

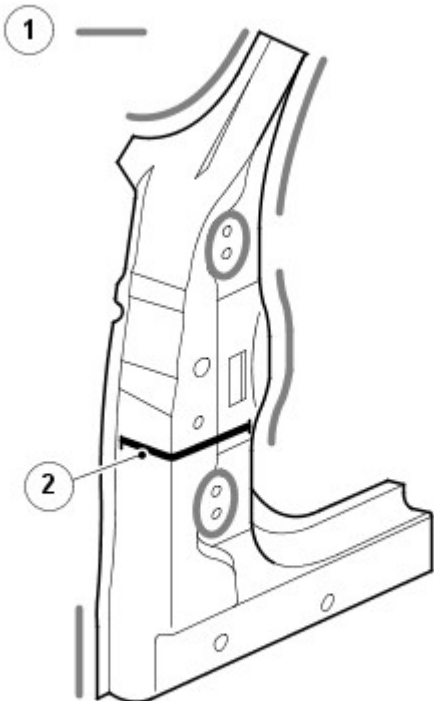
Item	Part Number	Description
1	-	6 plug welds.
2	-	4 plug welds.
3	-	12 plug welds.
4	-	10 plug welds.
5	-	13 plug welds.



E57675

20.

Item	Part Number	Description
1	-	Areas of adhesive.
2	-	Acoustic seal.



E57676

21. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

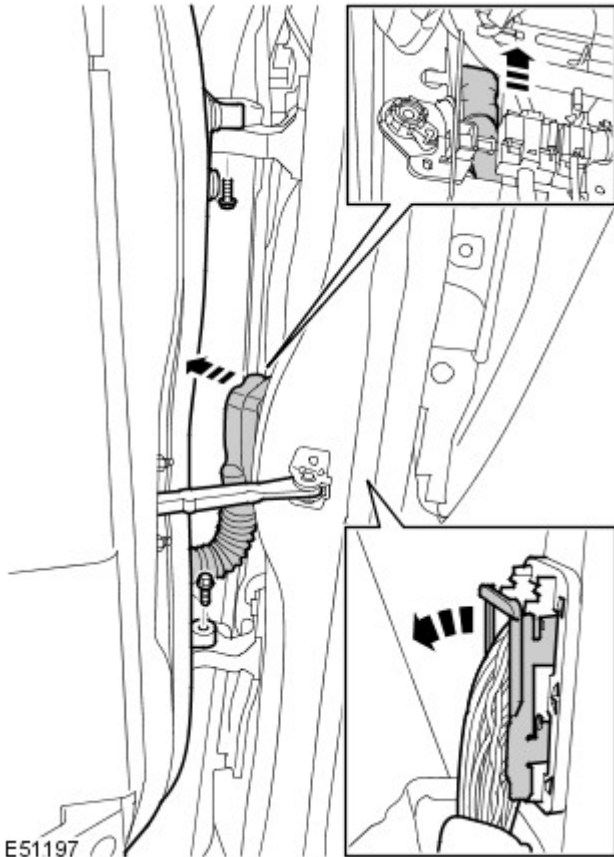
Side Panel Sheet Metal Repairs - Side Panel

Removal and Installation

Removal

1. Load vehicle onto ramp.
2. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
3. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
4. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
5. Remove the front and rear door assemblies.

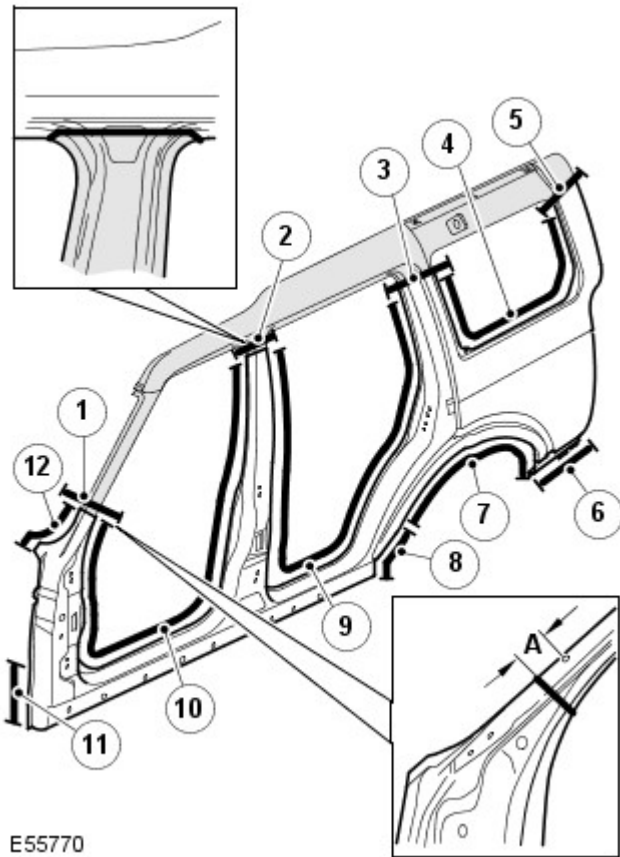
- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts



6. Remove front and rear door strikers.
7. Remove the insulation from the outer and inner bulkhead.
8. Remove the cowl side trim panel.
For additional information, refer to: [Cowl Side Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
9. Release the A-Pillar wiring harness.
10. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
11. R/H side: Remove the brake booster.
For additional information, refer to: [Brake Booster](#) (206-07 Power Brake Actuation, Removal and Installation).
12. R/H side: Remove the ABS module.
For additional information, refer to: [Anti-Lock Brake System \(ABS\) Module](#) (206-09A Anti-Lock Control - Traction Control, Removal and Installation).
13. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02B Acceleration Control - V6 4.0L Petrol, Removal and Installation).

14. Remove the footrest.
15. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
16. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
17. Remove the front and rear door weatherstrip.
18. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
19. Remove the Second row safety belt retractor.
For additional information, refer to: [Second Row Center Safety Belt Retractor - Vehicles With: 60/40 Split Seat](#) (501-20A Safety Belt System, Removal and Installation).
20. Remove the third row safety belt retractor.
For additional information, refer to: [Third Row Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
21. Remove the B-Pillar side impact sensor.
For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
22. Remove the side air curtain module.
For additional information, refer to: [Side Air Curtain Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
23. Remove the C-Pillar side impact sensor.
For additional information, refer to: [C-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
24. Remove the wiring harness from the B-Pillar.
25. Release the wiring harness from the rocker panel.
26. Release wiring harness from roof panel.
27. Remove the rocker panel outer trim.
28. Release the front and back carpet.
29. Remove rear wheel and tire.
30. Remove rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
31. Remove forced air extraction grille.
32. R/H side: Remove fuel tank.
For additional information, refer to: [Fuel Tank](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation).
33. R/H side: Remove the fuel tank filler pipe.
For additional information, refer to: [Fuel Tank Filler Pipe](#) (310-01B Fuel Tank and Lines - TDV6 3.0L Diesel, Removal and Installation).
34. R/H side: Remove the fuel filler interlock catch.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).
35. Remove the rear quarter window glass.
For additional information, refer to: [Rear Quarter Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
36. Remove the exhaust heatshields.
37. Remove the tailgate latch.
For additional information, refer to: [Liftgate Latch](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).
38. Remove tailgate weatherstrip.
39. With assistance remove the tailgate.
40. Remove the load space trims.
41. Remove the load space carpets.
42. Release wiring harness.

43.

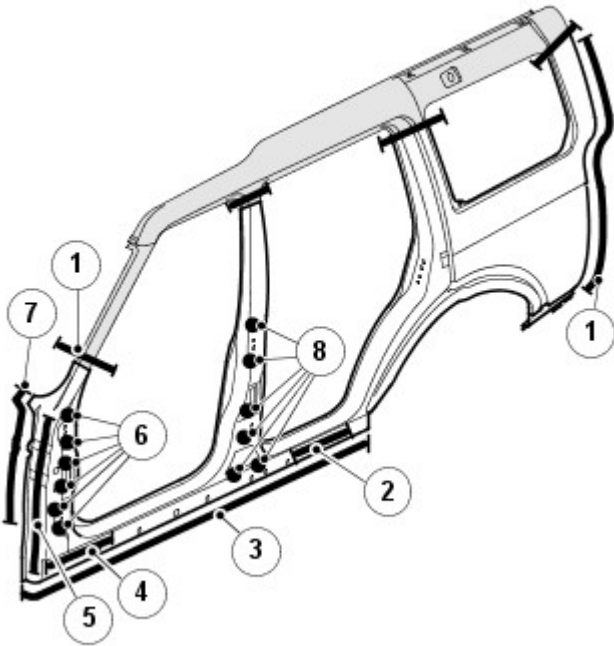


E55770

Item	Part Number	Description
A	-	Cut line is 55mm (2.165 inches) from A-Pillar trim hole.
1	-	Butt weld.
2	-	Cut line and butt weld.
3	-	Butt weld.
4	-	50 spot welds.
5	-	Butt weld.
6	-	5 spot welds.
7	-	40 spot welds.
8	-	9 spot welds.
9	-	100 spot welds.
10	-	98 spot welds.
11	-	8 spot welds.
12	-	15 spot welds.

44.

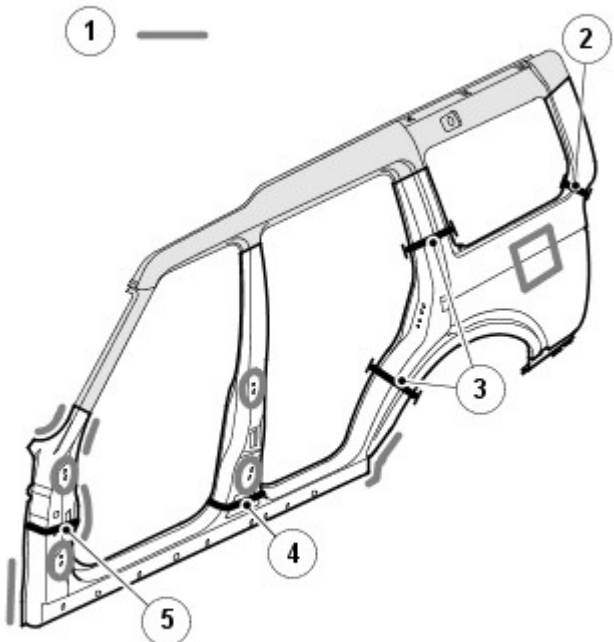
Item	Part Number	Description
1	-	22 plug welds.
2	-	3 plug welds.
3	-	38 plug welds.
4	-	4 plug welds.
5	-	10 plug welds.
6	-	6 plug welds.
7	-	13 plug welds.
8	-	6 plug welds.



E57699

45.

Item	Part Number	Description
1	-	Areas of adhesive.
2	-	Acoustic seal.
3	-	Acoustic seals.
4	-	Acoustic seal.
5	-	Acoustic seal.



E57700

46. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#)
(501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: Corrosion Protection (501-25B, Description and Operation).
- Tolerance checks.
For additional information, refer to: Body and Frame (501-26, Description and Operation).

Installation

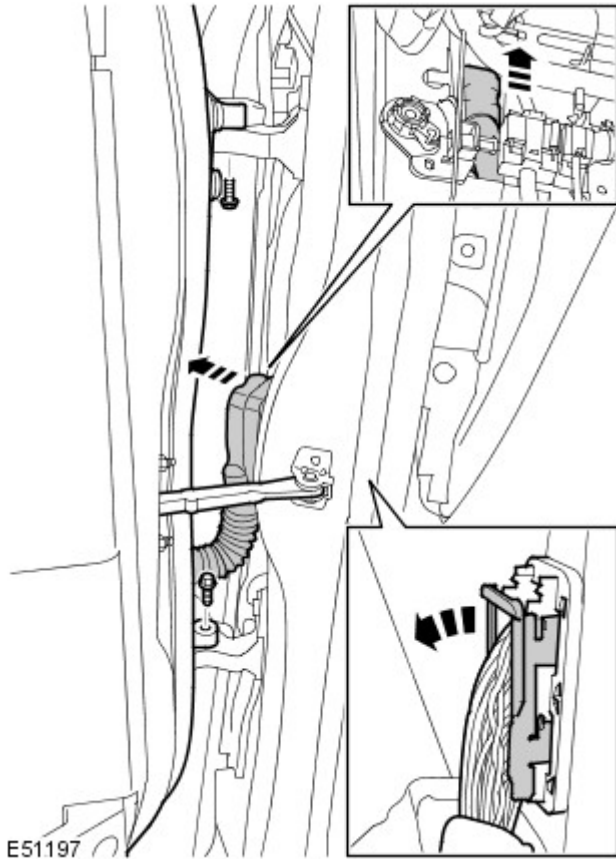
1. Install is the reversal of removal.

Side Panel Sheet Metal Repairs - B-Pillar Outer Panel

Removal and Installation

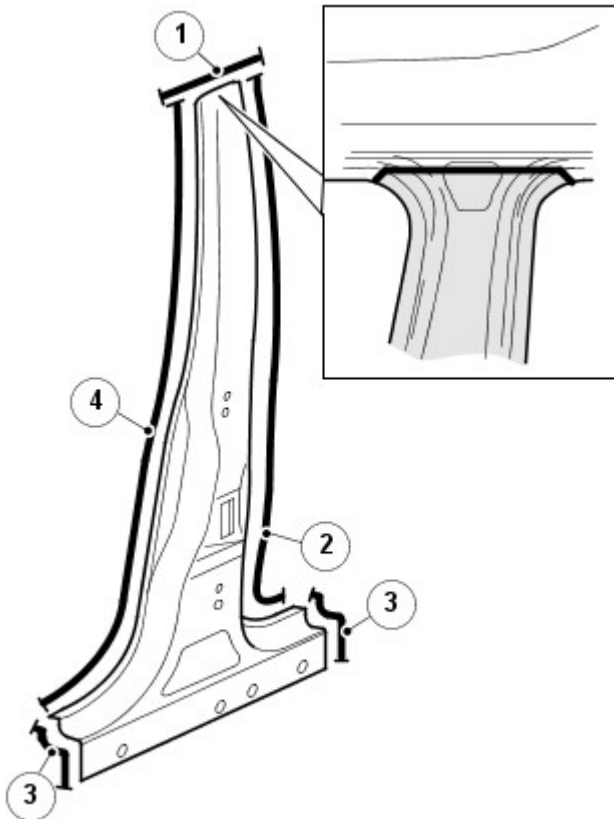
Removal

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the rear door assembly.



- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts

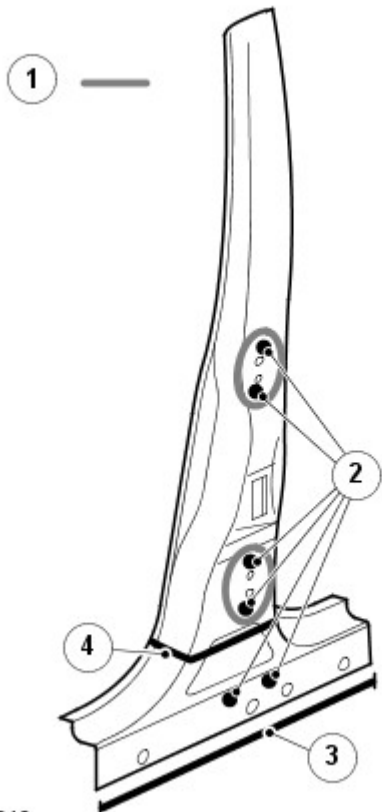
3. Remove front door striker.
4. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
5. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
6. Remove the B-pillar side impact sensor.
For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
7. Remove the side air curtain module.
For additional information, refer to: [Side Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
8. Remove the wiring harness from the B-pillar.
9. Release the wiring harness from the rocker panel.
10. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).
11. Remove the rocker panel outer trim.
12. Release the carpet.



E55946

13.

Item	Part Number	Description
1	-	Cut line and butt weld.
2,4	-	81 spot welds.
3	-	Butt welds.



E57346

14.

Item	Part Number	Description
1	-	Adhesive.
2	-	6 plug welds.
3	-	19 plug welds.
4	-	Acoustic seal.

15. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

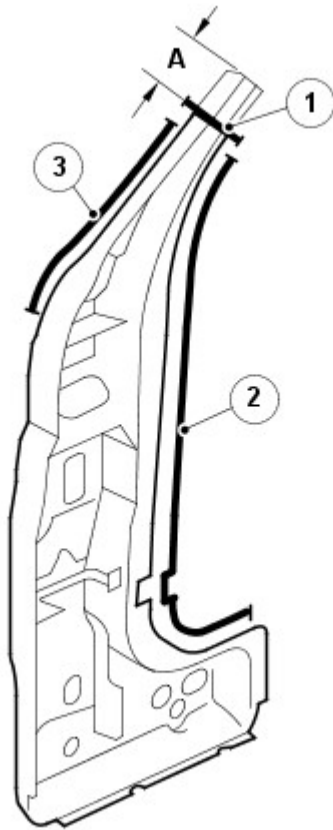
Side Panel Sheet Metal Repairs - A-Pillar Reinforcement

Removal and Installation

Removal

• NOTE: In this procedure the A-Pillar reinforcement is replaced in conjunction with the A-Pillar outer panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the A-Pillar outer panel.
For additional information, refer to: [A-Pillar Outer Panel](#) (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).
3. Remove the instrument panel.
For additional information, refer to: Instrument Panel - 2.7L Diesel (501-12, Removal and Installation).
- 4.

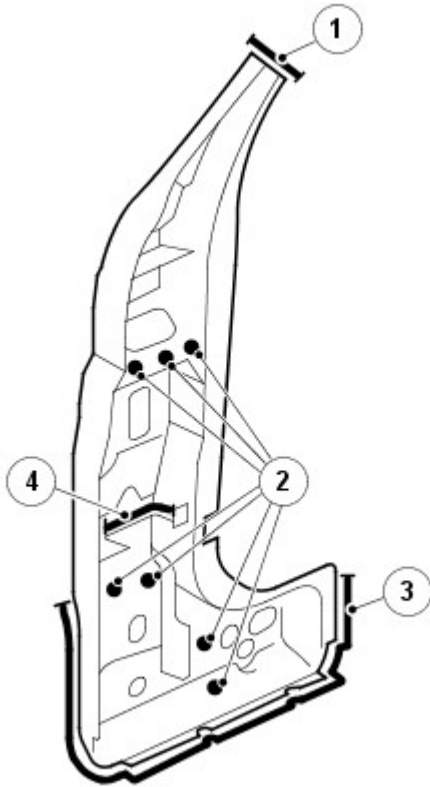


Item	Part Number	Description
A	-	Cut line 80mm (3.149 inches) from edge of A Pillar reinforcement.
1	-	Butt weld.
2	-	30 spot welds.
3	-	17 spot welds.

E55945

5.

Item	Part Number	Description
1	-	Butt weld
2	-	7 Plug welds.
3	-	16 plug welds.
4	-	Acoustic seal.



E57677

6. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Side Panel Sheet Metal Repairs - B-Pillar Reinforcement

Removal and Installation

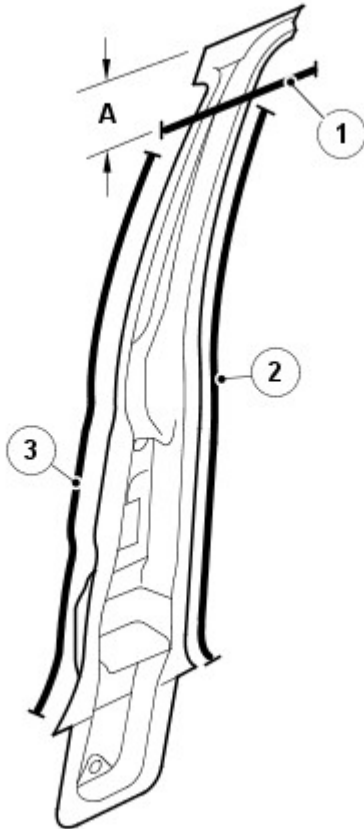
Removal

- NOTE: In this procedure the B-Pillar reinforcement is replaced in conjunction with the B-pillar outer panel.
- NOTE: The B-Pillar closing panel is fitted with the B-Pillar reinforcement.

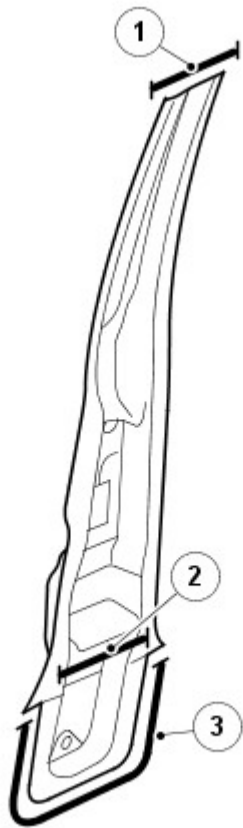
1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the B-pillar outer panel.
For additional information, refer to: [B-Pillar Outer Panel](#) (501-29 Side Panel Sheet Metal Repairs, Removal and Installation).

3.

Item	Part Number	Description
A	-	Cut line 140.0mm (5.51 inches)
1	-	Butt weld.
2,3	-	81 spot welds. (including the B-Pillar closing panel.)



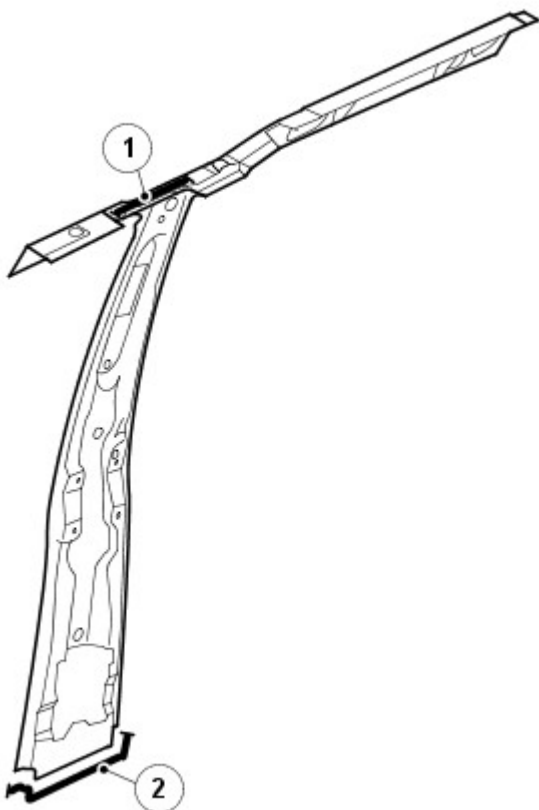
E55947



E57347

4.

Item	Part Number	Description
1	-	Butt weld.
2	-	Acoustic seal.
3	-	12 plug welds.



E55948

5. The B-Pillar closing panel is supplied with the cantrail. Remove the B-Pillar closing panel from the cantrail and fit the B-pillar closing panel to the B-Pillar reinforcement, as shown in graphic E55948 and E55947.

Item	Part Number	Description
1	-	9 plug welds.
2	-	4 spot welds.

6. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

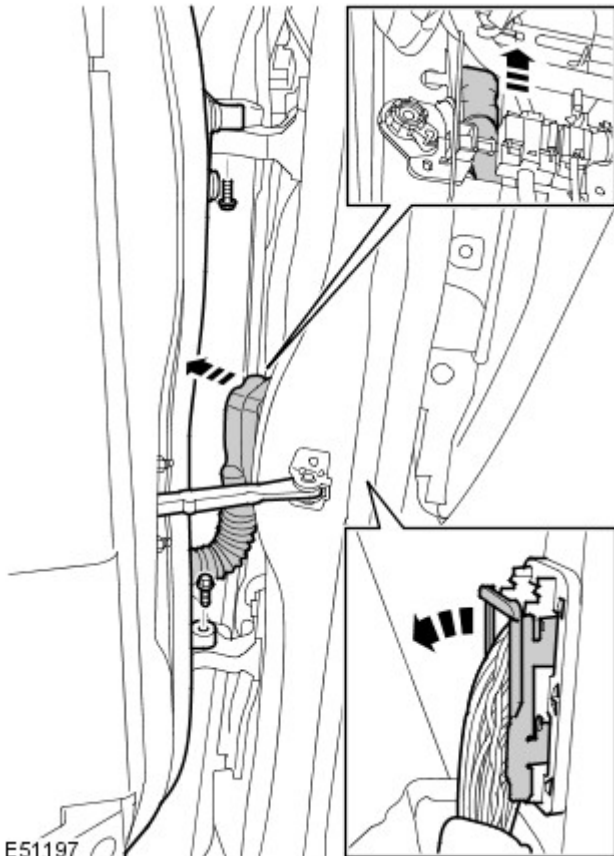
Side Panel Sheet Metal Repairs - Side Panel Front Section

Removal and Installation

Removal

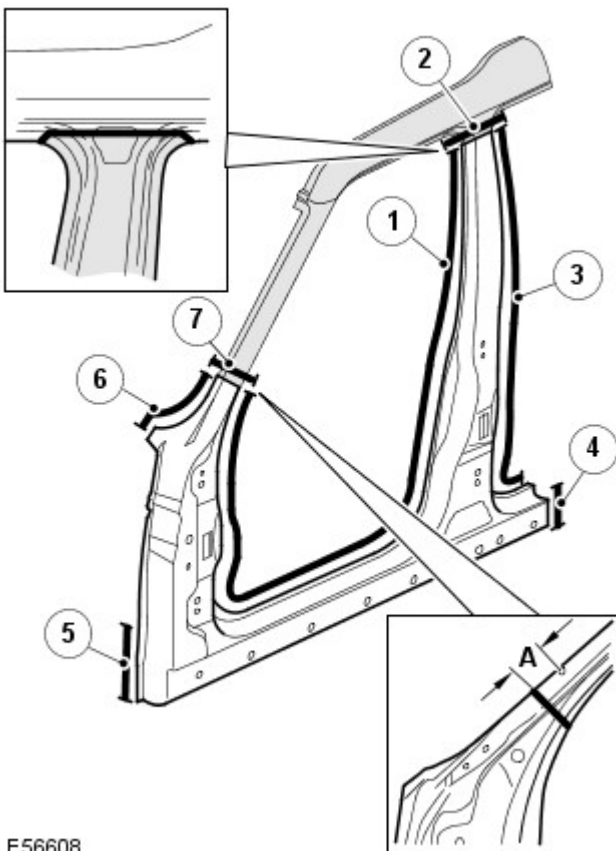
1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00, Specifications).
2. Remove the windshield glass.
For additional information, refer to: [Windshield Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
3. Remove the front fender.
For additional information, refer to: [Fender](#) (501-02 Front End Body Panels, Removal and Installation).
4. L/H side: Remove the battery junction box.
For additional information, refer to: [Battery Junction Box \(BJB\) - TDV6 2.7L Diesel](#) (418-00 Module Communications Network, Removal and Installation).
5. R/H side: Remove the brake booster.
For additional information, refer to: Brake Booster (206-07, Removal and Installation).
6. R/H side: Remove the ABS module.
For additional information, refer to: [Anti-Lock Brake System \(ABS\) Module](#) (206-09A Anti-Lock Control - Traction Control, Removal and Installation).
7. R/H side: Remove the accelerator pedal.
For additional information, refer to: [Accelerator Pedal](#) (310-02B Acceleration Control - V6 4.0L Petrol, Removal and Installation).
8. Remove the front and rear door assemblies.

- Disconnect the electrical connector
- Release the wiring harness grommet
- Release the wiring harness retaining clip
- Remove the 2 bolts



9. Remove front door striker.
10. Remove the insulation from the outer and inner bulkhead.
11. Remove the front and rear door weatherstrip.
12. Remove the footrest.
13. Release the A-Pillar wiring harness.
14. Remove the front safety belt retractor.
For additional information, refer to: [Front Safety Belt Retractor](#) (501-20A Safety Belt System, Removal and Installation).

15. Remove the B-Pillar side impact sensor.
For additional information, refer to: [B-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
16. Remove the side air curtain module.
For additional information, refer to: [Side Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
17. Remove the front seat.
For additional information, refer to: [Front Seat](#) (501-10 Seating, Removal and Installation).
18. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
19. Remove the wiring harness from the B-Pillar.
20. Release the wiring harness from the rocker panel.
21. Release wiring harness from roof panel.
22. Remove the rocker panel outer trim.
23. Release the front and back carpet.
- 24.

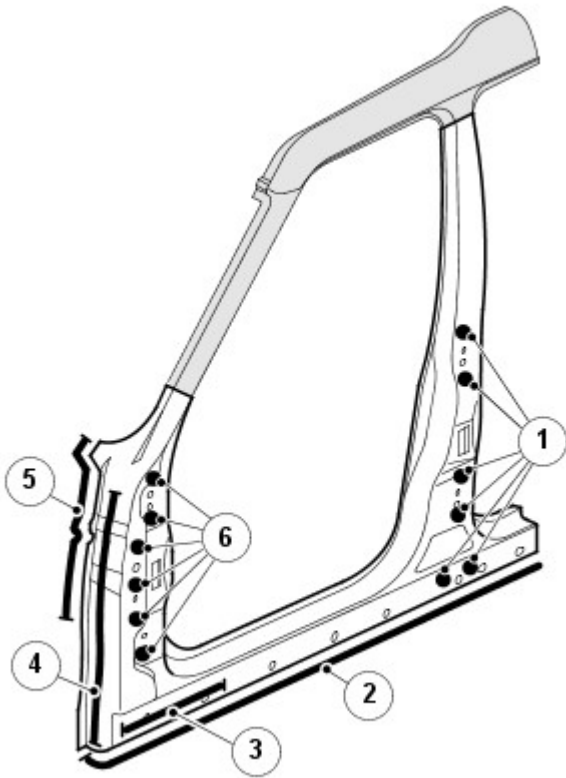


Item	Part Number	Description
A	-	Cut line is 55 mm (2.165 inches) from A-Pillar trim hole.
1	-	98 spot welds.
2	-	Butt weld.
3	-	80 spot welds.
4	-	Butt weld.
5	-	8 spot welds.
6	-	15 spot welds.
7	-	Butt weld.

E56608

25.

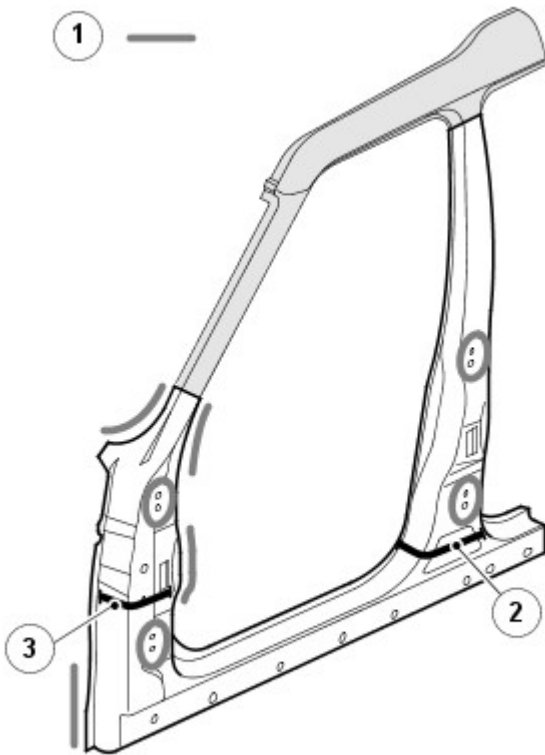
Item	Part Number	Description
1	-	6 plug welds.
2	-	31 plug welds.
3	-	4 plug welds.
4	-	10 plug welds.
5	-	13 plug welds.
6	-	6 plug welds.



E57174

26.

Item	Part Number	Description
1	-	Areas of adhesive.
2	-	Acoustic seal.
3	-	Acoustic seal.



E57175

27. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

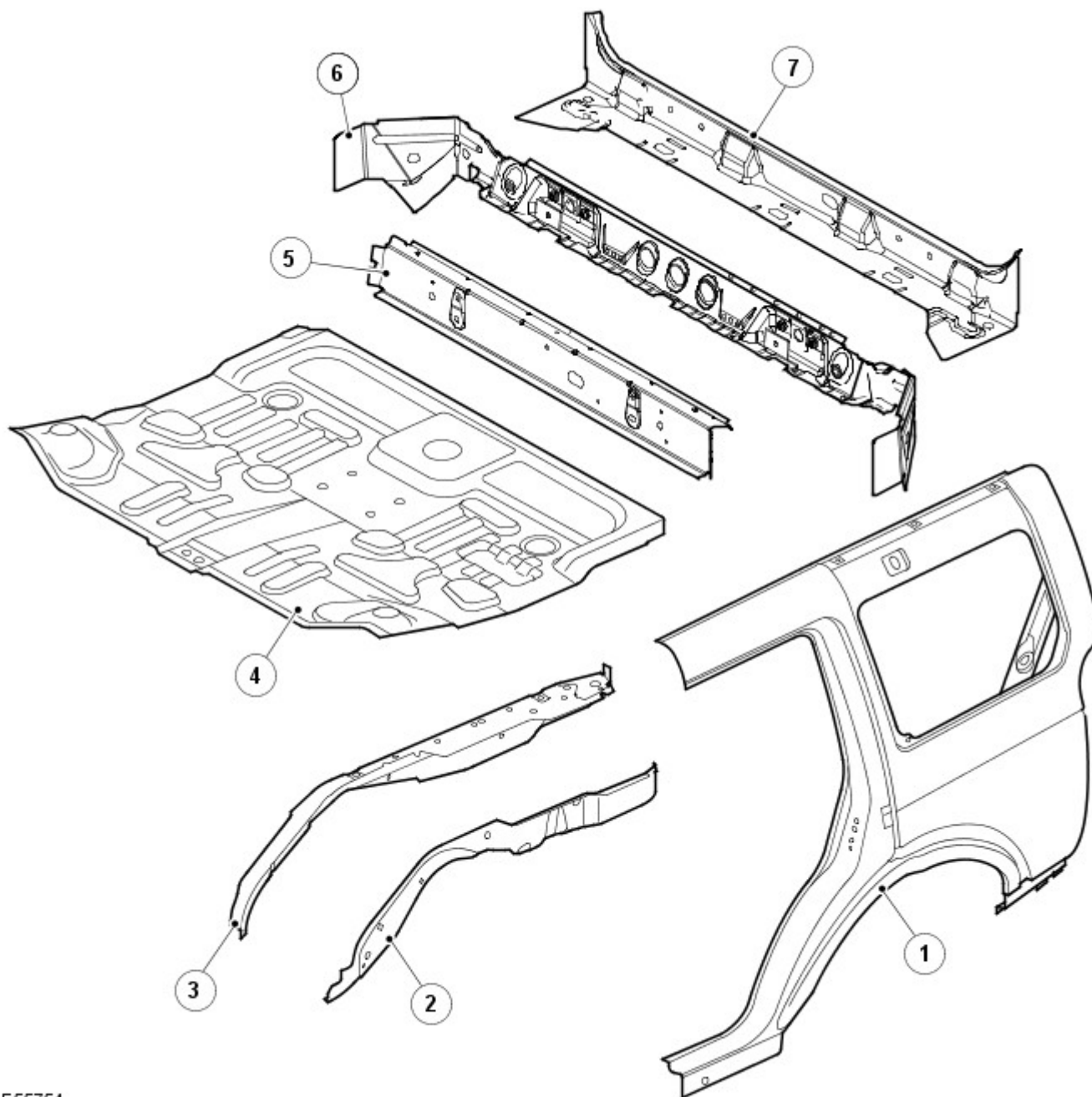
Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Rear End Sheet Metal

Description and Operation

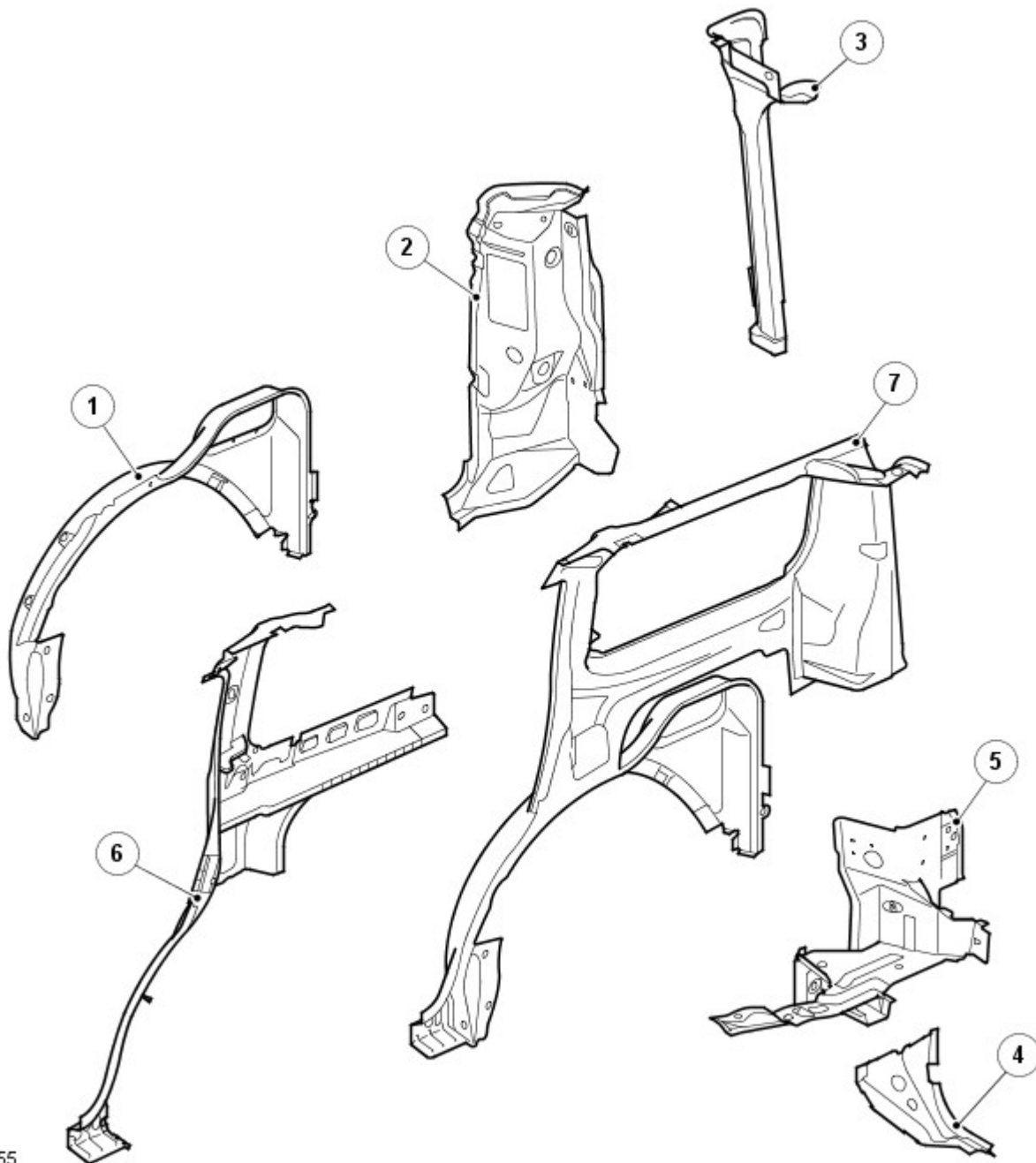
Rear end service panels



E55754

Item	Description	Service part No
1	Quarter panel outer	R/H ALA780100 L/H ALA780110
2	Rear side member	R/H AGA780021 L/H AGA780031
3	Rear side member	R/H AFD780080 L/H AFD780090
4	Rear floor panel	AFD780010
5	Rear crossmember	AQA780050
6	Rear panel reinforcement	AQR780080
7	Rear panel outer	AQA780030

Rear end service panels



E55755

Item	Description	Service part No
1	Rear wheelhouse outer	R/H ALK780100 L/H ALK780110
2	Rear lamp mounting panel	R/H AME780320 L/H AME780330
3	Water drain panel	R/H AME780300 L/H AME780310
4	D-pillar closing panel	R/H AFF780060 L/H AFF780070
5	D-pillar inner lower panel assembly	R/H AGY780060 L/H AGY780070
6	Inner quarter panel	R/H ALR780220 L/H ALR780230
7	Inner quarter panel/side panel rear section	R/H ALJ780120 L/H ALJ780130

Time schedules, front end

The following information shows the total time taken to replace single panels and complete assemblies. This time includes removal of Mechanical, Electrical and Trim (MET) items, plus paint times based on Metallic Clear Over Base Paint.

The times shown were generated by Thatcham (the motor insurance repair and research centre) and are to be used as a guide only.

Single panel times

Panel Description	Petrol	Diesel
Liftgate	9.0	9.0

Panel Description	Petrol	Diesel
Tailgate	6.7	6.7
Quarter panel L/H	23.4	23.4
Quarter panel R/H	23.7	23.7

Combination panel replacement times

The following panel combination times show the total time to remove/refit body panels, MET items and any paint process.

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
D-Pillar closing panel L/H and R/H		
Rear lamp panel		
Rear crossmember		
Rear panel		
Quarter panel		
Tailgate		
Total Time	L/H 35.6 R/H 35.9	L/H 35.6 R/H 35.9

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
D-Pillar closing panel L/H and R/H		
Rear lamp panel L/H and R/H		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel L/H and R/H		
Total Time	62.1	62.1

Combination panel times

Panel Description	Petrol	Diesel
Body off integraed frame		
Rear floor panel section		
Rear bumper		
Rear side member section		
D-Pillar closing panel		
D-Pillar inner lower panel assembly		
Rear lamp panel		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel		
Total Time	L/H 64.1 R/H 64.3	L/H 64.3 R/H 64.5

Combination panel times

Panel Description	Petrol	Diesel
Body off integraed frame		
Rear floor panel section		
Rear bumper		
Rear side member section L/H and R/H		
D-Pillar closing panel L/H and R/H		
D-Pillar inner lower panel assembly L/H and R/H		
Rear lamp panel L/H and R/H		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel L/H and R/H		
Total Time	87.4	87.6

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
D-Pillar closing panel		
D-Pillar inner lower panel assembly		
Rear lamp panel		
Rear panel		
Rear crossmember		
Tailgate		
Quarter panel		
Total Time	48.7	48.7

Combination panel times

Panel Description	Petrol	Diesel
Rear bumper		
Rear lamp panel		
Rear panel		
Rear crossmember		

Panel Description	Petrol	Diesel
D Pillar closing panel L/H and R/H		
Tailgate		
Total Time	27.1	27.1

Rear End Sheet Metal Repairs - Quarter Panel

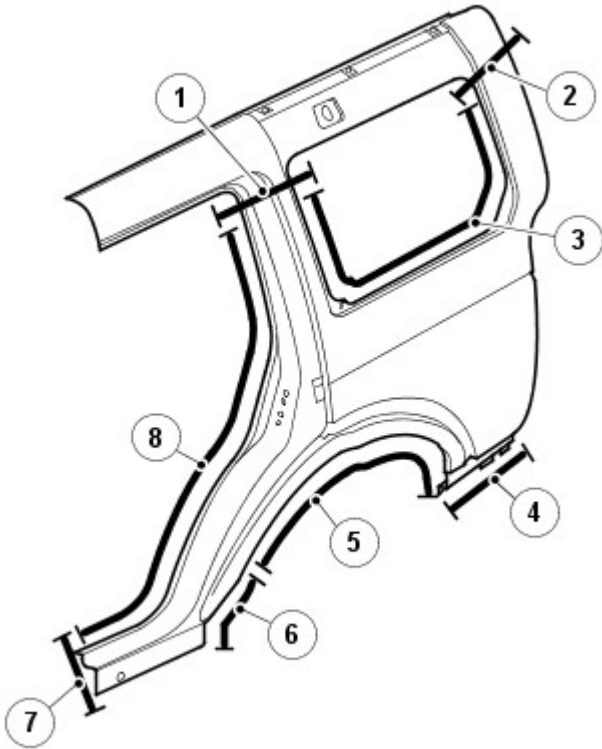
Removal and Installation

Removal

1. Load vehicle onto ramp.
2. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
3. Remove the rear wheel and tire.
4. Remove the rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
5. Remove the forced air extraction grille.
6. R/H side: Remove fuel tank.
For additional information, refer to: [Fuel Tank](#) (310-01A Fuel Tank and Lines - TDV6 2.7L Diesel, Removal and Installation).
7. R/H side: Remove the fuel tank filler pipe.
For additional information, refer to: Fuel Tank Filler Pipe (310-01C Fuel Tank and Lines - 2.7L Diesel, Removal and Installation).
8. R/H side: Remove the fuel filler interlock catch.
For additional information, refer to: [Fuel Filler Interlock Catch](#) (501-03 Body Closures, Removal and Installation).
9. Remove the headliner.
For additional information, refer to: [Headliner](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
10. Remove the rear seat.
For additional information, refer to: [Rear Seat - Vehicles With: 60/40 Split Seat](#) (501-10 Seating, Removal and Installation).
11. Remove the C-pillar side impact sensor.
For additional information, refer to: [C-Pillar Side Impact Sensor](#) (501-20B Supplemental Restraint System, Removal and Installation).
12. Remove the side air curtain module.
For additional information, refer to: [Side Air Curtain Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
13. Remove the rear quarter window glass.
For additional information, refer to: [Rear Quarter Window Glass](#) (501-11 Glass, Frames and Mechanisms, Removal and Installation).
14. Remove the rocker panel finisher.
15. Remove the exhaust heatshield.
16. Remove the tailgate latch.
For additional information, refer to: [Tailgate Latch](#) (501-14 Handles, Locks, Latches and Entry Systems, Removal and Installation).
17. Remove the tailgate weatherstrip.
18. With assistance remove the tailgate.
19. Remove the load space trims.
20. Remove the load space carpets.
21. Release the wiring harness.

22.

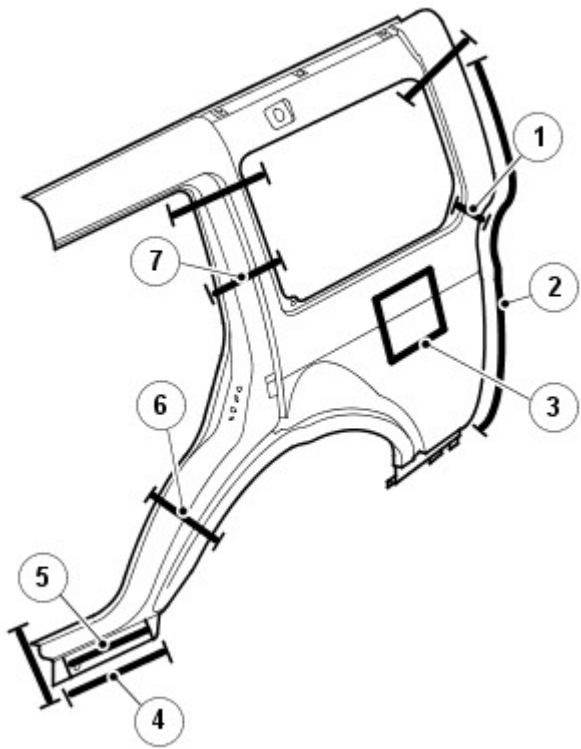
Item	Part Number	Description
1	-	Butt weld.
2	-	Butt weld.
3	-	50 spot welds.
4	-	5 spot welds.
5	-	40 spot welds.
6	-	9 spot welds.
7	-	Butt weld.
8	-	40 spot welds.



E56609

23.

Item	Part Number	Description
1	-	Acoustic seal.
2	-	16 plug welds.
3	-	Acoustic seal R/H.
4	-	7 plug welds.
5	-	3 plug welds.
6	-	Acoustic seal.
7	-	Acoustic seal.



E57109

24. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).

- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Inner Quarter Panel

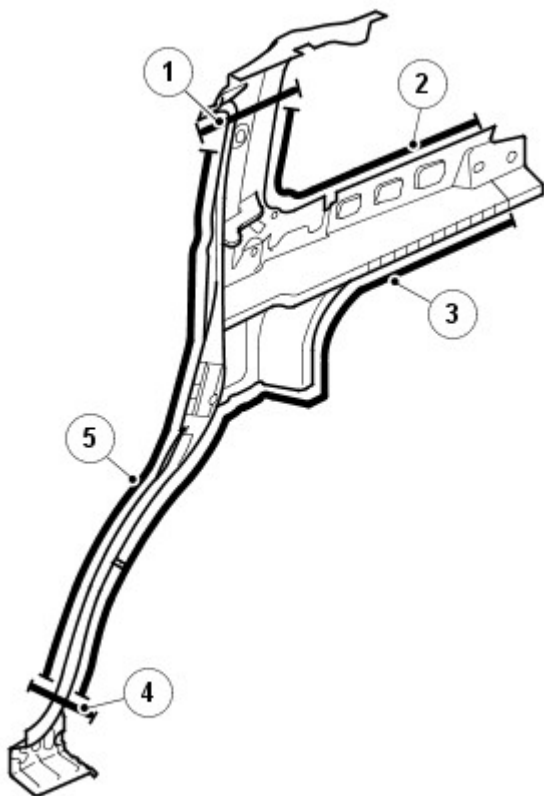
Removal and Installation

Removal

- NOTE: In this procedure, the inner quarter panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 3.

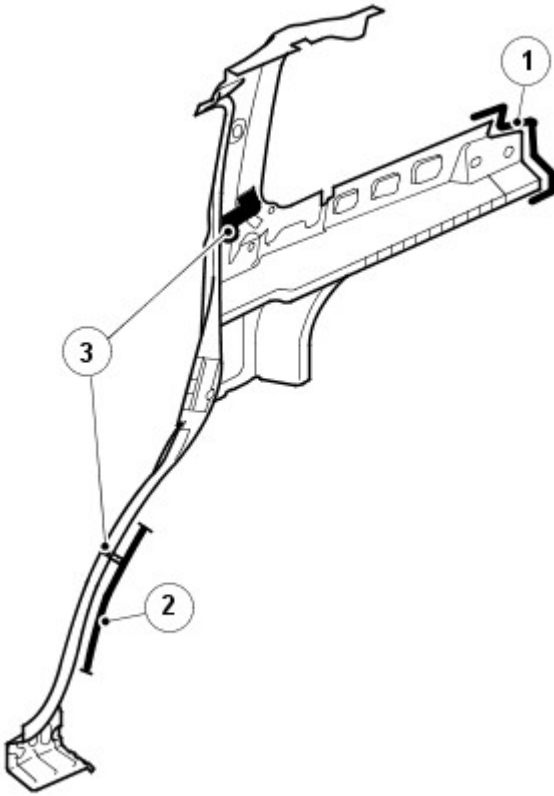
Item	Part Number	Description
1	-	Butt weld.
2	-	24 spot welds.
3	-	11 spot welds.
4	-	Butt weld.
5	-	40 spot welds.



E55760

4.

Item	Part Number	Description
1	-	5 plug welds.
2	-	8 plug welds.
3	-	Acoustic seals



E57103

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Water Drain Panel

Removal and Installation

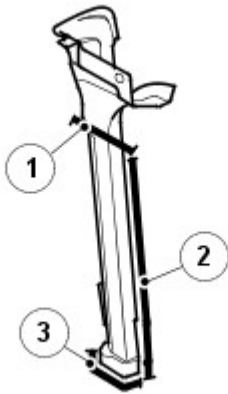
Removal

- NOTE: In this procedure, the water drain panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.

Item	Part Number	Description
1	-	Butt weld.
2	-	12 spot-welds.
3	-	2 plug-welds.



E55934

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Rear Wheelhouse Outer

Removal and Installation

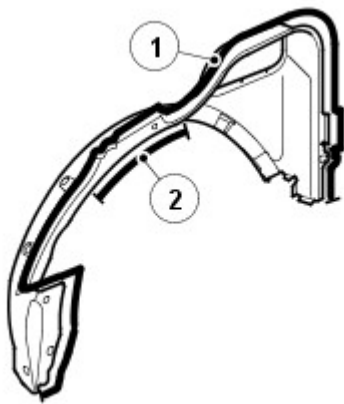
Removal

- NOTE: In this procedure, the rear wheelhouse outer is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Disconnect the parking brake cables.
For additional information, refer to: Parking Brake Cable (206-05 Parking Brake and Actuation, Removal and Installation).
3. Remove the brake line.
4. Remove the rear suspension.
For additional information, refer to: Rear Suspension (204-02 Rear Suspension, Description and Operation).
5. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

6.

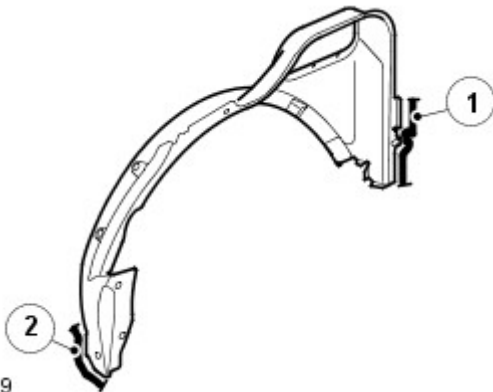
Item	Part Number	Description
1	-	60 spot welds.
2	-	10 spot welds.



E55930

7.

Item	Part Number	Description
1	-	160mm (6.29) adhesive.
2	-	2 plug welds and 5 spot welds.



E57119

8. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Rear Lamp Mounting Panel

Removal and Installation

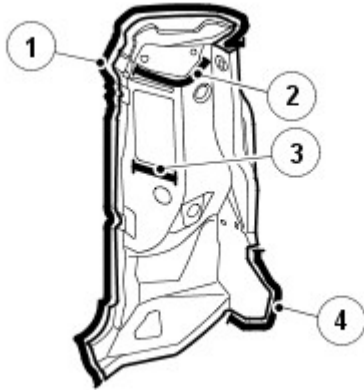
Removal

- NOTE: In this procedure, the rear lamp mounting panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

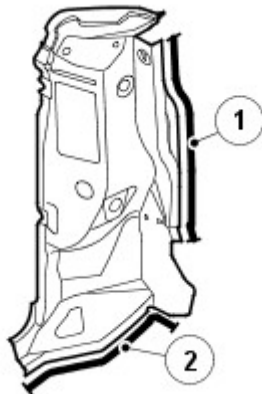
3.



E57102

Item	Part Number	Description
1	-	18 plug welds.
2	-	Adhesive.
3	-	3 plug welds.
4	-	2 plug welds.

4.



E55761

Item	Part Number	Description
1	-	16 spot welds.
2	-	11 spot welds.

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Back Panel

Removal and Installation

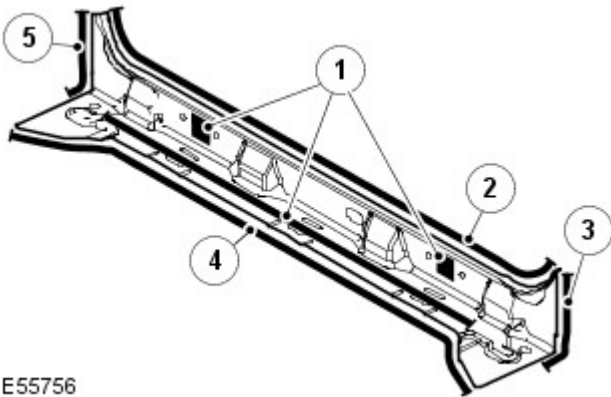
Removal

- NOTE: When replacing the back panel it is necessary to remove a section of the rear lamp panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
3. Remove both D-pillar trim panels.
For additional information, refer to: [D-Pillar Trim Panel](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Remove the tailgate hinge trim cover.
5. Remove the tailgate weather seal.
6. Remove the load space trims.
7. Remove the load space carpets.
8. With assistance remove the tailgate.
9. Remove the L/H exhaust heatshield tailpipe.
10. Remove the R/H exhaust heatshield tailpipe.
11. Remove the spare wheel and tire.
12. Release the back panel wiring harness.

13.

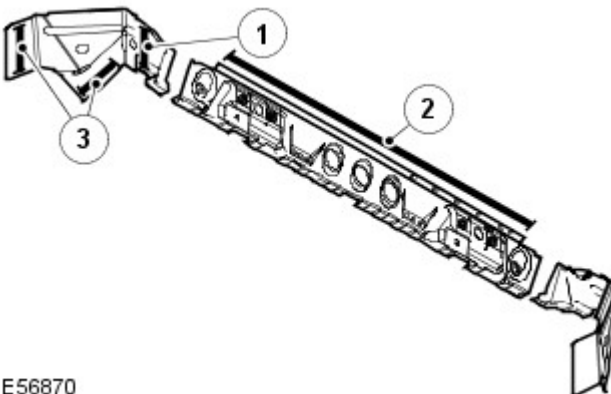
Item	Part Number	Description
1	-	20 plug welds.
2	-	42 spot welds.
3	-	4 plug welds.
4	-	21 plug welds.
5	-	4 plug welds.



E55756

14.

Item	Part Number	Description
1	-	2 plug welds. (R/H is symmetrically opposite to L/H)
2	-	30 spot welds.
3	-	7 spot welds. (R/H is symmetrically opposite to L/H)



E56870

15. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#)

(501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

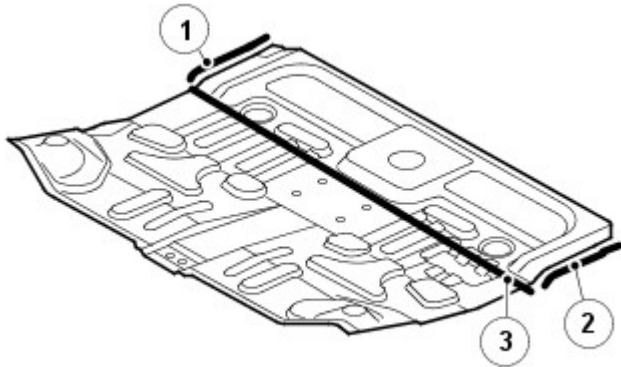
Rear End Sheet Metal Repairs - Rear Floor Panel Section

Removal and Installation

Removal

• NOTE: In this procedure, the rear floor panel section is replaced in conjunction with the back panel and rear crossmember.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the back panel.
For additional information, refer to: [Back Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
3. Remove the rear crossmember.
For additional information, refer to: [Rear Crossmember](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 4.



Item	Part Number	Description
1	-	Mig-weld.
2	-	Mig-weld.
3	-	Mig-welds and 18 plug-welds.

E55762

5. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

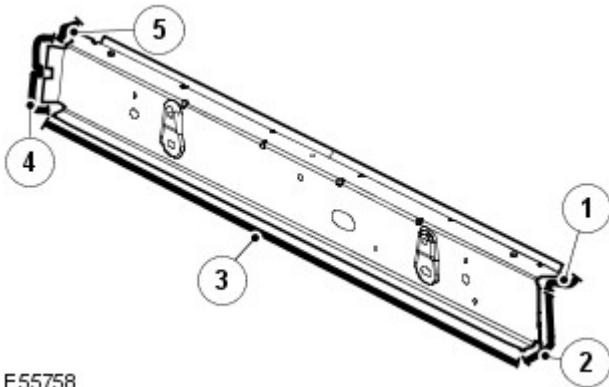
Rear End Sheet Metal Repairs - Rear Crossmember

Removal and Installation

Removal

- NOTE: In this procedure, the rear crossmember is replaced in conjunction with the back panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the back panel.
For additional information, refer to: [Back Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 3.



E55758

Item	Part Number	Description
1	-	Mig weld.
2	-	3 spot welds.
3	-	12 plug welds.
4	-	3 spot welds.
5	-	Mig weld.

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - Quarter/Side Panel Rear Section LH

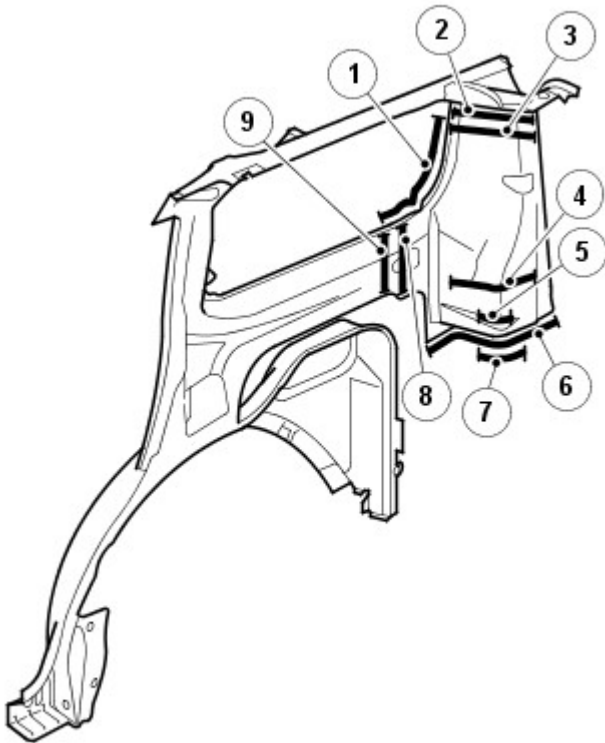
Removal and Installation

Removal

- NOTE: The quarter / side panel rear section R/H is symmetrically opposite to the L/H.
- NOTE: In this procedure, quarter / side panel rear section is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 3.

Item	Part Number	Description
1	-	15 spot welds.
2	-	Butt weld.
3	-	Butt weld.
4	-	Acoustic seal.
5	-	3 plug welds.
6	-	8 plug welds.
7	-	Mig weld.
8	-	5 plug welds.
9	-	Butt weld.



E55933

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

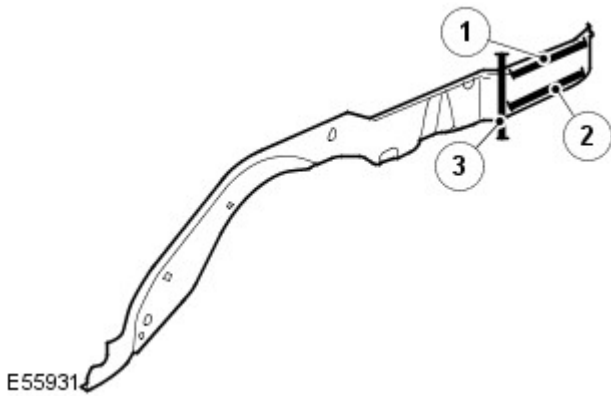
Rear End Sheet Metal Repairs - Rear Side Member Section

Removal and Installation

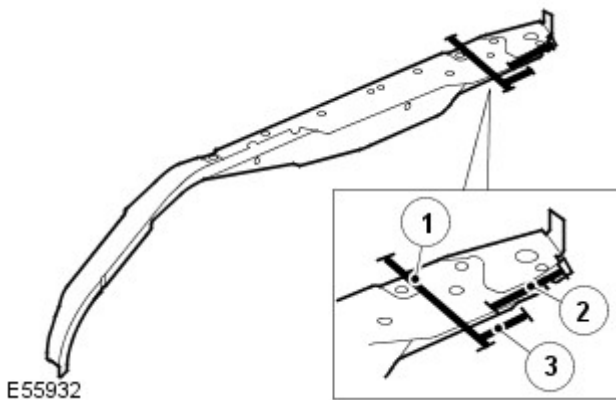
Removal

• **NOTE:** In this procedure, the rear side member section is replaced in conjunction with the back panel and rear crossmember.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the back panel.
For additional information, refer to: [Back Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
3. Remove the rear crossmember.
For additional information, refer to: [Rear Crossmember](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).
- 4.



Item	Part Number	Description
1	-	2 plug welds. (also see graphic E55932)
2	-	2 plug welds.
3	-	Butt weld.



- 5.

Item	Part Number	Description
1	-	Butt weld.
2	-	2 plug welds.
3	-	4 plug welds.

6. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - D-Pillar Inner Lower Panel

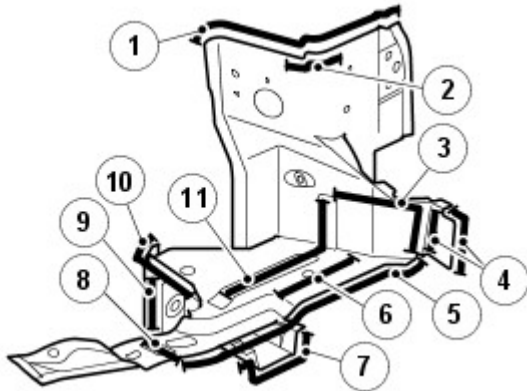
Removal and Installation

Removal

- NOTE: In this procedure the D-Pillar inner lower panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.



E56610

Item	Part Number	Description
1	-	8 plug welds.
2	-	3 plug welds.
3	-	4 plug welds.
4	-	Mig weld.
5	-	7 plug welds.
6	-	6 plug welds.
7	-	4 plug welds.
8	-	Butt weld.
9	-	Adhesive
10	-	4 plug welds.
11	-	6 plug welds.

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Rear End Sheet Metal Repairs - D-Pillar Closing Panel

Removal and Installation

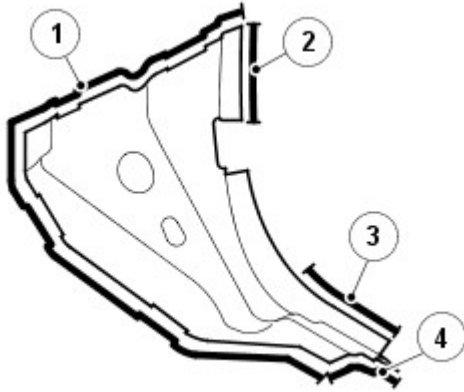
Removal

- NOTE: In this procedure the D-Pillar closing panel is replaced in conjunction with the quarter panel.

1. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
2. Remove the quarter panel.
For additional information, refer to: [Quarter Panel](#) (501-30 Rear End Sheet Metal Repairs, Removal and Installation).

3.

Item	Part Number	Description
1	-	Mig weld.
2	-	2 plug welds.
3	-	1 plug weld.
4	-	4 plug welds.



E56611

4. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. Install is the reversal of removal.

Full Frame and Body Mounting -


Torque Specifications

Description	Nm	lb-ft
HO2s harness bracket bolt	10	7
Transmission support crossmember nuts and bolts	90	66
Transmission support insulator through-bolt	175	129
Transmission undershield bolts	10	7
*Integrated-body frame to body bolts	133	98

* New bolts must be installed

Full Frame and Body Mounting - Tow Bar Mounting Check

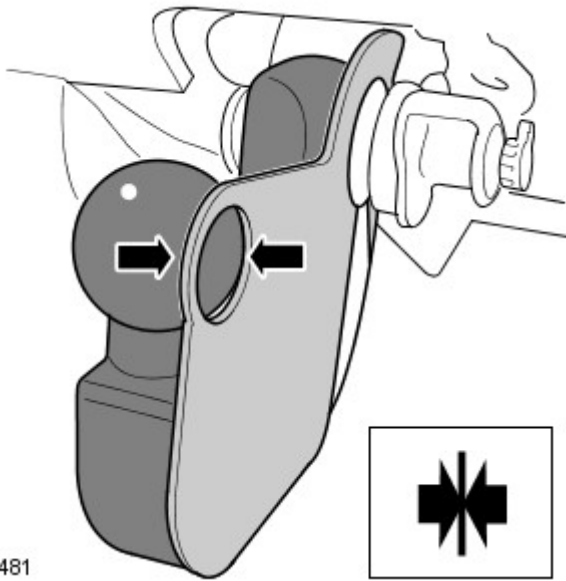
General Procedures

Special Tool(s)	
 E140509	Tow Bar Gauge JLR-501-201

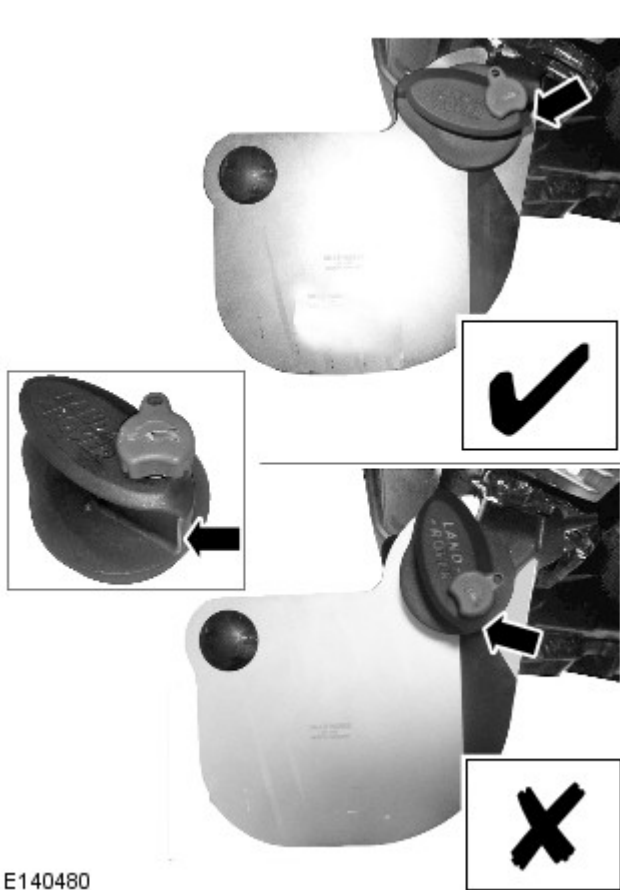
- 1. Pre test:** Check the detachable tow bar locking pin is moving freely without sticking.
- 2.** Insert the tow bar into the chassis following the owners handbook instruction.

3.  **CAUTION:** The special tool must be flat against the tow bar ball before taking measurements.


Hold the special tool JLR-501-201 against the tow bar as shown, failure to follow this instruction may result in an incorrect measurement.



E140481



E140480

4.  CAUTION: Make sure the special tool is mounted flush to the tow ball.

• NOTE: Note the position of the tow bar release handle.

Install the special tool as shown.

5. Check the position of the tow bar release handle against the special tool, and observe the following:

- If the tow bar release handle points to the red area of the special tool, go to Step 6.
- If the tow bar release handle points outside of the red area of the special tool, then the tow bar mounting is correct and no further action is required.

6. Install a new tow bar and check the tow bar mounting following Steps 3 - 5.


- If the tow bar release handle points to the red area of the special tool, install a new rear crossmember. For additional information, refer to: [Rear Crossmember](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Full Frame and Body Mounting - Transmission Support CrossmemberV6 4.0L Petrol/TDV6 2.7L Diesel

Removal and Installation

Removal

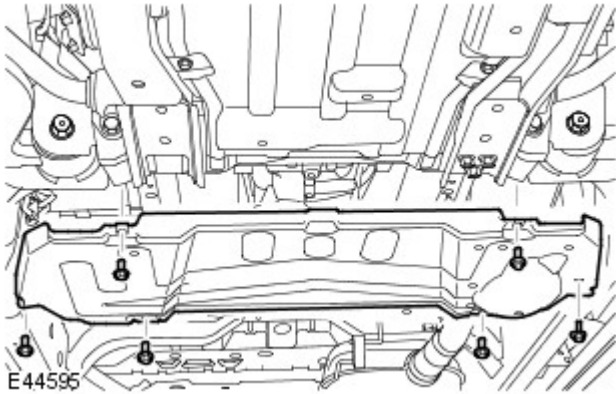
All vehicles

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission undershield.

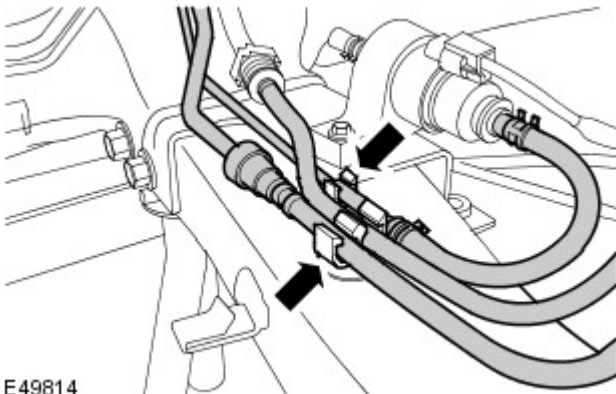
- Remove the 6 bolts.



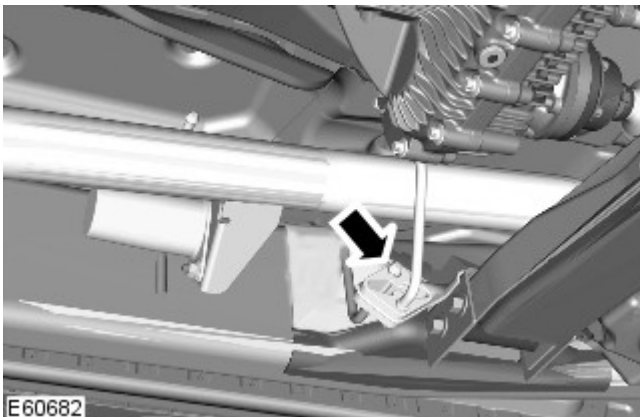
Vehicles with diesel engine

3. Release the 3 fuel lines.

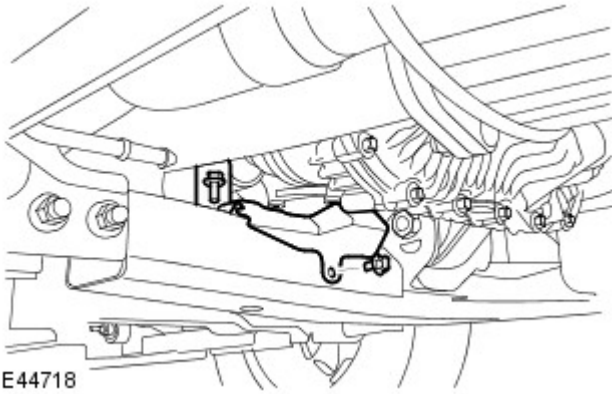
- Release from the 3 clips.



4. Release the exhaust front mounting.



Vehicles with petrol engine



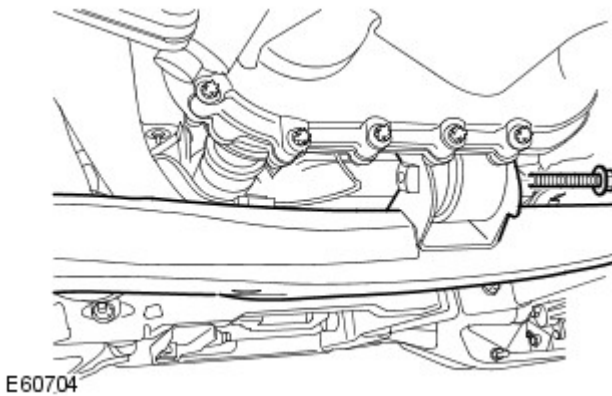
5. Release the HO2S wiring harness and bracket from the crossmember.

- Remove the 2 bolts.
- Tie the bracket aside.

All vehicles

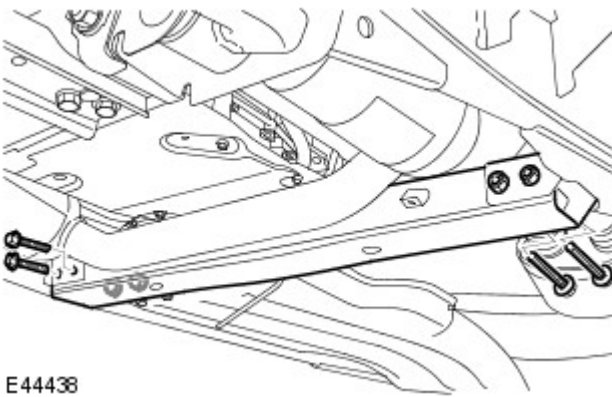
6. Remove the transmission support insulator through-bolt.

- Support the transfer case.



7. Remove the crossmember.

- Remove the 4 nuts and bolts.



Installation


All vehicles

1. Install the crossmember.

- Tighten the nuts and bolts to 90 Nm (66 lb.ft).

2. Install the transmission support insulator through-bolt and tighten to 175 Nm (129 lb.ft).

Vehicles with petrol engine

Vehicles with Diesel engine  Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

4. Secure the 3 fuel lines:

- Secure in the clips
- Attach the HO2S wiring harness and bracket to the crossmember.

5. Connect the exhaust front mounting.

- Tighten the bolts to 10 Nm (7 lb.ft).

All vehicles

6. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).


Full Frame and Body Mounting - Transmission Support CrossmemberTDV6

3.0L Diesel

Removal and Installation

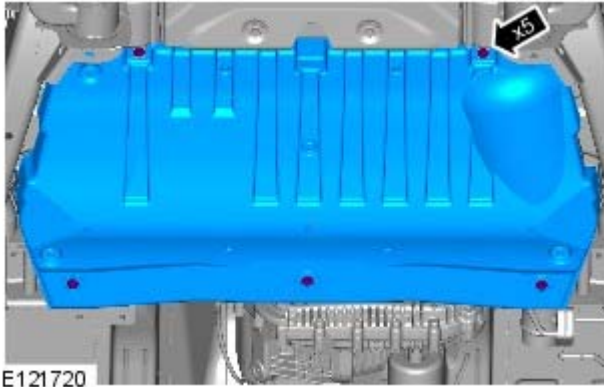
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

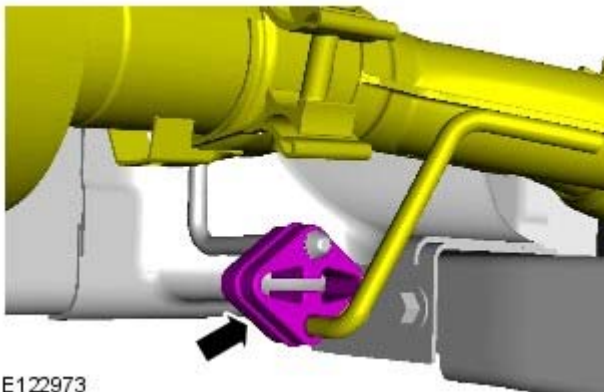
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

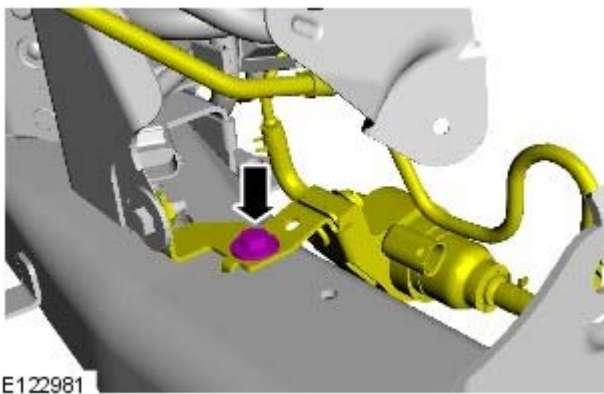
2.

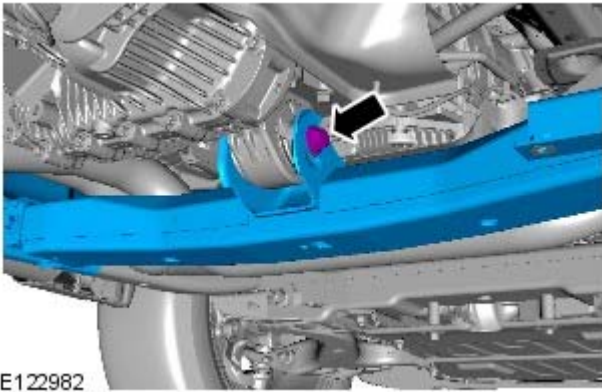


3.



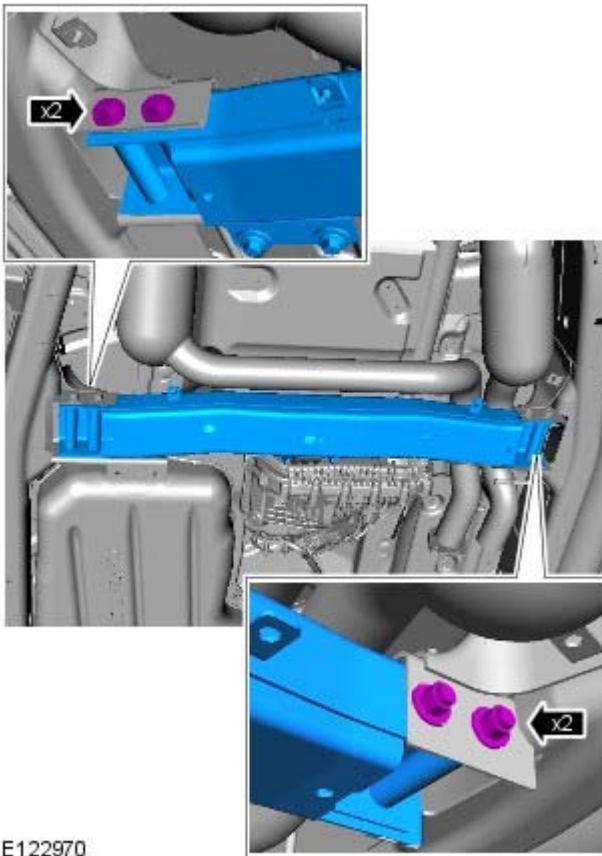
4.





5.

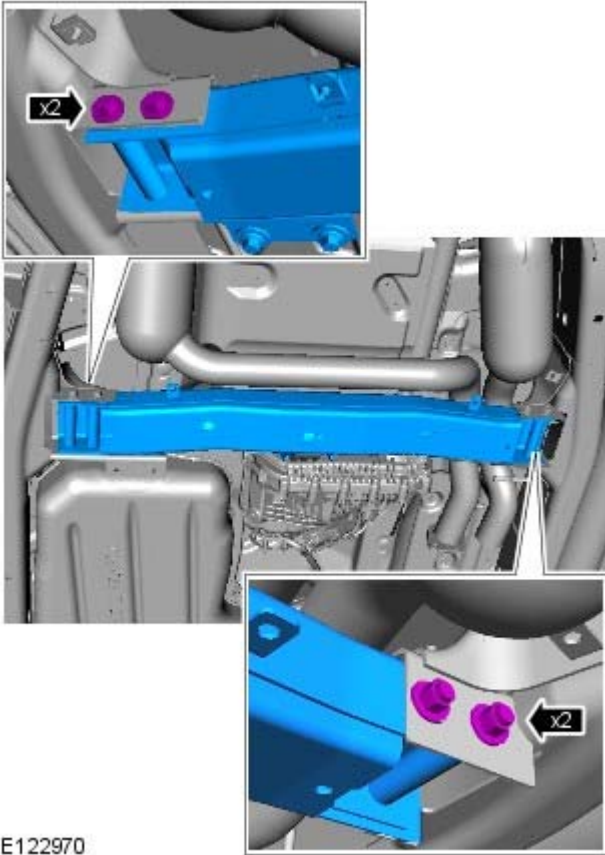
- Support the transfer case.



6.

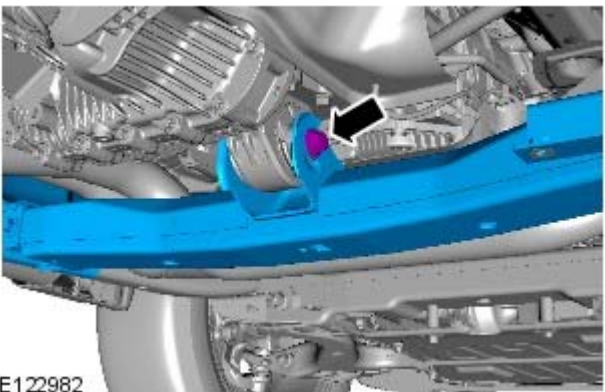
Installation

1. TORQUE: 115 Nm



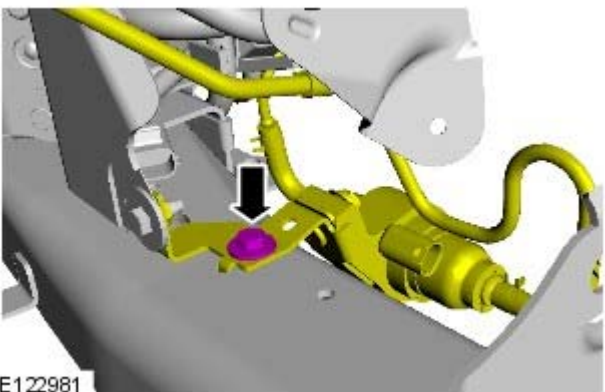
E122970

2. TORQUE: 175 Nm



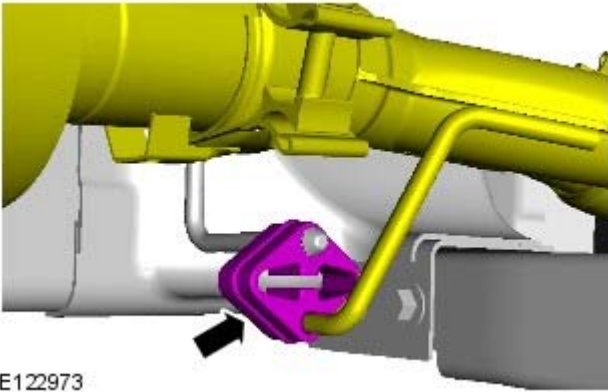
E122982

3. TORQUE: 10 Nm



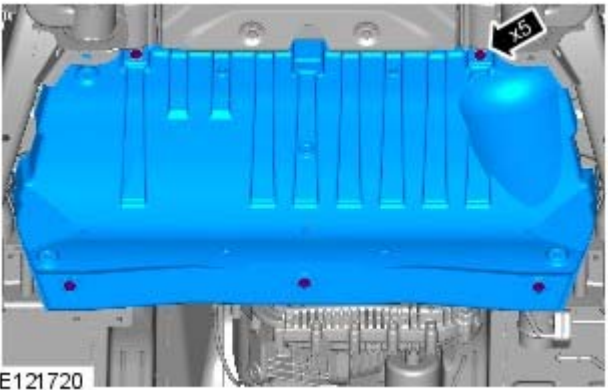
E122981

4.



E122973

5. TORQUE: 10 Nm




E121720

Full Frame and Body Mounting - Transmission Support CrossmemberV8 5.0L Petrol

Removal and Installation

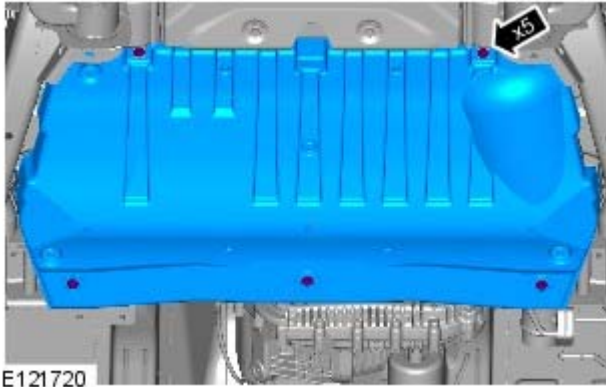
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

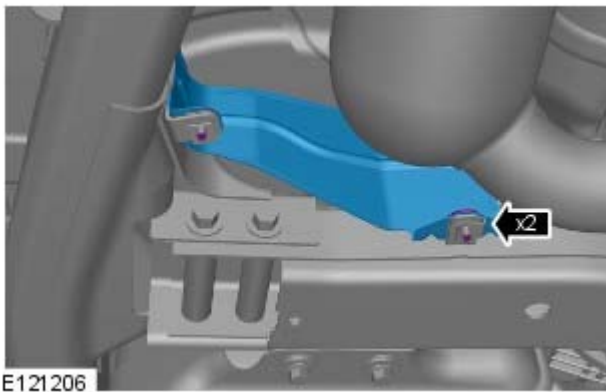
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

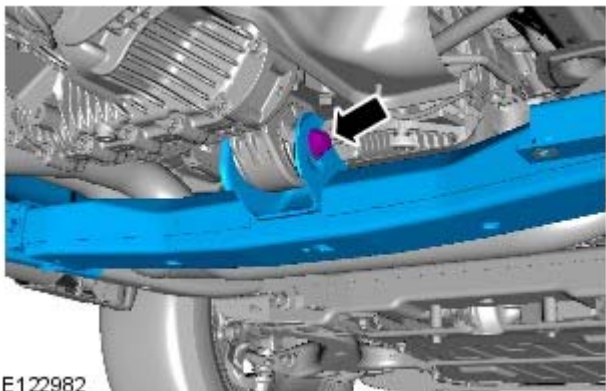
2.



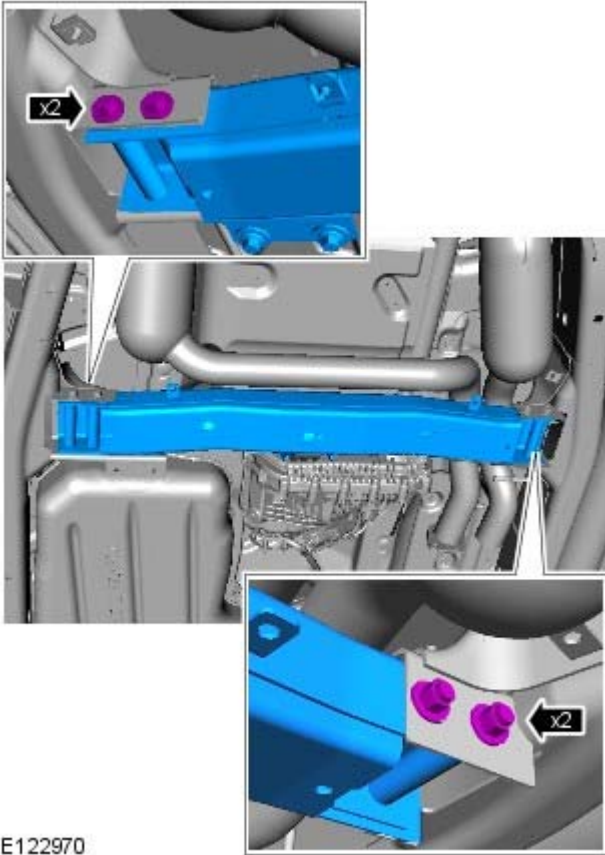
3.



4.



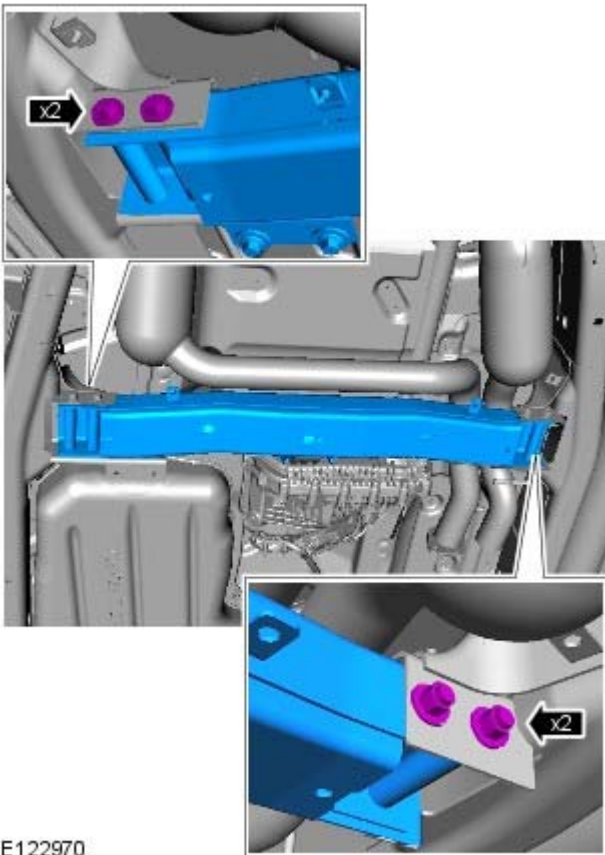
5.



E122970

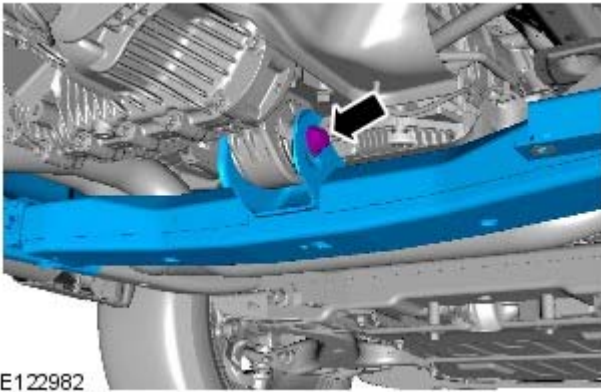
Installation

1. TORQUE: 115 Nm

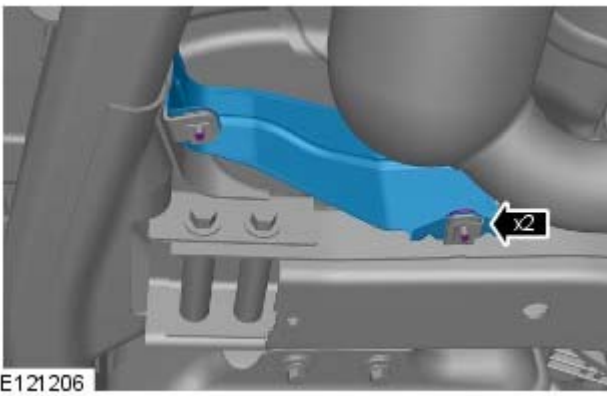


E122970

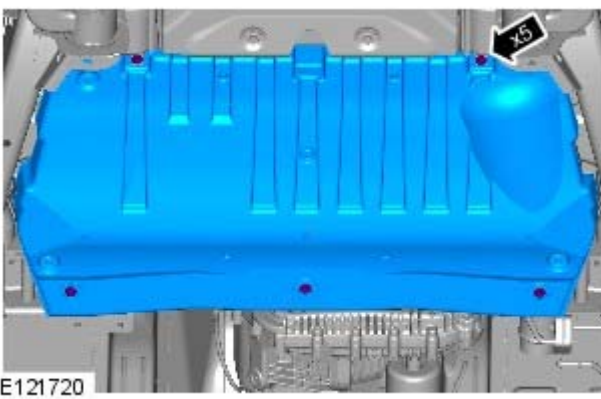
2. TORQUE: 175 Nm



3. TORQUE: 10 Nm



4. TORQUE: 10 Nm



5. Lower the vehicle.

Full Frame and Body Mounting - Rear Crossmember

Removal and Installation

Removal

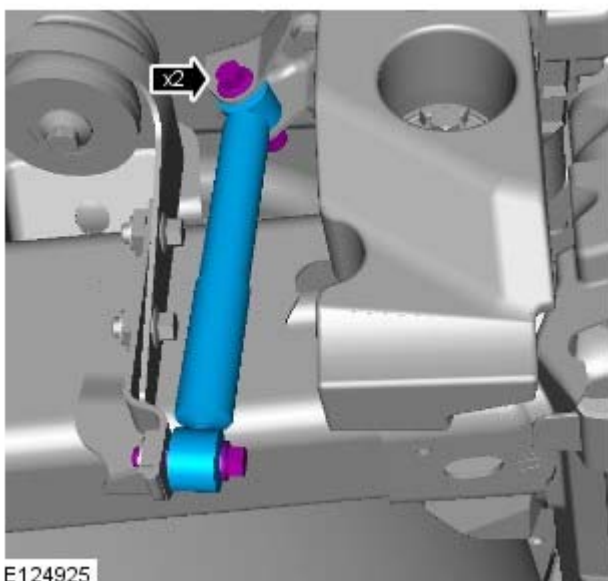
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Disconnect both battery cables.
For additional information, refer to: Specifications (414-00 Charging System - General Information, Specifications).
3. Remove the rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
4. Remove the spare wheel and tire.

5. **NOTE:** Left-hand shown, right-hand similar.

Remove both rear body mount dampers.

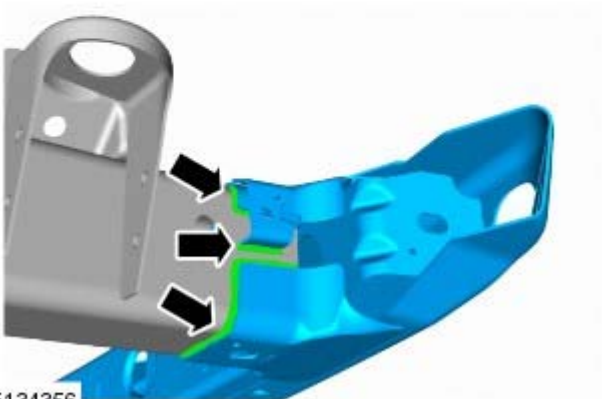
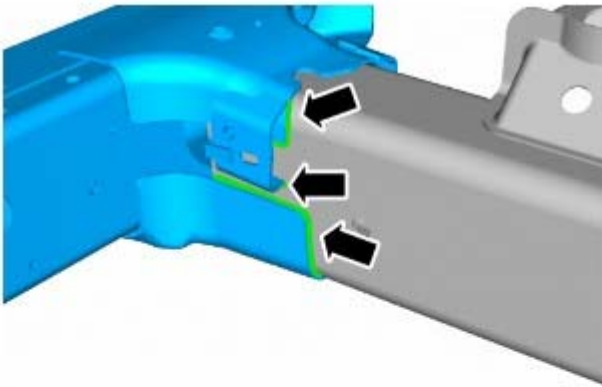


6. Remove the rear bumper fixings.

7. NOTE: Right-hand shown, left-hand similar.

Remove the rear crossmember.

Item	Description
-	Mig weld. (R/H is symmetrically opposite to L/H).



E134356

8. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. To install, reverse the removal procedure.

- Tighten both rear body damper(s) retaining bolts to 45Nm.

Full Frame and Body Mounting - BodyV6 4.0L Petrol/V8 5.0L Petrol

Removal and Installation

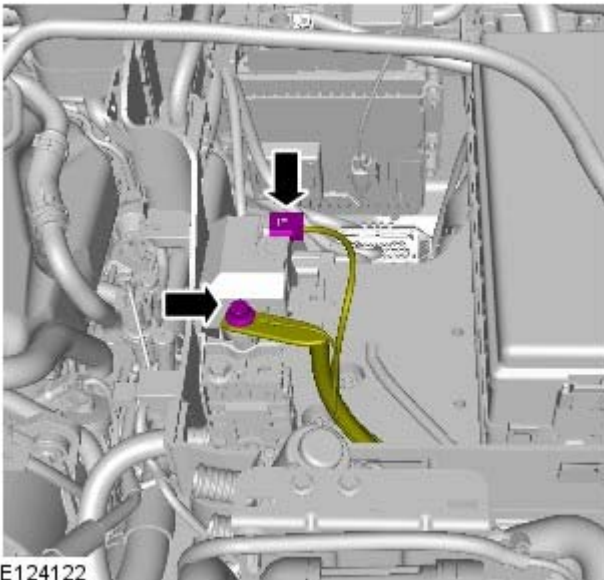
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the engine removed for clarity.

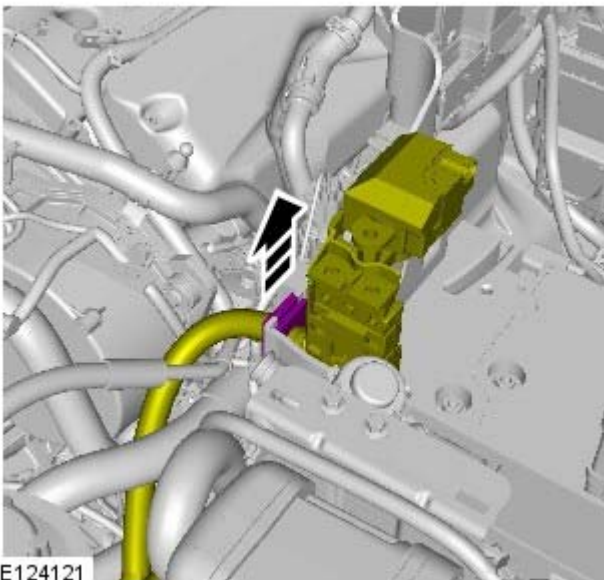
All vehicles

1. Remove the battery for access.
For additional information, refer to: Battery (414-01, Removal and Installation).

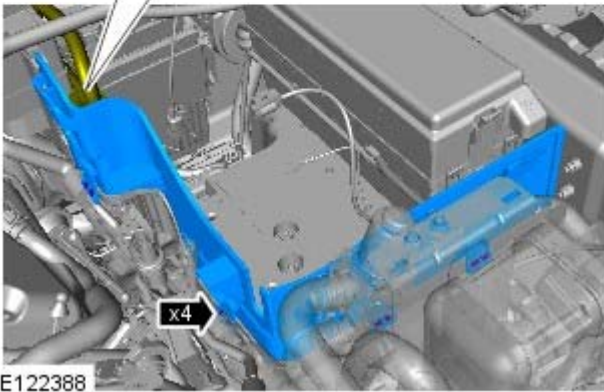
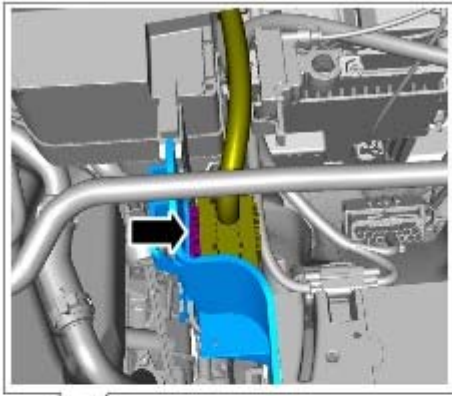
2.



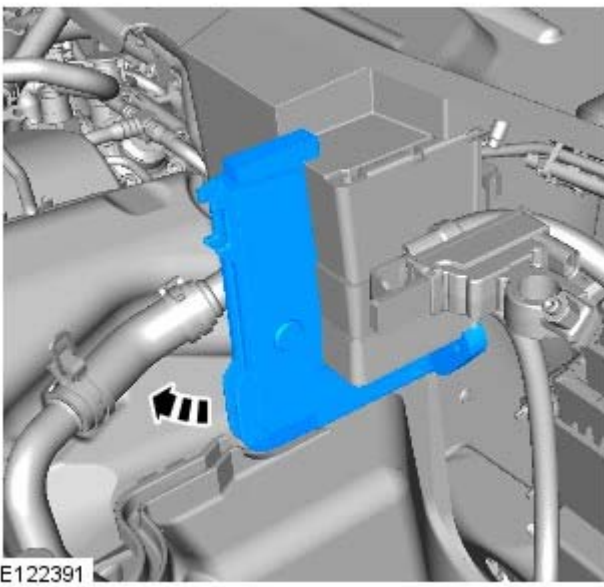
3.



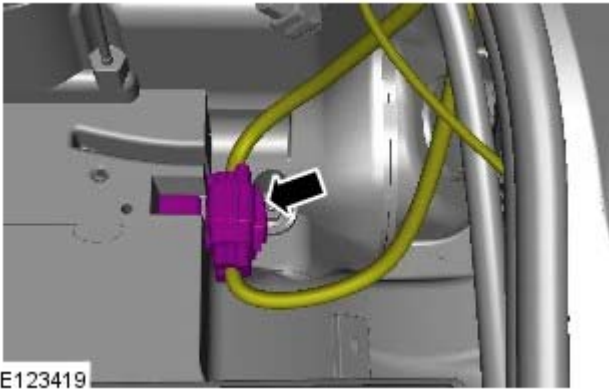
4. NOTE: RHD illustration shown, LHD is similar.



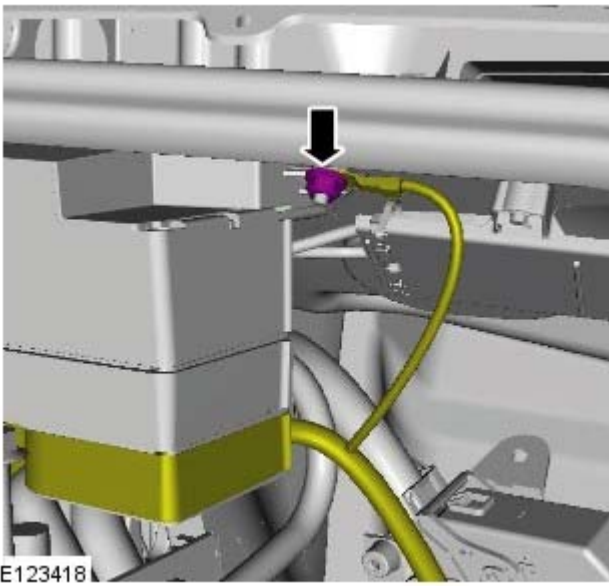
5.



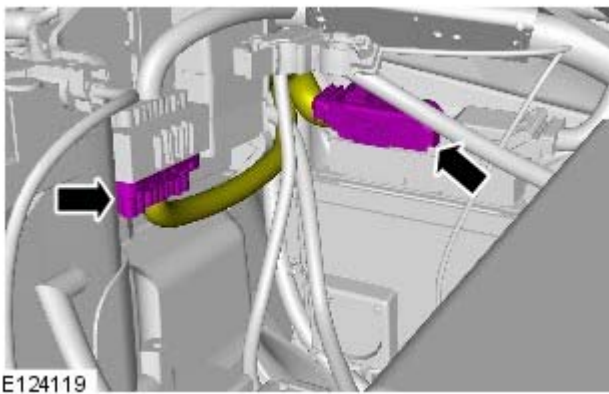
6.



7.



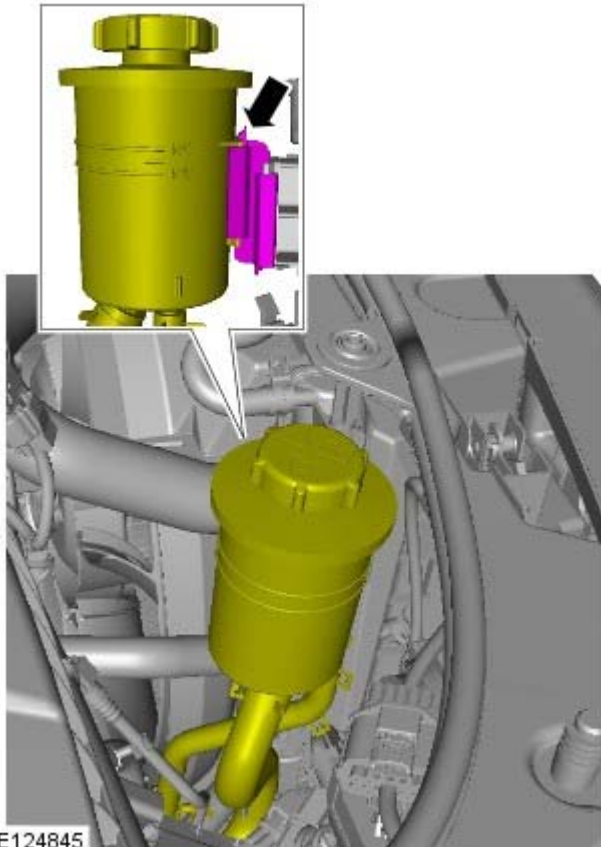
8.



9. For additional information, refer to: Air Cleaner LH (303-12, Removal and Installation).
10. For additional information, refer to: Air Cleaner RH (303-12, Removal and Installation).
11. For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
12. For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
13. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).
14. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

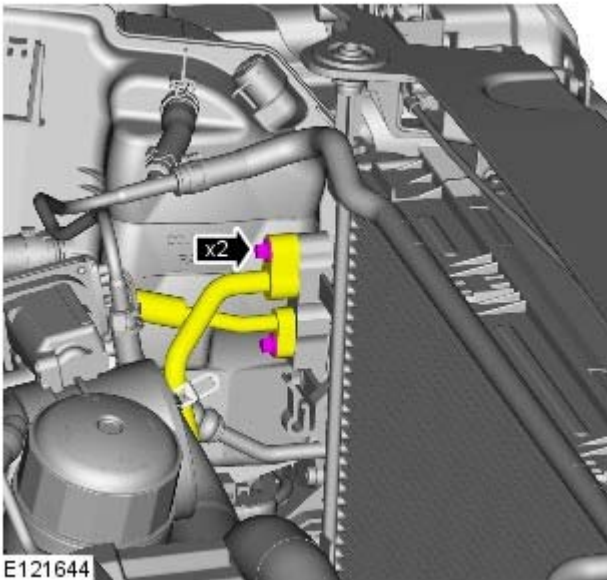
Vehicles with active damping

15.



E124845

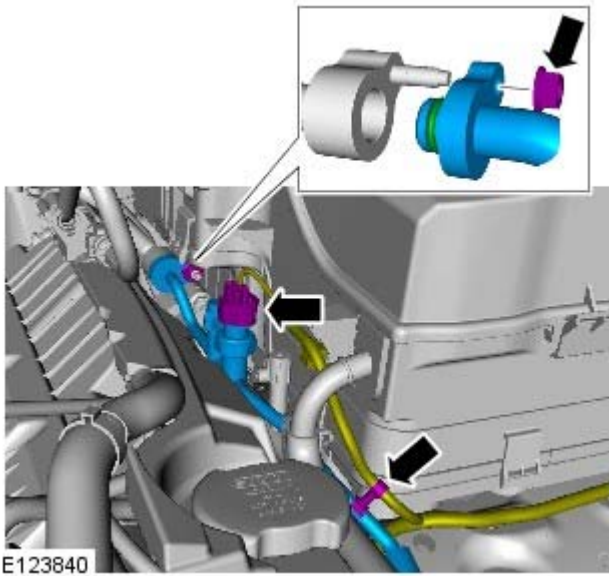
All vehicles




E121644

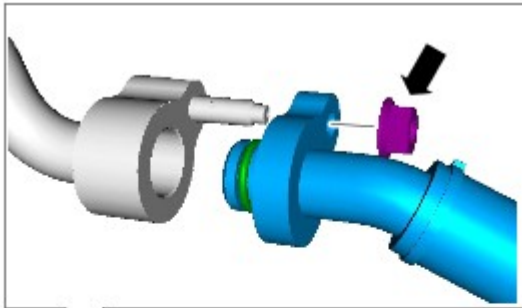
16.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.


- Remove and discard the 2 O-ring seals.



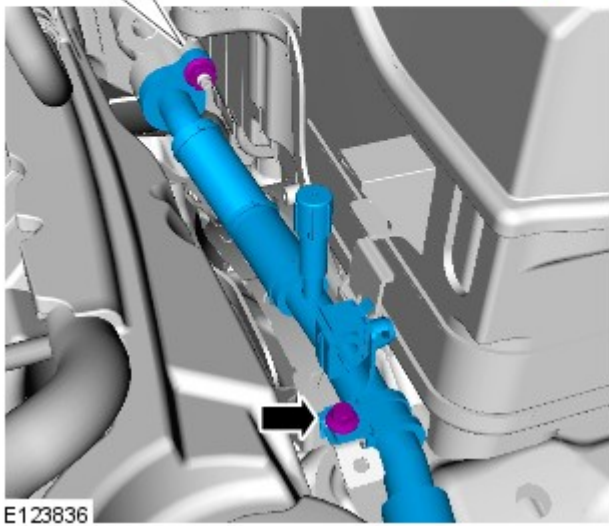
17.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

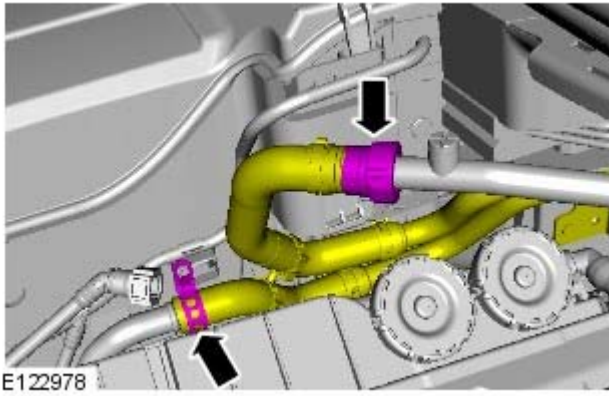
- Discard the O-ring seal.



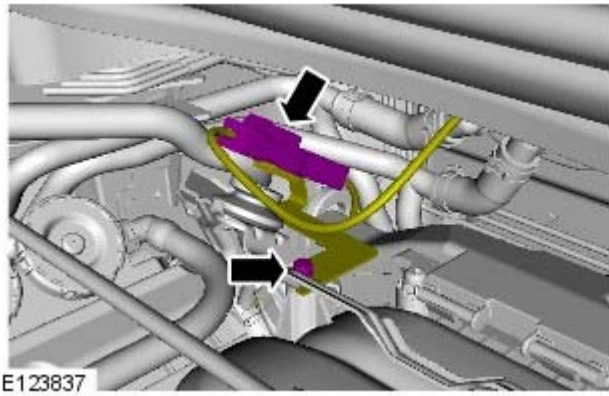
18.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

- Discard the O-ring seal.

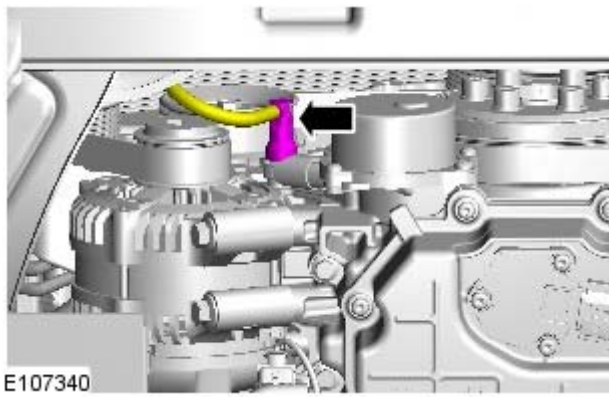




19.  WARNING: Be prepared to collect escaping fluid.

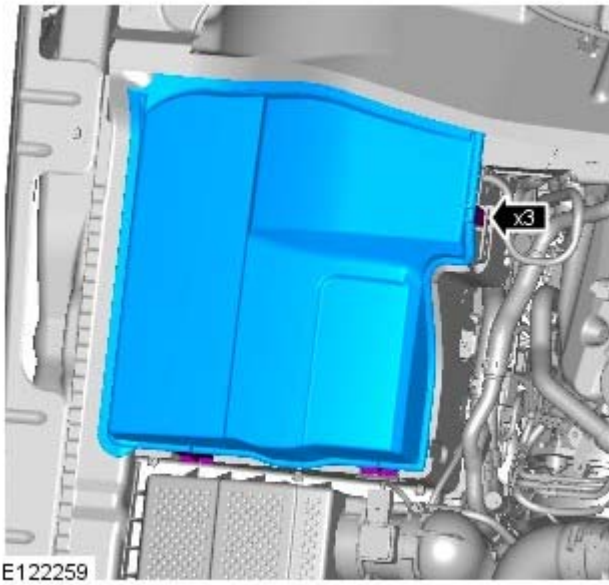


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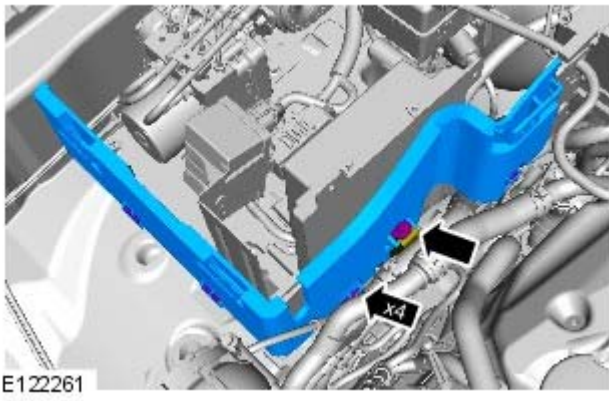


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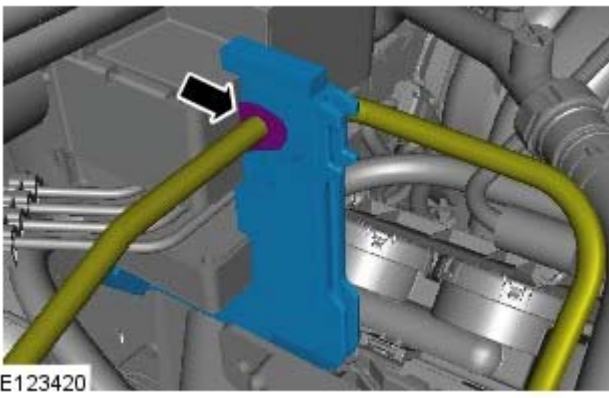
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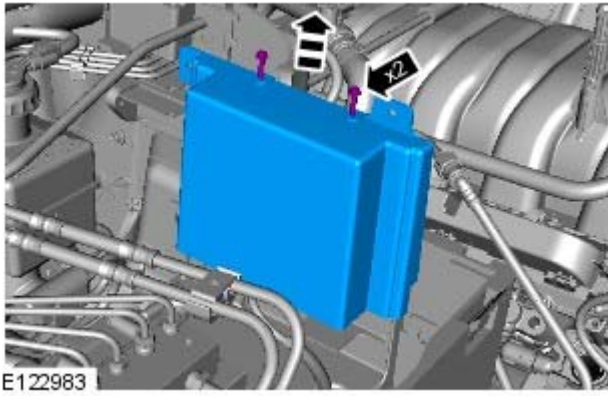
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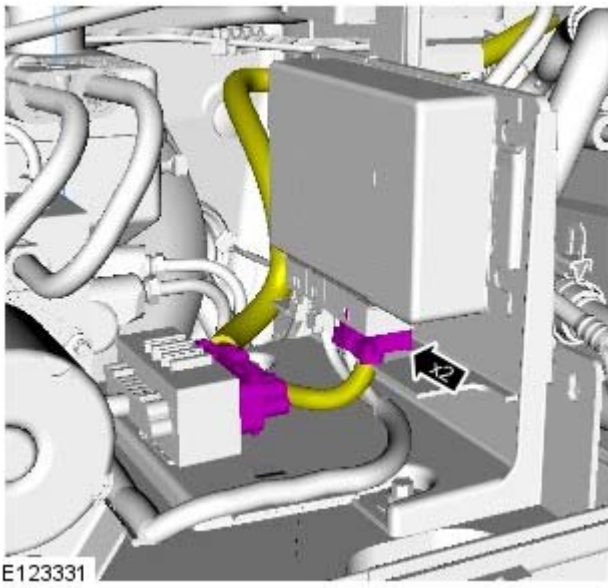
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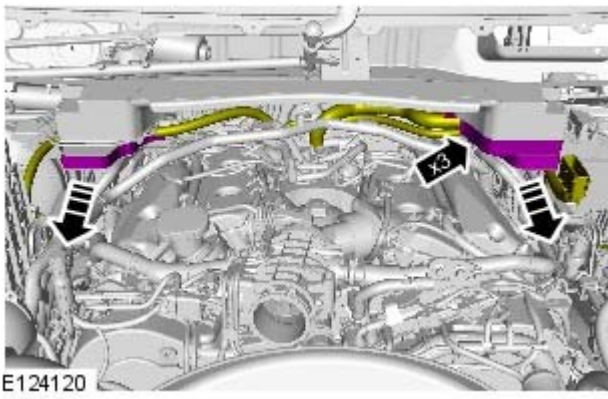
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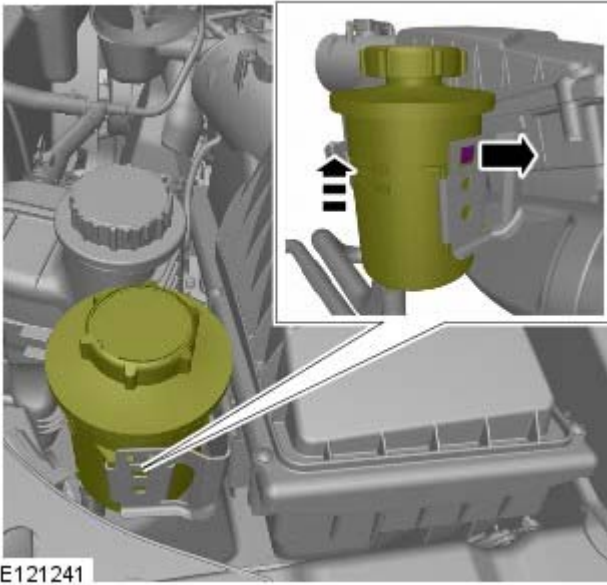
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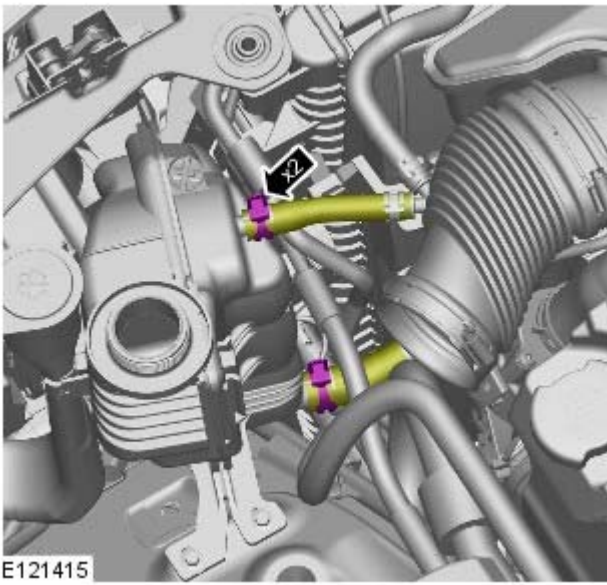
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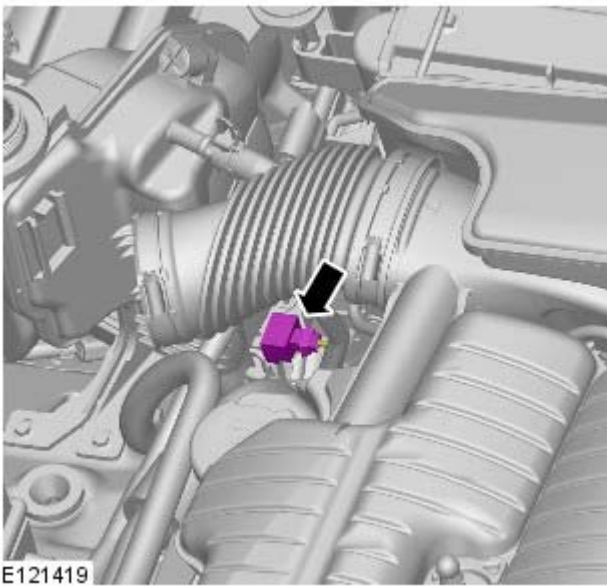
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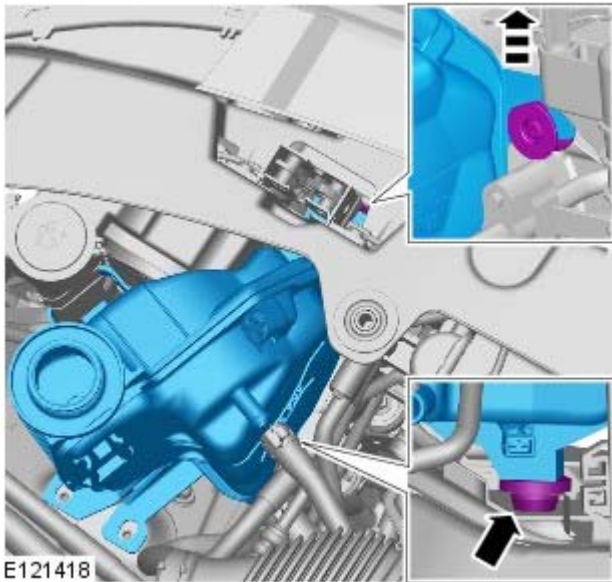


29.

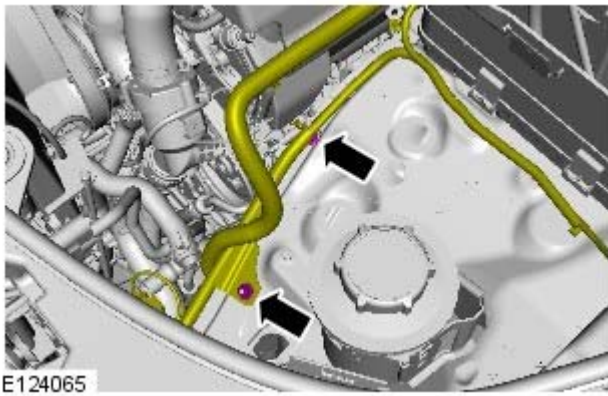


30.

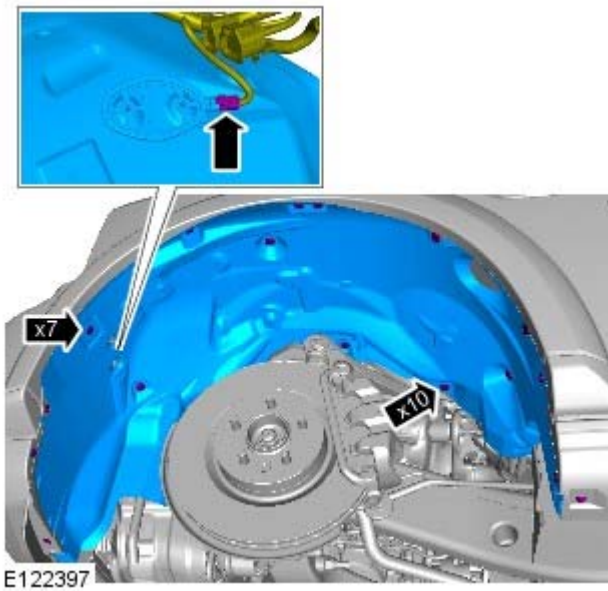




31.  CAUTION: Be prepared to collect escaping coolant.

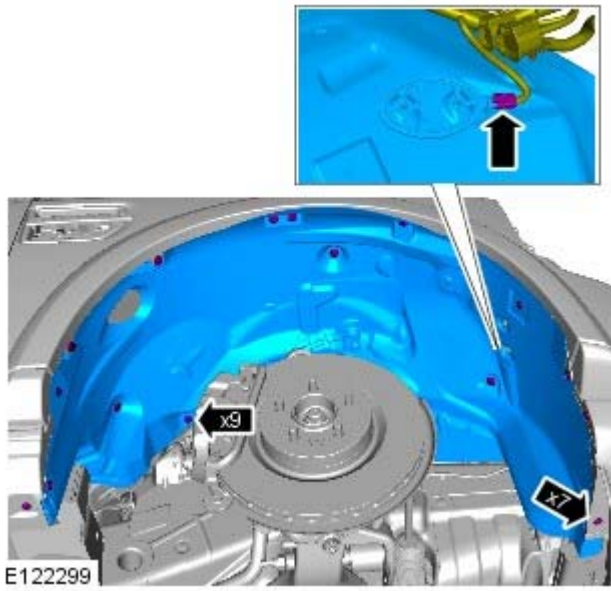


32.

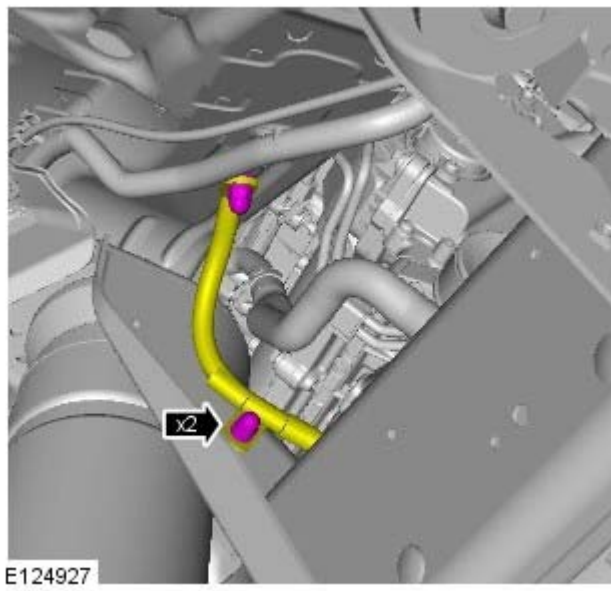


33.

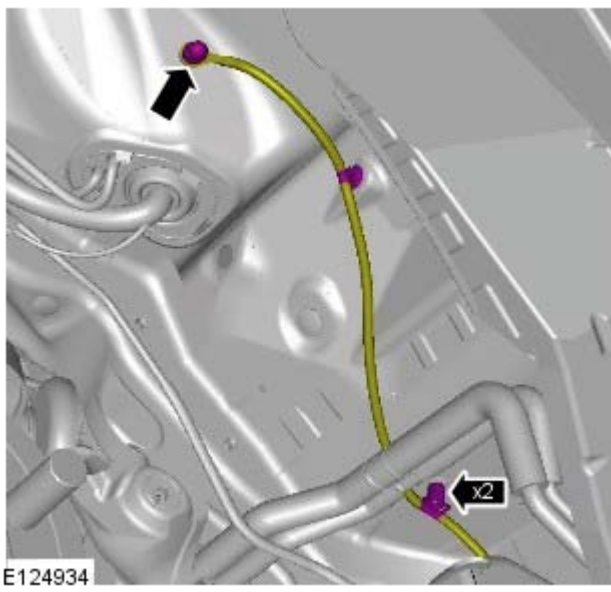
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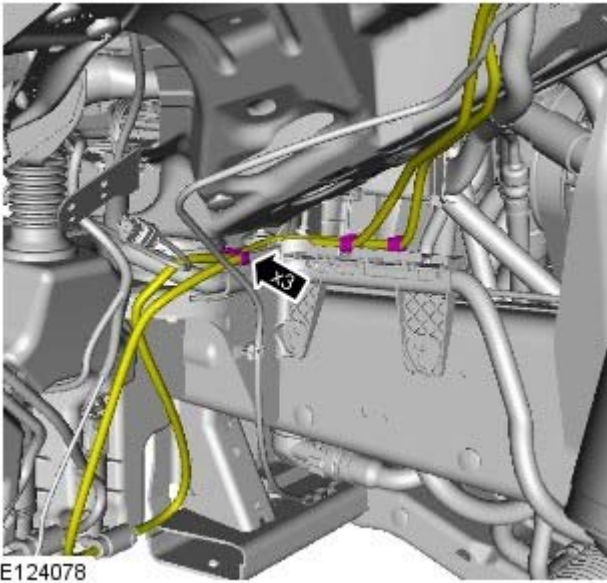
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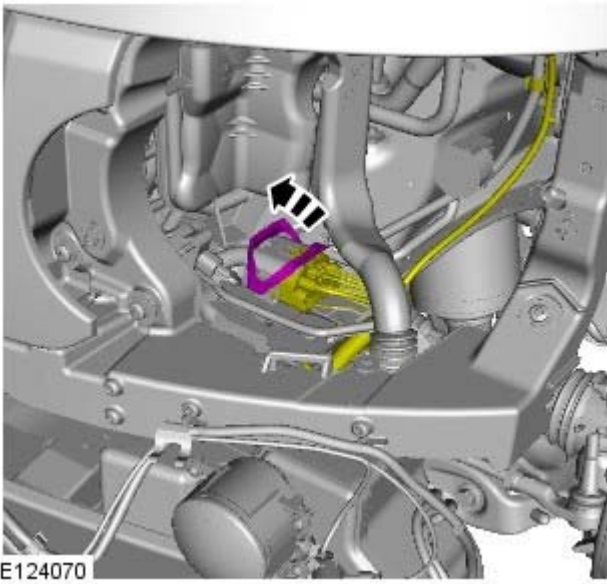
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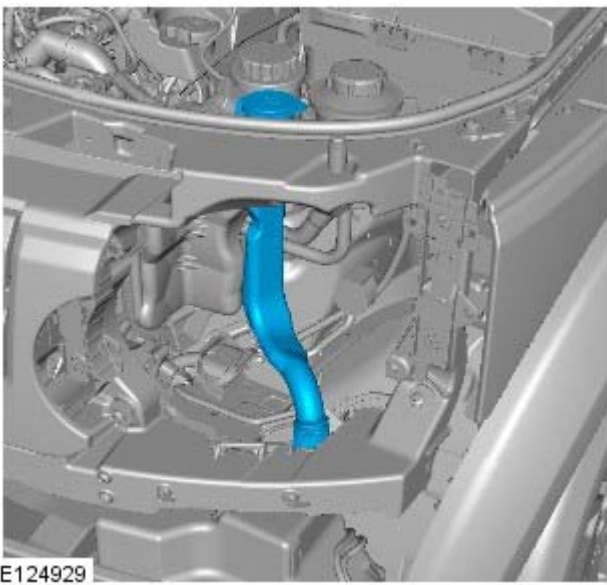
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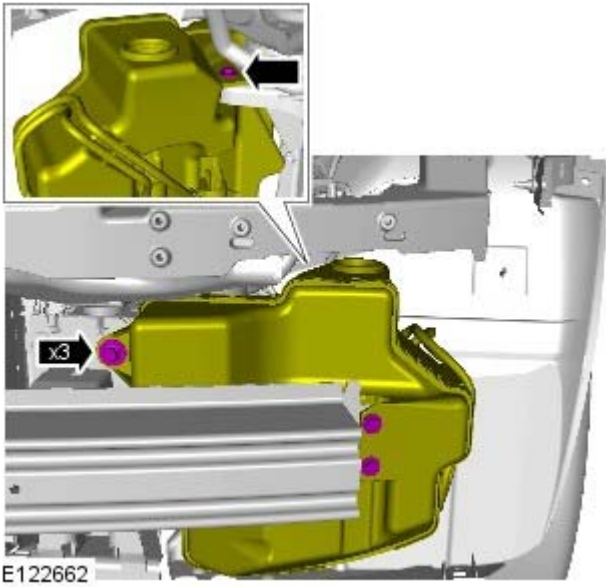
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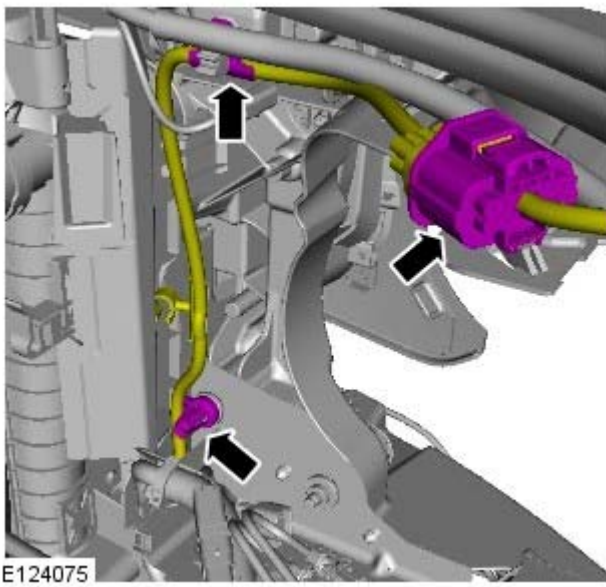
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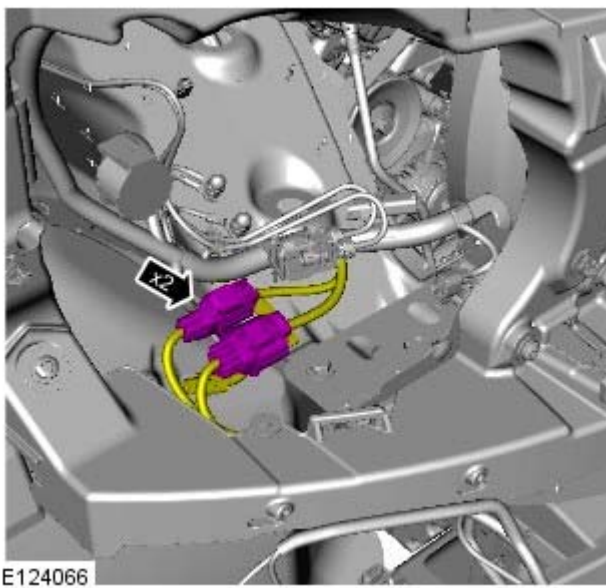
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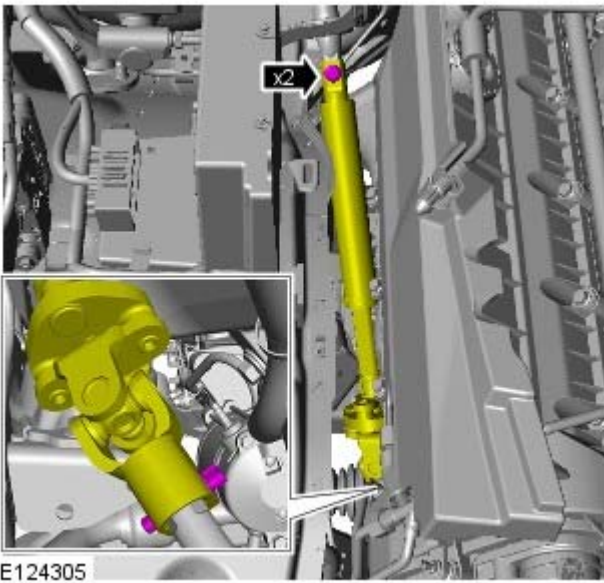
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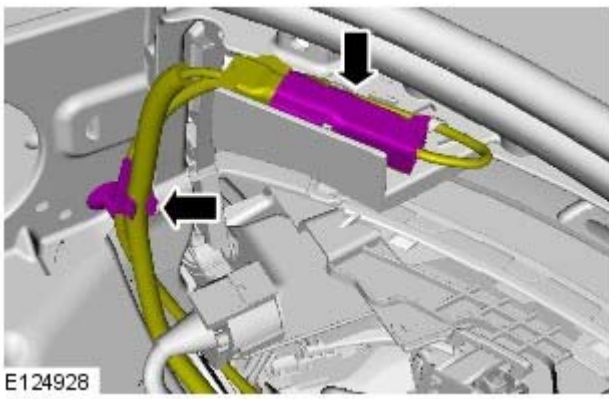
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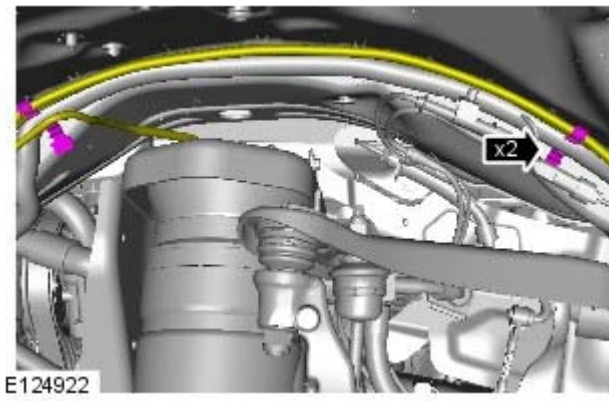
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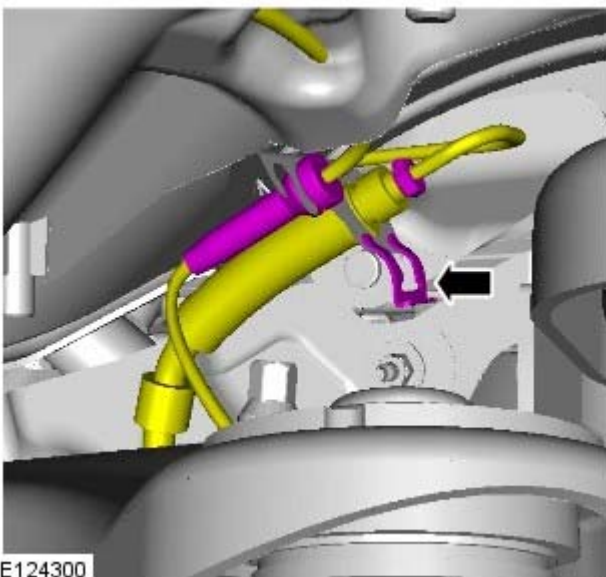
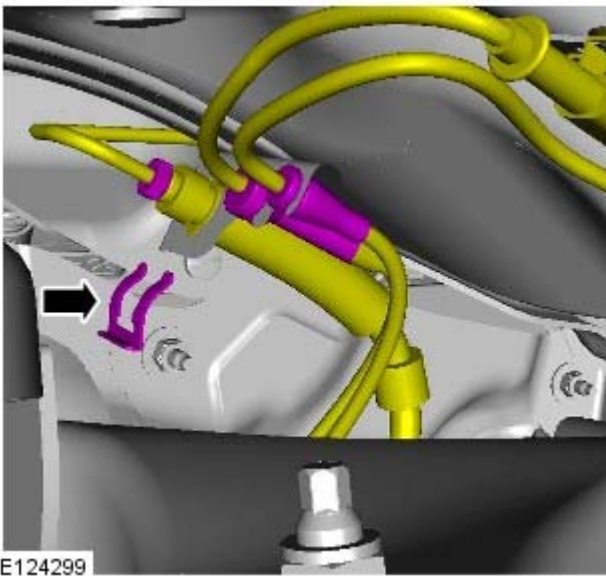
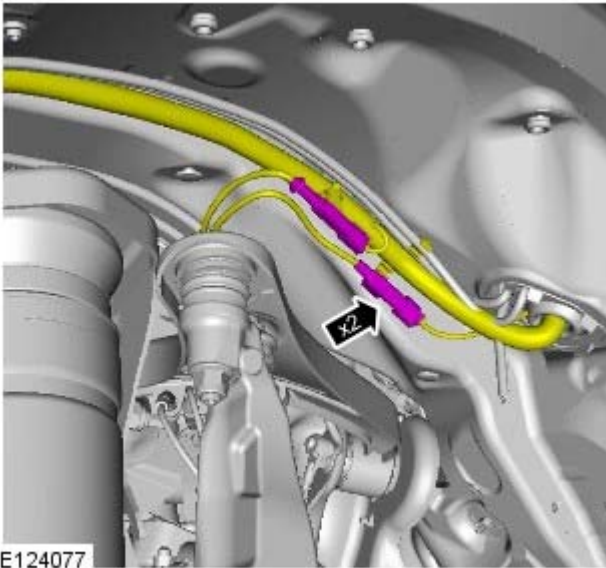
44.



45.



46.



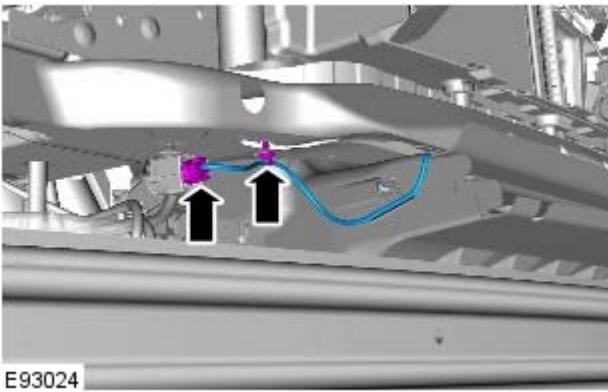
47. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

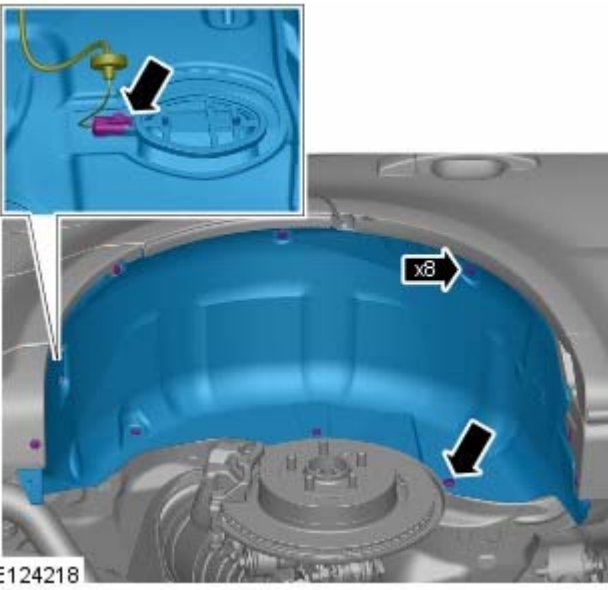
48. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

49.

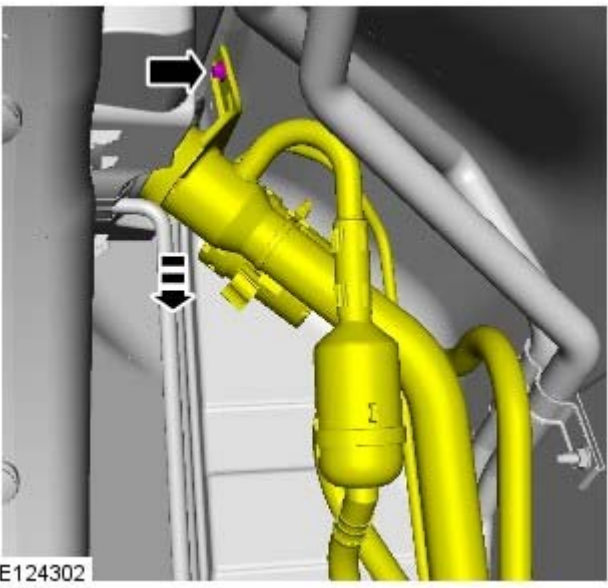


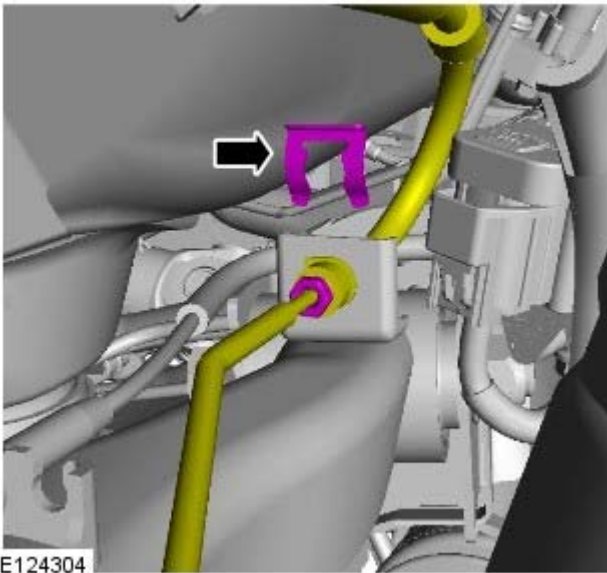
50.



51. Remove the fuel filler cap.

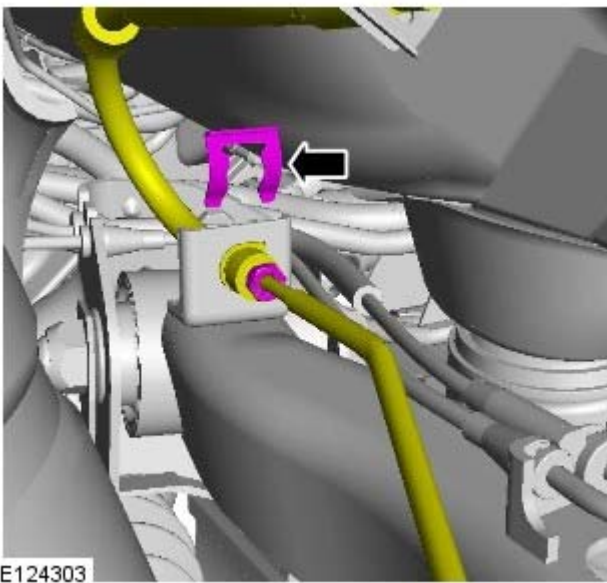
52.





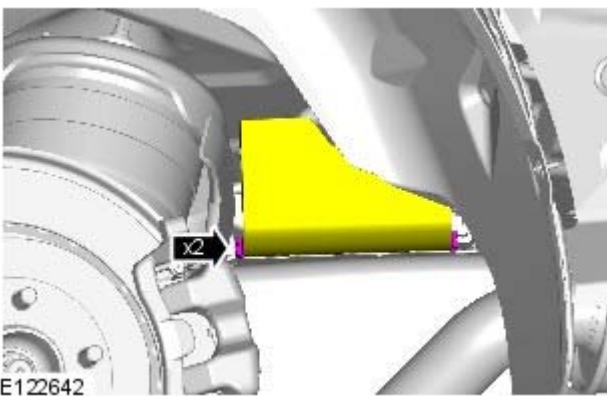
53. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.



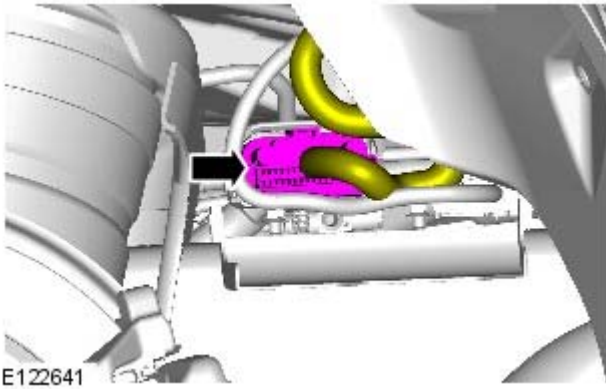
54. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

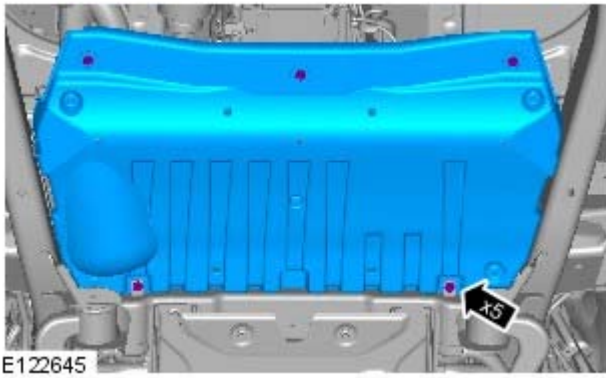


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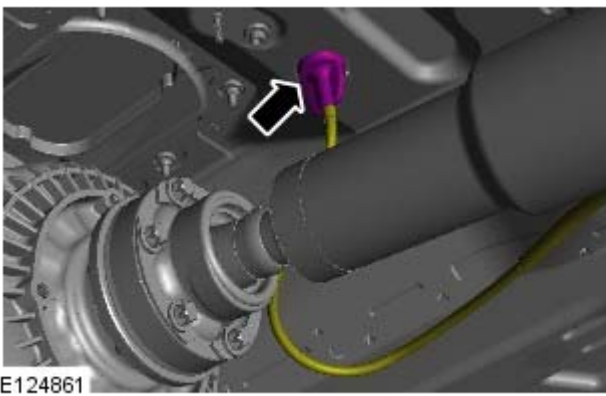
56.



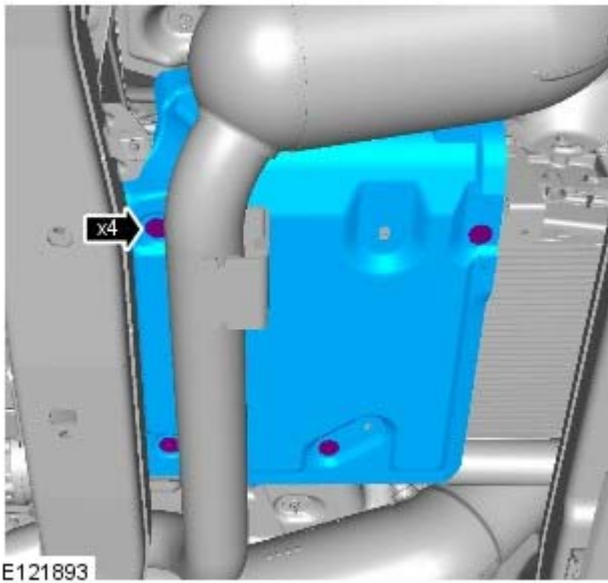
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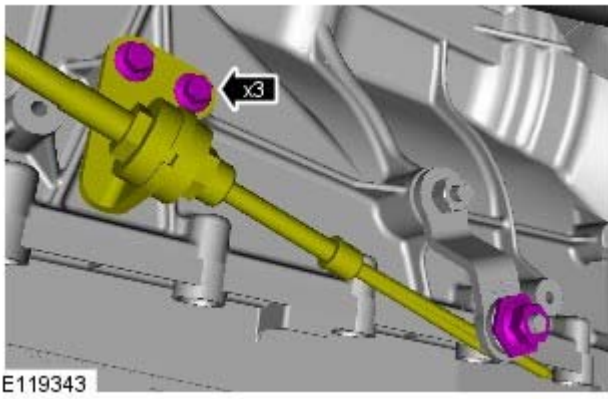
58.  CAUTION: Note the fitted position of the seal.



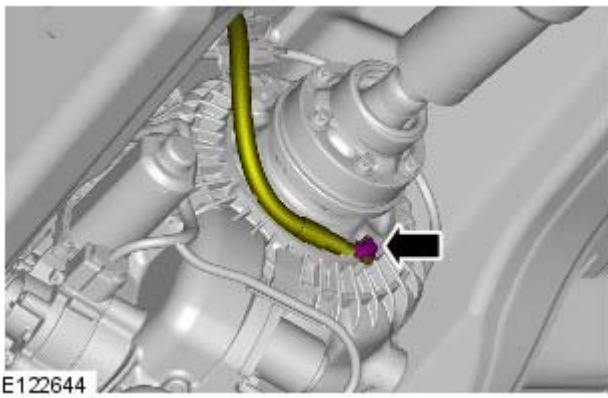
59.



60.

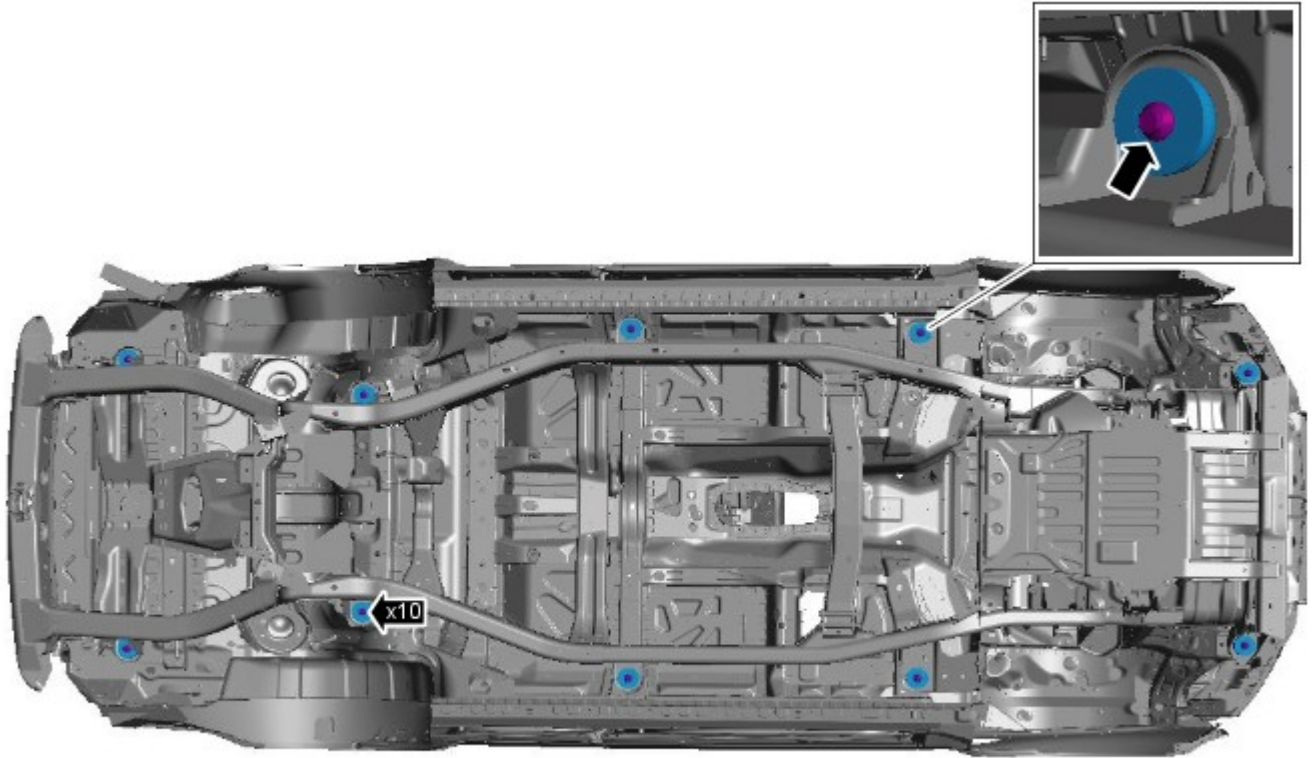


61.




62. Remove and discard the 10 body mount bolts.

- Remove the 10 spacing washers.



E124859

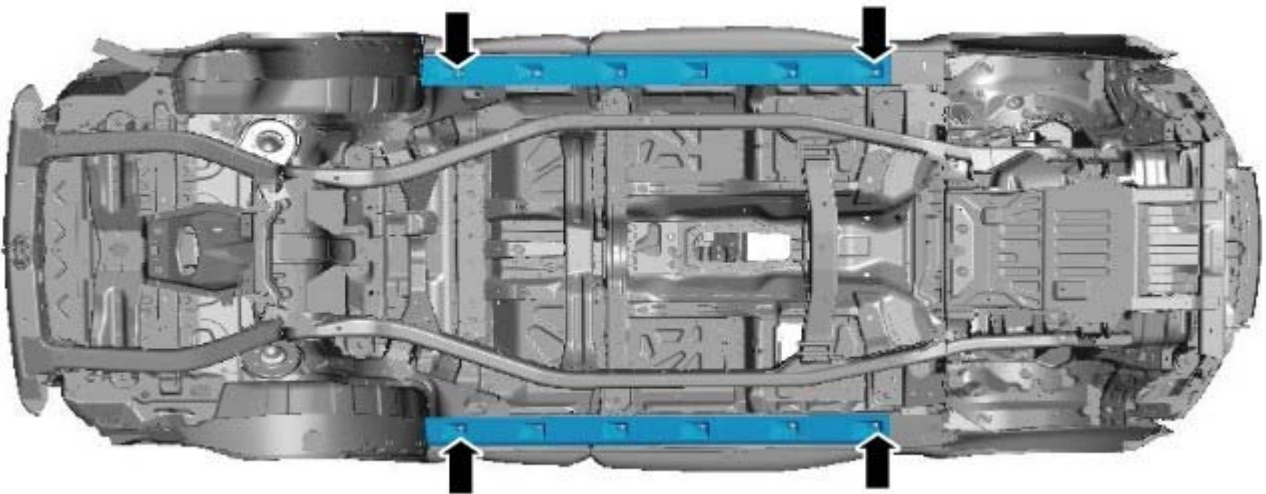
63. Carefully lower the vehicle and support the chassis with axle stands.

64.  CAUTION: To prevent the body becoming unstable when raised from the integrated body frame, install the vehicle tie down straps.

• NOTE: Note the fitted position of the body mounts.

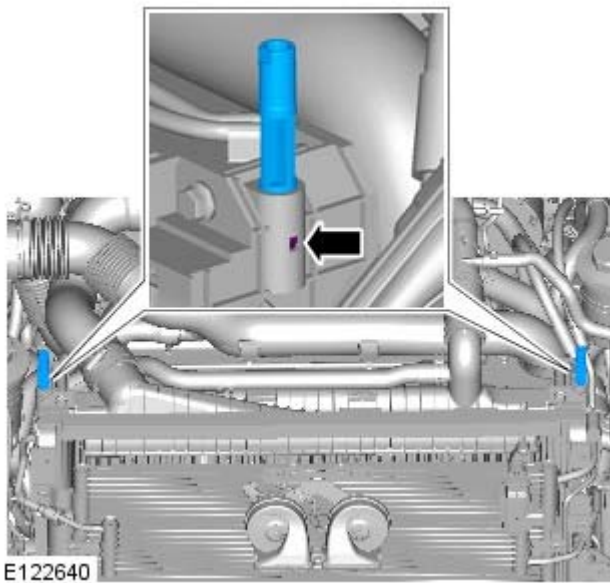
Using an assistant raise and support the body.

- Remove the body mounts.



E124860

65.



Installation

All vehicles

1. CAUTIONS:



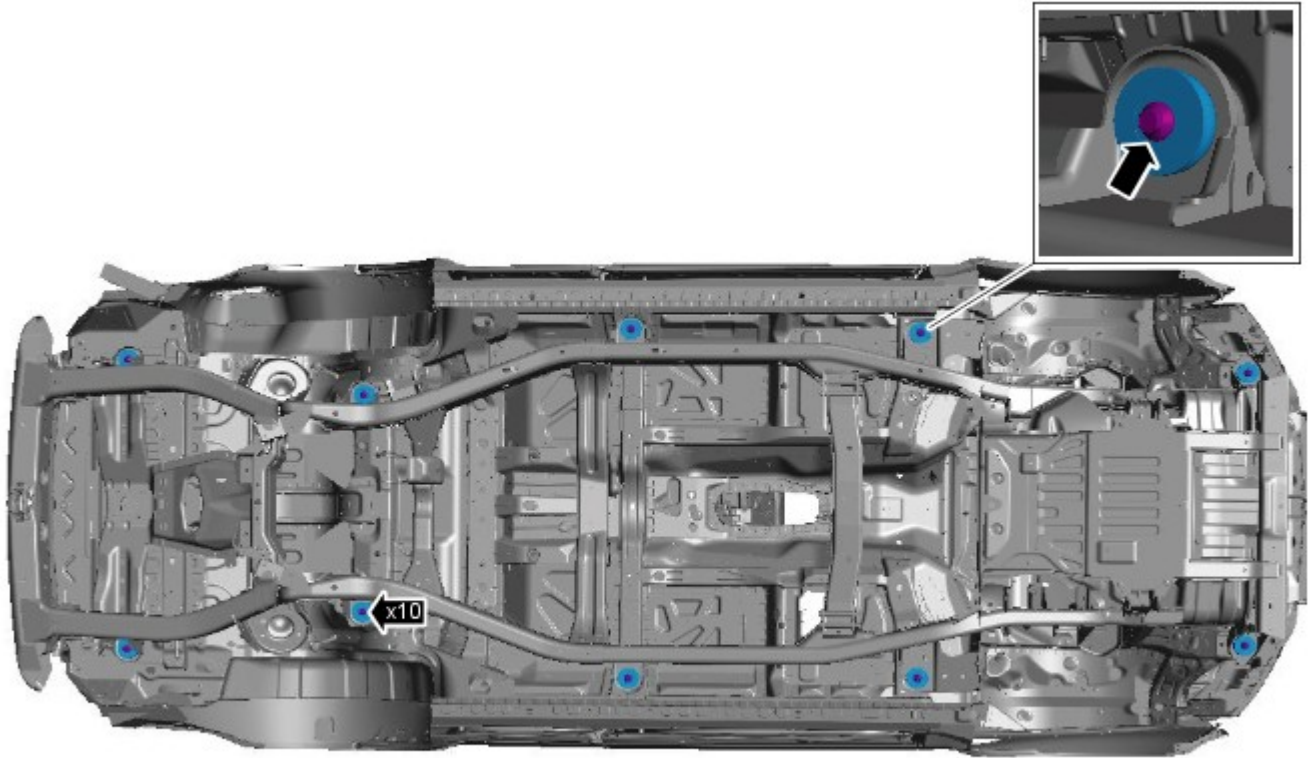
Make sure that new bolts are installed.



Make sure that all components are free and do not get caught up whilst lowering the body onto the integrated body frame.

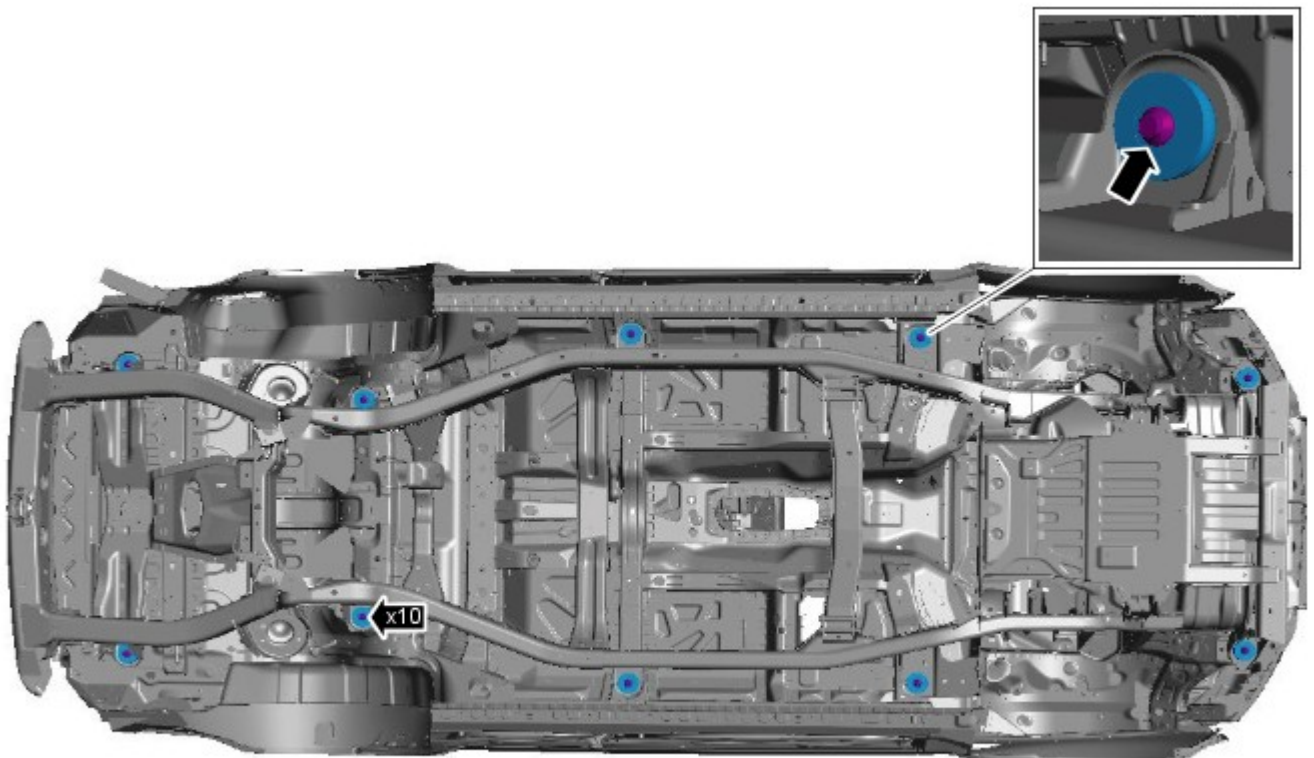
Using an assistant install the body to the integrated body frame.

- Install the body mounts.
- With assistance align the body and integrated body frame mounts.
- Install the bolts, but do not tighten fully at this stage.



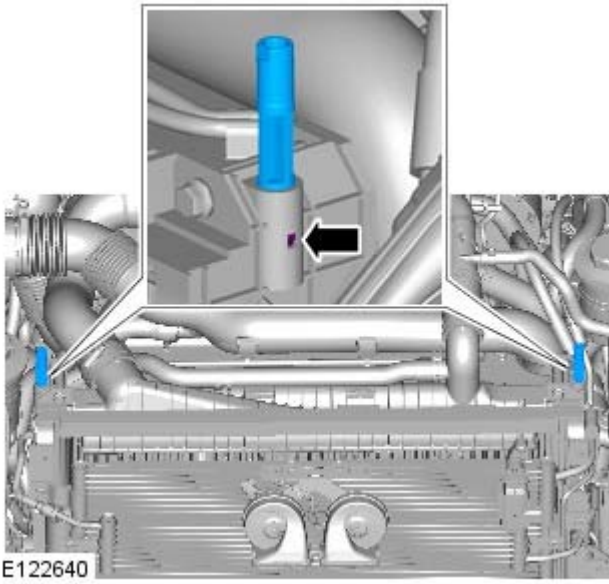
E124859

2. Remove the tie down straps securing the body.
3. TORQUE: 133 Nm

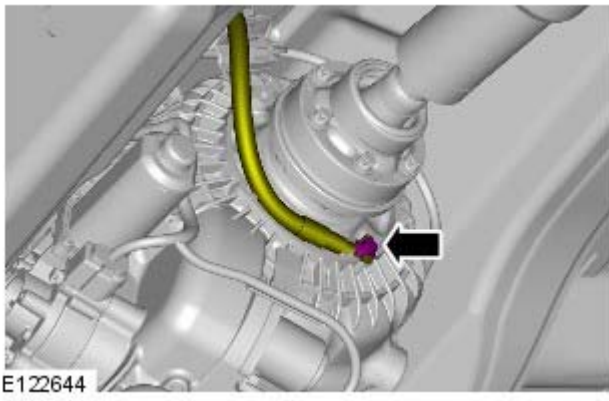


E124859

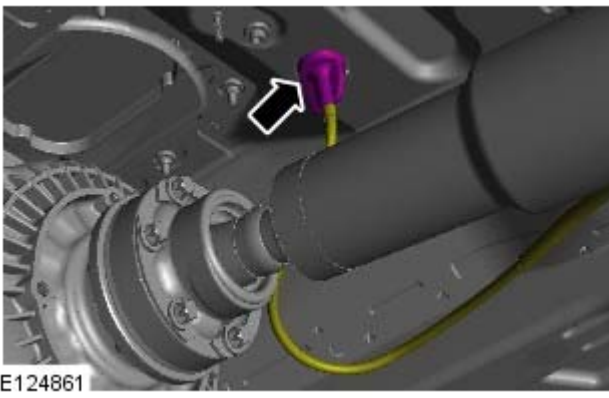
4.



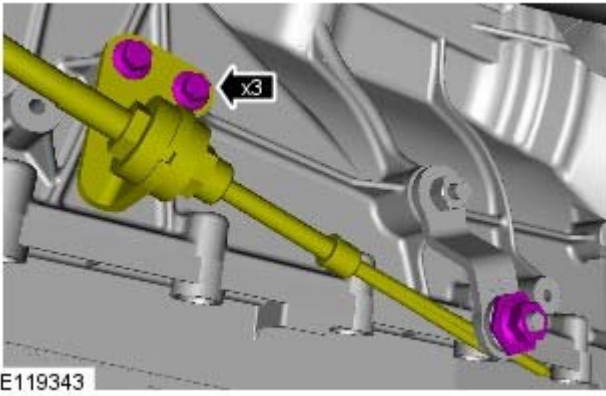
5. TORQUE: 25 Nm



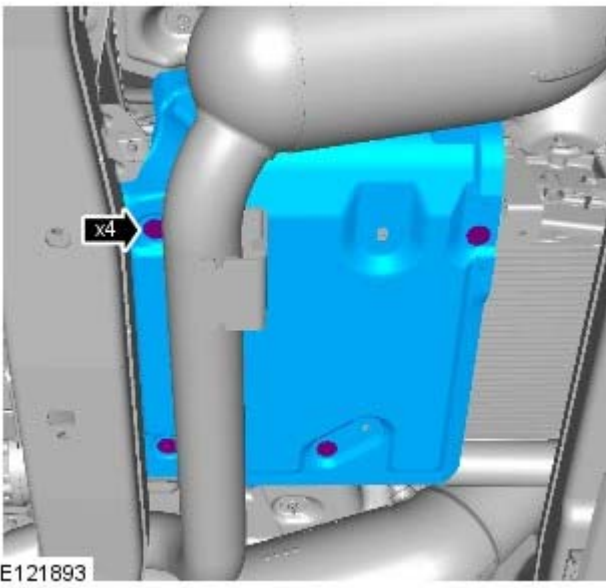
6.



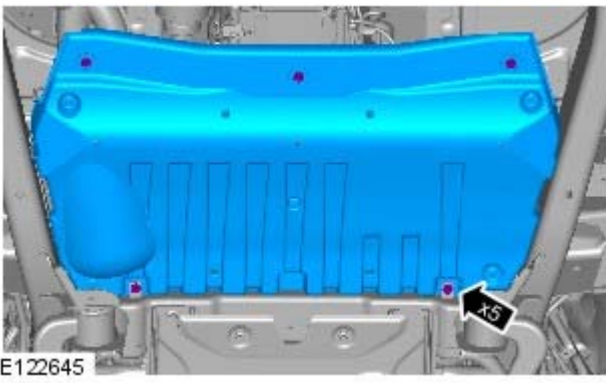
7.



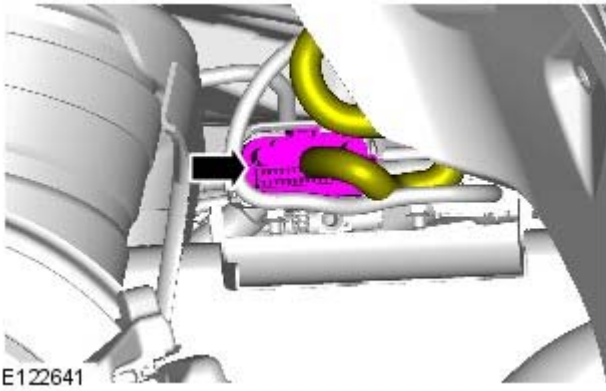
8. TORQUE: 12 Nm



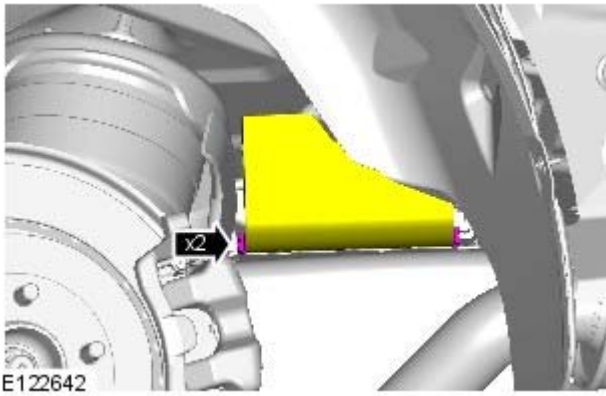
9. TORQUE: 12 Nm



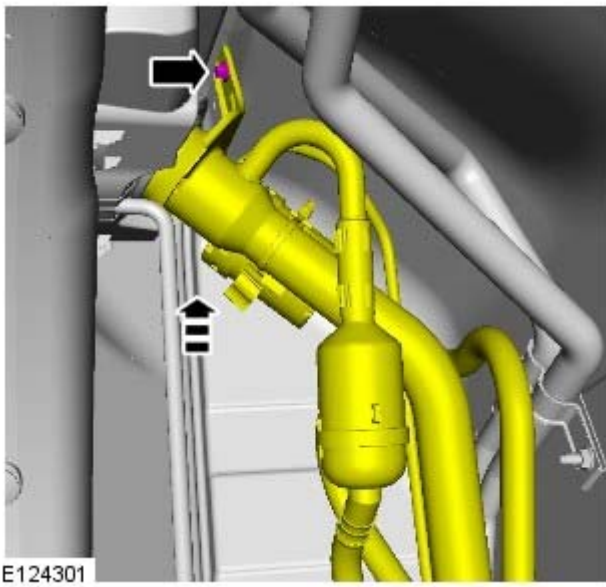
10.



11.

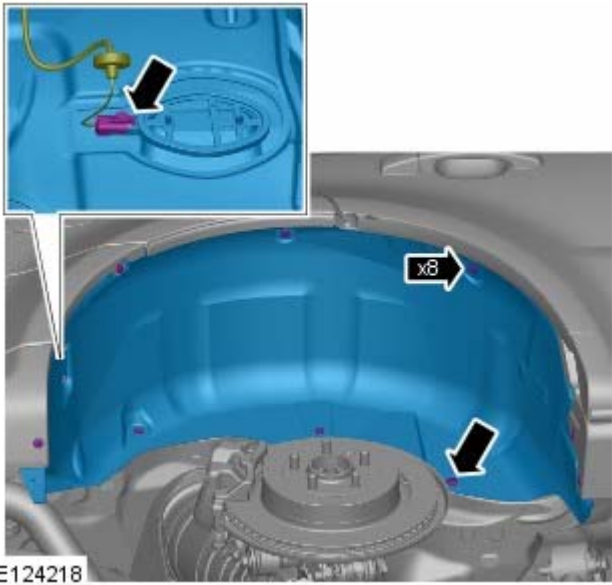


12. TORQUE: 12 Nm



13. Install the fuel filler cap.

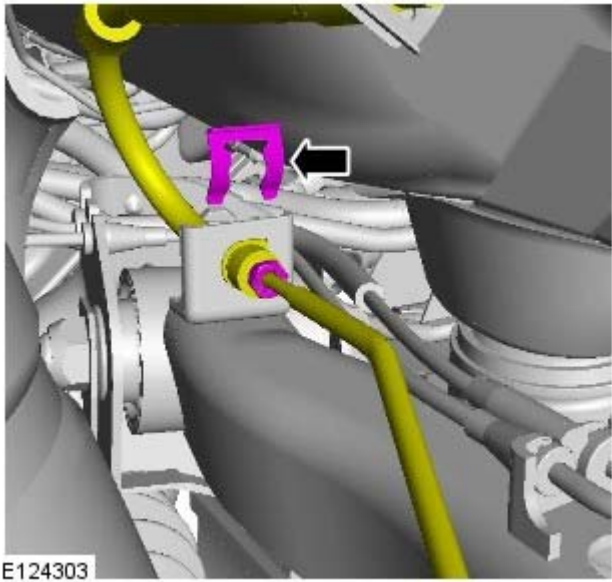
14.



15. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

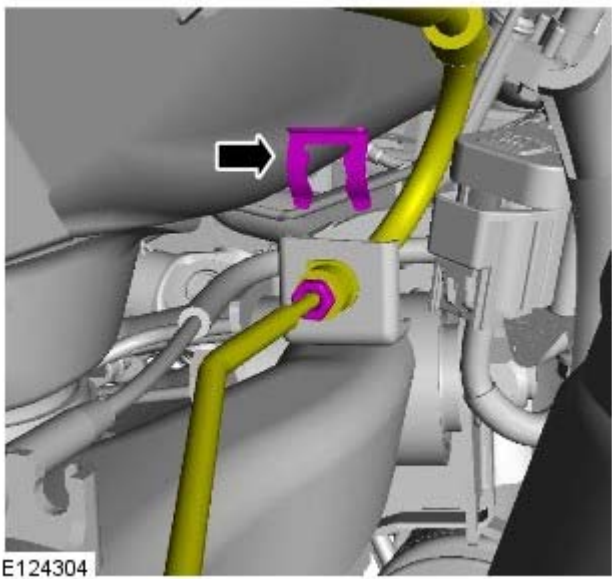
- Clean the component mating faces.
- Secure the clip.



16. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

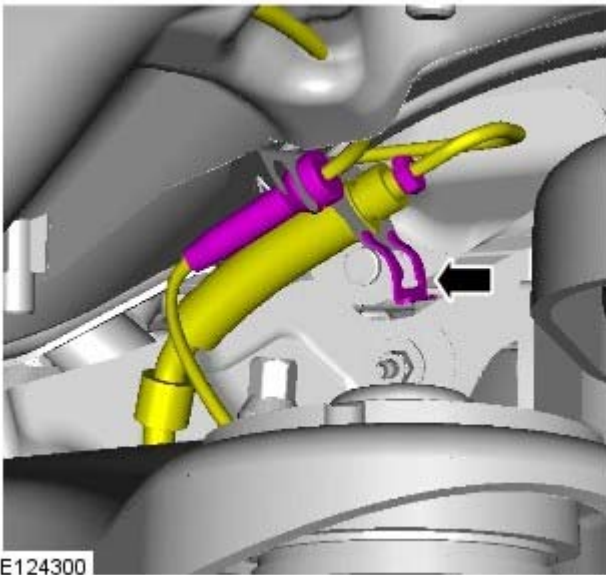
- Clean the component mating faces.
- Secure the clip.



17. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

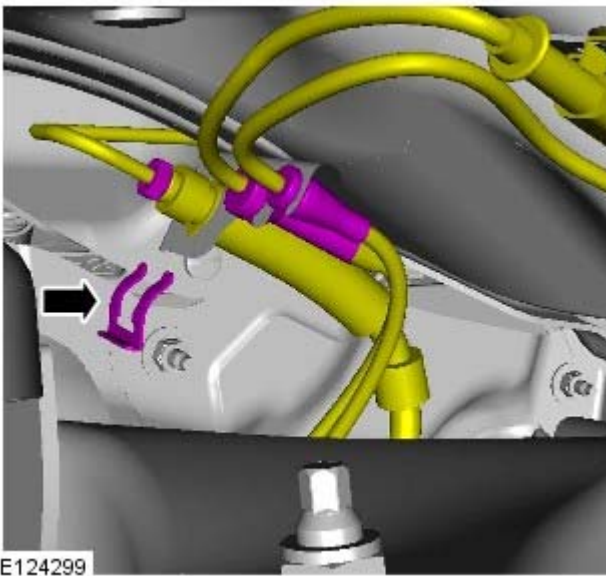
- Clean the component mating faces.
- Secure the clip.



18. NOTE: Remove and discard the blanking caps.

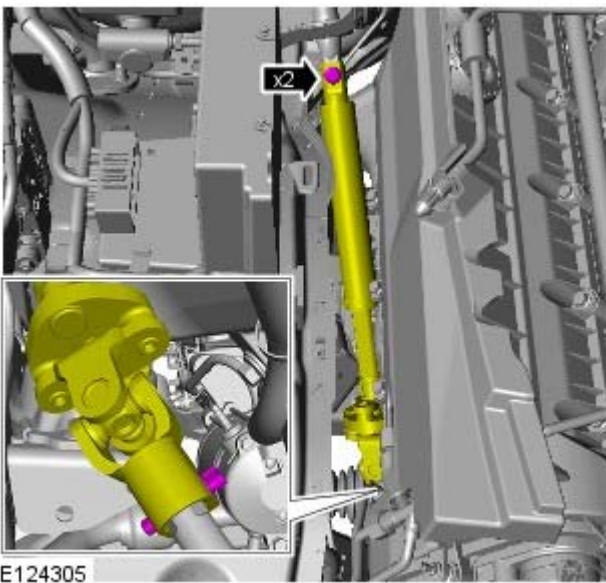
TORQUE: 16 Nm

- Clean the component mating faces.
- Secure the clip.

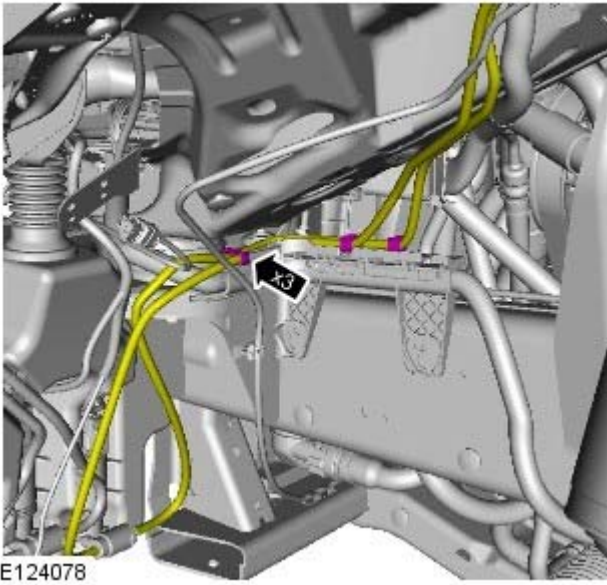


19.  WARNING: Make sure that a new bolt is installed.

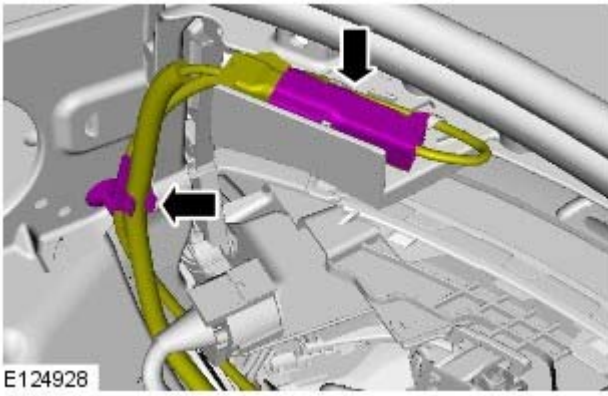
TORQUE: 25 Nm



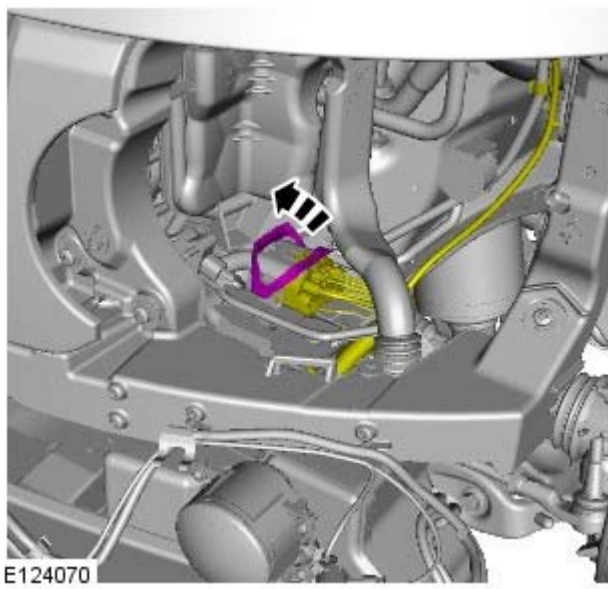
20.



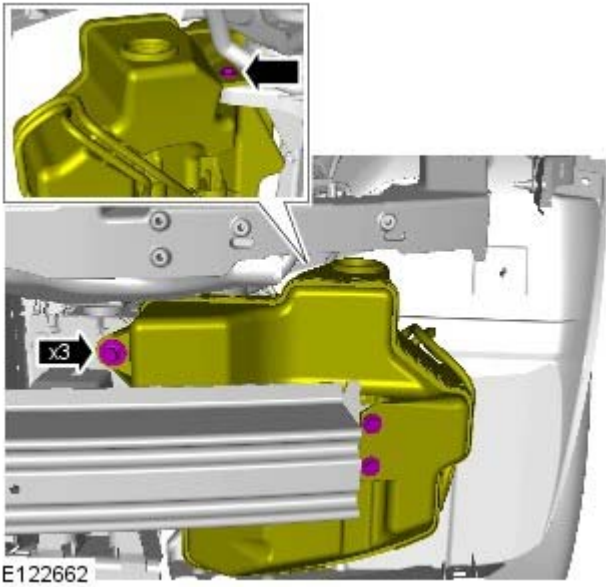
21.



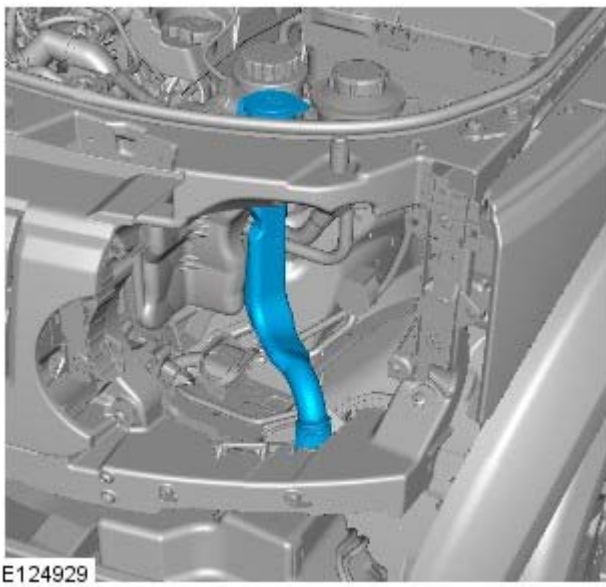
22.



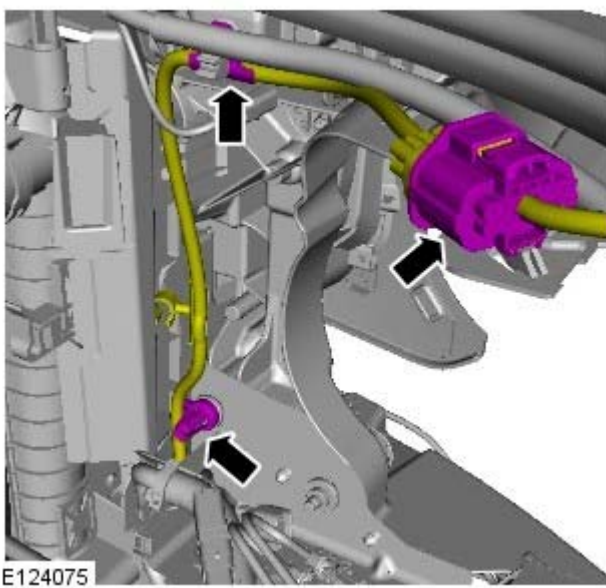
23. TORQUE: 12 Nm



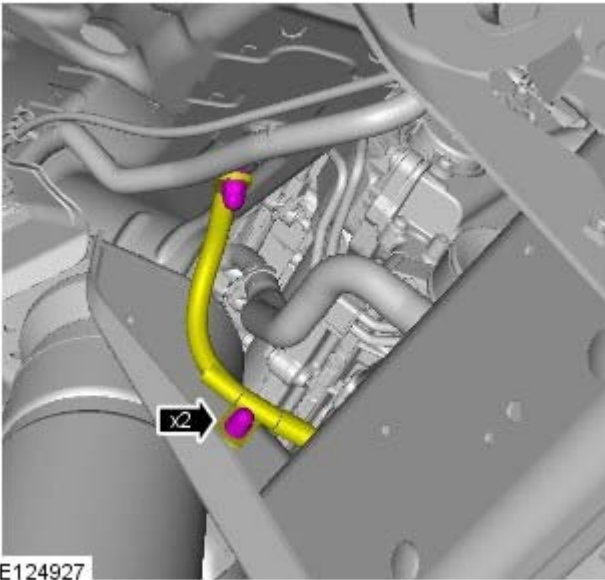
24.



25.

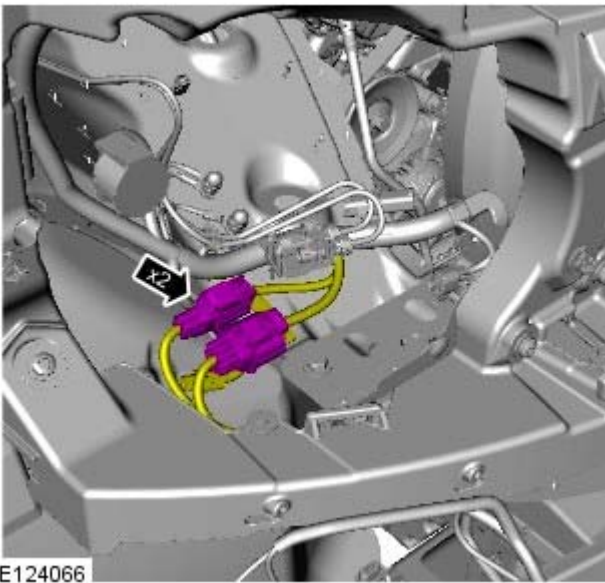


26. TORQUE: 20 Nm



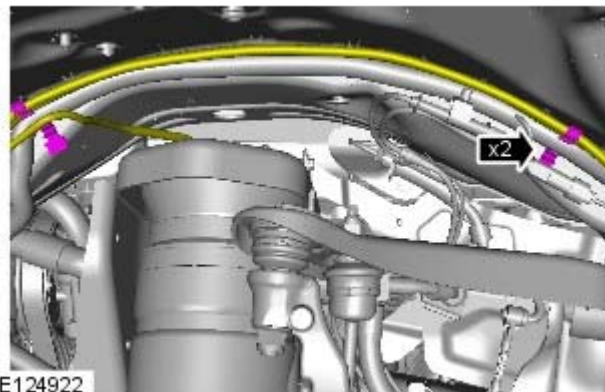
E124927

27.



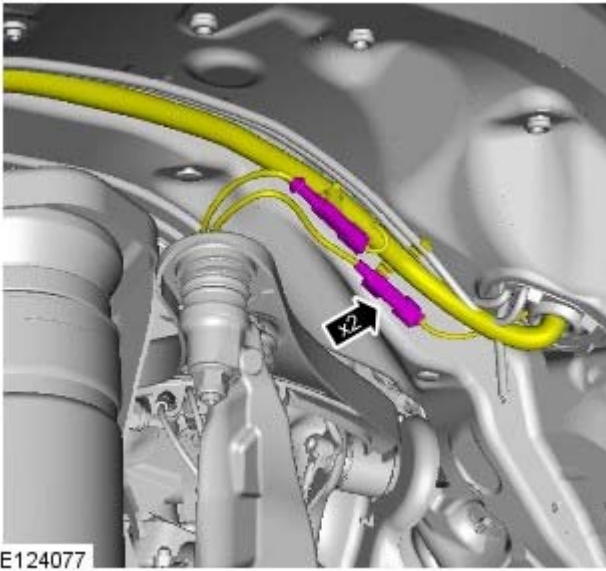
E124066

28.

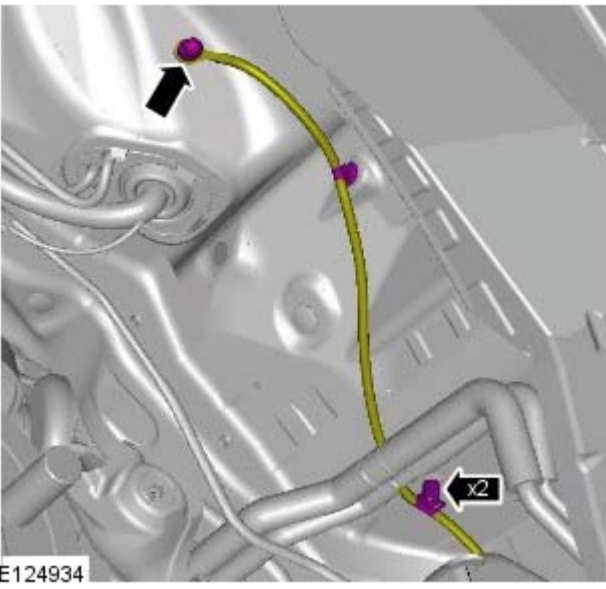


E124922

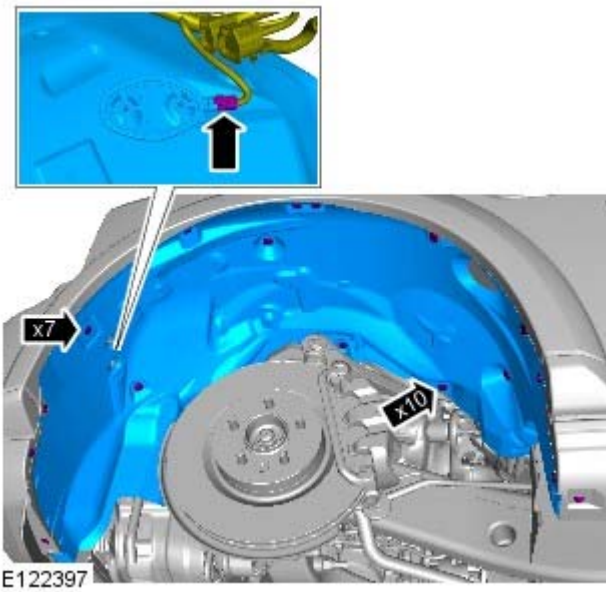
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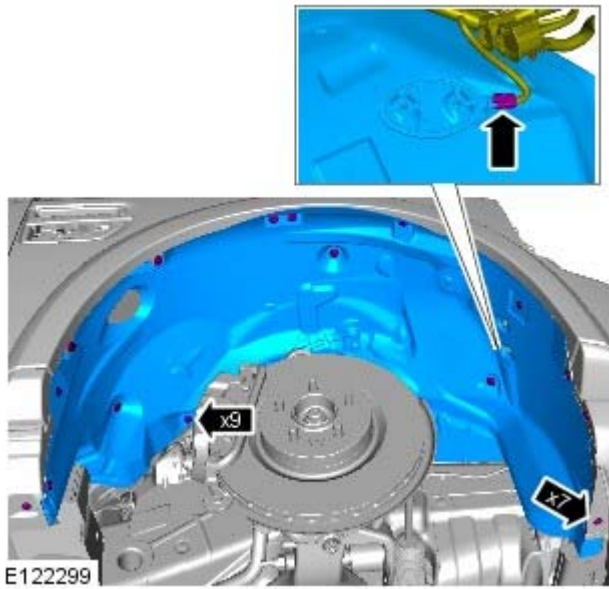
30. TORQUE: 20 Nm



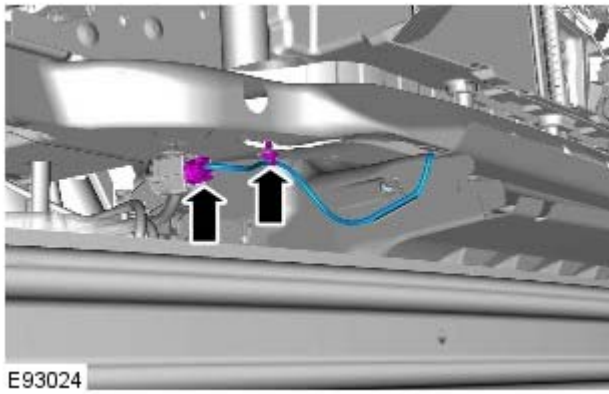
31.



32.

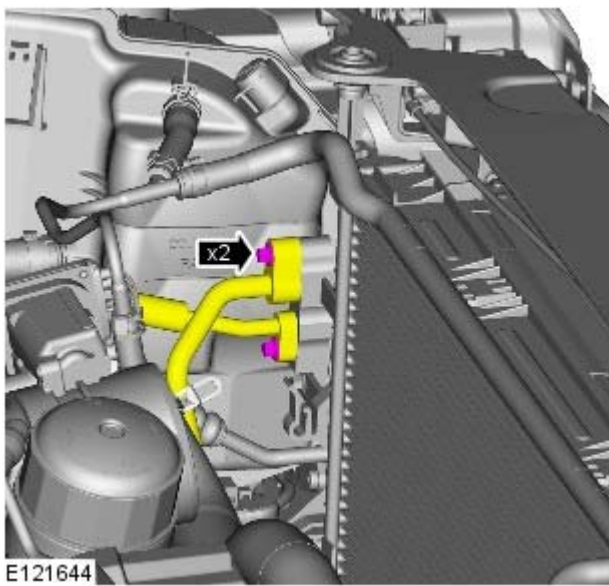


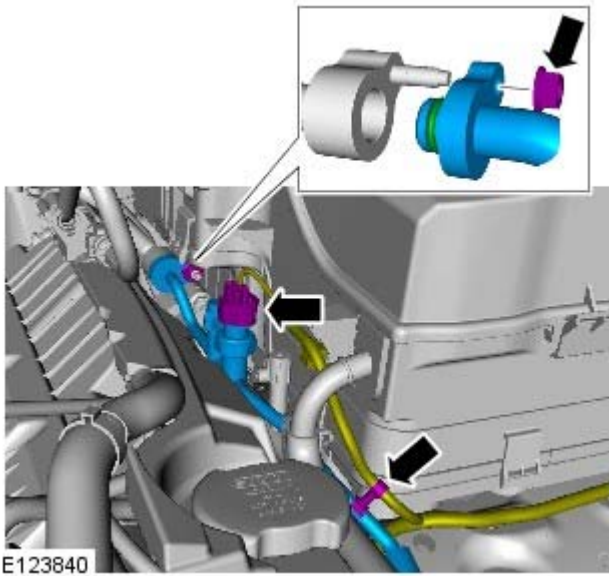
33.




34. TORQUE: 12 Nm

- Install new O-ring seals.

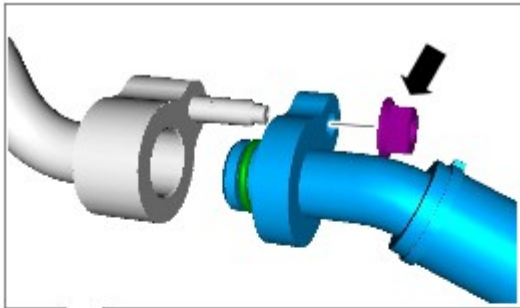





35.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

TORQUE: 12 Nm

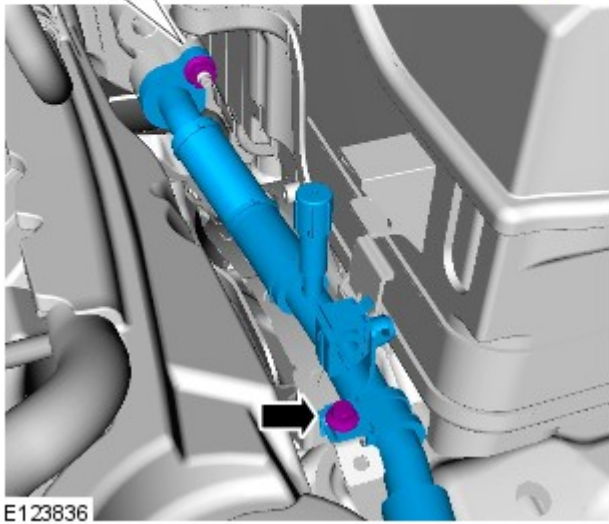
- Install new O-ring seals.

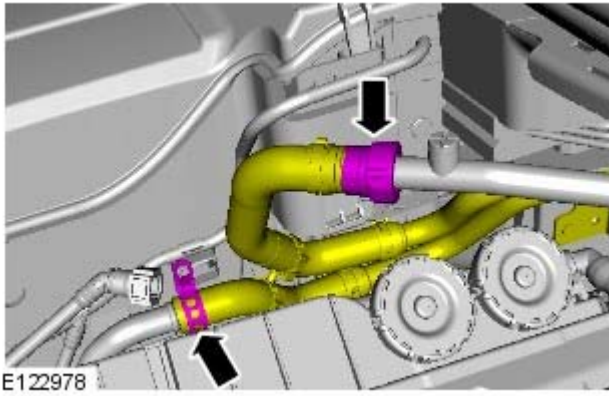


36.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

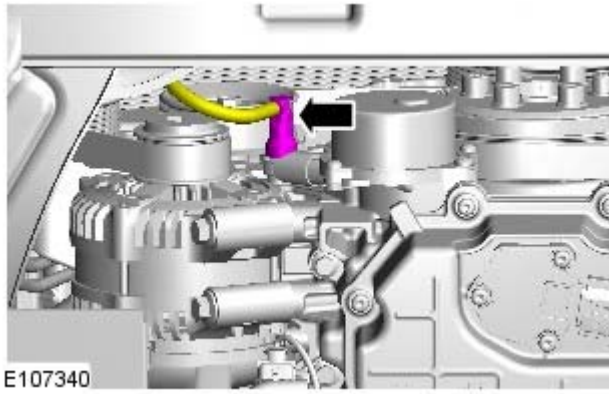
TORQUE: 12 Nm

- Install new O-ring seals.

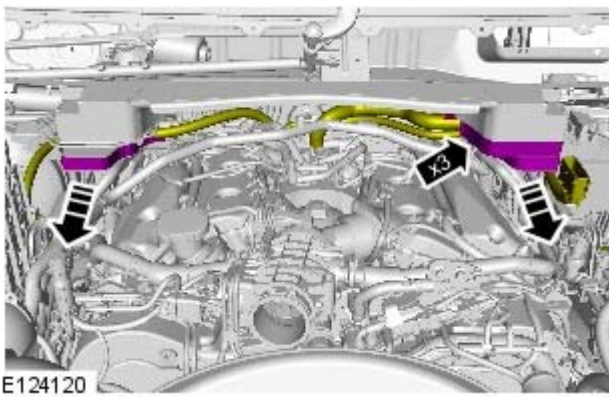




37.  WARNING: Be prepared to collect escaping fluid.

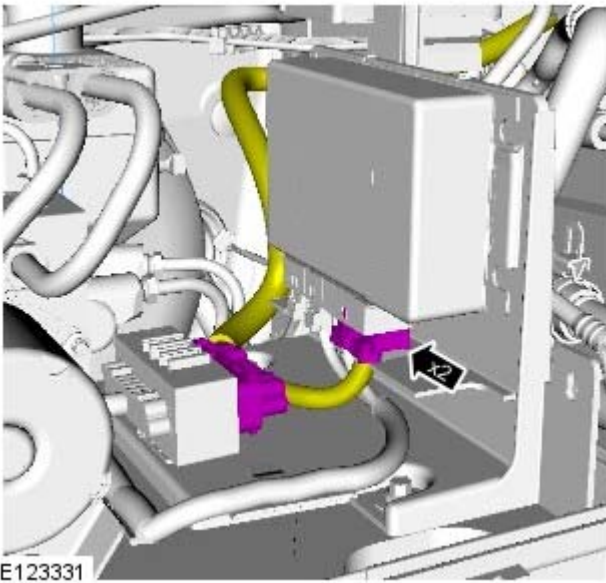


38.

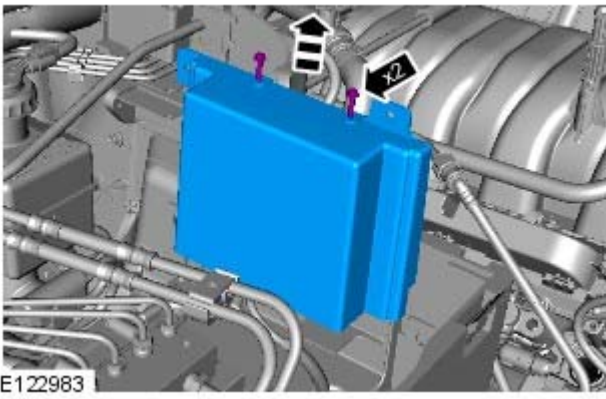


39.

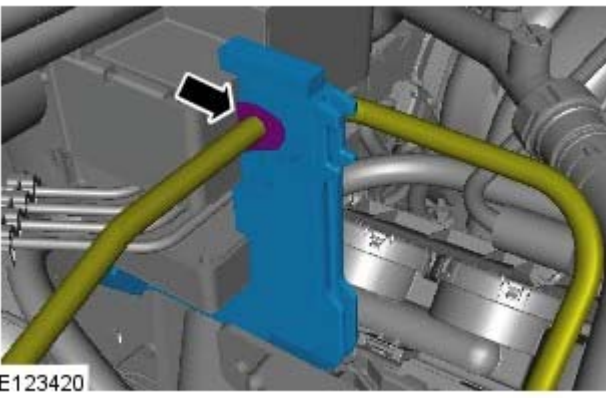
40.



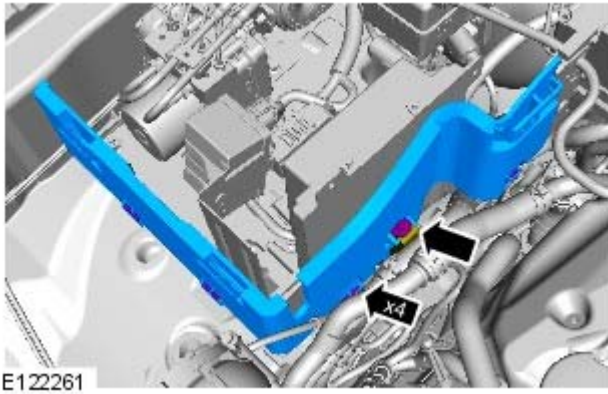
41. TORQUE: 8 Nm



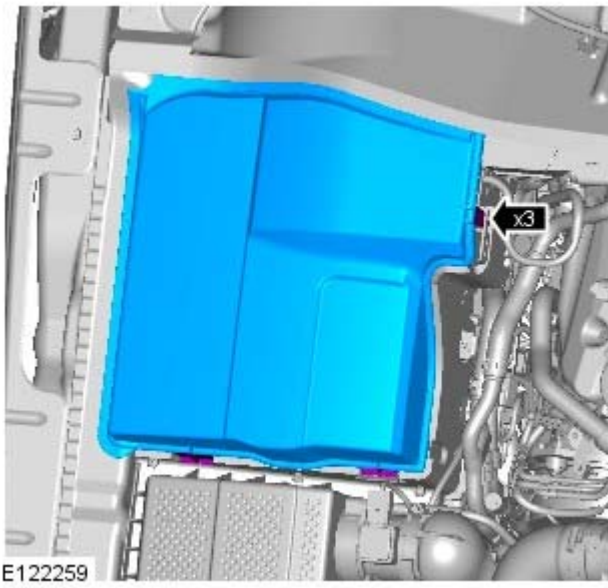
42.



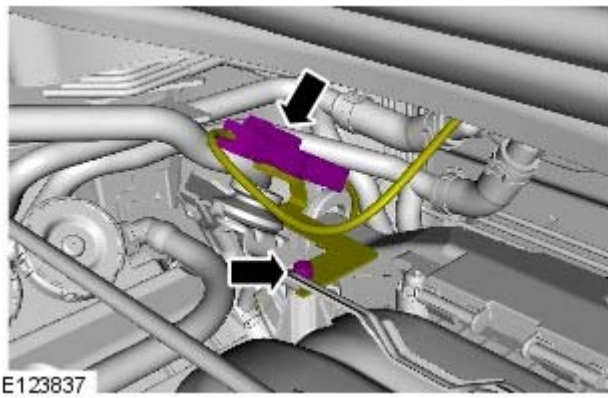
43. TORQUE: 10 Nm



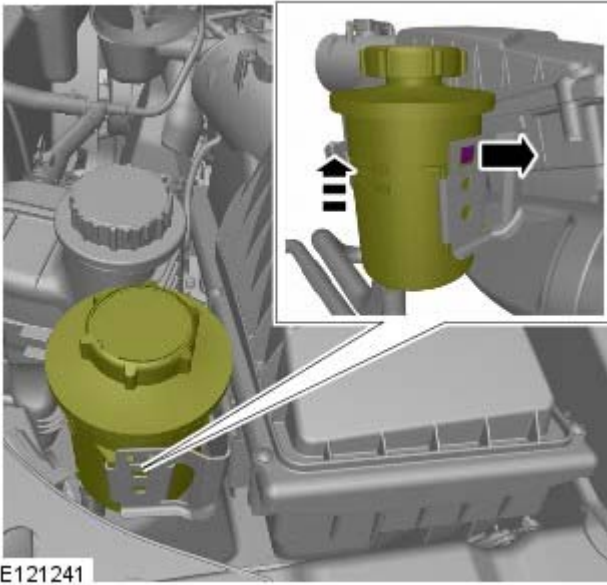
44.



45. TORQUE: 10 Nm

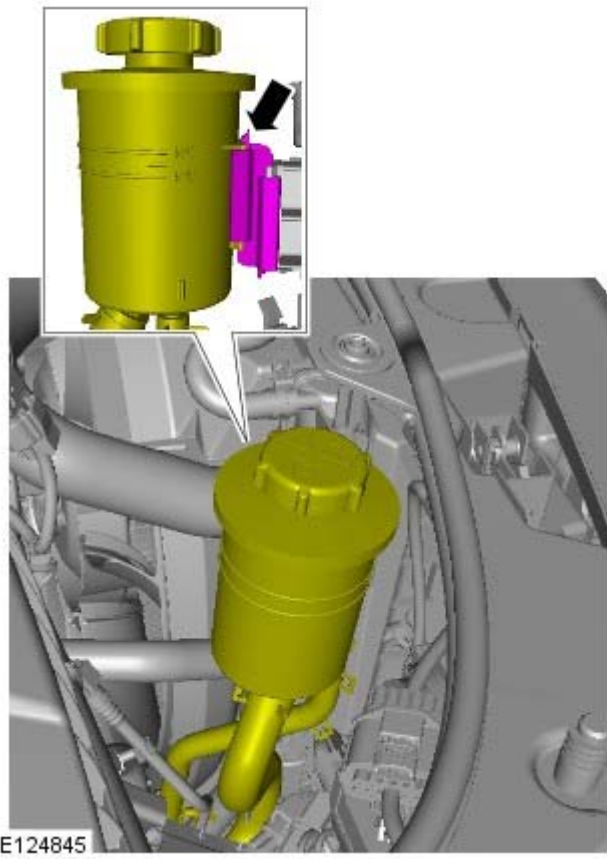


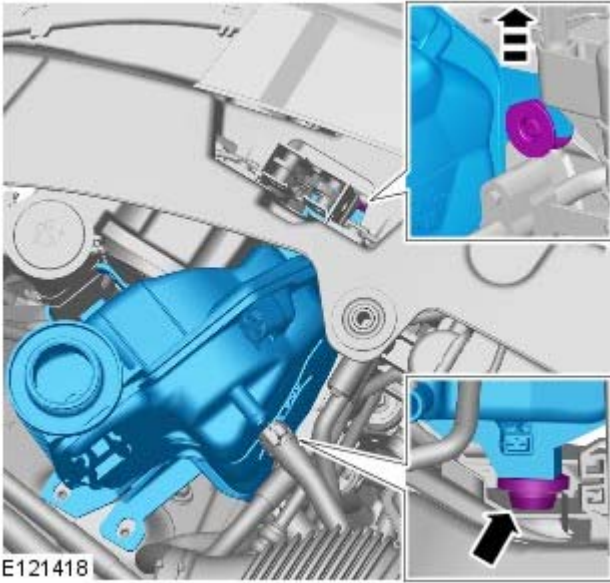
46.



Vehicles with active damping

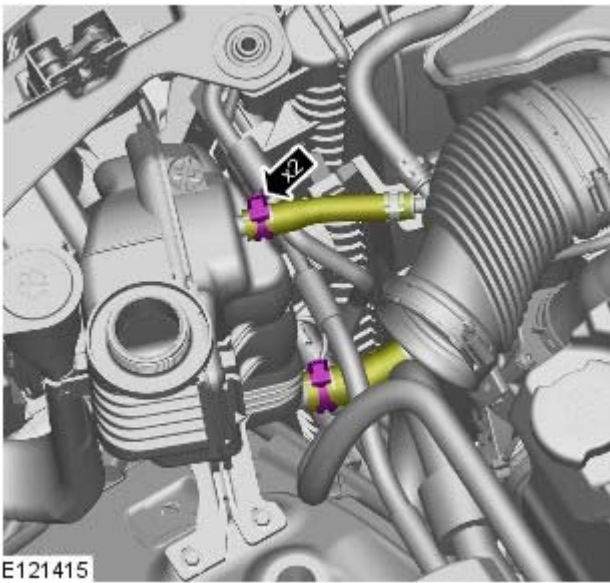
47.



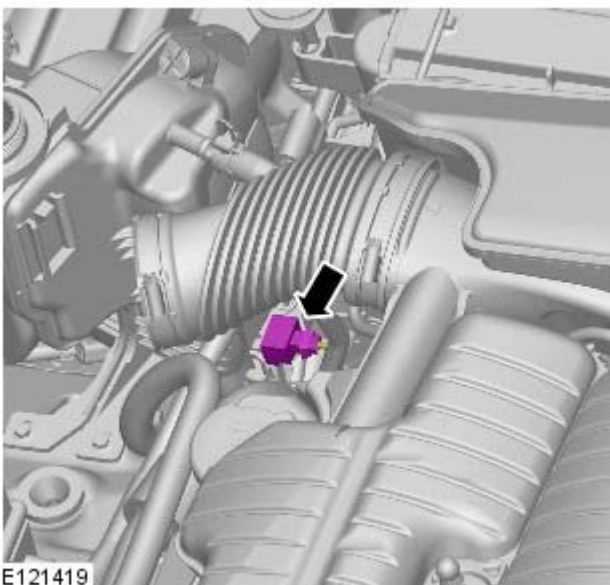


48.  CAUTION: Be prepared to collect escaping coolant.

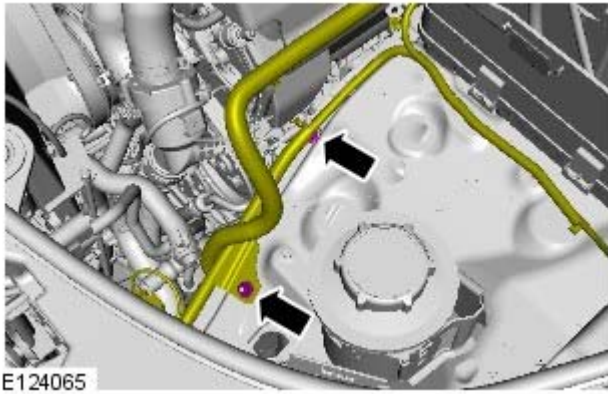
49.



50.



51. TORQUE: 10 Nm



All vehicles

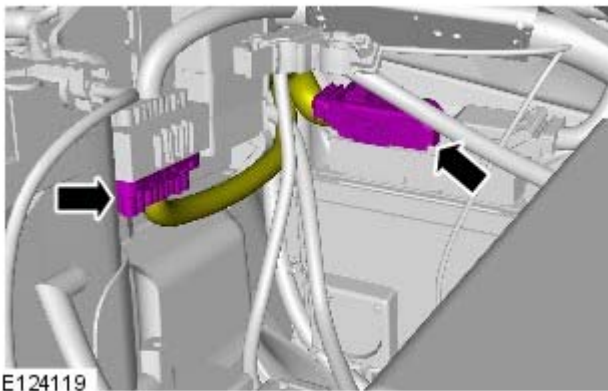
52. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

53. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

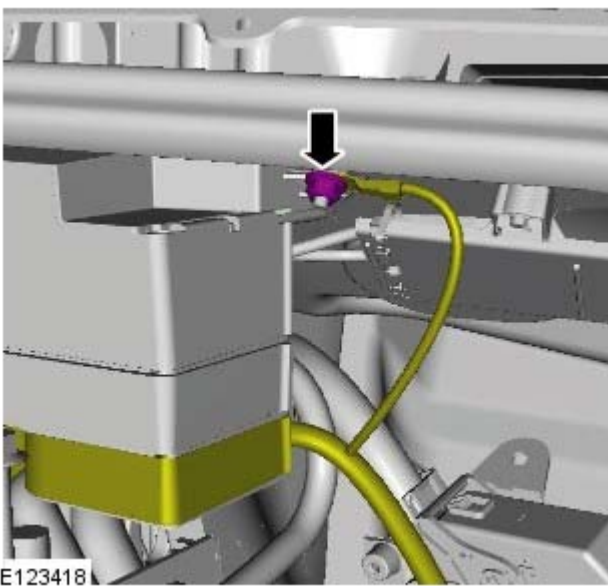
54. For additional information, refer to: Air Cleaner LH (303-12, Removal and Installation).

55. For additional information, refer to: Air Cleaner RH (303-12, Removal and Installation).

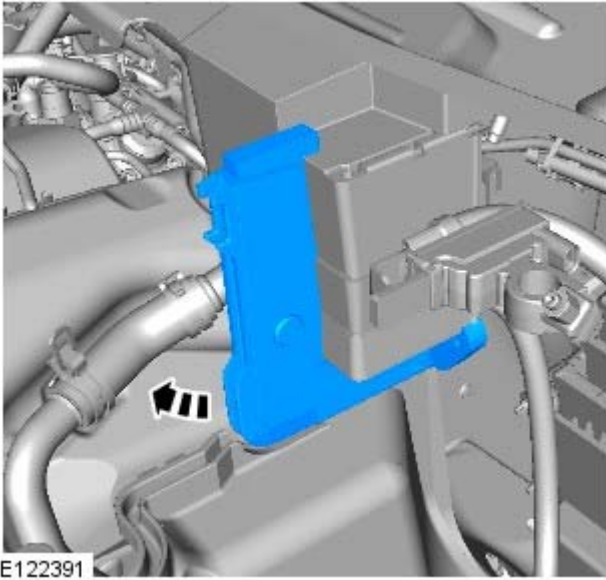
56.



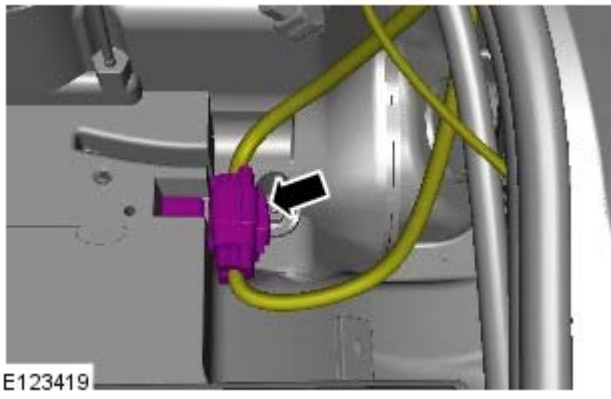
57. TORQUE: 10 Nm



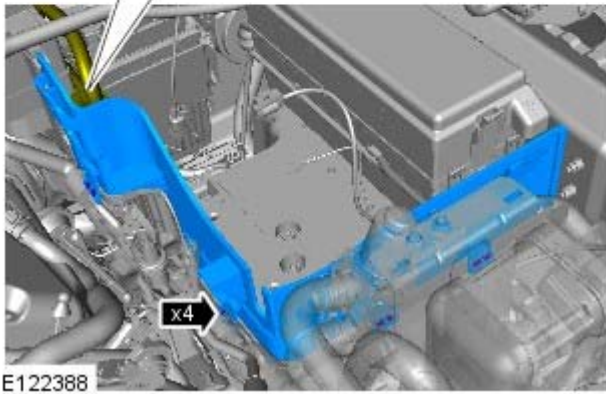
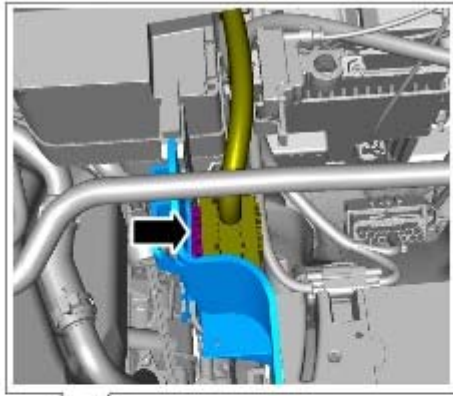
58.



59.

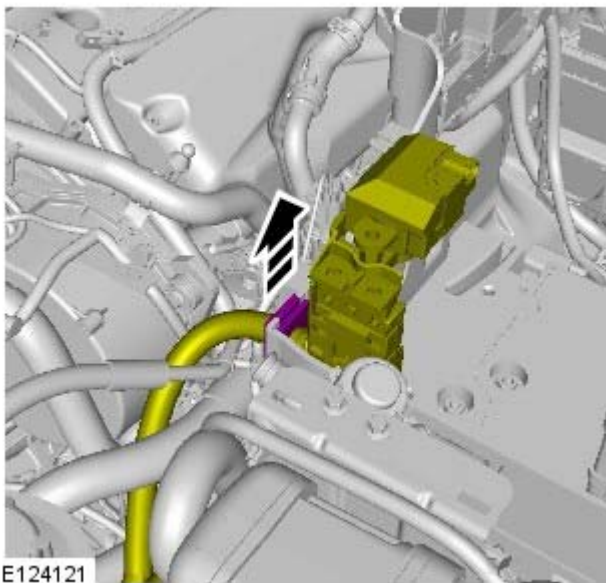


60. NOTE: RHD illustration shown, LHD is similar.



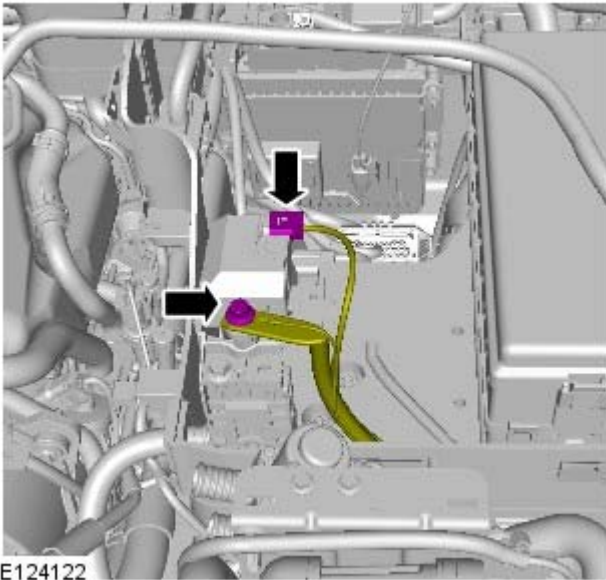
E122388

61.



E124121

62.



63. For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

64. For additional information, refer to: Battery (414-01, Removal and Installation).

65. For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

66. Bleed the braking system.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).

Full Frame and Body Mounting - BodyTDV6 3.0L Diesel/TDV6 2.7L Diesel

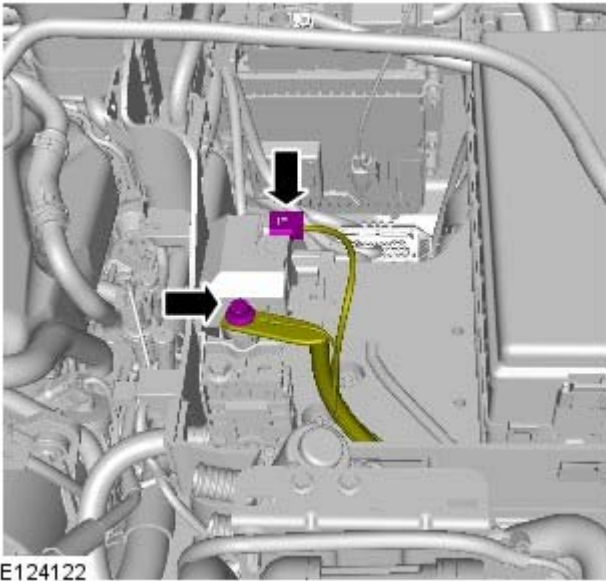
Removal and Installation

Removal

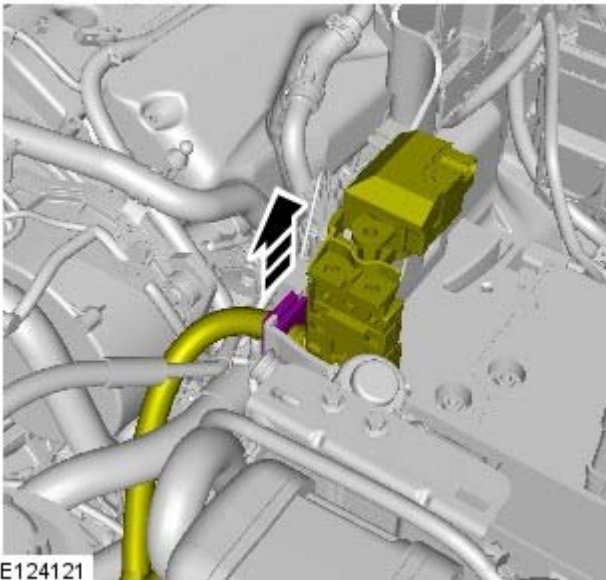
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the engine removed for clarity.

All vehicles

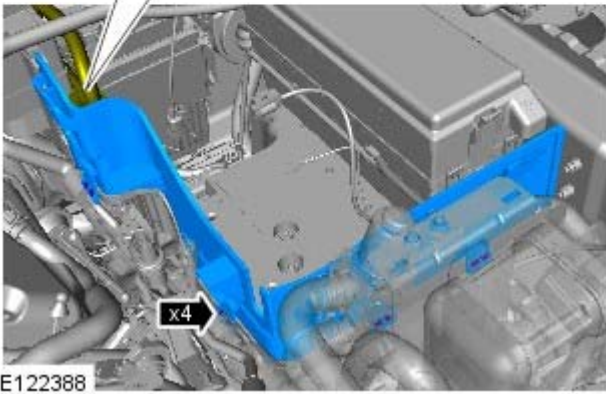
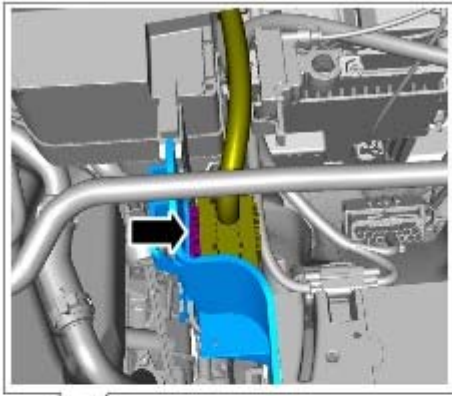
1. For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
2. Remove the battery.
For additional information, refer to: Battery (414-01, Removal and Installation).
- 3.



4.

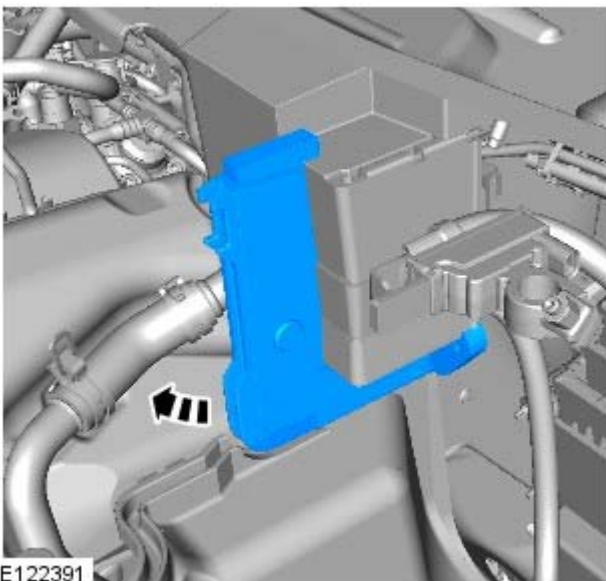


5. NOTE: RHD illustration shown, LHD is similar.



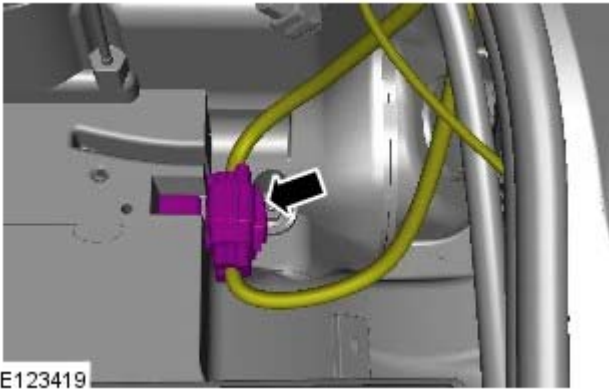
E122388

6.

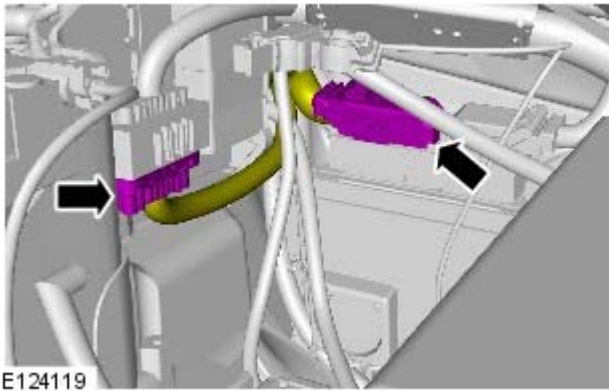


E122391


7.



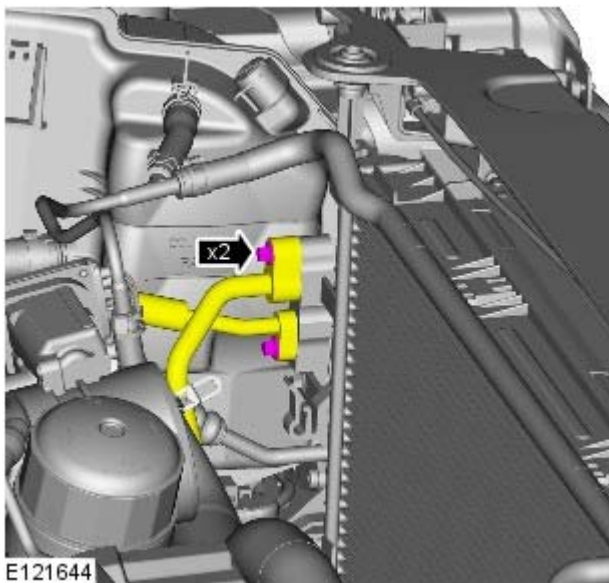
8.

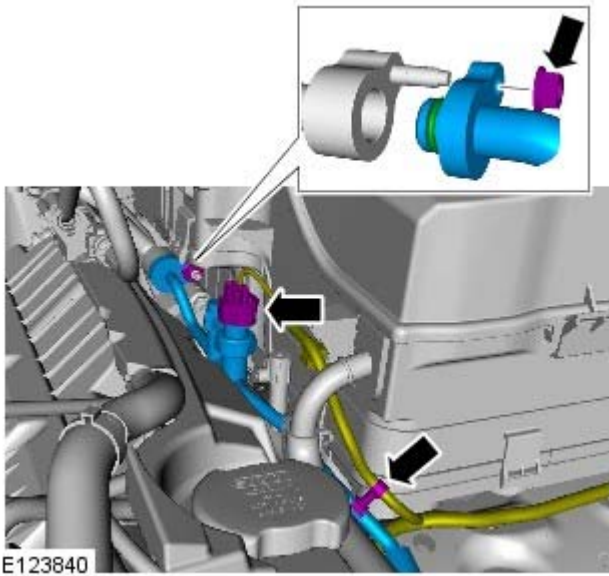



9. For additional information, refer to: Air Cleaner (303-12, Removal and Installation).
10. For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
11. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).
12. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

13.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

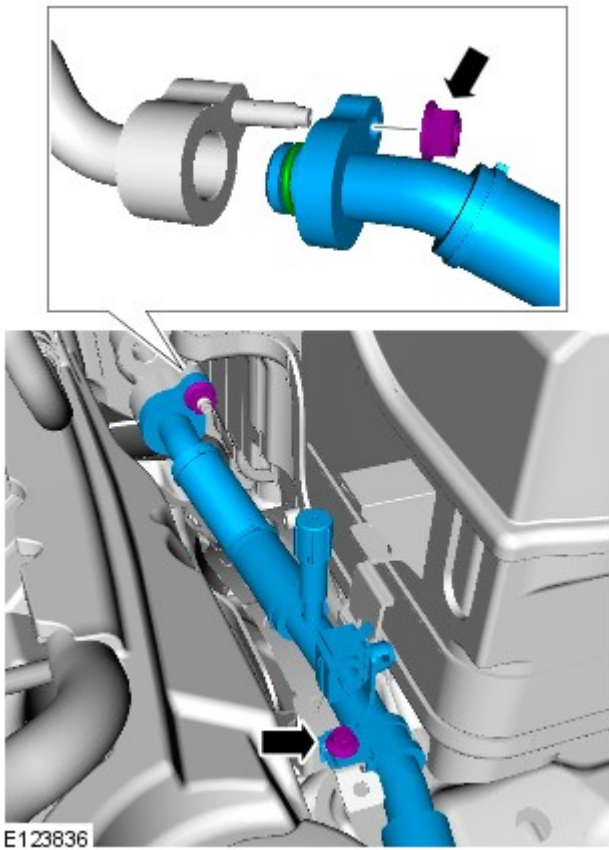
- Remove and discard the 2 O-ring seals.





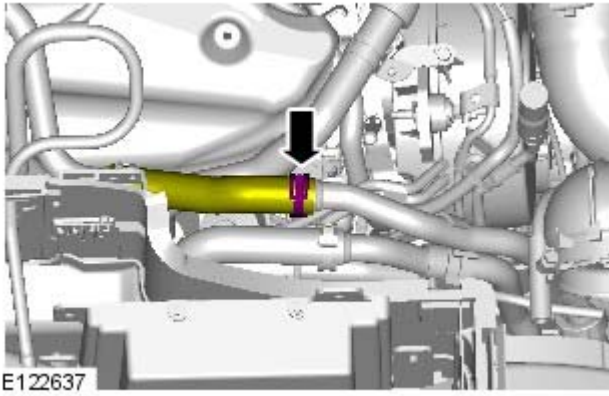
14.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

- Discard the O-ring seal.



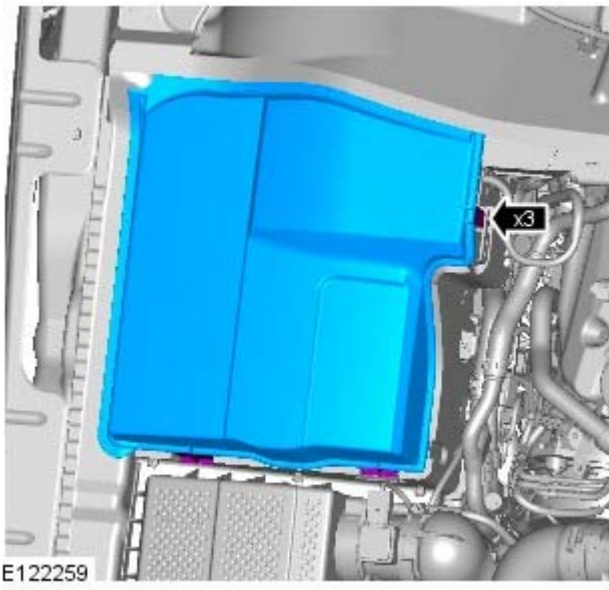
15.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

- Discard the O-ring seal.

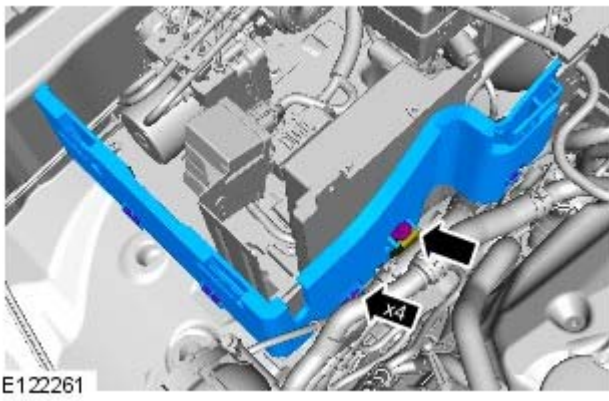


16.  **WARNING:** Be prepared to collect escaping fluid.

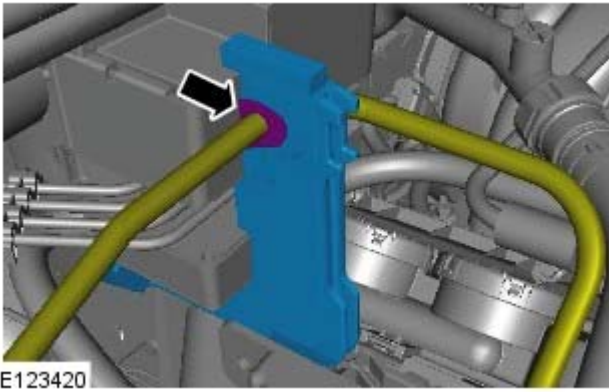
17.



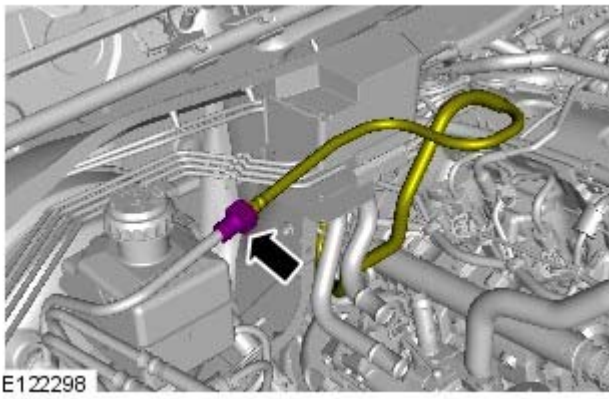
18.



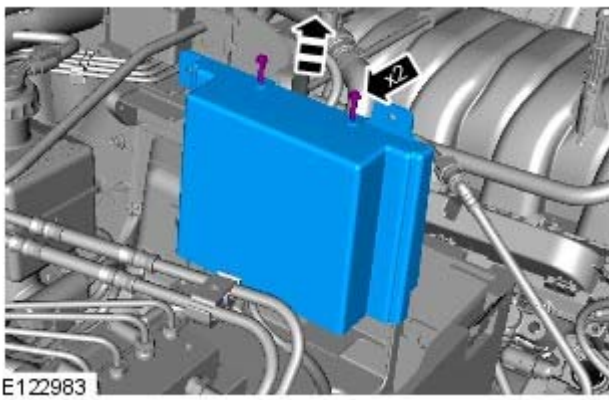
19.



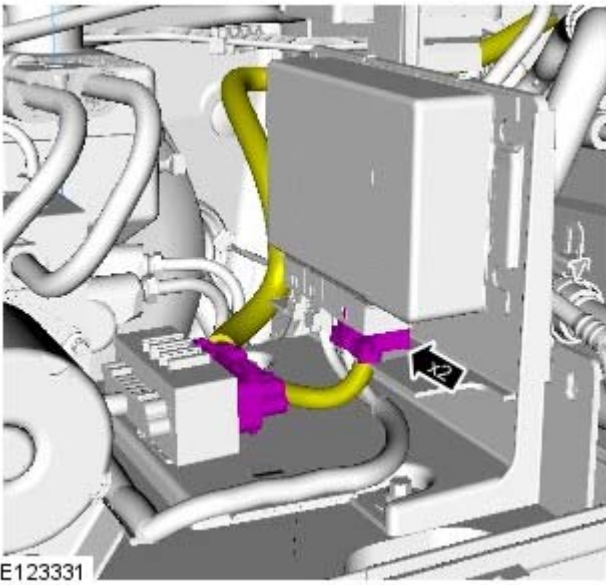
20.



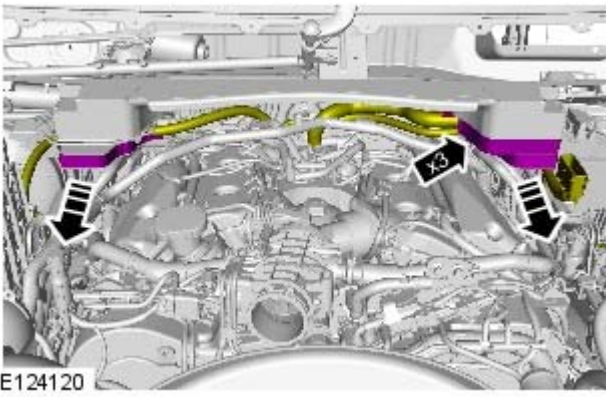
21.



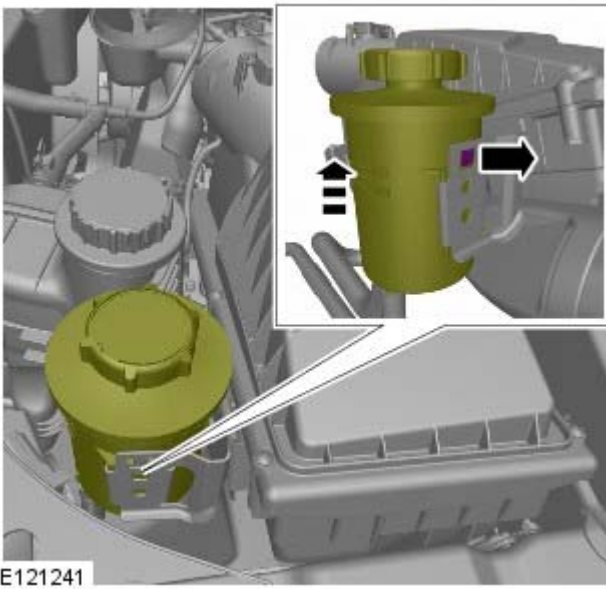
22.



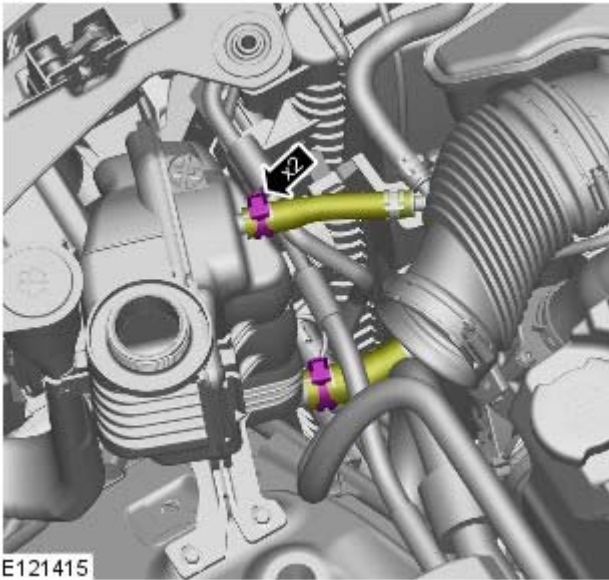
23.



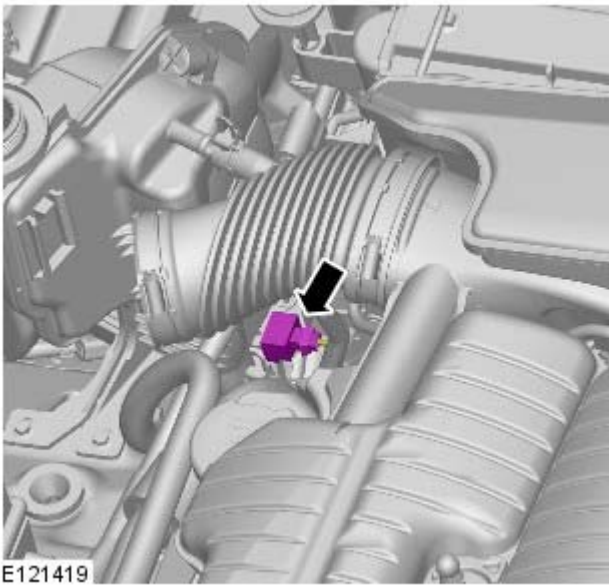
24.



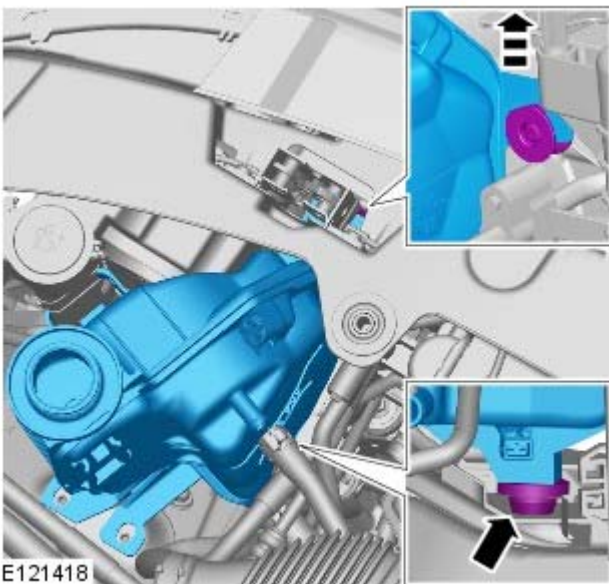
25.



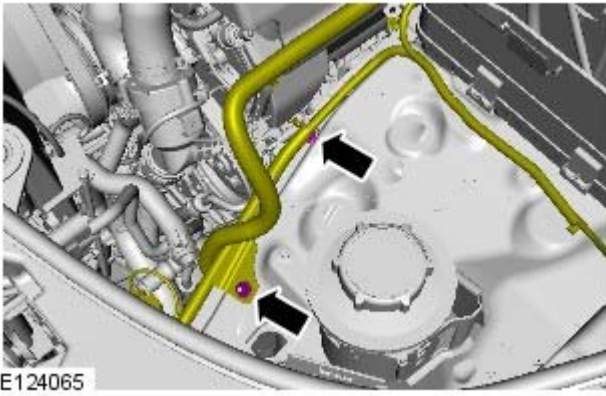
26.



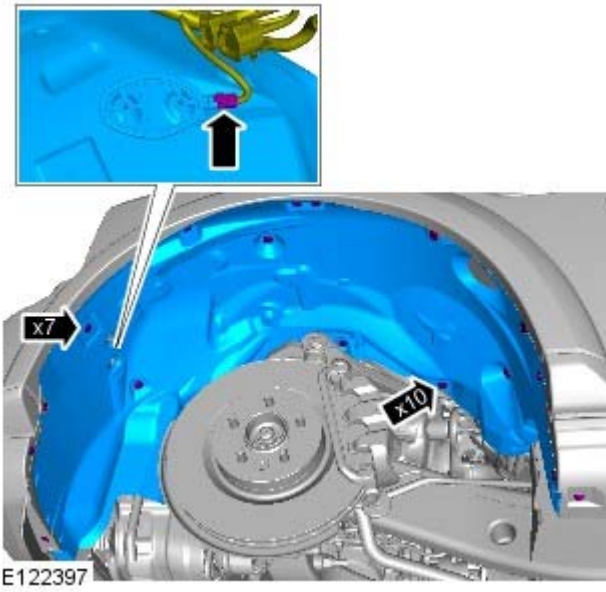
27.  CAUTION: Be prepared to collect escaping coolant.



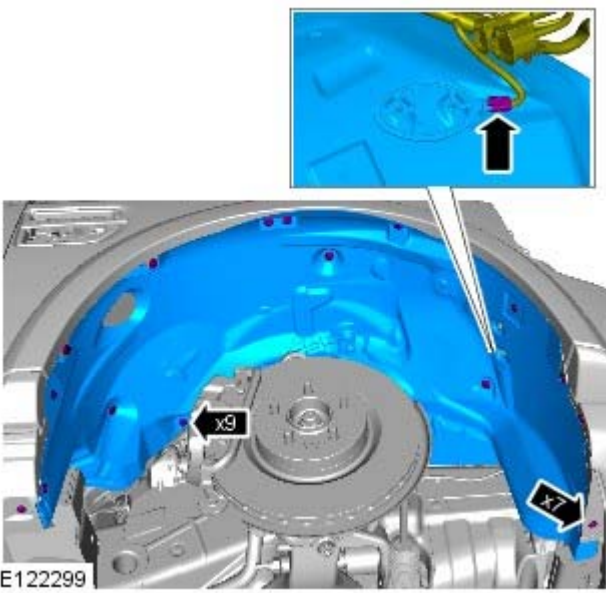
28.



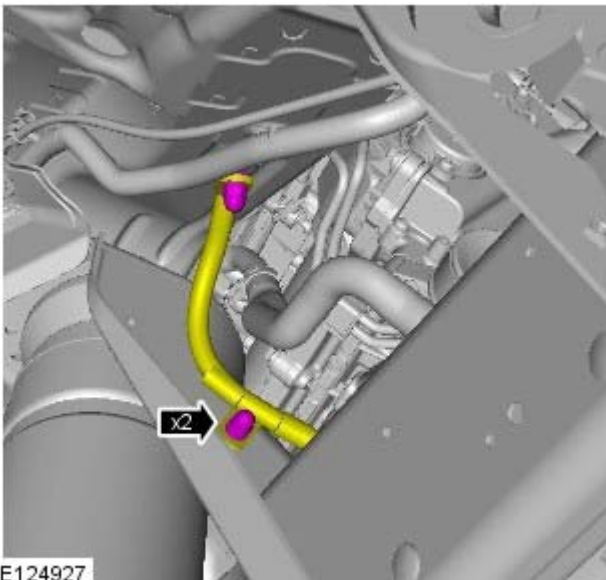
29.



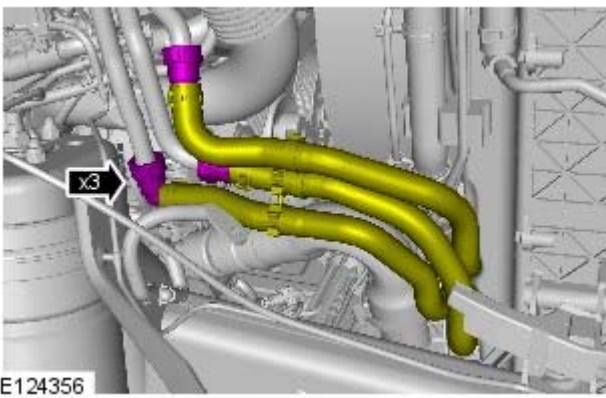
30.



31.

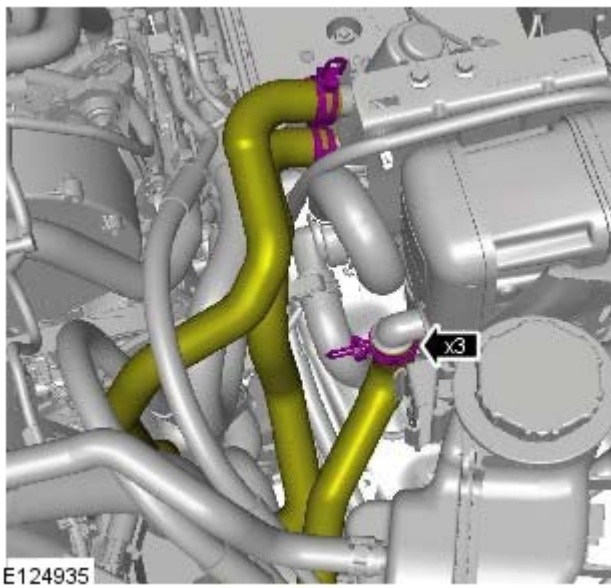


32.  CAUTION: Be prepared to collect escaping coolant.

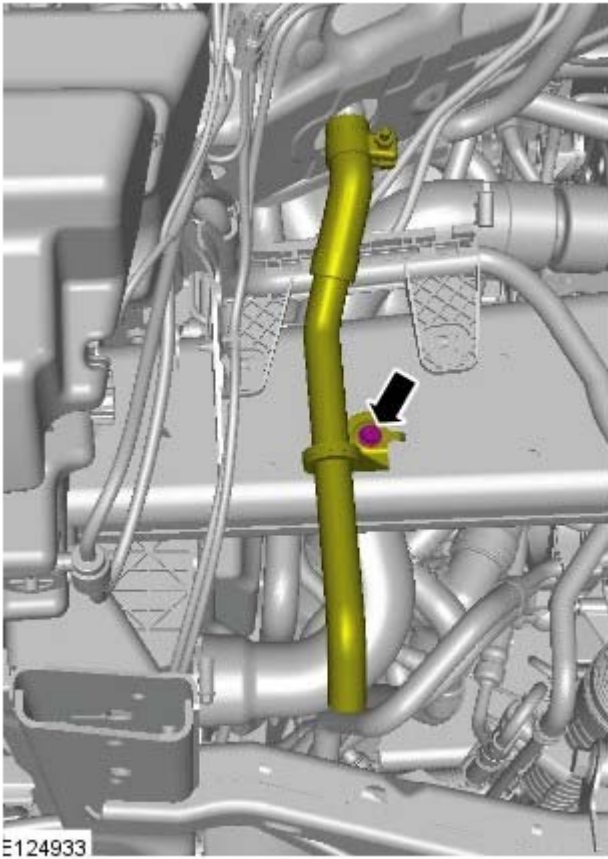


Vehicles with auxiliary heating

33.

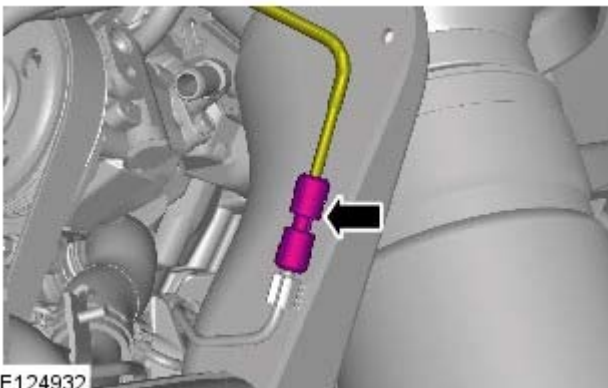


34.



E124933

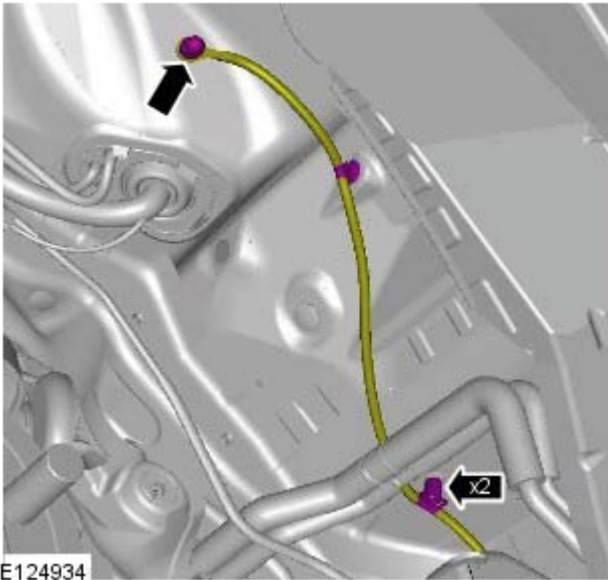
35.



E124932

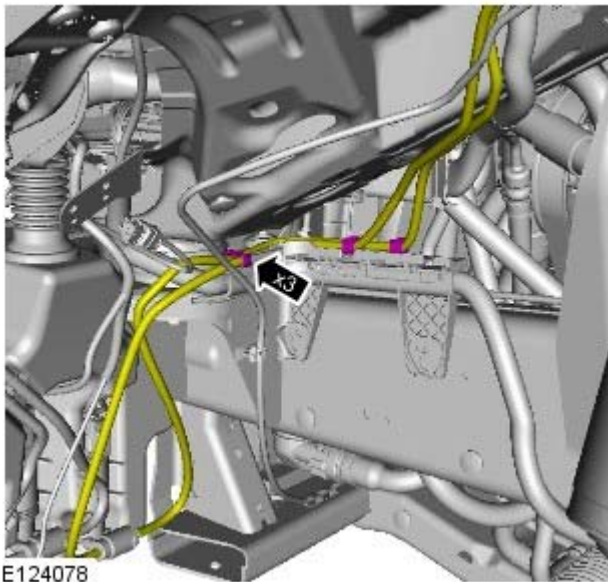
All vehicles

36.



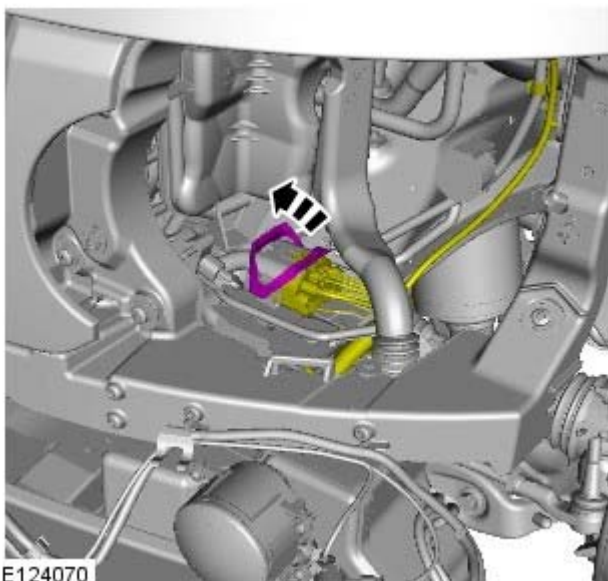
E124934

37.



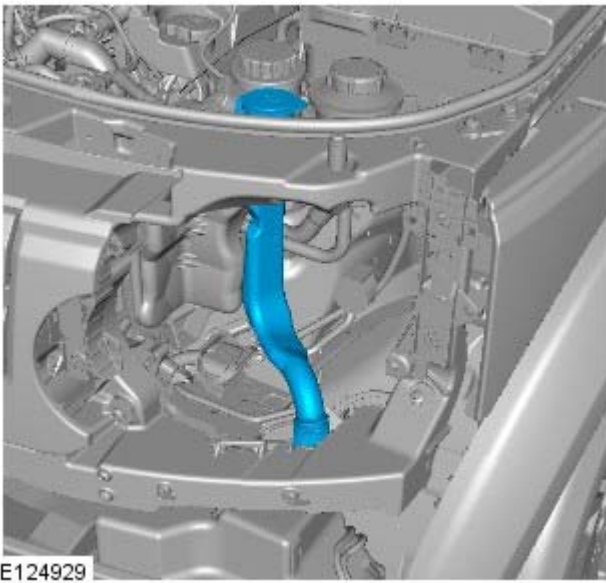
E124078

38.



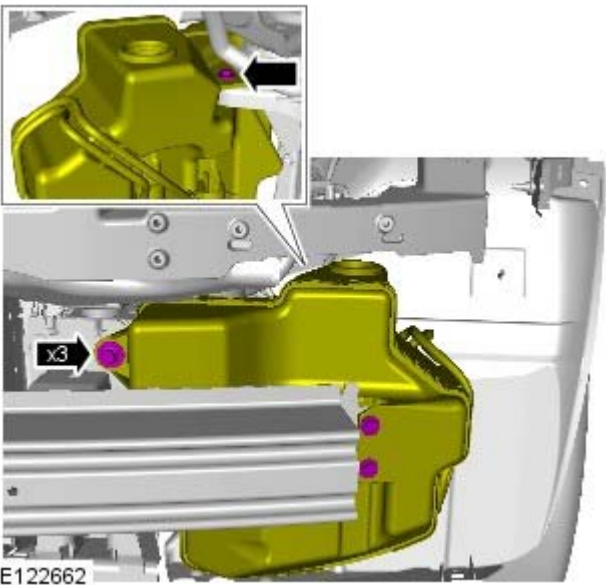
E124070

39.



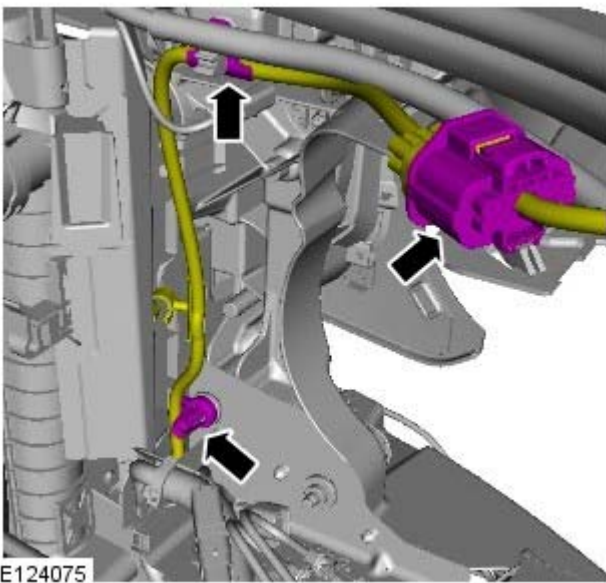
E124929

40.



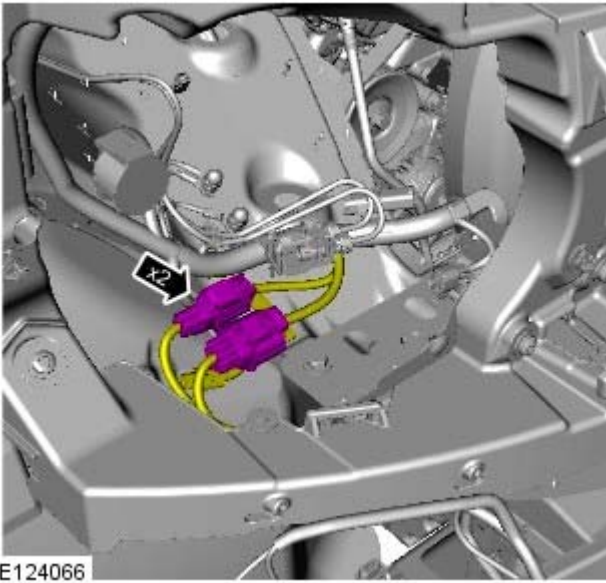
E122662

41.

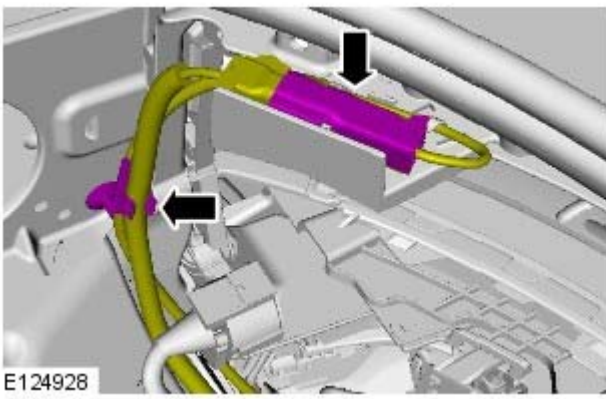


E124075

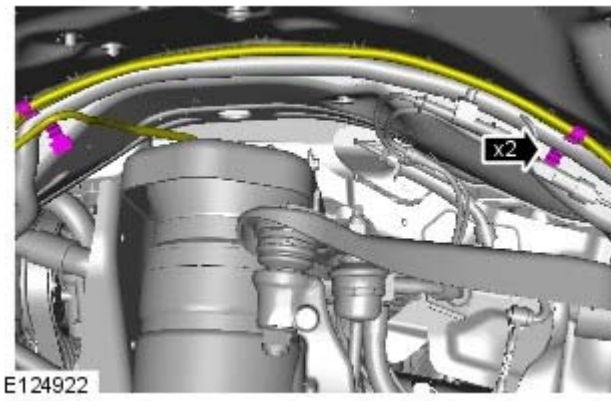
42.



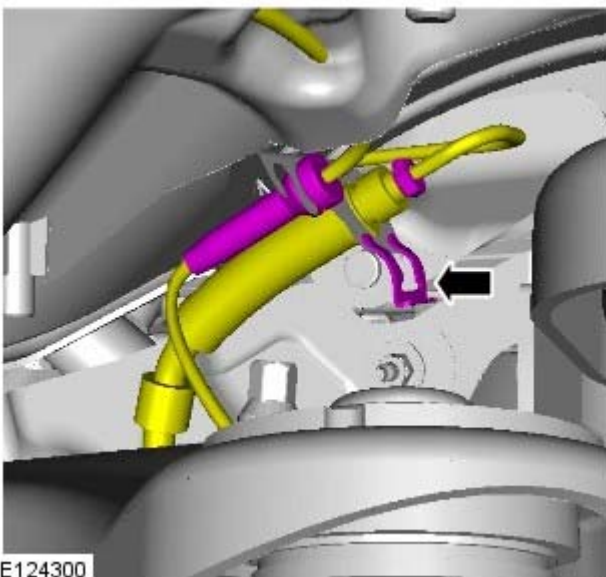
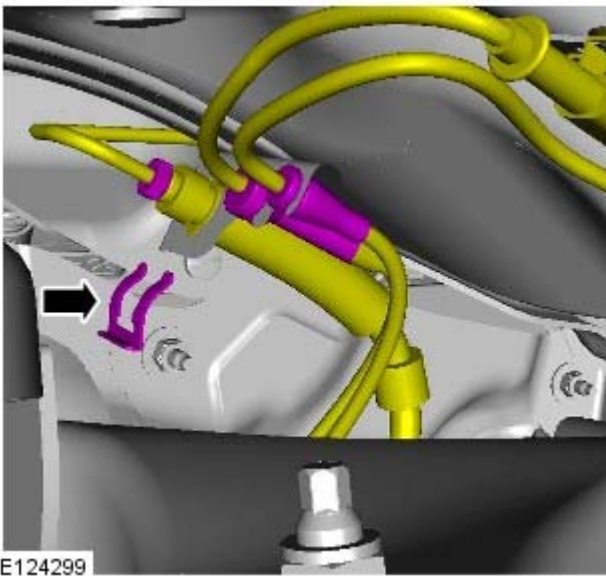
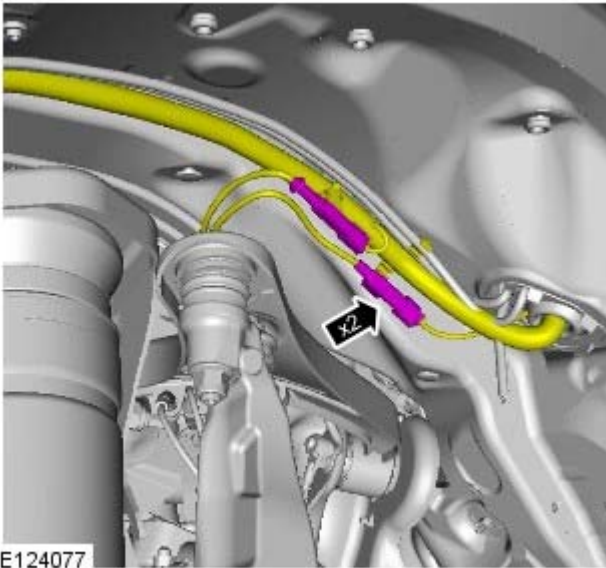
43.



44.



45.



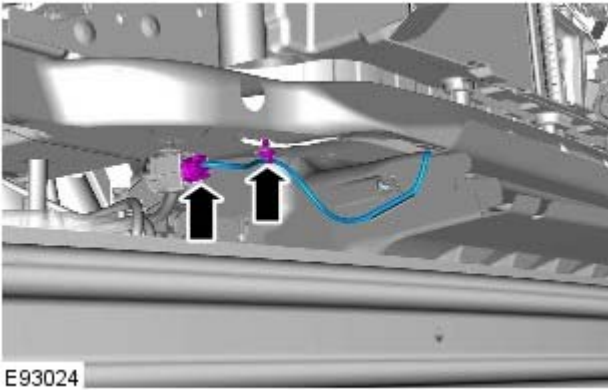
46. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

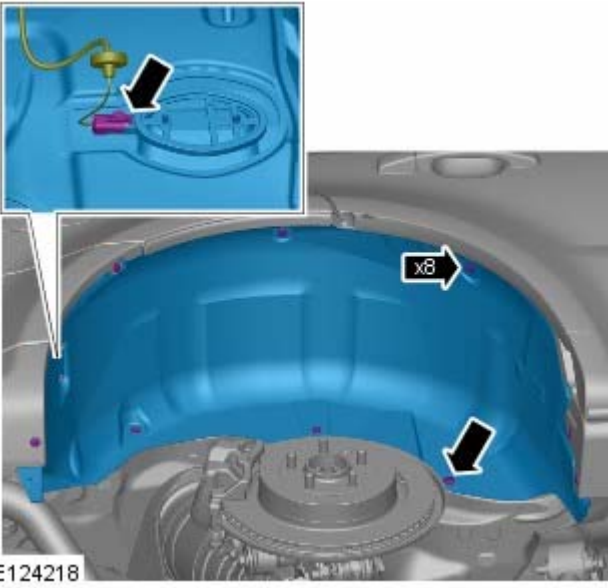
47. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

48.

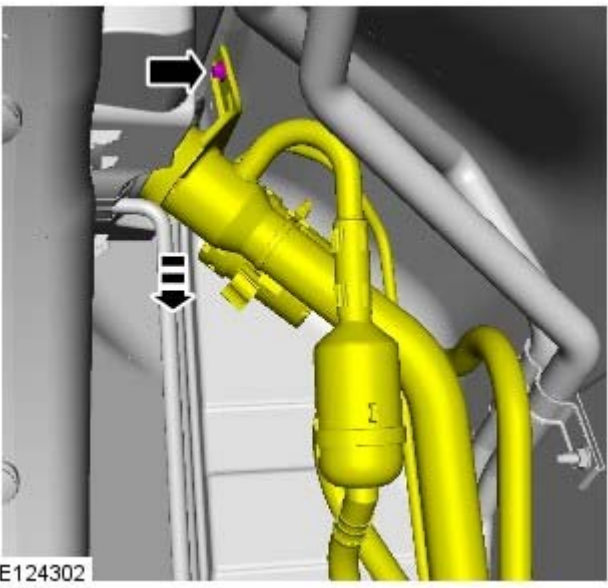


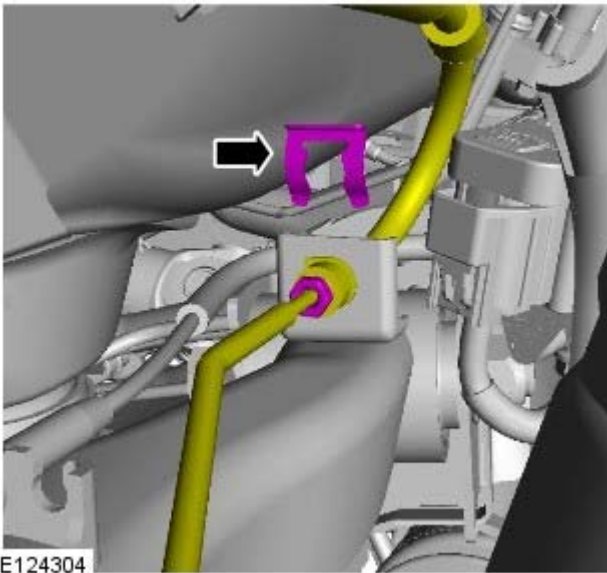
49.




50. Remove the fuel filler cap.

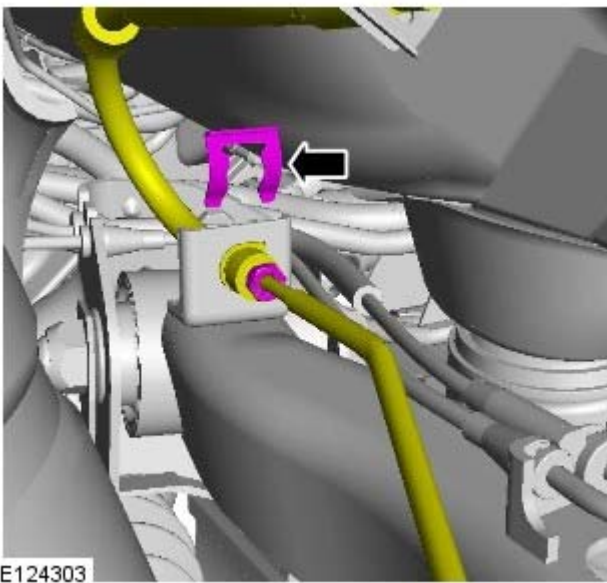
51.






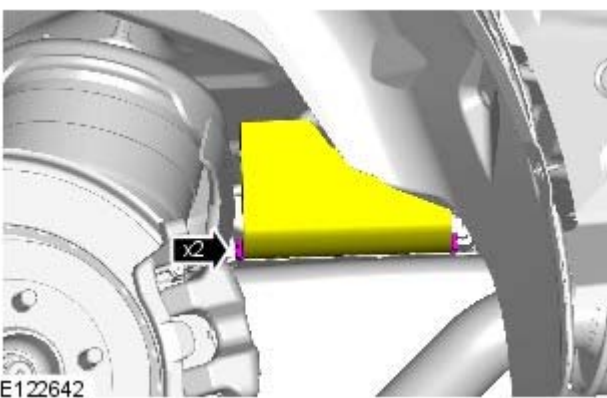
52.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.



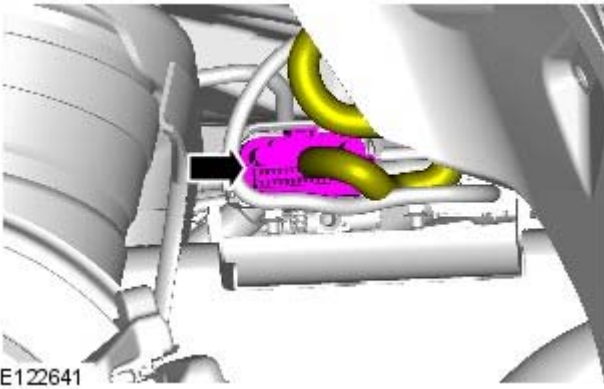
53.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

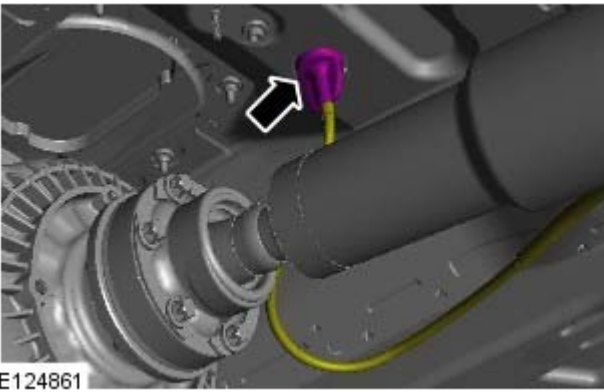


54.

55.

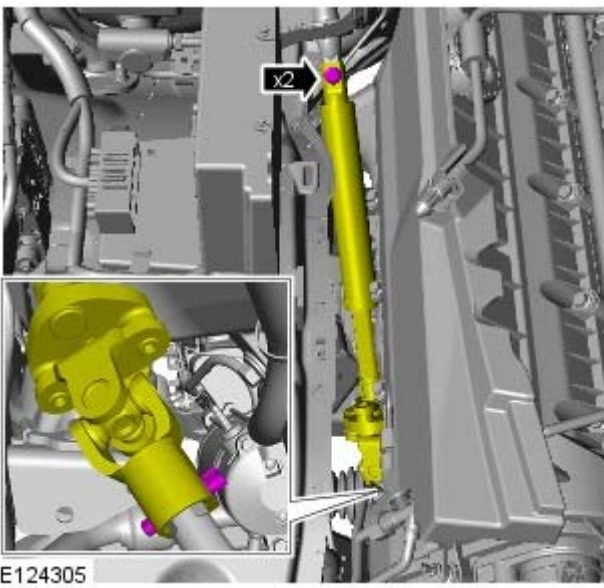


56.  CAUTION: Note the fitted position of the seal.

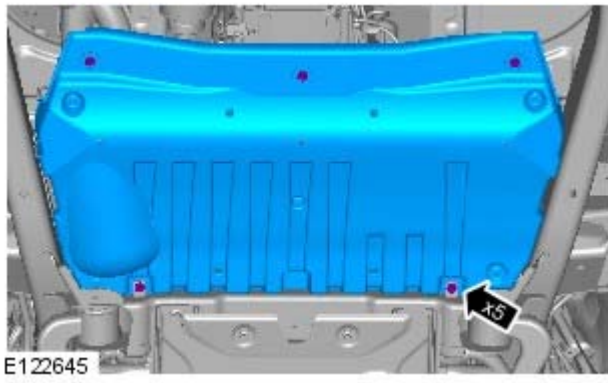


57.

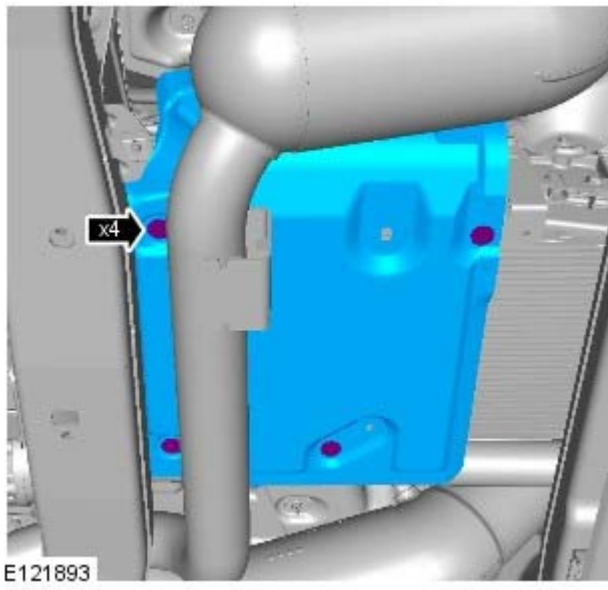
- Remove and discard the bolt.



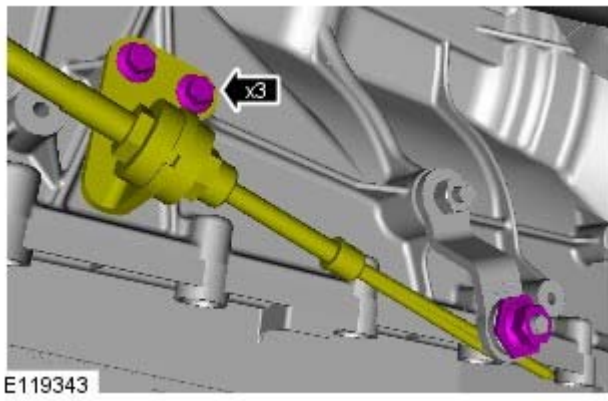
58.



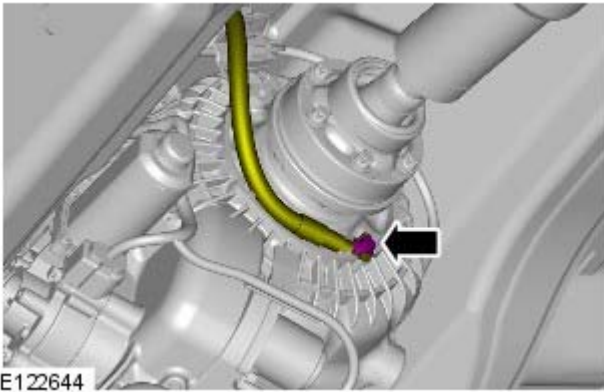
59.



60.



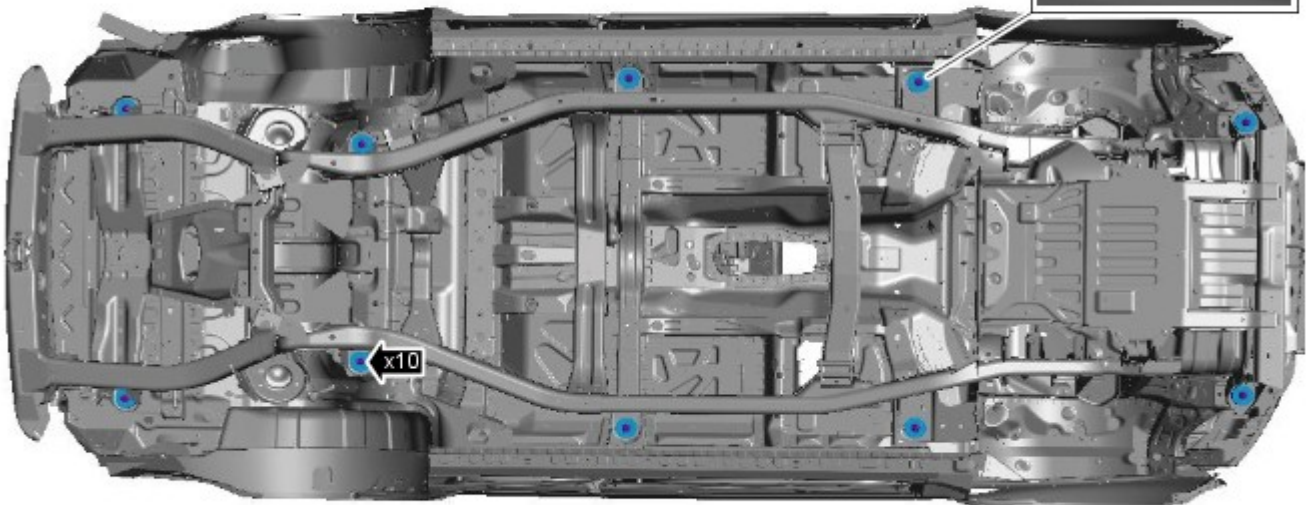
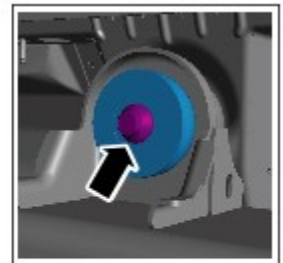
61.




62. Carefully lower the vehicle and support the chassis with axle stands.

63. Remove and discard the 10 body mount bolts.

- Remove the 10 spacing washers.



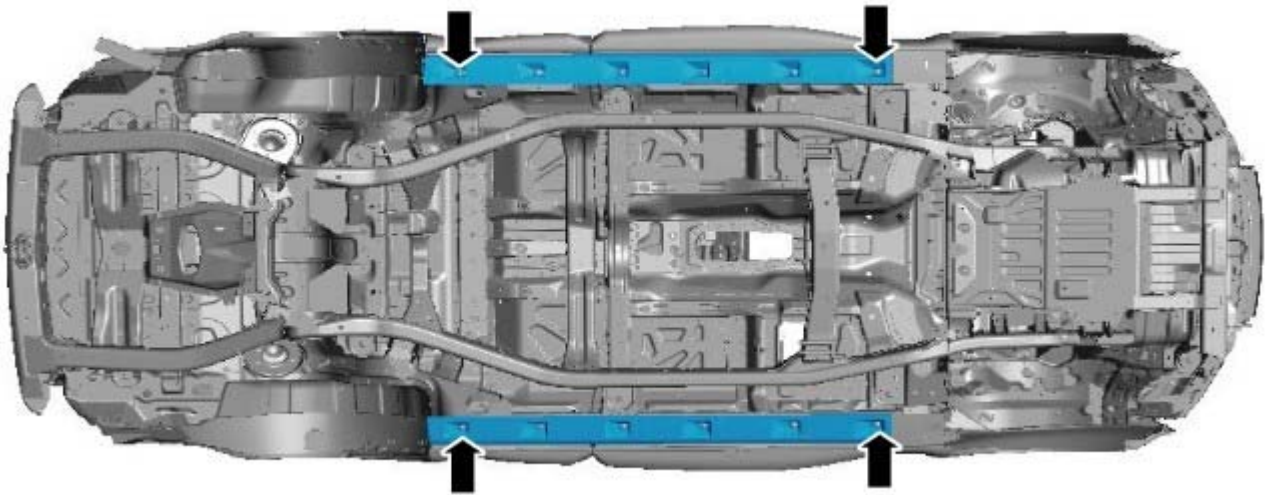
E124859

64.  CAUTION: To prevent the body becoming unstable when raised from the integrated body frame, install the vehicle tie down straps.

- NOTE: Note the fitted position of the body mounts.

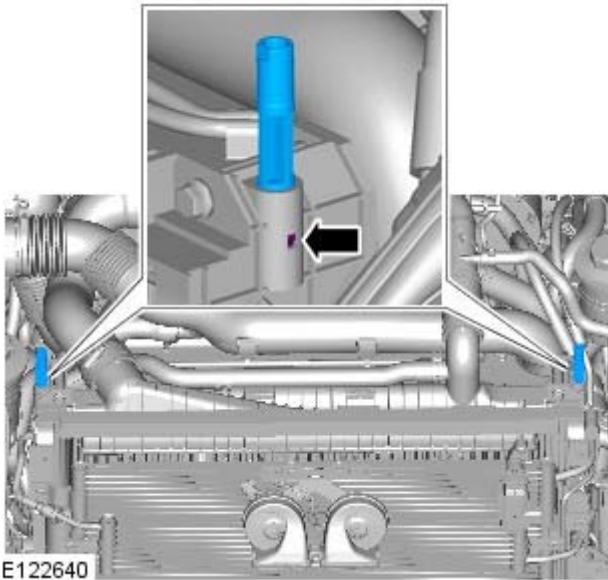
Using an assistant raise and support the body.

- Remove the body mounts.



E124860

65.



E122640

Installation

All vehicles

1. CAUTIONS:



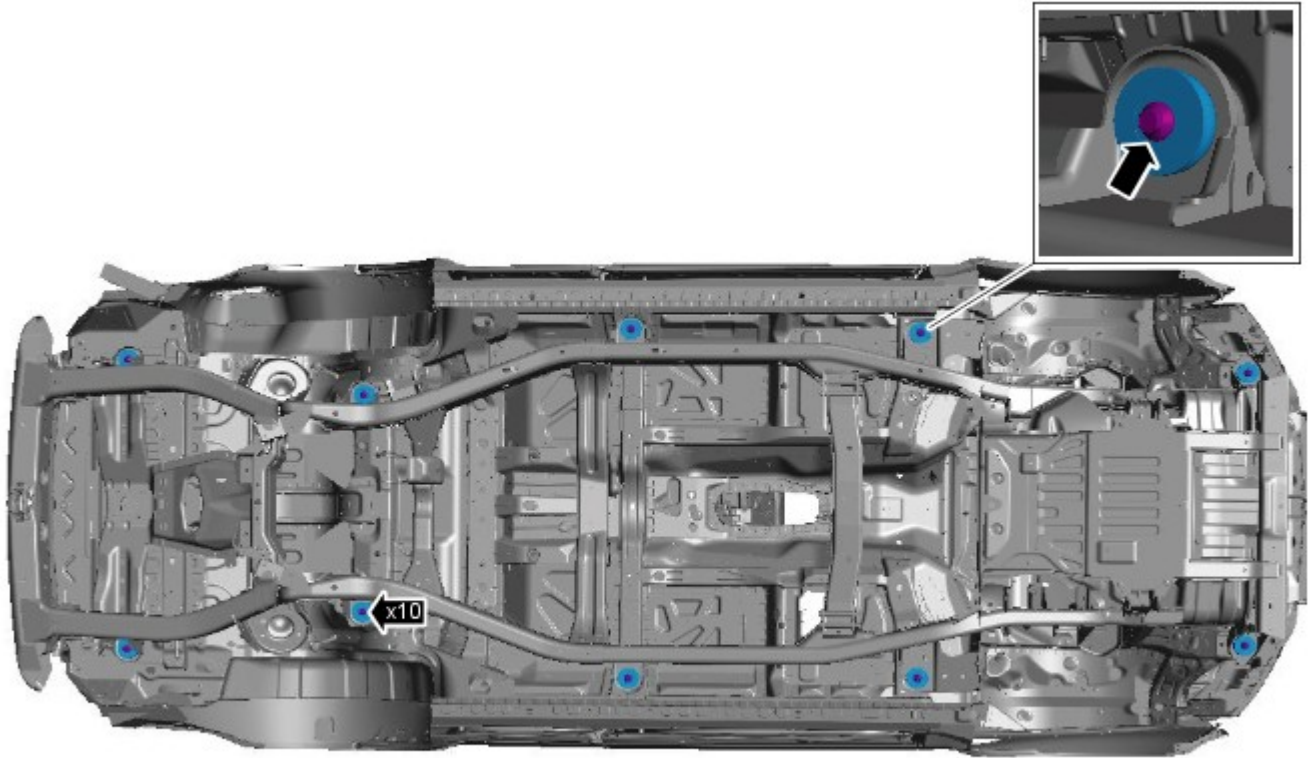
Make sure that new bolts are installed.



Make sure that all components are free and do not get caught up whilst lowering the body onto the integrated body frame.

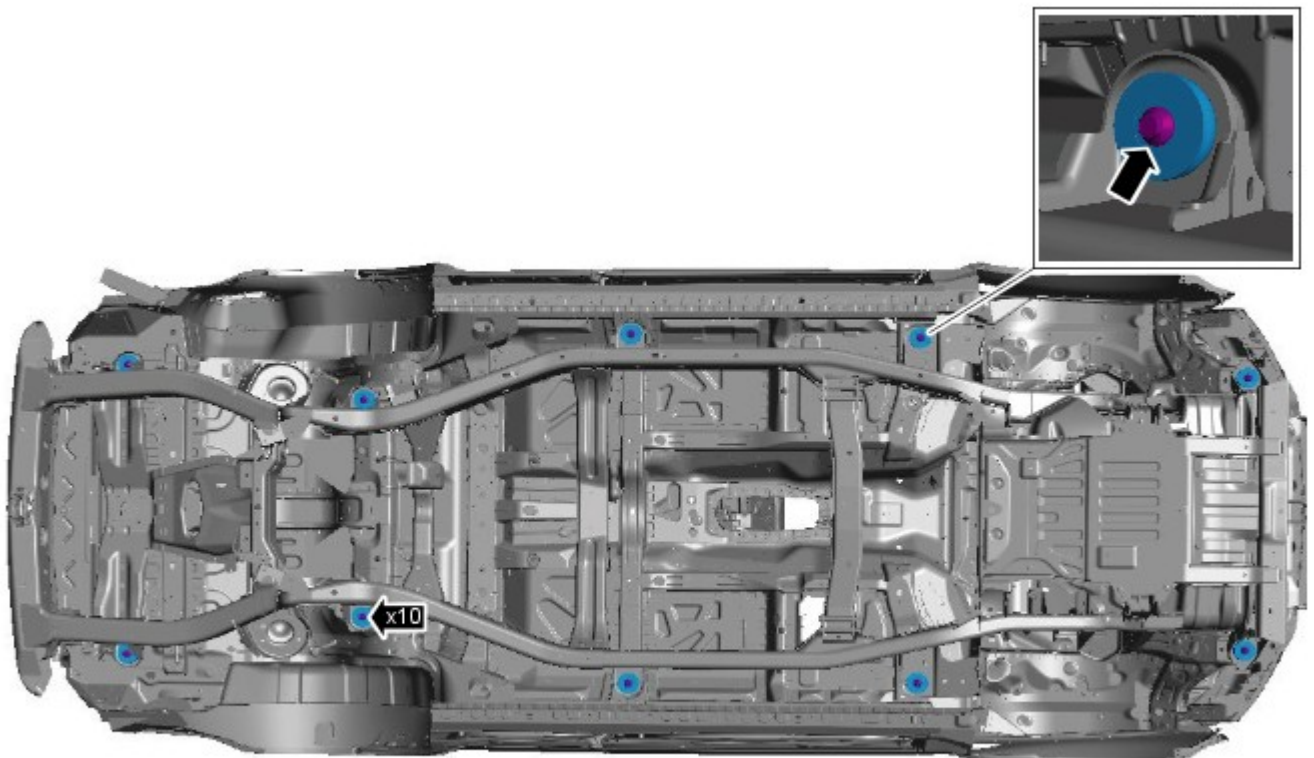
Using an assistant install the body to the integrated body frame.

- Install the body mounts.
- With assistance align the body and integrated body frame mounts.
- Install the bolts, but do not tighten fully at this stage.



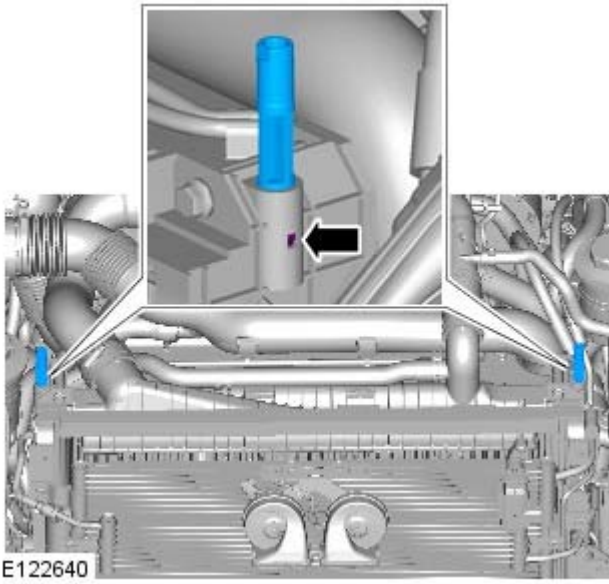
E124859

2. Remove the tie down straps securing the body.
3. TORQUE: 133 Nm

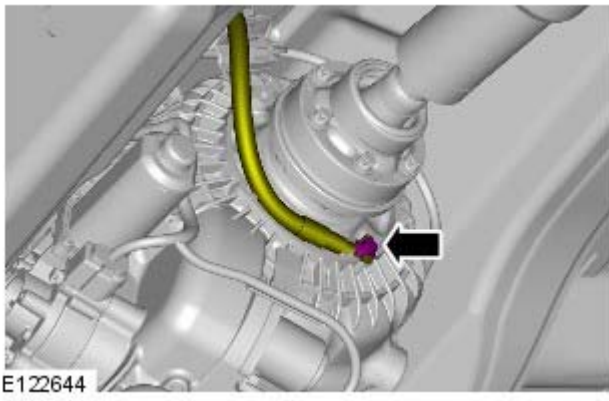


E124859

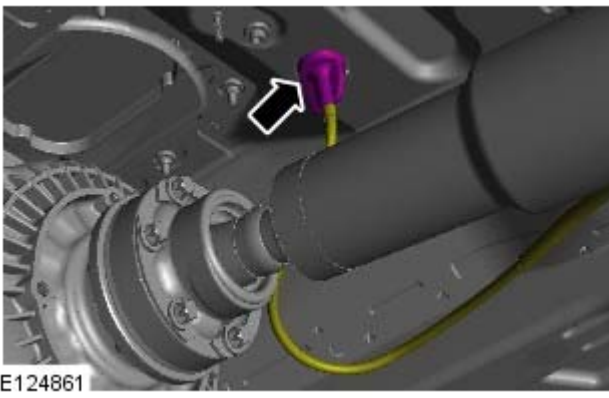
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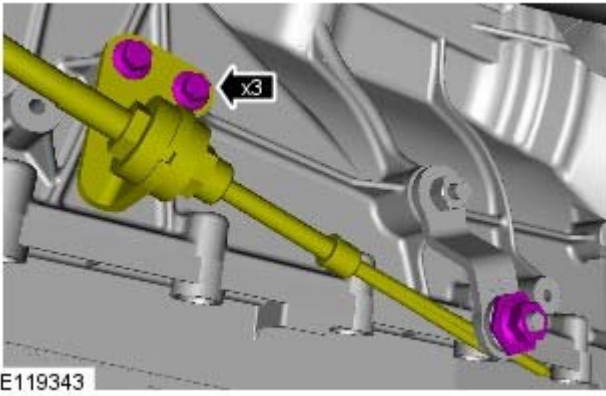
5. TORQUE: 25 Nm



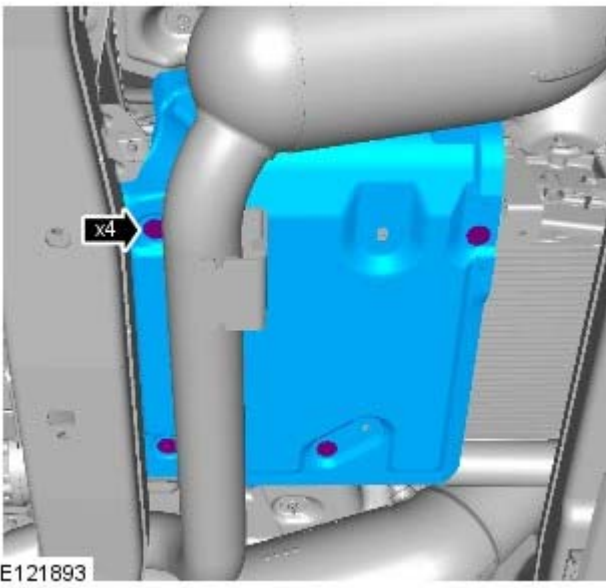
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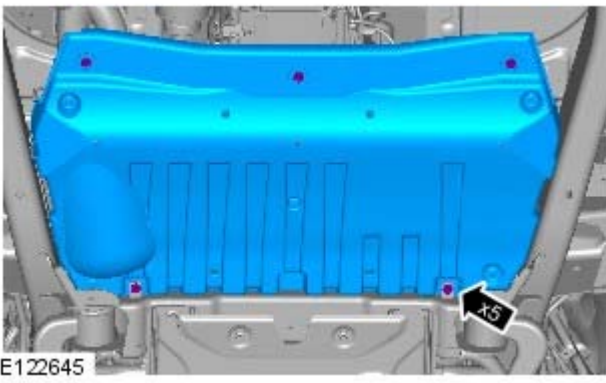
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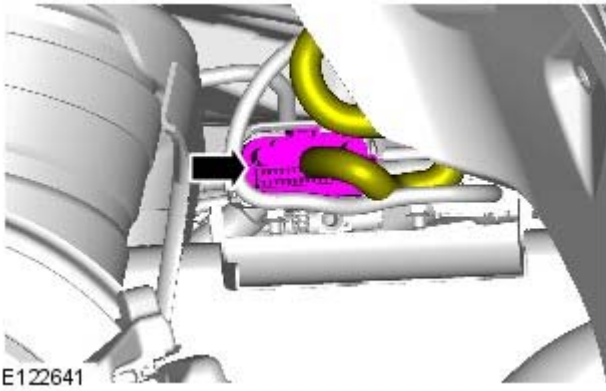
8. TORQUE: 12 Nm



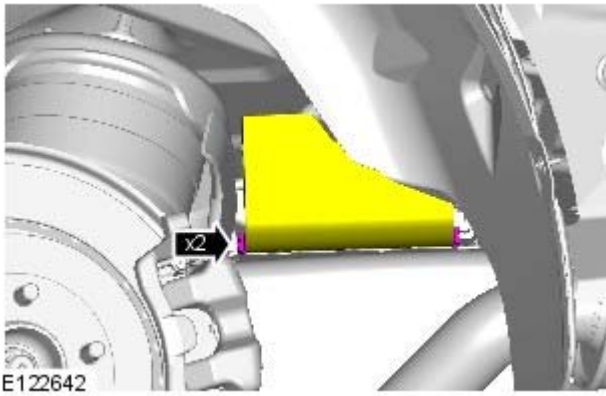
9. TORQUE: 12 Nm



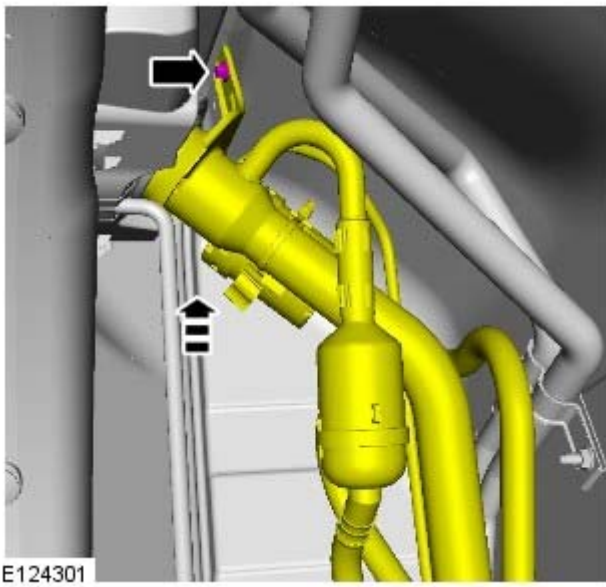
10.



11.

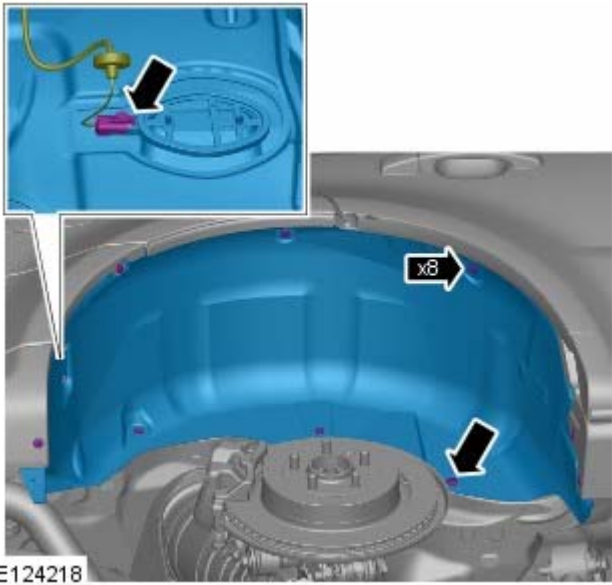


12. TORQUE: 12 Nm



13. Install the fuel filler cap.

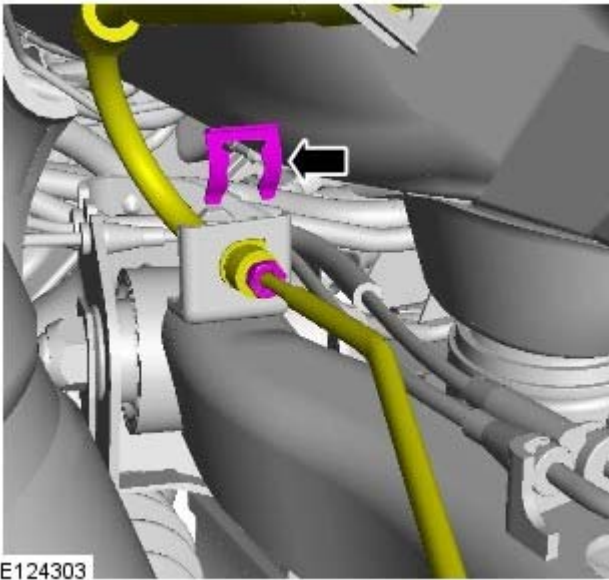
14.



15. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

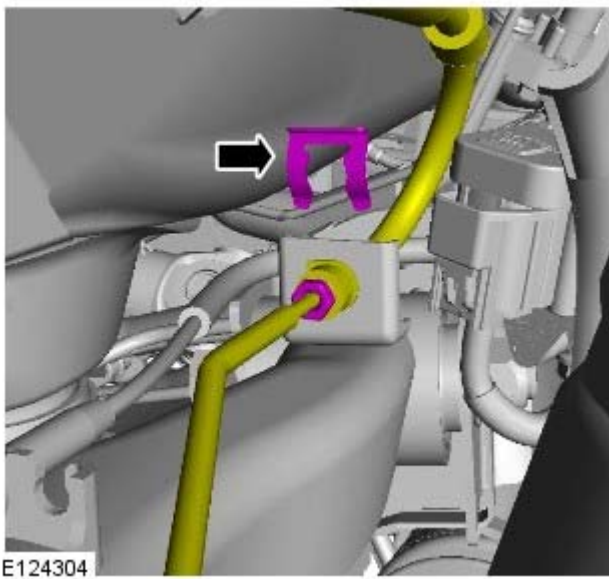
- Clean the component mating faces.
- Secure the clip.



16. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

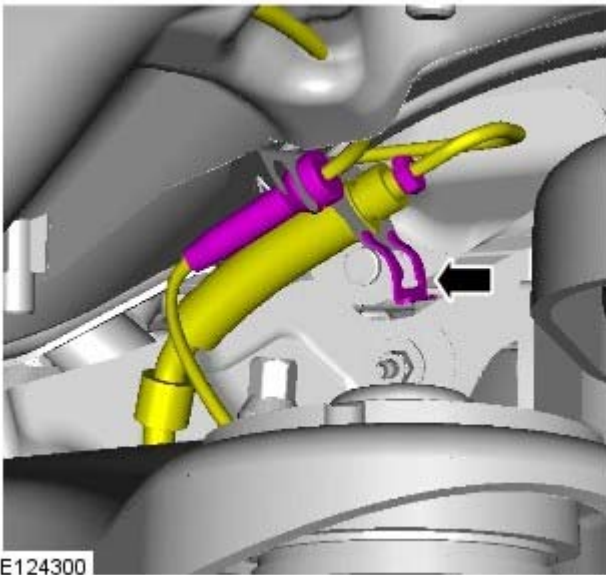
- Clean the component mating faces.
- Secure the clip.



17. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

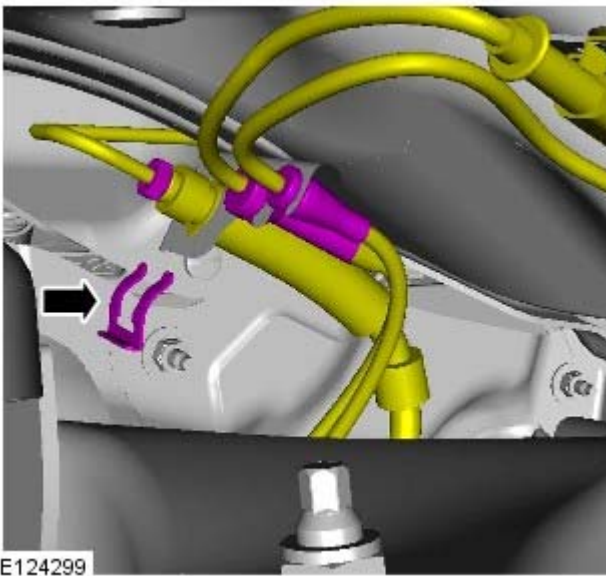
- Clean the component mating faces.
- Secure the clip.



18. NOTE: Remove and discard the blanking caps.

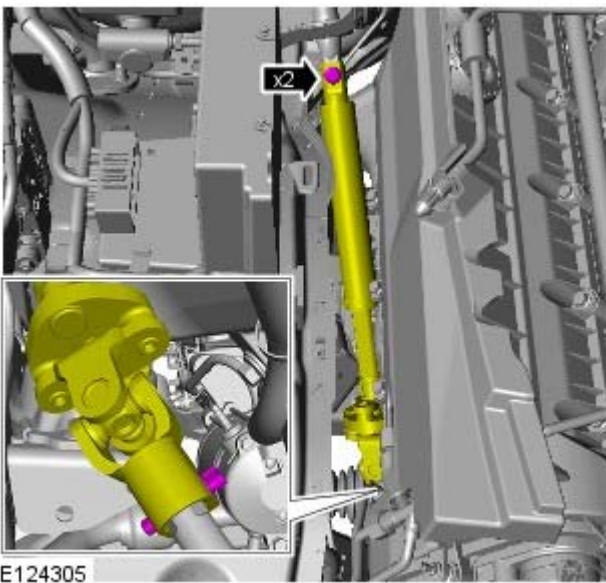
TORQUE: 16 Nm

- Clean the component mating faces.
- Secure the clip.

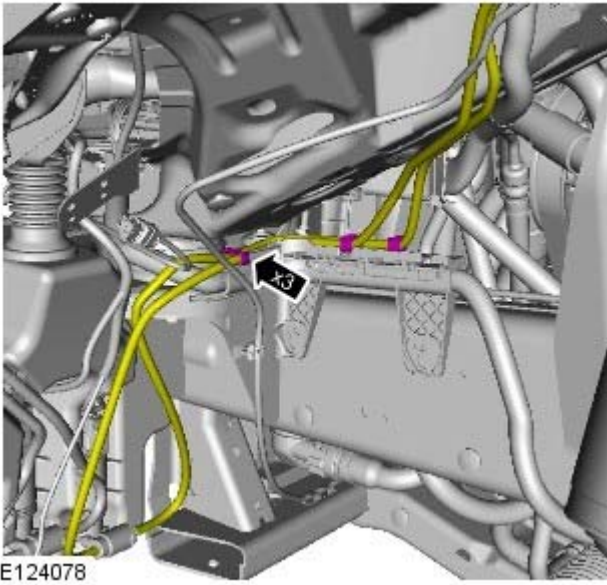


19.  WARNING: Make sure that a new bolt is installed.

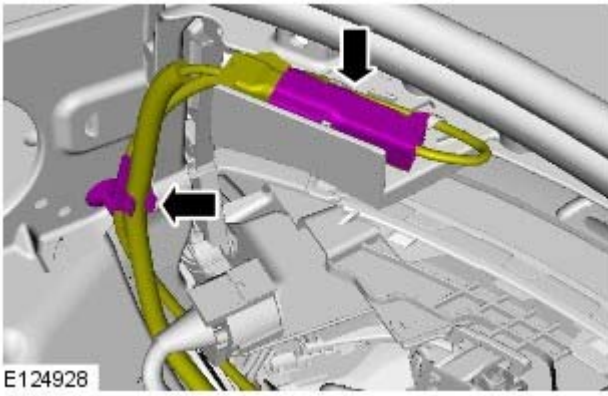
TORQUE: 25 Nm



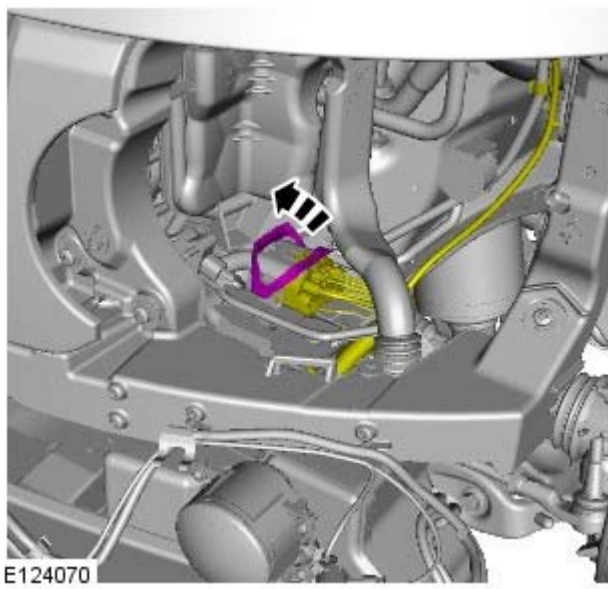
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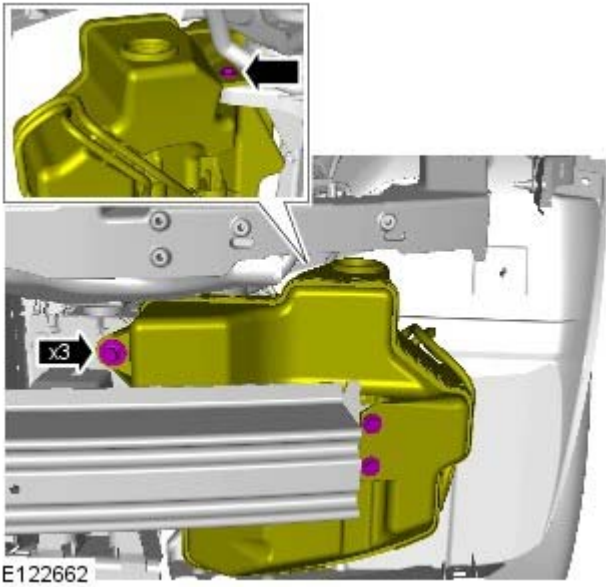
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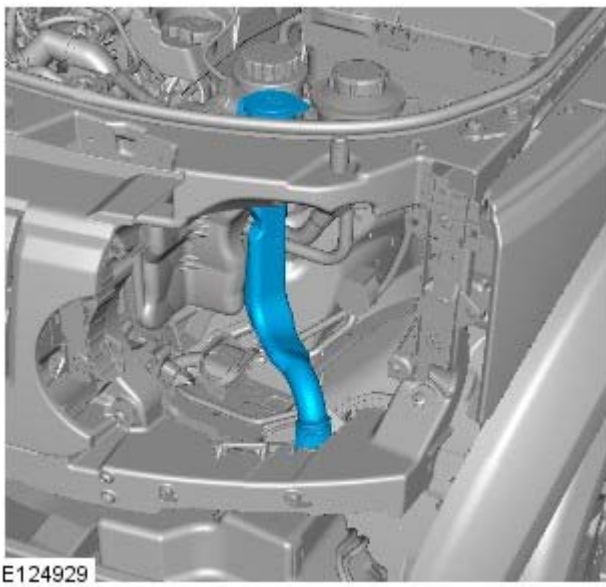
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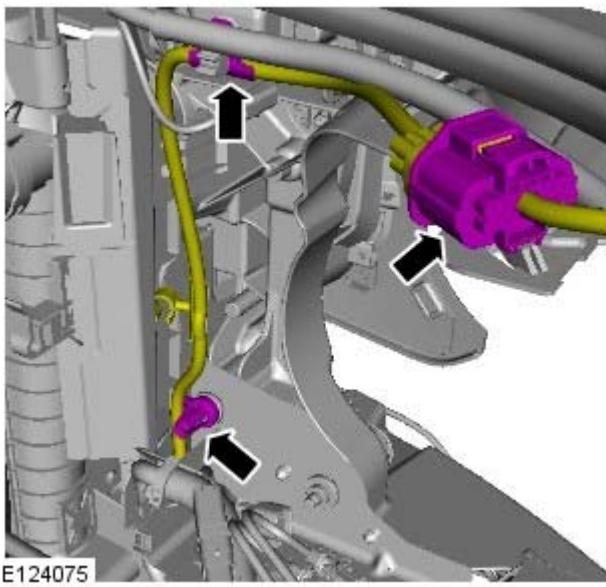
23. TORQUE: 12 Nm

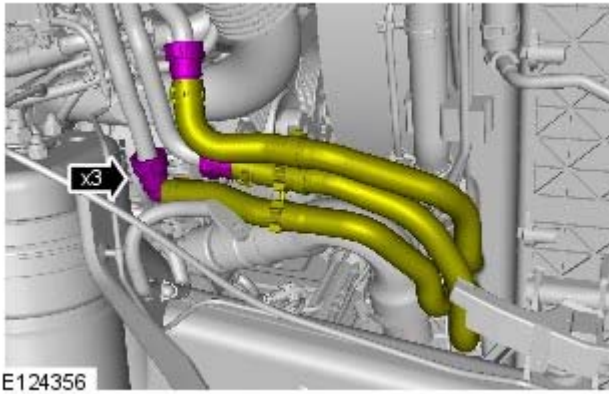


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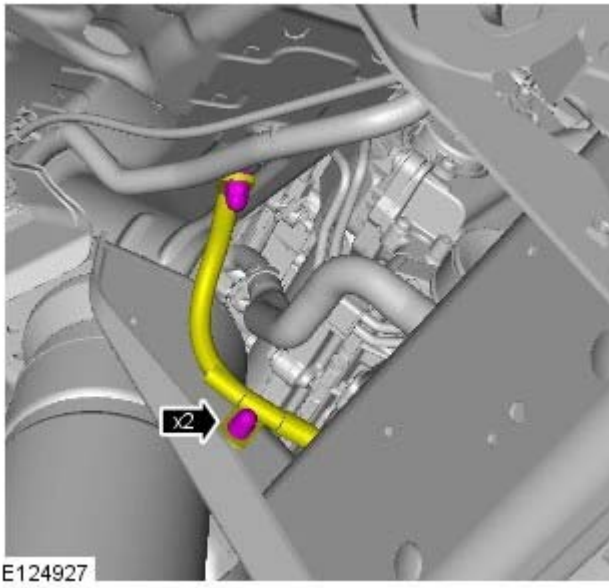
25.



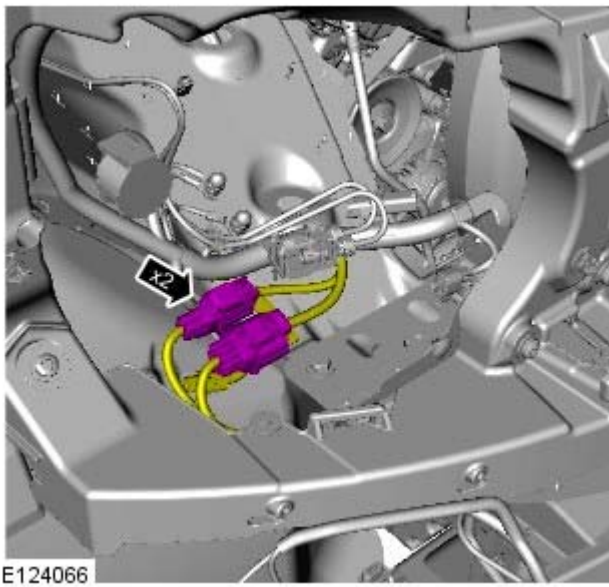


26.  CAUTION: Be prepared to collect escaping coolant.

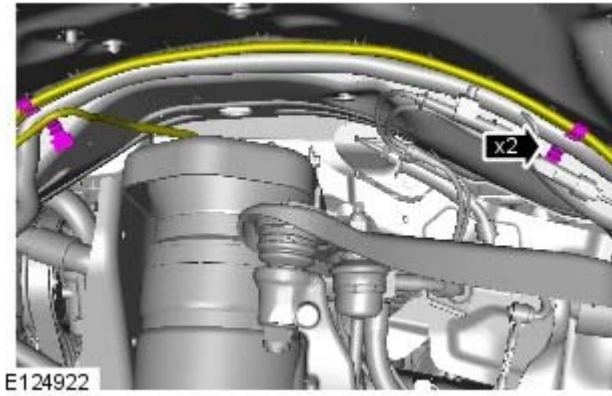
27. TORQUE: 20 Nm



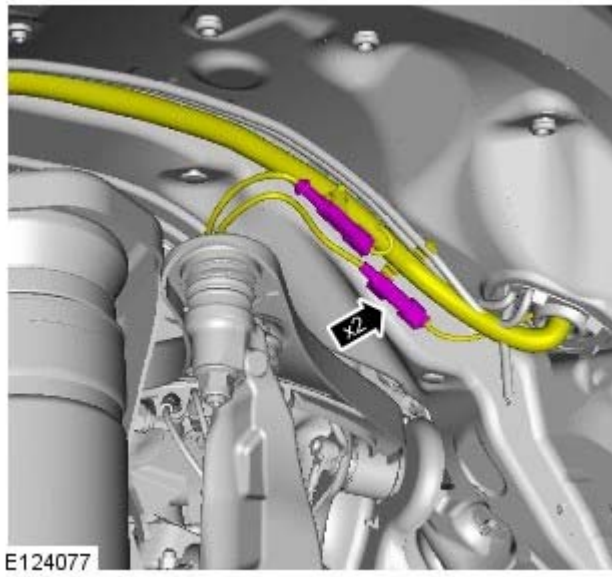
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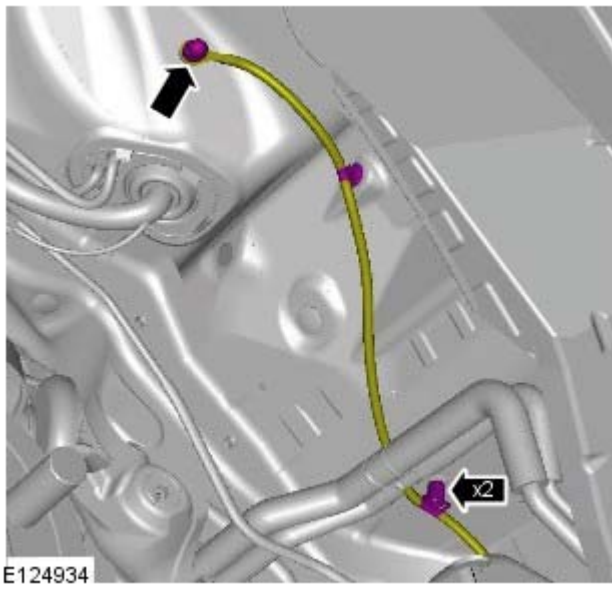
29.



30.

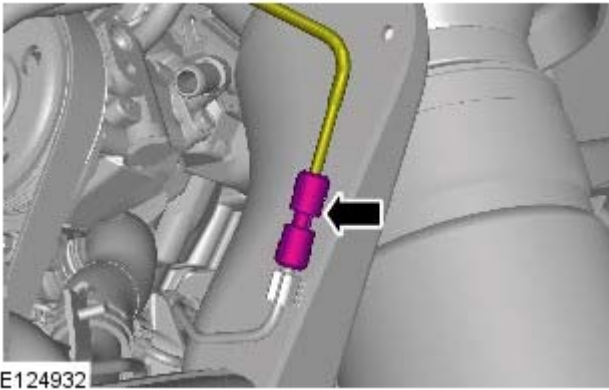


31. TORQUE: 20 Nm

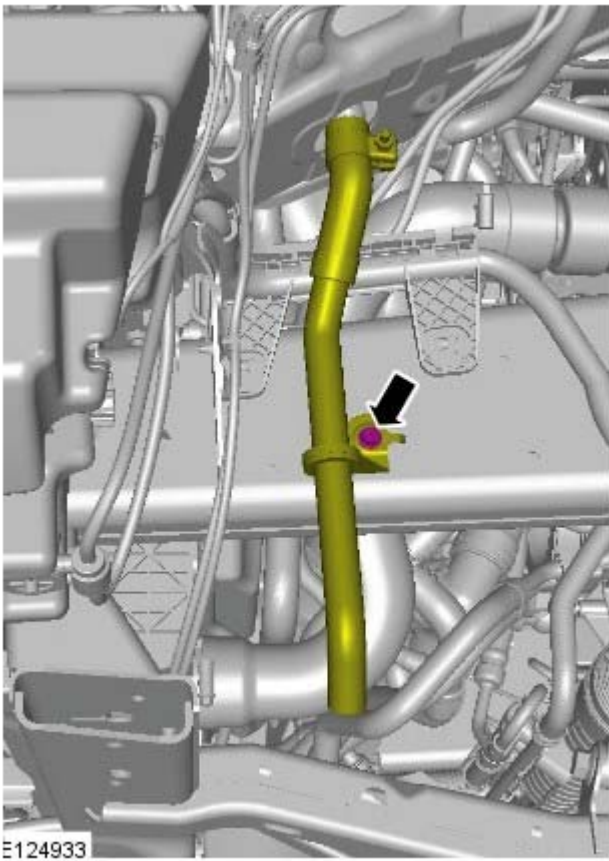


Vehicles with auxiliary heating

32.

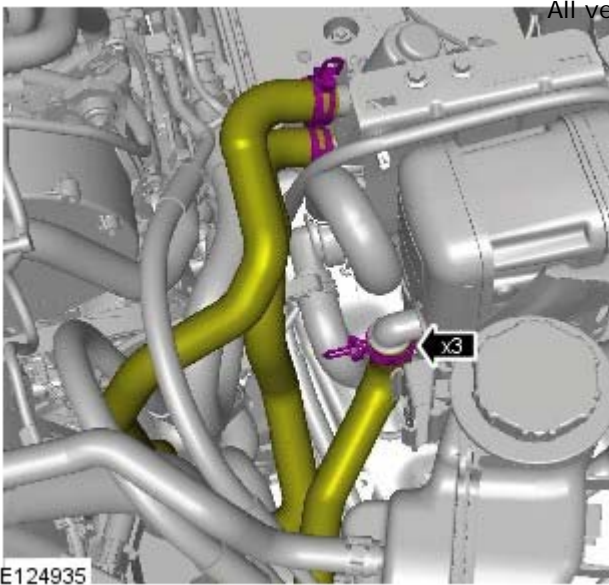


33. TORQUE: 10 Nm

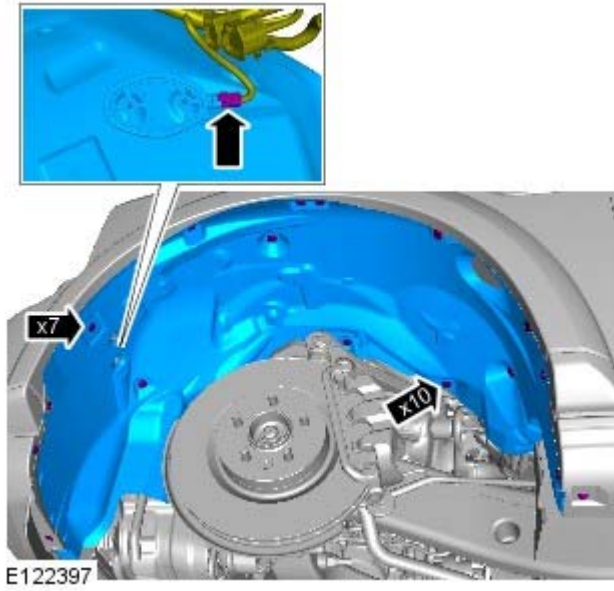


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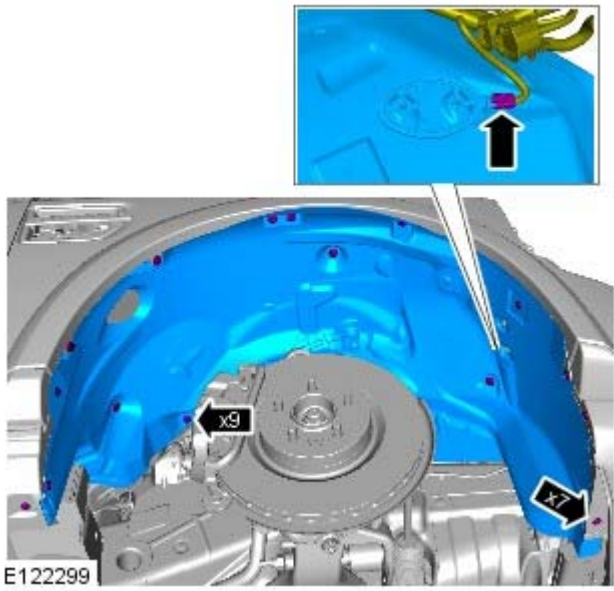
All vehicles



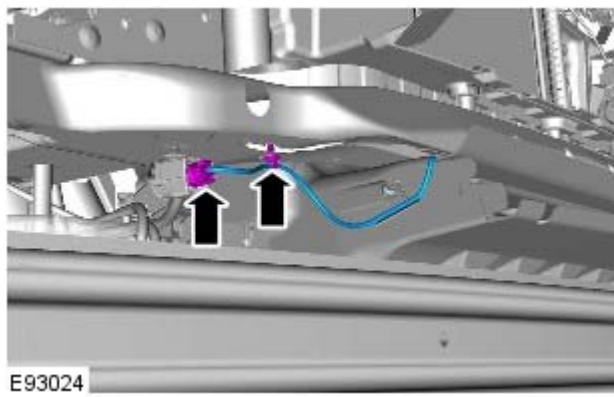
35.



36.

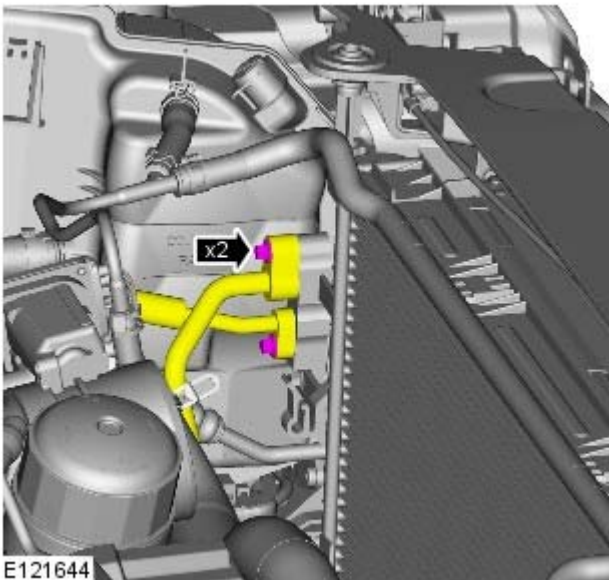



37.



38. TORQUE: 12 Nm

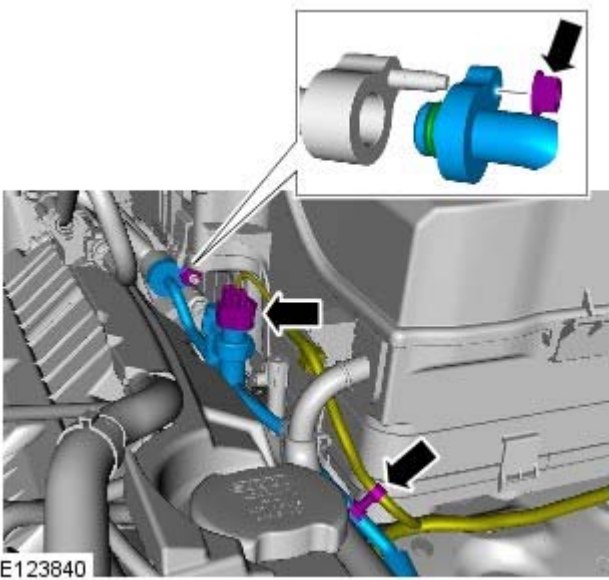
- Install new O-ring seals.

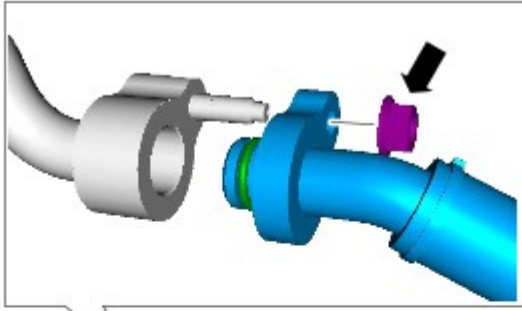



39.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

TORQUE: 12 Nm

- Install new O-ring seals.

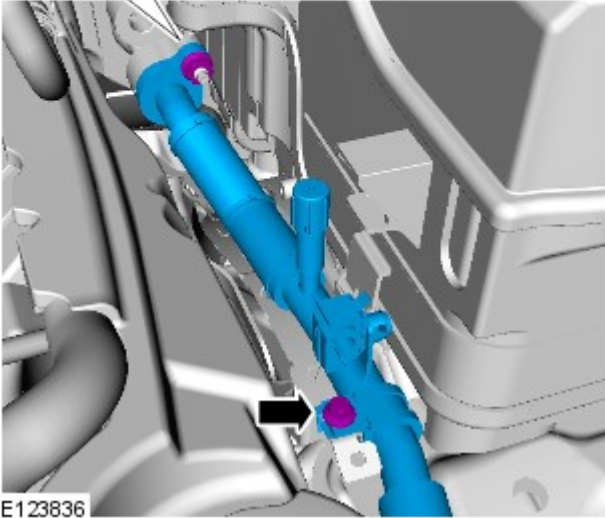




40.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

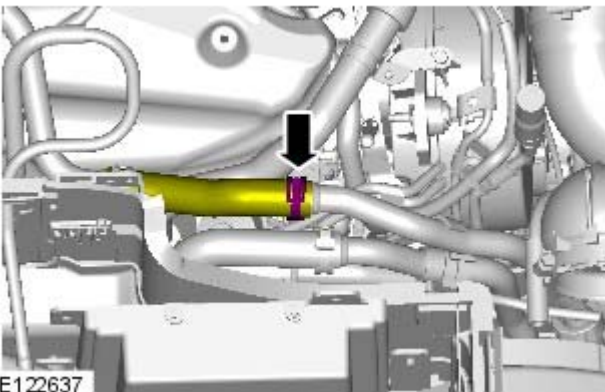
TORQUE: 12 Nm

- Install new O-ring seals.



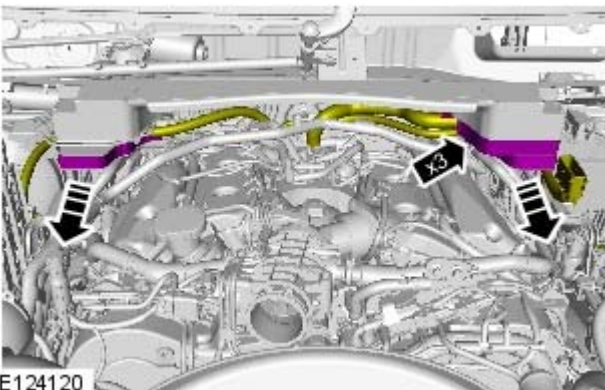
E123836

41.



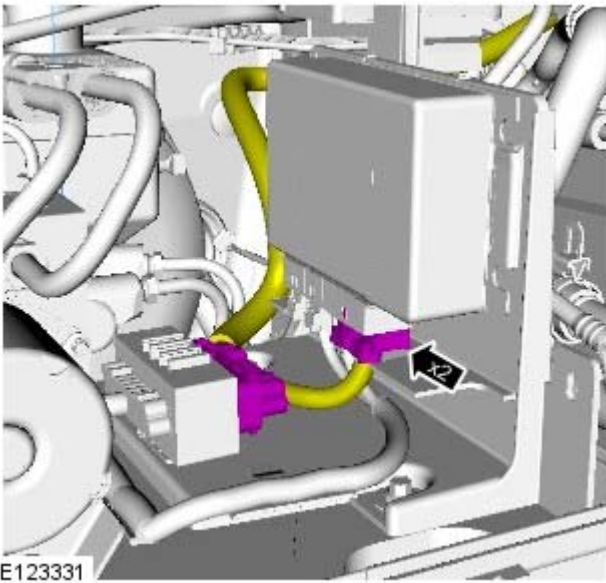
E122637

42.



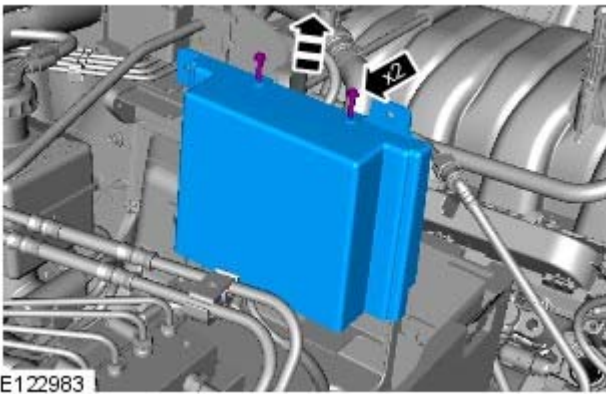
E124120

43.



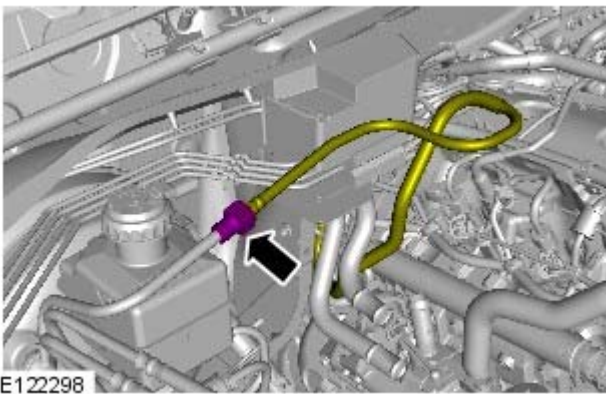
E123331

44. TORQUE: 8 Nm



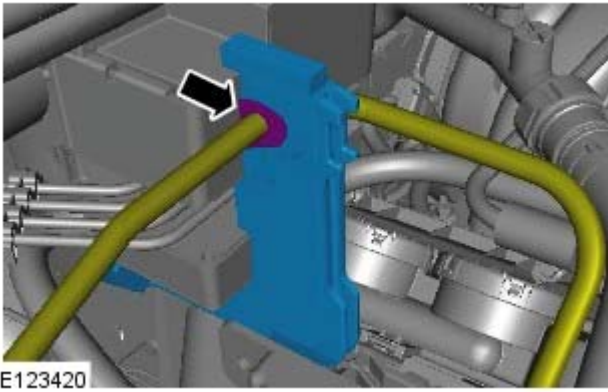
E122983

45.

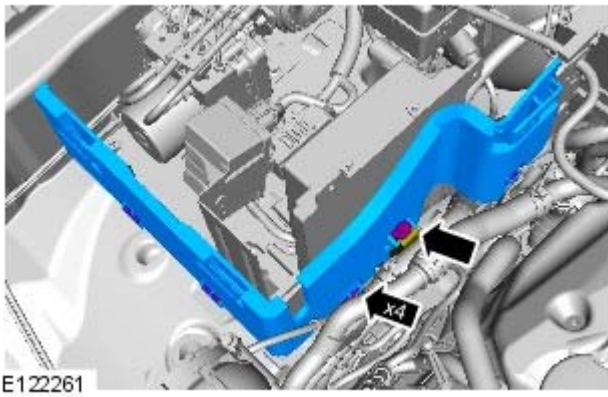


E122298

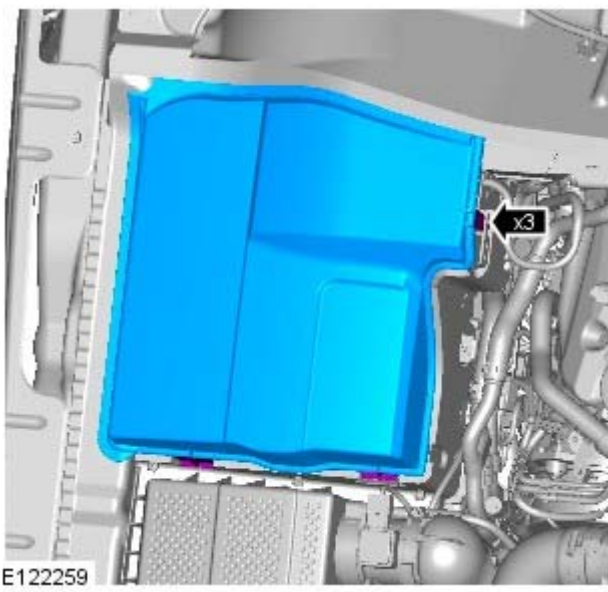
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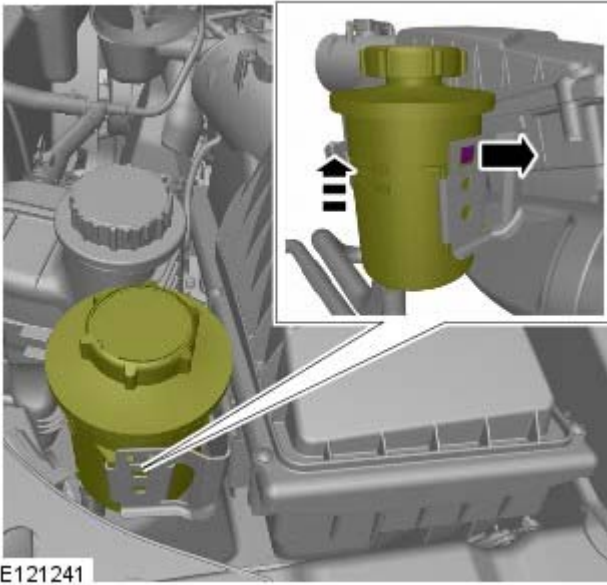
47. TORQUE: 10 Nm



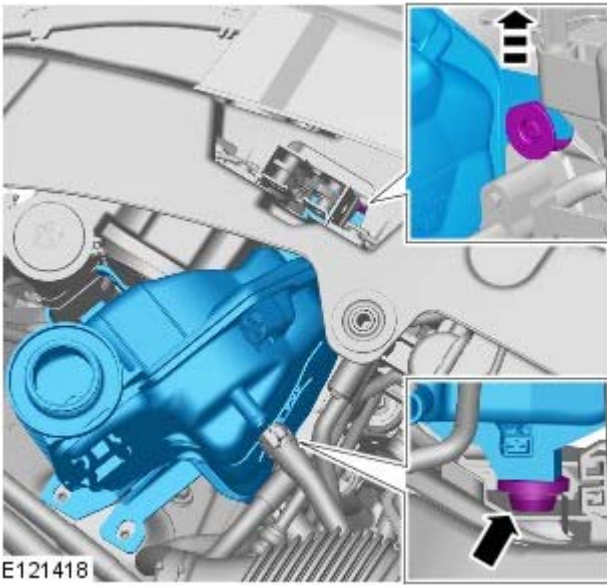
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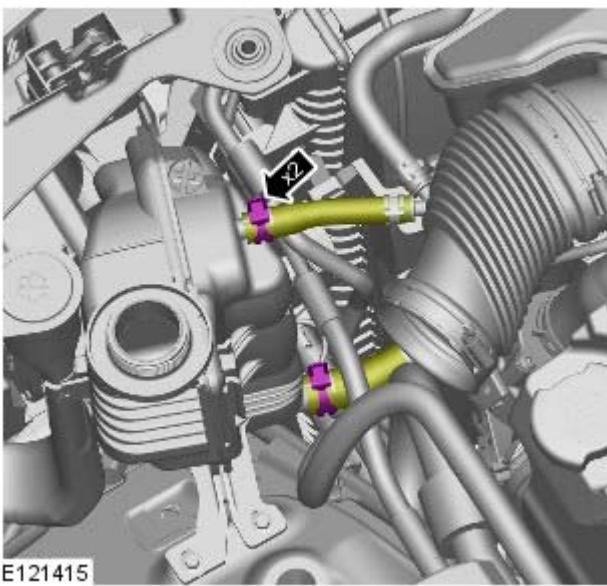
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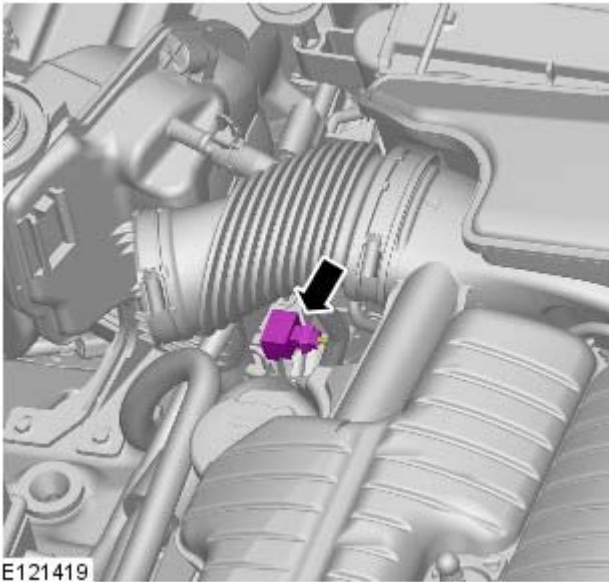
50.  CAUTION: Be prepared to collect escaping coolant.



51.

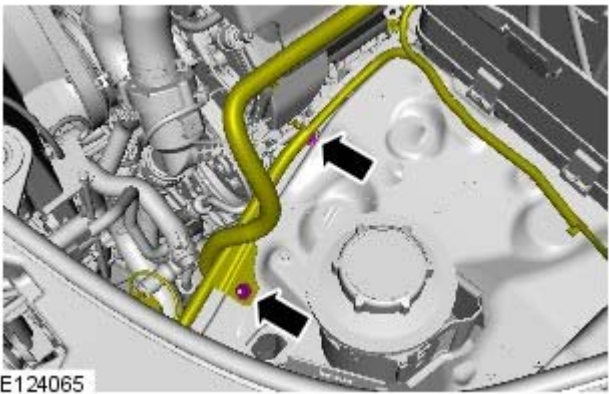


52.



E121419

53. TORQUE: 10 Nm



E124065

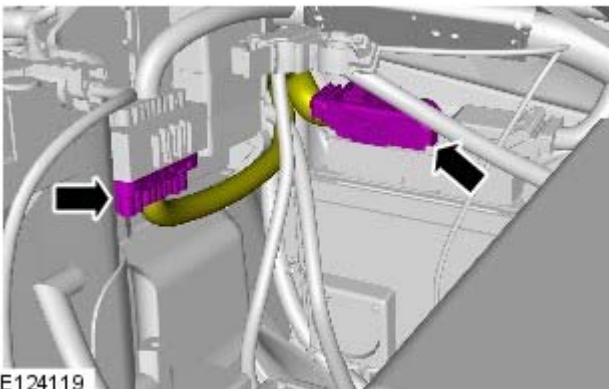
All vehicles

54. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

55. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

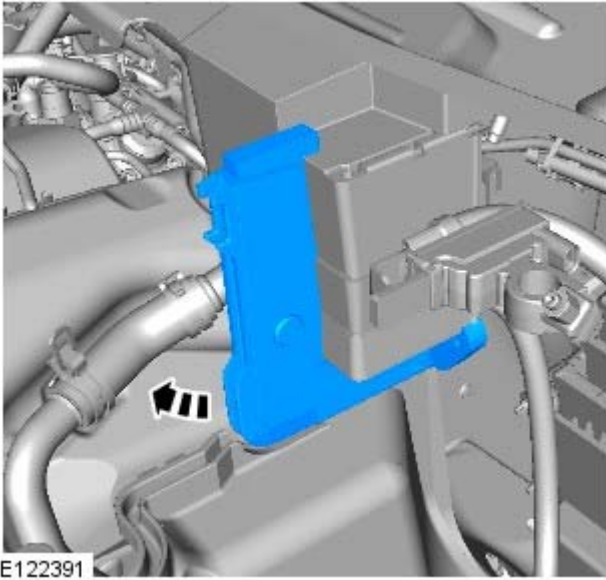
56. For additional information, refer to: Air Cleaner (303-12, Removal and Installation).

57.

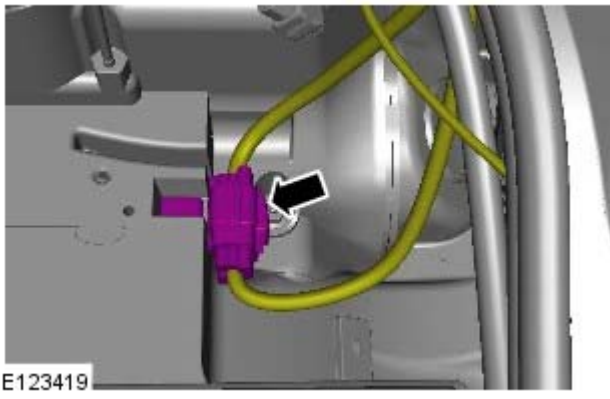


E124119

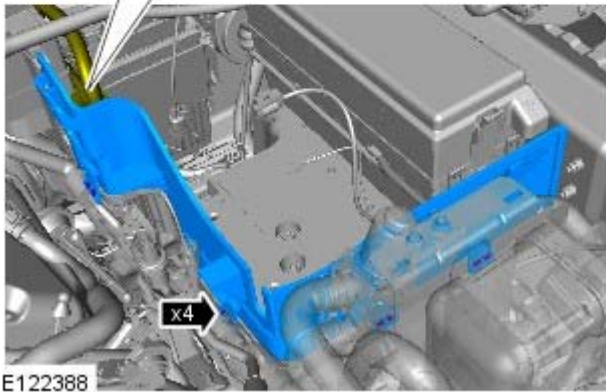
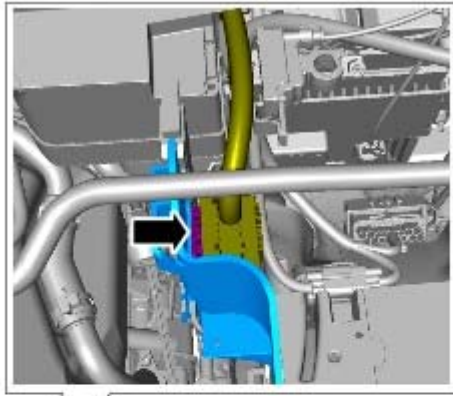
58.



59.



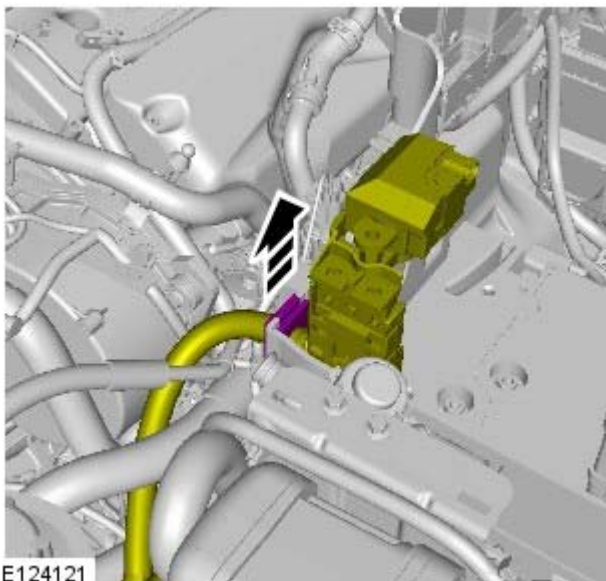
60. NOTE: RHD illustration shown, LHD is similar.



E122388

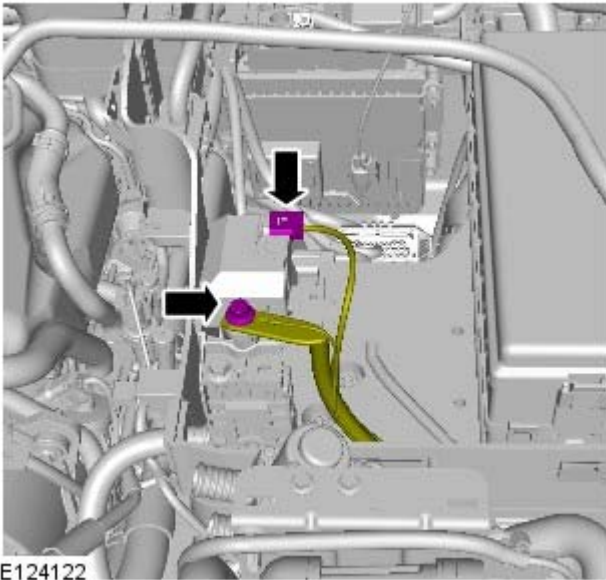
61.

- Cut the cable tie.



E124121

62. TORQUE: 10 Nm



- 63.** For additional information, refer to: Battery (414-01, Removal and Installation).
- 64.** For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
- 65.** For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
- 66.** Bleed the braking system.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).

Full Frame and Body Mounting -

Torque Specifications

Description	Nm	lb-ft
HO2s harness bracket bolt	10	7
Transmission support crossmember nuts and bolts	90	66
Transmission support insulator through-bolt	175	129
Transmission undershield bolts	10	7
*Integrated-body frame to body bolts	133	98

* New bolts must be installed

Full Frame and Body Mounting - Tow Bar Mounting Check

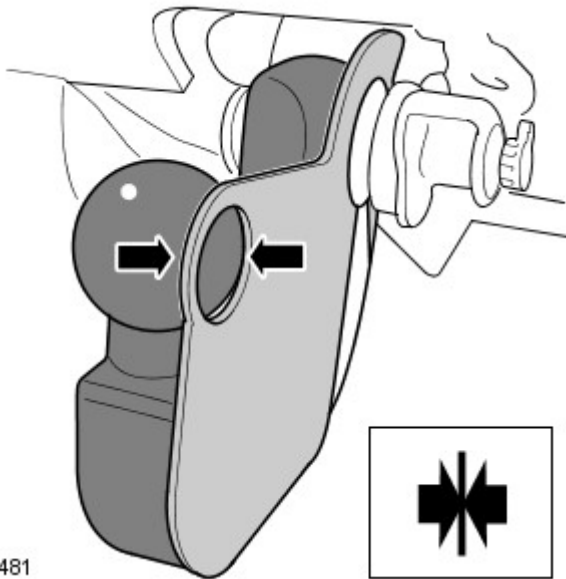
General Procedures

Special Tool(s)	
 E140509	Tow Bar Gauge JLR-501-201

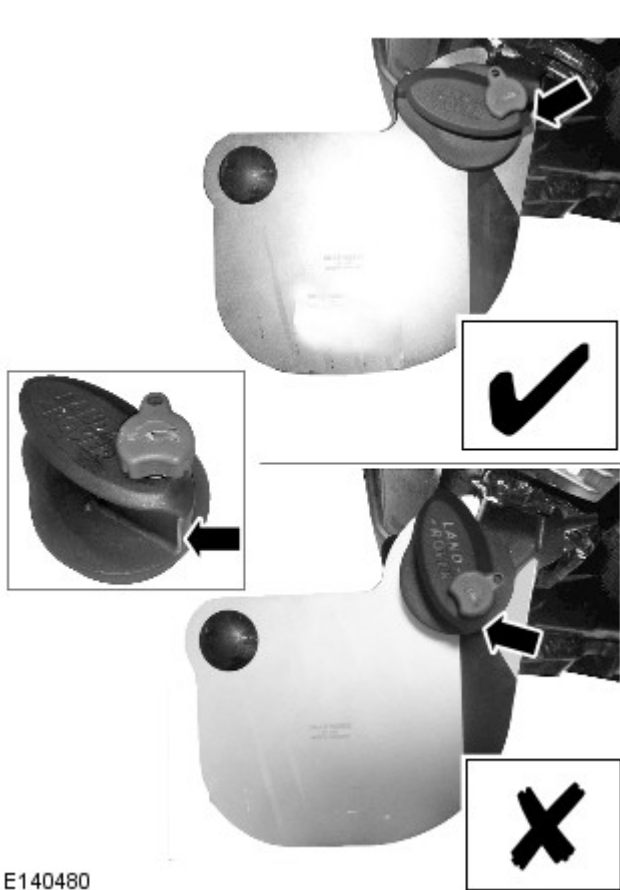
- 1. Pre test:** Check the detachable tow bar locking pin is moving freely without sticking.
- 2.** Insert the tow bar into the chassis following the owners handbook instruction.

3.  **CAUTION:** The special tool must be flat against the tow bar ball before taking measurements.

Hold the special tool JLR-501-201 against the tow bar as shown, failure to follow this instruction may result in an incorrect measurement.



E140481



E140480

4.  CAUTION: Make sure the special tool is mounted flush to the tow ball.

• NOTE: Note the position of the tow bar release handle.

Install the special tool as shown.

5. Check the position of the tow bar release handle against the special tool, and observe the following:

- If the tow bar release handle points to the red area of the special tool, go to Step 6.
- If the tow bar release handle points outside of the red area of the special tool, then the tow bar mounting is correct and no further action is required.

6. Install a new tow bar and check the tow bar mounting following Steps 3 - 5.


- If the tow bar release handle points to the red area of the special tool, install a new rear crossmember. For additional information, refer to: [Rear Crossmember](#) (502-02 Full Frame and Body Mounting, Removal and Installation).

Full Frame and Body Mounting - Transmission Support CrossmemberV6 4.0L Petrol/TDV6 2.7L Diesel

Removal and Installation

Removal

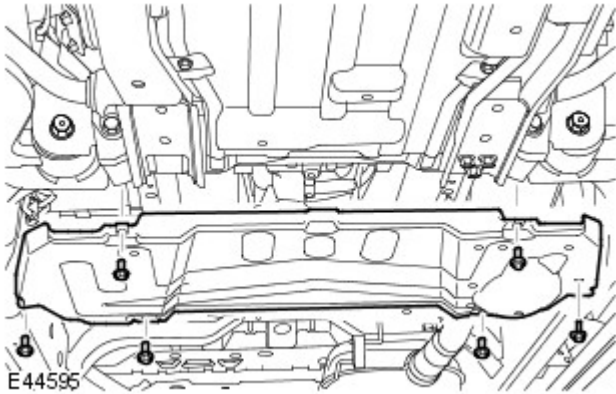
All vehicles

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the transmission undershield.

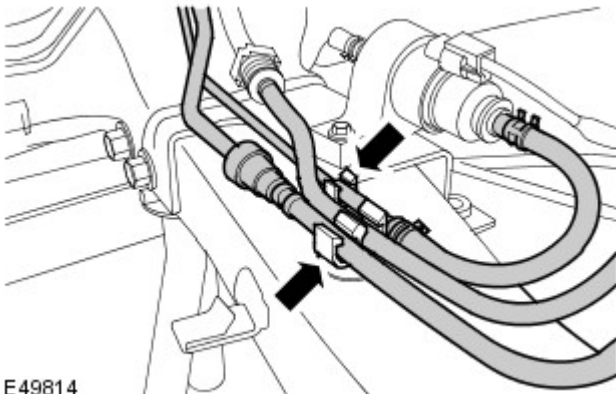
- Remove the 6 bolts.



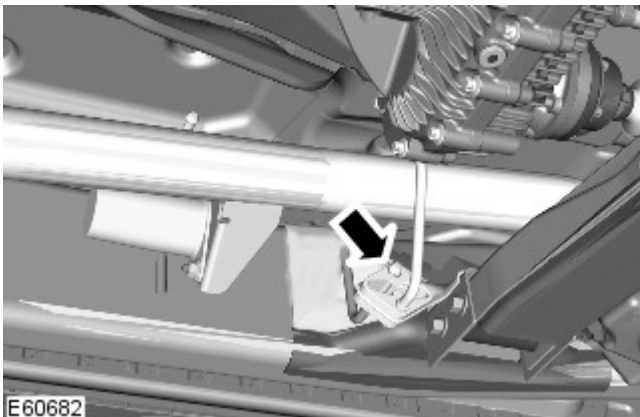
Vehicles with diesel engine

3. Release the 3 fuel lines.

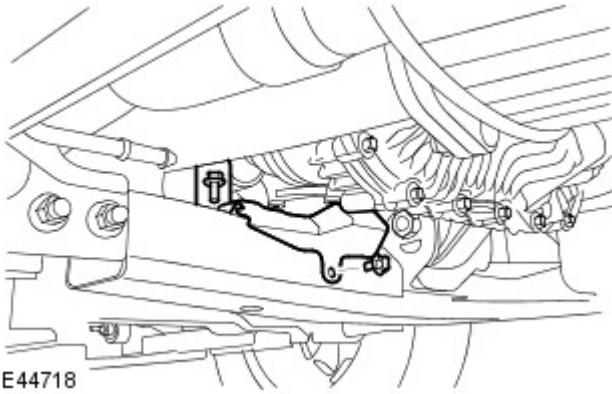
- Release from the 3 clips.



4. Release the exhaust front mounting.



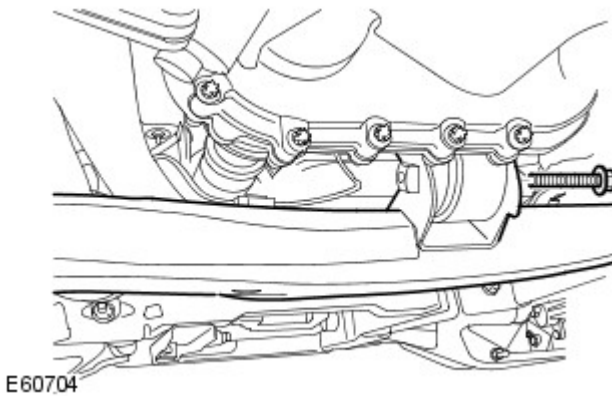
Vehicles with petrol engine



5. Release the HO2S wiring harness and bracket from the crossmember.

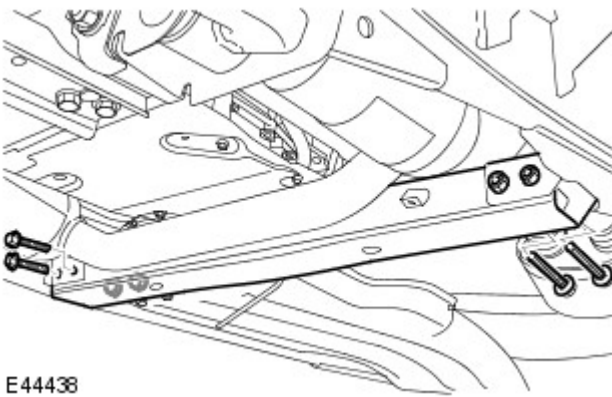
- Remove the 2 bolts.
- Tie the bracket aside.

All vehicles



6. Remove the transmission support insulator through-bolt.

- Support the transfer case.



7. Remove the crossmember.

- Remove the 4 nuts and bolts.

Installation


All vehicles

1. Install the crossmember.

- Tighten the nuts and bolts to 90 Nm (66 lb.ft).

2. Install the transmission support insulator through-bolt and tighten to 175 Nm (129 lb.ft).

Vehicles with petrol engine

Vehicles with Diesel engine  Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

4. Secure the 3 fuel lines:

- Secure in the clips
- Attach the HO2S wiring harness and bracket to the crossmember.

5. Connect the exhaust front mounting.

- Tighten the bolts to 10 Nm (7 lb.ft).

All vehicles

6. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).


Full Frame and Body Mounting - Transmission Support CrossmemberTDV6

3.0L Diesel

Removal and Installation

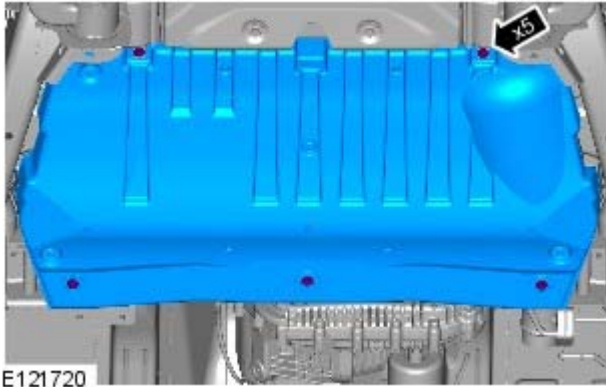
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

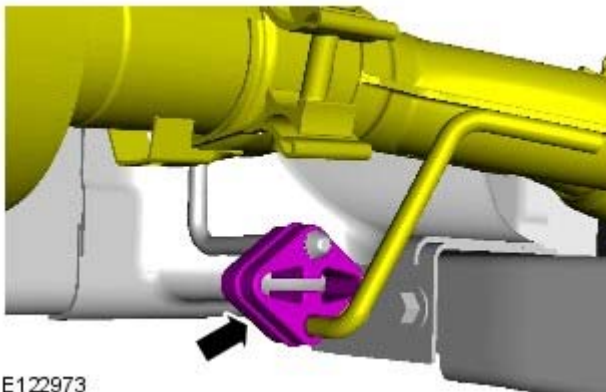
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

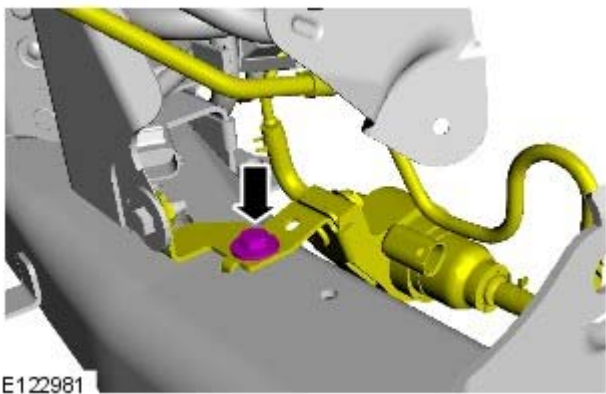
2.



3.

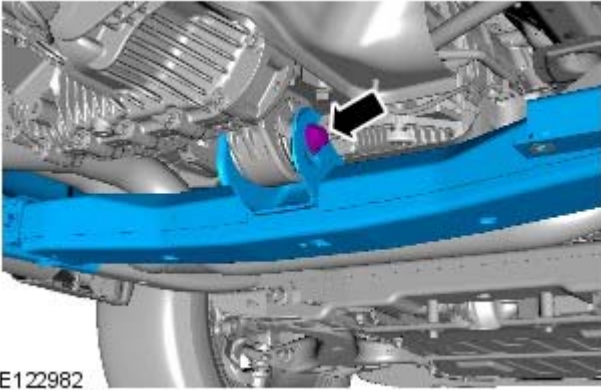


4.

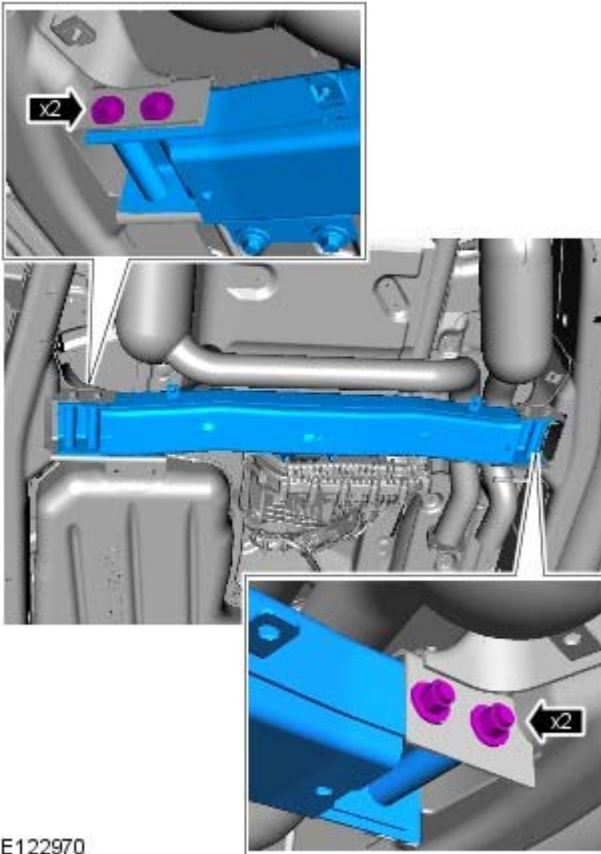


5.

- Support the transfer case.

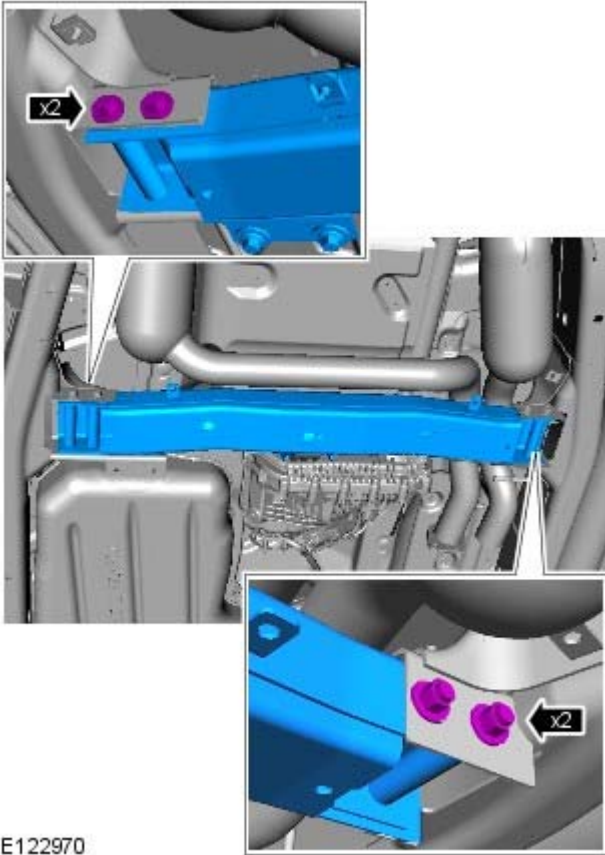


6.



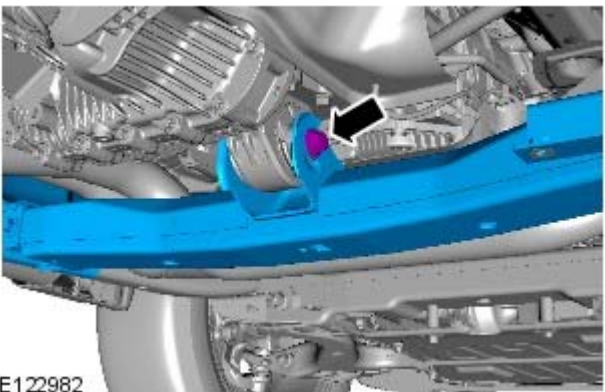
Installation

1. TORQUE: 115 Nm



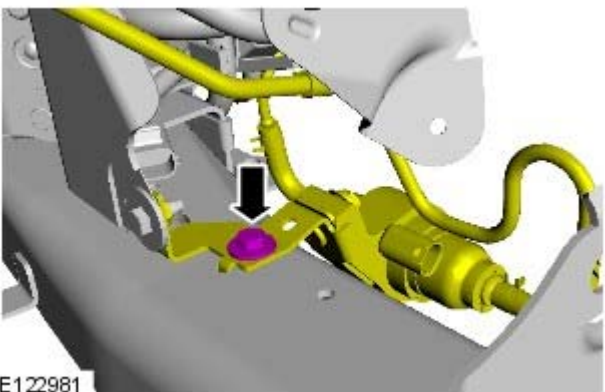
E122970

2. TORQUE: 175 Nm



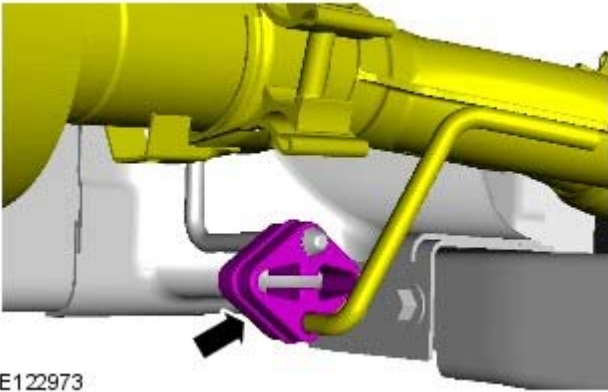
E122982

3. TORQUE: 10 Nm



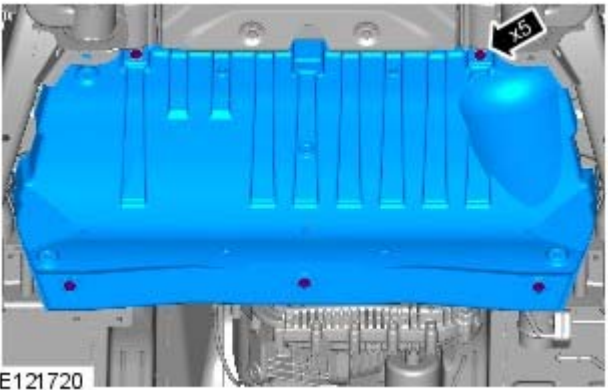
E122981

4.



E122973

5. TORQUE: 10 Nm




E121720

Full Frame and Body Mounting - Transmission Support CrossmemberV8 5.0L Petrol

Removal and Installation

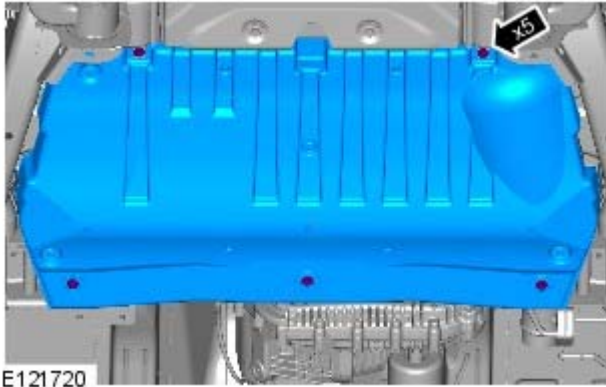
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Removal steps in this procedure may contain installation details.

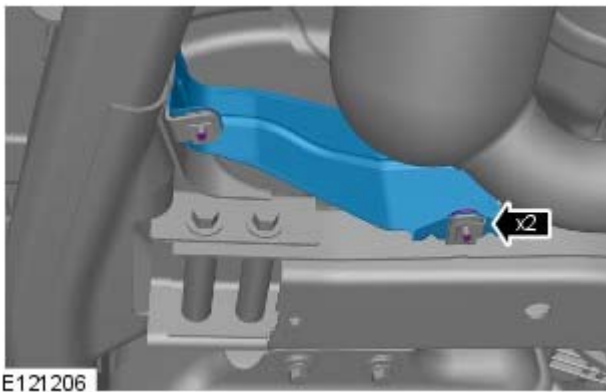
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

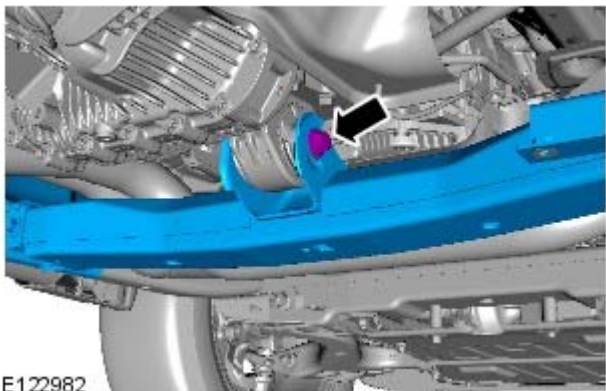
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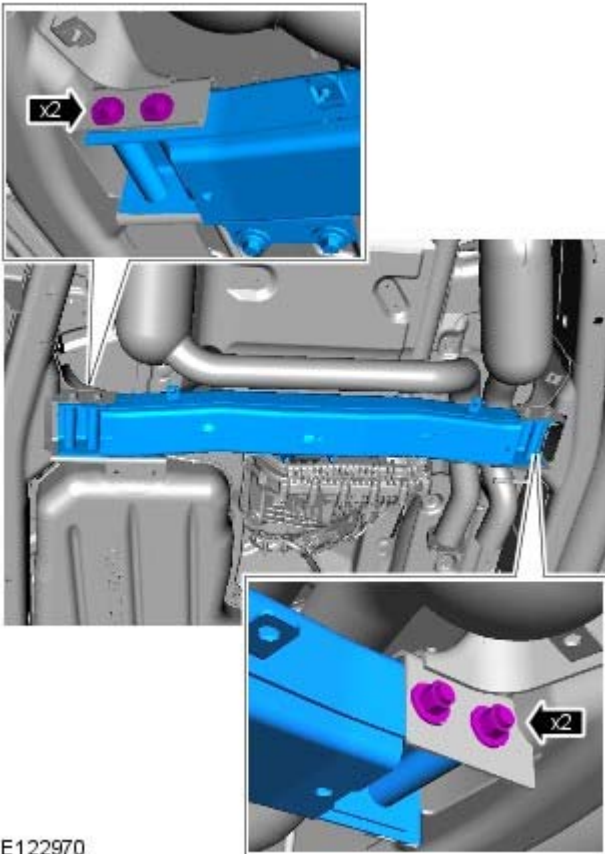
3.



4.



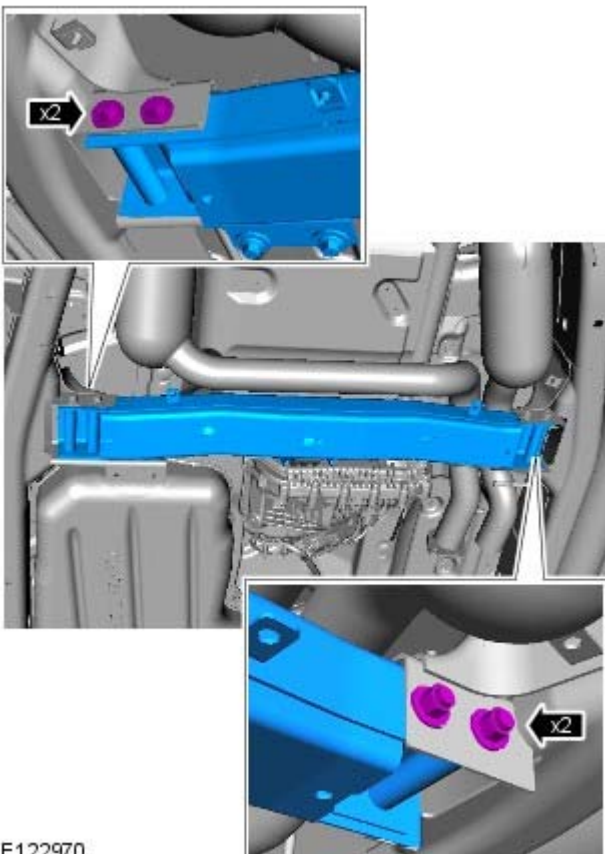
5.



E122970

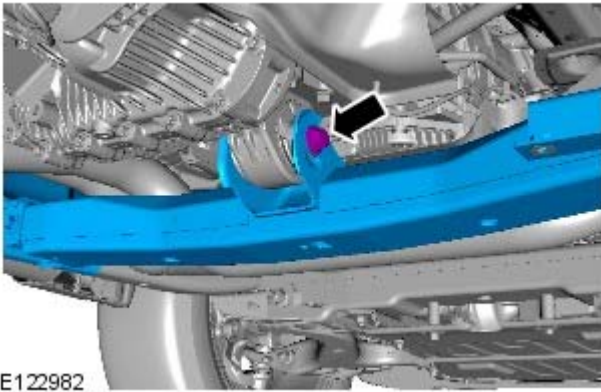
Installation

1. TORQUE: 115 Nm

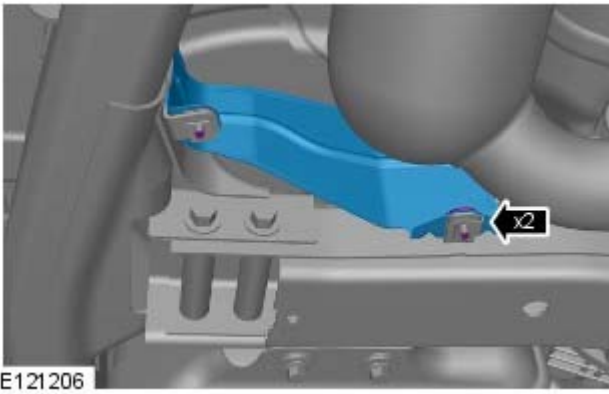


E122970

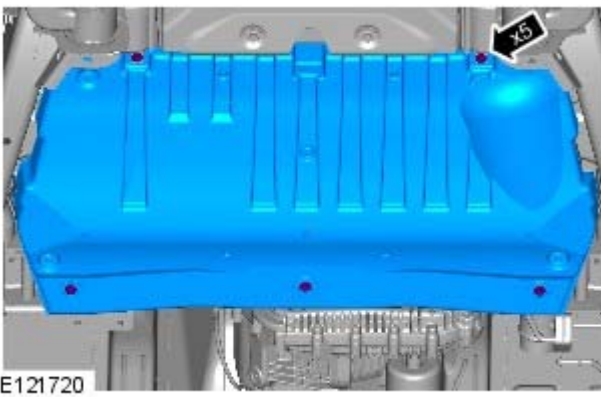
2. TORQUE: 175 Nm



3. TORQUE: 10 Nm



4. TORQUE: 10 Nm



5. Lower the vehicle.

Full Frame and Body Mounting - Rear Crossmember

Removal and Installation

Removal

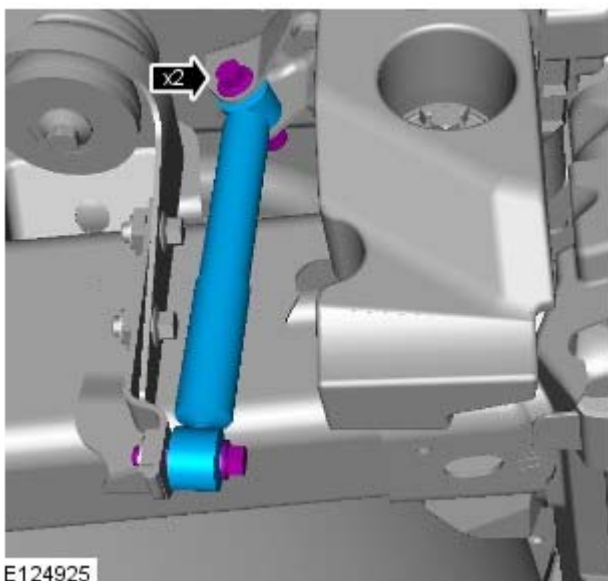
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Disconnect both battery cables.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
3. Remove the rear bumper cover.
For additional information, refer to: [Rear Bumper Cover](#) (501-19 Bumpers, Removal and Installation).
4. Remove the spare wheel and tire.

5. **NOTE:** Left-hand shown, right-hand similar.

Remove both rear body mount dampers.

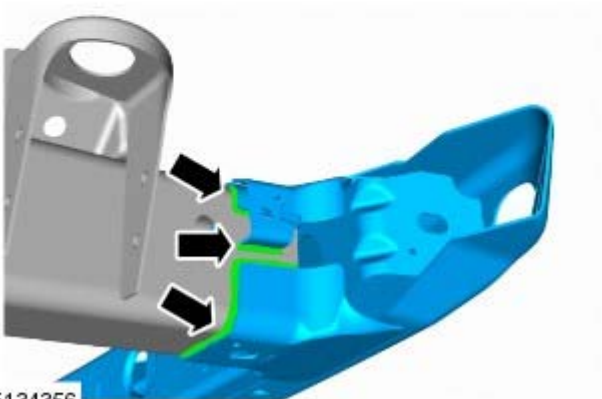
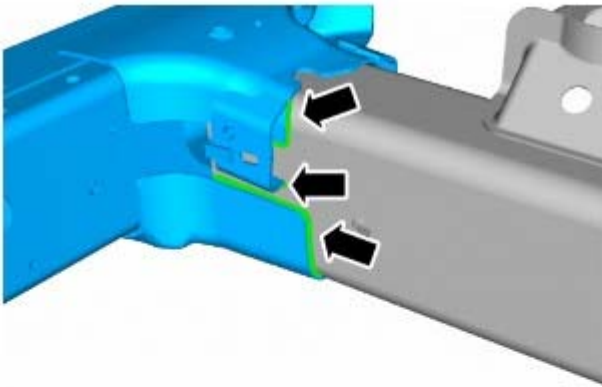


6. Remove the rear bumper fixings.

7. NOTE: Right-hand shown, left-hand similar.

Remove the rear crossmember.

Item	Description
-	Mig weld. (R/H is symmetrically opposite to L/H).



E134356

8. For additional information:

- Welding.
For additional information, refer to: [Body Repairs](#) (501-25A Body Repairs - General Information, Description and Operation).
- Corrosion protection.
For additional information, refer to: [Corrosion Protection](#) (501-25B Body Repairs - Corrosion Protection, Description and Operation).
- Tolerance checks.
For additional information, refer to: [Body and Frame](#) (501-26 Body Repairs - Vehicle Specific Information and Tolerance Checks, Description and Operation).

Installation

1. To install, reverse the removal procedure.

- Tighten both rear body damper(s) retaining bolts to 45Nm.

Full Frame and Body Mounting - BodyV6 4.0L Petrol/V8 5.0L Petrol

Removal and Installation

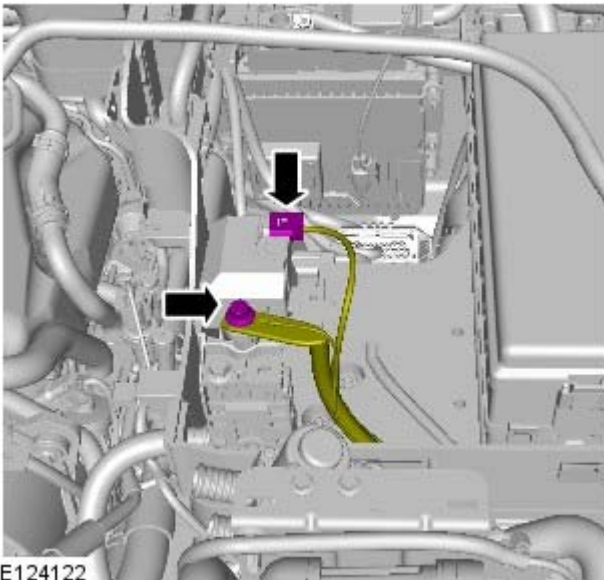
Removal

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the engine removed for clarity.

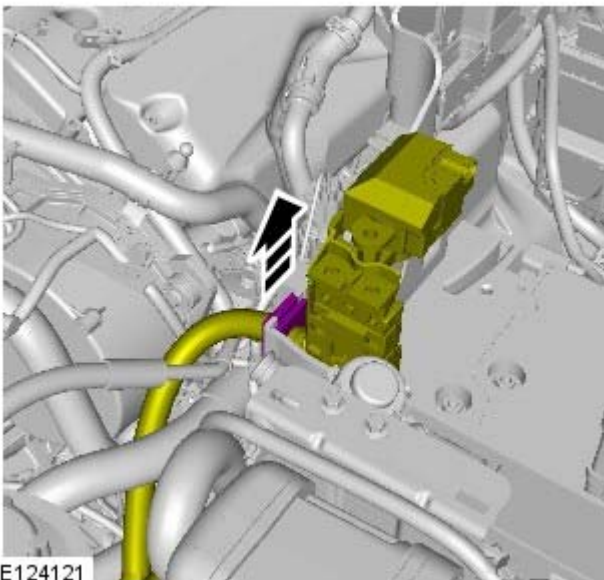
All vehicles

1. Remove the battery for access.
For additional information, refer to: Battery (414-01, Removal and Installation).

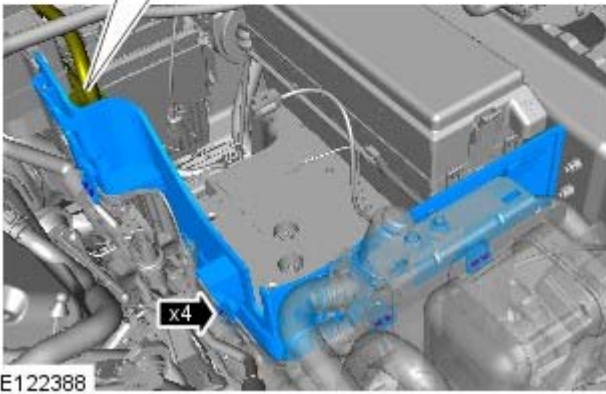
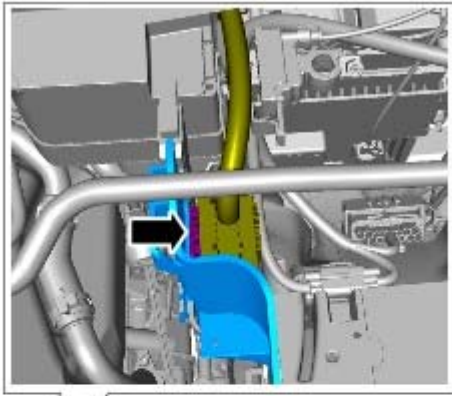
2.



3.

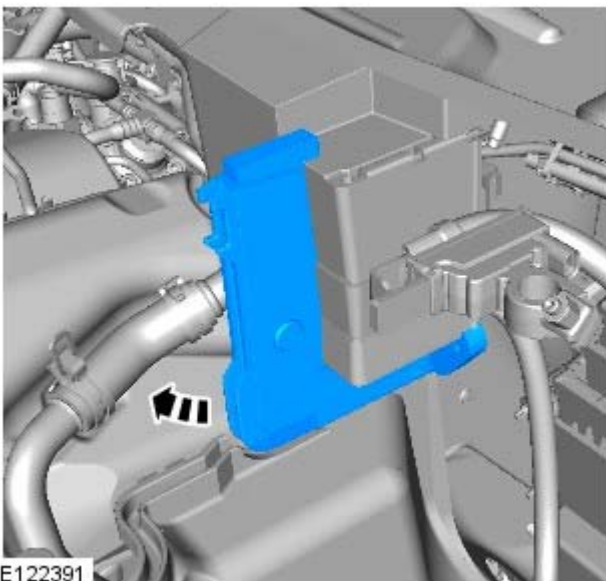


4. NOTE: RHD illustration shown, LHD is similar.



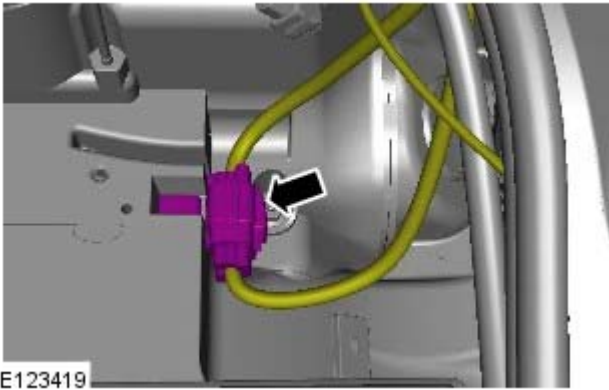
E122388

5.

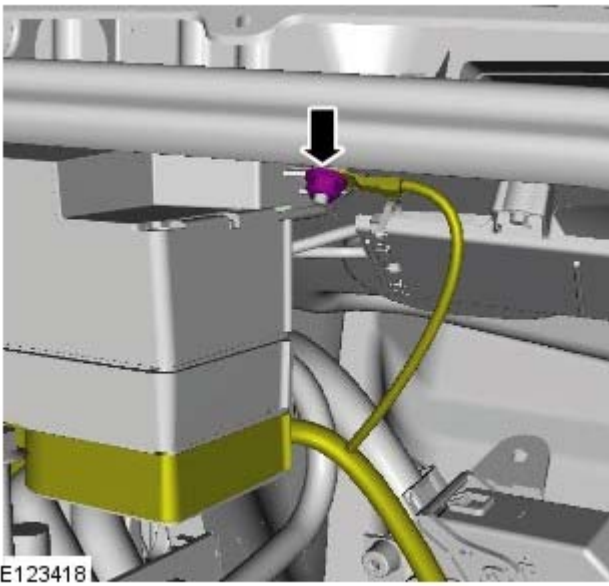


E122391

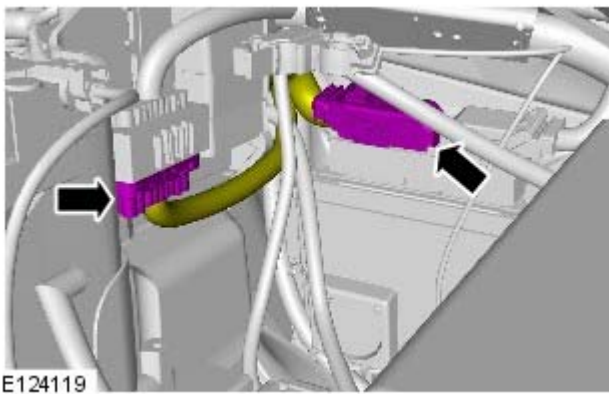
6.



7.



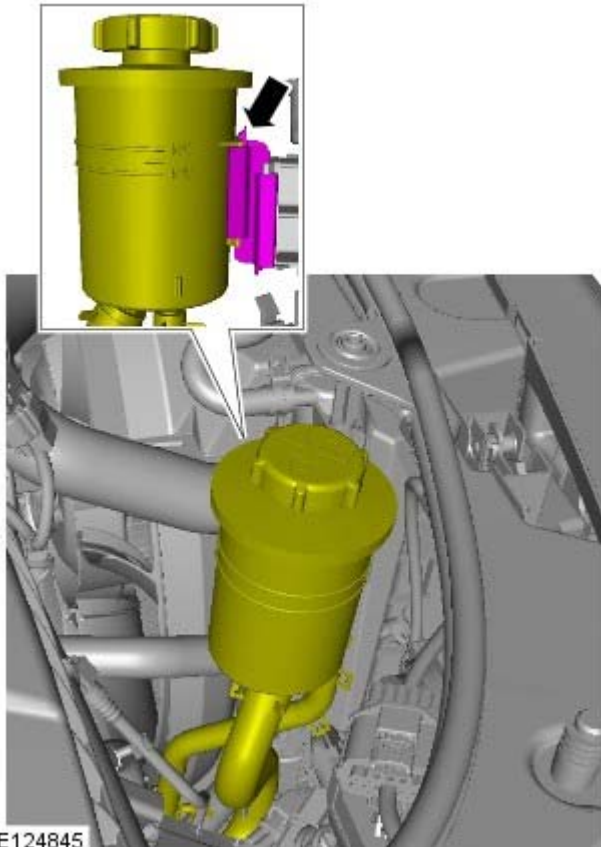
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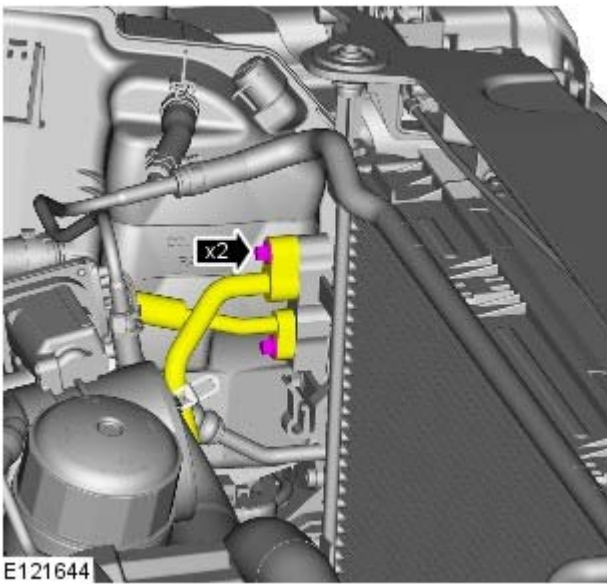
9. For additional information, refer to: Air Cleaner LH (303-12, Removal and Installation).
10. For additional information, refer to: Air Cleaner RH (303-12, Removal and Installation).
11. For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
12. For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
13. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).
14. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).


Vehicles with active damping

15.

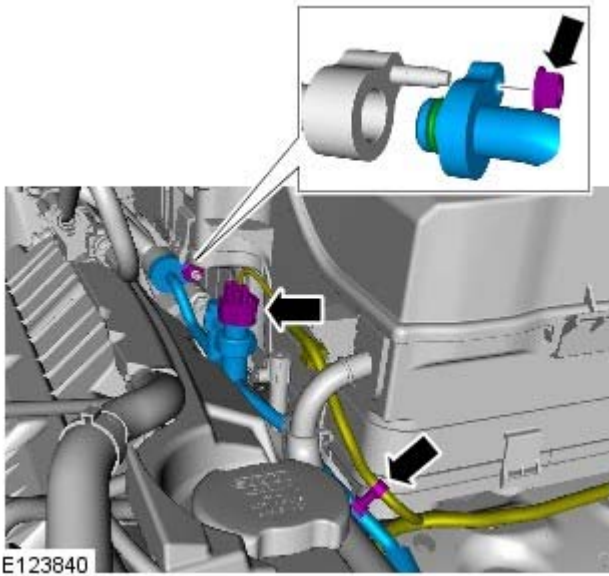


All vehicles




16.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

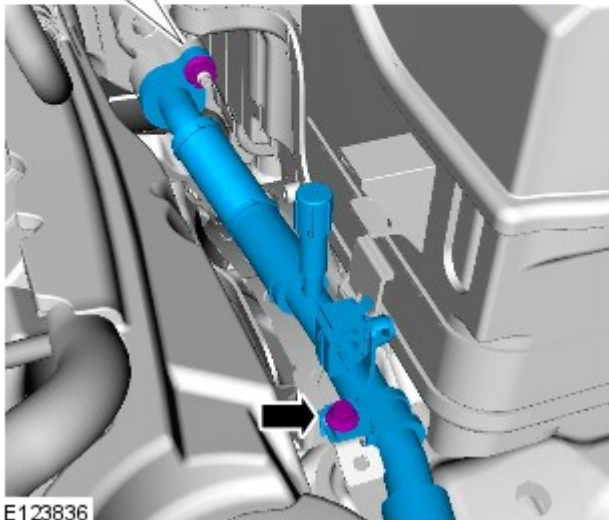
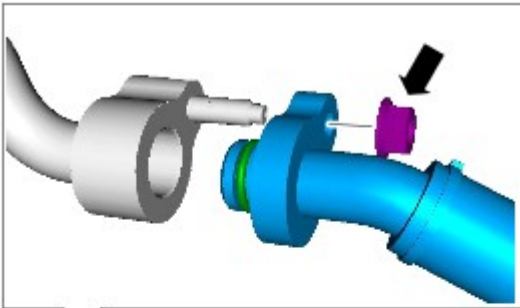
- Remove and discard the 2 O-ring seals.




E123840

17.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

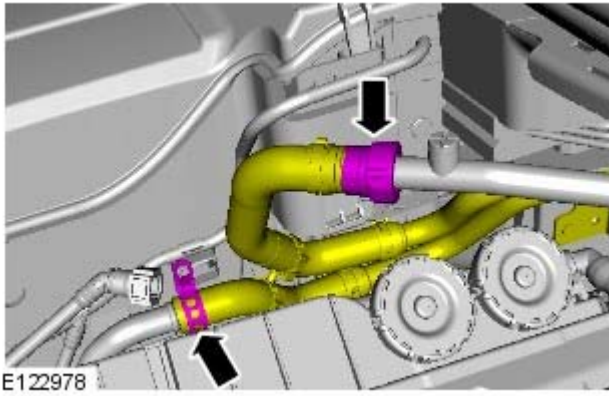
- Discard the O-ring seal.



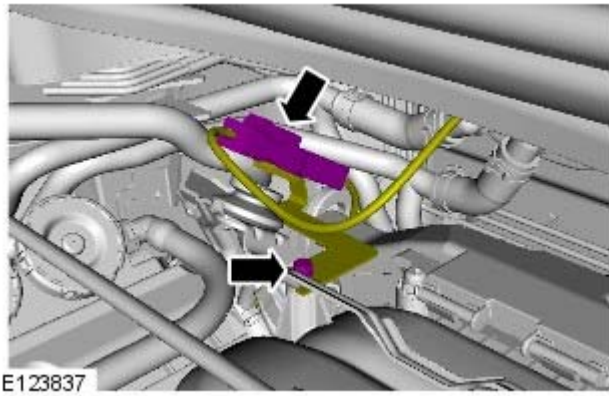
E123836

18.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

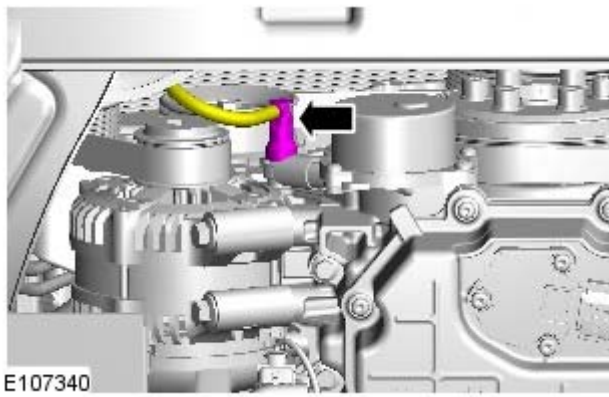
- Discard the O-ring seal.



19.  WARNING: Be prepared to collect escaping fluid.

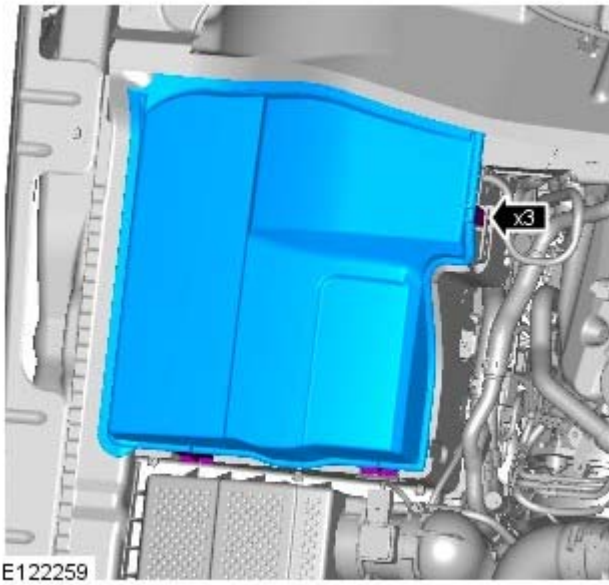


20.

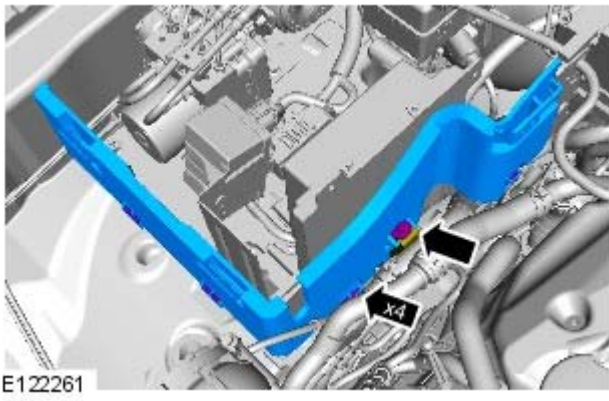


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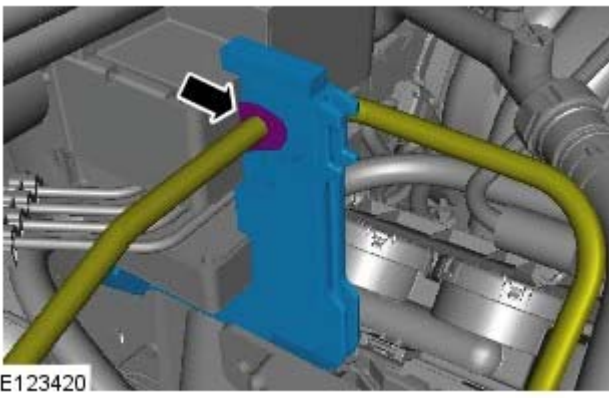
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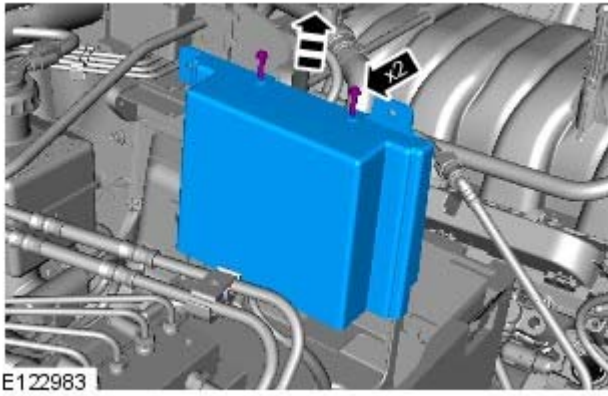
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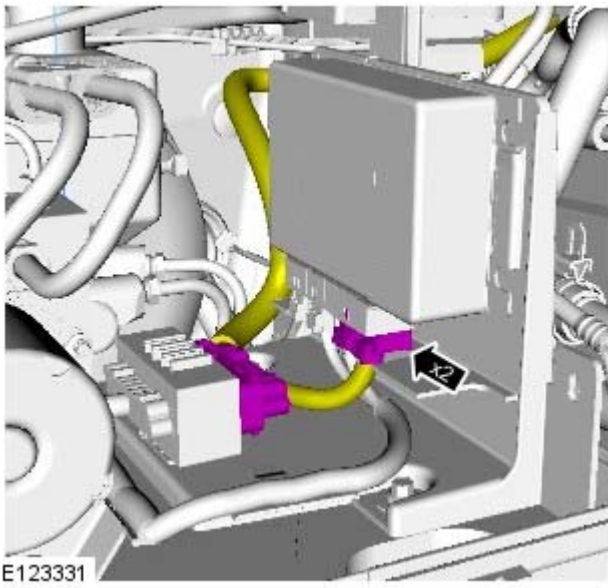
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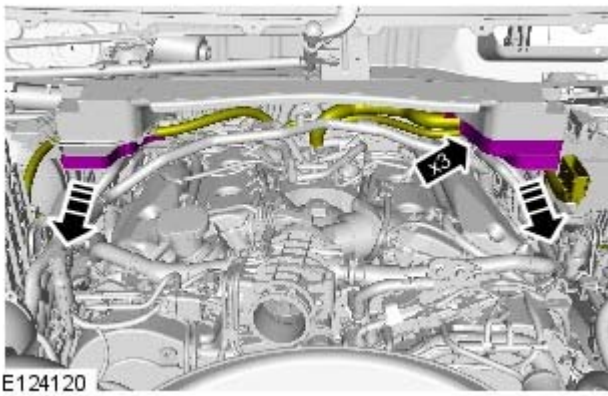
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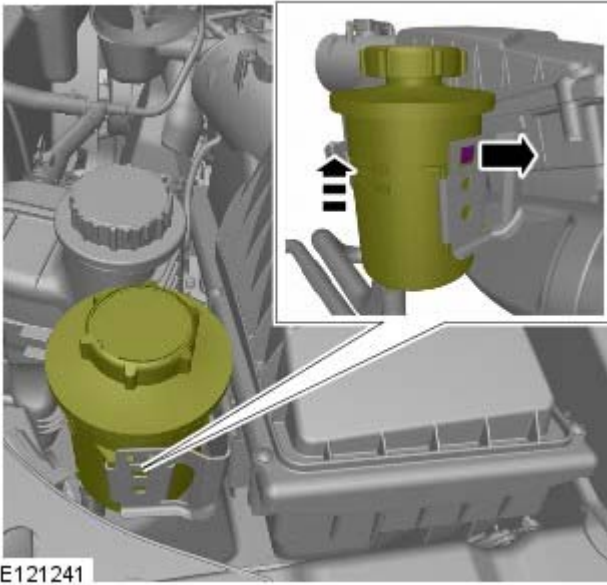
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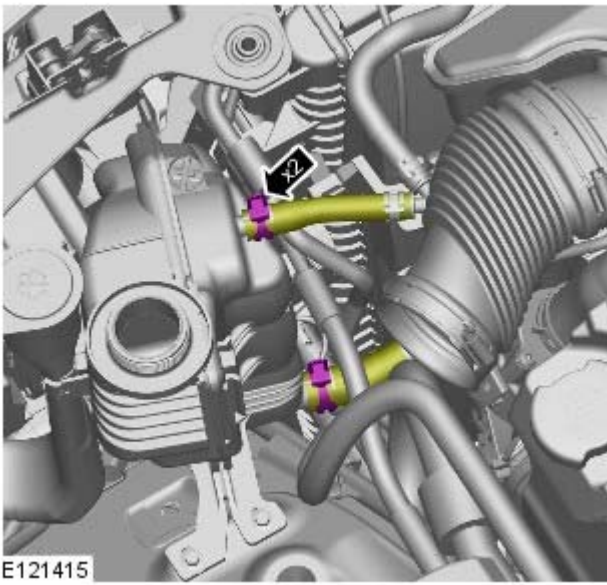
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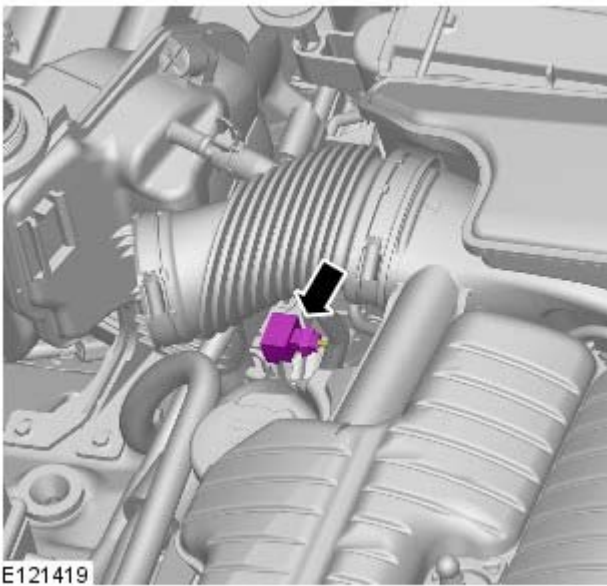
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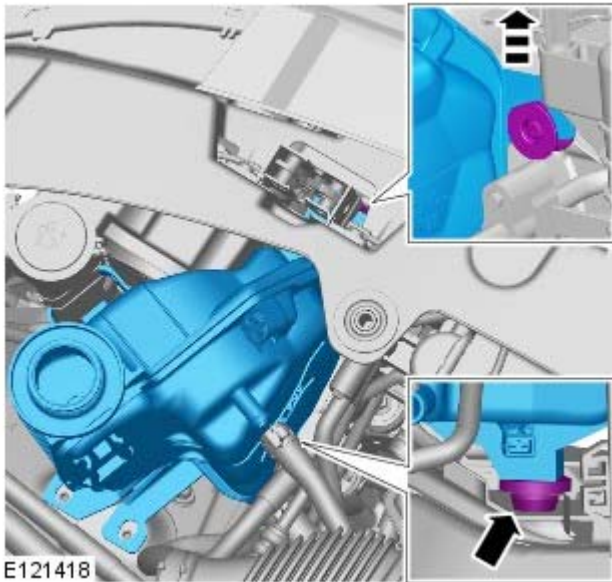


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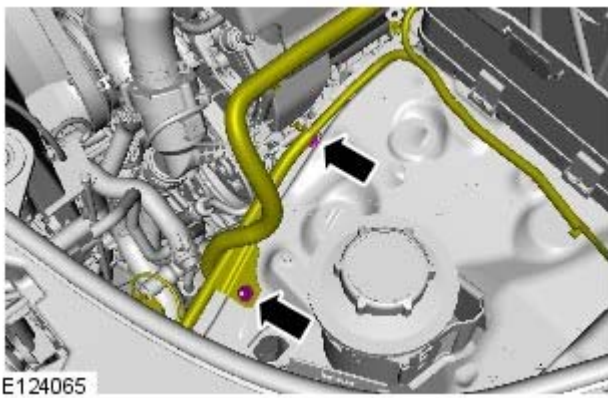


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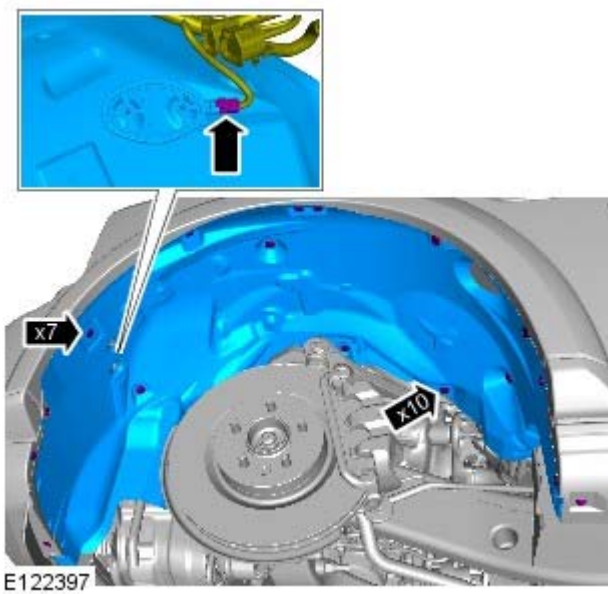




31.  CAUTION: Be prepared to collect escaping coolant.

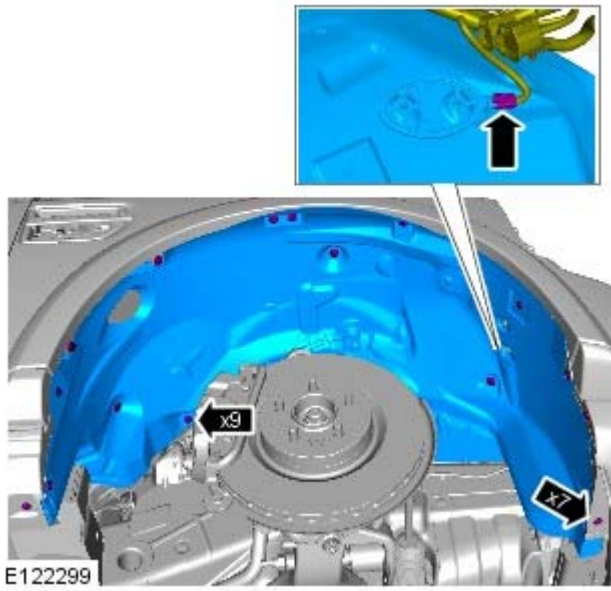


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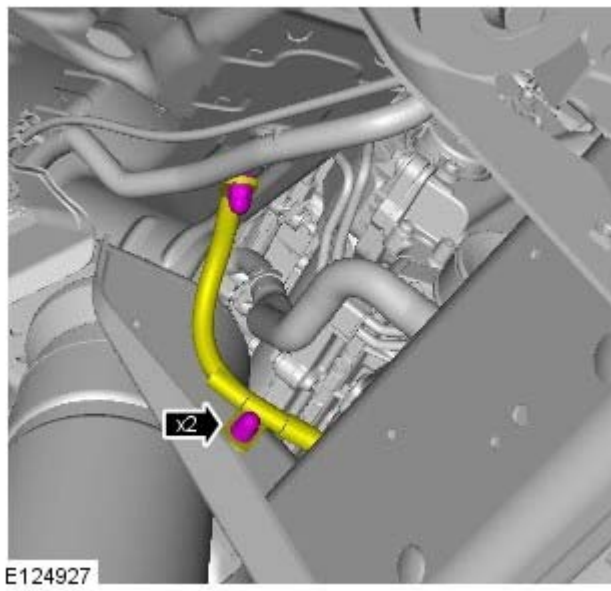


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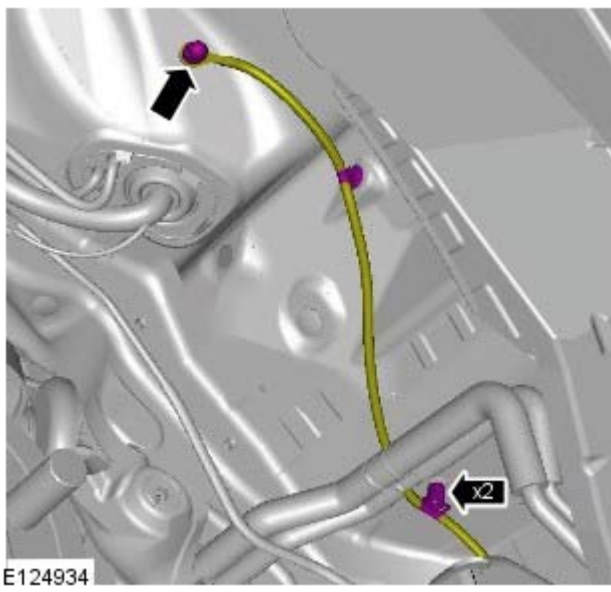
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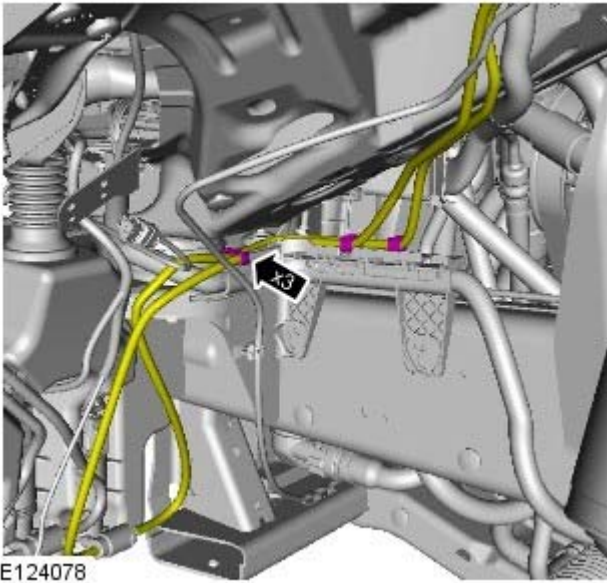
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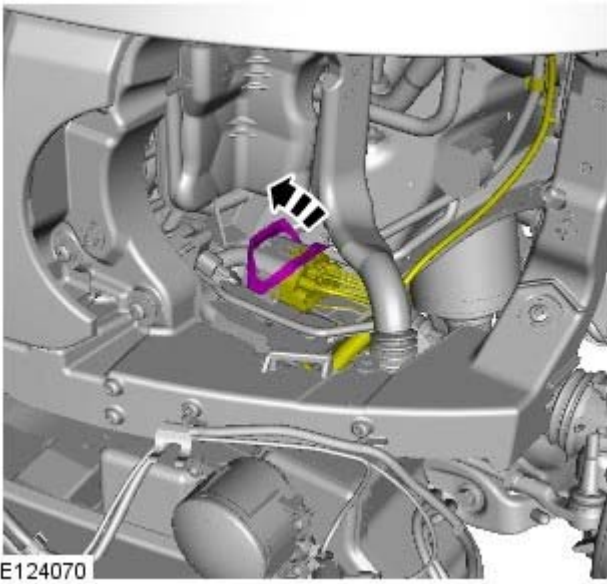
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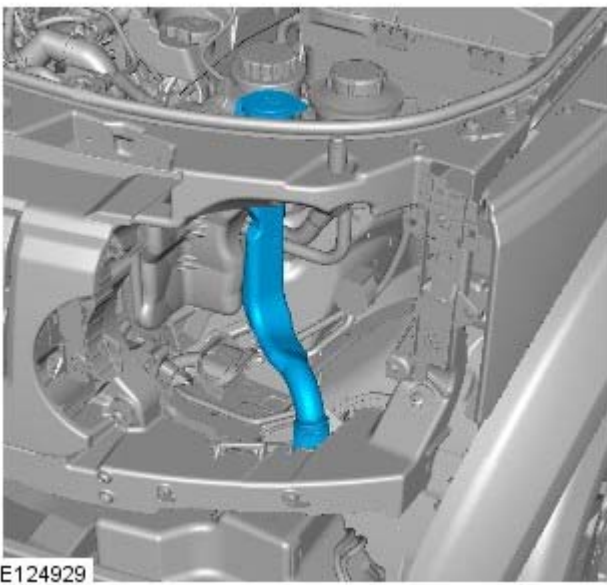
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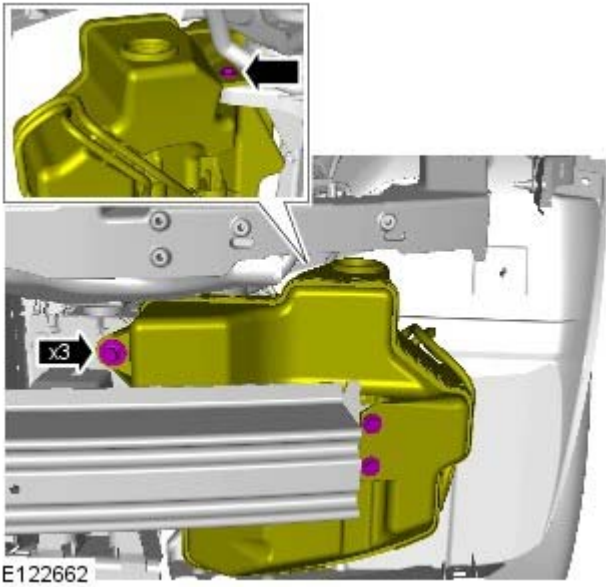
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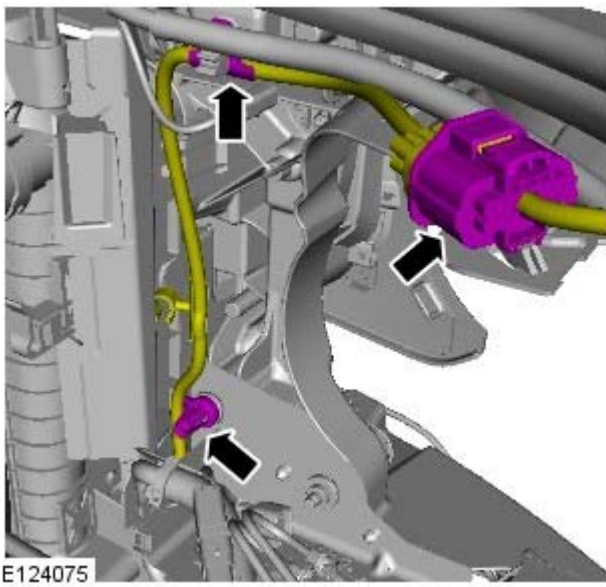
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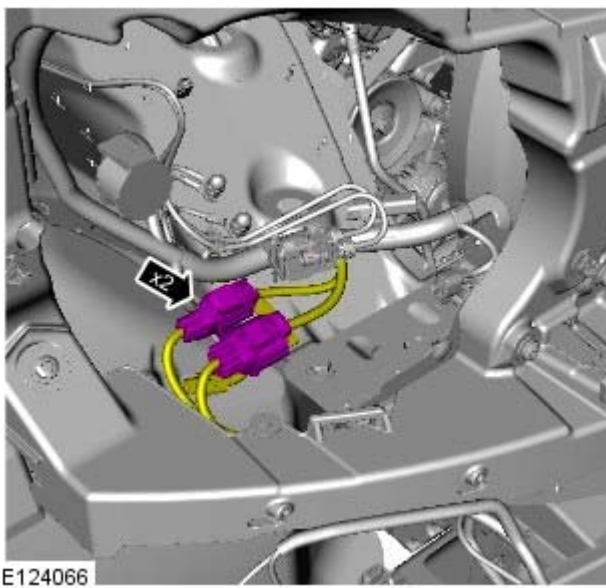
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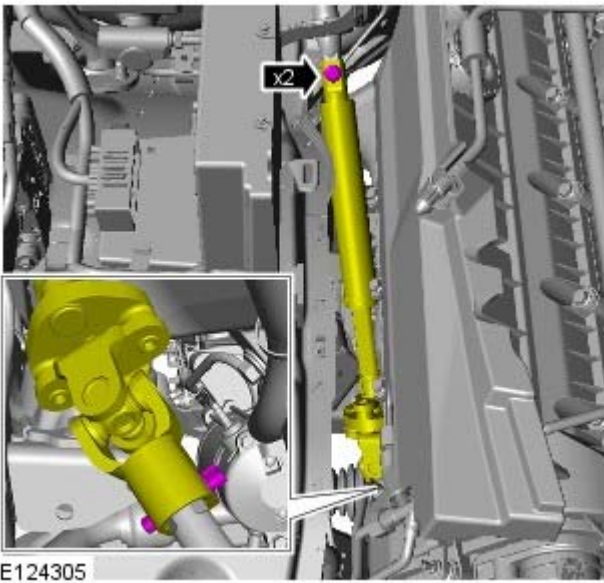
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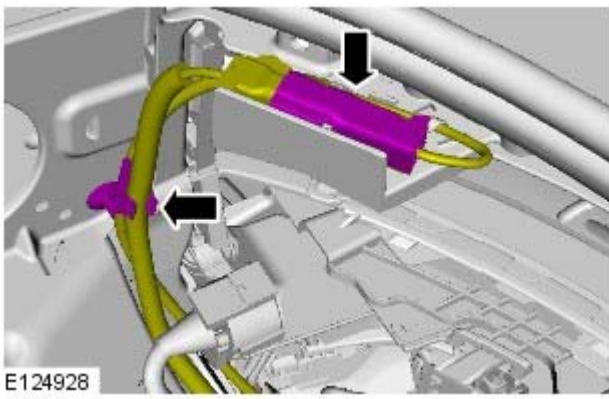
42.



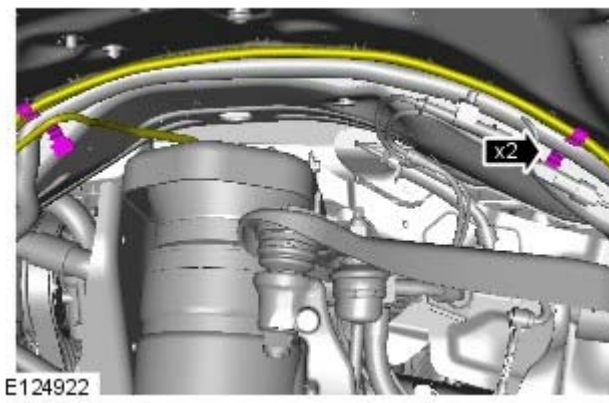
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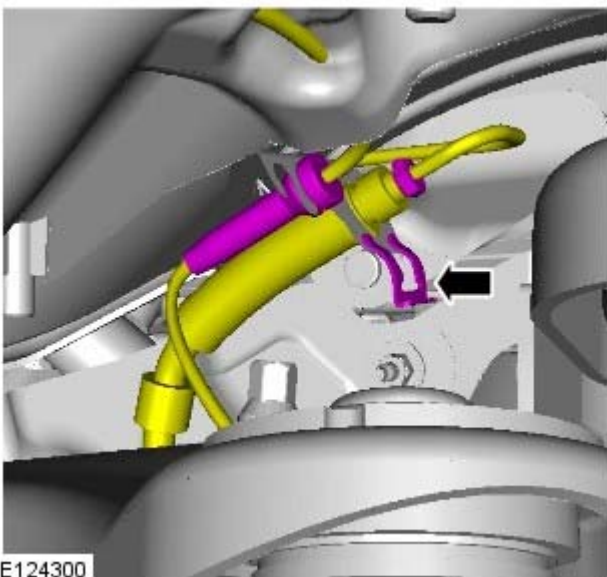
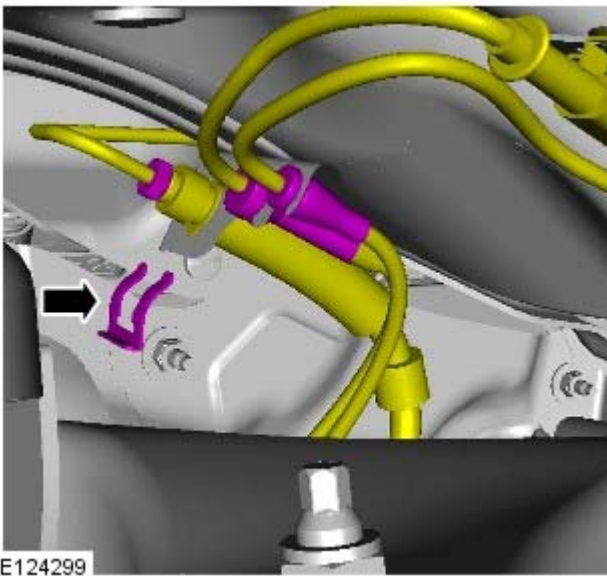
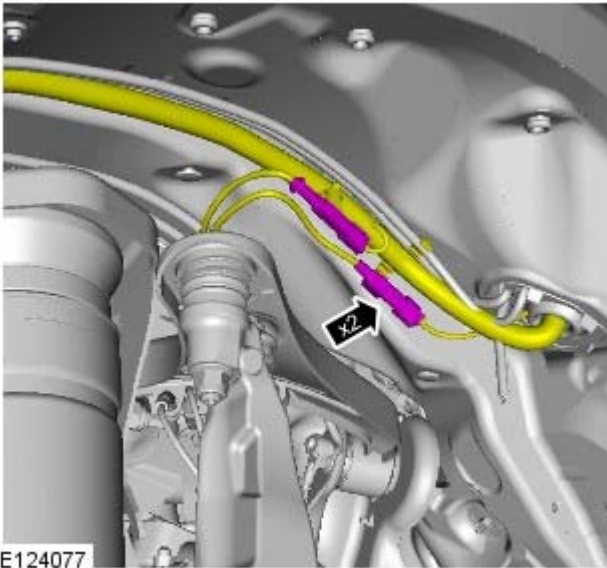
44.



45.



46.



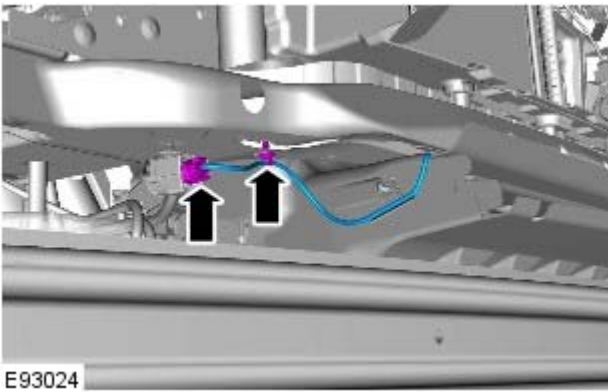
47. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

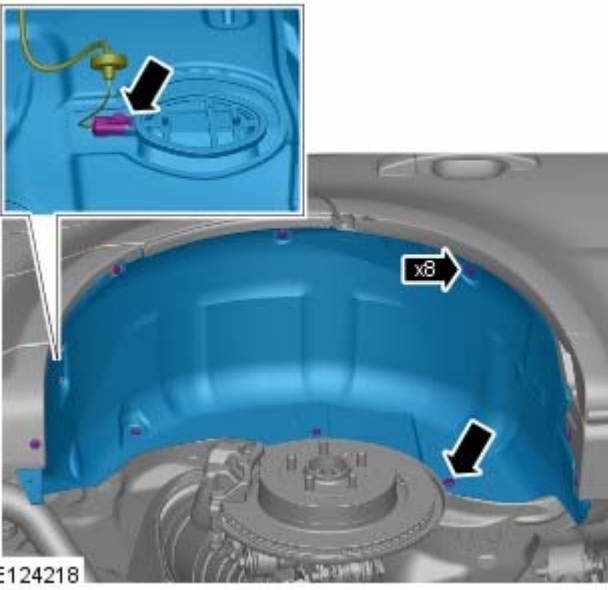
48. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

49.

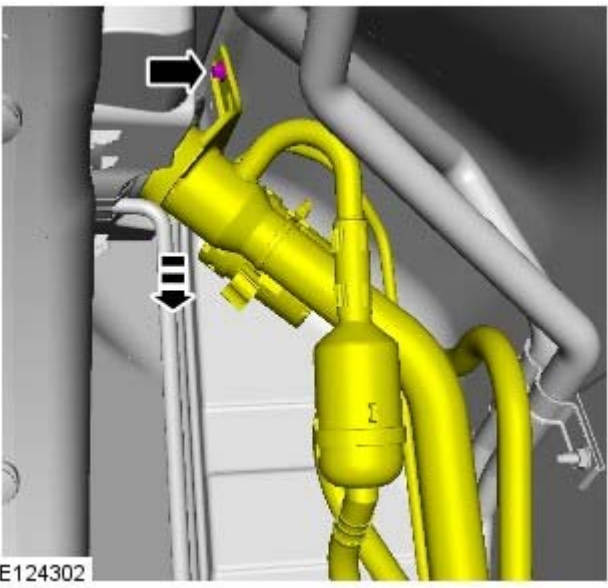


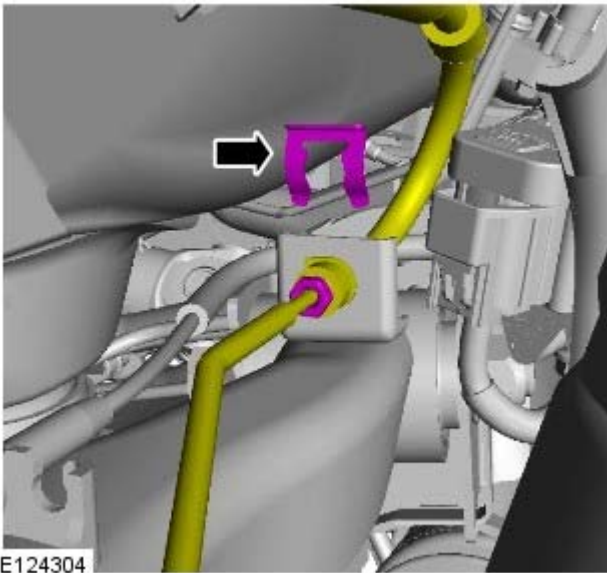
50.



51. Remove the fuel filler cap.

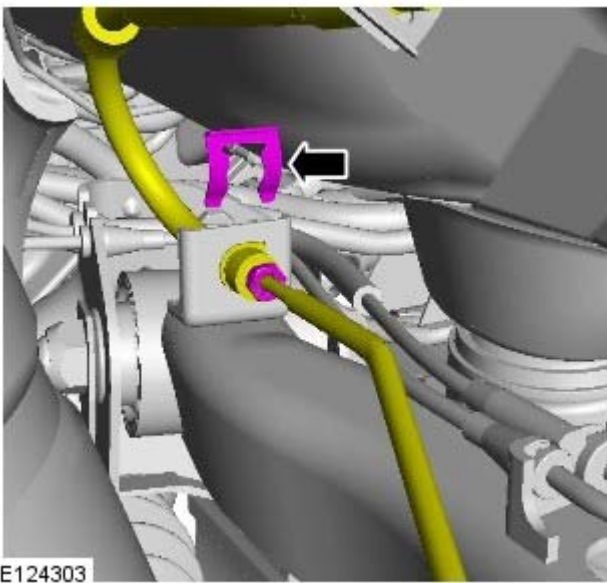
52.





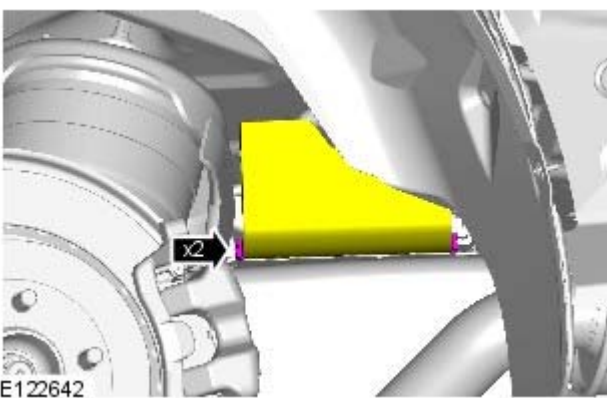
53. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.



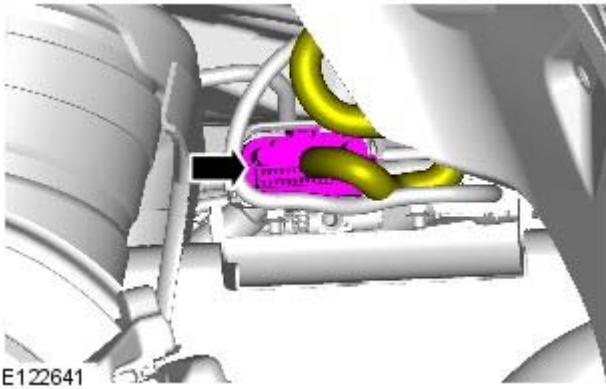
54. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

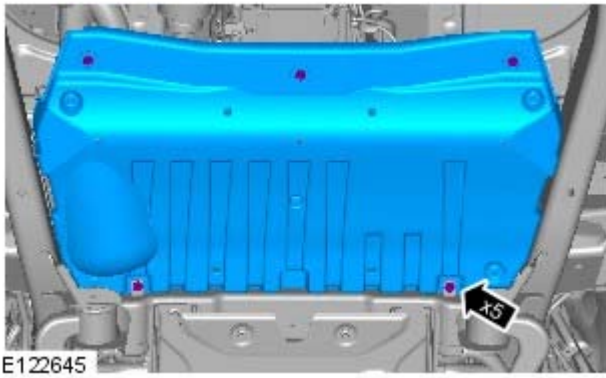


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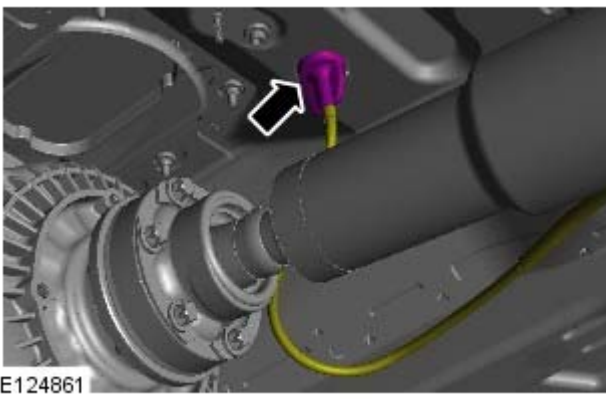
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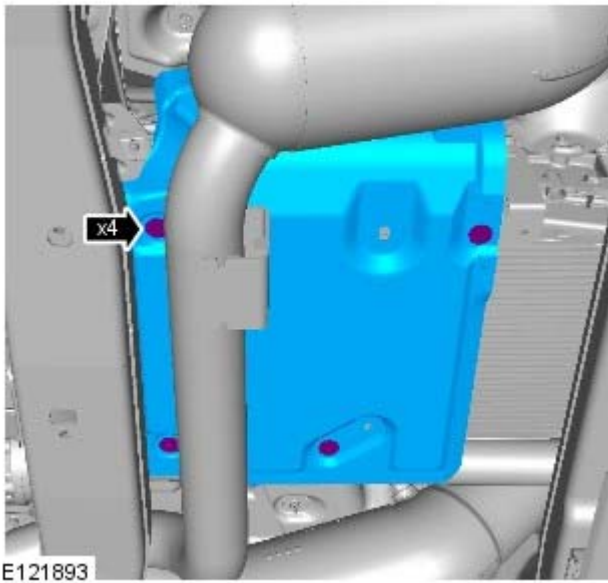
57.



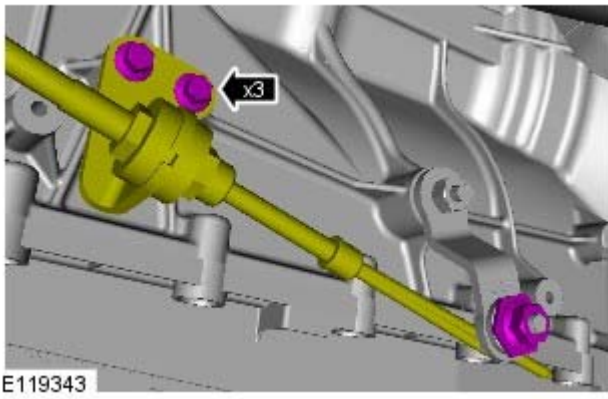
58.  CAUTION: Note the fitted position of the seal.



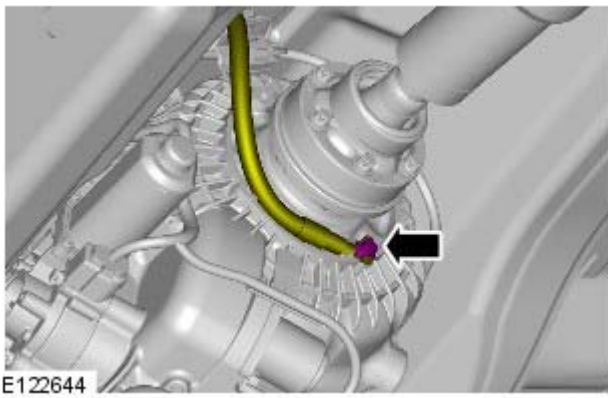
59.



60.

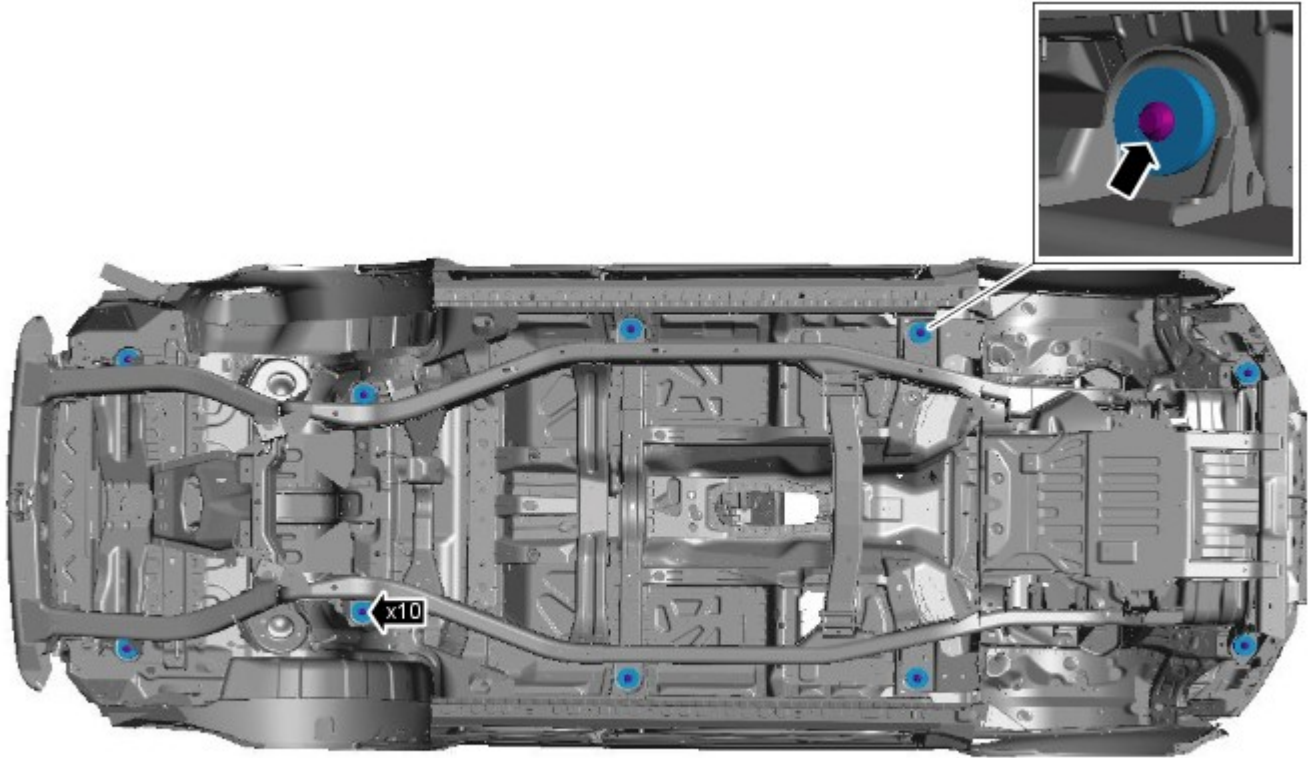


61.




62. Remove and discard the 10 body mount bolts.

- Remove the 10 spacing washers.



E124859

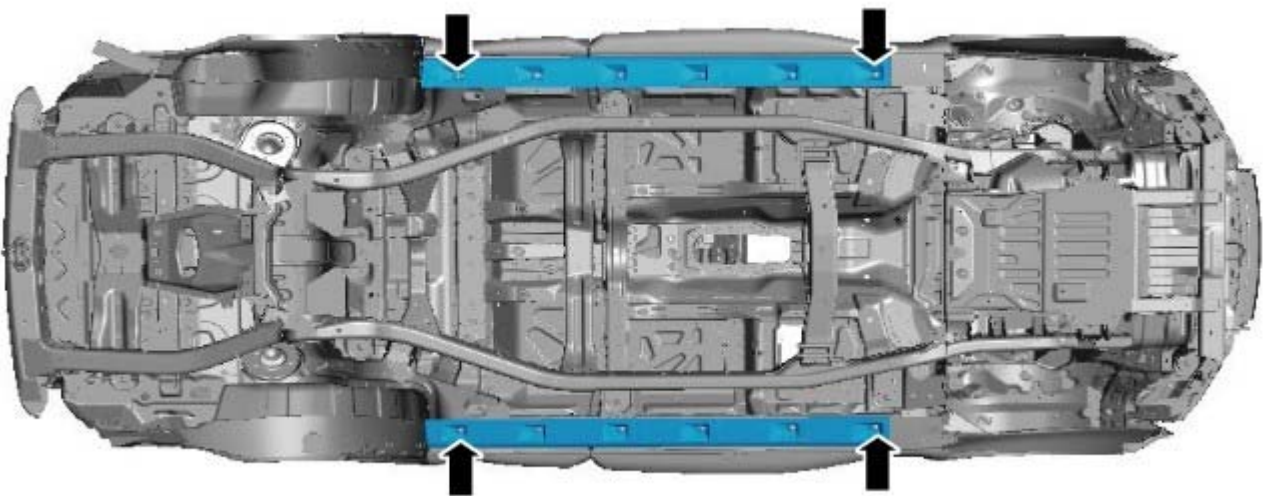
63. Carefully lower the vehicle and support the chassis with axle stands.

64.  **CAUTION:** To prevent the body becoming unstable when raised from the integrated body frame, install the vehicle tie down straps.

• **NOTE:** Note the fitted position of the body mounts.

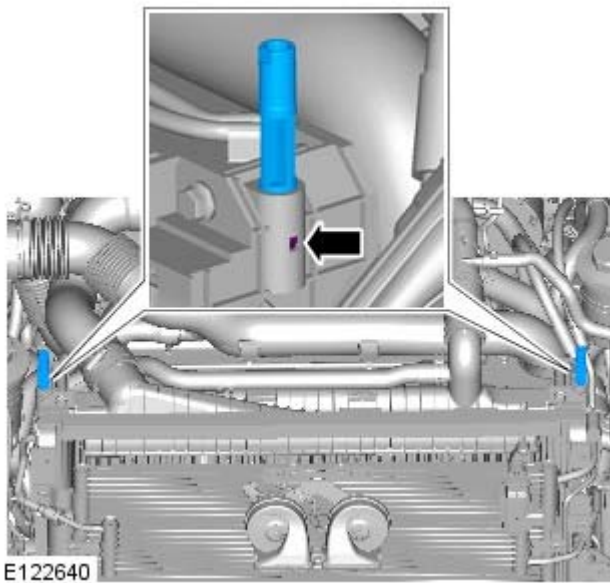
Using an assistant raise and support the body.

- Remove the body mounts.



E124860

65.



Installation

All vehicles

1. CAUTIONS:



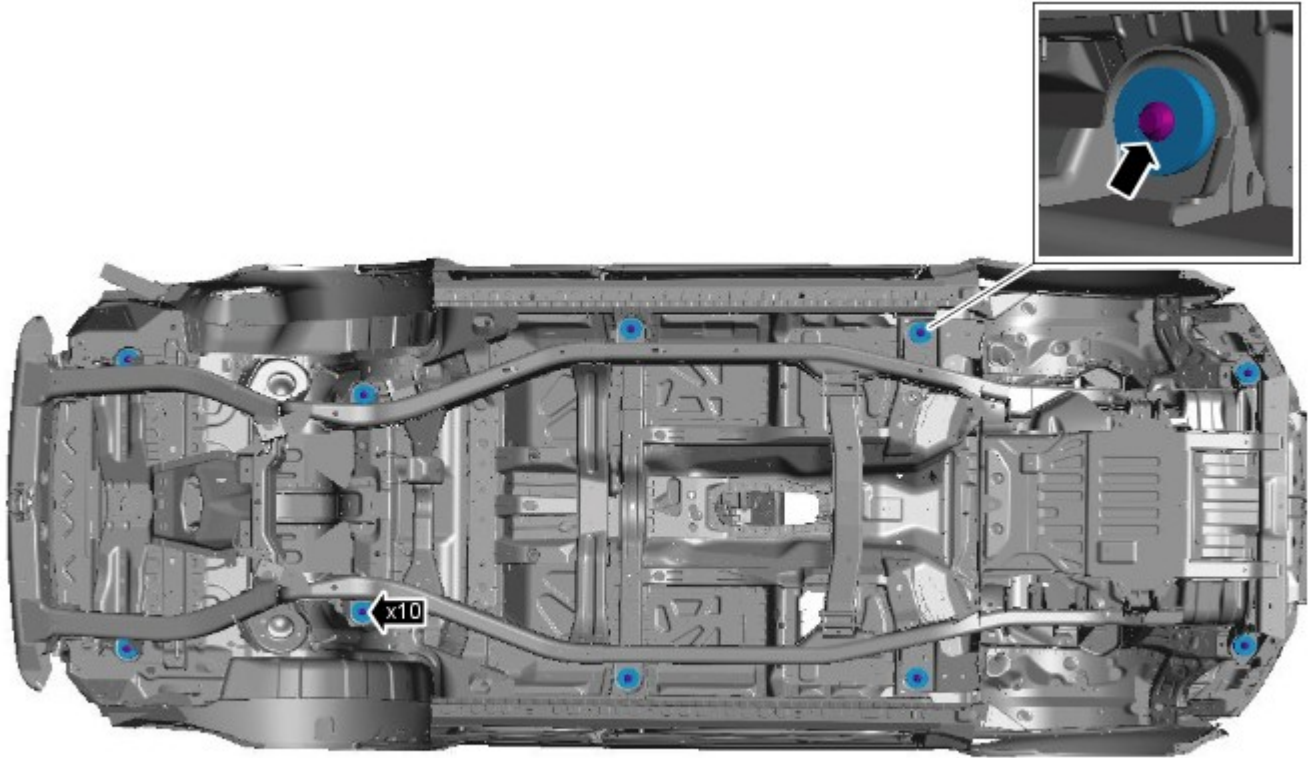
Make sure that new bolts are installed.



Make sure that all components are free and do not get caught up whilst lowering the body onto the integrated body frame.

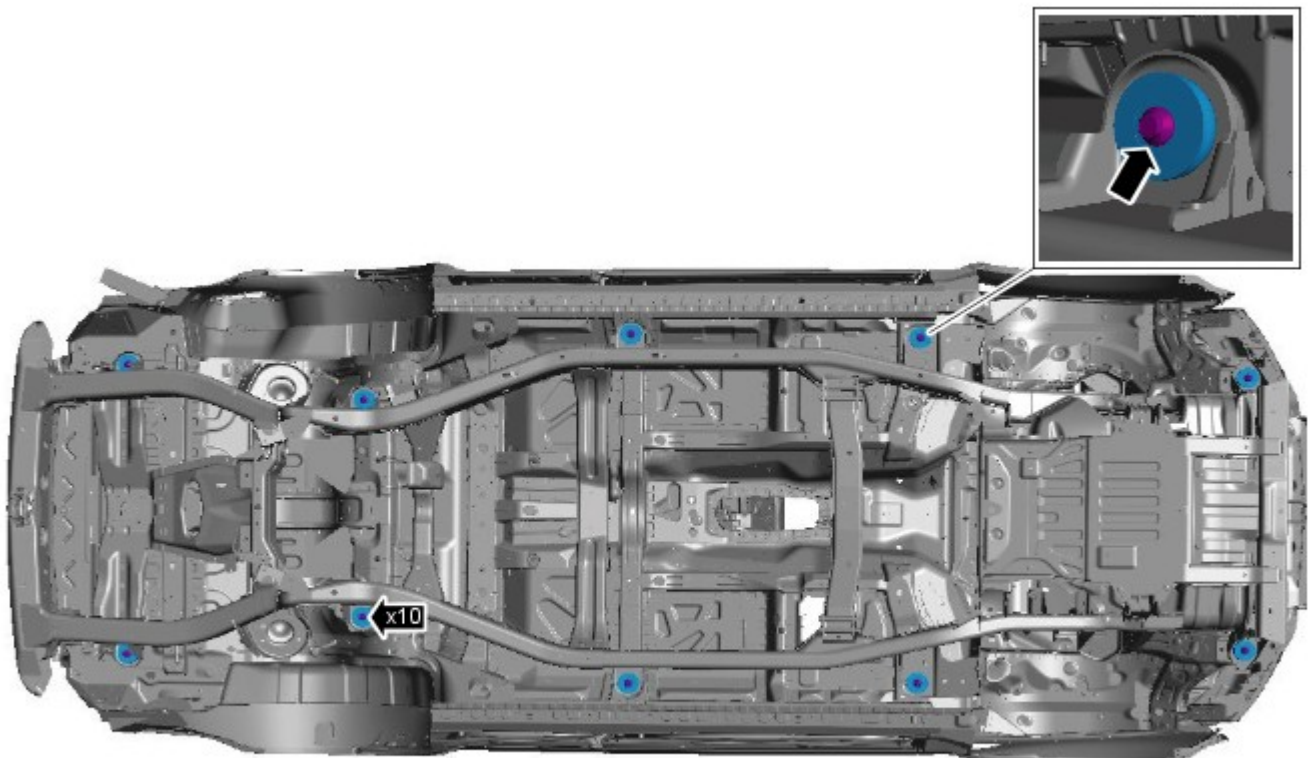
Using an assistant install the body to the integrated body frame.

- Install the body mounts.
- With assistance align the body and integrated body frame mounts.
- Install the bolts, but do not tighten fully at this stage.



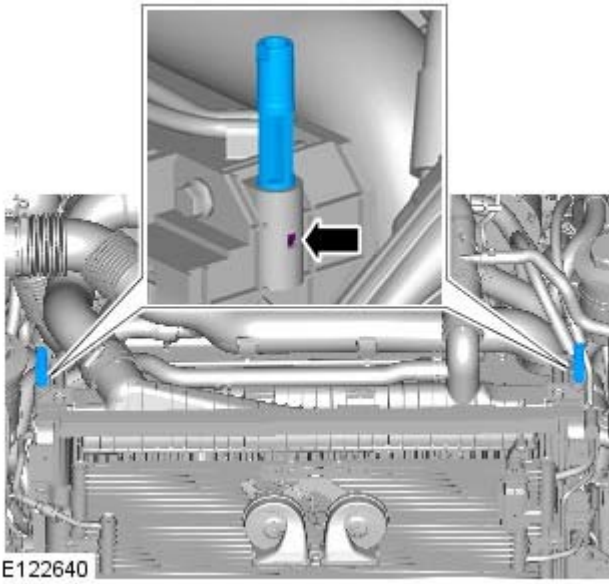
E124859

2. Remove the tie down straps securing the body.
3. TORQUE: 133 Nm

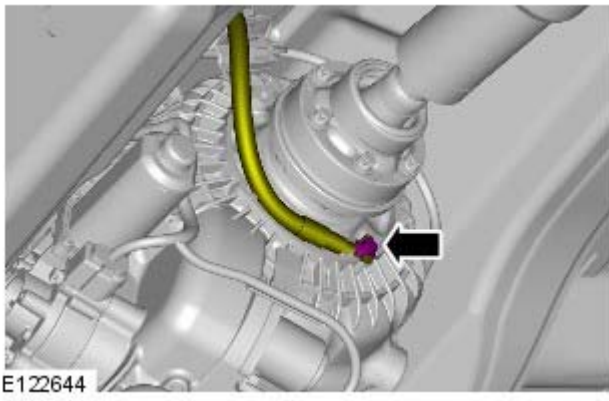


E124859

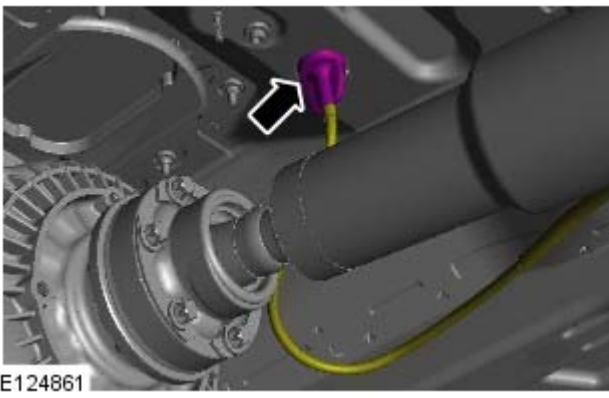
4.



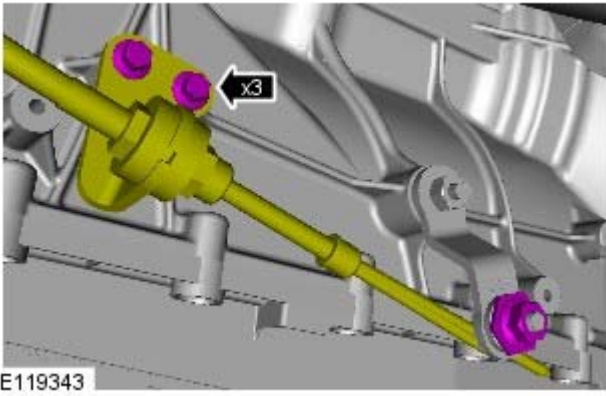
5. TORQUE: 25 Nm



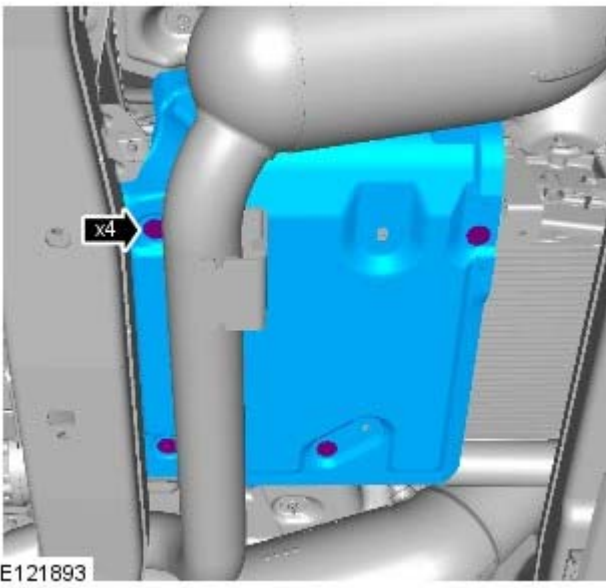
6.



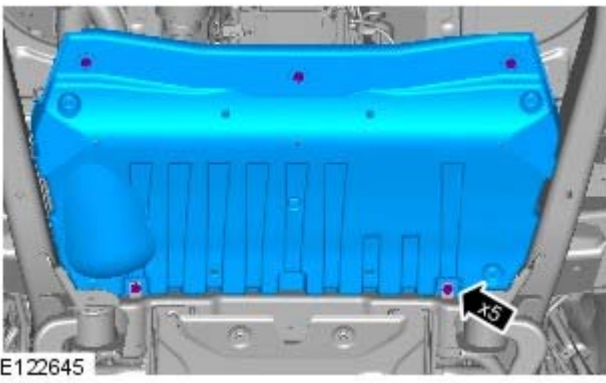
7.



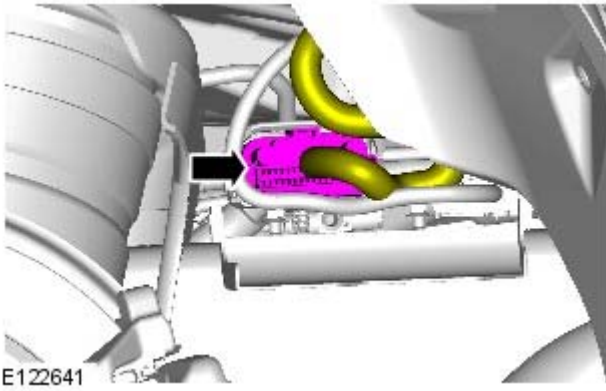
8. TORQUE: 12 Nm



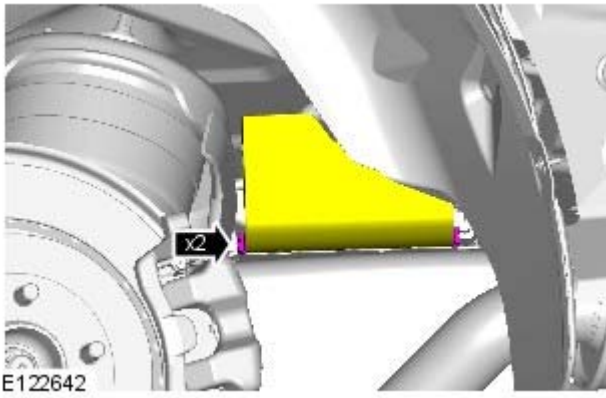
9. TORQUE: 12 Nm



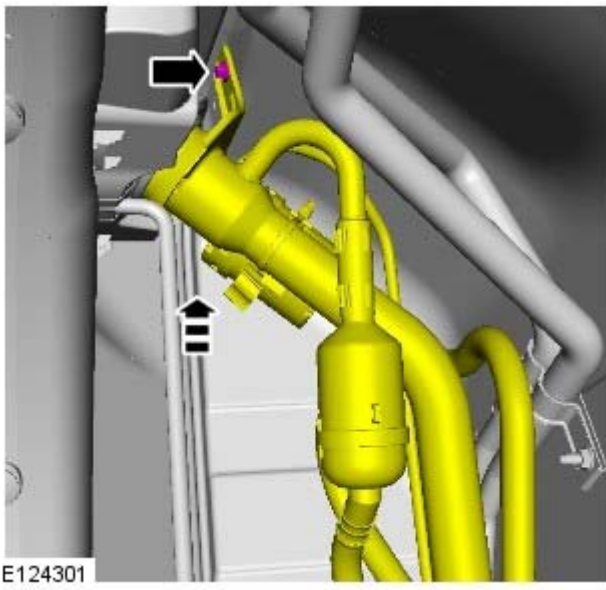
10.



11.

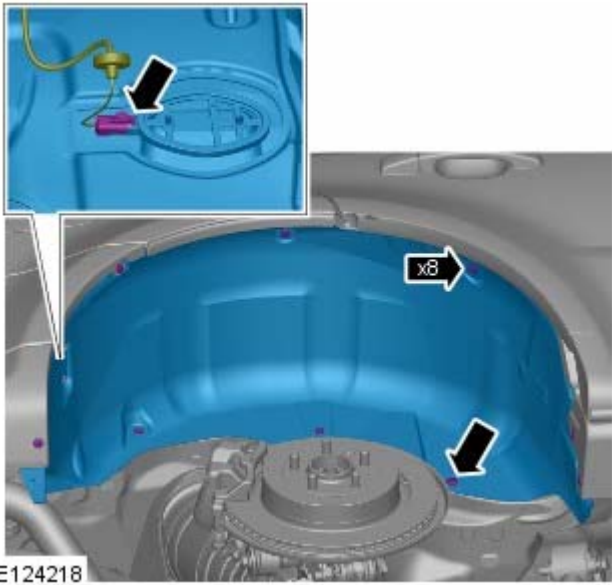


12. TORQUE: 12 Nm



13. Install the fuel filler cap.

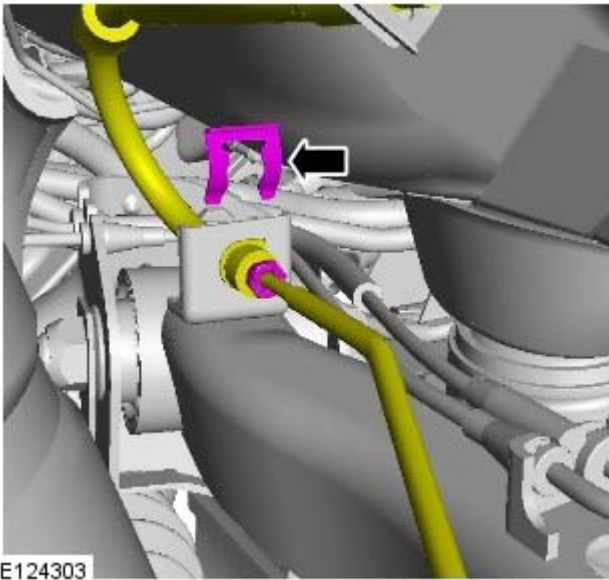
14.



15. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

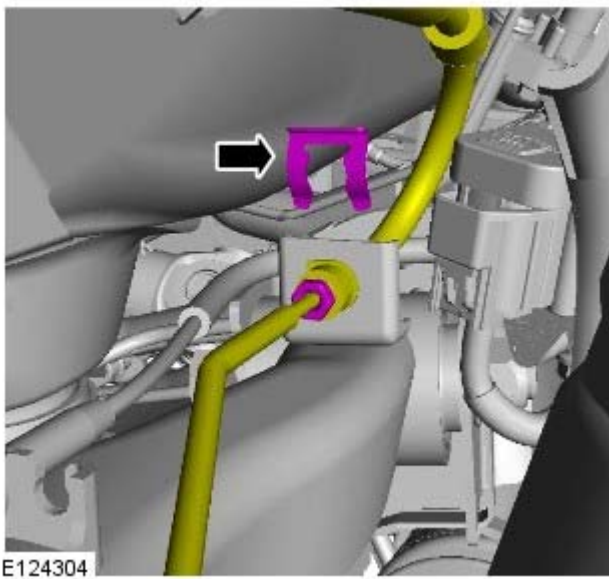
- Clean the component mating faces.
- Secure the clip.



16. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

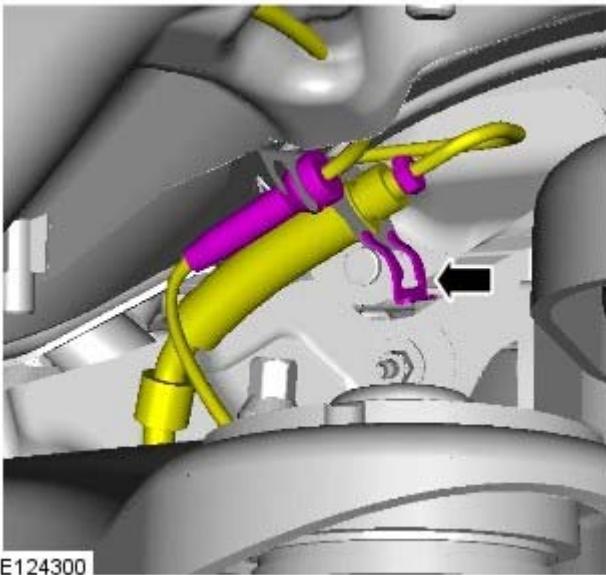
- Clean the component mating faces.
- Secure the clip.



17. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

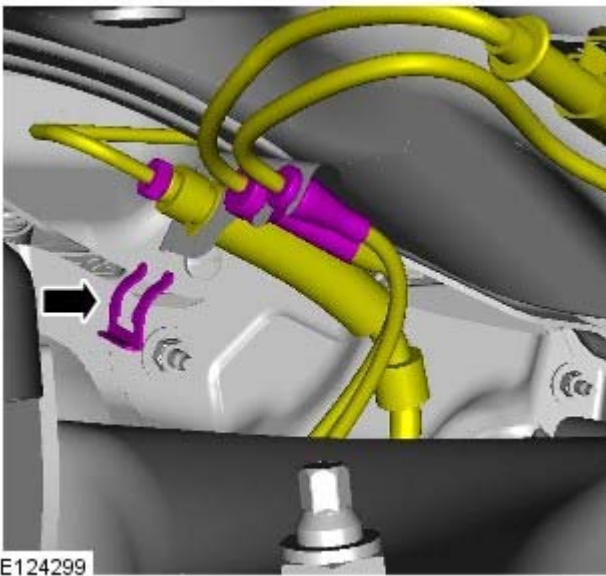
- Clean the component mating faces.
- Secure the clip.



18. NOTE: Remove and discard the blanking caps.

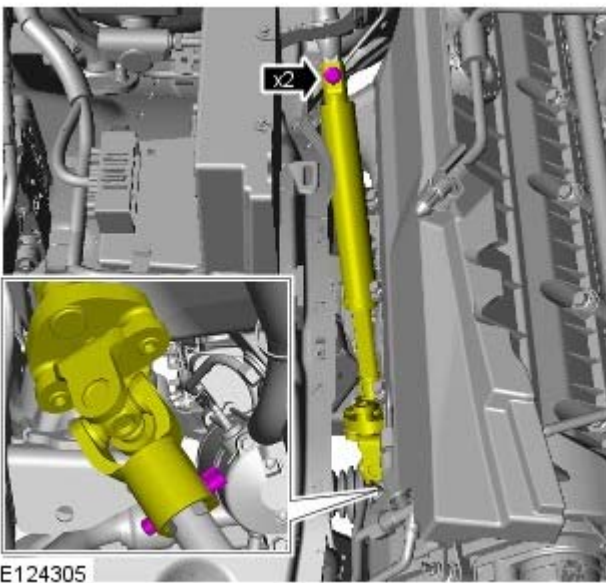
TORQUE: 16 Nm

- Clean the component mating faces.
- Secure the clip.

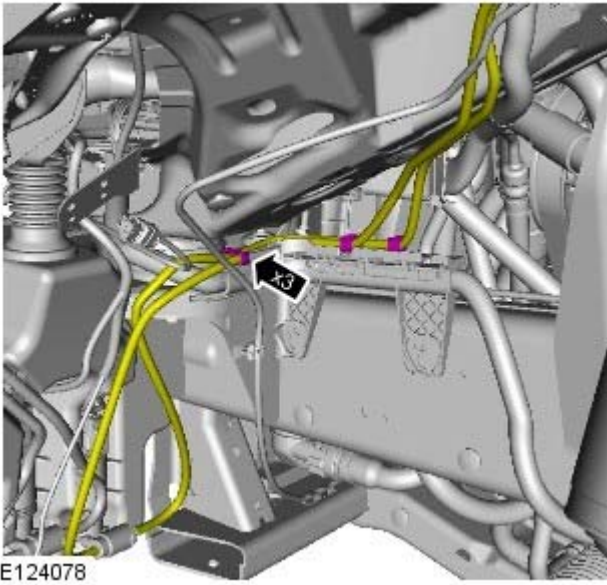


19.  WARNING: Make sure that a new bolt is installed.

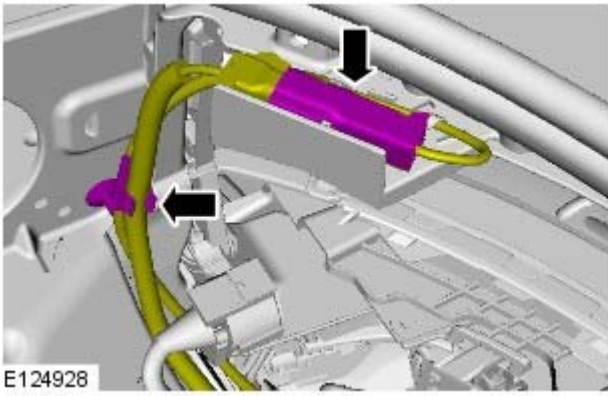
TORQUE: 25 Nm



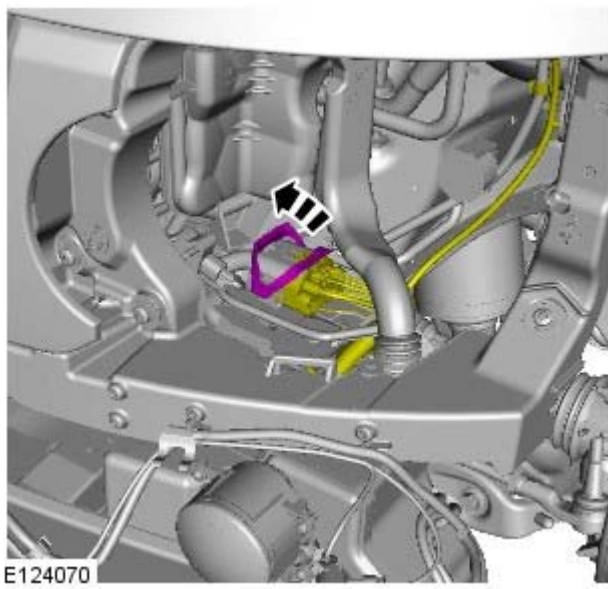
20.



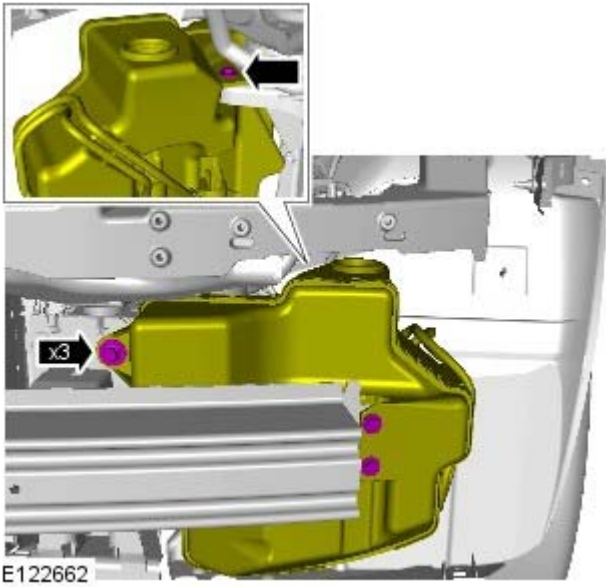
21.



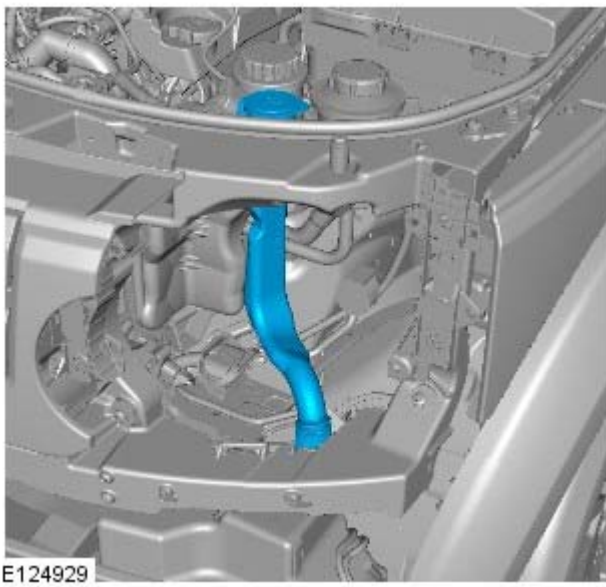
22.



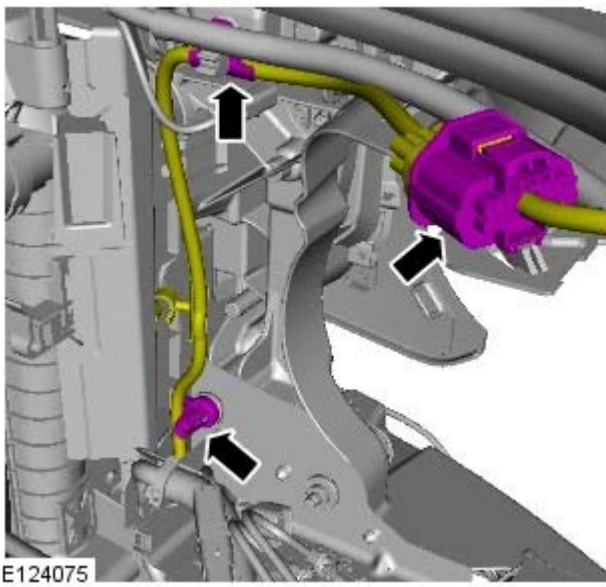
23. TORQUE: 12 Nm



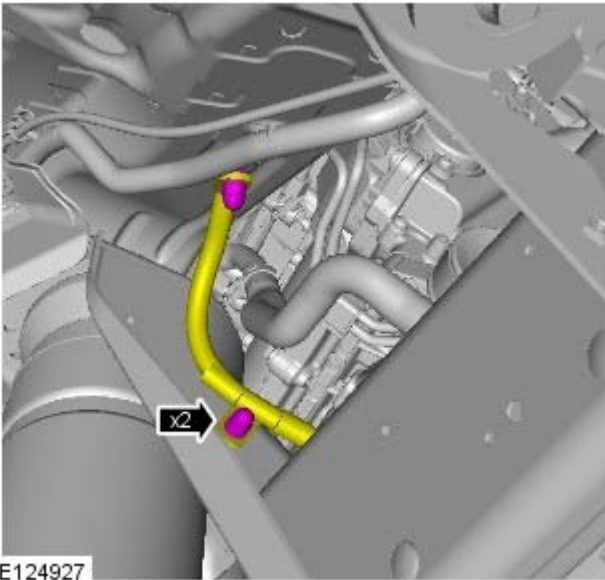
24.



25.

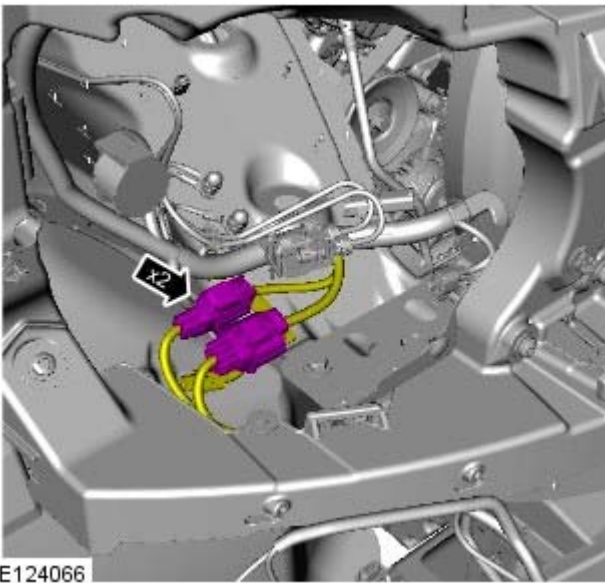


26. TORQUE: 20 Nm



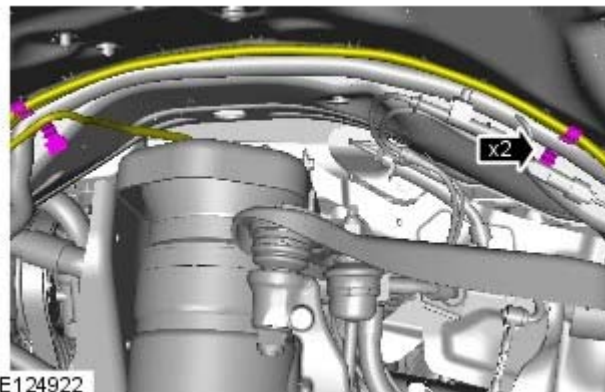
E124927

27.



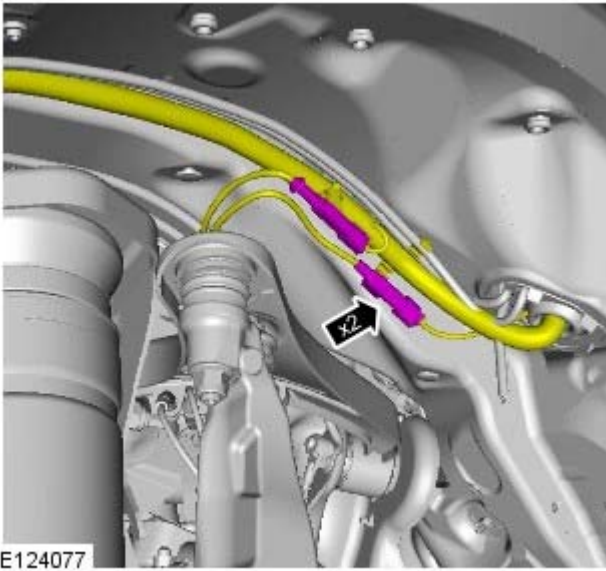
E124066

28.

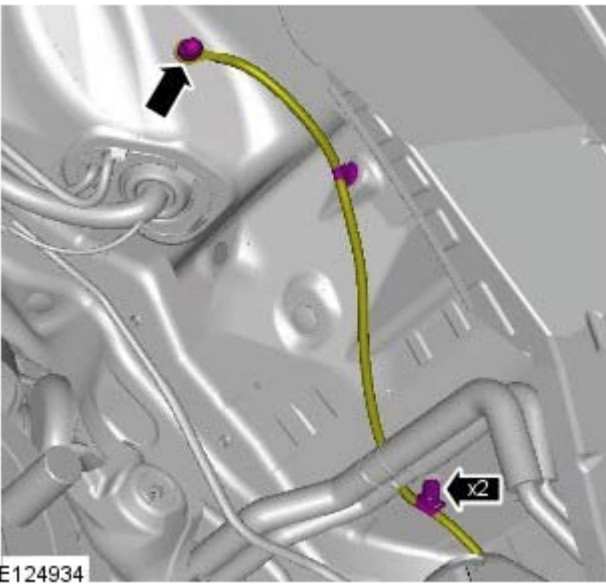


E124922

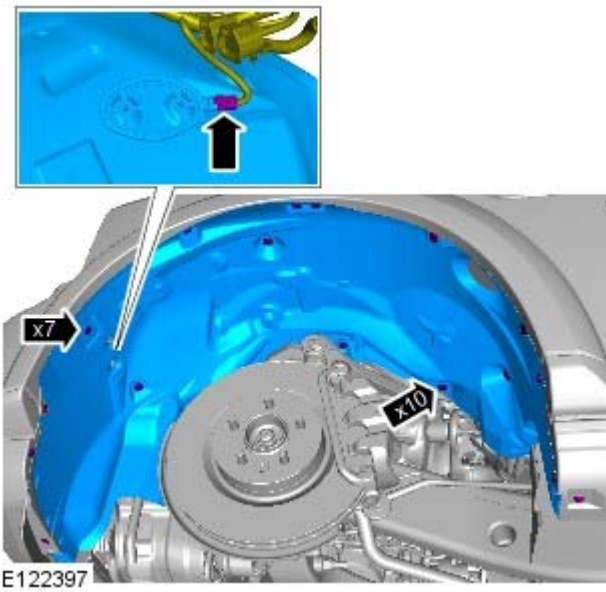
29.



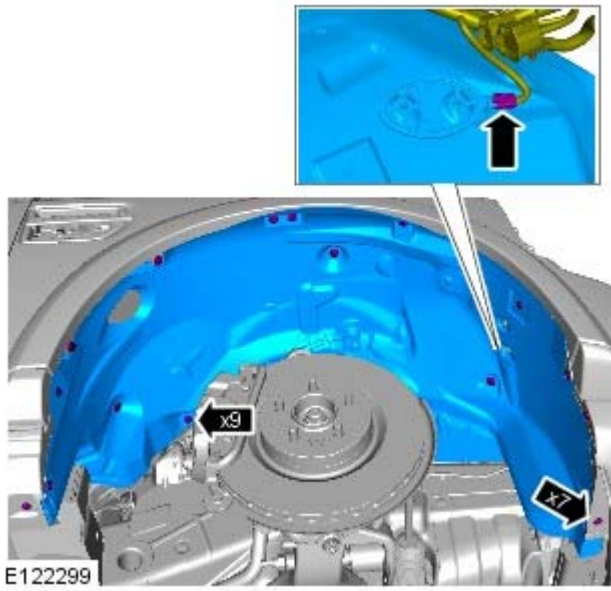
30. TORQUE: 20 Nm



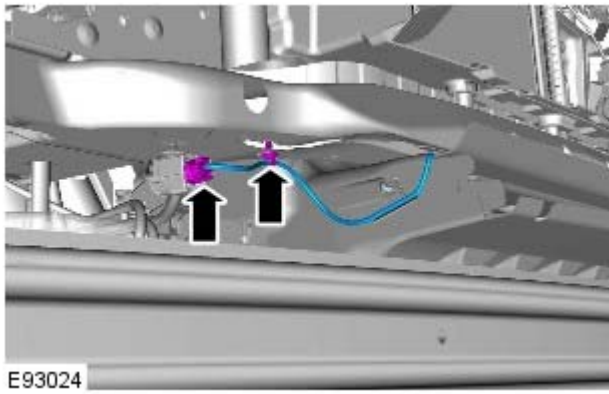
31.



32.

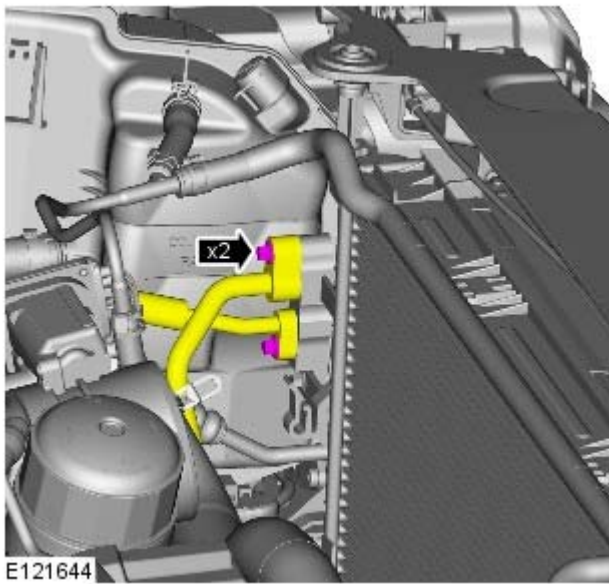


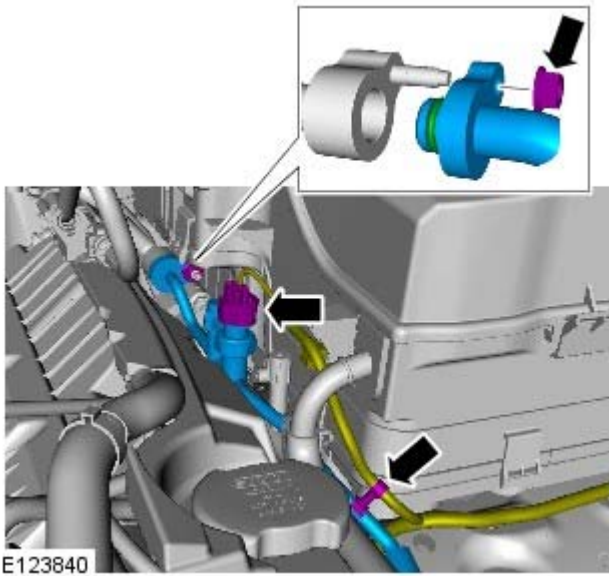
33.




34. TORQUE: 12 Nm

- Install new O-ring seals.

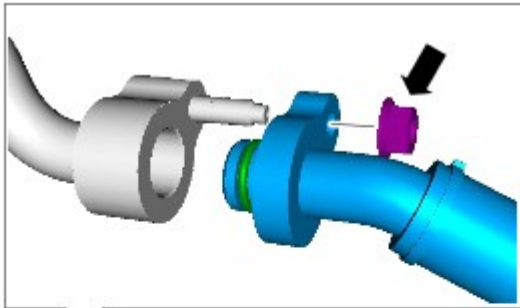





35.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

TORQUE: 12 Nm

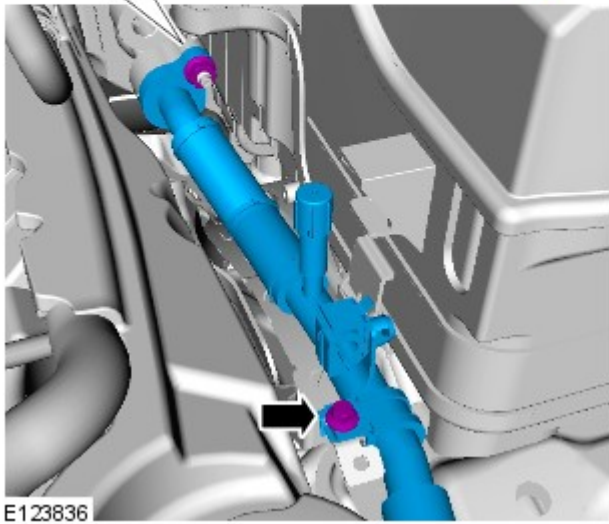
- Install new O-ring seals.

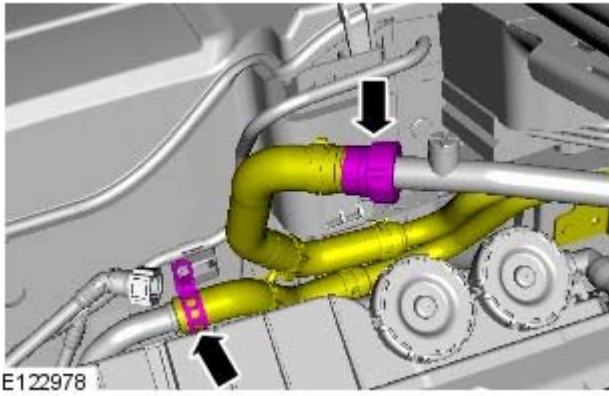


36.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

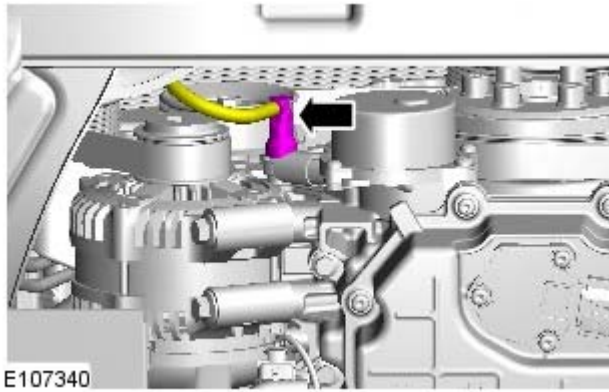
TORQUE: 12 Nm

- Install new O-ring seals.

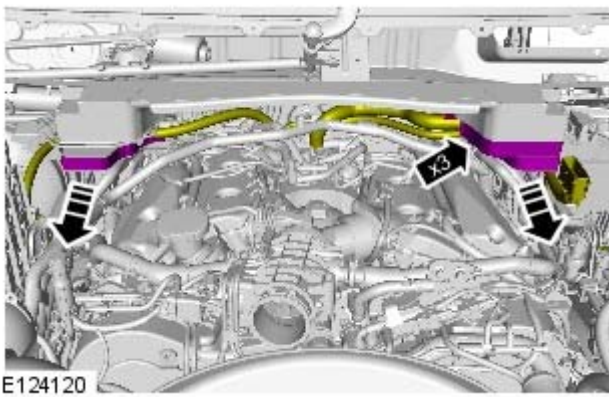




37.  WARNING: Be prepared to collect escaping fluid.

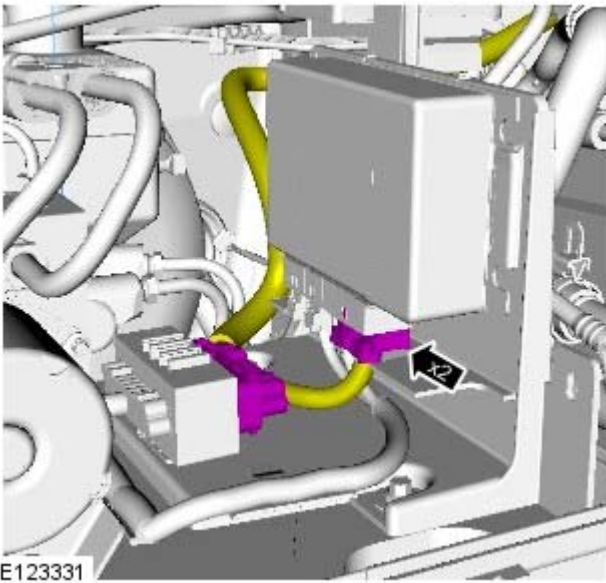


38.

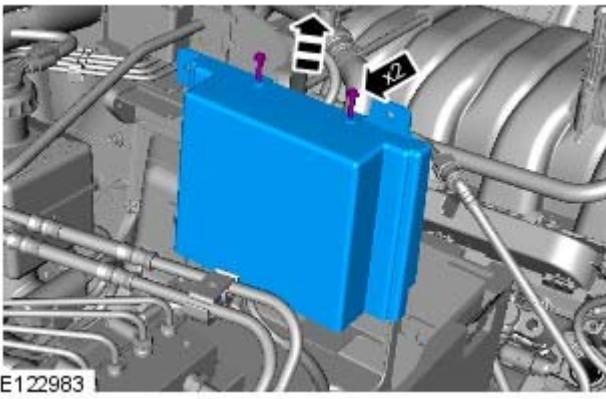


39.

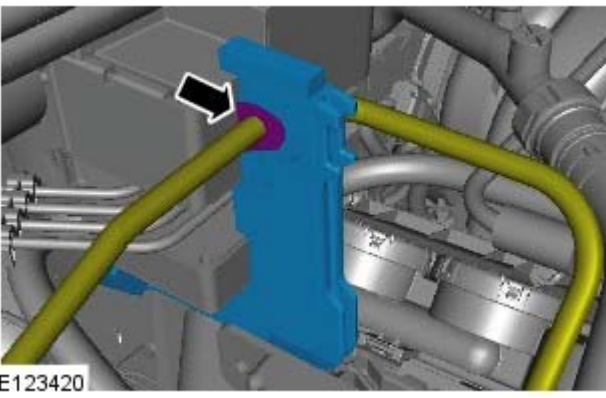
40.



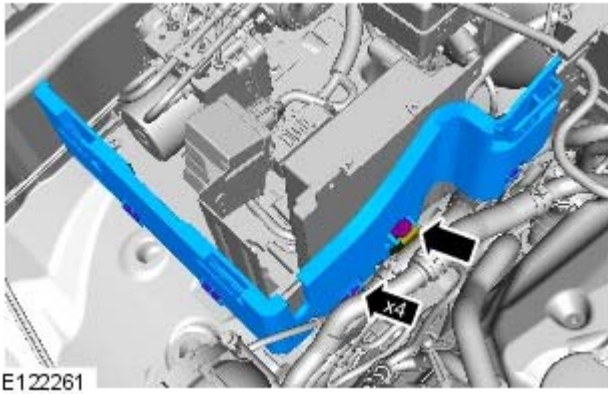
41. TORQUE: 8 Nm



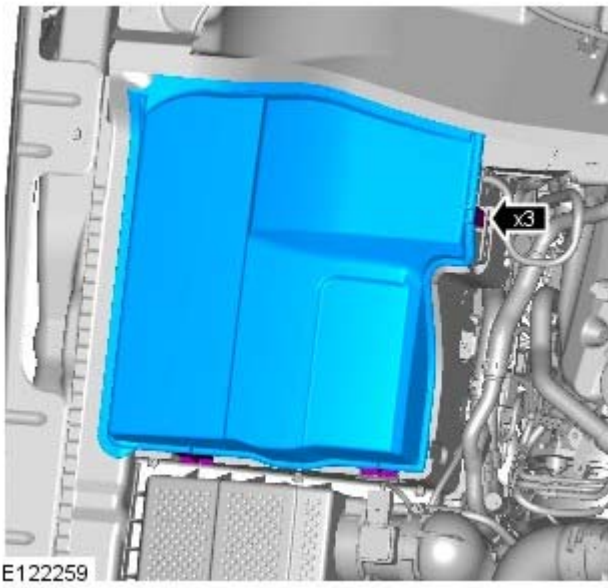
42.



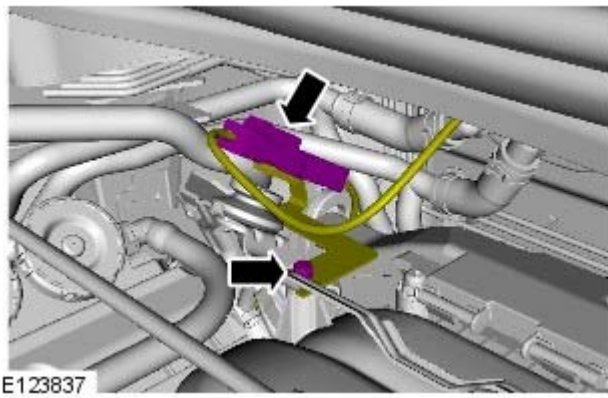
43. TORQUE: 10 Nm



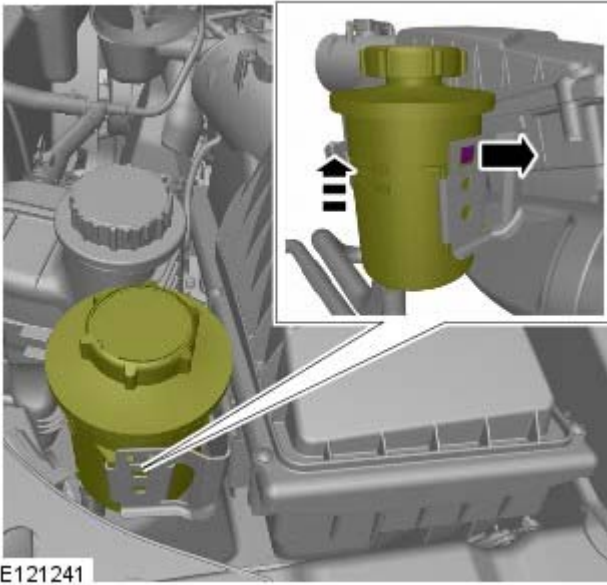
44.



45. TORQUE: 10 Nm



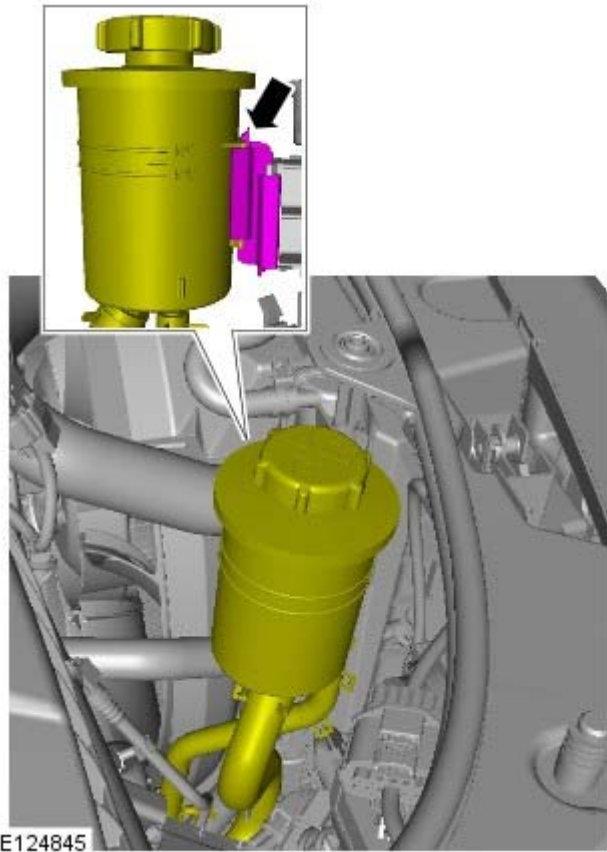
46.



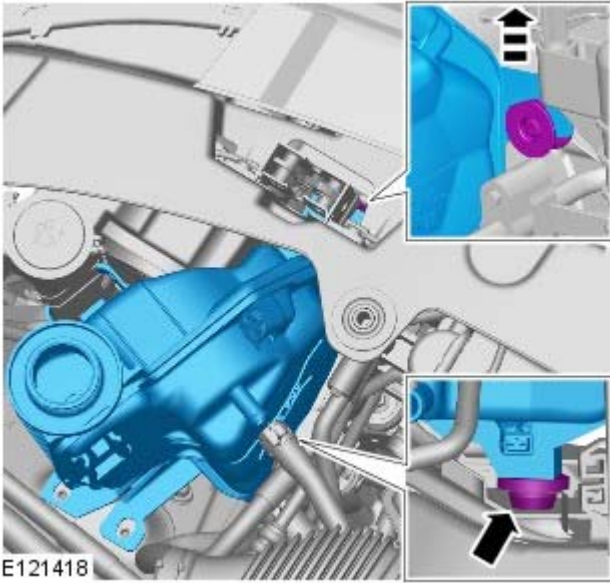
E121241

Vehicles with active damping

47.

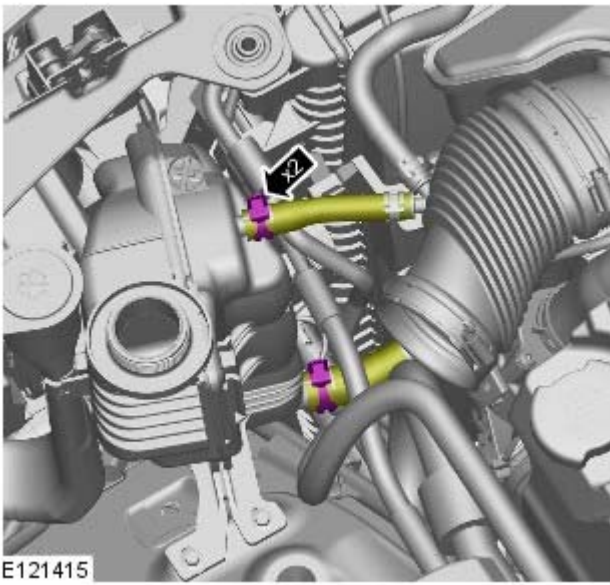


E124845

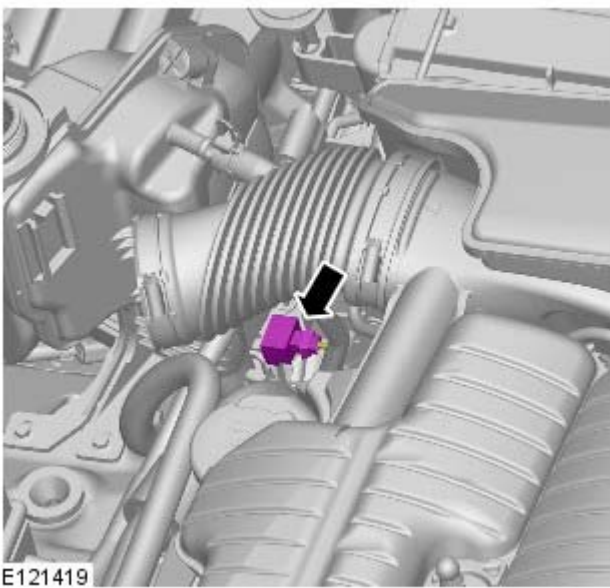


48.  CAUTION: Be prepared to collect escaping coolant.

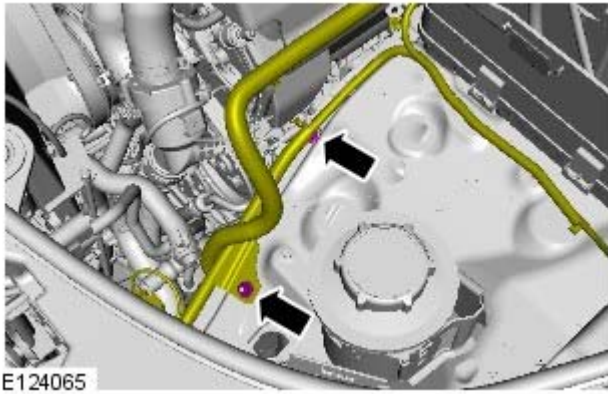
49.



50.



51. TORQUE: 10 Nm



All vehicles

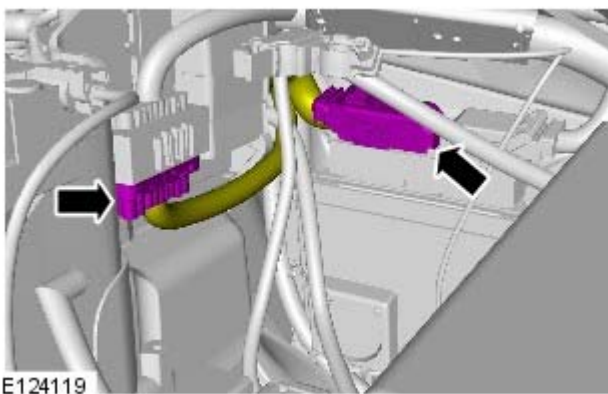
52. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

53. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

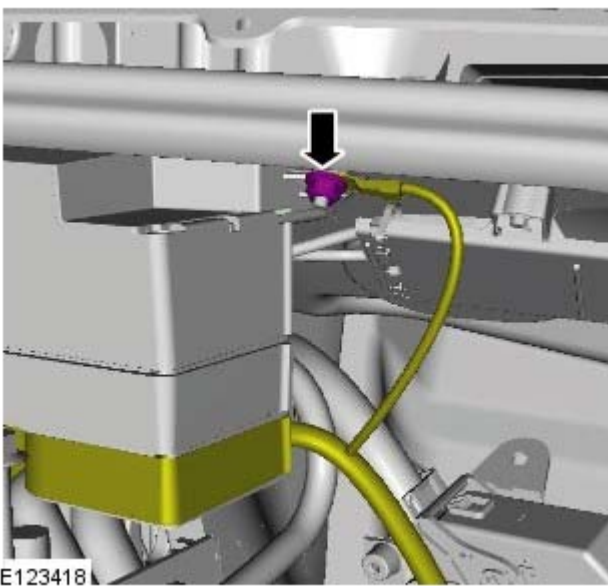
54. For additional information, refer to: Air Cleaner LH (303-12, Removal and Installation).

55. For additional information, refer to: Air Cleaner RH (303-12, Removal and Installation).

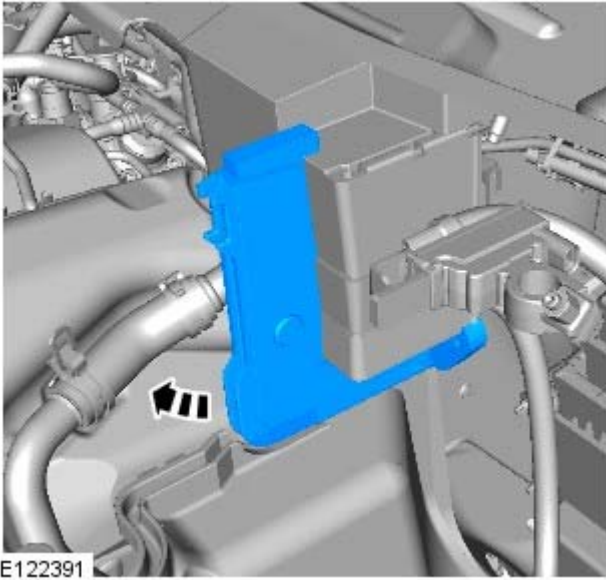
56.



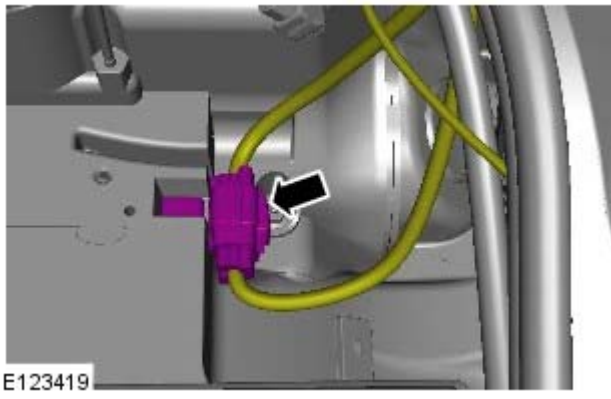
57. TORQUE: 10 Nm



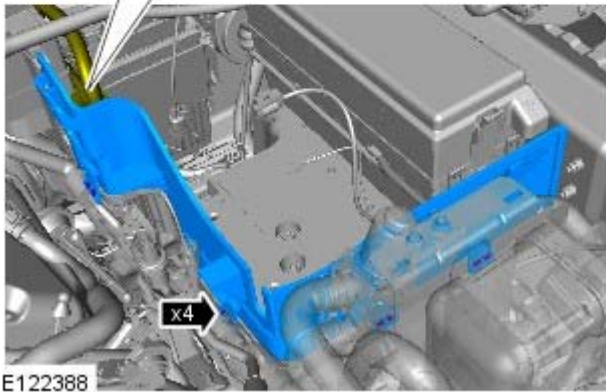
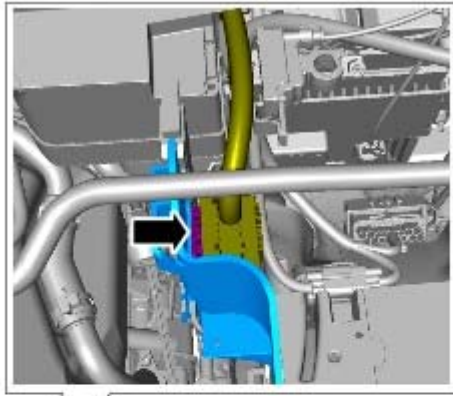
58.



59.

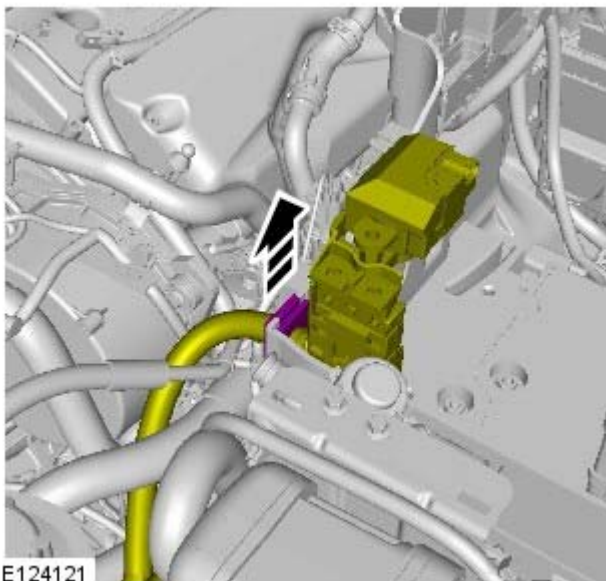


60. NOTE: RHD illustration shown, LHD is similar.



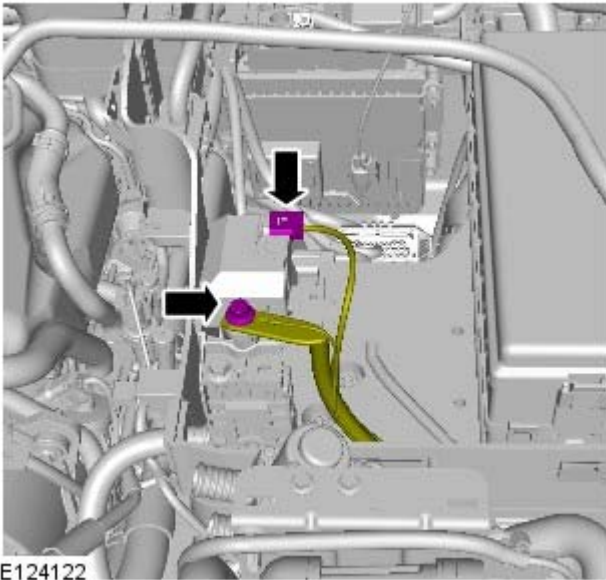
E122388

61.



E124121

62.



63. For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

64. For additional information, refer to: Battery (414-01, Removal and Installation).

65. For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

66. Bleed the braking system.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).

Full Frame and Body Mounting - BodyTDV6 3.0L Diesel/TDV6 2.7L Diesel

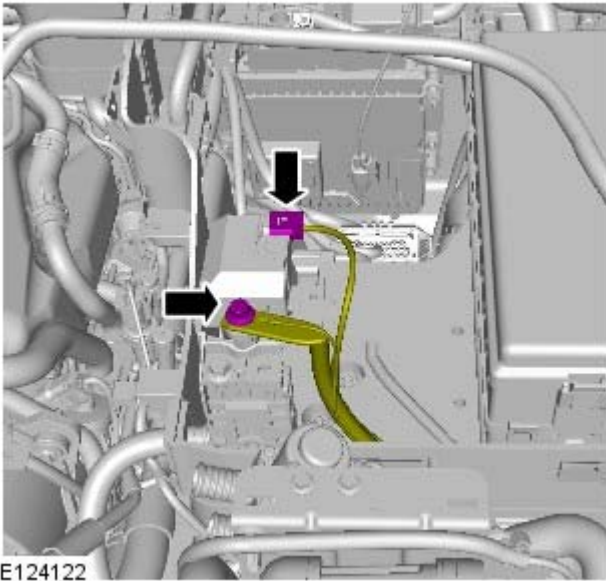
Removal and Installation

Removal

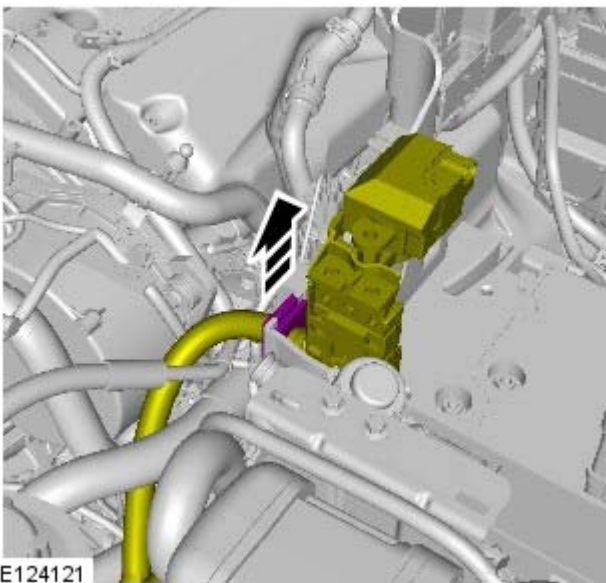
- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.
- NOTE: Some illustrations may show the engine removed for clarity.

All vehicles

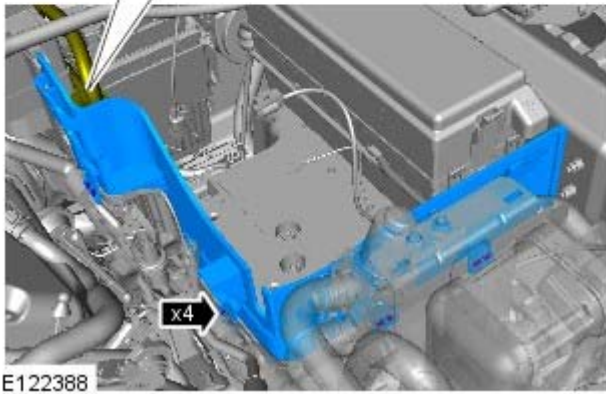
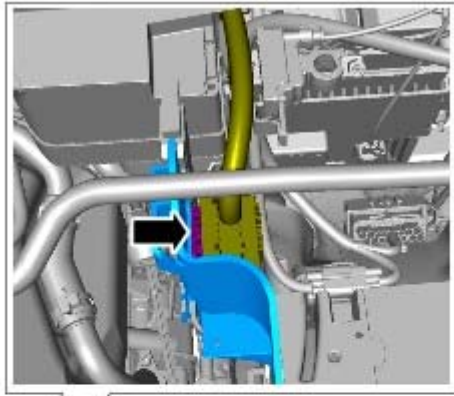
1. For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
2. Remove the battery.
For additional information, refer to: Battery (414-01, Removal and Installation).
- 3.



4.

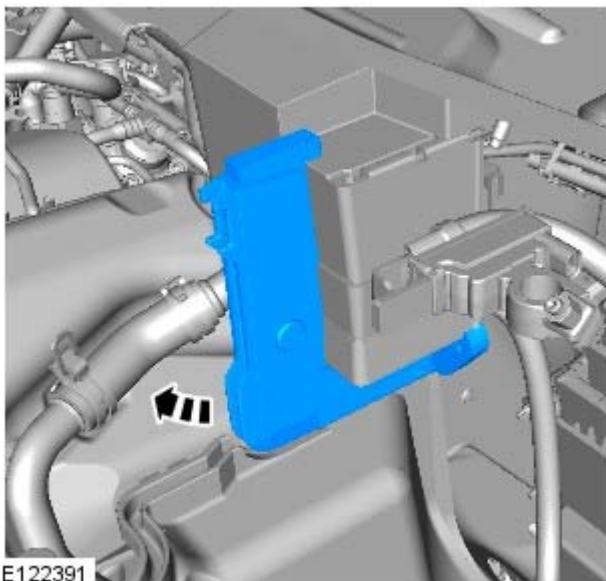


5. NOTE: RHD illustration shown, LHD is similar.



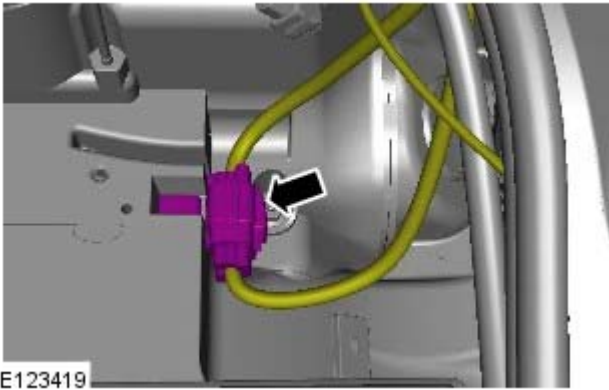
E122388

6.

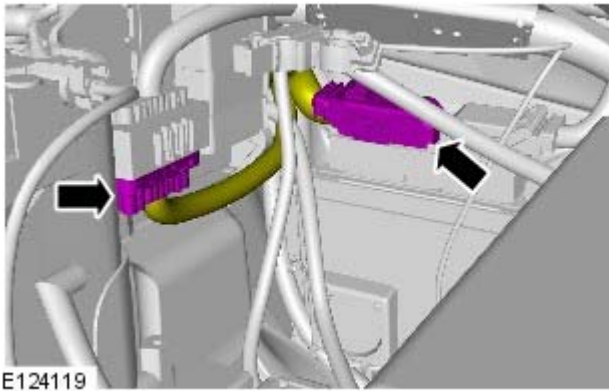


E122391


7.



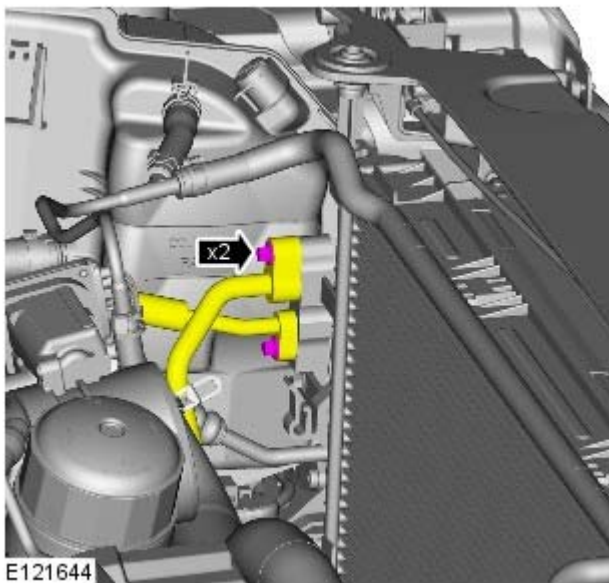
8.

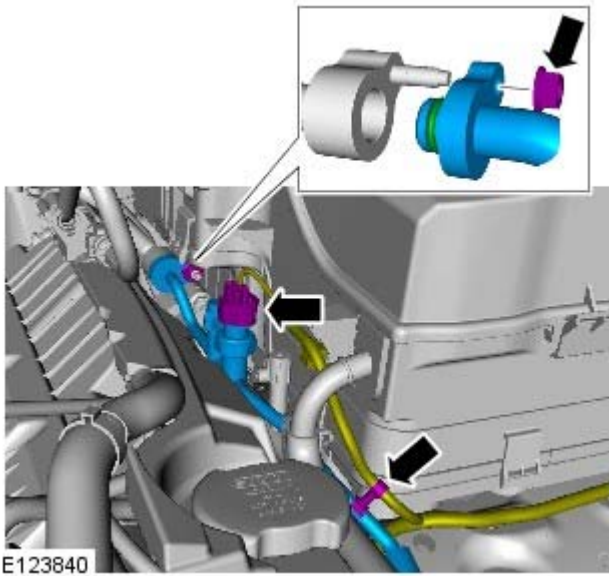


9. For additional information, refer to: Air Cleaner (303-12, Removal and Installation).
10. For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
11. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).
12. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).


13.  **CAUTION:** Make sure that all openings are sealed. Use new blanking caps.

- Remove and discard the 2 O-ring seals.

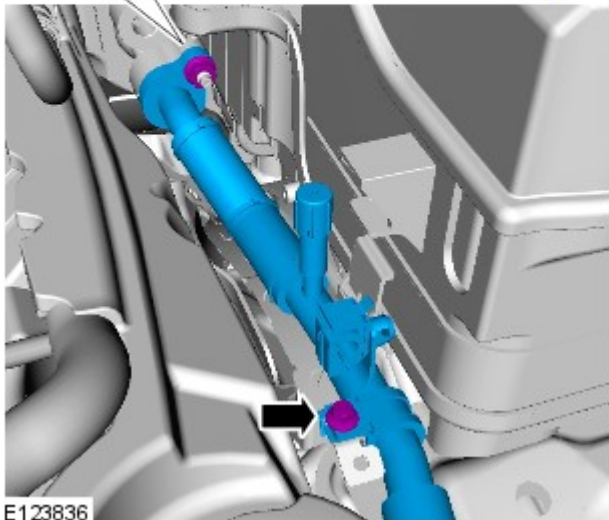
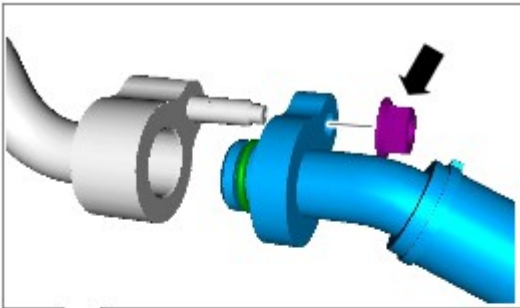





E123840

14.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

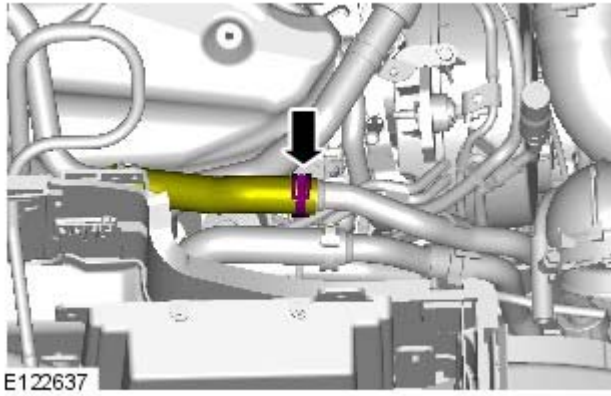
- Discard the O-ring seal.



E123836

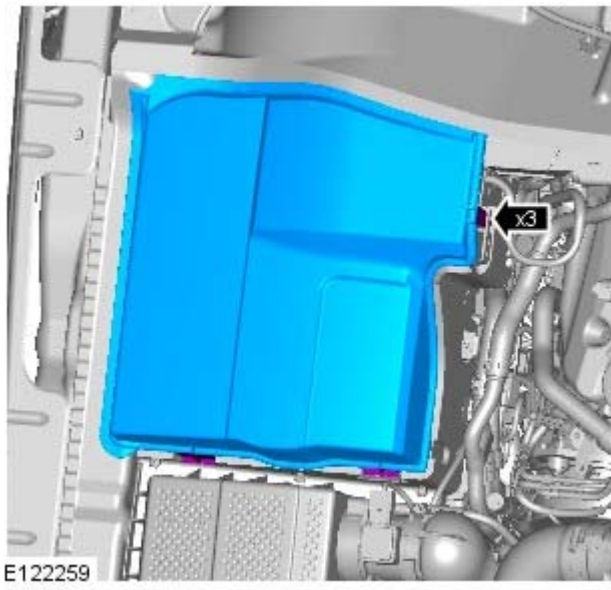
15.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

- Discard the O-ring seal.

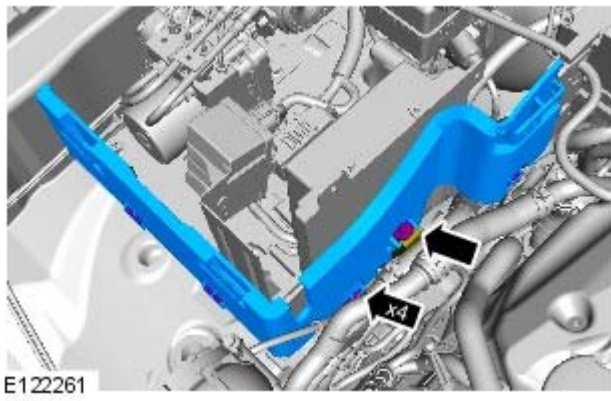


16.  WARNING: Be prepared to collect escaping fluid.

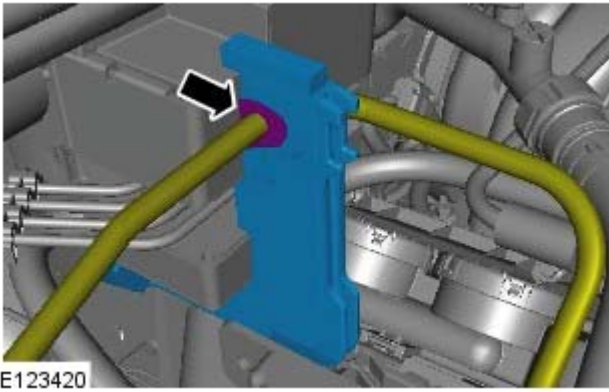
17.



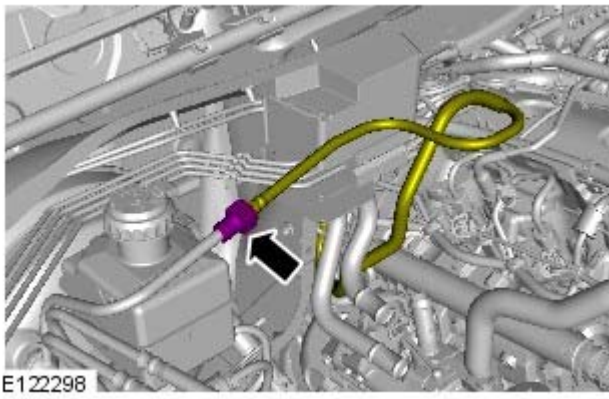
18.



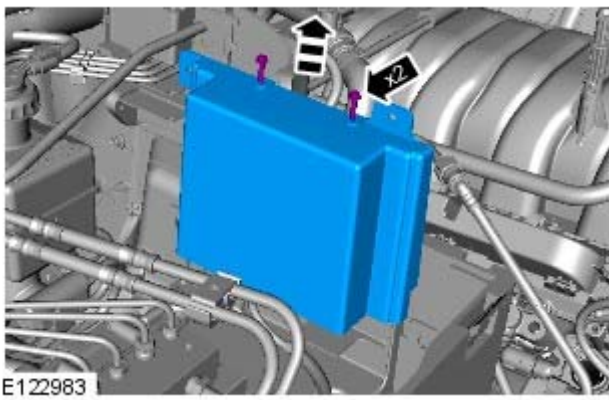
19.



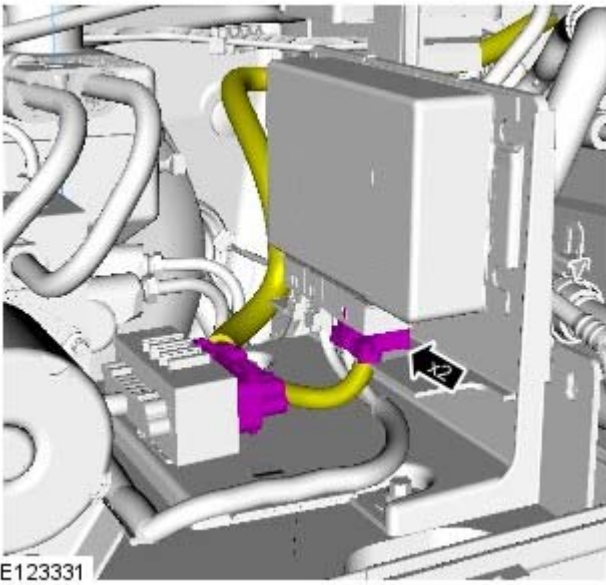
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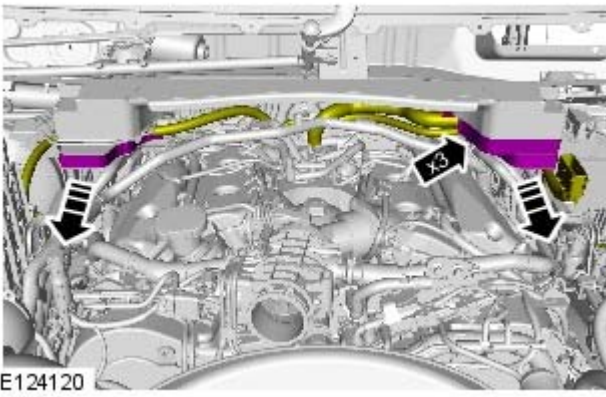
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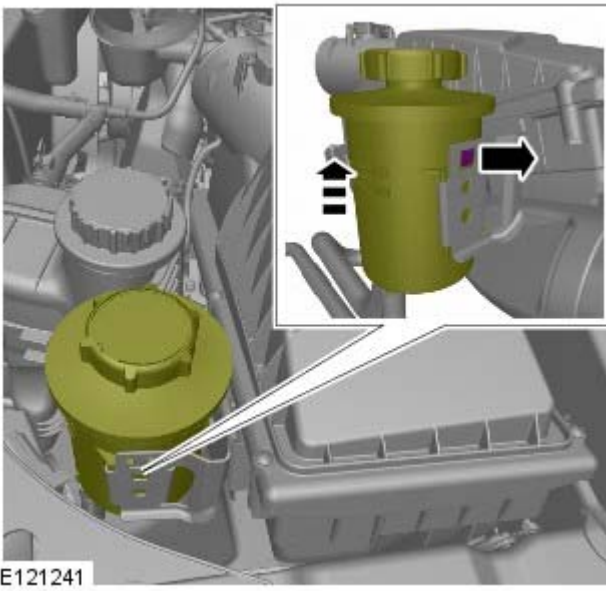
22.



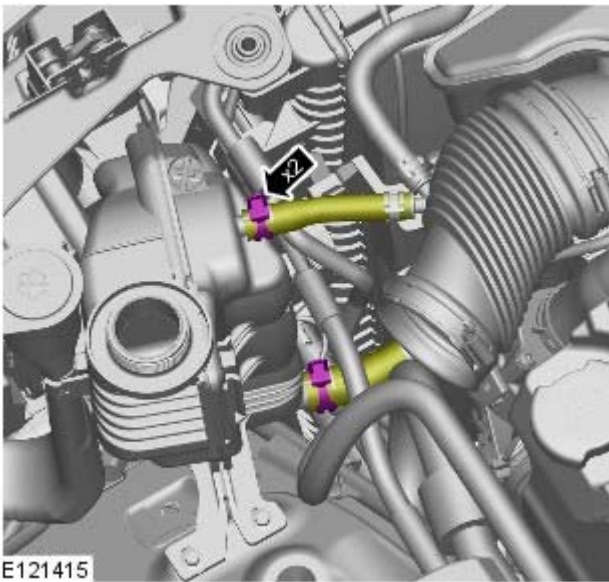
23.



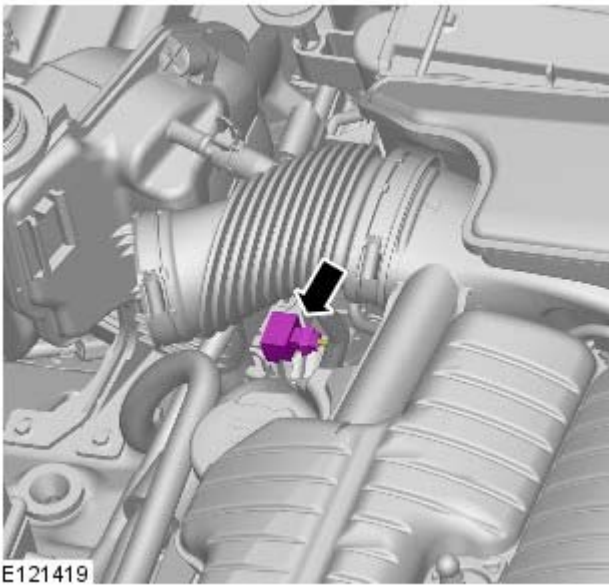
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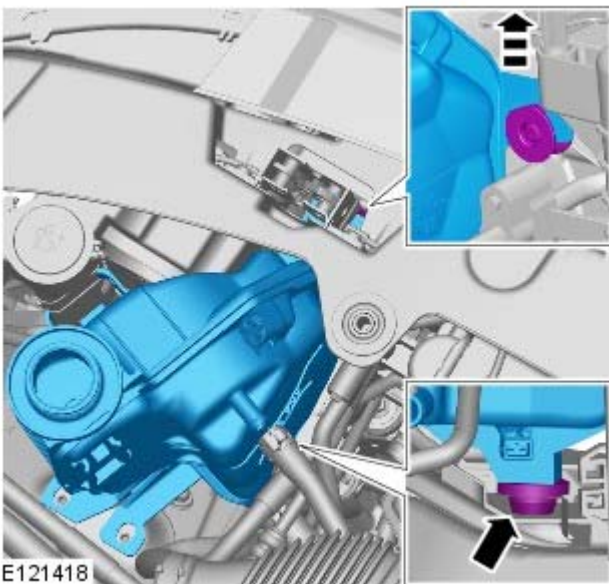
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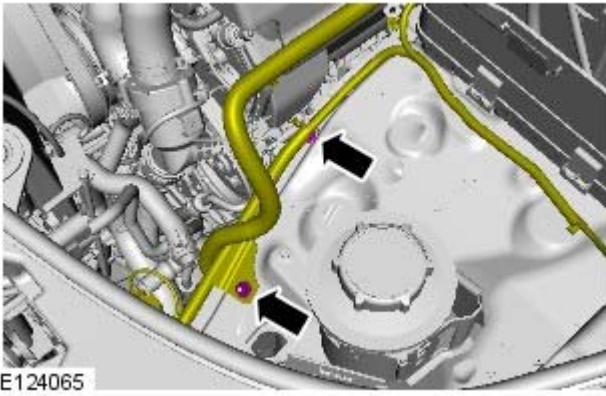
26.



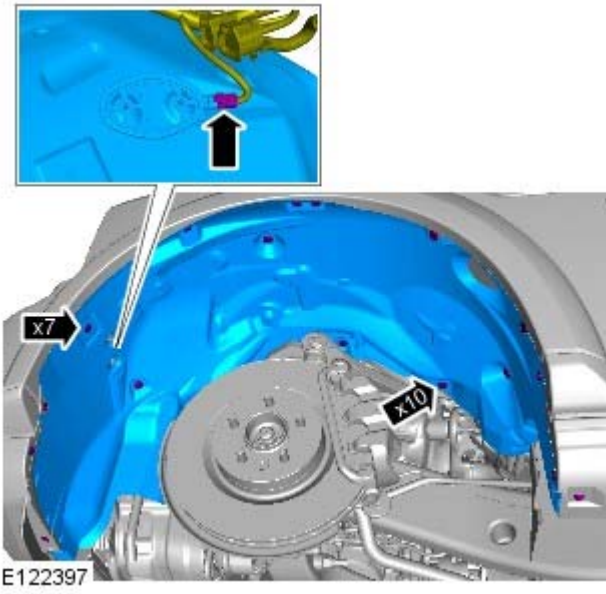
27.  CAUTION: Be prepared to collect escaping coolant.



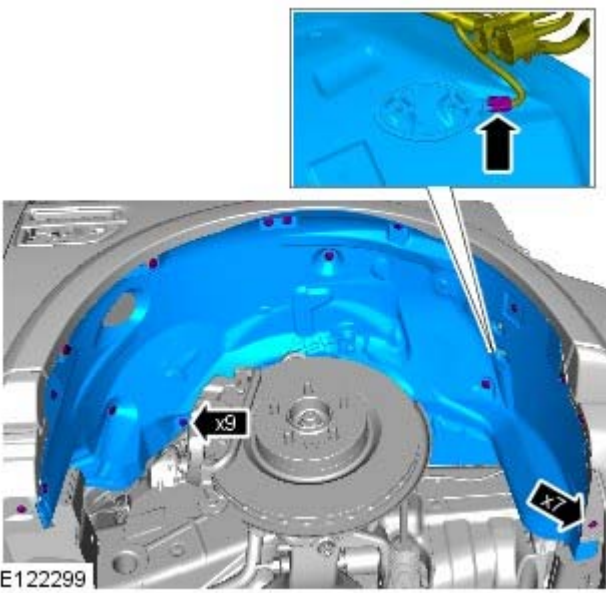
28.



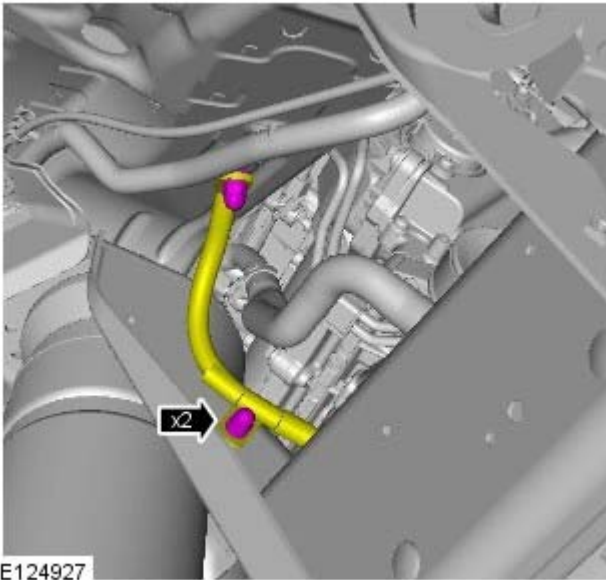
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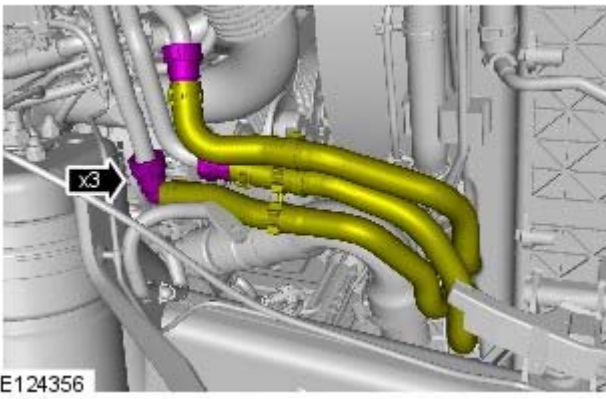
30.



31.

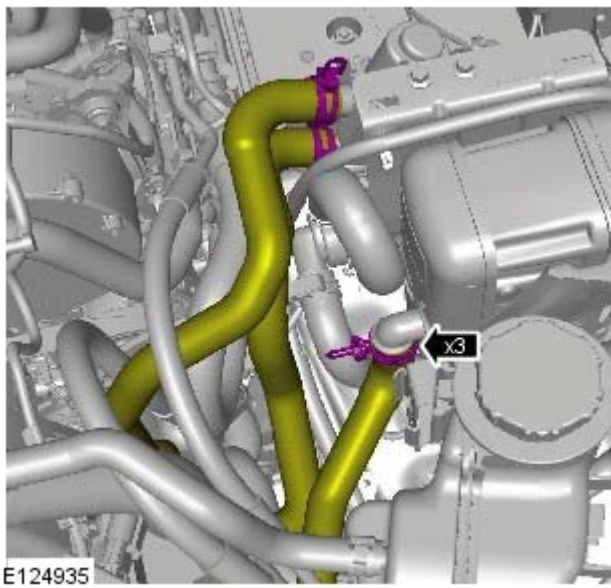


32.  CAUTION: Be prepared to collect escaping coolant.

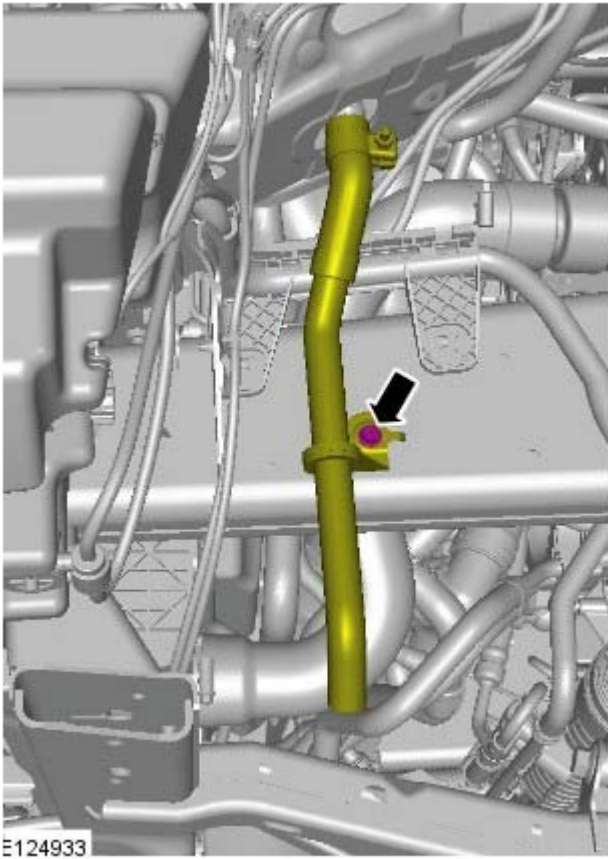


Vehicles with auxiliary heating

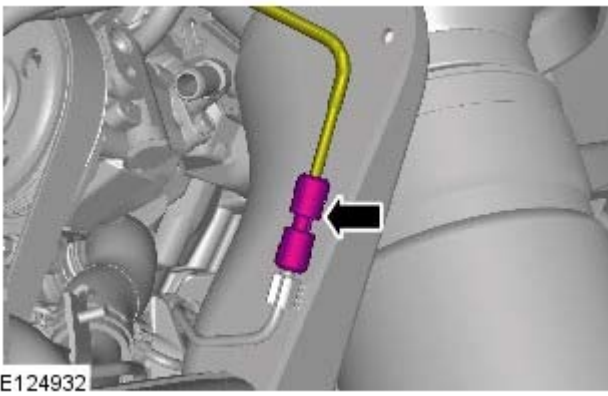
33.



34.

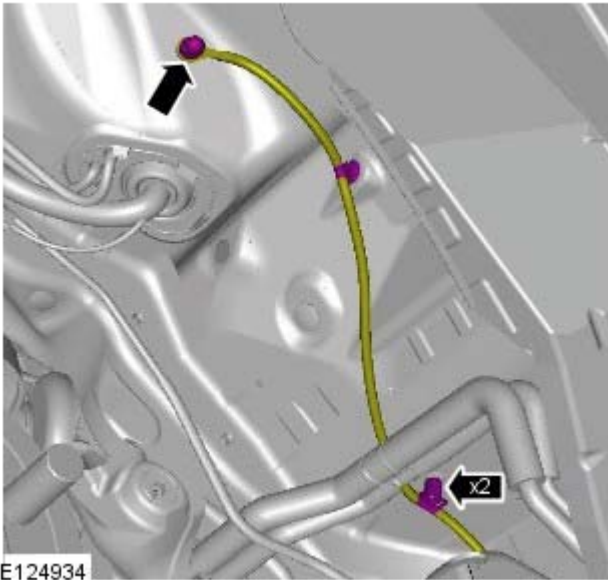


35.



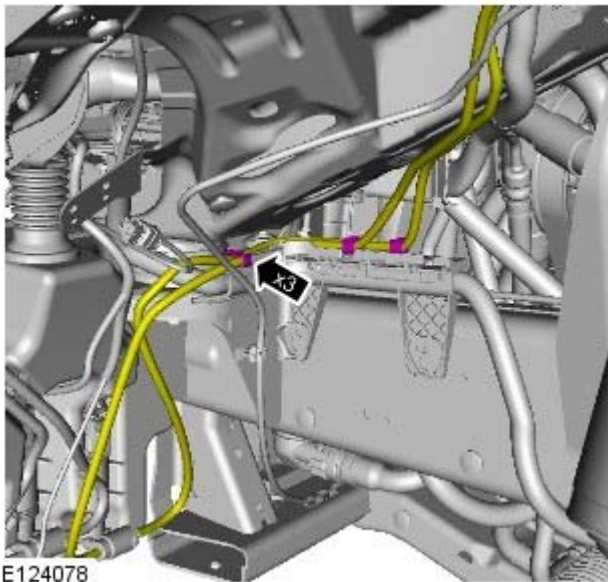
All vehicles

36.



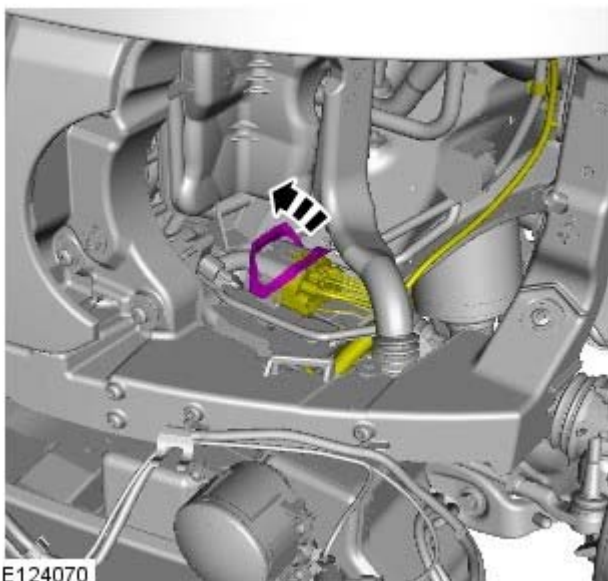
E124934

37.



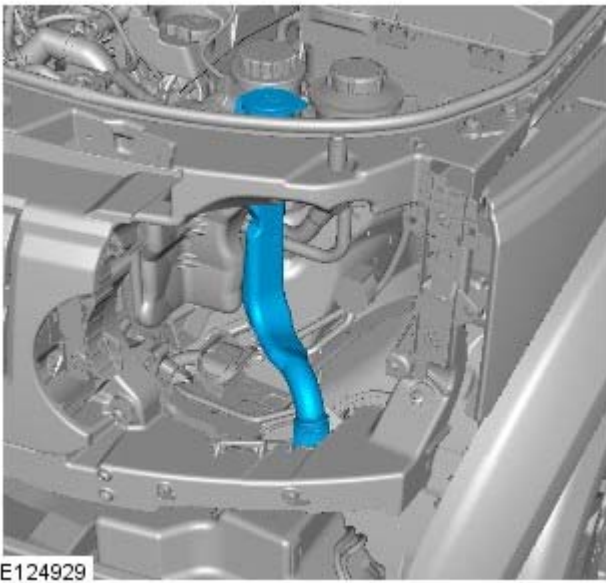
E124078

38.



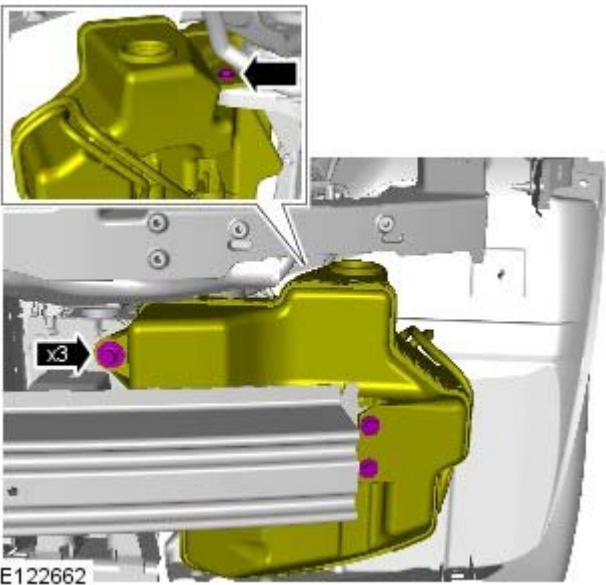
E124070

39.



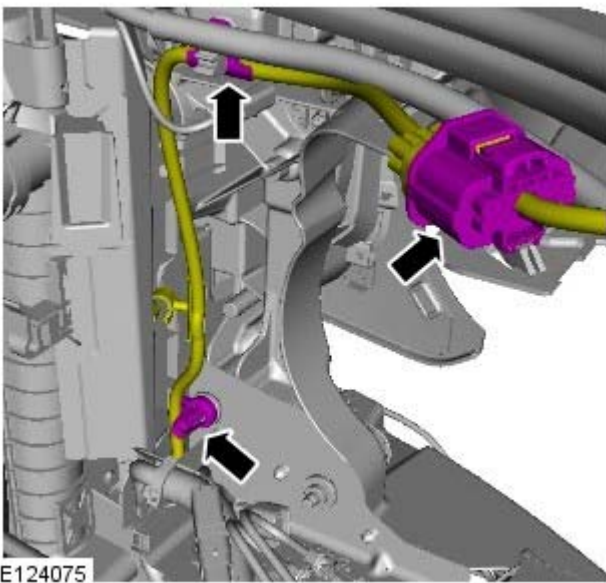
E124929

40.



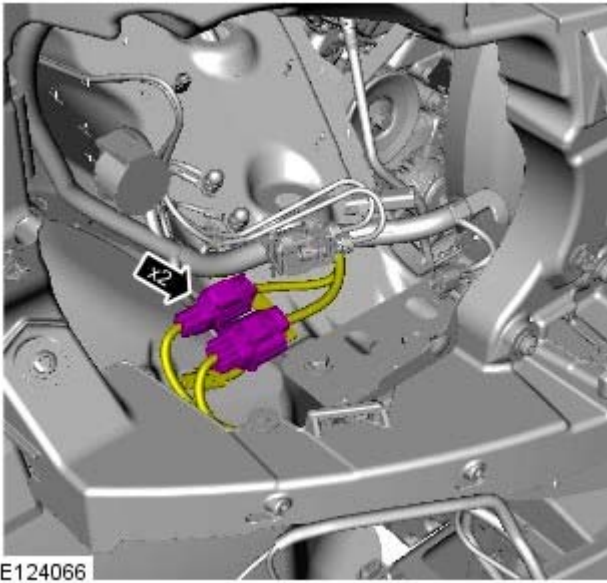
E122662

41.

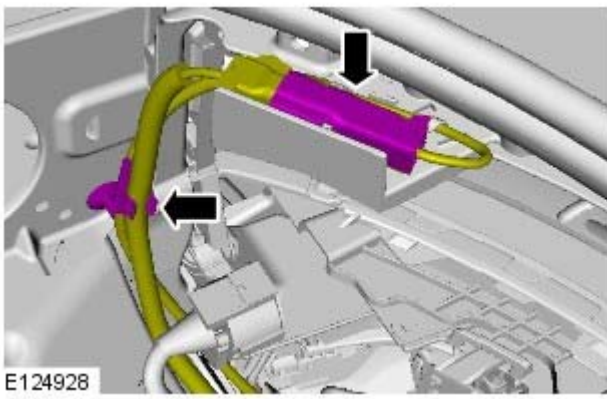


E124075

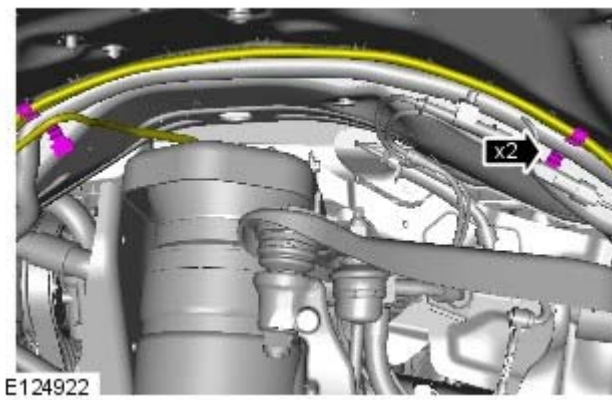
42.



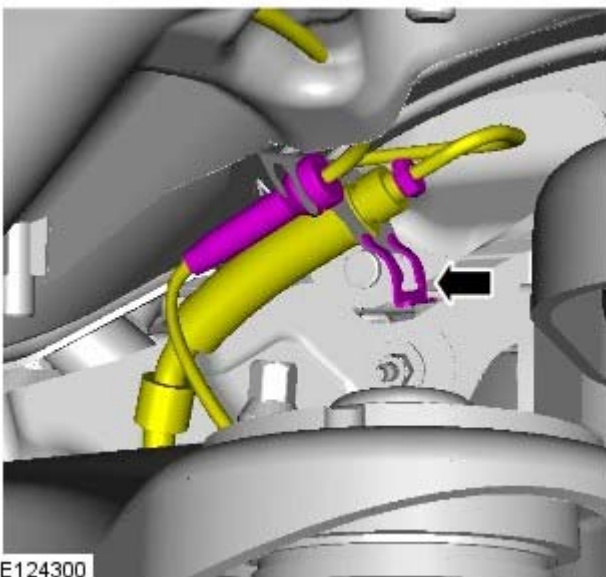
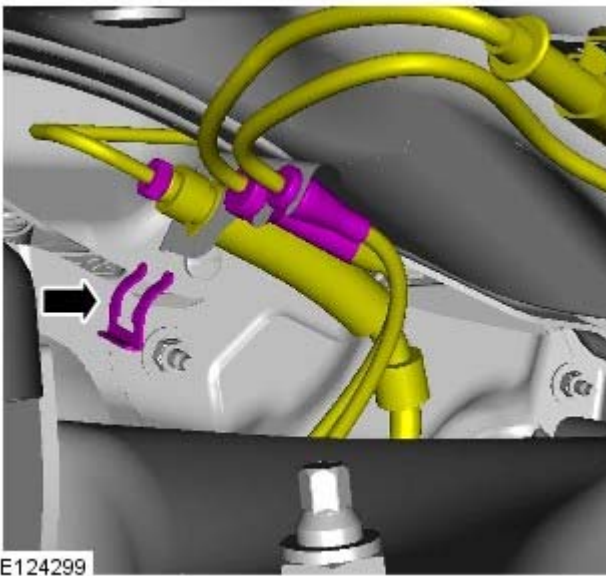
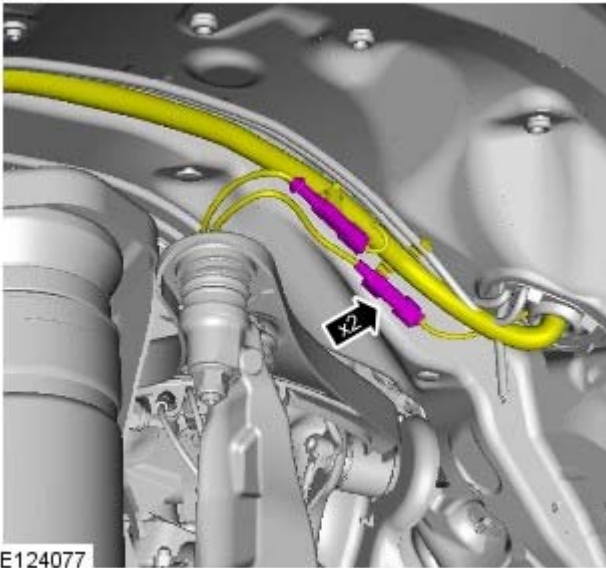
43.



44.



45.



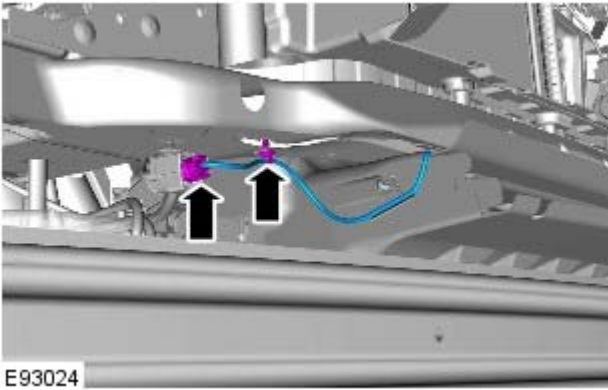
46. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

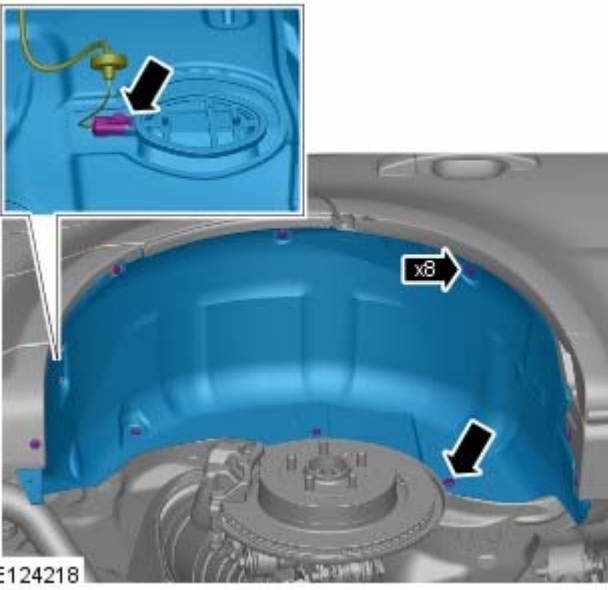
47. **⚠ CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.

48.

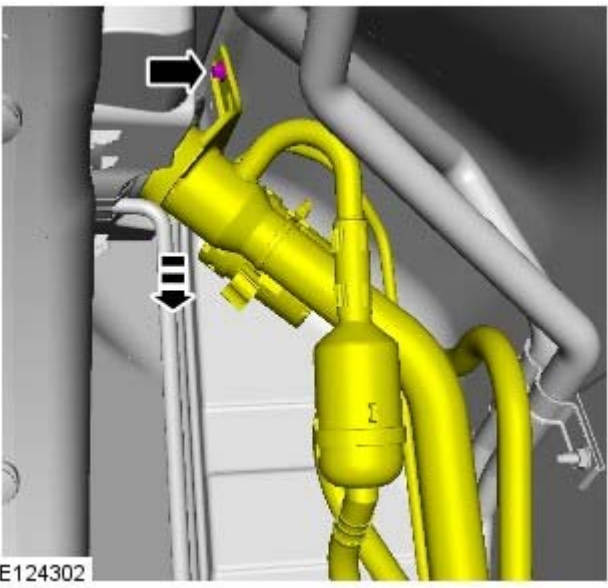


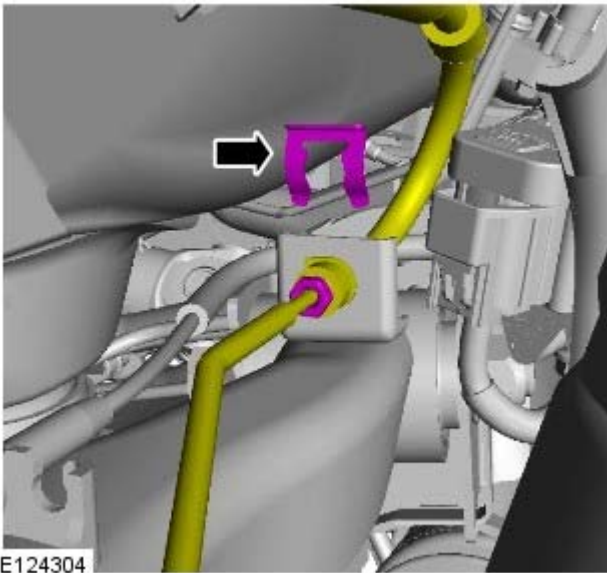
49.




50. Remove the fuel filler cap.

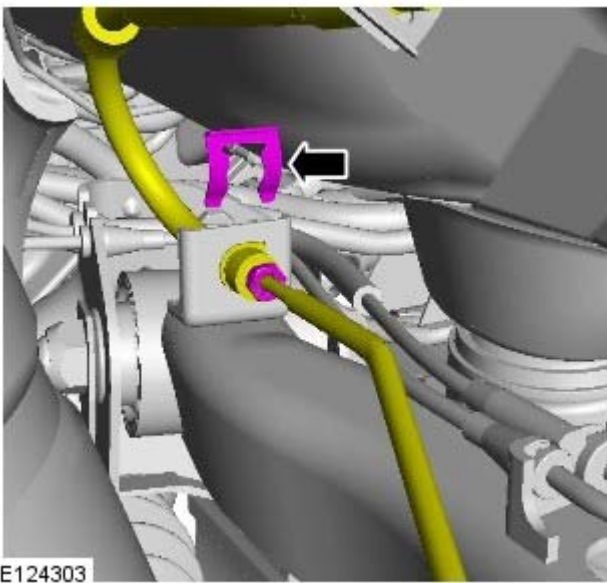
51.






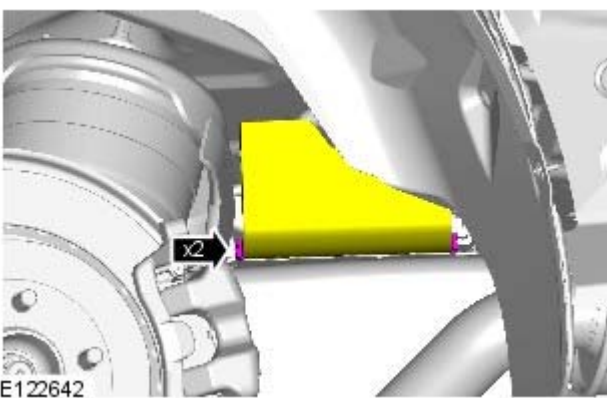
52.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.



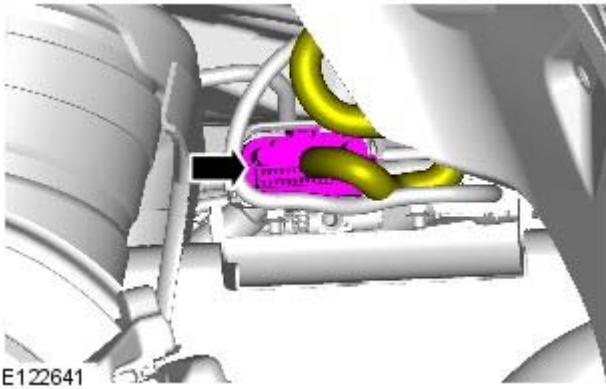
53.  **CAUTION:** Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.



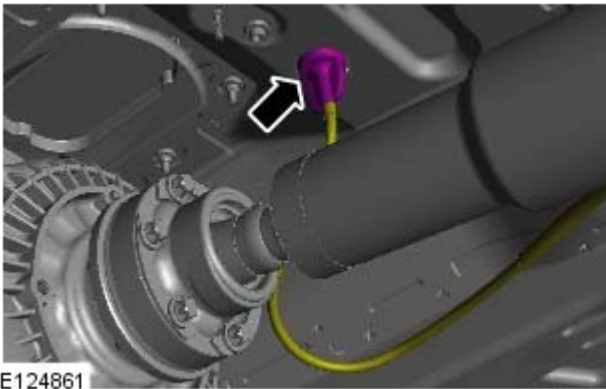
54.

55.



E122641

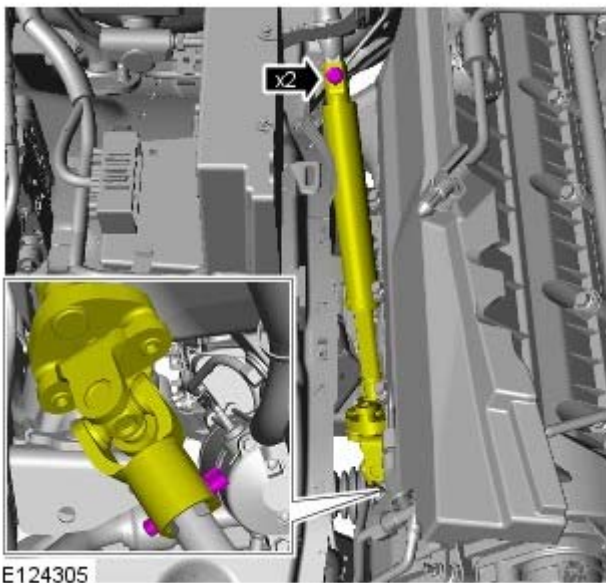
56.  CAUTION: Note the fitted position of the seal.



E124861

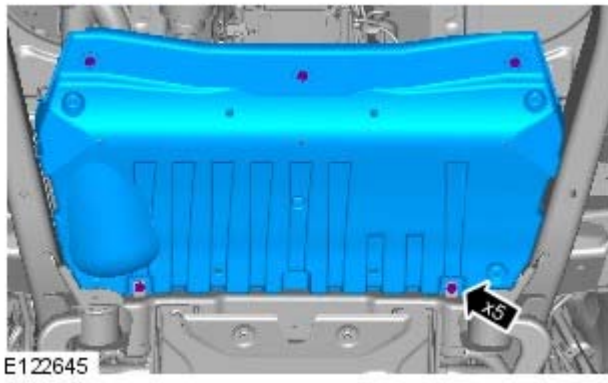
57.

- Remove and discard the bolt.

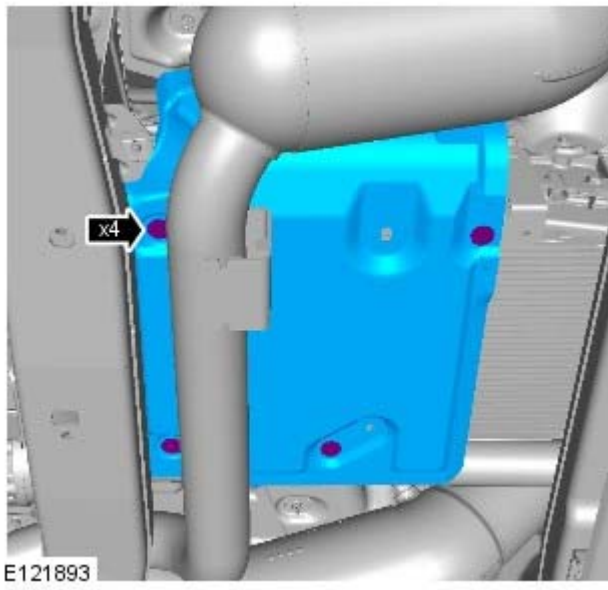


E124305

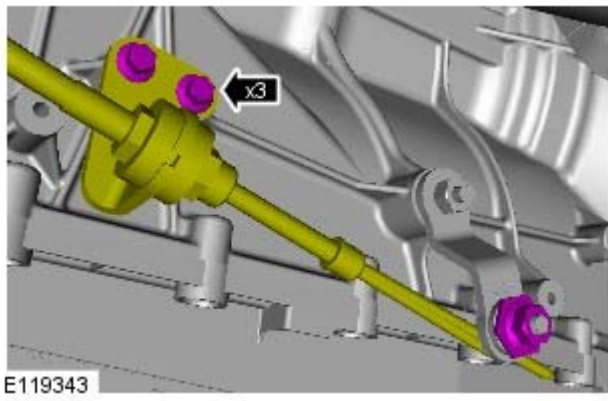
58.



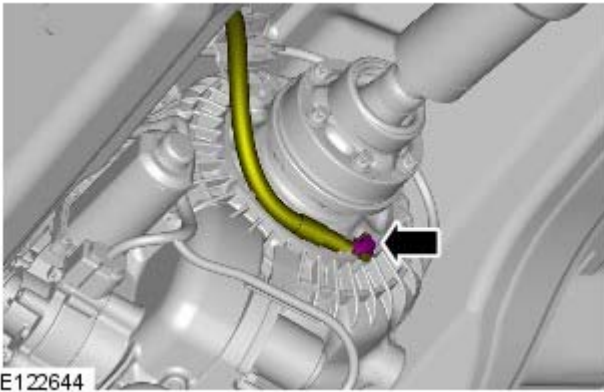
59.



60.



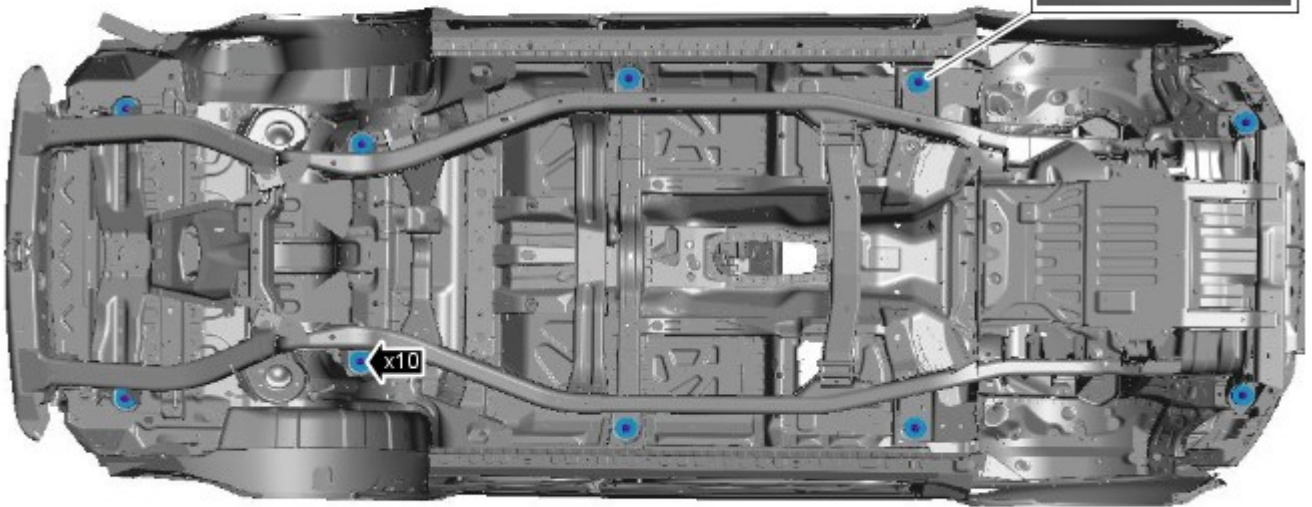
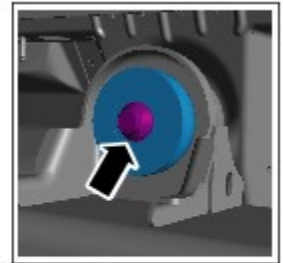
61.




62. Carefully lower the vehicle and support the chassis with axle stands.

63. Remove and discard the 10 body mount bolts.

- Remove the 10 spacing washers.



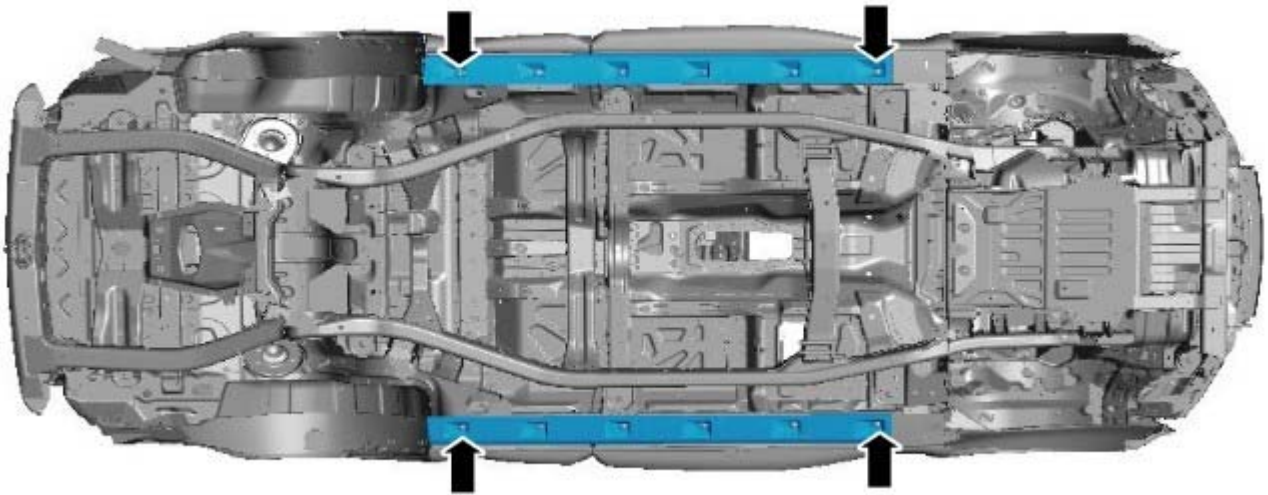
E124859

64.  CAUTION: To prevent the body becoming unstable when raised from the integrated body frame, install the vehicle tie down straps.

- NOTE: Note the fitted position of the body mounts.

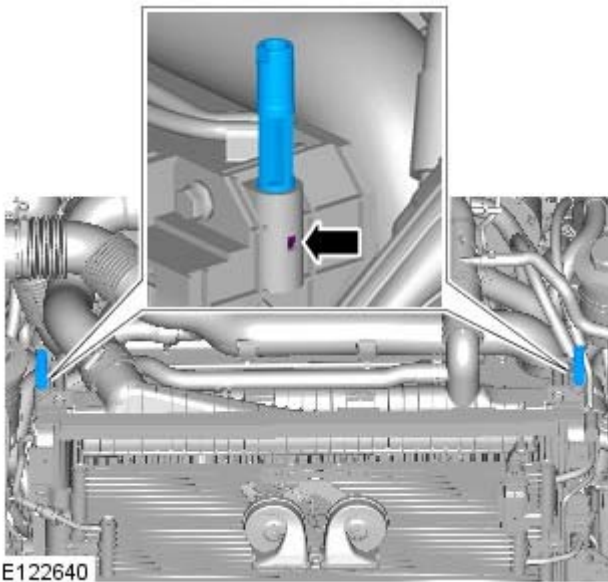
Using an assistant raise and support the body.

- Remove the body mounts.



E124860

65.



E122640

Installation

All vehicles

1. CAUTIONS:



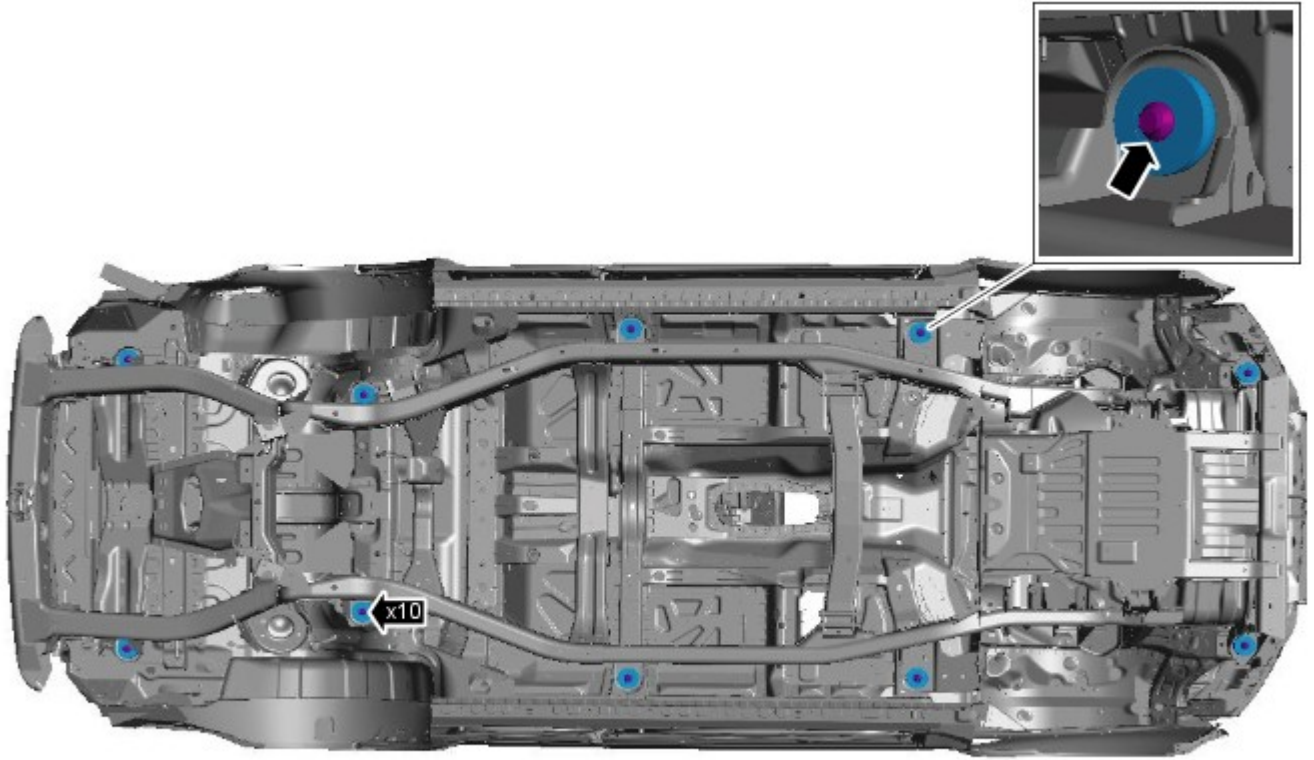
Make sure that new bolts are installed.



Make sure that all components are free and do not get caught up whilst lowering the body onto the integrated body frame.

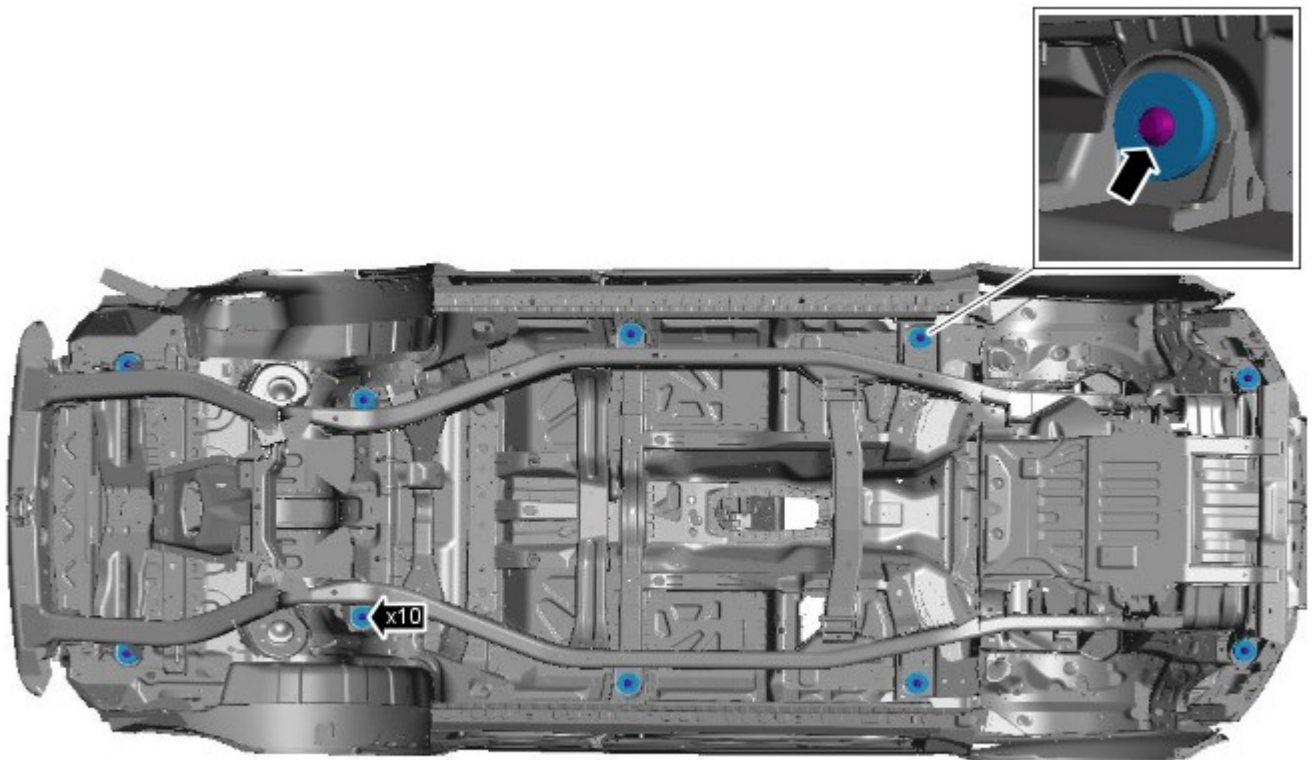
Using an assistant install the body to the integrated body frame.

- Install the body mounts.
- With assistance align the body and integrated body frame mounts.
- Install the bolts, but do not tighten fully at this stage.



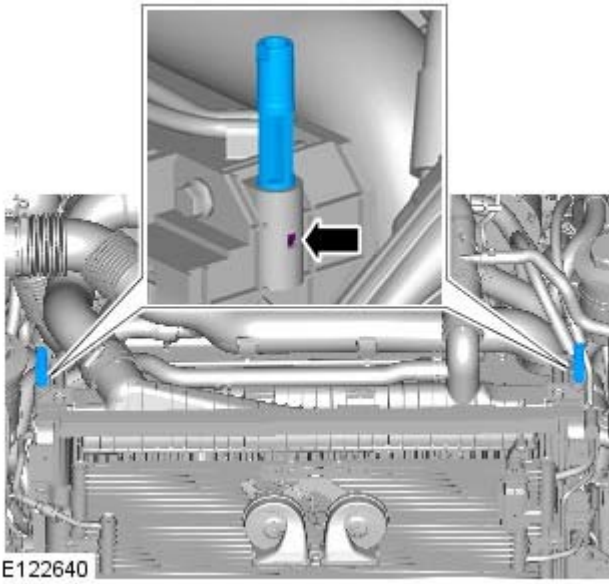
E124859

2. Remove the tie down straps securing the body.
3. TORQUE: 133 Nm

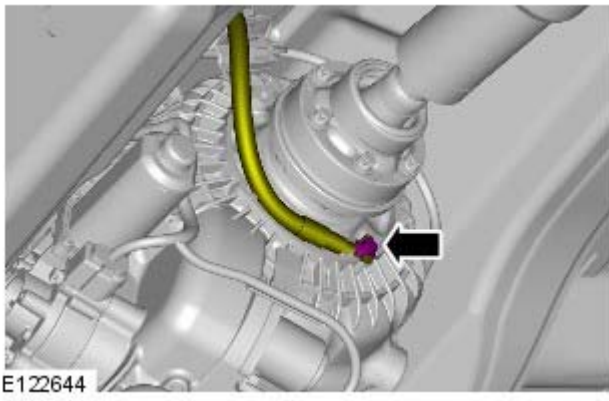


E124859

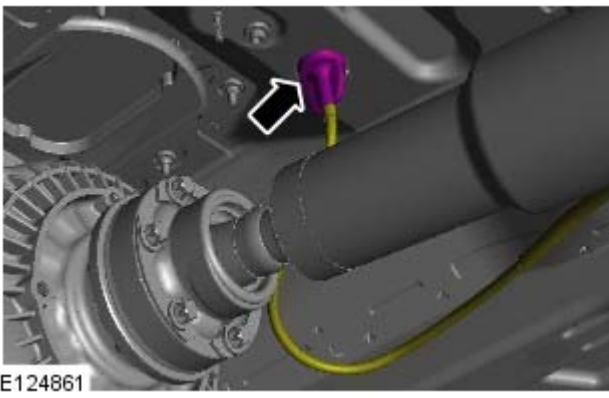
4.



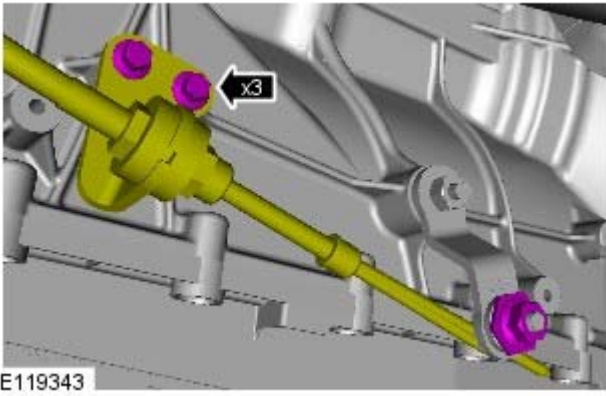
5. TORQUE: 25 Nm



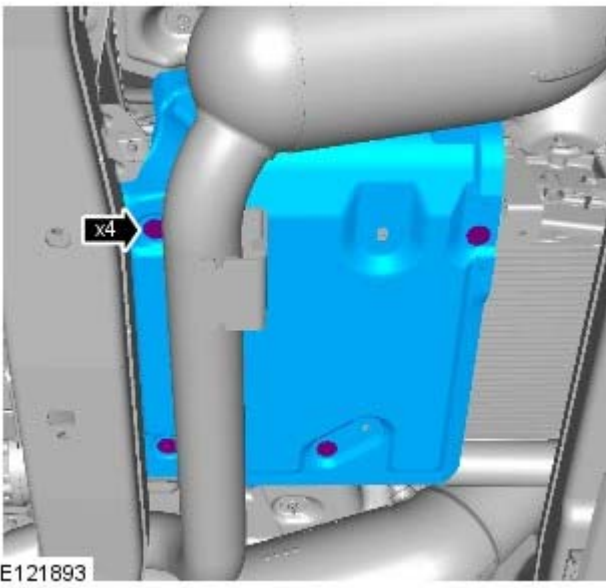
6.



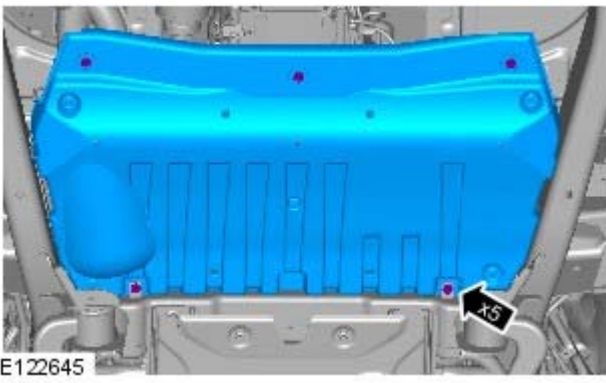
7.



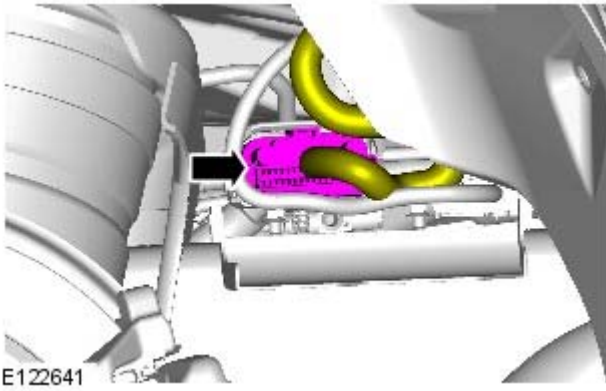
8. TORQUE: 12 Nm



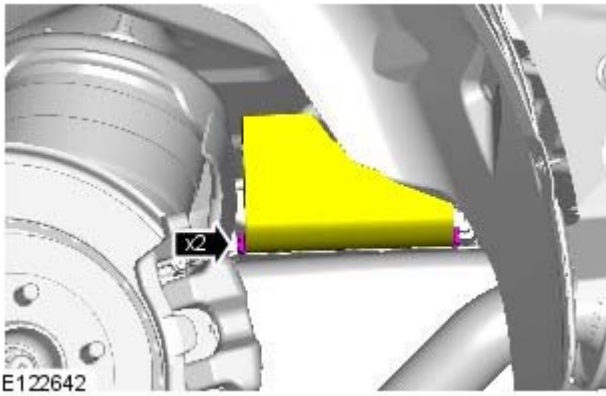
9. TORQUE: 12 Nm



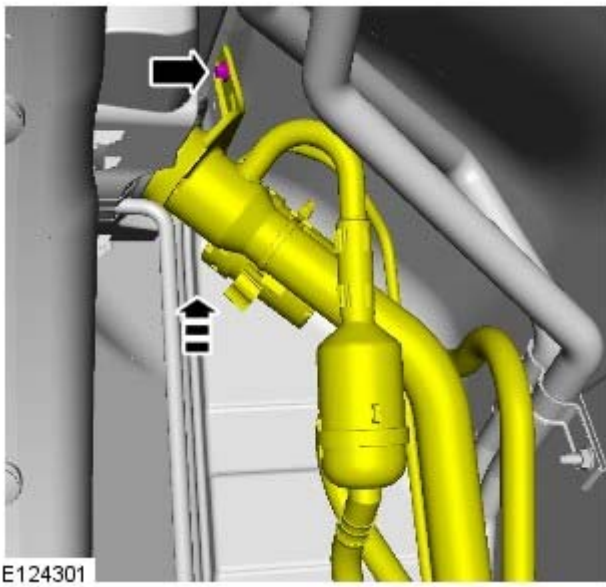
10.



11.

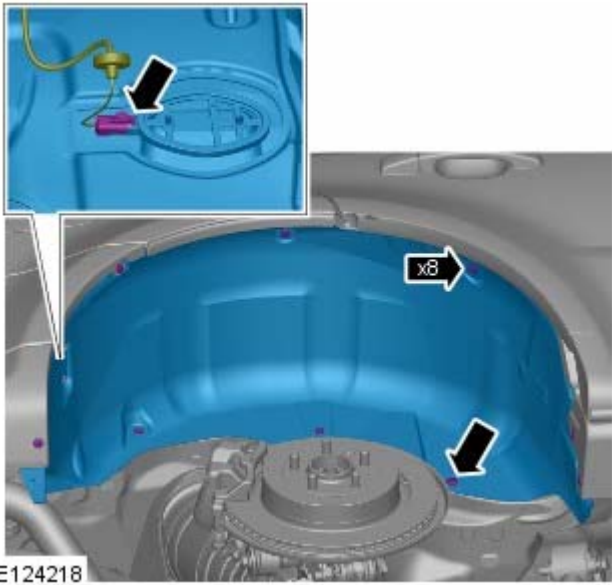


12. TORQUE: 12 Nm



13. Install the fuel filler cap.

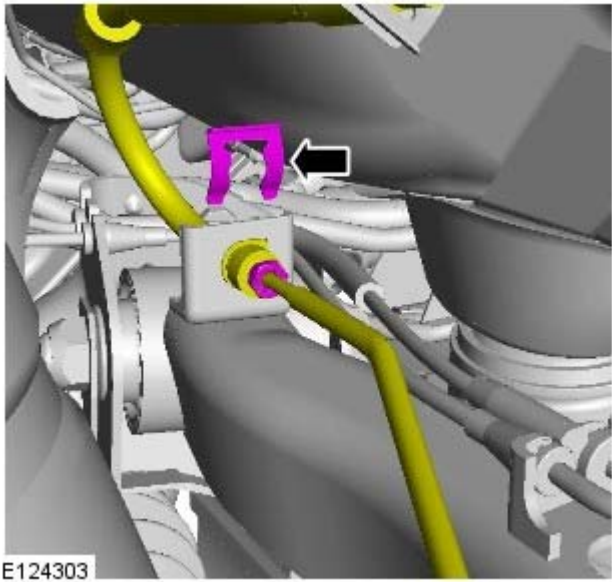
14.



15. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

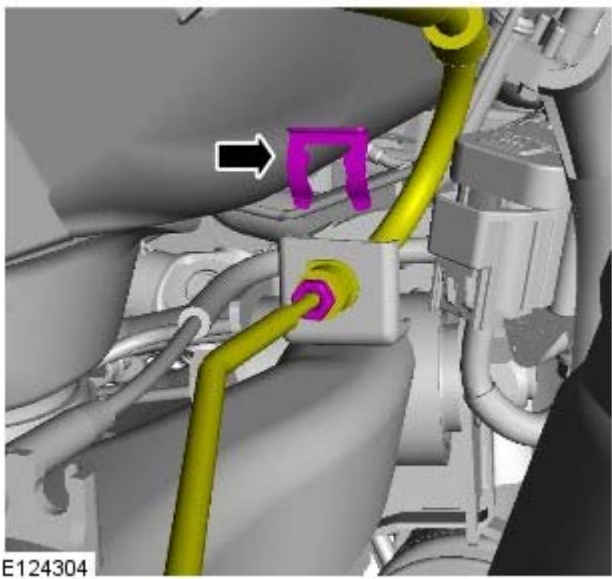
- Clean the component mating faces.
- Secure the clip.



16. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

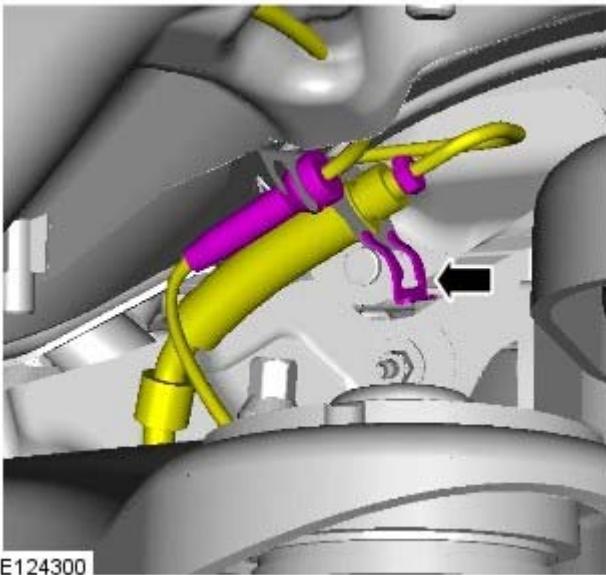
- Clean the component mating faces.
- Secure the clip.



17. NOTE: Remove and discard the blanking caps.

TORQUE: 16 Nm

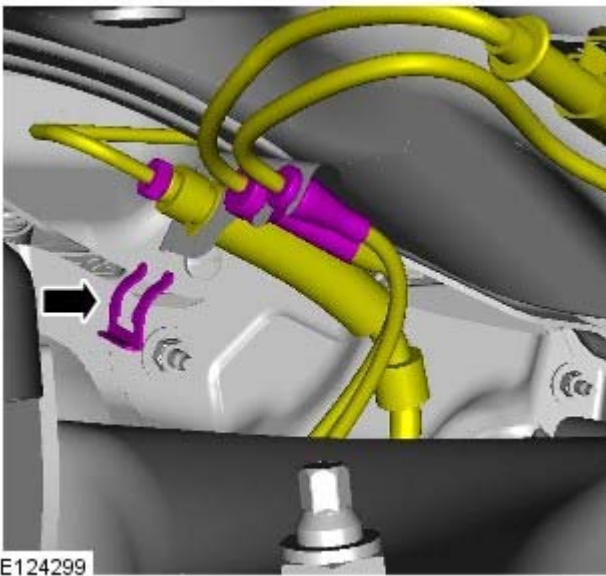
- Clean the component mating faces.
- Secure the clip.



18. NOTE: Remove and discard the blanking caps.

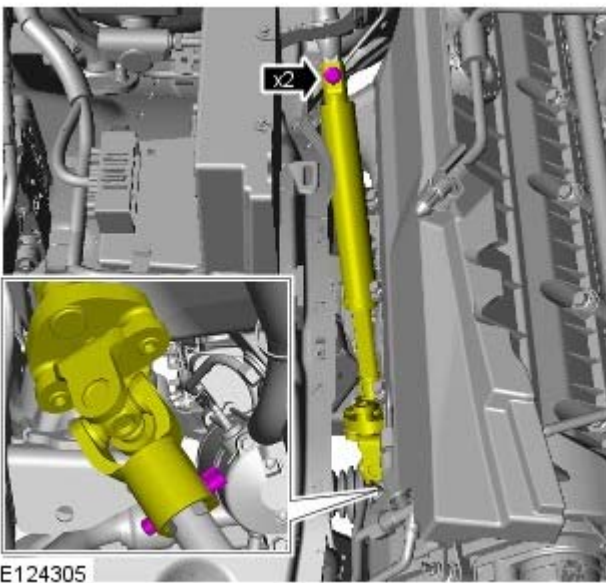
TORQUE: 16 Nm

- Clean the component mating faces.
- Secure the clip.

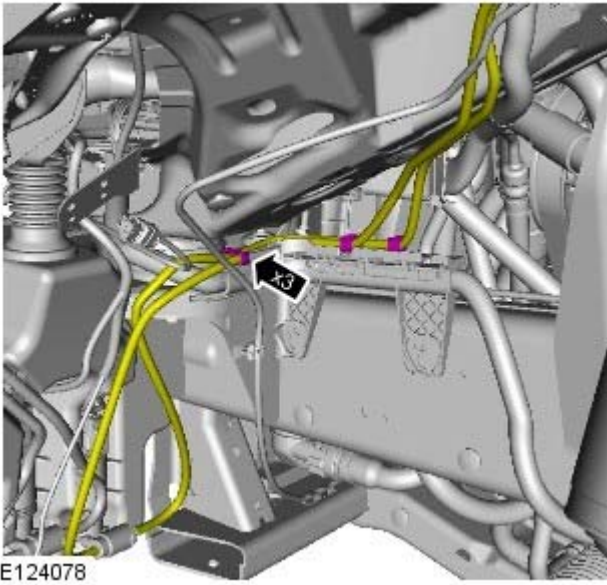


19.  WARNING: Make sure that a new bolt is installed.

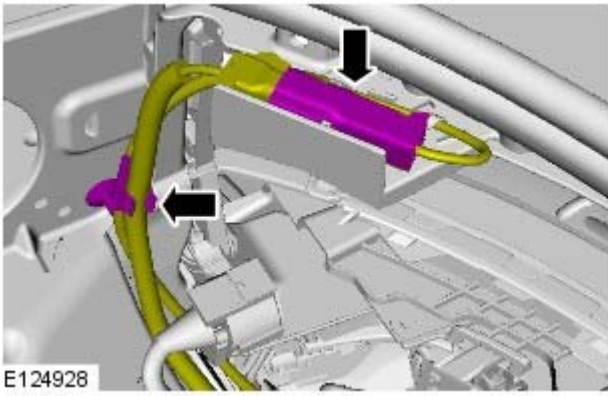
TORQUE: 25 Nm



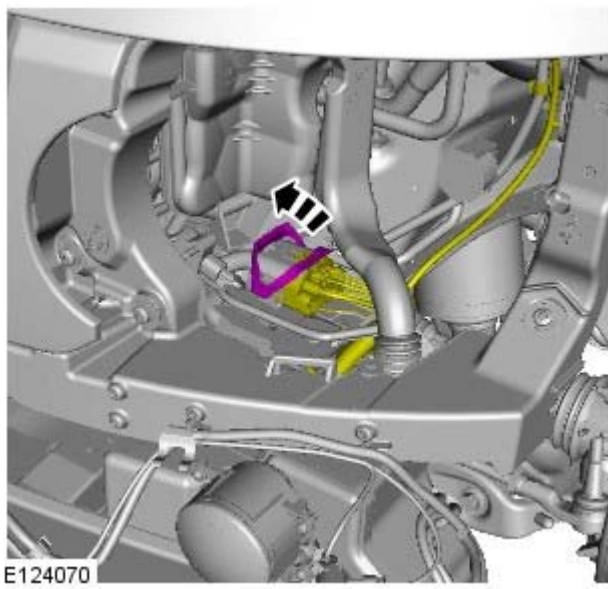
20.



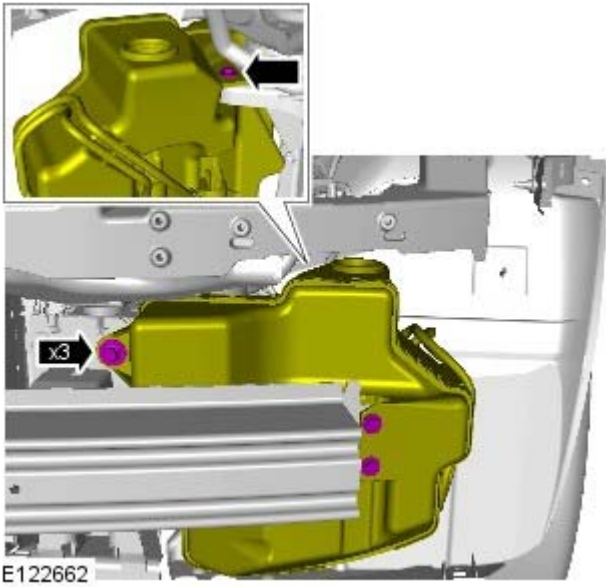
21.



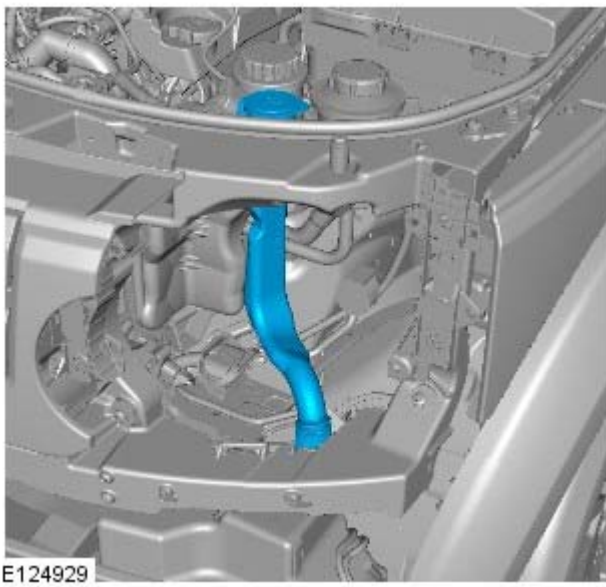
22.



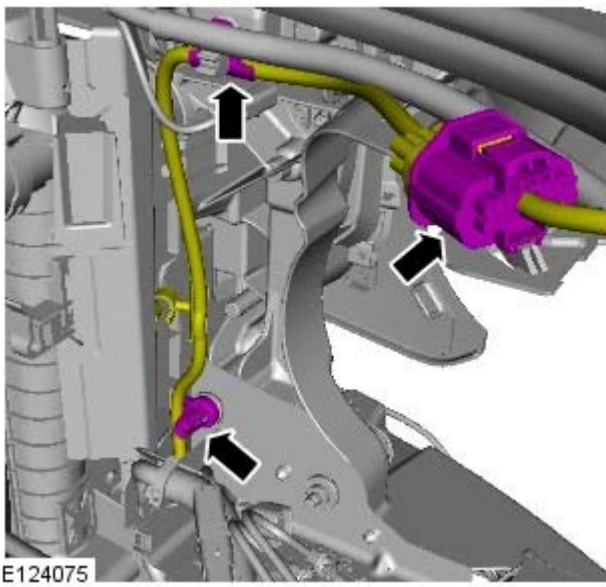
23. TORQUE: 12 Nm

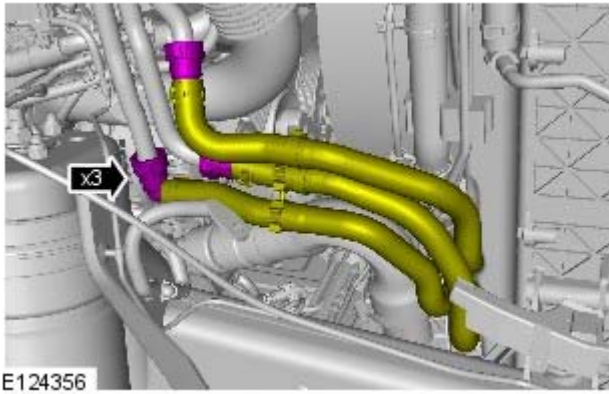


24.



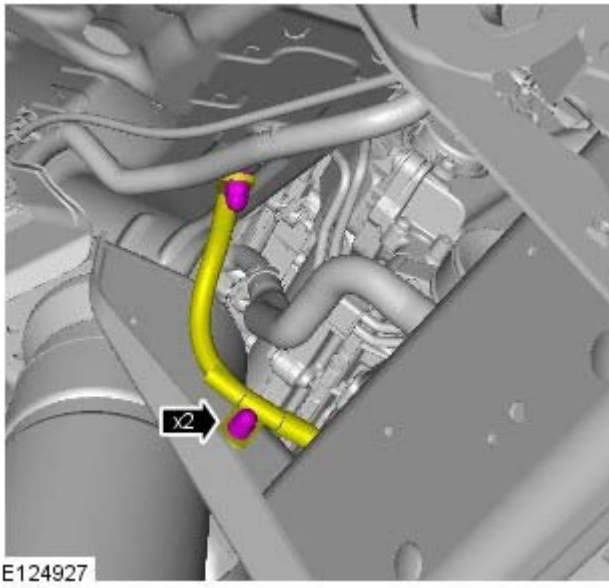
25.



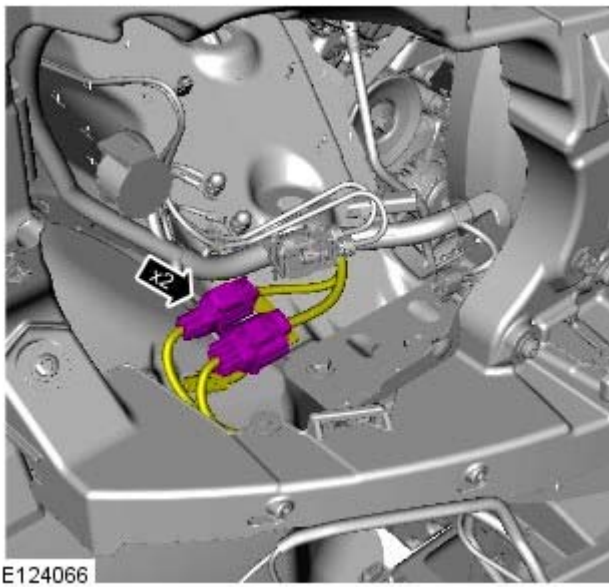


26.  CAUTION: Be prepared to collect escaping coolant.

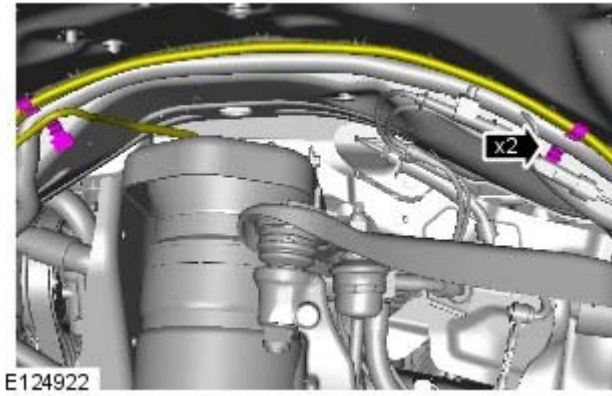
27. TORQUE: 20 Nm



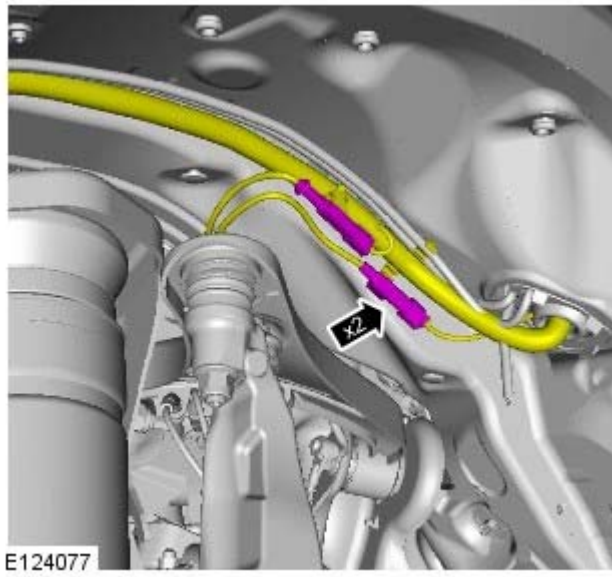
28.



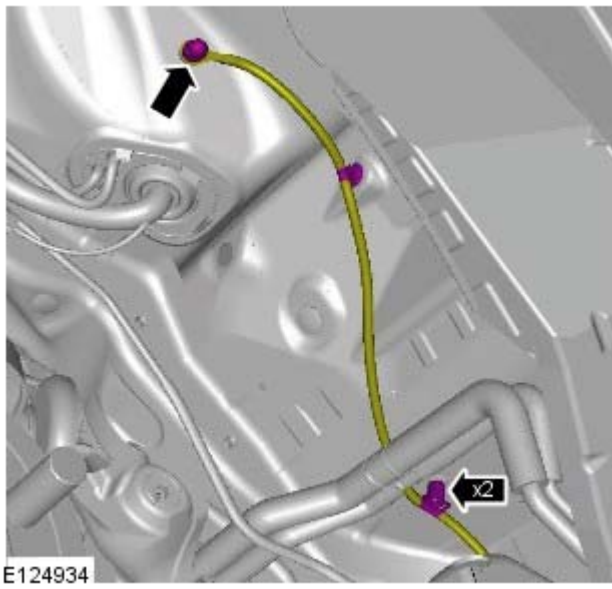
29.



30.

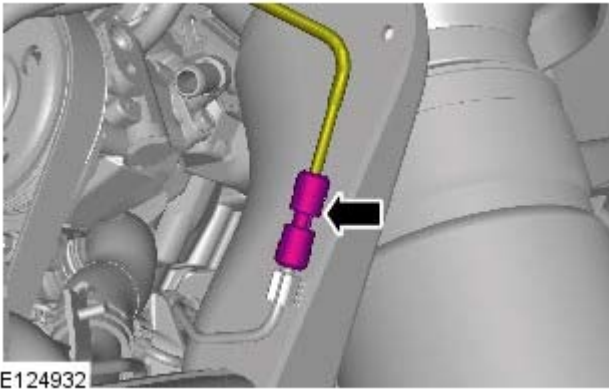


31. TORQUE: 20 Nm

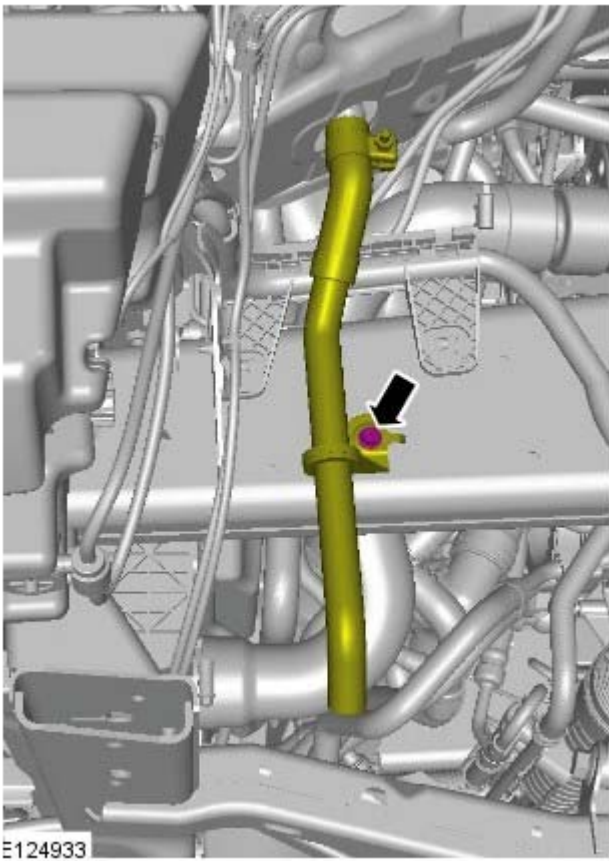


Vehicles with auxiliary heating

32.

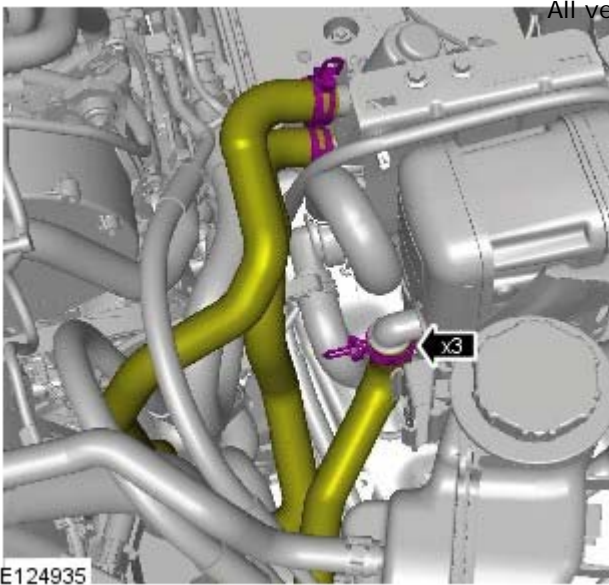


33. TORQUE: 10 Nm

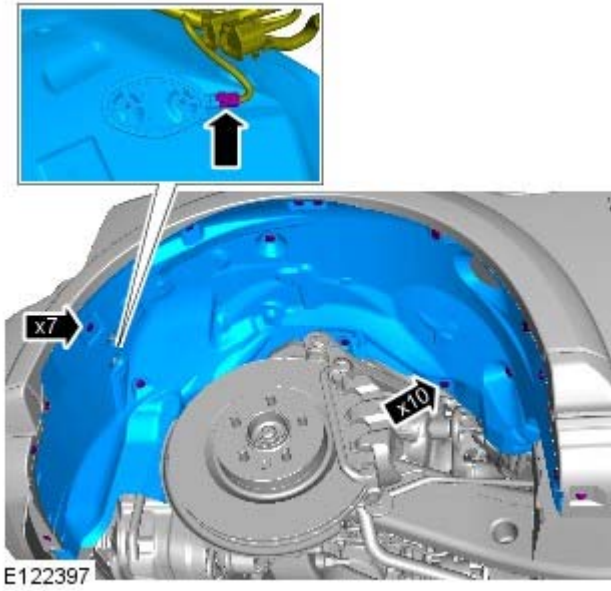


34.

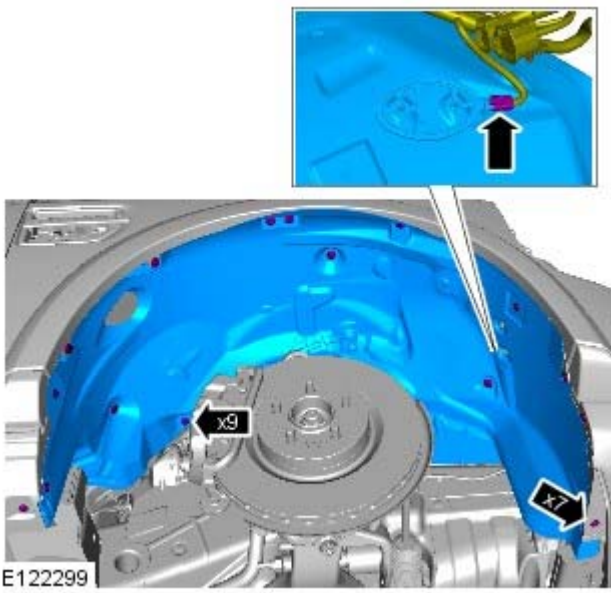
All vehicles



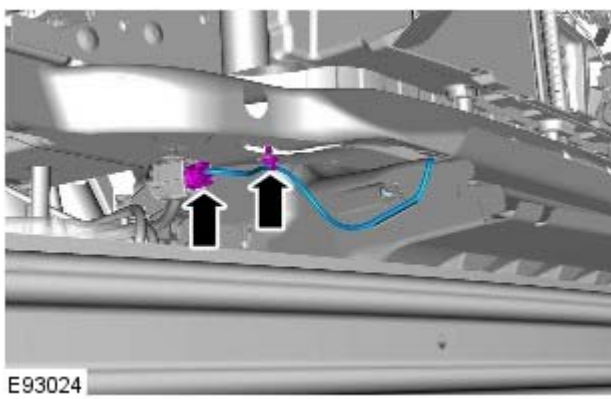
35.



36.

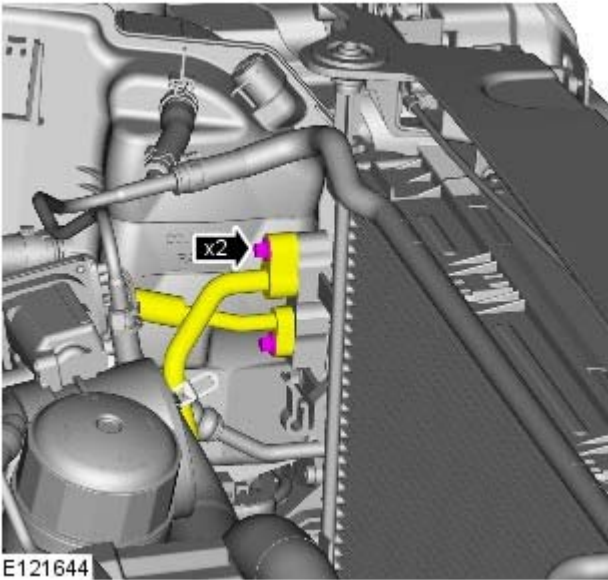


37.



38. TORQUE: 12 Nm

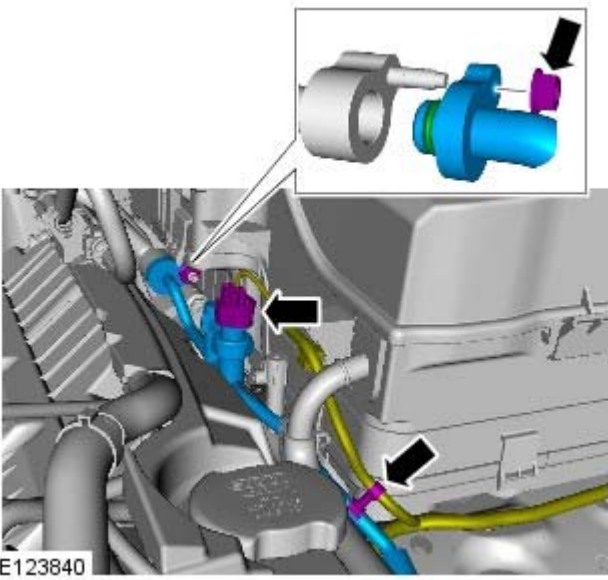
- Install new O-ring seals.

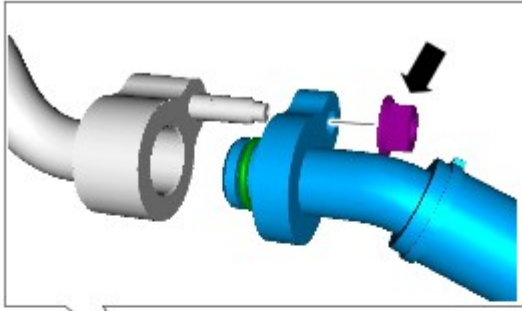



39.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

TORQUE: 12 Nm

- Install new O-ring seals.

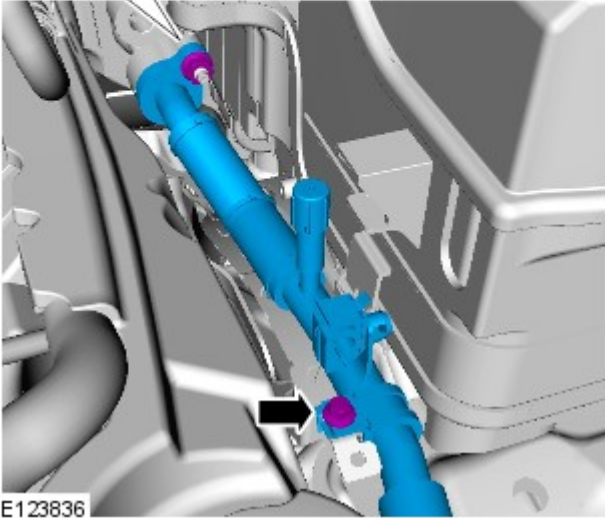




40.  CAUTION: Make sure that all openings are sealed. Use new blanking caps.

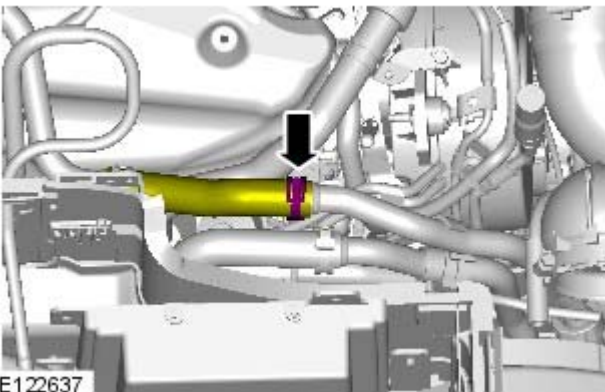
TORQUE: 12 Nm

- Install new O-ring seals.



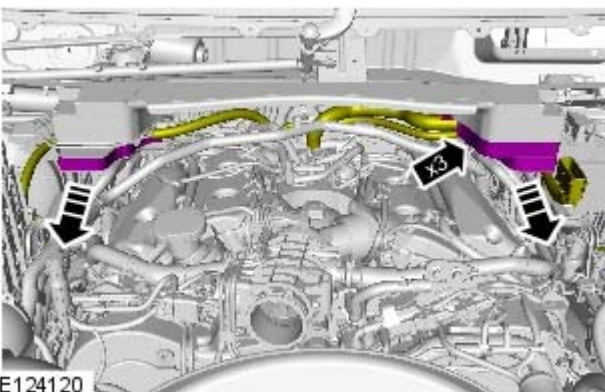
E123836

41.



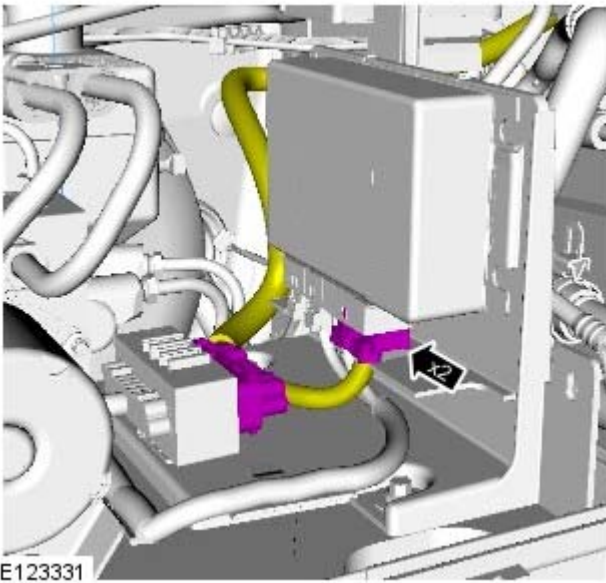
E122637

42.

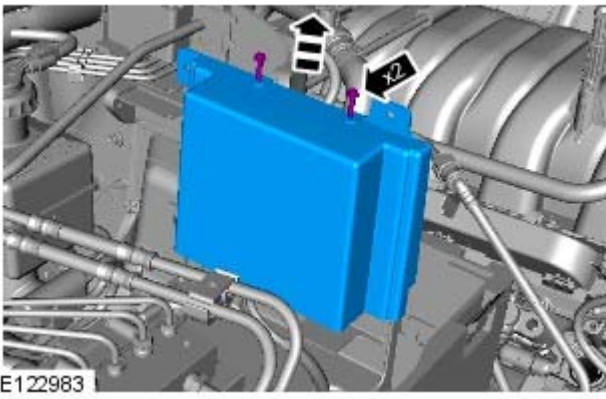


E124120

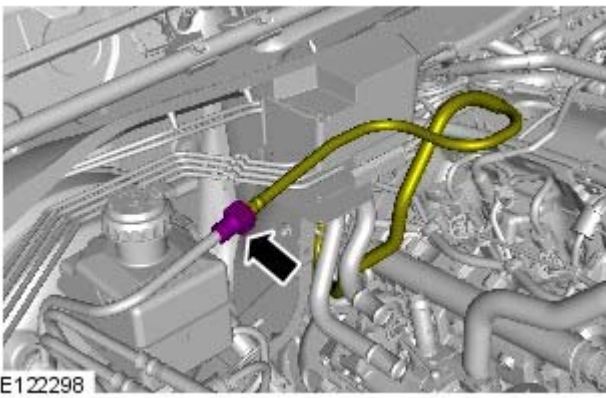
43.



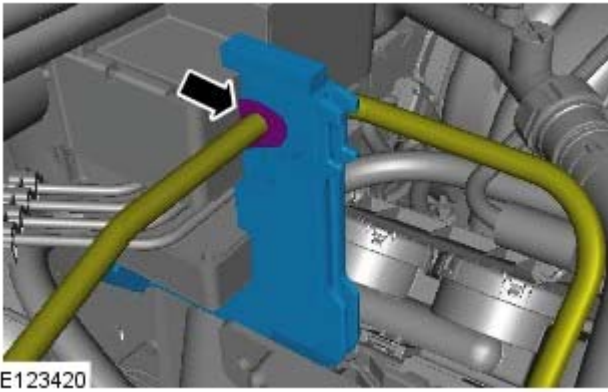
44. TORQUE: 8 Nm



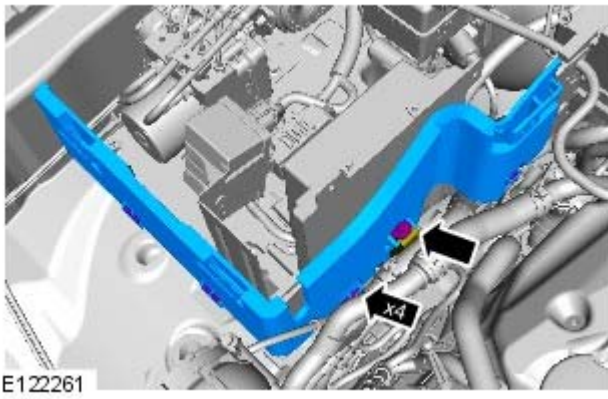
45.



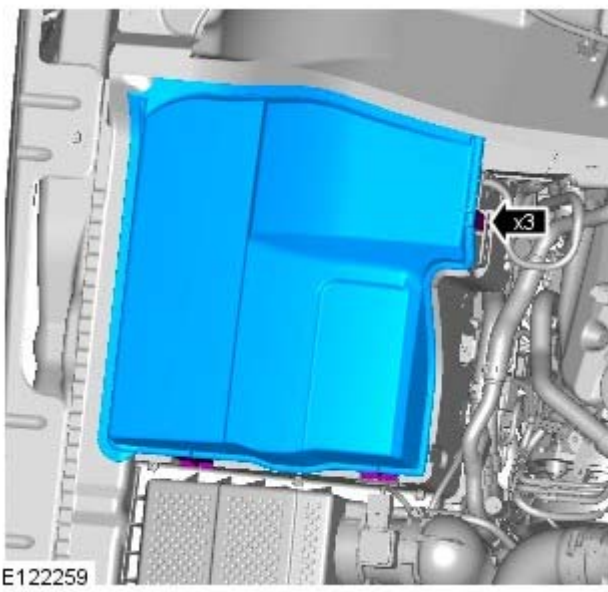
46.



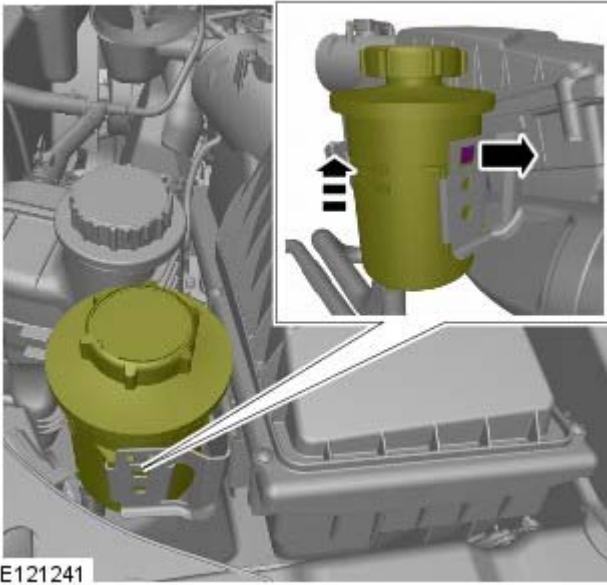
47. TORQUE: 10 Nm



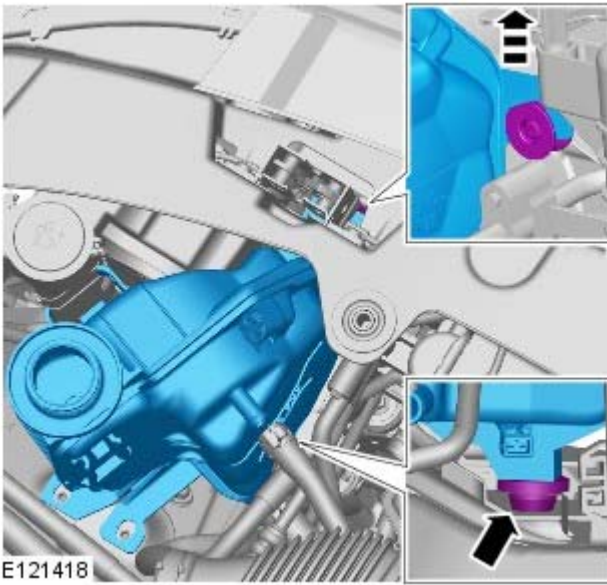
48.



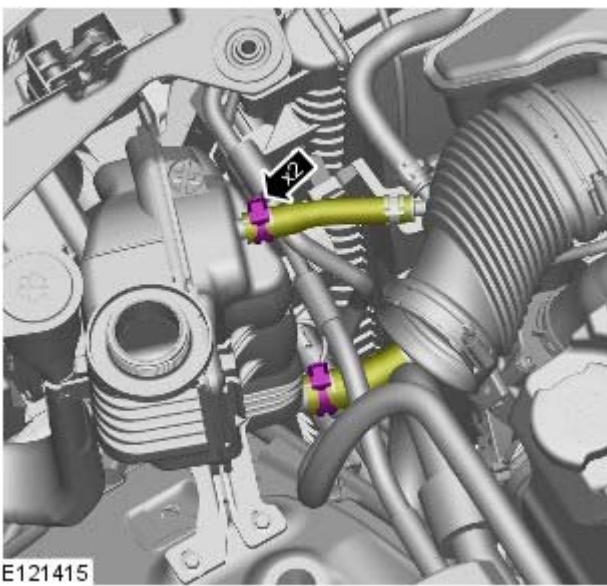
49.



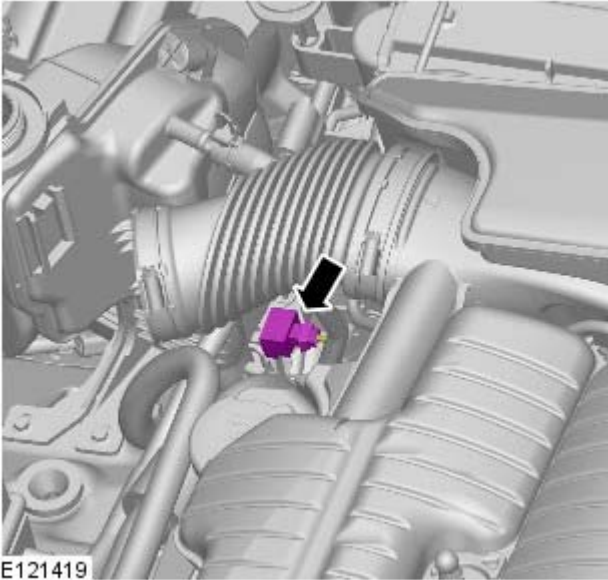
50.  CAUTION: Be prepared to collect escaping coolant.



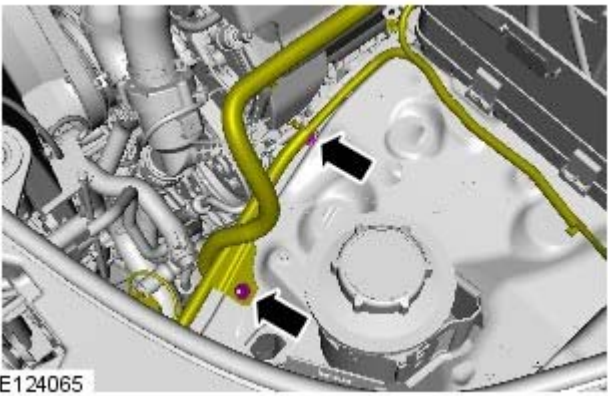
51.



52.



53. TORQUE: 10 Nm



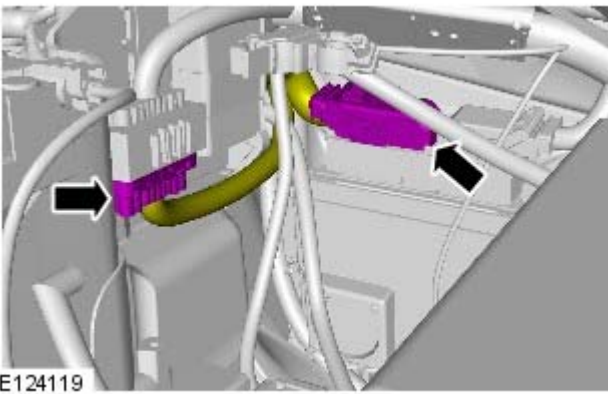
All vehicles

54. For additional information, refer to: Front Bumper Cover (501-19, Removal and Installation).

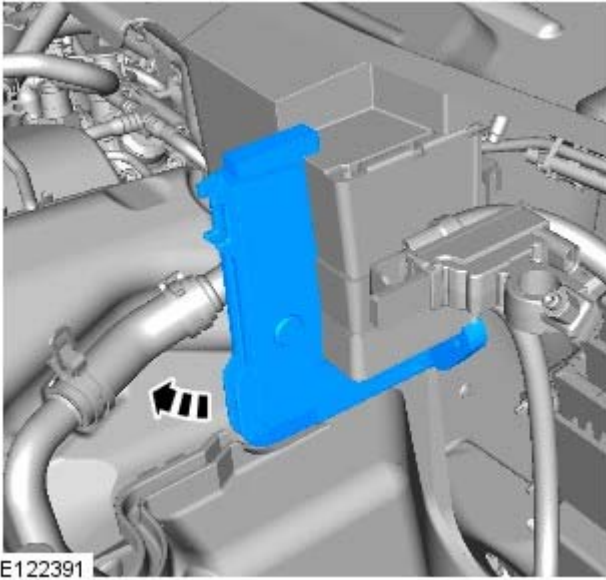
55. For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

56. For additional information, refer to: Air Cleaner (303-12, Removal and Installation).

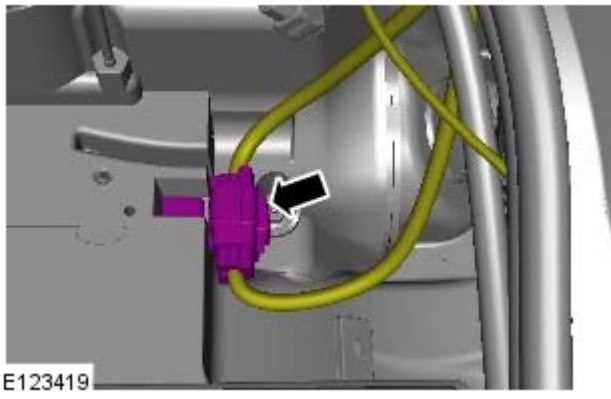
57.



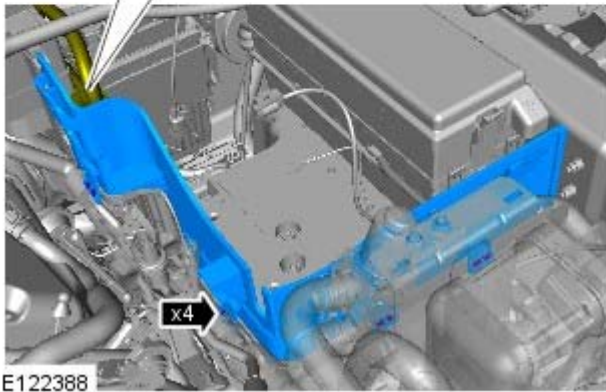
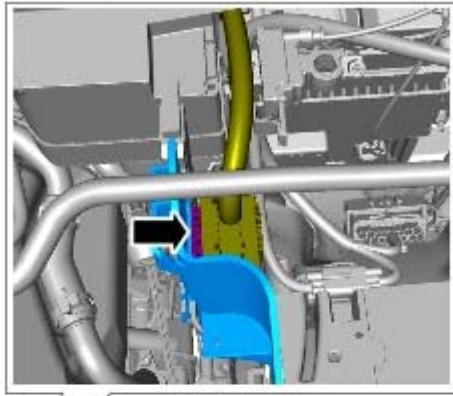
58.



59.



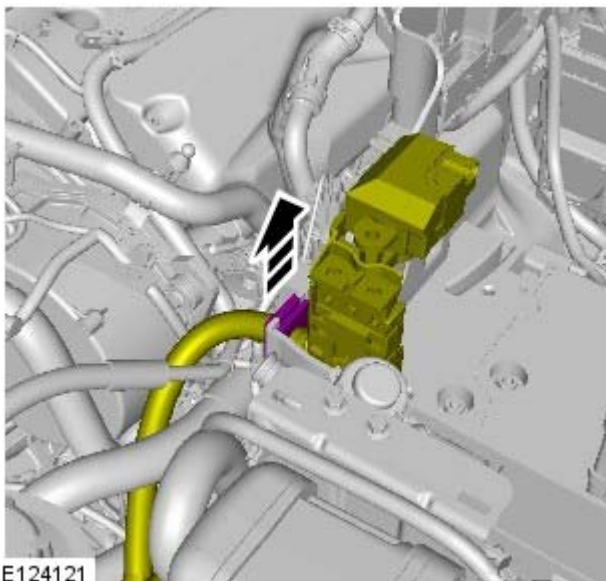
60. NOTE: RHD illustration shown, LHD is similar.



E122388

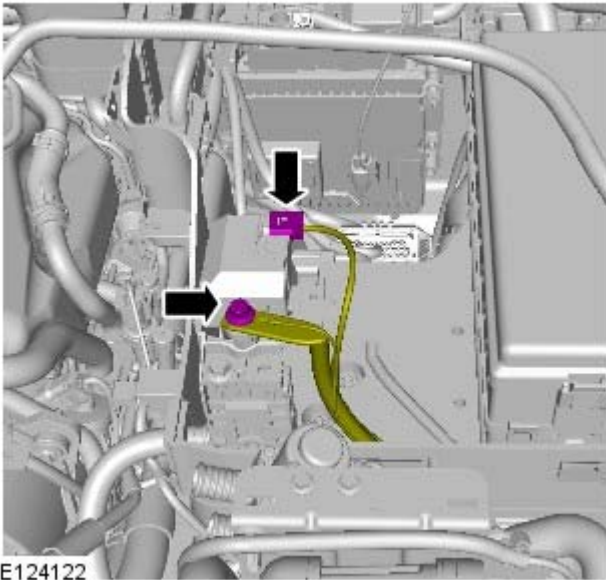
61.

- Cut the cable tie.



E124121

62. TORQUE: 10 Nm



- 63.** For additional information, refer to: Battery (414-01, Removal and Installation).
- 64.** For additional information, refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).
- 65.** For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
- 66.** Bleed the braking system.
For additional information, refer to: Brake System Bleeding (206-00, General Procedures).